

# VE7BQH Antenna Tables

How to compute  $T_{\text{total}}$  and enter an Antenna into the Tables

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## 1 Intro

Up to 2010 things were relatively easy.

1. An Antenna was designed in EZNEC or 4nec2
2. the Far Field Table (FFtab) generated after running a simulation of a 3D radiation pattern
3. TANT-Software was started
4. the right  $T_{\text{sky}}$  and  $T_{\text{earth}}$  entered
5. this FFtab loaded and computed.
6. Voila, Values for  $T_{\text{total}}$ ,  $T_{\text{loss}}$  and  $G/T_a$  were derived to be filled into the columns of the Excel Table.

With the change to editable  $T_{\text{sky}}$ ,  $T_{\text{earth}}$  in 2019 things started looking complex for entering an Antenna into the Excel Tables.

In reality that is not so, as most of the values are being computed or extrapolated from 2 entries only. Which are

1.  $T_{\text{pattern}}$  at the stated *old reference for  $T_{\text{sky}}$ ,  $T_{\text{earth}}$*
2. Average Gain value (AG).
3. Gain may be read from EZNEC or 4nec2, if no subject to Convergence Correction

The values for  $T_{\text{loss}}$ ,  $G/T_a$ ,  $G/T_{\text{sys}}$ ,  $S/N$  will be computed in the MS Excel automatically, provided the value for Gain for the 4-bay also is entered.

Case A shows the procedure using EZNEC.

Case B in Step-by-Step Example shows the procedure using 4nec2.

While this paper refers to both TANT and AGTC the AGTC is used as a reference in the VE7BQH Tables. It is known, that TANT may produce marginally differing values.

Basics like creating a model of a 4-bay of Yagis, producing a Far Field Table file from it and how to run that in AGTC/TANT, reading the F/B and VSWR Bandwidth conform to the Tables, see:

TANT Appendix

[https://www.dxmaps.com/docs/TANT\\_Manual\\_Appendix\\_v1\\_1.pdf](https://www.dxmaps.com/docs/TANT_Manual_Appendix_v1_1.pdf)

## 2 Does my Antenna Model need Convergence Correction?

The AG value divides antennas into those that can be calculated easily and those that require Convergence Correction. The *lossless* model should ideally show an AG = 1.000. If it shows a value > 1.000 Convergence Correction must be applied.

There are at least three ways to find out, whether an antenna model needs to be corrected. For all of these (1) wire losses must be set to zero, (2) a 3D radiation pattern plot with (3) a resolution of 1 degree is to be derived.

### 2.1 Check Average Gain Value in EZNEC

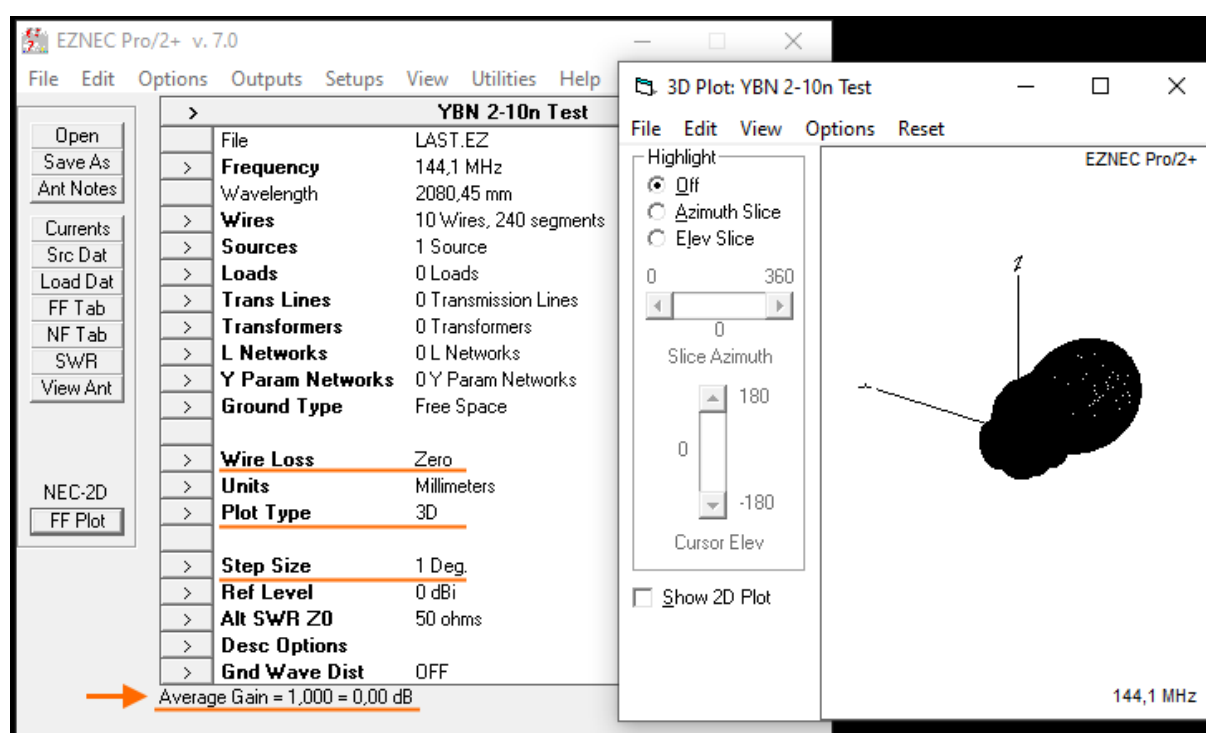
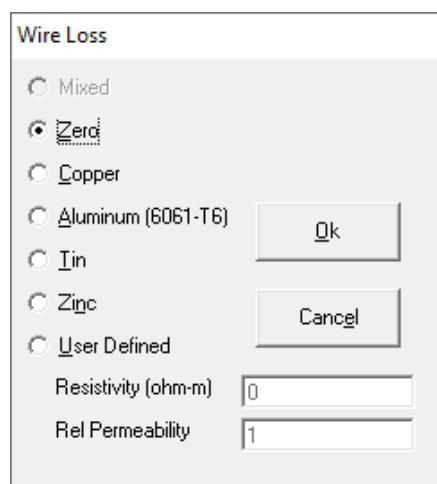


Fig. 2.1.1: EZNEC Pro/2+ v7.0 (identical in EZNEC v5, v6 etc.)



In EZNECs Main Window call *Wire Losses* > opt for 'Zero', choose *Plot Type* > 3D, set Step Size > 1 Degree.

With *Wire Losses* = Zero and a 3D-plot EZNEC shows the Average Gain value in the foot line of the Main Window.

## 2.2 Check Average Gain Value in 4nec2

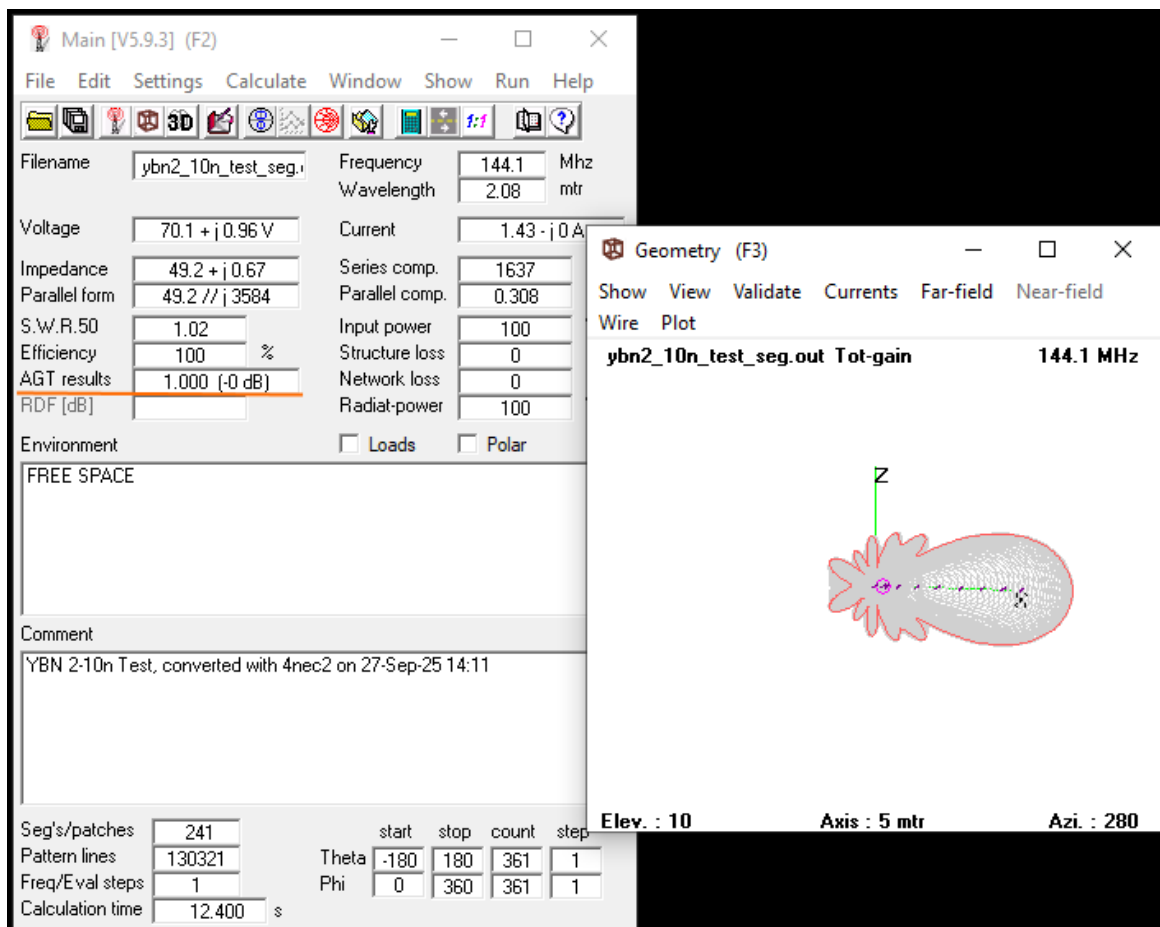
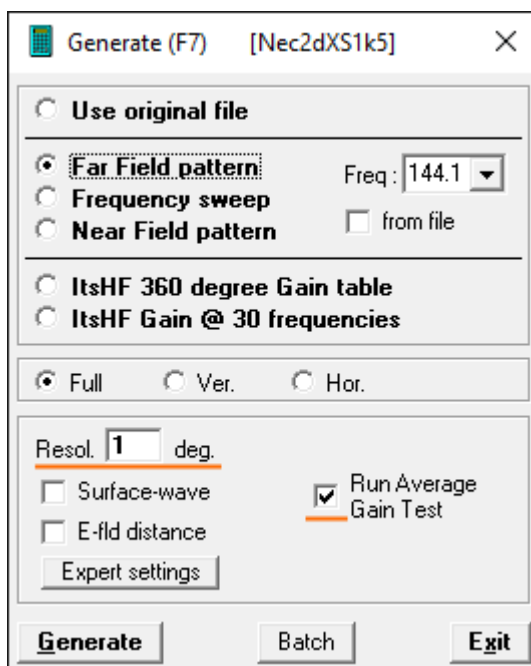


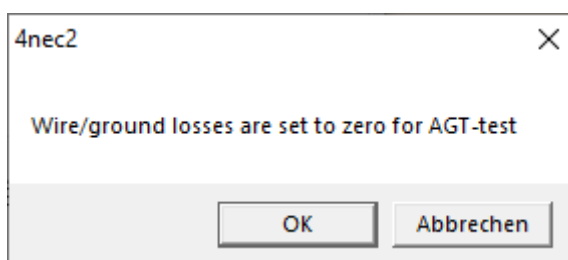
Fig. 2.1.2: 4nec2 v5.9.3 with Average Gain Test



Opt for 'Far Field Pattern', 'Full' and enter resolution = 1 degree.

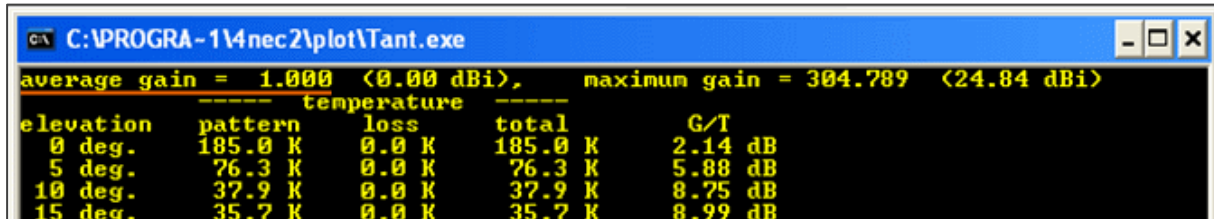
Upon checking 'Run Average Gain Test', a popup window 'Wire/ground losses are set to zero for AGT-test' opens, see below.

After running the analysis with these settings, the Average Gain value is displayed in the Main Window.



### 2.3 Check Average Gain Value using a Far Field Table

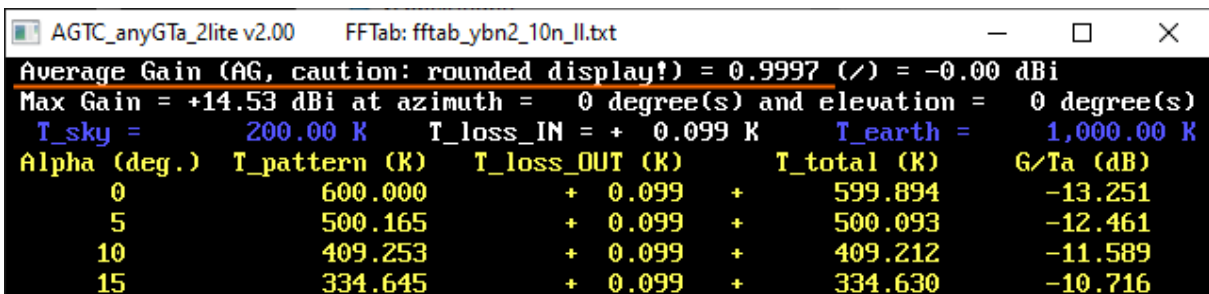
For producing a Far Field Table that is suitable to check on the Average Gain of an antenna model, as stated before (1) wire losses must be set to zero, (2) a 3D radiation pattern plot with (3) a resolution of 1 degree is to be derived.



The screenshot shows a window titled 'C:\PROGRA~1\4nec2\plot\Tant.exe'. It displays the following data:

| average gain = 1.000 <0.00 dBi>, maximum gain = 304.789 <24.84 dBi> |         |       |         |         |
|---|---------|-------|---------|---------|
| ----- temperature -----   |         |       |         |         |
| elevation   | pattern | loss  | total   | G/T     |
| 0 deg.  | 185.0 K | 0.0 K | 185.0 K | 2.14 dB |
| 5 deg.  | 76.3 K  | 0.0 K | 76.3 K  | 5.88 dB |
| 10 deg.   | 37.9 K  | 0.0 K | 37.9 K  | 8.75 dB |
| 15 deg.   | 35.7 K  | 0.0 K | 35.7 K  | 8.99 dB |

Fig. 2.3.1: Analysis of a *lossless* models Fftab in TANT-Software, AG = 1.000 > No Convergence Correction needed.



The screenshot shows a window titled 'AGTC\_anyGTa\_2lite v2.00' with the file 'FFTab: fftab\_ybn2\_10n\_II.txt'. It displays the following data:

| Average Gain (AG, caution: rounded display!) = 0.9997 (/) = -0.00 dBi      |                          |                                  |   |                                 |           |
|--|--------------------------|----------------------------------|---|---------------------------------|-----------|
| Max Gain = +14.53 dBi at azimuth = 0 degree(s) and elevation = 0 degree(s) |                          |                                  |   |                                 |           |
| T <sub>sky</sub> = 200.00 K  |                          | T <sub>loss_IN</sub> = + 0.099 K |   | T <sub>earth</sub> = 1,000.00 K |           |
| Alpha (deg.)   | T <sub>pattern</sub> (K) | T <sub>loss_OUT</sub> (K)        |   | T <sub>total</sub> (K)          | G/Ta (dB) |
| 0  | 600.000                  | + 0.099                          | + | 599.894                         | -13.251   |
| 5  | 500.165                  | + 0.099                          | + | 500.093                         | -12.461   |
| 10   | 409.253                  | + 0.099                          | + | 409.212                         | -11.589   |
| 15   | 334.645                  | + 0.099                          | + | 334.630                         | -10.716   |

Fig. 2.3.2 Analysis of a *lossless* models Fftab in AGTC-Software, AG = 0.9997 ~ 1.000 > No Convergence Correction needed.

### 3 Computing of $T_{\text{total}}$ and AG

#### 3.1 Case A: No Convergence Correction needed

If AG is  $\leq 1.000$ , only a single run in TANT or AGTC is needed.

1. Set program computing  $T_{\text{total}}$  and Gain to old reference for  $T_{\text{sky}}$ ,  $T_{\text{earth}}$
2. Compute the antenna model containing losses in the program computing  $T_{\text{total}}$  and Gain
3. Write up the values for Gain  $G$  in dBi,  $T_{\text{pattern}}$  at old reference for  $T_{\text{sky}}$ ,  $T_{\text{earth}}$  and AG.

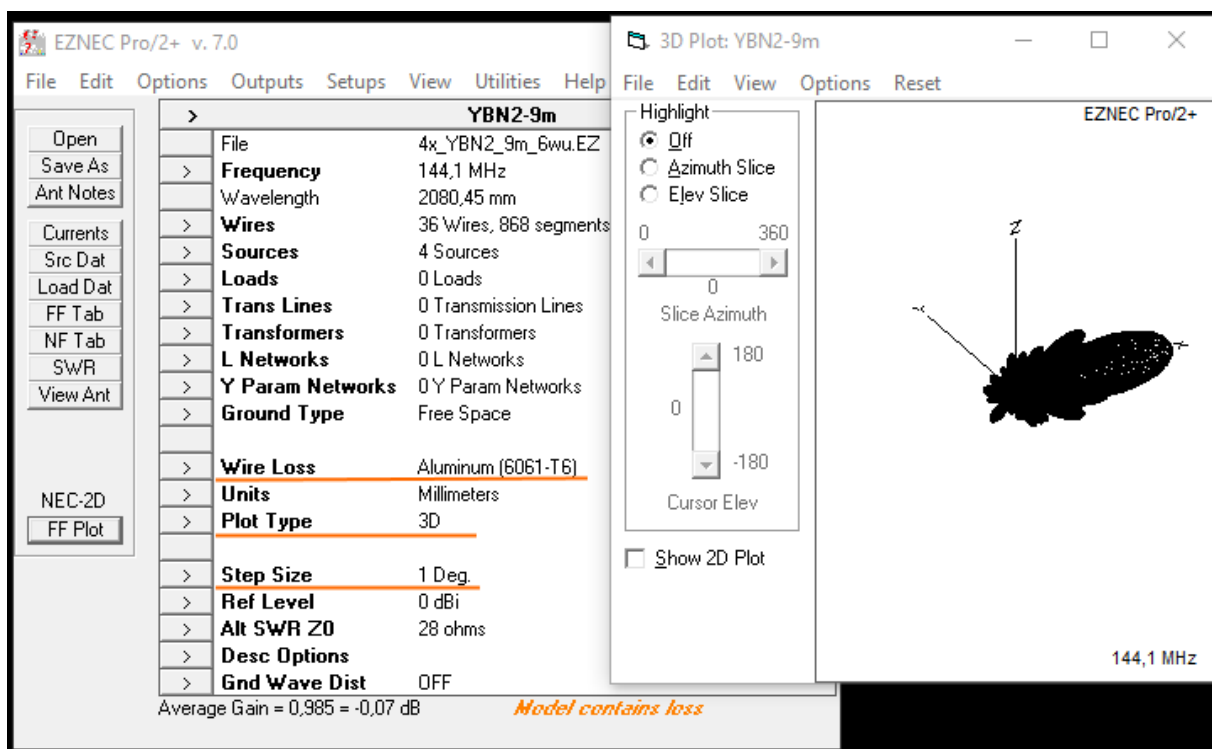


Fig. 3.1.1: EZNEC with all settings for computing a model *containing losses* to produce a Far Field Table

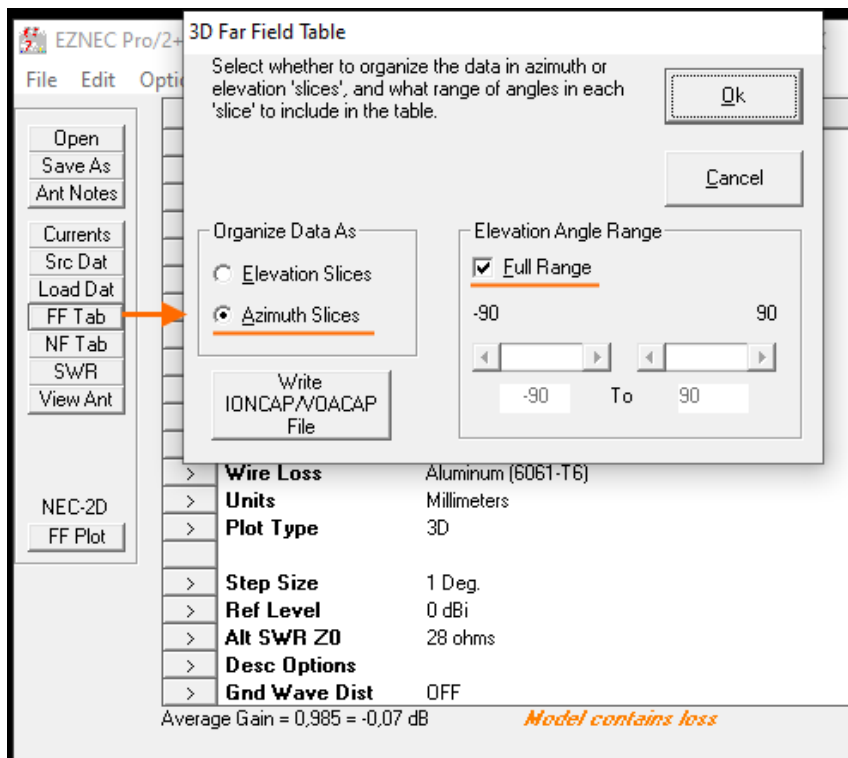


Fig. 3.1.2: How to produce a Far Field Table in EZNEC

Far Field Data

File Edit Search Format Help

EZNEC Pro/2+ ver. 7.0

YBN2-9m 30.09.2025 07:45:07

----- FAR FIELD PATTERN DATA -----

Frequency = 144,1 MHz

Reference = 0 dBi

Azimuth Pattern Elevation angle = -90 deg.

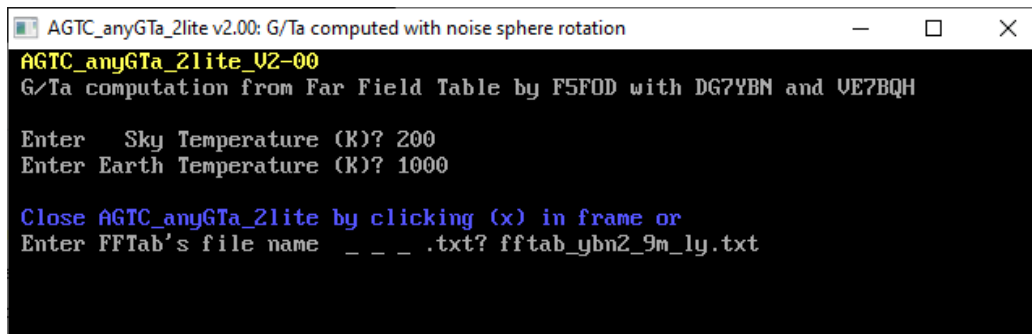
| Deg | U dB   | H dB   | Tot dB | U Pha   | H Pha |
|-----|--------|--------|--------|---------|-------|
| 0   | -99,99 | -23,42 | -23,42 | 0,00    | 58,52 |
| 1   | -58,58 | -23,42 | -23,42 | -121,48 | 58,52 |
| 2   | -52,56 | -23,42 | -23,42 | -121,48 | 58,52 |
| 3   | -49,04 | -23,43 | -23,42 | -121,48 | 58,52 |
| 4   | -46,55 | -23,44 | -23,42 | -121,48 | 58,52 |
| 5   | -44,61 | -23,45 | -23,42 | -121,48 | 58,52 |

Fig. 3.1.3: Far Field Table

Save as likewise 'fftab\_ybn2\_9m\_ly.txt' into the folder where your TANT or AGTC is located.

Now call TANT.exe in a DOSBOX or AGTC.

Enter Old Reference Temperatures for  $T_{\text{sky}}$ ,  $T_{\text{earth}}$  and the name of the Far Field Table (note, that in TANT only 5+8 DOS conform file names are allowed, like *antxy.txt*)



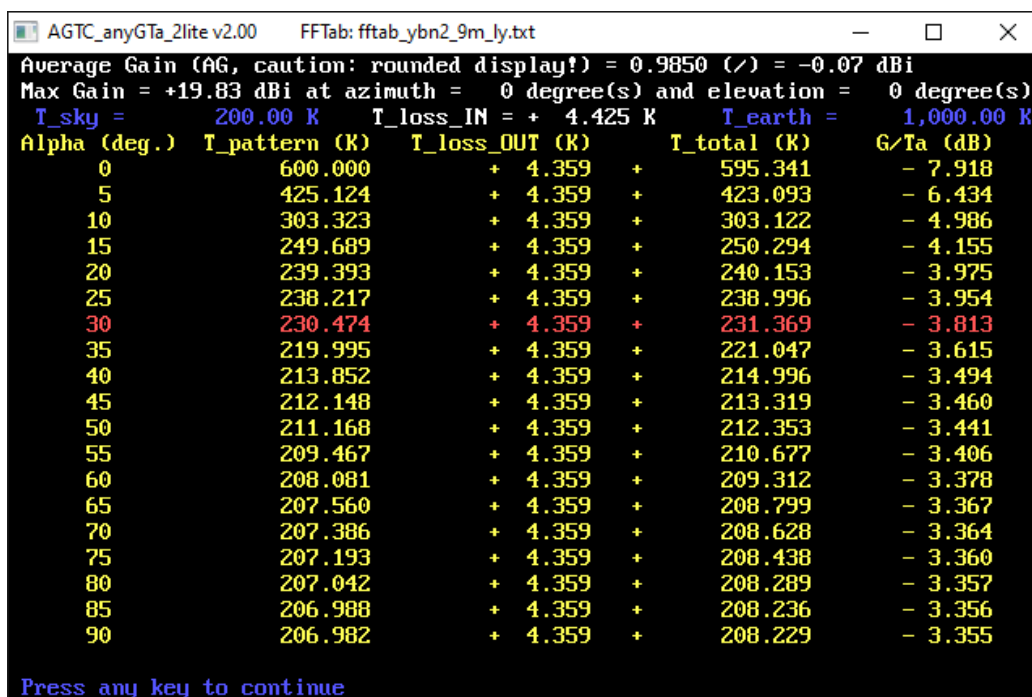
```

AGTC_anyGTa_2lite v2.00: G/Ta computed with noise sphere rotation
AGTC_anyGTa_2lite_V2-00
G/Ta computation from Far Field Table by F5FOD with DG7YBM and VE7BQH

Enter Sky Temperature (K)? 200
Enter Earth Temperature (K)? 1000

Close AGTC_anyGTa_2lite by clicking (x) in frame or
Enter FFTab's file name _ _ _ .txt? fftab_ybn2_9m_ly.txt
  
```

Fig. 3.1.4: AGTC in version anyGTa\_2lite v2.00 with entered temperatures and filename



```

AGTC_anyGTa_2lite v2.00    FFTab: fftab_ybn2_9m_ly.txt
Average Gain (AG, caution: rounded display!) = 0.9850 (°) = -0.07 dBi
Max Gain = +19.83 dBi at azimuth = 0 degree(s) and elevation = 0 degree(s)
T_sky = 200.00 K    T_loss_IN = + 4.425 K    T_earth = 1,000.00 K

Alpha (deg.)  T_pattern (K)  T_loss_OUT (K)  T_total (K)  G/Ta (dB)
0             600.000      + 4.359 +      595.341      - 7.918
5             425.124      + 4.359 +      423.093      - 6.434
10            303.323      + 4.359 +      303.122      - 4.986
15            249.689      + 4.359 +      250.294      - 4.155
20            239.393      + 4.359 +      240.153      - 3.975
25            238.217      + 4.359 +      238.996      - 3.954
30            230.474      + 4.359 +      231.369      - 3.813
35            219.995      + 4.359 +      221.047      - 3.615
40            213.852      + 4.359 +      214.996      - 3.494
45            212.148      + 4.359 +      213.319      - 3.460
50            211.168      + 4.359 +      212.353      - 3.441
55            209.467      + 4.359 +      210.677      - 3.406
60            208.081      + 4.359 +      209.312      - 3.378
65            207.560      + 4.359 +      208.799      - 3.367
70            207.386      + 4.359 +      208.628      - 3.364
75            207.193      + 4.359 +      208.438      - 3.360
80            207.042      + 4.359 +      208.289      - 3.357
85            206.988      + 4.359 +      208.236      - 3.356
90            206.982      + 4.359 +      208.229      - 3.355

Press any key to continue
  
```

Fig. 3.1.5: AGTC computed Far Field Table. Values to be used for entering into the Excel Table are  $T_{\text{pattern}}$  (30 degr.) = 230.474 K, AG = 0.9850.

### 3.2 Case B: Convergence Correction is needed

If AG is  $> 1.000$ , TANT or AGTC have to be run twice. Once with the antenna model *containing losses*, once with the *lossless* antenna model. It may be helpful to save the antenna design into two files, one lossless, one containing losses.

Suggestion

|   |  |
|---|--|
| <code>4x_Yagi_abc_dl6wu_minus_10perc_Iy.ez</code> | ... the file for the design <i>containing loss (lossy)</i> |
| <code>4x_Yagi_abc_dl6wu_minus_10perc_II.ez</code> | ... the file for the design <i>lossless</i>                |

1. Set TANT / AGTC to old reference for  $T_{\text{sky}}$ ,  $T_{\text{earth}}$
2. Compute the antenna model containing losses in the program computing  $T_{\text{total}}$  and Gain
3. Write down the values for Gain,  $T_{\text{pattern}}$  and Average Gain
4. Repeat same with the antenna model containing losses

Proceed with the Convergence Correction of the antenna data

5. Enter all the values into the Excels '*Convergence Correction*' sheet



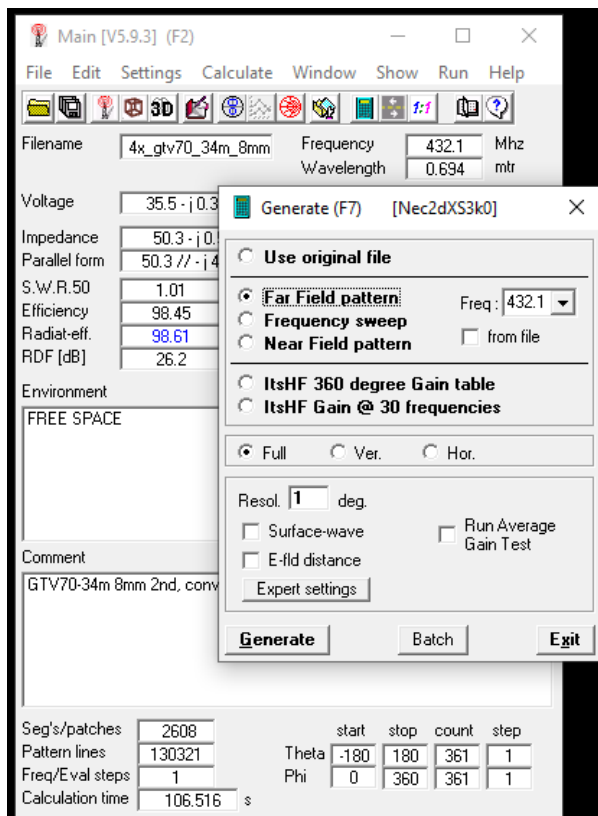
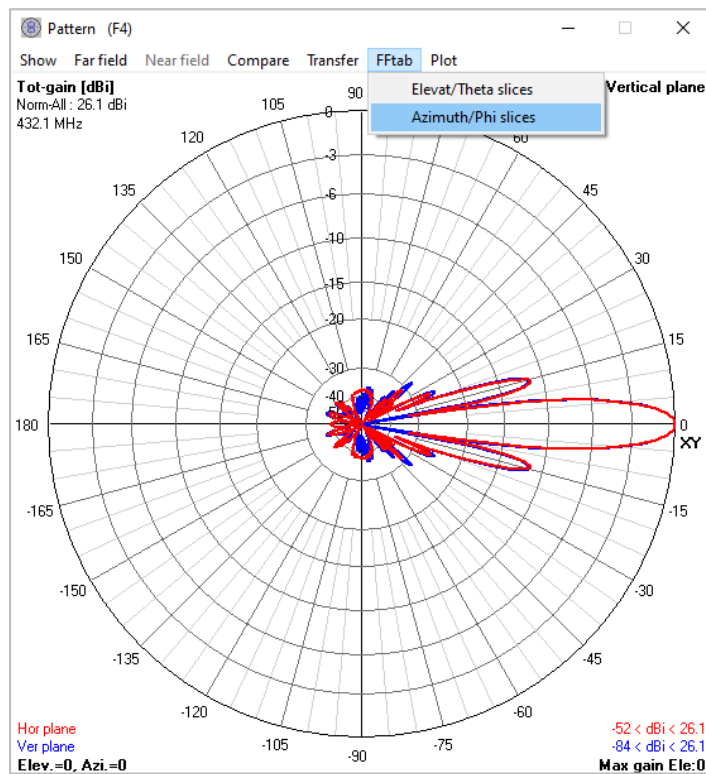


Fig. 3.3.3: 4nec2, Settings for producing a Full Pattern for a valid Far Field Table.

Produce a Far Field Table by using *Menu > Fftab > Azimuth/Phi slices*:



Repeat this for the model file for the lossless antenna, so that two Far Field Tables are produced.

Fig. 3.3.4: 4nec2's pattern window, full radiation pattern &gt; Menu &gt; Fftab &gt; Azimuth/Phi slices

Start AGTC and enter the old reference temperatures 20 K for  $T_{\text{sky}}$ , 350 K for  $T_{\text{earth}}$  and the FFTab of the model containing losses, 'gtv7034wly.txt' to be analysed.

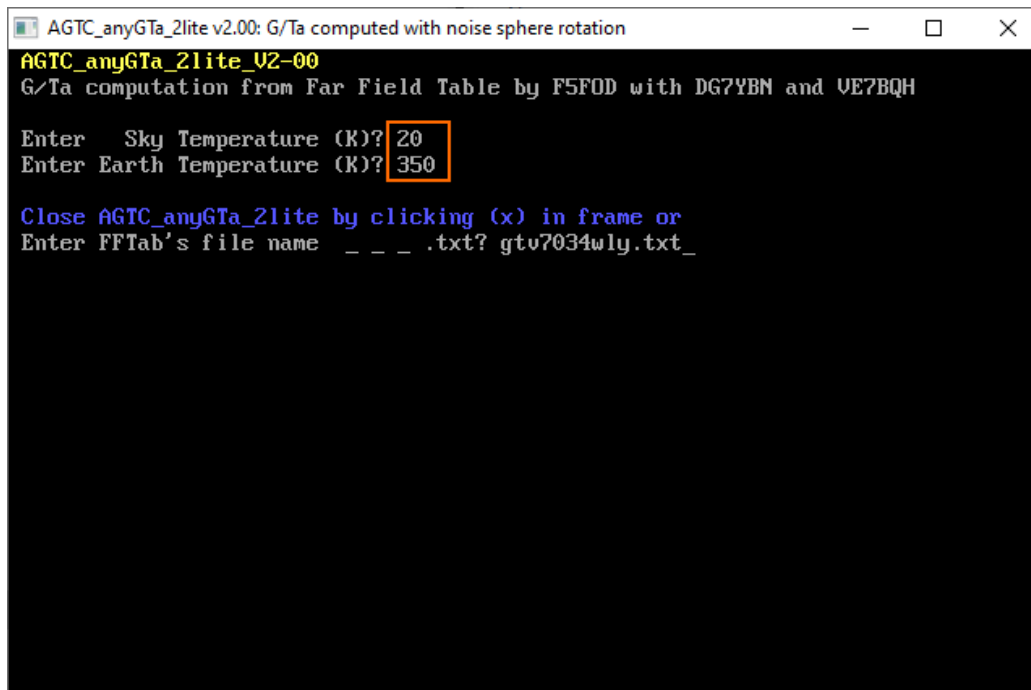


Fig. 3.3.5: AGTC in version anyGTa\_2lite v2.00 with entered temperatures and filename for the Far Field Table *with losses*

AGTC\_anyGTa\_2lite v2.00      FFTab: gtv7034wly.txt

Average Gain (AG, caution: rounded display!) = 0.9862 (✓) = -0.06 dBi

Max Gain = +26.10 dBi at azimuth = 0 degree(s) and elevation = 0 degree(s)

$T_{\text{sky}} = 20.00 \text{ K}$      $T_{\text{loss\_IN}} = + 4.072 \text{ K}$      $T_{\text{earth}} = 350.00 \text{ K}$

| Alpha (deg.) | $T_{\text{pattern}} \text{ (K)}$ | $T_{\text{loss\_OUT}} \text{ (K)}$ | $T_{\text{total}} \text{ (K)}$ | $G/Ta \text{ (dB)}$ |
|--------------|----------------------------------|------------------------------------|--------------------------------|---------------------|
| 0            | 185.000                          | + 4.016                            | 186.454                        | + 3.394             |
| 5            | 57.443                           | + 4.016                            | 60.664                         | + 8.271             |
| 10           | 34.484                           | + 4.016                            | 38.023                         | +10.300             |
| 15           | 28.557                           | + 4.016                            | 32.177                         | +11.024             |
| 20           | 23.458                           | + 4.016                            | 27.149                         | +11.762             |
| 25           | 22.726                           | + 4.016                            | 26.427                         | +11.879             |
| 30           | 22.518                           | + 4.016                            | 26.222                         | +11.913             |
| 35           | 22.489                           | + 4.016                            | 26.193                         | +11.918             |
| 40           | 22.337                           | + 4.016                            | 26.044                         | +11.943             |
| 45           | 22.161                           | + 4.016                            | 25.870                         | +11.972             |
| 50           | 22.070                           | + 4.016                            | 25.781                         | +11.987             |
| 55           | 22.040                           | + 4.016                            | 25.751                         | +11.992             |
| 60           | 22.036                           | + 4.016                            | 25.746                         | +11.993             |
| 65           | 22.032                           | + 4.016                            | 25.743                         | +11.993             |
| 70           | 22.015                           | + 4.016                            | 25.726                         | +11.996             |
| 75           | 21.993                           | + 4.016                            | 25.705                         | +12.000             |
| 80           | 21.974                           | + 4.016                            | 25.686                         | +12.003             |
| 85           | 21.962                           | + 4.016                            | 25.674                         | +12.005             |
| 90           | 21.962                           | + 4.016                            | 25.673                         | +12.005             |

Press any key to continue

Fig. 3.3.6: AGTC processed Far Field Table for the model *containing losses*

With losses: Gain = 26.10 dBi, AG = 0.9862,  $T_{\text{loss}} = 4.016 \text{ K}$ , read at 30 degr.:  $T_{\text{pattern}} = 22.518 \text{ K}$ ,  $T_{\text{total}} = 26.222 \text{ K}$ ,  $G/T_a = 11.913 \text{ dB/K}$

Start AGTC anew and enter the FFTab of the lossless model, 'gtv7034wll':

```

AGTC_anyGTA_2lite v2.00: G/Ta computed with noise sphere rotation
AGTC_anyGTA_2lite_V2-00
G/Ta computation from Far Field Table by F5FOD with DG7YBN and VE7BQH

Enter Sky Temperature (K)? 20
Enter Earth Temperature (K)? 350

Close AGTC_anyGTA_2lite by clicking (x) in frame or
Enter FFFab's file name _ _ _ .txt? gtv7034wll.txt

```

Fig. 3.3.7: AGTC in version anyGTA\_2lite v2.00 with entered temperatures and filename for the Far Field Table *with losses*

```

AGTC_anyGTA_2lite v2.00      FFFab: gtv7034wll.txt
Average Gain (AG, caution: rounded display!) = 1.0015 (/) = +0.01 dBi
Max Gain = +26.16 dBi at azimuth = 0 degree(s) and elevation = 0 degree(s)
T_sky = 20.00 K    T_loss_IN = - 0.430 K    T_earth = 350.00 K
Alpha (deg.)  T_pattern (K)  T_loss_OUT (K)  T_total (K)  G/Ta (dB)
0             185.000      - 0.431 +      184.844      + 3.492
5             57.459      - 0.431 +      57.114       + 8.593
10            34.499      - 0.431 +      34.119       +10.830
15            28.559      - 0.431 +      28.170       +11.662
20            23.444      - 0.431 +      23.048       +12.534
25            22.712      - 0.431 +      22.315       +12.674
30            22.503      - 0.431 +      22.106       +12.715
35            22.474      - 0.431 +      22.076       +12.721
40            22.323      - 0.431 +      21.925       +12.751
45            22.148      - 0.431 +      21.750       +12.785
50            22.058      - 0.431 +      21.660       +12.803
55            22.028      - 0.431 +      21.630       +12.809
60            22.024      - 0.431 +      21.626       +12.810
65            22.021      - 0.431 +      21.623       +12.811
70            22.004      - 0.431 +      21.606       +12.814
75            21.983      - 0.431 +      21.585       +12.818
80            21.965      - 0.431 +      21.567       +12.822
85            21.953      - 0.431 +      21.555       +12.825
90            21.952      - 0.431 +      21.554       +12.825

Press any key to continue Computed AG >= 1.001, G/Ta corrections may be needed

```

Fig. 3.3.8: AGTC processed Far Field Table for the *lossless* model. Note the negative loss value (!)

Lossless: Gain = 26.16 dBi, AG = 1.0015,  $T_{\text{loss}} = -0.431$  K, read at 30 degr.:  $T_{\text{pattern}} = 22.503$  K,  
 $T_{\text{total}} = 22.106$  K,  $G/T_a = 12.715$  dB/K

## 4 Convergence Correction

Any issue of the VE7BQH Antenna Table Excel since 2012 contains a sheet 'Convergence Correction'.

Just enter the data produced as in 3.3:

Lossless:

Gain = 26.16 dBi

AG = 1.0015

$T_{\text{pattern}}$  = 22.503 K (read at 30 degr.)

With losses:

Gain = 26.10 dBi

AG = 0.9862

$T_{\text{pattern}}$  = 22.518 K (read at 30 degr.)

|    | A | B | C | D | E | F | G | H | I | J | K | L |
|----|---|---|---|---|---|---|---|---|---|---|---|---|
| 1  |   |   |   |   |   |   |   |   |   |   |   |   |
| 2  |   |   |   |   |   |   |   |   |   |   |   |   |
| 3  |   |   |   |   |   |   |   |   |   |   |   |   |
| 4  |   |   |   |   |   |   |   |   |   |   |   |   |
| 5  |   |   |   |   |   |   |   |   |   |   |   |   |
| 6  |   |   |   |   |   |   |   |   |   |   |   |   |
| 7  |   |   |   |   |   |   |   |   |   |   |   |   |
| 8  |   |   |   |   |   |   |   |   |   |   |   |   |
| 9  |   |   |   |   |   |   |   |   |   |   |   |   |
| 10 |   |   |   |   |   |   |   |   |   |   |   |   |
| 11 |   |   |   |   |   |   |   |   |   |   |   |   |
| 12 |   |   |   |   |   |   |   |   |   |   |   |   |
| 13 |   |   |   |   |   |   |   |   |   |   |   |   |
| 14 |   |   |   |   |   |   |   |   |   |   |   |   |
| 15 |   |   |   |   |   |   |   |   |   |   |   |   |
| 16 |   |   |   |   |   |   |   |   |   |   |   |   |
| 17 |   |   |   |   |   |   |   |   |   |   |   |   |
| 18 |   |   |   |   |   |   |   |   |   |   |   |   |
| 19 |   |   |   |   |   |   |   |   |   |   |   |   |
| 20 |   |   |   |   |   |   |   |   |   |   |   |   |
| 21 |   |   |   |   |   |   |   |   |   |   |   |   |
| 22 |   |   |   |   |   |   |   |   |   |   |   |   |
| 23 |   |   |   |   |   |   |   |   |   |   |   |   |
| 24 |   |   |   |   |   |   |   |   |   |   |   |   |

**Correction of convergence errors**

Author: Brian V. Cake KF2YN ( ... formatted by DG7YBN)

Enter the data from EZNEC or TANT in cells F11 thru F13 and M11 thru M13 (Simply type over the example data)  
Excel will automatically compute the true gain, G and the true G/Ta

|                                  |        |     |
|----------------------------------|--------|-----|
| <b>ZERO Loss:</b>                |        |     |
| Gain (Go)                        | 26,160 | dBi |
| Average gain (Ko)                | 1,0015 | /   |
| Pattern temp. (T_Pattern), (Tpo) | 22,503 | K   |
| <b>With Loss:</b>                |        |     |
| Gain (G)                         | 26,100 | dBi |
| Average gain (K)                 | 0,9862 | /   |
| Pattern temp. (T_Pattern), (Tpl) | 22,518 | K   |
| <b>Corrected numbers:</b>        |        |     |
| Gain                             | 26,087 | dBi |
| Avg Gain                         | 0,9847 | /   |
| T_pattern                        | 22,503 | K   |
| T_loss                           | 4,430  | K   |
| Ta, antenna temp. T_total        | 26,590 | K   |
| G/T                              | 11,840 | dB  |

432.1 MHz Table
144.1 MHz Table
50.15 MHz Table
NF Calculator
**Convergence Correction**
...

Fig. 4.1: Convergence Correction sheet of the VE7BQH Antenna Tables Excel

For entering this antenna to the Tables Excel we need only these *corrected values*:

Gain = 26.087 dBi

$T_{\text{pattern}}$  = 22.503 K

AG = 0.9847

## 5 Enter this antenna into the VE7BQH Excel Table

1. Insert a new row in the Excel Table at fitting length of the antenna

|                  |              |            |       |       |                      |                       |                        |                         |                           |          |
|------------------|--------------|------------|-------|-------|----------------------|-----------------------|------------------------|-------------------------|---------------------------|----------|
|                  | Enter Tsky > |            | 27    | K     | Enter Tearth >       |                       | 1800                   | K                       |                           |          |
|                  |              |            |       |       |                      |                       |                        |                         |                           |          |
|                  |              | 1 Ant.     |       |       | 4 Antennas           |                       |                        |                         |                           |          |
| TYPE OF ANTENNA  | Length (m)   | GAIN (dBi) | E (m) | H (m) | G <sub>A</sub> (dBi) | T <sub>loss</sub> (K) | T <sub>total</sub> (K) | G/T <sub>A</sub> (dB/K) | G/T <sub>sys</sub> (dB/K) | S/N (dB) |
| RA3AQ AQ70-30f   | 7,90         | 20,33      | 2,08  | 2,04  | 26,08                | 5,64                  | 45,72                  | 9,48                    | 6,06                      | -12,33   |
| InnoV 30 LFA     | 8,08         | 20,45      | 2,27  | 2,22  | 26,42                | 6,83                  | 56,64                  | 8,89                    | 5,96                      | -12,44   |
| +GTV 70-34w      | 8,46         |            |       |       |                      | ####                  | #DIV/0!                | #DIV/0!                 | #DIV/0!                   | #DIV/0!  |
| *YU7EF EF7032-5  | 8,67         | 19,97      | 1,94  | 1,90  | 25,58                | 6,80                  | 51,56                  | 8,46                    | 5,32                      | -13,07   |
| InnoV 33 LFA     | 9,04         | 20,85      | 2,32  | 2,29  | 26,81                | 5,43                  | 52,40                  | 9,62                    | 6,51                      | -11,88   |
| DJ9BV OPT70-13wl | 9,22         | 20,85      | 2,35  | 2,29  | 26,80                | 5,24                  | 78,12                  | 7,87                    | 5,57                      | -12,82   |

Fig. 5.1: New line in the Excel at fitting length of antenna

2. Fill in the values for  $T_{\text{pattern}}$  at old reference for  $T_{\text{sky}}$ ,  $T_{\text{earth}}$  and AG into the columns on the far right.

|   |        |          |                        |
|---|--------|----------|------------------------|
| Internal use only, no need to publish               |        |          |                        |
| T <sub>pattern</sub> computed using                 |        |          |                        |
| T <sub>sky</sub> = 20 K, T <sub>earth</sub> = 350 K |        |          |                        |
| T <sub>pattern</sub>                                | "S"    | Avg Gain | < corrected if need is |
| 22,6010   | 2,7586 | 0,9809   |                        |
| 24,4933   | 4,7656 | 0,9770   |                        |
| 22,5030   | 2,6547 | 0,9847   |                        |
| 23,5309   | 3,7448 | 0,9771   |                        |
| 23,8993   | 4,1355 | 0,9816   |                        |
| 28,8015   | 9,3348 | 0,9822   |                        |

Fig. 5.2: Entry of key data  $T_{\text{pattern}}$  at Old reference Temperatures and Average Gain, ("S" is computed by the Excel).

3. Fill in the value for Gain for the 4-bay into column  $G_A$  in dBi in the Excel

|                  |              |            |       |       |                      |                       |                        |                         |                           |          |
|------------------|--------------|------------|-------|-------|----------------------|-----------------------|------------------------|-------------------------|---------------------------|----------|
|                  | Enter Tsky > |            | 27    | K     | Enter Tearth >       |                       | 1800                   | K                       |                           |          |
|                  | 1 Ant.       |            |       |       | 4 Antennas           |                       |                        |                         |                           |          |
| TYPE OF ANTENNA  | Length (m)   | GAIN (dBi) | E (m) | H (m) | G <sub>A</sub> (dBi) | T <sub>loss</sub> (K) | T <sub>total</sub> (K) | G/T <sub>A</sub> (dB/K) | G/T <sub>sys</sub> (dB/K) | S/N (dB) |
| RA3AQ AQ70-30f   | 7,90         | 20,33      | 2,08  | 2,04  | 26,08                | 5,64                  | 45,72                  | 9,48                    | 6,06                      | -12,33   |
| InnoV 30 LFA     | 8,08         | 20,45      | 2,27  | 2,22  | 26,42                | 6,83                  | 56,64                  | 8,89                    | 5,96                      | -12,44   |
| +GTV 70-34w      | 8,46         |            |       |       | 26,09                | 4,51                  | 44,27                  | 9,63                    | 6,13                      | -12,26   |
| *YU7EF EF7032-5  | 8,67         | 19,97      | 1,94  | 1,90  | 25,58                | 6,80                  | 51,56                  | 8,46                    | 5,32                      | -13,07   |
| InnoV 33 LFA     | 9,04         | 20,85      | 2,32  | 2,29  | 26,81                | 5,43                  | 52,40                  | 9,62                    | 6,51                      | -11,88   |
| DJ9BV OPT70-13wl | 9,22         | 20,85      | 2,35  | 2,29  | 26,80                | 5,24                  | 78,12                  | 7,87                    | 5,57                      | -12,82   |

Fig. 5.3: Enter Gain in column  $G_A$  for 4 Antennas

With 1., 2. and 3. being done properly,  $T_{\text{total}}$ ,  $G/T_A$ ,  $G/T_{\text{sys}}$ , S/N will be computed by the Excel.

|   |  |  |  |  |  |  |  |            |  |  |  |       |  |  |  |  |  |  |  |                      |  |  |  |                       |  |  |  |                        |  |  |  |                         |  |  |  |                           |  |  |  |          |  |  |  |          |  |  |  |         |  |  |  |             |  |  |  |             |  |  |  |          |  |  |  |        |  |  |  |               |  |  |  |             |  |  |  |             |  |  |  |                         |  |  |  |                         |  |  |  |
|---|--|--|--|--|--|--|--|------------|--|--|--|-------|--|--|--|--|--|--|--|----------------------|--|--|--|-----------------------|--|--|--|------------------------|--|--|--|-------------------------|--|--|--|---------------------------|--|--|--|----------|--|--|--|----------|--|--|--|---------|--|--|--|-------------|--|--|--|-------------|--|--|--|----------|--|--|--|--------|--|--|--|---------------|--|--|--|-------------|--|--|--|-------------|--|--|--|-------------------------|--|--|--|-------------------------|--|--|--|
| Reference Temperatures<br>Old Tsky=20K Tearth=350 |  |  |  | Estimated Values for man made noise (Tearth) on 432.1 MHz:<br>Rural = 760 K<br>Residential = 1800 K<br>City = 8200 K |  |  |  |            |  |  |  |       |  |  |  | acc. Man-Made Noise in Our Living Environments<br>U.R.S.I. Radio Science Bulletin No. 334, 09.2010 |  |  |  |                      |  |  |  |                       |  |  |  |                        |  |  |  |                         |  |  |  |                           |  |  |  |          |  |  |  |          |  |  |  |         |  |  |  |             |  |  |  |             |  |  |  |          |  |  |  |        |  |  |  |               |  |  |  |             |  |  |  |             |  |  |  |                         |  |  |  |                         |  |  |  |
| New: Tsky=27K                                     |  |  |  |  |  |  |  |            |  |  |  |       |  |  |  | Enter RX System NF > (dB)  |  |  |  |                      |  |  |  |                       |  |  |  |                        |  |  |  |                         |  |  |  |                           |  |  |  |          |  |  |  |          |  |  |  |         |  |  |  |             |  |  |  |             |  |  |  |          |  |  |  |        |  |  |  |               |  |  |  |             |  |  |  |             |  |  |  |                         |  |  |  |                         |  |  |  |
| Enter Tsky > 27                                   |  |  |  | Enter Tearth > 1800  |  |  |  |            |  |  |  |       |  |  |  | 0,75   |  |  |  |                      |  |  |  |                       |  |  |  |                        |  |  |  |                         |  |  |  |                           |  |  |  |          |  |  |  |          |  |  |  |         |  |  |  |             |  |  |  |             |  |  |  |          |  |  |  |        |  |  |  |               |  |  |  |             |  |  |  |             |  |  |  |                         |  |  |  |                         |  |  |  |
| 1 Ant.  |  |  |  | 4 Antennas   |  |  |  |            |  |  |  |       |  |  |  | 1 Ant.   |  |  |  |                      |  |  |  |                       |  |  |  |                        |  |  |  |                         |  |  |  |                           |  |  |  |          |  |  |  |          |  |  |  |         |  |  |  |             |  |  |  |             |  |  |  |          |  |  |  |        |  |  |  |               |  |  |  |             |  |  |  |             |  |  |  |                         |  |  |  |                         |  |  |  |
| Length  |  |  |  | 1 Ant  |  |  |  | E          |  |  |  | H     |  |  |  | G <sub>A</sub>   |  |  |  | T <sub>loss</sub>    |  |  |  | T <sub>total</sub>    |  |  |  | G/T <sub>A</sub>       |  |  |  | G/T <sub>sys</sub>      |  |  |  | S/N                       |  |  |  | F/R      |  |  |  | H Plane  |  |  |  | 1st SL  |  |  |  | 2nd SL      |  |  |  | Z           |  |  |  | e        |  |  |  | VSWR   |  |  |  | Feed System   |  |  |  | Convergence |  |  |  | KF2YN       |  |  |  | Tpattern computed using |  |  |  |                         |  |  |  |
| TYPE OF ANTENNA                                   |  |  |  | Length (m)   |  |  |  | GAIN (dBi) |  |  |  | E (m) |  |  |  | H (m)  |  |  |  | G <sub>A</sub> (dBi) |  |  |  | T <sub>loss</sub> (K) |  |  |  | T <sub>total</sub> (K) |  |  |  | G/T <sub>A</sub> (dB/K) |  |  |  | G/T <sub>sys</sub> (dB/K) |  |  |  | S/N (dB) |  |  |  | F/R (dB) |  |  |  | H Plane |  |  |  | 1st SL (dB) |  |  |  | 2nd SL (dB) |  |  |  | Z (ohms) |  |  |  | e (dB) |  |  |  | VSWR          |  |  |  | Feed System |  |  |  | Convergence |  |  |  | KF2YN                   |  |  |  | Tpattern computed using |  |  |  |
| RA3AQ AQ70-30f                                    |  |  |  | 7,90   |  |  |  | 20,33      |  |  |  | 2,08  |  |  |  | 2,04   |  |  |  | 26,08                |  |  |  | 5,64                  |  |  |  | 45,72                  |  |  |  | 9,48                    |  |  |  | 6,06                      |  |  |  | -12,33   |  |  |  | 30,57    |  |  |  | 16,8    |  |  |  | 22,1        |  |  |  | 51,6        |  |  |  | -0,01    |  |  |  | 1,10   |  |  |  | Folded Dipole |  |  |  | Yes         |  |  |  | 22,6010     |  |  |  | 2,7558                  |  |  |  | 0,9809                  |  |  |  |
| InnoV 30 LFA                                      |  |  |  | 8,08   |  |  |  | 20,45      |  |  |  | 2,27  |  |  |  | 2,22   |  |  |  | 26,42                |  |  |  | 6,83                  |  |  |  | 56,64                  |  |  |  | 8,89                    |  |  |  | 5,96                      |  |  |  | -12,44   |  |  |  | 36,60    |  |  |  | 13,9    |  |  |  | 20,3        |  |  |  | 49,6        |  |  |  | -0,79    |  |  |  | 2,38   |  |  |  | LFA-LOOP      |  |  |  | Yes         |  |  |  | 24,4933     |  |  |  | 2,6556                  |  |  |  | 0,9770                  |  |  |  |
| +GTV 70-34w                                       |  |  |  | 8,46   |  |  |  |            |  |  |  |       |  |  |  |  |  |  |  | 26,09                |  |  |  | 4,51                  |  |  |  | 44,27                  |  |  |  | 9,63                    |  |  |  | 6,13                      |  |  |  | -12,26   |  |  |  |          |  |  |  |         |  |  |  |             |  |  |  |             |  |  |  |          |  |  |  |        |  |  |  |               |  |  |  |             |  |  |  | 22,5030     |  |  |  | 2,6547                  |  |  |  | 0,9847                  |  |  |  |
| *YU7EF EF7032-5                                   |  |  |  | 8,67   |  |  |  | 19,97      |  |  |  | 1,94  |  |  |  | 1,90   |  |  |  | 25,58                |  |  |  | 6,80                  |  |  |  | 51,56                  |  |  |  | 8,46                    |  |  |  | 5,32                      |  |  |  | -13,07   |  |  |  | 27,70    |  |  |  | 23,1    |  |  |  | 24,2        |  |  |  | 51,3        |  |  |  | -1,56    |  |  |  | 3,44   |  |  |  | Dipole        |  |  |  | No          |  |  |  | 23,5309     |  |  |  | 3,7448                  |  |  |  | 0,9771                  |  |  |  |
| InnoV 33 LFA                                      |  |  |  | 9,04   |  |  |  | 20,85      |  |  |  | 2,32  |  |  |  | 2,29   |  |  |  | 26,81                |  |  |  | 5,43                  |  |  |  | 52,40                  |  |  |  | 9,62                    |  |  |  | 6,51                      |  |  |  | -11,88   |  |  |  | 36,55    |  |  |  | 13,3    |  |  |  | 19,2        |  |  |  | 50,1        |  |  |  | -0,03    |  |  |  | 1,17   |  |  |  | LFA-LOOP      |  |  |  | Yes         |  |  |  | 23,8993     |  |  |  | 4,1355                  |  |  |  | 0,9816                  |  |  |  |

Fig. 5.4: Full view

## 6 Self-Test

|                  |              |            |       |       |                      |                       |                        |                         |                           |          |  |
|------------------|--------------|------------|-------|-------|----------------------|-----------------------|------------------------|-------------------------|---------------------------|----------|--|
|                  | Enter Tsky > |            | 27 K  |       | Enter Tearth >       |                       | 1800 K                 |                         |                           |          |  |
|                  |              |            |       |       |                      |                       |                        |                         |                           |          |  |
|                  | 1 Ant.       |            |       |       | 4 Antennas           |                       |                        |                         |                           |          |  |
| TYPE OF ANTENNA  | Length (m)   | GAIN (dBi) | E (m) | H (m) | G <sub>A</sub> (dBi) | T <sub>loss</sub> (K) | T <sub>total</sub> (K) | G/T <sub>A</sub> (dB/K) | G/T <sub>sys</sub> (dB/K) | S/N (dB) |  |
| RA3AQ AQ70-30f   | 7,90         | 20,33      | 2,08  | 2,04  | 26,08                | 5,64                  | 45,72                  | 9,48                    | 6,06                      | -12,33   |  |
| InnoV 30 LFA     | 8,08         | 20,45      | 2,27  | 2,22  | 26,42                | 6,83                  | 56,64                  | 8,89                    | 5,96                      | -12,44   |  |
| +GTV 70-34w      | 8,46         |            |       |       | 26,09                | 4,51                  | 44,27                  | 9,63                    | 6,13                      | -12,26   |  |
| *YU7EF EF7032-5  | 8,67         | 19,97      | 1,94  | 1,90  | 25,58                | 6,80                  | 51,56                  | 8,46                    | 5,32                      | -13,07   |  |
| InnoV 33 LFA     | 9,04         | 20,85      | 2,32  | 2,29  | 26,81                | 5,43                  | 52,40                  | 9,62                    | 6,51                      | -11,88   |  |
| DJ9BV OPT70-13wl | 9,22         | 20,85      | 2,35  | 2,29  | 26,80                | 5,24                  | 78,12                  | 7,87                    | 5,57                      | -12,82   |  |

Fig. 6.1: Values at default  $T_{\text{sky}}$ ,  $T_{\text{earth}}$  for publishing the Tables, RX-NF = 0.75 dB (not in screenshot)

Setting  $T_{\text{sky}}$ ,  $T_{\text{earth}}$  to Old Reference values 20 K, 350 K and RX-NF = 0 dB the Tables cells shall show same values as computed with TANT or AGTC:

In this example the Convergence Corrected values are:

$T_{\text{total}} = 26.590$  K,  $G/T_A = 11.84$  dB/K,  $G/T_{\text{sys}}$  with RX-NF = 0 dB is equal to  $G/T_A = 11.84$  dB/K

|                 |              |            |       |       |                      |                       |                        |                         |                           |          |  |
|-----------------|--------------|------------|-------|-------|----------------------|-----------------------|------------------------|-------------------------|---------------------------|----------|--|
|                 | Enter Tsky > |            | 20 K  |       | Enter Tearth >       |                       | 350 K                  |                         |                           |          |  |
|                 | 1 Ant.       |            |       |       | 4 Antennas           |                       |                        |                         |                           |          |  |
| TYPE OF ANTENNA | Length (m)   | GAIN (dBi) | E (m) | H (m) | G <sub>A</sub> (dBi) | T <sub>loss</sub> (K) | T <sub>total</sub> (K) | G/T <sub>A</sub> (dB/K) | G/T <sub>sys</sub> (dB/K) | S/N (dB) |  |
| RA3AQ AQ70-30f  | 7,90         | 20,33      | 2,08  | 2,04  | 26,08                | 5,64                  | 27,70                  | 11,66                   | 11,66                     | -6,74    |  |
| InnoV 30 LFA    | 8,08         | 20,45      | 2,27  | 2,22  | 26,42                | 6,83                  | 30,60                  | 11,56                   | 11,56                     | -6,83    |  |
| +GTV 70-34w     | 8,46         |            |       |       | 26,09                | 4,51                  | 26,596                 | 11,84                   | 11,84                     | -6,55    |  |
| *YU7EF EF7032-5 | 8,67         | 19,97      | 1,94  | 1,90  | 25,58                | 6,80                  | 29,63                  | 10,86                   | 10,86                     | -7,53    |  |
| InnoV 33 LFA    | 9,04         | 20,85      | 2,32  | 2,29  | 26,81                | 5,43                  | 28,79                  | 12,22                   | 12,22                     | -6,17    |  |

Fig. 6.2: Values at Old Reference  $T_{\text{sky}}$ ,  $T_{\text{earth}}$ , RX-NF = 0 dB

The Excel Table shall show same or very near values.

For the accuracy of the 3<sup>rd</sup> decimal place of values small deviations may occur:

In this example  $T_{\text{total}}$  per Convergence Correction is 26.590 K, in the Excel Table it is computed to 26.596 K. Antennas with a less pin shaped beam will be much closer, the 4 x 34 Element model is a maximum challenge example.

We must not forget, that we have a set of complex formulas behind this, which enables scaling of  $T_{\text{total}}$  and all others according  $T_{\text{sky}}$ ,  $T_{\text{earth}}$  by the user input and all sorts of small errors from rounding values.