



TotalPower Visual-Manual

IONAA

mario.natali@gmail.com

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TotalPower

Introduction

TotalPower is a computer program designed to allow RF Band monitor and RF Noise measures using a low cost RTL-SDR dongle (<https://www.rtl-sdr.com/about-rtl-sdr/>).

The main functions are :

- 1. Plot of the RF signal captured from RTL-SDR on a continuous graph and instantaneous representation on an analog meter.**
- 2. Very flexible RF Band Monitor with several adjustments possible and a special Galaxy H-Line detection mode.**
- 3. Scan and automatic data-log of the noise received from a pre-defined sky area working in conjunction with PstRotator.**

(https://www.qsl.net/yo3dmu/index_Page346.htm)

WARNING : THIS FUNCTION CONTROLS DIRECTLY ROTORS. PLEASE BE SURE TO SET PROPERLY AZIMUTH AND ELEVATION LIMITS AND WATCH CAREFULLY THE MOVEMENTS TO PREVENT ANTENNA DAMAGES.

- 4. Data analysis of RF Noise data-logs obtained with Scan function.**



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Introduction

- ✓ **TotalPower is distributed with «Inno Setup» Windows installer that makes the installation process very easy and predictable.**
- ✓ **The installation process creates a main folder C:\Murmur and a subfolder named C:\Murmur\TotalPower . The user can change both directories.**
- ✓ **The program will use the subfolder to store program and support files. Several 3D example files are also provided.**
- ✓ **To fully remove the program from the PC please run the Windows uninstaller and remove manually the folders.**
- ✓ **TotalPower requires Computer running Windows 10 with 1.5 GHz or faster CPU and 200 MB of available memory.**
- ✓ **This program is alive thanks to the help, suggestions and guidance of many friends of the EME and SDR community and so I will appreciate the feedbacks from all users in order to continuously improve TotalPower.**



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Revision history

Revision History	
Date	Change
26 October 2023	Release 5.0.0
26 October 2023	Added the function to show the relative speed of the galaxy arms in the H-Line analyzer screen
26 March 2023	Release 4.0.0
26 March 2023	Redesigned analog meter
11 February 2023	Release 3.2.0
11 February 2023	Added reset button on analog meter
29 January 2023	Release 3.1.0
29 January 2023	Added possibility to enter frequency directly
26 November 2022	Release 3.0.0
26 November 2022	Added possibility to shrink all user and program interfaces
19 July 2022	Release 2.1.0
19 July 2022	Minor modifications of GUI
19 December 2020	Added more Azimuth / Elevation steps for finer scanning
10 October 2020	Release 2.0.0
8 October 2020	Modified the thread that capture the RTL-SDR buffer to decrease the CPU load
8 October 2020	Redesigned saving methodology of <3D plots directory> that was sometime failing



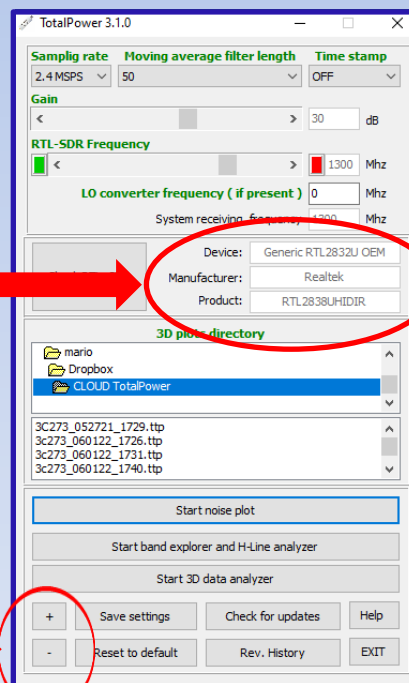
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RTL-SDR Installation

- ✓ The proper installation of the RTL-SDR is a prerequisite before starting the program.
- ✓ The installation guide of RTL-SDR is at :
<https://www.rtl-sdr.com/rtl-sdr-quick-start-guide/>

Please be sure that at the program start the RTL-SDR parameters are correctly displayed.

User interface zoom





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Noise plot

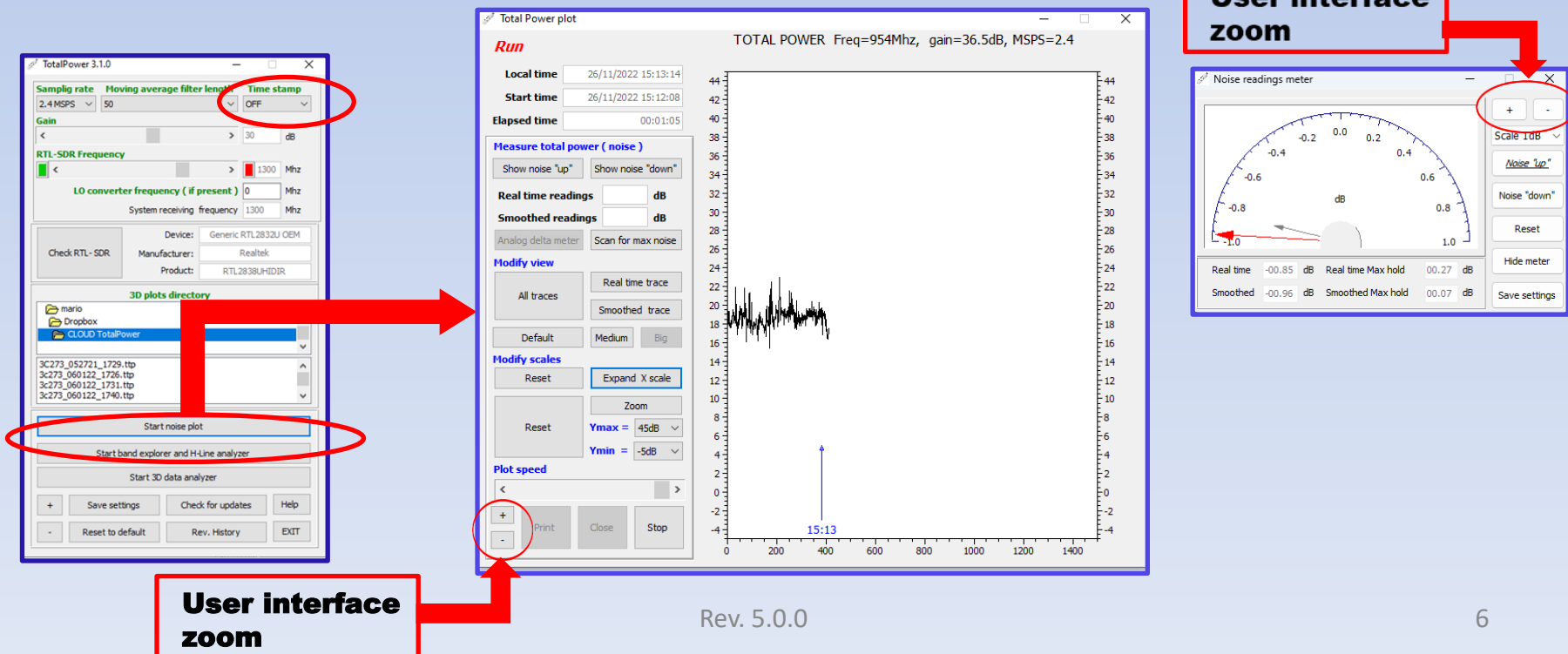
By clicking on «**Start noise plot**» the Total power plot mode will be activated.

When the plot function is active it will be possible to visualize an analog meter that will be very helpful to fine tune antenna pointing.

Note : This function works better with «Time stamp OFF» which allows higher plotting speed

It is also possible to generate long term plots to survey some specific band or to plot drift scans pointing the antenna to the future position of a noise source.

NOISE PLOT is demanding in processing power and so it may happen to see compressed plots if recordings are long. Faster computers mitigate this problem.





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Band monitor

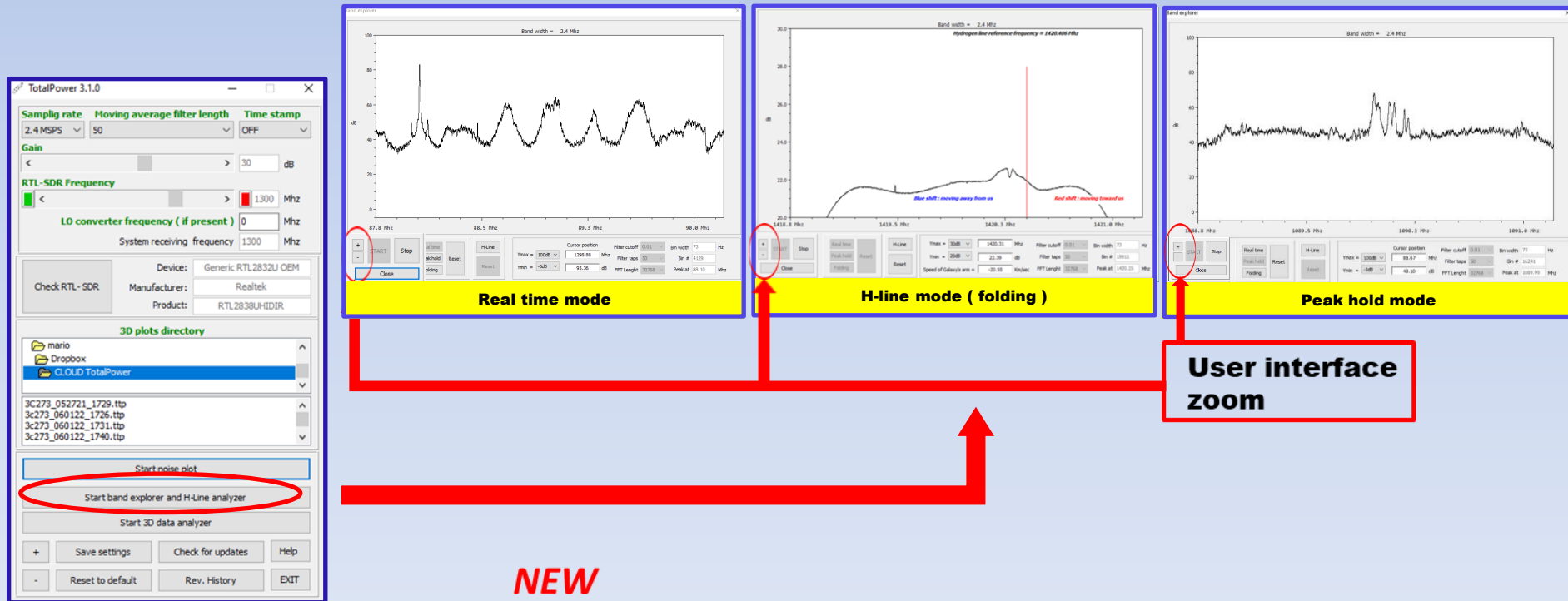
This function allows to monitor the signals at the frequency set for the RTL-SDR and with the bandwidth set with MSPS.

Three modes are available : real time, peak and folding.

The real time mode is a continuous survey of the frequency.

The peak mode holds the peaks received allowing to see the spikes (such as radar bursts) that otherwise will be invisible.

The folding mode is a special mode that integrates the signal received and so can help in enhancing and make visible weak signals. This mode is used when H-Line mode is activated and allows to see the H-Line signal coming from the galaxy even with small antennas.



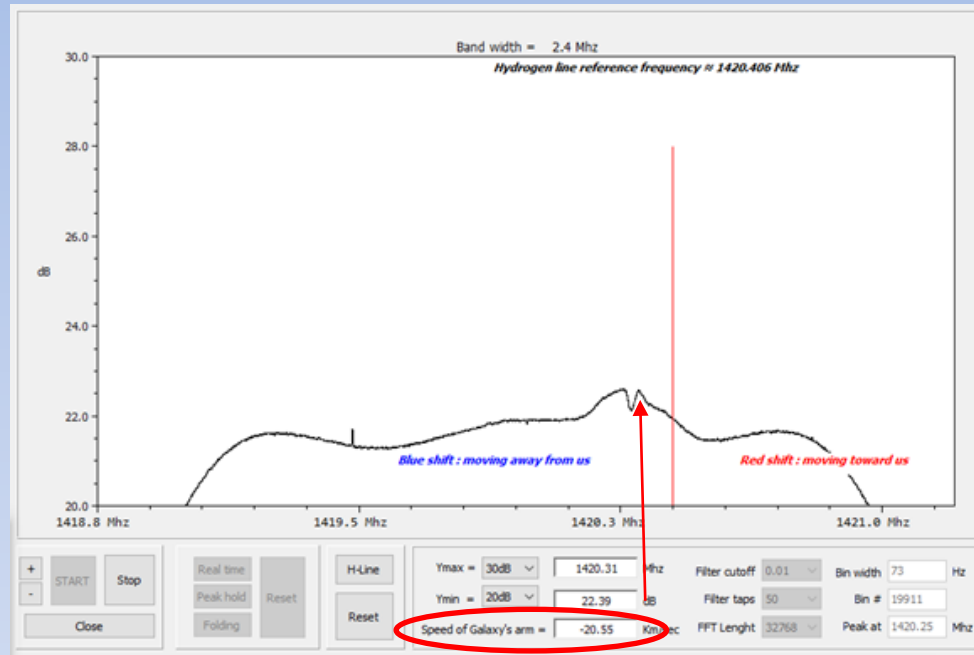


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H-Line analyzer

NEW IN VERSION 5.0.0

The H-Line function allows to estimate the speed of rotation of galaxy arms (respect to our position) due to doppler effect, measuring the delta in frequency between H-line received peaks and reference frequency.



By moving the cursor on the H-Line peaks, it is possible to see the speed of that arm of the galaxy. In the above example an area close to Sagittarius A shows two peaks that are originated from two arms of the galaxy.

The speed of the first arm is -20.55 Km/sec. Both arms are moving away from us.

The model to calculate the speed is simplified but is offering a very good estimate of the relative movement.



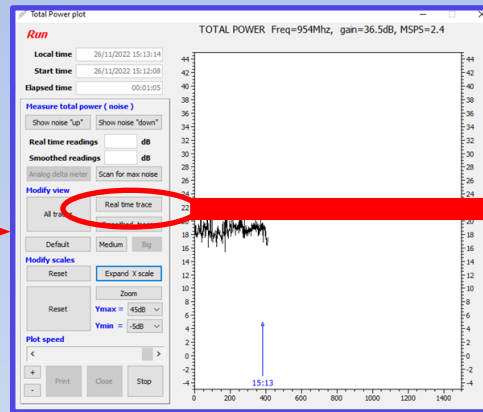
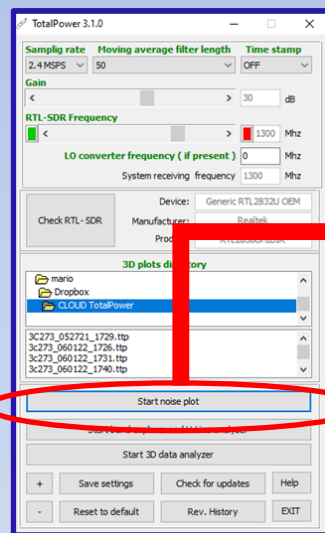
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Scan

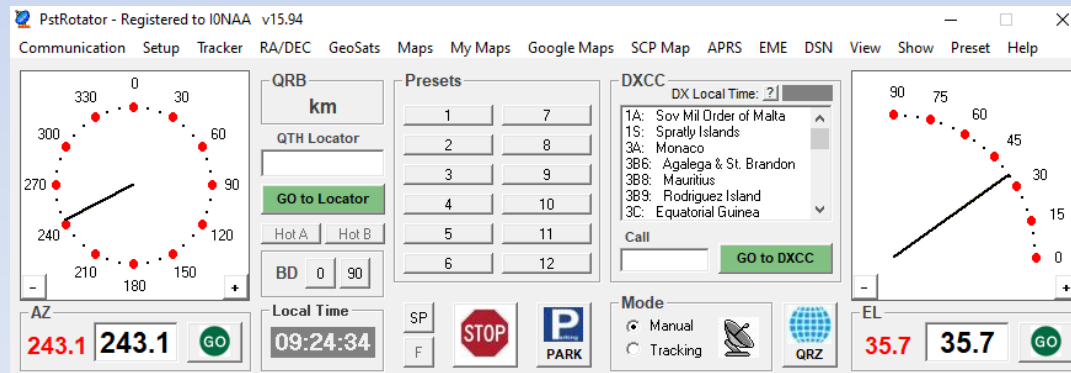
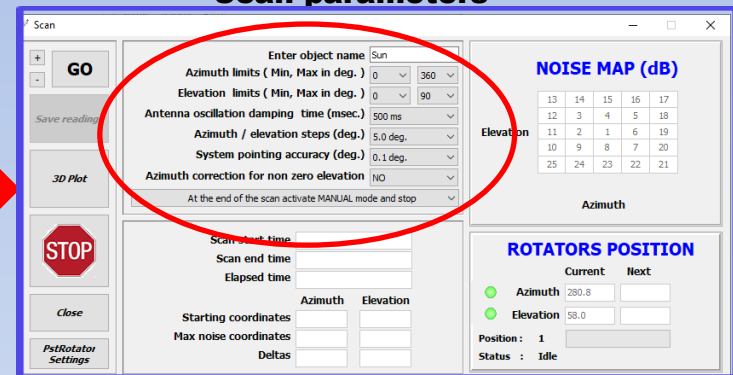
This is a function that, working in conjunction with the program PstRotator, creates a noise sky map positioning the antenna in 25 different directions.

The limits of the area to explore must be defined imposing Scan parameters.

Note : System pointing accuracy must be set as high as possible to avoid system hang up



Scan parameters





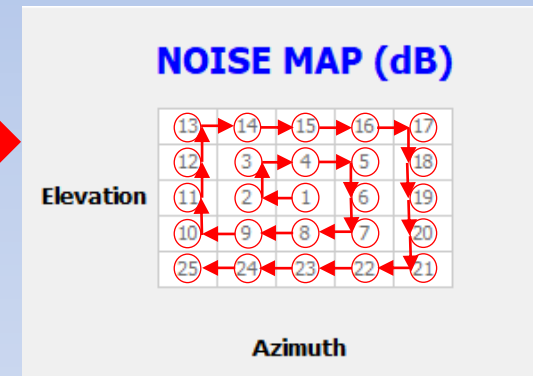
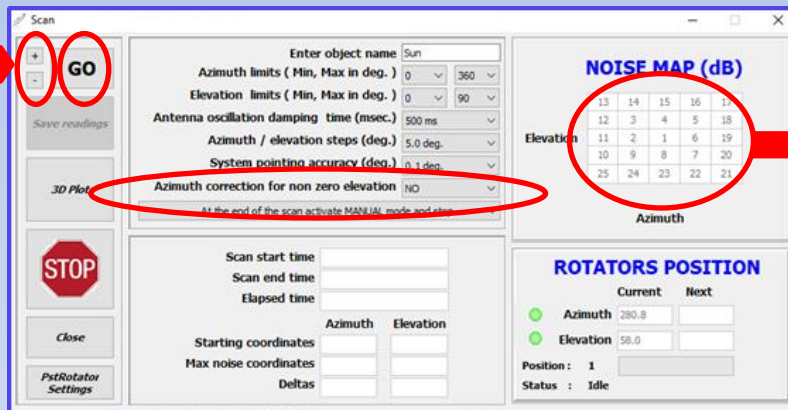
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Scan (cont'd)

The «**GO**» button will start a quasi-spiral movement of the antenna that will be implemented as a sequence of 25 stop and go steps from point 1 (starting point) to point 25.

The coordinates of each point will be derived from starting point adding a multiple of the Azimuth / elevation step defined in the parameters screen.

At each position, the program will stop the rotator, will wait the programmed damping time to minimize the antenna oscillation and will take a noise measurement . The noise measures will be displayed in the NOISE MAP area and will be also recorded in a file for further analysis with 3D Plot program described later.



User interface zoom

The button «**Azimuth correction for non zero elevation** » introduces a correction that allows to make the length of the travelled azimuth path during the scan identical independently from the elevation.

See https://www.eutelsat.com/files/contributed/support/pdf/Azimuth_Correction.pdf for more details.

NOTE : Please note that this can make the real azimuth step much bigger compared to the programmed one.



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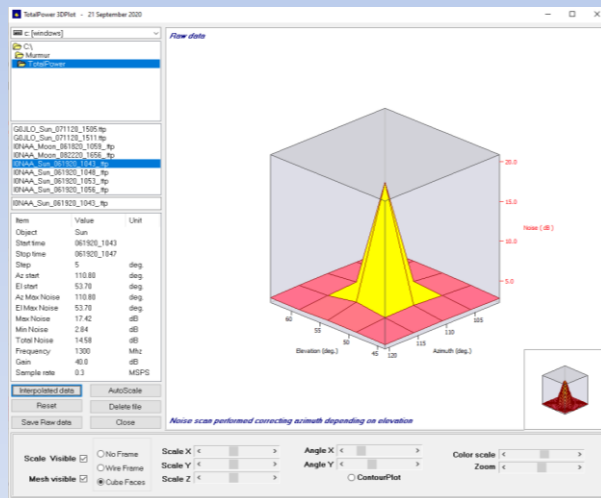
3D Plot

The « **3D PLOT** » function reads the data generated from the **SCAN** function and produces 3D Plots that can be modified and analyzed dynamically.

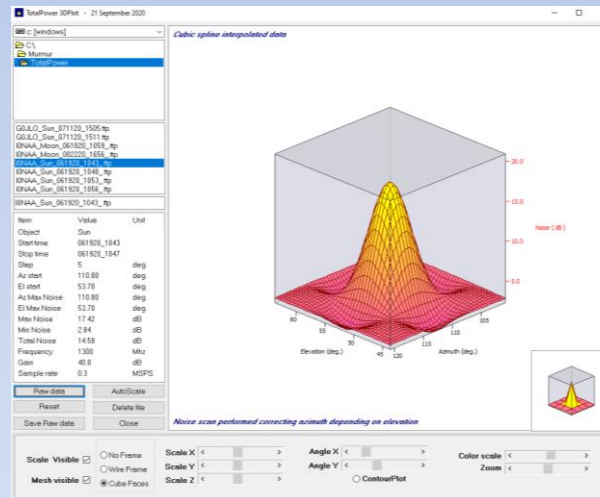
It is possible to visualize both raw data and interpolated data (cubic spline interpolation).

The « **ContourPlot** » button allows to visualize a Contour-like graph that can give useful information on the antenna pattern and on the noise signal source analyzed.

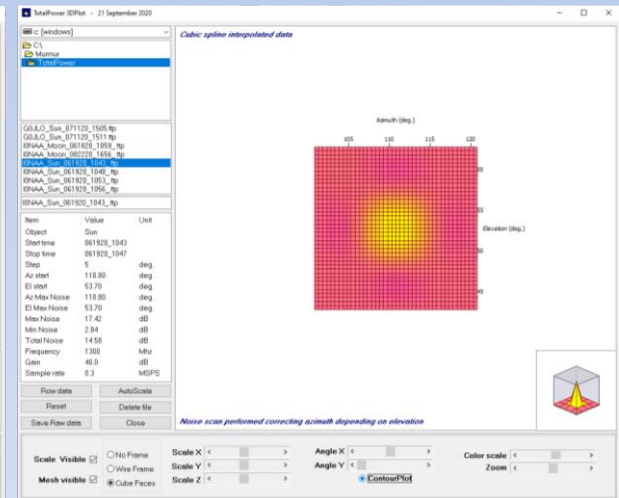
The « **Save raw data** » button allows to save in .csv format the data recorded for further analysis with external programs.



Sun plot raw data



Sun plot interpolated data

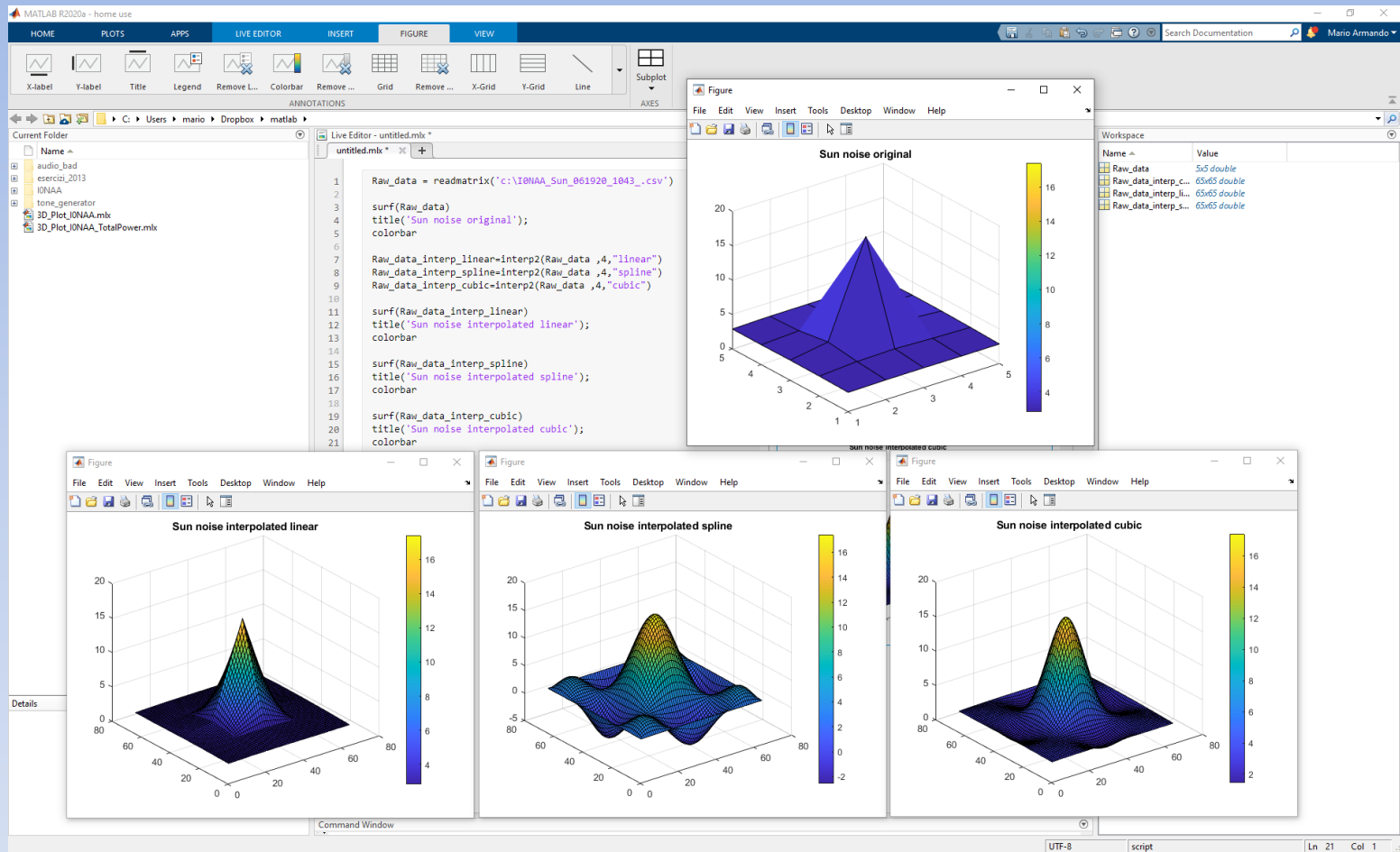


Sun contour plot



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3D Plot - Matlab



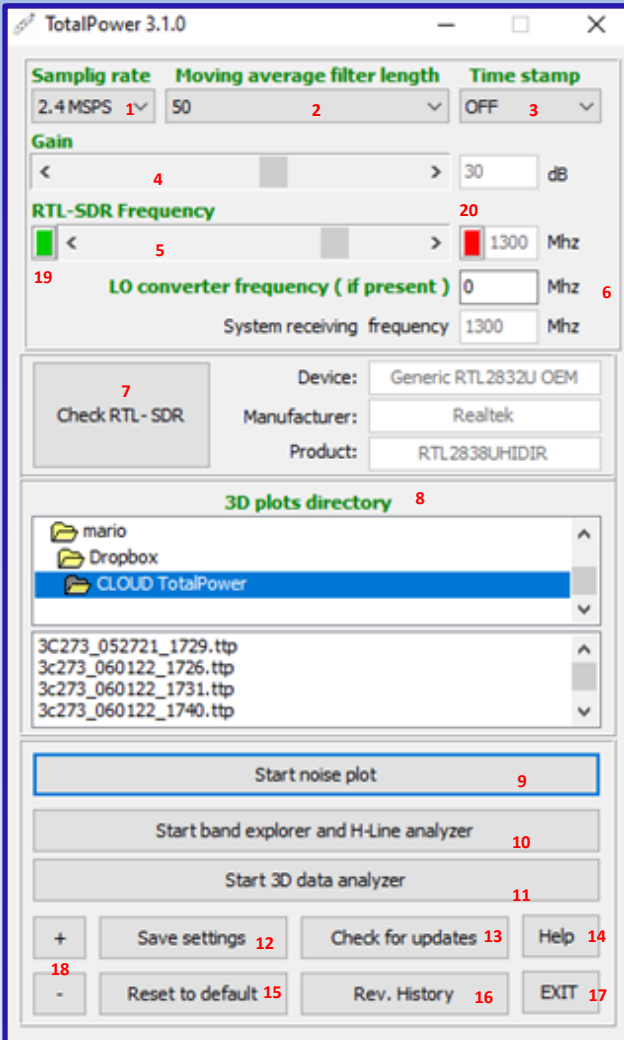
Example of 3D data-log analysis performed with *MATLAB®* (Home use)



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Main window

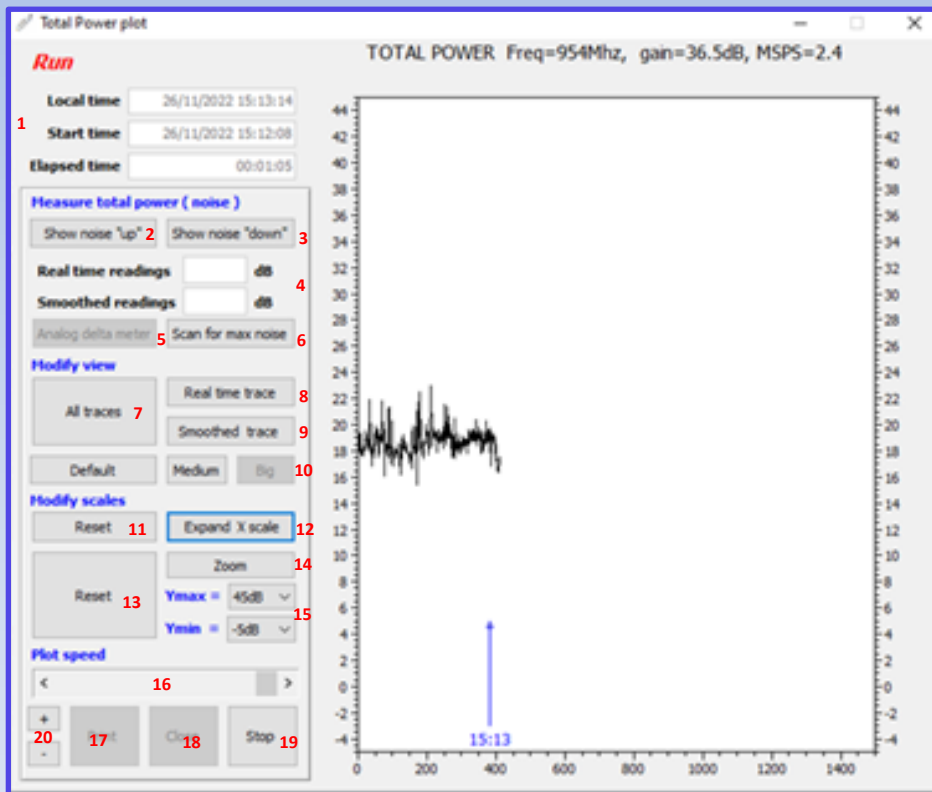
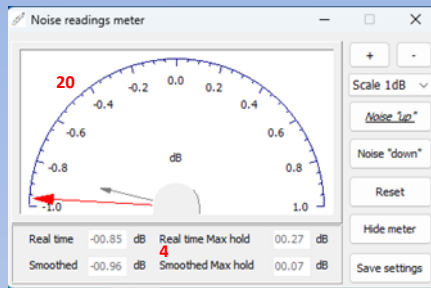
1. **RTL-SDR Sampling rate in MSPS (Mega Samples Per Second) : 2.4MSPS, 1.0 MSPS and 0.3MSPS allowed.**
2. **Moving average lengths (Low pass filter) : several filter lengths are available in order to smooth the plot.**
3. **Time stamp : OFF, 1minute, 2minutes, 4minutes or 10 minutes. The time stamp will be displayed directly on the plot.**
4. **RTL-SDR Gain in dB.**
5. **RTL-SDR Frequency in Mhz.**
6. **Frequency of Local Oscillator of converter (if present)**
7. **RTL-SDR check.**
8. **Working directory where TotalPower will store noise plots and initialization data.**
9. **Start of the noise / signal plot.**
10. **Start of the band monitor and H-Line analyzer .**
11. **Start of the program to analyze the noise plots.**
12. **Save all the settings identified with green color labels and the screen position of all program windows showed.**
13. **Check of current release of TotalPower ; the check is performed accessing the web site <http://i0naa.altervista.org/> .**
14. **Display of the this manual that is included in the download package.**
15. **Reset of initialization data (restart of TotalPower is required)**
16. **Show the change list history.**
17. **TotalPower program termination.**
18. **User interface zoom.**
19. **Activation of slider to change frequency.**
20. **Activation of direct input of frequency.**





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Plot window

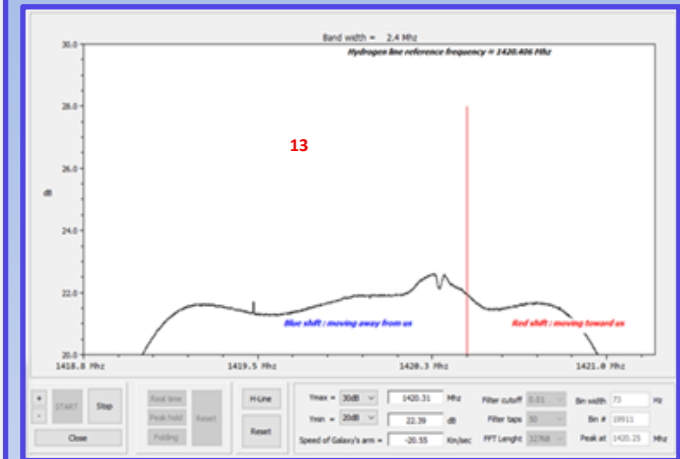
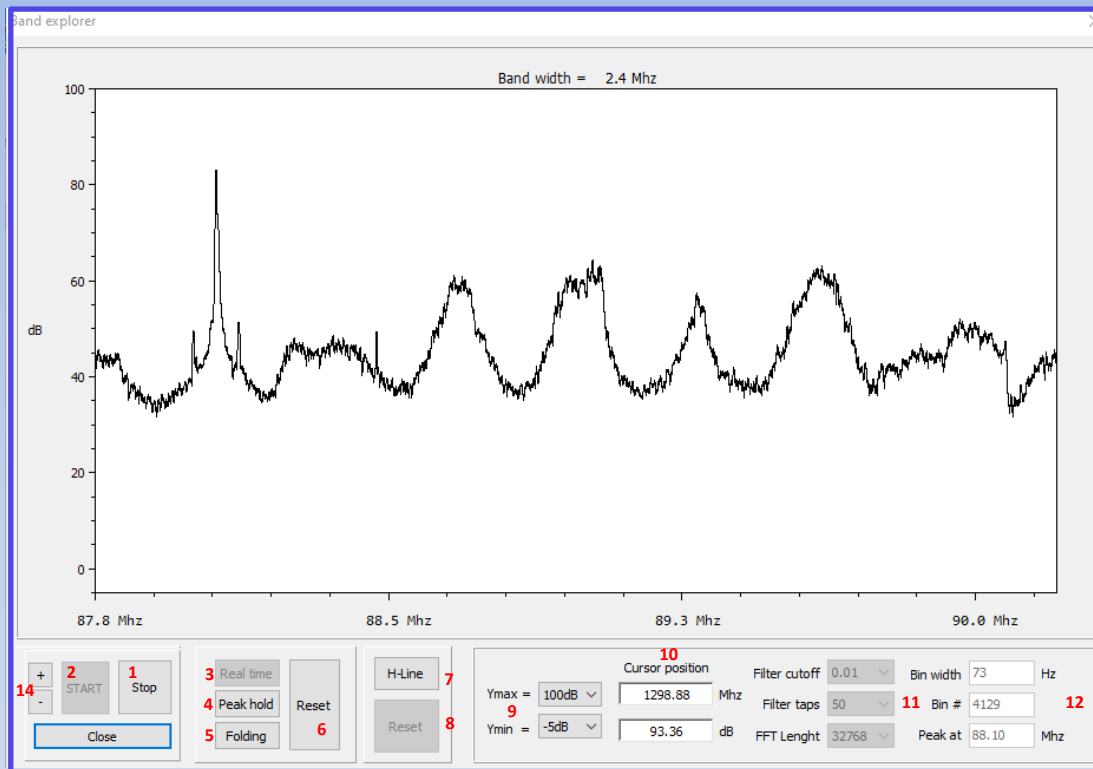


1. Current plot time parameters.
2. This function shows the increase of noise from the value detected at the time of the button click.
3. This function shows the decrease of noise from the value detected at the time of the button click.
4. Noise values (up or down) measured in real time and after moving average filtering (smoothed).
5. Analog meter (19) enable.
6. Once the noise measure is started (up or down) it is possible to enable an analogue meter (20)
7. Show both real time and smoothed trace.
8. Show real time trace only.
9. Show smoothed trace trace only.
10. Change plot dimension to allow better visibility.
11. Reset Y Scale to the default.
12. Expand X Scale in order to see more data.
13. Reset Y scale to default.
14. Zoom Y scale.
15. Set Max and Min of Y scale.
16. Plot speed adjustment.
17. Print Graph.
18. Stop plot.
19. Close screen.
20. Analog meter screen
21. User interface zoom



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Band explorer window



1. Start / Stop of Band Explorer .
2. Close the window.
3. Enable real time mode.
4. Enable Peak hold mode.
5. Enable folding mode (to enhance weak signals).
6. Reset functions to default.
7. Enable Hydrogen line (H-Line). observation mode.
8. Reset to default.
9. Set Max and Min of Y Scale.
10. X and Y of cursor position.
11. Adjustable Filter and FFT parameters
12. Output parameters of FFT.
13. H-Line window
14. User interface zoom

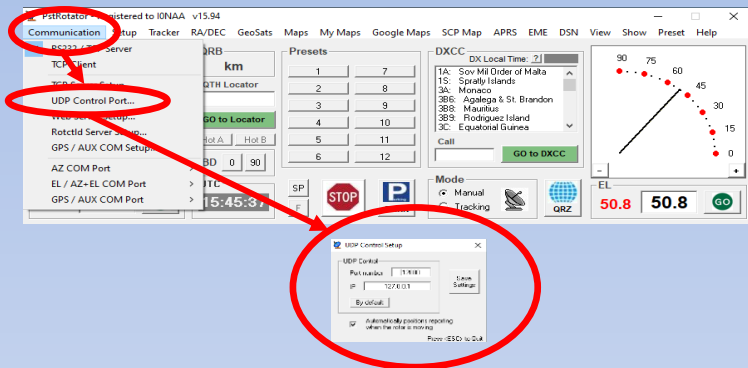


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PstRotator parameters

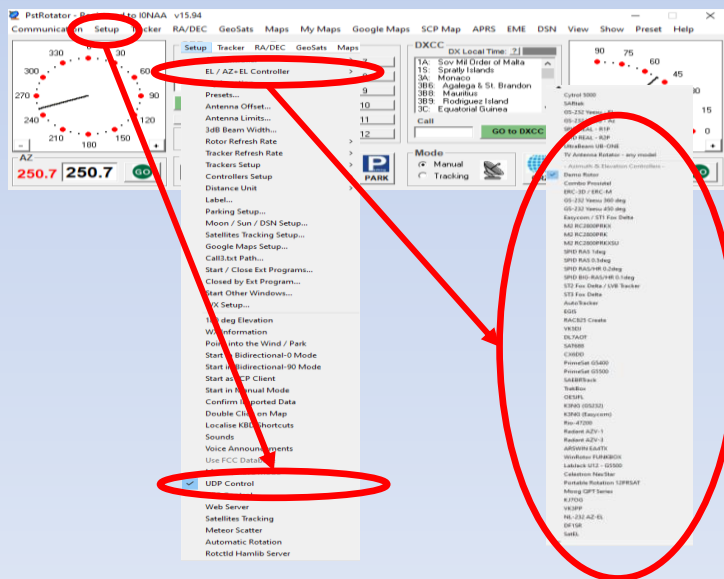
TotalPower SCAN function can produce sky noise maps working in conjunction with the program PstRotator (https://www.qsl.net/yo3dmu/index_Page346.htm) and moving automatically the antenna.

UDP Control in PstRotator must be active and set as per following notes :



1. Set UDP Control Port parameters:

- Communication->UDP Control Port
- Set Port number 12000 (default)
- Set IP 127.0.0.1
- Mark «Automatically Positioning reporting ...»
- Save Settings



2. Set UDP mode active :

- Setup->UDP Control

3. Set EL / AZ Controller :

- Setup->AL / EZ +EL Controller->
- Set your own controller



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Scan window

The screenshot shows the 'Scan' window of the TotalPower software. It contains several sections: a left sidebar with buttons for 'GO', 'Save readings', '3D Plot', 'STOP', 'Close', and 'PstRotator Settings'; a central area for entering scan parameters like object name, limits, and accuracy; a bottom section for scan timing and coordinates; a 'NOISE MAP (dB)' grid; and a 'ROTATORS POSITION' section showing current and next values for azimuth and elevation. Red numbers 1 through 18 are placed around the interface to correspond with the numbered list of instructions.

18 + 1 **GO**

2 Save readings

3 3D Plot

4 STOP

5 Close

6 PstRotator Settings

7 Enter object name Sun

8 Azimuth limits (Min, Max in deg.) 0 360

9 Elevation limits (Min, Max in deg.) 0 90

10 Antenna oscillation damping time (msec.) 500 ms

11 Azimuth / elevation steps (deg.) 5.0 deg.

12 System pointing accuracy (deg.) 0.1 deg.

13 Azimuth correction for non zero elevation NO

14 At the end of the scan activate MANUAL mode and stop

15 Scan start time
Scan end time
Elapsed time

16 **NOISE MAP (dB)**

Elevation				
13	14	15	16	17
12	3	4	5	18
11	2	1	6	19
10	9	8	7	20
25	24	23	22	21

Azimuth

17 **ROTATORS POSITION**

	Current	Next
● Azimuth	280.8	
● Elevation	58.0	

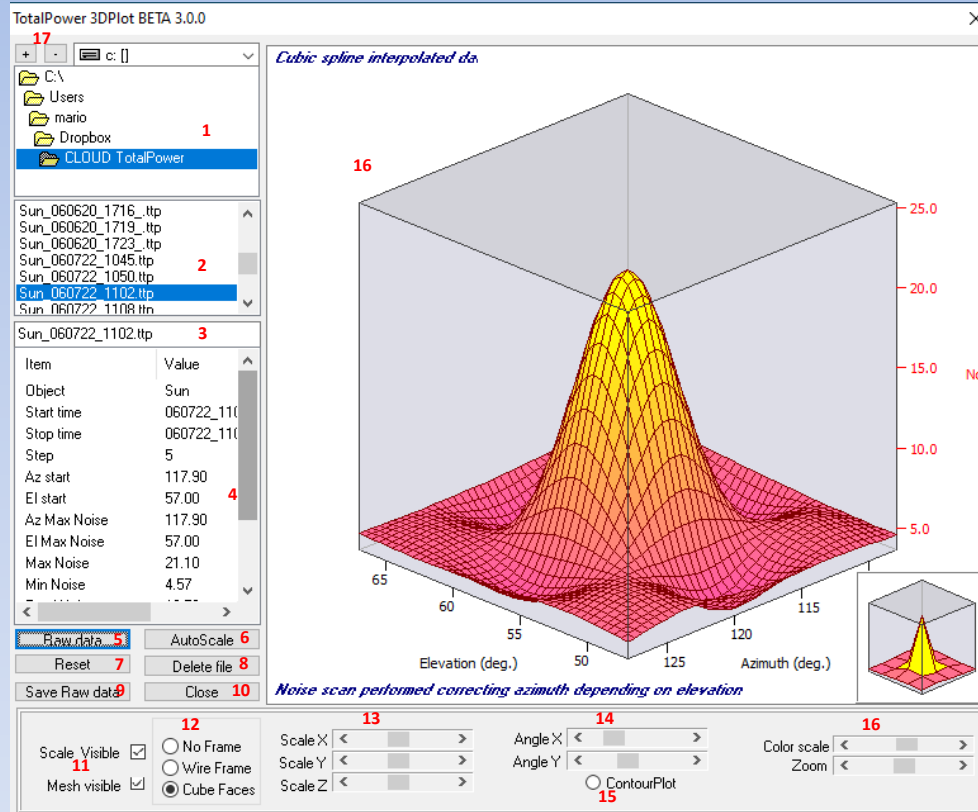
Position : 1
Status : Idle

1. Start Scan.
2. Save readings. This is available after completing the scan.
3. Start 3D analysis program.
4. STOP Scan but do not close the window.
5. Close the window.
6. Show the PstRotator settings.
7. Name of Scan (Object) . This will be the initial name of the file saved.
8. Set Azimuth limits.
9. Set Elevation limits.
10. Set oscillation damping time after the antenna movement.
11. Set Azimuth / Elevation scanning steps.
12. Set system pointing accuracy .
13. Enable routine that automatically compensate Azimuth steps in order to explore the same circular arc independently from elevation. The correction is higher for higher elevations.
14. Set action to be performed at the end of the scan.
15. Scan noise summary.
16. Scanning window showing in real time noise value measured.
17. Rotor window showing in real time rotor activity and position.
18. User interface zoom



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3D Plot window



1. Working directory where TotalPower will store noise plots and initialization data.
2. List of noise plots saved.
3. Noise file selected by clicking on previous screen.
4. Noise plots parameters . *Note that an asterix on Frequency denotes that a converter was used.*
5. Switch between raw data and interpolated data.
6. Automatic scale.
7. Reset to defaults.
8. Delete file selected in 3.
9. Save raw data as .csv for further evaluation.
10. Close program and window.
11. Switch on and off the plot scale and the plot mesh.
12. Modify plot frame.
13. Zoom of X,Y and Z scale.
14. Modify X and Y scale angles.
15. Contour-plot activation .
16. Modify color scale and zoom.
17. User interface zoom



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