Trimble NetRS Configuration Guide
For the HamSci TEC Project

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Getting a station running for the HamSci TEC Project involves four main steps: (a) hardware installation; (b) receiver configuration; (c) position determination; and (d) software configuration.

Hardware Installation

1. Install the antenna in a location with a good sky view. The mount should be sturdy so that the antenna does not move with the wind.

2. Install feedline. The antenna likely uses a type TNC connector; the radio uses a type N connector. For runs of 50 feet or less, thin cables like good quality RG8X or LMR240 are fine. For longer runs, LMR400 is preferred.

3. Connect the power/ethernet “dongle” to the DE26 connector on the rear of the receiver.

4. Connect antenna, ethernet cable, and power (12 – 24 VDC). Power can be provided either via a dedicated power cable connected to the radio if one is available, or via the barrel socket on the dongle. It doesn’t really matter which one you use.

5. Set up computer that will run file download/conversion software. This can be a Raspberry Pi model 3 or later, or a PC. It is dormant except for daily file processing, nominally at 0230 system time. It needs TCP/IP connectivity to the receiver, and the ability to open an SFTP connection to a remote system. Software configuration is discussed below.

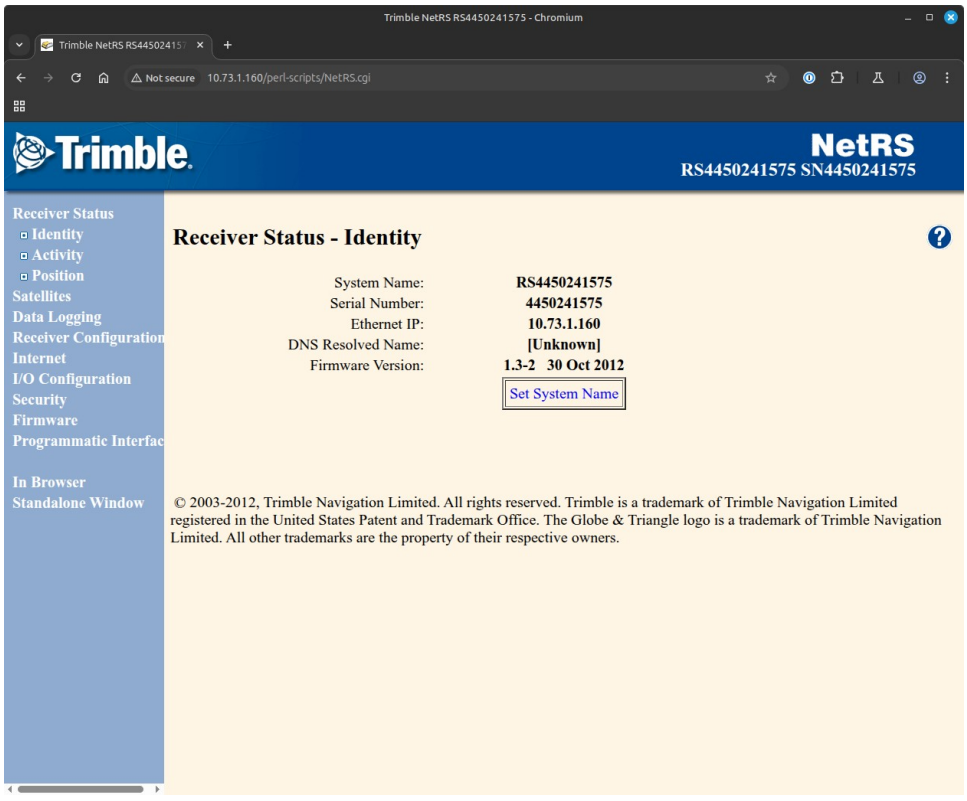
Receiver Configuration

1. Apply power to the receiver. It will probably start to boot up (all LEDs on or flashing) but if it does not, press the front-panel power switch once and it should start.

2. To reset the receiver to factory defaults, allow it to finish booting (LEDs stop flashing and only ethernet activity and power LEDs are on), then press the power button until the “EXT REF” LED (the one furthest to the left) turns on after about 15 seconds, and keep it pressed until the EXT REF LED turns off (another 15 seconds). Release the power button and watch the LEDs blink for a couple of minutes until only the ethernet activty and power LEDs remain on. After several minutes you should start to see the satellite LED blinking, indicating that the receiver is tracking.

3. The receiver will get an IP address via DHCP. Connect to it with a web browser. (Note: the receiver can use either HTTP on port 80 or HTTPS on port 443, but your browser will probably complain about a bad SSL certificate. Ignore the warning and venture on.)

4. The first page you see will be like this:



Click on “**Set System Name**” and change the name to something that makes sense for you. (Note – the receiver will use its system name as part of its data logging filenames. We will override that with the correct station name in the download/conversion process. Thus the system name can be whatever you would like.)

5. Click on “**Receiver Configuration**”.

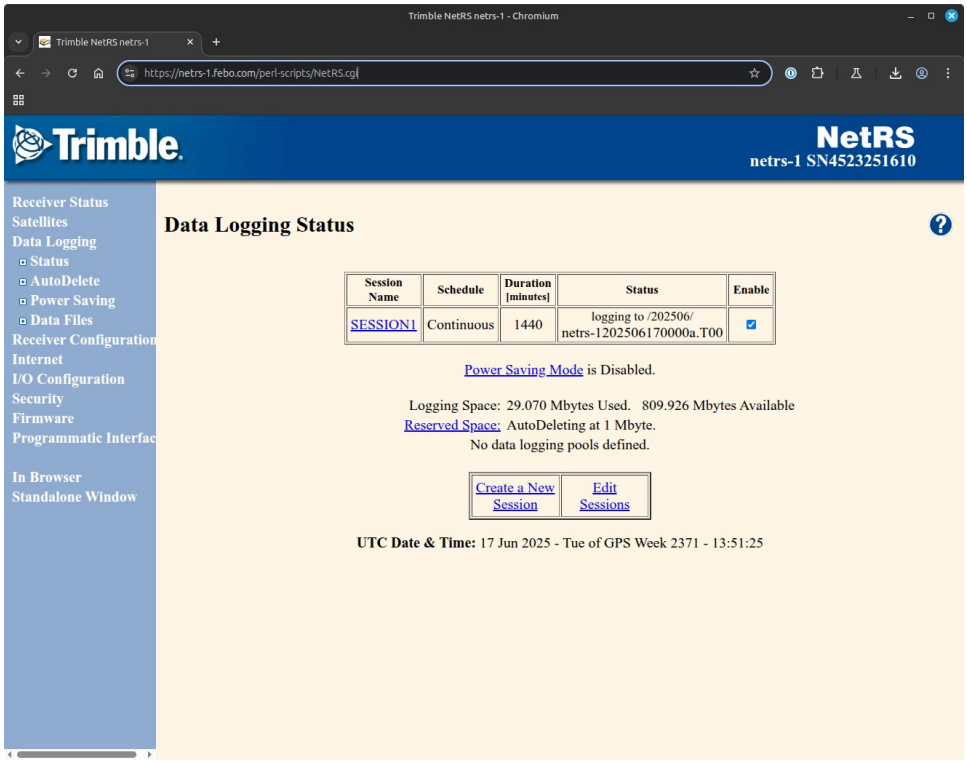
A. Click on “**Antenna**”. If your antenna is in the dropdown box, select it. If it’s not, select “unknown”. Leave the height at 0.000 unless you want to offset your measurement plane from the antenna height. Then click “OK”.

B. Click on “**Clock Steering**” and make sure that is **enabled**, unless you are using an external 10 MHz reference, in which case you **MUST** set it to **disabled**. Click OK.

C. Click on “**L2 Tracking**” and select “**L2C and L2-Y Code**”. Click OK.

D. You shouldn’t need to change anything else under Receiver Configuration for now, though you might want to experiment with things like Elevation Mask and PDOP Mask if your antenna location is challenged.

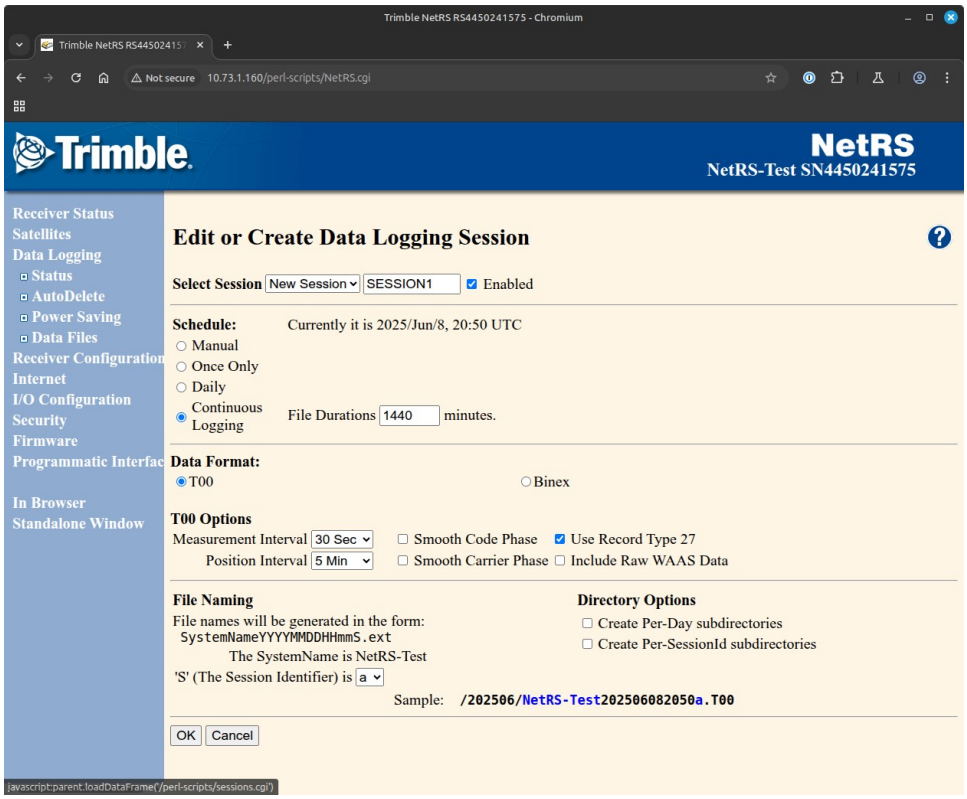
6. Click on “**Data Logging**” and you’ll see a screen like this:



If there are any logging sessions shown, click on the session name to edit, then click “Delete” at the bottom of the screen to delete them.

7. Click on “**Data Logging / Data Files**” which will show the currently saved files. Unfortunately, doing a reset does not delete existing files. You’ll need to manually delete the files shown on this screen. Click to select the directory, then click “**Delete All Files and Subdirectories in this directory**” to delete them. It’s tedious but should be done when setting up the receiver to maximize the free space for new files.

8. Click on “Create a New Session” and set it up like this:



9. Click on “**Data Logging / AutoDelete**” and make sure the AutoDelete box is clicked. The default of 1MB is OK.

10. Click on “**I/O Configuration / Reference Station**”. If the receiver is already locked to satelltes and tracking, click “**Here**” to set an initial estimate of the location, then click OK. (You can come back later to set this much more accurately.) Don’t worry about the RTCM, CMR, and BINEX parameters as we don’t use them.

That completes the basic setup. Click on “**Receiver Configuration**” and you’ll see a summary of the settings. Click on “**Receiver Status**” and “**Satellites**” and their submenus to see how the receiver is doing.

Determining Antenna Type

When generating positions that have millimeter accuracy, the characteristics of the antenna are important. In particular, the distance from the reference plane (usually the bottom of the antenna housing) to the antenna elements for both L1 and L2 are critical. Antennas used for this work are calibrated and their details maintained in a database by NOAA and accessible at https://geodesy.noaa.gov/ANTCAL/.

To use that database, use the “Browse Antenna Information By Company Brand and Model” button to search for the antenna manufacturer. Click on the manufacturer and you will be shown a table of all the antenna models in the database. Look in the fifth column for the model number. The first column contains the antenna code and the second column the radome type (in most cases, “NONE”).

For example, the Novatel GPS 702GG has a code of “NOV702GG_1.02” and radome of “NONE”.

When entering the antenna type as an argument to the programs, format it in quotes with a space between the code and the radome type. For example, for the Novatel GPS 702GG, use:

--antenna_type “NOV702GG_1.02 NONE”

Getting A More Accurate Location

Each day the receiver creates a data file with .T00 extension. The logging starts as soon as you enable the session, and a new file starts at midnight UTC the next day and at midnight every day thereafter (so the first day will likely cover less than 24 hours). You can check for files by going to "**Data Logging / Data Files**" and clicking on the appropriate YYYYMM directory. Once you have a file that includes 24 hours of data, download it by clicking on the file name. Then use the **convert_trimble.py** program to convert it to a RINEX file:

```
convert_trimble.py --antenna_type "<your_antenna_type>" <filename>
```

This will yield a RINEX file with the same base name but ".obs" extension. This file can be processed to determine your location to within a few millimeters. Here's how:

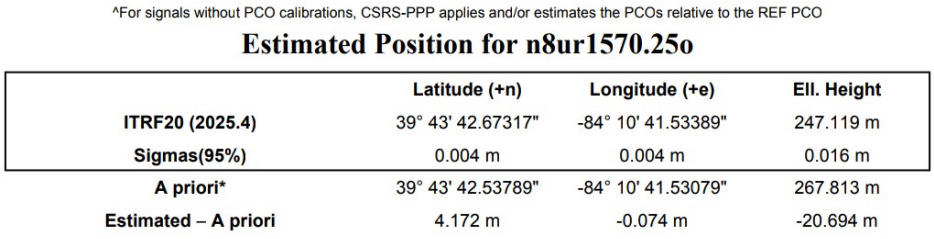
1. **Be very patient and wait until at least 1800 UTC the day after the file was completed**,[1] then go to the Natural Resources Canada Precise Point Position ("PPP") service at **webapp.csrs-scrs.nrcan-rncan.gc.ca/geod/tools-outils/ppp.php**.

2. Scroll down the page and:

   A. Enter your email address;
   B. Make sure the "**Static**" button is clicked;
   C. Select the "**ITRF**" tab;
   D. Use "**Choose File**" to select the RINEX file to upload; and
   E. Click "**Submit to PPP**".

If all goes well, you will see a notice that the file was successfully submitted for processing. The results will be emailed to you, usually within a few minutes to a couple of hours.

The results email will contain several links. The "full output" link provides several files, including a multi-page PDF file that has (almost) everything you'd want to know about your location. Open the PDF file and the first page will show your antenna's coordinates, often with an uncertainty of just a few millimeters.



^For signals without PCO calibrations, CSRS-PPP applies and/or estimates the PCOs relative to the REF PCO

Estimated Position for n8ur1570.25o

	Latitude (+n)	Longitude (+e)	Ell. Height
ITRF20 (2025.4)	39° 43' 42.67317"	-84° 10' 41.53389"	247.119 m
Sigmas(95%)	0.004 m	0.004 m	0.016 m
A priori*	39° 43' 42.53789"	-84° 10' 41.53079"	267.813 m
Estimated – A priori	4.172 m	-0.074 m	-20.694 m

1 To do its magic, the PPP service relies on data generated by monitoring stations around the world. There are three levels of this correction data – ultra, rapid, and final. "Final" gives the most precise results, but the correction data for a given day are not available until more than two weeks later. The "Ultra" results, on the other hand, are available a few hours after the end of the data, but are less precise. The "Rapid" results are available about 18 hours after the end of each day, and are usually the best compromise between quality and impatience.

Note the latitude, longitude, and ellipsoidal height in the box – those are the location of your antenna. The “Sigmas” gives you an idea of the uncertainty – here, just a few millimeters (note that height always has more uncertainty than horizontal position).

When you have a more precise location from the NRCan PPP results, you can go back into the receiver and click on “**I/O Configuration / Reference Station**” and enter the coordinates there. This isn’t strictly necessary because the conversion software will override that position, but it’s good practice.

More importantly, you will enter these coordinates into the command that runs the daily processing program. It will insert this position into the RINEX file that is uploaded to the Haystack TEC database.

Software Installation and Configuration

The gnss_ftp_tools software package runs once daily to perform three steps:

a. Download the prior day's .T00 data file from the receiver
b. Convert the .T00 file into an industry-standard RINEX file
c. Upload the RINEX file to the central data collection server

It is triggered at 0230 UTC daily by a systemd timer (not the cron job you might be familiar with). To set up the software:

1. On the system that will be running the processing software, do:

```
sudo apt install python3-paramiko ftp
```

2. If the system is a Raspberry Pi, do:

```
sudo apt install qemu-user-static binfmt-support
```

3. Download the latest release package from **https://github.com/n8ur/gnss_ftp_tools/release**

4. Install the package:

```
sudo tar xzf get_trimble_ftp-2025-06-07.tar.gz -C /
```

This will create a couple of directories and install programs in existing directories:

`/data/`	-- where the downloaded/uploaded files live
`/etc/systemd/system/`	-- systemd unit and timer files
`/usr/local/lib/gnss_ftp`	-- program module files
`/usr/local/bin/`	-- main programs
`/usr/local/share/doc`	-- documentation

5. Copy `/usr/local/share/doc/get_gnss_ftp.sh` to `/usr/local/bin/` and edit it for your local configuration:

```
#!/bin/bash
/usr/local/bin/get_gnss_ftp.py \
    -m /data/path \
    -f <netrs_ip_address \
    --station <station_name> \
    --organization "HamSci TEC Project" \
    --user "<user_name>" \
    --antenna_type "<antenna_type>" \
    --station_llh "lat_deg lon_deg height" \
    --sftp_host files.tapr.org \
    --sftp_user <usename> \
    --sftp_pass <password>
```

Explanation of the arguments:

-m is the “measurement_path” – the absolute path where the data files are stored. The installation program creates /data for this purpose.

-f is the fully qualified domain name or the IP address of the NetRS receiver.

--station is the assigned identifier for your station (“hsXX” where “hs” is for “hamsci” and XX is a two-digit number).

--user is your name and callsign.

--antenna_type is the IGS code for your antenna as determined above.

--station_llh are the coordinates of your antenna from the NRCan PPP report referred to above. You can enter this in one of several formats – decimal degrees, or DD MM SS. Put quotes around the entire string.

--sftp_host is the TAPR upload site.

--sftp_user and **sftp_pass** are the user and password you have been assigned for access to the file collection server.

6. Enable the systemd unit to run the program nightly:

```
sudo systemctl enable –now gnss_ftp.timer
```

When the get_gnss_ftp.sh script is triggered nightly by the systemd timer, it will download the prior day’s .T00 file from the NetRS receiver and process it through two free-but-not-open-source programs – runpkr00 which converts the proprietary Trimble .T00 file to an intermediate text form, and teqc which converts the intermediate form into an industry-standard RINEX file. Teqc also edits the command line options for station name, location, etc., into the RINEX header file.

The RINEX file is placed in the download/ directory of the measurement path. Then, the program uses sftp to copy the file to the TAPR collection server. Once that has successfully occurred, the file is moved from the download/ directory to the processed/ directory where it is retained unless the disk space checking routine triggers, in which case the oldest files will be deleted to reclaim space.

The program logs its operation in /var/log/get_gnss_ftp.log if run as root, or in ~/.local/log if run as a non-privileged user.