MULTIFIX 4 USERS MANUAL
Version 1.05

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AMENDMENT RECORD SHEET

Issue No	Date	Revised Section(s)	Revised Page No(s)	Authorised
1	Apr 2003	N/A	N/A	MK
2	June 2003	N/A	N/A	TH
3	Sept 2003	N/A	N/A	MK
4	Dec 2003	N/A	N/A	MK
5	Mar 2004	N/A	N/A	PAF

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1. INTRODUCTION

There are currently twelve applications in the Zero Suite as described in Section 2. This manual describes the installation, configuration, and real time operation of the following programs:

- MultiFix 4………………….. V1.05
- SkyLink……………………. V1.04
- Receiver Verify…………… V1.01
- Soccer ……………………. V1.04
- Log Pump………………… V1.01

2. ZERO APPLICATION RESUME

There are 12 applications available in the Zero group.

1. **MultiFix** is the core module to the zero suite. MultiFix performs all of the required GPS and DGPS calculations necessary to generate a position. MultiFix also includes extensive real-time QC analysis tools.

2. **Soccer** is an application allowing routing and monitoring of data between COM ports and sockets. The routing is via virtual ribbons. Data can be received on COM ports or Sockets and then routed through to multiple other COM ports or Sockets. Soccer can also be used as text logger, either logging to a text file, or logging simultaneous data, from multiple ports, for replay through LogPump.

3. **SkyLink** is an RTCM transfer/modification program, which can be used to apply Ionospheric corrections to Type 1 RTCM messages before outputting to DGPS firmware / software, that can not of itself derive a Iono-free solution of position.

4. **Qual 2** is a real time static position quality monitor application.

5. **Brunei** is a customised application specifically for the Brunei Shell VTS project.

6. **Prolive** is an application for re-vitalizing dongles. The dongles issued to run the Zero programs normally have a termination time based on the amount of usage. This program allows a re-authentication code to be entered to re-validate the dongle for future use with Zero and other Fugro software. The re-authentication code can be obtained from the Technical Support Group, where the Dongle Database is held. SkyLink does not require a dongle.

7. **LogPump** is an application for reading data originally logged by any zero program and then outputting that data to virtual ports, allowing the data to be replayed in any application.

8. **Position View** is a real time application either for comparing dynamic position sources against a static point position or for comparing position sources by using one of them as the reference. Position View can also select and output the most stable positioning source for output to another application, such as a single port DP system.

9. **Genesis** is the LRTK application for the solution of position from dual frequency code and carrier observables and associated Compressed correction data from one or more Genesis Reference stations.

10. **SkyNet Monitor** is a DGPS Monitoring and reporting tool, which can be used to monitor both GPS measurements and RTCM (single and Dual Freq) corrections and automatically generate daily reports. These can be used as a replacement for shore based DGPS monitoring or for detecting and reporting on scintillation or ionodelay effects.

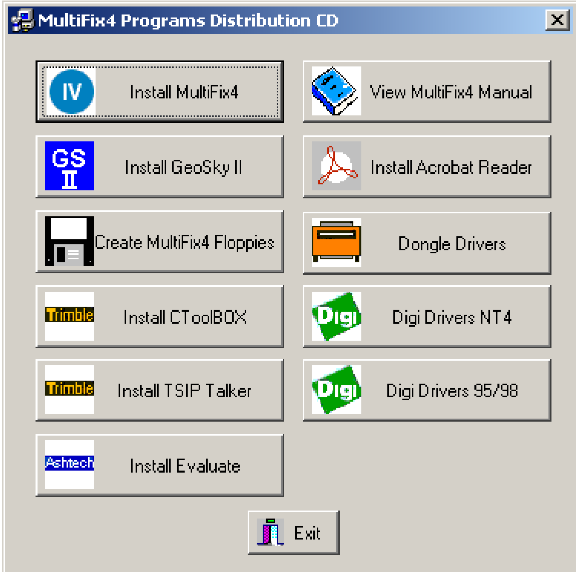
11. **GeoSky II** is a GPS and SkyFix mission-planning tool. The software is available free of charge and can download up to date information from the Internet or via a RxV configuration files

12. **RxV**, or Receiver Verify, is an add on to MultiFix that allows the software to use multiple GPS receivers in a single solution. This is intended for use aboard vessels where obstruction of the GPS antenna is common, such as aboard construction barges and jack up rigs.

3. SOFTWARE INSTALLATION

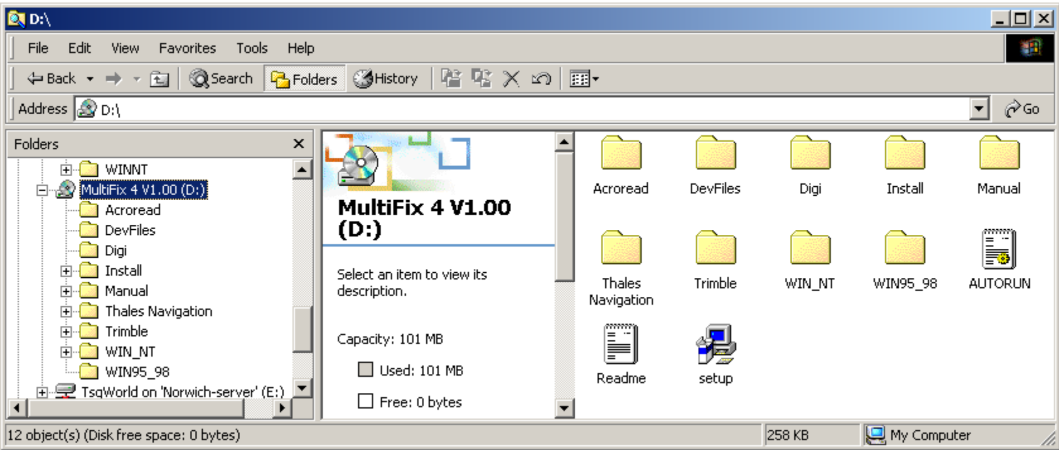
3.1. ZERO SUITE PROGRAMS

The program is supplied on a CD. Insert the CD into the drive.



The installation dialogue shown opposite should now appear. Click **[Install MultiFix4]**, then follow the on-screen instructions.

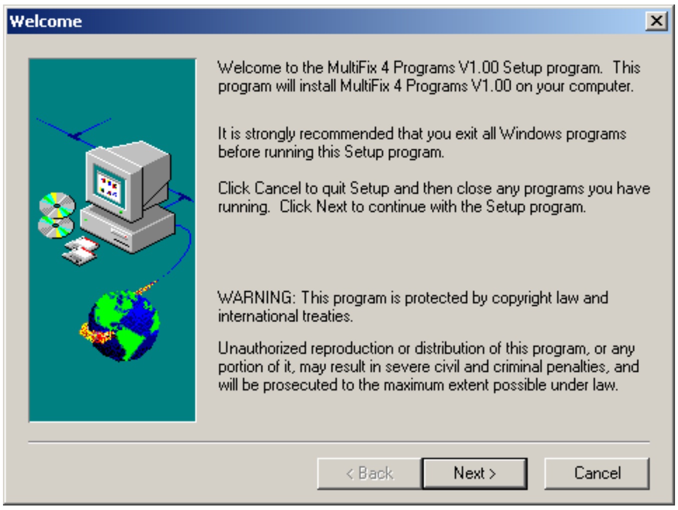
(If this installation screen does not appear access Windows Explorer by clicking “Start” \ “Programs” \ “Windows Explorer” and double-click the CD drive icon).



Doubling-click the set up application file to call up the MultiFix Program Distribution CD dialogue shown above.

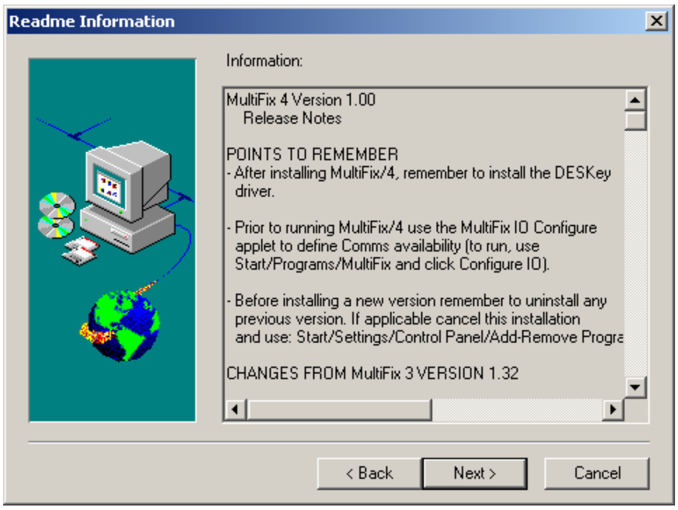
Note the on screen advice to shut down other applications. Also note that if at anytime an incorrect selection has been made, use **[<Back]** to retrace the steps through the installation wizard and make the correction.

Click the **[Next>]** button.



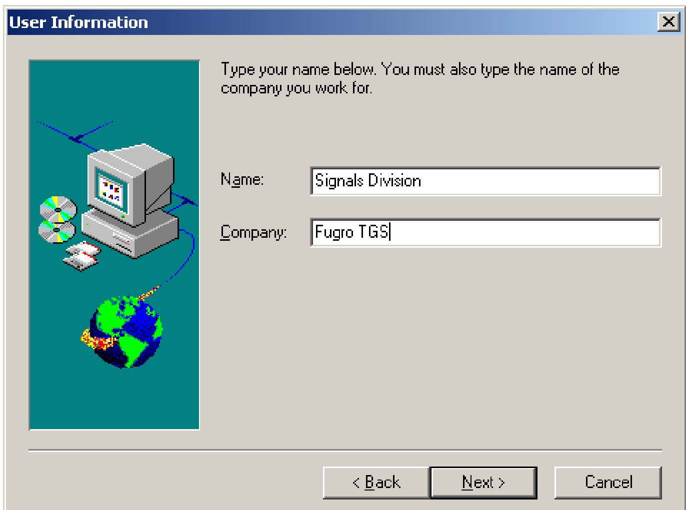
The Readme Information dialogue gives advice about the program development history. Use the vertical scroll bar to see that information

Click **[Next>]**.



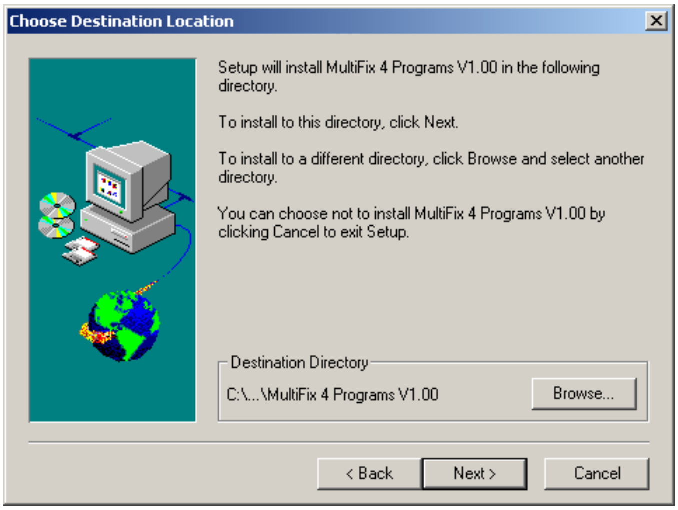
Enter a “Name:” and a “Company:” name.

Click **[Next>]**.

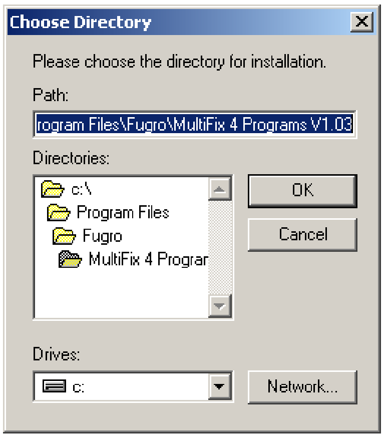


Choose where the applications are to be installed on the computer.

Use **[Browse…]** if C:\ Program Files \ Fugro \ MultiFix 4 Vx.xx is not acceptable.



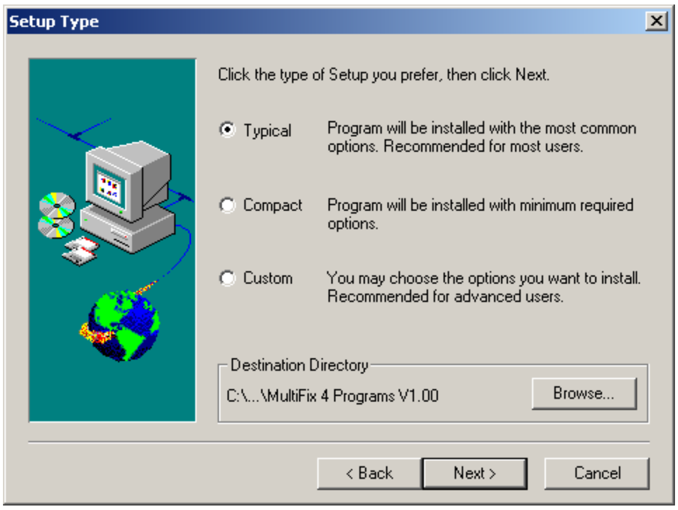
Click **[OK]** to exit from the Choose Directory dialogue and return to the Choose Destination Location dialogue. If the directory does not exist the program will ask whether the folder is to be created.



Now decide what applications are required.

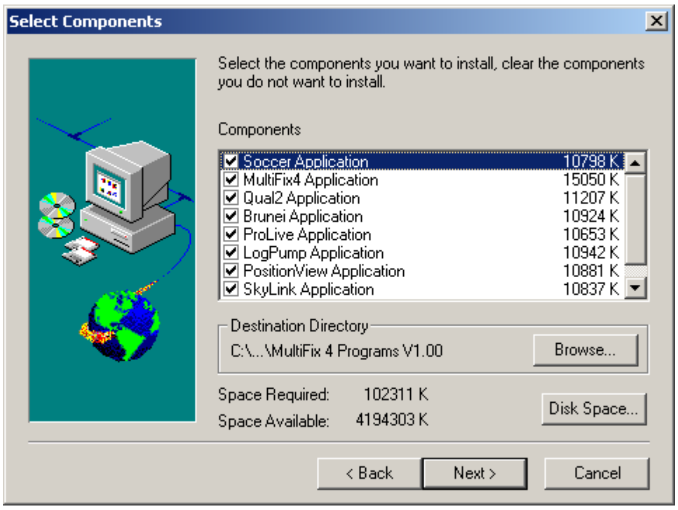
If "Typical" is selected, the applications Soccer, MultiFix 4, Qual 2, SkyLink, Receiver Verify (RxV), Prolive, LogPump and PositionView will be installed.

If "Compact" is selected MultiFix 4, Prolive and Soccer will be installed.



If "Customised" is selected, when **[Next>]** is used, the operator is allowed to select what is and is not installed.

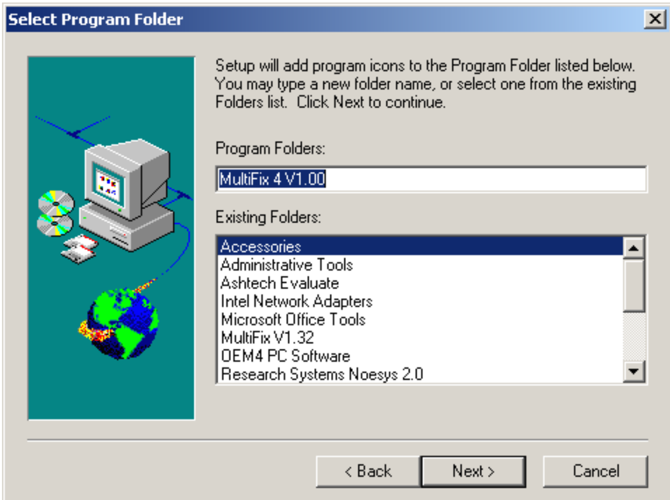
Note the **[Disk Space…]** button. If the reported "Space Required": is more than the currently selected drive can accommodate, the **[Disk Space…]** dialogue allows the destination drive to be changed, albeit the remainder of the path will stay the same.



With all the program(s) to be installed ticked, click the **[Next>]** button and the diversion into customised program selection rejoins the Typical or Compact installation route.

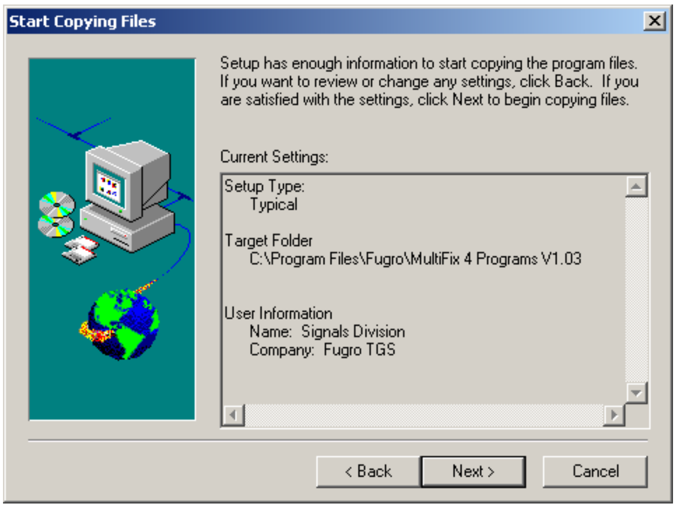
Now select an existing, or create a new, program folder into which the applications will appear. (This folder is seen when using "Start" \ "Programs").

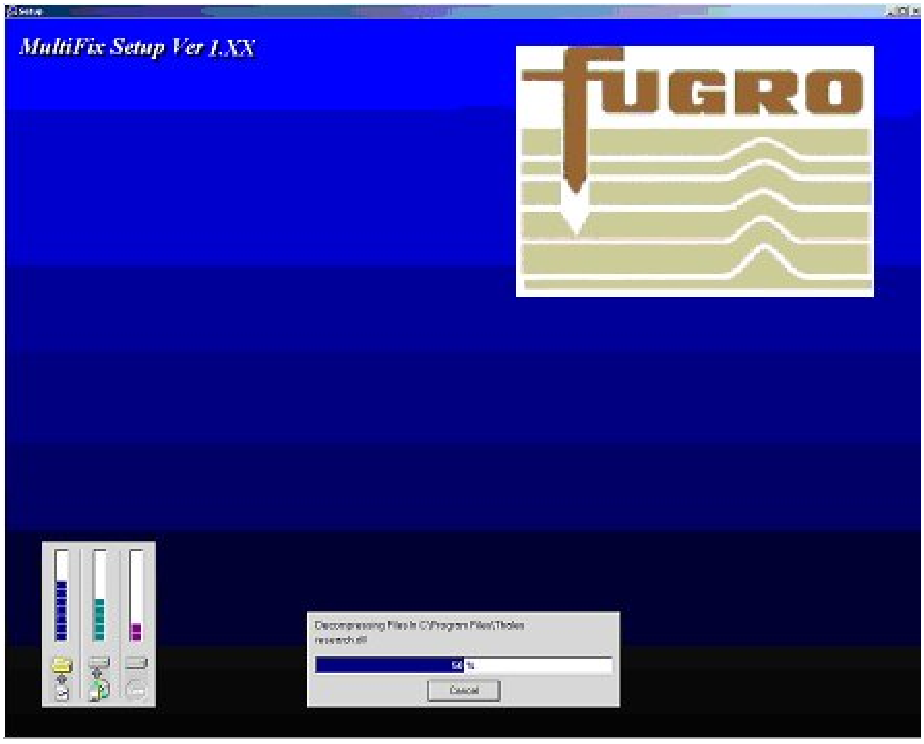
Click **[Next>]**.



The installation wizard reviews the selection made.

Clicking **[Next>]** now starts the installation and file copying.

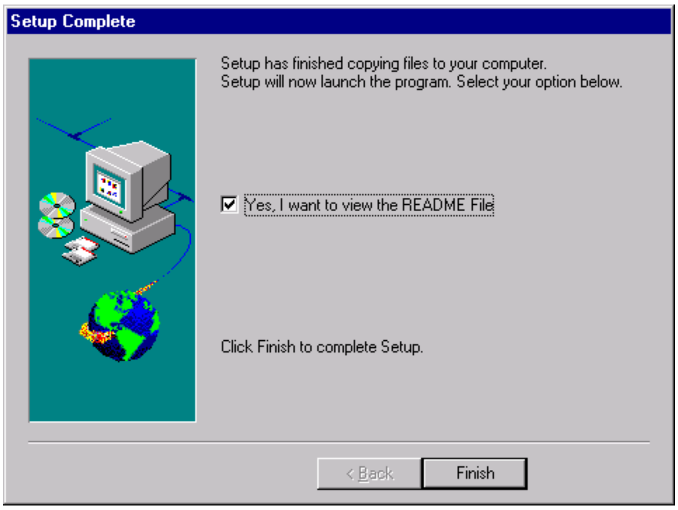




After copying the files the installation wizard states it is Creating Icons and Updating Registry Information.

A “MultiFix 4 Vx.xx” window is also opened and then minimised. It contains shortcuts to all the programs selected for installation.

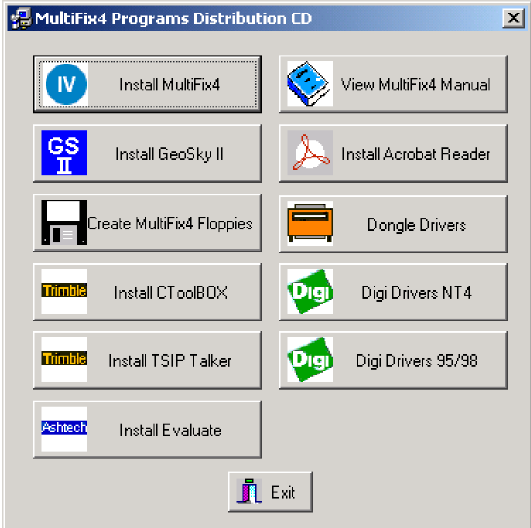
Clicking **[Finish]** completes the MultiFix Vx.xx programs installation process.

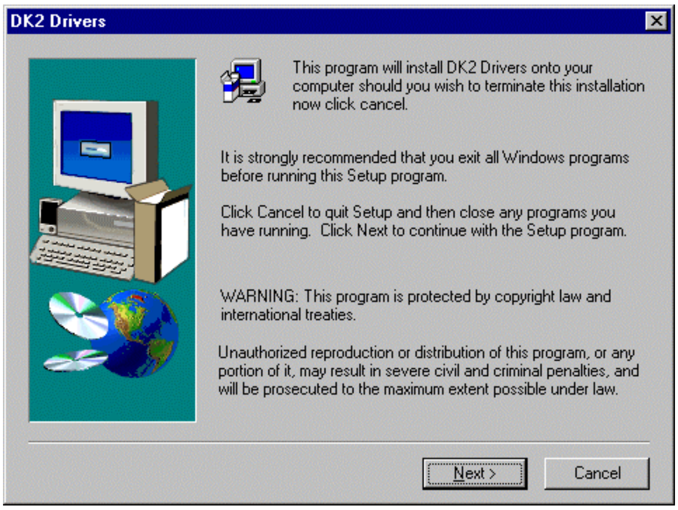


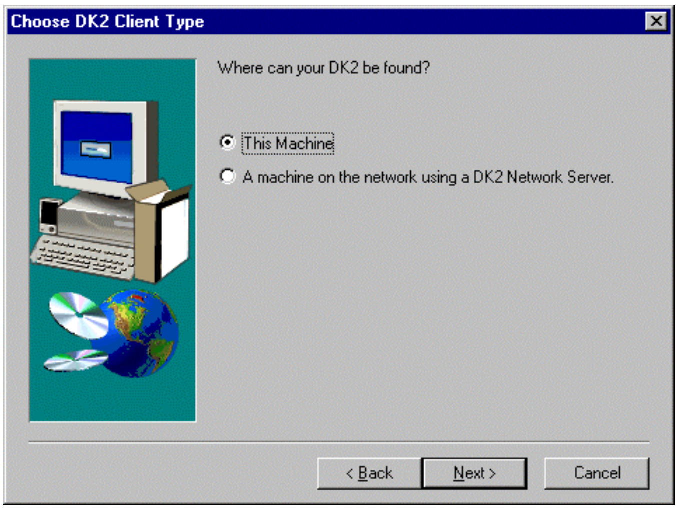
3.2. DONGLE DRIVERS

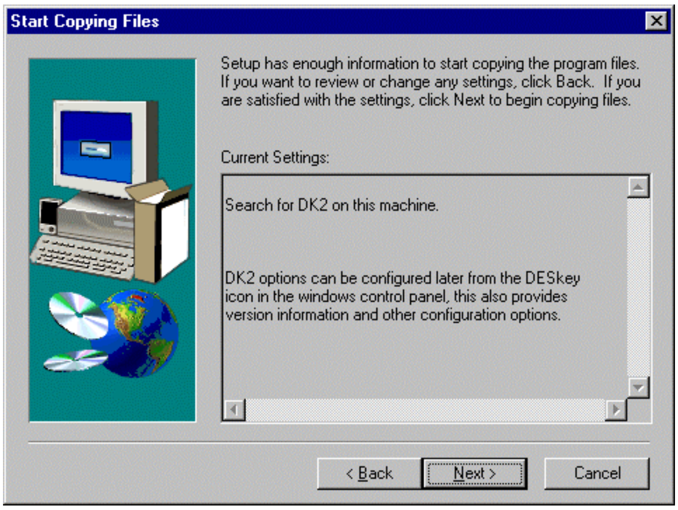
Because MultiFix 4 is dongle protected the dongle driver needs to be installed before the software can be used.

In the distribution dialogue click the **[Dongle Drivers]** button.







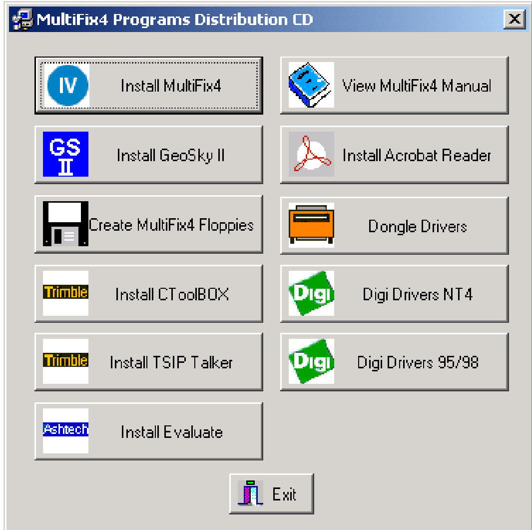


Note: - Using “Start” \ “Settings” \ “Control Panel” \ “Add/Remove Programs” check that there are not two DK DESKey dongle drivers loaded. For example the PC may have been used to run GNS2 with a DK12 dongle and the driver for that dongle is still installed. There are known conflicts when both are installed and the program may run for a while then report that there is no dongle present. Remove the DK12 dongle driver.

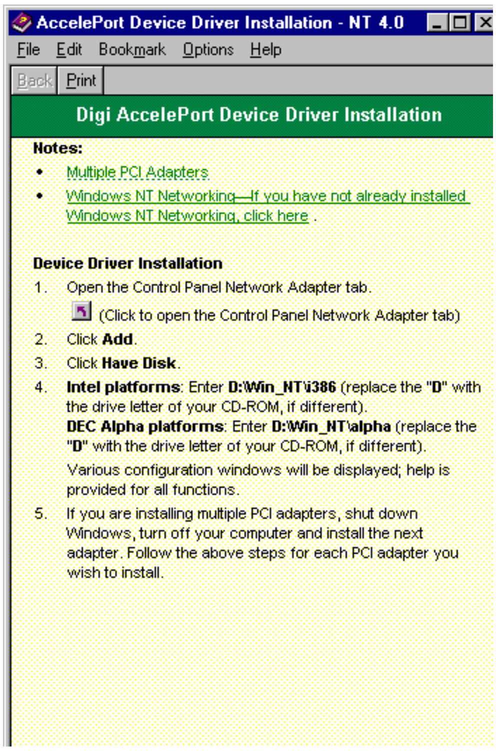
After copying the files there is again the invitation to restart the computer. This is necessary if MultiFix 4 is to be run straight away.

3.3. DIGIBOARD DRIVERS

To install Digiboard drivers click the relevant button for the Windows operating system under which the program is to run. The Digi drivers for Windows 2000 are part of the Windows 2000 operating system.



The example that follows is for Windows NT with a PC/8e Digiboard.



1. Click the arrow button in section 1 of "Device Driver Installation".
2. In the Networks dialogue, click **[Add…]**
3. In the Select Network Adapter dialogue, click **[Have Disk…]**.
4. In the Insert Disk dialogue type in the CD-ROM drive letter followed by \Win_nt\i386, e.g.D:\Win_nt\i386.
5. In the Select OEM Option dialogue highlight the Digiboard installed in the computer, for example "Digi PC/8e(ISA) Adapter", click **[OK]**.
6. In the Digiboard Adapter dialogue, check the "IO base port" and the "Memory base address". In the case of the PC/8e board, the "IO base port" number is set by the DIP switch settings, see diagram below. The "Memory base address" for a PC/8e is typically D0000. Click **[OK]** to exit.

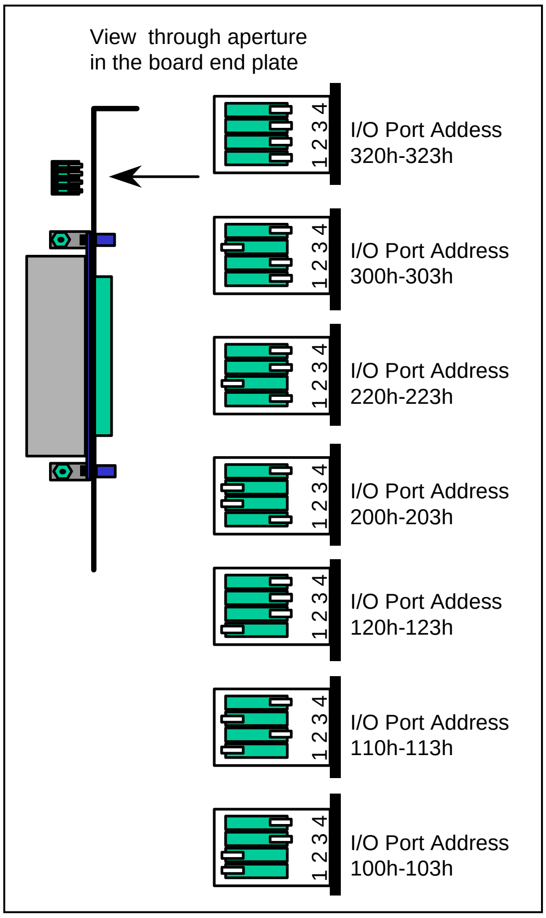


Figure 1 PC/8e Switch Settings for IO Base Address

7. **[Close]** the Network dialogue and as requested restart the computer.

The Digiboards must be mapped to the COM ports. The first Digiport should be numbered 1 higher than the in built ports in the computer.

3.4. PRE-CONFIGURATION

Assuming data is being input and or output via COM ports, before MultiFix 4 is run it is necessary to let the program know what COM ports are available.

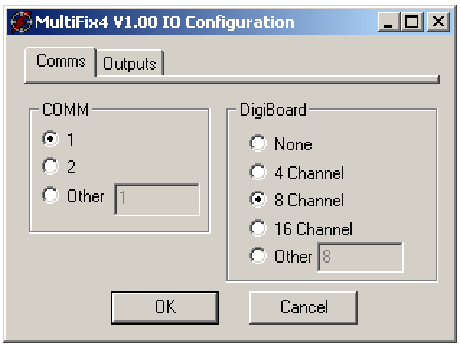
Likewise, assuming position data outputs will be required from MultiFix 4 the program needs to know the how to build those output messages. To do that, *.zpo output library files must be selected.

To accomplish both the above tasks, access the MultiFix Vx.xx IO Configuration Control Panel by selecting "Start" \ "Programs" \ "MultiFix 4 Vx.xx" \ "Configure IO"

As seen below the MultiFix IO Configuration dialogue has two tabs.

3.4.1. Comms Profile

Click the relevant radio buttons to indicate what COM ports and Digiboards are available to the program and then exit using **[OK]**.

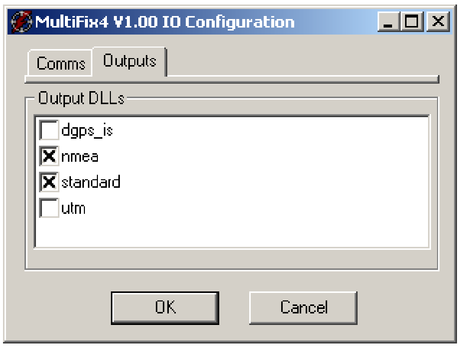


3.4.2. Output Pre-Selection

This tab is only required for use in MultiFix 4. To create output strings MultiFix 4 needs access to *.zpo library files. There are four output options included for general distribution, two of which are pre-selected. Each of these options are linked with the appropriate ZPO file

The NMEA output option enables MultiFix 4 to create,

- GGA,
- GGA + VTG,
- GLL,
- RTK and
- ZDA sentences.
- DPGGA
- GSA
- GST
- GSV



The STANDARD option enables MultiFix 4 to create,

- Trimble
- DNav
- ZeroLink
- Fugro UKOOA
- Geco UKOOA
- Geco UKOOA Version 2
- Fugro XP Expanded and
- Fugro XP Concise messages

The UTM option allows MultiFix 4 to create the Syledis and GEM 80 DP outputs.

The DGPS_IS option is a development tool and not required for standard work.

Two options, NMEA and STANDARD options are pre-selected by default. To add the UTM or DGPS_IS outputs check the appropriate boxes.

The set up of various outputs is covered in Section 4.3.3.5 on page 69. The format of the messages can be found in APPENDIX A - DATA OUTPUT STRINGS on page 316.

NOTE that the “Automatically adjust clock for daylight saving changes” option in the “Time Zone” tab under “Start” \ “Settings” \ “Control Panel” \ “Date/Time” should NOT be checked.

4. MULTIFIX 4

4.1. INTRODUCTION

MultiFix 4 is Fugro's fourth generation differential GPS real time position computation and QC program. It is an integral part of the SkyFix Premier service but can also be used with the standard SkyFix service. MultiFix 4 was released as a MultiFix 3 replacement but includes a new positioning mode called SkyFix-XP.

MultiFix 4 takes in Almanac, Ephemeris, Raw Code and Carrier measurements from either a single or a dual frequency GPS receiver (or from logged files for replay purposes).
It also inputs RTCM SC104 Version 2 differential correction messages from one or more RTCM Correction delivery systems, and Fugro Proprietary RTCM Type 55 Ionospheric range corrections. These are generated at selected SkyFix Premier reference stations and broadcast via the Fugro global network of high and low power L Band beams.

- There is no limit on the number of RTCM correction delivery systems.
- There is no limit on the number of RTCM differential reference stations.
- There is no limit on the number of computations.
- Each computation can employ corrections from any combination of reference stations available.
- The statistical evaluations are based upon the UKOOA recommendations.
- There is no limit on the number of outputs.
- There is no limit on the number of view windows.
- The view windows can be customised.

MultiFix 4 has been designed in a modular fashion such that data is passed between modules as if over a computer network. The core module MultiFix 4 performs the computation of the GPS antenna position. Additional modules are available with more to be made available in the future. While a single computer can be used, the various modules will equally be able to be run on different computers provided there is a network interconnection.
MultiFix 4 uses the EGM96 geoid/spheroid separation model.

The RTCM corrections that are generated at reference stations are contaminated by a variety of error components, one of which is Ionospheric delay. The Ionospheric delay is currently more variable because of greater sun spot activity. MultiFix 4's standard computation uses the Klobachar Ionospheric delay model. This model is updated periodically but is not responsive to the current short-term variability. MultiFix 4 has an additional calculation option when working with dual frequency receivers and when in receipt of Type 15 or 55 RTCM messages. With dual frequency receivers, estimates can be made of the Ionospheric delay by examining the differences between the measurements from the two frequencies. If the same procedure for estimation of Ionospheric delay is performed at the reference stations and on the mobile, both the RTCM corrections and the pseudo-ranges can have the Ionospheric delay removed, effectively providing an Iono-Free DGPS position solution.

SkyFix-XP approaches the differential technique from a totally different perspective. The global network of reference stations is used to track all satellites continuously throughout their orbit. These global observation sets are then combined into a single correction process. This process identifies, isolates and measures each individual source of error and provides a complete set of orbit corrections for each GPS satellite. As such this measurement set can be used at any location, regardless of distance to a reference station, making the system truly global. This technique is called SDGPS, Satellite Differential GPS, as the differential corrections are for the GPS satellite and not a specific reference station.

The remaining tropospheric and ionospheric error sources are estimated or eliminated at the user end. The Tropospheric error is removed utilising a Tropospheric modelling technique as part of the position calculation. Whilst the ionospheric delay is eliminated by using a dual frequency GPS receiver at the users location. Multipath and receiver noise at the users location are limited by using the carrier phase observations.

The SkyFix-XP SDGPS corrections are generated from two independent systems, each being identified by a unique source code ‘0’ and ‘1’. In case of failure on one system the correction source will automatically switch to the remaining system at the Network Control Centre. Fugro’s MultiFix 4 QC software can automatically identify a change in correction source and will notify the user without affecting the position calculation.

To provide an absolute confirmation of accuracy Fugro has installed regional monitor systems at a number of SkyFix stations at locations that are key to offshore operation. These provide real-time system performance information on the SkyFix Club website.

The text in this manual conforms to certain conventions

1. All command buttons are shown bold and bracketed with square brackets e.g. **[OK]**,
2. When a keyboard key is represented, it is shown bold and bracketed by greater than and lesser than symbols e.g. **<spacebar>**.
3. Direct quotations from dialogues or edit control slots are shown in normal text in quotations, e.g. “IO Channel:”

4.2. CONFIGURATION

4.2.1. SkyFix Single Frequency

The following diagrams outlines the hardware requirements and interconnections for a standard single-frequency SkyFix set up using Fugro's MK3 or MK5 decoders and an Ashtech DG16 GPS receiver.

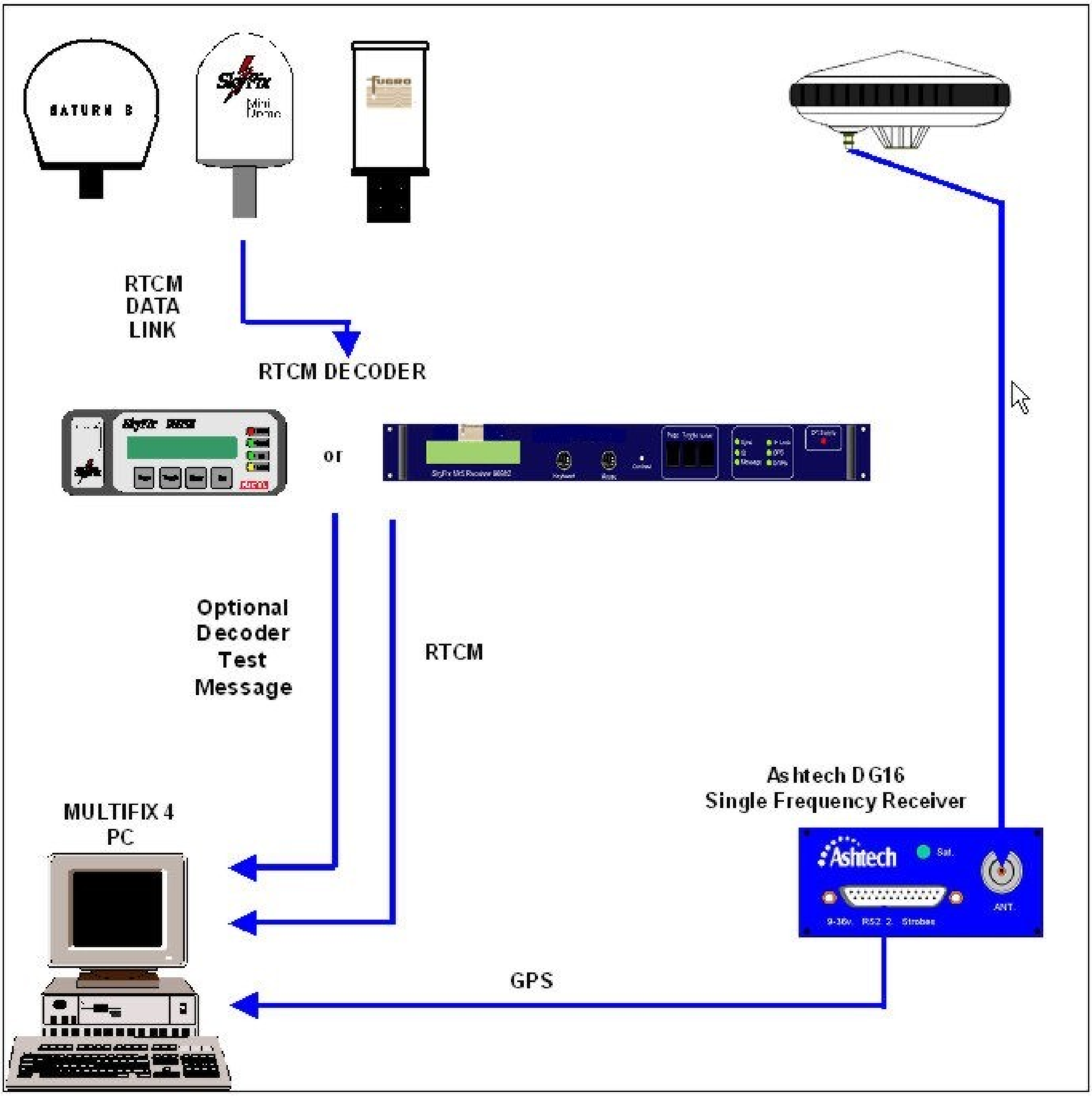


Figure 2 Example Interconnection with an Ashtech DG16 Receiver

4.2.2. SkyFix-XP / Premier Dual - Frequency

The following diagrams outlines the hardware requirements and interconnections for a SkyFix-XP or Premier dual-frequency set up using an Ashtech ZX Sensor or Trimble MS750 receiver.

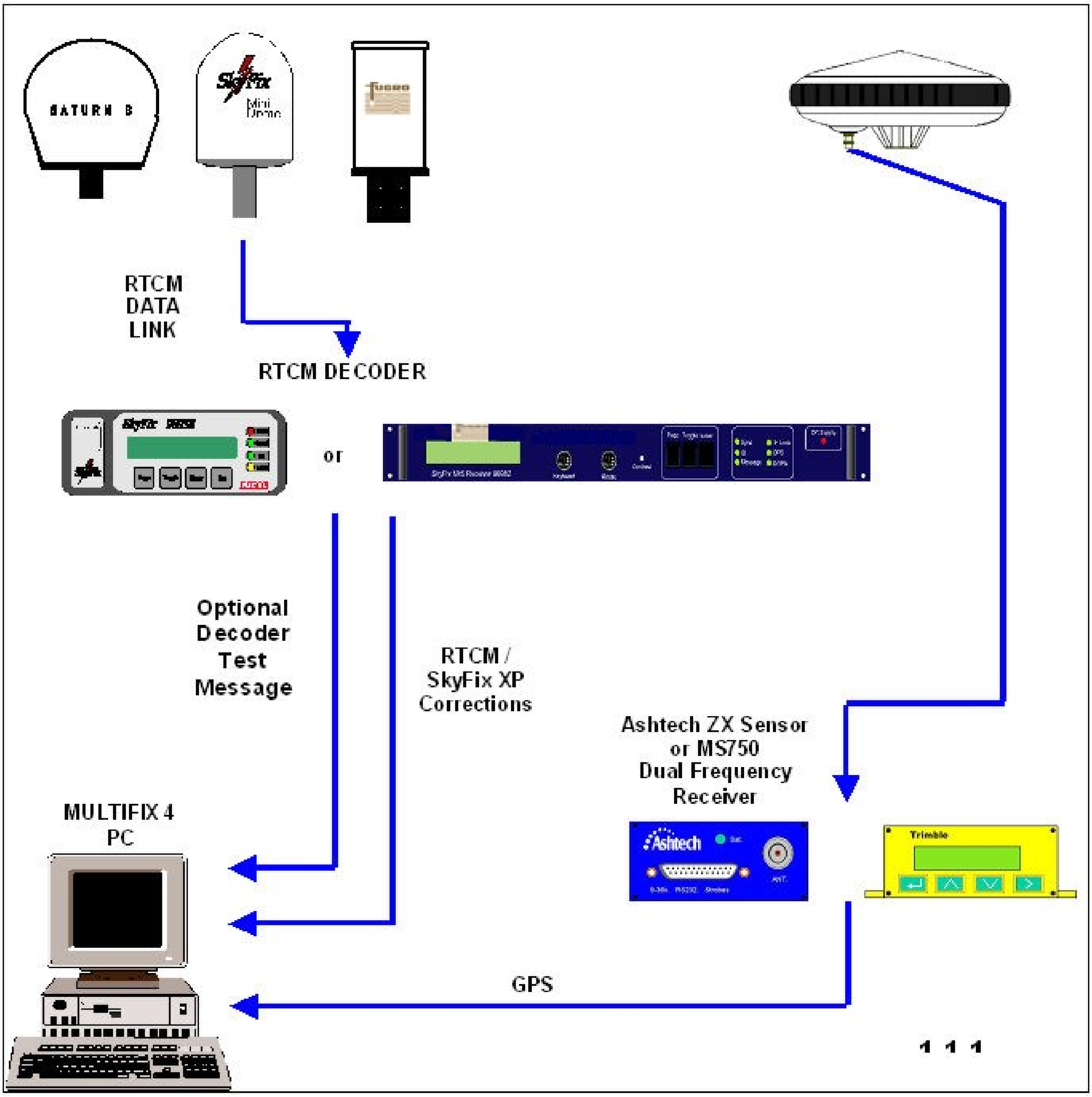


Figure 3. Example Interconnection with Ashtech ZX Sensor or Trimble MS750 Receiver

Although not shown above, other configurations are supported where the RTCM decoder has a GPS receiver board fitted. MultiFix 4 is then able to take the GPS measurement and other data as well as the RTCM correction from the Decoder.

4.2.3. HARDWARE REQUIREMENT

MultiFix 4 requires the following:

A PC running Windows 98, Windows NT, Windows 2000 or Windows XP. The minimum recommended PC is a Pentium III (or equivalent) processor with 128 MB RAM. A graphics resolution of at least 1024 by 768 pixels is advised in order to achieve maximum clarity of all the graphics displays. If two copies of MultiFix 4 are to be run on the same machine, or if more than 15 reference stations are used, then it is recommended to have a minimum of 256MB RAM.

For the installation of the software the PC requires a CD-ROM drive. It is possible to create installation floppy discs from the installation menu on the CD but 8 floppies are needed.

MultiFix 4 needs a single frequency GPS receiver to run in standard mode and a dual frequency GPS receiver to run in dual frequency SkyFix Premier or SkyFix-XP mode.

MultiFix 4 supports the following GPS receivers:

Manufacturer	Model	Type	Baud Rate (Minimum)	Baud Rate (Recommended)
Ashtech (Thales Navigation)	Z Family	Dual	38400	57600
Ashtech (Thales Navigation)	DG16	Single	9600	9600
Ashtech (Thales Navigation)	G12	Single	9600	9600
Ashtech (Thales Navigation)	GG24	Single	9600	9600
Trimble	BD112	Single	9600	9600
Trimble	DSM	Single	9600	9600
Trimble	DSM212	Single	9600	9600
Trimble	SK8	Single	9600	9600
Trimble	4000DS	Single	9600	9600
Trimble	BD750	Dual	38400	57600
Trimble	MS750	Dual	38400	57600
Trimble	5700	Dual	38400	57600
Trimble	4000 SSE	Dual	38400	57600
Trimble	4000 SSi	Dual	38400	57600
NovAtel	OEM4	Dual	57600	57600
NovAtel	Millennium	Dual	38400	57600

Assuming data is not being input or output over network sockets, the PC needs a minimum of 2 COM ports. One COM port is used for two-way communications to the GPS receiver and the second COM port for the input of RTCM corrections. As the second port is for input only it can also be used to output position messages by using a special breakout cable.

If there is more than one RTCM delivery system, or data is to be output on several ports, then additional COM ports will normally be required. These can be any proprietary asynchronous serial board (or PCMCIA card). The Windows drivers for these allow the board's (or card's) ports to be mapped as additional COM ports.

4.2.4. GPS RECEIVER CONFIGURATIONS

4.2.4.1. Ashtech (Thales Navigation) Receivers

Ashtech receivers can be controlled either from within MultiFix or externally using the Evaluate software from Thales Navigation.

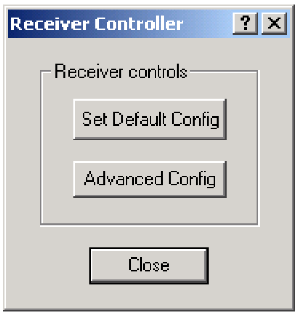
Evaluate must be used to establish and configure baud rates, but once communications have been established between the PC and MultiFix then MultiFix can complete the configuration process.

4.2.4.1.1.Configuration from within MultiFix

Assuming communications have been established between MultiFix and the GPS receiver then the receiver can be configured automatically by MultiFix.

The Command "Action" \ "Configure Ashtech" will launch the receiver configuration dialogue.

Select Set default configuration to complete the receiver configuration.



Note that if using a Z Family receiver then the Baud Rate must be set to a minimum of 38400 due to the large amount of data output from the receiver.

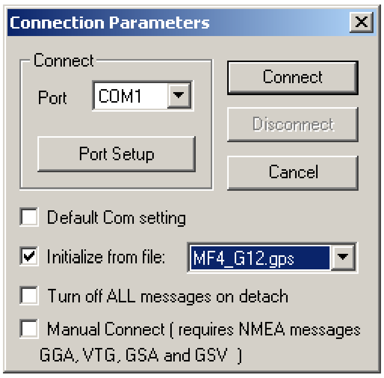
See section 4.3.5.6 for more details.

4.2.4.1.2.Ashtech Evaluate Configuration

Direct configuration of Ashtech receivers is usually via the Ashtech Evaluate program; alternatively they can be configured using a terminal program. The following relates to Ashtech Evaluate which is included on the MultiFix 4 installation CD.

Sample configuration files are also available on this CD. After installing the Evaluate software start the program by clicking the Ashtech Evaluate icon in the start menu. The user will be asked to choose a start up option. Select "Connect to GPS Receiver" and click **[OK]**.

In the Connection Parameters dialogue select the PC Port, tick the “Initialize from file:” box, remove the tick from all other boxes and select and the preferred initialisation file.

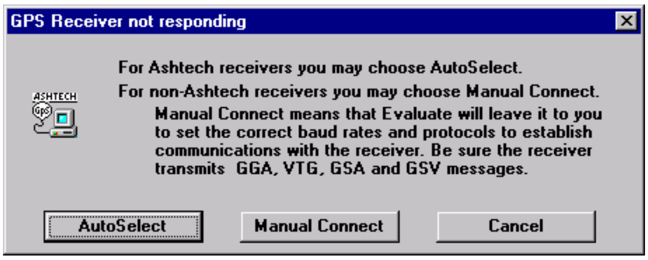


Pre-configured initialisation files can be found on the MultiFix 4 installation CD. These files must first be copied to the Evaluate \ Receiver folder.

Alternatively a file can be created from the text below. Re-name the new text file with a *.gps extension and place it in the Evaluate \ Receiver folder.

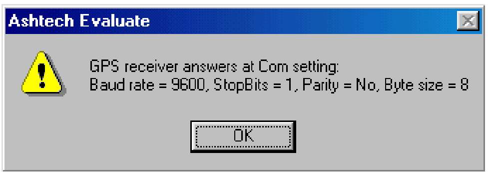
The benefit of using an initialisation file is that all configuration commands are sent to the receiver in a preferred sequence and can be followed by a command that saves all these settings in the battery backed-up memory of the receiver.

On clicking **[Connect]**, the software will try to establish connection with the receiver.



If the PC COM port settings do not match the port setting of the internal port on the GPS receiver, Evaluate will report that the GPS receiver is not responding.

By selecting the **[AutoSelect]**, Evaluate will cycle through all possible COM port parameter settings and will report if it finds the current receiver. Evaluate will then connect with the newly found settings.



If no matching port settings are found, investigate all cable connections and make sure that the receiver is powered on.

4.2.4.1.3.Ashtech Z-Family

The MF4_ZX.gps file contains

```
;
; Initialisation file for ZX-Sensor with MultiFix
;
; Set Measurement recording interval
$PASHS,RCI,1
; Set Raw Measurement elevation mask to 0 degrees
$PASHS,ELM,0
; Set the minimum number of SV measurements to 1
$PASHS,MSV,1
; Enable GGA position output
$PASHS,NME,GGA,A,ON
; Set GGA output to 10 second intervals
$PASHS,NME,PER,10
; Set Multipath Correlator
$PASHS,MLP,COD
; Enable UTS
$PASHS,UTS,Y
; Set the port A baud rate to 38400
$PASHS,SPD,7
; Enable the GPS Almanac GPS Ephemeris and GPS Measurement Messages
$PASHS,OUT,A,MBN,SNV,SAL,BIN
; Enable the GPS Almanac
$PASHR,ALM,A
; Save all current settings into the battery backed up memory
$PASHS,SAV,Y
```

4.2.4.1.4.Ashtech DG16

The MF4_DG16.gps file contains

```
; Initialisation file for DG16 with MultiFix
;
; Set Measurement recording interval
$PASHS,RCI,1
; Set Raw Measurement elevation mask to 0 degrees
$PASHS,ELM,0
; Set the minimum number of SV measurements to 1
$PASHS,MSV,1
; Set Code Measurement Smoothing ('Period','Order')
$PASHS,SMI,300,2
; Set Code Correlator Mode (E or S)
$PASHS,CRR,S
; Enable UTS
$PASHS,UTS,ON
; Enable GGA position output
$PASHS,NME,GGA,A,ON
; Set GGA output to 10 second intervals
$PASHS,NME,PER,10
; Set the port A baud rate to 9600
$PASHS,SPD,5
; Enable the GPS Almanac Messages
$PASHS,RAW,SAL,A,ON
; Enable the GPS Ephemeris Messages
$PASHS,RAW,SNV,A,ON
; Enable the GPS Measurement Data
$PASHS,RAW,MCA,A,ON
; Enable the GPS Measurement Data
$PASHS,RAW,PBN,A,ON
; Save all current settings into the battery backed up memory
$PASHS,SAV,Y
```

4.2.4.1.5.Ashtech G12

The MF4_G12.gps configuration file contains the following.

```
; Initialisation file for G12 with MultiFix
;
; Set the SNR Calculation to dB/Hz independent of the hardware
$PASHS,SNR,DBH
; Set Measurement recording interval
$PASHS,RCI,1
; Set Raw Measurement elevation mask to 0 degrees
$PASHS,ELM,0
; Set the minimum number of SV measurements to 1
$PASHS,MSV,1
; Enable GGA position output
$PASHS,NME,GGA,A,ON
; Set GGA output to 10 second intervals
$PASHS,NME,PER,10
; Set the port A baud rate to 9600
$PASHS,SPD,5
; Enable the GPS Almanac Messages
$PASHS,RAW,SAL,A,ON
; Enable the GPS Ephemeris Messages
$PASHS,RAW,SNV,A,ON
; Enable the GPS Measurement Data
$PASHS,RAW,MCA,A,ON
; Save all current settings into the battery backed up memory
$PASHS,SAV,Y
```

4.2.4.1.6.Ashtech GG24

The MF4_GG24.gps file contains

```
; Initialisation file for GG24 with MultiFix
;
; Set System to GPS only mode
$PASHS,SYS,GPS
; Set Measurement recording interval
$PASHS,RCI,1
; Set Raw Measurement elevation mask to 0 degrees
$PASHS,ELM,0
; Set the minimum number of SV measurements to 1
$PASHS,MSV,1
; Enable GGA position output
$PASHS,NME,GGA,A,ON
; Set GGA output to 10 second intervals
$PASHS,NME,PER,10
; Set the port A baud rate to 9600
$PASHS,SPD,5
; Enable the GPS Almanac Messages
$PASHS,RAW,SAL,A,ON
; Enable the GPS Ephemeris Messages
$PASHS,RAW,SNV,A,ON
; Enable the GPS Measurement Data
$PASHS,RAW,MCA,A,ON
; Save all current settings into the battery backed up memory
$PASHS,SAV,Y
```

4.2.4.2. Trimble Receiver Configuration

4.2.4.2.1. Trimble BD112

Both the BD112 and the DSM are Trimble single frequency receiver boards. They can be mounted in a 90938. If the 90938 decoder has a BD112 board fitted it will have the suffix F112. If a DSM board is fitted it will have the suffix /M.

The receiver boards do not retain configuration settings when not housed in a 90938, therefore when power is recycled they revert to their default settings. One of those defaults is the COM port parameter values which are 9600 8-ODD-1.

Within MultiFix use the Edit GPS Receiver dialogue (accessed using "Config" \ "GPS Rx…") to select BD112 (Trimble) from the drop down list of GPS receivers. Use "Action" \ "Configure TSIP" \ "Default" to configure the receiver to output the required message types.

Note- The "Configure TSIP" menu item only becomes available if a TSIP protocol receiver is selected.

If it is clear that MultiFix 4 is not communicating with the receiver it may be due to baud rate or other incompatibilities, (see Section 4.3.5.5 on page 86). In that case use the Trimble TSIP Talker application that can be found on the MultiFix installation CD.

TSIP Talker contains an option called TSIP Break. If on start-up TSIP Talker fails to establish communications with the receiver TSIP Break can be used. That will reset the Trimble serial port to 9600 8-ODD-1. Once communication has been established with those settings TSIP Talker can make further changes to the communication parameter settings.

Once the communication has been established return to "Action" \ "Configure TSIP" \ "Default" in MultiFix 4 to complete the receiver configuration.

4.2.4.2.2. Trimble DSM

As 4.2.4.2.1 but selecting DSM (Trimble) in place of BD112 (Trimble) from the drop down list of receivers.

4.2.4.2.3. Trimble DSM212

The DSM212 is a DSM single frequency receiver board housed in its own box. The front panel of the box has no control buttons. Connect the MultiFix 4 computer to either of the serial ports on the back of the DSM212 unit.

4.2.4.2.4.Trimble SK8

The Trimble SK8 is a navigation grade GPS receiver. It should not normally be used for survey operations.

The SK8 uses the same TSIP protocol as the DSM and BD112. It is also configured in the same way as per section 4.2.4.2.

4.2.4.2.5.Trimble MS750

The configuration of the MS 750 dual frequency receiver must be done in two stages. The first stage is via the front panel of the unit itself, and the second stage is via the “Yellow Box” display accessed from the “Receiver” option in the “View” / “GPS” pull-down menus.

IMPORTANT NOTE – It is essential that the baud rate is set to 38400 as if too low a baud rate (9600) is used then the serial port may be over loaded when there is a high number of SVs visible (greater than 10).

4.2.4.2.5.1.Front Panel Configuration

When the MS 750 is powered up, the front panel displays the Home screen (shown opposite). Use the green “**>**” button to toggle to the “Config GPS” display.

```
SV:07 PDOP3.2
RTK(FIX)
```

```
Config GPS
Press ∨ to Enter
```

The screen shown opposite will now appear. Press the “∨” button to access the “System Masks “ display.

```
Cnf:System Masks
Elev 10  Pdop 07
```

Press the “**>**” button to enable the cursor. Set the elevation mask to 0° and the PDOP mask to 99. Use the “**>**” button to move the cursor and the “∧” and “∨” buttons to change the values. Press the “↵” button to accept the entry.

```
CFG: Exit
Pre     to
```

Toggle to the “Exit Config” display by pressing the “∨” button. Press “↵” to exit this display and return to the “Config GPS” screen. Press “**>**” to toggle to the “Config Ports” screen.

```
Config Ports
Press ∨ to Enter
```

This will bring up the screen shown here. Press the “∨" button to toggle to the Port A configuration display.

```
CFG: Port A NONE
38400  8-NONE-1
```

The screen shown opposite will now appear. Use the “**>**” button to enable the cursor. Set the Baud rates to 38400, 8-None–1 using the “**>**” button to move the cursor and the “∧” and “∨” buttons to change the values. Then press “↵”.

```
CFG: NMEA    GGA
Port A   OFF
```

GPS data will only be output to MultiFix 4 from Port A, so it is not necessary to configure ports B-1 and B-2. Toggle past these screens using the "∨" button.

Ensure that the NMEA, GSOF and Time Tag configuration screens are all "OFF". Use the "**>**" button to enable and move the cursor and the "∧" and "∨" buttons to change the values. Then press "↵".

```
CFG: GSOF Port A
Pos Time OFF
```

```
CFG:1PPS TimeTag
Off
```

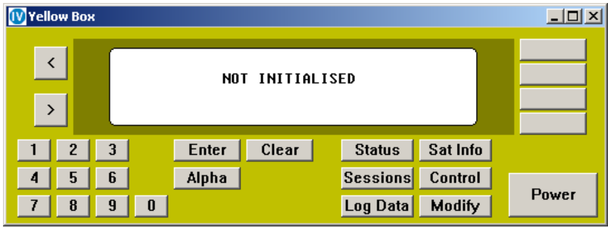
Toggle to the "Exit Config" display by pressing the "∨" button. Press "↵" to exit this display. This completes the front panel configuration for the MS 750.

```
CFG: Exit Config
Press ↵ to Exit
```

4.2.4.2.5.2.MultiFix 4 "Yellow Box" Remote Configuration

MultiFix 4 must be installed on the PC before this stage of the configuration process can be completed. This should be done in accordance with the instructions outlined in Section 3. Assuming that this has been done and that the receiver unit is connected to the PC, use "View" \ "GPS" \ "Receiver".

The screen shown opposite will appear. As soon as communication is established it will change to show the current front panel.

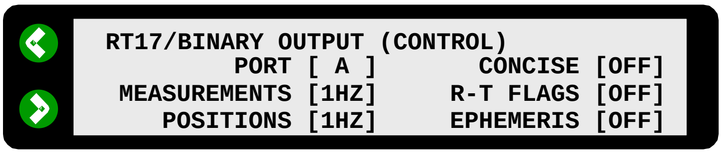


Press "Alpha" and then "Control" to reach the MENU (CONTROL) screen

Use the "**Alpha**" button to toggle to the menu screen displayed opposite. Select the <SERIAL PORT OUTPUT> option by clicking the blank button adjacent to it

The screen shown opposite will now appear. Click on the blank button adjacent to the <RT17/BINARY OUTPUT> option to access the screen shown below.

Using the "**Enter**" button to toggle to the desired parameter. Ensure that the correct output port is enabled and then set MEASUREMENTS and POSITIONS to **1HZ** using the "**Alpha**" button. EPHEMERIS should be set to "**ON**" (optional) and all other parameters should be set to "**OFF**".



Click on "**Enter**" until the MENU (CONTROL) screen is displayed.

4.2.4.2.6.Trimble BD750

The Trimble BD750 is the board version of the MS750 and can be found mounted inside the 90938 Genesis units. I/O configuration of the ports is via the front panel of the 90938. Configuration of the BD750 is via yellow box, as per Section 4.2.4.2.5.2.

4.2.4.2.7.Trimble 5700

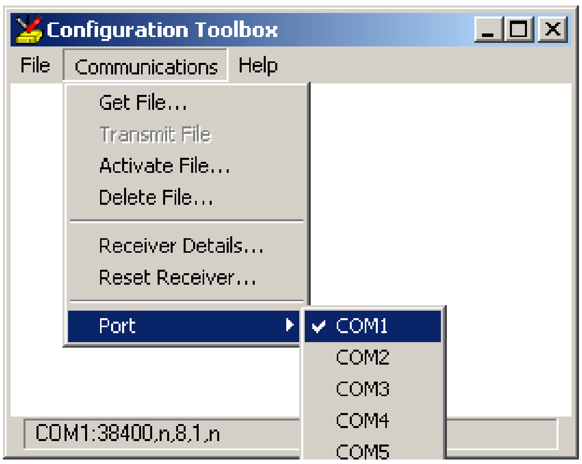
The configuration of the 5700 dual frequency receiver must be done in two stages. The first stage is completed using the Trimble Configuration Toolbox software, and the second stage is via the "Yellow Box" display accessed from the "Receiver" option in the "View" / "GPS" pull-down menus.

IMPORTANT NOTE – It is essential that the baud rate is set to 38400 as if too low a baud rate (9600) is used then the serial port may be over loaded when there is a high number of SVs visible (>10).

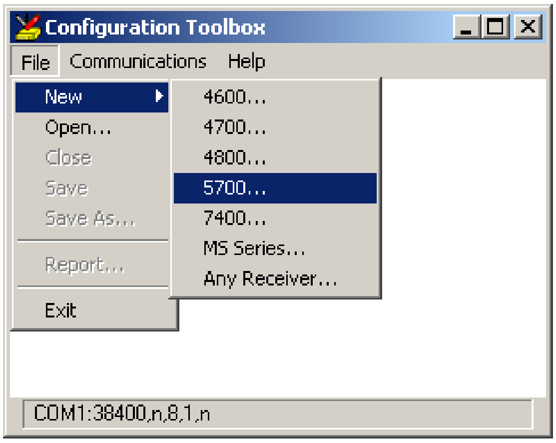
4.2.4.2.7.1.Trimble's Configuration Toolbox

Trimble's 'Configuration Toolbox' software is used initially to establish communications with the 5700. The software is available from Trimble or from a MultiFix installation disk. Connect the receiver to the PC as directed above and start the 'Configuration Toolbox' software.

First direct the software to the Com port that the receiver is connected to, "Communications" \ "Port"

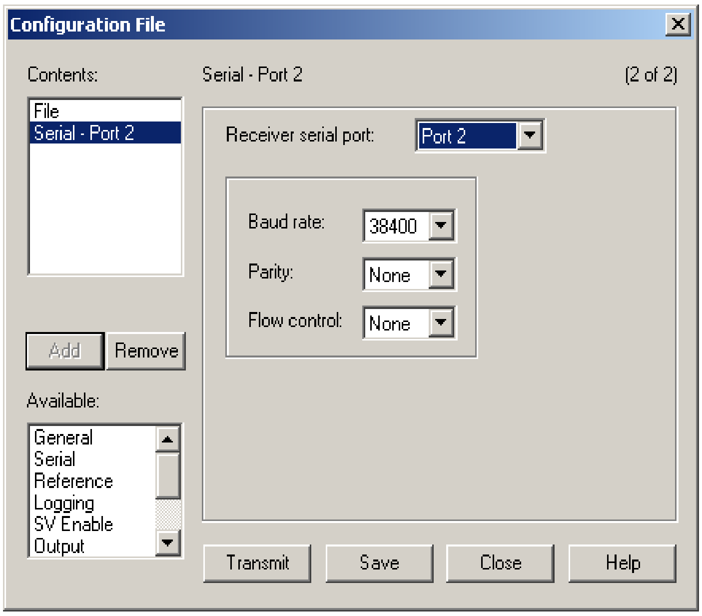


Select the receiver type, “File” / “New” select <5700>. This will launch a configuration box.



From the “Available” box highlight “Serial” and click **[Add].**

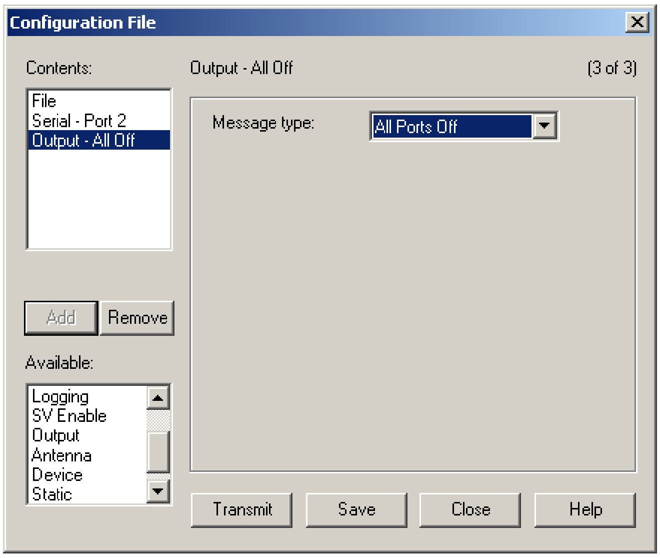
Select the receiver serial port and set the baud rate to “38400”.



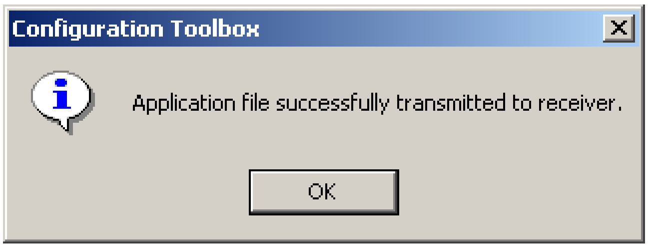
Next select “Output” from the “Available” box and click **[Add].**

Under “Message Type” select “All Ports Off”

Click on **[Transmit]**. This will now send the updates to the receiver.



If the transfer is successful the following dialogue box will appear. Click **[Ok]**.



.

The "Configuration File" dialogue can be closed without saving. Exit the Configuration Toolbox software, the remaining set-up of the 5700 will be completed in MultiFix.

4.2.4.2.7.2.MultiFix 4 "Yellow Box" Remote Configuration

This part of the configuration is identical to the Trimble MS750, see section 4.2.4.2.5.2 to complete 5700 configuration.

4.2.4.2.8. Trimble 4000DS

Set the COM Port Protocol Parameter Values

CONTROL / MORE…/

BAUD RATE/FORMAT /

SERIAL PORT n SETTINGS / CHANGE

```
PORT 1 BAUD RATE [     9600   ] <- CHANGE
           FORMAT [ 8-NONE-1 ] <- CHANGE
     FLOW CONTROL [    NONE   ] <- CHANGE
```

Enable MultiFix 4 Control of Trimble Receiver

CONTROL / MORE… /

REMOTE PROTOCOL

```
REMOTE INTERFACE PROTOCOL

[ DATA COLLECTOR COMPATIBLE ] <-- CHANGE
  (STX,DATA,CHECKSUM,ETX)
```

Select the Port for the MultiFix 4/Trimble Receiver Communication

CONTROL / MORE... /

CYCLE PRINTOUTS /

```
OUTPUT EVERY RECEIVER CYCLE
              RT SURVEY DATA  <-- NEXT
              PORT SELECTION  <-- NEXT
           ENABLE [ PORT 2 ]  <-- CHANGE
```

Ensure there are no other

Receiver Cycle Outputs are enabled (Use Top ←Next)

Select the Format for the MultiFix 4/Trimble Receiver Communication

CONTROL / MORE... /

CYCLE PRINTOUTS /

(Use Middle ←Next)

```
OUTPUT EVERY RECEIVER CYCLE
              RT SURVEY DATA  <-- NEXT
              CONCISE FORMAT  <-- NEXT
           ENABLE [  ON    ]  <-- CHANGE
```

Select the Port for the Receiver's Input of RTCM Corrections

CONTROL/

RTCM-104 INPUT

```
DIFFERENTIAL STATION             <-- MORE
RTCM-104 INPUTS [  ON/AUTO   ] <-- CHANGE
    PORT SELECT [   PORT 1   ] <-- CHANGE
         FORMAT [ VERSION 2 ] <-- CHANGE
```

Check there are No Other Outputs Enabled On the MultiFix 4/Trimble Receiver Communication Port

CONTROL / MORE… /

NMEA-183 OUTPUT

```
NMEA-183          ENABLE[ OFF ] <-- CHANGE
OUTPUT CONTROL       ALM[ OFF ] <-- CHANGE
                     BWC[ OFF ] <-- CHANGE
                                     MORE
```

Check that the Elevation Mask is not set higher in the Receiver than in MultiFix 4 (it can be lower).

CONTROL / MORE… /
MASKS/SYNC TIME

```
POSITIONING MASKS/SYNC TIME:     |
    ELEVATION MASK = +10º        | MINUS
         PDOP MASK =  07.0       |
      SV SYNC TIME =  001.0 SEC  | ACCEPT
```

4.2.4.2.9.Trimble 4000 SSE

When powering up the following screen will appear. In order to reach the standard screen press the “CLEAR” button on the front panel of the receiver.

```
     QUICK-START NOW! (SINGLE SURVEY) --
START PRE-PLANNED SURVEY (SINGLE SURVEY) --
   START FAST STATIC OR KINEMATIC SURVEY --
                                    MORE --
```

The standard screen, shown here, will now appear.

```
POSITIONING -   AUTO SV SELECT   |ELEV/AZM
POSITION FIX:   LAT/LON/HEIGHT   |POSITION
 SV029,03,23,31,21,15            |    DATE
PWR1+[■■■■■■]⇑  07:58:25 UTC     | OPTIONS
```

The following needs to be configured/checked.

Set the COM Port Protocol Parameter Values

CONTROL / MORE…/
BAUD RATE/FORMAT /
SERIAL PORT n SETTINGS / CHANGE

```
PORT 1 BAUD RATE [    9600   ] <- CHANGE
          FORMAT [ 8-NONE-1  ] <- CHANGE
    FLOW CONTROL [   NONE    ] <- CHANGE
```

Enable MultiFix 4 Control of Trimble Receiver

CONTROL / MORE… /
REMOTE PROTOCOL

```
REMOTE INTERFACE PROTOCOL

[ DATA COLLECTOR COMPATIBLE ] <-- CHANGE
  (STX,DATA,CHECKSUM,ETX)
```

Select the Port for the MultiFix 4/Trimble Receiver Communication

CONTROL / MORE... /
CYCLE PRINTOUTS /
Ensure there are no other Receiver Cycle Outputs are enabled (Use Top ←Next)

```
OUTPUT EVERY RECEIVER CYCLE
              RT SURVEY DATA  <-- NEXT
              PORT SELECTION  <-- NEXT
           ENABLE [ PORT 2 ]  <-- CHANGE
```

Select the Format for the MultiFix 4/Trimble Receiver Communication

CONTROL / MORE... /

CYCLE PRINTOUTS /

(Use Middle ←Next)

```
OUTPUT EVERY RECEIVER CYCLE
              RT SURVEY DATA  <-- NEXT
              CONCISE FORMAT  <-- NEXT
           ENABLE [  ON     ]  <-- CHANGE
```

Select the Port for the Receiver's Input of RTCM Corrections

CONTROL/

RTCM-104 INPUT

```
DIFFERENTIAL STATION              <-- MORE
RTCM-104 INPUTS [  ON/AUTO   ] <-- CHANGE
    PORT SELECT [   PORT 1   ] <-- CHANGE
         FORMAT [ VERSION 2 ] <-- CHANGE
```

Check that there are no other outputs enabled On the MultiFix 4/Trimble Receiver Communication Port

CONTROL / MORE… /

NMEA-183 OUTPUT

```
NMEA-183        ENABLE[ OFF ] <-- CHANGE
OUTPUT CONTROL     ALM[ OFF ] <-- CHANGE
                   BWC[ OFF ] <-- CHANGE
                                    MORE
```

Check that the Elevation Mask is not set higher in the Receiver than in MultiFix 4 (it can be lower)

CONTROL / MORE… /

MASKS/SYNC TIME

```
POSITIONING MASKS/SYNC TIME:      |
    ELEVATION MASK = +10º         | MINUS
         PDOP MASK =  07.0        |
     SV SYNC TIME =  001.0 SEC | ACCEPT
```

Ensure the receiver is set to dual frequency mode

CONTROL / MORE…/

L1 / L2 OPERATION

```
L1/L2 TRACKING: P,C/A-CODE | L1 TRACKING
                  P,X-CODE | L2 TRACKING
```

Only the L2 code can be disabled. Ensure that both the L1 and L2 codes are **enabled**.

4.2.4.2.10.Trimble 4000 SSi

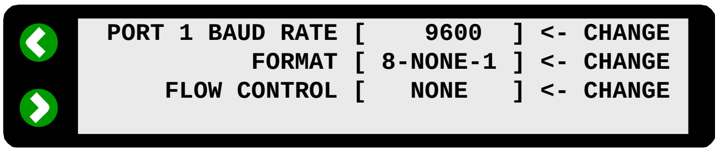
When powering up the following screen will appear. In order to reach the standard screen press the “CLEAR” button on the front panel of the receiver.

The standard screen, shown here, will now appear.

The following needs to be configured/checked.

Set the COM Port Protocol Parameter Values

CONTROL / MORE…/
BAUD RATE/FORMAT /
SERIAL PORT n SETTINGS / CHANGE

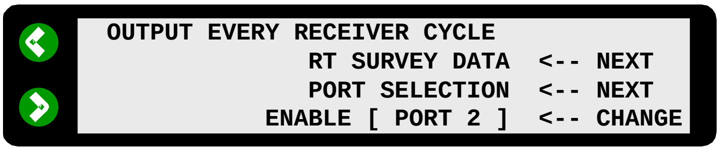


Enable MultiFix 4 Control of Trimble Receiver

CONTROL / MORE… /
REMOTE PROTOCOL

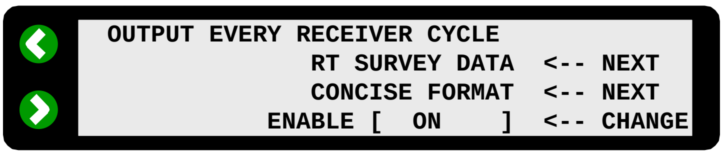
Select the Port for the MultiFix 4/Trimble Receiver Communication

CONTROL / MORE... /
CYCLE PRINTOUTS /
Ensure there are no other Receiver Cycle Outputs are enabled (Use Top ←Next)



Select the Format for the MultiFix 4/Trimble Receiver Communication

CONTROL / MORE... /
CYCLE PRINTOUTS /
(Use Middle ←Next)



Select the Port for the Receiver's Input of RTCM Corrections

CONTROL/

RTCM-104 INPUT

```
DIFFERENTIAL STATION               <-- MORE
RTCM-104 INPUTS [   ON/AUTO  ] <-- CHANGE
    PORT SELECT [    PORT 1  ] <-- CHANGE
         FORMAT [ VERSION 2  ] <-- CHANGE
```

Check there are no other outputs enabled On the MultiFix 4/Trimble Receiver Communication Port

CONTROL / MORE… /

NMEA-183 OUTPUT

```
NMEA-183          ENABLE[ OFF ] <-- CHANGE
OUTPUT CONTROL       ALM[ OFF ] <-- CHANGE
                     BWC[ OFF ] <-- CHANGE
                                      MORE
```

Check that the Elevation Mask is not set higher in the Receiver than in MultiFix 4 (it can be lower)

CONTROL / MORE… /

MASKS/SYNC TIME

```
POSITIONING MASKS/SYNC TIME:     |
    ELEVATION MASK = +10º        | MINUS
         PDOP MASK =  07.0       |
     SV SYNC TIME =  001.0 SEC   | ACCEPT
```

Ensure the receiver is set to dual frequency mode

CONTROL / MORE…/

L1 / L2 OPERATION

```
L1/L2 TRACKING: P,C/A-CODE | L1 TRACKING
                  P,E-CODE | L2 TRACKING
```

Only the L2 code can be disabled. Ensure that both the L1 and L2 codes are **enabled**.

4.2.4.3. NovAtel Receivers

4.2.4.3.1.NovAtel Millennium

For the NovAtel Millennium once communication has been established with the receiver using the NovAtel GPSolution software, MultiFix 4 can then be used to finalise the configuration.

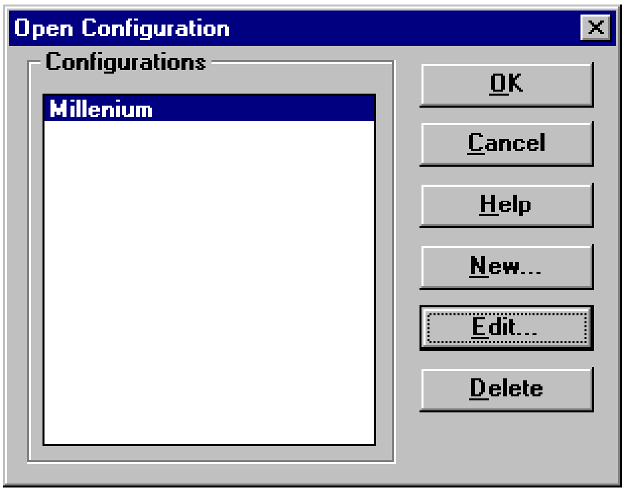
Communicating with the NovAtel Millennium OEM Card

Connect COM 1 on the NovAtel Millennium to COM 1 on the PC using a standard NovAtel communication cable.

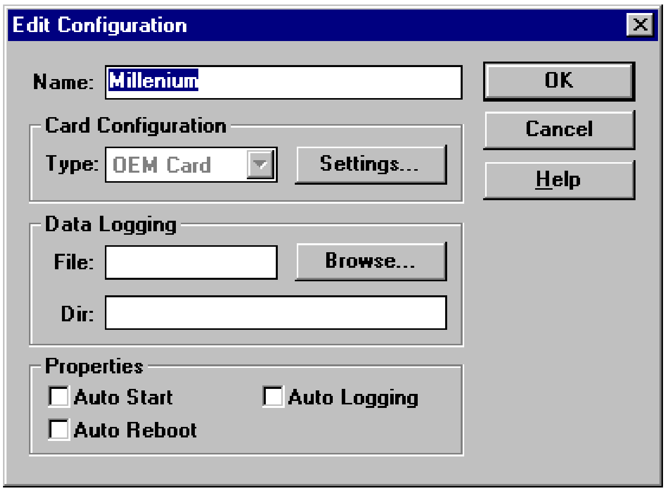
Run GPSolution

Go to “Card/Open..”

Create a “New...” configuration, for example with the name ‘Millennium’, or “Edit…” it to alter the settings.



Click “Settings…” on the edit configuration dialogue, to enter the window for configuring the Port parameters.



Select:

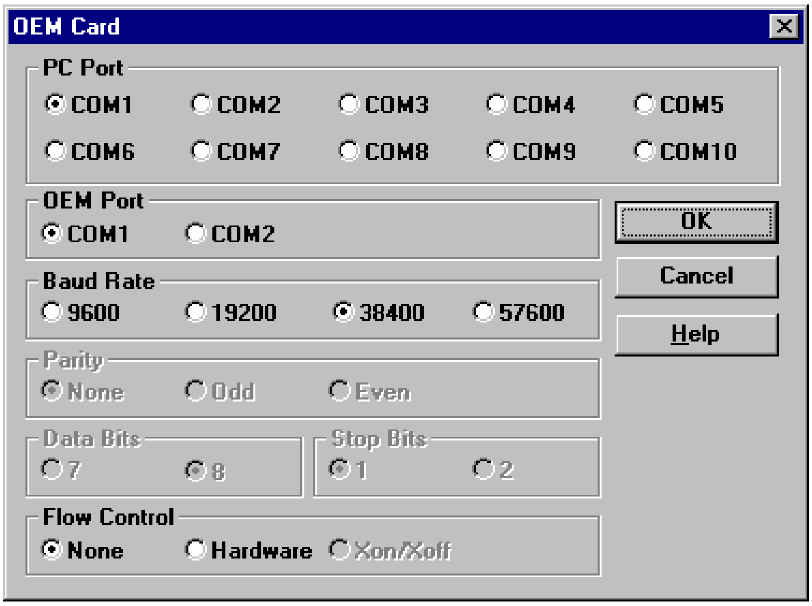
PC Port COM1

OEM Port COM1

Baud Rate 57600

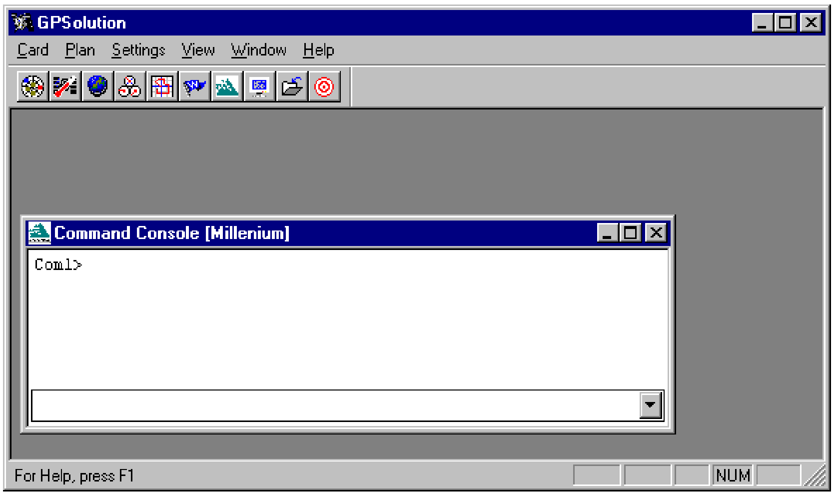
Flow Control None.

Confirm with **<OK>**. This will bring you back in the ‘Open Configuration’ window. Select **<OK>** GPSolution will now attempt to establish communication with the NovAtel Millennium OEM card

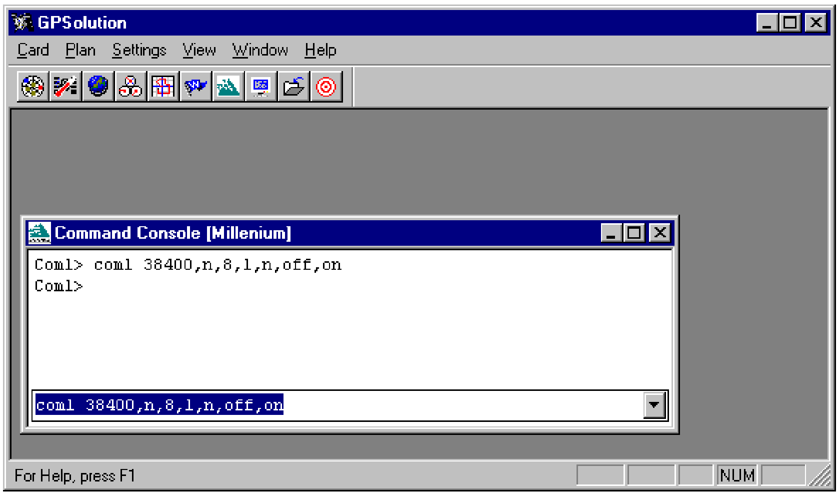


In case this procedure fails to establish a connection at a 57600 baud rate and establishes communication at a lower rate, the following steps allow the user to change the speed of the port.

Go to the "View/Command Console". This will open the adjacent window:



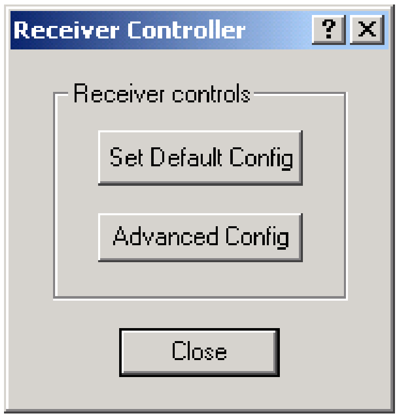
Type *Com1 57600,n,8,1,n,off,on* in the Command Line followed by Enter. The display will read:



Upon changing the baud rate, you will lose communication with the card. In this case, close the GPSolution application and restart using the configuration file created earlier.

Configuring the NovAtel Millennium from within MultiFix

Assuming communications have been established between MultiFix and the GPS receiver then the receiver can be configured automatically by MultiFix.



The Command "Action" \ "Configure Millennium" will launch the receiver configuration dialogue.

Select Set default configuration to complete the receiver configuration.

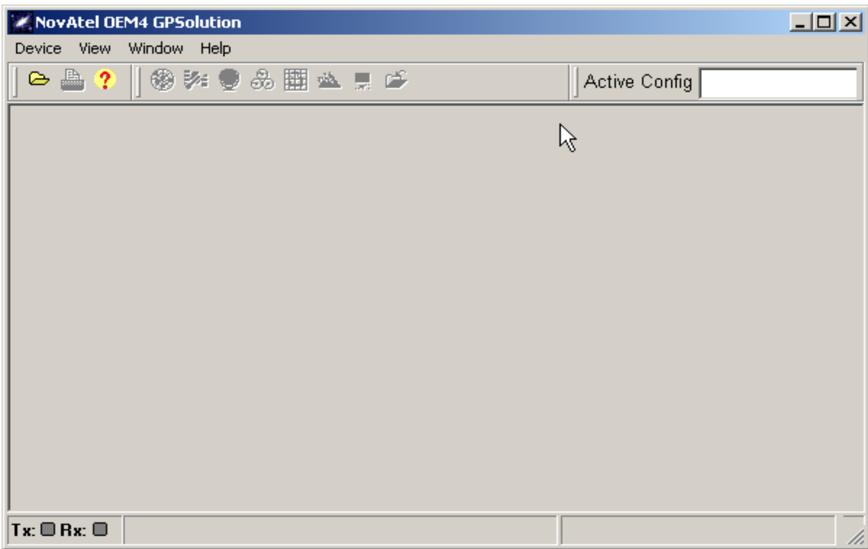
4.2.4.3.2.NovAtel OEM4

The OEM4 receiver is only available in MultiFix 4 v1.01 onwards. Configuration is similar to the millennium except NovAtel GPSolution 4 software is required.

Communicating with the NovAtel OEM4 Card

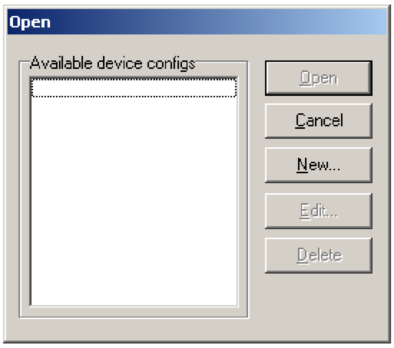
Connect COM1 on the NovAtel OEM4 to COM1 on the PC using a standard NovAtel communication cable.

Run NovAtel's GPSolution 4 software.

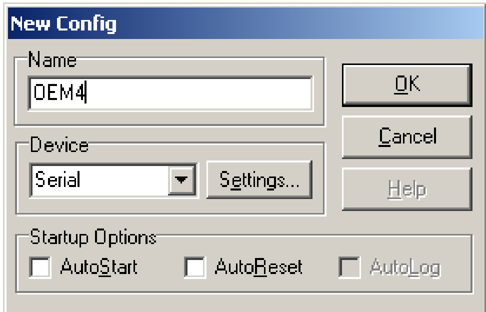


Go to "Device/Open

Create a “New...” configuration, for example with the name ‘OEM4’, or “Edit…” it to alter the settings.



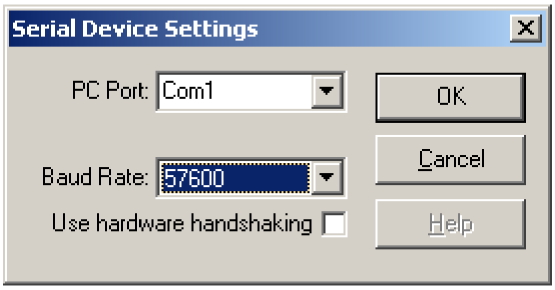
Type in a name and then click “Settings…” on the edit configuration dialogue, to enter the window for configuring the Port parameters.



Select:
PC Port COM1

Baud Rate 57600

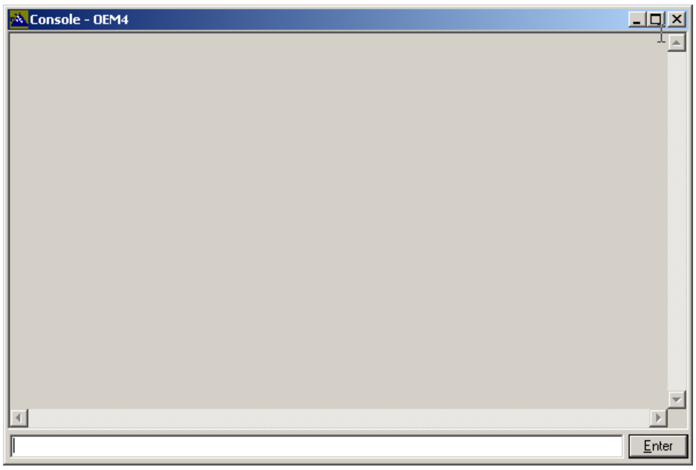
Hardware handshaking unchecked



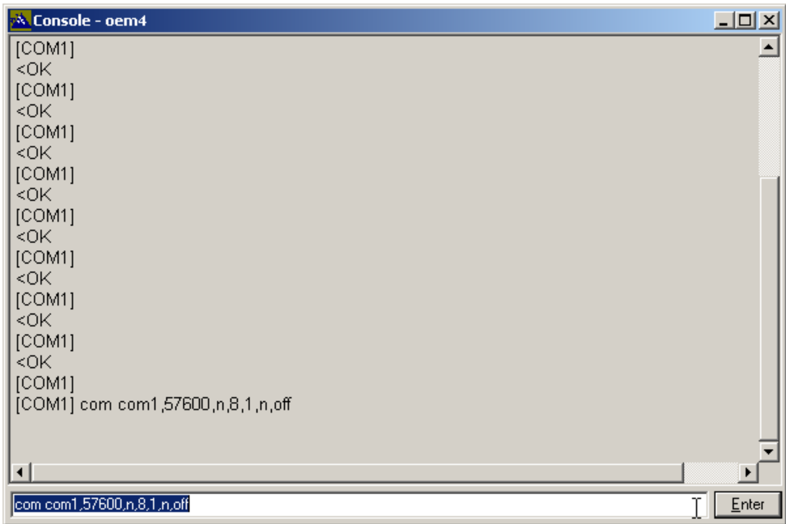
Confirm with **<OK>** twice. This will bring you back in the ‘Open Configuration’ window. Select **<Open>** GPSolution will now attempt to establish communication with the NovAtel OEM4 card

In case this procedure fails to establish a connection at a 57600 baud rate and establishes communication at a lower rate, the following steps allow the user to change the speed of the port.

Go to the “View/Console”. This will open the adjacent window:



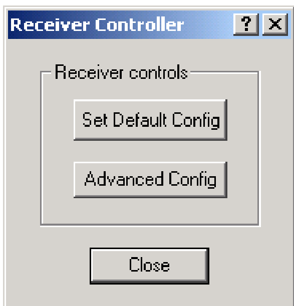
Type ***Com com1,57600,n,8,1,n,off*** in the Command Line followed by Enter. The display will read:



Upon changing the baud rate, you will lose communication with the card. In this case, close the GPSolution application and restart using the configuration file created earlier, but changing the baud rate to 57600 in ‘Device Settings’.

Configuration from within MultiFix

Assuming communications have been established between MultiFix and the GPS receiver then the receiver can be configured automatically by MultiFix

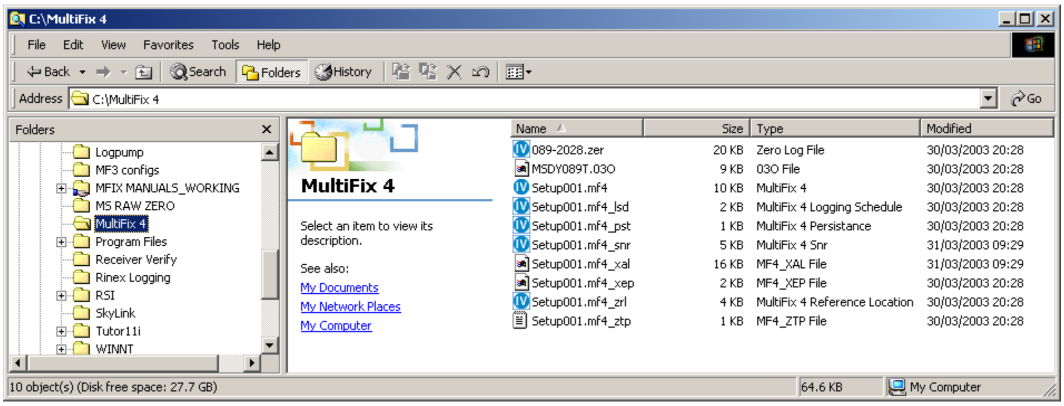


The Command “Action” \ “Configure OEM4” will launch the receiver configuration dialogue.

Select Set default configuration to complete the receiver configuration.

4.2.5. MultiFix 4 Files

Once MultiFix 4 has been installed and the program is run MultiFix 4 creates several files in the folder specified by the operator for saving the configuration file.



The *.MF4 is the core MultiFix 4 configuration file and is stored in XML format.

*.MF4_PST is the Persistence file; it contains the number, type, position and contents of windows in the application workspace when a configuration file is saved. It is written when the program is exited.

*.MF4_SNR is the receiver signal to noise ratio weighting tables. This is written periodically during a program run and when the configuration file is saved.

*.MF4_XAL file is the GPS almanac. This will be updated as the almanac changes and when the configuration file is saved. The XAL file is stored as in an XML format and can be exported to other applications.

*.MF4_ZRL is the Reference Location file that contains the positions of the reference stations in use. It will be written when a new Type 3 position for a reference station is received and when the configuration file is saved.

*.MF4_ZTP is the Trial Point configuration file that contains the current trial point position. It is updated when the position as derived by the first calculation has moved more than 1 km from the existing trial point position and when the configuration file is saved.

MF4_LSD is the Logging Schedule and will only be created when the program has logged data. It contains information on what has been logged and the identifying numbers given to the data. It is only written once logging has been started.

If log files are to be returned for analysis then ALL the above files should be returned also.

It is possible to modify an NMEA output string to accommodate clients' software. The definition of this modified string can be saved to a *.rdf file. The *.rdf file can then be reloaded. By default the file is saved to the MultiFix 4 configuration file directory.

This folder will also contain text files logging any Type 16 messages that are received during that day. See section 4.3.6.5.5 on page 123 for more details.

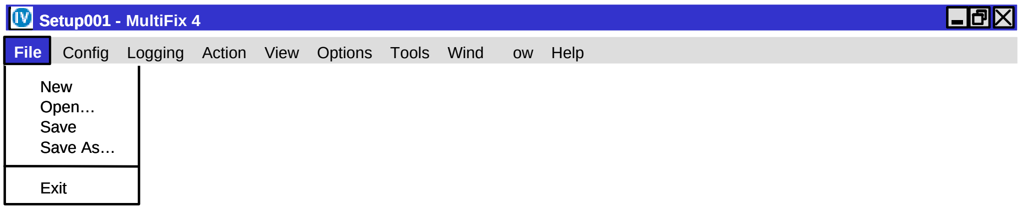
4.2.6. TO RUN MULTIFIX 4

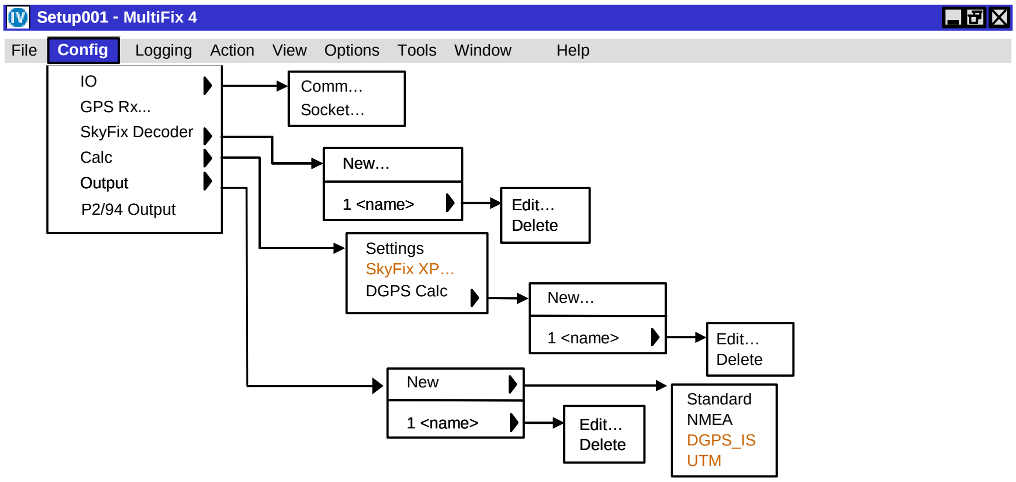
MultiFix 4 can be opened a variety of ways.

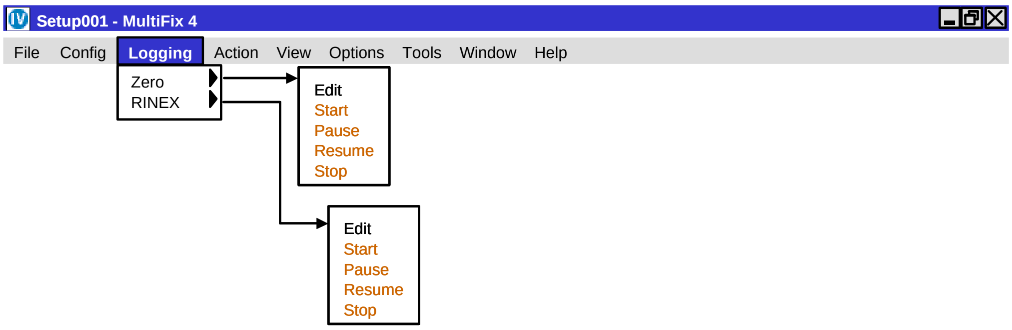
Use Windows Explorer to display the contents of the folder containing the MultiFix 4 program files and then double-clicking the “Multi4” application icon.

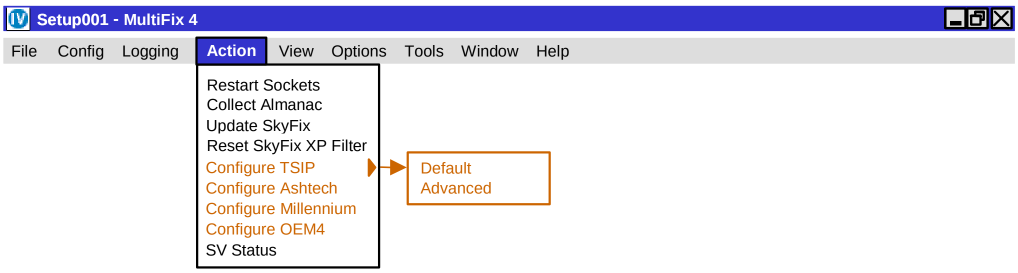
Use “Start” \ “Programs” \ “MultiFix 4 Vx.xx” and click “MultiFix 4”.

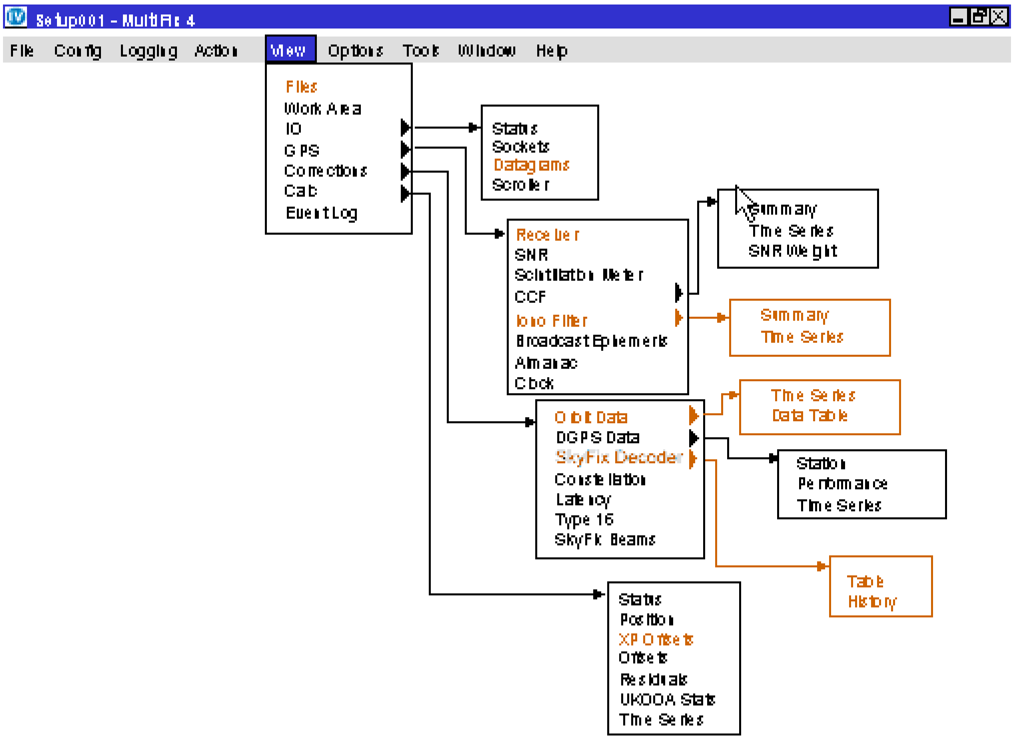
4.3. REAL TIME OPERATION

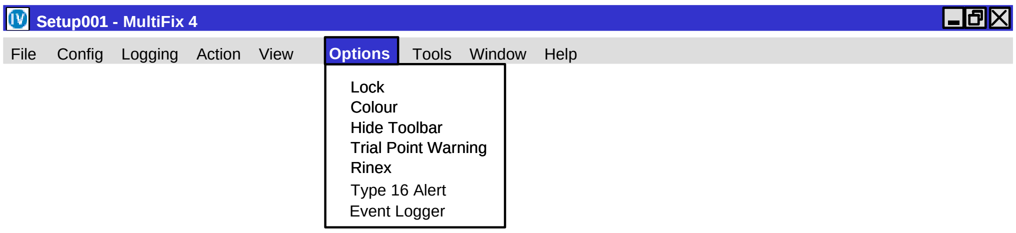


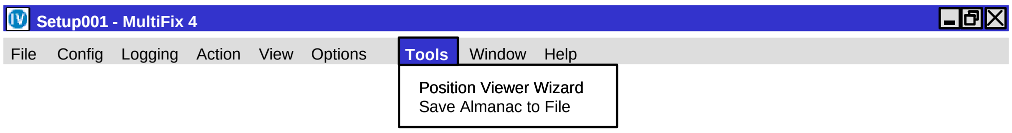


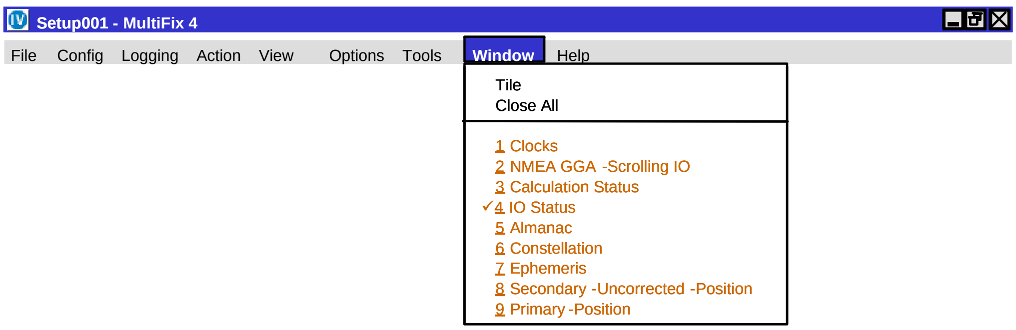





Setup001 - MultiFix 4
File Config Logging Action View Options Tools Window Help
Files
Work Area
IO
GPS
Corrections
Calc
Event Log
Status
Sockets
Datagrams
Scroller
Receiver
SNR
Scintillation Meter
CCF
Iono Filter
Broadcast Ephemeris
Almanac
Clock
Summary
Time Series
SNR Weight
Summary
Time Series
Orbit Data
DGPS Data
SkyFix Decoder
Constellation
Latency
Type 16
SkyFix Beams
Time Series
Data Table
Station
Performance
Time Series
Table
History
Status
Position
XP Offsets
Offsets
Residuals
UKOOA Stats
Time Series


Setup001 - MultiFix 4
File Config Logging Action View Options Tools Window Help
Lock
Colour
Hide Toolbar
Trial Point Warning
Rinex
Type 16 Alert
Event Logger


Setup001 - MultiFix 4
File Config Logging Action View Options Tools Window Help
Position Viewer Wizard
Save Almanac to File


Setup001 - MultiFix 4
File Config Logging Action View Options Tools Window Help
Tile
Close All
1 Clocks
2 NMEA GGA -Scrolling IO
3 Calculation Status
✓4 IO Status
5 Almanac
6 Constellation
7 Ephemeris
8 Secondary -Uncorrected -Position
9 Primary -Position

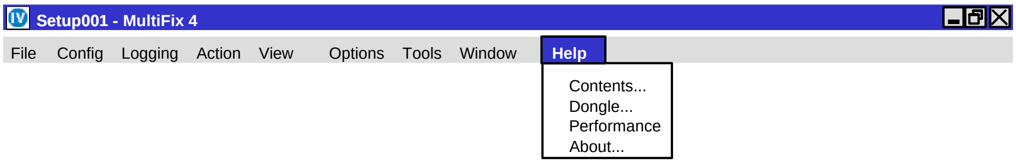


Figure 4 MultiFix 4 Menu Layout

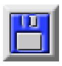
Note: - In the Figures above the menu items coloured brown are not always present as they are subject to program configuration or operation pre-conditions.

4.3.1. THE TOOL BAR

The Tool bar provides quick access to the most commonly used functions and windows in MultiFix. A description for each button is given when the mouse is held over the button for brief period.

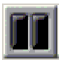
Details of each button are given below.

" Open configuration " This is the same as the "File" \ "Open" command.

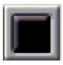


"Save configuration " This is the same as the "File" \ "Save" command.

"Start Logging" This is the same as the "Logging" \ "Zero" \ "Start" commands.



"Pause Logging" This is the same as the "Logging" \ "Zero" \ "Pause" command. NB this option is only visible once logging has been started.

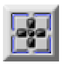
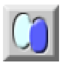


"Stop Logging" This is the same as the "Logging" \ "Zero" \ "Stop" command. NB this option is only visible once logging has been started.

" SV Status" This is the same command as " Action" \ "SV Status" and calls up the disable SV window.

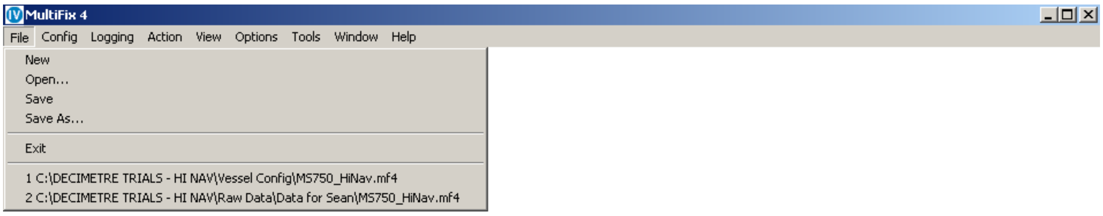
"Work Area" This is the same command as "View" \ "Work Area" and opens the work area display

"Scroller" This is the same command as "View \ "IO" \ "Scroller" and opens the IO scroller view.

	“GPS SNR”	This is the same command as “View” \ “GPS” \ “SNR” and opens the GPS Signal to Noise Ratio display.
	“Almanac”	This is the same command as “View \ “GPS” \ “Almanac” and opens the GPS Almanac display.
	“Latency”	This is the same command as “View \ “Corrections” \ “Latency“ and opens the RTCM Latency window.
	“Type 16”	This is the same command as “View \ “Corrections” \ “Type 16” and opens the Recent Type 16 warning window.
	“Status”	This is the same command as “View \ “Calc” \ “Status” and opens the standard Calculation Status window.
	“Position”	This is the same command as “View \ “Calc” \ “Position” command and opens the Position display window.
	“Offset”	This is the same command as “View” \ “Calc” \ “Offset” and opens the Position Offsets window.
	“Time Series”	This is the same command as “View \ “Calc” \ “Time Series” and opens the Time Series Plot window.

The toolbar can be hidden using the “Options” / “Hide Toolbar” command. See section 4.3.7.3 for more details.

4.3.2. FILE



At the bottom of the "File" menu is a list of recently used configuration files. Clicking on one of these files opens up the chosen configuration.

4.3.2.1. New

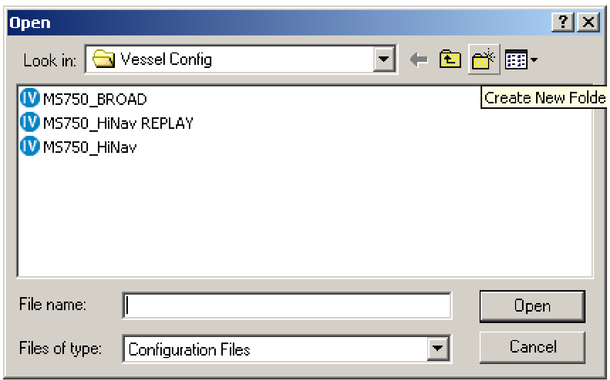
"File" \ "New…"

To start a new MultiFix 4 configuration select this option.

Be aware that starting a new configuration file will close the existing configuration and cease real time operation if the program is already in use. MultiFix will request confirmation before closing the existing configuration file and if the configuration has not been saved the user will again be prompted.

4.3.2.2. Open

"File" \ "Open…"



When initially opened the program does not know which configuration file to use. If a previously prepared configuration exists use this facility to select it.

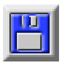
The configuration files contain the program name and version identifiers in a file header. They also include a configuration file version number. The program will not allow configuration files to be opened that are not compatible with the version of MultiFix that is currently being run. However if the configuration file version is the same they can be used even though created by a different program version.

File open can also be accomplished using the  button.

4.3.2.2.1. Save

"File" \ "Save"

The configuration file is not automatically saved when changes are made. This facility is therefore used to update the configuration file with the current settings. If the set-up is being undertaken for the first time and the configuration file does not have an identity, the use of "File" \ "Save" will open the Save As dialogue where a file name must be entered. Once a configuration file has been named, the use of "File" \ "Save" performs a save without calling up the Save As dialogue.

The name of the current configuration file appears in the application workspace title bar. If configuration changes are made that have not been saved, that file name has an "*" appended to it. After using File \Save the "*" is removed. File saving can also be accomplished using the  button.

4.3.2.3. Save As

"File" \ "Save As…"

If the latest configuration is to be saved without overwriting the current configuration file use the "File" \ "Save As…" option. This gives the option to create a new file leaving the previous file intact. The program immediately uses the new file as the current configuration file.

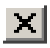
The Save As dialogue requires the operator to enter a name for the new configuration file. If an existing file name is entered the program will overwrite that file.

4.3.2.4. Exit

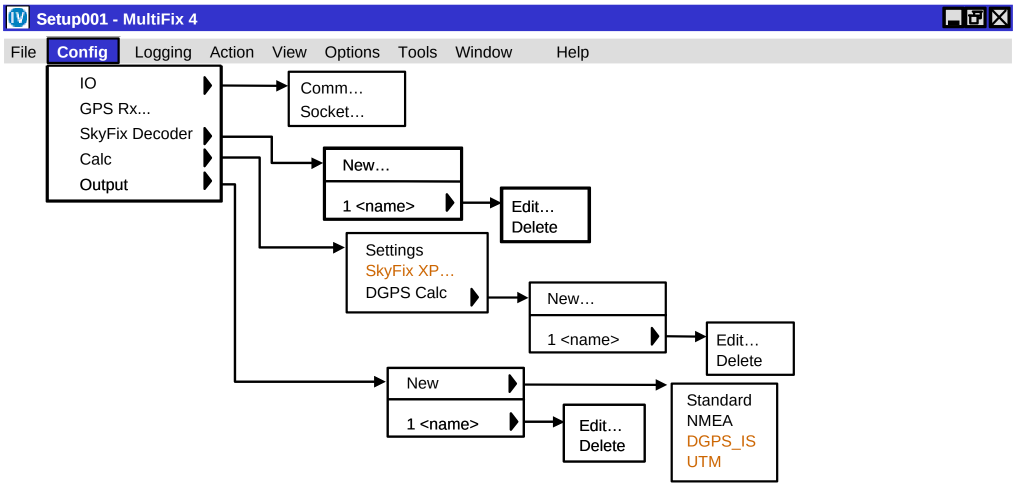
"File" \ "Exit"

This exit route is immediate if no configuration file is loaded.

Confirmation is required if a configuration file is in use. The user will be prompted to save the configuration if they have not already done so.

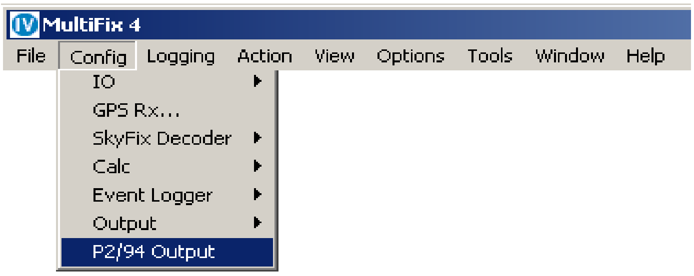
If the program is exited using the  button when the current configuration has not been saved, a dialogue is presented asking whether to save the configuration prior to exit or whether to cancel the exit. If there have been no configuration changes then the program will terminate immediately.

4.3.3. CONFIGURE



4.3.3.1. IO

"Config" \ "IO"



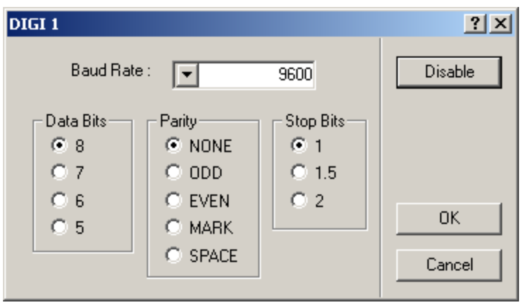
The "P2/94 Output" will only be visible if "P2/94" has been enabled in the "Options" menu.

4.3.3.1.1.Comm

"Config" \ "IO" \ "Comm…"

Earlier it was explained that the "Programs" / "MultiFix 4 Vx.xx" / "IO Config" applet needed to be run after installation to define what ports the computer has available (see section 3.4 on page 13). The parameters selected there determine the dialogue box that is presented when "Config" \ "IO" \ "Comm…" is selected.

Highlight one of the ports to be used and click **[Edit]**. This opens another dialogue box for setting the port parameter settings.



Click the **[Enable]** button to activate the port and set the Baud Rate, Data Bits, Parity and Stop Bits.

4.3.3.1.2.Sockets

"Config" \ "IO" \ "Socket…"

To be able to distribute and receive data over a network via sockets assumes each computer has Transmission Control Protocol / Internet Protocol (TCP/IP) installed. Sockets have the advantage over COM ports in that two or more programs can access the same data.

Sockets can transfer data between programs running on different computers or between two or more programs running on the same computer. (If a standalone (non-networked) computer running Windows NT is used and the data is to be shared between multiple programs running on that PC then the MS Loopback Adapter network adapter must be installed).

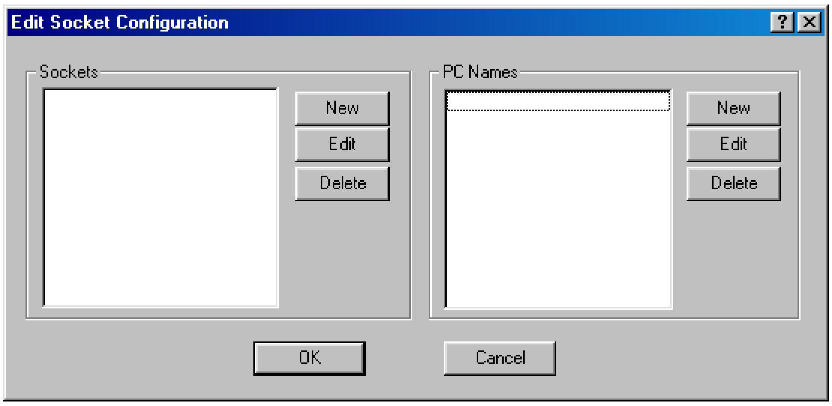
The TCP/IP protocol is a family of protocols that allow Internet data communication. Included in that family are two transport layer protocols, the Transport Control Protocol (TCP) and the User Datagram Protocol (UDP).

- The Transport Control Protocol establishes sessions between a Server and however many Clients that are accessing that Server. There is continual presence checking and acknowledging between each Server/Client pairs with messages always received in the order they were issued. A Server does not have control of the number of Clients that access the socket on which data is being presented. (It is often perceived that the Server provides data and the Client receives data, but once the connection is established the link is two-way).
- The User Datagram Protocol does not have the end-to-end checking overhead of the TCP. Instead packets of data are simply issued to the Internet in either broadcast mode, where any networked computer on the LAN can receive them, or in addressed mode where the data packets have headers specifying the addressees for whom the packets are intended. There is no guarantee with this protocol that the messages will arrive in the order they were issued. When setting up "Ribbons" to output datagrams a time interval can be specified to prevent data becoming corrupted, see section **7.3.2.2**. on "Ribbons". Broadcast datagrams cannot pass routers linking Local Area Networks (LAN) unless specifically configured.

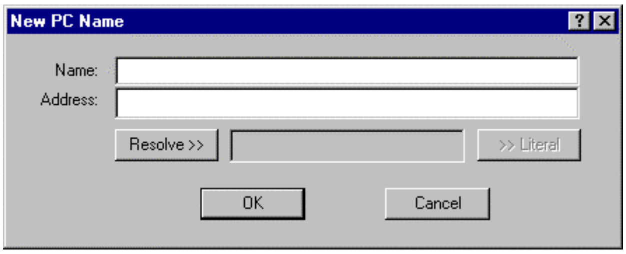
For most situations where Local Area Networks are involved Server / Client TCP sockets are the best choice Internet transport protocols.

4.3.3.1.2.1.The MultiFix 4 Computer as a TCP Client

For a Client to make contact with a Server, the operator must know the IP address (or the network identification name - see below) of the Server computer and the port number the Server is outputting the required data.

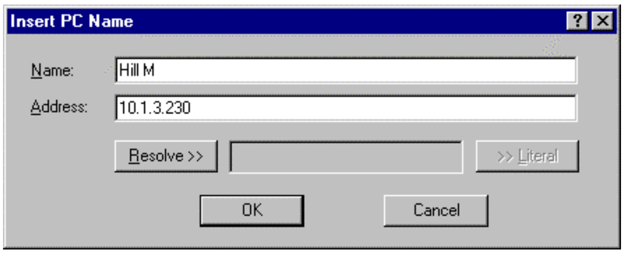


First, in the “PC Names” table click **[New]**.

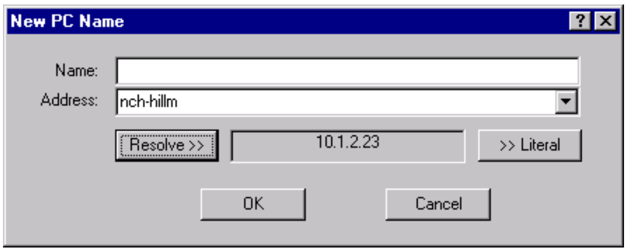


There are two possible ways of defining the server PC.

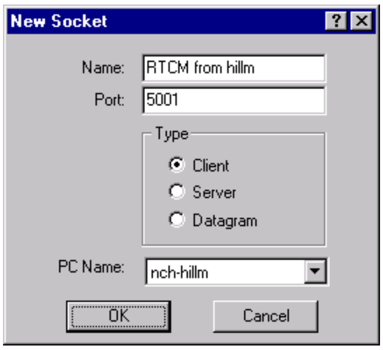
If the numerical IP address is known, enter a PC name in “Name:” and the IP address in “Address:” and click **[Resolve>>]**. Click **[OK].**



If the IP address is not known but the computer’s network identification name is, and if all computers involved are aware of local naming services (WINS / DNS), then type in the computer’s name in the “Address:” slot and click **[Resolve>>]**. Once the computer is found, its IP address will appear as shown. If required, use **[>>Literal]** to transfer the name and address to their named slots. Click **[OK].**



It is normal in a network for computers to be allocated new IP addresses when the PC is restarted. If the Client PC has a numerical entry for the address and the Server's address has changed, it will not be able to re-locate it. If the Client PC has the name of the Server PC in the address slot, it will automatically search to re-locate the Server PC by name. Assuming it is found, the Client PC will obtain the Server PC's current address.

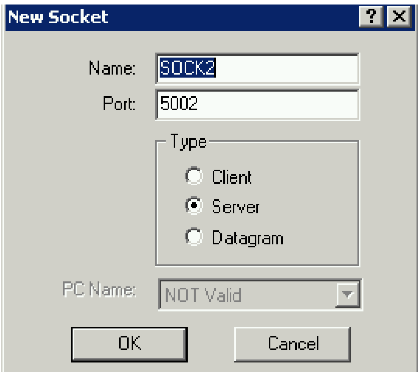


In the "Sockets" table click **[New]**.

Now check the "Client" radio button and select the "PC Name:" of the server.

Enter the number of the port on which the Server PC is presenting the data. Change the socket's default name if required.

4.3.3.1.2.2.The MultiFix 4 Computer as a TCP Server



If the MultiFix computer is to be a server then there is no need to add the MultiFix computer to the PC table; the program already knows the computer's IP address. This can be seen in the window called up by "View" \ "Sockets".

In the "Sockets" table click **[New]**. Give the socket a name and enter the Port number that the data will be output on. Click **[OK]** to exit.

4.3.3.1.2.3.Datagrams

It was explained in section 4.3.3.1.2 that the User Datagrams Protocol allows packets of data to be broadcast or to be sent to specific addresses without the overheads associated with the Transport Control Protocol.

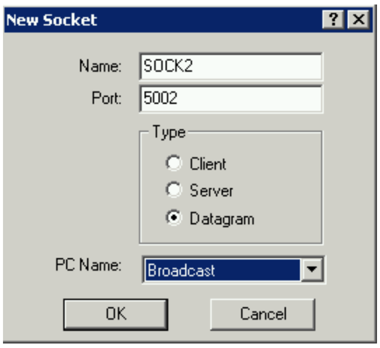
BROADCASTING

MultiFix 4 cannot give multiple addresses to packets of data so if information is to be made available to more than one computer in datagrams it must be broadcast on a particular port. A computer that is broadcasting on a port also listens to all data packets that are received on that port.

DATAGRAMS TO/FROM A SPECIFIC PC

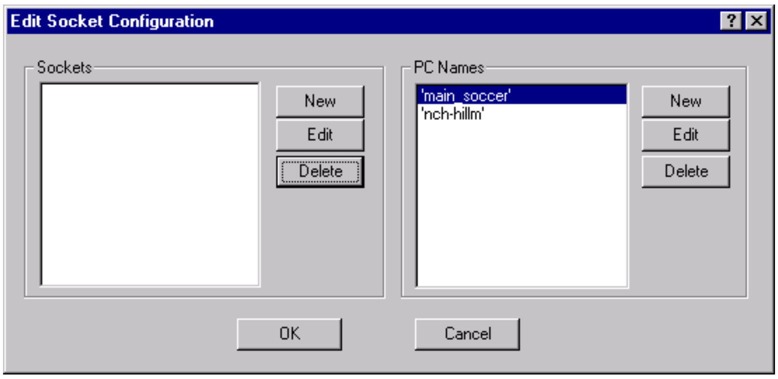
To transmit to or to receive from a specific computer, (which may itself be broadcasting), a PC must be set up with a datagram socket where the port number and the PC are identified.

To broadcast datagram packets, click the "Datagram" radio button and select "Broadcast" from the "PC Name:" list.



To target one specific PC requires that the Internet address of that PC should already have been identified. See Section 4.3.3.1.2.1 on page 55 for an explanation of adding PCs.

Once the PC has been entered in the "PC Names:" table click **[New]** in the "Sockets" table. Give the socket a name, enter the Port number and in the "PC Name list select the PC.



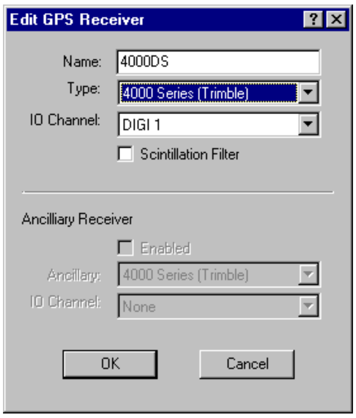
Click **[OK]** to exit.

Having set up sockets, the Edit Socket Configuration dialogue now shows the connection(s).

4.3.3.2. GPS Receiver

"Config" \ "GPS Rx…"

This calls up the Edit GPS Receiver.



Enter a receiver name in the "Name:" box. If this is left blank MultiFix will automatically assign a suitable name (e.g. 4000 DS (Trimble)). As with other name labels the program does not use it for receiver recognition purposes.

In the "Type:" section select the receiver that MultiFix 4 is to use. There are various possible selections.

- *Z Family (Ashtech)** are dual frequency receivers.
- *DG16 (Ashtech))** is a single frequency receiver
- *G12 (Ashtech))** is a single frequency receiver
- *GG24 (Ashtech)* * is a single frequency receiver and is fitted in the Fugro 90964 units
- *4000 Series (Trimble)* refers to either a single frequency 4000DS or a dual frequency SSE/SSI
- *MS750 (Trimble)* is a dual frequency receiver
- *BD750 (Trimble)* is a dual frequency receiver
- *5700 (Trimble)* is a dual frequency receiver
- *BD112 (Trimble)** is a single frequency receiver board fitted to the 90938/F112 SkyFix decoder.
- *DSM212 (Trimble)** is a single frequency receiver.
- *DSM (Trimble)** is a single frequency receiver board fitted to 90938/M SkyFix decoder.
- *SK8 (Trimble)** is a single frequency receiver board, but not recommended for offshore work. It has not been tested for full operation.
- *Millennium (NovAtel)* is a dual frequency receiver
- *OEM4 (NovAtel)* is a dual frequency receiver
- *Receiver Server* is used when the data is not live from an external receiver but is taken from raw data log files.
- *Receiver Verify* is used for interfacing to the Receiver Verify (RxV) Module.

The Scintillation Filter option allows MultiFix to monitor the tracking of individual SVs. If symptoms of scintillation are detected the SV is disabled until tracking becomes constant again, giving a massive reduction in position instabilities. Since this may affect the number of available satellites users are advised to operate in Height Aiding mode when the Scintillation Filter is enabled.

In the “IO Channel:” section select the port on which the receiver data is input.

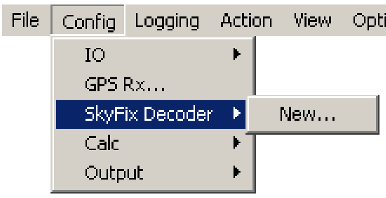
The Ancillary Receiver option is used for synchronising GPS measurements over a data link. This is not currently used.

When one of the receivers marked above with an asterix is selected, “Configure TSIP” or “Configure Ashtech” becomes available under the “Action” menu. This allows the receiver to be configured to output the correct data for MultiFix 4. The other Trimble Receivers are configurable using the Yellow box interface (“View” / “GPS” / “Receiver”). Refer to Section 4.3.6.4.1

Other manufacturers’ receivers require third party software to configure.

4.3.3.3. SkyFix Decoder

“Config” \ “SkyFix Decoder”

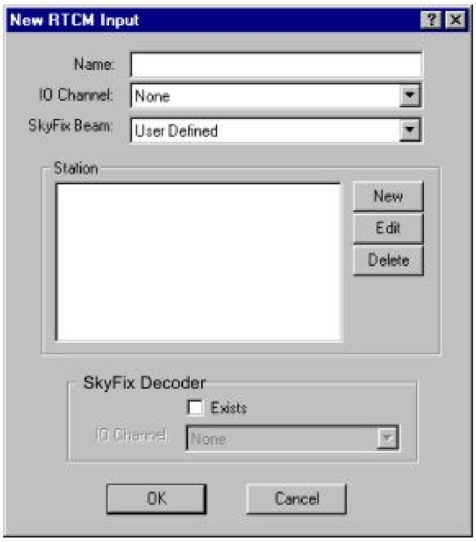


The program will automatically take in any type 55 messages received on any RTCM IO Channel to which it has access, but will only take in Type 1, 2, 3 and 9 messages from Stations ID’s it is configured to accept. It is possible that an RTCM source may contain only Type 55 messages. Such a source will still need to be given an identity and an “IO Channel” but no station IDs. Each Type 55 message contains Ionospheric delay information from one reference station. The station ID is also in the message that is transmitted every 30 seconds. The sequence cycles through each of the available reference station, so if 7 stations are contributing Type 55 messages the information for each station will be updated every 3½ minutes.

In the same way, for an XP calculation the correction source will need to be given an identity and an “IO Channel” but no station IDs. MultiFix will then accept the Fugro Proprietary Type 11, 48, 49 and 50 messages necessary for this mode.

4.3.3.3.1.New

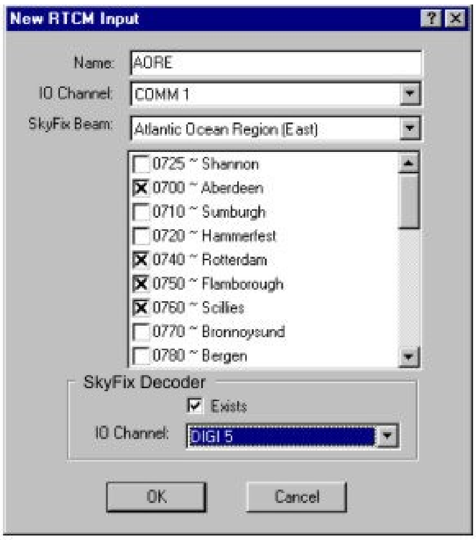
“Config” \ “SkyFix Decoder” \ “New…”



Click on “New…” to make a connection to a RTCM source.

In the New RTCM Input dialogue give the RTCM source a name and select the “IO Channel:” of the port that the differential corrections are available on.

If no name is given MultiFix will assign a suitable name automatically.



“SkyFix Beams:” contains a drop down list of all the satellite based Fugro RTCM sources. When one of those sources is selected, the dialogue is automatically populated with all the stations that carried by that system and the **[New]**, **[Edit]** and **[Delete]** buttons are lost.

It is then necessary to switch on any stations to be used by clicking the check box next to the station’s name.

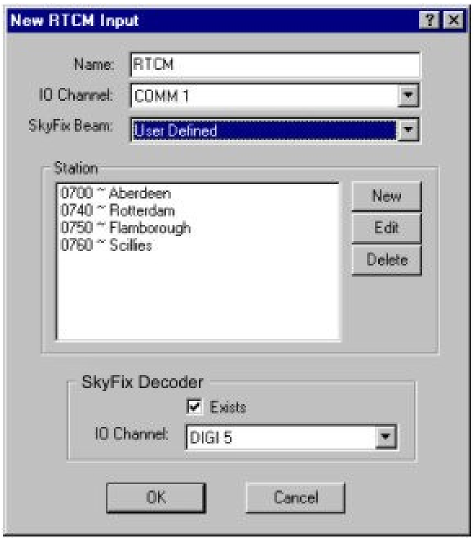
If SkyFix-XP mode is to be used then, along with a dual frequency GPS receiver, an RTCM input must be set up to obtain corrections. To do this enter a “Name”, “IO Channel”, and the relevant “SkyFix Beam” (Refer to ‘SkyFix-XP Service Description’ or www.thales-geosolutions.com for the latest XP availability information). No reference stations should be selected from the resultant list as only one set of XP corrections are available on each SkyFix beam. MultiFix will take in these messages as soon as this calculation is set up and “SkyFix-XP” mode has been checked in the “Config” \ “Calc” \ “Settings” dialogue.

SkyFix-XP corrections are broadcast using the following Fugro proprietary RTCM messages:

- **Type 11** – Almanac.
- **Type 48** – Absolute orbit, orbit rate, and clock corrections.
- **Type 49** – Absolute orbit and clock corrections.
- **Type 50** - Sub-metre clock corrections

If MultiFix 4 is being used with a non-satellite based RTCM delivery system, or station names or numbers have been changed, a manually compiled list can be made. To add reference stations manually in the "Station" table of the New RTCM Input dialogue leave the "SkyFix Beam:" set to User Defined and click the **[New]** button.

The program requires the station ID code number. A name is also required for identity purposes but is not significant in accessing the data.



Assuming the RTCM source is outputting more than one station, after clicking **[OK]** to add the station to the list, repeat the process to add the other required stations.

If Iono free operation is planned, three criteria must be met to be viable.

1. A dual frequency receiver must be interfaced to MultiFix 4.
2. RTCM Type 1, 2 and 3 messages from one or more reference stations must be available.
3. Type 15 or 55 Ionospheric error information must also be available from the same RTCM reference stations.

For Premier calculations there is no need to set up 6 reference stations if only one of them outputs Ionospheric error information as this will be the only station used in that mode.
If a SkyLink calculation is to be used however then both dual and single frequency stations can be combined. See section 4.3.3.4.3 for more details of Calculation type.

The ID of the type 55 messages is not declared as a station.

If a Mk 5, 90938 or 2403 Decoder is used to supply the RTCM corrections then it is possible to configure the decoder to output Bit Error Rate and Signal Voltage status information on a separate port (usually Port 4). If this data is required then check the "Exists" box and select the port receiving the data. This in turn activates the “SkyFix Decoder” menu item under “View” \ “Corrections”.

Click **[OK]** to accept the correction source.

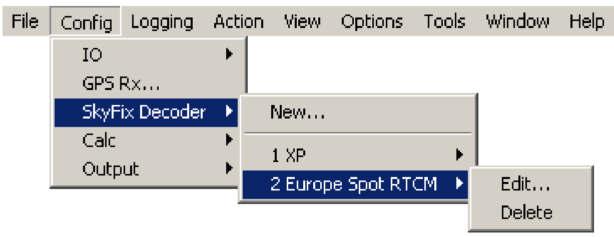
If there is more than one RTCM correction delivery system add another new source and set up using either of the two procedures above.

Assuming the RTCM interface has been established, the messages from the RTCM source can be viewed to see the Reference Station numbers that the program is receiving, (see Section 4.3.6.3.4.2 page 96).

4.3.3.3.2. Editing and Deleting

“Config” \ “SkyFix Decoder” \ “<name>” \ “Edit…” or “Delete”

With an RTCM source (or sources) now defined, when “Config” \ “SkyFix Decoder” is selected, the name (or names) given to the RTCM source(s) now appears in the sub-menu under the “New…” menu item.

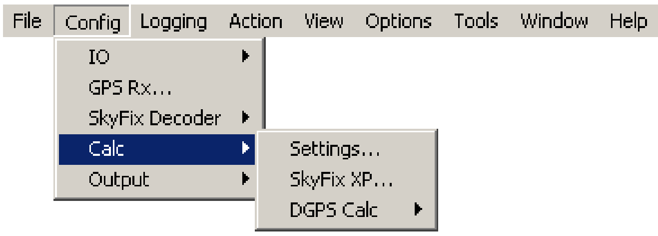


If the set up requires changing then highlight the name of the source and then select the “Edit…” option.

If the RTCM source is no longer in use, again use “Config” \ “SkyFix Decoder” \ “<name>” and select “Delete”. You will be asked to confirm or cancel the deletion. Be aware that an inappropriate deletion could severely impact on the correct operation of the program.

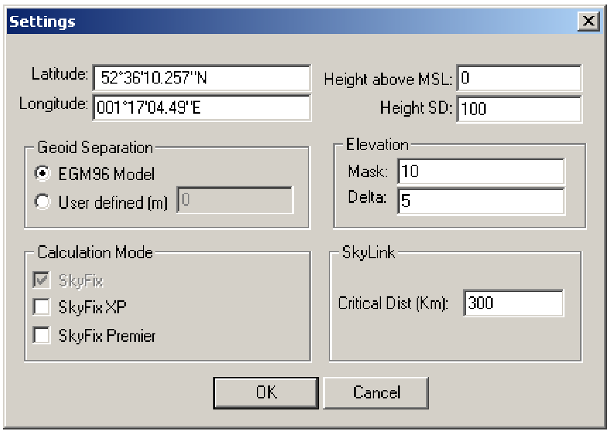
4.3.3.4. Calculations

"Config" \ "Calc"



4.3.3.4.1.Settings

"Config" \ "Calc" \ "Settings…" calls up the dialogue below.



Enter a Trial Point position in the "Latitude" and "Longitude" fields. This must be within, at the most, half a degree of Latitude and Longitude from the users current position.

Both the "Latitude" and "Longitude" fields allow a flexible form of data entry. The N/S or E/W can be entered at the start or end of the value. A space, comma or colon can separate the degrees, minutes and seconds values.

If the incorrect Trial point is entered (or no value at all) then MultiFix will attempt to derive an approximate position either from the current calculation, if available, or directly from the GPS Receiver.
In order to obtain a position from the GPS Receiver position outputs should be enabled on the data port being used by MultiFix. See Section 4.2.4 for details of how to configure the GPS Receiver.

MultiFix includes the EGM96 Geoid / Spheroid separation model. By default this model is used for all calculations. The separation is computed every epoch and the figure used within the calculation is the exact figure for the current location.

It is also possible to disable this model and apply your own Geoid / Spheroid separation value by selecting the "User Defined" radio button. This should only be used where the EGM96 model is not suitable, such as on locked waterways where the sea level is not coincident with the local Geoid.

The Geoidal height based on the Geoid / Spheroid separation is used in all displays in MultiFix unless otherwise stated. However, using the wrong Geoid / Spheroid separation will only affect the calculation process if height aiding is enabled.

Enter the height of the antenna above the ships water line, or Mean Sea Level (MSL), in “Height above MSL” box. This is approximately equal to the Geoid. The “Height above MSL:” and the “Height SD:” are used if the calculation is selected to be altitude aided, see 4.3.3.4.3. The smaller the “Height SD:” value the higher weight is given to the “Height above MSL:” value. The Height SD is dependant on the confidence of the initial antenna height measurement and the expected variation in antenna height due to vessel movement caused by swell and changes in draught. **Remember, when surveying on landlocked or inland waterways, the mean water level may be many metres above or below the Mean Sea Level/Geoid**.

In the “Elevation” table is “Mask” and “Delta”. “Mask” sets the minimum elevation at which a satellite will be used by the program. Do not set an elevation mask in this dialogue lower than the elevation mask used in the GPS receiver. Setting a lower mask does not change the receiver configuration. Setting a higher mask may be useful if SVs at slightly higher elevations are suffering from poor signal to noise ratios.

“Delta” is the number of degrees above the minimum elevation a satellite must be before it is fully weighted in a computation.

When using a SkyFix-XP calculation the “Elevation Mask” is hard coded to 5° and the “Delta” to 0° in order to have a minimum of 5 SV’s available. Setting the “Elevation Mask” and “Delta” will change the mask values for the SkyFix and SkyFix Premier calculations only.

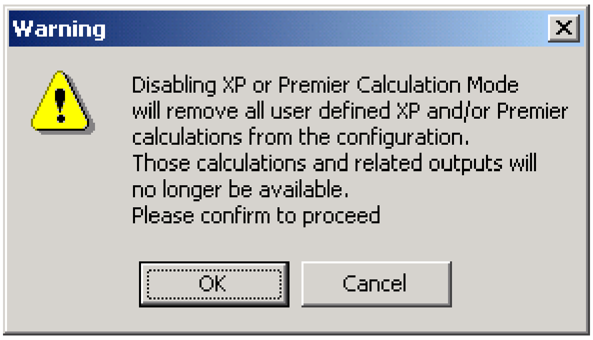
When setting up a SkyLink Mode calculation MultiFix will only use the single frequency corrections for stations that are within this range. This allows the user to add single frequency stations that are close to the work area (e.g. DeltaFix and IALA beacon stations), and are not significantly affected by differential ionospheric delays, into a dual frequency calculation. The “SkyLink Critical Distance” sets the threshold distance that MultiFix will use to switch from single to dual frequency calculation for each individual station. The default value is 300km.

The Trial Point is used when the Offsets Window is viewed. One of the options when right clicking on that window is to have the centre point at a fixed co-ordinate and to view the calculated positions with reference to that trial point. In this case the position will need to be entered with the highest possible precision to obtain realistic offset views.

If the “SkyFix premier” box is checked the SkyFix Premier dual frequency positioning mode is enabled.

If the “SkyFix-XP” box is checked the XP positioning mode is enabled. This reveals the additional menus “Config” / “Calc” / “SkyFix-XP…” (See section 4.3.3.4.2), “View” \ “Corrections” \ “Orbit Data” (See Section 4.3.6.5.1), and “View” \ “Calc” \ “XP Offsets” (See section 4.3.6.6.3).

When exiting XP or Premier positioning mode the following warning is issued:

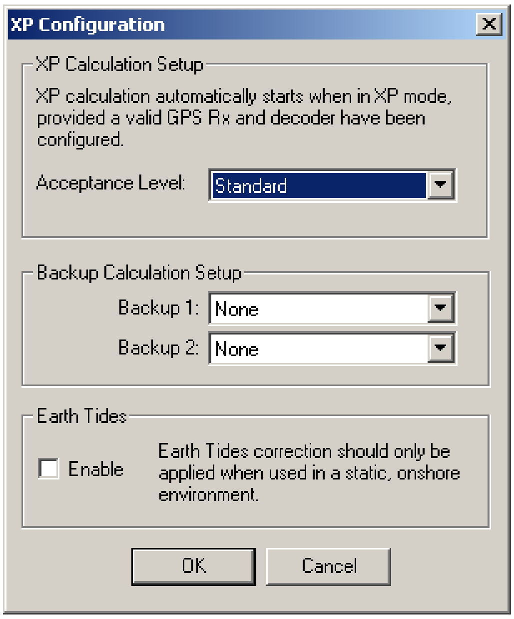


4.3.3.4.2.SkyFix-XP

“Config” / “Calc” / “SkyFix-XP…”

This menu becomes available when SkyFix-XP mode is enabled in “Config” \ “Calc” \ “Settings”.

The XP calculation will automatically start when XP mode is selected, assuming a valid GPS Receiver and decoder have been configured.



The "Acceptance Level" is used to set up how quickly XP solution will begin outputting a solution. There are four options:

- **Always** – The solution will always be output regardless of the level of XP solution convergence.
- **Standard** – This will output a position when the XP solution has converged to better than 1.5 metres.
- **Accurate** – A position will be output when the XP solution has converged to Decimetre level.

In the "Backup Calculation Setup" section, Backup1 and Backup 2 solutions can be selected if previously configured. These solutions will be used whilst the XP solution converges to the level chosen above, or if the solution falls below the selected convergence level during operation. The "View" \ "Calculation" \ "Status" window shows the current solution being output as described in section 4.3.6.6.1.

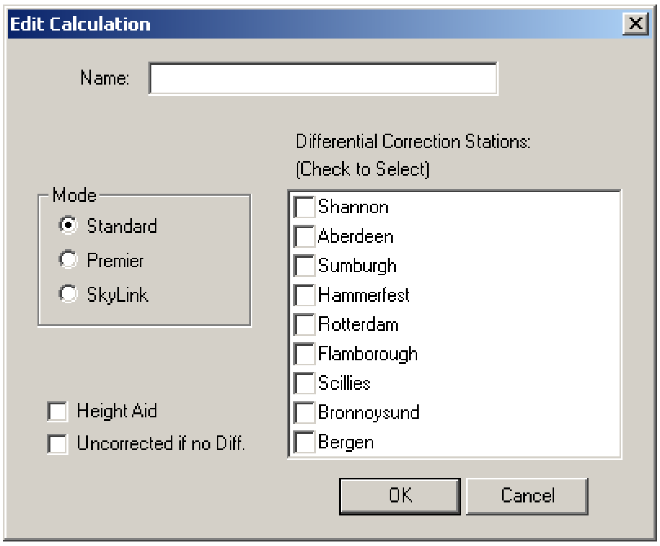
Tides are slight bulges in the areas of Ocean's, or Earth's, surface that faces the Sun and Moon. This is due to the gravitational attraction of these solar bodies. The bulge can be a few metres in oceans but is less pronounced on land, tending to give "Earth Tides" in the order of a few centimetres. The "Earth Tides" should only be "enabled" when using SkyFix-XP for static onshore applications. This allows MultiFix 4 to compensate for this effect.

For offshore projects ensure "Earth Tides" remains unchecked.

4.3.3.4.3. New Calculation

"Config" \ "Calc" \ "DGPS Calc" \ "New…"

provides the dialogue opposite.



The dialogue will contain all the RTCM reference station names entered when defining the RTCM source(s). If the same station was selected twice it will appear twice.

Give the Calculation a name and select the reference stations to be used in forming the solution. If no reference stations are selected the program will produce a non-differentially corrected stand-alone solution. If no name is given MultiFix will automatically generate an appropriate name for the computation based on the configuration of the solution

e.g. Network - L1L2 – H+, meaning a network solution using L1 and L2 with height aiding enabled.

Click the type of calculation required.

"Standard" creates a single frequency DGPS solution using the Klobachar Ionospheric model.

The following two options will only be available if SkyFix Premier mode is enabled in "Config" \ "Calc" \ "Settings".

"Premier" creates an Iono-Free DGPS solution. It presumes there is access to dual frequency data from a GPS receiver and Type 1 and Type 55 messages (skyfix Premier) from at least one of the selected reference station(s). A "Premier" solution will not use corrections from reference stations where only Type 1 or Type 55 messages are received, both must be available.

" SkyLink" allows MultiFix to add single frequency stations close to the user to a dual frequency calculation. Selection is based on the range to the station, as defined under the "Config" \ "Calc" \ "Settings…" configuration page. This function allows users to mix single and dual frequency corrections in a single calculation.

If SkyLink mode is selected all stations within a specified range threshold (the SkyLink Critical distance as defined in section 4.3.3.4.1) will be used. When a station lies outside of the range threshold it will only be used in dual frequency mode. Therefore, if a station only provides single frequency data and is outside of the critical distance it will not be used by MultiFix. If a station is within the range it will ONLY be used in single frequency mode.

This is because there will be no ionospheric range error (sometimes called gradient effect) on the corrections as the ionospheric delay will be nearly the same at both the reference station and the user location. This avoids the use of the noisier L2 measurements and will result in a smoother positioning performance.

NOTE Single Frequency Stations in excess of 300km will have a greater ionospheric range error that will bias the position calculation and negate any beneficial reduction of the L2 noise.

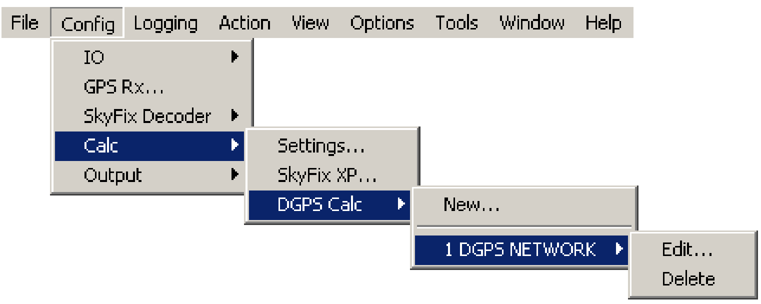
Click the “Height Aid” box if the calculation is to be aided by the height entered in the “Config” \ “Calc” \ “Settings…” configuration page.

In the event that all RTCM corrections are lost, if “Uncorrected if no Diff.” is ticked, the calculation will automatically switch to a standalone solution. Any outputs based on the calculation will continue with the differential flag in the messages set to non-diff. If the box is not ticked then loss of RTCM will mean the calculation will fail and any outputs based on the calculation will stop.

Clicking **[OK]** exits the dialogue and causes the calculation to commence.

4.3.3.4.4. Editing and Deleting

“Config” \ “Calc” \ “DGPS Calc” \ “<name>” \ “Edit…” or “Delete”



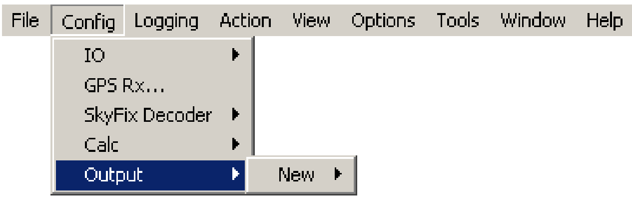
Once a calculation(s) has been defined the “Config” \ “Calc” \ “DGPS Calc” sub-menu contains the name (or names) of the calculation(s). If a name is highlighted the calculation can be “Edited…” or “Deleted”. Deletion requires a confirmation.

Assuming the set up has been accomplished correctly the program will now attempt to receive data and form a position solution(s).

At this point it is recommended that the configuration file be saved (See section 4.3.2.2.1).

4.3.3.5. Output

“Config” \ “Output”



If a position is to be supplied to another computer then an output must be defined.

Reference has already been made in Section 3.4.2 on page 13 to the fact that MultiFix 4 must have accessed the *.zpo library files before it can create the output formats listed below.

MultiFix 4 can create:

- 9 different Standard outputs, Trimble, DNAV, DNAV – Nautis Modification, ZeroLink, Fugro UKOOA, Geco UKOOA, Geco UKOOA Version 2, Fugro XP Expanded and Fugro XP Concise.
- 10 different NMEA outputs, GGA, GGA + VTG, GLL, RTK, ZDA, DPGGA, GGA (LDA), GSA, GST and GSV

  Note that the RTK sentence is a Fugro proprietary sentence. It has been included for future development but should not be used until Real Time Kinematic computations are being performed within MultiFix 4. The facility to create an RMC message is described under the User Modified section see page 73.

- 2 different Projection Grid (UTM) outputs known as Syledis and GEM 80 DP
- 1 Propriety XML Data output called DGPS_IS

The DPS_IS sentence is a Fugro proprietary sentence. It has been included for use with Fugro monitoring software.

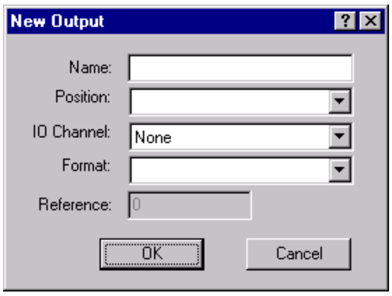
APPENDIX A - DATA OUTPUT STRINGS on page 316 has descriptions of all the output formats.

Note: When there is a time tag in a position output string, the time output will be the time of the fix, i.e. when the position calculation was performed, unless otherwise stated. This may be up to 1 second old by the time of output. MultiFix 4 does not predict the position contained in the string to the time of output. (This does not apply to the NMEA ZDA sentence where the time in the sentence is that of the moment of output). The time standard used in each output that contains time will be as defined by the format of the output, i.e. UTC or GPS time.

4.3.3.5.1.Standard Outputs

"Config" \ "Output" \ "New" \ "Standard"

Each output can only contain the results from a single calculation so the output could perhaps be given the same name as the calculation. If no name is given MultiFix will assign the name of the selected calculation to the output.



In the "Position:" section select the calculation from which the position is to be taken.

In the "IO Channel" section select the output route. Be aware that the list will still contain the channel that may already have been assigned to the GPS Receiver. As the communication with the GPS receiver is two-way it is not a valid channel for the position output strings.

Select the desired format for the output data string.

If the selected format is Trimble, Geco UKOOA, Geco UKOOA version 2 or ZeroLink, the "Reference" edit control can be set. These formats allow an additional identifier for differentiation purposes. If Trimble or one of the Geco UKOOA formats is selected the reference number should be in the range 00-99. If ZeroLink, then the number should be in the range 00-31.

ZeroLink is the format for communicating with other applications in the Zero suite of programs.

Warning, if ZeroLink is selected do not attempt to output via a COM port as the message is too large and will have a detrimental effect on the performance of the program.

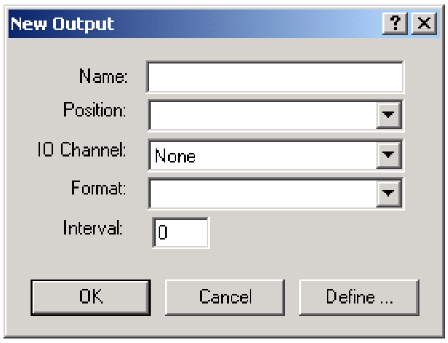
Fugro XP Expanded and Concise are proprietary Fugro output formats. The XP strings have been designed to reflect the operation of the SkyFix-XP calculation in MultiFix 4 and include the statistical parameters that are relevant for this type of calculation. An important characteristic of SkyFix-XP is that the XP calculation can fall back to normal DGPS calculations. Hence, the calculation can switch between a Kalman Filter approach and a Least Squares approach. This has an effect on what statistical parameters are relevant and available. The content of the end of the Expanded string, containing statistical parameters, therefore depends on the calculation mode used to derive the position.

The Concise string gives users the option to use a basic position & QC output, the Expanded string is required to have access to more satellite related QC information.

Click **[OK]** to activate the output.

4.3.3.5.2. Approved NMEA Sentence Outputs

“Config” \ “Output” \ “New” \ “NMEA”



As with the Standard outputs give the output a “Name”, a source computation in “Position” and assign an “I/O Channel” for output.

In the “Format” slot select the output format(s) required.

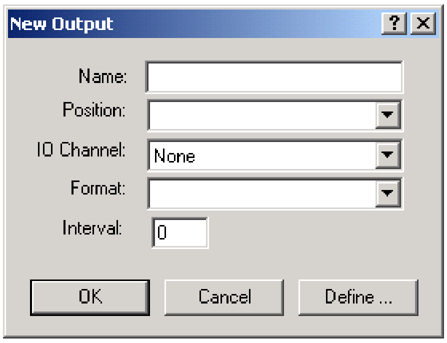
Sentence Formatter

GGA	=	Global Positioning System Fix Data
VTG	=	Course over Ground and Ground Speed
GLL	=	Geographic Position – Latitude/Longitude
RTK	=	Real Time Kinematic (not approved, Fugro proprietary, should not be used until MultiFix 4 supports RTK computations).
ZDA	=	UTC Time and Date
DPGGA	=	IMCA DGPS DP Interfacing Format, a standard format providing suitable data for DP systems.
GGA (LDA)	=	This is a modified version of the GGA string for interfacing to specific systems that cannot handle a latency figure of more than 10 seconds.
GSA	=	GNSS DOP and Active Satellites
GST	=	GNSS Pseudorange Error Statistics
GSV	=	GNSS Satellites in View

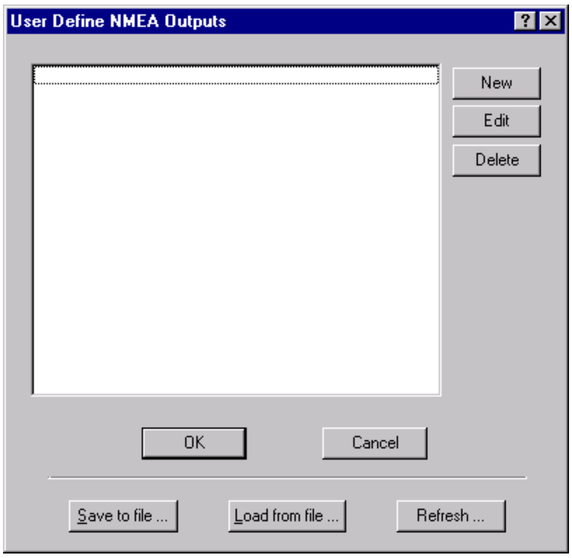
The “Interval” option allows the user to specify an interval (in seconds) between GGA outputs, to be used if an output rate of less than 1Hz is required.
Please note that setting is an actual interval, the software will supply the first available fix after the specified interval, so if the calculation processes is running slowly the difference in times tags may not equate to exactly the specified interval.

4.3.3.5.2.1.User Modified NMEA Sentences

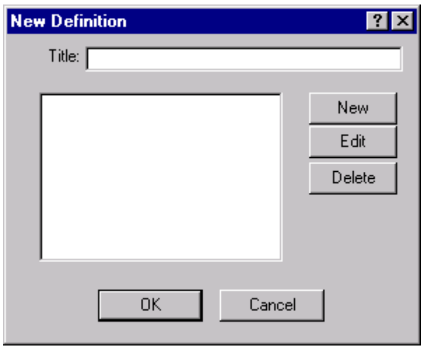
There is an added facility to create a user modified NMEA output that, while retaining the essential format, is customised for the recipient. In the New output dialogue click **[Define…]**.

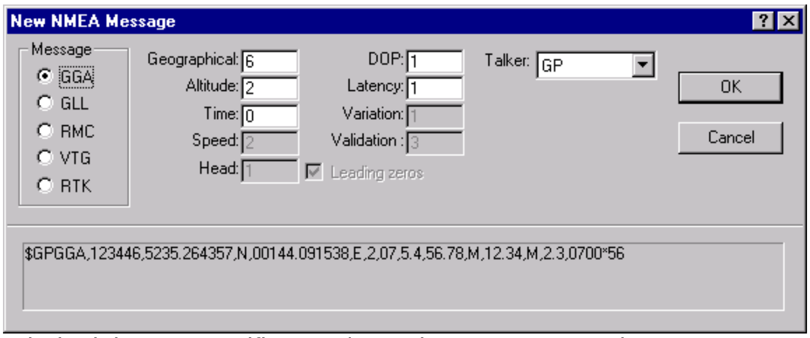


To create a new User Defined NMEA output click **[New]**.



Give the string a title then click **[New]**.





In the "Message" group click the NMEA sentence that is to be the basis for the output string. (Notice that RMC is an option not previously seen. RMC stands for the "Recommended Minimum Specific GPS/Transit Data" sentence).

The lower display table will show the construction of whichever sentence is selected.

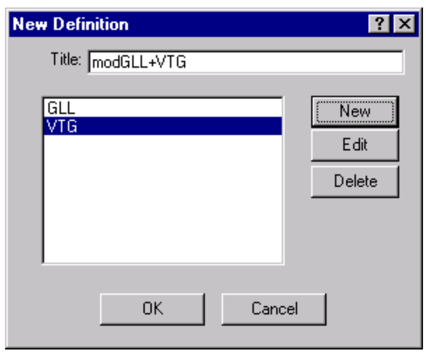
The rest of the dialogue will modify the basic sentence. Most fields refer to the number of decimal places associated with each field but if RMC or VTG is selected there is the added facility to have or suppress leading zeros to the course made good.

At the start of the sentence the first character which is a $ is a two letter talker identifier mnemonic followed by the three character Sentence Formatter. The two-letter talker identifier can be

GP	= Global Positioning System
SN	= Electronic positioning system, other/general
IN	= Integrated Navigation
RL	= Not NMEA standard, presumably Racal Ltd
??	= ??

If a change is made to the default format of the sentence, click in another active slot to see the change occur in the lower display table.

Once one NMEA sentence has been modified, another can be added.



[OK] exits to the User Define NMEA Outputs dialogue.

There are three buttons in this dialogue.

[Save to file…]
[Load from file…] and
[Refresh…]

[Save to file…] opens the Save definition to file dialogue. Enter a name for the Fugro Definition Format file and click **[Open]**

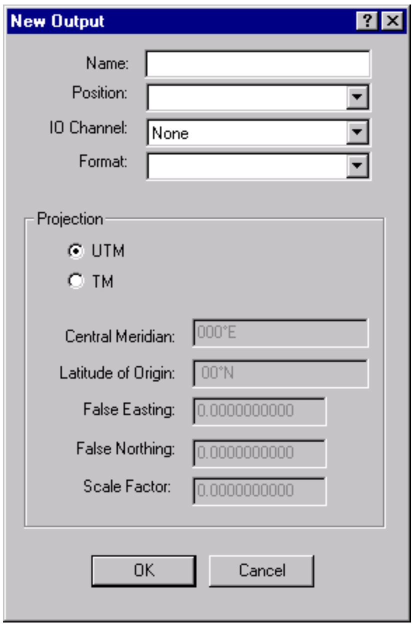
[Load from file…] opens the Load definition from file dialogue. The current *.rdf files will be listed. To revert to previously defined and saved user output sentences click **[Open]**.

[Refresh…] deletes all User Defined Outputs.

Once a user defined NMEA output has been created / loaded, its title is added to the approved NMEA sentence list so it can thereafter be selected for output.

4.3.3.5.3.UTM Outputs

"Config" \ "Output" \ "New" \ "UTM"



As with the Standard and NMEA outputs give the output a "Name", a source computation in "Position" and assign an "I/O Channel" for output.

Select the required "Format" ("Syledis" or "GEM 80 DP")

In the "Projection" table if "UTM" is clicked the co-ordinates in the string will be for the UTM Zone relevant to the current position.

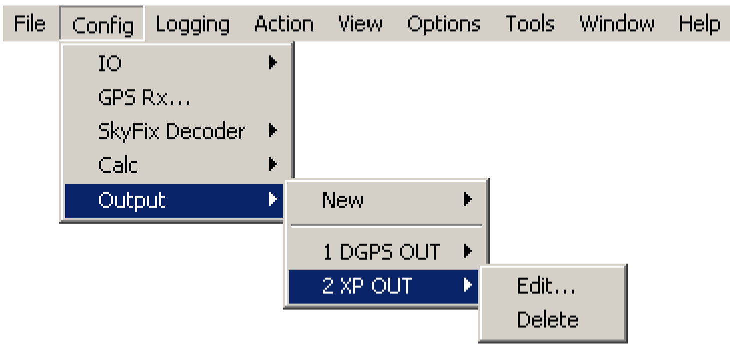
If "TM" is clicked the edit control slots, which are shown greyed out, become active and the parameters can be defined.

Grid co-ordinates will be based on the WGS 84 ellipsoid. There is no ellipsoid/datum transformation facility in MultiFix.

4.3.3.5.4.Editing and Deleting

"Config" \ "Output" \ "<name>" \ "Edit…" or "Delete"

Once an output has been defined the "Config" \ "Output" sub-menu, as well as having "New…" also has the output name (or names). If a name is highlighted, the calculation can be "Edited…" or "Deleted". Deletion requires a confirmation.



4.3.3.6. P2/94 Output

"Config" \ "P2/94 Output"

The "P2/94 Output" will only be visible if "P2/94" has been enabled in the "Options" menu.

MultiFix 4 has the capability to output raw GPS measurements, ephemeris and RTCM corrections in P2/94 format. The P2/94 format is used for the exchange of raw positioning data and is recommended by UKOOA for general use in the Oil and Gas, Exploration and Production industry.

The full P2/94 format is extensive and covers a wide-range of equipment. MultiFix 4 only outputs P2/94 records that are relevant to positioning, these are as follows:

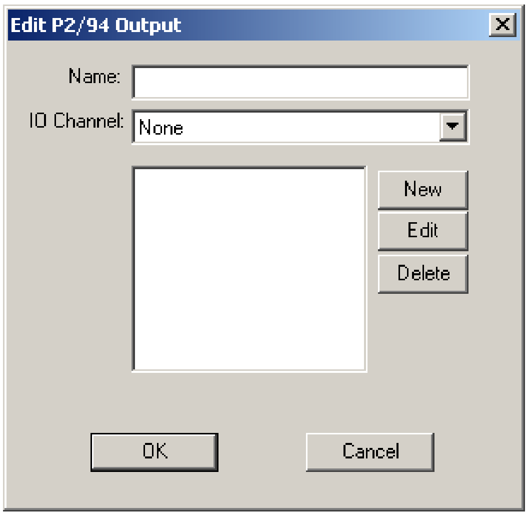
T55##	Inter-event network GPS Observations (## = Observation Type*)
T56##	Network GPS Observations continuation record (## = Observation Type*)
T6310-17	Updated GPS ephemerides & clock
T6320	Updated GPS UTC parameters
T6321-22	Updated GPS ionospheric model parameters
T65##	Inter-event Differential correction data (## is the differential Correction Source (DCS) Identifier) RTCM Type 1, Type 2 and Type 3 messages.

*Observation Type: ##20 – GPS pseudorange, clock bias per receiver per measurement
##22 – GPS carrier-phase
##23 – GPS instantaneous Doppler frequency

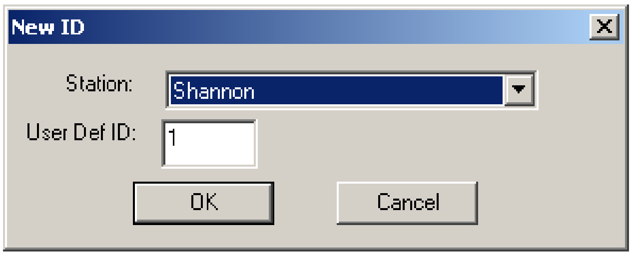
It is necessary to have already configured the GPS Rx and, if T65 records are required, a SkyFix decoder as well prior to creating a P2/94 output.

As with the Standard outputs give the output a "Name", and assign an "I/O Channel" for output.

Next select the differential reference stations that are required to be output by clicking **[New]**.

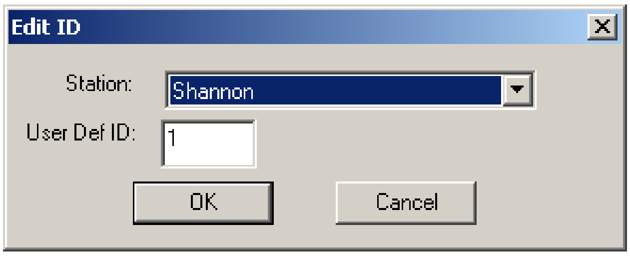


All the reference stations that were selected in the SkyFix decoder set-up will now be available in the dropdown box.



Select a station and then in the "User Def ID" enter a unique ID number to a maximum of 99 (MultiFix will not allow duplicate ID's). The ID does not have to represent the SkyFix ID, but is used to identify the individual reference stations in the P2/94 T65 records. Once completed select **[OK]**. This process has to be repeated for each reference station that is to be included in the P2/94 output.

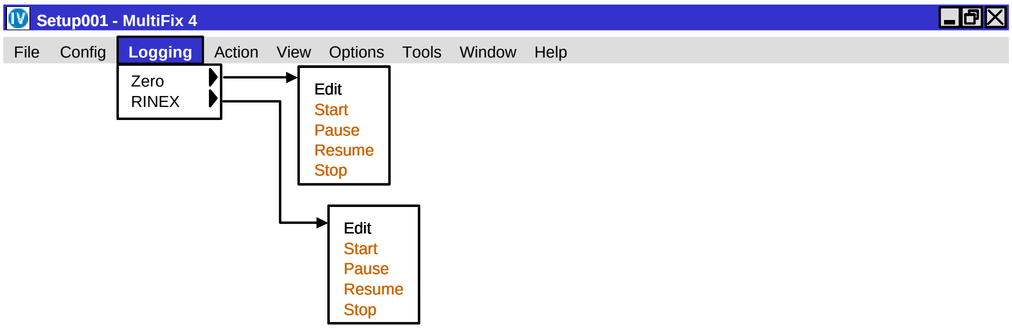
To edit a station already included, highlight the station in the list in the "Edit P2/94 Output" dialogue and click **[Edit]**.



The "Edit ID" dialogue will appear. Make the necessary changes and click **[OK]** when completed.

From the "Edit P2/94 Output" dialogue click **[OK]** to activate the output and complete the set-up. By clicking **[Cancel]** any changes will not be saved.

4.3.4. LOGGING

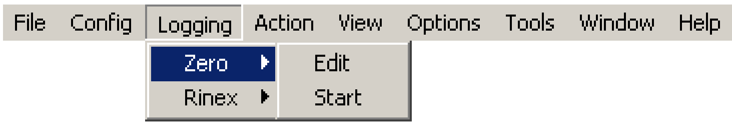


The Logging menu items shown above will change depending on the current state of logging. If no logging is taking place it will be "Edit" and "Start", if logging is ongoing it will be "Pause" and "Stop" and if logging is paused it will be "Resume" and "Stop".

The Rinex Logging menu will only be visible if "RINEX" has been enabled under the options menu.

4.3.4.1. Zero

"Logging" \ "Zero"

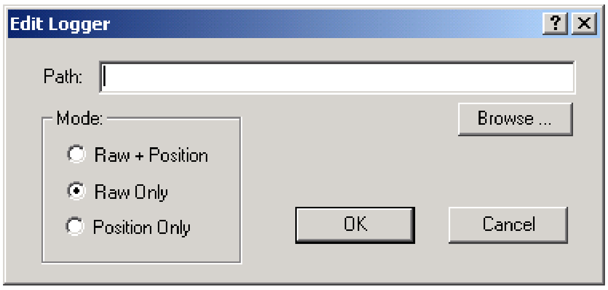


Zero log files can also be logged. These files can be read by LOGPUMP (See Section 8) where raw data can replayed and directed back into MultiFix regenerating pseudo-real time positions. Those positions can then be output from MultiFix to QUAL 2 or POSITIONVIEW software.

It is therefore possible for recoded real-time positions to be compared with regenerated positions.

4.3.4.1.1. Edit

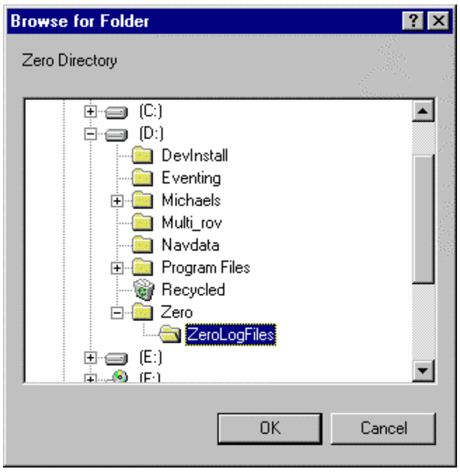
"Logging" \ "Zero" \ "Edit" calls up the dialogue shown.



Select the type of logging required. Note there are not separate raw and position files, the Zero Log (*.zer) files can contain both raw measurement and position data.

In most cases it is recommended to use the “Raw Only” option.

Select the folder into which the logged data is to go either by typing in the destination or by using the **[Browse…]** facility. This provides the Browse for Folder dialogue. The path can be defined by clicking on the desired destination folder.



Be aware that typing in a non-existent path **will not create a folder.** If a new folder is required for data logging it must be created on the desired hard drive with Windows Explorer before logging begins. If a viable destination is not entered the *.zer log files will be written into the MultiFix installation directory.

When the path and mode of logging have been selected click **[OK]**.

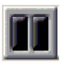
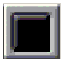
The files are named with the Julian day and PC time at the moment of creation, e.g. 061-1114.

When a file reaches 1.4 Mbytes in size it will automatically close and a new one will be created.

4.3.4.1.2.Starting, Stopping and Pausing

“Logging” \ “Zero” \ “Start” is a command.

The same is accomplished using the toolbar button. 

This will start the logging process. When data is being logged the menu options and toolbar buttons will change to “Pause”  and “Stop”. 

“Pause” will arrest the logging process until “Resume” or “Stop” are selected.

“Resume”, which has the same button as Start, will restart logging into the existing file.

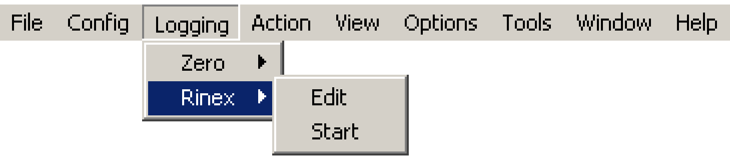
“Stop” will close the current log file.

When logging is started a Logging Schedule file is created in the same folder as the MultiFix application. This file is needed so that LOGPUMP can be set up correctly for the output of data. The schedule contains the MultiFix version number, reference station and calculation status information. There is only one file so if logging is stopped and then re-started the existing file is overwritten. This means that if configuration changes have been made between one log session and subsequent log sessions the Logging Schedule file will only be relevant for the last session. Therefore, if changes are to be made after logging is stopped use Explorer to make a copy of the Schedule file and keep a note of the *.zer log files to which it relates. Do not make configuration changes while logging is on going.

When being archived or when being forwarded for replay analysis, the configuration files (including the schedule file) should be kept with the log files.

4.3.4.2. Rinex

"Logging" \ "Rinex"



MultiFix 4 has the capability to log raw GPS observation in the RINEX (Receiver Independent Exchange) format. This is used to collect data for carrier phase post processing; typical usage is for verification after a final fix or for a post-processed RTK solution.

MultiFix will automatically generate file names following the standard naming convention, as follows:

SSSSDDDH.YYT

Where:

SSSS is the four character site identifier, this is user defined

DDD is the Julian day of year

H is a letter to differentiate between multiple files from the same day

YY is the year

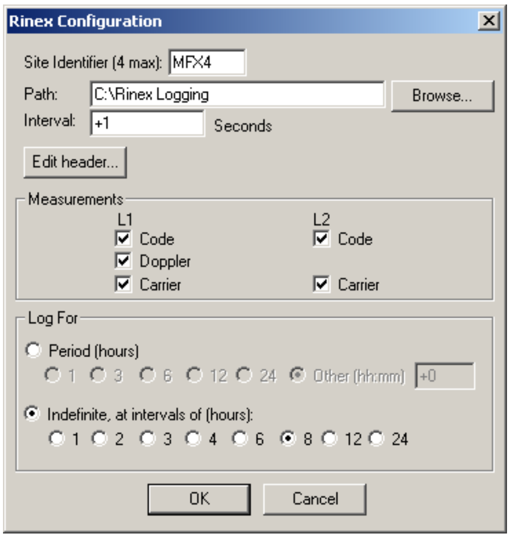
T is the file type, either o for observation files or n for navigation files.

MultiFix will automatically generate the files and file names based on the information provided. The file differentiator (H) used by MultiFix is a letter and will increase automatically when multiple sessions are conducted on the same day.

MultiFix will generate both observation (*.xxo) and navigation files (*.xxn).

4.3.4.2.1.Edit

"Logging" \ "Rinex" \ "Edit" calls up the dialogue shown.



Certain information is essential for the logging process. A unique 4-letter site identifier must be set which is used in the subsequent file name. Care should be taken not to duplicate the site name or to change it once it has been assigned to a specific locale.

Select the folder into which the logged data is to go either by typing in the destination in the "Path:" field or by using the **[Browse…]** facility.

The "Interval" box is used to enter the logging interval for data collection. This will trigger a record to be written every integer number of seconds past the hour. Therefore a setting of 30 seconds will write a measurement on every minute and at 30 seconds past every minute.

For Long range carrier phase post processing (such as to IGS stations) 30 seconds should be selected. For RTK post processing 1 second should be selected.

The "Measurements" section allows the user to select what measurements are required. In most cases all measurements should be selected.

NB a dual frequency receiver and antenna must be used to log L2 data.

The "Log For" options allow the user to define a predetermined file length based on time.

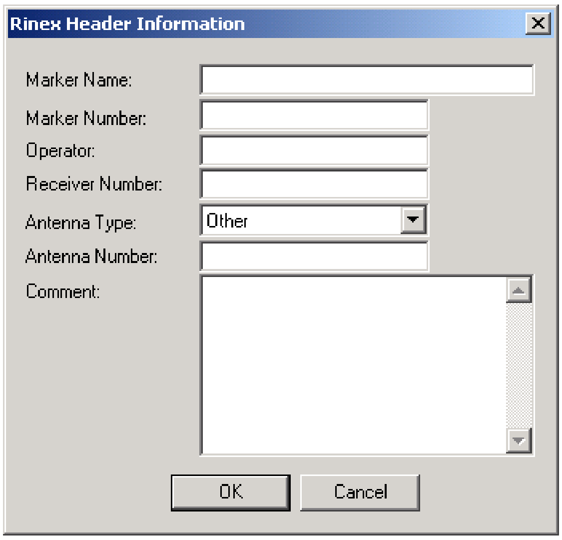
By selecting "Period" and an associated length of time from the radio buttons MultiFix will only log for the selected period.

Selecting "Indefinite" will force MultiFix to write sequential files of the defined period. This will set the start time of each file to the nearest round period of time. Therefore if a one hour interval is selected each file will start and stop on the hour. This will make the first file short of one hour but subsequent files will be as specified.

Periods of longer than one hour will be rounded into an even number in a 24 hour period e.g. a six hour period will start/stop at 00:00, 06:00; 12:00 and 18:00.

All time periods are set to GPS time and not local time.

4.3.4.2.1.1.Edit Header



The edit header dialogue allows the user to enter additional information to be written to the header. This data can be used in subsequent processing so should be filled in as completely as possible.

The "Marker Name" and "Marker number" entries are free text, these can be different (or the same) as the 4 letter Marker ID. This allows the user to provide a more legible name to assist in processing.

The "operator" is the name of the individual who collected the data.

The "Receiver Number" is the serial number of the GPS Receiver used to collect the data and is used for record keeping. Note that the receiver type is entered into the file automatically based on the GPS Receiver type selected within the "Config" \ "GPS Rx…" menu in MultiFix.

The "Antenna Type" is restricted to a drop down list of antennas commonly used with MultiFix. If the currently used antenna is not in the list then "Other" should be selected.

"Antenna Number" is a free text entry box for the serial number of the antenna, again used for record keeping.

The final "Comment" Box allows the user to enter any other pertinent information that may be of use to the processor.

4.3.4.2.2.Starting, Stopping and Pausing

"Logging" \ "Rinex" \ "Start" is a command.

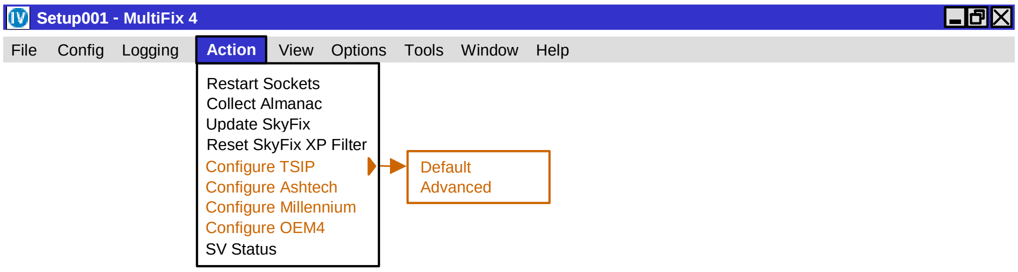
This will start the logging process. When data is being logged the menu options will change to "Pause" and "Stop".

"Pause" will suspend the logging process until "Resume" or "Stop" are selected.

"Resume" will restart logging into the existing file.

"Stop" will close the current log file.

4.3.5. ACTION



The Action menu item “Configure TSIP” will only appear if the GPS receiver selected uses the TSIP communication protocol, i.e. DSM (Trimble), BD112 (Trimble) or SK8 (Trimble).

The “Configure Ashtech” option will only be displayed if an Ashtech receiver is selected, i.e. Z Family, DG16, G12 or GG24.

In the same way the “Configure Millennium” and “Configure OEM4” options will only be displayed if a NovAtel Millennium or OEM4 receiver is selected.

4.3.5.1. Restart Sockets

“Action” \ “Restart Sockets”

On occasion heavy network traffic may lock up any or all TCP\IP socket ports. This option will reinitialise all currently open sockets without having to restart the software or editing the configuration files.

4.3.5.2. Collect Almanac

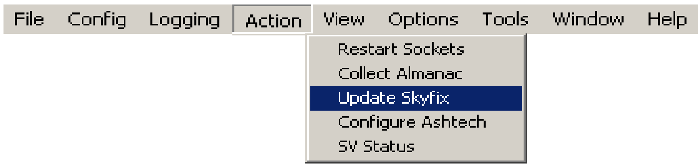
“Action” \ “Collect Almanac”

MultiFix 4 will not work without almanac data. When the program is first opened there is an automatic series of requests for almanac data to the GPS receiver. If the receiver is not available to the program at that time there will be no almanac data. Once communications with the receiver have been established a request for almanac data can be forced using this facility. Current almanac information is displayed under “View” \ “GPS” \ “Almanac” (see section.4.3.6.4.7 page 106).

Without a forced almanac update, almanac information would still be acquired albeit slowly. It can take up to 30 minutes to acquire all the information as it is updated at 1 SV per minute.

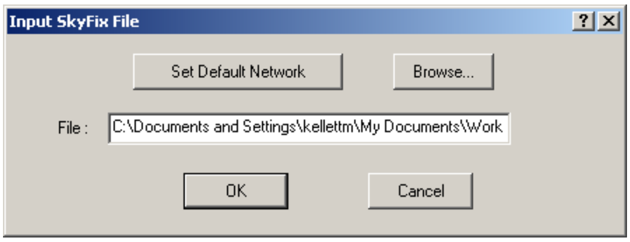
4.3.5.3. Update SkyFix

"Action" \ "Update SkyFix"



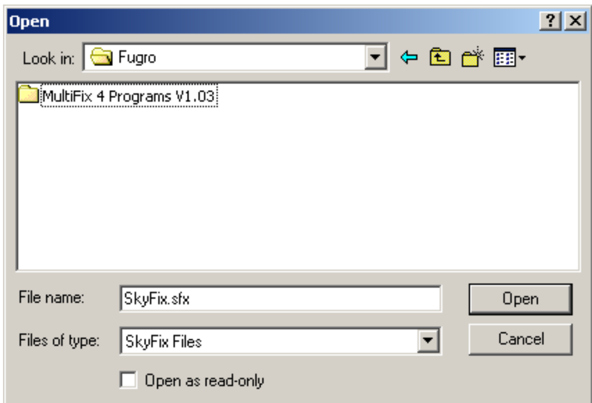
This function allows the user to update the SkyFix beams and station lists within MultiFix by means of an XML file with the extension *.sfx without having to wait for a new software release. When changes are made to the SkyFix network a new XML file will be made available to MultiFix users allowing them to update their software.

[Update SkyFix] option will call up a control menu.



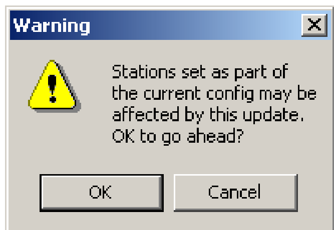
[Set Default Network] will default the SkyFix network information to the original set-up on the installation CD.

[Browse] will open the dialogue opposite. Select the new SkyFix Network file, this will have the extension *.sfx and click **[Open]**



Clicking on **[Ok]** will close the "Input SkyFix File" dialogue.

MultiFix will then display a "Warning", click **[Ok]** to accept the changes or **[Cancel]** to reject them.



NB changes made to stations or beams that are currently being used in the configuration will be affected.

4.3.5.4. Reset SkyFix-XP Filter

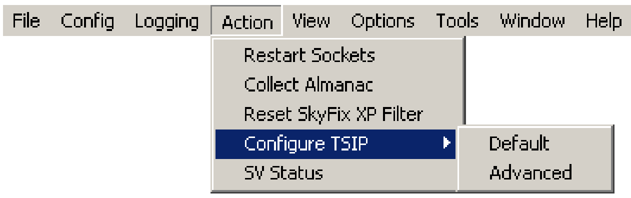
"Action" \ "Reset SkyFix-XP Filter"

This function empties all values from the Kalman Filter used in the SkyFix-XP position calculation. A warning window will appear asking for confirmation prior to performing the function.

Be aware that if the filter is reset then the XP solution will need to re-converge before it can be used.

4.3.5.5. Configure TSIP

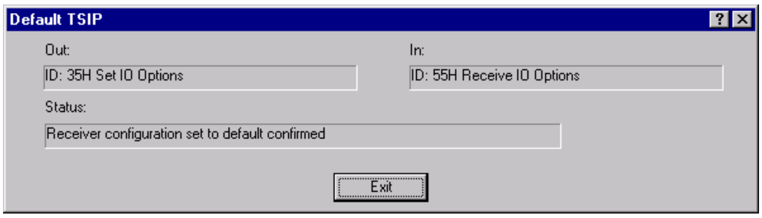
"Action" \ "Configure TSIP…"



This facility instructs a Trimble Standard Interface Protocol (TSIP) GPS receiver to output the information MultiFix 4 requires. This will need to be done each time power to the receiver is cycled. (If a 90938 has a BD112 or DSM fitted there is battery back up on the receiver when the 90938 is switched off).
This display is only visible when a TSIP controlled GPS receiver is selected.

4.3.5.5.1. Default TSIP Configuration

"Action" \ "Configure TSIP…" \ "Default"

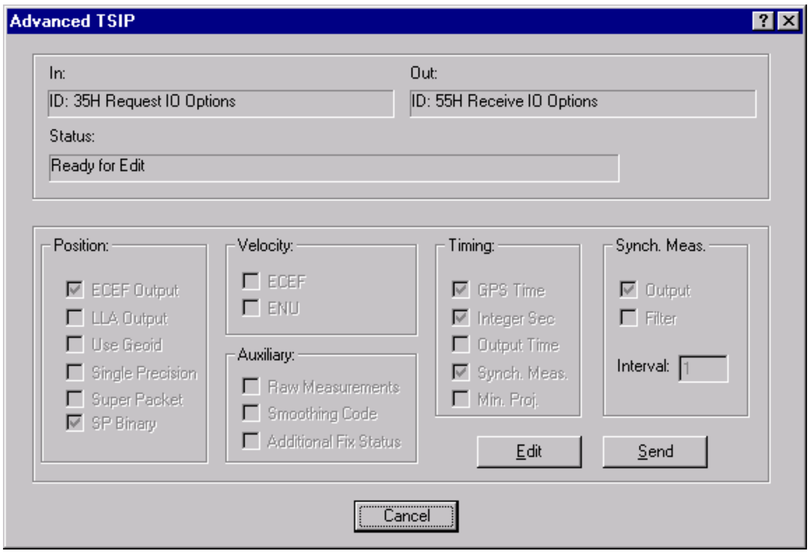


Accessing this dialogue causes the program to immediately send two configuration messages, a Synchronise Measurements message and an I/O Options message. As soon a response from the receiver is received the dialogue above will be shown. If there is no link between the computer and the receiver the dialogue will state "awaiting acknowledgement", "unable to set default parameters" or "waiting to reset default receiver configuration". Every 5 seconds it will retry to configure the receiver until **[Exit]** is clicked.

4.3.5.5.2. Advanced TSIP Configuration

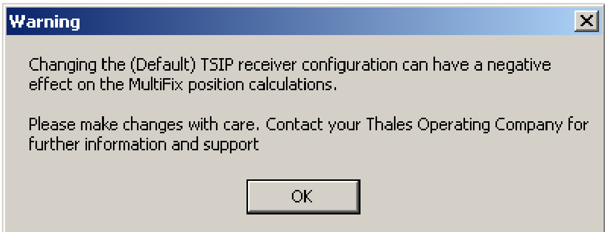
"Action" \ "Configure TSIP…" \ "Advanced"

As with the default configuration, as soon as this dialogue is accessed the program will try to establish communication with the receiver and try to configure it with the default configuration.

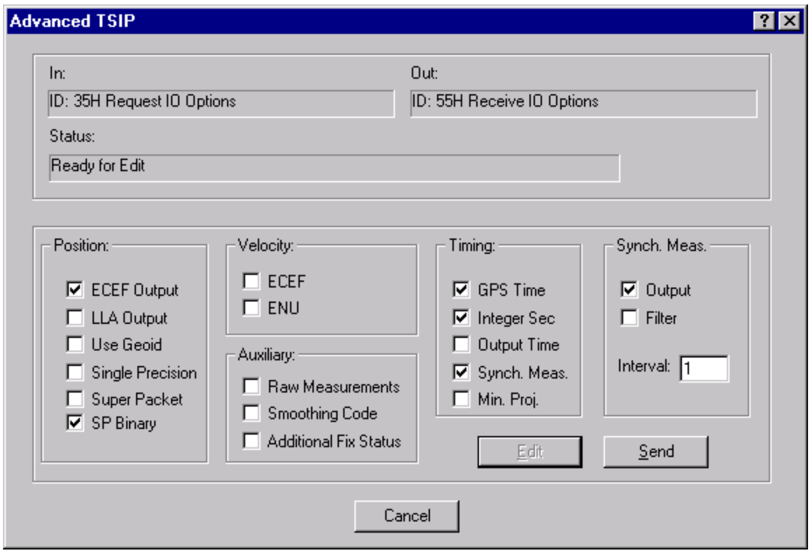


To change the configuration, click the **[Edit]** button.

The program provides a warning which must be read carefully. Clicking **[OK]** activates the Edit Controls in the "Position", "Velocity", "Timing" "Auxiliary" and "Synch. Mess." Tables.

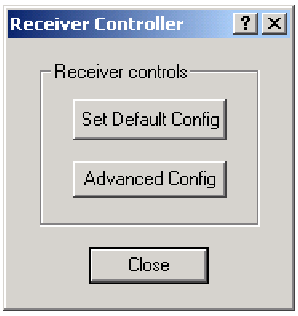


For a full explanation of the options available the reader is directed to the Trimble TSIP Reference document, Trimble Part No 34462-00. The latest revision that is held by the TSG is Rev B dated Feb 1999.



4.3.5.6. Configure GPS Receiver

"Action" \ "Configure Ashtech", "Configure Millennium", "Configure OEM4"



If an Ashtech or a NovAtel GPS receiver has been selected for use with MultiFix then the "Configure Ashtech", "Configure Millennium" or "Configure OEM4" dialogue will be made available.

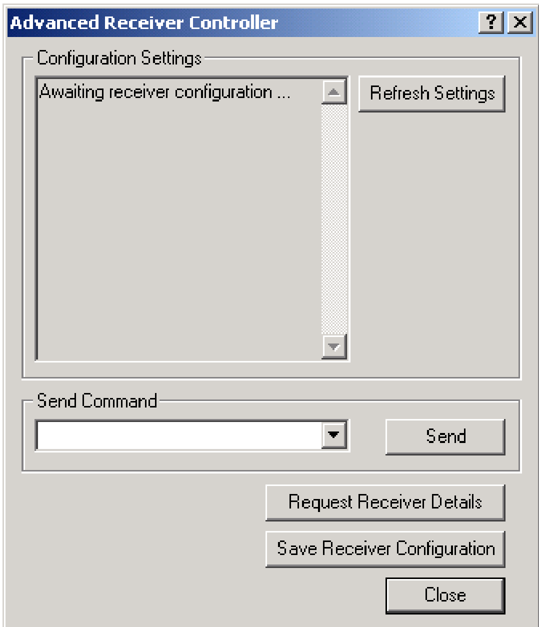
Assuming serial communications have already been established an Ashtech or NovAtel GPS Receiver can be configured from within MultiFix.

See section 4.2.4.1 Ashtech (Thales Navigation) Receivers or section 4.2.4.3 NovAtel for details on how to a establish communication link with the GPS Receiver.

4.3.5.6.1. Default Receiver configuration

Clicking on the **[Set Default Config]** button will send the basic set of commands needed to configure the selected unit for use with MultiFix.

4.3.5.6.2. Advanced Receiver configuration



The **[Advanced Config]** Button will call up a control menu.

[Refresh Settings] will update the display.

[Request Receiver Details] will interrogate the GPS receiver settings and send commands to the unit.

[Save Receiver Configuration] will save the current setting to the battery powered RAM on the receiver circuit board.

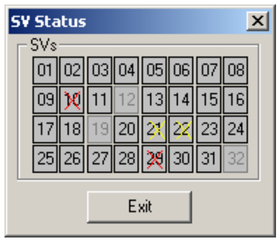
The "Send Command" dialogue allows the user to send additional commands to the GPS receiver. Please refer to the appropriate Ashtech or NovAtel handbooks for details of the available commands.

4.3.5.7. SV Status

"Action" \ "SV Status"

The SV Status dialogue can also be called up by clicking .

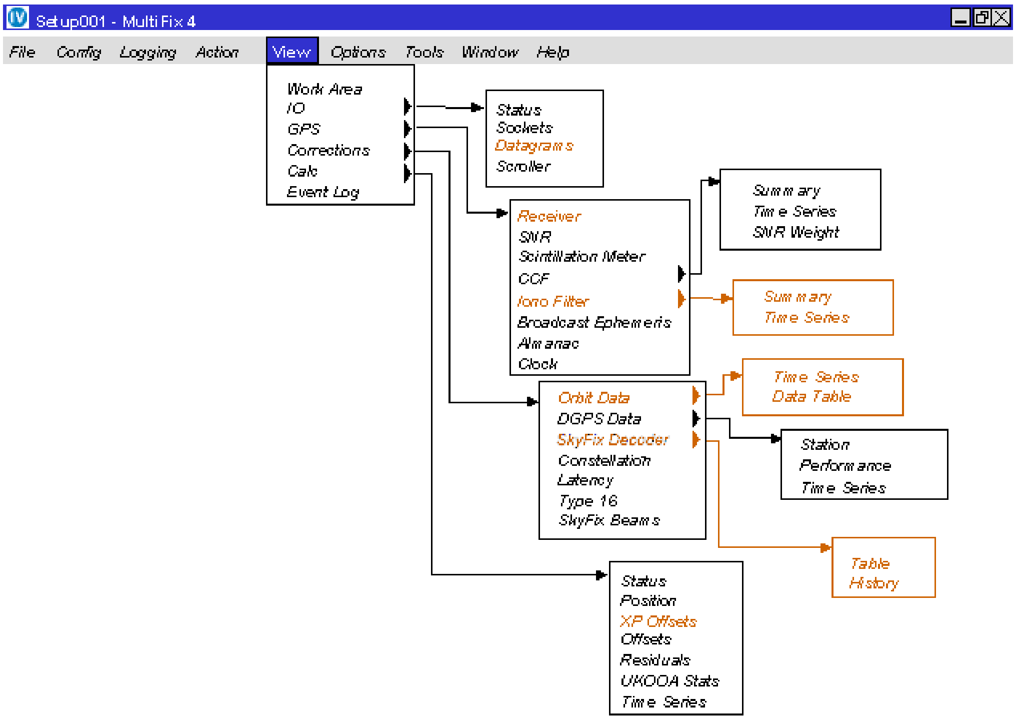
It shows a list of all the SV numbers. Numbers that are greyed out indicate that there is no current almanac data for them. Numbers with a yellow cross through them indicate that the satellite is unhealthy and will not be used in the computations.



If a number is clicked then that number will be shown with a red cross and the satellite will be excluded from all computations until re-enabled.

The SV Status dialogue is a modeless dialogue and unlike standard dialogues, program control can still be exercised while it stays open.

4.3.6. VIEW



The items show in brown will only appear if pre-conditions have been met.

"Files" will only appear in replay mode.

"Datagrams" only appears if a UDP socket has been defined.

"Receiver" only appears if a 4000 Series (Trimble), MS750 (Trimble) or BD750 (Trimble) is the selected GPS receiver type.

"Iono Filter" will only appear if one of the computations is designated as "Premier".

"SkyFix Decoder" only appears if it has been selected that one or more RTCM source(s) is a Fugro decoder and it is outputting test data.

Right-mouse clicking most windows allows the user to customise the display. Where that customisation is specific to the view window it will be mentioned in the relevant section in the manual. Several windows share the same two facilities of "Copy" and to "Save As…".

"Copy" places a bitmap of the window onto the clipboard from where it can be pasted into another application.

"Save As…" allows an html or bitmap file of the view window to be saved. By default the files will be placed in the folder that contains the MultiFix configuration file. The bitmap files are saved as *.bmp images but the html file does not contain images but instead has links to the images, so when MultiFix saves an html file the bitmaps are saved as well. When an html file is saved a Zero HTML Association file is also created. If the html file is deleted the associated bit maps are deleted as well

In common with many Windows programs, MultiFix allows display windows to be moved outside the area displayed by the monitor. The application workspace automatically extends and scroll bars are provided. The scroll bars allow the display area to move around the extended application workspace. There is no limit on the number of windows of any type that can be open in the application workspace. Multiple copies of the same window type can be open. Indeed it will be seen that once a window is open some types of window allow further selection of the data that is to appear in them.

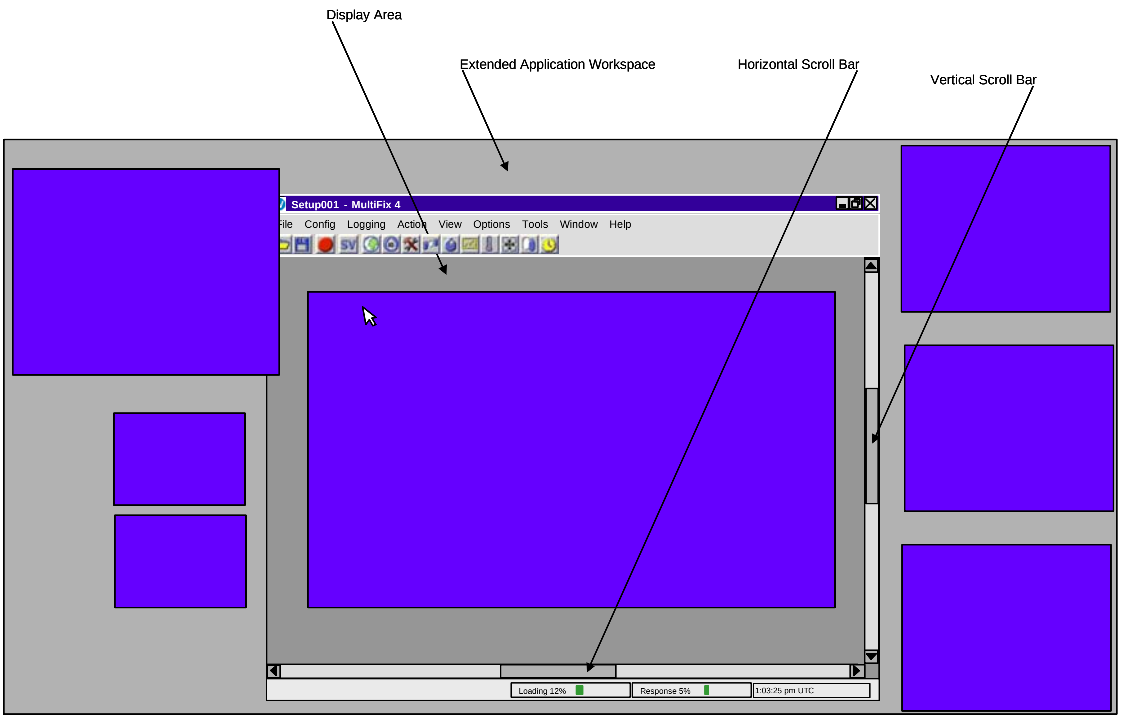


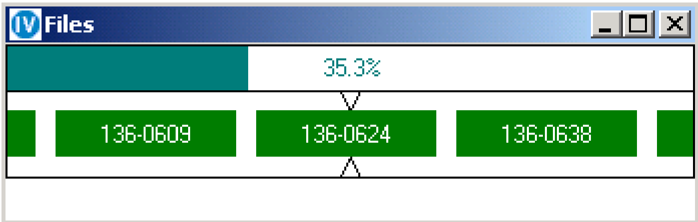
Figure 5 Windows Extending Beyond the Application Workspace

Most windows can be resized by clicking and dragging the corners or sides. Some windows that contain text will wrap the text message into the available space. Other windows containing text will simply be cropped as the window size reduces. Windows containing graphical information will resize down to a minimum and will then either crop the information or will introduce scroll bars.

4.3.6.1. Files

"View" \ "Files"

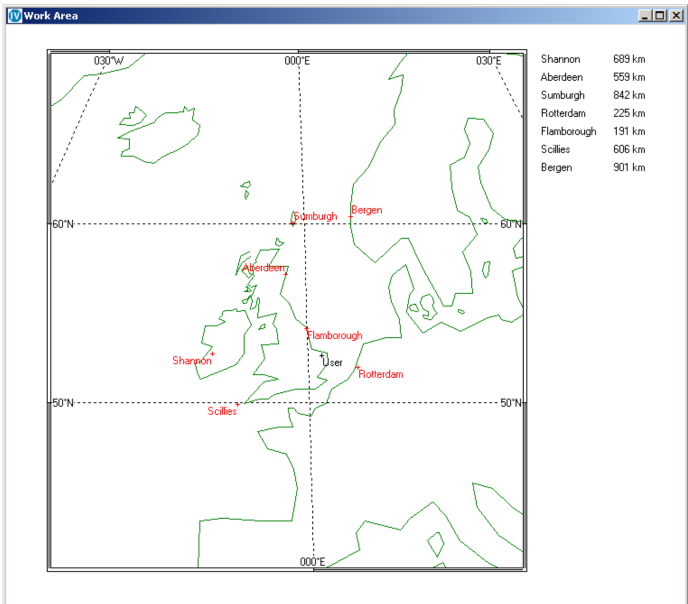
In replay mode the progress of the playback can be followed in the "Files" view window. The upper bar shows the status of the replay in percentage of the total time, while the lower part of the window shows the selected files as green blocks and the progress within the current file.



4.3.6.2. Work Area

"View" \ "Work Area"

This calls up a diagrammatic map, which will encompass the user's current position and the positions of all reference stations currently selected, and available, in the RTCM input data.



The right hand side of the window contains the ranges to each of the selected stations, based on the users current location.

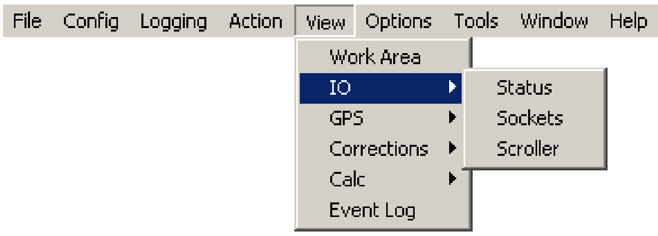
This window has a "Copy" and "Save As…" facility, accessed via the right mouse button click.

The work area can also be called up by clicking 

4.3.6.3. Input / Output

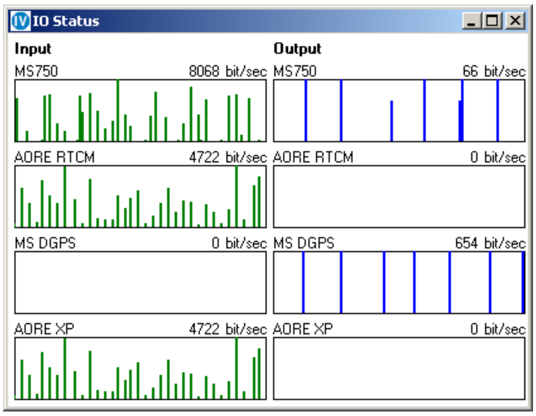
"View" \ "IO"

There are three sub-menus and each will call a window to the MultiFix 4 application workspace.



4.3.6.3.1. Status

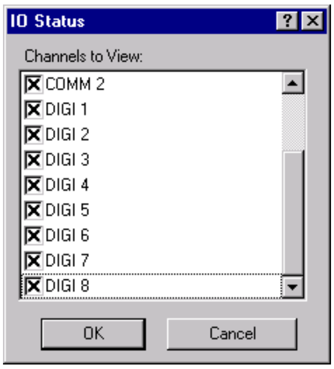
"View" \ "IO" \ "Status"



This window indicates when there is port activity.

By default the window will contain the ports MultiFix knows to exist. The "None" I/O Channel is at the top followed by streamed socket channels, datagram sockets and then the COM and Digiboard channels.

(When setting up Input / Output channels there is the option to select a dummy channel "None". If selected the blue vertical bars would be seen progressing across the None Output box.)



A right-mouse click calls up the **[Channel]** button. When this is clicked the IO Status dialogue is presented. This allows channels to be selected or deselected from the status window.

In the IO Status window the latest time is in the centre between the Input and Output columns. Each box indicates when data has been input or output, over the last 5 seconds, on that port by scrolling vertical bars from the centre to the outside edges of the window. The box re-scales such that the greatest data rate over the last 5 seconds is full scale. The current bit rate is shown opposite the I/O channel name.

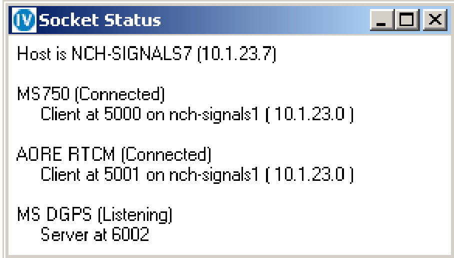
4.3.6.3.2.Sockets

"View" \ "IO" \ "Sockets""

A client socket can have three states,

Idle, Connecting and **Connected**.

Idle and Connecting will alternate while connection is trying to be established. There will also be a time countdown to the next attempt to make contact.



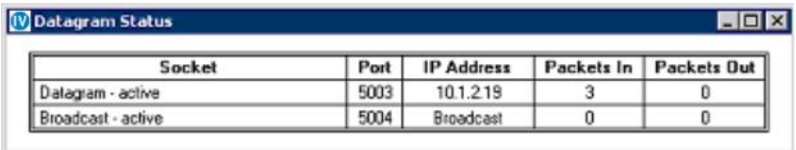
A server socket can have two states,

Idle and **Listening**.

The Idle status is almost immediately replaced by Listening.

4.3.6.3.3.Datagrams

"View" \ "IO" \ "Datagrams"



Socket	Port	IP Address	Packets In	Packets Out
Datagram - active	5003	10.1.2.19	3	0
Broadcast - active	5004	Broadcast	0	0

The Datagram Status window lists all Datagrams in use. The IP address indicates to which PC a link is in place or if it is transmitting a broadcast message. The "Packets In" and "Packets Out" window indicates if the datagram is working. If you are receiving data only the "Packets In" will increase. If you are transmitting to n PCs the "Packets In" will increase at n times the rate of the "Packets Out".

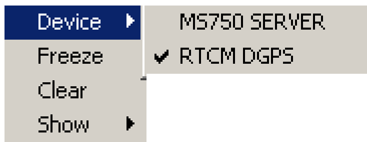
4.3.6.3.4.Scroller

"View" \ "IO" \ "Scroller"

Scroller is able to display any of the inputs and outputs. When first opened the display defaults to showing the link to/from the GPS receiver. To change to another IO Channel or to change the scrolling options, click the right mouse button.

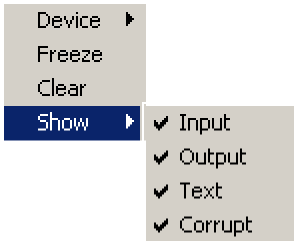
This calls up a menu box, which has "Device", "Freeze", "Clear" and "Show" as shown opposite.

If "Device" is highlighted there is a sub-menu which lists the different input / outputs. Top of the list is the name given to the GPS receiver. This is followed by the RTCM source(s) and then by the output(s).



If "Freeze" is selected the current window display is held and frozen appears in the windows title bar. Clicking "Freeze" again unfreezes the display. "Clear" will remove all information from the current window.

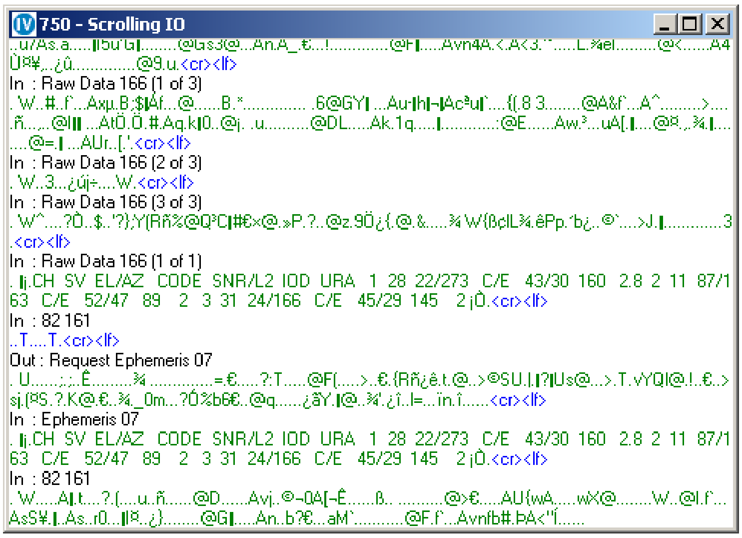
"Show" brings up a new sub-menu with four options: "Input", "Output", Text" and "Corrupt". A tick next to the option indicates that the relevant information is currently displayed in the Scroller window. These options may be toggled on or off by left clicking.



The text in the window is bottom justified and colour coded. Green indicates it has been successfully decoded and passed all parity checks, red indicates the data is corrupted and dark blue is reserved for the outputs, see 4.3.6.3.4.3 Output Strings. When a message is received or sent successfully a black text line is added as a label. Carriage return and line feed are shown in light grey.

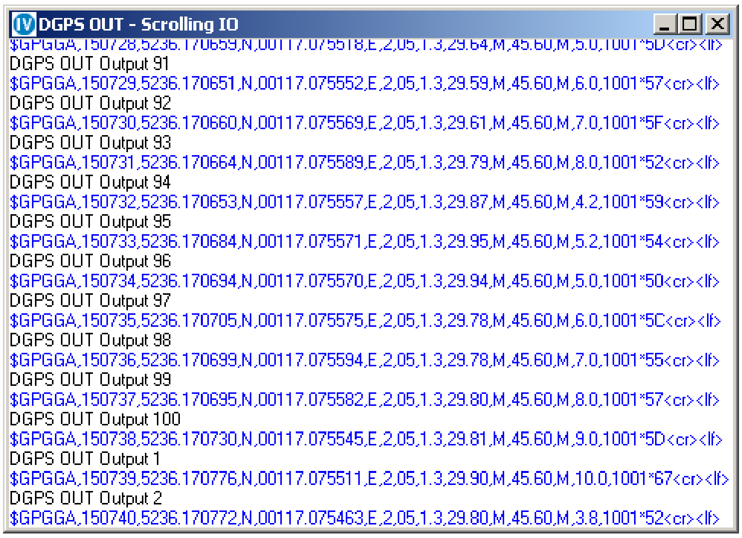
Scroller windows use a lot of resources and should be closed when they are not required.

4.3.6.3.4.1.GPS Receiver



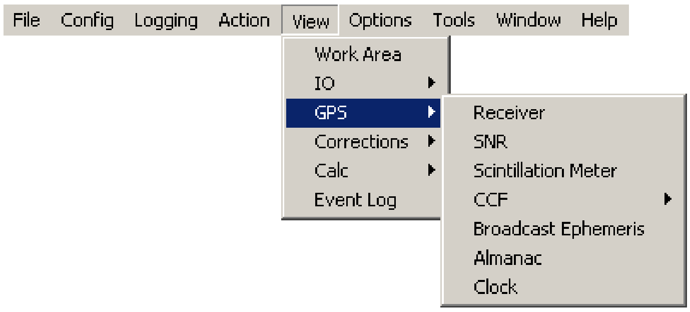
4.3.6.3.4.2.RTCM Input

4.3.6.3.4.3.Output Strings



4.3.6.4. GPS

"View" \ "GPS"

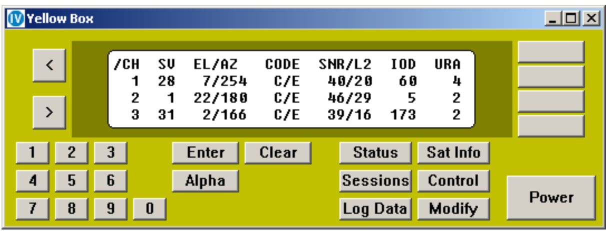


4.3.6.4.1.Receiver

"View" \ "GPS" \ "Receiver"

This menu item will only appear if a 4000 (Trimble), BD750 (Trimble) or an MS 750 (Trimble) GPS receiver has been defined. This window cannot be resized.

Assuming communication has been achieved between the receiver and the MultiFix program, the "Yellow Box" window acts as a remote interface with the GPS receiver in use. Clicking a button in the window performs that action on the receiver. Likewise if the menu on the receiver is being used the "Yellow Box" receiver window in MultiFix will update to the currently displayed page.



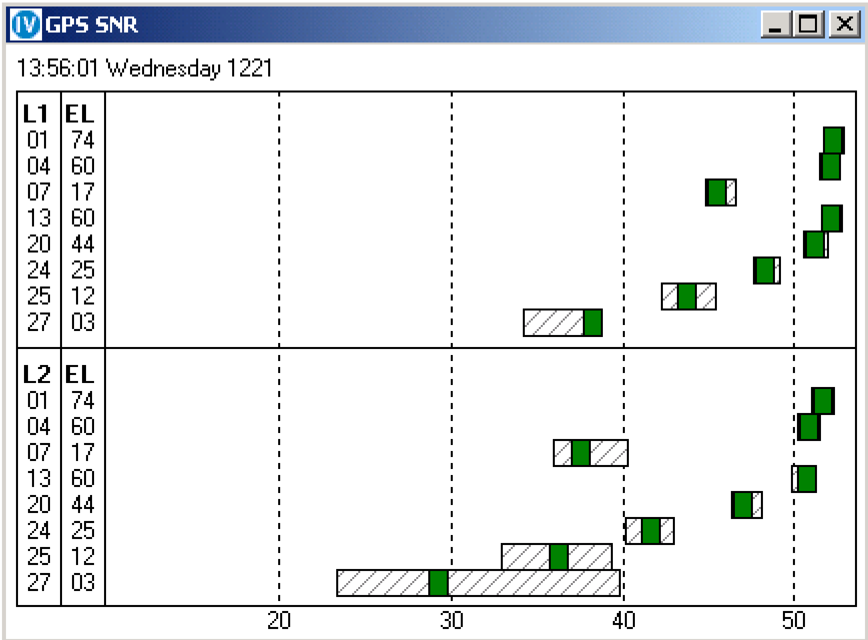
The UTC time displayed in the "Yellow Box" window will always be 1 or 2 seconds behind the UTC time shown in the Clock window. This is not a cause for concern as it is due to the time taken for the receiver to provide the front panel text.

Beware: Do not change the settings of the port communicating with the MultiFix 4 program. Once communication is lost it cannot be re-established from MultiFix 4 and must be done via the receiver.

4.3.6.4.2.Measurements

"View" \ "GPS" \ "SNR"

The display shows the signal to noise (SNR) levels of each of the tracked satellites as a button on a bar. The width of each bar shows the minimum and maximum over the last 60 updates. The button position shows the current value. The button will be Red when there are <30 values in the filter, Yellow when between 30 and 59 and Green when 60 values have been obtained.



If two Measurement windows are opened they will not show the same information until the second Measurement window has received 60 updates.
The signal level may vary widely if the satellite is just rising, setting, or if high levels of multipath are present.

The X-axis re-scales as a function of the least minimum and the greatest maximum to be displayed.
The Y-axis will re-scale as rising satellites are acquired and setting satellites are lost.

Satellites for which there is data from the GPS receiver will still appear in the window even if they are disabled in "Action" \ "SV Status".

If using a dual frequency receiver then SNR's will be shown for L1 and L2 when in Premier or XP mode.

The "**EL**" column shows the elevation angles of the tracked satellites. By right clicking and selecting the 

option satellites can be sorted by elevation angle. Unselecting this option will rearrange SNR's in ascending PRN order.

4.3.6.4.3.Scintillation Meter

"View" \ "GPS" \ "Scintillation meter"

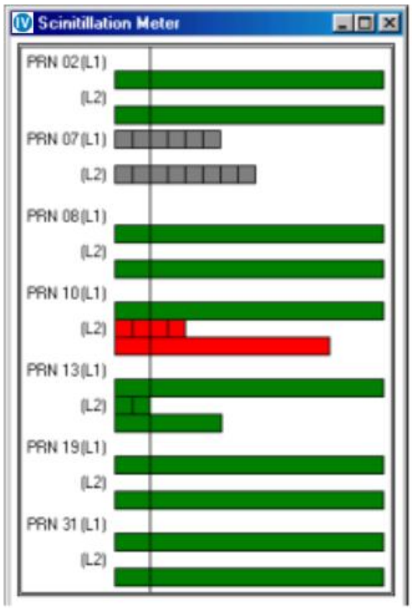
The "Scintillation Meter" window provides a visual display of how the scintillation filter is working.

For an explanation of scintillation see APPENDIX B – Understanding Scintillation.

The display contains four bars for each satellite currently being tracked.

The four bars are subdivided into two representing each frequency. The upper pair shows tracking on L1 and the lower pair shows L2.

The upper of each pair of bars represents the number of interruptions detected during the past 60 seconds. If there are no interruptions the bar remains empty.



The lower bar indicates the time since the last detected interruption. The full length of this bar equates to 60 seconds. The vertical black line across the whole display indicates the threshold for the maximum number of acceptable breaks during the past 60 seconds. This is set to two.

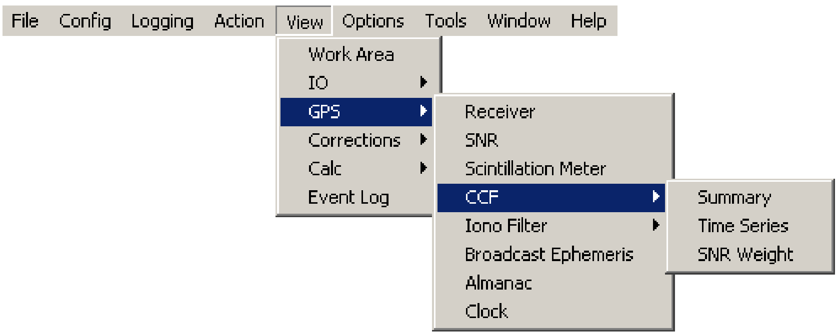
When data is acceptable the display remains green.

When the scintillation filter rejects data the display will turn red. If no data is currently available then the display will turn grey.

Please note that if data is rejected on L2 only data will remain available on L1 for single frequency calculations.

4.3.6.4.4.Code Carrier Filter (CCF)

"View" \ "GPS" \ "CCF"



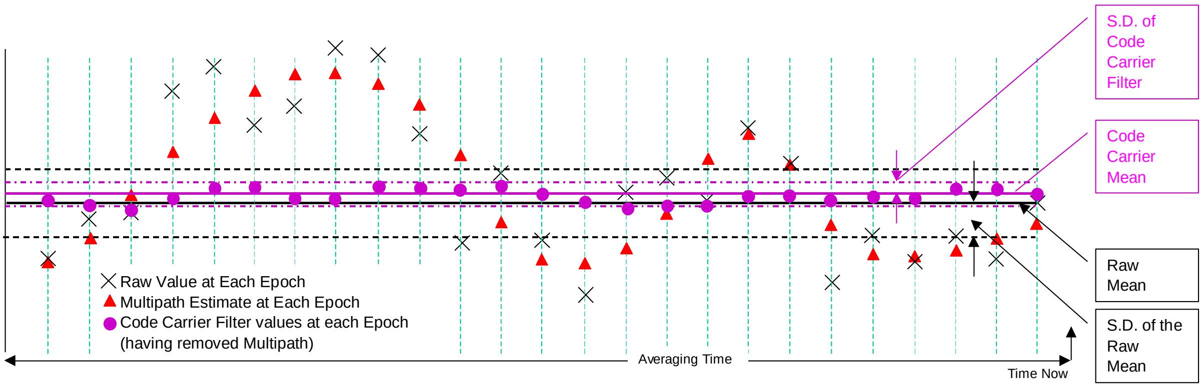


Figure 6 Graphical Representation of the Code Carrier Filter

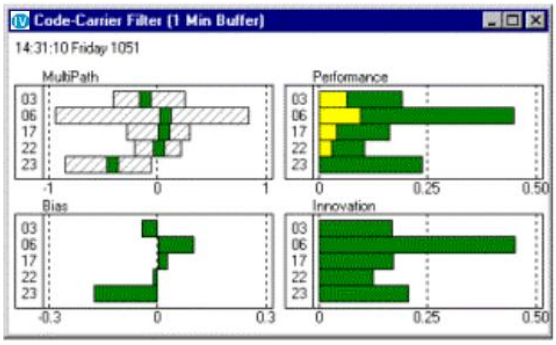
At the heart of the DGPS and Premier calculations is the Code Carrier Filter. This filter attempts to model and remove Multipath. Strong Multipath has a regular short-term cyclical pattern whereas noise is considered to be random, therefore for each epoch the program estimates what effect Multipath is having on the measurements from each satellite. It then derives measurement values with the estimated Multipath removed.

The heart of SkyFix-XP calculations is a Kalman Filter.

The Code Carrier Filter performance is displayed in the following two windows, "Summary" and "Time Series".

4.3.6.4.4.1. Summary

"View" \ "GPS" \ "CCF" \ "Summary"

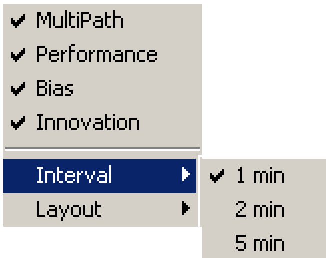


The code carrier filter displays are arguably the most significant displays for monitoring GPS measurement quality.

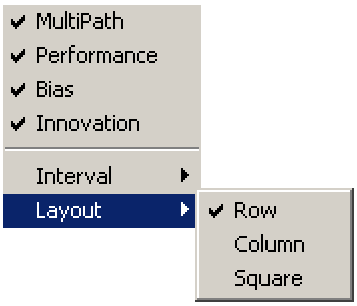
The right-mouse button provides display options for the window.

Any of the four bar chart information panels can be turned off or on by checking or un-checking the relevant name.

The averaging time used for the display can be set to 1 minute, 2 minutes or 5 minutes. (This does not change the Time Constant of the Filter itself). The averaging time is a moving window, losing the oldest adding the newest.



The layout can be set to Square (as shown above), Column or Row.



The yellow bars represent the standard deviation of the code carrier filters values and the green bars represent the standard deviation of the raw code carrier values.

All the panels re-scale as a function of the range of values to be displayed. Take particular note of the axis labels. All units are in metres.

“MultiPath” shows the results of the program’s modelling of the Multipath. Each Multipath panel button shows the current Multipath estimate. The hatched area shows the minimum, maximum range of the Multipath over the averaging time being used for the display. If the filter is working satisfactorily the buttons should oscillate either side of 0 in a random manner. If the values persist in fluctuating more than 2-5 metres, or some of the current values stay high, it may indicate the antenna is sited in an area prone to Multipath and removal to another location may be advisable.

“Performance” shows the Standard Deviation of the Code Carrier Filter values and the Standard Deviation of the Raw Code Carrier values.

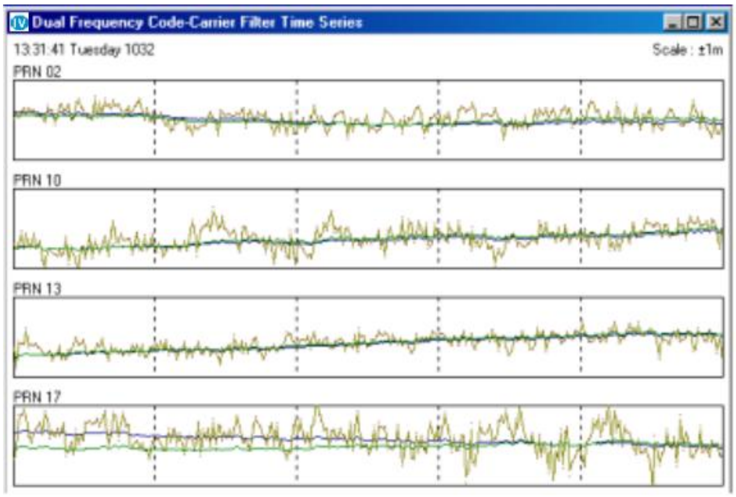
“Bias” shows the difference between the mean of the Filtered Code Carrier values and the mean of the Raw Code Carrier values. If the filter is working perfectly the mean of the filtered values should be the same as the mean of the raw values and therefore should be 0. A large difference indicates the filter is not modelling the raw data successfully.

Innovation shows the Standard Deviation of the Innovation. Innovation is the difference between the Code Carrier Filter’s predicted value and the Code Carrier Filter’s raw value (corrected for Multipath). If the filter is performing successfully the raw values should be randomly distributed around the filtered prediction. The movement should be due to receiver measurement noise and is an indication of the quality of the GPS measurements.

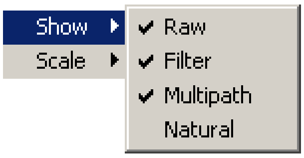
4.3.6.4.4.2.Time Series

"View" \ "GPS" \ "CCF" \ "Time Series"

This is a time series representation of the code carrier filter for each measurement over the last 5 minutes.



The right-mouse button provides display options for the window.

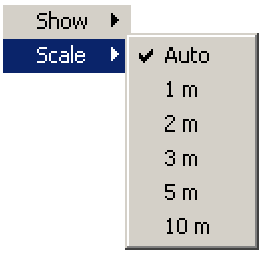


"Raw"- shows red dots representing the raw observations

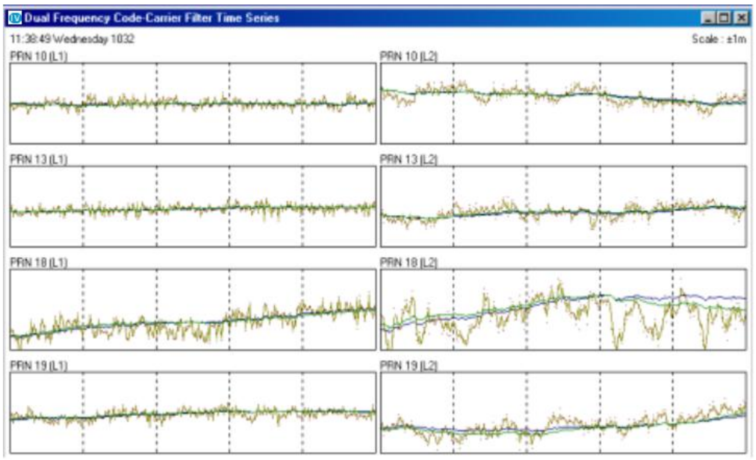
"Filter" - shows a smoothed green line indicating the observations after the Multipath estimate has been removed

"Multipath" - shows an erratic yellow line is the Multipath estimate.

"Natural" - a smooth blue line is going to be removed.



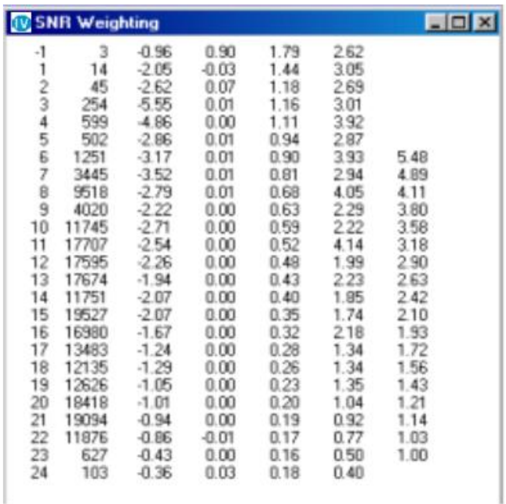
If dual frequency data is being received two sets of graphs will be displayed, showing the code carrier filter information of both the L1 and L2 frequencies.



4.3.6.4.4.3. SNR Weight

“View” \ “GPS” \ “CCF” \ “SNR Weight”

This screen provides information with regard to the signal to noise ratio weightings of the measurements. Generally, a lower SNR value is indicative of more noise and Multipath in an observation. MultiFix 4 will give more weight within the computation process to a measurement with a higher SNR value.



SNR Weighting

-1	3	-0.96	0.90	1.79	2.62	
1	14	-2.05	-0.03	1.44	3.05	
2	45	-2.62	0.07	1.18	2.69	
3	254	-5.55	0.01	1.16	3.01	
4	599	-4.86	0.00	1.11	3.92	
5	502	-2.86	0.01	0.94	2.87	
6	1251	-3.17	0.01	0.90	3.93	5.48
7	3445	-3.52	0.01	0.81	2.94	4.89
8	9518	-2.79	0.01	0.68	4.05	4.11
9	4020	-2.22	0.00	0.63	2.29	3.80
10	11745	-2.71	0.00	0.59	2.22	3.58
11	17707	-2.54	0.00	0.52	4.14	3.18
12	17595	-2.26	0.00	0.48	1.99	2.90
13	17674	-1.94	0.00	0.43	2.23	2.63
14	11751	-2.07	0.00	0.40	1.85	2.42
15	19527	-2.07	0.00	0.35	1.74	2.10
16	16980	-1.67	0.00	0.32	2.18	1.93
17	13483	-1.24	0.00	0.28	1.34	1.72
18	12135	-1.29	0.00	0.26	1.34	1.56
19	12626	-1.05	0.00	0.23	1.35	1.43
20	18418	-1.01	0.00	0.20	1.04	1.21
21	19094	-0.94	0.00	0.19	0.92	1.14
22	11876	-0.86	-0.01	0.17	0.77	1.03
23	627	-0.43	0.00	0.16	0.50	1.00
24	103	-0.36	0.03	0.18	0.40	

The first column shows the SNR value of the measurement.

The second shows the number of observations with that SNR value.

The third is the minimum measurement.

The fourth column is the mean.

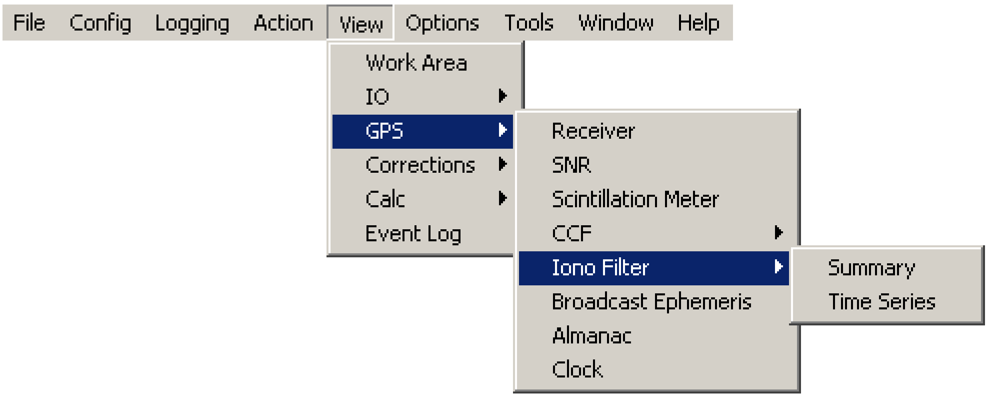
The fifth column is the standard deviation of the observations.

The sixth column shows the maximum value.

The final column shows the **relative weight** of the measurements with respect to the best value, which is assigned a value of 1.00. If there are less than 600 observations for an SNR value the program will use the next lowest SNR value with more than 600 observations. If no SNR values have more than 600 observations it will use the default setting.

4.3.6.4.5. Iono Filter

"View" \ "GPS" \ "Iono Filter"



The options available from the "Iono Filter" menu will only be available if MultiFix 4 is receiving dual frequency data from a GPS receiver using the CCF filter in a "Premier" calculation. Values of the ionospheric delay are derived from this filter. There are two options available from this menu that are the same as those available in the Code Carrier Filter menu as the same form of data is used in both filters, i.e. Time series and Summary. The data can be treated in the same way and therefore the same filters can be used.

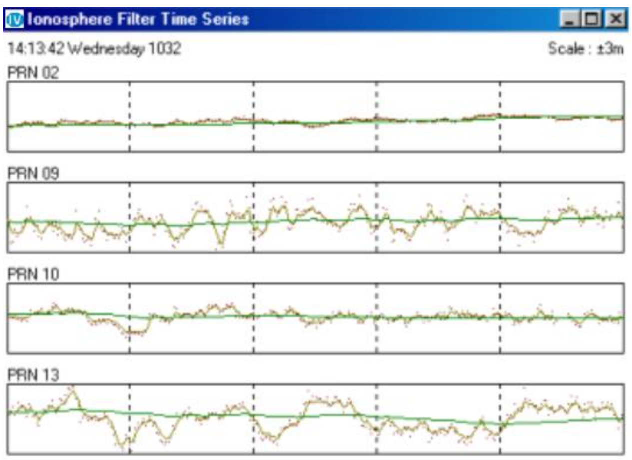
4.3.6.4.5.1. Summary

"View" \ "GPS" \ "Iono Filter" \ "Summary"

Refer to section 4.3.6.4.4.1 page 101.

4.3.6.4.5.2. Time Series

"View" \ "GPS" \ "Iono Filter" \ "Time Series"

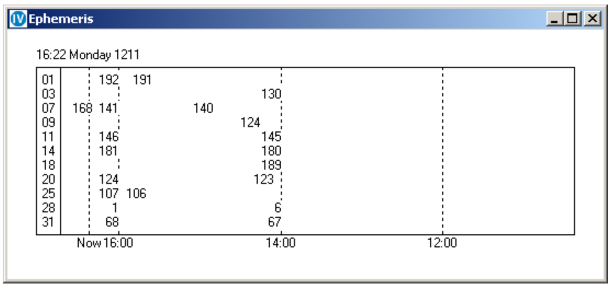


The time series plots for the Iono Filter will be noisier than the Code Carrier Filter plots because they are a combination of the L1 and L2 frequencies. Refer also to section 4.3.6.4.4.2 on page 103.

4.3.6.4.6. Ephemeris

"View" \ "GPS" \ "Broadcast Ephemeris"

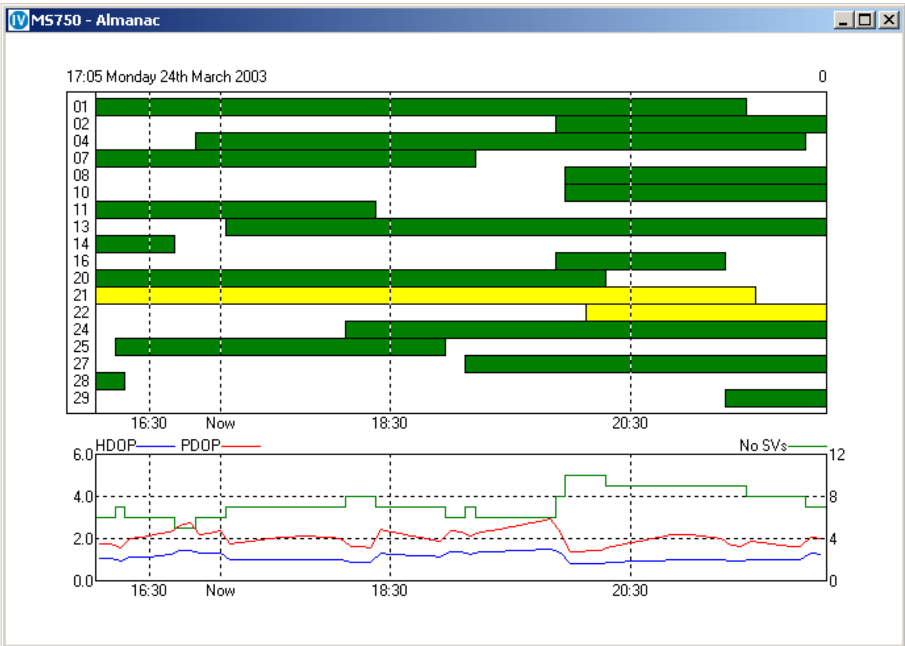
The Ephemeris window shows the previous 6-hour period. The Ephemeris issue number is placed at the time when an update was received. The issue number typically increments by 1 but that is not always the case. The majority of updates occur every 2 hours. Updates between this period may be due to a rising SV.



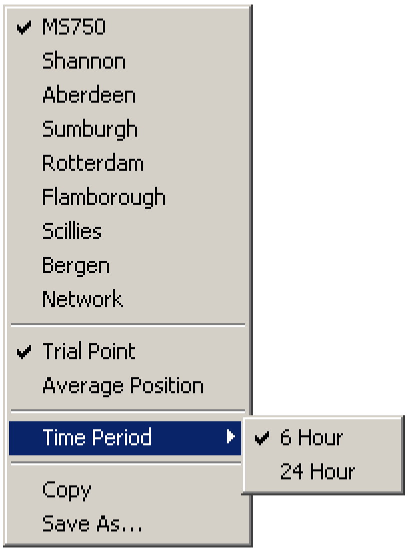
A right-mouse click on the window provides the "Copy" and "Save As…" facilities.

4.3.6.4.7. Almanac

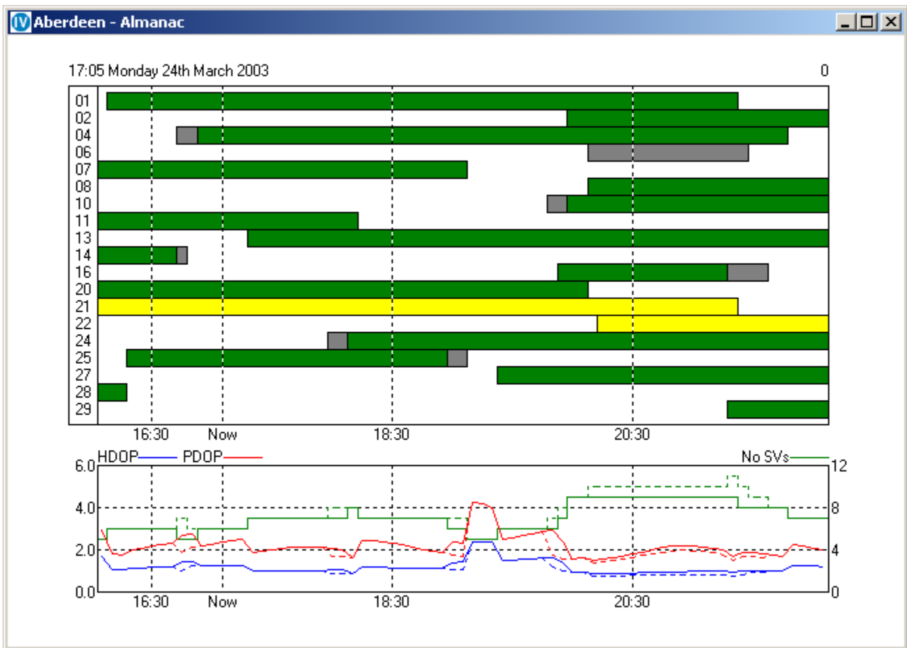
"View" \ "GPS" \ "Almanac"



A right-mouse click on the window provides the "Copy" and "Save As…" facilities as various other options.



The almanac view can show the "Average Position", which is the average of all the current calculations, or the "Trial Point", (mostly used during times when the program is offline or for planning purposes). This does not affect the view when the top item in the menu is selected, in this example MS750. This is the GPS receiver and when checked indicates the almanac is referring to the current average position. When one of the reference stations is selected extra information becomes available on the plot as shown below.



The top section of the Almanac window is a bar graph display of the availability of satellites over the previous 2 hours and the next 4 hours. This can be changed to a 24 hour view using the right click menu. The 24 hour view shows the current day, from midnight to midnight UTC.

- The green bars represent healthy satellites above the elevation mask.
- If an SV is disabled in the “Action” \ “SV Status” dialogue than the bar for that SV will appear red.
- The grey areas indicate the SV is above the 10° elevation mask at the reference station but not at the “average position” or the “trial point”. (Note that the minimum elevation mask is set in the “Config” \ “Calc” \ “Settings” dialogue, (see Section 4.3.3.4.1 on Page 63). By default this is 10º but can be changed resulting in the SV availability shown in the Almanac window altering.)
- The yellow bars represent unhealthy SV’s.

The lower section shows the Number of SV’s, PDOP and HDOP on a line graph over the time period specified.

- The number of satellites available for the selected position calculation is shown as a solid green line.
- The number of satellites visible at both the reference station(s) and the selected position is a green dashed line (where applicable).
- PDOP at the selected position as a red dashed line.
- PDOP based on the common satellites above the masks as a red solid line
- HDOP at the selected position is shown as a blue dashed line
- HDOP based on the common satellites above the masks as a blue solid line

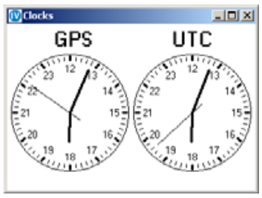
If “Network” is selected the Almanac window is based on the current “average position” or the “trial point” and will show a green availability bar if there is at least one of the reference stations that has a common satellite. If the bar is grey then the satellite is available at the “Average” position or “Trial Point” position but not at any of the reference stations.

It is worth noting that MultiFix 4 uses “Elevation Delta” for rising and setting satellites. “Elevation Delta” is a variable weighting of the satellite data in the position solution. The minimum elevation when a satellite starts to be used and the number of degrees above the minimum at which the satellite attains full weighting are set in the “Config” \ “Calc” \ “Settings” dialogue referred to above.

4.3.6.4.8.Clock

"View" \ "GPS" \ "Clock"

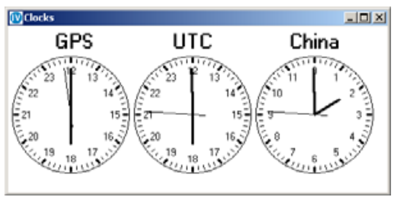
As can be seen, GPS Time was 13 seconds ahead of UTC Time when this screen dump was taken.



It is possible to include extra clocks in this display by right clicking in the window and selecting "Add Local…".

Enter a name for the clock and the time offset, in the format (hh:mm:ss), then click **[OK]**.

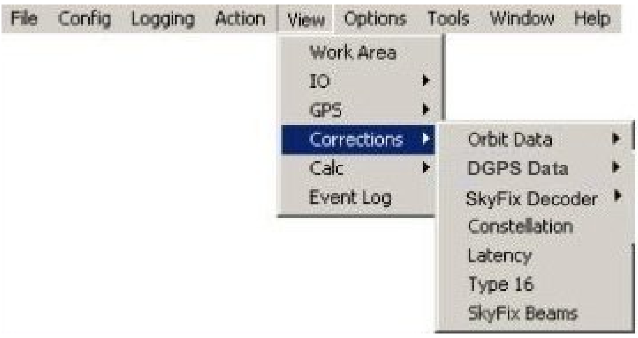
These can be used to provide a local time offset from UTC for the work area.



Right clicking on the window now provides extra options to "Edit", "Delete", or "Hide" the additional clock(s).

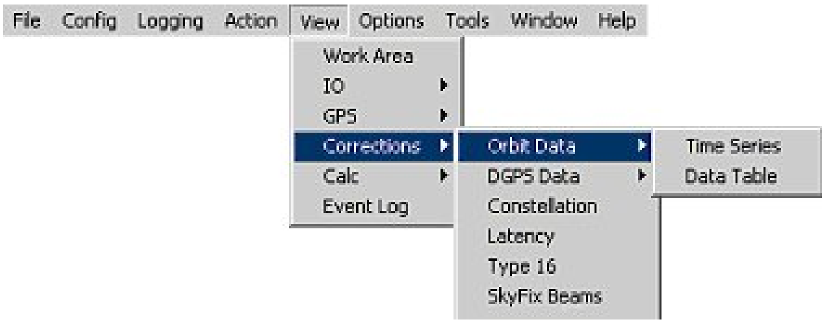
4.3.6.5. Corrections

"View" \ "Corrections"



4.3.6.5.1.Orbit Data

"View" \ "Corrections" \ "Orbit Data"



This menu is available when SkyFix-XP Mode is selected in "Config" \ "Calc" \ "Settings…"

4.3.6.5.1.1.Time Series

"View" \ "Corrections" \ "Orbit Data" \ Time Series"

This shows the received position and clock offsets for the selected satellites in four dimensions.

The red line is X, green is Y, blue is Z, and grey is Time.

To show the plot for a specific satellite, click the corresponding number on the number pad on the right hand side of the window. If more than one number is selected then the relevant graphs are added below the initial one.

Coloured crosses on the number pad indicate the status of the satellites as described below:

Yellow – The satellite is unhealthy. No plot is available.

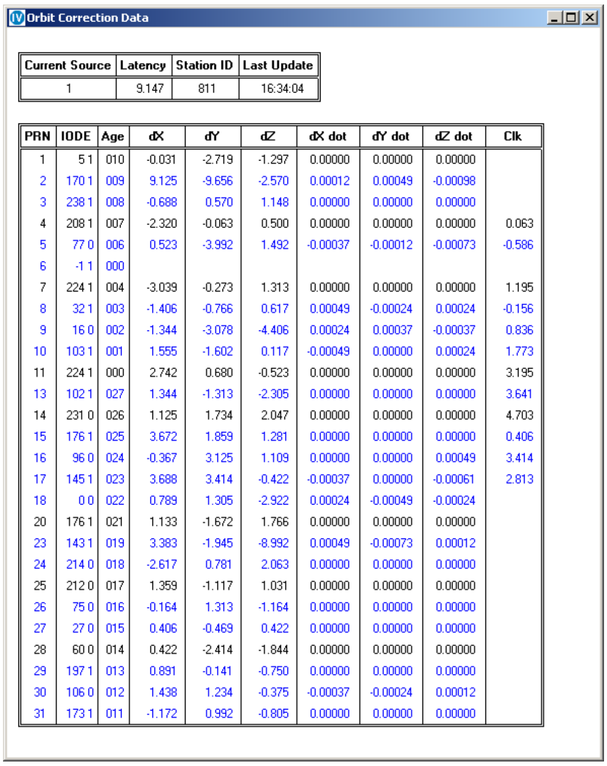
Light Blue (Aqua) – The satellite data is missing

Red – The satellite had been disabled by the user via the “Action” \ “SV Status” dialogue.

The pink vertical line in the example above represents an IODE change with the values shifting after this event reflecting the new information received.

4.3.6.5.1.2. Data Table

“View” \ “Corrections” \ “Orbit Data” \ Data Table”



Orbit Correction Data

Current Source	Latency	Station ID	Last Update
1	9.147	811	16:34:04

PRN	IODE	Age	dX	dY	dZ	dX dot	dY dot	dZ dot	Clk
1	5 1	010	-0.031	-2.719	-1.297	0.00000	0.00000	0.00000	
2	170 1	009	9.125	-9.656	-2.570	0.00012	0.00049	-0.00098	
3	238 1	008	-0.688	0.570	1.148	0.00000	0.00000	0.00000	
4	208 1	007	-2.320	-0.063	0.500	0.00000	0.00000	0.00000	0.063
5	77 0	006	0.523	-3.992	1.492	-0.00037	-0.00012	-0.00073	-0.586
6	-1 1	000							
7	224 1	004	-3.039	-0.273	1.313	0.00000	0.00000	0.00000	1.195
8	32 1	003	-1.406	-0.766	0.617	0.00049	-0.00024	0.00024	-0.156
9	16 0	002	-1.344	-3.078	-4.406	0.00024	0.00037	-0.00037	0.836
10	103 1	001	1.555	-1.602	0.117	-0.00049	0.00000	0.00024	1.773
11	224 1	000	2.742	0.680	-0.523	0.00000	0.00000	0.00000	3.195
13	102 1	027	1.344	-1.313	-2.305	0.00000	0.00000	0.00000	3.641
14	231 0	026	1.125	1.734	2.047	0.00000	0.00000	0.00000	4.703
15	176 1	025	3.672	1.859	1.281	0.00000	0.00000	0.00000	0.406
16	96 0	024	-0.367	3.125	1.109	0.00000	0.00000	0.00049	3.414
17	145 1	023	3.688	3.414	-0.422	-0.00037	0.00000	-0.00061	2.813
18	0 0	022	0.789	1.305	-2.922	0.00024	-0.00049	-0.00024	
20	176 1	021	1.133	-1.672	1.766	0.00000	0.00000	0.00000	
23	143 1	019	3.383	-1.945	-8.992	0.00049	-0.00073	0.00012	
24	214 0	018	-2.617	0.781	2.063	0.00000	0.00000	0.00000	
25	212 0	017	1.359	-1.117	1.031	0.00000	0.00000	0.00000	
26	75 0	016	-0.164	1.313	-1.164	0.00000	0.00000	0.00000	
27	27 0	015	0.406	-0.469	0.422	0.00000	0.00000	0.00000	
28	60 0	014	0.422	-2.414	-1.844	0.00000	0.00000	0.00000	
29	197 1	013	0.891	-0.141	-0.750	0.00000	0.00000	0.00000	
30	106 0	012	1.438	1.234	-0.375	-0.00037	-0.00024	0.00012	
31	173 1	011	-1.172	0.992	-0.805	0.00000	0.00000	0.00000	

The upper table of the “Orbit Correction Data” window shows:

“Current Source” – indicates whether System 0 or System 1 at the NCC is supplying the current SkyFix-XP corrections.

“Latency” – Total elapsed time from the time of reference station measurement to when the user applies the correction (Calculation Time + Communication Delay).

“Station ID” - which is the Beam ID for the SkyFix-XP corrections received.

“Last Update” - which is the GPS time of the last message received.

The lower table shows:

“PRN” - satellite number,

“IODE” - which is the Issue Of Data Ephemeris followed by a single bit IODE change flag (This toggles between 0 and 1 upon receipt of IODE).

“Age” - which is the elapsed time from the time corrections were last updated for a PRN.

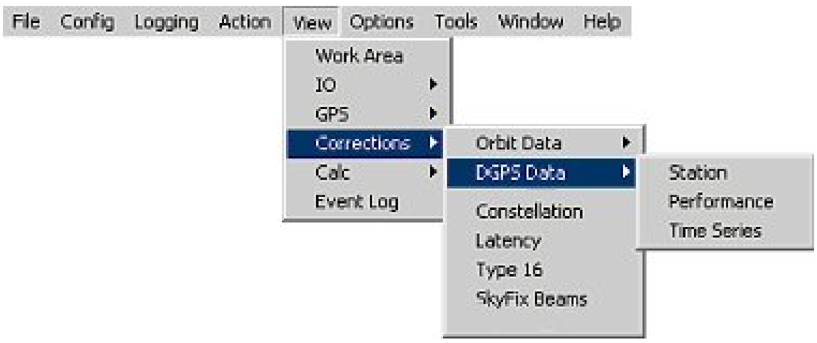
“dX”, “dY”, and “dZ” - which are the current absolute orbit corrections, (the three absolute corrections per message give the position correction of the satellite in the three axes of Euclidean space, relative to the broadcast ephemeris)

“dX dot”, “dY dot”, and “dZ dot” - which are the current orbit rate corrections (orbit rate corrections are used to predict the position of a given satellite during the period between its absolute orbit corrections).

“Clk” - which is the current clock correction (metre-level + sub-metre level corrections).

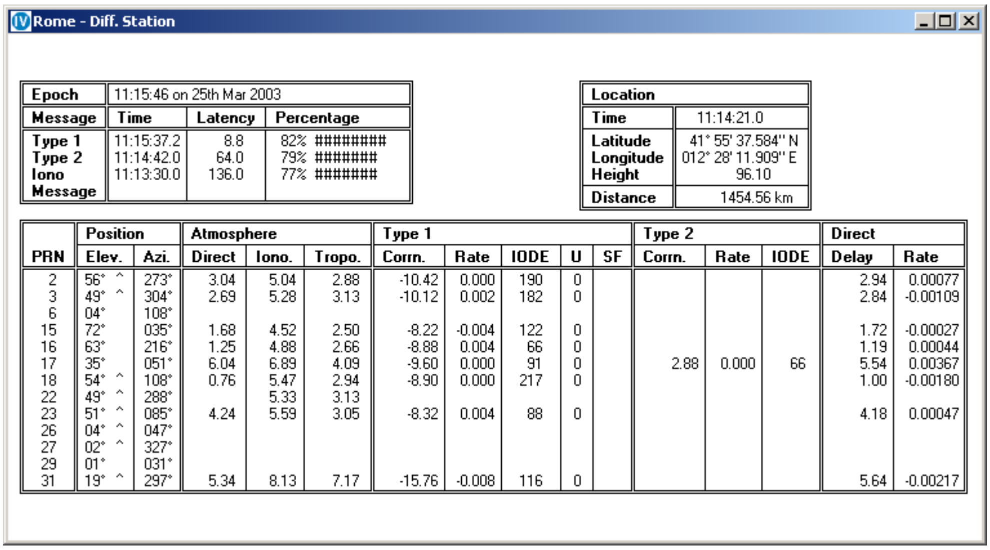
4.3.6.5.2.DGPS Data

“View” \ “Corrections” \ “DGPS Data”



4.3.6.5.2.1.Station

“View” \ “Corrections” \ “DGPS Data” \ “Station”



Epoch	11:15:46 on 25th Mar 2003		
Message	Time	Latency	Percentage
Type 1	11:15:37.2	8.8	82% ########
Type 2	11:14:42.0	64.0	79% #######
Iono	11:13:30.0	136.0	77% #######
Message			

Location	
Time	11:14:21.0
Latitude	41° 55' 37.584'' N
Longitude	012° 28' 11.909'' E
Height	96.10
Distance	1454.56 km

	Position		Atmosphere			Type 1					Type 2			Direct	
PRN	Elev.	Azi.	Direct	Iono.	Tropo.	Corrn.	Rate	IODE	U	SF	Corrn.	Rate	IODE	Delay	Rate
2	56° ^	273°	3.04	5.04	2.88	-10.42	0.000	190	0					2.94	0.00077
3	49° ^	304°	2.69	5.28	3.13	-10.12	0.002	182	0					2.84	-0.00109
6	04°	108°													
15	72°	035°	1.68	4.52	2.50	-8.22	-0.004	122	0					1.72	-0.00027
16	63°	216°	1.25	4.88	2.66	-8.88	0.004	66	0					1.19	0.00044
17	35°	051°	6.04	6.89	4.09	-9.60	0.000	91	0		2.88	0.000	66	5.54	0.00367
18	54° ^	108°	0.76	5.47	2.94	-8.90	0.000	217	0					1.00	-0.00180
22	49° ^	288°		5.33	3.13										
23	51° ^	085°	4.24	5.59	3.05	-8.32	0.004	88	0					4.18	0.00047
26	04° ^	047°													
27	02° ^	327°													
29	01°	031°													
31	19° ^	297°	5.34	8.13	7.17	-15.76	-0.008	116	0					5.64	-0.00217

The window initially opens showing the first RTCM reference station. To have the window show data for another station, right click on the window and select the station.

The top left table shows the time tag of the latest messages, the age of the corrections and the percentage.

For Type 1 messages a percentage of 30 seconds.

For Type 2 messages a percentage of 300 seconds.

For Iono (Type 55 or Type 15) messages a percentage of 600 seconds.

Message (Type 16) a percentage of 600 seconds. When received the message will be displayed at the top of the window and will remain for 10 minutes unless overwritten.

The Location shows the station position as received in the Type 3 message.

The lower table has various sub-sections.

“PRN” is the satellite number.

“Position” shows the satellites’ positions and if they are rising the elevation is tagged with a ^.

“Atmosphere” has: -

“Direct” is the ionospheric delay derived for the present moment from the dual frequency information. (It will not be present if a single frequency reference station is selected).

"Iono" is the ionospheric delay for time now from the Klobachar model

Tropo is the tropospheric delay for time now from the tropospheric model.

"Type 1" has: -

"Corrn.", which is the current pseudo-range correction

"Rate", which is the rate of change of the pseudo-range correction

"IODE", which is the Issue of Data Ephemeris

"U", which is the User Differential Range Error, (normally 0)

"SF" is flagged when the Correction Rate is greater then ±0.256 or when the correction is >±660.

The "Type 2" table will usually only be seen during an Ephemeris change (every 2 hours), when the mobile's GPS receiver is using a different Issue of Ephemeris to the reference station being viewed.

"Corrn", which is the correction to the correction based on the difference in IODE.

"Rate", which is the rate of change of the correction.

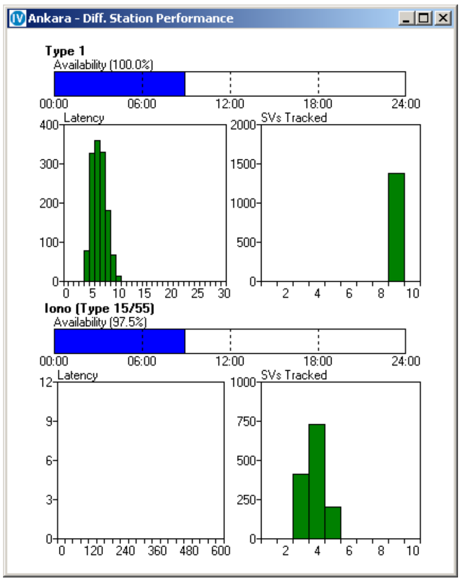
"IODE", which is the Issue of Data Ephemeris number.

"Direct" contains the Ionospheric delay values and rates as transmitted in the Type 15 or 55 messages. (Without Type 15/55 information the section will be omitted).

4.3.6.5.2.2.Performance

"View" \ "Corrections" \ "DGPS Data" \ "Performance"

This window refers to a particular reference station.



When first opened it defaults to the first reference station in the list. To change to another station use a right-mouse click and select a different station in the "Station" dropdown list.

A right-mouse click also shows that the view window can be copied and saved.

The RTCM Performance window has two sections. The top is for Type 1 RTCM correction messages. The bottom for Type 15/55 Ionospheric Delay correction messages. If the reference station has not got the capability to transmit Type 15 or 55 messages then that part of the window remains blank.

The “Availability” bar at the top refers to the current day, midnight to midnight.

- A grey area indicates a period when the program was not running.
- A red area indicates when there had been no corrections received from the station for more than 50 seconds.
- A white area indicates either corrections were present or that time of day has not yet been reached.

The “Latency” histogram shows how old the corrections from the station were at each epoch, so if corrections that were 2 seconds old on receipt were received regularly every 6 seconds the histogram would show a spread from 2 to 8 seconds.

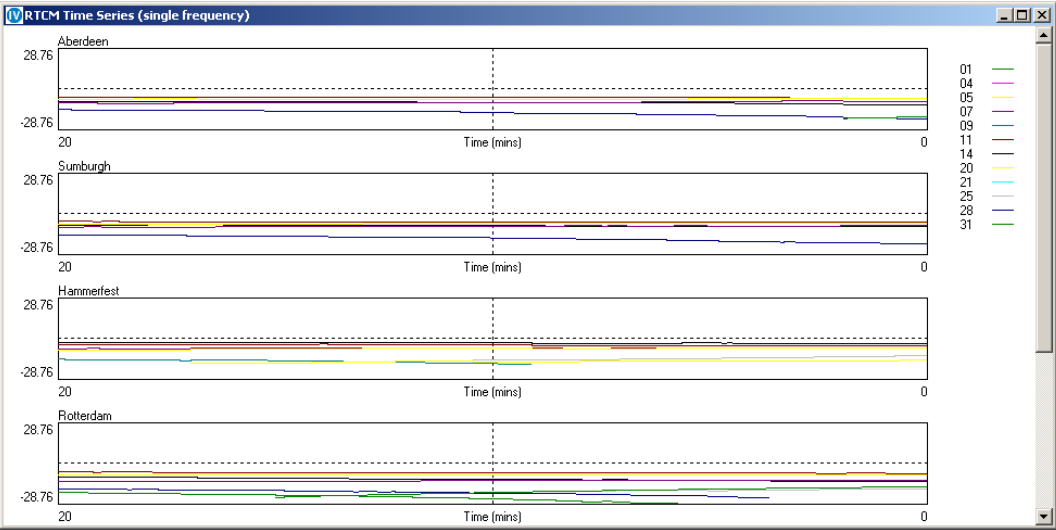
The “SV’s Tracked” histogram shows the spread in the numbers of SV’s tracked each epoch.

The “Iono Type 15/55” tables at the bottom show the same information as above for those message types. The permitted Type 15/55 messages are not considered stale until 600 seconds has elapsed rather than the 50 seconds for the Type 1 messages.

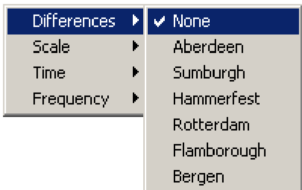
4.3.6.5.2.3.Time Series

"View" \ "Corrections" \ "DGPS Data" \ "Time Series"

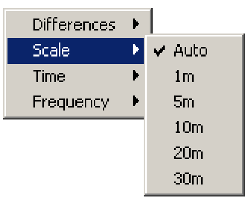
This window shows the pseudo-range differences between satellites computed positions for all selected reference stations. By clicking the mouse button on a satellite number in the key then the display changes to show only that satellite. The Y axis on the plot is metres.



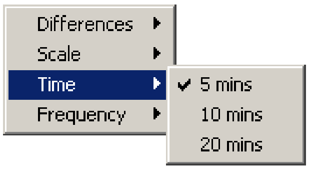
Right clicking on this window gives various options. Selecting a station in "Differences" will then difference all data to that station. This indicates how closely the positions for each satellite match at the selected reference stations.



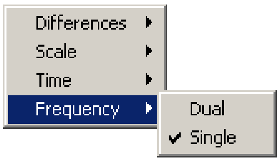
Selecting "Scale" will give the option to change the Y-Axis automatically or show it at 1, 5, 10, 20, or 30 metres.



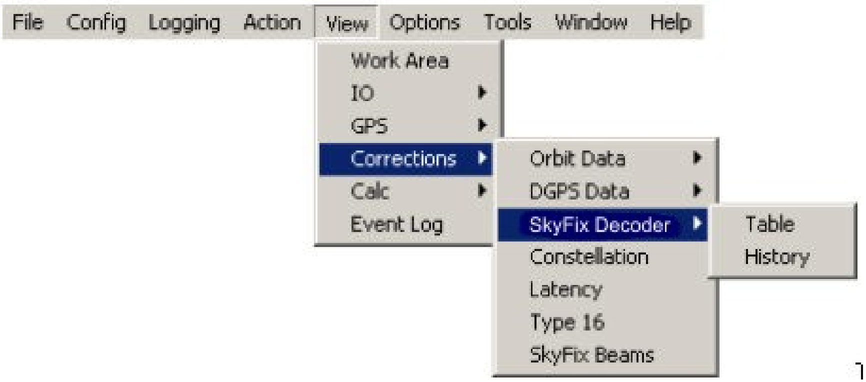
Selecting “Time” will rescale the X-axis to show 5, 10 or 20 mins.



Selecting “Frequency” \ “Dual” allows dual frequency data to be shown for reference stations set up as a Premier calculation.



4.3.6.5.3.SkyFix Decoder

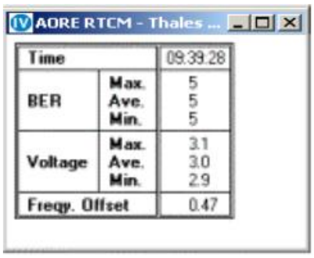


Assuming the SkyFix Decoder option has been enabled and given an IO channel, see Section 4.3.3.3.1 on page 60, the output from the decoder can be viewed.

The decoder can output “TEST” data on port 4 only. The interval between updates occurs every 1000 data blocks received and is proportional to the satellite channel data rate.
This update rate may be between 2.5 and 6 minutes.

4.3.6.5.3.1. Table

"View" \ "Corrections" \ "SkyFix Decoder"\"Table"



The table display presents the last data set received.

The BER or Bit Error Rate is typically between 5 and 7.

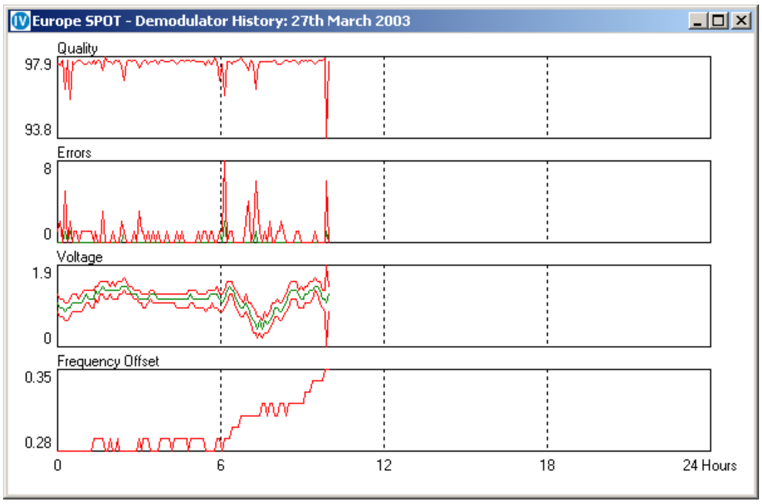
The Voltage is the signal strength voltage, <1 volt indicates poor signal level and >2 volts indicates good signal level. A large difference between min mean and max would indicate inconsistent tracking or interference.

The Frequency Offset should be in the range ±2.50 kHz.

4.3.6.5.3.2. History

"View" \ "Corrections" \ "Fugro Decoder" \ "History"

The history display presents a time series plot for the current 24 hour period. Each point represents a summary for the past 1000 data blocks i.e. each message received. Note that the plot will reset at midnight UTC.



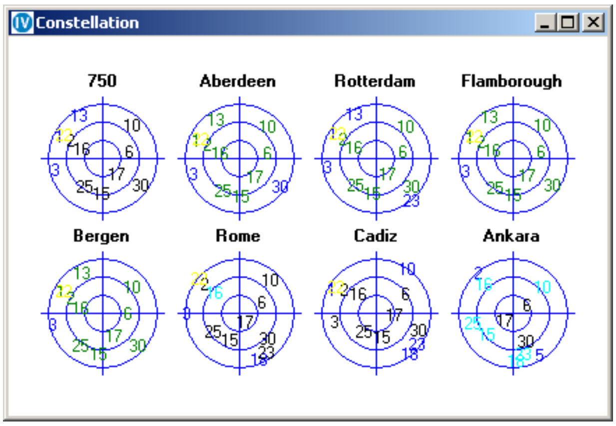
The plots displayed are as follows:

- **Quality** - The percentage of error free messages received
- **Errors -** There are two lines on this graph, the green relates block synchronisation losses and the red relates to the number of encoded block errors.
- **Voltage -** There are three lines, minimum and maximum (both red), and mean (green)

- **Frequency Offset -** The tuning frequency offset for the demodulator.

4.3.6.5.3.3.Constellation

"View" \ "Corrections" \ "Constellation"



The Constellation window shows the position of the satellites as seen at the GPS receiver and at each of the reference stations.

The outer ring of each Bullseye refers to 0° elevation and the centre is the zenith. The bottom centre of the SV numbers text is the current position, as shown below:

The satellite numbers are colour coded.

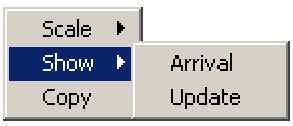
- **Black** - indicates L1 and L2 corrections are available for use in a calculation.
- **Green** - indicates L1 data only is available for use.
- **Light Blue** - indicates a satellite is expected but no corrections for that satellite have yet been acquired.
- **Dark Blue** - indicates the SV is below the elevation cut off.
- **Red** - indicates a satellite has been disabled in the SV Status dialogue.
- **Yellow** - indicates an unhealthy SV.

When the window is resized by click and dragging a corner, the program rearranges the constellation displays to best fit the available area.

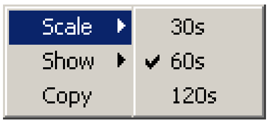
4.3.6.5.4.Latency

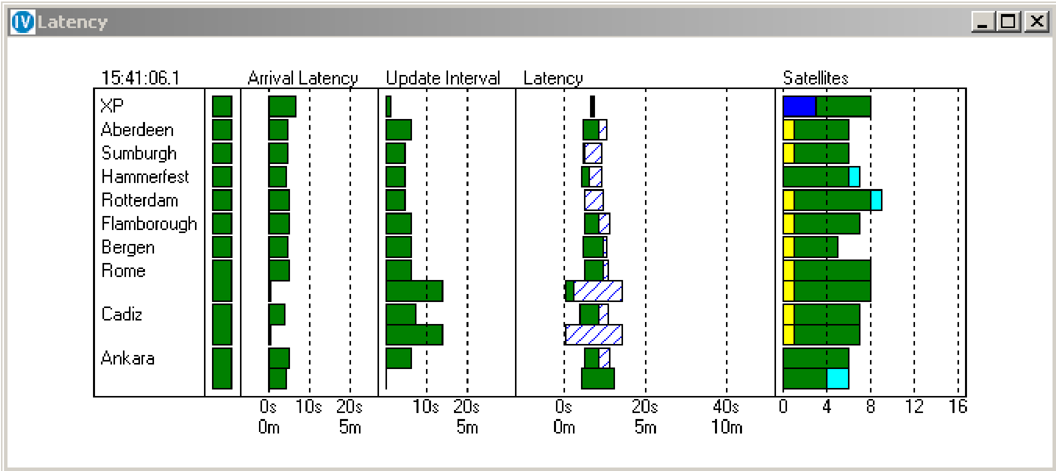
"View" \ "Corrections" \ "Latency"

By default this Window does not show the two columns "Arrival Latency" and "Update Interval" but a right-mouse click allows them to be added.



The right-mouse click also allows the time scale of the Latency columns to be changed and it allows the window to be copied to the clipboard.





The example above has two rows of information for each dual frequency reference station. The first row refers to Type 1 messages and the second row refers to Type 15 or 55 messages where applicable. These will only appear once messages have been received. The Type 1 rows and Type 15/55 rows have different time scales as can be seen at the bottom of the Latency columns.

The first column after the name of the station will show a green button when the program has received an RTCM Type 3 Reference Station position message. This only has to happen once after starting the program. The program will not use RTCM corrections from a reference station without a Type 3 message having been received.

The "Latency" column shows the correction update rate as a bar. The left-hand edge of the bar shows how old the current correction was when first received by MultiFix 4. It is a measure of the efficiency of the correction delivery system. (The corrections are time stamped with GPS time by the reference station, and as MultiFix 4 also has access to GPS time the age of the corrections at the time of receipt is known). The right-hand side of the bar advances until a new correction is received showing the age of the current correction. The bar also shows a hatched area showing the update rate of the last correction received.

For Type 1 messages:

- Bars will be green if the last correction was received in less than 25 seconds.
- They will be yellow between 25 and 37½ Seconds.
- They will be red if older than 37½ seconds. After 50 seconds the corrections from that reference station will no longer be deemed usable.

For Type 15/55 messages:

- The bars will be green if the last correction was received in less than 5 minutes.
- They will be yellow if received between 5 minutes and 7½ minutes.
- They will be red if older than 7½ minutes. Type 55 information is considered stale if it is more than 10 minutes old.

The “Latency” panel has a negative area. Some GPS correction systems (not SkyFix) try to predict corrections for a point of time in the future when a correction is to be used. If a fast data transfer system is used the corrections can arrive with a time stamp earlier than current time, in which case the bar will start in the negative portion of the panel.

The optional “Arrival Latency“ and “Update Interval” panels contain data extracted from the “Latency” panel.
In “Arrival Latency” the right-hand end of the bar shows how old the current corrections were when received by MultiFix 4.
In “Update Latency” the bar shows how long elapsed between the receipt of the current and previous correction messages.

The “Satellites” column shows how many satellites (viable for use by MultiFix) can be seen at each reference station.
The colour coding is: -

- **Green** - correction data has been received for the expected satellite(s).
- **Yellow** - the satellite(s) are unhealthy.
- **Dark blue** – the satellite(s) is in the high scale factor mode, i.e. the resolution is 32cms as opposed to 2cms. This is usually caused by a rate value greater than ±0.256m/sec.
- **Light blue (Aqua)** - no corrections have been received for one or more expected satellites, i.e. it is missing.
- **Red** - the satellite(s) has been disabled by the user in the SV Status dialogue.

In XP mode the following applies:

The whole bar indicates the total number of satellites in view at the GPS receiver.

- **Green** – Number of satellites with valid clock correction update received.
- **Dark Blue -** Number of satellites with no current clock correction update.

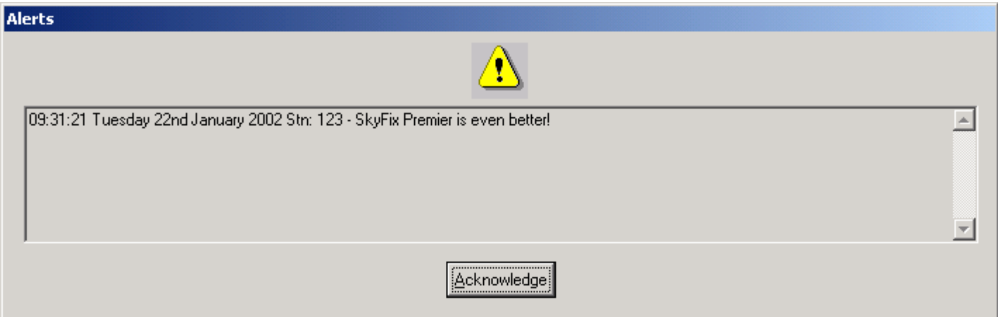
It is normal for this figure to vary as the corrections arrive in batches that include corrections for some SV's not currently visible. The received corrections are shown in "View" \ "Corrections" \ "Orbit Data" \ "Data Table" as black numbers in the "Clk" column (See Section 4.3.6.5.1.2).

4.3.6.5.5. Type 16

"View" \ "Corrections" \ "Type 16"

RTCM Type 16 messages are free text messages sent over the data link as part of the RTCM message. The SkyFix Network Control Centres (NCC's) send out messages to warn users of planned maintenance at stations or of known outages using the Type 16 facility.

When a Type 16 message is received an acknowledgment box will appear containing the text message. This can be closed by clicking the acknowledge button.



The alert box function can be disabled under "options" / "Type 16 Alert" See section 4.3.7.6 on page 144.

The Recent Type 16s window allows the user to review all messages received in the past 24 hours.

In addition, all received Type 16 messages are stored in a text file with a file name consisting of the configuration name and the days date (yyyymmdd), as below:

Configuration name_date_type16.txt

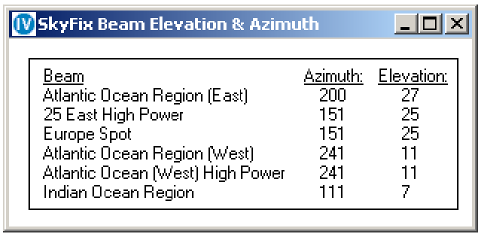
A new file will be generated every day at midnight UTC.

The files will be stored in the same directory as the current configuration.

4.3.6.5.6. SkyFix Beams

"View" \ "Corrections" \ "SkyFix Beams"

This calls up the "SkyFix Beams Elevation and Azimuth" display. This window includes the elevation and azimuth to each of the currently visible SkyFix satellites, based on the users current location.



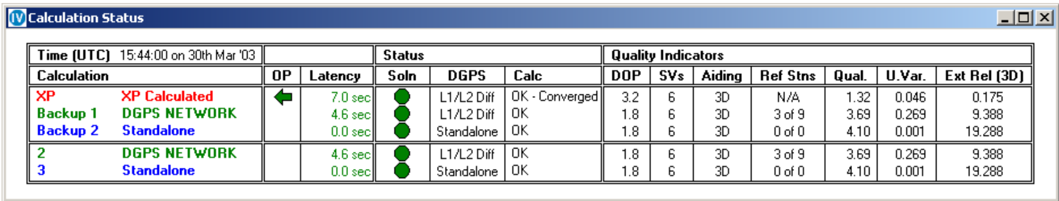
4.3.6.6. Calculations

"View" \ "Calc"

4.3.6.6.1. Status

"View" \ "Calc" \ "Status"

The Calculations Status window shows the status of the calculations.



In the "Calculation" section the solutions currently set up are displayed. If SkyFix-XP mode is selected in "Config" \ "Calc" \ "Settings", and a primary (and secondary if applicable) back-up source has been selected, then these will appear in the top box. All other solutions will be shown in the lower box.

In XP mode an "OP" (Output) column is also shown which displays, in the form of a green arrow, which solution is currently being used as the XP solution. In the situation above the "XP Calculated" position was being output. The transition between solutions is restricted to 1cm per epoch to prevent any jump in the output position, during this period the arrow is yellow.

The "Latency" column displays the update rate of the corrections for each solution.

The "Status" section contains three columns. "Soln" indicates the status of the solution by using an easily visible 'traffic light' system.

- **Green** – The solution is good.

- **Yellow** – The latency is too high (>25 seconds and <37.5 seconds) [If in SkyFix-XP mode then it can also be yellow if the solution is still converging]
- **Red** - Latency is >37.5 seconds.

The “DGPS” column states the type of solution:.

- **L1 Diff** – Single frequency RTCM corrections received
- **L1/L2 Diff** – Dual frequency RTCM corrections received
- **Standalone** – No RTCM corrections received

The “Calc” column can contain the following:

- **OK** – Position solution is good.
- **No Ephem** – No ephemeris data received.
- **Too Few Meas** – Enough SV’s in view but some expected measurements are missing. (Standalone and DGPS need a minimum of 4 SV’s, XP requires a minimum of 5).
- **Too Few SVs** – Not enough SV’s in view.
- **Too Few Ephem** - Enough measurements but not enough ephemeris data
- **No Diff** - No differential corrections received for a calculation requiring corrections. This will appear after receiving no corrections for more than 50 seconds.
- **Diff Too Old** - Differential Corrections are more than 30 seconds old.
- **Too Few Diff** - Not enough differential corrections to correct the calculation
- **Singular** - Can be seen when experiencing very bad satellite constellation, i.e. all in a narrow arc, or when reference station is geometry poor.
- **Divergent** - The least squares solution of the position is moving more than 1 millimetre after ten iterations.
- **Not Required** – No GPS data received.

If in SkyFix-XP mode then the following messages can also appear:

- **OK – Converging** – XP corrections are being received and the solution is converging.
- **OK – Converged** – XP solution has converged below the level specified in “Config” \ “Calc” \ “SkyFix-XP…”

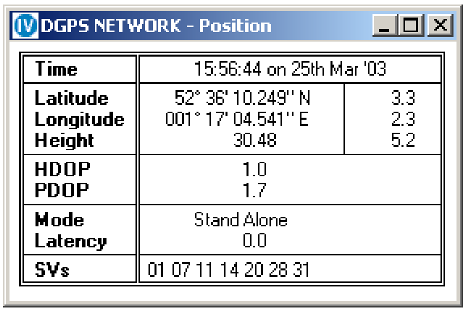
The “Quality Indicators” section shows various statistical values on the performance of the corresponding solutions.

- **DOP** - If there is no height aiding in the calculation it contains the PDOP, if height aided then it will contain the HDOP.
- **SVs** – The number of viable satellites
- **Aiding** – The method of height aiding employed by the solution. “3D” indicates no height aiding, “H+” indicates height aiding is being used
- **Ref Stns** – The number of reference station currently used out of the ones selected.
- **Qual.** - is the 3D a priori 50% radial error.
- **U. Var.** - is the unit variance. If the size of calculation’s residuals are as expected the Unit Variance will be 1.
- **Ext Rel**. – is the largest 2D error present, possibly resulting from an undetected outlier existing in the calculation.

4.3.6.6.2.Positions

"View" \ "Calc" \ "Position"

Displays the result of an active computation. When a new position window is opened it will default to show the first calculation. To select a different calculation, right click on the window to call up the calculation list where an alternative can be selected.



The column beside Latitude, Longitude and Height shows the 95% confidence level. The Height is with respect to the Geoid using the EGM96 model to determine the Geoid / Spheroid separation. Note that if the user has disabled the EGM96 model and entered their own value in the "Config" \ "Calc" \ Settings…" then this figure will be based on the entered value and not the EGM96 Model.

"Mode" can state whether the solution is "XP", "Differential" or "Stand Alone".

"Latency" is the age of the most recent Type 1 (Type 48, 49, or 50 for SkyFix-XP) message. If the calculation is a multiple reference station solution there may be older corrections used in the solution.

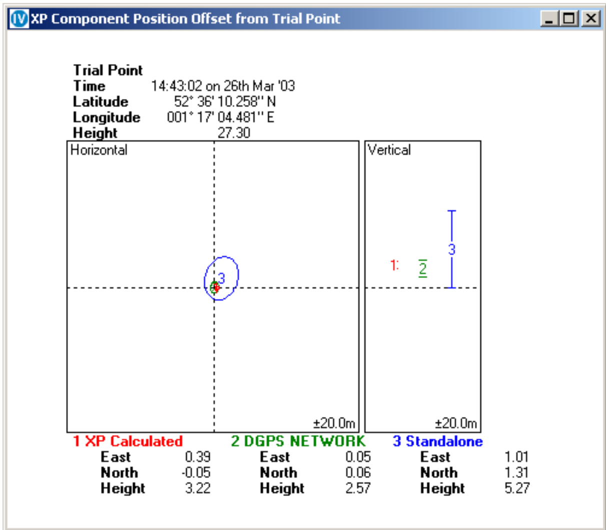
"SVs" are a list of the satellites used in the calculation.

Beware that if the computation fails the window will freeze showing the status at the last update, it will not turn red or clear the information.

4.3.6.6.3.XP Offsets

"View" \ "Calc" \ "XP Offsets"

This option becomes available once in SkyFix-XP mode. This window is essentially the same as the "View" \ "Calc" \ "Offsets" (See section 4.3.6.6.4) with the addition of a "Vertical" window showing height variations in the calculations as vertical bars. The vertical line for each calculation indicates the 2 x Standard Deviation (95%) either side.

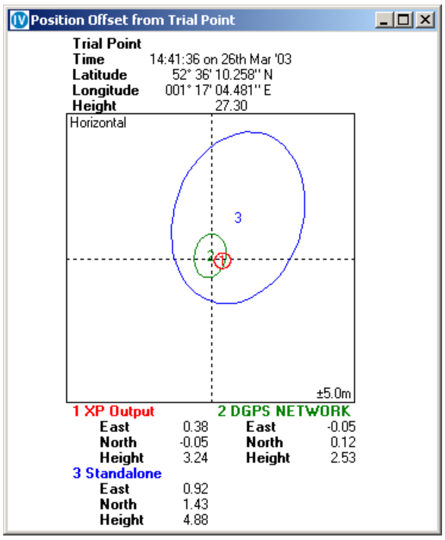


All other options are identical to the "View" \ "Calc" \ "Offsets" window.

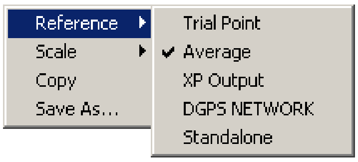
4.3.6.6.4. Offsets

"View" \ "Calc" \ "Offsets"

This window shows the delta East, North and Height and the error ellipse. The error ellipse is at the 95% confidence level.



As well as being copied and saved, the window has other options that are available by clicking the right-mouse button.

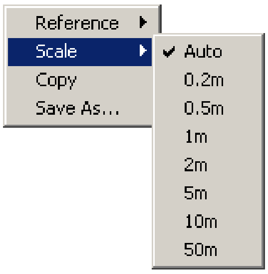


The first concerns the Origin to which the data is referenced point. It can be the Average of all the calculations, a static point, or any available computation.

The Average Latitude, Longitude and Height figure is not a mean but a weighted average. The Height is with respect to the Geoid.

The Trial Point is a static point as entered under "Config" \ "Calc" \ "Settings…". If this is changed while a window referenced to the trial point is open the origin of the display will move.

The data can also be referenced to any one of the available calculations.



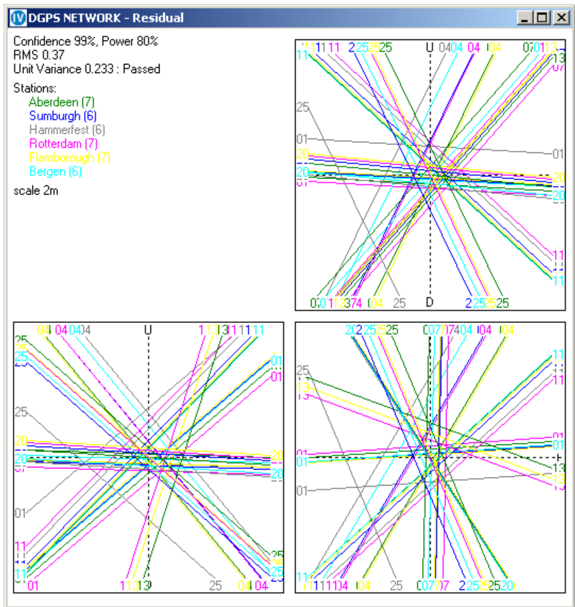
The scale of the display can be set to be 0.2, 0.5, 1, 2, 5, 10, or 50 metres from the centre to each edge. Alternatively it can be set to "Auto" in which case it will re-scale as required to show all the calculated positions and the error ellipses around those positions.

The information below the display shows the distance of each computation away from the origin.

4.3.6.6.5.Residuals

"View" \ "Calc" \ "Residuals"

This screen shows the Lines Of Precision (LOP) of the satellite ranges used in the position calculation. Each source of data is represented in a different colour. SV numbers are shown on each LOP in the appropriate colour for each reference station. The actual calculated position is at the intersection of the dashed lines in the centre of each view.



The graphs represent three sections through the calculated position.

The bottom right panel is a North Up Plan Display

The top right panel is a vertical section viewed from the South.

The bottom left panel is a vertical section viewed from the East.

The scale (shown under the "stations" list) changes automatically according to the spread of the LOP's.

If more than one position calculation has been defined (see section 4.3.3.4.3 on page 67) it is possible to switch between them by right-mouse clicking and then selecting the desired calculation.

Solution QC information is also provided. The values are derived from statistical tests and give an indication of how well the solution has been formed using the measurements available.

Confidence and Power are parameters used to define different tests of reliability as recommended by UKOOA. The Confidence value provides a number (3 standard deviations from the mean) with which the W-Test may be performed. The W-Test, combined with the Power, enables the program to calculate the Marginally Detectable error (MDE). This value may then be used to calculate the reliability of the measurement.

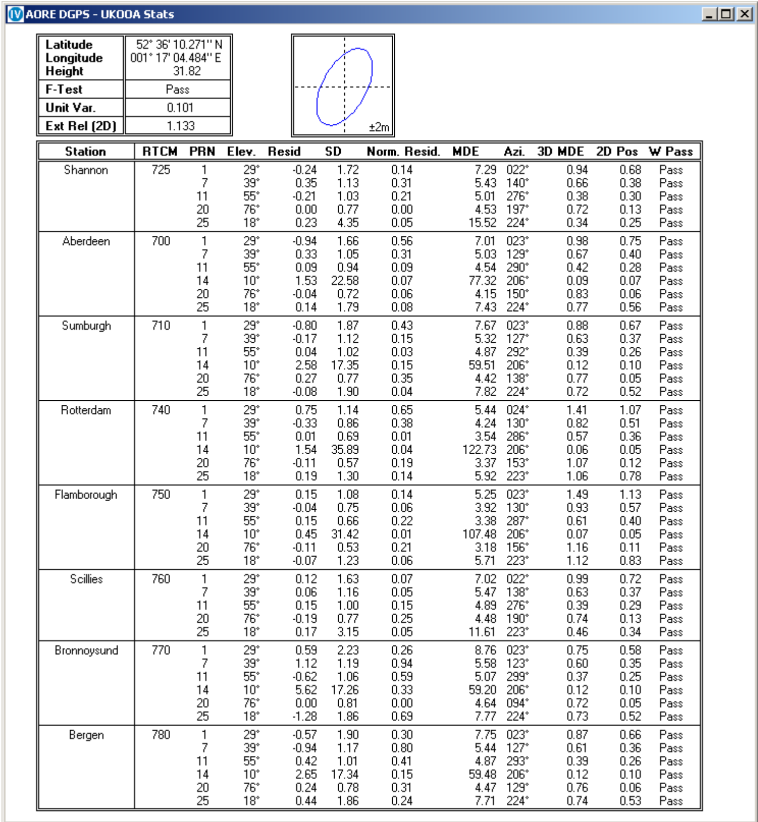
Unit Variance reflects the level of error between the actual and modelled values. **It is independent of quality** providing an indication of the reasonable performance of the program. As such there are no set ‘Pass’ or ‘Fail’ values for unit variance. The program takes into consideration parameters such as satellite geometry and amount of data used in order to derive a value. A “Fail” may result from large outliers in the measurements. These are easily identifiable from the section graphs.

RMS is the root mean square of the residuals.

The number in brackets next to the RTCM station name is the number of satellites that are common to both the current position and the reference station.

4.3.6.6.6.UKOAA Stats

“View” \ “Calc” \ “UKOOA Stats”



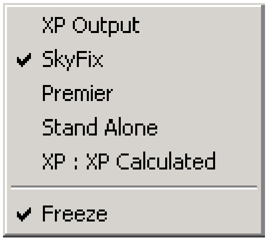
Latitude Longitude Height	52° 36' 10.271'' N 001° 17' 04.484'' E 31.82
F-Test	Pass
Unit Var.	0.101
Ext Rel (2D)	1.133

Station	RTCM	PRN	Elev.	Resid	SD	Norm. Resid.	MDE	Azi.	3D MDE	2D Pos	W Pass
Shannon	725	1	29°	-0.24	1.72	0.14	7.29	022°	0.94	0.68	Pass
		7	39°	0.35	1.13	0.31	5.43	140°	0.66	0.38	Pass
		11	55°	-0.21	1.03	0.21	5.01	276°	0.38	0.30	Pass
		20	76°	0.00	0.77	0.00	4.53	197°	0.72	0.13	Pass
		25	18°	0.23	4.35	0.05	15.52	224°	0.34	0.25	Pass
Aberdeen	700	1	29°	-0.94	1.66	0.56	7.01	023°	0.98	0.75	Pass
		7	39°	0.33	1.05	0.31	5.03	129°	0.67	0.40	Pass
		11	55°	0.09	0.94	0.09	4.54	290°	0.42	0.28	Pass
		14	10°	1.53	22.58	0.07	77.32	206°	0.09	0.07	Pass
		20	76°	-0.04	0.72	0.06	4.15	150°	0.83	0.06	Pass
		25	18°	0.14	1.79	0.08	7.43	224°	0.77	0.56	Pass
Sumburgh	710	1	29°	-0.80	1.87	0.43	7.67	023°	0.88	0.67	Pass
		7	39°	-0.17	1.12	0.15	5.32	127°	0.63	0.37	Pass
		11	55°	0.04	1.02	0.03	4.87	292°	0.39	0.26	Pass
		14	10°	2.58	17.35	0.15	59.51	206°	0.12	0.10	Pass
		20	76°	0.27	0.77	0.35	4.42	138°	0.77	0.05	Pass
		25	18°	-0.08	1.90	0.04	7.82	224°	0.72	0.52	Pass
Rotterdam	740	1	29°	0.75	1.14	0.65	5.44	024°	1.41	1.07	Pass
		7	39°	-0.33	0.86	0.38	4.24	130°	0.82	0.51	Pass
		11	55°	0.01	0.69	0.01	3.54	286°	0.57	0.36	Pass
		14	10°	1.54	35.89	0.04	122.73	206°	0.06	0.05	Pass
		20	76°	-0.11	0.57	0.19	3.37	153°	1.07	0.12	Pass
		25	18°	0.19	1.30	0.14	5.92	223°	1.06	0.78	Pass
Flamborough	750	1	29°	0.15	1.08	0.14	5.25	023°	1.49	1.13	Pass
		7	39°	-0.04	0.75	0.06	3.92	130°	0.93	0.57	Pass
		11	55°	0.15	0.66	0.22	3.38	287°	0.61	0.40	Pass
		14	10°	0.45	31.42	0.01	107.48	206°	0.07	0.05	Pass
		20	76°	-0.11	0.53	0.21	3.18	156°	1.16	0.11	Pass
		25	18°	-0.07	1.23	0.06	5.71	223°	1.12	0.83	Pass
Scillies	760	1	29°	0.12	1.63	0.07	7.02	022°	0.99	0.72	Pass
		7	39°	0.06	1.16	0.05	5.47	138°	0.63	0.37	Pass
		11	55°	0.15	1.00	0.15	4.89	276°	0.39	0.29	Pass
		20	76°	-0.19	0.77	0.25	4.48	190°	0.74	0.13	Pass
		25	18°	0.17	3.15	0.05	11.61	223°	0.46	0.34	Pass
Bronnoysund	770	1	29°	0.59	2.23	0.26	8.76	023°	0.75	0.58	Pass
		7	39°	1.12	1.19	0.94	5.58	123°	0.60	0.35	Pass
		11	55°	-0.62	1.06	0.59	5.07	299°	0.37	0.25	Pass
		14	10°	5.62	17.26	0.33	59.20	206°	0.12	0.10	Pass
		20	76°	0.00	0.81	0.00	4.64	094°	0.72	0.05	Pass
		25	18°	-1.28	1.86	0.69	7.77	224°	0.73	0.52	Pass
Bergen	780	1	29°	-0.57	1.90	0.30	7.75	023°	0.87	0.66	Pass
		7	39°	-0.94	1.17	0.80	5.44	127°	0.61	0.36	Pass
		11	55°	0.42	1.01	0.41	4.87	293°	0.39	0.26	Pass
		14	10°	2.65	17.34	0.15	59.48	206°	0.12	0.10	Pass
		20	76°	0.24	0.78	0.31	4.47	129°	0.76	0.06	Pass
		25	18°	0.44	1.86	0.24	7.71	224°	0.74	0.53	Pass

The UKOOA Stats provide a more rigorous analysis of the computations, and more specifically, the corrections used.

The calculation to be displayed can be selected by right clicking the window.

If “Freeze” is selected the current window display is held and frozen appears in the windows title bar. Clicking “Freeze” again unfreezes the display.



The display is divided into three parts.

The top left contains a summary table of the position and basic QC results.

The top centre contains a graphical plot of current error ellipse.

The bottom of the display contains the main results table including all of the UKOOA test results.

The Summary table includes current position, F-test result, the unit variance and the computed external reliability.

F-Test ....is a test applied to the unit variance. There is no fixed 'Pass' or 'Fail' values for unit variance. The program takes into consideration parameters such as satellite geometry and amount of data used in order to derive a value. A "Fail" may result from large outliers in the measurements.

Unit Variance...................reflects the level of error between the actual and modelled values. It is independent of quality providing an indication of the reasonable performance of the calculation.

External Reliability...........External reliability is assessed by calculating the effect that an undetected outlier (with the Magnitude of the MDE figure) will have on horizontal position. 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.

The Graphical Plot display contains the same error ellipse as is displayed in the "View" \ "Calc" \ "Offset" display.

The Main Table contains a number of details as listed below.

If Height Aiding is enabled the first line will be for Height. The "Residual" displayed is the difference between the entered height and the computed height for the selected calculation. SD for that residual is the value entered by the user under "Config" \ "Calc" \ "Settings…" when height aiding was first set up.

The additional rows are for the corrections for each satellite from each individual station used in the calculation.

Residual........................is the difference between the calculated range, based on the position solution, and the observed range.

SD.................................is the standard deviation for the residual

Normalised Residual ....is the Residual divided by the standard deviation. This forms the basis of the W-test and as such is a more accurate indicator of whether the observation is a potential outlier.

MDE..............................is Marginally Detectable Error. This is the smallest outlier that is likely to be detected by the current solution. This therefore is the internal reliability.

The next four columns represent the external reliability. This is the effect that each potential undetected outlier, as defined by the MDE, may have on the position solution. The three columns represent:

Azimuth.........................is the orientation of any potential error in 2D

3D MDE ....is the effect of the potential error with the size of an MDE on the calculation in 3D

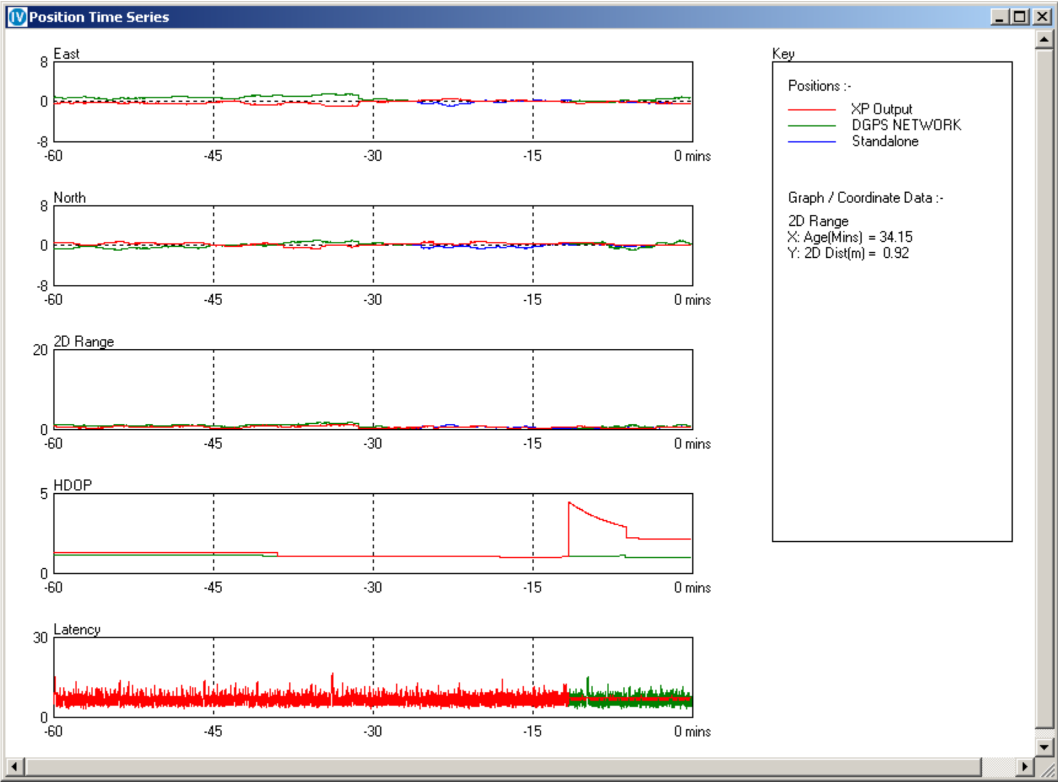
2D Pos ....is the effect of the potential error with the size of an MDE on the calculation in 2D, i.e. the horizontal plane.

W Pass ....is a pass-fail status window for the W-Test

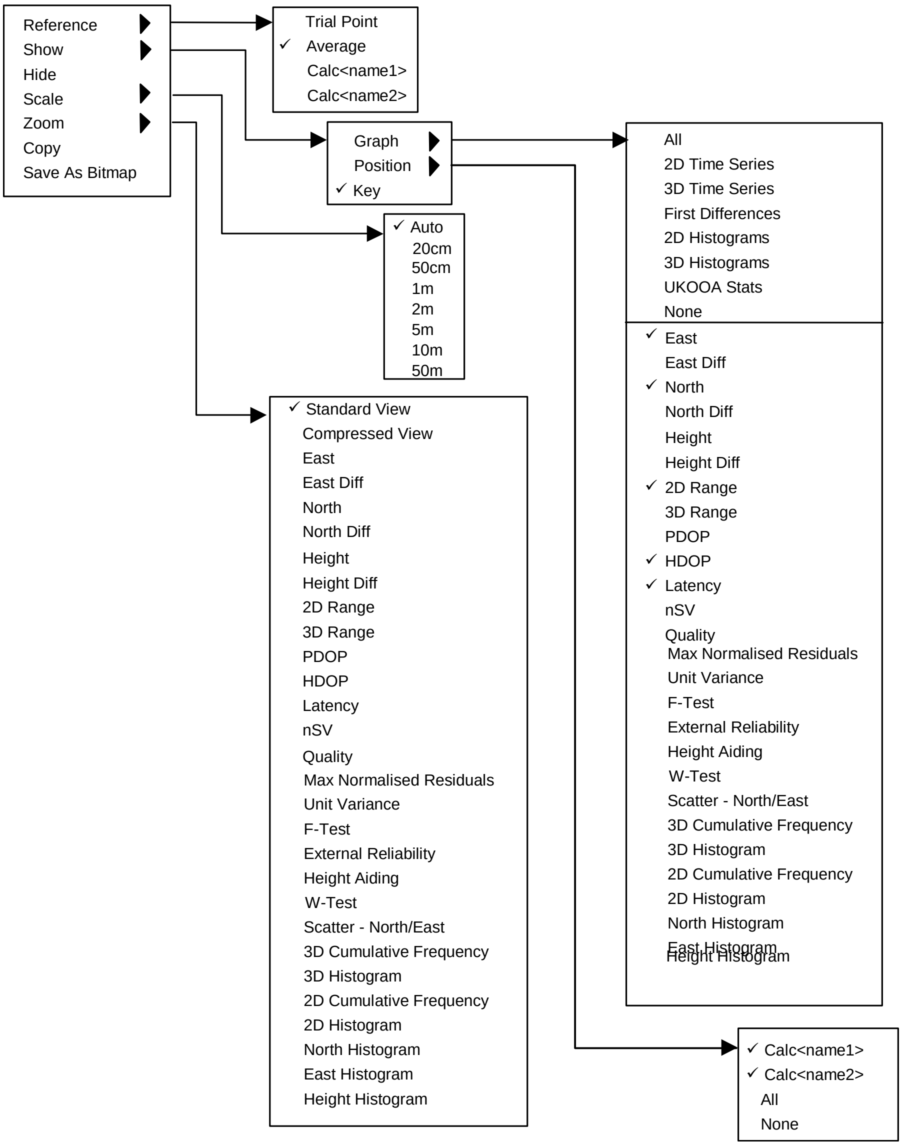
4.3.6.6.7. Time Series Plots

"View" \ "Calc" \ "Time Series"

This facility provides time series plots, scatter plots and histograms. All the graphs have a time constant of 60 minutes.



The window opens with a default status. What is shown and how it is displayed can be changed by a right-mouse click when the cursor is in the window. That provides access to the options shown below.



“Reference” allows the origin of the graphs displayed in the window to be changed.

“Trial Point” takes the Calculation Trial Point as the origin

“Average” takes the weighted mean of all the calculations

“Calc<name1>” takes the position formed by that named calculation.

“Show” / “Graph” allows an individual selection of what is to be shown in the window.

- “Show” / “Graph” / “All” puts all possible graphs into the window. This is not very practical because not all graphs can fit into the maximum window size.

“Show“ / “Graph“ / “2D Time Series“, “Show“ / “Graph“ / “3D Time Series“, “Show“ / “Graph“ / “First Differences“, “Show“ / “Graph“ / “2D Histograms“, “Show“ / “Graph“ / “3D Histograms“, and “Show“ / “Graph“ / “UKOOA Stats“ are all quick ways of making a reduced graph selection.

- “Show“ / “Graph“ / “2D Time Series“ is the default selection when the window is first opened. This option includes the time series plots East, North, 2D Range, HDOP, Latency and nSV
- “Show” / “Graph” / “3D Time Series” option opens East, North, Height, 3D Range, PDOP, Latency and nSV.
- “Show“ / “Graph“ / “First Differences“ opens East Diff, North Diff and Height Diff.
- “Show“ / “Graph“ / “2D Histograms“ opens Scatter – North/East, 2D Cumulative Frequency, 2D Histogram, North Histogram and East Histogram.
- “Show“ / “Graph“ / “3D Histograms“ opens Scatter – North/East, 3D Cumulative Frequency, 3D Histogram, North Histogram, East Histogram and Height Histogram.
- “Show” / “Graph” / “UKOOA Stats” opens Max. Normalised Residuals, Unit Variance, F-Test, External Reliability, Height Aiding and W-Test.
- “Show” / “Graph” / “None” switches all of the current graph displays off.

A tick against the graph name indicates it is included in the window. Individual graphs can be added or removed from the window by clicking their individual names.

“Show“ / “Position“ defaults with All calculations selected for inclusion in the graphs. The data for each calculation is colour coded and the key legend box shows the colours used against the calculation names.

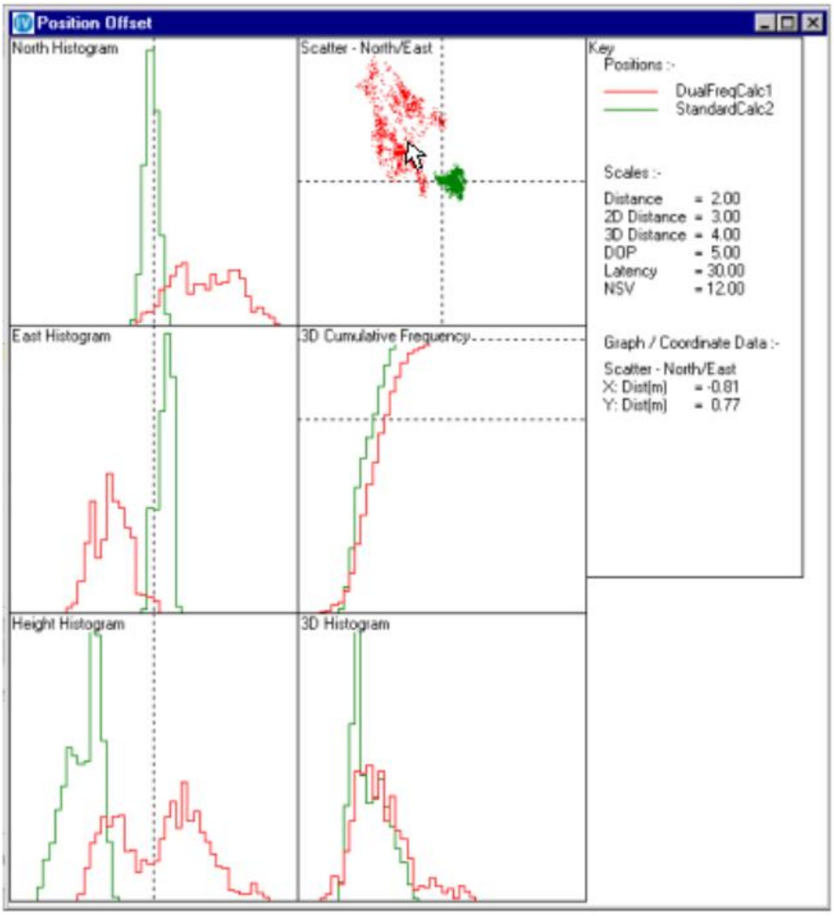
- “Show“ / “Position“ / “All“ toggles all available calculations on.
- “Show“ / “Position“ / “None“ toggles all available calculations off.
- “Show“ / “Key“ turns the key legend box off and on.

Hide will close the graph that the mouse cursor is over when the right mouse button is clicked.

“Scale” can be set to Auto, 20cm, 50cm, 1m, 2m, 5m, 10m or 50m metres. Auto ensures that graphs re-scale to show all the data over the last 60 minutes. Setting a scale distance will affect those graphs where either the X or Y axis (or in the case of the scatter plot both X and Y axes) is a distance. Graphs showing HDOP, PDOP Latency and nSV (number of satellites) will not be affected by selecting the scale.

“Zoom” defaults to the Standard View in which each graph has X and Y axis labels. This limits the number of graphs that can be shown in the window. Selecting the Compressed View option removes the space between the graphs and the axis labels. Those labels are then shown in the key legend box. Alternatively a single graph can be selected which will fill the whole window. This can also be achieved by double clicking on the required graph when in the standard view.

An example of the Compressed View display is shown below. The scale of the graphs is included in the key legend box in addition to the mouse cursor position, in terms of X and Y of the graph the cursor is over.



If a graph is to be viewed in more detail it can be selected individually in the Zoom selection menu. Any graph can be called up and it will fill the window, it does not need to be already open. To zoom into a graph that is already displayed double-click on the desired graph. To revert to the original display double-click on the graph again.

The graphs available are: -

East .... is a times series plot of the difference in Eastings between the calculated Eastings and the graph's Eastings origin.

East Diff .... is a times series plot of the difference in Eastings epoch to epoch.

North .... is a time series plot of the difference in Northings between the calculated Northings and the graph's Northings origin.

North Diff .... is a times series plot of the difference in Northings epoch to epoch.

Height .... is a time series plot of the difference in Height between the calculated Height and the graph's Height origin.

Height Diff........................... is a times series plot of the difference in Height epoch to epoch.

2D Range .... is a time series plot of the two dimensional radial distance between each calculation's position and the origin position.

3D Range .... is a time series plot of the three dimensional radial distance between each calculation's position and the origin position.

PDOP .... is a time series plot of the Positional Dilution of Precision value for each calculation

HDOP .... is a time series plot of the Horizontal Dilution of Precision value for each calculation

Latency .... is a time series plot of the age of the most recent RTCM Type 1 (Type 48, 49, 50 for XP) message received prior to the time each calculated position was formed. It's Y axis does not re-scale it is fixed at 30 seconds.

nSV .... is a time series plot of the number of satellites used in a calculation

Quality……………………….. is a time plot of the Qual value in the "View" \ "Calc" \ "Status" dialogue

Max. Normalised Residuals. is a time series plot of largest Normalised residual for the selection calculation.

Unit Variance. .... is a time series plot of the unit variance

F-Test .... is a time series plot of the F-test

External Reliability............... is a time series plot of the largest error, in 2D, that might result due to an undetected outlier existing in the calculation.

Height Aiding .... is a time series plot indicating if the solution is in height aiding mode or not.

W-Test……………………….. is a time series plot of the W-test. The W-test result is either a pass or fail

Scatter – North/East .... is a scatter plot two dimensional display of the calculated positions with respect to the origin of the plot.

3D Cumulative Frequency... is a graph showing the percentage of the time over the last 60 minutes that the three dimensional radial distance has been with n metres of the origin position. The 1 and 2 sigma lines are shown.

2D Cumulative Frequency... is a graph showing the percentage of the time over the last 60 minutes that the two dimensional radial distance has been with n metres of the origin position. The 1 and 2 sigma lines are shown.

3D Histogram .... is a histogram of the three dimensional radial distance between each calculated position and the origin position.

2D Histogram .... is a histogram of the two dimensional radial distance between each calculated position and the origin position.

North Histogram .... is a histogram of the difference in Northings between each calculated position and the origin's Northings

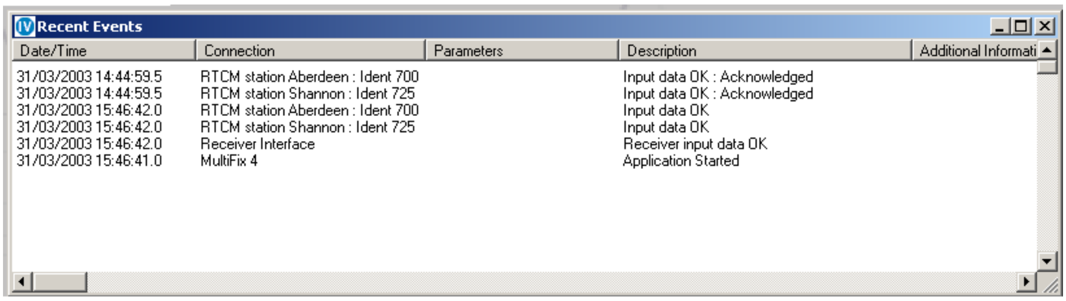
East Histogram.................... is a histogram of the difference in Eastings between each calculated position and the origin's Eastings

Height Histogram................. is a histogram of the difference in Height between each calculated position and the origin's Height.

Remember that the time constant for the data in all these graphs is 60 minutes.

4.3.6.7. Event Log

"View" \ "Event Log"



This dialogue shows a history of events that have occurred since MultiFix was started. The type of events that can be seen are shown below:

- **"Receiver Interface"** – "Receiver input data failed", "Receiver input data OK".
- **"Almanac Applet"** – "Satellite health change".
- **"Datagram Monitor"** – "Datagram error".
- **"Orbit Correction Applet"** – "Source changeover", "RTCM data failed", "RTCM data OK".

- **“RTCM Station XXXXX : Ident XXX”** – “Input data OK”, “Input data failed”.
- **“XP Calculation”** – “Transition Completed”

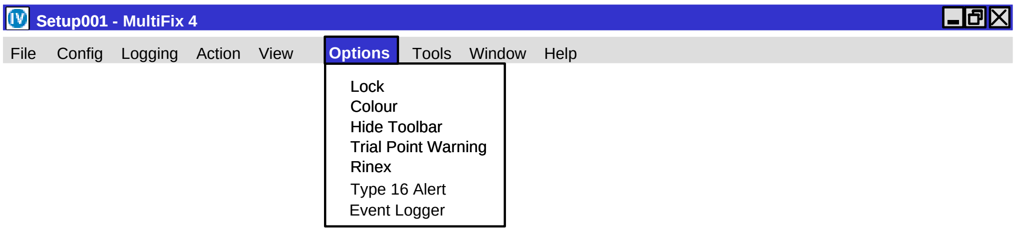
The Event Log will also be saved as a text file in the folder where the current MultiFix 4 configuration file is saved.

The file will be named with the format:

<ConfigFileName>_<YYYYMMDD>_EventLog.txt

e.g. Setup001_20030401_EventLog.txt

4.3.7. OPTIONS



4.3.7.1.1. Lock

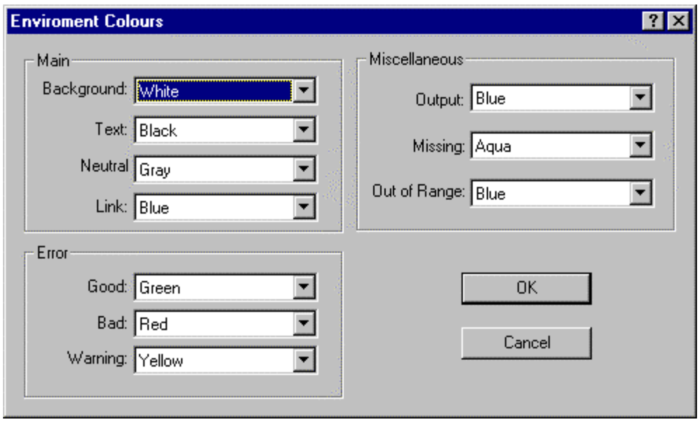
"Options" \ "Lock"

If the Lock option is chosen "File" and Config" are removed from the menu bar. Whilst locked, "Options" \ "Lock" changes to "Options" \ "Unlock". This reinstates "File" and Config" if selected.

4.3.7.2. Colour

"Options" \ "Colour"

If different colour schemes are required they can be set up here. Ensure that a false impression is not given when changing the colour coding, in particular relating to errors.



Some of the selections do not affect all view windows.

- "Main"

  "Background" and "Text" change the windows background and text colours.

  "Neutral" is used in the Latency window to show period when update may be expected.

  "Link" is not currently used.

- "Error".

  Various windows have stages of error state, these colours relate to them.

  "Good", "Bad" and "Warning".

- "Miscellaneous"

  "Output" as seen in the IO status and IO Scroller windows.

  "Missing" as seen in the Latency and Constellation windows.

"Out of Range" as seen in the Latency and Constellation windows when a satellite is below the mask.

4.3.7.3. Hide Tool Bar

"Options" \ "Hide Tool Bar"

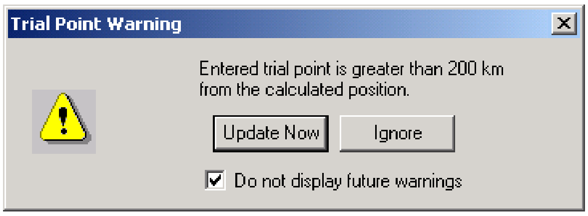
This will hide the shortcut toolbar displayed at the top of the MultiFix screen.

When hidden the option will change to "show toolbar" which will return the toolbar to the screen when selected.

4.3.7.4. Trial Point Warning

"Options" \ "Trial Point Warning"

When enabled, MultiFix will check the entered trial point value against the current position. If the trial point is in error of more than 200km a warning dialogue will be displayed, asking the user if they wish to update the trial point.



Clicking **[Update now]** will update the entered trial point to the user current location. **[Ignore]** will retain the old value.

This feature can be disabled from within the dialogue by checking the "Do not display future warning". The feature can be re-enabled by selecting Trial Point warning from the options Menu.

MultiFix utilises two trial points, the value entered in "Config" \ "Calc" \ "Settings" and the calculation value that is held in the configuration file. Even if an incorrect value for the trial point is retained the calculation will continue using an up to date position. The stored position is only modified if the user enters a new trial point position.

4.3.7.5. Rinex

"Options" \ "Rinex"

This enables or disables the Rinex data logging facility, accessible from the "Logging" \ "Rinex" menu, see section 4.3.4. When disabled the Rinex option will be not be shown in the logging menu.

4.3.7.6. Type 16 Alert

"Options" \ "Type 16 Alert"

If the user does not wish to be warned automatically of any Type 16 messages received then the alert dialogue box can be disabled.

See section 4.3.6.5.5 for more details of the Type 16 alert dialogue.

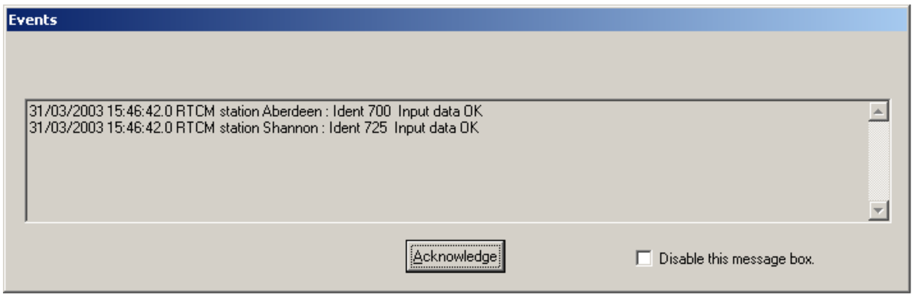
The messages will continue to be displayed in the Type 16 history window and written to the Type 16 log file.

If the alert dialogue is disabled a note is written to the log file stating that the feature has been disabled.

A tick mark will appear next to "Type 16 Alert" if it is currently enabled.

4.3.7.7. Event Logger

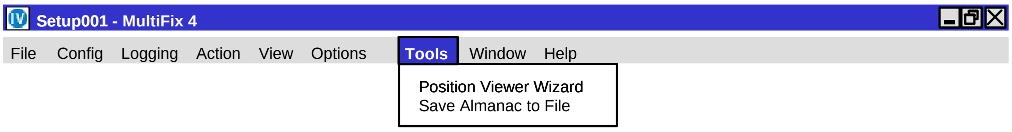
"Options" \ "Event Logger"



If the "Event Logger" option is ticked in the "Options" menu then a dialogue box, shown above, will appear automatically to warn the user of any event changes. The warning dialogue will remain on screen until the **[acknowledge]** button is clicked.

A list of events displayed is shown in Section 4.3.6.7.

4.3.8. TOOLS

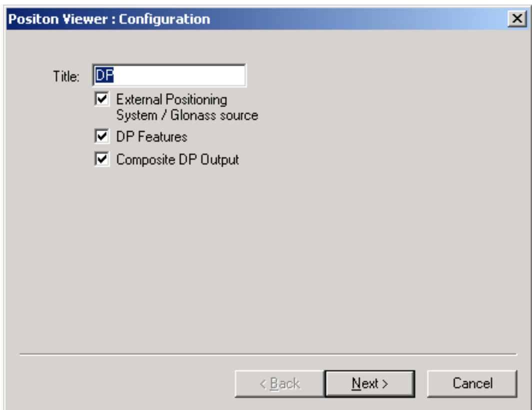


4.3.8.1. Position Viewer Wizard

"Tools" \ "Position Viewer Wizard"

Position Viewer enables the user to compare outputs from MultiFix with data from other systems, such as the Fugro 90964 GLONASS unit, and to automatically select the most stable solution. The Position Viewer Wizard is designed to co-ordinate the configuration of MultiFix 4 and the Position Viewer application.

The wizard operates as a series of dialogues. Note that if at anytime an incorrect selection has been made, use **[<Back]** to retrace the steps through the wizard and make the correction



1) Position Viewer Configuration

Enter a title for the configuration. This will be the name of the configuration file in MultiFix. Check the tick boxes for the features that you require.

The "External Positioning / Glonass Source" option is designed for use with the Fugro 90964 but applies to any external NMEA input.

The "DP Features" option will enable the auto select mode for selecting the most stable solution.

The "Composite DP Output" option will enable the Position output option in Position Viewer.

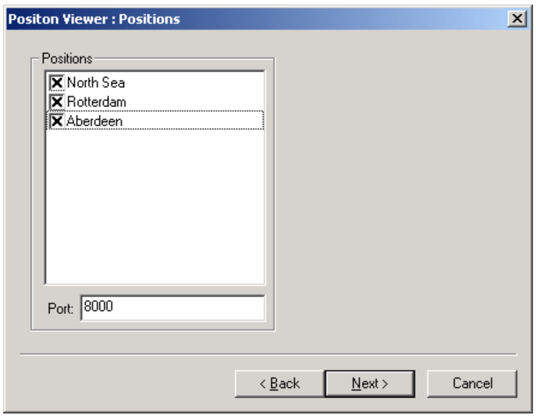
Click **[Next>]** to continue.

2) Position Viewer Positions

Select the positions you wish to export to Position Viewer.

Define the socket port number you wish to use to transfer the data

(see section 4.3.3.1.2 for more details about sockets).



This will set up the required socket configurations in both MultiFix and Position Viewer. It will also create corresponding inputs and outputs in both applications. The ZeroLink data format is used so only one data port is required.

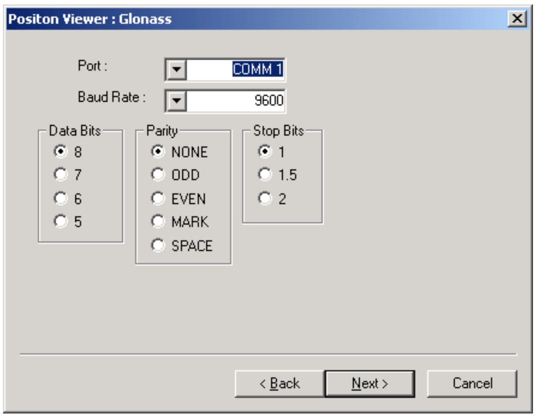
Click **[Next>]** to continue.

3) Position Viewer Glonass

Here the physical data port for the external input is defined. An NMEA GGA string from a Fugro 90964 is expected.

Alternative inputs can be set up within Position Viewer. See the Position Viewer manual for further details.

Click **[Next>]** to continue.

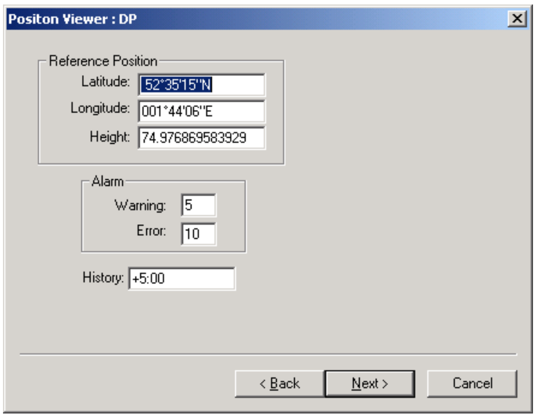


4) Position Viewer DP

Enter the initial reference position for the DP Auto Selector.

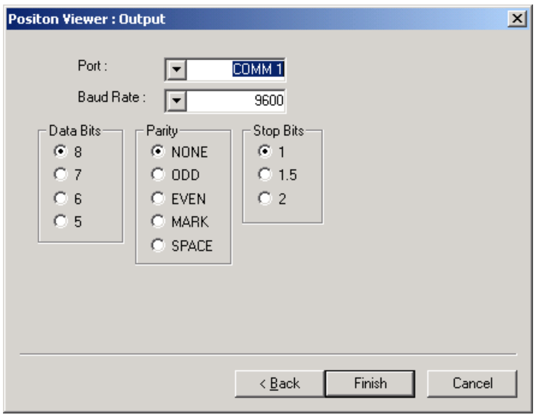
Set the alarm thresholds in metres and the “History”, which is the period over which the stability will be determined. (see Position Viewer manual for more details)

Click **[Next>]** to continue.



5) Output

Define the parameters for the port on which you wish to output the final position. By default this will be the DP Auto Select position.



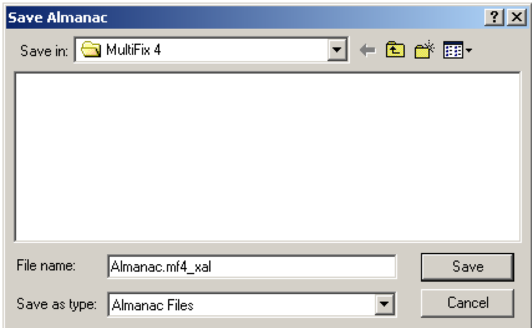
Click **[Finish]** to complete the process. A copy of Position Viewer will then be started automatically with the defined configuration.

4.3.8.2. Save Almanac to File

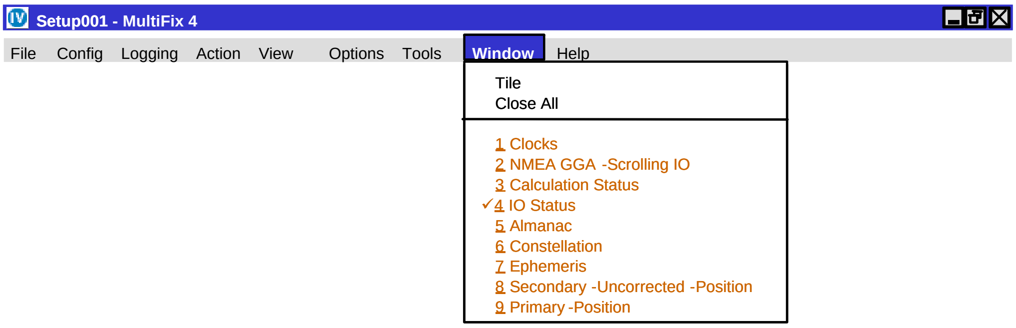
"Tools" \ "Save Almanac to File"

This option allows the user to save a copy of the GPS almanac (in Zero format) to an alternate location, such as a floppy disk.

The almanac can then be used in the GeoSky 2 application for GPS mission planning.



4.3.9. WINDOWS



The list will change depending on the number and types of windows that are open at any one time.

4.3.9.1. Tile

"Window" \ "Tile"

The tile command causes the application workspace to be reduced to the display area. The windows that are not minimised are fitted into the display area and the minimised windows are neatly stacked along the bottom of the screen.

4.3.9.2. Close All

"Window" \ "Close All"

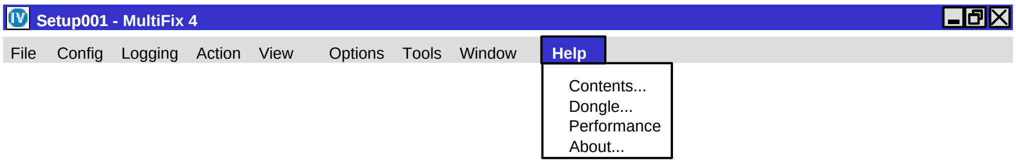
The close all command closes all windows irrespective of their status. As there is no confirmation required be careful not to use it in error.

4.3.9.3. The Open Windows

The "Window" drop down will also list all the windows currently open. Windows can be overlain one on top of another and it can be difficult to locate an obscured window. Clicking the window in the list causes the focus to shift to that window, the title bar is highlighted and it will appear on top of all the other windows. If there is an extended application workspace, and the selected window is off screen, the display area will not move to show the window but the title bar of the window will still become highlighted.

If there are more than 9 windows open the bottom line of the menu will be "More Windows…" If this is selected a dialogue opens listing all windows. Highlight one of them and close the dialogue.

4.3.10.HELP



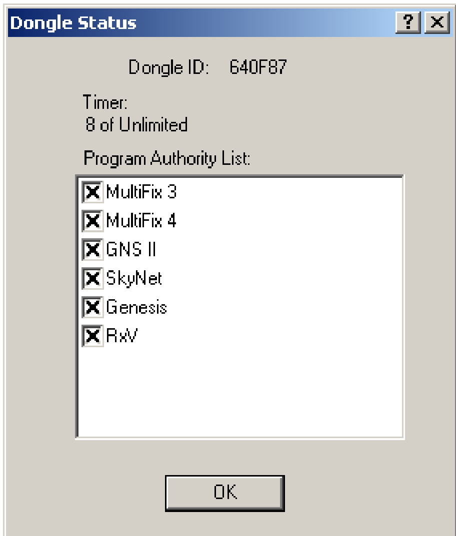
4.3.10.1.Help

"Help" \ "Contents…"

Launches the online help.

4.3.10.2.Dongle

"Help" \ "Dongle…"



Provides the information stating:

- Which programs the DK2 is authorised to run
- The time limit of the dongle
- The amount of use the dongle has already had.

At all times MultiFix 4 is being run the dongle is required in the computer's parallel port. If it is removed the program shuts down and an error message is posted.

If the time limit of the dongle expires the program shuts down and an expiry message is posted.

It is possible to revalidate the dongle by running the PROLIVE program and making a call to the Technical Support Group. The same program plus a telephone call can also be used to terminate a dongle so that it is no longer valid and no longer re-charged.

The list in the above dialogue requires refers to certain programs in the Zero Suite. SKYNET is a differential correction monitoring package, GENESIS is a Long Range RTK system that uses a similar software package to MultiFix, and RXV is a program called RECEIVER VERIFY which is described in Section 6.

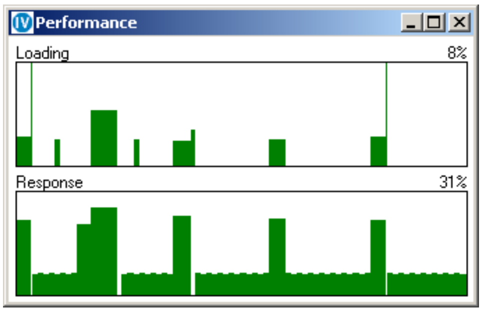
Several other programs in the Zero suite are not listed which also require a dongle validated for MultiFix. These are POSITIONVIEW, QUAL2 and LOGPUMP. Each of these 3 programs only requires the dongle when first being run. After that the dongle can be removed.

4.3.10.3.Performance

"Help" \ "Performance"

The Performance window shows how the program is handling the data acquisition and calculation process with the available resources. The window does not take into account other programs that are running simultaneously.

The graphs will be green below 50%, yellow between 50% and 75% and red when above 75%.

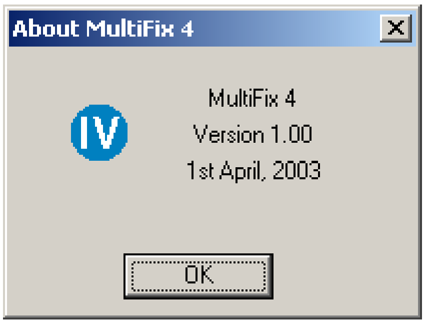


It is important there is enough time for all the processes to be completed in an orderly fashion. If there are too few resources the position solution may lag. The demand on the processor can be reduced by accessing only the data from the RTCM reference stations used in the computations, by having fewer computations and by closing windows.

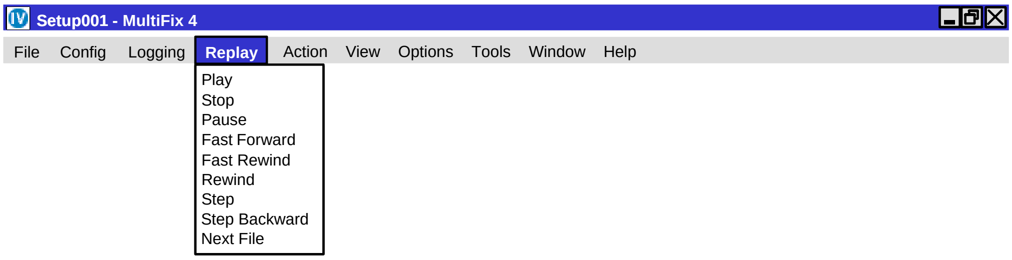
The performance information can also be seen in the bar at the bottom of the application window next to the UTC Time.

4.3.10.4.About

"Help" \ "About…" provides the version number and release date



4.4. MULTIFIX 4 REPLAY



When Raw Zero files have been logged it is possible to re-inject that same information into MultiFix 4 by using the Replay option. Replay will read the Zero Log (*.zer) files recorded by MultiFix 4 and create outputs, which MultiFix 4 can accept as source data. In Replay mode MultiFix 4 performs re-computations in pseudo-real time. See Section 4.3.4.1 on Zero logging on page 79.

To optimise the Replay operation not only must the Zero Log files be available but it is essential that the MultiFix 4 configuration and other associated files are available as well.

To replay raw GPS and RTCM data in MultiFix 4 first open the configuration file, which has been used for Zero logging. See Section 4.3.2.2 on page 51.

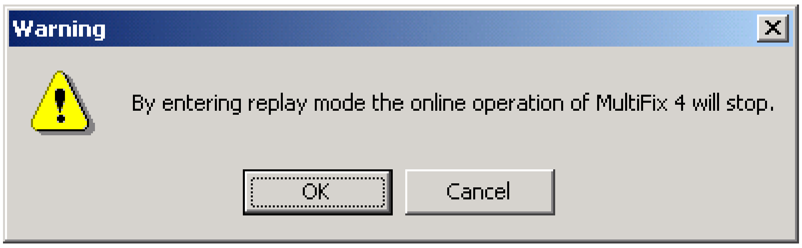
Select the logged files that are to be replayed in "Logging" \ "Zero" \ "Edit" either by typing in the destination or by using the **[Browse…]** facility. This provides the Browse for Folder dialogue. The path can be defined by clicking on the desired destination folder. When selecting files of different days for replay the Zero files have to be consecutive.

MultiFix 4 will recognize raw data input, thus any of the logging modes can be selected as long as the *.zer files contain raw data. Positions are not accepted by MultiFix 4 but they are by Qual 2 and Position Viewer. To replay position log files another Zero application, LOG PUMP has to be used. See Section 8.

When the path and mode of logging have been selected click **[OK]**.

The Replay menu and toolbar buttons will only be visible if "Replay" has been enabled under the Options menu.

Be aware that the online operation mode will stop when entering Replay mode. The program provides a warning, clicking **[OK]** activates the new menu.



While in replay mode the GPS receiver type cannot be changed and new SkyFix Decoder input cannot be defined. Evidently the selected GPS receiver cannot be configured from the Action menu.

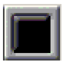
The "View" \ "IO" \ "Status" window will only show output data as raw data is not being received via physical ports or sockets but from the replay application within MultiFix 4. GPS Receiver input data will not be displayed in "View" \ "IO" \ "Scroller", RTCM input and Output strings however will be available.

In replay mode all other options and view windows will be available similarly to online operation. New calculations can be defined, as well as the calculation settings can be modified and new output strings can be generated. Even RINEX files can be logged in pseudo-real time.

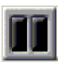
4.4.1. Replay options

Replay has 9 menu items, "Play", "Stop", "Pause", "Fast Forward", "Fast Rewind", "Rewind", "Step", "Step Backward" and "Next File". Each has a toolbar button equivalent.

"Play" starts the replay process and advances through the selected files with normal speed.



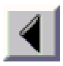
"Stop" resets the file reading to the start of the selected files.



"Pause" will arrest the replay process until another command is given.

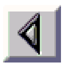
"Fast Forward" will advance in replay with high speed.

"Fast Rewind" will advance backwards in the calculation with high speed.



"Rewind" will advance in the files backwards with normal speed.

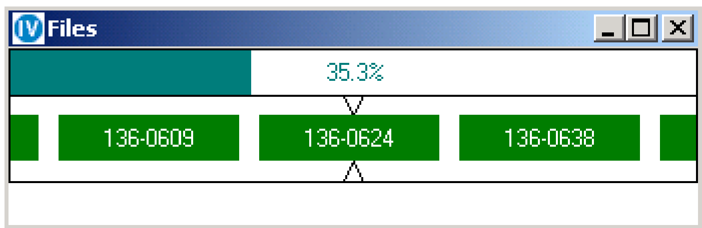
"Step" will move the pseudo-real time calculation one step forward feeding the next epoch GPS data or RTCM correction into the filter.



"Step Backward" will move one step back in the calculation.

"Next File" will jump to the start of the next file. If replaying the last file "Next File" will jump to the end of the file.

The progress of the replay can be followed in "View" \ "Files".



By disabling "Replay" under the Options menu the online operation mode restarts.

5. SKYLINK

5.1. INTRODUCTION

SkyLink is one of a series of applications available under the group name Zero. SkyLink is an RTCM transfer / modification program.

The RTCM Type 1 corrections that are generated at reference stations are contaminated by several error components, a major one of which is Ionospheric delay. Many DGPS firmware / software systems have used and still use the Klobuchar Ionospheric delay model to correct this error. This model is updated periodically but is not responsive to the current short-term variability caused by high levels of sunspot activity. An alternative to using the Klobuchar model methodology is to assess the Ionospheric delay element of every pseudo-range between each in view satellite and each reference station and between each in view satellite and the mobile. The Ionospheric delay element of each pseudo-range and RTCM correction can then be removed and an Iono-free solution of position derived. This methodology requires a dual frequency receiver on the mobile and at each reference station. The reference station then needs to either

1. Modify each correction in the Type 1 messages or
2. Output a message that contains corrections to be applied to the corrections in the Type 1 messages.

SkyFix Premier uses the latter approach and provides satellite/reference station Ionospheric delay information in Type 55 messages. Type 55 messages are Fugro proprietary messages, Type 15 is the standard message for the dissemination of Ionospheric delay information.

Given a dual frequency mobile receiver and RTCM type 55 messages, MultiFix 4 can provide a complete Iono-free solution of position, however some firmware / software can not, therefore SkyLink has been produced to improve the DGPS positioning performance of those firmware / software systems.

SkyLink has been produced primarily to

1. Generate Iono corrected Type 1 messages
2. Generate Type 15 messages from the Type 55 messages that are supplied by Fugro's SkyFix Premier service.

However, as will be seen, its functionality has been extended beyond its primary purpose.

What RTCM inputs and GPS receiver (if any) are required, starts with a decision on the required outputs. This in turn requires knowledge of the firmware / software that is to receive the SkyLink output. SkyLink has 5 output mode options.

Option 1 does not modify the messages but will add a carriage return to the end of each message. Therefore if the recipient firmware / software already performs Iono-free position calculations using dual frequency receiver data with RTCM Type 1and Type 55 messages but needs a carriage return terminator on each RTCM message, select Option 1 with carriage return.

If the recipient firmware / software

1. Already performs DGPS Iono-free position calculations using Type 1 and dual frequency receiver data but
2. Needs Type 15 rather than Type 55 messages,

select **Option 2** (with or without carriage return).

If the recipient firmware / software

1. Does not compute an Iono-free solution,
2. Does NOT use the Klobuchar model but
3. Will perform a DGPS calculation using Type 1 messages,

then SkyLink can modify the corrections in the RTCM Type 1 messages to remove the Ionospheric delay between the satellites and the reference stations and between the satellites and the mobile. In which case select **Option 3** (with or without carriage return).

If the recipient firmware / software does not

1. Does not compute an Iono-free solution,
2. Does use the Klobuchar model and
3. Will perform a DGPS calculation using Type 1 messages,

then SkyLink can modify the corrections in the RTCM Type 1 messages to remove the Ionospheric delay between the satellites and the reference stations and between the satellites and the mobile and then add the Klobuchar values that the recipient firm/software is going to remove. In which case select **Option 4** (with or without carriage return).

If the recipient firmware / software does not apply any Ionospheric corrections at all and there is no broadcast Ionospheric correction data available, then assuming SkyLink knows where it is, it can modify the corrections in the Type 1 messages with data taken from its own Klobuchar model. In which case select **Option 5** (with or without carriage return).

While there can be any number of outputs using any of the options, the output with the most stringent option governs the inputs and GPS receiver required by SkyLink.

Option	Output	RTCM Input	GPS Receiver
1	No change	Any RTCM Type messages without Carriage Return terminator	Not essential
2	Type 55 to Type 15	Must have RTCM Type 55 messages, (will also pass on other types as received).	Not essential
3	Corrected Type 1	Must have RTCM type 1, 2, 3 and 15 or 55 messages.	Dual frequency Ashtech ZX Sensor, MS750 or Trimble 4000SSE/SSI
4	Corrected Type 1 (Reverse Klobuchar)	Must have RTCM type 1, 2, 3 and 15 or 55 messages	Dual frequency Ashtech ZX Sensor, MS750 or Trimble 40000SSE/SSI
5	Apply Differential Klobuchar	RTCM Type 1 messages	Single frequency Ashtech DG16, Trimble 4000DS (or Dual frequency MS750 or Trimble 40000SSE/SSI)

SkyLink takes in RTCM SC104 Version 2 differential correction messages. These may be from any number of RTCM Correction delivery systems. As seen above it also takes in Fugro Proprietary RTCM Type 55 Ionospheric range corrections. These are generated at selected SkyFix Premier reference stations and are broadcast via the Fugro global network of high and low power L Band beams. The Type 55 format has recently been modified; the program is able to take in either style.

- There is no limit on the number of RTCM correction delivery systems.
- There is no limit on the number of RTCM differential reference stations.
- There is no limit on the number of outputs.
- There is no limit on the number of view windows
- The view windows can be customised

The text in this manual conforms to certain conventions

4. All command buttons are shown bold and bracketed with square brackets e.g. **[OK]**,

5. When a keyboard key is represented, it is shown bold and bracketed by greater than and lesser than symbols e.g. **<spacebar>**.
6. Direct quotations from dialogues or edit control slots are shown in normal text in quotations, e.g. “IO Channel:”

5.2. CONFIGURATION

5.2.1. HARDWARE INTERCONNECTION

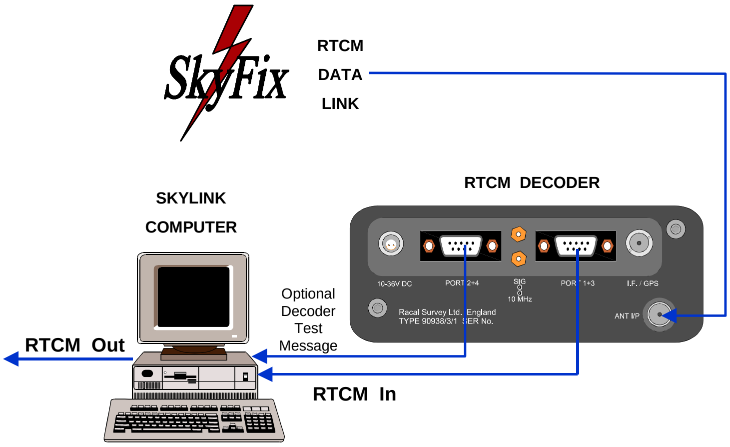


Figure 7 Example Configuration for SkyLink Options 1 or 2

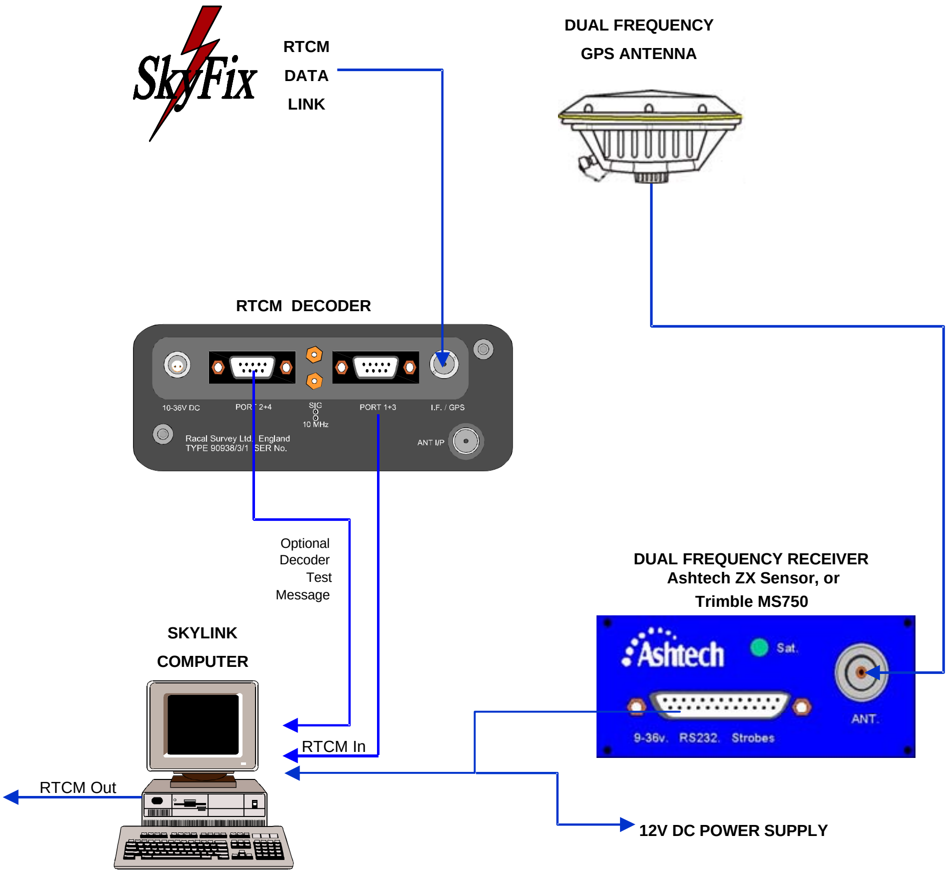


Figure 8 Example Configuration for SkyLink Options 3 and 4

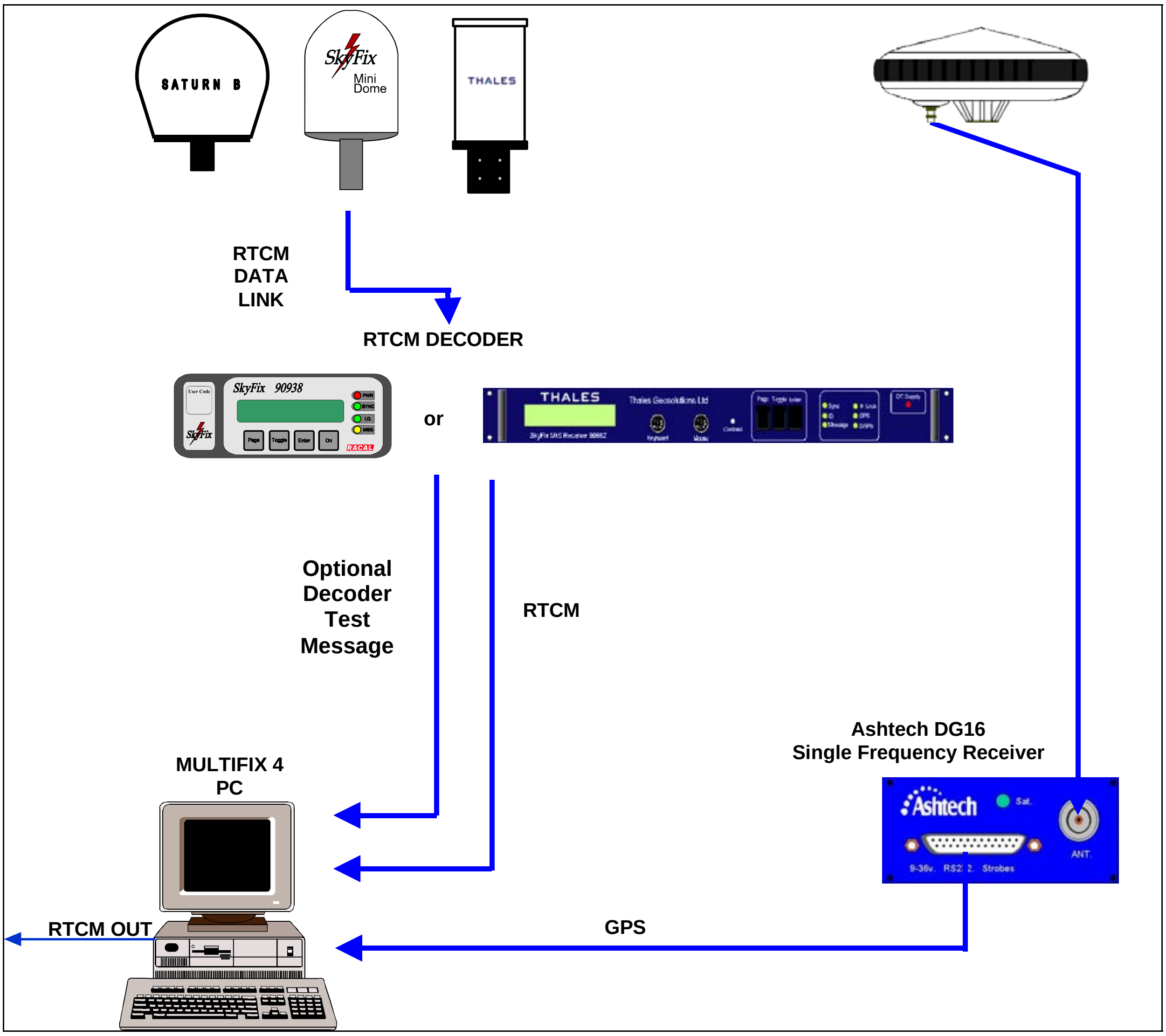


Figure 9 Example Configuration for SkyLink Option 5

5.2.2. HARDWARE REQUIREMENT

SkyLink requires the following:

A PC running Windows 98, Windows 2000 or Windows NT.
The PC will preferably be a PII or faster. A graphics resolution of at least 1024 by 768 pixels is recommended in order to achieve maximum clarity of all the graphics displays.

For the installation of the software the PC requires a CD-ROM drive. It is possible to create installation floppy discs from the installation menu on the CD but 8 floppies are needed.

Depending on the output option SkyLink may need a single frequency GPS receiver, such as the Ashtech DG16 or a dual frequency GPS receiver, such as the Ashtech ZX Sensor.

Again depending on the output option, assuming data is not being input or output over network sockets, the PC may need 1 COM port for two-way communications to the GPS receiver and a second COM port for the input of RTCM corrections. Given that the second port is for input only, by using a special breakout cable, the same COM port used for the RTCM input can also be used for the output of RTCM messages.

If there is more than one RTCM delivery system or data is to be output on several ports, then additional COM ports may be required. These can be any proprietary asynchronous serial board (or PCMCIA card) the Windows drivers for which, allow the board’s/card’s ports to be mapped as additional COM ports.

5.2.3. GPS RECEIVER CONFIGURATIONS

5.2.3.1. Ashtech (Thales Navigation) Receivers

Ashtech receivers can be controlled either from within MultiFix or externally using the Evaluate software from Thales Navigation.

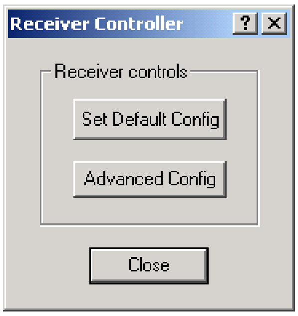
Evaluate must be used to establish and configure baud rates, but once communications have been established between the PC and MultiFix then MultiFix can complete the configuration process.

5.2.3.1.1.Configuration from within MultiFix

Assuming communications have been established between MultiFix and the GPS receiver then the receiver can be configured automatically by MultiFix.

The Command “Action” \ “Configure Ashtech” will launch the receiver configuration dialogue.

Select Set default configuration to complete the receiver configuration.



Note that if using a Z Family receiver then the Baud Rate must be set to a minimum of 38400 due to the large amount of data output from the receiver.

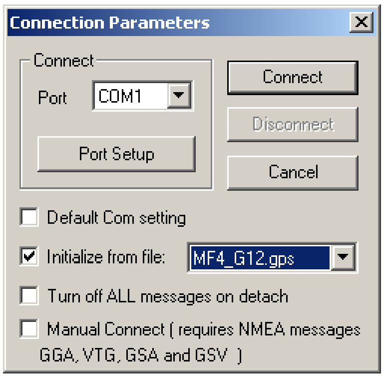
See section 4.3.5.6 for more details.

5.2.3.1.2.Ashtech Evaluate Configuration

Direct configuration of Ashtech receivers is usually via the Ashtech Evaluate program; alternatively they can be configured using a terminal program. The following relates to Ashtech Evaluate which is included on the MultiFix 4 installation CD.

Sample configuration files are also available on this CD. After installing the Evaluate software start the program by clicking the Ashtech Evaluate icon in the start menu. The user will be asked to choose a start up option. Select “Connect to GPS Receiver” and click **[OK]**.

In the Connection Parameters dialogue select the PC Port, tick the "Initialize from file:" box, remove the tick from all other boxes and select and the preferred initialisation file.

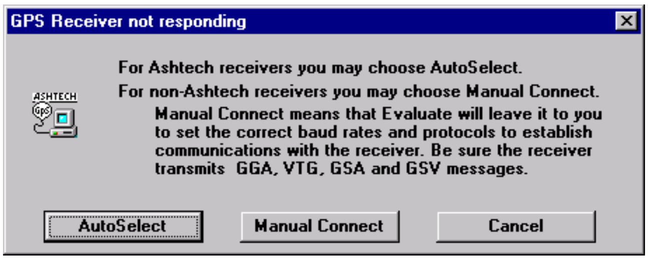


Pre-configured initialisation files can be found on the MultiFix 4 installation CD. These files must first be copied to the Evaluate \ Receiver folder.

Alternatively a file can be created from the text below. Re-name the new text file with a *.gps extension and place it in the Evaluate \ Receiver folder.

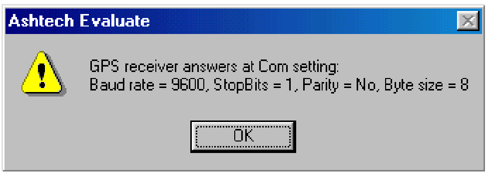
The benefit of using an initialisation file is that all configuration commands are sent to the receiver in a preferred sequence and can be followed by a command that saves all these settings in the battery backed-up memory of the receiver.

On clicking **[Connect]**, the software will try to establish connection with the receiver.



If the PC COM port settings do not match the port setting of the internal port on the GPS receiver, Evaluate will report that the GPS receiver is not responding.

By selecting the **[AutoSelect]**, Evaluate will cycle through all possible COM port parameter settings and will report if it finds the current receiver. Evaluate will then connect with the newly found settings.



If no matching port settings are found, investigate all cable connections and make sure that the receiver is powered on.

5.2.3.2. Trimble Receiver Configuration

5.2.3.2.1.Trimble 4000DS AND 4000SSE/SSI

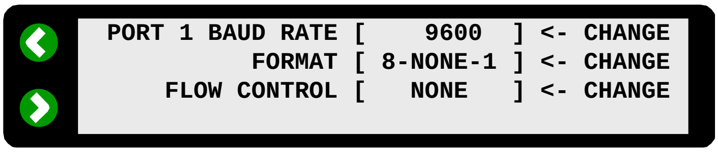
When powering up the 4000SSE/SSI receiver the following screen will appear. In order to reach the standard screen press the "CLEAR" button on the front panel of the receiver.

The standard screen, shown here, will now appear. The 4000DS defaults to this screen automatically when it is powered up

The following needs to be configured/checked.

Set the Comm Port Protocol Parameter Values

CONTROL / MORE…/ BAUD RATE / FORMAT / SERIAL PORT n SETTINGS / CHANGE



Enable SkyLink Control of Trimble Receiver

CONTROL / MORE… / REMOTE PROTOCOL

Select the Port for the SkyLink/Trimble Receiver Communication

CONTROL / MORE... / CYCLE PRINTOUTS /

Ensure there are no other Receiver Cycle Outputs are enabled (Use Top ←Next)

Select the Format for the SkyLink/Trimble Receiver Communication

CONTROL / MORE... /

CYCLE PRINTOUTS /

(Use Middle ←Next)

```
OUTPUT EVERY RECEIVER CYCLE
               RT SURVEY DATA  <-- NEXT
               CONCISE FORMAT  <-- NEXT
            ENABLE [  ON    ]  <-- CHANGE
```

*****Ensure the Receiver is Outputting Positions if SkyLink Option 4 or 5 Outputs required*****

CONTROL / MORE... /

CYCLE PRINTOUTS /

(Use Middle ←Next)

```
OUTPUT EVERY RECEIVER CYCLE
               RT SURVEY DATA  <-- NEXT
             OUTPUT POSITIONS  <-- NEXT
            ENABLE [  ON    ]  <-- CHANGE
```

(Optional) Select the Port for the Receiver's Input of RTCM Corrections

CONTROL/

RTCM-104 INPUT

```
DIFFERENTIAL STATION            <-- MORE
RTCM-104 INPUTS [  ON/AUTO   ] <-- CHANGE
    PORT SELECT [   PORT 1   ] <-- CHANGE
         FORMAT [ VERSION 2 ]  <-- CHANGE
```

Check that there are No Other Outputs Enabled On the SkyLink/Trimble Receiver Communication Port

CONTROL / MORE… /

NMEA-183 OUTPUT

```
NMEA-183        ENABLE[ OFF ] <-- CHANGE
OUTPUT CONTROL     ALM[ OFF ] <-- CHANGE
                   BWC[ OFF ] <-- CHANGE
                                   MORE
```

Check that the SV Sync Time is set to 1 second

CONTROL / MORE… /

MASKS/SYNC TIME

```
POSITIONING MASKS/SYNC TIME:     |
    ELEVATION MASK = +10º        | MINUS
         PDOP MASK =  07.0       |
      SV SYNC TIME =  001.0 SEC  | ACCEPT
```

If you are using a 4000SSE/SSI receiver ensure that it is set to dual frequency mode

CONTROL / MORE…/

L1 / L2 OPERATION

```
L1/L2 TRACKING: P,C/A-CODE | L1 TRACKING
                  P,E-CODE | L2 TRACKING
```

Only the L2 code can be disabled. Ensure that both the L1 and L2 codes are **enabled**. The diagram above shows the screen display for the 4000 SSI receiver in dual frequency mode. The display on the 4000 SSE receiver differs slightly: the **L2 TRACKING** codes will read **P,X** instead of **P,E**.

5.2.3.2.2.Trimble MS750

The configuration of the MS 750 dual frequency receiver must be done in two stages. The first stage is via the front panel of the unit itself, and the second stage is via the “Yellow Box” window (see Section 5.2.3.2.2.2).

5.2.3.2.2.1.Front Panel Configuration

When the MS 750 is powered up, the front panel displays the Home screen (shown opposite).

```
SV:07 PDOP3.2
RTK(FIX)
```

Use the green “**>**” button to toggle to the “Config GPS” display.

```
Config GPS
Press v to Enter
```

Press the “∨” button to access the “System Masks “ display.
Press the “**>**” button to enable the cursor. Set the elevation mask to 10° and the PDOP mask to 07. Use the “**>**” button to move the cursor and the “∧” and “∨” buttons to change the values. Press the “↵” button to accept the entry.

```
Cnf:System Masks
Elev 10  Pdop 07
```

```
CFG: Exit
Pre     to
```

Toggle to the “Exit Config” display by pressing the “∨” button. Press “↵” to exit this display and return to the “Config GPS” screen.

Press “**>**” to toggle to the “Config Ports” screen.

```
Config Ports
Press v to Enter
```

Press the “∨" button to toggle to the Port A configuration display.
Use the “**>**” button to enable and move the cursor and the “∧” and “∨” buttons to change the values, set the Baud rates to 9600, 8-None–1
Then press “↵”.

```
CFG: Port A NONE
9600  8-NONE-1
```

As it is assumed that SkyLink is connected to Port A, it is not necessary to configure ports B-1 and B-2. Toggle past these screens using the “∨” button.

Ensure that the NMEA,

```
CFG: NMEA    GGA
Port A   OFF
```

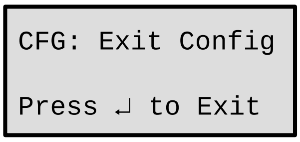
GSOF

```
CFG: GSOF Port A
Pos Time OFF
```

and Time Tag configuration screens are all “OFF”. Use the “**>**” button to enable and move the cursor and the “∧” and “∨” buttons to change the values. Then press “↵”.

```
CFG:1PPS TimeTag
OFF
```

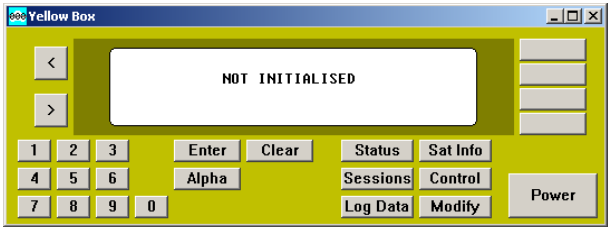
Toggle to the “Exit Config” display by pressing the “∨” button. Press “↵”to exit this display. This completes the front panel configuration for the MS 750.



5.2.3.2.2.2.“Yellow Box” Remote Configuration

SkyLink must be installed on the PC before this stage of the configuration process can be completed. This should be done in accordance with the instructions outlined in the software installation section (see section 3). Assuming that this has been done, and that the receiver unit is connected to the PC, use “View” \ “GPS” \ “Receiver”.

The screen shown opposite will appear. As soon as communication is established it will change to show the current front panel.

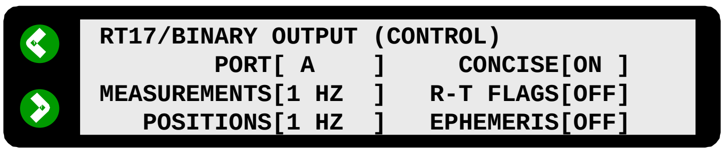


Press **[Alpha]** and then **[Control]** to reach the / MENU (CONTROL) screen

Use the **[Alpha]** button to toggle to the menu screen opposite. Select the <SERIAL PORT OUTPUT> option by clicking the button adjacent to it

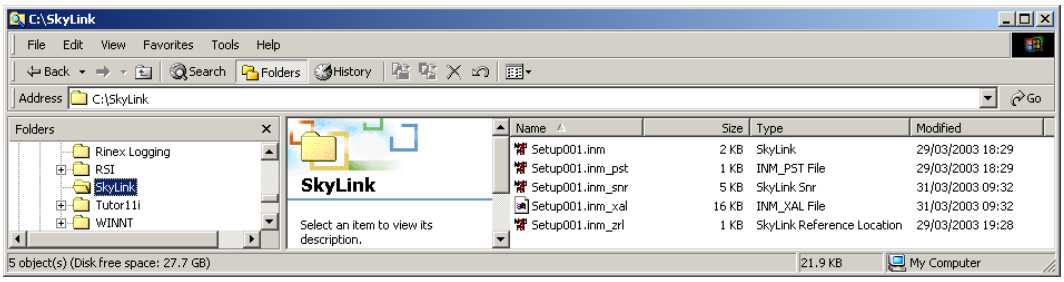
The screen shown opposite will now appear. Click on the button adjacent to the <RT17/BINARY OUTPUT> option to access the screen shown below.

Using the **[Enter]** button to toggle to the desired parameter. Ensure that the correct output port is enabled and, using the **[Alpha]** button, set MEASUREMENTS and POSITIONS to **1HZ** and CONCISE ON. **The receiver must supply POSITIONS if SkyLink Option 4 or 5 Outputs are required.**



Click on **[Enter]** until the MENU (CONTROL) screen is displayed.

5.2.4. SKYLINK FILES



After installation and after a program run, SkyLink will have created / stored several files in the folder selected by the operator for the configuration file.

The SkyLink type file is the configuration file.

The INM_PST file is a Persistence file. It contains the number, type, position and contents of windows in the application workspace when a configuration file is saved. It is also written when the program is exited.

The INM_ZRL file contains the reference station positions. It will be written when a new Type 3 position for a reference station is received and when the configuration file is saved.

The INM_SNR file contains the signal to noise information. That information is required to filter the dual frequency observations for the determination of the ionospheric delay. This is written periodically during a program run and when the configuration file is saved.

INM_XAL is the GPS almanac. This will be updated as the almanac changes and when the configuration file is saved.

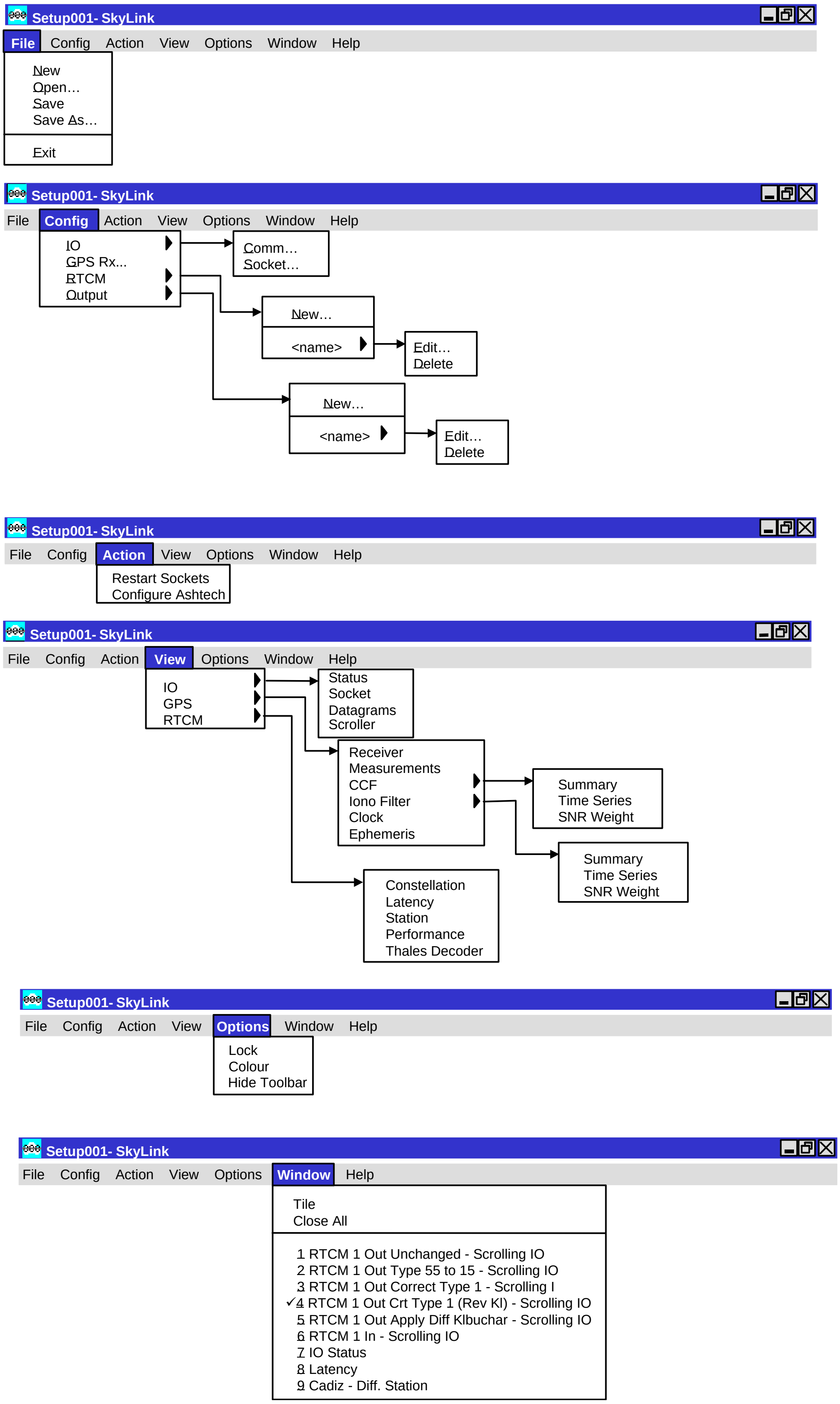
5.2.5. TO RUN SKYLINK

SkyLink can be opened a variety of ways.

Use Windows Explorer to display the contents of the folder containing the SkyLink program files and then double-clicking the “SkyLink” application icon.

Select “Start” \ “Programs” \ “MultiFix 4 Vx.xx” \ “SkyLink”.

5.3. REAL TIME OPERATION



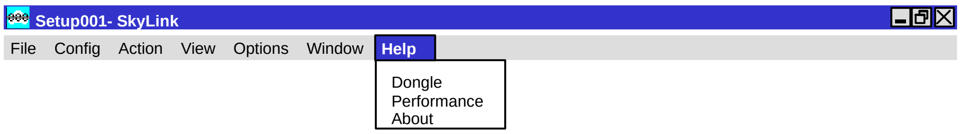
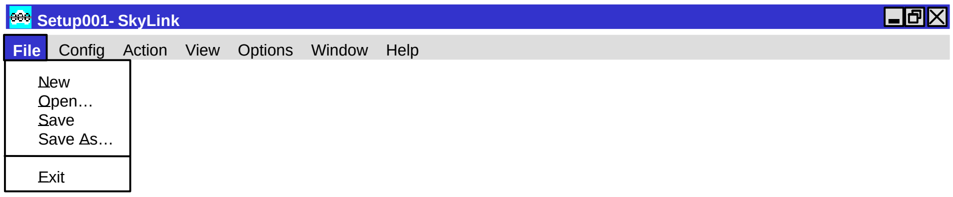


Figure 10 SkyLink Menu Layout

5.3.1. FILE



At the bottom of the "File" menu is a list of recently used configuration files. Clicking on one of these files opens up the chosen configuration.

5.3.1.1. New

"File" \ "New…"

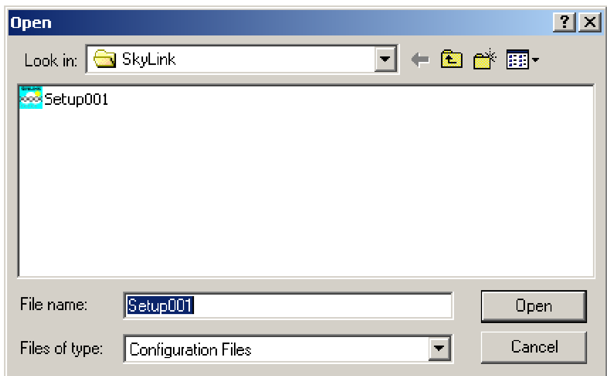
To start a new SkyLink configuration select this option.

Be aware that starting a new configuration will close the existing configuration and the program will cease outputting data.

5.3.1.2. Open

"File" \ "Open…"

When opened the program does not know which configuration file to open. Assuming a previously prepared configuration exists, use this facility to select it.



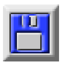
The configuration files have program name and version identifiers in a file header. They also have a configuration file version number. The program will not allow configuration files to be opened that are not compatible with the version of RxV that is currently being run. However if the configuration file version is the same they can be used even though created by a different program version.

File open can also be accomplished using  the button.

5.3.1.3. Save

"File" \ "Save"

A configuration is not automatically saved as changes are made, therefore use this facility to update the configuration file to the current status. If the set up is being undertaken for the first time and the configuration does not have an identity, the use of "File" \ "Save" will call up the Save As dialogue. That dialogue requires a name to be entered for the RxV files. Once a configuration has been named, use of "File" \ "Save" performs the save without calling up the Save As dialogue.

The name of the current configuration file appears in the application workspace title bar. If configuration changes are made that have not been saved, that file name has an * appended to it. After a File \Save the * is removed. File saving can also be accomplished using the  button.

5.3.1.4. Save As

"File" \ "Save As…"

If the current configuration is to be saved but not at the expense of overwriting the existing configuration files, use the "File" \ "Save As…" option. This creates new configuration files and leaves the previous files as they were. The program immediately commences to use the new files as the current configuration files.

The Save As dialogue requires the operator to enter a name for the new configuration file. If an existing file name is entered, the program will overwrite the existing files.

5.3.1.5. Exit

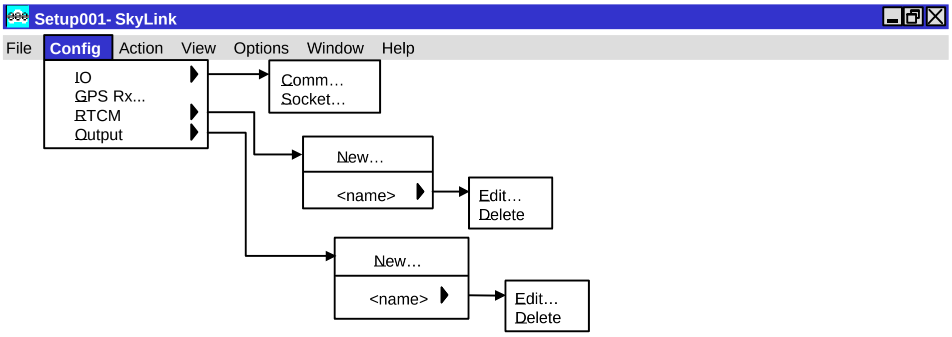
"File" \ "Exit"

This exit route is immediate if no configuration file is loaded.

Confirmation is required if a configuration file is in use. The user will be prompted to save the configuration if they have not already done so.

If the program is exited using the  button when the current configuration has not been saved, a dialogue is presented asking whether to save the configuration prior to exit or whether to cancel the exit. If there have been no configuration changes then the program will terminate immediately.

5.3.2. CONFIGURE

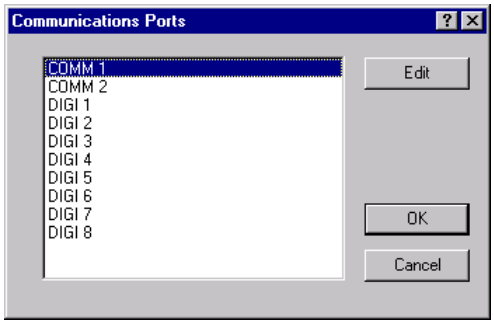


5.3.2.1. IO

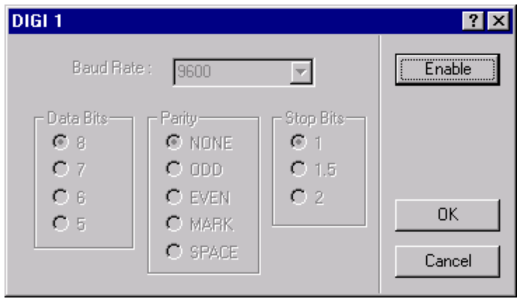
5.3.2.1.1. Comm

"Config" \ "IO" \ "Comm…"

Earlier it was explained that the "Programs" / "MultiFix 4 Vx.xx" / "IO Config" applet needed to be run after installation to define what ports the computer has available (see section 3.4 on page 13). The parameters selected there determine the dialogue box that is presented when "Config" \ "IO" \ "Comm…" is selected..



Highlight one of the ports to be used and click **[Edit]**. This opens another dialogue box for setting the port parameter settings.



Click the **[Enable]** button to activate the port and set the Baud Rate, Data Bits, Parity and Stop Bits.

5.3.2.1.2.Sockets

"Config" \ "IO" \ "Socket…"

To be able to distribute and receive data over a network via sockets assumes each computer has Transmission Control Protocol / Internet Protocol (TCP/IP) installed. Sockets have the advantage over COM ports in that two or more programs can access the same data.

Sockets can transfer data between programs running on different computers or between two or more programs running on the same computer. (If a standalone (non-networked) computer running Windows NT is used and the data is to be shared between multiple programs running on that PC then the MS Loopback Adapter network adapter must be installed).

The TCP/IP protocol is a family of protocols that allow Internet data communication. Included in that family are two transport layer protocols, the Transport Control Protocol (TCP) and the User Datagram Protocol (UDP).

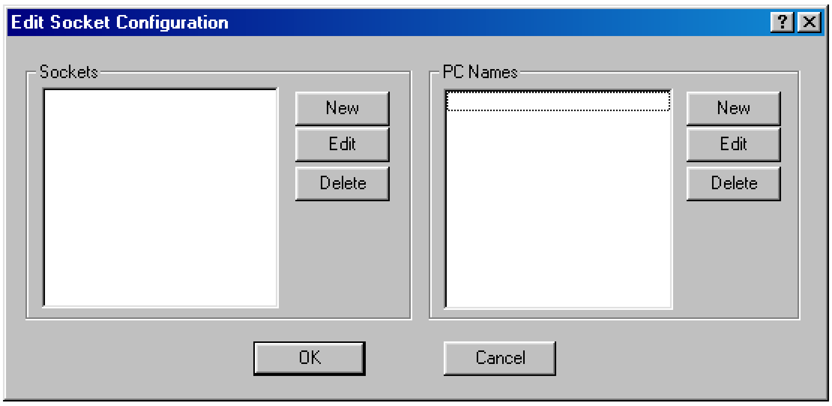
The Transport Control Protocol establishes sessions between a Server and however many Clients that are accessing that Server. There is continual presence checking and acknowledging between each Server/Client pairs with messages always received in the order they were issued. A Server does not have control of the number of Clients that access the socket on which data is being presented. (It is often perceived that the Server provides data and the Client receives data, but once the connection is established the link is two-way).

The User Datagram Protocol does not have the end-to-end checking overhead of the TCP. Instead packets of data are simply issued to the Internet in either broadcast mode, where any networked computer on the LAN can receive them, or in addressed mode where the data packets have headers specifying the addressees for whom the packets are intended. There is no guarantee with this protocol that the messages will arrive in the order they were issued. When setting up "Ribbons" to output datagrams a time interval can be specified to prevent data becoming corrupted, see section **7.3.2.2** on "Ribbons". Broadcast datagrams cannot pass routers linking Local Area Networks (LAN) unless specifically configured.

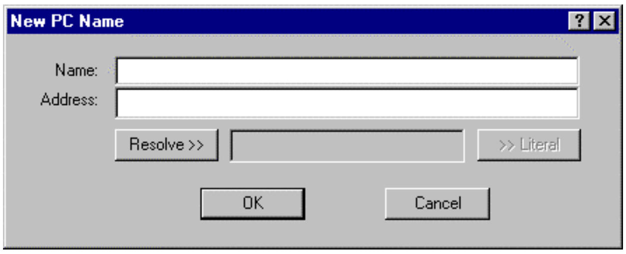
For most situations where Local Area Networks are involved Server / Client TCP sockets are the best choice Internet transport protocols.

5.3.2.1.2.1. The SkyLink Computer as a Client

For a Client to make contact with a Server, the operator must know the IP address (or the network identification name - see below) of the Server computer and the port number the Server is outputting the required data on.

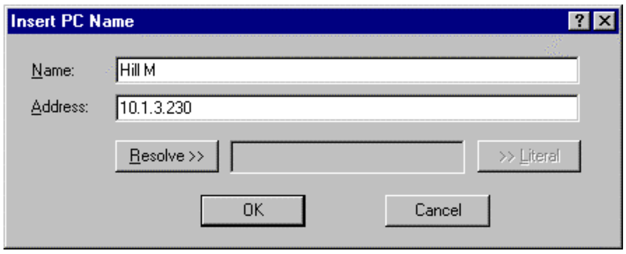


First, in the "PC Names" table click **[New]**..

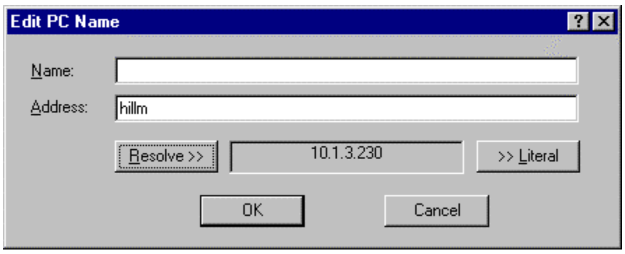


There are two possible ways of defining the server PC.

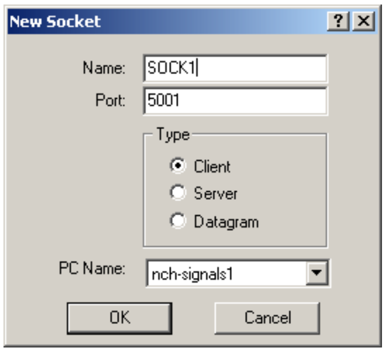
If the numerical IP address is known, enter a PC name in "Name:" and the IP address in "Address:" and click **[Resolve>>]**. Click **[OK]**.



If the IP address is not known but the computer's network identification name is, and if all computers involved are aware of local naming services (WINS / DNS), then type in the computer's name in the "Address:" slot and click **[Resolve>>]**. Once the computer is found, its IP address will appear as shown. If required, use **[>>Literal]** to transfer the name and address to their named slots. Click **[OK]**.



It is normal in a network for computers to be allocated new IP addresses when the PC is restarted. If the Client PC has a numerical entry for the address and the Server's address has changed, it will not be able to re-locate it. If the Client PC has the name of the Server PC in the address slot, it will automatically search to re-locate the Server PC by name. Assuming it is found, the Client PC will obtain the Server PC's current address.

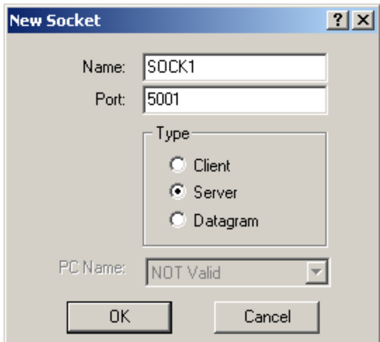


In the "Sockets" table click **[New]**.

Check the "Client" radio button and select the "PC Name:" of the server.

Enter the number of the port on which the Server PC is presenting the data. Change the socket's default name if required.

5.3.2.1.2.2.The SkyLink Computer as a Server



If the Log Pump computer is to be a server then there is no need to add the Soccer computer to the PC table; the program already knows the computer's IP address. This can be seen in the window called up by "Config" \ "IO" \ "Sockets", see 5.3.2.1.2 on page 173.

In the "Sockets" table click **[New]**. Give the socket a name and enter the Port number that the data will be output on. Click **[OK]** to exit.

5.3.2.1.2.3.Datagrams

It was explained in section 5.3.2.1.2 that the User Datagrams Protocol allows packets of data to be broadcast or to be sent to specific addresses without the overheads associated with the Transport Control Protocol.

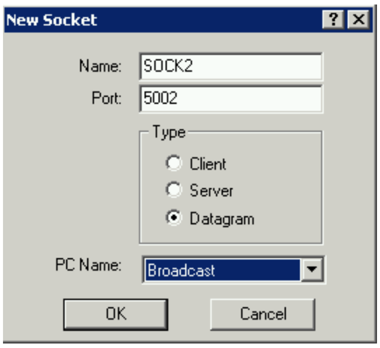
BROADCASTING

RxV cannot give multiple addresses to packets of data so if information is to be made available to more than one computer in datagrams it must be broadcast on a particular port. A computer that is broadcasting on a port also listens to all data packets that are received on that port.

DATAGRAMS TO/FROM A SPECIFIC PC

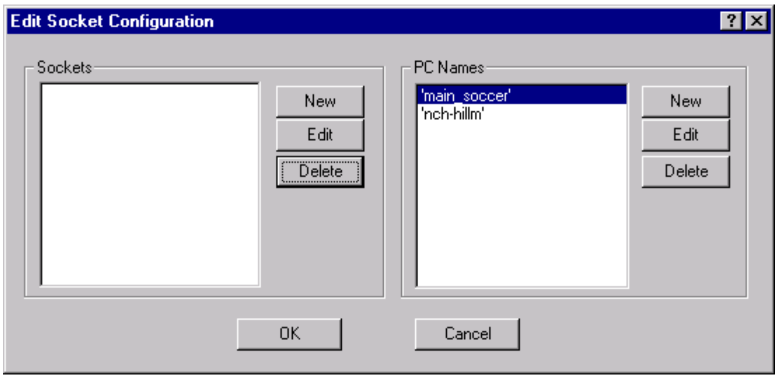
To transmit to or to receive from a specific computer, (which may itself be broadcasting), a PC must be set up with a datagram socket where the port number and the PC are identified.

To broadcast datagram packets, click the “Datagram” radio button and select “Broadcast” from the “PC Name:” list.



To target one specific PC requires that the Internet address of that PC should already have been identified. See Section 5.3.2.1.2.1 on page 174 for an explanation of adding PCs.

Once the PC has been entered in the “PC Names:” table click **[New]** in the “Sockets” table. Give the socket a name, enter the Port number and in the “PC Name list select the PC.



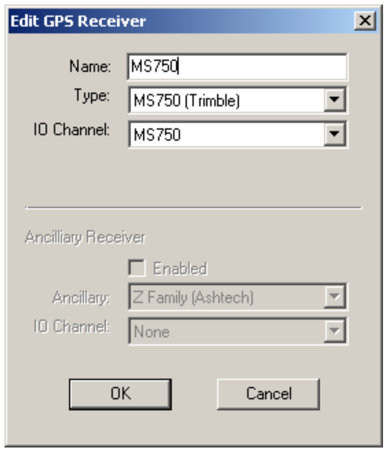
Click **[OK]** to exit.

Having set up sockets, the Edit Socket Configuration dialogue now shows the connection(s).

5.3.2.2. GPS Receiver

“Config” \ “GPS Rx…”

This calls up the Edit GPS Receiver.



Enter a receiver name in the “Name:” box. If this is left blank MultiFix will automatically assign a suitable name (e.g. 4000 DS (Trimble)). As with other name labels the program does not use it for receiver recognition purposes.

In the “Type:” section select the receiver that MultiFix 4 is to use.

There are various possible selections.

- *Z Family (Ashtech)** are dual frequency receivers.
- *DG16 (Ashtech))** is a single frequency receiver
- *G12 (Ashtech))** is a single frequency receiver
- *GG24 (Ashtech)* * is a single frequency receiver and is fitted in the Fugro 90964 units
- *4000 Series (Trimble)* refers to either a single frequency 4000DS or a dual frequency SSE/SSI
- *MS750 (Trimble)* is a dual frequency receiver
- *BD750 (Trimble)* is a dual frequency receiver
- *BD112 (Trimble)** is a single frequency receiver board fitted to the 90938/F112 SkyFix decoder.
- *DSM212 (Trimble)** is a single frequency receiver.
- *DSM (Trimble)** is a single frequency receiver board fitted to 90938/M SkyFix decoder.
- *SK8 (Trimble)** is a single frequency receiver board, but not recommended for offshore work. It has not been tested for full operation.
- *Millennium (NovAtel)* is a dual frequency receiver
- *Receiver Server* is used when the data is not live from an external receiver but is taken from raw data log files.
- *Receiver Verify* is used for interfacing to the Receiver Verify (RxV) Module.

In the “IO Channel:” section select the port on which the receiver data is input.

The Ancillary Receiver option is used for synchronising GPS measurements over a data link. This is not currently used.

When one of the receivers marked above with an asterix is selected, “Configure TSIP” or “Configure Ashtech” becomes available under the “Action” menu. This allows the receiver to be configured to output the correct data for MultiFix 4. The other Trimble Receivers are configurable using the Yellow box interface (“View” / “GPS” / “Receiver”).

Other manufacturers’ receivers require third party software to configure.

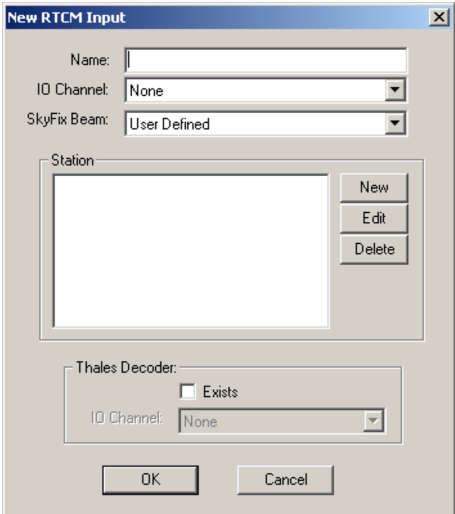
5.3.2.3. RTCM

"Config" \ "RTCM"

5.3.2.3.1.New

"Config" \ "RTCM" \ "New"

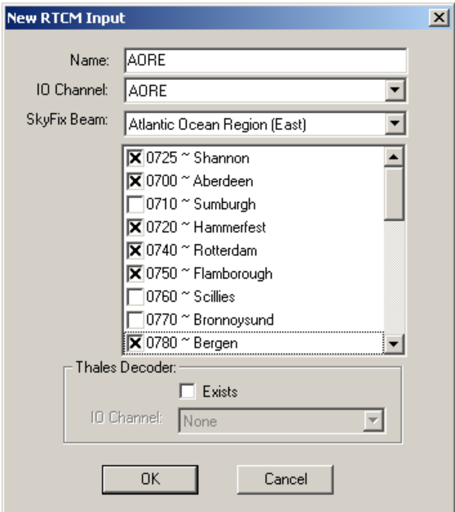
From "Config" \ "RTCM" there is a sub-menu option "New…" Click on that to make a connection to a RTCM source.



In the "New RTCM Input" dialogue give the RTCM source a name and select the "IO Channel:"

"SkyFix Beams:" contains a drop down list of all the satellite based Fugro RTCM sources. When one of those sources is selected, the dialogue is automatically populated with all the stations that carried by that system and the **[New]**, **[Edit]** and **[Delete]** buttons are lost.

If no name is given MultiFix will assign a suitable name automatically



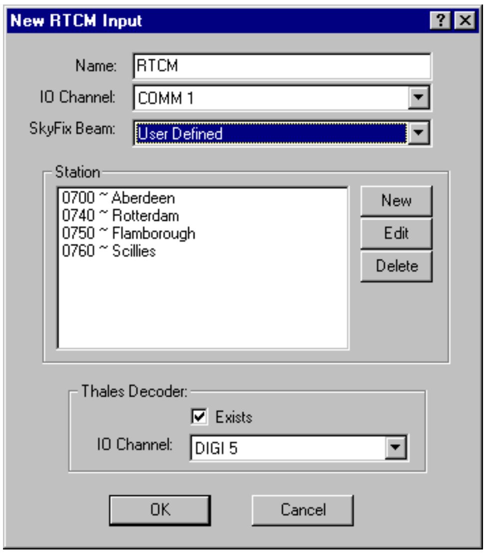
"SkyFix Beams:" contains a drop down list of all the satellite based Fugro RTCM sources. When one of those sources is selected, the dialogue is automatically populated with all the stations that carried by that system and the **[New]**, **[Edit]** and **[Delete]** buttons are lost..

It is then necessary to switch on any stations to be used by clicking the check box next to the station's name.

If MultiFix 4 is being used with a non-satellite based RTCM delivery system, or station names or numbers have been changed, a manually compiled list can be made. To add reference stations manually in the "Station" table of the New RTCM Input dialogue leave the "SkyFix Beam:" set to User Defined and click the **[New]** button.

The program requires the station ID code number. A name is also required for identity purposes but is not significant in accessing the data.

Assuming the RTCM source is outputting more than one station, after clicking **[OK]** to add the station to the list, repeat the process to add the other required stations.



If Iono free operation is planned, three criteria must be met to be viable.

1. A dual frequency receiver must be interfaced to MultiFix 4.
2. RTCM Type 1, 2 and 3 messages from one or more reference stations must be available.
3. Type 15 or 55 Ionospheric error information must also be available from the same RTCM reference stations.

If a Fugro 90938 or 2403 Decoder is supplying the RTCM corrections then it is possible to configure the decoder to output Bit Error Rate and Signal Voltage status information on a separate port (usually Port 4). If this data is required then check the “Exists” box and select the port receiving the data. This in turn activates the “SkyFix Decoder” menu item under “View” \ “Corrections”.

Click **[OK]** to accept the correction source.

If there is more than one RTCM correction delivery system add another new source and set up using either of the two procedures above.

Assuming the RTCM interface has been established, the messages from the RTCM source can be viewed to see the Reference Station numbers that the program is receiving, (see Section 5.3.4.1.4.2190).

If the RTCM source is no longer in use, again use “Config” \ “RTCM” \ “<name>” and select Delete. You will be asked to confirm or cancel the deletion. Clearly, an inappropriate deletion could impact severely on the normal operation of the program.

The program will take in any RTCM messages it receives on any RTCM IO Channel to which it has access. It is possible that an RTCM source may contain only Type 55 messages. Such a source will still need to be given an identity and an “IO Channel”. Each Type 55 message contains Ionospheric delay information from one reference station. The station ID is also in the message that is transmitted every 30 seconds. The sequence cycles through each of the available reference station, so if 7 stations are contributing Type 55 messages the information for each station will be updated every 3½ minutes.

5.3.2.3.2. Editing and Deleting

“Config” \ “RTCM” \ “<name>” \ “Edit…” or “Delete”

With an RTCM source (or sources) now defined, when “Config” \ “RTCM” is selected, the name (or names) given to the RTCM source(s) now appears in the sub-menu under the “New… menu item.

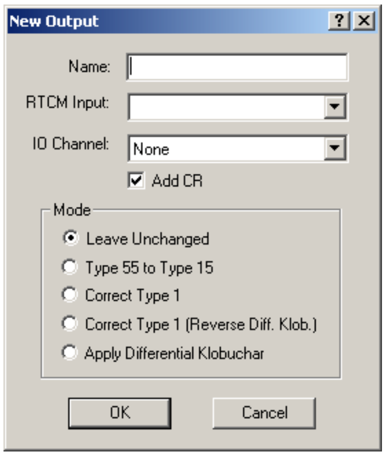
If the set up requires changing then highlight the name of the source and then select the “Edit…” option.

If the RTCM source is no longer in use, again use “Config” \ “RTCM” \ “<name>” and select “Delete”. You will be asked to confirm or cancel the deletion. Be aware that an inappropriate deletion could severely impact on the correct operation of the program.

5.3.2.4. Outputs

"Config" \ "Output"

In common with RTCM sources once an output has been defined it will appear by name in the menu drop down. Highlighting the name then allows it to be edited or deleted.



To create a new output select

"Config" \ "Output" \ "New…"

This calls up the dialogue shown opposite.

Enter a "Name" for the output.

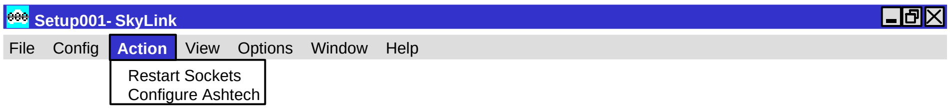
Select the "RTCM Input" source.

Select the "IO Channel" via which the messages are to be sent.

Select whether the output messages need to have a Carriage Return (CR) added to the end of each of them.

In the "Mode" table, select the required Option for output. The INTRODUCTION to this manual has discussed the options, their impact, input and hardware requirements. Please refer there for an explanation.

5.3.3. ACTION



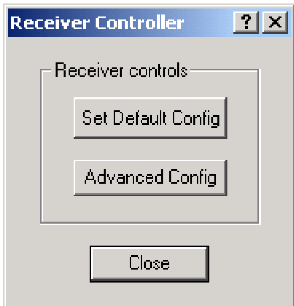
5.3.3.1. Restart Sockets

"Action" \ "Restart Sockets"

On occasion heavy network traffic may lock up TCP\IP socket ports. This option will reinitialise all currently open sockets without having to restart the software or editing the configuration files.

5.3.3.2. Configure Ashtech

"Action" \ "Configure Ashtech"



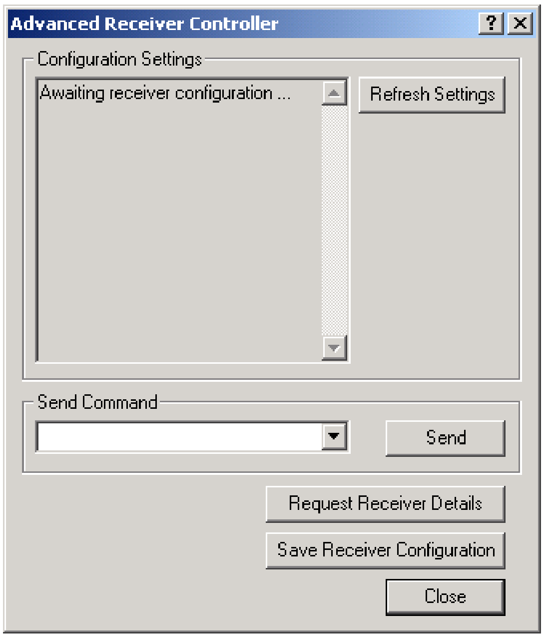
If an Ashtech GPS receiver has been selected for use with MultiFix then the "configure Ashtech" dialogue will be made available.

Assuming serial communications have already been established an Ashtech GPS Receiver can be configured from within MultiFix. See section 4.2.4.1 Ashtech (Thales Navigation) Receivers for details on how to a establish communication link with the GPS Receiver.

5.3.3.2.1. Default Ashtech configuration

Clicking on the **[Set Default Config]** button will send the basic command needed to configure the selected unit for use with MultiFix.

5.3.3.2.2.Advanced Ashtech configuration



The **[Advanced Config]** Button will call up a control menu.

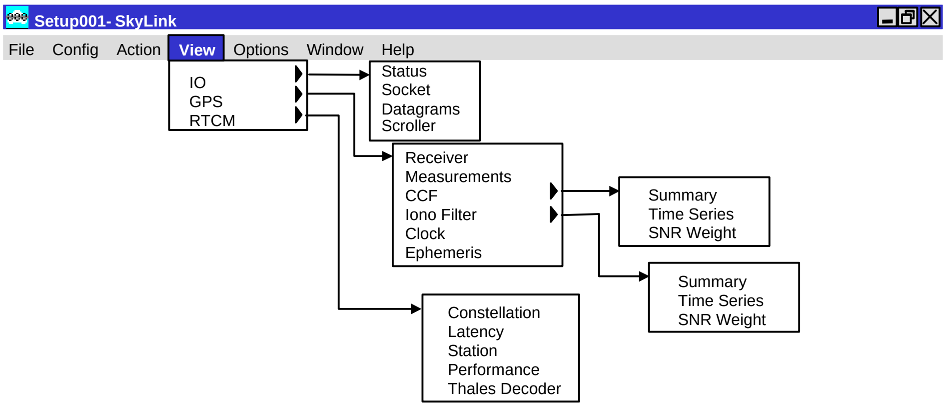
[Refresh Settings] will update the display.

[Request Receiver Details] will interrogate the GPS receiver settings and send commands to the unit.

[Save Receiver Configuration] will save the current setting to the battery powered RAM on the receiver circuit board.

The "Send Command" dialogue allows the user to send additional commands to the GPS receiver. Please refer to the appropriate Ashtech handbook for details of the available commands.

5.3.4. VIEW



Right-mouse clicking many windows allows the user to customise the display. Where that customisation is specific to the view window it will be mentioned in the relevant section dealing with that window. However several windows share the same two facilities, to “Copy” and to “Save As…”

“Copy” places a bitmap of the window onto the clipboard, from whence it can be pasted into another application.

“Save As…” allows an html file of the view window to be saved. By default it will be placed in the folder that contains the Log Pump configuration file.

In common with many Windows programs, SkyLink allows display windows to be moved outside the area displayed by the monitor. The application workspace automatically extends and scroll bars are provided. The scroll bars allow the display area to move around the extended application workspace. There is no limit on the number of windows of any type that can be open in the application workspace. Multiple copies of the same window type can be open. Indeed it will be seen that once a window is open some types of window allow further selection of the data that is to appear in them.

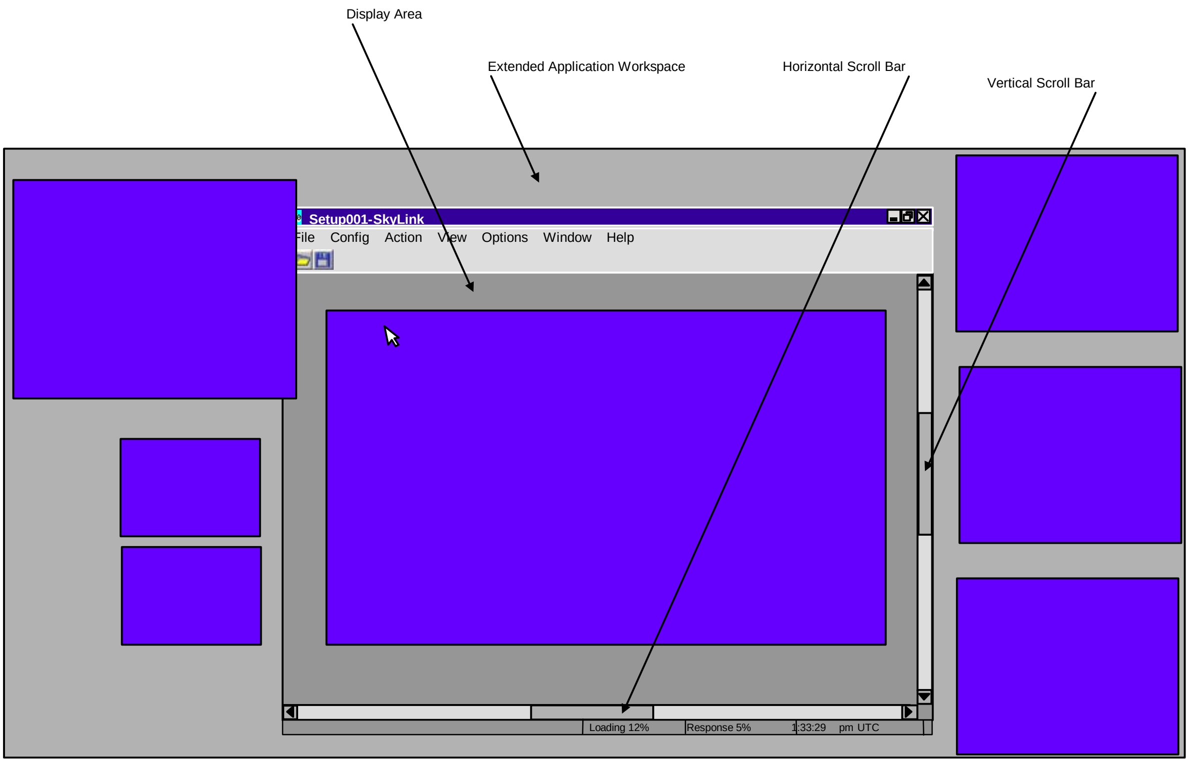


Figure 11 Windows Extending Beyond the Application Workspace

Most windows can be resized by clicking and dragging the corners or sides. Some windows that contain text will wrap the text message into the available space. Other windows containing text will simply be cropped as the window size reduces. Windows containing graphical information will resize down to a minimum and will then either crop the information or will introduce scroll bars.

5.3.4.1. Input / Output

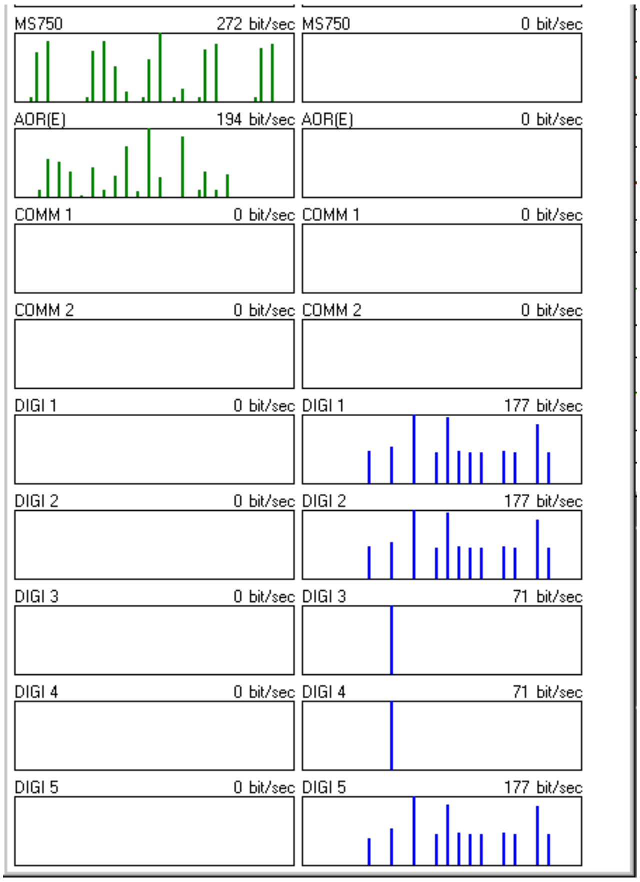
"View" \ "IO"

There are three sub-menus and each will call a window to the SkyLink application workspace.

5.3.4.1.1.Status

"View" \ "IO" \ "Status"

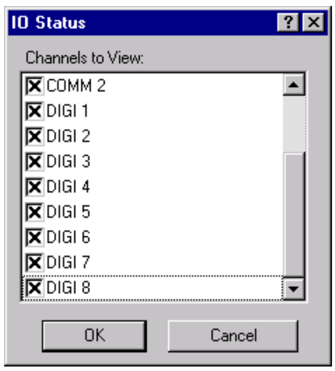
The window indicates when there is port activity.



By default the window will contain the ports Log Pump knows to exist. The "None" I/O Channel is at the top followed by streamed socket channels, datagram sockets and then the COM and Digiboard channels.

(When setting up Input / Output channels there is the option to select a dummy channel "None". If selected the blue vertical bars would be seen progressing across the None Output box).

A right-mouse click calls up the **[Channel]** button. When this is clicked the IO Status dialogue is presented. This allows channels to be selected or deselected from the status window.



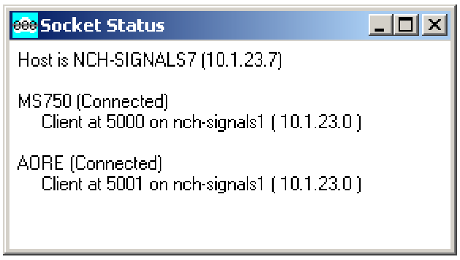
In the IO Status window the latest time is in the centre between the Input and Output columns. Each box indicates when data has been input or output, over the last 5 seconds, on that port by scrolling vertical bars from the centre to the outside edges of the window. The box re-scales such that the greatest data rate over the last 5 seconds is full scale. The current bit rate is shown opposite the I/O channel name.

5.3.4.1.2.Sockets

"View" \ "IO" \ "Sockets""

A client socket can have three states,

Idle, Connecting and **Connected**.



Idle and Connecting will alternate while connection is trying to be established. There will also be a time countdown to the next attempt to make contact.

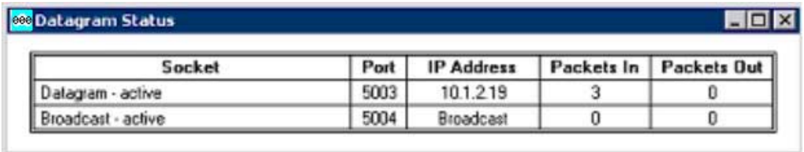
A server socket can have two states,

Idle and **Listening**.

The Idle status is almost immediately replaced by Listening.

5.3.4.1.3.Datagrams

"View" \ "IO" \ "Datagrams"



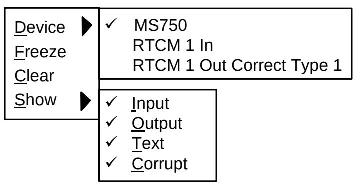
The Datagram Status window lists all Datagrams in use. The IP address indicates to which PC a link is in place or if it is transmitting a broadcast message. The "Packets In" and "Packets Out" window indicates if the datagram is working. If you are receiving data only the "Packets In" will increase. If you are transmitting to n PCs the "Packets In" will increase at n times the rate of the "Packets Out".

5.3.4.1.4.Scroller

"View" \ "IO" \ "Scroller"

Scroller is able to display any of the inputs and outputs. When first opened the display defaults to showing the link from the first GPS receiver in the configuration list.. To change to another IO Channel or to change the scrolling options, click the right mouse button.

This calls up a menu box, which has "Device", "Freeze", "Clear" and "Show" as shown opposite.



If “Device” is highlighted there is a sub-menu which lists the different input / outputs. Top of the list are the names given to the each of the GPS receivers. This is followed by the input from PDS.

If “Freeze” is selected the current window display is held and frozen appears in the windows title bar. Clicking “Freeze” again unfreezes the display. “Clear” will remove all information from the current window.

“Show” brings up a new sub-menu with four options: “Input”, “Output”, Text” and “Corrupt”. A tick next to the option indicates that the relevant information is currently displayed in the Scroller window. These options may be toggled on/off by left clicking.

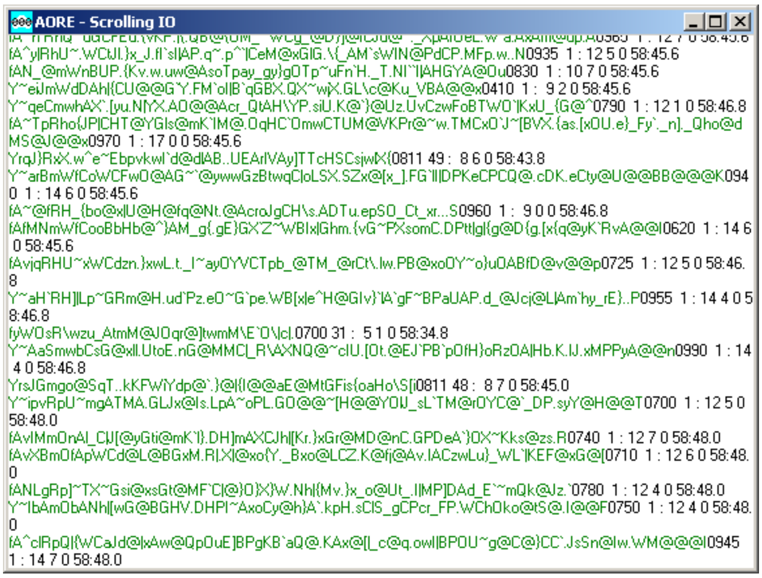
The text in the window is bottom justified and colour coded. Green indicates it has been successfully decoded and passed all parity checks. Red indicates the data is corrupted. Dark blue is reserved for outputs. When a message is received or sent successfully a black text line is added as a label. Carriage return and line feed are shown in light grey.

Scroller windows use a lot of resources and should be closed when they are not required.

For inputs it is usual to turn off the “Input” (green) section.

5.3.4.1.4.1.GPS Receiver

5.3.4.1.4.2.RTCM Input



5.3.4.1.4.3.Output Strings

5.3.4.2. GPS

"View" \ "GPS"

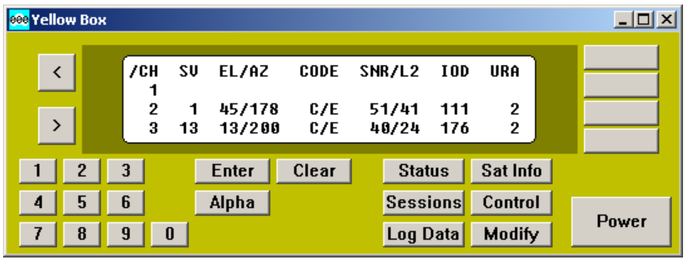
The various GPS views will only be meaningful if a GPS receiver is interfaced.

5.3.4.2.1.Receiver

"View" \ "GPS" \ "Receiver"

This menu item will only appear if a 4000 (Trimble), 4700 (Trimble), BD750 (Trimble) or an MS 750 (Trimble) GPS receiver has been defined. This window cannot be resized.

Assuming communication has been achieved between the receiver and the MultiFix program, the "Yellow Box" window acts as a remote interface with the GPS receiver in use. Clicking a button in the window performs that action on the receiver. Likewise if the menu on the receiver is being used the "Yellow Box" receiver window in MultiFix will update to the currently displayed page.



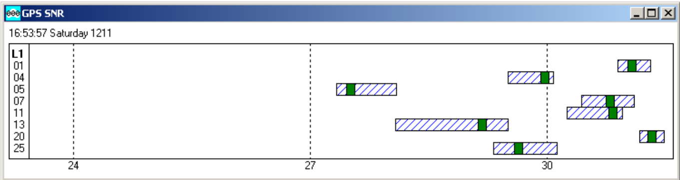
The UTC time displayed in the "Yellow Box" window will always be 1 or 2 seconds behind the UTC time shown in the Clock window. This is not a cause for concern as it is due to the time taken for the receiver to provide the front panel text.

Beware: Do not change the settings of the port communicating with the MultiFix 4 program. Once communication is lost it cannot be re-established from MultiFix 4 and must be done via the receiver.

5.3.4.2.2.Measurements

"View" \ "GPS" \ "Measurements"

The display shows the signal to noise (SNR) levels of each of the tracked satellites as a button on a bar. The width of each bar shows the minimum and maximum over the last 60 updates. The button position shows the current value. The button will be Red when there are <30 values in the filter, Yellow when between 30 and 59 and Green when 60 values have been obtained.



If two Measurement windows are opened they will not show the same information until the second Measurement window has received 60 updates.

The signal level may vary widely if the satellite is just rising, setting, or if high levels of multipath are present.

The X-axis re-scales as a function of the least minimum and the greatest maximum to be displayed.

The Y-axis will re-scale as rising satellites are acquired and setting satellites are lost.

Satellites for which there is data from the GPS receiver will still appear in the window even if they are disabled in "Action" \ "SV Status".

If using a dual frequency receiver then SNR's will be shown for L1 and L2.

5.3.4.2.3.Code Carrier Filter (CCF)

"View" \ "GPS" \ "CCF"

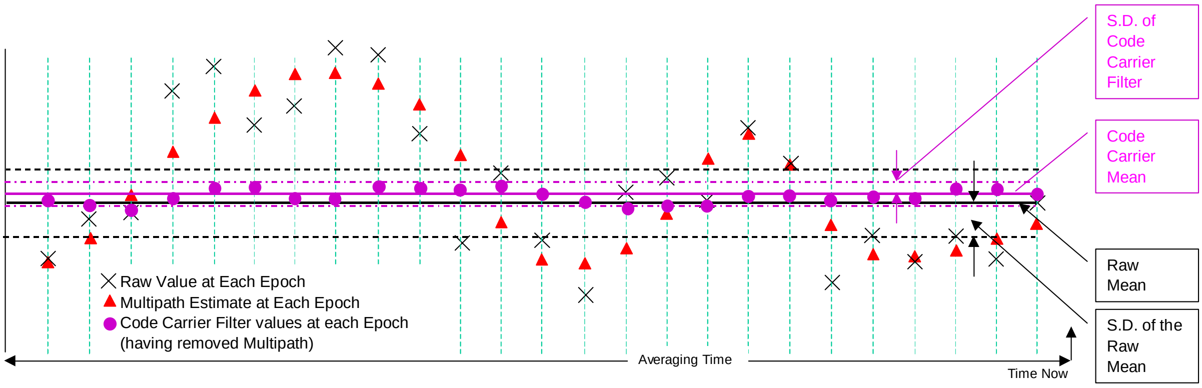


Figure 12 Graphical Representation of the Code Carrier Filter

At the heart of the program is the Code Carrier Filter. This filter attempts to model and remove Multipath. Strong Multipath has a regular short-term cyclical pattern whereas noise is considered to be random, therefore for each epoch the program estimates what effect Multipath is having on the measurements from each satellite. It then derives measurement values with the estimated Multipath removed.

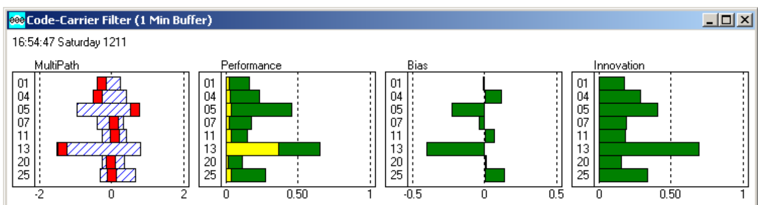
The Code Carrier Filter performance is displayed in the following two windows, "Summary" and "Time Series".

5.3.4.2.3.1.Summary

"View" \ "GPS" \ "CCF" \ "Summary"

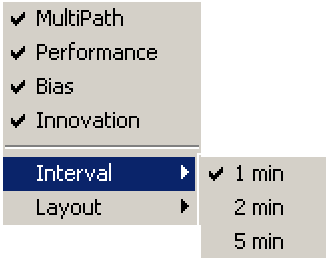
The code carrier filter displays are arguably the most significant displays for monitoring GPS measurement quality.

The right-mouse button provides display options for the window.

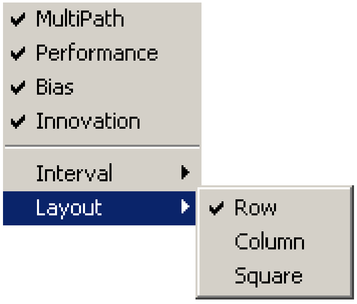


Any of the four bar chart information panels can be turned off or on by checking or un-checking the relevant name.

The averaging time used for the display can be set to 1 minute, 2 minutes or 5 minutes. (This does not change the Time Constant of the Filter itself). The averaging time is a moving window, losing the oldest adding the newest.



The layout can be set to Square (as shown above), Column or Row.



The yellow bars represent the standard deviation of the code carrier filters values and the green bars represent the standard deviation of the raw code carrier values.

All the panels re-scale as a function of the range of values to be displayed. Take particular note of the axis labels. All units are in metres.

"MultiPath" shows the results of the program's modelling of the Multipath. Each Multipath panel button shows the current Multipath estimate. The hatched area shows the minimum, maximum range of the Multipath over the averaging time being used for the display. If the filter is working satisfactorily the buttons should oscillate either side of 0 in a random manner. If the values persist in fluctuating more than 2-5 metres, or some of the current values stay high, it may indicate the antenna is sited in an area prone to Multipath and removal to another location may be advisable.

"Performance" shows the Standard Deviation of the Code Carrier Filter values and the Standard Deviation of the Raw Code Carrier values.

"Bias" shows the difference between the mean of the Filtered Code Carrier values and the mean of the Raw Code Carrier values. If the filter is working perfectly the mean of the filtered values should be the same as the mean of the raw values and therefore should be 0. A large difference indicates the filter is not modelling the raw data successfully.

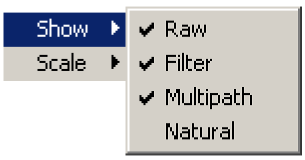
Innovation shows the Standard Deviation of the Innovation. Innovation is the difference between the Code Carrier Filter's predicted value and the Code Carrier Filter's raw value (corrected for Multipath). If the filter is performing successfully the raw values should be randomly distributed around the filtered prediction. The movement should be due to receiver measurement noise and is an indication of the quality of the GPS measurements.

5.3.4.2.3.2. Time Series

"View" \ "GPS" \ "CCF" \ "Time Series"

This is a time series representation of the code carrier filter for each measurement.

The right-mouse button provides display options for the window.

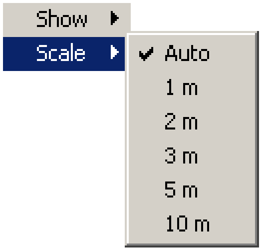


"Raw"- shows red dots representing the raw observations

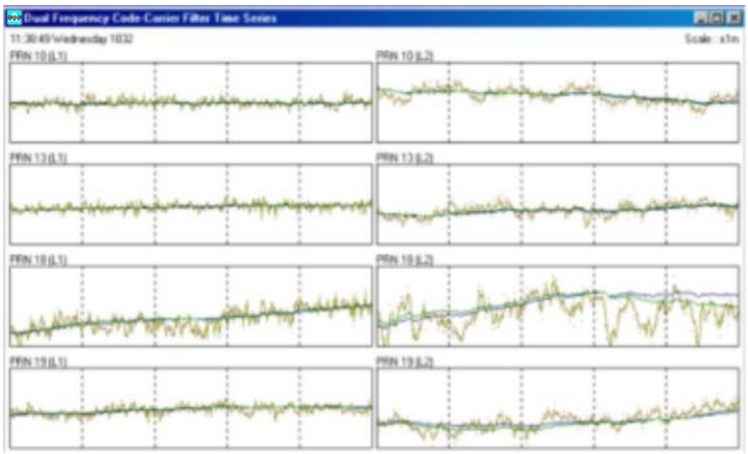
"Filter" - shows a smoothed green line indicating the observations after the Multipath estimate has been removed

"Multipath" - shows an erratic yellow line is the Multipath estimate.

"Natural" - a smooth blue line is going to be removed.



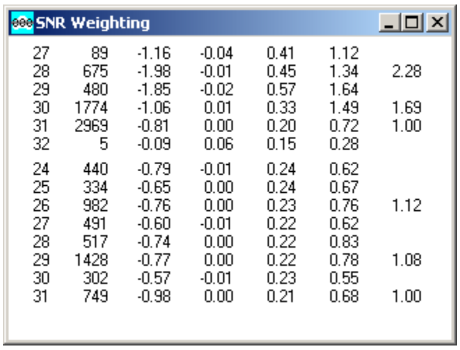
If dual frequency data is being received two sets of graphs will be displayed, showing the code carrier filter information of both the L1 and L2 frequencies.



5.3.4.2.3.3.SNR Weight

"View" \ "GPS" \ "CCF" \ "SNR Weight"

This screen provides information with regard to the signal to noise ratio weightings of the measurements. Generally, a lower SNR value is indicative of more noise and Multipath in an observation. MultiFix 4 will give more weight within the computation process to a measurement with a higher SNR value.



SNR Weighting

27	89	-1.16	-0.04	0.41	1.12	
28	675	-1.98	-0.01	0.45	1.34	2.28
29	480	-1.85	-0.02	0.57	1.64	
30	1774	-1.06	0.01	0.33	1.49	1.69
31	2969	-0.81	0.00	0.20	0.72	1.00
32	5	-0.09	0.06	0.15	0.28	
24	440	-0.79	-0.01	0.24	0.62	
25	334	-0.65	0.00	0.24	0.67	
26	982	-0.76	0.00	0.23	0.76	1.12
27	491	-0.60	-0.01	0.22	0.62	
28	517	-0.74	0.00	0.22	0.83	
29	1428	-0.77	0.00	0.22	0.78	1.08
30	302	-0.57	-0.01	0.23	0.55	
31	749	-0.98	0.00	0.21	0.68	1.00

The first column shows the SNR value of the measurement.

The second shows the number of observations with that SNR value.

The third is the minimum measurement.

The fourth column is the mean.

The fifth column is the standard deviation of the observations.

The sixth column shows the maximum value.

The final column shows the **relative weight** of the measurements with respect to the best value, which is assigned a value of 1.00. If there are less than 600 observations for an SNR value the program will use the next lowest SNR value with more than 600 observations. If no SNR values have more than 600 observations it will use the default setting.

SkyLink uses the relative SNR in tuning the CCF

5.3.4.2.4.Iono Filter

"View" / "GPS" / "Iono Filter"

The options available from the Iono Filter menu will only be valid if SkyLink is receiving dual frequency data. Values of the ionospheric delay are derived from this filter. The options available from the menu are the same as those available in the Code Carrier Filter menu because the same form of data is used in both filters. The data can be treated in the same way and therefore the same filters can be used.

5.3.4.2.4.1. Summary

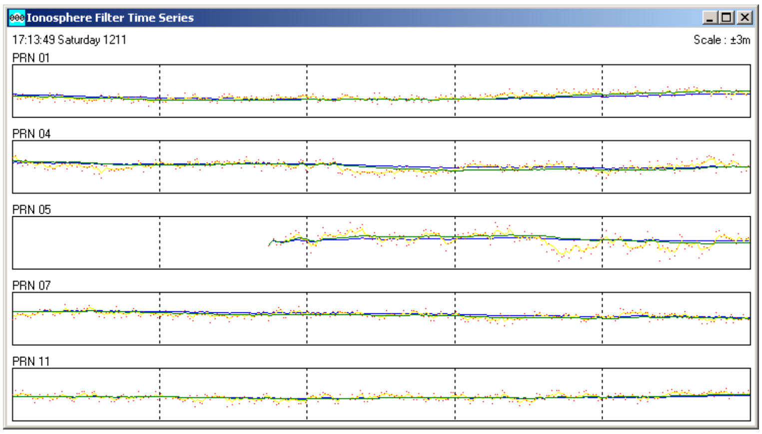
"View" / "GPS" / "Iono Filter" / "Summary"

Refer to section 4.3.6.4.4.1 page 101.

5.3.4.2.4.2.Time Series

“View” / “GPS” / “Iono Filter” / “Time Series”

The time series plots for the Iono Filter will be noisier than those for the Code Carrier Filter because they are a combination of the L1 and L2 frequencies. Refer also to section 4.3.6.4.4.2 on page 103.



5.3.4.2.4.3. SNR Weight

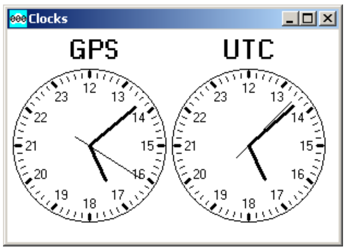
“View” / “GPS” / “Iono Filter” / “SNR Weight”

As with the Code Carrier Filter, the relative SNR weights are used to fine tune the filter.

5.3.4.2.5.Clock

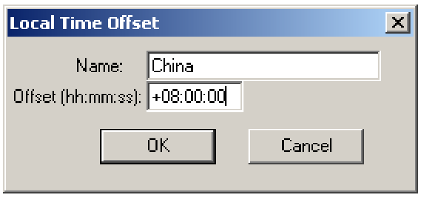
“View” \ “GPS” \ “Clock”

As can be seen, GPS Time was 13 seconds ahead of UTC Time when this screen dump was taken.

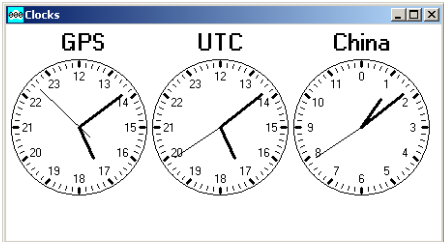


It is possible to include extra clocks in this display by right clicking in the window and selecting “Add Local…”.

Enter a name for the clock and the time offset, in the format (hh:mm:ss), then click **[OK]**.



These can be used to provide a local time offset from UTC for the work area.

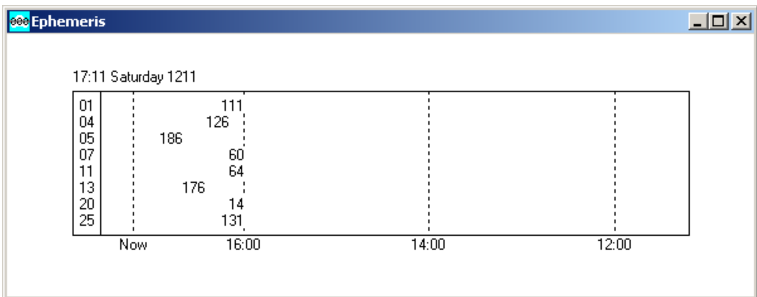


Right clicking on the window now provides extra options to "Edit", "Delete", or "Hide" the additional clock(s).

5.3.4.2.6.Ephemeris

"View" \ "GPS" \ "Ephemeris"

The Ephemeris window shows the previous 6-hour period. The Ephemeris issue number is placed at the time when an update was received. The issue number typically increments by 1 but that is not always the case. The majority of updates occur every 2 hours. Updates between this period may be due to a rising SV.



A right-mouse click on the window provides the "Copy" and "Save As…" facilities.

5.3.4.3. RTCM

"View" \ "RTCM"

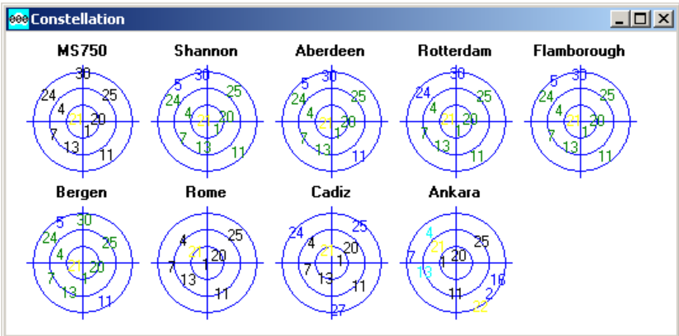
If the program is being run to output Option 1 or 2 RTCM messages, then no GPS receiver is required. Without a GPS receiver it is likely that there will be no almanac data. In that case many of the RTCM views will either not contain information or will be incomplete.

Likewise if only stations that were defined when configuring the RTCM input will be able to be seen in the following RTCM windows.

5.3.4.3.1. Constellation

"View" \ "RTCM" \ Constellation

The Constellation window shows the position of the satellites as seen at each of the reference stations.



The outer ring of each Bullseye refers to 0° elevation and the centre is the zenith. The bottom centre of the SV numbers text is the current position, as shown below:

14

The satellite numbers are colour coded.

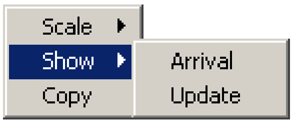
- Black indicates L1 and L2 corrections are available for use in a calculation.
- Green indicates L1 data only is available for use.
- Light blue indicates a satellite is expected but no corrections for that satellite have yet been acquired, which may be due to the satellite being set to unhealthy.
- Dark Blue indicates the SV is below the elevation cut off.
- If a satellite is disabled in the SV Status dialogue the number appears red.

When the window is resized by click and dragging a corner, the program rearranges the constellation displays to best fit the available area.

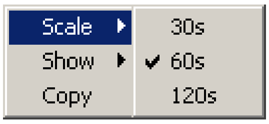
5.3.4.3.2.Latency

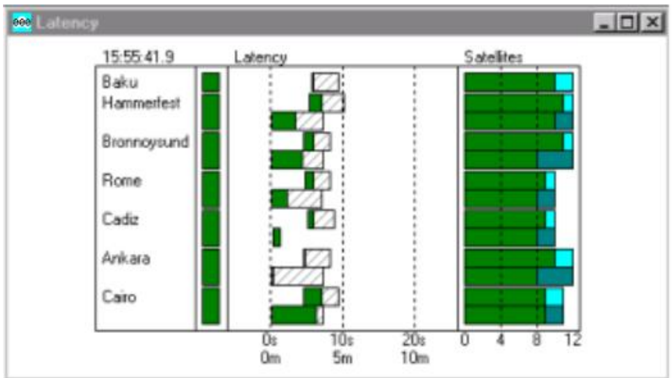
“View” \ “RTCM” \ “Latency”

By default this Window does not show the two columns “Arrival Latency“ and “Update Interval” but a right-mouse click allows them to be added.



The right-mouse click also allows the time scale of the Latency columns to be changed and it allows the window to be copied to the clipboard.





The example above has two rows of information for each dual frequency reference station. The first row refers to Type 1 messages and the second row refers to Type 15 or 55 messages where applicable. These will only appear once messages have been received. The Type 1 rows and Type 15/55 rows have different time scales as can be seen at the bottom of the Latency columns.

The first column after the name of the station will show a green button when the program has received an RTCM Type 3 Reference Station position message. This only has to happen once after starting the program. The program will not use RTCM corrections from a reference station without a Type 3 message having been received.

The “Latency” column shows the correction update rate as a bar. The left-hand edge of the bar shows how old the current correction was when first received by MultiFix 4. It is a measure of the efficiency of the correction delivery system. (The corrections are time stamped with GPS time by the reference station, and as MultiFix 4 also has access to GPS time the age of the corrections at the time of receipt is known). The right-hand side of the bar advances until a new correction is received showing the age of the current correction. The bar also shows a hatched area showing the update rate of the last correction received.

For Type 1 messages:

- Bars will be green if the last correction was received in less than 25 seconds.
- They will be yellow between 25 and 37½ Seconds.
- They will be red if older than 37½ seconds. After 50 seconds the corrections from that reference station will no longer be deemed usable.

For Type 15/55 messages:

- The bars will be green if the last correction was received in less than 5 minutes.
- They will be yellow if received between 5 minutes and 7½ minutes.
- They will be red if older than 7½ minutes. Type 55 information is considered stale if it is more than 10 minutes old.

The “Latency” panel has a negative area. Some GPS correction systems (not SkyFix) try to predict corrections for a point of time in the future when a correction is to be used. If a fast data transfer system is used the corrections can arrive with a time stamp earlier than current time, in which case the bar will start in the negative portion of the panel.

The optional “Arrival Latency“ and “Update Interval” panels contain data extracted from the “Latency” panel.
In “Arrival Latency” the right-hand end of the bar shows how old the current corrections were when received by MultiFix 4.
In “Update Latency” the bar shows how long elapsed between the receipt of the current and previous correction messages.

The “Satellites” column shows how many satellites (viable for use by MultiFix) can be seen at each reference station.
The colour coding is: -

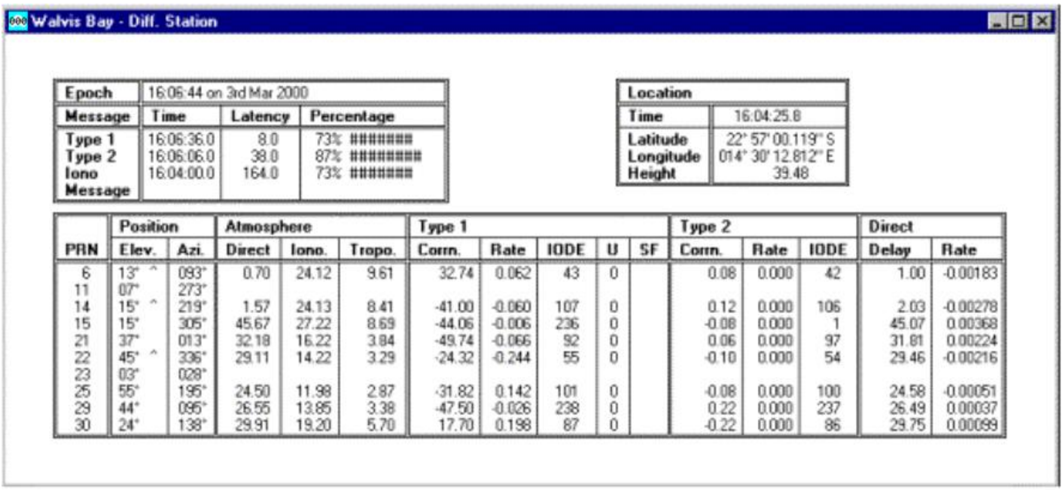
- **Green** - correction data has been received for the expected satellite(s).
- **Yellow** - the satellite(s) are unhealthy.
- **Dark blue** – the satellite(s) is in the high scale factor mode, i.e. the resolution is 32cms as opposed to 2cms. This is usually caused by a rate value greater than ±0.256m/sec.

- **Light blue (Aqua)** - no corrections have been received for one or more expected satellites, i.e. it is missing.
- **Red** - the satellite(s) has been disabled by the user in the SV Status dialogue.

(Without almanac information, the satellites table will show missing satellites. If there is no GPS receiver from which to obtain time, the latency information may be incorrect).

5.3.4.3.3.Station

"View" \ "RTCM" \ "Station"



Epoch	16:06:44 on 3rd Mar 2000		
Message	Time	Latency	Percentage
Type 1	16:06:36.0	8.0	73% ########
Type 2	16:06:06.0	38.0	87% ##########
Iono	16:04:00.0	164.0	73% ########
Message			

Location	
Time	16:04:25.8
Latitude	22° 57' 00.119" S
Longitude	014° 30' 12.812" E
Height	39.48

	Position		Atmosphere			Type 1					Type 2			Direct	
PRN	Elev.	Azi.	Direct	Iono.	Tropo.	Corrn.	Rate	IODE	U	SF	Corrn.	Rate	IODE	Delay	Rate
6	13° ^	093°	0.70	24.12	9.61	32.74	0.062	43	0		0.08	0.000	42	1.00	-0.00183
11	07°	273°													
14	15° ^	219°	1.57	24.13	8.41	-41.00	-0.060	107	0		0.12	0.000	106	2.03	-0.00278
15	15°	305°	45.67	27.22	8.69	-44.06	-0.006	236	0		-0.08	0.000	1	45.07	0.00368
21	37°	013°	32.18	16.22	3.84	-49.74	-0.066	92	0		0.06	0.000	97	31.81	0.00224
22	45° ^	336°	29.11	14.22	3.29	-24.32	-0.244	55	0		-0.10	0.000	54	29.46	-0.00216
23	03°	028°													
25	55°	195°	24.50	11.98	2.87	-31.82	0.142	101	0		-0.08	0.000	100	24.58	-0.00051
29	44°	095°	26.55	13.85	3.38	-47.50	-0.026	238	0		0.22	0.000	237	26.49	0.00037
30	24°	138°	29.91	19.20	5.70	17.70	0.198	87	0		-0.22	0.000	86	29.75	0.00099

The window initially opens showing the first RTCM reference station. To have the window show data for another station, right click on the window and select the station.

The top left table shows the time tag of the latest messages, the age of the corrections and the percentage.

For Type 1 messages a percentage of 30 seconds.

For Type 2 messages a percentage of 300 seconds.

For Iono (Type 55 or Type 15) messages a percentage of 600 seconds.

Message (Type 16) a percentage of 600 seconds. When received the message will be displayed at the top of the window and will remain for 10 minutes unless overwritten.

The Location shows the station position as received in the Type 3 message.

The lower table has various sub-sections.

"PRN" is the satellite number.

“Position” shows the satellites’ positions and if they are rising the elevation is tagged with a ^.

“Atmosphere” has: -

- “Direct” is the ionospheric delay derived for the present moment from the dual frequency information. (It will not be present if a single frequency reference station is selected).
- “Iono” is the ionospheric delay for time now from the Klobachar model
- “Tropo” is the tropospheric delay for time now from the tropospheric model.

“Type 1” has: -

- “Corrn.”, which is the current pseudo-range correction
- “Rate”, which is the rate of change of the pseudo-range correction
- “IODE”, which is the Issue of Data Ephemeris
- “U”, which is the User Differential Range Error, (normally 0)
- “SF” is flagged when the Correction Rate is greater then ±0.256 or when the correction is >±660.

The “Type 2” table will usually only be seen during an Ephemeris change (every 2 hours), when the mobile’s GPS receiver is using a different Issue of Ephemeris to the reference station being viewed.

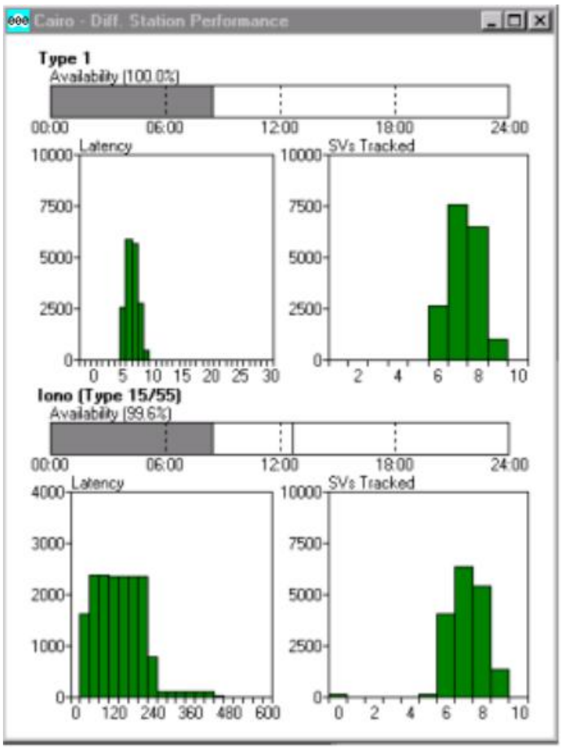
- “Corrn”, which is the correction to the correction based on the difference in IODE.
- “Rate”, which is the rate of change of the correction.
- “IODE”, which is the Issue of Data Ephemeris number.

“Direct” contains the Ionospheric delay values and rates as transmitted in the Type 15 or 55 messages. (Without Type 15/55 information the section will be omitted).

5.3.4.3.4.Performance

"View" \ "RTCM" \ "Performance"

This window refers to a particular reference station.



When first opened it defaults to the first reference station in the list. To change to another station use a right-mouse click and select a different station in the "Station" dropdown list.

A right-mouse click also shows that the view window can be copied and saved.

The RTCM Performance window has two sections.

The top is for Type 1 RTCM correction messages. The bottom for Type 15/55 Ionospheric Delay correction messages. If the reference station has not got the capability to transmit Type 15 or 55 messages then that part of the window remains blank

The "Availability" bar at the top refers to the current day, midnight to midnight.

- A grey area indicates a period when the program was not running.
- A red area indicates when there had been no corrections received from the station for more than 50 seconds.
- A white area indicates either corrections were present or that time of day has not yet been reached.

The "Latency" histogram shows how old the corrections from the station were at each epoch, so if corrections that were 2 seconds old on receipt were received regularly every 6 seconds the histogram would show a spread from 2 to 8 seconds.

The "SV's Tracked" histogram shows the spread in the numbers of SV's tracked each epoch.

The "Iono Type 15/55" tables at the bottom show the same information as above for those message types. The permitted Type 15/55 messages are not considered stale until 600 seconds has elapsed rather than the 50 seconds for the Type 1 messages.

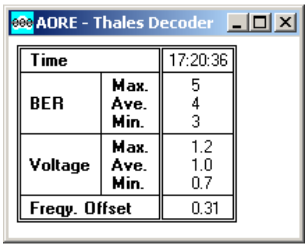
5.3.4.3.5.SkyFix Decoder

"View" \ "RTCM" \ "SkyFix Decoder"

Assuming the SkyFix Decoder option has been enabled and given an IO channel, see Section 5.3.2.3 on page 179, the output from the decoder can be viewed.

The decoder can output "TEST" data on port 4 only. The interval between updates occurs every 1000 data blocks received and is proportional to the satellite channel data rate.

This update rate may be between 2.5 and 6 minutes.

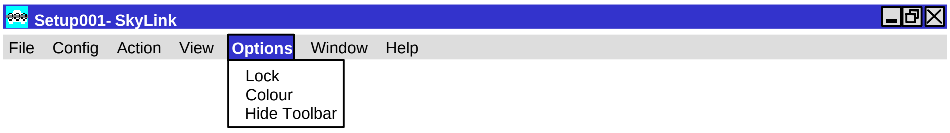


The BER or Bit Error Rate is typically between 5 and 7.

The Voltage is the signal strength voltage, <1 volt indicates poor signal level, >2 volts indicates good signal level.

The Frequency Offset should be in the range ±2.50 kHz.

5.3.5. OPTIONS



5.3.5.1. Lock

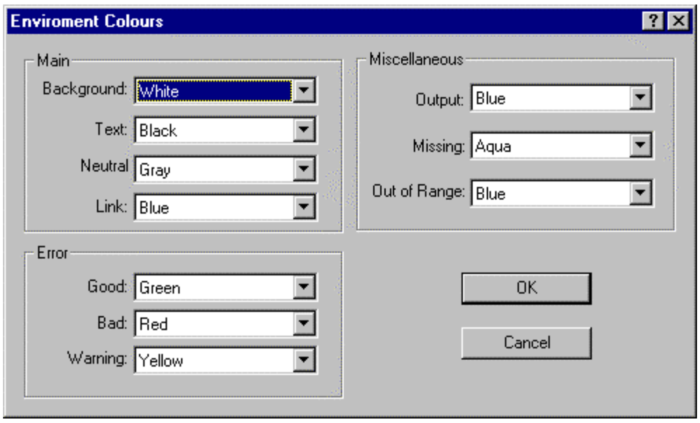
"Options" \ "Lock"

If the Lock option is chosen "File" and Config" are removed from the menu bar. Whilst locked, "Options" \ "Lock" changes to "Options" \ "Unlock". This reinstates "File" and Config".

5.3.5.2. Colour

"Options" \ "Colour"

If different colour schemes are required they can be set up here. Ensure that a false impression is not given when changing the colour coding, in particular relating to errors.



Some of the selections do not affect all view windows.

- "Main"

  "Background" and "Text" change the windows background and text colours.

  "Neutral" is used in the Latency window to show period when update may be expected.

  "Link" is not currently used.

- "Error".

  Various windows have stages of error state, these colours relate to them.

  "Good", "Bad" and "Warning".

- "Miscellaneous"

  "Output" as seen in the IO status and IO Scroller windows.

  "Missing" as seen in the Latency and Constellation windows.

"Out of Range" as seen in the Latency and Constellation windows when a satellite is below the mask.

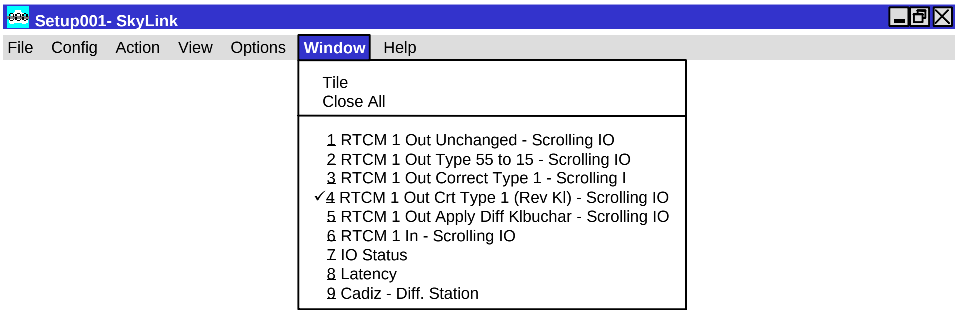
5.3.5.3. Hide Tool Bar

"Options" \ "Hide Tool Bar"

This will hide the shortcut toolbar displayed at the top of the MultiFix screen.

When hidden the option will change to "show toolbar" which will return the toolbar to the screen when selected.

5.3.6. WINDOWS



5.3.6.1. Tile

"Window" \ "Tile"

The tile command causes the application workspace to be reduced to the display area. The windows that are not minimised are re-sized and fitted into the display area The minimised windows are neatly stacked along the bottom of the screen.

5.3.6.2. Close All

"Window" \ "Close All"

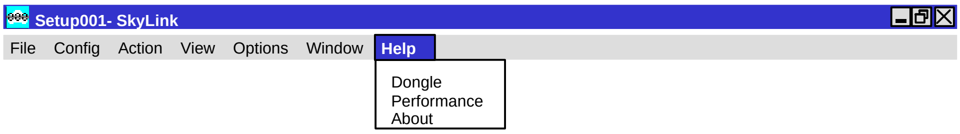
The close all command does just that. All the windows irrespective of their status will be closed. As there is no confirmation required, be careful not to use it in error.

5.3.6.3. The Open Windows

The "Window" drop down will also list all the windows currently open. Windows can be overlain one on top of another and it can be difficult to locate an obscured window. Clicking the window in the list causes the focus to shift to that window, the title bar is highlighted and it will come on top of all the other windows. If there is an extended application workspace and the selected window is off screen, while it will be the window with the focus the display area will not move to show the window.

If there are more than 9 windows open the bottom line will be "More Windows…" If that is selected a dialogue is opened listing all the windows. Highlight one of them and close the dialogue.

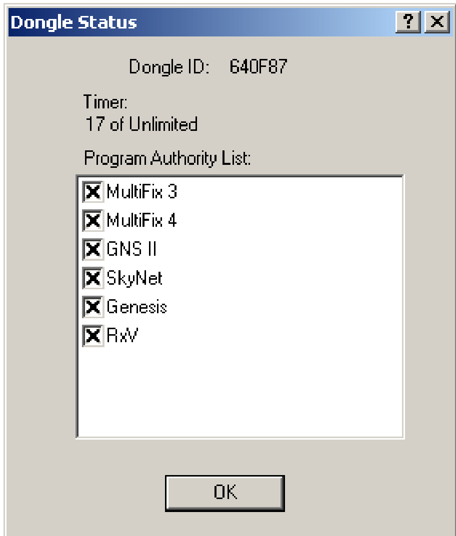
5.3.7. HELP



5.3.7.1. Dongle

"Help" \ "Dongle…" provides the information stating

- which programs the DK2 is authorised to run
- the time limit of the dongle
- the amount of use the dongle has already had.

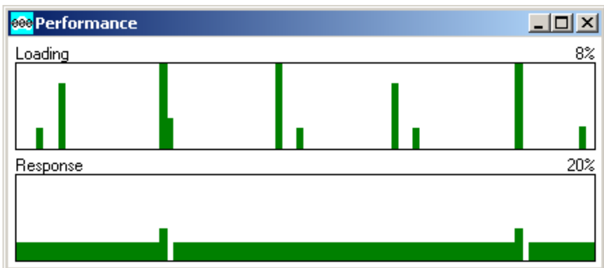


SkyLink does not require a dongle. If a dongle is in the parallel port it will be interrogated as shown opposite. If there is not one there a message will be posted saying no dongle present.

5.3.7.2. Performance

"Help" \ "Performance"

The Performance window shows how the program is handling the data acquisition and calculation process with the available resources. The window does not take into account other programs that are running simultaneously.



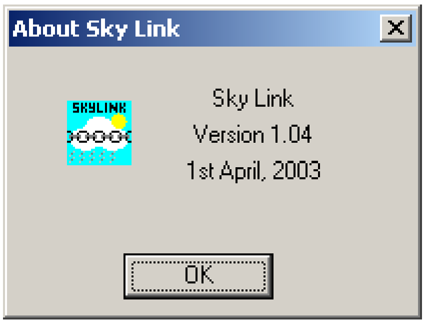
The graphs will be green below 50%, yellow between 50% and 75% and red when above 75%.

It is important there is enough time for all the processes to be completed in an orderly fashion. If there are too few resources the position solution may lag. The demand on the processor can be reduced by accessing only the data from the RTCM reference stations used in the computations, by having fewer computations and by closing windows.

The performance information can also be seen in the bar at the bottom of the application window next to the UTC Time.

5.3.7.3. About

"Help" \ "About…" provides the version number and release date



6. RECEIVER VERIFY (RXV)

6.1. INTRODUCTION

Receiver Verify, or RxV, is designed as an additional component to the core MultiFix 4 application and must be used in conjunction with MultiFix 4.

RxV takes in Almanac, Ephemeris, Raw Code and Carrier measurements from multiple GPS receivers. RxV also requires real-time antenna offset information from the PDS–Lite application. RxV then combines all off the information into a single set of GPS pseudoranges for a user-defined location. In this way, any blockage or interference in the GPS signals at an individual antenna location can be identified and corrected for, providing the user with a reliable stable and continuous GPS position even in the most difficult of situations.

RxV has been designed in a modular fashion such that data is passed between modules as if over a computer network. As such RxV must be used with both MultiFix 4 and PDS 2000 in order to function correctly.

While a single computer can be used for all three, the individual modules can also be run on different computers provided there is network interconnection available.

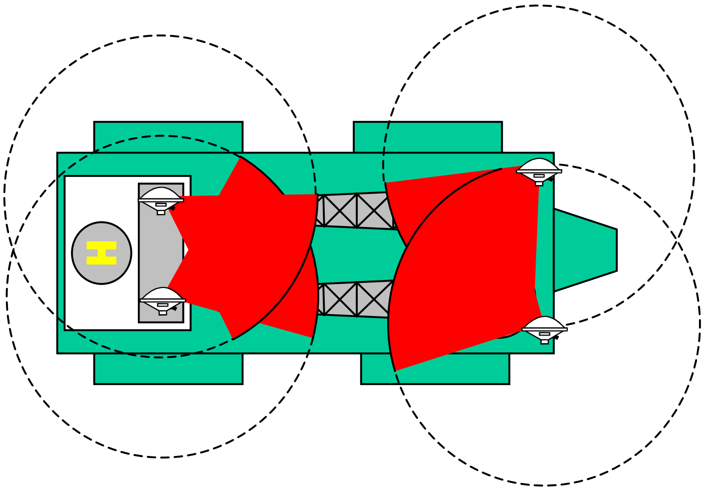
RxV is one of a series of programs available in the Zero Suite and this section relates primarily to RxV although there are some references in the manual to the other programs, such as MultiFix 4.

The text in this manual conforms to certain conventions

7. All command buttons are shown bold and bracketed with square brackets e.g. **[OK]**,
8. When a keyboard key is represented, it is shown bold and bracketed by greater than and lesser than symbols e.g. **<spacebar>**.
9. Each dialogue has a title. When the name is in the text it is underlined e.g. Edit GPS Receiver.
10. Direct quotations from dialogues or edit control slots are shown in normal text in quotations, e.g. “IO Channel:”

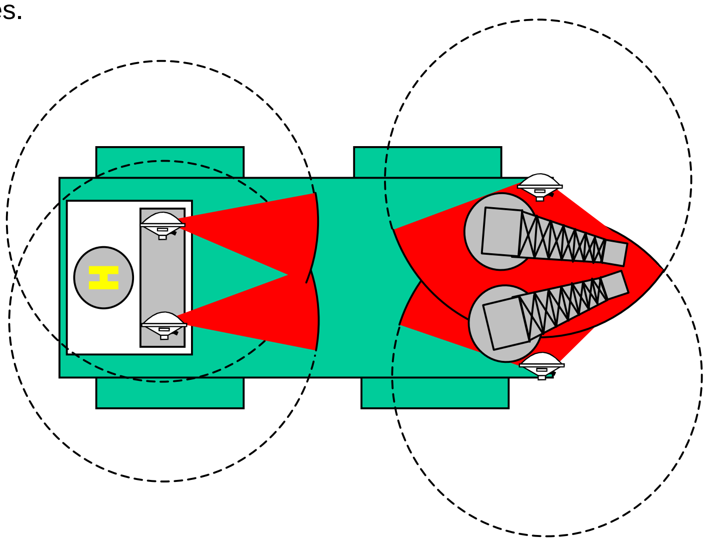
6.1.1. RXV APPLICATIONS

Many offshore vessels suffer unavoidable blockage of GPS satellites. Vessels such as Jack Up drilling rigs, lift boats and constructions barges have overhead obstructions, sometimes dynamic such as a crane, resulting in no suitable location for the GPS antenna. This can have serious implications on many projects, often during the most critical phase of the operation. In the example below a crane barge has four available locations for GPS antennas.



The two heavy lift cranes cause some obstruction, even when stowed. This can be in the form of direct blockage or as multipath and is marked in red on the diagram.

Traditionally this would be avoided by raising the antennas on a mast above the level of the stowed cranes.



When the cranes are operational the masking situation changes. The cranes will be lifted from their normal location and rise far above the GPS antennas.

It should be noted that in both of the examples that, between them, the array of GPS antennas has an unobstructed view in all directions. RxV allows the user to combine the unobstructed views from each antenna to produce a “virtual GPS antenna” at any selected location. In this way, stable positioning can be maintained throughout any operation, even if there is masking of the individual antennas.

6.1.2. Operational Theory

A GPS position is derived by combining the individual ranges from each GPS satellite. These satellite ranges are called Pseudorange as they are not direct measurements of distance but derived from the travel time of the signals form the GPS.

If the relative location and orientation of the GPS antenna is known, the range can be transposed to another location over a short range. RxV combines each set of pseudorange in this way by transposing the observations from each antenna to a common location. The resultant redundancy can be used to check if any of the transposed pseudoranges are obviously erroneous, and if so, removed. The remaining pseudoranges are then combined to derive a set of pseudoranges for a “virtual” antenna at the common location.

6.2. CONFIGURATION

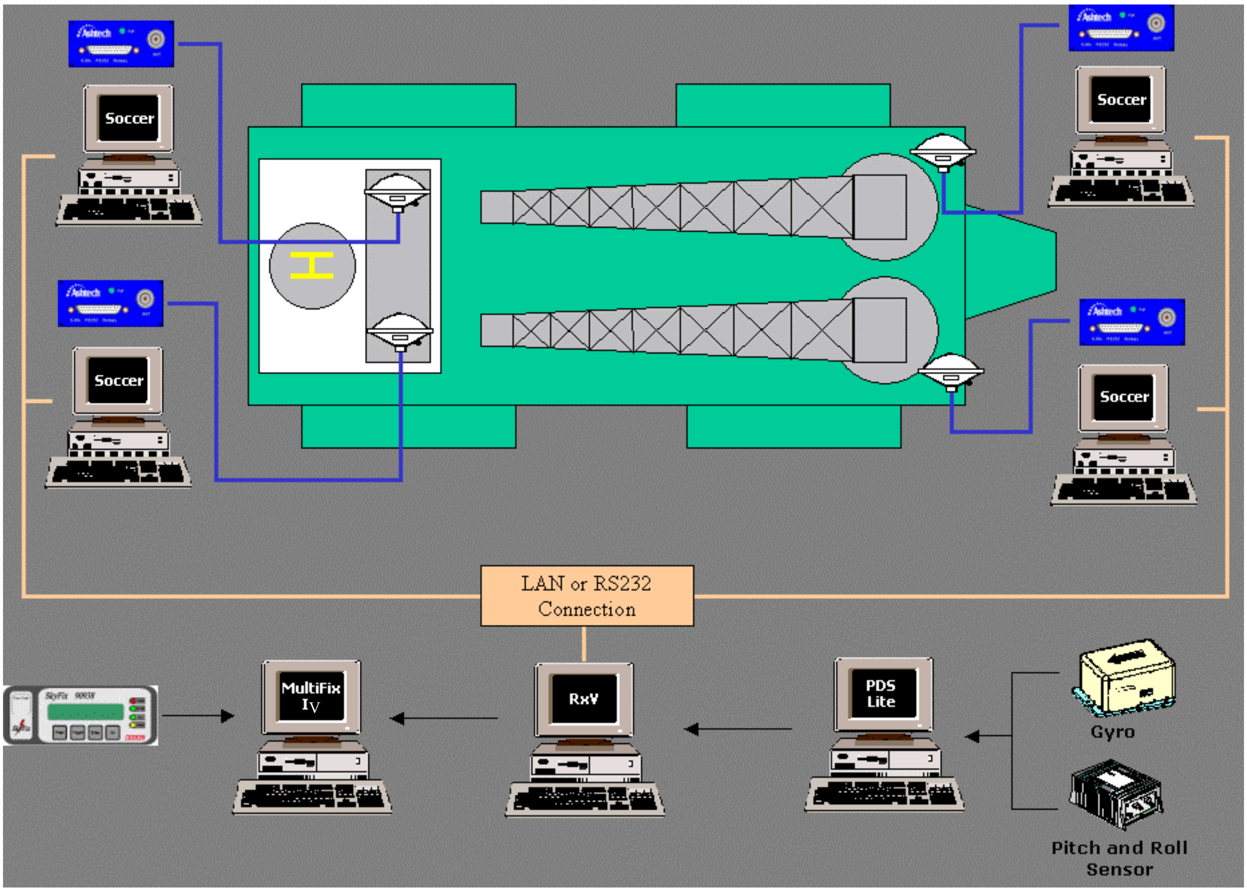


Figure 13 Example Interconnection with four GPS Receivers and soccer software

In the above example, four separate GPS receivers are being used in various locations around the vessel. The GPS measurements are transferred back to the RxV module via either a Local Area Network (LAN) or standard RS-232. If the data is to be transferred over a LAN then another zero application, Soccer, can be used to convert the serial data output from the GPS receiver into TCP/IP messages for transfer over the LAN.

It is possible to transfer the data using a number of techniques, including radio modems or fibre optic cables. The communications structure is based on the system most suitable for the vessel.

The PDS-Lite module requires inputs from both a pitch and roll sensor and a gyro. The MultiFix module will also require RTCM corrections, such as those from a 90938 SkyFix decoder, in order to provide a DGPS solution.

6.2.1. HARDWARE REQUIREMENTS

RxV requires the following:

A PC running Windows 98, Windows NT or Windows 2000. The minimum recommended PC is a 350 MHz Pentium II with 32 MB RAM. A graphics resolution of at least 1024 by 768 pixels is advised in order to achieve maximum clarity of all the graphics displays.

For the installation of the software the PC requires a CD-ROM drive. It is possible to create installation floppy discs from the installation menu on the CD but 8 floppies are needed.

RxV can use both a single frequency and dual frequency GPS receivers, but will not generate L2 observations

RxV 1.01 supports the following GPS receivers:

Manufacturer	Model	Single/Dual Frequency
Ashtech (Thales Navigation)	Z Family	Dual
Ashtech (Thales Navigation)	DG16	Single
Ashtech (Thales Navigation)	G12	Single
Ashtech (Thales Navigation)	GG24	Single
Trimble	BD112	Single
Trimble	BD750	Dual
Trimble	DSM	Single
Trimble	DSM212	Single
Trimble	SK8	Single
Trimble	4000DS	Single
Trimble	BD750	Dual
Trimble	MS750	Dual
Trimble	4000 SSE	Dual
Trimble	4000 SSi	Dual

6.2.2. COMMUNICATIONS NETWORK

The nature of MultiFix RxV requires the GPS receivers to be distributed widely about the vessel.

Running excessive antenna cables is not usually a viable option due to the potential distances involved. As an alternative, the data from each receiver can be transmitted back over a serial connection or LAN.

The simplest solution is to run serial cables from each receiver, however to operate over longer distances an RS232 to RS422 adapter would be needed.

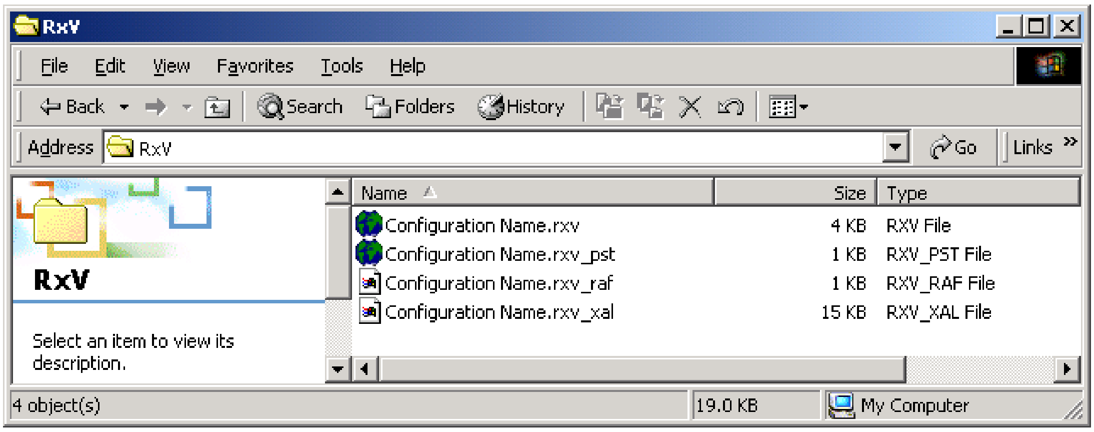
For installations in remote or inaccessible locations a radio telemetry system, such as the Thales TracsCOM can be used.

Alternatively a Local Area Network (LAN) can be used. Soccer is used to convert RS232 communications from the GPS Rx to a TCP/IP socket (See Section 7). The data can then be transmitted over a standard Ethernet network connection. Where space is limited, small serial to Ethernet converters are also available.

The existing ships IT infrastructure can be used (if available) or standard PC networking components can be used, including wireless networking products.

6.2.3. RXV FILES

After installation and after a program run, RxV will have created / stored several files in the folder selected by the operator for the configuration file.



The *.rxv is the core RxV configuration file and is stored in XML format.

rxv_PST is the Persistence file; it is the number, type, position and contents of windows in the application workspace when a configuration file is saved. It is written when the program is exited.

rxv_RAF is a GPS almanac. This will be updated as the almanac changes and when the configuration file is saved.

rxv_XAL file is another GPS almanac. This will be updated as the almanac changes and when the configuration file is saved. The XAL file is stored as in an XML format for export to other applications, such as GeoSky 2.

If log files are to be returned for analysis, then ALL the above files should be returned as well.

6.2.4. TO RUN RXV

RxV can be opened a variety of ways.

Use Windows Explorer to display the contents of the folder containing the RxV program files and then double-clicking the “Receiver verify” application icon.

Select “Start” \ “Programs” \ “MultiFix 4 Vx.xx” and click “Receiver Verify”.

6.2.5. MULTIFIX CONFIGURATION

In order to derive a position from the RxV output data MultiFix 4 must be used.

A data connection must be established between the two software modules. This can be either via sockets or through a serial port. If a serial port is used a high baud rate should be selected (38400 at least).

MultiFix is then configured as per a normal GPS receiver by selecting “Receiver Verify” as the GPS Rx. type.

6.2.6. INTERFACING TO PDS 2000 LITE

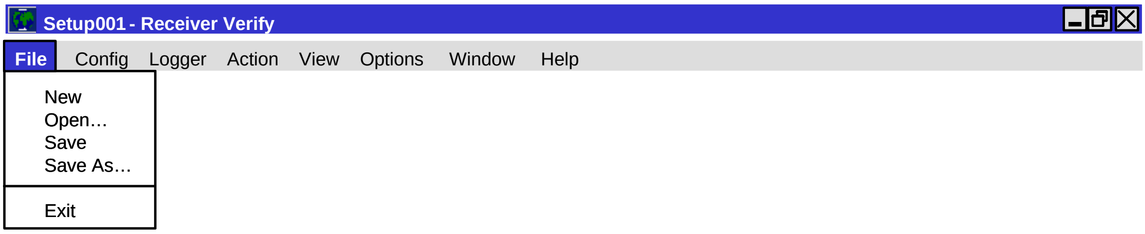
Pitch and Roll sensor information and offset measurements are handled by the PDS 2000 Lite module. Data is then provided as a 3D model of the relative physical relationship of the GPS antenna onboard based on their known offsets, the heading of the vessel and the motion of the vessel (pitch and roll).

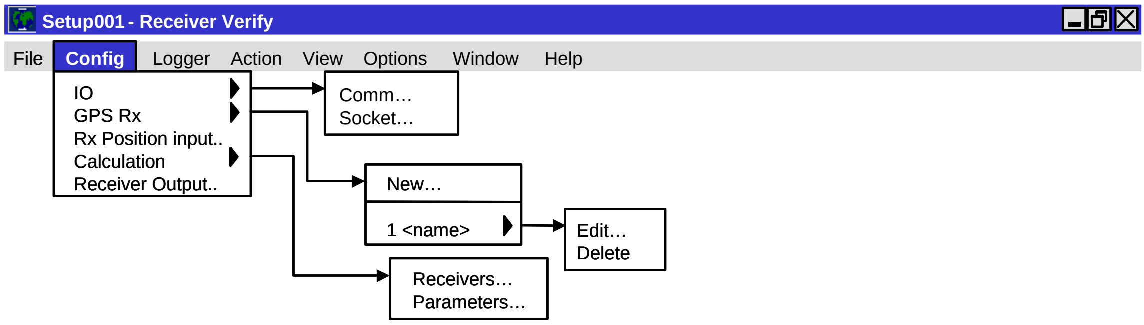
The module therefore requires a position input as well as gyrocompass and motion sensor data and outputs the model as a formatted message to Receiver Verify.

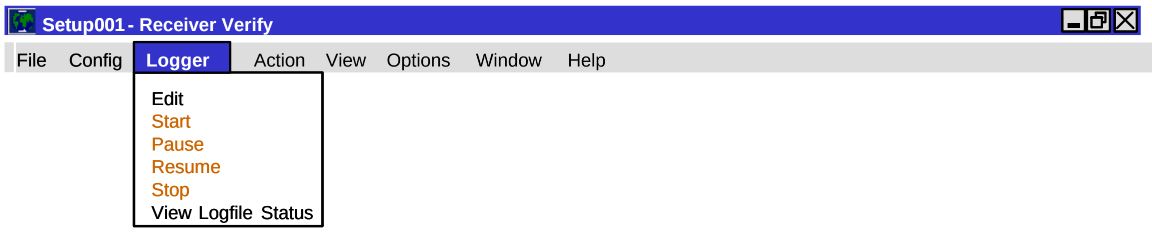
Please refer to the PDS manual for details of configuring PDS 2000 Lite.

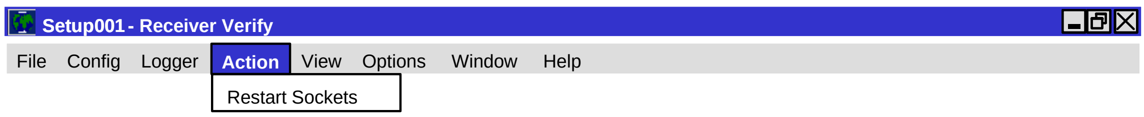
The input is then entered into Receiver Verify under Rx Position Input see section 0 for more details.

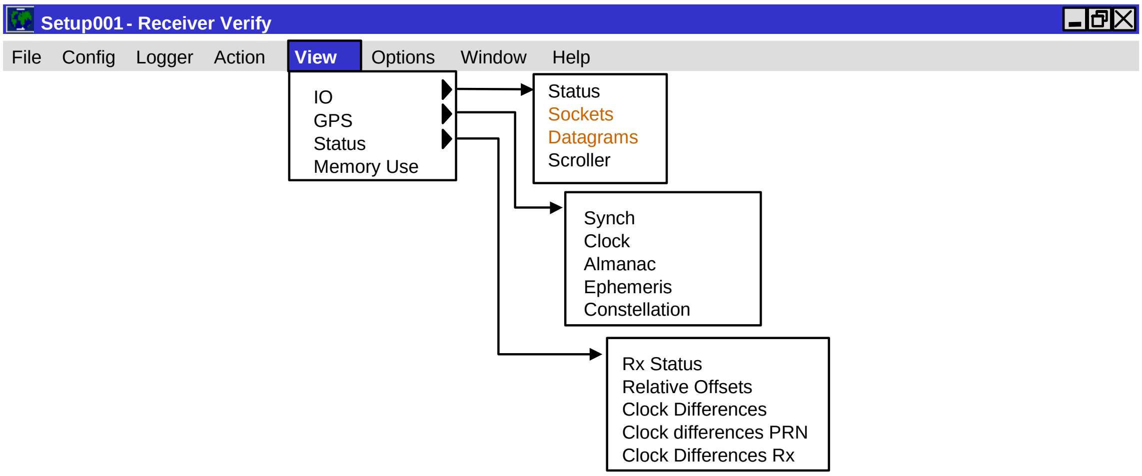
6.3. REAL TIME OPERATION

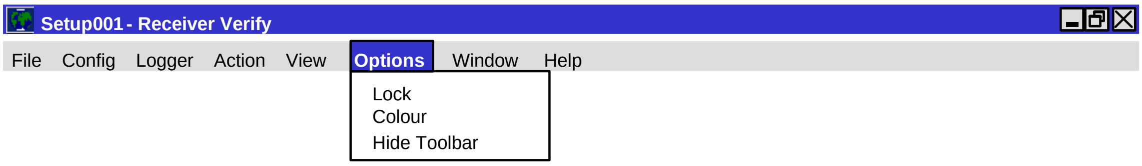


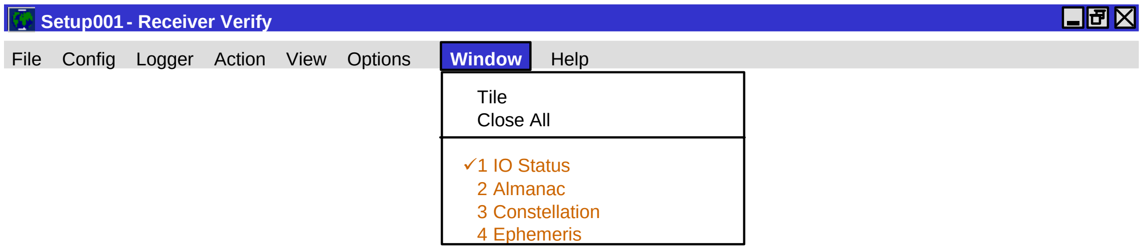


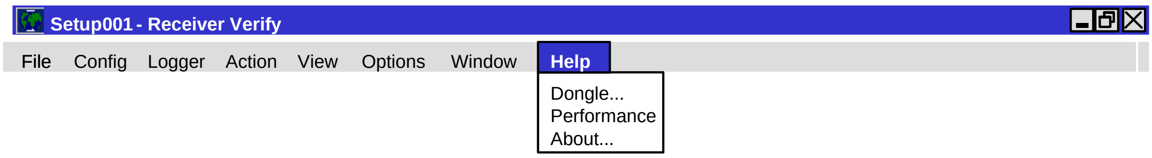




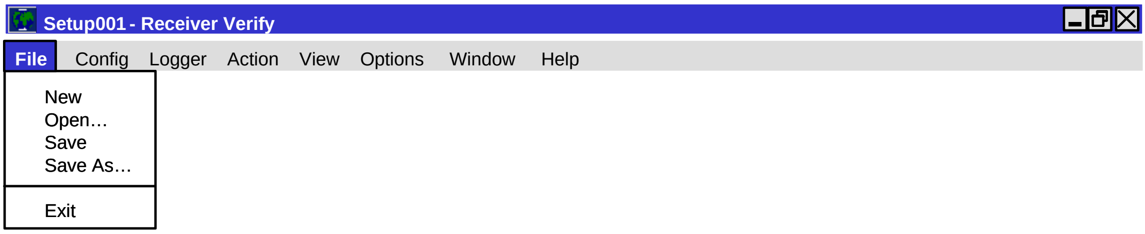

Setup001 - Receiver Verify
File Config Logger Action View Options Window Help
IO
GPS
Status
Memory Use
Status
Sockets
Datagrams
Scroller
Synch
Clock
Almanac
Ephemeris
Constellation
Rx Status
Relative Offsets
Clock Differences
Clock differences PRN
Clock Differences Rx


Setup001 - Receiver Verify
File Config Logger Action View Options Window Help
Lock
Colour
Hide Toolbar


Setup001 - Receiver Verify
File Config Logger Action View Options Window Help
Tile
Close All
✓1 IO Status
2 Almanac
3 Constellation
4 Ephemeris


Setup001 - Receiver Verify
File Config Logger Action View Options Window Help
Dongle...
Performance
About...

6.3.1. FILE



6.3.1.1. New

"File" \ "New…"

To start a new RxV configuration select this option.

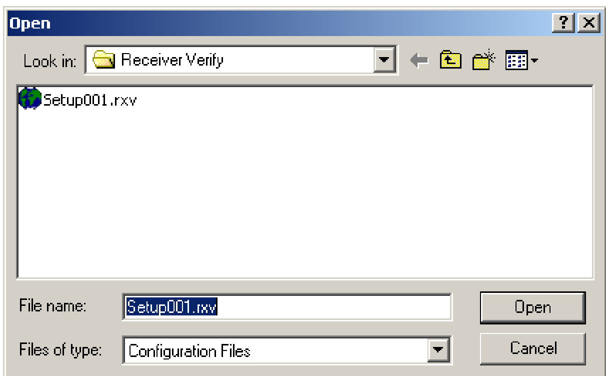
Beware, starting a new configuration will close the existing configuration and assuming the program is already up and running, it will cease real time operation. A confirmation box will request confirmation before closing the previous configuration. If the configuration has not been saved the confirmation box will prompt the user to do so.

At the bottom of the "File" menu is a list of recently used configuration files. Clicking on one of these files opens up the chosen configuration.

6.3.1.2. Open

"File" \ "Open…"

When opened the program does not know which configuration file to open. Assuming a previously prepared configuration exists, use this facility to select it.



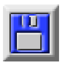
The configuration files have program name and version identifiers in a file header. They also have a configuration file version number. The program will not allow configuration files to be opened that are not compatible with the version of RxV that is currently being run. However if the configuration file version is the same they can be used even though created by a different program version.

File open can also be accomplished using  the button.

6.3.1.3. Save

"File" \ "Save"

A configuration is not automatically saved as changes are made, therefore use this facility to update the configuration file to the current status. If the set up is being undertaken for the first time and the configuration does not have an identity, the use of "File" \ "Save" will call up the Save As dialogue. That dialogue requires a name to be entered for the RxV files. Once a configuration has been named, use of "File" \ "Save" performs the save without calling up the Save As dialogue.

The name of the current configuration file appears in the application workspace title bar. If configuration changes are made that have not been saved, that file name has an * appended to it. After a "File" \ "Save" the * is removed. File saving can also be accomplished using the  button.

6.3.1.4. Save As

"File" \ "Save As…"

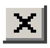
If the current configuration is to be saved but not at the expense of overwriting the existing configuration files, use the "File" \ "Save As…" option. This creates new RxV files and leaves the previous files as they were. The program immediately commences to use the new files as the current configuration files.

The Save As dialogue requires the operator to enter a name for the new configuration file. If an existing file name is entered, the program will overwrite the existing files.

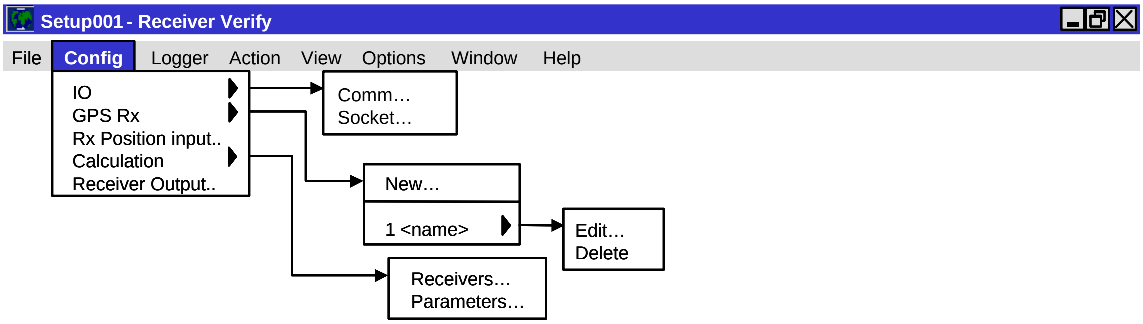
6.3.1.5. Exit

"File" \ "Exit"

This exit route is immediate if no configuration file is loaded.
Confirmation is required if a configuration file is in use. The user will be prompted to save the configuration if they have not already done so.

If the program is exited using the  button when the current configuration has not been saved, a dialogue is presented asking whether to save the configuration prior to exit or whether to cancel the exit. If there have been no configuration changes then the program will terminate immediately.

6.3.2. CONFIGURE



6.3.2.1. IO

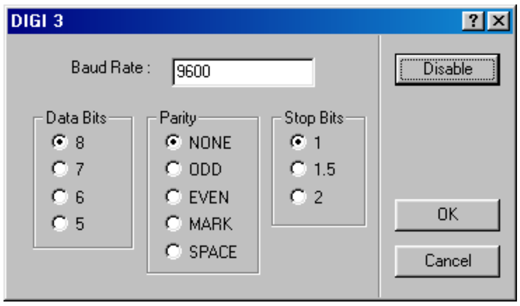
"Config" \ "IO"

6.3.2.1.1.Comm

"Config" \ "IO" \ "Comm…"

Earlier it was explained that the "Programs" / "MultiFix 4 Vx.xx" / "IO Config" applet needed to be run after installation to define what ports the computer has available (see section 3.4 on page 13). The parameters selected there determine the dialogue box that is presented when "Config" \ "IO" \ "Comm…" is selected.

Highlight one of the ports to be used and click **[Edit]**. This opens another dialogue box for setting the port parameter settings.



Click the **[Enable]** button to activate the port and set the Baud Rate, Data Bits, Parity and Stop Bits.

6.3.2.1.2. Sockets

"Config" \ "IO" \ "Socket…"

To be able to distribute and receive data over a network via sockets assumes each computer has Transmission Control Protocol / Internet Protocol (TCP/IP) installed. Sockets have the advantage over COM ports in that two or more programs can access the same data.

Sockets can transfer data between programs running on different computers or between two or more programs running on the same computer. (If a standalone (non-networked) computer running Windows NT is used and the data is to be shared between multiple programs running on that PC then the MS Loopback Adapter network adapter must be installed).

The TCP/IP protocol is a family of protocols that allow Internet data communication. Included in that family are two transport layer protocols, the Transport Control Protocol (TCP) and the User Datagram Protocol (UDP).

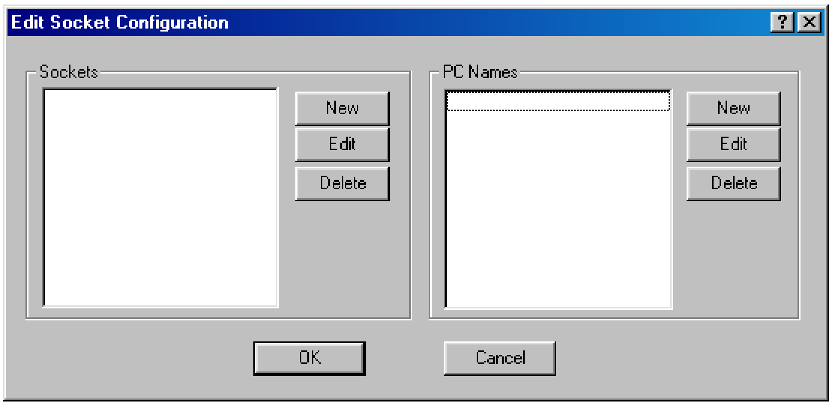
The Transport Control Protocol establishes sessions between a Server and however many Clients that are accessing that Server. There is continual presence checking and acknowledging between each Server/Client pairs with messages always received in the order they were issued. A Server does not have control of the number of Clients that access the socket on which data is being presented. (It is often perceived that the Server provides data and the Client receives data, but once the connection is established the link is two-way).

- The User Datagram Protocol does not have the end-to-end checking overhead of the TCP. Instead packets of data are simply issued to the Internet in either broadcast mode, where any networked computer on the LAN can receive them, or in addressed mode where the data packets have headers specifying the addressees for whom the packets are intended. There is no guarantee with this protocol that the messages will arrive in the order they were issued. When setting up "Ribbons" to output datagrams a time interval can be specified to prevent data becoming corrupted, see section on "Ribbons" 7.3.2.2. Broadcast datagrams cannot pass routers linking Local Area Networks (LAN) unless specifically configured.

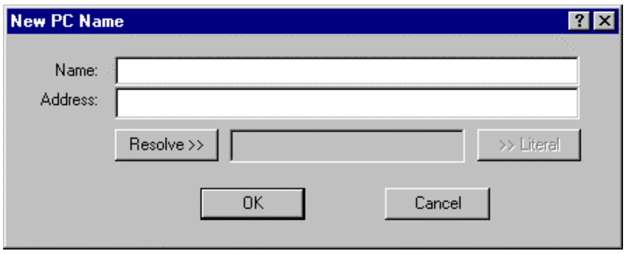
For most situations where Local Area Networks are involved Server / Client TCP sockets are the best choice Internet transport protocols.

6.3.2.1.2.1.The RxV Computer as a TCP Client

For a Client to make contact with a Server, the operator must know the IP address (or the network identification name - see below) of the Server computer and the port number the Server is outputting the required data on.

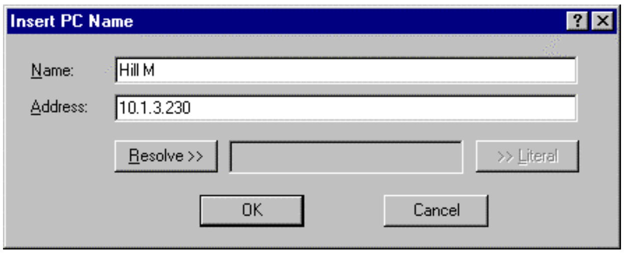


First, in the "PC Names" table click **[New]**.

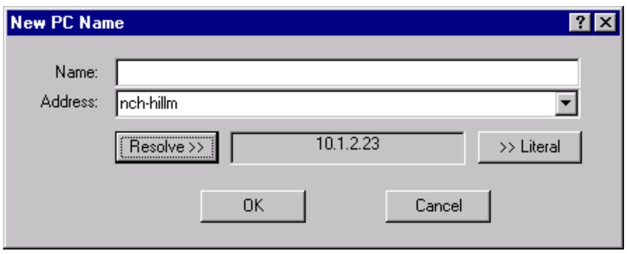


There are two possible ways of defining the server PC.

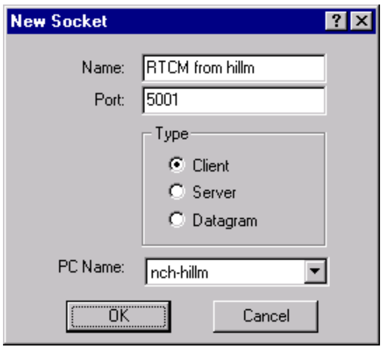
If the numerical IP address is known, enter a PC name in "Name:" and the IP address in "Address:" and click **[Resolve>>]**. Click **[OK].**



If the IP address is not known but the computer's network identification name is, and if all computers involved are aware of local naming services (WINS / DNS), then type in the computer's name in the "Address:" slot and click **[Resolve>>]**. Once the computer is found, its IP address will appear as shown. If required, use **[>>Literal]** to transfer the name and address to their named slots. Click **[OK].**



It is normal in a network for computers to be allocated new IP addresses when the PC is restarted. If the Client PC has a numerical entry for the address and the Server's address has changed, it will not be able to re-locate it. If the Client PC has the name of the Server PC in the address slot, it will automatically search to re-locate the Server PC by name. Assuming it is found, the Client PC will obtain the Server PC's current address.

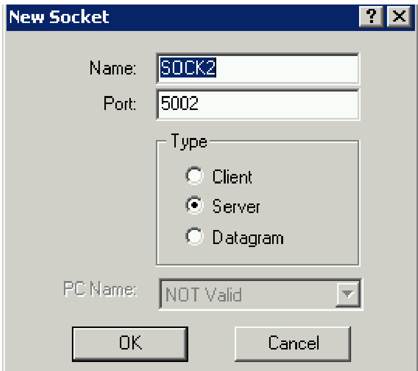


In the "Sockets" table click **[New]**.

Now check the "Client" radio button and select the "PC Name:" of the server.

Enter the number of the port on which the Server PC is presenting the data. Change the socket's default name if required.

6.3.2.1.2.2. The RxV Computer as a TCP Server



If the RxV computer is to be a server then there is no need to add the Soccer computer to the PC table; the program already knows the computer's IP address. This can be seen in the window called up by "View" \ "Sockets", see 6.3.5.1.2 on page 241.

In the "Sockets" table click **[New]**. Give the socket a name and enter the Port number that the data will be output on. Click **[OK]** to exit.

6.3.2.1.2.3.Datagrams

It was explained in section 6.3.2.1.2.3 that the User Datagrams Protocol allows packets of data to be broadcast or to be sent to specific addresses without the overheads associated with the Transport Control Protocol.

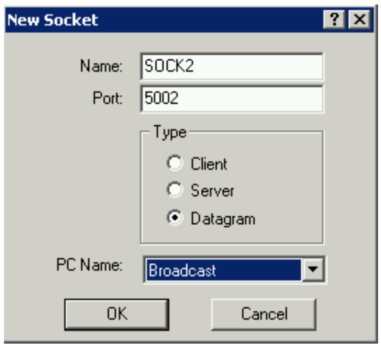
BROADCASTING

RxV cannot give multiple addresses to packets of data so if information is to be made available to more than one computer in datagrams it must be broadcast on a particular port. A computer that is broadcasting on a port also listens to all data packets that are received on that port.

DATAGRAMS TO/FROM A SPECIFIC PC

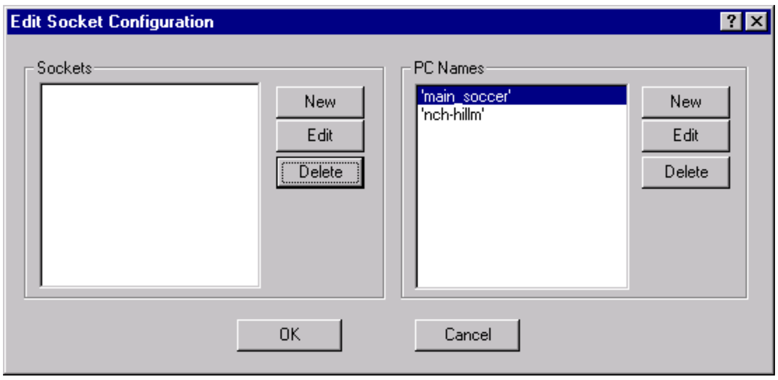
To transmit to or to receive from a specific computer, (which may itself be broadcasting), a PC must be set up with a datagram socket where the port number and the PC are identified.

To broadcast datagram packets, click the “Datagram” radio button and select “Broadcast” from the “PC Name:” list.



To target one specific PC requires that the Internet address of that PC should already have been identified. See Section 6.3.2.1.2.1 on page 226 for an explanation of adding PCs.

Once the PC has been entered in the “PC Names:” table click **[New]** in the “Sockets” table. Give the socket a name, enter the Port number and in the “PC Name list select the PC.



Click **[OK]** to exit.

Having set up sockets, the Edit Socket Configuration dialogue now shows the connection(s).

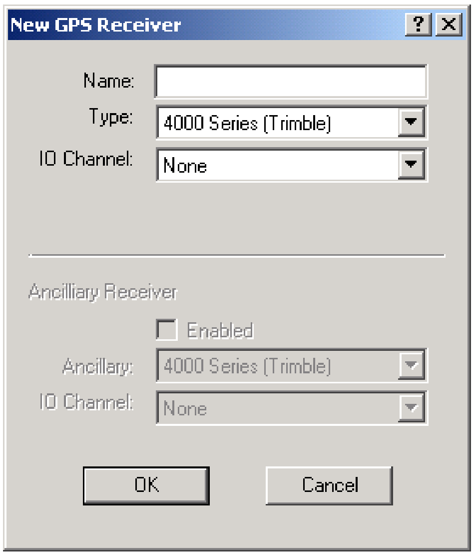
6.3.2.2. GPS Receiver

"Config" \ "GPS Receiver"

6.3.2.2.1.New Receiver

"Config" \ "GPS Receiver" \ "New…"

This calls up the "New GPS Receiver" dialogue shown opposite.



It is important that each receiver is given a relevant name. As with other name labels, the program does not use it for receiver recognition purposes However all of the graphical displays will use the given name. It is recommended that the physical location of the antenna is used for the name. E.g. Helideck or starboard bow etc..

In the "Type:" slot, select the receiver that RxV is to use.
There are various possible selections.

- *Z Family (Ashtech)** are dual frequency receivers.
- *DG16 (Ashtech))** is a single frequency receiver
- *G12 (Ashtech))** is a single frequency receiver
- *GG24 (Ashtech)* * is a single frequency receiver and is fitted in the Fugro 90964 units
- *4000 Series (Trimble)* refers to either a single frequency 4000DS or a dual frequency SSE/SSI
- *MS750 (Trimble)* is a dual frequency receiver
- *BD750 (Trimble)* is a dual frequency receiver
- *BD112 (Trimble)** is a single frequency receiver board fitted to the 90938/F112 SkyFix decoder.
- *DSM212 (Trimble)** is a single frequency receiver.
- *DSM (Trimble)** is a single frequency receiver board fitted to 90938/M SkyFix decoder.
- *SK8 (Trimble)** is a single frequency receiver board, but not recommended for offshore work. It has not been tested for full operation.
- *Millennium (NovAtel)* is a dual frequency receiver

- *Receiver Server* is used when the data is not live from an external receiver but is taken from raw data log files.
- *Receiver Verify* is used for interfacing to the Receiver Verify (RxV) Module.
- *Receiver Server* is used when the data is not live from an external receiver but is taken from another zero application. RxV outputs Receiver Server style data to MultiFix 4 using the Receiver Verify format..

Please note – Even if a dual frequency receiver is selected, the system will only operate in a single frequency mode.

In the “IO Channel:” edit control slot, select the receiver’s port.
The Ancillary Receiver option is used for synchronising GPS measurements over a data link. It is not used in the current version of RxV.

Note, even though it possible to use dual frequency receivers in RxV, it is not possible to generate a dual frequency measurement sets for the virtual antenna.

The receivers should be configured as per the MultiFix 4 section and may require third party software to configure them.

6.3.2.2.2.Editing and Deleting

“Config” \ GPS Receiver” \ “<name>” \ “Edit…” or “Delete”

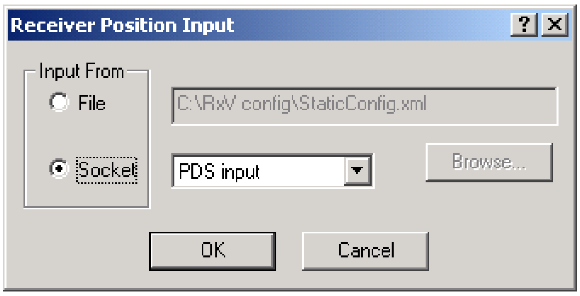
With GPS Receiver(s) now defined, when “Config” \ “GPS Receiver” is selected, the name (or names) given to the GPS Receiver(s) now appears in the sub-menu below the “New…” menu item.

If the set up requires editing, highlight the name of the source and then select the “Edit…” option.

If the GPS Receiver is no longer in use, again use “Config” \ “GPS” \ “<name>” and select “Delete”. You will be asked to confirm or cancel the deletion. Be aware that an inappropriate deletion could impact severely on the normal operation of the program.

6.3.2.3. Rx Position Input

"Config" \ "Rx Position Input…"



This calls up the "Receiver Position Input" dialogue.

This is used to define the source of the real-time antenna offsets.

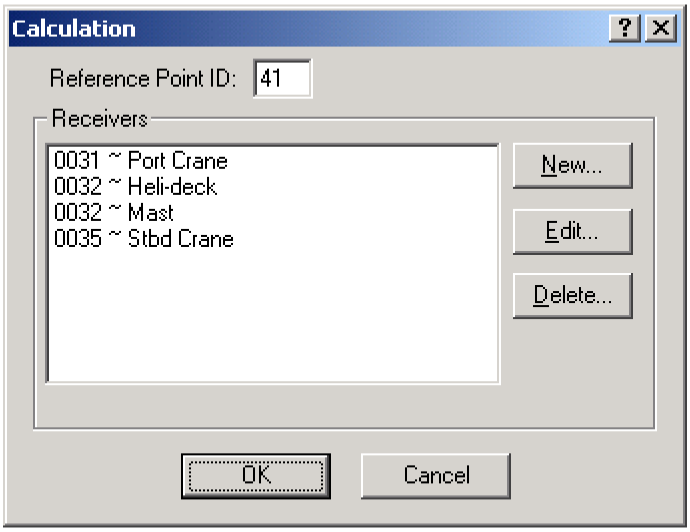
The PDS software application will provide continuous updates on the relative positions of each physical GPS antenna, based on measurements from the gyro and pitch/roll sensors. For static applications and training purposes, the antenna offsets can be entered using a file. See Appendix C for more details.

6.3.2.4. Calculation

"Config" \ "Calculation"

6.3.2.4.1.Receivers

"Config" \ "Calculation" \ "Receivers…" calls up the dialogue opposite.



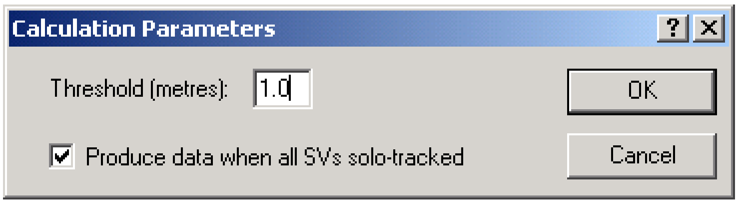
Each Individual GPS receiver should be given a unique name. It is recommended that a descriptive name, such as the location of the receiver, is used e.g. Heli-deck.
It is also recommended that the same names be used in the PDS-Lite module.

To select a GPS Receiver for the calculation click " New.."
Each receiver in the calculation must be given a unique position ID. This must match with the ID associated with the antenna position in the PDS 2000 Lite module.
Select the desired GPS "Receiver" from the drop down list (this is based on the GPS receivers already defined).

Each GPS receiver to be used in the calculation should be individually defined in this way. Settings can be changed at a later stage by using the "Edit.." button, or receivers deleted from the calculation using the "Delete.." button.

6.3.2.4.2.Parameters

"Config" \ "Calc" \ "Parameters…" provides the dialogue opposite.



The "Threshold (metres)" option allows the user to set the rejection criteria for the calculation process. Observations with Pseudorange residuals exceeding this threshold will be rejected. A value of 2.5m is recommended.

The “Produce data when all SVs solo-tracked” option allows the user to force the software to continue providing data for each satellite, even if it tracked by only one of the GPS receivers. This means that no independent checks can be performed on the collected data.

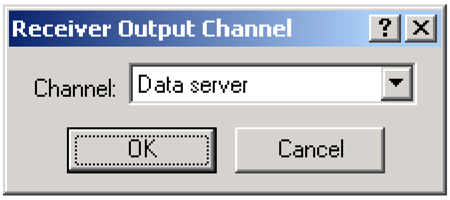
Clicking **[OK]** exits the dialogue and causes the calculation to commence.

6.3.2.5. Receiver Output

"Config" \ "Receiver Output…"

The result of the calculation process is a data set created for a virtual GPS receiver.

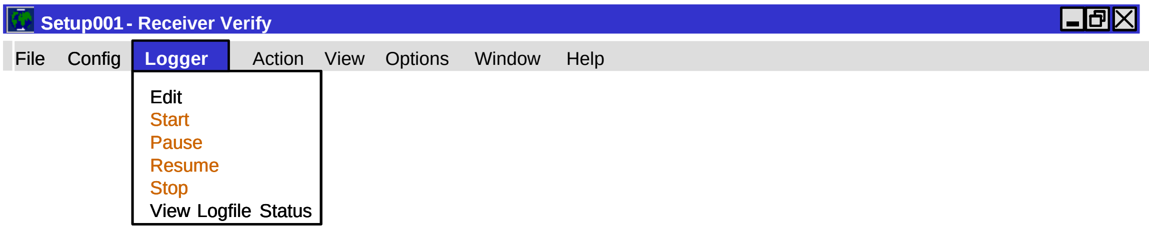
It is necessary to define the output channel for this newly created GPS data.



The data can only be used in MultiFix 3 (Ver 1.30 or later) and MultiFix 4. It is normally output on a socket but can be sent out on a serial port.

Note that if the data is to be sent out over a serial port a high baud rate should be used (38400 or more).

6.3.3. LOGGER

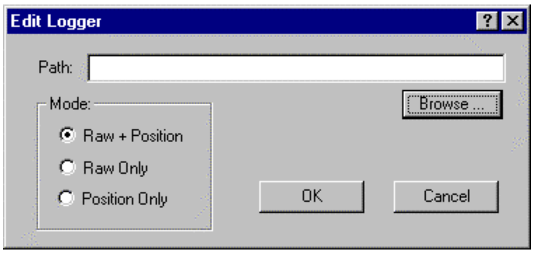


The Logger menu items shown above will change depending on the current state of logging. If no logging is taking place it will be "Edit" and "Start", if logging is ongoing it will be "Pause" and "Stop" and if logging is paused it will be "Resume" and "Stop".

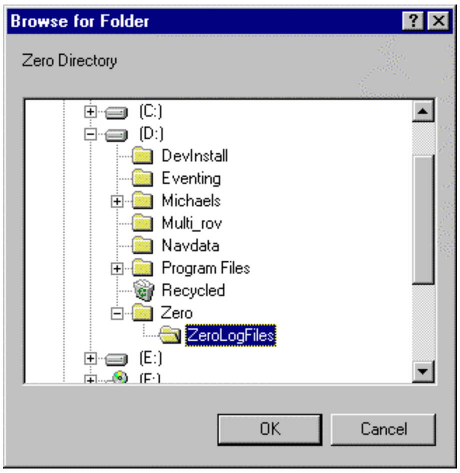
Zero log files can be read by LOGPUMP and the raw data can be directed back into RxV, where pseudo-real time observations will be formed. Those pseudo-real time positions can then be directed from RxV into MultiFix to derive a position.

6.3.3.1. Edit

"Logger" \ "Edit…" calls up the dialogue shown.



Select the "Mode" of logging required. Note there are not separate raw and position files, the Zero Log (*.zer) files can contain both raw measurement and position data.



Select the folder into which the logged data is to go either by typing in the destination or by using the **[Browse…]** facility. This provides the Browse for Folder dialogue. The path can be defined by clicking on the desired destination folder.

Be aware that typing in a non-existent path **will not create a folder.** If a new folder is required for data logging it must be created on the desired hard drive with Windows Explorer before logging begins. If a viable destination is not entered the *.zer log files will be written into the RxV installation directory..

When the path and mode of logging have been selected click **[OK]**

The logging files names are based on the Julian day and time at the time of opening, e.g. 061-1114, was started at 11:14 UTC on J-day 061.

When a file reaches 1.4 Mbytes in size it will automatically close and a new one will be created.

6.3.3.2. Starting, Stopping and Pausing

"Logger" \ "Start" is a command.

This will start the logging process. When data is being logged the menu options will change to "Pause" and "Stop".

"Pause" will arrest the logging process until "Resume" or "Stop" are selected.

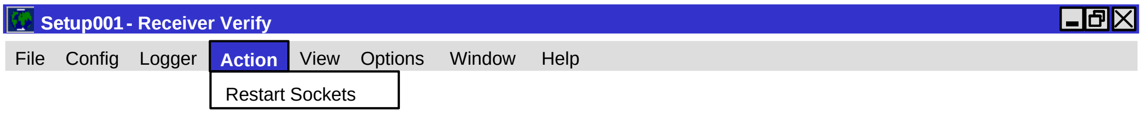
"Resume" will restart logging into the existing file.

"Stop" will close the current log file and stop the logging process.

When logging is started a Logging Schedule file is created (*.RxV_lsd). It is written into the same folder as the RxV configuration files. This file is needed so that LOGPUMP can be set up correctly for the output of data as it contains the unique logging Ids for each of the receivers. The schedule contains the RxV version number and calculation status information. There is only one file so if logging is stopped and then re-started the existing file is overwritten. If there have been configuration changes made between one log session and subsequent log sessions, the Logging Schedule file will only be relevant for the later sessions. Therefore, if changes are to be made after logging is stopped, use Explorer to make a copy of the Schedule file and keep a note of the *.zer log files to which it relates. Do not make configuration changes while logging is on going.

When being archived or when being forwarded for replay analysis, the Schedule file should be kept with the log files.

6.3.4. ACTION

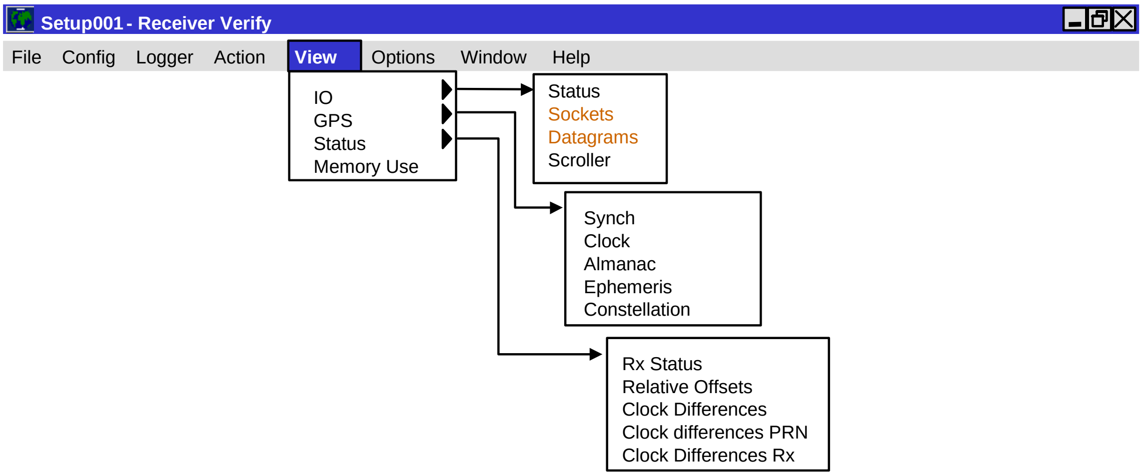


6.3.4.1. Restart Sockets

"Action" \ "Restart Sockets"

On occasion heavy network traffic may lock up TCP\IP socket ports. This option will reinitialise all currently open sockets without having to restart the software or editing the configuration files.

6.3.5. VIEW



The items show in brown will only appear if pre-conditions have been met.

“Datagrams” only appears if a UDP socket has been defined

Right-mouse clicking most windows allows the user to customise the display. Where that customisation is specific to the view window it will be mentioned in the relevant section dealing with that window.

In common with many Windows programs, RxV allows display windows to be moved outside the area displayed by the monitor. The application workspace automatically extends and scroll bars are provided. The scroll bars allow the display area to move around the extended application workspace. There is no limit on the number of windows of any type that can be open in the application workspace. Multiple copies of the same window type can be open. Indeed it will be seen that once a window is open some types of window allow further selection of the data that is to appear in them.

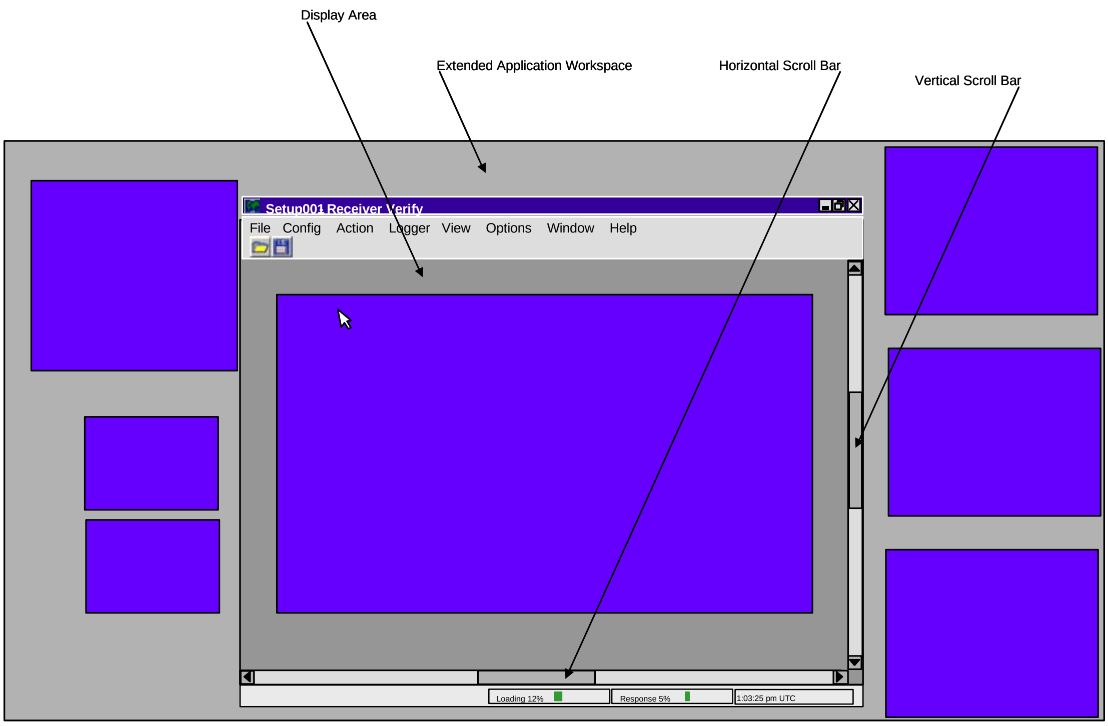


Figure 14 Windows Extending Beyond the Application Workspace

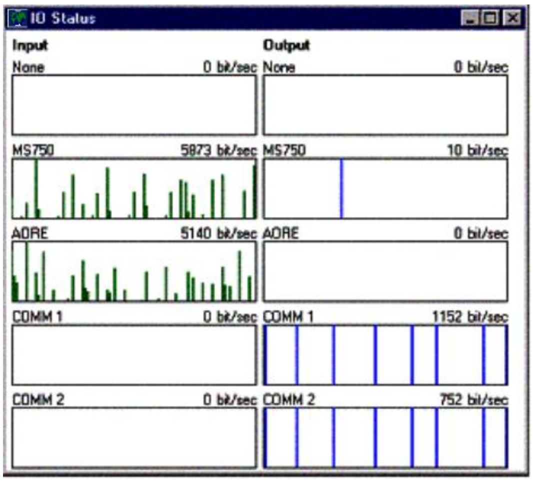
Most windows can be resized by clicking and dragging the corners or sides. Some windows that contain text will wrap the text message into the available space. Other windows containing text will simply be cropped as the window size reduces. Windows containing graphical information will resize down to a minimum and will then either crop the information or will introduce scroll bars.

6.3.5.1. Input / Output

"View" \ "IO"

There are three sub-menus and each will call a window to the RxV application workspace.

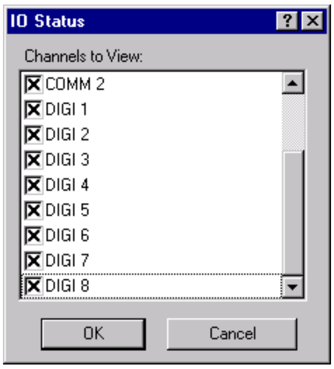
6.3.5.1.1.Status



This window indicates when there is port activity.

By default the window will contain the ports RxV knows to exist. The "None" I/O Channel is at the top followed by streamed socket channels, datagram sockets and then the COM and Digiboard channels.

(When setting up Input / Output channels there is the option to select a dummy channel "None". If selected the blue vertical bars would be seen progressing across the None Output box.)

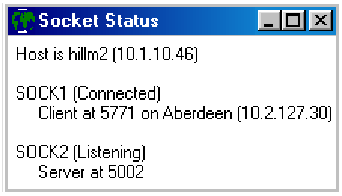


A right-mouse click calls up the **[Channel]** button. When this is clicked the IO Status dialogue is presented. This allows channels to be selected or deselected from the status window.

In the IO Status window the latest time is in the centre between the Input and Output columns. Each box indicates when data has been input or output, over the last 5 seconds, on that port by scrolling vertical bars from the centre to the outside edges of the window. The box re-scales such that the greatest data rate over the last 5 seconds is full scale. The current bit rate is shown opposite the I/O channel name.

6.3.5.1.2.Sockets

"View" \ "IO" \ "Sockets""



A client socket can have three states,

Idle, Connecting and **Connected**.

Idle and Connecting will alternate while connection is trying to be established. There will also be a time countdown to the next attempt to make contact.

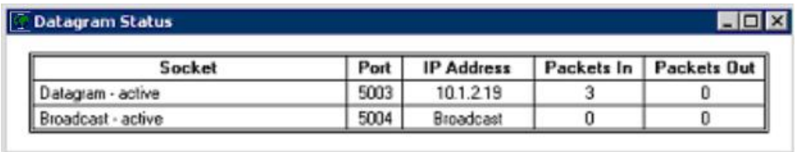
A server socket can have two states,

Idle and **Listening**.

The Idle status is almost immediately replaced by Listening.

6.3.5.1.3.Datagrams

"View" \ "IO" \ "Datagrams"



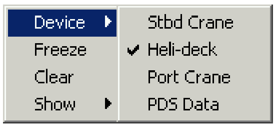
The Datagram Status window lists all Datagrams in use. The IP address indicates to which PC a link is in place or if it is transmitting a broadcast message. The "Packets In" and "Packets Out" window indicates if the datagram is working. If you are receiving data only the "Packets In" will increase. If you are transmitting to n PCs the "Packets In" will increase at n times the rate of the "Packets Out".

6.3.5.1.4.Scroller

"View" \ "IO" \ "Scroller"

Scroller is able to display any of the inputs and outputs. When first opened the display defaults to showing the link from the first GPS receiver in the configuration list.. To change to another IO Channel or to change the scrolling options, click the right mouse button.

This calls up a menu box, which has "Device", "Freeze", "Clear" and "Show" as shown opposite.



If "Device" is highlighted there is a sub-menu which lists the different input / outputs. Top of the list are the names given to the each of the GPS receivers. This is followed by the input from PDS.

If "Freeze" is selected the current window display is held and frozen appears in the windows title bar. Clicking "Freeze" again unfreezes the display. "Clear" will remove all information from the current window.

"Show" brings up a new sub-menu with four options: "Input", "Output", Text" and "Corrupt". A tick next to the option indicates that the relevant information is currently displayed in the Scroller window. These options may be toggled on/off by left clicking.

The text in the window is bottom justified and colour coded. Green indicates it has been successfully decoded and passed all parity checks. Red indicates the data is corrupted. Dark blue is reserved for outputs. When a message is received or sent successfully a black text line is added as a label. Carriage return and line feed are shown in light grey.

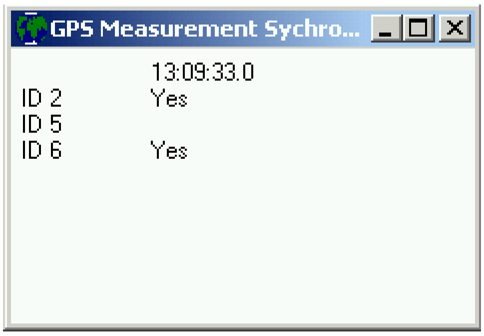
Scroller windows use a lot of resources and should be closed when they are not required.

6.3.5.2. GPS

"View" \ "GPS"

6.3.5.2.1.Synch

"View" \ "GPS" \ "Synch"



The GPS Synch display can be used to check that the time stamped data is being synchronised. The display will flash the result every epoch confirming that the data is in synch.

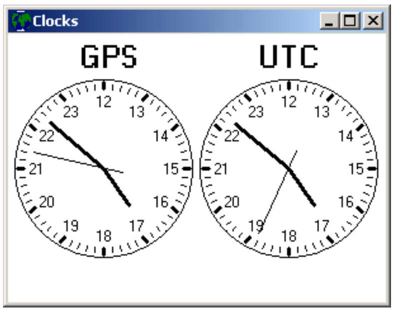
The ID number for each receiver is the internal ID number associated with the GPS receiver. If all the data is correctly synchronised then the receiver is marked "Yes".

The time given at the top of the table is the time for the measurement synchronisation.

6.3.5.2.2.Clock

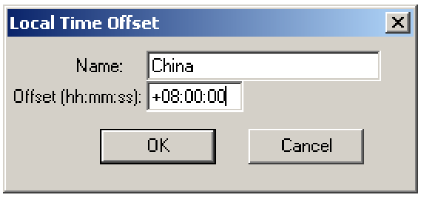
"View" \ "GPS" \ "Clock"

As can be seen, GPS Time was 13 seconds ahead of UTC Time when this screen dump was taken.

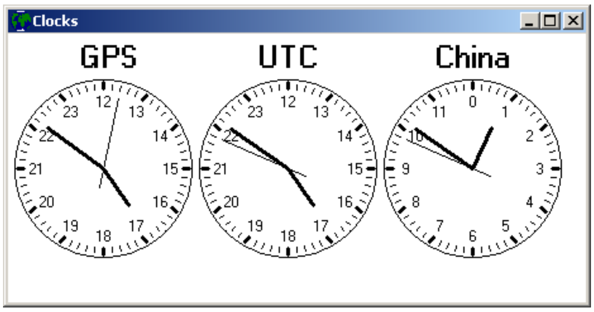


It is possible to include extra clocks in this display by right clicking in the window and selecting "Add Local…".

Enter a name for the clock and the time offset, in the format (hh:mm:ss), then click **[OK]**.



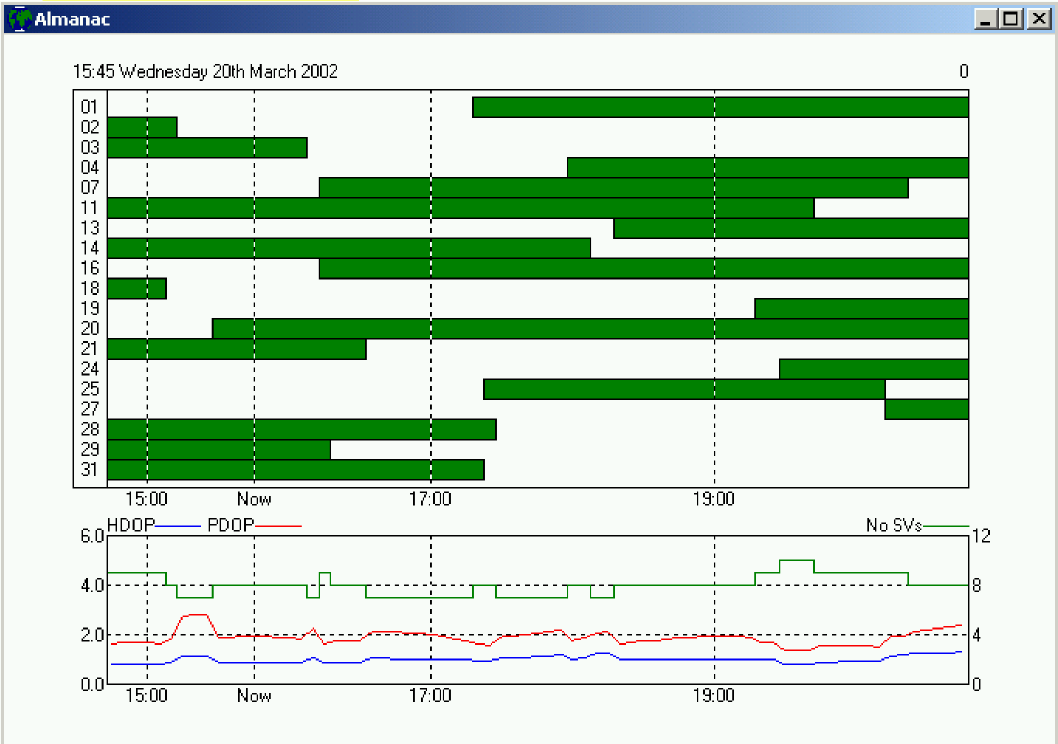
These can be used to provide a local time offset from UTC for the work area.



Right clicking on the window now provides extra options to “Edit”, “Delete”, or “Hide” the additional clock(s).

6.3.5.2.3.Almanac

"View" \ "GPS" \ "Almanac"



The almanac view illustrates the computed satellite availability for the virtual antenna, as defined in the configuration.

The top section of the Almanac window is a bar graph display of the availability of satellites over the previous 2 hours and the next 4 hours. This can be changed to a 24 hour view using the right click menu. The 24 hour view shows the current day, from midnight to midnight UTC.

- The green bars represent healthy satellites above the elevation mask.
- If an SV is disabled in the "Action" \ "SV Status" dialogue than the bar for that SV will appear red.
- The grey areas indicate the SV is above the 10° elevation mask at the reference station but not at the "average position" or the "trial point". (Note that the minimum elevation mask is set in the "Config" \ "Calc" \ "Settings" dialogue, (see Section 4.3.3.4.1 on Page 63). By default this is 10º but can be changed resulting in the SV availability shown in the Almanac window altering.)
- The yellow bars represent unhealthy SV's.

The lower section shows the Number of SV's, PDOP and HDOP on a line graph over the time period specified.

- The number of satellites available for the selected position calculation is shown as a solid green line.
- The number of satellites visible at both the reference station(s) and the selected position is a green dashed line (where applicable).
- PDOP at the selected position as a red dashed line.
- PDOP based on the common satellites above the masks as a red solid line
- HDOP at the selected position is shown as a blue dashed line
- HDOP based on the common satellites above the masks as a blue solid line

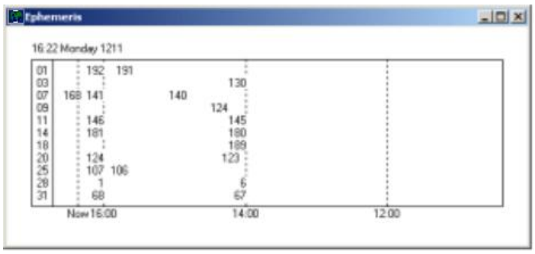
If "Network" is selected the Almanac window is based on the current "average position" or the "trial point" and will show a green availability bar if there is at least one of the reference stations that has a common satellite. If the bar is grey then the satellite is available at the "Average" position or "Trial Point" position but not at any of the reference stations.

It is worth noting that MultiFix 4 uses "Elevation Delta" for rising and setting satellites. "Elevation Delta" is a variable weighting of the satellite data in the position solution. The minimum elevation when a satellite starts to be used and the number of degrees above the minimum at which the satellite attains full weighting are set in the "Config" \ "Calc" \ "Settings" dialogue referred to above.

6.3.5.2.4. Ephemeris

"View" \ "GPS" \ "Ephemeris"

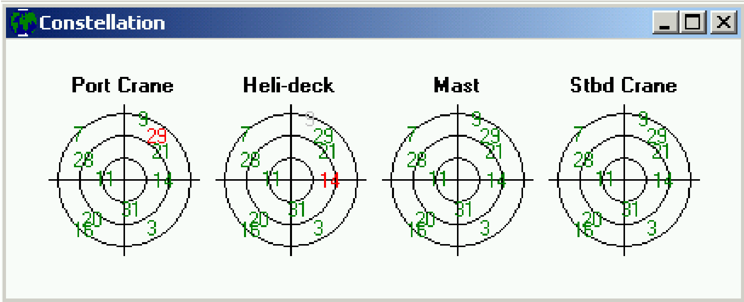
The Ephemeris window shows the previous 6-hour period. The Ephemeris issue number is placed at the time when an update was received. The issue number typically increments by 1 but that is not always the case. The majority of updates occur every 2 hours. Updates between this period may be due to a rising SV.



A right-mouse click on the window provides the "Copy" and "Save As…" facilities.

6.3.5.2.5.Constellation

"View" \ "GPS" \ Constellation



The Constellation window shows the position of the satellites as seen on each of the GPS receivers.

The outer ring of each Bullseye refers to 0° elevation, the centre is the zenith. The bottom centre of the SV numbers text is the current position, as shown below

The satellite numbers are colour coded.

- **Green** - indicates there are valid measurements available for use in the calculation.
- **Yellow -** indicates there are useable measurements available, but that they are approaching the residual threshold and may to subject to some level of degradation.
- **Red -** indicates that measurements are available but they exceed the residual threshold value and are therefore not used in the calculation.
- **Blue** - means that a satellite is expected but no corrections for that satellite have yet been acquired, which may be due to the satellite being set to unhealthy.
- **Grey -** indicates that a satellite is viewable from just one receiver and will not be output to MultiFix as it is not possible to check the validity of the measurements.

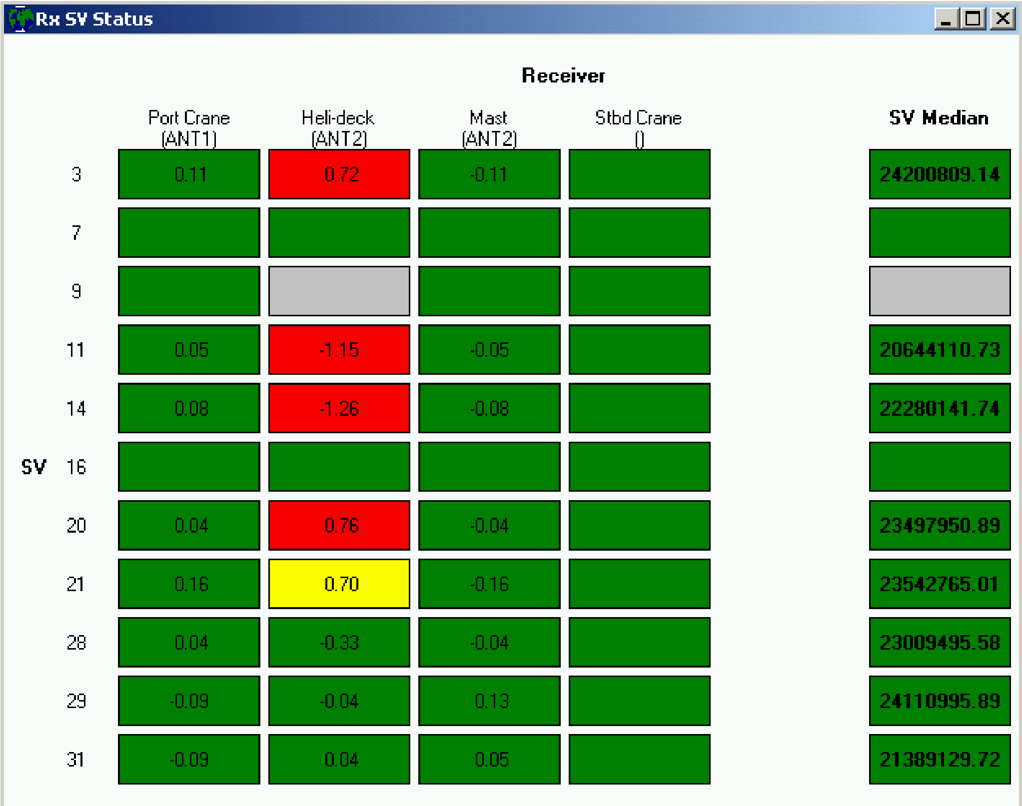
When the window is resized by click and dragging a corner, the program rearranges the constellation displays to best fit the available area.

6.3.5.3. Status

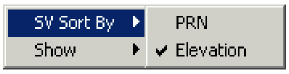
6.3.5.3.1.Status

"View" \ "Status" \ "Rx Status"

The Status display forms the primary display for RxV. The display provides a graphical summary of the measurement quality provided by each receiver, and the corresponding availability of data out put.



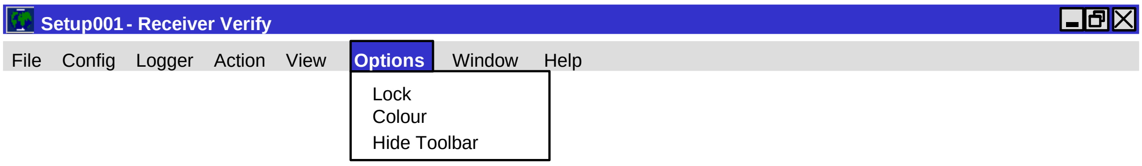
- Green indicates there are valid measurements available for use in the calculation.
- Yellow indicates there are useable measurements available, but that they are approaching the residual threshold and may to subject to some level of degradation.
- Red indicates that although measurements are available they exceed the residual threshold value and are not used in the calculation.
- Blue means that a satellite is expected but no corrections for that satellite have yet been acquired, which may be due to the satellite being set to unhealthy.
- Grey Indicates that a satellite is viewable from just one receiver and will not be output to MultiFix as it is not possible to check the validity of the measurements.



The display has a right click menu allowing the user to configure the display. The listing of the SVs can be sorted either by PRN number, for identification purposes, or elevation for monitoring purposes. SVs are listed by highest elevation first.

The Show menu allows the user to add details to the display, including the computed “Offsets” and the “Pseudoranges” Selecting Offsets will show the offset between the transposed pseudorange and the computed value for the virtual antenna. This is displayed in the individual colour coded status boxes. The actual computed pseudoranges can also be displayed by selecting “Pseudoranges”. This will display the computed pseudorange for the virtual antenna position.

6.3.6. OPTIONS



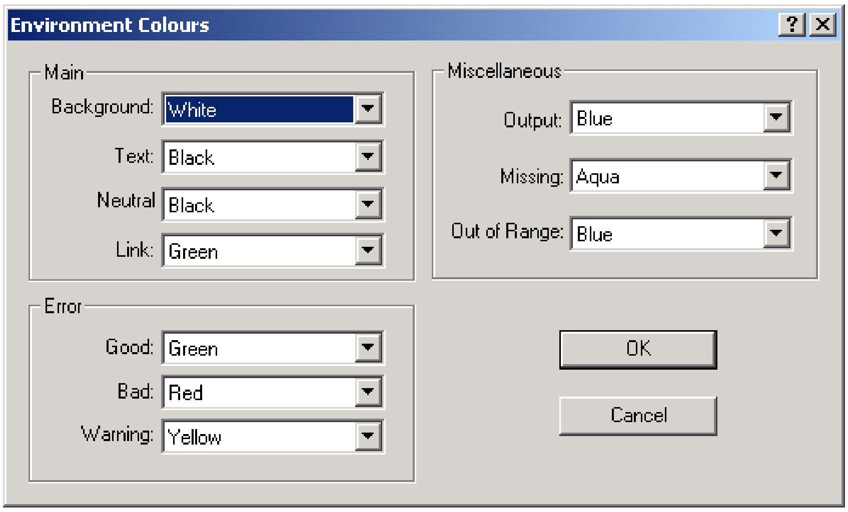
6.3.7. Lock

"Options" \ "Lock"

If the Lock option is chosen "File" and Config" are removed from the menu bar. Whilst locked, "Options" \ "Lock" changes to "Options" \ "Unlock". This reinstates "File" and Config".

6.3.8. Colour

"Options" \ "Colour"



If different colour regimes are required they can be set up here but beware that a false impression is not given when changing the colour coding. This particularly relates to errors.

Some of the selections do not affect all view windows.

- "Main"

  "Background" and "Text" change the windows background and text colours.

  "Neutral" is used in the Latency window to show period when update may be expected.

  "Link" is not currently used.

- "Error".

  Various windows have stages of error state, these colours relate to them.

  "Good", "Bad" and "Warning".

- "Miscellaneous"

  "Output" as seen in the IO status and IO Scroller windows.

"Missing" as seen in the Status and Constellation windows.

"Out of Range" as seen in the Status and Constellation windows

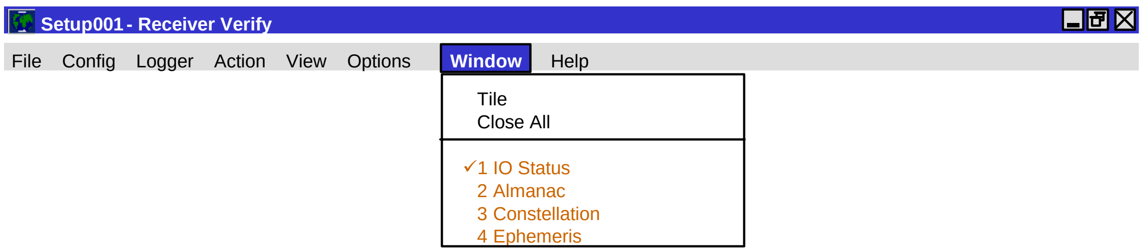
6.3.9. Hide Tool Bar

"Options" \ "Hide Tool Bar"

This will hide the shortcut toolbar displayed at the top of the MultiFix screen.

When hidden the option will change to "show toolbar" which will return the toolbar to the screen when selected.

6.3.10.WINDOWS



The list will change depending on the number and types of windows that are open at any one time.

6.3.10.1.Tile

"Window" \ "Tile"

The tile command causes the application workspace to be reduced to the display area. The windows that are not minimised are fitted into the display area and the minimised windows are neatly stacked along the bottom of the screen.

6.3.10.2.Close All

"Window" \ "Close All"

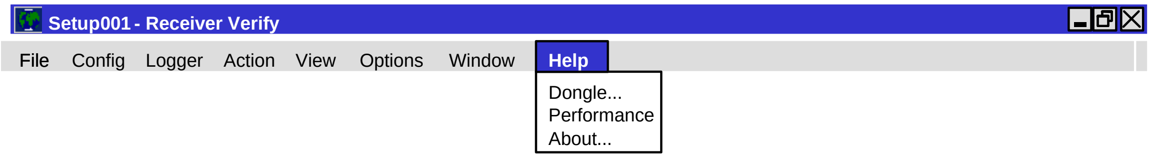
The close all command does just that. All the windows irrespective of their status will be closed. As there is no confirmation required be careful not to use it in error.

6.3.10.3.The Open Windows

The "Window" drop down will also list all the windows currently open. Windows can be overlain one on top of another and it can be difficult to locate an obscured window. Clicking the window in the list causes the focus to shift to that window, the title bar is highlighted and it will appear on top of all the other windows. If there is an extended application workspace, and the selected window is off screen, the display area will not move to show the window but the title bar of the window will still become highlighted.

If there are more than 9 windows open the bottom line of the menu will be “More Windows…” If this is selected a dialogue opens listing all windows. Highlight one of them and close the dialogue.

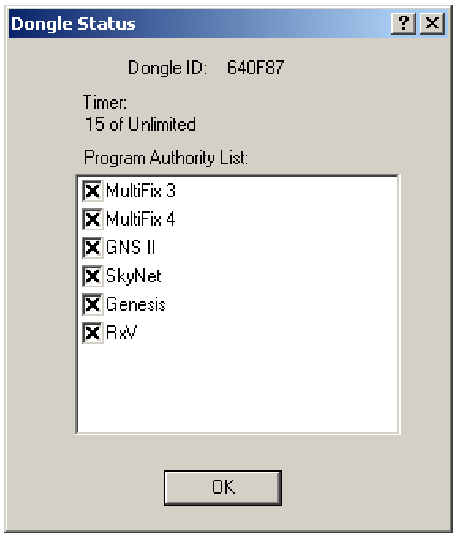
6.3.11.HELP



6.3.11.1.Dongle

"Help" \ "Dongle…" provides the information stating

- which programs the DK2 is authorised to run
- the time limit of the dongle
- the amount of use the dongle has already had.



At all times RxV is being run, the dongle is required in the computer's parallel port. If it is removed the program shuts down and an error message is posted.

If the time limit of the dongle expires the program shuts down and an expiry message is posted.

It is possible to revalidate the dongle by running the PROLIVE program and making a call to the Technical Support Group. The same program plus a telephone call can also be used to terminate a dongle so that it is no longer valid and no longer re-charged

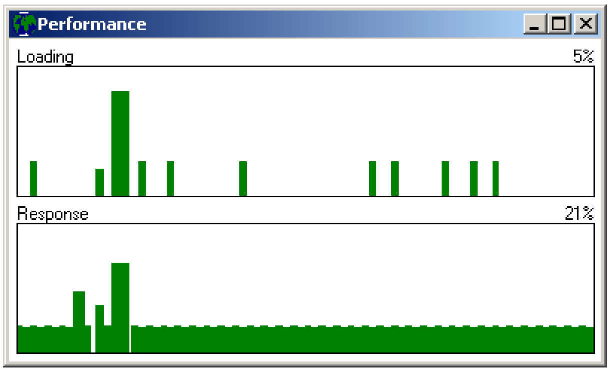
The list in the above dialogue requires refers to certain programs in the Zero Suite. SKYNET is a differential correction monitoring package and GENESIS is a Long Range RTK system that uses a similar software package to MultiFix

Several other programs in the Zero suite are not listed but they also require a dongle that must be validated for MultiFix 4. These are POSITIONVIEW, QUAL2 and LOGPUMP. Each of these 3 programs only requires the dongle when first being run. After the initial validation, the dongle can be removed.

6.3.11.2. Performance

"Help" \ "Performance"

The Performance window shows how the program is handling the data acquisition and calculation process with the available resources. The window does not take into account other programs that are running simultaneously.



The graphs will be green below 50%, yellow between 50% and 75% and red when above 75%.

It is important there is enough time for all the processes to be completed in an orderly fashion. If there are too few resources the position solution may lag. The demand on the processor can be reduced by accessing only the data from the RTCM reference stations used in the computations, by having fewer computations and by closing windows.

The performance information can also be seen in the bar at the bottom of the application window next to the UTC Time.

6.3.11.3. About

"Help" \ "About…" provides the version number and release date

6.4. RxV REPLAY

When data has been logged it is possible to re-inject that same information into RxV by using the program LOG PUMP.

LOG PUMP will read the Zero Log Files recorded by RxV and create outputs, which RxV can accept as source data.

To optimise the operation of the LOG PUMP program not only must the Zero Log Files be available but it is essential that the configuration and other associated files are available as well.

Instructions on the use of LOGPUMP and RxV replay are to be found in Technical Manual OM-076, which, at time of writing, is at Issue 0.

7. SOCCER

7.1. INTRODUCTION

Soccer is a communication program that allows data on physical ports to be made available on Internet TCP/IP sockets and vice versa. Therefore the Soccer program enables a sharing of resources over a local network of computers using COM ports or sockets, or to one PC running several programs concurrently. It is a means of streaming raw data to one or more users.

The text in this manual conforms to certain conventions

11. All command buttons are shown bold and bracketed with square brackets e.g. **[OK]**,
12. When a keyboard key is represented, it is shown bold and bracketed by greater than and lesser than symbols e.g. **<spacebar>**.
13. Each dialogue has a title. When the name is in the text it is underlined e.g. Edit GPS Receiver.
14. Direct quotations from dialogues or edit control slots are shown in normal text in quotations, e.g. “IO Channel:”

7.2. CONFIGURATION

7.2.1. HARDWARE REQUIREMENTS

Soccer requires the following:

A PC running Windows 98, Windows NT or Windows 2000 operating system. The minimum recommended specifications are a 350 MHz Pentium II processor with 32 MB RAM. A graphics resolution of at least 1024 by 768 pixels is advised in order to achieve maximum clarity of all the graphics displays. If Soccer is used in conjunction with MultiFix then please see MultiFix Hardware Requirements for a list of minimum specifications.

For the installation of the software the PC requires a CD-ROM drive. It is possible to create installation floppy discs from the installation menu on the CD but 8 floppies are needed.

Assuming data is not being input or output over network sockets, the PC needs a minimum of 2 COM ports. One COM port is used for two-way communications to the GPS receiver and the second COM port for the input of RTCM corrections. As the second port is for input only it can also be used to output position messages by using a special breakout cable.

If there is more than one RTCM delivery system, or data is to be output on several ports, then additional COM ports will normally be required. These can be any proprietary asynchronous serial board (or PCMCIA card). The Windows drivers for these allow the board's (or card's) ports to be mapped as additional COM ports.

7.2.2. TO RUN SOCCER

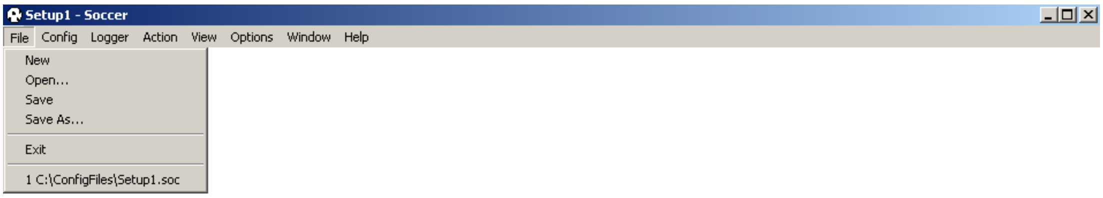
Soccer can be opened a variety of ways.

Use Windows Explorer to display the contents of the folder containing the Soccer program files and double-click the "Soccer" application icon.

Select "Start" \ "Programs" \ "MultiFix 4 Vx.xx" \ "Soccer".

7.3. REAL TIME OPERATION

7.3.1. FILE



7.3.1.1. New

"File" \ "New…"

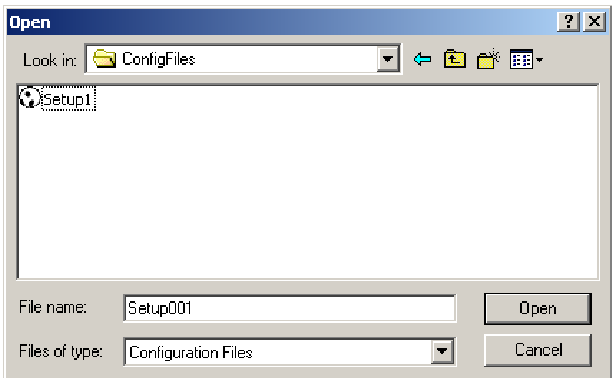
To start a new Soccer configuration select this option.

Be aware that starting a new configuration file will close the existing configuration and cease real time operation if the program is already in use. Soccer will request confirmation before closing the existing configuration file and if the configuration has not been saved the user will again be prompted.

At the bottom of the menu is a list of recently used configuration files. Clicking on one of these files opens up the chosen configuration.

7.3.1.2. Open

"File" \ "Open…"



When initially opened the program does not know which configuration file to use. If a previously prepared configuration exists use this facility to select it.

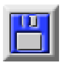
The configuration files contain the program name and version identifiers in a file header. They also include a configuration file version number. The program will not allow configuration files to be opened that are not compatible with the version of Soccer that is currently being run. However if the configuration file version is the same they can be used even though created by a different program version.

File open can also be accomplished using the  button.

7.3.1.3. Save

"File" \ "Save"

The configuration file is not automatically saved when changes are made. This facility is therefore used to update the configuration file with the current settings. If the set-up is being undertaken for the first time and the configuration file does not have an identity, the use of "File" \ "Save" will open the Save As dialogue where a file name must be entered. Once a configuration file has been named, the use of "File" \ "Save" performs a save without calling up the Save As dialogue.

The name of the current configuration file appears in the application workspace title bar. If configuration changes are made that have not been saved, that file name has an "*" appended to it. After using File \Save the "*" is removed. File saving can also be accomplished using the  button.

7.3.1.4. Save As

"File" \ "Save As…"

If the latest configuration is to be saved without overwriting the current configuration file use the "File" \ "Save As…" option. This gives the option to create a new file leaving the previous file intact. The program immediately uses the new file as the current configuration file.

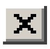
The Save As dialogue requires the operator to enter a name for the new configuration file. If an existing file name is entered the program will overwrite that file.

7.3.1.5. Exit

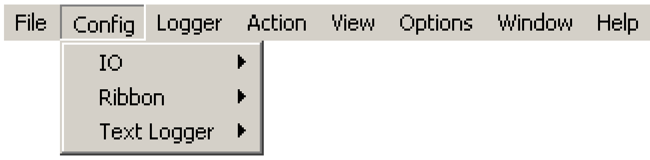
"File" \ "Exit"

This exit route is immediate if no configuration file is loaded.

Confirmation is required if a configuration file is in use. The user will be prompted to save the configuration if they have not already done so.

If the program is exited using the  button when the current configuration has not been saved, a dialogue is presented asking whether to save the configuration prior to exit or whether to cancel the exit. If there have been no configuration changes then the program will terminate immediately.

7.3.2. CONFIG



7.3.2.1. IO

"Config" \ "IO"

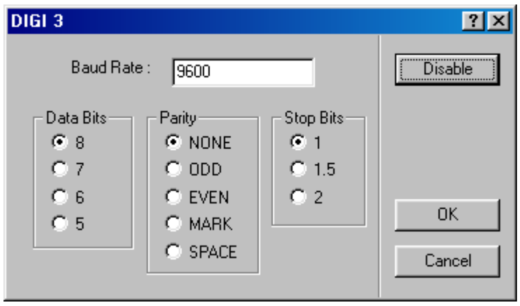
7.3.2.1.1.Comm

"Config" \ "IO" \ "Comm…"

Earlier it was explained that the "Programs" / "MultiFix 4 Vx.xx" / "IO Config" applet needed to be run after installation to define what ports the computer has available (see section 3.4 on page 13). The parameters selected there determine the dialogue box that is presented when "Config" \ "IO" \ "Comm…" is selected.

Highlight one of the ports to be used and click **[Edit]**. This opens another dialogue box for setting the port parameter settings.

Click the **[Enable]** button to activate the port and set the Baud Rate, Data Bits, Parity and Stop Bits.



7.3.2.1.2.Sockets

"Config" \ "IO" \ "Socket…"

To be able to distribute and receive data over a network via sockets assumes each computer has Transmission Control Protocol / Internet Protocol (TCP/IP) installed. Sockets have the advantage over COM ports in that two or more programs can access the same data.

Sockets can transfer data between programs running on different computers or between two or more programs running on the same computer. (If a standalone (non-networked) computer running Windows NT is used and the data is to be shared between multiple programs running on that PC then the MS Loopback Adapter network adapter must be installed).

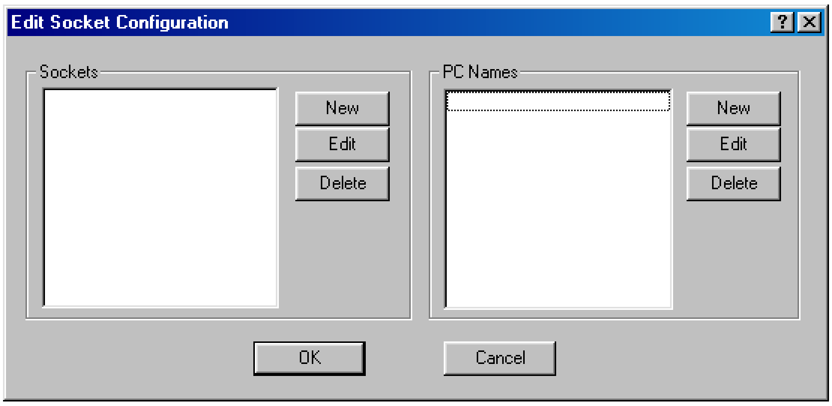
The TCP/IP protocol is a family of protocols that allow Internet data communication. Included in that family are two transport layer protocols, the Transport Control Protocol (TCP) and the User Datagram Protocol (UDP). Soccer supports both these transport protocols from Version 1.25 onwards.

- The Transport Control Protocol establishes sessions between a Server and however many Clients that are accessing that Server. There is continual presence checking and acknowledging between each Server/Client pairs with messages always received in the order they were issued. A Server does not have control of the number of Clients that access the socket on which data is being presented. (It is often perceived that the Server provides data and the Client receives data, but once the connection is established the link is two-way).
- The User Datagram Protocol does not have the end-to-end checking overhead of the TCP. Instead packets of data are simply issued to the Internet in either broadcast mode, where any networked computer on the LAN can receive them, or in addressed mode where the data packets have headers specifying the addressees for whom the packets are intended. There is no guarantee with this protocol that the messages will arrive in the order they were issued. When setting up "Ribbons" to output datagrams a time interval can be specified to prevent data becoming corrupted, see section on "Ribbons" 7.3.2.2. Broadcast datagrams cannot pass routers linking Local Area Networks (LAN) unless specifically configured.

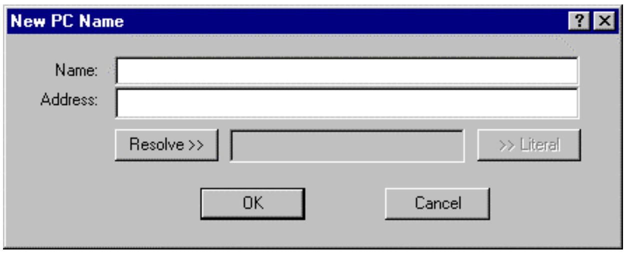
For most situations where Local Area Networks are involved Server / Client TCP sockets are the best choice Internet transport protocols.

7.3.2.1.2.1. The Soccer Computer as a TCP Client

For a Client to make contact with a Server, the operator must know the IP address (or the network identification name - see below) of the Server computer and the port number the Server is outputting the required data.

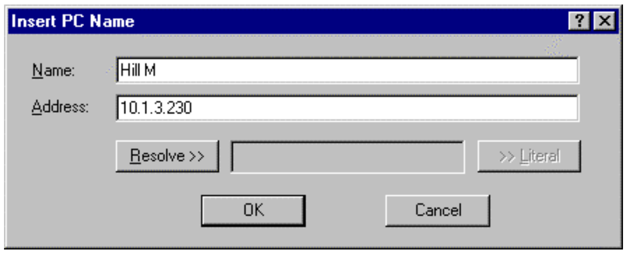


First, in the "PC Names" table click **[New]**.

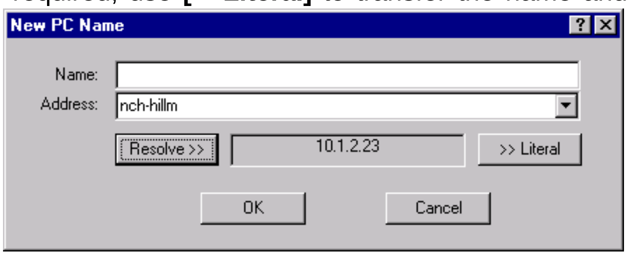


There are two possible ways of defining the server PC.

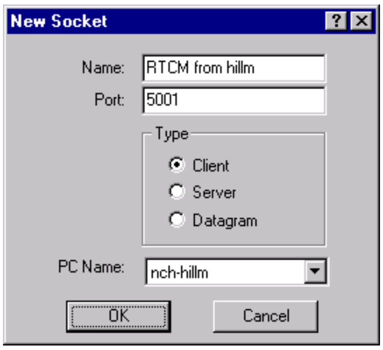
If the numerical IP address is known, enter a PC name in "Name:" and the IP address in "Address:" and click **[Resolve>>]**. Click **[OK].**



If the IP address is not known but the computer's network identification name is, and if all computers involved are aware of local naming services (WINS / DNS), then type in the computer's name in the "Address:" slot and click **[Resolve>>]**. Once the computer is found, its IP address will appear as shown. If required, use **[>>Literal]** to transfer the name and address to their named slots. Click **[OK].**



It is normal in a network for computers to be allocated new IP addresses when the PC is restarted. If the Client PC has a numerical entry for the address and the Server's address has changed, it will not be able to re-locate it. If the Client PC has the name of the Server PC in the address slot, it will automatically search to re-locate the Server PC by name. Assuming it is found, the Client PC will obtain the Server PC's current address.

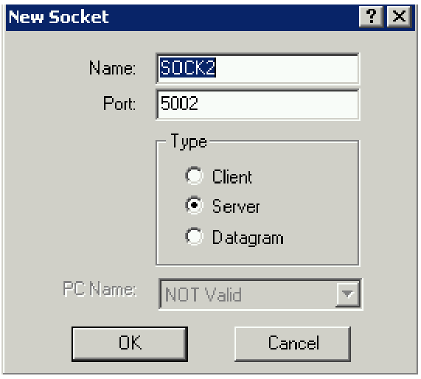


In the "Sockets" table click **[New]**.

Now check the "Client" radio button and select the "PC Name:" of the server.

Enter the number of the port on which the Server PC is presenting the data. Change the socket's default name if required.

7.3.2.1.2.2.The Soccer Computer as a TCP Server



If the Soccer computer is to be a server then there is no need to add the Soccer computer to the PC table; the program already knows the computer's IP address. This can be seen in the window called up by "View" \ "Sockets", see 7.3.5.2 on page 273.

In the "Sockets" table click **[New]**. Give the socket a name and enter the Port number that the data will be output on. Click **[OK]** to exit.

7.3.2.1.2.3.Datagrams

It was explained in section 7.3.2.1.2 that the User Datagrams Protocol allows packets of data to be broadcast or to be sent to specific addresses without the overheads associated with the Transport Control Protocol.

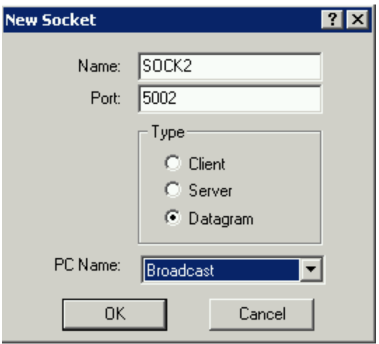
BROADCASTING

Soccer cannot give multiple addresses to packets of data so if information is to be made available to more than one computer in datagrams it must be broadcast on a particular port. A computer that is broadcasting on a port also listens to all data packets that are received on that port.

DATAGRAMS TO/FROM A SPECIFIC PC

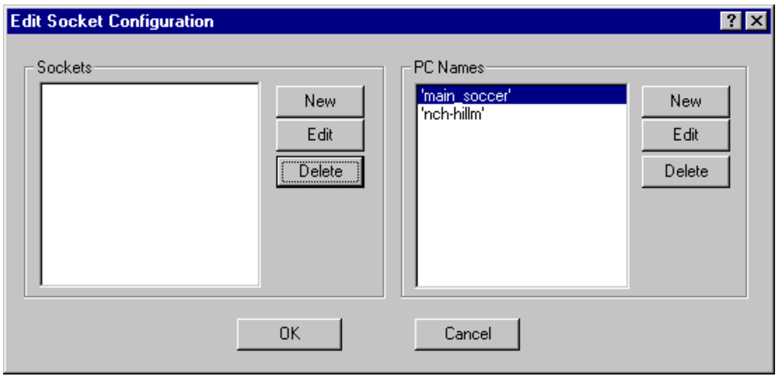
To transmit to or to receive from a specific computer, (which may itself be broadcasting), a PC must be set up with a datagram socket where the port number and the PC are identified.

To broadcast datagram packets, click the “Datagram” radio button and select “Broadcast” from the “PC Name:” list.



To target one specific PC requires that the Internet address of that PC should already have been identified. See Section 7.3.2.1.2.1 on page 263 for an explanation of adding PCs.

Once the PC has been entered in the “PC Names:” table click **[New]** in the “Sockets” table. Give the socket a name, enter the Port number and in the “PC Name list select the PC.

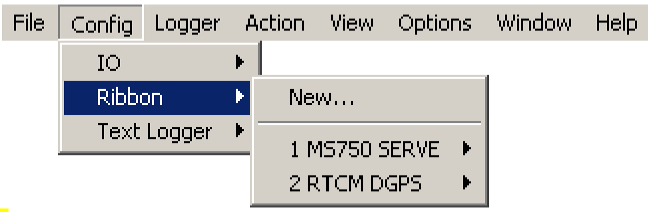


Click **[OK]** to exit.

Having set up sockets, the Edit Socket Configuration dialogue now shows the connection(s).

7.3.2.2. Ribbon

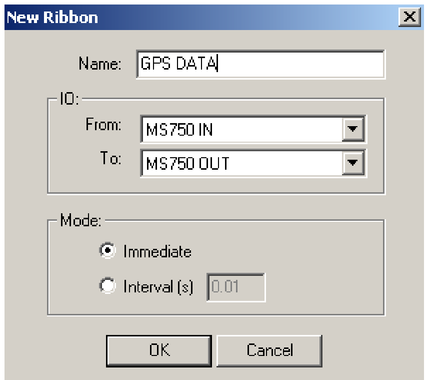
"Config" \ "Ribbon"



7.3.2.2.1.New

"Config" \ "Ribbon" \ "New…"

In order to output any data from Soccer it is necessary to define a pathway between the incoming and outgoing data within the program. Data can be output either on a socket port or an available COM port.



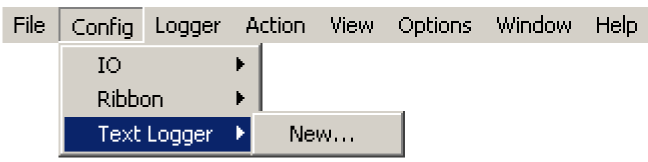
Select "Config" \ "Ribbon" \ "New…" and the New Ribbon window (shown right) will appear. Give the ribbon a name and then select the relevant Input and Output location.

The "Mode" section should only be used when outputting data using datagrams. If using TCP sockets then the default selection "Immediate" should be used. As datagrams are random packets of data Soccer allows for an "Interval" to be set to prevent the data becoming corrupted. This interval refers to the time Soccer waits after receiving incoming packets of data before re-sending the data out as datagrams. This helps prevent incoming data packets being randomly split before they are re-sent. It is recommended that the default value 0.01 should be used but this can be increased if corrupted data is seen.

To apply this ribbon click **[OK]**. From the "View" menu select "IO Status". The **Output** column should show data being output from the program on the relevant port or socket.

7.3.2.3. Test logger

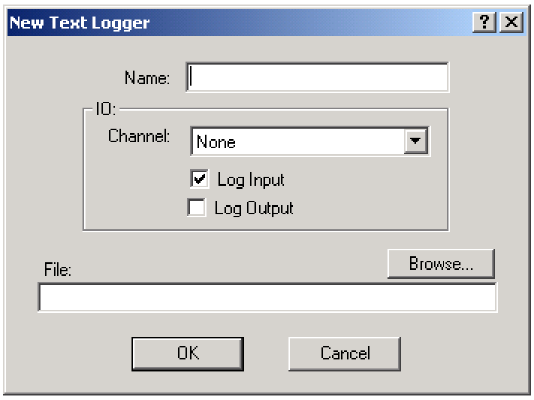
"Config" \ "Text Logger"



7.3.2.3.1.New

"Config" \ "Text Logger" \ "New"

Data can be logged as a text file. Any number of Text loggers can be set up to log to separate files.

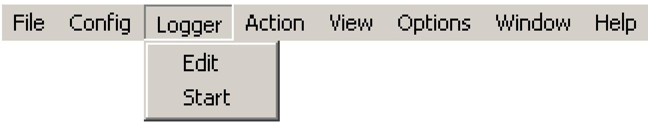


Select "New.." to define the file name and locations of the log file to be created.
You will also need to define the IO channel you wish to log.

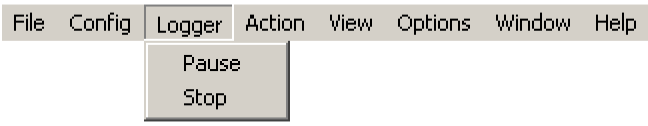
Soccer can distinguish between data coming into and going out of an IO port. The user can select to log with incoming, outgoing or both sets of data.

7.3.3. LOGGER

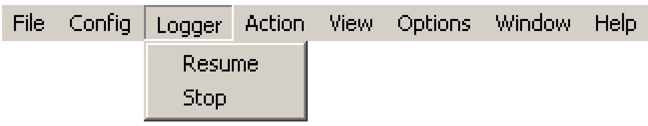
The Logger menu items will change depending on the current state of logging. If no logging is occurring it will display "Edit" and "Start".



If logging has been started it will display "Pause" and "Stop".



If logging is paused it will display "Resume" and "Stop".

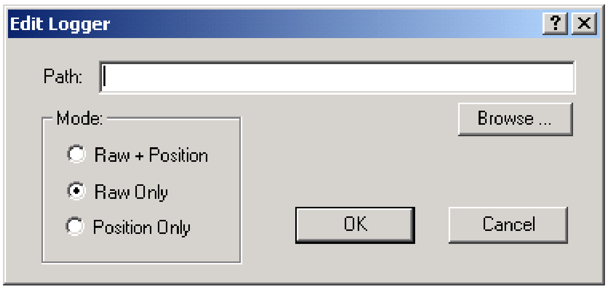


Using this menu Zero files are logged. These files can be read by LOGPUMP (See Section 8) where raw data can replayed and directed back into MultiFix regenerating pseudo-real time positions. Those positions can then be output from MultiFix to QUAL 2 or POSITIONVIEW software.

It is therefore possible for recoded real-time positions to be compared with regenerated positions.

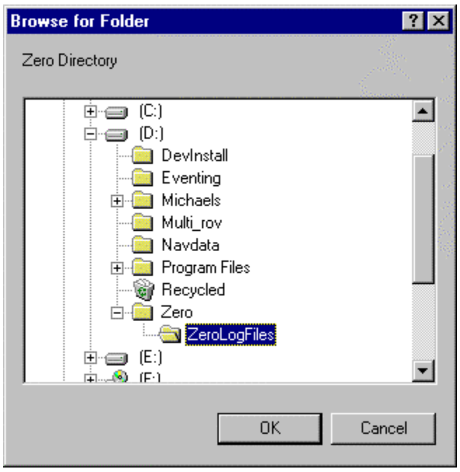
7.3.3.1. Edit

“Logger” \ “Edit” calls up the dialogue shown.



Select the type of logging required. Note there are not separate raw and position files, the Zero Log (*.zer) files can contain both raw measurement and position data.

In most cases it is recommended to use the “Raw Only” option.



Select the folder into which the logged data is to go either by typing in the destination or by using the **[Browse…]** facility. This provides the Browse for Folder dialogue. The path can be defined by clicking on the desired destination folder.

Be aware that typing in a non-existent path **will not create a folder.** If a new folder is required for data logging it must be created on the desired hard drive with Windows Explorer before logging begins. If a viable destination is not entered the *.zer log files will be written into the Soccer installation directory.

When the path and mode of logging have been selected click **[OK]**.

The files are named with the Julian day and time at the moment of creation, e.g. 061-1114.

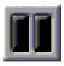
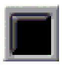
When a file reaches 1.4 Mbytes in size it will automatically close and a new one will be created.

It should be noted that Soccer file formats **are not** the same as Soccer 2 file formats.

7.3.3.2. Starting, Stopping and Pausing

"Logger" \ "Start" is a command.

The same is accomplished using the toolbar button. 

This will start the logging process. When data is being logged the menu options and toolbar buttons will change to "Pause"  and "Stop". 

"Pause" will arrest the logging process until "Resume" or "Stop" are selected.
"Resume" uses the same button as Start and will restart logging into the existing file.
"Stop" will close the current log file.

When logging is started a Logging Schedule file is created in the same folder as the Soccer application. This file is needed so that LOGPUMP can be set up correctly for the output of data. The schedule contains the Soccer version number, reference station and calculation status information. There is only one file so if logging is stopped and then re-started the existing file is overwritten. This means that if configuration changes have been made between one log session and subsequent log sessions the Logging Schedule file will only be relevant for the last session. Therefore, if changes are to be made after logging is stopped use Explorer to make a copy of the Schedule file and keep a note of the *.zer log files to which it relates. Do not make configuration changes while logging is on going.

When being archived or when being forwarded for replay analysis, the configuration files (including the schedule file) should be kept with the log files.

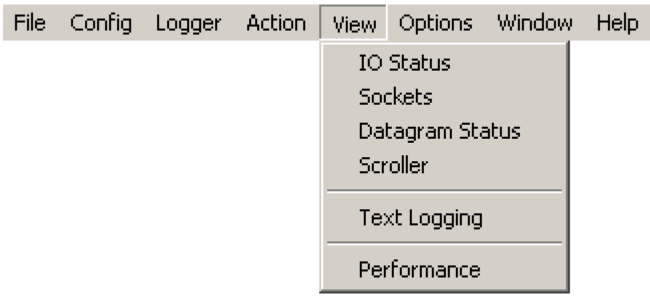
7.3.4. ACTION

7.3.4.1. Restart Sockets

“Action” \ “Restart Sockets”

On occasion heavy network traffic may lock up TCP\IP socket ports. This option will reinitialise all currently open sockets without having to restart the software or editing the configuration files.

7.3.5. VIEW



Right-mouse clicking most windows allows the user to customise the display. Where that customisation is specific to the view window it will be mentioned in the relevant section in the manual. Several windows share the same two facilities of “Copy” and to “Save As…”.

“Copy” places a bitmap of the window onto the clipboard from where it can be pasted into another application.

“Save As…” allows an html or bitmap file of the view window to be saved. By default the files will be placed in the folder that contains the Soccer configuration file. The bitmap files are saved as *.bmp images but the html file does not contain images but instead has links to the images, so when Soccer saves an html file the bitmaps are saved as well. When an html file is saved a Zero HTML Association file is also created. If the html file is deleted the associated bit maps are deleted as well

In common with many Windows programs, Soccer allows display windows to be moved outside the area displayed by the monitor. The application workspace automatically extends and scroll bars are provided. The scroll bars allow the display area to move around the extended application workspace. There is no limit on the number of windows of any type that can be open in the application workspace. Multiple copies of the same window type can be open. Indeed it will be seen that once a window is open some types of window allow further selection of the data that is to appear in them.

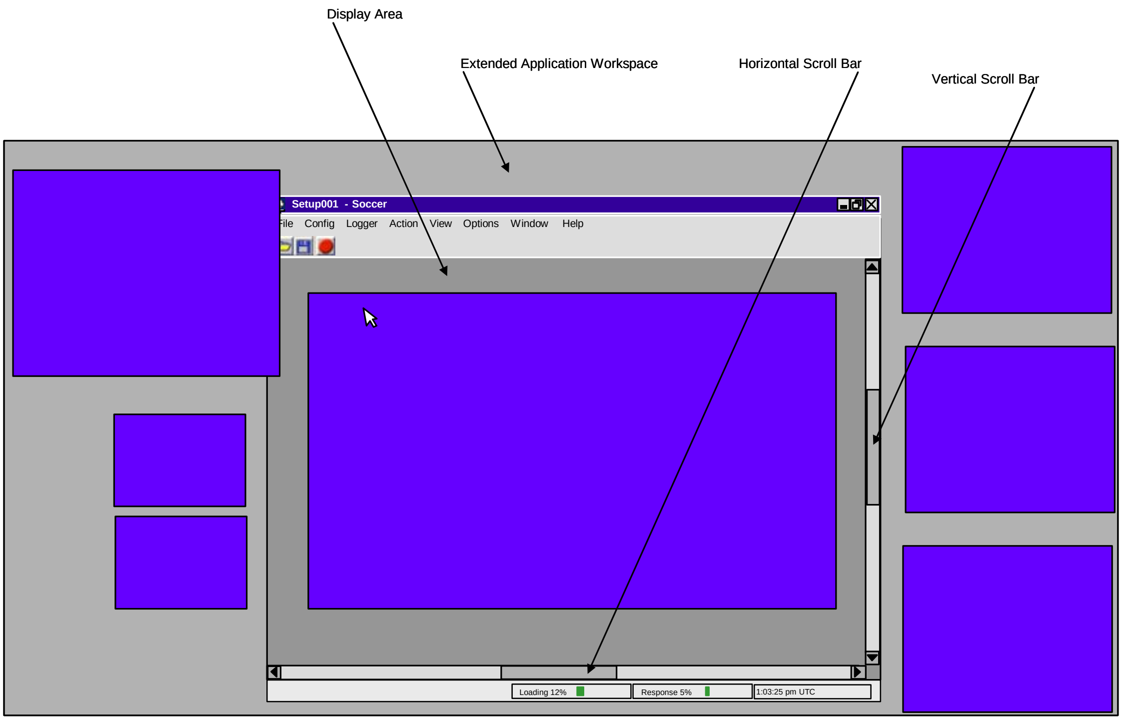


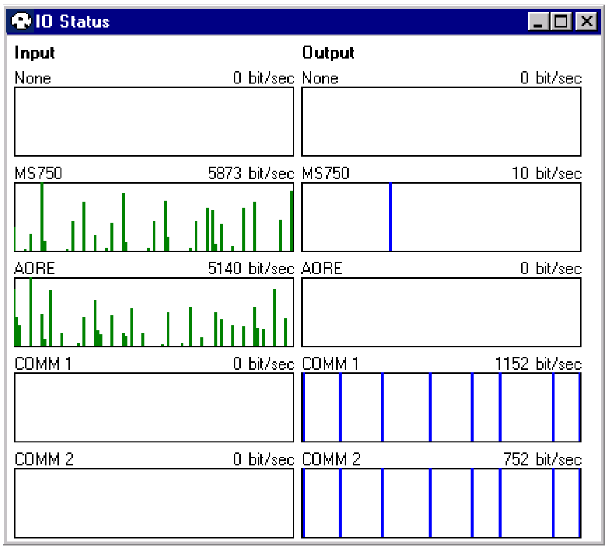
Figure 15 Windows Extending Beyond the Application Workspace

Most windows can be resized by clicking and dragging the corners or sides. Some windows that contain text will wrap the text message into the available space. Other windows containing text will simply be cropped as the window size reduces. Windows containing graphical information will resize down to a minimum and will then either crop the information or will introduce scroll bars.

7.3.5.1. IO Status

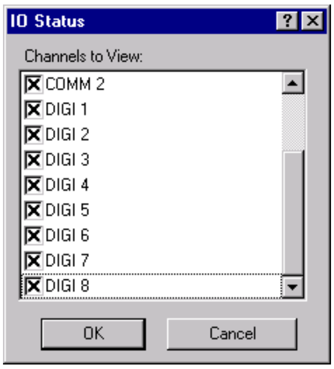
"View" \ "IO Status"

This window indicates when there is port activity.



By default the window will contain the ports Soccer knows to exist. The "None" I/O Channel is at the top followed by streamed socket channels, datagram sockets and then the COM and Digiboard channels.

(When setting up Input / Output channels there is the option to select a dummy channel "None". If selected the blue vertical bars would be seen progressing across the None Output box.)



A right-mouse click calls up the **[Channel]** button. When this is clicked the IO Status dialogue is presented. This allows channels to be selected or deselected from the status window.

In the IO Status window the latest time is in the centre between the Input and Output columns. Each box indicates when data has been input or output, over the last 5 seconds, on that port by scrolling vertical bars from the centre to the outside edges of the window. The box re-scales such that the greatest data rate over the last 5 seconds is full scale. The current bit rate is shown opposite the I/O channel name.

7.3.5.2. Sockets

“View” \ “Sockets””

A client socket can have three conditions,

Idle, Connecting and **Connected**.

Idle and Connecting will alternate while connection is trying to be established. There will also be a time countdown to the next attempt to make contact.

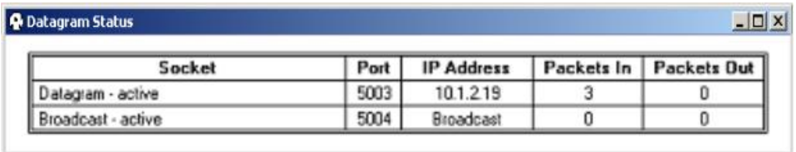
A server socket can have two conditions,

Idle and **Listening**.

The Idle status is almost immediately replaced by Listening.

7.3.5.3. Datagram Status

“View” \ “Datagram Status”



Socket	Port	IP Address	Packets In	Packets Out
Datagram - active	5003	10.1.2.19	3	0
Broadcast - active	5004	Broadcast	0	0

The Datagram Status window lists all Datagrams in use. The IP address indicates to which PC a link is in place or if it is transmitting a broadcast message. The “Packets In” and “Packets Out” window indicates if the datagram is working. If you are receiving data only the “Packets In” will increase. If you are transmitting to n PCs the “Packets In” will increase at n times the rate of the “Packets Out”.

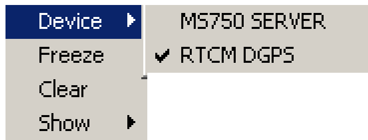
7.3.5.4. Scroller

"View" \ "Scroller"

Scroller is able to display any data that is input or output in Soccer. When first opened the display defaults to showing the link to/from the GPS receiver. To change to another IO Channel or to change the scrolling options, click the right mouse button.

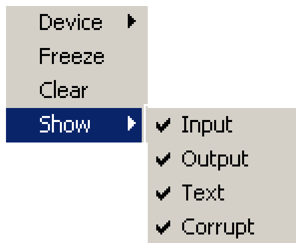
This calls up a menu box, which has "Device", "Freeze", "Clear" and "Show" as shown below.

If "Device" is highlighted there is a sub-menu which lists the different input / outputs. Top of the list is the name given to the GPS receiver. This is followed by the RTCM source(s) and then by the output(s).



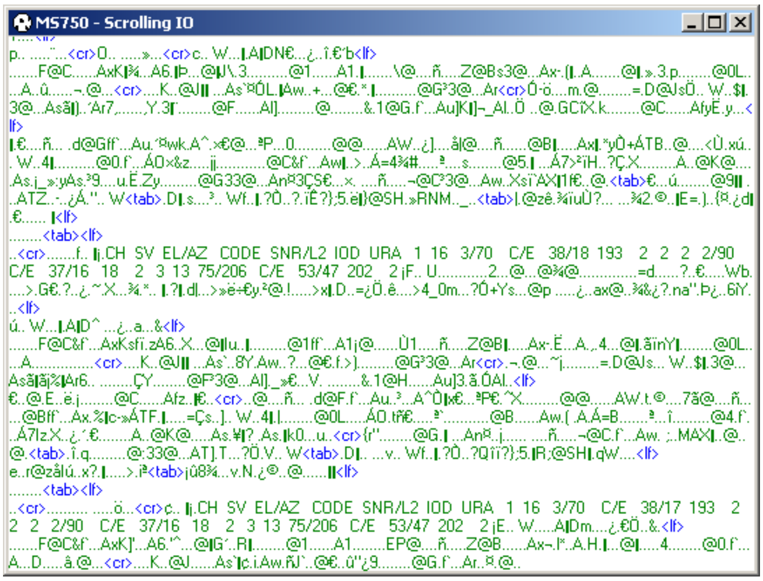
If "Freeze" is selected the current window display is held and frozen appears in the windows title bar. Clicking "Freeze" again unfreezes the display. "Clear" will remove all information from the current window.

"Show" brings up a new sub-menu with four options: "Input", "Output", Text" and "Corrupt". A tick next to the option indicates that the relevant information is currently displayed in the Scroller window. These options may be toggled on or off by left clicking.

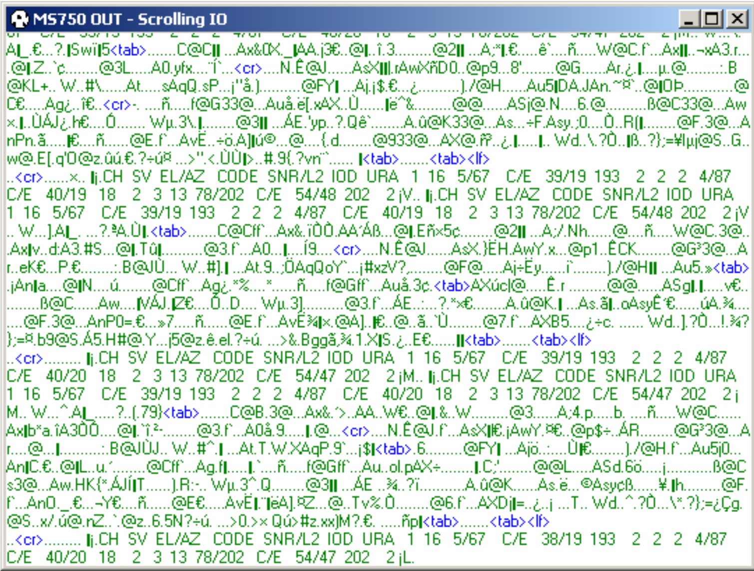


The text in the window is bottom justified and colour coded. Green indicates it has been successfully decoded and passed all parity checks, red indicates the data is corrupted and dark blue is reserved for the outputs, see 7.3.5.4.2.

7.3.5.4.1.RTCM Input



7.3.5.4.2.Output Strings

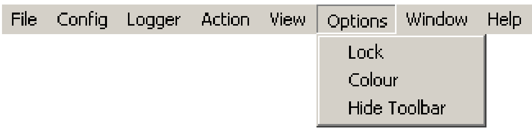


7.3.5.5. Text Logging

"View" \ "Text Logging"

Text Logging is not currently functional.

7.3.6. OPTIONS



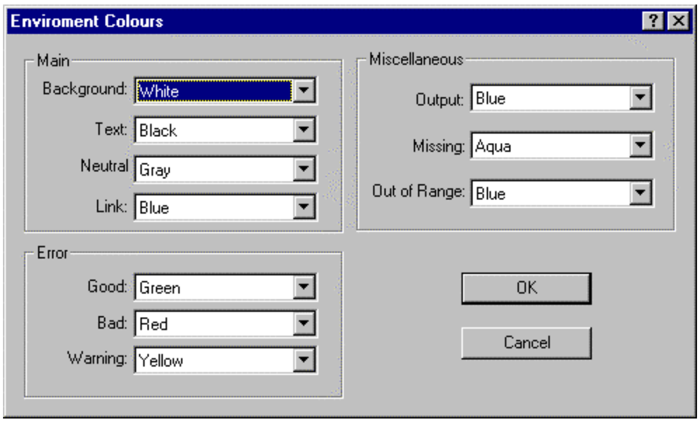
7.3.6.1. Lock

"Options" \ "Lock"

If the Lock option is chosen "File" and Config" are removed from the menu bar. Whilst locked, "Options" \ "Lock" changes to "Options" \ "Unlock". This reinstates "File" and Config" if selected.

7.3.6.2. Colour

"Options" \ "Colour"



If different colour schemes are required they can be set up here. Ensure that a false impression is not given when changing the colour coding, in particular relating to errors.

Some of the selections do not affect all view windows.

- "Main"

  "Background" and "Text" change the windows background and text colours.

  "Neutral" is used in the Latency window to show period when update may be expected.

  "Link" is not currently used.

- "Error".

  Various windows have stages of error state, these colours relate to them.

  "Good", "Bad" and "Warning".

- "Miscellaneous"

  "Output" as seen in the IO status and IO Scroller windows.

  "Missing" as seen in the Latency and Constellation windows.

"Out of Range" as seen in the Latency and Constellation windows when a satellite is below the mask.

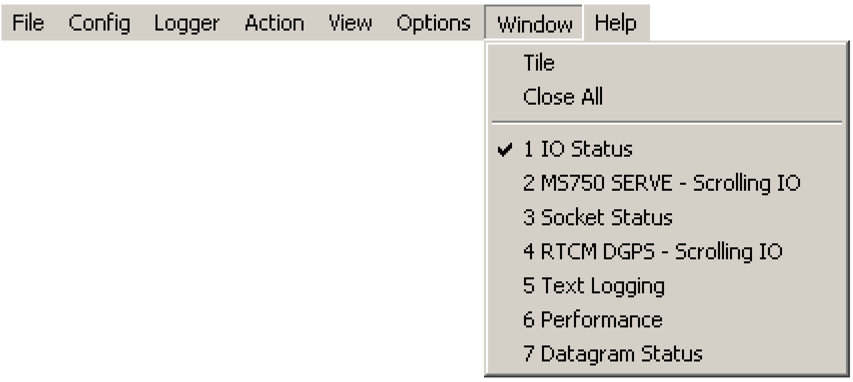
7.3.6.3. Hide Tool Bar

"Options" \ "Hide Tool Bar"

This will hide the shortcut toolbar displayed at the top of the MultiFix screen.

When hidden the option will change to "show toolbar" which will return the toolbar to the screen when selected.

7.3.7. WINDOWS



The list will change depending on the number and types of windows that are open at any one time.

7.3.7.1. Tile

"Window" \ "Tile"

The tile command causes the application workspace to be reduced to the display area. The windows that are not minimised are fitted into the display area and the minimised windows are neatly stacked along the bottom of the screen.

7.3.7.2. Close All

"Window" \ "Close All"

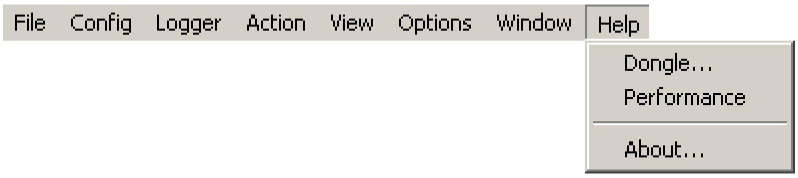
The close all command closes all windows irrespective of their status. As there is no confirmation required be careful not to use it in error.

7.3.7.3. The Open Windows

The "Window" drop down will also list all the windows currently open. Windows can be overlain one on top of another and it can be difficult to locate an obscured window. Clicking the window in the list causes the focus to shift to that window, the title bar is highlighted and it will appear on top of all the other windows. If there is an extended application workspace, and the selected window is off screen, the display area will not move to show the window but the title bar of the window will still become highlighted.

If there are more than 9 windows open the bottom line of the menu will be “More Windows…” If this is selected a dialogue opens listing all windows. Highlight one of them and close the dialogue.

7.3.8. HELP

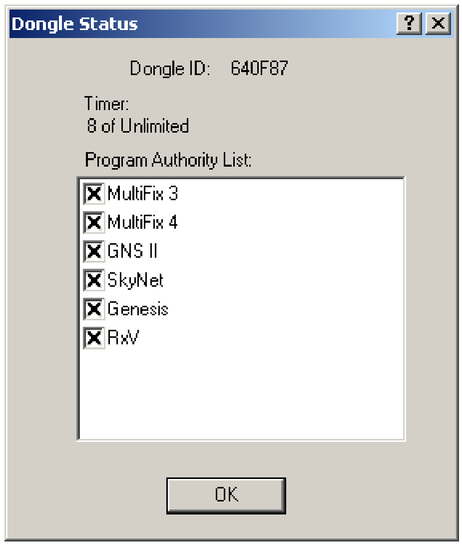


7.3.8.1. Dongle

"Help" \ "Dongle…"

Provides the information stating:

- Which programs the DK2 is authorised to run
- The time limit of the dongle
- The amount of use the dongle has already had.



At all times Soccer is being run the dongle is required in the computer's parallel port. If it is removed the program shuts down and an error message is posted.

If the time limit of the dongle expires the program shuts down and an expiry message is posted.

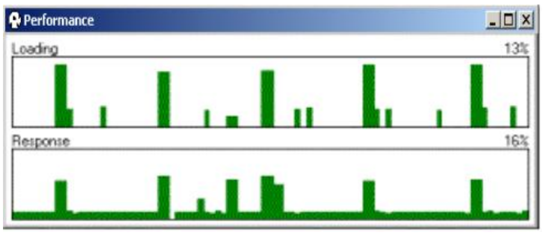
It is possible to revalidate the dongle by running the PROLIVE program and making a call to the Technical Support Group. The same program plus a telephone call can also be used to terminate a dongle so that it is no longer valid and no longer re-charged.

The list in the above dialogue requires refers to certain programs in the Zero Suite. SKYNET is a differential correction monitoring package, GENESIS is a Long Range RTK system that uses a similar software package to MultiFix, and RXV is a program called RECEIVER VERIFY which is described in Section 6.

Several other programs in the Zero suite are not listed which also require a dongle validated for Soccer. These are POSITIONVIEW, QUAL2 and LOGPUMP. Each of these 3 programs only requires the dongle when first being run. After that the dongle can be removed.

7.3.8.2. Performance

"Help" \ "Performance"



The Performance window shows how the program is handling the data acquisition and calculation process with the available resources. The window does not take into account other programs that are running simultaneously.

The graphs will be green below 50%, yellow between 50% and 75% and red when above 75%.

It is important there is enough time for all the processes to be completed in an orderly fashion. If there are too few resources the position solution may lag. The demand on the processor can be reduced by accessing only the data from the RTCM reference stations used in the computations, by having fewer computations and by closing windows.

The performance information can also be seen in the bar at the bottom of the application window next to the UTC Time.

7.3.8.3. About

"Help" \ "About…" provides the version number and release date

7.4. SOCCER AND MULTIFIX 4

MultiFix takes in data from a GPS receiver and from a RTCM data link in order to compute a position.

Using MultiFix on its own it is not possible to make the GPS or RTCM data available to other programs. If another MultiFix user requires raw data it is necessary to set up an entirely new hardware configuration for that program. Simply put, the raw data being input into the program cannot be 'shared' which this may present problems with regard to available resources.

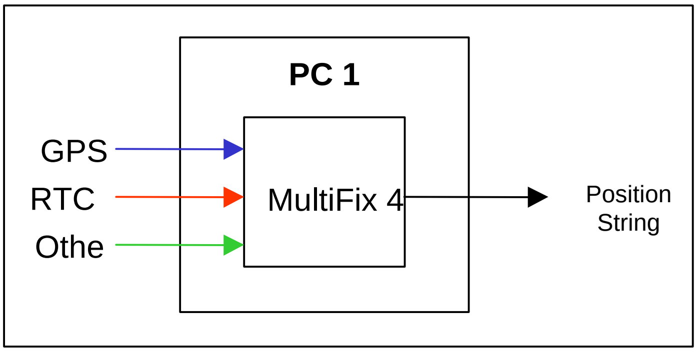


Figure 16 Outputs Available from Soccer

To overcome the problem of sharing data the Soccer application can be used to receive the GPS pseudo-ranges and RTCM corrections. Pathways (ribbons) are then established within the Soccer program to enable any of this data to be made available to multiple users on a local network via socket connections.

The diagram shown overleaf shows only one copy of Soccer running on each computer, but there can be several Soccer applications running on the same PC.

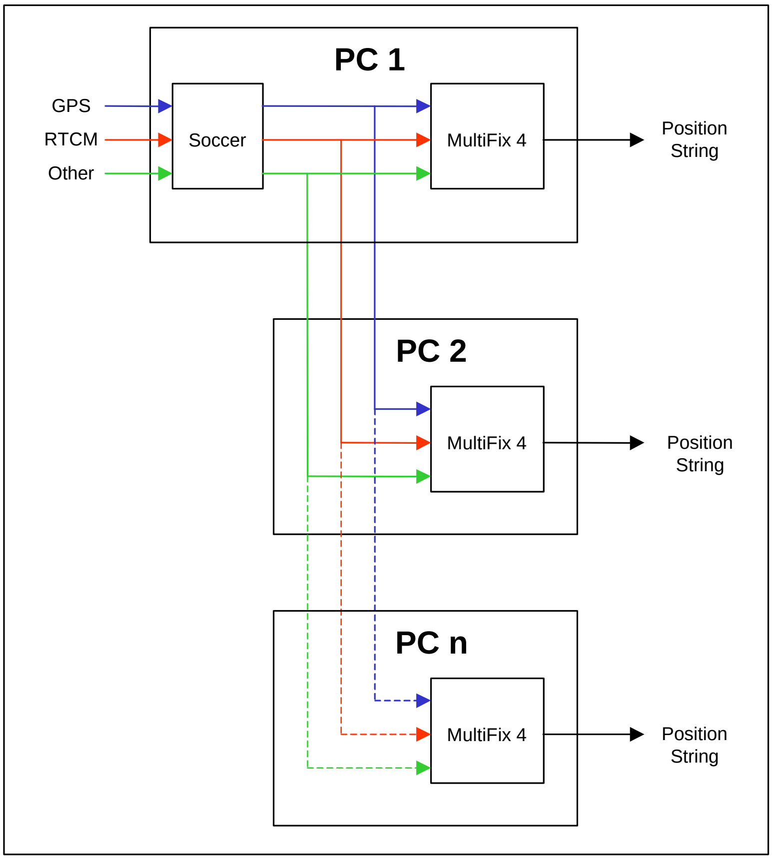
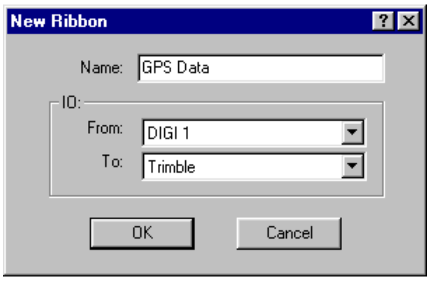


Figure 17 Outputs Available from Soccer Configuration

Connect up the hardware as per the instructions outlined in section 0. Then run up the Soccer program by clicking “Start” \ “Programs” \ “MultiFix 4 Vx.xx” \ “Soccer”.

It is first necessary to configure the COM ports. Click on “Config” \ “IO” \ “Comm…” select the desired COM ports, click **[Enable]** then set the correct Baud Rates and Parity. This procedure is also described in section 4.3.3.1.1 on page 53. From the “View” menu select “IO Status”. The **Input** column should show data being input into the program on the relevant COM ports.

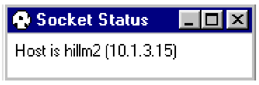
In order to output the raw data from Soccer, it is necessary to define a pathway within the program. It should be remembered that any data could be output either on a socket or an available COM port.



Select “Config” \ “Ribbon” \ “New…” and the New Ribbon window will appear. Give it a name and then select the relevant Input and Output location. To apply this ribbon click **[OK]**. From the “View” menu select “IO Status”. The **Output** column should show data being output from the program on the relevant port or socket.

“Config” \ “IO” \ “Sockets…” defines the socket (which may also be regarded as a virtual port) that the data will be output on. The configuration of sockets within Soccer is described in Section 7.3.2.1.2 on page 262.

It should be noted that the name and IP address of the host computer is always displayed in the **Socket Status** window. This can be accessed by clicking “View” \ “Sockets”.



8. LOG PUMP

8.1. INTRODUCTION

Log Pump and MultiFix 4 are two of the applications in the Zero Suite of applications. MultiFix 4 is able to form differential Iono-free solutions of position given data from a GPS receiver and Type 1, 2, 3 and 15 or 55 RTCM Type messages. It also has the ability to record data from its GPS receiver and any RTCM sources to which it is interfaced and to log the position solutions. Log Pump can read and output the recorded data and pass it back into MultiFix 4 where re-computations can be performed in pseudo-real time. Log Pump also has the facility to output the logged positions to Qual 2, where they can be statistically analysed.

This section covers the configuration and operation of the Lop Pump application and specific points of note for the configuration of the MultiFix 4 application. For complete advice on the set up and operation of the MultiFix 4 program see Section 4.

In common with other Zero programs

- There is no limit on the number of RTCM correction systems.
- There is no limit on the number of RTCM differential reference stations.
- There is no limit on the number of outputs
- There is no limit on the number of view windows
- Many view windows can be customised

The text in this manual conforms to certain conventions.

- All dialogue command buttons are shown bold and square bracketed, e.g. **[OK]**.
- When a keyboard key is represented, it is shown bold and bracketed by greater than and lesser than symbols e.g. **<spacebar>**.
- Direct quotations from dialogues or edit control slots are shown in normal text in quotations, e.g. “IO Channel:”

8.2. CONFIGURATION

8.2.1. HARDWARE INTERCONNECTION

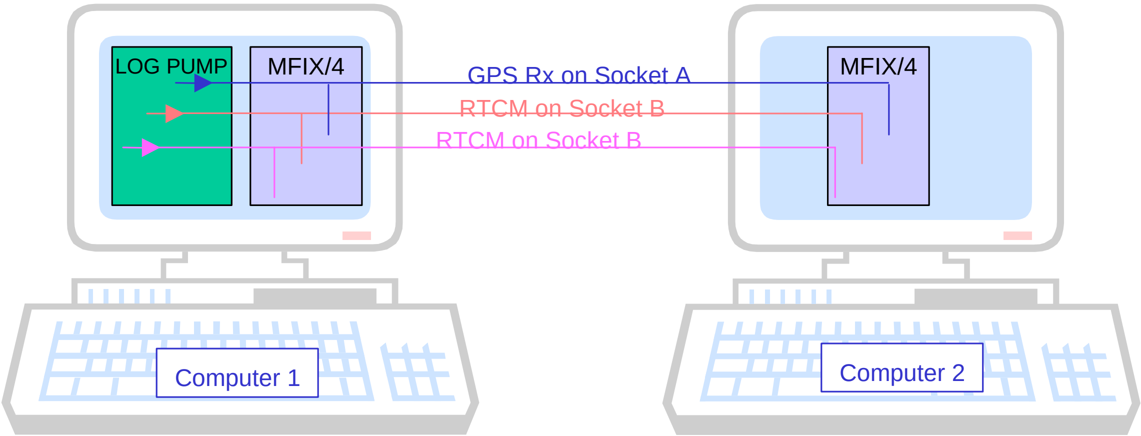


Figure 18 Example Configuration for Re-computation of Position Solutions

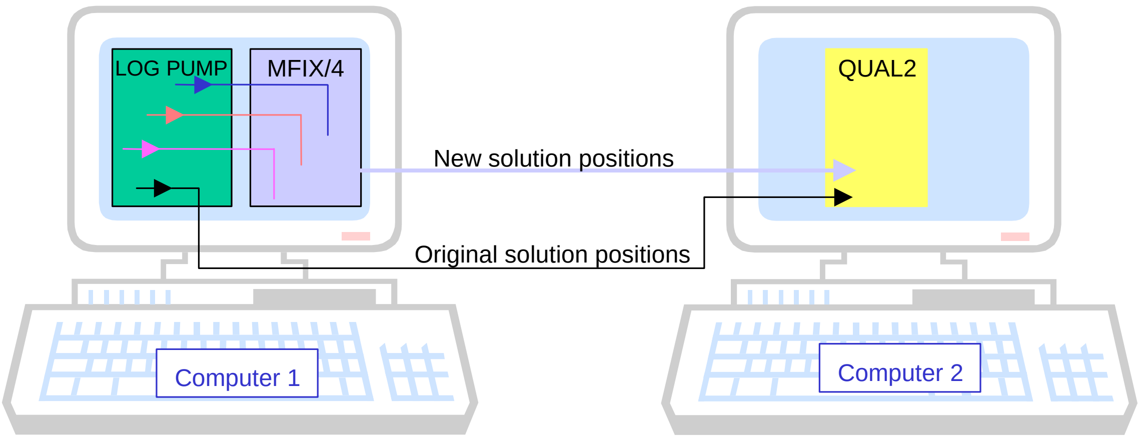


Figure 19 Example Configuration for Comparison of Position Solutions in Qual 2

Note: - Log Pump and MultiFix 4 do not have to be run on the same computer. They can be run on independent computers with the data transferred between them, usually using sockets.

8.2.2. HARDWARE REQUIREMENT

Log Pump requires the following:

A PC running Windows 98, Windows 2000 or Windows NT.
The PC will preferably be a PII or faster. A graphics resolution of at least 1024 by 768 pixels is recommended in order to achieve maximum clarity of all the graphics displays. A faster machine with more memory may be required if MultiFix 4 is to be used, See Section 4.2.3. It is recommended that the PC has network capabilities so sockets can be used for outputting data.

For the installation of the software the PC requires a CD-ROM drive. It is possible to create installation floppy discs from the installation menu on the CD but 8 floppies are needed.

Assuming data is not being input or output over network sockets, the PC needs a minimum of 2 COM ports. One COM port is used for two-way communications to the GPS receiver and the second COM port for the input of RTCM corrections. As the second port is for input only it can also be used to output position messages by using a special breakout cable.

If there is more than one RTCM delivery system, or data is to be output on several ports, then additional COM ports will normally be required. These can be any proprietary asynchronous serial board (or PCMCIA card). The Windows drivers for these allow the board's (or card's) ports to be mapped as additional COM ports.

8.2.3. LOG PUMP FILES

Log Pump has its own configuration and persistence files that are normally stored in the folder into which the application was installed. The persistence file contains the number, type, position and contents of windows in the application workspace when a configuration file is saved. It is also written when the program is exited.

Log Pump reads the *.zer files written by MultiFix 4. Zero log files are named using the Julian day and time when opened.

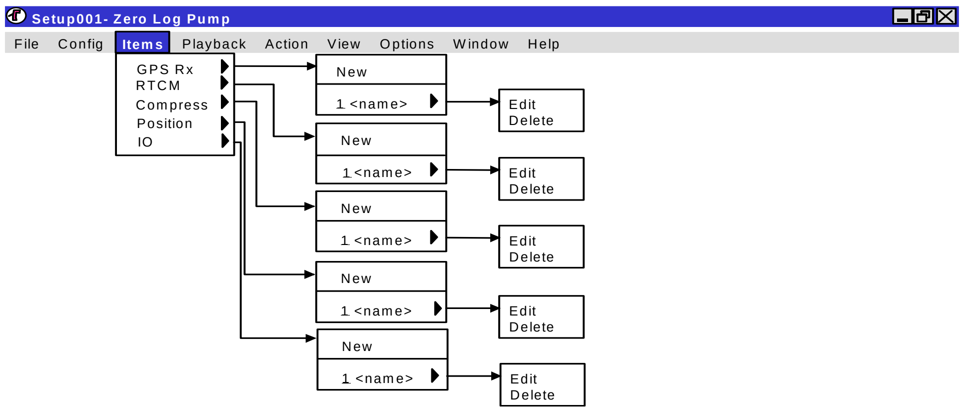
8.3. REAL TIME OPERATION

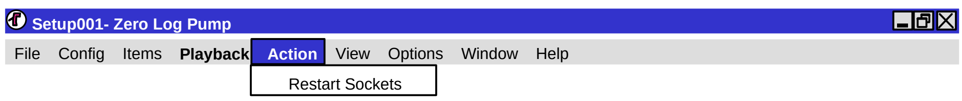
Log Pump can be opened a variety of ways.

Use Windows Explorer to display the contents of the folder containing the Log Pump program files and then double-clicking the “Log Pump” application icon.

Drag the “Log Pump” application icon from the Windows Explorer window onto the desktop to create a shortcut. Thereafter double-click the shortcut.

Use “Start” \ “Programs” \ “Zero” and click “Log Pump”.





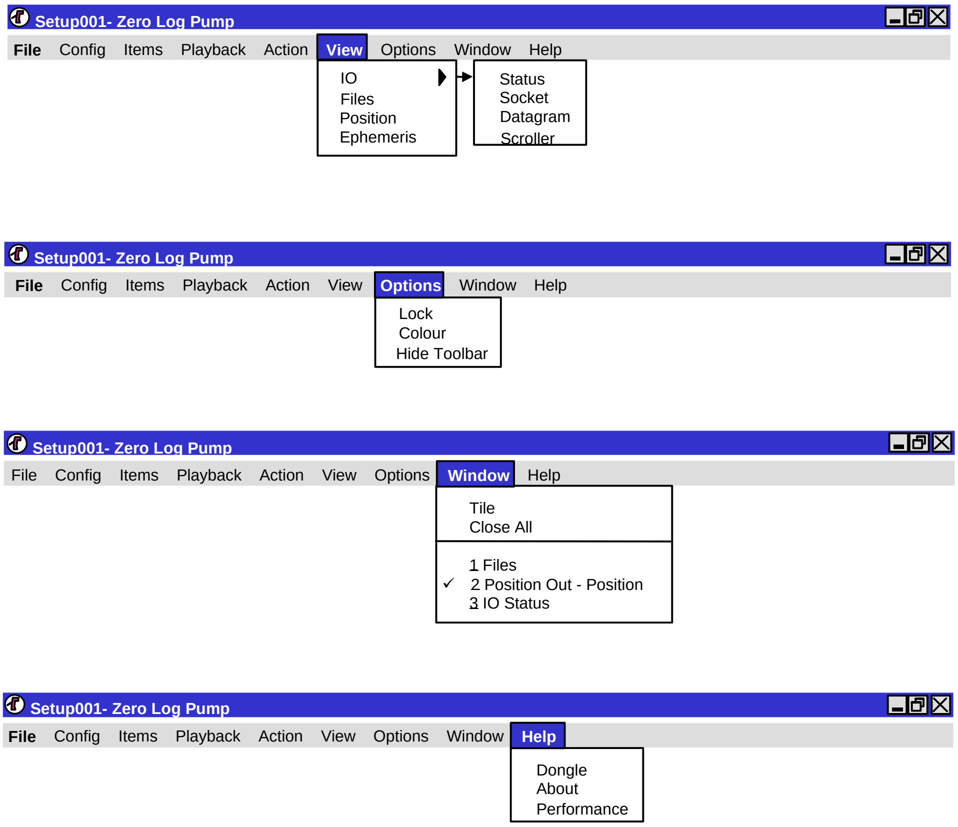


Figure 20 Log Pump Menu Layout

8.3.1. FILE

8.3.1.1. New

"File" \ "New…"

To start a new Log Pump configuration select this option.

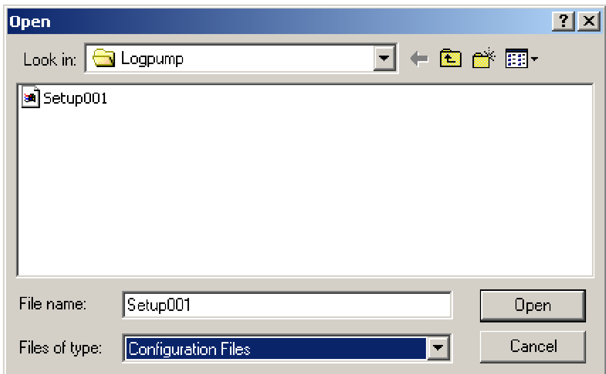
Be aware that starting a new configuration will close the existing configuration and the program will cease outputting data.

At the bottom of the "File" menu is a list of recently used configuration files. Clicking on one of these files opens up the chosen configuration.

8.3.1.2. Open

"File" \ "Open…"

When opened the program does not know which configuration file to open. Assuming a previously prepared configuration exists, use this facility to select it.



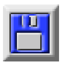
The configuration files have program name and version identifiers in a file header. They also have a configuration file version number. The program will not allow configuration files to be opened that are not compatible with the version of Log Pump that is currently being run. However if the configuration file version is the same they can be used even though created by a different program version.

File open can also be accomplished using  the button.

8.3.1.3. Save

"File" \ "Save"

A configuration is not automatically saved as changes are made, therefore use this facility to update the configuration file to the current status. If the set up is being undertaken for the first time and the configuration does not have an identity, the use of "File" \ "Save" will call up the Save As dialogue. That dialogue requires a name to be entered for the Log Pump files. Once a configuration has been named, use of "File" \ "Save" performs the save without calling up the Save As dialogue.

The name of the current configuration file appears in the application workspace title bar. If configuration changes are made that have not been saved, that file name has an * appended to it. After a File \Save the * is removed. File saving can also be accomplished using the  button.

8.3.1.4. Save As

"File" \ "Save As…"

If the current configuration is to be saved but not at the expense of overwriting the existing configuration files, use the "File" \ "Save As…" option. This creates new configuration files and leaves the previous files as they were. The program immediately commences to use the new files as the current configuration files.

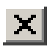
The Save As dialogue requires the operator to enter a name for the new configuration file. If an existing file name is entered, the program will overwrite the existing files.

8.3.1.5. Exit

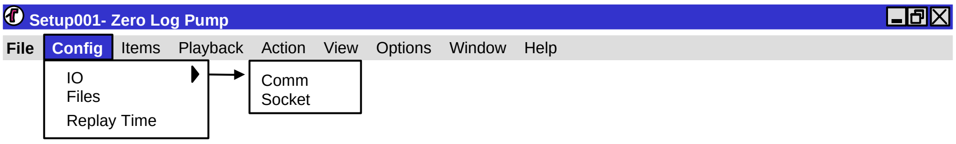
"File" \ "Exit"

This exit route is immediate if no configuration file is loaded.

Confirmation is required if a configuration file is in use. The user will be prompted to save the configuration if they have not already done so.

If the program is exited using the  button when the current configuration has not been saved, a dialogue is presented asking whether to save the configuration prior to exit or whether to cancel the exit. If there have been no configuration changes then the program will terminate immediately.

8.3.2. CONFIGURE



8.3.2.1. IO

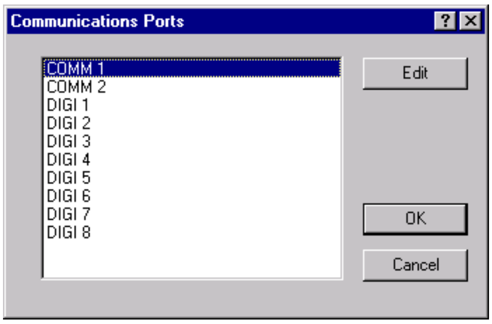
"Config" \ "IO"

8.3.2.1.1.Comm

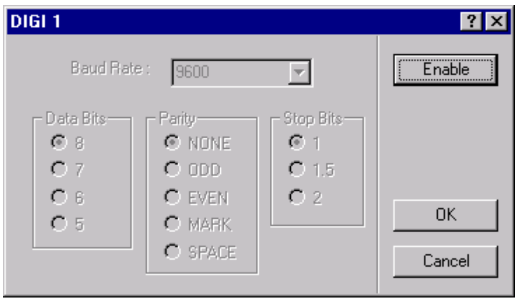
"Config" \ "IO" \ "Comm…"

Earlier it was explained that the "Programs" / "MultiFix 4 Vx.xx" / "IO Config" applet needed to be run after installation to define what ports the computer has available (see section 3.4 on page 13). The parameters selected there determine the dialogue box that is presented when "Config" \ "IO" \ "Comm…" is selected.

Highlight one of the ports to be used and click **[Edit]**. This opens another dialogue box for setting the port parameter settings.



Click the **[Enable]** button to activate the port and set the Baud Rate, Data Bits, Parity and Stop Bits.



8.3.2.1.2. Sockets

"Config" \ "IO" \ "Socket…"

To be able to distribute and receive data over a network via sockets assumes each computer has Transmission Control Protocol / Internet Protocol (TCP/IP) installed. Sockets have the advantage over COM ports in that two or more programs can access the same data.

Sockets can transfer data between programs running on different computers or between two or more programs running on the same computer. (If a standalone (non-networked) computer running Windows NT is used and the data is to be shared between multiple programs running on that PC then the MS Loopback Adapter network adapter must be installed).

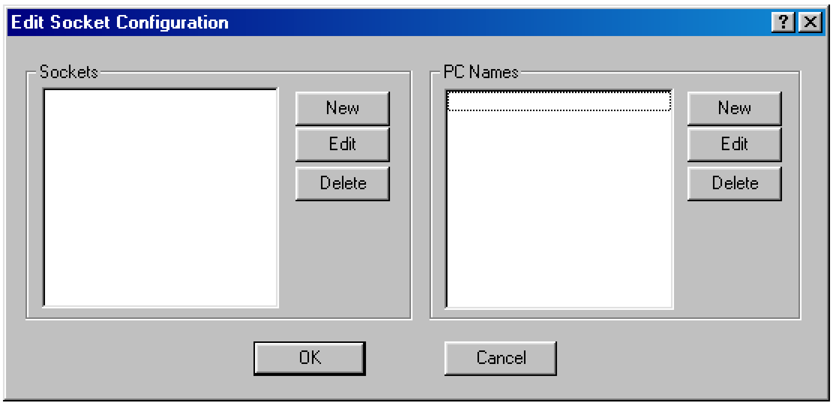
The TCP/IP protocol is a family of protocols that allow Internet data communication. Included in that family are two transport layer protocols, the Transport Control Protocol (TCP) and the User Datagram Protocol (UDP).

The Transport Control Protocol establishes sessions between a Server and however many Clients that are accessing that Server. There is continual presence checking and acknowledging between each Server/Client pairs with messages always received in the order they were issued. A Server does not have control of the number of Clients that access the socket on which data is being presented. (It is often perceived that the Server provides data and the Client receives data, but once the connection is established the link is two-way).
The User Datagram Protocol does not have the end-to-end checking overhead of the TCP. Instead packets of data are simply issued to the Internet in either broadcast mode, where any networked computer on the LAN can receive them, or in addressed mode where the data packets have headers specifying the addressees for whom the packets are intended. There is no guarantee with this protocol that the messages will arrive in the order they were issued. When setting up "Ribbons" to output datagrams a time interval can be specified to prevent data becoming corrupted, see section on "Ribbons" **7.3.2.2**. Broadcast datagrams cannot pass routers linking Local Area Networks (LAN) unless specifically configured.

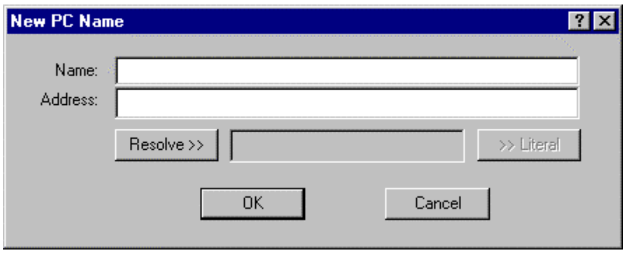
For most situations where Local Area Networks are involved Server / Client TCP sockets are the best choice Internet transport protocols.

8.3.2.1.2.1.The Log Pump Application as a Client

For a Client to make contact with a Server, the operator must know the IP address (or the network identification name - see below) of the Server computer and the port number the Server is outputting the required data on.

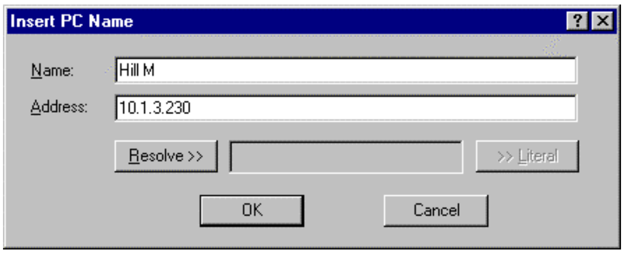


First, in the “PC Names” table click **[New]**.

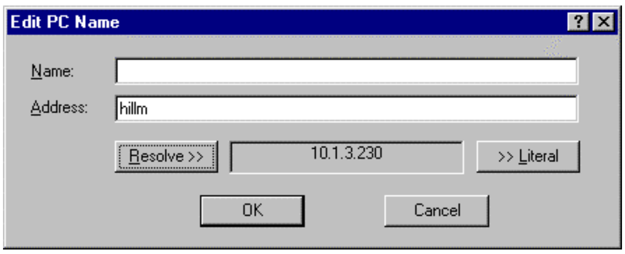


There are two possible ways of defining the server PC.

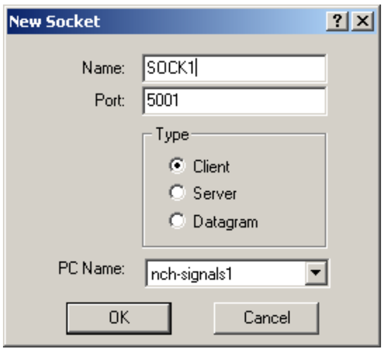
If the numerical IP address is known, enter a PC name in “Name:” and the IP address in “Address:” and click **[Resolve>>]**. Click **[OK]**.



If the IP address is not known but the computer’s network identification name is, and if all computers involved are aware of local naming services (WINS / DNS), then type in the computer’s name in the “Address:” slot and click **[Resolve>>]**. Once the computer is found, its IP address will appear as shown. If required, use **[>>Literal]** to transfer the name and address to their named slots. Click **[OK]**.



It is normal in a network for computers to be allocated new IP addresses when the PC is restarted. If the Client PC has a numerical entry for the address and the Server’s address has changed, it will not be able to re-locate it. If the Client PC has the name of the Server PC in the address slot, it will automatically search to re-locate the Server PC by name. Assuming it is found, the Client PC will obtain the Server PC's current address.

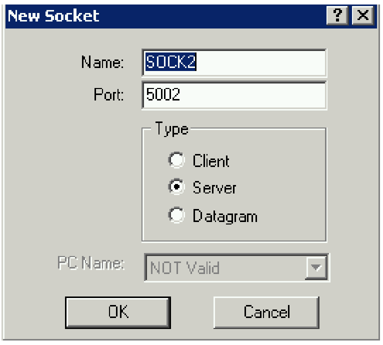


In the "Sockets" table click **[New]**.

Check the "Client" radio button and select the "PC Name:" of the server.

Enter the number of the port on which the Server PC is presenting the data. Change the socket's default name if required.

8.3.2.1.2.2.The Log Pump Application as a Server



If the Log Pump computer is to be a server then there is no need to add the Soccer computer to the PC table; the program already knows the computer's IP address. This can be seen in the window called up by "View" "IO"\ \ "Sockets", See Section 8.3.6.1.2 on page 306.

In the "Sockets" table click **[New]**. Give the socket a name and enter the Port number that the data will be output on. Click **[OK]** to exit.

8.3.2.1.2.3.Datagrams

It was explained in section 8.3.2.1.2.3 that the User Datagrams Protocol allows packets of data to be broadcast or to be sent to specific addresses without the overheads associated with the Transport Control Protocol.

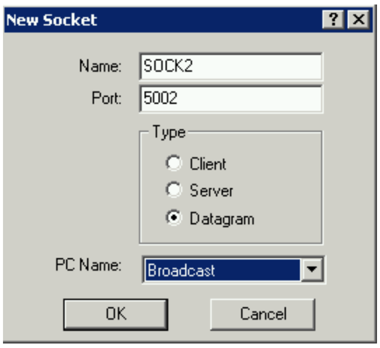
BROADCASTING

Log pump cannot give multiple addresses to packets of data so if information is to be made available to more than one computer in datagrams it must be broadcast on a particular port. A computer that is broadcasting on a port also listens to all data packets that are received on that port.

DATAGRAMS TO/FROM A SPECIFIC PC

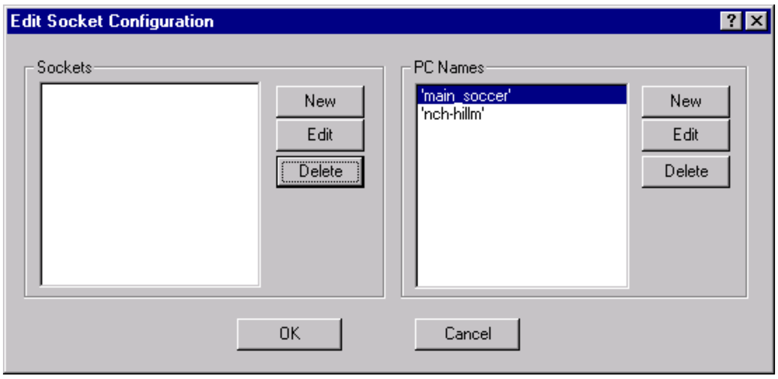
To transmit to or to receive from a specific computer, (which may itself be broadcasting), a PC must be set up with a datagram socket where the port number and the PC are identified.

To broadcast datagram packets, click the "Datagram" radio button and select "Broadcast" from the "PC Name:" list.



To target one specific PC requires that the Internet address of that PC should already have been identified. See Section 8.3.2.1.2.1 on page 293 for an explanation of adding PCs.

Once the PC has been entered in the "PC Names:" table click **[New]** in the "Sockets" table. Give the socket a name, enter the Port number and in the "PC Name list select the PC.



Click **[OK]** to exit.

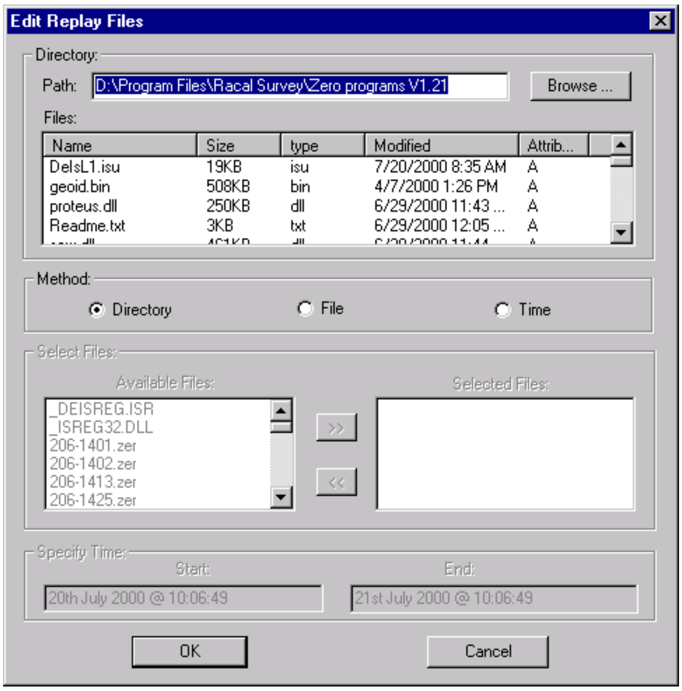
Having set up sockets, the Edit Socket Configuration dialogue now shows the connection(s).

8.3.2.2. Files

"Config" \ "Files"

This is used to select the logged files that are to be used for replay.

Use **[Browse…]** to locate the directory containing the *.zer files to be replayed.



If all the *.zer files in the directory are to be replayed click the "Directory" radio button.

If particular *.zer files are to be selected, first click the "File" radio button. Now highlight the *.zer files that are to be replayed. Use **<shift>** or **<Ctrl>** to make multiple file selections. Now use the **[>>]** to transfer them to the "Selected Files" table.

If a particular time period is to be covered click the "Time" radio button. This activates the "Specify Time" table. The program allows entry of garbage in either the "Start" or "End" edit control slots, but if an entry is incorrect it will not allow the edit control slot to be exited or other dialogue elements to be used. The @ symbol is the separator between date and time. Date can be entered as 1st April 2003, 01 April 2003, 01 Apr 2003, or 01-4-2003. Time can be entered as 10:34:22, 10,34,22 or 10-34-22. Single figure hours do not need a preceding 0.

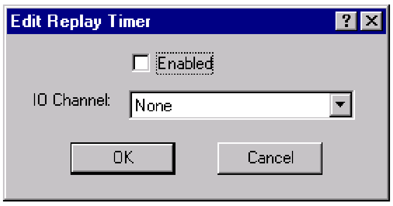
Once **[OK]** is used to exit the dialogue the "View" \ "Files" window will show the files that have been selected for replay.

8.3.2.3. Replay Time

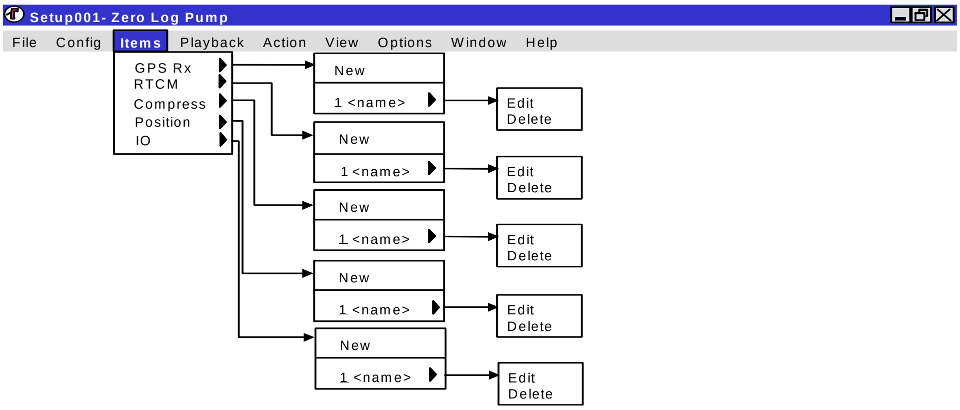
"Config" \ "Replay Time…"

This sets the period of time to be replayed.

This is non-operative in this version of Log Pump and in the current MultiFix 4 version. The intention is to output a time pulse such that when the data is fast-forwarded in Log Pump MultiFix 4 keeps up with the faster output rate. At the moment it is expecting data paced at 1Hz.



8.3.3. Items

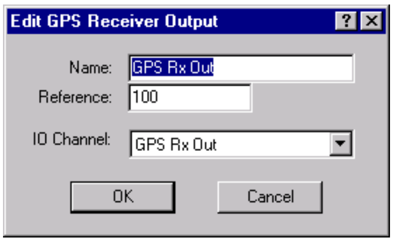


8.3.3.1. GPS Receiver

"Items" \ "GPS Rx…"

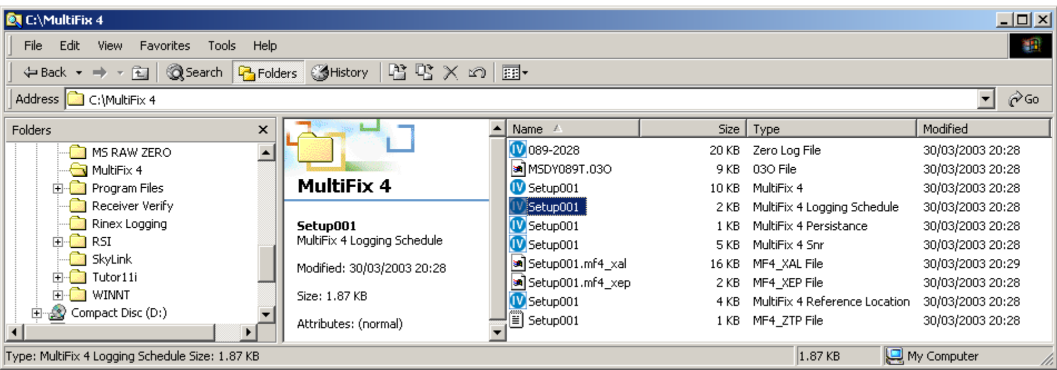
This used when Log Pump is set up to output Raw data to MultiFix 4 where positions are recalculated in pseudo-real time.

Give the receiver a name.



When the GPS measurements from the receiver were recorded the data was tagged with a GPS receiver reference number. (This caters for a possible future development to the program when more than one receiver will be able to be used). To check the number it is necessary to open the MultiFix 4 Logging Schedule file. The Logging Schedule file is written by MultiFix 4 every time logging is started. It is written to the directory into which the program is installed, which may or may not be the directory that contains the zero log files themselves.

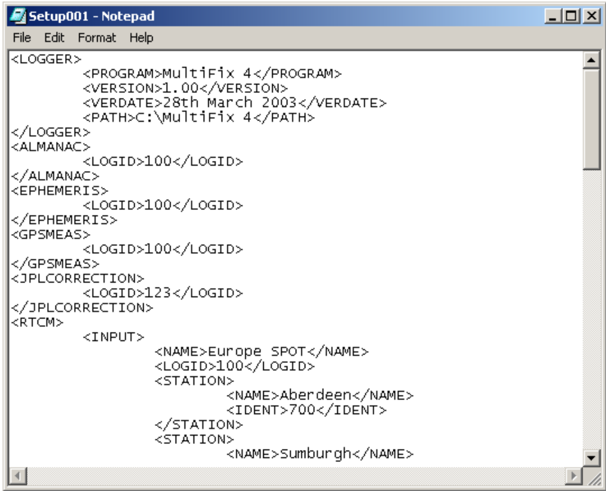
The file can be opened with Notepad.



Name	Size	Type	Modified
089-2028	20 KB	Zero Log File	30/03/2003 20:28
MSDY089T.03O	9 KB	03O File	30/03/2003 20:28
Setup001	10 KB	MultiFix 4	30/03/2003 20:28
Setup001	2 KB	MultiFix 4 Logging Schedule	30/03/2003 20:28
Setup001	1 KB	MultiFix 4 Persistance	30/03/2003 20:28
Setup001	5 KB	MultiFix 4 Snr	30/03/2003 20:28
Setup001.mf4_xal	16 KB	MF4_XAL File	30/03/2003 20:29
Setup001.mf4_xep	2 KB	MF4_XEP File	30/03/2003 20:28
Setup001	4 KB	MultiFix 4 Reference Location	30/03/2003 20:28
Setup001	1 KB	MF4_ZTP File	30/03/2003 20:28

You see in the example that the “GPSMEAS” has a “LOGID” of 100.

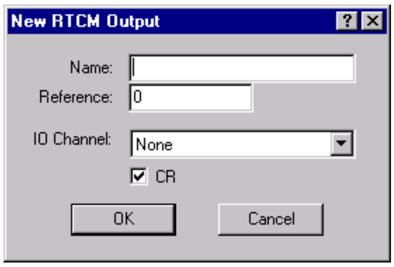
Select the “IO Channel:” via which the GPS Measurements will be sent. This channel needs to be two-way because MultiFix 4 will also be making requests for almanac data and Log Pump will need to respond to those requests.



8.3.3.2. RTCM

“Items” \ “RTCM” \ “New”

Give the Output a name.



As described in 8.3.3.1 above, enter the “LOGID” of the RTCM.

Enter the “IO Channel” by which the RTCM data is to be output.

Decide whether a Carriage Return needs to be added to the end of each RTCM message. (MultiFix 4 will use either).

If several RTCM sources have been recorded in the *.zer files and are to be replayed, set up a different RTCM Output for each of the LOGID numbers.

Once an RTCM output has been established, it can be edited by using “Config” \ “RTCM” \ “<name>” \ “Edit…” or deleted by using “Config” \ “RTCM” \ “<name>” \ “Delete”

8.3.3.3. Compress

“Items” \ “Compress”

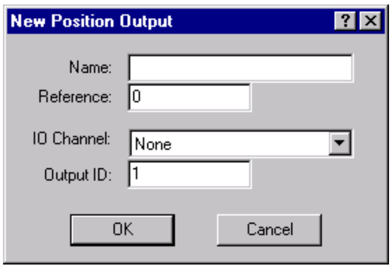
This function is not currently functional.

8.3.3.4. Position

“Items” \ “Position” \ New”

This is used for adding different position outputs.

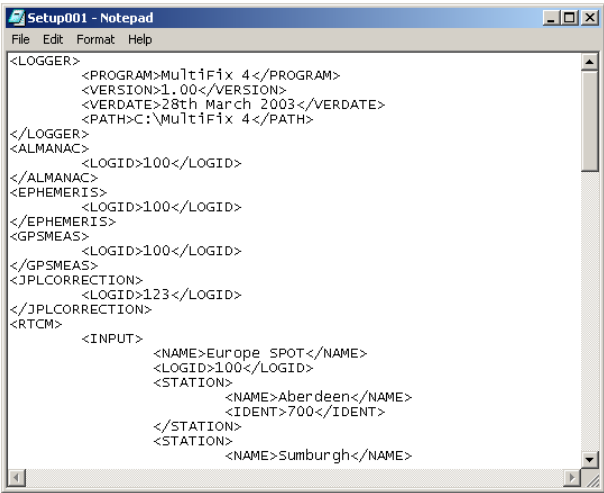
When setting up logging in MultiFix 4 there are three options, “Raw”, “Position” and “Raw+Position”. The earlier configuration of the GPS Receiver Output and the RTCM Output was concerned with outputting Raw data to MultiFix 4 where positions can be recomputed in pseudo-real time.



Positions are not accepted by MultiFix 4 but they are by Qual 2. Therefore the situation can arise where Log Pump outputs Raw data to MultiFix 4, which then recomputes positions from that Raw data and outputs those positions in ZeroLink format to Qual 2. At the same time Log Pump outputs positions directly to Qual 2 and the two position solutions are compared.

Give the output a name.

View the MultiFix 4 Logging Schedule file to see the LOGID of the positions. There will be a different ID for each calculation set up in MultiFix 4 when the logging was taking place. In this example there was only one calculation (“Europe SPOT”).



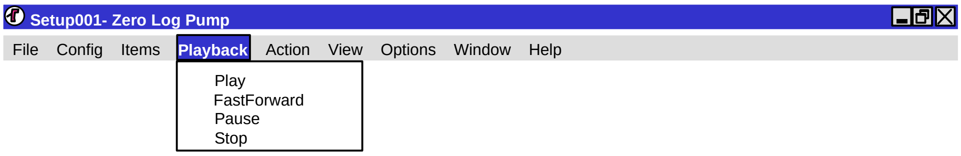
Having decided what position is to be read from the recording files, select the “IO Channel” that is to carry the position output and also decide what “Output ID:” that position is to have. The “Output ID:” must be in the range 00<->31. Do not confuse this with the LOGID, it is not the same.

Use **[OK]** to exit the “New Position Output” dialogue.

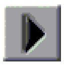
Once a position output has been established, it can be edited by using “Config” \ “Position” \ “<name>” \ “Edit…” or deleted by using “Config” \ “Position” \ “<name>” \ “Delete”

8.3.3.5. IO

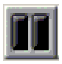
8.3.4. PLAYBACK

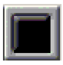


As seen "Playback has four menu items, "Play", "FastForward", "Pause" and "Stop". Each has a toolbar button equivalent.

"Play" 

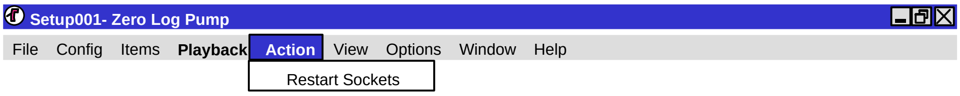
"FastForward" 

"Pause" 

"Stop" 

Stop resets from the file being read to the start of the selected files.

8.3.5. ACTION

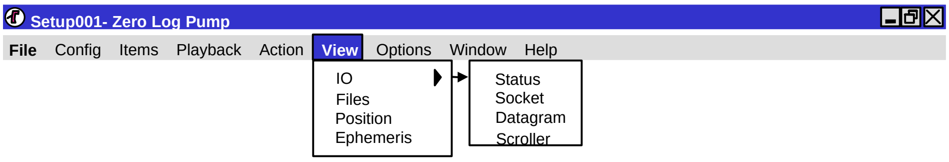


8.3.5.1. Restart Sockets

"Action" \ "Restart Sockets"

On occasion heavy network traffic may lock up TCP\IP socket ports. This option will reinitialise all currently open sockets without having to restart the software or editing the configuration files.

8.3.6. VIEW



Right-mouse clicking many windows allows the user to customise the display. Where that customisation is specific to the view window it will be mentioned in the relevant section dealing with that window. However several windows share the same two facilities, to “Copy” and to “Save As…”

“Copy” places a bitmap of the window onto the clipboard, from whence it can be pasted into another application.

“Save As…” allows an html file of the view window to be saved. By default it will be placed in the folder that contains the Log Pump configuration file.

In common with many Windows programs, Log Pump allows display windows to be moved outside the area displayed by the monitor. The application workspace automatically extends and scroll bars are provided. The scroll bars allow the display area to move around the extended application workspace. There is no limit on the number of windows of any type that can be open in the application workspace. Multiple copies of the same window type can be open. Indeed it will be seen that once a window is open some types of window allow further selection of the data that is to appear in them.

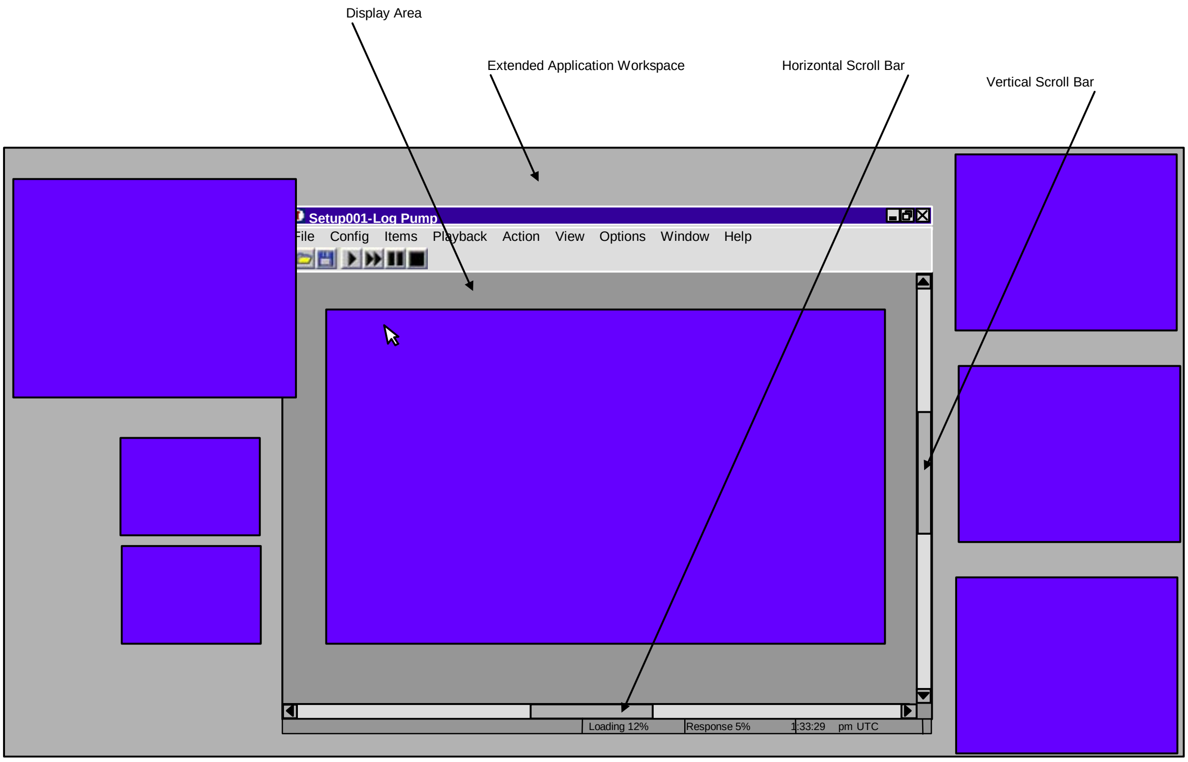


Figure 21 Windows Extending Beyond the Application Workspace

Most windows can be resized by clicking and dragging the corners or sides. Some windows that contain text will wrap the text message into the available space. Other windows containing text will simply be cropped as the window size reduces. Windows containing graphical information will resize down to a minimum and will then either crop the information or will introduce scroll bars.

8.3.6.1. Input / Output

"View" \ "IO"

There are three sub-menus and each will call a window to the Log Pump application workspace.

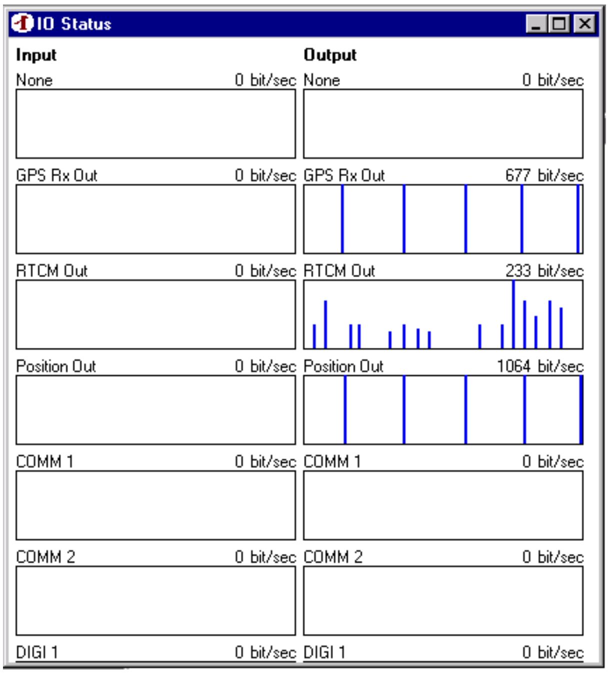
8.3.6.1.1.Status

"View" \ "IO" \ "Status"

This window indicates when there is port activity.

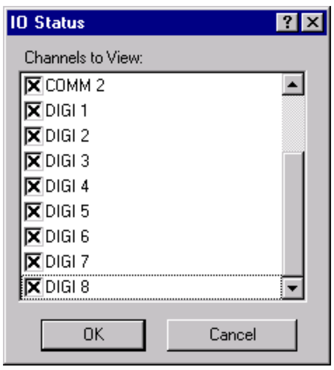
By default the window will contain the ports Log Pump knows to exist. The "None" I/O Channel is at the top followed by streamed socket channels, datagram sockets and then the COM and Digiboard channels.

(When setting up Input / Output channels there is the option to select a dummy channel "None". If selected the blue vertical bars would be seen progressing across the None Output box.)



A right-mouse click calls up the **[Channel]** button. When this is clicked the IO Status dialogue is presented. This allows channels to be selected or deselected from the status window.

In the IO Status window the latest time is in the centre between the Input and Output columns. Each box indicates when data has been input or output, over the last 5 seconds, on that port by scrolling vertical bars from the centre to the outside edges of the window. The box re-scales such that the greatest data rate over the last 5 seconds is full scale. The current bit rate is shown opposite the I/O channel name.



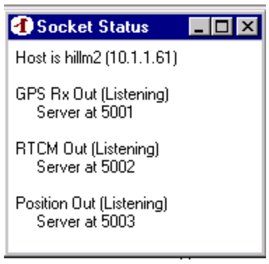
8.3.6.1.2.Sockets

"View" \ "IO" \ "Sockets""

Client sockets can have three states,

Idle, Connecting and **Connected**.

Idle and Connecting will alternate while connection is trying to be established. There will also be a time countdown to the next attempt to make contact.



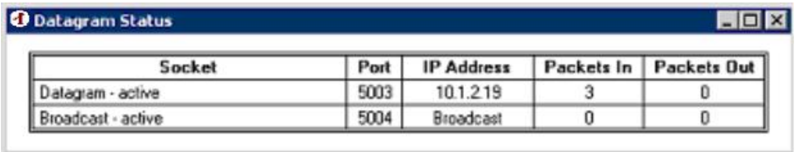
Server sockets can have two states,

Idle and **Listening**.

The Idle status is almost immediately replaced by Listening.

8.3.6.1.3.Datagrams

"View" \ "IO" \ "Datagrams"



Socket	Port	IP Address	Packets In	Packets Out
Datagram - active	5003	10.1.2.19	3	0
Broadcast - active	5004	Broadcast	0	0

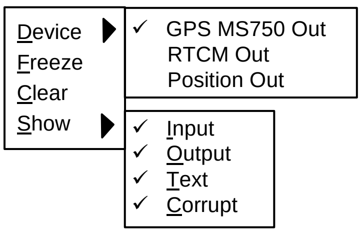
The Datagram Status window lists all Datagrams in use. The IP address indicates to which PC a link is in place or if it is transmitting a broadcast message. The "Packets In" and "Packets Out" window indicates if the datagram is working. If you are receiving data only the "Packets In" will increase. If you are transmitting to n PCs the "Packets In" will increase at n times the rate of the "Packets Out".

8.3.6.1.4.Scroller

"View" \ "IO" \ "Scroller"

Scroller is able to display any of the inputs and outputs. When first opened the display defaults to showing the link from the first GPS receiver in the configuration list.. To change to another IO Channel or to change the scrolling options, click the right mouse button.

This calls up a menu box, which has "Device", "Freeze", "Clear" and "Show" as shown opposite.



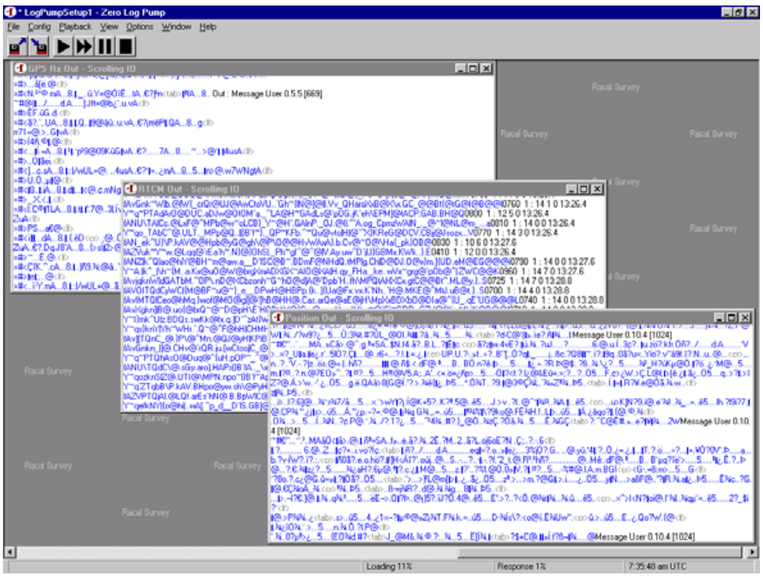
If “Device” is highlighted there is a sub-menu which lists the different input / outputs. Top of the list are the names given to the each of the GPS receivers. This is followed by the input from PDS.

If “Freeze” is selected the current window display is held and frozen appears in the windows title bar. Clicking “Freeze” again unfreezes the display. “Clear” will remove all information from the current window.

“Show” brings up a new sub-menu with four options: “Input”, “Output”, Text” and “Corrupt”. A tick next to the option indicates that the relevant information is currently displayed in the Scroller window. These options may be toggled on/off by left clicking.

The text in the window is bottom justified and colour coded. Green indicates it has been successfully decoded and passed all parity checks. Red indicates the data is corrupted. Dark blue is reserved for outputs. When a message is received or sent successfully a black text line is added as a label. Carriage return and line feed are shown in light grey.

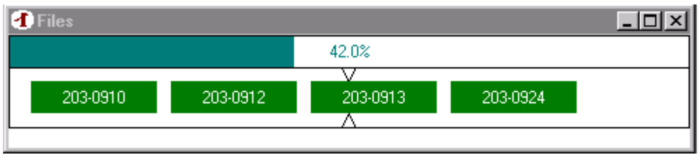
Scroller windows use a lot of resources and should be closed when they are not required.



8.3.6.2. Files

"View" \ "Files"

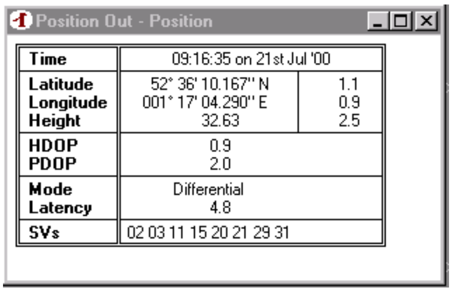
This window shows the progress of the replay.



8.3.6.3. Position

"View" \ "Position"

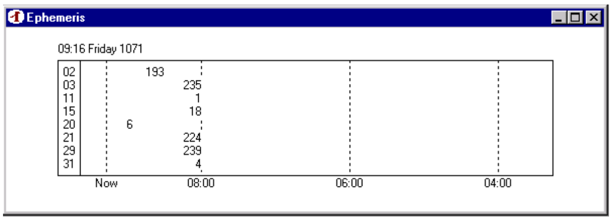
This assumes that positions were recorded as well as the raw data. This window shows the positions that are being output. If there is no position output it will be labelled "unassigned".



8.3.6.4. Ephemeris

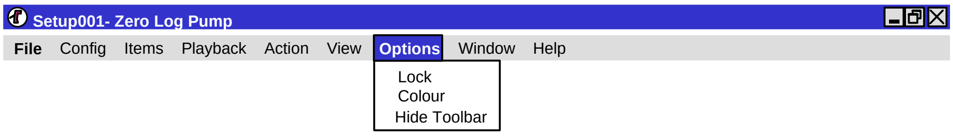
"View" \ "Ephemeris"

The Ephemeris window shows the previous 6-hour period. The Ephemeris issue number is placed at the time when an update was received. The issue number typically increments by 1 but that is not always the case. The majority of updates occur every 2 hours. Updates between this period may be due to a rising SV.



A right-mouse click on the window provides the "Copy" and "Save As…" facilities.

8.3.7. OPTIONS



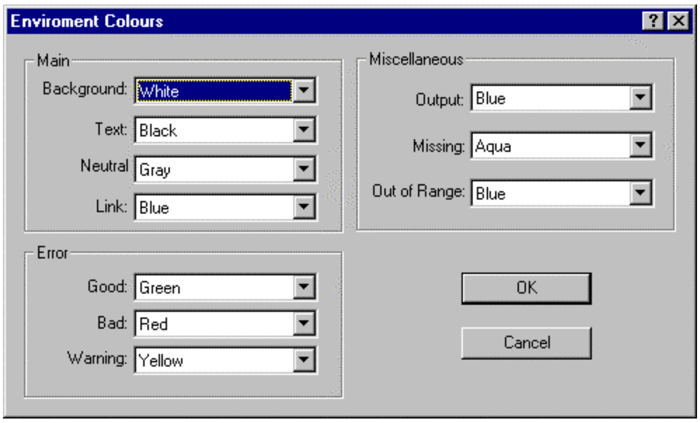
8.3.7.1. Lock

"Options" \ "Lock"

If the Lock option is chosen "File" and Config" are removed from the menu bar. Whilst locked, "Options" \ "Lock" changes to "Options" \ "Unlock". This reinstates "File" and Config".

8.3.7.2. Colour

"Options" \ "Colour"



If different colour regimes are required they can be set up here but beware that a false impression is not given when changing the colour coding. This particularly relates to errors.

Some of the selections do not affect all view windows.

- Main"

  "Background" and "Text" change the windows background and text colours.

  "Neutral" is used in the Latency window to show period when update may be expected.

  "Link" is not currently used.

- "Error".

  Various windows have stages of error state, these colours relate to them.

  "Good", "Bad" and "Warning".

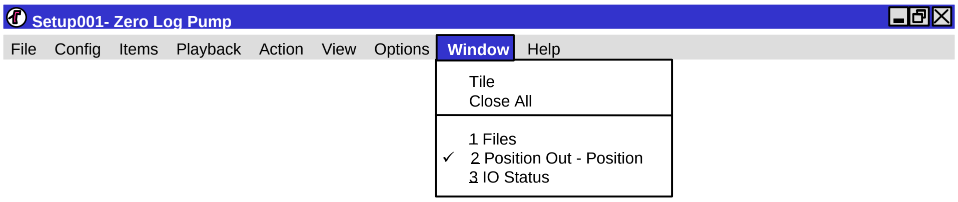
- "Miscellaneous"

  "Output" as seen in the IO status and IO Scroller windows.

  "Missing" as seen in the Status and Constellation windows.

  "Out of Range" as seen in the Status and Constellation windows

8.3.8. WINDOWS



8.3.8.1. Tile

"Window" \ "Tile"

The tile command causes the application workspace to be reduced to the display area. The windows that are not minimised are fitted into the display area and the minimised windows are neatly stacked along the bottom of the screen.

8.3.8.2. Close All

"Window" \ "Close All"

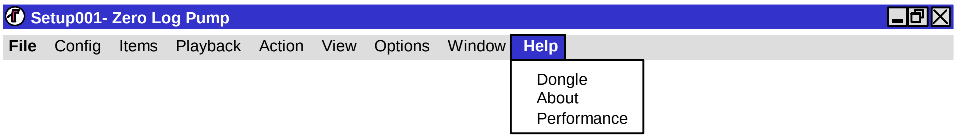
The close all command closes all windows irrespective of their status. As there is no confirmation required be careful not to use it in error.

8.3.8.3. The Open Windows

The "Window" drop down will also list all the windows currently open. Windows can be overlain one on top of another and it can be difficult to locate an obscured window. Clicking the window in the list causes the focus to shift to that window, the title bar is highlighted and it will appear on top of all the other windows. If there is an extended application workspace, and the selected window is off screen, the display area will not move to show the window but the title bar of the window will still become highlighted.

If there are more than 9 windows open the bottom line of the menu will be "More Windows…" If this is selected a dialogue opens listing all windows. Highlight one of them and close the dialogue.

8.3.9. HELP

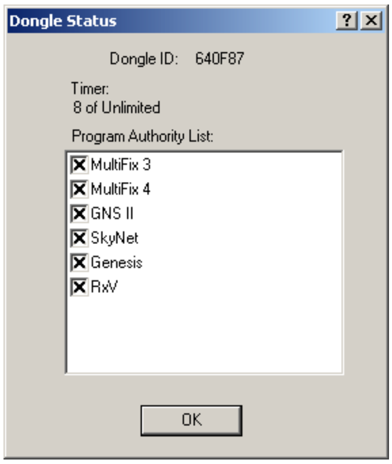


8.3.9.1. Dongle

"Help" \ "Dongle…"

Provides the information stating:

- Which programs the DK2 is authorised to run
- The time limit of the dongle
- The amount of use the dongle has already had.



At all times Soccer is being run the dongle is required in the computer's parallel port. If it is removed the program shuts down and an error message is posted.

If the time limit of the dongle expires the program shuts down and an expiry message is posted.

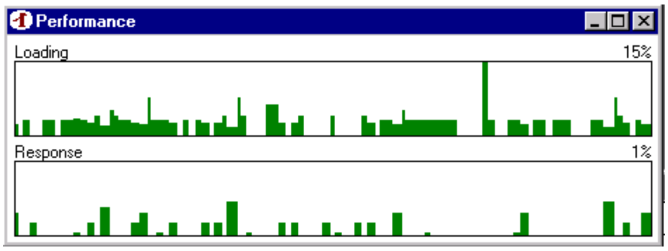
It is possible to revalidate the dongle by running the PROLIVE program and making a call to the Technical Support Group. The same program plus a telephone call can also be used to terminate a dongle so that it is no longer valid and no longer re-charged.

The list in the above dialogue requires refers to certain programs in the Zero Suite. SKYNET is a differential correction monitoring package, GENESIS is a Long Range RTK system that uses a similar software package to MultiFix, and RXV is a program called RECEIVER VERIFY which is described in Section 6.
Several other programs in the Zero suite are not listed which also require a dongle validated for Soccer. These are POSITIONVIEW, QUAL2 and LOGPUMP. Each of these 3 programs only requires the dongle when first being run. After that the dongle can be removed..

8.3.9.2. Performance

"Help" \ "Performance"

The Performance window shows how the program is handling the data acquisition and calculation process with the available resources. The window does not take into account other programs that are running simultaneously.



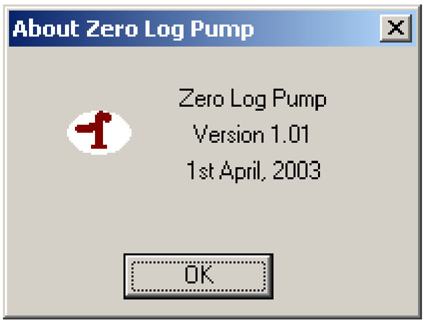
The graphs will be green below 50%, yellow between 50% and 75% and red when above 75%.

It is important there is enough time for all the processes to be completed in an orderly fashion. If there are too few resources the position solution may lag. The demand on the processor can be reduced by accessing only the data from the RTCM reference stations used in the computations, by having fewer computations and by closing windows.

The performance information can also be seen in the bar at the bottom of the application window next to the UTC Time.

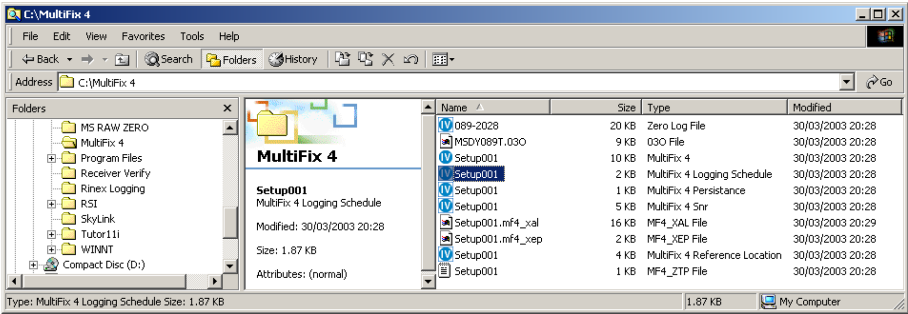
8.3.9.3. About

"Help" \ "About…" provides the version number and release date



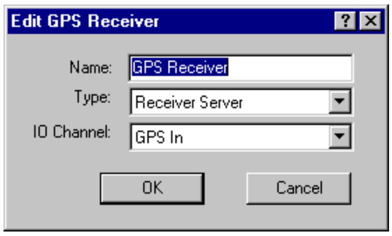
8.4. MULTIFIX 4 SET UP FOR REPLAY

Ideally when data is to be replayed, as well as the *.zer log files all configuration files that were current at the time of the logging should be available as well. By opening the configuration file, the person responsible for the replay can see what types of calculations were being run and what reference stations were used by the calculations.



The only changes that would then normally be required would be

1. the I/O Channel for the receipt of GPS data from Log Pump rather than a live receiver.
2. the I/O channel(s) for the receipt of RTCM data from Log Pump rather than from an RTCM decoder.
3. the type of GPS receiver. For replay the receiver type needs to be “Receiver Server” rather than one of the more usual receiver types.



Without all configuration files, the person conducting the replay will not know the types of calculation being run, whether height aided or not nor the reference station(s) used in those calculations. However if the MultiFix 4 Logging Schedule file is available, the RTCM sources and the defined reference stations will be seen, see the following.

```
<LOGGER>
        <PROGRAM>MultiFix 4</PROGRAM>
        <VERSION>1.21</VERSION>
        <VERDATE>30th June 2000</VERDATE>
        <PATH>D:\MFix3LogFiles</PATH>
</LOGGER>
<ALMANAC>
        <LOGID>100</LOGID>
</ALMANAC>
<EPHEMERIS>
        <LOGID>100</LOGID>
</EPHEMERIS>
<GPSMEAS>
        <LOGID>100</LOGID>
</GPSMEAS>

<RTCM>
        <INPUT>
        <NAME>AOR(E)</NAME>
        <LOGID>100</LOGID>

        <STATION>
        <NAME>Baku</NAME>
        <IDENT>410</IDENT>
        </STATION>

        <STATION>
        <NAME>Hammerfest</NAME>
        <IDENT>720</IDENT>
        </STATION>

        <STATION>
        <NAME>Bronnoysund</NAME>
        <IDENT>770</IDENT>
        </STATION>

        <STATION>
        <NAME>Rome</NAME>
        <IDENT>800</IDENT>
        </STATION>

        <STATION>
        <NAME>Cadiz</NAME>
        <IDENT>810</IDENT>
        </STATION>

        <STATION>
        <NAME>Ankara</NAME>
        <IDENT>830</IDENT>
        </STATION>

        <STATION>
        <NAME>Cairo</NAME>
        <IDENT>960</IDENT>
        </STATION>
        </INPUT>

        <INPUT>
        <NAME>UKRTCM</NAME>
        <LOGID>200</LOGID>
        <STATION>
        <NAME>Flamborough</NAME>
        <IDENT>750</IDENT>
        </STATION>

        <STATION>
        <NAME>Scillies</NAME>
        <IDENT>760</IDENT>
        </STATION>

        <STATION>
        <NAME>Rotterdam</NAME>
        <IDENT>740</IDENT>
        </STATION>
        </INPUT>
</RTCM>

<POSITION>
        <CALC>
        <NAME>NSeaNetwork</NAME>
        <LOGID>100</LOGID>
        </CALC>

        <CALC>
        <NAME>LocalNetwork</NAME>
        <LOGID>200</LOGID>
        </CALC>
</POSITION>
```

Figure 22 Example MultiFix 4 Logging Schedule File

Once Log Pump has started to replay files and is outputting data to MultiFix 4 there may be a requirement to use “Action” \ “Collect Almanac” to force an almanac update before new positions will be formed. In all aspects the operator has the same control of MultiFix 4 as if it were being run in real time with live data. Reference should be made to the MultiFix 4 section for information on configuring and running the program online.

If MultiFix 4 has been set up using a configuration file returned with the log files, it is recommended that “File” \ Save As…” is used to make a duplicate so that any configuration changes made during the replay do not overwrite the configuration that was originally used.

APPENDIX A - DATA OUTPUT STRINGS

NMEA GGA SENTENCE

```
         1111111111222222222233333333334444444444555555555566666666667777777777788
1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901
         |         |         |         |         |         |         |         |
$GPGGA,HHMMSS,DDMM.mmmmmm,N,DDDMM.mmmmmm,E,Q,NN,P.p,AA.aa,M,GG.gg,M,T.t,RFID*CS¬^
```

where

$	Start of Sentence Delimiter
GP	Talker Device Identifier
GGA........................	Sentence Formatter
, ...	Comma
HHMMSS	UTC Time of Fix, (up to 1 second old by time of output)
DDMM.mmmmmm	Latitude at time of fix
N............................	Latitude Hemisphere Specifier, N or S
DDDMM.mmmmmm	Longitude at time of fix
E............................	Longitude Hemisphere Specifier E or W
Q............................	GPS Quality Indicator 0 = Fix invalid, 1 = non-diffGPS using C/A code, Fix valid, 2 = DiffGPS using C/A code, Fix valid, 3 = GPS using P code, Fix valid
NN..........................	Number of satellites used in Fix
P.p........................	HDOP
AA.aa....................	Antenna Altitude at time of fix with respect to Geoid (+ve Antenna above Geoid)
M............................	Height units, M = Metres
GG.gg....................	Geoid / Spheroid separation (+ve Geoid above WGS84 spheroid)
T.t........................	Time in seconds since last RTCM type 1 or type 9 message
RFID......................	Differential reference station ID, if a network it will be 1001, 1002, etc.
*CS........................	Checksum
¬............................	Carriage Return
^............................	Line Feed

GGA (LDA)

This is a modified version of the GGA string where the latency figure is divided by 5. This is for interfacing to equipment that will not allow a latency figure in excess of 10 seconds. By dividing the Latency, rather than fixing it, the system will still time out if a latency of 50 seconds is exceeded.

NB - This function should not be used on occasions that Selective Availability is enabled on the GPS system.

NMEA GSA SENTENCE

```
         111111111122222222223333333333
123456789012345678901234567890123456789
         |         |         |
$GPGSA,M,P,nn  ..  nn,p.p,h.h,v.v,*cs¬^
```

where

$	Start of Sentence Delimiter	
GP	Talker Device Identifier	
GSA........................	Sentence Formatter	
,............................	Comma	
M............................	Mode	M = Manual, forced to operate in 2D or 3D mode
		A = Automatic, allowed to automatically switch 2D/3D
P............................	Positioning mode indicator 1 = Fix not available, 2 = 2D, 3 = 3D	
nn .. nn..........	ID numbers of satellites used in solution*	
p.p........................	PDOP	
h.h........................	HDOP	
v.v........................	VDOP	
*cs	Checksum	
¬............................	Carriage Return	
^............................	Line Feed	

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

a) GPS satellites 1 – 32

b) Glonass 65 - 96

NMEA GST SENTENCE

```
         1111111111222222222233333333334444444445
1234567890123456789012345678901234567890123456789 0
         |         |         |
$GPGST,hhmmss.ss,r.r,s.s,d.d,o.o,l.l,m.m,a.a,*cs¬^
```

where

$	Start of Sentence Delimiter
GP	Talker Device Identifier
GST........................	Sentence Formatter
,...........................	Comma
HHMMSS.ss	UTC Time of Fix, (up to 1 second old by time of output)
r.r........................	RMS value of standard deviation of the range inputs to the navigation process
s.s........................	Standard deviation of semi-major axis of error ellipse (m)
d.d........................	Standard deviation of semi-minor axis of error ellipse (m)
o.o........................	Orientation of semi-major axis of error ellipse (degrees from True North)
l.l........................	Standard deviation of latitude error (m)
m.m........................	Standard deviation of longitude error (m)
a.a........................	Standard deviation of altitude error (m)
*cs	Checksum
¬...........................	Carriage Return
^...........................	Line Feed

NMEA GSV SENTENCE

```
         1111111111222222222233333333334444444444555555555
1234567890123456789012345678901234567890123456789012345678
         |         |         |
$GPGSV,n,m,tt,ss,ee,aaa,NN,............,ss,ee,aaa,NN,*cs¬^
              └──────────┘ └──────────┘ └──────────┘
                   SV1         SV2-3         SV4
```

where

`$`	Start of Sentence Delimiter
`GP`	Talker Device Identifier
`GSV`........................	Sentence Formatter
`,`............................	Comma
`n`............................	Total number of messages, 1 to 9[1]
`m`............................	Message number, 1 to 9[1]
`tt`..........................	Total number of satellites in view

The following section is repeated for each satellite, to a maximum of 4 per string

`ss`..........................	Satellite ID number[2]
`ee`..........................	Elevation, degrees, 90° maximum
`aaa`........................	Azimuth, degrees True, 000 to 359
`NN`..........................	SNR

*cs	Checksum
¬............................	Carriage Return
^............................	Line Feed

[1] Satellite information may require the transmission of multiple messages all containing identical field formats. The first field specifies the total number of messages, minimum value 1. The second field identifies the order of this message (message number), minimum value 1.

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

a) GPS satellites 1 – 32

b) Glonass 65 - 96

NMEA VTG SENTENCE

```
         1111111111222222222233333333
1234567890123456789012345678901234567
         |         |         |
$GPVTG,CCC.c,T,,,SSS.s,N,VVV.v,K*cs¬^
```

where

$	Start of Sentence Delimiter
GP	Talker Device Identifier
VTG........................	Sentence Formatter
, ...	Comma
CCC.c	Course Over Ground
T............................	True
SSS.s	Speed Over Ground
N............................	Knots
VVV.v	Speed Over Ground
K............................	Kilometres per Hour
*cs........................	Checksum
¬............................	Carriage Return
^............................	Line Feed

The null fields would contain Course Over Ground Magnetic if MultiFix 4 new anything about magnetic North.

NMEA GLL SENTENCE

```
         111111111122222222223333333333444444444455555
123456789012345678901234567890123456789012345678901234
         |         |         |         |         |
$GPGLL,DDMM.mmmmmm,S,DDDMM.mmmmmm,W,HHMMSS.ss,Q,M*cs¬^
```

where

$	Start of Sentence Delimiter
GP	Talker Device Identifier
GLL	Sentence Formatter
, ...	Comma
DDMM.mmmmmm	Latitude
S	Latitude Hemisphere N or S
DDDMM.mmmmmm	Longitude
W	Longitude Hemisphere E or W
HHMMSS	UTC Time of the position
Q	Status Flag, A = Valid, V = Not Valid
M	Position System Mode Indicator (see note below)
	A = Stand Alone, D = Differential, E = Estimated,
	M = Manual Input, S = Simulated, N = Not valid
*cs	Checksum
¬	Carriage Return
^	Line Feed

Note: - Between the NMEA 0183 Standard versions 2.01 and 2.30 the GLL sentence has had an extra field added after the Status Flag and before the checksum, this is called the Positioning System Mode Indicator. The 2.30 Standard says that both the Status Flag and Positioning System Mode Indicator fields must not be null fields.

MultiFix 4 complies with the 2.01 Standard and does not include the Position System Mode Indicator.

RTK SENTENCE

Not to be used until Real Time Kinematic computations supported by the MultiFix 4.

NMEA ZDA SENTENCE

```
         111111111122222222223333333333
123456789012345678901234567890123456789
         |         |         |
$GPZDA,HHMMSS.ss,DD,MM,YYYY,±hh,mm*cs¬^
```

where

`$`	Start of Sentence Delimiter
`GP`	Talker Device Identifier
`ZDA`........................	Sentence Formatter
`,`	Comma
`HHMMSS.ss`	UTC Time
`DD`..........................	Day in Month
`MM`..........................	Month in Year
`YYYY`......................	Year
`±hh`........................	Local Time Zone hours offset, always zeroes
`mm`..........................	Local Time Zone minutes offset, always zeroes
*cs	Checksum
¬............................	Carriage Return
^............................	Line Feed

NMEA RMC SENTENCE

```
         111111111122222222223333333333444444444455555555556666666667
1234567890123456789012345678901234567890123456789012345678901234567890
         |         |         |         |         |         |         |
$GPRMC,HHMMSS.ss,Q,DDMM.mmmmm,N,DDDMM.mmmmm,W,SS.s,CCC.c,DDMMYY,,*cs¬^
```

where

$	Start of Sentence Delimiter
GP	Talker Device Identifier
RMC........................	Sentence Formatter
, ...	Comma
HHMMSS.ss	UTC Time of fix
Q...........................	Status flag, A = valid, V = invalid
DDMM.mmmmm	Latitude
N...........................	Latitude Hemisphere, North or South
DDDMM.mmmmm	Longitude
W...........................	Longitude Hemisphere, East or West
SS.s	Speed Over ground in knots
CCC.c	Course Over Ground, True
DDMMYY	Date
*cs........................	Checksum
¬...........................	Carriage Return
^...........................	Line Feed

The null fields refer to the Magnetic Variation

NMEA UKOOA / IMCA DP SENTENCE

```
         111111111122222222223333333333444444444455555555556666666666777777777788 8
123456789012345678901234567890123456789012345678901234567890123456789012345678901 2
         |         |         |         |         |         |         |         |
$DPGGA,HHMMSS.SS,DDMM.mmmm,N,DDDMM.mmmm,E,Q,NN,P.p,UAA.aa,M,UGG.gg,M,T.t,DGPS*CS¬^
```

where

$	Start of Sentence Delimiter
DP	Talker Device Identifier
GGA........................	Sentence Formatter
, ...	Comma
HHMMSS..................	UTC Time of Fix, (up to 1 second old by time of output)
DDMM.mmmm	Latitude at time of fix
N...........................	Latitude Hemisphere Specifier, N or S
DDDMM.mmmm	Longitude at time of fix
E...........................	Longitude Hemisphere Specifier E or W
Q...........................	DGPS Quality Indicator (see table below)
NN..........................	Number of satellites used in Fix
P.p........................	HDOP
U	Sign of Altitude above or below MSL/Geoid.
AA.aa....................	Antenna Altitude at time of fix with respect to MSL/Geoid
M...........................	Height units, M = Metres
U	Sign of Geoidal separation (+ve Geoid above WGS84 spheroid)
GG.gg....................	Geoid / Spheroid separation
T.t........................	Time in seconds since last RTCM type 1 or type 9 message
DGPS......................	DGPS system identifier, DGPR = DGPS Radio-Based Link DPGI = DGPS Satellite -based link
*CS........................	Checksum
¬...........................	Carriage Return
^...........................	Line Feed

Notes – DGPS indicator is fixed to DPGI.

DGPS Quality Indicator

DQI	Status of Solution	Precision	Comment
0	Failed solution	N/A	-
1	Uncorrected	N/A	Solution obtained but no differential
2	Corrected but no redundancy	N/A	Minimum DGPS Solution
3	Corrected Position; Redundancy of 1	Poor	Poor Dilution of Precision (DOP)/ Geometry
4	Corrected Position; Redundancy of 1	<10m	Adequate DOP / Geometry
5	Corrected Position; Redundancy > 1	<10m	Ability to reject Outlier; Gradual improvement in geometry/DOP
6	Corrected Position; Redundancy > 1	<10m	Ability to reject Outlier; Gradual improvement in geometry/DOP
7	Corrected Position; Redundancy > 1	<4m	Ability to reject Outlier; Gradual improvement in geometry/DOP
8	Corrected Position; Redundancy > 1	<2m	Ability to reject Outlier; Gradual improvement in geometry/DOP
9	Corrected Position; Redundancy > 1	<0.5m	Ability to reject Outlier; Gradual improvement in geometry/DOP

DNAVN OUTPUT FORMAT

```
               1111111111222222222233333333334444444444555555555566666666667777777778
1234567890123456789012345678901234567890123456789012345678901234567890123456789 0
         |         |         |         |         |         |         |         |
[DJJJMMDDYYHHMMSS.sLL.lDN523516.65E0014404.22+057.4CCC.cSSS.sXXXYYYPP.pHH.hMRDQq

                   111111111111111111111111111111111111111111111111
888888888899999999990000000000111111111122222222223333333333444444
123456789012345678901234567890123456789012345678901234567890123456
         |         |         |         |         |         |
mmssN##SNREF              ##SNREF              //nsref]cs ¬^
```

where

[............................	Start Character
D	Day of Week (0-6, 0 is Sunday)
JJJ	Julian Day
MMDDYY....................	Date
HHMMSS.s	UTC Time of Record
LL.l........................	Time of Record minus Time of Fix in seconds
D	Datum Flag (0=WGS 72, 1=WGS 84, 2= NAD 84, 3 = NAD 83, 4-9= reserved)
N	Latitude Hemisphere Specifier (N or S)
523516.65	Latitude (DDMMSS.ss)
E	Longitude Hemisphere Specifier
0014404.22	Longitude (DDDMMSS.ss)
+057.4....................	Altitude with respect to Ellipsoid (±m)
CCC.c......................	Course Over Ground (deg True)
SSS.s......................	Speed Over Ground (kts)
XXX	3D Position Error (m, 1-σ)
YYY	2D Position Error (m, 1-σ)
PP.p........................	PDOP (invalid if only 3 SV's are being tracked)
HH.h........................	HDOP
M	Operating Mode (0=No Solution, 1=4SV,2=3SV+Alt Aid, 3=3SV+Clk Aid, 4=2SV+Alt Aid +Clk Aid, 5=All in View)
R	Receiver Code (0-6=Reserved, 7=C/A, L1 only, Carrier Aided, 8-9=Reserved)
D	Receiver Dynamics (0=Static, 1=Low……9=High)
Q	Position Quality (0=Poor, 9=Good)
q	Differential Quality (0=No Corrections, 1=Poor…..9=Good)
mmss........................	Time Since Last Correction
N	Number of SV's Tracked

.... first SV PRN

SN .... first SV SNR (Trimble Units)

RE .... first SV Range Residual Error (m)

F .... first SV Status Flag (Bit 0=Elevation Flag, 0=SV is above mask,

•

•............................... ##SNREF repeated for each SV

•

nn .... last SV PRN (This will be determined by the number of satellites being tracked)

nn .... last SV SNR (Trimble Units)

nnn .... last SV Range Residual Error (m)

n .... last SV Status Flag

] .... Stop Character

cs .... Checksum (The hexadecimal representation of the modulo-256 sum of the characters from “[“ to “]” inclusive

¬ .... Carriage Return

^ .... Line Feed

DNAVN – NAUTIS MODIFICATION

The Nautis Modified DNAV out put is in the same format to the standard DNAV, other than that a maximum number of satellites (10) are fixed within the output string. This allows a Nautis navigation system to accept DNAV strings that would normally contain 10 or more SVs.

TRIMBLE OUTPUT FORMAT

```
         111111111122222222223333333333444444444455555555556666666666677777
1234567890123456789012345678901234567890123456789012345678901234567890123 4
         |         |         |         |         |         |         |
[ID Day 294 DD-MMM-YY HH:MM:SSF52:35.2785N 001:44.0637E ±0094  2.4 ClkOff
```

```
                        111111111111111111111111111111111
7777788888888888999999999990000000000011111111112222222222223333
5678901234568901234567890123456789012345678901234567890123
    |        |         |         |         |         |
±VVV.vv SSS.ss HHH.h +0.0000E+00 0000 3 nn,nn,nn,nn,nn]¬^
```

Where

[............................	Start Character
ID..........................	Station Identification Number
Day........................	Day of Week
294........................	Julian Day
DD-MMM-YY...........	Date (e.g. 13-Apr-00)
HH:MM:SS.............	UTC Time
F...........................	Differentially Corrected Flag (d = Corrected, Space = Uncorrected)
52:35.2785..........	WGS 84 Latitude (DD:MM.mmmm)
N...........................	Latitude Hemisphere Indicator (N or S)
001:44.0637........	WGS 84 Longitude
E...........................	Longitude Hemisphere Indicator (E or W)
±0094....................	Height of Antenna Referenced to WGS 84 spheroid
02.4......................	PDOP
ClkOff..................	Calculated Receiver Clock Offset in Nanoseconds
±VVV.vv................	Vertical Component of Velocity
SSS.ss..................	Horizontal Component of Velocity
HHH.h....................	Heading of Vessel (deg. True)
+0.0000E+00........	Receiver Clock Frequency Offset from GPS
0000 3 nn, ,nn	If 6 or less satellites then four zeros followed by the minimum number of satellites required by the fix and then the PRN numbers of satellites used in the position fix
nn, ... ,nn........	If more than 6 satellite then the PRN's of Satellites used in Position Fix
]...........................	Stop Character
¬...........................	Carriage Return
^...........................	Line Feed

ZEROLINK

This is the data exchange format for all the Zero suite programs.

It is a binary (non-ASCII) format.

FUGRO UKOOA OUTPUT FORMAT

```
         111111111122222222223333333333444444444455555555556666666666777777777788888
123456789012345678901234567890123456789012345678901234567890123456789012345678901234
         |         |         |         |         |         |         |         |
[LTV**HHMMSSsDDMMYYAAaGDDMMSSsssNDDDMMSSsssEHHHHh^MXXxYYyZZZPPpQQqRRrUUuFKKkLLlCCcBB
```

```
               111111111111111111111111111111
888889999999999900000000001111111111222222222 2
567890123456789012345678901234567890123456789
     |         |         |         |
NNnn  ..  ..  nnTTFFR refstncdes optionalcs¬^
```

Where

[...........................	Start Character
L...........................	Length of Message
T...........................	Message Type Identifier
V...........................	Message Version Identifier
*...........................	Message Dependant Byte
*...........................	Message Dependant Byte
HHMMSSs................	UTC Time of Fix
DDMMYY..................	Date of Fix (DDMMYY)
AAa.......................	Age of Data
G...........................	Datum Indicator (W=WGS 84, Z=Other Datum, ?=Datum Not Known)
DDMMSSsss............	Latitude
N...........................	Latitude Hemisphere Specifier (N or S)
DDDMMSSsss..........	Longitude
E...........................	Longitude Hemisphere Specifier (E or W)
HHHh......................	Height (HHHH.h) -999.9 to 9999.9 in m
^...........................	Height Reference Indicator (S=Spheroidal Height, M=Height above MSL ie. Orthometric)
M...........................	Mode (H=Height Aided, 3=3D Solution, ?=Unknown)
XXx........................	95% Error Ellipse semi-major axis (m)
YYy........................	95% Error Ellipse semi-minor axis (m)
ZZZ........................	95% Error Ellipse Max Direction (°)
PPp........................	95% Latitude s d / Precision Value (m)
QQq........................	95% Longitude s d / Precision Value (m)
RRr........................	95% Height s d / Precision Value (m)
UUu........................	Unit Variance
F...........................	F Test (P=Pass, F=Fail)

`KKk`........................	HDOP (DD^D)
`LLl`........................	PDOP (DD^D)
`CCc`........................	External Reliability (m) (Largest Position MDE at the Configured Level – typically 80%)
`BB`..........................	LOP with External Reliability (SV PRN ‘01’-‘99’ or ‘HT’ if Altitude or ‘00’ if computed but not used due to lack of redundancy)
`NN`..........................	Number of SVs used at the Mobile N
`nn .. .. nn`........	Satellite PRN Numbers
`TT`..........................	W-Test rejected LOP (if any) (SV PRN ‘01’ – ‘99’, ‘HT’ if Altitude, ‘00’ = OK)
`FF`..........................	Total Number of SVs used in Solution (Approximately = $N \times \nu$ for multi-reference station solution).
`R`............................	ν Number of Reference Stations Used (0-9, 9 = 9 or more)
`refstncds`...........	The Codes of the Reference Station used. (Up to 9 three digit codes, first 9 if more than 9, if less than 9 padded with 0’s))
`optional`.............	Optional additional data before checksum
`CS`..........................	Checksum
¬............................	Carriage Return
^............................	Line Feed

GECO UKOOA OUTPUT FORMAT

```
         111111111122222222223333333333444444444455555555556666666666777777777788
123456789012345678901234567890123456789012345678901234567890123456789012345678901
         |         |         |         |         |         |         |         |
[0101NPMulti 1.32WWWWTTTTTTT.tAA.a_DD_MM.mmmmmN_DDD_MM.mmmmmEAAA.aHHH.hVVV.vUU.uuu
```

```
                 11111111111111111111111111111111111111111111
8888888999999999990000000000111111111122222222223333333333444444
3456789012345678901234567890123456789012345678901234567890123 4
       |         |         |         |         |         |
XX.xxxYY.yyyZZ.zzz@@.@@@##.###FFSATREF  SatNos  RefStnIds  ]¬^
```

where

`[`	Start Character
`01`	Record Identifier
`01`	Format Version
`NP`	Nav Point Number
`_`	Space
`Multi 1.32`	System Name/ Version (Should identify system and software version)
`WWWW`	GPS Week Number since January 6th 1980
`TTTTTTT.t`	Seconds in GPS week (GPS time)
`AA.a`	Age of Fix
`_DD_MM.mmmmm`	Latitude
`N`	Latitude Hemisphere Identifier (N or S)
`_DD_MM.mmmmm`	Longitude
`E`	Longitude Hemisphere Identifier (E or W)
`AAA.a`	Spheroidal Height (above WGS 84)
`HHH.h`	HDOP
`VVV.v`	VDOP
`UU.uuu`	Unit Variance
`XX.xxx`	Variance Latitude
`YY.yyy`	Covariance Lat/Long
`ZZ.zzz`	Variance Longitude
`@@.@@@`	Variance Height
`##.###`	External Reliability
`FF`	Fix Status (0=No or Bad Fix, 1=Alt. Aiding, 2=Alt Hold, 3=3D Fix)
`SAT`	Number of Satellites Used
`REF`	Number of Reference Stations Used For This Fix

`SatNos`	PRN Numbers of the satellites used in fix
`RefStnIds`	ID's of the Reference Stations used in the fix
`]`	End Character
`¬`............................	Carriage Return
`^`............................	Line Feed

GECO UKOOA VERSION 2 OUTPUT FORMAT

```
         1111111111222222222233333333334444444444555555555566666666667777777777888
1234567890123456789012345678901234567890123456789012345678901234567890123456789012
         |         |         |         |         |         |         |         |
[0101NPMulti 1.32WWWWTTTTTTT.tAA.a_DD_MM.mmmmmN_DDD_MM.mmmmmEAAA.aHHH.hVVV.vUU.uuu
```

```
                 111111111111111111111111111111111111111111111
88888889999999999000000000011111111112222222222333333333344444
34567890123456789012345678901234567890123456789012345678901234
       |         |         |         |         |         |
XX.xxxYY.yyyZZ.zzz@@.@@@##.###FFSATREF  SatNos  RefStnIds  ]¬^
```

where

[...........................	Start Character
01.........................	Record Identifier
01.........................	Format Version
NP.........................	Nav Point Number
_...........................	Space
Multi 1.32..........	System Name/ Version (Should identify system and software version)
WWWW......................	GPS Week Number since 21st August 1999
TTTTTTT.t...........	Seconds in GPS week (GPS time)
AA.a......................	Age of Fix
_DD_MM.mmmmm......	Latitude
N...........................	Latitude Hemisphere Identifier (N or S)
_DD_MM.mmmmm......	Longitude
E...........................	Longitude Hemisphere Identifier (E or W)
AAA.a....................	Spheroidal Height (above WGS 84)
HHH.h....................	HDOP
VVV.v....................	VDOP
UU.uuu..................	Unit Variance
XX.xxx..................	Variance Latitude
YY.yyy..................	Covariance Lat/Long
ZZ.zzz..................	Variance Longitude
@@.@@@..................	Variance Height
##.###..................	External Reliability
FF.........................	Fix Status (Single Freq. 0=No or Bad Fix, 1=Alt. Aiding, 2=Alt Hold, 3=3D Fix)
....	(Dual Freq. 4=No or Bad Fix, 5=Alt. Aiding, 6=Alt Hold, 7=3D Fix)
SAT........................	Number of Satellites Used

REF........................ Number of Reference Stations Used For This Fix

SatNos.................. PRN Numbers of the satellites used in fix

RefStnIds........... ID's of the Reference Stations used in the fix

] .... End Character

¬........................... Carriage Return

^........................... Line Feed

FUGRO XP EXPANDED OUTPUT FORMAT

```
         111111111122222222223333333333444444444455555555556666666666777777777788888
123456789012345678901234567890123456789012345678901234567890123456789012345678901234
         |         |         |         |         |         |         |         |
**XHHMMSS.sDDMMYYAA.aDDMMSS.ssssNDDDMMSS.ssssEHHHH.hhHHHH.hhNNN.nnEEE.eeC.ccccHHH.hh
```

```
               1111111111111111
8888899999999990000000000111111
5678901234567890123456789012345
     |         |
XXX.xxYYY.yyZZZLL.lHHH.hPPP.pMM
```

Differential Only – this section is only generated if a standard differential calculation is used, either as a standard calculation or an XP back-up (i.e. XP Mode = 2, 3, 4, 5 or 6)

```
1111111111111111111111111111111111111111111111111111111111
1111222222222233333333334444444444555555555566666666667777
6789012345678901234567890123456789012345678901234567890123
|         |         |         |         |         |
UU.uuFRR.rrrrBBNNnn  ..  ..  nnRRCCiiiX  ..  ..  iiiX*XX¬^
```

XP Only - this section is only generated if a true XP calculation is used (i.e. XP Mode = 0 or 1)

```
1111111111111111111111111111111111111111111111111111111111111111111111
1111222222222233333333334444444444555555555566666666667777777777888888
6678901234567890123456789012345678901234567890123456789012345678901234
|         |         |         |         |         |
UU.uuFRR.rrrrBBNNnn  ..  ..  nnUU.uuIRR.rrrrBBNNnn  ..  ..  nniii*XX¬^
```

Where

`*`............................	Message Dependant Byte
`*`............................	Message Dependant Byte
`X`............................	Hexadecimal identifier
`HHMMSS.s`..............	UTC Time of Fix
`DDMMYY`.................	Date of Fix (DDMMYY)
AA.a.....................	Age of Data
`DDMMSS.ssss`........	Latitude
`N`............................	Latitude Hemisphere Specifier (N or S)
`DDDMMSS.ssss`......	Longitude
`E`............................	Longitude Hemisphere Specifier (E or W)
`HHHH.hh`................	Height above mean sea level (HHHH.hh) -999.99 to 9999.99 in m
`HHHH.hh`................	Height of geoid (mean sea level) above WGS84 ellipsoid (HHHH.hh) -999.99 to 9999.99 in m

`NNN.nn` .... 95% Latitude Standard Deviation / Precision Value (m)

`EEE.ee` .... 95% Longitude Standard Deviation / Precision Value (m)

`C.cccc` .... Correlation Coefficient - 1 to +1

`HHH.hh` .... 95% Height Standard Deviation / Precision Value (m)

`XXX.xx` .... 95% Error Ellipse semi-major axis (m)

`YYY.yy` .... 95% Error Ellipse semi-minor axis (m)

`ZZZ` .... 95% Error Ellipse Max Direction with respect to North (°)

`LL.l` .... Latency (s)

`HHH.h` .... HDOP (DDD^D)

`PPP.p` .... PDOP (DDD^D)

`M` .... Calculation Mode

0 – No Solution
1 – XP
2 – Dual Frequency Diff. 3D
3 – Dual Frequency Diff. 2D
4 – Single Frequency Diff. 3D
5 – Single Frequency Diff. 2D
6 – Standalone

`M` .... XP Mode

0 – No Solution
1 – XP
2 – Converging to XP
3 – Backup Solution 1
4 – Converging to Backup Solution 1
5 – Backup Solution 2
6 – Converging to Backup Solution 2

DIFFERENTIAL ONLY – this section is only generated if a standard differential calculation is used, either as a standard calculation or an XP back-up (i.e. XP Mode = 2, 3, 4, 5 or 6)

`UU.uu` .... Unit Variance

`F` .... F Test (P=Pass, F=Fail)

`RR.rrrr` .... External Reliability (m) (Largest Position MDE at the Configured Level – typically 80%)

`BB` .... PRN with highest External Reliability value

`NN` .... Number of SVs used in the calculation

`nn .. .. nn` .... Satellite PRN Numbers

`RR` .... Number of Reference Stations Used (0-99)

`CC` .... Number of Reference Stations in Configuration (0-99)

`iii` .... The ID Code of Reference Station 1. (three digit code)

`X` .... Number of SVs from Reference Station 1. (hexadecimal character)

.
.
.

iii........................	The ID Code of Reference Station n. (three digit code)
x............................	Number of SVs from Reference Station n. (hexadecimal character)
*XX........................	Checksum
¬............................	Carriage Return
^............................	Line Feed

XP ONLY - this section is only generated if a true XP calculation is used (i.e. XP Mode = 0 or 1)

UU.uu....................	Unit Variance, delta calculation
F............................	F Test (P=Pass, F=Fail), delta calculation
RR.rrrr................	External Reliability (m) (Largest Position MDE at the Configured Level – typically 80%), delta calculation
BB..........................	PRN with highest External Reliability value
NN..........................	Number of SVs used in the delta calculation
nn .. .. nn........	Satellite PRN Numbers in the delta calculation
UU.uu....................	Unit Variance, filter calculation
I............................	Innovation Check (P=Pass, F=Fail), filter calculation
RR.rrrr................	External Reliability (m) (Largest Position MDE at the Configured Level - typically 80%), filter calculation
BB..........................	PRN with highest External Reliability value
NN..........................	Number of SVs used in the filter calculation
nn .. .. nn........	Satellite PRN Numbers in the filter calculation
iii........................	XP SkyFix Beam ID
*XX........................	Checksum
¬............................	Carriage Return
^............................	Line Feed

FUGRO XP CONCISE OUTPUT FORMAT

```
                  111111111122222222223333333333444444444455555555556666666666777777777788888
1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234
                  |                   |                   |                   |                   |                   |                   |                   |
**XHHMMSS.sDDMMYYAA.aDDMMSS.ssssNDDDMMSS.ssssEHHHH.hhHHHH.hhHHH.hhXXX.xxYYY.yyZZZUU.
```

```
            11111111111111111111
8888899999999999000000000011111111111
5678901234567890123456789012345678 9
     |          |          |
uuFRR.rrrrLL.lHHH.hPPP.pNNMMRR*XX¬^
```

Where

*............................	Message Dependant Byte
*............................	Message Dependant Byte
X............................	Hexadecimal identifier
HHMMSS.s	UTC Time of Fix
DDMMYY	Date of Fix (DDMMYY)
AA.a	Age of Data
DDMMSS.ssss	Latitude
N............................	Latitude Hemisphere Specifier (N or S)
DDDMMSS.ssss	Longitude
E............................	Longitude Hemisphere Specifier (E or W)
HHHH.hh	Height above mean sea level (HHHH.hh) -999.99 to 9999.99 in m
HHHH.hh	Height of geoid (mean sea level) above WGS84 ellipsoid (HHHH.hh) -999.99 to 9999.99 in m
HHH.hh	95% Height Standard Deviation / Precision Value (m)
XXX.xx	95% Error Ellipse semi-major axis (m)
YYY.yy	95% Error Ellipse semi-minor axis (m)
ZZZ........................	95% Error Ellipse Max Direction with respect to North (°)
UU.uu	Unit Variance, filter calculation
F............................	F-Test for Backup solution or Innovation Check for XP solution (P=Pass, F=Fail)
RR.rrrr	External Reliability (m) (Largest Position MDE at the Configured Level - typically 80%), filter calculation
LL.l......................	Latency (s)
HHH.h	HDOP (DDD^D)
PPP.p	PDOP (DDD^D)
NN..........................	Number of SVs used in the calculation
M............................	Calculation Mode 0 – No Solution

1 – XP
2 – Dual Frequency Diff. 3D
3 – Dual Frequency Diff. 2D
4 – Single Frequency Diff. 3D
5 – Single Frequency Diff. 2D
6 – Standalone

M........................... XP Mode

0 – No Solution
1 – XP
2 – Converging to XP
3 – Backup Solution 1
4 – Converging to Backup Solution 1
5 – Backup Solution 2
6 – Converging to Backup Solution 2

RR.......................... Number of Reference Stations Used (0-99)

*XX........................ Checksum

¬............................ Carriage Return

^............................ Line Feed

UTM / SYLEDIS

```
          111111111122222222223333333334
1234567890123456789012345678901234567890
          |         |         |         |

_Y±NNNNNNN.n_X±EEEEEEE.e_Ffff_Qqqqqqqq¬^
```

where

_	Space
Y	Y co-ordinate Identifier
±NNNNNNN.n	Northings to 0.1 of a metre
X............................	X co-ordinate Identifier
±EEEEEEE.e	Eastings to 0.1 of a metre
F............................	Differential Flag Identifier
fff........................	000 = Diff Corrected, 001 = Stand Alone
Q............................	Quality Flag Identifier
qqqqqqq	Not Implemented, always 0000000
¬............................	Carriage Return
^............................	Line Feed

The Eastings and Northings will be Transverse Mercator co-ordinates, the projection grid is defined when setting up the output.

UTM/GEM 80 DP

```
         111111111122222222223333333
123456789012345678901234567890123456
         |         |         |
_Y±NNNNNNN.n_X±EEEEEEE.e_Q_qDRMLPM¬^
```

where

_	Space, ASCII character 32
Y	Y co-ordinate identifier, (ASCII character 89)
±	Sign + or -
NNNNNNN.n	Northings (leading zeros when necessary)
X...........................	X co-ordinate identifier, (ASCII character 88)
EEEEEEE.e	Eastings (leading zeros when necessary)
Q...........................	Quality Field Identifier
q...........................	Quality : Filtering Strictness n
DRM	Quality :DRMS (metres) nnn
LPM	Quality :LPME (metres) nnn
¬...........................	Carriage Return
^...........................	Line Feed

The Eastings and Northings will be Transverse Mercator co-ordinates, the projection grid is defined when setting up the output.

DGPS_IS

This output is under development and not fully implemented.

APPENDIX B – UNDERSTANDING SCINTILLATION

Recent increases in the level of solar activity have had noticeable effects on GPS receiver equipment. Effects can be categorised into two distinct effects:

a) Ionospheric delay

b) Scintillation

Ionospheric Delay is sometimes called the gradient effect. It is caused by the GPS signal slowing as it passes through the ionosphere. The signals are slowed at different rates at different locations, depending on the path taken through the earth's atmosphere. When a DGPS system is in use, the path of the signal through the atmosphere from the individual satellites will be different to the reference station and to the user. Therefore, standard pseudorange corrections, that only model the atmospheric differences, may not fully remove the range error.

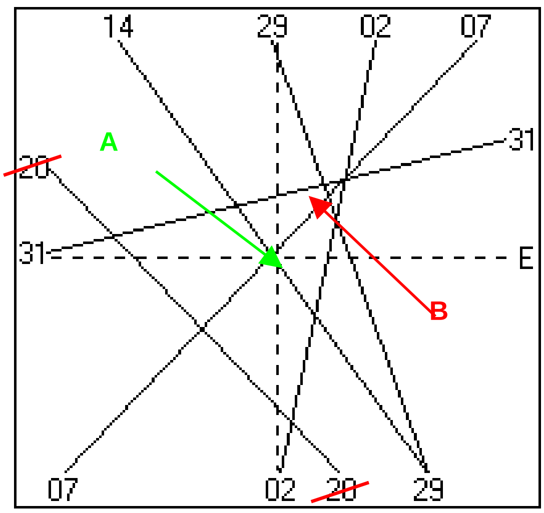
This error is removed by using dual frequency observations, such as with SkyFix premier. The second frequency allows the magnitude of the delay to be measured at both the reference station and the users location. The error can then be removed.

Scintillation is a different phenomenon. The GPS signal is itself damaged in the ionosphere leading to failure of the GPS receiver to maintain a lock on the satellite. This same problem can occur to the satellite based RTCM delivery links, be they SPOT or Inmarsat, as discussed later.

The net effect is that instabilities are introduced into the position calculation, potentially each time a satellite is removed or reintroduced into the solution. This is best illustrated by looking at an example.

In the MultiFix screen shot on the right (taken from "View" \ "Calculation" "Residuals" the individual lines of position from each SV can be visualised in 2D. The users position is derived by a weighted least squares adjustment to fit within all the lines of position. This is in the centre of the display and is marked by the letter A.

Now, consider a scenario where SV 20 is suddenly removed from the calculation. The correct solution for a least squares adjustment is then close to point B.



The size of the resulting position jump is obviously dependant on both the size of the "cocked hat" (and resulting error ellipse) and the effect of the missing SV on that cocked hat. There are many factors to consider when reviewing the residuals including but not restricted to:

- Number of SVs in view,
- Geometry of SVs
- Elevation of individual SVs

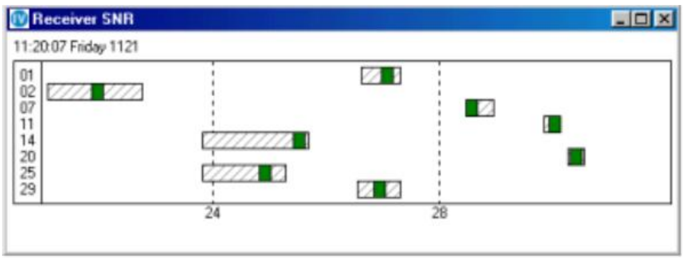
During periods of high ionospheric activity this cocked hat will be large (the solution will be divergent) due to ionospheric delay, the effects will therefore be greater. This effect will be reduced if dual frequency observations are used, as the cocked hat will once again be small.

We have seen here the potential effect of scintillation on a single SV. In reality, scintillation will affect more than one SV at a time, although it rarely affects all SVs at the same time. With the removal of each SV, the stability of the solution is reduced, thereby increasing the effect of subsequent satellite losses.

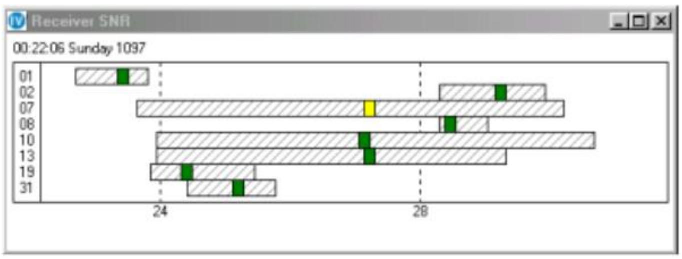
Detecting Scintillation

Ionospheric conditions are at their worst around the geomagnetic equator. Therefore, if you are in the Southern Hemisphere satellites to the North are the most likely to be affected, conversely in the Northern Hemisphere satellites to the South are most effected. If you are close to the equator all satellites may be affected.

There are a number of ways of detecting scintillation within MultiFix. The first sign is within the Signal to Noise Ratios (SNR). These can be viewed in MultiFix 4 under “View” \“GPS” \“Measurements”. High variations in SNR are indicative of scintillation. Note you will also see low fluctuating SNRs with low elevation satellites or other forms of interference.

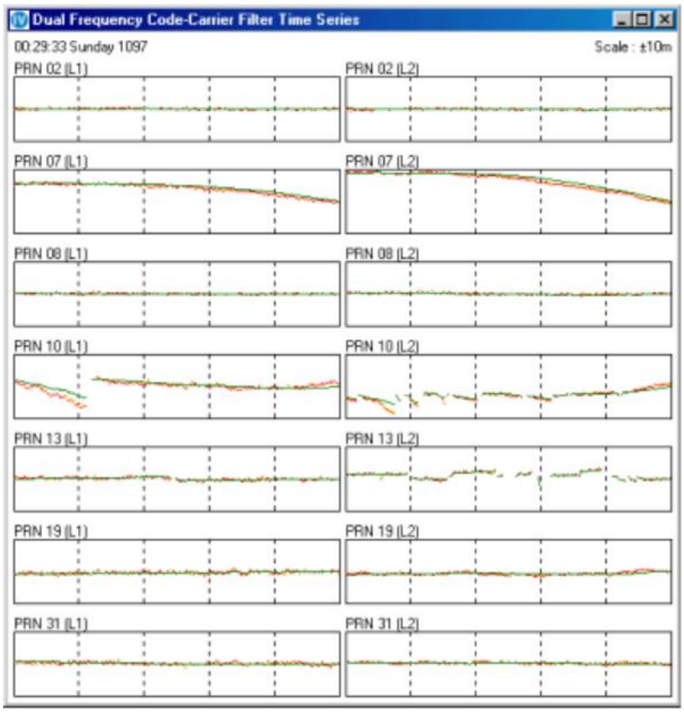


The adjacent screen shot is of SNRs under normal conditions. The scale bar on each measurement is the variation over the past 100 records.



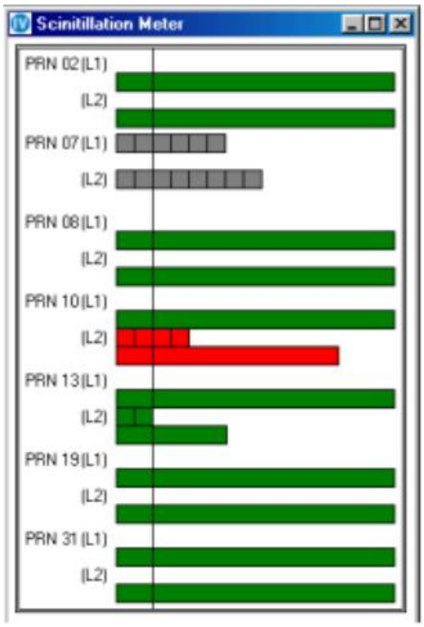
This second plot is taken from a period of scintillation and demonstrates the scale of the variation typically seen.

A more graphical indication of the effect of scintillation can be found in the Time series Code Carrier Filter (CCF).



In this display the tracking of the individual SVs in both L1 and L2 can be visually monitored. In the following screen shot there are interruptions, caused by scintillation on PRN 13 (L2 only) and PRN 10 (L1 and L2). These breaks in data can cause the position jumps that make scintillation such a problem. As you can see the breaks are not continuous, the satellite repeatedly drops in and out. This continuous change is what creates the repeated position instabilities, making the solution unusable.

Combating Scintillation



MultiFix 4 contains a scintillation meter and filter facility. The displays, detects and helps to remove the effects of scintillation. This scintillation meter summarises which satellites are being interrupted. By enabling the Scintillation filter, the satellites that are frequently interrupted will be removed from the calculation until they have stabilised again. This gives a significant improvement in performance, although users need to be aware that it will result in a reduced number of satellites.

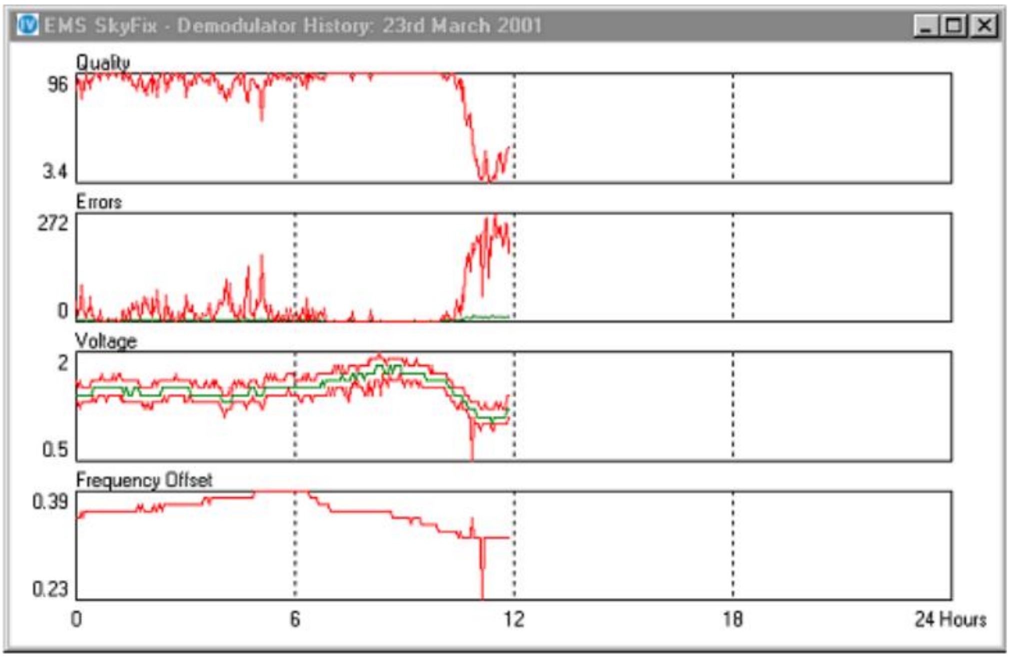
It is therefore recommended to work in height aiding mode when using the scintillation meter.

For more details of the ‘Scintillation Filter’, see Section 4.3.3.2 on page 58, and for the ‘Scintillation Meter’, see Section 4.3.6.4.3 on page 99.

Scintillation of the Data Links

Scintillation can also affect the continuity of the DGPS satellite link signals, both Inmarsat and SPOT.

MultiFix 4 includes the option to display the quality of the Fugro SkyFix decoder signals, as below, see MultiFix 4 Section for further details.



The Demodulator History display, found under “View” \ “Corrections” \ “SkyFix Decoder” \ “History” provides an illustrative summary of the stability of the SkyFix signal as recorded by the decoder. During scintillation on may see that the “Quality” drops, that the “Errors” increase and that the Minimum and Maximum “Voltage” separation widens.

A more detailed description of the Demodulator History view can be found in Section 4.3.6.5.3.2 on Page 118.

APPENDIX C – STATIC POSITION OFFSET FILE

Where RxV is to be used in a static environment, or for training purposes, the PDS module is not required. Instead, the fixed antenna locations can be entered into an XML file, as below.

Each Location requires a unique “Point ID”. The ID is defined within RxV under config\calculation\Receivers…”. Each receiver requires a unique ID, additional IDS can be defined for the location of the virtual antenna, for the output.

The name is for reference purposes and is shown on the “Rx SV Status” window in brackets.

Latitude, Longitude and height are used to define the point location.

An example XML file is given below. User defined text is marked in black.

```
- <Vessel>
    <Name>Vessel Name</Name>
  - <Point ID="31">
      <Name>Mast head</Name>
      <Latitude>52° 36' 10.25692" N</Latitude>
      <Longitude>1° 17' 04.49008" E</Longitude>
      <Height>76.036</Height>
    </Point>
  - <Point ID="32">
      <Name>Helideck</Name>
      <Latitude>52° 36' 10.25505" N</Latitude>
      <Longitude>1° 17' 04.45858" E</Longitude>
      <Height>75.890</Height>
    </Point>
  - <Point ID="33">
      <Name>Stbd Crane</Name>
      <Latitude>52° 36' 10.16859" N</Latitude>
      <Longitude>1° 17' 04.17211" E</Longitude>
      <Height>75.825</Height>
    </Point>
  - <Point ID="40">
      <Name>Virtual antenna</Name>
      <Latitude>52° 36' 10.00" N</Latitude>
      <Longitude>1° 17' 04.00" E</Longitude>
      <Height>70.00</Height>
    </Point>

  </Vessel>
```