www.wireless-planning.com
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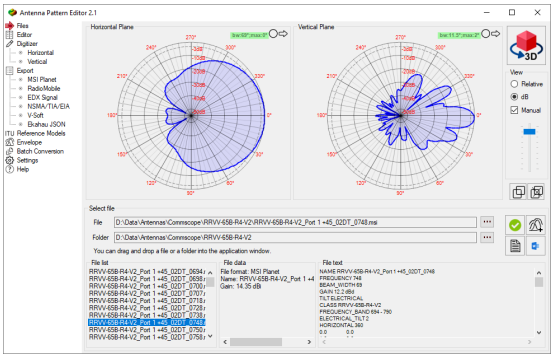
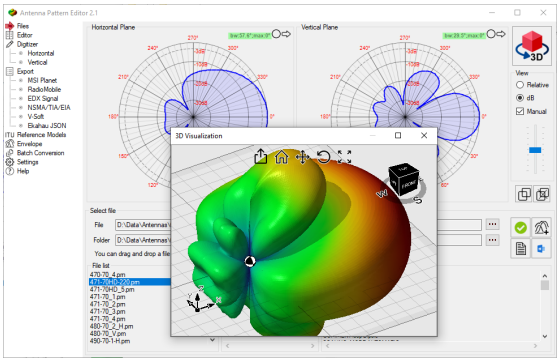
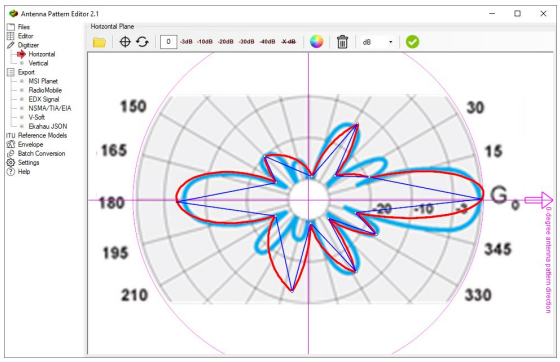
Antenna Pattern Editor 2.1

User Manual







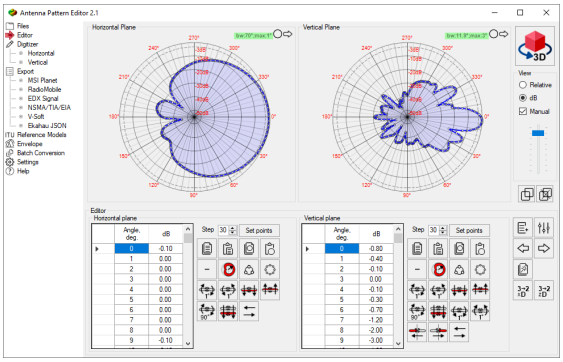


Table of Contents

From the Developers

We made every effort to create a user-friendly and intuitive application. However, we recommend that you spend some time reading this User Manual to get the most out of the Antenna Pattern Editor.

Features

Antenna Pattern Editor is a versatile tool that allows you to view, create, edit, and convert antenna pattern files. The main idea behind the program is to provide users with the ability to quickly create an antenna pattern file using various methods.

An antenna pattern file is a simple text or XML file that describes the main characteristics of an antenna - radiation patterns, gain, frequency range, name, manufacturer, and other data. These files are used in various radio planning tools including our RadioPlanner, Indoor RadioPlanner, MLinkPlanner and EMF Planner (see https://www.wireless-planning.com/).

Due to the large number of antenna pattern file formats, it often happens that an antenna pattern file in the exact format you need is not available. In this case, using Antenna Pattern Editor, you can easily convert the file to the format you need.

Sometimes the antenna information is just a picture of the antenna pattern. In such cases, using Antenna Pattern Editor, you can prepare the necessary file in just a few minutes. Thanks to its simple graphical interface and cubic spline interpolation algorithm, you can get the desired file by pointing out only a few characteristic points on the downloaded image. You can use images in any raster format - png, jpg, bmp, tiff.

With Antenna Pattern Editor, you can view, compare, edit, transform and normalize antenna patterns as well as perform a number of other functions described below.

Features:

- View 2D/3D antenna patterns in linear and logarithmic scales
- View text information from antenna pattern file
- Create/edit the antenna pattern in the table form with advanced copy and paste capabilities
- Create an antenna pattern from the picture (digitizing)
- Perform various transformations of antenna pattern (rotation, mirroring, normalize, etc.)
- Create of antenna patterns on various ITU-R reference models
- Antenna pattern report in Word, Excel, and PDF
- Export antenna patterns to various formats
- Calculation of the width of the main lobe in the horizontal and vertical plane, as well as the electrical antenna tilt
- Create an antenna pattern envelope file from a set of antenna patterns
- Batch convert antenna pattern files between formats

Antenna Pattern Editor supports most antenna pattern file formats. Both simple formats with two patterns in azimuth and elevation planes (e.g., MSI Planet, Radio Mobile V3, Ekahau *.json antenna pattern) and more complex formats with antenna patterns in different polarizations and “slice” formats (NSMA, TIA/EIA-804-B, EDX) are supported. Full 3D formats ETS-Lindgren and Satimo are also supported.

Supported antenna pattern file formats:

- MSI Planet (*.msi, *.pla, *.pln, *.ptn, *.txt, *.ant)
- Radio Mobile V3 (*.ant)
- NSMA WG16.99.050 (*.adf *.dat *.nsma *.nsm *.txt)

- TIA/EIA-804-B (*.adf)
- EDX (*.pat)
- Ekahau (*.json)
- Atoll (*.txt)
- Asset (*.xml)
- Mentum Planet (*.pafx)
- AntPat (*.ana)
- CelPlan (*.txt)
- RadioSoft ComStudy (*.pt2)
- V-Soft (*.pat, *.vep)
- 3D formats: ETS-Lindgren, Satimo (*.csv)

Samples of all these files can be found in the folder with the installation file.

Installation and Activation

Antenna Pattern Editor is compatible with x64 and ARM processors on Windows 10/11. The minimum computer configuration required is a Core i3 CPU, 4 GB RAM, 200 GB HDD, a video card, and a monitor with support for 1366x768 resolution.

To install the program, run the Setup_AntennaPatternEditor.exe file. Select your language and click Install to launch the installation process. Click Next. To continue the installation process, read and accept the License Agreement by activating the checkbox “I accept the terms in the License Agreement” and clicking Next.

After installing Antenna Pattern Editor, you will see a new entry in the Start menu and a shortcut on the desktop.

During the 30-day trial period, you can try most of the program's features, except for export. To use all the features in the software, you need to purchase a license and activate the software.

To purchase Antenna Pattern Editor, click on Help - Purchase. This will open the purchase page in your browser. After making a purchase, you will immediately receive an activation ID code via email. Then click Help - Enter your Activation ID code, enter your code and click ACTIVATE.

Software Update

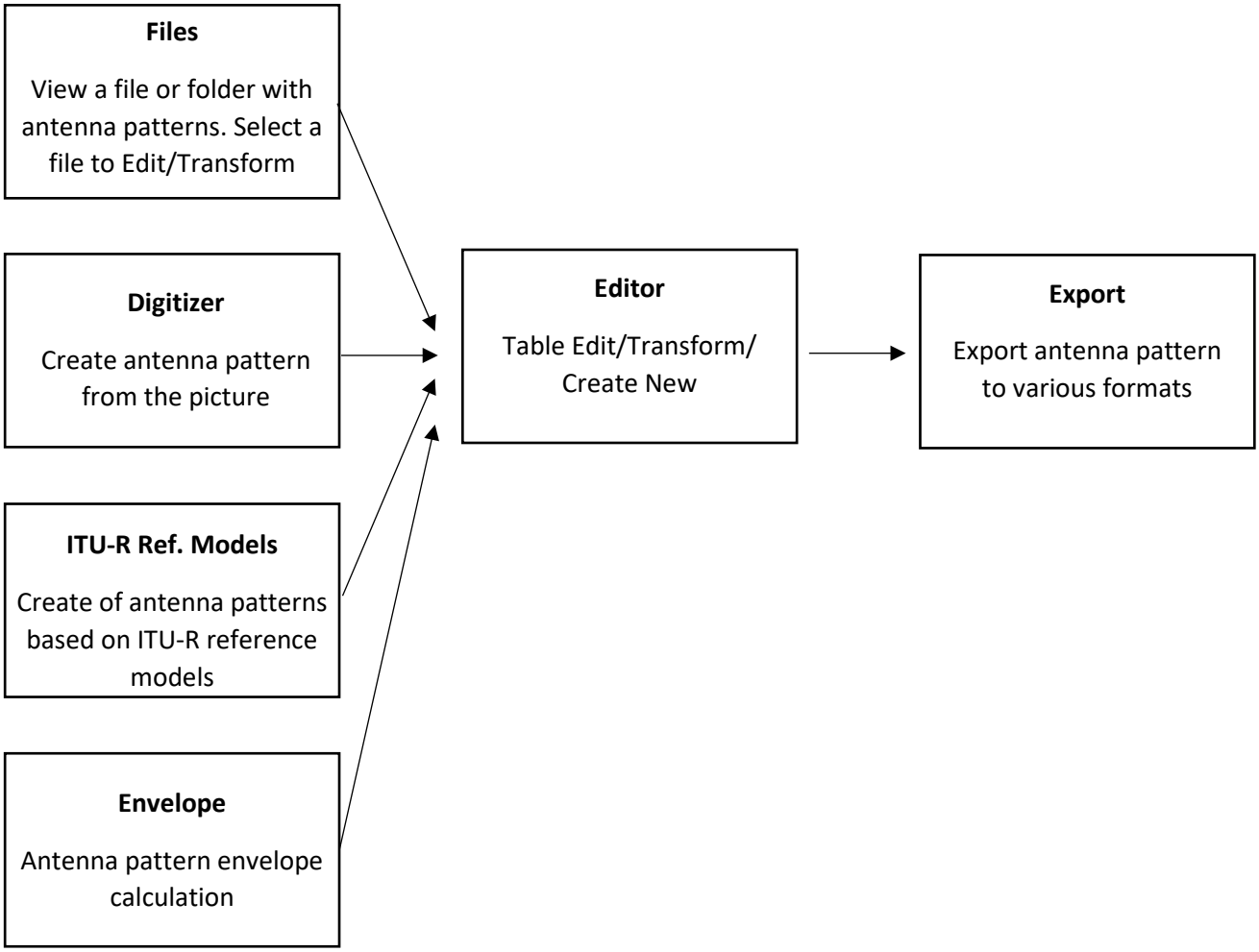
We periodically release free updates that improve the functionality and stability of the software.

Antenna Pattern Editor supports both manual and automatic update checks. The program will check for available updates each time it starts. To check for updates manually, click Help - Check for Updates. If an update is available, a window will open displaying the current and available versions. Download the update from the provided link and install it manually (make sure to close Antenna Pattern Editor before installing the update).

Settings

Units	Values Units in the Editor: - dB - Relative (E/Emax) - dB + Relative (E/Emax)

How to Work with the Antenna Pattern Editor



The general principle of Antenna Pattern Editor's operation can be understood from the block diagram above. The program has several blocks, each with its own function:

Files: Here, you can view antenna patterns and prepare antenna datasheets in Word, Excel, and PDF formats. You can also select an antenna pattern for further editing.

Digitizer: This block allows you to digitize an antenna pattern presented as an image. The resulting vector data for the antenna pattern in the azimuth and elevation planes is then transferred to the Editor for further processing.

ITU-R reference models: In this block, you can create an antenna pattern based on ITU-R reference models. The resulting antenna pattern is transferred to the Editor for further processing.

Envelope: This block calculates an antenna pattern envelope from a set of individual antenna patterns. This is often required to determine the worst-case radiation situation in terms of harmful effects of radio waves.

Editor: Here, a new antenna pattern is created/edited in tabular form and transformations, normalization, and other processing of the antenna pattern are performed.

Export: In this block, the antenna pattern is exported to various formats. Export is performed for the antenna pattern placed in the Editor.

Each block serves a specific purpose and together they provide a comprehensive tool for working with antenna patterns.

User Interface

The user interface of Antenna Pattern Editor uses a Tree View interface (multi-level tree) as its main user menu. The controls for this interface are located on the left side of the main panel. When you select a menu item, the corresponding panel opens on the right.

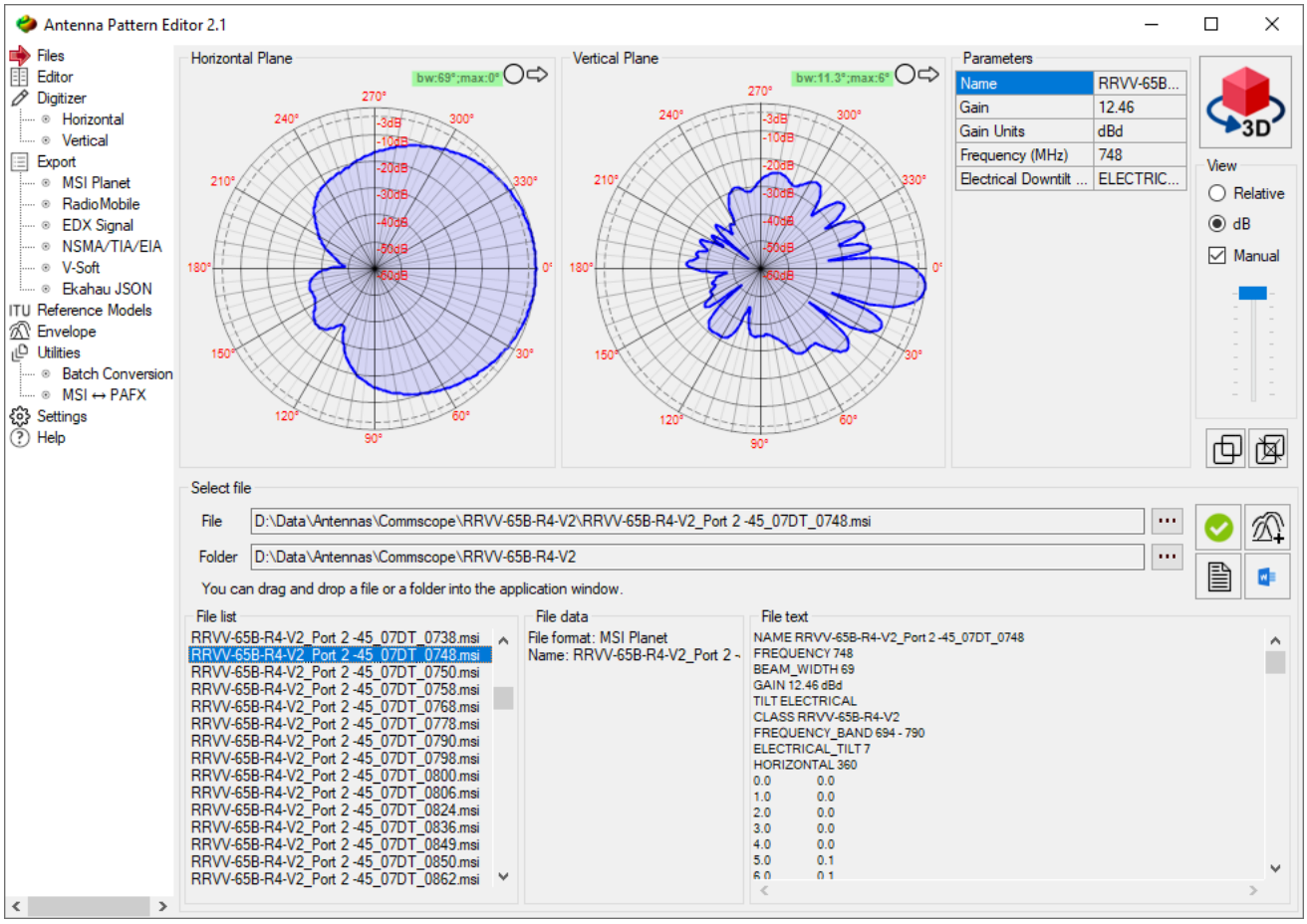
View and Select Antenna Pattern File

To view and select an antenna pattern file, you can use the Files menu. Here, you can also generate a report in the form of a specification for a specific antenna in Word, Excel, or PDF format. You can upload either a single file or a folder with a set of files.

Antenna Pattern Editor allows you to view antenna patterns as well as other information from antenna pattern files. You can open a file or folder in the standard way or simply by dragging and dropping the desired file or folder into the Antenna Pattern Editor window.

If you open a folder with a set of antenna files, a list will appear on the left side. You can select the desired antenna from that list. Files from folders enclosed within the current folder will not be displayed.

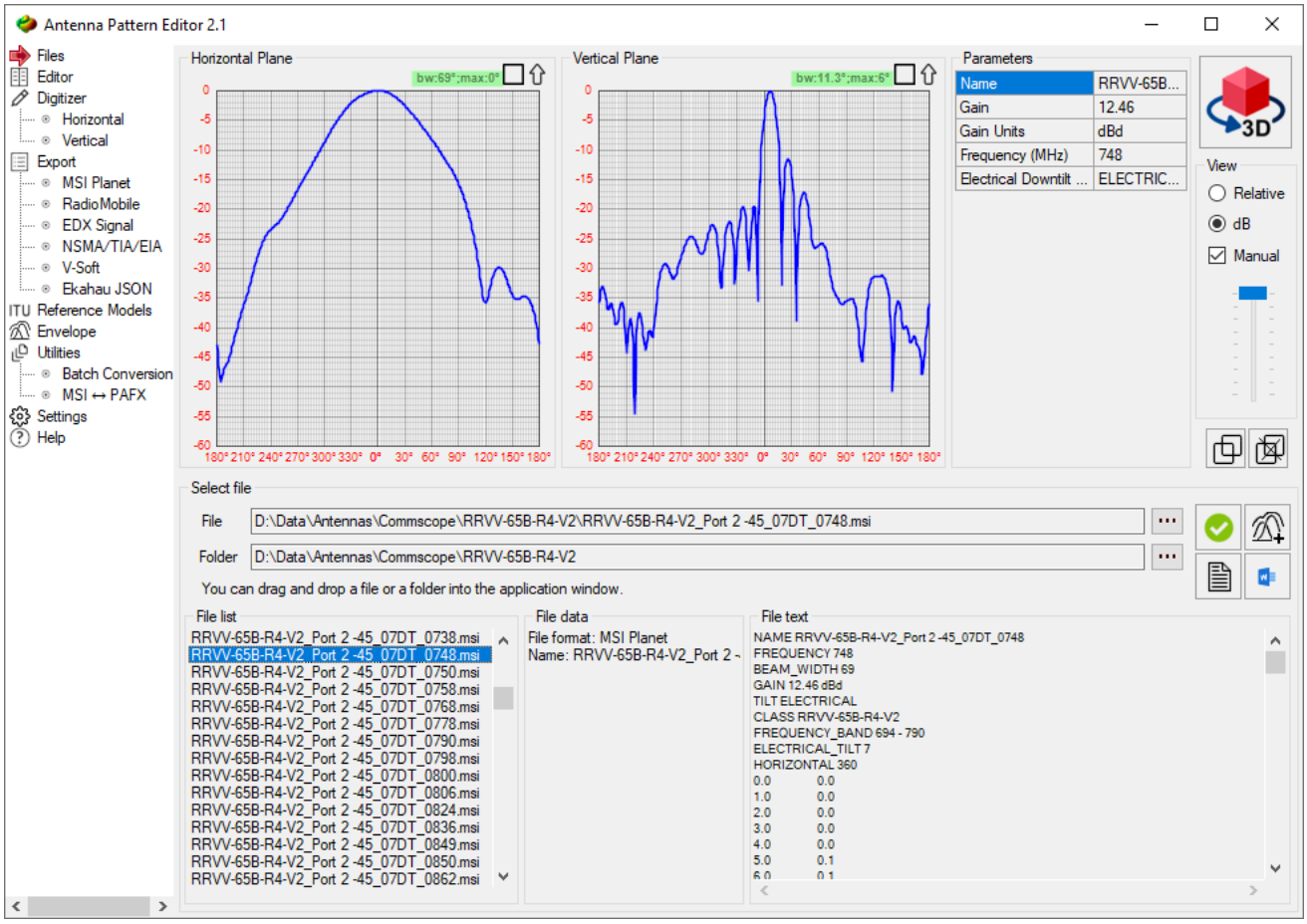
After selecting a file, images of the antenna pattern in horizontal and vertical planes will appear on the top panel. Information about the antenna pattern file format, antenna name, and gain will appear on the right. The full text of the antenna pattern file will be shown in a separate block.



View Antenna Pattern Files

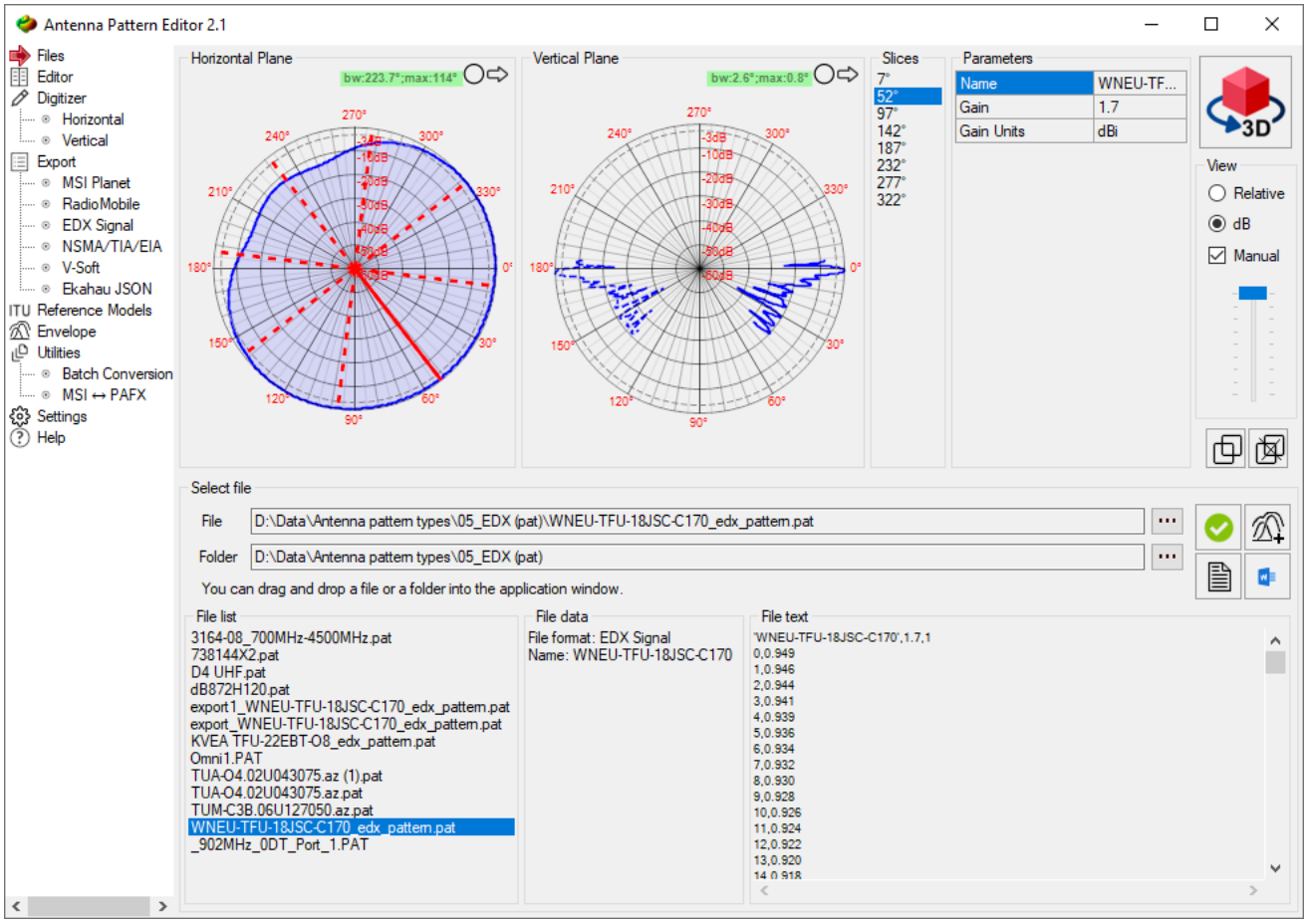
You can use the tools located to the right of the antenna pattern to change the display of the antenna pattern - in relative units (E/Emax) or dB. The scale is set automatically, but for dB, you can also set the scale manually by clicking on Manual and moving the slider. If the antenna pattern is not normalized, a corresponding mark will appear above it.

Using the controls  above the antenna pattern, you can select its representation (in polar or Cartesian coordinate system) as well as the antenna pattern orientation (up or right). This allows you to customize the display of the antenna pattern to your preferences.



Antenna Pattern in Cartesian Coordinate System

If the antenna pattern file contains patterns for several polarizations or slices (some file formats allow this), then an additional field for selecting options will appear. To view the corresponding antenna pattern, you can click on the appropriate option (polarization type or slice azimuth).



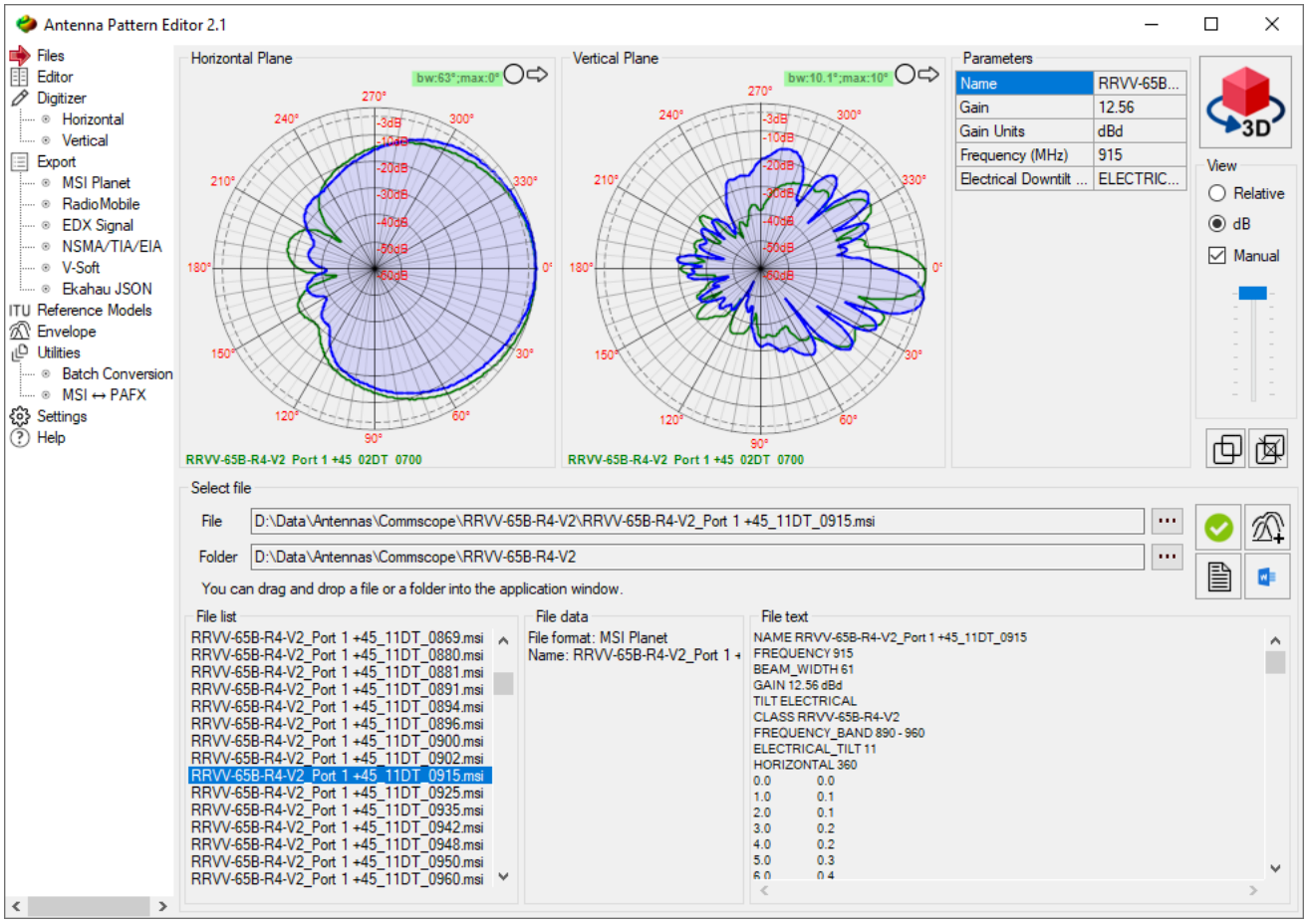
Sample antenna with multiple slices in EDX format

The width of the main lobe is displayed at a level of 3 dB (E/Emax=0.7) on both the horizontal and vertical antenna patterns. The main lobe azimuth and vertical tilt are also displayed. These values are calculated from the information in the antenna pattern file.

If you want to use the current antenna pattern for further editing, you can click on the “Select this antenna for editing” button, after which the editor will open and a copy of the antenna pattern will be transferred to it.

Comparison of two antenna patterns

Antenna Pattern Editor allows you to compare the patterns of two antennas. To do this, you can select the first pattern and click on the “Add antenna pattern to comparison” button. The name of the antenna will be displayed below the diagram in green, and the antenna pattern will be frozen in the diagram with a green outline. Now you can select the second antenna and visually compare the two antenna patterns. This feature allows you to easily compare and evaluate the differences between two antenna patterns.



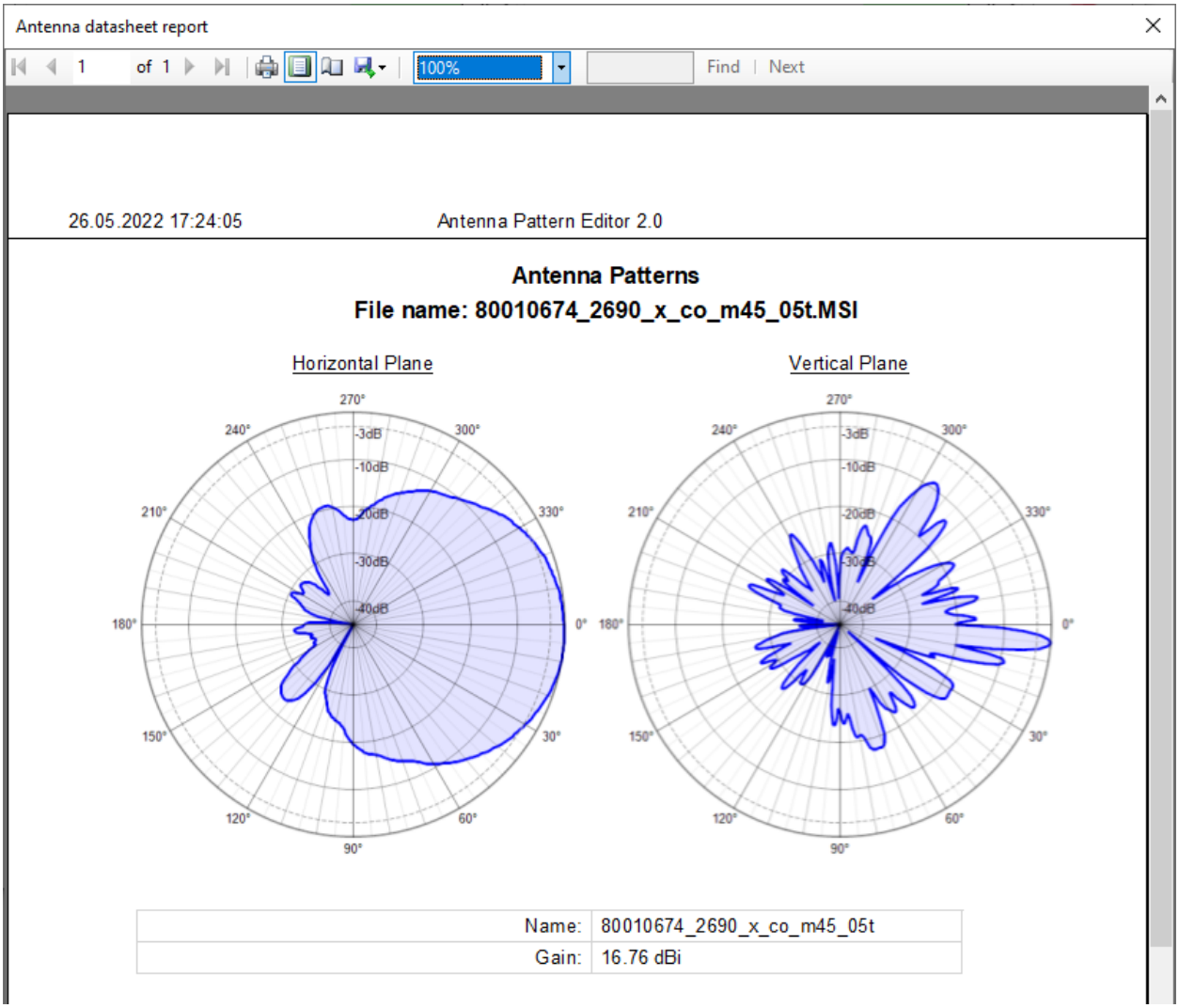
Comparison of two antenna patterns

Add antenna pattern to compare

Remove antenna pattern from comparison

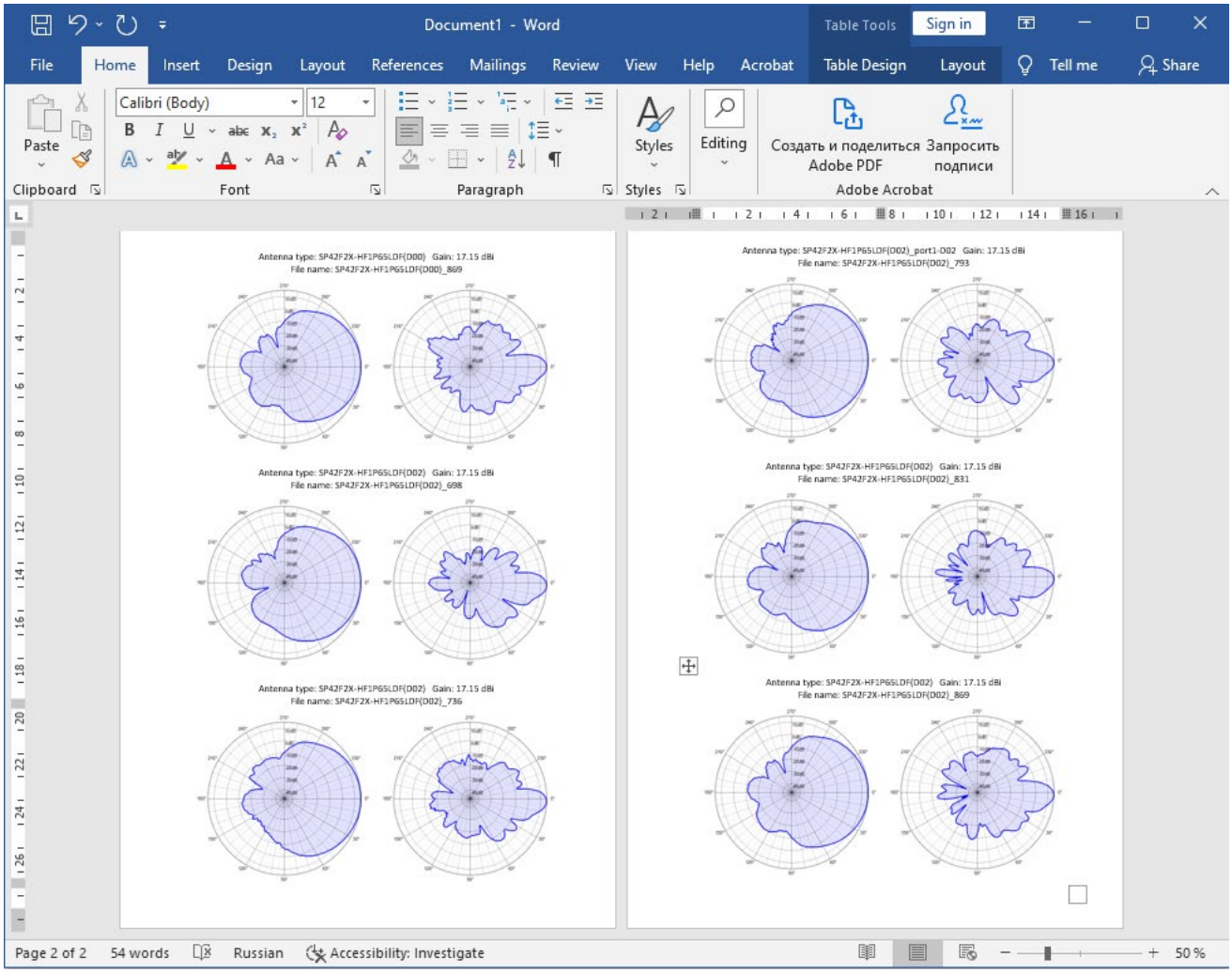
Antenna Data Sheet

Antenna Pattern Editor provides a report of the main characteristics of the antenna, which can then be saved in Word, Excel, or PDF format. To view the report, you can click on the Antenna data sheet button. The report is generated based on the pattern of the current antenna and the header data of the description file. To save the report in Word, Excel, or PDF formats, you can use the appropriate tool from the top panel.



Antenna Datasheet Report

Antenna Pattern Editor also provides a multi-page report of multiple antenna patterns in Word. To do this, select multiple antenna patterns at once and click Antenna Datasheet Report in Word. You must have Microsoft Word installed on your computer to obtain this report.

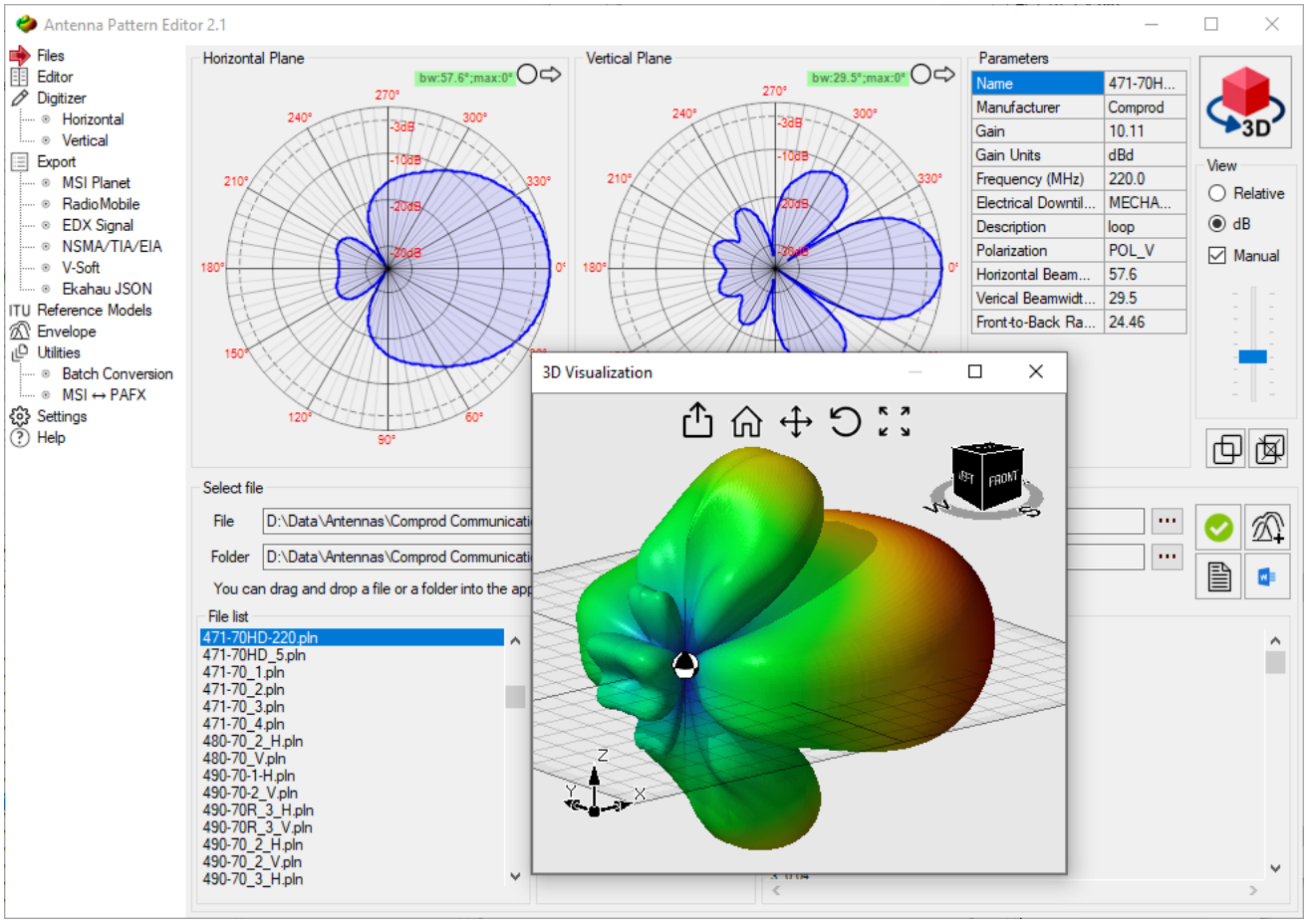


Multi-page Report in Word

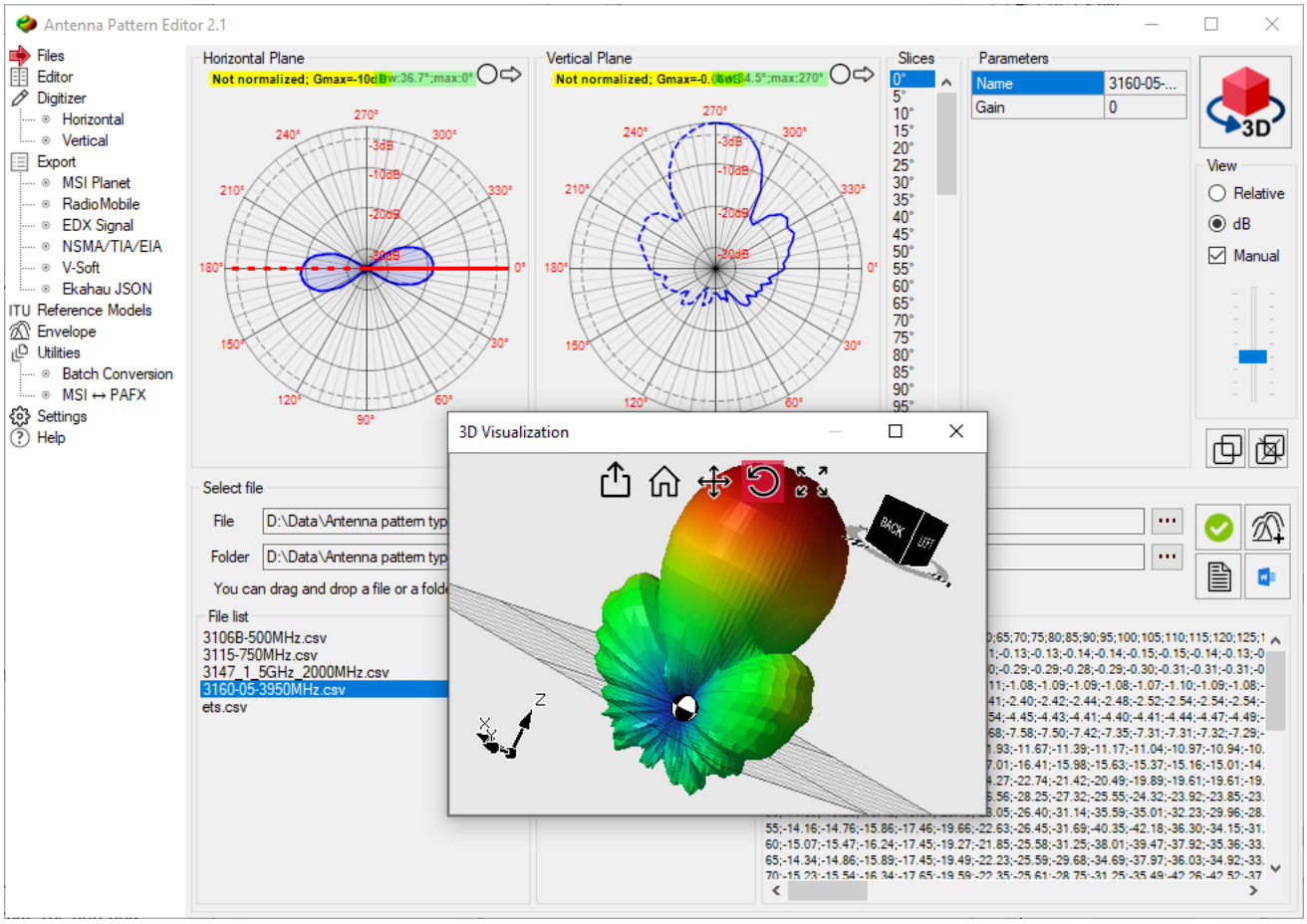
3D Antenna Pattern Visualization

Antenna Pattern Editor can perform 3D visualization of antenna patterns. The conversion of 2D antenna pattern into 3D is performed using the CrossWeighted conversion algorithm. For full 3D formats (ETS-Lindgren, Satimo), direct display is performed in the spherical coordinate system.

To view the antenna pattern in 3D, you can click on the 3D button, which is located in the upper right corner. The 3D model of the selected antenna will open in a separate window. The 3D visualization controls are at the top. Rotation of a 3D visualization is most conveniently performed using the ViewCube in the upper right corner. The ViewCube is a cube-shaped widget placed in an upright corner of the window. When used as an orientation controller, the ViewCube can be dragged, or the faces, edges, or corners can be clicked on, to easily orient the scene to the corresponding view. When acting as an orientation indicator, the ViewCube turns to reflect the current view direction as the user re-orients the scene using other tools.



3D visualization of 2D antenna pattern

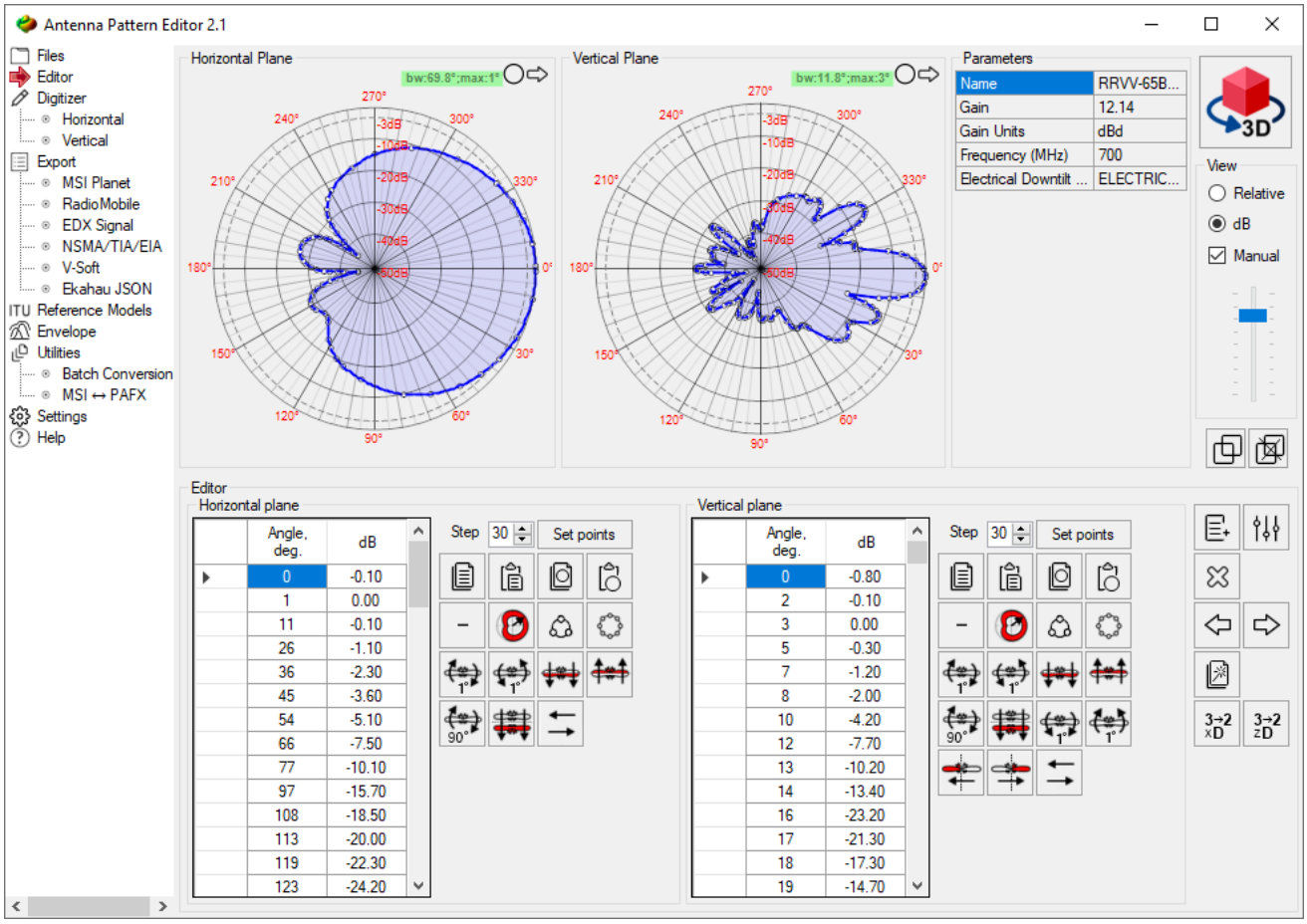


3D Antenna Pattern Visualization

Edit/Transform/Create Antenna Pattern

In the “Editor” block of Antenna Pattern Editor, you can create, edit, and transform antenna patterns in a tabular form. When an antenna pattern is placed in the editor, regardless of its previous format, the antenna pattern values are converted to a universal form in which dB values can be either positive or negative, and the angles will always be in the range of 0 to 360 degrees.

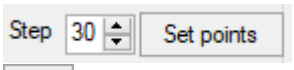
You can manually fill in and edit the table, and there are also advanced options for copying and pasting table cells using the Paste from Clipboard Wizard from spreadsheets, text files, and even antenna patterns from FM and TV queries from the FCC website www.fcc.gov. This makes it easy to work with antenna patterns and make any necessary changes or transformations.



Editor

Transformation of Antenna Pattern

You can use the tools in the Transformation menu of Antenna Pattern Editor to perform various transformations of the antenna pattern in the horizontal and vertical planes. This allows you to easily manipulate and modify the antenna pattern to meet your needs.



Fill the table with azimuths/elevations at a given interval

Copy selected cells to the clipboard

Paste data from clipboard

Copy all cells to the clipboard

Replace all cells with data from the clipboard

Make all dB values negative. This conversion is required when copy-pasting into a table of values from a text file of antenna patterns in MSI format

Normalize or set any absolute maximum values of the antenna pattern

Simplify antenna pattern by using Douglas-Peucker algorithm

Interpolate in 1 degree step


Rotate the antenna pattern clockwise 1 degree


Rotate the antenna pattern counterclockwise 1 degree


Copy the antenna pattern from top to bottom


Copy the antenna pattern from bottom to top


Rotate the antenna pattern clockwise 90 degrees


Vertical mirroring of the antenna pattern


Tilt both sides of the antenna pattern 1 degree down


Rotate both sides of the antenna pattern 1 degree up


Copy the right side of the antenna pattern to the left


Copy the left side of the antenna pattern to the right


Swap antenna pattern panels


Create a new antenna pattern


Edit antenna pattern parameters


Undo


Redo

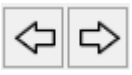

Open Paste from Clipboard Wizard

Transform 3D antenna pattern with maximum radiation along the X-axis to 2D antenna pattern

Transform 3D antenna pattern with maximum radiation along the Z-axis to 2D antenna pattern

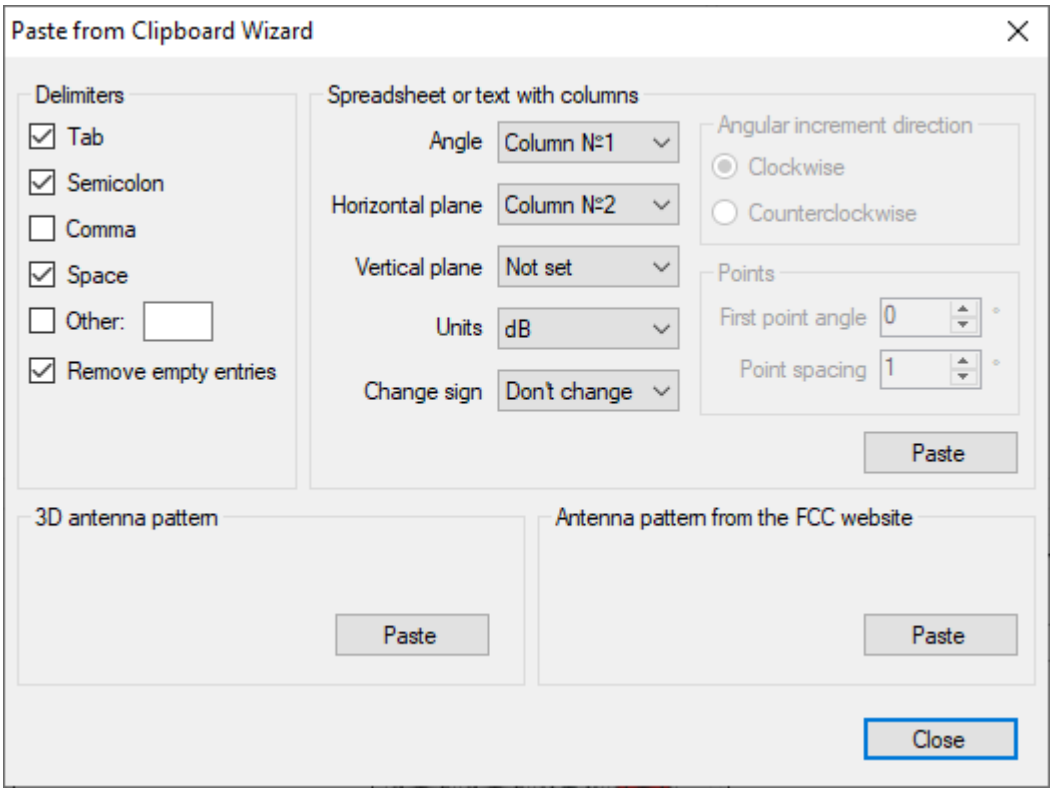
Manual Entry and Editing of Antenna Patterns

When manually entering and editing an antenna pattern in the Editor, you can simply enter the angle values and the corresponding antenna pattern values in logarithmic or relative units (the units are set in Settings). You only need to enter one of the values, and the other will be calculated automatically. To delete rows in the table, you can select these rows in the left empty field and press Delete on your keyboard.

Any action in the editor can be undone or redone using the undo and redo tools. 

Copying Antenna Pattern Data from Spreadsheets and Text Files Using the Paste from Clipboard Wizard

Paste from Clipboard Wizard is a universal tool for copying and pasting antenna patterns from any text file or spreadsheet.

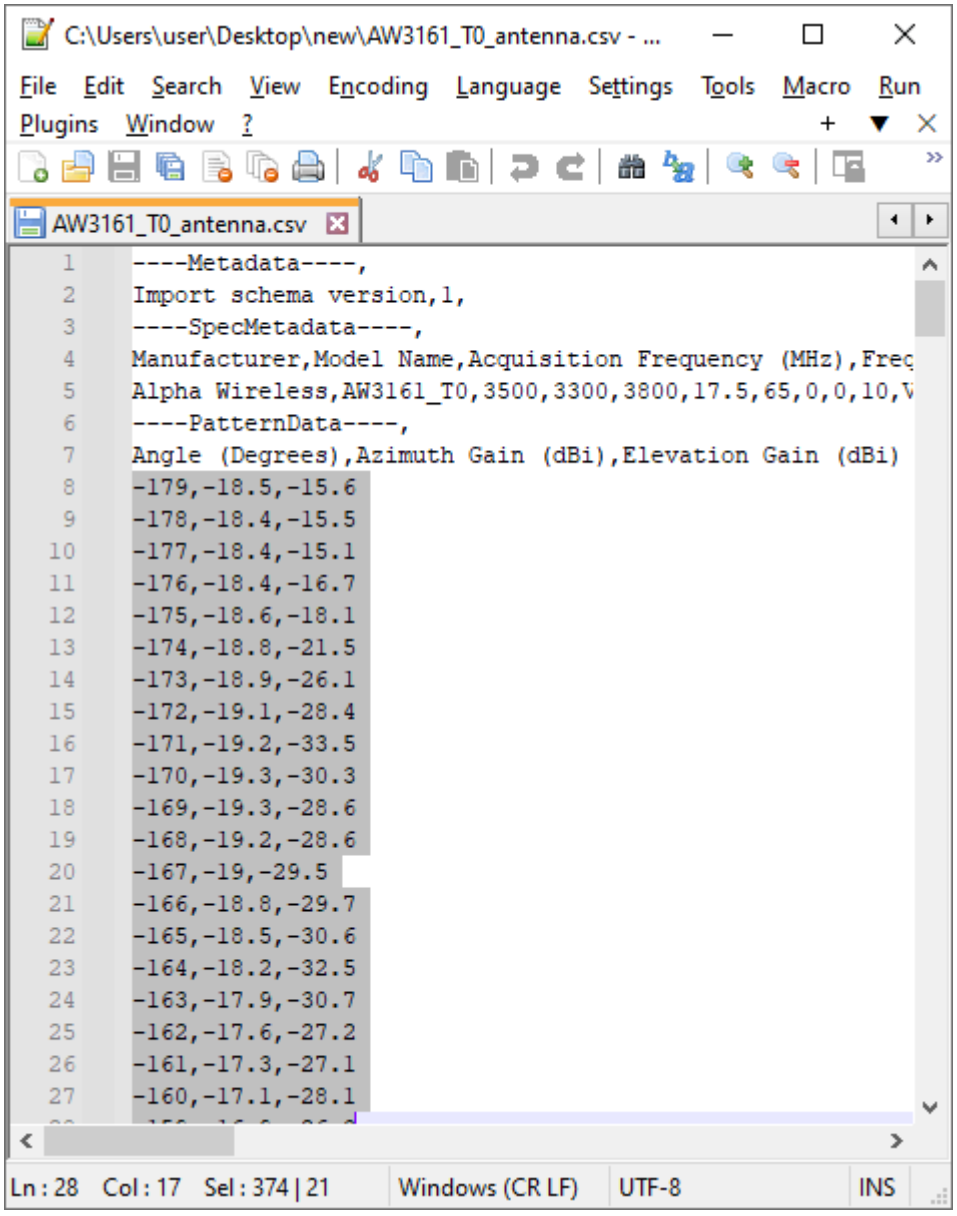


Paste from Clipboard Wizard

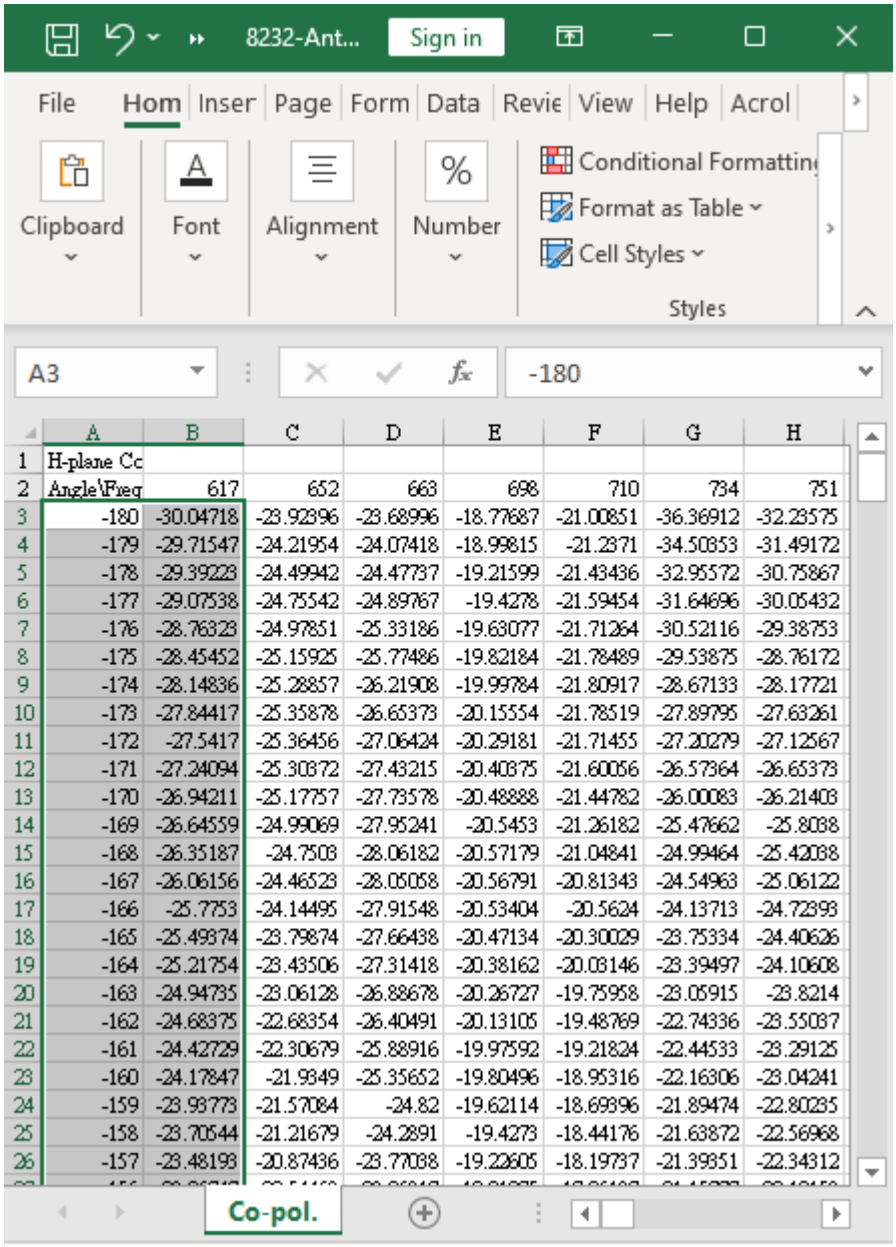
Delimiters	Delimiters in copied text or spreadsheet between angle data and antenna pattern data in horizontal and vertical planes
Angle	The column number with angle data in the copied text, or setting angles directly.
Horizontal plane	The column number containing data on the antenna's horizontal radiation pattern or an indication that this data is not present in the copied text.
Vertical plane	The column number containing data on the antenna's vertical radiation pattern or an indication that this data is not present in the copied text.
Units	Units (dB or relative) of imported antenna patterns.
Change sign	Change the sign of units during import
Angular increment direction	Direction of angular increment when there is no column with angles in the imported data
First point angle	Angle of the first point when there is no angle column in the imported data

Point spacing	Point spacing when there is no column with angles in the imported data

Copy the antenna pattern data from a text file or spreadsheet and run Paste from Clipboard Wizard. Specify the symbols that are used in your file to delimit the values of different columns (for spreadsheets, this is TAB), and also select the column number in the copied data for the angle values and the antenna pattern in the horizontal and vertical planes. If the data you copied does not have a column with angles, you can specify the angles directly with the desired spacing. If there is no antenna pattern for a particular plane in the data you copied, you need to select "Not Set" for that plane. After setting up the import, click "Paste." If you imported one plane, repeat the settings for the second plane and click "Paste."



Copy antenna pattern from a text file



	A	B	C	D	E	F	G	H
1	H-plane Cc							
2	Angle\Freq	617	652	663	698	710	734	751
3	-180	-30.04718	-23.92396	-23.68996	-18.77687	-21.00851	-36.36912	-32.23575
4	-179	-29.71547	-24.21954	-24.07418	-18.99815	-21.2371	-34.50353	-31.49172
5	-178	-29.39223	-24.49942	-24.47737	-19.21599	-21.43436	-32.95572	-30.75867
6	-177	-29.07538	-24.75542	-24.89767	-19.4278	-21.59454	-31.64696	-30.05432
7	-176	-28.76323	-24.97851	-25.33186	-19.63077	-21.71264	-30.52116	-29.38753
8	-175	-28.45452	-25.15925	-25.77486	-19.82184	-21.78489	-29.53875	-28.76172
9	-174	-28.14836	-25.28857	-26.21908	-19.99784	-21.80917	-28.67133	-28.17721
10	-173	-27.84417	-25.35878	-26.65373	-20.15554	-21.78519	-27.89795	-27.63261
11	-172	-27.5417	-25.36456	-27.06424	-20.29181	-21.71455	-27.20279	-27.12567
12	-171	-27.24094	-25.30372	-27.43215	-20.40375	-21.60056	-26.57364	-26.65373
13	-170	-26.94211	-25.17757	-27.73578	-20.48888	-21.44782	-26.00083	-26.21408
14	-169	-26.64559	-24.99069	-27.95241	-20.5453	-21.26182	-25.47662	-25.8038
15	-168	-26.35187	-24.7503	-28.06182	-20.57179	-21.04841	-24.99464	-25.42038
16	-167	-26.06156	-24.46523	-28.05058	-20.56791	-20.81343	-24.54963	-25.06122
17	-166	-25.7753	-24.14495	-27.91548	-20.53404	-20.5624	-24.13713	-24.72393
18	-165	-25.49874	-23.79874	-27.66438	-20.47134	-20.30029	-23.75334	-24.40626
19	-164	-25.21754	-23.43506	-27.31418	-20.38162	-20.03146	-23.39497	-24.10608
20	-163	-24.94735	-23.06128	-26.88678	-20.26727	-19.75958	-23.05915	-23.8214
21	-162	-24.68375	-22.68354	-26.40491	-20.13105	-19.48769	-22.74336	-23.55037
22	-161	-24.42729	-22.30679	-25.88916	-19.97592	-19.21824	-22.44533	-23.29125
23	-160	-24.17847	-21.9349	-25.35652	-19.80496	-18.95316	-22.16306	-23.04241
24	-159	-23.93773	-21.57084	-24.82	-19.62114	-18.69396	-21.89474	-22.80235
25	-158	-23.70544	-21.21679	-24.2891	-19.4273	-18.44176	-21.63872	-22.56968
26	-157	-23.48193	-20.87436	-23.77038	-19.22605	-18.19737	-21.39351	-22.34312

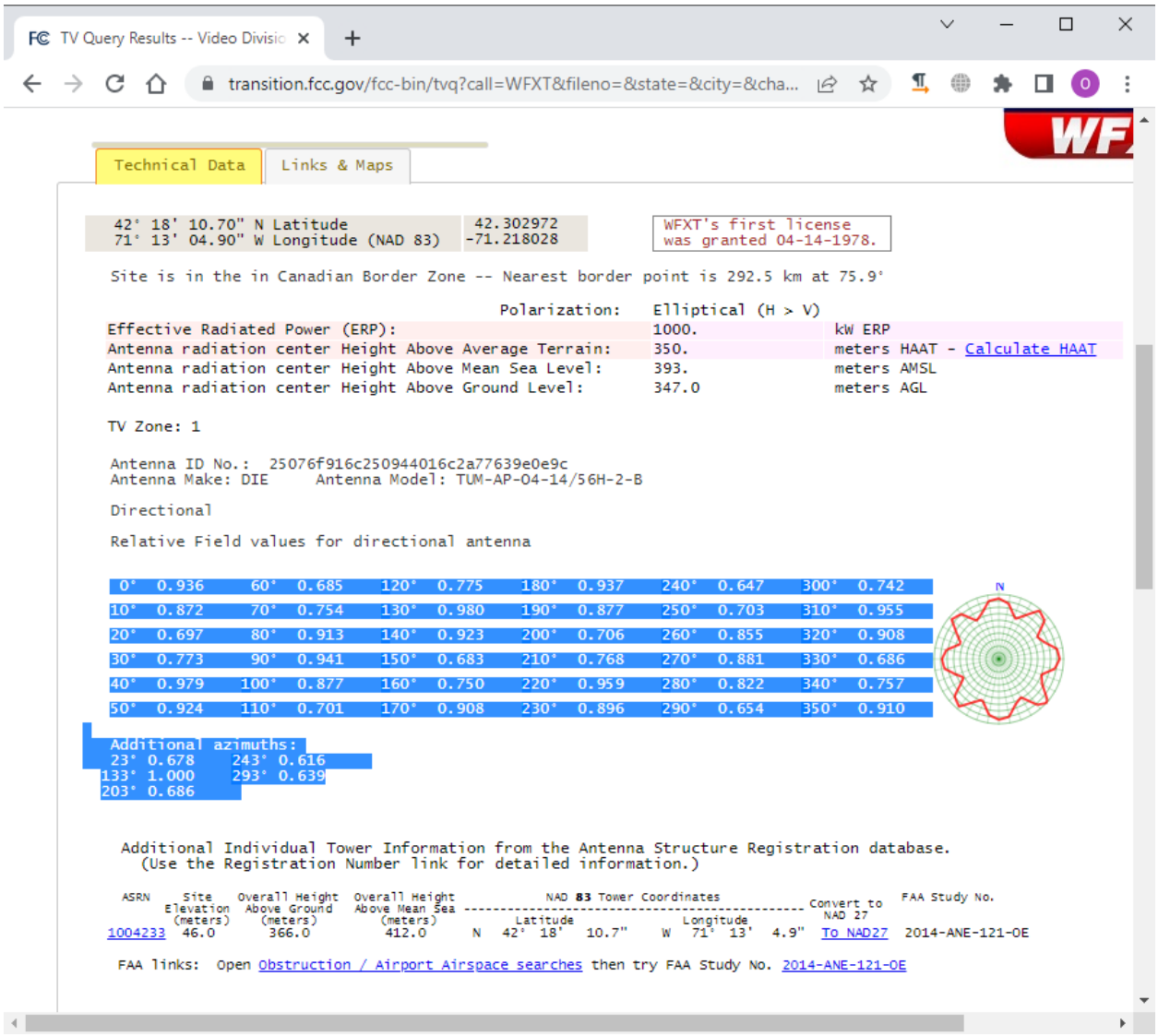
Copy H-plane antenna pattern from an Excel file

We have prepared a video on working with Antenna Pattern Editor, which shows examples of importing antenna pattern data using Paste from Clipboard Wizard from various text file and spreadsheet options.

Copy Antenna Pattern from FCC Website

In Paste from Clipboard Wizard, you can also copy antenna patterns from standard FM and TV query results directly from the FCC website. By using these queries, you can find the antenna parameters of FM and TV broadcasting stations in the FM, VHF, and UHF bands. Queries are made from addresses https://www.fcc.gov/media/television/tv-query and https://www.fcc.gov/media/radio/fm-query. Queries can be made by various parameters such as call sign, state, city, etc. Simply copy the data lines from the website

for the antenna azimuth pattern and click "Paste" in the appropriate section of the Paste from Clipboard Wizard.



Copy antenna pattern from FCC website

Working with original 3D antenna patterns

Importing antenna patterns in 3D format

Antenna Pattern Editor allows you to import 3D antenna pattern data obtained on special stands - echo chambers (ETS-Lindgren, Satimo and similar) for their further visualization, conversion to 2D format, editing and saving in any 2D format.

The original 3D data for import should be presented as a table in Excel, Word or similar editors. This table can be easily prepared from a standard measurement file, which typically contains the results of antenna pattern measurements in polar coordinates for Theta and Phi angles for various frequency ranges. The prepared table for one antenna pattern must be copied entirely to the clipboard and then pasted into the antenna pattern editor using the Paste 3D antenna pattern data in Paste from Clipboard Wizard.

Requirements for the table:

1. The table must contain in the first row or column the values of Theta angles in the range from 0 to 180 degrees or Phi angles in the range from 0 to 359 degrees in increments of 1 degree or more.

2. The remaining cells of the table, except for the first, must contain the values of the antenna pattern in dBi in normalized or absolute values.

3. The first cell of the table can contain any information.

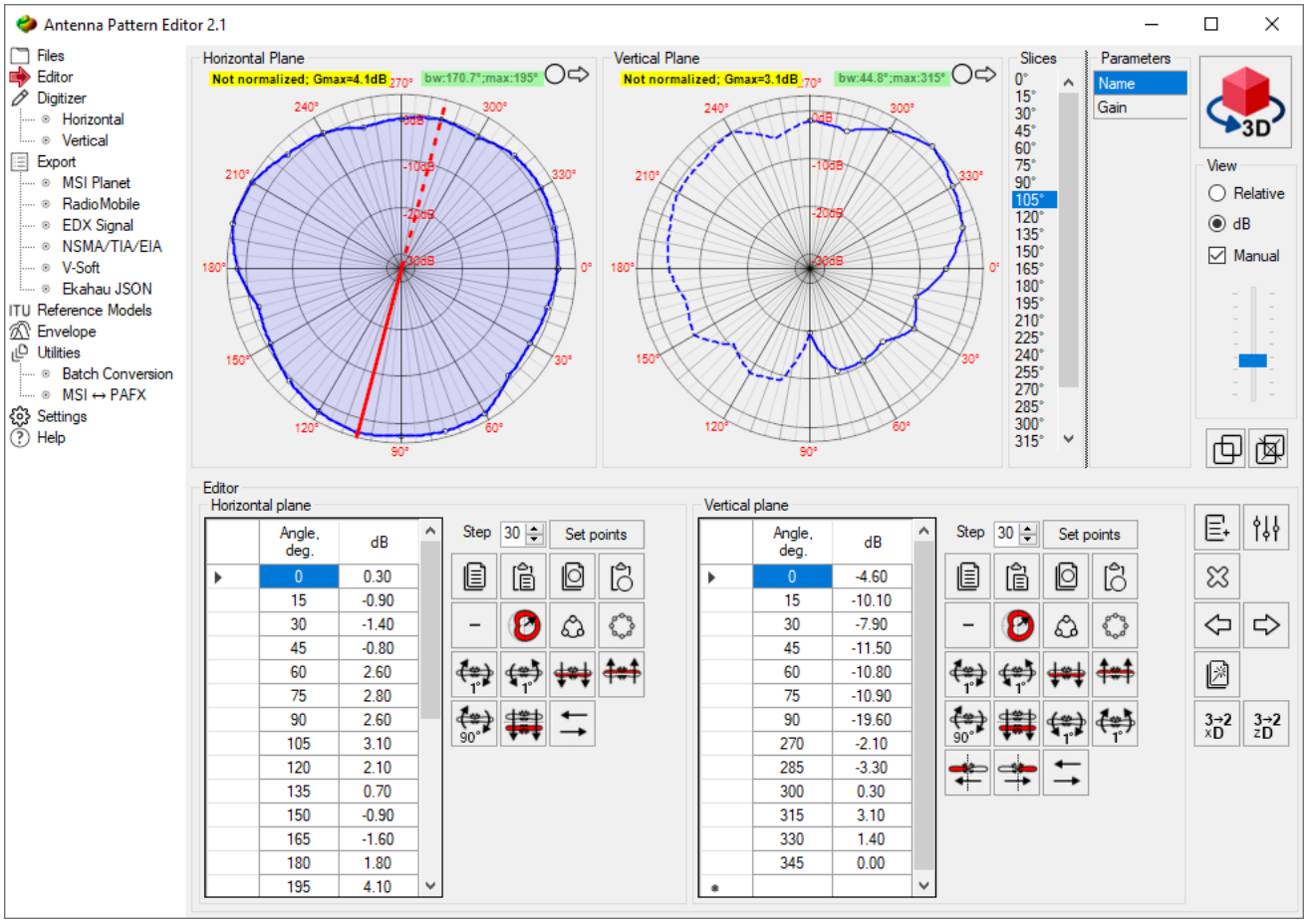
Examples of tables:

Phi by rows, Theta by columns:

Phi\Theta	0.0	15.0	30.0	45.0	60.0	75.0	90.0	105.0	120.0	135.0	150.0	165.0	180.0
0.0	-2.1	-1.5	-2.1	-1.0	0.3	-0.4	-2.6	-6.4	-7.6	-9.3	-7.9	-12.8	-20.5
15.0	-2.2	-1.3	-1.4	-0.9	-1.8	-1.1	-4.0	-5.6	-5.7	-10.0	-11.6	-12.0	-17.2
30.0	-2.7	-1.4	-1.7	-1.9	-2.4	-3.3	-4.5	-5.5	-6.4	-9.5	-11.0	-11.5	-15.1
45.0	-2.8	-1.5	-2.0	-1.9	-0.8	-4.5	-4.8	-5.3	-6.0	-9.9	-11.1	-11.5	-15.9
60.0	-2.6	-1.8	-2.1	-0.6	2.6	-3.4	-5.5	-3.8	-5.4	-10.9	-13.2	-10.6	-16.4
75.0	-2.2	-2.4	-1.1	0.9	2.8	-0.3	-5.6	-4.0	-8.0	-11.8	-15.3	-8.0	-18.1
90.0	-2.1	-3.0	-0.3	2.6	2.3	0.5	-5.3	-8.3	-10.9	-12.1	-13.0	-8.1	-20.3
105.0	-2.1	-3.3	0.3	3.1	1.4	0.0	-4.6	-10.1	-7.9	-11.5	-10.8	-10.9	-19.6
120.0	-1.8	-3.3	0.3	2.1	0.1	-1.0	-3.7	-7.2	-6.4	-14.2	-8.9	-10.7	-17.9
135.0	-1.8	-3.0	-1.3	0.7	-0.9	-3.6	-3.3	-5.0	-6.1	-16.6	-7.6	-9.6	-18.7
150.0	-1.6	-2.8	-5.1	-0.9	-1.8	-4.0	-3.2	-5.0	-5.6	-15.4	-8.2	-11.4	-20.5
165.0	-1.6	-2.9	-6.7	-2.9	-1.9	-3.3	-2.8	-4.8	-4.7	-12.7	-10.6	-11.2	-21.5
180.0	-2.1	-3.3	-4.0	-3.3	1.8	-3.0	0.5	-3.9	-4.4	-11.2	-11.1	-10.5	-20.5
195.0	-2.2	-3.7	-1.4	-2.1	4.1	0.8	2.5	-2.7	-4.6	-9.1	-8.1	-10.2	-17.2
210.0	-2.7	-4.1	-2.8	-0.4	-0.3	3.6	-0.8	-2.5	-5.3	-6.6	-7.4	-8.8	-15.1
225.0	-2.8	-4.7	-4.8	1.3	-4.0	1.2	-4.7	-2.2	-5.4	-6.2	-11.2	-8.4	-15.9
240.0	-2.6	-5.4	-3.1	0.3	-3.6	-1.5	-4.6	-2.3	-6.7	-6.7	-11.9	-9.2	-16.4
255.0	-2.2	-6.0	-1.9	-2.5	-2.2	-2.6	-3.4	-3.9	-9.8	-8.5	-10.6	-10.0	-18.1
270.0	-2.1	-5.4	-1.1	-2.1	-1.2	-3.0	-3.5	-6.0	-7.5	-12.1	-8.9	-11.3	-20.3
285.0	-2.1	-4.9	-0.2	-1.4	-1.2	-2.7	-3.6	-6.4	-5.2	-10.6	-7.9	-9.0	-19.6
300.0	-1.8	-4.3	-0.7	-0.9	-1.0	-1.7	-2.9	-5.8	-3.8	-7.7	-6.2	-6.1	-17.9
315.0	-1.8	-3.8	-1.0	0.9	1.0	0.2	-1.7	-3.1	-3.4	-5.4	-4.6	-5.8	-18.7
330.0	-1.6	-3.8	-1.2	1.3	1.2	0.4	-1.7	-2.2	-4.6	-4.5	-5.2	-6.1	-20.5
345.0	-1.6	-2.6	-2.3	0.8	0.6	-0.4	-2.0	-2.5	-5.6	-6.7	-6.6	-9.4	-21.5
360.0	-2.1	-1.5	-2.1	-1.0	0.3	-0.4	-2.6	-6.4	-7.6	-9.3	-7.9	-12.8	-20.5

Theta by rows, Phi by columns:

Theta\Phi	0.0	30.0	60.0	90.0	120.0	150.0	180.0	210.0	240.0	270.0	300.0	330.0
0.0	-1.5	-2.7	-2.5	-2.4	-2.9	-2.0	-1.5	-2.7	-2.5	-2.4	-2.9	-2.0
15.0	-2.8	-1.2	0.4	1.1	0.6	-2.5	-4.6	-8.5	-11.6	-7.4	-7.8	-13.4
30.0	-3.7	-1.7	-0.1	-1.3	-3.7	-5.2	-4.7	-3.5	-0.9	-0.7	-2.3	-3.9
45.0	-0.4	-5.6	-1.0	1.0	0.1	-1.5	-1.2	2.0	1.5	0.0	-2.1	-1.9
60.0	0.5	-2.5	1.8	1.8	-0.3	-0.7	1.7	1.9	-0.7	-2.2	-2.5	-0.7
75.0	-0.9	-5.7	-2.9	-0.1	-0.4	-4.3	-1.5	2.9	-1.8	0.0	-4.3	-0.5
90.0	-2.6	-3.1	-5.3	-4.2	-4.4	-4.0	-0.8	0.5	-1.4	-3.0	-3.0	-3.2
105.0	-6.1	-6.7	-3.6	-7.8	-6.2	-4.0	-2.9	-2.5	-5.0	-2.6	-4.5	-5.5
120.0	-8.5	-6.2	-5.9	-8.2	-5.9	-5.3	-1.7	-6.2	-4.9	-8.6	-6.8	-5.2
135.0	-12.5	-11.0	-11.4	-9.2	-13.5	-16.5	-14.1	-8.6	-3.9	-7.0	-10.9	-8.9
150.0	-9.9	-9.4	-13.6	-13.4	-9.7	-6.4	-9.1	-5.8	-11.7	-8.2	-8.1	-8.8
165.0	-12.4	-10.9	-8.7	-8.7	-11.8	-14.8	-14.0	-7.2	-7.2	-7.0	-5.3	-6.9
180.0	-17.8	-13.0	-16.4	-17.1	-18.3	-26.4	-17.8	-13.0	-16.4	-17.1	-18.3	-26.4



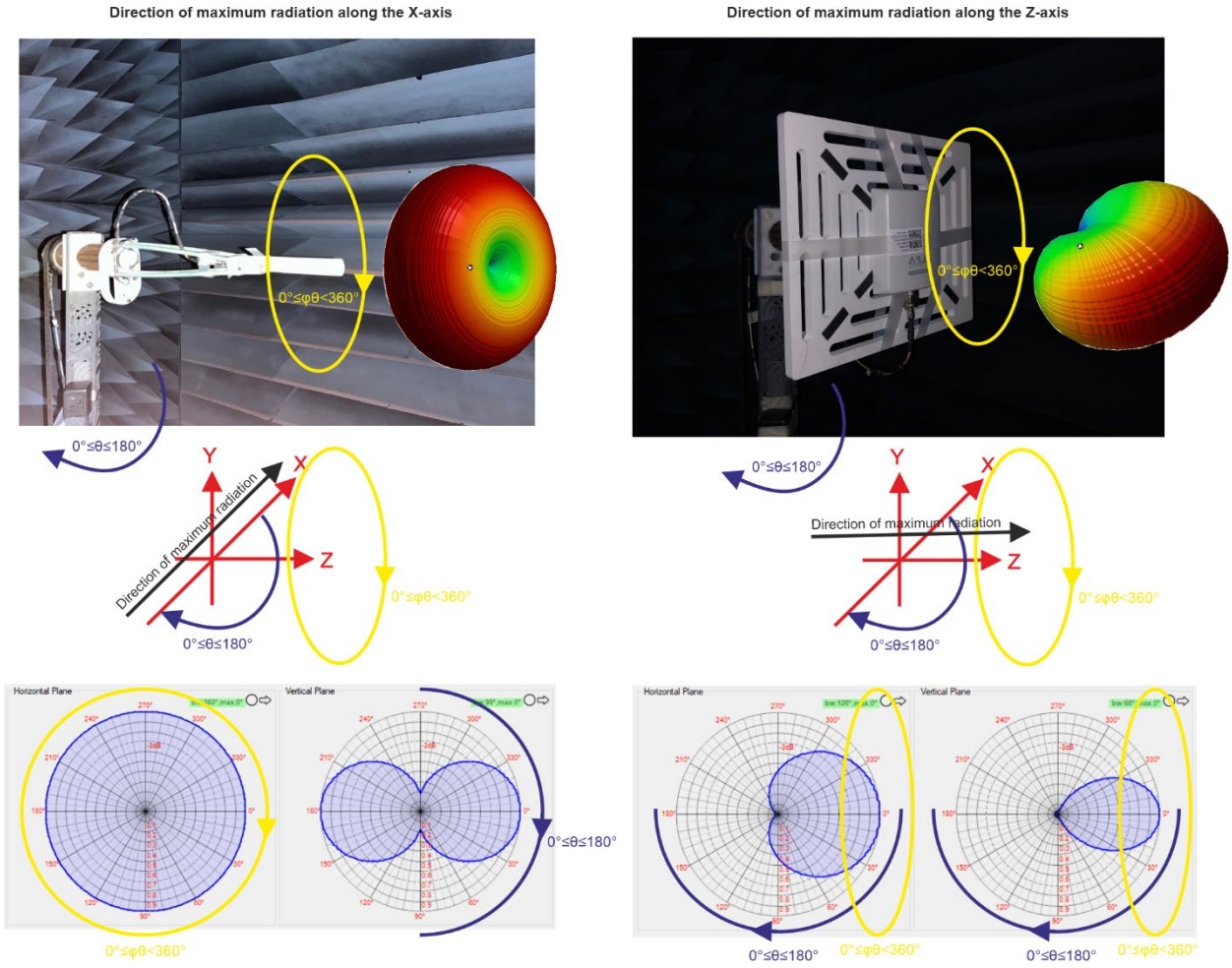
Imported 3D antenna pattern

Converting an Antenna Pattern from 3D to 2D

Programs that use antenna patterns for coverage modeling most often use a 2D antenna pattern, which represents the antenna with patterns in the horizontal and vertical planes.

The Antenna Pattern Editor has two tools for converting the antenna pattern from 3D to 2D. The choice of one or another tool for conversion is determined by how the antenna was positioned relative to the axes during the measurements on the stand.

The antenna can be positioned with maximum directivity either along the X axis (usually for omni antennas) or along the Z axis (usually for directional antennas), see the explanatory figure below.



If during measurements on the stand the antenna was positioned with maximum radiation along the X-axis, then it is necessary to convert the antenna radiation pattern from 3D to 2D using the tool **Transform 3D antenna pattern with maximum radiation along the X-axis to 2D antenna pattern**.

If during measurements on the stand the antenna was positioned with maximum radiation along the Z-axis, then it is necessary to convert the antenna radiation pattern from 3D to 2D using the tool **Transform 3D antenna pattern with maximum radiation along the Z-axis to 2D antenna pattern**.

The transformation is performed for the selected slice.

Digitizing of the Antenna Pattern Picture

In cases where the antenna pattern is presented as an image, you can prepare an antenna pattern file by digitizing this image. To do this, you can upload a file with a picture of a horizontal antenna pattern, mark several characteristic points on it, mark the center of the polar coordinate system, and one or more levels in dB of the antenna pattern. Then, you can perform the same operations with the vertical antenna pattern, fill in several fields with the antenna parameters, and save the antenna pattern in the desired format.

Toolbar:

 - open antenna pattern image (* .png, * .jpg, * .bmp, * .tiff)

 - point the center of the polar coordinate system on the image

 - rotate 0-degree antenna pattern direction

- point the appropriate level in the image

- delete all pointed levels

 - change the color of the resulting antenna pattern line

 - clear the antenna pattern line

- units

 - Finish digitizing the Horizontal/Vertical plane and copy it to the Editor.

Here is a detailed step-by-step procedure for digitizing an antenna pattern picture using Antenna Pattern Editor:

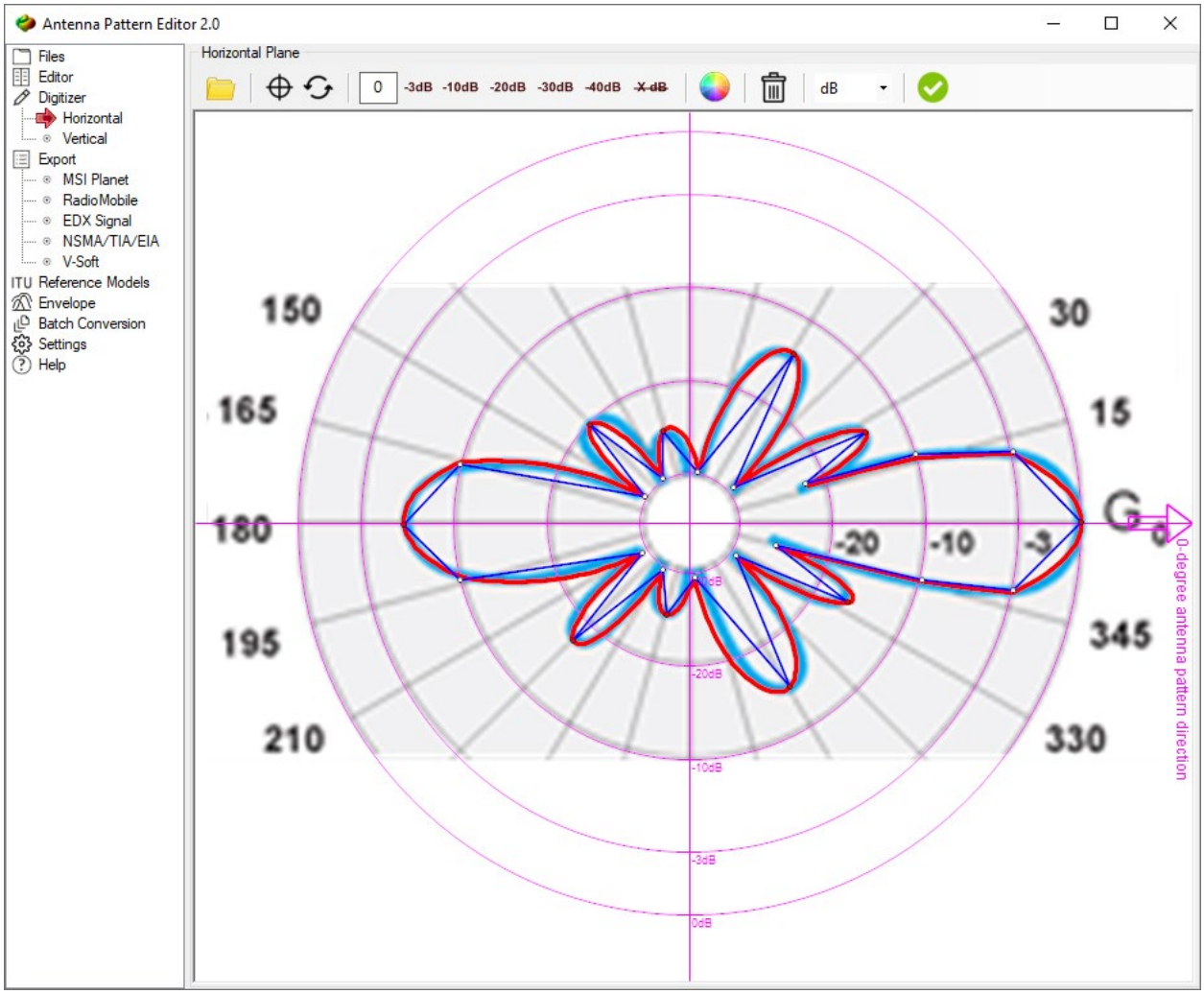
Step 1. Go to the Digitization – Horizontal Plane. Download the image file of the antenna pattern in the horizontal plane, or paste the image from the clipboard. You can move the downloaded image by holding down the mouse wheel and dragging, and you can scale it by rotating the mouse wheel.

Step 2. Set the center of the polar coordinate system to the center of the antenna pattern. Click on the tool  , and then click on the center of the downloaded image antenna pattern.

Step 3. Using the tool  , specify the direction of the antenna pattern by 0 degrees (antenna manufacturers provide the antenna pattern, in which the direction of the antenna pattern at 0 degrees is sometimes indicated up, sometimes to the right).

Step 4. Using the dB - E/Emax tool, specify the units in which the antenna pattern in the image is shown - in decibels or relative units.

Step 5. Set the nodes of the polyline (it is marked in blue) on the characteristic points of the image of the antenna pattern (usually these are the maxima and minima of the antenna pattern, as well as the characteristic bends of the antenna pattern). You can move a polyline node by clicking it with your left mouse button, delete a node by clicking it with your right mouse button, and create an additional node by clicking on a polyline with your right mouse button.



Digitization of antenna pattern in the H-plane

Step 6. Evaluate the coincidence of the resulting antenna pattern, which is shown in red (the color can be changed using the tool) with the original image of the antenna pattern. To make the resulting radiation pattern smooth in any of the nodes, you should enable spline interpolation in it by double-clicking the left mouse button, and the node will be highlighted in red. If necessary, add additional nodes (do not forget - nodes are added on the blue polyline with the right mouse button) until a satisfactory match with the picture is obtained.

Step 7. If the antenna image is given in decibels in the original image, then you need to specify the levels from the range -3, -10, -20, -30 or -40 dB, which are marked on the loaded image of the antenna pattern (several are better, since the scale on image antenna pattern may be non-linear). To do this, click on the desired button, and then click on the appropriate level in the image antenna pattern. If the antenna image is shown in relative units on the image, then the -3, -10, -20, -30, and -40dB levels are not required, except for the following case. Very rarely, but it happens that some manufacturers draw the antenna pattern in relative units, in which 0 is not in the center, but at a certain radius from the center. In this case, at a radius corresponding to 0, you need to specify the level of -40dB. This level will be taken as 0.

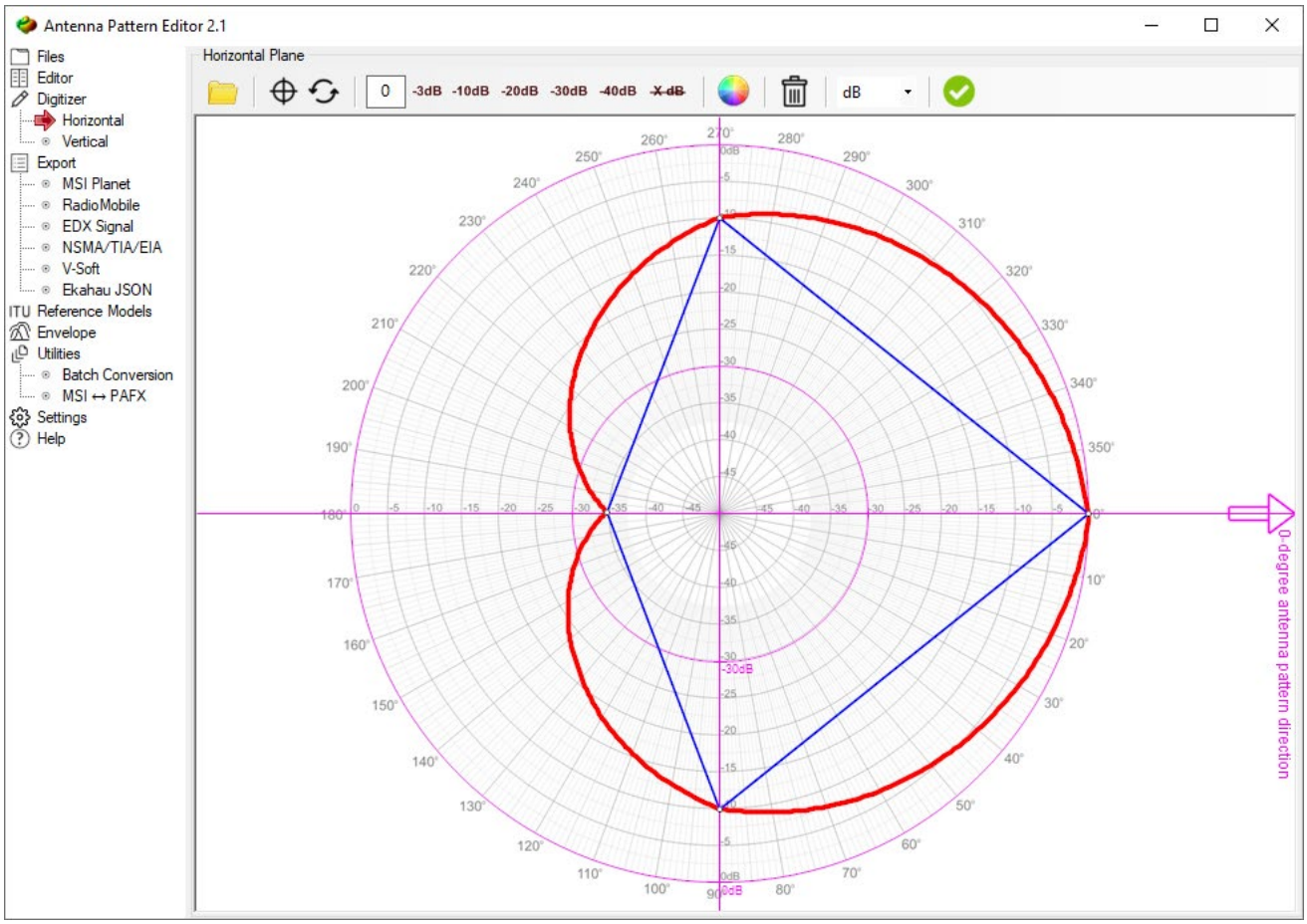
Step 8. Click on button to digitize the horizontal-plane antenna pattern. Then it will appear in the **Editor** menu.

Step 9. On the **Vertical Plane** tab, repeat steps 1-8 for the Vertical plane antenna pattern.

This procedure allows you to easily digitize an image of an antenna pattern and create an antenna pattern file from it.

Creating an Antenna Pattern Using a Graphical Editor

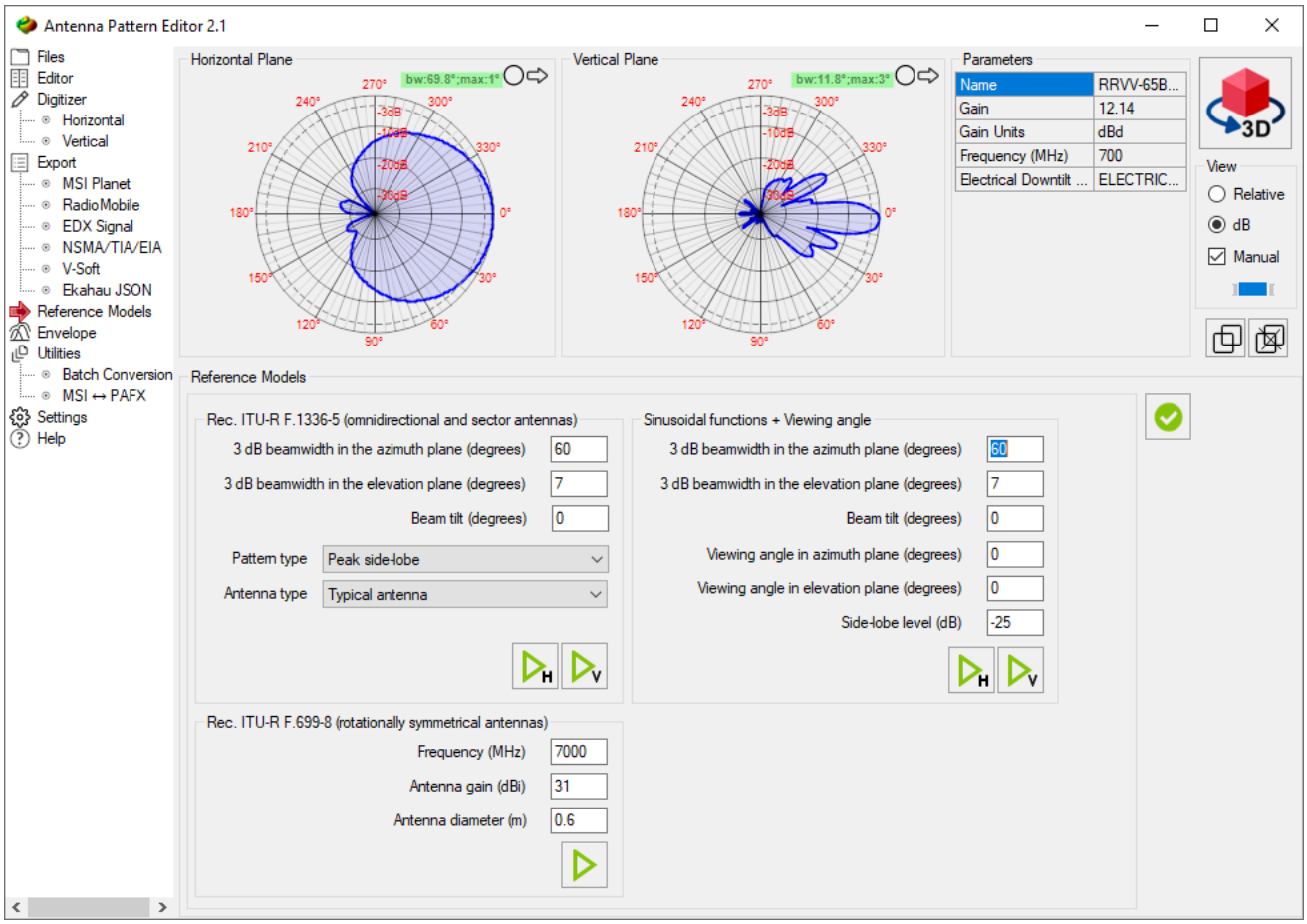
Using the digitizer, you can quickly draw an antenna pattern from a blank antenna pattern in a logarithmic or linear scale. Blank templates can be opened for the horizontal and vertical antenna pattern with the tool . Next, you must specify the values of the antenna pattern on the blank template in accordance with the step-by-step instructions outlined in the section on Digitizing the antenna image.



Drawing an Antenna Pattern Using a Blank Template

Antenna Pattern Synthesis Based on ITU-R Reference Models

Antenna Pattern Editor allows you to synthesize an antenna pattern in accordance with reference models based on information about the main characteristics of the antennas, such as main lobe width, side-lobe level, frequency range, tilt, etc.



Antenna Pattern Synthesis by Reference Models

For sector and omnidirectional antennas, the synthesis of radiation patterns is carried out in accordance with Rec. ITU-R F.1336-5 “Reference radiation patterns of omnidirectional, sectoral and other antennas for the fixed and mobile service for use in sharing studies in the frequency range from 400 MHz to about 70 GHz”.

3 dB beamwidth in the azimuth plane (degree)	3 dB beamwidth in the azimuth plane (degree)
3 dB beamwidth in the elevation plane (degree)	3 dB beamwidth in the elevation plane (degree)
Beam tilt (degree)	Beam tilt (degree)
Pattern Type: - Peak side-lobe - Average side-lobe	Type of antenna pattern approximation: - on the peaks (maximums) of the side lobes - the average level of the side lobes
Antenna Type - Typical antenna - Improved side-lobe performance antenna	Antenna Type - Typical antenna - Improved side-lobe performance antenna


- Create a H-plane pattern


- Create a V-plane pattern


- Create an antenna pattern


- Copy antenna pattern to the Editor

For rotationally symmetrical antennas (microwave antennas and satellite earth stations antennas), the synthesis of the antenna pattern is carried out in accordance with Rec. ITU-R F.699-8 “Reference radiation patterns for fixed wireless system antennas for use in coordination studies and interference assessment in the frequency range from 100 MHz to 86 GHz”.

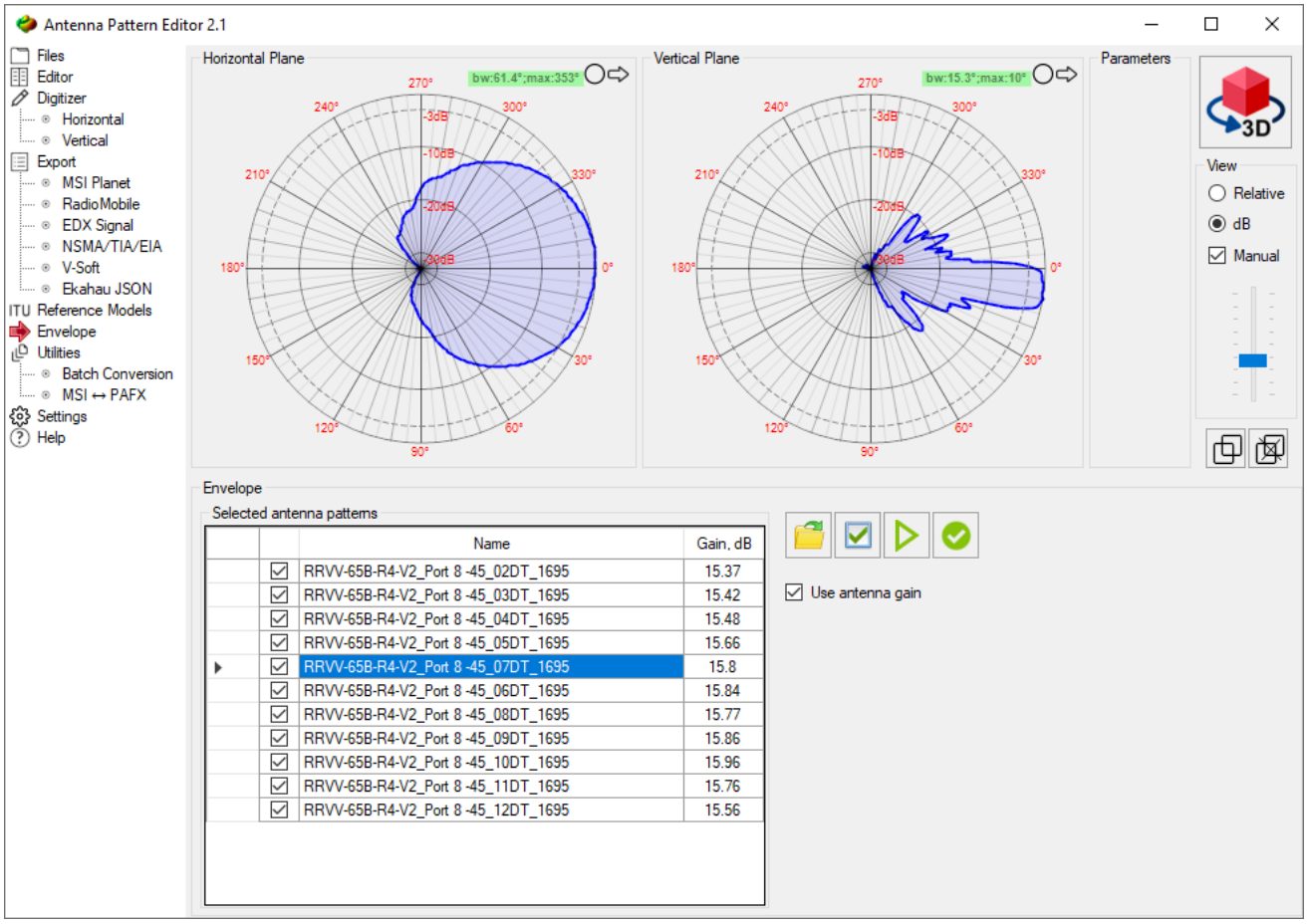
Frequency (MHz)	Frequency, MHz
Antenna gain (dBi)	Antenna gain, dBi
Antenna diameter (m)	Antenna diameter, m

Another common antenna synthesis method that can be used in the program is synthesis using a sinusoidal function and viewing angle.

3 dB beamwidth in the azimuth plane (degree)	3 dB beamwidth in the azimuth plane, degree
3 dB beamwidth in the elevation plane (degree)	3 dB beamwidth in the elevation plane, degree
Beam tilt (degree)	Beam tilt (degree)
Viewing angle in the elevation plane (degree)	Viewing angle in the elevation plane, degree
Side-lobe level (dB)	Side to main lobe level, dB

Envelope

Antenna Pattern Editor has an **Envelope** menu where you can prepare an antenna pattern envelope from a set of individual antenna patterns. This is frequently required to determine the worst-case radiation situation in terms of the harmful effects of radio waves.



Create an antenna pattern envelope

 - Select a folder with antenna pattern files

 - Select/Deselect All

 - Create an envelope pattern

 - Copy envelope pattern to the Editor

You can select individual antenna patterns in the “Files” menu using the “Add this antenna pattern to envelope” button  to include them in the set for creating an antenna pattern envelope. You can also add all antennas from a specific folder to the set in the “Envelope” menu. All selected files will appear in the “Selected antenna patterns” list, and only antenna patterns marked with a tick in the list are included in the calculation.

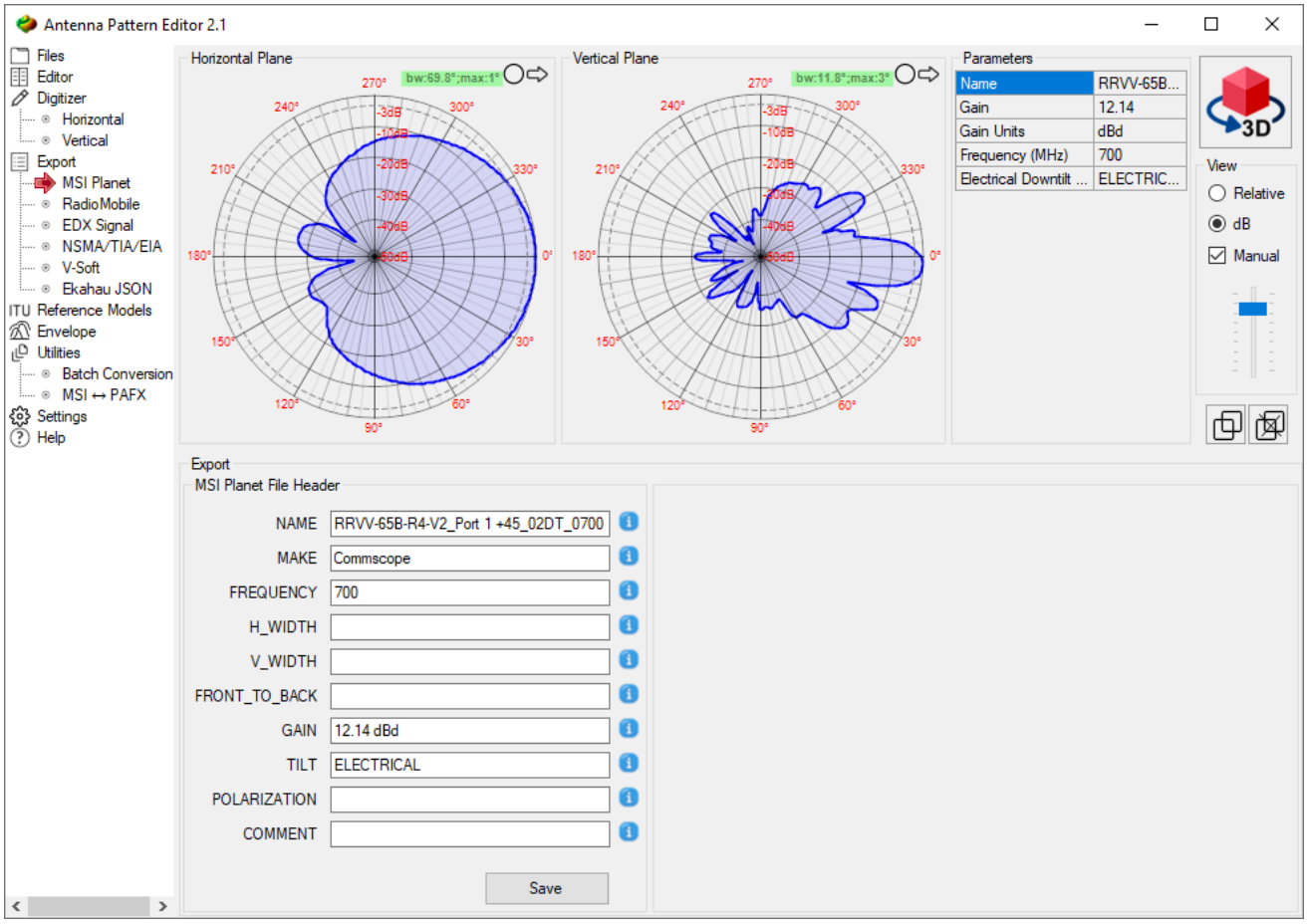
You can also take into account the gain of each antenna in the set. The gain values will be loaded from the files, but you can edit them manually directly in the table if needed.

Export Antenna Pattern to Files of Various Formats

Antenna Pattern Editor allows you to save the antenna pattern file in any of the following formats:

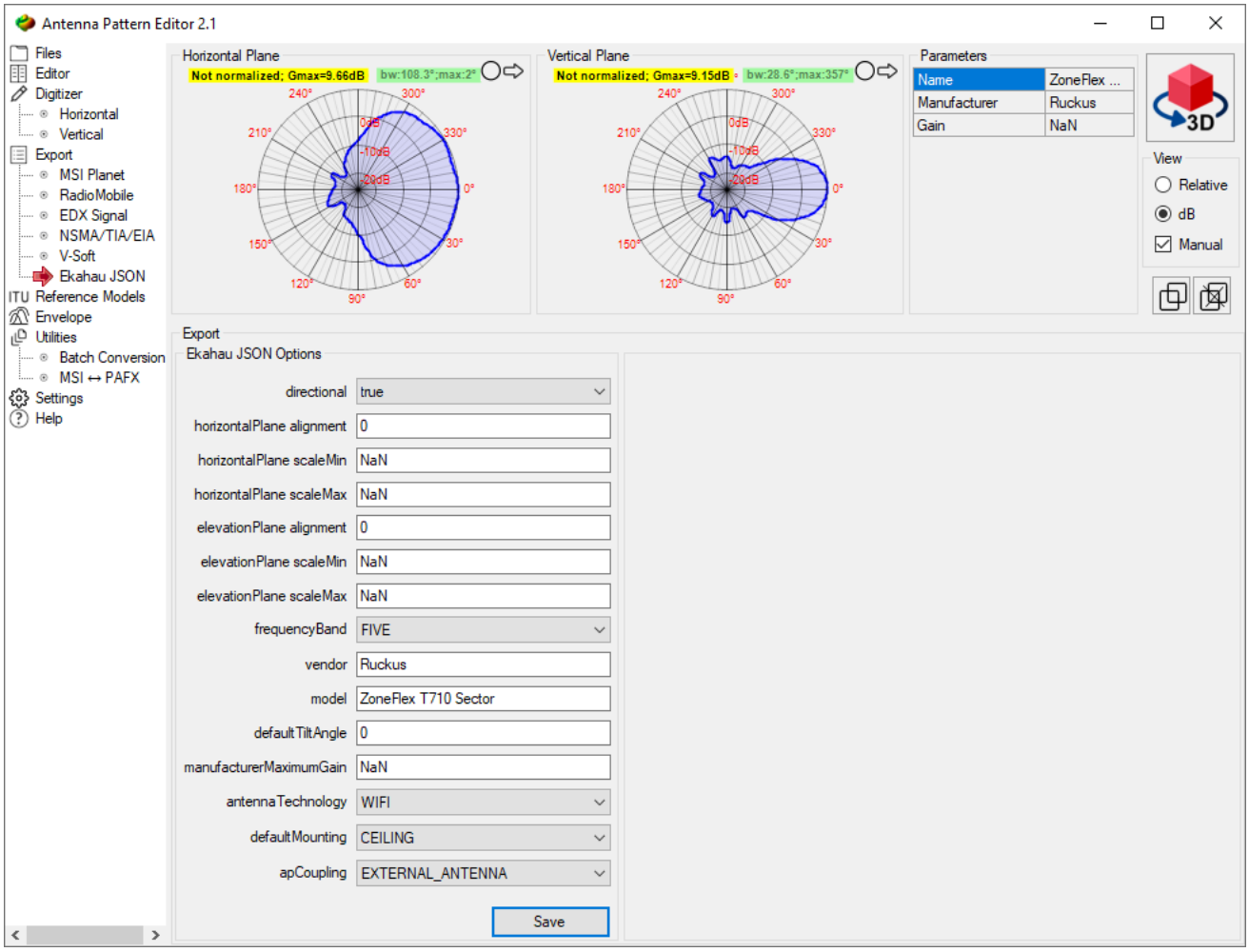
- MSI Planet
- Radio Mobile V3
- EDX Signal
- NSMA TIA/EIA-804-B
- V-Soft
- Ekahau (*.json)

Export is performed for the antenna pattern placed in the Editor.



Export Antenna Pattern to MSI file

To save an antenna pattern file in Antenna Pattern Editor, you can select the desired format in the Export menu, then fill in the header fields corresponding to this format. Information for each field appears when you hover over the icon next to the corresponding field. The user usually determines the completeness of the header by themselves. In radio planning tools, often only the antenna pattern from the file is used, and the heading is rarely used. To save the file, you can click the Save button.



*Export Antenna Pattern to Ekahau *.json file*

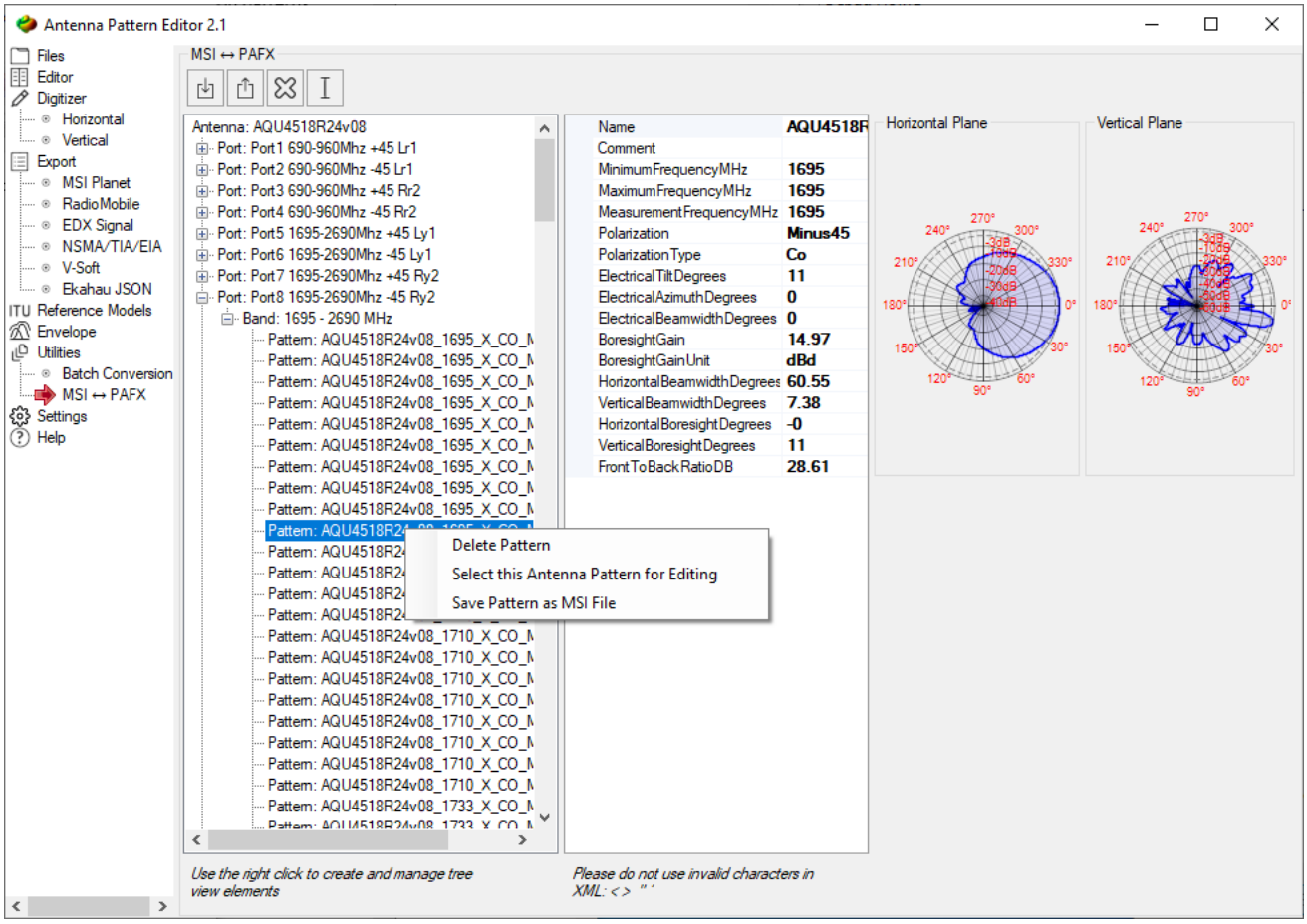
Please note: in the trial version, it is possible to export antenna patterns only in the Radio Mobile V3 format (*.ant). Export to all declared formats is possible only in the full version.

Utilities

Creating a PAFX Antenna Based on MSI Antenna Patterns

The MSI ↔ PAFX utility enables the creation of PAFX files—archives of XML files that store comprehensive information about antenna parameters and radiation patterns.

A PAFX file fully encapsulates the characteristics of modern multiport antennas, including radiation patterns for all ports, frequency ranges, polarizations, and electrical tilt angles.



MSI ↔ PAFX Utility

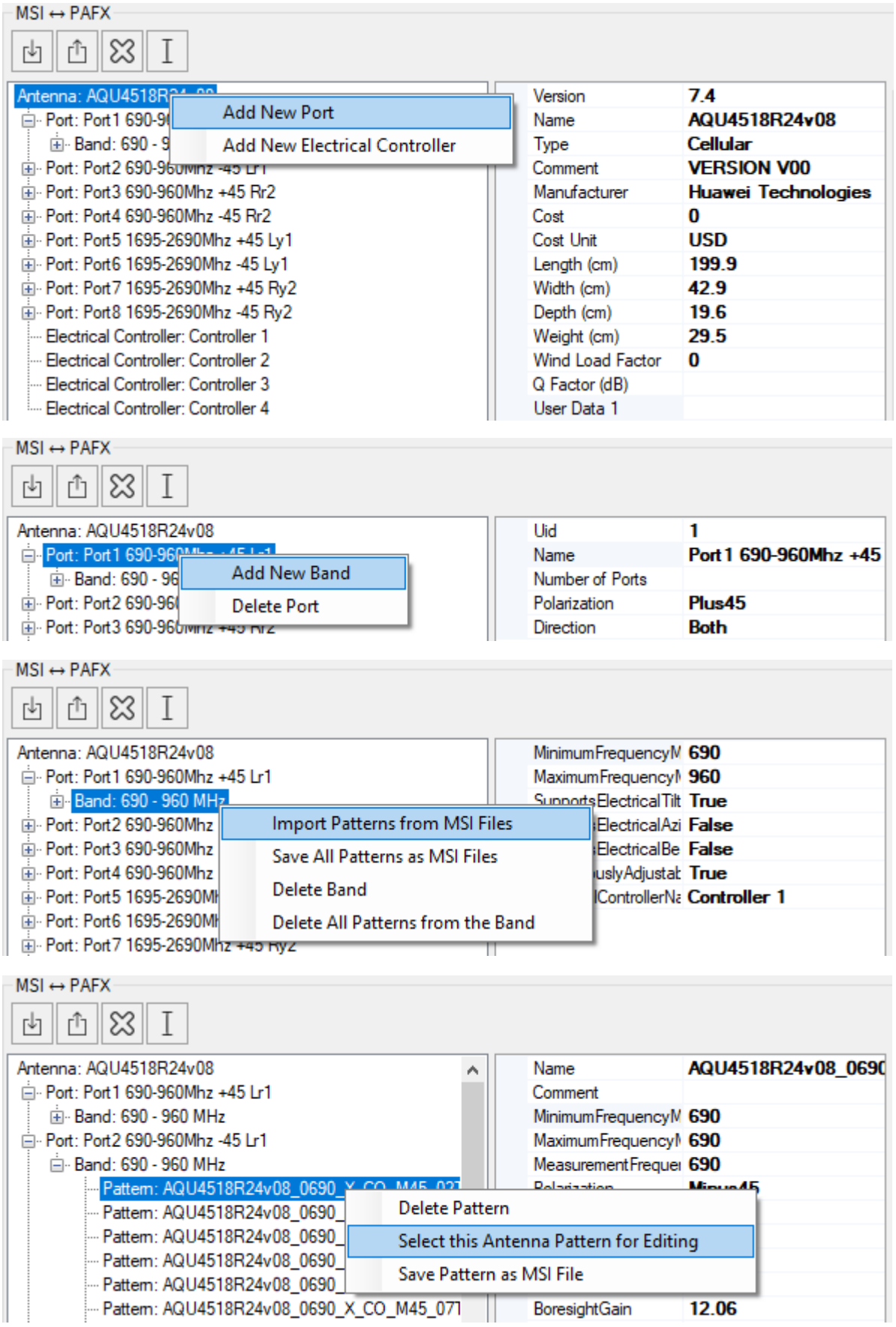
Toolbar:

- Load PAFX file
- Save PAFX file
- Clear antenna parameters
- Make the antenna pattern names as AntennaName_Port_ElectricalTilt_MesurementFrequensy. This tool is designed to create unique names for all antenna patterns to correctly save a set of XML files.

In the MSI ↔ PAFX utility, antennas are represented as a tree structure, with ports and frequency ranges organized as nodes. Additionally, you can create electrical tilt angle controllers within the software.

To create or edit the antenna structure, use the right mouse button. Antenna parameters can be specified in the properties panel displayed on the right. Radiation patterns for a selected frequency range are imported directly from MSI files, and you also have the option to import a group of MSI files simultaneously.

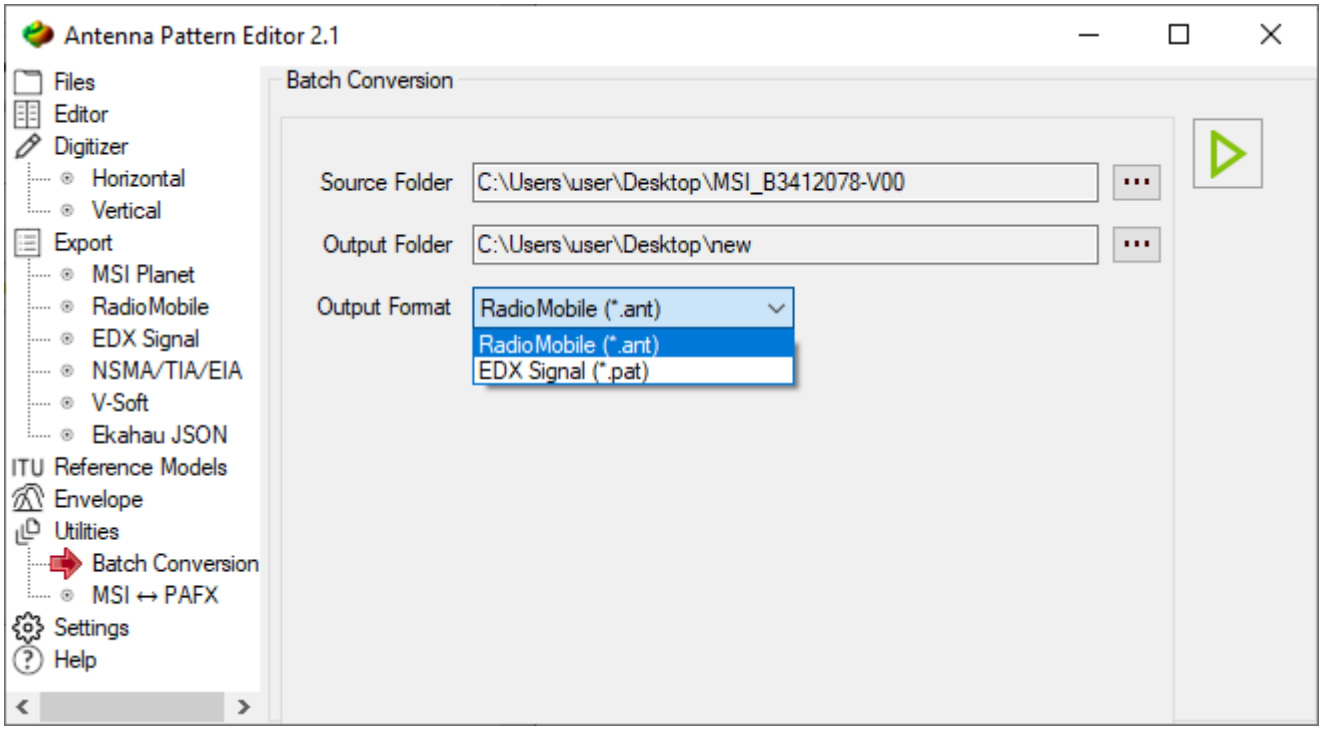
The utility allows for the creation, saving, opening, and editing of PAFX files. Furthermore, you can export a specific directional pattern or a group of directional patterns for a single frequency range in MSI format. Using the right mouse button, it's also possible to place a chosen directional pattern from the PAFX file into the Editor.



Editing antenna structure elements in PAFX format

Batch Conversion of Antenna Pattern Files Between Different Formats

The Antenna Pattern Editor has a batch conversion utility that allows you to convert a set of antenna pattern files between different formats. To perform the conversion, you can select the source and output folders, as well as the format in which you want to convert the files. Then, you can click the **Convert all files in the folder button** to start the conversion process. This allows you to easily convert multiple antenna pattern files between different formats at once.



Batch Conversion

Appendix 1. Antenna pattern formats

MSI Planet Antenna Pattern File Format

Planet is a RF propagation simulation tool initially developed by MSI. Planet was a 2G radio planning tool which has set a standard in the early days of computer aided radio network design. The antenna pattern file and the format which is currently known as ".msi" format or .msi-file has become a standard.

The antenna pattern file is an ASCII Text file and the general information; horizontal data points and vertical data points are stored in one file. The left column label and the data is separated by at least one space. The horizontal data and vertical data can be separated by at least one space or a Tab character.

There must be 360 data points (0 through 359) for the Horizontal data and 360 data points (0 through 359) for the Vertical data. Zero degrees represents North for the Horizontal pattern, and Zero degrees represents the horizon for the Vertical pattern. The antenna gain unit is dBd. If the Gain is in dBi, it must be indicated after the Gain value (separated with at least one space). All gain data points are relative to maximum gain being zero. Any value below zero is assumed to be negative. Do not include the minus sign for these values.

The name of the antenna should be the first line of the file.

antenna.msi	
NAME	<name>
MAKE	<make>
FREQUENCY	<frequency>
H_WIDTH	<h_width>
V_WIDTH	<v_width>
FRONT_TO_BACK	<front_to_back>
GAIN	<gain>
TILT	<tilt>
POLARIZATION	<polarisation>
COMMENT	<comment>
HORIZONTAL	360
0	<0H>
.	
.	
359	<359H>
VERTICAL	360
0	<0V>
.	
.	
359 <359V>	

Variables:

Variable	**Comment**
NAME	Name of the antenna
MAKE	Name of the manufacturer

FREQUENCY	Frequency in MHz
H_WIDTH	Opening angle in the horizontal plane between the -3 dB points
V_WIDTH	Opening angle in the vertical plane between the -3 dB points
FRONT_TO_BACK	Front to back ratio in dB
GAIN	Antenna gain in dBd when in dBi this must be specfified
TILT	Electrical tilt of the main beam in degrees
POLARIZATION	Horizontal, vertikal, +45 or -45
COMMENT	Comment
0H..359H	Horizontal gain datapoints per horizontal angle relative to maximum gain being zero. Any value below zero is assumed to be negative. *Minus sign is not used with these values*
0V..359V	Vertical gain datapoints per vertical angle relative to maximum gain being zero. Any value below zero is assumed to be negative. *Minus sign is not used with these values*

Restrictions when exporting to the MSI file format:

If the antenna pattern in the editor contains sets of patterns for different polarization or slices, then only the set that is currently displayed will be exported.

If the antenna pattern in the editor contains a number of points other than 360, then these patterns will be converted to the format 0-360.

If the antenna pattern in the editor does not contain a full 360-degree circle, then the antenna pattern values in the missing sector will be linearly interpolated.

Radio Mobile V3 Antenna Pattern File Format

This antenna pattern file format is used in the popular free radio planning application Radio Mobile.

This format stores the antenna pattern in the horizontal plane and the pattern in the vertical plane in one file.

More information about the format can be found at the link:

http://radiomobile.pe1mew.nl/?The_program:File_formats:Antenna_.ant_format_%28V3%29

If the antenna pattern in the editor contains sets of patterns for different polarization or slices, then only the set that is currently displayed will be exported.

If the antenna pattern in the editor contains a number of points other than 360, then these patterns will be converted to the format 0-360.

If the antenna pattern in the editor does not contain a full 360-degree circle, then the antenna pattern values in the missing sector will be linearly interpolated.

EDX Signal Antenna Pattern File Format

This antenna pattern file format is used in EDX Signal/Signal Pro planning tools.

This format stores the antenna pattern in the horizontal plane and a set of slices in the vertical plane at given azimuths in one file.

More information about the EDX Signal format can be found at the link:

https://help.edx.com/help/directional-antenna-pattern-file

Restrictions when exporting to the EDX file format:

The antenna pattern in the horizontal plane can contain any number of points.

All slices must contain the same number of points in the range of -90 to +90 degrees.

If the antenna in the editor contains several sets of antenna patterns in different polarization, then the set that is currently displayed will be saved.

If the current format does not support slices (for example, the MSI format), then two slices will be created during saving at azimuths of 0 and 180 degrees.

NSMA and TIA/EIA-804-B Antenna Pattern File Format

In NSMA antenna pattern file format, one or more pairs of horizontal and vertical patterns for different polarization is stored in one file.

Full information in NSMA (National Spectrum Management Association) recommendation WG16.99.050 "Antenna Systems – Standard Format for Digitized Antenna Patterns" at the link:

https://nsma.org/wp-content/uploads/2016/05/wg16_99_050.pdf

Antenna pattern file format according to the TIA/EIA-804-B standard almost completely coincides with the NSMA format.

Restrictions when exporting to the NSMA/TIA/EIA-804-B file format:

Each antenna pattern can contain any number of points in the range of 0-360 degrees.

If the antenna pattern does not contain a full 360-degree circle, then the missing sector will be linearly interpolated.

If the antenna pattern contains multiple vertical plane pattern slices, only the one currently displayed will be saved.

V-Soft Antenna Pattern File Format

This format is used in V-soft software v-soft.com

In this format, the antenna pattern is divided into two files:

The vertical plane antenna pattern is saved to a file with the *.vep extension. It contains 181 points in the range -90...+90 degrees.

The horizontal plane antenna pattern is saved to a file with the *.pat extension. It contains 360 points (a full circle of 360 degrees, 0...359).

Restrictions when exporting to the V-Soft file format:

If the antenna pattern in the editor contains several sets of antenna pattern for different polarization, then the currently displayed one will be saved when exporting to a file.

If the antenna pattern in the editor contains points with an interval other than 1 degree, then this antenna pattern will be interpolated with an interval of 1 degree.

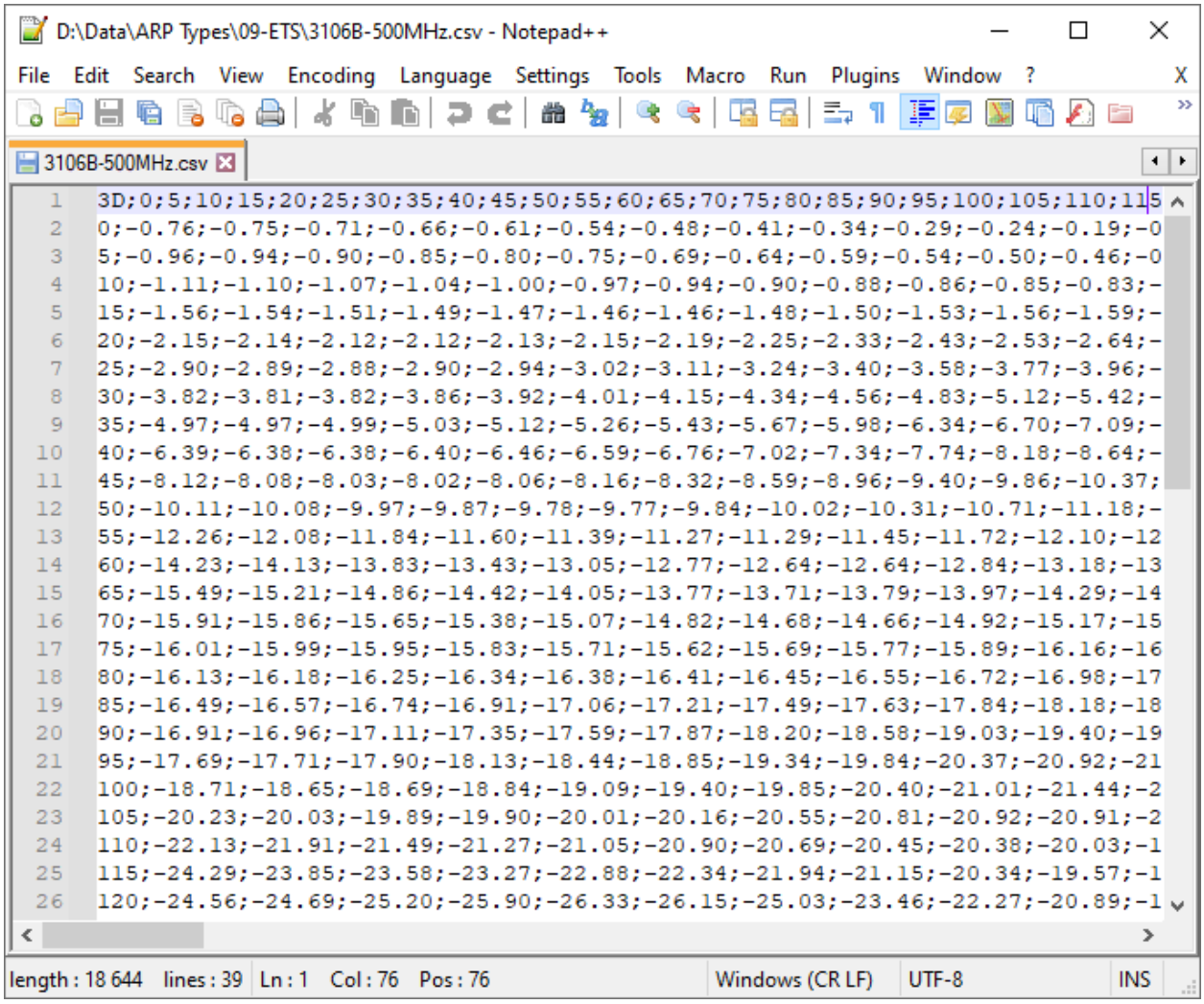
When exporting, all points on the vertical plane antenna pattern that are outside the range of -90 to +90 degrees will be deleted.

Ekahau JSON Antenna Pattern File Format

This format is used in Ekahau software products. The format is not officially published, its approximate description can be found on the Internet by searching for "Create your own antenna in Ekahau".

3D Antenna Pattern File Format

Antenna Pattern Editor supports a simple 3D file format as a CSV text file with antenna pattern values and semicolon delimiters:



File sample in 3D format

Where:

3D is a sign of a 3D file

first line - theta angles from 0 to 359 degrees

first column - phi angles from 0 to 180 degrees

Such a file can be easily obtained from 3D ETS-Lindgren or Satimo file using any spreadsheet editor.