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## VOACAP Type-13 Files for Amateur Band Antennas

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**A**mateur interest on the use of propagation software is growing, especially as VOACAP becomes more readily available. The best way to obtain the most accurate propagation forecasts and analyses for a given amateur installation is to use within VOACAP an antenna that closely resembles the actual station antenna at each frequency of operation. The resemblance need not be physical, but needs only to have a radiation pattern that closely fits the performance of the station antenna.

```
10-meter Yagi 3 elements long boom at 75' above average ground
4      4 parameters
0.00 [ 1] Max Gain dBi...
13    [ 2] Antenna Type...: 360 x 91 gain values follow
0.0   [ 3] Efficiency (for IONCAP)
28.5  [ 4] Frequency
0      -99.99  1.73  7.46  10.5  12.34  13.42  13.92  13.9  13.39  12.33
      10.58  7.8  3.07  -7.51  -1.28  5.4  8.83  10.9  12.16  12.84
      13.04  12.79  12.1  10.91  9.1  6.37  2.1  -4.46  -1.95  3.56
      6.85  8.93  10.27  11.09  11.5  11.55  11.27  10.67  9.72  8.37
      6.53  4.04  0.67  -3.13  -3.19  0.23  3.14  5.21  6.66  7.68
      8.37  8.78  8.98  8.97  8.79  8.44  7.93  7.27  6.45  5.47
      4.31  2.97  1.43  -0.31  -2.2  -4.04  -5.37  -5.68  -5.01  -3.92
      -2.8  -1.82  -1.01  -0.36  0.15  0.53  0.81  1.01  1.13  1.18
      1.18  1.13  1.04  0.92  0.76  0.57  0.36  0.13  -0.13  -0.4
      -0.7
1      -99.99  1.73  7.45  10.5  12.34  13.42  13.91  13.9  13.39  12.33
      10.58  7.8  3.06  -7.51  -1.28  5.4  8.83  10.9  12.16  12.84
      13.03  12.79  12.1  10.91  9.09  6.37  2.1  -4.46  -1.95  3.55
      6.84  8.93  10.27  11.09  11.5  11.55  11.27  10.67  9.72  8.37
      6.53  4.04  0.67  -3.14  -3.19  0.23  3.14  5.2  6.66  7.68
      8.37  8.78  8.97  8.97  8.79  8.44  7.93  7.27  6.45  5.47
      4.31  2.97  1.43  -0.31  -2.2  -4.04  -5.37  -5.68  -5.01  -3.92
      -2.8  -1.82  -1.01  -0.36  0.15  0.53  0.81  1.01  1.13  1.18
      1.18  1.13  1.04  0.92  0.76  0.57  0.36  0.12  -0.13  -0.4
      -0.7
2      -99.99  1.72  7.44  10.49  12.33  13.41  13.9  13.89  13.38  12.32
      10.57  7.79  3.06  -7.51  -1.29  5.39  8.82  10.89  12.15  12.83
      13.03  12.78  12.09  10.9  9.09  6.36  2.09  -4.46  -1.96  3.55
      6.84  8.92  10.26  11.08  11.49  11.54  11.26  10.66  9.71  8.36
      6.52  4.03  0.66  -3.14  -3.19  0.23  3.13  5.2  6.66  7.68
      8.36  8.78  8.97  8.96  8.78  8.43  7.93  7.27  6.45  5.46
      4.31  2.96  1.42  -0.32  -2.2  -4.04  -5.38  -5.68  -5.02  -3.92
      -2.8  -1.82  -1.01  -0.36  0.14  0.53  0.81  1.  1.12  1.18
      1.18  1.13  1.04  0.91  0.76  0.57  0.36  0.12  -0.13  -0.4
      -0.7
3      -99.99  1.71  7.43  10.48  12.32  13.39  13.89  13.88  13.37  12.3
      10.55  7.78  3.04  -7.51  -1.3  5.38  8.81  10.88  12.14  12.81
      13.01  12.77  12.08  10.89  9.07  6.35  2.08  -4.46  -1.97  3.54
      6.82  8.91  10.25  11.07  11.48  11.53  11.25  10.65  9.7  8.35
      6.51  4.02  0.65  -3.14  -3.2  0.22  3.12  5.19  6.65  7.67
      8.35  8.77  8.96  8.95  8.77  8.42  7.92  7.26  6.44  5.46
      4.3  2.96  1.42  -0.32  -2.21  -4.04  -5.38  -5.69  -5.02  -3.92
      -2.8  -1.82  -1.01  -0.37  0.14  0.52  0.81  1.  1.12  1.18
      1.18  1.13  1.04  0.91  0.76  0.57  0.36  0.12  -0.13  -0.4
      -0.7
```

VOACAP has a provision for using a special file type, type-13, which is a file of the radiation pattern in all azimuth directions and for all elevation angles, in 1-degree increments. The first 4 azimuth bearings plus the header material appear in the screen grab of a sample (which is from one of the collections referenced below). Each antenna at each frequency of operation requires an ASCII file about 260 KB long to include all elements of the pattern in the proper format. The file uses the compass rose (clockwise) convention and counts elevation from the horizon. In addition, each antenna must be over ground, and for many types of antennas, performance may vary with the ground quality. You can find the maximum gain in the first sample entries at an elevation angle between 6° and 7°. All antennas that can be rotated and are directional are oriented to place the main lobe due North (0 degrees azimuth). Use VOACAP controls to re-aim the antenna at a desired target communications region. Fixed antennas present different challenges for the user, and individual description sheets that accompany each (future) collection will make suggestions on how to best use these files.

Amateurs versed in the use of NEC or MININEC can create custom models of their actual antennas. Since NEC and MININEC generally use phi and theta conventions to produce the radiation pattern report, conversion is tedious at best. The latest version of EZNEC at its Plus and Pro levels can produce the desired type-13 files by use of the 3-dimension plot option.

Amateurs who are not familiar with antenna modeling may not have access to radiation patterns of typical amateur station antennas. Therefore, I have begun a process of producing type-13 files of monoband antennas to cover most of the HF amateur bands. The files come in collections as the download list below indicates. Each file is zipped and contains a considerable number of files internally. Each collection contains models with the same performance characteristics for each amateur band. Where relevant--for horizontal antennas especially--there are at each frequency variations of files for different heights above ground. The heights for the upper HF region (20 through 10 meters) are 35', 55', 75', and 95', corresponding generally to typical amateur tower heights. For the lower HF bands from 80 through 30 meters, different files exist for heights of 75' and 100'. For vertical antennas, especially those using a ground or near ground mounting, there are variations for ground qualities known as very good, average, and very poor. Where relevant, there are also variations for different sizes of radial fields, namely, 4, 16, and 64 buried radials.

Each file collection contains a 1-page document describing the specific file-name coding used for that group. A sample appears below. VOACAP restricts type-13 files to 8 characters, requiring a careful coding to provide key file data. Since all antennas are monoband antennas, the group document also specifies any key features. For example, the collections for Yagis include the free-space gain and boom length of the model to allow the user to select an antenna whose performance most closely matches the station antenna, even if the station antenna is a multi-band array.

The collection does not attempt to model commercially built (or even home built) multi-band antennas. With the facilities available to most antenna makers, developing type-13 files for each antenna in their line at each operating frequency should be standard practice and would allow the maker to classify the file as authorized. Until makers take this step, most amateurs will have to estimate the performance of their antennas and select from the collections (as they slowly emerge) the model that is closest in performance and other variables to the station antenna.

Despite the relative ease of constructing an individual type-13 file using the latest modeling software, the development of generally usable collections of files is a long-term task. For

example, each zipped Yagi file contains 28 separate type-13 files for 80 through 10 meters. Therefore, the overall collection will grow very slowly and may not suit a particular need for a very long time from the beginning of the project (July, 2007). Nevertheless, I shall make each new collection, small or large, available as it is developed. Since each zipped file is itself very large, I recommend that you only download those files that are potentially useful to your station. As well, the site has protections against bulk downloading.

The following list shows what is presently available for [download](#). For both Yagis and quads, there are two versions in order to provide an adequate step in the forward gain values within the collection.

1. Monoband Yagi Antennas: The Yagi collection consists of versions using 2 through 8 elements, with a long-boom and a short-boom version of the 3-element Yagi.

2-element driver-reflector Yagis (6.2 dBi free-space gain)

3-element short-boom Yagis (7.1 dBi free-space gain)

3-element long-boom Yagis (8.2 dBi free-space gain)

4-element Yagis (8.8 dBi free-space gain)

5-element Yagis (10.1 dBi free-space gain)

6-element Yagis (11.5 dBi free-space gain)

7-element Yagis (12.4 dBi free-space gain)

8-element Yagis (13.3 dBi free-space gain)

2. Monoband Quad Beams: The quad collection consists of versions using 2 through 6 elements, with a wider-band and a higher-gain version of the 3-element quad.

2-element quads (7.0 dBi free-space gain)

3-element wider-band quads (8.6 dBi free-space gain)

3-element higher-gain quads (9.2 dBi free-space gain)

4-element quads (10.4 dBi free-space gain)

5-element quads (11.1 dBi free-space gain)

6-element quads (11.7 dBi free-space gain)

3. Other Rotatable Horizontal Arrays

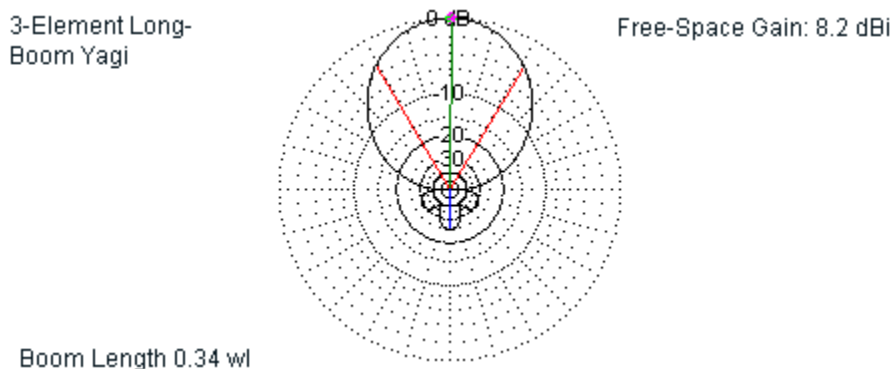
2-element Moxon rectangle (6.0 dBi free-space gain)

2-element phased array (or 2-element driver-director Yagi) (6.7 dBi free-space gain)

2-Element Bi-Directional W8JK Flat-Top with  $1\text{-}\lambda$  elements and  $\frac{1}{2}\text{-}\lambda$  spacing (6.0 dBi free-space gain)

2-Element Bi-Directional W8JK Flat-Top with  $1\text{-}\lambda$  elements and  $\frac{1}{4}\text{-}\lambda$  spacing (7.0 dBi free-space gain)

At my personal website, there are free-space azimuth-equivalent patterns to provide the potential user with an idea of the relevant pattern shape. In some cases, this additional data may play a role in selecting a proper “close match” to a station’s antenna. The following sample pattern goes with the 3-element long-boom Yagi in the sample type-13 file. The pattern and the associated type-13 files use models at their design frequency, where the front-to-back ratio is usually the highest. Gain and front-to-back ratio may change with frequency within a given amateur band. Changing the type-13 file frequency does not alter the radiation pattern values. That only occurs for the models from which we derive the type-13 files. Hence, type-13 files, even when customized for a specific antenna and antenna environment, are close but often not exact replications of actual antenna performance at a given operating frequency. (For patterns of each collection, go to <http://www.cebik.com/model/type13a.html> .)



One way to simplify the file structure within your version of VOACAP is to download only the collection (or collections) that have the most promise of closely matching your station antenna (or antennas). Unzip the files into a separate hard-drive directory. Then copy only the relevant files to your directory within the VOACAP program. You may rename the files within the 8-character limit, retaining the extension. As well, you may open the files within Notepad or Wordpad and revise the top line description to suit your needs. However, do not disturb the format of the remaining lines of the file.

As a general guide to the file-name coding used—at least for horizontal directional beams—the following notes are drawn from one of the collection documents (the 3-element long-boom Yagi sampled in the two figures).

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The attached 28 type-13 VOACAP files cover a 3-element long-boom Yagi design with versions for 80 through 10 meters. The files derive from EZNEC Pro/4 models.

Each file name for this set uses the following code system for the 8 characters allowed in the name.

Sample: Y 20m 3l 55 . 13

a. b. c. d. extension

a. The first file-name element is a single letter designating the antenna type: Y = Yagi (Q = quad beam; M = Moxon rectangle; other designators to emerge as needed)

b. The 2<sup>nd</sup> through 4<sup>th</sup> characters indicate the antenna frequency band. On each band, the frequency is normally the arithmetic center frequency of the band. (10 meters for these models runs from 28.0 to 29.0 MHz. The 80/75—meter band is a special case.) For the amateur bands from 80 through 10 meters, the model frequencies are as follows. You may adjust the frequency as desired within VOACAP for each band on the assumption that your beam is optimized for that frequency. However, do not use a file for one band on another, since the gain and elevation angles do not coincide across bands.

Band	Frequency	Band	Frequency	Band	Frequency
80	3.6 MHz	30	10.125 MHz	15	21.225 MHz
75	3.9 MHz	20	14.175 MHz	12	24.94 MHz
40	7.15 MHz	17	18.118 MHz	10	28.5 MHz

c. The 5<sup>th</sup> and 6<sup>th</sup> characters designate the number of elements and the boom length. 3l differentiates the long-boom model from others with a shorter boom. The long-boom model uses a boom length of about 0.34  $\lambda$ , which limits the forward gain to approximately 8.2 dBi in free space. The type-13 files will show the maximum gain over ground at each height.

d. The final two characters indicate the height of the antenna above average ground. The heights for upper-HF models are 35', 55', 75', and 95', corresponding to the most common tower heights used by amateur radio operators. For models in the 30-meter through 80-meter bands, the available heights are 75' and 100' (the latter coded as 00).

All files use a ground quality termed "average" (conductivity 0.005 S/m, relative permittivity 13), since the performance of horizontal antennas is not exceedingly sensitive to changes in ground quality.

All type-13 files in this set orient their main forward lobes due North (0° azimuth). Use VOACAP controls to reset the azimuth heading in the desired direction.

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The file coding will change according to the types of antennas that form parts of future collections. For example, ground-mounted vertical monopoles may replace the element number, boom-length, and height entries with a coding for the ground quality and the number of radials in the model.

The collections of models provide the VOACAP user with antennas that are more likely to provide performance patterns that are closer to station antennas than the samples provided with most versions of the propagation software. However, in critical cases, the propagation forecaster or analysts should create custom models of the actual antennas used, with the exact height and ground quality values beneath the antenna.

These notes are no substitute for mastering your particular VOACAP software. Moreover, the collections are made available without charge and without warranty. Use of the files is solely the responsibility of the user. -30-

You may download the above listed Type-13 files directly from the software menu in the [Guests Rooms](#).

[Click for Biography of LB Cebik](#)



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