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EMF Planner 7.0

Software for EMF exposure modelling and analysis

User Manual

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From the Developers

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

Features

EMF Planner is a simulation software designed for the modelling, analysis and visualization of EMF exposure from any radio transmitter - base stations of any standard, TV and radio broadcasting stations, satellite earth stations, PtP, PtMP, Wi-Fi, etc.

EMF Planner is an internationally adapted version of our SanZone software that we have been developing for over 20 years and have released six editions, making EMF Planner the seventh.

The software is intended for users involved in the design, operation and supervision of transmitting radio facilities.

Main Features:

— Calculation of EMF level by point source method according to Recommendation ITU-T K.70 (2020) *Mitigation techniques to limit human exposure to EMFs in the vicinity of radiocommunication stations;*

— Calculation and visualization of exposure areas in horizontal and vertical planes;

— Calculation of electromagnetic field levels at control points;

— Convenient interface that allows you to quickly enter the parameters of many radiating sources;

— Choice of many exposure limits recommended by different countries and organizations;

— Reports on the electromagnetic field and the total exposure in graphical and tabular form;

— Accounting for the calculation of terrain and buildings;

— Using maps from OpenStreetMap, Google, Bing and other map services as a base map;

— If necessary - easy and visual calibration of the custom base map in any image format;

— Import of a 3D plan model in vector format from the OpenStreetMap project database with buildings height information.

— Quick creation of a terrain model from an automatically loaded Digital Elevation Model (DEM);

— Built-in editor of vector objects (buildings, labels, contour lines and terrain elevations);

— Generation of a full report according to a custom Microsoft Word template;

— Export to DWG/DXF AutoCAD file

— Greater computing speed due to optimization of the algorithm and the use of streaming calculations. Calculations are distributed among threads, which makes it possible to perform computing 4-24 times faster (depending on the number of threads supported by the processor).

— Using MSI Planet and NSMA antenna pattern files;

— Built-in automatic unit converter between W, mW, dBW, dBmW

— Visualization of calculations in 3D, export to an interactive 3D pdf file;

Installation and Activation

PC software requirement:

1. Windows 7/8/8.1/10/11 64-bit,

2. To use all EMF Planner features, the Microsoft Word and Excel must be installed on the computer.

The minimum computer configuration is 64-bit Windows, Core i3 CPU, 4GB RAM, 200GB HDD, video card, and monitor with support for 1920x1080, although the program can be installed on a less productive computer.

The recommended computer configuration is 64-bit Windows, Core i5 CPU, 16GB RAM, 256GB SSD, video card, and monitor with support for 1920x1080.

Run the Setup_ EMF Planner.exe file. Select your language and press the Install to launch the installation process. Click Next. To continue the installation process, read and accept the License Agreement. Activate the checkbox "I accept the terms in the License Agreement" and press Next.

After installing EMF Planner, you will see a new line in the Start menu and a shortcut on the desktop.

During the 7-day trial period, you can try out all the features of the program (without the project save function). To use the software after the trial period, you must purchase a license and activate the software.

To buy EMF Planner, click on Help - Purchase, after which the purchase page will open in the browser. After making a purchase, you will immediately receive an activation ID code to your email. Then click Help - Enter your Activation ID code, enter your code and click on ACTIVATE.

Software Update

Periodically, we release free, ongoing updates that improve the functionality and stability of the software.

EMF Planner 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 there is an available update, a window will open with current and available versions. Download the update from the link and install it manually (close EMF Planner before installing the update).

Quick Start. How to work with the EMF Planner

1. Create a new project (it is created by default when you start the software).

2. Enter the data for each of the radiating sources (frequency, system type, transmitter power, attenuation, antenna pattern, etc.) - see the Radiation Sources section.

3. Set the required transmitter power conversion factors for each transmitter type in the Conversion Factors menu

4. Set the required EMF exposure limits in the EMF Limits menu

5. If you have your own map image to overlay the calculation visualization on it, then calibrate it as described in the Calibrate Map Image section. If you are going to use one of the standard base maps then skip this.

6. Set a point of origin and calculation grid on the map - see "Origin and Grid" section.

7. Set a location of each radiation source's antenna on the basemap as described in the Antenna Locations section.

8. If you want to take into account the terrain in your calculation, then load it from our Digital Elevation Model (DEM) or draw it manually – see Terrain section.

9. Load from the database or draw/edit using the built-in editor the surrounding buildings and specify the height of the buildings and the base elevation for each building (if you use terrain) -see the Buildings section.

10. If necessary, put additional borders and labels on the map - see the section Lines and Labels.

11. Calculate the exposure in horizontal and vertical planes at different heights - see Sections Horizontal Sections and Vertical Sections

12. Get graphs and tables of the total values of the EMF and its components from different radiating sources at the required azimuths.

13. Perform calculation of EMF levels at control points on the ground, on the roofs of buildings and inside buildings.

14. Generate of a full report on a custom Microsoft Word template.

The software package contains several sample projects. We advise you to start with these samples.

User interface

The main menu is located on the left side of the main program window. Selecting one of the menu items next to it opens the panel corresponding to that item. You can change the size of the panels as needed using the separator.

When entering some menus, the base map will also appear on the right. You can choose to display one of the preinstalled basemaps, or set up your own basemap (see Settings).

Navigation on the base map is carried out using the mouse. Use the mouse wheel to move the map **(you need to click on the wheel)** and change the scale (Zoom) of the map (scroll the wheel forward / backward). The current Zoom is displayed next to the basemap name. The desired Zoom can also be selected from the drop-down list.
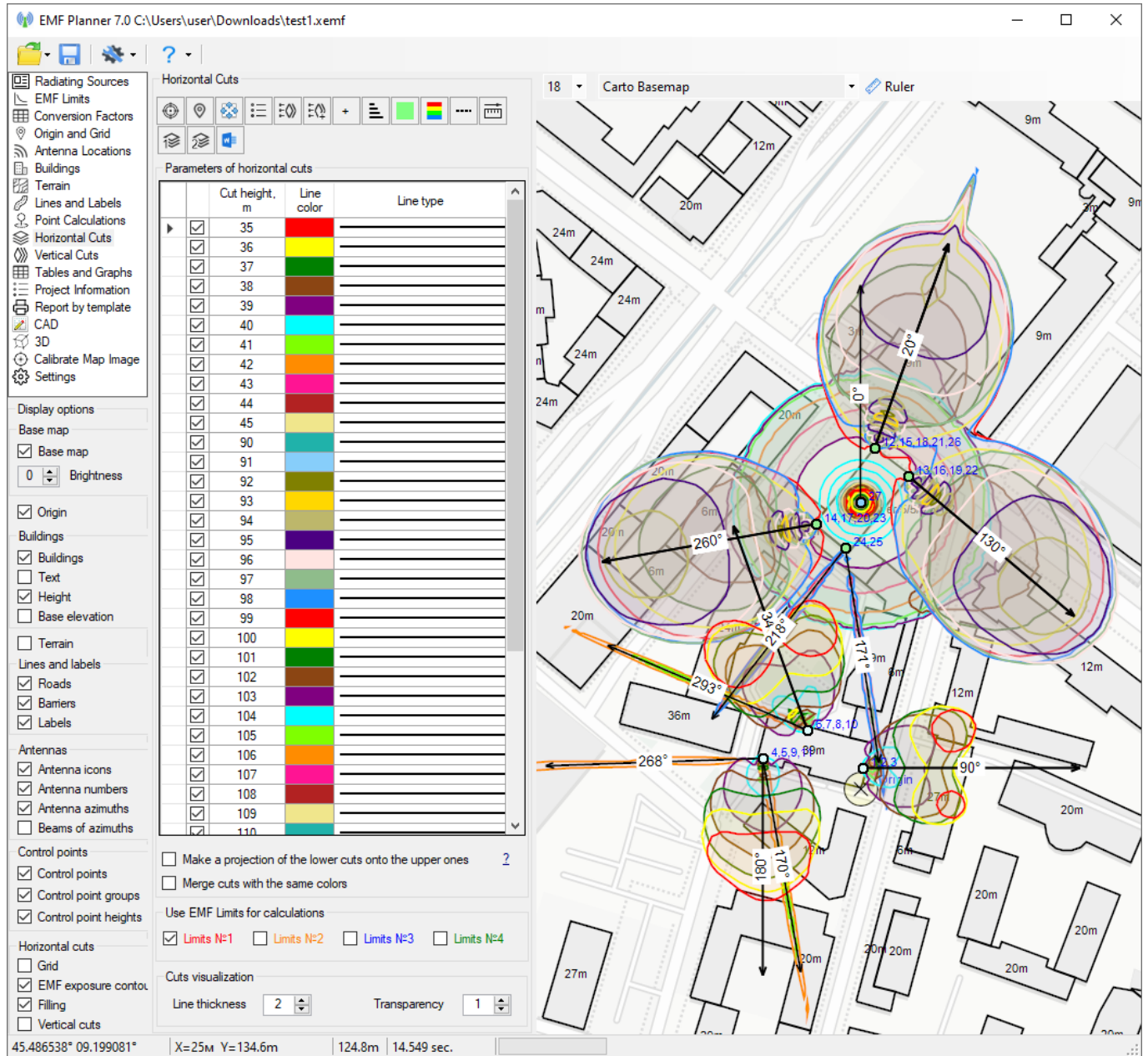
User interface

At the bottom, under the main menu, there is a panel with options for displaying various elements on the basemap.
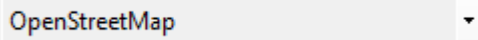
Main toolbar:

- Standard tools for working with files: Create, Open, Save. Project files have *.xemf extension.

- Save the project.

? ▾   - Help

11 ▾   - The current base map zoom

OpenStreetMap ▾   - The current base map

- The tool "ruler," which allows measuring the distance and azimuth between any two points. To perform a measurement, click on the ruler, then click on any two points of the map and you will see the distance between the points and the azimuth from first to second. To exit, right-click anywhere on the map.

Radiating Sources

Entering the initial data on EMF sources is performed in the Radiating Sources window, which opens by default when the software is launched.

Some important definitions:

Active EMF source	To the left of each of the EMF sources there is a mark about the activity of this source, which can be set and removed with a mouse click. ATTENTION: If the source is not active (the label is missing), then it is not taken into account in the calculations. You can make all sources active at once or turn them off by clicking on the corresponding tool in the toolbar or by clicking on the top cell of the column.
Current source (string)	The line with the EMF source that was last clicked. It is marked with a black triangle on the left.
Selected sources (strings)	Selected (highlighted) rows with EMF sources. In the table, rows can be selected in a row or in random order using Ctrl. The selected rows are highlighted with a blue background.

Radiating Sources Menu

Toolbar:

Icon	Description
✛	Create a copy of the selected rows
⤴	Move selected rows up one position
⤵	Move selected rows down one position
⊤	Move selected rows to the beginning of the table
⊥	Move selected rows to the end of the table
☑	Inclusion/Exclusion of all sources in the calculation. You can also make all sources active at once or turn them off by clicking on the column heading.
🖺	Copy selected lines to clipboard
🖺	Paste lines from clipboard (after current line)
◎	Calculate antenna beamwidths for all sources based on antenna pattern files. The values of the antenna pattern width in the horizontal and vertical planes are calculated according to the loaded antenna pattern data for a level of -3 dB and may differ slightly from the data specified by the manufacturer.
↺	Calculate the value of the antenna beamwidth for the current source

Radiating source report in MS Word

Radiating source reports in MS Excel

Row colors Using this tool, the user can highlight rows in the list of radiation sources with different colors, which greatly helps when working with large tables (for example, in this way it is possible to highlight radiation sources belonging to different operators). To change the color of rows - select them in the table and click on the required color.

Radiating sources parameters:

Radiating sources name: Name of the source or type of equipment;

Type of service: System type from drop down list

Frequency, MHz: Radiating source frequency;

Transmitter power, W: Transmitter power.

Transmitter power (in W) can be entered directly into the table by clicking once on this cell. When you double-click on the cell with the transmitter power value, a unit converter appears, in which you can enter power, for example, in dBm, after which automatic conversion to W will be performed and when you click OK, this value will be saved in the table.

		Radiation source name	Type of service	Frequency, MHz	Transmitter power, W	Number of TX	Total atten., dB	Antenna model	Antenna azimuth, deg	Antenna gain, dB
▶	001	☑ 900_60	GSM	900	12.05	1	0	742265V02	60	16
	002	☑ 900_130	GSM	900	12.05	1	0	742265V02	130	16
	003	☑ 900_320	GSM	900	12.05					16
	004	☑ 2100_60	UMTS	2100	10.42					18.3
	005	☑ 2100_130	UMTS	2100	10.42					18.3
	006	☑ 2100_320	UMTS	2100	10.42					18.3
	007	☑ 23 GHz 0.6 HP	PtP	23000	0.1995					40
	008	☑ 18 GHz 0.6 HP	PtP	18000	0.2512					39.2
	009	☑ 23_1 GHz 0.6 HP	PtP	23000	0.1995					40
*		☐	Other	1000	0					0

Unit conversion dialog:

12.05	W
12050	mW
10.8	dBW
40.8	dBm

Cancel   OK

Transmitter Power Unit Conversion

Number of TX: The number of combined transmitters;

Total atten., dB – Attenuation in the feeder path. There are two ways to enter attenuation in the feeder path in the program. The first way is to directly change the attenuation value in the table by single-clicking on the required cell. The second way is to double-click on the cell and enter data for each of the elements of the feeder path in the form that appears, and the program will automatically calculate the attenuation value at the frequency specified by the source.

TX path attenuation calculation

The length and number of jumpers is set as the sum of the corresponding lengths in meters, for example, if there are two jumpers, one 2m long and the other 3m long, then 2+3 must be entered in the corresponding field. The number of jumpers can be any, the number of connectors is calculated automatically according to the number of jumpers. After pressing the OK button, the value of the total attenuation is copied into the "Total Attenuation" cell. The characteristics of the feeder path elements are stored in the project file.

Even if you filled out this form and calculated the attenuation, then you can always change the attenuation value with one mouse click on the "Total Attenuation" cell.

Antenna model: The name of the antenna model is automatically taken from the name of the antenna pattern file, but it can be corrected manually.

When a source is selected, the antenna pattern of that source will be shown on the right side of the screen. The antenna pattern file must be loaded for each of the radiating source by clicking on the corresponding icon at the top of the radiation pattern.

Antenna azimuth, degrees: Antenna azimuth;

Antenna gain, dBi: Antenna gain;

Antenna height, m: The height of the antenna radiation center from the ground level or base elevation of the building (see Antenna Locations);

Antenna size, m: Vertical antenna size, or diameter for aperture antennas;

Mechanical tilt, degree: Mechanical antenna tilt. Down - negative value;

Electrical Tilt, degrees: The "electrical tilt" of the antenna, in degrees, is used for reporting purposes only.

Antenna BW H-plane, degrees: The width of the horizontal antenna pattern, used only for the report;

Antenna BW V-plane, degrees: The width of the vertical antenna pattern, used only for the report;

Location (Tower/Roof/Facade): Antenna location. "Tower" - the height of the antenna will be measured from the terrain elevation at the tower location point; "Roof" and "Facade" - the height of the antenna will be counted from the base elevation of the building on which the antenna is installed. For more details, see the Terrain section.

New or Existing: The radiating source status (used only for the report);

Owner: The name of the company that owns this radiating source (only used for reporting purposes). The name can be entered directly into the corresponding table cell (to do this, click on Specify manually), or you can select from the list that appears. This list can be edited in the Settings menu.

Some handy features when working with the radiating source table:

1. The order of the columns in the table can be changed, to do this, simply drag the column by its heading to a new position. The order of the columns is remembered when the program is closed.

2. The width of some columns can be changed at will, the width of the other part of the columns is set automatically.

3. In the table, you can select multiple rows in a row or individual rows with Ctrl

4. Selected lines can be moved, deleted and copied, as well as their color can be changed using the corresponding icons in the toolbar.

5. The copied lines can be pasted both in the same project and in another open in another instance of the application. The location of the antennas on the base map in the project to which the sources are copied will remain unchanged, since their location is tied to geographic coordinates.

6. To delete the selected rows, press the Delete key

7. You can enter one numeric value at the same time in all selected cells in one column. To do this, select the desired cells in one column in a row or individual cells using Ctrl and enter the desired numerical value.

8. To select all cells in a column, click on the column heading

9. To change the activity status of all sources, click on the heading of the first column

10. You can insert a column of data from Microsoft Word or Excel into the table via the clipboard using the keyboard shortcuts Ctrl+C/Ctrl+V or Ctrl+Insert/Shift+Insert

11. Antenna azimuth can be "0÷360" for which it is enough to enter any non-numeric character. The text "0÷360" will be included in the report and the azimuth 0° will be used for the calculation.

In the right part of the "Radiating Sources" window there is an antenna pattern of the current radiation source and tools for working with this antenna pattern.
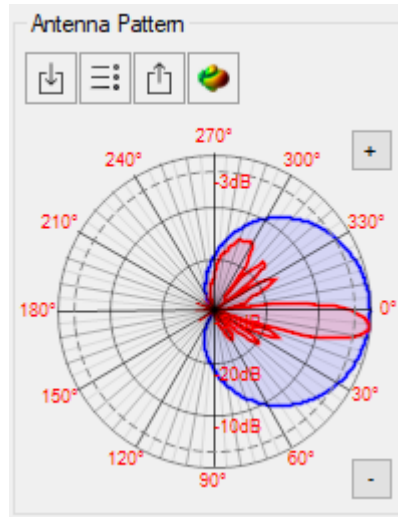
Antenna pattern toolbar

Load antenna pattern in MSI or NSMA format

Select antenna pattern from the list. Allows you to select an antenna from the antenna catalog with a preview. The path to the folder with antenna patterns is specified in the Settings menu. When you first click on the button Select antenna pattern from the list after starting the program, the directory of pattern files is scanned, which can take tens of seconds, depending on the number of files.

Save the antenna pattern file in MSI format of the current source. This function is useful when you want to save a antenna pattern file from a third party project.

Launch the installed Antenna Pattern Editor utility (https://www.wireless-planning.com/antenna-pattern-editor). With the Antenna Pattern Editor, you can view, edit, transform, normalize, digitize the antenna pattern from the image, etc.

Rotate the vertical antenna pattern up 1 degree

Rotate the vertical antenna pattern down 1 degree
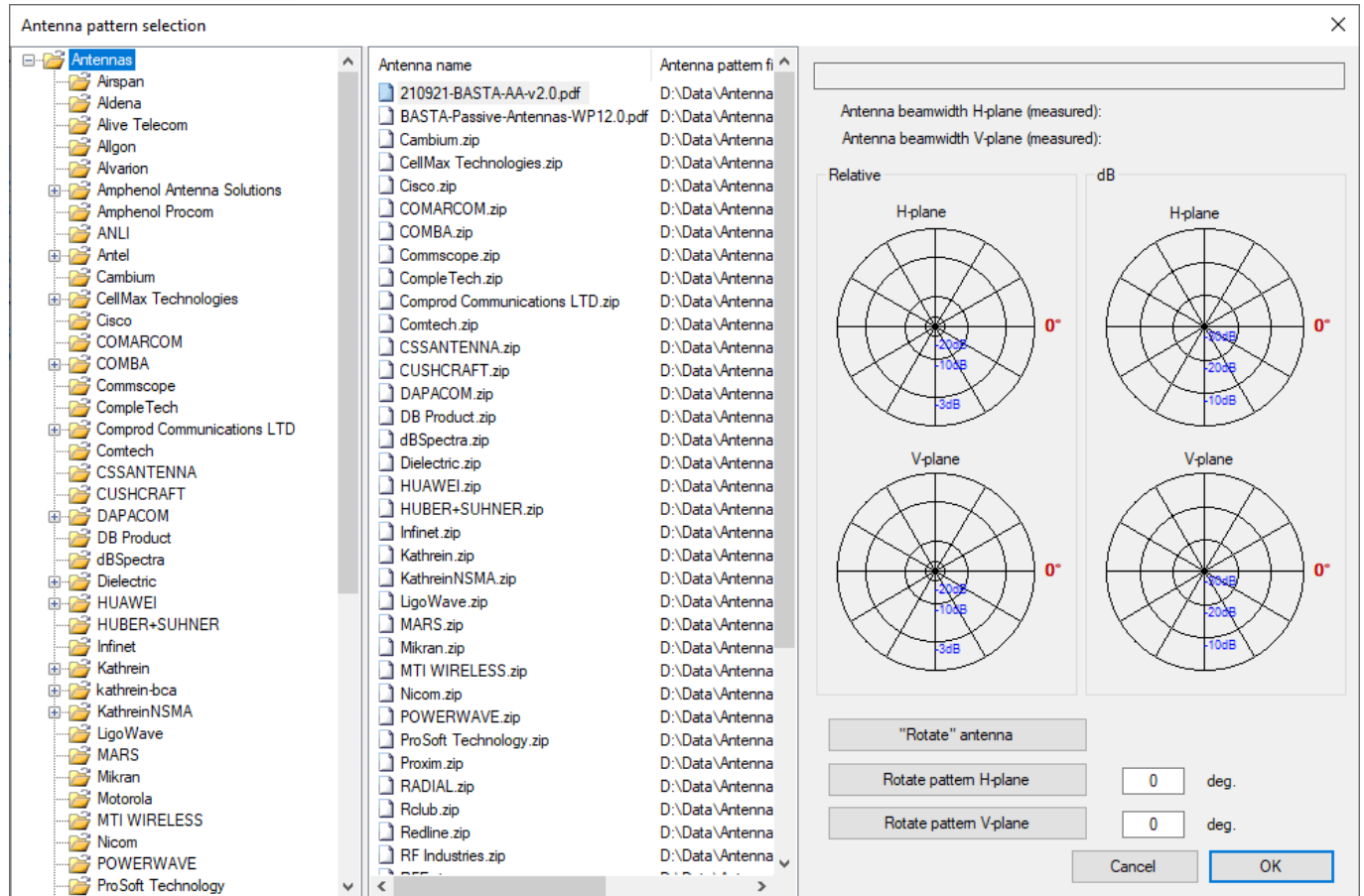
Selecting antenna pattern from the catalog

In the lower right corner of the Radiating Sources panel there is a universal calculator that allows you to quickly calculate the value of the three quantities - transmitter power, attenuation in the feeder, or power at the antenna connector from two known values. Powers can be set in any units (W, mW, dB, dBW, dBmW).
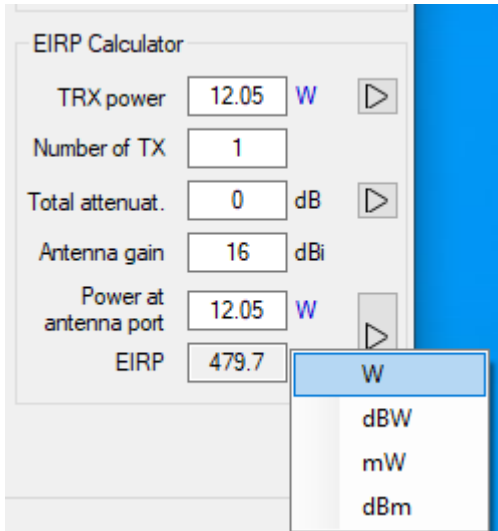
Universal Calculator

EMF Exposure Limits

In this menu, you can select the EMF exposure limits recommended by some organizations and state administrations. In addition, up to 4 custom EMF exposure limits can be set.

Exposure limits are set using the coefficients E and A in the equation:

Limit=ExF^A

where F - frequency in MHz

These coefficients may be different depending on the frequency range.
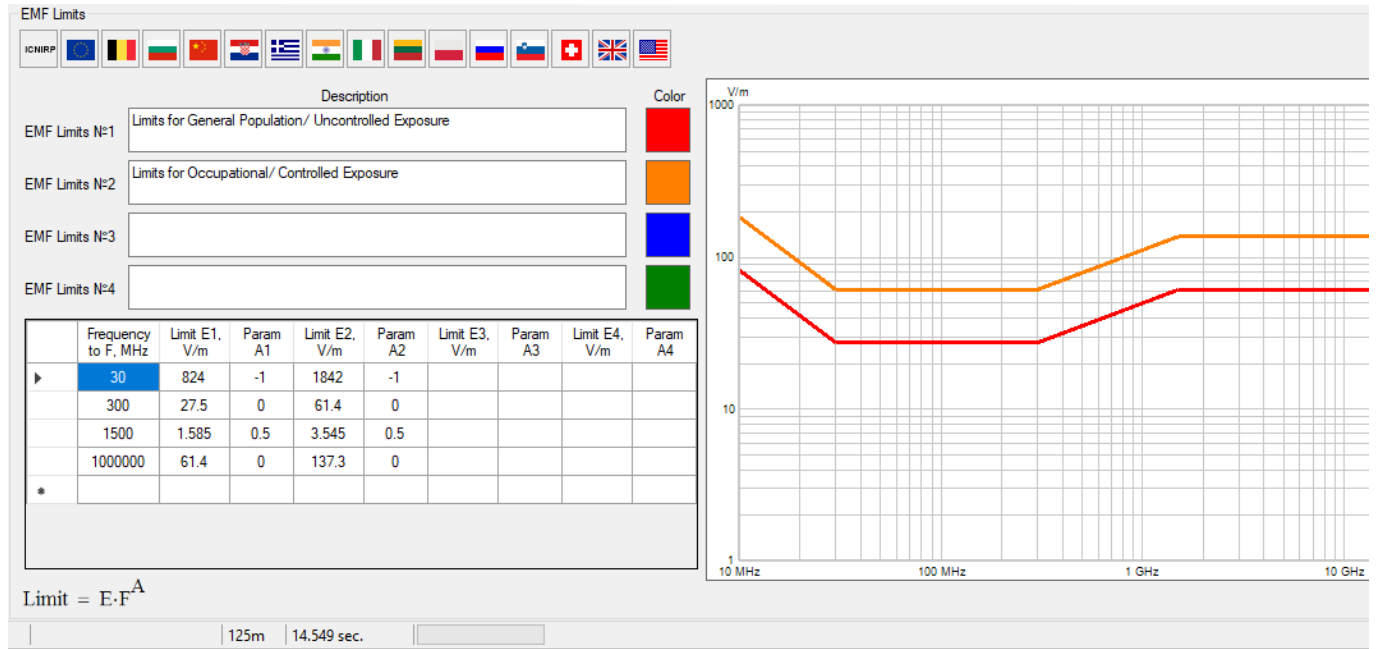
Exposure Limits

Conversion Factors

This menu sets the conversion factor for different types of services. This is the factor by which the rated power of the transmitter is multiplied when calculating the electromagnetic field strength.

Using the toolbar, you can set the conversion factors in accordance with the Rec. ITU-T K.70 recommendation or make all the conversion factors equal to 1. The user can change these factors in the table manually.

If you set a conversion factor equal to zero in a table cell, then the conversion factor will be calculated according to the following equation:

$K=(1+(n-1)*\alpha_{PC}* \alpha_{DTX})/n$

where:
n is the number of GSM carriers
α_{PC} is 0.7 (power control)
α_{DTX} is 0.7 (discontinuous transmission)

Conversion Factors

ITU	1

Type of Service	K for Limits №1	K for Limits №2	K for Limits №3	K for Limits №4
GSM	1	1	1	1
UMTS	1	1	1	1
LTE	1	1	1	1
5G	0.31	0.75	1	1
CDMA	1	1	1	1
DECT	1	1	1	1
TETRA	1	1	1	1
P25	1	1	1	1
DMR	1	1	1	1
PtP	1	1	1	1
PtMP	1	1	1	1
FM	1	1	1	1
DVB	1	1	1	1
T-DAB	1	1	1	1
DRM	1	1	1	1
DMB	1	1	1	1
TV PAL	0.7	0.7	0.7	0.7
TV NTSC	0.6	0.6	0.6	0.6
TV SECAM	1	1	1	1
WiFi	1	1	1	1
WiMAX	1	1	1	1
AM DSB	1.25	1.25	1.25	1.25
AM SSB	0.6	0.6	0.6	0.6
Other	1	1	1	1

K=0 means that the equation for GSM is used

Conversion Factors

Calibrate Map Image

It is assumed that the user will use one of the standard basemaps (OpenStreetMap, Google Sat, Bing, and others), **and in this case, it is not necessary to calibrate the map image.**

In cases where the base map at the site location is of poor quality or does not contain the necessary information, the user can use a custom raster image (png, jpg, bmp, tif, gif) as the base map. Anchoring and scaling a custom bitmap is done in the "Calibrate Map Image" menu.

After calibrating a raster image, work with it is carried out in the same way as with one of the map servers - in the list of servers, you only need to select "Calibrated Map Image" (the first one in the list).

Toolbar:

Load Image

Delete Image

Set the reference point and line on the image to the screen center

Set the reference point and line on the base map to the screen center

Refresh the pyramid of tiles

Navigation both on the image and on the base map is carried out by pressing the mouse scroll wheel, zooming in and out - by scrolling the wheel in one direction or another (like in AutoCAD, NanoCAD, etc.).
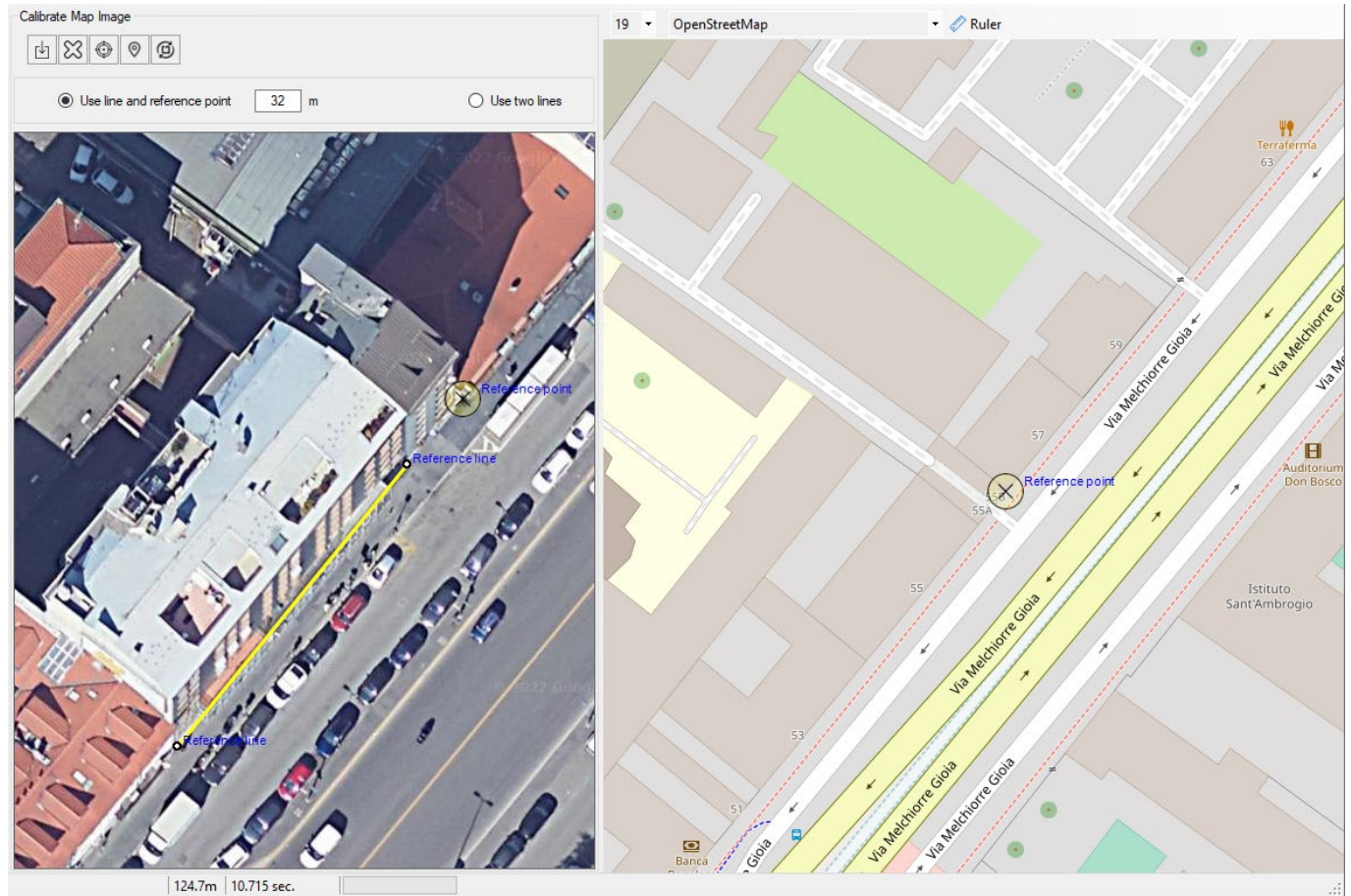
The user has two ways to calibrate a raster image - by a reference point and one reference line, or by two reference lines.

Calibration of a raster image by line and reference point

With this method, the user sets the same place on the raster image and the map (reference point), then, for scaling, sets the length of the known (reference) segment on the raster image.

Select the "Use line and reference point" method. Set the reference point on the raster image by dragging the appeared sign with the mouse. On the selected map on the right, you should also indicate the reference point in the same place. Then specify the known distance between two any points on the bitmap by dragging the ends of the reference segment to these points (shown in yellow) with the mouse. This can be any distance or overall size known to you - for example, the wall length of a building.

Now you can select in the right from the list of maps the very first "Calibrated map image" - this is the result of the binding. If you have performed the calibration again, then you should click on the toolbar "Refresh the pyramid of tiles".

Calibration of a raster image by line and reference point

Calibration of a raster image by two lines

With this method, the user specifies the same reference lines on the raster image and on the base map on the right. Thus, both scaling and georeferencing are performed at once.

Select the "Use two lines" method. After loading a raster image, specify the reference line on it, and then set the line corresponding to it on the base map. After that, you should select the base map "Calibrated map image" - this will be the result of the binding. If you have performed the calibration again, then you should click on the toolbar "Refresh the pyramid of tiles".
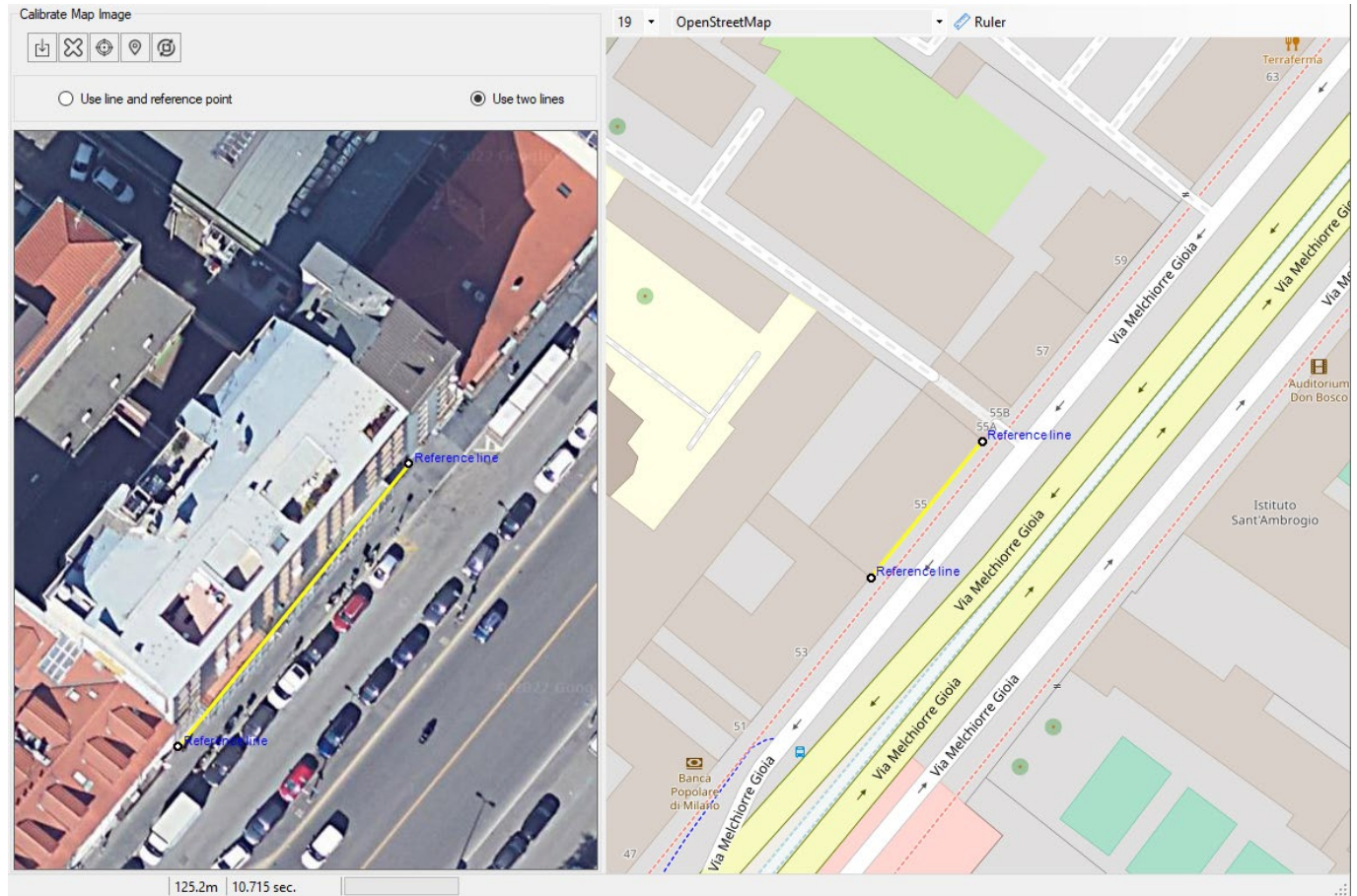
Calibration of a raster image by two lines

Setting the Origin and Calculation Grid

The origin is a point with coordinates X=0 and Y=0, relative to which the coordinates of all radiation sources and control points are indicated (in meters). The location of the origin point can be changed at any time, while the location of antennas and control points on the base map will not change, since they are tied to geographic coordinates. Only the coordinates of the antennas and control (in meters) points relative to the origin will change, which will not affect the calculation results. You can choose any point as the origin of coordinates. For example, it could be one of the antennas, the center of a tower, or the corner of a building. Moving the origin of coordinates is carried out by dragging the mouse. You can also set the origin of coordinates by right-clicking the mouse.
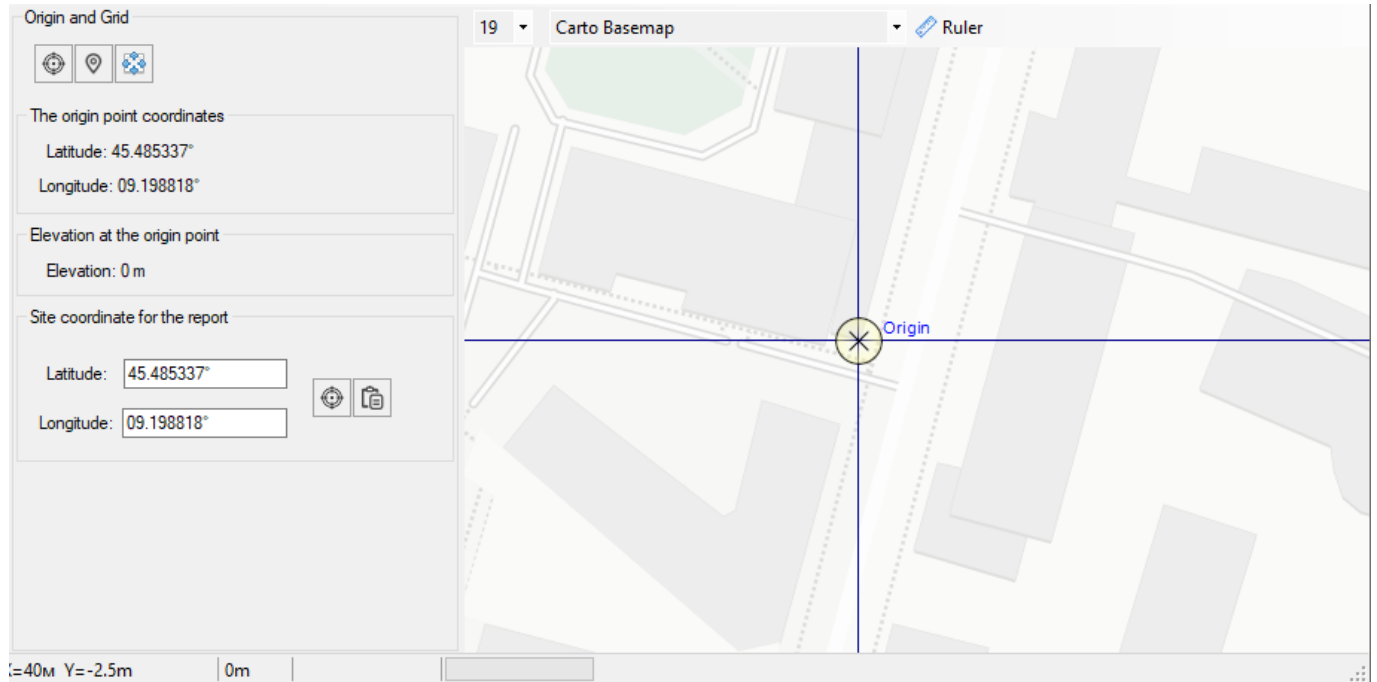
Origin and Grid

Toolbar

|	
	Show origin point at screen center
	Set origin point in the screen center
	Set the size of the calculation grid relative to the origin
Site coordinate	Site coordinate for the report
	Display the site at the screen center
	Insert origin point coordinates

After setting the origin of coordinates, be sure to specify the calculation grid dimensions. The grid is set relative to the origin using the appropriate tool on the toolbar. Do not make the grid size too larger than the expected size of the exposure area, you can increase it later at any time. The grid size can also be changed by moving its borders with the mouse.
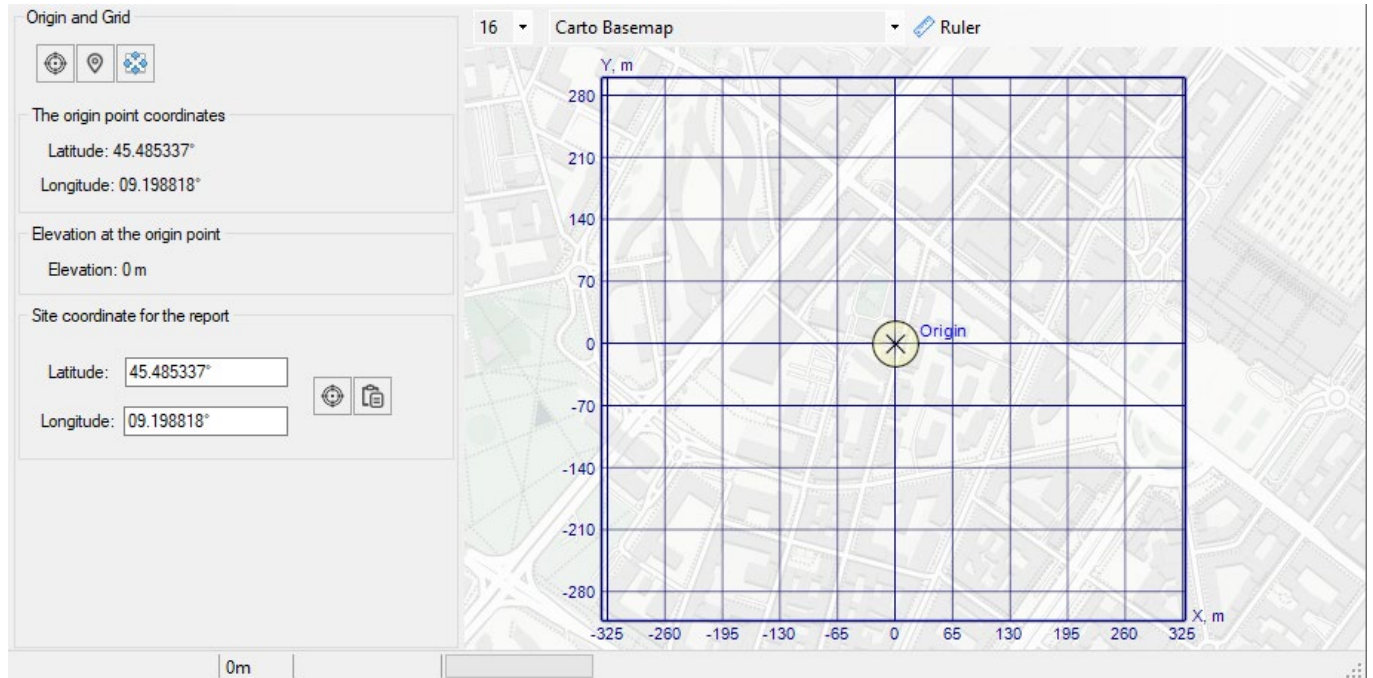
Calculation Grid
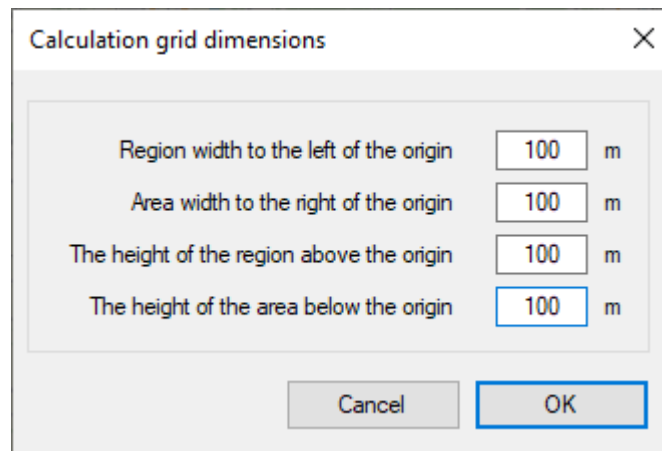
Grid dimensions

Enabling/disabling the display of the origin and grid on the map is performed in the "Display Options" panel under the main menu.

Antenna Locations

In this menu, the placement of antennas of radiation sources on the situational plan is carried out.

Antenna Locations

The antenna location can be set in one of the following ways:

1. Input in the table the X and Y antenna coordinates relative to the origin (in meters).
2. Move the antenna to the desired location on the base map using drag and drop.
3. Select the desired antennas in the table, then right-click on the desired location and select "Move selected antennas" from the context menu.
4. Move the antenna using the toolbar.

Toolbar:

⊕	Position the map to a point with a selected antenna
⊙	Move selected antennas to the screen center
▷▷	Move all selected antennas to the current antenna point

⊠ Move all selected antennas to the origin

⊗ Move origin to current antenna point

Maximum capture distance is the conditional distance at which the antennas are "attracted" during mouse dragging.

The parameters for displaying antennas on the situational plan are controlled in the "Display parameters" panel, located under the main menu.

Buildings

In this menu, the user can create and edit a buildings layer. These buildings will then be taken into account when performing calculations and preparing all types of reports.
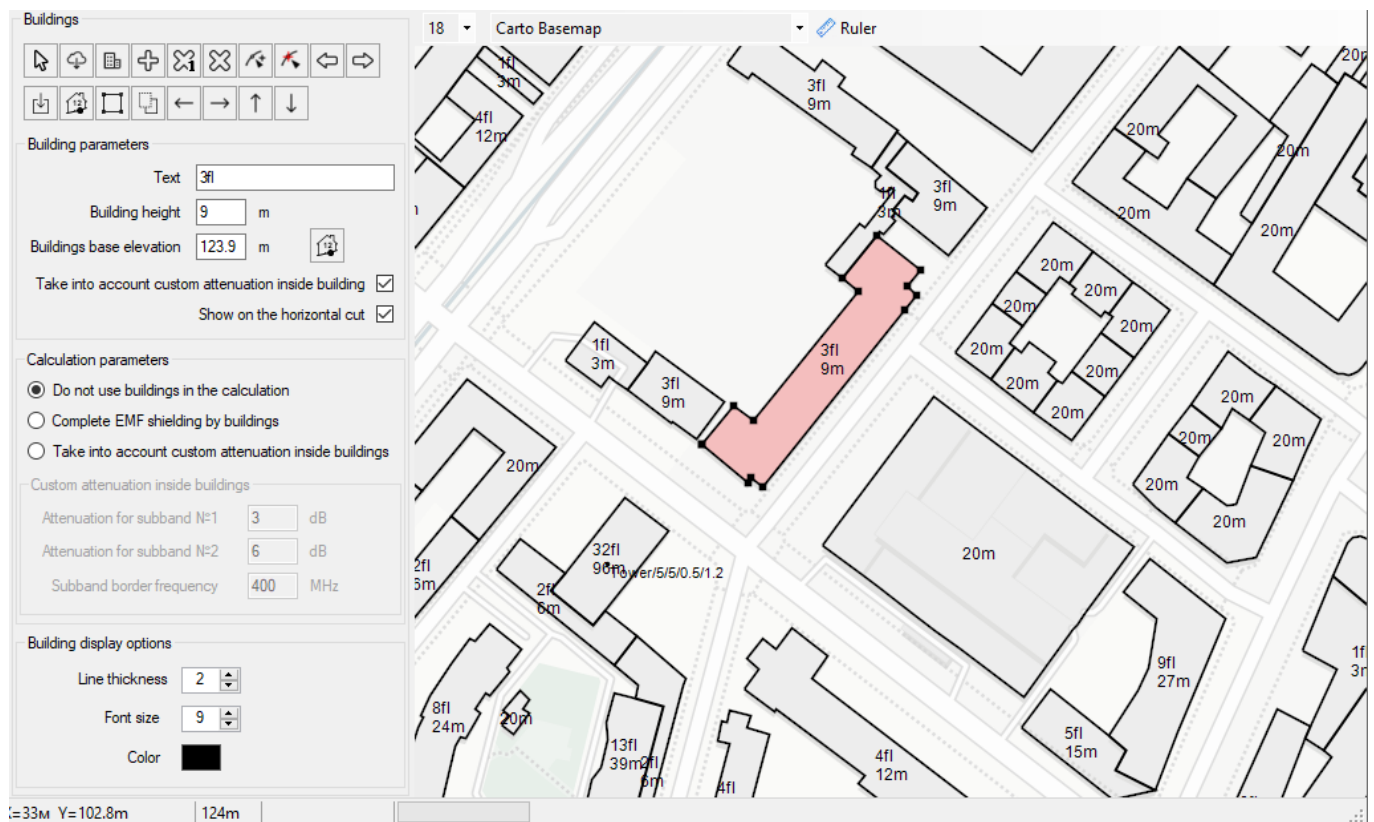
Buildings

Toolbar:

[cursor icon]	Select a building
[cloud upload icon]	Load building polygons within the screen from the OpenStreetMap database
[building icon]	Add building. Building drawing tool. The last segment will appear automatically when you click the right mouse button. After drawing, specify the parameters of the building.
[plus icon]	Create a copy of the selected building
[delete one icon]	Delete selected building
[delete all icon]	Delete all buildings
[add node icon]	Add node. Adds a node to the outline of the selected building
[import icon]	Import building polygons from a KML file
[elevation icon]	Fill in all building's base elevation based on the terrain data. In this case, you can choose how the base elevation of buildings will be determined - by the minimum, maximum or average value of the elevations of the corners of the buildings.
[square corners icon]	Square building corners
[delete node icon]	Delete node. Removes a node from the outline of the selected building.
[left arrow icon]	Undo
[right arrow icon]	Redo
[move back icon]	Move the selected building to the back
[move arrow icon]	Move all buildings by one pixel

Building parameters

Text: in this field you can enter a label that will be displayed on the building;

Building height, m: Building height in meters;

Base elevation, m: Building base elevation in meters relative to sea level; If the project takes into account the terrain, then building base elevation must be specified for all buildings that fall into the calculation area (by default, they are all equal to 0). Building base elevation is the surface of any structural element of a building or structure (for example, the floor level of the 1st floor, the top of the foundation, etc.). Building base elevation is needed to correctly take into account the relative position of the antennas that are located on the roofs and facades of various buildings. Since when placing antennas on a building or antenna support, designers set the antenna suspension heights relative to the base elevation of this particular building or antenna support.

For a quick initial filling of zero values for buildings, use the button "Fill in all buildings base elevation based on the terrain data".

Take into account attenuation inside building: Enable/disable ability to apply custom attenuation to this building.
Show on horizontal cut: Enabling/disabling the display of this building on horizontal cuts.

Calculation Parameters

Do not use buildings in the calculation. If this option is active, then buildings do not affect the calculation in any way.
Complete EMF shielding by buildings. Shielding means the complete absence of the level of the electromagnetic field at a given point from the source, if the line of sight from this source to this point is closed by the building.
Take into account attenuation inside buildings. With this option, the user can set the loss for the penetration of the electromagnetic field into the building for two frequency bands. In this case, outside buildings, the EMF level will be calculated for line-of-sight conditions (without shielding).

Building display options

Select the thickness and color of the lines with which the buildings will be displayed, as well as the font size for the labels on the buildings.

The parameters for displaying buildings on the map are configured on the "Display Options" panel located in the main menu.
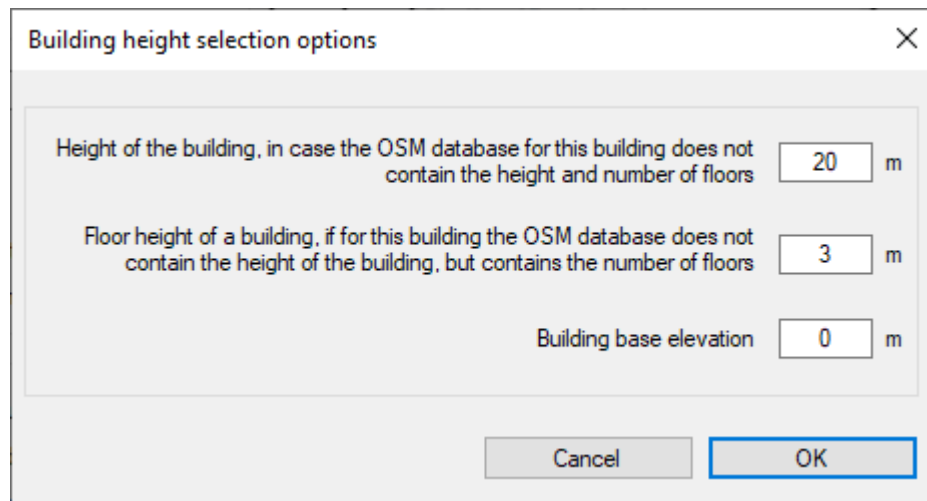
In EMF Planner, there are three ways to create a building layer:

1. Import of buildings from the database of OpenStreetMap (OSM) open project www.openstreetmap.org with the possibility of further additions/editing if necessary. A layer of buildings with height and number of floors is imported, which allows you to quickly get a 3D map model, bypassing the routine stage of manually drawing buildings. This greatly speeds up the data preparation stage.

2. Import building from a KML file

3. Drawing buildings - Manual digitization of the building's contours from the base map, with manual input of the height of buildings.

Import from OpenStreetMap Database

To import a layer of buildings from the OpenStreetMap database within the screen boundaries, click on the button [⬆️] "Load building polygons within the screen area from the OSM database". You should not select an area with a size much larger than necessary for calculations, as this may slow down the speed of work. A window will appear warning that all missing buildings within the screen will be loaded from the OSM database. This is done in order to be able to supplement the previously loaded buildings, the height parameters of which have already been edited by the user. If a building has already been loaded earlier, then, provided that the contours of the building have not changed, it will not be loaded from the database (because the height, number of floors and the base elevation mark of the building can be already edited). Then a window will appear with a choice of parameters for the height of buildings. The database of the OpenStreetMap project more often contains information about the number of floors of a building than information about its height in meters, so if the height of the building is not explicitly specified in the OSM database, then during import it is determined by the number of floors and the height of one floor. In the same window, you must specify the height for buildings whose information about the number of floors is not available in the OSM project database. In addition, here you can enter the base elevation for all imported buildings.
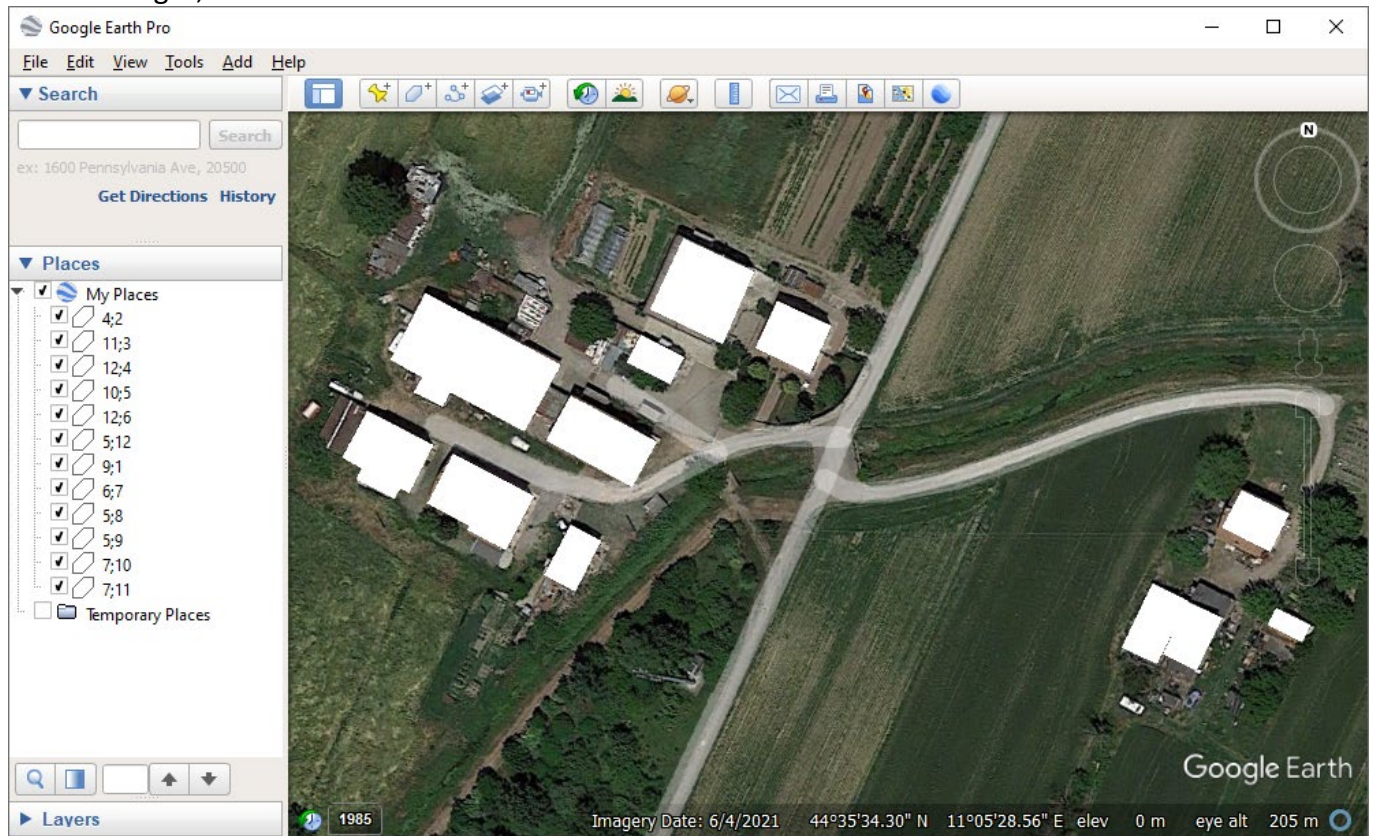

Building height selection options

Import from KML file

The software also allows you to import a building layer from a custom dataset via the KML format. In order to get building heights and labels, they must be specified in the name of each building polygon in the format: height; label.

Building polygons in KML

Drawing buildings

Use Building drawing tool [icon]. The last segment will appear automatically when you click the right mouse button. After drawing, specify the parameters of the building.

Terrain

If the area around the site has a terrain with a significant difference in elevation, then it should be taken into account in the calculations.

In the Terrain menu, EMF Planner allows you to digitize the terrain using a fairly simple built-in toolkit. It allows you to specify the parameters of contour lines and elevation points on the map, after which a digital elevation model will be built using the triangulation method.

Strictly speaking, it is impossible to turn off the use of terrain in the EMF Planner, but by default the height of all terrain points is 0, that is, all buildings are located, as it were, on "flat" terrain with one elevation equal to 0, and if you do not need to take into account the height difference on the map, then you can not enter the Terrain menu.
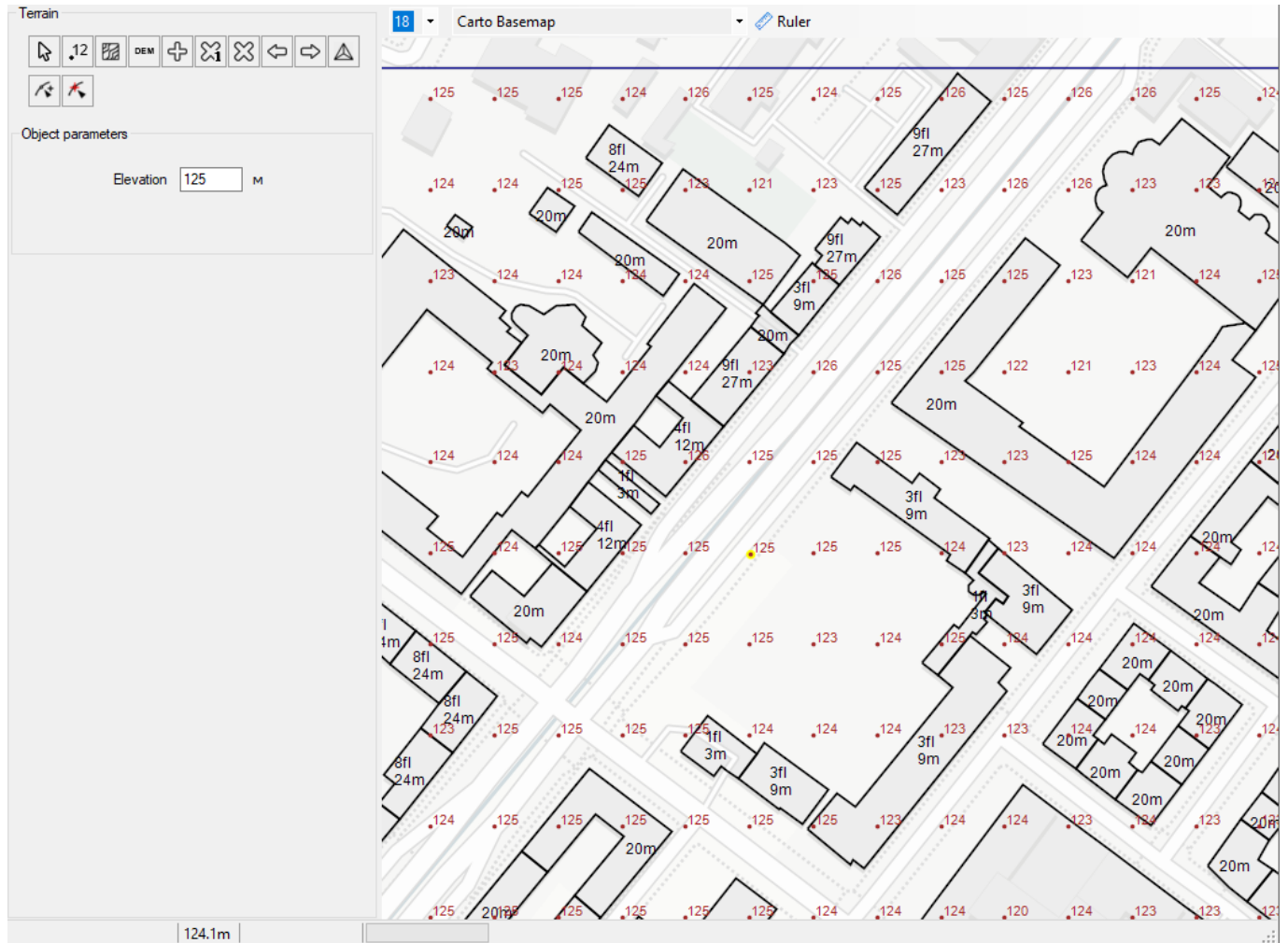
Terrain Menu

Toolbar:

     Select object (elevation point or elevation contour)

     Add elevation

	Add elevation contour
	Use DEM data as terrain elevation
	Create a copy of the selected object
	Delete selected object
	Delete all objects
	Undo
	Redo
	Show triangulation result
	Add node on selected elevation contour
	Delete node on selected elevation contour

To draw a contour line, press the button (Add terrain contour line) and draw the contour line with a mouse click (to finish drawing, click the right mouse button). Then you need to specify the elevation of the contour. To complete the work of drawing contour lines on the situational plan, double-click with the right mouse button, and you will switch to the Object Selection tool.

In addition to terrain contours, you can add terrain elevation points to the map. To do this, press the button (Add terrain elevation), then specify the location with the mouse and enter the value of the elevation.

Both contour lines and point elevations can be selected, moved with the mouse, and deleted with Delete.

The program allows you to quickly create a terrain model from an automatically loaded DEM. To do this, set the screen area of the desired size (the elevations will be loaded within the screen boundaries) and click the button. After that, the entire existing terrain on the situational plan will be deleted (if it has already been created by that moment) and elevation data will be loaded onto the entire screen area. These elevations can be manipulated as if they were manually created – they can be moved, edited and deleted.

After all the necessary horizontals and (or) individual elevations of the terrain are marked, click on the button (Show triangulation result), after which a digital elevation model of the terrain will be built,

triangulation triangles will appear on the situational plan, and at the bottom in the status bar, along with current coordinates will display information about the height of the terrain at the location of the mouse pointer. Triangulation is also performed automatically when you exit the terrain panel.

Enabling/disabling the display of terrain contours on the map is performed in the "Display Options" panel located under the main menu.

Lines and Labels

In this menu, you can add linear objects (roads, barriers) and point objects to the map - labels and a schematic representation of antenna towers.

Toolbar:

⌖	Select object (line or label)
⬇	Load polylines of roads and railings within the screen from the OpenStreetMap database
🖉	Add road
---	Add a barrier
T	Add a label
✚	Create a copy of the selected object
✖	Delete selected object
✖	Delete all objects
⇦	Undo
⇨	Redo
⚲	Add node on selected line
⚲	Delete node on selected line

⚡ Break knot on selected line

← Move all objects by one pixel

EMF Planner allows download roads and barriers from the OpenStreetMap database. To do this, set the desired area of the screen and click on the download tool on the toolbar.

To draw a road or a barrier manually, click on the corresponding tool and draw the object with a mouse click (to finish drawing the object, click the right mouse button). Then enter the parameters of the object - the type and thickness of the lines. In the selected object, you can drag nodes with the mouse. In the selected object, you can also delete, break, and also add nodes - to do this, click on the corresponding tool, and then on the desired node on the object or on the place on the object where you want to add a node.
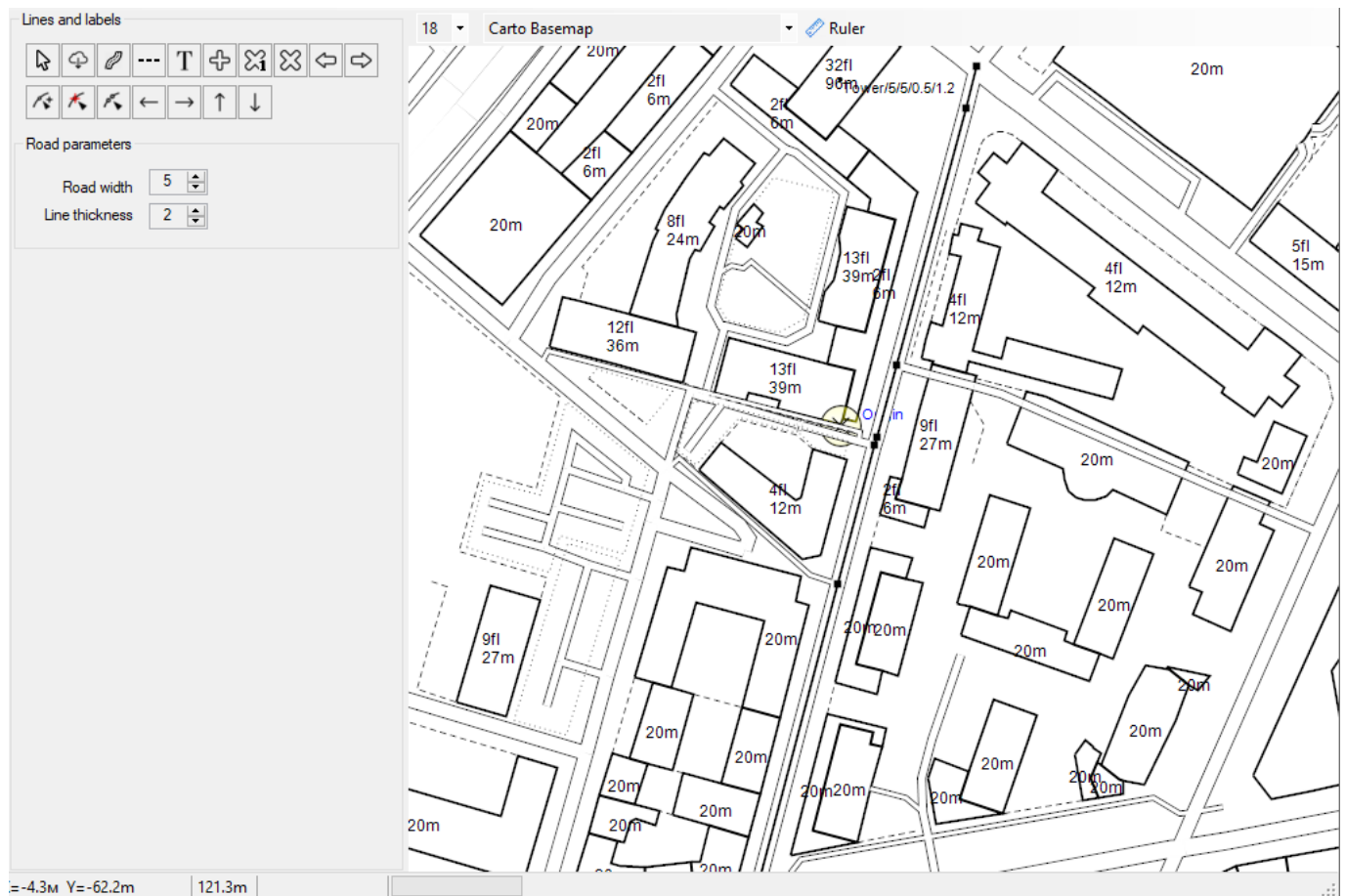
Road Drawing

In addition to lines, labels can be added to the situational plan. To do this, click the button **T** (Add label), then point the mouse at the place and enter the text. If you now click somewhere else on the screen, this label will also appear there. In the window that appears, you can change the label parameters.

Using the toolbar, you can also delete, duplicate selected objects, and move all objects.

The parameters for displaying lines and labels on the map are controlled in the "Display Options" panel located under the main menu.

Drawing antenna towers on the map

EMF Planner allows to map antenna towers - towers / masts located on the ground or supports on the roofs of buildings, after which these structures will appear on vertical cuts and 3D visualization.

In order to install the antenna support, you need to create a label in this place with a special code like Tower/H1/H2/L1/L2, where H1,H2,L1,L2 are the parameters of the antenna tower:
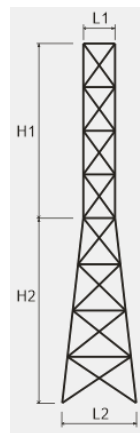
Antenna tower parameters

If H2=0, then the antenna tower takes the form of a rectangular prism. If the antenna tower falls into the contour of a building, it will mean that it is located on the roof of this building.
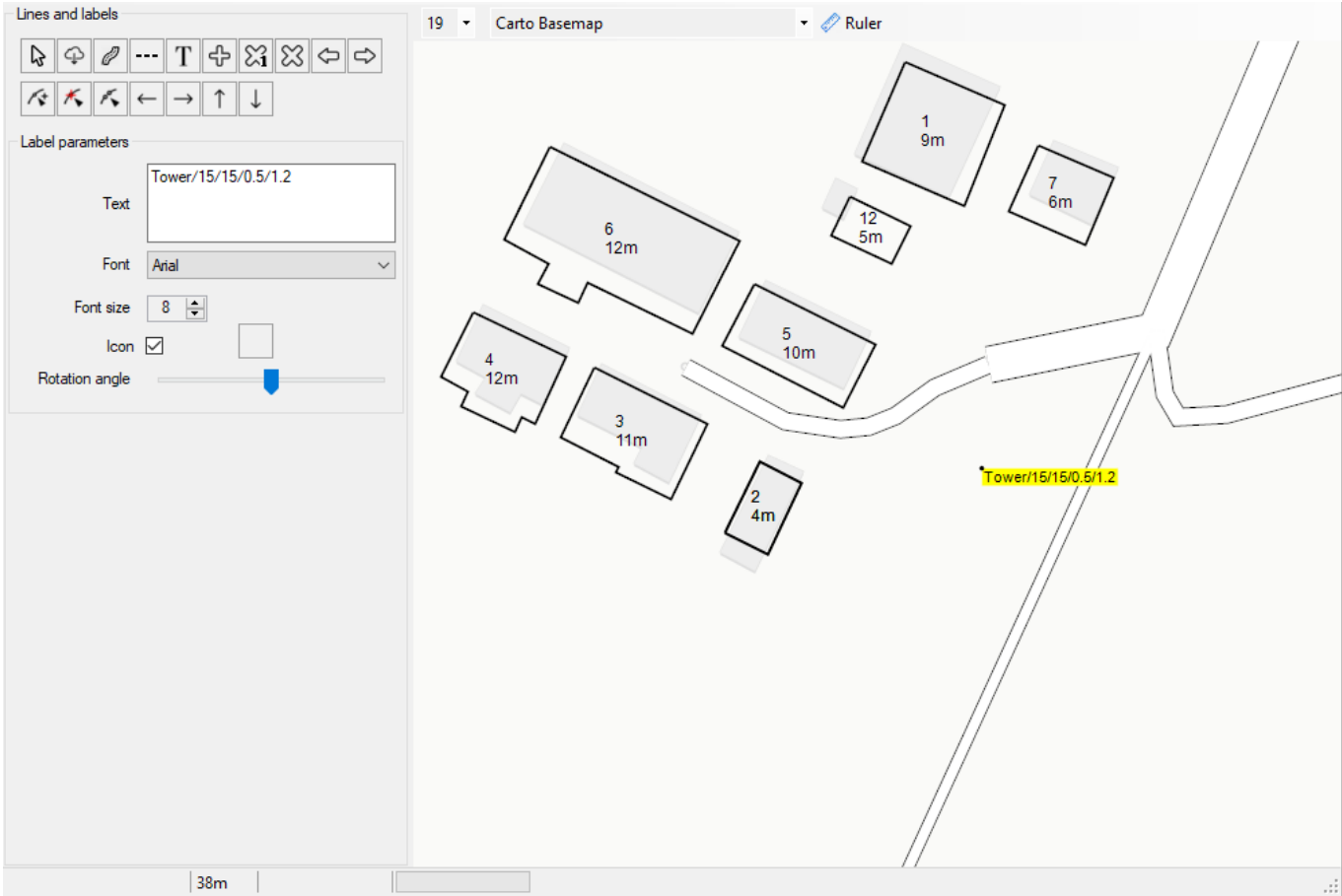
Drawing antenna towers on the map
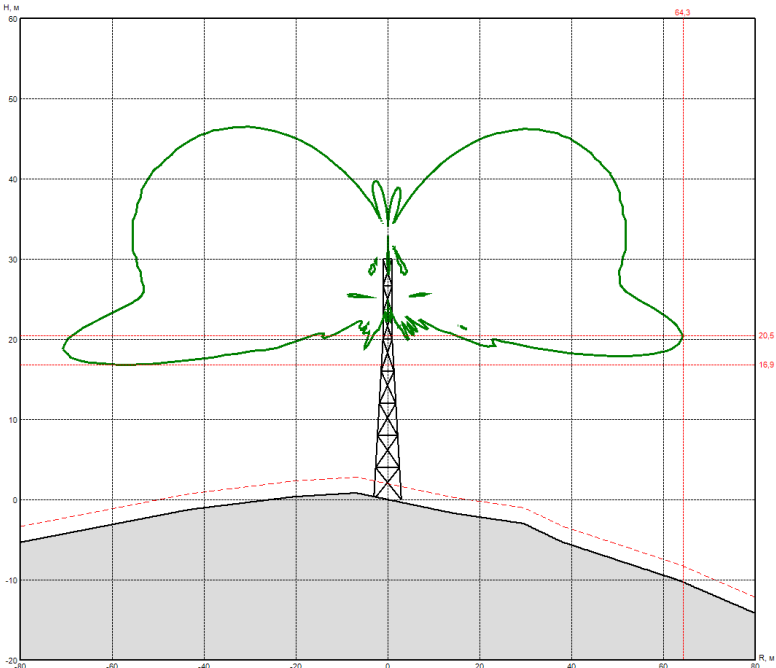
Antenna tower on the ground in a vertical cut

Performing calculations

Vertical Cuts

The calculation is performed for cuts marked as active in the list. You can select multiple checkboxes at once with the mouse and then enable or disable them.

Vertical Cut

Toolbar:

	Fill in the list of vertical Cuts by azimuths of antennas of active radiating sources
	Fill in the list of vertical Cuts according to the azimuths of the active radiating sources antennas, taking into account bidirectional antennas, for which the direction of the Cut will be determined by the radiation pattern maximums

+	Add additional vertical cuts in a range of angles from the origin
≡	Sort Cuts by azimuth
1)))	Calculation of all active vertical Cuts with grid №1
2)))	Calculation of all active vertical Cuts with grid №2
1)	Calculation of the selected vertical Cut with grid № 1
2)	Calculation of the selected vertical Cut with grid № 2
o⋮	Reduce the length of the Cuts according to the results of the calculation
ö	Reduce the height of the Cuts according to the results of the calculation
◇	Delete all dimension lines for all Cuts
W	Reports for vertical Cuts

Display Options: Set Display Options for Vertical Sections

The list of vertical cuts can be generated automatically for each of the radiation sources by pressing the button "Fill the list of vertical cuts with the azimuths of antennas of active radiation sources". The planes of each of these cuts pass through the corresponding source in the direction of its radiation. The list itself, as well as individual parameters of each of the cuts, can be edited. At the bottom of the window there is a figure explaining the cuts parameters.

Using the buttons on the toolbar, you can perform the calculation in all or in individual cuts with different grid (1 or 2) at once. The calculation results for the cut will be displayed on the right when you click on the line of the corresponding cut.

After changing the vertical cut calculation parameters in the table, recalculation does not occur automatically so that the parameters are applied - perform the calculation in this cut (or cuts).

On the image of cuts, the characteristic measurement lines (dimensions) will be shown in red. The display of these lines can be controlled on the left in the Display Options menu. The user can add additional measurement points using the context menu that appears when the right mouse button is clicked on the image of the vertical cut.

Horizontal Cuts

There are two types of calculation for horizontal cuts:

1. Calculation for one exposure limit for different heights. In this case, the user can select the color and line type for cuts at different heights.

2. Calculation for several exposure limits for the same height or for the projection of a cut set at the terrain. In this case, the cut color is given by the color of the corresponding exposure limit. If one height is given, then the cut will be made exactly at that height. If several heights are specified, then the maximum impact area from this range of heights will be projected onto the terrain.
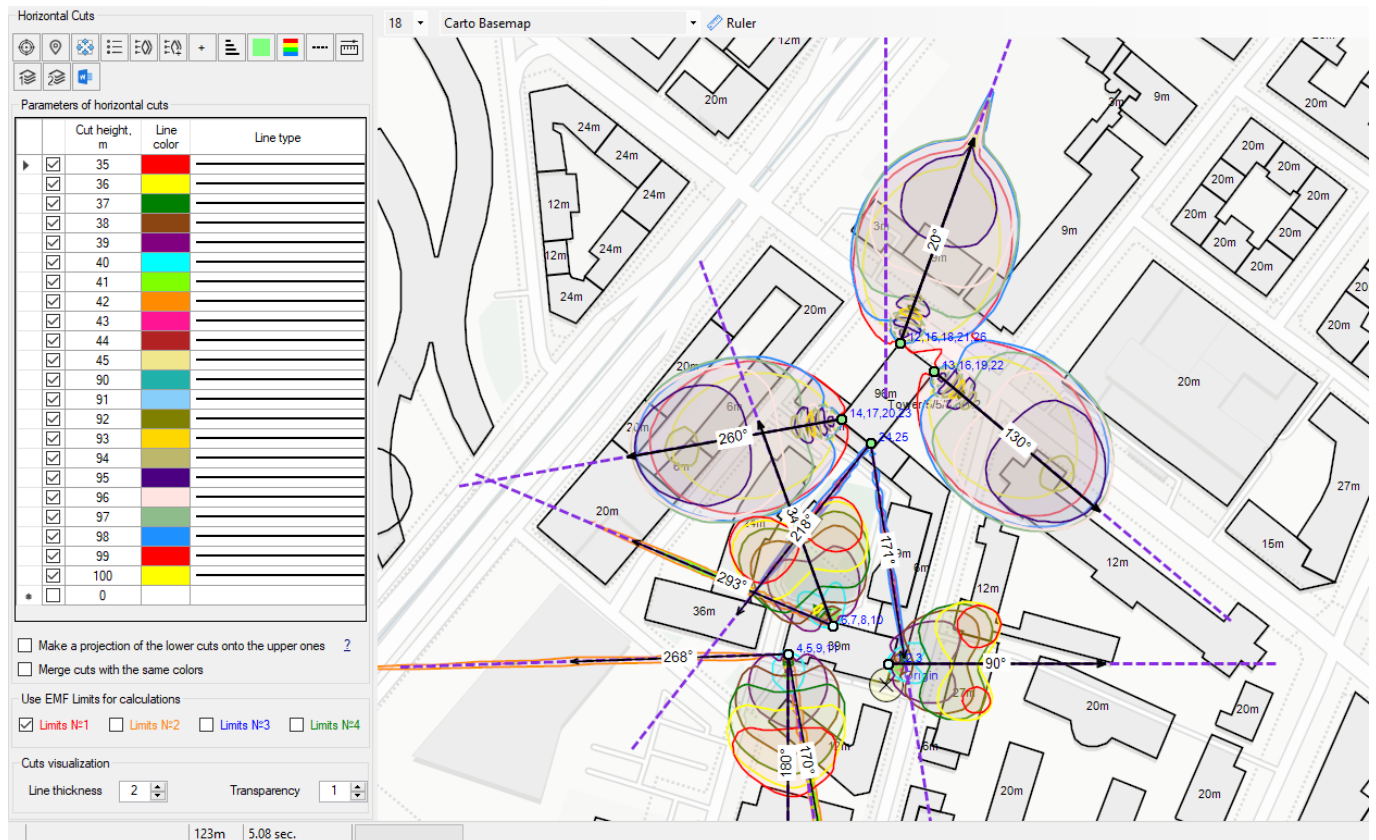
Calculation for one exposure limit for different heights

Toolbar:

     Display the calculation area in the center of the screen

⊙	Move the calculation area to the center of the screen
⊕	Set the size of the calculation grid relative to the origin
☰	Fill in the list of horizontal cuts with the heights of antennas of active radiating sources
⋮◊	Add to the list of horizontal cuts the heights of the maxima of vertical cuts (if a calculation has already been performed in vertical cuts)
⋮◊₊	Add to the list of horizontal cuts the heights of the maxima of vertical cuts + addition (if the calculation has already been performed in vertical cuts)
+	Add cuts with heights in the specified range
≡	Sort the list of cuts by height
🟩	Set one color for the selected Cuts (the color is taken first in the selected list)
🌈	Set different colors for all cuts
----	Set different line types for all cuts
📏	Set vertical Cut along the ruler (if the ruler is active)
⧉	Calculation of horizontal cuts with grid №1
⧉	Calculation of horizontal cuts with grid №2
W	Reports for horizontal cuts

The calculation is performed for cuts marked as active in the list. You can select multiple checkboxes at once with the mouse and then enable or disable them.
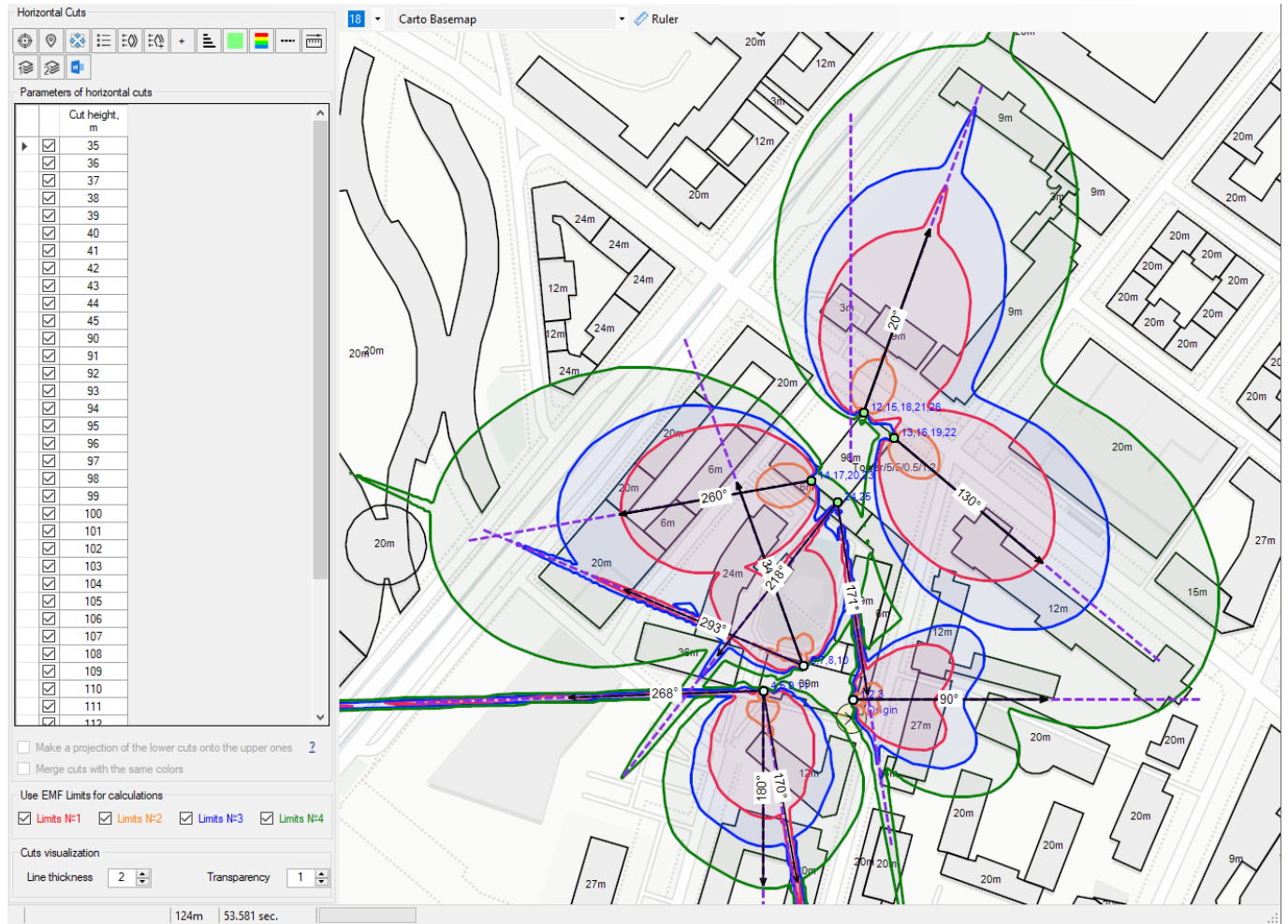
Calculation for several exposure limits for the same height or for the projection of a cut set at the terrain

The blue color on the map shows the boundaries of the grid in which the calculations of horizontal cuts will be performed. Resizing this grid is done by shifting its borders with the left mouse button or using the ![icon] "Set the size of the calculation grid relative to the origin" tool. For the correct display of the background of the cuts, it is necessary that this section be entirely in the calculation grid.

The table "Parameters of horizontal cuts" contains a list of heights for which calculations will be performed. The calculation will be performed only for cuts marked as active. The number of cuts, their heights, as well as the background color and line type for cut contours can be changed in the table. To delete several cuts in the table at once, select them with the mouse pointer and press Delete. Click on the button "Fill in the list of horizontal cuts with the heights of antennas of active radiating sources" to generate this list automatically by the heights of active radiating sources. The heights of the cuts are indicated from the origin. Before performing a calculation in horizontal cuts, it is recommended to first perform a calculation in vertical cuts so that you can use the tools ![icon] "Add to the list of horizontal cuts the heights of the maxima of vertical cuts" or ![icon] "Add to the list of horizontal cuts the heights of the

maxima of vertical cuts + addition ". The list of horizontal cuts formed using these tools will include heights with maxima in the area of exceeding the exposure limit.

Make a projection of the lower cuts onto the upper ones – an option that allows you to get the maximum exposure area in the drawing with the image of the horizontal cut without taking into account the possible reduction in the area of the upper sections.

Merge cuts of the same color - an option in which cuts of the same color, going in a row, overlap each other and shift to the height of the smallest cut.

The options "Make a projection of the lower cuts onto the upper ones", as well as "Merge cuts of the same color" are needed to visually represent areas with exceeded exposure limits in the drawing of horizontal cuts. For more accurate display of cuts, as well as for further 3D visualization, these options should be disabled.
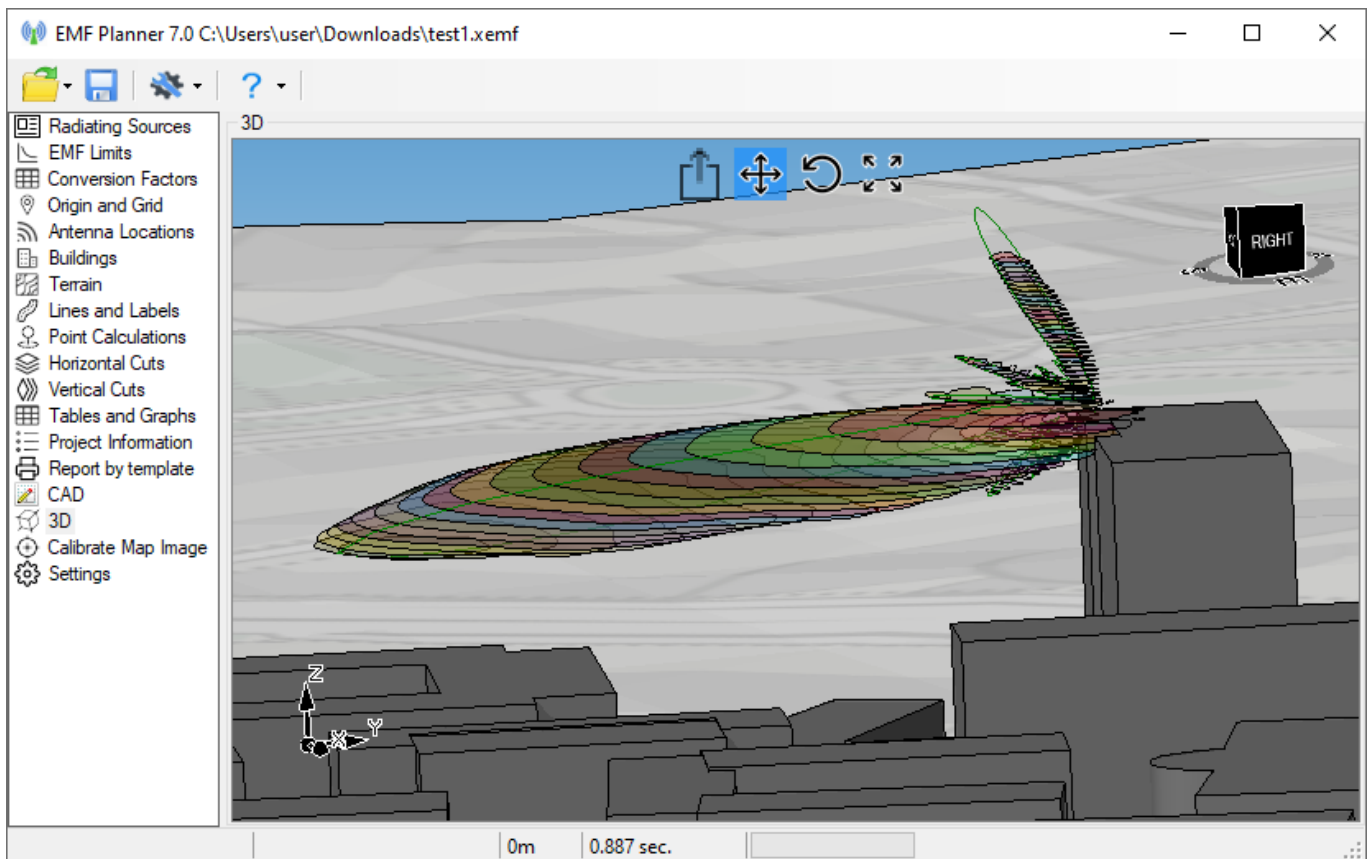
Calculation result with disabled options " Make a projection of the lower cuts onto the upper ones ", and " Merge cuts of the same color"
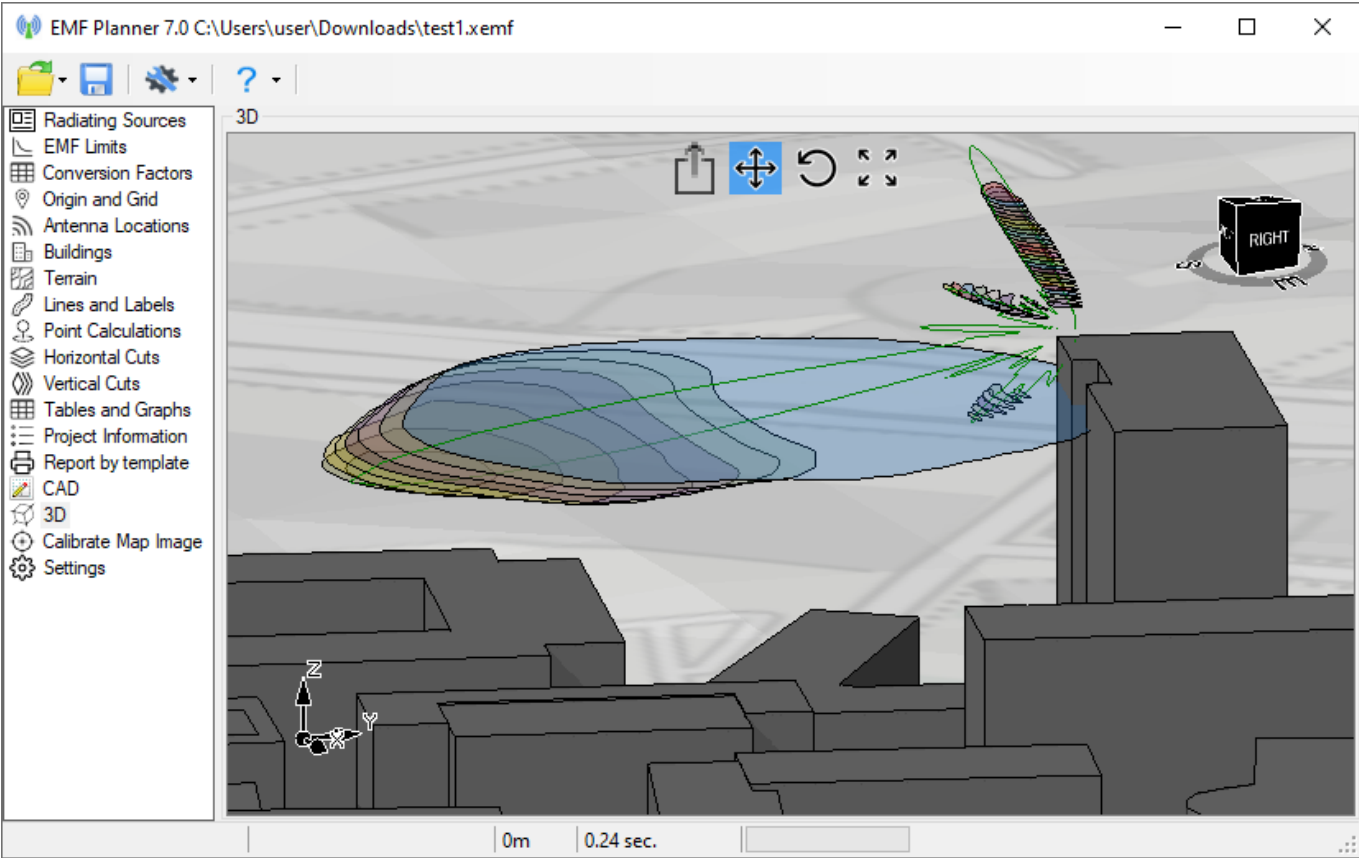
Calculation result with the option " Merge cuts of the same color " enabled
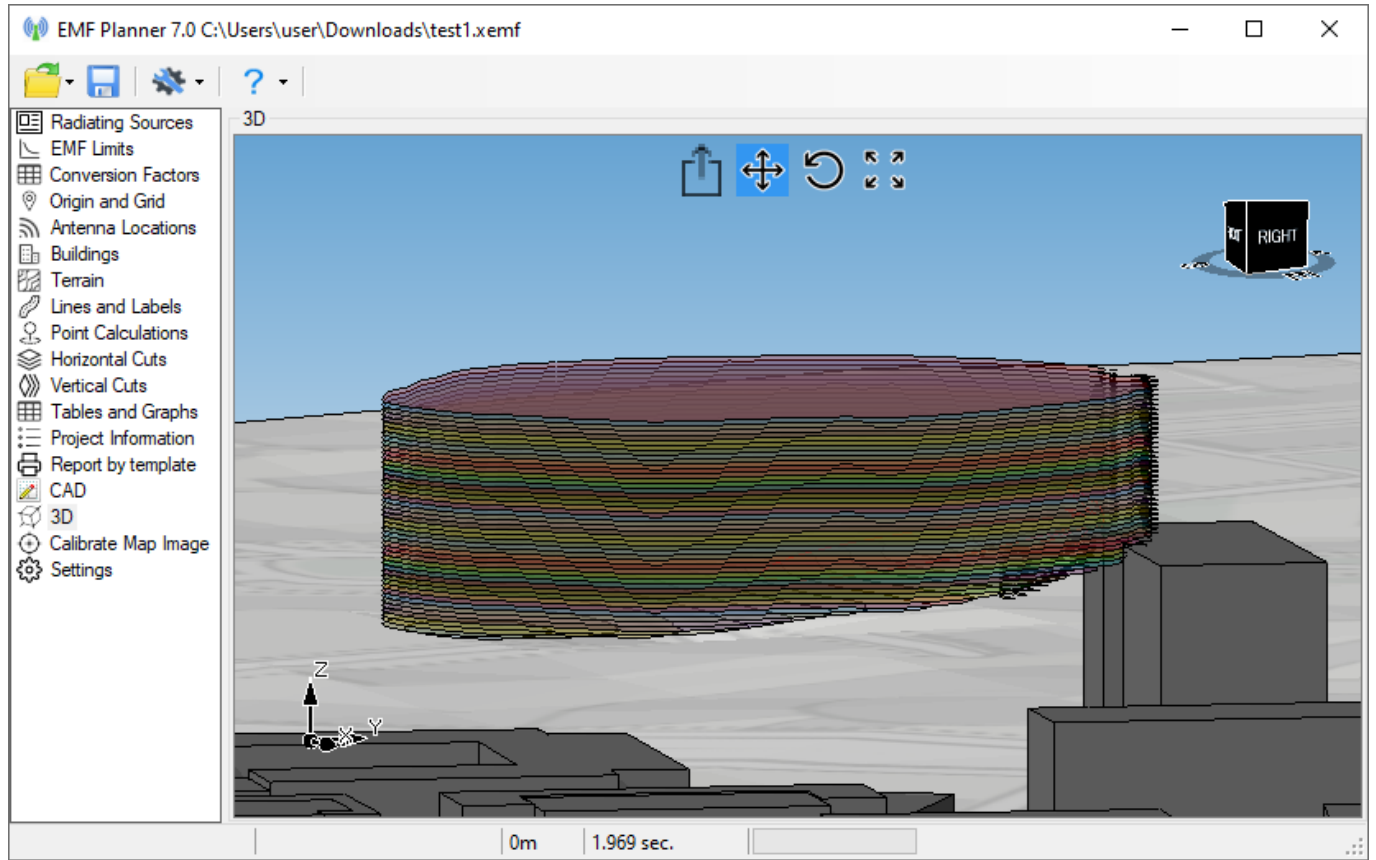
Calculation result with the option "Make a projection of the lower cuts onto the upper ones"

It should be taken into account that changing the state of activity of rows in the "Parameters of horizontal cuts" table, as well as the colors and types of the cut lines after the calculation, not only changes the display of the cuts, but also is the initial data for the next calculation. Therefore, we recommend that after changing the parameters in the "Parameters of horizontal sections" table, always perform a new calculation. After the calculation is completed, the result may change, because when using the options "Make a projection of the lower cuts onto the upper ones", and "Merge cuts of the same color", some sections affect others.

The parameters for displaying horizontal cuts on the map are controlled in the "Display Options" panel located under the main menu.

On the map, purple dashed lines show the projections of vertical cuts for which the calculation was performed. To quickly view the cut, click on the corresponding line, and a pop-up window with this vertical cut will appear on the screen.
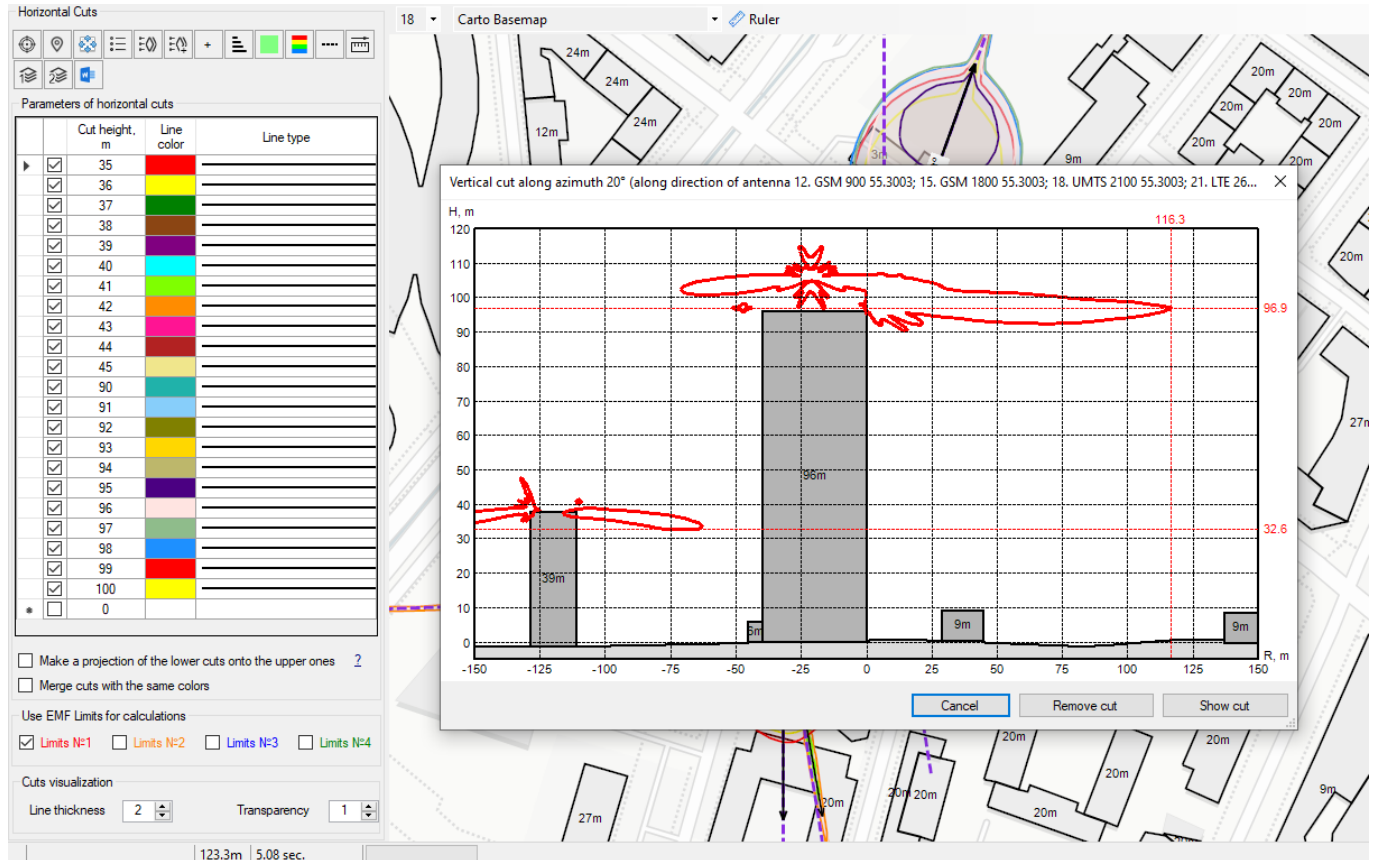
Quick view of vertical cut

You can quickly add a new vertical cut by specifying its location on the map. To do this, click on the Ruler tool, specify the location of the vertical cut with the ruler, and click on the [⊞]"Set vertical Cut along the ruler" tool.

Tables and Graphs

In this menu, you can get graphs and tables with the results of calculating the levels of the electromagnetic field and exposure based on the forms of standard aliases.
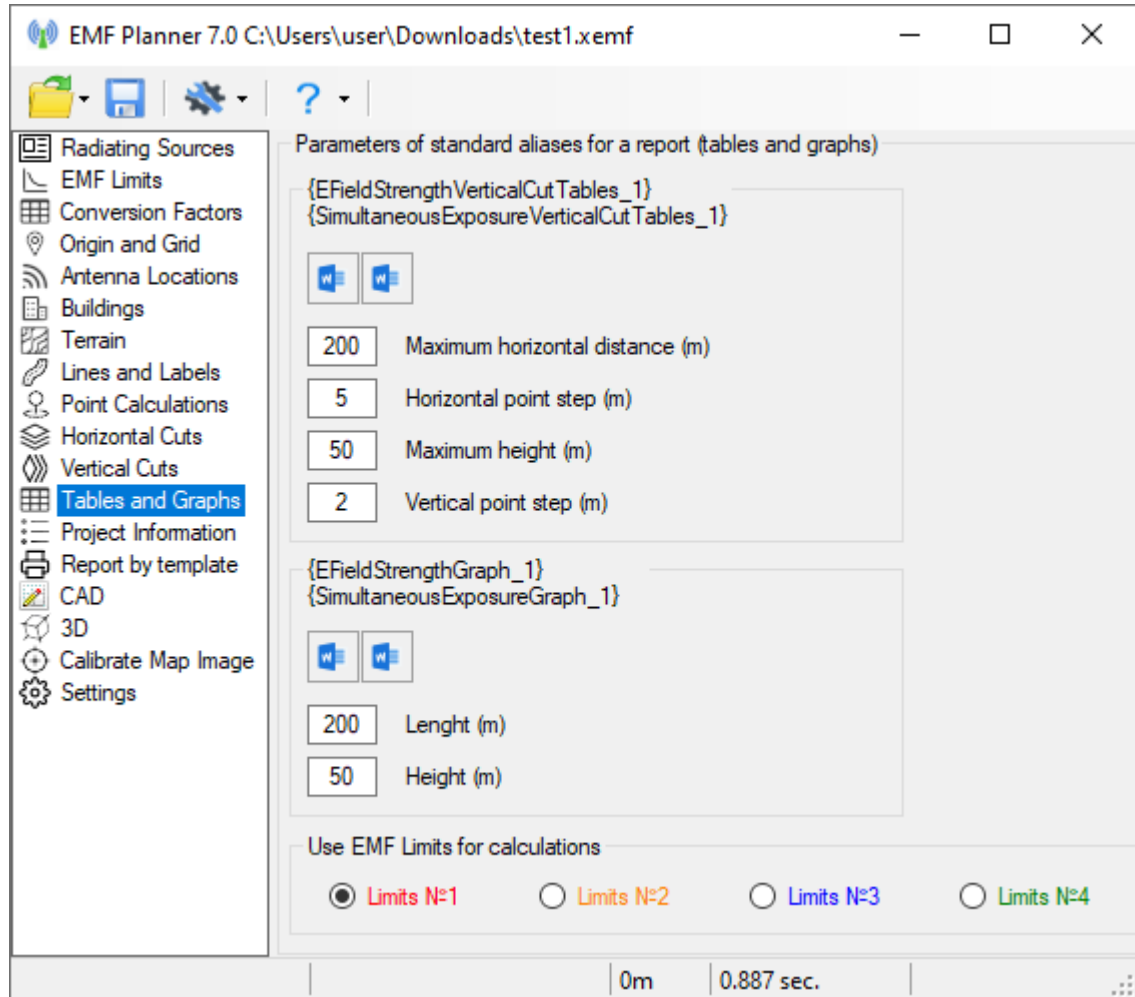
Tables and Graphs

Toolbar:

   Create a report in Microsoft Word

Simultaneous exposure (%)

- graph at hight 1.5 m along azimuth 60° (along direction of antenna №01. 900_60; 04. 2100_60)
- graph at hight 1.5 m along azimuth 125° (along direction of antenna №07. 23 GHz 0.6 HP)
- graph at hight 1.5 m along azimuth 130° (along direction of antenna №02. 900_130; 05. 2100_130)
- graph at hight 1.5 m along azimuth 220° (along direction of antenna №08. 18 GHz 0.6 HP)
- graph at hight 1.5 m along azimuth 290° (along direction of antenna №09. 23_1 GHz 0.6 HP)
- graph at hight 1.5 m along azimuth 320° (along direction of antenna №03. 900_320; 06. 2100_320)

E-field Strength (V/m)

- graph at hight 1.5 m along azimuth 60° (along direction of antenna №01. 900_60; 04. 2100_60)
- graph at hight 1.5 m along azimuth 125° (along direction of antenna №07. 23 GHz 0.6 HP)
- graph at hight 1.5 m along azimuth 130° (along direction of antenna №02. 900_130; 05. 2100_130)
- graph at hight 1.5 m along azimuth 220° (along direction of antenna №08. 18 GHz 0.6 HP)
- graph at hight 1.5 m along azimuth 290° (along direction of antenna №09. 23_1 GHz 0.6 HP)
- graph at hight 1.5 m along azimuth 320° (along direction of antenna №03. 900_320; 06. 2100_320)

Point Calculations

In this menu, you can get the result of calculating the EMF level and exposure at control points.

Control Points

Toolbar:

Icon	Description
⊕	Position the map to the selected point
◉	Move selected points to the center of the screen
⚲	Create a point in the center of the screen
⇧	Move Selected Point Group Up
⇩	Move Selected Point Group Down

[icon]	Move points that are less than 2 meters away from the antenna azimuth line exactly on the antenna azimuth line. The control points will appear exactly on the corresponding vertical cuts.
[icon]	Calculation at all points
[icon]	Calculation at a selected point for a range of heights
[icon]	Point reports

You can combine control points into several groups. This is done for convenience when working with large maps to separate control points located, for example, near different buildings. Groups can be made active or inactive (then they will be excluded from the calculation).

A control point can have one of three location types - Ground, Building, or Window. For Building or Window locations, the height of the control point will be referenced from the base elevation of this building. For the "Ground" location, the height of the control point will be measured from the terrain elevation at this point.

When calculating for control points of the "Building" or "Earth" types, the level of the electromagnetic field will be determined from all radiating sources that are not shielded by neighboring buildings, taking into account the set attenuation. If the control point is of type "Building", then the shielding of the building in which this control point is not taken into account.

For points of type "Window", the level of exposure will also be determined from all radiating sources that are not shielded by neighboring buildings, taking into account attenuation. Additionally, the location of this point inside the building near the window is modeled. This is done as follows - during the calculation, the wall of the building closest to this point is determined, and this wall is made "transparent" for those radiating sources whose direct rays enter the given point through this wall.

A control point can be created using the corresponding button on the toolbar or using the context menu on the base map. The control point can be moved by dragging it with the left mouse button, or removed by selecting it with the right mouse button on the situation plan. You can also change the location of the control point by entering the appropriate X and Y coordinates in the table. Control points can be deleted by selecting them in the table and clicking Delete.

Control point calculation results — □ ×

Radiating Source / Control Point	1.1.1	1.1.2	1.2.1	1.2.2	1.3.1	1.3.2	1.4.1	1.4.2	1.5.1	1.5.2	1.6.1	1.6.2	1.7.1	1.7.2
Location	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground
Height (m)	1.1 m	1.9 m	1.1 m	1.9 m	1.1 m	1.9 m	1.1 m	1.9 m	1.1 m	1.9 m	1.1 m	1.9 m	1.1 m	1.9 m
Elevation (m)	38.0 m	38.0 m	36.2 m	36.2 m	37.0 m	37.0 m	37.2 m	37.2 m	37.3 m	37.3 m	38.0 m	38.0 m	37.5 m	37.5 m
Simultaneous exposure (%)	0.0448	0.0433	0.0070	0.0044	1.2966	1.7337	2.0814	2.4654	0.1625	0.1111	3.2853	4.5338	0.3158	0.5388
Total E-field strength (V/m)	0.0635	0.0624	0.0252	0.0200	0.3416	0.3950	0.4328	0.4710	0.1209	0.1000	0.5437	0.6387	0.1685	0.2202
Total eq. plane-wave power density (W/m²)	0.0000	0.0000	0.0000	0.0000	0.0003	0.0004	0.0004	0.0005	0.0000	0.0000	0.0007	0.0010	0.0000	0.0001
001 E-field strength for 900_60 (V/m)	0.0034	0.0035	0.0006	0.0004	0.0564	0.0648	0.3596	0.4000	0.1053	0.0868	0.0070	0.0097	0.1565	0.2008
002 E-field strength for 900_130 (V/m)	0.0433	0.0445	0.0240	0.0174	0.2968	0.3409	0.1395	0.1552	0.0095	0.0079	0.0016	0.0022	0.0221	0.0283
003 E-field strength for 900_320 (V/m)	0.0020	0.0021	0.0038	0.0027	0.0055	0.0063	0.0187	0.0208	0.0519	0.0428	0.0927	0.1274	0.0226	0.0290
004 E-field strength for 2100_60 (V/m)	0.0016	0.0015	0.0011	0.0017	0.0227	0.0269	0.1857	0.1835	0.0247	0.0214	0.0483	0.0564	0.0534	0.0797
005 E-field strength for 2100_130 (V/m)	0.0460	0.0434	0.0062	0.0090	0.1574	0.1864	0.0607	0.0600	0.0029	0.0025	0.0126	0.0148	0.0060	0.0089
006 E-field strength for 2100_320 (V/m)	0.0045	0.0042	0.0017	0.0025	0.0052	0.0062	0.0034	0.0034	0.0109	0.0094	0.5334	0.6231	0.0051	0.0076
007 E-field strength for 23 GHz 0.6 HP (V/m)	0.0002	0.0002	0.0002	0.0002	0.0011	0.0012	0.0002	0.0002	0.0002	0.0002	0.0001	0.0001	0.0002	0.0002
008 E-field strength for 18 GHz 0.6 HP (V/m)	0.0003	0.0003	0.0008	0.0009	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
009 E-field strength for 23_1 GHz 0.6 HP (V/m)	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0003	0.0003	0.0002	0.0002

Calculation at all points

Calculation results for Control Point №1 (Control point group №1) — □ ×

Hights

Elevation at control point: 38 m

Hmin 1 m
Hmax 15 m
Step 1 m

[Refresh]

Graph of simultaneous exposure distribution by height

Table of distribution of simultaneous exposure and components by heights

Radiating Source / Hight (m)	1 m	2 m	3 m	4 m	5 m	6 m	7 m	8 m	9 m	10 m	11 m	12 m	13 m	14 m	15 m
Simultaneous exposure (%)	0.0450	0.0431	0.0420	0.0432	0.0446	0.0486	0.0536	0.0616	0.0749	0.0969	0.1330	0.1792	0.2438	0.3678	0.6661
Total E-field strength (V/m)	0.0636	0.0623	0.0615	0.0623	0.0633	0.0661	0.0694	0.0744	0.0821	0.0934	0.1094	0.1270	0.1481	0.1819	0.2448
Total eq. plane-wave power density (W/m²)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
001 E-field strength for 900_60 (V/m)	0.0034	0.0035	0.0037	0.0039	0.0041	0.0044	0.0047	0.0052	0.0058	0.0065	0.0074	0.0085	0.0097	0.0110	0.0126
002 E-field strength for 900_130 (V/m)	0.0432	0.0446	0.0463	0.0487	0.0513	0.0552	0.0597	0.0657	0.0730	0.0819	0.0930	0.1060	0.1211	0.1382	0.1578
003 E-field strength for 900_320 (V/m)	0.0020	0.0021	0.0021	0.0023	0.0024	0.0026	0.0028	0.0031	0.0034	0.0038	0.0044	0.0050	0.0057	0.0065	0.0074
004 E-field strength for 2100_60 (V/m)	0.0016	0.0015	0.0014	0.0013	0.0012	0.0012	0.0012	0.0012	0.0012	0.0015	0.0019	0.0024	0.0029	0.0041	0.0065
005 E-field strength for 2100_130 (V/m)	0.0462	0.0430	0.0400	0.0384	0.0365	0.0357	0.0348	0.0342	0.0367	0.0439	0.0567	0.0688	0.0840	0.1169	0.1855
006 E-field strength for 2100_320 (V/m)	0.0045	0.0042	0.0039	0.0038	0.0036	0.0035	0.0034	0.0033	0.0036	0.0043	0.0056	0.0068	0.0083	0.0115	0.0183
007 E-field strength for 23 GHz 0.6 HP (V/m)	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0003	0.0003	0.0003	0.0003	0.0004
008 E-field strength for 18 GHz 0.6 HP (V/m)	0.0003	0.0003	0.0003	0.0003	0.0004	0.0004	0.0004	0.0004	0.0004	0.0005	0.0005	0.0005	0.0006	0.0006	0.0007
009 E-field strength for 23_1 GHz 0.6 HP (V/m)	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0003	0.0003	0.0003	0.0003	0.0004

Calculation at a selected point for a range of heights

You can control the display of Control Points in the "Display Options" panel under the main menu.

Report by Template

In this menu, with one click of the mouse, you can get a complete report that includes everything you need - initial data, calculation results in the form of tables and graphics, as well as an explanatory note.

Local reports can be quickly obtained in the respective menus - Radiating Sources, Point Calculations, Horizontal cuts, Vertical cuts, Tables and Graphs. Local reports are alias, which are prepared by the developers of the EMF Planner. These are various versions of tables with initial data, as well as tables, graphs and drawings with calculation results. The specification of these bookmarks is given in Appendix 1. The list of aliases is constantly updated at the request of users.

The general report is generated based on a Microsoft Word template and can contain both standard and custom aliases.

Custom are aliases with the syntax of the form {Base station No.}, {Object placement address}, and so on. These are variables that the user places in the text of the report template, so that later, after the report is generated, they can be replaced with values from a specific project. The user himself determines what the alias name corresponds to in each project in the correspondence table {Alias name} = Alias text.

A Microsoft Word template (*.dot extension) is a document used as a template for creating new documents. A template can contain its own style, formatting, arbitrary text, and embedded aliases.
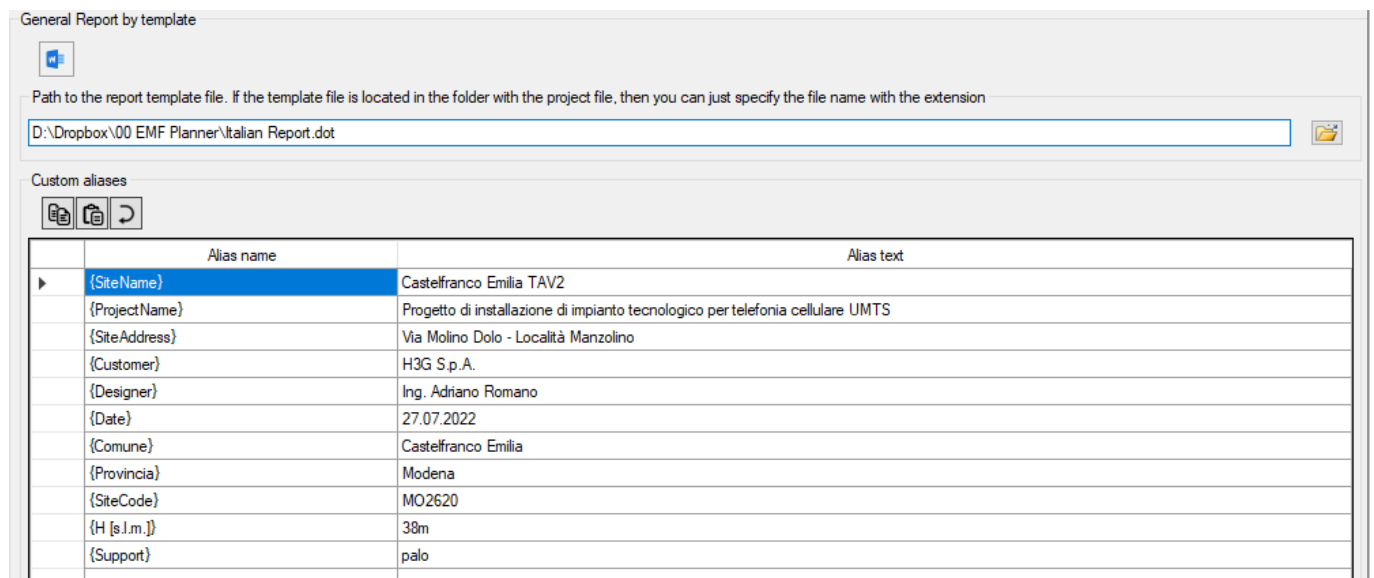
Custom aliases

Toolbar:

Create a general report from a Microsoft Word template

Show a list of standard aliases for a general report

Path to the report template file. If the template file is located in the folder with the project file, then you can only specify the file name with the extension. **The template file must be in a Microsoft Office trusted location!**

Custom aliases Toolbar:

Copy alias set to clipboard

Paste a set of aliases from the clipboard

Restore the original set of custom aliases

The procedure for preparing a general report:

1. In the "Custom aliases" table, specify the names and corresponding text for custom aliases. Custom aliases can be copied from project to project using the corresponding toolbar buttons.
2.   Familiarize yourself with the specification of standard aliases in the menu Report by template - List of standard aliases (see Appendix 1).
3. Create a report template with the *.dot extension, placing the names of custom and standard aliases in the template at your discretion. When generating a report, instead of these aliases, the EMF Planner will insert the corresponding data. Along with the program distribution kit, in the Templates folder, there are several *.dot templates prepared by us, on the basis of which the user can create his own templates.
4. Specify the path to the template file
5. Click the Create report button

Export to CAD

EMF Planner allows you to export the results of calculations in horizontal cuts to a DWG or DXF AutoCAD file with separation by layers.
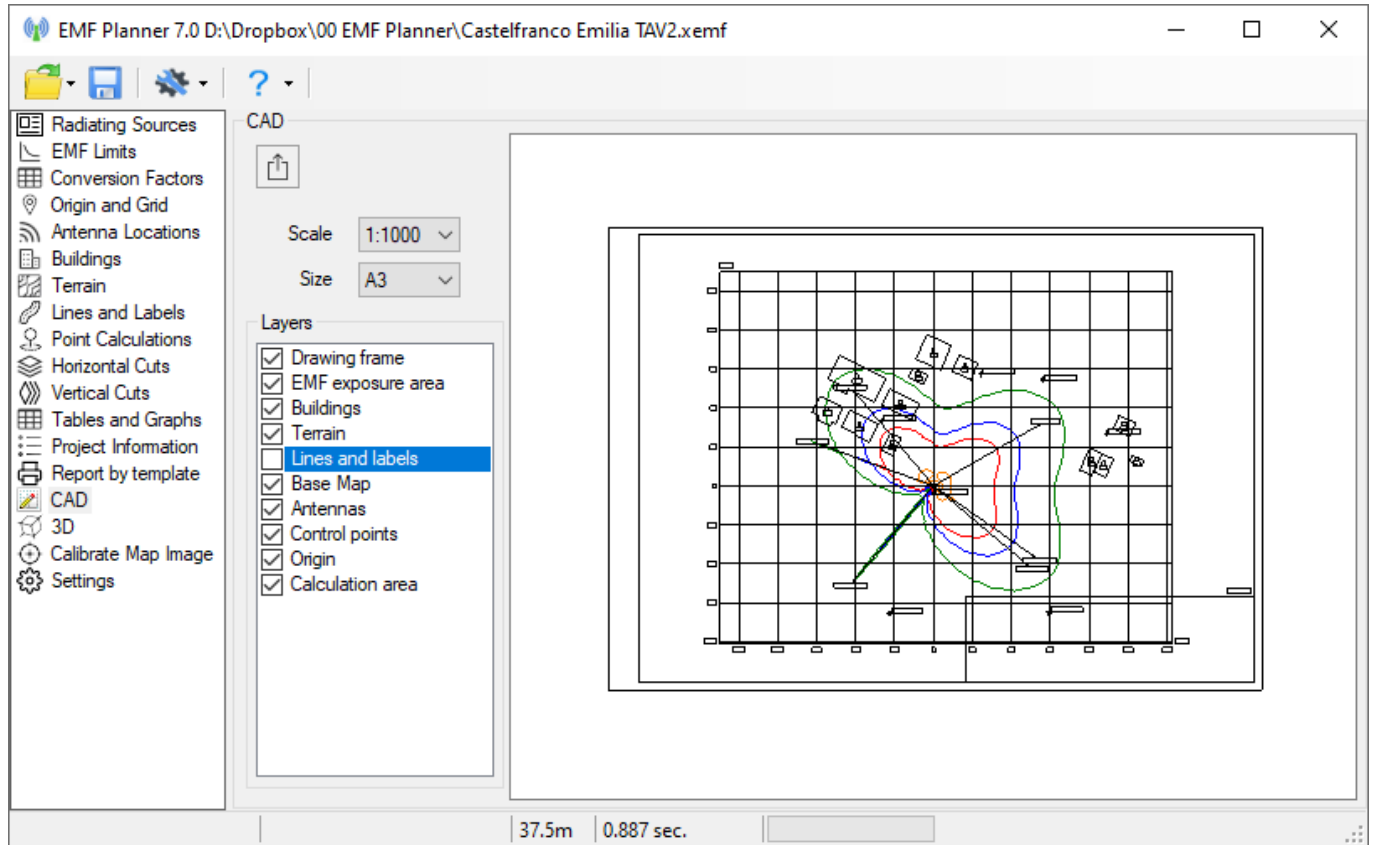
Export to DWG/DXF CAD file

Toolbar:

	Export horizontal cuts drawing to DWG/DXF file
Scale	Selecting the drawing scale from the drop-down list
Size	Selecting the paper size

Select the layers you need, sheet format, drawing scale and click "Export drawing to DWG / DXF file". The selected elements will be saved in different layers of the CAD file.
When exporting, the base map will be saved in the drawing file with the current zoom, so in order to get a high-quality image of the base map, you should set a large zoom (it may take additional time to load the base map).

3D visualization

EMF Planner allows you to perform 3D visualization of the calculation results of exposure area cuts, maps with buildings, roads, terrain and antenna supports. 3D visualization allows the user to view the shape of the exposure area in detail from different sides, taking into account all the surrounding structures. The resulting 3D visualization can be exported to PDF format.

To create a 3D visualization, perform the calculation in vertical and horizontal cuts and then go to the 3D visualization menu. When calculating in horizontal cuts, the options "Make a projection of the lower cuts onto the upper ones" and "Merge cuts of the same color" must be disabled.

In order for the 3D visualization of the expose area to look more voluminous, the horizontal cuts must be evenly and quite often distributed over the heights.

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 up right 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.

To export 3D visualization to an interactive pdf file, click on ⬆.

Please pay attention! If you are unable to make a 3D visualization, then most likely due to the fact that there are elements of the old project that are far from the calculation area. This often happens when the user makes his project based on a sample. Please remove these elements using the tool on the top toolbar:
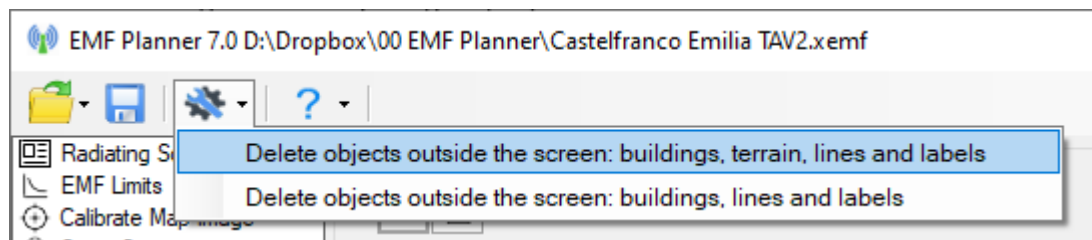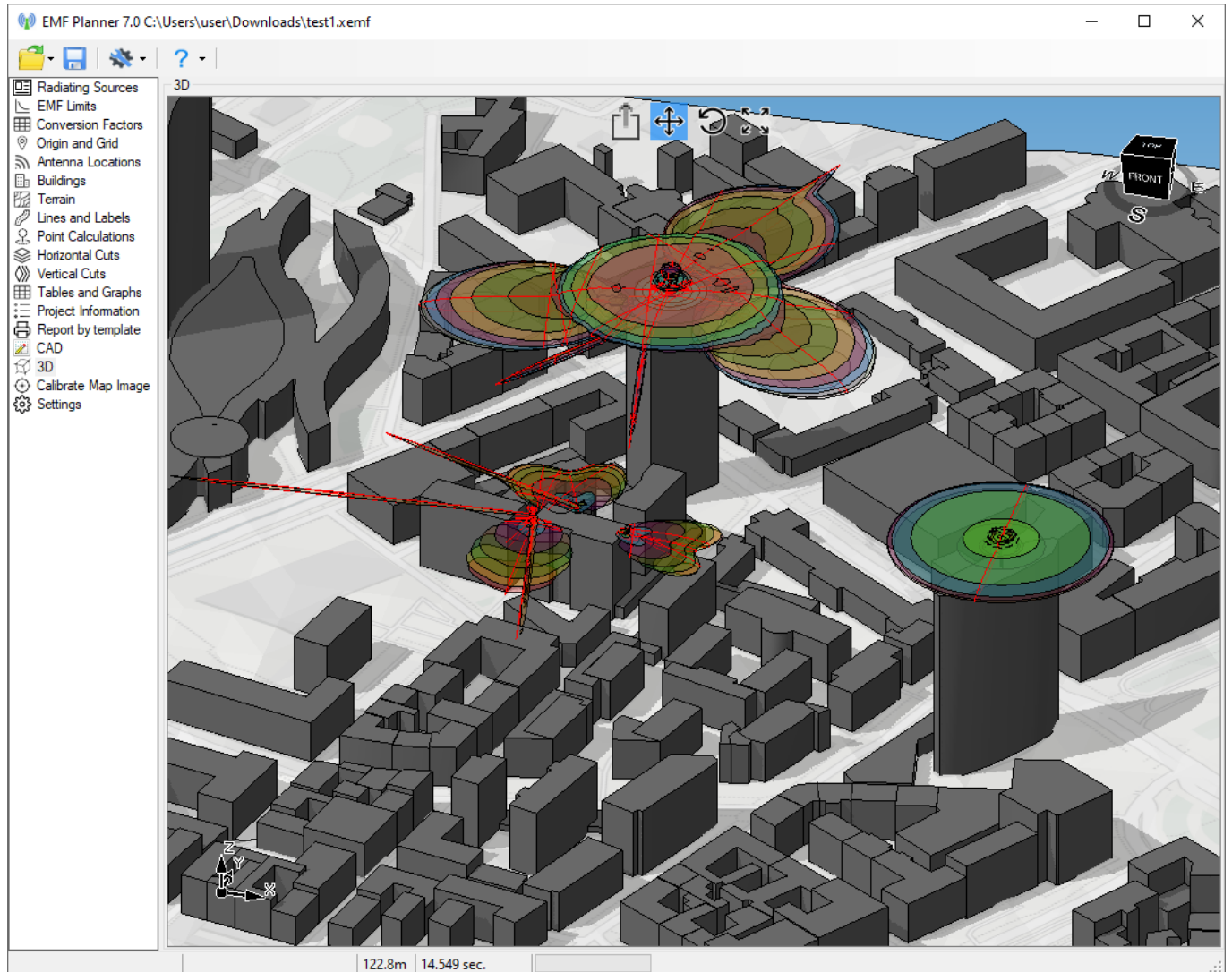
3D visualization

Settings

This menu allows you to configure some project and application settings.

Settings

Reflection coefficient k=1-1.6	Electric field strength reflection coefficient k=1-1.6
Maximum matrix size	The maximum size of the matrix side, which is reserved in memory for calculations in cuts (50...1000). Small matrix size - for rough (fast) calculation, large size - for precise calculation (slower)
Path to the map cache folder	The path to the folder where downloaded base map tiles will be saved for quick access. This will speed up the application. The downloaded maps will remain on your computer and you will be able to view them when you do not have an Internet

	connection. This folder is created automatically when the application is launched for the first time. You can change this folder.
Path to the folder with antenna pattern files (to display the list of antenna patterns)	Path to the folder with antenna patterns. When selecting the antenna pattern from the list, the user will have the opportunity to familiarize himself with the pattern of any antenna before selecting it.
Proxy Settings	If you are using a proxy server to access the Internet, enter its IP-address and port number. If the proxy server requires authentication, enter the username and password.
Owner list	List of owners of radiating sources for quick selection. This list will appear when you click in the "Owner" column in the "Radiating Sources" windows.

Coordinate Format	Geographic coordinate format:
	  - Decimal Degrees (N44.345678 W134.567893)
	  - Degrees, Minutes, Seconds (N44^0 34' 23.7'' W134^0 29' 23,4'')
	  - Degrees, Decimal Minutes (N44^0 34.2356' W134^0 29.2354')

Base map settings	You can configure your own custom base map by specifying a tile server URL.

Appendix 1. List of standard aliases

{Coordinates}

Site coordinates set in the "Origin and Grid" menu.

Sample:
N44°35'36.2" E11°05'30.2"

{AntennaPatterns}

Antenna Pattern and main characteristics

Sample:

Antenna 742265V02 (G = 18.3 dBi, f = 2100 MHz)
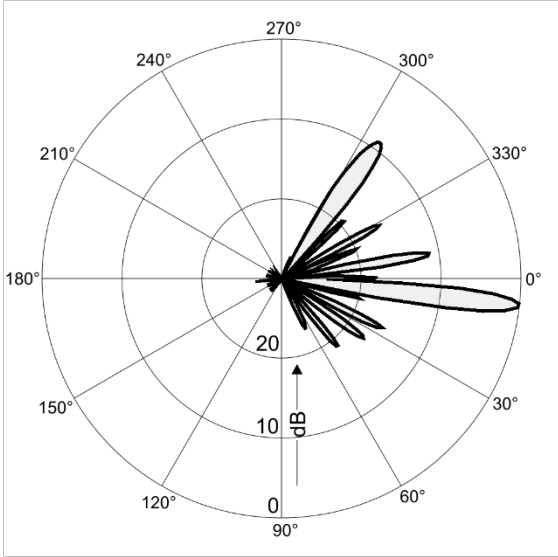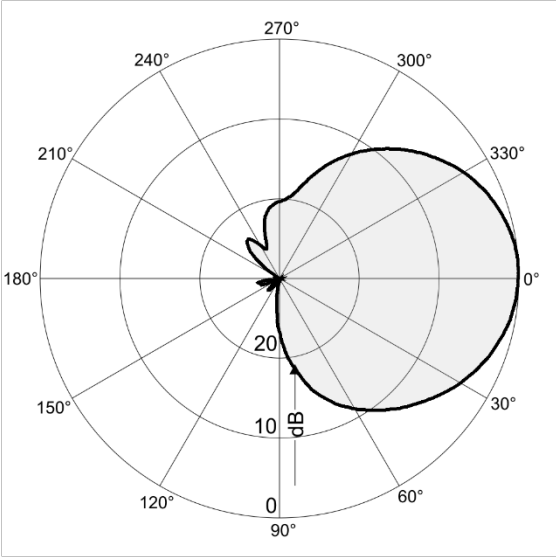
{HorizontalCutsA4_1}

Horizontal cut for A4 format

Sample:
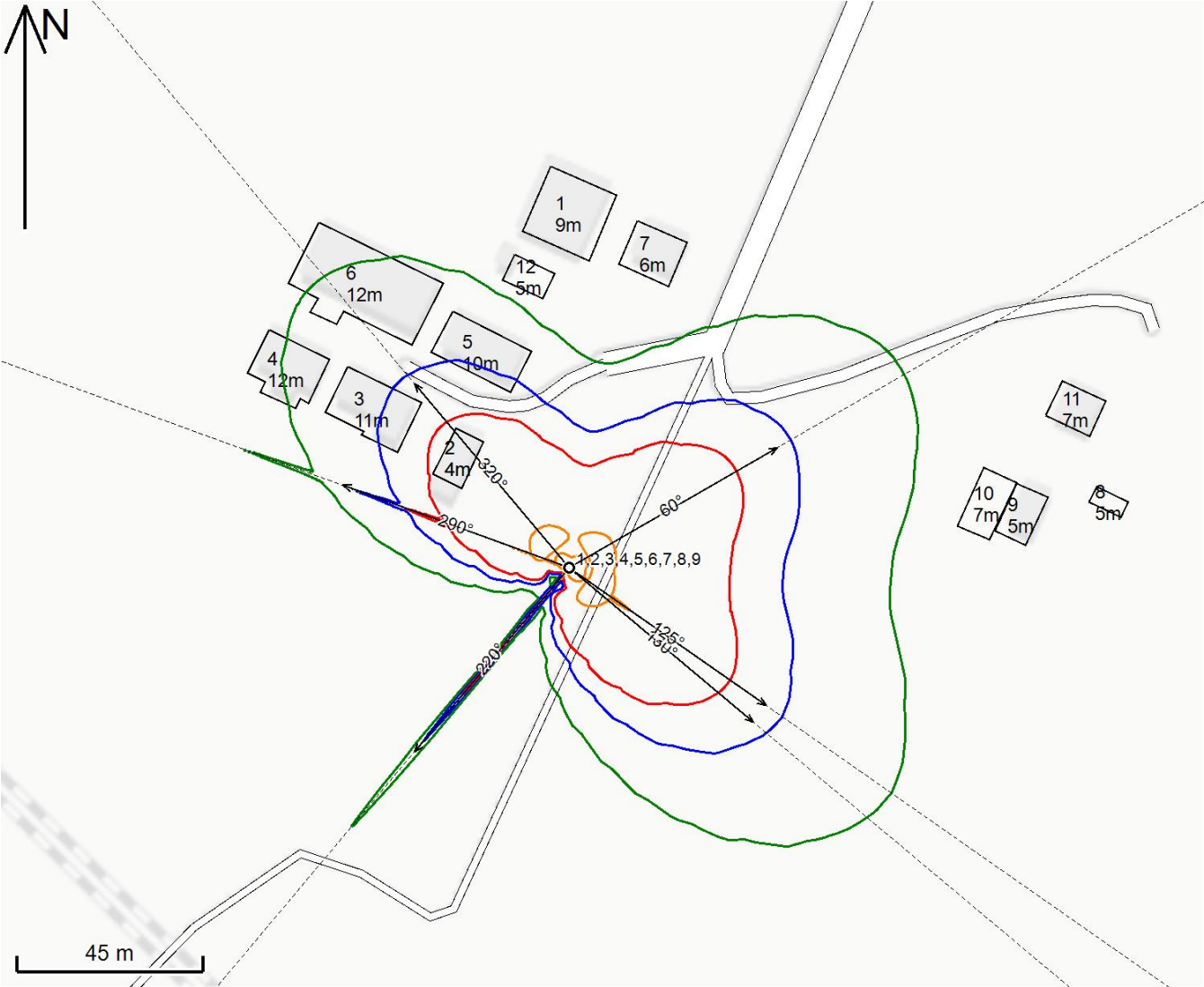
🟥	- Inside buildings and/or every space with people might stay continuously more than 4 hours (garden, terrace, balcony, etc)
🟧	- Every space with people usually stay continuously less than 4 hours (streets, open fields, etc)
🟦	- 75% of EMF Limits №2
🟩	- Full safety value

{VerticalCuts_1}

Vertical cuts in all azimuths for A4 format

Sample:

Vertical cut along azimuth 130°
(along direction of antenna №02. 900_130; 05. 2100_130)
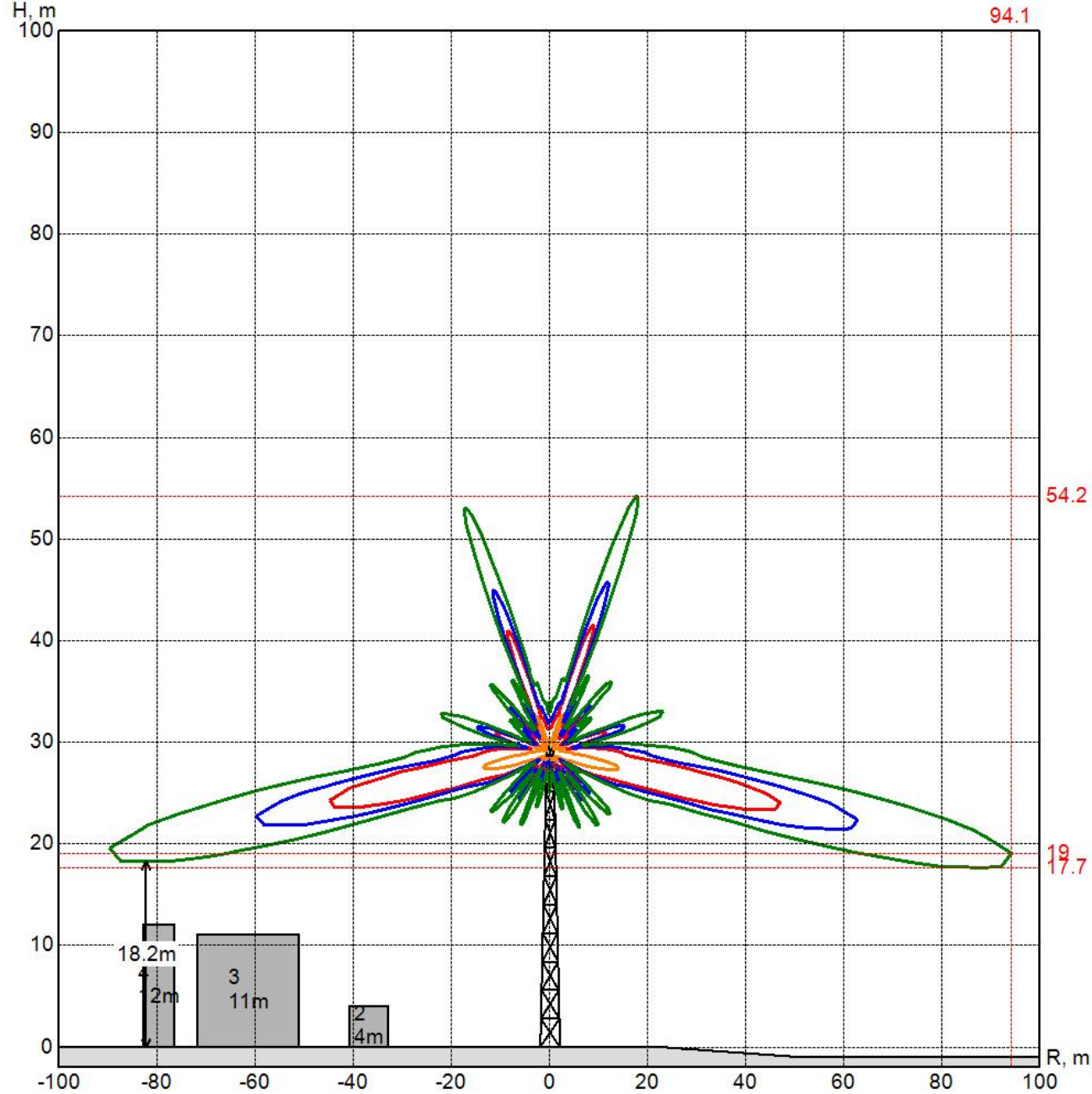
{ControlPointTable_1}

Control Point Calculation Results

Sample:

Number of point	Azimuth (deg)	X, m	Y, m	R, m	Location	Height above ground level (m)	Simultaneous exposure (%)	Total E-field strength (V/m)	Total eq. plane-wave power density (W/m²)
1.1	176.63	0.3	-5.1	5.11	Ground	1.1	0.011214	0.063538	0.000010
1.2	176.63	0.3	-5.1	5.11	Ground	1.9	0.010847	0.062489	0.000010
2.1	199.02	-28.2	-81.8	86.52	Ground	1.1	0.001767	0.025225	0.000001
2.2	199.02	-28.2	-81.8	86.52	Ground	1.9	0.001119	0.020072	0.000001
3.1	137.51	74.3	-81.1	109.99	Ground	1.1	0.324152	0.341606	0.000309
3.2	137.51	74.3	-81.1	109.99	Ground	1.9	0.433427	0.395011	0.000413
4.1	73.25	111.3	33.5	116.23	Ground	1.1	0.520359	0.432815	0.000496
4.2	73.25	111.3	33.5	116.23	Ground	1.9	0.616370	0.471055	0.000588
5.1	23.09	30.7	72	78.27	Ground	1.1	0.040648	0.120968	0.000038
5.2	23.09	30.7	72	78.27	Ground	1.9	0.027781	0.100006	0.000026
6.1	321.79	-32.9	41.8	53.19	Ground	1.1	0.821346	0.543768	0.000784
6.2	321.79	-32.9	41.8	53.19	Ground	1.9	1.133466	0.638786	0.001082
7.1	45.99	70.5	68.1	98.02	Ground	1.1	0.078950	0.168588	0.000075
7.2	45.99	70.5	68.1	98.02	Ground	1.9	0.134715	0.220221	0.000128

{EFieldStrengthGraph_1}

Sample:

E-field Strength (V/m)
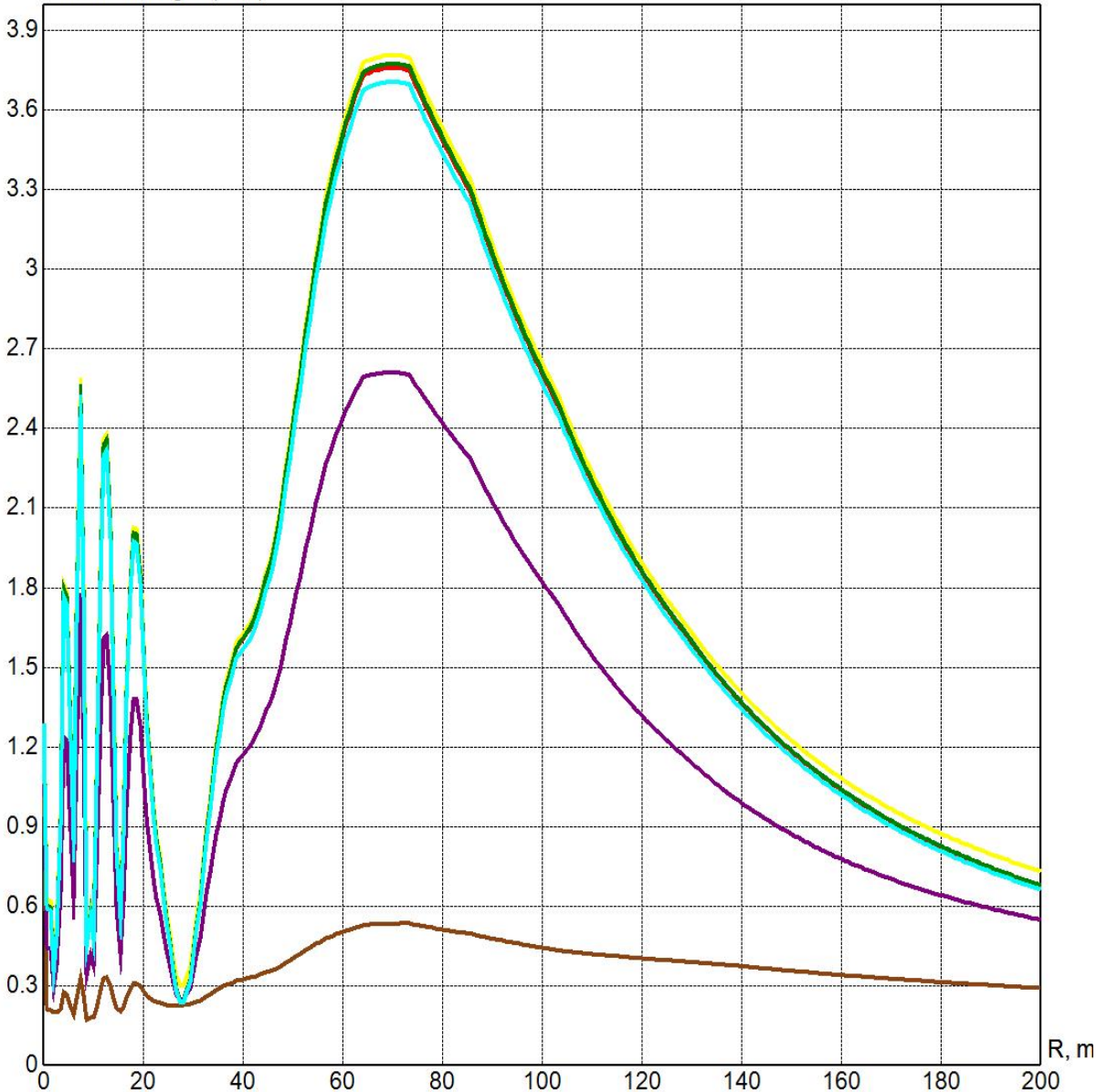
- graph at hight 20 m along azimuth 60° (along direction of antenna №01. 900_60; 04. 2100_60)
- graph at hight 20 m along azimuth 125° (along direction of antenna №07. 23 GHz 0.6 HP)
- graph at hight 20 m along azimuth 130° (along direction of antenna №02. 900_130; 05. 2100_130)
- graph at hight 20 m along azimuth 220° (along direction of antenna №08. 18 GHz 0.6 HP)
- graph at hight 20 m along azimuth 290° (along direction of antenna №09. 23_1 GHz 0.6 HP)
- graph at hight 20 m along azimuth 320° (along direction of antenna №03. 900_320; 06. 2100_320)

{SimultaneousExposureGraph_1}

Sample:

Simultaneous exposure (%)
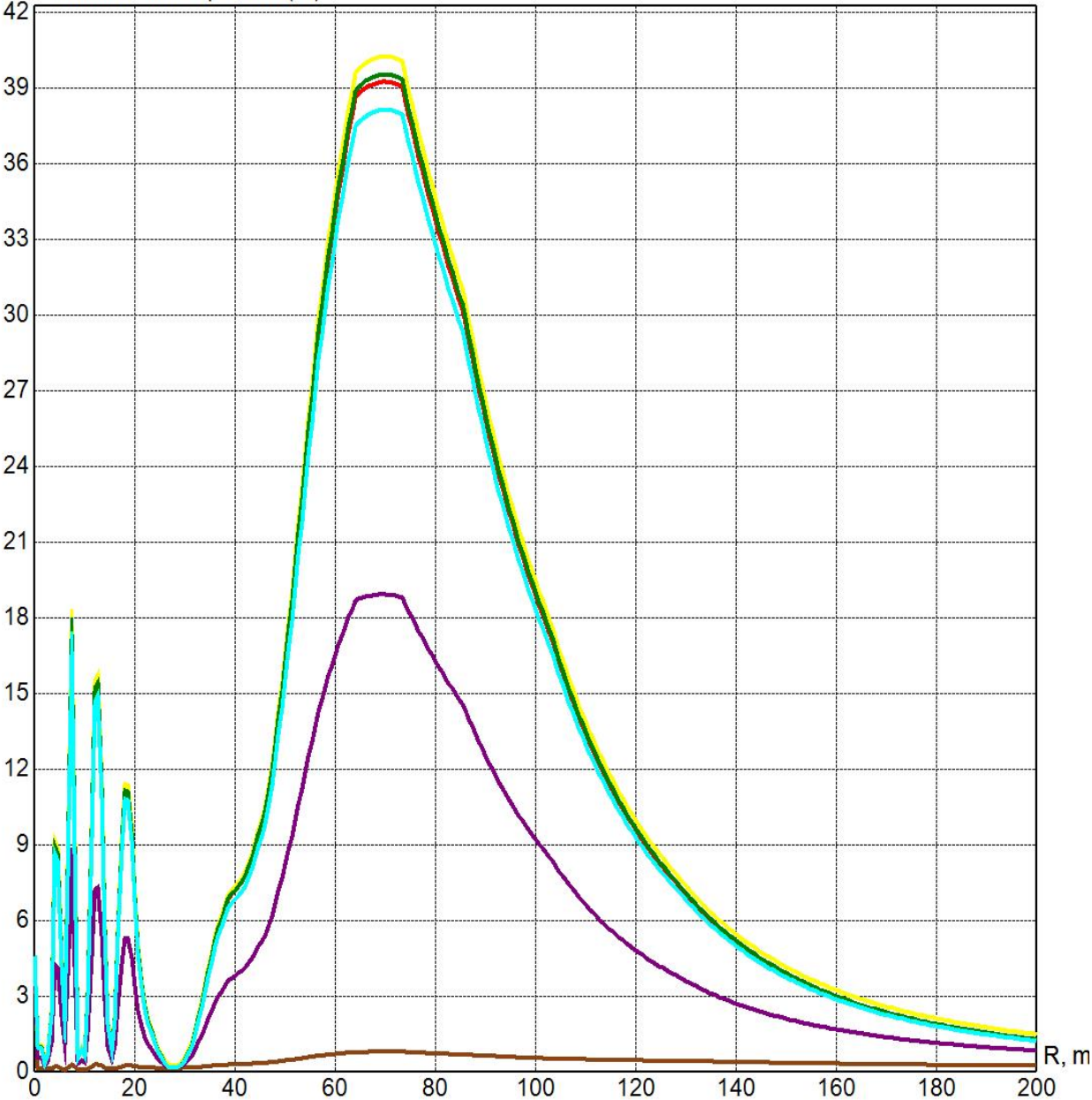
- graph at hight 20 m along azimuth 60° (along direction of antenna №01. 900_60; 04. 2100_60)
- graph at hight 20 m along azimuth 125° (along direction of antenna №07. 23 GHz 0.6 HP)
- graph at hight 20 m along azimuth 130° (along direction of antenna №02. 900_130; 05. 2100_130)
- graph at hight 20 m along azimuth 220° (along direction of antenna №08. 18 GHz 0.6 HP)
- graph at hight 20 m along azimuth 290° (along direction of antenna №09. 23_1 GHz 0.6 HP)
- graph at hight 20 m along azimuth 320° (along direction of antenna №03. 900_320; 06. 2100_320)

{RadiationSourcesTable_1}

Table with radiating sources optimized for A4 Landscape format.

Sample:

№	Radiation source name	Type of service	Frequency, MHz	Transmitter power, W	Number of TX	Total attenuation, dB	Transmitting antenna model	Antenna azimuth, deg	Antenna gain, dBi	Antenna height, m	Antenna size, m	Mechanical downtilt, deg	Electrical downtilt, deg	Antenna beam width H-plane, deg	Antenna beam width V-plane, deg	Owner
1	900 60	GSM	900	12.05	1	0	742265V02	60	16	29	1.9	0	6	66.3	10.3	H3G
2	900 130	GSM	900	12.05	1	0	742265V02	130	16	29	1.9	0	6	66.3	10.3	H3G
3	900 320	GSM	900	12.05	1	0	742265V02	320	16	29	1.9	0	6	66.3	10.3	H3G
4	2100 60	UMTS	2100	10.42	3	0	742265V02	60	18.3	29	1.9	0	6	54.5	4.3	H3G
5	2100 130	UMTS	2100	10.42	3	0	742265V02	130	18.3	29	1.9	0	6	54.5	4.3	H3G
6	2100 320	UMTS	2100	10.42	3	0	742265V02	320	18.3	29	1.9	0	6	54.5	4.3	H3G
7	23 GHz 0.6 HP	PtP	23000	0.1995	1	0	23 GHz 0.6	125	40	27.2	0.6	0	0	1.1	1.1	H3G
8	18 GHz 0.6 HP	PtP	18000	0.2512	1	0	18 GHz 0.6	220	39.2	27.2	0.6	0	0	1.9	1.9	H3G
9	23 1 GHz 0.6 HP	PtP	23000	0.1995	1	0	23 GHz 0.6	290	40	27.2	0.6	0	0	1.1	1.1	H3G

{EFieldStrengthVerticalCutTables_1}

Sample:

E-field strength (V/m) along azimuth 60° (along direction of antenna №01. 900_60; 04. 2100_60)

H, m	R, m																				
	0 m	5 m	10 m	15 m	20 m	25 m	30 m	35 m	40 m	45 m	50 m	55 m	60 m	65 m	70 m	75 m	80 m	85 m	90 m	95 m	100 m
30 m	14.905	10.632	1.9357	2.6144	2.4905	2.2824	2.0688	1.8861	1.7244	1.5841	1.4626	1.3571	1.2625	1.1781	1.1041	1.0387	0.9805	0.9285	0.8816	0.8392	0.8007
28 m	11.603	16.745	27.446	13.240	7.4095	4.9501	3.7169	3.0310	2.5558	2.2084	1.9439	1.7360	1.5733	1.4421	1.3310	1.2359	1.1535	1.0814	1.0178	0.9612	0.9106
26 m	4.1718	1.7349	1.2632	5.5818	10.496	11.037	9.1488	7.2049	5.5710	4.4134	3.5479	2.9248	2.4699	2.1275	1.8610	1.6501	1.4805	1.3422	1.2390	1.1524	1.0768
24 m	2.3559	0.7396	3.5934	0.4694	2.4707	3.3491	5.2897	6.6198	6.7583	6.2069	5.4893	4.7605	4.0931	3.5083	3.0466	2.6480	2.3154	2.0441	1.8206	1.6346	1.4819
22 m	1.6648	1.6438	2.9584	2.3865	0.5116	0.9934	2.0103	2.3922	3.3448	4.2969	4.7985	4.8306	4.6200	4.3170	3.9209	3.5359	3.2139	2.8575	2.5596	2.3084	2.0947
20 m	1.2892	1.5393	0.4851	0.5783	1.5707	0.5039	0.4210	1.2406	1.6079	1.8606	2.4159	3.0579	3.4989	3.7386	3.7576	3.6791	3.4847	3.3093	3.0496	2.8120	2.6057
18 m	1.0523	1.5018	1.1550	1.9548	0.9550	1.1440	0.4680	0.2270	0.7195	1.1789	1.3365	1.5223	1.8800	2.3203	2.6956	2.9337	3.0618	3.0744	3.0565	2.9214	2.7973
16 m	0.8892	0.7539	1.4666	0.5064	1.0827	1.2394	0.8877	0.4273	0.1579	0.4111	0.8207	1.0599	1.1456	1.2881	1.5337	1.8480	2.1474	2.3661	2.5202	2.5923	2.6012
14 m	0.7698	0.3726	0.5170	0.2465	1.3974	0.3469	1.1978	0.7232	0.3913	0.1564	0.2526	0.5562	0.8235	0.9538	1.0029	1.1163	1.2932	1.5255	1.7632	1.9631	2.0993
12 m	0.6788	0.2593	0.6773	1.0054	0.5154	1.0920	0.4146	1.0723	0.6095	0.3600	0.1614	0.1630	0.3708	0.6116	0.7723	0.8477	0.8922	0.9850	1.1170	1.2989	1.4849
10 m	0.6070	0.1870	0.8150	1.1084	0.2641	1.0667	0.5765	0.6333	0.9131	0.5279	0.3328	0.1664	0.1253	0.2566	0.4519	0.6214	0.7193	0.7648	0.8066	0.8813	0.9826
8 m	0.5489	0.1532	0.8065	0.5479	0.2650	0.4846	0.9861	0.2478	0.7321	0.7955	0.4657	0.3091	0.1705	0.1006	0.1804	0.3311	0.4869	0.6046	0.6701	0.6975	0.7360
6 m	0.5010	0.1404	0.6655	0.3350	0.8312	0.1969	0.8551	0.6608	0.2375	0.7565	0.6808	0.4165	0.2884	0.1714	0.0933	0.1263	0.2405	0.3801	0.4972	0.5742	0.6226
4 m	0.4608	0.1373	0.4658	0.4259	0.8697	0.1479	0.4458	0.8503	0.3775	0.3725	0.7186	0.5925	0.3766	0.2694	0.1703	0.0938	0.1035	0.1849	0.2953	0.4043	0.4941
2 m	0.4266	0.1435	0.3074	0.5131	0.5649	0.3580	0.1617	0.7124	0.6679	0.1927	0.4681	0.6773	0.5235	0.3437	0.2522	0.1679	0.0956	0.0865	0.1403	0.2271	0.3278
0 m	0.3971	0.1519	0.2123	0.5485	0.3044	0.6837	0.1754	0.4084	0.7469	0.4495	0.1739	0.5185	0.6217	0.4685	0.3160	0.2371	0.1648	0.0974	0.0739	0.1043	0.1791

{SimultaneousExposureVerticalCutTables_1}

Sample:

Simultaneous exposure (%) along azimuth 60° (along direction of antenna №01. 900_60; 04. 2100_60)

H, m	R, m																				
	0 m	5 m	10 m	15 m	20 m	25 m	30 m	35 m	40 m	45 m	50 m	55 m	60 m	65 m	70 m	75 m	80 m	85 m	90 m	95 m	100 m
30 m	**617.15**	**314.01**	10.409	18.986	17.230	14.471	11.889	9.8816	8.2604	6.9708	5.9427	5.1164	4.4281	3.8557	3.3865	2.9972	2.6709	2.3948	2.1592	1.9565	1.7810
28 m	**373.99**	**778.92**	**2092.5**	**486.95**	**152.50**	68.067	38.377	25.520	18.145	13.548	10.497	8.3717	6.8761	5.7769	4.9217	4.2433	3.6962	3.2485	2.8775	2.5667	2.3036
26 m	48.346	8.3613	4.4326	86.547	**306.06**	**338.39**	**232.50**	**144.19**	86.213	54.107	34.966	23.763	16.945	12.573	9.6212	7.5638	6.0888	5.0044	4.2646	3.6892	3.2213
24 m	15.418	1.5196	35.868	0.6122	16.956	31.156	77.726	**121.72**	**126.87**	**107.01**	83.702	62.953	46.538	34.191	25.784	19.478	14.892	11.607	9.2074	7.4223	6.1001
22 m	7.6988	7.5057	24.311	15.820	0.7273	2.7415	11.226	15.896	31.078	51.289	63.960	64.820	59.290	51.768	42.705	34.729	28.692	22.681	18.199	14.802	12.188
20 m	4.6171	6.5823	0.6539	0.9290	6.8536	0.7055	0.4924	4.2752	7.1817	9.6163	16.213	25.975	34.007	38.827	39.222	37.599	33.732	30.421	25.833	21.965	18.860
18 m	3.0765	6.2655	3.7061	10.614	2.5336	3.6360	0.6085	0.1432	1.4380	3.8607	4.9621	6.4373	9.8181	14.955	20.184	23.908	26.041	26.255	25.950	23.707	21.736
16 m	2.1963	1.5791	5.9748	0.7124	3.2566	4.2670	2.1891	0.5072	0.0693	0.4696	1.8710	3.1208	3.6456	4.6090	6.5345	9.4868	12.810	15.551	17.643	18.667	18.796
14 m	1.6464	0.3857	0.7425	0.1688	5.4247	0.3344	3.9853	1.4528	0.4254	0.0680	0.1772	0.8595	1.8840	2.5270	2.7942	3.4618	4.6454	6.4645	8.6362	10.705	12.242
12 m	1.2800	0.1869	1.2742	2.8081	0.7380	3.3126	0.4776	3.1942	1.0320	0.3600	0.0724	0.0738	0.3820	1.0390	1.6571	1.9962	2.2112	2.6952	3.4658	4.6870	6.1250
10 m	1.0236	0.0972	1.8454	3.4132	0.1938	3.1607	0.9232	1.1144	2.3161	0.7743	0.3077	0.0769	0.0436	0.1829	0.5673	1.0729	1.4374	1.6248	1.8072	2.1576	2.6824
8 m	0.8372	0.0652	1.8071	0.8339	0.1951	0.6525	2.7013	0.1706	1.4889	1.7578	0.6025	0.2655	0.0808	0.0281	0.0904	0.3046	0.6586	1.0156	1.2473	1.3514	1.5047
6 m	0.6974	0.0548	1.2305	0.3118	1.9193	0.1077	2.0311	1.2130	0.1567	1.5901	1.2874	0.4818	0.2311	0.0816	0.0242	0.0443	0.1607	0.4013	0.6867	0.9158	1.0770
4 m	0.5900	0.0524	0.6027	0.5039	2.1012	0.0607	0.5520	2.0088	0.3958	0.3855	1.4347	0.9752	0.3940	0.2016	0.0806	0.0244	0.0297	0.0950	0.2423	0.4540	0.6782
2 m	0.5056	0.0572	0.2624	0.7313	0.8866	0.3561	0.0726	1.4101	1.2393	0.1032	0.6087	1.2746	0.7615	0.3281	0.1767	0.0783	0.0253	0.0207	0.0547	0.1432	0.2985
0 m	0.4380	0.0641	0.1252	0.8357	0.2574	1.2986	0.0854	0.4633	1.5497	0.5612	0.0840	0.7468	1.0736	0.6097	0.2774	0.1562	0.0754	0.0263	0.0151	0.0302	0.0891