WinFrog Device Group:	**GPS**
Device Name/Model:	**NMEA GPS**
Device Manufacturer:	**National Marine Electronics Association** PO Box 3435 New Bern NC 28564-3435, USA Tel: (252) 638-2626 Fax:(252) -638-4885 E-mail: nmea@coastalnet.com
Device Data String(s) Output to WinFrog:	GGA, GLL, GGK, GST, VTG, ODP, ZDA (time and date only), VTG, GST; Trimble proprietary TSS, UTC, GGK, GGK_SYNC POS/MV proprietary PASHR, PRDID
WinFrog Data String(s) Output to Device:	N/A
WinFrog Data Item(s) and their RAW record:	POSITION 303, 306(GST), 998(VTG) HEADING 409 TIMEDATE 999

DEVICE DESCRIPTION:
There is no one device that is named “NMEA GPS”. NMEA stands for the National Marine Electronics Association, a group that defined the NMEA 0183 Standard for interfacing marine electronics devices. NMEA is a voluntary industry standard, first released in March of 1983. The NMEA 0183 Standard defines electrical signal requirements, data transmission protocol, timing and specific sentence formats for a serial data bus. Most GPS manufacturers have designed their GPS receivers to be able to output positional data that complies with NMEA’s defined standards.

NMEA standards are updated from time to time with the latest version (2.30) released in March 1998. The NMEA 0183 standard calls for data communication in the form of coded "sentences." Each sentence begins with the character "$" and ends with a carriage return and line feed (<CR><LF>). These last two characters are "control" characters and are not normally printed (for this reason they are shown enclosed in brackets). Between the beginning and end of each sentence are "fields" of data, each field separated by a comma. The first field in any sentence (field 0) begins with the two-letter talker mnemonic code ("talkers" are devices that send out information, "listeners" take it in) followed by the three-letter code for the sentence.

In terms of GPS positional data, there are two specific data strings that can be generated by the GPS receivers, and likewise used by WinFrog: “GGA” and “GLL”. If possible, it is preferable to utilize the GGA data string as it contains more quality control information than the GLL message.

GPS receivers are also usually capable of outputting accurate GPS time information in the form of the NMEA “ZDA” message. In addition, if a 1PPS signal is often available.

WinFrog can be configured to synchronize its time to the more accurate GPS time, including the detection of the 1PPS pulse for more precise synchronization.

The benefit of using NMEA GPS data is that it doesn't matter which manufacturer created the GPS receiver, the data output is the same. (Note: the NMEA Sercel device output is slightly different. See the NMEA Sercel device documentation for more information).

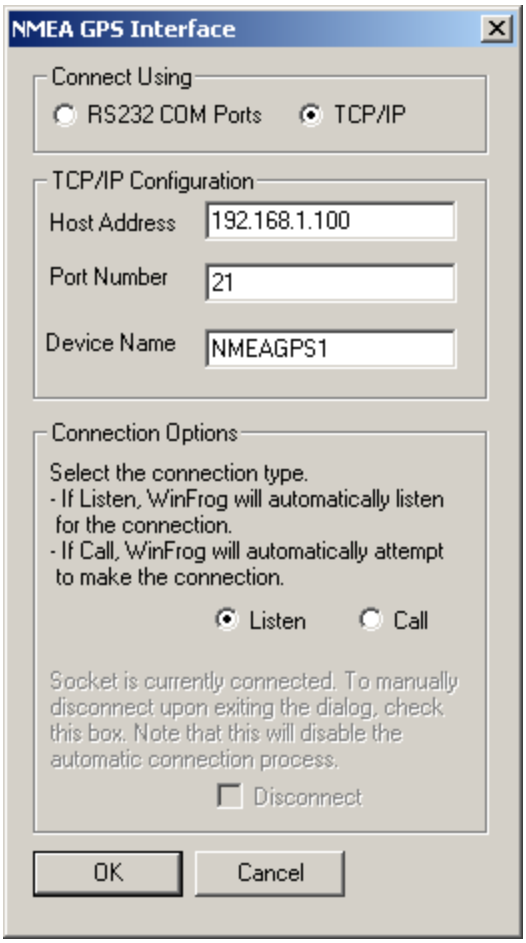
The downside to using NMEA data is that it can only provide limited quality control information as compared to utilizing WinFrog's pseudorange calculations. As well, you must be able to configure the GPS receiver itself for correct operation – i.e. WinFrog cannot be used to configure the device.

Refer to the Configuration Details paragraph below for a description of the GPS type NMEA messages that can be utilized by WinFrog.

DEVICE CONFIGURATION INSTRUCTIONS

WINFROG I/O DEVICES > EDIT I/O:
This device can support communications with either an RS232 COM port or a TCP/IP port. When using the TCP/IP port this device can be configured to make the connection or listen for connections.

When adding the NMEA GPS device, the following dialog appears in which you can select either RS232 or TCP/IP as the data communications protocol.



Connect Using:
Select either RS232 or TCP/IP as the data connection device. When you select RS232 and click OK, the standard Device I/O Parameters dialog opens in which you can select the Com port, baud rate, etc. Selecting TCP/IP enables the controls within this dialog pertaining to the connection settings.

TCP/IP Configuration:
If TCP/IP is selected, enter the IP address and port number of the GPS receiver and the name that WinFrog is to display for this device. Select whether WinFrog is to **Listen** (default) for a connection or initiate the connection with a **Call**. If Listen is selected, upon exiting this dialog with OK, WinFrog immediately starts listening for a call from the respective device. If Call is selected, upon exiting this dialog with OK, WinFrog immediately attempts to make the connection. In either case, WinFrog monitors the status of the connection or lack thereof, and automatically listens or calls as required. The socket connection status is displayed in the I/O Device Window.

If in Call mode and connected when this dialog is opened, an option to manually disconnect is available at the bottom of the dialog. If this is selected, upon exiting with OK, the connection is disconnected and the automatic connection process is suspended. If it is desired to re-connect, this dialog must be re-accessed and the option

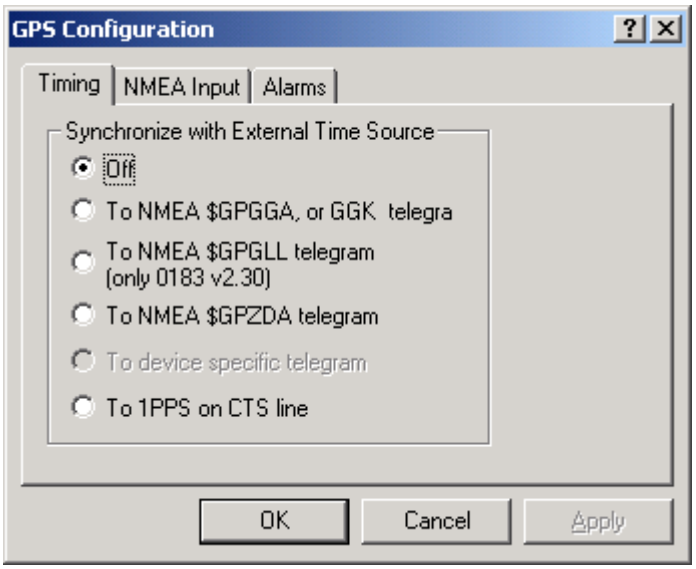
to re-activate the automatic connection process is available at the bottom of the dialog. Checking this option and exiting with OK causes WinFrog to immediately attempt to automatically connect. It is important to note that if the automatic call process is suspended due to exiting WinFrog, the suspended state is not saved and WinFrog will immediately start automatically attempting to connect when initialized.

Serial Configuration:
If the RS-232 option is selected, click OK and the configuration proceeds with the standard serial communications configuration.

The NMEA format originally stated the following communication parameters. WinFrog defaults to these settings. The serial port parameters on newer GPS receivers are completely user configurable.

Baud Rate 4800
Data Bits: 8
Stop Bits: 1
Parity: None

WINFROG I/O DEVICES > CONFIGURE DEVICE:
The NMEA GPS is added to WinFrog from the GPS device group. The NMEA GPS device must be configured at the I/O Device window level. The GPS Configuration dialog box appears, as seen below.



In order to derive an accurate position, GPS receivers must first resolve time very accurately. By utilizing a pseudorange to an “extra” GPS satellite, the receiver is able to synchronize its time to the highly accurate Cesium/Rubidium clocks used by the

satellites themselves. At least four satellites are typically required, three satellites if the GPS antenna height is held fixed.

WinFrog is able to synchronize to external time sources, typically a GPS receiver, including the 1PPS pulse (new in v3.2). The time synchronization is done at the vehicle level using the TIMEDATE data item.

The NMEA GPS device supports the synchronization of WinFrog to the $--ZDA telegram and/or 1PPS with $--ZDA telegram.

This device also supports the synchronization of WinFrog to the NMEA $--GGA and $--GLL telegrams. However, these are not recommended as there is an inherent latency in the UTC time included in the telegram and the time the telegram is sent out. This is typically approximately 0.7 seconds for a $--GGA telegram.

1. Interfacing

If using the 1PPS...

WinFrog looks for the 1PPS pulse on the CTS line of the serial port, therefore if the 1PPS signal is to be used, this must be connected to the CTS line at the WinFrog serial port.

Some GPS receivers produce a pulse that is too short and cannot be detected by a computer serial port. The signal must be stretched and/or increased in magnitude. The Trimble 4000 is an example of this. In this case a pulse stretcher is required. The stretched pulse needs to be connected to the CTS line of the same COM port that the GPS receiver is ending its time and navigation data to.

On many receivers, the 1PPS can be used as is, for example the Sercel NR203.

Besides the 1PPS signal, WinFrog requires a telegram defining the time of the pulse just received. Typically the NMEA $--ZDA telegram is used unless a device specific telegram is used, for example in the case of the Trimble 1PPS device (Trimble 4000).

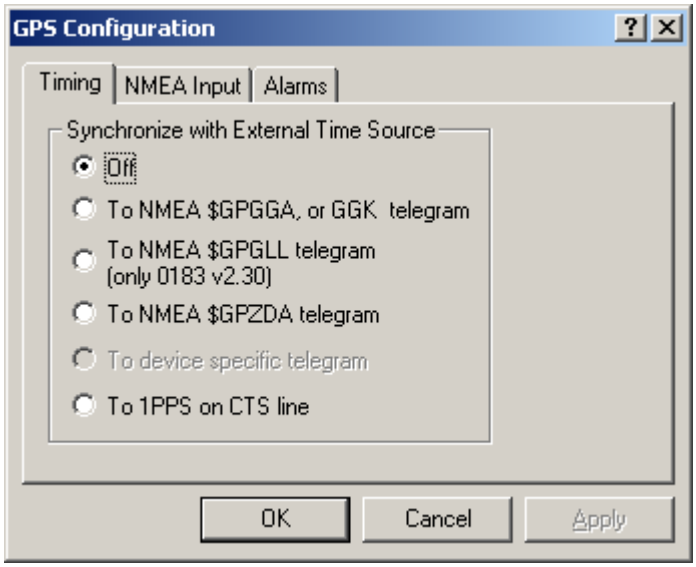
The 1PPS and associated time telegram must be input on the same port.

If using a NMEA telegram...

In the case of using a NMEA telegram such as the $--ZDA alone to synchronize WinFrog, the reception of the starting character (‘$’) of the telegram is detected and time stamped. This time stamp is used as the *pulse* detection time associated with the telegram’s UTC time.

2. Configuring the Device

Timing

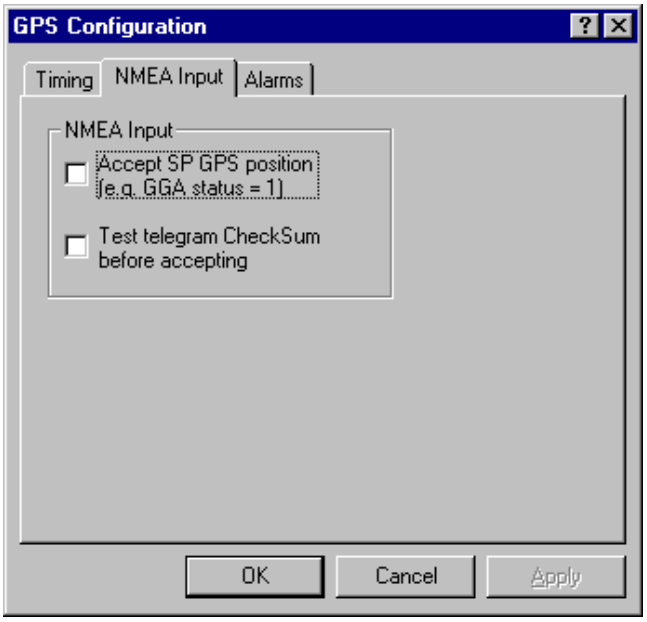


Select the synchronization option to be used. The preferred and most precise option is *To 1PPS on CTS line*, followed by *To NMEA $GPZDA telegram*, then the $GPGLL telegram and lastly the $GPGGA telegram. Note that this configuration tells WinFrog what option is to be associated with the TIMEDATE data type once it has been associated with a vehicle – it does not initiate the actual synchronization.

NOTE: The 1PPS option is not available when interfacing with TCP/IP sockets.

NOTE: The computer's system clock is not reset to the GPS time – only WinFrog's time is affected by enabling one of the synchronizing options.

NMEA Input

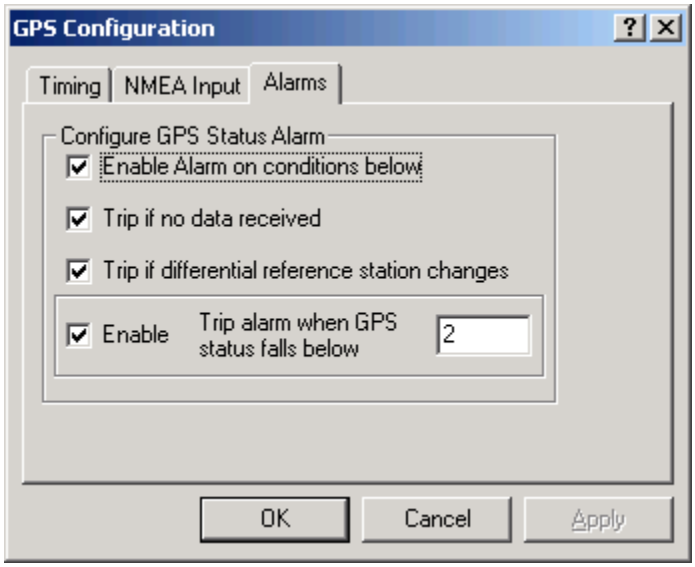


The **NMEA Input** dialog box allows you to configure WinFrog to "test" the received NMEA data string and react accordingly, as described below.

Accept SP GPS Position (e.g. GGA status=1)
Select this checkbox to have WinFrog utilize Single Point (i.e. non-differentially corrected) positional information. This non-differential status is identified in the GGA data string when a value of 1 is found in the Status field. (See below for further details on the GGA data string).
The GGA message must be used for this test; the GLL data string does not provide differential status information.
NOTE: Non-differential GPS data positioning is rated at only aprox. plus/minus 20 meters. This may not be adequate for high accuracy positioning tasks.

Test Telegram CheckSum before accepting
Select this checkbox to have WinFrog utilize the **CheckSum** value from the received data string. WinFrog will compare the checksum value to the number of values in the NMEA data string. If the number is not the same, WinFrog will not utilize the data string.

Alarms



Configure GPS Status Alarm:
Select the Enable Alarm checkbox to enable an audible (beeping) alarm. Note: if a sound card is present the beep is controlled by the Asterisk event in Window's Sound and Media Properties setup found in the Control Panel. With this option enabled, you can define the alarm to sound if the **GPS Status falls below** a certain number, as entered in the provided field. The value to be entered refers to the GGA string status field, defined as follows:

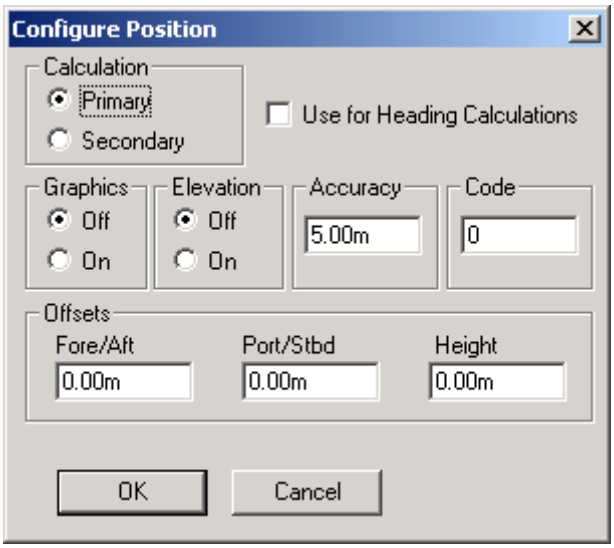
0= no GPS signal
1= Single Point GPS Positioning Mode
2= DGPS Positioning Mode
3= GPS PPS Mode
99= Simulator Mode
10= Simulator Mode Edit

Enable the "Trip if no data received" to detect communications failure. Note: this alarm will not occur upon initial setup; only after data has been received the first time then stops for about 15 seconds will the alarm occur.

Enable the "Trip if differential reference station changes" to detect changes in Multifix if it changes from XP to network or single point.

WINFROG VEHICLE > CONFIGURE VEHICLE DEVICES > DEVICE DATA ITEM > EDIT:
Adding the NMEA GPS device creates three data items: POSITION, TIMEDATE and HEADING. Once the data items have been added to the vehicle, they must be edited to suit the application.

Data item: GPS, NMEAGPS1, POSITION
The POSITION data item must be edited once it is added to a vehicle's device list. Highlight the data item in the vehicle's device list and click the Edit button. The Configure Position dialog box appears as seen below.



Calculation:
Set the Calculation selection to Primary or Secondary. Devices set to Primary calculation are used to provide a vessel position. Note that more than one Primary positioning device can be added to a vehicle's device list; data from these devices will be combined in a weighted mean solution. (See the paragraph on Accuracy below for more on the weighting of Primary calculation device data).
If the Calculation type is set to Secondary, WinFrog will simply monitor the device's data. WinFrog will not use the position data from the device in the final solution of the vehicles' position.

Note: In the case of Primary device failure, WinFrog will not automatically use the Secondary devices for the vessel's position computation. Instead, the vehicle's positioning will go to dead reckoning (if dead reckoning is turned on). You must manually change a Secondary device to Primary in order for the data to be utilized.

Use For Heading Calculations:
Select this checkbox if the device is to be used in conjunction with another GPS device for determination of the heading of the vessel.

Graphics:
If On is selected, a labeled square will show the raw (offset but unfiltered) location of the GPS antenna in the Graphics and Bird's Eye windows. This provides a means of comparing raw device and filtered vehicle positions.

Elevation:
Setting the Elevation option to On will result in the elevation determined by GPS to be used as the elevation of the vessel referencing the GPS (WGS84) Ellipsoid. The sounder data recorded in WinFrog's .RAW data files will not be affected.
This option is meant only for those applications where there is no fixed vertical reference (i.e. mean sea level), such as on a river. For acceptable results, this option requires the use of high accuracy "RTK" GPS data.

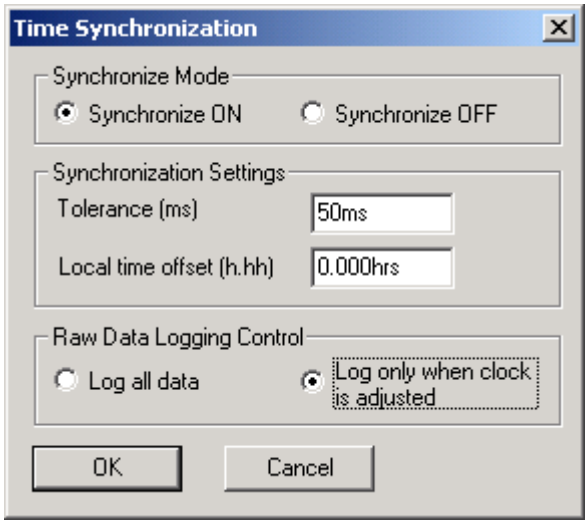
Accuracy:
The Accuracy value entered provides WinFrog with the expected accuracy of the position from this device. This value is used in the weighting of this device compared to other positioning devices that may be added to the vehicle's device list. The smaller the value entered, the more accurate it is considered to be, and hence the more weight that will be applied to the device's data.
The Accuracy parameter can be changed from the suggested values; changes should be made with caution, however, as they will affect the final filtered position of the vehicle.

Code:
This entry window is used when the GPS data is being received by a remote GPS receiver connected via telemetry link. If this is the case, set the Code to coincide with the code parameters associated with the GPS unit being used.
For all other applications, the Code entry must be set to 0.

Offsets:
Offsets are required to associate the GPS antenna position with the vessel's Common Reference Point (i.e. CRP). The offsets are applied *from* CRP (of the vehicle) *to* the GPS antenna location.
Forward Offsets are entered as positive values.
Aft Offsets are entered as negative values.
Starboard Offsets are entered as positive values.
Port Offsets are entered as negative values.
Height Offsets are positive upwards. (It is suggested that the vessel's Height origin should be at the water line.

Data item: GPS, NMEAGPS1, TIMEDATE

The TIMEDATE data item must be edited once it is added to a vehicle's device list. Highlight the data item in the vehicle's device list and click the Edit button. The Time Synchronization dialog box appears as seen below.



Synchronize Mode

The synchronization can be turned On or Off. Note that multiple TIMEDATE data items can be added to the same or other vehicles, but WinFrog will only allow one to be set to On and actually be used to synchronize the WinFrog clock. The others can only be compared to the WinFrog clock.

Synchronization Settings

The tolerance setting controls the maximum limit of the deviation of the WinFrog clock from the timing device before WinFrog resets its clock. This should not be set too small, or the clock will constantly be re-setting. A tolerance of 50 ms for a 1PPS pulse results in the resetting of the clock approximately every 5-6 minutes.

WinFrog monitors the variation between the UTC time and the WinFrog clock using a fading history of the last 20 samples of the variation between the WinFrog clock synchronization time stamp and the associated UTC time. This is filtered using a Central Tendency algorithm. When the filter result exceeds the tolerance, the clock is reset.

Local time offsets can be entered to allow synchronization to UTC while working in a local time zone. The offset is entered in +/-hours.

Raw Data Logging Control

You can control the logging of the TIMEDATE raw data records. Every time synchronization data reception update can be logged, i.e. a raw record every second. Alternatively, the data is only logged to the raw file when the clock is reset.

The data logged includes the time of the clock adjustment and the amount it was adjusted.

Note that this is only in affect if Raw Data recording is turned on.

3. Monitoring the synchronization

The synchronization of the WinFrog clock can be monitored from the Calculation Window using the Data Item Text and Time Series options.

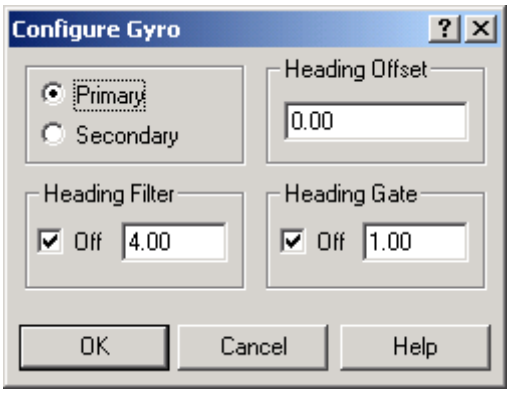
In the Data Item Text panel, the following information is displayed:

- Status
  Displays the data type status (On/Off) and the associated device status.
- Sync'd at
  Displays the time the WinFrog clock was last adjusted.
- Computer time
  WinFrog clock time stamp of last synchronization data input
- UTC time
  UTC time (from device) of last synchronization data input
- Raw Delta
  The difference between the UTC and associated WinFrog time stamp (UTC – WinFrog) for the last epoch
- Filter Delta
  The difference between the UTC and filtered WinFrog time for the last epoch

In the Time Series panel, the difference between the UTC time and the raw and filtered WinFrog times are plotted.

Data item: GPS, NMEAGPS1, HEADING

The HEADING data item must be edited once it is added to a vehicle's device list. Highlight the data item in the vehicle's device list and click the Edit button. The Configure Gyro dialog box appears as seen below.



Calculation (Primary/Secondary):
Set the type of calculation to Primary or Secondary by selecting the appropriate radio button. Devices set to Primary are used to provide the vehicle with heading information. However unlike the Position data items, WinFrog does not calculate a weighted mean solution for multiple Heading data items. If more than one Heading data item is set to primary, the vessels heading, in WinFrog, will jump back and forth between the two. Devices set to Secondary are simply monitored, and are not used in the vehicle's calculations.

In the case of Primary device failure, WinFrog will not automatically use the Secondary device(s). You must manually change a Secondary device to Primary status in order for it to be used in the vehicle's calculations.

Heading Offset:
A correction value (as determined from a gyro calibration) can be input in the Heading Offset box. This value is added to the heading value from the device to provide a corrected heading for the vehicle. Note that positive or negative values can be entered.

Heading Filter/Heading Gate:
The Heading Filter is used to "smooth" heading values used by the vehicle. The value entered in the Heading Filter indicates the number of headings that will be used to predict the next heading value. The larger the value entered, the "heavier" the filter will be – i.e. the slower the vehicle's heading will respond to changes.

The Heading Gate defines a tolerance value to limit the use of anomalies in gyro readings. If the next observed gyro value received falls outside the specified range of predicted values (i.e. plus or minus the entered value), the value will not be used.

CONFIGURATION DETAILS:
Most NMEA GPS receivers output data utilizing the standard RS-232 serial protocols.

Serial Port Connections

DB-25	DE-9	Signal	Direction
2	3	Tx Data	→
3	2	Rx Data	←
4	7	Request to Send	→
5	8	Clear to Send	←
6	6	Data Set Ready	←
7	5	Signal Ground	
8	1	Data Carrier Detect	←
20	4	Data Terminal Ready	→
22	9	Ring Indicator	←

Typically, interfacing to a NMEA GPS device requires only the reception of data.
If this is the case, you are required to connect only the **Tx** Data pin on the GPS device to the **Rx** Data pin on the WinFrog computer, and to connect the **Signal Ground** pins between the two devices.

Those that support TCP/IP protocol are connected with a standard network cable, though the connector at the receiver may not be standard. They may be stand alone or part of an existing network.

Raw Data Logging:

A talker typically sends a group of sentences at intervals determined by the unit's update rate, but generally not more often than once per second. Characters following the "*" are a checksum. Checksums are optional for most sentences, according to the standard.

The following are the NMEA 0183 strings:

GGA - Global Positioning System Fix Data:
The sentence begins with the start character "$." Next comes the talker identifier and sentence format code. GP stands for GPS. GGA is the NMEA sentence type. Next come the sentence fields, then a carriage return and line feed close the sentence. Following is an example:

$--GGA,hhmmss.ss,llll.ll,a,yyyyy.yy,a,x,xx,x.x,x.x,M,x.x,Mx.x,xxxx*hh<CR><LF>
$--GGA,123519,4807.038,N,01131.324,E,1,08,0.9,545.4,M,46.9,M, , *42

Where:

123519	Fix taken at 12:35:19 UTC
4807.038,N	Latitude 48Deg. 07.038 min N
01131.324,E	Longitude 11Deg 31.324 min E

1	Fix quality:	0 = invalid fix	3=GPS PPS Mode,fix valid
		1 = GPS fix	99= Simulator Mode
		2 = DGPS fix	10= Simulator Mode Edit
08	Number of satellites being tracked		
0.9	Horizontal dilution of position		
545.4,M	Altitude, Metres, above mean sea level		
46.9,M	Height of geoid (mean sea level) above WGS84 ellipsoid		
(Empty field)	time in seconds since last DGPS update		
(Empty field)	DGPS station ID number		

ZDA-Time and Date:

$--ZDA,hhmmss.ss,xx,xx,xxxx,xx,xx*hh<CR><LF>

Where:

hhmmss.ss	UTC
xx	Day (01 to 31) UTC
xx	Month (01 to 12) UTC
xxxx	Year UTC
xx	Local zone hours (00 to ±13 hrs)
xx	Local zone minutes (00 to +59)

Note: Local time zone is the magnitude of hours plus the magnitude of minutes added, with the sigh of local zone hours, to local time to obtain UTC. Local zone is generally negative for East longitudes with local exceptions near the International Date Line.

Example: At Chatham Is. (New Zealand) at 12:30 PM local time on June 10,1995

$GPZDA,234500,09,06,1995,-12,45*6C<CR><LF>

In the Cook Islands at 1500 local time on June 10,1995:

$GPZDA,0130000,11,06,1995,10,30*4A<CR><LF>

GSA – GNSS DOP and Active Satellites:

$--GSA,a,b,cc,cc,cc,cc,cc,cc,cc,cc,cc,cc,cc,d.d,e.e,f.f*hh<CR><LF>

Where:

a	Mode: M= Manual, forced to operate in 2D or 3D mode. A=Automatic, allowed to automatically switch 2D/3D
b	Mode: 1= Fix not available, 2=2D, 3=3D
cc	ID numbers of satellites used in solution
d.d	PDOP
e.e	HDOP
f.f	VDOP