# CW85

NAVSYNC

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### Revision History of Version 1.0

| Revision | Date | Released By | Note |
|---|---|---|---|
| 0 | 8/29/06 | Engineering | Advance Release |
| 1 | 4/17/07 | Engineering | Preliminary Release |

Table 1 Revision History

### Other Documentation

*The following additional documentation may be of use in understanding this document.*

| Document | By | Note |
|---|---|---|
| None are available at this time | | |

Table 2 Additional Documentation List

# 1 Description

## 1.1 Introduction

The CW85 combines GPS technology with WiFi transport. Incorporating Navsync's own CW25 module with ultrasensitive GPS receiver, the CW85 provides an 802.11b transmission containing NMEA streams giving device location (longitude and latitude) and UTC time. The 802.11b supports WEP encryption and is fully configurable to a specific network.

## 1.2 GLOBAL POSITIONING SYSTEM (GPS)

The Global Positioning System (GPS) is a military satellite based navigation system developed by the U.S. Department of Defense, which is also made freely available to civil users. Civilian use of GPS is made available at the user's own risk, subject to the prevailing Dept. of Defense policy or limitations, and to individuals understanding of how to use the GPS.

In today's satellite constellation there are a minimum of 24 operational satellites (plus several operational spares) in 6 orbital planes, at an altitude of about 22,000 km. The GPS system can give accurate 3-D position, velocity, time, and frequency, 24 hours a day, anywhere around the world. GPS satellites transmit a code for timing purposes, and also a 'Navigation message' that includes their exact orbital location and system integrity data. Receivers use this information, together with data from their internal almanacs, to precisely establish the satellite location. The receiver determines position by measuring the time taken for these signals to arrive. At least three satellites are required to determine latitude and longitude if your altitude is known (e.g. a ship at sea), and at least a fourth to obtain a 3-D fix.

## 1.3 GPS Positioning and Navigation

The CW85 needs to be able to see at least 4 satellite vehicles (SV's) to obtain an accurate 3-D position fix. When traveling in a valley or built-up area, or under heavy tree cover, you will experience difficulty acquiring and maintaining a coherent satellite lock. Complete satellite lock may be lost, or only enough satellites (3) tracked to be able to compute a 2-D position fix, or even a poor 3D fix due to insufficient satellite geometry (i.e. poor DOP). Note also, that inside a building or beneath a bridge, it probably will not be possible to update a position fix. The Receiver can operate in 2-D mode if it goes down to seeing only 3 satellites by assuming its height remains constant. But this assumption can lead to very large errors, especially when a change in height does occur. A 2-D position fix is not to be considered a good or an accurate fix as it is simply "better than nothing" fix.

The receiver's antenna must have a clear view of the sky to acquire satellite lock. Remember always, it is the location of the antenna, which will be given as the position fix. If the antenna is mounted on a vehicle, survey pole, or backpack, allowance for this must be made when using the solution.

To measure the range from the satellite to the receiver, two criteria are required: signal transmission time, and signal reception time. All GPS satellites have several atomic clocks, which keep precise time, and these are used to time-tag the message (i.e. code the transmission time onto the signal) and to control the transmission sequence of the coded signal. The receiver has an internal clock to precisely identify the arrival time of the signal. Transit speed of the signal is a known constant (the speed of light), therefore: time x speed of light = distance.

Once the receiver calculates the range to a satellite, it knows that it lies somewhere on an imaginary sphere whose radius is equal to this range. If a second satellite is then found, a second sphere can again be calculated from this range information. The receiver will now know that it lies somewhere on the circle of points produced where these two spheres intersect. When a third satellite is detected and a range determined, a third sphere would intersect the area formed by the other two. This intersection occurs at just two points. The correct point is apparent to the user, who will at least have a very rough idea of position. A fourth satellite is then used to synchronize the receiver clock to the satellite clocks. In practice, just 4 satellite measurements are sufficient for the receiver to determine a position, as one of the two points will be totally unreasonable (possibly many kilometers out into space).

This assumes the satellite and receiver timing to be identical. In reality, when the CW85 compares the incoming signal with its own internal copy of the code and clock, the two will no longer be synchronized. Timing error in the satellite clocks, the Receiver, and other anomalies, mean that the measurement of the signals transit time is in error. This effectively, is a constant for all satellites, since each measurement is made simultaneously on parallel tracking channels. Because of this, the resultant ranges calculated are known as "pseudo-ranges".

To overcome these errors, the CW85 then matches or "skews" its own code to become synchronous with the satellite signal. This is repeated for all satellites in turn, thus measuring the relative transit times of individual signals. By accurately knowing all satellite positions, and measuring the signal transit times, the user's position can be accurately determined. Utilizing its considerable processing power, the CW85 rapidly updates these calculations from satellite data to provide a real time position fix.

The following DOP terms are computed by the CW85:

***HDOP*** Horizontal Dilution of Precision (Latitude, Longitude)
***VDOP*** Vertical Dilution of Precision (Height)
***TDOP*** Time Dilution of Precision (Timing errors)
***PDOP*** Position Dilution of Precision (3-D positioning)
***GDOP*** Geometric Dilution of Precision (3-D position & Time)
**Estimated accuracy** = DOP x measurement accuracy

While each of these terms can be individually computed, they are formed from covariances, and are not independent of each other. For example, a high TDOP will cause receiver clock errors which will eventually result in increased position errors. Horizontal accuracy figure of 95% is the equivalent to 2RMS (twice root-mean-square), or twice the standard deviation radial error. Similarly, for vertical and time errors, a figure of 95% is the value of 2 standard-deviations of vertical or time error.

· Root-mean-square (RMS) error is the value of one standard deviation (67%) of error.
· Circular Error Probability (CEP) is the value of the radius of a circle, centered at a position containing 50% of the position estimates.
· Spherical Error Probability (SEP) is the spherical equivalent of CEP, which is centered at a position containing 50% of the position estimates.

CEP and SEP are not affected by large errors, which could make the values an overly optimistic measurement. These probability statistics are not suitable for use in a high accuracy positioning system. The CW85 reports all accuracy’s in the form of a standard deviation (RMS) value.

## 1.4 Operation

Upon power up, the CW85 will initialize and then will attempt to obtain a valid GPS fix. The unit begins sending the GPGLL① string prior to having an accurate fix and continues to send out this stream until it is powered down. The LED indicator is lit while the unit waits to recieve a GPGLL string from the GPS reciever. The LED indicator then turns off briefly as the string is transmitted transmitted via the WiFi transmitter. This behavior is repeated as long as the CW85 remains on.

Cold start (ie - the first time the unit turns on and has no ephemeris or almanac data) requires 35db or higher signal strength and 15 minutes minimum on time to get current almanac and ephemeris data. After this data is received by the module, low-level signal testing may be done.

### Key Features of the CW85 include:

- Sensitive GPS receiver with tracking as low as -185dBW
- 802.11b compliant
- 128 bit-WEP encryption
- WPA encryption (not available in ADHOC mode)
- Portable – may operate on 6 AA alkaline batteries

The specifications in the following sections refer to the standard software builds of the CW85. The performance and specification of the CW85 can be modified with the use of customized software builds.

① Please refer to section 4.1 NMEA Configuration Details for information on other available NMEA messages and output rates that are user configurable.

# 2 SPECIFICATION

## 2.1 Performance

**GPS RECEIVER SPECIFICATIONS**

| | | |
|---|---|---|
| Physical | Max Velocity / Altitude | 515ms$^{-1}$ / 18,000m (increased rating version available subject to export license) |
| | Max Acceleration / Jerk | 4g / 1gs$^{-1}$ (sustained for less than 5 seconds) |
| Sensitivity | Acquisition/Tracking | -173dBW / -185dBW |
| | Acquisition TIme(Outdoor) | Cold: <60s<br>Warm: <45s<br>Hot: <2s<br>Re-acquisition: <0.5s (90%confidence) |
| Accuracy | Position: Outdoor / Indoor | <5m rms / <50m rms |
| | Velocity | <0.05ms-1 |
| | Latency | <200ms |
| | Raw Measurement Accuracy | Pseudorange <0.3m rms, Carrier phase <5mm rms |
| | Tracking | Code and carrier coherent |
| General | Receiver Type | 12 Parallel Channel x 32 taps up to 32 pointFFT. Channels, taps, and FFT can be switched off to minimize power or simulate simpler designs. |
| | Processor | ARM 966E-S on a 0.18µ process at 96MHz. |
| | User Memory | 64K loaded from 24K on module EEPROM or external EEPROM. |
| **GENERAL SPECIFICATIONS** | | |
| | Power (Avg.) | 1.7W |
| | Recommended Batteries | 6 AA Alkaline Batteries |
| | Minimum Transmission on Recommended Batteries | 4 Hours |
| | Minimum Voltage In | 4.0 V |
| | Maximum Voltage In | 9.6V |
| | Operating Temp Range (w/o Batteries) | TBD |
| | Shock/Vibration | TBD |
| | GPS Fix Rate | Once per 1.024 sec |
| | Wireless Transmission Rate | Once per 1.024 sec |
| Antenna Requirements | | |
| | 802.11b Antenna | 50Ω, Reverse SMA connector |
| | GPS Antenna | Internal Antenna Provided |

Table 3 CW85 Specification

## 2 SPECIFICATION continued

### 2.2 Transmission Distances

Estimation of maximum transmission distance on 802.11b signal versus transmission rate:

| | Open Plan Building | Semi Open Office | Closed Office |
|---|---|---|---|
| 11 Mbps | 160 m (525 ft) | 50 m (165 ft) | 25 m (80 ft) |
| 5.5 Mbps | 270 m (855 ft) | 70 m (230 ft) | 35 m (115 ft) |
| 2.0 Mbps | 400 m (1300 ft) | 90 m (300 ft) | 40 m (130 ft) |
| 1.0 Mbps | 550 m (1750 ft) | 115 m (375 ft) | 50 m (165 ft) |

To give the longest possible transmission range, the CW85 is pre-configured to transmit at 1.0 Mbps.

**Table 4 CW85 Transmission Distance**

### 2.3 Block Diagram

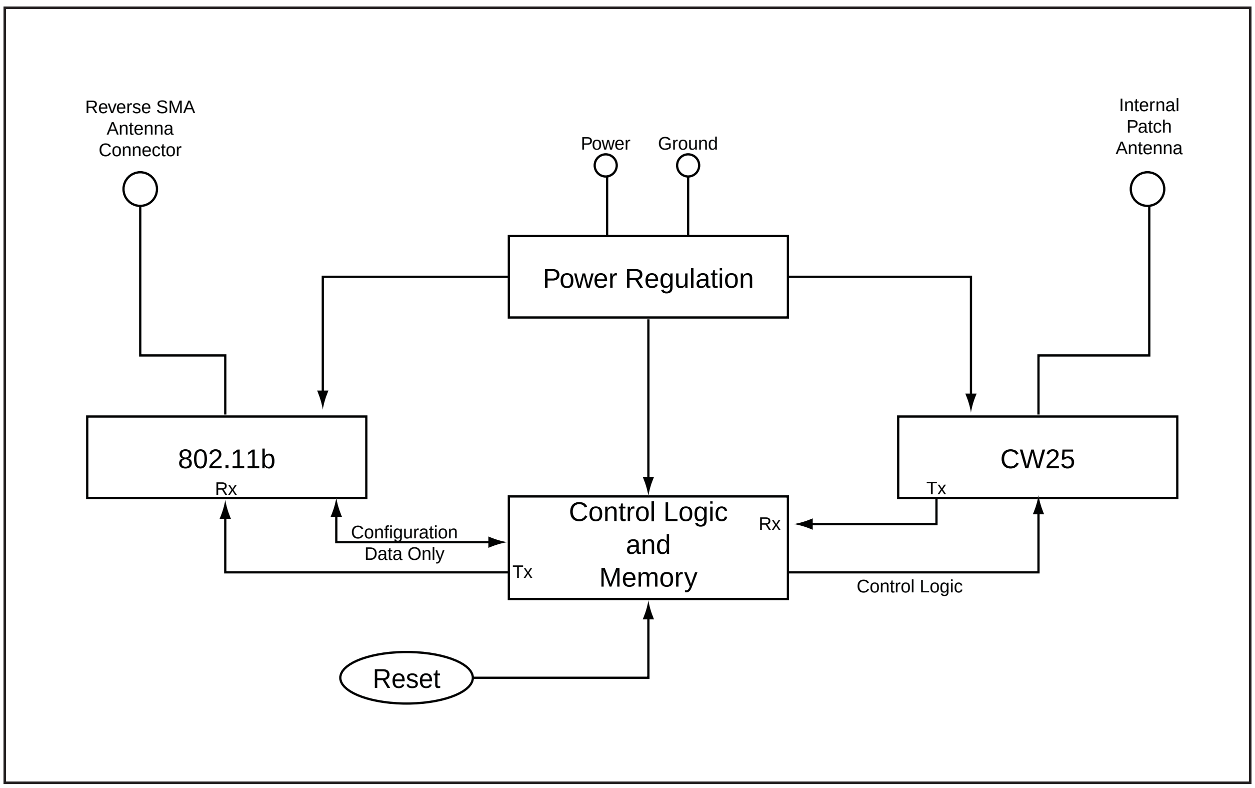
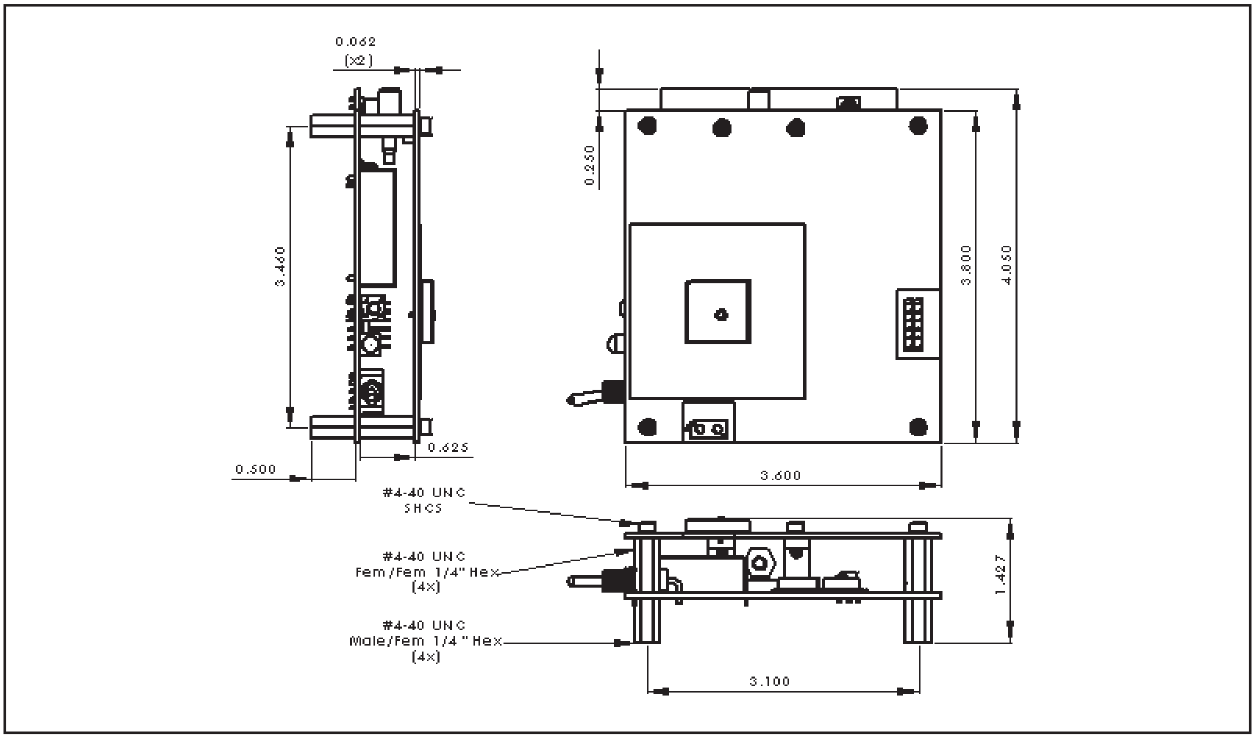



**Figure 1 CW85 Block Diagram**

## 2.4 Mechanical Dimensions




* No antenna is shown as various 50Ω, Reverse SMA antennas may be used with this device.

**Figure 2 CW85 Dimensions**

## 2.5 Power Connection

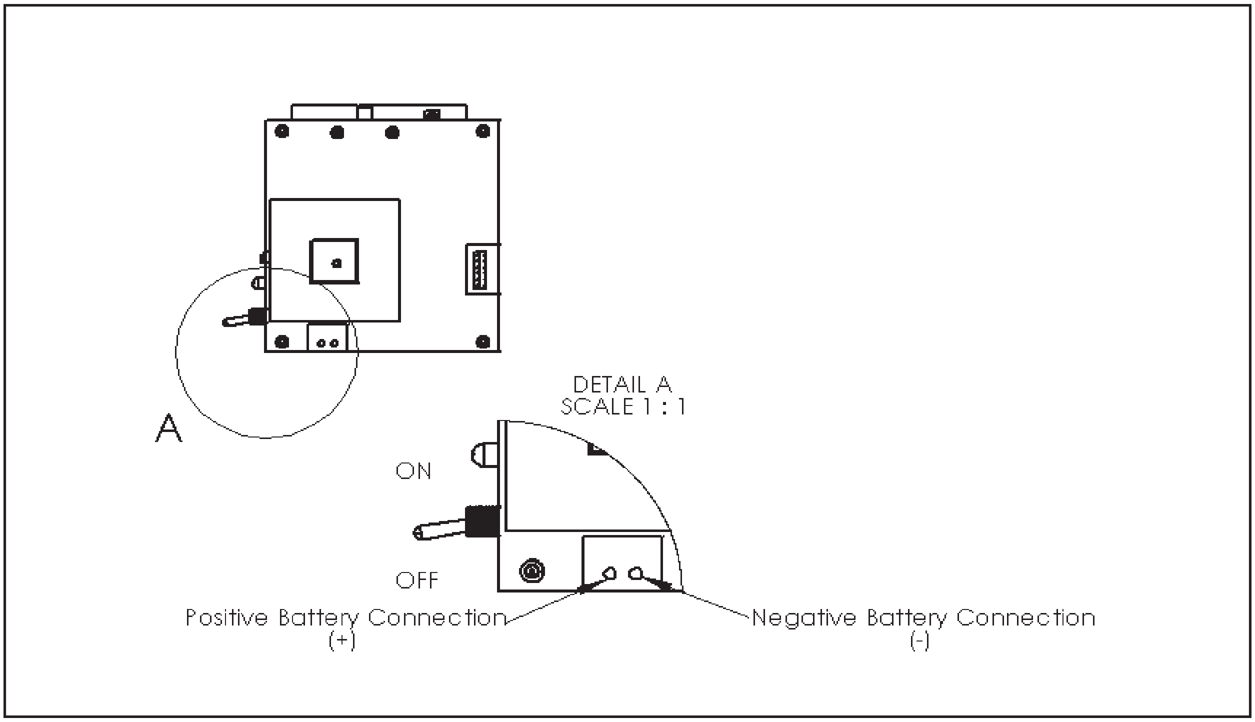



**Figure 3 External Battery Connection**

# 3 DEVICE CONFIGURATION

## 3.1 General Information

The device may be configured through the configuration menu, which is accessed through a telnet session, or through WEB-Manager. To access either of these, they must be enabled in the following manner:

Approximately 40 seconds are required for the device to initialize; the LED blinks approximately once per second after the device fully initializes. Pressing the reset button will cause the LED to turn off, and the device will reset to its specified default state, and will enable telnet and WEB-Manager (which are disabled at all other times). This process takes approximately a minute to complete, and the LED will come on steadily when the process is finished.

The default 802.11 network settings of the CW85 are as follows:

Topology: Infrastructure Mode
Source IP: DHCP client. If no DHCP server is found, the device sets its own IP address in the Class B range 169.254.0.1 to 169.254.255.254, with a subnet of 255.255.0.0.
Source Port: 10001
Network SSID: LTRX_IBSS
Data Rate: 1 Mbps
WEP/WPA Security: NONE
Packet type: UDP
Destination IP: 0.0.0.0
Destination Port: 0

At this point, WEB-Manager can be accessed via a web browser using the IP address of the unit, or the configuration menu can be accessed by using telnet to port 9999 of the unit.

Details about configuration using Telnet are found in Section 3.1, while details on configuration using WebManager are found in Section 3.2.

If the assigned IP address of the unit is not easy to determine, or if a DHCP server is not available on the network, a utility from Lantronix called DeviceInstaller can be used to determine/set the IP of the device. It also has a interface that can telnet into Port 9999 or launch WebManager. It can be downloaded at:
http://www.lantronix.com/device-networking/utilities-tools/device-installer.html

Please note that the SSID of the device needs to match that of the wireless network DeviceInstaller is used in or the devices cannot be seen. Also, the device will show up as WiPort on the network, not CW85. The Lantronix WiPort is contained inside of the CW85 and controls the wireless networking of the device. See section 3.3 for further details about DeviceInstaller.

Once the IP address is known/assigned, the destination IP and port need to be assigned to the proper location on your nework. Additionally, encryption can be enabled, the data rate can be changed, and the topology can be changed from infrastructure to AD-HOC, if desired.

Following configuration of either of the above methods, press the reset button again. This will cause the access to either configuration method to be disabled, and will reinitialize the unit. This process will take about a minute, and the LED will turn off while this occurs. After the process is finished, the LED will begin blinking approximately once per second and the CW85 will resume its normal operation.

## 3.2 Configuration Via Telnet

Setup menu and options:

After a telnet session is opened with port 9999 on the device, a similar message to the following should be received:

MAC address 00204AFFFF30
Software version V6.0.0.0 (050214)
Press Enter to go into Setup Mode

Press Enter within 5 seconds or the connection will auto-terminate. If the connection terminates, simply telnet into the device again. Once Enter is pressed, the setup menu should be displayed:

Change Setup:
0 Server
1 Channel 1
2 Channel 2
3 Email
4 WLAN
5 Expert
6 Security
7 Defaults
8 Exit without save
9 Save and exit
Your choice ?

To specify network settings, you may need to access option 0, option 1, and/or option 4. The default setting for each option is displayed in parenthesis. To retain the default value, press 'ENTER'.

Under Option 0, you will get the following options:
IP Address : ( 0) ( 0) ( 0) ( 0) _
Set Gateway IP Address (N) ? Y
Gateway IP addr ( 0) ( 0) ( 0) ( 0)_
Netmask: Number of Bits for Host Part (0=default) (0) _
Change telnet config password (N) ? _
Change DHCP device name (not set) ? (N) Y
Enter new DHCP device name : (not set)

You may change the IP address, Gateway IP address, and Netmask. An example IP setting would be 192.168.1.101 for the IP address, 192.168.1.1 for the Gateway, and 255.255.255.0 for the Netmask (this Netmask would be set by typing 8 into the menu above to signify 8 bits for the host portion of the address). To enable the DHCP client, set the IP address to 0.0.0.0 and the netmask to 0.

Under Option 1, you will get these options:
Baudrate (9600) ? _

I/F Mode (4C) ? _
Flow (0) ? _
Port No (10001) ? _
ConnectMode (0C) ? _
Datagram Type (01)?_
Remote IP Address : ( 0) ( 0) ( 0) ( 0)_
Remote Port ( 0) ? _
Pack Cntrl( 00) ? _
SendChar 1 ( 0) ? _
SendChar 2 ( 0) ? _

You may change the Port number (which is the source port for UDP packets that are outgoing), Remote IP Address, and Remote Port. The Remote IP Address and Port are the destination address and port for the outgoing UDP packets. Changing other options may cause the device to fail to operate.

Selecting menu option 4 gives you the following choices:
Enable WLAN (Y) ? _
Topology 0=Infrastructure, 1=Adhoc (0) ?
Network name (LTRX_IBSS) ? _
Security 0=none, 1=WEP, 2=WPA (0) ? _
If WEP security is selected, then the following options are displayed:

Authentication 0=open/none, 1=shared
Encryption 0=WEP64, 1=WPE128 (0) ?
Display current key (N) ?
Change key (N) ?
Key type 0=hex, 1=passphrase (0) ?
Enter key:

IF WPA security is selected, then the following options are displayed:

Allow WEP group keys (N) ?
Display current key (N) ?
Change key (N) ?
Key type 0=hex, 1=passphrase (1) ?
Enter key: () ?

Please note that WPA security is available in infrastructure mode only.

Data rate 0=Fixed, 1= Auto (0)?
Data rate 0=1, 1=2, 2=5.5, 3=11 Mbps(0) ?
Enable power management (N) ? _

The options that may be modified in this menu are Topology, Network Name, Channel, Security and Data Rate.

Topology can be selected as infrastructure, which would be used if connecting to Access Points, or ADHOC, which would be used for peer-to-peer connections.

Network name may be modified to fit your SSID.

Channel number must be appropriate for the country the device is used in. This is the channel that the device will create a network in IF it cannot detect a pre-existing specified network.

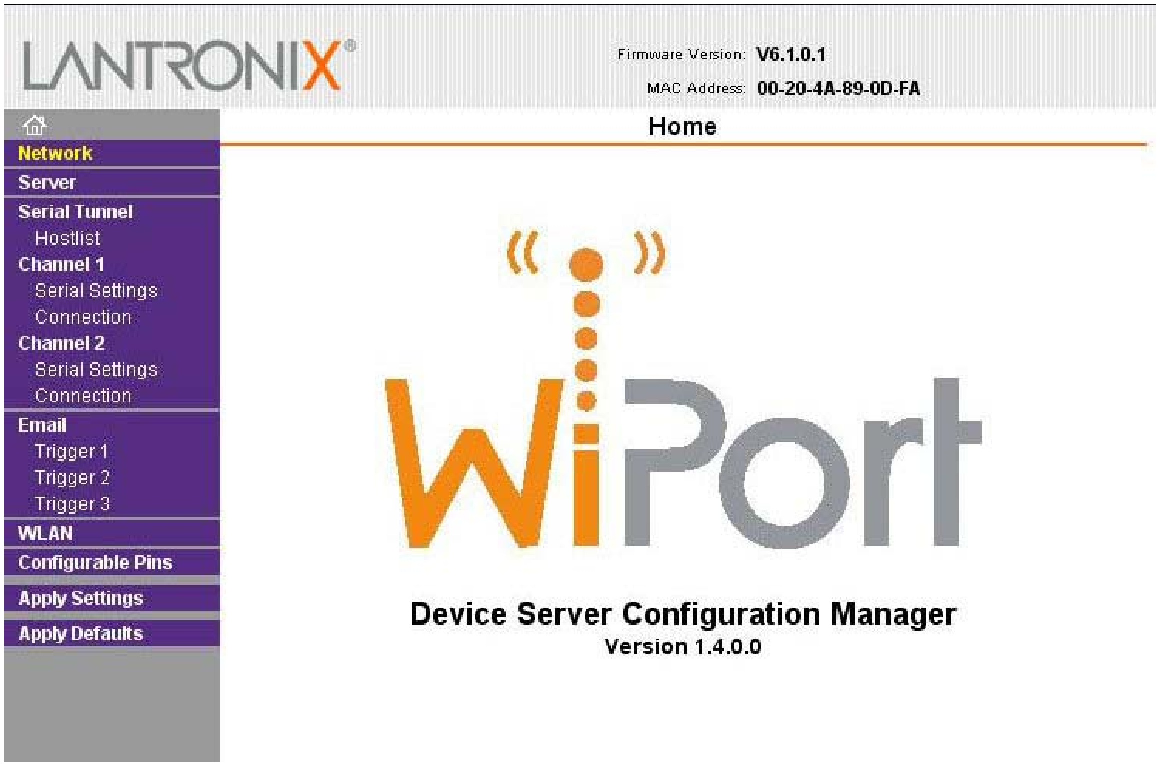
Any data rate may be chosen, but a slower data rate, in general, corresponds to a longer transmission radius.

Changing options other than those specifically mentioned could result in an unusable device.

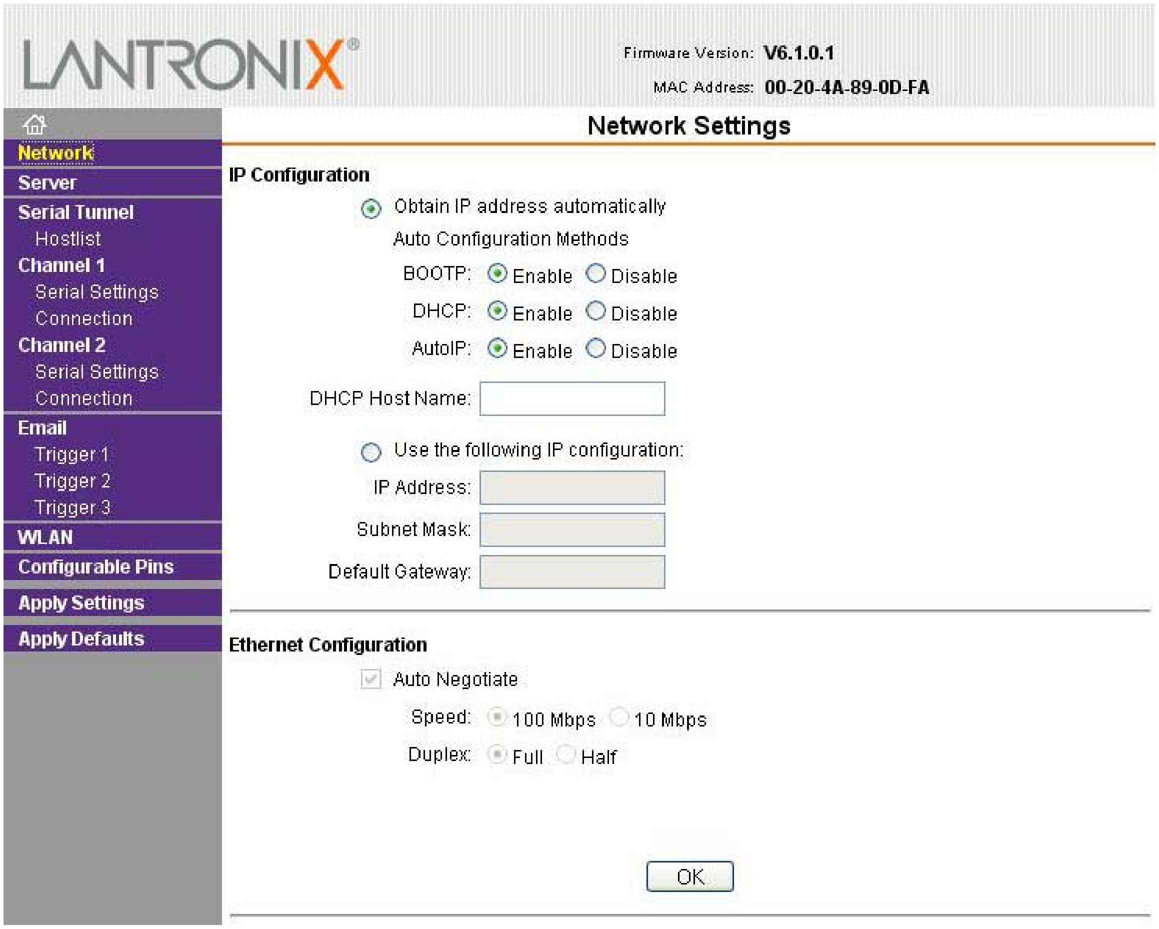
## 3.3 Configuration via WebManager

Once the IP address of the CW85 is known and the device has been placed in configuration mode by pressing the reset button, the WebManager is accessed by typing the IP address of the unit into the web address space of your internet browser (please note that the device will need to have an IP address valid on your local network). A pop-up asking for login and password will appear, just press OK.

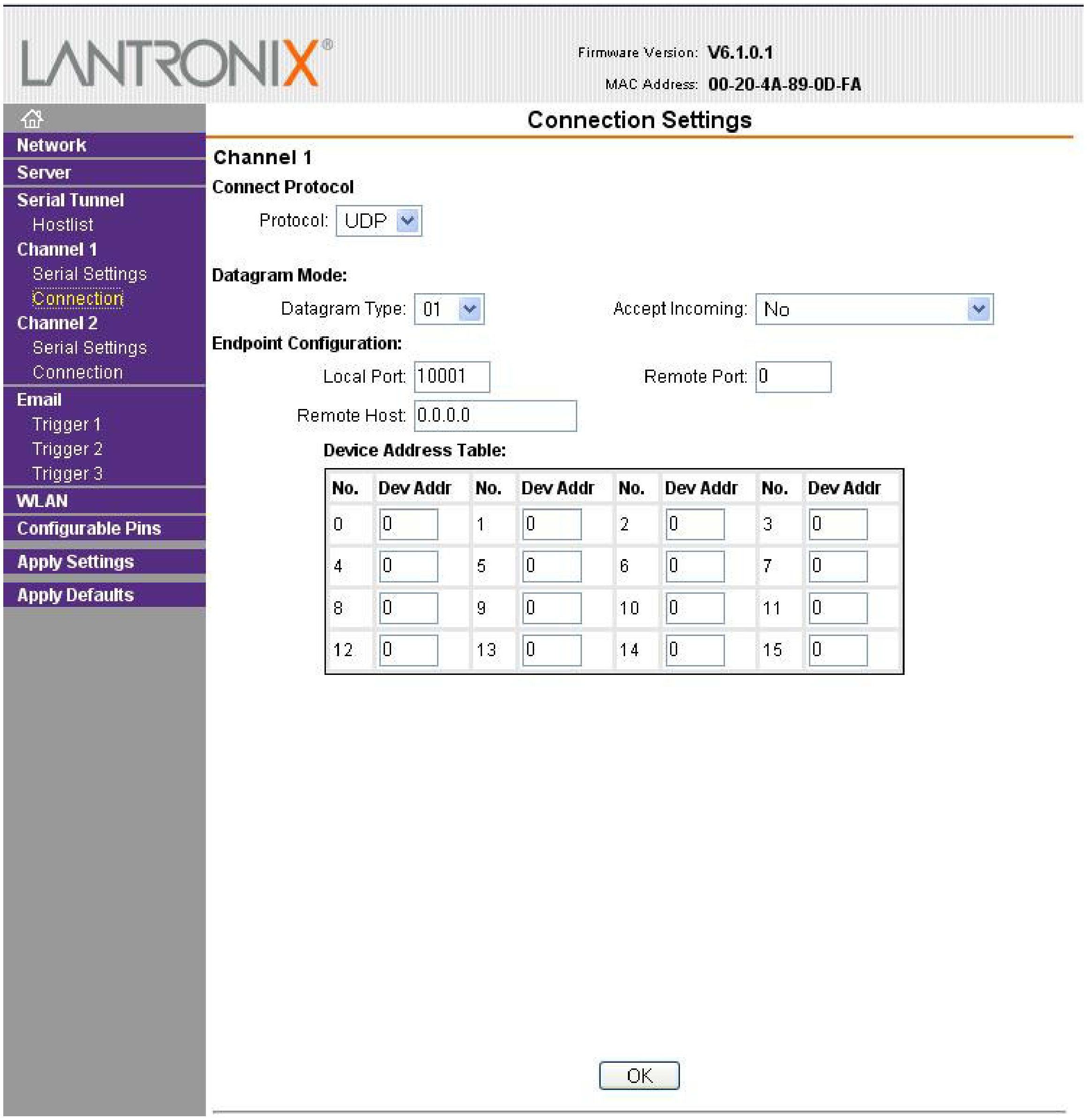
The following webpage will appear:



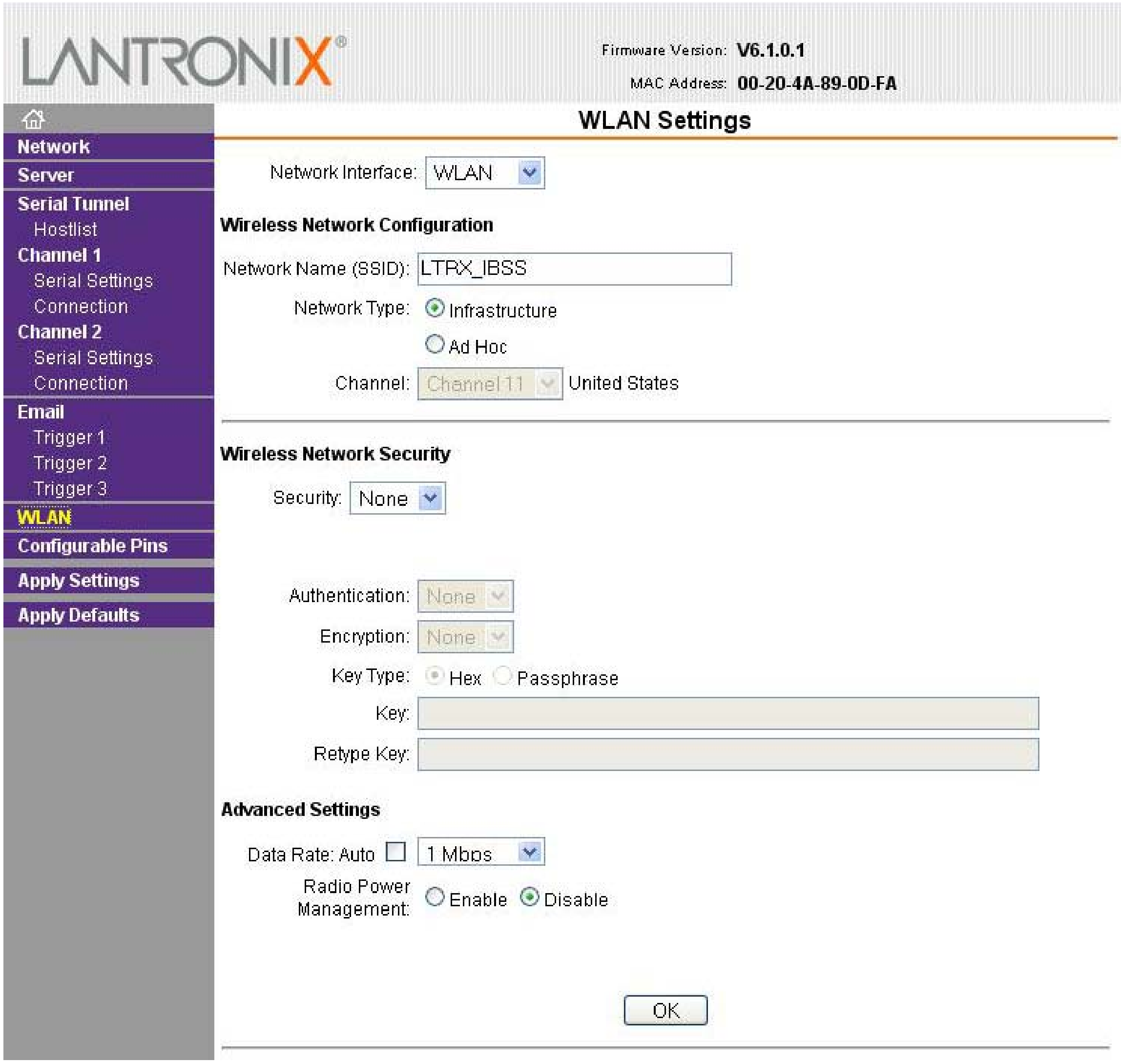
From the left-hand menu, you may need to configure Network, Channel 1 connection, and WLAN. The Network settings may already be set to your desired network, but if not, you may change the IP address of the unit in this section.



The Channel 1 connection contains the IP address and Port that you wish to transmit data to. You will want to fill in this information only.



The WLAN settings contain the SSID, encryption, and data transmission rate. You may adjust any of these parameters to fit your individual network.



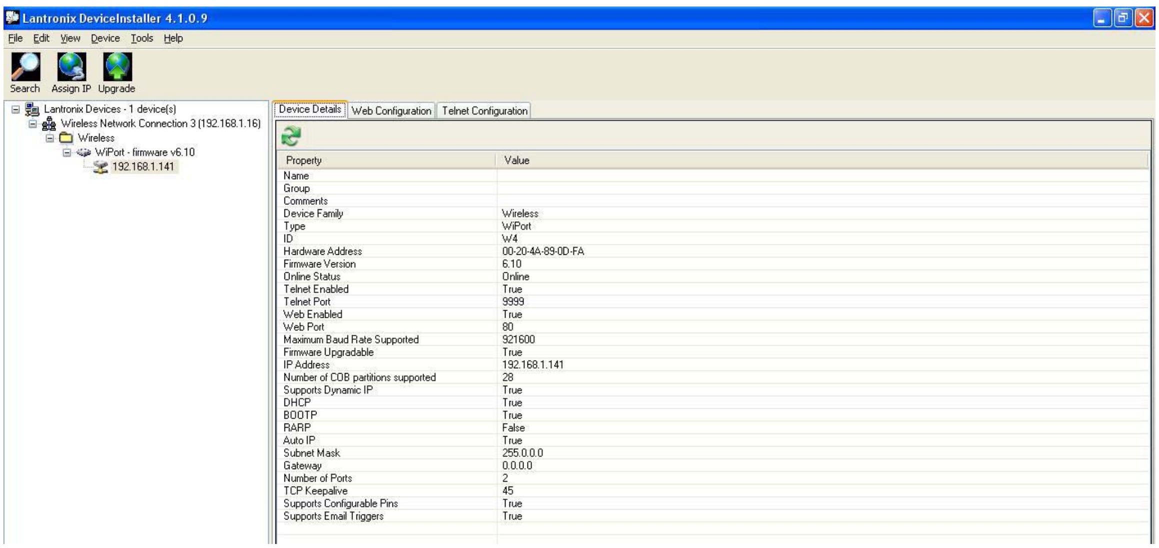

Please make sure to click the OK button at the bottom of each respective page to save any information you have entered, and please click "Apply Settings" in the left hand menu when you have finished your configuration. This will cause the unit to reboot.

Press the reset button on the CW85 once the wireless configuration is complete to resume normal operation. Please note that it will take approximately one minute to resume normal operation, at which point the LED will begin blinking.

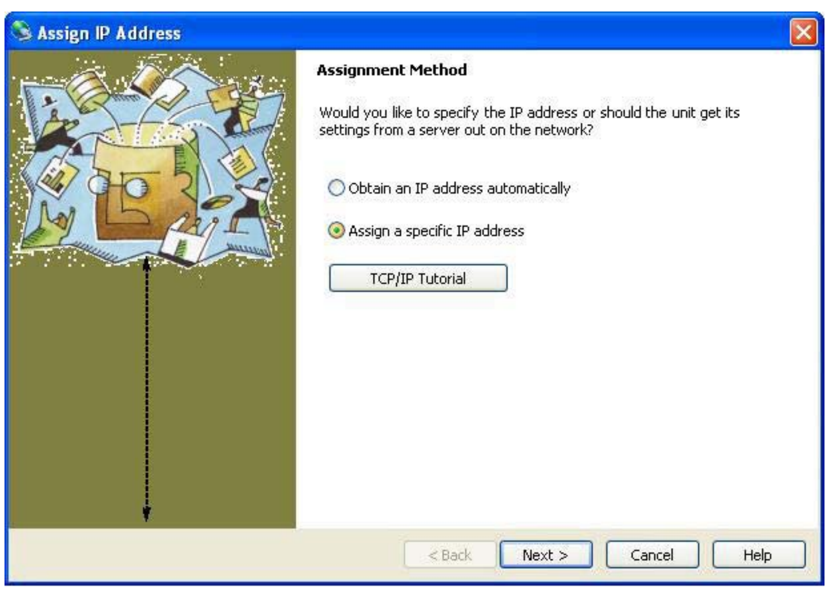
## 3.4 Configuration via Device Installer

DeviceInstaller is a convenient utility to use to determine the IP or to set the IP of your CW85. Load the software onto any computer in your wireless network. After launching the application, press the “search” button to locate any Lantronix devices on your network (Lantronix is the manufacturer of the embedded wireless device inside the CW85).

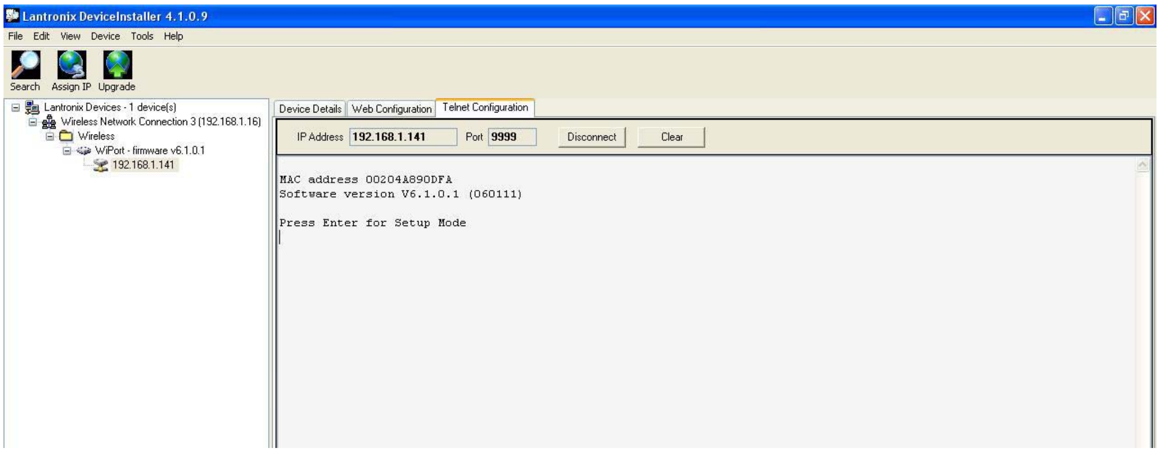
If an IP address on your network has already been assigned to the device, it will show up under the Network in the “Wireless” folder, under WiPort. Clicking on the device IP address will allow some of its internal parameters to be read.




If the device has not yet received an IP address, it will assign itself an address in the 169.254.xxx.xxx address range, with a Class B subnet. Select the device by clicking on the IP, and the option to “Assign IP” will be available on the top menu.



Once the IP has been successfully set, the DeviceInstaller utility can be used to access port 9999 on the device, or to launch WebManager.  The tabs for each of these are on the right hand window (Web Configuration or Telnet Configuration tabs).




Please see section 3.1 for Telnet access or section 3.2 for WebManager access.

# 4 COMMAND REFERENCE

## 4.1 Command Format

Once a UDP connection has been established, it is a bi-directional communication channel with the CW85. The CW85 will accept commands via this connection that can alter both the NMEA output messages, and internal parameters that can affect the GPS fix quality. The Navsync CW85 has a unique set of proprietary commands.

The commands to the unit have the following general formats:
$PRTHS,<id>,<msg fields><cr><lf>
$PRTHQ,<id>,<msg fields><cr><lf>

The commands from the unit have the following general format:
$PRTHR,<id>,<msg fields>[*<checksum>]<cr><lf>

| Field | Description |
|---|---|
| PRTHS | Requires the CW85 receiver to Set system settings. |
| PRTHQ | Query command to the CW85 receiver. |
| PRTHR | Response to a $PRTHQ or an acknowledgement of a $PRTHS. |
| <id> | 4 character command identifier. |
| <msg fields> | Message fields for the message and are all positional. Optional or unknown fields are shown as nulls (ie adjacent commas). Trailing commas to the end of a message (ie nothing but null message fields)are not required. |
| *<checksum> | A checksum byte for checking accuracy defined as follows: The checksum is displayed as a pair of ASCII characters, (0-9 and A-F inclu sive) whose value represents the hexadecimal value of the checksum byte. When used, it always appears as the last field of the sentence and is prefixed by field delimiter “*” (HEX 2A) instead of “,” and followed by <CR><LF> (HEX 0D 0A). The checksum value is calculated by XOR’ing (exclusive OR’ing also known as Modulo 2 Sum) the 8 binary data bits of each valid data charac ter in the sentence between the “$” (HEX 24) and “*” (HEX 2A) characters. The “$” (HEX 24)and the “*” (HEX 2A) characters are not included in the checksum. |
| <cr><lf> | The ASCII codes 0Dh and 0Ah (carriage return and line feed respectively. |

Null fields within a command shall be interpreted as “use current value” where appropriate. Null fields must be delimited by adjacent commas when they exist between two non-null fields. If all trailing fields after a given field are null, further commas are not required.

## 4.2 NMEA Configuration Details

**Purpose**

The NMEA output can be configured for different transmission rates and content. The transmission rates are based on the 1.024 second update rate. The content may include any or all of the NMEA messages listed in the chart below.

**Query Format**

$PRTHQ,U1OP<cr><lf>
A query into the CW85 will return a response string (see below) with the current device settings.

## 4.2 NMEA Configuration Details continued

**Set Format**

$PRTHS,U1OP,{abbrev=rate)<cr><lf>

Sending the output configuration set command will set the response strings and the CW85 will respond with a response string (see below) with the new configuration settings once they are applied.

The command takes the form:

$PRTHS,U1OP,GLL=2,GGA=4,GSV=0<CR><LF>

The remainder of the string is of the form “GLL=1,GSV=4,PLT=1”. The specific contents supported is dependent on the NMEA sentences supported by the system. Only the settings which are to be altered need to be listed. A NMEA checksum of the form “*4D” is appended to the output string. The list of currently supported NMEA sentences are as shown below. To turn a sentence output off completely, simply specify zero as the duration for that command. Subsequent commands may reassign an output period to sentences disabled in this way, effectively re-enabling the output sentence. This command also supports a shortcut by means of an “ALL” specifier. When this is encountered, the period specified is applied to all sentences. An example of this is shown below, where every message output on port 1 will be printed at a 5-second period with the exception of the GPRMC sentence, which will be output every second, and the POLYT sentence, which will be disabled.

$PRTHS,U1OP,ALL=5,RMC=1,PLT=0

If a command is issued which is badly formatted or does not adhere to these constraints, it will be discarded.

**Response / Acknowledge Format**

$PRTHR,U1OP,{abbrev=rate}*<checksum><cr><lf>

An example response string is shown below. In this example, all sentences are output every second, except GPGSV, which is output every three seconds, and POLYT, which is not output at all (i.e. the sentence output is disabled).

$PRTHR,U1OP,GLL=1,RMC=1,VTG=1,GGA=1,GSA=1,GSV=3,PLT=0,PLP=1,PLS=1,PLI=1*0C

The list of currently supported NMEA sentences are shown below, together with the abbreviated name used in the response string.

| Field | Description |
|---|---|
| GLL | GPGLL - Geographic Position - Latitude longitude |
| RMC | GPRMC - Recommended Minimum Specific GNSS Sentence |
| VTG | GPVTG - Course Over Ground and Ground Speed |
| GGA | GPGGA - GPS Fix Data |
| GSA | GPGSA - GNSS DOPS and Active Satellites |
| GSV | GPGSV - GNSS Satellites in View |
| PLT | POLYT - Time |
| PLP | POLYP - Position (Lat, Long) |
| PLS | POLYS - Satellite data |
| PLI | POLYI - Additional Information |
| ALL | Settings will affect all strings |

## 4.3 PRTH<Q|S|R>,DYNA: RECEIVER DYNAMICS

**Purpose**

This message Sets, Queries and Responds to the receiver host dynamics and hence the maximum receiver tracking dynamics expected. The degree of filtering performed by the navigation and timing Kalman filter is dependant on the selected receiver platform.

**Query Format**

$PRTHQ,DYNA<cr><lf>

**Set Format**

$PRTHS,DYNA,*platform*<cr><lf>

**Response / Acknowledge Format**

$PRTHR,DYNA,*platform**<checksum><cr><lf>

| **Field** | **Description** |
|---|---|
| *Platform* | Receiver's platform (integer, range 0 – 10) |
| | 0 = Fixed base station, Timing and Frequency modes etc |
| | 1 = Stationary, but unknown position |
| | 2 = Man pack / walking |
| | 3 = Automotive / Land Vehicle |
| | 4 = Marine |
| | 5 = Airborne, Low dynamics (<1g) |
| | 6 = Airborne, Medium dynamics <2g) |
| | 7 = Airborne, High dynamics (<4g) |
| | 8 = Airborne, Very High dynamics (<8g) |
| | 9 = Drone, Missile dynamics (<16g) |
| | 10 = Pure least squares mode (ie semi-infinite dynamics assumed) |

## 4.4 PRTH<Q|S|R>,RSET: RE-SET THE RECEIVER

**Purpose**

This message Sets, Queries and Responds to a receiver re-set command with optional actions such as clearing specific data groups stored in the CW85 ASIC battery backed memory area, or entering a "sleep" mode. The data areas that can be cleared include satellite almanacs, ephemerides, and
receiver configuration parameters.
Note that "sleep" mode are not currently supported in the CW85 technology. This command invokes a 2 second time out prior to the reset being invoked so that there are two chances (on a 1Hz build) of seeing the acknowledgement message first.

**Query Format**

$PRTHQ,RSET<cr><lf>

**Set Format**

$PRTHS,RSET,{[*option*],[*option*],….}<cr><lf>

## 4.4 PRTH<Q|S|R>,RSET: RE-SET THE RECEIVER contnued

**Response / Acknowledge Format**

$PRTHR,RSET,{[*option*],[*option*],….}*<checksum><cr><lf>

A response option of NO, indicates that no reset command is currently activated.

| **Field** | **Description** |
|---|---|
| *Option* | A list of character descriptors to indicate which, if any, of the optional actions are to be undertaken prior to the software re-set.<br>“CONFIG”=clear the receiver configuration data in battery backed RAM.<br>“EPH” = clear the satellite ephemeris data in battery backed RAM.<br>“ALM” = clear the satellite almanac data in battery backed RAM.<br>“SLEEP” = enter a “sleep” mode, still to be defined.<br>“ALL” = clears all of the above |

## 4.5 PRTH<Q|S|R>,DRLM: DEAD RECKONING LIMIT

**Purpose**

This message Sets, Queries and Responds to the limit for the forward predictive Dead Reckoning, after the last valid fix (epochs). The dead reckoning will progress at constant velocity for the first half of this period and then reduce to a standstill during the second half. Note that since this value has units of epochs, it will have a different effect on a 1Hz CW85 receiver to that on a 2Hz, 5Hz or 10Hz CW85 receivers.

**Query Format**

$PRTHQ,DRLM<cr><lf>

**Set Format**

$PRTHS, DRLM,*DR_Limit*<cr><lf>

**Response / Acknowledge Format**

$PRTHR, DRLM, *DR_Limit**<checksum><cr><lf>

| **Field** | **Description** |
|---|---|
| *DR_Limit* | Number of epochs to dead reckon for (integer, range 0 –32768) |

## 4.6 PRTH<Q|S|R>,ILLH: INITIALIZED LAT, LONG, HEIGHT POSITION

**Purpose**

This message Sets, Queries and Responds to the initialised geodetic position (latitude, longitude, ellipsoidal height and antenna height above the reference marker) in the receiver’s current user datum.

The position RMS accuracy is used to decide how much importance to put on the input values and should be set with care.

**Query Format**

$PRTHQ,ILLH<cr><lf>

## 4.6 PRTH<Q|S|R>,ILLH: INITIALIZED LAT, LONG, HEIGHT POSITION continued

**Set Format**

$PRTHS,ILLH,*LatDeg, LatMin, LatSec, LatH, LonDeg, LonMin, LonSec, LonH, EllHt, AntHt, posRMS* <cr><lf>

**Response / Acknowledge Format**

$PRTHR,ILLH,*LatDeg, LatMin, LatSec, LatH, LonDeg, LonMin, LonSec, LonH, EllHt, AntHt, posRMS**<checksum><cr><lf>

| **Field** | **Description** |
|---|---|
| *LatDeg* | Latitude degrees (floating point, range ±90.0) |
| *LatMin* | Latitude minutes (floating point, range ±59.999999) |
| *LatSec* | Latitude seconds (floating point, range ±59.99999) |
| *LatH* | Latitude hemisphere (char 'N' or 'S') |
| *LonDeg* | Longitude degrees (floating point, range ±90.0) |
| *LonMin* | Longitude minutes (floating point, range ±59.999999) |
| *LonSec* | Longitude seconds (floating point, range ±59.99999) |
| *LonH* | Longitude hemisphere (char 'E' or 'W') |
| *EllHt* | Height of the reference marker above the current user datum reference ellipsoid in metres (floating point, range ±18,000.0) |
| *AntHt* | Height of the antenna phase centre above the reference marker height defined by *EllHt* above in metres (floating point, range ± 18,000.0) |
| *posRMS* | RMS accuracy of the input position (metres) (floating point, range 0 - 999999.0) |

Note that since the Degree, Minutes and Seconds fields will accept floating point values then a decimal degree value, or an integer degree, decimal minute value can be input directly by setting the minutes and seconds fields to zero as appropriate (eg 52.12345678,0,0,N or 52,14.123456,0,N).

## 4.7 PRTH<Q|S|R>,ITIM: INITIALISE TIME AND DATE

**Purpose**

This message Sets, Queries and Responds to the user initialised time and date. Two input options are available, one allowing a calendar date and GMT time to be input and the other a GPS week number and seconds of week. The input date is acted upon regardless and is primarily used to set the GPS week inside the receiver. The time input will not be used if is set to zero, or if the receiver is currently tracking any satellites and therefore already has a good submillisecond knowledge of time. If the time input is not used then the Response message returns the values used or assumed instead of those input. The time RMS accuracy is used to decide how much importance to put on the input values and should be set with care.

**Query Format**

$PRTHQ,ITIM<cr><lf>

**Set Format**

Using a GMT time format

$PRTHS,ITIM,*timeRMS*,GMT,*day,month,year*,[*hours*],[*minutes*],[*seconds*]<cr><lf>

Using a GPS time format

$PRTHS,ITIM,*timeRMS*,GPS,*gps_week*,[*gps_time*]<cr><lf>

## 4.7 PRTH<Q|S|R>,ITIM: INITIALISE TIME AND DATE continued

**Response / Acknowledge Format**

$PRTHR,ITIM,*timeRMS*,GMT,*day,month,year*,*hours*,*minutes*,*seconds*,GPS,*gps_week*,*gps_time**<checksum><cr><lf>

| Field | Description |
|---|---|
| *timeRMS* | RMS accuracy of the input time-tag (seconds) (floating point, range 0 – 999999.0). |
| *day* | day of month (integer, range 1 – 31). |
| *month* | month of year (integer, range 1 – 12). |
| *year* | 4 digit year (integer, range 1980 – 2047). |
| *hours* | hours of day (integer, range 0 – 23). |
| *minutes* | minutes of hour (integer, range 0 – 59). |
| *seconds* | seconds of minute (floating point, range 0 – 59.999). |
| *gps_week* | GPS week number, including pre GPS roll-over weeks, eg. 1037 (integer, range 0 – 32768) |
| *gps_time* | GPS Time of Week in seconds (floating point, range 0.0 –604800.0). |

## 4.8 PRTH<Q|S|R>,MMSV: MIN & MAX SATELLITES FOR A POSITION SOLUTION

**Purpose**

This message Sets, Queries and Responds to the minimum and maximum number of satellites the receiver will use for a position solution. Increasing the minimum number of satellites will improve the accuracy achieved when a sufficient satellites are available, but may reduce the time when a solution can be produced. Reducing the maximum number of satellites may reduce the accuracy of the
position solution, but will decrease the amount of processing power required for the solution.
Note that setting the Maximum satellites to less than 4 will prevent the receiver from performing a 3D position solution. Likewise setting the minimum number of satellites greater than 3 will prevent the receiver performing a 2-D, altitude fixedsolution. The maximum must be greater than or equal to the minimum number of satellites.

**Query Format**

$PRTHQ,MMSV<cr><lf>

**Set Format**

$PRTHS,MMSV,[*min_NSV*],[*max_NSV*]<cr><lf>

**Response / Acknowledge Format**

$PRTHR,MMSV,*min_NSV,max_NSV**<checksum><cr><lf>

| Field | Description |
|---|---|
| *min_NSV* | Minimum Satellites used for a position / time solution (integer, range 0-12) |
| *max_NSV* | Maximum Satellites used for a position / time solution (integer, range 0-12) |

### 4.9 PRTH<Q|S|R>,MCNO: MINIMUM SIGNAL CNO

**Purpose**

This message Sets, Queries and Responds to the satellite tracking minimum signal to noise ratio (C/No) required for inclusion into the navigation solution.

**Query Format**

$PRTHQ,MCNO<cr><lf>

**Set Format**

$PRTHS,MCNO,*min_CNO*<cr><lf>

**Response / Acknowledge Format**

$PRTHR,MCNO,*min_CNO**<checksum><cr><lf>

| Field | Description |
|---|---|
| *min_CNO* | The minimum satellite tracking C/No required for inclusion into the navigation solution (integer, range 0 – 60 dB/Hz). |

### 4.10 PRTH<Q|S|R>,ELVM: SATELLITE ELEVATION MASK

**Purpose**

This message Sets, Queries and Responds to the satellite elevation mask angle below which satellite data will not be used in the navigation and time solution.

**Query Format**

$PRTHQ,ELVM<cr><lf>

**Set Format**

$PRTHS,ELVM,*nvElevMask*<cr><lf>

**Response / Acknowledge Format**

$PRTHR,ELVM,*nvElevMask**<checksum><cr><lf>

| Field | Description |
|---|---|
| *nvElevMask* | The navigation and time solution elevation mask angle in degrees (integer, range 0 –90). |

### 4.11 PRTH<Q|S|R>,COMA: COMA MODE

**Purpose**

This message Sets, Queries and Responds Coma mode. Coma mode puts the receiver to sleep for a predetermined period of time.

**Query Format**

$PRTHQ,COMA<cr><lf>

**Set Format**

$PRTHS,COMA,*Period*<cr><lf>

**Response / Acknowledge Format**

$PRTHR,COMA,*Period**<checksum><cr><lf>

| Field | Description |
|---|---|
| *Period* | The period in milliseconds that the receiver will sleep. |

## Section 5 NMEA Messages

### 5.1 General NMEA Information

By default, the CW85 is configured to output only the GPGLL, Geographic position NMEA message once every 1.024 seconds. However, as noted in Section 4, the output message is configurable (and multiple messages are possible). There are two main types of messages: 'Approved' and 'Proprietary'. All messages start with $, have fields delimited by commas, and end with <CR><LF>. Approved messages are recognized by the first 5 characters after the $, which define both the kind of talker providing the information (2 characters, GP in the case of a GPS), and the type of information (3 characters).

The following Approved messages are available from the CW85:

| Message | Section |
|---|---|
| GPGLL | 5.1 |
| GPRMC | 5.2 |
| GPGVT | 5.3 |
| GPGGA | 5.4 |
| GPGSA | 5.5 |
| GPGSV | 5.6 |

Proprietary messages are indicated by a P following the $, with the next 3 characters indicating the manufacturer (from a listing of mnemonic codes), and the 5th character being selected by that manufacturer for the particular sentence structure. Proprietary messages must conform with the general NMEA structures, but are otherwise undefined outside of the manufacturer's own documentation.

The following Proprietary messages are available from the CW85:

| Message | Section |
|---|---|
| POLYT | 5.7 |
| POLYP | 5.8 |
| POLYS | 5.9 |
| POLYI | 5.10 |

## Approved NMEA messages

### 5.2 GPGLL, Geographic position, Lat/Lon.

Latitude and longitude, with time of position fix and status.
$*GPGLL, Latitude,N,Longitude,E,hhmmss.sss,Status,Mode*cs*

| Field | Description |
|---|---|
| $GPGLL | NMEA sentence header (Position Data) |
| Latitude | User datum latitude degrees, minutes, decimal minutes format (ddmm.mmmmmm) |
| N | Hemisphere: 'N'= North, 'S' = South |
| Longitude | User datum longitude degrees, minutes, decimal minutes format (dddmm.mmmmmm) |
| E | Longitude Direction: 'E'= East, 'W'= West |
| hhmmss.sss | UTC Time in hours, minutes, seconds.and decimal second format. |
| Status | Status: V=navigation receiver warning, A=data valid |
| Mode | Mode Indicator:<br>D = Valid, Differential<br>A = Valid, Autonomous<br>E = Invalid, Estimated<br>N = Invalid, Not Valid |
| cs | Message checksum in hexadecimal |

## 5.3 GPRMC, Recommended Minimum data.

The 'Recommended Minimum' sentence defined by NMEA for GPS/Transit system data..
$GPRMC,hhmmss.sss,status,latitude,Hemisphere,longitude,E,spd,cmg,ddmmyy,mv,mvd,Mode*cs

| **Field** | **Description** |
|---|---|
| $GPRMC | NMEA sentence header (Recommended Minimum Sentence) |
| hhmmss.sss | UTC Time in hours, minutes, seconds. |
| status | Status: V=navigation receiver warning, A=data valid |
| Latitude | User datum latitude degrees, minutes, decimal minutes format (ddmm.mmmmmm) |
| N | Hemisphere: 'N'= North, 'S' = South |
| Longitude | User datum longitude degrees, minutes, decimal minutes format (dddmm.mmmmmm) |
| E | Longitude Direction: 'E'= East, 'W'= West |
| spd | Speed over ground (knots) |
| cmg | Course made good |
| ddmmyy | Date in Day, Month, Year format |
| mv | Magnetic variation |
| mvd | Magnetic variation direction |
| Mode | Mode Indicator:<br>D = Valid, Differential<br>A = Valid, Autonomous<br>E = Invalid, Estimated<br>N = Invalid, Not Valid |
| cs | Message checksum in hexadecimal |

## 5.4 GPVTG, Course over ground and Ground speed.

Velocity is given as Course over Ground (COG) and Ground Speed
$GPVTG,cogt,T,cogm ,M ,knots,N,kph,K,Mode*cs

| **Field** | **Description** |
|---|---|
| $GPVTG | NMEA sentence header (Speed and heading) |
| cogt | Course over ground (true) |
| T | True - fixed field |
| cogm | Course over ground (magnetic) |
| M | Magnetic - fixed field |
| knots | Speed over ground (knots) |
| N | Knots - fixed field |
| kph | Speed over ground (kph) |
| K | Kilometers per hour – fixed field |
| Mode | Mode Indicator:<br>D = Valid, Differential<br>A = Valid, Autonomous<br>E = Invalid, Estimated<br>N = Invalid, Not Valid |
| cs | Message checksum in hexadecimal |

## 5.5 GPGGA, GPS fix data.

Time and position, together with GPS fixing related data.

$GPGGA,hhmmss.sss,Latitude,N,Longitude,E,FS,NoSV,HDOP,Altref,M,msl,M,DiffAge,DiffStation*cs

| Field | Description |
|---|---|
| $GPGGA | NMEA sentence header (Position Data) |
| hhmmss.sss | UTC Time in hours, minutes, seconds. and decimal second format. |
| Latitude | User datum latitude degrees, minutes, decimal minutes format (ddmm.mmmmmm) |
| N | Hemisphere: ‘N’= North, ‘S’ = South |
| Longitude | User datum longitude degrees, minutes, decimal minutes format (dddmm.mmmmmm) |
| E | Longitude Direction: ‘E’= East, ‘W’ = West |
| FS | Fix Status:<br>0 No fix<br>1 Standard GPS<br>2 Differential GPS |
| NoSv | Number of satellites used in the position solution |
| HDOP | 2-D Horizontal Dilution of Precision (0.00 to 99.99) |
| AltRef | Altitude (meters) above user datum ellipsoid. |
| M | Units of height (meters) |
| msl | Mean Sea Level |
| M | Units of Mean Sea Level (meters) |
| DiffAge | Age of differential correction |
| DiffStation | Differential base station ID |
| cs | Message checksum in hexadecimal |

## 5.6 GPGSA, GPS DOP and Active satellites.

GPS receiver operating mode, satellites used for navigation, and DOP values.

$*GPGSA*,Smode,FS,sv,sv,sv,sv,,,,,,,,PDOP,HDOP,VDOP*cs

| Field | Description |
|---|---|
| $GPGSA | NMEA sentence header (Satellite Data) |
| Smode | A= Automatic switching 2D/3D; M=Manually fixed 2D/3D |
| FS | Fix Status:<br>1 No fix<br>2 2D GPS Fix<br>3 3D GPS Fix |

| | |
|---|---|
| sv | Satellites in use, null for unused fields (12 available fields) |
| PDOP | 3-D Position Dilution of Precision (0.00 to 99.99) |
| HDOP | 2-D Horizontal Dilution of Precision (0.00 to 99.99) |
| VDOP | Vertical Dilution of Precision (00.0 to 99.9). |
| cs | Message checksum in hexadecimal |

### 5.7 GPGSV, GPS Satellites in View.

The number of satellites in view, together with each PRN, elevation and azimuth, and C/No value. Up to four satellite details are transmitted in one message, with up to three messages used as indicated in the first field.

$GPGSV, NoMsg, MsgNo, NoSv{,sv,elv,az,cno}{,sv,elv,az,cno}{,sv,elv,az,cno}{,sv,elv,az,cno}*cs

Note: {} designate optional sections that appear only if there is satellite data.

| Field | Description |
|---|---|
| $GPGSV | NMEA sentence header (Satellite Data) |
| NoMsg | Total number of GPGSV messages being output |
| MsgNo | Number of this message |
| NoSv | Number of satellites in view |
| sv | Satellites ID |
| elv | Satellite elevation angle (degrees) |
| az | Satellite azimuth angle (degrees) |
| cno | Satellite signal/Noise ration (dB/Hz) |
| cs | Message checksum in hexadecimal |

## Proprietary NMEA Messages

### 5.8 POLYT, Time of Day

$POLYT,hhmmss.sss,ddmmyy,UTC_TOW,week,GPS_TOW,Clk_B,Clk_D,PG,BLANK,BLANK,BLANK,BLANK*cs

| Field | Description |
|---|---|
| $POLYT | Navsync Proprietary NMEA sentence header (Position Data) |
| hhmmss.sss | UTC Time in hours, minutes, seconds.and decimal seconds format. |
| ddmmyy | Date in day, month, year format. |
| UTC_TOW | UTC Time of Week (seconds with microseconds resolution) |
| week | GPS week number (continues beyond 1023) |
| GPS_TOW | GPS Time of Week (seconds with microseconds resolution) |
| Clk_B | Receiver clock Bias (nanoseconds) |
| Clk_D | Receiver clock Drift (nanoseconds/second) |
| PG | 1PPS Granularity (nanoseconds) |
| BLANK | Reserved for future use |
| BLANK | Reserved for future use |
| BLANK | Reserved for future use |
| BLANK | Reserved for future use |
| cs | Message checksum in hexadecimal |

### 5.9 POLYP, Position Data

$POLYP,hhmmss.sss,Latitude,N,Longitude,E,AltRef,FS,Hacc,Vacc,SOG,COG,Vvel,ageC,HDOP,VDOP,
PDOP,GDOP,TDOP,GU,RU,DR *cs

| Field | Description |
|---|---|
| $POLYP | Navsync Proprietary NMEA sentence header (Position Data) |
| hhmmss.sss | UTC Time in hours, minutes, seconds, and decimal seconds format. |
| Latitude | User datum latitude degrees, minutes, decimal minutes format (ddmm.mmmmmm) |
| N | Hemisphere: ‘N’ = North, ‘S’ = South |
| Longitude | User datum longitude degrees, minutes, decimal minutes format (dddmm.mmmmmm) |
| E | Longitude Direction: ‘E’ = East, ‘W’ = West |
| AltRef | Altitude (meters) above user datum ellipsoid. |
| FS | Fix Status:<br>NF = No Fix<br>DR = Predictive Dead Reckoning solution<br>DA = Predictive Dead Reckoning solution with DR aiding<br>G1 = Partial GPS solution with DR aiding<br>G2 = Stand alone 2D solution<br>G3 = Stand alone 3D solution<br>D1 = Partial Differential GPS solution with DR aiding<br>D2 = Differential 2D solution<br>D3 = Differential 3D solution |

| | |
|---|---|
| Hacc | Horizontal (2 sigma) accuracy estimates (0 to 99999 meters) |
| Vacc | Vertical (2 sigma) accuracy estimates (0 to 99999 meters) |
| SOG | Speed Over Ground (knots) (0.000 to 999.999 knots) |
| COG | Course Over Ground (true) in degrees (0.00 to 359.99 degrees) |
| V_vel | Vertical (positive Up) velocity (m/s) (0.000 to 999.999 m/s) Hemisphere |
| ageC | Age of most recent DGPS Corrections applied (seconds).<br>(00.00 to 99.99 = none available) |
| HDOP | 2-D Horizontal Dilution of Precision (00.00 to 99.99) |
| VDOP | Vertical Dilution of Precision (00.00 to 99.99). |
| PDOP | 3-D Position Dilution of Precision (00.00 to 99.99) |
| GDOP | 4-D Geometric Dilution of Precision (00.00 to 99.99) |
| TDOP | Time Dilution of Precision (00.00 to 99.99) |
| GU | Number of GPS satellites used in the navigation solution |
| RU | Number of GLONASS satellites used in the navigation solution |
| DR | Dead Reckoning aiding status bits (in ASCII Hex)<br>bit 0 - Altitude Position Aiding applied<br>bit 1 - Vertical Velocity Aiding applied<br>bit 2 - (GPS-GLONASS) time difference aiding applied<br>bit 3 - External Distance travelled input used<br>bit 4 - External Speed input used<br>bit 5 - External Track input used<br>bit 6 - External Delta-Track input used.<br>bit 7-8 Reserved for future use |
| cs | Message checksum in hexadecimal |

## 5.10 POLYS, Satellite Status

$POLYS,GT{,ID,s,AZM,EL,SN,LK}{,ID,s,AZM,EL,SN,LK}{,ID,s,AZM,EL,SN,LK}{,ID,s,AZM,EL,SN,LK}
{,ID,s,AZM,EL,SN,LK}{,ID,s,AZM,EL,SN,LK}{,ID,s,AZM,EL,SN,LK}{,ID,s ,AZM,EL,SN,LK}
{,ID,s,AZM,EL,SN,LK}{,ID,s,AZM,EL,SN,LK}{,ID,s,AZM,EL,SN,LK}{,ID,s,AZM,EL,SN,LK}*cs

Note: {} designate optional sections that appear only if there is satellite data.

| Field | Description |
|---|---|
| $POLYS | Navsync Proprietary NMEA sentence header (Satellite Data) |
| GT | Number of GPS satellites tracked |
| ID | Satellite PRN number (1-32) |
| s | Satellite status<br>- = not used<br>U = used in solution<br>e = available for use, but no ephemeris |
| AZM | Satellite azimuth angle (range 000 - 359 degrees) |
| EL | Satellite elevation angle (range 00 - 90 degrees) |
| SN | Signal to noise ratio in (range 0 - 55 dB/Hz) |
| LK | Satellite carrier lock count (range 0 - 255 seconds)<br>0 = code lock only<br>255 = lock for 255 or more seconds |
| cs | Message checksum in hexadecimal |

## 5.11 POLYI, Additional Information Message

$POLYI,JN,jammer,EXT{,efields},INT{,ifields},BLANK*cs

Note: More than one {efield} or {ifield} may be present, each separated by commas

| **Field** | **Description** |
|---|---|
| $POLYI | Navsync Proprietary NMEA sentence header (Additional Information) |
| JN | Fixed descriptor field |
| jammer | Detected Jammer to Noise Ratio [dB/Hz] |
| EXT | Fixed descriptor field, indicates the use of externally provided ancillary measurements e.g. received from Network Assistance. All comma separated fields following, up to the INT field descriptor, are externally provided measurements |
| efields | DIFF = Differential Inputs<br>TSYNC = Time synchronisation<br>CLKB = Clock Bias<br>FREQ = Frequency (of reference oscillator)<br>HPOS = Horizontal position<br>VPOS = Vertical Position (altitude)<br>VVEL = Vertical Velocity<br>DIST = Distance Moved<br>SPEED = Current Speed<br>TRACK = Current track<br>DTRACK = Delta track (change in direction) |
| INT | Fixed descriptor field, indicates the use of internally provided ancillary measurements e.g. retrieved from non volatile memory. All comma separated fields following, are internally provided measurements |
| ifields | TSYNC = Time synchronisation<br>CLKB = Clock Bias<br>FREQ = Frequency (of reference oscillator)<br>HPOS = Horizontal position<br>VPOS = Vertical Position (altitude)<br>VVEL = Vertical Velocity<br>DIST = Distance Moved<br>SPEED = Current Speed<br>TRACK = Current track<br>DTRACK = Delta track (change in direction) |
| BLANK | Reserved for future use |

# CW85

NAVSYNC

| | |
|---|---|
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