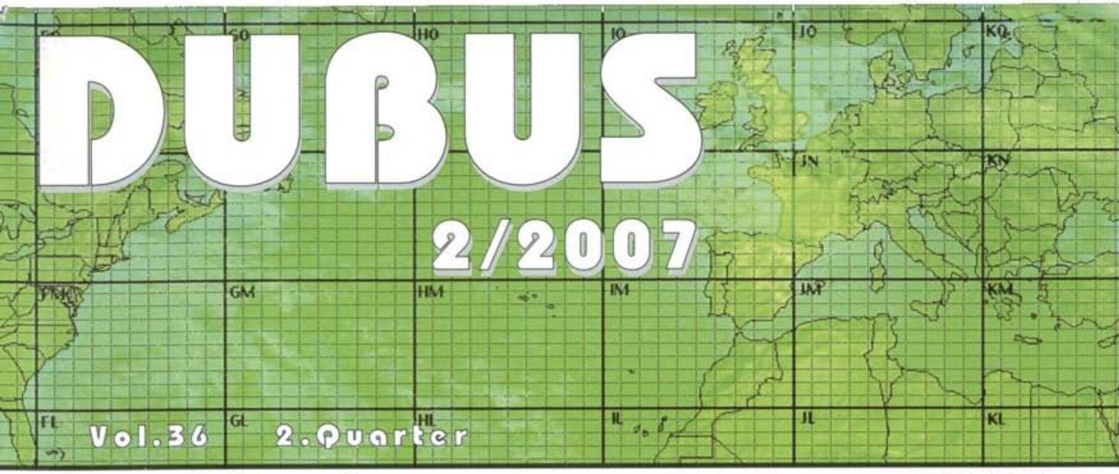

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Content / Inhalt 2/07

Title: The 30m Jamesburg Dish was activated for the first time sucessfully on 23cm EME in February 2007. See report on page 107.

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Editorial

Dear DUBUS Reader!

Welcome to issue 2/2007. As promised we present this time a nice article from ON4KHG for a not so exotic band ☺. More to come in the next issues.

As you can see, the content of DUBUS magazine contains about 2/3 technical articles now. This is not because we do not like to publish activity reports but we did not get too many of them recently. It seems that (almost) none wants to spend some time to send such reports. We think it is worth to report (and store) QSO data of long distance Tropo, Aurora, FAI RS and Es QSOs as these data are also useful for scientifical research.

DF5AI and DUBUS were considering a kind of univeral VHF-DX QSO database for a long time but have not found a good solution so far. Any suggestions and advise would be welcome.

Backscatter on satellite surfaces: Recently when working 2m-EME on JT65 CT1HZE got two reports from stations in northern DL indicating reflections from satellites. Elevations, distances and path geometry make it quite unlikely that Meteor Scatter has been involved. We would like to hear from others who have made such experiences. And is there anyone who could write something about the theoretical background?

Please keep sending your reports and technical articles.

Thank you!

Have a nice summer and DX season!

73 from Joe, DL8HCZ / CT1HZE
and the DUBUS team!

Liebe DUBUS Leser!

Willkommen zur Ausgabe 2/2007. Wie versprochen präsentieren wir diesmal einen schönen Artikel von ON4KHG, der mal nicht für ein so exotisch hohes Band ist ☺. Weitere folgen in den nächsten Ausgaben.

Wie man sieht, besteht der Inhalt des DUBUS-Magazins inzwischen zu 2/3 aus Technik. Dies ist nicht, weil wir keine Aktivitätsberichte mehr drucken wollen, sondern, weil wir in letzter Zeit nicht allzu viele bekommen. Es sieht so aus, als ob (fast) niemand mehr etwas Zeit opfern will, solche Berichte und Logs zu schicken. Wir meinen, dass es wichtig ist, QSO-Daten von DX via Tropo, Aurora, FAI, RS und Es zu berichten (und zu speichern), weil diese Daten auch für wissenschaftliche Forschung interessant sind.

DF5AI und DUBUS denken seit längerer Zeit über eine universelle VHF-DX-QSO-Datenbank nach, sind aber noch zu keiner guten Lösung gekommen. Vorschläge und Hilfe diesbezüglich wäre willkommen.

Reflektionen an Satelliten: Vor kurzem hat CT1HZE beim 2-m-EME-Betrieb in JT65 zwei Berichte aus Nord-DL erhalten, die auf Reflektion des Signals an Satelliten hindeuten. Elevation, Entfernung und Geometrie lassen eine Beteiligung von Meteor-Scatter ausscheiden. Wir würden gerne von anderen hören, die ähnliche Beobachtungen gemacht haben. Und gibt es jemanden, der etwas über den theoretischen Hintergrund schreiben könnte?

Wir bitten wieder alle um Einsendung von Aktivitätsberichten und technischen Artikeln.
Vielen Dank!

Einen schönen Sommer und DX-Saison!

73 von Joachim, DL8HCZ / CT1HZE
und vom ganzen DUBUS-Team!

Design and Building of a 300W MOSFET Push-Pull Power Amplifier for 144MHz

Gaëtan Horlin, ON4KHG

1. Introduction

Although valves are quite a common choice amongst the amateur community for building (high) power amplifiers, I opted for building a MOSFET Solid-State Power Amplifier (SSPA) instead. For 144 MHz I am using a remote transverter located close to my antenna tower, so I preferred to build a low voltage amplifier, in order to avoid setting-up a remote high voltage power supply. Here are the advantages and drawbacks of solid-state power amplifiers.

Advantages:
- No high voltage
- No heat-up time
- Less mechanical machining
- Lightweight equipment, easy to carry
- No retune needed (thermal drift)
- High MTBF.

Drawbacks:
- Limited amount of power, unless paralleling amplifiers
- Expensive transistors
- The MOSFET Gate is sensitive to electrostatic charges

The goal of this article is not only to describe such an amplifier, but also to provide experimental guidelines to design a push-pull MOSFET amplifier. The one described here is narrowband and provides more than 250 W RF power, for a current consumption of 18-20 A at 28 V.

2. Selection of the transistor

For a push-pull amplifier one can of course use two RF power transistors of the same type, but Gemini transistors – two transistors in the same package – are preferred for ease and compactness of building. They are readily available, and their characteristics are more closely matched than two independent devices, so they provide better amplifier symmetry. This table lists some Gemini transistors capable of at least 200 W RF power.

Reference	Manufacturer	Supply voltage (V)	Output power (W)	Gain (dB)	Efficiency (%)
BLF248	Philips	28	300	13	67
BLF278	Philips	50	300	16	55
BLF368	Philips	32	300	13,5	62
MRF141G	Motorola	28	300	14	55
MRF151G	Motorola	50	300	16	55
D1028UK	Semelab	28	300	13	60
DU28200M	M/A-COM	28	200	13	62
SD2932	STM	50	300	16	60
SR401	Polyfet	28	300	13	55

I chose 28V operation as that can easily be achieved, for example by putting two 13.8V power supplies in series, and there are also compact 28V SMPS (Switched Mode Power Supplies) available on the market nowadays. However, if you are about to build a dedicated power supply, it would be wise to select a 50V transistor, as these have more gain and are capable of better intermodulation (IMD) behaviour. Thanks to its availability and relatively cheap price, we selected the **MRF141G**.

3. Theory of operation

The amplifier is based upon a push-pull design. It consists of an input 0-180° phase splitter driving two identical active devices working in antiphase. At the output, the same 0-180° phase splitter is used as a combiner to deliver the output power of the two active devices to the amplifier load. The phase splitters are actually acting as transformers between the unbalanced coaxial input and output, and the balanced PA itself.

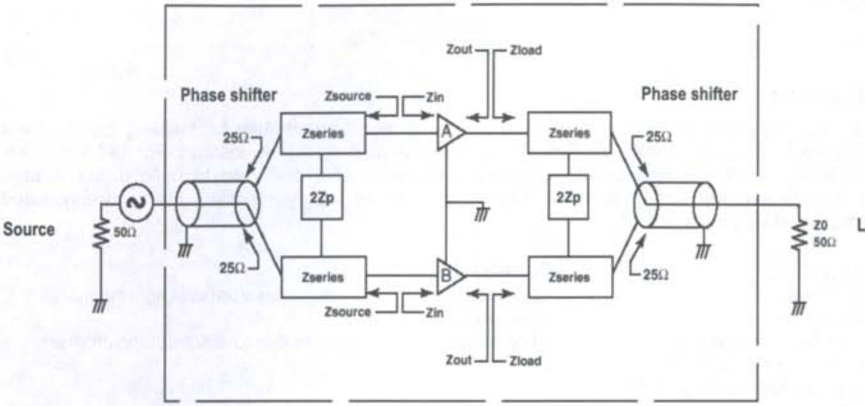


Fig. 1: Block diagram of a push-pull amplifier

Starting from the input source, the phase splitter delivers on its outputs both 0° and 180° phase shifted components of the input drive signal, together with converting the unbalanced 50Ω source impedance towards a 2 * 25 Ω balanced impedance. The purpose of the following network (Z_{series} and $2Z_p$) is to transform this 25Ω into the input impedance (Z_{in}) of blocks A and B, actually the active devices or transistors. Following these transistors, a similar network converts the 2 * 25Ω balanced impedance of the output phase splitter/balun so that the transistors are each loaded by the complex conjugate (Z_{load}) of their output impedance (Z_{out}). In other words, the matching network will force the 25 Ω impedance to look like Z_{out}^* to the transistors ($Z_{load} = Z_{out}^*$). The transistors are operated in class B and each of them is conducting during alternate half-cycles.

4. Design of the amplifier

4.1. MOSFET high-level theory

The transistor used here is a NMOS (N-channel enhancement mode) device, the physical structure of which is shown in Fig. 2 below.

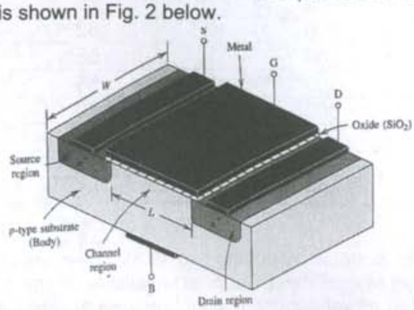


Fig. 2: Structure of a NMOS FET

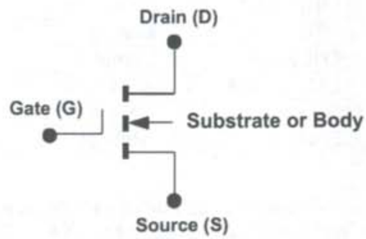


Fig. 3: Electronic symbol

With a positive voltage on the Drain (D) with respect to the Source (S), the Gate (G) must be biased to a positive voltage (again with respect to Source) to allow a Drain-Source current (I_d) to flow. This can be seen in Fig. 4.

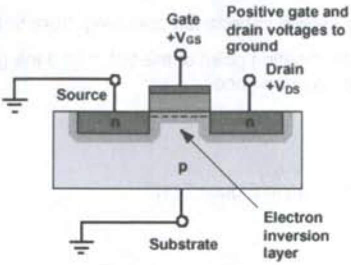


Fig. 4: Biasing of a NMOS FET

The minimum (threshold) value of the Gate-Source voltage which allows a D-S current to begin to flow is V_{gs}(th). The value of V_{gs}(th) is controlled during device fabrication and typically lies in the range 0.5 to 3 volts. Figure 5 below is the transfer characteristic of the device, and g_{fs} is the transconductance.

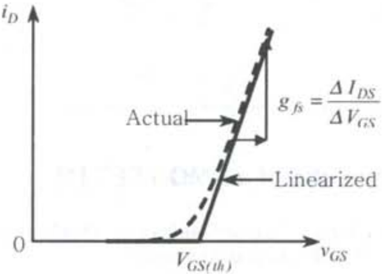


Fig. 5: Transfer characteristic

4.2. Baluns

The baluns are made of 50Ω coaxial cable having an electrical length of λ/4. The outer braid is grounded at only one end, the unbalanced termination, while the other end is floating and makes a balanced termination. Charge conservation requires that the currents on the centre conductor and on the outer braid maintain equal magnitude, and there is a 180° phase difference at any point along the line.

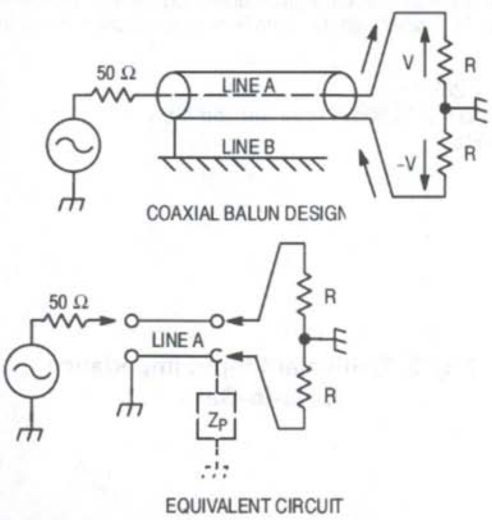


Fig. 6: Electrical schematic of the Baluns

Knowing the characteristic impedance of the Balun (Z_{balun}) to be 50Ω, we have:

$$Z_{balun} = \sqrt{50 * 2 * R} \Rightarrow R = 25\Omega$$

So, by themselves, the baluns are already providing some impedance matching, from 50Ω to 25Ω.

Z_p in Figure 6 is the parasitic impedance between the floating point of the balun and the ground. This must be kept as high as possible ($Z_p >> R$) to avoid an unbalance.

4.3. Input and output impedances

The equivalent schematic of a single NMOS FET is given in Figure 7 [1]:

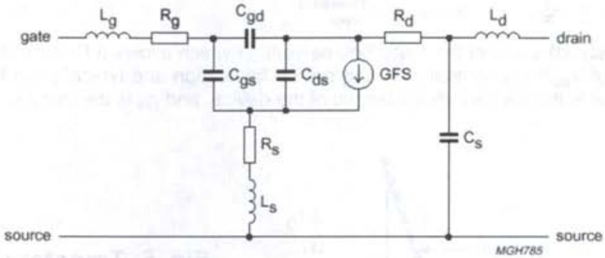


Fig. 7: Equivalent schematic of a NMOS FET [1]

All of the major and parasitic components shown in Figure 7 are embedded in models used by non-linear simulation tools, though only some of the values can be found in data sheets.

Regarding impedance matching, S-parameters are useless here as these are only valid for small signals, while we are operating here in large signals. Nevertheless, the **large signal** input and output impedances of the MRF141G can be extracted from its data sheet (see Appendix 1):

- $Z_{in} = (R_{in} + jX_{in})\ \Omega = (1.20 - j1.50)\ \Omega$
- $Z_{load}{}^* = Z_{out} = (R_{out} + jX_{out})\ \Omega = (3.90 - j0.85)\ \Omega$

These are Gate-to-Gate and Drain-to-Drain impedances, for a given operating voltage, bias, frequency of operation – and also for a particular resistor in parallel with the Gate (which is not often stated in the data sheet). The impedances are valid for:

- V_{dd} (Drain voltage) = 28V
- I_{dq} (quiescent current) = 2 * 250mA (see Section 4.5.)
- Frequency = 145 MHz

4.3.1. Input Impedance

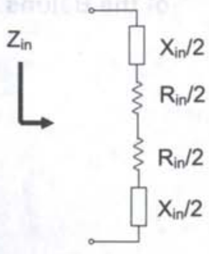


Fig. 8: Equivalent input impedance Gate-to-Gate

It is assumed the reactance given in the data sheet is a net one, i.e. resulting from both the reactance of the die (capacitive) and the inductive reactance due to the leads and bonding wires of the transistor.
To perform the design, we consider **each side** (or die) of the transistor **individually** ("half") and we will calculate the matching circuit for $Z_{in\,half} = \frac{R_{in}}{2} + j\frac{X_{in}}{2}$.

We then consider the input series impedance extracted out of the data sheet:

$Z_{in\,half}$ (Ω)	*Equivalent series circuit*
0,60 – j0,75	0,60 Ω + 1,46 nF

4.3.2. Output Impedance

4.3.2.1 First Method

In a similar way as in Section 4.3.1., we derive the series output impedance out of the data sheet and, considering one side of the transistor, we get:

$Z_{out\,half}$ (Ω)	*Equivalent series circuit*
1,95 – j0,42	1,95 Ω + 2,60 nF

4.3.2.2 Second Method

Beside the input & output series impedances given in the data sheet, the equivalent (simplified) schematic of the output impedance of one side (die) of the transistor can be represented as follows:

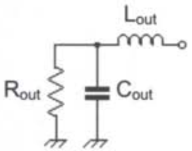


Fig. 9a: Equivalent parallel schematic for one die

$$R_{out} = R_{load} = \frac{(V_{dd} - V_{sat})^2}{2 * P_{out}} = \frac{(0{,}85 * V_{dd})^2}{2 * P_{out}}$$

$$L_{out} \approx 0{,}6\,nH$$

$$C_{out} = 1{,}2 * C_{oss}$$

V_{dd} = 28V, P_{out} = 150W (per transistor die/side) and C_{oss} = 420pF (per die).
The "1.2" multiplying factor (actually ranging from 1.15 to 1.3) in the calculation of C_{out} is an empirical factor due to the voltage swings that make C_{oss} varying, as indicated in some application notes [1].
L_{out} is assumed from figures found in data sheets and application notes.
By substituting in the equations, we get:

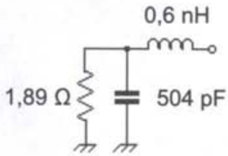


Fig. 9b

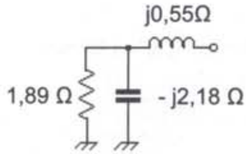


Fig. 9c

When using the equations given in Appendix 3 for parallel to series impedance transformation, we can derive the series equivalent schematic (valid only at the same frequency):

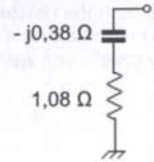


Fig. 10: Equivalent series schematic for one die

4.3.2.3 First versus Second Method

As a summary of the two methods, we have:

Method	*$Z_{out\ half}$ (Ω)*	*Equivalent series circuit*
First	1,95 – j0,42	1,95 Ω + 2,60 nF
Second	1,08 – j0,38	1,08 Ω + 2,89 nF

On a 25Ω normalized Smith chart, both impedances are relatively close to each other. From now on, we will work with the second method.
The topic of data sheet impedances, impedances for conjugate match or for best efficiency and S-parameters has been extensively explained in [2].

4.4. Synthesis of the matching networks

Since the transistor input & output impedances have been defined, the task of the designer regarding matching is shown below (still considering one die of the transistor) :

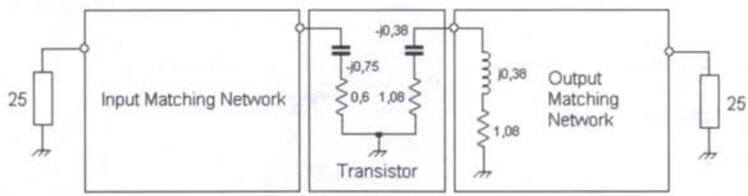
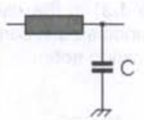
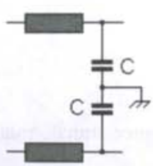


Fig. 11: Equivalent schematic of the input and output impedances

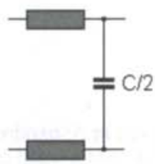
The impedance matching networks are made of low-pass filter sections (made of capacitors and printed striplines):



The two sides of the amplifier will be "merged" as follows:



which is equivalent to:



If the amplifier is well balanced, the currents flowing at the junction of both C capacitors are equal in amplitude and in opposite directions. That point is then acting as a **virtual ground**, so that the ground connection can be omitted and one capacitor (of half value) instead of two can be used.

The matching could be achieved by mean of a single low-pass matching section but this must be avoided. Because the input and output impedances of the transistor are very low, a single matching section would require a very high operating Q. High Q will lead to high circulating currents and hence high losses, together with potential instability and too narrow bandwidth. Therefore the matching should be achieved using several cascaded sections, each of which can have a more moderate working Q.

Though the synthesis of the matching networks can be done graphically "by hand" on a paper Smith chart, it is more straightforward to use computer software. The one used is **Smith V2.03** written by Fritz Dellsperger, HB9AJY [3].

For this design it is convenient to use a chart that is normalized to 25Ω, and the characteristic impedance of the matching striplines has also been set to 25 Ω. There is an infinite number of possible solutions to "link" 25 Ω (centre of the chart) to $Z_{in\ half}$ and $Z_{out\ half}{}^*$ but always keep in mind a low Q (Q curves can be drawn on the chart) is recommended while choosing the elements.

4.4.1. Synthesis of the input matching network

The input matching network transforms the transistor input impedance $Z_{in\ half} = (0.6 - j0.75)\Omega$ towards the $(25 + j0)\Omega$ impedance present after the input balun. In other words, the input matching network makes $Z_{in\ half}$ appear like a $(25 + j0)\Omega$ load to the input balun.

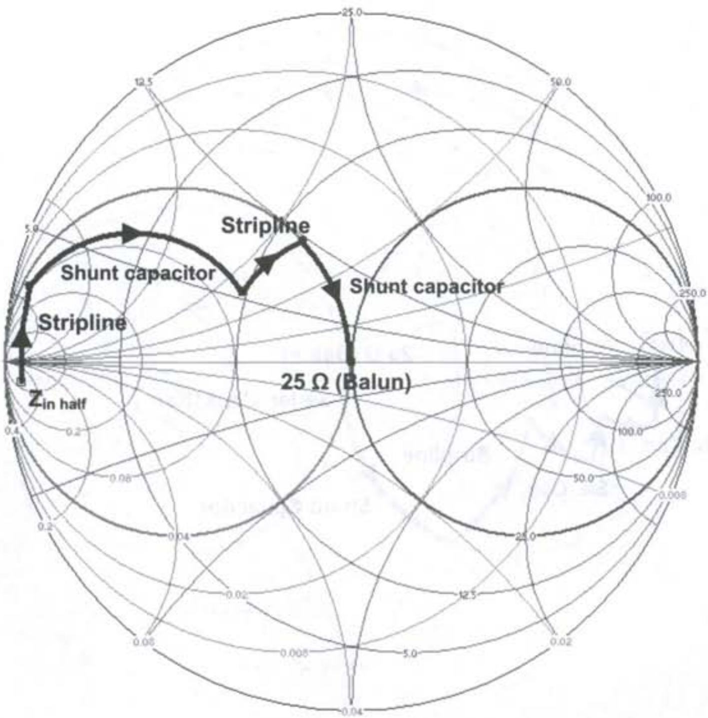


Fig. 12: Input matching network synthesis on the Smith chart

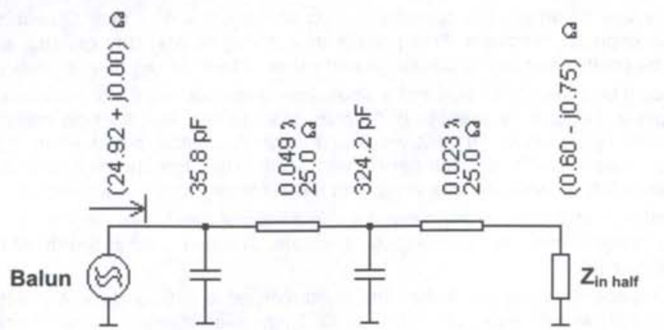


Fig. 13: Components of the input network (one side)

4.4.2. Synthesis of the output matching network

The output matching network transforms the (25 + j0)Ω impedance of the output balun into $Z_{out\ half}^*$ which is the complex conjugate of the transistor output impedance. The output matching network makes (25 + j0)Ω to appear like $Z_{out\ half}^*$ to the Drain of the transistor, so that the reactive parts of $Z_{out\ half}$ and $Z_{out\ half}^*$ cancel each other, while the resistive parts are equal and provide the most efficient power transfer.

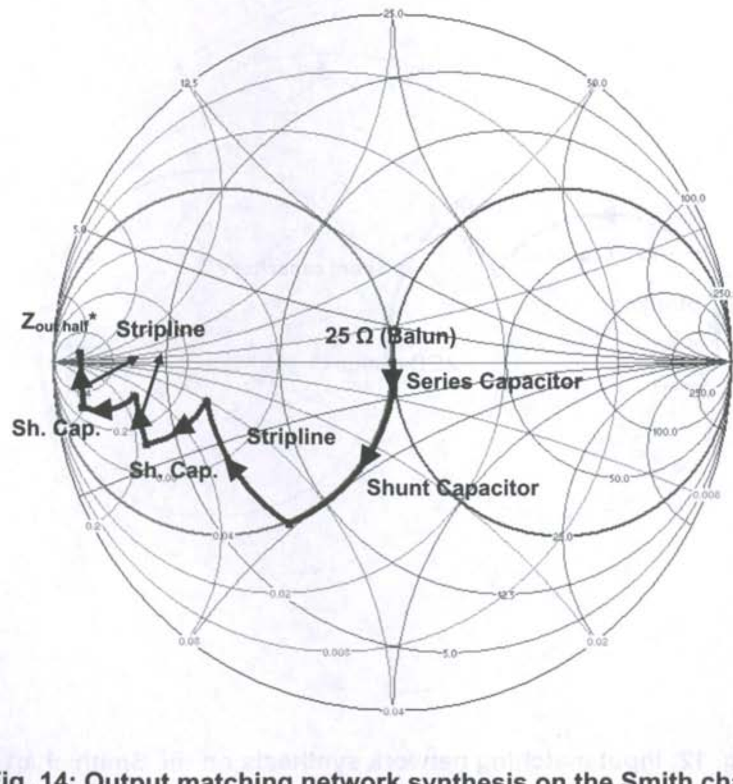


Fig. 14: Output matching network synthesis on the Smith chart

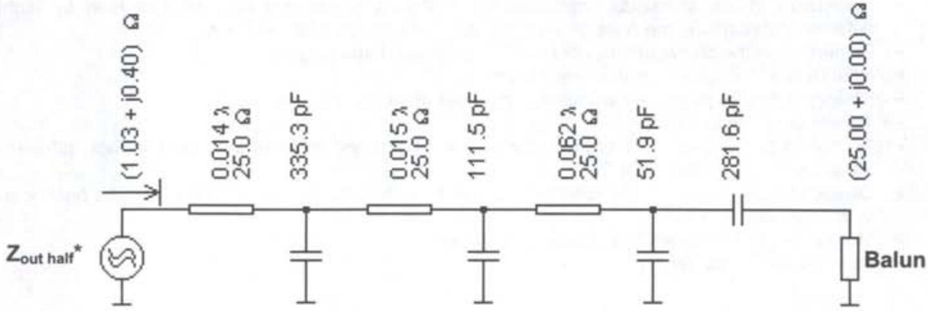


Fig. 15: Components of the output network (one side)

4.4.3. Comparison between actual and theoretical values

The amplifier was first built with the theoretical values obtained as above; but it was not delivering the expected output power, was exhibiting an efficiency lower than 50%, and had a poor input VSWR. The component values then had to be optimized.

The method used was simply "cut and try", which is not very scientific but I don't have any way to measure the actual transistor impedances, and don't have access to famous non-linear design software tools. The tables below indicate the differences between the theoretical component values and the actual optimized values.

Input Matching Network		
Component	*Theoretical value*	*Actual value*
Stripline	0,023 λ	0,023 λ
Shunt Capacitor	324 pF	324 pF
Stripline	**0,049 λ**	**0,057 λ**
Shunt Capacitor	**36 pF**	**Variable 44 to 76 pF**
Shunt Capacitor	-	**10 pF at balun input** (C24 on the RF board part list)

Output Matching Network		
Component	*Theoretical value*	*Actual value*
Series Capacitor	282 pF	282 pF
Shunt Capacitor	52 pF	52 pF
Stripline	0,062 λ	0,062 λ
Shunt Capacitor	112 pF	112 pF
Stripline	0,015 λ	0,015 λ
Shunt Capacitor	**335 pF**	**300 pF**
Stripline	**0,014 λ**	**0,013 λ**

The differences are highlighted in bold. We see that the values of the actual built amplifier are either the same as the theoretical design, or quite close. The small final changes make a big difference in performance, but the theoretical design was absolutely necessary to bring us to this place.

The difference in the input network can be explained by the fact the damping circuit (see Section 4.6) used for stability purpose introduces new components and hence modifies the impedance. It has also been found experimentally that adding a shunt capacitor of 10pF in front of the input balun (C24 on the RF board) improves the input VSWR.

From a general point of view, if an amplifier is not performing as expected (gain, efficiency, output power) according to the theoretical values of the matching networks' components, the reasons could be:

- Dispersion in the transistor characteristics (different production batches can lead to slightly different impedances, the ones given in the data sheets are average ones)
- Dispersion in the characteristics of the PCB (mainly printed striplines)
- Rounding of the figures on the Smith chart
- Rounding due to graphical derivation of data out of the data sheets
- Tolerance of the components
- According to the class of operation (conduction angle), the value of the load can look different to the transistor (see Section 4.5)
- Quiescent current (I_{dq}), Drain voltage (V_{dd}) and Gate-Source resistor different than the ones stated in the data sheet (if stated)
- Mutual coupling between the striplines (push-pull)
- Imperfection of the baluns.

4.5. Biasing of the amplifier

If the amplifier was operated in class A (small signal), the two dies inside the MRF141G conduct at the same time and the current flowing through each Drain is *i*. Given an impedance transformation ratio *n* (between the Drain and the load), the current flowing in the 50Ω output load (i_L) is:

$$i_L = \frac{2*i}{n}$$

And the voltage (v_L) across this load is: $$v_L = i_L * 50 = \frac{2*i*50}{n}$$

While the voltage on each Drain is: $$v_d = \frac{v_L}{n}$$

And the load seen from the Drains is: $$R_{dA} = \frac{v_d}{i} = \frac{v_L}{n*i} = \frac{2*50}{n^2}$$

When the amplifier is operated in push-pull class B, the Drain-to-Drain voltage swing is twice that of a single-ended class A amplifier. Only one of the two dies inside the transistor package is conducting (on alternate half-cycles, the other being blocked). So, the current flowing in the 50 Ω output load is:

$$i_L = \frac{i}{n}$$

And the load seen from the Drains is: $$R_{dB} = \frac{50}{n^2}$$

We then see that: $$R_{dB} = \frac{R_{dA}}{2}$$

So, the load seen from the Drains in class B is half the one seen in class A. From an amplifier gain point (A_v) of view, we have:

- $A_{V\ Small\ Signal} = g_{fs\ Small\ Signal} * R_{dA}$
- $A_{V\ High\ Signal} = g_{fs\ High\ Signal} * R_{dB} = g_{fs\ High\ Signal} * \frac{R_{dA}}{2}$

To be linear, the amplifier must have the same gain for small and large signals. Then:

$$A_{V\ Small\ Signal} = A_{V\ High\ Signal} \quad => \quad g_{fs\ Small\ Signal} * R_{dA} = g_{fs\ High\ Signal} * \frac{R_{dA}}{2}$$

We can conclude: $g_{fs\ Small\ Signal} = \dfrac{g_{fs\ High\ Signal}}{2}$

The amplifier has then to be biased so that the slope of the transfer characteristic without RF excitation (or $g_{fs\ Small\ Signal}$) is half the high-signal slope ($g_{fs\ High\ Signal}$). This avoids crossover distortion, as shown on the following picture:

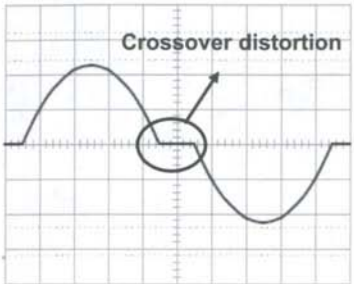


Fig. 16: Crossover distortion

The goal is then here to set up a Gate voltage (V_{gs0}) so that a quiescent current (I_{dq}) flows through each Drain.

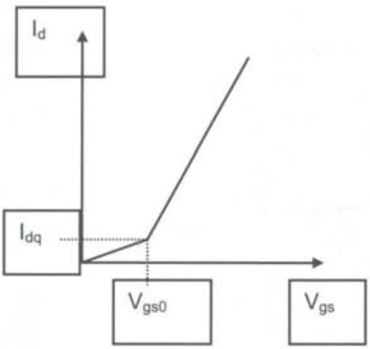


Fig. 17: Bias point on the transfer characteristic

A MOSFET Gate behaves like a capacitor at DC, thanks to its very high impedance. So, biasing the Gate requires very little current and a simple resistor voltage divider easily fulfils the requirement. Here is an extract from the schematic of the bias network (see Section 5.1.1 for more details).

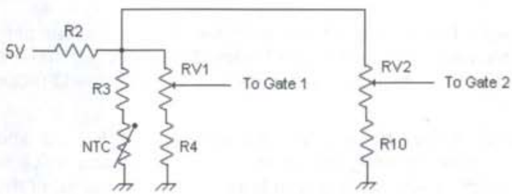
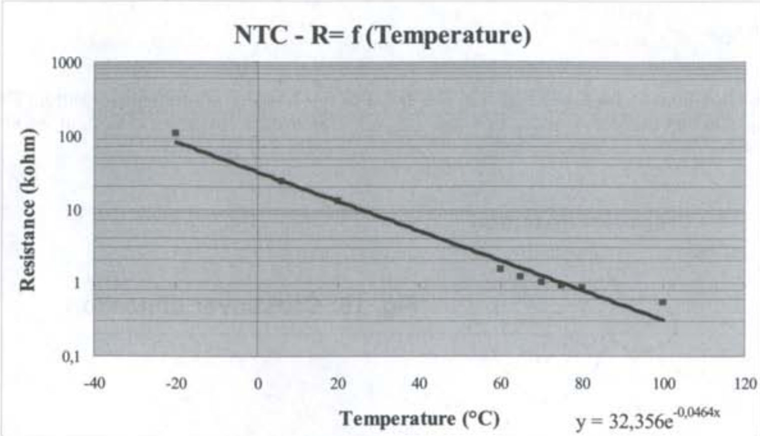


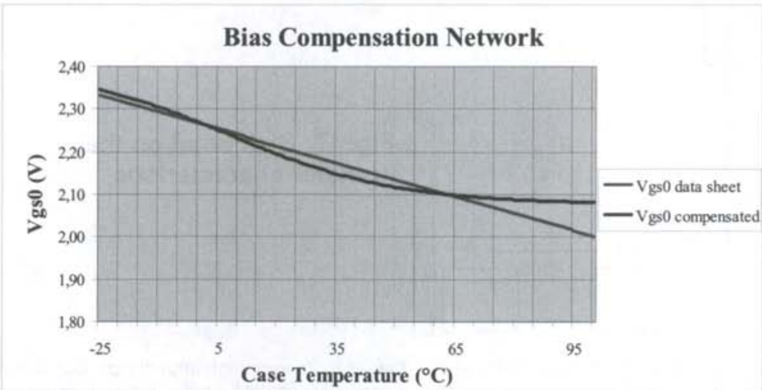
Fig. 18: Gate bias network

RV1 and RV2 are adjusted to get a quiescent current of 250mA through each Drain. This is achieved with a V_{gs0} around 2.2V on each Gate (@ 25°C).

The data sheet tells us that the V_{gs0} varies according to the case temperature of the transistor, so that some amount of temperature compensation is needed to keep a stable bias point. This is achieved by mean of a NTC (Negative Temperature Coefficient) resistor. I reused one from my junk-box; unfortunately it is unmarked, so I measured the NTC characteristic:



Knowing the value of the NTC according to the temperature, and having already fixed the values of all the components except R2 and R3, these last two values have been calculated (their ratio) so that the compensated V_{gs0} follows the same slope as V_{gs0} in function of the case temperature given in the data sheet. Obviously, both the case of the transistor and the NTC must be in close thermal contact.



4.6. Stability

No particular calculation has been done to assess the stability of the amplifier. Instead, a damping network (R15-C25-C26) has been added at the input (idea extracted from Philips data sheet [4]) and the Gate resistor (R7/R8) value has been carefully selected on test. Both methods help to damp the Q factor of the input network.

With the values shown on the schematic of the RF Board, the amplifier is stable, even if its input and output are left open-circuit (no load). If there is no input damping circuit, or if the Gate resistor value is above 10Ω, the amplifier runs into oscillation. A damping network has also been tried at the output of the amplifier but it turned out to be useless. From a general point of view, the solutions helping to stabilize a power amplifier are:

- Low Q matching networks (*)
- Damping of matching networks (*)
- Series or parallel Gate resistor (*)
- Drain to Gate feed-back.

Three of those methods (*) are used here.

4.7. Low-Pass Filter (LPF)

A 5-pole LPF has been added at the output of the amplifier to attenuate the harmonics and also those intermodulation (IMD) products that fall close to the harmonic frequencies. It is worthwhile to mention here that thanks to the Push-Pull configuration, the even-numbered harmonics (2f, 4f...) and the even-order IMD products (f_1+f_2, $2f_1+2f_2$,...) are already well attenuated by the amplifier itself (if well balanced).

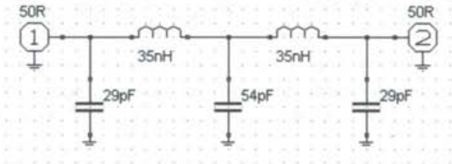


Fig. 19: Output Low-Pass Filter

The design of the filter has been conducted using the freeware **RFSim99** [5]. The transfer function (S21) and return loss (S11) are shown on the graph here after. The filter starts to cut-off a bit above 200 MHz.

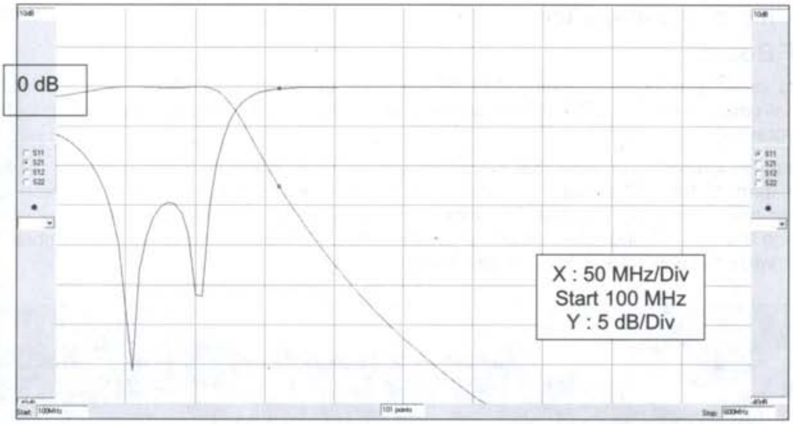


Fig. 20: Simulated transfer function of the LPF

There would still be room to move the cut-off closer to 150 MHz. However, the measurements done on the built LPF show that the out-of-band rejection is a few dB better than the simulated performance (the effect of the screen between the two inductors was not simulated).

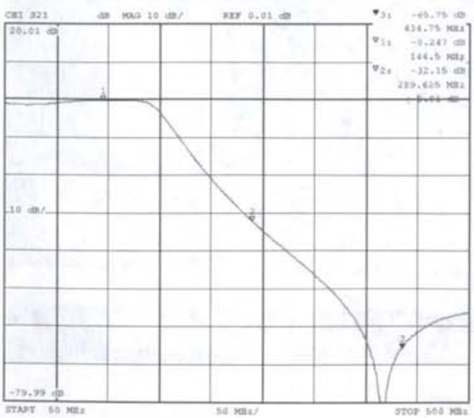


Fig. 21: Measured transfer function of the LPF

From the measurement (Fig 21), we get the table below:

Frequency	***S21 (dB)***	***Remark***
145	- 0,25	Fundamental (f_0)
290	- 32	2nd Harmonic ($2*f_0$)
435	- 66	3rd Harmonic ($3*f_0$)
580	- 52	4th Harmonic ($4*f_0$)

The rejection of the 3rd Harmonic is 66 dB. This value would be decreased if the cut-off frequency were moved closer to 150 MHz, or if other self-resonant frequencies were introduced by using components of different value; so the design has been kept like it is. The return loss (S11) is better than 30 dB over the 2m band.

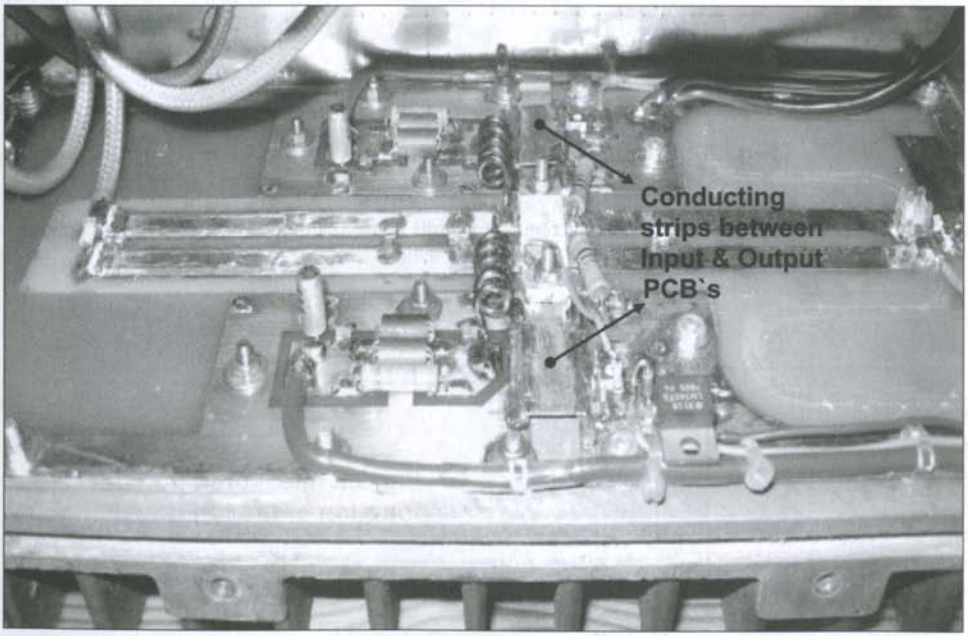
The LPF PCB also includes a basic directional coupler to assess the Direct (Dir.) and Reflected (Ref.) powers for output power monitoring purpose, and to supply the VSWR protection circuit. The coupling loss amounts to 30.6 dB on the coupled line.

5. Building of the amplifier

5.1. RF Board

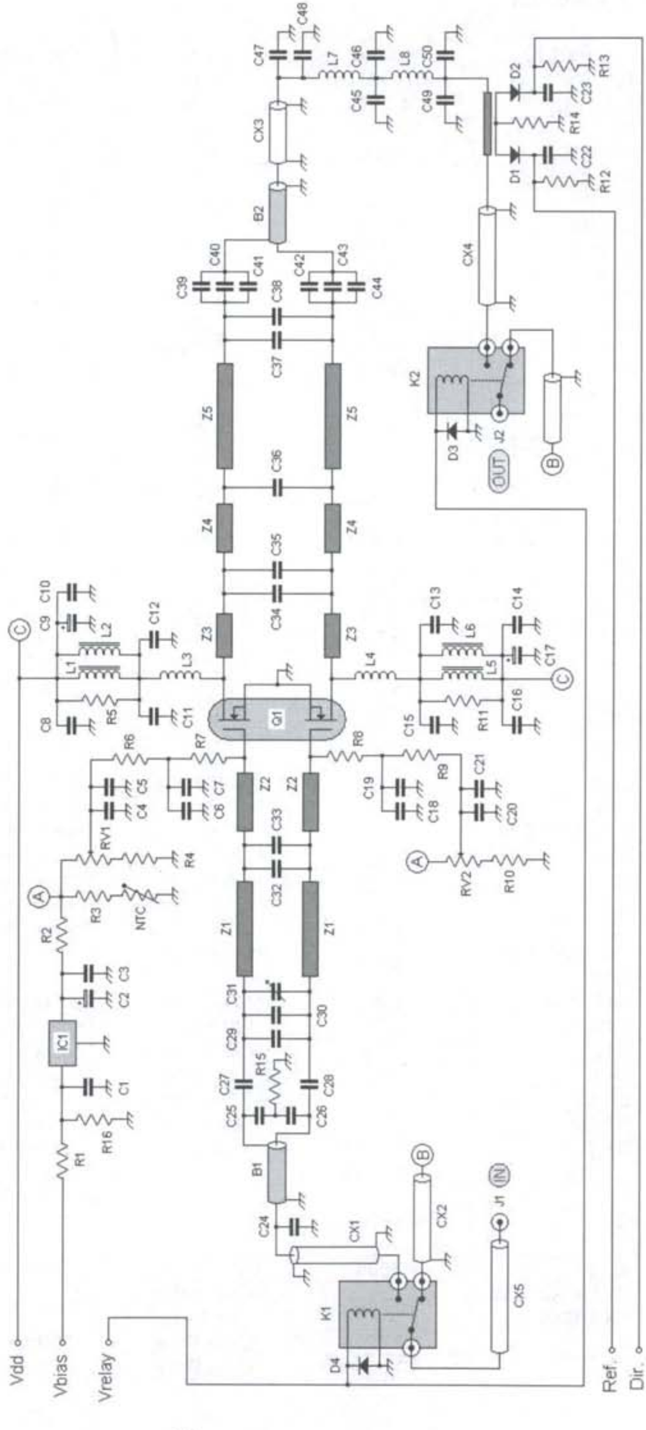
This "board" actually includes three different PCBs: an input board, an output board, and a small PCB with a directional coupler and the LPF. Where needed, the boards are bridged by copper conducting strips (see photographs).

Readers may be interested to know that the schematic has been drawn with only a simple drawing editor (MS Paint, part of the MS operating systems). A master file including the most common electronic symbols has been "manually" created. The schematics are then drawn by reusing that same common file and by using the "select" and "copy-paste" functions. Lines are then drawn to link the symbols between each other, while the unused symbols are just deleted.



RF Board

5.1.1. Schematic of the RF board



5.1.2. Parts list

Part ID	Value	Type	Supplier	Remarks
R1	1 kΩ	¼ W	Various	Through Hole
R2	4,7 kΩ	¼ W	Various	Through Hole
R3	20 kΩ	¼ W	Various	Through Hole
R4, R10	10 kΩ	¼ W	Various	SMD 1206
R5, R11	8,2 Ω	1 W	Various	Metal Film MR52
R6, R9	1 kΩ	1,6 W	Various	Metal Film PR37
R7, R8	10 Ω	1 W	Various	Metal Film MR52
R12, R13	1 MΩ	¼ W	Various	SMD 1206
R14	47 Ω	¼ W	Various	SMD 1206
R15	10 Ω	1 W	Various	Metal Film MR52
R16	10 kΩ	¼ W	Various	Through Hole
RV1,.RV2	10 kΩ	3314 (¼ W)	Bourns	SMD
NTC	10 kΩ	@ 25°C – See section 4.5.		
C1, C5, C7, C10, C12, C13, C14, C19, C21, C22, C23	1 n	X7R	Various	SMD 1206
C2	1 µ	Tantalum 16V	Various	SMD
C3, C4, C6, C8, C11, C15, C16, C18, C20	100 n	X7R	Various	SMD 1206
C9, C17	10 µ	Electrolytic 50 V	Various	Through Hole
C24	10 p	NP0 500V	Philips	R100G19COGL **(1)**
C25, C26	27 p	P100 Porcelain	Temex (Hi-Q)	500CHB270FV
C27, C28	1 n	P90 Porcelain	ATC (100B)	ATC100B102KW500
C29	4,7 p	P100 Porcelain	Temex (Hi-Q)	500CHB4R7BV
C30	15 p	NP0 500V	Philips	R150G19COGL
C31	2-18 p	PTFE dielectric film	Philips	2222 809 05217
C32	150 p	P90 Porcelain	ATC (100B)	ATC100B151JW500
C33	12 p	P100 Porcelain	Temex (Hi-Q)	500CHB120FV
C34, C39, C44	82 p	P100 Porcelain	Temex (Hi-Q)	500CHB820FV
C35	68 p	P100 Porcelain	Temex (Hi-Q)	500CHB680FV
C36	56 p	P100 Porcelain	Temex (Hi-Q)	500CHB560FV
C37	18 p	P100 Porcelain	Temex (Hi-Q)	500CHB180FV
C38	8,2 p	P100 Porcelain	Temex (Hi-Q)	500CHB8R2BV
C40, C41, C42, C43	100 p	P100 Porcelain	Temex (Hi-Q)	500CHB101FV
C47, C50	6,8 p	P100 Porcelain	Temex (Hi-Q)	500CHB6R8BV
C48, C49	22 p	P100 Porcelain	Temex (Hi-Q)	500CHB220FV
C45	15 p	P100 Porcelain	Temex (Hi-Q)	500CHB150FV
C46	39 p	P100 Porcelain	Temex (Hi-Q)	500CHB390FV
L1, L2, L5, L6		VK200 Choke	Philips	
B1, B2		λ/4 Balun	Home	See section 5.1.3.
D1, D2	5082-2811	Schottky	Agilent (HP)	Through Hole
D3, D4	1N4148		Various	Through Hole
Q1	MRF141G		Motorola, Tyco Electronics, M/A-Com	**(2)**
IC1	7805	5V Regulator	Various	
CX1, CX2, CX3, CX4, CX5	RG 400	Coax cable sections	Huber&Suhner	
K1	CX120A	Coax Relay	Tohtsu	
K2	CX520D	Coax Relay	Tohtsu	

J1	Female N		Connector	Various	On Front-Panel	
J2	Female N		Connector	Various	Part of K2 (CX520D)	
Homemade Inductors' data						
	Value	**Internal Ø**	**Wire Ø**	**Length**	**Winding**	**# Turns**
L3, L4	≈ 35 nH	5 mm	1,5 mm	17 mm	Spaced	4,5
L7, L8				14 mm, mounted 5 mm above PCB		3,5
Stripline data						
	Length (mm)		**Width (mm)**	**El. Length (λ)**	**Remarks**	
Z1	61,0		7,5	0,057		
Z2	23,5			0,023		
Z3	14,0			0,013	0,3mm th., 5mm wide CuAg strip soldered on PCB'stripline	
Z4	16,0			0,015		
Z5	68,0			0,062		
PCB`s: 1.6mm thick, double sided FR4 epoxy glass fibre (ε_r = 4.6)						

(1): Experimentally, it has been found this capacitor improves the input Return Loss.
(2): Can be bought at RF Parts (http://www.rfparts.com) in the USA. ASI Advanced Semiconductor Inc (http://www.advancedsemicondurctor.com) is also selling the MRF141G.

5.1.3. Baluns

The input Balun is made of RG 316 PTFE dielectric 2,5 mm O.D. coaxial cable manufactured by H&S. The output Balun is made of RG 400 cable of the same manufacturer. The velocity factor (V_f) of both cables is 0,695.

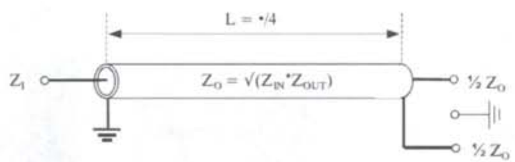


Fig. 22: Drawing of the Baluns

Both cables have an electrical length of λ/4, and the velocity factor (V_f) of both cables is 0.695.

This leads to a physical length of $\frac{300}{145} * 0,25 * V_f = 36 cm$

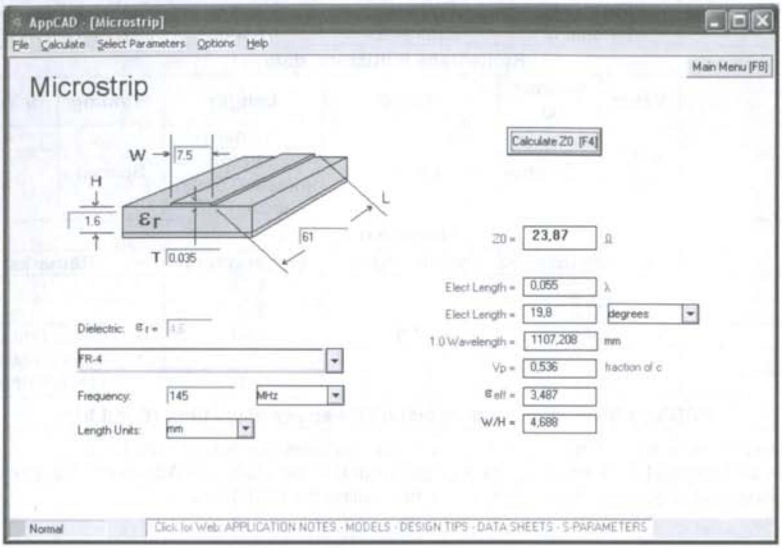
Make them a little bit longer to allow the solder junctions with the matching striplines. Both baluns are wound as shown on the pictures (see Section 8). The winding diameter amounts to around 50 mm. As can be noticed on the same pictures, λ/8 printed baluns with semi-rigid cable were initially used but without too much success.

Note: Huber and Suhner is no longer manufacturing the RG316 or RG400, but the Enviroflex 316 and 400 instead. These cables have slightly different characteristics.

5.1.4. Matching striplines and PCBs

The three PCBs comprising the RF board are made of double-sided FR4 epoxy glass fibre. All PCB's are screwed directly onto the heatsink. When it is all about high currents and low impedances, ground continuity is very important, also for stability of the amplifier. Apart from the RF tracks, the layout is not critical. The two sides of the boards are linked together by copper strips all around the edges (Cu foil is easily available from the external "braid" of a piece of H100 coax cable) and also by as many through-board "vias" as possible. The input and output PCBs are also liked together by copper strips along both sides of the Gemini transistor package. The pictures of Section 8 are self-explanatory.

The striplines have been designed using the freeware **AppCAD** [6] from Agilent. Here is an example :



The constructional data of the critical RF tracks are shown on the pictures below :

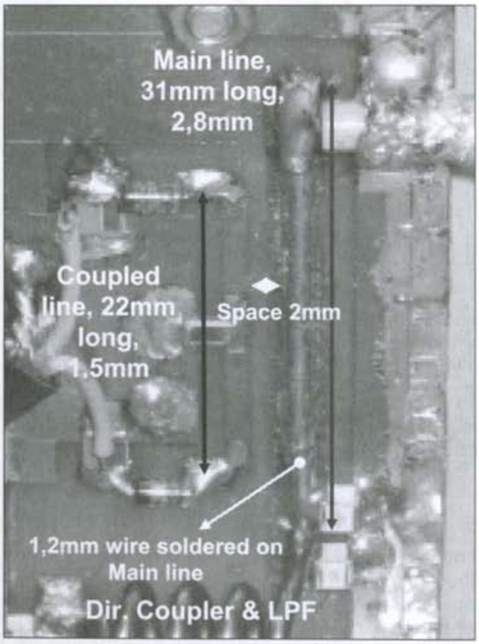


Fig. 23: Directional coupler: RF tracks details

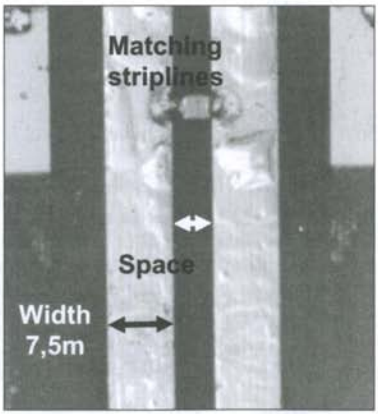


Fig. 24: Matching striplines details

5.1.5. Cooling

The aluminium heatsink has been recycled from a military surplus power supply (see pictures in Section 8). No heat transfer calculation has been done, but the heatsink turned out to be big enough to allow SSB/CW operation without any extra cooling (at room temperature). When it is hot – and remember, this amplifier is designed to be operated outdoors, of course protected against rain but in a non air-conditioned environment – or indeed for heavy-duty operation, a snail blower provides more than enough cooling. Even during long periods of operation, the heatsink stays at room temperature.

The transistor is screwed onto a 1 mm thick piece of copper, acting as a heat spreader. The heat spreader is itself in close contact (screwed) with the heatsink.

To avoid mechanical stress due to temperature changes, it is normally recommended to bend the transistor leads. However, it hasn't been done here: the transistor leads have been kept straight and soldered directly to the PCBs, with no problems.

5.2. Control board

This board supervises the amplifier. It has been constructed using perforated matrix board with holes surrounded by copper pads on a 0.1-inch (2.54 mm) grid.

Once S1 (front-panel) is set to "ON" and S2 (front-panel) is set to "Operate", the amplifier is ready. In RX, the green LED D6 lights on the front panel. When the PTT input is grounded, the amplifier goes to TX mode; this is indicated by the red LED D5. The amplifier is sequenced to avoid "hot" switching of the coax relays K1 and K2 (RF Board) when RF is present. RV2 and C7 introduce a further time delay so that the bias is only applied to the transistor AFTER the K1 and K2 have been switched to TX (Normally Open position of the coax relays).

The operational amplifiers IC2A and IC2D shape the voltage out of the directional coupler (LPF PCB) to drive the TH1 thyristor that is the heart of the VSWR protection circuit. RV3 sets the VSWR threshold above which the amplifier goes into protection. In the protection mode, the amplifier goes into RX mode (bias is disabled and the coax relays go back to Normally Closed state). The thyristor latches the amplifier in protection mode until the "Reset" push button (front-panel) is pressed – which should not be done until after the VSWR fault in the antenna line has been found. IC2B amplifies the voltage sampled out of the direct power by the directional coupler. This voltage is approximately proportional to the square root of the output power. It could be displayed on a front-panel meter; but for my own station, where the amplifier is 50m away from the shack, a "Monitor" output jack has been provided so that the proper working of the amplifier can be monitored remotely. I use a simple LED that varies in brightness according to the RF output power; or alternatively a voltmeter can of course also be used.

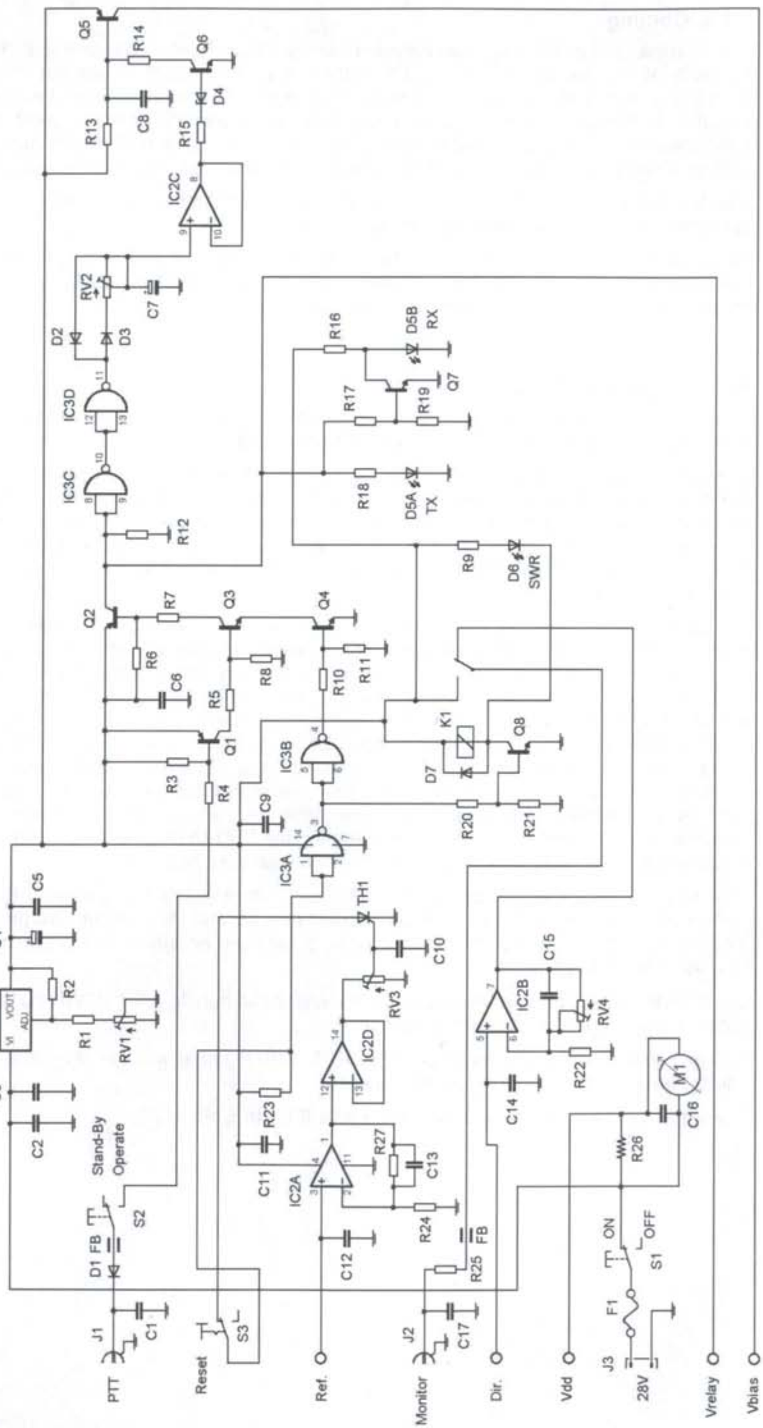
RV4 sets the maximum voltage on the "Monitor" output in normal operation. If the amplifier goes into protection due to bad VSWR, the relay K1 switches, so that the monitor voltage goes to high state until the "Reset" button is pressed. This can serve to activate an alarm; in the present case, the monitoring LED lights at full brightness.

The **VSWR protection is mandatory**, the transistor can handle a 5:1 VSWR but a short or an open in the antenna line makes the VSWR to be infinite…

R26 is a shunt resistor (75 mV drop under 30 A) that, together with the M1 meter, indicates (on the front-panel) the Drain current drawn by the transistor.

The schematic here has been drawn with **EAGLE Light Edition** [7].

5.2.1. Schematic of the Control board



5.2.2. Parts List

As this is a low frequency board, the package of the components (through hole or SMD) is not critical, and is not mentioned in the table below.

Part ID	Value	Type	Supplier	Remarks
R1	1,6 kΩ	¼ W	Various	
R2	237 Ω	¼ W	Various	Tolerance 1%
R3, R4	3,3 kΩ	¼ W	Various	
R5, R15,R17,R20,R21	2,2 kΩ	¼ W	Various	
R6, R8, R11, R19	10 kΩ	¼ W	Various	
R7, R9, R14, R18	1 kΩ	¼ W	Various	
R10, R13	4,7 kΩ	¼ W	Various	
R12	47 kΩ	¼ W	Various	
R16, R23, R25	820 Ω	¼ W	Various	
R22	220 kΩ	¼ W	Various	
R24	100 kΩ	¼ W	Various	
R26	2,5 mΩ	Shunt Resistor, 75 mV drop at 30 A		
R27	1 MΩ	¼ W	Various	
RV1	2,2 kΩ	½ W	Various	
RV2	50 kΩ	½ W	Various	
RV3	10 kΩ	½ W	Various	
RV4	1 MΩ	½ W	Various	
C1, C2, C6, C8, C9, C10, C11, C12, C13, C14, C15, C16, C17	1 n	X7R	Various	
C3, C5	100 n	X7R	Various	
C4	15 µ	Electrolytic 50 V	Various	
C7	1 µ	Tantalum 16V	Various	
D1, D2, D3	1N4148		Various	
D4	9,1 V	BZX79C Zener diode	Philips	
D5	Dual color LED	Red/Green	Various	On Front-Panel
D6	LED	Red	Various	On Front-Panel
TH	2N5064	Thyristor	Various	
Q1	2N2907	PNP	Various	
Q2	BD676	Darlington PNP	Various	
Q3, Q4, Q6, Q7, Q8	BC109	NPN	Various	
Q5	2N2904	PNP	Various	
IC1	LM317T	Volt. regulator	Various	
IC2	LM324	AOP	Various	
IC3	HEF4011BD	NAND gates	Various	
K1	DO12-M	12V relay	Fujitsu	Any small relay is OK
S1	Switch	SPDT	Various	10 A handling, Front-Panel
S2	Rotary switch	At least 2 positions	Various	On Front-Panel
S3	Push button	Norm. Closed	Various	On Front-Panel
M1		Drain current meter	Various	Sold with shunt resistor (R26) – 6,8 mA for full scale deviation, 11 Ω internal resistor
F1	25A	Car fuse	Various	
J1, J2	RCA Jack	Connector	Various	On Front-Panel
J3		Power Connector	Various	On Front-Panel
FB	Ferrite bead		Various	
PCB	perforated	board		

6. Commissioning

This section describes the steps to be achieved in order to set the amplifier up and running.

1. Set RV1 of Control board so that its "hot" end (the one linked with R1) is connected to ground.
2. Set RV1 and RV2 of RF board so that the slider is set to the "cold" ends (the ends linked with R4 and R10 respectively). Short-circuit R4 and R10 of the RF board to ground (the MRF141G is cut off).
3. Set the slider of RV3 of the Control board to the "cold" end (ground).
4. Slowly adjust RV1 to get 13V at the output of the LM317 (IC1). Be careful not to exceed 15V for the safety of IC3.
5. Without any RF drive applied, set the PTT input (J1 of Control board) to ground back and forth, while adjusting RV2 of the Control board so that V_{bias} (collector of Q5 on the Control board) only rises AFTER the coaxial relays have been switched.
6. Disconnect CX3 from the RF board from the amplifier's output PCB and terminate it with a 50Ω load (min 10W). Mechanically switch K2 of the RF board and inject 8W of RF power on J2 (front-panel) of the RF board. Then, adjust RV3 of the Control board so that the front-panel "VSWR" LED lights. This sets the VSWR protection threshold. At full output power (300W), a reflected power of 8W corre sponds to a 1.4:1 VSWR. Remove the 50Ω load and re-connect CX3 on the output PCB of the RF board.
7. Connect a wattmeter and a high-power 50Ω load (> 300W) to J2 of the RF board. Connect a trans ceiver to J1 of the RF board, through a VSWR/watt-meter. Link the transceiver's PTT output to J1 of the Control board. Set the transceiver power output to 3W and key it. Adjust C31 of the RF board (with an insulated screwdriver) to achieve the best possible input VSWR while checking the output power. Around 100W of output power must be obtained. Slowly increase the transceiver power while re-adjusting C31 to keep a good input VSWR. The worst VSWR is 1.3 at mid drive power. At low and full drive, the VSWR-meter needle doesn't deviate at all. With 13W of drive power, the output power should be around 300W, together with a 50% efficiency. Below 300W, it is normal that the efficiency is worse. Due to the dispersion of the characteristics of the components (compared to the ones used here), perfect matching probably won't be achieved at first try. Extra tuning of the capacitors in the matching networks would then be required. This will be achieved by temporarily soldering variable capacitors instead of, or in parallel with the ones already in place. Capacitors of the same type as C31 will do the job.

   Tuning is an iterative process. Start at low drive power levels and tune the output matching network, from the transistor to the output, back and forth. Then, tune the input network the same way. After wards, come back to retuning the output network. Continue carefully, at gradually increasing drive levels up to the maximum.
8. Adjust RV4 of the Control board to obtain the wanted monitor output voltage on J2 of the Control board.

7. Performance

Due to lack of measurement equipment, the performance assessment has been quite limited. However, at least the input/output power characteristic has been measured, as seen here:

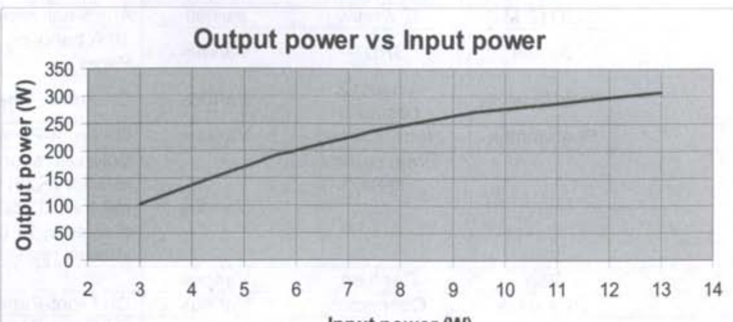


Fig. 25: Output power versus input power

The mean **gain** is **15 dB** and the **1 dB compression point** lies at **280W** output power. Although the intermodulation products and harmonic rejection have not been measured, the following picture, extracted from a Motorola application note [8], shows the harmonic rejection of a **broadband** amplifier (no output filtering) using the MRF141G. One clearly sees that at low frequencies, the push-pull configuration shows the even harmonics already well rejected (without any LPF) by the amplifier of its own, while the odd harmonic levels remain quite high. However, the falling gain at UHF means that at 144 MHz, the worst harmonic level is -45 dBc (third harmonic). Assuming the amplifier described here behaves the same way as the broadband one (which is unlikely to occur, thanks to the narrowband nature of the present amplifier, and the matching networks made of LPF sections) and then including the rejection provided by the output LPF, a (theoretical) **minimum harmonic rejection of 77 dBc** can be expected for all orders.

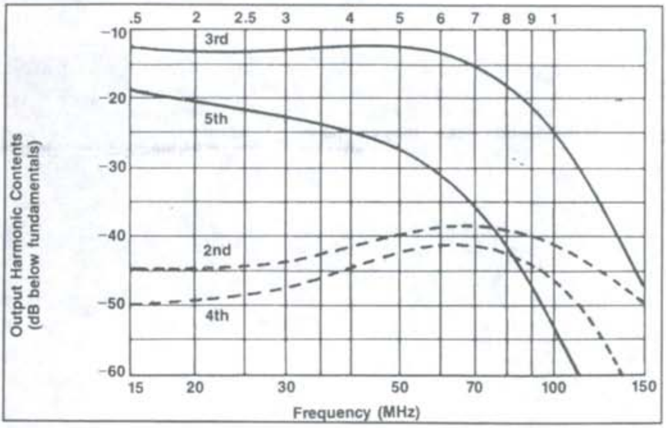
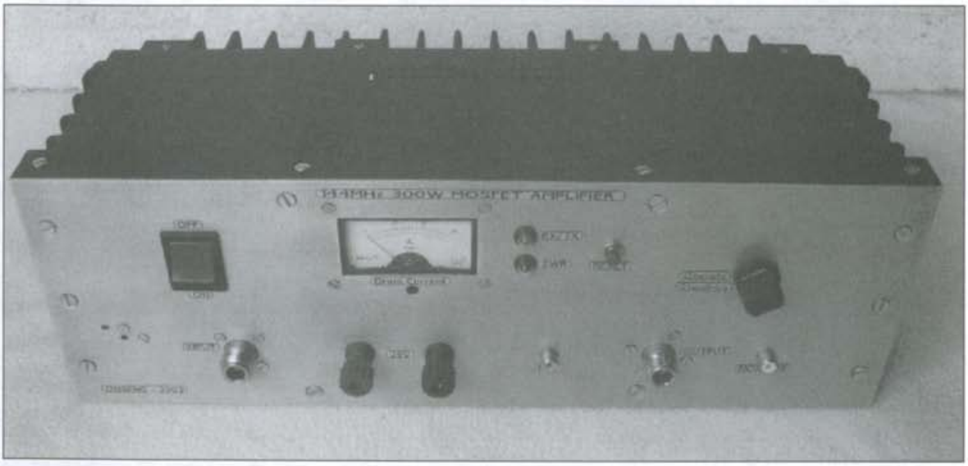


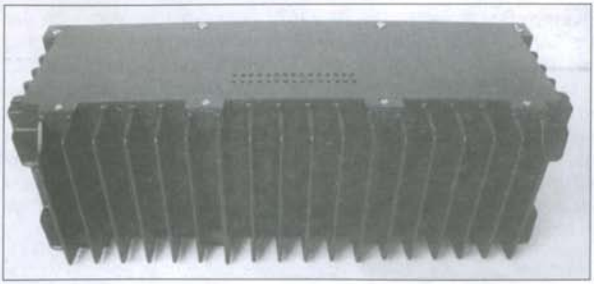
Fig. 26: Harmonic content of a broadband MRF141G

From a very subjective point of view, excessive splattering has never been reported, even by nearby stations. The current drawn to achieve full output power lies around **20A at 28V**, yielding an **efficiency of 53%**.

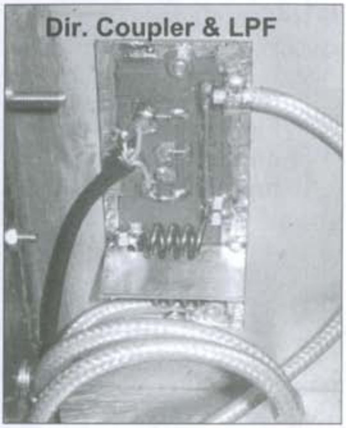
8. Pictures

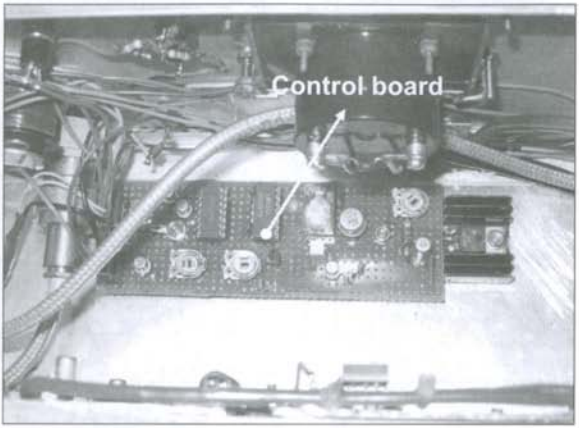
This section shows in pictures some further constructional details of the amplifier.

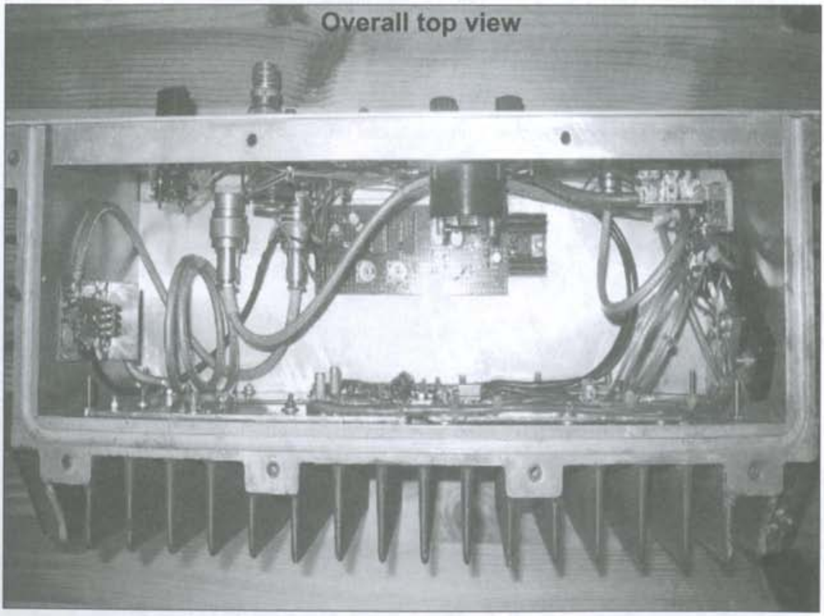


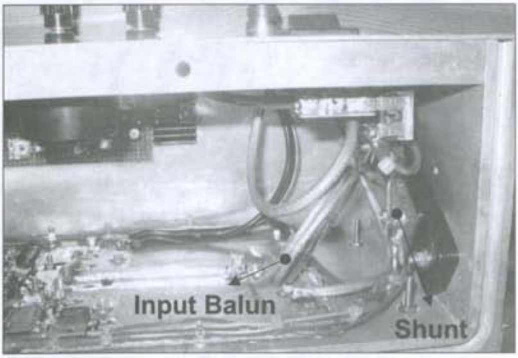


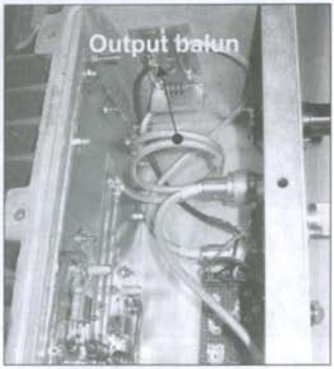

144MHz 300W MOSFET AMPLIFIER
Drain Current

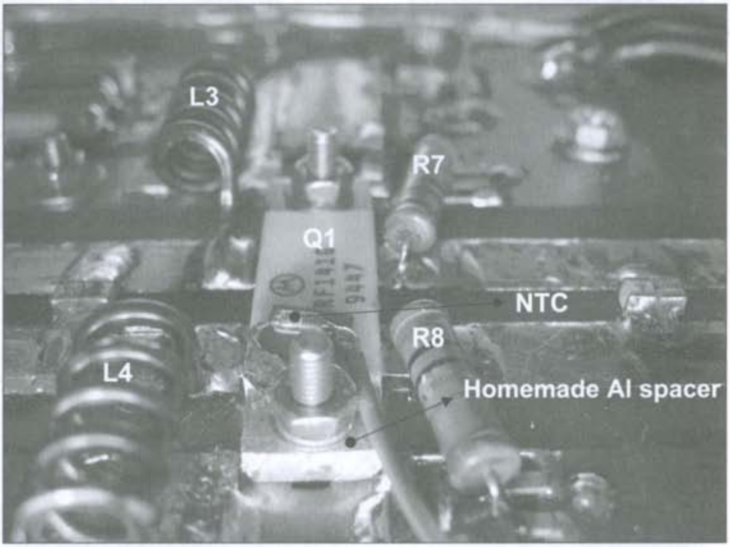

Dir. Coupler & LPF

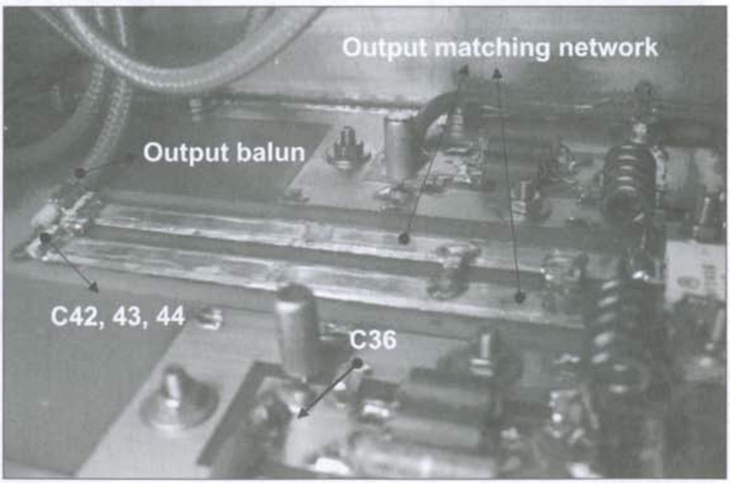

Control board


Overall top view


Input Balun
Shunt


Output balun


L3
R7
Q1
NTC
R8
L4
Homemade Al spacer


Output matching network
Output balun
C42, 43, 44
C36

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SEMICONDUCTOR TECHNICAL DATA

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Designed for broadband commercial and military applications at frequencies to 175 MHz. The high power, high gain and broadband performance of this device makes possible solid state transmitters for FM broadcast or TV channel frequency bands.

- Guaranteed Performance at 175 MHz, 28 V:
  Output Power — 300 W
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  Efficiency — 50%
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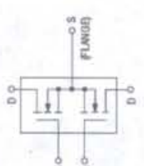
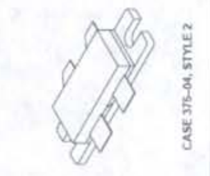
- Nitride Passivated Die for Enhanced Reliability

MRF141G

300 W, 28 V, 175 MHz
N–CHANNEL
BROADBAND
RF POWER MOSFET





CASE 375–04, STYLE 2

MAXIMUM RATINGS

Rating	Symbol	Value	Uni
Drain–Source Voltage	V_{DSS}	65	Vd
Drain–Gate Voltage	V_{DGO}	65	Vd
Gate–Source Voltage	V_{GS}	±40	Vd
Drain Current — Continuous	I_D	32	Ad
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	500 2.85	Wat W/°
Storage Temperature Range	T_{stg}	–65 to +150	°C
Operating Junction Temperature	T_J	200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Uni
Thermal Resistance, Junction to Case	$R_{θJC}$	0.35	°C/

NOTE — CAUTION — MOS devices are susceptible to damage from electrostatic charge. Reasonable precautions in handling and packaging MOS devices should be observed.

830 km. Meanwhile PP5XX (GG53qw) made a QSO with PY1NB (GG87mo) in SSB/CW RS 55 and RST 559 covering 700 km of distance. This propagation (possibly Tropo) included 3 states: Santa Catarina, São Paulo and Rio de Janeiro, this last one difficult to be copied in most of the time on 144 MHz.

PY1BCN (GG87KL, 144.070 MHz, 7 Ele Yagi, 1475m a.s.l.) is promoted by Rio DX Group and the QSL goes via PY1ZV. More informations at: http://riodxgroup.blogspot.com

PY0FF/B on the air

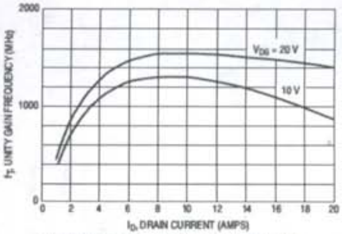
André PY0FF informs that the PY0FF/B is now qrv with 50 Watts on 144,2989 MHz in CW (144.298.2 on USB) and 7 elements Yagi pointed to Europe. Despite F/B attenuations he expects some reports from Brazilian stations on the coast, indeed. This new activity makes all wonder if some QSO between continental Northeast Brazil and Europe is possible over one extreme long path since the directions of the antennas are similar with PY0FF between the circuit. D44TD is located "only" 2500 km far from PY0FF and 3000 km from the PY7 coast, all oceanic regions. These are potential paths for transatlantic QSOs. For any reception of PY0FF/B please send a report to: py0ff@noronha.com.br

ARI EME MARATHON 2006 - Result

Category1B 432MHz QRO(SSB/CW)			
CALL	**QSO**	**DXCC**	**SCORE**
FR5DN	80	21	168.000
OK1DFC	61	23	140.300
JA6AHB	54	15	81.000
Category 3B 432 MHz DGT			
OK1DFC	61	27	164.700
JA6AHB	13	9	11.700
Category 1C 1296 MHz QRO (SSB/CW)			
OK1DFC	114	24	273.600
JA6AHB	86	20	172.000
Category 2C 1296 MHz QRP (SSB/CW)			
IW2FZR	230	24	552.000
IK3COJ	168	23	386.400
OK1KIR	125	28	350.000
1296 MHz DGT - CHECK LOG 2006			
JA6AHB	15	11	16.500
OK1KIR	10	9	9.000
Category 2304 MHz (SSB/CW)			
OK1KIR	52	17	88.400
Category 5760 MHz (SSB/CW)			
OK1KIR	11	8	8.800
Category 10 GHZ (SSB/CW)			
IQ4DF	59	14	82.600
OK1KIR	9	7	6.300

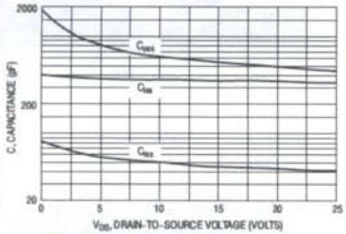
Award will be assigned during EME Meeting in Marina di Pietrasanta (LU) on April 29th 2007.
73, IW0BET Giovanni iw0bet @ libero.it

TYPICAL CHARACTERISTICS



NOTE: Data shown applies to each half of MRF141G.

Figure 4. Common Source Unity Gain Frequency versus Drain Current



NOTE: Data shown applies to each half of MRF141G.

Figure 5. Capacitance versus Drain–Source Voltage

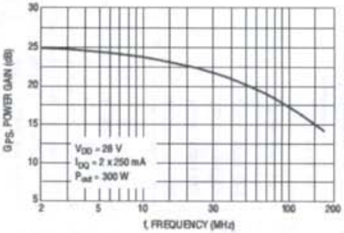


Figure 6. Power Gain versus Frequency

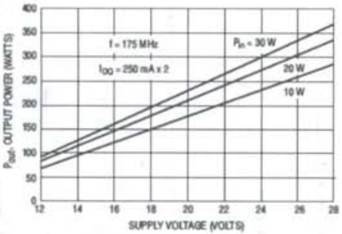
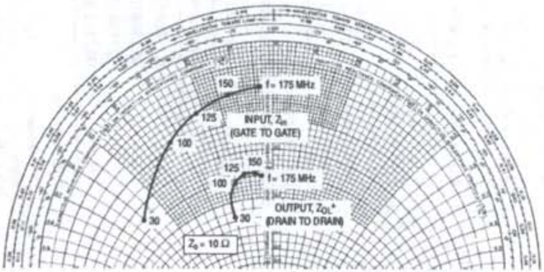


Figure 7. Output Power versus Supply Voltage



Z_{OL}^* = Conjugate of the optimum load impedance into which the device output operates at a given output power, voltage and frequency.

Figure 8. Input and Output Impedances

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS (1)					
Drain–Source Breakdown Voltage (V_{GS} = 0, I_D = 100 mA)	$V_{(BR)DSS}$	65	—	—	Vdc
Zero Gate Voltage Drain Current (V_{DS} = 28 V, V_{GS} = 0)	I_{DSS}	—	—	5.0	mAdc
Gate–Body Leakage Current (V_{GS} = 20 V, V_{DS} = 0)	I_{GSS}	—	—	1.0	µAdc
ON CHARACTERISTICS (1)					
Gate Threshold Voltage (V_{DS} = 10 V, I_D = 100 mA)	$V_{GS(th)}$	1.0	3.0	5.0	Vdc
Drain–Source On–Voltage (V_{GS} = 10 V, I_D = 10 A)	$V_{DS(on)}$	0.1	0.9	1.5	Vdc
Forward Transconductance (V_{DS} = 10 V, I_D = 5.0 A)	g_{fs}	5.0	7.0	—	mhos
DYNAMIC CHARACTERISTICS (1)					
Input Capacitance (V_{DS} = 28 V, V_{GS} = 0, f = 1.0 MHz)	C_{iss}	—	350	—	pF
Output Capacitance (V_{DS} = 28 V, V_{GS} = 0, f = 1.0 MHz)	C_{oss}	—	420	—	pF
Reverse Transfer Capacitance (V_{DS} = 28 V, V_{GS} = 0, f = 1.0 MHz)	C_{rss}	—	35	—	pF
FUNCTIONAL TESTS (2)					
Common Source Amplifier Power Gain (V_{DD} = 28 V, P_{out} = 300 W, I_{DQ} = 500 mA, f = 175 MHz)	G_{ps}	12	14	—	dB
Drain Efficiency (V_{DD} = 28 V, P_{out} = 300 W, f = 175 MHz, I_D (Max) = 21.4 A)	η	45	55	—	%
Load Mismatch (V_{DD} = 28 V, P_{out} = 300 W, I_{DQ} = 500 mA, f = 175 MHz, VSWR 5:1 at all Phase Angles)	ψ	No Degradation in Output Power			

NOTES:
1. Each side measured separately.
2. Measured in push–pull configuration.

TYPICAL CHARACTERISTICS

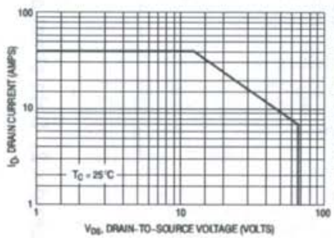


Figure 2. DC Safe Operating Area

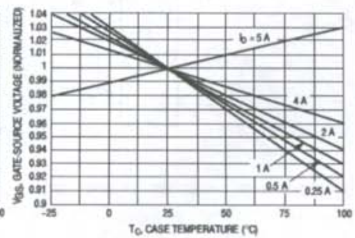
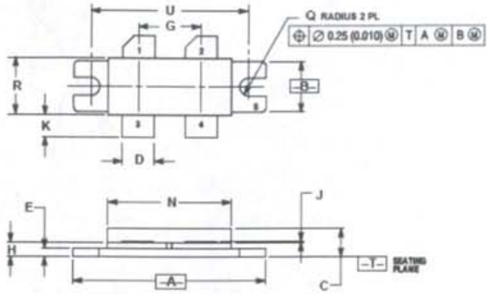


Figure 3. Gate–Source Voltage versus Case Temperature

PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	1.330	1.350	33.79	34.29
B	0.370	0.410	9.40	10.41
C	0.190	0.230	4.83	5.84
D	0.215	0.235	5.47	5.96
E	0.050	0.070	1.27	1.77
G	0.430	0.440	10.92	11.18
H	0.102	0.112	2.59	2.84
J	0.004	0.006	0.11	0.15
K	0.185	0.215	4.70	5.33
N	0.845	0.875	21.46	22.22
Q	0.060	0.070	1.52	1.78
R	0.390	0.410	9.91	10.41
U	1.100 BSC		27.94 BSC	

STYLE 2:
PIN 1. DRAIN
2. DRAIN
3. GATE
4. GATE
5. SOURCE

CASE 375–04
ISSUE D

Appendix 2: Data sheet of the C31 (RF board) Philips variable capacitor

FILM DIELECTRIC TRIMMERS
Philips type 222 809

- High temperature type
- Housing dimensions 8 mm x 8 mm x 9 mm
- For basic grid of 2,54 mm
- For professional applications, e.g. fine adjustment of h.f. tuned circuits

QUICK REFERENCE DATA

C_{min}/C_{max}	0.5/2 to 2/18 pF
Rated voltage (DC)	300 V
Housing diameter	8 mm x 8 mm x 9 mm
Climatic category (IEC 68)	40/125/21
Related specification	IEC 418-1 and 4

Selection chart

Vertical spindle, top and bottom adjustment.

value (pF) C_{min}/C_{max}	round head catalogue number	hex. head catalogue number
0.5/2	2222 809 05011	2222 809 05021
1.2/3.5	2222 809 05215	2222 809 05225
1.8/10	2222 809 05216	2222 809 05226
2/18	2222 809 05217	2222 809 05227

DESCRIPTION

The trimmers consist of a polysulphone housing, brass rotor and plated brass stator with a PTFE film as the dielectric. The stator plates with their tag are heat sealed to the housing. The rotor contact surfaces are plated to ensure a long life and a stable contact even under severe climatic conditions. Flux absorption between the vanes is prevented. A colour dot indicates the maximum capacitance.
The trimmers have top and bottom adjustment. Top adjustment should be done by means of a screwdriver and bottom adjustment by means of the key as shown in Fig.4.

MECHANICAL DATA

Outlines	see Fig.1
Effective angle of rotation	180°
Operating torque	
C_{max} = 3.5 pF	1 to 15 mNm
C_{max} = 10 and 18 pF	2.5 to 20 mNm
Maximum axial thrust ($\Delta C \leq 0.3\%$ of C_{max})	2 N
Mass	approx. 0.45 g

Mounting

The trimmers can be mounted on printed-circuit boards with hole diameter min. 2.54 mm. For hole pattern, see Fig.3.

Soldering conditions: max. 260 °C, max. 10 s. (See Tests and Requirements).

ELECTRICAL DATA

Rated voltage (DC)	300 V
Test voltage (DC) for 1 min.	600 V
Contact resistance	max. 5 mΩ
Insulation resistance between stator and rotor	min. 10 000 MΩ
Category temperature range	−40 to + 125 °C
Climatic category (IEC 68)	40/125/21
Minimum storage temperature	−55 °C

Table 1

guaranteed max. C_{min} min. C_{max} at 200 kHz pF	catalogue number	shape of head	tan δ at $C_{max} \times 10^{-4}$ 1 MHz	tan δ at $C_{max} \times 10^{-4}$ 100 MHz	temp. coeff. (note 1) 10^{-6}/K	min. f_{res} at C_{max} MHz	colour of base	smallest packing quantity
0.5/2	2222 809 05011 2222 809 05021	round hex	≤ 10	≤ 20	−250 ± 200	1200	no	140
1.2/3.5	2222 809 05215 2222 809 05225	round hex	≤ 10	≤ 20	−250 ± 150	850	orange	140
1.8/10	2222 809 05216 2222 809 05226	round hex	≤ 10	≤ 20	−350 ± 150	580	white	140
2/18	2222 809 05217 2222 809 05227	round hex	≤ 10	≤ 25	−350 ± 150	360	red	140

Note

1. C at 60% to 80% of C_{max}; T from + 20 °C to + 125 °C.

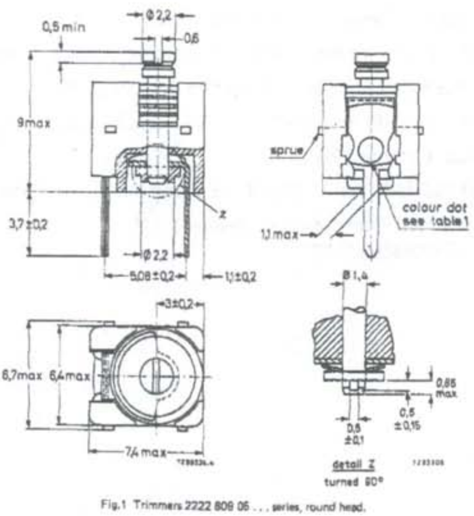
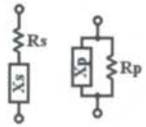


Fig.1 Trimmers 2222 809 05 . . . series, round head.

Appendix 3: Series <> parallel impedance transformation equations



$$Rp = \frac{Rs^2 + Xs^2}{Rs} \qquad Xp = \frac{Rs^2 + Xs^2}{Xs}$$

$$Rs = \frac{Rp \cdot Xp^2}{Rp^2 + Xp^2} \qquad Xs = \frac{Rp^2 \cdot Xp}{Rp^2 + Xp^2}$$

Note: the series and parallel networks are equivalent at one frequency only.

Hinweis: Das serielle und parallele Netzwerks sind nur auf einer Frequenz äquivalent.

10. References

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Design und Konstruktion einer 300-Watt-MOSFET-Push-Pull-Endstufe für 144 MHz

Gaëtan Horlin, ON4KHG

1. Einleitung

Obwohl Röhren bei Funkamateuren eine ziemlich übliche Wahl sind, um (Hoch-) Leistungsverstärker zu bauen, habe ich mit für die Option des Baus eines MOSFET Solid-State Power Amplifiers (SSPA) entschieden. Für 2m-Betrieb verwende ich einen ferngesteuerten Transverter, der sich nahe meines Antennenmastes befindet. Um nun den Bau eines ferngesteuerten Hochspannungsnetzteiles zu vermeiden (man bedenke die Witterungseinflüsse), zog ich es lieber vor, eine Transistorendstufe mit einem Niedrigspannungsnetzteil zu bauen. Hier einmal die Vor- und Nachteile einer solchen Endstufe:

Vorteile:
- Keine Hochspannung
- Keine Vorheizzeit
- Weniger mechanische Arbeiten
- Leichtgewichtig, einfach zu tragen
- Kein Nachabstimmen nötig (thermische Drift)
- Hohe MTBF

Nachteile:
- Begrenzte Leistung, außer man schaltet parallel
- Teure Transistoren
- Das Gate ist empfindlich gegen elektrostatische Ladungen

Der Zweck dieses Artikels ist nicht nur das Beschreiben eines solchen Verstärkers, sondern auch, grundsätzliche Richtlinien für das Design eines push-pull MOSFET-Verstärkers zu geben. Der hier beschriebene Verstärker ist schmalbandig und liefert mehr als 250 W HF bei einer Stromaufnahme von 18-20A bei 28V.

2. Auswahl des Transistors

Man hätte zwei einzelne Transistoren (natürlich des gleichen Typs) auswählen können, um den Verstärker zu bauen, aber da Zwillingstransistoren, d.h. zwei Chips in einem Gehäuse, einfach erhältlich sind, wurde diese Ausführung wegen der einfacheren und kompakten Realisierbarkeit vorgezogen. Außerdem sind sie besser für eine perfekte Symmetrie des Verstärkers, die Charakteristiken sind ähnlicher (matched) als bei zwei einzelnen Transistoren.
Die Tabelle (siehe unten) umfasst eine Liste von Zwillingstransistoren (es ist keine umfassende Liste), die wenigstens 200W HF-Leistung erzeugen können.

Reference	Manufacturer	Supply voltage (V)	Output power (W)	Gain (dB)	Efficiency (%)
BLF248	Philips	28	300	13	67
BLF278	Philips	50	300	16	55
BLF368	Philips	32	300	13,5	62
MRF141G	Motorola	28	300	14	55
MRF151G	Motorola	50	300	16	55
D1028UK	Semelab	28	300	13	60
DU28200M	M/A-COM	28	200	13	62
SD2932	STM	50	300	16	60
SR401	Polyfet	28	300	13	55

Es wurde 28V-Versorgung gewählt, weil das sehr leicht z.B. durch Serienschaltung von zwei 13.8-Volt-Netzteilen erzeugt werden kann. Außerdem gibt es heutzutage ja auch kompakte 28-V-Schaltnetzteile auf dem Markt. Wenn man aber selber ein Netzteil für die PA bauen will, wäre es sicher weise, einen 50-V-Transistor zu wählen. Diese haben mehr Verstärkung und bessere Intermodulationseigenschaften (IMD). Wegen der Verfügbarkeit und des relativ „günstigen" Preises, wurde hier der **MRF141G** ausgewählt.

3. Theoretische Grundlagen

Der Verstärker basiert auf einem Push-Pull-Design. Es besteht aus einem 0-180° Eingangsphasenschieber, der zwei gleiche aktive gegenphasig arbeitende Bauteile treibt. Am Ausgang liefert ein gleicher 0-180° Phasenschieber die Ausgangsleistung an die Last. Die Phasenschieber arbeiten als BALUN (BALanced-UNbalaced), der ein balanciertes System, das in Bezug zu Masse symmetriisch ist, (der Verstärker selbst) in ein unbalanciertes System transformiert, bei dem eine Seite geerdet ist, (hier die Quelle, d.h. der Sender oder die Last, d.h. das Antennenkoaxkabel).

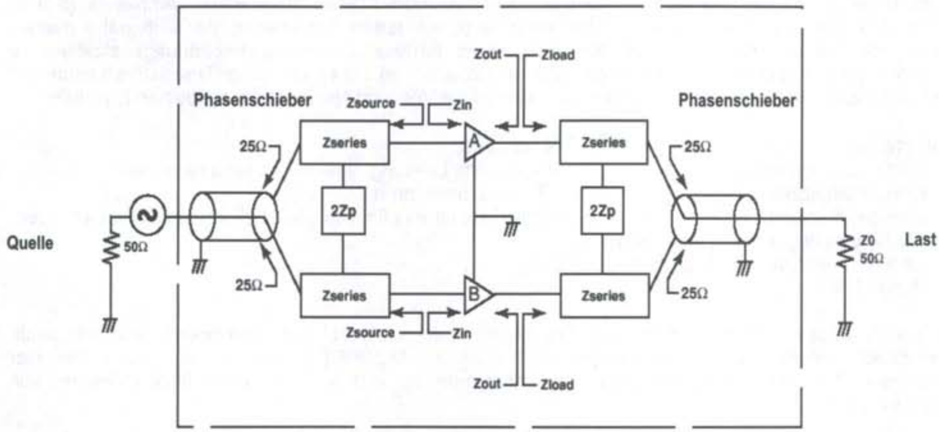


Abb. 1: Blockschaltbild Push-Pull-Verstärker

Ausgehend von der Quelle liefert der Phasenschieber an seinen Ausgängen beide, d.h. die 0° und 180° Komponenten des Eingangssignals und konvertiert die unbalancierte 50 Ω Impedanz der Quelle zu 2 * 25 Ω balancierter Impedanz. Der Zweck des folgenden Netzwerkes (Z_{series} & $2Z_p$) besteht darin, diese 25 Ω in die Eingangsimpedanz (Z_{in}) der Blöcke A & B (d.h. der Transistoren) umzuwandeln. Diesen Transistoren folgend wandelt eine ähnliches Netzwerk die balancierte 2 * 25 Ω Impedanz des Ausgangsphasenschiebers/Balun so um, dass die beiden Transistoren jeweils mit der komplexen gepaarten Impedanz (Z_{load}) ihrer Ausgangsimpedanz (Z_{out}) belastet werden. Mit anderen Worten: Das Anpassungsnetzwerk zwingt die 25 Ω Impedanz wie die Impedanz Z_{out}^* für die Transistoren auszusehen ($Z_{load} = Z_{out}^*$). Die Transistoren arbeiten in Klasse B und jeder von ihnen ist abwechselnd während einer Halbwelle leitend. Der Ausgangsphasenschieber/Balun arbeitet genauso wie der Eingangsphasenschieber, nur umgekehrt.

4. Design des Verstärkers

4.1. MOSFET (Metal Oxide Semiconductor Field Effect Transistor) - Theorie

Der hier verwendete Transistor ist ein NMOS FET (N-channel enhancement mode), seine Struktur zeigt Abb. 2.

Mit einer positiven (in Bezug auf die Source – S) Spannung an Drain (D), muss das Gate (G) positiv vorgespannt werden (in Bezug auf die Source), um einen Stromfluß Drain-Source zu ermöglichen. Diese Vorspannung schaltet dann den Transistor ein. Das kann man in Abb. 4 sehen.

Der minimale Wert (Schwelle) von V_{gs} (Gate-Source-Spannung), der einen Strom D-S (I_d) ermöglicht, ist $V_{gs}(th)$. Der Wert von $V_{gs}(th)$ wird während der Fabrikation der Transistoren kontrolliert und liegt typisch im Bereich von 0.5 bis 3 Volt. In Abb. 5 wird die Transfer-Charakteristik gezeigt, g_{fs} ist die Steilheit.

4.2. Baluns

Die Baluns werden aus 50 Ω Koaxkabel angefertigt und haben eine elektrische Länge von λ/4. Das Ende mit dem geerdeten Außenleiter bildet einen unymmetrischen Abschluß während das erdfreie Ende des Baluns symmetrisch ist. Für einen Ladungserhalt ist es nötig, dass die Ströme auf dem Innen- und Außenleiter gleich groß bleiben und eine 180° Phasendifferenz auf jedem Punkt der Leitung besteht. Abb. 6.

Mit Wissen, dass die charakteristische Impedanz des Baluns (Z_{Balun}) gleich 50 Ω sein soll, erhalten wir:

$$Z_{Balun} = \sqrt{50*2*R} \Rightarrow R = 25\ \Omega$$

Also schon durch sich selbst liefern die Baluns einen Betrag von Impedanzanpassung, weil sie die Quellen- und Lastimpedanzen des Verstärkers von 50 auf 25 Ω erniedrigen.

Z_p ist die parasitäre Impedanz zwischen dem erdfreien Punkt des Baluns und Masse. Diese muss so hoch wie möglich gehalten werden (Z_p >> R), um eine Unsymmetrie zu vermeiden.

4.3. Eingangs- und Ausgangsimpedanzen

Das Äquivalenzschaltbild eines NMOS FET zeigt Abb. 7 (nur ein einzelner Transistor ist gezeigt).

Für einige der Komponenten in Abb. 7 können Werte in Datenblättern gefunden werden, während alle diese Werte in Modellen eingebunden sind, die von nicht-linearen Simulationshilfsmitteln verwendet werden.

Bezüglich der Impedanzanpassung sind die S-Parameter hier nutzlos, da sie nur für niedrige Signalpegel gültig sind und wir hier mit hohen Pegeln arneiten. Trotzdem können die Ein- und Ausgangsimpedanzen des MRF141G für hohe Signalpegel aus seinem Datenblatt extrahiert werden (Siehe Anhang 1):

- $Z_{in} = (R_{in} + jX_{in})\ \Omega = (1{,}20 - j1{,}50)\ \Omega$
- $Z_{load}^* = Z_{out} = (R_{out} + jX_{out})\ \Omega = (3{,}90 - j0{,}85)\ \Omega$

Dieses sind Gate-zu-Gate und Drain-zu-Drain-Impedanzen für eine gegebene Arbeitsspannung, Vorspannung, Arbeitsfrequenz und für einen bestimmten Widerstand parallel zum Gate (was nicht so oft in den Datenblättern angemerkt wird). Die Impedanzen sind gültig für:

- V_{dd} (Drain Spannung) = 28 V
- I_{dq} (Ruhestrom) = 2 * 250 mA (Siehe Abschnitt 4.5.)
- Frequenz = 145 MHz

4.3.1. Eingangsimpedanz

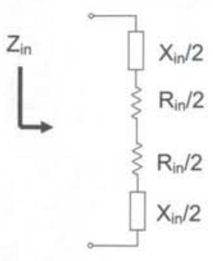


Abb. 8: Äquivalente Eingangs-impedanz Gate zu Gate

Es wird angenommen, dass der Wert im Datenblatt für die Reaktanz (Blindwiderstand) ein saldierter ist, d.h. er resultiert aus sowohl der Reaktanz des eigentlichen Chips (kapazitiv) und der induktiven Reaktanz durch die Anschlüsse und Bonddrähte des Transistors.

Um das Design zu vollrichten, betrachten wir **jede Seite** des Transistors **individuell** („halb") und wir

berechnen den Anpassungskreis für: $Z_{in\,halb} = \frac{R_{in}}{2} + j\frac{X_{in}}{2}$.

Dann nehmen wir die Eingangsserienimpedanz, extrahiert aus dem Datenblatt, an als::

$Z_{in\,halb}$ (Ω)	***Equivalenter Serienkreis***
0,60 – j0,75	0,60 Ω + 1,46 nF

4.3.2. Ausgangsimpedanz

4.3.2.1 Erste Methode

In ähnlicher Weise wie in Abschnitt 4.3.1. leiten wir die Serienausgangsimpedanz aus dem Datenblatt ab und erhalten unter Annahme einer Seite des Transistors:

$Z_{out\,halb}$ (Ω)	***Equivalenter Serienkreis***
1,95 – j0,42	1,95 Ω + 2,60 nF

4.3.2.2 Zweite Methode

Neben den Ein- und Ausgangsserienimpedanzen, die im Datenblatt genannt werden, kann das (vereinfachte) Äquivalenzschaltbild der Ausgangsimpedanz von einer Seite des Transistors wie folgt dargestellt werden, siehe Abb. 9a (engl. Text).

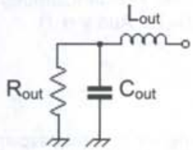


Fig. 9a: Äquivalentes Parallelschaltbild für einen Chip

$$R_{out} = R_{load} = \frac{(V_{dd} - V_{sat})^2}{2 * P_{out}} = \frac{(0{,}85 * V_{dd})^2}{2 * P_{out}}$$

$$C_{out} = 1{,}2 * C_{oss}$$

$$L_{out} \approx 0{,}6\,nH$$

V_{dd} = 28 V, P_{out} = 150 W (pro Transistor Chip/Seite) und C_{oss} = 420 pF (pro Chip).
Der Faktor "1,2" (tatsächlich varriiert er von 1,15 bis 1,3) in der Brechnung von C_{out} ist ein empirischer Faktor, aufgrund der Spannungsschwankungen, die C_{oss} schwanken lassen, wie auch in einigen Applikationsbemerkungen angegeben [1].
L_{out} wird angenommen aus Werten aus Datenblättern und Applikationsbemerkungen.
Durch Einsetzen in die Gleichungen erhalten wir:

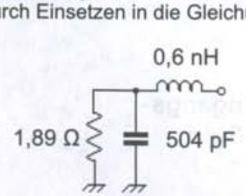


Fig. 9b

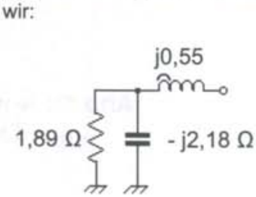


Fig. 9c

Unter Verwendung der Gleichungen für parallele und serielle Impedanztransformation aus Anhang 3 können wir das Serienäquivalenzschaltbild ableiten (Abb. 10)

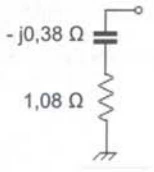


Abb. 10: Serien-Äquivalentschaltbild für einen Chip

4.3.2.3 Vergleich erste gegen zweite Methode

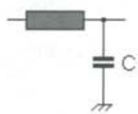
Zusammenfassend für beide Methoden haben wir:

Methode	*$Z_{out\ halb}$ (Ω)*	*Äquivalenter Serienkreis*
Erste	1,95 – j0,42	1,95 Ω + 2,60 nF
Zweite	1,08 – j0,38	1,08 Ω + 2,89 nF

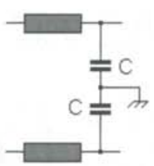
Auf einem normalisierten 25 Ω Smith-Diagramm-Chart, liegen beide Impedanzen relativ nahe beieinander. Im weiteren werden wir hier mit der zweiten Methode arbeiten. Die Themen Datenblattimpedanzen, Impedanzen für gepaarte Anpassung oder für beste Effektivität und S-Parameter werden ausführlich erklärt in [2].

4.4. Synthese der Anpassungsnetzwerke

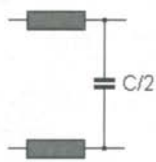
Da die Ein- und Ausgangsimpedanzen des Transistors definiert wurden, ist die Aufgabe für den Designer bezüglich der Anpassung in Abb. 11 (für einen Chip des Transistors) dargestellt.
Die Impedanzanpassungsnetzwerke werden aus Abschnitten von Tiefpassfiltern (bestehend aus Kondensatoren und gedruckten Leitungen) hergestellt:



Die beiden Seiten des Verstärkers werden wie folgt zusammengeführt:



was äquivalent ist mit:



Wenn der Verstärker gut ausbalanciert ist, sind die Ströme an der Verbindung der beiden Kondensatoren C gleich groß in der Amplitude und entgegengesetzt in der Richtung. Dieser Punkt stellt dann eine **virtuelle Erde** dar, so dass die Erdverbindung weggelassen werden kann und stattdessen ein Kondensator (mit halbem Wert) anstatt der beiden verwendet werden kann.

Die Anpassung könnte durch ein einzelnes Tiefpassglied erreicht werden, aber das muss vermieden werden: In der Tat sehen wir, dass Eingangs- und Ausgangsimpedanzen des Transistors sehr niedrig sind, so dass ein einziges Anpassungsglied Kreise sehr hoher Güte (Q) erfordern würde. Hohe Güte führt zu hohen Stromflüssen und dadurch hohen Verlusten zusammen mit möglicher Unstabilität und zu schmaler Bandbreite. Also wird die Anpassung besser erreicht durch Verwendung meherer kaskadierter Glieder.

Obwohl die Synthese des Ampassungsnetzwerkes graphisch „von Hand“ im Diagramm gemacht werden kann, ist es einfacher eine Software zu verwenden. Die hier verwendete ist **Smith V2.03** von Fritz Dellsperger, HB9AJY [3]. Hier wurde auf 25 Ω normalisiert.

Es gibt eine unbegrenzte Anzahl von Lösungen, um 25 Ω (Mitte des Diagramms) zu verbinden von $Z_{in\ halb}$ und zu $Z_{out\ halb}{}^*$, aber man sollte immer ein niedriges Q im Auge behalten (Q-Linien können im Diagramm eingezeichnet werden), wenn man die Elemente auswählt. Die charakteristische Impedanz der anpassenden Leiterbahn wurde auf 25 Ω gesetzt.

4.4.1. Synthese des Eingangsanpassungsnetzwerkes

Das Eingangsanpassungsnetzwerk transformiert die Transistoreingangsimpedanz $Z_{in\ halb} = (0{,}6 - j0{,}75)\ \Omega$ auf die (25 + j0) Ω Imepedanz, die nach dem Eingangsbalun vorhanden ist. Mit anderen Worten, das Eingangsanpassungsnetzwerk bewirkt, dass $Z_{in\ halb}$ für dein Eingangsbalun aussieht, wie eine (25 + j0) Ω Last. (Abb. 12, Abb. 13)

4.4.2. Synthese des Ausgangsanpassungsnetzwerkes

Das Ausgangsanpassungsnetzwerk transformiert die (25 + j0) Ω Impedanz des Ausgangsbaluns auf $Z_{out\ halb}{}^*$, die komplexe Paarung der Ausgangsimpedanz des Transistors. Das Ausgangsanpassungsnetzwerk zwingt die (25 + j0) Ω für die Drains des Transistors so auszusehen, wie $Z_{out\ halb}{}^*$, so dass die Blindkomponenten von $Z_{out\ halb}$ aud $Z_{out\ halb}{}^*$ einander auslöschen, während die ohmschen Anteile alle gleich sind und dann die effektivste Lesitungsübertragung liefern. (Abb. 14 und Abb. 15)

4.4.3. Vergleich von Realität und Theorie

Mit den erhaltenen theoretischen Werten wurde der Verstärker aufgebaut, aber lieferte letztendlich nicht die erwartete Ausgangsleistung und zeigte eine Effektivität von unter 50%. Also wurden die Werte der Bauteile optimiert, um die Ausgangsleistung und Effektivität zu erhöhen und das Eingangs-SWR zu verbessern. Optimiert wurde nach der Methode „Versuch & Irrtum“.....

Dies ist nicht sehr wissenschaftlich, aber wir haben hier kein Mittel, um die realen Transistor-Impedanzen zu messen oder per toller Software zu simulieren. Die folgenden Tabellen zeigen die Unterschiede zwischen den theoretisch ermittelten und den in der Realität für die Bauteile optimierten Werten.

Eingangsanpassungsnetzwerk		
Bauteil	*Theoretischer Wert*	*Realer Wert*
Streifenleitung	0,023 λ	0,023 λ
Shuntkondensator	324 pF	324 pF
Streifenleitung	**0,049 λ**	**0,057 λ**
Shuntkondensator	**36 pF**	**variabel 44 bis 76 pF**
Shuntkondensator	**-**	**10 pF am Balun input** (C24 auf der HF-Platinen-Liste)

Ausgangsanpassungsnetzwerk		
Bauteil	*Theoretischer Wert*	*Realer Wert*
Serien-Kondensator	282 pF	282 pF
Shuntkondensator	52 pF	52 pF
Streifenleitung	0,062 λ	0,062 λ
Shuntkondensatorr	112 pF	112 pF
Streifenleitung	0,015 λ	0,015 λ
Shuntkondensatorr	**335 pF**	**300 pF**
Streifenleitung	**0,014 λ**	**0,013 λ**

Die Differenzen sind fett gedruckt. Wir sehen, dass die Werte für den Verstärker in der Realität exakt denen des theoretischen Designs entsprechen oder nahe daran liegen.

Der Unterschied beim Eingangsnetzwerk kann durch die Tatsache des Dämpfungskreises (siehe Abschnitt 4.6) erklärt werden, der für Stabilitätszwecke dient und neue Komponenten einführt und deshalb die Impedanz verändert. Es wurde auch experimetell herausgefunden, dass das Hinzufügen eines Shuntkondensators von 10pF vor dem Eingangsbalun (C24 auf der HF-Platine), das Eingangs-SWR verbessert.

Generell kann man sagen, dass, wenn ein Verstärker mit den theoretischen Werten für das Anpassungsnetzwerk nicht wie erwartet (hinsichtlich Verstärkung, Effektivität, Ausgangsleistung) arbeitet, dies folgende Gründe kaben kann:

- Streuungen bei den Eigenschaften des Transistors (verschiedene Produktionschargen können zu leicht veränderten Impedanz-Werten führen; die in den Datenblättern angegebenen sind Durchschnittswerte)
- Streuungen bei den Eigenschaften des Dielektikums der Platine (PCB), beeinflussen hauptsächlich die HF-Leitungen (Streifenleitungen)
- Rundungen der Werte im Smith-Diagramm
- Rundungen bei graphischer Ableitung von Daten aus Datenblättern
- Toleranzen der Bauteile
- Je nachdem, in welcher Klasse dier Verstärker arbeitet, kann der Wert der Last für den Transistor anders aussehen (siehe Abschnitt 4.5.)
- Ruhestrom (I_{dq}), Drain.Spannung (V_{dd}) und Gate-Source-Widerstand sind anders als im Datenblatt angegeben (sofern angegeben)
- Gegenseitige Verkopplungen zwischen den Leiterbahnen (Push-Pull)
- Unvollkommenheit der Balune

4.5. Vorspannungseinstellung

Wenn in Klasse A (niedrige Signalstärke) gearbeitet wird, leiten die beiden Chips im MRF141G zur gleichen Zeit und der Strom durch jedes Drain ist i. Mit einem Impedanztransformationsverhältnis n (zwischen Drain und der Last), beträgt der Strom (i_L), der in der 50 Ω Ausgangslast fließt:

$$i_L = \frac{2 * i}{n}$$

Und die Spannung (v_L) über der Last beträgt: $v_L = i_L * 50 = \frac{2 * i * 50}{n}$

Während die Spannung über jeder Drain ist: $v_d = \frac{v_L}{n}$

Und die Last von der Drain aus gesehen ist: $R_{dA} = \frac{v_d}{i} = \frac{v_L}{n * i} = \frac{2 * 50}{n^2}$

Im Push-Pull-Betrieb in Klasse B (hohe Signalstärke), ist die Drainspannungsspitze doppelt so groß, wie die eines einfach abgeschlossenen Klasse-A-Verstärkers. Nur einer der zwei Chips im Transistorgehäuse leitet abwechselnd (der andere ist geblockt). Also beträgt der Strom in der 50 Ω Ausgangslast:

$$i_L = \frac{i}{n}$$

Und die Last von Drain aus gesehen ist: $R_{dB} = \frac{50}{n^2}$

Dann sehen wir, dass $R_{dB} = \frac{R_{dA}}{2}$

Also ist die Last von den Drains ausgesehen in Klasse B halb so groß, wie in Klasse A.Aus Sicht eines Verstärkungspunktes (A_v) haben wir:

- $A_{V\,Small\,Signal} = g_{fs\,Small\,Signal} * R_{dA}$
- $A_{V\,Large\,Signal} = g_{fs\,Large\,Signal} * R_{dB} = g_{fsSLargeSignal} * \frac{R_{dA}}{2}$

Um Linearität zu haben, muss der Verstärker die gleiche Verstärkung für kleine und große Signale aufweisen, d.h.

$$A_{V\ Small\ Signal} = A_{V\ Large\ Signal} \quad => \quad g_{fs\ Small\ Signal} * R_{dA} = g_{fs\ Large\ Signal} * \frac{R_{dA}}{2}.$$

Wir können folgern: $g_{fs\ Small\ Signal} = \frac{g_{fs\ Large\ Signal}}{2}$

Der Verstärker muss dann so vorgespannt werden, dass der Anstieg der Verstärkungscharakteristik ohne HF-Erregung (oder $g_{fs\ Small\ Signal}$) die Hälfte des Signalanstiegs bei starkem Signal ist ($g_{fs\ Large\ Signal}$). Das vermeidet Übernahmeverzerrungen (crossover distortion) wie in der Abb. 16 gezeigt.
Das Ziel ist also hier eine Gatespannung (V_{gs0}) aufzubauen, so dass ein Ruhestrom (I_{dq}) durch jedes Drain fließt.

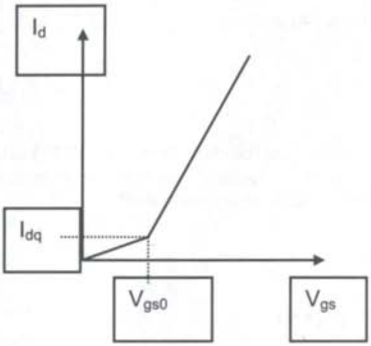


Abb. 17: Vorspannungspunkt in der Transfercharakteristik

Ein MOSFET-Gitter verhält sich aufgrund seiner hohen Impedanz wie ein Kondensator bei Gleichspannung. Deshalb braucht ein Gate zur Vorspannungserzeugung nur einen kleinen Strom und ein einfacher Widerstandsspannungsteiler erfüllt hier leicht die Anforderungen. Abb. 18 zeigt einen Auszug der Vorspannungserzeugung aus dem Schaltbild (siehe Abschnitt 5.1.1.).

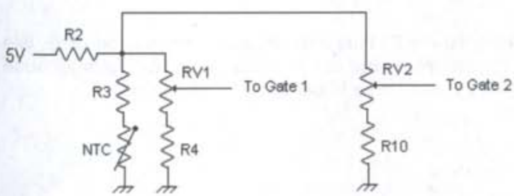


Abb. 18: Gate-Vorspannungserzeugung

RV1 und RV2 werden auf 250mA Ruhestrom für jede Drain eingestellt. Das wird erreicht mit einer V_{gs0} von etwa 2,2 V an jedem Gate (bei 25°C). Sobald die Temperatur (des Transistorgehäuses) schwankt, muss V_{gs0} angepasst (kompensiert) werden, um denselben Ruhestrom (I_{dq}) wie bei 25°C zu erreichen.
Das Datenblatt sagt uns, dass V_{gs0} mit der Gehäusetemperatur des Transistors schwankt, so dass eine gewisse Temperaturkompensation nötig ist, um einen stabilen Vorspannungspunkt zu erhalten. Dies wird mittels eines NTC-Widerstands (Negative Temperature Coefficient). I habe einen aus der Bastelkiste verwendet, der leider nicht beschriftet war. Deshalb habe ich den Wert des NTC über die Temperatur gemessen und den folgenden Graphen erhalten (siehe engl. Text!).

Mit Wissen des NTC-Wertes für die Temperatur und den bereits bestimmten Werten für alle Komponenten bis auf R2 und R3, wurden diese berechnet (ihr Verhältnis), so dass die kompensierte V_{gs0} denselben Verlauf hat, wie die V_{gs0} in Funktion der Gehäusetemperatur wie im Datenblatt angegeben (siehe Abb. im engl. Text!). Natürlich müssen Transistorgehäuse und NTC in engem thermischen Kontakt sein.

4.6. Stabilität

Es wurde keine besondere Berechnung für die Stabilität des Verstärkers angestellt. Stattdessen wurde ein Dämpfungsnetzwerk (R15-C25-C26) am Eingang hinzugefügt (die Idee stammt aus einem Philips Detenblatt [4]) und der Wert für den Gate-Widerstand (R7/R8) wurde sehr sorgfältig ausgewählt (im Verstärker ausgetestet). Beides hilft, den den Q-Faktor im Eingangsnetzwerk herabzusetzen.

Mit den Werten, die im Schaltbild für das HF-Board zu sehen sind, ist der Verstärker stabil, sogar, wenn Eingang und Ausgang offen gelassen sind (keine Last). Wenn es keinen Dämpfungskreis im Eingang gibt, oder wenn der Wert des Gate-Widerstandes über 10 Ω liegt, fängt der Verstärker an zu schwingen.
Ein Dämpfungsnetzwerk wurde am Ausgang des Verstärkers ausprobiert, zeigte sich aber als wirkungslos. Allgemein kann man sagen, dass folgende Lösungen helfen, einen Verstärker zu stabilisieren:

- Anpassungsnetzwerke mit niedrigem Q (*)
- Dämpfung der Anpassungsnetzwerke (*)
- Gate-Widerstand in Serie oder parallel (*)
- Drain zu Gate Rückkopplung

Drei (*) wurden hier verwendet.

4.7. Tiefpassfilter (TPF)

Ein 5-poliges-Tefpassfilter (TPF) wurde am Ausgang des Verstärkers hinzugefügt, um die Harmonischen und Intermodulationsprodukte abzuschwächen. Es ist hier erwähnenswert, dass dank der Push-Pull-Konfiguration, die Produkte gerader Ordnung (f_1+f_2, $2f_1+2f_2$,...) und Harmonischen ($2f_1$, $2f_2$,...) bereits durch den Verstärker selbst gut unterdrückt sind (wenn er gut balanciert ist). Abb. 19 zeigt das Schaltbild des LPF. Das Design des Filters wurde mit der Freeware **RFSim99** [5] durchgeführt. Die Transferfunktion (S21) und Returnloss (S11) zeigt die Abb. 20. Das simulierte Filter beginnt etwas über 200 MHz abzuschneiden.

Es gäbe noch genug Reserve, um näher an 150 MHz zu gehen. Die Praxismessungen haben jedoch ergeben, dass das aufgebaute TPF eine einige dB bessere Unterdrückung außerhalb des Bandes aufweist, als das simulierte Filter (der Effekt durch die Abschirmung zwischen den beiden Induktivitäten wurde nicht mit simuliert). Die Messung zeigt Abb. 21. Aus dieser erhalten wir folgende Tabelle:

Frequenzt	*S21 (dB)*	*Bemerkung*
145	- 0,25	Fundamental (f_0)
290	- 32	2^{nd} Harmonic ($2*f_0$)
435	- 66	3^{rd} Harmonic ($3*f_0$)
580	- 52	4^{th} Harmonic ($4*f_0$)

Die Unterdrückung der 3. Harmonischen beträgt 66 dB. Um diesen Wert durch weitere Verschiebung Richtung 150 MHz nicht zu verschlechtern und das Einführen anderer Eigenresonanzen durch Bauteile mit anderen Werten zu vermeiden, wurde das Design so gelassen, wie es ist. Der Returnloss (S11) ist besser als 30 dB über das 2m-Band.

Die Platine für den TPF enthält auch einen einfachen Richtkoppler, um die vor- und rücklaufende Leistung am Ausgang für Monitorzwecke zu gewinnen und um die VSWR-Schutzschaltung zu versorgen. Der Koppelungsverlust summiert sich zu 30.6 dB auf der gekoppelten Linie.

5. Bau des Verstärkers

5.1. HF-Board

Diese Platine umfasst tatsächlich drei verschiedene PCBs: Eine Input-PCB, eine Output-PCB und eine kleine PCB mit dem TPF und Richtkoppler.
Das Schaltbild (siehe Abschnitt 5.1.1.) wurde mit einem einfachen Zeichenprogramm (in diesem Fall MS Paint, Teil der normalen MS-Software). Ein Grundfile, das die gebräuchlichsten elektronischen Schaltsymbole enthält, wurde „manuell" erstellt. Das Schaltbild wurde gezeichnet durch Verwendung dieses Grundfiles und Verwendung der Funktionen "Select" und "Copy-Paste" in MS Paint. Linien wurden dann gezeichnet, um die Symbole zu verbinden. Die verbliebenen nicht verwendeten Symbole wurden

einfach gelöscht. Siehe Abb. „RF-Board" im engl. Text (Text: Leitende Steifen zwischen Input- und Output-PCBs)

5.1.1. Schaltbild der HF-Platine (siehe engl. Text)

5.1.2. Stückliste (siehe engl. Text)

(1): Es wurde experimentell gefunden, dass dieser Kondensator den Input-Returnloss verbessert.
(2): Kann bezogen werden von RF Parts (http://www.rfparts.com) in den USA. ASI Advanced Semiconductor Inc (http://www.advancedsemicondurctor.com) bietet den MRF141G auch an.

5.1.3. Baluns

Der Eingangsbalun wurde angefertigt aus RG 316 Koaxkabel mit PTFE-Dielektrikum und 2,5 mm Außendurchmesser, hergestellt von H&S. Der Ausgangsbalun wurde aus RG 400 Kabel des selben Herstellers angefertigt. Der Verkürzungsfaktor (V_f) beträgt für beide Kabel 0,695. Abb. 22 zeigt die Beide Kabel haben eine elektrische Länge von λ/4 und eine charakteristische Impedanz von 50 Ω.

Das ergibt eine physikalische Länge von $\frac{300}{145} * 0{,}25 * V_f = 36cm$

Man macht sie ein wenig länger, um die Lötverbindungen auf den Striplines machen zu können. Beide Baluns wurden ausgeführt, wie in den Bildern in Abschnitt 8 im engl. Text zu sehen. Der Durchmesser der Windungen beträgt etwa 50mm. Wie man auf diesen Bildern auch erkennen kann, wurden anfangs gedruckte λ/8 Baluns mit semi-rigid Kabel verwendet, allerdings ohne allzu großen Erfolg.

Bemerkung: Huber & Suhner stellt RG 316 & RG 400 nicht mehr her, aber stattdessen Enviroflex 316 und 400. Diese haben etwas andere Daten.

5.1.4. Streifenleitungen für die Anpassung und PCBs

Die drei PCBs des HF-Boads sind aus 1.6mm dickem doppelseitigem FR4 Material (Epoxy-Glasfiber, ε_r = 4.6). Abgesehen von den HF-Leitungen ist das Layout nicht kritisch. Die beiden Seiten der Platine sind durch Kupferstreifen miteinander -rundherum und so viele, wie möglich- verbunden (Kupferfolie bekommt man leicht aus der Schirmung eines Stückes H100-Koaxkabels).
Weiter sind auch die Input- und Output-PCSs mit Kupferstreifen zu jeder Seite des Transistors verbunden. Die Bilder in Abschnitt 8 sind selbsterklärend. Wenn sich alles um hohe Ströme und niedrige Impedanzen dreht, ist Massekontinuität sehr wichtig – auch für die Stabilität des Verstärkers. Alle PCBs werden direkt auf den Kühlkörper geschraubt. Die Streifenleitungen konnten mit Hilfe der Freeware **AppCAD** [6] von Agilent entworfen werden. Ein Beispiel zeigt das Bild (siehe engl. Text). Die Abmessungen für die kritischen HF-Leitungen zeigen die Abb. 23 (Richtkoppler) und 24 (Streifenleitungen).

5.1.5. Kühlung

Der Kühlkörper wurde aus einem Militär-Netzteil wiederverwendet (siehe Bilder in Abschnitt 8). Es wurde keine Berechnung für die Wärmeableitung vorgenommen, aber es stellte sich heraus, dass der Kühlkörper groß genug war, um SSB/CW-Betrieb ohne zusätzliche Hilfsmittel zu machen (bei Raumtemperatur). Bei heißem Wetter (erinnern wir uns: der Verstärker arbeitet „draußen", natürlich gegen Regen geschützt, aber natürlich ohne Klimaanlage) kühlt ein langsamer Lüfter den Verstärker herunter bei langen Einsätzen. Das bringt mehr als genug Kühlung. Auch bei langen Einsätzen bleibt der Kühlkörper auf Raumtemperautur.

Der Transistor ist auf ein dünnes (1mm) Kupferblech geschraubt, das als Wärmeverteiler dient und das in engem Kontakt (verschraubt) mit dem Kühlkörper (Aluminium) steht. Etwas Wärmeleitpaste wurde auch verwendet.

Um mechanische Beanspruchungen durch Temperaturwechsel zu vermeiden, wird empfohlen, die Anschlüsse des Transistors zu biegen. Dies wurde hier allerdings nicht gemacht. Die Anschlüsse wurden hier gerade gelassen und so auf die PCBs gelötet.

5.2. Kontroll-Platine

Diese Platine überwacht den Verstärker. Es wurde auf einer perforierten Platine montiert, auf der sich Löcher und Kupfer-Pads im Abstand von "e" befinden (1 e = 2,54 mm). Sobald der Schalter S1 (Frontplatte) auf „ON" steht und S2 (Frontplatte) auf „Operate", ist der Verstärker betriebsbereit.
Wenn der PTT-Eingang (Frontplatte) geerdet wird, geht der Verstärker in den TX-Modus; dies wird durch die rote LED (D5A) auf der Frontplatte angezeigt. Es ist eine Ablaufsteuerung eingebaut, damit „heißes" Schalten der Koaxrelais vermieden wird. RV2 und C7 erzeugen eine Zeitverzögerung, so dass die Vorspannung erst an die Transistoren gelangt, nachdem die Koaxrelais K1 und K2 (HF-Board) auf TX geschaltet haben (normal sind die Koaxrelais in offener Position). Im RX-Status leuchtet die grüne LED (D5B) auf der Frontplatte.
Die Operationsverstärker IC2A und IC2D formen die "reflektierte" Spannung aus dem Richtkoppler (TPF PCB), um den Thyristor TH1 anzusteuern, der das Herzstück der VSWR-Schutzschaltung darstellt.
RV3 bestimmt die VSWR-Schwelle, ab der der Verstärker abgeschaltet wird. Bei der Abschaltung wird die Vorspannung abgeschaltet und die Koaxrelais gehen in den normal geschlossenen Zustand (RX-Mode).
Der Verstärker bleibt im abgeschalteten (Protection) Modus solange, bis die Reset-Taste (Frontplatte) gedrückt wurde (nachdem der Fehler in der Antennenleitung gefunden wurde). IC2B verstärkt die Spannung, die aus dem Vorwärtsteil des Richtkopplers gewonnen wurde. Diese Spannung ist proportional zur Ausgangsleistung und könnte auf dem Messgerät der Frontplatte angezeigt werden. Bei mir ist stattdessen ein Monitor-Ausgang auf der Frontplatte, so dass das ordnungsgemäße Arbeiten des Verstärkers abgesetzt (im Shack, 50m vom Ort der PA entfernt) mittels einer LED (nicht im Schaltbild) beobachtet werden kann, die entsprechend der HF-Ausgangsleistung aufleuchtet. Statt nur der LED kann natürlich auch ein Voltmeter verwendet werden. RV4 bestimmt die maximale Spannung des Monitor-Ausgangs.
Wenn durch schlechtes VSWR die Schutzschaltung des Verstärkers ausgelöst wird, schaltet das Relais K1, so dass die Monitor-Spannung hoch geht, solange bis die Reset-Taste gedrückt wurde. Das kann verwendet werden, um einen Alarm auszulösen. Im vorliegenden Fall leuchten dann die Monitor-LED und die Frontplatten-LED (D6) in voller Stärke, wenn der Verstärker in Protection geht.
Die **VSWR-Schutzschaltung ist unverzichtbar**, der Transistor kann ein VSWR von 5:1 vertragen, aber ein kurzes Öffnen in der Antennenleitung macht das VSWR unendlich...
R26 ist ein Shunt-Widerstand (75 mV Abfall bei 30 A), der, zusammen mit dem Messgerät M1, den totalen Drain-Strom, der vom Transistor gezogen wird (auf der Frontplatte) anzeigt. Das Schaltbild wurde hier mit der **EAGLE Light Edition** gezeichnet [7].

5.2.1. Schaltbild für die Kontrollplatine (siehe engl. Text)

5.2.2. Stückliste für die Kontrollplatine (siehe engl. Text)

Da dies eine NF-Platine ist, ist die Art der Komponenten (SMD oder normal) nicht kritisch. Deshalb gibt es dazu keine Angabe in der Tabelle.

6. Inbetriebnahme

Hier werden die Schritte in der Folge beschrieben, um den Verstärker aufzubauen und zum Laufen zu bekommen.

1. RV1 auf der Kontrollplatine so einstellen, dass das heiße Ende (dasjenige, das mit R1 verbunden ist, an Masse liegt.
2. RV1 & RV2 auf dem HF-Board so einstellen, dass der Schleifer an den kalten Enden steht (diejenigen, die mit R4 und R10 verbunden sind). R4 & R10 auf dem HF-Board nach Masse kurzschließen (der MRF141G ist dann blockiert).
3. Den Schleifer von RV3 auf der Kontollplatine auf das kalte Ende stellen (Masse).
4. Langsam RV1 so einstellen, dass 13V am Ausgang des KM317 (IC1) anliegen. Vorsichtig dabei sein, damit für die Sicherheit von IC3 nicht 15V überschritten werden.
5. Ohne Anlegen von HF, den PTT-Eingang auf der Frontplatte (J1 auf der Kontrollplatine) immer wieder gegen Masse legen und dabei RV2 auf der Kontrollplatine so einstellen, dass V_{bias} (Kollektor von Q5 auf der Kontrollplatine) ansteigt, NACHDEM die Koaxrelais geschaltet haben.
6. Verbindung von CX3 am Ausgang des Verstärkers der Ausgangs-PCB (HF-Board) abklemmen und mit einer 50 Ω Last abschließen (min. 10W). Mechanisch K2 auf der HF-Platine umschalten (zur normal offenen Position) und 8W HF-Leistung an J2 (Frontplatte) anlegen. Dann RV3 auf der

Kontrollplatine so einstellen, dass die "SWR" LED (D6) auf der Frontplatte leuchtet. Dies stellt die VSWR-Schwelle für die Schutzschaltung ein. Bei voller Ausgangsleistung (300W), entspricht eine reflektierte Leistung von 8 Watt einem VSWR von 1,4:1. Die 50 Ω Last entfernen und CX3 wieder an die Ausgangs-PCB auf dem HF-Board anschließen.

7. J2 (Frontplatte) des HF-Boards mit einer 50 Ω Hochleistungsdummyload (> 300W) über ein Wattmeter abschließen. Einen Transceiver an J1 (Frontplatte) des HF-Boards über ein VSWR-/Wattmetter anschließen. Den PTT-Ausgang des Transceivers mit J1 (Frontplatte) der Kontrollplatine verbinden. Die Leistung des Transceivers auf 3 Watt einstellen und auf TX gehen. C31 auf dem HF-Board mit einem isolierten Schraubenzieher auf bestmögliches Eingangs-VSWR abgleichen während man die Ausgangsleistung im Blick behält. Ungefähr 100 Watt Output müssen erreicht werden. Langsam den Output des Transceivers erhöhen und C31 nachabgleichen, um ein gutes Eingangs-VSWR zu behalten. Der schlechteste Returnloss ist 18 dB bei mittlerer Treiberleistung, bei niedriger und voller Treiberleistung bewegt sich die Nadel des VSWR-Meters nicht. Mit 13W Treiberleistung sollte der Output bei etwa 300 Watt liegen und es sollten 50% Effektivität erreicht werden. Unter 300W ist es normal, dass die Effektivität schlechter ist. Aufgrund der Bauteile-Steuungen (im Vergleich zu den hier verwendeten), wird die perfekte Anpassung wahrscheinlich nicht gleich beim ersten Versuch erreicht werden. Eine extra Abstimmung der Kapazitäten des Anpassungsnetzwerkes ist dann erforderlich. Dies geschieht durch zeitweises Einlöten von Trimmern anstatt der vorhanden Kondensatoren oder parallel zu diesen. Kondensatoren des selben Typs wie C31 sind geeignet. Das Abstimmen ist ein schrittweiser Prozess. Man beginnt mit niederiger Treiberleistung und stimmt das Ausgangsanpassungsnetzwerk ab vom Transistor zum Ausgang vor und zurück. Dann wird das Eingangsnetzwerk in gleicher Weise abgestimmt. Danach wird wieder zur Abstimmung des Ausgangsnetzwerks zurückgekehrt. Und so geht es weiter bei verschiedenen Treiberleistungen bis das Maximum erreicht ist.
8. RV4 auf der Kontrollplatine einstellen, um die gewünschte Monitor-Spannung an J2 (Frontplatte) der Kontrollplatine zu erhalten (proportional zur Ausgangsleistung).

7. Leistungsverhalten

Aufgrund des Fehlens von Meßgeräten ist die Beurteilung des Leistungsvermögens ziemlich eingeschänkt. Wenigstens konnte jedoch die Ausgangsleistung gemessen werden, wie in Abb. 25 zu sehen. Die mittlere Verstärkung beträgt 15 dB und der 1 dB Kompressionspunkt liegt bei 280 Watt Ausgangsleistung. Obwohl IM-Produkte und die Unterdrückung der Harmonischen nicht gemessen wurde, zeigen wir in der Abb. 26, die aus einer Motorola Applikationsnote [8] entnommen wurde, die Unterdrückung der Harmonischen eines Breitbandverstärkers, der den MRF141G verwendet. Man sieht deutlich, dass bei niedriger Frequenz im Ausgangssignal des Verstärkers die geraden Harmonischen bereits gut unterdrückt sind (ohne TPF), während die Stärke der ungeraden Harmonischen ziemlich hoch bleibt. Bei 144 MHz jedoch ist die schlechteste (dritte) Harmonische bei -45 dBc. Angenommen der hier beschriebene Verstärker verhält sich genauso wie der Breitbandverstärker (was unwahrscheinlich ist, dank der schmalbandigen Natur des vorliegenden Verstärkers, bei dem die Anpassungsnetzwerke aus Tiefpässen bestehen) kann mit der Unterdrückung des Ausgangstiefpassfilters eine minimale (theoretische) Unterdrückung der Harmonischen von 77dBc erwartet werden (für alle Ordnungen).
Aus meiner sehr subjetiven Sicht wurde starkes Splattern nie berichtet, auch nicht von nahen Stationen. Der Strom für volle Ausgangsleistung liegt bei etwa 20A bei 28V, was eine Effektivität von 53% ergibt.

8. Bilder

In diesem Abschnitt werden Bilder mit Details zum Bau des Verstärkers gezeigt.

9. Anhang

Siehe engl. Text.

10. Referenzen

Siehe engl. Text.

High-Efficiency Feedhorns for Prime-focus Dishes

Part 1 — VE4MA feedhorn and variations

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Measurements by Tommy Henderson, WD5AGO - wd5ago@arrl.net

The VE4MA feedhorn[1], an open cylindrical waveguide surrounded by a choke ring, has long been a popular amateur feed for parabolic dish antennas, since it offers very good performance and is readily reproduced without sophisticated machinery. The similar Chaparral-style feedhorn[2], which adds multiple choke rings, is very common in satellite TVRO dishes.

The septum polarizer, as recently described[3] by OK1DFC, has become a popular way to generate circular polarization. Utilizing some idle computer time, an effort was begun to optimize the VE4MA feedhorn with a septum polarizer for circular polarization. Some unexpected results have led to a larger analysis with conclusions that may differ from the prevailing wisdom, but have been verified by measurements made by WD5AGO. Some improved variations of the VE4MA and Chaparral feedhorns are described which show some of the highest calculated *and measured* efficiencies to date for a prime-focus dish.

What we often call a "feedhorn" includes several separate elements: an antenna which shapes the beam for improved dish illumination, a waveguide section (round, square, or rectangular), perhaps a circular polarizer, and an excitation region (waveguide, probe transition to coax, or other transition). While these elements may interact, each has a separate function and may be analyzed independently. It is not necessary to exactly replicate all the dimensions from end-to-end, but it would be foolhardy to make changes without considering possible interactions.

Thus, we will separate the following elements for examination in a series of articles:

- **VE4MA horn, Part 1.**
- **Chaparral-style horn, Part 2.**
- **Septum polarizer in circular waveguide, and VE4MA and Chaparral horns with septum polarizer, Part 3.**

The excitation is a separate problem; all analysis here, using Ansoft **HFSS** software[4], will use single-mode waveguide excitation. Probe transitions in circular waveguide were studied in a previous paper[5], so probes will not be included here. *The probe is not part of the antenna.* The only complication which might be added by probe excitation would be additional waveguide modes; if the waveguide section preceding the horn is sufficiently long, then the additional modes will not reach the horn and thus not affect the radiation pattern. Single-mode excitation eliminates this potential complication from the analysis.

Dish illumination review

The ideal illumination for a parabolic dish antenna would provide uniform energy over the reflector surface, with no spillover energy missing the dish. Real feed antennas do not provide this ideal distribution. Figure 1, from the *W1GHZ Microwave Antenna Book – Online*[6], shows the desired illumination vs. a typical (idealized) feed pattern. The typical pattern energy decreases from the central peak, while the desired pattern energy *increases* toward the edges to compensate for space attenuation – the edge of the dish is farther from the feed than the center of the dish.

The typical feed pattern also has spillover energy which misses the reflector, and real feeds have sidelobes and backlobes which also waste energy. For many feeds, it has been found that the tradeoff between illumination and spillover yielding best efficiency occurs when the illumination (not the feed pattern – we must account for space attenuation) is about 10 dB down at the edge of the dish. This 10 dB feed taper is just a rule-of-thumb; for accurate analysis, we use pattern integration, calculating the

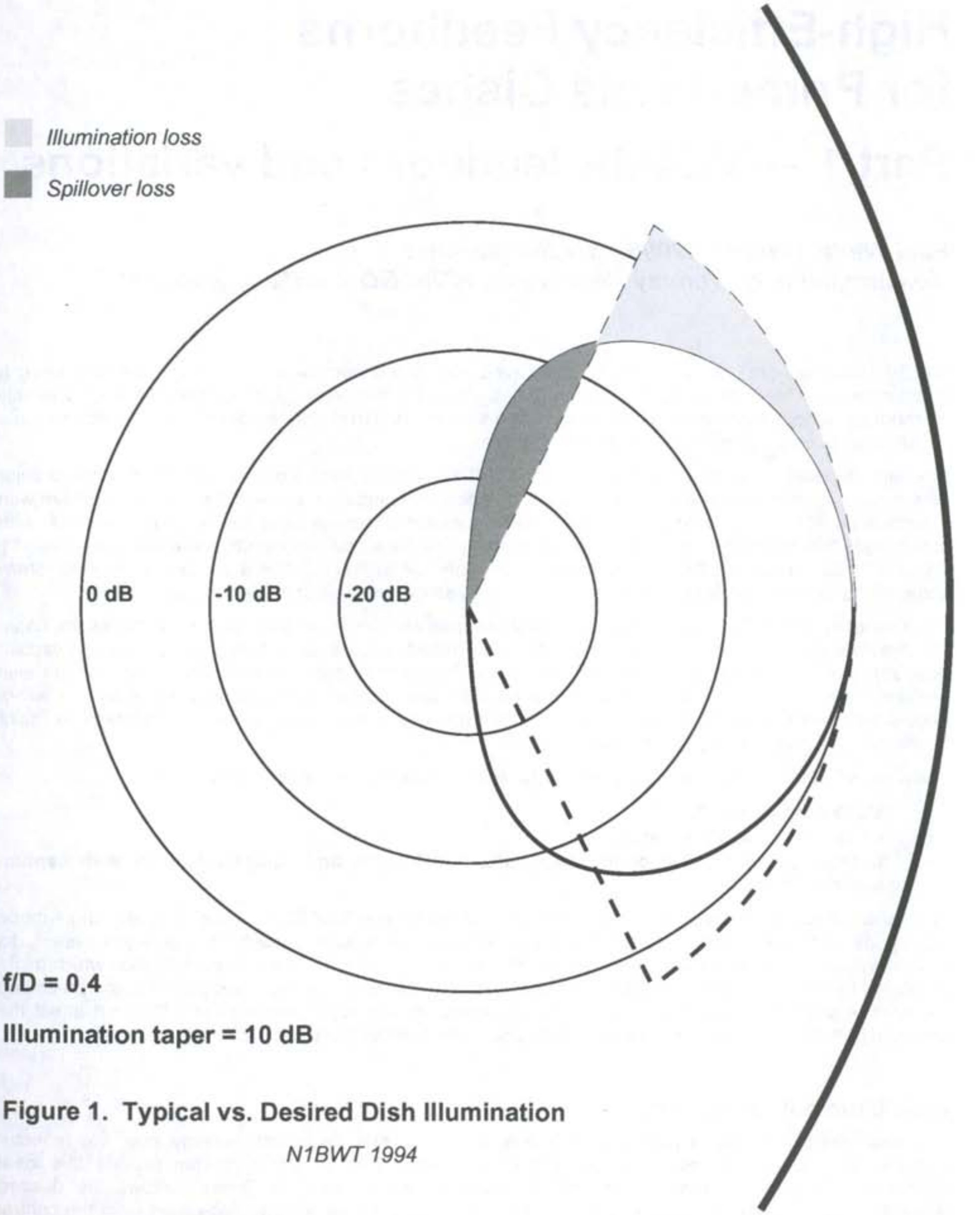


Figure 1. Typical vs. Desired Dish Illumination

N1BWT 1994

Figure 1 Typical vs. Desired Dish Illumination

N1BWT 1994

efficiency for the full three-dimensional feed pattern (in practice, for well behaved feeds, only a few cuts, typically the **E-** and **H-**plane cuts, through the 3D pattern are necessary).

Note: all efficiency calculations are for an arbitrary 20λ dish diameter and a 1.7λ feed diameter, or a constant blockage ratio of 0.085, so that we are comparing apples to apples. For small dishes, the actual blockage is more significant and efficiency should be recalculated.

VE4MA Feed

The VE4MA feed[1] is based on a paper by Kumar[7]. This horn, which adds a single ring around a circular waveguide (Figure 2), has patterns shown in both papers which are not maximum at the center, but rather increase somewhat like our desired feed before tapering off like a typical feed – see Figure 1. Thus, the pattern, shown in Figure 3, tends to be more like the desired illumination, and provides somewhat better efficiency than a simple feed, for instance, the open circular waveguide ("coffee-can feed") without the ring. The pattern and efficiency plots for open circular waveguide feeds are shown in Figure 4; calculated efficiency is lower than the VE4MA feed for all but the largest diameters, and those larger diameters are large enough to propagate additional modes which will degrade the performance.

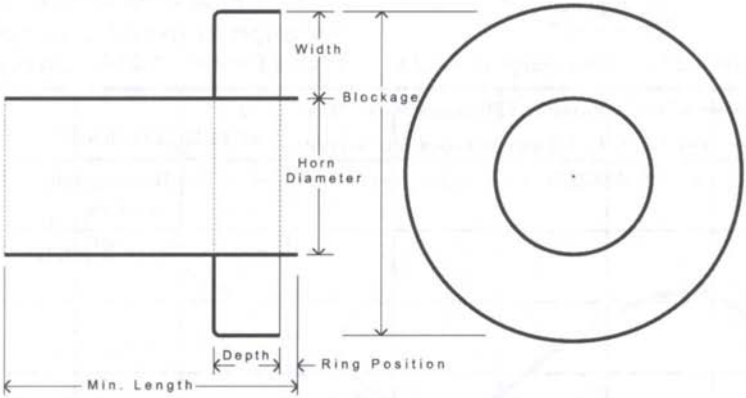


Figure 2. VE4MA (Kumar) Feed

It was suggested by Kumar that a ring dimension, ½λ wide x ½λ deep, forms a resonant structure which creates the improved pattern. Therefore, hams have carefully duplicated the dimensions published[8] by Barry, VE4MA, for this feed, with very good results. One reason for the popularity of this feed is that it works well for conventional dishes over a wide range of ***f*/D**; the feed is optimized by the position of the ring with respect to the rim of the central horn.

If the ring is resonant, there should be a clear peak in performance with dimensions that are resonant. However, when I first varied the dimensions, the only slight peak was with one ring position, with the ring 0.15λ behind the rim of the central horn. Varying the other dimensions, I could find no peak at all – either there is no peak, or it is so sharp that we have no hope of duplicating it. The performance was nearly identical over a broad range of dimensions, suggesting that we could make better use of available materials. Performance was slightly better over a range of smaller ring dimensions, which would have the additional benefit of reduced blockage. The improvement with a smaller ring could be significant for the smaller dishes used by many hams.

The VE4MA dimensions specify a circular waveguide horn diameter of 0.77λ. My previous work with the OK1DFC septum found that the septum worked best with a 0.71λ diameter circular waveguide, so most of the variations in ring dimensions I tried were with the smaller 0.71λ diameter so that they would also work with a septum polarizer. However, comparing feedhorns with the same ring dimensions on the two different diameter horns showed little difference, as illustrated in Figure 5 for the original ring dimensions of 0.5λ wide and 0.5λ deep, and for a smaller ring of 0.35λ wide and 0.35λ deep in Figure 6 below.

Original VE4MA Feed 0.77λ horn diameter
Ring 0.50λ wide x 0.50λ deep, 0.15λ behind rim
Figure 3

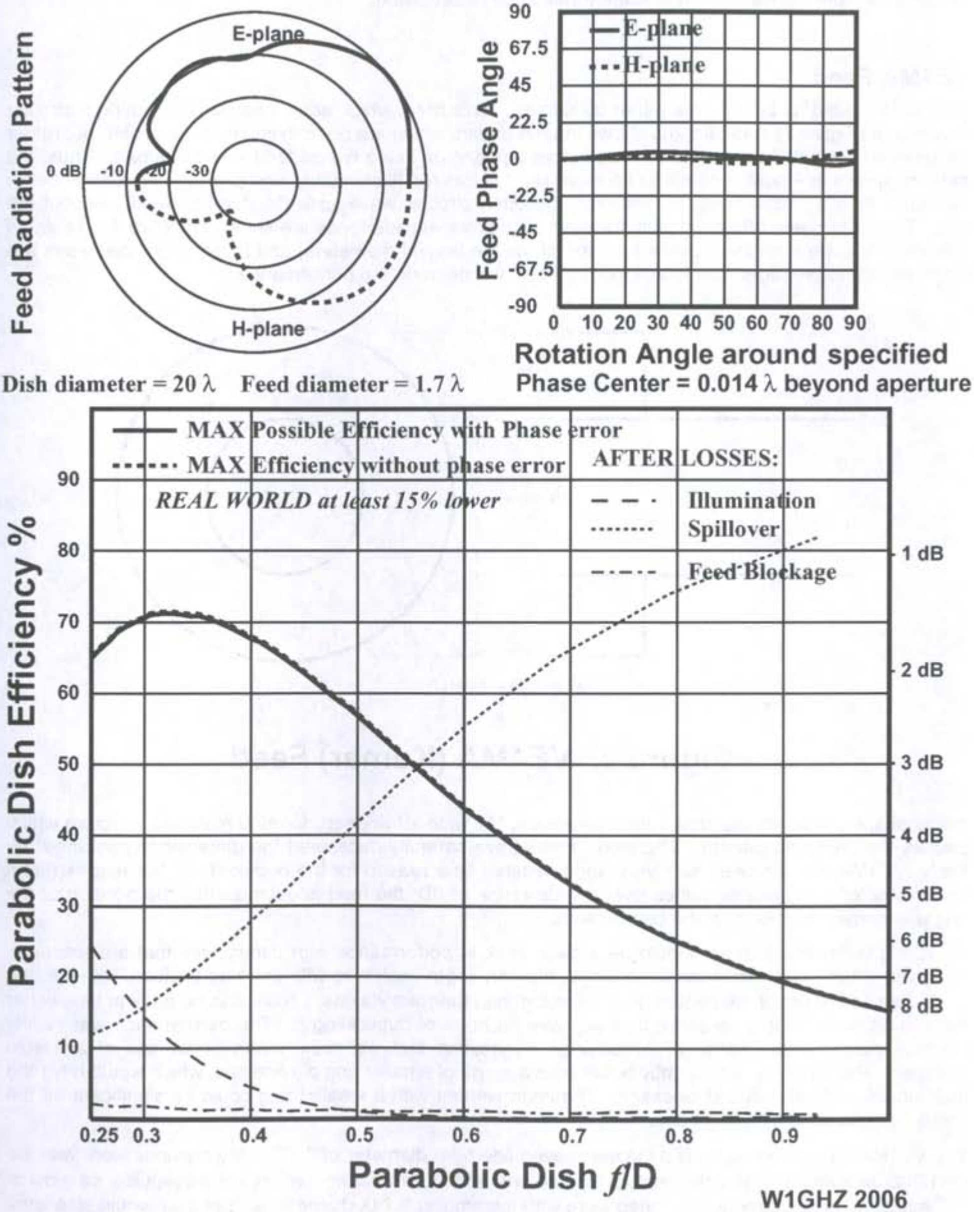
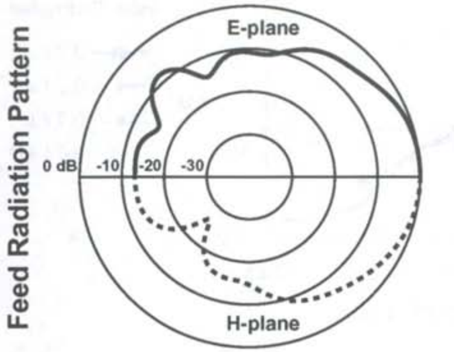
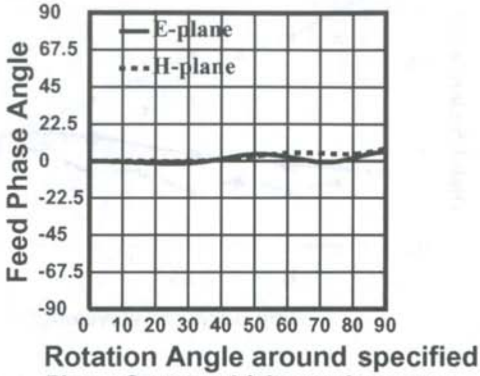


Figure 3

Cylindrical waveguide feeds, no ring
"Coffee-can Feed"
Figure 4





Dish diameter = 20 λ Feed diameters listed

Phase Center = 0 λ beyond aperture

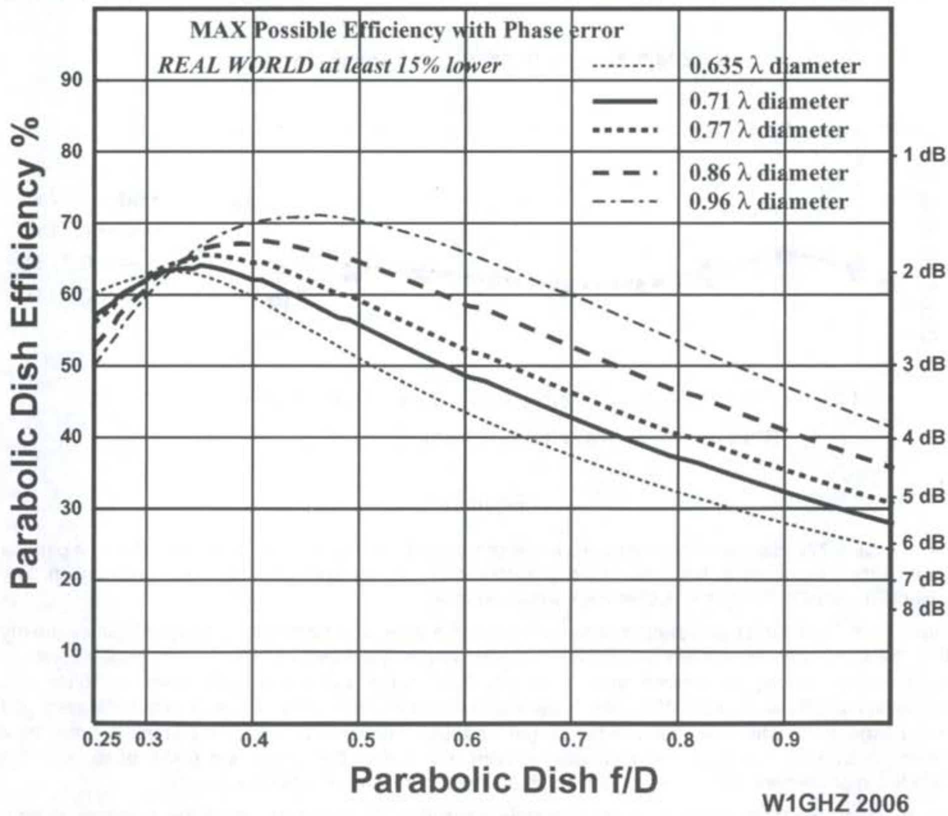


Figure 4

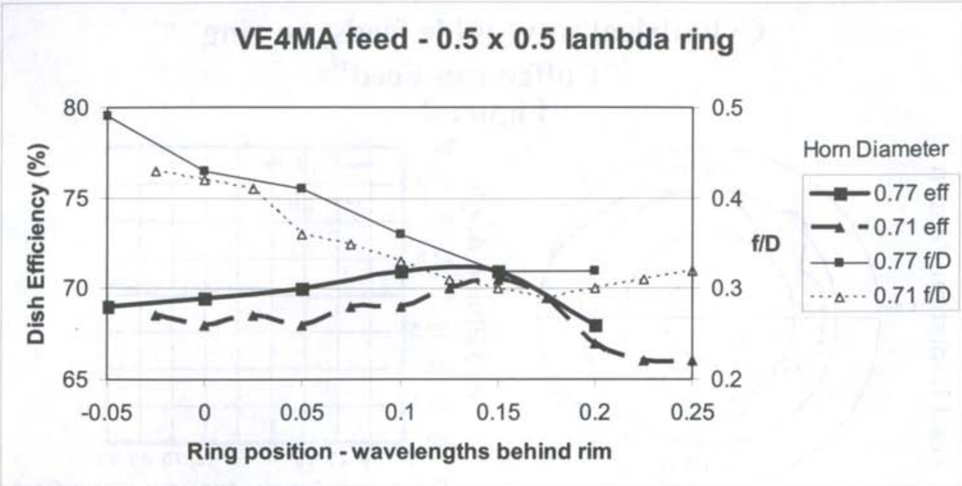


Figure 5 VE4MA feed – horn diameter comparison

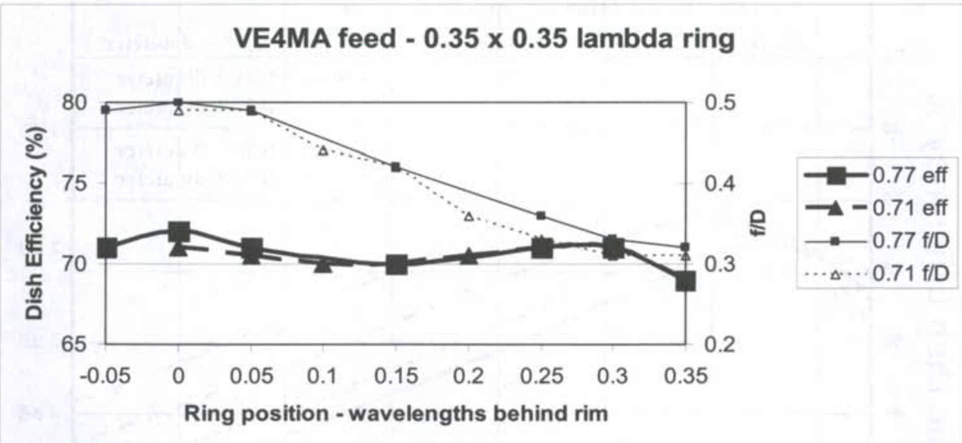
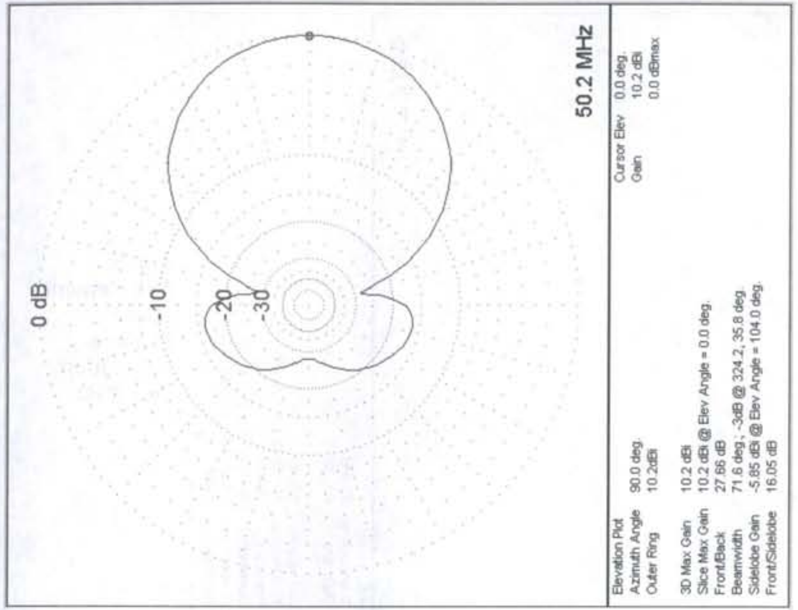


Figure 6

The original 0.77λ diameter horn might have a slight advantage, but the two diameters give comparable performance, and sizes in between would probably work just as well. So, for linear polarization, any available material in this range of diameters would be good.

Later, I tried much larger and deeper rings, and did find a peak with significantly higher efficiency (nearly 80%), for a ring with dimensions around 0.6 to 0.65λ wide and 0.4 to 0.45λ deep. The peak extends to another range of ring dimensions around 0.65 to 0.75λ wide and 0.3 to 0.4λ deep. I chose ring dimensions of 0.6λ wide and 0.45λ deep to be near the center of this peak. Figure 7 is the efficiency plot for this larger horn, which we shall call the "Super-VE4MA." For larger dishes, 20λ and up, this may be a winner. WD5AGO has built and measured a horn with a ring 0.6λ wide and 0.45λ deep, with the predicted improvement in sun noise – see the measurement results in Appendix A.

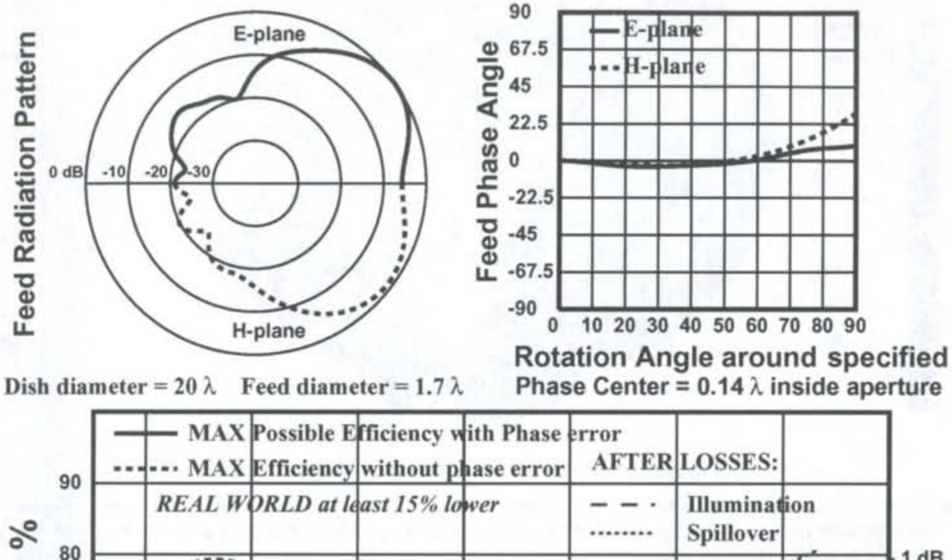
The improved feedhorn does show the desirable distinctive dip in the center of the radiation pattern, shown in the 3D plot in Figure 8. We might conclude that Kumar was on the right track, but lacked the software to refine the dimensions.



5 el - 6m + 5 el - 4m YAGI

Fig. 8:
5+5 element
yagi
E-plane
simulation
50.2 MHz

Super-VE4MA feed, 0.71λ horn diameter
Ring 0.60λ wide x 0.45λ deep, 0.15λ behind rim
Figure 7



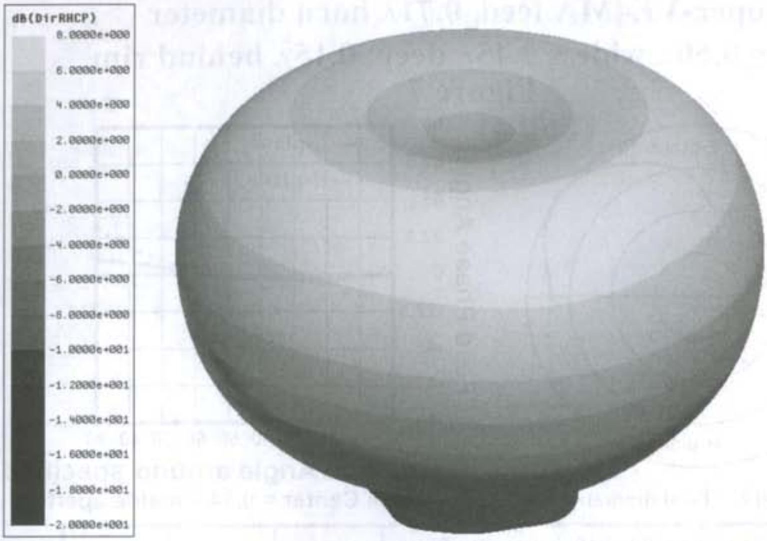


Figure 8 3D pattern for Super VE4MA feed

The larger ring provides higher efficiency with horns of both 0.71λ and 0.77λ diameter, as shown in Figure 9. The downside of the larger ring is that the improved efficiency is only useful for a limited range of ***f*/D**, roughly 0.35 to 0.45. The high efficiency is achieved with the rim of the choke ring 0.15λ behind the rim of the central waveguide – Figure 9 shows that an error of only 0.05λ reduces efficiency, so this position is fairly critical.

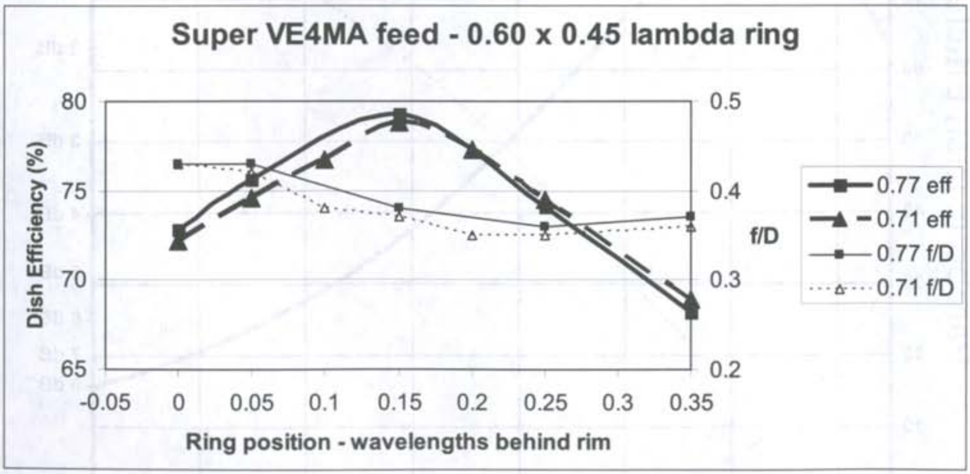


Figure 9 Super VE4MA feed – horn diameter comparison

For ***f*/D** outside the range 0.35 to 0.45, some of the smaller versions provide good performance, as good as or better than the original VE4MA dimensions, over a wider range of ***f*/D**. Some promising combinations include a ring 0.35λ wide and 0.35λ deep in Figure 6 above, a ring 0.4λ wide and 0.3λ deep shown in Figure 10, and a ring 0.25λ wide and 0.25λ deep shown in Figure 11. The last one seems particularly attractive for very small dishes, since the blockage is much less than the original dimensions while the efficiency is as good or better.

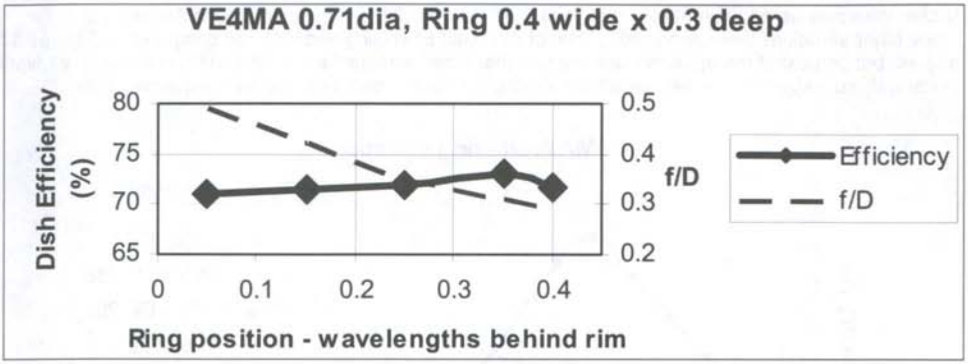


Figure 10

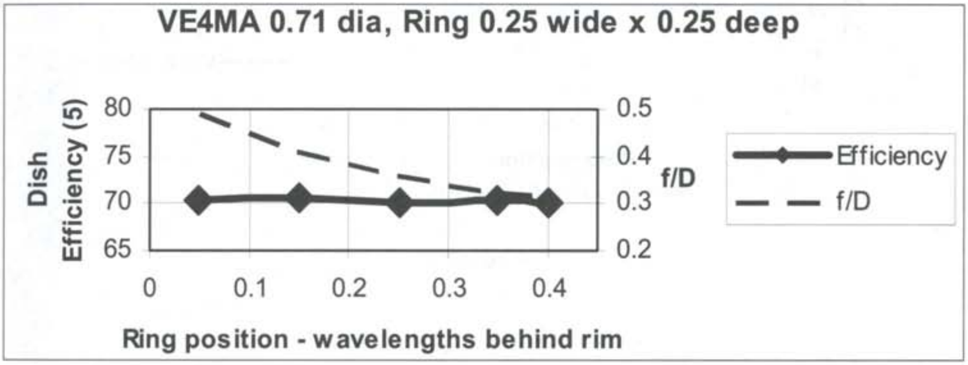


Figure 11

The smallest ring was suggested by CT1DMK, 0.12λ wide and 0.26λ deep. Figure 12 shows that it is not quite as good as the others, but not significantly worse. The blockage of this feed is quite small, since the overall diameter is less than one wavelength.

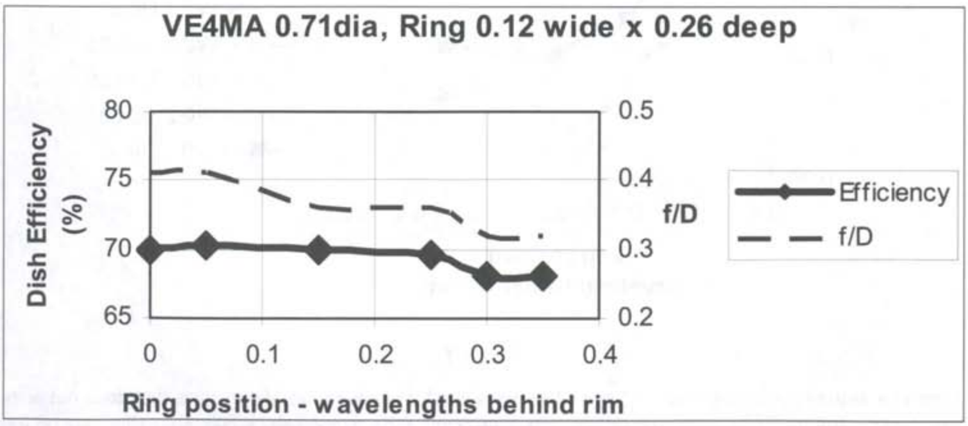


Figure 12

Rather than bury us with numbers at this point, I will include all the simulation data in Appendix B. Many other variations were analyzed. A few of the most promising versions are compared in Figures 13 and 14, but perusal of the appendix will suggest that most combinations of ring width and depth will work pretty well, so a size that can be made from available materials can be found for most applications.

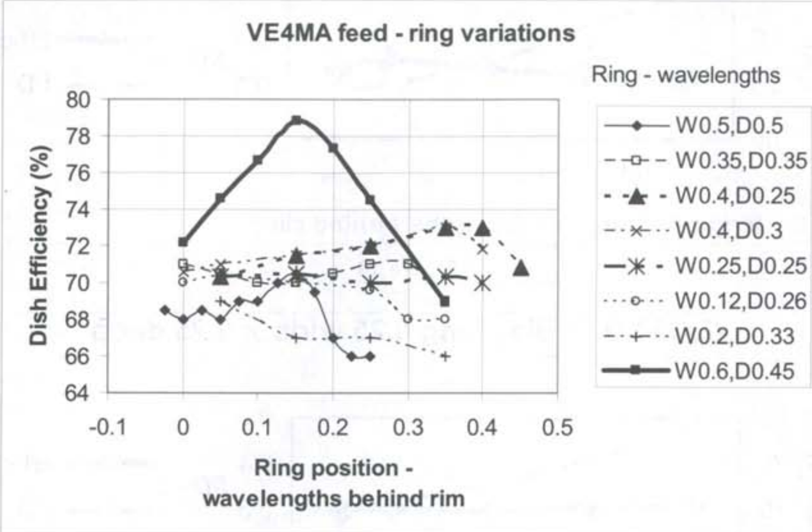


Figure 13

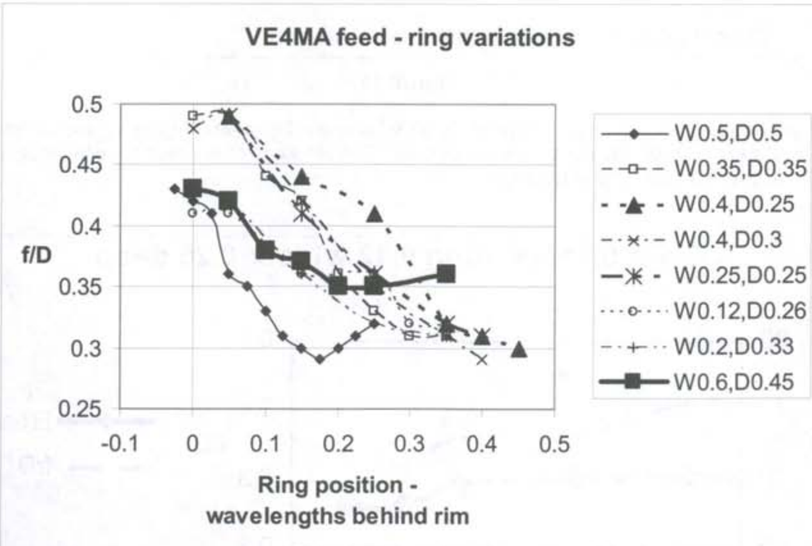


Figure 14

Plotting a wide range of ring sizes in Figure 15 shows that there is a range of ring sizes that does not work well: widths around 0.55λ wide with depths less than about 0.5λ provide low efficiency. This may be the other side of the resonance. Appendix B probably shows all the details more clearly.

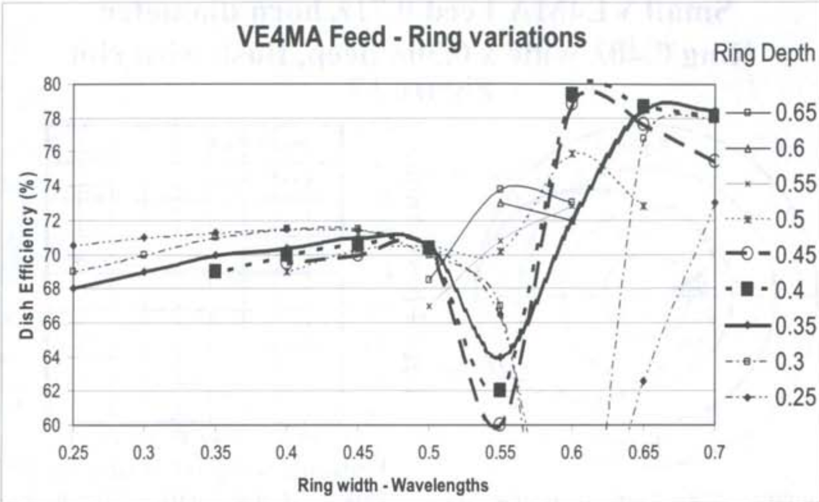


Figure 15

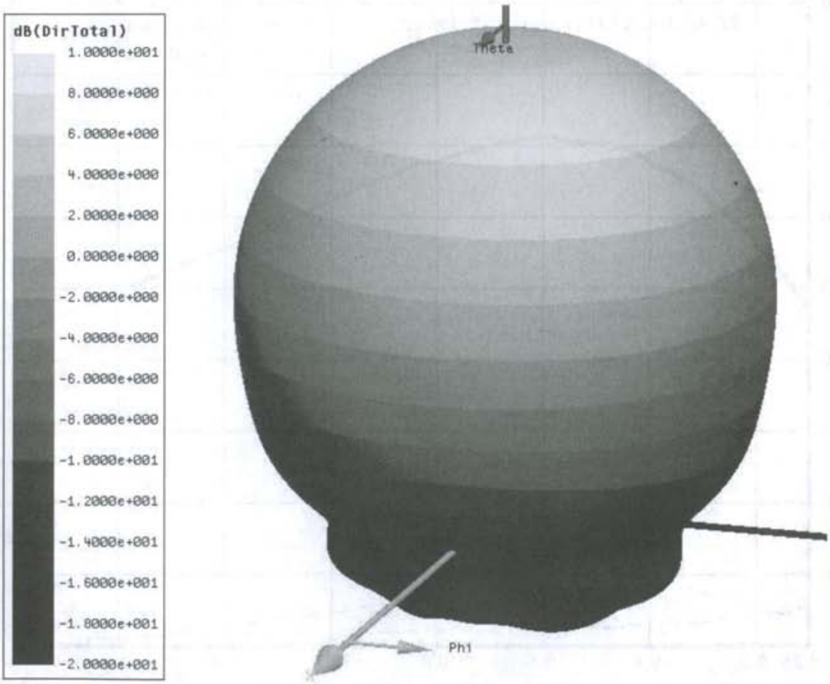


Figure 16 Small VE4MA feed, ring 0.4λ wide x 0.3λ deep, flush with rim

Also worth noting are the radiation patterns produced by these horns as the ring position is varied. With the ring forward, flush with the rim of the circular waveguide at the aperture, the patterns are similar to the typical feed in Figure 1. An example of a 3D pattern with the rim flush is shown in Figure 16, and the

Small VE4MA Feed 0.71λ horn diameter
Ring 0.40λ wide x 0.30λ deep, flush with rim
Figure 17

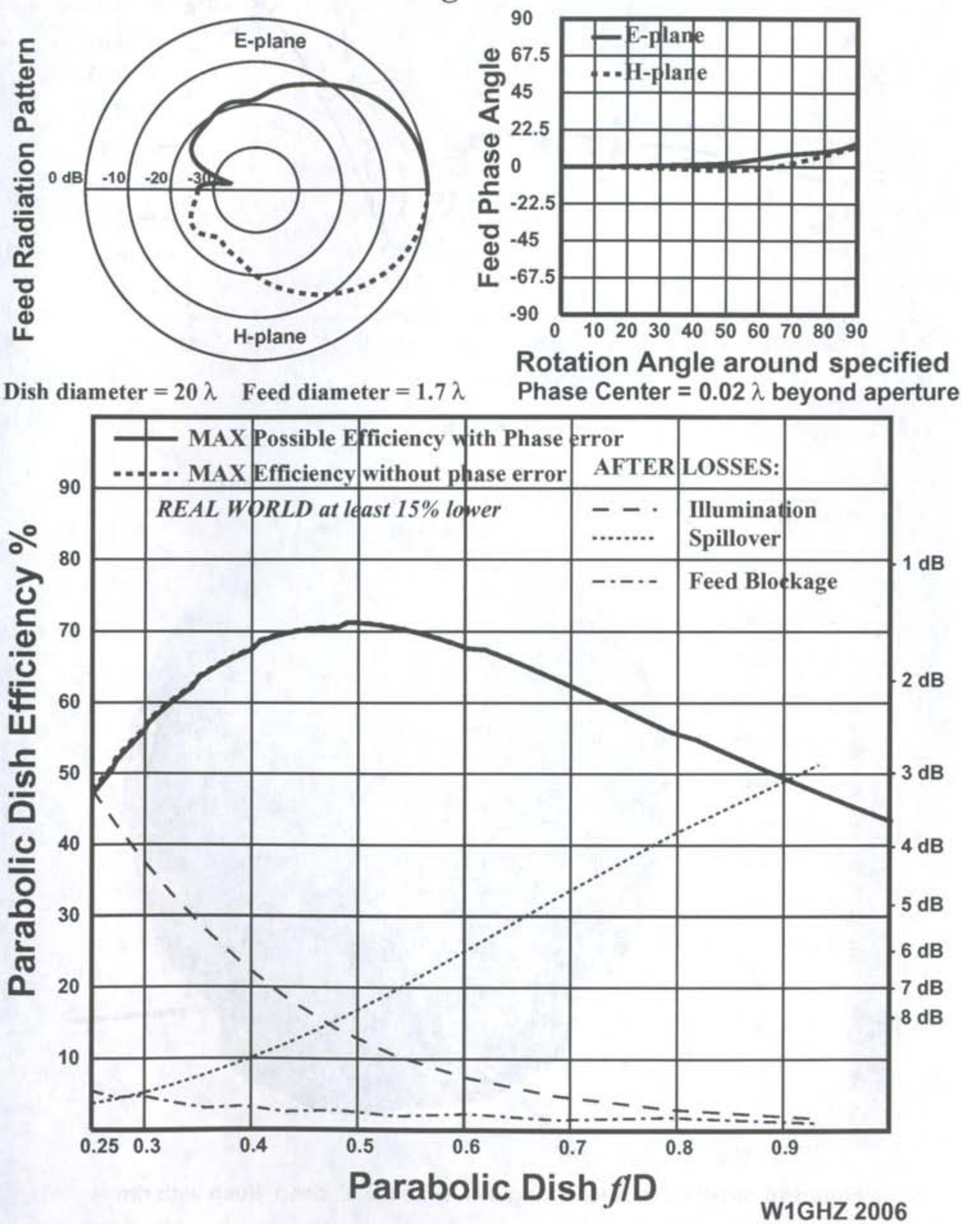


Figure 17

efficiency plot, Figure 17, shows that this position is best for a dish with **f/D** around 0.45 to 0.5. As the ring is moved back, the pattern broadens with the maximum moving away from the center for improved efficiency – this is more pronounced in the **E**-plane. Figure 18 is a 3D example of this pattern shape, for the original VE4MA dimensions. The efficiency plot for this pattern in Figure 3 shows that moving the ring back is better for deep dishes, with **f/D** as low as 0.3. The Super-VE4MA pattern in Figures 7 and 8 is much more axisymmetrical. As the ring is moved back, the back lobes become stronger, probably reducing efficiency slightly, but the maximum energy moves from the center of the dish toward the edge to provide better illumination efficiency. Thus, the ring position seems to have a stronger effect on efficiency than on optimum **f/D**. Therefore, we may choose the ring dimensions to utilize available materials, and adjust the ring position for best efficiency, starting with the data in Appendix B and optimizing it using sun noise measurements.

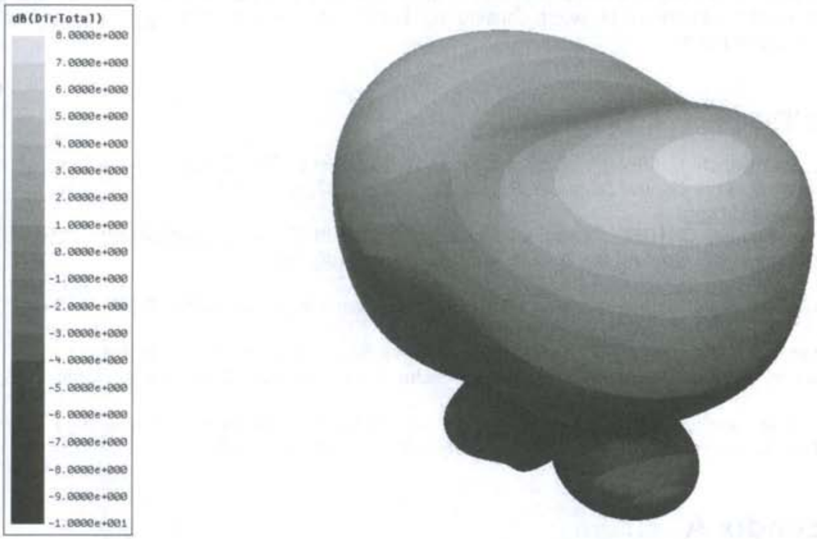


Figure 18 – Original VE4MA dimensions, ring 0.15λ behind rim

Phase Center

The phase center for all variations of the VE4MA feed is roughly at the center of the aperture, but varies a bit with different ring sizes and positions. The total variation is only quarter-wavelength or so, but a ¼λ error in axial position can lose a dB of gain for a deep dish, turning a good feed into a mediocre one. Therefore, we should consult Appendix B for the calculated phase center for each combination, followed by sun noise measurements for final adjustment.

Summary

The test results in Appendix A are very encouraging. The measurements by WD5AGO are completely independent from the simulations by W1GHZ, yet the comparable results are consistent. The efficiency derived from sun noise measurements is 12 to 14% lower than efficiency calculated from simulations in all cases. Previous antenna tests have shown real world efficiency to be about 15% lower than simulation for small dishes. Therefore, we can believe that the measurements validate the simulation results.

We have discovered some improved dimensions for the VE4MA feedhorns which offer improved performance. Measured efficiencies as high as 65% surpass any previous amateur results for a prime-focus dish, as well as most commercial results. Calculated efficiencies are only about one dB below perfection, so it is hard to imagine that significant further improvements are likely.

All of the results for variations on the VE4MA feed are tabulated in Appendix B, to enable usage of available materials and to allow optimization for a particular dish. A number of hams have successfully duplicated these feeds with good results.

From the results, we may draw some conclusions:

- The original VE4MA feedhorn provides good efficiency for a wide range of dish ***f*/D**.
- A larger version of the VE4MA feed, which we call the "Super-VE4MA," provides excellent efficiency, the highest to date for a prime-focus dish, but over a smaller range of dish ***f*/D**.
- Smaller versions of the VE4MA feed work as well as the original over a broad range of ring dimensions, offering lower blockage for very small dishes.
- The probe is not part of the antenna. It could be 100 meters away, at the far end of the feedline. The loss might reduce the transmitted power, but will not affect the radiation pattern of the antenna.

If you have a feed that is working well and providing good results, there is no need to change it. However, if you feel that a better feed could help, or if you don't have a feed yet and are still deciding, then one of the improved feeds described here could be a good choice. For EME, where every dB really matters, these improved feeds should be worth considering. But the most important thing is to put a feed in your dish and get it on the air!

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- Appendix A

Circularly-polarized Feedhorn Measured Data

Tommy Henderson, WD5AGO

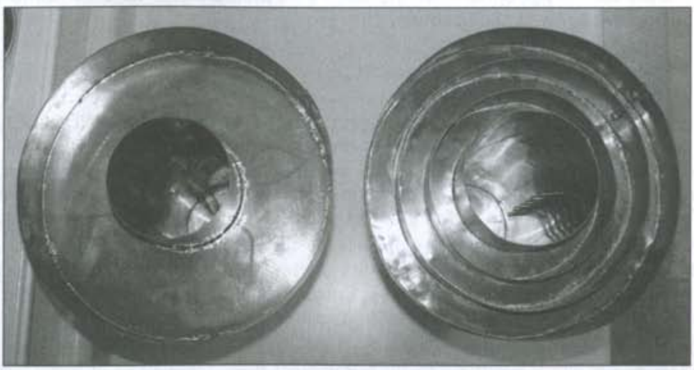


Fig. 19 VE4MA feed with septum polarizer and Chaparral-style feed with screw polarizer

Here we have a comparison of several circularly-polarized feeds for 13cm. All scalar choke rings are adjusted for best **G/T** for a 2.4 M, 0.37 ***f*/D** Dish (20λ diameter at 13cm). Feed blockage was not as big a factor in **G/T** as seen from the chart. To avoid blockage, which lowers the gain in smaller dishes, a closer spaced 3-ring scalar, with rings spaced 0.15λ was produced. As seen from W1GHZ data, a 0.2λ spacing would have yielded another 1 % efficiency placing it about 62%, still 2% to 3% down from the Super VE4MA with one large ring. All three-ring versions yielded EME echoes 2 to 3 dB out of the noise with a 35 K front end.

Feed	Horn diameter	Ring width	Ring Depth	Polarizer		Sun noise	Cold Sky to Ground	Measured Efficiency	Simulated Efficiency
	λ	λ	λ			dB	dB		
Round	0.71			Septum		9.9	5.2	51%	64%
VE4MA	0.71	0.3	0.3	Septum		10.3	6.6	56%	70%
Chaparral	0.71	2 x 0.17	0.33	Septum		10.4	7	58%	
Chaparral	0.71	3 x 0.15	0.33	Septum		10.5	7	60%	72%
VE4MA	0.71	0.6	0.45	Septum		10.9	6	65%	78%
Chaparral	0.76	3 x 0.17	0.33	7-screw		10.6	6.8	61%	
VE4MA	0.77	0.5	0.5	5-screw		10.4	6.8	58%	
VE4MA	0.71	0.3	0.3	hybrid		9.6	4.5		
Chaparral	0.76	3 x 0.2	0.2	Septum				64%	78%
Chaparral	0.71	3 x 0.2	0.2	Septum				63%	77%
Noisehorn							7.8		

Table: Measured dish efficiency from sun noise measurement below

The measured dish efficiency is 12 to 14% lower than simulated. Typical difference for real world is 15% lower than simulation for a small dish.

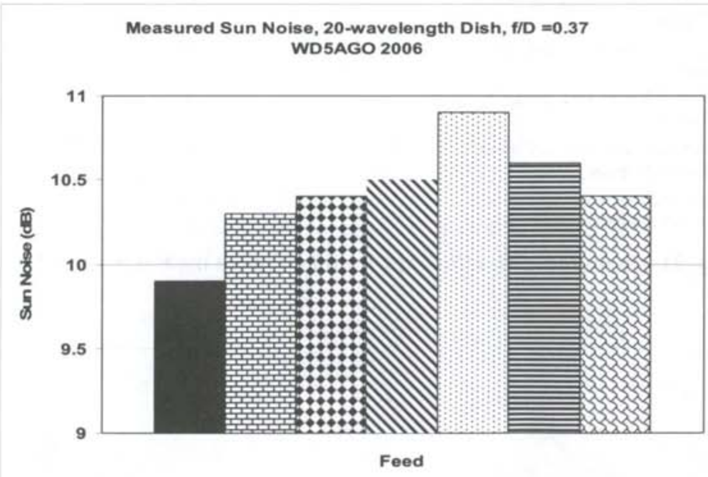
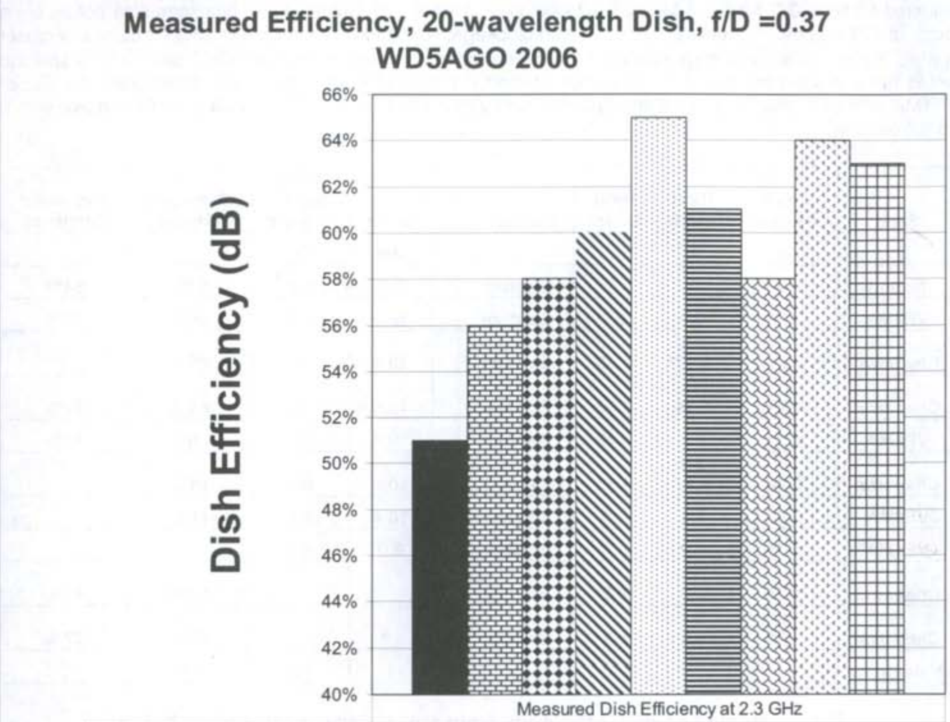


Fig. 20 Measured Sun Noise at 2.3 GHz (SFU@75)



	Measured Dish Efficiency at 2.3 GHz
Round septum, no rings	51%
1 Ring 0.3 wide x 0.3 deep	56%
2 Rings 0.17 wide x 0.33 deep	58%
3 rings 0.15 wide x 0.33 deep	60%
Super VE4MA, 1 Ring 0.6 wide x 0.45 deep	65%
3 Rings 0.17 wide x 0.33 deep, 7-screw polarizer	61%
VE4MA 0.5 wide x 0.5 deep, 5-screw polarizer	58%
3 rings 0.20 wide and 0.20 deep, 0.76 horn diameter	64%
3 rings 0.20 wide and 0.20 deep, 0.71 horn diameter	63%

Fig. 21 Measured dish efficiency from sun noise measurement above

- Appendix B Simulation Data from HFSS W1GHZ 2006

VE4MA Feedhorns 0.77λ Horn Diameter

with different ring sizes and positions

Original VE4MA

Horn Diam. λ	Ring width λ	Ring depth λ	Ring behind rim λ	Dish efficiency	f/D best	Phase center λ	Return Loss dB	Front /Back dB
0.77	0.5	0.5	-0.05	69%	0.49	-0.18	22.5	23
			0	69.5%	0.43	-0.24	24	19
			0.05	70%	0.41	-0.23	24	17
			0.1	71%	0.36	-0.17	21.5	14
			0.15	71%	0.32	0.014	18.5	13
			0.2	68%	0.32	0.11	17.5	12

dB

Super VE4MA

Horn Diam. λ	Ring width λ	Ring depth λ	Ring behind rim λ	Dish efficiency	f/D best	Phase center λ	Return Loss dB	Front /Back dB
0.77	0.6	0.45	0	72.8%	0.43	-0.37	17	23
			0.05	75.6%	0.43	-0.37	18	24
			0.15	79.3%	0.38	-0.07	19.5	23
			0.25	74.1%	0.36	0.2	19	21
			0.35	68.2%	0.37	0.14	20.5	23

Small Ring

Horn Diam. λ	Ring width λ	Ring depth λ	Ring behind rim λ	Dish efficiency	f/D best	Phase center λ	Return Loss dB	Front /Back dB
0.77	0.35	0.35	-0.05	71%	0.49	0.1	18	27
			0	72%	0.5	0	19	26
			0.05	71%	0.49	-0.06	20.5	15
			0.15	70%	0.42	-0.11	24.5	11
			0.25	71%	0.36	-0.1	24.5	16
			0.3	71%	0.33	0	21.5	14
			0.35	69%	0.32	0.08	20	13

1296 published dimensions

Horn Diam. λ	Ring width λ	Ring depth λ	Ring behind rim λ	Dish efficiency	f/D best	Phase center λ	Return Loss dB	Front /Back dB
0.77	0.52	0.52	0.1	71.1%	0.34	-0.11	20.5	13
			0.15	70%	0.33	0.1	18	13

2304 published dimensions

Horn Diam. λ	Ring width λ	Ring depth λ	Ring behind rim λ	Dish efficiency	f/D best	Phase center λ	Return Loss dB	Front /Back dB
0.77	0.54	0.48	0	68%	0.43	-0.2		18
0.77	0.55	0.55	0.15	67%	0.33	0.11	18.5	12

VE4MA Feedhorns 0.71λ Horn Diameter

with different ring sizes and positions

Original VE4MA ring size

Horn Diam. λ	Ring width λ	Ring depth λ	Ring behind rim λ	Dish efficiency	f/D best	Phase center λ	Return Loss dB	Front /Back dB
0.71	0.5	0.5	-0.025	68.5%	0.43	-0.21	19	11
			0	68%	0.42	-0.21		18
			0.025	68.5%	0.41	-0.24	21.5	17
			0.05	68%	0.36	-0.24	22	16
			0.075	69%	0.35	-0.21	22	15
			0.1	69%	0.33	-0.18	21.5	14
			0.125	70%	0.31	-0.11	20	13
			0.15	70.5%	0.3	-0.03	18.5	12
			0.175	69.5%	0.29	0.1	17	12
			0.2	67%	0.3	0.18	16	11
			0.225	66%	0.31	0.21	16	12
			0.25	66%	0.32	0.2	15.5	14

Small ring

Horn Diam. λ	Ring width λ	Ring depth λ	Ring behind rim λ	Dish efficiency	f/D best	Phase center λ	Return Loss dB	Front /Back dB
0.71	0.4	0.25	0	69%	0.48	0.07	14	23
			0.05	70.3%	0.49	0	15	25
			0.15	71.5%	0.44	-0.08	17	25
			0.25	72%	0.37	-0.11	19.5	22
			0.35	73%	0.32	-0.07	23	16
			0.4	73%	0.31	0	21.5	15
			0.45	70.8%	0.3	0.1		13

Small ring

Horn Diam. λ	Ring width λ	Ring depth λ	Ring behind rim λ	Dish efficiency	f/D best	Phase center λ	Return Loss dB	Front /Back dB
0.71	0.4	0.3	0	70.6%	0.48	0.02	15	26
			0.05	71.0%	0.49	-0.04	16	26
			0.15	71.5%	0.42	-0.11	18.5	24
			0.25	72.0%	0.35	-0.11	22	19
			0.35	73.0%	0.31	0	21	14
			0.4	71.8%	0.29	0	19	13

Small Ring

Horn Diam. λ	Ring width λ	Ring depth λ	Ring behind rim λ	Dish efficiency	f/D best	Phase center λ	Return Loss dB	Front /Back dB
92	0.25	0.25	0.05	70.3%	0.49	0.06	15	26
			0.15	70.5%	0.41	-0.04	17.5	24
			0.25	70.0%	0.36	-0.06	20	21
			0.35	70.3%	0.32	-0.06	21.5	17
			0.4	70.0%	0.31	0	21	15

Super VE4MA

Horn Diam. λ	Ring width λ	Ring depth λ	Ring behind rim λ	Dish efficiency	f/D best	Phase center λ	Return Loss dB	Front /Back dB
0.71	0.6	0.45	0	72.2%	0.43	-0.4	15.5	22
			0.05	74.6%	0.42	-0.37	16.5	23
			0.1	76.7%	0.38	-0.3	17	22
			0.15	78.8%	0.37	-0.14	17	21
			0.2	77.3%	0.35	0.13	17	21
			0.25	74.5%	0.35	0.23	17	19
			0.35	68.9%	0.36	0.17	17	21

Small ring

Horn Diam. λ	Ring width λ	Ring depth λ	Ring behind rim λ	Dish efficiency	f/D best	Phase center λ	Return Loss dB	Front /Back dB
0.71	0.35	0.35	0	71%	0.49	0	16	25
			0.05	70.5%	0.49	-0.07	17	14
			0.1	70%	0.44	-0.1	18.5	13
			0.15	70%	0.42	-0.13	20	11
			0.2	70.5%	0.36	-0.13	21.5	18
			0.25	71%	0.33	-0.11	22.5	16
			0.3	71%	0.31	-0.03	21	14
			0.35	69%	0.31	0.086	18.5	12

Smallest Ring simulated

Horn Diam. λ	Ring width λ	Ring depth λ	Ring behind rim λ	Dish efficiency	f/D best	Phase center λ	Return Loss dB	Front /Back dB
0.71	0.12	0.26	0	70.0%	0.41	0.1	14	24
			0.05	70.3%	0.41	0.06	15.5	22
			0.15	70.0%	0.36	0	16.5	20
			0.25	69.6%	0.36	0	19.5	18
			0.3	68.0%	0.32	0	20	17
			0.35	68.0%	0.32	0	20	16

Single Ring of Chaparral

Horn Diam. λ	Ring width λ	Ring depth λ	Ring behind rim λ	Dish efficiency	f/D best	Phase center λ	Return Loss dB	Front /Back dB
0.71	0.2	0.33	0.05	69%	0.42	0	17	21
			0.15	67%	0.36	-0.03	18.5	18
			0.25	67%	0.32	-0.03	21	16
			0.35	66%	0.31	0.014	21	13

VE4MA feed, 0.71λ horn diameter with different ring dimensions, all 0.15λ behind rim W1GHZ 2006

Dish efficiency

WIDE > / DEEP λ	0.75λ	0.7λ	0.65λ	0.6λ	0.55λ	0.5λ	0.45λ	0.4λ	0.35λ	0.3λ	0.25λ
0.65				73.0%	73.8%	68.5%					
0.6				72.0%	73.0%	68.0%					
0.55				72.8%	70.8%	67.0%					
0.5		70.6%	72.8%	75.9%	70.2%	70.5%	70.3%	69.0%			
0.45	74.3%	75.5%	**77.6%**	**78.8%**	60.0%	70.3%	70.0%	69.5%			
0.4	**77.5%**	**78.1%**	**78.7%**	**79.4%**	62.0%	70.4%	70.6%	70.0%	69.0%		
0.35	**77.8%**	**78.5%**	**78.5%**	72.0%	64.0%	70.5%	71.0%	70.4%	70.0%	69.0%	68.0%
0.3	**77.8%**	**78.0%**	**76.8%**	47.0%	67.0%	70.0%	71.5%	71.5%	71.0%	70.0%	69.0%
0.25	75.2%	73.0%	62.6%	50.0%	66.5%	70.5%	71.4%	71.5%	71.3%	71.0%	70.5%
0.2						70.0%			71.0%		70.7%
0.15						68.0%			68.0%		68.0%
0.1									63.5%		

Best f/D

WIDE > / DEEP λ	0.75λ	0.7λ	0.65λ	0.6λ	0.55λ	0.5λ	0.45λ	0.4λ	0.35λ	0.3λ	0.25λ
0.65				0.41	0.42	0.42					
0.6				0.37	0.42	0.37					
0.55				0.35	0.42	0.31					
0.5		0.38	0.36	0.36	0.31	0.3	0.31	0.31			
0.45	0.38	0.37	0.37	0.37	0.25	0.33	0.33	0.36			
0.4	0.41	0.41	0.39	0.39	0.31	0.36	0.36	0.36	0.36		
0.35	0.42	0.42	0.42	0.41	0.41	0.42	0.41	0.41	0.42	0.42	0.41
0.3	0.43	0.43	0.43	0.49	0.42	0.42	0.43	0.42	0.42	0.42	0.42
0.25	0.45	0.45	0.49	0.25 to 0.5	0.33	0.43	0.43	0.44	0.43	0.43	0.41
0.2						0.44			0.49		0.43
0.15						0.44			0.45		0.44
0.1									0.41		

Phase Center, wavelengths in front of aperture

WIDE > / DEEP λ	0.75λ	0.7λ	0.65λ	0.6λ	0.55λ	0.5λ	0.45λ	0.4λ	0.35λ	0.3λ	0.25λ
0.65				0.17	0	0.08					
0.6				0.24	0.08	0					
0.55				0.26	0.14	0.186					
0.5		0.3	0.26	0.13	-0.03	-0.03	0	-0.04			
0.45	0.17	0.13	-0.01	-0.14	-0.2	-0.19	-0.14	-0.17			
0.4	-0.03	-0.08	-0.17	-0.27	-0.23	-0.2	-0.19	-0.17	-0.14		
0.35	-0.11	-0.18	-0.26	-0.23	-0.14	-0.18	-0.16	-0.13	-0.13	-0.1	-0.07
0.3	-0.16	-0.24	-0.33	-0.53	-0.1	-0.13	-0.11	-0.11	-0.1	-0.086	-0.04
0.25	-0.27	-0.39	-0.06	-0.05	-0.08	-0.08	-0.08	-0.06	-0.04	-0.04	
0.2						0			0		0
0.15						0.07			0.086		0.07
0.1									0.14		

Hocheffektive Erreger für Spiegel mit Primärfokus

Teil 1 - VE4MA Feedhorn und Variationen

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Das VE4MA-Feedhorn[1], ein offener zylindrischer Wellenleiter, der von einem Choke-Ring umgeben ist, ist seit langer Zeit ein populärer Erreger für Parabolspiegelantennen bei Funkamateuren, da er sehr gute Leistungseigenschaften hat und leicht ohne hochspezielle Maschinen nachgebaut werden kann.
Das ähnliche Chaparral-Feedhorn[2], bei dem mehrere Choke-Ringe hinzugefügt werden, ist sehr gebräuchlich bei SAT-TV-Spiegeln.

Der Septum-Polarisator, wie kürzlich von beschrieben[3] von OK1DFC, ist ein sehr populärer Weg geworden, zirkulare Polarisation zu erzeugen. Mit Hilfe von etwas freier Computerrechenzeit, wurde eine Optimierung eines VE4MA-Feedhorns mit Septum-Polarisator für zirkulare Polarisation begonnen. Etwas unerwartete Resultate führten zu einer größeren Analyse mit Schlüssen, die sich vielleicht von der herrschenden Meinung unterscheiden, die aber durch Messungen von WD5AGO verifiziert wurden.
Einige verbesserte Abwandlungen des VE4MA- und Chaparral-Feedhorns werden beschrieben und zeigen einige der höchsten heutzutage je errechneten *und gemessenen* Effektivitäten für einen Primärfokus-Spiegel.

Was wir oft ein "Feedhorn" nennen, umfasst mehrere einzelne Elemente: Eine Antenne, die den Strahl für gute Ausleuchtung des Spiegels formt, einen Wellenleiter-Abschnitt (rund, quadratisch oder rechteckig), eventuell einen zirkularen Polarisator, und einen Erreger-Abschnitt (Wellenleiter, Einkopplung Sonde-Koax-Übergang oder ein anderer Übergang). Diese Elemente können sich beeinflussen, haben aber jedes eine separate Funktion und sollten unabhängig voneinander analysiert werden. Es ist nicht nötig alle Dimensionen ganz genau von einem bis zum anderen Ende zu replizieren, aber es wäre töricht, Änderungen vorzunehmen, ohne mögliche Interaktionen zu berücksichtigen.
Deshalb werden wir die folgenden Elemente zur Untersuchung in einer Serie von Artikeln aufteilen:

- **VE4MA-Horn, Teil 1.**
- **Chaparral-Horn, Teil 2.**
- **Septum-Polarisator in zirkularem Wellenleiter, und VE4MA-/Chaparral-Hörner mit Septum Polarisator, Teil 3.**

Die Erregung ist ein separates Problem; sämtliche Analysen dafür, unter Verwendung der Ansoft **HFSS** software[4], benutzen Einzelmode-Wellenleiter-Erregung. Übergänge in zirkulare Wellenleiter mit Einkoppelsonden wurden in einem vorigen Aufsatz[5] behandelt, so dass dies hier nicht behandelt wird.
Die Einkoppelsonden sind nicht Teil der Antenne. Die einzige Komplikation, die durch Sonden-Erregung hinzugefügt werden kann, könnten zusätzliche Wellenleiter-Modes sein. Wenn die Wellenleiter-Sektion vor dem Horn ausreichend lang ist, werden die zusätzlichen Modes das Horn nicht erreichen und deshalb auch das Strahlungsdiagramm beeinflussen. Einzelmode-Erregung schaltet diese potentielle Komplikation bei der Analyse aus.

Spiegel-Ausleuchtung rekapituliert

Bei idealer Ausleuchtung für einen Parabolspiegel würde die Energie gleichmäßig über die Oberfläche des Reflektors verteilt und keine Energie durch Überstrahlen würde verloren gehen. Reale Feeds bieten diese ideale Verteilung nicht. Abb. 1 aus dem *W1GHZ Microwave Antenna Book – Online*[6] zeigt die benötigte Ausleuchtung gegen ein typisches (idealisiertes) Strahlungsdiagramm eines Feeds. Typischerweise fällt die Strahlungsenergie vom zentralen Peak weg ab, während die Energie im benötigten Diagramm zum Rand hin *ansteigt*, um die Freiraumabschwächung zu kompensieren – der Rand des Spiegels ist weiter vom Feed entfernt als der Mittelpunkt des Spiegels.

Das typische Feed-Diagramm hat überschießende Energie, die den Reflektor nicht trifft, und reale Feeds haben Seiten- und Nebenzipfel, die ebenfalls Energie vergeuden. Für viele Feeds wurde gefunden, dass der Kompromiss zwischen Ausleuchtung und Überschuß zur Erreichung bester Effektivität bei etwa 10 dB Absenkung der Ausleuchtung (nicht des Feed-Diagramms, wir müssen die Freiraumdämpfung berücksichtigen) am Rand des Spiegels liegt. Die 10-db-Abnahme ist nur eine Daumenregel; für eine akkurate Analyse wird das Diagramm integriert und wir rechnen die Effektivität im voll dreidimensionalen Strahlungsdiagramm (in der Praxis sind – bei sich gut verhaltenen Feeds – nur einige Schnitte, typischerweise die E- und H-Feld-Schnitte, durch das 3-D-Diagramm notwendig).

Anmerkung: Alle Effektivitätsberechnungen gelten für einen willkürlichen Spiegel von 20λ Durchmesser und einen Feed-Durchmesser von 1.7λ oder ein konstantes Blockierungsverhältnis von 0.085, so daß wir Äpfel mit Äpfeln vergleichen. Für kleine Spiegel ist die vorliegende Blockierung signifikanter und die Effektivität sollte nachgerechnet werden.

VE4MA-Feed

Das VE4MA-Feed[1] basiert auf einer Veröffentlichung von Kumar[7]. Dieses Horn, das einen einzelnen Ring um einen zirkularen Wellenleiter hinzufügt (Abb. 2), hat Diagramme, die in beiden Veröffentlichungen gezeigt, nicht im Zentrum das Maximum haben, sondern etwas ansteigen, so wie bei unserem gewünschten Feed, bevor sie Abfallen wie bei einem typischen Feed. Siehe Abb. 1. Deshalb tendiert das Diagramm, was in Abb. 3 gezeigt ist, mehr zu unserer erwünschten Ausleuchtung und erbringt etwas bessere Effektivität als ein einfaches Feed, z.B. ein offener zirkularer Wellenleiter (Kaffeekannen-Feed) ohne den Ring. Das Diagramm und die Effektivitätsplots für offene zirkulare Feeds zeigt Abb. 4; Die errechnete Effektivität ist niedriger als beim VE4MA-Feed für alle, außer den größten, Durchmesser und diese größten Durchmesser sind groß genug, um zusätzliche Modes fortzuleiten, was die Leistungsfähigkeit herabsetzt.

Von Kumar wurde vorgeschlagen, daß ein Ring mit den Dimensionen ½λ breit x ½λ tief eine resonante Struktur formen würde, die ein verbessertes Diagramm bewirken würde. Folglich haben Amateure sorgfältig die Abmessungen mit sehr guten Ergebnissen dupliziert, die von Barry, VE4MA, publiziert wurden[8]. Ein Grund für die Popularität dieses Feeds liegt darin, dass es für konventionelle Spiegel über einen breiten f/D-Bereich gut arbeitet. Das Feed wird optimiert durch die Position des Ringes in Bezug zur Kante des zentralen Horns.

Wenn der Ring resonant ist, sollte eine klare Spitze in der Performance bei den Dimensionen sein, die resonant sind. Jedoch, als ich zuerst die Dimensionen variierte, war der einzige leichte Peak mit einer Ring-Position von 0.15λ hinter der Öffnungskante des zentralen Horns. Variieren der anderen Abmessungen bewirkte, dass überhaupt kein Peak oder ein so scharfer Peak gefunden wurde, dass er nicht reproduzierbar wäre. Die Performance war nahezu identisch über einen breiten Bereich der Dimensionen, was nahe legte, dass verfügbare Materialen hätten besser verwenden werden können.
Die Performance war leicht besser im Bereich von kleineren Ring-Dimensionen, was den zusätzlichen Vorteil von reduzierter Blockade hätte. Die Verbesserung mit einem kleineren Ring könnte bedeutsam bei kleineren Spiegeln sein, die von vielen Amateuren benutzt werden.

Die VE4MA-Abmessungen spezifizieren ein rundes Wellenleiterhorn mit Durchmesser von 0.77λ. Bei meiner vorigen Arbeit mit dem OK1DFC-Septum habe ich herausgefunden, dass das Septum am besten bei 0.71λ Durchmesser des zirkularen Wellenleiters arbeitet, so dass die meisten Variationen mit den Ringgrößen, die ich ausprobierte, für den kleineren 0.71λ Durchmesser gemacht wurden, so dass sie auch mit dem Septum-Polarisator arbeiten würden. Allerdings zeigte der Vergleich von Feedhörnern mit gleichen Ringgrößen und den beiden Hörnern unterschiedlichen Durchmessers nur kleine Unterschiede, wie in Abb. 5 illustriert für die originalen Ring-Dimensionen von 0.5λ Weite und 0.5λ Tiefe und für einen kleineren Ring von 0.35λ Weite und 0.35λ Tiefe in Abb. 6 darunter.

Das originale Horn mit 0.77λ Durchmesser könnte einen kleinen Vorteil haben, aber beide Durchmesser ergeben vergleichbare Performance, und Größen zwischen diesen beiden würden wahrscheinlich genauso gut sein. Also, für lineare Polarisation wäre jedes verfügbare Material in diesem Bereich von Durchmessern gut.
Später habe ich viel größere und tiefere Ringe ausprobiert und fand einen Peak mit signifikant höherer Effektivität (fast 80%) einen Ring mit Dimensionen von um 0.6 bis 0.65λ Weite und 0.4 bis 0.45λ Tiefe.

Der Peak erstreckt sich bis zu einem anderen Bereich von Ringdimensionen von um 0.65 bis 0.75λ Weite und 0.3 bis 0.4λ Tiefe. Ich wählte Ringdimensionen von 0.6λ Weite und 0.45λ Tiefe, um nahe dem

Zentrum dieses Peaks zu liegen. Abb. 7 ist der Effektivitäts-Plot für dieses größere Horn, was wir das „Super-VE4MA" nennen sollten.
Für größere Spiegel von 20λ und mehr, sollte dies der Gewinner sein. WD5AGO hat ein Horn gebaut mit einem Ring von 0.6λ Weite und 0.45λ Tiefe und die vorhergesagte Verbesserung beim Sonnenrauschen gemessen. Siehe Messergebnisse in Anhang (Appendix) A.

Das verbesserte Feedhorn zeigt den erwünschten ausgeprägten Dip im Zentrum des Strahlungsdiagramms, zu sehen im 3-D-Plot in Abb. 8. Wir könnten schließen, dass Kumar auf dem richtigen Weg war, aber die Software nicht hatte, um die Dimensionen zu verfeinern.

Der größere Ring liefert höhere Effektivität bei Hörnern von 0.71λ und 0.77λ Durchmesser, wie in Abb. 9 gezeigt. Die Kehrseite des größeren Rings ist, dass die verbesserte Effektivität nur für einen begrenzten ***f*/D**-Bereich von ungefähr 0.35 bis 0.45 nützlich ist. Die hohe Effektivität wird erreicht mit der Kante des Choke-Rings 0.15λ hinter der Kante des zentralen Wellenleiters. Abb. 9 zeigt, dass ein Fehler von nur 0.05λ die Effektivität reduziert, d.h. diese Position ist ziemlich kritisch.

Für ***f*/D** außerhalb des Bereichs von 0.35 bis 0.45 liefern einige der kleineren Versionen gute Performance, die so gut oder besser ist als bei den originalen VE4MA-Dimensionen und über einen weiteren **f/D**-Bereich. Einige viel versprechende Kombinationen beinhalten einen Ring von 0.35λ Weite und 0.35λ Tiefe, siehe Abb. 6, einen Ring von 0.4λ Weite und 0.3λ Tiefe, gezeigt in Abb. 10, und einen Ring von 0.25λ Weite und 0.25λ Tiefe, gezeigt in Abb. 11. Letzerer scheint besonders attraktiv für sehr kleine Spiegel zu sein, da die Blockade viel geringer als bei den originalen Dimensionen ist, während die Effektivität gleich gut oder besser ist.

Der kleinste Ring wurde von CT1DMK vorgeschlagen, 0.12λ weit und 0.26λ tief. Abb. 12 zeigt, dass er nicht ganz so gut ist, wie die anderen, aber auch nicht signifikant schlechter. Die Blockierung ist bei diesem Feed sehr gering, da der gesamte Durchmesser unter einer Wellenlänge liegt.

Anstatt uns hier mit Zahlen zu erschlagen, füge ich die gesamten Simulations-Daten im Anhang B bei.
Viele andere Variationen wurden analysiert. Einige wenige der am meisten versprechenden Versionen werden in Abb. 13 und 14 verglichen, aber die Durchsicht des Anhangs wird ergeben, dass die meisten Kombinationen von Ringweite und –tiefe sehr gut funktionieren, so dass eine Größe für die meisten Anwendungsfälle gefunden werden kann, die dann auch aus verfügbarem Material hergestellt werden kann.

Aufzeichnen eines weiten Bereiches von Ringgrößen in Abb. 15 zeigt, dass es einen Bereich von Ringgrößen gibt, der nicht gut funktioniert: Weiten von um 0.55λ mit Tiefen von weniger als 0.5λ bewirken niedrige Effektivität. Dies könnte die Gegenseite der Resonanz sein. Anhang B zeigt alle diese Details wahrscheinlich viel klarer.
Auch erwähnenswert sind die Strahlungsdiagramme, die von diesen Hörnern produziert werden, wenn die Position des Rings variiert wird. Mit dem Ring vorwärts geschoben, bündig mit der Kante an der Öffnung des zirkularen Wellenleiters, sind die Diagramme ähnlich dem typischen Feed in Abb. 1.
Ein Beispiel eines 3-D-Diagramms mit bündiger Kante zeigt Abb. 16, und der Effektivitäts-Plot, Abb. 17, zeigt, dass diese Position die beste für einen Spiegel mit ***f*/D** um 0.45 bis 0.5 ist. Wenn der Ring nach hinten bewegt wird, wird das Diagramm breiter, wobei sich das Maximum aus dem Zentrum für verbesserte Effektivität heraus bewegt – dies ist in der **E**-Ebene deutlicher ausgeprägt.
Abb. 18 ist ein 3D-Beispiel dieser Diagrammform für die originalen VE4MA-Dimensionen. Der Effektivitäts-Plot für dieses Diagramm in Abb. 3 zeigt, dass das Nachhintenbewegen des Rings besser für tiefe Spiegel ist, mit **f/D** herunter bis 0.3.
Die Diagramme des Super-VE4MA-Horns in Abb. 7 und 8 sind viel achsensymmetrischer. Wenn der Ring nach hinten bewegt wird, werden die hinteren Nebenzipfel größer, die die Effektivität wahrscheinlich etwas verringern, aber die Hauptenergie bewegt sich vom Zentrum des Spiegels zum Rand und bewirkt eine effektivere Ausleuchtung. Folglich scheint die Ringposition einen größeren Einfluß auf die Effektivität zu haben, als ein optimales **f/D**. Folglich sollten wir die Dimensionen des Rings so wählen, dass wir verfügbares Material verwenden können und die Ringposition für beste Effektivität justieren, ausgehend von den Daten aus Anhang B und anschließende Optimierung durch Messung von Sonnenrauschen.

Phasenzentrum

Das Phasenzentrum für alle Variationen des VE4MA-Feeds liegt grob im Zentrum der Öffnung, aber variiert ein wenig mit verschiedenen Ringgrößen und Positionen. Die maximale Abweichung beträgt nur eine Viertel Wellenlänge oder ähnlich, aber ein ¼λ Fehler in der axialen Position kann einen Verlust von 1 dB bei einem tiefen Spiegel bedeuten, was ein gutes Feed in ein mittelmäßiges verwandelt. Folglich sollten wir Anhang B benutzen für das Phasenzentrum für die jeweilige Kombination, gefolgt wieder von Messungen des Sonnenrauschens für die endgültige Justierung.

Zusammenfassung

Die Testergebnisse im Anhang A sind sehr ermutigend. Die Messungen von WD5AGO sind völlig unabhängig von den Simulationen von W1GHZ, die vergleichbaren Ergebnisse sind übereinstimmend. Die Effektivität, die aus Messungen des Sonnenrauschens erhalten wurde, liegt in allen Fällen 12 bis 14% niedriger als die Effektivität in den Simulationen. Frühere Antennentests haben gezeigt, dass die Effektivität in der Realität für kleine Spiegel um 15% niedriger als in Simulationen liegt. Folglich können wir annehmen, dass die Messungen die Simulationsergebnisse bestätigen.

Wir haben einige verbesserte Abmessungen für die VE4MA-Feedhörner entdeckt, die verbesserte Performance bringen. Gemessene Effektivitäten von 65% übertreffen jegliche bisherigen Ergebnisse für Primärfokus-Spiegel im Amateurbereich, genauso wie die meisten kommerziellen Ergebnisse. Die gerechneten Effektivitäten liegen nur etwa 1 dB unterhalb eines perfekten Wertes, so dass es schwer vorstellbar ist, dass noch signifikante deutliche Verbesserungen möglich sind.

Alle Ergebnisse für die Variationen des VE4MA-Feeds sind in Anhang B aufgelistet, um die Verwendung verfügbarer Materialen und die Optimierung für einen speziellen Spiegel zu ermöglichen. Eine Anzahl von Amateuren hat diese Feeds mit guten Ergebnissen nachgebaut. Aus den Ergebnissen können wir folgende Schlüsse ziehen:

- Das originale VE4MA-Feedhorn liefert gute Effektivität über einen weiten *f*/D-Bereich des Spiegels.
- Eine größere Version des VE4MA-Feeds, die wir "Super-VE4MA" nennen, liefert exzellente Effektivität, und zwar die höchste heutzutage für einen Primärfokus-Spiegel, aber über einen kleineren ***f*/D**-Bereich.
- Kleinere Versionen des VE4MA-Feed arbeiten so gut wie das Original über einen weiten Bereich unterschiedlicher Ring-Dimensionen und bringen weniger Blockierung bei sehr kleinen Spiegeln.
- Die Einkopplungssonde ist nicht Teil der Antenne. Sie könnte 100m entfernt am Ende der Speiseleitung sein. Der Verlust würde wohl die abgestrahlte Leistung reduzieren, aber nicht das Strahlungsdiagramm der Antenne verändern.

Wenn man ein Feed hat, das gut arbeitet und gute Resultate bringt, gibt es keine Veranlassung es zu wechseln. Wenn man aber der Meinung ist, das ein besseres Feed helfen könnte, oder man noch gar kein Feed besitzt uns sich im Entscheidungsprozess befindet, dann könnte eines der hier beschriebenen verbesserten Feeds eine gute Wahl sein. Bei EME, wo jedes dB wirklich zählt, sollte man diese verbesserten Feeds wirklich in Betracht ziehen. Das wichtigste ist aber nach wie vor, überhaupt ein Feed in den Spiegel zu bauen und qrv zu werden!

Referenzen

Siehe englischer Text oben.

- Anhang A: siehe engl. Text oben

Zirkular polarisiertes Feedhorn - Messwerte

Tommy Henderson WD5AGO

Hier haben wir einen Vergleich diverser zirkular polarisierter Feeds für 13cm: Alle skalaren Choke-Ringe wurden für bestes **G/T** für einen 2.4m, 0.37 ***f*/D** Spiegel (20λ Durchmesser bei 13cm) justiert. Blockierung des Feed war kein großer Faktor im **G/T** wie aus der Tabelle ersichtlich. Um Blockierung, die den Gewinn kleiner Spiegel herabsetzt, zu vermeiden, wurde ein skalarer 3er-Ring mit engerem Abstand, mit Ringen in 0.15λ-Abstand, produziert. Wie aus den Daten von W1GHZ ersichtlich, würde ein 0.2λ-Abstand weitere 1% an Effektivität erbringen, und diese dann bei 62% liegen, was immer noch 2% bis 3% down unter dem Super-VE4MA mit einem großen Ring liegt. Alle 3-Ring-Versionen erbrachten EME-Echos von 2-3 dB über dem Rauschen mit einem 35 K Frontend.

Tabelle: Durch Sonnenrauschen gemessene Spiegel-Effektivität

- Anhang B: siehe engl. Text oben

Von W1GHz simulierte Daten für VE4MA Feedhörner von 0.77 und 0.71 Lambda Durchmesser mit verschiedenen Ringgrößen und Ringpositionen.

6m / 4m High Gain Dual Band Yagis

by Ljubisa Popa – Pop, YU7EF

The reason for this article and antenna design is something that the majority of us suffer from - it is always a problem with limited space for all our antennas and usually we all want to be able to operate all bands.

Since here in YU we are expecting official approval to use the 70MHz band, I have been thinking for some time how to become QRV with a decent antenna without the need to have more aluminum on my apartment building. Neighbours are already not very happy with me climbing the roof and installing my antennas, currently a Cushcraft R7 vertical and a 5 element 6m yagi.

I figured that I don't really need a very big antenna for 4m since there isn't too much activity anyway, so, some directional antenna with a few dB gain will do the job, definitely better than a vertical.

Last summer I had just built and installed my new 5 element 6m yagi (EF0605C - see http://www.yu1arc.com/yu7ef/ef0605c.htm) that works really excellently, so, while recently working on a dual band antenna for N4BAA (17m/12m) it crossed my mind I can do the same for 6m/4m and the only question was what would happen to my existing antenna performance. I didn't want to spoil this antenna by inserting 4m elements – performance had to be the same without any adjustments or changes.

As I already had some experience in designing a few HF sleeve fed antennas I started by inserting a 4 element yagi and have spent some time for adjusting the 4m antenna element positions to get low SWR on the additional antenna. At that point I didn't really think and care too much about gain and pattern – the main issue was to get reasonable SWR without changes to the original antenna. It turned out I can do it with a very nice gain, just slightly lower than a mono band yagi. Most importantly, my original antenna did not show any signs of degradation so then I decided to go for 5 elements on 4m and tried to get more gain than the initial 8dBi with 4 elements. After another few weeks of tweaking and optimization I got the result that is shown in the following pictures and diagrams.

Fig. 1: 5 plus 5 element Yagi for 6m and 4m

My antenna now has 10.2dBi free space gain on 6m - 0.1dB less compared with the original mono band yagi, and almost 9.9dBi on 4m. I consider it more than sufficient for my needs and with about 50w from my FT847 I should be able to work any station I hear. Having in mind that the antenna is installed very high, on the top of a seven story building, this should be a very good antenna. All I have to do is to prepare additional 4m elements and install them on my antenna. The original 6m antenna remains as it is, no changes required at all and I don't need additional run of coax cable downstairs to my room. Unfortunately, bad weather and my trip to Nepal has prevented me from doing it yet but definitely I will take the next opportunity to do so.

My 6m antenna was built using surplus 12mm and 10mm aluminum tubing, tapered, with dimensions as shown on the drawing. All five elements for 4m are made from from 10mm tubing. Note that the element spacing is what is essential for this antenna and it must be done with a **precision within 1mm** since the impedance on 4m is very much affected if the elements are not in the right place, particularly the 4m "driven" element.The original 6m elements were attached to the 25mm boom using clamps I had in my drawer – brought back from Bangkok when I was working there. This way it is very easy to move the elements slightly if required so I will use the same clamps for the additional 4m elements. However, any type of element clamp can be used as long as the spacing is maintained to the correct values. I would even suggest future builders should go for insulated element holders – similar to those used by the DK7ZB antennas. I didn't have something like that available and used what was to hand.

Since the driven element is a split dipole, it is necessary to install a RFC at the feed point as shown on the pictures of my antenna. I used RG58 cable but it would be better to use RG142. This will prevent common mode currents flowing over the coax shield and current imbalance on the dipole halves. As a former I used a piece of 50mm PVC pipe and the coil is made by close winding 8 turns of cable. The feedpoint itself is additionally sealed with plastic to prevent water entering the cable as it can be seen on pictures.
I am sure that this antenna will be welcomed by many hams having the same problem as I do, so I would appreciate any feedback of the results and experience, as well as pictures of built antennas.

Addendum: If one wants to use insulated elements, located above the boom, then a boom correction factor is not required. However, if one still wants to use non-insulated elements than one should add some 5-6mm to the length of the elements, EXCEPT driven element, since that one has to be insulated in any case.

Note: These new designs have not yet been tested or measured in reality. In any case it can be expected that these designs will work very well.

Reference: http://www.yu1arc.com/yu7ef

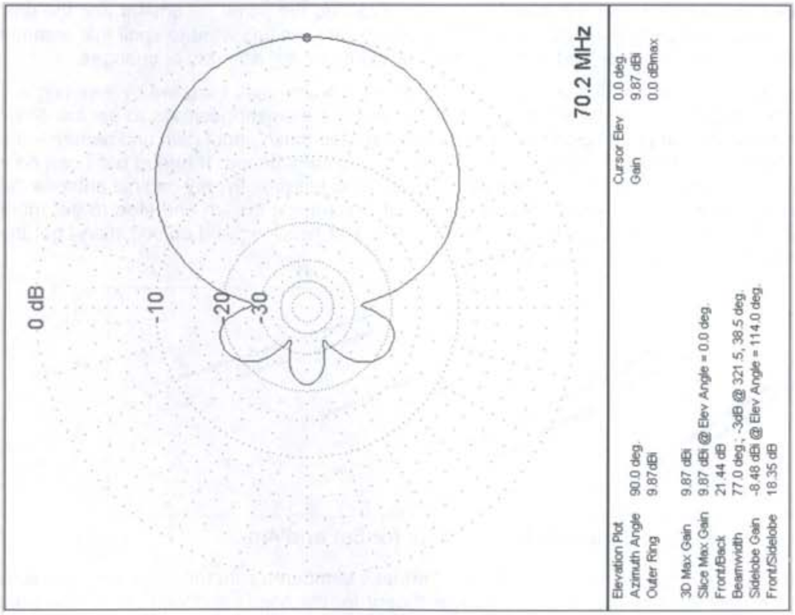

Fig. 2: 5+5 element yagi E-plane simulation 70.2 MHz

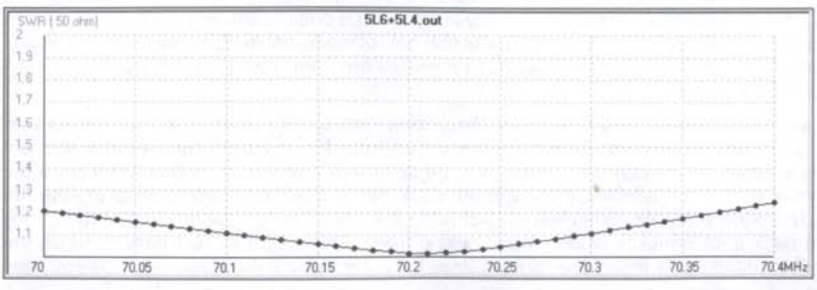

Fig. 3: SWR plot 5 + 5 element yagi for 70 MHz

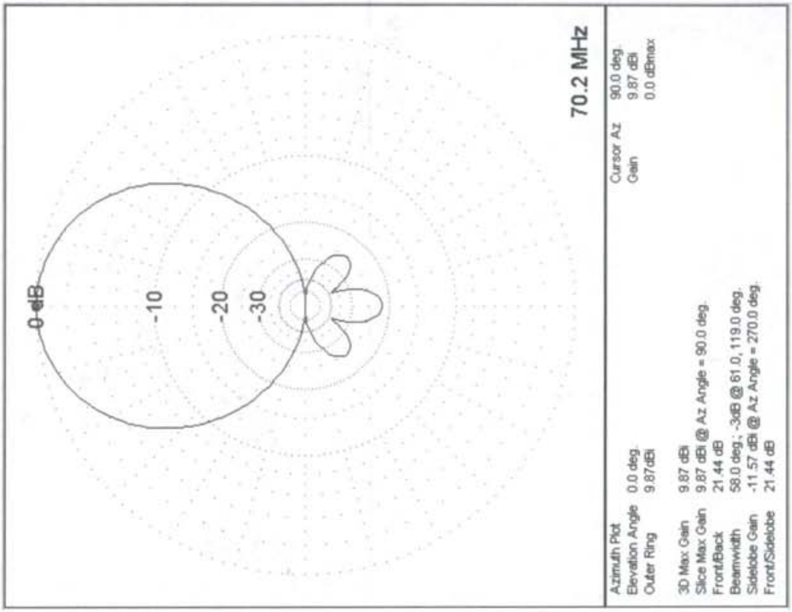

Fig. 5: 5+5 element yagi H-plane simulation 70.2 MHz

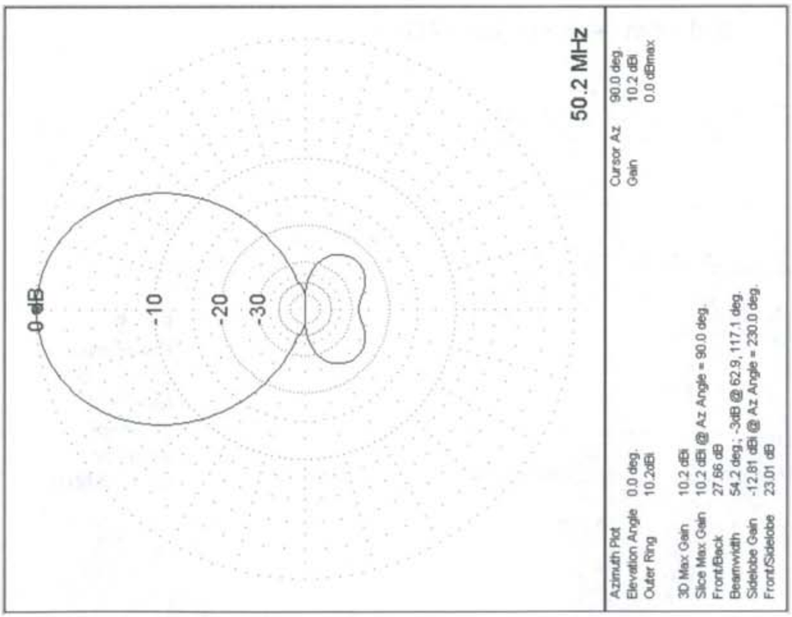

Fig. 6: 5+5 element yagi H-plane simulation 50.2 MHz

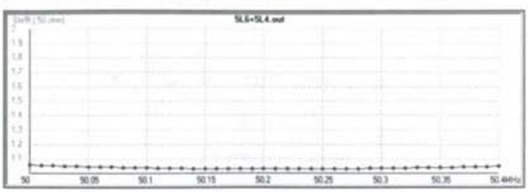

Fig. 7: SWR plot 5 + 5 element yagi for 50 MHz

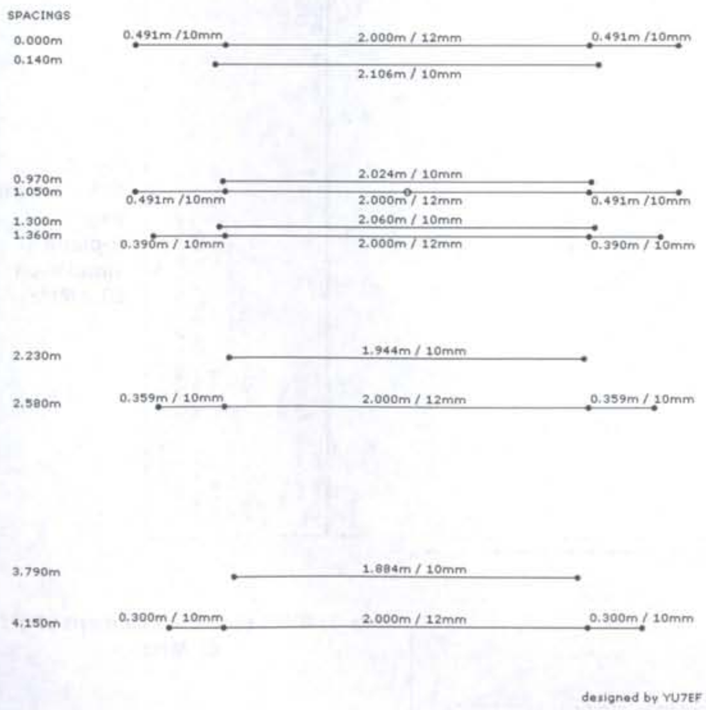

Fig. 9: Freespace dimensions for 5 + 5 element yagi for 50 + 70 MHz

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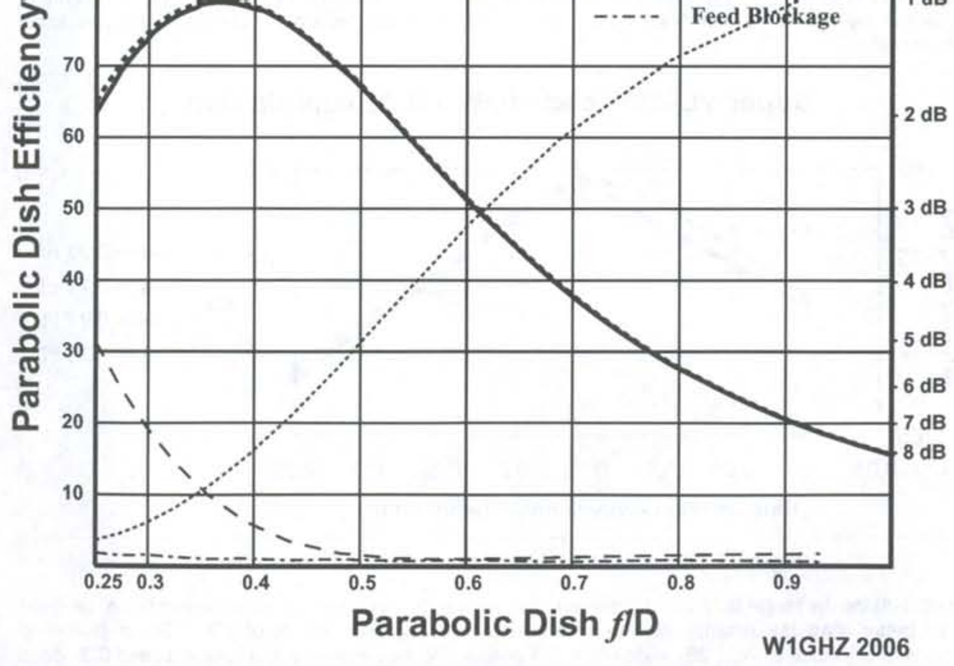


Figure 7

Furthermore a really long antenna has been designed that contains 7 elements on 6m and 8 elements on 4m on a 9m boom. In practice the dimensions have to be adhered to t very accurately.

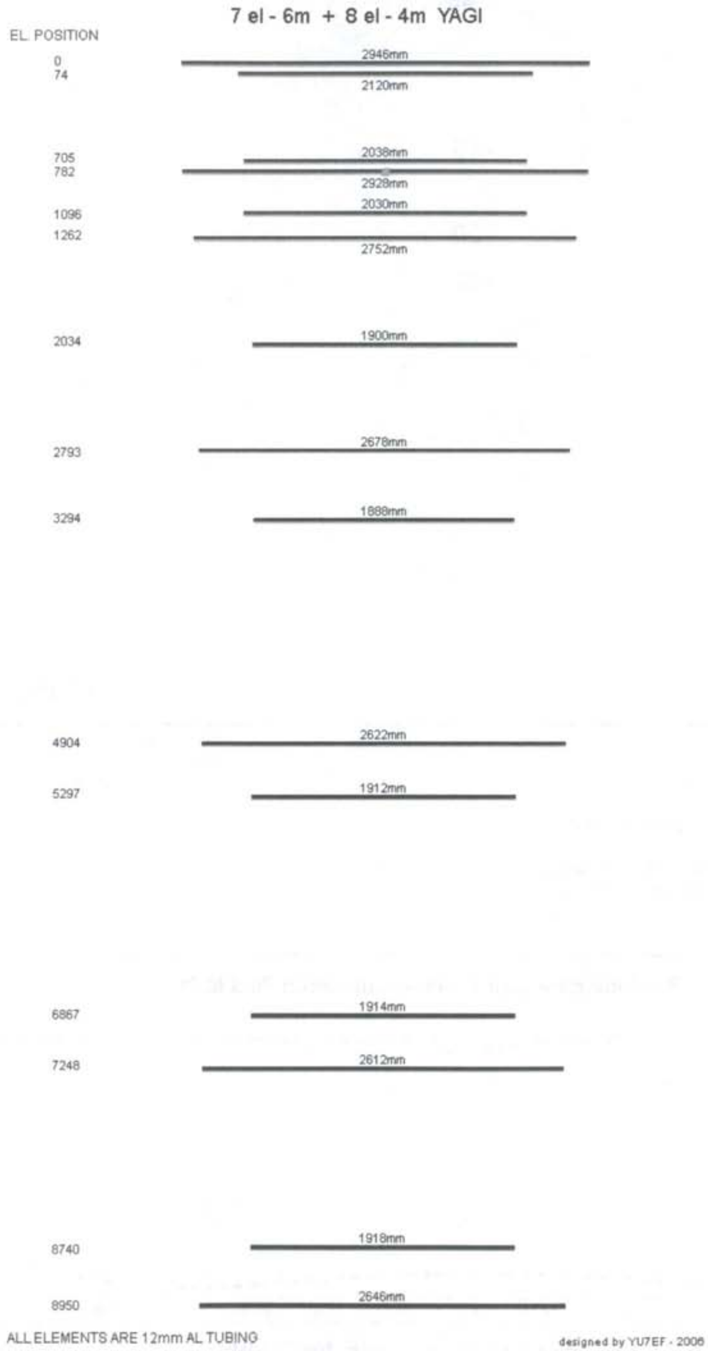


Fig. 10: Freespace dimensions for 7 + 8 element yagi for 50 + 70 MHz

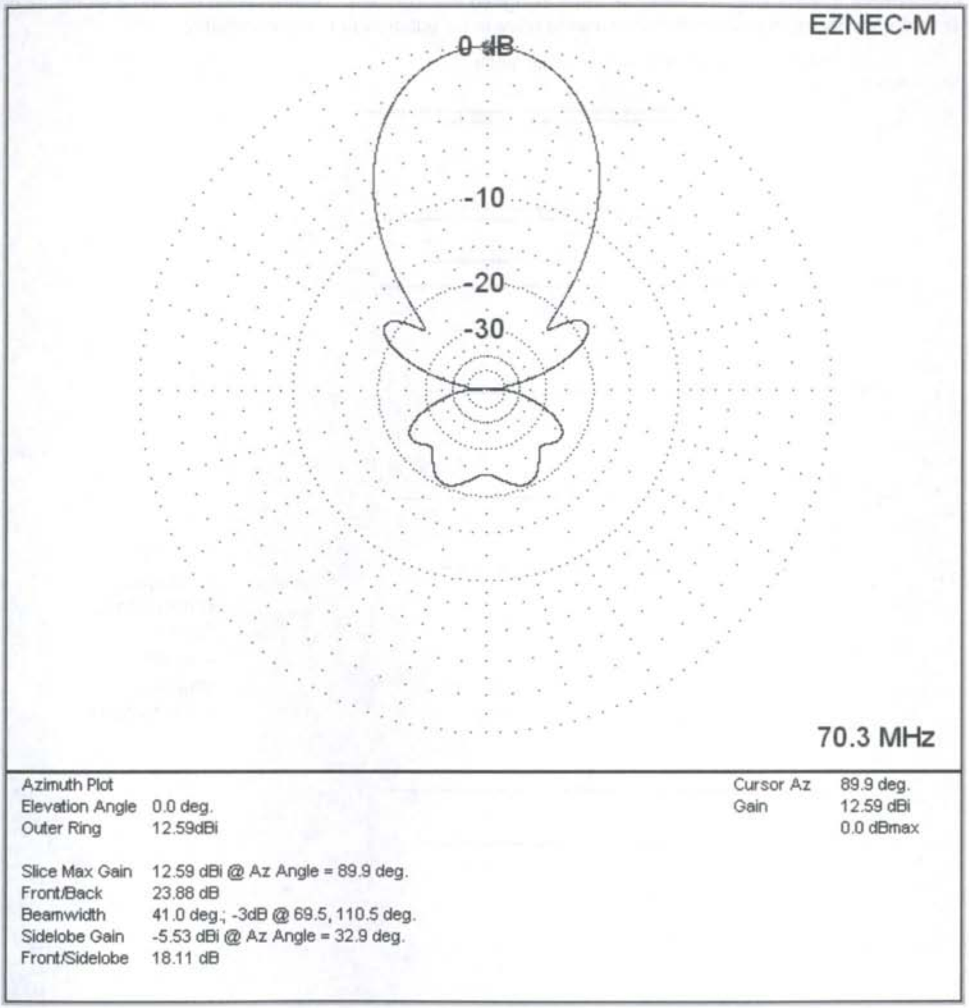


Fig. 11: 7 + 8 element yagi H-plane simulation 70.3 MHz

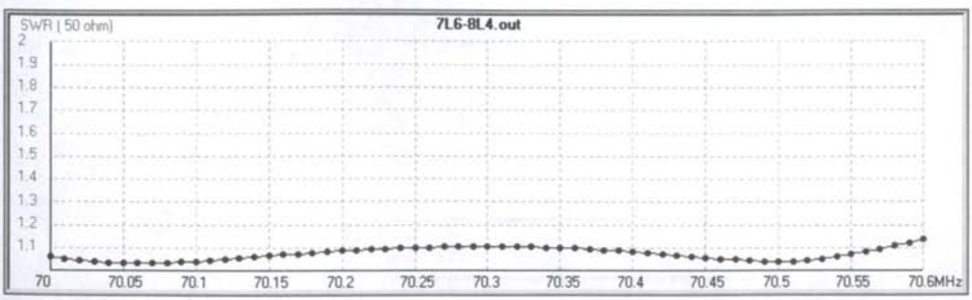


Fig. 12: SWR plot 7 + 8 element yagi for 70 MHz

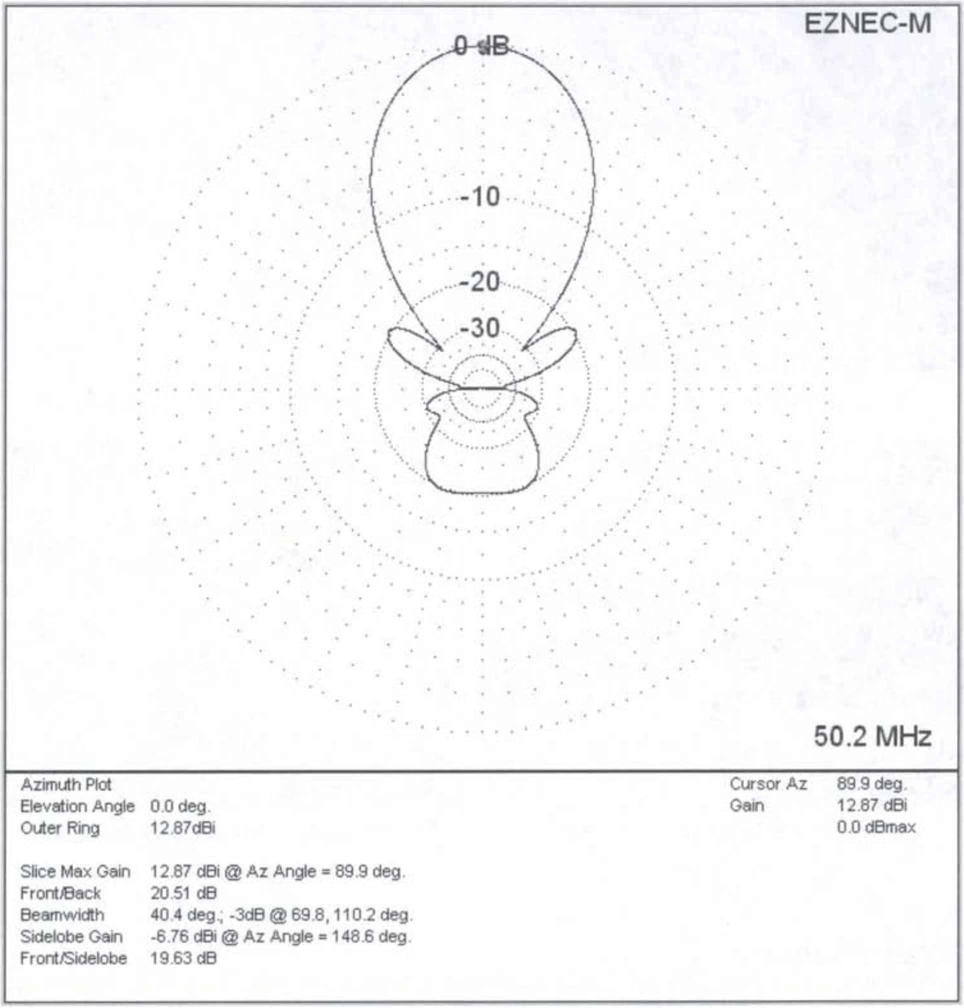


Fig. 13: 7 + 8 element yagi H-plane simulation 50.2 MHz

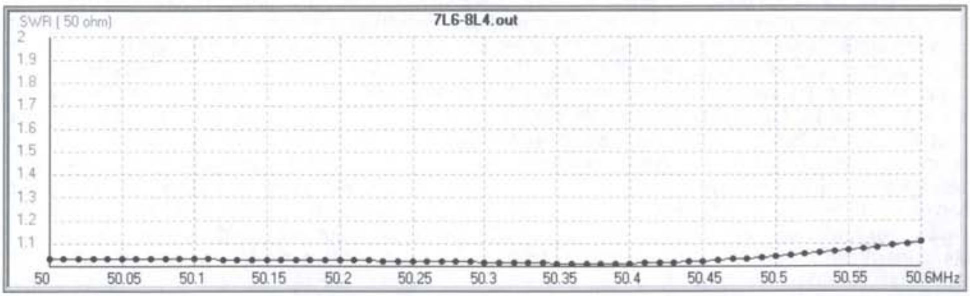


Fig. 14: SWR plot 7 + 8 element yagi for 50 MHz

Fig. 15: Element holder at YU7EF

Fig. 16: A solution for the driven element

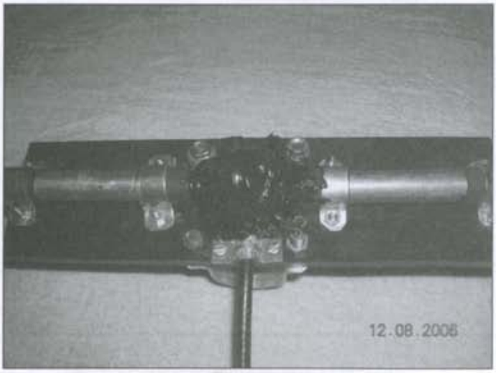


Fig. 17: Sealed driven element

Fig. 18: Driven element with RF choke

Deutsche Kurzfassung:

YU7EF hat Kombi-Yagis für das 4m und 6m-Band neu designt und simuliert: Eine 5 + 5 Element yagi, 4.15m lang und eine 7 + 8 Element yagi, 9m lang. Die Antennen zeichnen sich dadurch aus, dass der Gewinn nahezu dem von Monobandyagis entspricht (ca. 0.1 dB weniger) und das SWR für beide Bänder hervorragend ist. Wichtig ist, dass die Abmessungen auf 1mm genau eingehalten werden! Bei isolierter Montage der Elemente über dem Boom brauchen die Abmessungen nicht korrigiert werden. Andernfalls muss eine Boomkorrektur vorgenommen werden. Bei unisolierter Montage müssen 5-6mm bei jedem Element addiert werden. Der Dipol muss auf jeden Fall isoliert montiert werden. Die Antennen sind für 25mm Boomdurchmesser gerechnet und die Elemente sind aus Alurohr von 12 bzw. 10mm Durchmesser, Siehe Abb. 9 und 10 für die genauen Abmessungen. Eine Ausführungsmöglichkeit für den Dipol zeigen die Abb. 16 bis 18. Eine HF-Drossel wurde durch 8 Windungen des Koaxkabels mit 50mm Durchmesser (hier RG 58) realisiert, um Mantelwellen zu unterdrücken). Mehr zu den Antennen von YU7EF, der Boomkorrektur u.a. gibt es im Web in englischer Sprache unter: http://www.yu1arc.com/yu7ef. Hinweis: Diese Kombi-Yagis sind bisher noch nicht in der Praxis getestet und gemessen worden. Aufgrund der hervorragenden bisherigen Ergebnisse und der Designerfahrung des Autors, ist aber davon auszugehen, dass diese Antennen funktionieren werden. Der Autor würde sich über Rückmeldungen von OM freuen, die seine Antennen nachbauen. Eine kommerzielle Nutzung seiner Designs ist nicht erlaubt. Grund für das Vorstellen dieser Yagis ist, dass das 4m-Band nun in vielen Ländern in Europa für den Amateurfunk nutzbar ist und viele 6m-OPs, die keinen Platz für eine zweite Yagi haben, damit auf beiden Bändern qrv werden können. (CT1HZE)

Fixing Marconi 'TFT' power heads

by Paul Marsh, M0EYT

As many of you will know, the old Marconi 6460 'TFT' power meters are pretty popular, you often see them on eBay for a reasonable price, but the power heads can be in an unknown condition. I purchased one on eBay along with a 100mW head, and it seems to work fine over its DC to 12GHz frequency range. Naturally, I've been keeping my eyes open for other power heads, but these seem rare, so I turned to broken power heads with a view to fixing them. I'll describe where I am to date, and what I've been able to fix. In a nutshell, the 6240 and 6421 type heads seem fixable. The higher frequency variants like the 6440N types have so far not been fixed. "TFT" incidentally is an acronym from General Microwave Corporation meaning "thin film thermoelectric". It is also worth reading www.freepatentsonline.com/3694746.pdf . The principle of operation of this type of power head is that of a thermo-electric calorimeter using bismuth and nichrome thermocouples.

Fig. 1: A typical Marconi TFT power head

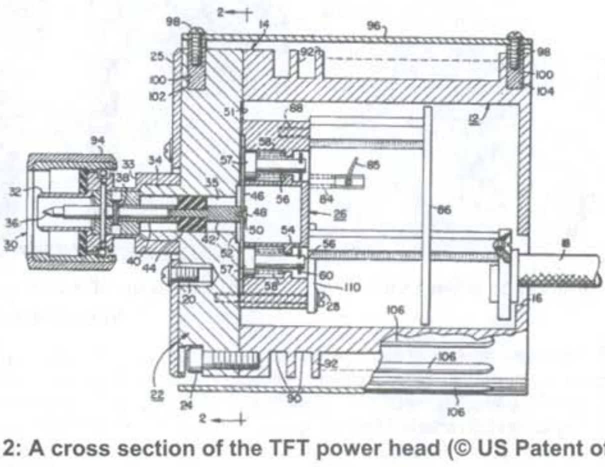


Fig. 2: A cross section of the TFT power head (© US Patent office)

What goes wrong?

There is a simple answer to this: "POWER" The reason for failure in the majority of power heads is that they are simply given too much RF power, which causes the bismuth and nichrome thermocouple structures to break down or evaporate.

The Marconi power heads are well constructed and the power detection element is sandwiched between two lumps of aluminium – this is for thermal dissipation reasons, as well as physical protection. Out of the numerous power elements that I have seen, not one has shown signs of damage due to physical shocks, such as a drop.

The photo below (Fig. 3a) shows a sensor element from a 100mW power head that has been exposed to too much RF. On the right Fig 3b "**Fig 3**" (© US Patent office) shows the sensor as described in the US patent first issued in 1970!. The sensor element is fitted such that the centre pin of the N type connector is connected to the centre of the element (72 in Fig 3b). This is done with a tiny screw and washer. You can clearly see that the tracks have literally evaporated due to high power RF exposure. Either side of the centre pin are two large areas of conductive material (70 and 71 in Fig 3b), used for the capacitive coupling of the RF to ground, whilst providing a DC return to the meter unit (81 and 82 in Fig 3b). Usually the resistance across the two DC contacts should be somewhere between about 150R and 250R for a working power head. The resistance of the sample in the photo below was 'open circuit', therefore not useable as a power detector. A handy check on 'rally' power heads would be to use a multi meter to check for this value. The power sensors cannot fail short, so if this condition is seen, it is most probably due to dodgy wiring in the plug or power sensor body.

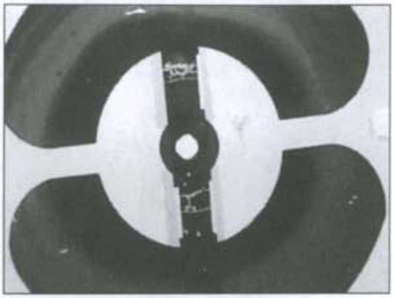


Fig. 3a: Power sensor element of a TFT head

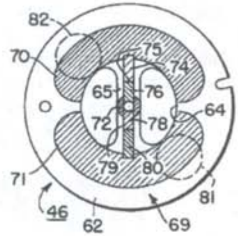


FIG. 3

Fig. 3b: "Fig. 3"

Type 6440N heads

The 6440N power heads I have all suffered from too much RF power, and sub sequentially the material has been evaporated off the sensor element.

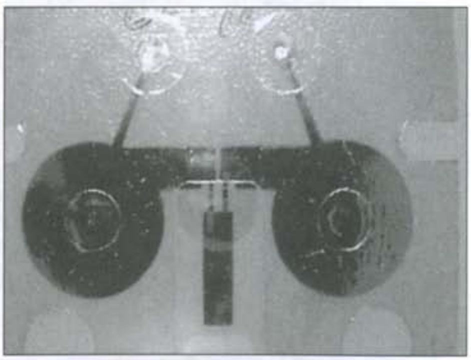


Fig. 4: Damaged 6440N type power sensor

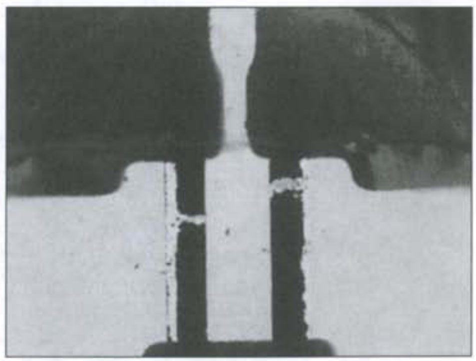


Fig. 5: Close up of a damaged 6440N TFT power sensor

What this picture shows is the element from one of the higher frequency power sensors. To the bottom is the RF input which rests on some 50ohm track from the N connector. The input track is 2mm across, which gives you some idea of the small scale that we're working with. Either side of the input are the DC take off points that feed the meter. This whole assembly is sandwiched in an aluminium block with spring loaded DC contacts. The power sensor is covered by a mica or plastic insulation piece with holes cut in it to allow the contacts to be made for RF and DC. A higher magnification picture is shown below and you can clearly see that the tracks in the thermocouples are completely open circuit; in fact the material has evaporated. In this case, it may be possible to fix these as they are not right on the actual thermocouple junction. The main problem is that the tracks are 0.25mm wide and as such extremely fiddly to work with.

Type 6240 and 6421 heads

The 6240 and 6421 heads are 10mW and 100mW power handling. The majority of ones that I have seen have had failures that are fixable. For some reason the tracks always seem to break where they either contact the large surface area capacitive pad or at the RF input pad, and therefore are fixable.

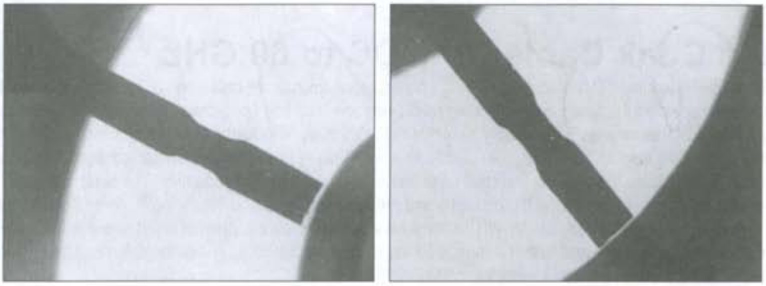


Fig. 6 a and b

The two pictures (Fig. 6 a and b) above show the failure points – both are clean breaks and fixable. In this example, the power sensor is of the 10mW variety. Only one sample of a power head had its sensor elements completely vaporised due to a massive amount of RF power, but most exhibit the clean break type of failure.

Fixing the heads

A simple way to fix the power heads is to use something like silver loaded glue, or 'magic PCB fixer' available from eBay – its basically silver paint. First this was tested to establish its resistance when dry; a short line about 5mm long was painted onto a piece of plastic. It was then left to dry over night and the following day; it was tested with an ohm meter. The result was less than 0.1 ohms; therefore it's quite suitable for fixing the power sensor elements. The power sensor element looks like it's made by spraying or otherwise depositing layers of conductive material on thin mica like substrate, the layers are built up resulting in a thermocouple type of device which generates voltage when heated by RF.

The method for fixing the power sensors is first to make an assessment of how damaged the power sensor element is. You have to carefully remove the power sensing element from the housing first – be very careful undoing the centre screw in the 642x type heads – its easy to slip and shove the screwdriver through the mica!

Generally if the break is small and clean, it's possible to fix the head with the conductive silver paint. If most of the power sensing element has evaporated, then there is probably not enough of the thermocouple left to make a useable sensor. If there are just 'cracks' or gaps at the extreme ends of the sensor elements, then it should be possible to fix with silver paint. Ideally this needs to be done under a microscope in order to accurately place the paint. Once applied, leave the sensor element in a warm place overnight, somewhere like an airing cupboard is ideal. You can do a quick sanity check with a multi-meter once the paint has been applied, to make sure you have the right resistance across the DC take off pads. For my fixes, I used both a stereo microscope and an Intel kids PC microscope belonging to (me) my son...

So far, a 10mW head and a 100mW head have been successfully fixed. At the current rate, successful fixes are achieved around 33% of the time which is not bad if you can buy a 'broken' head for under a fiver. The unrecoverable heads could be used as first class housings for home made noise heads as the RF path is DC decoupled, good to 18GHz, and the case is sturdy.

Work is currently under way to see if it's possible to replace the thin film thermocouples with very small leaded variants, if this is successful, a Scatterpoint article will be generated. Another related line of work is to generate a solid state chopper circuit to replace the noisy mechanical chopper used in the Marconi 6460 meters.

Further Reading

Its well worth checking out the online patent office, and looking up **3,694,746** which is the original patent filed by General Microwave Corporation. The patent gives an excellent overview of how the power sensors work, along with some detailed diagrams which helps in understanding the thinking behind the design. Colour pictures of those power head sensors mentioned in this article are online at http://www.uhf-satcom.com/tft

Thanks to Steve G4KNZ, Peter G3LRP, Geoff G7RMG for providing broken power heads for use in this investigation.

New Products / Microwave Parts

Flexible Coax Cable from DC to 60 GHz

Advanced Technical Materials (ATM) manufactures high performance microwave cable that utilizes only the very best materials, incorporating proprietary manufacturing methods, which yield very low Insertion Loss characteristics, high power capability and is Amplitude and Phase Stable on a level not readily available in the microwave industry. This product line has five different sizes of cable designed to operate from DC-60 GHz. ATM utilizes a solid, silver plated copper center conductor and Expanded PTFE dielectric material which allows for very low Insertion Loss and high power handling capability. The outer conductor is a flat, silver plated copper foil wrapped helically around the dielectric and mechanically locked to the dielectric core to promote superior phase and amplitude stability, as well as, very low VSWR performance. A silver plated copper, braided shield is then added to increase the axial tensile quality of the cable and further enhance RF leakage characteristics. The outer jacket is a tough, high temperature thermoplastic that can withstand temperatures from -65° to +200° Celsius.

All this adds up to a very superior microwave cable product that can meet the most demanding requirements. This product can be sold in bulk cable form, or as fully guaranteed cable assemblies. ATM tests all cable and assemblies 100% for Impedance, Insertion Loss and VSWR, other electrical requirements can be tested for in our well equipped Test Lab. ATM works for our customers to provide great service, excellent pricing and fast deliveries, with the highest possible quality available in the microwave cable industry.
See cable data and losses for CM 100 to CM 500 in the tables below.
Advanced Technical Materials Inc, 49 Rider Avenue, Patchogue, NY 11772,
Voice: (631) 289-0363, Fax: (631) 289-0358
Email: atm@atmmicrowave.com, URL: http://www.atmmicrowave.com

Cable Type:	**100**	**135**	**160**	**210**	**300**	**500**
Frequency Operation (GHz)	DC - 60	DC - 40	DC - 35	DC - 26.5	DC - 18	DC - 11
Size O.D. (in)	0.100	0.145	0.170	0.210	0.300	0.500
Impedance (ohms)	50	50	50	50	50	50
Dielectric Type	SPTFE	EPTFE	SPTFE	EPTFE	EPTFE	PE
Capacitance (pF/ft)	29	24	29	24	24	23
Time Delay (ns/ft)	1.4	1.2	1.4	1.2	1.2	1.15
Velocity (%)	70	84	70	84	84	85
RF Leakage	>100dB to 18 GHz	>100dB to 18 GHz 80dB to 40 GHz	>100dB to 18GHz	>100dB to 18 GHz	>100dB to 18 GHz	>100dB to 11 GHz
Cut Off Frequency (GHz)	62	46	35	33	19	11.6
Weight (lbs/100ft)	1.9	3	6.5	7	12.5	15
Min Bend Radius (in)	0.25	0.5	0.75	1.0	1.75	2
Temp Range (min/max °C)	-65°/+200°	-65°/+200°	-65° to +200° C	-65°/+200°	-65°/+200°	-65°/+120°

Please consult factory on specifications regarding phase stability of our cables.

Typical Assembly* VSWR: (All Applicable Cable Types)			
	DC - 12 GHz	1.30: 1	*Spec. includes Connectors
	DC - 18 GHz	1.35: 1	
	DC - 26.5 GHz	1.40: 1	
	DC - 40 GHz	1.45: 1	
	DC - 50 GHz	1.50: 1	
	DC - 60 GHz	1.60: 1	

Total Cable Assembly Loss:

To calculate Total Cable Assembly Loss use the following formula:

(-0.012 dB x F) x 2 = Connector Losses + Cable Loss (see table below) **= Total Cable Assembly Loss**. F = Frequency (GHz)
Example: 3 foot long CF-300 cable w/SMA Connectors @ 18 GHz: Model#: CF-300-36-SM-SM:
(0.012 x 18) x 2 = 0.432dB [Connector Loss] + 0.20dB/foot x 3 = 0.60 [Cable Loss] = **[Total Cable Assembly Loss] = -1.032dB**

Mikrowellenkabel als Rohkabel oder konfektionierte Kabelarmaturen von DC bis 60 GHz

Die flexiblen Mikrowellenkabel von ATM gibt es für Frequenzen bis 35 GHz (CF-160-Serie) bzw. bis 60 GHz (CF-100-Serie). Beiden Baureihen haben geringe Verluste sowie Amplituden- und Phasenstabilität.

Erhältlich sind sowohl Rohkabel als auch konfektionierte Kabelarmaturen mit nahezu allen Koaxialanschlusstypen. Es ist dabei selbstverständlich, dass jedes einzelne Kabel hinsichtlich Impedanz, Einfügedämpfung und VSWR getestet wird. Neben der kommerziellen Variante sind die Kabel auch in militärischer Ausführung verfügbar.
Info/Bezug für DL/EU: Tactron Elektronik Schmidt-Fürst oHG, Bunsenstr. 5/II, 82152 Martinsried, Tel: 089-895 56 90, Fax: 089-857 76 05, e-Mail: info@tactron.de

Loss values below are for Cable only. For Total Cable Assembly Loss, see above.						
Cable Type:	**100**	**135**	**160**	**210**	**300**	**500**
@ Frequency:	**Insertion Loss (dB/100ft)**					
2 GHz	29	20	20	11	6	4
4 GHz	43	26	27	16	9	6
6 GHz	54	31	32	20	11	8
8 GHz	63	36	37	23	13	10
10 GHz	72	40	42	26	15	11
12 GHz	81	44	48	28	17	
14 GHz	88	47	54	31	19	
16 GHz	96	50	60	33	20	
18 GHz	103	53	64	36	22	
20 GHz	110	56	68	38		
22 GHz	117	59	72	39		
24 GHz	124	62	77	42		
26 GHz	130	64	82	44		
28 GHz	136	67	88			
30 GHz	142	69	92			
32 GHz	148	71	97			
34 GHz	154	74	104			
36 GHz	160	76				
38 GHz	166	78				
40 GHz	172	80				
50 GHz	199					
60 GHz	225					

Average Power						
Cable Type:	**100**	**135**	**160**	**210**	**300**	**500**
@ Frequency:	**Avg. Power (W)**					
1.0 GHz	375	540	625	800	1900	2500
2.0 GHz	250	400	435	600	1400	1600
3.0 GHz	150	300	330	475	1100	1200
6.0 GHz	100	210	225	320	650	700
12.0 GHz	70	160	175	210	520	550 to 11GHz
18.0 GHz	50	100	125	160	400	

New RF switch technology: MEMS

RF MEMS are switches with interesting features like ultra small size, low power consumption, QRG range 0 to 26 GHz up to 30W RF. There are not too many manufacturers yet. Radant MEMS and TeraVicta offer these devices already, Pnasonic, Omron and otheres have announced to follow. Here some info from TeraVicta about their MEMS. Probably these switches are quite interesting for microwave amateur radio, too....

"TeraVicta Technologies designs and manufactures MEMS (Micro Electro Mechanical Systems) switches which provide superior electrical and RF performance. TeraVicta's MEMS based switching solutions open new possibilities in both RF performance and design integration with other electronic components, which was never before possible with competing solutions.

TeraVicta RF MEMS switches combine the performance advantages of electromechanical relays with the manufacturability advantages of solid state switches. MEMS switches provide the ultra-low losses, high isolation, and high linearity of relays, but with the significant size, power consumption, and cost advantages of high volume wafer fabricated solid state switches such as GaAs FETS and PIN diodes. MEMS switches are also unique in that they are broadband (meaning they can operate over a wide frequency range). The unique attributes of TeraVicta's RF MEMS switch significantly increase the battery life and/or range of any radio, including cell phones, wireless LANs, and PDAs.

TeraVicta's switch is an electrostatically actuated cantilever-beam which consists of a metal beam suspended above a control electrode (gate) and a signal electrode (source). The base of the beam is anchored to the source and the free standing tip of the beam is suspended above a third electrode (drain). When a sufficiently large voltage is applied to the gate relative to the source, the resultant electrostatic force pulls the beam toward the drain until the signal tip and the drain contacts come together. At that point, the switch is closed and a signal path is formed through the beam from the source to the drain Because the actuation is electrostatic, no quiescent current is required to maintain closure, leading to an ultra low power device."

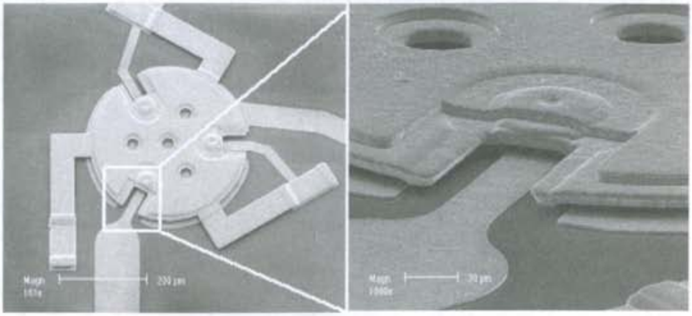


Fig.: MEMS - High Force Disk Actuator

TT712-68CSP

SPDT 7GHz RF MEMS switch

- Wide Frequency Range: DC to 7GHz
- High Isolation: 35dB @ 1GHz
- High Linearity: IP3 > 65dBm
- Low Insertion Loss: < 0.1dB @ 1GHz
- Low Power Consumption: < 3mW (3V)
- Switching Speed: < 100µs
- Peak RF Power: 30W
- Life Cycle Reliability: > 100 million
- Ultra Small Size: 3.25mm x 4.5mm x 1.25mm in CSP-12

TeraVicta Technologies, Inc., 2535 Brockton Drive, Austin, Texas 78758-4411, U.S.A.
Phone +1-512-684-8700, Fax +1-512-684-8701, http://www.teravicta.com

New 10 GHz Outdoor Transverters from BTV

For the microwave bands, the availability of reasonably-priced equipment is highly limited, and experts having access to microwave test equipment are also rare. The situation is not significantly affected even by the top-notch products and kits by DB6NT. Before one can reach for a key or a microphone to start at a microwave band, there are still many obstacles to overcome. The BTV company, OK2's ER, MMO, VLT and BNG decided to resolve this microwave dilemma. They have created and are marketing a set of microwave outdoor transverters integrated with antennas (OTA). These new outdoor transverter/antennas (OTAs) utilize 30 or 60-cm parabolic antennas, the hardware comes factory-adjusted and fully tested. By simply connecting this OTA with one's UHF TRX via a "reasonably" long (tens of meters) coaxial cable, even technical laymen can easily start operating at microwave bands. The authors are sure that their new OTAs will allow many radio amateur contest enthusiasts to operate from their "fire-places" provided they are located at a suitable QTH. The new OTA design is expected to substatially improve the availability of microwave technology, to expand radio-amateur activities into "higher" bands. By this contribution, microwave activities will become more common even beyond the annual contests. Available are: Microwapp HR10A (EIRP = 800 W) and HR10B (EIRP = 8 kW).

For more info contact: B PLUS TV a.s., Pozarnicka 140, 742 83 Klimkovice, Czech Republik, Phone (+420) 556 420 360, e-mail: kotala@btv.cz
web: www.btv.cz. http://www.btv.cz/en/enindex.php ?id=m5/ transvertor10GHz#s .

RFMD

RF2878

**3V LOW NOISE AMPLIFIER/
3V PA DRIVER AMPLIFIER**

RoHS Compliant & Pb-Free Product

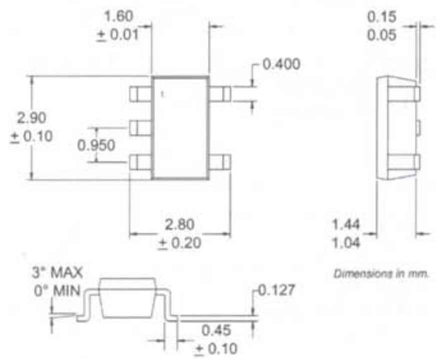
Typical Applications

- TDMA/CDMA/FM Cellular PCS LNA
- Low Noise Transmit Driver Amplifier
- General Purpose Amplification
- Commercial and Consumer Systems

Product Description

The RF2878 is a low noise amplifier with a very high dynamic range designed for digital cellular applications. The device functions as an outstanding front end low noise amplifier or power amplifier driver amplifier in the transmit chain of digital subscriber units where low transmit noise power is a concern. When used as an LNA, the bias current can be set externally. When used as a PA driver, the IC can operate directly from a single cell Li-ion battery and includes a power down feature that can be used to completely turn off the device. The IC is featured in a standard SOT 5-lead plastic package.

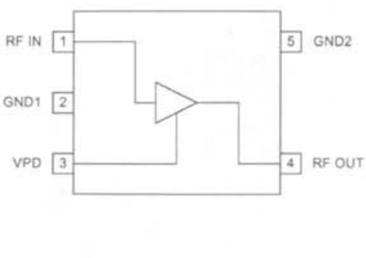
NOTE: The RF2878 is a Pb-free product. If a non-Pb-free product with the same functionality and package is desired, please see the RF2361.



Package Style: SOT 5-Lead

Optimum Technology Matching® Applied

- [ ] Si BJT
- [x] GaAs HBT
- [ ] GaAs MESFET
- [ ] Si Bi-CMOS
- [ ] SiGe HBT
- [ ] Si CMOS
- [ ] InGaP/HBT
- [ ] GaN HEMT
- [ ] SiGe Bi-CMOS



Functional Block Diagram

Features

- Low Noise and High Intercept Point
- Adjustable Bias Current
- Power Down Control
- Single 2.5V to 6.0V Power Supply
- 150MHz to 2500MHz Operation
- Extremely Small SOT 5-Lead Package

Ordering Information

RF2878	3V Low Noise Amplifier/ 3V PA Driver Amplifier
RF2878 PCBA-D	Fully Assembled Evaluation Board (Driver)
RF2878 PCBA-L	Fully Assembled Evaluation Board (LNA)

RF Micro Devices, Inc.
7628 Thorndike Road
Greensboro, NC 27409, USA

Tel (336) 664 1233
Fax (336) 664 0454
http://www.rfmd.com

RF2878

Absolute Maximum Ratings

Parameter	Rating	Unit
Supply Voltage, V_{CC}	-0.5 to +8.0	V_{DC}
Power Down Voltage, V_{PD}	$\leq V_{CC}$	V_{DC}
Input RF Level	+10	dBm
Operating Ambient Temperature	-40 to +85	°C
Storage Temperature	-40 to +150	°C

Caution! ESD sensitive device.

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Overall					
RF Frequency Range		150 to 2500		MHz	
Low Noise Amplifier 881 MHz Performance					Schematic per LNA Application; T=25°C, RF=881MHz, V_{PD}=2.8V, R1=1kΩ
Gain	19.5	20		dB	V_{CC}=3.0V, I_{CC}=7.6mA
	19.5	20		dB	V_{CC}=2.7V, I_{CC}=7.5mA
Noise Figure		1.4	1.6	dB	V_{CC}=3.0V, I_{CC}=7.6mA
		1.4	1.6	dB	V_{CC}=2.7V, I_{CC}=7.5mA
Input IP3		+6.0		dBm	V_{CC}=3.0V, I_{CC}=7.6mA
		+5.5		dBm	V_{CC}=2.7V, I_{CC}=7.5mA
Low Noise Amplifier 1950 MHz Performance					Schematic per LNA Application; T=25°C, RF=1950MHz, V_{PD}=2.8V, R1=1kΩ
Gain	12.5	13		dB	V_{CC}=3.0V, I_{CC}=6.4mA
	12.5	13		dB	V_{CC}=2.7V, I_{CC}=6.3mA
Noise Figure		1.3	1.5	dB	V_{CC}=3.0V, I_{CC}=6.4mA
		1.3	1.5	dB	V_{CC}=2.7V, I_{CC}=6.3mA
Input IP3		+16.5		dBm	V_{CC}=3.0V, I_{CC}=6.4mA
		+16.0		dBm	V_{CC}=2.7V, I_{CC}=6.3mA
Driver Amplifier 836 MHz Performance					Schematic per Driver Amplifier Application; T=25°C, RF=836MHz, V_{PD}=2.8V
Gain	19.5	20.5	21.5	dB	V_{CC}=3.5V
	19.5	20.5	21.5	dB	V_{CC}=3.0V
	19.5	20.5	21.5	dB	V_{CC}=2.7V
Output IP3	25	+32.0	35	dBm	V_{CC}=3.5V
		+29.0		dBm	V_{CC}=3.0V
		+27.8		dBm	V_{CC}=2.7V
Noise Figure		1.9	2.0	dB	V_{CC}=3.5V
		1.85	2.0	dB	V_{CC}=3.0V
		1.8	2.0	dB	V_{CC}=2.7V
Reverse Isolation		25		dB	V_{CC}=3.5V
		25		dB	V_{CC}=3.0V
		25		dB	V_{CC}=2.7V
Input VSWR		1.8:1	2.0:1		
Output VSWR		1.25:1	2.0:1		Using External LC network used on evaluation board.
P_{1dB}	13	14.4		dBm	V_{CC}=3.5V
	12	12.5		dBm	V_{CC}=3.0V
	10.5	11.5		dBm	V_{CC}=2.7V

Note: Municom offers the RF2878 for less than 4 Euro for low quantities.
Municom GmbH, Fuchsgrube 4, 83278 Traunstein, Germany. Tel.: +49 (0) 861 / 1 66 77 – 0, Telefax: +49 (0) 861 / 1 66 77 – 88, E-Mail: info@municom.de, Internet: www.municom.de

Microwave USA

Editor: Kent Britain, WA5VJB
WA5VJB@flash.neet

Lately I have been doing quite a bit of work with Vivaldi antennas from 1 to 30 GHz.

The Vivaldi antenna is an extension of the V antenna. As you make the V longer and longer, the gain improves. If you want to use the V antenna over a wider range of frequencies, there is an advantage to making the V as two Exponential Curves.

When you make the Exponential Curve out of two sheets of metal the curves can be feed 1/4 wave from a back short. This works well but only over a narrow range of frequencies. It has been found that making the back short a circle results in a very broad frequency response.

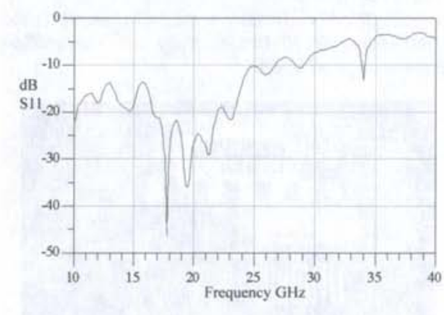


Fig.: Return Loss – coaxial feed

These antennas have been made on .20 mm Fiberglas board. Board this thin is normally only used as inter layer material for multilayer PC Boards. Using material this thin keeps the dielectric loss to a minimum. If the antennas were made on a Duroid type material they would be too fragile for any practical use.

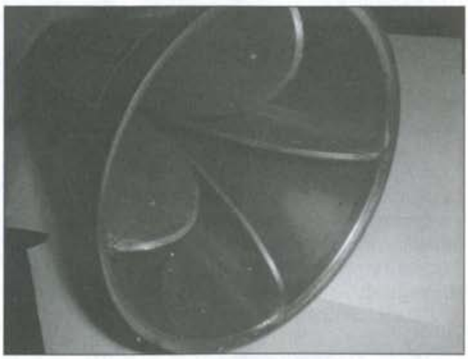


Fig.: Ridged Horn

I like to think of the Vivaldi as a Ridged Horn antenna, then just take away the horn. The antennas are very broad with a -20 dB Return Loss from 9 GHz to just over 24 GHz. And while the antennas have a poor Return Loss below 9 GHz, they do have forward gain down to 3 GHz. At 10 GHz forward gain is almost 10 dBi, we have not gain tested the antennas at 24 GHz as yet, but gain should be near 10 dBi. at 24 GHz.

Next I need to get about 500 more of these boards made.

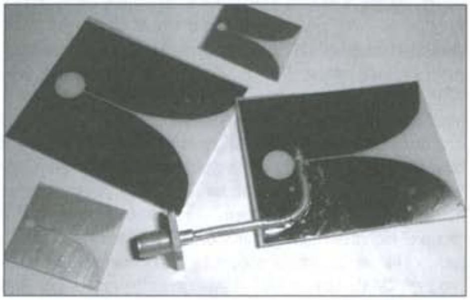
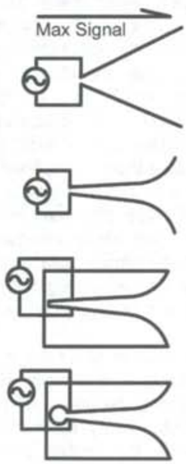
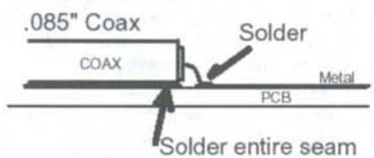


Fig.: Vivaldi Antenna for 10 to 25 GHz





Antennas will be available for about 5 €.
For more information check:
www.WA5VJB.com

ATV News

Bernd Beckmann, OE5BDO / DJ9PE
e-mail: Bernd.beckmann@gmx.net

24 GHz ATV in densely built areas

A QSO on the higher microwave frequency requires normally free propagation possibilities (quasi-optical view) between the stations. This possibility hardly is available in a large city, especially not at all if no free and high antennas are available. Another difficulty are the substantial higher requirements for the transmission of a ATV signal in relation to the narrow band modes. Nevertheless DJ9PE and DC6WU experiment with ATV in Munich/Bavaria a town with over a million of inhabitants, already for five years on 24 GHz.

The distance between both stations is 13.1 km. The path runs diagonally across the city with a typical structure of a large city with multistorey buildings, industrial areas, housing estates and green areas between them. An additional problem is a group of high trees at a distance of 100 m in front of DJ9PE´s dish. The terrain profile shown by a commercial computer program that takes land development, vegetation and geological formations into account resulted in a number of high objects and thus no free line of sight is possible between the 2 stations. DJ9PE transmits with 0.6 watts and recently with 4 watts on 24.220 GHz with a 0,48 m dish from the 8th floor of a house. DC6WU receives the signal with a 0,60 m dish on his balcony on the 4th floor and transmitts the received picture back on 10 GHz to DJ9PE for monitoring. By this way naturally also 24 / 10 GHz duplex QSOs are possible.

In the meantime nearly hundred QSO were accomplished each season and they show a completely non-uniform result. There were days with constant B5 signals for hours, others with very fast B0-B5 QSB, other ones with weak pictures and finally also ones with hardly ascertainable signals. The recording of the meteorological data so far brought no clear results about the involved propagation.However a relative large influence of the air layers over a large city may be assumed.

Since the kind of structure of the city is not homogeneous, consisting from buildings and roads which store thermal energy and also from colder areas with water, green and a small forest, probably locally ascending and dropping air masses with different temperatures and air humidities will occur, which reflect differently. This may be results in the strong QSB, which varied in very short but also very long intervals from total failure to B5. The best results brought calm weather in the evenings and nights where probably a low inversion layer over the city can develop.

The well-known water vapor absorption on 22 GHz does not have influence on the signal due to the short distance.

Anyway the fact of the possibiltiy of completing a QSO on ATV in each case over a short distance without an optical path is interesting. For sure under such conditions it is not possible to make QSOs at any time and at any weather conditions. Thus it is much fun to make such QSOs from time to time even over hours with a constant strong signal.

Bernd Beckmann, DJ9PE / OE9BDO

Fig. 1: 24 GHz ATV TRX with 0.48m dish and 0.33m dish above for RX on 10 GHz.

Foto 1: 24 GHz-ATV - Transceiver mit 0.48m Spiegel, darüber 0.33m Spiegel für 10 GHz Empfang mit behelfsmäßiger Fenstermontage bei DJ9PE

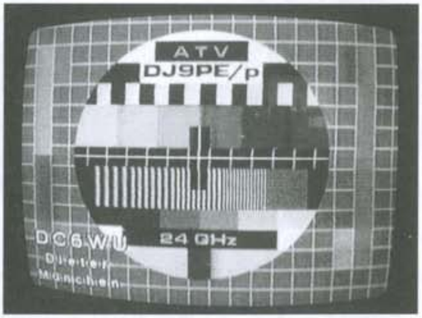


Fig. 2: Test picture received by DC6WU on 24 GHz and sent back on 10 GHz to DJ9PE (picture taken by DJ9PE)

Foto 2: Das von DC6WU empfangene und auf 10 GHz an DJ9PE zurückgesendete 24 GHz Testbild (Aufnahme von DJ9PEs Bildschir)

24 GHz – ATV im bebauten Gelände

Verbindungen auf den höheren Mikrowellenbändern erfordern normalerweise ungestörte Ausbreitung (quasioptische Sicht) zwischen den Stationen. Diese Möglichkeit ist kaum einem OM in einer Großstadt gegeben, schon gar nicht dann, wenn keine Hochantennen zur Verfügung stehen. Eine weitere Schwierigkeit sind die wesentlich höheren Anforderungen zur Übertragung eines ATV-Signals im Verhältnis zu den Schmalbandmodulationsarten.

Dennoch experimentieren DJ9PE und DC6WU in der Millionenstadt München schon seit fünf Jahren auf 24 GHz mit ATV. Die Entfernung zwischen beiden Stationen beträgt 13,1 km. Die Strecke führt diagonal über die Stadt mit einer typische Großstadtbebauung von Hochhäusern, Industriegebieten und Wohnanlagen aber auch dazwischen liegenden Grünflächen. Erschwerend kommt bei DJ9PE eine in etwa 100m Entfernung vom Sendespiegel stehende hohe Baumgruppe hinzu. Der Geländeschnitt eines kommerziellen Computerprogrammes mit Bebauung, Vegetation und geologischen Formationen ergab eine Reihe hoher Objekte und damit keinerlei Sichtverbindung.

DJ9PE sendet auf 24.220 GHz mit 0.6 Watt und seit kurzem auch mit 4 Watt sowie einen 0,48 m Spiegel aus dem 8. Stock eines Wohnhauses. DC6WU empfängt das Signal mit einem 0,60 m Spiegel auf seinem Balkon in 4. Stock und sendet es zur Überwachung auf 10 GHz an DJ9PE zurück. Hier sind auch 24 / 10 GHz Duplex QSOs möglich.

Die inzwischen fast hundert zu jeder Jahreszeit durchgeführten Verbindungen zeigen ein völlig uneinheitliches Ergebnis. Es gab Tage mit stundenlangen konstanten B5-Rapporten, solche mit Sekunden schnellem B0-B5 QSB, andere mit verrauschten Bildern und schließlich auch welche mit kaum feststellbaren Signalen.

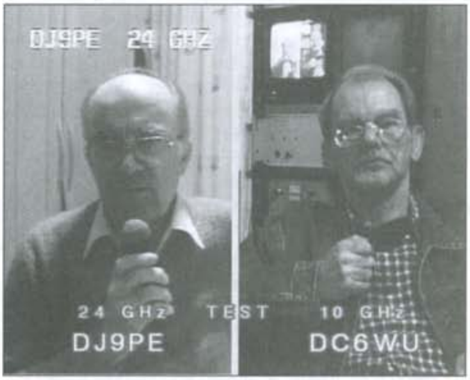


Fig. 3: Here DC6WU has added his own picture to the on 24 GHz from DJ9PE received picture and sent it back to DJ9PE on 10 GHz. (picture taken by DJ9PE). Tricky but one can see what is possiblle with ATV.

Foto 3: Hier hat DC6WU dem empfangenen 24 GHz - Bild sein eigenes Konterfei dazugemischt und dann auf 10 GHz an DJ9PE zurückgesendet (Aufnahme von DJ9PEs Bildschirm). Etwas verzwickt aber man sieht, was mit ATV möglich ist.

Die Aufzeichnung der meteorologischen Daten brachte bisher keine eindeutigen Erkenntnisse über die Ausbreitungsbedingungen. Relativ groß dürfte allerdings der Einfluß der Luftschichtungen über einer Großstadt sein.

Da die Bebauung nicht homogen ist, sondern neben Wärme speichernden Bauten und Strassen auch Wasser- und Grünflächen sowie im geschilderten Fall auch ein Waldstück enthält, werden die örtlich aufsteigenden oder absinkenden Luftmassen verschiedene Temperaturen und Luftfeuchtigkeiten aufweisen, die dann unterschiedlich reflektieren. Dies äußerte sich durch starkes QSB, das in meist sehr kurzen aber auch langen Intervallen zwischen Totalausfall und B5 schwankte. Die besten Ergebnisse bringen wettermäßig ruhige Abende und Nächte, an denen sich vermutlich eine niedrige Inversionsschicht über der Stadt aufbauen kann.

Die bekannte Dämpfung durch Wasserdampfabsorbtion auf 22 GHz hat aufgrund der kurzen Entfernung keinen Einfluß auf das Signal.

Interessant ist auf jedem Fall die Tatsache, daß eine 24 GHz - Verbindung, noch dazu in ATV, auch ohne optische Sicht und unter schwierigen Verhältnissen zumindest auf kurze Entfernung möglich ist. Absolut störungsfreie und zu jeder Tages- und Nachtzeit bei jeder Wetterlage verfügbare Verbindungen werden unter den geschilderten Bedingungen nicht möglich sein. Um so erfreulicher sind dann die Verbindungen mit starken und über Stunden konstanten Signalen. (DJ9PE)

Another distance world record on Laser ATV

On April 4th/5th 2007 Tom, DL9OBD and Wilfried, DJ1WF have set a new distance world record on Laser ATV over 83.3k. The optical path from the Wolfswarte (in the Harz mountains, some 700 m a.s.l.) to the city of Hannover allowed the transfer of totally noise free pictures for quite some time. The previous record has been set by the same operators just on January 22nd 2007 over a distance of 70km. Congratulations!

Entfernungsrekord für Laser-ATV erneut gebrochen!

In der Nacht vom 04.04. zum 05.04.2007 wurde der am 22.01.2007 aufgestellte Entfernungsrekord von 70km Luftlinie für Laser-ATV erneut gebrochen. Tom, DL9OBD und Wilfried, DJ1WF stellten den bislang aktuellen auch von Tom und Wilfried gehaltenen Entfernungsrekord für Laser-ATV ein und setzten die Marke auf 83,3km. Ludwig, DO2LN war ebenfalls dabei. Es wurden wieder zeitweise absolut rauschfreie Fernsehbilder incl. Ton über die Lasereingabe von DB0TVH übertragen. Der Senderstandort befand sich dieses Mal auf der Wolfswarte im Harz in der Nähe von Torfhaus (10°29'43.4" O, 51°47'30.7" N. Gratulation! (DL8HCZ)

DL9OBD and DJ1WF with their Laser TX

Microwave Europe

Editor: Simon Lewis, DL4PLM

GM4PLM@hotmail.com

Hello and welcome to another microwave column.

New Microwave Firsts Programme for UKuG

This award recognises the achievements of British stations in making first contacts with other countries. It also serves to build a comprehensive list of firsts as a historic record of the development of microwave operating techniques in Great Britain. Of course if your at the opposite end of the contact you can also claim and the award scheme is not just for UK stations! A full set of rules can be found on the UkuG page http://www.microwavers.org/firsts.htm

UK Microwave Group "Firsts" Award

Dorsten Microwave Event 2007

On Saturday 24 Feb Nick DL/GM4OGI and myself visited the microwave meeting at Dorsten, which is about 40 minutes north of Düsseldorf by autobahn. It's a close event and one that I can visit for a few hours without destroying a whole weekend traveling – so a good one for a few hours chat and to sniff around the small flea market. This year seemed very quiet when we arrived and I was quite surprised when many people suddenly flowed out the lecture hall! Ok – not quiet then! The event is not really a trade event – but there are always some flea market tables and a few of the commercial boys do find a corner. There was plenty of activity around Hubert's table from Micro-Mechanik who had some lovely fine engineering on display with his superbly machined components and Roberto DG0VE who was showing off his very nicely made SHF amplifiers. The event is really close to the Martlesham event and they even have their very own set of "Ian's" doing the catering! So with a coffee and "schnittchen" (a small open sandwich), we made our way around the many familiar faces and callsigns catching up on the latest news. The event also hosts a set of fine lectures and whilst mainly in German they do offer an interesting insight into the different style of operating between mainland Europe and the UK scene. Freddy ON6UG was also again in attendance lugging round his 1m dish! Although the weather when we arrived was a little damp, Freddy found a window in the rain to demonstrate his 8 GHz satellite reception setup and produced some nice signals from some more distant DX corners of our solar system! Back inside we caught some more coffee and a hunt in some of the flea market boxes before calling it a day and heading back off down the Autobahn to Düsseldorf.

I actually like this event – it reminds me very much of Martlesham as its not really a commercial event but one where people go to socialise and catch up on the latest microwave gossip and show off what they have been building during the winter. UK readers should think about the variety of low cost airlines flying into the region as both Cologne and Düsseldorf are not more than 1-1.5 hours away, I think also some flights into airports further north like Munster also fly into the UK. Why not combine the trip with a weekend away with the XYL – Nord Rhein Westfalen has some lovely towns and cities to visit – Muenster for example is a very historic area and well worth a visit – German autobahns are lovely to drive and generally its pretty easy to get from place to place quite quickly, combined with the low fuel price (around 1.12€ at the time of writing) it makes it an attractive weekend. Don't forget the other super VHF and up events that also take place such as the microwave meetings in France, Holland and the other superb events such as the VHF and up event at Weinheim and of course the excellent Ham Radio 2007 in Friedrichshafen. Hope to see you at one of these events soon. Viele Grüße, Simon DL4PLM/GM4PLM.

TK qrv on Microwave again

TK/F5BUU and TK/F1AAM will be QRV, like almost every years, from JN42JS and/or JN41IW from June 16 to June 29.They will be active on SSB/CW and ATV.

144 MHz:	**(talkback): 250w/11el**
1296 MHz:	**100w/2*35el**
2320 MHz:	**80w yagi or dish**
5760 MHz:	**15w/90cm**
10368 MHz:	**50w/90cm**
24048 MHz:	**2w/90cm**

There is some possilities to get a wifi ON4KST access, but this is not sure yet. They are expecting big RS openings , like last year, and will be very interested to try with DL by this mode. This expection is part of the regular "Grande Bleue" yearly DX session. Others station will be QRV around the mediterranean sea . In this moment we know only for sure that HB9RXV/HB9AZN will be on the coast in JN12, and F6KUG/P in Cap d'Agde.

One more word about rain scatter activity. Activity in F is particularly high nowadays during RS openings. The southern part of France, previously not very active, is now much better, with stations in IN94/IN93/JN12/JN03/JN23/JN33 ect. So please look for us during good openings 73 Dom/F6DRO

UkuG Award for ON4KST

Alain Stievenart, ON4KST has been awarded an outstanding contribution award by UkuG at its annual Round Table conference on 12th November 2006 in recognition of the outstanding contribution he has made to amateur radio through the hosting of the free ON4KST web pages.

Ian Lamb G8KQW presenting Alain ON4KST his award

GM 6cms EME Activity

Mark GM4ISM writes "spent the week before the Dubus EME contest of 24/25 march frantically building a 6cm station in order to make his first 6cm QSO. The equipment was a 1.8m dish, linear polarisation, HB transverter, DB6NT preamp and 50W SSPA. After some initial problems, the first signal was heard from 8N1EME, and about 2 hours later the transmit side was completed. GM4ISM exchanged 559 449 with 8N1EME for his first ever QSO on 6cm, and also for a first UK to JA contact on the band. A few skeds with other stations were not completed , but GM4ISM heard RW1AW and OK1KIR, and partial copy of F2TU. Both F2TU and RW1AW reported hearing Mark at times. The system was not performing as well as it should, both sun and moon noise were lower than expected, but there was no time to optimise anything.

GM4ISM temporary EME setup for 5.7GHz

Future operation on 6cm will be on the main 2.4m dish, which could not be used due to local obstructions for JA. A few photos of the system can be seen at www.dc2light.co.uk/6cm.htm

UKuG Microwave Contest Report

Ray GM4CXM sends in this report on his recent contest activity: 10w 4x 44el @ 11m on 1296 MHz

Contacts over 500 Km on 01/04/2007:

1750 G3XDY 539008 529018 JO02OB 564

1823 SM6HYG 55009 55001 JO58RG 988

SK7UHI and OZ1UHF were audible in the morning and faded out before any activity was heard. A DXC spot from SM6HYG in the evening indicated copy of GB3EDN and despite no copy of any SM or OZ beacons at the time in IO75, a schedule with Carl produced a solid contact on SSB with his signals peaking 58. 73 Ray GM4CXM, IO75tw.

Ray also reports he has now commissioned his 150w SSPA – watch out in the contests for his signals – he has a well sited station in GM and will do very well – congrats Ray!

New 10 GHz beacon from Southern France

On Easter sunday, I put the beacon I am building for a future JN05 location, in my garden (JN03TJ) for test purposes. The beacon was located on a small 5m tower. It is running 2w into 10 slots. I was very lucky, as it enabled detection of the first significant early RS opening. Almost immediatly F6APE in IN97QI hrd it via RS (474km), which is longer distance than winter type rain scatter. Then many QSOs took place between JN03/IN94/JN04/JN05 and IN97. This beacon should normaly move to JN05 before the real start of the 2007 RS season. The JN05 location is quite idealy suited, as it is almost in the center of the country and may be very usefull. QRG till now is 10368900, but we may change it a bit later. 73 Dom/F6DRO

New 3m Dish Kit from RF Ham Design

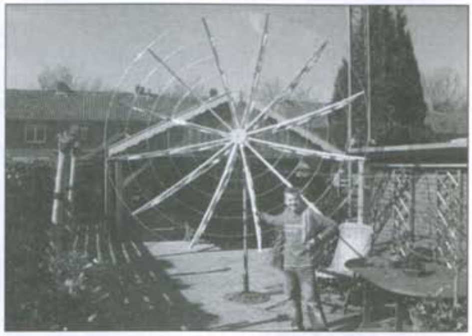
RF HAMDESIGN 3 Meter PRIME FOCUS MESH DISH KIT (F/D=0.4) This MESH DISH KIT is easy to assemble, 20mm square tube aluminium is used for the 12 rib contruction which are pre-assembled and ready to place at the 20cm, 10mm thickness aluminium centers. The kit is supplied with a 4 leg feed support, all assembling parts and 6mm square mesh, which can be used up to 6cm band (max 6GHz). You only need a hand driller, a hand riveter, Spanner No:10, a hand cutter and some time to assemble this monster! This 3 Meter DISH KIT can be used together with the APLHA-SPID Azimuth & Elevation rotator. A dish mount to Alpha installed needs counter weights.

3 METER DISH KIT SPECIFICATIONS : (Efficiency 65%)

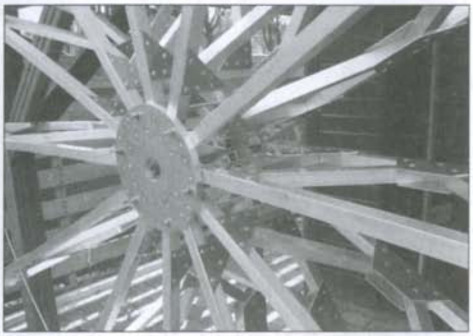
Frequency	Gain dBd	-3dB angle (dgr)
1296 MHz	30.3	5.7
2320 MHz	35.4	3.2
3456 MHz	38.8	2.1
5760 MHz	43.3	1.3
WEIGHT:	39 kg	ex feed and mast clamp

More details on the RF Ham Design webpage at: http://www.rfhamdesign.com/products/parabolicdishkit/168290990812ee11f/index.html

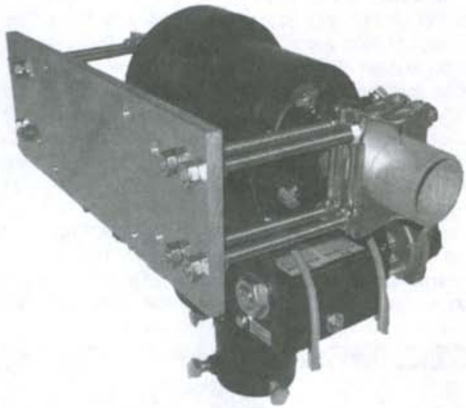
2 parts mesh mounted



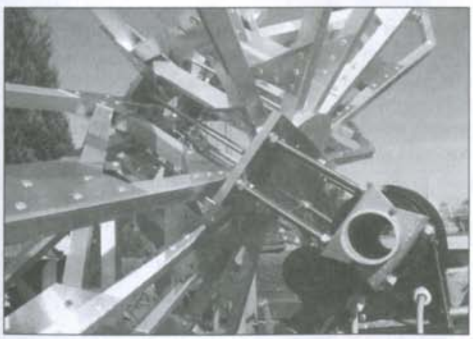
Son (12 years) of manager @ 3Meter dish (Mesh not mounted)



Close up center (no mesh mounted)



As option available
mast/rotor mount clamp



Close up back, mounted at Aplha Spid AZ&EL rotator

3 Meter Dish KIT delivererd inc. all mounting parts,
........all nuts (stainless steel)
........all bolts (stainless steel)
........all blind pop-rivets (incl. 4.1mm bore)
........4-leg feed support
........mesh 6mm square (galvanized steel)
........milled aluminium center
........do It Your Self manual incl lot's of picture's

This DISH KIT does Not include: Mast clamp, Dish feed / clamp. PRICE 3 Meter Dish Kit: EUR. 1189,- (inc. VAT) Shipment to lot's of countries possible. E-mail tp PA4FP for a quotation: info@rfhamdesign.com

VHF Australia / New Zealand

ZL2DX to VK7MO Tropo-ducting Extension of Meteor Scatter - with comments also on VK7MO-ZL3TY contact

by Rex Moncur, VK7MO

This report of a 2 meter FSK441 contact between ZL2DX and VK7MO over a distance of 2327 km appears to provide another example of a tropo-ducting extension of meteor scatter. This was ZL2DX's first ever 2m contact with VK. A contact between ZL3TY and VK7MO at the same time seems also to have benefited from the tropo-ducting extension.

Background

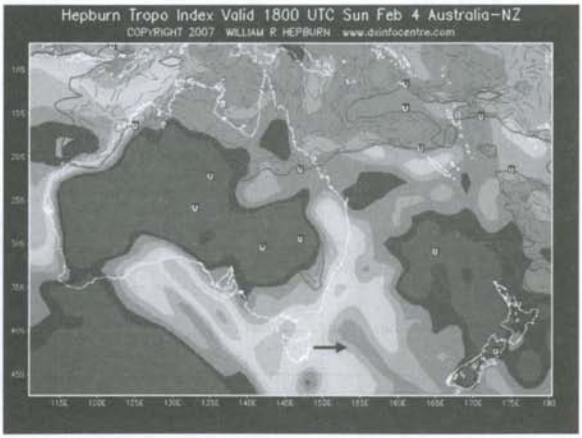
ZL2DX is located at Martinborough (height above sea level =170 metres) around 50 km east of Wellington. In beaming to VK7MO on the southernly hotspot he beams close to the Orongaronga Range which is 500 to 700 meters above his location at around 35 km. This range could reduce his horizon by about 1 degree. At around 150 km he beams over the mountains on the South Island which would provide a 1500 to 2000 meter barrier to tropo-scatter but is too far away to affect his meteor scatter horizon.

VK7MO is located at Tolmans Hill (antenna height above sea level =330 metres) a suburb of Hobart and beams over approximately 50 km of land with heights varying up to 350 meters. The take-off angle is zero degrees.

Using the general rule of thumb for meteor scatter that one looses 100 km from the 2400 km maximum distance for every 1 degree of lost horizion the maximum range is thus between 2300 and 2400 km under normal conditions without tropo-extension. This means the normal path of 2327 km is right at the limit.

ZL2DX and VK7MO have been attempting to complete a meteor scatter contact most days over a 3 week period in January 2007. The period of the tests was typically one or two hours each morning around 7.00 am local NZ time. The tests produced typically only one or two partial pings each day and feel well short of a completed QSO. This is typical of long meteor scatter paths close to the 2400 km limit under normal conditions. On 4 February 2007 the Hepburn charts indicated a strong prospect of a tropo-ducting extension and a QSO was completed with the rate of pings was significantly increased over the typical level. Thus this QSO gives further support to earlier examples of dual mode tropo-ducting to meteor scatter propagation. (eg ZL3TY to VK5ZK and VK5ZLX, in 2005/6 summer and ZL1IU to VK7MO on 2 occasions during the 2006/2007 summer, see last DUBUS issue 1/07).

Hepburn chart, February 4th, 2007



The chart shows a yellow ducting area east of Tasmania extending by about 200 km from Hobart out into the Tasman Sea. This would reduce the meteor scatter path length to around 2100 km which while still a long meteor scatter path makes in much more viable and should usefully increase the number of pings. Support for tropo-ducting is that just after the contact VK7MO worked VK2ZT near Newcastle at 5-3 and 5-2 on SSB and also the fact that VK7MO and ZL3TY (1951 km) completed much more quickly than is normal on FSK441 suggesting the path to ZL3TY also benefited by the dual mode propagation.

All text file VK7MO

```
181535  Transmitting: FSK441  CQ VK7MO
*185000  6.5  100  3 16   22    VI7MO ZL2DX  VK7OK
185046  Transmitting: FSK441  ZL2DX/16 VK7MO
#185200 13.5  480  7 26  -64    Q ZL3TY CQ ZL3TY CQ ZN3TY CQ ZN3TY CQ ZL
185230  Transmitting: FSK441  ZL2DX/16 ZL3TY/27 VK7MO
#185400 23.8  240  9 26  -64    Y VK7MO/R26 ZL3TY VK7MO/R26 /L750O ID
185442  Transmitting: FSK441  ZL2DX/16 3TY/RRR VK7MO
#185500  6.6  160  3 26  -64    Y VK7MO/R2V ZL7TY  0G H#P
#185600  1.3  280  8 26  -64     ZL3TY VK7MO/73 ZL3TY VK7MO/73 ZL3TY WKG
185630  Transmitting: FSK441  ZL2DX/16 VK7MO
*201400 13.6   20  0 00  150 R26                                      1
*201400 13.7   20  0 00  152 R26                                      1
201444  Transmitting: FSK441  RRR                       (Shorthand)
*202400  6.7   20  0 00  152 R26                                      3
*203600  6.4   20 -2 00  163 73                                       1
*204300 21.8   20  5 00  162 73                                       3
204333  Transmitting: FSK441  73                        (Shorthand)
```

The file shows signal received from ZL2DX (*) and from ZL3TY (#). The contact with ZL3TY was complete in just 3 minutes which compares to typically 10 to 20 minutes under normal conditions.

Signals received by ZL2DX

```
184930 15.6  120  3 26  -64    CQ VK7LO?CQ VK   /
190030 16.6   80  2 16  -64   MO Z81DX/ V/VI
190730 15.5  120  2 26  -64   56  K,MO QHB D512 V
193330  8.0  160  2 26 -150   /16 VK7IK/Z 2DX51655K8O?
193830  4.8   80  4 16 -107   /16 VK7MO  E C
195130 15.0  280  3 26 -107   2DX/163VK7MO ZL2DX/16 VK7AO ZO2DX 86O G7
195630 11.2  100  4 16 -107   6 VK7MO ZL2F00062
200430 10.7  100  5 16 -107   MO ZL2DX/9V  J4M2
202930 12.7   20  7 00 -170 RRR                                     3
204130  6.3   20 -2 00 -170 RRR                                     1
204600  1.8   20 -1 00 -180 73                                      2
205730  8.8   20  7 00 -187 73                                      3
210530 25.3   20  5 00 -180 73                                      3
```

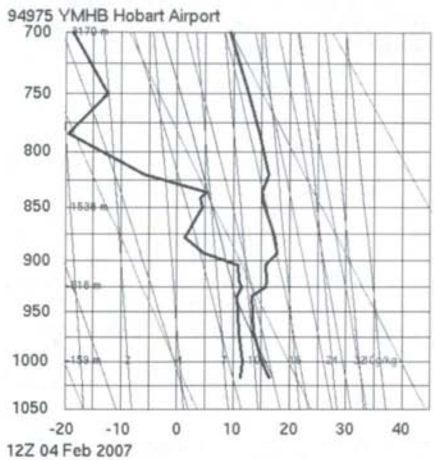
Note: Multiple decodes of the same ping have been deleted.

Composite of pings received

```
#184930 15.6  120  3 26  -64    CQ VK7LO?CQ VK   /
*185000  6.5  100  3 16   22   VI7MO ZL2DX  VK7OK
#190030 16.6   80  2 16  -64   MO Z81DX/ V/VI
#190730 15.5  120  2 26  -64   56  K,MO QHB D512 V
#193330  8.0  160  2 26 -150   /16 VK7IK/Z 2DX51655K8O?
#193830  4.8   80  4 16 -107   /16 VK7MO  E C
#195130 15.0  280  3 26 -107   2DX/163VK7MO ZL2DX/16 VK7AO ZO2DX 86O G7
#195630 11.2  100  4 16 -107   6 VK7MO ZL2F00062
#200430 10.7  100  5 16 -107   MO ZL2DX/9V  J4M2
*201400 13.6   20  0 00  150 R26                                     1
*202400  6.7   20  0 00  152 R26                                     3
#202930 12.7   20  7 00 -170 RRR                                     3
*203600  6.4   20 -2 00  163 73                                      1
#204600  1.8   20 -1 00 -180 73                                      2
*204300 21.8   20  5 00  162 73                                      3
#210530 25.3   20  5 00 -180 73                                      3
```

Overall there were 16 pings received in just over 2 hours compared to typically one or two in two hours or about a 10 fold increase in numbers of pings. This is consistent with reducing the meteor scatter path length from 2300 to around 2100 km as implied by the 200 km tropo-ducting indicated by Hepburn.

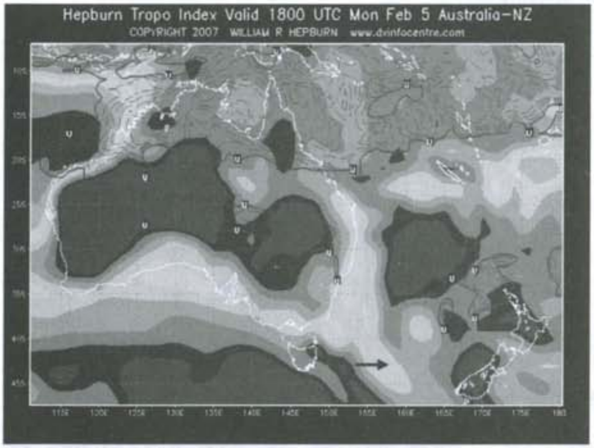
Duct height



The Upper Air Chart on the left is produced with radiosonde measurements from the Bureau of Meteorology observing station at Hobart airport and provided on the web by the University of Wyoming.
It is seen that there are temperature inversions at around 800, 1000 and 1600 meters. All would be sufficient height to extend meteor scatter as the land to the East of Hobart does not rise above 350 metres. Interestingly the path to up the coast to Newcastle would traverse areas with mountains higher than 1000 meters so that path might rely on the higher inversion at least at the Tasmanian end.

Test next day 5 February 2007

A day later tests over 90 minutes produced no pings at all either way between ZL2DX and VK7MO and a much lower rate of pings between ZL3TY and VK7MO. The Hepburn chart (see below on the left side) shows that the yellow patch indicating ducting had moved out into the Tasman Sea and thus there was no opportunity for a tropo-ducting extension into Hobart – giving further support to the view that the results on 4 February were produced by a tropo-ducting extension of meteor scatter.



Options for Tropo-ducting extensions

In the case of ZL2DX mountains on the South Island which provide a 1500 to 2000 meter barrier* and are unlikely to allow low loss ducting necessary for dual mode propagation. Thus the only likely prospects for ducting extensions are when there is a strong indication of ducting at the VK end. This differs from ZL3TY who has a clear view across the Tasman and can take advantage of tropo-ducting at his end also. For the same reasons ZL stations on the East Coast of the South Island will be unable to use tropo-ducting extensions due to the Southern Alps and will need to look for tropo-extensions at the VK end. On the VK side stations west of the Great Dividing range will be cut-off from tropo-extensions and will be limited to using this mode to working West Coast ZL station when the extension is on the East side of the Tasman.

* ZL3DX advises that he often does receive strong signals from Nick ZL1IU over a mountainous 600 km path which suggests low loss ducting. This path is across maintains up to 1500 meters high although there might be lower gaps. Thus there is some evidence that in ZL it might be possible to have low loss ducts beyond the 600 to 800 meters that has been reported (Andrew Martin VK3KAQ – Gippstech 2005) as applying in South East Australia.

Conclusion

It seems likely that the enhanced ping rates on 4 February for the QSOs reported here between VK7MO and ZL3TY and ZL2DX were both the result of shortening of the meteor scatter path and thus making more meteors visible in the centre of the path to both stations and that this shortening was the result of tropo-ducting. Thus these results add further weight to the theory of tropo-extension of meteor scatter.

VHF South America

Editor: Flàvio Archangelo, PY2ZX
PY2ZX@mandic.us

Sporadic E over South America

Listeners point in Garopaba, Brazil

Some information came from Brazilian DXers during the late summer about Sporadic E openings to Chile and Argentina. These reports are still few considering all the Es activity on the northern hemisphere but reflects new awareness for different paths of propagation not well or constantly used by the hams in the region.

On January 17, 2007 Francisco, PY2FGJ has monitored in Itapecirica da Serra (GG66nf) the Channel 3 VHF-TV station from Viña del Mar, Chile (2610 km).

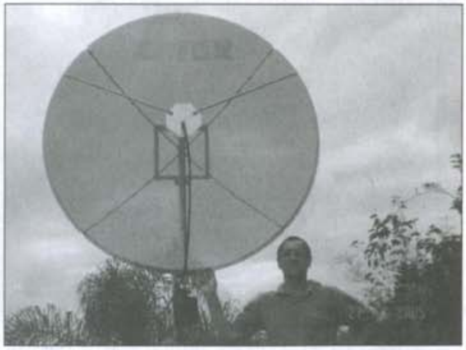
On January 20, 2007 the listeners Fabio Mattos, Anderson Torquato and myself in Garopaba (GG51qx) have enjoyed one Es to Argentina on 88 MHz. We were under heavy rainfall on one mountain with a great view to Garopaba city and the south part of Santa Catarina Island. We kept the receiver on 88,1 MHz (Radio Gazeta of São Paulo, about 500 km far) when suddenly we heard advertising in spanish language for just about 10 seconds. After some minutes we heard again this station but loud. So we made one quick scanning and then several other spanish speaking radio stations were on the dial of one simple Degen DE-1103 receiver with just a telescopic antenna! In one 3rd period of propagation we stayed on 95,1 MHz listening announcements and talks related to "La Rioja". Crossing the log data collected with internet information we found for this frequency the "Fenix FM" in La Rioja, northwest Argentina, about 1780 km away from Garopaba.

On January 31, 2007 the information came from Central Brazil: Kleibe PP2KR portable at Mundo Novo (GH46th) received several FM stations from Northern Brazil, including the distant PT8 State of Acre (1940 km) and State of Amazonia (1580 km) between 1900 – 2130z.

Another report came from Peter, PP5XX (GG53qw, 12 elements, 100 Watts), who usually first listens the beacon LU5EGY on 50,038 MHz and then makes calls on 2 meters toward southwest. On February 3rd 2007 he made a SSB QSO with LU7FA (FF96mw, 12 elements, 100 Watts) over 1413 km on 144,200 MHz. He also heard LU4HP (FF87pi, 17 elements, 100 Watts) but didn't complete the 1547 km QSO. He repeated the QSO with LU7FA at 2150z on March 11; 2006. An MP3 file of this contact is available www.radioamador.com/vhf/audio/lu7fa_pp5xx_11032007.mp3

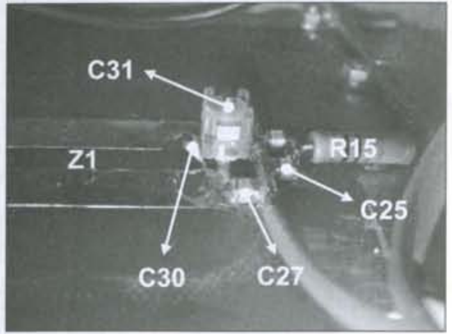
More messages about propagation in South America or available on the VHF-DX Network: http://br.groups.yahoo.com/group/vhf-dx

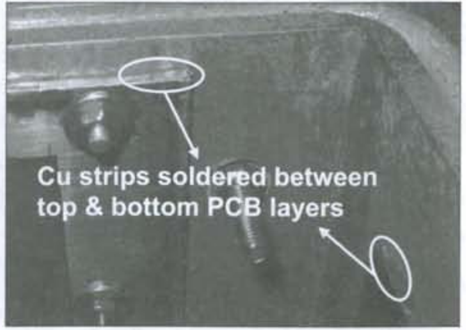
Brazilian 1,2 GHz Record

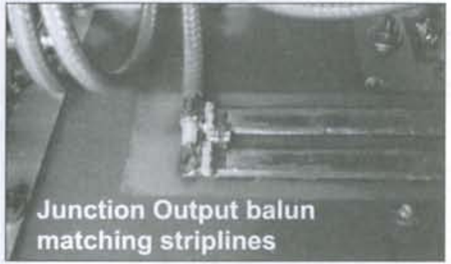


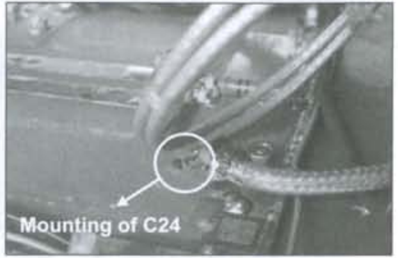
New dish of PY2ANE

A new point-to-point QSO between Cláudio, PP5CFL (Florianópolis, GG52RJ) and Orlando, PY2ANE (Ribeirão Pires, GG66SH) on 1296,1 MHz FM reached a distance of 485 km and makes a new mark for the Brazilian 23cm record. According to Orlando the signals in FM were between RS 51 / 55 for about 45 minutes (20:05 until 20:50 local time) on March, 28; 2007. The setups: PP5CFL: 10 watts, home made helical antenna with 20 turns RHCP. PY2ANE: 20 watts, home made dish with 1,5 meter of diameter RHCP by helical antenna with 2,5 turns.
At the same time several UHF-TV stations from Santa Catarina (PP5) were copied for hours with high quality of image on PY2ANE´s QTH using Philips receiver, Thevear antenna and RGC06.





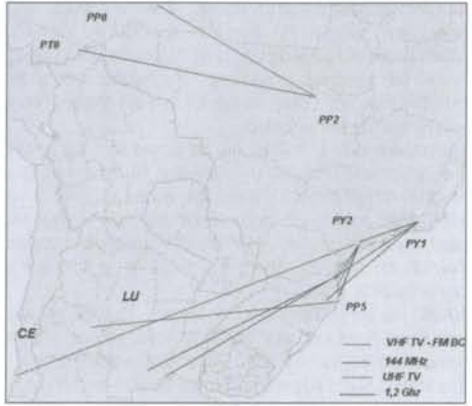




9. Appendix

Appendix 1: Data sheet of the MRF141G

Propagation to Rio de Janeiro



Map with all the paths mentioned in this column

On March, 28 and 29, 2007; the stations PY2RE, PY2EJ, PP5XX heard the PY1BCN beacon on 144,070 MHz (GG87kl, State of Rio de Janeiro). The most distant was PP5FMM who listened the beacon from Serra da Boa Vista (GG52kh) over

PP2SIX beacon back

The traditional PP2SIX beacon on 50,073 MHz returns on the air transmitting with 7 Watts into a vertical antenna from Anápolis (GH53MP). QSL pse to Ronnan Werneck (PP2RON), P.O. Box 571 - Goiânia - Goiás - 74.001-970 - Brazil.

Events

CB144: 02/03 June: 144 MHz Brazilian Contest (open for stations outside Brazil, too): http://www.gbvudx.org

FENARCOM: 20/22 July: Brazilian Hamvention, this year united with the Araucaria DX Group Meeting, in Americana/SP: http://www.fenarcom.com.br/english/english.htm

CQWW VHF Contest: 21/22 July: 50 & 144 MHz: http://www.cqww-vhf.com

continued from page 110

2-m-EME News

Heinz Borde, DM2BHG
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1. CONTEST RESULTS

- **AA1YN** (Lee) The 2006 ARRL EME Contest results and scores have been posted on the league website at: http://www.arrl.org/contests/results/2006/eme.pdf

DUBUS-CW-Activity

-**IK3MAC** (Graziano) All QSOs on CW random. SV3KH, YO2AMU, ON7EH, IK2DDR, S54T, G4DHF, EA3DXU, G7RAU, OH6CH, PA3CWN, SP7DCS, CT1HZE, G4KWQ, F3VS, SV1BTR, SM2CEW, N5BO, LZ2US, I3EVK, YU1IO, YO5BIN, W5UWB, ON4DPX, OK1MS, IQ3AZ, DL2FCN, OH4EA, IK1FJI, F9HS, DK3EE, DL5MAE

-**IK1FJI** (Valter): SP7DCS, IK2DDR, G4DHF, YO2AMU, OH6CH, I3EVK, DL5MAE, OK1MS, IK3MAC, DK3EE, SV1BTR, PA3CWN, WQ5S, ON4DPX, heard LZ2US, CT1HZE ; total 14QSO X 14 = 196 POINTS

2. AROUND 2-m-EME

EB1DNK (Jose Manuel):
Hello all, this is my contact list, 2 m, EME on 18/02/2007 with my new rig, IC-7400 and GS35B:
10:28 EA6VQ -10
10:39 EB2FJN -23 #125
10:51 EA3DXU -21
11:03 RA4HCN -21 #126
11:49 OH6ZZ -23 #127
12:36 UA9HK -21 #128
13:04 F6FHP -17

- **PA3DZL** (Jac): Wkd 144 MHz JT65B:
SM5CFS, DL6BF, IK7EZN, K5GMX, F1DUZ, K0KP OK2UZL, EA3DXU, F1TE, OK1TEH, EA5CJ, XE2AT, N5KDA

-**PE1BTX** (Gerard): I was QRV the past weeks on 2 mtr EME

2007-02-25	4N160SRS	-13db	
2007-02-26	W5UWB	-16db	single yagi station
2007-02-26	YO3DMU	-28db	single yagi station
2007-02-28	SP3VCS	-27db	2x6el (1wl)
2007-02-28	SP3XBO	-30db	100 Watt
2007-02-28	OK2UZL	-18db	
2007-03-01	IQ3AZ	-23db	
2007-03-02	8N1EME	-23db	big dish project
2007-03-02	DM2BHG	-21db	
2007-02-03	W5UWB	-16db	single yagi station
2007-03-03	K6MYC	-18db	

3. NEWs AND INFORMATION

-MAP65 status report (K1JT, Joe):

A month ago I mentioned here a piece of SDR software that I have been working on, tentatively called MAP65. Many people have written to ask for more details. I have consequently placed a status report and a MAP65 screen shot on the WSJT web site. Links to them are given below.

Very briefly: MAP65 is the "back end" of a a wideband receiver optimized for JT65 signals. It works together with Linrad and suitable RF hardware to provide automatic polarization-matched reception of all detectable JT65 signals in a 90 kHz passband, in real time. The program runs under both Windows and Linux. In the future it will probably work with Winrad, as well as Linrad.

The present state of MAP65 can be judged from the screen shot, which was produced by processing 10 minutes of data recorded on November 11, during the second weekend of the ARRL EME contest. In those 10 minutes, MAP65 decodes nearly 50 callsigns of EME stations operating between 144.100 and 144.160. My EME antenna at the time was a pair of 2MXP20 yagis.

MAP65 has not yet been used "on the air". My EME antenna was taken down just after the 2006 ARRL contest, and its replacement will not be erected until warmer weather arrives.

The MAP65 Status Report and Screen Shot can be found at:
http://physics.princeton.edu/pulsar/K1JT/MAP65_Status.txt
http://physics.princeton.edu/pulsar/K1JT/MAP65_1.JPG

Like WSJT, MAP65 will be "Open Source" software. I hope that these small tidbits of information will entice some others to participate in the program's development.

-EMC problem with US Digital A2 encoders

(JJ F1EHN): A few OMs asked me about EMC problem on VHF and UHF bands with using US Digital A2 type encoders. I have asked to the technical support team of USD and with their agreement I have copied their answer on my web site.

You will find some advices in a pdf file available @ F1EHN Download page <http://perso.orange.fr/f1ehn/download.htm> (see at USD encoders). I hope these advices will help you. Please, send me your test report and I will inform USD about it.

-EME CONFERENCE 2008

The Associazione Radioamatori Italiani (hereafter A.R.I.), through its Comitato Regionale Toscano (hereafter C.R.T.), has started organizing the XIII international EME Conference, to be held in August 2008 in Florence, Italy. The date has been tentatively set as Aug. 8 -10.

As we would like to start sizing up the number of participants, we have prepared a questionnaire available on:
www.ari-crt.it/eme2008/questionnaire.html

It would be of considerable help to us if the interested parties would take the time to fill it out and send it back to us. The answers do not commit you in any way. We appreciate the cooperation. 73's from the C.R.T.

-SDR-IQ receiver: RFSPACE will soon release the little brother of the SDR-14 receiver. This receiver covers the frequency range of 500 Hz to 30 MHz in 1 Hz steps. It can also be used for higher frequencies using downconverters. The maximum realtime BW of this unit will be 190 KHz. We are also working on a sonar module, ultrasound module and IR module. In order to make the unit affordable to the experimenter, we will offer the unit as a board level assembly ready to plug and play. The powering is by the USB port so no

power supply is required. The unit measures 3.75x3.75 inches. You can read more about this unit here:
http://www.rfspace.com/sdriq.html

-WINRAD Version 1.24 available

Alberto I2PHD reports the release of a new WINRAD version. It can be freely downloaded from www.weaksignals.com as well as the mirror site http://www.winrad.org

- A Dedicated CW EME Logger

After numerous requests Chris N0UK has added a dedicated CW EME logger to his set of VHF/UHF dx related chat sites. It is available at www.chris.org/cgi-bin/cw-eme.

4. ONCE THERE WAS A CHAT ABOUT

(Chats of common iterest in INTERNET)

-PA-Question (PA3CWN,Oene):

Recently I have build a 2 m amplifier with 2 x GI7b but experience some troubles. I have build this amplifier with separate bias control, so I can adjust each tube separately and therefore the cathode 's are not connected as seen in all the 2 tubes designs but each tube get's it's input RF via a capacitor.

First I build an amplifier with stripline according to G4DCV his design, but got only few Watts out. Then I rebuild the design to the 'lazy builder' design of YU1AW to see if the tubes (NOS) were still 'alive' and yes they were;I am able to get somewhat 700 Watts out at abt 40 - 50 W input,so the tubes are doing as expected.But with this design consisting of 2nF / 30kV from anode to coil and tune cap to earth and output coupling by another variable capacitor, I experience that is is extremely sharp and when the amp starts getting warm I have to retune every time I am on the air again. Output drops each sequence to the 50W level and this is in practice not working.Also at some points of chancing the output coupling C it starts sparking and that is really bad. 1 C has already got black and those RF voltages must be huge !!

Now I am thinking of rebuilding this to a version with stripline.My anode chamber is not that big so I guess have to play with the dimensions.My questions: Does anyone have had those experiences and does a stripline gives me a 'flatter' resonance so I have not to retune that often ?My single GI7b has also a stripline (DJ9HO design) and when it has warmed up I only have to retune very little, so I guess a stripline is much better (it even gives some extra cooling surface). And how are the stripline dimension influenced by the dimensions of the anode chamber ? I read that the distance from bottom to stripline and also from stripline to top are important for the dimensions.

OZ5IQ (Kim): These tubes seems to be rather temperature UNstable, so be certain, they plenty of AIR.Otherwise, you will have to "track" the full Po level, during transmission. And keep in mind, that the looser you couble to the tank, the higher you will get to the unloaded Q! To get an idea of the loaded Q, try to let it get warmed up, (lower the bias) or IDling a while, AND IF the PA needs to retune, your blower is eigher to small (cant resist the counterpressure) or U can ADD an extra blower to help "pulling out the hot air" this might help cooling the anodeline in general.

K2TXB (Russ): Oene, If the amplifier tuning is so sharp them the tubes are not loaded heavily enough. Increase the coupling and retune. Continue doing this until the tuning gets broad and the power output falls off slightly. Then reduce the coupling just until you can get full power out but the tuning is still broad.

5. TREASURY INTERNET

- LIDL level (Frank, PA4EME): For those who have found a Lidle level or bought one from me at Würzburg.... Johan, PA3FPQ, is explaining on his webpage a solution for a stable readout. The URL is:
http://members.chello.nl/j.swienink1/elevation.html
Also a simple solution for the time-out with a simple NE555 timer.

-EME-directory (W5LBT, Bob): you can find the emedir at my website www.w5lbt.com.

- WSJT Home Page (K1JT, Joe): This brief note is to let people know that the web server used for the WSJT Home Page has been changed. The new URL is http://physics.princeton.edu/pulsar/K1JT/

6. EXPEDITIONS

Antarctica is QRV again

Ernie, W1MRQ, has returned to McMurdo station in Antarctica (RB32HD). Though this was already in January he is only now QRV again. The reason is that he found his array severely damaged when he arrived at the station: It had crashed when he was still at home in the States. Since his return Ernie has been busy repairing it in his little spare time left. Now he reports "mission accomplished" and KC4/W1MRQ is once again QRV on 2- meters for skeds.

The station is the same as last year: FT-847, 200 watt brick and 4 x 6 elements but with no azimuth or elevation rotors. Ernie removed them as the idea wasn't a good one. So his system now is mostly good only for Europe and to North America. He doesn't have the elevation to clear the hills around McMurdo to have a good shot for Asia and the Pacific. KC4/W1MRQ is also QRV on 70 cm with 30 elements and 50 watts for the biggest guns on this band. Ernie hopes for a lot of skeds on 2 m. He can be reached at w1mrq@yahoo.com Please only use this e-mail address and not his government address if anyone knows that one at all. QSLs are via: Larry K1CA and not Ernie's published address, it's wrong.

PJ4 (Bonaire, Netherlands Antilles)

René PE1L and Peter PA3CNX will be active from the island Bonaire, Netherlands Antilles (FK52) from June 8th until June 24th, 2007. They will work JT65 and also some CW with 4 x 9 ele DK7ZB (Wimo), about 1 kW out from a solid state amp and a 0,3 dB nf preamp (they will even bring a spare one). They will have full elevation, everything is tested o.k. and will be shipped in April. René writes that they will have internet access from PJ4 and a BLOG page to announce details and complete QSOs. A log search will be updated every day. They will mainly work random and maybe make some skeds only after the first bulk of stations is worked. Further details – i.e. frequencies – will be communicated later.

CT3/DK2ZF dxpedition cancelled

Rolf suffered big problems after arriving in CT3: Two tubes of his H-frame were damaged and therefore it was not possible to set up the 4 yagi group. Another problemwas an nf level issue from transceiver to the laptop. Rolf is working on both and with a bit of luck he might get it sorted out and come back at least with a single yagi. Let's keep fingers crossed....however, he plans another tour to CT3 in fall 2007 (or to CU Azores in 2008).

JA1RJU, Ryu qrv as DX0JP on 2m EME from Spratly Isl.

HK1DX, EME Report

To travel with your family and bring your radio is not exactly the same as a DXpedition, but you can try to do a good job...

My experience on V/UHF consists of some years operatiing in tropo, Es, MS-FSK441 and hill top contesting.

On EME I did just three contacts last year (2006) from my home station: RU1AA, KB8RQ on 2m (17el, 100w, 25db/0,3nf) and HB9Q on 70cm (31el, 50w), nothing else.

No CW capable, only WSJT (I am one of those new EME guys coming because of WSJT).

Destination; HK1DX, Loc. FJ29em, Caribbean sea.

I brought with me: Kenwood TS-2000-X, antennas; CushCraft 17B2 (17el, 4,5wl) and Hy-Gain UB7031-DX (31el, 8wl), from Pepe - EA1TA (SK). Amplifiers; 2m 180w and 70cm 100w brick amps from Manuel – EB1DEY, SP-2000 2m SSB Rx preamplifier and sequencer from Dithmar – DF7KF (sent later), Switching power supply, SWR/Power meter and RG-213 from HG Radio; GPS, Ecoflex 10 coaxial cables, etc.

To do some radio from a remote place is different and to do it alone under 35 degrees on the Caribbean sea it is so different from your home country. I had to build a tower with three water pipes and some steel rods...as well the tower tip, antenna mast, etc. But I did it. I build up a 4m high tower plus 1 more meter from the tip. With another water pipe I did a mast and I put the 70cm and 2m yagis on the top.

No rotor, no elevation, no preamp, no antenna control, no internet access (internet-café at 10 minutes). I did the azimuth adjust manually...pulling the antennas with a rope. If I had moon visibility, it was easy to target but with a cloudy sky or new moon was difficult, then I did it with a compass...and it worked. For MS it was fine but for EME, every 10 or 15 minutes I had to run upstairs (to the terrace) to re-adjust the azimuth and run again downstairs, it was funny.

EA1DDO as HK1DX on EME

Anyway, Nov, 25th I did the first call on the moon on the Americas window. I got Dave`s – W5UN signal but it was not possible to complete. Later, on the EU window, first call and first answer, of course, Sam – RN6BN (best -23db, no preamp). It was the beginning of my first EME activation. Then I did some more contacts but with difficulties. I detected a Rx problem, because it was very difficult to get the signals on the SpecJT. I checked all the system, radio, cabling, antennas, etc. I used a MFJ-269 Antenna Analyzer as well and everything was fine, no problem found at all, but all signals were low on the Rx side. On the Tx side all was fine with good signal reports received.

Then I changed some parameters on the system, set to 300-2800 on the radio Rx filter, AGC off, Sync=0 on the WSJT, etc. At the same time I installed the Rx preamp (Tnx Dithmar) and elevation capability, but manually, pulling a rope (no elevation rotor). After those changes the system performed much better and I could do more EME contacts. Not as many as I would like but...

The last 2m EME contact was Pietro - I2RV on Jan 5th, but in between I was trying many more contacts which for different reasons were not possible to finish successfully, for example; Dithmar – DF7KF, Spiros – SV8CS, Joe – CT1HZE, Hide - JH5FOQ, Joop - PA0JMV, and many more. I am so sorry and I want to thank all of them for the effort.

About 70cm, I noticed low interest, just a few hams were interested to try with me and most of them got it. Exactly three of them. The first was Dan – HB9Q, of course. It was so easy and fast, even our last exchange after the RRR and 73 was "QSY 144"... His best was -18db!! (remember, 31el no preamp). After a few days I set a new 70cm activation window and I got up to three signals!! The strongest was Jan - DL9KR on CW and a little bit later, a few Hz up my friend Zdenek – OK1DFC and Al – K2UYH. Following the skeds proposal for this day, Dec 2nd, I tried first with Jan using the CW Tx capability of the WSJT with no result. Jan's signal was much better than the rest, similar to Dan's signal. I am more than sure that if Jan had used JT65, we could have done the contact. Then, I changed back to JT65b and tried with Zdenek with no result. I got Zdenek best -25db but he did not copy me. My last opportunity was Al, I got his signal at -26db similar to Zdenek but fortunately this time he got my answer and I finished the second 70cm EME contact.

HK1DX EME Shack

Later, on Dec 30th Zdenek and me tried again successfully with Zdenek best -25db including some minutes of Faraday presence.

The opposite situation was with Doug – VK3UM. We tried some times and I always got his CW signal but he never got mine...Doug tried polarity changes and different window times but it was always not possible. Doug told me that I need 6db more on Tx. Next time Doug.

Wayde - K3MF I got just one day his signal at -25db but "disappeared" and I lost him.

I am not sure but it looks like in 70cm was "easier" to Rx and the signals are cleaner than in 2m. I just need more Tx power.

Finally, here is the result:

25/11/2006 15:44	RN6BN KN95MA	O	2 m.	JT65	EME
25/11/2006 15:52	DK3BU JO33NO	O	2 m.	JT65	EME
25/11/2006 17:15	DL8YHR JO44GV	O	2 m.	JT65	EME
25/11/2006 17:31	KB8RQ EN8ØAD	O	2 m.	JT65	EME
26/11/2006 17:15	DK3EE JO41GU	O	2 m.	JT65	EME
26/11/2006 17:51	EA6VQ JM19HN	O	2 m.	JT65	EME
28/11/2006 18:36	HB9Q JN47CG	O	70 cm.	JT65	EME
02/12/2006 21:49	K2UYH FN2ØQG	O	70 cm.	JT65	EME
28/12/2006 19:32	KB8RQ EM79SV	O	2 m.	JT65	EME
28/12/2006 20:12	W5UN EM23MG	O	2 m.	JT65	EME
30/12/2006 22:55	OK1DFC JO6ØRN	O	70 cm.	JT65	EME
03/01/2007 23:48	RU1AA KP4ØXD	O	2 m.	JT65	EME
04/01/2007 00:04	OZ1LPR JO44UW	O	2 m.	JT65	EME
04/01/2007 00:35	RA3AQ KO85JE	O	2 m.	JT65	EME
04/01/2007 00:54	HB9Q JN47CG	O	2 m.	JT65	EME
05/01/2007 01:12	SM7BAE JO65	O	2 m.	JT65	EME
05/01/2007 01:38	DL8GP JN39LH	O	2 m.	JT65	EME
05/01/2007 01:50	K9MRI EN7ØIU	O	2 m.	JT65	EME
05/01/2007 01:58	W7MEM DN17OT	O	2 m.	JT65	EME
05/01/2007 02:42	I2RV JN45PL	O	2 m.	JT65	EME

It is not a large log but it was my first EME activation in a far destination and I had a lot of problems including some AC blackouts, one tornado, raining a lot, domestic injury, etc. I learned a lot for future activations because I hope to come back this or next year. I left the antennas (two for 2m and 1 for 70cm), one power supply, one swr/watt meter and the coaxial cables.

Thinking about the future, the next time I hope to bring with me a second 70cm antenna and both bands Rx preamps. I need to finish my 2m 500w amplifier and look for another one for 70cm. I would like to try 23cm as well but it looks complicated. I have a 23cm capable radio and one antenna (55el) but I would need a Tx power amplifier and even a Rx preamp. We will see... Of couse, next time I'll try to get internet access at HK1DX home and antenna rotators.

If anyone is interested, the HK1DX call is located in the "Puerto Balsillas" apartments which are for rent.

I want to thank to many of you for trying EME with me and I want to say "I am sorry" to many people I did not hear. I am very pleased to confirm to some guys HK/SouthAmerica by EME on 2m and 70cm bands.

Thanks to Manuel-EB1DEY, Gabriel-EA6VQ, Rod/Grupo HG-EA7JX, Dithmar-DF7KF, CushCraft and my lovely wife Luz Elena. This activation is dedicated to Pepe – EA1TA (SK).

Thank you. 73, Maximo – EA1DDO / HK1DX
EA1DDO@Hotmail.com www.EA1DDO.es
www.HK1DX.com www.PuertoBalsillas.com

EME News

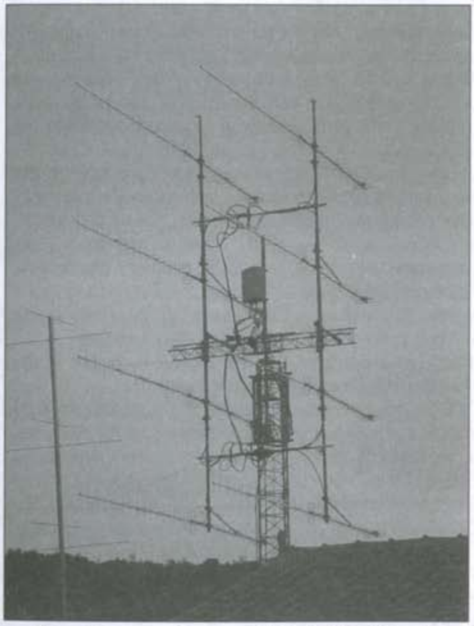
70cm & up

Editor: Bernd Wilde, DL7APV

Intro

2007 contest season has started. Condx and participation are as always, so and so. On the 20m net came the idea to reinstall the QRP section 025-030 on 70 & 23CM. Let me or K1RQG know about your choice.

ARRL contest results are not officially published on the ARRL web page, but this year we had a lot of confusion about the score and a lot of check-logs. Lets see what will be published. I missed the REF/DUB contest due to high winds here. Several expeditions and many new small stations on JT65 coming up on 432 so we hope for more activity this year.



New 70cm xpol array. 8*26el. 8.5wl H pol, 8*20el. 6wl V pol. from SV1BTR - but performance problems

432 MHz

Feb. Activity Period

G3LTF: wkd: SM2CEW, UA3PTW, SV1BTR, NC1I, OZ4MM, OZ6OL,K2UYH, Heard UT2EG. Condx seemed quite good. It was dissapointing not to find more US stations active, its a long time since I worked a new US station on 432 MHz!

OZ6OL wkd: UA3PTW, VK4AFL, DL7APV, NC1I, SV1BTR, OZ4MM, UT2EG, G3LTF, SM2CEW.

OZ4MM wkd: UA3PTW, VK4AFL, SM3BYA, DF3RU, UT2EG, DL7APV, NC1I, OZ6OL, SM2CEW, G3LTF, DL7AFB, SV1BTR & K2UYH. Hrd EA3DXU with 449 signal.

NC1I: wkd SV1BTR, K3MF, OZ6OL, UT2EG, OZ4MM, G3LTF, SM2CEW, DL7APV (I believe it has been MANY years since my last QSO with Bernd), K2UYH 55/55 solid SSB signals. I started listening and calling CQ at around 0330 but nothing was heard until 0400 and then suddenly several stations popped up. It seemed like everybody waited for 0400 like it was the start of a contest. At 0600 everyone disappeared. Frank

SV1BTR wkd: NC1I, UA3PTW, UT2EG, OZ6OL, G3LTF, OZ4MM, SM2CEW, DL7APV, K2UYH.

DL7AFB within the past I improved my station continously and did some nice qso's in both, CW and JT. In my eyes JT is a fantastic mode, making it comfortable to work stations at the edge of perceptibility, in particular for small stations with 4x22 yagi and 700Watts like me. Bodo wkd in dec SM3JQU (O/O CW), PA3CSG (O/O-CW), OZ4MM (O/O-CW), EA3DXU (-16/-20) & OK1DFC (O/O-JT:-13/?). In Jan ZS6WAB (-23/-22), who was using just 160 Watts into a 5m dish. On Jan, 7th I completed random qso's with K3MF (O/O-JT:-25/?) and G3LTF (559/449-CW). Jan. 27th UA3PTW (559/549-CW) & DF4UE (-23/-20) - also just 4 yagis. After several MNR-blocked attempts I've got a call from Terry, W7AMI, who uses 4x33 FO Yagis. We completed our qso with (-24/-23). That night I worked also OZ6OL (CW). On Feb. 1st I had qso with Salvo, DK3SE (-26/-25), who uses 4x21 Yagi. On Feb. 2nd S53RM (-22/-22), who used 8x26 and 700 W & EA3DXU agn (-17/-24). On Feb. 3rd I tested with Jimmy, SV1BTR, who put some nice 559 signals in speaker quality, but unfortunately he did'nt copy me. For more see www.dl7afb.homepage.t-online.de/eme/eme.htm best regards Bodo

DUBUS/REF Contest

EA3DXU: I was QRV only time to time, unfortunately the CW activity was very low and still decrease, I remember the good " old days " when in the same contest I was able to complete 30 QSOs running 500W, now 6db more power, better preamplifier, same antenna only 12 QSOs. I am not sure if CW hams are running in right way. Worked: VK3UM, SV1BTR, DL9KR, KL6M, G3LTF, UA3PTW, HB9Q (called on CW in his JT65B QRG), G4RGK, SP6JLW, VK4AFL, OZ4MM, SM2CEW. I see some regular big gun was not QRV, hrd other small stations impossible to recognize in my small 2 yagi, 73 de Josep

DL4MEA: Günter activated 70cm in the REF/Dub contest. I decided to build the loop feed for deep dishes that CT1DMK presented. This time I found a new situation than in the many years of EME before: I was receiving much better than transmitting! I heard many stations clearly and without big problems: DL9KR, K1FO, UA3PTW, SM3AKW, G4RGK, EA3DXU, DF3RU, K2UYH, SP6OLW. But I only had QSOs with G3LTF, KL6M, SV1BTR and OZ4MM. I worked: (24.03.2007) G3LTF, KL6M, SV1BTR, OZ4MM, (25.03.2007) VK3UM and K2UYH. I got QRZ from UA3PTW, SM3AKW, DK3WG, SM2CEW. I heard DL9KR, K1FO, DF3RU, EA3DXU, RW1AW, SP6OLW(?), G4RGK, RW1AW. I'm happy to be back on 70cm, even when the band is totally spoiled with noise. Rig: 4.5m dish, loop feed (CT1DMK) hor-vert, KA0RYT preamp, GS35b, abt. 1kW at the feed, FT847, Wideband-Winrad. Sun noise measured at 9dB. Thanks for all the QSOs and sorry for those who did not hear me. 73, Günter

DL9KR: Dear CW friends, sorry about spending 1,5 hours in the contest on Saturday only. Family commitments had priority. Much distracted by commotion. Conditions mediocre and quite unstable. Worked VK3UM, EA3DXU, SP6JLW, KL6M, UA3PTW, SV1BTR, YO2IS, OH2DG, OZ6OL, G4RGK, W8TXT (unexpectedly early!),SM2A, DF3RU, RW1AW and F3VS. Heard FR5DN, OZ4MM and G3LTF, all 579. Hope next DUBUS won't coincide with grandchildrens' birthdays. TNX & 73! Jan

F2TU: Best the contest since 2000 on 5.7Ghz. 11 qsos including initials: Big Dish 8N1EME ssb 59/59 # 22, JA4BLC O/O # 23 (2.5m - 20w), WD5AGO O-529/O # 24 (2.5m - 25w). At my moon rise, the first qso with 8N1EME was 559/559 with my dish blocked on more than 60% by the mountain! The surprise was JA4BLC qrp, unexpected on 6cm, in random. On 10GHz, 12 qsos. All already contacted. But disappointed not to have qso VK3NX obstructed by its trees for my window, IK3RTI not qrv (too many wind) and W5LUA its broken relay on 5.7 & 10GHz. To hold 1 day for the 5.7GHz and 1 day for the 10GHz is excellent. It's a pity that all did not follow. On 70cm, only 1 hour qrv with 11 qsos. Best 73 Philippe

FR5DN: the stations worked during the contest : 24/03/2007: UA3PTW, SP6JLW, KL6M, VK3UM, G3RGK, G3LTF, JA6AHB, OH2DG, SV1BTR, RW1AW, SM3AKW, DK3WG, DF3RU, RW3PX, YO2IS, K1FO, F3VS, W8TXT, OZ6OL with MOON AT <1°, 25/03/2007: VK3UM, OZ4MM, SM3JQU, G3LQR, VE6TA (VERY loud on some sequence) SM2CEW (Very LOUD !!) K2UYH (loud to barely audible) SV1BTR was loud most of the time. Heard/called were: EA3DXU, SM2BMZ, JH0WJF, SP3??P, DL9KR (really very weak on some sequence) Very little activity on sunday. Sri for stations who answered me, I know there was someone calling, but impossible to get the call correctly. Vy73 Phil

OZ6OL wkd: VK3UM, KL6M, SM2CEW, G3LTF, SV1BTR, DL9KR, SP6JLW, UA3PTW, FR5DN, OH2DG, K2UYH, SM3AKW, SM3BYA, DL1YMK, G4RGK, OZ4MM, JA6AHB, DK3WG, VE6TA, K1FO. Hrd, but not wkd: RW1AW, F2TU, DF3RU, W8TXT, SM2A, EA3DXU Still fun working stations in cw random with no internet/logger/telephone back-up 73 Hans 5m dish 600Watt

SM3BYA: on Saturday the ionosphere at 62 N was pretty disturbed during the day. Signals came and went in a space of just a few minutes or less. When working Peter/CEW at 1257 UT, he reported strong aurora. Having only 550 watts at the antenna and not being able to rotate polarisation in those conditions makes for hard going. There was also a brief disturbance Sunday afternoon, but not as strong as the one on Saturday. Wkd: UA3PTW, SM3AKW, VK3UM, KL6M, G3LTF, JA6AHB, SM2CEW, FR5DN, VE6TA, OH2DG, SV1BTR, SP6JLW, SM3JQU, G4RGK, OZ4MM, F2TU and OZ6OL. Cwnr K2UYH (30 min) wkd: K2UYH & K1FO. Had to work unusually hard for both contacts. CWNR or hrd: DL5FN, DL9KR, DF3RU, DK3WG, EA3DXU, F3VS, RW1AW, I5CTE, JA9BOH, JH0WJF, NC1I, SM2A and VK4AFL. Many of these were weak, watery and chopped up by scintillation and seemed to come on for just a QSO or two and then disappearing completely. 73 and thanks to all Gudmund

SM3JQU: During Saturday we had a birthday party for my children. Family from grandparents to cousins where gathered. In the afternoon I think it was some 8 to 10 people from 4 to 74 years old, visiting my shack (<2m2 open floor) to listen to eme. With excellent timing we got the cq from SV1BTR and made a speaker level qso! All of them knowing my hobby but newer heard an eme signal before. This time I also got very nice echoes' from my neighbours' SM3AKW and SM3BYA at a level never heard before. I managed to make a recording of SM3AKW with tropo+as+eme signals´ at the same time. Saturday: UA3PTW, KL6M, SV1BTR, SM3BYA, SM3AKW, G3LTF, OZ4MM and at the time only qrz from FR5DN. Sunday: VK3UM, FR5DN new#, K2UYH, G4RGK. Qrz from EA3DXU, DK3WG, K1FO. 73 Per 4*32el h-pol 1kW and ~0.4dB NF

SP7DCS: I had a great time this year during contest. System is still 4 x 25el (open-wire) and 200W at shack (when cold hi hi). I can say that I have maximum of 150W at antenna. I made 2 qsos - congrats to Stig and Mike for great RX. Log: OZ4MM RO/O #5, KL6M O/RO #6. I also heard: SV1BTR, VK3UM, DL9KR, K1FO, G3LTF, K2UYH, UA3PTW, SP6JLW, DL1?MK?, VK4AFL, FR5DB, SM2CEW, RW1AW, DK3WG, VE6TA, SM3BYA, G4RGK. Also VK3UM had great signal. I was calling Doug a long time and we close to make it. VY 73 ! de Chris

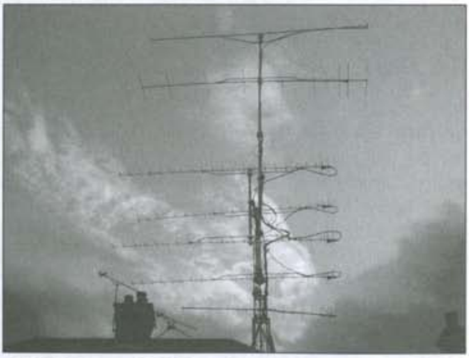
SV1BTR: had a guest operator, who has come in the shack for the last months and has decided to stay. This is Mr Murphy. Jimmy had a elevation actuator stopped working right at moonrise, 15 yr old transceiver went dead, flashovers in an amp. Therefore he lost 5+ hrs of activity, rx is still 2db down in receive, and noise pickup is 4-5db higher than before. Jimmy found no activity from US/Canada, except 6 stations. Congrats to them and a big thank you! For those absent, pls remember that despite its title of EU EME Contest, this is a first class worldwide, truely random, EME Competition, so do not get confused by the (EU) name contest being continent selective., hi.

Wkd 32 (29 Sat / 3 Sun), compared to 37 in 2006 (when i had only H pol. back then). Those were: KL6M, SP6JLW, UA3PTW, VK3UM, EA3DXU, OH2DG, SM3AKW, RW1AW, F3VS, G4RGK, FR5DN, DF3RU, G3LTF, RW3PX, OZ6OL, GW3XYW, JA6AHB, YO2IS, DL9KR, K2UYH, VE6TA,

SM3JQU, DL1YMK, SM3BYA, W8TXT, K1FO, DL4MEA, OZ4MM, F2TU, JH0WJF, SM2CEW, NC1I. Finally, a personal observation: It has been extremely rewarding to me, to see, not a single self spot, not a single online sked request, any online chat, any qso exchange info, during the 70cm cw section. 73, Jimmy

VE6TA: Had an enjoyable time again this contest despite the substantial ionospheric disturbance at high latitudes and the shortfall in active stations. The auroral effect caused polarity spreading at low elevation angles and and extreme QSB on the weaker stations. Despite this, I managed to work 3 new initials to bring me to 122 on this band. Wkd: G4RGK, JA9BOH, JA6AHB, KL6M, W8TXT, SV1BTR, SM3AKW, RW1AW, G3LTF, SM3BYA, DF3RU, OH2DG, UA3PTW, K1FO, K2UYH, F2TU #120, OZ4MM, VK3UM, SM2CEW, SP6JLW, FR5DN, OZ6OL, F3VS #121, I5CTE #122. Stations went from extremely weak to extremely strong as G3LTF has remarked, within an hours time. Hrd: EA3DXU, SM2A, DK3WG, VK4AFL, and DL7AFB. We need more stations on to keep the critical mass going. 73's Grant

VK3UM: Doug had high winds at NA window on Saturday 24th March (>80kph). The conditions were the worst I have experienced for a very long time. Polarity was changing rapidly and over a wide range, deep fading was evident for the whole period as well. On top of all that Libration was most significant as well. It required considerable patience with the smaller stations to wait until polarisation and QSB combined favorably. I learnt later from Peter SM2CEW that there was considerable Aurora activity Wkd: 24/03/2007 JA6AHB, UA3PTW, SM3AKW, SP6JLW, RW3PX, SM2A, SM3BYA, OH2DG, KL6M, EA3DXU, G4RGK, SM2CEW, DL5FN, JA9BOH, G3LTF, SV1BTR, OZ6OL, DL1YMK, OZ4MM, FR5DN, DL9KR, 24/03/2007 K2UYH, VE6TA, RW1AW, SM5IOT, S53J, F3VS, SM3JQU, DL4MEA, DL7AFB for 30 QSO's Multipliers 27. Regards Doug



G8VHI new 432 4yagi group ready for EME

YO2IS: was pleased to run again the annual DUBUS contest, as usual on 432 MHz. Rig, antenna and.the op in good shape, Murphy stayed away, mixed conditions with spectacular " up's / down's ". Saturday was able to get 4 QSO's in one hour, two of them DL9KR and G3LTF on my CQ !, that happens rarely here, no echo's at all ! By surprise heard KL6M, this time eastwards, was able to get a solid QSO sunday, he realy did move the S meter!. Saturday results, all QSO's betveeen 14.15 and 14.55, SV1BTR O/O, FR5DN O/O always solid copy, DL9KR 579/559, G3LTF 569/539. The evening showed good activity, but all where CWNR: G4RGK, K1FO, K2UYH, UA3PTW, RW1AW, DF3RU, SM3AKW, SP6JLW most of them called for 30 minutes, not a single QRZ!. Sunday the story followed the same way, again 4 QSO's from 13.20 to 15.20, OZ4MM O/O, KL6M O/O, SM2CEW 559/439 JA6AHB O/O, then nothing more on the evening. For the first time was able to work 4 continents during an EME contest Eu, Af, NA, As from my downtown location with elevations over 40 degrees and a more than a dozen of loud birdies in the first 25 KHz of the 70cm band. Do remember the silence and strong EME signals back in 90's.had 42 QSO's in the 1992 ARRL EME contest. Am still working on the new 23cm EME project, its a slow one. 73 Szigy.

432 & up (net) news

DL1YMK made a major repair action with Monica's help on the damaged dish. Put new mesh panels in for those 'blown by the wind'. Looks that the structure is not skewed at all, which is a kind of miracle to me, regarding the gales it had to withstand. Garden looks like test range for cruise missiles, incredible, lots of work for the chain saw. Will try to repair 70cm array next week, if weather permitting, hope the elevation gear is ok still, looks like the H-frame is bent in the gear itself, should be repairable by changing the aluminium tubing.

G0SXC: Kevin, interested to set up EME station, has acquired 8 acres and can maybe get on 70cm. CW is prime interest.

G4RGK: bad storms around, but survived with minor damage, will be on 23cm for a while.

G4DDK: it seems like I didn't get away without damage to the dish in the recent wind storm, after all. A hinge pin had worked loose on the polar mount leading to the scissor jack collapsing back against the verical mount. This in turn bent the top hinge support plate. I think I have repaired the damage, but perversly the bent plate may give me a couple of degrees more negative declination! The main culprit seems to have been vibration from the dish with the strong, gusty wind that reached 99MPH (160kph) on the local coastal headland. All the terrestrial antennas survived without damage. It guess they are not big enough. I also found rain water in a receive - feed N coupler on the dish. This may explain the 'funny' noises on receive that caused me to fail on a couple of skeds late last year. I hope to be back on 23cm EME again soon. 73 de Sam,

OE5MPL: Peter is a relatively new 70 cm EME station that operates from a ham location in JN78cj away from his home QTH. He runs ~500 W on 70 cm to a 4 x 21 el yagis array.

RW1AW worked on three bands: 3cm, 6cm and 70cm in the REF/DUbus contest. It was very difficult to distribute in regular

intervals time active. The maximum of time has chosen for SHF bands and it is especial 5.7GHz for work with new stations. I was afflicted with problems with LNA for 70cm, it appeared badly. Many thanks for high activity on 5.7GHz and 10GHz bands! AURORA and Mr. Faradey did not prevent to work productively on these SHF bands. Log 5760: VK3NX 559/559, 8N1EME 599/599 #, ES5PC 539/579 #, OK1KIR 569/569, IK2RTI 569/569, F2TU 569/569, 8N1EME 59/59+20 SSB, LX1DB 58/55, OE9ERC 569/569 #,WD5AGO O/RO #. My congratulations for Tommy WD5AGO! After replacement feeds for work CP - a level. His signal has grown on 2-3dB and him QRP signal on March , 25 very much became confidently audible !
10368: VK3NX 559/559, OK1CA 579/579, F5JTA 559/559, HB9BHU 559/559, SP7JSG 559/559, F5VKQ 559/559, F/DJ2DY O/549 #, GW4DGU 539/539, IQ4DF 599/559, G4NNS 559/539, DF9QX 569/539, LX1DB 569/569, OK1KIR 55/55 SSB good heard DL2LAC.no find W5LUA on March 25
70CM for two busy hours only 15 QSO, the loudest stations were: SV1BTR, DL9KR, OZ4MM, VK3UM, KL6M. vy 73 Alex

SM4IVE: working to put up 70cm yagis again, all is up and running. had two big storms in Jan and a lot of folks off the air. Dish is status quo, no progress at this time.

UZ5DZ: Vlad is temporarily off 70 cm EME while he builds a permanent antenna. He was active during the ARRL EME Contest with 8 x 18 el yagis, a GS35 PA and MGF 1302 preamp. First QSOs on EME were with VK3UM, NC2I, OH2PO and DL9KR. I expect to be QRV again soon.

VA7GO: bad winds and destroyed a dish, plans on building yagi array for 70cm.

WA9HIR : worked on 432 el rotor, and now working. now to make plate to mount on tower.

1296 MHz

F5JWF: I worked on January 26/27 on 23cm. It was my first trial with my brand new station and surprised, for my first key down, I could hear my echoes about 8dB above the noise. I was working with LDMOS PA which give 130W and I have planned to couple few such device in parallele to get little more power. I use the same 12 foot solid dish with home made tracking than for 3cm. The feed of the antenna is base on OK1DFC septum. I worked in CW LA8LF, LA9NEA, ON7UN, OK1CA, LX1DB, K5JL, ES5PC, RW1AW, IK3COJ, G3LTF Then few stations in JT65C: ES5PC, ES6RQ, SM5LE, JA6AHB Of course all of them are for initial. I will now spend some time to get this system heavy-duty and waterproof, specifically the 26V power supply which was temporarly installed in the food of the mast. On 24/25 feb I worked the following stations on 23cm. In CW: VK3UM, HB9BBD, JA4ZZS, F2TU, LA9NEA, DJ9YW, K9SLQ, VE6TA, KL6M, OK1CA, 8N1EME, LA8LF, OZ4MM, In JT65C: SM5LE In SSB: F2TU amazing that SSB QSO was possible. A lot of rain on my side but hopefully my new station is now more or less waterproof. Conditions: 3.7m 120W in the focal point NF=0.7dB. Best 73's to all / Phil

G3LTF: I was only able to be active for a short time in the **SSB contest** 12.15-1430 but I had fun and there was quite a bit of activity . Worked 9 stations on ssb, OZ6OL, VK3UM, VK4AFL, OH2DG, LA8LF, OK1CA, ON7UN, LX1DB, DL0SHF. Heard SM4DHN working stations but never found him calling CQ. On CW I worked SM5LE and heard VK4TL and LA9NEA. Conditions were excellent. 73 Peter

OZ6OL: The weather was not good for the **SSB** contest. Snow, shower, frost & wind forced me to stay in the radioshack (he he) and not remove the 70CM feed from dish to get a little better performance on 23cm, but the condition was good and I worked 16 stations: VK3UM, OK1CA, RW1AW, G3LTF, LX1DB, ON7UN, DL0SHF, GW3XYW, K9SLQ, IZ1BPN, OH2DG, VE6TA, LA8LF, K5JL, K2UYH, and W7BBM. heard were: WA6PY, K5GW, IK3COJ and more. RIG is all home brew tranceiver etc and with SSB RF clipp. was the modulation easy readable? 5M DISH, 250W on feed. Thanks for the QSO Hans

SM5LE: reports on Jan SSB contest: Nice activity, even though I did not mange to work any SSB QSO. I did hear LX1DB and DL0SHF 55 but I have only 200 W SSB so there was no response. BUT I had a nice Activity Weekend anyway tnx to all that did some CW (and JT) after SSB contest QSO:s. Did work : JA6AHB JT65, F5JWF JT65 #, ES6RQ JT65 & CW #, G3LTF CW, LA8LF CW, LA9NEA CW, OK1CA CW, K5GW CW, K5JL CW, LA8LF CW, RA1AW CW, G4DZU JT65, W5LUA JT65. In Feb wonderful weekend again! Exiting Big Dishes projects. I did 8N1EME (32m) and AD6IW (30m) on CW. Heard some SSB also. Also some other random CW , tnx for repeated QSO:s . In DUBUS dig. contest I did #13 QSO , all on random. Weakest -26dB and strongest -11dB. 73 Sven 2,2 m dish Sept. feed 250W/ 0.4 dB, 7dB sun

WA6PY was on 1296 for **SSB** EME Contest Jan 17 and QSO'd on CW K5JL LA8LF, VA7MM, IZ1BPN, then on SSB LX1DB, K2UYH, IZ1BPN, LA8LF, VE6TA. On Jan 18 I called CQ. Someone very weak called me but I needed few more sequences to get callsign. Then K5JL called me and told that KL6M was calling me. After QSO with K5JL I called KL6M, and Mike was quite good copy with me. He was about 100 Hz below K5JL. This other weak station was about 350 Hz below. After KL6M I called again QRZ, but did not heard this other weak station anymore. I should be able to QSO him, but I needed few more sequences to copy. Please remember that I have only 3.6 m dish f/D=0.36 under illuminated with W2IMU feed. VY 73 Paul

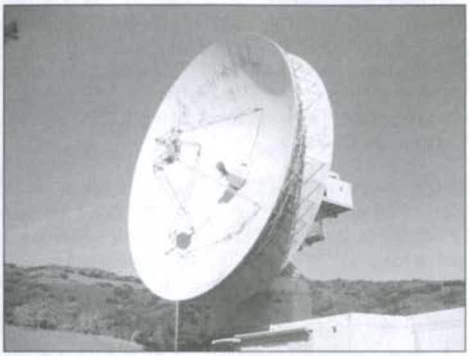
Jamesburg Dish: Huge successes this weekend! Echoes were up as high as S9, with S2-S5 average. Dish gain estimated at 46 dB actual vs 49dB ideal. Contacts were made with 19 different stations in Japan, North America, and Europe.
AD6IW contacts: JR4ZZS cw/ssb, KL6M, VE6TA. K9SLQ, W6YX, LA8LF, ES5PC, WA5WCP, WA6PY, IK3COJ, WW2R, UR5RX, M0OY, W5LUA, DF3RU cw/ssb, K5GW cw/ssb, SM5LE

W6BY contacts: JR4ZZS

N9JIM contacts: JR4ZZS, JA6AHB, JR4AEP

Lots of help to make this first weekend operation work after 4-5 months of preparation. AA6EG, W6BY, N9JIM, AD6IW, KK6MK, N5XSA, KF6ZEO, WB6DCE, AA6IW, AD6FP, Rico, Andre, Jeff, and many more! Rig: FT817, Transv. 60W into VE1ALQ circular feed, feeding cassegrain **29.7 M dish**. RX was .7dB LNA after abt 2.5dB losses thru LMR600, Sun noise was 20dB. Dish positioning was done manually by reading the F1EHN outputs, and twisting the control knobs on AZ & EL. Our best tracker was Rico with 0.01 deg accuracy for an extended period. http://www.jamesburgdish.org/ . The group will be active again on several occasions in the future.

AD6IW, Goran & Jim, N9JIM/6 & the Jamesburg crew



30m Jamesburg Dish on 23cm EME

2320 MHz

DL4MEA: Günter repaired his 13cm PA and extended his dish to 4,5m. Now he was able to read even his SSB echos nicely without filtering. Thats really great. In SSB contest Günter hrd SSB ON7UN 42, K9SLQ 52, DL0SHF 53 and LA8LF 42. While repairing and optimizing the 2nd stage preamp to the ATF35076 optimum NF parameters, at 0130 local time, my wife came into the shack and asked for a lift to the hospital. Well, the reason is male, his name is Stefan and was born on 27.01.2007 at 12:15. After reinstallation of the 2nd stage outside and in the short time that I had to listen to the moon there were nice signals of K5JL 57 and again K9SLQ 57. TX on 23cm will follow soon. 73, Günter

RW1AW wkd 30/31 March all random: DL4MEA, IK2RTI # - first UA-I on 13cm, IW2FZR #. 73 Alex

3400/3456 MHz

Putting together the info from Al, W5LUA and Greg, NA4N plus a few web page visits I think we have the following truely active stations. It would be helpful to update/ correct it and get it in the EME news letter and net notes . In the QRG column "T/R both" means the station can make QSOs on either band and work cross band.

The good news is that it looks like most people can work 3456 and so crossband may not be needed very often.

The bad news is that the polarisation is pretty mixed and if we are ever to get this band into the sort of shape that 13cm is now getting to, i.e. QSOs with 3 continents in a single days moon pass just like on 23cm we surely have to go circular eventually.

(Obviously power helps, if someone runs 200W and linear I'll hear them OK on my CP, but they may not hear my 30W CP on their linear pol.)

Anyone have any ideas about a date for an activity period in the next few months, the DUBUS weekend 21st April would be natural but its already very busy with the KH7 expedition on as well? How about May 20th?

73 Peter G3LTF

CALL	QRV status	QRG	Polarisation
LX1DB	QSOs	T/R both	linear?
G4NNS	QSOs	T/R both	Circ + lin
OK1CA	QSOs	?	?
OH2AXH	QSOs	3408	?
W5LUA	QSOs	3456	Horizontal
WA9FWD	QSOs	3456	Horizontal
VE4MA	QSOs	3456	linear
OE9ERC	QSOs	3456	circ
G3LTF	echoes	T/R both	lin, building septum
G3LQR	heard sigs	T/R 3400	lin
VK3NX	building	???	undecided
W6BY	building	3456	circ
NA4N	building	3456	lin

5760 MHz

GM4ISM: exactly 1 week before the weekend if the 24/25 March, I decided to throw a 6cm EME station together. The aim was to work 8N1EME, with a 1.8m dish. I ended up with 50W Tx power and a 1dB nf. This system still had plenty of margin for 8N1EME, they were a genuine 579 at one point, and I exchanged 559 449 reports with them. Following the QSO, I tried with several larger European stations, but no QSO resulted. Hrd F2TU, RW1AW & OK1KIR. A few photos of the system can be seen at www.dc2light.co.uk/6cm.htm

Mark

VK3NX: wkd Dubus contest 24th: RW1AW, 8N1EME, OK1KIR, F2TU, heard W5LUA, IK2RTI (?). Regards Charlie

10 GHz

VK3NX: Optimized his system & can hear echoes for the first time. With vertical polarisation he wkd RW1AW with a very easy QSO 559/559. He would like to thank the many people whom have responded to my technical questions and rendered assistance over the last few months and have helped me optimise my system to this point. In Dubus contest he wkd: 25th: OK1KIR #, RW1AW, OK1CA #, DF9QX #, heard F2TU, F5VKQ. Regards Charlie, 3.7M dish

RW1AW: On February, 27 in 12.30-12.42 UTC the first 10GHz EME QSO AUSTRALIA / RUSSIA took place. Force of a signal EME setup Charlie VK3NX (559/559) has allowed me to accept his signal on Loudspeaker of mine TS-2000. Many thanks for new initial and DXCC on two bands: vy 73 Alex

On March 30th, Jim, **N8ECI** & **KA8ABR** hrd their own echos with 10 db at the old Voice of America shortwave transmitting site located just north of Cincinnati, Ohio. RIG 7,2m dish (F/D = .3), preamp 0,6db/ PA 8W. A sequencer won at the '04 EME conference in New Jersey controls all switched sub-components. The dish and mount was built by Vertex/RSI in '90, and it was removed from service and abandoned in position in '94. Unfortunately, the mount is a degenerate alt-az system that can only point between 120 and 240 degrees azimuth. The EME station is located near 39.10 degrees north lattitude and 84.51 degrees west longitude. Station call is **WC8VOA**. For more see www.wc8voa.org. Tnx to G4HUP, I2PHD, W5LUA, W1GHZ, WA3ZKR, the Engineering Department at Vertex/RSI in Kilgore, Texas. The moon looks different to me tonight! 73 Mike Murphy **KA8ABR**

OK1CA: wkd in Dub contest SP7JSG #, G4NNS, IQ4DF, HB9BHU, GW4DGU #, W5LUA, F3VS #, HB9SV #, WA6PY #, OK1KIR, RW1AW #, DF9QX #, VK3NX #, F5VKQ #, F5JTA #, F2TU, DL2LAC #, LX1DB and F/DJ2DY # 27. 73 Franta

F5JTA: wkd in dubus test OK1CA, RW1AW, HB9BHU, F2TU, F3VS, IQ4DF(1), IQ4DF(2) DF9QX , LX1DB, QSO nc with F5VKQ, CWNR: WA6PY, F/DJ2DY. Comparison with previous contest in 2006 shows big improvements on DF9QX signal level and HB9BHU reception sensibility. 73 Guy, 3,5m Cassegrain dish

Expeditions

8N1EME: I would like to report you with great pleasure that the performance of IBA-4 EME antenna was surperb. The idea to use loop feed for low bands using the subreflector as a ground plane seems to be the best and ideal, and contributed a lot for multi-band operation of this big dish.

MHz	QSO Total	CW	SSB	JT	SSB/ CW
144	154	11	1	142	0
432	67	34	2	31	0
1296	71	50	21	0	0
5760	31	23	6	0	2

8N1EME QSO breakdown

ALL TOTAL 323 EME-QSOs including dupes. We performed slide lectures and open-house experiment on March 03, with some 100 attendants. Several school boys and a girl came to the IBA-4 EME class on 1296 MHZ, to listen to the echoes of the anouncement of their names by USA EMEers. In spite it was after mid-night, Al K2UYH, Wayne K9SLQ and J. K5JL came in the EME class. Their efforts contributed a lot to our educational activities of the project.

An eleven-year old boy with the first class amateur license joined us to contact with K5JL on 1296 SSB. Perhaps this is the world record of the EME operation by the youngest amateur. We would kindly offer you the most heartful thanks to you and your engineering staffs of Czech Technical University. The round septum feed of 1296 MHz, made by OM2ATT, showed the best performance for our BIG-DISH system. QSL via JH6RTO. QSL cards to someone who had QSO will be issued in a few months. We are happy to send our QSL to a SWL too. Send us your detailed reports! For more details, visit our site: http://8n1eme.jp
Mike, JH1KRC & Seiji, JH6RTO

BY China EME Expedition

DL3OCH, is again on tour. He will be in BY end of May. He plans to make some EME operation on 1296 with his single yagi. After some mails to BY OMs they are very interested to make some more at the BY4RRR club station located in a school. The EME location and the final EME call are not fixed yet, as well as a possibility for a big dish. The school, is located in the city of Nanjing (7 Mio inhabitants) with lot of QRM, the contest location from B4R is abt 30km outside with less qrm level. Cw will be preferably, but with a single yagi it will be the first JT65 operation from BY. More news will follow, as the BY HAMS are very motivated to do more on EME in the future maybe. Bodo will try what ever is possible. 73 de Bodo, DL3OCH (BT4EME), www.dl3och.de

TF/DL1YMK: will be qrv on 70/23/13cm 9th of May to 1st of June from HP84US in Iceland. They will have 1kW+ on 70, 600W on 23cm and 200W on 13cm. The WX situation is much more risky compared to sunny South, but as they say: no risk, no fun. In the following here is our operational plan:

May	UTC	UTC	QRG	Remarks
12	0500	1000	1296.035	Random
12	1000	1400	1296.045	Skeds
13	0500	1200	432.035	Random
13	1200	1600	432,045	Skeds
14	0500	1800	432,045	Skeds
15	0500	1900	1296,045	Skeds
16	0600	2000.	1296,045	Skeds
17	0700	2200	2320,045	Skeds
		RX	2304,045	
18	0700	2000	2320,045	Skeds
		RX	2304,045	
19	0000	2359	1296	Dubus-Contest
20	0000	2359	1296	Dubus-Contest
21-24			Open	(JT65??)

We think to be QRV via internet with email access except further notice on moon-reflector. Generally, we will be active on the random frequencies after any sked completed, but we kindly ask people to keep the sked frequencies clear from calling in, because in CT3 we learned that we lost some potential QSO's with weak stations. Tailending is absolutely no problem, if done on the random frequency. I hope to increase our efficiency by this procedure. If there is no interest in skeds any more during the designed sked slots, we automatically will tune on the random frequencies. Many thanks in advance for your reliable assistance.
vy 73/88 de Monika & Michael

Bruce Clark, **K0YW**, with the support of the OAHU Contest Club, K5GW with Texas Towers, W5LUA, K5JL, WD5AGO, WA5WCP, K1RQG, and many others put KH6 on 23 and 13cm EME. The expedition dates were: 19 April thru 28 April, 2007. The location was the contest station of Alex Benton, KH6YY, BL11CG. EME-Call: **KH7X**. Only CW/SSB. QSL's will be handled by N2PF. QRG 1296.020 MHz + 2304.050 MHz. RX also on 2320.050 / 2424.050 MHz RIG: 23 cm TS-2000 + Transv. 400W. 3.7m dish. RX 0.28 db NF. 13cm DEM 2304 Transv. 0.4 db nf/150W. 73 K0YW k0yw@frontier.net and the KH6 Gang (KH6ND, KH7U and KH6YY)

Silent Key

DJ8QL passed away in January at age 87. Franz started 70cm EME in summer '78 and moved to include 23 cm EME without much delay. An avid experimenter on VHF through EHF, he also was a member of the Marconi-
Award-winning DF0EME group (23 & 13 cm EME). Franz will be remembered as an outstanding partner and friend. 73 Jan DL9KR

73 Bernd DL7APV

EUROPEAN EME Contest Digital - Feb. 24/25, 2007

Results 432 MHz

1	OH2PO	44100	21	21	QRO MULTI
	(OPs: OH2HYT, OH2PO)				
2	UT3LL	1600	4	4	QRP SIN
3	JA6AHB	900	3	3	QRP SIN
4	OK1TEH	400	2	2	QRP SIN
4	S51ZO	400	2	2	QRP SIN

Results 1296 MHz

1	SM5LE	14300	13	11	QRP SIN
2	OK1KIR	13200	12	11	QRP MULTI
	(Ops: OK1DAI, OK1DAK, OK1DCI, OK1VAO)				
3	PA3FXB	11000	11	10	QRP SIN
4	JA6AHB	3000	6	5	QRP SIN
5	LA2Z	2500	5	5	QRP SIN
	(Op LA6MV)				

Soapbox

LA2Z: First try on JT65. Some problems to make it work, then finally able to run quite weak signals.

OH2PO: Equipments were home made ~16m dish and QRO power. All QSOs made using JT65B. RF-conditions felt excellent while we were on air. Too bad weather: Had several problems with dish and so operated only at the first moon pass. Rotation system crashed at start of first pass, got fixed over 6 hours after workable elevation. Rotation crashed again at beginning of the second pass. Second crash was major. Calculated, that fixing it would take so long, that contest would have been over - so choose to wait warmer weather before fixing. This is my first contest log to abroad and first ascii log, so please inform any mistakes. Jyrki Malinen / OH2HYT

PA3FXB: It was my first EME contest ever! I just started EME just a few months ago... My equipment is a TS2000X, PA with 4 times 2C39 which gives me 250W but because of cable loss (approx. 2,2 dB) 150W at the feed. The feed is the OK1DFC septum feed with flare because my dish has a F/D of 0,5 Preamp FHX35 0,35 dB NF. AZ/EL Rotor from Alfa Spid. The homemade dish is 3m in diameter and was constructed years ago. Gain should be arround 28 dB. The purpose of the dish was contesting at our contest station PI4GN. Therefore it is possible to take it apart into 9 parts of about one metre in size, so that it can be transported in a normal car. Putting it together and taking it apart every contest appeared to be rather time consuming, so we used it only once and after that it was parked at my attic...Since then we use a 2m dish for the contest. Works well enough. Because of WSJT I developed interest in EME. There is not so much space around my house and therefore it is not possible to put arrays of 2 or more yagi's for 2m or 70cm in my Versatower. Last year I made a 12el DK7ZB for 2m and a 27el DK7ZB for 70cm to replace my more than 20-year-old Cue Dee antennas. This was sure an improvement! I worked some stations on 2m EME and on 70cm I worked HB9Q with 50W on EME. This made me very enthusiastic for EME. I remembered the 3m

dish in my attic and thought that it would make a nice antenna for 23cm EME. In the same attic there was still an old little tower of 2m high, which once was on the flat where I lived in 1983. It would make a perfect tower for the dish. There is one round terrace in my backyard of about 4m. Just enough room for a 3m dish. There are a lot of houses around me so my moon window is very limited, but during wintertime when the moon is high there are possibilities. My wife was not very amused by the idea of losing the terrace to my hobby, so we decided to put the dish there during wintertime and take it down during summertime. So I am portable in my own garden.
73, PA3FXB, pa3fxb@amsat.org

OK1KIR: It was a really nice contest, we are not very experienced with digital modulation and this contest is great opportunity to improve. We were QRV only on Saturday, but made 12 QSOs. 73, Jan, OK1VAO, for OK1KIR team

Congratulations to all winners!

<u>Reminder</u>

EU EME Contest

23cm CW on May 19th/20th

FAI News

Reports, Info, Theory

Editor: Dom Dehays, F6DRO
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2006 QSO Summary - Part 2 (final)

UT	STN1	STN2	LOC1	LOC2	QRB	QTF/ SCP/ Rem.
			19. June			
1437	G4LOH	IC8FAX	IO70JC	JN70CN	1843	
1440	G4LOH	I8MPO	IO70JC	JN70FP	1853	
1503	F5VHX	YU1IO	JN04FT	KN04IQ	1595	60/??
1529	F8DBF	IK7UXY	IN78RI	JN90DC	**2027**	Hrd
			20. June			
1748	F4DSD	I8MPO	JN23JO	JN70FP	862	70/??
			21. June			
1421	F6EAS	I8MPO	IN98LV	JN70FP	1525	JN39
			23. June			
1536	EA6VQ	YU7XL	JM19MP	JN95NT	1478	
			24. June			
0658	F5VHX	YU1EV	JN04FT	KN04DW	1559	
0706	F5VHX	YU7EW	JN04FT	KN05HP	1578	
0711	G4LOH	YU1EV	IO70JC	KN04DW	**1988**	Hrd
0723	G4LOH	IC8FAX	IO70JC	JN70CN	**1843**	90/??
1020	F6DRO	9A1UN	JN03TJ	JN65TF	975	
1024	F4BWJ	9A1CCY	IN93MP	JN85PO	1457	
1723	I8MPO	EA3DXU	JN70FP	JN11CM	1030	292/?
1744	EA6VQ	SV1BTR	JM19MP	KM18NO	1733	Hrd
1839	IC8FAX	UT5JCW	JN70CN	KN64SN	1640	Buda
1859	9A4EW	IC8FAX	JN95KG	JN70CN	647	
			6. July			
1226	F6DRO	HA8CE	JN03TJ	KN06EN	1512	
1246	F6DRO	OK2ZZ	JN03TJ	JN89DN	1313	JN59
1333	G4LOH	OK2POI	IO70JC	JN99BL	1670	85/?
1803	I4RHP	YO4FNG	JN54QL	KN44HD	1371	
1850	F6DRO	HA8CE	JN03TJ	KN06EN	1512	
1852	F6DRO	S54M	JN03TJ	JN86CL	1196	
1902	G4LOH	IC8FAX	IO70JC	JN70CN	**1843**	
1907	F5VHX	S54O	JN04FT	JN75PS	1164	
1915	F5VHX	YU1IO	JN04FT	KN04IQ	1595	
1917	F5VHX	9A1CCY	JN04FT	JN85PO	1319	
1918	EA3AXV	HA5CW	JN01TJ	JN97PM	1554	
1928	I8MPO	G4LOH	JN70FP	IO70JC	**1853**	Hrd
1934	F5VHX	YU1EV	JN04FT	KN04DW	1559	
1934	F5VHX	YU1EW	JN04FT	KN04CN	1558	
1948	F4DSD	YO2LEA	JN23JO	KN06WK	**1853**	
1951	HA8CE	F4DSD	KN06EN	JN23JO	1265	275/?
2000	HB9AA	YU1IO	JN36BK	KN04IQ	1150	Hrd
2001	F6DRO	YU7EW	JN03TJ	KN05HP	1523	Hrd
2006	S57EA	LZ1ZX	JN76HE	KN32IO	1038	60/?
2007	ER1AN	IC8FAX	KN46KX	JN70CN	1374	
2014	F6DRO	LZ2FO	JN03TJ	KN13KX	1705	Hrd
2014	F1VJQ	LZ2FO	IN95OL	KN13KX	**1870**	
2023	F5VHX	HA5CW	JN04FT	JN97PM	1477	
2023	F5VHX	HA6ZB	JN04FT	KN07BV	1543	
2024	YO2LEA	F1VJQ	KN06WK	IN95OL	1749	
2026	S57EA	LZ1ZX	JN76HE	KN32IO	1038	60/?
2037	F6DRO	YU7EW	JN03TJ	KN05HP	1523	
2039	LZ1ZP	YO4GJH	KN22ID	KN35XG	435	320/? FAI?
2100	TA1D	IV3GBO	KN41LN	JN66OA	1355	
2105	LZ1ZY	IV3GBO	KN13OT	JN66OA	824	FAI?
2131	LZ3GM	IV3GBO	KN32RL	JN66OA	1199	
			7. July			
1138	DH2UAK	G4LOH	JO71FU	IO70JC	1386	Hrd
1140	SP6GWB	G4LOH	JO80HK	IO70JC	1545	
1447	LZ1ZX	IV3DXW	KN32IO	JN65QQ	1116	
2011	G4LOH	IC8FAX	IO70JC	JN70CN	**1843**	
2022	IK0BZY	G4LOH	JN61GW	IO70JC	1638	
2115	F6DRO	OK2POI	JN03TJ	JN99BL	1430	JO20 strong
			8. July			
1731	HA5UK	EA6VQ	JN67OM	JM19MP	1197	
1735	HA1FV	EA6VQ	JN87JJ	JM19MP	1401	
1741	ER1AN	IC8FAX	KN46KX	JN70CN	1374	
1745	HA5OV	EB3DYS	JN97NS	JN11CK	1509	
1752	F6DRO	HA8UG	JN03TJ	JN97OM	1442	JN48 hrd
1802	IK0BZY	LZ1ZX	JN61GW	KN32IO	1167	
1806	F6DRO	HA5OV	JN03TJ	JN97NS	1442	JN48
			9. July			
0829	LZ1ZP	EA6VQ	KN22ID	JM19MP	**1864**	
1313	IK2DDR	G4LOH	JN55GN	IO70JC	1276	315/?
			11. July			
1824	I8MPO	F6FHP	JN70FP	IN94TR	1292	
1853	F6FHP	YU1IO	IN94TR	KN04IQ	1662	JN36
1908	I8MPO	F0EZJ	JN70FP	JN05DK	1266	
1930	F6DRO	IC8FAX	JN03TJ	JN70CN	1086	
2001	G4LOH	IC8FAX	IO70JC	JN70CN	1276	
			12. July			
1915	LZ1ZX	HB9FAP	KN32IO	JN46EW	1521	
1916	LZ1ZX	I1DMP	KN32IO	JN35UB	1545	Buda
1923	IC8FAX	ER1AN	JN70CN	KN46KX	1374	Buda
1942	UT5JCW	IC8FAX	KN64SN	JN70CN	1640	Buda
1943	IW0FFK	LZ1ZX	JN61FS	KN32IO	1176	Buda
1952	IC8FAX	YO3DMU	JN70CN	KN34BJ	1065	Buda
1958	IC8FAX	LZ1ZX	JN70CN	KN32IO	1063	Buda
1958	S57EA	LZ1KJ	JN76HE	KN31CS	1048	60/?
2000	S57EA	LZ1ZX	JN76HE	KN32IO	1038	62/?
2005	IC8FAX	LZ1DP	JN70CN	KN22TK	973	
2017	S57EA	EA3DXU	JN76HE	JN11CM	1121	283/?
2023	F5VHX	YU1IO	JN04FT	KN04IQ	1595	
2029	F6DRO	YU1IO	JN03TJ	KN04IQ	1529	
2036	F5VHX	IC8FAX	JN04FT	JN70CN	1217	Hrd
2048	F1VJQ	IC8FAX	IN95OL	JN70CN	1334	
2052	F6FHP	IC8FAX	IN94TR	JN70CN	1277	
2053	S57EA	EB3EHJ	JN76HE	JN01VO	1170	280/?
2106	F4DSD	HA8UG	JN23JO	JN97OM	1202	
2109	F4DSD	YO2LEA	JN23JO	KN06WK	1376	45/?
2124	F4DSD	YO5CFI	JN23JO	KN16WJ	1528	
2125	HA5CW	F4DSD	JN97PM	JN23JO	1211	
			17. July			
2048	IC8FAX	YO2LEA	JN70CN	KN06KN	856	
			18. July			
1204	F5VHX	YU1IO	JN04FT	KN04IQ	1595	
1215	F5VHX	9A1UN	JN04FT	JN65TF	1035	
1928	G4LOH	IC8FAX	IO70JC	JN70CN	**1843**	

UT	STN1	STN2	LOC1	LOC2	QRB	QTF/ SCP Rem
			18 July			
1951	I8MPO	G4LOH	JN70FP	IO70JC	**1855**	Hrd
2015	IK0BZY	G4LOH	JN61GW	IO70JC	1638	
			25 July			
2045	G4LOH	IC8FAX	IO70JC	JN70CN	1843	JO40
2113	IC8FAX	ER1AN	JN70CN	KN46KX	1374	BUD A
			26 July			
1129	I8MPO	G7RAU	IO90IR	IO70JC	1653	Hrd
1921	IC8FAX	RZ6BU	JN70CN	KN84PV	**1939**	
			30 July			
2005	G4LOH	IC8FAX	IO70JC	JN70CN	**1843**	JO40
			03 Aug			
2009	UT5JCW	IC8FAX	KN64SN	JN70CN	1640	Hrd
2011	IC8FAX	ER1AN	JN70CN	KN46KX	1374	Hrd
2013	UT5JCW	IC8FAX	KN64SN	JN70CN	1640	
2027	UT5JCW	IZ4BEH	KN64SN	JN54WL	1713	
2101	LZ1ZX	IZ4BEH	KN32IO	JN54WL	1212	
			04 Aug			
2102	IC8FAX	UT5JCW	JN70CN	KN64SN	1640	
			11 Aug			
1919	RZ6BU	S50C	KN84PV	JN76JG	1752	BUD A
2058	S57TW	EA2AGZ	JN75EX	IN91DV	1363	Hrd
2107	IK0BZY	G4LOH	JN61GW	IO70JC	1638	
			12 Aug			
2225	I8MPO	G4LOH	JN70FP	IO70JC	**1853**	Hrd
2247	IC8FAX	G4LOH	JN70CN	IO70JC	**1843**	
			13 Aug			
1035	F5VHX	YT1VP	JN04FT	JN94WG	1536	Hrd
1414	IC8FAX	G4LOH	JN70CN	IO70JC	**1843**	
1503	S57TW	UT5JCW	JN75EW	KN64SN	1505	
			14 Aug			
2027	G4LOH	TK5JJ	IO70JC	JN41IW	1405	
2041	G4LOH	IW3GXW	IO70JC	JN65DE	1416	
2054	F6DRO	9A1CCY	JN03TJ	JN85OO	1258	
2105	F6DRO	YU1EV	JN03TJ	KN04CN	1489	
2107	IZ5EME	G4LOH	JN52NS	IO70JC	1489	Hrd
2110	F6DRO	F8DO	JN03TJ	JN26IF	398	JN36 Hrd
2114	F6DRO	9A3JH	JN03TJ	JN75AD	1007	
2132	T98GTH	F6FHP	JN84OT	IN94TR	1385	
			16 Aug			
2020	LZ5GM	IV3GBO	KN32QL	JN66OA	1193	
			23 Aug			
2024	F6DRO	YU1IO	JN03TJ	KN04CN	1489	
			02 Sept			
2317	F6DRO	OM8A	JN03TJ	JN87WW	1355	Hrd
2334	F6DRO	9A5Y	JN03TJ	JN85PO	1264	Hrd
			03 Sept			
0021	F6DRO	OM8A	JN03TJ	JN87WW	1355	Hrd
0047	F6DRO	S57O	JN03TJ	JN86DT	1210	Hrd
0958	F6DRO	UR7D	JN03TJ	Kn18jt	1733	Hrd

We wish you a sucessfull FAI season in 2007.
First QSOs are possible already in May in case we get some days with high MUF (3m) or even better with 2m Es.

PLEASE send us your reports / logs. Thank you!

NLC's – NoctiLucent Clouds: Call for Obvervations & Reports

by Ken Osborne, G4IGO - g4igo@talktalk.net

I have been asked over the last few year or so about NLC's – NoctiLucent Clouds. I see no point in re-running information which is abundant on the Internet. I suggest that those of you that are interested please look at the following sites and you will have a very good idea about what they are, what probably causes them – and some superb pictures.

A satellite (AIM - Aeronomy of Ice in the Mesosphere) is due to be launched by the end of April looking into NLC's and PMC's (Polar Mesospheric clouds). Both NLC and PMC are believed to be the root of the very long distant QSO's that took place between Alaska and Mid EU and G and JA (the paths from JA to Mid EU may well be of a different origin – or show how far south NLC / PMC can exist).

It will be of considerable interest if we, the amateur community can add our help to this study – and help justify our existence in this troublesome time. To this end I ask that anytime you have a clear sky to a Northerly direction from early May to late August we go out and have a look at the sky and see if we can see them. I then suggest that people can send to me their reports of what they see – or DID not see – a negative report is as good as a positive one. I will then batch them up and send them off to the interested parties.

Please do try and assist – after all most of us have worked the same stations and DX over and over again – so nothing will be new – but to take a 5 minute break and go take a look will cost nothing – and you will be part of the experiment.

The view is that NLC and the recently found PMC, are also related to Global warming – they now seem to be occurring more frequently and at lower latitudes than ever before - lets add to the knowledge.

Please send to me an email with date, the time span, your nearest town / city (please don't use grid locators – the other parties wont know what that is), any comment such as description that you feel they look like – there is a reporting system which you will find on many of the sites – but up to you if you wish to use it – the main thing is to record the event) and if you took any pictures where they may be accessed. Most of us will probably be viewing in the late evening around local time of 2130 to 2400 – but it will probably be more important to have observations from the 0000 to 0400 local time frame – most people are not up and observing!! Also we can perhaps see how it ties in with the possible openings that occur to the east in the morning – the night time observations will see how it ties in with openings to the west.

It is very easy to photograph the NLC with any camera. Usually a 2 to 5 sec exposure on a wide or standard lens will suffice – digital or film. Even less exposure can be achieved if the display is a good one. The main thing that will determine if you are observing NLC's is that they are clearly being unlit by the Sun (long since set) and they have a steel blue colour – particularly as the Sun sets lower. My Email for reports etc is **g4igo@talktalk.net** – mark the subject **"NLC observation"** please.

The sites to look at are, in no particular order:

http://www.nlcnet.co.uk/
http://www.kersland.plus.com/
http://en.wikipedia.org/wiki/Noctilucent_clouds
http://science.nasa.gov/headlines/y2003/19feb_nlc.htm
http://www.polarx.net/NoctilucentClouds.htm
http://www.sci.fi/~fmbb/astro/nlc.htm
http://spaceweather3.com/nlcs/gallery2006_page1.htm
http://www.bbc.co.uk/weather/features/understanding/nacreous_noctilucent.shtml
http://freespace.virgin.net/eclipsing.binary/whatarenlc.html
http://www.popastro.com/sections/aurora/nlc.htm
http://www.weatherscapes.com/album.php?cat=clouds&subcat=nlc
http://www.mikeoates.org/mas/observe/nlc/
http://lasp.colorado.edu/aim/aim_resources.htm
http://www.nasa.gov/mission_pages/aim/edge_of_space.html
http://scienceweek.com/2004/sc040806-3.htm
http://www.windows.ucar.edu/tour/link=/earth/Atmosphere/NLC.html
http://www.news.uiuc.edu/NEWS/04/0126gardner.html
http://gwest.gats-inc.com/nlc_epo/epo_home_page.html
http://cas.hamptonu.edu/research/topics/6-4pscpmc.html
http://www.spp.astro.umd.edu/Personnel/Milikh/PMC_paper.pdf

There are of course many more – but these should answer most questions and give the best insight to the clouds. Good hunting. Please try and give a small amount of your time to this survey – and enjoy them when they appear. 73 Ken, G4IGO

Tropo Reports

2m, 70cm and up

Editor: Wolfgang Schneider, DJ8ES

DJ8ES@gmx.de

2m – 2m – 2m

OZ/DK0G, JO45GD, wkd March ´07:

F5PEJ (JN09XT, 742km); DK0ES (JN48TN, 736km); OK1KFH (JN69WR, 703km); OL8R (JN69JJ, 702km); SP2IPK (JO93LR, 692km); DK0CG (JN59RJ, 670km); DF4IP (JN49HE, 663km); DL0NF (JN59PL, 658km); OK1OPT (JN69NX, 653km); DR1H (JN59OP, 638km); DK1FG (JN59OP, 638km); ON6YF (JO20KC, 613km); ON6MG (JO10VK, 613km); ON3AP (JO10OS, 604km); M5C (JO01PU, 603km); ON7LAO (JO20CK, 599km); M0HKB (JO02OB, 593km); DJ2FH (JN49KU, 589km); DL3TF (JO50VF, 589km); ON4WY (JO11LC, 584km); DF2CK (JO71AD, 577km); DK4KW/P (JO60GN, 576km); ON4POO (JO20DP, 576km); DK5NJ (JO50TI, 572km); DB6NT (JO50TI, 572km); DG1NPV (JO50TI, 572km); ON6ZT (JO10WU, 571km); G0KPW (JO02RF, 568km); ON4CAP (JO11PD, 566km); ON5AEN (JO10VW, 566km); OT7E (JO11TA, 564km); DL0GTH/P (JO50RK, 559km); DL5ARM (JO50JI, 554km); DL8DAU (JO40ME, 553km); DL1ARJ/P (JO60AR, 545km); DK5km); A (JO50IK, 544km); DQ8N/P (JO50NM, 543km); DK5A (JO50km,538km); DJ0VZ (JO30GL,537km); DR5A (JO30EM, 535km); ON4CJU (JO20PS, 533km); DJ2IA (JO61WN, 533km); G0UIQ (JO02PW, 533km); DL8UAT (JO61TL, 530km); ON4ZN (JO21FB, 530km); OR0A (JO20KW, 529km); PE1EWR (JO11SL, 526km); ON4BAX/P (JO20MW, 524km); DF0MTL (JO61JF, 520km); DH1PAL (JO30JP, 514km); DL6KA (JO30DS, 510km); DL8WKR (JO61CD, 508km); DH1TS (JO30QQ, 502km); DF9QT (JO30OR, 500km)

Rolf (DK7FU, OZ/DK0G) writes:

The Contest Crew of DK0G carried out a HF, VHF and SHF activity week from 27.2. till 6.3. on the Danish island Roemoe, JO45GD.

OZ/DK0G participated in the 13 cm NAC, the VHF/UHF Contest on 3./4. March and in the 2m NAC on 6.3.2007.

General remark: Condx were normal, too windy for any duct to build-up over the North Sea. Lost one mast and 3 antennas one day before the contest due to galeforce wind.

As during earlier activities from Roemoe, we noticed a big difference in activity in-between the contests. There is a clear preference in Scandinavia for the NAC, on 2m one can almost make the same points in 4 hours NAC as in 24 hours of the VHF/UHF contest.

Great surprise was the 13 cm NAC: we participated for one hour, made 5 QSO, with 154 km average. ODX SK7MW with 287km.

Our effort to log more G-stations (QRB from Roemoe about 600 km) on 2m by installing a 9el fixed pointed to UK with dedicated 300 W didn't work out. Only 4 G-stations made it into our log.

Log extract 2m 24h contest:
ODX DK0ES, JN48TN, 736 km,
2m NAC: ODX F5PEJ, JN09XT, 742 km,
13cm NAC: ODX SK7MW, JO65MJ, 274 km
Rig: 2m 1 x 17 el +2 x 4 el + 1 x 9 el, 1 KW; 13cm 1.5m dish at 6m 60 W. tnx for info Rolf

Contestcrew OZ/DK0G: DH6OBN (Lars), DK7FU (Rolf), DL9ABD (Edel), SWL (Matthias), DL2OCB (Stefan), DG3FEH (Holger), DJ8ES (Wolfgang)

DK7QX, JO42KH, wkd on 2m (>700km):

21.12.06 17:39	LA3YNA	JO48OR	713km
22.12.06 15:20	GW8IZR	IO73TI	896km
22.12.06 17:53	EI5FK	IO51RT	1189km
24.12.06 10:00	GW3JXN	IO72RC	913km
24.12.06 19:39	MM0SJT	IO87UE	896km
24.12.06 19:42	GM0TGE	IO87TF	903km
24.12.06 22:55	2M0DDS	IO87VI	902km

rig: 100W, MGF1302, 8 Ele Yagi
tnx for info Eckhard

PA5DD, JO22IC, Jan – Apr ´07 wkd (>600km):

OZ1HDF (JO55UN, 600km); OZ2PBS (JO55XJ, 602km); OZ7IGY (JO55WM, 606km); OZ1MG (JO65CO, 629km); OZ7AMG (JO65HP, 653km); SK7MW (JO65MJ, 660km); SK7CY (JO65RJ, 683km); EA2TO/P (IN83NK, 1115km).
tnx for info Uffe

70cm – 70cm – 70cm

G3XDY, JO02OB, wkd (>700km):

09/01/2007	OZ9KY	JO45VX	709km
04/02/2007	DC7QH	JO62QN	828km
04/02/2007	DM1PIO	JO72BM	879km
04/02/2007	DL6ABC	JO62ON	816km
04/02/2007	DC3GR/P	JO72CB	887km
04/02/2007	DL7URH/P	JO61EI	772km
04/02/2007	DL1VPL	JO61UA	871km

04/02/2007 DJ9MG	JO52TC	711km
04/02/2007 DK2GR	JN59IE	741km
13/02/2007 OZ9KY	JO45VX	709km
04/03/2007 DLØGTH/P	JO5ØRK	735km
13/03/2007 SK7MW	JO65MJ	860km
13/03/2007 OZ9KY	JO45VX	709km

tnx for info John

OE5VRL/5, JN78DK, wkd (>600km):
G8APZ (JO01DO, 1058km); G8VHI (IO92FM, 1206km); G8JVM (IO82SP, 1269km); G0RRJ (IO91FE, 1174km); G3YDY (JO01FQ, 1050km); ON7GB (JO21IA, 746km); G0LGS/p (IO81XV, 1222km); G3MEH (IO91QS, 1124km).
rig: 100 Watt, 3m Parabol. tnx for Info Rudi

PA5DD, JO22IC, Jan – Apr ´07 wkd (>500km):
OZ1BEF (JO46OE, 542km); OZ9KY (JO45VX, 545km); OZ2LD (JO54TU, 552km); OZ1MFP (JO55SK, 584km); OZ2PBS (JO55XJ, 602km); OZ8ZS (JO55RT, 606km); OZ1MG (JO65CO, 629km); SK7MW (JO65MJ, 660km).
tnx for info Uffe

DK7QX, JO42KH, wkd on 70cm (>600km):

06.11.06 23:14 G4DEZ	JO03AE	602km
06.11.06 23:19 G1HLT	IO93JD	684km
07.11.06 18:37 M0GHz	IO81VK	766km
21.12.06 18:48 LA6LCA	JO59FE	770km
22.12.06 17:26 G3LTF	IO91GG	719km
22.12.06 20:44 SP7TEE	JO91QR	720km
23.12.06 09:58 GW8IZR	IO73TI	896km
23.12.06 13:40 GW8ASD	IO83LB	806km
23.12.06 16:13 GW3TKH	IO81JM	832km
23.12.06 21:44 G8VHI	IO92FM	706km
24.12.06 23:17 MM3ERP	IO87RJ	921km
24.12.06 23:24 MM0DQP	IO88KI	1010km
27.12.06 12:19 EA1EBJ	IN73FL	1451km
27.12.06 12:23 F5HGO	JN05AI	1006km
27.12.06 16:38 F5DQK	JN18GR	600km

rig: 65W, MGF1302, 18 Ele Yagi
tnx for info Eckhard

23cm + up

OZ1FF, JO45BO, wkd:
23cm (>500km):

16/01/07 19:47 DK3WG	JO72GI	553km
16/01/07 20:19 SA4Z	JO79OF	584km
20/02/07 18:31 DK3WG	JO72GI	553km
20/02/07 18:37 DG1KJG	JO3ØNT	537km
20/02/07 18:40 SM6QA	JO78FM	501km
20/02/07 18:43 DJ5BV	JO3ØKI	590km
20/02/07 19:02 DB6NT	JO5ØTI	629km
20/02/07 19:31 SM4RPP	JO79HH	566km
20/02/07 20:00 G3XDY	JOØ2OB	600km
04/03/07 09:18 PI4Z	JO11WM	533km
04/03/07 10:01 DF9IC	JN48IW	742km
04/03/07 11:24 DR6A	JN59FW	649km
11/03/07 10:28 G8VR	JOØ1RJ	642km
11/03/07 11:24 G8APZ	JOØ1DO	681km
11/03/07 18:24 G3XDY	JOØ2OB	600km
20/03/07 18:06 SM6QA	JO78FM	501km
20/03/07 18:12 SA4Z	JO79OF	584km
20/03/07 18:55 DJ5BV	JO3ØKI	590km
20/03/07 19:04 DF9IC	JN48IW	742km
20/03/07 19:14 DB6NT	JO5ØTI	629km
20/03/07 19:46 DR6A	JN59FW	649km
20/03/07 20:18 G3XDY	JOØ2OB	600km
27/03/07 16:06 G8GXP	IO93FQ	657km

rig: 145 Watt, 1,5m Parabol

13cm (>300km):

03/03/07 19:50 ON4HRT/P	JO2ØMW	558km
04/03/07 09:33 PI4Z	JO11WM	533km
04/03/07 10:29 DM7A	JO4ØXL	583km
11/03/07 18:28 G3XDY	JOØ2OB	600km
27/03/07 19:04 DF9IC	JN48IW	742km
27/03/07 20:15 DB6NT	JO5ØTI	629km
27/03/07 20:41 SMØDFP	JO89VL	719km
27/03/07 21:25 G3XDY	JOØ2OB	600km

rig: 125 Watt, 1,5m Parabol

3cm (>300km):

27/02/07 18:48 PA3CEG	JO33FB	302km
27/02/07 19:23 SM6AFV	JO67GQ	356km
11/03/07 11:40 G4EAT	JOØ1HR	655km
11/03/07 18:31 G3XDY	JOØ2OB	600km
11/03/07 20:11 PAØGUS	JO23TA	330km
27/03/07 20:23 SM7GEP	JO77IP	462km
27/03/07 20:35 SM6AFV	JO67GQ	356km
27/03/07 21:02 SM6EAN	JO57WQ	326km
27/03/07 21:08 SK7MW	JO65MJ	310km
27/03/07 21:35 SM7ECM	JO65NQ	314km

tnx for info Kjeld

OE5VRL/5, JN78DK, wkd
23cm: G4EAT (JO01HR, 1040km); G0RRJ (IO91FE, 1174km); G3AUS (IO80DN, 1318km); G8APZ (JO01DO, 1058km); M0GHZ (IO81VK, 1224km). rig: 100 Watt, 3m Parabol
13cm: G0RRJ (IO91FE, 1174km); G4EAT (JO01HR, 1040); PA3AWJ (JO21GW, 795km).
rig: 400 Watt, 3m Parabol
6cm: M0GHZ (IO81VK, 1224km); G8APZ (JO01DO, 1058km); G3XDY (JO02OB, 1012km); PA3AWJ (JO21GW, 795km). rig: 10 Watt, 3m Parabol
3cm: G4EAT (JO01HR, 1040km); G8APZ (JO01DO, 1058km); PA3AWJ (JO21GW, 795km)
rig: 10 Watt, 3m Parabol. tnx for Info Rudi

PA5DD, JO22IC, Jan – Apr ´07 wkd (>400km):
23cm: OZ6OL (JO65DJ, 620km); OZ1FF (JO45BO, 451km); SM7ECM (JO65NQ, 681km); OZ2LD (JO54TU, 552km); OZ9KY (JO45VX, 545km); OZ1BGZ (JO65AP, 623km); SM6AFV (JO67GQ, 799km); SK7MW (JO65MJ, 660km); OZ1FF (JO45BO, 451km); DF9IC (JN48IW, 451km); OZ1BGZ (JO65AP, 623km).
13cm: DF9IC (JN48IW, 451km); SK7MW

(JO65MJ, 660km); OZ1FF (JO45BO, 451km); SM7ECM (JO65NQ, 681km). tnx for info Uffe

DK7QX, JO42KH, wkd on 23cm (>500km):

07.11.06 07:40	G3XDY	JO02OB	523km
07.11.06 18:35	M0GHZ	IO81VK	766km
07.11.06 18:44	G4FSG	JO02PC	517km
07.11.06 18:46	G4KIY	IO92WN	610km
07.11.06 18:54	M0GAV	IO93GK	704km
07.11.06 18:57	G8GXP	IO93FQ	713km
07.11.06 19:19	G4AJC	IO91VJ	631km
07.11.06 19:22	G4MKF	IO91HJ	710km
07.11.06 19:23	G4DDK	JO02PA	518km
07.11.06 19:42	G4ZDT	JO02KQ	543km
21.12.06 18:50	LA6LCA	JO59FE	770km
21.12.06 21:28	SM3LBN	JP80IO	1038km
23.12.06 08:55	G7NCG	JO02AM	599km
23.12.06 09:00	G4BEL	JO02BI	594km
23.12.06 09:03	G4KIY	IO92WN	610km
23.12.06 09:21	G4MAP	IO82XH	741km
23.12.06 13:08	GW8ASD	IO83LB	806km
23.12.06 15:38	G4EAT	JO01HR	568km
23.12.06 15:46	G8JVM	IO82SP	767km
23.12.06 16:20	GW3TKH	IO81JM	832km
23.12.06 19:51	G4BEL	JO02BI	594km
23.12.06 21:46	G8VHI	IO92FM	706km
27.12.06 22:05	OE5XBL	JN68PC	563km
27.12.06 22:10	DL3LFA	JN67LU	575km

rig: 60W, MGF1302, 44 ele. tnx for info Eckhard

G3XDY, JO02OB, wkd

1.3GHz (>600km):

20/02/2007	DK6AS	JO52JJ	653km
20/02/2007	SK7MW	JO65MJ	860km
04/03/2007	DK6AS	JO52JJ	653km
04/03/2007	DR6A	JN59FW	688km
11/03/2007	F6FHP	IN94TR	823km
11/03/2007	OZ3ZW	JO54RS	742km
11/03/2007	SM7FMX	JO65KN	857km

2.3GHz (>600km):

16/01/2007	DF9IC	JN48IW	633km
04/02/2007	DK2GR	JN59IE	741km
20/02/2007	DF9IC	JN48IW	633km
27/02/2007	SK7MW	JO65MJ	860km
27/02/2007	DF9IC	JN48IW	633km
04/03/2007	DF9IC	JN48IW	633km
11/03/2007	OZ1FF	JO45BO	600km
20/03/2007	DF9IC	JN48IW	633km
27/03/2007	OZ1FF	JO45BO	600km
27/03/2007	SK7MW	JO65MJ	860km

3.4GHz (>400km):

04/02/2007	DL2DR	JO31TO	444km
04/03/2007	DJ6JJ	JO31LG	406km

5.7GHz (>400km):

04/02/2007	DL2DR	JO31TO	444km

10GHz (>400km):

04/02/2007	DL2DR	JO31TO	444km
04/03/2007	DJ6JJ	JO31LG	406km
11/03/2007	OZ1FF	JO45BO	600km

pse ur Tropo-Report to:

DJ 8 ES @ gmx.de

Aurora Reports

PA5DD in JO22IC wkd on 144 MHz:

2007-01-29

1740	LA8NK	JO48KM	55A	55A	762km
1741	LA3BO	JO59CD	55A	57A	857km

Beacon Reports via Aurora on 2m:

*** = SK2VHF + = LA2VHF JP53 nil = SK4MPI JP70**

Date		UTC	Beacon heard from area / loc.
31.1.		1730	OH5 (KP30)
	*	2055	SM2 (KP03)
5.2.		1645-1900	OH2 (KP20), OH5 (KP30), OH7
7.2.		1900	OH5 (KP30)
12.2.		1615	OH5 (KP30)
		2300	SM2 (KP03)
13.2.		1636-1800	OH5 (KP30), UA3 (KO88)
	*+	2050	SM2 (KP03)
		2300	LA (JO59)
14.2.		1305	OH5 (KP30)
		1805-1850	OH5 (KP30), ES (KO28)
		1955	DL (JO53)
15.2.		1650	OH5 (KP30)
		2025-2035	UA1 (KP50), ES (KO28)
19.2.		1700-1720	OH5 (KP30), ES (KO28)
22.2.		1730	OH5 (KP30)
25.2.		2050	LA (JP33)
27.2.		1635-1910	LA (JP33)
28.2.		1740	OH6 (KP22)
		2120-2140	UA1 (KP50), LA (JP33)
7.3.		1415	OH5 (KP30)
		1720	LA (JP33)
9.3.		1815	OH5 (KP30)
11.3.		1605	OH5 (KP30)
		1720-2010	OH6 (KP02), OH5 (KP30)
12.3.		1640	OH5 (KP30)
13.3.		1425-1500	OH5 (KP30)
		1845-2100	OH5 (KP30), SM2 (KP03)
16.3.		2130	LA (JP20)
23.3.	+	2245	OH1 (KP00)
25.3.		1405	SM2 (KP15)
26.3.		1535-1700	SM2 (KP15), DL (JO53), UA1
27.3.		1730-1800	OH5 (KP30), UA1 (KP50)
1.4.		1235	SM2 (KP15)
		1615	DL (JO53)
2.4.		1355	OH5 (KP30)
		1615	UA1 (KP50)

6m News
Reports, Expeditions, Infos
Editor: Joachim Kraft, DL8HCZ

Propagation

Es activity over Europe was quite calm untill mid April as usual. Anyway it was even qieter than in spring 2006. On April 12th ST2A worked into Northern Italy arround 18z.

In February, March and April the ZD7VC beacon was copied on many evenings from CT, EA7, EA6, IT9. ZD8VHF from Ascencion was copied only 2 times by CT1HZE. It looks like that there is something wrong with this beacon. Also the S9SIX and TR8CA beacons were copied on several occasions from southern Europe. ZS6TWB/B was copied only on 2 afternnoons from CT and EA. 9Q1D and 9Q1EK are quite active on 6m now and qrv and beaconing almost every evening. They worked on several days into southern Europe. C5DXC is a newcomer on 6m from The Gambia. His CW beacon was heard already in CT/EA.

Expeditions & OPs

3X Guinea: UA6JR is qrv as 3XM6JR and RW3AZ as 3XD2Z. They stay 2 years and are qrv on 6m.

9Q Kongo: Gus, 9Q1D is qrv on 6m until the end of June. George, 9Q1EK is qrv permanently now on 6m from Kinshasa. Loc. For both is JI75pq.

9V Singapur: PF5X is qrv as 9V1DX until October 2007 also on 6m. Rig:100w + 5/8 vertical.

A2 Botswana: ZS&WB etc. Will be qrv from July 6 to 21 on 6m, incl. EME in JT65A.

C5 Gambia: Noz, C5DXC ist qrv on 6m with 100w and quadloop. He will have a yagi soon. Loc.: IK13.

DU7 Philippines: DU7/PA0HIP is qrv now from a better QTH in PK10xh with 2 x 5 ele. May be also from PK20ah later on.

HH Haiti: HH4/W3CMP will be qrv again on 6m from June 17th to 26th. Same location as last year: FK39.

FM Martinique: FM5JC, Eric, will leave after several years in FM in July and goes back to France. He will go QRT on June 15th and plans to be back qrv as F5JKK from IN87 from about July 12th.

IO61 EI2IP has moved permanently to IO61 and is qrv on 6m/4m from now on.

J8 St. Vincent: J8/W6JKV will be qrv from June 28th to July 11th with QRO and good take off to EU.

OE Austria: The channel 2 TV transmitter Jauerling (49750) wird will be switched off on June 12th 2007. More OE amateurs will be able to get qrv then.

OJ0 Market Reef: SM1TDE will be qrv on 6m from July 1 to Loc.: JP90.

OX Greenland: OZ1DJJ will be qrv on 6m as OX3LX (and/or OX2A, XP1AB) from July 10th to 17th. Loc. GP47TA.

TF/OY: G4ODA will be qrv from June 5 to 28 from several squares in TF on 6m. From June 29 to July 1 he will be qrv from OY.

PJ4 Bonaire: PA3CNX has moved permanently to PJ4 and will be qrv soon as PJ4NX with 800w and 1wl yagi. Loc. FK52ud.

ST Sudan: T98A is qrv untill the end of July as ST2A. He has 100W + 3 Ele. Loc.: KK13FK. After his ST job he will go to 9G, Ghana.

V2 Antigua: WB4WXE will be qrv on 6m from June 9. to 23. with 350W + 6 Ele. H has a clear takeoff to EU.

VP2E Anguilla: W7XU etc. plan a 6m operation in June/July. If VP2E does not work out then TZ Mail is the next choice.

ZA Albania: ZA/UT7DW is qrv permanently from JN91WX.

Beacons

C6AFP/B has made QSY to 50040.4 kHz and QRO to 30W.

CU8DUB/B 50002.5 MHz, HM49KL, 10W, Loop, Omni, proposal for mid May 2007.

D44DUB HK86NO, is a proposal for 2007. QRG 50029 MHz.

9M4SIX ist the new call of ex 9M2TO/B, OJ05dj, 50.005.

9Q1D/B 50021.0 JI75pq, 10W, vertical. Is qrv untill the end of June.

CE... N3DB Dave is currently organizing a new 6m beacon in Chile.

OH1SIX is QRT and will change call and QTH (probably to KP20bb).

PY0FF 50006.0 HI36TD, will be qrv again soon.

V51VHF is qrv again after many years of silence since January 22nd on 50021.0 MHz from a new QTH in JG87GN (2000m a.s.l.).

4m News
Reports, Expeditions, Infos
Editor: Joachim Kraft, DL8HCZ

Power Amplifier for 70 MHz

The well known ACOM company plans to start to develop a 70 MHz 1 KW PA in the second half of this year.

DX-News

OZ3ZW considers a 4m operation from CT3 in July or September. So far CEPT operation on 4m from CT is not permitted. The only chance to get qrv is to operate from a local ham.

OY/G4ODA may be qrv also on 4m from June 29 to July 1.

Greenland: OZ1DJJ will be qrv on 4m as OX3LX (and/or OX2A, XP1AB) from July 10th to 17th. Loc. GP47TA.

Poland on 4m: The SP telecom authority has announced that a future amateur radio allocation on the 4m band will contain a range of 200 kHz with a max. output power of 15 W. A date of the band relase is not fixed yet.

SV 4m beacon

SV1DH will erect a 4m beacon with the callsign SV1FOUR. The beacon will run about 1 W to a yagi beaming EU.

News & Comments

Editor: Joachim Kraft, DL8HCZ
info@DUBUS.de

I3CLZ/B on 10 GHz

The 10 GHz beacon I3CLZ has changed to a better QTH, Mount Baldo, JN55NR (2219 m a.s.l.). QRG is 10368.940 MHz, ERP 600mW.

Many beacons in DL QRT

Note: Several beacons in DL on 2m, 70cm and up are currently going QRT or change QTH because there are new restrictions from May 1st 2007 for all the locations owned by the German Telekom. Affected are e.g. DL0UB, JO62: will go QRT on 2m, 70cm & 9cm. Sysops look for a new QTH. -
DB0KI, JO50, is already QRT on all QRGs from 2.3 to 24 GHz. 23cm will be back soon. 2m + 70cm remains on air allthough antenna had to be reduced in height. Several other beacons will go QRT. Also several digipeaters, clusters, mailboxes and repeaters in DL will go QRT.

MMMonVHF Info

MMMonVHF Make More Miles on VHF is available on a new Internet Portal. Just check: **www.mmmonvhf.de**
You will find expedition news a new VISUAL VHF database and many other features. Please submit your info to:
info@mmmonvhf.de .The MMMonVHF-Team: Ansgar DG2KBC, Bernd DK3XT, Erwin DK5EW, Guy DL8EBW, Jani HA5CRX, Peter OZ1LPR and Peter PA3BIY.

Scandinavian VHF Meeting 2007

We have the pleasure of inviting you to the 29th annual VHF/UHF/SHF meeting 2007. This years meeting will be hosted by Hamargruppen av NRRL (LA3R), with help from NRRL VHF-committee and Gjøvik og Totengruppen av NRRL (LA5G) having their club station located at Starum (JP50KQ). Starum is a School and Conference Centre operated by the Civil Defense. This years activities will be as usual, with lectures, flea market, competition, NRAU VHF-managers meeting, Saturday evening Ham-Dinner and other relevant activities. Do not hesitate to book the weekend 8th to10th of June. We are looking forward seeing you. More Info at: www.nrrl.no/VUSHF2007

Grande Bleue 2007

takes place on the weekend of June 23/24. Detailed information about the participating stations with many pictures and other important hints are on the web at www.swissatv.ch (Zone Activité).

SP Microwave Meeting

From August 17th to 19th 2007 there will take place a Micrwowave meeting in Zieleniec (JO80EI), Poland.

G0KZG/MM Info

Andy Adam, GM0KZG, writes: I have recently changed jobs. I am still at sea, but now working on Fishery Protection Ships working around Scotland. I have just completed my first trip, and will shortly start my 2nd trip. We work 3 weeks on/off. I hope eventually to operate again on 2m, but it probably will not be this year. The ship I work on at the moment covers the sea areas from the coast out to about 50kms, so not many fully "wet" squares. Other ships in the fleet operate out to 250kms, and it will be when I change to these ships that I will probably start /MM again, but again, will probably not be this year. If there is any change in this, I will email you, and tell you when any operation will start.

TF and OY/G4ODA Expedition

Just to confirm that Paul (G1GSN) and I plan to return to TF this June, just waiting for the ferry tickets to come through. We should arrive Tuesday 5th June and leave Thursday 28th June. Also will be in OY 29,30 June and 1st July. Does not appear any hope of 4m in TF so it will just be 50mhz and 144. We are allowed 100 watts on 6 and 500 watts on 2. As always this is a holiday with radio not a full dxpedition so operating/location etc not known in advance (although always try and monitor 6 and be ready to get on air quickly). Plan to try and do some of the cross country routes if the snow has melted enough so hope to put on some squares there. In OY will try to get ferry to IP61 if poss. 73 Keith, G4ODA

Anguilla on 2m EME

KJ9I will be qrv as VP2EDS from Anguilla on 2m EME in JT65 from may 18 to 21. QRG 144.102 MHz. QSL via KJ9I. If time permits another rare DXCC will be activated directly after the VP2E operation.

OJ0 Market Reef Expedition

SM1TDE plans to be qrv on 2m and 6m from July 1 to 7.

OX Greenland Expedition

OZ1DJJ is qrv again as OX3LX from July 10 to 17 on 6m, 4m and 2m. Incl. EME on 2m. Loc. GP47TA. Also OX2A or XP1AB call will be used during this activity.

Crete on 2m EME

SV9CVY will be qrv on 2m EME in CW and JT65 soon with 4 x 15 ele and 700W. Loc.: KM25.

D44TD EME Expedition

In the first week of August a team from DL plans to be qrv on 6m, 2m and 70cm EME from D44TD's QTH on Cape Verde (HK86no).

EA8 activity on Micowaves?

Anyone there going for holiday to EA8 in June/July/August and may bring a decent microwave station (2.4 to 24 GHz)?
I am interested in tests / skeds. CT1HZE info@dubus.de

Redaktionsschluss für DUBUS 3/2007 ist der 1. August 2007. - Deadline for reports etc. for DUBUS 3/2007 is August 1st 2007.

DUBUS Beacon List 50 MHz and 70 MHz, May 2007, by CT1HZE

QRG	Call	Locator	Pwr	Antenna	QTF	m asl	Mode	Status	Last Report	Remarks
50000	GB3BUX	IO93BF	25	2x turnstile	Omni	460	A1	24	0507	
50000	9A1CAL	JN86EL	1	7-ele	Vary	15	A1	24	0207	
50000	YO7AQF	KN24KV	5		Omni			24	0507	YO7AQF
50001.0	VE1SMU	FN84	25	3-el Yagi	90		A1	24	0806	
50001.3	IW3FZQ	JN55VF	8	5/8 GP	Omni		A1	24	0107	
50001.5	IK1PLD/B	JN43CW	0.1	Vertical	Omni		A1		0105	QRT
50002.5	CU8DUB	HM49KL	10	H-Loop	Omni	1000	A1	24	0507	(Proposal)
50003	PY2LDF	GG67	5					?	0206	Temp. beacon?
50003	VE2TH	FN46HT	3	Hor. Dipole				24	0706	QRV?
50003	7Q7SIX	KH74	5					24	1005	QRT
50003	IQ6VP	JN62QI	10	Deltaloop	N/S		A1	24	1006	
50004.0	I0JX	JN61HV	10	5/8 Vert	Omni		F1	24	0507	
50004.7	4N0SIX	KN04FU	1	Dipole	NNE/SSW	400	F1	24	0905	QRT now
50005	9M4SIX	OJ05DJ	50	5/8 GP	Omni		A1	24	0107	ex 9M2TO
50006	A71A	LL55SH	110	J-Pole	Omni		A1	24	0706	
50006	PY0FF	HI36TD	30	Ringo Vert	Omni		A1	24	0507	
50006.5	ZS2SIX	KF25UX	25	Dipole			F1	24	1106	Temp. QRT
50007	ZD7VC/B	IH74DB	40	Halo Horiz.	Omni		A1	24	0507	
50007	VA2ZFN	FN08HE	4	Halo	Omni		A1	24	0307	
50007	HG1BVB	JN87FI	10	2xDipole	Omni		A1	24	0507	
50007.8	DU1EV	PK04MP	10	½ GP	Omni		A1	24	0107	
50008	XE2HWB	DL44UC	10	Vertical	Omni		A1	24	0506	
50008	K0GUV	EN26	8				A1	INT	1206	
50008	I5MXX	JN53JU	10	3/4 Vert	Omni	20	A1	24	0507	I5MXX
50008	LU1DMA	GF05XI	10	x-dipole	Omni			INT	0406	
50009.5	PY2SFY	GG77GA	4	5/8 GP	Omni		A1	24	1006	
50010.8	SV9SIX	KM25NH	30	Vert. Dip.	Omni		F1	24	1006	Temp. QRT
50010	JA2IGY	PM84JK	10	5/8 GP	Omni		A1	24	1006	JA1VOK
50011	TG9SO/B	EK44SM	30	V-Ringo	Omni		A1	24	0407	TG9RB
50011	ZS5ACT	KG50LD	5	5/8 GP	Omni		A1	TEST	1004	
50012	OX3SIX	HP15EO	100	Dipole	E-W	1500	F1	24	0706	Temp. QRT
50013	HP1DCP	FJ09FA	5	Dipole	N/S		A1	24	1006	
50013	CU3URA	HM68QM	5	5/8 V	Omni		A1	24	0507	
50013	LZ1JH	KN22TK	1	GP	Omni	520		24	0107	LZ1DP
50014	V73SIX	RJ39RJ	70	Pan Loop			A1	24	1206	
50014.5	9M6SMC	OJ85AX	2	Turnstile	Omni			24	1104	Probably temp. QRT
50015	9Y4AT	FK90ER	25	3-el Yagi	N/NW		A1	24	0307	
50015	YS1YS	EK53JQ	15	Double Zepp	Omni		A1	?	0804	Probably QRT
50015.3	SR3SIX	JO92DF	5	¼ GP	Omni		A1	24	0902	QRT
50015.5	LU9EHF	FF95	15	Inv. Vee			A1	24	1004	QRT
50015.5	VA2MGL/B	FN47UQ	5	½ Vert	Omni		A1	24	0105	QRT?
50015	SV5SIX	KM46CF	0.2	dipole	Omni		A1	24	1006	SV5BYR
50016	GB3BAA	IO91PS	10	V-dipole	Omni	195	A1	24	0507	
50017	JA6YBR	PM51RT	50	Turnstile	Omni		A1	24	0606	JA1VOK
50017	OH0SIX	JP90XI							Proposal	
50018	VE4ARM	EN09MW	50	3-el Yagi	NE		A1	24	0307	
50018	PR8ZIX	GI64GL	45	Halo	Omni		A1	24	0507	PR8ZX
50019	IZ1EPM	JN34WR	15	5/8 Vert	Omni	400	A1	24	0207	
50019	CX1CCC	GF15	5	GP Omni				INT?	1004	QRT
50020	IW8RSB	JM88HW	10	dipole		8	A1	24	0307	
50020	GB3SIX	IO73SG							Proposal?	
50020.7	IK5ZUL	JN52JW						24	0507	
50021	V51VHF	JG87GN					A1	24	0407	qrv again!
50021	ER3SIX	KN47JG	10	GP					0705	QRT
50021	9Q1D/B	JI75PQ	10	Vertical	Omni		A1	25	0507	Temp. Beacon
50022	S55ZRS	JN76MC	8	¼ GP	Omni	1219	A1	24	0507	
50022	HG8BVB	KN06OQ	5	GP	Omni		A1	24	0507	

50023	UN1SIX	MN83KE	7	GP	Omni	870		24	0507	UN7QX
50022	OZ7IGY	JO55WM	30	Turnstile	Omni	92	F1A	24	0507	
50023	XE1KK	EK09QC	20	Ringo	Omni		A1	24	0107	
50023	LX0SIX	JN39AV	10	Horiz Dipole	N/S			24	0507	
50023.0	JA1ZYK	QM05	10	Hentenna				24	0806	
50023	SR5SIX	KO02LL	2	Dipole	SW/NE	100	A1A	24	0906	Call change SP5XMU
50024	ZP5AA	GG14	3	5 ele yagi	N			24	0406	ZP6CW
50024	VE9BEA	FN66	3	Vertical	Omni		A1	24	0105	QRT
50025	6Y5RC	FK18	15	5-el					0806	
50025	9H1SIX	JM75FV	7	5/8 GP	Omni		F1	24	1006	
50025	YV4AB	FK60AD	25	Ringo	Omni	1210	A1	24	0407	
50025	VE4SPT	EO26PI	100	3 el yagi	N		A1	24	0307	KG0VL
50025.4	OH1SIX	KP11QU	40	4 Turnstiles	Omni	157	A1	24	0407	QRT will change QTH+call
50026	SR9FHA	KN09BW	4	GP	Omni		F1a	24	0207	
50026	VP9DUB	FM72OH	10	Loop	Omni		A1	24	0407	
50026.5	IQ4FA	JN54TT	5/1	GP	Omni		A1	24	0507	I4JJE
50027	CN8MC	IM63NX	20	J-Pole	Omni			24	0806	Temp. with QRP
50027	JE7YNQ	QM07	2	T'stiles	Omni		A1	24	0806	JA1VOK
50027.8	SR6SIX	JO81HH	7	GP	Omni		F1	24	0504	QRT
50028	SR3FHB	JO91CP	5		Omni	180	F1	24	0507	
50028	XE2ED	DM10	15	½ Vert.	Omni		A1	24	0207	
50028.0	SR8SIX	KN19CN	10	Dipole			A1	?	0203	QRT
50028	5T5DUB	IK28AC	20	GP	Omni		A1	24	0407	
50029	D44DUB	HK86NO	20	Halo	Omni		A1	24	0507	Proposal
50029	P29BPL	QI30	25					24	0105	QRT
50030	9A0BHH	JN85JO	4	X-Yagi	Omni	485	A1	24	0507	
50030	IS0GRB	JM49OF	1	Horiz. Dip	N-S		A1	24	0806	
50030	VY1DX/B	CP20					A1	24	0207	
50031	HG7BVA	JN97QK	5	Vertical	Omni		A1	24	0207	
50031.5	CT0SIX	IM59	10E	Dipole	E/W		F1	24	0507	
50032	ZD8VHF	II22TB	10	Vertical	Omni	744		24	0407	
50032	JR0YEE	PM97	2	Loop			A1	24	0207	JA1VOK
50033	OH5RAC	KP30HV	26E	2dBD	200	145	F1	24	1006	
50033	VE2RCS	FN25	5				A1	24?	0606	QRV?
50033	VE7FG	CO83SW	50	¼ GP	Omni	1051	A1	24	0407	
50034	YU1EO	KN04ML	1	GP	Omni		A1	24	1006	
50035	CQ3SIX	IM12OP	10	Halo	Omni		F1	24	0507	
50035	ET3VSC	KJ99IA						QRT	0703	Call will change to ET3BN
50035	HC8GR	EI59	30	Halo			A1	24	1105	
50035	OY6BEC	IP62MB	15W	Vertical	Omni		F1	24	0507	
50036	VE4VHF	EN19LM	35	Vertical	Omni		A1	24	0307	
50036	OA4A/B	FH17	13	Vertical	Omni		A1	24	0507	
50036.6	SR2SIX	JO93BC					A1		0702	QRT
50036.6	CT1ART	IM67AH	30	6 el Yagi	270		A1	24	0507	
50037.5	ES0SIX	KO18CW	15	Horiz Dip.	E/W	35	A1	24	0507	
50038	VA2MGL/B	FN47UQ	5	Quad-Turn.H	Omni		A1	24	0205	2. beacon on 15.5 is o.k.!
50038	C21SIX	RI39LL	25	Dipole	E-W		F1	24	0505	
50038	LU5EGY	GF05	15	GP	Omni		A1	24	0407	
50039	VO1ZA	GN37	10	¼ Vert	Omni		F1	24	0806	
50039	FY7THF	GJ35	10	Vertical	Omni			24	0407	
50039.5	VE4PL	EO11					A1	?	0805	Probably QRT now
50040	ZL3SIX	RE66	65	2xDipole	NW/NE		A1	24	0207	
50040	SV1SIX	KM17UX	25	Vert Dip	Omni		F1	24	0407	will change QTH
50040	VE2YKT	FN37LS	0.5	5-el Yagi			A1	24	0806	VE2YKT
50040.4.	C6AFP	FL16HS	30	5/8 Ringo	Omni		A1	24	0507	
50041	VE6EMU	DO33	35	4-el Yagi	NNE		A1	24	0307	
50041	ON0SIX	JO20EP	5	X-Dipole	N-S		A1	24	0804	QRT
50042	YF1OO	OI33	15	GP				EXP	1104	QRT
50042.5	GB3MCB	IO70OJ	40	Dipole E/W			F1	24	0507	

50043	VE6ARC	DO05	25	GP	Omni		A1	24	0806	
50043.3	ZL1VHF	RF73MB	20	1/2Vert@4m	Omni		A1	24	0304	QRV?
50044	ZS6TWB	KG46RD	10	5/8 Vertical	Omni		A1	24	0507	ZS6NK
50044,5	LZ2CM	KN13NE	0.5	GP	Omni	1500	A1	24	0507	LZ1DP
50045	OX3VHF	GP80	20	GP	Omni	15	F1	24	0806	
50045	SR2FHM	JO94II	7		Omni		A1	24	0507	
50045.6	JW5SIX	KQ26MM	10	Dipole	Omni		A1	24	0407	
50047	VK8RAS	PG66	20	X-Dipoles	Omni	300	A1	24	0307	
50047	4N1ZNI	KN03WH	1	GP	Omni	200	F1	24	1006	
50047	JW7SIX	JQ68TB	10	3-el Yagi	S	10	A1	24	0407	LA0BY
50048.2	VE8BY	FP53RS	25	Vert Dip	Omni		F1	24	0507	
50048.5	TR0A	JJ40	15	5-el	N		F1	24	0507	CT1HZE
50048.7	JW9SIX	JQ94LM	10	GP	Omni		A1	24	1206	
50049	VA2WW	FN46	5				A1	24	0304	probably QRT
50049.5	LZ2CC	KN22GS	5	GP	Omni	1500	A1	24	1106	LZ1DP
50049.8	LZ1SJ	KN32DR	2	GP	Omni			24	0207	
50050	FO5DR	BH52	50	Dipole						Temp. QRT
50050	ZS6DN	KG44DE	100	5-el Yagi	SE			24	0406	QRT
50050	6Y5RC	FK17						24	0305	
50050	ZZ3SIX	GF49JW	10	Hor.Dipole	N-S		A1	23	1106	
50051	LA7SIX	JP99EC	30	4-el Yagi	190		A1	24	0207	
50051	AL7QY	AP74GM	45	Halo	Omni		A1	24	0606	
50051	YO9FTR	KN25XG	5	Vert 1/2	Omni		F1	?	0706	
50052	EI0SIX	IO63NF	25	Vertical	Omni		A1	24	0507	
50052	SK2CP	KP07MU	10	5-el Yagi	NW	478	A1	24		Proposal
50053	XE3RCM	EL50	1	Dipole			A1	24	0307	
50053.5	PI7SIX	JO22NC	12	Dipole	N/S	40	A1	24	1106	
50054	OZ6VHF	JO57EI	25	x-dipole	Omni	84	A1	24	0307	
50054	VE2YAT	FO40SI	3	2 ele quad			A1	24	1206	
50055	V44KAI	FK87QH	2	5/8 Vert	Omni		A1	24	0307	
50055	EA3SIX	JN01VO	50	5/8 Vert	Omni		A1	24	0906	
50056	VA7SIX	CN89	10	Ringo	Omni	200	A1	24	1206	VA7SL
50056	I8EMG/B	JM89BJ	40	V-Dipole	Omni	1389	A1	24	0507	
50057	IT9X	JM78RE	10	Horiz Loop	Omni		A1	24	0507	
50057	VK7RAE	QE38	25	X-Dipoles	Omni	220	A1	TQRT	1205	WIA location change
50057	TF3SIX	HP94BC	20	GP	Omni		A1	24	1206	
50057	K3DEL	FM28FN	5	SQLoop	Omni	33	A1	INT	0205	W3OR Intermittant
50057.5	VK4RGG	QG62	10	Turnstile	Omni		A1	24	0307	
50058	HB9SIX	JN47QG	0.2	J-Pole	Omni		A1	24	0507	
50058	IQ4AD	JN54DT	8	GP	Omni		A1	24	0507	
50058	OE3XLB	JN87AT	10	5-el Yagi				24	1006	
50058	WB4LHD	EM55DB	15	squalo	Omni		A1	Temp.	1006	WB4LHD
50059	HG5BVC	JN97MK	1	Coll-Vertical	Omni			24	1106	
50059.5	VE3UBL	FN03	10	Turnstile	Omni		A1	24	0706	
50059.5	K4TQR	EM63OM	4	Dipole	NW/SE		A1	24	0307	
50059.7	W4CBX	EM86VN					A1	24	0906	
50060.0	EA3JA/B	JN11BI			Omni			?	1006	QRV?
50060.0	KD4NMI	FM05RT	100	Vert. Dip.	Omni		A1	24	0307	
50060.0	GB3RMK	IO77UO	40	Dipole	N/S	270	F1	24	0706	only with QRPP
50060.0	WB5LLI	EM40	20	GP 20ft	Omni		A1	24	0307	ex call W5VAS
50060.0	WB0RMO	EN10	25	Squalo			A1	24	0107	
50060	K5AB	EM01					A1	24	0507	
50060	LU4HH	FF78UP	1	3db Vert	Omni		A1	24	0407	
50061	W3HH	EL89	3	1/4 Vert	Omni		A1	24	0307	
50061	K9MU	EN44	7	Dipole	N/S		A1	24	0207	
50061.5	NH6P	BK29	100	7 ele Yagi	USA		A1	24	0307	OP NH6P
50062	GB3NGI	IO65VB	10		Omni	518			0204	Proposal
50062	K8UK	EN82JP	2	Omni			A1	24	0205	QRV?
50062	K8JA	EN82JP	2		Omni		A1	24	0906	

50062	W7KNT	DN36	20	Vertical	Omni		A1	24	0107	
50062.5	WB4WOR	FM05BT	2	GP@3m	Omni		A1	24	0505	QRV?
50062.5	KB6BKN	CM88	30	3 Ele	E		A1	24?	0806	
50063	W9JN	EN54DN	1,10	Halo	Omni		A1	24	0207	
50063	LY0SIX	KO24PS	7	Slop. Dipole			A1	24	0906	
50063	KE4SIX	EM83XL	5	GP	Omni		A1	24	0207	W4WTA
50063	KF4ODI	EM56	10	Halos			A1	24	1205	Prob. QRT now
50063.5	NL7Z	BP51	25	H-Dipole	E-W		A1	24	0107	
50063.5	K7UV	DN31XM	10E	H. Loop	Omni		A1	24	0706	K7UV
50064.0	W3VD	FM19NE	7	Squalo	Omni		A1	24	0207	
50064	GB3LER	IP90JD	30	Horiz.Dip.	N/S	100	F1	24	0507	
50065	KL7/KG0VL	BP75XW	100	Horiz.	Omni		A1	24	0107	KG0VL
50065	GB3IOJ	IN89WE	10	Dipole	E/W	115	F1	24	0507	
50065	VQ9SIX	MI62	10	Vertical	Omni		A1	24	0404	QRT
50065	LU2MSA	FF57AC							0207	
50065	KS5V	EL09SS	5	Horiz. Dip.	E/W		A1	24	1005	Probably QRT nw
50065.0	W0IJR	DM79	20	2-ring halo	Omni		A1	24	0407	= KA0CDN
50065.2	KH6HI	BL01	50	Halo	Omni		A1	24	0207	
50065.5	W0MTK	DM59	4	4 Vees	Omni		A1	24	0107	
50066	K8EB	EN73					A1	24	0507	
50066	W5GPM	EM26	5	quad			A1	24	0407	
50066.0	VK6RPH	OF88	10	U Dipole	Omni	366	A1	24	0107	WIA
50066	W5SIX	DM54WA	1	5-el Yagi	060		A1	24	0806	
50066	WA1OJB	FN54	10	2-el Coll.	EU		A1	24	1206	
50066	K1MS	FN42GM	15	3 ele	050		A1	24	0806	
50066.9	K4HRS	EL98QA	10	Loop	Omni		A1	24	0307	
50067	EA4CRP	IM68MU						?	0806	QRV?
50066.7	KQ4E	EM86	10	halo	Omni		A1	24	0706	
50067	WZ8D	EM79	15	6-el@75'	S-Am		A1	seasonal	0207	
50067	OH9SIX	KP36OI	35	2x X-dipole	Omni	192	A1	24	0107	
50067	N7DB	CN85RM	5	halo	Omni		A1	Days	0806	
50067	N3LL	EN90WI	5	Loop 25'	Omni		A1	24	0207	
50067.5	N8PUM	EN65BX	10	Dipole	Omni		A1	24	0606	
50067.7	K0EC	DM69	45	1/2V+1/2H	E-W		A1	24	0206	
50068	N6NB	DM05SB	25	5 Ele yagi	60		A1	24	0107	in winter 5W to 315 deg
50068.1	W7RV	DM35	2	5el	120		A1	24	0606	
50068	LZ0SIX	KN12QP	20	GP	Omni	670	A1	24	0205	QRT
50068	N9UM	EN52WG	10	Loop@8m	Omni		A1	INT	0104	new Call KG9PF QRV?
50068.5	K2ZD	FN20US	20	5/8 V	Omni		A1	24	1106	
50068.8	XE2OR	DL98OK	35	3-el Yagi	Varies		A1	Temp	0806	
50068.9	K6FV	CM87UL	100		varies	55/275	A1	24	1006	
50069	W7BAS	CN87TG	10	5-el	090		A1	24	0604	probably QRT
50069	KL7FU	BQ11	50		Omni		A1	24	1104	probably QRT
50069	W9VW	EM69WT	12	Turnstile 70'	Omni		A1	24	0207	
50069	W8GTX	EN82	3	loop 25'	Omni		A1	24	1006	
50069.5	N0UD	DN87	50	3-el@6m	N		A1	24	0107	
50069	XE3ARV	EK59							0706	
50069	K4IDC	EM76MA	0.35	Loop	Omni		A1	24	1206	
50069	YO4KRB	KN44HE	2.5						0906	
50069	N1NTE	FN42	5	H Dipole			A1	24	Proposal	
50070	W1RA	FN41	15	Vert. Dipole	Omni		A1	24	1204	QRT
50070	EA3VHF	JN01MV						?	0107	sometimes QSY to 50060
50070	WA7X	DM49HO	100	J-Pole	Omni		A1	24	0307	
50070	N3LEL	FN00CK	1	Dipole			A1	24	0104	QRV?
50070	K4AR	EM76...					A1		0104	QRT for QTH+Call-change
50070	W4CLM	EM95RP					A1	24	0107	
50070	K4KWK	EM75	1	dipole 30'			A1	24	0606	
50070	KG6JAI	DMO4UE	25	Vertical	Omni		A1	24	1006	
50070	ZS6SVJ/B	KG43FT	5	Dipole	N/S		A1*	24	0606	* plus SSB + RTTY

50070.5	W9AFB	EN50	8	Dipole	Omni		A1	24	0706	
50070.5	K0ETC	EM27RB	10	Turnstile	Omni		A1	24	0706	
50071	LU1WDY	FE76IS	5	1/4 GP@10m	Omni		A1	24	0307	
50071	W5HN	EM13SJ	0.8	Halo	Omni		A1	24	0307	W5LUA
50071	W7WKR	CN98PI	25	X Dipole	Omni		A1	24	0105	QRT
50071	W3DOG	FM28KI	45	loops 275'	Omni		A1	24	0307	
50072.5	W4IO	EM81	1	Vertical	Omni		A1	24	0803	QRT, Op nw in EL88
50073	PP2SIX	GH53MP	7	GP	Omni		A1	24	0507	qrv again
50073	NN7K	DM09CN	1	Squalo@15'	Omni		A1	24	1206	Loc DM09AV?
50073	K0KP	EN36WT	100	Delta Loop	Omni		A1	24	0307	
50073	WA6LIE	CM96EQ	5/40	4ele 8m	20		A1	24	0506	
50074	KD4HLG	EM73	3/30	AR6			A1	24	0206	
50074	PY8ELO	GI25AR	10				A1		1006	
50074	W5RP	DM91							0307	
50074	N7LT	DN45	3	¼ GP	Omni		A1	24	1006	N7LT
50074	K8PLF	EN81EN							0207	
50074.8	EH1DVY	IN81	10	Vertical	Omni		A1	24	0906	
50075	K1QVR	FN32VF	1	1/4 GP	Omni		A1	24	1204	QRT
50075	KC8SZU	EN82FP	100	Horiz Loop	Omni		A1	PT	0504	QRT
50075	VR2SIX	OL72BH	12/4/1.2/0.4	1/4GP	Omni	450		24	0207	
50075	N4RT	EM60	20	Vertical	Omni		A1	24	0104	QRT
50075	KA7BGR	CN82	40	2x2el	SW/NE		A1	24	0906	
50075	NL7XM/2	FN20IP	3	dipole	Omni		A1	24	0207	
50075	KL7GLK/3	FM18SW	4	Turnstile	Omni		A1	24	0307	KL7GLK
50075	WP4MZA	FK78DI	5	Vertical	Omni		A1	INT	0706	
50075	YO3JW	KN35FC	10	vertical	Omni		A1	24	1106	
50075.3	LW2ETU	GF05TI	1	GP	Omni		A1	24	0307	
50076	WR9L	EN61BD	10	Turnstile	Omni		A1	24	0307	
50076	OH5SIX	KP30JU	50	2x XDipole	Omni	130		TEST	0506	Temp. QRV
50076	WA8LXJ	EM88FT					A1	?	0606	temp. QRV
50076.5	W9FZ	EN43TP	0.2				A1	24	0506	W9FZ
50077	K4AHO	EL98FR	7.5	Vert@30'	Omni		A1	24	0306	
50077.5	VK4BRG	QG48	3	Turnstile	Omni		A1	TQRT	0105	QRT
50077.6	N0LL	EM09OW	14	2 halos	Omni		A1	24	0307	
50078	AC3A	EM28QV	10	Loop	Omni			24	0706	AC3A
50078	WD8OST	EN76XC	10	6el@45'			A1	24	0207	changing QRG often, 090
50078	OD5SIX	KM74	8	¼ vert.	Omni			24	0806	
50078	PT7BCN	HI06RF	5	GP	Omni			TQRT	0902	QRT
50078	NM7D	DM37FB	15	1/4 Vert	Omni		A1	24	1106	
50078.2	TI2NA	EJ79	50	Vertical	Omni		A1	24	0205	QRT
50079	KK7CQ	DM33	10	Squalo			A1			Proposal
50079	JX7SIX	IQ50RX	10	Slope dip	Omni	269	A1	24	0806	
50079	W4CHA	EL88	30	Quadloop	Omni		A1	24	0307	
50079	W3CCX	FM29JW	4	halo@500'	Omni		A1	24	0307	
50080	S9SIX	JJ30HE	3	Horiz	Omni	600	A1	24	0507	
50080	K0UO	EM07SA	10	Omni			A1	24	0307	K0UO
50080	ZS1SIX	JN96FB	10	Inv. V Dipole	Omni		F1	24	0106	ZR2DX
50080	FK8SIX	RG37FR	15	GP	Omni		F1	24	0307	
50080	UU5SIX	KN74AL	10	dipole 1300				24	0107	
50080	4X4SIX	KM71NU	5	dipole 500m	NW/SW		A1	24	1006	
50080	PP1CZ	GG99UQ	3	5-el	N				0205	temp? QRT now
50080	VE3RCN	FN14TH	3-50	5-ele	varies		A1	IRR	0105	
50081	LZ2SIX	KN33							0503	QRT now
50081.5	LU3EMK	GF05					A1	Not24	0302	QRT now
50082.5	LU8DCH	FF66UQ	1.5	5/8	Omni		A1	24	0306	
50082.5	UT7UV/A	KO40VK	10	1/4 GP	Omni		A1	24?	0706	
50083	DF0ANN	JN59PL	2	Hor Loop	Omni		A1	24	0507	
50083	DG0HGW	JO64QC	2		Omni		A1		1006	Proposal
50083	DB0DUB	JO31HF	2	Horizontal	Omni		A1	24	0107	

50084	LU7YS	FF49IU	5	GP	Omni		A1	24	0207	
50084.0	UT5G	KN66LS	10	GP	Omni		A1	24	0307	
50087	VK4RTL	QH30JQ	10	Vee	Omni	582		IRR	0307	WIA
50088	HC2FG	EI97	5	J-pole	Omni		?		1103	Prob. QRT now
50090	ZZ2LER	GG66	10	dipole	Omni		A1	24	1104	Prob. QRT now
50090,5	WP4F	FK68WL	5	GP	Omni		A1	24	0804	Prob. QRT now
50120	VK2RS	QF46SN	5	6el Quagi	N			temp.	0306	
50239	VK2RSY	QF56MH	25	Turnstile	Omni	240	A1	24	0205	qrv soon (VK2XQ)
50240 *	OM0MRA	JN88NE	1	Diploe	225/315	570	A1	24	0205	Proposal
50283	VK3RMH	QF22OH	10	Double Loop	Omni		A1	24		Temp. QRT
50288	VK2RHV	QF57SC	25	Turnstile	Omni		A1	24	1206	
50289	VK2RSY	QF56MH	12	Dipole	Omni		A1	24	0106	QRT
50293	VK3RMV	QF02WH	15	9-el@37m	N	305	A1	24	1206	WIA (ex VK3SIX)
50297	VK7RST	QE37	15	Dipole	E/W		F1	24	0107	WIA
503xx	CS1RLA	IM57NX							0407	Proposal
50300	F5TND	IN96OL	10	7 ele	changes			IRR	0806	
50304	VK6RSX	OG89	50	Hor. dip.	Omni	50	A1	24	0407	WIA
50306	VK6RBU	OF76	25	3-el Yagi	80/260	10/100	A1	24	0107	WIA
50308	VK6RTW	OF84	10	Horiz			A1	24	0104	Prob. QRT now
50309	F8KOT/B	JO10OS	1						1106	Temporary
50310	VK8VF	PH57IO	10	3 Ele Yagi			A1		1206	QRT VK8DA/GF
50315.0	FX4SIX	JN06CQ	25	2xHor.Dip	Omni		A1	24	1006	F5GTW qrt until 1/07
50315	VK5RBV	PF95MK	12	Hor. halo	Omni		A1	24	0106	
50320	F8BHU/B	JN17NA	4		Omni				1206	
50321	ZS5SIX	KG50	8	Halo			A1		1006	QRV ?
50350	9A2ZH/B	JN73RW	1/5	H dipole	N/S		A1	24	0804	QRT in 2006
50386	F1GTU	JN05IF	5	Loop Omni			A1	IRR	0606	QRV weekends
50395	EA5SIX	IM98VX	10	3 ele	35		A1	?	0804	QRT
50480	JH8ZND	QN02UW	10	5/8 GP	Omni		A1	24	0107	JA1VOK
50485	JH9YHP	PM86	2	13-el	SE		A1		0204	probaby QRT
50490	JG1ZGW	PM95VP	10	7el Yagi	S		A1	24	0606	JA1VOK
50499.5	5B4CY	KM64PT	20	¼ GP	Omni		F1	24	0706	
50520.3	SZ2DF	KM25	1kw	4x16 el el.	30 ele	330		IRR	Summer	temp. QRT
51030	ZL2MHB	RF80			Omni		RTTY	24?	0605	probably QRT
52275	ZL2MHF	RE78NU	10	V ½ Dip	Omni		F1	24	0207	RE78NS
52315	VK3RSX	QF13IR	10	Turnstile	Omni		A1	24	0104	VK3PA Prob. QRT
52346.5	VK4ABP	QG26	10	¼ Vert.	Omni	480	A1	24	0407	WIA
52450	VK5VF	PF95	8	Turnstile	Omni	680	A1	24	1206	WIA
52490	ZL2SIX	RE68	10				F1	?	1206	

DUBUS Beacon List 70 MHz, by CT1HZE/DL8HCZ

70000	GB3BUX	IO93BF	20	2 x Turnstile	Omni	456	A1	24	05/07	CT1HZE
70007	GB3WSX	IO80QW	2,25	5 Ele	70	105	F1A	24	05/07	CT1HZE
70012	OX4MB	GP47TA	25	5 Ele	85	300	FSK	24	08/06	OZ1DJJ
700..	9A0...	JN85								Proposal
70016	GB3BAA	IO91PS	25	2xDipole	Omni	272		24	05/07	CT1HZE
70020	GB3ANG	IO86MN	100	3 Ele Yagi	160	370	A1	24	05/07	CT1HZE
70021	OZ7IGY	JO55WM	25	3 Ele Yagi	225	30	A1	24	05/07	CT1HZE
70025	GB3MCB	IO70OJ	40	4 Ele Yagi	45	320	A1	24	05/07	CT1HZE
70027	GB3CFG	IO74CR	20	2 x 3 ele	45+135				05/07	CT1HZE
70035	OY6BEC	IP62OA	25		SW	300		24	05/07	QRV again
70029	S55ZMB	JN76VK	5	4 Ele Yagi	310	250	A1	24	05/07	CT1HZE
70040	SV1FOUR	KM17	1	Yagi	NE		A1	24	05/07	Proposal
70113,5	5B4CY	KM64FT	10	6 Ele Yagi	315	100	A1	24	05/07	temp. QRT 5B8AV
70608	CQ5FOUR	IM59	10	Ring horiz.	Omni		A1	24	04/07	CT1HZE
70612	CU8DUB	HM49KL	20	dipole	E/W	500	A1	24	04/07	CT1HZE
75300	ZD8DUB	II22TB	10	3 Ele Yagi	335	730		24	10/06	CT1HZE

There are NO 4m beacons qrv from South Africa (ZS) anymore.

DUBUS 2m and 70cm beacon list, 5/2007, by DL8HCZ

QRG	Call	Locator	m asl	Antenna	QTF	Pwr	Info/Keeper	Last Update	Remarks
144.010	PY2PE	GG66PO	1250	3x5/8 vert	Omni	10	PY2ZX	10/06	New beacon
144.055	ZZ2TXT	GG69BG	600	vertical	Omni	10	PY2ZX	10/06	ex PY2JI
144.060	PY5XX/B	GG54RE					PY5CC	10/06	Under repair
144.060	ER1VHF	KN46KW	180	5/8 GP	Omni	5		10/06 DL8HCZ	
144.070	PY1BCN	GG87KL	1475	7 ele yagi				03/07	
144.145	EW6DS/B	KO45IG					EW6DS	11/06 RV3YM	
144.146	LZ2CC	KN22GS	1480	GP	Omni	5	LZ2CC	02/05 LZ1DP	QRT
144.170	KH6HME	BK29GO	2501	2x7 Ele.	to CA	1200e		06/06	
144.280	VE2FUT	FN35		Horiz.		10		07/04	
144.284	VE1CBC	FN63						10/06	
144.285	WA1ZMS/B	FM07FM	1280	2 x Yagi	NE	100	WA1ZMS	11/06	Transatlantic Bcn QRV!
144.289	KL7GLK	FM18SW		turnstile	omni	5	KL7GLK	02/06 .	
144.289	KL7GLK	FM18SW		2 x 13 ele	EU	100	KL7GLK	02/06	Temporary qrv in June/July
144.297	K4OBX	FM25FG		yagi	EU	30		10/06 W4HAT	QRT
144.298	PY0FF/B	HI36TD	5	7 Ele yagi	EU	50	PY0FF	04/07	
144.300	ZD8VHF	II22TB	730	4 ele Yagi	335	20	ZD8I	11/06	yagi temp. Vertical
144.301	VP9DUB	FM72OH		4 ele Yagi	EU	30	VP9IV	03/07	
144.304	5T5SN/B	IK28AC		Yagi	EU	60	5T5SN	05/07	qrv 5/07 to 09/07
144.341	UT5EC	KN78MM	180	4 x Yagi	Omni	10		03/07 UR5LX	
144.345	RN6MT	KN97LN	120	Ring Dipole	Omni	5	UR5LX	04/07	
144.367	UT5G	KN66LS	80	Dipole	N/S	5		10/06 UR5LX	will change to .450
144.370,5	UR4YWW	KN28WG	280	Turnstile	Omni	4		02/05 UR5LX	QRT
144.387,5	RA3IM	KO56UM	230	Discone	Omni	9		02/05 RA3IS	temp. QRT
144.400	VO1ZA	GN37JS	90	11 El Yagi	EU	250	VO1NA	07/04 .	QRT
144.402	UA3IFI	KO76WF	160	¼ V	Omni	5		02/05 RA3IS	temp. QRT
144.402	OY6BEC	IP62OA	40	11 El Yagi				09/04	QRT
144.403	EI2WRB	IO62IG	248	5 Ele Yagi	95	40	EI8JA	05/07 DL8HCZ	
144.404	EA1VHF	IN53RE	615	Halo	Omni	25	EA1DKV	05/07 CT1HZE	
144.405	F5XAR	IN87KW	165	9 eleYagi	290	400	F6ETI	05/07 F6HTJ	
144.405	CT1ART	IM67AH	510	H Loop	Omni	40	CT1EPS	05/07 CT1HZE	
144.406	GB3SSS	IO70IA	50	8/8 slot Yagi	252	200	G3AGA	05/07	Transatlantic Beacon
144.410	FX3THF	IN88GS	145	9 el Yagi	90	50	F6DBI	05/07	Call changes to F5XSF
144.410	DB0SI	JO53QP	90	Big wheel	Omni	10 TX	DL1SUZ	05/07 DL8HCZ	
144.410	DB0MFI	JN58GV	440	Big wheel	Omni	4 TX	DK1MFI	10/05 DK1MFI	Proposal
144.410	RB4NA	LP30VF	24	2 x 9 Ele	15+150	5TX	UA4NX	08/06	
144.411	IQ1SP/B	JN44VC	745	Turnstile	Omni	1	IK1LBW	05/07 I1DMP	
144.412	SK4MPI	JP70NJ	520	4 x 6 el Yagi	45/315	1500	SM4HFI	05/07 SM6CEN	
144.412	CT1ARN/B	IN61NR	1110	Vertical Coll	Omni	10		01/06	QRV?
144.414	DB0JW	JO30DU	238	5 el Yagi	22	50	DL9KAS	04/07 DL8HCZ	
144.415	IQ2MI/B	JN35WW	4559	5 ele	110	0.1TX	IW2ELP	04/07 DL8HCZ	F1A
144.415	ZS2VHF	KF25UX			Omni	10	ZS2FM	11/06 ZS2ECH	Temp. QRT
144.416	PI7CIS	JO22DC	40	Dipole	E/W	50	PA0CIS	05/07 DL8HCZ	
144.417	OH9VHF	KP36OI	310	10 dBd	200	200		04/07	
144.417	CU3DUB	HM68		Dipole	NE/SW	1	CU3EQ	04/07 CU3EQ	Proposal
144.418	ON0VHF	JO20HP	180	Clover leaf	Omni	10	ON7ZV	04/07 DL8HCZ	
144.419	IQ2CY/B	JN55AD	46	Big wheel	Omni	10	IK2THZ	04/07 DL8HCZ	ex I2M
144.420	HG5BVA	JN97LM	485	Slot	Omni	1	HA5BDJ	02/05 HA1YA	Proposal
144.420	ZS1VHF	JF96					ZR1AEE	11/06 ZS1TX	QRT
144.420	CU8DUB	HM49KL	585	4 ele Yagi	E	60	CU8AO	05/07 CT1HZE	
144-420	LZ2CM/B	KN13NE		GP	Omni	0.5	LZ2CM	05/07 LZ2CM	
144.420	DB0RTL	JN48PL	480	Big wheel	Omni	15	DL8SDL	01/04 DL8HCZ	QRT!
144.421	OZ...	JO46/47		2 x Yagi	300	250	OZ7IS	Transatlantic Beacon	Proposal
144.421	CS3DUB	IM12op		Yagi	EU	30	CT1HF	04/07 CT1HZE	Test Operation
144.422	DB0TAU	JO40HG	326	4x4 el Yagi	Omni	15	DL4FCS	10/06	Temp. QRT
144.423	PI7HVN	JO22WW	52	Halo	Omni	10	PA3FHY	04/07	ex PI7FHY
144.424	IN3IYD/B	JN56NB	225	GP	Omni	0.1	IN3IYD	10/06 DL8HCZ	

144.425	F5XAM	JO10EQ	99	Big wheel	Omni	14	F6BPB	05/07	F6HTJ	call still FX2VHF
144.425	RB3PB	KO93BD			Omni	5	RW3PF	10/06		
144.426	SR9VHK	JO90MH		Dipole		3	SP9DSD	04/07		
144.426	EA6VHF	JM08SQ	150	Halo	Omni	25	EA6FB	10/06		
144.427	OK0EJ	JN99FN	1323	2 el Yagi	270	0.3	OK2UWF	05/07	DL8HCZ	
144.427	PI7PRO	JO22NA	10	Halo	Omni	10	PI4VRZ	07/06	G7RAU	
144.428	DB0JT	JN67JT	785	4 x Dipole	Omni	30	DJ8QP	04/07	QRV!	
144.429	SR3VHC/B	JO91CQ	180	cross dipole	Omni	1	SP3DRT	04/07		
144.429	IQ3MF/B	JN65RW	130	2xTurnstile	Omni	4	IV3HWT	05/07	DL8HCZ	ex IV3HWT/IV3A
144.430	GB3VHF	JO01DH	268	2x3el Yagi	315	40	G0FDZ	05/07	CW/RTTY/JT65	
144.431	9A0BVH	JN85JO	485	V-Dipole	Omni	3.2		12/06		
144.432	9H1A	JM75FV						02/04	9H1BN	QRT!
144.433	OH7VHF	KP52IJ	165	2xBigWheel	Omni	50		04/07	OH6DD	
144.433	FR1GZ/B	LG79		9 Ele Yagi	N	50	FR1GZ	07/06	FR1GZ	
144.433	IZ3DVW/B	JN55VF						03/07		
144.434	DB0LBV	JO61EH	232	2xDipole	Omni	0.4TX	DL1LWM	10/06		
144.434.5	HB9OK	JN45MW	1601	Halo	Omni	3,5	HB9DUR	10/06		
144.435	HB9H	JN46KE	1600	2xDipole	Omni	0.3/3	HP9BQX	10/06		QRT since 2003
144.435	RN6BN/B	KN95LC		Dipole		5	RN6BN	10/06	RB6BN	
144.435	SK2VHG	KP07NN		16 el Yagi	180	800e	SK2CP	07/06		
144.436	DA5DUB	JO40AQ	693	4 x 4 ele		1K	DM8MM	05/07	DM8MM	Test OP
144.438	OK0EO	JN89QQ	602	Ring dipole	SW	0.05/0.12	OK2VLX	05/07	DL8HCZ	Planned
144.438,5	OZ3VHF	JO55JH	35	Clover Leaf	Omni	0.5?		05/07	DL8HCZ	
144.439	EB3VHF	JN01SU		5/8	Omni	20	EA3DGI	10/06	F6HTJ	
144.440	SV2DCD/B	KN00LI	1800	2 x 6 Ele yagi	330+180	2 x 15	SV2DCD	05/07		
144.440	DB0RG	JO51AN	428	V Dipole	Omni	1	DL4OAN	04/05		Proposal
144.440	ZS0VST			8 el Yagi	0	30	ZS4NS	03/00	ZS5JF	Planned
144.441	LA4VHF	JO28WL	50	2x8el Yagi	200/0	280e	LA1YCA	10/06	LA0BY	Proposal
144.441	CT0TWO	IM59OM		Vertical	Omni	0.25		05/07	CT1HZE	
144.442	IK4PNJ/B	JN54QK	300	X-Dipole	Omni	1/10	IK4PNJ	10/06	ex I4A	Proposal
144.443	OH2VHF	KP20BB	65	2xYagi	20/230	130	OH2LNM	10/06	OH6DD	
144.444	DB0KI	JO50WC	985	Halo	Omni	2.5	DC9NL	05/07	Test operation	
144.444	IQ5LU/B	JN53GW	1000	Big wheel	Omni	6	IW5BHY	05/07	DL8HCZ	ex I5A
144.445	GB3LER	IP90JD	108					06/02	G3UUT	QRT
144.446	OK0EB	JN78DU	1084	Miniwheel	Omni	0.06/0.007	OK1APG	05/07		
144.447	SK1VHF	JO97CJ	65	2xCloverleaf	Omni	10e		10/06	SM6CEN	
144.448	HB9HB	JN37OE	1300	3 el Yagi	345	120	HB9AMH	05/07		
144.448	SK6VHF	JO57TX	120	M2 Loop	Omni	4 TX	SM6CEN	10/06	SM6CEN	
144.449	I0A	JN61		2 x Bigwheel	Omni	10	IW0BCF	01/04	I5WBE	QRT
144.450	DL0UB	JO62KK	110	Corner Dipole	Omni	12 TX	DL7ACG	03/07	DL7ACG	will go QRT
144.450	F5XAV	JN24GB	100	Big Wheel	Omni	10	F5IHN	05/07	F6HTJ	
144.450	RB3PA	KO84UF	260	5 dBD	Omni	1	RA3PG	10/06		
144.451	LA7VHF	JP99EC	320	10 el Yagi	190	20	LA5TFA	05/07	LA0BY	
144.452	OK0EC	JO60CF	778	3 el Yagi	90	0.7	OK1VOW	05/07	DL8HCZ	
144.453	GB3ANG	IO86MN	370	4 el Yagi	160	20	GM4ZUK	05/07		
144.453	I0G	JN63IB	1200	4 x dipole	Omni	10	IW0QIT	11/04	DL8HCZ	QRT
144.454	IW0UMP/B	JN40QW	350	Turnstile	Omni	1	IW0UGR	05/07	DL8HCZ	ex IS0A
144.455	OH5ADB	KP30NN	65	Dipole	135/315	0.1		05/07	OH6DD	
144.456	SR5VHP	KO01LI	110		Omni	3	SQ5BE	06/06	JT65-BCN	Proposal
144.456	DB0RHN	JO50AL	930	Dipole	0/180	1 TX	DK9MS	04/04	Proposal	ex DB0GD
144.457	SK2VHF	JP94TF	300	2 x 10 el Yagi	0/225	100e		05/07	SM6CEN	
144.458	F1XAT	JN15AO	913	Big wheel	Omni	25	F1HSU	05/07	F6HTJ	
144.460	HG1BVA	JN86CW	370	2 x Big Wheel	Omni	5	HA1YA	05/07	HA1YA	
144.460	VK6RPH	OF88	337	Horizontal	Omni	10		12/06	WIA	
144.460	TF3VVV	HP94BC		Vertical	Omni	25	TF3GW	10/06	TF3YH	
144.461	SK7VHF	JO65KJ	15	halo	Omni	5e		05/07	DL8HCZ	
144.462	IQ0RI/B	JN62LK	1700	4 Ele Yagi	330?	5		10/06	QRT	
144.463	LA2VHF	JP53EG	710	12 el Yagi	15	500	LA1K	05/07	LA0BY	
144.464	I7A	JN81EC	685	Big wheel	Omni	8	I7FNW	07/06	CT1HZE	

144.465	DF0ANN	JN59PL	630	V Dipole	Omni	0.3 TX	DL8ZX	05/07		
144.465	CN8LI	IM64		13 el Yagi	N	5 TX	CN8LI	06/04		Temp. QRV
144.466	OZ4UHF	JO75LD	130	Big wheel	Omni	10	OZ1HTB	05/07	OZ2TG	
144.467	HB9RR	JN47FI	904	4 x Dipole	Omni	0.0225	HB9RR	10/06		
144.467	I8A	JM78WD	1778	SqLo	Omni	8	I8GMP	11/04	DL8HCZ	QRT
144.467	OK0ED	JN99DQ	290	2xDipole	Omni	0.1	OK2UWF	05/07	DL8HCZ	
144.468	F1XAW	JN26IX	561	Big wheel	Omni	16	F1RXC	05/07	F6HTJ	
144.468	IH9GPI/B	JM56XT		2 x 3 Ele	5	10e	IH9GPI	05/07	DL8HCZ	
144.468	LA6VHF	KP59AL	70	9 el Yagi	210	300	LA4OO	10/06	LA0BY	QRT
144.469	GB3MCB	IO70OJ	320	3 el Yagi	45	40	G3YJX	05/07	G3YJX	
144.469	IT9A	IM67LX	825	2xBigwheel	Omni	10	IT9QPF	11/04	DL8HCZ	QRT
144.470	OH2VHH	KP20MH	75	Halo	Omni	2		05/07	OH6DD	
144.470	OK0EZ	JN79VV	350	X-Dipole	Omni	1	OK1DXF	05/07	DL8HCZ	
144.471	OZ7IGY	JO55WM	96	Big wheel	Omni	25	OZ7IS	05/07	OZ2TG	
144.471	OK0EL	JO70SQ	900	Dipole	90/270	0.005	OK1AIY	05/07	OK1TEH	
144.471	SV8CS/B	KM07LR						01/07		
144.472	IT9G	JM68QE		5 Ele	360	35e		10/06	I5WBE	Call -> IT9PA?
144.473	LY2WN	KO25GC	95	Turnstile	Omni	10	LY2WN	06/06	LY2WN	
144.474,5	YU1VHF	KN04OO	204	5 Ele Yagi	320	7	YU1AU	05/07		
144.475	DB0SGA	JN69KA	1024	4x4el Yagi	Omni	5 TX	DJ4YJ	05/07	DJ4YJ	ex DL0SG
144.475	OM0MVA	JN88NE	570	Dipole	Omni	0.11	OM3ID	03/07	DL8HCZ	
144.476	F5XAL	JN12LL	1100	Big Wheel	Omni	10	F6HTJ	05/07	F6HTJ	
144.477	DB0ABG	JN59WI	522	Big Wheel	Omni	4 TX	DJ3TF	03/99	DJ3TF	QRT
144.478	LA3VHF	JO38RA	30	9 el Yagi	180	120	LA3BAA	05/07	LA0BY	
144.479	SR5VHF	KO02ON		Turnstile	Omni	0.75	SP5TAT	01/02	SP6LB	QRT
144.479	IQ9BF/B	JM77NO	800	2xBigWheel	Omni	3e	IW9AFI	10/06	DL8HCZ	Proposal
144.480	ZS6TWB/B	KG46RD		8 x 17 Ele	N	15TX	ZS6WAB	05/07	ZS6NK	on when OP not qrv
144.480	LA8VHF	JO48XX	300	3x2 el Yagi	150	100	LA6LCA	05/07	DL8HCZ	
144.482	HG8BVA	KN06PW	85	5 Ele	260	5	HA8MV	05/07	HA1SS	
144.482	GB3NGI	IO65VB	518	2x4 el Yagi	45/120	25	GI6ATZ	03/07	DL8HCZ	
144.482	D44DUB	HK86NO		4 Ele Yagi	EU	40	D44TD	05/07	CT1HZE	Proposal
144.482	I8EMG/B	JM89BJ	1400	Halo	Omni	3	I8EMG	05/07	I8EMG	
144.484	UU9JJ	KN64RO	60	dipole	N/S	5	UU9JJ	11/06	UU9JJ	
144.484	EA8...	IL18		Yagi NNE		10	EA8AHH	04/07	DL8HCZ	Proposal
144.485	TK5ZMK	JN41JS	635	Big Wheel	Omni	10	TK5EP	05/07	DL8HCZ	
144.485	SR5VHW	KO02PF	100	4 x dipole	Omni	10	SP5XMU	05/04	DL8HCZ	QRT
144.486	DM0PR	JO44JH	75	4x6el Yagi	0/180	200TX	DL8LD	05/07	DL8HCZ	
144.486	IW1DJS/B	JN45AB			Omni		IW1DJS	02/07	DL8HCZ	
144.487	SR2VHM	JO94II		9 Ele yagi	210	7	SQ2BXI	05/07	DL8HCZ	
144.488	SV3AQR/B	KM07QS		Big Wheel	Omni	5	SV3AQR	04/07		
144.488	S55ZRS	JN76MC	1219	Dipole	Omni	1	S57C	05/07	DL8HCZ	
144.490	DB0FAI	JN58IC	590	16 el Yagi	305	1kw e	DL5MCG	05/07	DL5MCG	
144.490	HG3BVA	JN96CC	535	Slot	Omni	1	HG5AZB	02/05	HA1YA	Proposal
144.500	RA3GFV	KO92SO	140	V-Dipole	Omni	5	RA3GFV	02/07	RA3GFV	A1A
144.621	UU1DX/B	KN74BW	350	Dipole		4	UU1DX	'05/07	UU1DX	
145.250	RB9FA	LO88DA		Vertical	Omni	3	RV9FF	05/06	RV9FF	QRT

70cm

432.128	S55ZNG	JN65UU	643	Horiz. Loop	Omni	0.1	S59DKS	02/04	S51KQ	QRT
432.280	UT5EC	KN78MM	180	4 x yagi	Omni			10/06	UR5LX	QRT
432.367	UT5G	KN66LS	80	Dipole	N/S	5	UT7GA	10/06	UR5LX	will change to .450
432.395	YU1UHF	KN04OO	204	6 ele Yagi	320	10	YU1AU	05/07	YU7EF	
432.400	UT3BW	KN29UA	365	crossdipole	Omni	2		01/04	UT3BW	QRT
432.400*	OE3XMB	JN77TX	1154	11 Ele	337	5	OE3FFC	05/07		ex 432.800
432.400	GB3BSL	IO81QJ	252	4 x 3 el Yagi	90	250	GW8AWM	01/07	on	ex **432.934***
432.401*	SK2UHF	JP94WG	445	2 x20 el coll	0/225	300e	SK2AT	05/07	SM6CEN	ex 432.875
432.401	UU9JJ	KN64RO	60	dipole	N/S	5	UU9JJ	05/07	UU9JJ	
432,402	OY6BEC	IP62OA		7 dBD	135°	50e		01/04	LA0BY	QRT
432.403	EI2WRB	IO62IG	248	12 el Yagi	95	5	EI8JA	05/07	EI8JA	
432.404*	F1ZNI	JN23MM	114	BigWheel	Omni	10	F1AAM	05/07	F6HTJ	Temp. QRT

432.404*	SK1UHF	JO97CJ	65	Slot	Omni	30	SM1IUX	05/07	SM1MUT	ex 432.950
432.405*	PI7QHN	JO22KH	20	3 dB Gain	Omni	2	PA0QHN	04/06	OZ1BEF	ex 432.905
432.406*	HG8BUA	KN06PW	85	9 el Yagi	260	5	HA8MV	10/06	Temp. QRT	ex 432.908
432.406	OK0EO	JN89QQ	602	Ring Dipole	SW	0.05/0.12	OK2VLX	05/07	Proposal	ex 432.966
432.407	PI7YSS	JO32CD	60	Halo	Omni	2	PA0JAZ	07/04	DL8HCZ QRT	ex 432.895
432.407.5	CT1ART/B	IM67AH	510	Vertical	Omni	10	CT1EPS	05/07	CT1HZE	
432.408	SK5UHF	JP80SA		Dipole	N/S			12/06	DL8WX	
432.408*	F5ZPH	IN87KW	165	4 Ele	135	20	F6ETI	05/07	F6HTJ	
432.410	DB0ZW	JN69AT	650	Slot	Omni	1 TX	DC9RK	02/05	Temp. QRT	ex 432.810
432.412*	DB0JG	JO31GT	45	Clover Leaf	Omni	1 TX	DL3QP	05/07	DL3QP	ex 432.925
432.412*	SK6UHF	JO67EH	175	Clover Leaf	Omni	10	SM6ESG	05/07	SM6CEN	
432.413*	F5XAG	JN14EB				40		05/07	F6HTJ	new QTH
432.414	DB0JW	JO30DU	238	2 x 11 el Yagi	45	5	DL9KAS	01/07	on **432.969***	
432.415	DB0UBI	JO42GE	125	8el Coll	30	12	DD8QA:	QRT since 4/04		ex 432.920
432.416*	PI7CIS	JO22DC	40		Omni	100	PA0CIS	05/07		ex 432.816
432.417*	OH9UHF	KP36OI	307	9 dBd gain	200	70		05/07		ex 432.945
432.418*	F1ZQT	IN95OX	80	Big Wheel	Omni	1	F1MMR	05/07	F6HTJ	
432.420*	F5XAS	JN12BL	2400	Big Wheel	Omni	15	F6HTJ	05/07	F6HTJ	
432.420*	DB0VC	JO54IF	300	4xDQ	Omni	10	DL8LAO	05/07		ex 432.990
432.423*	PI7HVN	JO22WW	50	Horizontal	Omni	0.5	PE1HUE	05/07		ex 432.873
432.425	DB0YI	JO42XC	480	Big wheel	Omni	4 TX	DL4AS	07/06	QRT for ever	ex 432.900*
432.425	EA6UHF	JM08PV	470	Halo	Omni	10	EA6FB	temp. QRT		ex 432.918
432.425	DB0MMO	JN49RV	585		Omni	10	DH4FAJ	05/07		
432.425*	LY2WN	KO25GC	96	2 x dipole	Omni	32	LY2WN	05/07		
432.427	OK0EJ	JN99FN	1323	2 ele	W	03	OK2UWF	05/07		
432.428	SR3UHD	JO91CQ	180	cross dipol	Omni	1	SP3DRT	11/06	Proposal F1A	
432.429*	HB9OK	JN45MW	1601	Halo	Omni	3,5	HB9DUR	08/04	Temp. QRT	ex 432.938,5
432.430	GB3MLY	IO93EO	600	6 el Yagi	150	40	G3PYB	03/07		ex **432.910***
432.430	DB0MFI	JN58GV	440	Big wheel	Omni	4 TX	DK1MFI	10/05	DK1MFI	Proposal for 2006
432.432*	HB9F	JN36XN	3581	Cornerrefl.	N/S	15	HB9MHS	05/07		ex 432.984
432.432*	HG7BUA	JN97KR	700	Vert. Collin.	Omni	3	HA5ED	05/07	HA1YA	ex 432.930
432.432*	OH6UHF	KP13GM	55	3xBig Wheel	Omni	7	OH6UH	05/07		ex 432.840
432.435*	DB0LBV	JO61EH	234	2xSlot	Omni	2TX	DL1LWM	08/06		ex 432.845
432.435*	OH5SHF	KP30HV	145	Turnstile	Omni	1		05/07	OH6DD	ex 432.935
432.436*	F5XAZ	JN06KN	144	Big wheel	Omni	50	F5EAN	05/07	F6HTJ	ex 432.886
432.438	HG6BUA	KN07AU	1015	Slot	Omni	1	HG5ED	02/05	HA1YA	Proposal .945?
432.439*	DB0RG	JO51AN	428	V-Dipole	Omni	1	DL4OAN	04/05	Proposal	ex 432.940
432.440*	SK7MHH	JO86GP	45	Alford slot	Omni	100e		05/07	SM6CEN	ex 432.940
432.440	F1ZTV	JN24WX	2120	Loop	Omni	3	F1LCE	05/07	F6HTJ	
432.441	LA5UHF	JO28UO	170	6 ele	180	200e	LA3EQ	05/07	LA0BY	
432.441*	F5XBA	JN18KF	166	4xHB9CV	Omni	10	F2AI	10/06	F6HTJ	Temp. QRT
432.442*	I8EMG/B	JM89BJ	1389	3 Ele	290	5	I8EMG	05/07	I8EMG	
432.443*	OH2UHF	KP20BB	65	2x 10 dBi	20/225	60		05/07	OH6DD	ex 432.852
432.444*	DB0KI	JO50WC	1058	4 x 8 vertic.	Omni	10	DC9NL	05/07		ex 432.840*
432.445*	DB0OS	JO40CW	730	Slot	270	0.3	DL1DKS	02/06	DL1DKS	ex 432.945
432.445	GB3LER	IP90JD	104	12 el Yagi	165	675	GM4IPK	06/02	G3UUT	QRT
432.446	OK0EB	JN78DU	1084	Mini Wheel	Omni	0.03/0.01	OK1APG	05/07	on **432.965***	ex 432.970
432.446*	OZ1UHF	JO57FJ	150	Big wheel	Omni	10	OZ9NT	05/07	OZ2TG	
432.447	S55ZRS	JN76MC	1219	Slot Dipole	Omni	1	S50M	05/07	S51KQ	ex **432.950***
432.447*	DB0IH	JN39ML	630	Slot	Omni	1	DD1VB	05/07		ex 432.950
432.448	S55ZCE	JN76OH	554	GP (V)	Omni	0.07	S51KQ	02/04	temp QRT	ex 432.980
432.449*	HG3BUA	JN96CC	585	Slot	Omni	1TX		01/07	HA5NF	ex 432.946
432.450*	DL0UB	JO62KK	110	2 x Malteser	Omni	5 TX	DL7ACG	04/07	DL7ACG	will go QRT
432.450*	I5WBE/B	JN53LK	300	2x7 el Yagi	15/260	6	I5WBE	05/07	DL8HCZ	ex 432.450
432.452	OK0EC	JO60CF	778	10 el Yagi	90	1	OK1VOW	05/07		**ex 432.980***
432.453	GB3ANG	IO86MN	370	9 el Yagi	170	100	GM4ZUK	05/07		ex **432.980***
432.455*	SK3UHF	JP92FW		4xD-quad?	Omni	10	SM3AFT?	05/07		ex 432.855
432.456	DB0RHN	JO50AL	930	Dipole	N/S	1 TX	DK9MS	04/04	Proposal	ex .800 db0gd
432.460	EB3UHF	JN01SU		Big Wheel	Omni	20TX	EA3DGI	05/07		

432.460*	SK4BX/B	JO79LH	270	4x10el log p	Omni	43	SM4RWI	05/07	ex SK4UHF	ex 432.905
432.460*	DB0LB	JN48NV	367	Cornerdipole	N/S	0.2TX	DK3PS	05/07		ex 432.945
432.463	LA2UHF	JP53EG	710	10 Ele Yagi	15	300e	LA1K	10/06	LA0BY QRT	ex 432.870
432.465*	DF0ANN	JN59PL	630	Big wheel	Omni	1 TX	DL8ZX	05/07		ex 432.965
432.467	ON4UHF	JO20ET	180	Clover leaf	Omni	0.5	ON4LC	10/06	DL8HCZ QRT	on 432.990*
432.468	LA6UHF	KP59AL	70	15 el Yagi	210	40	LA4OO	10/06	LA0BY QRT	ex 432.865
432.470	GB3MCB	IO70OJ	320	4 e agi 45/	12		G3YJX	02/04	G3YJX	QRT
432.471*	OK0EZ	JN79VV	350	Crossdipole	Omni	1	OK1DXF	10/06	Temp. QRT	ex 432.871
432.471*	OZ7IGY	JO55WM	93	Omni+ 9el	Omni/45	30/300	OZ7IS	05/07	OZ7IS	ex 432.930*
432.475*	ES0UHF	KO18DN		Ring	Omni	12	ES2NJ	05/07		ex 432.835
432.470	HG5BUA	JN97LM	485	Slot	Omni	1	HA5BDJ	05/07	HA1YA	
432.475	DB0SGA	JN69KA	1024	4 x 9 Yagi	Omni	5TX	DJ4YJ	temp. QRT		ex 432.975
432.475	HG1BUA	JN87FI	725	Slot	Omni	3 TX	HA1YA	01/07	HA1YA	ex **432.975***
432.477	DB0ABG	JN59WI	522	Big Wheel	Omni	1 TX	DJ3TF			QRT
432.478*	LA3UHF	JO38RA	12	13 el Yagi	180	50	LA3BAA	11/06	temp. QRT	ex 432.880
432.478	OM0MUA	JN88NE	570	Dipole	90/270	0.08	OM3ID	05/07		ex 432.888*
432.479	SR5UHW	KO02OF	130	Turnstile	Omni	0.25	SP5TAT		QRT?	ex 432.982
432.480*	LA8UHF	JO59FB	30	8 el Yagi	90/180	50	LA6LCA	05/07	LA0BY	ex 432.820
432.480	IQ3TS/B	JN65WP	377	Collinear 4dB	Omni	1.5	IV3LNQ	05/07	I5WBE	
432.482	OZ2ALS	JO45UB	28	4 x dipole	Omni	40	OZ9DT	01/04	OZ2TG QRT	ex 432.983
432.482	GB3NGI	IO65VB	518	12 el Yagi	125	250	GI6ATZ	02/04	GI6ATZ	Proposal
432.485*	LA4UHF	JO29PJ	75	10 el Yagi	200	50	LA9NQ	10/06	LA0BY QRT	ex 432.890
432.488*	DB0AD	JO40AQ	693	Dipole	Omni	10	DL7AJA	05/07	DL7AJA	ex 432.913*
432.489*	OK0EA	JO70UP	1355	2 x 15 el Yagi	S+W	3	OK1AIY	05/07	ex 432.935	Temp QRT
432.489*	SK7MHL	JO65OR	100	Alford slot	Omni	40	SM7ECM	05/07	SM7ECM	ex 432.970
432.490	OH7UHF	KP32TW	215	6 dBd	225	15/1.5/.15		05/07	OH6DD	**ex 432.875***
432.490	GB3SUT	IO92CO	270	2 x8 el Yagi	0/135	10	G8XGG	08/04	QRT	ex 432.885
432.838*	9A0BUH	JN85JO	485	V dipole	Omni	3.8	9A2MP	12/06	Proposed QRG: 432.431	
432.883	DB0INN	?						02/07		
432.886*	OK0EP	JO80OC	1505	2 x 4 el Yagi	W+SE	2x3	OK1VPZ	05/07	will stay on old QRG!	
433.750	YO7AQF	KN24KV			Omni	1	YO7AQF	05/07	YO7AQF	
432.xxx	RN6MT	KN97LN	120		Omni		RN6MT	02/05	UR5LX	Proposal

*** / bold** on 70cm indicates on which QRG (old / new) the beacon was QRV at the reported date. Still several beacons are qrv on the "old" QRG.