GPS 10

TECHNICAL

SPECIFICATIONS

RECORD OF REVISIONS

Revision	Revision Date	Description	ECO #
A	12/10/04	Initial Release	--

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1   INTRODUCTION

1.1   CAUTIONS

$$\boxed{\textbf{CAUTION}}$$

The GPS system is operated by the government of the United States, which is solely responsible for its accuracy and maintenance. Although the GPS 10 is a precision electronic NAVigation AID (NAVAID), any NAVAID can be misused or misinterpreted, and therefore become unsafe. Use these products at your own risk. To reduce the risk, carefully review and understand all aspects of these Technical Specifications before using the GPS 10. When in actual use, carefully compare indications from the GPS to all available navigation sources including the information from other NAVAIDs, visual sightings, charts, etc. For safety, always resolve any discrepancies before continuing navigation.

$$\boxed{\begin{array}{c}\textbf{FCC}\\\textbf{Compliance}\end{array}}$$

The GPS 10 complies with Part 15 of the FCC interference limits for Class B digital devices FOR HOME OR OFFICE USE. These limits are designed to provide reasonable protection against harmful interference in a residential installation, and are more stringent than "outdoor" requirements.

Operation of this device is subject to the following conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.

- Increase the separation between the equipment and receiver.

- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

- Consult the dealer or an experienced radio/TV technician for help.

The GPS 10 does not contain any user-serviceable parts. Unauthorized repairs or modifications could result in permanent damage to the equipment, and void your warranty and your authority to operate this device under Part 15 regulations.

This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

1.2 LIMITED WARRANTY

This Garmin product is warranted to be free from defects in materials or workmanship for one year from the date of purchase. Within this period, Garmin will at its sole option, repair or replace any components that fail in normal use. Such repairs or replacement will be made at no charge to the customer for parts or labor, provided that the customer shall be responsible for any transportation cost. This warranty does not cover failures due to abuse, misuse, accident or unauthorized alteration or repairs.

THE WARRANTIES AND REMEDIES CONTAINED HEREIN ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES EXPRESS OR IMPLIED OR STATUTORY, INCLUDING ANY LIABILITY ARISING UNDER ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, STATUTORY OR OTHERWISE. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, WHICH MAY VARY FROM STATE TO STATE.

IN NO EVENT SHALL GARMIN BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, WHETHER RESULTING FROM THE USE, MISUSE, OR INABILITY TO USE THIS PRODUCT OR FROM DEFECTS IN THE PRODUCT. Some states do not allow the exclusion of incidental or consequential damages, so the above limitations may not apply to you.

Garmin retains the exclusive right to repair or replace the unit or software or offer a full refund of the purchase price at its sole discretion. SUCH REMEDY SHALL BE YOUR SOLE AND EXCLUSIVE REMEDY FOR ANY BREACH OF WARRANTY.

To obtain warranty service, contact your local Garmin authorized dealer. Or call Garmin Customer Service at one of the numbers shown below, for shipping instructions and an RMA tracking number. The unit should be securely packed with the tracking number clearly written on the <u>outside</u> of the package. The unit should then be sent, freight charges prepaid, to any Garmin warranty service station. A copy of the original sales receipt is required as the proof of purchase for warranty repairs.

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1.3 OVERVIEW

The GPS 10 product includes an embedded receiver and an antenna. Based on the proven technology found in other Garmin 12-channel GPS receivers, the GPS 10 tracks up to 12 satellites at a time while providing fast time-to-first-fix, one-second navigation updates, and low power consumption. This generation of GPS sensors adds the capability of FAA Wide Area Augmentation System (WAAS) differential GPS. The GPS 10's far-reaching capability meets the sensitivity requirements of land navigation as well as the dynamics requirements of high-performance aircraft.

The GPS 10 design uses the latest technology and high-level circuit integration to achieve superior performance while minimizing space and power requirements. All critical components of the system including the RF/IF receiver hardware and the digital baseband are designed and manufactured by Garmin to ensure the quality and capability of the GPS. The hardware capability combined with software intelligence makes the GPS 10 easy to integrate and use.

The GPS 10 series products are designed to withstand rugged operating conditions and are waterproof to IEC 60529 IPX7, immersion in 1 meter of water for 30 minutes. This complete GPS receiver requires no additional components to be supplied by an OEM or system integrator. It is provided with an internal rechargeable battery and 12 V DC charging adapter. The only requirements are a 12 Volt DC power source and a clear view of the GPS satellites. Internal FLASH memory allows the GPS to retain critical data such as satellite orbital parameters, last-known position, date and time. End user interfaces such as keyboards and displays are the responsibility of the application designer.

1.4 FEATURES

- 12-channel GPS receiver tracks and uses up to 12 satellites for fast, accurate positioning and low power consumption.

- Differential DGPS capability using real-time WAAS corrections yielding position errors of less than 3 meters.

- Compact, rugged design ideal for applications with minimal space. Receiver position information can be displayed directly on a chart plotter or PC.

- User initialization is not required. Once installed, unit automatically produces navigation data after position fix is acquired.

- User-configurable navigation mode (2-dimensional or 3-dimensional fix).

- Configurable for binary format carrier phase data output.

- FLASH-based program and non-volatile memory. New software revisions available through Web site download. Non-volatile memory does not require battery backup.

- Integrated Bluetooth® (Class 2) wireless technology module for communication with a mobile device.

- On-board rechargeable main power battery and a backup battery to maintain the real-time clock for up to 3 weeks.

- Configurable parameters include expected position, current time and date, preferred position fix type (2D, 3D, or automatic), and velocity filter time constant (none, automatic, or your choice between 2 and 255 seconds).

- Magnetic mount for attachment to ferrous surfaces. (Velcro adhesive backed patch for non-magnetic surfaces.)

- 12 V DC Cigarette Lighter Charging Adapter

- Waterproof design allows continuous exposure to the prevailing weather conditions at most locations.

1.5   GPS 10

There is one version of the GPS 10 available.

1.5.1   GPS 10 Wireless Receiver

The GPS 10 uses Bluetooth wireless technology to interface with a mobile device (Computer/PDA) that is Bluetooth wireless technology enabled.

Class 2 Bluetooth device with power control capability based on the Bluetooth System Specification, Version 1.1. The supported profile is Serial Profile (SSP)

Accessories provided with the GPS 10: Velcro Mounting Patch (Not shown0, 12 V DC Cigarette Lighter Charging Adapter.

12 V DC Charging Adapter, P/N 010-10412-00

Optional Accessories: Suction Cup Windshield Mount, 110-115 V AC Charging Adapter

Suction Cup Mount P/N 010- 10616-00   AC Charging Adapter P/N 010-10413-00

Power Plug Specifications for charging the GPS 10 from user provided power source: 5 V DC (Range 4.5 to 5.5 V DC @ 600 mA)
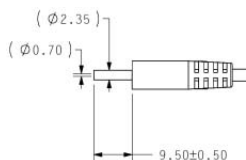
1.6 TECHNICAL SPECIFICATIONS

Specifications are subject to change without notice.

1.6.1 Physical Characteristics

1.6.1.1 Size
45mm wide, 88mm long and 19mm in height.

1.6.1.2 Weight
80.0 grams

1.6.1.3 Color
Black w/Gray Accents

1.6.1.4 Case Material
Polycarbonate thermoplastic case that is waterproof to IEC 60529 IPX7 level (immersion in 1 meter of water for 30 minutes)

1.6.2 Electrical Characteristics

1.6.2.1 Input Voltage
4.8 – 6.5V

1.6.2.2 Input Current
500mA @ 5.0V

1.6.2.3 Battery

- Capacity: 900mAHr

- Charging rate: Approx. 3 Hrs

- Operating rate: Approx. 10 Hours with WAAS enabled.

1.6.2.4 Battery Charger (Garmin Model DD-05-1000)

- Input   10 to 30 V AC

- Output   4.9 to 5.25 V DC @ 1.0 A

1.6.2.5 GPS Receiver Sensitivity
-165 dBW minimum

1.6.3 Environmental Characteristics

1.6.3.1 Operating Temperature Range

- -30°C to + 60°C   Powered from external supply

- -10°C to +60°C   Powered by internal batteries

1.6.3.2 Battery Charging Temperature Range

-5°C to +45°C   (Outside this temperature range, battery charging is not possible)

1.6.3.3 Storage Temperature

-40°C to +90°C

1.6.4 GPS Performance

1.6.4.1 Receiver
WAAS enabled; 12 parallel channel GPS receiver continuously tracks and uses up to 12 satellites (up to 11 with PPS active) to compute and update your position.

1.6.4.2 Acquisition Times
- Reacquisition: Less than 2 seconds

- Warm: Approx. 15 seconds (all data known)

- Cold: Approx. 45 seconds (initial position, time, and almanac known; ephemeris unknown)

- AutoLocate^{TM}:   5 minutes (almanac known; initial position and time unknown)

- SkySearch: 5 minutes (no data known)

1.6.4.3 Update Rate
1 record per second

1.6.4.4 Accuracy
- GPS Standard Positioning Service (SPS)
  Position: < 15 meters, 95% typical
  Velocity: 0.1 knot RMS steady state
- WAAS
  Position: < 3 meters, 95% typical
  Velocity: 0.1 knot RMS steady state
- PPS Time: ±1 microsecond at rising edge of PPS pulse
- Dynamics: 999 knots velocity (only limited at altitude greater than 60,000 feet), 6g dynamics

1.6.5 Interfaces

1.6.5.1 GPS 10 Electrical Characteristics
Communicate with Host Platform via Bluetooth (Class 2) Serial Profile

Typical Range: up to 32 feet (10 meters)

1.6.5.2 GARMIN Interface
Refer to the *GARMIN GPS Interface Specification Addendum* for specific information about the GARMIN Protocol. The document is located on the Garmin Web site at:
http://www.garmin.com/support/commProtocol.html. See also Appendix B: Binary Phase Output Format for additional information concerning access to raw pseudo-range and carrier phase data from the GPS 10.

Refer to the *GARMIN GPS Interface Specification* for details on the GARMIN interface. At the time of this printing, these specs are available from the technical suppport section of our Web site:
http://www.garmin.com/support/commProtocol.html.

1.6.5.3 GPS 10 Protocol
- NMEA 0103 Version 2.0 or NMEA 0103 Version 2.30 (Version 2.0 is factory default, programmable by data field 7 of the PGRMC1 sentence described in Section 3.1.4 Additional Sensor Configuration Information (PGRMC1).

- Available NMEA 0103 output sentences include GPALM, GPGGA, GPGSA, GPGSV, GPRMC, GPVTG, GPGLL, PGRME, PGRMF, PGRMT, PGRMV, and PGRMB (GARMIN proprietary sentences). See Section 3.2 Transmitted NMEA 0103 Sentences for format descriptions.

- Configuration and initialization is accomplished with NMEA 0103 input sentences. Allows initialization of information such as expected position, date, time, earth datum, and differential mode. See Section 3.1 Received NMEA 0103 Sentences for format descriptions.

- Configurable for binary data output including GPS carrier phase data

2   MECHANICAL CHARACTERISTICS & MOUNTING

The unit contains an integrated magnetic mount and is supplied with a Velcro patch for mounting on non-ferrous surfaces. The following drawing show example geometry for mounting hardware in case you wish to design your own custom mount. Figure 1 shows the mounting footprint. Figure 2 shows operational characteristics of the GPS 10.
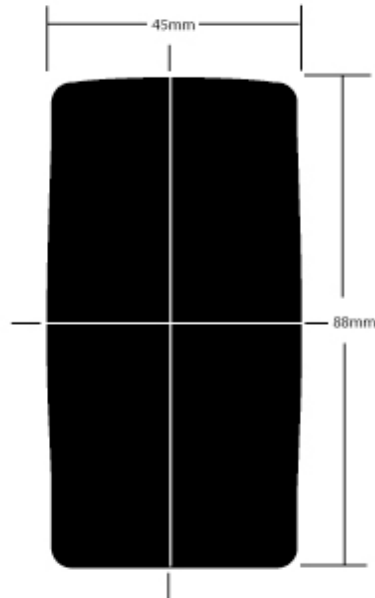
Figure 1. GPS 10 Bottom Case Dimensions

Figure 2. GPS 10 Operational Characteristics

3   GPS 10 SOFTWARE INTERFACE

The interface protocol design of the GPS 10 product is based on the National Marine Electronics Association's NMEA 0103 ASCII interface specification. This standard is fully defined in *NMEA 0103, Version 2.30*. Copies may be obtained from NMEA, www.nmea.org.

In addition to the standard NMEA 0103 sentences, the GPS 10 may also be configured to transmit information over their serial interface using NMEA 0103 compliant Garmin proprietary sentences. These proprietary sentences begin with the characters, "$PGRM", instead of the characters "$G" that are typical of the standard NMEA 0103 sentences. The characters "$P" indicate that the sentence is a proprietary implementation and the characters and "GRM" indicate that it is Garmin's proprietary sentence. The letter (or letters) that follow the characters "$PGRM" uniquely identifies that particular Garmin proprietary sentence.

It is also possible to configure the GPS 10 to transmit binary phase data information over their serial interface. See Appendix B: Binary Phase Output Format for details.

The following sections describe the NMEA 0103 data format of each sentence transmitted and received by the GPS 10 product.

3.1   RECEIVED NMEA 0103 SENTENCES

The following paragraphs define the sentences that can be received on the GPS sensors' port. Null fields in the configuration sentence indicate no change in the particular configuration parameter. All sentences received by the GPS sensor must be terminated with <CR><LF>, the ASCII characters for carriage return (0D hexadecimal) and line feed (0A hexadecimal). The checksum *hh is used for parity checking data and is not required, but is recommended for use in environments containing high electromagnetic noise. It is generally not required in normal PC environments. When used, the parity bytes (hh) are the ASCII representation of the exclusive-or (XOR) sum of all the characters between the "$" and "*" characters, non-inclusive. The hex representation must be a capital letter, such as 3D instead of 3d. Sentences may be truncated by <CR><LF> after any data field and valid fields up to that point will be acted on by the sensor.

3.1.1   Almanac Information (ALM)

The $GPALM sentence can be used to initialize the GPS sensor's stored almanac information in the unlikely event of non-volatile memory loss or after storing longer than six months without tracking GPS satellites.

$GPALM,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>,<10>,<11>,<12>,<13>,<14>,<15>*hh<CR><LF>

<1>	Total number of ALM sentences to be transmitted by the GPS sensor during almanac download. This field can be null or any number when sending almanac to the GPS sensor.
<2>	Number of current ALM sentence. This field can be null or any number when sending almanac to the GPS sensor.
<3>	Satellite PRN number, 01 to 32
<4>	GPS week number
<5>	SV health, bits 17-24 of each almanac page
<6>	Eccentricity
<7>	Almanac reference time
<8>	Inclination angle
<9>	Rate of right ascension
<10>	Root of semi major axis
<11>	Omega, argument of perigee
<12>	Longitude of ascension node
<13>	Mean anomaly
<14>	af0 clock parameter
<15>	af1 clock parameter

3.1.2   Sensor Initialization Information (PGRMI)

The $PGRMI sentence provides information used to initialize the GPS sensor's set position and time used for satellite acquisition. Receipt of this sentence by the GPS sensor causes the software to restart the satellite acquisition process. If there are no errors in the sentence, it will be echoed upon receipt. If an error is detected, the echoed PGRMI sentence will contain the current default values. Current PGRMI defaults (with the exception of the Receiver Command, which is a command rather than a mode) can also be obtained by sending $PGRMIE to the GPS sensor.

$PGRMI,<1>,<2>,<3>,<4>,<5>,<6>,<7>*hh<CR><LF>

<1>	Latitude, ddmm.mmm format (leading zeros must be transmitted)
<2>	Latitude hemisphere, N or S
<3>	Longitude, dddmm.mmm format (leading zeros must be transmitted)
<4>	Longitude hemisphere, E or W
<5>	Current UTC date, ddmmyy format
<6>	Current UTC time, hhmmss format
<7>	Receiver Command, A = Auto Locate, R = Unit Reset

3.1.3   Sensor Configuration Information (PGRMC)

The $PGRMC sentence provides information used to configure the GPS sensor's operation. Configuration parameters are stored in non-volatile memory and retained between power cycles. The GPS sensor will echo this sentence upon its receipt if no errors are detected. If an error is detected, the echoed PGRMC sentence will contain the current default values. Current default values can also be obtained by sending $PGRMCE to the GPS sensor.

$PGRMC,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>,<10>,<11>,<12>,<13>,<14>*hh<CR><LF>

<1>	Fix mode, A = automatic, 2 = 2D exclusively (host system must supply altitude), 3 = 3D exclusively
<2>	Altitude above/below mean sea level, -1500.0 to 10000.0 meters
<3>	Earth datum index. If the user datum index (96) is specified, fields <4> through <8> must contain valid values. Otherwise, fields <4> through <8> must be null. Refer to Appendix A Earth Datums for a list of earth datums and the corresponding earth datum index.
<4>	User earth datum semi-major axis, 6360000.000 to 6380000.000 meters (.001 meters resolution)
<5>	User earth datum inverse flattening factor, 285.0 to 310.0 (10^{-9} resolution)
<6>	User earth datum delta x earth centered coordinate, -5000.0 to 5000.0 meters (1 meter resolution)
<7>	User earth datum delta y earth centered coordinate, -5000.0 to 5000.0 meters (1 meter resolution)
<8>	User earth datum delta z earth centered coordinate, -5000.0 to 5000.0 meters (1 meter resolution)
<9>	Differential mode, A = automatic (output DGPS data when available, non-DGPS otherwise), D = differential exclusively (output only differential fixes)
<10>	NMEA 0103 Baud rate, 1 = 1200, 2 = 2400, 3 = 4800, 4 = 9600, 5 = 19200, 6 = 300, 7 = 600
<11>	Velocity filter, 0 = No filter, 1 = Automatic filter, 2-255 = Filter time constant (e.g., 10 = 10 second filter)
<12>	Not used
<13>	Not used
<14>	Dead reckoning valid time 1-30 (sec)

All configuration changes take effect after receipt of a valid value except baud rate and PPS mode. Baud rate and PPS mode changes take effect on the next power cycle or an external reset even

3.1.4   Additional Sensor Configuration Information (PGRMC1)

The $PGRMC1 sentence provides additional information used to configure the GPS sensor operation. Configuration parameters are stored in non-volatile memory and retained between power cycles. The GPS sensor will echo this sentence upon its receipt if no errors are detected. If an error is detected, the echoed PGRMC1 sentence will contain the current default values. Current default values can also be obtained by sending $PGRMC1E to the GPS sensor.

$PGRMC1,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>*hh<CR><LF>

<1>	NMEA 0103 output time 1-900 (sec)
<2>	Binary Phase Output Data, 1 = Off, 2 = On.
<3>	Automatic Position Averaging when Stopped, 1 = Off, 2 = On
<4>	No Effect (DGPS beacon frequency – 0.0, 283.5 – 325.0 kHz in 0.5 kHz steps)
<5>	No Effect (DGPS beacon bit rate – 0, 25, 50, 100, or 200 bps)
<6>	No Effect (DGPS beacon scanning, 1 = Off, 2 = On)
<7>	NMEA 0103 version 2.30 mode indicator, 1 = Off, 2 = On
<8>	DGPS mode, W = WAAS Only, N = None (DGPS disabled)
<9>	Power Save Mode, P = Power Save mode, N = Normal

Configuration changes take effect immediately, with the exception of Binary Phase Output Data, which takes effect on the next power cycle or a reset event. A reset can be commanded by sending the sentence "$PGRMI,,,,,,,R" (refer to Section 3.1.2 Sensor Initialization Information (PGRMI)). If the GPS sensor is in the Binary data mode, it is necessary to send the following eight-byte data stream to temporarily change the data format to NMEA 0103. Then follow by sending a PGRMC1 sentence that turns off the Binary Phase Output Data format:

10 0A 02 26 00 CE 10 03 (Hexadecimal)

3.1.5   Output Sentence Enable/Disable (PGRMO)
The $PGRMO sentence provides the ability to enable and disable specific output sentences. The following sentences are enabled at the factory: GPGGA, GPGSA, GPGSV, GPRMC, and PGRMT.

$PGRMO,<1>,<2>*hh<CR><LF>

<1>	Target sentence description (e.g., PGRMT, GPGSV, etc.)

<2>	Target sentence mode, where:
	        0 = disable specified sentence
	        1 = enable specified sentence
	        2 = disable all output sentences
	        3 = enable all output sentences (except GPALM)
	        4 = restore factory default output sentences

The following notes apply to the PGRMO input sentence:

1. If the target sentence mode is '2' (disable all), '3' (enable all), or '4' (restore defaults), the target sentence description is not checked for validity. In this case, an empty field is allowed (e.g., $PGRMO,,3), or the mode field may contain from 1 to 5 characters.

2. If the target sentence mode is '0' (disable) or '1' (enable), the target sentence description field must be an identifier for one of the sentences that can be output by the GPS sensor.

3. If either the target sentence mode field or the target sentence description field is not valid, the PGRMO sentence will have no effect.

4. $PGRMO,GPALM,1 will cause the GPS sensor to transmit all stored almanac information. All other NMEA 0103 sentence transmission will be temporarily suspended.

5. $PGRMO,,G will cause the COM port to change to GARMIN Data Transfer format for the duration of the power cycle. The GARMIN mode is required for GPS 10 series product software updates.

6. $PGRMO,,M will cause the Auto shutoff feature to activate. The sensor will power off if the Bluetooth link is broken or fails to establish within 15 minutes.

7. $PGRMO,,N will cause the Auto shutoff feature to deactivate.

3.1.6   Adaptive transmission Mode Enable/Disable (PGRMN)
The $PGRMN sentence provides the ability to enable and disable the adaptive transmission mode to extend the battery life by putting the GPS 10 circuits into low power mode to reduce the current consumption.

1. $PGRMN,,A sets the adaptive transmission mode to ON.

    $PGRMN,,F sets the adaptive transmission mode to OFF.

3.2 TRANSMITTED NMEA 0103 SENTENCES

The subsequent paragraphs define the sentences that can be transmitted by the GPS 10.

3.2.1 Sentence Transmission Rate

Sentences are transmitted with respect to the user selected baud rate.

The GPS sensor will transmit each sentence (except where noted in particular transmitted sentence descriptions) at a periodic rate based on the user selected baud rate and user selected output sentences. The GPS sensor will transmit the selected sentences contiguously. The length of the transmission can be determined by the following equation and Tables 2 and 3:

$$\text{length of transmission} = \frac{\text{total characters to be transmitted}}{\text{characters transmitted per second}}$$

Sentence	Output by Default?	Maximum Characters
GPRMC	✔	74
GPGGA	✔	82
GPGSA	✔	66
GPGSV	✔	70
PGRME	✔	35
GPGLL		44
GPVTG		42
PGRMV		32
PGRMF		82
PGRMB	✔	40
PGRMT	Once per minute	50

Table 1: NMEA 0103 Output Sentence Order and Size

Baud	Characters per Second
300	30
600	60
1200	120
2400	240
4800	480
9600	960
19200	1920
38400	3840

Table 2: Characters per Second for Available Baud Rates

The maximum number of fields allowed in a single sentence is 82 characters including delimiters. Values in the table include the sentence start delimiter character "$" and the termination delimiter <CR><LF>. The factory set defaults will result in a once per second transmission at the NMEA 0103 specification transmission rate of 4800 baud.

Regardless of the selected baud rate, the information transmitted by the GPS sensor is referenced to the one-pulse-per-second output pulse immediately preceding the GPRMC sentence, or whichever sentence is output first in the burst (see Table 2 above).

3.2.2 Transmitted Time

The GPS sensor outputs UTC (Coordinated Universal Time) date and time of day in the transmitted sentences. Before the initial position fix, the on-board clock provides the date and time of day. After the initial position fix, the date and time of day are calculated using GPS satellite information and are synchronized with the one-pulse-per-second output.

The GPS sensor uses information obtained from the GPS satellites to add or delete UTC leap seconds and correct the transmitted date and time of day. The transmitted date and time of day for leap second correction follow the guidelines in *"National Institute of Standards and Technology Special Publication 432 (Revised 1990)"* (for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402, U.S.A.).

When a positive leap second is required, one second is inserted at the beginning of the first hour (0h 0m 0s) of the day that the positive leap is occurring. The minute containing the leap second is 61 seconds long. The GPS sensor would have transmitted this information for the leap second added December 31, 1998 as follows:

$GPRMC,235959,A,3851.3651,N,09447.9382,W,000.0,221.9,071103,003.3,E*69

$GPRMC,000000,A,3851.3651,N,09447.9382,W,000.0,221.9,081103,003.3,E*67

$GPRMC,000000,A,3851.3651,N,09447.9382,W,000.0,221.9,081103,003.3,E*67

$GPRMC,000001,A,3851.3651,N,09447.9382,W,000.0,221.9,081103,003.3,E*66

If a negative leap second should be required, one second will be deleted at the end of some UTC month. The minute containing the leap second will be only 59 seconds long. In this case, the GPS sensor will not transmit the time of day 0h 0m 0s (the "zero" second) for the day from which the leap second is removed.

$GPRMC,235959,A,3851.3650,N,09447.9373,W,000.0,000.0,111103,003.3,E*69

$GPRMC,000001,A,3851.3650,N,09447.9373,W,000.0,000.0,121103,003.3,E*6A

$GPRMC,000002,A,3851.3650,N,09447.9373,W,000.0,000.0,121103,003.3,E*69

3.2.3   Global Positioning System Almanac Data (ALM)

Almanac sentences are not normally transmitted. Almanac transmission can be initiated by sending the GPS sensor a $PGRMO,GPALM,1 command. Upon receipt of this command, the GPS sensor will transmit available almanac information on GPALM sentences. During the transmission of almanac sentences, other NMEA 0103 data output will be temporarily suspended.

$GPALM,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>,<10>,<11>,<12>,<13>,<14>,<15>*hh<CR><LF>

<field information> can be found in Section 3.1.1 Almanac Information (ALM).

3.2.4   Global Positioning System Fix Data (GGA)

$GPGGA,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>,M,<10>,M,<11>,<12>*hh<CR><LF>

<1>	UTC time of position fix, hhmmss format
<2>	Latitude, ddmm.mmmm format (leading zeros will be transmitted)
<3>	Latitude hemisphere, N or S
<4>	Longitude, dddmm.mmmm format (leading zeros will be transmitted)
<5>	Longitude hemisphere, E or W
<6>	GPS quality indication, 0 = fix not available, 1 = Non-differential GPS fix available, 2 = Differential GPS (DGPS) fix available, 6 = Estimated
<7>	Number of satellites in use, 00 to 12 (leading zeros will be transmitted)
<8>	Horizontal dilution of precision, 0.5 to 99.9
<9>	Antenna height above/below mean sea level, -9999.9 to 99999.9 meters
<10>	Geoidal height, -999.9 to 9999.9 meters
<11>	Differential GPS (RTCM SC-104) data age, number of seconds since last valid RTCM transmission (null if not an RTCM DGPS fix)
<12>	Differential Reference Station ID, 0000 to 1023 (leading zeros will be transmitted, null if not an RTCM DGPS fix)

3.2.5   GPS DOP and Active Satellites (GSA)

$GPGSA,<1>,<2>,<3>,<3>,<3>,<3>,<3>,<3>,<3>,<3>,<3>,<3>,<3>,<4>,<5>,<6>*hh<CR><LF>

<1>	Mode, M = manual, A = automatic
<2>	Fix type, 1 = not available, 2 = 2D, 3 = 3D
<3>	PRN number, 01 to 32, of satellite used in solution, up to 12 transmitted (leading zeros will be

	transmitted)
<4>	Position dilution of precision, 0.5 to 99.9
<5>	Horizontal dilution of precision, 0.5 to 99.9
<6>	Vertical dilution of precision, 0.5 to 99.9

3.2.6 GPS Satellites in View (GSV)

$GPGSV,<1>,<2>,<3>,<4>,<5>,<6>,<7>,...<4>,<5>,<6>,<7>*hh<CR><LF>

<1>	Total number of GSV sentences to be transmitted
<2>	Number of current GSV sentence
<3>	Total number of satellites in view, 00 to 12 (leading zeros will be transmitted)
<4>	Satellite PRN number, 01 to 32 (leading zeros will be transmitted)
<5>	Satellite elevation, 00 to 90 degrees (leading zeros will be transmitted)
<6>	Satellite azimuth, 000 to 359 degrees, true (leading zeros will be transmitted)
<7>	Signal to noise ratio (C/No) 00 to 99 dB, null when not tracking (leading zeros will be transmitted)

NOTE: Items <4>,<5>,<6>, and <7> repeat for each satellite in view to a maximum of four (4) satellites per sentence. Additional satellites in view information must be sent in subsequent bursts of NMEA 0103 data. These fields will be null if unused.

3.2.7 Recommended Minimum Specific GPS/TRANSIT Data (RMC)

$GPRMC,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>,<10>,<11>,<12>*hh<CR><LF>

<1>	UTC time of position fix, hhmmss format
<2>	Status, A = Valid position, V = NAV receiver warning
<3>	Latitude, ddmm.mmmm format (leading zeros will be transmitted)
<4>	Latitude hemisphere, N or S
<5>	Longitude, dddmm.mmmm format (leading zeros will be transmitted)
<6>	Longitude hemisphere, E or W
<7>	Speed over ground, 000.0 to 999.9 knots (leading zeros will be transmitted)
<8>	Course over ground, 000.0 to 359.9 degrees, true (leading zeros will be transmitted)
<9>	UTC date of position fix, ddmmyy format
<10>	Magnetic variation, 000.0 to 100.0 degrees (leading zeros will be transmitted)
<11>	Magnetic variation direction, E or W (westerly variation adds to true course)
<12>	Mode indicator (only output if NMEA 0103 version 2.30 active), A = Autonomous, D = Differential, E = Estimated, N = Data not valid

3.2.8 Track Made Good and Ground Speed (VTG)

$GPVTG,<1>,T,<2>,M,<3>,N,<4>,K,<5>*hh<CR><LF>

<1>	True course over ground, 000 to 359 degrees (leading zeros will be transmitted)
<2>	Magnetic course over ground, 000 to 359 degrees (leading zeros will be transmitted)
<3>	Speed over ground, 000.0 to 999.9 knots (leading zeros will be transmitted)
<4>	Speed over ground, 0000.0 to 1051.8 kilometers per hour (leading zeros will be transmitted)
<5>	Mode indicator (only output if NMEA 0103 version 2.30 active), A = Autonomous, D = Differential, E = Estimated, N = Data not valid

3.2.9 Geographic Position (GLL)

$GPGLL,<1>,<2>,<3>,<4>,<5>,<6>,<7>*hh<CR><LF>

<1>	Latitude, ddmm.mmmm format (leading zeros will be transmitted)
<2>	Latitude hemisphere, N or S
<3>	Longitude, dddmm.mmmm format (leading zeros will be transmitted)
<4>	Longitude hemisphere, E or W
<5>	UTC time of position fix, hhmmss format
<6>	Status, A = Valid position, V = NAV receiver warning
<7>	Mode indicator (only output if NMEA 0103 version 2.30 active), A = Autonomous,

	D = Differential, E = Estimated, N = Data not valid

3.2.10 Estimated Error Information (PGRME)

$PGRME,<1>,M,<2>,M,<3>,M*hh<CR><LF>

<1>	Estimated horizontal position error (HPE), 0.0 to 999.9 meters
<2>	Estimated vertical position error (VPE), 0.0 to 999.9 meters
<3>	Estimated position error (EPE), 0.0 to 999.9 meters

3.2.11 GPS Fix Data Sentence (PGRMF)

$PGRMF,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>,<10>,<11>,<12>,<13>,<14>,<15>*hh<CR><LF>

<1>	GPS week number (0 - 1023)
<2>	GPS seconds (0 - 604799)
<3>	UTC date of position fix, ddmmyy format
<4>	UTC time of position fix, hhmmss format
<5>	GPS leap second count
<6>	Latitude, ddmm.mmmm format (leading zeros will be transmitted)
<7>	Latitude hemisphere, N or S
<8>	Longitude, dddmm.mmmm format (leading zeros will be transmitted)
<9>	Longitude hemisphere, E or W
<10>	Mode, M = manual, A = automatic
<11>	Fix type, 0 = no fix, 1 = 2D fix, 2 = 3D fix
<12>	Speed over ground, 0 to 1051 kilometers/hour
<13>	Course over ground, 0 to 359 degrees, true
<14>	Position dilution of precision, 0 to 9 (rounded to nearest integer value)
<15>	Time dilution of precision, 0 to 9 (rounded to nearest integer value)

3.2.12 Sensor Status Information (PGRMT)

The GARMIN Proprietary sentence $PGRMT gives information concerning the status of the GPS sensor.
This sentence is transmitted once per minute regardless of the selected baud rate.

$PGRMT,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>*hh<CR><LF>

<1>	Product, model and software version (variable length field, e.g., "GPS 10 VER 2.05")
<2>	ROM checksum test, P = pass, F = fail
<3>	Receiver failure discrete, P = pass, F = fail
<4>	Stored data lost, R = retained, L = lost
<5>	Real time clock lost, R = retained, L = lost
<6>	Oscillator drift discrete, P = pass, F = excessive drift detected
<7>	Data collection discrete, C = collecting, null if not collecting
<8>	GPS sensor temperature in degrees C
<9>	GPS sensor configuration data, R = retained, L = lost

3.2.13 3D velocity Information (PGRMV)

$PGRMV,<1>,<2>,<3>*hh<CR><LF>

<1>	True east velocity, 514.4 to 514.4 meters/second
<2>	True north velocity, 514.4 to 514.4 meters/second
<3>	Up velocity, 999.9 to 9999.9 meters/second

3.2.14 DGPS Beacon Information (PGRMB)

NOTE: PGRMB is not supported at this time.

$PGRMB,<1>,<2>,<3>,<4>,<5>,K,<6>,<7>*hh<CR><LF>

<1>	Beacon tune frequency, 0.0, 283.5 – 325.0 kHz in 0.5 kHz steps
<2>	Beacon bit rate, 0, 25, 50, 100, or 200 bps
<3>	Beacon SNR, 0 to 31

<4>	Beacon data quality, 0 to 100
<5>	Distance to beacon reference station in kilometers
<6>	Beacon receiver communication status (0 = Check Wiring, 1 = No Signal, 2 = Tuning, 3 = Receiving, 4= Scanning)
<7>	DGPS fix source (R = RTCM, W = WAAS, N = Non-DGPS Fix)
<8>	DGPS mode, A = Automatic, W = WAAS Only, R = RTCM Only, N = None (DGPS disabled)

3.3   BAUD RATE SELECTION

Baud rate selection can be performed by sending the appropriate configuration sentence to the GPS sensor as described in the $PGRMC Section 3.1.2 Sensor Initialization Information (PGRMI), field <10>.

APPENDIX A: EARTH DATUMS

The following is a list of the Garmin GPS 10 Earth datum indices and the corresponding earth datum name (including the area of application):

0   ADINDAN - Ethiopia, Mali, Senegal, Sudan

1   AFGOOYE - Somalia

2   AIN EL ABD 1970 - Bahrain Island, Saudi Arabia

3   ANNA 1 ASTRO 1965 - Cocos Island

4   ARC 1950 - Botswana, Lesotho, Malawi, Swaziland, Zaire, Zambia, Zimbabwe

5   ARC 1960 - Kenya, Tanzania

6   ASCENSION ISLAND 1958 - Ascension Island

7   ASTRO BEACON "E" - Iwo Jima Island

8   AUSTRALIAN GEODETIC 1966 - Australia, Tasmania Island

9   AUSTRALIAN GEODETIC 1984 - Australia, Tasmania Island

10   ASTRO DOS 71/4 - St. Helena Island

11   ASTRONOMIC STATION 1952 - Marcus Island

12   ASTRO B4 SOROL ATOLL - Tern Island

13   BELLEVUE (IGN) - Efate and Erromango Islands

14   BERMUDA 1957 - Bermuda Islands

15   BOGOTA OBSERVATORY - Colombia

16   CAMPO INCHAUSPE - Argentina

17   CANTON ASTRO 1966 - Phoenix Islands

10   CAPE CANAVERAL - Florida, Bahama Islands

19   CAPE - South Africa

20   CARTHAGE - Tunisia

21   CHATHAM 1971 - Chatham Island (New Zealand)

22   CHUA ASTRO - Paraguay

23   CORREGO ALEGRE - Brazil

24   DJAKARTA (BATAVIA) - Sumatra Island (Indonesia)

25   DOS 1968 - Gizo Island (New Georgia Islands)

26   EASTER ISLAND 1967 - Easter Island

27   EUROPEAN 1950 - Austria, Belgium, Denmark, Finland, France, Germany, Gibraltar, Greece, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland

28   EUROPEAN 1979 - Austria, Finland, Netherlands, Norway, Spain, Sweden, Switzerland

29   FINLAND HAYFORD 1910 - Finland

30   GANDAJIKA BASE - Republic of Maldives

31   GEODETIC DATUM 1949 - New Zealand

32   ORDNANCE SURVEY OF GREAT BRITAIN 1936 - England, Isle of Man, Scotland, Shetland Islands, Wales

33   GUAM 1963 - Guam Island

34   GUX 1 ASTRO - Guadalcanal Island

35	HJORSEY 1955 - Iceland
36	HONG KONG 1963 - Hong Kong
37	INDIAN - Bangladesh, India, Nepal
38	INDIAN - Thailand, Vietnam
39	IRELAND 1965 - Ireland
40	ISTS O73 ASTRO 1969 - Diego Garcia
41	JOHNSTON ISLAND 1961 - Johnston Island
42	KANDAWALA - Sri Lanka
43	KERGUELEN ISLAND - Kerguelen Island
44	KERTAU 1948 - West Malaysia, Singapore
45	L.C. 5 ASTRO - Cayman Brac Island
46	LIBERIA 1964 - Liberia
47	LUZON - Mindanao Island
48	LUZON - Phillippines (excluding Mindanao Island)
49	MAHE 1971 - Mahe Island
50	MARCO ASTRO - Salvage Islands
51	MASSAWA - Eritrea (Ethiopia)
52	MERCHICH - Morocco
53	MIDWAY ASTRO 1961 - Midway Island
54	MINNA - Nigeria
55	NORTH AMERICAN 1927 - Alaska
56	NORTH AMERICAN 1927 - Bahamas (excluding San Salvador Island)
57	NORTH AMERICAN 1927 - Central America (Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua)
58	NORTH AMERICAN 1927 - Canal Zone
59	NORTH AMERICAN 1927 - Canada (including Newfoundland Island)
60	NORTH AMERICAN 1927 - Caribbean (Barbados, Caicos Islands, Cuba, Dominican Republic, Grand Cayman, Jamaica, Leeward Islands, Turks Islands)
61	NORTH AMERICAN 1927 - Mean Value (CONUS)
62	NORTH AMERICAN 1927 - Cuba
63	NORTH AMERICAN 1927 - Greenland (Hayes Peninsula)
64	NORTH AMERICAN 1927 - Mexico
65	NORTH AMERICAN 1927 - San Salvador Island
66	NORTH AMERICAN 1983 - Alaska, Canada, Central America, CONUS, Mexico
67	NAPARIMA, BWI - Trinidad and Tobago
68	NAHRWAN - Masirah Island (Oman)
69	NAHRWAN - Saudi Arabia
70	NAHRWAN - United Arab Emirates
71	OBSERVATORIO 1966 - Corvo and Flores Islands (Azores)
72	OLD EGYPTIAN - Egypt
73	OLD HAWAIIAN - Mean Value

74	OMAN - Oman
75	PICO DE LAS NIEVES - Canary Islands
76	PITCAIRN ASTRO 1967 - Pitcairn Island
77	PUERTO RICO - Puerto Rico, Virgin Islands
78	QATAR NATIONAL - Qatar
79	QORNOQ - South Greenland
80	REUNION - Mascarene Island
81	ROME 1940 - Sardinia Island
82	RT 90 - Sweden
83	PROVISIONAL SOUTH AMERICAN 1956 - Bolivia, Chile, Colombia, Ecuador, Guyana, Peru, Venezuela
84	SOUTH AMERICAN 1969 - Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Venezuela, Trinidad and Tobago
85	SOUTH ASIA - Singapore
86	PROVISIONAL SOUTH CHILEAN 1963 - South Chile
87	SANTO (DOS) - Espirito Santo Island
88	SAO BRAZ - Sao Miguel, Santa Maria Islands (Azores)
89	SAPPER HILL 1943 - East Falkland Island
90	SCHWARZECK - Namibia
91	SOUTHEAST BASE - Porto Santo and Madeira Islands
92	SOUTHWEST BASE - Faial, Graciosa, Pico, Sao Jorge, and Terceira Islands (Azores)
93	TIMBALAI 1948 - Brunei and East Malaysia (Sarawak and Sabah)
94	TOKYO - Japan, Korea, Okinawa
95	TRISTAN ASTRO 1968 - Tristan da Cunha
96	User defined earth datum
97	VITI LEVU 1916 - Viti Levu Island (Fiji Islands)
98	WAKE-ENIWETOK 1960 - Marshall Islands
99	WORLD GEODETIC SYSTEM 1972
100	WORLD GEODETIC SYSTEM 1984
101	ZANDERIJ - Surinam
102	CH-1903 - Switzerland
103	Hu - Tzu - Shan
104	Indonesia 74
105	Austria
106	Potsdam
107	Taiwan - modified Hu-Tzu-Shan
108	GDA - Geocentric Datum of Australia
109	Dutch

APPENDIX B: BINARY PHASE OUTPUT FORMAT

In binary phase output mode, GPS 10 series products will transmit two types of packets once per second. One record contains primarily post-process information such as position and velocity information. The second record contains receiver measurement information. For the GPS 10, the records are sent at a default baud rate of 9600 baud, 8 data bits, and no parity.

To turn these records on, use the $PGRMC1 NMEA sentence as described in Section 3.1.4.

(Refer to the *GARMIN GPS Interface Specification* for details on how to form and parse Garmin packets. At the time of this printing, these specs are available from the technical suppport section of our Web site: http://www.garmin.com/support/commProtocol.html.)

For the GPS 10, the two records must be enabled independently by commands to the unit (Refer to the *GARMIN GPS Interface Specification USB Addendum* for details on how to form and parse Garmin packets over USB. At the time of this printing, these specs are available from the technical suppport section of our Web site: http://www.garmin.com/support/commProtocol.html.) The ID of each command should be 10 decimal to signify that the record is a command. The data portion of the packet should be one of the following:

Function	Command (base 10)
Position Record On	49
Position Record Off	50
Receiver Measurement Record On	110
Receiver Measurement Record Off	111

Note that the satellite data information is also enabled when the position record is enabled.

Records sent over RS232 begin with a delimiter byte (10 hex). The second byte identifies the record type (33 hex for a position record, 34 hex for a receiver measurement and 72 hex for a satellite data record). The third byte indicates the size of the data. The fourth byte is the first byte of data. The data is then followed by a checksum byte, a delimiter byte (10 hex), and an end-of-transmission character (03 hex). Additionally, any DLEs (0x10) that appear between the delimeters are escaped with a second DLE. There is sample code at the end of this section that will strip off the DLEs and ETXs.

RS232 Packet:

- 0x10   (DLE is first byte)

- 0x##   (Record ID – single byte)

- 0x##   (Number of data bytes – single byte)

- data bytes   (See descriptions below)

- 0x##   (2's complement of the arithmetic sum of the bytes between the delimiters)

- 0x10   (DLE)

- 0x03   (ETX is last byte)

USB packets contain only the record ID, size, and data payload. Refer to *the GARMIN GPS Interface Specification USB Addendum* for details on how to form and parse Garmin USB packets.

USB Packet:
- 0x##   (Record ID – single byte)

- 0x##   (Number of data bytes – single byte)

- data bytes   (See descriptions below)

The data bytes of each packet contain the record specified by the record ID. A description of each record follows.

Satellite Data Record
The satellite data has a record ID of 0x72 with 84 (0x54) data bytes. The data bytes contain the data for the 12 channels as described below. For each satellite, the following data is available:

typedef   struct

```
    {
    uint8        svid;          //space vehicle identification (1-32 and 33-64 for WAAS)
    uint16       snr;           //signal-to-noise ratio
    uint8        elev;          //satellite elevation in degrees
    uint16       azmth;         //satellite azimuth in degrees
    uint8        status;        //status bit-field
    } cpo_sat_data;
```

The status bit field represents a set of booleans described below:

Bit	Meaning when bit is one (1)
0	The unit has ephemeris data for the specified satellite.
1	The unit has a differential correction for the specified satellite.
2	The unit is using this satellite in the solution.

This pattern is repeated for all 12 channels for a total of 12 X 7 bytes = 84 (0x54) bytes :

```
typedef    struct
           {
           cpo_sat_data
           cpo_sat_data
           cpo_sat_data
           cpo_sat_data
           cpo_sat_data
           cpo_sat_data
           cpo_sat_data
           cpo_sat_data
           cpo_sat_data
           cpo_sat_data
           cpo_sat_data
           cpo_sat_data
           } cpo_all_sat_data
```

The RS-232 Packet for the Satellite Record looks like:

- 0x10   (DLE is first byte)

- 0x72   (Record ID – single byte)

- 0x54   (Number of data bytes – single byte)

- cpo_all_sat_data

- 0x##   (2's complement of the arithmetic sum of the bytes between the delimiters)

- 0x10   (DLE)

- 0x03   (ETX is last byte)

The USB Packet for the Satellite Record looks like:

- 0x72   (Record ID – single byte)

- 0x54   (Number of data bytes – single byte)

-    cpo_all_sat_data

Position Record
The Position Record has a record identifier of
```
typedef struct
    {
    float       alt;
    float       epe;
    float       eph;
    float       epv;
    int         fix;
    double      gps_tow;
    double      lat;
    double      lon;
    float       lon_vel;
    float       lat_vel;
    float       alt_vel;
    float       msl_hght;
    int         leap_sec;
    long        grmn_days;
    } cpo_pvt_data;
```
alt   Ellipsoid altitude (meters)
epe   Est pos error (meters)
eph   Pos err, horizontal (meters)
epv   Pos err, vertical (meters)
fix   0 = no fix; 1 = no fix; 2 = 2D; 3 = 3D; 4 = 2D differential; 5 = 3D differential;
            6 and greater - not defined
gps_tow   GPS time of week (sec)
lat   Latitude (radians)
lon   Longitude (radians)
lon_vel   Longitude velocity (meters/second)
lat_vel   Latitude velocity (meters/second)
alt_vel   Altitude velocity (meters/second)
msl_hght   Mean sea level height (meters)
leap_sec   UTC leap seconds
grmn_days   Garmin days (days since December 31, 1989)

Receiver Measurement Record
```
typedef struct
    {
    unsigned long    cycles;
    double           pr;
    unsigned int     phase;
    char             slp_dtct;
    unsigned char    snr_dbhz;
    char             svid;
    char             valid;
} cpo_rcv_sv_data;

typedef struct
    {
    double           rcvr_tow;
    int              rcvr_wn;
    cpo_rcv_sv_data  sv[ 12 ];
} cpo_rcv_data;
```

rcvr_tow   Receiver time of week (seconds)
rcvr_wn   Receiver week number
cycles   Number of accumulated cycles
pr   Pseudorange (meters)
phase   To convert to (0 -359.999) multiply by 360.0 and divide by 2048.0
slp_dtct   0 = no cycle slip detected; non-zero = cycle slip detected

snr_dbhz   Signal strength - db Hz
svid   Satellite number (0-31 and 119-138 for WAAS) Note - add 1 to offset to current svid numbers.
valid   0 = information not valid; non-zero = information valid

DLE and ETX bytes:
Sample C code to receive the two records should filter DLE and ETX bytes as described below:

```c
typedef enum
    {
    DAT,
    DLE,
    ETX
    } rx_state_type;

/* Declare and initialize static variables */
static char          in_que[ 256 ];
static int           in_que_ptr = 0;
static rx_state_type rx_state = DAT;


.
.
.


void add_to_que( char data )
{
#define DLE_BYTE 0x10
#define ETX_BYTE 0x03

if ( rx_state == DAT )
    {
    if ( data == DLE_BYTE )
        {
        rx_state = DLE;
        }
    else
        {
        in_que[ in_que_ptr++ ] = data;
        }
    }
else if ( rx_state == DLE )
    {
    if ( data == ETX_BYTE )
        {
        rx_state = ETX;
        }
    else
        {
        rx_state = DAT;
        in_que[ in_que_ptr++ ] = data;
        }
    }
else if ( rx_state == ETX )
    {
    if ( data == DLE_BYTE )
        {
        rx_state = DLE;
        }
    }
if ( in_que_ptr > 255 )
    {
    in_que_ptr = 0;
    }
```

}

APPENDIX C: GPS 10 AND WINDOWS SERIAL MOUSE ISSUE

Problem: It is possible for Windows to incorrectly interpret the NMEA 0103 output of the GPS 10 as the output of a Microsoft Serial BallPoint Mouse. When that happens, Windows loads drivers for the Serial BallPoint Mouse. This causes the cursor to move erratically about the display, clicking, right clicking, double clicking, dragging and dropping displayed items as it goes. On Windows 2000 and Windows XP, you may not experience the problem if you wait until after the computer is booted before connecting the GPS 10 to the serial communications port. This problem is not specific to the GPS 10. Any NMEA 0103 device connected to a Windows computer's serial port is likely to cause this problem. Below are several possible solutions to this problem.

Note: If your GPS 10 came with Garmin nRoute™ Navigation Software, you will not have this problem because the unit is programmed to produce data according to the binary format that is described in Appendix B: Binary Phase Output Format.

If you wish to use a different navigation software application with your GPS 10, you will need to de-select the "Phase Output Data" option that is discussed in Solution 3 below.

Solution 1: The easiest solution is to disable the Serial BallPoint mouse in the Device Manager. Of course, this solution assumes that you do not need to use a Serial BallPoint mouse with your computer. When the wild mouse problem occurs follow the steps below.

1. Unplug the DB9 connector.

2. Right-click on the My Computer icon on your desktop and select Properties to open Device Manager

3. Go to the hardware tab of the resulting pop-up window and click on the Device Manager button.

4. Right-click on the Serial BallPoint Mouse and choose the option to disable (NOT uninstall) this device.

Solution 2: Do not plug the DB9 connector into the computer until the computer is turned on and the operating system is completely booted up and running. Every time you use the GPS 10 PC/LVC, you will need to start the computer and operating system before making the connection between the GPS 10 PC and the computer. This solution usually works on Windows 2000 and Windows XP computers.

Solution 3: Change the default output of the GPS 10 so that it does not automatically send NMEA 0103 data to the computer (change the default configuration to enable "Phase Output Data"). Use the Garmin Sensor Configuration Software, named SNSRCFG.EXE, provided on the Web site to enable "Phase Output Data." SNSRCFG.EXE is included with the latest GPS 10 firmware, available at http://www.garmin.com/support/agree.jsp?product=010-00321-05.

Please note that by enabling "Phase Output Data," the device will no longer appear as a NMEA 0103 device to your computer. As a result, mapping applications that expect to hear NMEA 0103 data will not recognize your GPS 10 P/LVC until you re-enable the NMEA 0103 output, disabling the "Phase Output Data" in the process.

Refer to Appendix D: Sensor Configuration Software for complete information about downloading the Sensor Configuration Software application.

After the Sensor Configuration Software is installed and running on your computer, follow the steps below to change the default data output of the GPS 10.

1. Select the **GPS 10** from the list of sensors and click **OK.** The Sensor Configuration Software opens with the default configuration file for the GPS 10, as shown on the next page.

2. Select **Config** > **Switch to NMEA Mode (**or press the F10 key).

3. Select **Comm** > **Setup** to open the Comm Setup Window.
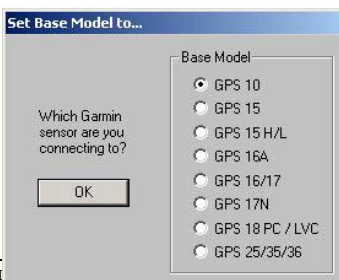
4. Select the Serial Port to which the GPS 10 is connected. Select Auto to have the program automatically determine the Baud Rate, or select Manual to manually select the Baud Rate of the GPS 10. Click OK when done.
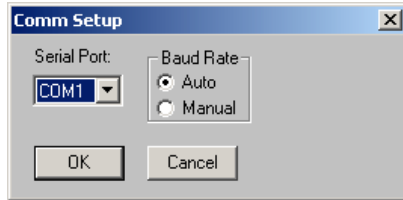
5. Click the Connect icon ⚏⚏, or select **Comm** > **Connect** to connect to the GPS 10.

6. To view the current programming of the GPS 10, select **Config > Get Configuration from GPS** (or press the F8 key). The current programming of the GPS 10 is displayed in the window, as shown on the previous page.

7. Open the Sensor Configuration Window by pressing the F6 key or selecting **Config > Sensor Configuration.**
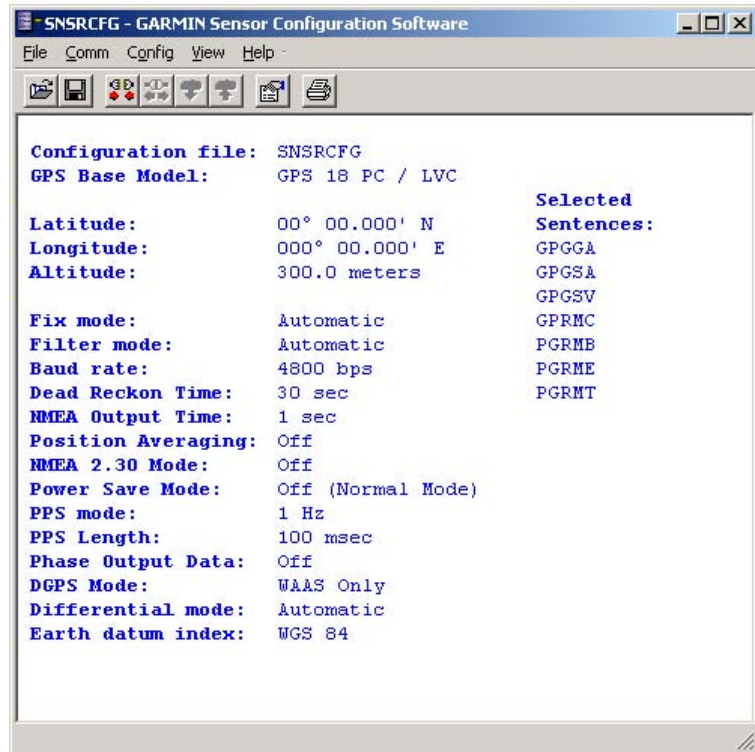
8. Place a check mark in the box next to "Binary Output Data" to change the GPS 10 to GARMIN Mode. The unit will keep this change in the programming until you change it again in the software.

   Note: Selecting **Config** > **Switch to Garmin Mode (**or pressing the F11 key) only changes the unit to work in Garmin Mode until power is cycled through the unit again. For a more permanent change, refer to step 8 above.

9. Click OK when completed enabling "Binary Output Data."

10. When you are ready to upload the changes into the GPS 10, select **Config > Send Configuration to GPS** (or press the F9 key). The new configuration is then loaded into the GPS 10.

11. You may disconnect and close the software when finished. The software configuration can also be saved for future reference.

Refer to Appendix D: Sensor Configuration Software for complete information about downloading the Sensor Configuration Software application.
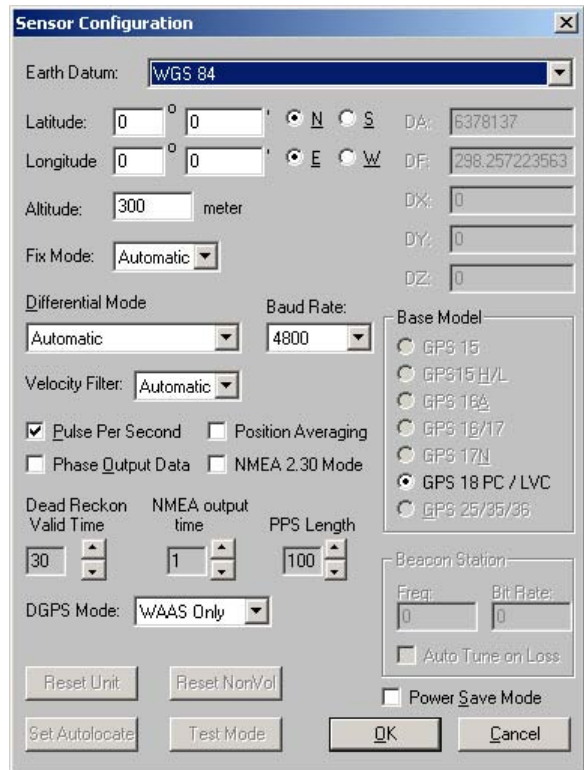
## APPENDIX D: SENSOR CONFIGURATION SOFTWARE

SNSRCFG configures the GPS sensors based on user-selected parameters. Some application features include the ability to download GPS sensor configuration, maintain different configurations in files, and perform GPS sensor configurations quickly with the use of one function key.

This section provides a brief overview of the Sensor Configuration Software. Refer to this section when using the software to configure your Garmin sensor.

Downloading the Sensor Configuration Software

The Garmin Sensor Configuration Software (**SNSRCFG.exe)** is available from the Garmin Web site. To download the software, start at http://www.garmin.com/oem, select the GPS 10, and then select Software Updates. The Garmin Sensor Configuration Software (SNSRCFG.exe) is included in the software update download.
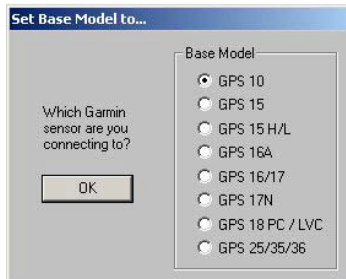
Selecting a Model

After opening the program (snsrcfg.exe), the following screen appears. Select the radio button next to the type of Garmin sensor you are configuring.

Connecting to the Sensor

After selecting the type of sensor, the following window opens. This is the Main Interface Screen for the program.

To configure your sensor, you must first connect to the sensor.

1. Select **Config** > **Switch to NMEA Mode (**or press the F10 key).

2. Select **Comm** > **Setup** to open the Comm Setup Window.

3. Select the Serial Port to which the sensor is connected. Select Auto to have the program automatically determine the Baud Rate, or select Manual to manually select the Baud Rate of the GPS 10. Click OK when done.

4. Click the Connect icon 🎲, or select **Comm** > **Connect**.

5. To view the current programming of the sensor, select **Config > Get Configuration from GPS** (or press the F8 key). The current programming of the sensor is displayed in the window shown to the right.
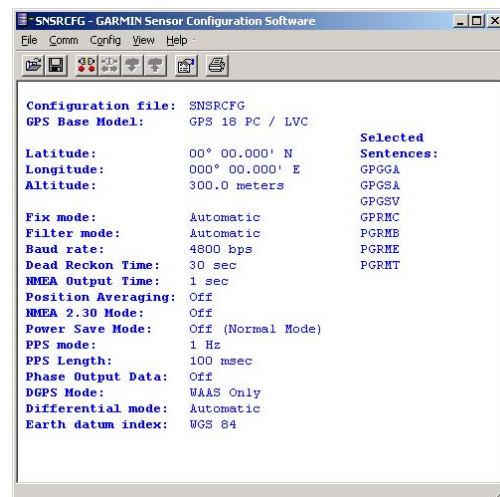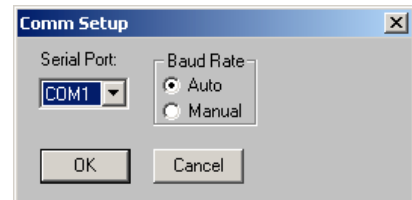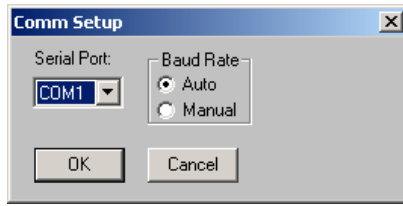
File Menu

The File Menu allows you to open, save, and print sensor configurations. The items in the File Menu work like most Windows-based programs.

Comm Menu

The Comm (Communication) Menu allows you to set the port number, baud rate, and then connect and disconnect from the sensor.

Setup: Opens the Comm Setup Window, shown to the left. Select the Serial Port to which the sensor is connected from the drop-down list. Then select Auto (the program determines the baud rate on its own) or Manual (you then enter the baud rate) for the Baud Rate entry.

Connect: Select **Connect** to connect to the sensor to change or view the configuration.

**Disconnect**: Select Disconnect to disconnect from the sensor.

Config Menu

The Config (Configuration) Menu allows you configure the sensor as it is connected.

Sensor Configuration (F6): Opens the Sensor Configuration Window, shown to the right. Many of the fields in this window should be left alone. Please refer to the beginning of this manual for clarification about some of these fields. For the most part, this window is used to enter a new Latitude, Longitude, and Altitude for the sensor. This is especially helpful when you are programming the sensor for use in a particular geographic location.

Resetting the Unit (Reset Unit) performs a reset on the unit, much like cycling the power.

Resetting the non-volatile memory (Reset NonVol) will clear all of the data from the non-volatile memory.

NMEA Sentence Selections (F7): Displays the NMEA Sentence Selections Window. If the sentence is enabled, a check mark appears in the box to the left of the sentence name. Click the box to enable or disable to the sentence.
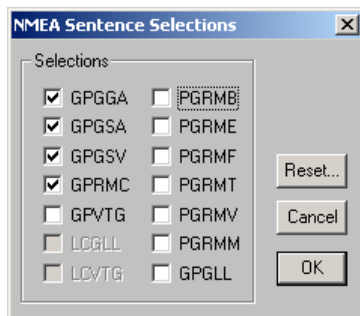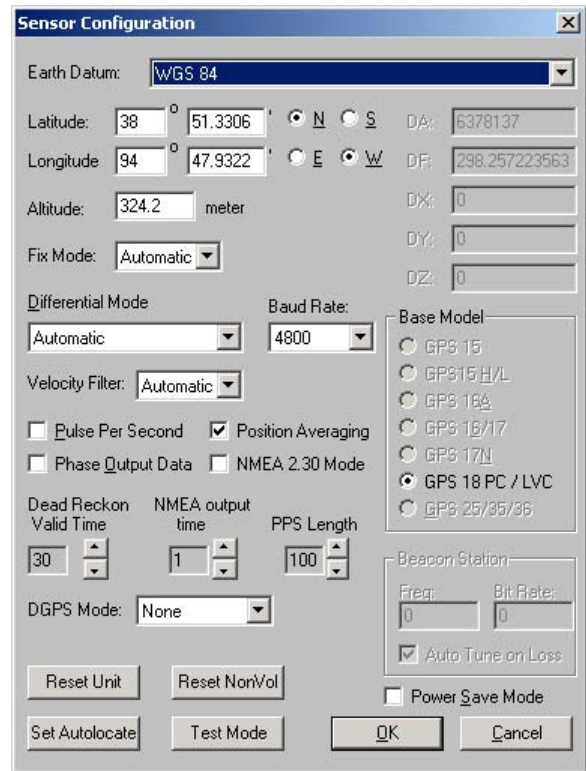
Get Configuration From GPS (F8): Retrieves the current programming from the sensor. The programming is then displayed in the Main Interface Window.

Send Configuration To GPS (F9): Sends the changes you have made to the programming to the sensor.

Switch to NMEA Mode (F10): Switches the unit to NMEA Mode. The sensor must be in NMEA Mode when connected to this software.

Switch to Garmin Mode (F11): Switches the unit to Garmin Mode.

Update Software (F12): After you have downloaded a new software version for the sensor, you can update the sensor with the new software. Select Update Software and then select the file using the Open dialog box. You must locate both the *.rgn file and the updater.exe file.

View Menu

The View Menu allows you to view the NMEA sentences transmitted by the sensor. You can also customize how the program looks by showing and hiding the Toolbar and Status Bar.

Help Menu

The Help Menu displays the software version and copyright information.

For the latest free software updates (excluding map data) throughout the life of your Garmin products, visit the Garmin Web site at www.garmin.com.

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