GPS 10x
TECHNICAL
SPECIFICATIONS

RECORD OF REVISIONS

Revision	Revision Date	Description	ECO #
A	12/6/06	Initial Release	--

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1 INTRODUCTION

1.1 CAUTIONS

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 10x 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 10x. 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.

FCC Compliance

The GPS 10x 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 10x 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.

Battery Warnings

If these guidelines are not followed, the lithium-ion battery may experience a shortened life span or may present a risk of damage to the GPS unit, fire, chemical burn, electrolyte leak, and or injury. Contact your local waste department to properly dispose of the unit/battery.

- Do not leave the unit exposed to a heat source or in a high temperature location, such as in the sun in an unattended vehicle on a hot day. To prevent damage, remove the unit from the vehicle or store it out of direct sunlight, such as in the glove box.

- Do not incinerate.

- When storing the unit for a limited length of time, store within the following temperature range: -4˚ to 140˚F (-20˚ to 60˚C). When storing the unit for an extended time, store within the following temperature range: 32˚ to 77˚F (0˚ to 25˚C).

- Do not operate the unit outside of the following temperature range: 14˚ to 140˚F (-10˚ to 60˚C).

- Keep the used battery away from children. Do not disassemble, puncture, or damage the battery.

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 Product Support at one of the numbers listed 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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1200 E 151st Street, Olathe, Kansas 66062 U.S.A.
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Fax. 913/397.8282

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Unit 5, The Quadrangle, Abbey Park Industrial Estate, Romsey, SO51 9DL U.K.
Tel. 44/0870.8501241 (outside the UK) 0808 2380000 (inside the UK)
Fax 44/0870.8501251

Online Auction Purchases: Products sold through online auctions are not eligible for rebates or other special offers from Garmin. Online auction confirmations are not accepted for warranty verification. To obtain warranty service, an original or copy of the sales receipt from the original retailer is required. Garmin will not replace missing components from any package purchased through an online auction.

International Purchases: A separate warranty is provided by international distributors for units purchased outside the United States. This warranty is provided by the local in-country distributor and this distributor provides local service for your unit. Distributor warranties are only valid in the area of intended distribution. Units purchased in the United States or Canada must be returned to the Garmin service center in the United Kingdom, the United States, Canada, or Taiwan for service.

1.3   OVERVIEW

The GPS 10x product is a high sensitivity SiRFstarIII™ GPS receiver with WAAS capability, a removable rechargeable lithium-ion battery, and Bluetooth® wireless technology capability. The GPS 10x 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 10x's far-reaching capability meets the sensitivity requirements of land navigation as well as the dynamics requirements of high-performance aircraft.

The GPS 10x 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 GPS RF/IF receiver hardware and the GPS 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 10x easy to integrate and use for laptop/tablet PC, PDA, and smart phone applications by incorporating a Class 2 Bluetooth module within the unit.

The GPS 10x product is designed to withstand rugged operating conditions. This complete GPS receiver requires no additional components to be supplied by an OEM or system integrator. A removable rechargeable lithium-ion battery and 12 VDC charging adapter are provided with the receiver. The only requirement is 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

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

- High sensitivity SiRFstarIII™ GPS receiver 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 chartplotter or laptop/tablet PC, PDA, or smart phone with Bluetooth wireless technology capability.

- 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.

- Removable rechargeable main power battery.

- The real-time clock can run for up to 2 months after the battery enters a low battery mode.

- 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).

- Four anti-skid mounts for flat surface placement.

- Includes 12 VDC Cigarette Lighter Charging Adapter.

- Auto Power On Mode: When in the Off mode and connected to a switched 12 V DC external power source, the GPS 10x automatically turns On when external power is turned on. (example: a cigarette lighter controlled by the vehicle ignition switch.)

1.4.1   GPS 10x Wireless Receiver

The GPS 10x 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 10x:

- 12 VDC Cigarette Lighter Charging Adapter with Mini B-USB Connector (010-10563-00)

DC Charging Adapter

- Belt Clip (145-00956-70)
- Optional 110-115 V AC Charging Adapter with Mini B-USB connector (010-10723-00)

Belt Clip   **Optional Charging Adapter**

1.5   TECHNICAL SPECIFICATIONS

Specifications are subject to change without notice.

1.5.1   Physical Characteristics

1.5.1.1 Size
42 mm wide, 77 mm long and 18 mm in height (.697" H x 1.65"W x 3.04"D)

1.5.1.2 Weight
2.1 ounces (60 grams)

1.5.1.3 Color
Matt Metallic Silver with Black accents

1.5.1.4 Case Material
Polycarbonate thermoplastic and ABS case

1.5.2 Electrical Characteristics

1.5.2.1 Input Voltage
4.5–5.5 V

1.5.2.2 Input Current
500mA @ 5.0 V

1.5.2.3 Battery
- Capacity: 1100 mAHr

- Charging rate: Approx. 4 Hrs

- Operating time: Approx. 22 Hours with WAAS enabled.

1.5.2.4 Battery Charger
The included Cigarette Lighter Adapter (010-10563-00) can be used to charge the GPS 10x's internal battery

1.5.3 Environmental Characteristics

1.5.3.1 Operating Temperature Range
- -30°C to + 60°C   Powered from external supply

- -10°C to +60°C   Powered by removable rechargeable battery

1.5.3.2 Battery Charging Temperature Range
5°C to 45°C

- Input   10 to 30 V AC

- Output 4.9 to 5.25 V DC @ 1.0 A

1.5.3.3 Storage Temperature
-30°C to 60°C

1.5.4 GPS Performance

1.5.4.1 Receiver
High sensitivity SiRFstarIII™ GPS receiver; WAAS-enabled.

1.5.4.2 Acquisition Times
(On average for a stationary receiver with a clear view of the sky.)
- Warm: <1 sec

- Cold: <38 sec

- Factory Reset: <45 sec

1.5.4.3 Update Rate
1 record per second, continuous

1.5.4.4 Accuracy
- GPS accuracy
  Position: <10 meters, typical
  Velocity: 0.05 meters/sec RMS

- GPS (WAAS) accuracy
  Position: <5 meters, typical
  Velocity: 0.05 meters/sec RMS

1.5.5 Interfaces

1.5.5.1 GPS 10x Electrical Characteristics

- Communicate with Host Platform via Bluetooth Serial Profile

- Typical Range: up to 32 feet (10 meters)

1.5.5.2 Garmin Interface

Refer to the *Garmin Device Interface Specification* 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 A: Binary Phase Output Format for additional information concerning access to raw pseudo-range and carrier phase data from the GPS 10x.

1.5.5.3 GPS 10x Protocol

- NMEA 0183 Version 2.0 or NMEA 0183 Version 2.30 (Version 2.0 is factory default, programmable by data field 1 of the PGRMC1 sentence described in Section 3.1.1 Additional Sensor Configuration Information (PGRMC1). To determine the specific sentences supported by SiRF, refer to the SiRF website.

- Available NMEA 0183 output sentences include GPGGA, GPGSA, GPGSV, GPRMC, GPVTG, GPGLL, and PGRMT (Garmin proprietary sentences). See Section 3.2 Transmitted NMEA 0183 Sentences for format descriptions.

- Configuration and initialization is accomplished with NMEA 0183 input sentences. Allows initialization of information such as expected position, date, time, earth datum, and differential mode. See Section 3.1 Received NMEA 0183 Sentences for format descriptions.

- Configurable for binary data output including GPS carrier phase data.

2 MECHANICAL CHARACTERISTICS & MOUNTING

Figure 1 shows the operational characteristics of the GPS 10x. Figure 2 shows the auxiliary power plug dimensions. Power Plug Specifications for charging the GPS 10x from user provided power source: Mini-USB connector (Range 4.5 to 5.5 VDC @ 500 mA)

Figure 1. GPS 10x Operational Characteristics

Bluetooth LED

Rapid Flashing Blue: Power On, Bluetooth On
Slow Flashing Blue: Bluetooth link established

Power Status LED

Flashing Yellow-Green: Charging in progress
Solid Yellow-Green: Battery charged
Flashing Orange: Low battery
Solid Orange: Faulty battery or system error

Power On.Off Button

Mini-USB Connector for Power Cable
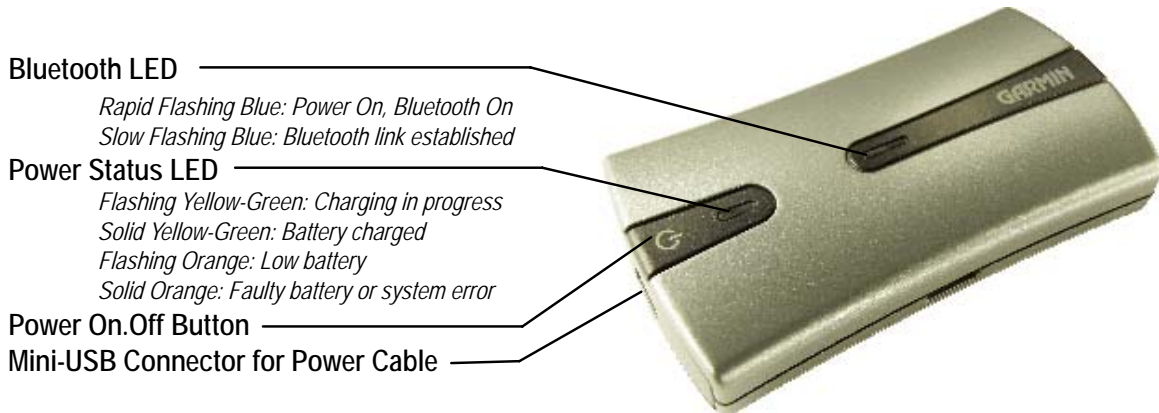
3 GPS 10X SOFTWARE INTERFACE

The interface protocol design of the GPS 10x product is based on the National Marine Electronics Association's NMEA 0183 ASCII interface specification. This standard is fully defined in *NMEA 0183, Version 2.30*. Copies may be obtained from NMEA, http://www.nmea.org/.

In addition to the standard NMEA 0183 sentences, the GPS 10x may also be configured to transmit information over their serial interface using NMEA 0183 compliant Garmin proprietary sentences. These proprietary sentences begin with the characters, "$PGRM", instead of the characters "$G" that are typical of the standard NMEA 0183 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 10x to transmit binary phase data information over their serial interface. See Appendix A: Binary Phase Output Format for details.

The following sections describe the NMEA 0183 data format of each sentence transmitted and received by the GPS 10x product.

3.1 RECEIVED NMEA 0183 SENTENCES

The following paragraphs define the sentences that can be received on the GPS sensor's 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 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>,<10>,<11>,<12>*hh<CR><LF>

<11>	Auto Power Off, 1 = Off, 2 = On
<12>	Power On with External Charger, 1 = Off, 2 = On

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. 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 0183. 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)

3.1.2 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,,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.

3.2   TRANSMITTED NMEA 0183 SENTENCES

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

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
GPGGA	✔	82
GPGSA	✔	66
GPGSV	✔	70
GPGLL		44
GPVTG		42
PGRMT	Once per minute	50

Table 1: NMEA 0183 Output Sentence Order and Size

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 0183 specification.

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).* This document is 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 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)

3.2.4   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 0183 version 2.30 active), A = Autonomous, D = Differential, E = Estimated, N = Data not valid

3.2.5   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 0183 version 2.30 active), A = Autonomous, D = Differential, E = Estimated, N = Data not valid

3.2.6   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 0183 version 2.30 active), A = Autonomous, D = Differential, E = Estimated, N = Data not valid

3.2.7   GPS DOP and Active Satellites (GSA)
$GPGSA,<1>,<2>,<3>,<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

3.2.8

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 0183 data. These fields will be null if unused.

3.2.9 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>,,,,,,,,

<1>	Product, model and software version (variable length field, e.g., "GPS 10 SW VER 2.01 BT VER 1.27 764")

APPENDIX A: BINARY PHASE OUTPUT FORMAT

In binary phase output mode, GPS 10x 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.

Refer to the *Garmin Device 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 at http://www.garmin.com/support/commProtocol.html.

For the GPS 10, the two records must be enabled independently by commands to the unit. 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 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 Device Interface Specification* for details on how to form and parse Garmin USB packets. The document is located on the Garmin Web site at http://www.garmin.com/support/ commProtocol.html.

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:

38   INDIAN - Thailand, Vietnam
- 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;
```

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

```
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;


.
.
.

    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 + = undefined
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)

DLE and ETX bytes:

```c
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 B: GPS 10X AND WINDOWS SERIAL MOUSE ISSUE

Problem: It is possible for Windows to incorrectly interpret the NMEA 0183 output of the GPS 10x 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 10x to the serial communications port. This problem is not specific to the GPS 10x. Any NMEA 0183 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 you are using Garmin nRoute™ Navigation Software with your GPS 10x, you will not have this problem because the unit is programmed to produce data according to the binary format that is described in Appendix A: Binary Phase Output Format.

If you wish to use a different navigation software application with your GPS 10x, 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 the **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 **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 10x, you will need to start the computer and operating system before making the connection between the GPS 10x PC and the computer. This solution usually works on Windows 2000 and Windows XP computers.

Solution 3: Change the default output of the GPS 10x so that it does not automatically send NMEA 0183 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 10x firmware.

Please note that by enabling "Phase Output Data," the device will no longer appear as a NMEA 0183 device to your computer. As a result, mapping applications that expect to hear NMEA 0183 data will not recognize your GPS 10x until you re-enable the NMEA 0183 output, disabling the "Phase Output Data" in the process.

Refer to

Appendix C: 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 10x.

1. Select the **GPS 10x** from the list of sensors and click **OK.** The Sensor Configuration Software opens with the default configuration file for the GPS 10x, 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.
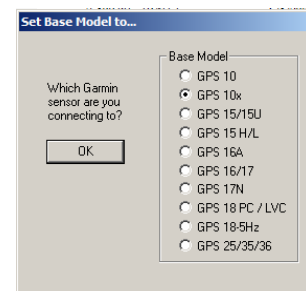
4. Select the Serial Port to which the GPS 10x is connected. Select **Auto** to have the program automatically determine the Baud Rate, or select **Manual** to manually select the Baud Rate of the GPS 10x. Click **OK** when done.

Click the Connect icon [icon], or select **Comm** > **Connect** to connect to the GPS 10x.
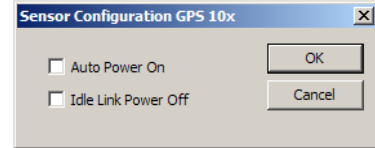
5. Place a check mark in the box next to "Binary Output Data" to change the GPS 10x to Garmin Mode. The unit will keep this change in the programming until you change it again in the software.

    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.

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

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

Refer to

Appendix C: Sensor Configuration Software for complete information about downloading the Sensor Configuration Software application.
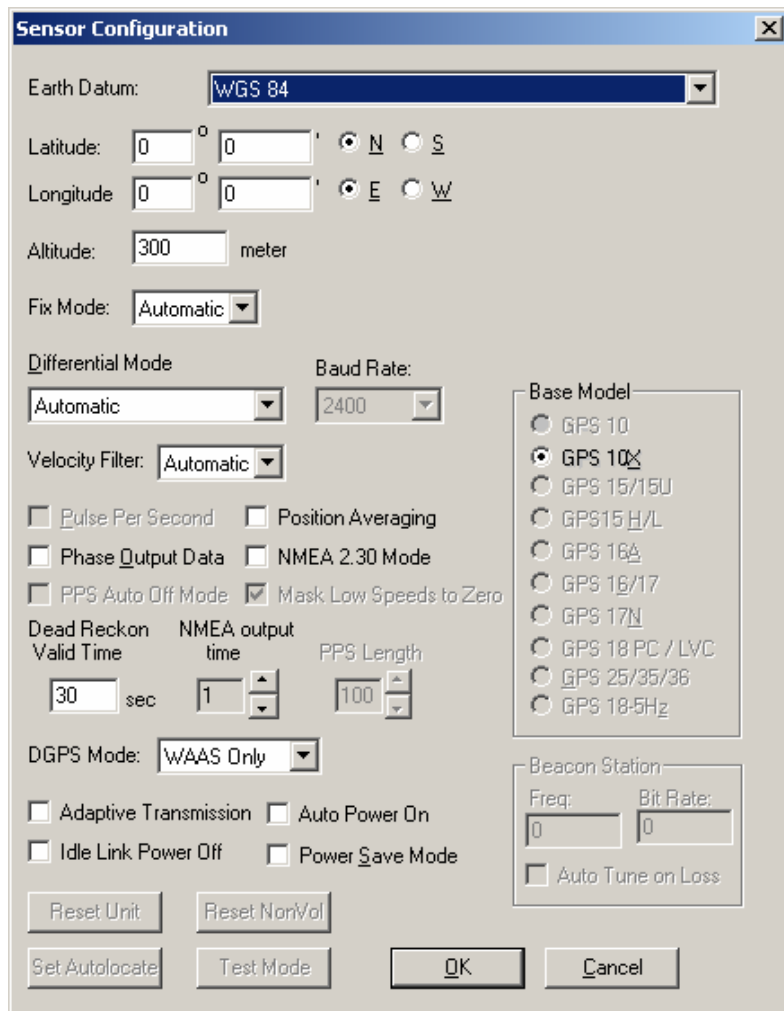
APPENDIX C: SENSOR CONFIGURATION SOFTWARE

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 10x, and then select Software Updates. The Garmin Sensor Configuration Software (SNSRCFG.exe) is included in the software update download.
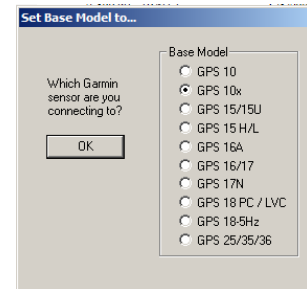
Selecting a Model

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 10x. 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.
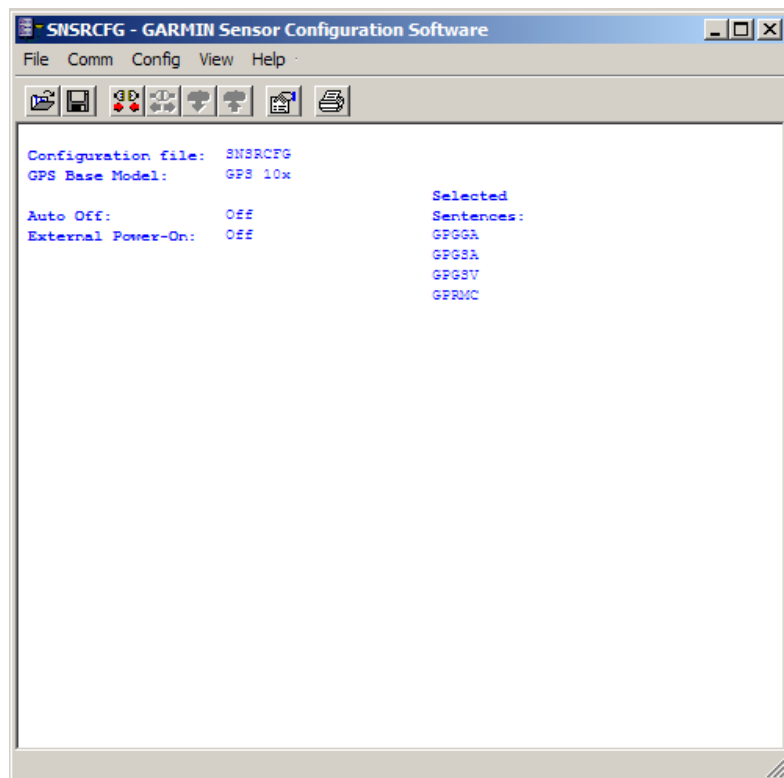
File Menu

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.
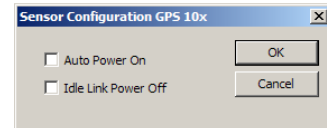
Config Menu

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

NMEA Sentence Selections (F7): Displays the NMEA Sentence S elections 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.

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.
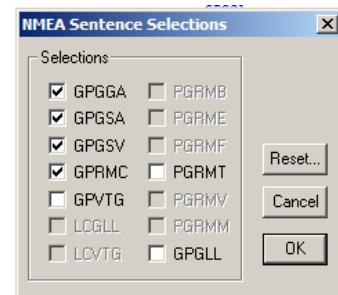
View Menu

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.
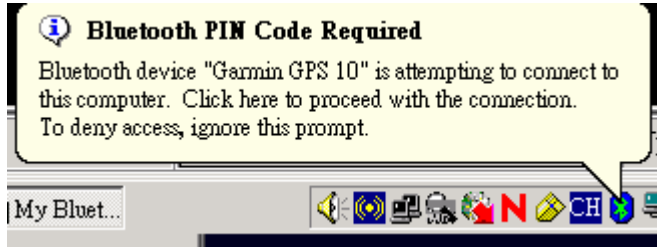
Help Menu

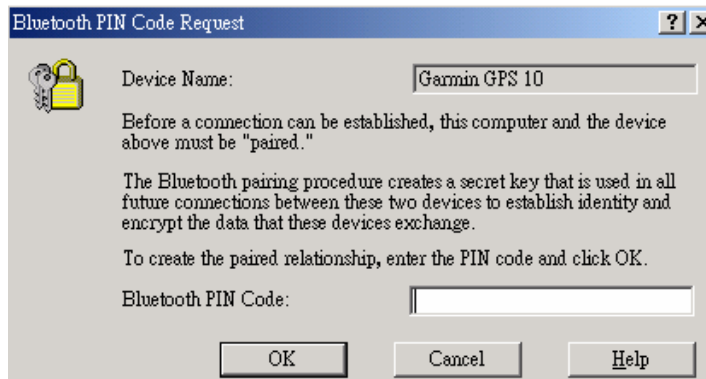The Help Menu displays the software version and copyright information.

APPENDIX D: HOST SYSTEM CONSIDERATIONS:

PIN Code

Some systems may or may not require a PIN Code in order to recognize the GPS 10x.
The default PIN code for GPS 10x is "1234". When you initially make this connection or the connection is terminated unexpectedly.

Just type "1234" and click **OK**.