

<b>WinFrog Device Group:</b>	<b>GPS</b>
<b>Device Name/Model:</b>	<b>NMEA GPS</b>
<b>Device Manufacturer:</b>	<b>National Marine Electronics Association</b> PO Box 3435 New Bern NC 28564-3435, USA Tel: (252) 638-2626 Fax:(252) -638-4885 E-mail: nmea@coastalnet.com
<b>Device Data String(s) Output to WinFrog:</b>	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
<b>WinFrog Data String(s) Output to Device:</b>	N/A
<b>WinFrog Data Item(s) and their RAW record:</b>	POSITION                    303, 306(GST), 998(VTG) HEADING                    409

**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.

This device can provide time synchronization using one of the following sources: \$-GGA, \$-GGK, \$-GLL, \$-ZDA, or 1PPS with \$-ZDA. See chapter 8.

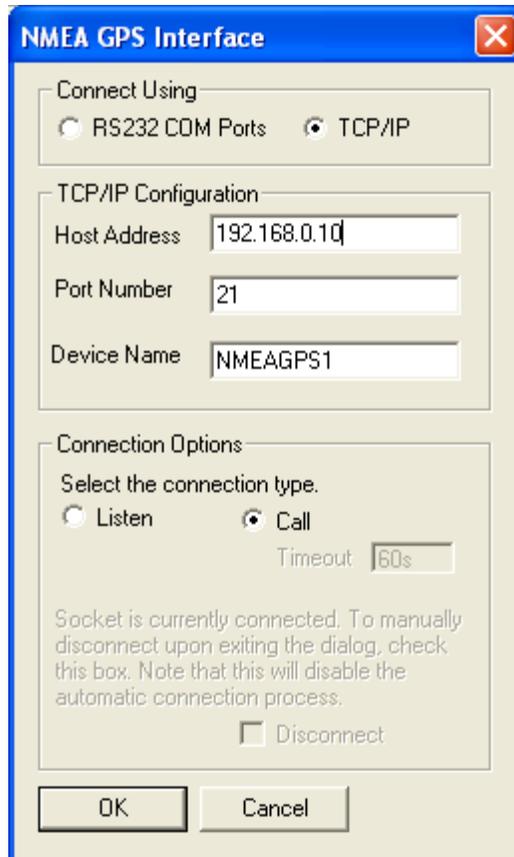
## ***DEVICE CONFIGURATION INSTRUCTIONS***

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### **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.

Note: The Timeout option for the Call mode is not enabled for this device.

**Serial Configuration:**

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

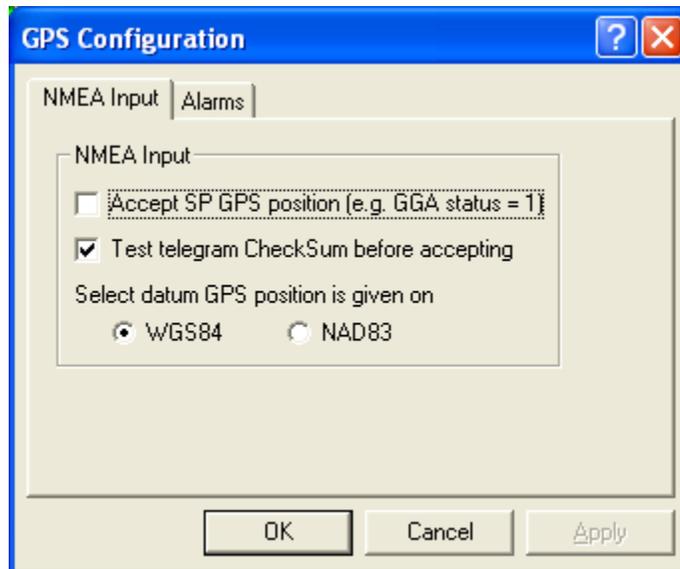
The NMEA format originally stated the following communication parameters. WinFrog defaults to these settings. The serial port parameters on newer GPS receivers are completely user configurable.

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.

**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 approx. plus/minus 20 meters. This may not be adequate for high accuracy positioning tasks.

**Test Telegram CheckSum before accepting**

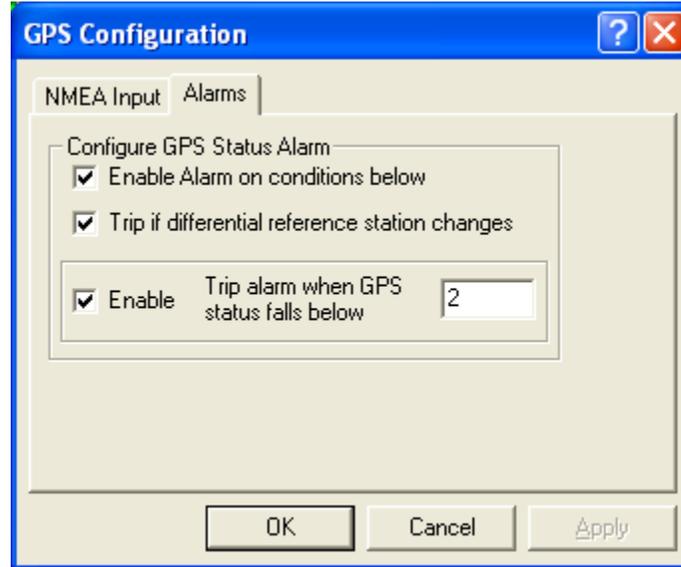
Select this checkbox to have WinFrog utilize the **Checksum** value from the received data string. WinFrog will compare the checksum value to the number of values in the NMEA data string. If the number is not the same, WinFrog will not utilize the data string.

**Select datum GPS position is given on**

Generally, GPS receivers output the position in WGS84, ITRF00 or ITRF05. For WinFrog applications, WGS84, ITRF00 and ITRF05 are considered to be close enough as to be the same. However, there are instances when the output GPS position may be NAD83, which is not the same as WGS84. In this case, it is critical that NAD83 be selected here. WinFrog will then transform the NAD83 position to WGS84 when it is received to normalize it to the ellipsoid that WinFrog uses as the standard for GPS.

An example of when the position may be in NAD83 is when using a USCG beacon as a differential correction source.

## 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.

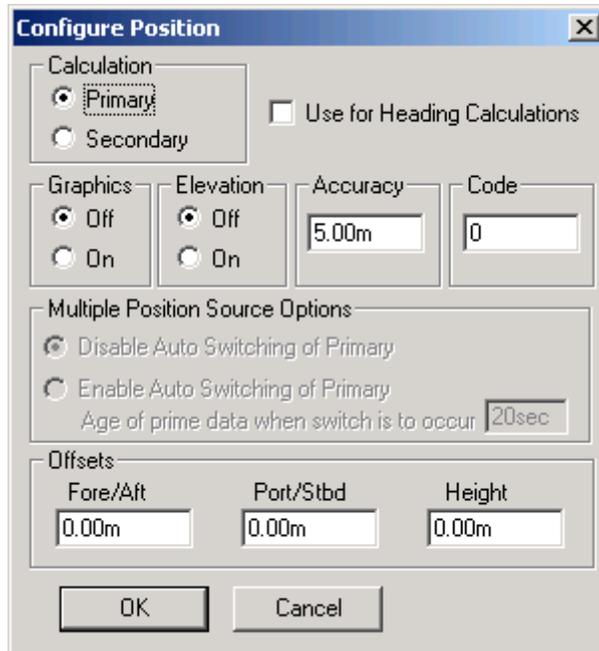
Enable the "Trip if differential reference station changes" to detect changes in Multifix if it changes from XP to network or single point.

### WINFROG VEHICLE > CONFIGURE VEHICLE DEVICES > DEVICE DATA ITEM > EDIT:

Adding the NMEA GPS device creates two data items: POSITION 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 data from a secondary device in the final solution of the vehicle's position.

If auto switching is enabled (see below) a secondary may automatically become a primary should all the primaries fail.

#### 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.

**Multiple Position Source Options:**

This group box allows you to enable automatic switching of a secondary to primary should the data from all POSITION and PSEUDORANGE data items set to primary timeout. The **Age** entered is the length of time that the secondary will wait in the absence of data from all primaries, before taking over as primary. This age is only entered for the secondary.

For example, if the POSITION or PSEUDORANGE data items associated with two GPS receivers were set to primary and the POSITION or PSEUDORANGE data item of a third GPS receiver was set to secondary, both primary GPS receivers must time out before the secondary will become the primary. Upon the recovery of either of the original primary data items, the original primary will be reset to primary and the original secondary will be reset to secondary.

Note for the auto switching feature to work, there must be at least one primary and one secondary enabled. For example, given two data items, one set to primary with the auto switching disabled and the other set to secondary with the auto switching enabled, if the primary fails the secondary is not set to primary and the vehicle positioning stops until the primary data item recovers.

**Disable Auto Switching of Primary:**

If this data item is not to be involved in the auto switching process, check this box. As stated above, this data item is then not involved in the auto switching process in any way.

**Enable Auto Switching of Primary:**

If this data item is to be involved in the auto switching process, either as a primary or a secondary, check this box. If set to secondary, enter the Age of data the primary data items must reach before this secondary is switched to act as the primary.

In order for this option to be effective you must have at least one primary and one secondary. If there are multiple secondary data items that are enabled for switching, the first one to receive data will become primary.

Note: This option is not enabled unless WinFrog determines that there is more than one POSITION and/or PSEUDORANGE data item associated with the respective vehicle. The exception to this is the case of a WinFrog with the Remote module operating as a Controlled Remote being configured remotely from the Controller. In this case, the option is always enabled even though it may not be applicable. The operator must be aware of what is available on the Remote and configure the data item accordingly.

Note: This option is not available in the WinFrog Remote package.

Note: This option is not available for USBL based POSITION data items.

**Offsets:**

Offsets are required to associate the GPS antenna position with the vessel's Common Reference Point (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.

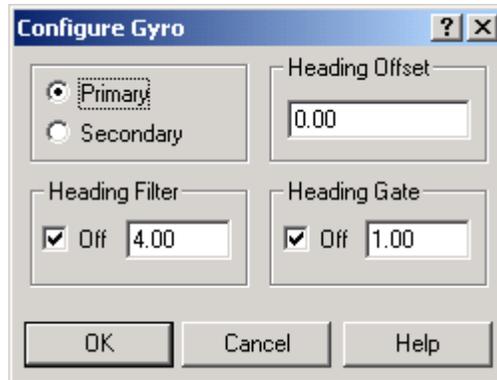
Starboard Offsets are entered as positive values.

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, NMEA GPS1, 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,lll.ll,a,yyyy.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,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