VE7BQH Antenna Tables

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

2025-10-04

DG7YBN

Index

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_{sky} and T_{earth} entered
5. this FFtab loaded and computed.
6. Voila, Values for T_{total}, T_{loss} and G/Ta were derived to be filled into the columns of the Excel Table.

With the change to editable T_{sky}, T_{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. $T_{pattern}$ at the stated *old reference for T_{sky}, T_{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_{loss}, G/T_a, G/T_{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

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

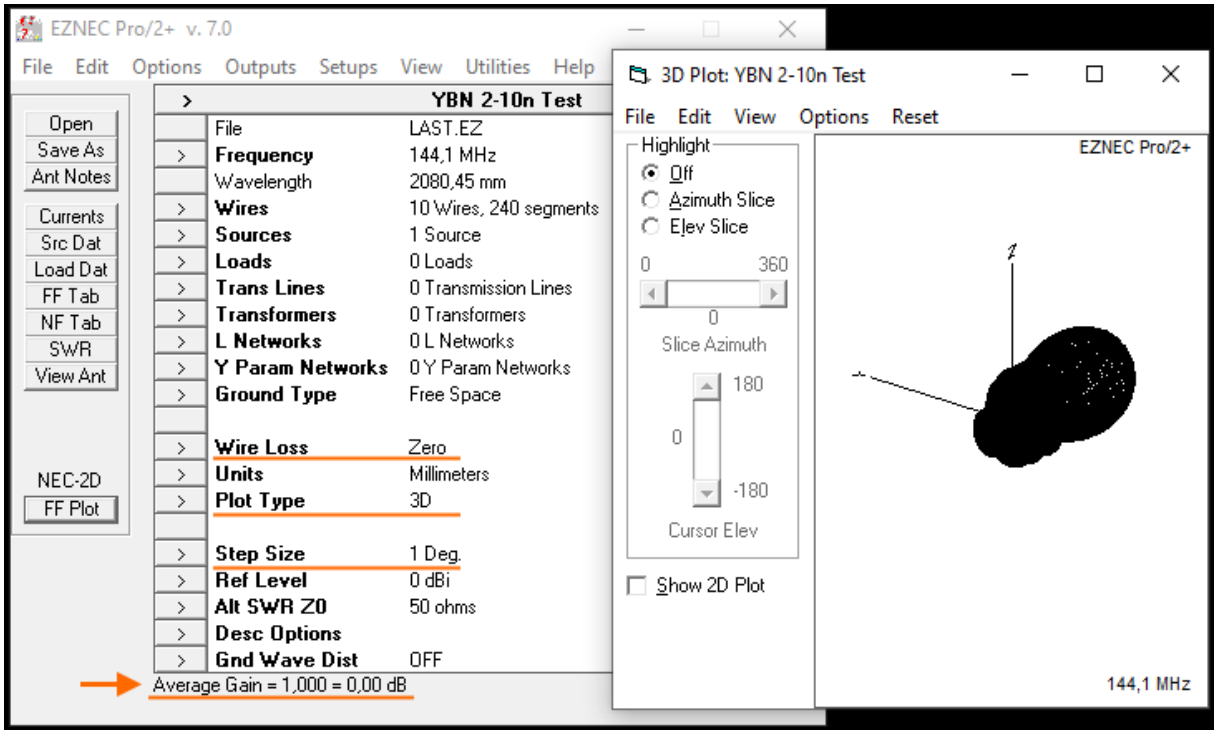
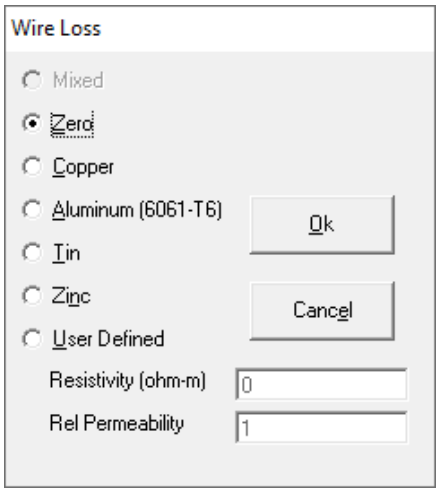


Fig. 2.1.1: EZNEC Pro/2+ v7.0 (identical in EZNEC v5, v6 etc.)



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

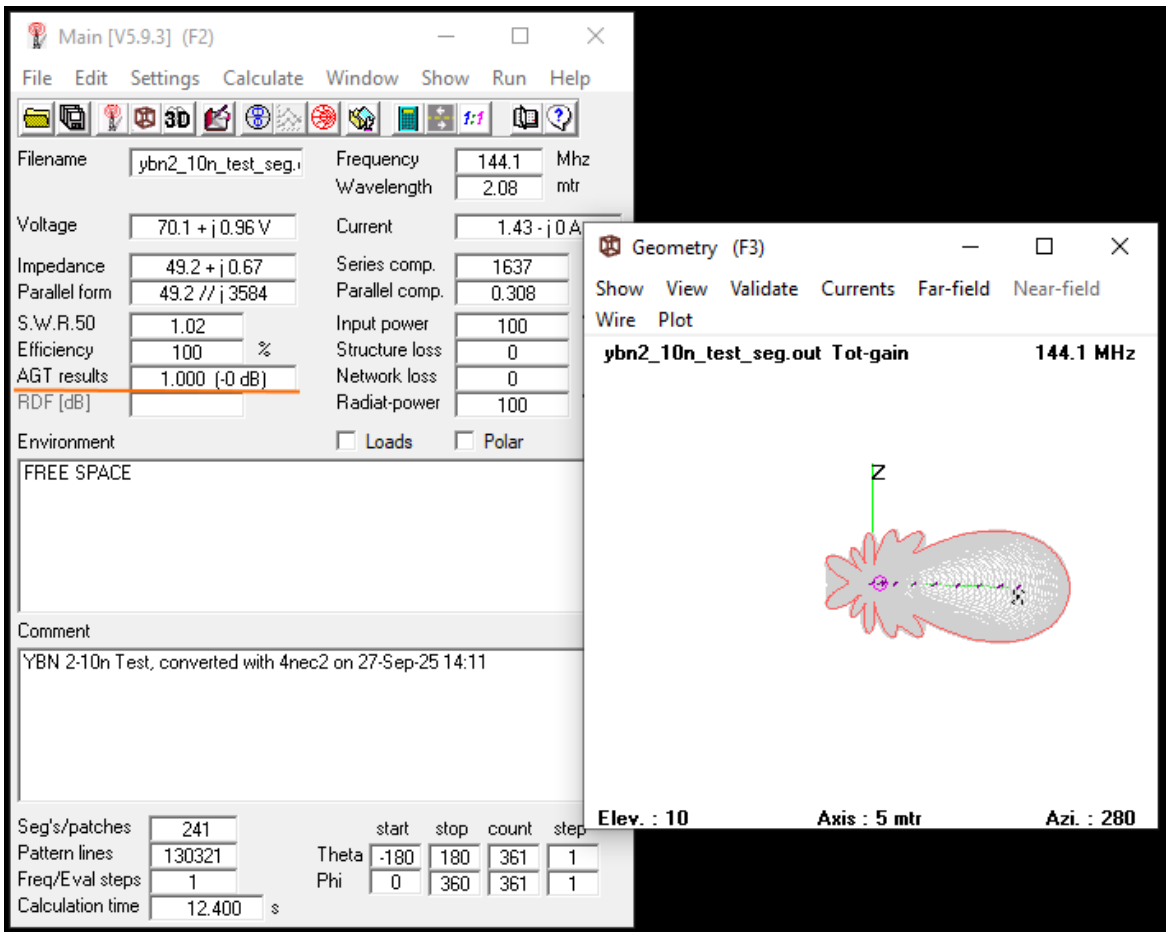
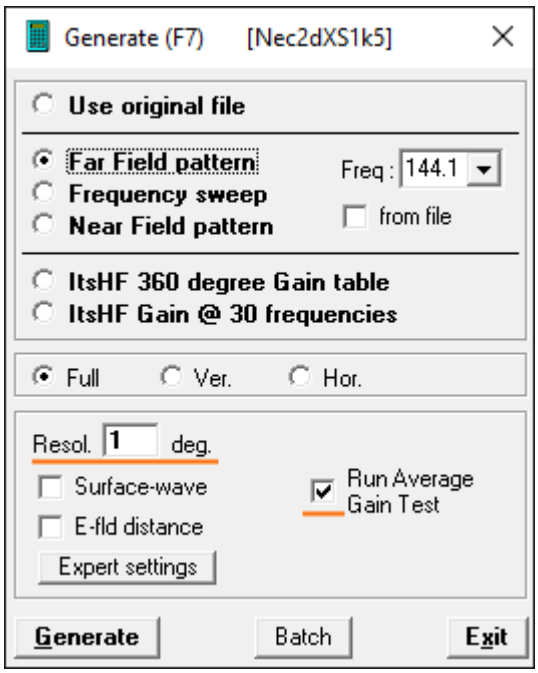


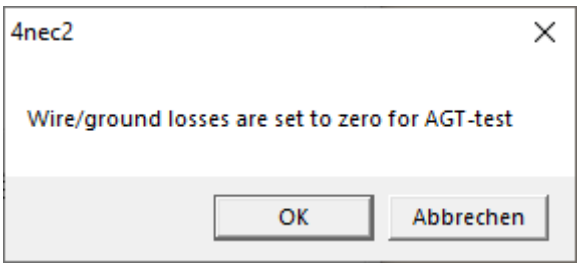
Fig. 2.1.2: 4nec2 v5.9.3 with Average Gain Test



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.

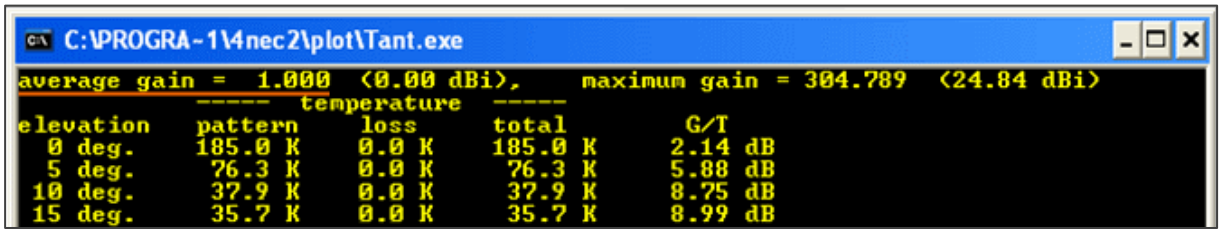


Fig. 2.3.1: Analysis of a *lossless* models FFtab in TANT-Software, AG = 1.000 > No Convergence Correction needed.

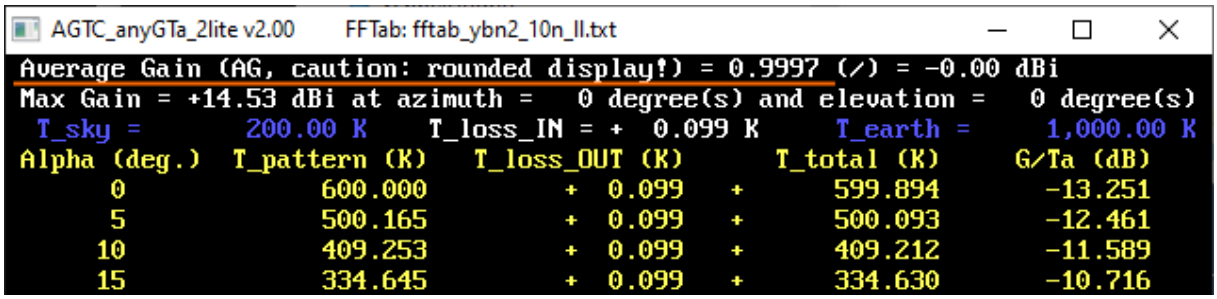


Fig. 2.3.2 Analysis of a *lossless* models FFtab in AGTC-Software, AG = 0.9997 ~ 1.000 > No Convergence Correction needed.

3 Computing of T_{total} and AG

3.1 Case A: No Convergence Correction needed

If AG is ≤ 1.000, only a single run in TANT or AGTC is needed.

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

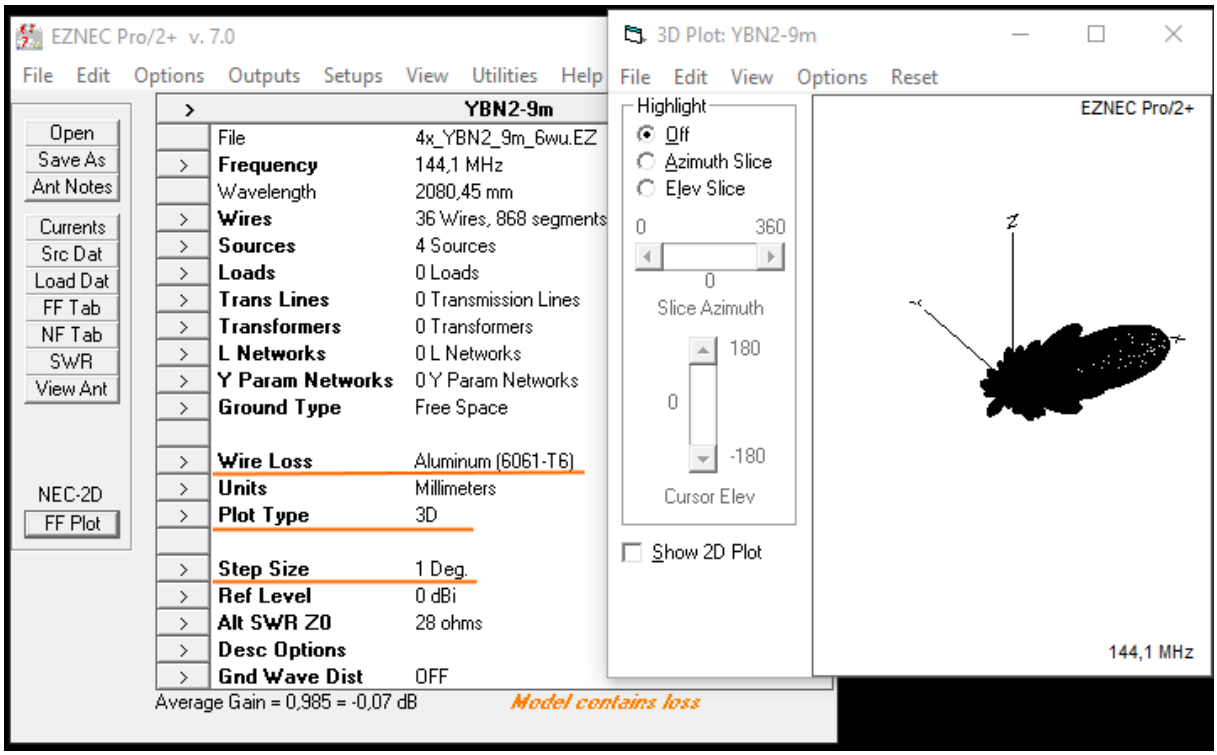


Fig. 3.1.1: EZNEC with all settings for computing a model *containing losses* to produce a Far Field Table

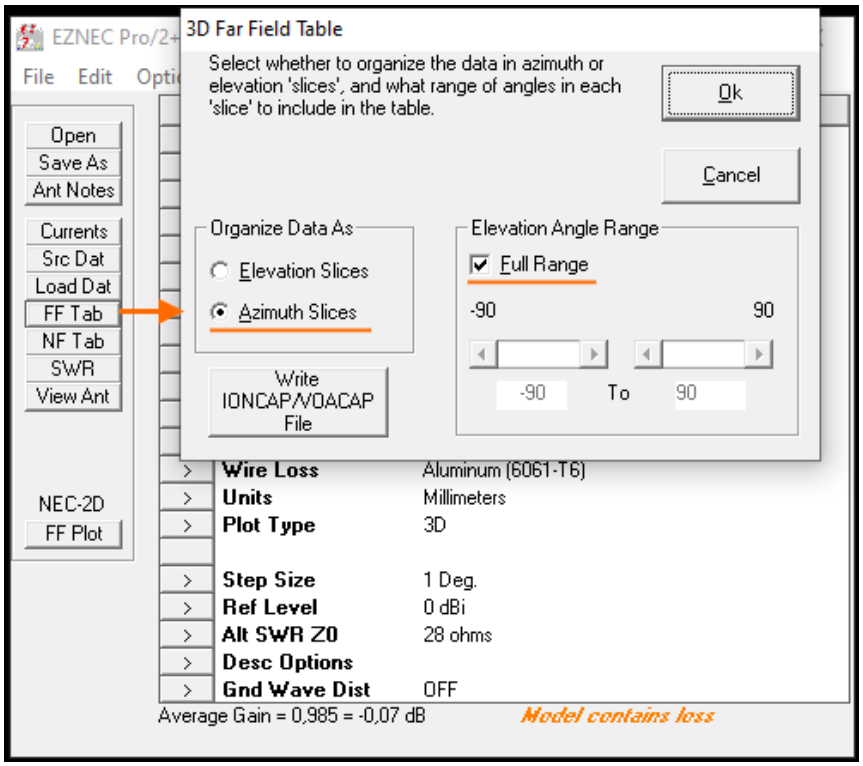


Fig. 3.1.2: How to produce a Far Field Table in EZNEC

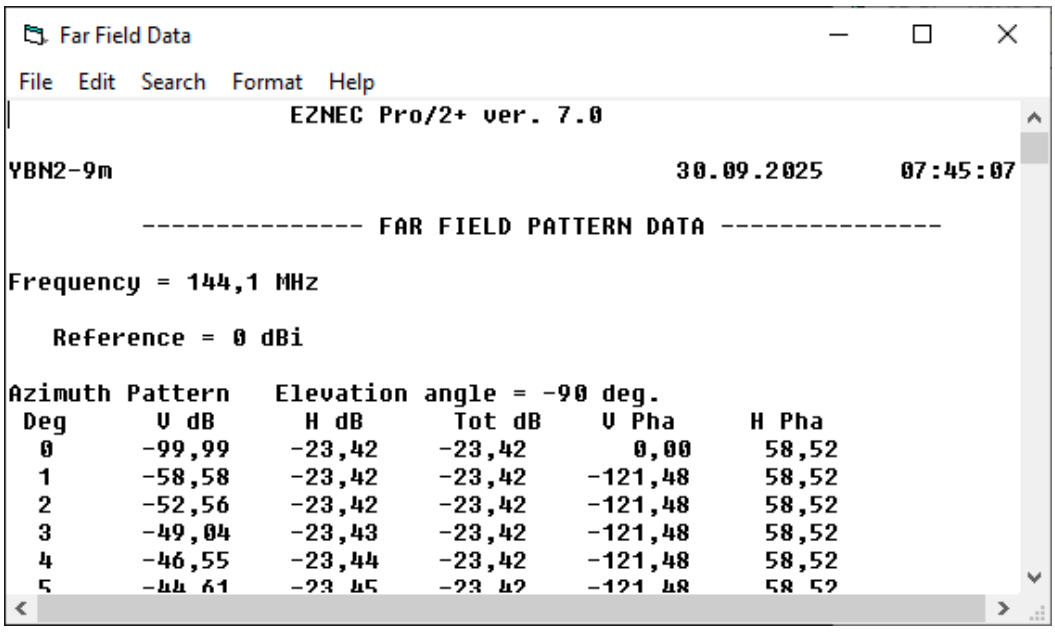


Fig. 3.1.3: Far Field Table

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_{sky}, T_{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*)

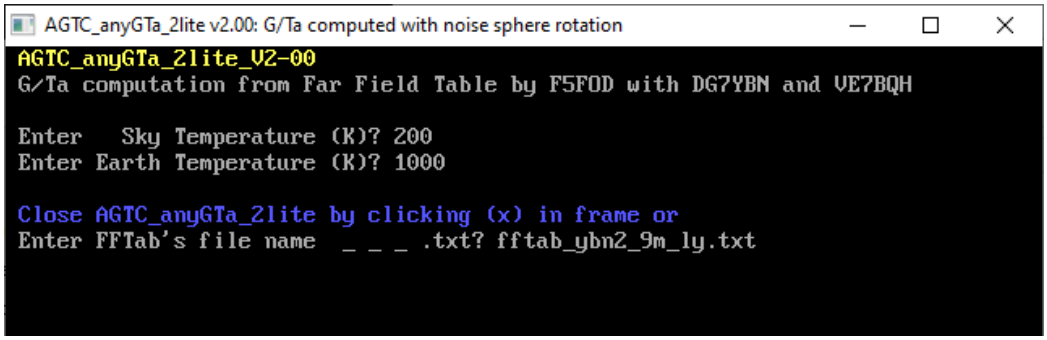


Fig. 3.1.4: AGTC in version anyGTA_2lite v2.00 with entered temperatures and filename

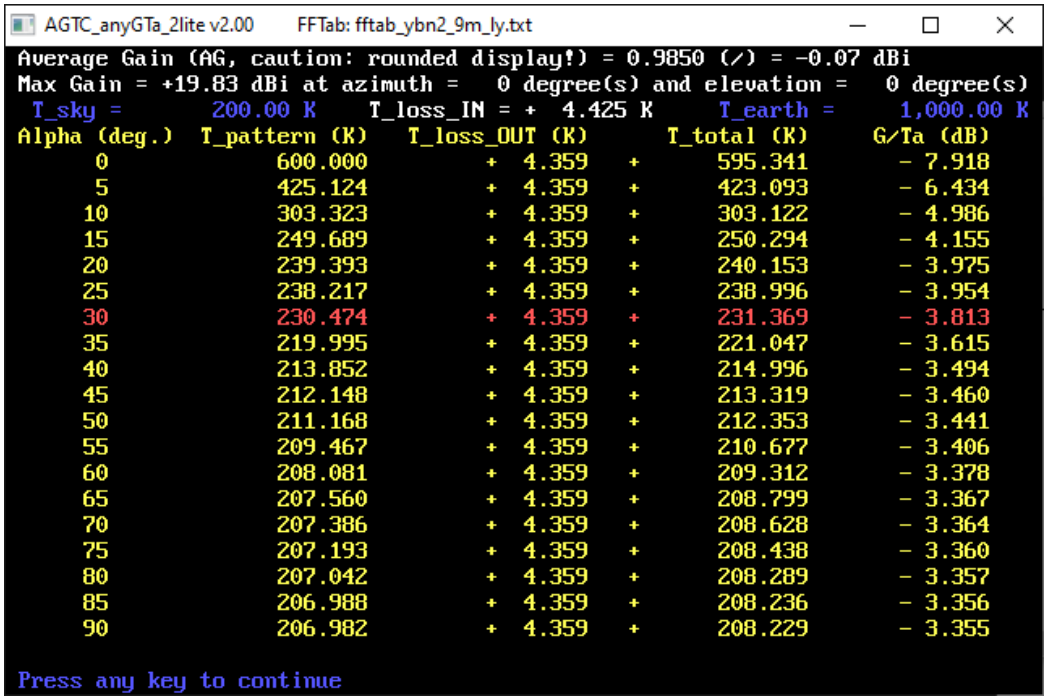


Fig. 3.1.5: AGTC computed Far Field Table. Values to be used for entering into the Excel Table are $T_{pattern}$ (30 degr.) = 230.474 K, AG = 0.9850.

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

*4x_Yagi_abc_dl6wu_minus_10perc_**ly**.ez* … the file for the design *containing loss* (*lossy*)
*4x_Yagi_abc_dl6wu_minus_10perc_**ll**.ez* … the file for the design *lossless*

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

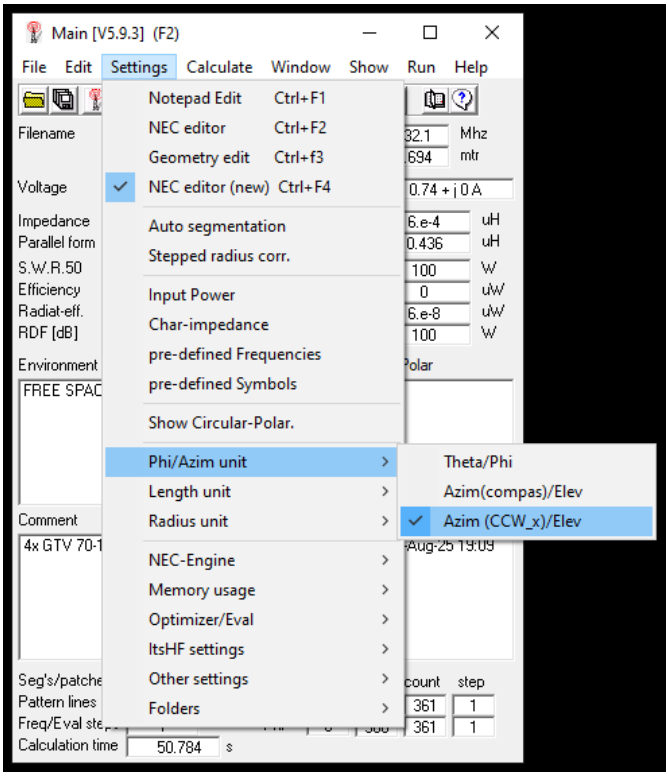
Proceed with the Convergence Correction of the antenna data

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

3.3 Case B: Step-by-Step Example

Analysis of an antenna bay for 432.1 MHz:
4x_GTV70_34w_8mm_6wu_lossy.EZ
4x_GTV70_34w_8mm_6wu_lossless.EZ

Fig. 3.3.1: Windows Explorer, example filenames, 2 Far Field Tables as *gtv7034wly.txt* (containing losses), *gtv7034wll.txt* (lossless). Note AGTC program's exe in same folder for convenient entering of filenames.



Note that in 4nec2's Menu > *Settings* > Phi/Azim unit must be > *Azim (CCW_x)/Elev.* > for producing a valid Far Field Table for AGTC or TANT.

Fig. 3.3.2: 4nec2, Settings for producing a Far Field Table with valid format.

Open the model file containing losses and do a 3D = full pattern lot with resolution *1 deg.,* at *432.1 MHz* respectively frequency given in the Tables for the band applied:

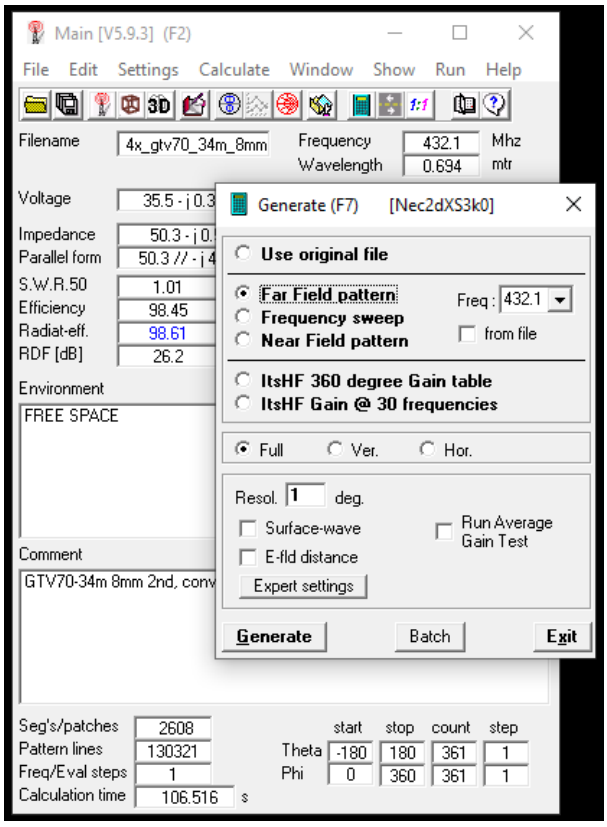
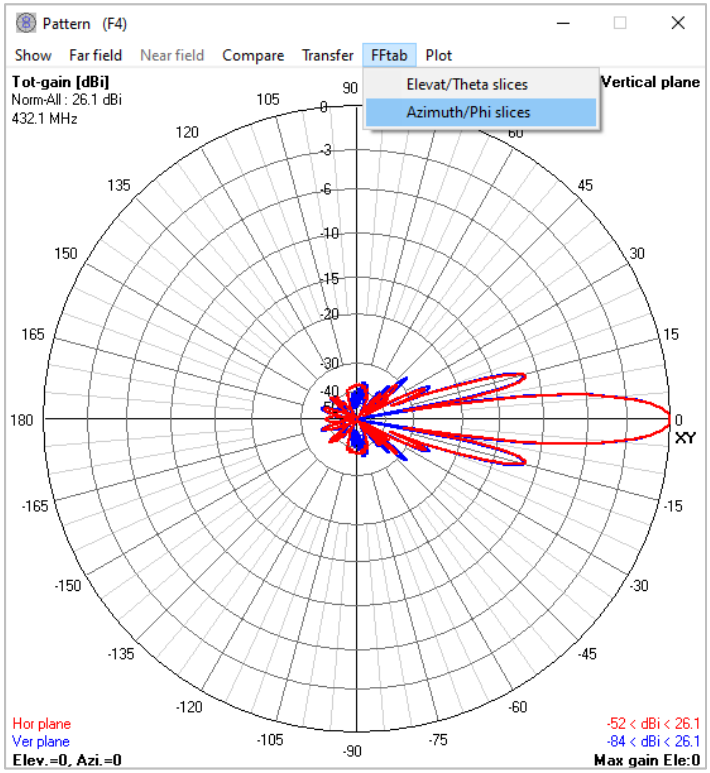


Fig. 3.3.3: 4nec2, Settings for producing a Full Pattern for a valid Far Field Table.

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 > Menu > FFtab > Azimuth/Phi slices

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

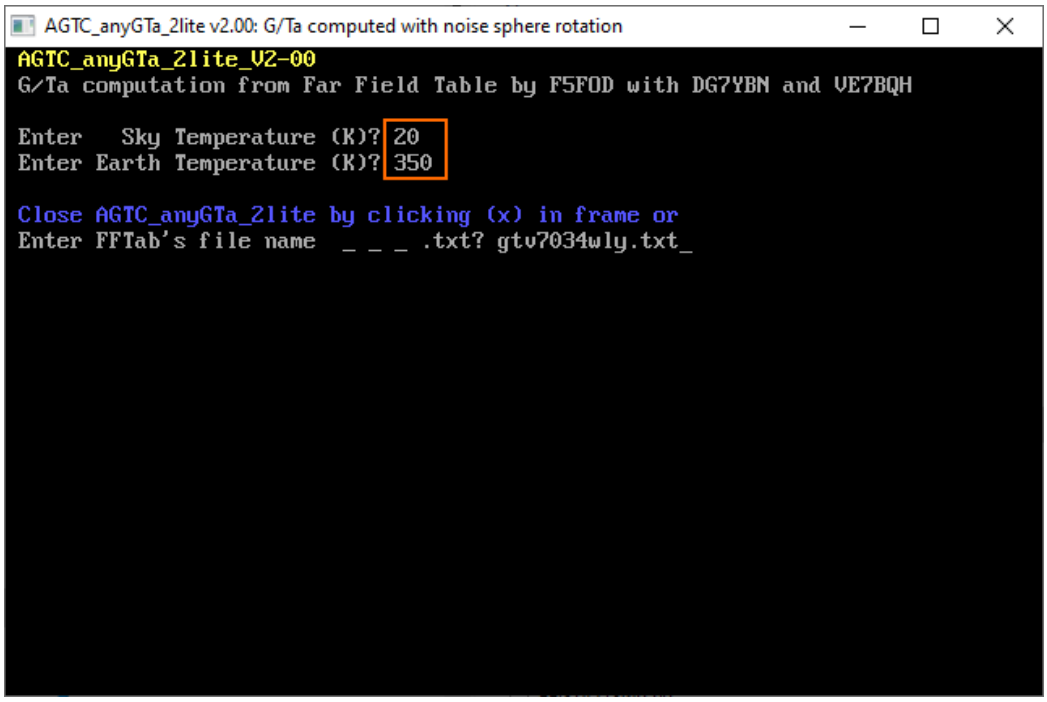


Fig. 3.3.5: AGTC in version anyGTA_2lite v2.00 with entered temperatures and filename for the Far Field Table *with losses*

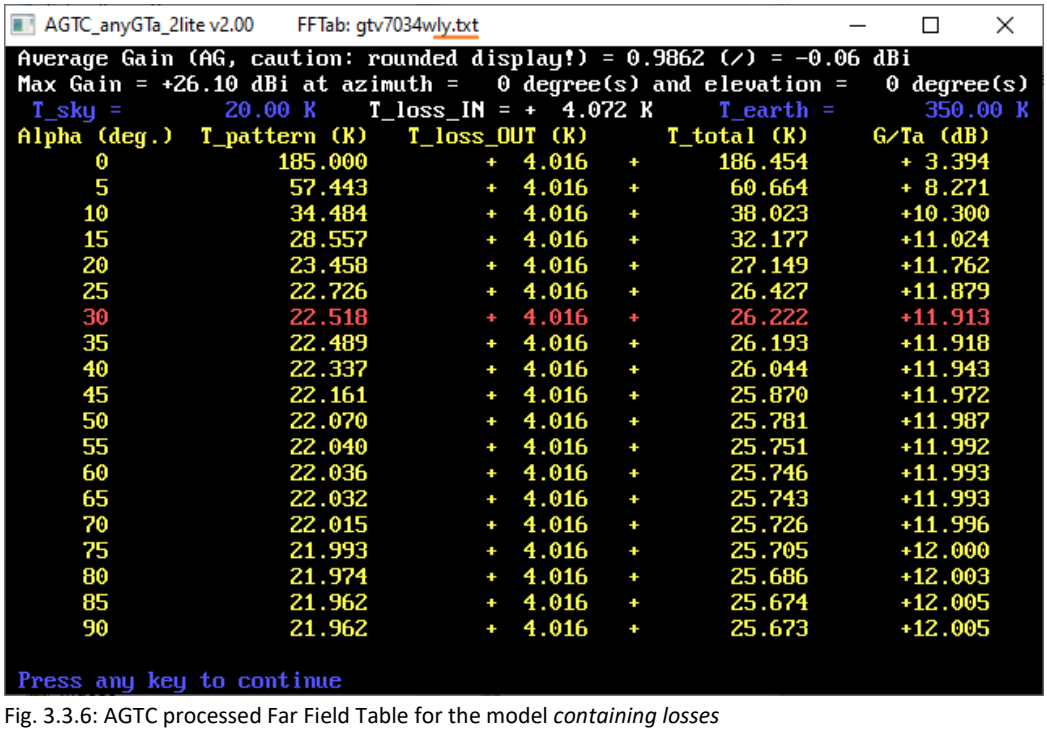


Fig. 3.3.6: AGTC processed Far Field Table for the model *containing losses*

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

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

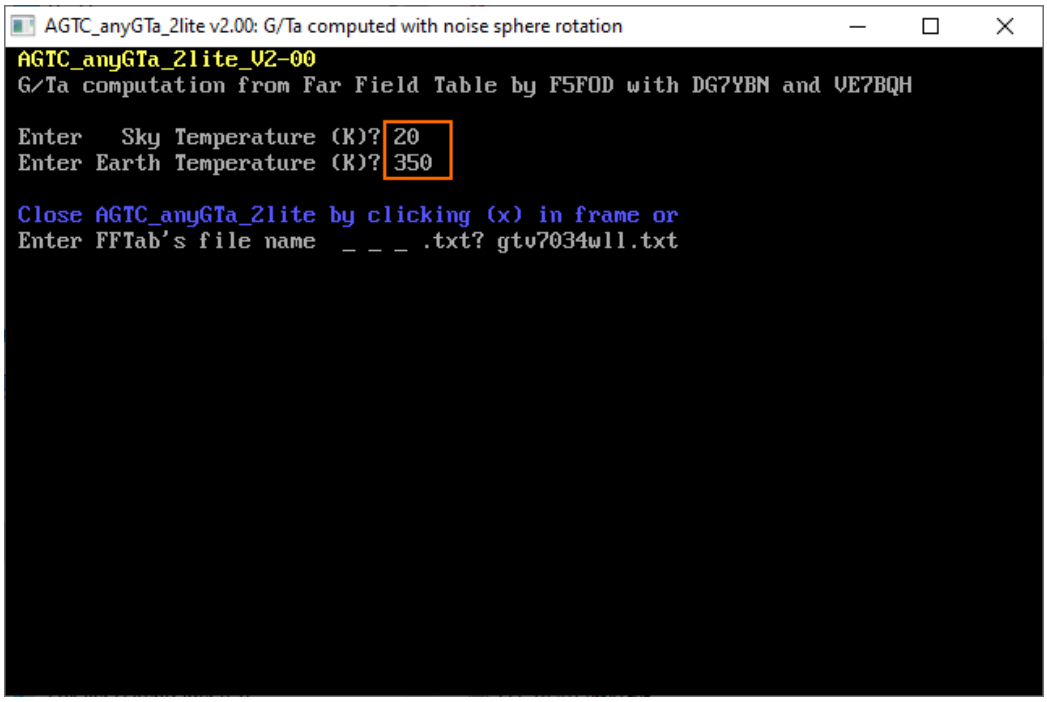


Fig. 3.3.7: AGTC in version anyGTA_2lite v2.00 with entered temperatures and filename for the Far Field Table *with losses*

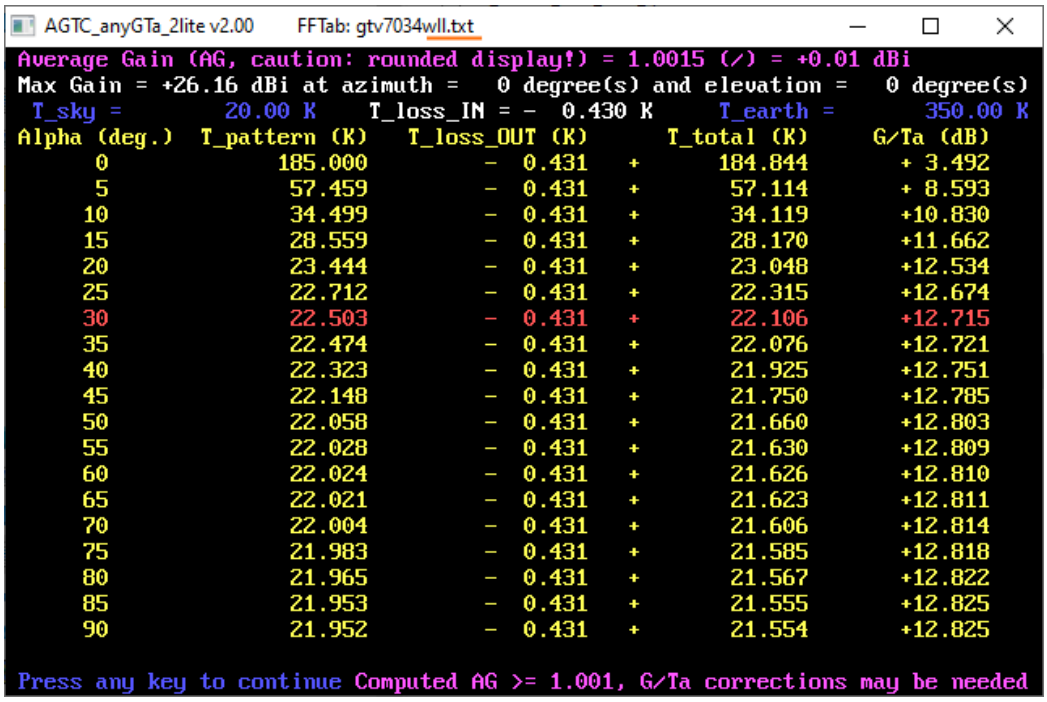


Fig. 3.3.8: AGTC processed Far Field Table for the *lossless* model. Note the negative loss value (!)

Lossless: Gain = 26.16 dBi, AG = 1.0015, T_{loss} = - 0.431 K, read at 30 degr.: $T_{pattern}$ = 22.503 K, T_{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
$T_{pattern}$ = 22.503 K (read at 30 degr.)

With losses:
Gain = 26.10 dBi
AG = 0.9862
$T_{pattern}$ = 22.518 K (read at 30 degr.)

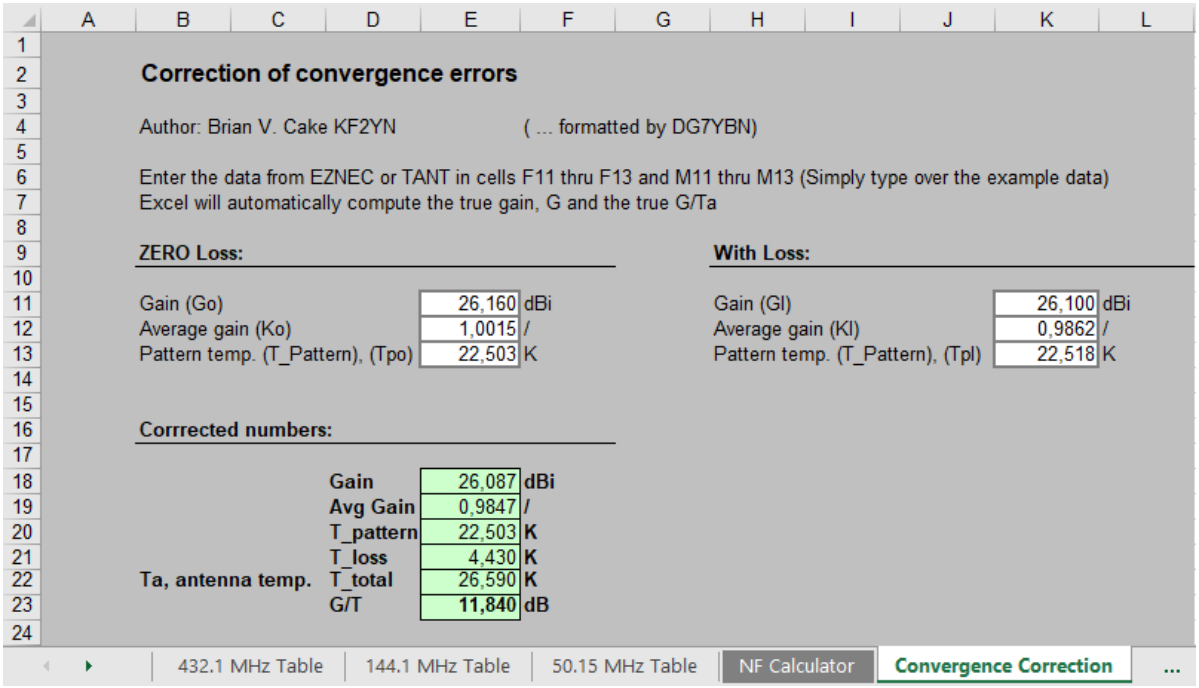


Fig. 4.1: Convergence Correction sheet of the VE7BQH Antenna Tables Excel

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

Gain = 26.087 dBi
$T_{pattern}$ = 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_A (dBi)	T_{loss} (K)	T_{total} (K)	G/T_A (dB/K)	G/T_{sys} (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 $T_{pattern}$ at old reference for T_{sky}, T_{earth} and AG into the columns on the far right.

Internal use only, no need to publish			
Tpattern computed using			
Tsky = 20 K, Tearth = 350 K			
Tpattern	"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 *$T_{pattern}$* 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_A (dBi)	T_{loss} (K)	T_{total} (K)	G/T_A (dB/K)	G/T_{sys} (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_{total}, G/T_a, G/T_{sys}, S/N will be computed by the Excel.

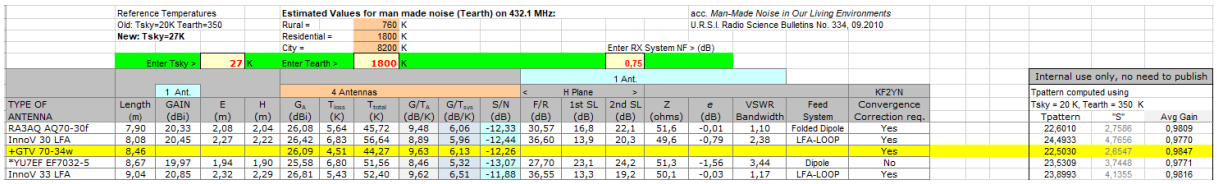


Fig. 5.4: Full view

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_A (dBi)	T_{loss} (K)	T_{total} (K)	G/T_A (dB/K)	G/T_{sys} (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_{sky}, T_{earth} for publishing the Tables, RX-NF = 0.75 dB (not in screenshot)

Setting T_{sky}, T_{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_{total} = 26.590 K, G/T_A = 11.84 dB/K, G/T_{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_A (dBi)	T_{loss} (K)	T_{total} (K)	G/T_A (dB/K)	G/T_{sys} (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_{sky}, T_{earth}, RX-NF = 0 dB

The Excel Table shall show same or very near values.

For the accuracy of the 3rd decimal place of values small deviations may occur:
In this example T_{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_{total} and all others according T_{sky}, T_{earth} by the user input and all sorts of small errors from rounding values.