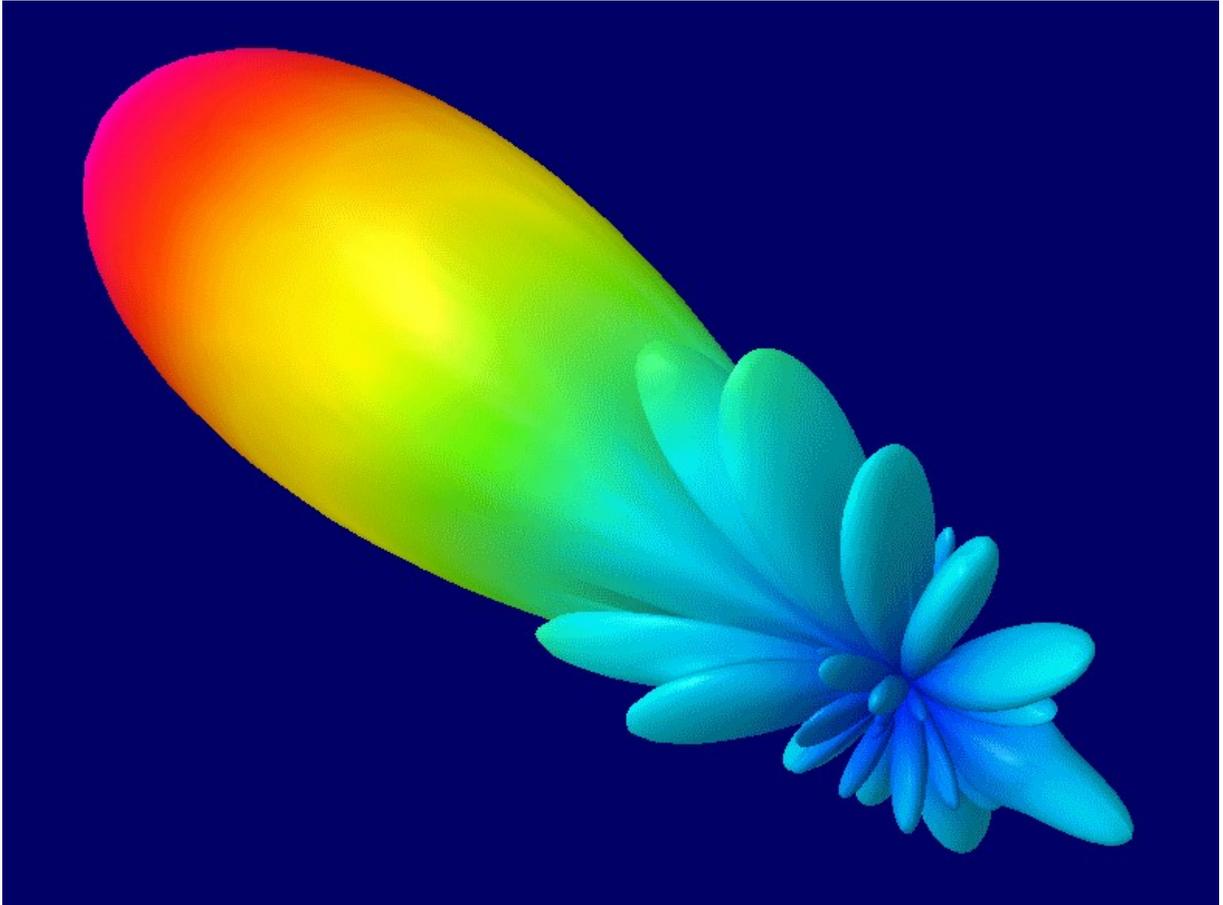


# TANT V1.4

Illustrated add-on to the original "readme.txt"  
issued by Sinisa, YT1NT, VE3EA on April 23, 2006



- How to build EZNEC files for TANT
  - How to run TANT
  - How to interpret results

Manual Version 1.4 - Dec - 2017  
A revised and supplemented issue of Version 1.2  
written by Hartmut, DG7YBN on Feb. 07 - 2009  
with kind help of YU7EF and supervision by YT1NT.

## Foreword by DG7YBN

You may think that calculating Antenna Temperature is for the EME operators only and complicated anyhow. The advanced reader may know of the theoretically only minor advantage in Signal to Noise ratio of a lower noise temperature Yagi against a Yagi design that is optimised to yield maximum forward gain on 144 MHz. But practise tells a different story for many applications.

You may imagine a scenario where you try to pick up a weak signal on the 2 m band and suddenly you have a noise floor of 6 dB extra in your RX because someone in the neighbourhood turned on his plasma TV. Likewise in contest you may receive a notorious side splatter from a close by competitor.

As you are familiar with common antenna specifications you well know that given the source of noise is on the rear side these unwanted receptions could be less using a Yagi with a better F/B ratio. If you improve your Yagi design from an F/B of 22 dB to 28 dB you will get a 6 dB advantage in Signal to Noise ratio when the unwanted signal comes in from behind. A "Low Noise" or "Low Temperature" Yagi design seeks to minimise most rear and side lobes in favour of this effect.

That is theory in free space conditions. In the pitfalls of reality the wave propagation is coming in to your antenna in a manifold of ways. We have diffraction and reflection all over when focusing on interfering signals evolved by a terrestrial source.

Now think of all the side lobes of an antenna far field pattern. All of them will pick up some amount of that interfering signal. F/B ratio alone is a poor figure to characterise the directivity features of your design to the full extend. And that is why the engineers and physicists created the parameter of Antenna Temperature. Its gives an exact measure of what noise expressed in temperature an antenna pattern will pick up when placed in an environment of given noise temperature. If we now add the parameter Antenna G/T we link the Antenna Temperature in a given simplified noise environment to its forward gain. Antenna G/T now is equivalent to Signal to Noise ratio for the antenna alone.

However System G/T as specified by the ITU and professionals includes the whole receiver chain. Which starts at the antenna in its environment with added balun or symmetrising device, phasing lines etc. to coax relay, preamplifier, feed line, receivers Noise Figure ... but with the Antenna G/T adding to the whole line as first stage. We may note that the S/N at the antenna terminal is the best we ever get in our system. All other stages add their Noise Figure or losses.

With this manual and the program TANT you easily get into that theory with just a few minutes spent on your PC.

What is new?

New parts in V1.4 are marked with vertical bars on left as here

## What is TANT?

TANT is a program written by Sinisa, YT1NT. It computes Far Field table output originating from antenna radiation pattern that have been produced with EZNEC from version 3 to the actual version 5.0 onwards (or any other exactly similar table format holding complete Far Field data). TANT calculates **Antenna Temperature** and **G/T Ratio** for antenna elevation angles from 0 to 90 degrees in steps of 5 degrees whilst assuming uniform sky and earth temperatures for the full sight of sky sphere ( $\pi$  in radian) respectively earth up to horizon ( $2\pi$  in radian for polar coordinates). TANT is a DOS program that can be run from either MS-DOS prompt or MS-DOS Console when using Windows environment.

## What is the actual version of TANT?

TANT 1.2 - Build: April 23. 2006 (in fact there is one release only)

## What is the calculation base of TANT's equations?

Common Base for calculating the antenna temperature is the integration of infinitesimal slices of temperature in observation direction multiplied with equal slice of antenna beam characteristic in that direction over the sight of (noise) temperature emitting environment.

The well known article by Rainer Bertelsmeier, DJ9BV "Effective Noise Temperatures of 4-Yagi-Arrays for 432 MHz EME" presents the full set of equations and theory. It is a good introduction to antenna temperature and G/T ratio.

See Dubus-Magazine 4/87

## How to install TANT

TANT does not need to be installed. It consists of a single executable (.exe) file. Place it in the same folder as your EZNEC pattern files and run it from there.

## Terminology:

TANT - refers to the programs name  
Tant - refers to Antenna Temperature in Kelvin [K]  
FF - Far Field

## Picture on front page:

FF-Plot of a 4 yagi bay of YU7EF's 10 ele. Yagis EF0210LT closely spaced to minimise sidelobes but still delivering 18.8 dBi. Generated with 4nec2X (3D viewer extension plot).

## How to generate a Far Field table suitable for TANT analysis

First you must build a proper Far Field table of your antenna with EZNEC.  
 Building a Far Field Table <FF-Tab> file that can be computed by TANT in three steps:

**Step 1:** Build your EZNEC model file in a way that

- X** axis = element position on boom
- Y** axis = element length
- Z** axis = height of element i.e. distance to ground

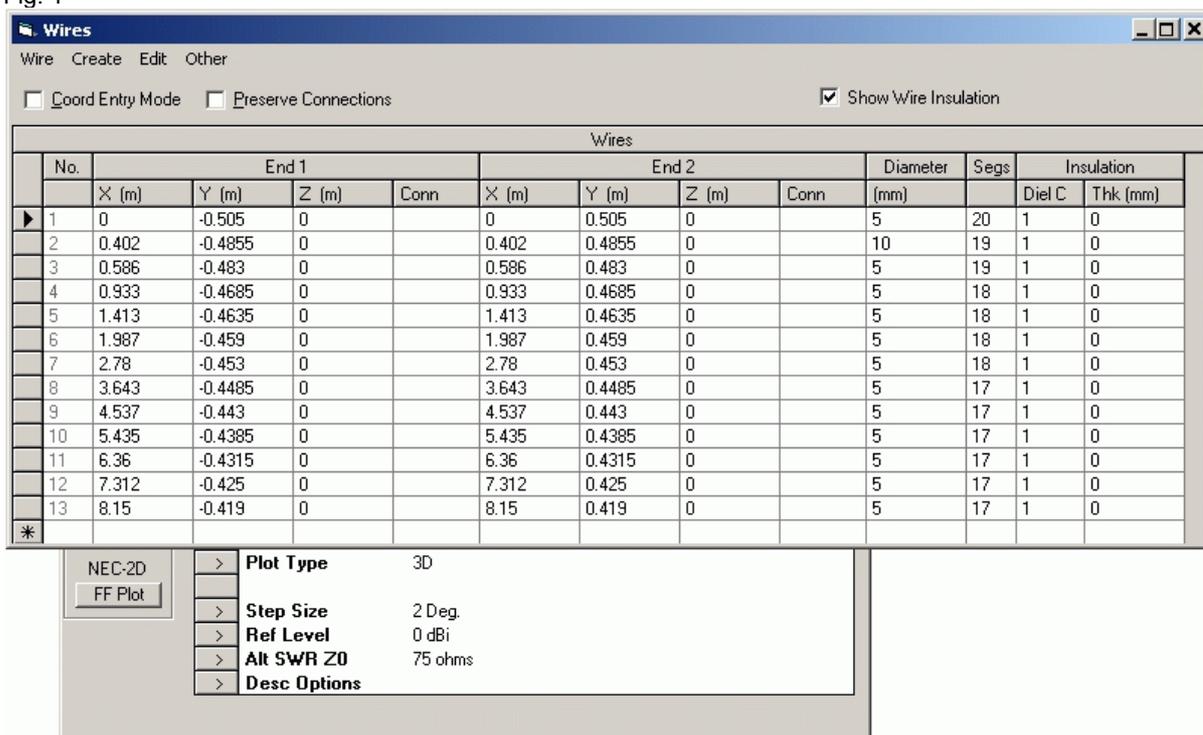
Maximum gain must occur at elevation angle = 0 degrees and azimuth angle = 0 degrees.

Set parameter “**Step Size**” for pattern calculation accuracy to **1, 2** or at least **3 Deg**.

Set parameter “**Ref Level**” to **0 dBi**.

(See EZNEC main window, underneath “Wires” window)

Fig. 1



Example file model: YU7EF 'EF0213' - 13 ele. Yagi for 144 MHz in EZNEC+ v 5.0 \*

\* The above design is the sole property of Ljubisa Popa, YU7EF. Distribution and publishing of these data and information is permitted ONLY for radioamateur purposes and construction. Use of these information and data for any commercial purposes is strictly prohibited without the written authorization of Ljubisa Popa.

**Step 2:** Select “Options” and set Parameter “Angle Convention” to “CCW From X Axis”.

Fig. 2

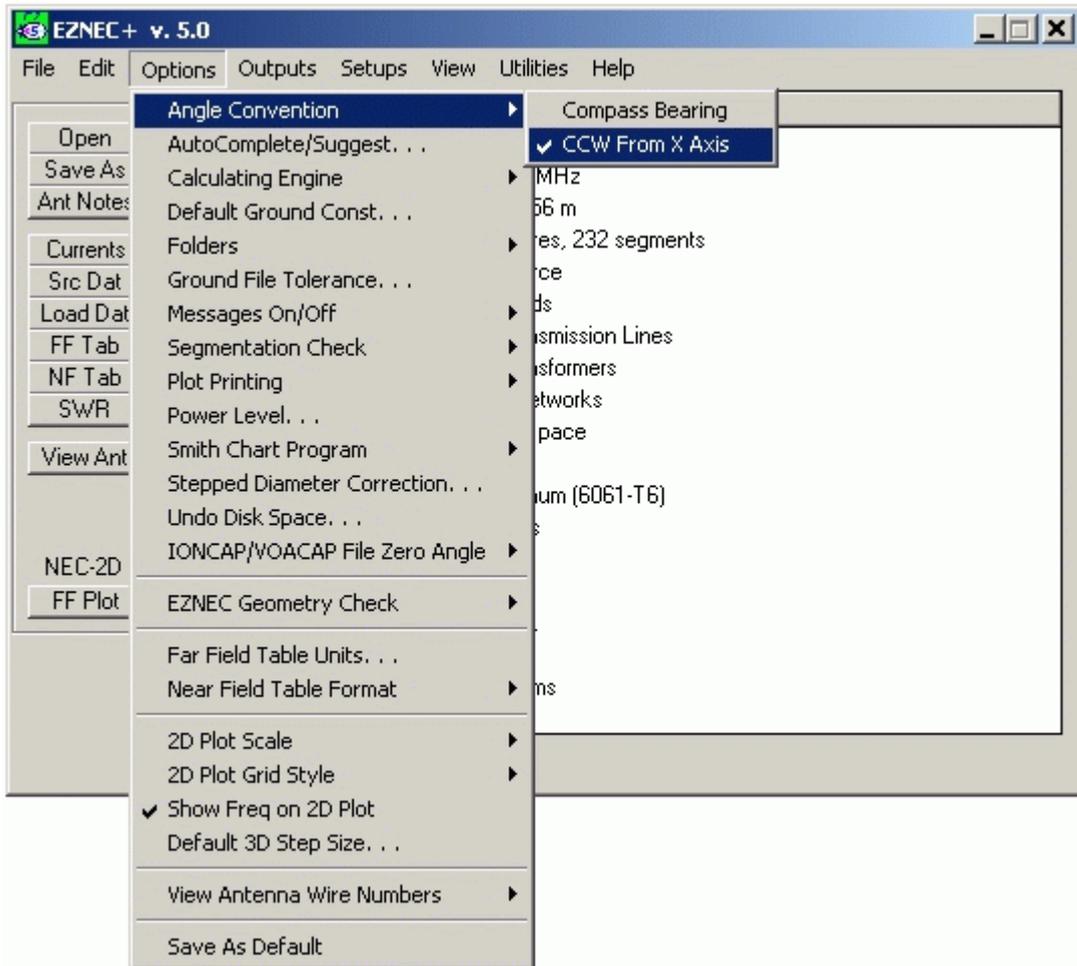
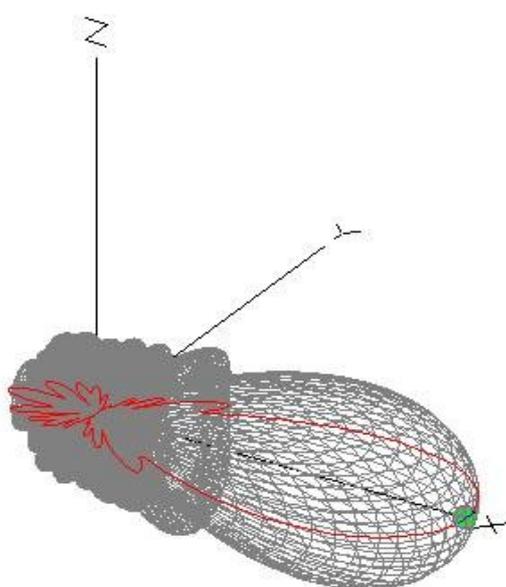


Fig. 3



Next run Far Field Plot <”FF Plot”> with “Plot Type” = “3 Dimensional” to create the “3 D Plot” radiation pattern.

**Left:**

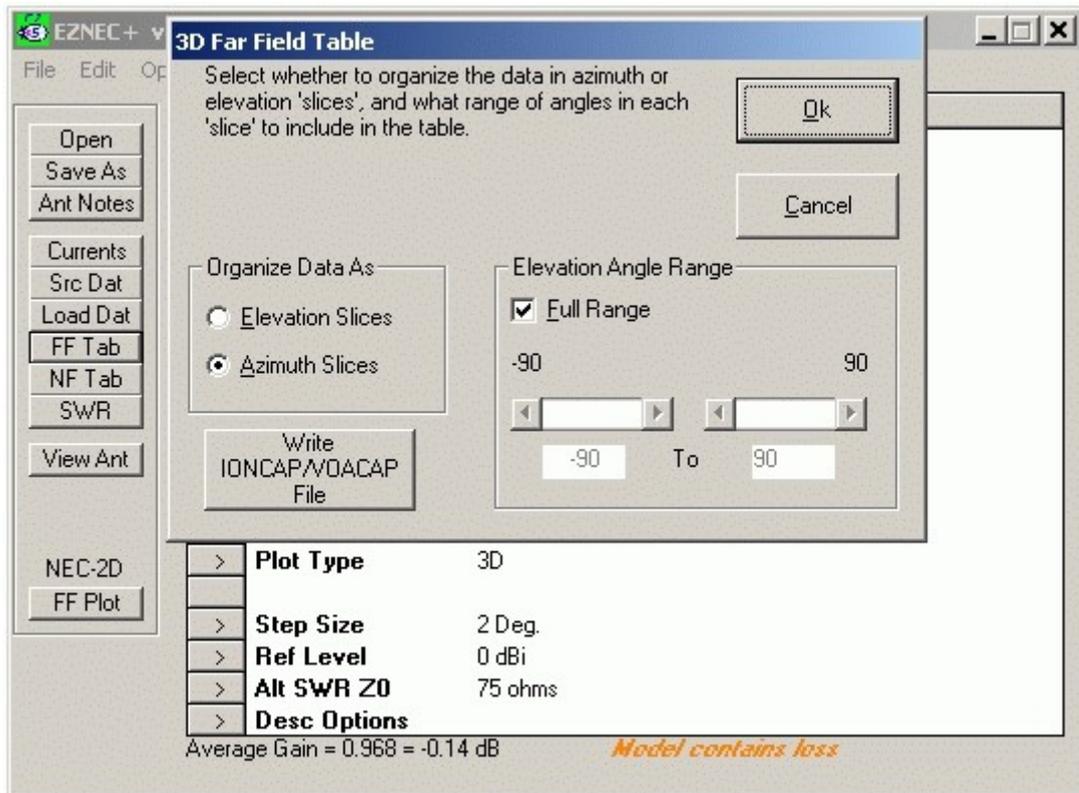
This is what your 3D pattern should look like (you do not need to highlight the azimuth slice as in this example).

**Pattern must not necessarily be symmetrical** since there are no shortcuts being taken in the TANT computing engine. The entire pattern must be present and integration is always over the entire space. Just make sure, that all axis are in place and maximum gain occurs at elevation angle = 0 deg. and azimuth angle = 0 deg.

**Step 3:** How to generate the Far Field Table that TANT shall use to compute the antenna temperature and G/T ratio.

Clicking the “FF Tab” button produces the **3D Far Field Table – Form** (see below).

Fig. 4



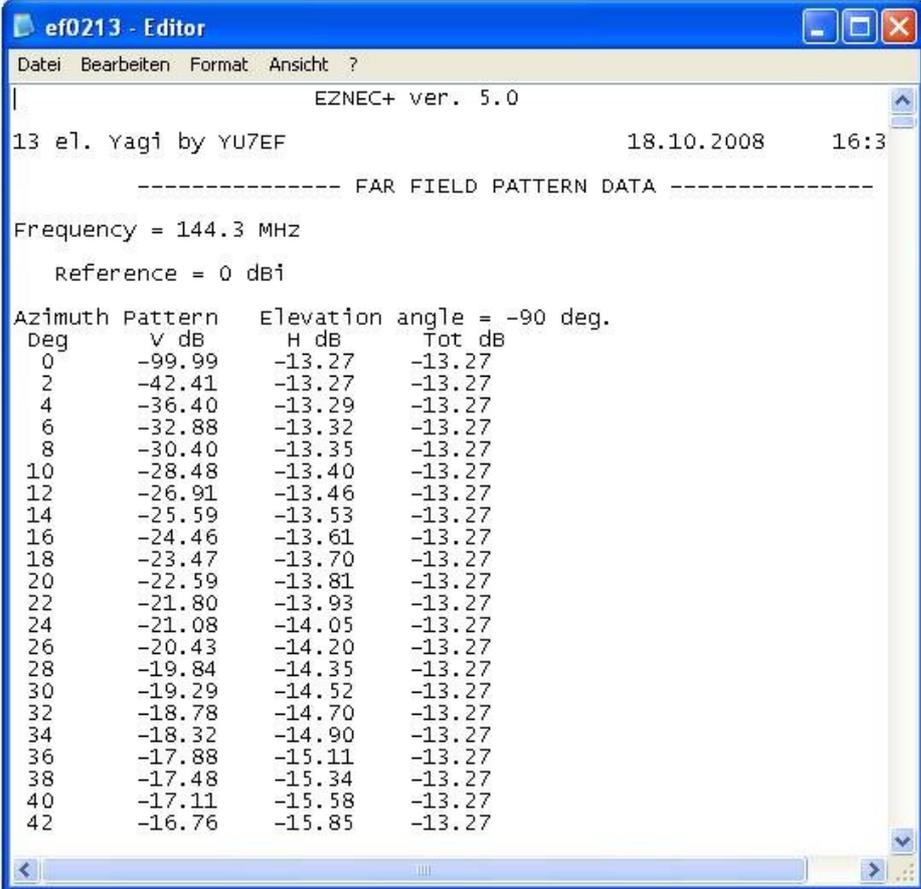
Select option “**Azimuth Slices**” and check “**Full Range**”.

Press “**Ok**” button and EZNEC will generate a .txt file containing the Far File data in a table.

The FF Tab – file you just generated should look like this:

The content of the second line may vary of course as it is depending on your comments to the NEC file. Valid for correct calculations by TANT is the Reference level of 0 dBi and the tables following the header. See notes below on Decimal Separator.

Fig. 5



```
ef0213 - Editor
Datei Bearbeiten Format Ansicht ?
EZNEC+ ver. 5.0
13 e1. Yagi by YU7EF 18.10.2008 16:3
----- FAR FIELD PATTERN DATA -----
Frequency = 144.3 MHz
Reference = 0 dBi
Azimuth Pattern Elevation angle = -90 deg.
Deg V dB H dB Tot dB
0 -99.99 -13.27 -13.27
2 -42.41 -13.27 -13.27
4 -36.40 -13.29 -13.27
6 -32.88 -13.32 -13.27
8 -30.40 -13.35 -13.27
10 -28.48 -13.40 -13.27
12 -26.91 -13.46 -13.27
14 -25.59 -13.53 -13.27
16 -24.46 -13.61 -13.27
18 -23.47 -13.70 -13.27
20 -22.59 -13.81 -13.27
22 -21.80 -13.93 -13.27
24 -21.08 -14.05 -13.27
26 -20.43 -14.20 -13.27
28 -19.84 -14.35 -13.27
30 -19.29 -14.52 -13.27
32 -18.78 -14.70 -13.27
34 -18.32 -14.90 -13.27
36 -17.88 -15.11 -13.27
38 -17.48 -15.34 -13.27
40 -17.11 -15.58 -13.27
42 -16.76 -15.85 -13.27
```

Save this file using the “**8+3 DOS filename**” convention. In straight words: use a name with 6 characters followed by a period dot and ending “txt” (example: “ef0213.txt”).

**Important Note:**

Decimal separator for the table values must be a period “.” as TANT cannot handle the comma “,” that you might eventually get due to the regional settings your Windows Controls. EZNEC does not provide the choice of what separator to use (see EZNEC User Manual on “Decimal Separator”). TANT will react on the comma separator with immediate shut down.

If you dislike manipulating your PC’s Windows settings you may load the FF Tab file in some advanced Text Editor like MS Word or Open Office Writer and exchange commas with periods using the auto – replace function on whole text. Then save in .txt format again.

Do not try this in MS-Editor: it will take ages to replace the average of 10,000 ... 40,000 commas by periods.

## How to run TANT

Start TANT by double clicking the TANT.exe file.

Fig. 6



```
C:\PROGRA-1\EZWA\Ant\tant\tant.exe

TANT 1.2  (April 23, 2006)  by Sinisa YT1NT, UE3EA
Computes Antenna Temperature and G/T Ratio
for elevations from 0 to 90 degrees in steps of 5 degrees.
(Uniform Sky and Earth temperatures assumed.)

Using the program:

  1. Model your antenna in free space using EZNEC 3 or 4.

     a. Maximum gain must occur at elevation = 0 and azimuth = 0.
     b. In Options, Far Field Table Units: select dBi.
     c. In Desc Options, Plot, Fields: select Total field for 3D.
     d. Set Plot Type to 3D, and Step Size to 1, 2 or 3 degrees.
     e. Click FF Tab button, wait, select Azimuth Slices, check Full Range.
     f. Save the Far Field Pattern data to a folder using 8+3 DOS filename.

  2. Run TANT from the same folder and follow instructions.

Press any key to continue.
```

Press any key and then press “1” to type in your FF Tab file name (example ‘ef0213.txt’).

Fig. 7



```
C:\PROGRA-1\EZWA\Ant\tant\tant.exe

TANT 1.2  (April 23, 2006)  by Sinisa YT1NT, UE3EA
Computes Antenna Temperature and G/T Ratio
for elevations from 0 to 90 degrees in steps of 5 degrees.
(Uniform Sky and Earth temperatures assumed.)

Please Select:

  1. Far Field Pattern file = ef0213.txt      Only 8+3 DOS filenames can be used.
  2. Sky   Temperature [K] = 200.00
  3. Earth Temperature [K] = 1000.00
  4. Compute
  5. Help
  6. Quit

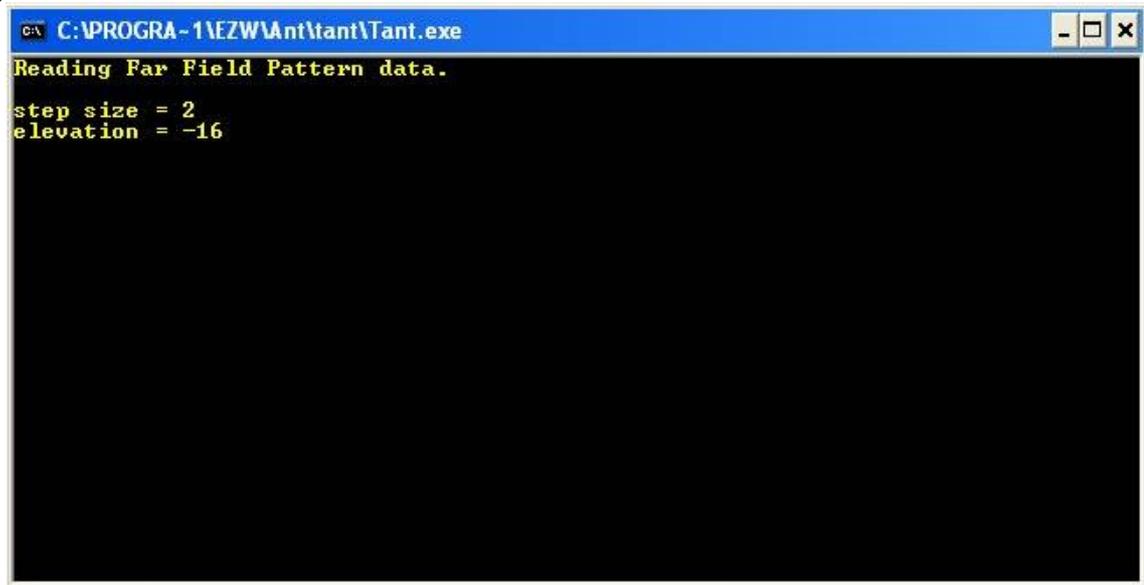
Please select option 1-6.
```

Then press “Return”. Finally press “4” to compute your file.

The advanced user may vary “Sky Temperature” and “Earth Temperature” in similar manner. Do not change these figures at the moment and do not change them if you like to compare your data with the well acknowledged standard in the VE7BQH Temperature and G/T ratio Table (which is based on these environment temperatures and 30 degrees of antenna elevation angle) for analysis on 144 MHz. See § Setting Sky – and Earth temperatures.

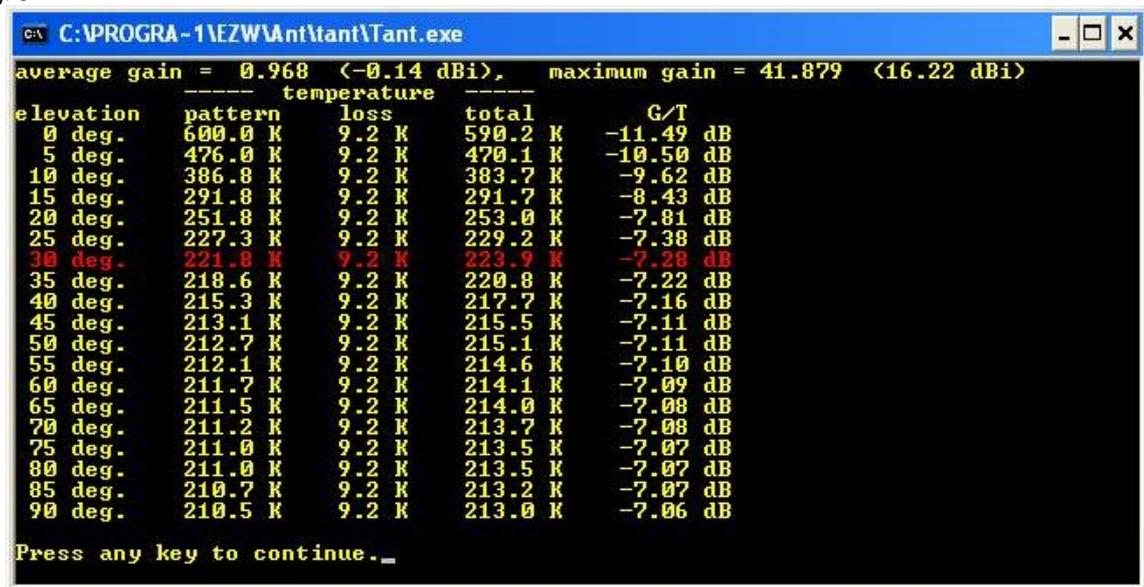
If TANT is running properly it shall look like this while computing:

Fig. 8



And this is what the output looks like:

Fig. 9



Note the red line for the 30 degrees elevation angle for easier comparison with Yagi Analysis 3.54 (YA 3.54). This became the standard angle since it was chosen by DJ9BV as being a typical elevation angle [of the antenna] for EME applications. But there is nothing magic about 30 degrees. Depending on the application, some other elevation angle may be of more use for you.

Values in this example are referring to the EF0213 Yagi.

## How to interpret results

Antenna temperature in TANT is computed in and displayed in 3 values:

**Tpattern** - applies to a lossless antenna with exactly the same **shape** of the pattern as for Ttotal. This is arrived at by compensating for the loss as calculated below; Tpattern shows the "directional qualities" of the antenna pattern, ignoring ohmic losses.

**Ttotal** - applies to the antenna pattern exactly as supplied by EZNEC = Tant

**Tloss** = Ttotal - (Tpattern attenuated by the loss)

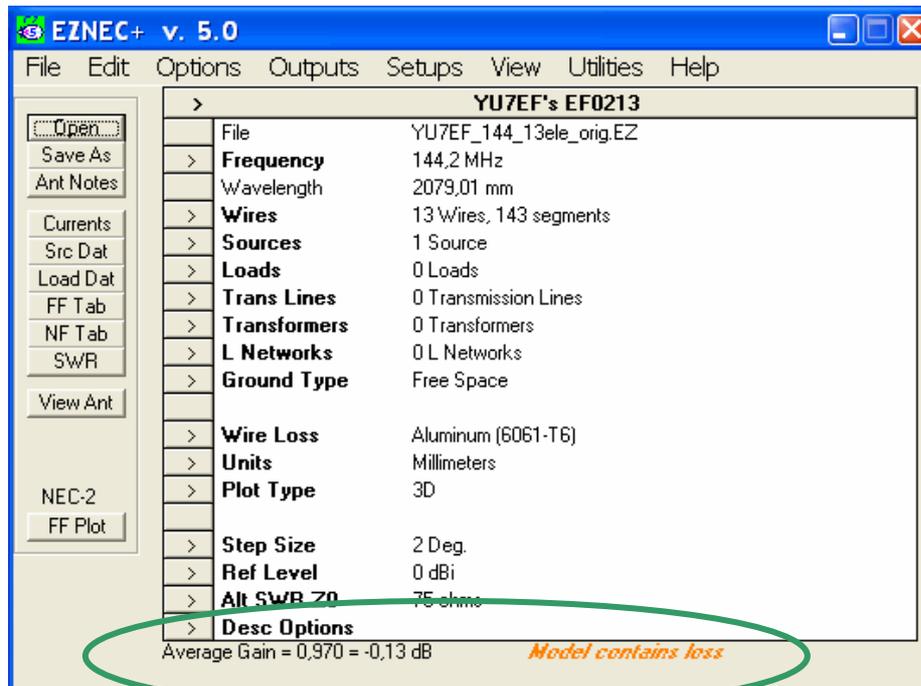
These are explanations in short given by YT1NT. For details the reader might refer to "Antenna G/T Calculators with Open Source Code, Part 1" in Dubus 1/2017.

The information on ohmic losses is contained in the EZNEC and 4nec2 Far Field Table. It is the difference between 0.00 dBi and power gain averaged over all directions = Average Gain. The Average Gain with Wire Losses turned to 'Zero' is 1.000 for an ideal NEC model; the Average Gain employing real Material Losses must be < 1.000. The difference is the Loss expressed in Tloss [K]. To add the temperature of the Loss to the Pattern temperature it has to be converted into Loss L [/]:

$$T_{total} = \frac{T_{pattern} + (L - 1) 290 K}{L} \quad \text{using } L \text{ [/] expressed as } L = \frac{T_{loss}}{290 K} + 1$$

The Average Gain is displayed on the Bottom Line of the EZNEC main window once you have run the 3D far field plot (see EZNEC User Manual on "Average Gain"):

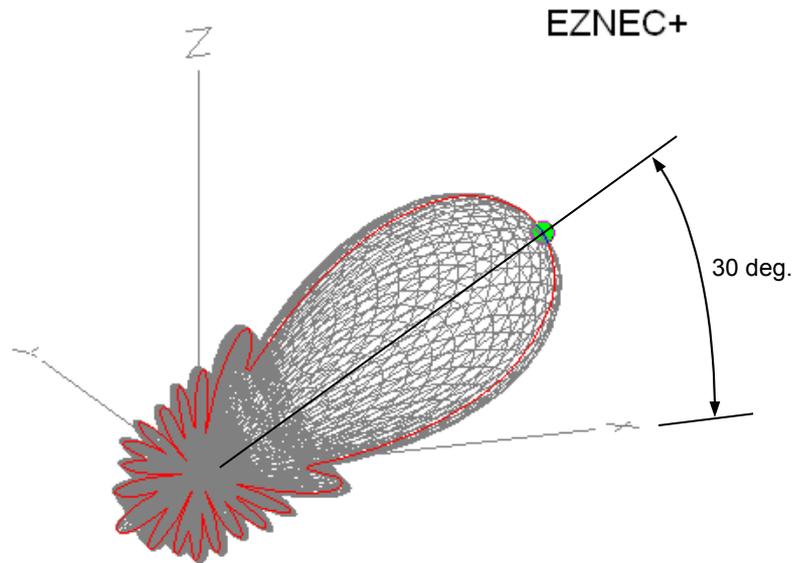
Fig. 10



**Antenna elevation:**

The following picture shows the Far Field of the example yagi in 30 deg. elevation. Do not arrange wires i.e. antenna in EZNEC in that position yourself since you would loose the “maximum gain at 0°” convention. **This picture is for demonstration only.** TANT does this virtually for you in the output in steps of 5° over a variation from 0 to 90°.

Fig. 11



Example: YU7EF ‘EF0213’ - 13 element yagi for 144 MHz in EZNEC+ v 5.0

At an antenna elevation of 0° the  $T_{\text{pattern}}$  is always the average of  $T_{\text{Sky}}$  and  $T_{\text{Earth}}$  for any antenna having a symmetrical pattern relative to the horizontal plane, regardless of the actual pattern, gain, losses, F/B, F/S or sidelobe level (see Excursion on terrestrial operation).

**G/T ratio:** (as from VE7BQH G/T simulation table descriptions)

G/T ratio is a figure of merit used to determine the receive capability of the antenna:

$$G/T = (G_a + 2.15) - (10 \cdot \log T_a) \quad [\text{dB}]$$

Example, using the EF0213 data:

$$\begin{aligned} G/T &= (14.07 \text{ dBd} + 2.15 \text{ dB}) - (10 \cdot \log 223.9 \text{ K}) \\ &= 16.22 \text{ dB(i)} \quad - (10 \cdot \log 223.9 \text{ K}) \\ &= 16.22 \text{ dB} \quad - 23.50 \text{ dB} \\ &= -7.28 \text{ dB} \end{aligned}$$

Interpretation: More positive (i.e. less negative) figures are better.

Antenna gain  $G_a$  is in dB vs. dipole (dBd). The addition of 2.15 dB matches a figure vs. isotropic radiator (dBi). Temperature is expressed in dB by conversion with  $10 \cdot \log$ .

## Setting Sky and Earth temperatures (added by DG7YBN)

To compare two antennas regarding Tant or G/T ratio, the employed **Tsky**, **Tearth** and **antenna elevation** angle must be identical. When publishing a Tant figure, one should enclose the chosen temperatures and elevation when diverse to the standards given below.

### Notes on Tsky:

At VHF and above the noise pick up from the sky is cosmic noise radiated from sources like the sun, galaxies and quasars. The noise power varies with frequency and direction. Some parts of sky are called 'hot' while those emitting the least radiation are called 'cold sky'. As TANT uses a uniform Tsky an average over the full sky sphere must be established.

### Notes on Tearth:

In the real world man made noise adds to that theoretical value. City or industrial environments bring up average values of 2000 K peaking 5000 K easily on 144 MHz \*.

#### 144 MHz

As stated before, the well acknowledged standard in the VE7BQH Temperature and G/T ratio table for 144 MHz arrays uses: **Tsky = 200 K, Tearth = 1000 K, elev. = 30 deg.**  
However I see these values fitting: **Tsky = 250 K, Tearth = 1000 K, elev. = 30 deg**

#### 432 MHz

The figures descending from the before mentioned article by DJ9BV are being used by most amateur radio antenna designers: **Tsky = 20 K, Tearth = 350 K, elev. = 30 deg.**

Other sources and suggestions for Tsky:

- Tsky = 40 K (YU1AW, "VHF Antenna Noise Temperature", antenneX No.132, Apr. 2008)

#### 1296 MHz and above

The following figures may be reasonable: **Tsky = 10 K, Tearth = 290 K, elev. = 30 deg.**

\*) It may be effective to take a 360° sweep of noise at your location against a termination resistor at the antenna feed point as a 290 K base value. Then average your readings and subtract Tsky. This value may be used as Tearth in the Tant calculation for your private receiving system noise analysis.

## What does that mean to terrestrial low signal communication?

Excursion by YT1NT (edited by DG7YBN):

May we consider a general case of an antenna with a symmetrical elevation pattern i.e. equal top and bottom half-spaces. This is always the case with

- Single Yagis
- Multiple Horizontally Stacked Yagis
- Multiple Vertically Stacked Yagis

with symmetrical current distributions, when all of these antennas are operated with an elevation of 0 degrees. In other words, this is almost always the case in terrestrial communication.

Under these conditions, the 'antenna temperature' does **not** depend at all on the radiation pattern, and it is always:

$$T_{\text{ant}} = (T_{\text{sky}} + T_{\text{earth}}) / 2 \quad \text{(ignoring ohmic losses)}$$

As TANT is assuming uniform sky and earth temperatures for the full sight (360° turn) of sky sphere respectively earth up to horizon what you get is just the medium value between  $T_{\text{sky}} = 200 \text{ K}$  and  $T_{\text{Earth}} = 1000 \text{ K}$ .

Every per coordinate determined infinitesimal patch of environment in the sky has a complementary patch on the ground. Since the antenna pattern is symmetric, the gain per sky patch and complementary earth patch is equal. Hence all the integration mechanism may be crossed out of the equation. What is left may look as simple as this:

$$(200 \text{ K} + 1000\text{K}) / 2 = 600 \text{ K}$$

In straight words:

- $T_{\text{ant}}$  will stay the same as long as the elevation pattern is symmetrical.
- $T_{\text{ant}}$  will **not** depend on gain, sidelobes, F/B or F/R ratio, etc.

Does this mean that  $T_{\text{ant}}$  indicates absolutely **nothing** about antenna qualities for terrestrial communications? .... Yes, it indicates absolutely nothing if you take the  $T_{\text{ant}}$  – figure for 0° of antenna elevation angle as an objective. This follows from the assumptions underlying the definition of antenna temperature ( $T_{\text{ant}}$ ) and specifically the assumption that  $T_{\text{earth}}$  is the same in all directions. If  $T_{\text{earth}}$  is the same in all directions then sidelobes and F/B ratio do not matter on the issue of antenna temperature.

Of course, we all know that sidelobes and F/B ratio matter very much in real world terrestrial communication. But this is not taken into account in the  $T_{\text{ant}}$  definition. Thus consequently  $T_{\text{ant}}$ , as it is computed through constant  $T_{\text{sky}}$  and  $T_{\text{earth}}$  plus a pattern that is 100% symmetrical in both horizontal and vertical planes cannot express those valuable qualities of antennas for terrestrial communication. If we wanted to express the 'quality' of the antenna's directional pattern, we'd have to define different  $T_{\text{earth}}$  values in different directions. Until we do so, both, the assertions of  $T_{\text{ant}}$  and TANT are of limited use for terrestrial work. We may only deduce that a Yagi with lower  $T_{\text{ant}}$  than a referencing one at 30° elevation will be quieter in terrestrial work.

## TANT and Windows 7 / 8 / 10

TANT will not run on 64 Bit Operating Systems. Not matter what you try to run it in Windows 7 'compatibly' mode.

One way to get TANT working is to install DOSBOX ([www.dosbox.com](http://www.dosbox.com)). DOSBOX is free and an Open Source project. In the DOSBOX mount the folder containing TANT as if it would be a drive in UNIX and run it from there.

Below you find a brief description how to start TANT in DOSBOX (thanks to IZ2FLY).

DOSBOX prompt is DOS! ... you need to use some long forgotten DOS command lines ...

Lets imagine a folder named "my\_TANT" which holds the TANT.exe.  
It is placed right on drive c on your native windows installation.

When starting up DOSBOX it will appear as an extra drive, let it be 'z' in our example

```
(.) prompt is      z:\ > _
(1) type          mount c c:\my_TANT                & return
(.) prompt shows  Drive C is mounted as local directory c:\my_TANT
(.)              z:\ > _
(2) type          C:\                               & return
(.) prompt shows  C:\ > _
(3) add           TANT.exe                          & return
```

This should start TANT. Now proceed as usually.

What I found a bit peculiar is that you mount the folder 'my\_TANT' as drive c: here.  
Thus changing to c: in DOSBOX opens folder 'my\_TANT'.

Some old DOS commands that might help you

```
(1) 'x:\' & return =>    change to directory or drive x:
(1) 'cd..' & return =>   to step down one directory
(2) 'dir' & return =>    to list content of the current directory
```

You can even configure the DOSBOX autoexec.bat by a right side mouse click on its desktop icon. A DOSBOX properties window will open, in which you may lay down command lines the DOSBOX will execute at start up. Basically these may be same as in example above. Thus TANT can start automatically after DOSBOX is started when added to the autoexec.bat.

Please note: DOSBOX is Freeware. Though I explain how to use TANT in DOSBOX no guarantee is given whatsoever. Use DOSBOX at your own risk.

*Note: Windows 7, 8 and 10 are registered trademarks of Microsoft Corporation in the United States and/or other countries.*

## Notes from original readme.txt as far as not mentioned above

Antenna temperature and G/T [ratio] are not parameters of the [sole] antenna itself. Instead, they are parameters of the entire “antenna + ambient” system.

$T_{\text{total}} = T_{\text{loss}} + (T_{\text{pattern}} \text{ attenuated by loss})$ , exactly as  $T_A$  in DJ9BV’s article.

Whenever  $T_{\text{pattern}} > T_{\text{ref}}$  (290K), any antenna loss will LOWER the  $T_{\text{total}}$ , i.e. it will DECREASE the total noise power towards the thermal noise power at  $T_{\text{ref}}$ . Of course, this can not be used to improve G/T or S/N ratios.

Based on the equations presented by DJ9BV the pattern temperature ( $T_{\text{pattern}}$ ) is exactly the same as  $T_A$  in DJ9BV’s article. It represents the sum of “forward”, “sidelobe” and “backward” temperatures (which is likely not the same as the sum of similar named values in YA 3.54).

Please note that terms “forward”, “sidelobe” and “backward” in DJ9BV’s Article (and like wise in YA 3.54) have nothing to do with your antenna’s pattern. They are just unfortunately chosen names for differential parts of the integration surface, related to the 30 degrees elevation used and having no relation whatsoever to the actual antenna pattern.

[Rainer (DJ9BV) had to give some names to those sections in which he split the integration paths of the complete pattern surface.]

Please note that there is an error in DJ9BV’s article.

In section 4 the integration surface is partitioned incorrectly to “forward”, “sidelobe” and “backward” parts. As stated there, the partitioning is correct only for azimuth values of 0 and 180 degrees.\*

The noise temperature and G/T treatment in YA 3.54 seem to be based on DJ9BV’s article. However, with our antenna samples YA 3.54 results were in substantial agreement with TANT results, although it is not clear whether it was so because the error was small in the samples tested, or because YA 3.54 performed the integration correctly.

You can keep TANT running while you work in EZNEC. When you’re ready, save the pattern file and select Compute in TANT.

Bear in mind that 0.1 K accuracy in  $T_{\text{pattern}}$  or  $T_{\text{total}}$  would demand less than 0.002 dB error in pattern, which cannot be expected from NEC modelling. Even the resolution of 0.01 dB in the EZNEC pattern file is far better than actual accuracy.

(\*) see notes acc. DJ9BV in addendum on last page

## **Disclaimer**

No guarantee whatsoever, use TANT at your own risk.  
TANT is freeware, use TANT for any purpose you like.

## **Acknowledgements by Sinisa, YT1NT**

To YU1CF for numerous suggestions, testing and providing test samples and EZNEC patterns files.

To YT1NP for testing with EZNEC Demo versions.

To YU7EF and YU7XL for most stimulating discussion leading to the development of TANT.

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My own thanks go to YU7EF, who helped me generously to get TANT running, provided all the EZNEC screenshots and the fine 13 element yagi demonstration model as an advanced selection from his Low Temperature Antenna Gallery (see [www.yu7ef.com](http://www.yu7ef.com) for more).

vy73, Hartmut, DG7YBN

## Addendum by DG7YBN and F5FOD

Please note that during the development of the *AGTC\_lite* program we found out that

- the DJ9BV's article contains no errors,
- his results are 100% exact for any antenna with a symmetrical pattern.

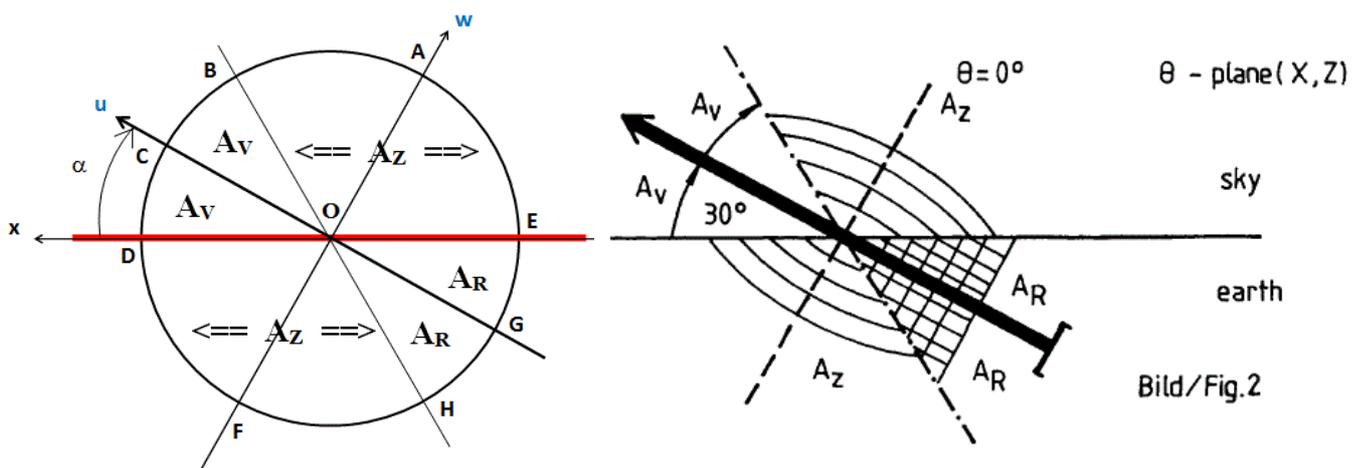
The corresponding mathematical demo is written in "Antenna G/T Calculators with Open Source Code, Part 4" in DUBUS 4/2017.

To clarify the names of zones we add the corresponding names we gave the zones in our independent derivation and drawings of these:

*Av*, *Forward* ... is forward = ahead the antenna,  
*Az*, *Sidlobe* ... are side lobes = sides of the antenna,  
*Ar*, *Backward* ... is backward = behind the antenna.

Left: as in our article in DUBUS 4/2017

Right: DJ9BV, DUBUS 4/1987



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A final note from myself, DG7YBN:

With v1.4 of the TANT Manual I will stop support for TANT and move on to *AGTC\_lite* as program for computing Antenna Temperature and G/T from Far Field Tables. For details on *AGTC\_lite* and download see here:

[http://dg7ybn.de/Ant\\_soft/Antenna\\_GT\\_f5fod.htm](http://dg7ybn.de/Ant_soft/Antenna_GT_f5fod.htm)