

Scintillation Monitor Operations

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For CASCADE/SCINTMON running in real-time Linux using PCI Aerospace Innovations GPS Builder boards. Previous versions of this manual for for GEC Plessey GPS Builder boards running on the ISA bus in DOS.

For updates to this manual and the tools mentioned in it, check <http://gps.ece.cornell.edu>

General

The Global Positioning System (GPS) ionospheric scintillation monitor (“ScintMon”) developed by Cornell University's Space Plasma Physics group consists of a modified Aerospace Innovations GPS Builder card. As such, most of its operation is similar to the operation of the development software that comes with the kit. Significant modifications include: (1) elimination of all the portions of code pertaining to differential corrections, (2) addition of Fast, Scintillation Log (FSL) file capability, (3) an updated carrier-to-noise ratio estimator for the display, (4) an S4 index estimator, (5) user specification of RINEX2 and FSL header fields, and (6) data output that can be used for plotting in real time. To support these modifications, several new receiver commands have been added, old commands have been deleted and the displays have been updated. This manual, intended to supplement the Mitel/Zarlink GPS Builder-2™ Designer's Guide (found at <http://www.zarlink.com>), summarizes the changes and other important aspects of operation.

Setting up (Hardware)

In order to use the scintillation monitor, you must have a PC-compatible computer (preferably having a 200 MHz or faster Pentium® processor and at least a 10 GB hard drive) with the Aerospace Innovations GPS card installed into a PCI slot.

Note that almost all modern computers have enough extra hardware and software “features” to cause interrupt conflicts with the GPS card and receiver software. In particular, the GPS card should occupy its own IRQ (this can be verified using the Linux tool `lspci`). Examples of common features which are known to cause conflicts include: ethernet cards, sound cards, modem cards, certain SCSI card configurations, power management software. Effects of interrupt conflicts range from missed accumulation data to receiver software lockup. Experience has shown that the best chance for successful setup and operation of the GPS card and software comes with the simplest systems.

In plain language, view all computer features which are designed for “easy setup” or to make the computer “user friendly” or into a “multimedia center” with suspicion. Setting up the GPS card will be far easier if you eliminate all unnecessary hardware and software from the computer used for controlling the receiver at the outset. For example, the current Cornell Portable Scintillation Monitor computers have only a graphics card, a CD burner, an ethernet card, and GPS cards installed; — no sound cards, modems, etc.

Returning to the GPS card itself, note that the daughter board has some jumpers as well. These

should normally be left alone. One of these jumpers, *JP2*, is important to check when troubleshooting, however. The AI GPS card requires a pre-amplified antenna to operate (the recommended Group Allis antennas provide 26-35 dB of gain). Jumper *JP2*, when installed, allows the 5 volt DC regulator on the GPS board to supply power to the antenna preamplifier via the antenna cabling. *Important note: The GPS Builder-2™ manual incorrectly refers to the antenna power supply jumper as JP3. The correct jumper is JP2. If in doubt, trace from the 7805 regulator IC (3 pin case, looks like a transistor) to the socket of the short run of coaxial cable to the antenna connector to find the correct jumper. Please refer to Figure 1. at the end of this document.*

Mount the antenna by means of a magnet attached to its underside or a bolt assembly. The antenna should be placed on a suitable piece of steel or weather-treated iron (do not use aluminum, unless it is significantly thick > 5mm), roughly 50-100 cm on a side, which acts as a ground plane. For the October 1996 campaign, Cornell provided ground planes made of steel. Set the ground plane level in a spot where it has an unobstructed view of the sky — ideally, from horizon to horizon at all azimuth angles. Potential obstructions includes trees, hills, buildings and metal structures (cars, fencing, vents, etc.). Remember that GPS signals have about a 19-24 cm wavelength and therefore can scatter effectively from small structures. When scattered GPS signals reach the antenna, their interference with the direct signal from the satellite is called *multipath*. Multipath causes variations in signal amplitude and alters the timing code that GPS uses for ranging.

The ideal spot to place the antenna would be on the ground in an open field, away from trees, hills, buildings, etc. Since such spots are not always available, or near a suitable place to operate the computer, the next best alternative is to place the antenna on a roof, above as many obstructions as possible. Set the antenna above any vents or structures and away from the edge of the roof. Also, stabilize the antenna so that it will not fall off or blow down in stiff wind, by securing the ground plane if necessary. Wherever you place the antenna, make sure to note all potential obstructions in the site log (by azimuth and the estimated highest elevation where they can be seen from the antenna).

If you do choose a roof site or other elevated site for the GPS antenna, be aware that our experience has been that you *will* see multipath, regardless of how few obstacles are visible above zero elevation. We currently believe that the multipath seen on elevated antennas stems from the imperfect nature of the ground planes; that is, reflections from the ground “leak” into the antenna and interfere with the direct signal, even at negative elevation angles. Multipath produces variations in signal strength which may be difficult to distinguish from scintillations under some circumstances. Two characteristics of multipath allow it to be identified. First, multipath variations tend to repeat from one day to the next since the satellites follow nearly the same track across the sky on successive days. Second, multipath variations typically have longer time scales than scintillations. For example, equatorial scintillation periods are on the order of tens of seconds, while multipath variations occur on time scales of minutes. (Note, however, that there is some overlap between the fastest multipath and the slowest scintillations.)

The last major concern with the antenna and cabling is moisture. Make certain that any exposed cable connectors are sealed using either liquid electric tape or RTV silicone. We have had serious problems in the past regarding antennas that are damaged by rain. Fortunately, the Group Allis antennas we are now recommending seem to be more weather-proof.

Since power measurements are of interest for the scintillation monitor, using a short, low-loss cable is important. If the cable must be long (>15 meters), signal amplifiers, placed near the antenna, are important. When running the cable, be careful not to allow the cable to be kinked, snagged or pinched. When connecting the cables to the antenna or receiver, do not over-tighten or force the connectors. The SMA-type connectors used by the GPS card and the antenna may be damaged more easily than other, larger

RF connectors.

Finally, before plugging the computer in, be sure that the computer is set to the correct local power supply voltage: 110 or 220 VAC. Power electricity quality is also an issue, but is more likely to be out of the experimenter's control. If an uninterrupted or filtered power source is available, that supply should be used. Any transient which causes the computer to reset will stop data logging. Consequently, make sure that the computer automatically starts the scintillation monitor program with data logging when it boots up (see the Linux init script see below). That way, power problems will cause only temporary interruptions, rather than complete data loss for the rest of the night.

Setting up (Software)

This version of the GPSBuilder card resides on the PCI bus. Although Microsoft Windows versions of software may work with the card, we have chosen to use a real-time variant of the UNIX-like operating system, Linux, instead. The advantages to this are twofold. First, Linux is free (see the GNU Public License for info on distribution of the Linux kernel and GNU software). Second, GPS receivers should run in a real-time environment in order to execute in a timely manner.

Linux comes in a variety of distributions. Some common ones are Redhat, Suse, Mandrake, and Debian. We prefer to use Debian because it provides the simplest installation platform and is very robust. Debian can be found at <http://www.debian.org>. In order to use the CASCADE/SCINTMON software, the Linux must be "patched" in order to make it real time. Currently, RTAI (<http://www.rtai.org>) is the real-time operating system that is supported.

To install Linux and RTLinux, please follow the installation instructions on the respective websites. It is recommended that a 2.4.xx version of the Linux kernel is used. The 2.6.xx kernels are not currently supported and the older 2.2.xx version are rather outdated.

The CASCADE/SCINTMON GPS receiver comes has two components. The first component is a real-time Linux kernel module that contains the entire GPS receiver software, called arch.o. Due to licensing restrictions (with Mitel/Zarlink) we cannot distribute the source code of the receiver. The second component of the receiver is the user interface/data logging software. This program is a standard Linux program. Its name is cascade. This part of the receiver is not restricted by a license, thus its source code is freely available.

The CASCADE/SCINTMON software package provides the following files:

File Name	Description
arch.o	Scintillation monitor GPS receiver code, version 1.31 (040504)
cascade	Scintillation monitor interface program, version. 1.59 (031109)
cmd.ini	Initial command file for CASCADE/SCINTMON
alm.ini	Initial GPS satellite almanac for CASCADE/SCINTMON
fslextract4	FSL signal strength extraction utility, version
lsum4	Summary file (*.sum) creation program

The initial command file (see **Appendix** for an example file) must be modified prior to using the software. The initial command file contains the starting guess for the receiver's position, the number of channels that the receiver will use to track GPS signals, the elevation mask angle, header information and settings for various other operating parameters. The configuration file contains three parameters which must be set properly in order for the receiver to function. These three parameters are the DMA address and IRQ number, which must be set to match the hardware settings (see previous section), and the offset between Universal Time Coordinated (UTC) and local time where the receiver is operated.

Use a text editor (e.g., nano, vi, or emacs) to modify the command and configuration files for your station. Command syntax for IP is *IP latitude longitude*, where *latitude* and *longitude* are in position format. Position format is *+DDD.ddd*, where *DDD* are the integer degrees and *ddd* are decimal degrees. Also, set the reference position (RP line, same format as IP) to the initial position guess.

The elevation mask should be set to 10 degrees (*EM 10.0* command) to prevent GPS satellites at low elevations from being tracked, thus avoiding *some* problems with multipath. Leave the maximum PDOP (Positional Dilution of Precision) set to 99.0 (*PM 99.0* command). The remaining lines in *cmd.ini* determine the single character station identifier and various blocks of header information for the output files.

The single character station identifier (*ST x* command, where *x* represents a number or a letter) determines the FSL and RINEX output filenames to be used. For current use, the following station identifiers are assigned:

StationID	Character
Tucuman, Argentina	A
Natal, Brazil	B
San Jose dos Campos, Brazil	C
Ancon, Peru (station 1 - West)	P, Q
Maui, Hawaii, USA	L
Santa Maria, Brazil	S, T
Macaes, Brazil	M
Cuiaba, Brazil	J, K
Sao Luis, Brazil	H, I
Cachoeira Paulista, Brazil	F, G
Ithaca, NY, USA	K
Puerto Rico	?
Bear Lake, Utah, USA	?

Note: We will supply you with a station identifier in a supplemental letter that you should receive

with this document.

Automatically generated filenames are in the following format: *yymmddIn.FSL* (for FSL files) or *yymmddIn.N* (for RINEX2 navigation files), where *yy* are the last two digits of the UTC calendar year, *mm* and *dd* are the UT month and day, *I* is the station identifier character and *n* is the file number (0-9), in case several files are taken during a single day. For example, the first FSL file logged on 6 Oct 2001 at Tucuman, Argentina would be 011006A0.FSL.

All of the commands in *cmd.ini* which begin with the letter H are used to set header information in the FSL and RINEX files. The header commands must be followed by a space and then the string to which the appropriate header block is to be set. Header setting commands are:

Command	Description	Characters
HA	Agency of Observer (e.g., Cornell University, etc.)	40
HC	Comment (should be set to <i>ABC CAMPAIGN</i>)	60
HM	Marker Name (city and country where receiver is sited)	60
HN	Antenna number (serial number or number marked on antenna)	20
HO	Observer's Name	20
HT	Antenna type (may be omitted)	20

You should set the header comments to appropriate values for your station. Note that the “Characters” column specifies the maximum number of characters allowed in the given header block.

Since UTC time is either ahead of local time or 0, the time offset should be non-negative. For example, US Eastern Standard Time lags UTC by five hours, so a station set to local time in New York state should have its time offset set to 5 hours.

Finally, in order for the CASCADE/SCINTMON program to restart automatically following the loss and subsequent restoration of electrical power, the following lines must be added to the Linux init process as an init script (usually found in */etc/init.d*). There is some variation between the different distributions as to how init scripts are ran. An example script file is located in the **Appendix**. This script inserts the RTLinux modules, loads the receiver module, and then starts the display program.

Also, as discussed above, the *SL 1* and *RN 30* commands should be added to the end of the *cmd.ini* file to restart data logging.

Running the Program

The program should perform some initial hardware tests, clear the screen and show the F1 display (see **Appendix**) as it begins to search for and lock onto the available GPS satellites' signals. In the middle rows of the screen, the F1 display shows which satellites are currently being tracked on each of the 12 channels of the GPS card. Among the important status indicators on this display are the lock indicators (next to last column, entitled “Locks”) and the carrier-to-noise ratio figures (second to last column, entitled “C/N0”). Within a few minutes after startup, at least one of the channels should show the symbols “CCBF” in the “Locks” column and numbers (typically around 35-50 dB-Hz) for the carrier-to-noise ratio.

Once the receiver has locked onto a few satellites and downloaded some navigation information from them, the program should shortly begin computing a GPS navigation solution, consisting of the position of the antenna and offset of the system clock from GPS time. The “SVs” display at the top of the top of the screen should be non-zero, the “Nav” display (just below “SVs”) should indicate “3D” and the position (“Lat”, “Lon”, “Hgt”) and speed (“Spd”, “Hdg”, “ROC”) displays should show continuously changing numbers. Finally, the “OscErr” should have a small value (< 5 ppm).

Controlling the Program

The CASCADE/SCINTMON program, is controlled by entering commands at the prompt. Two types of commands exist. First, the function commands, F0-F6, control which text display is shown. The **Appendix** illustrates some of the more useful displays. The channel status display, or F1 display, is the default display shown on startup.

In addition to function commands, the software is also controlled a slew of other two-letter commands, examples of which include the commands in the cmd.ini file. Some examples of these commands have already been mentioned.

The F0 display (shown in the **Appendix**) is a help display and lists all of the valid commands except the commands to set header blocks (HA through HT in the software setup section). A short summary of useful commands is given below:

Command	Description
QA	Quit the program after saving the current satellite almanacs to the alm.ini file. Always use QA rather than QU to ensure that the almanacs get updated.
F n	Select a display. Valid values for n are 0-6.
ST id	Set the current station ID character (A-Z or 0-9) used in FSL and RINEX filenames. To view the current station ID character (as well as the header blocks) select the F6 display.
EM x.x	Set the elevation mask to x.x degrees. That is, satellites with elevations below x.x degrees will not be used in navigation solutions or have their information saved in log files.
PM x.x	Set the PDOP mask to x.x. This number should be set to 99.9.
IP posn string	Set the initial position of the receiver to posn string (see software setup section). Usually only used in cmd.ini file.
RP posn string	Set the reference position of the receiver to posn string (see software setup section). Usually only used in cmd.ini file. Set this to the same posn string as the IP command above.
RN n	Log RINEX data at n second intervals. RINEX files are text data files in a standard format. Two types of RINEX files may be saved using the CASCADE/SCINTMON software: (1) observation files (distances, actually “pseudoranges,” to satellites and other measurements), and (2) navigation files (satellite ephemeris data and other

parameters). Note: in the current version of the SCINTMON program, RINEX2 observation files are not saved. Only observation files use the *n* parameter; navigation files do not. Effectively, then, use RN *n* ($n \neq 0$) to start RINEX navigation file logging and RN 0 to stop RINEX logging. The F4 display shows the current status of RINEX data logging.

- SL *n* Toggle scintillation logging (i.e, enter SL to start data logging; then enter SL again to stop data logging). Scintillation logging saves many parameters to disk in a proprietary binary format, including 50 samples per second of satellite signal strength data. If the receiver has just started up, scintillation logging will not begin until the receiver has started computing a navigation solution and the receiver's clock error ("OscErr") has converged to a constant value. The F4 display shows the current status of scintillation logging operation.
- LT *n* Set the local time different from UTC. The variable *n* is the number of hours that UTC lead local time. For example, in New York state Eastern Standard Time leads UTC by 5 hours, so *n* should be 5 in this case.

Daily Operation

The following daily routine should be adhered to for the field campaign, once the station has been set up and running for a day:

- 1) Before quitting the CASCADE/SCINTMON program in the morning, use the F2 display (see **Appendix**) to look at the number of missed accumulations. Log the number of missed accumulations. Also log the oscillator error ("Osc Err" in upper right hand corner of F1 display).
- 2) Quit the CASCADE/SCINTMON program with the QA command. Log the time that the program is exited. Note whether any power interruptions occurred during the night for the daily log. Use the UNIX command `ls *.fsl` and look for multiple files on the UTC date corresponding to the previous night. Multiple files indicate power interruptions.
- 3) Generate a summary file of the scintillation activity. The program `lsum` is used to generate the summary file. The command is `lsum4 file`, where *file* is the prefix (name minus the .fsl suffix, *yymmddIn* format see software setup section under the ST command) of the file you wish to investigate and *ID* is the single character site ID (i.e. I). `lsum4` with the filename *yymmddIn.sum* that contains the satellite position, scintillation index, and signal power for each satellite in view at one minute intervals. The resultant summary file is small and transportable (~150kB). Cornell University expects a copy of the summary file from each station for every day in which the scintillation monitor was active.
- 4a) Using the supplied MATLAB files (`cppow2.m` and `cpelaz2.m`) generate summary plots of the scintillation activity. `cppow2.m` generates a plot of the signal power for each satellite. `cpelaz2.m` generates an elevation/azimuth plot of the satellites' trajectories along with a bubble-like indicator of the magnitude of scintillation activity. The figures generated by `cppow2.m` and `cpelaz2.m` should be archived by either printing them out or exporting the files to images (an option in MATLAB). Note that if MATLAB is not available, a free version, called Octave, is useful. The scripts should also work with Octave.
- 5) Backup the previous night's files using your own software. CD-ROMs can be made using Linux programs, e.g. `mkisofs` and `cdrecord`. Graphical CD-ROM burning programs are also available. Name

backup sets according to the following convention: *YYMMDD_sitename_BACKUP*, where *YY*, *MM*, *DD* are the two digit year, month and day that logging stopped and *sitename* is a one-word name for the site. For example, the backup set from Ancon for the log files which stopped on 03 October 2001 would be named 011003_ANCON_BACKUP.

6) Before starting the program in the evening, delete the oldest *.fsl and *.nav files which have been backed up.

7) Start CASCADE/SCINTMON approximately one hour before local sunset. Start RINEX data logging with the *RN 30* command and FSL file logging with the *SL* command. Note the time the program was started in the daily log. Once the oscillator error has stabilized, and FSL logging has started, note the value of oscillator error on the daily log. Make sure that the CASCADE/SCINTMON program is tracking satellites (use the F1 display) before you leave the station unattended. If the receiver has not picked up enough satellites to begin a navigation solution within about 10 minutes, something is wrong. Investigate and report the results in the daily log.

Unattended Operation

The sample cmd.ini and associated files in the **Appendix** give an example setup for unattended operation. As discussed in the section on setting up the software, the sample cmd.ini file starts FSL data collection and RINEX logging as soon as CASCADE/SCINTMON starts.

This procedure for unattended operation works well unless there are power failures or the disk fills up. If power failures occur, some subtle aspects of the CASCADE/SCINTMON program come into play. First, given the recommended autostart configuration discussed in the section on setting up the software, if power goes out and then returns, data logging begins *immediately*. That is, if the power goes out and comes back at 1200 UTC in the example above, logging for that day begins at 1200 rather than the programmed 2200 UTC (but logging will stop at 1100 UTC the next day as planned, unless there are further power failures). Second, the *SL* command is a “toggle,” while the *RN 30* and *RN 0* commands explicitly turn RINEX data logging on and off, respectively. The difference between these two types of commands may lead to unexpected results for some command file setups in the event of power loss.

If power failures occur close together in time, CASCADE/SCINTMON may generate several RINEX navigation files but only one FSL file. While RINEX logging begins immediately, FSL data logging is delayed until the receiver has acquired several satellites' signals and the receiver's estimate of its oscillator error has stabilized, a process which usually takes about 5 minutes. Between the time that the initial *SL* command is issued and the time that the oscillator error stabilizes, FSL data logging is in “wait” mode and CASCADE/SCINTMON does *not* open the FSL file. So, if a power failure occurs in “wait” mode, two RINEX navigation files will be generated (the first will be small), but only one FSL file will appear. Furthermore, the numbering sequence of the two types of files will be different. For example, the resulting file may be named 011006A0.nav, 011006A1.nav and 011006A0.fsl. In this case, the trouble is that the files that go together (011006A1.nav and 011006A0.fsl) are numbered differently, and lsum4 will not work properly. The only fix is for the operator to delete the small file, 011006A0.nav, and to rename 011006A1.nav to 011006A0.nav by hand.

On a final note, the procedures recommended under the section on daily operation need to be modified for unattended operation. At a minimum, the operator should log the names and sizes of files generated for each day during the period when the station ran automatically. We also suggest that the operator examine each data set and make notes prior to backing it up. Of course, after unattended operation for several days, it is extremely important that the operator back up and delete old files since the hard disk

will be very full.

Using lsum4 (version 4.00)

The **lsum4** utility allows for the create of summary files. The utility uses an FSL file (*yymmddIn.fsl*) and the associate RINEX2 navigation file (*yymmddIn.nav*) to generate the summary file. Note that both the FSL file and the nav (RINEX2 navigation) file must be present and have the same prefix for lsum4 to work properly.

The syntax for SUM is:

```
lsum4 file_prefix
```

where *file_prefix* is in the format *yymmddIn* (see Setting Up (Software)) and is the prefix of the FSL and NAV files. Note that lsum4 uses both the FSL file and the NAV file, so it is extremely important that these two files exist and cover the same time period. Note that there may be mismatches between FSL and NAV sequence numbers (the *n* in the *file_prefix* format) because RINEX2 navigation data logging begins immediately whereas FSL data logging waits until the clock error has stabilized. For a case where sequence number mismatches could occur, see the section above on unattended operation.

If you want to generate a summary file from 011016Q0.fsl and 011016Q0.nav, for example, enter:

```
lsum4 011016Q0
```

The resultant file, in this example has the name 011016Q0.sum, contains header information about the site and the receiver position and records at one minute intervals that contain satellite position, S4 index (amplitude scintillation index) and signal power for each satellite in view.

Summary files are an excellent way to view the scintillation activity during a nightly run on the scintillation monitor. MATLAB routines can generate figures that show a survey of the signal power from each satellite during the night or an elevation/azimuth plot of the satellites' trajectories along with an indicator of the S4 index.

Using fslextract4 (version 1.41)

The fslextract4 utility allows for extraction of data from an FSL file. The utility uses an FSL file (*yymmddIn.fsl*) and extract data from it. Possible types of data are 50Hz raw or interpolated signal power or integrated carrier phase measurements. The most commonly extracted data is 50Hz signal power.

The syntax for fslextract4 is:

```
fslextract4 -[wpt] fslfile [prn] [start stop]
```

where *fslfile* is in the format *yymmddIn.fsl* (see Setting Up (Software)) and is the FSL file to extract data from. The option -w extracts raw signal power data, -i extracts interpolated signal power data, and -c extracts integrated carrier phase data. The option *start* is the start time in GPS time (ahead of UTC by 13 seconds as of 8/18/2001) HHMM format and the option *stop* is the stop time in GPS time. Indicating a start and/or stop time only extracts the data within the range of times.

For example, if you want to generate a file, 011016Q0.w02, containing raw signal power data from PRN 2

on October 16, 2001 from 2100 to 2200 GPS time, enter:

```
fslextract4 -wpt 011016Q0.fsl 23 2100 2200
```

OR

```
fslextract4 -wp 011016Q0.fsl 23
```

The resultant file in the first example has the name 011016Q0.w02, contains the raw 50Hz data for PRN 2 with time stamps in decimal TICS (a TIC is 0.0999999 seconds ~roughly 1/10 of a second) and the signal power. Recall that to convert the signal power to dB, use the operation $10*\log_{10}(S)$, where S is the signal power.

In the second example, the output contains the *interpolated* 50Hz signal power data for PRN 23 with time stamps in decimal TICS and the signal power.

Due to timing errors unearthed in the original DOS version of SCINTMON and FEXTRACT, the tool fslextract4 is still in beta stage. Look for updates to it in the near future.

Miscellaneous

Useful equipment to take to remote field sites includes: AC adapter plugs, electrical tape, pocket knife (not too big to carry on an airplane!), compass, elevation measuring tool, Phillips screwdriver, regular screwdriver, pliers, measuring tape, camera, extra lengths of low-loss cable.

Backup tape requirements: TAPES ARE NOT RECOMMENDED DUE TO THEIR TENDENCY TO FAIL.

Backup CD-ROM requirements: approximately one (1) standard 650MB writeable CD-R per station for 6 days of operation.

Contact Information

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APPENDIX

cmd.ini File

```
RP 42.0 -76.0 220.0
IP 42.0 -76.0 220.0
EM 10.0
PM 99.0
ST Z
HC ABC CAMPAIGN
HM HALEAKALA, HI
HO BRENT LEDVINA
HA CORNELL UNIVERSITY
HN 1
WA 11 33
LL 1800 600
DT 10
```

Sample Linux init script S99local (usually placed in /etc/rc2.d/)

```
#!/bin/sh
# sample init script for RTAI and the CASCADE/SCINTMON
# receiver. Note that the paths used below may be different
# on your computer.

# load the RTLinux modules
cd /usr/src/rtlinux/
sh scripts/insrtl

# load the core receiver module
cd /home/brent/cascade
/sbin/insmod arch.o

# start the user interface
./cascade &

exit 1
```

ERRATA

The only major software issue that is currently not resolved involves the GPS satellite almanac file, alm.ini. Sometimes this file can become corrupted causing the receiver to fail upon startup. If any problems with the receiver exist, please delete this file to see if that helps.

F1 Display

Lat	42.44350	Spd	0.1	SVs	5	CTrack	FLL	Date	19/04/04
Lon	-76.48184	Hdg	222.3	Nav	3D	GDOP	5.9	GPS	22:07:48
Alt	238.9701	ROC	0.2	NS	CHAN	DO	-335.6	OscErr	0.21

CH	SV	ELV	AZI	DOPP	NCO	UERE	SF	PRerr	PRRerr	LOCK	C/N0	iS4
1	29	17	54	-3075	-3410	2	3	6.5	0.0	CCBF	37.4	+0.32
2	15	48	303	2028	1693	2	3	5.7	-0.0	CCBF	46.7	+0.08
3	---	--	--	--	--	--	--	--	--	--	--	--
4	---	--	--	--	--	--	--	--	--	--	--	--
5	21	64	194	-1475	-1809	2	3	7.0	0.2	CCBF	45.1	+0.03
6	---	--	--	--	--	--	--	--	--	--	--	--
7	---	--	--	--	--	--	--	--	--	--	--	--
8	---	--	--	--	--	--	--	--	--	--	--	--
9	9	52	127	1690	1355	2	3	5.4	0.0	CCBF	46.7	+0.03
10	18	70	332	895	561	2	3	6.4	-0.1	CCBF	44.7	+0.03
W11	33	0	0	0	-342	0	0	0.0	0.0	CC	40.7	+0.01
N12	---	--	--	--	-10000	--	--	--	--	--	24.0	--

>

Cascade 1.59 (031021)

You typed: f1

F2 Display

Lat	42.44353	Spd	0.1	SVs	5	CTrack	FLL	Date	19/04/04
Lon	-76.48181	Hdg	43.0	Nav	3D	GDOP	5.8	GPS	22:08:12
Alt	247.9171	ROC	0.2	NS	CHAN	DO	-333.9	OscErr	0.21

Processing Status

Missed Accumulations	10
Missed Measurements	12
Missed Observations	0
Missed Subframes	0

Channels Allocated	12	Channels In Use	12
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>

Cascade 1.59 (031021)

You typed: f2

F3 Display

Lat	42.44354	Spd	0.2	SVs	5	CTrack	FLL	Date	19/04/04
Lon	-76.48178	Hdg	227.0	Nav	3D	GDOP	5.8	GPS	22:08:25
Alt	247.7735	ROC	0.6	NS	CHAN	DO	-336.7	OscErr	0.21

Current Operating Parameters

Elevation Mask	10.0 degrees
PDOP Mask	20.0
Search Mode	4
Carrier Tracking	FLL
Fixed Positioning	0
UTC-LocalTime Diff	5 hours

>
You typed: f3

Cascade 1.59 (031021)

F4 Display

Lat	42.44352	Spd	0.2	SVs	5	CTrack	FLL	Date	19/04/04
Lon	-76.48180	Hdg	241.4	Nav	3D	GDOP	5.8	GPS	22:08:36
Alt	245.2759	ROC	-0.2	NS	CHAN	DO	-332.0	OscErr	0.21

FSL and Rinex Logging Status

FSL Inactive	
FSL Data File	<none>
Records	0

Rinex Inactive	
Logging Interval	0 sec
Navigation Data File	<none>
Records	0
Observation Data File	<none>
Records	0

Automated Data Collection DISABLED
Start time 0000 UTC (1900 LT)
Stop time 0000 UTC (1900 LT)

>
You typed: f4

Cascade 1.59 (031021)

F5 Display

Lat	42.44353	Spd	0.1	SVs	5	CTrack	FLL	Date	19/04/04
Lon	-76.48178	Hdg	192.0	Nav	3D	GDOP	5.8	GPS	22:08:48
Alt	251.7517	ROC	-0.2	NS	CHAN	DO	-329.5	OscErr	0.21

Observer Info

Observer	Brent Ledvina
Agency	Cornell University
Site ID	K
Station Marker	Cauchoeira, Paulista Brazil
Comment	Permanent Scintillation Site

Receiver Type	Cascade
Receiver Version	1.59
Receiver Number	MITEL - GP2020/2021

> Cascade 1.59 (031021)
You typed: f5

F0 Display

Lat	42.44353	Spd	0.1	SVs	5	CTrack	FLL	Date	19/04/04
Lon	-76.48177	Hdg	214.5	Nav	3D	GDOP	5.7	GPS	22:08:56
Alt	259.6853	ROC	-0.3	NS	CHAN	DO	-333.1	OscErr	0.21

CS - Initiate a cold start
CH x - Set the number of active channels to x
DS x - Deselect the PRN x
EM x.x - Set the elevation mask to x.x degrees
LA - Load Almanacs
LI x - Set the position logging interval (0-60 sec)
PM x.x - Set the PDOP mask to x.x
RN x - Log Rinex data at an x second interval (0 stops logging)
RS x - Reselect the PRN x
SA - Save Almanacs
SD x x x - Set the date
SL x - start (1) or stop (0) Fast Scintillation Logging
TL x - use FLL (1) or PLL (2)

> Cascade 1.59 (031021)
You typed: f0