



Getting started with MMANA-GAL antenna analysis software

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Since these help pages were written, there has been a new and rather complete help file written for MMANA-GAL which makes many of the more obscure aspects of the program clearer. You can download this new help file [by clicking here](#) and saving it to your hard drive. Unzip it into a folder and open index.html with your browser. Note: This is not the file that is on the official MMANA web site, but it is the version which I prefer, since it has been corrected for grammar, errors, and typos.

The following pages are a beginning set of steps to follow so that you can get an idea of what [MMANA-GAL](#) does, and how to use it for simple tasks. It is a very capable and detailed piece of software, but don't be put off by that. I assume that you have some basic antenna theory. If not, consider reading the material by W4RNL at Antennex in detail, as it is a great place to learn theory and modeling together. Here I will just show the steps to open an example file from the many models that come with MMANA-GAL. From those examples, one can gain a wealth of knowledge that can guide antenna selection.

A Simple 20m Dipole in Free Space

- Start up MMANA-GAL. Click on File->Open-> and navigate to the C:\Program Files\MMANA-GAL\ANT, -> HF Simple -> Dipole -> double click on DP20.maa. This is a simple 20m dipole.
- On the Geometry tab, note that there is one line in the Wires table. Models are made of wires, which here is defined as a linear conductor of radius R (in millimeters). The cells in this table are very much like the cells in a spread sheet, and can be modified in the same way. This table has the start (X1,Y1,Z1) and end points (X2,Y2,Z2) for all the wires that make a model. In this case the start point is at -5.17 meters, and the end point is at 5.17 meters on the Y axis. All points in the model are on a 3D rectilinear grid, with X being the conventional forward direction, Y being the side, and Z pointing vertically. The R column indicates the wire is 1 mm in radius. The other values are details of the computation process, which can be left at the defaults. The frequency drop down box can be changed to other values if desired for experimentation purposes. We'll leave it at 14.05MHz for now.
- On the bottom left, you will see the sources table. There is one voltage source, which is indicated by "w1c". This means the center of Wire1, which is where the impedance and SWR are calculated. The voltage and phase of this source is arbitrary, as it is the only one. If there are more than two sources, then adjustment of the voltages and phases are

relevant.

- Now click on the View tab. This shows the model in 3D space. Click and drag on the window to rotate the view point. Click on the Wire to get the physical details about it on the right side of the window. This view is much more useful for models with more numerous wires, to verify that the Geometry page has the proper info.
- Now click on the Calculate tab. This window is used to do the computations in order to determine the Gain, Front to Back Ratio, Impedance, and SWR for the model. You can test the model in free space, in other words far away from any other object, or at some height above ground. For now try free space. The material of the antenna can be changed, from ideal no loss conductor, to Cu, Al, or Fe. Leave it at no loss for now.
- At the bottom, click on the Start button, and MMANA-GAL will return the results of its computation in the first line of the table. This shows, reading across the columns: a resistance of 71.5 ohms, a slight bit of reactance, an SWR on a 50 ohm system of 1.43, no gain over a dipole dBd (since it *is* a dipole), 2.13 dBi, which is gain over an isotropic (perfectly spherical) source, no F/B ratio, no lobe in the elevation pattern, in free space, with no ground, and horizontal polarization. All the things we would want to see with a theoretical dipole such as this.
- Now click on the Far field plots to get a look at the horizontal pattern on the left, and the vertical pattern on the right. Click on the patterns to get numerical details. Notice that elevation is only shown as the upper portion of the free space pattern, the bottom is identical.
- Now go back to the Calculate tab, and select some real values. Let's try Cu wire, over real ground, at a height of 20m. Click calculate again and note the changes. We now have a resistance of 78.6 ohms, a bit more reactance, an SWR of 1.61, a gain of 7.13 dB over an isotropic source, and a peak in the vertical elevation pattern of 14.9 degrees. Click on the Far field plots tab and notice the difference that ground reflection has made. This shows that some of the energy of the dipole radiates at the lower angle, but some also radiates at a much higher angle.
- Finally, go back to the Calculate tab and click on Plots. This allows you to see the changes in the antenna over a range of frequencies. Adjust the BW bandwidth drop down box to the number of kHz you want to scan. Click the detailed button, and look at the plots of impedance, gain and F/B, and far field patterns. Not very interesting for a dipole, but very useful for more complex arrays.

A Simple 20m Ground Mounted Vertical

- Now let's try a vertically polarized antenna. Click File -> Open -> ANT -> HF Simple -> Vertical -> Vert20.maa. This is a quarter wave vertical mounted on the ground. Notice in the Geometry tab that there is again only 1 wire, but it now has a Z component only, all others are zero. Note in the sources table that "w1b" now indicates the voltage source is at the beginning of wire 1. Click to the View tab to see the vertical in all its glory.

- Go to the calculate tab and click Start. Notice in the first line of the results table, that the feed point impedance is now at 36.6 ohms, and the gain over isotropic is just under 0 dBi. This is what we would expect for a poor ground situation. Also note in the far fields tab that the lobes are peaking at a moderate angle, with a deep null at the zenith.
- Back in the Calculate tab, click on Ground setup. This window allows for changing the model's ground parameters. The default values of dielectric constant and conductivity are for fair to average sorts of soils, so without more info let's leave these. But at the bottom click on the "On-radial boundary" checkbox, and fill in 12 radials of 1mm wire, and click OK. Now click Start again and notice that we have more gain, and at a lower angle. You can go up to greater numbers of radials and see how the gain continues to improve, and the angle lowers in the far fields view.
- When done go back and uncheck the Radial Boundary box. Do these results translate into the real world? As with all models, there are many unknowns which will always make for variations to real world results. But the important factor is that it gives direction and weight to things we might want to try, like adding radials to a vertical.
- How about trying to load this thing up on 40m? For that we can try center loading, not the most efficient means but workable. Go back to the Geometry tab, and type an entry of "w1c" into the loads table, first row under the "Pulse" column. The Type column comes up as "LC", which means a coil in series with a capacitor. Click on that again to see that one could also have an impedance in the form of $R+jX$, or S. (No need to worry about the latter.) Now type in 20.0 in the L(uH) column, and leave C(pF) at zero. Put in 100 in the Q column, indicating a less than excellent coil (small wire on a small form). Finally change the Frequency box to 7.05MHz. Now go to the Calculate tab and hit that old Start button again.
- Notice that the vertical is almost resonant at the new frequency (small amount of jX), but has a lower R, and a lower gain. This is what we would expect for a loaded vertical. Now, as in the previous case, go back and change the ground system to something like 64 radials, and see the difference. You can also go back to the Geometry tab and change the Q to 200, 300, 400,... and notice how a better coil will reduce losses (higher Q means fatter wire and bigger form.)
- Finally, go to the View tab and notice the red line next to the vertical. This is the antenna current indicator. The further the red line is away from the antenna, the more RF current is flowing at that point. Also notice the red X indicating the location of the loading coil. The source is the red circle. There is a sudden change in the current at the coil location, all in line with what we would expect.

You are now in a position to open and examine any of the included example files in MMANA-GAL and go through these same steps to see how each behaves as you vary height, materials, and dimensions. By playing with these example models you will get an idea of how modeling can be used to test out new ideas before going to the effort to build them in real materials. If you change any of the values in the file, MMANA-GAL will ask if you want to save it before closing. Say no unless you want to keep the changes. The Help file in MMANA-GAL at present is Zen sparse, but still has plenty of useful info there, once you get the feel for the program. If you run into problems making a model, try to search through the messages, or ask a question, at [the Yahoo MMHamsoft group](#). It's very likely someone has done the same sort of thing in the past. Enjoy!

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