WinFrog Device Group:	**GPS**
Device Name/Model:	**INStar**
Device Manufacturer:	CDL Web site: http://www.cdltd.net
Device Data String(s) Output to WinFrog:	See attached (icon at the end of document)
WinFrog Data String(s) Output to Device:	None
WinFrog Data Item(s) and their RAW record:	POSITION 303 HEADING 910 ATTITUDE 413

DEVICE DESCRIPTION:

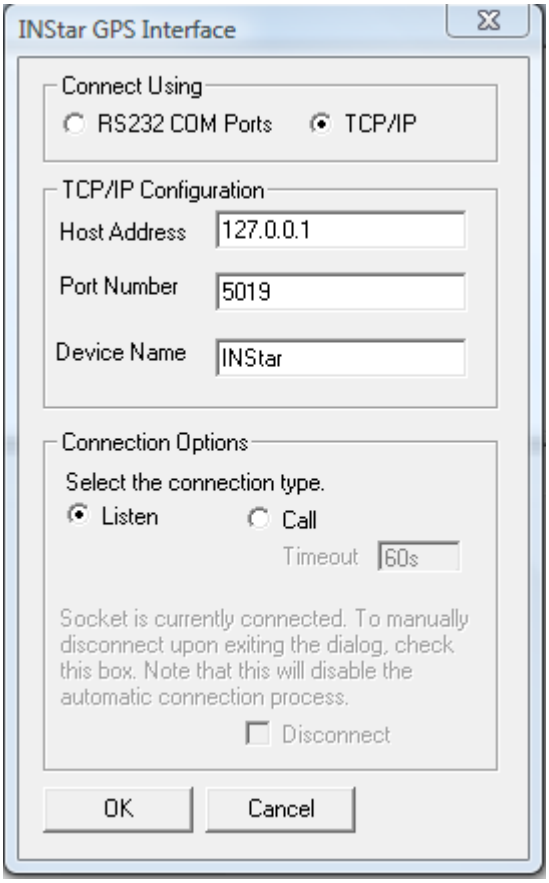
This device outputs an NMEA proprietary telegram. The telegram is from a telemetry network and supports multiple vehicle positions, thus each telegram contains a code representing a particular vehicle.

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



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, 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.

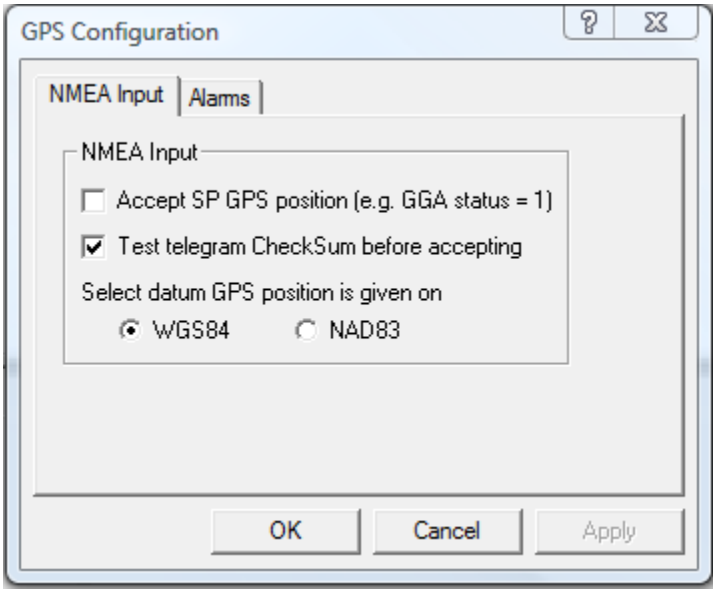
The NMEA format originally stated the following communication parameters. WinFrog defaults to these settings. The serial port parameters on newer GPS receivers are completely user configurable.

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

WINFROG I/O DEVICES > CONFIGURE DEVICE:

The INStar device is added to WinFrog from the GPS device group. This 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).

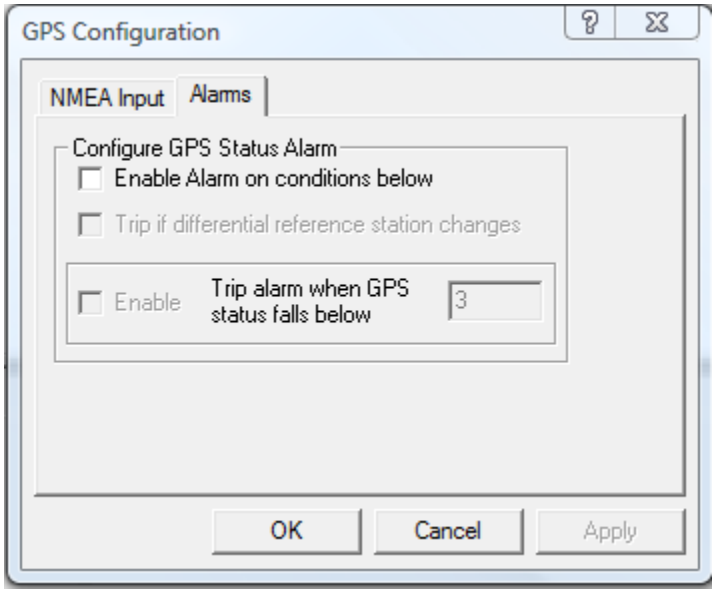
The GGA message must be used for this test; the GLL data string does not provide differential status information.
NOTE: Non-differential GPS data positioning is rated at only approx. plus/minus 20 meters. This may not be adequate for high accuracy positioning tasks.

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 RTK Mode

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.

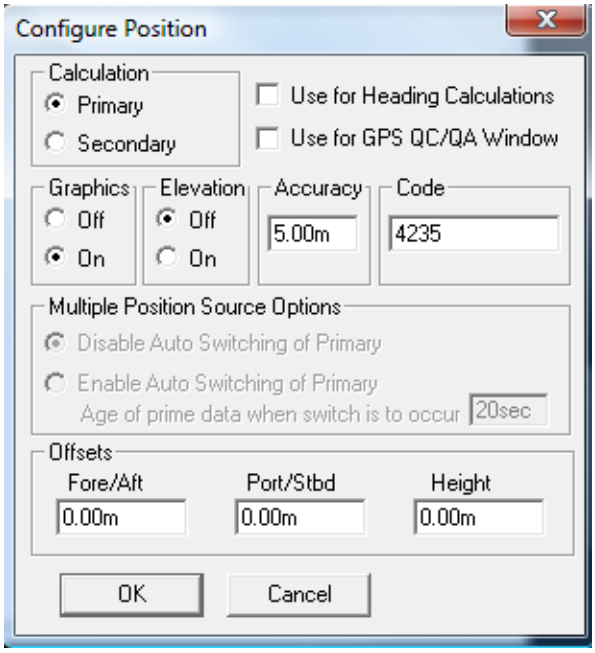
WINFROG VEHICLE > CONFIGURE VEHICLE DEVICES > DEVICE DATA ITEM > EDIT:

Adding the INStar GPS device creates three data items: POSITION, ATTITUDE, and HEADING. Once the data items have been added to the vehicle they must be edited to suit the application.

Data item: GPS, INStar, POSITION

The GPS, INStar, POSITION data item is used to assign a position to a vehicle. This data item can be added to more than one vehicle. WinFrog determines which telegram’s data to assign to which vehicle by the code you enter on the dialog below.

Highlight this data item in the vehicle’s device list and click the Edit button to open the Configure Position dialog box 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:
This option is not used by this device.

Graphics:
Select the On radio button to display a labeled square showing 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 the GPS to be used as the elevation of the vessel's CRP, referencing the GPS (WGS84) Ellipsoid. The height of the antenna above (below) the CRP must be entered. 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:
Enter the code associated with this vehicle. You can see the available codes by viewing the decoded data window.

Multiple Position Source Options:
This group box allows you to enable automatic switching of a secondary to primary should the data from all POSITION 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 data items associated with two GPS receivers were set to primary and the POSITION 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 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 may be 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, INStar, HEADING

The GPS, INStar, HEADING data item is used to assign the heading found in the same telegram that the position was in, to the vehicle. This necessitates adding the POSITION telegram to the same vehicle and entering the correct code. (If you do not want to use the position, set it to secondary.)

Highlight this data item in the vehicle's device list and click the Edit button to open the Configure Gyro dialog box as seen below.

Heading Data Item Options:
Application Mode (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 heading information. Devices set to Secondary are simply monitored, and are not used in the vehicle's calculations.

Note that WinFrog supports automatic switching from a designated Primary to a Secondary in the event that data from the Primary fails (see Multiple Heading Sources Options).

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.

Multiple Heading Sources Options:
WinFrog supports automatic switching from a designated Primary source to an alternate Secondary source in the event that the Primary fails. The first Secondary source to receive data after the Primary has failed becomes the alternate Primary providing the heading for the vehicle. When the designated Primary is detected as active again, the alternate Primary source reverts to Secondary and the designated Primary provides the heading data to the vehicle.

If an alternate Secondary fails and there are additional Secondary sources, it in turn is detected by the first of the remaining operational Secondary sources to receive data after the failure, at which time this Secondary becomes the alternate Primary.

Note that this option is only available if more than one HEADING source is associated with the respective vehicle. Changes made to the Auto Switching options for any one of the HEADING data items are automatically assigned to the others upon exiting this dialog with OK. If the Auto Switching option is enabled and the respective HEADING source has been set to Primary, all others are automatically set to Secondary. The exception to this is when configuring a WinFrog Controlled Remote (WinFrog with a Remote module) from a Controller. In this case, changes

made to one HEADING source are not automatically made to other HEADING sources. The operator must explicitly make them for each HEADING source.

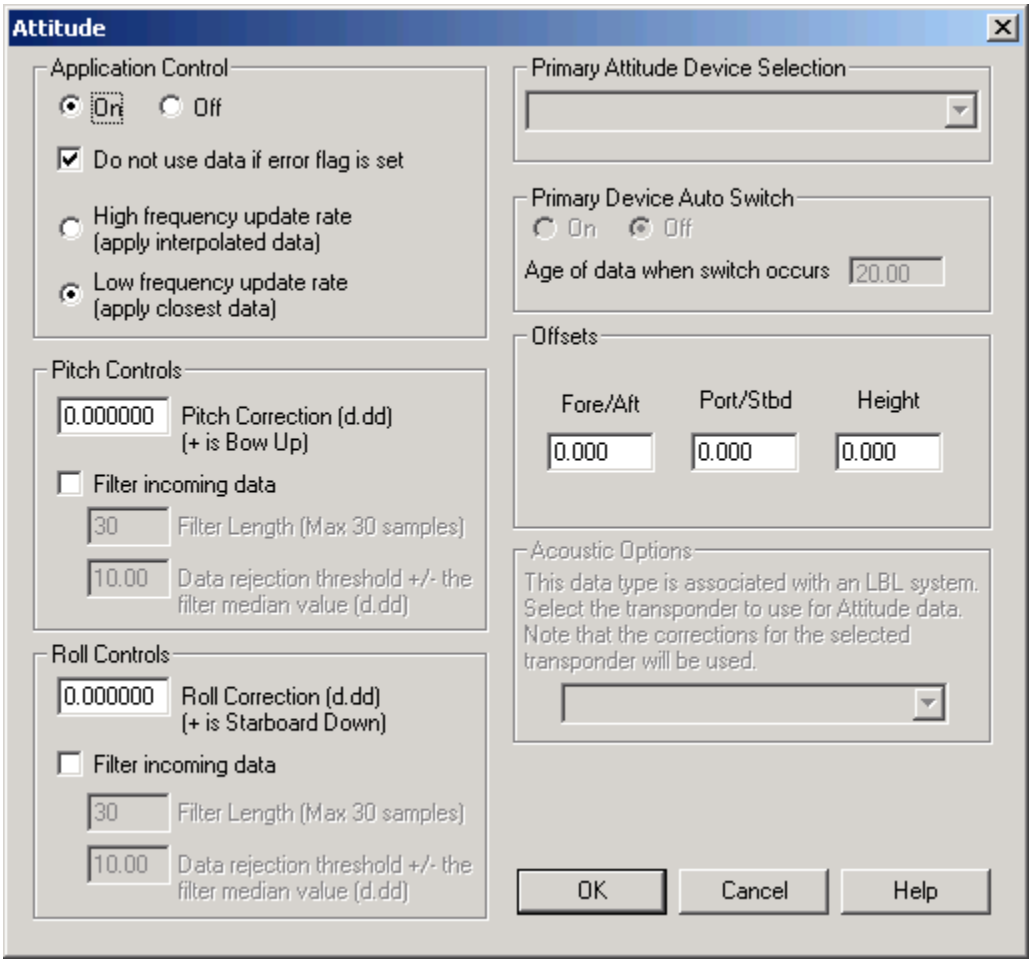
This option is not available in the WinFrog Remote package.

Disable/Enable Auto Switching Operation:
Select the mode you wish to operate WinFrog.

Age of data in seconds when switch occurs:
Enter the age of data that is permitted before the source is considered to have failed.

Data item: GPS, INStar, ATTITUDE

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



Attitude
By default, the sensor mode is off, meaning that data from the device will not be used in the vehicle's calculations. To turn the sensor on, and begin using the inclination corrections in the position output, click the 'On' radio button.

Error flag testing
The error flag check box is applicable to those devices that output a code indicating the data is either good or bad. If checked and the device supports such a code in its telegram, WinFrog will look at the code and if the data is indicated as bad, WinFrog will not use the data.

Sensor Update Frequency Rate
If the associated attitude sensor has a high frequency update rate (e.g. 10Hz and higher) it is appropriate to extract attitude data for application by either interpolating or extrapolating for a given epoch. In this case, the *High frequency update* option should be selected. Some attitude sensors have slow update rates, in particular those installed in acoustic transponders that require interrogation. For these sensors interpolation/extrapolation can produce a bad value as there is insufficient information to determine the correct shape of the curve (aliasing). Thus the most current attitude needs to be used. In this case, select the *Low Frequency update* option. This option applies to the use of the attitude data by the following data items:

- POSITION
- ELEVATION
- ALTITUDE
- XPONDER
- LBL TRANSCEIVER
- PROFILE

Pitch and Roll
There are two control groups, one for each of pitch and roll. Correction values can be added in this section of the window. The correction values (entered in units of degrees-decimal degrees) are added to the raw pitch and roll values received from the device before the data is applied to the vehicle's calculations. Ensure that entered values adhere to the sign convention used by WinFrog. You can verify that the corrections are entered properly by viewing the pitch and roll values in the I/O Device window and the Vehicle Text window.

Filtering
Additionally you may filter the incoming values to remove extraneous noise or spikes – check boxes are provided to switch this feature on or off. A filter length (up to 30 samples) and a threshold value (applied to the median of the samples in the filter to obtain lower and upper bounds) can be entered. Any pitch or roll values outside of the bounds are rejected and not used in the vehicle calculations, but will be recorded in the RAW files. If either one of pitch or roll is rejected, both values are ignored, although you may set up the filtering parameters for them separately. The status of

the filters, including the current valid range for each of pitch and roll, and the percentage of values rejected, can be viewed in the calculations window, selecting the appropriate ATTITUDE data item.

> ***Important:***
> Do not enable filtering unless there is a high enough data rate (say 10hz) to correctly determine the shape of the curve. Essentially, if the low frequency update rate is selected above, do not enable filtering.

Primary Attitude Device Selection
If more than one attitude device is present, you may select one of them to be primary and the others to be secondary and allow WinFrog to automatically switch between them should the primary system stop sending data or has bad data. There must be at least two attitude data items added to the vehicle to use this feature. (Note: The attitude and offset data displayed in this dialog is for the attitude device corresponding to the data item that is being edited. Selecting a Primary Attitude Device from the drop down list does not affect these values for any attitude device in the list. Every attitude device needs to be set up for its own corrections and offsets.)

Primary Device Auto Switch
Select the On radio button to turn on this feature. Then enter the time out time in the edit box. If WinFrog does not receive data from the primary attitude device, or if it receives bad data for this length of time, it will switch to the next secondary that is enabled and has good data.

Auto Switch Feature Usage
To use this feature first turn the sensor on as described in the Attitude section above. Next, select the attitude device that you wish to be primary from the drop down list box. Then turn the primary device auto switch on and enter the time out time. Then edit all the other attitude data items and enable them in the Attitude group box. Note that the same selected primary will be displayed for all attitude data items; similarly, the automatic feature will be turned on and the time out time will be the same. However, you must individually enable each attitude device in the Attitude group box.

Offsets
These are not applicable in this case.

Acoustic Options
This applies to long base line acoustic transponders that have inclinometers. See the LBL Acoustics chapter for more information.

TELEGRAM SPECIFICATIONS

Message Format:

The $PCDLI message is sent by the INStar unit and along with ID, position information, attitude information, it contains additional status and sensor information.

The length of the $PCDLI message exceeds the standard NMEA telegram message specification of 79 characters. The end-user of this message needs to accommodate the additional characters provided. The following table provides a list of the $PCDLI message fields and their definitions.

Field	Usage	Format	Description
1	$PCDLI	ASCII	CDL INStar proprietary header
2	ID Number	Integer	ID of the INStar unit sending this message
3	Date	YYYYMMDD	UTC Data of the GPS Position message.
4	Time	HHMMSS.ss	UTC Time of the GPS Position message.
5	Latitude	Decimal	WGS84 Latitude. + is North, - is South.
6	Longitude	Decimal	WGS84 Longitude. + is East, - is West.
7	Altitude	Decimal	The MSL altitude in meters.
8	Heading	Decimal	The heading in degrees relative to True North.
9	Pitch	Decimal	The pitch in degrees. + is Bow Up.
10	Roll	Decimal	The roll in degrees. + is Starboard Up.
11	ROT	Decimal	The Rate of Turn in degrees per second. + is Starboard rotation, - is Port rotation.
12	GPS Status	Integer	Solution Indicator: 0 = no GPS lock or position 1 = Autonomous GPS position 2= Differential corrected GPS position (SBAS, RTCM, etc..) 4 = RTK fixed integer GPS position
13	No. SVs	Integer	The number of satellites in use for the GPS position computation.
14	HDOP	Decimal	Horizontal dilution of precision.
15	MS2 Status	Hexadecimal	Mode Flag: 0 = Idle 1 = Coarse stationary align 2 = Fine stationary align 3 = Static Tilt (Static) 4 = Dynamic Tilt (Dynamic) 6 = Magnetic Calibration 9 = Aided Navigation (AHRS)
16	SoG	Decimal	Speed over Ground in Kilometres per hour.
17	CoG	Decimal	Course over Ground in degrees relative to True North.
18	dGPS Ref.	Integer	Reference Station identifier.
19	Temperature	Decimal	INStar temperature sensor reading – degrees Celsius.
20	Voltage	Decimal	INStar supply voltage reading - volts.
21	*	ASCII	NMEA telegram message termination character
22	Checksum	ASCII	XOR of bytes between (but not including) the dollar sign and asterisk
23	<cr><lf>	0x0D 0x0A	Carriage Return and Line Feed

Example $PCDLI Sentence:

$PCDLI,1016,20120406,184012.50,29.8043519295,-95.56066857583,0.9,312.5,-0.5,1.5,-1.2,2,8,1.1,9,005.5,309.1,0133,20.5,13.2*7F<cr><lf>

Where:

1016	INStar Unit Number = 1016
20120406	Date: April 6th, 2012 UTC
184012.50	Time: 18:40:12.5 UTC
29.8043519295	Latitude: 29.8043519295 degrees North
	or 29' 48.2611158" N
-95.56066857583	Longitude: 95.56066857583 degrees West
	or 95' 33.6401146" W
0.9	Mean Sea Level: 0.9 meters
312.5	Heading: 312.5 degrees True North
-0.5	Pitch: 0.5 degrees Bow Down
1.5	Roll: 1.5 degrees Starboard Up
-1.2	Rotation: 1.2 degrees per second anticlockwise
2	Differential GPS position computation
8	Eight satellite being used in the GPS computation of position
1.1	HDOP: 1.1
9	MS2 Status: Aided AHRS mode
005.5	SoG: 5.5 Kilometres per hour
309.1	CoG: 309.1 degrees True North
	Yaw = difference Heading – CoG = 3.4 degrees
0133	Differential GPS corrections from SBAS ID: 133
20.5	Measured temperature of 20.5 degrees Celsius
13.2	Measured supply voltage of 13.2Vd.c.
*7F	Termination character plus checksum = 7F