AA272C
Winter 2001

Introduction to the Garmin GPS35-PC GPS receiver

This document is intended to provide all of the basic information required to operate and to interface with the Garmin GPS receivers used in this class. *Please read this document thoroughly before attempting to operate the GPS receiver. Failure to operate the receiver correctly could result in damage to the unit.*

As with any piece of electronic equipment, you must be careful with the GPS receiver. The following guidelines will help you keep your GPS35 unit (and the class course assistants) happy and functional:

- Handle the GPS unit with care. Extreme vibration or physical shock to the unit can damage it.

- Unless you have purchased your own GPS35 receiver, *do not open, tamper with, paint, or otherwise modify* the GPS receiver. **We expect to get the receiver back in the exact same condition as when we gave it to you.** If necessary, you may modify the cigarette lighter socket (the part with the red and black clips) as you wish.

- Only apply 6-40 Volts DC power to the GPS unit. If you are unsure whether your power supply is providing voltage with in this range, test it with a voltmeter *before* you connect it up to the receiver. Never connect the receiver to an AC power source (like a wall outlet).

- The GPS35 is water-resistant; you may operate the GPS35 outside in the rain. However, the GPS35 is not waterproof, so don't submerge the receiver underwater (or in any other fluid).

- Do not have GPS35 powered and attached to your computer while the computer is booting up. If you do this, the operating system may think the GPS35 is something else, and will incorrectly configure the serial port to which the GPS35 is attached. If you do this by mistake, try turning off the GPS35 and rebooting your computer.

- Apply power to the GPS35 before running any of the course-provided software. If you run the software and *then* turn on the unit after the software is running, the software will not work.

- When the power supply to the GPS35 gets weak (e.g., your battery starts running out of power), there is a possibility that the GPS35 will continue to send raw data but will **not** send any ephemeris data. To ensure that this does not happen, we recommend that you use well-charged or fresh batteries when taking important data.

- If you are in any way unsure about the operation of the GPS35 unit, *please* contact one of the course assistants prior to doing anything to the receiver that you might later regret. We're here to help you!

1.0 The Garmin GPS35-PC Receiver

The Garmin GPS35-PC receiver is an integrated Global Positioning System antenna and receiver. Despite its (relatively) low cost, it is a very powerful and capable receiver. While some older "handheld" GPS receivers only have the capability of tracking 1-4 GPS satellites at any given time, the GPS35 can track 12 GPS satellites simultaneously. Given the current constellation of 27 satellites, it is unlikely that you will ever have 12 or more satellites in view at the same time; however, depending on the receiver's visibility of the sky, you will likely see seven, eight, or more satellites tracked simultaneously.

Unlike many popular handheld GPS units, the GPS35 does not have a built-in display. Rather, the user interfaces with the GPS35 by connecting the unit up to a computer via a serial data port. For the purposes of this class, this feature facilitates the collection and processing of large amounts of GPS data.

Further, unlike most handheld GPS units, the GPS35 outputs *raw* GPS data, including *pseudorange, carrier phase,* and *signal-to-noise ratio (SNR)* for each satellite being tracked, as well as *ephemeris* data used in the calculation of the exact orbital positions of the GPS satellites being tracked. In the AA272C class, you will gain hands-on experience in processing this raw data to determine an estimate of user position.

1.1 GPS35 power supply

The GPS35 unit requires an unregulated 6-40 Volt DC input. The power cable has a cigarette lighter jack attached to its end. We have provided a cigarette lighter socket with positive (red) and ground (black) clips. Feel free to modify the *cigarette socket adapter* (the part with the red and black clips attached) and wires as required to provide power to the GPS35 unit (e.g., if you want to cut the wires and splice a 9-volt battery connector on the end, go right ahead; just be careful about which connection is positive and which is ground). However, unless you have purchased your own GPS35, *do not modify any part of the GPS35 unit, including the wires and connectors attached to the unit!*

The cigarette lighter jack attached to the GPS35 has a 5 Amp fuse inside. If the GPS35 unit will not operate, it may be because the fuse has been burnt out. *Unscrew the top off the cigarette lighter jack carefully: the little metal cap is easily lost. Never operate the GPS35 without the fuse. If you must replace the fuse, replace it with an identical 5 Amp fuse only!*

You may use any 6-40VDC power source to power the unit. A 12 VDC power supply or a 9-Volt battery are examples of adequate sources of electricity. *Never hook the GPS35 directly to an AC power source (such as an electrical wall socket)!*

1.2 GPS35 serial interface

The GPS35 provides data through an RS-232 serial connection. The unit actually has two *internal* data ports. On the GPS35-PC, only one of these data ports sends data out the serial connection at any given time. Software commands are used to switch between these two data sources. Internal port 1 provides ASCII data based on the National Marine Electronics Association (NMEA) 0183 protocol, providing data messages which provide useful position, velocity, and status data. Internal port 2 provides binary raw data, including pseudorange and carrier phase data. The units are initially configured to provide port 1 data at 4800 baud and port 2 data at 9600 baud. In this class, we will only be using data from internal port 2.

It is highly recommended that you utilize the interface software provided by the course assistants (available on the AA272 web page) and apply power to the GPS unit just prior to running the software. If you do so, you shouldn't have to worry about anything in the previous paragraph, as the course software automatically switches the GPS unit to port 2 to receive raw pseudorange and carrier phase data when the software initially starts running. However, note that if power is *cycled* (intentionally or unintentionally) on the GPS35, it will switch to port 1 when power is reapplied. If this happens while the software is running, you must restart the course software to switch the unit back to port 2.

Currently, the GPS35 interface software works only with a PC running Windows 95, 98, or NT (see Lab #1 for more information about "gpscomm.exe"). However, the data files created by this software can be read into MATLAB running on any operating system.

1.3 Data rate and satellite acquisition time

Once powered, the GPS35 unit provides data output once per second.

The time required to start transmitting valid satellite data will vary depending on how recently the receiver has been operating:

- *Warm start:* Typically, if the receiver has been operating recently, or if power is briefly interrupted, the receiver will reacquire satellites and start transmitting valid satellite data within 15 seconds.

- *Cold start:* If the receiver does not have current ephemeris data (e.g., when the receiver has been off for a few hours or more), it may take up to 45 seconds for the receiver to start transmitting valid satellite data.
- *Starting with no information:* If the receiver has never been turned on (which is very likely the case when you first get your receiver), or if the receiver is moved more than 1500 km with the power off, the internal battery has failed, or the stored time is off by more than 30 min, the receiver must go through the process of searching the sky for valid satellites and acquiring almanac data. This process can take from 5-15 minutes, so be patient.

Of course, you must have a reasonably unobstructed view of the sky (particularly the southern sky) for any GPS receiver to operate properly.

2.0 The GPS35 Test Utility

Unfortunately, the GPS35 does not have an LED on it to tell you when it is on or not. Sometimes, it may not be clear whether or not your GPS35 is actually working. Thus, to check to see whether or not your GPS35 is even on, we have provided "gpstest.exe", a Windows executable that helps you determine if your GPS35 is properly powered and connected to your computer. Download "gpstest.exe" from the AA272C Web site.

Before running "gpstest.exe," make certain that the DB-9 serial connector from the GPS35 is securely attached to a COM port that didn't have anything attached to it while the computer was booting up. Make certain that the cigarette lighter plug is firmly inserted into the cigarette lighter socket, and that you are ***prepared*** to attach (don't do it yet!) the **red** wire to the positive power supply or battery lead and to attach the **black** wire to the negative battery lead or to ground. It's never a bad idea to check your power supply voltage with a voltmeter to verify that the voltage is really in the 6-40VDC range.

To run "gpstest.exe", double-click on the icon, or open up a DOS window and run "gpstest.exe" from the appropriate directory. Follow the instructions on the screen carefully.

If your GPS35 is working correctly, you will see output that looks something like:

```
GPSTEST.EXE v1.0 - Garmin GPS35 test utility

This program checks to see whether or not your GPS35
is operational.  Please read carefully the document
'Introduction to the GARMIN GPS35-PC GPS Receiver'
before attempting to operate the receiver

Hit <ctrl-c> at any time to quit

Enter the COM port to which the GPS35 is attached (1-4): 2

Remove power from the GPS35, then reapply power to the GPS35 now
Hit <enter> to proceed:

Starting test...
PRAGMA Pack test successful
Little-endian test successful

Opening COM port 2 for communication with GPS35...
 a&Sôb  3725.3094,N,12208.1829,W,000.0,000.0,160399,015.3,E*72
$GPGGA,043452,3725.3094,N,12208.1829,W,0,00,,,M,,M,,*4D
$GPGSA,A,1,,,,,,,,,,,,,*1E
$GPGSV,3,1,11,01,04,195,,03,40,306,,06,14,153,,09,03,099,*7F
$GPGSV,3,2,11,17,53,067,,21,53,257,,22,14,243,,23,74,006,*78
$GPGSV,3,3,11,26,23,046,,29,15,190,,31,07,321,,,,,*4C
$GPRMC,043453,V,3725.3094,N,12208.1829,W,000.0,000.0,160399,015.3,E*73
```

```
$GPGGA,043453,3725.3094,N,12208.1829,W,0,00,,,M,,M,,*4C
$GPGSA
Successfully receiving GPS35 port 1 data at 4800 baud

Switching to GPS35 port 2...
Received GPS35 receiver data packet
Received GPS35 receiver data packet
Received GPS35 receiver data packet
Sending request for ephemeris data...
Received GPS35 ephemeris data packet
Received GPS35 receiver data packet
Received GPS35 receiver data packet
Received GPS35 receiver data packet
Received GPS35 receiver data packet
Received GPS35 receiver data packet
Successfully receiving GPS35 port 2 data at 9600 baud

Your GPS35 is operational
```

Note that you may or may not get a response to the request for ephemeris data (particularly if you are indoors!). If you are outside with a good view of the sky, and the receiver has been powered for 5-15 minutes, if you rerun "gpstest.exe" you *should* get ephemeris data.

If you do not get the output above, check for the following possibilities:

- The powered GPS35 or something else was hooked up to the COM port you are trying to use at the time the computer booting up (unplug your GPS35 from the computer and reboot).
- The GPS35 is plugged into the wrong COM port.
- The power supply or battery being used may not be supplying voltage in the 6-40VDC range (try a different source of power).
- Electricity may not be flowing to the receiver (check all electrical connections external to the receiver housing itself, including the fuse inside the cigarette lighter plug.

If your problem does not seem to be related to one of these, contact one of the course assistants for help.

3.0 Additional Information

For information about the GPS35, test programs, and Matlab utilities, look on the AA272C Web site at:

http://www.stanford.edu/class/aa272c

Some additional information can be found on the Garmin Web site:

http://www.garmin.com