



SDR Satellite Tracking (V2)

It's all about the software!

SDR-RADIO.com

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1 Introduction

This document describes the Satellite tracking support in version 2 of the SDR Console from SDR-Radio.com. The satellite tracking is contained in its own DLL to ensure portability across many applications.

This dll provides full support for satellite tracking:

- Generation of standard satellite displays with the footprint superimposed on a map of the earth,
- Frequency correction to compensate for Doppler,
- Automatic loading of Keplerian data,
- List of next passes for selected satellites.

1.1 OrbitTools

The dll uses the public edition of The OrbitTools Libraries by Michael F. Henry, the condition of use being that the application in which the dll is used is non-commercial, specifically:

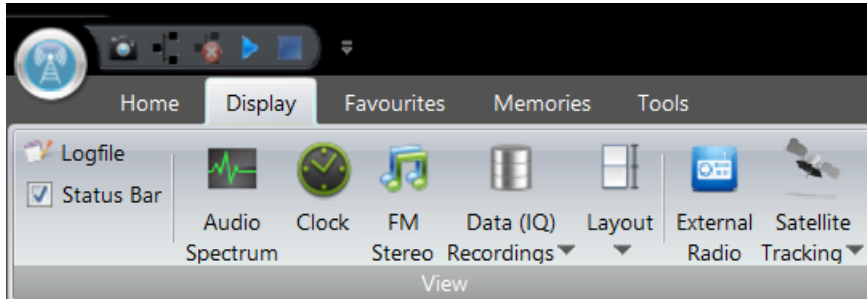
The Public Edition software may be used free of charge for non-commercial applications only; commercial users please contact the author for information regarding the Standard and Professional Editions of the software. For more information about this library please visit <http://www.zeptomoby.com/satellites/>.

1.2 Icons

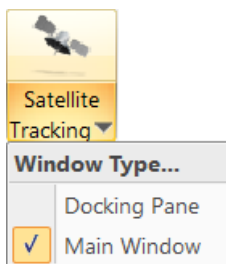
Icons from <http://www.iconspedia.com/>.

2 Starting

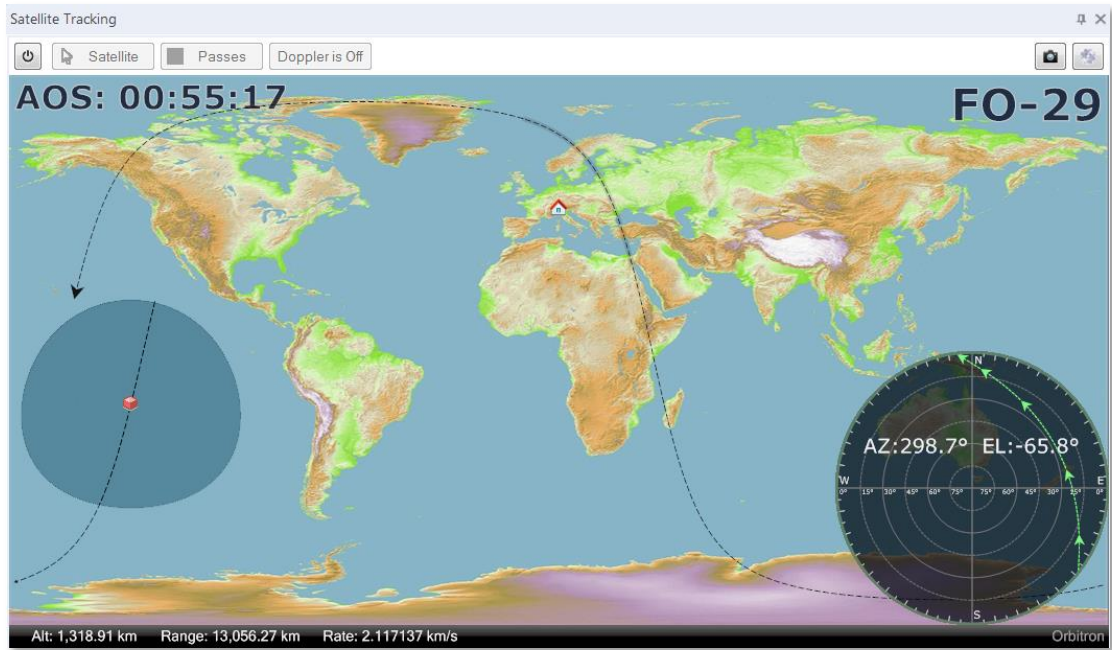
From the ribbon bar select the Display pane, then Satellite Tracking.



The satellite tracking window can be displayed in either a standard docking pane or in a larger main window. To select the window type click the bottom half of the Satellite Tracking button; you must restart this program for changes to take effect.



When you click in the top half of the satellite tracking button the satellite tracking window is displayed, all options are selected here. When first displayed the window shows the position of the currently selected satellite, this is not updated until the Power button at the top left is pressed.

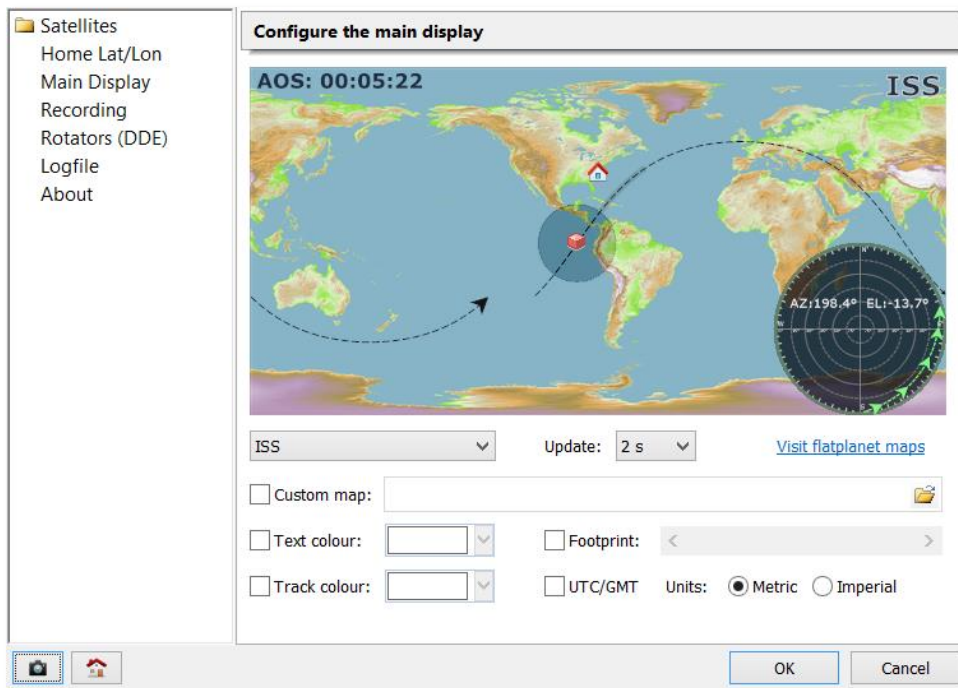


3 Configuring

Once you have started the window you will need to enter your home latitude and longitude and optionally change the appearance of the software.

To display the options select the top-right 'cogs' button.

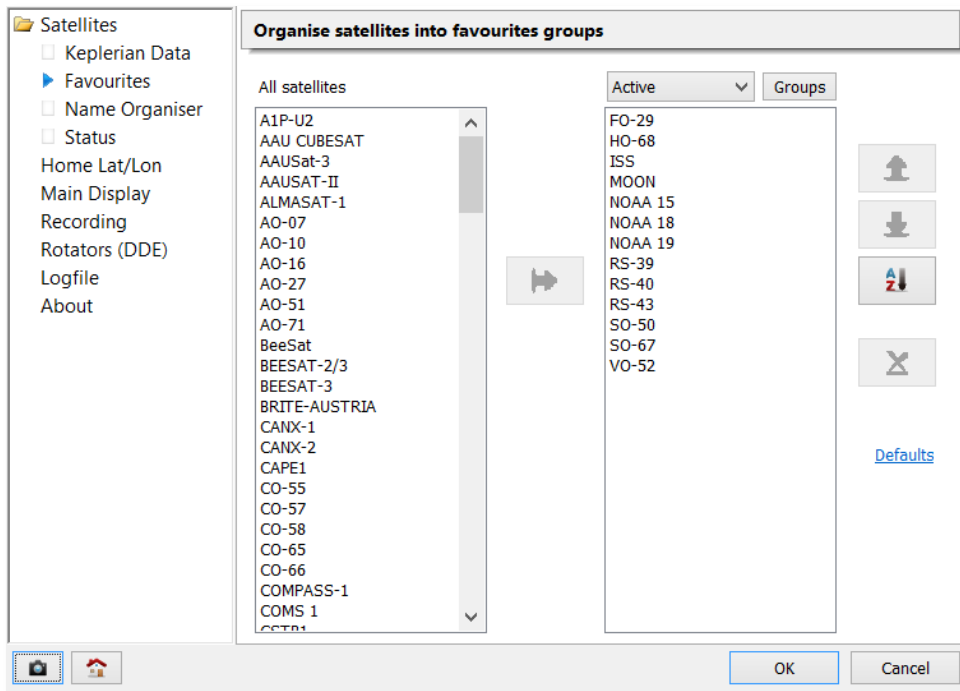
3.1 Main Display



Here you configure the visual aspects of the display and the update rate. If using a low power PC such as an ATOM system then you may want to set an Update rate of five or even ten seconds. For other systems with an i3 or better one or two seconds is fine.

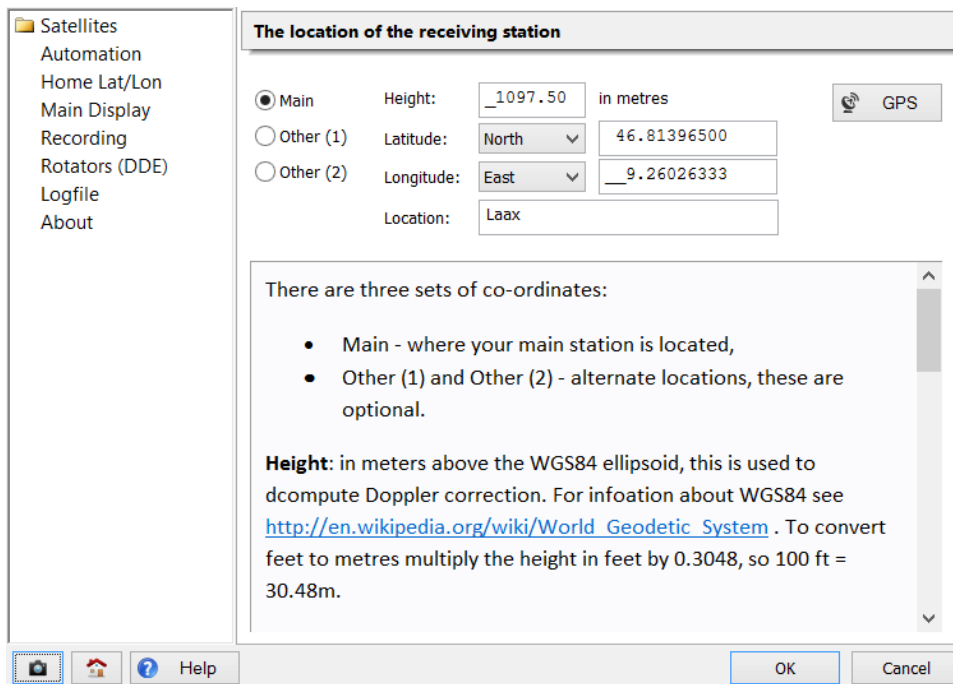
There are many free background maps available on the internet, a good source is [Flatplanet](http://flatplanet.com).

3.2 Favourites



There are many satellites flying around, some more interesting than others. Here you organise them into groups of favourite definitions, for example Amateur, Weather etc.

3.3 Home Lat/Lon



Make sure *Home* is selected, then enter your latitude, longitude and height above sea level in metres (To convert feet to metres multiply the height in feet by 0.3048, so 100 ft = 30.48m). To determine your latitude and longitude use Google Maps, right-click on your location and select the Lat/Lon option from the popup menu.

Use the optional *Other (1)* and *Other (2)* entries for other locations of interest.

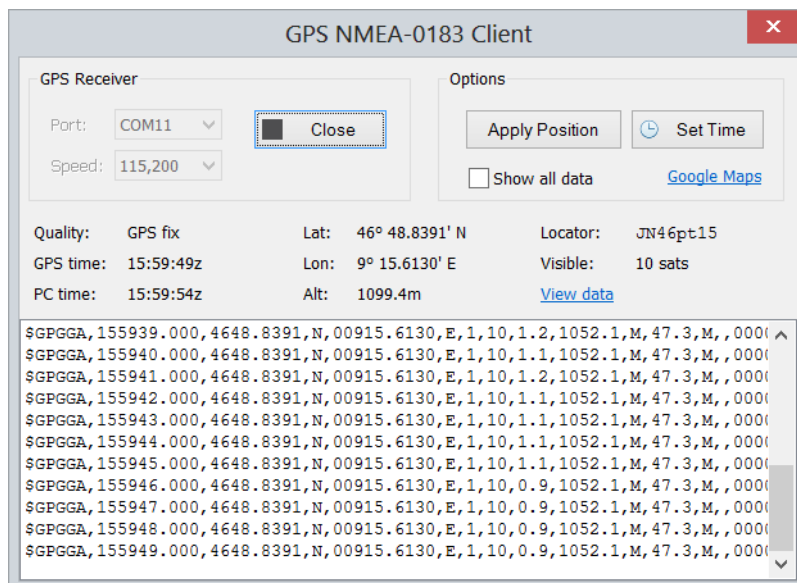
3.4 GPS

Click GPS to open the GPS NMEA-0183 Client window. This window supports GPS devices which have a serial port interface, for example the Navilock NL-402U USB GPS / Galileo receiver.

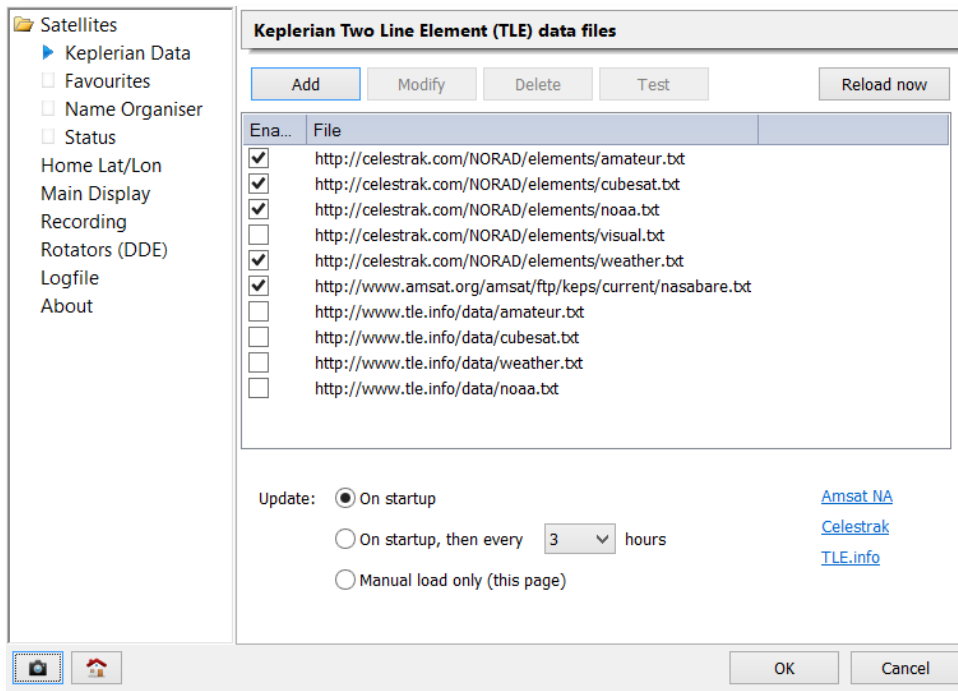
Select the correct COM port and press *Connect*. When a good fix is available the Quality field displays the text *GPS fix*. Click *Apply Position* to update the Home Lat/Lon values with the currently displayed latitude, longitude and altitude.

To check the current position press *Google Maps* (an internet connection is required).

When you have finished just close the window.



3.5 Keplerian Data



This program uses the Two Line Element (TLE) data files together with your location and the current time to determine the current location of the satellites.

These files are available from a variety of sources, principally:

- [Amsat NA](http://www.amsat.org),
- [Celestrak](http://www.celestrak.com),
- [TLE info](http://www.tle.info).

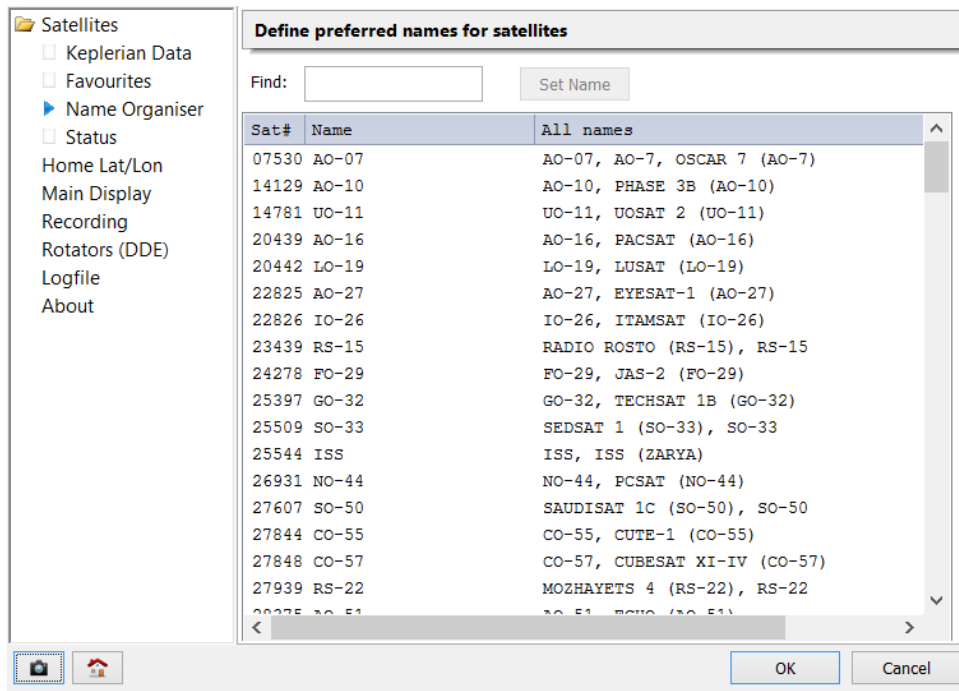
Also select the update options – there is no need to update more than once or twice a day.

If an internet connection is not available then the cached copies of the most recently downloaded files are used.

3.5.1 Custom TLE Data

To use TLE data which is not available via a web page you can always use a file URL which takes the form file://host/path for example file://localhost/c:/my_data/tle.txt. For more information see http://en.wikipedia.org/wiki/File_URI_scheme.

3.6 Name Organiser



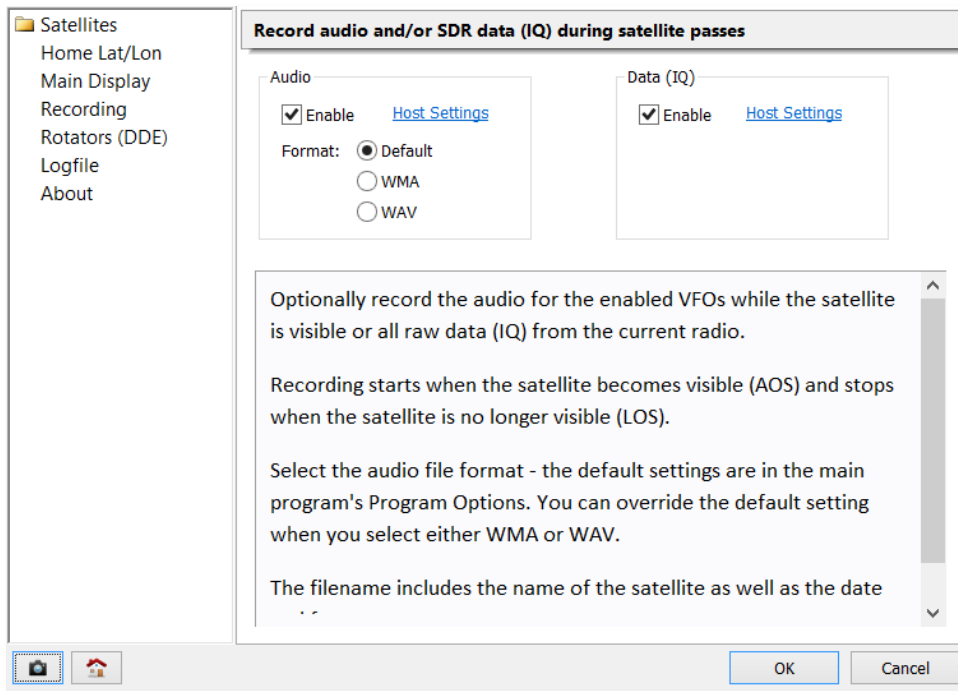
Use this window to define the preferred name for a satellite. Satellites are uniquely defined by the catalog number in the Keplerian TLE data; this data also includes a suggested name. If you load TLE data from more than one source then you will encounter conflicting names.

An example where you would often change the name is the satellite with catalog number 14129 known as PHASE 3B (AO-10); this satellite is normally referred to as AO-10.

Similarly the satellite with catalog number 37855 is referred to as A1P-U2, HRBE and M-CUBED & EXP-1 PRIME.

Note: After changing satellite names you must review your Favourite definitions, these are not updated automatically.

3.7 Recording

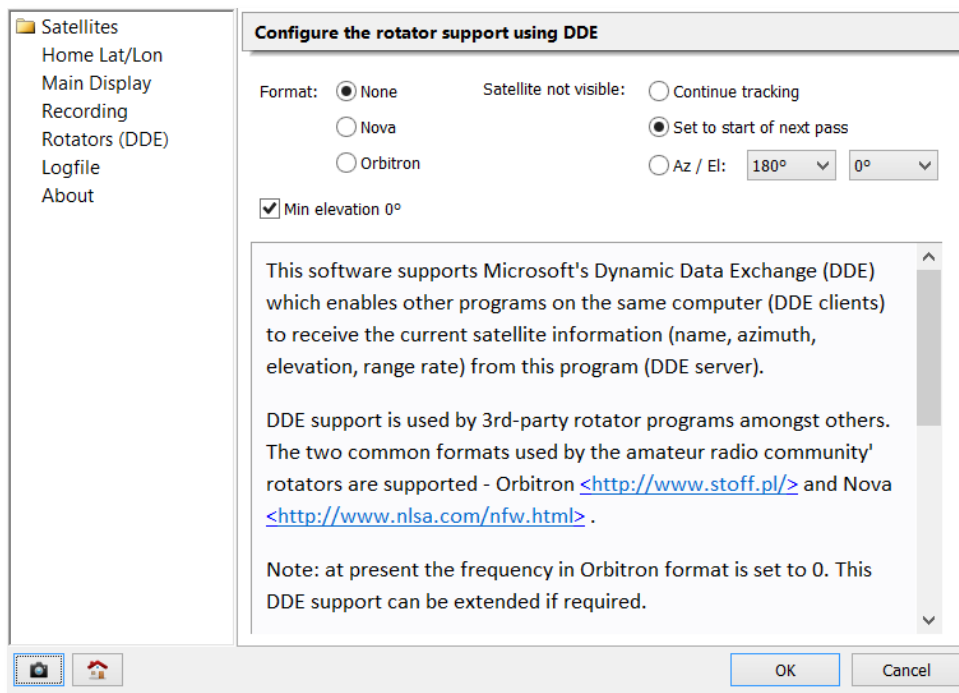


With the recording option you record the audio for the enabled VFOs while the satellite is visible. Recording starts when the satellite becomes visible (AOS) and stops when the satellite is no longer visible (LOS).

Select the audio file format - the default settings are in the main program's Program Options. You can override the default setting when you select either WMA or WAV.

The audio filename includes the name of the satellite as well as the date and frequency.

3.8 Rotators (DDE)



This software supports Microsoft's Dynamic Data Exchange (DDE) which enables other programs on the same computer (DDE clients) to receive the current satellite information (name, azimuth, elevation, range rate) from this program (DDE server).

DDE support is used by 3rd-party rotator programs amongst others. The two common formats used by the amateur radio community' rotators are supported - [Orbitron](http://www.stoff.pl/) and [Nova](http://www.nlsa.com/nfw.html).

Note: at present the frequency in Orbitron format is set to 100MHz. This DDE support can be extended if required.

If Min elevation 0° is checked then the DDE elevation will never be less than 0° (the antenna will not point below the horizon).

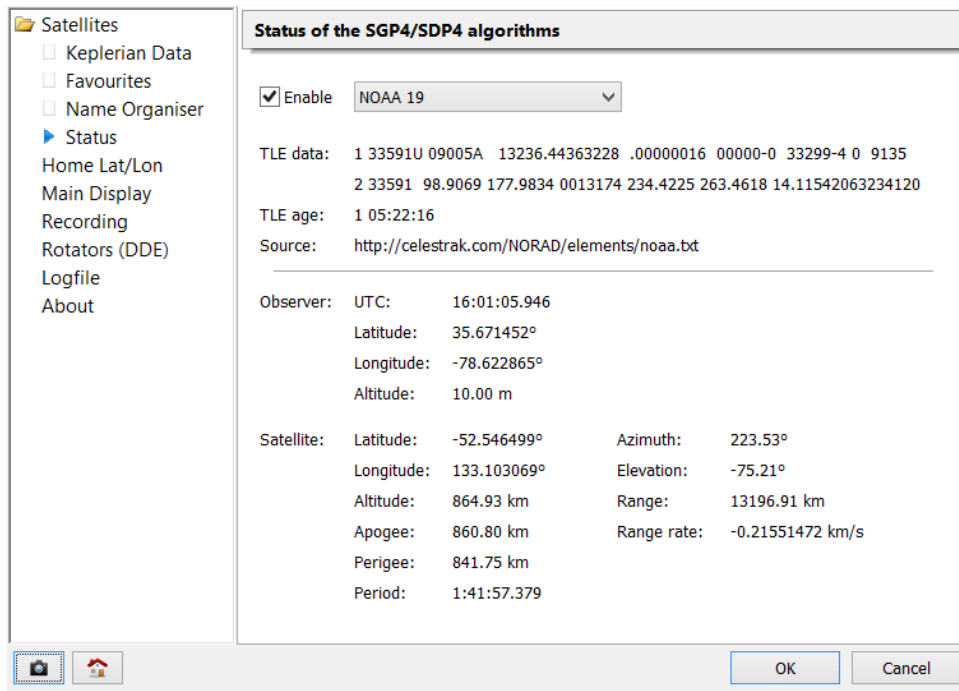
If the satellite is not visible then you have these options:

- Continue tracking (pointless, just wears out the rotator),
- Set to start of next pass (makes more sense),
- Park antenna at specific Az/EI (for example to avoid strong wind) and move to the start of the next pass 60 seconds before AOS.

For more information about DDE please visit

http://en.wikipedia.org/wiki/Dynamic_Data_Exchange.

3.9 Status



This window was developed as a diagnostic aid to show the status of a selected satellite.

An explanation of some fields:

- TLE age – the age of the current TLE data definition for the current satellite, the age is in ddd hh:mm:ss format.
- Apogee – distance when a satellite is at its furthest point from the earth.
- Perigee – distance when a satellite is at its closest point to the earth.
- Period – period of rotation, in this case the satellite's period is one hour and forty-one minutes.
- Range – the current distance from the observer (your home location).
- Range rate – the rate at which the satellite is accelerating towards (-ve) or away from (+ve) the observer.

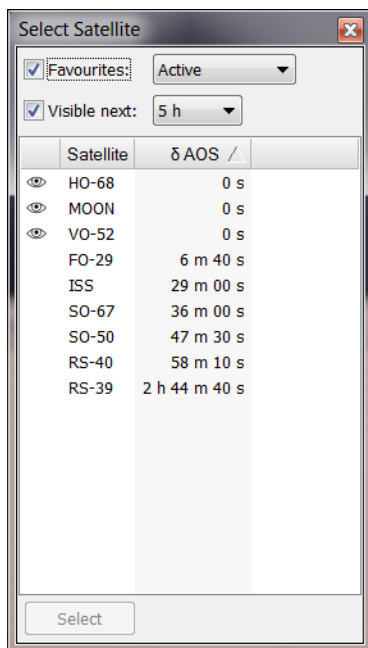
4 Selecting A Satellite

There are two ways to select the current satellite:

1. Satellite,
2. Next Passes.

4.1 Satellite

This is a simple window which lists either all satellites or the satellites in a favourite definition.

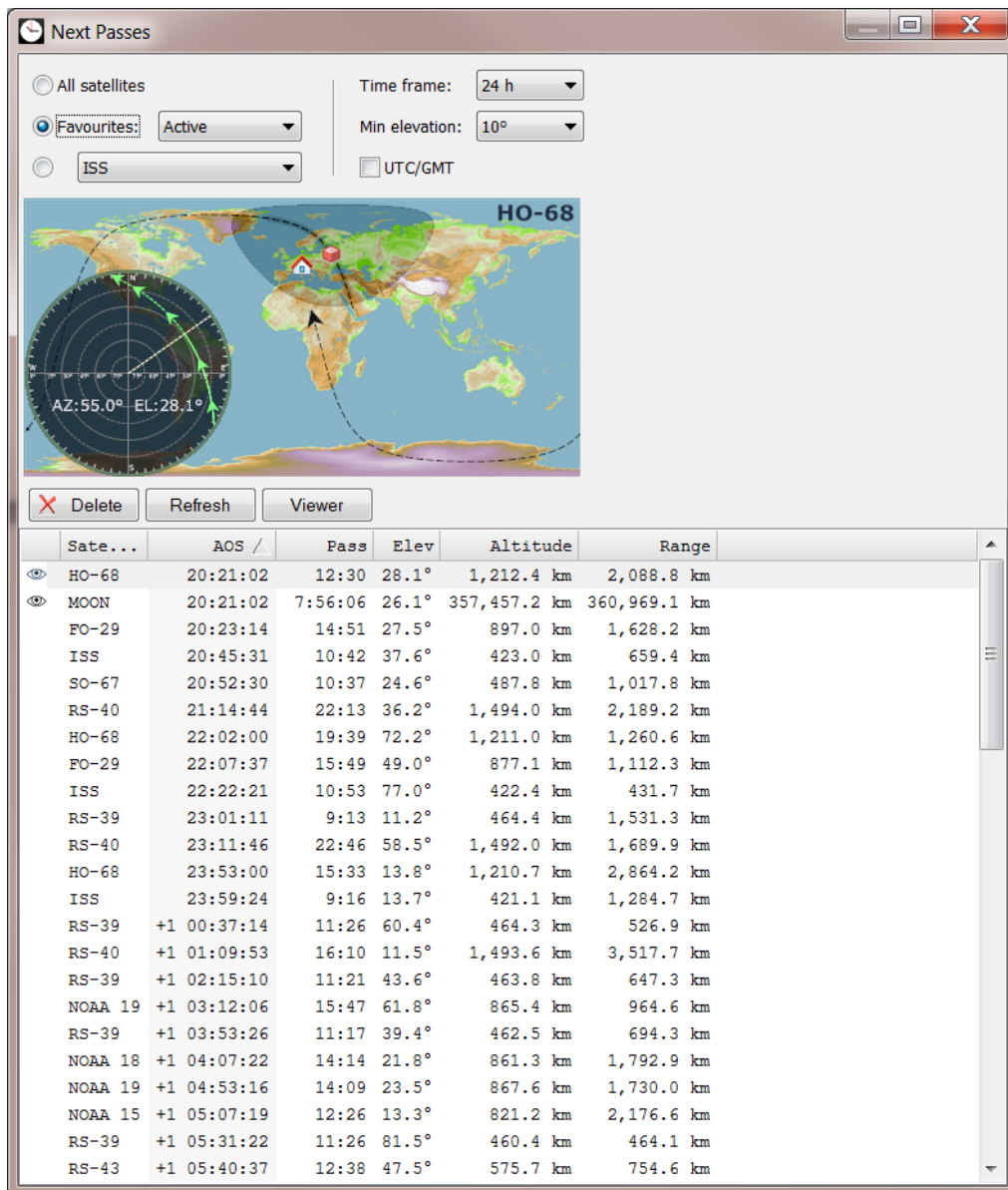


Use the *Visible next* option to restrict the list to those satellites visible within the selected time frame.

4.2 Next Passes

This is a more advanced window which shows the next passes visible at the observer's location based on these criteria:

- All / favourite definition / single selection
- Time frame
- Minimum elevation



The track for the first selected pass in the list is automatically shown in the small display window. To select a satellite (and close this window) double-click an entry in the list.

5 Doppler Correction

Radio signals from non-stationary satellites will be shifted in frequency, the formula for adjusting the received frequency is:

$$\text{Frequency} * (1.0 / 299792.458) * \text{RangeRate}$$

Where frequency is the received frequency, 299792.458 the speed of light in kilometres per second and RangeRate the speed at which the satellite is accelerating towards or away from the observer in kilometres per second.

To automatically apply Doppler correction, press the *Doppler* button. When Doppler correction is being applied a small progress bar is displayed as a visual indication.

Doppler correction is applied to the main spectrum and waterfall and the active VFO panes.

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