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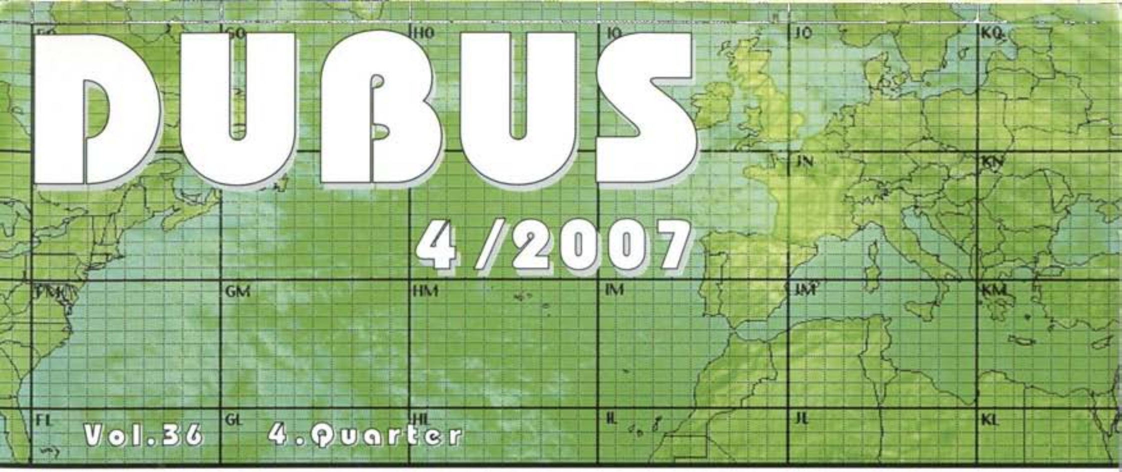
4/2007

Vol.36 4.Quarter



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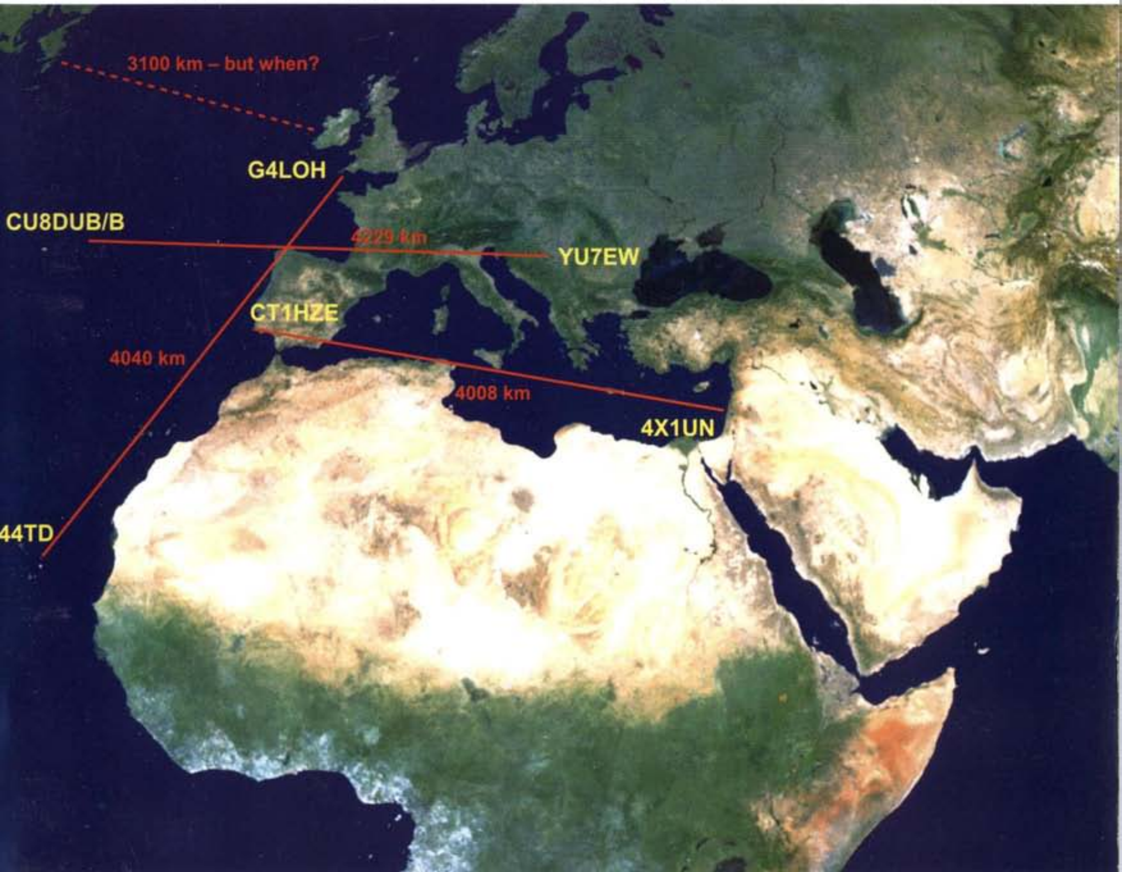

incl. new Region 1 Tropo Record

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Content / Inhalt 4/07

Title: New IARU Region 1 Tropo record from G4LOH to D44TD on Aug 4th.

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Please send all new technical articles to CT1HZE (address below).

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EME News, 2m	Heinz Borde, DM2BHG, Meisenweg 7, D-38820 Halberstadt email: Heinz.Borde@t-online.de
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Austria	OE1WRS, Werner Roedl,Mappesgasse 2/1/3, 2320 Schwechat, Tel: +43-664-3564584 Fax: +43-1-7073181, email: roedl@attglobal.net
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Romania	Augustin Preoteasa, YO7AQF, Banat 13, Bl. B2 Sc. D Ap. 15, 110408 Pitesti Phone +40-788-234-273, email: augustin.preoteasa@soliber.net
Russia	Sergej Joutiaev, RW3BP, P.O. Box 462, 111555 Moscow, email: rw3bp@co.ru
R.S.A.	Ivo Chladek, ZS6AXT, P.O.Box 3093,1745, Kenmare email: zs6axt@telkomsa.net
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Editorial

Dear DUBUS Reader!

Here is the last issue for 2007 and it is time again to ask you to renew your subscription for 2008 with your national distributor (or directly with us) as soon as possible. See order form on page 3.

We would be happy to see all subscriptions renewed again for 2008, of course.

Please check for dates and partly new rules for the European EME contest 2008 on page 112. This contest will take place in memoriam of EA3DXU who died in October 2007. We hope for many participitiants to honour Jose. We are also happy to announce that EA3DXU, Jose M. Prat Parella gets the honour to be the member #1 in the DUBUS Hall of fame for VHF/UHF/SHF operators.

We want to thank all who have sent articles or bits of information throughout 2007, especially OM6AA, DL4MEA, DC0DA, F4BUC, VK7MO, ON4KHG, W1GHZ, YU7EF, DL2AM, DJ5HG, DF5AI, DK5LV, YU7XL, DL2FCN, F6AGR, PE1ITR, K1JT, G4ODA and 9H1LO (chronological order).

Please keep sending your reports and technical articles for the benefit of all readers. Thank you!

Seasons's Greetings to all readers and friends and all the best for 2008

from Joe, DL8HCZ / CT1HZE
and the DUBUS team!

Liebe DUBUS Leser!

Hier ist nun die letzte Ausgabe für das Jahr 2007 und es ist schon wieder Zeit, das Abo für 2008 zu verlängern. Wir bitten alle unsere Leser in DL zu unserer Arbeitserleichterung, das Abo für 2008 möglichst zwischen dem 2. Januar und dem 29. Februar 2008 zu verlängern. Der Abo-Preis beträgt 25 Euro für 2008. Wir würden uns freuen, wenn uns möglichst alle Leser auch im Jahr 2008 weiterhin treu bleiben.

Auf Seite 112 finden sich die Termine und überarbeiteten Ausschreibungsbedingungen für den Europäischen EME Contest 2008. Dieser Contest findet im Gedenken an EA3DXU statt, der im Oktober 2007 verstarb. Wir hoffen auf viele Teilnehmer, die Jose so die letzte Ehre erweisen können. Wir freuen uns, auch bekannt geben zu können, daß EA3DXU, Jose M. Prat Parella als erster in die DUBUS-Ruhmeshalle für VHF/UHF/SHF-Amateure aufgenommen wird.

Wir möchten uns bei allen herzlich bedanken, die im Jahr 2007 Artikel oder Informationen geschickt haben, ganz besonders aber bei OM6AA, DL4MEA, DC0DA, F4BUC, VK7MO, ON4KHG, W1GHZ, YU7EF, DL2AM, DJ5HG, DF5AI, DK5LV, YU7XL, DL2FCN, F6AGR, PE1ITR, K1JT, G4ODA und 9H1LO (zeitliche Reihenfolge).

Wir bitten weiterhin zahlreich Aktivitätsberichte und technische Artikel einzusenden, damit alle Leser davon profitieren können.

Wir wünschen unseren Lesern und Freunden alles Gute für 2008!

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

High-Efficiency Feedhorns for Prime-focus Dishes

Part 3 - Septum polarizers and circular polarization

by Paul Wade, W1GHZ ©2007 - w1ghz@arrl.net
Measurements by Tommy Henderson, WD5AGO - wd5ago@arrl.net

The first two parts of this article described optimization of the VE4MA and Chaparral-style feedhorns to improve dish efficiency. The calculations and measurements were made using linear polarization. Our intuition suggests that these axisymmetric structures would have similar performance with circular polarization, but further investigation will show that this is not always true.

Circular polarization offers a significant advantage for EME communications, eliminating polarization offsets due to geometry and to Faraday rotation. Many implementations provide the additional advantage of separate transmit and receive ports with opposite sense of polarization – reflecting off the moon reverses the sense of the polarization. One popular polarizer uses a stepped-septum in the waveguide feed to the horn which illuminates the dish, but any polarizer that provides good circular polarization to the horn will give identical performance.

Septum Polarizer

The popular septum feed as described by OK1DFC[1] is an unflared square horn, or simply a square waveguide, with an internal stepped septum polarizer which transforms linear polarization into circular polarization. The septum polarizer is based on a set of published dimension in square waveguide, from a paper by Chen and Tsandoulas[2], and adapted for ham use by OK1DFC. Using the open-ended square waveguide as a feed provides reasonably good performance, about 67% calculated efficiency for an ***f*/D** around 0.37, shown in Figure 33, but not nearly as good as the VE4MA and Chaparral-style horns. Also, there is no way to adjust the plain septum feed for different ***f*/D.** The heavy lines in the Feed Radiation Pattern are RHCP (Right Hand Circular Polarization), while the light broken line is for all polarizations – the rear lobes are not well polarized, but it does not matter since this is all spillover.

I previously[3] found that the same septum dimensions for square waveguide could be scaled to provide good circular polarization in circular waveguide of 0.71λ diameter. With the septum, circularly-polarized performance of an open-ended circular waveguide as a feed, shown in Figure 34, is comparable to linear polarization, in Part 1, but not quite as good as the square version. However, the round version of the septum polarizer is compatible with the VE4MA and Chaparral-style horns.

I first made some attempts to improve on the septum in circular waveguide, but with confusing results. I finally realized that the isolation is seriously affected by the horn – any mismatch at the aperture (typically 10 to 15 dB return loss), between the horn and free space, is reflected back to the other port as reduced isolation between the two polarizations. Feeding a prime focus dish, the problem is even worse: reflection from the shadowed portion of the reflector, perhaps 15 dB down, has reversed polarity so that isolation is compromised. Therefore, attempts to achieve high isolation in the feed, separate from the dish, seemed rather futile! We can demonstrate the effect of any mismatch in software, by placing a "Perfectly Matched Layer" over the aperture, so that there is no reflection. Of course, this fictitious layer only exists in software. In Figure 35 below, isolation and return loss of the open-ended waveguide, on the left, is compared with the perfectly-matched aperture on the right. The matched aperture shows better isolation over a wider frequency range. More important, changes to the aperture, by adding rings or horns, will affect the isolation.

How much isolation is necessary? A septum will never provide enough isolation to protect the receiver from the high-power transmitter – a switch will always be required. However, with low isolation, transmit power leaking into the unwanted port would either be absorbed, or reflected and radiated in the opposite polarization. Either way, power is lost, reducing efficiency. For 20 dB of isolation, only 1% of the power is lost, so 20 dB is probably a reasonable goal. However, recent septum development by OM6AA[4], in circular waveguide, and RA3AQ[5], in square waveguide, appear to have good performance with improved isolation.

Another paper with septum dimensions, by Bornemann and Labay[6], suggests that a thicker septum may improve isolation. A few quick trials suggest this may be true in square waveguide, which could be useful for higher-frequency septums, where machining the whole polarizer from solid metal might be easier than assembly of small parts. A more important observation was that septum dimensions and thickness had no effect on antenna pattern or performance. This is better demonstrated by simulations of feeds excited by pure circular polarization (easy in software).

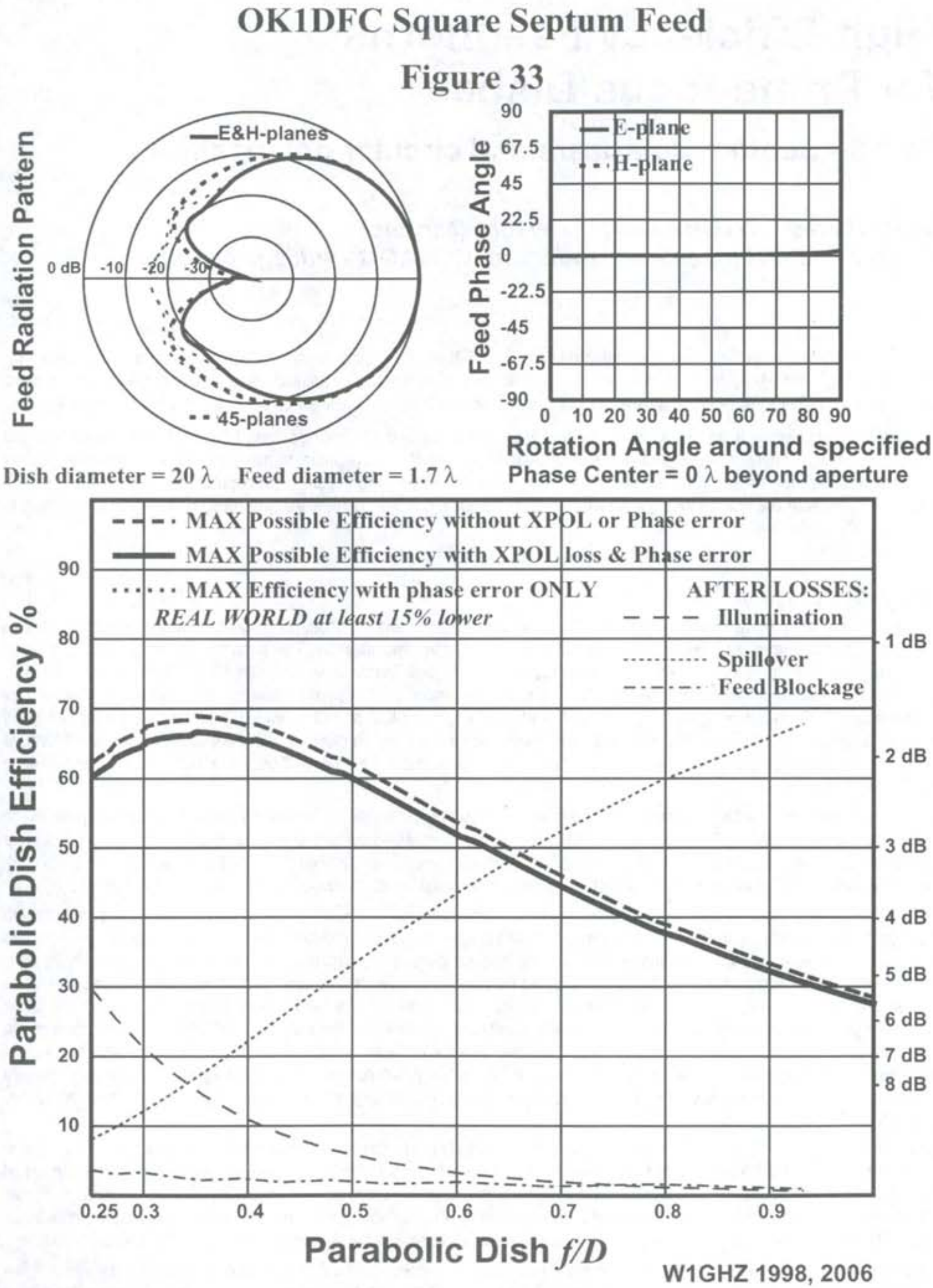
OK1DFC Square Septum Feed
Figure 33
Feed Radiation Pattern
E&H-planes
45-planes
0 dB
-10
-20
-30
Dish diameter = 20 λ Feed diameter = 1.7 λ
Feed Phase Angle
E-plane
H-plane
90
67.5
45
22.5
0
-22.5
-45
-67.5
-90
0 10 20 30 40 50 60 70 80 90
Rotation Angle around specified
Phase Center = 0 λ beyond aperture
MAX Possible Efficiency without XPOL or Phase error
MAX Possible Efficiency with XPOL loss & Phase error
MAX Efficiency with phase error ONLY
REAL WORLD at least 15% lower
AFTER LOSSES:
Illumination
Spillover
Feed Blockage
Parabolic Dish Efficiency %
90
80
70
60
50
40
30
20
10
1 dB
2 dB
3 dB
4 dB
5 dB
6 dB
7 dB
8 dB
0.25 0.3 0.4 0.5 0.6 0.7 0.8 0.9
Parabolic Dish f/D
W1GHZ 1998, 2006

Fig. 33

Round Septum Feed, 0.71l diameter, no rings

Figure 34

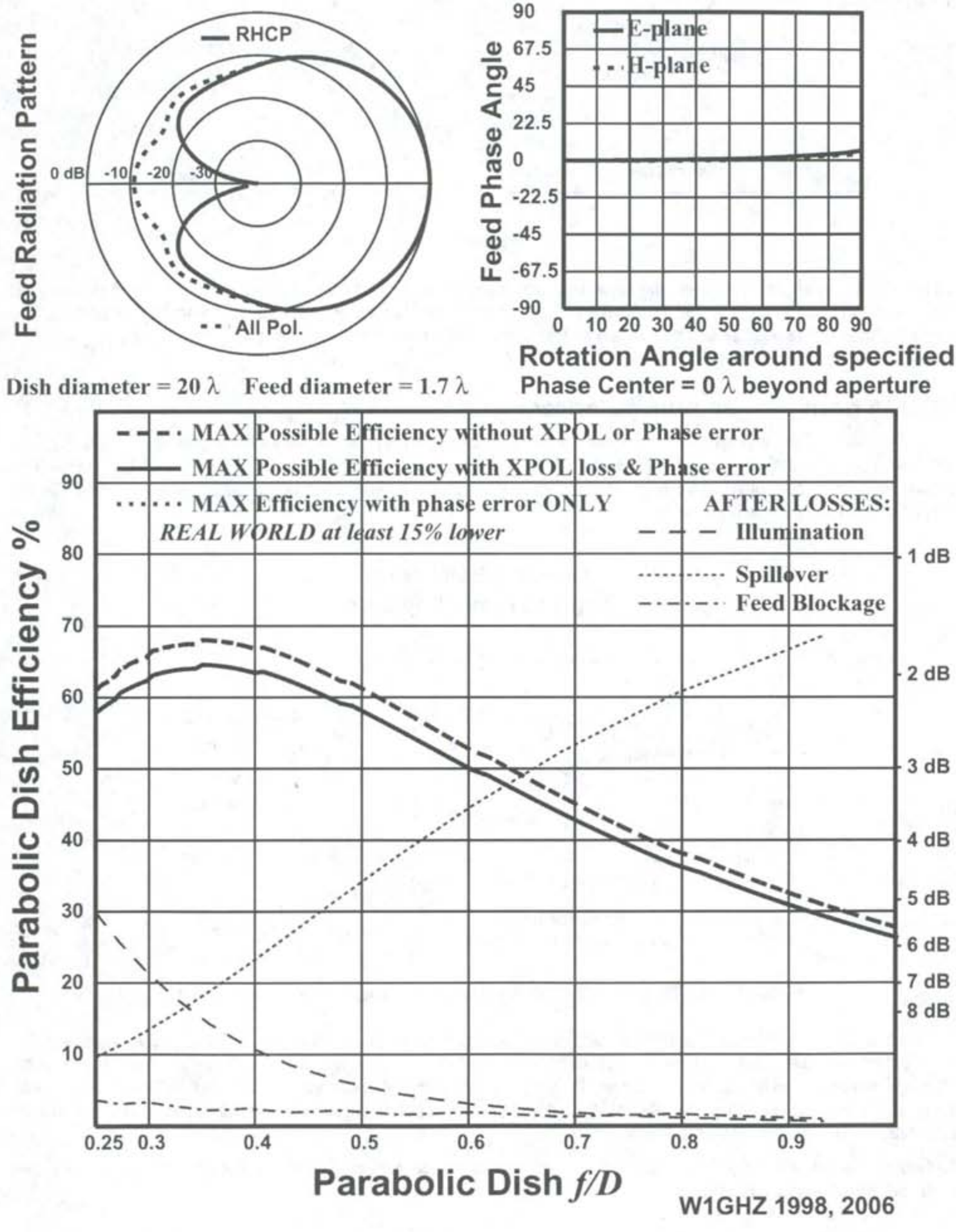

Fig. 34

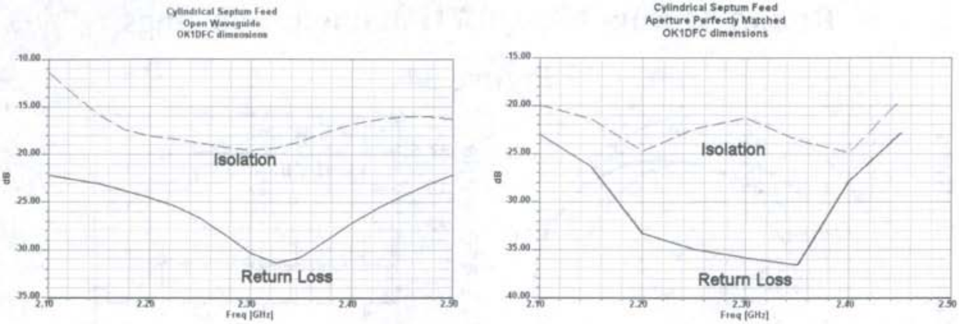

Figure 35

Comparison of these simulations with the same feed with a septum polarizer shows little difference in antenna performance. Thus, we may conclude that any polarizer providing good circular polarization will also provide good antenna performance. The septum polarizer offers good circular polarization with no adjustment, and with lower loss than some other choices.

VE4MA horn with septum polarizer

Several variations of the VE4MA horn were simulated with a septum polarizer. The results for the original ring dimensions, 0.5λ wide and 0.5λ deep, are summarized in Figure 36, and compared with linear polarization. Efficiencies are similar, but lower for circular polarization, particularly as the ring is moved back from the ring to widen the illumination angle and favor smaller ***f*/D**. The best ***f*/D** at each ring position is unchanged.

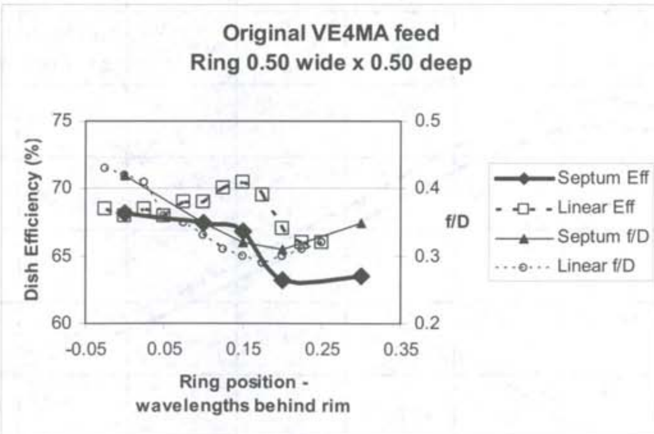

Figure 36. Original VE4MA feed, circular and linear polarization

The lower efficiency with circular polarization appears to be due to cross-polarization (XPOL) loss. We might expect that unwanted side and rear lobes would not have good circular polarization, but these are accounted for as spillover loss. However, Figure 37 shows the plot of efficiency accounting for XPOL that is significantly lower than it would be if XPOL is ignored. Thus, some of the energy illuminating the reflector must also have undesired polarization, either the opposite sense of circular polarization or just random linear polarization.

To properly calculate efficiency while accounting for cross-polarization, we must consider the total power radiation pattern as well as the pattern for desired polarization:

$$\eta = \frac{\int(\text{desired polarization illuminating reflector})}{\int(\text{total radiated power in all polarizations})}$$

PI9CM	26/26	G6HIE	27/26
G1ZJP	26/26	F6HVK	27/26
G4DHF	27/26	G4DEZ	27/37
DF8IK	27/27	GW8IZR	27/26
PA5KM	27/27	F1DUZ	26/26
DJ9CZ	27/27	PE1AHX	27/27
DF2ZC	26/26	DK4TG	26/26
PA1GYS	27/26	DL7ZAU	26/26
ON7GP	28/27	GW8ASA	27/26
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ON7EH	27/27	DL1EAP	27/27
PA0ZH	26/26	DL4EBV	27/27

All with TS2000 / HB 3cx800 PA / HB preamp and single 12ele M2 Yagi and Honda 2000i 2kw generator.

OY/G4ODA – takeoff from IP61

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G4FUF	37/26	GW8IZR	27/26
GM4ISM	26/26	G7CNF	26/26
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DK7QX, JO42KH, wkd (>900km):

13.10.07 18:50 EA2TO/P IN82LX 1365km
13.10.07 18:55 F4EZJ JN05DK 987km
13.10.07 20:37 F6HRO IN88JQ 943km
13.10.07 20:46 F5APM IN97HG 923km
rig: 100W, MGF1302, 8 Ele Yagi, tnx for info Eckhard

EA2TO/2, IN83FE, wkd on 2m > 1000km:

13.10.2007

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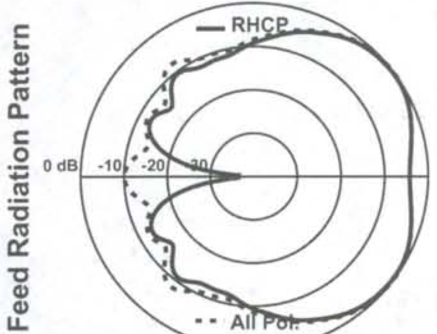
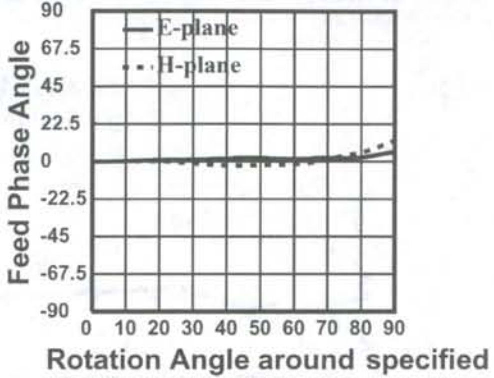
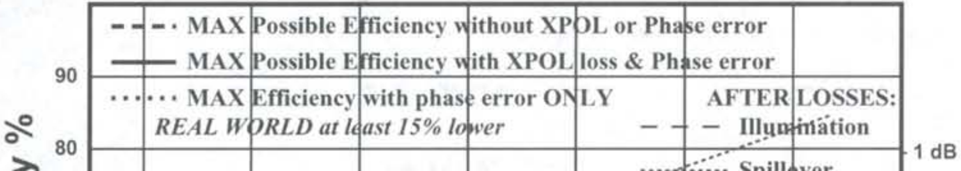
17:18	ON4POO	55	56	JO20DP	1017
17:23	DL1YMK	52	52	JO33RP	1414
17:27	PA2CHR	54	54	JO22XA	1209
17:34	PA2M	52	53	JO21IP	1125
17:36	PA3GDY	51	51	JO21RX	1185
17:38	PA3FXB	55	55	JO33KC	1342
17:41	PD7ES	53	33	JO22SA	1192
17:45	PE2RMI	53	53	JO23MH	1294
17:48	DK4U	529	529	JO42FD	1332
17:49	DK5AL	529	559	JO51BS	1388
17:53	PA4PS	559	579	JO33GH	1348
17:55	PA3BIY	559	529	JO22EB	1151
18:01	DG5AAG	53	52	JO51CT	1395
18:10	PA3GFY	53	55	JO23SC	1291
18:14	PA3DOL	57	57	JO22MT	1246
18:17	DJ6AG	51	51	JO51EQ	1395
18:18	DL8AKI/P	52	52	JO51CH	1360
18:19	DF0CI	52	52	JO51CH	1360
18:23	DL1YAW	51	52	JO41DX	1310
18:29	DJ0VZ	55	55	JO30GL	1106

Original VE4MA feed, 0.71λ horn diameter
Ring 0.50λ wide x 0.50λ deep, 0.15λ behind rim
Figure 37





Dish diameter = 20 λ Feed diameter = 1.7 λ



A modified version of my **PHASEPAT** program does this calculation, integrating both sets of patterns.

Two of the versions with smaller rings are compared in Figure 38, with a ring 0.4λ wide and 0.25λ deep, and Figure 39, with a ring 0.35λ wide and 0.35λ deep. For both of these cases, the efficiencies for linear and circular polarization are about equal for ***f*/D** greater than about 0.35. However, for deep dishes, with ***f*/D** < 0.35, efficiency improves with linear polarization and decreases with circular polarization. Again, the best ***f*/D** at each ring position, as well as the phase center, not shown, do not change with polarization.

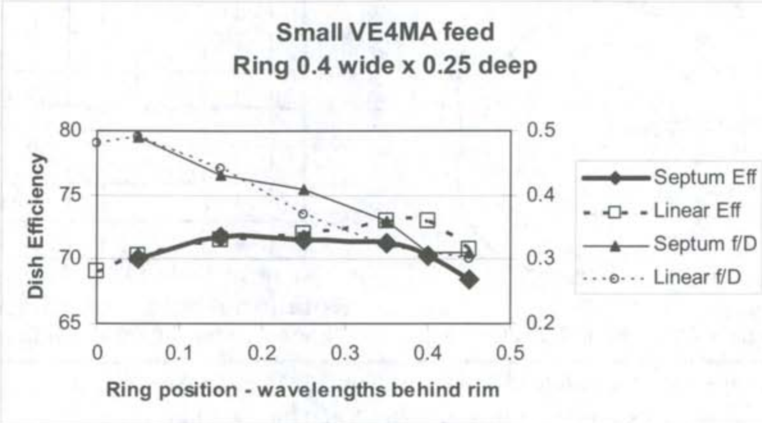


Figure 38

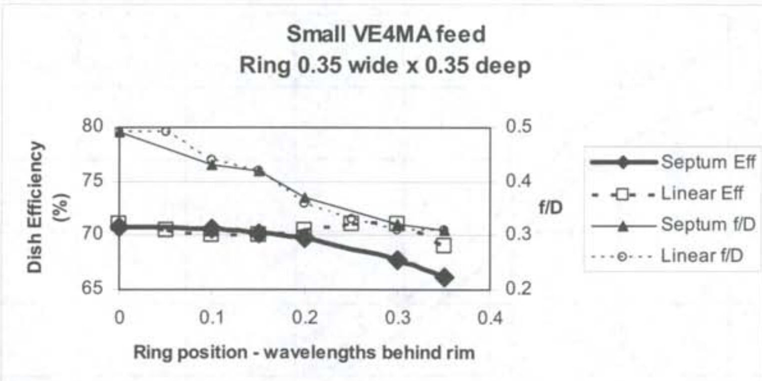


Figure 39

The version with the 0.35λ wide and 0.35λ deep ring, with the ring 0.2λ behind the rim, was also examined over a range of frequencies, summarized in Figure 40. Efficiency was good from 2.1 to 2.5 GHz, roughly 20% bandwidth, while isolation and return loss peaked at 2.3 GHz, shown in Figure 41. This suggests that the polarizer, like the horn, is relatively broadband. An alternate way of looking at it is that the diameter of the circular waveguide containing the septum is not critical for circular polarization – all dimensions can be scaled to fit available tubing diameters. Isolation may be compromised somewhat, and excitation probes will need adjustment for good VSWR.

The Super VE4MA from Part 1 works very well with a septum feed, showing efficiency comparable to linear polarization at all ring positions in Figure 42, but the best ***f*/D** range is still fairly limited, around 0.35 to 0.45. The 3D radiation pattern in Figure 43 shows the dip at boresight like our desired illumination in Figure 1. The efficiency plot for the best ring position is very similar to the plot with linear polarization in Figure 7, and has almost no XPOL loss.

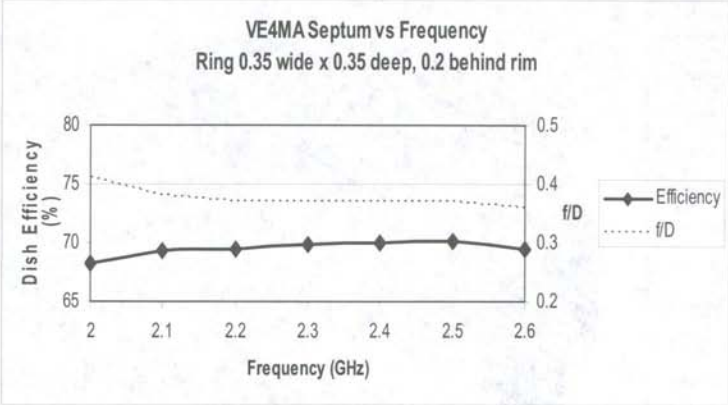


Figure 40

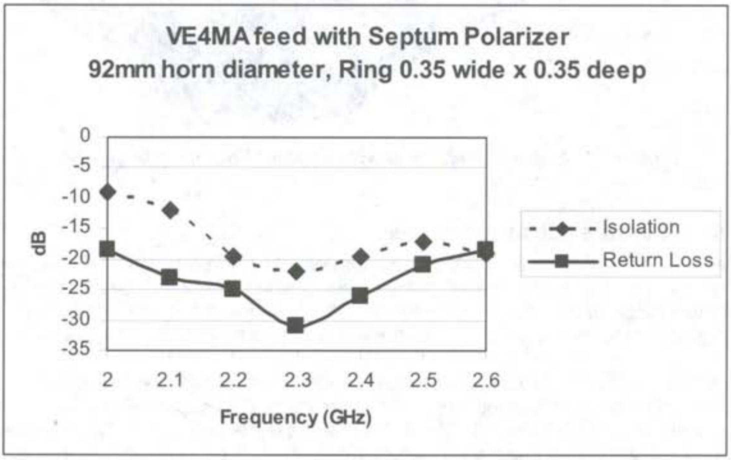


Figure 41

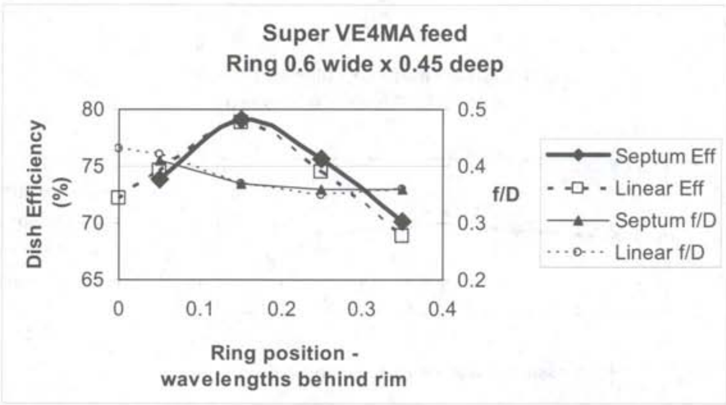


Figure 42

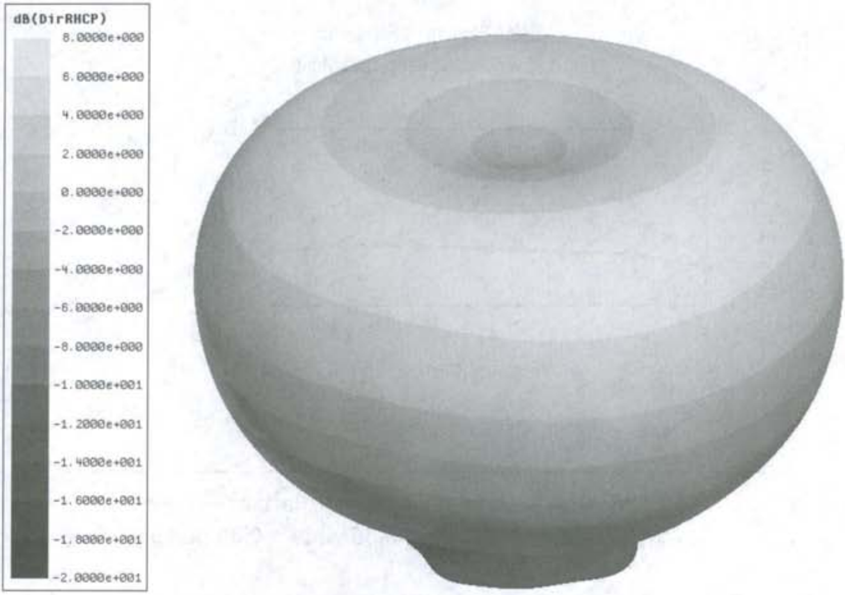


Figure 43. Super VE4MA feed with Septum Polarizer, 3D pattern

Chaparral horn with septum polarizer

As we saw in Part 2, Chaparral-style horns with the best combinations of ring dimensions can provide excellent performance, with dish efficiency nearly as high as the Super-VE4MA feed, and provide high efficiency over a wider range of dish **f/D**. However, the additional complexity of multiple rings only seems worthwhile for deep dishes, with low **f/D**, since there are no other feeds that provide good efficiency for these reflectors. Now we will examine the performance of the Chaparral horns with circular polarization.

Several of the examples of a Chaparral horn with three rings were tried with a septum polarizer for circular polarization. The first, with three rings each 0.17λ wide and 0.30λ deep, was simulated over a range of choke positions with the septum polarizer. The results are summarized in Figure 44: efficiency with Circular Polarization is slightly lower, with XPOL loss increasing as the rings are moved back to favor deeper dishes. Note that it is still good at all positions. The position with best efficiency for deep dishes, 0.35λ behind the rim, provides probably the best CP efficiency available for very deep dishes: 72.4% for **f/D** = 0.32, and still pretty good at 66% for **f/D** = 0.25, as shown in Figure 45. Again, the heavy lines in the Feed Radiation Pattern are RHCP and the broken line is for all polarizations.

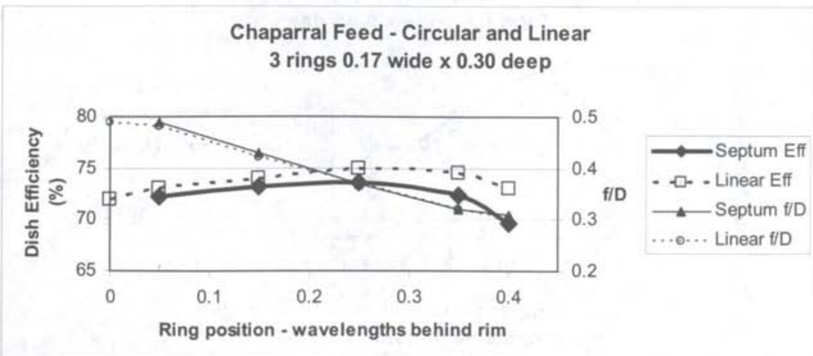


Figure 44

Chaparral Feed 0.71λ horn diameter
3 Rings 0.17λ wide x 0.30λ deep, 0.35λ behind rim
Figure 45

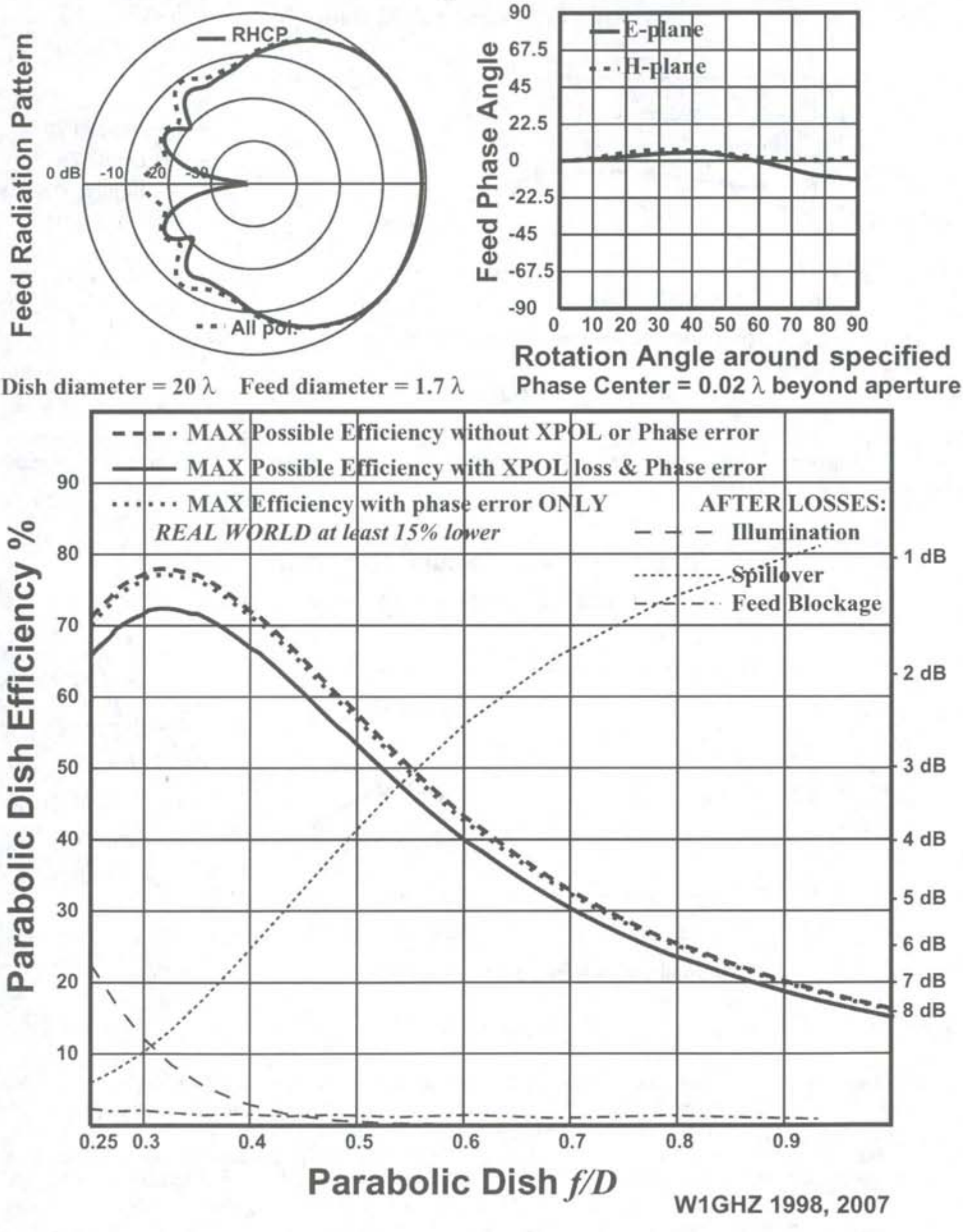


Fig. 45

A second Chaparral horn, with three rings each 0.20λ wide and 0.33λ deep, was also simulated over a range of choke positions with the septum polarizer. This version is not as good with circular polarization, as shown in Figure 46.

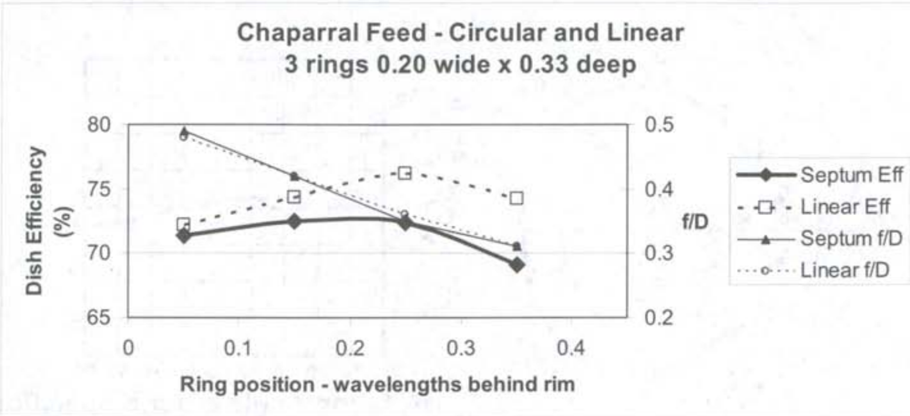


Figure 46

A Chaparral horn with three shallow rings, each 0.20λ wide and 0.15λ deep, showed good efficiency for deep dishes with linear polarization. When simulated over a range of choke positions with the septum polarizer, this version is not as good with circular polarization, as shown in Figure 47.

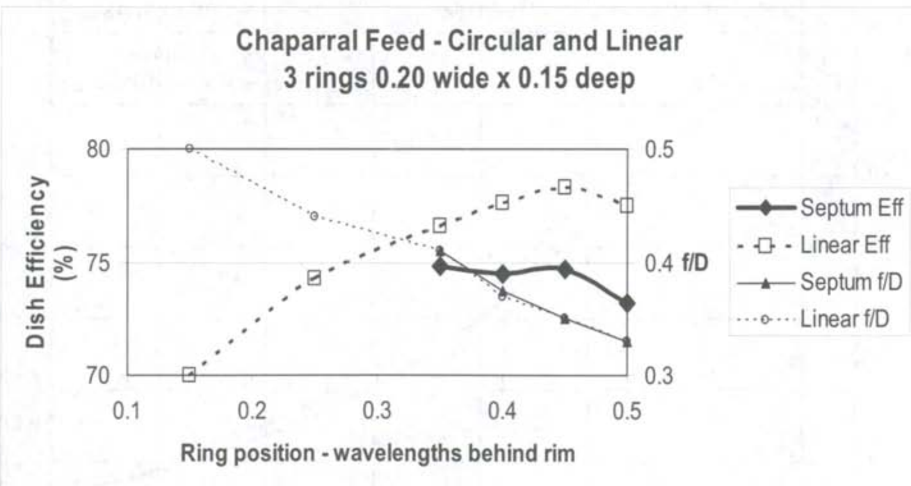


Figure 47

A Chaparral horn with four rings, each 0.15λ wide and 0.33λ deep, showed good efficiency with linear polarization over a wide range of **f/D**, as low as 0.28. When simulated over a range of choke positions with the septum polarizer, the efficiency with circular polarization falls off for deeper dishes due to XPOL loss, as shown in Figure 48.

In order to determine why the version with larger and deeper rings did not work as well with a septum polarizer, I tried one of the best Chaparral variations with perfect circular polarization (easy in software) as well as with circular polarization generated by a septum. The comparison, for three rings each 0.20λ wide and 0.20λ deep, is shown in Figure 49. The efficiency with pure circular polarization is close to the linear performance for shallow dishes, but falls off by a couple of percentage points for deeper dishes. With the septum polarizer, efficiency falls off a bit more for deeper dishes. However, even with the septum polarizer, it is still pretty good: 71% for **f/D** = 0.32.

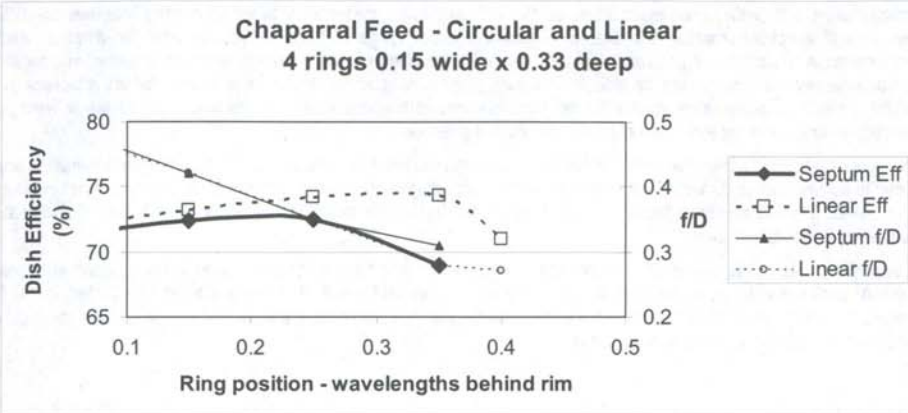


Figure 48

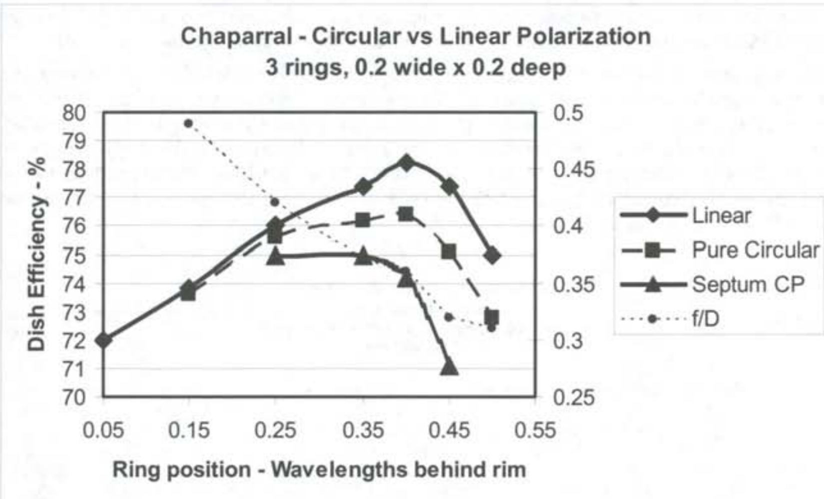


Figure 49

Like the VE4MA horn, the best f/D at each ring position, as well as the phase center, not shown, does not change with polarization for the Chaparral feeds. Calculated phase center for each combination is listed in the Appendix.

All of the above circular polarization dish efficiencies were calculated for the feed only, with no regard for cross-polarization added by the reflector. With linear polarization, deep dishes have significant cross-polarization near the 45°-cut planes, because the reflector surface is at an odd angle to the polarization vector. The same effect causes cross-polarization at all angles with circular polarization. This is detrimental in applications requiring high polarization purity, but I believe the efficiency loss for the desired polarization is still small.

Circular Polarization

Since circular polarization appears to present some additional difficulties with antenna performance and evaluation, perhaps a slightly deeper discussion would help our understanding.

One way to evaluate the performance of a dish antenna by sun noise measurements, comparing the noise power received from the sun with the noise power received from cold sky. However, this does not evaluate the quality of circular polarization – noise is randomly polarized in both instances, so we may expect the same results as we measure for linear polarization. There are no celestial sources with well-defined polarization, so far-field polarization measurements for good-sized antennas are difficult unless a large anechoic chamber is available. A ground-reflection range of the type typically used for amateur antenna measurements is unsuitable for circular polarization; according to Hanson[7], "on a ground reflection antenna test range, the antenna under test must be rotated, or tedious calibration procedures must be employed to account for the difference in the reflection coefficients of the range surface for the horizontal and vertical components of the field." So we are at least partly dependent on simulations for evaluation of circularly-polarized antennas.

From Figure 49, we may infer that both the horn and the septum distort the circular polarization at wide illumination angles required to illuminate deep dishes. Even a perfect polarizer, providing perfect circular polarization to the horn, is not as good for deeper dishes. We also saw this effect with some of the VE4MA feeds – the exception, the Super-VE4MA, falls off so fast at low **f/D** any effect is probably hidden.

The apparent cause of the poorer CP performance at small **f/D** is that the circular polarization is not as good at the wider illumination angles (theta) needed for deep dishes. Frequently, the circularity of a CP antenna is given, or adjusted, for the feed boresight, but this is not as important for a prime-focus feed – the feed boresight is usually blocked. A CP feed must provide good circular polarization over the whole reflector.

Axial ratio

Usually, circularity is measured and quantified by the axial ratio, the ratio of the strongest and weakest directions of polarization. Axial ratio is measured by rotating an antenna with linear polarization at the other end of a range, to find the strongest and weakest polarizations. For perfect circular polarization, the components are equal and the axial ratio is 0dB. The larger the axial ratio, the less circular and more elliptical is the polarization. For perfect linear polarization, the axial ratio is infinite.

Measurement of the axial ratio over the whole pattern would be really difficult, but in simulation, it is just more numbers to crunch. For the version in Figure 39, with a ring 0.35λ wide and 0.35λ deep, the axial ratios are plotted in Figure 50 with the ring flush with the rim, providing good linear and CP efficiency for an **f/D** of 0.49, and in Figure 51 with the ring pulled back 0.3λ, providing good linear efficiency for an **f/D** of 0.31, but a few points lower (68 %, by no means terrible) for CP. In Figure 50, the axial ratio is better than 0.6 dB over an illumination half-angle of 60°, which covers the whole reflector, while in Figure 51, the axial ratio is better than 1 dB over only about 12° and falls off to 5 dB at the edge of the reflector, which subtends an illumination half-angle of 75° for **f/D** = 0.31. Here we can see the difference for small **f/D**.

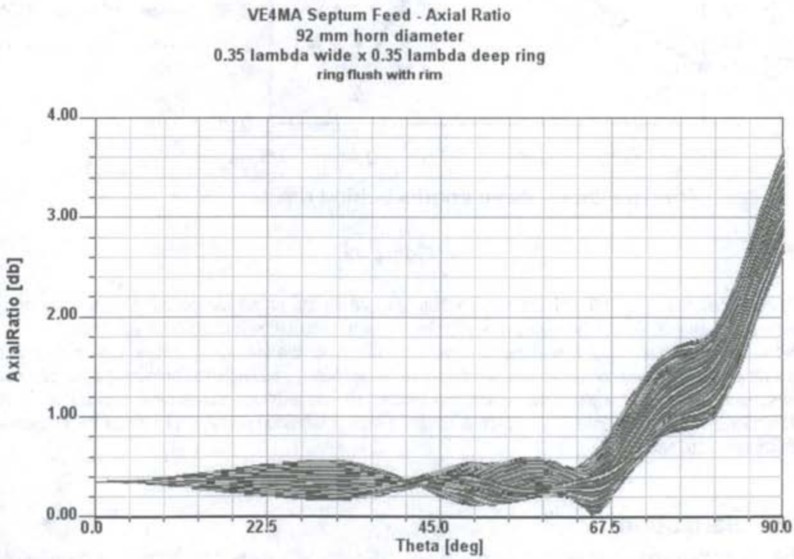


Figure 50

Figures 50 and 51 are plots of axial ratio not in just the E- and H-planes, but in a large number of planes, at one degree increments of rotation around the feed. Thus we can see how consistent the circular polarization is in three dimensions.

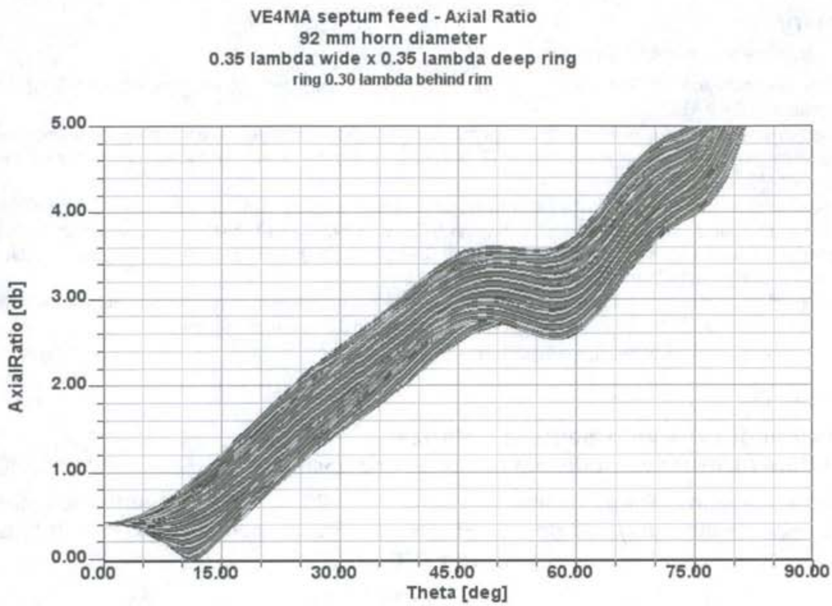


Figure 51

Finally, we return to the original VE4MA feed, which suffered significant XPOL loss with circular polarization. Figure 52 shows the axial ratio becoming very elliptical as Theta increases. We can only conclude that ring dimensions can seriously distort the symmetry of circular polarization.

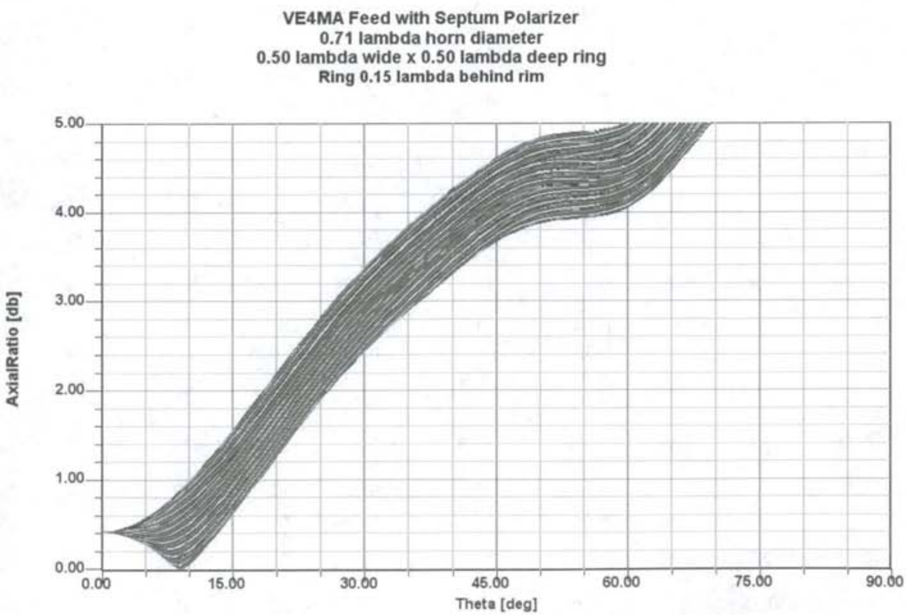


Figure 52

Summary

From the results, we may draw some conclusions:

- All these feedhorns work well (in simulation) with the OK1DFC septum polarizer to provide circular polarization, but efficiency decreases for **f/D < 0.35**.
- The septum polarizer, or any other polarizer, does not affect the antenna radiation, except to make the polarization circular; any polarizer that excites the antenna with good CP will result in the same pattern. Of course, a poor polarizer will degrade performance.
- The polarizer is not part of the antenna – just like the probe – if there is enough distance to limit interactions (perhaps 1λ).
- For linear polarization, horn diameters of 0.71λ and 0.77λ work equally well, and there is no reason to believe that intermediate diameters will not work as well. The OK1DFC septum polarizer works best with a waveguide diameter of 0.71λ, but small variations do not affect polarization.
- The range of feed dimensions that yields good performance provides opportunities to use available materials effectively.
- For best performance, the Super-VE4MA feed and a dish **f/D** around 0.37 are recommended.
- Even if your antenna is not optimum, put it on the air!

Appendix D

VE4MA Feedhorns with Septum Polarizer

- 0.71 λ Horn Diameter with different ring sizes and positions **W1GHZ 2007**

Horn <u>Diameter</u> λ	Ring <u>width</u> λ	Ring <u>depth</u> λ	behind <u>rim</u> λ	Dish <u>efficiency</u> *with XPOL*	f/D <u>best</u>	Phase <u>center</u> λ	Return <u>Loss</u> dB	Isolation <u>R to L</u> dB
0,71	0,5	0,5	0	68,2	0,42	-0,21	32	20
			0,1	67,4	0,35	-0,21	32	23
			0,15	66,8	0,32	-0,06	31	20
			0,2	63,2	0,31	0,17	31	17
			0,3	63,5	0,35	0,18	32	16
0,71	0,35	0,35	0	70,7	0,49	0	31	16,5
			0,1	70,6	0,43	-0,1	34	18,5
			0,15	70,2	0,42	-0,13	30	20
			0,2	69,8	0,37	-0,13	31	22
			0,3	67,8	0,32	-0,01	31	23
			0,35	66,2	0,31	0,07	32	23
0,71	0,35	0,25	0,05	70,3	0,49	0,04	31	15
			0,15	71,7	0,43	-0,06	31	17
			0,25	71,5	0,41	-0,1	30,5	20
			0,35	70,6	0,35	-0,086	31,5	23
			0,4	69,8	0,32	0	32	23
0,71	0,4	0,25	0,05	70,1	0,49	0,03	30,5	15
			0,15	71,8	0,43	-0,07	30	17,5
			0,25	71,5	0,41	-0,13	32	20,5
			0,35	71,3	0,36	-0,085	32	24
			0,4	70,3	0,31	0	29,5	23
			0,45	68,5	0,31	0,1	31	19,5
0,71	0,6	0,45	0,05	73,9	0,41	-0,37	31,5	17
			0,15	79,1	0,37	-0,186	32	17
			0,25	75,6	0,36	0,23	30	17
			0,35	70,1	0,36	0,18	31	18
0,71	0,5	0,25	0,15	70,6	0,43	-0,07	31,5	17,5
0,71	0,25	0,2	0,15	71	0,43	0	31	16
0,71	0,12	0,26	0,3	67,9	0,36	0	31,5	21

Chaparral-style Feedhorns with Septum Polarizer

0.71 λ Horn Diameter with different ring sizes and positions **W1GHZ 2007**

Horn Diameter λ	Ring width λ	Ring depth λ	behind rim λ	Dish efficiency *with XPOL*	f/D best	Phase center λ	Return Loss dB	Isolation R to L dB
Three rings - Septum								
92 mm	0,17	0,3	0,05	72,2	0,49	-0,04	31	17
			0,15	73,2	0,43	-0,14	31,5	19
			0,25	73,6	0,37	-0,13	32,5	22
			0,35	72,4	0,32	0,02	31,5	21
			0,4	69,6	0,31	0,11	32	19
Three rings - Septum								
92 mm	0,2	0,33	0,05	71,4	0,49	-0,11	33	18
			0,15	72,5	0,42	-0,2	32	20
			0,25	72,4	0,35	-0,14	32,5	23,5
			0,35	69,1	0,31	0,1	32	19,5
Three rings - Septum								
92mm	0,2	0,2	0,25	75	0,42	-0,17	31	19
			0,35	75	0,37	-0,13	33	22
			0,4	74,2	0,36	-0,09	32	23
			0,45	71,1	0,32	0,04	31	21
Three rings - Septum								
92	0,2	0,15	0,35	74,8	0,41	-0,16		
			0,4	74,5	0,375	-0,13		
			0,45	74,7	0,35	-0,06	32	22
			0,5	73,2	0,33	0,06		
Three rings - Septum								
92	0,15	0,33	0,25	72	0,35	-0,11	32,5	
Two rings - Septum								
92	0,17	0,33	0,25	69,2	0,35	-0,086	31	
Four rings – Septum								
92	0,15	0,33	0,05	71,2	0,49	-0,11	31,5	
			0,15	72,4	0,42	-0,18	31,5	
			0,25	72,5	0,35	-0,14	33	
			0,35	69	0,31	0,1	32	

Chaparral-style Feedhorns with Perfect Circular Polarization

0.71 λ Horn Diameter with different ring sizes and positions **W1GHZ 2007**

Horn Diameter λ	Ring width λ	Ring depth λ	behind rim λ	Dish efficiency *with XPOL*	f/D best	Phase center λ
Three rings - Circular (pure)						
92mm	0,2	0,2	0,15	73,6	0,49	-0,1
			0,25	75,6	0,42	-0,14
			0,35	76,2	0,37	-0,1
			0,4	76,4	0,36	-0,03
			0,45	75,1	0,32	0,06
			0,5	72,8	0,31	0,11
Three rings - Circular (pure)						
92mm	0,17	0,2	0,15	75,8	0,45	-0,13
			0,25	74,8	0,42	-0,14
			0,35	75,3	0,36	-0,11
			0,4	75,4	0,36	-0,06
			0,45	73,4	0,32	0,03
			0,5	72,2	0,3	0,1
Three rings - Circular (pure)						
92mm	0,17	0,26	0,15	73,1	0,44	-0,11
			0,25	74	0,41	-0,14
			0,35	73,3	0,34	-0,07
			0,4	72,7	0,32	0,04
			0,45	71,1	0,3	0,11
Three rings - Circular (pure)						
92mm	0,27	0,2	0,15	74,2	0,49	-0,11
			0,25	76,2	0,43	-0,14
			0,35	76,4	0,38	-0,06
			0,4	75,5	0,35	0,04
			0,45	73,7	0,36	0,1
Three rings - Circular (pure)						
92 mm	0,2	0,33	0,05	71,9	0,49	-0,11
			0,15	73,3	0,42	-0,2
			0,25	74,2	0,35	-0,14
			0,35	71	0,31	0,1

References

1. Zdenek Samek, OK1DFC, "Information and practical hints for the construction of a septum feed," ***DUBUS***, 1/2003, pp. 39-47.
2. Ming Hui Chen, G. N. Tsandoulas; A wide-band square-waveguide array polarizer, *IEEE Transactions on Antennas and Propagation*, vol. 21, pp. 389-391, May 1973.
3. P. Wade, W1GHZ, "Analysis of the OK1DFC Septum Feed," ***DUBUS***, 1/2003, pp. 22-38.
4. Rastislav Galuscak – OM6AA, & Pavel Hazdra, "Prime-focus circular waveguide feed with septum polarization transformer," ***DUBUS***, 1/2007, pp. 8-32.
5. http://www.ok1dfc.com/eme/technic/septum/ra3aq-23-13.pdf
6. J. Bornemann & V.A. Labay, "Ridge Waveguide Polarizer with Finite and Stepped-Thickness Septum," *IEEE Transactions on Microwave Theory and Techniques*, August 1995, pp. 1782-1787.
7. J.S. Hollis, T.J. Lyon, & L. Clayton, Jr., "*Microwave Antenna Measurements*," Scientific-Atlanta, July, 1970, p. 10-13.

Hocheffektive Erreger für Spiegel mit Primärfokus

Teil 3 — Septum-Polarisatoren und zirkulare Polarisation

von Paul Wade, W1GHZ ©2007 - w1ghz@arrl.net
Messungen von Tommy Henderson, WD5AGO - wd5ago@arrl.net

In den ersten beiden Teilen dieses Artikels wurde die Optimierung von VE4MA- und Chaparall-Feedhörnern beschrieben, um die Effektivität des Spiegels zu verbessern. Die Berechnungen und Messungen wurden unter Verwendung von linearer Polarisation durchgeführt. Unsere Intuition sagt uns, dass diese achsensymmetrischen Strukturen ähnliche Leistungsdaten bei zirkularer Polarisation aufweisen sollten; weitere Untersuchungen werden aber zeigen, dass dies nicht immer der Fall ist.

Zirkulare Polarisation bietet bei EME-Kommunikation einen signifikanten Vorteil: Die Eliminierung von Polarisationsunterschieden aufgrund der Geometrie und der Faraday-Rotation. Viele Ausführungen bieten den zusätzlichen Vorteil von getrennten Ports für Sender und Empfänger mit unterschiedlicher Drehrichtung der Polarisation – die Reflektion am Mond dreht den Polarisationsrichtung um. Ein populärer Polarisator ist das gestufte Septum in einem Wellenleiter-Feed als Teil des Horns, das den Spiegel ausleuchtet. Aber jeder Polarisator, der gute zirkulare Polarisation an das Horn liefert, wird eine identische Leistung erbringen.

Septum-Polarisator

Das populäre Septum-Feed, wie von OK1DFC[1] beschrieben, ist ein ungeweitetes quadratisches Horn oder einfach ein quadratischer Wellenleiter mit einem inneren gestuften Septum-Polarisator, der die lineare in zirkulare Polarisation umwandelt. Der Septum-Polarisator basiert auf einem Satz von Dimensionsdaten für den quadratischen Wellenleiter, der in einer Abhandlung von Chen und Tsandoulas[2] veröffentlicht wurde und für den Amateurfunk von OK1DFC adaptiert wurde. Die Verwendung eines quadratischen Wellenleiters mit offenem Ende als Feed liefert eine akzeptable, gute Leistung: 67% berechnete Effektivität für ein f/D von etwa 0.37, wie in Abb. 33 gezeigt, aber nicht annähernd so gut, wie die VE4ME- und Chaparral-Hörner. Auch gibt es keine Möglichkeit, das reine Septum-Feed für verschiedene f/D zu justieren. Die fetten Linien im Strahlungsdiagramm des Feeds sind RHCP (rechtsdrehende zirkulare Polarisation), während die helle unterbrochene Line für alle Polarisationen steht – die rückwärtigen Zipfel sind nicht gut polarisiert, aber das ist unbedeutend, da dies alles in den Überschuss geht.

Zuvor[3] habe ich herausgefunden, dass die gleichen Septum-Dimensionen von einem quadratischen Wellenleiter auch umgerechnet werden können, um gute zirkulare Polarisation in einem runden Wellenleiter von 0.71λ Durchmesser zu liefern. Mit Septum bei einem zirkularen offenen Wellenleiter als Feed sind die Leistungsdaten der Zirkularität, wie in Abb. 34 gezeigt, vergleichbar mit linearer Polarisation (Teil 1), aber nicht ganz so gut wie die quadratische Version. Die runde Version des Septum-Polarisators jedoch, ist vergleichbar mit den VE4MA- und Chaparral-Hörnern.

Zuerst machte ich einige Versuche, das Septum in einem zirkularen Wellenleiter zu verbessern – mit verwirrenden Ergebnissen. Schließlich realisierte ich, dass die Isolation stark durch das Horn beeinflusst wird – jede Fehlanpassung im Öffnungsbereich (typisch 10 bis 15 dB Returnloss) zwischen Horn und Freiraum wird zum anderen Port als reduzierte Isolation zwischen den beiden Polarisationen reflektiert.

Bei einem Feed in einem primärfokalen Spiegel ist das Problem sogar noch größer: Reflektionen vom abgeschatteten Teil des Reflektors, vielleicht 15 dB niedriger, haben umgedrehte Polarität, so dass die Isolation herabgesetzt wird.
Deshalb scheinen Versuche, eine hohe Isolation in einem Feed, abgetrennt von einem Spiegel zu erreichen, ziemlich sinnlos!
Man kann den Effekt einer jeden Fehlanpassung per Software zeigen, indem man eine "perfekt angepasste Schicht" über die Öffnung legt, so dass es keine Reflektion gibt. Natürlich gibt es diese gedachte Schicht nur in der Software. In Abb. 35 sind Isolation und Returnloss des offenen Wellenleiters links mit der perfekt angepassten Öffnung rechts verglichen. Die angepasste Öffnung zeigt eine bessere Isolierung über einen breiteren Frequenzbereich. Wichtiger ist, dass Änderungen der Öffnung durch Hinzufügen von Ringen oder einem Horn die Isolation beeinflussen wird.

Wie viel Isolation ist nötig? Ein Septum wird nie genug Isolation liefern, um den Empfänger von einem Hochleistungssender zu schützen – ein Schalter wird immer notwendig sein. Bei niedriger Isolation jedoch, wird Sendeleistung, die in den unerwünschten Port einströmt, entweder absorbiert oder reflektiert und mit entgegen gesetzter Polarisation abgestrahlt. Wie auch immer, diese Leistung ist verloren und mindert die Effektivität. Bei 20 dB Isolation ist nur 1% der Leistung verloren, also sind 20 dB wohl ein annehmbares Ziel. Immerhin zeigen die aktuellen Septum-Entwicklungen von OM6AA[4] für zirkularen Wellenleiter und RA3AQ[5] für quadratischen Wellenleiter gute Leistungsdaten mit verbesserter Isolation.

In einer anderen Veröffentlichung über Septum-Dimensionen von Bornemann und Labay[6] wird vorgeschlagen, dass ein dickeres Septum die Isolation verbessern könnte. Einige schnelle Versuche legten nahe, dass sich dies für quadratische Wellenleiter bewahrheiten könnte, was nützlich sein könnte bei Septen für höhere Frequenzen, wo das maschinelle Herstellen des ganzen Polarisators aus dickem Metall eventuell einfacher ist, als der Zusammenbau aus kleinen einzelnen Teilen. Eine wichtigere Beobachtung war, dass die Septum-Dimensionen und Dicke keinen Effekt auf das Antennendiagramm oder die Leistungsdaten hatten. Dies wird besser mit Simulationen von Feeds gezeigt, die mittels reiner zirkularer Polarisation erregt werden (leicht per Software machbar).

Vergleich dieser Simulationen mit dem gleichen Feed mit einem Septum-Polarisator zeigen kaum Unterschiede in den Leistungsdaten der Antenne. Folglich können wir wohl schließen, dass ein jeglicher Polarisator, der gute zirkulare Polarisation liefert, auch gute Leistungsdaten für die Antenne erbringen wird. Der Septum-Polarisator bietet ohne Justierung gute zirkulare Polarisation und hat geringere Verluste als andere Varianten.

VE4MA-Horn mit Septum-Polarisator

Verschiedene Variationen des VE4MA-Horns wurden mit einem Septum-Polarisator simuliert. Die Ergebnisse für die originalen Ringdimensionen von 0.5λ Weite und 0.5λ Tiefe sind in Abb. 36 zusammengefasst und mit wurden mit linearer Polarisation verglichen. Die Effektivitäten sind ähnlich, aber niedriger für zirkulare Polarisation, besonders dann, als der Ring nach hinten versetzt wurde, um den Ausleuchtungsbereich zu vergrößern und kleinere f/D zu begünstigen. Das beste f/D für jede Ring-Position blieb unverändert.

Die niedrigere Effektivität bei zirkularer Polarisation scheint durch Kreuzpolarisationsverluste verursacht zu werden. Wir sollten erwarten, dass unerwünschte Seiten- und Rückwärtszipfel keine gute zirkulare Polarisation aufweisen, diese werden jedoch dem Verlust durch Überschuss zugerechnet. Abb. 37 zeigt aber, dass der Effektivitätsplot mit Kreuzpolarisation XPOL einbezogen signifikant niedriger ist, als er bei Ignorierung derselben wäre. Folglich muss einige der Energie, die den Reflektor ausleuchtet, auch unerwünschte Polarisation aufweisen, entweder entgegen gesetzte zirkulare oder irgendeine zufällige lineare Polarisation.

Um die Effektivität unter Berücksichtigung der Kreuzpolarisation genau berechnen zu können, müssen wir das gesamte Strahlungsdiagramm genauso wie das Diagramm für die erwünschte Polarisation berücksichtigen:

$$\eta = \frac{\int(\text{desired polarization illuminating reflector})}{\int(\text{total radiated power in all polarizations})}$$

Erwünschte Polarisation, die den Reflektor ausleuchtet
Gesamte abgestrahlte Leistung in allen Polarisationen

Eine modifizierte Version meiner Software **PHASEPAT** ermöglicht diese Berechnung und integriert beide Diagramme.

Zwei der Versionen mit kleineren Ringen werden in Abb. 38 verglichen, mit einem Ring von 0.4λ Weite und 0.25λ Tiefe, und in Abb. 39 mit einem Ring von 0.35λ Weite und 0.35λ Tiefe. In beiden Fällen sind die Effektivitäten für lineare und Zirkulare Polarisation ungefähr gleich für f/D größer als etwa 0.35. Für tiefe Spiegel mit f/D < 0.35 jedoch nimmt die Effektivität mit linearer Polarisation zu und sinkt bei zirkularer. Wieder ändert sich das beste f/D für jede Ringposition, genauso wie das Phasenzentrum (hier nicht gezeigt), nicht mit der Polarisation.

Die Version mit dem 0.35λ weiten und 0.35λ tiefen Ring, 0.2λ hinter dem Rand, wurde auch über einen Bereich von Frequenzen untersucht, was in Abb. 40 zusammengefasst dargestellt ist. Die Effektivität war von 2.1 bis 2.5 GHz gut, also etwa 20% Bandbreite, während Isolation und Returnloss eine Spitze bei 2.3 GHz hatten, wie in Abb. 41 gezeigt. Das legt nahe, dass der Polarisator, genauso wie das Horn, relativ breitbandig ist. Eine andere Betrachtungsweise wäre, dass der Durchmesser des zirkularen Wellenleiters, der das Septum enthält, nicht kritisch für die zirkulare Polarisation ist, d.h. alle Abmessungen können so skaliert werden, dass sie für verfügbare Rohrdurchmesser passen. Die Isolation könnte dann etwas herabgesetzt sein und die Erregersonden werden eine Justierung für bestes VSWR benötigen.

Das Super-VE4MA aus Teil 1 funktioniert sehr gut mit einem Septum-Feed und zeigt Effektivitäten vergleichbar der der linearen Polarisation für alles Ringpositionen, siehe Abb. 42; der beste f/D-Bereich ist aber weiterhin einigermaßen begrenzt auf etwa 0.35 bis 0.45. Das 3D-Strahlungdiagramm in Abb. 43 zeigt einen Abfall in Achsrichtung wie unsere erwünschte Ausleuchtung aus Abb. 1. Der Effektivitätsplot für die beste Ringposition ist sehr ähnlich zu dem Plot bei linearer Polarisation in Abb. 7 und hat fast keine Verluste durch Kreuzpolarisation.

Chaparral Horn mit Septum-Polarisator

Wie wir im Teil 2 gesehen haben, können Chaparral-Hörner mit den besten Ringkombinationen exzellente Leistungsdaten aufweisen, mit Spiegeleffektivitäten von nahezu der Höhe wie beim Super-VE4MA-Feed, und hoher Effektivität über einen breiteren f/D-Bereich. Die zusätzliche Komplexität der multiplen Ringe jedoch, scheint nur für tiefe Spiegel mit niedrigem f/D gerechtfertigt, da es keine anderen Feeds gibt, die gute Effektivität für diese Reflektoren aufweisen. Nun werden wir die Leistungsdaten von Chaparral-Hörnern bei zirkularer Polarisation untersuchen.

Verschiedene Muster von Chaparral-Hörnern mit drei Ringen wurden mit einem Septum-Polarisator für zirkulare Polarisation ausprobiert. Das erste mit drei Ringen, jeder 0.17λ weit und 0.30λ tief, wurde mit Septum-Polarisator über einen Bereich von Choke-Positionen hinweg simuliert. Die Ergebnisse sind in Abb. 44 zusammengefasst: Die Effektivität mit zirkularer Polarisation ist leicht herabgesetzt, die Kreuzpolarisationsverluste nehmen zu, wenn die Ringe nach hinten versetzt werden, um tiefere Spiegel zu favorisieren. Anzumerken ist, dass sie immer noch in allen Positionen gut ist. Die Position mit der besten Effektivität für tiefe Spiegel, 0.35λ hinter dem Rand, liefert wahrscheinlich die beste zirkulare Effektivität, die für sehr tiefe Spiegel verfügbar ist: 72.4% für ***f*/D** = 0.32, und mit 66% immer noch recht gut für *f*/D = 0.25, wie in Abb. 45 gezeigt. Wieder sind die dicken Linien hier im Strahlungsdiagramm des Feeds für RHCP und die unterbrochene Linie für alle Polarisationen.

Ein zweites Chaparral-Horn mit drei Ringen, jeder 0.20λ weit und 0.33λ tief, wurde ebenfalls mit Septum-Polarisator über einen Bereich von Choke-Positionen simuliert. Diese Version ist bei zirkularer Polarisation nicht so gut, wie in Abb. 46 gezeigt.

Ein Chaparral-Horn mit drei flachen Ringen, jeder 0.20λ weit und 0.15λ tief, zeigte gute Effektivität für tiefe Spiegel bei linearer Polarisation. Mit Septum-Polarisator über einen Bereich von Choke-Positionen simuliert, ist diese Version bei zirkularar Polarisation nicht so gut, wie in Abb. 47 gezeigt.

Eine Chaparral-Horn mit vier Ringen, jeder 0.15λ weit und 0.33λ tief, zeigte gute Effektivität bei linearer Polarisation über einen weiten f/D-Bereich bis 0.28 herab. Mit Septum-Polarisator über einen Bereich von Choke-Positionen simuliert, fällt die Effektivität bei zirkularer Polarisation für tiefere Spiegel aufgrund von Kreuzpolarisationsverlusten ab, wie in Abb. 48 gezeigt.

Um herauszufinden, warum die Version mit den größeren und tieferen Ringen mit einem Septum-Polarisator nicht so gut arbeitet, habe ich eine der besten Chaparral-Variationen ausprobiert mit perfekter zirkularer Polarisation (softwaremäßig ist das einfach) und mit zirkularer Polarisation, die durch eine Septum erzeugt wurde. Der Vergleich für drei Ringe, je 0.20λ weit und 0.20λ tief, ist in Abb. 49 gezeigt. Die Effektivtät mit reiner zirkularer Polarisation liegt nun nahe den Leistungsdaten bei linearer Polarisation für flache Spiegel, fällt aber für tiefere Spiegel um einige Prozentpunkte ab. Mit dem Septum-Polarisator fällt die Effektivität für tiefere Spiegel ein bisschen mehr ab, ist jedoch sogar mit dem Septum-Polarisator immer noch sehr gut: 71% für *f*/D = 0.32.

Wie beim VE4MA-Horn, ändert sich das beste f/D für jede Ringposition, genauso wie das Phasenzentrum (hier nicht gezeigt), nicht mit der Polarisation beim Chaparral-Feed. Gerechnete Phasenzentren für jede Kombination sind im Anhang (siehe engl. Text oben) aufgelistet.

Alle obigen Spiegeleffektivitäten für zirkulare Polarisation wurden nur für das Feed gerechnet, ohne Berücksichtigung der Kreuzpolarisation, die durch den Reflektor hinzugefügt wird. Bei linearer Polarisation weisen tiefe Spiegel signifikante Kreuzpolarisation nahe den 45°-Schnittebenen auf, weil die Reflektoroberfläche in einem ungünstigen Winkel zum Polarisationsvektor liegt. Derselbe Effekt erzeugt Kreuzpolarisation bei allen Winkeln bei zirkularer Polarisation. Das ist unerwünscht bei Applikationen, die hohe Polarisationsreinheit erfordern, ich denke aber, dass der Effektivitätsverlust für die erwünschte Polarisation immer noch recht gering ist.

Zirkulare Polarisation

Da zirkulare Polarisation anscheinend einige zusätzliche Schwierigkeiten bei den Leistungsdaten und der Bewertung einer Antenne mit sich bringt, könnte eine etwas tiefer gehende Diskussion helfen unser Verständnis zu verbessern.

Eine Art die Leistung eines Antennensystems zu bestimmen, ist die Messung des Sonnenrauschens: Vergleich der von der Sonne empfangenen Rauschleistung gegenüber der Rauschleistung von kalten Himmel. Das, jedoch, bestimmt nicht die Qualität der zirkularen Polarisation – das Rauschen ist nämlich in beiden Fällen zufällig polarisiert, so dass wir dieselben Resultate erwarten können, als wenn wir mit linearer Polarisation messen würden. Es gibt keine Quellen am Himmel mit einer definierten Polarisation, so dass Fernfeldmessungen der Polarisation von größeren Antennen schwierig sind, sofern keine großer reflexionsfreier Raum zur Verfügung steht. Eine Bodenwellenstrecke, die typischerweise für Messungen an Amateurantennen benutzt wird, ist nach Hanson[7] ungeeignet für zirkulare Polarisation, "bei einer Bodenwellenantennenteststrecke, muss die Testantenne rotiert werden, oder es müssen mühsame Kalibrierungsprozesse angewendet werden, um den Unterschied der Reflektionskoeffizienten der Streckenoberfläche für die horizontalen und vertikalen Komponenten des Feldes zu berücksichtigen." Damit sind wir wenigstens zum Teil abhängig von Simulationen für die Bewertung von zirkular polarisierten Antennen.

Aus Abb. 49 könnten wir folgern, dass beides, sowohl Horn, als auch Septum, die zirkulare Polarisation bei weiten Ausleuchtungswinkeln stören, die für die Ausleuchtung tiefer Spiegel nötig sind.

Sogar ein perfekter Polarisator, der perfekte zirkulare Polarisation an das Horn liefert, ist nicht so gut für tiefere Spiegel. Wir haben diesen Effekt auch bei einigen VE4MA-Feeds gesehen, die Ausnahme, das Super.VE4MA, fällt so schnell bei niedrigem f/D ab, dass jeder Effekt dadurch wahrscheinlich verborgen wird.

Der offensichtliche Grund für die schlechtere Leistung bei zirkularer Polarisation für kleine f/D ist, dass die zirkulare Polarisation bei weiteren Ausleuchtungswinkeln (theta), die für tiefe Spiegel gebraucht werden, nicht mehr so gut ist. Häufig wird die Zirkularität einer zirkular polarisierten Antenne gegeben oder justiert auf die Achsrichtung des Feeds, aber das ist nicht so wichtig für einen primärfokalen Spiegel, denn die Achsrichtung des Feed ist normalerweise blockiert. Ein Feed für zirkulare Polarisation muss gute zirkulare Polarisation über den ganzen Reflektor liefern.

Axial Ratio

Üblicherweise wird die Zirkularität gemessen und Quantifiziert durch die Axial Ratio, dem Verhältnis des stärksten zur schwächsten Richtung der Polarisation. Die Axial Ratio wird gemessen durch Drehen einer Antenne mit linearer Polarisation am anderen Ende der Teststrecke, um die stärkste und schwächste Polarisation zu finden. Für perfekte zirkulare Polarisation sind die Komponenten gleich und die Axial Ratio ist 0 dB. Je größer die Axial Ratio, desto weniger zirkular und desto elliptischer ist die Polarisation. Für perfekte lineare Polarisation ist die Axial Ratio unendlich.

Eine Messung der Axial Ratio über das gesamte Diagramm hinweg wäre wirklich schwierig, aber in der Simulation sind es einfach nur mehr Zahlen. Für die Version in Abb. 39, mit einem Ring von 0.35λ Weite und 0.35λ Tiefe sind die Axial Ratios in Abb. 50 gezeigt; mit dem Ring bündig am Rand, wird gute lineare und zirkulare Effektivität für ein f/D von 0.49 geliefert. Und in Abb. 51 mit um 0.3λ zurückgezogenem Ring wird gute lineare Effektivität für ein f/D von 0.31 geliefert, aber einige Punkte niedriger für zirkular (68 %, was keinesfalls schrecklich schlecht ist). In Abb. 50 ist die Axial Ratio besser als 0.6 dB über einen Illuminations-Halbwinkel von 60°, was den ganzen Reflektor abdeckt, während in Abb. 51 die Axial Ratio besser als 1 dB über nur etwa 12° ist und auf 5 dB an den Rändern des Reflektors abfällt, was einen Illuminations-Halbwinkel von 75° entgegensetzt für f/D = 0.31. Hier können wir den Unterschied für kleine f/D sehen.

Abb. 50 und 51 sind nicht nur Plots der Axial Ratio in der E- und H-Ebene, sondern in einer großen Zahl von Ebenen in 1-Grad-Rotationsschritten um das Feed. Folglich können wir sehen, wie konsistent die zirkulare Polarisation in den drei Dimensionen ist.

Zum Schluss kehren wir zum originalen VE4MA-Feed zurück, das bei zirkularer Polarisation unter deutlichen Verlusten durch Kreuzpolarisation leidet. Abb. 52 zeigt, dass die Axial Ratio sehr elliptisch wird bei zunehmendem Winkel Theta. Wir können nur folgern, dass die Ring-Ausdehnung die Symmetrie der zirkularen Polarisation ernsthaft stören kann.

Zusammenfassung

Aus den Ergebnissen können wir einige Schlüsse ziehen:

- Alle diese Feeds arbeiten (in der Simulation) gut mit dem OK1DFC-Septum-Polarisator zur Erzeugung zirkularer Polarisation, aber die Effektivität sinkt für **f/D < 0.35**.
- Der Septum-Polarisator, oder jeder andere Polarisator, beeinflusst nicht die Strahlung der Antenne, ausser das er sie zirkular macht; jeder Polarisator, der die Antenne mit guter zirkularer Polarisation erregt, wird dasselbe Diagramm als Ergebnis haben. Natürlich wird ein schlechter Polarisator die Leistung mindern.
- Der Polarisator ist nicht Teil der Antenne – genau wie die Sonden – sofern genug Abstand zur Begrenzung von Interaktionen vorhanden ist (vielleicht 1λ).
- Für lineare Polarisation arbeiten Horndurchmesser von 0.71λ und 0.77λ gleich gut und es gibt keinen Grund zur Annahme, dass Durchmesser dazwischen nicht genauso gut arbeiten. Der OK1DFC-Septum-Polarisator arbeitet am besten mit einem Wellenleiterdurchmesser von 0.71λ, aber kleine Abweichungen haben keinen Einfluss auf die Polarisation.
- Der Bereich von Dimensionen für Feeds, die gute Leistung ergeben, ermöglicht vorhandene Materialen effektiv zu nutzen.
- Für beste Leistung empfiehlt sich das Super-VE4MA-Feed und ein Spiegel mit **f/D** von etwa 0.37.
- Auch wenn die eigene Antenne nicht optimal ist, werde damit QRV!

Appendix/Anhang D

Siehe engl. Text oben

Referenzen

Siehe engl. Text oben

Design of Primary Feeds for the 32m KDDI Antenna System IBA-4 in Cassegrain Configuration

R. Galuscak-OM6AA*, M. Watanabe-JH1KRC †, P. Hazdra*, K. Seki-JJ1NNJ †, S. Takeda –JH1EFA †, M. Prochazka, JH1NBN, Y. Uchiyama †**

**Czech Technical University in Prague, FEE, Department of Electromagnetic Field, Technicka 2, 166 27, Prague, Czech Republic, e-mail: om6aa@yahoo.com*

†Nippon Medical School Chiba-Hokuso Hospital Imba, Chiba, Japan, e-mail: jh1krc@syd.odn.ne.jp

***former VUST Prague, Czech Republic, now private antenna consultant, e-mail: prochazkamir@volny.cz*

1. Introduction

A proposal for using the KDDI 32-meter Cassegrain reflecting dish antenna (see Fig.1) for amateur radio EME (Earth-Moon-Earth microwave communication utilizing the Moon as a passive reflector) was initiated in 2006 when a group of Japanese amateur radio enthusiasts met for a special meeting at KDDI-Ibaraki Satellite Communication Center in Takahagi City, Japan. This center, which is scheduled to be closed in the near future, was built as a communication node for INTELSAT services and has several immense parabolic dish antennas and associated infrastructure buildings for administrative, research, construction and maintenance purposes.

At the present time, not all KDDI antennas are in active service; some being in stand-by mode. This resulting availability of "antenna time" along with a favorable approval from KDDI fostered creation of amateur radio's "Project Big Dish," whose charter was to communicate on the 144 (2m), 432 (70cm), 1296 (23cm) and 5760 (6cm) MHz amateur radio bands. A special license and call sign, 8N1EME, was issued by the Japanese Telecommunication Authorities for this event. One of the requirements for its issue was to disclose the antenna's calculated radiation patterns. A special taskforce consisting of 40 Japanese radio amateurs was formed to solve the associated technical and logistic problems. Later, engineers from Czech Technical University in Prague were invited into the team for consulting and designing the 2m, 70cm and 23cm primary feeds. Support from the Japan Amateur Radio League enabled Project Big Dish to work on solving the many problems associated with launching its station onto the air within six months, before this Center totally ceased operations.

Problems concerning the design of primary feeds are described in this paper.

Fig. 1 32m KDDI Antenna System IBA-4

2. Electrical Requirements

Electrical requirements for the antenna system were determined based on antenna geometry, taking into account each band's specifications and operational requirements. The theoretical maximum directivity for each band was calculated with the formula

$$\text{Dir} = 10\log\left[\frac{\pi^2}{\lambda^2}\left(D_m^2 - D_s^2\right)\right] \qquad \text{(dBi)} \qquad (1)$$

where D_m is the main reflector's diameter (32 meters), D_s is the subreflector's diameter (2.9 meters), and λ is the wavelength. Consequently, the theoretical maximum directivity for the 2m band is 33.63 dBi. For 70cm it is 43.18 dBi and for 23cm it is 52.72 dBi. Band specifications were based on polarization characteristics: linear polarization for 2m and 70cm; circular polarization for the 23cm band. The sumarized requirements for electrical parameters were:

I. High gain – good efficiency
II. Vertical polarization for 2m and 70cm bands
III. RH & LH circular polarization for the 23cm band
IV. Prompt band-switching without requiring tuning for multiband operation (not simultaneously)
V. Minimum possible reciprocal influence between feeds

From the available KDDI antenna geometry drawings it was apparent that both the subreflector and main reflector are "shaped," i.e. custom geometries which are neither true parabolic nor hyperbolic. Unfortunately, accurate antenna system dimensions were not available and therefore, all computations for the feed design were made for a non-shaped Cassegrain antenna system with dimensions based on the main antenna's geometry. See Fig. 2a. ICARA [1] software was used to compile the picture.

3. Mechanical Requirements

Mechanical design and construction was to conform to the agreement made between the EME group and KDDI Company. That was, any permanent changes to KDDI antennas such as drilling, milling, edging, etc. was not allowed. Another constraint, to not remove or move the hyperbolic subreflector, was the most limiting, as we later discovered.

Logistic requirements neccessitated quick and easy installation and removal of the antenna feeds on/from the antenna structure and mechanical construction should allow for the positional movement of the 144 and 432 MHz feeds for initial impedance matching alignment.

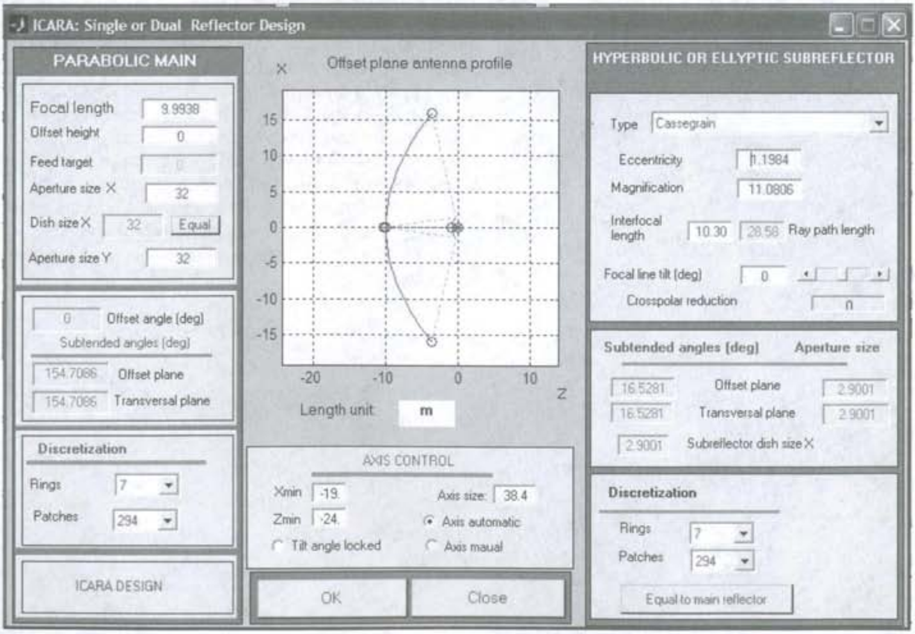


Fig. 2a KDDI Cassegrain Antenna Geometry

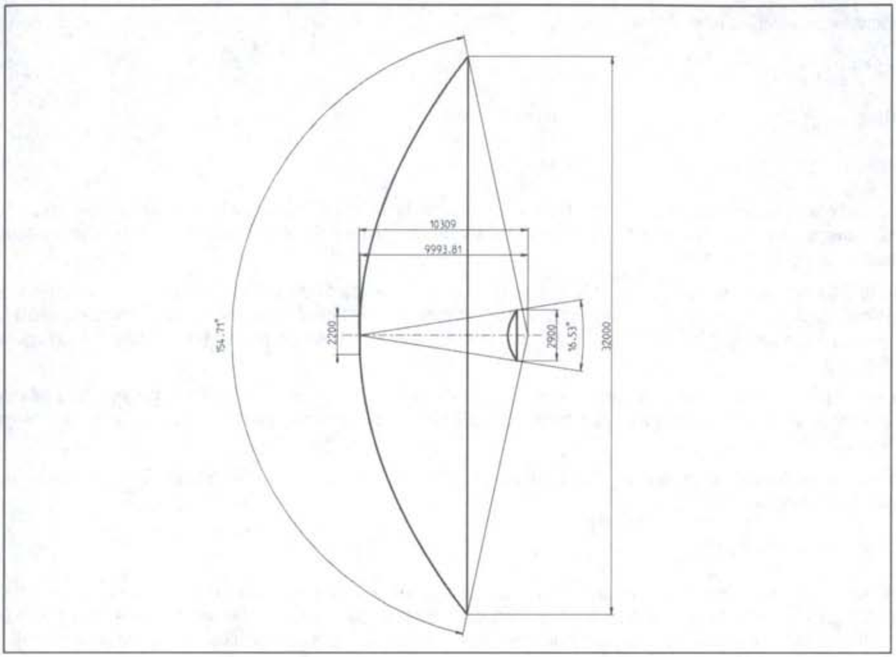


Fig. 2b KDDI Cassegrain Antenna Geometry

4. Design of the 23 cm Feed

Detailed examination of the KDDI Cassegrain antenna system's geometry enables us to determine computer modeling parameters for the hyperbolic subreflector and parabolic dish reflector. See Fig. 2b.

From [2], equations for the hyperbolic subreflector are:

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1 \qquad (2)$$

where $b^2 = c^2 - a^2$ (3)

focal length $f_{hyp} = 2c$ (4)

$$\text{eccentricity} \quad e = \frac{c}{a} \qquad (5)$$

$$\text{magnification} \quad M = \frac{e+1}{e-1} \qquad (6)$$

From these equations, values for the hyperbolic subreflector constants are determined:

a = 4301.2
b = 2840.1
c = 5154.5
e = 1.1984
M = 11.0806

Equations for the parabolic reflector are:

$$y^2 = 4 f x \qquad (7)$$

focal length $\quad f_{par} = f \qquad (8)$

eccentricity $\quad e = 1 \qquad (9)$

Based on these equations and the antenna's dimensions, a model of the KDDI Cassegrain antenna system was created using ICARA software. Antenna models for FEKO [3] and CST MW Studio [4] were also determined for additional computations and optimization of the antenna system.

From Fig. 2 we can see that the focus of the KDDI Casegrain antenna is located behind the vertex of the main parabolic reflector. To facilitate placing the primary feed in this location, a 2.2 m diameter aperture is incorporated in the main parabolic reflector design. This technically elegant configuration eliminates problems associated with the primary feed blocking the main parabolic reflector.

For proper operation and to avoid substantial degradation in efficiency caused by diffractive effects, the antenna's subreflector diameter should exceed 10 wavelengths. As a result, the KDDI Cassegrain antenna's operating frequency is forced to be greater than about 1 GHz.

To determine the optimum edge taper for the subreflector, ICARA software was used. This software utilizes a radiation pattern modeled by the function

$$U(\theta) = \cos^{2N} \theta \qquad \text{for } \theta \leq \pi/2 \qquad (10)$$

which very closely approximates the primary feed's actual radiation pattern. The results are compiled in Fig. 3 and show that, apparently, an 11 dB edge taper is best. The feed's taper must take into account space attenuation, so it is calculated to be the sum of the subreflector edge taper plus space attenuation. To calculate edge space attenuation, the antenna geometry and equations (2) and (3) were used.

We calculated a value of -0.6 dB for space attenuation, so the required taper for the feed is 10.4 dB.

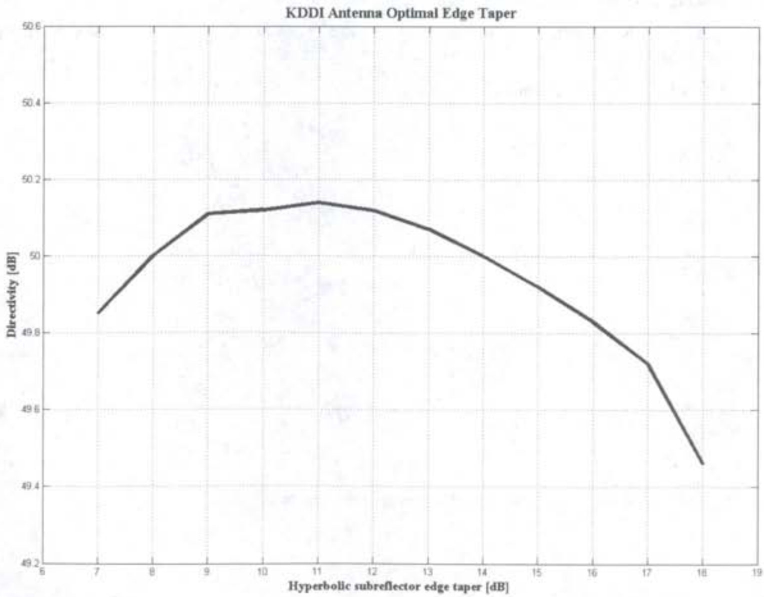


Fig. 3 Subreflector Edge Taper Characteristics

Based on the cos ^{2N} θ function we determined the primary feed directivity as follows:

$$\text{beamwidth}\,[Lvl(dB)] = 2\cos^{-1}\left(10^{-Lvl(dB)/20N}\right) \qquad (11)$$

$$N = \frac{-Lvl\,(dB)}{20\log[\cos(\text{beamwidth}_{Lvl(dB)}/2)]} \qquad (12)$$

$$\text{Directivity} = 10\log[2(2N+1)] \quad [dBi] \qquad (13)$$

Inserting actual KDDI antenna values ($Lvl = 10.4$ dB, $\text{beamwidth}_{10.4db} = 16.5°$) into equation (12), we get N = 114.7. Subsequently, from equation (13), calculated directivity of the primary feed for this antenna system should be 26.6 dBi, basis an ideal lossless feed. As mentioned in the previous section, the KDDI reflectors are shaped for optimum efficiency. For shaped Cassegrain antenna systems, some authors [5], [6] recommend the use of edge tapers between 13 and 16 dB to lower diffraction losses and to better-fit field distribution characteristics to the shaped hyperbolic subreflector.

For our purposes, we specified a subreflector edge taper of 11 dB or higher, which meant utilizing a primary feed gain of greater than 26.6 dB. To achieve this value of gain, the primary feed should have an effective area (considering the circular aperture) of

$$A = \pi (D/2)^2 \qquad (14)$$ where A is effective area, D is aperture diameter

$$\text{Directivity} = \frac{4\pi A}{\lambda^2} \qquad (15)$$

$$\text{and Gain} = \frac{4\pi A}{\lambda^2}\,\eta a \qquad (16)$$ where ηa is aperture efficiency.

Consider an aperture efficiency of 63 %. To compensate for aperture losses it is necessary to achieve a primary feed directivity of 28.6 dB, ($\text{Directivity}_{ratio} = 726$).

By combining equations (14) and (15)

$$D = \sqrt{\left((\text{Directivity}\ \lambda^2)/\pi^2\right)} \qquad (17)$$

Inserting KDDI antenna values ($\text{Directivity}_{ratio} = 726$, $\lambda = 0.231$ m) into equation (17) we get D = 1.98 m for the minimum diameter of the primary feed aperture. The primary feed can be realized using a horn or dish antenna of at least 1.98 m diameter placed at the focus of the KDDI antenna. Since a horn configuration was impractical due to the required length, a 2.32 m diameter, $f/D_{ratio} = 0.43$ dish antenna fitted with a circularly polarized feed (Fig. 4) developed by Galuscak and Hazdra [7] was chosen. The larger-than-required diameter ensures some reserve gain and the operational features of the circularly polarized feed enables utilization of both RH and LH circular polarization with good impedance matching and without the need for additional mechanical or electrical adjustments.

Due to physical limitations in the mechanical construction of the primary feed, consisting of a 2.32m dish and the Galuscak-Hazdra feed, it was not possible to place its phase center at the exact focus of the KDDI antenna system. The phase center was placed slightly forward relative to the hyperbolic subreflector which can cause a slight reduction of overall system efficiency.

Note that the phase center of a dish antenna assembly is not focused to a compact localized "point," but is distributed in 3-D space in the form of a torus located between the parabolic reflector and its focus [8].

Since a single full-wave analytical computer computation of the entire modeled KDDI antenna system consisting of main parabolic dish, hyperbolic subreflector, and primary feed consisting of a dish and its associated circularly polarized feed was impractical due to its size and complexity, the calculations were divided into two steps. First, the primary feed was modeled using CST MW Studio software. The radiation pattern output from this computation expressed in electric field in ASCII format was then imported to FEKO software as a point input driving source for the KDDI Cassegrain antenna model. Special data "translation" software for rapid data transformation from CST MW Studio to FEKO format was developed by Petra Galuscakova. The calculated copolarization radiation pattern is shown in Fig. 5. An overall antenna system design efficiency of 52% was achieved.

Fig. 4 Primary Feed for 23 cm

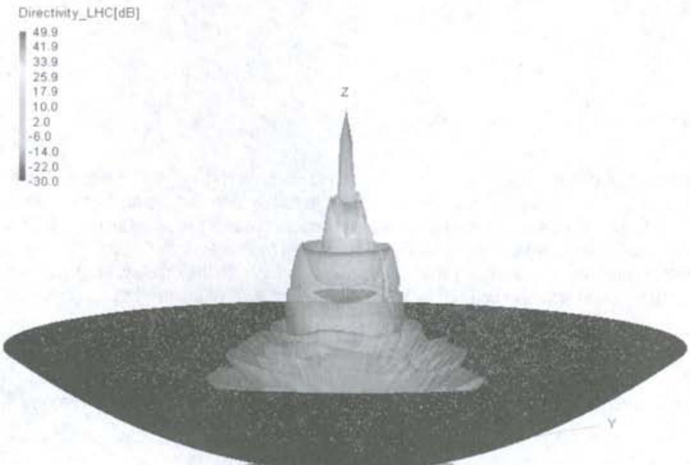


Fig. 5 Copolarization Radiation Pattern 3D - Phi = 90 Deg.

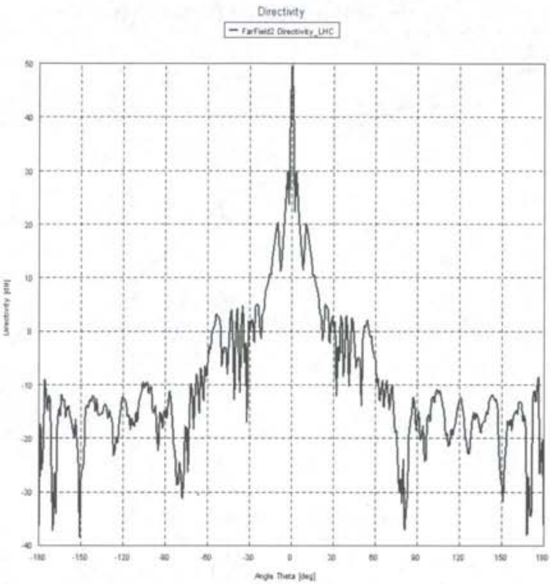
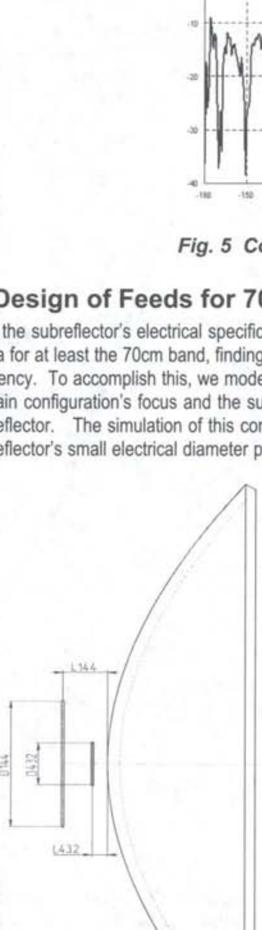


Fig. 5 Copolarization Radiation Pattern 2D - Phi = 90 Deg.

5. Design of Feeds for 70cm and 2m Bands

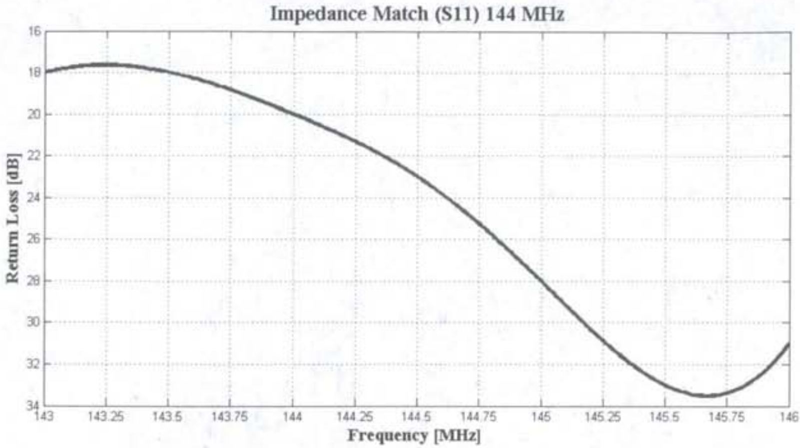
With the subreflector's electrical specifications from the previous section in mind, we tried to configure the KDDI Cassegrain antenna for at least the 70cm band, finding a reasonable compromise between simple mechanical construction and useable system efficiency. To accomplish this, we modeled the antenna's driving source as a 9-element Yagi antenna located between the Cassegrain configuration's focus and the subreflector so as to achieve both E and H plane edge tapers of 11 dB for the hyperbolic subreflector. The simulation of this configuration yielded an overall antenna system efficiency of about 36 %. Apparently, the subreflector's small electrical diameter prevented us from achieving a higher efficiency. Also, this design did not comply with the requirements for mechanical construction and therefore was not considered for further use.



Due to time constraints for studying various other possibilities for 2m and 70cm feeds, a design using two single-wavelength loop antennas placed in front of the hyperbolic subreflector was used. This configuration was a tradeoff between mechanical construction complexity and efficiency degradation, mainly on the 70cm band. This feed's geometry is shown in Fig. 6. As we can see, the combination of a loop antenna with the hyperbolic subreflector creates a virtual prime-focus feed for the main parabolic reflector, but with relatively high axial deviation (axial defocusing) from it's properly positioned, in-focus, main parabolic reflector. To study the radiation pattern and to adjust the impedance match, a parametric model of the feed was designed using CST MW Studio software. The variables were the loops' diameters (D) and their distance (L) from the subreflector, see Fig 6. The phase center of this structure is located between the loops and vertex of the hyperbolic subreflector. The deviation between the feed's phase center and parabolic reflector focus was 0.46 λ for the 2m band and 1.29 λ for the 70cm band. This axial defocusing introduces a phase error loss, whose magnitude can be calculated using maximum phase deviation and quadratic phase error loss calculations [2]. Additional details are available in the reference.

Impedance matching was adjusted by varying the distance between the loop antennas and hyperbolic subreflector and also by the loop's lengths. Good impedance match were attained on both bands. See Fig. 7.

Fig. 6 2m and 70 cm Loops Geometry



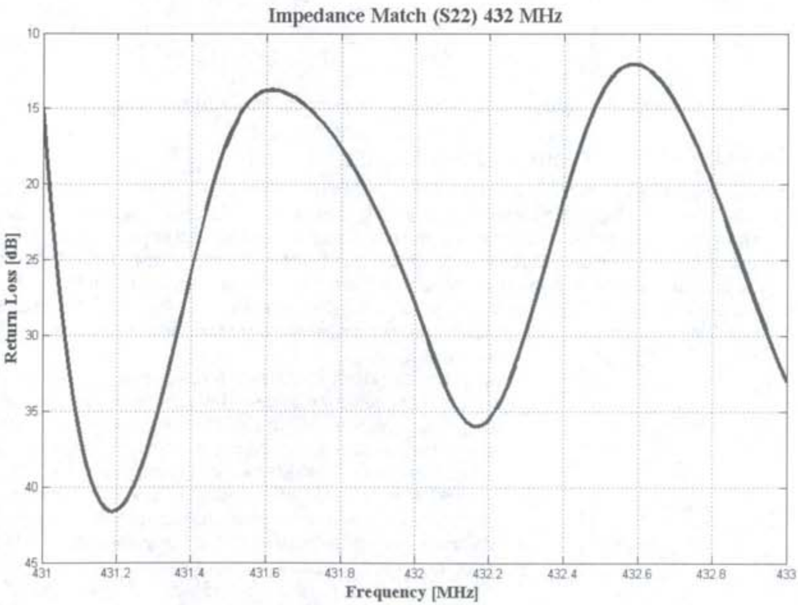


Fig. 7 Antenna Impedance Match, 2m (above), 70cm (below)

Changes in the radiation pattern due to varying the loops' positions relative to the subreflector were negligible. The calculated radiation pattern expressed in ASCII electric field format was again imported into FEKO software to calculate the final antenna system's radiation pattern. Patterns for 2m and 70cm are shown in Fig. 8 and Fig. 9. From the figures, it is apparent that efficiency degradation (31% on 2m{28.5dBi}, 13 % on 70cm{34.3dBi}) caused by the improper primary feed position is substantial. By comparison, the same feed placed at a parabolic reflector focus should operate at 53% efficiency. Unfortunately, it was not possible to change the position of the hyperbolic subreflector with the objective of improving the efficiency. S_{21} isolation between loops, which does not have an influence on practical operation, is shown in Fig.10.

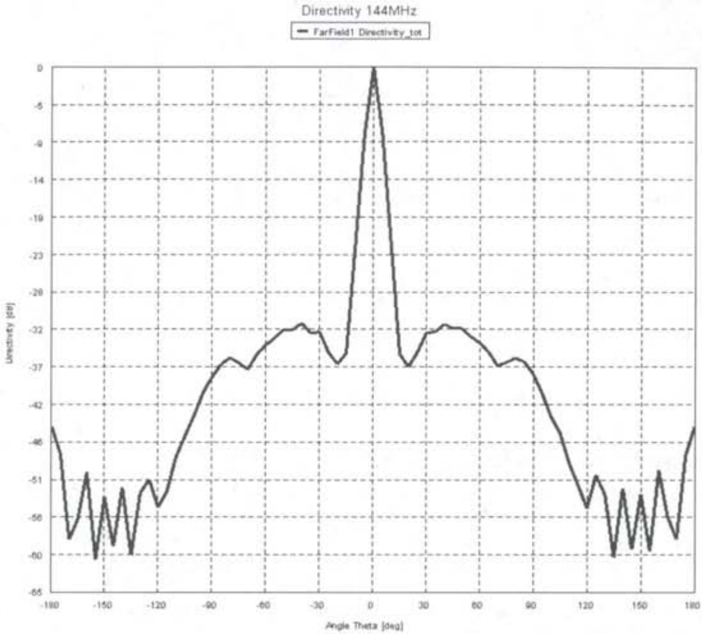


Fig. 8 2D Normalized Radiation Pattern 144 MHz, Phi = 90 Deg.

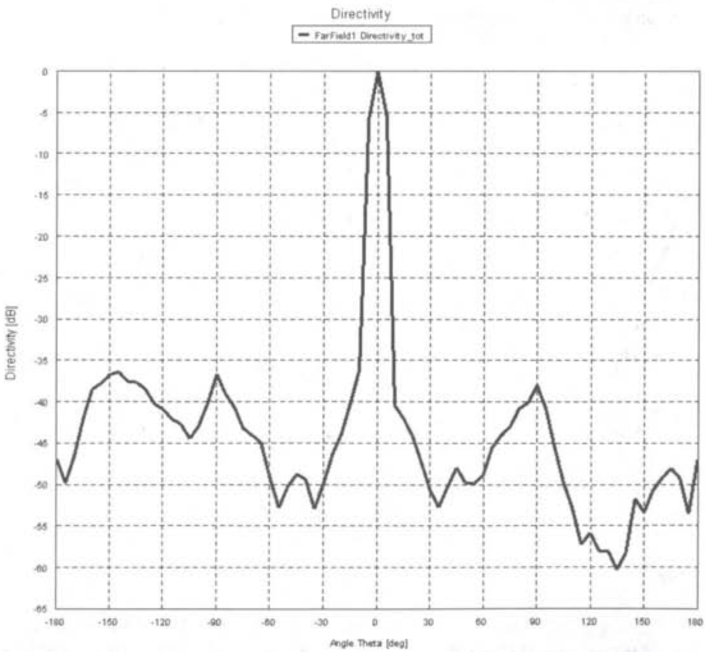


Fig. 9 2D Normalized Radiation Pattern 432 MHz , Phi = 90 Deg.

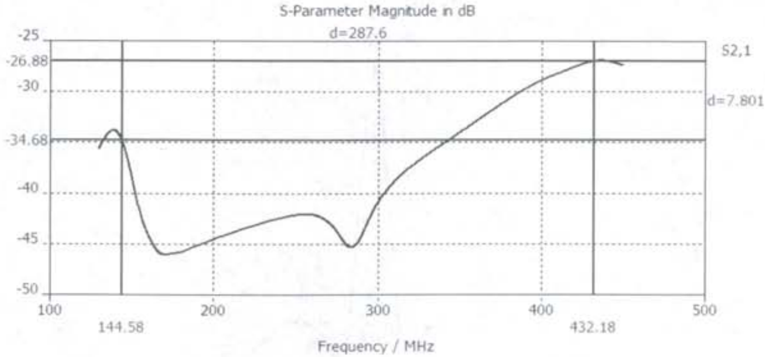


Fig. 10 S21 Isolation between Loops

6. Temperature Concerns for the KDDI Antenna System

For Cosmic-to-Earth radio communication systems, it is very important for the receiving system's noise budget to be as low as possible to permit reception of very weak signals. The antenna-temperature interaction plays a very important role in the receiving chain. The antenna temperature performance calculation is conceptually described as multiplying the spatial function of antenna gain by the temperature distribution of the space surrounding the antenna, integrated over all space. For the KDDI antenna system, "Kelvin Sum" software [9] was used to calculate the temperature characteristics. Based on a published program [10] modified by Miroslav Prochazka, this software assumes a rotationally symmetrical radiation pattern along the z-axis and incorporates the defined temperature behavior of antenna surroundings in its calculations.

The KDDI antenna temperature characteristics calculated for Earth temperature TO = 290 ° K, as a function of elevation angle are plotted in Fig.11. From this figure it is apparent that for the 23cm band and very low elevation angles, a Cassegrain antenna configuration has higher noise temperature than a configuration consisting of a parabolic reflector equipped with a prime focus feed. (We are considering these configurations for the 2m and 70 cm bands.) This is mainly due to spillover illumination of the hyperbolic subreflector. On the other hand, at higher elevation angles, the Cassegrain configuration exhibits very low noise temperature, which is very suitable for EME communication.

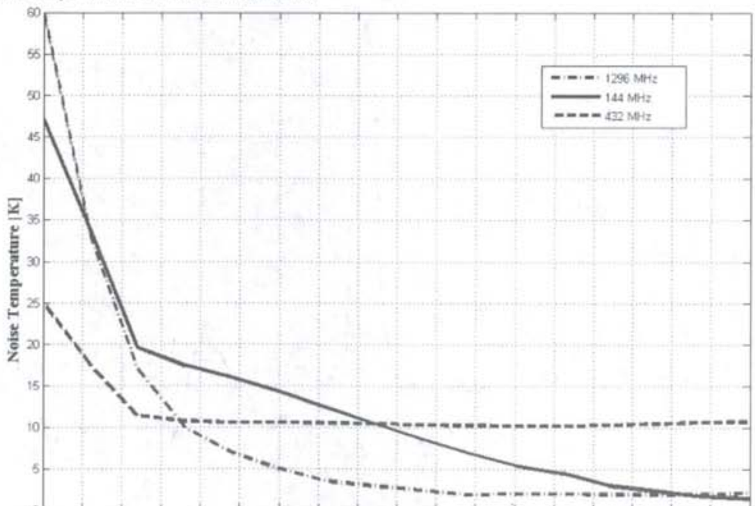


Fig. 11 The KDDI Antenna calculated Noise Temperature Characteristic (For a better comparison of the antennas noise characteristic for various configurations, the frequency independent noise source was calculated. Atmospheric noise was neglected)

7. Considerations for Practical Feed Construction

Feed construction and realization for immense antennas entail several specific challenges. One must consider that the mounting location of primary feeds for 70cm and 2m bands at an antenna elevation angle of 90 degrees is about 40 meters above ground level. This implies that to maintain safety at the high elevation, all montage and changes to the antenna system must be performed with the aid of special cranes (at great expense) and only by specially qualified personnel under strictly determined conditions. Any additional parameter settings or adjustments made directly to the antenna during this operation are not allowed, since it could additionally impact the economic budget of the project.

The feed for 23cm was assembled and tested on the ground and then installed in the KDDI system. Feeds for 2m and 70cm consisted of loop antennas made from copper tubing affixed to an insulating plate. See Fig 12, 13, 14. This assembly was placed in its calculated location relative to the hyperbolic subreflector by authorized personnel using a "marionette style" pull-up/pull-down tension cable mechanism. The distance between the loop antenna feed and hyperbolic subreflector was set by foam-plastic blocks affixed to the insulating plate. Later, no further adjustment was deemed necessary for optimizing VSWR.

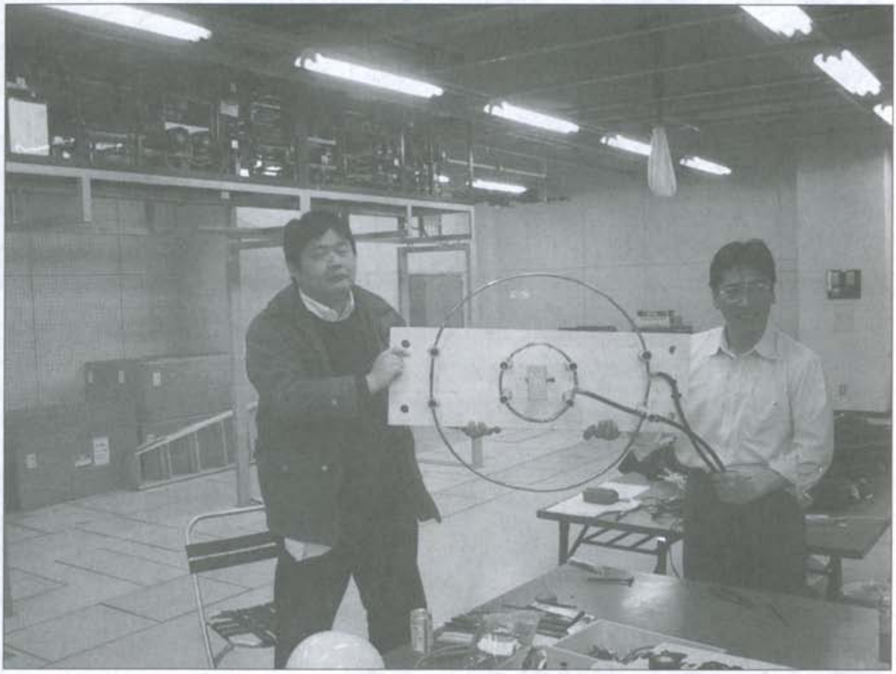


Fig. 12 144 and 432 MHz Loops

8. Practical Results

Since special measurement equipment was not available at the time, Sun noise was measured several times on each band only to functionally verify the antenna's beaming system and receiving chain. Measurement precision was not sufficient to provide an accurate antenna characteristic; however, measured results indicate good agreement between calculated and actual antenna gain. The measured value of gain was found to be somewhat higher than the calculated value; the calculation error being attributed to the inability of the simulation to take into consideration all factors influencing antenna performance, such as actual sub- and dish reflector shapes and especially the actual amount of feed defocusing.

On 4 March, 2007, at 00.00 UTC, values of 8.5 dB @ 144 MHz and 15.0 dB @ 432 MHz were measured for Sun to cold sky differential noise levels. The measurement on 1296 MHz, however, was not successful due to the receiver's limited dynamic range. An alternate method of antenna performance verification is to statistically evaluate the contact success rate i.e. number of established contacts with other stations, taking into account an Earth- Moon-Earth link energy budget. The 8N1EME station worked with 154 stations on the 2m band, 67 stations on 70cm and 71 stations on 23cm. Also, this analysis confirms calculated antenna performance.

Fig. 13 Feed Installation

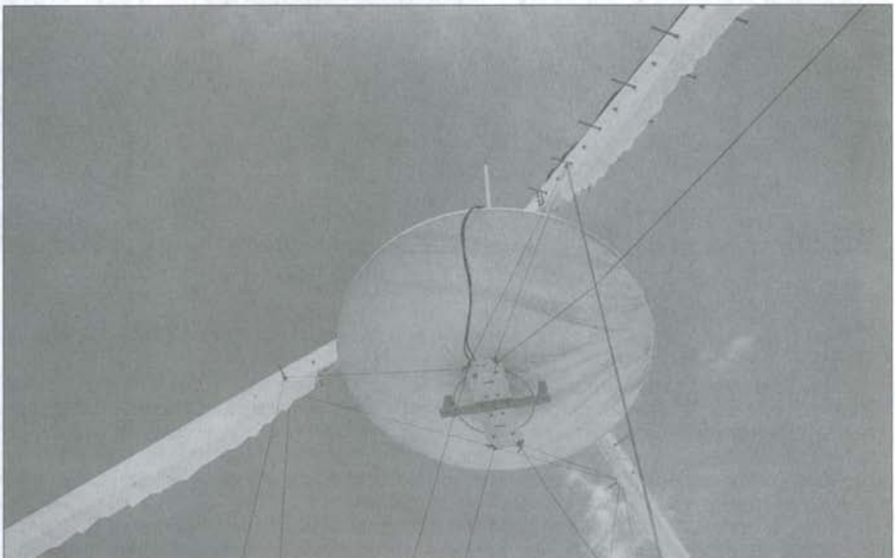


Fig. 14 "Marionette Style" Tension Cable Mechanism

9. Summary and Conclusions

The opportunities and challenges presented by Project Big Dish made quite the "dream project" for each member of the working team. We had the opportunity to design, fabricate, test and use an antenna system based on the KDDI Cassegrain antenna, and transformed it into a multiband antenna touting a unique *triple* reflector configuration on the 23cm band! See Fig. 15

Fig. 15 KDDI Antenna Equipped with 2m, 70cm and 23cm Feeds

Project Big Dish was not only a significant amateur radio event, but also provided many antenna engineering, ham-radio and RF electromagnetic propagation learning opportunities. More details about Project Big Dish may be found at [11].

10. Acknowledgement

The authors would like to express their thanks to Robert Valenta, for his valuable remarks and help in creating this article.

11. References

[1] ICARA, Induced Current Analysis of Reflector Antennas-software, www.com.uvigo.es/ant/icara_english.htm
[2] Milligan, Thomas A. "Modern Antenna Design" *Wiley-IEEE Press*, 2nd edition, July 11, 2005
[3] FEKO_EM systems-Software & SS.A. (Pty) Ltd, website: www.feko.info
[4] Computer Simulation Technology website: www.cst.de
[5] Prochazka, Miroslav " Výpočet anténní soustavy Cassegrain s tvarovou korekcí zrcadel" *Slaboproudý obzor*, 12/1983
[6] Kildal, P.S. "The effects of subreflector diffraction on the aperture efficiency of a conventional Cassegrain antenna-An analytical approach" *IEEE Transactions on Antennas and Propagation*, Volume 31, Issue 6, Nov 1983, pp 903 - 909
[7] Galuscak, Rastislav-OM6AA; Hazdra, Pavel; "Prime-focus circular waveguide feed with septum polarization transformer" DUBUS, 1/2007
[8] Carter, David "Phase Centers of Microwave Antennas" *IRE Transactions on Antennas and Propagation*, 1956, pp 597 – 600
[9] Prochazka, Miroslav "Kelvin Sum"-software, Privately developed software program, 1999
[10] Bui-Hai, " ANTENNES MICRO-ONDES" 08/01/1999 MASSON
[11] http:// 8N1EME.jp
[12] Wade, Paul-W1GHZ "Multiple Reflector Dish Antennas" website: www.w1ghz.org/antbook/conf/conf.htm

Design von Primären Feeds für das 32-m-KDDI-Antennensystem „IBA-4“ mit Cassegrain-Konfiguration

R. Galuscak-OM6AA*, M. Watanabe-JH1KRC †, P. Hazdra*, K. Seki-JJ1NNJ †, S. Takeda –JH1EFA †, M. Prochazka**, JH1NBN, Y. Uchiyama †

**Tschechische Technische Universität, Prag, FEE, Department of Electromagnetic Field, Technicka 2, 166 27, Prague, Czech Republic, e-mail: om6aa@yahoo.com*

†Nippon Medical School Chiba-Hokuso Hospital Imba, Chiba, Japan, e-mail: jh1krc@syd.odn.ne.jp

***vormals VUST Prag, Tschechien, jetzt privater Berater, e-mail: prochazkamir@volny.cz*

1. Einleitung

Im Jahr 2006, als sich eine Gruppe japanischer Amateurfunk-Enthusiasten zu einem besonderen Treffen im KDDI-Ibaraki Satellite Communication Center in Takahagi City (Japan) versammelte, entstand der Vorschlag, den KDDI-32-m-Cassegrain-Spiegel (siehe Abb. 1) für Erde-Mond-Erde-Betrieb auf den Amateurfunk-Mikrowellenbändern einzusetzen. Dieses Zentrum, das in absehbarer Zeit geschlossen werden soll, wurde einst als Kommunikationsknoten für den INTELSAT-Dienst errichtet und besteht aus mehreren großen Parabolantennen und der zugehörigen Infrastruktur, wie Gebäuden für Administration, Forschung, Konstruktion und Wartung. Zu Zeit sind nicht alle der KDDI-Antennen in aktivem Betrieb, einige befinden sich im „Stand-by“ Mode. Das Vorhandensein von „freier Antennezeit“ zusammen mit einer Zustimmung durch KDDI unterstützte das Schaffen des Amateurfunkprojektes „Big Dish“, dessen Ziel Betrieb auf den Bändern 144 (2m), 432 (70cm), 1296 (23cm) und 5760 (6cm) MHz sein sollte. Für dieses Ereignis wurde von der japanischen Telekommunikationsbehörde eine Sonderlizenz und das Sonderrufzeichen 8N1EME erteilt. Eine Bedingung für die Lizenz war das Angeben des berechneten Strahlungsdiagramms der Antenne. Eine besondere Arbeitsgruppe von 40 japanischen Funkamateuren wurde gebildet, um die technischen und logistischen Probleme zu lösen. Später wurden Ingenieure der Tschechischen Technischen Universität Prag in das Team eingeladen, um Primäre Feeds für 2m, 70cm und 23cm zu diskutieren und entwickeln. Unterstützung des japanischen Amateurfunkverbands JARL ermöglichte dem Projekt Big Dish die vielen Probleme zu lösen, die mit dem Start der Station auf den Bändern innerhalb von 6 Monaten vor dem endgültigen Schließen der Anlage, verbunden waren. Die Probleme, die das Design der Primären Feeds betreffen, werden in diesem Artikel beschrieben.

2. Elektrische Anforderungen

Die elektrischen Anforderungen für das Antennensystem wurden bestimmt basierend auf der Antennengeometrie unter Berücksichtigung der Spezifikationen für jedes Band und betriebstechnischer Erfordernisse. Die theoretisch maximale Directivity für jedes Band wurde berechnet mit der Formel

$$\mathrm{Dir} = 10\log\left[\frac{\pi^2}{\lambda^2}\left(D_m^2 - D_s^2\right)\right] \quad \text{(dBi)} \qquad (1)$$

mit D_m für den Durchmesser des Hauptreflektors (32 Meter), D_s für den Durchmesser des Subreflektors (2.9 Meter), und λ für die Wellenlänge. Daraus folgt, dass die theoretisch maximale Directivity für das 2m-Band 33.63 dBi beträgt. Für 70cm sind es 43.18 dBi und für 23cm 52.72 dBi. Die Band-Spezifikationen basieren auf den Polarisationscharakteristiken: Lineare Polarization für 2m und 70cm; zirkulare Polarization für das 23cm-Band. Zusammengefasst sind die Anforderungen an die elektrischen Parameter:

1. Hoher Gewinn – gute Effektivität
2. Vertikale Polarisation für das 2m- und 70cm-Band
3. RH & LH (rechts- und linksdrehende zirkulare) Polarisation für das 23cm-Band
4. Schnelle Bandumschaltung ohne Nachabstimmung bei Multibandbetrieb (nicht zeitgleich)
5. Geringstmögliche gegenseitige Beeinflussung zwischen den Feeds.

Aus den vorliegenden Zeichnungen der KDDI-Antenne war offensichtlich, dass sowohl Subreflektor als auch Hauptreflektor „verformt" waren, d.h., es sich um eine maßgeschneiderte Geometrie handelte, die weder rein parabolisch noch hyperbolisch ist. Leider waren keine genauen Abmessungen des Antennensystems verfügbar und deshalb wurden alle Berechnungen für das Feed-Design für eine nicht geformte Cassegrain-Antenne mit Dimensionen basierend auf der Geometrie der Hauptantenne durchgeführt. Siehe Abb. 2a. Die Software ICARA [1] wurde benutzt, um dieses Bild zu erstellen.

3. Mechanische Anforderungen

Das mechanische Design und die Konstruktion wurde in Übereinstimmung mit der Vereinbarung der EME-Gruppe und der Firma KDDI durchgeführt, die besagte, dass keine dauerhaften Veränderungen an den KDDI-Antennen durchgeführt werden durften, wie z.B. Bohren, Fräsen, Abkanten. Eine weitere Beschränkung war, dass der hyperbolische Subreflektor nicht entfernt oder bewegt werden durfte, was wie wir später lernen mussten, der am meisten limitierende Faktor war.

Logistische Anforderungen bedingten eine schnelle und einfache Installation und Entfernung der Feeds an der Antenne und die mechanische Konstruktion sollte eine Veränderung der Position der 144-MHz- und 432-MHz-Feeds für eine anfängliche Justierung zur Impedanzanpassung zulassen.

4. Design des 23-cm-Feed

Eine detaillierte Untersuchung der Geometrie des KDDI-Cassegrain-Antennensystems versetzt uns in die Lage, Parameter für die Computer-Simulation für den hyperbolischen Subreflektor und den parabolischen Reflektor zu bestimmen. Siehe Abb. 2b.

Nach [2] sind die Gleichungen für den hyperbolischen Subreflektor:

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1 \qquad (2)$$

mit $b^2 = c^2 - a^2$ (3)

Fokuslänge $f_{hyp} = 2c$ (4)

$$\text{Exzentrizität} \quad e = \frac{c}{a} \qquad (5)$$

$$\text{Vergrößerung} \quad M = \frac{e+1}{e-1} \qquad (6)$$

Aus diesen Gleichungen werden die Werte für die Konstanten des hyperbolischen Subreflektors bestimmt:

A = 4301.2
b = 2840.1
c = 5154.5
e = 1.1984
M = 11.0806

Die Gleichungen für den parabolischen Reflektor sind:

$y^2 = 4 f x$ (7)

Fokuslänge $f_{par} = f$ (8)

Exzentrizität $e = 1$ (9)

Basierend auf diesen Gleichungen und den Dimensionen der Antenne wurde mit der Software ICARA ein Modell für das KDDI-Cassegrain-Antennenssystem geschaffen. Antennenmodelle mit FEKO [3] und CST MW Studio [4] wurden ebenfalls ermittelt für weitere Berechnungen und Optimierungen des Antennensystems.

Aus Abb. 2 können wir ersehen, dass der Fokus der KDDI-Casegrain-Antenne hinter dem Scheitelpunkt des Hauptparabolreflektors liegt. Um eine Platzierung des primären Feeds in dieser Position zu ermöglichen, wurde eine 2.2m große Öffnung in das

Design des Hauptparabolreflektors eingearbeitet. Diese technisch elegante Konfiguration eleminiert Probleme, die mit der Blokkierung des Parabolreflektors durch das Primäre Feed verbunden sind.
Für eine gute Arbeitsweise und um eine merkliche Herabsetzung der Effektivität durch Beugungseffekte zu vermeiden, sollte der Durchmesser des Subreflektors der Antenne größer als 10 Wellenlängen sein. Daraus resultiert, dass die Arbeitsfrequenz der KDDI-Cassegrain-Antenne gezwungenermassen größer als etwa 1 GHz sein muss.
Um den optimalen Abfall an den Kanten für den Subreflektor zu bestimmen, wurde die Software ICARA verwendet. Diese Software verwendet ein Strahlungsdiagramm, dass durch die folgende Funktion modelliert wird,

$$U(\theta) = \cos^{2N} \theta \qquad \text{für } \theta \leq \pi/2 \qquad (10),$$

die dem realen Strahlungsdiagramm des Primären Feed sehr nahe kommt. Die Ergebnisse sind in Abb. 3 (Charakteristik des Randabfalls des Subreflektors) zusammengestellt und zeigen, dass – offensichtlich – ein 11 dB Abfall am Rand am besten ist. Der Abfall des Feeds muss die Streckendämpfung berücksichtigen, d.h. er errechnet sich als Summe aus Abfall am Rand plus Streckendämpfung. Um die Streckendämpfung für den Rand zu berechnen, wurden die Gleichungen (2) und (3) verwendet. Wir haben einen Wert von -0.6 dB für die Streckendämpfung errechnet, so dass der benötigte Abfall für das Feed 10.4 dB beträgt.

Basierend auf der Funktion $\cos^{2N} \theta$ haben wir die Direktivität des Primären Feed wie folgt bestimmt:

$$\text{Öffnungswinkel}\,[Lvl(dB)] = 2 \cos^{-1} (10^{-Lvl(dB)/20N}) \qquad (11)$$

$$N = \frac{-Lvl\,(dB)}{20 \log[\cos(\text{Öffnungswinkel}_{Lvl(dB)}/2)]} \qquad (12)$$

$$\text{Directivity} = 10 \log [2\,(2N+1)] \quad [dBi] \qquad (13)$$

Durch Einsetzen der aktuellen Werte der KDDI-Antenne ($Lvl = 10.4$ dB, $\text{Öffnungswinkel}_{10.4db} = 16.5°$) in Gleichung (12) erhalten wir für N = 114.7. Danach, aus Gleichung (13), sollte die berechnete Directivity des Primären Feed für dieses Antennensystem 26.6 dBi sein, bezogen auf ein ideales, verlustloses Feed. Wie oben bereits erwähnt, sind die KDDI-Reflektoren für optimale Effektivität besonders geformt. Für geformte Cassegrain-Antennensysteme, empfehlen einige Autoren [5], [6] einen Rand-Abfall von 13 bis 16 dB zu verwenden, um Beugungsverluste zu vermindern, und um die Eigenschaften der Feldverteilung besser an den hyperbolisch geformten Sybreflektor anzupassen.

Für unsere Zwecke haben wir einen Randabfall von 11 dB oder mehr am Subreflektor spezifiziert, was bedeutet, ein Gewinn von 26.6 dB oder mehr beim Primären Feed zu verwenden. Um diesen Wert für den Gewinn zu erreichen, sollte das primäre Feed eine effektive Oberfläche (unter Annahme einer kreisförmigen Öffnung) haben von:

$$A = \pi (D/2)^2 \qquad (14)$$ mit A für die effektive Fläche, D für den Durchmesser der Öffnung

$$\text{Directivity} = \frac{4\pi A}{\lambda^2} \qquad (15)$$

$$\text{und Gewinn} = \frac{4\pi A}{\lambda^2}\, \eta a \qquad (16)$$ mit ηa für die Öffnungseffektivität.

Es wird eine Öffnungseffektivität von 63% angenommen. Um die Verluste der Öffnung zu kompensieren, ist es nötig, eine Direktivität des Primären Feed von 28.6dB zu erreichen. ($\text{Directivity}_{ratio} = 726$).

Durch Kombination der Gleichungen (14) und (15) wird

$$D = \sqrt{\left((\text{Directivity}\ \lambda^2) / \pi^2 \right)} \qquad (17)$$

Durch Einsetzen der KDDI-Antennenwerte ($\text{Direktivität}_{ratio} = 726$, $\lambda = 0.231$ m) in Gleichung (17) erhalten wir D = 1.98 m für den minimalen Durchmesser der Öffnung des primären Feeds. Das primäre Feed kann realisiert werden als Horn oder Spiegel mit mindestens 1.98 m Duchmesser im Fokus der KDDI-Antenne. Da ein Horn aufgrund der benötigten Länge unpraktisch war, wurde ein Spiegel von 2.32 m Durchmesser mit $f/D_{ratio} = 0.43$ mit zirkular polarsiertem Feed (Abb. 4), entwickelt von Galuscak und Hazdra [7], gewählt. Der größer als nötige Durchmesser stellt etwas Gewinnreserve sicher und die Betriebseigenchaften des zirkular polarisierten Feeds ermöglicht die Verwendung von sowohl links- als auch rechtsdrehender zirkularer Polarisation unter guter Impedanzanpassung und ohne das Benötigen von weiteren machanischen oder elektrischen Justierungen.

Aufgrund der physikalischen Begrenzungen in der mechanischen Konstruktion des Primären Feeds, bestehend aus einem 2.32m Spiegel und dem Galuscak-Hazdra-Feed, war es nicht möglich, dessen Phasenzentrum exakt im Fokus des KDDI-Antennensystems anzuordnen. Das Phasenzentrum wurde etwas weiter vorne relativ zum hyperbolischen Subreflektor platziert, was eine leichte Herabsetzung der gesamten Systemeffektivität hervorrufen kann.

Anzumerken ist, dass das Phasenzentrum einer Spiegelantennenkonstruktion nicht in einem kompakten Punkt fokussiert ist, sondern im dreidimensionalen Raum in Form eines Ringes zwischen dem Parabolreflektor und seinem Fokus verteilt ist [8].

Da eine einzige analytische computergestützte Ganzwellen-Berechnung des kompletten modellierten KDDI-Antennensystems, bestehend aus Hauptparabolspiegel, hyperbolischem Subreflektor und Primärem Feed, das auch aus Spiegel und zugehörigem zirkular polarsierendem Feed besteht, aufgrund der Größe und Komplexität unpraktisch war, wurden die Berechnungen in zwei Stufen unterteilt. Zuerst wurde das Primäre Feed mit der Software „CST MW Studio" modelliert. Das Strahlungsdiagramm dieser Berechnung ausgedrückt als elektrisches Feld wurde dann im ASCII-Format in die FEKO-Software importiert als punktförmige Eingangsquelle zum Treiben des KDDI-Antennenmodells. Eine spezielle „Übersetzungs"-Software für die schnellen Datentransformation von „CST MW Studio" ins FEKO-Format wurde von Petra Galuscakova entwickelt. Das errechnete Strahlungsdiagramm für die Kopolarisation ist in Abb. 5 gezeigt. Eine Gesamteffektivität des Systems von 52% wurde erreicht.

5. Design von Feeds für das 70-cm- und 2-m-Band

Mit den elektrischen Spezifikationen des Subreflektors aus dem vorherigen Abschnitt im Hinterkopf, versuchten wir die KDDI-Cassegrain-Antenne wenigstens für das 70cm-Band zu konfigurieren und einen Kompromiss zwischen einfacher mechanischer Konstruktion und brauchbarer Systemeffektivität zu finden. Um das zu erreichen, modellierten wir als die Antenne treibende Quelle eine 9-Element Yagi so lokalisiert zwischen dem Fokus der Cassegrain-Anordung und dem Subreflektor, dass im E- und H-Feld am hyperbolischen Subreflektor ein Randabfall von 11 dB erreicht wird. Die Simulation dieser Konfiguration resultierte in einer Gesamteffektivität der Antenne von etwa 36%. Offensichtlich hinderte uns der kleine elektrische Durchmesser des Subreflektors am Erreichen einer höheren Effektivität. Auch erfüllte dieses Design nicht die Bedingungen für die mechanische Konstruktion und wurde nicht weiter für die Praxis in Betracht gezogen.

Aufgrund der zeitlichen Beschränkungen weitere Möglichkeiten für 2m- und 70cm-Feed zu untersuchen, wurde ein Design verwendet, das zwei Einlambda-Loopantennen vor dem hyperbolischen Subreflektor verwendet. Diese Konfiguration war besonders auf 70cm ein Kompromiss zwischen der Komplexizität der mechanischen Konstruktion und der Verschlechterung der Effektivität. Die Geometrie dieses Feeds zeigt Abb. 6. Wie wir sehen können, erzeugt die Kombination von Loop-Antenne mit dem hyperbolischen Subreflektor ein virtuelles Primäres Feed für den Hauptparabolreflektor, aber mit einer relativ großen axialen Abweichung (axiale Defokussierung) vom genau - im Fokus – positionierten Hauptparabolreflektor. Um das Strahlungsdiagramm zu untersuchen und die Impedanzanpassung einstellen zu können, wurde ein parametrisches Modell des Feeds mit der Software „CST MW Studio" vorgenommen. Die Variablen waren die Durchmesser (D) der Loops und ihr Abstand (L) vom Subreflektor, siehe Abb. 6. Das Phasenzentrum dieser Struktur befindet sich zwischen den Loops und dem Scheitel des hyperbolischen Subreflektors. Die Abweichung zwischen dem Phasenzentrum des Feeds und dem Fokus des Parabolreflektors war 0.46 λ für das 2m-Band und 1.29 λ für das 70cm-Band. Diese axiale Defokussierung verursacht einen Verlust durch Phasenfehler, dessen Größe errrechnet werden kann aus der maximalen Phasenabweichung und Berechnungen des quadratischen Phasenfehlerverlustes [2]. Weitere Details sind in der Referenz verfügbar.

Impedanzanpassung wurde durch Variieren des Abstands zwischen den Loopantennen und dem hyperbolischen Subreflektor und auch der Längen der Loops vorgenommen. Eine gute Impedanzanpassung wurde auf beiden Bändern erreicht. Siehe Abb. 7. Änderungen im Strahlungsdiagramm aufgrund der Änderung der Positionen der Loops relativ zum Subreflektor waren vernachlässigbar. Das gerechnete Strahlungsdiagramm ausgedrückt als elektrisches Feld wurde wieder im ASCII-Format in die FEKO-Software importiert, um das endgültige Strahlungsdiagramm der ganzen Antenne zu berechnen. Die Diagramme für 2m und 70cm sind in Abb. 8 und Abb. 9 gezeigt. Aus den Abbildungen ist ersichtlich, dass die Herabsetzung der Effektivität (31% auf 2m {28.5dBi}, 13 % auf 70cm {34.3dBi}), verursacht durch die unpassende Position des Primären Feeds, erheblich ist. Zum Vergleich: Das selbe Feed, platziert im Fokus des Parabolreflektors, sollte mit 53% Effektivität arbeiten. Leider war es nicht möglich, die Position des hyperbolischen Subreflektors zu verändern, um die Effektivität zu verbessern. Die S_{21} Isolation zwischen den Loops, die keine Bedeutung für den praktischen Betrieb hatte, zeigt Abb. 10.

6. Temperatur-Überlegungen für das KDDI Antennensystem

Bei Weltraum-Erde-Funkkommunikationssystemen ist es sehr wichtig, dass das Rauschen beim Empfangsteil so niedrig wie möglich ist, um die Aufnahme von sehr schwachen Signalen zu ermöglichen. Die Wechselwirkung mit der Antennentemperatur spielt eine sehr wichtige Rolle in der Empfangskette. Die Berechnung der Antennentemperatur wird im Konzept beschrieben durch Multiplikation der räumlichen Funktion von Antennengewinn mit der Temperaturverteilung des Raumes um die Antenne integriert über den Gesamtraum. Für das KDDI-Antennensystem wurde die Software "Kelvin Sum" [9] verwendet, um die Temperatur-Charakteristik zu berechnen. Basierend auf einem veröffentlichten Programm [10], modifiziert durch Miroslav Prochazka, geht diese Software von einem rotationssysmmetrischen Strahlungsdiagramm entlang der Z-Achse aus und bezieht das definierte Temperaturverhalten der Antennenumgebung mit in die Berechnungen ein. Die KDDI-Antennentemperaturcharakteristik gerechnet für die Erdtemperatur von To = 290 K als Funktion des Elevationswinkels ist in Abb. 11 aufgetragen. Aus dieser Abbildung ist ersichtlich, dass für das 23cm-Band und sehr niedrige Elevationswinkel, eine Cassegrain-Antennenkonfiguration eine höhere Rauschtemperatur hat, als eine Konfiguration bestehend aus einem Parabolreflektor, der mit einem primärfokalen Feed versehen ist. (Wir betrachten diese Konfigurationen für das 2m- und 70cm-Band). Dies ist hauptsächlich durch die überschiessende Ausleuchtung des hyperbolischen Subreflektors bedingt. Auf der anderen Seite zeigt die Cassegrain-Konfiguration bei höheren Elevationwinkeln sehr niedrige Raustemperaturen, was für EME-Betrieb sehr passend ist.

7. Überlegungen für die praktische Konstruktion der Feeds

Die Konstruktion und Realisierung eines Feeds für riesige Antennen führt zu einigen besonderen Herausforderungen. Man muss bedenken, dass der Befestigungsort für die Primären Feeds für das 70cm- und 2m-Band bei einem Elevationswinkel der Antenne von 90 Grad etwa 40 Meter über Grund liegt. Das bedeutet, dass, um Sicherheit bei dieser Höhe zu gewährleisten, jegliche Montage- und Änderungsarbeiten am Antennensystem nur mit Hilfe eines Spezialkrans (zu hohen Kosten) und nur durch speziell qualifiziertes Personal unter strengen Auflagen durchgeführt werden können. Jegliche zusätzlichen Einstellungen oder Justierungen direkt an der Antenne während des Betriebs sind nicht zulässig, da dies das finanzielle Budget des Projekts beeinträchtigen würde. Das 23cm-Feed wurde am Boden zusammengebaut und getestet und dann in das KDDI-System eingebaut. Die Feeds für das 2m- und 70cm-Band bestanden aus Loopantennen aus Kupferrohr, das auf einer Isolierplatte befestigt war. Siehe Abb. 12, 13 und 14. Diese Anordnung wurde in seiner berechneten Position in Bezug zum hyperbolischen Subreflektor durch autorisiertes Personal mittels eines verspannten Seilmechanismus zum Hoch- und Herunterziehen im „Marionetten-Stil" angebracht. Der Abstand zwischen Loopantennen-Feed und hyperbolischem Subreflektor wurde mittels Klötzen aus geschäumtem Kunststoff, die an der Isolationsplatte befestigt waren, eingestellt. Eine VSWR-Optimierung wurde später als nicht nötig erachtet.

8. Ergebnisse der Praxis

Da zu der Zeit keine speziellen Messmittel verfügbar waren, wurde nur das Sonnenrauschen mehrfach auf jedem Band gemessen, um das Steuerungssystem und die Empfangskette des Systems funktional zu verifizieren. Die Messgenauigkeit war nicht ausreichend, um eine genaue Antennencharakteristik zu liefern. Immerhin indizieren die gemessenen Ergebnisse eine gute Übereinstimmung zwischen berechnetem und tatsächlichem Antennengewinn. Man fand den gemessenen Gewinn etwas höher als den berechneten Wert. Der anhaftende Rechenfehler durch die Unzulänglichkeit der Simulation beinhaltet alle Faktoren, die die Leistungsfähigkeit der Antenne beeinflussen, wie tatsächliche Form von Reflektor und Subreflektor und besonders die tatsächliche Defokussierung des Feeds.
Am 4. März 2007 um 00.00 UTC wurden für die Differenz des Rauschens von Sonne zu kaltem Himmel für 2m 8.5 dB und für 70cm 15.0 dB gemessen. Eine Messung auf 23cm war jedoch aufgrund des begrenzten Dynamikbereichs des Empfängers nicht erfolgreich. Eine alternative Methode die Leistung einer Antenne zu verifizieren, ist die statistische Auswertung der erfolgreichen Kontakte, d.h. der Anzahl gelaufener Verbindungen mit anderen Stationen, unter Berücksichtigung der Energiebilanz der Erde-Mond-Erde-Strecke. Die 8N1EME-Station hat mit 154 Stationen auf dem 2m-, 67 Stationen auf dem 70cm- und 71 Stationen auf dem 23cm-Band gearbeitet. Auch hier bestätigt die Analyse die berechnete Antennenleistung.

9. Zusammenfassung und Schluß

Die Möglichkeiten und Herausforderungen des Projekts Big Dish machten es für jedes Mitglied der Arbeitsgruppe zu einem „Traumprojekt". Wir bekamen die Möglichkeit, ein Antennensystem basierend auf der KDDI-Cassegrain-Antenne zu entwickeln, bauen, testen und benutzen, bauten sie aus zu einer Multiband-Antenne mit einem einzigartigen Dreifach-Reflektor für das 23cm-Band! Siehe Abb. 15. Das Projekt Big Dish war nicht nur ein bedeutendes Ereignis für den Amateurfunk, sondern lieferte viele Gelegenheiten zum Dazulernen bei der Antennenentwicklung, dem Amateurfunk und der Wellenausbreitung. Weitere Details über das Projekt Big Dish findet man unter [11].

10. Danksagung

Die Autoren bedanken sich bei Herrn Robert Valenta, für seine wertvollen Anmerkungen und die Hilfe beim Erstellen dieses Artikels.

11. Referenzen

Siehe engl. Text oben.

Design of 2m and 70cm Receiver front-ends with high sensitivity and high dynamic range using GSM devices

by Henning-Christoph Weddig, DK5LV

Introduction

The fast growing GSM technology has made amplifiers available with low noise and high dynamic range, and mixers with high intercept point. Receiver front-ends built with these devices should outperform existing designs. Some design considerations have been presented at UKW Tagung Weinheim [1, 2]. In this article, two well-known front-end designs have been analysed using system simulation, some usable devices are introduced, and the performance of a modern front-end with LNA, filter, mixer and first crystal filter has been calculated.

System simulation of two high performance front-ends

The complete receiver chain or a part of it is divided into stages. The data for NF, 1dB compression-point and IP of these stages can be taken from datasheets or from measurements. The system performance is then calculated by combining these data.

System noise figure is calculated using

$$F_{ges} = F_1 + \frac{F_2 - 1}{G_1} + \frac{F_3 - 1}{G_1 \bullet G_2} + \frac{F_4 - 1}{G_1 \bullet G_2 \bullet G_3} + \ldots\ldots$$

Noise figure and gain in dB have to be transformed to numbers (10 exp(x/10)). Calculating the IP of cascaded stages is based on the assumption that the IP products of the individual stages will add in phase. In real life, products may also tend to cancel so we are calculating a worst-case scenario. Formulas for IP calculation of two stages can be found in references [8 –15]. Reference [8] also shows a graphical solution, for the case where the output IP of each stage is known. The result then can be combined with a third stage etc. This is hard work.

Some software makes the job much easier. AppCad, available for DOS and Windows [4], has a noise-calc function. The author is using Syscalc, ver 4. A full version 5, limited to 30 days use, or a 'light' version without time limit can be found on [3].
Such software allows a performance simulation and optimisation of the entire system while changing parameters of the stages.

DJ7VY_Frontend

	Vorkreis	LNA "Norton" Verstärker	Bandpass	Mixer MCL SRA 1H	Diplexer	Anpass Verstärker	Nachsetzer	Total
NF (dB)	0.45	1.30	2.30	6.00	1.20	3.60	10.00	2.42
Gain (dB)	-0.45	21.00	-2.30	-5.50	-1.20	8.40	0.00	19.95
OIP3 (dBm)	100.00	33.00	100.00	20.50	100.00	34.40	30.00	24.39
OP1dB (dBm)	100.00	23.00	100.00	10.00	100.00	14.00	20.00	14.00
NF+ (dB)		1.09		0.11		0.23	0.23	
IP3+ (dBm)	0.00	0.75	0.00	2.73	0.00	0.46	1.40	
Po (dBm)	-117.45	-96.45	-98.75	-104.25	-105.45	-97.05	-97.05	

Input Pwr (dBm)	-117.00	System Temp (K)	290.00		
Modulation: Custom					
System BW (MHz)	0.00	MDS (dBm)	-136.79	Input IP3 (dBm)	4.44
S/N (dB, Actual)	19.79	S/N (dB, Req'd)	20.00	Output IP3 (dBm)	24.39
Srce Temp (K)	290.00	Sens. Loss (dB)	0.00	OIM3 (dBm)	-339.94
Te Eff. (K)	216.13	Sensitivity (dBm)	-116.79	ORR3 (dB)	242.89
SFDR3 (dB)	94.15	G/T (dB/K)	-17.04	IRR3 (dB)	80.96

Fig. 1: System simulation of a front-end by DJ7VY

Front-end by Michael Martin, DJ7VY

In [5] Michael Martin (DJ7VY) presented a 2 m front-end with noise figure = 2.42 dB (NF of following RX = 10 dB) or 2.27dB (NF of following RX = 6 dB), gain = 20 dB, and IP3 = 7.75 dB (if an SRA-1H mixer is used). This front-end was designed as a converter for a 10m rx with an IP of +30 dBm. It had a filter (G = -0.45 dB), two cascaded Norton-amps (G = 9.5 and 12 dB), a BPF (G = -2.7 dB), a diode ring mixer with IF-diplexer followed by a FET IF amp in common gate circuit. The original reference [5] shows a diagram of NF and gain of the individual stages; for this analysis, the IPs had to be extracted from the text and for the preamp from [6].

This author has also found good IMD performance with the Norton amplifiers, but the reverse gain is high because of the negative feedback with the transformer, and some oscillation at about 800 MHz had to be cured. A ferrite bead of "wrong material" on the collector lead deteriorated the IMD-performance. Fig. 1 shows the simulation results for the DJ7VY front-end using Syscalc. All IPs are output IPs. Output and Input IPs (OPIP and IPIP) differ only by the stage gain: OPIP = IPIP + Gain (in dB). In a mixer that has negative gain, the OPIP is lower than the IPIP. Below, the blocks NF, gain, OPIP and 1dB compression point are found in the first four rows. The following rows show how much effect the individual stage has on the NF and IP of the entire chain. The third row shows the output power of the stage with –117dBm at the input. The lower part of the results table shows sensitivity at 20 dB S/N (-117.85 dBm), noise floor (also called MDS = minimum discernible signal = -137.85 dBm) and SFDR3 (spurious free dynamic range, third order = 92.09 dB), all at 3kHz Bandwith (SSB) and T amb = 290K.

The contribution of the individual stages to the output IP is not shown. In [5] it is mentioned that the mixer is the weakest part of this concept, and the crystal-filter has an IP of about 25 to 30 dBm.

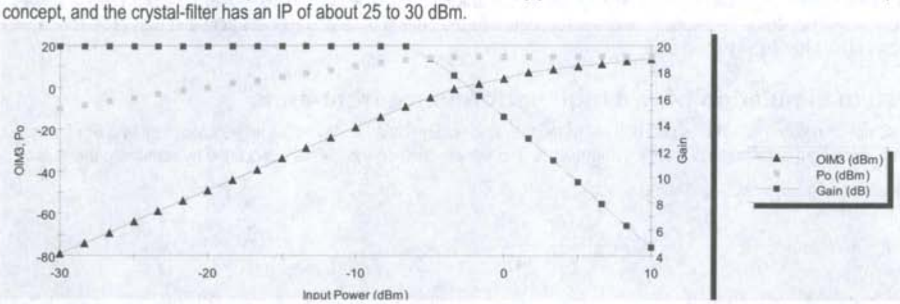


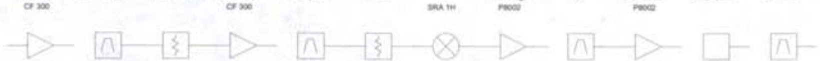
Fig. 2: Output power and power of third order IMD vs. input power of the front-end shown in Fig. 1

Fig. 2 shows output power and third order IMD for –30 dBm to +10 dBm at the input. The vertical line at –5 dBm input power shows the 1dB compression point, relative to an uncompressed gain of 19.95 dB. This corresponds to 13.95 dBm output power (-5 dBm + 19.95 dB – 1 dB = 13.95 dBm).

2m / 70 cm Transceiver by Claus Neie, DL7QY

The second analysis was done for the DL7QY Transceiver, described in [7]. The data of the individual stages were taken from DUBUS 3/85, page 208. The IP of the first attenuator and the BPFs was assumed to +100 dBm, and the 1 dB compression point was assumed to be 10 dB below the OPIP. In [7] is not clearly shown if the named IPs are IPIP, and IPIP3 of the first crystal filter (2 pole) is unknown. An assumed IPIP3 of +14 dBm for the CF300 amplifier stages (supplied with 9V/20 mA DC) seems to be a bit high,as the OPIP3 would then be +15 dBm + 22 dB = +37 dBm. A table with IMD products for 70cm is also shown in [7]. From this a IPIP3 of +14dBm can be calculated.

SSCW 702



	1. Preamp CF 300	1. Bandpass	1. Attenuator	2. Preamp CF 300	2. Bandpass	2. Att	Mixer SRA 1H	1. IF Stage P8002	1 QF	2. ZF Stufe P8002	Linear Gain	X-tal Filter	Total
NF (dB)	0.60	3.00	10.00	1.10	3.00	8.00	5.00	2.20	1.00	2.20	1.00	3.00	1.37
Gain (dB)	22.00	-3.00	-10.00	22.00	-3.00	-8.00	-5.50	7.00	-1.00	3.50	-1.00	-3.00	20.00
OIP3 (dBm)	37.00	100.00	100.00	42.00	100.00	37.00	20.00	34.00	35.00	31.50	30.00	33.00	20.31
OP1dB (dBm)	17.00	100.00	100.00	32.00	100.00	27.00	10.00	24.00	25.00	21.00	20.00	23.00	14.83
IP3+ (dBm)	0.15	0.00	0.00	0.39	0.00	0.09	1.56	0.27	0.17	0.92	1.05	0.24	
NF+ (dB)	0.50			0.12			0.07	0.07		0.02	0.00		
Po (dBm)	-95.00	-98.00	-108.00	-86.00	-89.00	-97.00	-102.50	-95.50	-96.50	-93.00	-94.00	-97.00	

Input Pwr (dBm)	-117.00	System Temp (K)	290.00		
Modulation: Custom					
System BW (MHz)	0.00	MDS (dBm)	-137.83	Input IP3 (dBm)	0.31
S/N (dB, Actual)	20.83	S/N (dB, Req'd)	20.00	Output IP3 (dBm)	20.31
Srce Temp (K)	290.00	Sens. Loss (dB)	0.00	OIM3 (dBm)	-331.61
Te Eff. (K)	107.88	Sensitivity (dBm)	-117.83	ORR3 (dB)	234.61
SFDR3 (dB)	92.09	G/T (dB/K)	-16.00	IRR3 (dB)	78.20

Fig. 3: System simulation of a front-end by DL7QY

It is not clear, why DL7QY implemented two 22 dB amplifier stages with fixed and variable attenuators in between (maybe the impedance match is better?) and also the calculation of the IP of the complete system is hard to understand. The simulated NF (1.35 dB) and gain do correspond with the published values, but the calculated IPIP3 (+0.31 dBm) differs from the published value (+5 dBm). DL7QY mentions a better IP by using SAY-1 or VAY-1 mixers, but it is not clear if the following stages (buffer amplifier and crystal filter) can deal with the higher input power.

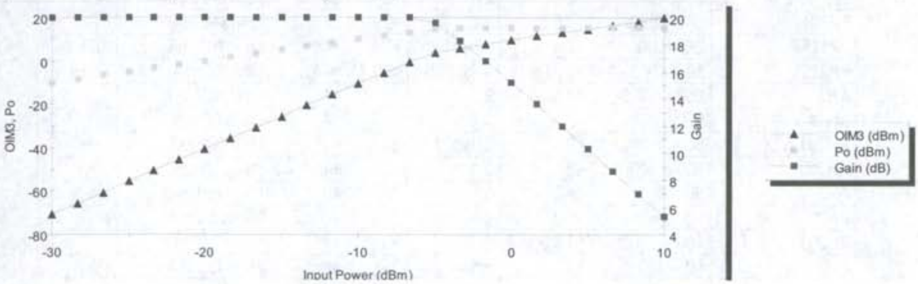


Fig. 4: Output power and power of third order IMD vs. input power of the front-end shown in fig. 3

Fig. 4 shows the output power and IMD3 with –30 dBm to +10 dBm at the input. DL7QY's front-end behaves quite similarly to the DJ7VY's; although DL7QY's 1 dB compression point is a bit higher, IMD3 levels at –30 dBm input power are less good, –70 dBm compared with -80 dBm for DJ7VY.

Conclusions of the simulations

- Both of these older front-ends use preamps with low NF and high dynamic range. The gain is high to get a good system NF. At 20 dB gain, the NF of the following stages contributes only 1/100 to the system NF.
- The influence of the mixer to the system IP is only partially mentioned.
- The contribution of the IP of the crystal filter is not shown clearly.

Some new LNA ICs, mixers, crystal filters

We now move on to the analysis of more modern front-ends using new ICs for the low noise amplifier (LNA), and new mixers and crystal filters.

LNA

Table 1 shows some amplifier ICs with low noise and high IP, that could be useful in RX front-ends. There are even more suitable devices available for sure. The best IP3 and low NF can be found in the pHEMT-amps from Filtron solid state and the FET-amps from Watkins Johnson and Exelics.

Filtron offer the LP750, LP1500 and LP3000. The LP750 is available in SOT343 or SOT89 package. The SOT 343 device has a lower IP and low NF, while the SOT89 device has better IP and higher NF. Both are designed for about 1.85 GHz; they are only conditionally stable on 2m and 70cm and have to be tamed with some negative feedback.

Watkins Johnson has also upgraded its FETs and amplifier ICs in the last year. The FH1 is a FET with unknown technology. It can be operated at Idss with zero gate bias, or at ID < Idss with negative gate bias [22]. When operated at Id < Idss the NF decreases, but also the IP. The FH1 is only conditionally stable on 2m and 70cm, so some external circuitry is needed for stability. Scaling the original matching networks from 240 MHz to 144 MHz and 432 MHz confirmed the published values. The Watkins Johnson devices AH1 to AH3 need only a positive supply voltage and they unconditionally stable. Negative feedback seems to be implemented internally, but therefore the NF is higher. The integrated coupling capacitor sets the lowest usable frequency. The AH-devices are made in the SOT98 package, and good cooling has to be applied. The AH1 is usable from 70cm up to 13cm, AH2 and AH3 are usable on 6m and 2m. AH2 is designed for 75 Ω systems, and transformers have to be used in 50 Ω systems.

The two devices by Sirenza Microdevices are also SOT89 packaged. Ttheir IP is lower than the Watkins Johnsons devices, but since there are no internal coupling capacitors they are usable from low frequencies.

The new GAL-types by Mini Circuits have NFs from 3.5 to 4.5 dB and OPIPs of +35 dBm.

Low NF and high IP are offered by the RF2360 from Microdevices. It is designed for CATV purposes and is suitable for 50 Ω and 75 Ω systems. External coupling capacitors set the lowest frequency, so the device is usable from shortwave up to 23 cm. The package is SO16. There are no S-parameter sets for simulations available yet. Some tests showed that narrowband matching networks are necessary.

Manu-facturer	Type	Frequency range MHz	Gain dB	NF dB	P_{1dB} dBm	$OPIP_3$ dBm	Power supply	Notes
Watkin Johnson	FH1	---	18 typ.	1.2	+21	42	5 V/150 mA	(1)
	FH101	???	18 typ.	2.0	+18	+36	5 V/140 mA	FET
	FHF1	3 – 6 GHz	12	2.4	+21	39	5V/140 mA	FET
	FP101	50 – 3000	13.5	2.0	+26	37	5V/340 mA	FET
	FP1189	DC-4000	17@1900	3.8@1960	+28	+40	8 V/100 mA	FET
	FP2189	50 – 4000	15.2@915	4.2@915	+30.2	+44.3	8V/250 mA	FET
	AH1	250 – 3000	13.5	2.7	21	41	5 V /150 mA	
	AH11	250 – 3000	12	3.7	+27	44	5V/600 mA	(2)
	AH101	50 – 1500	13	5. typ. 3.5	+27	+45	9 V/200 mA	
	AH102	350 – 3000	13	3.1	+27	+45	9V/200 mA	
	AH2	50 – 860	14.5	3.5	20	40	5 V/150 mA	(3)
	AH22	50 – 860	11.3	4.5	23	?	5 V/300 mA	(4)
	AH201	400 – 2200	17@900	4	+30	+47	11V/330 mA	
	AH3	50 – 450	13.5	3.5 –4.5	20	40	5 V/150 mA	(5)
	AH4	250 – 6000	13.5	2.7	+21	+41	5 V/150 mA	(6)
	AL1	300 – 2500	21	1.4	23	+20	5V/45 mA	
	AM1	60 – 3000	14	2.4	+18	+37	4.5 V/75 mA	
	AP3	100-6000	15	2	+25	+39	8V/100 mA	FET (6)
	AP4	100-6000	16	1.5	+27	+40	8V/200 mA	FET (6)
	AG101	60 – 3000	14	2.4	+15	+32	4.5 V/50 mA	
	AG302	DC – 5000	15@900	3.6	+13	+27	5V/35 mA	
	AG303	DC-5000	20.5@900	3.6	+13	+27	5V/35 mA	(7)
	AG402	DC-5000	15@900	4.3	+17	+32	6V/60 mA	
	AG403	DC-2000	20.5	3.7	+17	+31	6V/60 mA	
	AG602	DC-2800	14@900	14	+18.5	+33.5	6V/75 mA	
	AG603	DC-2700	17.6@900	4.5	+18.5	33.5	6V/75 mA	
RF Micro devices	RF2360	5-1500	20	1.2	24	37.2	7 V/120 mA	(8)
	RF2361	150-2500	20	1.3 typ.	14.4	36.5	3 V/ 8 mA	(9)
Mini Circuits	GAL-6	DC-4 GHz	12.2	4.5	18.2	35.5	5.2 V/10 mA	(10)
	GAL-4		14.1	4	17.5	34	4.6 V/65 mA	
	GAL-51		17.5	3.5	18	35	4.5 V/65 mA	
	GAL-5		19.4	3.5	18	35	4.4 V/65 mA	
Filtronic Solid State	FP750 SOT 343	1.8 GHz	18	0.7	21	38	3.3 V/110 mA	11
	FP750 SOT89	1.8 GHz	18	0.7	26	40	5 V/110 mA	
	LP1500 SOT89	1.8 GHz	18	1	27.5	44	5 V/250 mA	
	LP3000 SOT89	1.8 GHz	16	1.3	29	46	5 V/ 500 mA	
Exelics	EPA240D-SOT89	DC-6GHz	15	0.8 typ	33 typ	40	8 V/350 mA	12
	EPA480C-SOT89	DC-6GHz	14	1.2	36 typ	43	8 V/750mA	
	EPA018A-SOT23	DC-6GHz	18	0.9	20	27	6 V/30 mA	
	EFA120-SOT89	DC-4 GHz	15	1.2	28	42	7 V/180 mA	
	EFA120D-SOT89	DC-4GHz	15	1.2	28	42	7 V/180 mA	
	EFC240D-SOT89	DC-4GHz	14	?	30.5	47	9V/270 mA	
	EFA240-SOT89	DC-4 GHz	14	1.2	31	48	7 V/350 mA	
	EFA480C-SOT89	DC-4 GHz	13	2	34	48	7V / 750 mA	
Sirenza Micro-devices	SGA-6586	DC-2500	25.6	2.6	21.5	33.8	5 V/80 mA	(13)
	SGA-7489	DC-3000	23	2.9	22.6	37.2	5 V/130 mA	(14)

Table 1

Notes to Table 1

1. FET, needs negative gate bias, no internal negative feedback, conditionally stable at low frequencies (2 m, 70 cm); can be used with U_{GS} = 0 V at Idss.
2. Dual amplifier in improved SOIC-8 case, used in balanced or push-pull circuits.
3. For CATV circuits, system impedance 75 Ω
4. For CATV-circuits, system impedance 75 Ω, dual amplifier in improved SOIC-8 case

5. NF = 4.5 dB @ 40 MHz, 3.5 dB @450 MHz, for 50 Ω systems
6. Land Grid Array package (similar to BGA)
7. InGaP HBT 'gain block', internally matched to 50 Ω
8. Values are for f = 500 MHz, no S-parameters available yet.
9. Different values, depending on frequency and circuitry (LNA; driver amplifier)
10. Gain at f = 1 GHz
11. AlGaAs/InGaAs pseudomorphic high electron mobility transistor (pHEMT) usable in receivers for WLL/RLL (wireless local loop) WLAN and GPS frequency ranges
12. Values at f = 2 GHz; NF at ID = 150 mA is lower (0.4 dB)
13. Values at 850 MHz; OPIP3 for two output signals +3 dBm each; SiGe technology
14. Values at 500 MHz, measured in a test circuit at 2 GHz.

Mixers

Table 2 shows some different mixers. Most of the 'new ones' were designed for 800 – 1000 MHz and 1800 – 2000 MHz and data are only available for these frequencies. Therefore only mixers capable of working in the amateur bands are shown. Data of some well known high level mixers by Mini Circuits were included for comparison, and to be able to simulate the older front-end designs [5, 7]. The HMJ-5 by Watkins Johnson has the best IPIP3 of +35dBm, followed by SYM-25 DHW from Mini Circuits. Assuming a conversion loss of 6 dB, the respective OPIP3 values are +29 dBm and +24 dBm. The IPIP3 of the following stages should be at least equal to these values, or better; otherwise the system performance would be degraded. On 23 cm the HMJ-7 is a good choice. The SYM-25 DHW could be used in converters for 23 cm or 13 cm.

Manu-facturer	Type	Frequency range MHz	Conver-sion loss dB	NF dB	P_{1dB} dBm	$IPIP_3$ dBm	LO-level dBm	Notes
Watkin Johnson	HMJ-5	40 - 1000	7.5	9.5	+23	35 typ.	+17	1
	HMJ-7	1000 - 2000	8.5 typ	10.5 typ.	+23	24 min. 34 typ.	+21	2
	SME1400B-17	1-2200	6.5	6.5	+13	+27	+17	
	SMJ 1500-17B	10 - 1500	6	?	?	+20	+17	
Mini Cir-cuits	ADE-1H	0.5-500	5.3	?	+10	23	+17	3
	ADE-1HW	5-750	6	?	+10	26	+17	
	ADE-10H	400-1000	7	?	+10	30	+17	
	TUF-18DHSM	100-1800	7.3	?	+10	27	+17	
	SYM-14H	100-1300	6.5	?	+14	30	+17	
	SYM-18H	5-1800	5.75	?	+14	30	+17	
	SYM-25DHW	80-2500	6.4	?	+14	30	+17	
	HJK-3H	140-180	8			40	+17	4
	SRA-1H	0.5 - 500	6.01		+10	KA	+17	5
	RAY-1	5 - 500	6.57		+15	kA	+23	
	SAY-1	0.1-500	4.85		+20	kA	+23	
	VAY-1	0.5 - 500	5.79		+24	kA	+27	
Hittite	HMC296HS9	1.1 – 1.7 GHz	7	7. max. 10	Min 10. typ 14	Min 20. typ 24	+3 - +11	6
Analog Devices	AD8343	Max. 2500	+7.1	14.1	2.8	16.5	5V. 50 mA	7

Table 2

Notes to Table 2

1. FET mixer; LO power 17 dBm; LO 30 – 900 MHz; IF 5 – 250 MHz. Bias +3 V / 35 mA.
2. FET mixer; LO power 21 dBm; RF/LO = 1000 – 2000 MHz; IF 10 – 1000 MHz. Bias +5 V / 40 mA.
3. Values are valid for middle frequency range ($2{*}f_L$ to $f_U/2$)
4. HJK-3H or HUD-eH are specified for RF range 140 – 180 MHz, with fixed LO-frequency = 160 MHz and IF frequency range 0.5 – 20 MHz. Manufacturer claims IPIP3 = 40 dBm at 140 MHz
5. The datasheet by Mini Circuits claims the IPIP3 to be 10 – 15 dB above the 1 dB compression point, but this is not specified in the datasheets
6. Double balanced FET mixer with GaAs FET's in a SOIC8 case. Data in table hold for +11 dBm LO-power, IF frequency range 0 – 700 MHz; IC needs negative gate-bias 1-5 V
7. Active mixer; LO-power –10 dBm; conversion gain 7.1 dB; matching circuitry necessary at input and output

Crystal filters

Crystal filters are seldom used in commercial equipment, so there are not too many devices available from only a few manufacturers. SAW-filters are too wide. The author found only a few manufacturers, offering two-pole and four-pole devices on 21.4, 45 or 70 MHz. The 45 MHz filters are available in 'fundamental mode' and 'overtone mode', the latter having higher impedances (some kΩ). There are few data available concerning IMD. Friedrich Krug, DJ3RV did some measurements on 9 MHz filters by KVG [16]. A two-pole monolithic filter XF 910 had IPIP3 of +42 dBm for two signals outside the passband. XFM-9S 05 and XFM-9S 01 reached +40dBm. Filters using discrete crystals like the XF-9B only reach +34 to +36 dBm. This may be due to the ferrite transformers inside. It is not known, if the monolithic filters use ferrite transformers. For reception on 70 cm, an IF of 9 MHz is too low, so 21.4 MHz or higher is the right choice. Only partial data of the 21.4 MHz filters are available. DL7QY claimed +36 dBm IPIP3 for the Telequarz TQF 21-06 filters, used in his transceiver [7]. This is similar to the XF 9B.

An old sheet from Toyocom [18] mentioned that, for monolithic filters (TQF-600 series, 70 ... 100 MHz), two signals of -15 dBm each outside of the passband produce IMD in the passband of <-95 dBm. Third order intermodulation then is 80 dB down, and IPIP3 would be +25 dBm. Similar values are valid for monolithic filters, claimed one manufacturer. The best values would be about +30 dBm, but the passband performance will be degraded. In the early eighties an interesting design from Telefunken showed up in several magazines. A broadband match for the mixer was obtained without using a FET-amp as buffer [21]. A hybrid-powersplitter is used, followed by two allpass filters, two crystal filters and a second power splitter. This was used as a combiner. The data of the crystal filters are unknown. Ulrich Graf, DK4SX mentioned the use of special crystals with large surfaces.

Conclusions about modern front-end devices

- Highly linear LNAs with low noise are easy to build using the available modern ICs.
- Mixers with high IPIP3 and medium LO-power are available. The OPIP3 of the LNA is normally higher than the IPIP3 of the mixer, making the mixer the weak stage of the front-end.
- Monolithic crystal filters at f >9 MHz, e.g. 21.4 MHz (possibly), 45 MHz and above can achieve IPs of +25 ... +30 dBm. Therefore their influence on the system performance is not negligible. Because all ports of the mixer need a broadband match, and this is usually done by a diplexer at the IF port, followed by a common-gate J-FET [5, 7] or a common-base bipolar transistor [17], the filter has to accept a lot of power, further degrading the system performance.

Simulation of a "new" front-end

The amplifier FH1 or RFMD 2360 amplifier devices and the mixer HMJ-5 are included as stages of a "new" front-end to be simulated. Because the OPIP of the LNA is higher than the IPIP of the mixer, the gain of the LNA should not be set too high. The mixer and crystal filter do not see too much power then. The author did some preliminary measurements on FH1 and HMJ-5 stages by Watkins Johnson, confirming the datasheet values. The mixer was matched using diplexers on all ports (T-filters [20], calculated with [21]). To avoid a J-FET buffer amp, the IF port was matched using a diplexer. The match in the stopband of the crystal filter is done by a circuit using a 90° hybrid (Mini circuits SCPQ-60). Both outputs are feeding two identical monolithic two-pole crystal-filters (45 MHz), extracted from one four-pole-filter via a matching network. Their outputs are combined by a second 90° hybrid. The isolation ports of the hybrids are connected to 50 Ω loads. The mixer has a broadband match, and each crystal filter has to accept only half of the signal power. Compared with a single two-pole crystal filter, third order IMD should be down by 9 dB in this arrangement, so the total IP3 should be increased by 9/2 dB = 4.5 dB. The stopband attenuation is similar to the single filter.

LNA-Mix

	Eingangs-Filter	LNA WJ FH1	Bandfilter	Mixer WJ HMJ 5	Diplexer	"roofing" X-tal filter	Total
NF (dB)	0.50	1.20	2.00	7.00	0.50	3.00	2.47
Gain (dB)	-0.50	17.70	-2.00	-6.20	-0.50	-3.00	5.50
OIP3 (dBm)	100.00	42.90	100.00	29.00	100.00	25.00	21.71
OP1dB (dBm)	100.00	21.00	100.00	19.00	100.00	20.00	9.30
IP3+ (dBm)	0.00	0.52	0.00	2.35	0.00	2.75	
NF+ (dB)		0.98		0.31	0.04		
Po (dBm)	-117.50	-99.80	-101.80	-108.00	-108.50	-111.50	

Input Pwr (dBm)	-117.00	System Temp (K)	290.00		
Modulation: Custom					
System BW (MHz)	0.00	MDS (dBm)	-136.73	Input IP3 (dBm)	16.21
S/N (dB, Actual)	19.73	S/N (dB, Req'd)	20.00	Output IP3 (dBm)	21.71
Srce Temp (K)	290.00	Sens. Loss (dB)	0.00	OIM3 (dBm)	-377.93
Te Eff. (K)	222.53	Sensitivity (dBm)	-116.73	ORR3 (dB)	266.43
SFDR3 (dB)	101.96	G/T (dB/K)	-17.10	IRR3 (dB)	88.81

Fig. 5: System simulation of a front-end using active devices by Watkins Johnson

Fig. 5 shows the simulation of the front-end using an input filter (assumed 0.5 dB insertion loss) to attenuate out-of-band signals, and the LNA uses a FH1. A BPF is inserted for image rejection (assumed 2 dB insertion-loss) followed by the mixer HMJ-5. The compression point of the passive stages was assumed to be +100 dBm, and the 1 dB compression points of the mixer and the crystal filters were assumed to be 10 dB below their OPIP3. With an overall gain of 5.5 dB, the system NF is 2.47 dB. The OPIP3 is +21.71 dBm, the IPIP3 is 16.21 dBm, the OP1dB is +9.3 dBm.

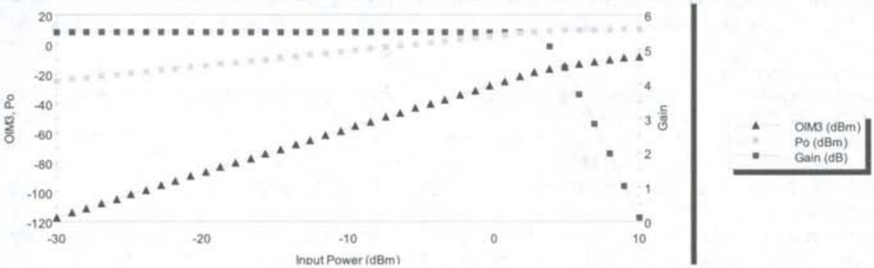


Fig. 6: Output power and power of third order IMD vs. input power of a front-end shown in fig. 5

Fig. 6 shows output power and third order IMD versus input power from –30 dBm to +10 dBm. The vertical line at +4 dBm shows the 1 dB compression point of the front-end. The output power is then (+4 dBm + 5.5 dB – 1 dB) = 8.5 dBm. The advantage of the new design compared to [5] and [7] is the 10 dB higher 1 dB compression point (raised from –5 to +5 dBm). The noise figure is 1 dB higher, but acceptable for "normal" VHF and UHF work.

LNA-Mix

	Eingangs-HP	LNA RFMD 2360	Bandfilter	Mixer WJ HMJ 5	Diplexer	"roofing" x-tal Filter	Total
NF (dB)	0.50	1.20	2.00	7.00	0.50	2.00	2.08
Gain (dB)	-0.50	20.00	-2.00	-6.20	-0.50	-2.00	8.80
OIP3 (dBm)	100.00	37.20	100.00	29.00	100.00	25.00	21.17
OP1dB (dBm)	100.00	24.00	100.00	19.00	100.00	20.00	13.30

Input Pwr (dBm)	-117.00	System Temp (K)	290.00		
Modulation: Custom					
System BW (MHz)	0.00	MDS (dBm)	-137.13	Input IP3 (dBm)	12.37
S/N (dB, Actual)	20.13	S/N (dB, Req'd)	20.00	Output IP3 (dBm)	21.17
Srce Temp (K)	290.00	Sens. Loss (dB)	0.00	OIM3 (dBm)	-366.94
Te Eff. (K)	178.27	Sensitivity (dBm)	-117.13	ORR3 (dB)	258.74
SFDR3 (dB)	99.66	G/T (dB/K)	-16.70	IRR3 (dB)	86.25

Fig. 7: System calculation of a front-end with RF 2360 as LNA

Fig. 7 shows the results when using a RF2360 instead of an FH1. Overall gain is higher and therefore the noise figure drops by 0.39 dB. It is astonishing that the 1 dB compression point also increases by 1 dB. However, neither of these designs should be driven to the 1 dB compression point, because the crystal filters will not accept more than 1 mW = 0 dBm for longer time without damage.

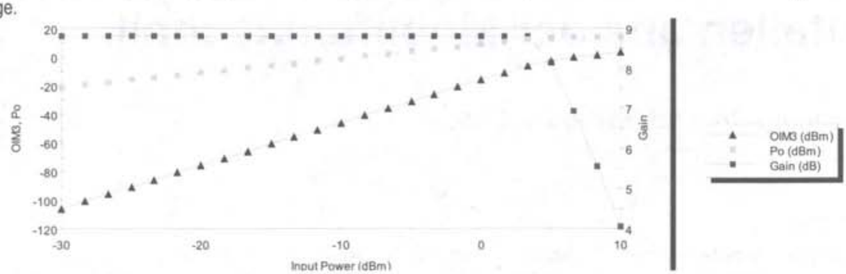


Fig. 8: Output power and power of third order IMD vs. input power of the front-end shown in fig. 7

Conclusion

The author has designed a combined front-end for 2m and 70cm. The performance of some stages (LNA) was not as planned. A better solution is coming soon.

Literature

[1] Überlegungen zum Design großsignalfester Empfänger-Frontends für das 6m, 2m, 70 cm und 23 cm Band mit modernen Bauteilen, Dipl. Ing. Henning Christof Weddig, Tagungsband der 46. UKW Tagung Weinheim 2001
[2] Überlegungen zum Design großsignalfester Empfänger-Frontends für das 2m und 70 cm Band mit modernen Bauteilen Dipl. Ing. Henning Christof Weddig, Tagungsband der 47. UKW Tagung Weinheim 2002
[3] Die Programme Syscalc und Eclipse (Netzwerkanalyse Programm) können nach Angabe der persönlichen Daten unter www. Ardentech.com heruntergeladen werden.
[4] www. Hp.woodshot.com
[5] Modernes Eingangsteil für 2m Empfänger mit großem Dynamikbereich und geringen Intermodulationsverszerrungen Michael Martin DJ 7VY, UKW-Berichte 2/1978
[6] Neuartiger Vorverstärker für 145-MHz und 435-MHz-Empfänger Michael Martin DJ7VY, UKW-Berichte 4/1977
[7] SSCW 702 SSB/CW 2m & 70 cm Duoband Transceiver, Claus Neie DL7QY, DUBUS 2/85, 3/85, 4/85
[8] Anzac RF and Microwave Components, Datenbuch 1984, Amplifier Application Note, Seite 13
[9] Single Sideband Systems & Circuits, William E. Sabin & Edgar O. Schoenike, McGraw-Hill Book Company 1987, Seite 105
[10] Receiving System Design, Stephen J. Erst, Artech House 1984, Seite 99
[11] A BASIC approach to Calculating Intercept points and Noise Figure, William Sabin, QST 10/81, Seite 21 ff
[12] IMD: Still unclear after 20 years, John H. Jacobi, Microwaves & RF November 1986, Seite 119 126
[13] Calculating the cascade intercept point of communication receivers, Brian P. Gross WA7DTB, ham radio August 1980, Seite 50-52
[14] RF IF Designer's Handnbook, Mini Circuits 1992
[15] Derivation für 3rd-oder intercept points for two cascaded stages, pdf-File im Programm Syscal5 lite, Arden Technologies
[16] Vielseitig einsetzbares ZF-Teil für 2m-Empfänger und Nachsetzer, Teil 2, Friedrich Krug DJ3RV, UKW-Berichte 4/1981
[17] Lineares Frontend für den Amateur-Eigenbauempfänger, Teil 1 und 2, Ulrich Graf DK4SX, Funk-Telegramm, ca. 1998
[18] Crystal Units, Crystal Filters, Crystal Oszilltors, Toyocom 1989 / 1990,
[19] Diplexer für Ringmischer, Eugen Berberich DL8ZX, UKW-Berichte 2/1996
[20] Anpaßschaltungen für Dioden-Ringmischer, Joachim Kestler DK1OF, UKW-Berichte 4/1975
[21] Communication Receivers, DSP, Software Radios, and Design, Third Edition, Ulrich Rohde, Jerry Whitaker, Seite 340, 341
[22] FH1, Application Circuit at 240 MHz, Applikationsbericht January 2002, Watkin Johnson

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Überlegungen zum Design eines Empfänger-Frontends mit hoher Empfindlichkeit und großem Dynamikbereich für das 2m und 70cm-Band mit Bauteilen aus der Mobilfunktechnik

von Henning-Christoph Weddig, DK5LV

Einleitung

Bedingt durch die stürmische Entwicklung im Mobilfunkbereich sind rauscharme und hoch aus-steuerbare Verstärker-IC's sowie Mischer mit einem hohen IP auf dem Markt erhältlich. Damit soll-te es möglich sein, Empfänger-Eingangsteile aufzubauen, die bezüglich er Großsignalfestigkeit ver-bunden mit einer niedrigen Rauschzahl bisherige Designs übertreffen. In [1] und [2] stellte der Verfasser bereits einige Überlegungen zum Design eines derartigen Fron-tends auf. In diesem Beitrag werden zunächst zwei seit Jahrzehnten bekannte Hochleistungs-Frontends mittels Systemsimulation analysiert, danach einige für Amaterfunk-Frequenzbereiche geeignete Bauteile aus dem Mobilfunkbereich vorgestellt um schließlich anhand von Systemsimulationen die zu erwartenden Daten eines „modernen" Frontends bestehend aus LNA, Filter, Mischer und erstem Quarzfilter zu ermittelt.

Systemsimulations-Daten zweier Hochleistungsfrontends

Bei der Systemsimulation wird ein Teilsystem oder auch ein gesamter Empfänger in Unterbaugruppen aufgeteilt. Für die Daten der einzelnen Baugruppen: Rauschzahl, 1 dB Kompressionspunkt und der jeweilige Interceptpunkt können Datenblattangaben oder gemessene Daten verwendet werden. Aus diesen Einzeldaten werden die dazugehörigen Daten des Gesamtsystems bestimmt. Die Rauschzahl Fges eines Gesamtsystems wird mittels der Formel

$$F_{ges} = F_1 + \frac{F_2 - 1}{G_1} + \frac{F_3 - 1}{G_1 \bullet G_2} + \frac{F_4 - 1}{G_1 \bullet G_2 \bullet G_3} + \ldots\ldots$$

bestimmt. Die Rauschzahlen F und Verstärkungen G sind zu „delogarithmieren", falls sie in Dezibel vorliegen. Will man den Gesamt-Interceptpunkt von kaskadierten Stufen angeben, geht man davon aus, daß sich die Intermodulationsprodukte der ersten Stufe mit der gleichen Phasenlage zu den Intermodulationsprodukten der zweiten Stufe addieren. In der Praxis muß das aber nicht immer zutreffen, teilweise Auslöschungen sind möglich. Damit würde sich ein besserer Interceptpunkt ergeben. Die Annahme der gleichen Phasenlage führt also zu "worst case" Betrachtungen.

In der Literatur [8], [9], [10], [11], [12], [13], [14] und [15] sind Formeln zur Berechnung des Interceptpunktes zweier kaskadierter Stufen angegeben. In [8] ist zusätzlich ein Diagramm aufgetragen, mit dessen Hilfe man den Gesamt-Interceptpunkt zweier Verstärkerstufen graphisch bestimmen kann, wenn deren Einzel-Ausgangs-Interceptpunkte bekannt sind.

Da meist mehr als zwei Stufen eines Empfangssystems vorliegen, kann man nach Zusammenfassung der ersten beiden Stufen den Interceptpunkt dieser zusammengefaßten Stufen mit einer dritten Stufe usw. sukzessive bestimmen. Der Rechenaufwand „zu Fuß" ist jedoch erheblich.

Die mühsame Auswertung kann von einer Reihe von Programmen übernommen werden. So bietet z.B. die Toolsammlung „AppCad" in der alten DOS- und neuen Windows-Version [4] unter dem Stichwort „Noisecalc" eine Systemsimulation an. Der Verfasser benutzt das Programm Syscalc in der Version 4. Eine auf 30 Tage Laufzeit limitierte neue Vollversion 5 oder eine uneingeschränkt verwendbare jedoch abgespeckte „Lite-Version" kann von [3] heruntergeladen werden. Der Vorteil einer Systemsimulation per Software liegt darin, daß durch Variation verschiedener Parameter der Anwender schnell den Einfluß von Einzelparametern auf das Gesamtsystem untersuchen und optimieren kann, ohne die Schaltung aufbauen und durchmessen zu müssen.

Frontend von Michael Martin DJ7VY

Michael Martin (DJ7VY) beschrieb in [5] ein 2-m-Frontend, das nach eigenen Angaben folgende Daten erreicht: Rauschzahl = 2,42 dB (Rauschzahl {NF} des Nachsetzers = 10 dB), bzw. 2,27 dB (NF des Nachsetzers = 6 dB), Verstärkung = 20 dB, IPIP3 = 7,75 dBm (mit Mischer SRA 1H). Das Frontend war als Konverter für einen 10-m-Kurzwellenempfänger gedacht, dessen Eingangs-IP wurde mit +30 dBm angenommen. Das Frontend besteht aus einem Eingangsfilter (G = -0,45 dB), zwei in Serie geschalteten „Norton.-Verstärkern" (G = 9,5 dB, 12 dB), einem Bandfilter (G = -2,7 dB) einem Schottkydioden-Ringmischer mit Diplexer im ZF-Ausgang und einem Verstärker in Gate-Schaltung. In [5] wird ein Pegelplan angegeben, in dem die Rauschzahlen und Verstärkungen der Einzelbaugruppen angegeben sind, die Werte der Interceptpunkte musste sich der Verfasser jedoch aus dem Text und [6] für die Daten des Vorverstärkers zusammensuchen. Der Verfasser kann aus eigener Erfahrung die guten Intermodulationswerte der "Norton-Verstärker" bestätigen, mußte jedoch unerwünschte Schwingneigungen (im 800 MHz Bereich) bekämpfen. Eine Ferritperle des „falschen Materials" über dem Kollektoranschluss erhöhte die Intermodulationsprodukte stark! Auch wird aufgrund der transformatorischen Gegenkopplung nur eine niedrige Rückwärtsdämpfung erreicht.

Bild 1 zeigt die Ergebnisse der Systemsimulation mittels Syscalc des von DJ7VY aufgebauten Eingangsteils. Syscalc bezieht die Interceptpunkte aller Baugruppen auf den Ausgang. OPIP und IPIP unterscheiden sich lediglich durch die Verstärkung (oder Abschwächung der jeweiligen Baugruppe. In Datenblättern wird der Interceptpunkt eines Verstärkers auf den Ausgang, der IP eines Mischers jedoch auf den Eingang bezogen (Magie der großen Zahlen!). Wegen des Mischverlusts passiver Mischer verringert sich der OPIP um die Mischdämpfung. Unterhalb der Blöcke sind in den oberen vier Zeilen die Rauschzahlen, Verstärkungen, Ausgangsinterceptpunkte und 1-dB-Kompressionspunkte der jeweiligen Stufe angegeben. Die beiden darunter liegenden Zeilen geben Auskunft über den Beitrag der jeweiligen Stufe bezüglich Interceptpunkt und Rauschzahl zu den Gesamtwerten. In der dritten Zeile wird der Ausgangspegel der jeweiligen Stufe bei einem angenommenen Eingangssignal von –117 dBm angegeben. In der unteren Liste sind für dieses Frontend bei einer Bandbreite von 3 kHz (SSB-Betrieb) und 290-K-Temperatur die Ergebnisse der Empfindlichkeit für einen Signal-Rauschabstand von 20 dB (-117,85 dBm), das Grundrauschen („noise floor" oder auch MDS = minimum discernible signal = -137,85 dBm) und der intermodulationsfreie Dynamikbereich (SFDR3 = spurious free dynamic range third order = 92,09 dB) angegeben. Leider fehlt eine detaillierte Betrachtung des Einflusses der einzelnen Bautruppen auf den Gesamt-IP. Dem Text in [5] ist nur zu entnehmen, daß der Mischer eine der „Schwachstellen" des Konzepts ist. Auch das Quarzfilter hat seinen Angaben zufolge nur einen begrenzten Interceptpunkt von 25 bis 30 dBm ([5] Seite 116 letzter Absatz). Bild 2 zeigt einen Graphen, in dem für den Eingangsleistungsbereich –30 dBm bis +10 dBm die Ausgangsleistung und Intermodulationsprodukte dritter Ordnung aufgetragen sind. Der senkrechte Strich am rechten Rand zeigt die Eingangsleistung an, bei dem das Frontend den 1 dB Kompressionspunkt erreicht. Er wird bei einer Eingangsleistung von -6 dBm erreicht. Die dazugehörige Ausgangsleistung ist -5 dBm + 19,95 dB – 1 dB = 13,95 dBm.

2m / 70 cm - Transceiver von DL7QY

Die zweite Systemanalyse mittels Syscalc bezieht sich auf den von DL7QY in [7] vorgestellten Transceiver. Die Angaben der Daten der Einzelbaugruppen sind dem Pegelplan (DUBUS 3/85, Seite 208) entnommen. Die IPs des ersten Abschwächers und der Bandpässe wurde zu +100 dBm, der 1-dB-Kompressionspunkt (P1dB) zu 10 dB unterhalb des Interceptpunktes angenommen. Leider geht aus [7] nicht eindeutig hervor, ob die Interceptpunkte der Baugruppen auf den Eingang bezogen werden. Der Ausgangsinterceptunkt OPIP3 ist die Summe des Eingangsinterceptpunktes IPIP3 und der Verstärkung der Stufe (in dB). Der IPIP3 des ersten Quarzfilters (zweipolig, diskret aufgebaut) fehlt. Auch erscheint der IPIP3 der mit einem GaAs-FET CF 300 aufgebauten Verstärkerstufen mit +14 dBm reichlich hoch, der OPIP3 beträgt dann +15 dBm + 22 dB = +37 dBm bei einer Gleichstromversorgung von 9V/20 mA. An anderer Stelle in [7] ist eine Tabelle mit Intermodulationsabständen für das 70 cm Band angegeben, aus deren Daten man einen IPIP3 von 14 dBm errechnen kann. Dem Verfasser ist nicht klar, warum DL7QY zwei Vorstufen mit jeweils 22 dB Verstärkung einsetzt, um das verstärkte Signal dann jeweils mittels festem bzw. variablen Abschwächer wieder herunterzusetzen. Soll mit dieser Maßnahme die Ausgangs-Anpassung der Verstärker verbessert werden? Auch ist die Berechnung des Gesamt-Interceptpunkts unklar. Die von Syscalc ausgerechnete Gesamt-Rauschzahl (1,35 dB) und Verstärkung stimmen mit dem Pegelplan von DL7QY überein. Beim Interceptpunkt (Syscalc: IPIP3 = +0,31 dBm; DL7QY +5 dBm) ergeben sich jedoch erhebliche Unterschiede. DL7QY bietet den Empfänger mit verschiedenen Mischern an, der Interceptpunkt wird seinen Angaben nach durch den Einsatz eines SAY-1 bzw. VAY-1 weiter verbessert. Ob jedoch die Baugruppen nach dem Mischer (Verstärker, Quarzfilter) die dann erhöhten Forderungen an Intermodulationsabständen erfüllen, ist [7] nicht zu entnehmen. Bild 4 zeigt einen Graphen, in dem für den Eingangsleistungsbereich –30 dBm bis +10 dBm die Ausgangsleistung und Intermodulationsprodukte dritter Ordnung aufgetragen sind. Im Vergleich zu Bild 2 fällt auf, daß sich beide Frontends ähnlich verhalten, der 1-dB-Kompressionspunkt liegt etwas höher, die IM-Produkte betragen bei einer Eingangsleistung von –30 dBm -70 dBm (DJ7VY – 80 dBm).

Schlußfolgerungen der Systemsimulationen

- Bei beiden Frontends wurde besonderer Wert auf rauscharme und hoch aussteuerbare Verstärkerstufen Wert gelegt. Die Verstärkung wurde so hoch gelegt, daß die Rauschzahlbeiträge der folgenden Stufen nur unwesentlich in die Gesamt-Rauschzahl eingehen. Wenn die erste Stufe eine Verstärkung von 20 dB besitzt, geht die Rauschzahl der folgenden Stufe nur mit 1/100 in die Gesamtrauschzahl ein.
- Der Beitrag des Mischers zum Gesamt-IP des Frontends wird zwar erwähnt, jedoch nicht näher beleuchtet.
- Auch der Einfluß des begrenzten IPs des dem Mischer folgenden Quarzfilters wird nur unzureichend untersucht.

Übersicht neuer LNA-ICs, Mischer, Quarzfilter

LNA (low noise amplifier)

In der Tabelle 1 sind einige Verstärker-ICs aufgelistet, die sich durch eine niedrige Rauschzahl und hohen Interceptpunkt auszeichnen. Diese Bausteine eignen sich als Vorverstärker in einem Empfänger-Frontend. Es kann jedoch kein Anspruch auf Vollständigkeit erhoben werden.

Die (zur Zeit) höchsten Interceptpunkte dritter Ordnung bei gleichzeitig niedriger Rauschzahl bieten laut Datenblattangaben die pHEMT-Verstärker der Firma Filtronic Solid State, dicht gefolgt von FETs der Firma Watkins Johnson und Exelics.

Filtronic Solid State bietet drei Typen an: LP750, LP1500 und LP3000. Der LP750 wird in zwei Gehäuseformen angeboten, im kleinen SOT343 Gehäuse und im SOT89 Gehäuse. Der Typ im kleineren Gehäuse weist einen etwas niedrigeren Interceptpunkt auf, der größte Bruder hat die höchste 1 dB Kompressionsleistung bei gleichzeitig höherer Rauschzahl.

Die Bauteile sind für den Frequenzbereich um 1,85 GHz gedacht, sie sind im 2m- und 70-cm-Band nur bedingt stabil und müssen deshalb durch Gegenkoppelungen stabilisiert werden. Gegenüber dem letzten Jahr hat sich die Anzahl der neuen hochlinearen FETs und Verstärker ICs bei Watkins Johnson stark erhöht. Der Typ FH1 ist ein FET dessen Technologie im Datenblatt nicht erwähnt wird. Er benötigt eine negative Gate-Vorspannung, wenn er mit einem bestimmten Drainstrom betrieben werden soll, der kleiner als der maximale Drainstrom IDSS ist. Der FH1 ist im 2m- und 70-cm-Band nur bedingt stabil, es ist deshalb eine externe Beschaltung zur Erzielung einer absoluten Stabilität notwendig. Laut einem Applikationsbericht des Herstellers [22] kann dieser FET jedoch auch bei UGS = 0 V, d.h. bei maximalem Drainstrom betrieben werden. Versuche des Verfassers mit diesem Bauteil bestätigten die guten Werte auch bei Skalierung der Original-Anpaßschaltungen (für 240 MHz) auf die beiden Amateurfunkbereiche 2m und 70 cm. Werden die FH-Typen mit verringertem Drainstrom betrieben, erniedrigt sich die Rauschzahl, jedoch sinkt dann auch der erzielbare Interceptpunkt ab.

Die Typen AH1 bis AH3 kommen mit einer Betriebsspannung aus. Sie sind absolut stabil, wahrscheinlich intern gegengekoppelt, dadurch erhöht sich jedoch die Rauschzahl. Auch der Koppelkondensator am Eingang ist bei diesen Typen integriert, deshalb ist die untere Frequenzgrenze festgelegt. Auch die AH Typen werden im SOT 89 Gehäuse geliefert. Aufgrund der hohen Verlustleistung ist eine ausreichende Kühlung über die Masseflächen der Leiterplatte zu sorgen. Der Typ AH1 ist wegen der unteren Grenzfrequenz ab dem 70-cm-Band, aber dafür auch für das 23-cm- und sogar 13-cm-Band, geeignet, wogegen der AH2 und AH3 für das 6-m- und 2-m-Band prädestiniert sind. Der AH2 ist für 75-Ohm-Systeme gedacht, für 50-Ohm-Systeme müssen Transforma-

Transformationsschaltungen angewendet werden.
Auch die beiden Verstärker von Sirenza Microdevices sind im SOT 89 Gehäuse untergebracht, ihre Interceptpunkte sind niedriger als die der Typen von Watkins Johnson, ihre untere Grenzfrequenz wird jedoch durch die externen Koppelkondensatoren bestimmt. Die neuen GAL-Typen von Mini Circuits weisen Rauschzahlen zwischen 3,5 und 4,5 dB bei Ausgangs-Interceptpunkten von ca. +35 dBm auf. Eine niedrige Rauschzahl bei einem hohen Interceptpunkt und guter Verstärkung bietet der Typ RF2360 von RF Microdevices. Dieser Verstärker ist für Kabelfernsehanwendungen (CATV) konzipiert. Durch die Größe der externen Koppelkondensatoren wird die untere Grenzfrequenz bestimmt, dadurch kann er als rauscharmer Vorverstärker im Kurzwellenbereich bis zum 23-cm-Band eingesetzt werden. Dieser Baustein wird im SO-16 Gehäuse geliefert. Dieser Baustein kann laut Datenblatt sowohl in einer 50-Ohm- als auch 75-Ohm-Umgebung eingesetzt werden. Leider sind momentan keine detaillierten S-Parametersätze für eine Simulation verfügbar, um Aussagen über eine breitbandige (?) Anpassung geben zu können. Ein Probeaufbau zeigte, daß für einen optimalen Betrieb Schmalband-Anpassschaltungen notwendig sind.

Mischer

Tabelle 2 zeigt eine Auflistung verschiedener Mischer. Viele der „Neuerscheinungen" sind für die Mobilfunk-Frequenzbereiche 800 – 100 MHz und 1800 – 2000 MHz entwickelt und optimiert worden, und nur für diesen Frequenzbereich spezifiziert. Deshalb wurden Mischer in die Tabelle aufgenommen, mit denen die Amateurfunkbereiche abgedeckt werden können.
Einige Daten lang bekannter „high level" Mischer von Mini Circuits wurden in die Tabelle aufgenommen, um Systemsimulationen zweier „alt bekannter" Designs /5/, /7/ durchführen zu können. Der Mischer HMJ-5 von Watkins Johnson hat laut Datenblatt den höchsten Eingangs-Interceptpunkt von +35 dBm, gefolgt von dem Mini Circuits Mischer SYM-25 DHW. Bei einer Mischdämpfung von ca. 6 dB ergeben sich Ausgangs-Interceptpunkte von +29 dBm bzw. +24 dBm. Die nachfolgenden Stufen sollten einen mindest gleich großen oder besser höheren Eingangs-IP aufweisen, um keinen zu hohen Einfluß auf den Gesamt-Interceptpunkt des Frontends zu nehmen. Für das 23-cm-Band ist der Einsatz des HMJ-7 eine interessante Lösung. Alternativ könnte der SYM-25 DHW von Mini Circuits für einen großsignalfesten Konverter des 23 -cm- und 13-cm-Bandes eingesetzt werden.

Quarzfilter

Quarzfilter werden im kommerziellen Bereich kaum noch eingesetzt, deshalb ist das Angebot an Quarzfiltern erheblich geschrumpft. Die Anzahl der Quarzfilterhersteller ist erheblich geschrumpft. Neuentwicklungen sind nicht auszumachen, SAW-Filter haben in eine zu große Durchlassbandbreite. Aufgrund einer Marktrecherche des Verfassers sind wegen der niedrigen Nachfrage nur sehr noch wenige Hersteller für monolithische Quarzfilter vorhanden. Es werden zwei- und vierpolige Quarzfilter für 21,4, 45 und 70 MHz angeboten. Bei den 45 MHz Filtern gibt es zwei Varianten: „fundamental mode" und „overtone mode". Letztere weisen eine höhere Abschlussimpedanz (im Kiloohm Bereich) auf.
Bezüglich der Intermodulationsfestigkeit sind nur wenige Informationen verfügbar. OM Friedrich Krug DJ3RV hat in [16] Untersuchungen an 9 MHz Quarzfiltern der Firma KVG durchgeführt. Seinen Messungen zufolge erreichte ein zweipoliges monolithisches Filter XF 910 für zwei Störsignale im Sperrbereich des Filters einen IPIP3 von +42 dBm. Auch die monolithischen Filter XFM-9S 05, und XFM-9S 01 weisen IPs von +40 dBm auf. Diskret aufgebaute Filter wie das altbekannte XF 9B weisen einen niedrigeren IPIP3 von +34 ... +36 dBm auf. Möglicherweise rührt diese Verschlechterung von den internen Anpassungstransformatoren mit Ferritkernen her. Es ist jedoch nicht klar, ob die monolithischen Filter gleichfalls interne Ferritkernübertrager besitzen.
Für den Empfang des 70-cm-Bandes ist eine erste Zwischenfrequenz von 9 MHz nicht möglich. Hier sollte man eine ZF von 21,4 MHz oder höher benutzen. Wie die Situation bei Quarzfiltern der Mittenfrequenz 21,4 MHz aussieht, wurde bislang nicht ausführlich untersucht. OM Neie gibt für die in seinen Transceiver [7] verwendeten Quarzfilter (von Telequarz, TQF 21-06) einen IPIP3 von +36 dBm an. Dieser Wert ist mit dem 9 MHz Filter XF 9 B vergleichbar.
Einem alten Katalog der Firma Toyocom [18] entnahm der Verfasser, daß monolithische Quarzfilter (TQF-600 Serie, Mittenfrequenz 70 – 100 MHz) für zwei Außerbandsignale von je –15 dBm Inbandintermodulationsabstände von < -95 dBm erreichen. Daraus ergibt sich ein Intermodulationsabstand d3 = 80 dB, der IPIP3 beträgt dann +25 dBm. Ähnliche Werte gelten laut mündlicher Auskunft eines Quarzfilterherstellers auch für andere monolithische Quarzfilter. Maximal sei ein IPIP3 von +30 dBm erreichbar, dann erhöhen sich jedoch die Amplituden der Nebenresonanzen. Anfang der 80er Jahre erschien in verschiedenen Fachzeitschriften eine interessante Schaltung, die den Entwicklern eines Kurzwellenempfängers der Firma Telefunken eingefallen war. Sie gewährleistet den breitbandigen Abschluß des ZF-Ports eines Mixers mit Diplexer, jedoch ohne folgenden FET-Verstärker in Gate-Schaltung direkt gefolgt von einem Quarzfilter. Diese Schaltung ist z.B. in [21] wiedergegeben. Sie setzt sich aus einem hybriden Leistungsteiler, zwei Allpassfiltern, gefolgt von zwei Quarzfiltern und einem weiteren Leistungsteiler zusammen. Letzterer wirkt als Leistungssummierer. Die Daten der Quarzfilter werden nicht angegeben. Laut Korrespondenz mit Ulrich Graf, DK4SX, sind bei den Quarzfiltern spezielle Quarze mit großer Fläche benutzt worden, weitere Angaben konnte er nicht machen.

Fazit

- Rauscharme und gleichzeitig hochlineare Vorverstärker (LNA) sind mit den momentan auf dem Markt angebotenen ICs einfach realisierbar.
- Mischer mit einem hohen Interceptpunkt bei relativ niedriger Lokalsozillatorleistung sind verfügbar, jedoch ist der OPIP3 des LNA stets höher als der IPIP3 des Mischers. Damit ist der Mischer die erste „Schwachstelle" eines Frontends.

• Monolithische Quarzfilter für Durchlaßfrequenzen > 9 MHz (21,4 MHz ?), d.h. 45 MHz und höher weisen IPs von +25 dBm, bestenfalls +30 dBm auf. Der Einfluß des Interceptpunktes des ersten Quarzfilters am ZF-Ausgang des Mischers ist gleichfalls nicht vernachlässigbar. Nach gängiger Literaturmeinung müssen alle Ports eines Mischers, speziell der ZF-Port mit der Systemimpedanz (50 Ohm) abgeschlossen werden, bzw. „sehen". Der breitbandige und reflektionsarme Abschluss des ZF-Ports wurde bislang mit einem Diplexer und einem nachfolgenden Verstärker mit J-FETs in Gate-Schaltung [5], [7] bzw. mit Bipolartransistoren in Basisschaltung [17] erreicht. Die Verstärkung dieser Stufe „belastet" jedoch das Quarzfilter und verschlechtert zusätzlich den Gesamt-Interceptpunkt!

Systemsimulation eines neuen Frontends

Die Bauteile des Verstärkers FH1 bzw. des RFMD 2360 als LNA und des HMJ-5 als Mischer werden als Bausteine eines neuen Empfängereingangsteils in der folgenden Systemsimulation eingesetzt. Da der OPIP des LNA höher als der IPIP des Mischers ist, sollte die Verstärkung des LNA nicht zu hoch gewählt werden, um den Mischer nicht unnötig mit „Störsignalen" zu belasten. Auch das Quarzfilter „freut" sich über nicht zu hohe Pegel.
Der Verfasser führte Voruntersuchungen an Einzelbaugruppen (LNA und Mischer) mit Bauteilen der Firma Watkins Johnson (FH1 und HMJ-5) durch. Die Datenblattangaben der einzelnen Module konnten bestätigt werden. Der Mischer wurde an allen Ports mit Diplexern (überbrücktes T-Filter laut [20], berechnet mit den Formeln in [21]) abgeschlossen.
Um eine breitbandigen impedanzrichtigen Abschluss des ZF-Ports für alle Frequenzen ohne zusätzlichen Breitband-Verstärker in Gate-Schaltung zu gewährleisten, wurde ein Diplexer eingesetzt. Den impedanzrichtigen Abschluß außerhalb der Durchlaßfrequenz der Quarzfilter übernimmt eine Schaltung, die mit einem 90° Hybrid (Mini Circuits SCPQ-60) im Eingang besteht. Seine beiden Ausgänge werden über Anpaßschaltungen (50 Ohm - Quarzfilterimpedanz) auf zwei gleiche monolithische Zweipol-Quarzfilter (45 MHz Mittenfrequenz) aus einem Vierpolfilter gewonnen, geleitet, deren Ausgänge durch ein zweites 90° Hybrid zusamengefaßt werden. Die isolierten Ports beider Hybriden werden jeweils auf 50-Ohm-Abschlußwiderstände geführt.
Neben dem so erreichten breitbandigen Abschluß des ZF-Ports des Mischers erhalten beide Quarzfilter jeweils durch die Aufsplittung des ersten Hybrids nur die halbe Leistung, die durch das zweite Hybrid bis auf die niedrigen Verluste des zweiten Hybrids wieder phasenrichtig addiert werden. Intermodulationsprodukte dritter Ordnung müßten in dieser Anordnung um 9 dB sinken, der Gesamt-IP dieser Quarzfilteranordnung um 9/2 dB = 4,5 dB gegenüber einem Quarzfilter aus Einzel-Zweipolquarzen steigen.
Bezüglich der Weitabselektion wirkt diese Filteranordnung jedoch nur wie ein Zweipolfilter.
Bild 5 zeigt die Systemsimulation dieses Eingangsteils bestehend aus einem Eingangsfilter mit einer möglichst niedrigen Einfügungsdämpfung (hier zu 0,5 dB angenommen) zur Abschwächung starker Außerbandsignale, dem LNA mit einem FET FH1, einem Bandfilter das die Spiegelselektion bestimmt und mit einer Einfügedämpfung von 2 dB angesetzt wird und dem Mischer HMJ-5. Die Kompressionspunkte und Interceptpunkte der passiven Baugruppen wurde mit +100 dBm angenommen.
Bei einer Gesamtverstärkung von 5,5 dB wird eine Gesamtrauschzahl von 2,47 dB, erreicht. Der OPIP3 beträgt +21,71 dBm, der IPIP3 beträgt 16,21 dBm, der OP1dB +9,3 dBm. Für die 1 dB Kompressionspunkten des Mischers und des Quarzfilters wurden „Schätzwerte" angenommen, d.h. der 1 dB Punkt liegt 10 dB unterhalb des OPIP3.
Bild 6 zeigt einen Graphen in dem über den Eingangsleistungsbereich –30 dBm bis +10 dBm die Ausgangsleistung und Intermodulationsprodukte dritter Ordnung aufgetragen sind. Der senkrechte Strich am rechten Rand zeigt die Eingangsleistung an, bei dem das Frontend den 1-dB-Kompressionspunkt erreicht. Er wird bei einer Eingangsleistung von +4 dBm erreicht. Die dazugehörige Ausgangsleistung ist +4 dBm + 5,5 dB – 1 dB = 8,5 dBm. Auffallend an dem neuen Design ist gegenüber [5] und [7] der höhere 1 dB Kompressionspunkt, der jetzt um 10 dB von –5 auf + 5dBm angestiegen ist. Die Empfindlichkeit ist zwar um ca. 1 dB niedriger, als in den Referenzdesigns, dies ist nach Meinung des Verfassers für den „normalen" VHF- und UHF-Betrieb ausreichend. Wird der LNA mit dem FH1 durch ein RF2360 von RF Microdevices ersetzt, ergeben sich folgende Gesamtdaten, siehe Bild 7. Bedingt durch die höhere Verstärkung ergibt sich eine etwas höhere Gesamt-Verstärkung und eine um 0,39 dB niedrigere Gesamtrauschzahl. Erstaunlicherweise erhöht sich der 1-dB-Kompressionspunkt des Gesamtsystems um ca. 1 dB, obwohl der LNA eine höhere Verstärkung und einen niedrigeren 1-dB-Kompressionspunkt aufweist.
Bei beiden Designs ist jedoch zu berücksichtigen, dass das Frontend nicht bis zum 1 dB Kompressionspunkt ausgesteuert werden sollte, da die Quarzfilter nur Eingangsleistungen bis maximal 1 mW = 0 dBm ohne Langzeitschädigung vertragen.

Schlußbemerkung

Der Verfasser hat ein erstes Layout eines kombinierten Frontends für das 2m und 70 cm Band angefertigt, die Aufbauten von Teilbaugruppen (LNA) waren jedoch nicht befriedigend. An einer verbesserten Version wird gearbeitet.

Literatur

Siehe engl. Text oben.

More about Oblong Antennas

by Slobodan Bukvic, YU7XL, yu7xl@nadlanu.com

Inspired by the article "Oblong Antennas for VHF" in DUBUS 3/2007, and disappointed with relatively poor results, I have designed several "wings" of oblongs, for 144, 432 and 1296 MHz, up to 61 elements. My experience says there are no better antenna types than the Yagi. This article is not to confirm such a statement; but there is one thing, at least, which makes the oblong a very interesting antenna. If you take an optimized Yagi antenna, and change its element diameter from, for example, 5.0 mm to 5.5 mm, such an antenna is for scrap. But, if you take an oblong and change its element diameter from 5 to even 10 mm, such an antenna will still be usable. That means the oblong is very insensitive to construction errors and to surrounding conditions. Better to say, it is more predictable to obtain what is designed in reality. But designing oblong antennas is much more difficult than for Yagis. First, many more segments must be used for modelling, and this makes your PC slow down. The biggest problem is the low impedance for quads and oblongs. The ratio between element height and width can be changed and, accordingly, the best ratio between impedance and other parameters can be defined.

My good friend Andra, YU1QT, gave some models in the article mentioned above. The conclusion of this article was: high sidelobes, not easy to build, poor gain in comparison with yagis. In other words, there seemed to be no reason to build and to use such an antenna. YU1QT made some omissions, though, because he did not "tweak" his models.

Nowadays many computer programs are available for antenna modeling. Some of them are very useful and free. 4NEC2 by Arie Voors, www.http://home.ict.nl/~arivoors/ is probably the best. Also good (and even better in some respects) is EZNEC www.eznec.com/ by W7EL, but this is more expensive software, though its core is based on the same NEC2 engine.

I am using 4NEC2, as YU1QT did. 4NEC2 has an optimizer but it is not quite friendly with oblongs. You have to put the optimizer to work and, after it has finished, you must "tweak" the obtained results by your own hands and brain. Without tweaking, you will get an antenna as given in Andra's article. Such additional work is really hard, but it is usually well rewarded, because you can normally get 0.5 dB more gain, and several dBs more sidelobe suppression.

I performed this additional work by searching for best G/T ratio. That means, you have to make a small change in antenna dimensions, then check the response in terms of G/T, and adopt the change if G/T improves. For G/T calculations, I am using TANT, a small DOS program made by YT1NT (VA3TTN) http://www.geocities.com/va3ttn/Tant.zip. It is quite a tiring job, because hundreds of calculations have to be made. Therefore I deeply recommend Arie to implement an automatic "search for best G/T" calculation in his 4NEC2 optimizer; that action would make modeling much better and easier.

Now I want to give one oblong antenna design 1296 MHz. If you are interested in other designs, please send an e-mail request to yu7xl@nadlanu.com

Super Oblong Antenna for 1296 MHz

I have found that smaller diameter of wires gives better results with oblongs. The answer is, maybe, that smaller diameter brings a higher value of impedance. Anyway, this can be well used on the UHF bands. Silver-plated copper wire of 1 and 1.5 mm diameter is used in my simulations. It is very suitable for manipulation (cutting, bending, soldering), resistant against corrosion and has the best conductivity in the long term, meaning minimum losses. The wire is cheap and easy to find.

All elements have to be mounted insulated over the boom. If the elements are at least 10 mm apart of the boom surface, the diameter of the boom is not very important. I have designed several tens of oblong antennas for 1296 MHz. Here described is the biggest one, consisting of 61 elements and giving excellent performance. Its boom length is nearly 6 metres! According to simulations, you can expect the following: gain of 23.2 dBi, F/B of 35.2 dB. The first sidelobes are suppressed 20 dB in the horizontal (E) plane and 19.7 dB in the vertical (H) plane. The main lobe is 13.6 x 13.8 degrees wide (E x H). The total antenna temperature (without losses) is 19.8K and G/T +10.2 dB. A bandwidth of 17 MHz can be expected for SWR better than 1.5, and the impedance at the central frequency of 1296.9 MHz is exactly 50±j0 Ω. You will nowhere see such a clean and sharp pattern as here, for this antenna! This antenna is just being built by YT1WV and will be ready for the next season. All antennas designed in 4NEC2 gave the expected performance when checked in practice, so there is no reason not to start building this antenna now.

Oblong Antenna Q2361S for 1296 MHz – by YU7XL

Performance Data

TYPE	ELE	L (mm)	G (dBi)	F/B (dB)	F/Sh (dBi)	F/Sv (dBi)	Hor (◦)	Ver (◦)	Temp (◦K)	G/T (dB)	ΔF * (MHz)
Q2361S	61	5957	23.20	35.20	20.09	19.66	13.6	13.8	19.8	+10.23	17.2

*** ΔF given for SWR=1.5**

Dimensions

	Ref	De	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12
Pos	**0**	**52**	**96**	**175**	**263**	**354**	**456**	**552**	**656**	**759**	**865**	**974**	**1083**	**1194**
Length	**102.0**	**94.0**	**90.0**	**86.0**	**84.0**	**81.0**	**80**	**79.0**	**78.0**	**77.0**	**75.0**	**75.0**	**74.0**	**74.0**

	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26
Pos	**1301**	**1407**	**1516**	**1627**	**1741**	**1850**	**1957**	**2063**	**2172**	**2275**	**2386**	**2481**	**2578**	**2675**
Length	**74.0**	**74.0**	**72.0**	**72.0**	**72.0**	**72.0**	**72.0**	**72.0**	**72.0**	**71.0**	**71.0**	**70.0**	**70.0**	**70.0**

	D27	D28	D29	D30	D31	D32	D33	D34	D35	D36	D37	D38	D39	D40
Pos	**2769**	**2874**	**2971**	**3084**	**3182**	**3277**	**3377**	**3467**	**3562**	**3657**	**3759**	**3861**	**3959**	**4058**
Length	**69.0**	**69.0**	**69.0**	**69.0**	**68.0**	**68.0**	**68.0**	**68.0**	**68.0**	**68.0**	**68.0**	**68.0**	**68.0**	**68.0**

	D41	D42	D43	D44	D45	D46	D47	D48	D49	D50	D51	D52	D53	D54
Pos	**4156**	**4258**	**4355**	**4459**	**4561**	**4662**	**4763**	**4851**	**4951**	**5051**	**5152**	**5255**	**5357**	**5458**
Length	**67.0**	**67.0**	**67.0**	**67.0**	**67.0**	**67.0**	**67.0**	**67.0**	**67.0**	**67.0**	**67.0**	**67.0**	**67.0**	**67.0**

	D55	D56	D57	D58	D59
Pos	**5569**	**5671**	**5771**	**5871**	**5957**
Lengt h	**67.0**	**67.0**	**67.0**	**67.0**	**67.0**

REMARKS: : - All elements made of silver plated wire Ø1 mm
- The height of all rectangles is 19 mm
- All dimensions given in millimetres

Diagrams

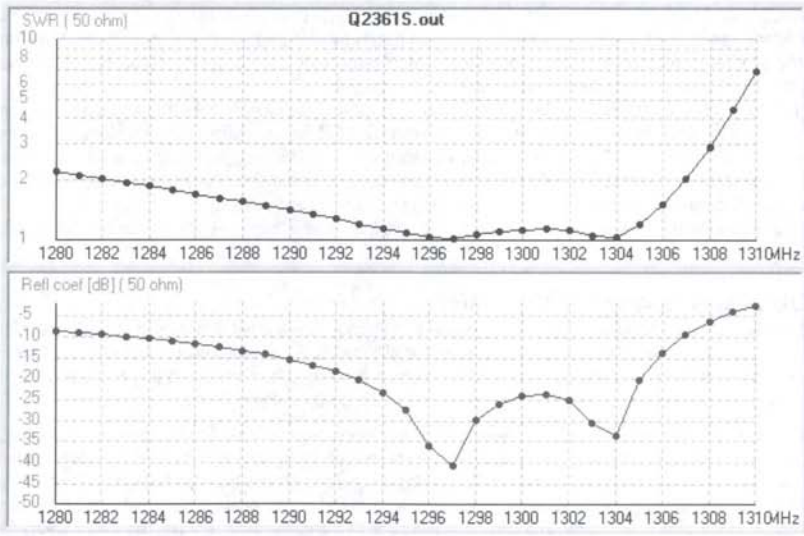


Fig. 1: SWR (top) and refl. coef. (bottom) for the 61 ele oblong antenna (4NEC2 simulation)

Editor: *A re-simulation of the antenna with the provided dimensions by YU7EF with EZNEC showed the following results: gain 23.06 dBi, F/B 34.8 dB. There is about 0.15 dB less in gain than in the 4NEC2 simulation because YU7XL did not consider the internal loss of the antenna's material. Anyway the good pattern and performance date were confirmed in general.*

YU7EF comments: For comparison this antenna was simulated by YU7EF with different materials for the elements: with no loss, 23.19 dBi; silver 23.06 dBi; copper 23.05 dBi; aluminium 22.98 dBi; stainless steel 22.28 dBi. This design is really good or I should say results are remarkable, even with loss included. Again there is only the question of building it with such a good precision to maintain the specifications. Since this is a 23 cm antenna it might be possible to have it in reality but this is a very long antenna which will require at least a 30x30 mm boom. Even if the elements are spaced 10mm above the boom, the question is if they would be influenced by such a large boom, or if it would be required to introduce a boom correction.

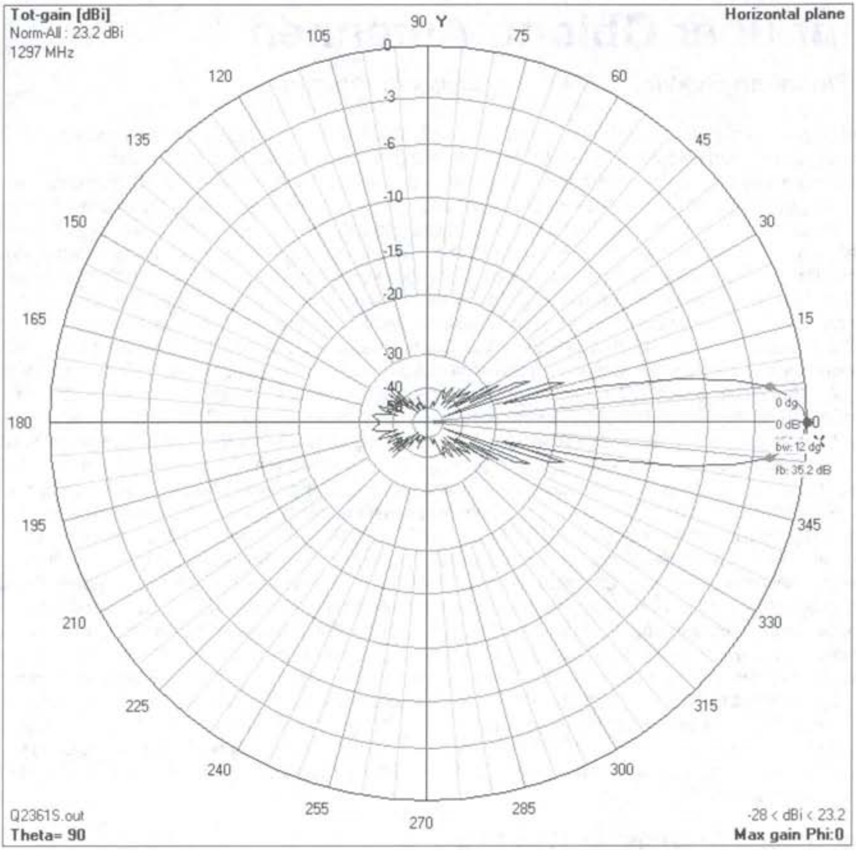
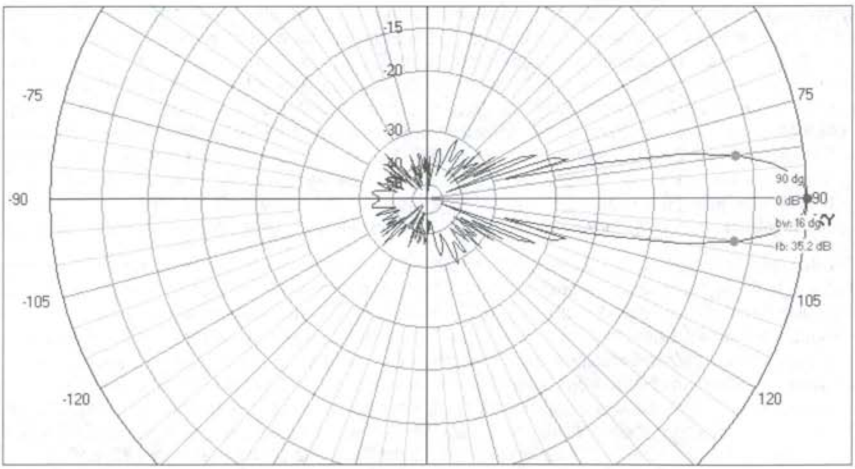


Fig. 2: 61 element Oblong for 23cm – horizontal plane (top) and vertical plane (bottom) (4NEC2 simulation)



Mehr über Oblong-Antennen

von Slobodan Bukvic, YU7XL, yu7xl@nadlanu.com

Inspiriert durch den Artikel „Oblong Antennas for VHF" im Dubus 3/2007, und enttäuscht über die relativ schlechten Ergebnisse, habe ich die „Oblong" weiter entwickelt für 144, 432 und 1296 MHz (hier in einer Version bis zu 61 Elementen).
Meine Erfahrung sagt, dass es keinen besseren Antennentyp als die Yagi gibt. Dieser Artikel eignet sich nicht dazu, dieses Satement zu bestätigen.... Es gibt wenigstens eine Sache, die eine oblonge Antenne zu einer sehr interessanten Antenne macht: Wenn man die beste Yagi nimmt und den Elementdurchmesser von z.B. 5 auf 5.5 mm erhöht, kann man die Antenne verschrotten. Wenn man aber eine Oblong nimmt und den Durchmesser von 5 auf 10mm erhöht, ist die Antenne immer noch brauchbar. Das bedeutet, daß die Oblong sehr unempfindlich gegen Konstruktionsfehler und die Umgebung ist. Anders ausgedrückt: Man kann eher erwarten, daß man das, was entwickelt wurde, auch in der Realität erhält. Aber das Designen ist viel schwieriger als bei Yagis. Es müssen hier viel mehr Segmente verwendet werden und das verlangsamt die Geschwindigkeit auf dem PC. Das größte Problem ist die niedirge Impedanz bei Quads und Oblongs. Das Verhältnis zwischen Element-Höhe und – Breite kann verändert werden und folglich kann das beste Verhältnis zwischen Imdedanz und anderen Parametern damit festgelegt werden. Mein Freund Andra, YU1QT, hat einige Versionen in oben erwähntem Artikel vorgestellt. Das Fazit dieses Artikels war: Große Nebenzipfel, nicht einfach zu bauen, niedriger Gewinn im Vergleich zu Yagis. Mit anderen Worten, es gabe keinen Grund solch eine Antenne zu bauen und zu verwenden. YU1QT hat einige Fehler gemacht, vor allem hat er seine Modelle nicht fein optimiert. Heutzutage gibt es viele Computerprogramme für das Modellieren von Antennen. Einige sind sehr nützlich und umsonst. 4NEC2 von Arie Voors (www.http://home.ict.nl/~arivoors) ist wahrscheinlich das beste. Auch gut (und sogar besser) ist EZNEC (www.eznec.com) von W7EL, was aber professionelle Software ist, die teuer ist. Beide Programm-Kerne basieren auf den selben Grundlagen. Ich verwende auch 4NEC2, so wie YU1QT. 4NEC2 hat eine Optimierfunktion, die nicht sehr angenehm bei oblongen Antennen ist. Nachdem der Optimierer gearbeitet hat, muss man die Ergebnisse per Hand und mit dem eigenen Kopf weiter verfeinern und optimieren. Ohne diese Prozedur erhält man die Ergebnisse wie von YU1QT vorgestellt. Diese zusätzliche Arbeit ist wirklich sehr aufwändig, aber man wir belohnt, weil man normalerweise dabei 0.5 dB mehr Gewinn erreichen kann und eine um einige dB bessere Unterdrückung der Nebenzipfel. Ich führe diese zusätzliche Optimierung durch, in dem ich nach dem besten G/T suche. Das bedeutet, daß man eine kleine Änderung bei den Dimensionen der Antenne macht, dann guckt, wie sich das G/T verändert, und dann diese Änderung beibehält, wenn das G/T besser wird. Für G/T-Berechnungen verwende ich das kleine DOS-Programm TANT von YT1NT (VA3TTN), siehe www.geocities.com/va3ttn/Tant.zip. Dies ist eine ziemlich ermüdende Arbeit, weil hunderte solcher Berechnungen gemacht werden müssen. Deshalb würde ich mir dringend wünsche, daß Arie eine Funktion „Suche nach bestem G/T" in dem Optimierer von 4NEC2 implementieren könnte. Das würde das Designen verbessern und erleichtern. Ich möchte hier das Design einer Oblong für 1296 MHz vorstellen. Bei Interesse an anderen Modellen, bitte beim Autor per email anfragen.

Super Oblong Antenne für 1296 MHz

Ich habe gefunden, dass kleinere Durchmesser für die Drahtelemente bessere Ergebnisse bei oblongen Antennen bringen. Das kann eventuell dadurch begründet sein, daß diese eine höhere Impedanz erzeugen. Das kann auch gut auf den UHF-Bändern gemacht werden. Versilberter Kupferdraht von 1 bzw. 1.5mm Durchmesser wurde in meinen Simulationen verwendet. Dieser ist sehr gut bearbeitbar (Schneiden, Biegen, Löten...), resistent gegen Korrosion und hat schließlich auch die beste Leitfähigkeit, d.h. die geringsten Verluste. Dieser Draht ist billig und überall erhältlich. Alle Elemente müssen isoliert über dem Boom montiert werden. Dann ist der Durchmesser des Booms nicht sehr wichtig. Die Elemente sollten jedoch mindestens 10 mm von der Oberfläche des Booms entfernt sein. Ich habe einige Dutzend Versionen von Oblongs für 23cm entwickelt. Hier wird die größte Antenne, die 61 Elemente hat und exzellente Daten aufweist, beschrieben. Die Boomlänge beträgt ca. 6 m! Folgendes kann man erwarten: Gewinn 23,20 dBi, F/B 35,20 dB. Die Nebenzipfel sind 20,09 dB (horizontal) und 19,66 dB (vertikal) unterdrückt. Die Hauptkeule ist 13,6 x 13,8 Grad weit. Die gesamte Antennentemperatur (ohen Verluste) beträgt 19,8K und das G/T +10,23 dB. Die Bandbreite von 17.2 MHz kann für ein SWR besser als 1,5 erreicht werden. Die Impedanz bei 1296,9 MHz beträgt exakt 50±j0 Ohm. Man wird kaum irgendwo solch ein sauberes und scharfes Diagramm wie hier, bei dieser Antenne, finden! Diese Antenne wird zur Zeit gerade von YT1WV aufgebaut und in der nächsten DX-Saison fertig sein. Bisher haben alle mit 4NEC2 entwickelten Antennen die erwarteten Ergebnisse auch in der Praxis gezeigt. Deshalb gibt es keinen Grund diese Antenne jetzt noch nicht zu bauen.

(Red.: Eine Nachsimulation der Antenne durch YU7EF mit EZNEC zeigt die folgenden Ergebnisse: F/B 34.8dB, Gewinn 23.06 dBi. Die etwa 0.15 weniger Gewinn im Vergleich zu der 4NEC2-Simulation von YU7XL liegen darin begründet, daß dieser die internen Verluste des Materials unberücksichtigt ließ. YU7EF kommentiert: Dieses Design ist wirklich gut oder ich sollte sagen bemerkenswert, auch wenn die internen Verluste mit eingerechnet werden. Wieder stellt sich aber die Frage, ob solch eine Antenne in der Praxis mit der nötigen Genauigkeit gebaut werden kann, so dass die Leistungsdaten auch erreicht werden. Da hier eine 23cm-Antenne vorliegt, könnte das möglich sein. Da sie aber sehr lang ist, sollte der Boom mindestens 30 x 30 mm sein. Auch wenn die Elemente 10mm über dem Boom sind, bleibt die Frage, ob sie nicht evtl. doch durch diesen noch beeinflußt werden und eine Boomkorrektur durchgeführt werden muß. Zum Vergleich wurde die Antenne von YU7EF mal mit verschiedenen Materialen durchgerechnet: keine Verluste 23.19, Silber 23.06, Kupfer 23.05, Alu 22.98 und Edelstahl 22.28 dBi.

QRO Lowpass Filter for 2m PAs

by Bodo Heyl, DL2FCN - bodoheyl@gmx.de

I was in need of a low pass filter for my home brew GS35 2m PA. The output power of this PA is up to 750W, thus the parts for the low pass filter have to be dimensioned accordingly.

One can find several articles in the literature or on the web about constructing 2m power amplifiers. Quite often the necessity of a low pass filter at the output is ignored or only mentioned in passing. The optimal design for a low pass filter is a coaxial version. One can find a construction manual for this type at F1FRV. Anyway I considered the mechanical complexity too great for me. In UKW-Berichte 2/2000 I found an article from DJ5AP which described the fascinating idea of using Teflon as the dielectric for the capacitors of the filter. I built a modified test version where the filter capacitors were made from aluminium sheet with a Teflon sheet below. I had no access to the RT Duroid material that was used by DJ5AP for the plates. The filter worked but the dielectric losses in the Teflon sheet and the losses in the coils caused marked heating of the filter. As a compromise I added a small blower. Anyway I was not really happy and started to search for a better solution.

The filter from DJ5AP consists of 4 capacitors and 3 coils (7 poles). In order to reduce the required space for the plate capacitors I have searched for a 5 pole filter and found one on the website from DL4MEA (see GS35 PA for 2m) which was originally designed by ON5FF (DUBUS 3/85). My idea was to use self made air-dielectric plate capacitors. Calculation gave in 2 capacitors of 18 pF, each consisting of two plates of 58 mm x 67 mm with a distance of 2mm between the plates. See fig. 1. This should fit in an available case. The bottom of this tinplate case of 147 x 73 x 38mm (LxWxD) was reinforced with a PCB. M3 Nylon screws and nuts (source: DIY store) were used as spacers and for mounting the plates of the capacitor. I have checked the Nylon screws for losses in a Microwave oven. They did not get warm after a 20 minute test.

Both plate capacitors were built and at a distance of 2.5 mm the desired capacity of 18 pF was attained. The slightly larger distance compared with the calculation is caused by stray capacitances which had not been considered. In the description from DL4MEA 2mm silvered copper wire was used. I have made the coils from 2.5mm silvered copper wire. The new dimensions for the coils were calculated with the YU1AW's program "HeliCoil". The dimensions for the coils are shown in table 1.

L No	Turns	Material	Coil Ø mm	Length mm
L1 and L3	3	CuAg 2,5mm Ø	11	17
L2	4	CuAg 2,5mm Ø	13	19

Table 1

After the assembly the filter had to be only slightly adjusted. Tuning wands – rods with a ferrite and brass slug at each end are very helpful. By dunking them into the coil I was able to see if the inductance had to be increased or decreased while I watched the frequency response and attenuation at the same time. The results achieved are shown in fig. 2. The completed filter is shown in fig. 3.

Summary

With simple and cheap materials a low pass filter was constructed successfully which has been used with QRO for several months without any problems. With an input power of 750W RF and TX periods of 1 minute the coils get a little bit more than hand-hot. The filter should work well with > 1KW. The generated heat is dissipated very well by the aluminium plates. No special parts are required and the filter can be built with simple tools.

Literature and References

1. Ingo Gaspard, DF1VH, personal communication
2. Gerhart Schmitt, DJ5AP, Tiefpassfilter für 2m und 70cm im Selbstbau (UKW-Berichte 1+2/2000)
3. ON5FF, 144 MHz Leistungsendstufe (DUBUS 3/1985, Technical reports)
4. Günter Köllner, DL4MEA, A 144MHz Amplifier with a GS35b, http://www.qsl.net/dl4mea/2g35.htm
5. Program HeliCoil 3.1 http://yu1aw.ba-karlsruhe.de/softw.htm
6. Paul Chominski, WA6PY GU-84b 2m Amplifier http://www.nd2x.net/gu84-amp.html
7. F1FRV: http://f1frv.free.fr/main3e_Filtres_LP.html

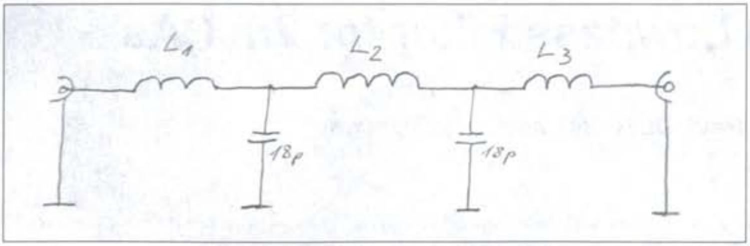


Fig. 1: Circuit Diagram / Schaltung

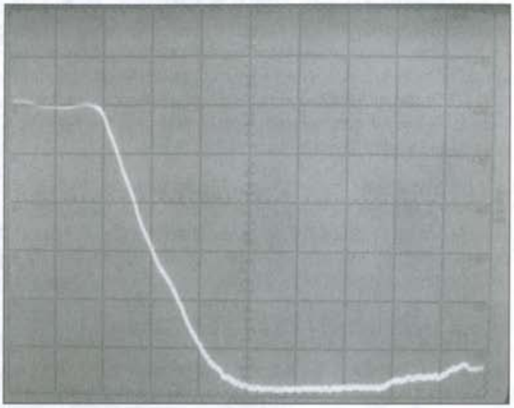


Fig. 2: Measured attenuation - Y 10dB/cm X 100MHz/cm > 1MHz -1GHz
144 MHz = -0,15dB 182 MHz = -3dB 288 MHz = -32dB 432 MHz = -56dB

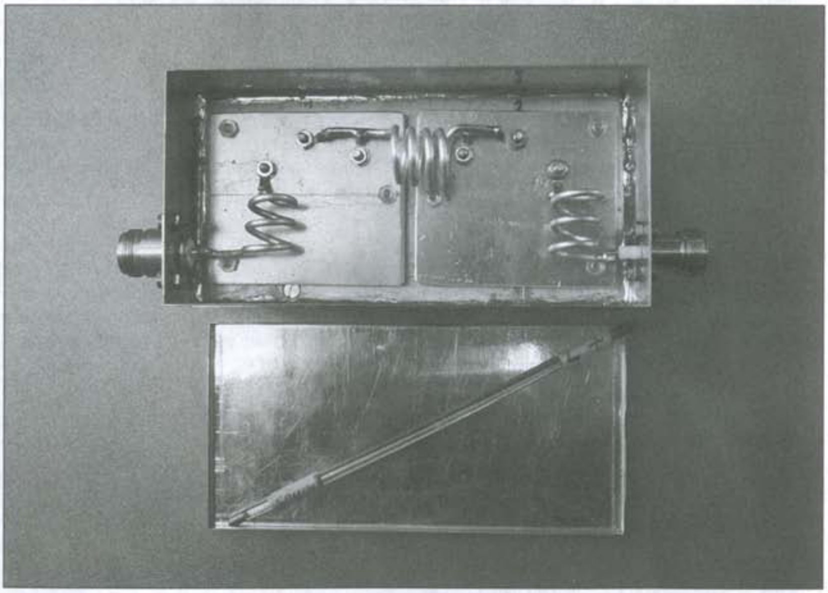


Fig. 3: 2m Low pass filter

QRO-Tiefpass-Filter für 2m PAs

von Bodo Heyl, DL2FCN - bodoheyl@gmx.de

Für meine 144-MHz-Eigenbau-PA mit der GS35B wurde ein Tiefpassfilter benötigt. Die Ausgangsleistung meiner PA beträgt bis zu 750 Watt, die Bauteile des Tiefpassfilters müssen entsprechend dimensioniert werden.

In der Literatur bzw. Internet findet man einige Bauanleitungen für 2m PAs, die Notwendigkeit der Nachschaltung eines Tiefpasses wird meistens großzügig übergangen oder nur am Rande erwähnt. Der optimale Tiefpass ist der koaxiale Typ, man findet bei F1FRV eine Bauanleitung für diesen Typ, der mechanische Aufwand war mir aber zu hoch.
In den UKW-Berichten Heft 2/2000 findet sich eine Bauanleitung von DJ5AP; die Idee, das Dielektrikum der Filterkapazitäten aus Teflon-Material zu machen, faszinierte mich. Ich baute eine abgewandelte Testversion, die Filterkondensatoren bestanden aus Alublech mit untergelegter Teflonfolie. Das Plattenmaterial RT-Duroid, wie DJ5AP es benutzte, stand mir nicht zur Verfügung.
Das Filter funktionierte, allerdings führten die dielektrischen Verluste im Teflonmaterial und die Spulenverluste zu einer starken Erwärmung des Filters, ich habe als Notlösung einen kleinen Lüfter eingebaut. So richtig zufrieden war ich nicht, ich habe nach einer besseren Lösung gesucht.
Das Filter von DJ5AP besteht aus 4 Kondensatoren und 3 Spulen (7polig). Um den Flächenbedarf für die Plattenkondensatoren zu minimieren, habe ich ein fünfpoliges Filter mit nur zwei Kondensatoren gesucht und auf der Website von DL4MEA (GS35 PA für 2m) gefunden, dieses Filter ist ursprünglich ein Entwurf von ON5FF (DUBUS 3/85)
Die Idee war, selbstgebaute Plattenkondensatoren mit Luftdielektrikum zu verwenden. Eine überschlägige Berechnung ergab, dass die zwei Kondensatoren von je 18pf aus zwei Platten von je 58 mm x 67 mm gebaut werden konnten, bei einem Plattenabstand von 2mm und so in das vorhandene Gehäuse passen. Der Boden des Weissblechgehäuses mit den Abmessungen 147 x 73 x 38mm (LxBxH) wurde mit einer Leiterplatte versteift. Als Abstandshalter und Befestigungsschrauben der Kondensatorplatten verwende ich M3 Nylonschrauben und Muttern (z. Bsp. Baumarkt). Die Nylonschrauben habe ich in der Mikrowelle auf evtl. Verluste geprüft, sie haben sich nach 20 Minuten nicht erwärmt.

Die beiden Plattenkondensatoren wurden aufgebaut, bei einem Abstand von 2,5mm wurde die gewünschte Kapazität von je 18pF erreicht. Der etwas erhöhte Abstand gegenüber der Berechnung hängt mit Streukapazitäten zusammen, die bei der obigen Rechnung nicht erfasst wurden. In der Originalbeschreibung von DL4MEA wurde für die Spulen 2mm versilberter Kupferdraht verwendet, ich habe die Spulen aus 2,5mm versilberten Kupferdraht gewickelt. Die neuen Dimensionen der Spulen habe ich mit dem YU1AW Programm „Berechnung von Luftspulen" errechnet. Tabelle 1 zeigt die Daten.

L Nr	Wdg.	Material	Spule Ø mm	Länge mm
L1 und L3	3	CuAg 2,5mm Ø	11	17
L2	4	CuAg 2,5mm Ø	13	19

Tabelle 1

Nach dem Zusammenbau musste das Filter nur noch geringfügig abgeglichen werden. Sehr hilfreich war dabei ein Abgleichstab mit einem Ferrit- bzw. Messingkern im jeweiligen Ende, so konnte ich erkennen, durch Eintauchen des Messing oder Kupferkernes in die entsprechende Spule, ob die Induktivität erhöht oder erniedrigt werden musste, bei gleichzeitiger Betrachtung des Frequenzganges bzw. der Durchgangsdämpfung. Die Ergebnisse zeigt Abb. 2. In Abb. 3 wird das fertige Filter gezeigt.

Zusammenfassung

Es ist mir gelungen mit einfachen und preisgünstigen Mitteln ein Tiefpassfilter zu bauen, dass im QRO Betrieb bisher einige Monate ohne Probleme betrieben wurde. Bei einer Eingangsleistung von 750 Watt und Sendedauer von 1 Minute werden die Spulen etwas mehr als handwarm, die entstehende Wärme wird sehr gut über die Aluplatten abgeführt. Das Filter sollte problemlos bis über 1 KW arbeiten. Es werden keine Spezialbauteile benötigt, das Filter kann mit einfachen Werkzeugen gebaut werden.

Literatur und Referenzen

Siehe am Ende des engl. Textes oben.

24 GHz PA with 3 Watt Output

by Philipp Prinz, DL2AM - prinz.DL2AM@t-online.de

Introduction

For active 24 GHz operators or those who want to become active on 24 GHz in the future, the power amplifier described here will surely be of interest. For this amplifier a TGA 4905 CP from TriQuint is used. This amp achieves 23 dB gain at 2 Watts output, the maximum output is 3 Watts. If you look at the price performance ratio and compare with 10 GHz, this chip is really cheap. The input and output matching is not very good with return losses of 8 to 10 dB. The supply voltages are +6.5V and -0.8V at max. 3A. For the casing I chose copper for thermal reasons. Aluminium is also a possiblity if the bottom is thick enough (8mm). For drilling and tapping copper one needs a lot of skill for M 1.4 threads. Thus Hubert Krause (www.micro-mechanik.de) has manufactured the casings for me. The measurements for the casing are 58 x 58 mm outside, 50 x 50 mm internal, the depth is 13 mm and the total height is 19 mm. The SMA jacks should be stripline types. The RF-PCB is fixed as usual with 2 component silver glue and is heated at 110 ° C for 1 hour (electric iron / hotplate), see fig. 1.

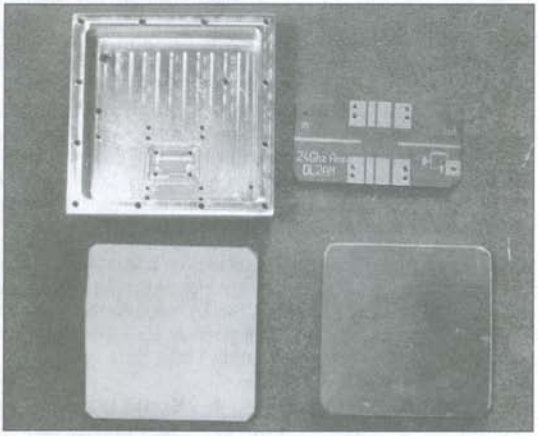


Fig. 1: Casing, PCB, silicone rubber and aluminium plates

A piece of silicone rubber is placed on top of the pcb in the casing, followed by a block of hardwood or aluminium and then all is pressed together. See fig. 2.

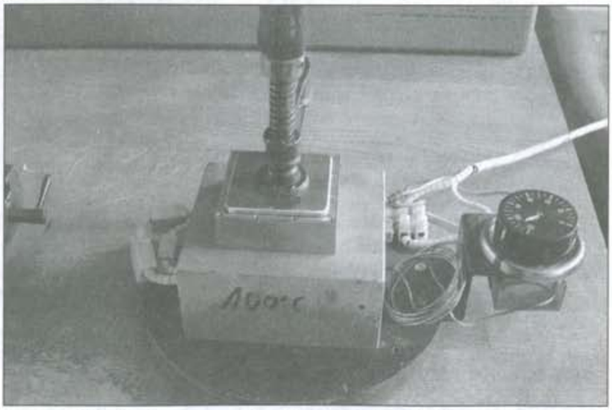


Fig. 2: Pressing the glued PCB into the casing

The cut-out for the chip is made carefully with a scalpel. The bottom face of the chip cut-out has to be very smooth and must not have any gouges . In the center of the chip a little bit of thermal conductive paste is applied.

DC tests

First DC tests have shown that the 6.5 Volt supply voltage has to be kept at 0V when applying the supply voltages until the negative voltage has got to it's desired value. This is not the case when using the usual DC supply circuit as there is still 1.2V at output of the low drop stabiliser. I have developed a new DC supply circuit and PCB which fulfills the requirements and the problem was solved. This new circuit has the advantage of allowing the possibility of PTT switching which enables power saving during receive periods (e.g. important for the German Bayerischer Bergtag Contest). After fitting the DC board all parts should be checked very carefully both visually and with an ohm-meter. See fig. 3.

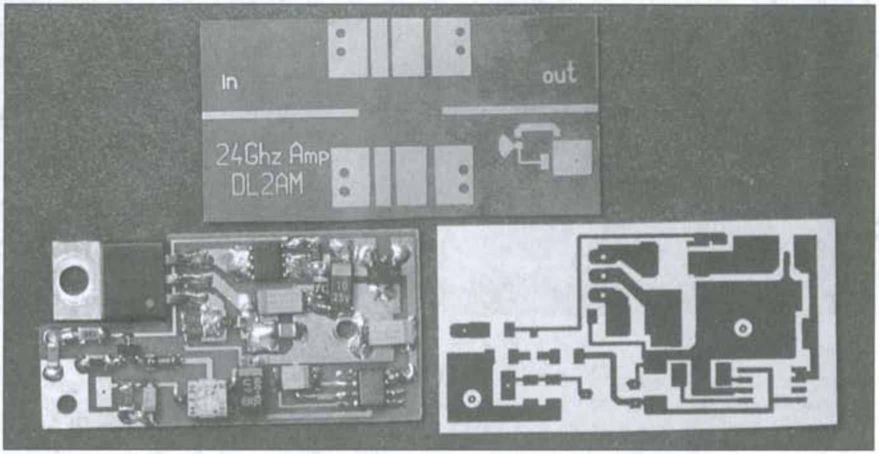


Fig. 3: DCpart PCB and layout (bottom) and RF PCB (top)

Now we can apply +11 to 13 V DC to the DC feedthrough. Then we should measure about +6.5 V at the low voltage drop stabiliser and at the slider of potentiometer P1 a voltage adjustable from 0 to about -3.5 V. If this is not possible we first have to locate the mistake. Also check if the +6.5V drain voltage at the low drop stabiliser on pin 2 is dropping to 0.1 V or less if the negative voltage fails. To do this briefly connect a resistor of about 20 Ohm from Pin 1 of the MAX 861 to ground. This procedure is necessary in order to be able to check the protection circuit for the drain voltage when the negative gate voltage is missing and to prevent a higher inrush current than the adjusted bias current. Afterwards the potentiometer should be set to the maximum negative voltage.

Fig. 4: Checking all carefully

RF test

Now the components can be fitted to the RF board. See the circuit diagram. For the connections from the RF input and output very small tapered copper foil strips can be cut and soldered between the 50 Ohm striplines and the chip. This soldering work can be done only with the help of a magnifying glass of at least 4 dioptres. Beware of short circuits. The RF input and output of the chip are high resistance and can be checked easily. See fig. 4. The bridge from the DC supply to the chip can be made with solder as the distances are small.

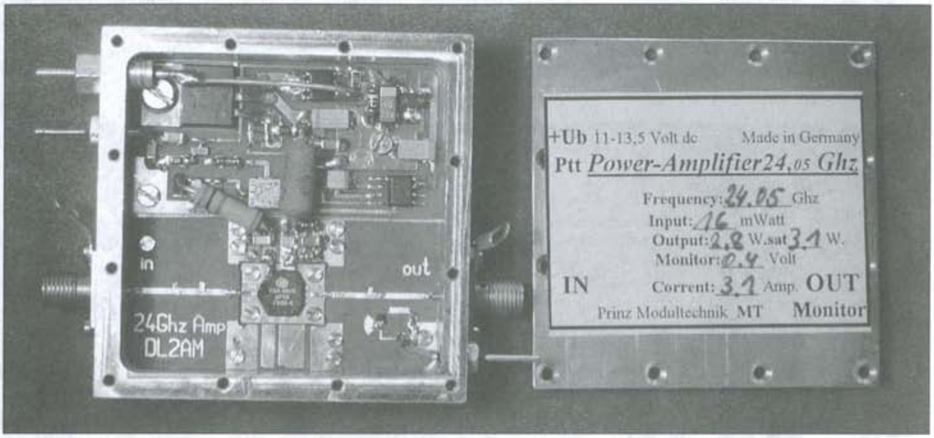


Fig. 5: 24 GHz Ampfifier

Now RF testing can start. Set the bias current to about 2.1 A, which corresponds to about -0.7V at the chip. The current limit of the power supply should be set to 3.5 A. Now one can apply 5 mW of drive on 24 GHz. It will be necessary to add one tuning flag at both the input and output. The flags should be small, about 1.0 x 0.5 mm. With these tuning flags you can tune for maximum output. You have to do this very carefully as the input and output matching is not very good and the device current can very quickly exceed the maximum. If fitting the cover results in oscillation, glue some absorbing foam under the cover. Figure 5 shows the completed amplifier. Figure 6 shows the measured results of input vs. output power. Data sheets are available on the web at www.triquint.com.

Acknowledgement

I want to thank Werner Nägele, DK5TZ, for manufacturing the PCB.

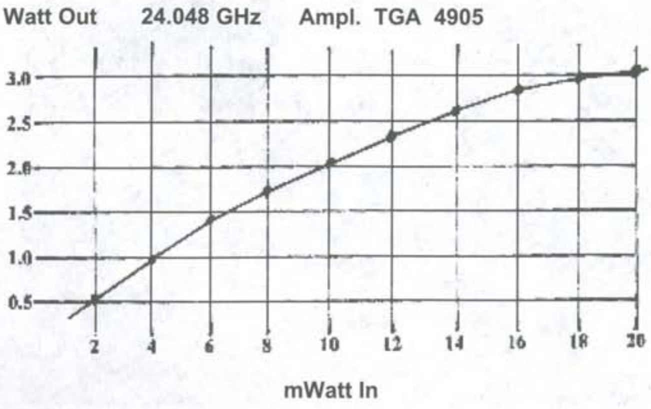


Fig. 6

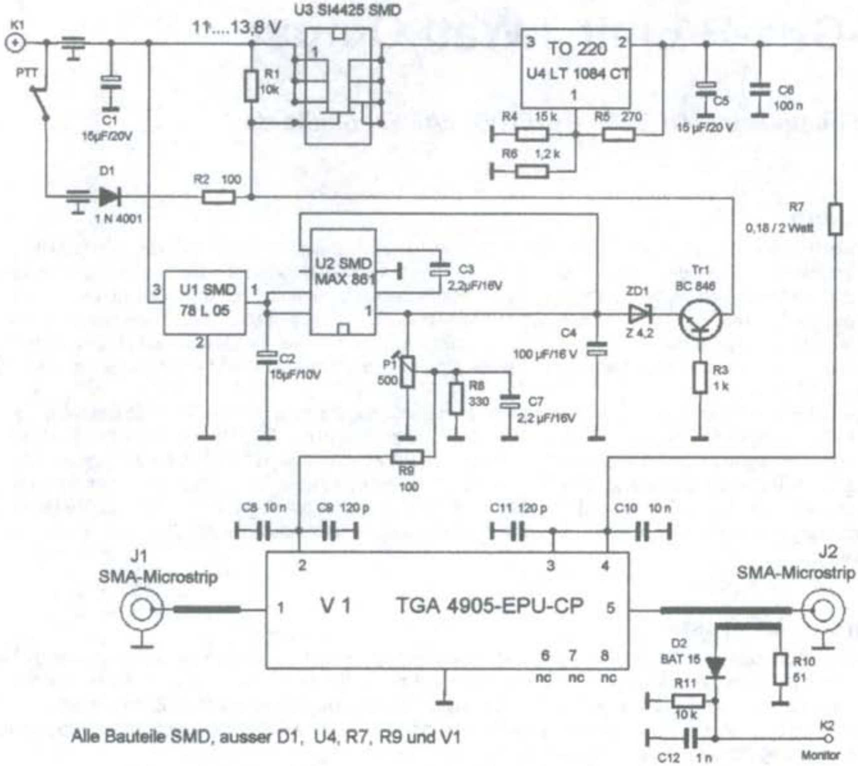


Fig. 7: Circuit diagramm – all parts SMD except D1, U4, R7, R9 and V1

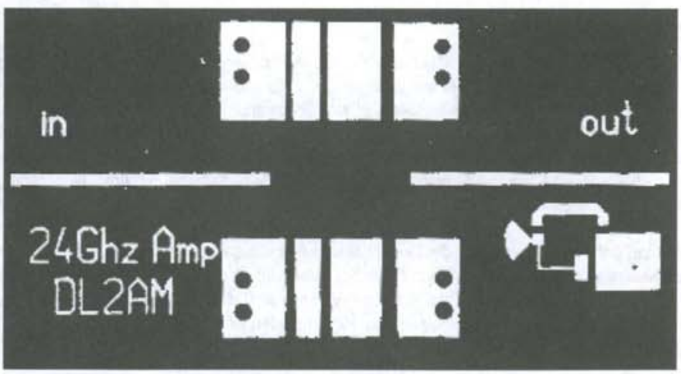


Fig. 8: RF PCB layout – not to scale

24-GHz-PA mit 3 Watt Output

von Philipp Prinz, DL2AM - prinz.DL2AM@t-online.de

Einleitung

Für 24 GHz-Aktivisten oder, die es noch werden wollen, ist dieser nachstehend beschriebene Verstärker sicher von Interesse. Für diesen Verstärker benutze ich den TGA 4905 CP von TriQuint. Dieser bringt 23 dB Gain bei 2 Watt out, die maximale Ausgangsleistung ist 3 Watt. Wenn ich bei diesem Chip das Preis- Leistungsverhältnis betrachte und mit 10 GHz vergleiche, so ist dieser sehr günstig. Die Ein- und Ausgangs-Anpassung liegt nicht gerade hoch bei 8 - 10 dB und die Betriebsspannung ist 6,5 Volt und - 0,8 Volt bei 3 Amp. Als Gehäusematerial wählte ich aus thermischen Gründen Kupfer. Ein Gehäuse aus Alu geht auch, wenn der Boden kräftig genug ist (8 mm). Beim Bohren und Gewindeschneiden braucht man bei Kupfer schon großes Bohr- und Schneidgefühl bei M 1,4 Gewinde.

Deswegen hat Hubert Krause www.micro-mechanik.de mir auch die Kupfergehäuse angefertigt. Die Maße dieses Gehäuses sind: außen 58 x 58 mm, innen 50 x 50 mm, die Tiefe 13 mm und die Gesamthöhe 19 mm. Die SMA-Buchsen sollten Stripline sein. Die HF-PCB ist üblicherweise mit 2-Komponenten-Silberleitkleber eingeklebt und wird bei 110 ° 1 Std. erhitzt (Bügeleisen / Herdplatte), siehe Foto 1. In das Gehäuse lege ich eine Silikon-Platte und darauf eine passende Hartholzplatte oder Aluplatte und presse dies zusammen, siehe Foto 2. Die Aussparung für den Chip schneide ich mit dem Skalpell vorsichtig aus. Die Unterseite der Chip-Ausfräsung muß sehr sauber sein und darf keine Vertiefungen aufweisen. In der Mitte des Chip bringe ich ein wenig Wärmeleitpaste an.

Die ersten DC-Tests

Diese Tests haben ergeben, daß unbedingt die 6,5 Volt Versorgungs-Spannung beim Anlegen der Betriebsspannung so lange 0 Volt sein muß, bis die negative Spannung das Soll erreicht hat. Bei den üblichen DC-Versorgungen ist dies nicht der Fall, da stehen immer noch 1,2 Volt am Low-Drop-Regler an. Ich fertigte eine neue DC-PCB an, die diese Eigenschaften hat und somit war das Problem behoben. Dieser Schaltungszusatz hat noch den Vorteil, daß eine PTT-Einrichtung gemacht werden kann. Beim Bayerischen Bergtag-Contest ist dies wichtig (kein Stromverbrauch bei Empfang).

Nach dem Einbau der DC-PCB muß eine sorgfältige Überprüfung aller Teile optisch und ohmsch vorgenommen werden, siehe Foto 3. Nun kann 11-13 Volt an die DC-Durchführung angelegt werden. Daraufhin sollte am Low-Drop-Regler an PIN 2 ca. + 6,5 Volt anliegen und am Poti P 1 am Ausgang 0 bis ca. minus 3,5 Volt einstellbar anliegen. Wenn dies nicht möglich ist, muß zuerst der Fehler behoben werden. Auch muß kontrolliert werden, ob die + 6,5 Volt-Drain-Spannung am Low-Drop-Regler an Pin 2 bei Ausfall der negativen Spannung auf mindestens 0,1 Volt abfällt. Dazu muss ein Widerstand von ca. 20 Ohm vom Ausgang des MAX 861 Pin 1 gegen Masse gehalten werden. Diese Maßnahme ist notwendig, um die gut wirkende Schutzschaltung (Drainspannungsabschaltung) bei fehlender negativer Gate-Spannung, und Verhinderung eines erhöhten Einschaltstromes als der eingestellte Ruhestrom, kontrollieren zu können. Anschließend ist das Poti auf größte negative Spannung zu stellen.

Der HF-Test kann beginnen

Nun kann die HF-Platine bestückt werden, siehe Schaltplan. Für die Verbindungen vom HF-Ein- und Ausgang können ganz spitze Kupferplättchen geschnitten und zwischen 50 Ohm-Leitungen und Chip angelötet werden. Diese Lötarbeiten können nur unter einer Lupe mit minimal 4 Dioptrien vorgenommen werden. Achtung Kurzschluß! Der HF-Aus- und Eingang des Chip ist hochohmig und kann somit leicht nachgeprüft werden. Siehe Foto 4. Die Brücke von der DC- Versorgung zum Chip kann mit Zinn gemacht werden, wenn die Abstände klein sind. Jetzt kann der erste HF-Test beginnen. Den Ruhestrom stellt man auf ca. 2,1 Amp. ein, das sind ungefähr - 0,7 Volt am Chip. Die Strombegrenzung des Netzteils sollte bei 3,5 Amp. eingestellt sein. Nun kann mal mit 5 mWatt bei 24 GHz angesteuert werden. Es ist nötig, am Ein- und Ausgang je ein Tuning-Fähnchen anzubringen. Diese sollten sehr klein und schmal sein, ca. 1 x 0,5 mm. Mit diesen Tuning-Fähnchen kann auf maximale Leistung abgeglichen werden. Es ist sehr vorsichtig dabei vorzugehen, da die Eingangs- und Ausgangsanpassung nicht besonders gut ist und der Strom sehr schnell über das Maximum ansteigen kann. Wenn durch Schließen des Deckels eine Gehäuse-Resonanz auftritt, muß unter den Deckel Leitgummi geklebt werden. Foto 5 zeigt den fertigen Verstärker. Das Leistungs-Diagramm zeigt die erreichten Werte, siehe Abb. 6. Die Datenblätter können unter www.triquint.com runtergeladen werden.

Danksagung

Bedanken möchte ich mich bei Werner Nägele, DK5TZ, für das Anfertigen der PCB.

Sun Noise Measurement

by Rex Moncur, VK7MO

Because of the statistical variability of noise it is not possible measure sun noise to much better than about 0.5 dB (at 95% confidence) in SSB bandwidth receivers with a typical analogue or digital multimeter. However, if you are set up for Digital Modes with an interface from your receiver to a computer with a sound card, Owen Duffy, VK1OD, has produced a program that can integrate the noise over much longer periods and achieve resolutions well below 0.1 dB. Owen's program is designed to provide accurate measurements of noise figure and is called NFM for Noise Figure Meter. NFM can be downloaded at:

http://www.vk1od.net/nfm/

While NFM is aimed at Noise Figure measurement it includes a high resolution true RMS audio voltmeter, calibrated in dB, which can be used for sun noise measurements. While one must take care to operate the program in a region where you system is linear it avoids the errors of using an attenuator where the inevitable change of impedance will introduce errors. In its unregistered version the program integrates noise for up to 0.5 seconds but for a nominal fee one can extend this to 100 seconds and improve the resolution at the 95% confidence level to well below 0.1 dB. Owen provides information on the relationship between resolution and integration time, bandwidth and confidence level at the following URL.

http://www.vk1od.net/fsm/nmu.htm

For sun noise measurement all one needs to do is set the integration time in the box marked "Interval (s)" in the top Yellow area of the program to an appropriate value, say 30 seconds. Then point the antenna at cold sky and press the "1 Noise LO" button which will produce a cold sky measurement in a bit over 30 seconds; then point to the Sun and press the "2 Noise HI" button which will after a similar period give the sun noise measurement. The sun noise in relation to cold sky or Y factor measurement is then shown under the box identified as "Y(2) (dB)".

As sun noise varies as a function of Solar Flux one needs to know the actual Solar Flux at your frequency of operation and Owen has produced a useful tool for interpolating this from data provided by NOAA derived from various solar observatories around the World. You can access this tool at:

http://www.vk1od.net/qsrf/index.htm

If you feed the Solar Flux into a program such as VK3UM's, EME Calculator with your station parameters it will give you the expected sun noise rise which can be compared to your measured sun noise rise as an indicator of station performance. Doug's program can be downloaded at:

http://www.vk3bez.org/vk3um_software.htm

NFM can also be used to assist measurement of antenna patterns at microwave frequencies using sun noise as the signal. Figure 1 is an example of the pattern of VK7MO's 2.3 metre dish at 2.3 GHz plotted from noise measurements made with NFM.

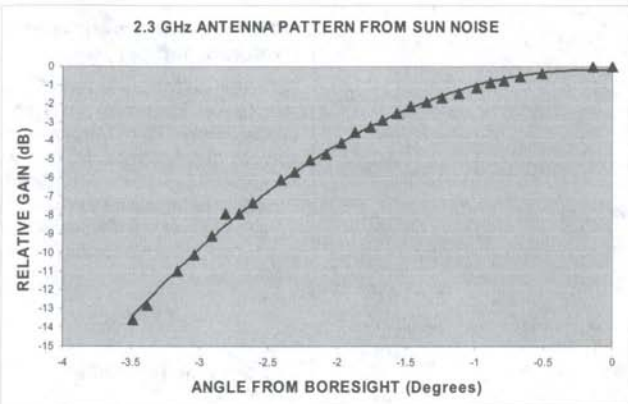


Fig. 1: Example of Antenna Pattern plotted from sun noise measurements with NFM

Messung des Sonnenrauschens

von Rex Moncur, VK7MO

Wegen der statistischen Variabilität des Rauschens ist es nicht möglich, Sonnenrauschen viel genauer als auf etwa 0,5 dB (bei 95% Vertrauen) mit Empfängern in SSB-Bandbreite und einem typischen anlogen oder digitalen Voltmeter zu bestimmen. Wenn man jedoch für die digitalen Betriebsarten ausgerüstet ist und ein Interface vom Empfänger zu einem Computer mit einer Soundkarte besitzt, kann man mit Hilfe eines Programms von Owen Duffy, VK1OD, das Rauschen über einen längeren Zeitabschnitt integrieren und Genauigkeiten von unter 0.1 dB erreichen. Owens Programm wurde entwickelt, um genaue Messungen der Rauschzahl zu ermöglichen und es heisst NFM für Noise Figure Meter. NFM kann heruntergeladen werden unter:

http://www.vk1od.net/nfm/

NFM zielt ab auf das Messen der Rauschzahl und beinhaltet ein hochauflösendes Echt-RMS Audiovoltmeter, das für Messungen des Sonnenrauschens benutzt werden kann. Während man dafür Sorge tragen muss, dass das Programm in einem Bereich läuft, wo das eigene System linear arbeitet, vermeidet es Fehler durch Verwendung eines Abschwächers, die unausweichlich durch Impedanzänderungen entstehen. In der unregistrierten Version integriert das Programm das Rauschen über bis zu 0.5 Sekunden, aber für eine Registrierungsgebühr kann dies auf bis zu 100 Sekunden ausgedehnt werden und verbessert die Auflösung bei 95% Vertrauensniveau auf besser als 0.1 dB. Owens liefert Informationen über die Beziehung zwischen Auflösung und Integrationszeit, Bandbreite und Vertrauensniveau unter der folgenden URL:

http://www.vk1od.net/fsm/nmu.htm

Für ein Messen des Sonnenrauschens ist alles, was man tun muss, die Integrationszeit im Kasten, der mit "Interval (s)" bezeichnet ist, im oberen gelben Bereich des Programms, auf einen angemessenen Wert von, sagen wir, 30 Sekunden zu setzten. Dann die Antenne auf den kalten Himmel ausrichten und "1 Noise LO" anklicken, was eine Messung des Rauschens des kalten Himmels über 30 Sekunden auslöst; dann die Antenne auf die Sonne ausrichten und auf "2 Noise HI" klicken, was nach einer gleich langen Periode die Messung für das Sonnenrauschen ergibt. Das Sonnenrauschen in Relation zu kaltem Himmel oder Y-Faktor-Messung ist dann gezeigt unter dem Kasten bei "Y(2) (dB)".

Da das Sonnenrauschen eine Funktion des solares Fluxes ist, muss man den aktuellen Solaren Flux für seine Arbeitsfrequenz kennen und Owen hat eine nützliches Hilfsmittel geschaffen, was dies aus Daten, die von der NOAA geliefert werden, interpoliert. Die NOAA bekommt diese Daten von verschiedenen Observatorien rund um die Welt. Zu diesem Hilfsmittel hat man Zugang unter:

http://www.vk1od.net/qsrf/index.htm

Wenn man den Solaren Flux in ein Programm wie VK3UMs EME-Calculator zusammen mit den eigenen Stationsparametern eingibt, errechnet es das zu erwartende Sonnenrauschen, das mit dem gemessenen Sonnenrauschen verglichen werden kann, als ein Indikator für die Leistungsfähigkeit der eigenen Station. Dougs Programm kann man herunterladen unter:

http://www.vk3bez.org/vk3um_software.htm

NFM kann auch dazu verwendet werden, bei der Bestimmung von Antennendiagrammen auf Mikrowellenfrequenzen zu helfen, wobei das Sonnenrauschen als Signal dient. Abb. 1 ist ein Beispiel eines Diagramms von VK7MOs 2.3m-Spiegel auf 2,3 GHz, errechnet aus mit NFM durchgeführten Rauschmessungen.

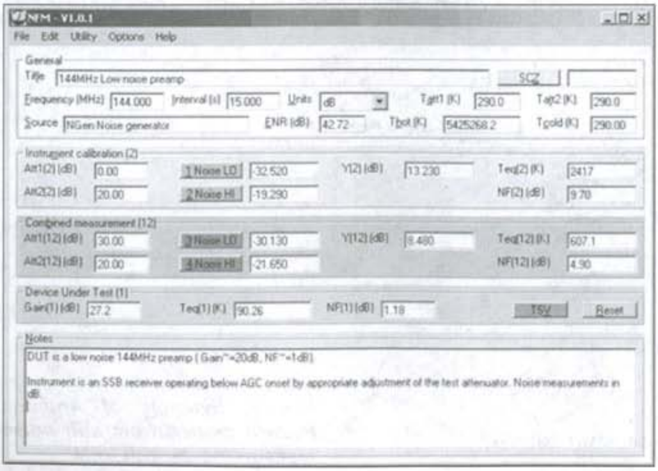


Fig. 2: Screenshot NFM © VK1OD

Backscatter on Satellites: A Reality

Jean-L. Rault, F6AGR - f6agr@orange.fr

Introduction

Backward or forward scattering from artificial satellites or space stations with amateur means is a subject which has been debated for many years. However, it seems that no documented experiment and/or audio records have ever been made available up to now to prove that such a propagation mode is effectively possible using amateur-type equipment.
So I decided in 2001 to test such a propagation mode, using a detailed and well defined test protocol. The results of some preliminary link budget computations gave a little encouragment. Using the Russian MIR space station as the radio reflector, in 2001 I started a test campaign with Philippe Martin, F6ETI and after several adjustments, we finally got perfectly audible space echoes in CW mode on 144 MHz.

The target

The largest available space 'bird' in 2001 was the Russian MIR station. So we decided to use it for our experiments on 144 MHz, knowing that MIR was programmed to decay and burn up in the upper atmosphere during the first months of that year. With no more cosmonauts on board, we were then reducing the risk of disturbing any ground/space radio links (The MIR cosmonauts were frequently using VHF links when they were flying over their STOUP ground control station located near Moscow).

Experiment parameters

Link budget

According to the equipment available at both our stations, the following radio link budget link was estimated.

Transmitting station (F6ETI)	
RF power ouput	300 W
Antenna gain (linear polarisation)	13 dBi
Cable loss	1.5 dB
Transmitting frequency	144.1 MHz
Target distance	400 km
Target	
MIR Equivalent radar surface	30 m^2
Receiving station (F6AGR)	
Antenna gain (RH or LH circular polarisation)	15 dBi
Cable loss	2 dB
Noise factor	1 dB
Receiving bandwidth	10 Hz
Target distance	400 km
Circular versus linear polarisation loss	-3 dB
Link budget result	
Signal to noise ratio	+ 3.3 dB

Ground stations and target location

Both ground stations have to be located at a proper distance: if they are too close, the ground wave transmitted by the station A will be strongly received at the station B and any space echo may be obscured by the incoming direct ground signal. If the stations are too far away from each other, the space target will not be seen at the same time by the two stations.
During the test period, the MIR altitude was about 350 km, so the distance between F6ETI and F6AGR (about 450 km) was considered as correct for such a MIRror experiment.

Tracking the target

Many satellite tracking programmes are available on the Internet, whose purpose is to determine the exact positions of many satellites at any time. Winorbit 3.6 for exemple, developped by Carl Gregory, K8CG, is a user-friendly freeware program which can be downloaded from www.amsat.org/amsat/ftpsoft.html#win-trk.

Such software needs up-to-date satellite Keplerian elements to deliver accurate target data such as azimuth, elevation and Doppler frequency shift, information which is essential to point the transmitting and receiving aerials in the right direction and to tune the receiver to the right frequency. Such fresh Keplerian elements (keps) can be downloaded each week from http://www.amsat.org/amsat/keps/menu.html.

Time reference

A good time reference is essential for both ground stations to point their aerials to the right direction at the right time. The duration of a satellite pass such as MIR is about 1 to 10 minutes each 90 minutes, and the PC clock must be precisely adjusted. The best way to get accurate time is to synchronise the internal PC clock to one of the atomic time servers freely available on the Internet. For such a task, a simple and effective freeware program such as Dimension4, is perfect. Dimension4 is downloadable from www.thinkman.com/dimension4/ Using such time servers permits an accuracy of a few tens of milliseconds which is good enough for our experiments.

Picture 1: 144 MHz transmitting aerial

Doppler frequency shift

The Doppler shift of the reflected signals on a fast moving target has to be carefully taken into consideration. The total Doppler shift is the sum of the uplink and the downlink Doppler shifts. Let's consider for exemple a case where the satellite is approaching both stations. First, the signal received by the satellite is positively shifted, for exemple + 2 kHz, (depending on the relative speed between the approaching target and the transmitting station). That positively shifted signal is then reflected to the receiving station, and so it is affected again by another Doppler shift depending on the relative speed between the target and the receiving station, for exemple + 3 kHz. Thus the total Doppler shift is + 5 kHz and the receiver VFO will have to be adusted 5 kHz higher than the transmitting frequency. For a space station like MIR or the ISS flying at 7 km/s, the maximum total Doppler shift can be about + or – 6 kHz on 144 MHz (that is +/- 18 kHz on 432 MHz and more than +/- 400 kHz on 10 GHz). So it is essential to predict and to correctly time stamp the expected frequency shifts. If not, the task of finding a weak echo whose frequency is not well known will be a very difficult challenge!

		F6ETI/IN87iq							F6AGR /	JN18dq	
Date	**Time**	**Az**	**El**	**F6ETI/ MIR Doppler**	**F6ETI/MIR range(km)**	**Az**	**El**	**F6AGR/ MIR Doppler**	**F6AGR/ MIR range(km)**	**Total Doppler @F6AGR**	**Doppler variation (Hz/sec)**
21/02/2001	20:59:50	203	4	3003	1505	218	1	3272	1810	6275	-
21/02/2001	21:00:00	201	4	2957	1443	217	1	3257	1742	6214	-12.2
21/02/2001	21:00:10	200	5	2905	1382	216	2	3240	1675	6145	-13.8
21/02/2001	21:00:20	198	6	2844	1322	215	3	3219	1607	6063	-16.4
21/02/2001	21:00:30	196	7	2775	1264	214	3	3196	1541	5971	-18.4
21/02/2001	21:00:40	194	8	2695	1207	213	4	3169	1474	5864	-21.4
21/02/2001	21:00:50	192	8	2603	1151	212	5	3138	1409	5741	-24.6
21/02/2001	21:01:00	189	9	2497	1098	211	6	3101	1344	5598	-28.6
21/02/2001	21:01:10	186	10	2374	1048	209	7	3058	1280	5432	-33.2
21/02/2001	21:01:20	183	11	2231	1000	208	7	3009	1216	5240	-38.4
21/02/2001	21:01:30	180	12	2068	955	206	8	2950	1154	5018	-44.4
21/02/2001	21:01:40	176	13	1880	914	204	9	2881	1094	4761	-51.4

Table 1

Test protocol

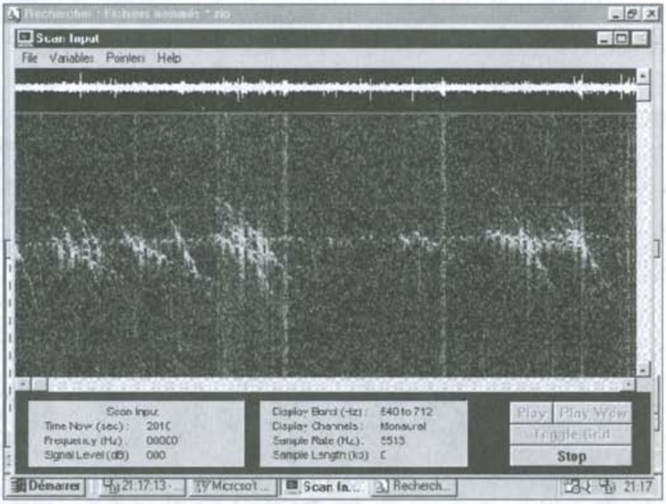
The test protocol we used for the MIRror experiment was as follows:

1) Predicting with Winorbit 3.6 the satellite passes which should give the best chances of positive results (that is eliminating the passes which are too low over the horizon and choosing the passes where the target is as close as possible of both ground stations).

2) Computing and printing a table giving at ten second intervals the precise azimuth and elevation of the target during an entire pass, to allow both stations to properly point their antennas (Note that sophistated stations can nowadays use fully automatic systems. In that case, the Az/El antennas rotors and the transmitter and receiver VFOs can be automatically computer driven)

3) Computing and printing a table giving at ten second intervals the precise Doppler shift at the receiving station (to simplify the test, it was decided to transmit with a fixed frequency). Table 1 summarizes all the data necessary for a test.

4) Running the test: It is recommended to record the audio output of the receiver so the results can be analysed after the satellite pass at leisure. Spectrum analysis software is also highly desirable to help the operator to visualize any weak echoes. During an actual pass and when using a manually operated station, the receiving operator becomes very busy and quite stressed, and tends to look like Shiva the Indian god. He has to simultaneously control the azimuth and elevation rotors, constantly look at the time display, continuously adjust the receiver VFO (the frequency drift speed can reach 100 Hz per second on 144 MHz) and listen carefully during the few minutes of the pass to any audio weak CW signal! Spectrum Lab, developped by DL4YHF is a very helpful freeware program developed by Wolfgang Büscher. It can be downloaded from www.qsl.net/dl4yhf. Spectrum Lab is able to display real time audio spectrum analysis, and to record simulteously audio .wav files, which is useful for further potential echo analysis.

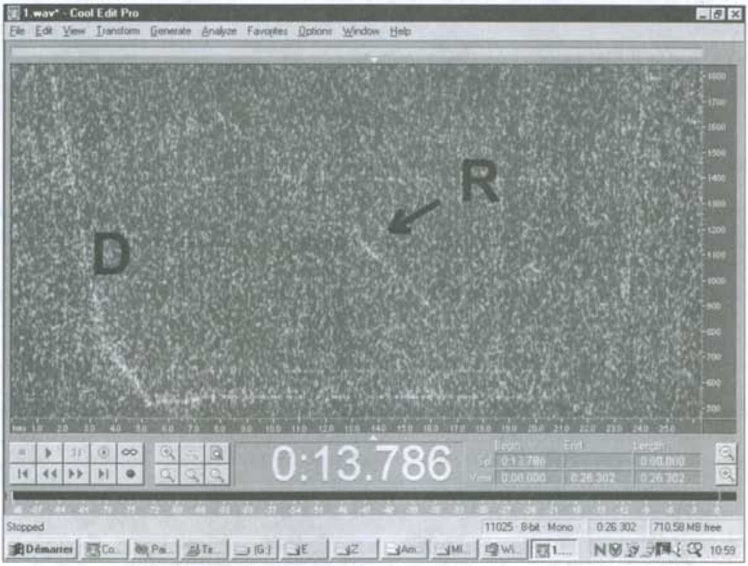


Picture 2: Exemple of tropospheric signals and aircraft scatter received during the tests

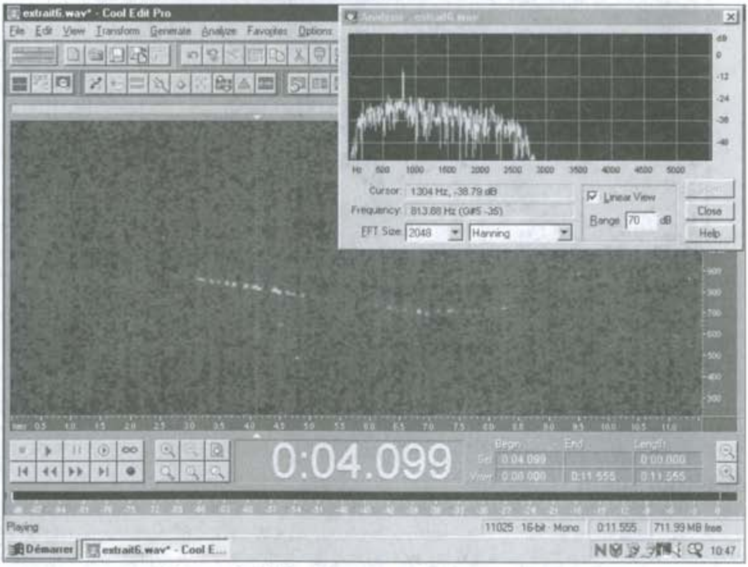
The MIRror experiment

Philippe, F6ETI used for his transmissions a 9 element Yagi beam installed on an EME AzEl mount (see picture 1). He was running about 300 W RF ouput and using an Elbug to transmit automatically his CW calls at 80 wpm. So he had only to deal with its antenna positioning controls during the MIR pass. On my side, I used an Oscar-class station fitted with a circularly polarised 12 element Yagi (RHCP or LHCP) already in use for conventional contacts via amateur satellites. The 144 MHz antenna was followed by a masthead preamplifier (NF: 0.7 dB). The receiver was an ICOM IC-821H. Picture 2, shows a spectral analysis of some preliminary transmissions by F6ETI on 144.100 MHz. The horizontal line corresponds to the F6ETI signal transmitted from Britanny and received by F6AGR near Paris via tropospheric scatter. The slanted lines are echoes from aircraft. They show by a descending Doppler shift which corresponds to target speeds of about 400 knots.

The first echoes reflected by MIR were received on February the 21st, 2001 at 21h 37m 32s UTC, when MIR was at its CPA (closest point of approach). The signal was faintly audible, but not really decodable (see picture 3) because the transmission speed was around 80 wpm. The D spectral line is the troposcatter signal (changing frequency is due to some manual VFO adjustment), and the R line, with the expected negative slant of 94 Hz/s is the signal reflected from MIR. After such an encouraging result, we decided to continue the tests during the next evening.



Picture 3: First faint MIR scatter echoes



Picture 4: MIR echoes received on 22/06/2001

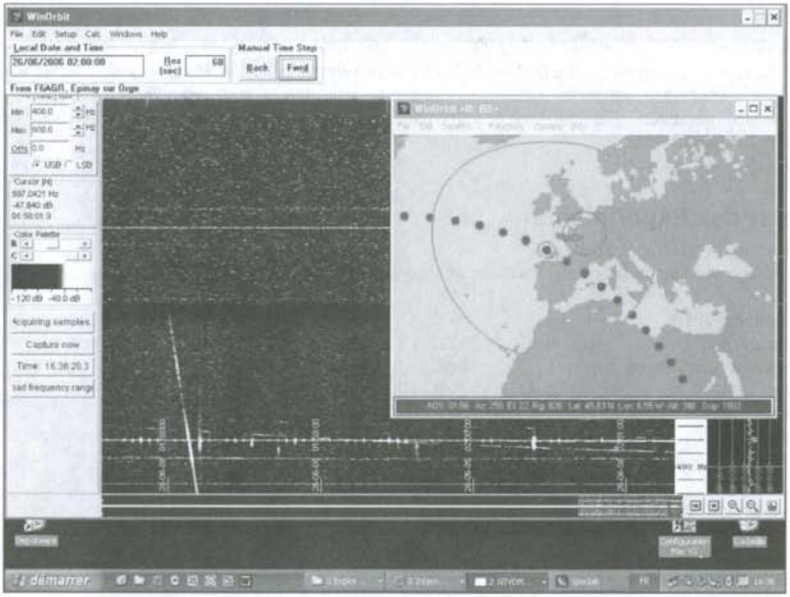
Much better echoes were captured (see picture 4) at 21h 38m 52s on the 22nd of February 2001. The CW speed was slowed down to 20 wpm, which helped with decoding the message in real time by ear. The Doppler shift due to the fast moving target was again as predicted. The signal to noise ratio was good enough (up to + 12 db) to allow good decoding by ear. An audio record of these echoes can be downloaded from http://www.dd1us.de/historical%20sounds%20from%20space.html

Surprisingly, these echoes were captured when MIR was low on the horizon, and far away from the two ground stations. Picture 5, computed by Winorbit 3.6 shows that MIR was flying over North Germany when the highest amplitude echoes occurred. It means that it was backscatter, rather than forward scatter. One supposition about the high amplitude of the echoes is that they were specular reflexions on the large flat solar panels of the Russian space station.

Picture 5: Location of MIR when the strongest echoes were received

Discussion

This MIRror experiment clearly shows that satellite scatter is possible with simple amateur equipment. It was not possible to perform further tests in 2001 because MIR decayed rapidly and burnt in the upper atmosphere over the Pacific Ocean. In 2007, such tests with the ISS (International Space Station) should give better results, because the ERS (Equivalent Radar Surface) of the ISS is much higher than the one of MIR. For those who are not familiar with satellite tracking and spectrum analysis software, it is easy nowadays to use the French GRAVES radar for training purposes. GRAVES, a french Space Surveillance system radar, is transmitting 24 hours a day a CW signal on 143.050 MHz.
(See: www.fas.org/spp/military/program/track/graves.pdf).
Due to the impressive ERP in use on GRAVES, many satellite echoes can be easily received (see picture 6 showing ISS echoes received from GRAVES on the 26th of June 2006). Even strong Moon echoes can be received with low gain receiving antennas, so GRAVES is a perfect tool for training beginners. Amateur satellite scatter is a wide field for experimentation: testing various targets, trying other frequencies, playing with various tracking tools and spectrum analysis software: so may beautiful girls, so little time, sigh!



Picture 6: ISS echoes using GRAVES radar as transmitter

Backscatter an Satelliten: Eine Realität

Jean-L. Rault, F6AGR - f6agr@orange.fr

Einleitung

Rückwärts – oder Vorwärts-Scatter an künstlichen Satelliten oder Raumstationen mit Amateurmitteln ist ein Thema, das seit vielen Jahren diskutiert wird. Anscheinend gibt es bisher aber kein dokumentiertes Experiment und/oder Audiofile, das verfügbar gemacht wurde, um zu beweisen, dass solch ein Übertragungsmodus effektiv unter Verwendung von amateurtypischem Gerät möglich ist. Deshalb beschloss ich im Jahr 2001, diese Ausbreitungsart mittels eines detaillierten und gut festgelegten Testprotokolls zu untersuchen. Einige vorab angestellten Berechnungen der zu erwartenden Signalstärken über diese Strecke ergaben wenig aussichtsreiche Ergebnisse. Unter Verwendung der russischen Raumstation MIR als Reflektor haben wir 2001 eine Testreihe mit Philippe Martin, F6ETI, durchgeführt und nach einigen Feineinstellungen haben wir schließlich perfekt hörbare Echos aus dem Weltraum in CW auf 144 MHz erhalten.

Das Ziel

Der größte verfügbare Vogel im Weltraum im Jahr 2001 war die MIR-Station. Deshalb entschieden wir, sie für unser Experiment auf 144 MHz zu verwenden, wissend, dass die MIR dafür vorgesehen war, in den ersten Monaten dieses Jahres abzusinken und in der oberen Athmosphäre zu verglühen. Ohne Kosmonauten an Bord gab es auch keine Gefahr, irgendwelche Erde-MIR-Funkkommunikation zu stören. (Die MIR-Kosmonauten haben oft VHF-Kanäle verwendet, wenn die über ihrer STOUP-Bodenstation nahe Moskau waren.)

Parameter des Experiments

Berechnung der Signalstärke über die Strecke.
Anhand der verfügbaren Technik bei beiden Stationen, wurde die folgende Bilanz für die Signalstärke abgeschätzt.

Sendende Station (F6ETI)	
HF Power Ouput	300 W
Antennengewinn (lineare Polarisation)	13 dBi
Kabelverluste	1.5 dB
Sendefrequenz	144.1 MHz
Entfernung zum Ziel	400 km
Ziel	
MIR Äquivalente Radaroberfläche	30 m2
Empfangende Station (F6AGR)	
Antennengewinn (R oder L zirkulare Polarisation)	15 dBi
Kabelverluste	2 dB
Rauschfaktor	1 dB
RX-Bandbreite	10 Hz
Entfernung zum Ziel	400 km
Polarisationsverlust zirkular zu linear	3 dB
Ergebnis	
Signal-Rauschverhältnis	+ 3.3 dB

Bodenstationen und Ort des Ziels

Beide Bodenstationen müssen in einer günstigen Entfernung liegen: Wenn sie zu nahe sind, wird die Bodenwelle von Station A sehr stark von der Station B empfangen und kann eventuell das Echo aus dem Raum total überdecken. Wenn die Stationen zu weit auseinander liegen, wird das Ziel im Weltraum von beiden Stationen nicht gleichzeitig gesehen. Während der Testperiode betrug die Höhe der MIR etwa 350 km, so dass die Entfernung von F6ETI zu F6AGR (etwa 450km) als korrekt für solch ein „MIRror"-Experiment angesehen wurde.

Verfolgung des Ziels

Es gibt viele Programme für die Bahnverfolgung von Satelliten im Internet, um deren exakte Position zu jeder Zeit bestimmen zu können. Z.B. Winorbit 3.6., entwickelt von Carl Gregory, K8CG, ist ein bedienerfreundliches Freeware-Programm, das man sich herunterladen kann unter www.amsat.org/amsat/ftpsoft.html#win-trk .
Solche Software benötigt aktuelle Kepler-Elemente für die Satelliten, um genaue Zieldaten, wie Azimut, Elevation und Dopplerverschiebung liefern zu können, was unbedingt nötig ist, damit man die Antennen der sendenden und empfangenden Station in die richtige Richtung drehen und den Empfänger auf die richtige Frequenz stellen kann. Solche aktuellen Kepler-Elemente („keps") kann man wöchentlich herunterladen unter www.amsat.org/amsat/keps/menu.html .

Zeitreferenz

Eine gewisse Zeitreferenz ist essentiell für beide Bodenstationen, damit die Antennen zur richtigen Zeit in die richtige Richtung stehen. Die Dauer eines Durchgangs bei der MIR betrug 1 bis 10 Minuten alle 90 Minuten und die PC-Uhr muss genau gestellt sein. Der beste Weg seine PC-Uhr akkurat laufen zu lassen, ist die Synchronisation mit Atomuhren über das Internet, was kostenlos möglich ist. Für den Zweck gibt es die einfache und effektive Software „Dimension 4" (D4), die kostenlos heruntergeladen werden kann unter http://www.thinkman.com/dimension4/ . Jeder WSJT-User hat sowas heutzutage sowieso auf seinem PC laufen. Die Verwendung solcher Zeitserver aus dem Web ergibt eine Genauigkeit von einigen Millisekunden auf dem PC, was für unsere Experiment gut genug ist.

Dopplerfrequenzverschiebung

Die Dopplerfrequenzverschiebung des reflektierten Signals an einem sich schnell bewegenden Objekt muss sorgfältig berücksichtigt werden. Die gesamte Dopplerfrequenzverschiebung ist die Summe der Verschiebungen bei Uplink und Downlink. Nehmen wir einen Fall an, bei dem der Satellit auf beide Stationen zukommt. Zuerst wird das Signal, das vom Satelliten „empfangen" wird, positiv verschoben, z.B. + 2 kHz, abhängig von der relativen Geschwindigkeit zwischen dem sich nähernden Ziel und der sendenden Bodenstation. Dieses positiv verschobene Signal wird dann zur empfangenden Station reflektiert und unterliegt so nochmals einer weiteren Dopplerverschiebung, abhängig von der relativen Geschwindigkeit zwischen dem Ziel und der empfangenden Bodenstation, z.B. + 3 kHz. Folglich beträgt die gesamte Dopplerverschiebung + 5 kHz und der VFO am Empfänger muss um 5 kHz höher als die Sendefrequenz eingestellt sein. Für eine Raumstation wie die MIR oder ISS, die mit 7 km/s fliegen, beträgt die maximale totale Dopplerverschiebung etwa + oder – 6 kHz auf 144 MHz (das ergibt +/- 18 kHz auf 432 MHz und mehr als +/- 400 kHz auf 10 GHz). Es ist also ganz wichtig, die erwarteten Dopplerverschiebungen über die Zeit richtig vorauszuberechnen. Wenn man das nicht tut, wird die Angelegenheit ein schwaches Echo zu finden, dessen Frequenz nicht genau bekannt ist, eine sehr schwierige Herausforderung!

Testprotokoll

Das Testprotokoll, das wir für die MIRror-Experimente verwendet haben, sah so aus:
1) Vorhersage der Durchgänge mit Winorbit 3.6., bei denen die besten Chancen für positive Ergebnisse zu erwarten waren (d.h. die Durchgänge, die zu tief über dem Horizont sind, weglassen und Wählen von Durchgängen, wo das Ziel so dicht wie möglich an beiden Bodenstationen heran war).
2) Berechnung und Ausdruck einer Tabelle, die alle 10 Sekunden den genauen Azimuth und Elevation des Zieles für den gesamten Durchgang angibt, um beiden Stationen die genaue Ausrichtung der Antennen zu ermöglichen. (Anmerkung: Gut ausgerüstete Stationen können heutzutage vollautomatisch die Antennen mit Az/El. nachführen und die TX- und RX-VFOs können automatisch vom PC gesteuert werden.)
3) Berechnung und Ausdruck einer Tabelle, die alle 10 Sekunden die genaue Dopplerverschiebung für die Empfangsstation angibt. (Um den Test zu vereinfachen, wurde entschieden, immer auf einer konstanten Frequenz zu senden). Tabelle 1 fasst alle nötigen Daten für den Test zusammen.
4) Durchführung des Tests.

Es empfiehlt sich, das empfangene Signal am Empfänger aufzuzeichnen, um es nach dem Durchgang in Ruhe analysieren zu können. Eine Software, die das Spektrum analysiert und darstellt hilft hier, schwache Echos zu visualisieren. Während eines Durchgangs und bei Verwendung einer manuell kontrollierten Station, wird der OP auf der RX-Seite ziemlich hektisch und ge-

stresst sein und bald aussehen wie der indische Gott Shiva... Er muss simultan Azimut, Elevation, Uhrzeit und RX-VFO (die Frequenz kann auf 2m bis zu 100 Hz pro Sekunde wandern) kontrollieren und auch noch auf ein schwaches CW-Signal während der wenigen Minuten des Durchgangs hören!
Spectrum Lab, enwickelt von DL4YHF, ist eine sehr hilfreiche freie Software. Man kann sie herunterladen unter www.qsl.net/dl4yhf . Spectrum Lab kann in Echtzeit Audiospektren analysieren und anzeigen und Audio-Dateien (WAV) abspeichern, was für anschließende genauere Analysen gut ist.

Das "MIRror"-Experiment

Philippe, F6ETI, hat bei seinen Aussendungen eine 9-Element-Yagi verwendet, die auf einer Az/El.-Konstruktion für EME montiert war. Siehe Foto 1. Er hat 300W HF Output verwendet und mit einem Elbug automatisch seine CW-Rufe mit 80 WpM ausgesendet, so dass er sich während des MIR-Durchgangs nur um die Antennennachführung kümmern musste. Auf meiner Seite wurde eine OSCAR-Station mit einer zirkular polarisierten (links- oder rechtsdrehend) 12-Element-Yagi verwendet, die bereits für gewöhnlichen Satellitenfunk in Gebrauch war. An der 2m-Antenne befand sich ein Mastvorverstärker (NF: 0.7 dB). Der Empfänger war ein ICOM IC-821H.
In Bild 2 kann man ein Spektrum einer Vorabaussendung von F6ETI auf 144.100 MHz sehen. Die horizontale Linie in der Mitte des Bildes entspricht dem Troposcatter-Signal, das von F6ETI in der Britannie ausgesendet und bei F6AGR nahe Paris empfangen wurde. Die schrägen Linien sind Echos von Flugzeugen. Sie unterliegen einer negativen Dopplerverschiebung, die einer Geschwindigkeit von etwa 400 Knoten (850km/h) entspricht).
Die ersten Echos von der MIR wurden am 21.2.2001 um 21:37 und 32 Sekunden UTC empfangen, als die MIR sich an ihrem CPA (closest point of approach = nahestem Punkt) befand. Das Signal war schwach hörbar, aber nicht wirklich dekodierbar, siehe Bild 3, weil die Gebegeschwindigkeit 80 WpM war. Die D-Linie entspricht dem Tropo-Signal (die Frequenzänderung ist durch etwas manuelles Nachstellen des VFO verursacht worden), die R-Linie, mit dem erwarteten negativen Abfall von 94 Hz/Sek. ist das von der MIR reflektierte Signal. Nach so einem ermutigendem Ergebnis beschlossen wir, die Tests am folgenden Abend fortzusetzen.
Viel bessere Echos konnten am 22.2.2001 um 21:38 und 52 Sekunden eingefangen werden (siehe Bild 4). Die CW-Geschwindigkeit wurde auf 20 WpM herabgesetzt, was half, die Nachricht in Echtzeit mit dem Ohr hören und dekodieren zu können. Die Dopplerverschiebung durch das sich schnell bewegende Ziel entsprach wieder der Vorhersage. Das Signal-Rauschverhältnis war gut genug (bis zu +12 dB), um eine Dekodierung per Ohr zu erlauben. Ein Audiofile dieser Echos kann man im Web herunterladen unter: www.dd1us.de/historical%20sounds%20from%20space.html .
Überraschenderweise wurden diese Echos aufgenommen, als sich die MIR niedrig über dem Horizont und weit weg von den Bodenstationen befand. Bild 5, eine Darstellung aus Winorbit 3.6, zeigt, dass die MIR sich über Norddeutschland befand, als die Echos am stärksten waren. Das bedeutet, dass es sich um Rückwärts-Streuung handeln musste. Eine Annahme ist, dass diese hohen Amplituden der Echos durch Reflektionen an den großen, flachen Solarpanelen der Raumstation entstanden.

Diskussion

Dieses "MIRror"-Experiment zeigt eindeutig, dass Satelliten-Scatter mit einfachem Amateur-Equipment möglich ist. Weitere Tests in 2001 waren nicht möglich, da die MIR dann schnell absank und über dem Pazifik in der oberen Atmosphäre verglühte. Solche Tests mit der ISS sollten bessere Ergebnisse ergeben, da die ERS (Equivalent Radar Surface, Äquivalente Radaroberfläche) viel größer als bei der MIR ist. Für alle, denen das Verfolgen von Satelliten und Software mit Spektrumdarstellung neu ist, ist es heutzutage einfach, mit dem französischen GRAVES-Radar zu üben. GRAVES ist ein Radar, das auf 143.050 MHz 24 Stunden lang ein CW-Signal zur Weltraumüberwachung ausstrahlt. Siehe: /www.fas.org/spp/military/program/track/graves.pdf .
Aufgrund der hohen ERP, die von GRAVES verwendet wird, kann man viele Echos von Satelliten (siehe Bild 6, das Echos von GRAVES an der ISS am 26.6.2006 zeigt) empfangen. Sogar starke Echos des Mondes können mit kleinen Antennen empfangen werden. GRAVES ist also ein perfektes Werkzeug für Trainingszwecke.
Amateur-Satelliten-Scatter bietet ein weites Feld für Experimente: Verschiedene Ziele, verschiedene Frequenzen, Spielen mit verschiedenen Nachführungsmethoden, verschiedene Software für die Analyse – so viele schöne Spielereien, aber zu wenig Zeit!

The 143.050 MHz Graves Radar - a VHF Beacon

Rob Hardenberg, PE1ITR - pe1itr@amsat.org

Introduction

This article is about the Graves radar located in Dijon, France (JN27si), operating on 143.050 MHz. The radar is interesting for VHF radio amateurs and a great source for experiments. The signal is a powerful continuous wave signal without any modulation. It is on the air 24/7(i) and has been transmitting since December 2005. This makes it suitable as a beacon for all kinds of propagation experiments such as moonbounce, meteorscatter etc... Everybody who listened to the radar signal is very enthusiastic about it and speaks about the impressive signal levels. A nice thing is that the radar operates close to the 144 MHz amateur radio band, so existing weak signal equipment can be used. The Graves Radar system is a bi-static radar system with separate tx and rx locations. Its main purpose is to detect satellites and determine their orbital parameters.

I found on the Internet the "Graves Sourcebook" (ii) which gives a lot of information. By observing the radar signals and with the help of other radio amateurs I got some better understanding about how the radar works. This article is a short introduction on how to receive the radar.

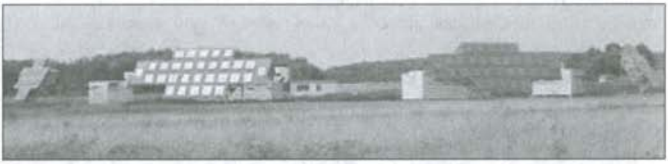


Fig. 1: The Graves TX antennas

How does the radar transmitter work?

The radar has 4 separate phased-array antenna systems (see fig. 1) that are tilted. Each antenna covers a sector of 45 degrees in azimuth. The radar illuminates the southern sky so the area from 90 degrees to 270 degrees azimuth is covered.

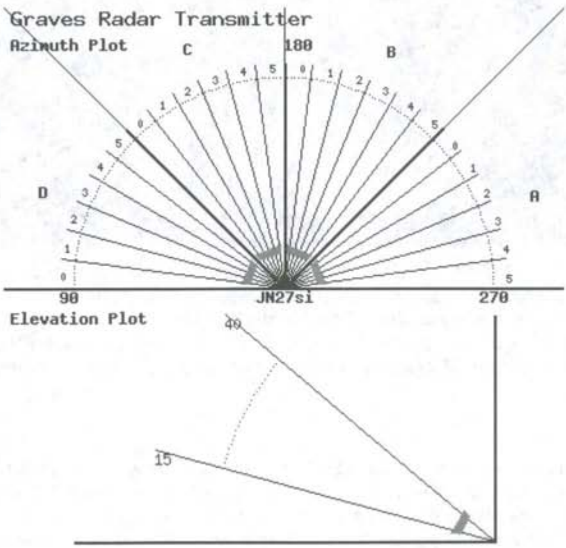


Fig. 2: Graves beam pattern

Azimuth Beam Pattern

The horizontal beamwidth is 7.5 degrees. As seen in figure 2 there are 4 sectors numbered A, B, C and D. If one sector is viewed more closely, for example sector D (90 to 135 degrees azimuth), it can be seen that the beam takes 6 steps each of 7.5 degrees to sweep this complete sector. It takes 19,2 seconds to step through one sector. So one step of a section is 3.2 seconds. This is explained in detail in table 1. One sector is scanned 4500 times in 24 hours.

Step	Azimuth (degr.)	Duration (sec.)	Start time
0	090.0 - 097.5	3.2	00:00.0
1	097.5 - 105.0	3.2	00:03.2
2	105.0 - 112.5	3.2	00:06.4
3	112.5 - 120.0	3.2	00:09.6
4	120.0 - 127.5	3.2	00:12.8
5	127.5 - 135.0	3.2	00:16.0
		Total 19.2	End at 00:19.2 and starting again on step 0

Table 1

This pattern is exactly the same for the beams in sector A (225-270), B(180-225) and C(135-180). So 4 beams are simultaneously scanning the southern sky (see fig. 3) like a lighthouse.

Elevation Beam Pattern

I found on the Internet that the vertical beamwidth is 25 degrees. I observed moonrise on the Graves radar and the reflection started at when the moon is 15 degrees elevation at JN27si. When the moon is 40 degrees elevation reflections are still very good.

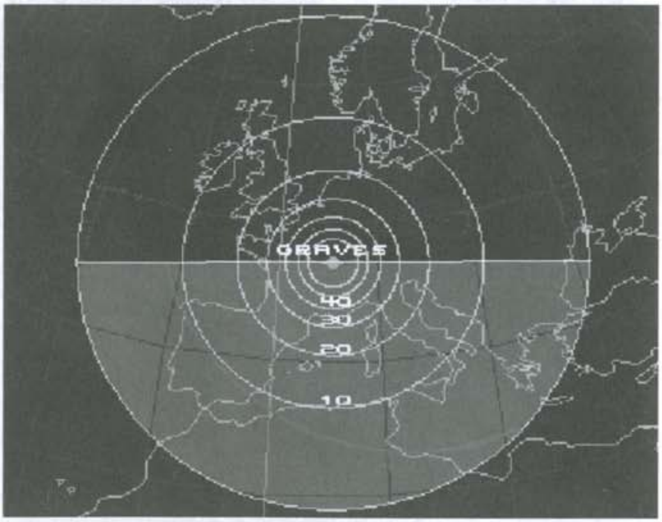


Fig. 3: Coverage of the GRAVES radar – the grey sector over southern Europe is the estimated area where space objects of about 300 to 400km height should be audible a by forward scatter reflections, the maximum distance should be about 2000km. Backscatter signals are audible from countries north of GRAVES over shorter distances. So far there have been reports from SM5 and LA about 1600km away. From CT3 (some 300km out of range) nothing has been heard so far.

GRAVES wherefor?

GRAVES stands for "Grand Réseau Adapté à la Veille Spatiale" which means a system for controlling the space. The system is used by the French military to detect and measure the orbits of satellites and other orbiting things in the space which could be a harm for France. See fig. 4 for the basic working principle of the system. "E" is the location of the TX in Broyes-les-Pesmes south-east of the city of Dijon (JN27si) and "R" is the location of the RX some 380km south of the TX north of the city of Apt (Revest-du-Bion). Probably there are more RX stations, there is mentioned a German RX station in some reports on the web.

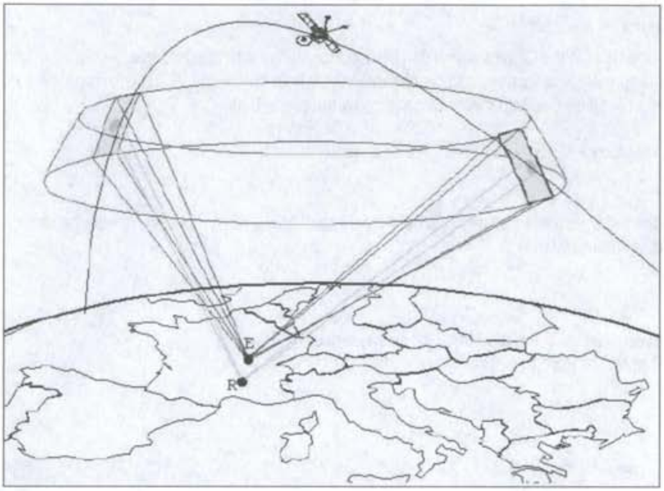


Fig. 4: Illustration of the principle of the GRAVES radar

Moonreflection

Great reflections can be received, when the moon is within the radar scanning range. It is possible to get reflections for 12 hours. A moon reflection can be received with a small one yagi station and an ssb receiver. I know amateurs who have managed this with a ground plane or discone antenna.

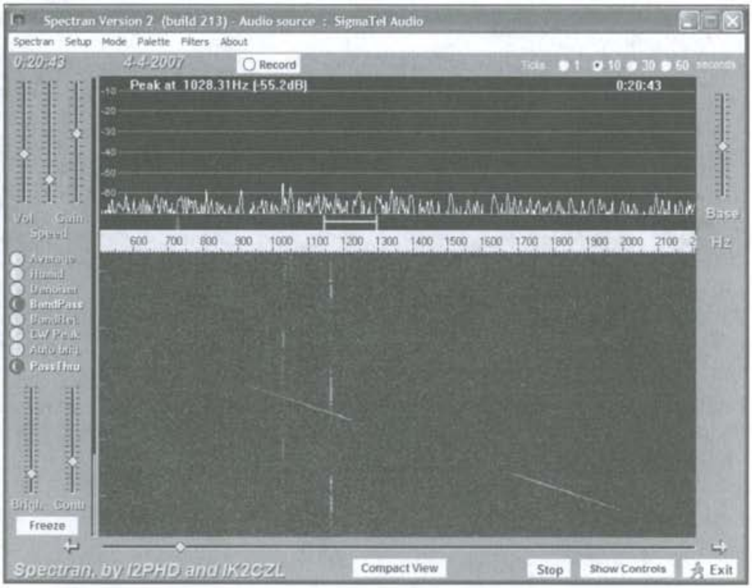


Fig. 5: Moon echoes from GRAVES

The screenshot of the Spectran software above (figure 5) shows a moon reflection where the beam pattern described earlier can clearly be observed. The moonbounce signal is at 1160Hz. You can see the 19.2 second scan pattern and also the 3.2 second steps of switching the antenna azimuth. The direct signal via tropo is at 1040Hz. I am located 450Km north of the radar. Also seen is a reflection on a passing satellite.

Other applications

Besides the moonbounce beacon the Graves signal can be used for many more applications:

1. Living in Europe, strong meteor reflections can be observed the whole day. Andy, G7IZU, is using the radar for his online meteorscatter detection alert system. See http://www.tvcomm.co.uk/radio/live_b.html
2. Satellite tracking.
3. High power beacon to study FAI, Es or maybe TEP propagation.
4. Fill in yourself......

Please try to receive the radar yourself and be amazed. Also let me know if new applications with the radar are developed which could be interesting for amateur radio.

73 Rob, PE1ITR

(i) Sometimes the Graves radar is off the air. I think for maintenance.
(ii) http://www.fas.org/spp/military/program/track/graves.pdf

Appendix

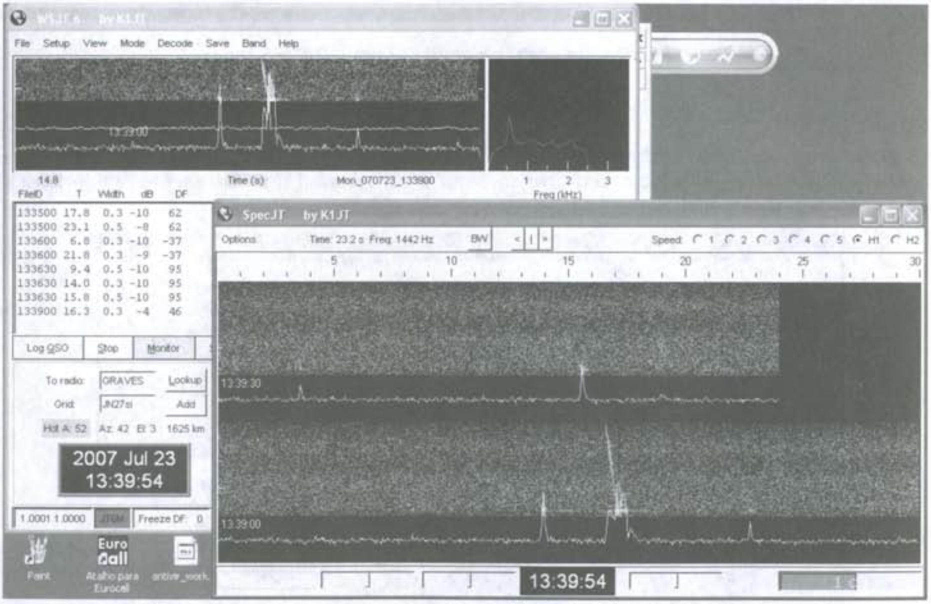


Fig. 6: WSJT-Screenshot of the GRAVES signal on 143.050 as received by CT1HZE on July 23 2007 showing meteor reflections and a satellite trace peaking -4 dB on the WSJT scale. The distance to GRAVES is 1625km. Antenna used at CT1HZE is 4 x 11 ele yagi.

Das 143.050 MHz Graves-Radar - eine VHF-Bake

Rob Hardenberg, PE1ITR - pe1itr@amsat.org

Einleitung

Dieser Artikel stellt das Graves-Radar vor, das sich nahe Dijon (JN27si) in Frankreich befindet und auf 143.050 MHz sendet. Dieses Radar ist interessant für UKW-Funkamateure und eine großartige Quelle für Experimente. Das Signal ist ein leistungsstarkes CW-Signal ohne Modulation. Es wird seit Inbetriebnamhe im Dezember 2005 rund um die Uhr jeden Tag gesendet (i). Das macht es geeignet für alle Arten von Ausbreitungsbeobachtungsexperimenten, wie EME, MS etc. Jeder, der sich diese Radar-Signale einmal angehört hat, ist begeistert und bestätigt die beeindruckenden Signalstärken.

Schön ist, dass das Radar nahe dem 144 MHz-Amateurfunkband arbeitet, so dass bereits vorhandenes Equipment von DX-Sationen direkt benutzt werden kann. Das Graves-Radarsystem ist ein bistatisches Radar mit einem getrennten Standort für Sender und Empfänger. Sein Hauptzweck liegt in der Aufspürung von Satelliten und Bestimmung ihrer Bahndaten.
Ich habe im Internet das "Graves Sourcebook" (ii) gefunden, das viele Informationen in engl. Sprache gibt. Durch eigenes Beobachten der Radarsignale und mit Hilfe von anderen Funkamateuren habe ich ein besseres Verständnis der Arbeitsweise dieser Anlage gewonnen. Dieser Artikel gibt eine kurze Einführung, wie man das Signal empfangen kann. Abb. 1 zeigt die etwa 15 x 6 Meter großen Sendeantennen der Graves-Sendeanlage.

Wie arbeitet der Radar-Sender?

Das Radar besteht aus vier getrennten gephasten Antennensystemen (siehe Abb. 1), die **tilted** sind. Jede Antenne deckt einen 45-Grad großen Azimut-Sektor ab. Das Radar leuchtet den südlichen Himmel von 90 bis 270 Grad Azimut aus.

Das Azimuth-Diagramm

Der horizontale Strahl hat eine Breite von 7,5 Grad. Wie in Abb. 2 ersichtlich, gibt es vier Sektoren, die mit A, B, C und D bezeichnet werden. Wenn man sich einen Sektor genauer betrachtet, hier z.B. den Sektor D (90 bis 135 Grad Azimut), kann man sehen, dass der Strahl in 6 Schritten von je 7.5 Grad den gesamten Sektor abtastet. Ein Schritt dauert 3.2 Sekunden. Es braucht 19.2 Sekunden, um durch einen Sektor zu laufen. Dies ist im Detail in Tabelle 1 aufgezeigt. Ein Sektor wird in 24 Stunden 4500 Mat gescannt.

Schritt	Azimut (Grad)	Dauer (Sek.)	Startzeit
0	090,0 - 097,5	3,2	00:00,0
1	097,5 - 105,0	3,2	00:03,2
2	105,0 - 112,5	3,2	00:06,4
3	112,5 - 120,0	3,2	00:09,6
4	120,0 - 127,5	3,2	00:12,8
5	127,5 - 135,0	3,2	00:16,0
		Total 19,2	Ende bei 00:19,2 und Start wieder bei Schritt 0

Tabelle 1

Dieses Schema verläuft exakt gleich in den Strahlungssektoren r A (225-270), B(180-225) und C(135-180 Grad). Alle 4 Sektoren werden gleichzeitig abgescannt, wie ein Leuchtturm über dem südlichen Himmel, siehe Abb 3.

Das Elevations-Diagramm

I habe im Internet gefunden, dass der vertikale Öffnungswinkel 25 Grad beträgt. Ich habe den Mondaufgang über dem graves.Radar beobachtet und gefunden, dass die Echos beginnen, wenn der Mond 15 Grad Elevation von JN27si aus hat. Bei 40 Grad Elevation sind noch gute Echos zu sehen. Abb. 3 zeigt den angenommenen Bereich (der graue Sektor) über Südeuropa, wo Reflektionen von Objekten, die sich in 300 bis 400km Höhe im Weltraum befinden, mittel Vorwärtsscatter hörbar sind. Maximale Entfernungen von ca. 2000km sollten erreichbar sein. Backscatter-Signale sind von Ländern nördlich von Graves hörbar.

GRAVES wofür?

GRAVES steht für "Grand Réseau Adapté à la Veille Spatiale" in etwa heisst das System für die Weltraumüberwachung. Das System wir vom französischen Militär zur Erkennung und Banhvermessung von Satelliten und anderen Dingen im Weltraum benutzt, die eine eventuelle gefahr für Frankreich sein könnten. Abb. 4 zeigt das Grundprinzip der Arbeitsweise. „E" ist der Standort des Senders in Broyes-les-Pesmes südöstlich der Stadt Dijon (JN27si) und "R" ist der Standort des RX 380 km südlich des TX nördlich der Stadt Apt (Revest-du-Bion). Wahrscheinlich werden die Signale von weiteren Empfangsstationen ausgewertet, es soll auch eine in DL geben, wie im Internet zu lesen ist.

Mondechos

Großartige Echos können empfangen werden, wenn sich der Mond innerhalb des Scanbereiches des Radars befindet. Dann können für bis zu 12 Stunden Echos empfangen werden. Ein Mondecho kann mit kleinen Einyagistationen und SSB-Empfänger empfangen werden. Ich kenne Amateure, die dies sogar mit einer GP oder Discone-Antenne geschafft haben.

Der mittels der Spektran Software erzeugte Screenshot in Abb. 5 zeigt eine Reflektion vom Mond, bei der das oben beschriebene Strahlungsdiagramm klar nachvollogen werden kann: Das Moonbounce-Signal liegt bei 1160 Hz. Man sieht das 19.2-Sekunden-Intervall und auch die 3.2-Sekunden-Schritte über den Azimut. Das direkte Tropo-Signal liegt bei 1040 Hz. Ich befinde mich 450km nördlich des Radars. Man sieht auch eine Reflektion an einem vorbeiziehenden Satelliten.

Andere Anwendungen

Neben der Mondbake kann das Graves-Signal auch für viele andere Zwecke verwendet werden:

1. Von Europa aus können starke Meteoriten-Bursts über den ganzen Tag beobachtet werden. Andy, G7IZU, verwendet das Graves-Radar inzwischen für sein online MS-Alarmsystem, siehe: http://www.tvcomm.co.uk/radio/live_b.html
2. Satellitenverfolgung
3. Leistungsbake für die Beobachtung von FAI, Es oder evtl. sogar TEP-Ausbreitung.
4. weitere, eigene Ideen.....

Versuchen Sie selbst einmal das Radarsignal zu hören und lassen Sie sich in Erstaunen versetzen! Falls weitere Ideen für Anwendungen des Signals im Afu-Bereich vorhanden sind, wäre ich für eine Mitteilung dankbar.
73, Rob, PE1ITR

(i) Manchmal ist das Graves-Radar ausgeschaltet, ich denke wegen Wartungsarbeiten.
(ii) http://www.fas.org/spp/military/program/track/graves.pdf

Abb. 6 zeigt einen mittels WSJT erzeugten Screenshot des Graves-Signals, wie er von CT1HZE am 23.7.2007 empfangen wurde. Man sieht MS-Reflektionen und die Spur eines Satelliten, die auf der WSJT-Skala immerhin eine Stärke von -4dB erreicht. Die Entfernung zu Graves beträgt 1625km. Beobachtet wurde mit 4 x 11 Ele. Yagis.

Antenna farm from Fritz Herbst, DL3YB (ex DL3YBA) in JO42. Fritz was born in 1922 and got a Silent Key in June 2007. Fritz was one of Germanys first DXers on 2m, 70cm and 4m in the 1950´s. He was active on these bands for more than 50 years. Fritz holds many first ever contacts from DL. His outstanding activity and results will never be forgotten. (DL8HCZ)

The DJ5HG Challenge

by Joe Taylor, K1JT

In a recent paper[1] DJ5HG seeks to discredit weak-signal contacts that use the WSJT "Deep Search" algorithm to decode transmissions of the JT65 digital protocol. After presenting some information-theoretic arguments about the quantity of information transferred between stations in such a contact, he ends the paper with a specific challenge:

> "If there is any remaining person believing that deep search can communicate an amount of information as specified above (21 bits) please send me the algorithm A that encodes arbitrary 21 bits (or 4 upper-case characters plus decimal digits) into a JT65 message and the algorithm B that reconstructs these 21 bits (or 4 characters) from what is displayed on the screen by the deep search decoder. The search for these algorithms may provide you with deep insight. So it may not be waste of time although the task is proven to be impossible."

The original paper[2] on the JT65 protocol and its implementation describes how the Deep Search (DS) decoder works. It uses "prior knowledge" about the types of messages most likely to appear in a marginal QSO attempt; it combines this knowledge with a (necessarily incomplete) list of the callsigns of many weak-signal VHF/UHF operators. The decoder examines a weak signal to see if its pattern of data tones matches the encoded sequence corresponding to any one of the hypothetical messages constructed on the basis of specified rules, using the information at hand. If a match is found with a high level of confidence, that message is displayed on the screen. Otherwise, the decoder remains silent.

Response to the Challenge

The length *N* of the DS search list is unspecified; in principle it has no upper bound except those imposed by computer memory and speed limitations. Since the challenge suggests using four-character alphanumeric messages (about 1.7 million possibilities), I made small program changes to enable testing for such messages in the DS decoder. The result is WSJT version 5.9.7, revision 509. An installation file that anyone can download to perform the challenge test has been placed at physics.princeton.edu/pulsar/K1JT/WSJT597r509.EXE. The source code for WSJT is also open and available to anyone. Code for any revision can be retrieved from the repository at developer.berlios.de/projects/wsjt.

The design of JT65 is such that the algorithms A and B sought by DJ5HG are trivial. Every possible four-character alphanumeric sequence is already a legitimate JT65 message, as defined in the original specification[2]. No conversions of any kind are required, either on input (algorithm A) or output (algorithm B). So the challenge boils down to this question: can the Deep Search algorithm decode every possible four-character alphanumeric message? The answer is "Yes," as anyone can easily confirm by using WSJT 5.9.7 r509.

The program changes in WSJT 5.9.7 r509 (relative to WSJT 5.9.7 r383) are these:

1. A check-button labeled **DJ5HG Challenge** has been added to the **Decode | JT65** menu on the user interface.

2. When the **DJ5HG Challenge** menu item is activated, the list of hypothetical messages examined by the DS decoder is extended to include all possible four-character alphanumeric groups.

Not surprisingly, decoding takes longer when WSJT operates in the **DJ5HG Challenge** mode—although not by as much as you might expect. The first decode takes about one minute on my desktop machine. Subsequent decodings take about 15 seconds. Setting up the necessary $N = 1.7$ million hypothetical messages is time consuming, but since the results are stored they need be done only once.

I made a lengthy test in which 2000 test transmissions of a random four-character message were generated at $S/N = -26.5$ dB in 2500 Hz bandwidth using mode JT65B. The transmissions were received by WSJT 5.9.7 r509. This signal level was chosen so that the Koetter-Vardy decoder in WSJT would fail, forcing the use of the DS decoder. The correct four-character message was

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[1] K. von der Heide, DJ5HG, *DUBUS*, 36, No 3, pp. 63–66, 2007.

[2] J. Taylor, K1JT, "The JT65 Communications Protocol", *QEX*, September-October 2005, pp. 3–12.

received 1116 times, or 56% of the trials. There were zero false decodes. At the "Aggressive Deep Search" level there were 1456 correct decodes (73%) and exactly one false decode. The false decode was marked with "?" and assigned confidence level 1 on WSJT's 1-10 scale.

In a paper submitted to the IARU Region 1 VHF/UHF/Microwave Committee in advance of its February 2007 meeting in Vienna,[3] DJ5HG wrote of the Deep Search decoder: "...if the list would contain all licensed callsigns (which is impractical), the confidence drops to zero, and in most cases some other message would fit better resulting in a wrong decode." This statement is false, as demonstrated by the test just described — and by further tests performed some 18 months ago which extended the size of the search list to an even larger number, $N = 2^{22}$ (about 4.2 million).

All recent versions of WSJT include a built-in simulator for testing the decoders. I used it to perform my tests, running a second copy of WSJT (it need not be the r509 version) on another computer—call it computer 2— acting as "transmitter." To perform the test this way yourself, connect the soundcard output of computer 2 to soundcard input of computer 1, which will run WSJT 5.9.7 r509. In the main WSJT window of computer 2, enter an arbitrary four-character alphanumeric message in the **Tx1** text box and "#−26.5" in **Tx6**. When you click the **Auto** button, computer 2 will generate audio "transmissions" at $S/N = -26.5$ dB. Select **DJ5HG Challenge** on the **Decode | JT65** submenu on computer 1, and click **Monitor**. Be sure that the system clocks on the two computers are within a second or so of the same time. Computer 1 should decode the arbitrary four-character transmitted messages correctly more than half the time, and you will see very few (if any) false decodes.

Sensitivity and Length of Deep Search List

It is easy to be quantitative about the dependence of sensitivity on N, the length of the deep-search list. A good way to do this is by measuring the fraction of correctly decoded test transmissions (and also the rate of false decodes) as a function of signal-to-noise ratio, for different values of N. Such measurements have been made and published before[4] for the default callsign list, which has 4822 callsigns and produces $N = 9707$ test messages. For purposes of comparison, Figure 1 reproduces the previously published curve and adds the corresponding one for $N = 1.7$ million, as required for the DJ5HG challenge with four-character cipher groups. It is easy to see that the measured sensitivity difference is no more than 1.0 dB.

Further Comments on Minimal QSOs

It seems appropriate to add here a few comments on the use of "prior information" when decoding a weak signal, and its relevance to the question of minimal valid QSOs. The QSO guidelines we have used for many decades can be traced to an essay on the subject in 1957 by Edward P. Tilton, W1HDQ, long-time VHF Editor of *QST* magazine. Scanned copies of Tilton's two-page essay can be found at
physics.princeton.edu/pulsar/K1JT/Tilton_QST_March_1957_p55.JPG and
physics.princeton.edu/pulsar/K1JT/Tilton_QST_March_1957_p56.JPG. He presents minimum requirements for two-way work to be considered a contact: positive identification of calls at both ends, complete exchange of signal reports or some other information, and acknowledgments. Implicit in Tilton's essay is the fact that the callsigns involved in a QSO may be already known to both operators. The calls must be positively identified, but that process does not necessarily "transfer information" in the sense being measured and advocated by DJ5HG. The signal report, however, should transfer real information that was not known in advance. Of course, prior knowledge may be available to operators using any communication mode. In VHF/UHF weak-signal work such knowledge frequently exists and may be a significant portion of the skill that gives experienced operators an advantage when copying very marginal signals. Lists of active stations, including both mental and physical lists, were developed and widely used long before JT65 came along. It is impossible to quantify the way in which prior knowledge influences copy by a human operator, but experience teaches us that it is "several dB easier" to copy one's own call, or a familiar call, than a random 4-to-6 character alphanumeric sequence.

For all of these reasons, I believe that the IARU Region 1 VHF/UHF/Microwave Committee acted wisely in February 2007 when adopting the guideline now contained in the Region 1 VHF Manager's Handbook. The published guideline is fully consistent with the version Tilton adopted in 1957, and is essentially identical to the one proposed by DJ5HG—but without the latter's problematic quantitative requirement, which cannot be objectively evaluated for traditional modes decoded by humans.

If ever there should be a desire for a rigorous test of the information-transfer capabilities of different communication modes under the most marginal S/N conditions, the test must involve transmission and reception of information that cannot be known in advance. Real callsigns cannot serve this purpose, because the active ones may be well known to any experienced operator.

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[3] K. von der Heide, DJ5HG, "A General Comment on B08 and B18," submitted to IARU Region 1 VHF/UHF/Microwave Committee, February 2007.

[4] J. Taylor, K1JT, "Open Source WSJT", in *Proceedings of the 12th International EME Conference*, Wurzburg, 2006; see also reference 2.

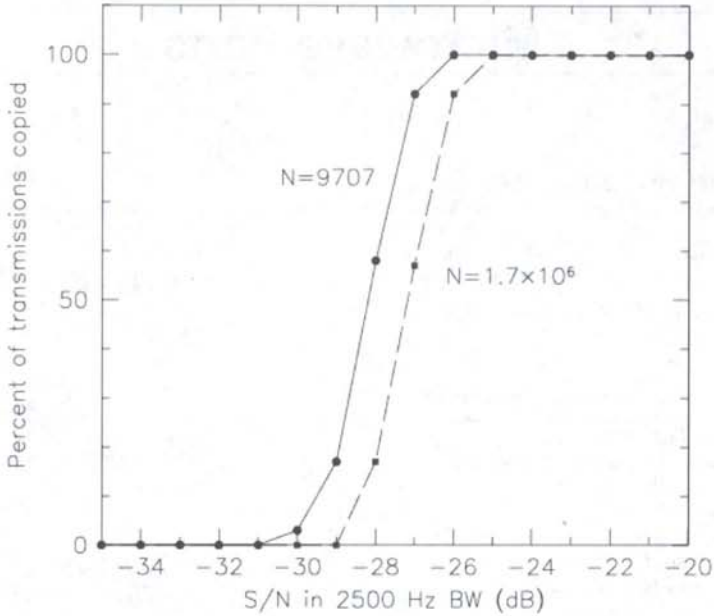

Fig. 1. - Percentage of simulated JT65B transmissions copied correctly by the Deep Search decoder, plotted as a function of signal-to-noise ratio for list lengths N = 9707 and N = 1.7 × 10⁶. At all signal levels the measured false-decode rate is less than 0.1%, too small to be shown on this scale.

Conclusion

The WSJT Deep Search decoder works well with the arbitrary four-character messages specified in the DJ5HG Challenge. Indeed, it works well even if the search list is made longer by another factor of about 2.5, so as to contain significantly more than the total number of licensed amateur callsigns. The default callsign database provides a decoding "gain" of about 1 dB when compared with such a full-length database. That gain is probably less than the comparable advantage experienced by human operators when they copy familiar callsigns under marginal conditions.

A Reply by Klaus, DJ5HG

In my paper I simply expressed a proven fact. If that is experienced as „... seeks to discredit ..." then there is a general misunderstanding concerning basic manners. If the community decides that for a valid QSO it is not necessary to receive any callsign then I will accept it. But if the community demands for the reception of callsigns then the community would discredit JT65DS. I am still waiting for someone who meets the challenge. What Joe, K1JT, tries to sell as a solution is just another mode. It is not the mode used in JT65DS. A digital mode is defined by several parameters, one of them is the code, i.e. the set of codewords that can be decoded by the decoder. In this case, the code of the new mode is not the same as in JT65DS. Indeed, all code words of the new mode never can be generated from the usual callsign list, and codewords of the new mode never will be decoded correctly by the DS decoder of JT65. That's far away from the challenge. I never pretended that 21 bits cannot be communicated by an arbitrary digital mode. I only stated that JT65 with it's implemented DS decoder cannot communicate callsigns. If now a new mode is added which really communicates the necessary bits then this mode should be used in the QSOs and the old version with the DS decoder discarded. Of course, the new mode will teach you that the transfer of a callsign via the radio path is not so easy as JT65DS leads someone to believe.

NPTB00050 Datasheet

NITRONEX
CORPORATION

Gallium Nitride 28V, 50W Broadband High Electron Mobility Transistor

Built using the SIGANTIC® NRF1 process - A proprietary GaN-on-Si technology.

FEATURES

- Designed for wireless infrastructure, instrumentation, medical, and other broadband applications at frequencies from 400 - 3000 MHz.
- Typical CW performance at V_{DD} = 28 Volts, I_{DQ} = 450 mA, frequency 3000 MHz.
  - Output Power: 50 Watts
  - Drain Efficiency: 60%
  - Small Signal Gain: 11.5 dB
- 100% CW Tested at 3000 MHz
- Thermally-enhanced package
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- Lead-free and RoHS compliant
- Subject to EAR99 Export Control

NPTB00050

Broadband
50 Watt, 28 Volt
GaN HEMT

RoHS

Maximum Ratings - Not simultaneous. (T_C=25 +/- 3° C unless otherwise noted).

Rating	Symbol	Value	Units
Drain-Source Voltage	V_{DS}	100	V
Gate-Source Voltage	V_{GS}	-10, 3	V
Total Device Power Dissipation (Derated above 25° C)	P_D	55	W
Thermal Resistance (Junction-to-Case)	θ_{JC}	3.20	°C/W
Storage Temperature Range	T_{STG}	-65 to +150	°C
Operating Junction Temperature	T_J	200	°C

ESD Sensitivity

ESD Model	Class
Human Body Model (per JESD22-A114)	1A (>500 Volts)
Machine Model (per JESD22-A115)	M1 (>100 Volts)

Also available NPTB00025 – 25 W version

ATV News

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

9A0TVR – ATV repeater in Croatia

With the start-up of the ATV repeater 9A0TVR on the 1396m high Mt. Ucka (proximity of Opatja) on the eastern part of the Istrian peninsula in Croatia now ATV activities are possible into the northern Adria region. As first receiption reports have shown, the repeater can be be seen with excellent signal strengths in northern Italy and southern Austria. This repeater is particularly interesting for amateurs who make holiday on one of the numerous beaches of the Italian east coast. So the test picture of the repeater could be seen from IK3/DJ9PE near Bibione (Venezia) with a 33cm-dish on 10 GHz over 100 km with P5 without any problems. Other reception reports showed that this is still possible with a 20db-horn-antenna. IW4CJM receives 9A0TVR south of Rimini over a distance of more than 180 km.

IK3/DJ9PE receiving 9A0TVR on 10 GHz

The responsible person for the repeater is Darko, OE7DBH, an active repeater desinger und constructor, who built the Austrian ATV repeaters OE7XLT and OE7XSI.

9A0TVR works nonstop and transmitts on 10410 MHz with horizontal polarisation. The input frequencies are 1255 MHz, 1262 MHz, 1272 MHz, 2380 MHz and 2407 MHz also horizontal. The DTMF control takes place on 144.740 MHz.

Bernd, DJ9PE / OE5BDO

Microwave Japan

Seiji Fukushima, Ph.D, JH6RTO
e-mail: JH6RTO@ieice.org

Operation on 24 GHz by JI1CBS

Some microwavers think that QSOs on such a band are only common from remote locations like mountains. This may be somewhat true. But I am very fortunate to live in one of the high mansions near Metropolitan Tokyo to see all the Kanto (JA1) plains. Some city buildings function as reflectors for hidden stations behind hills.

JI1CBS antennas and takeoff

Please look at my log in Table 1. All the QSOs have been made mostly in FM from my shack in Toda, Saitama of a grid PM95tt, using an IC-1275, a UTV24G transverter, and a DB6NT preamplifier. A 60cm Cassegrain dish is built on the top of the building with antennas for other bands and about 25m high. The propagation is always just line-of-sight or reflections. Thanks to the high population of microwave enthusiasts in the Kanto plains and my wonderful location, these QSOs have been successfully established. Jun, JI1CBS

Callsign	QTH	yyyymmdd	UTC	RS	Path or reflector	QTF
JR1LQE	Setagaya, Tokyo	20061103	0521	59	Line-of-sight	175
JA1WQF	Toride, Ibaraki	20060413	1414	59	Line-of-sight	55
JA1CUY	Narashino, Chiba	20030712	1158	59	Ikebukuro Bldgs	125
JA1ODA	Saitama, Saitama	20060915	0555	59	Line-of-sight	5
JH1UGF	Yokohama, Kanagawa	20060323	1415	59	Roppongi Hills	155
JN1AYV	Chigasaki, Kanagawa	20060331	1310	59	Mt. Tanzawa	210
JA1KVH	Arakawa, Tokyo	20010218	1445	59	Ikebukuro Bldgs	125
JR1FRH	Kita, Tokyo	20010218	1318	59	Line-of-sight	80
JH1IGC	Yokohama, Kanagawa	20001125	1509	59	Unknown	200
JA1ELV	Kamakura, Kanagawa	20060217	1300	59	Mt. Tanzawa	210
JA7JJN/1	Kiyose, Tokyo	20060321	0142	59	Saitama Bridge	280
7N3UUH	Kawagoe, Saitama	20060521	0212	59	Golf course	300
JF1TPR	Machida, Tokyo	20061009	0458	59	Shinjuku Bldgs	160
JA1CYC	Yokohama, Kanagawa	20061009	1420	59	Unknown	198
JA1DWD	Kawasaki, Kanagawa	20061216	1425	51	Unknown (SSB)	140
JR3LGE/1	Setagaya, Tokyo	20061216	1348	59	Shinjuku Bldgs	160
JA1UPJ	Yokohama, Kanagawa	20061209	1357	59	Shinjuku Bldgs	160
JA1DOZ	Ageo, Saitama	20061231	1523	59	Saitama Bldgs	330
JJ1IQR	Saitama, Saitama	20060331	1440	59	Saitama Bldgs	330
7N4TYL	Saitama, Saitama	20060510	1400	59	Ikebukuro Bldgs	125
JO1MWX	Honjo, Saitama	20060603	0814	54	Line-of-sight	290
JE1XHP	Saitama, Saitama	20060512	1210	59	Line-of-sight	0
JK1EXO	Setagaya, Tokyo	20070912	1413	59	Line-of-sight	180

Table 1

Microwave USA

Editor: Kent Britain, WA5VJB
WA5VJB@flash.net

1460km on 10 GHz from Mexico

During the first half of the ARRL 10 GHz contest, the North American 3 cm record was broken 5 times this August with the last QSO at 1460 km.

4C2WH/XE2 (WB6CWN) traveled to the southern tip of Baja, Mexico DL34wt. Frank made 53 QSO's back into southern California using the coastal duct along the Mexico/California Pacific coast.. The first new record was W6QIW at 1315 km, then 7 minutes later he worked N6CA and KH6WZ at 1320 km. Chip and Wayne both moved their stations then worked Frank again at 1448 km. The next day AD6FP worked 4C2WH/XE2 on 3 cm from CM96wa for the 1460 km record.

4C2WH/XE2, DL34wt, camp and sea takeoff

All 5 of these records were at least 200 km beyond the end of the tropo. While the XE2 stations was operating near the Pacific Ocean, the northern stations where at a heights near 2000 m. Signals were weak but good with most of the QSO's on CW. All stations were in the 80 cm, 10 watt, 2 dB NF class. Frank was as far south as it is possible to travel on the Baja peninsula, but there are more northern high spots for the California stations. Watch for the records to be extended next 10 GHz tropo season.

4C2WH/XE2 setup

Transpacific Tropo 2007 Report

K6QXY, Bob, CM88ql, reports about the reception of the KH6HME beacons from Hawaii (BK29go) in 2007. **This is a 3789km path!**

He reports that 2007 was the worst season he has ever observed (any he is doing this for many years now). (Month/Day)

1/9	KH6HME/B 144 MHz @ 2330Z
1/18	KH6HME/B 144 MHz @ 2215Z
1/19	KH6HME/B 144&432&1296 MHz @ 0550Z
7/10	KH6HME/B 144&432&1296 MHz @ 0550Z
	KH6HME/B 144&432&1296 MHz @ 2335Z

In 2006 he had the beacons in on 17 days in June/July. In 2007 only on 2 days! For comparison see DUBUS issue 1/2007, p. 86.

KH6HME/B are on 144.170, 222.1, 432.078, 1296.250 MHz. They are on 24/7 on top of a volcano ~ 8000 ft. elev. The duct is high ~ 8000ft. on the KH6 end and near sea level in Southern California & near 2000ft. elevation in Northern California I have a dedicated receiver and antannas looking at KH6 and scan beacon frequencies every day. 73, K6QXY

(Also the Atlantic Tropo in 2007 was down in 2007, there were less openings from G to EA8 and CT to CU/EA8. de CT1HZE)

1st WAS Award on 1296 MHz

W5LUA, Al Ward completed the first ever WAS on 23cm working WA5WCP/7 in Wyoming, Utah and Idaho. He also worked the same 3 states on 2304 MHz, which brings him up to 33 states on 13 cm.

Microwave Europe

Editor: Simon Lewis, DL4PLM
GM4PLM@hotmail.com

Hello and welcome to another microwave column. Although the summer weather has not been good across Northern Europe, there has in the recent weeks been some excellent tropo conditions. Our Southern Europe ham friends will of course agree they received too much sun and not enough tropo! As the winter arrives thoughts turn to new construction for the season ahead and ideas for new bands. What new band will you activate next year?

Activity day on 10GHz via Mt. Blanc

Our yearly activity day (JA Journeé d'Activité in memoriam of F6BSJ) took place on Sunday 15th July 2007. Some 15 stations were active, although several experts were on holidays. The first qso between HB9DUG and F6FGI was "interrupted" at 0808 by F6DKW Maurice in Paris. He was calling in SSB. (JN18CS; QRB 482km to Mont Blanc

JN35KT). The signals on both sides were between RS 53 and 41. Unfortunately conditions were changing a few minutes later, and no further QSO was possible. At 1000 I1BOC/P Domenicus, in JN35PK and I1TEX /P Michele, in JN35US called us with good signals between 59 and 55 (forward scatter). The second most distant station was F1CLQ/P Michel in JN37NV (Ballon d'Alsace) and he was 59! Here some participating stations:

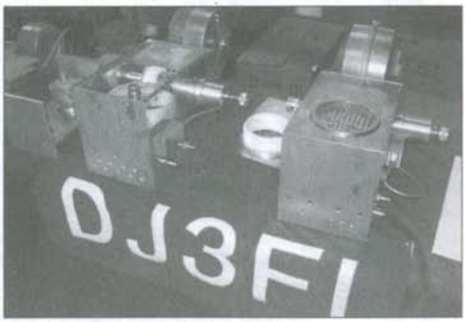
F1CLQ/p JN37nv, F1EJK/p JN37kt, F1JRZ/p JN26fk, F1URI/p JN36cd, F5AYE/p JN36cd, F6DKW JN18cs, F6FGI JN26xf, F8BXA JN26oc, F9HX/p JN25mq, HB9ADJ/p JN35me, HB9AMH JN37qd, HB9DUG/p JN36dk, HB9RXV/p JN36gs, I1BOC/p JN35pk, I1TEX/p JN35us.

According to F8DO, Marius, F6BSJ, Jean Marie, always had predicted that QRBs of 500km from Mont Blanc should be possible. A new map, with enhanced tropo conditions, created by the program Radio Mobile (see back cover full color picture!) shows, that at a distance of about 350 to 450 km to the Mt. Blanc qsos could be tried out. OPs in or around towns like Montpellier, Nîmes, Limoges, Orléans, Paris, Reims, Luxembourg, Mannheim, Heilbronn, Stuttgart and Ulm should look for signals from the Mt. Blanc! (west to north-east of Mt. Blanc, from north-east to south-east, the Mt.Blanc is hidden by the Alps and south-east to south again QSO's should be tried out. (forward scatter, see). Please listen to JN35KT on Sundays at 1100z on 10368.100 MHz or during a "JA" (last Sunday of a month) from 0600 or 0700 onwards and always to F1URI/B on 10368.928 MHz.
Many stations of the above station-list are on ON4KST! Thanks to Jens DL7VTX, who provided the map of Radio Mobil. The next JA F6BSJ should not be during the period of holiday and should start early in the morning at about 0600 or 0700. Reference: DUBUS 1/2006: 10GHz Scatter over Mont Blanc.

On Sunday 05th August 07 the report of F6DKW was RST 529, almost the same signals as for the activity day. The equipment: F6DKW: 0.9m dish with 10W, F6FGI: 1m dish with 10W. 73 de Herbert, F6FGI

Weinheim 2007 Report

As this is a close event for myself living in Dusseldorf (only a few hours to the south and a nice drive), I made my annual pilgrimage to VHF and up event at Weinheim at the end of September. I was pretty time bound over the weekend and so could not stop over and camp at the club station so this was really a flying visit – hope I can find more time from my QRL next year! The event was greeted by good weather, warm sunshine and clear blue skies at the end of period of nice weather, although many camping at the club station commented on the very cold start they found getting out of their tents that morning!. Indeed driving down the route was good, coming down the A3 heading south, through some quite dense fog and cold air, it was a nice drive and we arrived in plenty of time. Parking the car I immediately found Rainer DF6NA already loading his car with the first day's purchases! Early birds get the bargains at WH! I was also accompanied by Nick GM4OGI – soon to be DL4xxx as he is also relocating to DL land to work alongside me and Nicks first trip to WH. He seemed suitably impressed having run into a well known name within seconds of jumping out of the Landrover! First thoughts were sad for me however, in that the event seemed quieter than the past years and even inside the halls the large amount of space was noticeable. But that should not put anyone off visiting – maybe the past years spoilt me too much and certainly there was the regular faces to be seen. For me this event is much more a social event than a buying trip – the flohmarkt still holds lot of interesting items and some bargains but as at any rally also some "joke" prices ☺ Would someone really pay 250€ for a Liner 2! Of course as always some interesting items on the market, some very nice high power tube amps from DJ3FI, some dish kits from OK1DFC could be found outside and of course the normal goodies from DB6NT etc. Michael was showing off his new transverter range which include 10 MHz inputs for frequency locking.
Of course running around the tables you always bump into people you know and it was good to have a quick but brief chat to Sam G4DDK and John G3XDY, both well known faces on the UK microwave scene, as they were dashing off to an EME lunch. Catering at WH is always great and the staff of the School again did a great job supporting the day.
As always a pleasant visit, there is a great deal to see during the day and it is a wonderful opportunity to meet some of the well known faces during the event. There is a whole range of lectures planned throughout the day and live demonstrations taking place both at the school at Bensheim and at the club station camp site.
Its well worth a visit and always a relaxed and enjoyable event and highly recommended. See you next year? (Date will be Sept. 13/14, 2008!) 73 Simon DL4PLM



Microwave Museum

The UkuG webpage contains an interesting link to the lover of all things microwave and provides an interesting insight into some of the technologies from the past. Well worth browsing and I am sure you will find yourself saying "ohhh I remember those!" http://www.microwave-museum.org

Microwave Activity in Malta

by Stanley Grixti, 9H1LO

The Malta Amateur Radio League, established in 1922, has never stopped evolving. Since the very early days of radio, when a handful of dedicated radio amateurs, through their hard work and dedication, and under great duress from the very fact that Malta was a colony and these amateurs operated under strict guidelines from the authorities concerned and in some cases, one can say, were only tolerated rather than permitted, managed to advance this wonderful hobby 'amateur radio'. The early days of AM radio, was the forerunner, and here great advances were made - it is enough to mention Professor Tonna Barthet, whose contribution to radio and radio amateurs could be described as a "goldmine".

In radio technology, Robbie Galea established the first radio contacts on the island, hence laying down the road to progress, it is well worth mentioning, that in those days, radio amateurs were not allowed to experiment as much as they would have liked to do, everything they did, had to be authorized, suffice to say that the use of the 2 metre band was acquired by sheer co-incidence, and by the intervention of a radio amateur, whose occupation was a dentist - the same goes for construction work, this was a taboo for the authorities, shortage of spare parts and components did not help either, however, in spite of all these difficulties, MARL and it's members continued to grow in numbers and experiments . As time moved on, advances in radio techniques and the launching of more satellites, the availability of satellite dishes and the hard work and dedication by some radio amateurs, the use of high frequency transmissions appeared on the horizon.

MARL once again is in the forefront of these experiments as one can deduce from the following article, the idea is to encourage and inform other radio amateurs in the use of 10 GHz SSB and ATV transmissions.

Around 1983, three very dedicated radio amateurs namely 9H1ES, 9H1GB and 9H1FX carried out the first test transmissions, using home brew equipment, void of many test instruments and limited output power e.g. 20 milliwatts, wideband IF of 250 kHz and only using a mixer diode (1N23) and a parabolic antenna with a diameter of 45 cms and using a penny feed system. It is relevant to add that these tests were carried out on a strictly 'line of sight basis' Other tests were made with other stations, e.g. Sicily, IT9OSF and IT9MHI and Sardinia Island. Various difficulties were encountered with for example, temperature, humidity factors, but in spite of all this the group managed. A large number of contacts were managed during these difficult times, during morning, afternoons evening and night times. In time, improvements were made by the introduction of:

9H1ES in the 1980's

GUNN PLEXERS
MORE SENSITIVE IF (30 MHz)
AFC

These improvements helped to extend the quality of the contacts, due to enhanced stability. Larger antennas were also used to increase the EIRP and improvements were noted in the contacts between stations in Lampedusa and Sardinia Island.

Construction

Around 1987, 9H1ES constructed a 10GHz transverter with an output power of 200 mwatts. For IF an FT290 MK1 was used and contacts were made with I8 stations, Sardenia and Spain using 1metre parabolic dish using front fed horn system with a waveguide feed. Two years later in 1989 due to personal situations and family bereavements, 9H1ES interest declined and all activity stopped completely. Activity again picked up in 2002 by 9H1LO who introduced a system using all home brew equipment, and once again ATV tests were carried out using modified ex TVRO LNBs for TX and Rx. LNBs were modified to allow transmission on 10.475 GHz. These were base band modulated and the output power was about 40 mW - on the receive side, an ex TVRO analogue receiver and retuned LNBs were used. In June 2002, 9H1LO received the first pictures by coincidence from an A.T.V. repeater in Ragusa, JM75IA, Sicily.

9H1LO Receiving Ragusa ATV Repeater

Malta Amateur Radio League showed a lot of interest in these tests and activities, and permission for the ATV mode was applied for and eventually obtained. As 9H1LO had limited experience, he asked for assistance from 9H1ES, who had vast experience in Microwave techniques. This created and regenerated a lot of interest on the part of 9H1ES, and 9H1ES restarted building the required ATV equipment from scratch, although 9H1ES had 10 GHz transverter and Gunn plexers and associated materials i.e. wave guides and dishes. For someone who was only equipped with SSB 10 GHz equipment, 9H1ES had to build again from scratch a modified TVRO LNB with IF of TVRO rcvr from 950 to 1700 MHz with a local oscillator of 9.410 GHz. After completing and building this equipment 9H1ES tested for reception with the Ragusa repeater signals. This resulted in good quality pictures. Encouraged by this development, 9H1ES and 9H1LO combined all their efforts and equipment in order to establish communications. It is a great pleasure for me to mention the assistance given by 9H1PF, who manufactured a slotted wave-guide antenna (16 slots) with 180 degrees beamwidth. This gave excellent results. MARL once again, helped to create more interest in the subject, and has installed an ATV repeater in Mdina. It was built by 9H1LO and the antennas by 9H1ES and 9H1PF. Relevant information is as follows: TX 10.475 GHz - RX 1.275 GHz.


9H1LO & 9H1ES with the 9H1ATV Repater

10 GHz SSB tests

Another radio amateur involved in the 10 GHz operation is 9H1BN, but had to relinquish his interest due to lack of operators and lack of activity in this mode. 9H1BN and 9H1VW discussed the possibility of setting up equipment for this operation. 9H1VW ordered assembled and in some cases manufactured wave guides with the assistance of 9H1BN. Together they tuned the equipment and more and more operators were encouraged and interested in the 10 GHz SSB mode. 9H1LO modified a commercial data transceiver tuned it to 10.368.200 MHz.

9H1LO's setup consisted of:

> 200mw of rf power
> 60 cms off-set chaparral fed dish fed with 2 mtrs of very low loss cable (RG142)
> IF transceiver FT-290 mk1

9H1ES old equipment consisted of:

> SSB electronica transverter
> PW parabolic antenna with penny feed system - output power 200 mwatts
> IF FT-290 mk2

9H1ES installed a beacon at his residence using modulated frequency shift keying fed into a wave guide from shack to roof area approx 15metres up and carried out tests on 10.368.900 to revive and regenerate his equipment. Carried out tests between his home qth and Selmun area over approx a distance of 9 kms and another test from his qth to Mellieha over approx 11kms distance. It was here that 9H1ES established the following based on his observations. Although there was no line of sight, contacts were established. This was remarkable, as every theory indicated that line of sight conditions must be present. As the results obtained did not include line of sight conditions 9H1ES asked Marco 9H1BN to carry out further tests, because it was evident that the case for line of sight conditions held no solid ground. Test equipment was once again set up by 9H1ES and 9H1BN to prove that line of sight conditions were not mandatory. Mentioned earlier, 9H1LO completed building his equipment for 10 GHz and tested with 9H1ES to establish exact frequency offset, an important requirement. 9H1LO set up his test equipment at Xemxija inside a hotel situated at sea level and was 6 stories high, 9H1ES set up similar test equipment at his QTH.

Between these two operators there was one large obstacle, Wardija Hill. Once again, results from these tests showed poor results, signal levels were 3 by 3. But contacts were successful. Another attempt was made by 9H1LO at his QTH. Conditions were far from perfect, hazy wx. 9H1LO decided to give it a go and tested again from inside. His QTH overlooked Wardija Hill and his test equipment was located in the centre of the room, one window overlooking Wardija Hill. 9H1ES set up the same equipment but extended the length of the wave guide 3 metres above roof level and installed a 45 cm dish with a penny feed system. 9H1ES beacon was switched on to help 9H1LO to locate signals from 9H1ES. A two metre operation (talkback) was also being used to make sure that the contact was not lost. After peaking the dishes orientation, 9H1ES immediately switched off the beacon and installed the transverter, but this time the output power was 20 watts resulting in satisfactory results with reports of 5/5 and 5/9 respectively - another proof that line of sight condition is not mandatory.

MARL members organized a field day coordinated and set up by 9H1ES, using maps and coordinates were as follows:

9H1VW - Msida bridge	9H1BN – Paola
9H1LO - Lija (qth of 9H1SP)	9H1ES - Mellieha heights

These four operators established 4 way contacts at 1830 local time on the 18 th January 2004 - contact was continuous in spite of their individual dish orientation, contact remained static and solid. These contacts again highlight the point, that line of sight communications is not the rule - these four operators did not have to set their dishes to a particular point - but on the contrary retained their dishes orientation and still managed to make the contacts. Yet, another test carried out between the coordinates of Mosta and Naxxar with 9H1VW and 9H1ES, with 9H1VWs dish pointing towards a windmill and 9H1ES was totally dwarfed by a school, proving the point once again, that of no line of sight was necessary. Reports of 5/9 both ways were obtained.

9H1ES on 10GHz SSB

The test to end all tests

On the 31 st January 2004, a test to end all tests took place between 9H1ES, 9H1LO and 9H1VW located at two different points and coordinates. The day was nice with 50 percent humidity and no wind present, both operators set up talkback on 2 metres via R4 repeater, initially the tests proved negative and no contact was made, 9H1ES decided to replace his 48 cm dish with a one metre dish in order to increase the gain, again negative results. Orientatation checks made to no avail. 9H1ES increased power by applying a TWT delivering 20 watts power output into a one metre dish. On switching on 9H1ES was heard by 9H1VW, located at some point at Delimara tower, 9H1ES then peaked his dish and quickly informed 9H1VW that he was receiving 9H1VW with a shift difference of 71 kHz, it was then very clear to all concerned that the reason for no contacts was because of the shift difference involved namely 71KHz. In fact 9H1ES removed the TWT used only 200 mW power with the same one metre dish, changed to SSB mode and communication was established with very good results of 5/5 all round. 9H1LO joined the group running these tests and established communications both with 9H1ES and 9H1VW.

9H1LO on 10 GHz SSB

Conclusion

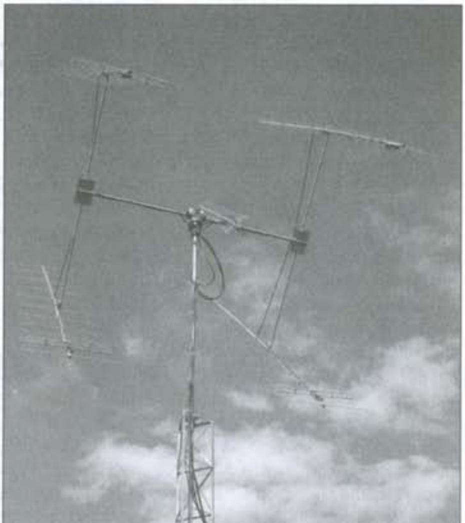
Since the aforementioned activities these radio amateurs have made many other QSO's with stations in Sicily, Italy, Spain, Sardenia, Israel and others. The article has been written with one thing in mind, to encourage radio amateurs to get interested in this mode of communication, it is a unique form of contact, gives enormous satisfaction to all those that want to get involved in constructing or building or installing their home brew equipment. They will find assistance and experience of operators who have personally tried, tested, built, modified and improved equipment, and MARL is looking forward with pride and satisfaction, to the day, not in the far distant future, when 10 GHz SSB operation becomes what the 2 metre operation was a few years ago.
Contact info@9h1mrl.cjb.net for more info.

VHF South America

Editor: Flàvio Archangelo, PY2ZX
py2zx_dx@hotmail.com

New EME station in Brazil: PY4OG

One of the most active VHFers in Brazil is now ready for EME contacts. Mr. José Márcio Salles PY4OG (former PY4LOG) is working from GG78qq on 144 MHz with 12 element 4 yagis in horizontal polarization, Cellflex lines and full elevation / azimuth capabilities. The transmitter is a TS2000 plus Henry 2102 giving between 300 to 600W output with 25W input. The first EME QSO of PY4OG took place in August 2007 when he worked KB8RQ and since then he did not stop to make moonbounce QSOs! Some of then are OZ1LPR, RU1AA, S52LM, I2RV, PA0JMV, DK3WG, RA6DA, RK3FG, IK1UWL, F6HVK, F6FHP, DK3EE, WQ5S, F1DUZ, DL8GP, F9HS, ES6RQ, DJ7OF, DF2ZC, SM7GVF, CT1HZE, PA3CMC. The firsts QSLs cards received came from DK3WG, RK3FG, RU1AA and RA6DA, all with RST "O" and nearby -20db levels. He described: "In cumulative six hour of operation time I've worked 10 countries... Incredible the high number of WSJT users and the goodwill from dedicated operators..." Soon PY4OG will be with additional setups: Masthead LNA on the current system "for new contacts with QRP stations", a new secondary system with 4 yagis 12 elements on vertical polarization plus the third system with 8 yagis 12 elements for 432 MHz.



PY4OG antennas

José Márcio, PY4OG

Márcio told that he received a lot of help from expertised DXers like Sílvio PY2SRB, Orlando PY2ANE, Carlos PY2HCD, Júnior PY2BJO and Horta PY2NI, who designed his antennas based on a K1FO model. PY4OG can be found on N0UK and ON4KST's chat for skeds or by e-mail as well, mainly on weekends. He recently confirmed his HF DXCC working BS7H. Certainly for him a new field for DXCC and VUCC is now open. At the time I wrote this article he was planning to be QRV in ARRL EME contest's weekends. E-mail: py4og@uol.com.br

New Caribbean station: PJ4NX

Since June, 2007 Mr. Peter de Graaf, PJ4NX (also PA3CNX) is QRV from Bonaire (FK52ud). The station on 2 meters has 4 x 9 elements Wimo DK7ZB antenna (5 meters boom, 18 dBd), Sip RAS Rotor, TS2000 and the solid state Italian amplifier Archimede ITB 1000 (1 kW output). On 6 meters he is qrv with a 6 element I0JXX Yagi (6m boom) and SPE 1K amplifier, also used for HF work.

PJ4NX station in Bonaire

With this setup and PE1L he was active as PJ4EME. Like PY4OG he is on tzhe ON4KST's chat and also available via skype and MSN for organising skeds. Peter build one interesting website with photos, logbook, grid marks and general information about Bonaire: www.kralendijk.org.
E-mail: pa3cnx@amsat.org .

Beacon Update

Durval, PY2DUN informs on the VHF-DX Network that the **PY2XW** beacon is qrv on 50,074 MHz from GG67LF with 3 watts and a inverted Vee. The message is "PY2XW GG67LF".

The **PY2WFG** beacon was heard loud despite is transmits only with 5 watts output. The frequency is 50,003 MHz loc. GG66.

TI2NA seems to have changed a bit the frequency on the dial: 50,081 MHz according to spots of KD4ESV and KE4WBO on Oct 04th 2007. This beacon usually is one of the best indicators for propagation to Central America.

PU1BRU seems to have running a (temporary?) beacon on 144.080 MHz from GG99UP, with 50 w and H pol. antenna transmitting CW in 60 seconds intervalls.

G3USF is still providing very important and updated data about the status of the worldwide beacons on 50 MHz. Heis now covering 40 MHz, too. Don't forget to help and send your contributions: http://www.keele.ac.uk/depts/por/50.htm

3m/2m TEP Update – Autumn 2007

Rubens Ferraz Pedroso heard the following stations in GG46 since Sep 25, 2007 (until mid October). He used Sony ICSW-7600 and wire for SWL.

MHz	UTC	Station	Country
90.7	0104	NBC Kingstown	St Vincent
91.1	0035	Observer FM	Antigua
91.9	0047	Hitz FM St. John´s	Antigua
92,0	0045	RFO Radio	Martinique
92,5	0051	Faro del Caribe	Antigua
94.0	2351	RFO Trinité	Martinique
94.3	2355	RFO Morne Rouge	Martinique
92.0	0035	RFO Macoubá	Martinique
95,7	0032	Praise FM	St Vincent
96.7	0007	ZIZ Basseterre	St. Kitts
96.9	0115	ZIZ Basseterre	St. Kitts
97,0	0120	RFO	Guadeloupe
97.9	0048	NRJ	Martinique
98,6	0038	RCI Point-à-Pitre	Guadeloupe
99,9	0146	WEFM	St Vincent
102.6	0108	NRJ Basse-Terre	Guadeloupe
103.7	0039	Hitz FM	St. Vincent
107.5	0113	NBC Kingstown	St. Vincent

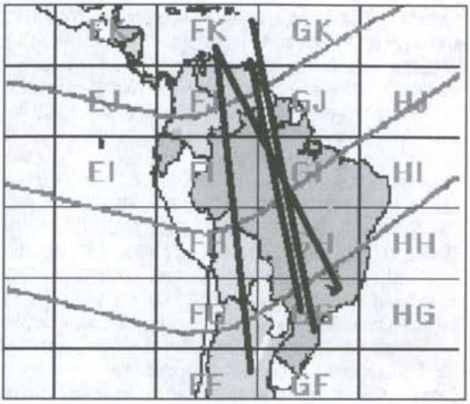
André, **PY5EW**, GG46iw, living in the same region of Rubens, worked **9Z4FZ, 9Z4DMA and 9Z4GU** (FK90, Trinidad and Tobago) on Oct 1st 2007, at 01 z all SSB with 55 signals on 144,200 MHz. On Oct 8th at 00.42z he worked **FG5GP**, FK96hd, with 52 reports on 144.200 MHz.

Samuel Cássio in GG67 (PY2) listened on Oct 21, 2007 to the Voice of Barbados on 92,9 MHz and CBC Barbados on 94,7 MHz with SINPO 24322. He used as receiver a Degen DE 1103 and telescopic antenna.

Peter de Graaf, **PJ4/PA3NCX** worked from Bonaire (FK52) on Oct 8th at 0040z to **LU1FDQ** (FF97ow, 50w, 7 ele, 4979 km). **LU5FCI,** (FF98OI, 4933km, 50w, 7 ele), **LU8EEM** (GF05TI, 5306km) and **LU3EE** (GF05FI, 5283km) were wkd on Oct, 19 0135-0204z. Reports 52 to 55 in SSB.

Robert Alain, **FG5GP** (FK96) from Guadeloupe worked Peter **PP5XX** (GG53qw) with 57 SSB signals on 144,200 MHz, 20 Oct at 2337z. The audio of Alain´s audio capture from PP5XX is on www.144mhz.com.br/audio.asp

João Komuves, **PY2REK** (GG65ot) also heard at same time **FG5GP** with 51 in Itanhaém, São Paulo. His team Dardo VHF DX Group is planning their second Comprida Island expedition in the of 2007.



2m TEP QSOs on Oct. 1st, 8th, 20th 2007

Nearly perfect equidistant locations in relation to the magnetic equator (the line in the middle) are the secret for successfull 2m TEP QSOs in the solar minimum (SFI abt. 70)

Roger Harrison, VK2ZRH comments on the latest 2m TEP QSOs: "These contacts are "classic" Evening-type or 'ducted-mode' TEP - given the reported times, frequencies and circuit geometries. Ducted mode TEP is supported by equatorial plasma bubbles (EPBs), NOT by the equatorial ionospheric anomaly (EIA). These bubbles of depleted ionisation thread the equatorial ionosphere and extend symmetrically north-south across the geomagnetic equator. Ionisation inside the bubbles can be a 10th to a 1000th less than the surrounding F layer, while the bubble wall has a sharp boundary, where the ion (and electron) density changes rapidly between the inside and the outside of the bubble. A signal from a VHF transmitter at a suitable location in one hemisphere can enter the end of the bubble at a grazing angle (close to tangent) to the magnetic field at that point and then "skids" around the top wall of the bubble until it exits the bubble in the opposite hemisphere where a station at a favourable location can receive the signal. The current ARRL handbook and many websites have the propagation mode for ducted mode TEP quite wrong, or very confused, unfortunately. The enhanced ionisation of the EIA, which sits at between 10 and 20 degrees geogmagnetic latitude either side of the geomagnetic equator, will not support 144 MHz propagation. In any event, the EIA has generally dissipated after sunset on the F layer. The generation of the bubbles and support for 144 MHz propagation is not wholly dependent on a high solar flux index (SFI), although their incidence increases and decreases with the solar cycle (fewer during minimum years, many more during maximum years).

2-m-EME News

Heinz Borde, DM2BHG
e-mail: Heinz.Borde@t-online.de

1. CONTEST RESULTS

1.1. ARI CW Contest

VA3TO (Hugh) Worked: IK3MAC, Heard (but no replies from): SV1BTR (~144.049), F3VS (~144.040, big birdie nearby), LZ2US ~144.050), F1FLA (~144.042). Other incomplete calls heard around 144.052 - .053 MHz.

K1JT (Joe): I was able to be QRV on 144 MHz CW for a little over five hours on Saturday morning and another three hours Sunday morning. It was a great pleasure to work the following 30 stations on CW: IK3MAC, SV1BTR, OK1MS, F1FLA, SP7DCS, G3ZIG#, SM2CEW, I1AXE#, IK1FJI#, LZ2US, DL100DAN#, I3EVK#, RA6DA, ES6RQ, YO2AMU#, DK3EE, KB8RQ, F3VS, OH6CH#, PA3CWN, OK1KKD#, SM2A#, SM7GVF#, YU1CF, IV3GBO#, DL5MAE#, W7MEM, SV3AAF#, RU1AA, G4DHF#. The 14 new initials bring my total on 144 MHz to 329*. I now have very firmly imprinted on my mind the slow, perfectly sent CW from Stan, OK1MS; the nice "swing" in the cadence of CW from Roy, G3ZIG (along with his not-quite-stable QRG); the extra letter-spacing of the precise CW from from Jimmy, SV1BTR, and the extra-slow SK dit...dit at the end of each of his QSOs; the frequent extra dit on the "6" ("dah-di-di-di-di-dit") from Ants, ES6RQ; the incredibly loud signal and crisp CW from Graziano, IK3MAC ... and the fist, signal strength, and signal quality of nearly every other operator that I heard and listened to. I worked everyone I heard except for I1ANP and N1WR (called once or twice each, with no response) and RN6MT (heard him once only). Does anyone know what N1WR was doing, and from where? He had a strong signal, and called a few very short CQs (just 15 seconds or so), but I never heard him make any QSOs. I judged the activity from EU to be fairly good, but from NA it was somewhere between poor and non-existent. I was not on for the JA-VK-ZL windows. All in all, it was a most enjoyable EME weekend. Many thanks to ARI for organizing the event, and to all those who responded to my calls!

OK1MS (Stan) I was QRV on ARI contest and worked following stations on 2m CW random. SV1BTR RU1AA IK3MAC SP7DCS JH0WJF JH2COZ LZ2US I3EVK SV3AAF IK1FJI G4DHF I1ANP I1AXE I2RV F3VS G3ZIG F1FLA F9HS SM2CEW K1JT SM7GVF RA6DA YO2AMU DL100DAN # KB8RQ F0CXO DK3EE JR3REX RX1AS YU1CF ES6RQ PA3CWN DL5MAE SM2A # 881 – CW Heard was: OH6CH, IV3GBO, YO3FFF, EA3DXU, ON7EH, ON4DPX.

EA3DXU (Josep) This year I got several commitments and other personal dificultys , finally I was only QRV 4 hours on saturday morning, then my report is very small, only 5 QSOs: IK3MAC SV1BTR LZ2US IK1FJI F3VS.

SM7GVF (Kjell), I was QRV part time during this week end.Worked in CW were: F0CXO F3VS F1FLA G3ZIG IK1FJI IK3MAC SV1BTR SM2CEW RU1AA LZ2US SM2A # OK1MS DL100DAN # ES6RQ KB8RQ SP7DCS K1JT # G4DHF I3EVK

G4DHF (David) Here are the results of my part-time operations on 144MHz. I'm limited to around 46deg of elevation at the moment and I still need to move my tower so that the antennas clear my house to the West. At the moment I'm limited to around 30deg toward the USA :(. I found activity to be very high, but conditions varied enormously. At times signals were extremely loud, only to fade into the noise within half and hour or so. This was evident on many of my echoes, which suggested that polarity rotation was often quite rapid on my H-pol system. I worked many of the regulars with good signals at the beginning of the event, but was unable to hear some of them later. I completed with,IK3MAC SV1BTR SP7DCS YO2AMU LZ2US SV3AAF# I3EVK# JH0WJF OK1MS IK1FJI F1FLA I2RV RA6DA OH6CH DL100DAN PA3CWN KB8RQ DK3EE G3ZIG F3VS YU1CF I1AXE# OK1KKD# SM2A# ES6RQ# DL5MAE K1JT# SM7GVF

1.2. ARRL CONTEST

K1JT (Joe) The bottom line for me this weekend was 48 QSOs and 32 multipliers. (Modest totals, yes; but I am pleased with them as a start. It's already better than I did in both weekends last year, operating as Single Operator assisted.) Oh yes, I should mention that the 48 QSOs included my EME initials #197 through #211. If I worked you, many thanks! If we have missed connecting so far, I hope to work you in November.

DG0OPK (Michael) wkd: RN6BN, 7K3LGC(new#), RA0FCA (new#), RV3IG, DL9MS, S52LM, EB5EEO, IK1UWL, EB1DNK(new#), EA2AGZ, EA6VQ, HB9Q, AO5SE, EI4DQ, DF2ZC, DL8GP, W5UN, DK5EW, N9JIM(new#), K6MYC. There was alot of activity...sometimes very hard to crack the pileup with the low power...many more stations were heard...it was a nice fun to give some points...hope to see you next time

9A9B (Branimir) According my own echo, I heard almost all the time, it was really excellent conditions; but not high activity. Here are my result: OK1MS, IK3MAC, SV1BTR, LZ2US, F3VS, RN6BN, SP7DCS, I3EVK, F1FLA, IV3GBO, YO2AMU. Completed 11 QSOs and heard IK2DDR and K9?

RU1AA (Alex) The first leg of contest turned out to be difficult for me.At the very begining my antenna TX/RX switch (at the top of the tower) failed, then Mirage B1016 came out of order. The rig(and me as well) are getting older.. The pain in my back did not permit me to operate sitting at the table and CW. I must apologize for my absence on announced frequencies .144 and .044. After some time I understood, that I should work in "DIGITAL" cathegory,although CW is my favorit mode. At last I managed to repair the rig and operated CW for 2 hours before the end of the test with 19 QSOs, but the activity already was poor. I'd like to thank all the people who found me and called, who replied me. The score is 181-JT65, 19-CW.

DL2FCN (Bodo) results in JT65B (worked) AO5SE, HB9Q, EB5EEO, K4SV, HA6NQ, WW8M, RU1AA, RN6BN, RA0FCA, IK1UWL, AO6VQ, S52LM, EA2AGZ, F5GHP, F8DO, OH4LA, K9MRI, RV3IG, ZS6OB, RX1AS, W5UN, KB8RQ, K9DX, OM3BC, DK5EW, DK3BU, 7K3LGC, EA3BB, EI4DQ, IK7EZN, RA6DA, YO9FRJ, YU7AA, SM5CUI and a lot of other stations seen, but no reply...

SV3AAF (Petros) All QSOs were random and made in CW (heavyweight) mode. No internet loggers - No emails - No talk back frequencies. Only EME radio path was used with the corresponding station. Stations worked on 144 Mhz: SV1BTR, IK3MAC, RN6BN, RA6DA, F1FLA, OK1MS, F0CXO, SP7DCS, LZ2US, F3VS, K9MRI.

OZ6OL (Hans) Was qrv sunday on 144 Mhz and worked: IK3MAC, F3VS, RN6BN, RU1AA, Hrd LZ2US, SV1BTR. tnx qso....only 500Watt and 13db ant. with AZand EL.

PA3CWN (Oene) I have been qrv for almost all the time on CW in both passes and found condx from time to time excellent !!! worked 22 stations so far. I can add 7 new CW initials to my list, making it now 48 in total .Thanks to all the stations worked SP7DCS, RN6BN, LZ2US, OK1MS, SV1BTR, F3VS, IK2DDR, IK3MAC,K9MRI, W5UN, SM7GVF, F1FLA, F0CXO,K9DX, DK3BU, New ones: K6PF, I3EVK,, IV3GBO, YO9FRJ, WA6PY, OK1KKD, N9JIM, Heard were RX1AS, I2RV, UA4AQL, SM2CKR, W0PT, K1CA, SV3AAF,DL5MAE, IK1UWL, F6FHP, HB9Q, K1JT, YO2AMU and a 9A ??

SM7GVF (Kjell), I worked CW unassisted, only part of the time, which I regret. Thanks for these QSOs: IK3MAC, RN6BN, W5UN, K9DX, SV1BTR, F3VS, SM2CKR #, PA3CWN, OK1MS, F1FLA, SM2CEW SP7DCS, LZ2US, JN1CSO #, JHØWJF #, UA4AQL, RU1AA, YO2AMU.

VA3TO (Hugh) I operated for 2 hours on Oct. 27 and 1 hour on Oct. 28, CW only. Worked: IK3MAC both nights (2nd time for test only) RN6BN. Heard but nothing more than QRZ from: SV1BTR, F3VS, LZ2US ...and several other partials.

2. AROUND 2-m-EME

IK1FJI (Valter): Like many others i want to send my thanks to Wolfgang for the efford for active 1A. I also spend a lot of hours lissen to the signal from Wolfgang, but i always see the trace on the pc screen but very hard find the enought signal for decode the whole call.One or two times i can heard cq cq de.....so i try to call him, but back on rx i loose again the signal.Also amplifier problem home power main swicth go off a lot of times, so something is wrong in my PA.In the evening with low elevation noise and other things i shut down all and qrt. Never seen so bad conditions all the moon pass. thanks again Wolfgang, Ben and sure better next time. Thank you very much for your huge effort to activate 1A0KM on EME. We understand it was very difficult to drive such a long distance and straight on arrival put up the 2m system to work EME just for one day and I believe we all appreciate that a lot. It seems the sporadic E conditions prevented you from completing EME QSOs but in exchange gave you Es QSOs on Saturday.

IK3MAC (Graziano): Many thanks to Wolfgang and Ben for active 1A on CW.Thanks again Wolfgang for two nice EME QSO on CW ,I have received 1A0KM 30db over my noise.See you again Wolfgang from some rare dxcc.

SV3AAF (Petros): EME propagation was poor with higher attenuation than usual as well as Faraday rotation conditions. Put together the high noise level in the middle of a big city and we understand the situation gets much worse.I called you for a few periods only after 15:30 UTC when Faraday eased at least for us in Europe and I had a clearer copy of your signals.

EA3DXU (Josep) On this month of August, have completed a very small number of QSOs only 17, but 2 are new DXCC and 3 more new initial

2 - 8 D44TD DXCC # 109 , initial # 763

6 - 8 WJ6T initial # 764

6 - 8 HA6NA " # 765

7 - 8 9K2YM DXCC # 110 , initial # 766, after many hours looking for best conditions (single 5WL + 400W)

24 - 8 SV9GPV initial # 767

KR7O/YB2ARO (Robert) I had an unplanned opportunity to operate from the 30M dish at Jamesburg. It was very exciting to be able to use such a structure and to hear for the first time my voice returning from the moon on both 2M and 9CM. Apologies to Josep and any others responding to my CW CQs prior to 1900z as I xperienced high QRM at times from the 3.4GHz station operating random, non-sequenced, but 9cm was the primary objective of this activation. I also experienced high noise for extended periods (not sure if local or terrestrial) at times. Apologies also for my poor CW fist. I am not a CW super-op and using a paddle that I was not used to only made things worse. Heard almost no replies to my CW CQs, not sure if it was due to RX conditions on my end or because everybody was chasing the 1A station. I heard a big pileup on the 1A, but never heard the 1A. I suspect there was strong polarity lockout as I heard nothing from some sked partners (or even my echos) for extended periods. I heard reports that people copied me fine at the same time.Power output:CW: 800w,JT65. Stations worked:

WA4NJP O RO 1712Z CW RANDOM

OZ1LPR O RO 1948Z JT65 RANDOM -17

AA9MY O RO 1956Z JT65 RANDOM -15

WQ5S O RO 2030Z CW ?? Did you get our RRR??

PY2SRB O RO 2048Z JT65 RANDOM -22

WQ5S O RO 2054Z JT65 RANDOM -15

JH2COZ O RO 2205Z CW

KB8RQ O RO 2248Z JT65 RANDOM -6

VK4CDI O RO 2303Z JT65 RANDOM -16

JH0MHE O RO 2310Z JT65 RANDOM -18

W7MEM O RO 2322Z JT65 RANDOM -12

K7XQ O RO 0002Z JT65 RANDOM -10

JS3CTQ RO O 0008Z JT65 RANDOM -16

JM1GSH O RO 0020Z JT65 RANDOM -27

EB2FJN (Pedro) This night is the special for me in EME. I completed 3 QSOs with only 2x13 and TS-790 PWR (top 45w). 1- RA6AX. (only 1 call, fast qso), 2- KB8RQ. (qso with 3call), 3- W5UN. (2h 20min for complete QSO, no good condition). Of course, all QSO in random mode.

3. EXPEDITIONS

1A0KM EME expedition story

(**DL5MAE,** Wolfgang): It was rather challenging operation and I am still puzzled why things were going so bad (on EME) this time?! Maybe you have some idea? Some background: We arrived at 1A0KM around 0800 utc on saturday 14th.We were not able to build up any antennas immediately as the "diplomat"was just coming in...So everything was kept QUIET until the early afternoon.We were looking around the QTH to find a place to build up the antennas.We decided to build up the antenna in the garden of 1A0KM. Unfortunately after a while we got the info that its not possible to build it up in the garden...So the only place was on the parking area.... We got the OK to build up our antennas there.So the problem was now that we had the high building towards east and we needed about 45 deg elevation to see the moon.Another problem was the palm-tree to the south and another tree to the north. So it was very hard to rotate the antenna...We used 3-dimensional-rotations (elevation-azimut- up/down by the pneumatic mast)to overcome the problem...Everything was very difficult...!!!! 1A0KM is just too small DXCC!We build up the array on saturday afternoon and got ready abt 16utc. We got alot of cross-modulation with preamp 1. So we changed to preamp 2 (not so sensitive!).First test with Jimmy, SV1BTR failed. Lots of noise on our side (from the city!) and no good condx towards SV. Anyway, next day we thought it will become our day...It took us until 0850 utc until we got an reply from Jimmy, SV1BTR, as the moon was just behind the church and we needed 45deg of elevation.We heard Jimmy very loud and clear and QSO was done withhin a few minutes. Then EA6VQ was heard but lost in QSB. Afterwards IK3MAC was worked easily.A few more CQs were sent out and several stations answered but lost due to fast QSB.The morning-moon-slot was not that long as very soon the palm-tree blocked us and one of the antenna touched the tree already. So we decided to go for lunch and started operation after 12.30 utc again. At 1315 utc KB8RQ was answering and we made a quick QSO. He was very loud and only one call was needed.At 1345 utc I heard Peter, SM2CEW, calling us.I had a lot of QRM at this time from our short-wave station. However, we were able to work Peter through the noise.Later IK3MAC called us again and we exchanged 559/529 reports. Graziano was really loud!I also heard other stations with but only bits like V3S (F3VS?/SV3AAF?), A4J (???), 7DC (SP7DCS?) and others but my personal deep search was switched off (hi). At 20 degrees of elevation I had to quit EME as one of the antenna touched the palm-tree...(again!) I continously called CQ in hope of chance of conditions. But I had the feeling the conditions were just stack continously and did not change for the whole day. Also only one day after new-moon was not good but I had no other choice due to work and high elevation is needed at 1A0KM for EME. Despite the poor results on EME we had a great time at 1A0KM and we have to thank very much our hosts for the invitation. At least the first EME contacts are done from 1A0KM and we made also some nice Es/FAI/TROPO and CW meteorscatter contacts.We met a lot of new radio friends, which is most important for me. Sorry to those trying hard and we could not work due to conditions or other circumstances. Personally, for me, its always interesting what a human is able to achieve (or not) also under difficult situations.

Looking forward for the next challenge... 73, Wolfgang

A25 EME for Africa

The A25 EME operation conducted by the EME For Africa project has ended. Although the trip had to be shortened by several days the results still compare well to the EME operation from Swaziland earlier in the year.

By 10 AM on the 5th of July 2007 the trailer was loaded at the QTH of ZS6WB and we were ready to start the five hour drive to the Botswana operating site.The sun was getting close to the horizon as we reached the operating site, but we had planned on this and had taken portable gas and fluorescent lighting to use while assembling the station. By 9 PM the antenna array was up and the station assembled and tested, so we had time for a cup of coffee while waiting for the moon to rise in just over an hour at 2230 local time. Pine took the first operating shift as A25OB while A25HL (ZS6WB) kept the antenna pointed in the right direction and made coffee to keep Pine awake through the cold African night. The first completed contact was with SP6GWB at 2210 utc and from that time on we had no problem staying awake with plenty of excitement. A total of 44 QSOs were completed by Pine in this session, most of them calls very familiar to both of us. The last QSO before moonset went into the log about 1030 on Friday morning and we could finally get some rest.

In our three days of operation Pine and I completed 115 EME QSOs on 144 MHz with 95 different stations and all QSOs were random with no internet assistance (and no internet). Twenty stations contacted both operators but most called for the second QSO in quiet periods when the operator had been calling for some time without any takers. Thanks to all for the good operating manners.

HB0 – Liechtenstein on the Moon

From 6 to 8 October 2007 Eric DF9UX, Erwin DK5EW and Stephan DK5TE wanted to activate HB0 Liechtenstein on EME. Shortly before the dxpedition start DF9UX fell ill so this dxpedition became a two person activity. At 5 am local time on Saturday 6 October Erwin and Stephan left for Liechtenstein. 4 hours later they arrived at the QTH in Malbun and another two hours later and seven chairs of the chair lift used for the equipment everything was on site. At 3 pm they could do their first tx tries with on the communicated working frequency. (Rig was an IC-7400, ME-1500 by HA1YA, a preamp with MGF1302 and 4 x 10 el) .All of a sudden there was the first caller: Hans DL8GP had apparently monitored the frequency and so made the first contact. The pile-up began and the group completed another 10 QSOs within the remaining 90 minutes moon time. Sunday morning activity started at 0330 local to use the VK/JA window; Guy VK2KU was the first in the log. Another 50 QSOs were completed. Sadly QRM from European stations resulted in some JA QSOs being NC. And getting up Monday morning wasn't quite that easy for the two dxpeditioners as a substantial lack of sleep was obvious. However, it paid off: ON7EH, UA9SL,UT2XQ, HA6NQ, PE1BTX und RX1AS were worked making the total EME count 65 contacts from HB0. strong side effects: Erwin and Stefan now permanently think of where to go next, EME and meteorscatter of course...Erwin has uploaded a bunch of pictures to his website www.dk5ew.de.

4. NEWS AND INFORMATION

K1JT (Joe) I write to let you know that a German translation of the WSJT6 User's Guide and Reference Manual has been done by Eike Barthels, DM3ML. I have placed a copy on the WSJT web site, at http://physics.princeton.edu/pulsar/K1JT/WSJT6_Handbuch_deutsch.pdf

DK3WG is QSL-Manager only fer EME-QSOs: RU1AA, RA3IS, RK3FG, RV3IG, RW3PX, UA3MBJ, UA3PTW, RN4AT, UA4ALU, UA4AQL, RA6DA, RN6MT, RA9YDL, RV9JD, UA9FAD, UA9SL, UA9YLU, UR5LX and UX3LV.

Tilt sensor

A tilt sensor made in Finland. The company is VTI Technologies. Datasheet is easy to find on their homepage. There is one interesting thing with their sensors: They already offer a digital output, so one won't have all the troubles with analog signals over long lines. It seems as their samples policy is working over digikey, so it might even be possible to get small quantities, but I did not check.

Experimental Modes in WSJT 5.9.8

Some of us have been experimenting recently with two new narrow-band digital modes called JT2 and JT4. A basic description and a status report is now available at http://physics.princeton.edu/pulsar/K1JT/JT2_JT4.TXT

After reading the status report, if you are interested in making some tests of your own you can download WSJT version 5.9.8 r558 at

http://physics.princeton.edu/pulsar/K1JT/WSJT598.EXE

Flex 5000 with LINRAD (W3SZ ,Roger): Just a quick note to say I had a ball using the Flex 5000 with Linrad during the first leg of the 2007 ARRL International EME contest, just finshing a few hours ago. I really liked the combination and put a brief set of pictures at:

http://www.nitehawk.com/w3sz/flex-linrad.html.

5. ONCE THERE WAS A CHAT...

(Chats of common interest from the INTERNET)

- AGC Off Mod FT 847 OZ1PIF, Peter has succeded in solving this problem. He grounds the basis of Q1079 (on the AF-CNTL board) through a 56 Ohm resistor, this completely disables the AGC as indicated by the S-meter. For more see: http://www.frenning.dk/OZ1PIF_HOMEPAGE/FT-847%20AGC-Off%20Mod.htm

- RX1AS design PA (PA3CWN, Oene): I am building a RX1AS design PA right now and it has a half wave tube connected to the anode as resonator. This tube has a diameter of 55 mm and the lenth of the total resonator including cooler is 53 cm. The housing is 170mm by 170mm. I want to use a 40mm tube so the whole impedance of the resonator will change. I think it is going upwards. Now my question is what effect will this be ?? Too much mismatch ? and do I need to lengthen or shorten the resonator to get it in resonance ? I want to keep the same housing distances, but my feeling tells me that it should change also with 40mm tube, because the whole line can be seen as coax. Maybe it is best to use 55 mm tube instead, but I was just curious and cannot find any software that calculates it for me The tube used will be a GS-35b The info I refering to, is at

www.pa3csg.hoeplakee.nl/GS35-2M/GS35-2M.html

DJ3JJ (Andreas): pse download appcad from the link below to calculate:

http://www.hp.woodshot.com/appcad/version302/setup.exe

- Heater cooling (PA3CWN, Oene) During my present building of an RX1AS type 2m amplifier, I got a very important hint from Nanko PA0V about cooling the heater. In a lot of designs, there is air blown against the heater and cathode of the GS-35b for cooling purposes.This way I also wanted to cool my heater, but Nanko pointed me at the fact of the little holes just beneath the cathode and the hole with a gaze at the bottom of the tube.This is in fact a 'circuit' where airflow should pass THROUGH !The filament generates heat and the airflow takes care of the immediate transport of heat instead of the heater warming up the metal of the cathode and filament base. I think everyone of us using a GS-35b has felt how hot this base can get. I saw a picture from Nanko and made it myself also. I made an 'airtight' kathode compartiment and blow air into the little holes. The bottom (with the larger hole with gaze) lies outside this air tight compartiment and there the air comes out again. Off course this can also be reversed in blowing air into the bottom hole and leaving the little ones, but in my case this was the most practical way in cooling the heater. This way the filament lies in an airstream, which causes a direct 'heatflow' to the outside of the base. The heat has no need to build up and heatening the base and cathode,because WITHOUT direct airflow the filament first gets very hot, spreading it's heat to the environment, which is metal and this takes time to heat up.WITH direct airflow the tube gets rid of heat immediately. In my case I first reconditioned my GS-35b using the 'blow against' method and the base was getting bloody hot, but now with the airflow method, the base is simply warm and the air coming out of the bottom hole is about 40 degrees Celsius. I think it really helps in giving the GS-35b a longer life,because those holes and 'circuit' for airflow THROUGH the base are not just ment 'for the show' by its inventor ! And if the GS-35b is working hard, there is a lot of heat generated, so better to help the tube in the way it is designed too. This way I also wants to thank Nanko for the great advice, which is very much appreciated !!!

- Quarter wave transformation (Tom): I´m using a four port Lambda/2 power devider. My question is: how do the two 50 ohm impedance coax quarter wave transformers 'transform' the combined impedance that would seem to me to be 12.5 ohms (DC measurement)at the center of the power divider, to be 50 ohms?

Bryce: A 1/4 wave coax impedance transform is calculated by Zcoax = SQRT (Zin *Zout), rearranging Zout = (Zcoax^2/Zin). Zin the impedance on one end, Zout on the other, and Zcoax the impedance of the 1/4 wave length of coax. You have Zin = 25 ohms and are using a 1/4 wavelength of LMR400 which is 50 ohms, therefore Zout = 50^2/25 = 2500/25 = 100 ohms. The 1/4 wave of 50 ohm coax transforms the 25 ohms at the input to 100 ohms at the output. Putting these two 1/4 sections (each showing 100 ohms) in parallel will give 50 ohms at the center.

- Actuator read out (DK5EW, Erwin) a friend of me is planing to setup a EME rig. He will use a actuator for elevation.I was searching Ham sites and internet but I didn't find any homemade controller for a actuator.Does anybody can provide a link for a elevation control ?

F1TE (Lucien): I use a Jack for drive elevation of my EME antennas whose movement is linearized by a correction table in a PIC µcontroler.Here the description of my tracker.
http://www.f1te.org/Tracker/trackeur_gb.htm

CT1DMK (Luis): Depending on the precision you want you may disregard or not the axis offsetof the both actuator and support point.(both have an impact on the equations used)If one wants to get it precise to the 0.1deg or lessneed to consider this, and it will no longerbe a simple 2*sin(x/2).If the antenna bw is a few degrees wide you can keep it simple and disregard this.

OZ5IQ (Kim) I think it (ineariasion) should be taken into account, why the sloppyness of the system, antennas used,/ beam "size" window. IF a dish is used or a vy large antennasystem, I find it nessary but still REMEMBER - the MOON is still only aprx. 0,5 degr. in the sky !! Almost whatever we do, the elastic/sloppyness in the system it is larger ! So for a 4 yagi-system - a potmeter will do well enough. Choose a 1%, if nessary.

– H frame question (W1IPL, Wilt) Hello all, Are any of you aware of a published discussion or have thoughts on interaction of support members in an H frame on array pattern? In this case 4X12 yagis for 2M stacked just under 11ft apart according to VE7BQHs table.

WB9UWA (Jim) The interaction of the vertical members of an H frame on the vertical side of the array can be substantial and will degrade gain and pattern to something between moderate and severe unless it is handled properly. I believe GM4JJJ did his properly. Here is his web site:
http://www.gm4jjj.co.uk/

6. TREASURY INTERNET

FT847 AGC Off Mod
http://www.frenning.dk/OZ1PIF_HOMEPAGE/FT-847%20AGC-Off%20Mod.htm

Calculation of Coax Resonators
www.hp.woodshot.com/appcad/version302/setup.exe

GS35B PA
www.pa3csg.hoeplakee.nl/GS35-2M/GS35-2M.html

Fan Control
http://www.controlres.com/stratus.htm

Digital LIDEL Inclinometer
http://members.chello.nl/j.swienink1/elevation.html

DXCC EME top list in OK.
www.vhf.cz/rekordytoplisty/emetrtoplisty/okemetop.htm

VE7BQH rope yagi
www.bigskyspaces.com/w7gj/longyagi.htm

Fingerstock
www.rfhamdesign.com/products/parts/fingerstock/index.html

Tracker www.f1te.org/Tracker/trackeur_gb.htm

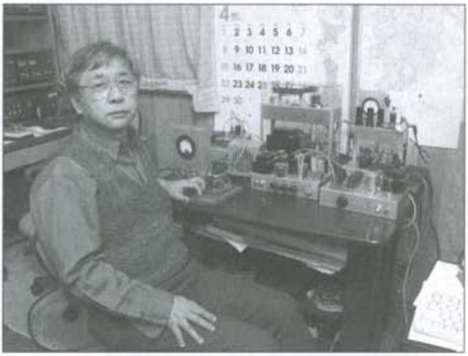
MAP 65 A paper on the MAP65 program has been placed on the Documentation page of the WSJT web site.
http://physics.princeton.edu/pulsar/K1JT/MAP65.pdf

EME Calculator V. 4.00 & EME Planner update
www.ve1alq.com/downloads/software/vk3um.htm

Fully digital Amateur TRX
http://www.adat.ch/index_e.html

FLEX 5000 with LINRAD
http://www.nitehawk.com/w3sz/flex-linrad.html

DF2ZC´s NEWSLETTER www.df2zc.de/newsletter



JA0BZC on 2m EME with 100% tube station – LNA with 6CW4, PA with 829B. Takao wkd IK3MAC in the EU EME contest 2007 with 60W out and 8 x 17 ele. in CW

The Dubus 2m CW EME Activity Event and Contest

Dates 1st quarter 2008

January 18 (Friday) 2100-0000 UTC and
January 19 1300-1600
February 16 (Sat.) 1230-1530 & 2030-2330
March 8 (Sat.) 0600-0900 & 1400-1700
April none, as there is European EME Contest CW section. - QRG 144.040 – 144.060

The Dubus 70cm CW EME Activity Event

Dates 1st quarter 2008

January 19 (Friday) 2200-0000 UTC and
January 20 1500-1700
February 16 (Sat.) 2200-0000 and
February 17 (Sun.) 1400-1600
March none, as there is European EME Contest CW section. -QRG 432.005-432.030

D44TD Expedition Report

Norbert, DL8LAQ, Antonio, D44TD and Frank, DL8YHR

From August 1 to 7th 2007 Norbert, DL8LAQ and Frank, DL8YHR visited Antonio, D44TD, on Sal Island ,Cabo Verde, Loc. HK86no. Main purpose was 2m EME but also a bit EME on 6m and 70cm. Here the log. **2m EME in JT65B**:

1.8. DK3EE, I2RV, PA3CMC, OZ1LPR, PE1L, PA0ZH, DK2PH, DL8GP

2.8. EI4DQ, SM5CUI, RK3FG, UA9YLU, OK1CU, RU1AA, RX1AS, DJ7OF, KB8RQ, W5UN, K1JT, ES6RQ, RA6DA, S52LM, PA0JMV, AA7A, WA4NJP, DL9MS, SP6GWB, F9HS, F1DUZ, S54T, EA3DXU, S54T, EB5EEO, WQ5S, CT1HZE, OH1NOR, G4FUF, K7XQ, DK4TG, S53J

3.8. PE1BTX, OM3BC, LY2BAW, YO9FRJ, RZ3AED, F6HVK, DL7FF, I1ANP, F6BKI, DF7KF, PA3CSG, SV8CS, DL8EBW, PA3FPQ, DH3YAK, DJ9CZ, W5UWB, KC7V, DK3BU, HB9Q, AA7A, K6MYC, N5KDA, I3MEK, RV3IG, EA2AGZ, W7MEM, WJ6T, F6DRO, F8DO, XE2AT, W7GJ, ZL2DX

4.8. SP2OFW, IK1UWL, UA4AQL, DM2BHG, IW4ARD, PA3CEE, OE6IWG, RA3AQ, UA)FAD, DK5YA, F1TE, SV3KH, S57TW, ON7UC, RN6BN, LY2BAW, DL8GP, W8PAT, EA6VQ, LA8KV, ZS6OB, DF2ZC, F6FHP, RA6AX, F6BEG, EA5SE, OH4LA, W8WN, SM7BAE, VE7TIL, WE9Y, K1CA

5.8. JH5FOQ, JH2COZ, JS3CTQ, JH0MHE, JM1GSH, OK1UGA, DK5EW, DK1KO, RA9YDL, DD0VF, DK0VHF, DH4FAJ, PA3COB, DL2NUD, G4CBW, OH7PI, WB9PNU, PA1T

2 Yagis for 2m and 70cm EME on the same boom

6.8. 9H1TX, UR5LX, PY2SRB, PA1GYS, SM2ILF, RV3IG, HA6NQ, DK3WG, DL6BF, RU1AA, YU7AA, EI4DQ, PA0JMV, GW3YXW, IK2DDR, UA3MBJ, DH7FB/p, K9CT, K7MAC

7.8. 9H1PA, OH3KLJ, ZS6WB, IK0BZY, G4YTL, DJ8MS, F5JNX, UT6UG, F1NWZ, W0HP, DM1CG, PA3CSG, IK2CDI, AA9MY, PE1RDP (dupes not listed here)

D44TD antenna farm

2m Tropo on 2.8:

1906 CT1HZE	IM57	53 55	SSB	
1910 EA7TL	IM66			
1915 EB7DBX		SSB		
1916 EA7BYM	IM66	SSB		
1825 CT1HZE	IM57NH 519 / 539 CW			**70cm 2693km**
1829 CT1HZE	IM57NH 559 / 559 CW			70cm
1935 EA7TL	IM66HS		SSB	**70cm 2839km**
on 3.8.				
0452 CT1HZE	IM57NH JT65			
2045 CT1HZE	IM57NH FM 59 59 2693km			
on 4.8.				
1918 G4LOH	IO70JC 419/319			

New IARU Region 1 Tropo Record on 2m: 4048km

on 5.8.			
1835 EA7BKY			
1841 EA7BYM	IM66UM SSB		2764km
1845 EB7GWV	IM66		

EME shack D44TD, operated by DL8YHR

CW-EME on 2m:
4.8. IK3MAC, IK1FJI, W5UN, KB8RQ, SV1BTR, OK1MS

JT65 EME on 6m: 4.8. W7GJ, W1JJ 6.8. K6MYC

CW EME on 70cm: 4.8. DL9KR, OZ4MM

JT65 EME on 70cm: 5.8. HB9Q

6m Es: 4.8. EA8AQV, CT3HF
5.8. ON4IQ, F8DBF, G3SED, G3FPQ, G0JHC, G4DEZ.

QSL info for this operation only via ON4IQ.

EME News

70cm & up

Editor: Bernd Wilde, DL7APV

Intro: The major event was the **ARRL contest**. With some discussions in front about a boycott, while some CW ops are not happy with the rules, separate classes for JT & CW are prefered. Due to this discussion activity on 432 was very low, while the condx were something like best in last 10 years. On 23cm acitivity was good but with some strange condx. Back in Sept. the microwave contest had good activity with normal condx. Many said that they need more time for the contest to change the feed for qsy and work all stations.

EME conference 2008 in Florence Aug. 8-10
130 persons replied to the Comitato Regionale Toscano (C.R.T) so far. Please visit the homepage and answer the prepared a questionnaire at: www.ari-crt.it/eme2008/questionnaire.html
The answers do not commit you in any way.
73's from the C.R.T. (I5WBE)

432 MHz

I5YDI: Luigi is new on 432. He has a modest system with 4 x 22 el FO HB yagis, a 3CX800 PA & MGF1302 preamp. He is interested in CW skeds.

IK6EIW: Stefano is QRV after many years of absence: I put my old array 4x26el HB BV yagis, 500w & 0.5 dB NF. 1 Sept wkd VK3UM & UA3PTW, 2 Sept K2UYH (strong), SM2CEW, & hrd SM3AKW + SV3AAF. 9 Sept DL9KR & hrd FR5DN + G4RGK. I plan a 12' TVRO dish for 23.

JA5NNS: Sho is back with 12 yagis.

KC4/W1MRQ: Ernie is now QRT from Antarctic. He was on 70cm and expects to be back in Aug 09. In the mean time he will be moving to ZD8 where hopes to be QRV after the first of the year.

UT5JCW is new, he is using TS-2000x + GS35B + 4x28el M2, MGF4919 preamp sun 10db. 73 Serge

VE7TIL Due to one *neighbour's* complaint about my antennas I have been ordered off the air by the City. I will be QRT. Thank-you to all that have made my visit on the moon so much fun. 73 Scott

WA3BZT: Edward will be putting Delaware (FM29ep) back on 432 & 1296. He purchased W1QC station and getting ready for operation. He has all equipment for that except a 432 MHz feed and is looking for suggestions. W1QC's dish can extend from 17' to 20 feet.

UT5JCW 70cm antennas

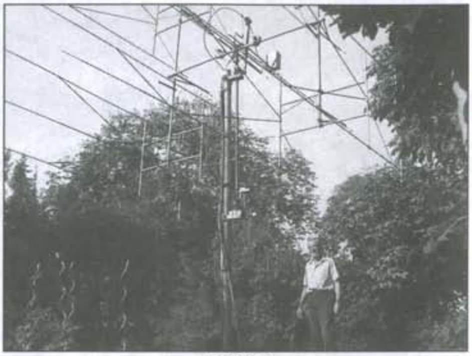
W8TXT: got on 27 Sep, echoes right away with 8 Yagis & hrd K4EME QRZ, and called Cowles many times. Sep 29. wkd JA6AHB rcv 539 and sent Toshio 579. will be looking for K4EME again. 8 yagis and 600w at antenna. 17 db sun noise.

432/1296 ARRL I

DL4MEA wkd **1296**: RA3AQ, SM4DHN, K4QI, WA6PY, DF3RU, SP6JLW, N2UO, SM3AKW, DL1YMK, ES5PC, OZ6OL, K1JT, WW2R, K9SLQ, N0OY, IK3COJ, G3LTF, OK1DFC, OK1KIR, G4CCH, SK0UX, OH2DG, HB9Q, RW1AW, VA7MM, N9JIM, OK1CA, SM3LBN, RD3DA, JH5LUZ, JA3ERE, ON4BCB, LA9NEA, IK2RTI, IK2MMB, JA4BLC, JR4AEP, JA6AHB, DL4DTU, IZ1BPN, OZ4MM, VE6TA, W5LUA, W2DRZ, K9BCT, K7XQ, AL7RT, OE5JFL, VK4AFL*, JF3HUC, JA8IAD*, IW2FZR, VK3UM*, LX1DB (SSB), EA3UM, F5JWF. *=These stations had a significant QSB. At the same time Eu stations did not have QSB. I never before observed such an effect neither 23cm nor 13cm. Total number of QSO: 56, Absolutly great! The first time that I am satisfied with my antenna system. 73, Günter

DL9KR 432: Perigee alone could not explain the enormous signal strengths observed during the first part. A cofounder must have been a well-defined polarization which was horizontal throughout. The absence of fast libration vs. tens of seconds long QSB periods was something peculiar, too. The stable horizontal Faraday prevented some Qs with horizontally polarized stations in the USA due to geographical offset. KE2N & K0RZ were just very week. Wkd : UA3PTW, SV3AAF, K1FO, G4RGK, DL1YMK, I1NDP (loud), RW3PX, UT2EG, UT5JCW, VE6TA, K2UYH, W8TXT, K1JT, SM3BYA (ragchew), K4EME, OH2PO, DF3RU, HB9Q,

SP6JLW, K0RZ, KE2N, KL7HFQ, OK1TEH, K1RQG, IK2RTI #863, DL5FN, JA0TJU #864, SM3AKW, JA9BOH, KL6M (loud), IK6EIW, PE1ITR, OZ4MM, VK4AFL, SV1BTR, RA3EC #865 KO82, I5YDI #866, G3LQR, UT3LL, JH4JLV, YO2IS, G3HUL, DL7UDA, SM2A, F6APE #867. Oct-28 G3LTF, WA6PY, DL7APV, OE5JFL, K3MF, VK3UM, I5CTE, DK8VS, JA6AHB, JA5NNS and JA0TJU dupe. Where were the S5s? GL & 73! Jan.



DL9KR

F5JWF: A lot of fun this week end with 28 stations worked on 1296 CW. OK1DFC, G4CCH, G3LTF, OK1CA, OE5JFL, SK0UX, SM4DHN, LA9NEA, OZ6OL, OK1KIR, SM3LBN, SM3AKW, ES5PC, RA3AQ, K9SLQ, K1JT, K2UYH, RW1AW, K4QI, OZ4MM, W5LUA, RA3AQ, VK3UM, ON4BCB, IW2FZR, DL4GA, JA4BLC, F5FEN. After the EME Dubus contest last spring it is my second attend to 23cm contest.

G3LTF: It seemed generally good on **1296** with lots of activity. Condx on **432** seemed to be very variable with rapid fluctuations in signal strength especially from the higher latitude stations and polarisation was spread on most signals and on echoes. 1296 total of 60, new record for me in one weekend. Only hrd & not wkd was I5MPK. 432 total of 32, hrd but not wkd JH4LJV. I also noted the fading that DL4MEA commented. 1296MHz at abt. 2000Z stations from JA & VK exhibited deep long fades with periods of 5s or more. This did not have the characteristics of libration fading, it can't be polarisation shift, so I believe it must have been strong absorbsion in the ionosphere. It was not evident on echoes or Eu signals. I changed to 432 & at 2030 I was seeing the same fading effect on the JA signals, but deeper and for longer periods. When the signals faded I tried to recover them by changing polarisation but it had no effect. It disappeared at 2220Z. 73 Peter

IW2FZR: **1296** I thank all for fun during the ARRL contest. I noticed strong and fast QSB on some signals, The time cycle was about 5/7 seconds looking traces of Spectran. Unfortunately, I did not take note of QSO suffering from QSB. But even in moments of absolute calm that I have made listening signal very low. I wkd 41 QSO. de Dario

K3MF: I was only able to be QRV on the second pass due to work commitments but made 10 QSO's with two new initials on **432**. Had a late start due to the fact the house and trees blocked the rising moon and had only 5 hrs. of operating time. HB9Q (cw & JT), OH2PO (cw), K0RZ (cw), KL6M (cw), OE5JFL (cw) new initial, DL9KR (cw), K1JT (cw) new initial, DL7APV (cw) and PE1ITR (JT). Wayde

K1RQG: worked 32 this weekend on **70 cm** EME. I missed a few that I never heard calling CQ such as DL7APV with a 569 signal. KE2N spent a great deal of time elsewhere, but had a 57 signal and could have been easily worked on CW. Pearl and I became grandparents for the first time Saturday afternoon to a baby girl. (Congrats Joe!! de apv)

K1JT/K2UYH: Many thanks to all for the contest QSOs and a most enjoyable weekend! Our results at the K1JT/K2UYH combination effort were: **432** 26qso, **1296** 52 qso. Ours will be a Mixed-Mode contest entry, unassisted of course. If we have already worked you on CW (or digital), we hope to work you on the other mode in November. Reminders to everyone: **Even small stations should call CQ some of the time**. If you don't, there is little chance for you to make QSOs with other stations who use primarily S&P operating techniques. If you call CQ, many of us can find you and we will certainly call! 73, Joe & Al

K7XQ: **1296** CW: SM4DHN#, K9SLQ, N9JIM#, K4QI#, OK1DFC, G3LTF, LA9NEA, HB9Q, OZ6OL, RW1AW, K1JT#, G4CCH, WA6PY, JA4BLC#, JA6CZD#, JR4AEP#, OK1CA, OE5JFL#, RW1AW, OZ4MM, IW2FZR#, DL4MEA#, OH2DG#, AL7RT#, N0OY#. 1296 SSB: N9JIM#, 1296 JT: N9JIM#, WW2R#, VA7MM#. The new 3 meter dish is working exceptionally well. Signals on 1296 and 2304 are extremely loud and TX echoes here are now abt 20 dB S/N. Jeff

ON4BCB Made 48 QSO's & 26 initials on **1296**. 27/10/2007: G3LTF, OK1DFC, OH2DG #36, G4CCH, K5JL, SM4DHN, RA3AQ #37, OK1KIR, RW1AW, SM3AKW, ES5PC, OE5JFL #38, DL4MEA, LA9NEA, SK0UX #39, IK3COJ #40, SP6JLW #41, RA3AQ Dupe, IK2MMB, JA6AHB #42, JA4BLC, JR4AEP #43, IW2FZR, SM3LBN #44, DL4DTU #45. 28/10/2007: K9SLQ #46, N2UO #47, LA2Z #48, N0OY #49, K4QI, OK1CA, VE6TA, K9BCT #50, K1JT #51?, N0JIM #52, OZ4MM, DF3RU, VK4AFL #53, VK3UM, OZ6OL, IZ1BPN #54, JF3HUC #55, F5JWF #56, JR4AEP Dupe?, JA4LJB #57, JA8IAD #58, LX1DB #59, G3LQR #60. I missed a lot of the Usuals which where not QRV, looking for them in November. Strongest signal was SM4DHN & K9SLQ. I also noticed a strong Slow QSB and big doppler with JA stations as mentiond by DL4MEA and G3LTF. 73 Walter ON4BCB, Jan ON4CO, Ward ON4CCM

OK1DFC: **1296** MHz. Like others I had same problems, EU stations where very good readable. But VK, KL7 and VE is different story. VK3UMs signal looked like lin pol with long & very deep qsb to zero in sinus period. More problems I had with Trevor's VK4AFL signal. Trevor was not so strong like Doug, but QSB was terrible. Same effect I have observed on Jas, but the QSB was not so deep. Opposite in W, when I worked AL7RT he must to thing that DFC is crazy. His signal was quit strong enough for easy QSO, but I was not able to complete call. Each letter was damaged to many different letters & I had really serious problem to complete his call. Trust me no alcohol during contest here. I thing that in the moment something happened with Earth electromagnetic field. Many stations closer to polls KL7, VE, VK where in deep QSBs or slashed letters. I was QRV whole the time and reached my personal record in first leg, 70 stations & 34 multipliers. It was really great time; & 11#. Highlight was N9JIM, Jim SSB first 57 & 2nd night CW 599. Other SSB QSO I had with Alex RW1AW and I thing that it was probably first EME SSB QSO in Russia language on 23cm. Alex was also very strong 58. Other full S-meter scale I got from Darrell K9SLQ. Best regards, Zdenek

OK1TEH: wkd **70cm** CW: DL9KR, OH2PO, PA3CSG #, hrd K1FO, KL6M. 70cm/JT65: HB9Q, OH2PO, PA3CSG, DL7APV, saw: PE1ITR, ZS6WAB, SM2A. **23cm**/CW: hrd 419: K9SLQ, N9JIM. Tnx all CU 73 de Matej, Rig 70: 600w/23el, 23: 120w/17dB wifi dish.

OZ4MM: was active on **432** and **1296MHz** CW to give some activity and have fun. Found very good conditions with outstanding signals on 1296. 432 was also very good here. 432MHz showed fine conditions. Here I got 37 stations, initials with UT5JCW, JA0TJU, I5YDI. 1296Mhz was just great, big signals everythere, 49 stations worked sofar. Initials here with RD3DA, F5JWH, SP7DCS and PA3FXB. The 96KHz wide SDR-IQ receiver was running & it was a great view specialy on 1296, watching more than 25 stations same time working from the bottom to .035. CU de Stig

PE1ITR: It was very succesfull contest from our location. We made 14 qso's on **432**MHz with 6 initials and the best was that for the first time I could hear our own echo's on the speakers! Rig : 8x21 el, GS35b PA, 0,35db pre-amp. Arno PE1RDP gathered 8 times 21 el tonna yagi's. At the house of his parents-in-law (jo21rm) we put this together into an array of 8 stacked yagi's /p style. It was interesting to see how this array performed compared to the 2 yagi array at my home qth. Wkd : 27/10 JT65b: HB9Q, OH2PO, RK3WWF #, PA3CSG #, SM2A, ZS6WAB #. 27/10 CW: DL9KR, SV1BTR #, I1NDP, 28/10 JT65b: K3MF, 28/10 CW: OE5JFL #, DL7APV, KL6M, K1JT #. 73 Rob

RA3AQ: This year I operated on 23cm from Sergey's RW3BP shack. Using a really small, but optimized setup I did 52 qsos. Hrd were N2UO, SV1OE, SM5LE, JA8IAD, JA4LJB, W5LUA, K9BCT, EA3UM. 2.4m offset dish, 0.24dB NF, 500W

RU3ACE: was operated with RD3DA from Yuri in KO85TK in 2-nd moon window only. We wkd 36 station on 1296CW & hrd about 10 stn. Many times calling VK4AFL, ON4BCB but QRZ only. Station worked: N9JIM RA3AQ, OK1CA, RW1AW, OK1KIR, OK1DFC ES5PC, SK0UX, SM4DHN, OZ6OL, DL4MEA, G4CCH, OE5JFL, SM3LBN, G3LTF, LA9NEA, JA4BLC, JA8ERE, IZ1BPN, DF3RU, IK2MMB, IW2FZR, SM3AKW, IK2RTI, K9SLQ, LA2Z, K4QI, N0OY, OH2DG, K1JT, SP6JLW, K9BCT, VE6TA, OZ4MM, WA6PY, W5LUA. 73! Max, 3,7m dish 250w

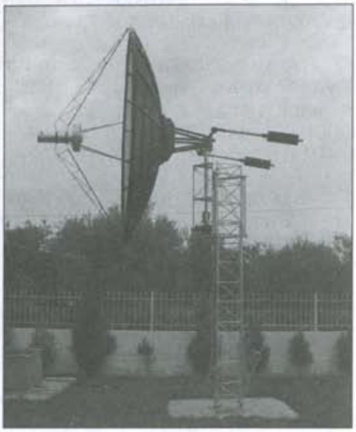
RW1AW I thank all for high activity! Technical problems have not allowed me to work in the second round in full force - there was a refusal of the equipment and I could not work the last 6 hours. As a result of only 62 QSO on 23cм and 5new initials. vy 73 Alex

SK0UX: This weekend we were qrv again after quite some time. On 1296 we made 60 qso:s and some 30+ multipliers. It was great to discover that so many new stations has joined the fun; 24 initials during the weekend! Ops : Per/SM0DFP, Peo/SM0EPO and Hans/SM0MXO 73:s /Hans

SM2A (SM2ILF) was only on Saturday, sunday too much winds. Condx were good. wkd : 27/10 **70CM** JT65; ZS6WAB, PE1ITR, OH2PO, RK3WWF #,OH4LA, F6APE #, EB5EEO #, 27/10 cw DL1YMK #, K1FO, DL7APV, RW3PX #, G3LTF, UA3PTW, SV1BTR, DL9KR. Hrd G4RGK, UT2EG, SM3JQU, OH2PO, DL7UDA. 73 de, Stefan

SP7DCS: added a preamp to the system. In spite of QRP, I managed to work: random: 27/09/07 G4CCH, OZ6OL#, G3LTF#, OK1DFC#, sked: 28/09/07 K2UYH#, SP6JLW# first SP-SP on 23cm eme!!!. 30/09/07 LA9NEA# DJ9YW# SM5LE#13. I am extremly please to work Sven as both of us are small stations! It will be very difficult to work smaller station now; hrd: VK4AFL, VK3UM, JA6AHB, I5MPK, SM3LBN. These are my first steps on **23cm**, but I am getting more interested in this band. 73 Chris

SV1BTR: wkd in CW (heavyweight) mode: 36 on **70cm**. Enjoyed the Contest very much, especially on 70cm. FR5DN, UA3PTW, SV3AAF, RW3PX, UT2EG, VK4AFL, KL6M, DL9KR, DF3RU, DL5FN, OH2PO, DL1YMK, G3LQR, I1NDP, OZ4MM, DL7APV, SM3JQU, JH4JLV, HB9Q, SM2A, PE1ITR, K1FO, K1RQG, DL7UDA, W8TXT, G3LTF, K0RZ, KL7HFQ, SP6JLW, I5CTE, JA9BOH, JA5NNS, G4RGK, JA6AHB, JA0TJU, SM3AKW. 73 Jimmy



SV1BTR new 3.6m dish for 23cm EME

SV3AAF: made all QSOs in CW (heavyweight) **432MHz**: DL9KR, HB9Q, K1FO, OH2PO, UA3PTW, I1NDP, K1RQG, OE5JFL, KL6M, SV1BTR, DF3RU, DL7APV, G4RGK, RW3PX, K0RZ, VK3UM, OZ4MM, JA6AHB, JA9BOH, SP6JLW. Many thanks to the stations calling me but I did not manage to have a full copy of their callsigns. GL, 73 de Petros

VK3UM: **70cm** polarity was aligned through out & signals were remarkably stable. All Eu, US & JA signals rx here were predominately horizontal and I tx hor. all of the time, usually vert for US. US signals had the spectral purity like AF signal generator! Most unusual. WA6PY secondary echos were hrd also years ago (late 80's). I too + many others, experienced ~1 second primary echos for about 20 minutes during an ARRL Contest. Due to gale force winds Doug was qrv just under 3 hours total. 73 till next time Doug

WA6PY wkd on **432**: OE5JFL, OZ4MM, UA3PTW. On 1296: DL4MEA, G3LTF, G4CCH, HB9Q, IZ1BPN, JR4AEP, JA8ERE, JH5LUZ, JA8IAD, JA4BLC, JA6AHB, JA6CZD, LA9NEA, OK1DFC, OH2DG, OZ6OL, RA3AQ, SM3AKW, SK0UX, SP6JLW, VA7MM, VE3KRP, VK4AFL, K1JT, N2UO, WW2R, K2DH, K4QI, AL7RT, K7XQ, N9JI, K9SLQ. Working conditions are difficult, lot of smoke from nearby wildfire causing heavy headache. At 1023 GMT during JA window, I heard double echoes, second echoes were delayed about 1 sec after EME echoes, very weak. I repeated experiment for few minutes. Frequency of secondary echoes were almost the same as EME echoes. After 5 minutes this secondary echoes vanished. GL, 73 Paul

WW2R: On **1296** condx were good. Had 31 qsos including 9 initials OE5JFL, N9JIM, SP6JLW, K7XQ, OH2DG, SK0UX, IZ1BPN, RA3AQ, IK3COJ. On **432** condx were bad. Echoes non existant. Only wkd OH2PO. CWNR K1JT, DL9KR, VE6TA, KL6M, hrd K0RZ, HB9Q, SV1BTR. SV1BTR was the loudest signal heard all weekend. Dave

ARRL 13cm & up

DL4MEA wkd: es5pc, ok1kir, g3ltf, iw2fzr, ve6ta, ok1ca, df3ru, rw1aw, called ssb but no answer: dl0shf, called crossband but no answer: wd5ago, k1jt, kl6m (lost in moonset) hrd crossband: sm3akw, hb9sv, oe9erc, f5jwf, sm3akw, g3ltf SSB dupe, oz4mm, dl0shf, f2tu(*1), worked crossband: wd5ago, k1jt, w5lua, wa6py, kl6m, hb9q, called crossband: na4n (*2). (*1) very fine, speeded down to match my cw knowledge, worth to mention, thanks (*2) cwnr. Would those that have the capabilty to listen on both check both bands before CQing if the downlink is free? It happend that my mirror on 2304 became occupied by bigger stations capable of listening. 73, Günter

G3LTF wkd DF3RU #, F2TU, RW1AW, OH2DG, OK1KIR, ES5PC, IK2RTI #, SM3AKW, OE9ERC, HB9SV, (Xband) F5JWF #, SP6GWN #, K1JT (Xband) DL4MEA. CWNR were W5LUA, WD5AGO, NA4N, PA0BAT. But as usual I did hear a lot of others on 2304 and called them, mostly many times, WD5AGO, WA6PY, KL6M, NA4N, K7XQ, IW2FZR,and OK1CA. I would be interested to hear of anyone who called me X band and didnt get a reply, when the RIT runs out its easy to make an setting error on split operation. I added (*=X-band-QSO) VK3NX*, JA4BLC*, JA8IAD*, IW2FZR, OK1CA, G3LQR, DL4MEA ssb,VE6TA, W5LUA*, WD5AGO*, OZ4MM, WA6PY*, DL0SHF, HB9Q*. CWNR JA8ERE. On 9cm I wkd W5LUA after a 4am fight with Mr Murphy that I eventually won. I think we shall find this had the highest number of stations active of any 13 cm contest ever. 73 Peter

GW4DGU Having done a lot of work on my dish and rx, I was hoping to give a more positive report, but although I had good echoes, including my best SSB echoes so far, and RW1AW was his normal 559, signals from many other people seemed strangely weak. Perhaps it was the shock to my system caused by getting out of bed before 4am! Stations hrd or wkd (#) RW1AW #, IK2RTI cwnr, F2TU #, F5JWF cwnr, WA6PY, WA7CJO, IQ4DF #. Few other stations hrd but they didn't make it onto my scratch pad. A good weekend here! The new dish surface has improved the G/T a lot, although I've not yet characterised it, as I didn't finish fitting it until 1800 on Friday. I guess that activity was diluted a bit by people trying to run three, four, or five bands. Several people who I'd expected to be QRV on 3cm were clearly playing elsewhere, or were only around for a short while! I wkd: RW1AW, F2TU, IQ4DF, F5JTA#, IK2RTI#, OK1KIR#, OK1CA, WA7CJO, G4NNS#. CWNR: HB9SV, DL0SHF, F5JWF, WA6PY, I4BER. Chris

HB9JAW activated with DL3OCH the big dish from HB9Q. Bodo (OCH) started & wkd: ES5PC, HB9SV, IW2FZR, F2TU, OK1CA, OK1KIR, SM3AKW, At 23 UT JAW showed up & calling agn but no one heard. Sudden F5JWF heard on 2320.098. But no reply to our call on 2304.098. After that nothing for hours. At 0049 IK2RTI 429 579 2304 (This is a surprise as I must have worked him with a broken Preamp.) Then I called over 1 hours, but could not hear the echos anymore. Frustrated I went for a nap. At 06.00 I wake up and went for a system test. Weak echos again. After a while I turned antenna to the sun and discovered no Sunnoise. Exchanging the preamp to a old hb one the antenna on the sun again, there was sunnoise back. K1JT, VE6TA, OE9ERC, RW1AW, W5LUA, WD5AGO, G3LTF, DL4MEA, NA4N, WA6PY, DL0SHF, KL6M. Tnx for the QSO's & sorry if you have called while we were with a broken preamp. 73 Michel

ES5PC wkd On 13cm: HB9SV, SM4DHN, OK1KIR, IK2RTI, G3LTF, F2TU, DF3RU, SM3AKW, RW1AW, F5JWF, K1JT, OK1CA, OH2DG, VE6TA, WD5AGO, WA6PY, NA4N, DL4MEA, KL6M, VK3NX, JA4BLC, HB9Q, IW2FZR, G3LQR, OE9ERC, JA8IAD. On 6cm: F2TU, RW1AW, OK1KIR, VK3NX, OK1CA. It was apparently a good improvement on 6 cm after tracking software improvement. Worked OK1KIR easily on sunday evening and after that successful skeds with VK3NX and OK1CA. It was really good activity and strong signals on 6 cm on Sunday evening. 1st Oct I worked VK7MO on 2301 MHz in all three JT65 modes (JT65C, B, A). We saw no difficulties with decoding, even in JT65A. VK7MO has GPS locked frequency, on my station I have a 10 MHz high precision OCXO for phase locking the LO. Later I also worked OE9ERC on 2320 MHz JT65C. 73 & GL, Viljo

F2TU For this contest, I juggled by changing seven times of feed on the dish what asked for a total of 90 min, luckily the wx was good. Rule of European contest is better, but only if you work one day on 10Ghz and one day on 5.7GHz both the same weekend, weekends separated for 13 & 23cm. And also you are classified in each band, ARRL you choice only one. In spite of that it was a very good contest: 13cm 30 qsos (27 for 2006), 6cm 7 qsos (5), 3cm 14 qsos (7). Thank you with all for the qsos and my excuses with those which called me without having answer. 73 Philippe

F5JTA 10G reports wx & conditions were optimum. No technical issue to deplore. The dream! Wkd: sept 29th RW1AW, G4NNS, WA6PY, F2TU, IQ4DF, WA7CJO, OK1CA, F5JWF, F5VKQ, SP7JSG. Sept 30th GW4DGU, OK1KIR. 12 random qsos (11 in 2006) with SP7JSG + GW4DGU as initials. Cwnr: HB9SV, IK2RTI despite their loud signals. Hrd & called several periods K6RE at 29/09 07:36 but already trees blockage on the west side at this period. Thanks to all. Vy best 73's.

F5JWF After few month of stand by due to TWT problem on my 3cm equipment I was back for the ARRL EME 2007 on september 29/30. This week end was dedicated for 2300 and up. The last month I have worked hard to find a new TWT for 3cm and was forced to reorganized all the transverter due to mecanical constraint. I have got some progress to finished a new 13cm station based on refurbished UMTS PA which provide 170W...300W. This equipment was finalised in september and first echoes were heard for the contest. The PA is powered by a new 28V/50A linear power supply designed by my friend Bozo. I am now on the moon with 170W on 13cm and 40W on 3cm and my echos are more confortable. I worked on 13cm on 29/30 september F2TU, RW1AW, G3TLF, OK1KIR, OE9ERC, ES5PC, G3LQR, DL4MEA, IW2FZR, SM3AKW, VE6TA, DL0SHF all report I have got is around 53..57 and F2TU was contacted in SSB. My 3cm logbook was little bit more empty as a focuse my time in 13cm: F2TU, RW1AW, IQ4DF, F5JTA. Best 73 Phil

K1JT & K2UYH, it was a pleasure to work the stations: F2TU, RW1AW, OK1KIR, G3LTF, SM3AKW, HB9SV, ES5PC, OK1CA, IW2FZR, W5LUA, VE6TA, NA4N, WD5AGO, DL4MEA, WA6PY, OZ4MM, DL0SHF, HB9Q. on 13cm over the weekend, using the callsign K1JT at the fine station of K2UYH. Apologies to those we may have missed. The trees continue to grow on properties adjacent to the K2UYH QTH, so the available moon-elevation window is inexorably shrinking. 73, Joe and Al

K7XQ My first experience on 13 cM EME, very long hours but a good first success, time to optimize now. Operated for 14 hours. Worked two stations OK1CA#1, KL6M #2, CWNR: F2TU, RW1AW, VK7MO (JT65) very loud above noise. Tried but no copy: W5LUA (about 8 db above noise, not quite enough for me to pick him out). Echoes were consistant most all night at 8–10dB above the noise. 200 watts at PA output. Need to get used to signals on 2304, much more fluttery than 1296. Hard to find right settings in radio to pickout characters. Jeff

NA4N wkd the following stations: F2TU, RW1AW,W5LUA, HB9SV, OK1CA, IW2FZR, K1JT, ES5PC, WD5AGO, WA6PY, VE6TA, OE9ERC, HB9Q, and DL0SHF. I worked 3 new stations, still having problems receiving on 2320, sorry guys. Over all I had a good time thanks. Greg

OK1CA I was QRV on **13, 9, 6 and 3cm** during the ARRL EME Contest microwaves part. I worked 27 QSO & 7 initials on 13cm, only 1 QSO with W5LUA on 9cm, 6 QSO on 6cm & 6 initials and 14 QSO on 3cm & 4 initials. My first EME QSO on

6cm band, my sixt EME band. I had heavy rain a strong wind at Sat., the Sun was clear. 73 Franta

OK1KIR 2300 MHz worked on 29.9 RW1AW, HB9SV, OH2DG, ES5PC, G3LTF, F2TU, DF3RU #68; OE9ERC, SM3AKW, IK2RTI, F5JWF #69, K1JT, IW2FZR, VE6TA, OK1CA, DL4MEA, NA4N, WD5AGO, WA6PY, VK3NX #70, HB9Q #71 and G3LQR. hrd W5LUA,KL6M and JA8IAD. **5760** MHz 30:9 ES5PC, OK1CA #28, RW1AW, JA6CZD, F2TU. Only hrd VK3NX. **10368** MHz 30.9 GW4DGU #35, IK2RTI, HB9SV, RW1AW, IQ4DF, OK1CA, F5JTA, K6RE #36, WA6PY, G4NNS, I4BER #37, WA7CJO, F2TU, DL0SHF and F5VKQ #38. We started QSO with SP7JSG 549 –sri but then we lost Czeslaw signals. 73 Jan, ok1vao, for OK1KIR team

OZ4MM reports of his limited **13CM** activity. Too many mechanical faults on saturday prevented me to be QRV, but after repair the hole day, my dish tracking was again OK. Sunday morning I was QRV 1 1/2 hours & wkd KL6M, DL4MEA, IW2FZR, VE6TA, W5LUA, G3LTF, SM3AKW, RW1AW, OE9ERC, K1JT (same as K2UYH), WA6PY, WD5AGO. In the evening Bodo, DL3OCH was kind to activate HB9Q again and got them in the log. Only 13 stations this year, but got rewired my tracking control, hi. CU de Stig,

RW1AW wkd 19 random QSO: G4NNS, F2TU, SP7JSG, F5JTA, F5JWF, IK2RTI, GW4DGU, K6RE #, WA7CJO, WA6PY, DK7LJ, IQ4DF, F5VKQ, DL0SHF, OK1KIR, HB9SV, W6YFK #, OK1CA, I4BER. I regret that in September, 29-30 stations could not work which were active on **10G** only three weeks ago! And in period ARRL Microwave contest it would be possible to lead on a range 10G not less than 27-29 random QSOs. I hope for activity of the JA friends on 3cm band EME! vy 73 Alex

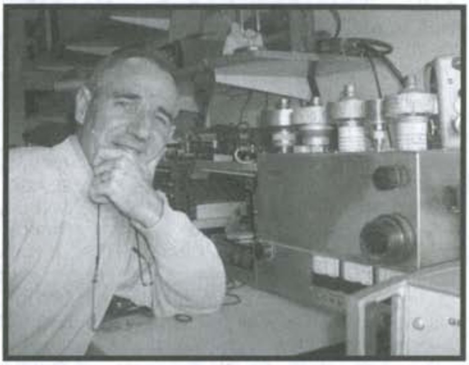
Results from Henryk **SP6GWN**. It is first **13cm** eme station from SP. He had a lot of technical problems in arrl contest, but managed to work 3 qsos. His equipment is: 2.7m dish + 100W. 24/09/07 sked F2TU# first 13cm eme in SP!!! 29/09/07 ARRL F2TU, G3LTF# first SP-F, OK1CA# first SP-OK. He is not yet ready for skeds as he discovered some technical problems.
VY 73! de Chris SP7DCS

VE6TA: severe wx and equipment breakdowns playing a big part. Wkd **13cm** most with great signals due to perigee: OK1CA, WD5AGO, K1JT, HB9SV, SM3AKW, DL4MEA, OK1KIR, ES5PC, IW2FZR, RW1AW, F2TU, WA6PY, F5JWF#, G3LTF, W5LUA, OZ4MM, DL0SHF, OE9ERC, NA4N, HB9Q#. At the end of the first european window, my 24 vdc supply decided to retire again, so I missed the asia/VK window. For the second pass I borrowed the boat battery for a power supply. Wkd okay but man those batteries are heavy! 73's to all. Grant

WA6PY wkd **10GHz**: F5JTA, IQ4DF, F2TU, RW1AW, W6YFK, WA7CJO, G4NNS, OK1KIR, hrd: GW4DGU I4BER, very good signals and shortly SP7JSG. **13cm** wkd: IW2FZR, W5LUA, RW1AW, F2TU, ES5PC, VE6TA, OK1KIR, WD5AGO, NA4N, SM3AKW, K1JT, G3LTF, OZ4MM, DL4MEA, DL0SHF, OE9ERC, HB9Q. Hrd HB9SV, OK1CA. I was unable to rx VK3NX because my TS2000 covers only down to 142 MHz. 73 Paul

EA3DXU Silent KEY

In the morning of oct 5th 2007 at 4:30 UTC my brother EA3DXU is SK, its keyer is in silence for always. Rest in Peace, Pau EA3BB



I was very sorry to hear the news, Josep's death is a great loss to the eme community. I first worked him on 432 EME, as /P, in 1990 and thereafter many times. Often in contests we would take 20 minutes or more to get the calls through, his system was quite small and he had a high local noise level. But Josep was a man who did not give up and you always knew that if you were prepared to hang in there then so was he. I met him twice at EME conferences and everyone present will remember the great presentation of his groups 23cm expedition to C31 which was characterised by tremendous attention to preparation and detail. We shall miss him and all his contributions to EME. R.I.P Josep. Peter G3LTF

DUBUS Hall of fame for VHF/UHF/SHF operators

I am happy to announce that

EA3DXU, Jose M. Prat Parella

gets the honour to be the member #1 in the DUBUS Hall of fame for VHF/UHF/SHF operators. EA3DXU get´s this unique award for his outstanding activity on the bands over decades. Thank you Josep for your great activity! 73 Joe, DL8HCZ/CT1HZE, DUBUS Magazine, Publisher
The DUBUS/REF EUROPEAN EME contest 2008 will be held im memory of EA3DXU.

73 Bernd DL7APV

Lunar Weekend Calendar for 2008 (by DL7APV)

2400 Sat/ 0000 Sun	Decl. (deg)	Signals (dB)	Sun off-set/°	Sky temp, K,432	Comments & contest dates
Jan 05/06	-27,7	-1,8A	+29 DP	55	Moon in south, apogee
Jan 12/13	-03,9	-0,52	-56 DA	22	Daytime
Jan 19/20*	+28,0	-0,23	+170 N	45	**ATP** sat 22-0 sun 15-17, ARRL Tcontest
Jan 26/27	+16,8	-1,53	-130 N	25	Near apogee, night
Feb 02/03	-28,2	-1,76A	+49 DP	118	Moon in south, apogee
Feb 09/10	+00.9	-0,43	-36 DA	23	**DUBREF contest 2m-23cm digital only**
Feb 16/17*	+27,6	-0,33	+164 N	40	**ATP** sat 22-0 sun 14-16, 23cm ssb-Test
Feb 23/24	-00,7	-1,45A	+161 N	19	Near apogee, night
Mar 01/02	-27,7	-1,7	+69 DP	175	EU V/UHF T-contest, Moon in south, apogee
Mar 08/09	+05,3	-0,35	+20 DP	24	Near Perigee, daytime
Mar 15/16	+25,7	-0,33P	+157 N	30	**DUBREF contest 432 & 5760 & up CW**
Mar 22/23	+20,0	-0,73	-160 N	16	Cold background, night
Mar 29/30	-26,8	-1,65A	+82 DP	136	Near apogee, moon in south
Apr 05/06	+08,1	-0,26	-1	SUN	Near Perigee, sun noise
Apr 12/13*	+23,4	-0,43	+171 N	25	**DUBREF 2m & 2.3 GHz & 3.4 GHz CW** **ATP** sat 21-23 sun 12-14
Apr 19/20	-13,9	-1,73A	-173 N	26	Apogee
Apr 26/27	-25,1	-1,58	+105 DP	68	Moon in south
May 03/04*	+12,8	-0,2	-21 DA	25	EU V/UHF T-contest, **ATP** sun 5-7&12-14
May 10/11	+20,1	-0,53	-175 N	17	**DUBREF contest 23cm CW/ssb**
May 17/18	-17,5	-1,8A	+173 N	27	Moon in south, apogee
May 24/25	-22,6	-1,43	-135 N	35	Moon in south
May 31/01	+16,3	**-0,14P**	-41 DA	25	**ARI Digital** contest
Jun 07/08*	+16,7	-0,56	+59 DP	15	**ATP** sat 17-19 sun 11-13
Jun 14/15	-20,7	-1,82A	+168 N	30	ARRL T contest, apogee, moon in south
Jun 21/22	-19,5	-1,33	-160 N	30	Moon in south
Jun 28/29	+21,3	-0,13	-7	35/SUN	Sun close, Near Perigee
Jul 05/06	+13,3	-0,66	+39 DP	15	EU V/UHF T-contest
Jul 12/13	-23,3	-1,85A	+160 N	33	Moon in south, apogee
Jul 19/20	-16,0	-1,33	-178 N	30	Moon in south
Jul 26/27*	+22,9	**-0,05P**	-76 DA	29	**ATP** sun 0-2 sun 8-10
Aug 02/03	+09,1	-0,79	+20 DP	16	ARRL T contest
Aug 09/10	-25,3	-1,88A	-111 DA	36	Moon in south, apogee
Aug 16/17	-12,3	-1,23	+178 N	**30**	**EME Meeting in Florence !**
Aug 23/24*	+25,4	**-0,02P**	-90 DA	28	**ATP** sat 23-1+ sun 6-8
Aug 30/31	+06,2	-0,89	+2	SUN	Sun noise
Sep 06/07	-26,6	-1,9A	-89 DA	41	EU 2m T-contest
Sep 13/14	-08,6	-1,13	+170 N	25	ARRL T contest
Sep 20/21	+26,9	**-0,01P**	-109 DA	35	ARI CW/ssb
Sep 27/28	+01,1	-0,98	-12 DA	18	SUN close
Oct 04/05	-27,2	-1,91A	-69 DA	49	Eu 432&up T-Contest
Oct 11/12	+17,3	-1,03	+156 N	25	Nighttime
Oct 18/19	27,3	**-0,00P**	-122 N	40	Good weekend! (Maybe ARRL?)
Oct 25/26	-02,5	-1,08	-36 DA	20	Daytime, cold background
Nov 01/02	-27,1	-1,91A	-39 DA	116	Eu 2m CW T-Contest
Nov 08/09	-01,1	-1,03	+136 N	25	Nighttime
Nov 15/16	+26,7	**-0,00P**	-174 N	43	Good weekend! (Maybe ARRL?)
Nov 22/23	-08,5	-1,19	+50 DP	27	Daytime
Nov 29/30	-26,5	-1,9A	-23 DA	175	Moon in south, Apogee
Dec 06/07	+02,8	-0,93	+118 DP	25	Daytime
Dec 13/14*	+25,5	**-0,02P**	-170 N	35	ATP sat 19-21 sun 4-6
Dec 20/21	-12,3	-1,27	+70 DP	27	Daytime
Dec 27/28	-25,3	-1,89A	+8	129/SUN	Moon in south, Apogee & sun noise

A= Apogee (loss=1.9dB), P=Perigee (loss=0dB), *ATP= DUBUS 70cm **A**ctivity**T**ime**P**eriod, see also http://www.sm2cew.com/dubus-aw-70.html for info and updates

Sun Offset *vs* Time of Day for Visible Moon

-180° -120° -30° 0° +30° +120° +180°

Night N	Day (AM) DA	Sun noise S	Day (PM) DP	Night N

EUROPEAN EME CONTEST 2008

sponsored by DUBUS and REF

In memory of Jose M. Prat Parella, EA3DXU

The European EME contest is intended to encourage world-wide activity on moonbounce. Each different call prefix forms a Multiplier.

1. Contest Dates & Bands

First weekend	**February 9/10**	**00 - - 24 UTC**	**144, 432 & 1296 MHz - Digital only**
Second weekend	**March 15/16**	**00 - - 24 UTC**	**432 MHz and 5.7 GHz and up CW/SSB**
Third weekend	**April 12/13**	**00 - - 24 UTC**	**144 MHz and 2.3 / 3.4 GHz CW/SSB**
Fourth weekend	**May 10/11**	**00 - - 24 UTC**	**1296 MHz CW/SSB**

2. Sections and Awards

QRP 144MHz <100kW EIRP 432MHz <400kW EIRP 1296MHz <600kW EIRP but no separate QRP/QRO categories
QRO On 144, 432 and 1296MHz, stations with EIRP equal to or greater than stated above.
PRO Non-amateur equipment or antenna. PRO stations will have scores listed separately.
CW/SSB All QSOs in CW and/or SSB mode – no other modes used
DIG All QSOs in digital mode – no other modes used
MULTI Multi-OP is >1 OP – but no separate category

Multi-operator and QRO stations will be highlighted in the general classifications. All QRP/QRO band winners and QRP/QRO multiband winners will receive a year's free subscription to DUBUS magazine. The multiband section contains weekend 2, 3 and 4 only. In each band/section certificates will be sent to ALL entries

3. Rules

3.1 For the purpose of the contest only one scoring per valid QSO with the same station can be logged in each band.
3.2 During the European EME Contest dates & times, communication via the Earth-Moon-Earth path is the only type of communication permitted by participants and stations worked.
3.3 **During Contest time**, it is not allowed to use other communications medium such as internet or packet radio, to self spot, announce CQ frequency, make skeds, exchange any QSO progress info, confirm whether the QSO was valid or not.
3.4 Spotting other stations for activity reasons, is permitted.
3.5 If stations participating in the Contest choose to use 'real time' communication outside the Earth-Moon-Earth path so as to solicit contacts for themselves, they are permitted to do so, only outside their Contest participation time. In such a case, re-entering the Contest for the remaining of their respective weekend, moon time, is not allowed.
3.6 Stations participating in the Microwave bands (2.3GHz and above) are permitted to announce their time plan of proposed band segment activity, during times when they have no moon visibility.
3.7 Stations deviating from the rules are not eligible to submit logs for the European EME Contest.

4. Contest Exchange

For a valid EME QSO, both stations must have copied all of the following:
4.1 Both callsigns from the other station
4.2 Signal report from the other station (using TMO procedure or RST)
4.3 R, from the other station, to acknowledge complete copy of 4.1 & 4.2

5. Logs

Logs must be separate for each band, and should be in normal "logbook" format.
Top line: Your callsign, Band
Each QSO: Date/Time, Callsign, Report sent, Report received, Points, Multiplier
Bottom line: Total points, Total multipliers, Total claimed score.

6. QSO Points

CW/SSB/DIGITAL:
100 points for each random QSO completed on 144/432/1296MHz.
10 points for each sked QSO completed on 144/432/1296MHz.
100 points for each random QSO completed on 2.3GHz or higher bands.
50 points for each sked QSO completed on 2.3GHz or higher bands.

7. Multipliers

Each different call prefix is a multiplier (e.g. DL1, DK9, SM2, S51, S54, G6, KM5, W5, JA6, VK4, WA6, K6, PA1, PE1, etc). See example of WPX Contest rules for further details on prefix multipliers.

8. Total Scores

Single band score = [Total of QSO points] * [Total of multipliers].
There will be one QRP winner and one QRO winner on each band.
Multiband score = [(Total sum of points on 144-1296MHz) +
(2 * total sum of points on 2.3GHz or above)] * [Total sum of multipliers on all bands]
Multiband stations will also be listed as an entry on each separate band worked, and can also win single-band awards.

9. Contest Entries

Copy of the log for each band with details of points, multipliers and total points.
The following information **MUST** also be included for each band:
1. Output power, transmit cable loss, antenna type and gain
2. Categories: QRO/QRP - single/multi operator - CW/SSB – DIG
3. Start time and end time of Contest participation time
4. Name(s) of all operators
5. Grid locator.

Other info is welcome: Comments, conditions, station details, photographs, etc.

10. Sending Your Entry

Contest entries **MUST** be sent no later than 20 days after the end of the last contest weekend (i.e. in the mail or e-mail by 31 MAY 2008).

Entries for the **FIRST weekend (Digital)** must be send no later than 12 days after February 10th (i.e. in the mail by 12th February 2008)

Mail address: Joachim Kraft, Gruetzmuehlenweg 23, 22339 Hamburg, Germany
You can also e-mail your contest entry in any common format to: **info@dubus.de or DUBUS@web.de**
All email entries will be acknowledged within one week. For further questions contact: info@dubus.de

Good Luck in the Contest!

For REF: Patrick Magnin, F6HYE

For DUBUS: Joachim Kraft, DL8HCZ/CT1HZE

Referee: Dimitris Vitorakis, SV1BTR

Sporadic E
144 MHz – Reports

All QSOs with "59 59" reports unless otherwise noted, hrd = also with 59, times UT

CT1HZE, IM57nh, wkd

July 6

0959 F1ORL JN08
1001 G7RAU IO90
1002 DK8VS
1005 HB9BRU
1006 F1MOC JN06
1006 F5DQK JN18
1007 F1AFJ JN06
1008 F1NPX
1009 LX2LA JN39
1013 F1EDF JN18
1017 F5VHX JN04
1017 F1DLZ
1018 F6DKW JN18
1019 F1DUJ JN07
1020 F1BQX JN18
1021 G3JHM
1021 G3WZT IO90
1021 F0FEK
1022 F1DRR IN98
1022 F1NPX
1023 F6ETZ IN97
1023 ON8AB JO10
1024 F2ATR JN09
1028 DJ9CZ JO31
1031 ON4PS
1032 ON7CL
1033 F0FKP
1036 CU8DUB/B 599 hrd
1037 OQ4U JO20
1037 ON3EA
1038 F1CXX JN18
1039 ON4IMM JO11
40 minutes opening, 30 QSOs

YU7EW, KN05HP, hrd

1045-48 + 1051-52 CU8DUB/B HM49KL max 559, 4229km

This is the largest distance report for a 2m beacon from Europe, and a beacon world record for 2m Sporadic E. See map below.

At the time of this report there were two active Es "clouds" reported, one over EA1/EA2 and the second over the Atlantic Ocean (IN00/01)

On 1039 EI5FK IO51rt wkd EB7BQI IM67MF and at 1043 EA7GV IM87ec. At 1036 G4LOH wkd EA7HEN IM87ax. F5VHX JN04ft reported CU8DUB/B at 1036 via Es.

The question is what has happened over the eastern part of the path. There where also high MUF areas up to 70 to 80 MHz probably but nothing reported on 2m. On 6m the band was open from Northern DL to Southern Italy earlier and from Austria / Hungary to Malta and EA3. Also from southern France 6m was open to southern Italy arround 10z. At 1240z there was also double hop Es on 4m from CT to SV1. A suiting Tropo path from YU7 to southern France is another possibility but quite unlikely. A chordal Es path is most likely.

Map July 6th 2007
CU to YU over 4229km

CT1HZE, IM57nh, wkd

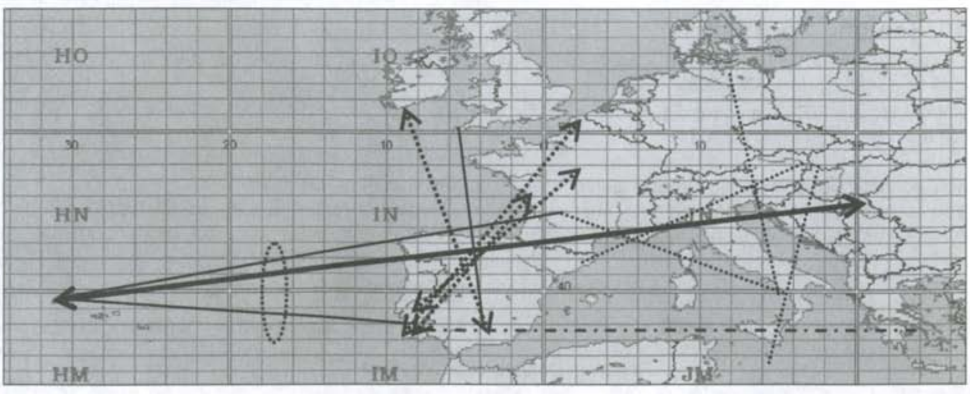
July 8

IARU contest:
1104 IV3GBO JN66
1105 9A1Z JN86
1106 S59DEM JN75
1107 S53D JN76
1108 S57O JN86
1115 I5PVA/6 JN63
1121 HG5M hrd only
1123 IW2HAJ JN45
1124 9A1CCU JN85
1125 IZ4AIK JN63

1302 G7RAU IO90
1304 G7EVP/p IO93
1305 G4SED IO90
1306 G5XV IO91
1306 G6HIE IO90
1307 G4HUN IO92
1307 G4CZP/p IO90
1308 G6HKS IO92
1308 G4DOL IO80
1309 G4CBW IO83
1309 G4ROB IO93
1310 G1HLT/p IO
1310 G3CKR/p IO93
1311 GX5FZ/p IO93
1312 M0BAO/P IO80
1312 G4SGI IO81
1313 G4EZT IO92
26 QSOs, 35 min. open

July 9

1515 IC8EGO JN70
1516 TK5JJ JN41
1517 IK0OKY JN61
1522 IK0OEA JN53
1525 IK5FTQ JN
1526 IK5CQV JN53
1528 F1OMQ JN25
1529 EB3DYS JN



1529 I1DMP JN35
1531 I3MEK JN55
1531 ON5LGS
1532 IZ5ILU JN53
1533 I0RHJ JN61
1537 IK0FTA JN61
1538 IW0AIJ JN61
1539 IS0SNE JN40
1539 I6BQI JN72
1542 IZ5IJY JN53
1541 IK5JWQ JN
1541 I8TWK/8 JN70
1542 DK3BU JO33
1543 DL8EBW JO31
1543 ON4LEA JO30
1544 DG1FKA JO31
1544 DJ9UX JO31
1545 DL9DBJ JO31
1545 DG5YIL JO
1545 ON3AP JO10
1545 DL5MAE JN58
1547 DM1HD JO31
1547 ON7CL JO20
1547 DH6SN JO30
1547 DL4AO JO42
1548 ON5GD JO
1540 G4EAT JO01
1549 PA3EAQ JO31
1549 DJ2JS
1549 DL9DBJ
1549 DK9TF
1550 LX1DB JN39
1550 DF1CF JN57
1550 DL9GS JO31
1550 DF8IK JN49
1551 DL5EBS
1551 DL8YAU
1551 ON5EW
1551 DL2KQ JO30
1552 PA4PS JO32
1553 DK5RQ JN58
1553 PC1T
1553 DC6IA JO30
1553 DJ9DL JO31
1553 DK5HX JO43wn 2312km
1554 DL8LAQJO43xu **2338km**
1555 DL2KK
1555 ON7LAO JO20
1556 DJ3AK JO52gj 2258km
1556 DG5AAG
1557 DL5YEE
1557 DJ6KW
1559 DO9EM
1557 ON7KC
1557 DO5KMS JO30
1557 DJ9MG JO52
1558 DL9OBD JO42
1558 DK1KO JO53ct **2347km**
1559 DD0NM JN59
1559 DL1SDA
1559 DJ9FG
1600 DG5NFF
1600 DC6AH
1601 F6ACU JN38
1601 DK5HN JN48
1601 DK2EA JN59
1601 DL4YY JO60
1602 DL4DWA JO61qh **2343km**
1602 DG0JMB JO60lv 2294km
1602 DL3OCA
1603 DL2CQ JO31
1603 DL1SMA
1603 ON5SA
1604 F4EIK JN28
1604 DL1NBM JN49
1605 PC1T
1605 DK0MD JO31
1605 DJ2JA JO40
1605 OK1FD JO
1605 DK5DQ
1606 F6FGO
1606 DL2AKT JO50
1607 PA4AR JO22
1607 PA2DB
1607 DK2CF
1607 F8DLS JN19
1607 DG9NFD JN59
1608 F1MPQ JN
1608 PA1VW
1609 PE2RMI JO23
1609 PA3DOL JO22
1609 DH4JF JO30
1610 F5APQ JO00
1610 IW5BENJN53
1610 EA3ADW JN11
1610 DL1PR
1611 DK6FX
1611 DB2KA JO30
1612 DL4YBZ
1612 DK1KR JO53hw **2377km**
1613 IK0RWX JN61
1614 F5EQR
1614 DJ6JJ JO
1614 F1RYW JN18
1615 DK1VC JO31
1616 F0CSU
1616 DG3WD JN39
1616 F1BKM
1619 ON4KBE JO20
1629 DK9OY JO52
1622 IZ5ILU JN53
1622 DG1KJG JO30
1623 PE1PQX JO32
1624 PA3FPQ JO22
1624 PE1LWT JO22
1624 IZ5BIT JN53
1624 DL1KDA JO30
1624 IK4BHO
1626 DG3YEL
1626 I8MPO JN70
1627 IW4DMH
1627 I5ARS
1628 I1ANP JN44
1628 IK5/DK3EE JN53
1629 I5BOL
1630 I5XX JN53
1632 EA8/G4RGK IL38bq
55F 55F **FAI** CW QTF 55 deg
1633 IK0FTA JN61
1634 IK0BZY JN61
1634 DK3T
1636 F6AOI
1636 IW5BEN JN53
1637 IK5ORJ JN53
1638 IK4GMHJN54
1638 IW3GXW JN65
1639 I5XDF JN52
1640 9A1CCY JN85oo **2352km**
1640 IZ4JIF JN64
1641 9A3ASF JN65
1645 IK5DHL JN53
1645 IK1JXY
1646 I0SMG JN61
1646 EA6SA JM19 55/59 **FAI**
1647 IW0AIJ JN61
1648 I4ENO JN54
1651 IN3ZTR/3 JN55
1652 DL2ARD JO60
1654 DK5OX JN59
1654 DL2DN
1655 ON4KHG JO10
1655 DB6NT JN59
1655 DF5NK JN59
1655 DL4SDW
1656 PE1HWO
1657 OK1TEH JO60
1657 PA2M
1657 DF1NP JN58
1658 HB9DFG JN37
1658 DF1CF JN57
1659 PA0LOU
1659 PA5WT JO22
1703 I1DMP
1703 I2FAK JN45
1722 ON4KHG JO10 (cw)
1722 ON4IMM
1723 PA2JWN JO22
1723 PA8KM
1723 PE9GG
1723 ON4BG JO10
1723 PD4HDB
1724 PE1ITR JO21
1725 PD7ES JO22
1725 DK1KO JO53
1728 DK1KO JO53

1911 PD0HCV JO31
1912 ON7CL
1913 ON4POO JO20
1914 OR4A JO10

1918 IK1WVR JN44
1919 IZ4BEH JN54
1928 I8MPO 55F 58F **FAI**
1941 F6DRO 52F/51F **FAI**
then 57F /57F 22 / 280 deg
185 QSOs, 126 minutes open

On July 9th from about 1520 to 1711 UTC there was a major opening from EA8 to PA, DL, ON F, I and G. Even the very last 2 DXers from DL (DL8EBW and DK1KO) who had not wkd EA8 yet and waited 25 years did it now!

DK1KO, JO53CT, wkd:

1555 **EA8BEX IL27GX 3552km**
1559 CT1HZE IM57NH 2345km
1606 **EA8AVI IL28PC 3504km**
1611 EA4DB IN80EJ
1619 **EA8CCG IL18TM 3543km**
1623 **EA8TX IL18QI 3572km**
ODX in ES (Ed: and best DX of the whole opening!)

DL8EBW, JO31NF, wkd:

1538 **EA8AVI IL28FC 3193km**
1543 CT1HZE IM57
1550 **EA8BEX IL27GX 3201km**
1554 CT1BYM IM58
1555 **EA8TJ IL18RI 3220km**
1558 EA7DBX IM77 hrd
1601 **EB8CDX IL18NI 3237km**
1602 EA4DB IN80
1604 EB1TT IN72
1610 EA4LU IM68
1613 CT1EAT IM68
1618 **EA8CCG IL18TM 3195km**
1622 EA8TX IL18QI 55 hrd
Es ODX for me with 3237km!

CT1HZE, IM57nh, wkd

July 14

1326 DK5EW
1327 DL1MAJ/p JN57
1328 DG1NPJ
1330 DJ8RZ
4 QSOs, 4 minutes open

July 31

1025-1055 CU8DUB/B HM49kl
30 minutes open

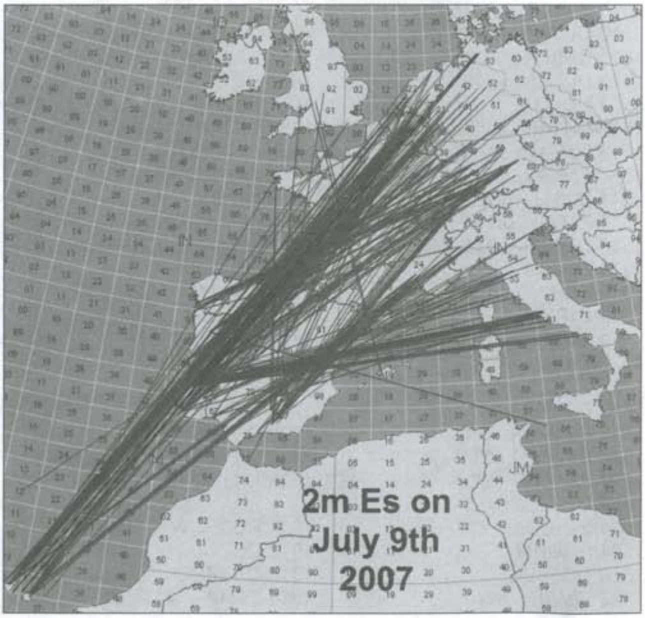
August 1

1254 G4FOH JO02
1255 F1BKM IN98
1255 G0KLX IO91
1255 G3BNE JO01
1257 G4CMF IO90
1258 F1DUZ IN97
1259 G3DNQ
1259 PA5KM JO11
1259 2E1DNC
1300 G4FUF JO01
1300 M3FUN
1301 M3EZB IO80
1306 M0PRO
1307 GW0VWD IO81
1308 G4DCV IO91
1312 G4PBP IO82
1314 G4EAT
1315 M0IKB
1316 G4IDG IO82
1316 G3LTF
1818 G4RRA 55/59 IO80 (1w rf)
1318 MW1MFY
1318 G0NNF IO92
1320 GB3ANG/B IO86mn hrd
1325 G4LOH IO70
1343 G7MRL IO84
1346 G8AXW IO83
1348 M0XAT IO84
28 QSOs, 30 minutes open

This was the end of the 2007 2m Es season for me.
I worked **1153** 2m Es QSOs in 2007 and 2m was open **1173 minutes** (= 19.5 hours) in total. (vs. 752 QSOs in 2006).
Just for fun I announced a quiz on ON4KST chat (and via email) and let the people guess how many QSOs I made on 2m Es in 2007. Here the result:

DG9MAQ	147
OK1TEH	180
HA5CRX	220
DF1GL	234
OH6ZZ	238
IT9VDQ	244
ZS6AXT	255
ON4KHG	281
S51WX	320
HA5CW	333
DF5NK	400
PA3DOL	412
OZ8ZS	435
DG0OPK	450
PA0JMV	555
DL3JPN	560
DD0VF	585
S57SU	650
OZ1CLL	651
UT5ER	800
ON7GB	1145
I8MPO	1501
DL8EBW	2100
CT1BYM	4100
DJ3JJ	9876

As we can see **ON7GB** is the closest and made a very good guess. He gets 5 years DUBUS for free. Congratulations!



FAI News
2007 QSO Summary

Editor: Dom Dehays, F6DRO
f6dro@wanadoo.fr

Date	QTR	STN1	STN2	LOC1	LOC2	QRB	QTF/SCP	Rem
May 12	1719	F6FHP	SV2JL	IN94TR	KN10LO	**1955**	90/??	
	1735	F6FHP	LZ1ZP	IN94TR	KN22ID	**2037**	90/??	hrd
May 29	1742	F1GTU	9A9C	JN05IE	JN85LI	1270		hrd
	1752	F6FHP	9A9C	IN94TR	JN85LI	1361		
June 2	1509	G4LOH	I6BQI	IO70JC	JN72AK	1700	JO40	
	1513	G4LOH	IC8FAX	IO70JC	JN70CN	**1843**	JO40	
	1553	F6FHP	SV1BTR	IN94TR	KM18NO	2059	75/??	hrd
	1636	IK2YXK	SV1BTR	JN45OP	KM18NO	1386		hrd
	1643	IK1JXY	YO8ROO	JN44WC	KN36			
	1703	I3MEK	SV1BTR	JN55SJ	KM18NO	1217		
June 5	1813	DK3SE	CT1HZE	JN37VP	IM57NH	1779	260	hrd
	1820	DK7DR	CT1HZE	JN48HD	IM57NH	1867	245/25	
	1825	DF9IC	CT1HZE	JN48IW	IM57NH	**1917**	255/25	
	1830	DK5YA	CT1HZE	JN49NX	IM57NH	**2010**	245/25	
	1832	HB9DFG	CT1HZE	JN37SM	IM57NH	1756	260/25	
	1836	DL8EBW	CT1HZE	JO31NF	IM57NH	**1995**	250/25	
	1839	PA3DRL	CT1HZE	JO21PS	IM57NH	**1954**		
	1841	DL2ARD	CT1HZE	JO60AR	IM57NH	**2227**	hrd	
	1847	DK4U	CT1HZE	JO42FD	IM57NH	**2132**	hrd	
	1839	DF9RJ	CT1HZE	JN68GS	IM57Nh	**2148**	255/25	
	1849	DF9IC	CT1HZE	JN48IW	IM57NH	**1917**		
June 6	2101	IK0BZY	G4LOH	JN61GW	IO70JC	**1839**		
June 13	1629	EA6VQ	CT1DMK	JM19MP	IN50QP	997		
	1814	CT1HZE	EA6SA/p	IM57NH	JN20	1160	60/?	
	1836	CT1HZE	I8YGZ	IM57NH	JN70HR	2064	60/?	
	1948	F1DVP	IC8FAX	JN12JN	JN70FP	992		
June 14	0551	LZ1ZP	UA6MA	KN22ID	KN97VE	1315		
	0555	LZ1ZX	UA6MA	KN32IQ	KN97VE	1143		
June 16	0636	RZ6BU	I6BQI	KN84PV	JN72AK	**1883**	Buda	hrd
	1935	RZ6BU	YU1EV	KN84PV	KN04CN	1348	Buda	
	1937	IC8FAX	RZ6BU	JN70CN	KN84PV	**1939**		
June 19	0802	RZ6BU	YU1EV	KN84PV	KN04CN	1348		hrd
	1429	IC8FAX	EA6VQ	JN70CN	JM19MP	955		hrd
	1528	F5VHX	IC8FAX	JN04FT	JN70CN	1212		
	1530	IK0BZY	EA1FBF	JN61GW	IN73WJ	1370		
	1542	F5VHX	I8MPO	JN04FT	JN70FP	1232		
	1550	S54O	EA6VQ	JN75PS	JM19MP	1209	270/??	
	1625	EA5ZF	IV3GBO	IM99VT	JN66OA	1290		
	1626	I8MPO	CT1HZE	JN70FP	IM57NH	2044	285/53	
	1630	CT1HZE	IK0SMG	IM57Nh	JN61		/330	hrd
	1640	IW2DAL	EA5ZF	JN45NN	IM99VT	994		
June 20	2015	F6DRO	IC8FAX	JN03TJ	JN70CN	1086	60/??	hrd
	2037	G4LOH	IK0BZY	IO70JC	JN61GW	1638	90/??	
	2059	I8MPO	G4LOH	JN70FP	IO70JC	**1853**		hrd
	2059	I6BQI	G4LOH	JN72AK	IO70JC	1700		
	2117	G4LOH	IW0FIY	IO70JC	JN61GW	1638		
June 23	0747	S51AT	YO5BQQ	JN75GW	??????			hrd
June 24	1835	I8MPO	G4LOH	JN70FP	IO70JC	**1853**		
	1836	IC8FAX	G4LOH	JN70CN	IO70JC	**1843**	JO30	
	1839	HA1FV	G4LOH	JN87JJ	IO70JC	1635		hrd
June 27	2102	RZ6BU	YU1IO	KN84PV	KN04IQ	1307		
June 29	2027	F4DSD	YU1EV	JN23JO	KN04CN	1234		
July 01	1516	UT5JCW	IC8FAX	KN64SN	JN70CN	1640	Buda	
	1815	IC8FAX	EB5EEO	JN70CN	IM98PG	1305	TK	
	1832	F6HTJ	9A5CW	JN12KQ	JN65UF	911		hrd
	1834	F5ODA	9A5CW	JN13LE	JN65UF	886		

July 5	1119	RZ6BU	IC8FAX	KN84PV	JN70CN	**1939**		hrd
July 9	1632	CT1HZE	EA8/G4RGK	IM57NH	IL38BQ	1063	55/	
	1646	CT1HZE	EA6SA	IM57NH	JM19LO	1063	60/	
July 9	1921	F6DRO	CT1HZE	JN03TJ	IM57MH	1122	280/22	hrd
	1929	I8MPO	CT1HZE	JN70FP	IM57MH	**2052**	285/55	
	1942	F6DRO	CT1HZE	JN03TJ	IM57MH	1122	280/22	
	1954	ON4KHG	CT1HZE	JO10XO	IM57MH	1798		hrd
	2045	F6DRO	IC8FAX	JN03TJ	JN70CN	1086	80/??	
July 10	2040	IK0BZY	G4LOH	JN61GW	IO70JC	1638		
July 14	1732	F4BWJ	YU7EW	IN93MP	KN05HP	1717		
	1751	F6FHP	YU1EV	IN94TR	KN04CN	1624		
	1752	IZ5EME	G4LOH	JN52NS	IO70JC	1489		hrd
	1820	F6DRO	YU7EW	JN03TJ	KN05HP	1523	JN47	
	1820	I8MPO	G4LOH	JN70FP	IO70JC	**1853**		
	1823	F6DRO	YU7AS	JN03TJ	KN05DJ	1496	JN47	
	1824	F6DRO	S57TW	JN03TJ	JN75EX	1047	JN47	
July 15	1222	RZ6BU	SP6GJS	KN84PV	??			hrd
July 18	1552	F6DRO	LZ1AG	JN03TJ	KN22ID	**1883**		
	1923	IK1SPR	LZ1ZX	JN34TQ	KN32IQ	1547		
	1923	IK1SPR	LZ1ZP	JN34TQ	KN22ID	1406		
	1926	I4XCC	UT5JCW	JN63GV	KN64SN	1670		
	1930	LZ1ZX	I1DMP	KN32IQ	JN35UB	1542		
	1939	YO3DMU	IK1SPR	KN34BJ	JN34TQ	1463		
	1940	LZ1ZX	S57Q	KN32IQ	JN76PA	976		
	1949	IZ4BEH	YO2DQI	JN54WL	??		Buda	
	2000	I3MEK	YO3DMU	JN55SJ	KN34BJ	1153		
	2009	LZ1ZP	F6DRO	KN22ID	JN03TJ	**1883**		
	2011	IC8FAX	F6DRO	JN70CN	JN03TJ	1086		
	2013	YO7NE	IQ3AZ	KN25EC	JN65QQ	861		
	2025	IK0BZY	F6DRO	JN61GW	JN03TJ	907		
	2027	IK0SMG	F6DRO	JN61ER	JN03TJ	899		
	2056	YO7NE	IK1SPR	KN25EC	JN34TQ	861		
	2101	IK1SPR	YO3HCV	JN34TQ	KN34BK	1463		
July 19	2005	IC8FAX	UT5JCW	JN70CN	KN64SN	1640		
July 21	1529	F6DRO	SV8CS	JN03TJ	KM07JS	1730	JN64	hrd
July 24	1657	F6DRO	YU7EW	JN03TJ	KN05HP	1523		
	1705	F6DRO	YO3DMU	JN03TJ	KN34BJ	**1959**		
	1712	HA3HV	F6DRO	JN86UK	JN03TJ	1308		
	1732	HA5OV	F6DRO	JN97NJ	JN03TJ	1433		
Aug 4	1035	SV2JL	F6DRO	KN10LO	JN03TJ	1785		
Aug 5	1534	IT9CJC	RZ6BU	JM76IW	KN84PV	**2085**		
Aug 8	1856	RZ6BU	S57TW	KN84PV	JN75EX	1786		
	1907	RZ6BU	9A1CCY	KN84PV	JN85OO	1570		hrd
	1926	LZ1ZP	I1DMP	KN22ID	JN35UB	1404		
	1935	RZ6BU	9A5CW	KN84PV	JN65UF	**1846**	Buda	hrd
	1945	S57LM	LZ1ZX	JN76HD	KN32IQ	1033		
	1946	UU1DX	9A5CW	KN74BW	JN65UF	1599		
	1959	LZ1ZP	9A5CW	KN22ID	JN65UF	948		hrd
	2023	IV3DNC	LZ1ZX	JN65??	KN32IQ			
Aug 12	2102	S57LM	LZ9X	JN76HD	KN32	980	Buda	
	2108	S57LM	LZ1BB	JN76HD	KN12SS	800	Buda	
	2125	I1DMP	LZ1BB	JN35UB	KN12SS	1291	Buda	
Aug 13	1903	HB9FAP	LZ1ZP	JN46EW	KN22ID	1397		
Aug 14	2243	I8MPO	F1VJQ	JN70FP	IN95OL	1348		

Is there anyone who has any hint or idea about possible FAI on 432 MHz? I would be very interested to discuss about this topic. Also I look for possible test partners on 70cm when there is good FAI on 2m. 73, Joe, CT1HZE - info@DUBUS.de

TF and OY/G4ODA - Expedition Report

G4DHF reports: Pleased to say safely back to being a boring G4 again. Delighted to work you (Ed: CT1HZE) from Iceland, I know its seems not to be a good path from CT but your signal gets to places others don't! I am sure I heard you at other times but could not make it. Had a great time and managed to visit lots of places I had been trying to get to for some time. Did not however hit all targets so there is plenty of excuse to go back.

6m was not kind to me when I was over in the far west and north west, apart from one short opening to the west (on 19/6 worked NP3CW and KE4WBO). On the other hand when I got back to the south/east conditions were great and managed about 1050 QSOs on 6m before leaving TF.

2m was to an extent disappointing in that only the same few stations seemed to be on when I was in some of the more difficult squares to the west (although that is too far for most in Eu). I had noted your list of most wanted squares a couple of issues ago and was determined to try and activate IP35, which was in range for a number of stations. I had tried to do this on a previous trip but the site that looked easy on a map was not possible due to difficulties in finding somewhere to stop and proximity of houses. This time I targeted a road further north which was "fun". Most of the time wx was kind, indeed drier than in UK, but not in IP35. The road, which was only passable to four wheeled drive vehicles, had only been opened 3 days before I arrived there and the snow drifts were still in evidence. Setting up the aerials on a mountain in a gale whilst it was snowing made me question my sanity but the number of contacts completed made it worthwhile. I hope those operating from the comfort of a warm shack appreciated it.

Anyway the results on 2 were as follows, I hope I have not missed anything but at times I was running 2m MS and 6m Es at the same time and I have prepared this note in a bit of a hurry.

TF/G4ODA wkd on 2m FSK-MS:

9/6/07 IP06

G4RRA	26/26	G4DEZ	26/26
G4DHF	27/27	G4FUF	26/27

10/6/07 IP06

EI5FK	27/26	G4DEZ	27/37
GW8IZR	27/26	EI2IP	26/26
G4IGO	27/27	G0UWK	28/27
GM4CXM	27/27	MM5AJW	26/26
MM0DQP	27/26	G4CBW	27/27
G4HGI	26/27	G4YTL	28/28
G8APZ	26/26	G8VHI	27/27

12/6/07 HP96

G4DEZ	26/26	G4RRA	26/27
GM6VXB	27/27	G4CBW	27/27
G4DHF	27/27	EI4DQ	27/27

TF/G4ODA – takeoff in IP06

14/6/07 HP74

G0UWK	27/26	EI5FK	26/26
G4CBW	26/27		

16/6/07 HP75

G4YTL	26/26	G4DHF	26/26
GM6VXB	26/27	G4CBW	27/27
G0UWK	26/26		

18/6/07 HP86

G4DEZ	27/26	GM6VXB	27/27
G0UWK	27/27	G4CBW	27/27

26/6/07 IP35

PA5DD	28/26	G4CBW	27/27
G4FUF	27/26	G4RRA	26/27
LA4YGA	26/26	PE1AHX	28/27
ON4KHG	27/27	G8VHI	27/27
PA3BIY	27/27	G0UWK	28/27
G8VYK	27/37	PA1VW	27/28
ON7EH	27/27	DJ9CZ	28/26
G4DHF	27/27	PA3ECU	27/26
PE1HWO	27/27	PA3FPQ	38/27
DL8BDU	26/26	PA0PVW	27/27
G1ZJP	27/27	G4YTL	26/38

TF/G4ODA – camp in IP14

Then as OY/G4ODA from IP61 on 30/6/07:

G4RRA	27/27	G4CBW	27/27
DL8BDU	27/26	G0UWK	27/26
EI5FK	27/26	EI4DQ	26/26

All with permitted 25w and 4 el HB yagi (and some kit problems)- shame no Es.   73, Keith G4ODA

TF/G4ODA – mobile shack

Tropo Reports
2m, 70cm and up
Editor: Wolfgang Schneider, DJ8ES
DJ8ES@gmx.de

2m

DB5KN, JO31NB, wkd (>800km):

05/08/07 04:54 EA1FDI/P	IN52LV	1520km
02/09/07 08:57 ED1RCM	IN73TA	1245km

tnx for info Mike

18:30	DF1VW	54	55	JN39HJ	1029
18:34	DF8AE	529	55	JO41GX	1322
18:36	DM1T	53	54	JO41DX	1310
18:37	DF6VL	52	53	JO42GC	1332
18:39	DL2KCK	55	55	JO31OA	1182
18:45	DK5QN	559	559	JO42FA	1322
18:48	PE1HWO	539	559	JO21GV	1142
18:50	DL5YEE	53	55	JO42GF	1342
18:52	DK7QX	51	51	JO42KH	1365
18:52	DK7UP	53	53	JO30NI	1126
18:56	DL8YE	52	51	JO31MH	1197
18:57	DL1PR	52	55	JO30JS	1142
19:00	DL0WAE	54	55	JO42DC	1320
19:06	DL0PP	54	54	JO40BP	1201
19:10	DJ5BV	57	59	JO30KI	1113
19:14	DG1KJG	52	54	JO30NT	1162
19:15	DL9GS	55	53	JO31OM	1222
19:19	DL5YET	55	55	JO41EV	1308
19:20	DJ5HG	52	52	JO53IM	1546
19:21	DL2VB	52	53	JO31LN	1214
19:23	DK5E	56	57	JO42FA	1322
19:24	DH0DX	55	55	JO41EX	1314
19:27	DL4YDC	51	51	JO41HW	1323
19:31	DL5ZL/P	529	529	JO51CH	1360
19:34	PA3CMC	559	559	JO21WI	1147
19:35	PA4EME	559	539	JO20WX	1115
19:37	DF9YF	529	529	JO42GE	1339
19:51	**SK7MW**	**52**	**51**	**JO65MJ**	**1799**
20:10	**OZ2PBS**	**52**	**52**	**JO55XJ**	**1750**
20:17	PA3CWN	59	59	JO33AH	1329
20:19	DG9YIH	51	52	JO32QI	1299
20:20	PE1AXM	53	55	JO11VM	1079
20:21	PH4S	53	54	JO33JF	1350

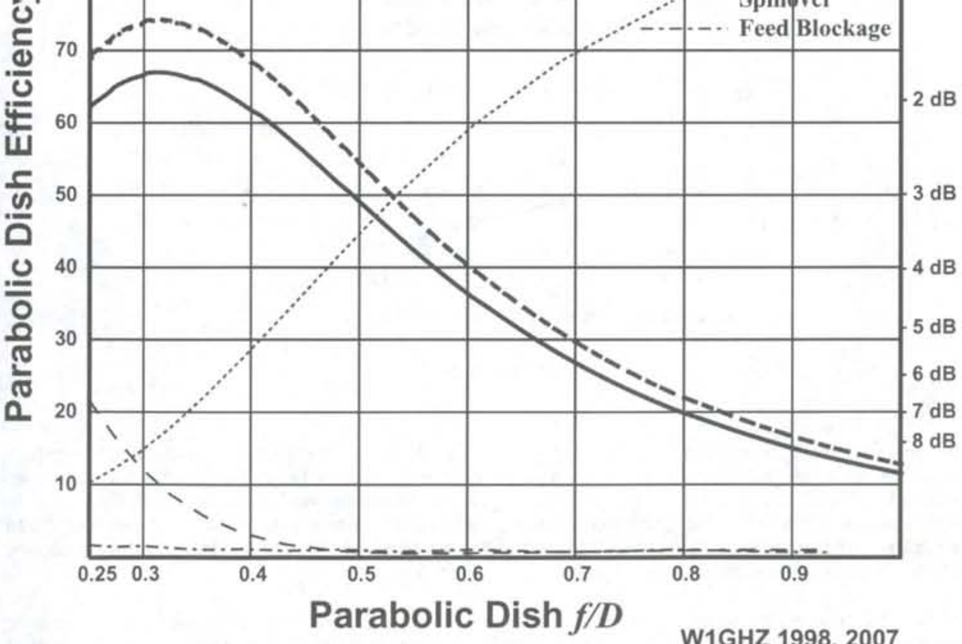


Fig. 37

20:22	PE2JMR	52	53	JO33HG	1347
20:23	PA0ANS	52	52	JO33CE	1324
20:24	OZ1BNN	53	55	JO55PM	1732
20:26	OT1D	53	55	JO21FD	1069
20:30	PE1GNP	51	51	JO31IX	1237
20:31	ON4CHP	52	53	JO21JD	1083
20:32	PE1KXH	52	52	JO21XD	1133
20:33	PD4HDB	52	52	JO32HN	1284
20:36	DG8YHH	52	53	JO32QI	1299
20:37	ON5AEN	55	55	JO10VW	1024
20:40	DO8YLB	51	52	JO41ES	1298
20:47	DH2DAM	529	559	JO31PH	1209
20:49	DL8EBW	559	519	JO31NF	1194
20:52	OZ8ZS	519	519	JO55RT	1763
20:54	PA5WT	559	569	JO22HG	1180
20:56	DK1PZ	539	559	JO41TH	1329
20:59	DJ9UX	519	529	JO31MD	1184
21:04	PA3EAQ	529	559	JO31CI	1162
21:06	DK5DQ	53	52	JO31PG	1206
21:07	DA2A	53	52	JO31PG	1206
21:12	PE1REA	51	41	JO22IR	1226
21:24	PE2AEX	52	55	JO22LU	1247
14.10.2007					
08:18	**LA2PHA**	**52**	**52**	**JO38IB**	**1800**
08:32	**LA6LI**	**52**	**52**	**JO38IB**	**1800**
08:34	G4CBW	59	59	IO83UB	1101
08:38	ON5JV	53	55	JO20EP	1023
08:42	PE2RMI	52	55	JO23MH	1290
08:55	G8IYG	54	55	IO82XT	1075
09:02	G0UWK	53	57	IO83VC	1106
09:40	ON4POO	52	52	JO20DP	1019
09:44	M0HKB	57	57	JO02OB	1048
09:57	EI5FK	59	53	IO51RT	1029
10:23	G0JJG	559	559	JO02LE	1055
10:28	G0CUZ	599	599	IO82WM	1043
11:53	G0TRB	51	51	IO92EO	1056
15:09	G4PBP	59	59	IO82WO	1052
16:40	G8JVM	59	59	IO82SP	1054
16:41	G4UKP	59	59	IO83VC	1106
16:49	G4EZT	59	59	IO92CE	1009
16:51	G0NNF	57	55	IO92AL	1039
16:52	G4DHF	54	57	IO92UU	1101
17:01	G6LI	51	57	IO92UU	1101
17:03	M0DTS	51	53	IO94IL	1266
17:04	G0ELJ	52	53	IO92DM	1046
17:06	G4TIF	53	51	IO92FH	1025
17:07	M0IKB	51	53	IO94SG	1252
17:10	G4KWQ	59	59	IO92AQ	1062

OE8GVK/3, JN88GR, wkd (>800km):

01.09.07 11:16	I8MPO	JN70FP	914km
02.09.07 12:46	I1AXE	JN34QM	842km

rig: K2 + TR144H, 400W, 18El.M2, tnx for info Gert

ON5AEN, JO10VW, wkd (>900km):

04/08/07 20:09	EB2GJK/P	IN93GF	945km
04/08/07 20:13	EA2CLU/P	IN93IA	960km
04/08/07 21:27	EA2BFM/P	IN83FE	1025km
04/08/07 22:03	EC1DMY/P	IN82KF	1103km
04/08/07 22:07	EB1DNA/P	IN63FL	1192km
04/08/07 23:08	EA1UU	IN83GJ	1002km
05/08/07 07:55	EA1FDI/P	IN52LW	1318km
02/09/07 08:16	ED1DCM	IN73TA	1076km
02/09/07 08:24	EA2BFM/P	IN83FE	1025km
16/09/07 08:52	OK2KJT	JN99AJ	1031km
16/09/07 09:03	OK2ULQ	JN99BM	1033km
16/09/07 09:39	OM3TRN	JN99CH	1045km
16/09/07 11:31	OM3ARM/P	JN99CH	1045km

FT225RD, 16el, MGF1302, GS35b. tnx for info Hans

ON6ZT, JO10UU, wkd Jun – Sep ´07 > 900km:
SK6DK (JO67EH, 913km); SM6VYP (JO67AT, 943km); SM6DBZ (JO58RG, 963km); SI6B (JO68EJ, 1006km); SM6WCQ/P (JO68DC, 977km); SK6DW (JO68CE, 982km); SM6VTT (JO68BG, 986km); LA0BY (JO59IX, 1106km); EA2BFM/P (IN83FE, 1014km), EA1QS/p (IN52TM, 1304km); EA2BFM/p (IN83FE, 1013km); EA1FDJ/p (IN52LW, 1306km); ED1RCM (IN73TA, 1064km); EA1CJF/p (IN72WS, 1077km); EA1OS/p (IN63AR, 1182km); tnx for info Hans

PA3CWN JO33ah wkd (>900km):

09/8/2007	OY9JD	IP62oa	1228km
27/8/2007	F6FHP	IN94tr	1062km
01/9/2007	EA1FDI/p	IN52lw	1601km
02/9/2007	EA2BFM/p	IN83fe	1328km
02/9/2007	ED1RCM	IN73ta	1378km

PA5DD, JO22IC, wkd Sep/Okt ´07 (>800km):
EI2IP (IO61CX, 853km); SM4GRP (JO69HF, 935km);

SM7GVF (ex SM4GVF), JO77GA, wkd >1000km:

14.10.2007					
21:49	G6LI	O92UU	449	599	1051 km
21:39	G3YDY	JO01FQ	559	579	1085
21:30	M0HAZ	IO92XW	559	579	1032
21:20	G0CUZ	IO82WM	439	559	1176
21:18	G3LTF	IO91GG	439	529	1218
21:11	G0NNF	IO92AL	55	58	1169
21:10	G4CQM	IO70ST	55	56	1416
21:08	G4KWQ	IO92AQ	579	579	1157
21:06	G3TA	IO81XS	439	559	1217
21:03	G4CBW	IO83UB	559	559	1155
21:00	G4ZFJ	JO01HO	559	559	1082
20:52	GW7SMV	IO81LN	569	559	1287
20:49	G4DHF	IO92UU	559	569	1051
18:11	F1BKM	IN98MV	559	599	1370
18:04	M3SDE	IO92FJ	55	59	1150
18:03	GW7SMV	IO81LN	56	59	1287
17:58	G8VHI	IO92FM	57	59	1143
17:51	G3KZR	IO81SC	569	579	1284
17:50	GOMJW	IO91JO	559	569	1182
17:32	F6KIF/P	JN19XH	55	55	1107
17:17	G4IGO	IO80NW	559	559	1319
17:14	G0JJG	JO02LE	559	599	1024
17:12	G7RAU	IO90IR	539	599	1247
12:58	M0HKB	JO02OB	55	55	1019
12:56	G4EAT	JO01HR	559	559	1073
12:44	G0NCE	JO01GK	559	559	1098
10:40	F8ZW	JN38SP	559	559	1042
10:25	F5JNX	JN37PV	549	539	1125
10:05	F6HVK	JN27LH	45	52	1259
10:01	F0CXO	JN26PP	559	559	1314
09:52	F6FLB	JO00WX	559	589	1063
04:25	ON4ARF	JO10MV	59	59	1012
13.10.2007					
23:10	F5GHP	IN96LE	55	55	1607
23:09	F6HRO	IN88JQ	55	57	1502
23:07	F6HMQ	JN18GP	56	55	1228
22:40	F5JKK	IN87PR	539	559	1553
22:26	F5DQK	JN18GR	559	559	1220
22:24	F5MFI	JN07XT	559	539	1328
22:22	G6HKS	IO92BO	559	599	1157

22:18 G4DEZ	JO03AE	59	59	1013	
22:16 G4RRA	IO80BS	569	579	1386	
21:58 F6FHP	**IN94TR**	**559**	**529**	**1713**	**Tr ODX**
21:55 F6KIF/P	JN19XH	59	59	1107	
21:53 F5DE	JN05DP	559	539	1599	
21:41 F1ISM	JN09VK	55	58	1192	

70cm

DK7QX, JO42KH, wkd (>800km):

02.05.07 22:08 MM5AJW IO88KI 1010km
13.10.07 22:52 F1NZC JN15MR 846km

DB5KN, JO31NB, wkd:

05/08/2007 06:15 EA1FDI/P IN52LV 1520km

G3XDY, JO02OB, worked (>800km):

08/07/2007 DFØMTL JO61
10/07/2007 SK7MW JO65
04/08/2007 EA2BFM/P IN83
04/08/2007 EB2GJK/P IN93
04/08/2007 EA2CLU/P IN93
05/08/2007 EA1FDI/P IN52
11/09/2007 SK7MW JO65
06/10/2007 DM7A JO6Ø
07/10/2007 DK1MFI JN58
07/10/2007 DFØMTL JO61
07/10/2007 OL8R JN69
07/10/2007 DL9EE/P JN67
07/10/2007 SK7MW JO65
07/10/2007 DLØFM JN57
11/10/2007 OK1VVT JO6Ø
13/10/2007 OZ9GE JO66 tnx for info John

23cm + up

DB5KN, JO31NB, wkd 23cm (>400km):

07/07/2007 18:21 G3SDC/P JOØ2ST 429km
07/07/2007 18:27 GØVHF/P JOØ1PU 413km
08/07/2007 07:35 OL4A JO6ØRN 448km
08/07/2007 07:43 OK2KKW JO6ØJJ 405km
tnx for info Mike

DK7QX, JO42KH, wkd on 23cm (>600km):

05.05.07 21:00 G3OHM/P IO92GB 704km
05.05.07 22:50 G4KIY IO92WN 610km
13.10.07 21:15 G3LTF IO91GG 719km
tnx for info Eckhard

G3XDY, JO02OB, worked

1,3 GHz (>800km):

08/07/2007 DM7A JO6Ø
05/08/2007 EA1FDI/P IN52
24/08/2007 SM7GEP JO77
11/09/2007 SM6AFV JO67
07/10/2007 DFØMTL JO61
07/10/2007 F6BHI/P JN15
07/10/2007 DM7A JO6Ø
07/10/2007 OL4A JO6Ø
07/10/2007 DFØYY JO62
13/10/2007 OZ2LD JO54
13/10/2007 OZ9GE JO66

2.3 GHz (>500km):

07/07/2007 DFØOL JO4Ø
08/07/2007 DKØZB JO42
06/10/2007 DKØZB JO42
07/10/2007 DFØOL JO4Ø
16/10/2007 DF9IC JN48

3.4GHz (>400km):

07/07/2007 DK2MN JO32
07/07/2007 DFØOL JO4Ø
02/10/2007 GI4ISM/M IO64
tnx for info John

G4ALY, IO70VL, wkd on Oct. 14th 2007:
1500z EA2/F2CT IN93IA 858km on 13cm and then on 10 GHz and also 5.7 GHz. All 3 QSOs are 1st G/EA contacts on those bands. Rig: 75cm dish on 3/6cm with 4.5W on 3cm and 12.5w on 6cm. A 67 el Wimo yagi and 20w were used on 13cm.

G8KQW, IO91BN, wkd on July 16th 2007:
0620 SM4DHN JP60VAA 59 59 on 23cm and then on 10 GHz with 539 559 with 2W and 48cm dish **1347 km. This is a new 10GHz UK distance record!**

OZ1FF, JO45BO, worked

1,3 GHz (>600km):

26/06/07 18:22 DB6NT JO5ØTI 629km
26/06/07 18:49 DF9IC JN48IW 742km
26/06/07 19:39 SMØDFP JO89VL 719km
24/07/07 18:15 DB6NT JO5ØTI 629km
24/07/07 19:43 DF9IC JN48IW 742km
28/08/07 20:04 DB6NT JO5ØTI 629km
28/08/07 20:09 DF9IC JN48IW 742km
25/09/07 18:01 DF9IC JN48IW 742km
25/09/07 19:05 DB6NT JO5ØTI 629km
07/10/07 10:09 DM7A JO6ØLK 659km
23/10/07 18:22 DB6NT JO5ØTI 629km
23/10/07 18:24 DL9GK JO5ØTI 629km
23/10/07 19:07 SMØDFP JO89VL 719km
23/10/07 19:32 DL6NAA JO5ØVF 646km

Kjeld (OZ1FF) writes:

Hello DUBUS, little TR/RS this summer, therefore most of the QSO were made under nominal propagation conditions. By using reflection on airplanes on 23/13cm it is however possible to always make contacts in the 600 to 800 km range. Since a few weeks I'm also qrv on 6 cm. Skeds are welcome. Vy 73 de OZ1FF

2.3 GHz (>600km):

26/06/07 18:22 DB6NT JO5ØTI 629km
26/06/07 18:49 DF9IC JN48IW 742km
26/06/07 19:39 SMØDFP JO89VL 719km
24/07/07 18:15 DB6NT JO5ØTI 629km
24/07/07 19:43 DF9IC JN48IW 742km
28/08/07 20:04 DB6NT JO5ØTI 629km
28/08/07 20:09 DF9IC JN48IW 742km
25/09/07 18:01 DF9IC JN48IW 742km
25/09/07 19:05 DB6NT JO5ØTI 629km
07/10/07 10:09 DM7A JO6ØLK 659km
23/10/07 18:22 DB6NT JO5ØTI 629km
23/10/07 18:24 DL9GK JO5ØTI 629km
23/10/07 19:07 SMØDFP JO89VL 719km
23/10/07 19:32 DL6NAA JO5ØVF 646km

5.7 GHz (>400km):

25/09/07 19:17 SM7GEP JO77IP 462km

10 GHz (>300km):

26/06/07 17:25 SM6EAN JO57WQ 326km
26/06/07 17:54 PA3CEG JO33FB 302km
26/06/07 18:30 SM6ESG JO67CC 302km
26/06/07 19:18 SM6AFV JO67GQ 356km

26/06/07 20:37	SM7ECM	JO65NQ	314km
26/06/07 20:40	SK7MW	JO65MJ	310km
24/07/07 18:04	DL1SUN	JO53PN	305km
24/07/07 18:20	DJ8MS	JO64CB	313km
24/07/07 18:26	DJ1LP	JO64CB	313km
24/07/07 19:37	SM6AFV	JO67GQ	356km
24/07/07 20:29	SM7ECM	JO65NQ	314km
06/10/07 18:32	SK7MW	JO65MJ	310km
07/10/07 10:28	PAØEZ	JO22OF	421km
09/10/07 20:34	DL6NAA	JO5ØVF	646km
23/10/07 17:22	PA3CEG	JO33FB	302km
23/10/07 18:36	SM6AFV	JO67GQ	356km
23/10/07 19:46	SM7GEP	JO77IP	462km
23/10/07 20:18	SK7MW	JO65MJ	310km
23/10/07 20:32	SM7ECM	JO65NQ	314km

tnx for Info Kjeld

PA5DD, JO22IC, wkd Sep/Okt ´07 (>600km)

23 cm:

18.09.07 17:32	SK7MW	JO65MJ	660km
18.09.07 17:41	SM7ECM	JO65NQ	681km

13 cm:

25.09.07 18:18	OZ1FF	JO45BO	451km
25.09.07 18:51	DF9IC	JN48IW	451km
14.10.07 10:16	OZ2LD	JO54TU	552km

SM7ECM, JO65NQ, wkd

23cm (>600km):

17/07/07	SM3BEI	JP81NG	663km
17/07/07	PA3AWJ	JO21GW	701km
17/07/07	PA0S	JO21FW	705km
17/07/07	OH0JFP	KP00AB	635km
21/08/07	SM3BEI	JP81NG	663km
21/08/07	PA0S	JO21FW	705km
21/08/07	PA3AWJ	JO21GW	701km
21/08/07	DL6NCI	JO50VI	600km
21/08/07	DF9IC	JN48IW	809km
21/08/07	YL3AG	KO26AW	687km
21/08/07	OH0JFP	KP00AB	635km
18/09/07	PA5DD	JO22IC	680km
18/09/07	PA3AWJ	JO21GW	701 km
18/09/07	DF9IC	JN48IW	809km
18/09/07	SM3BEI	JP81NG	663km
18/09/07	OH0JFP	KP00AB	635km
18/09/07	SM4DXO	JP71SB	614km
18/09/07	DL6NAA	JO50VF	614km
18/09/07	PA0S	JO21FW	705km
13/10/07	PA2M	O21IP	715km
13/10/07	F6CBH	JN19BH	1029km
14/10/07	F1DBE/P	JN19BC	1046km
14/10/07	PA5KM	JO11WL	771km
14/10/07	G3AUS	IO80DN	1259km
16/10/07	SM3BEI	JP81NG	663km
16/10/07	PA0S	JO21FW	705km
16/10/07	DL6NAA	JO50VF	614km
16/10/07	DB6NT	JO50TI	602km
16/10/07	DL8TSB	JO50TI	602km
16/10/07	DL9GK	JO50TI	602km
16/10/07	DF9IC	JN48IW	809km
16/10/07	SM4DXO	JP71SB	614km

13cm (>500km):

26/06/07	PA3CEG	JO33FB	521km
26/06/07	SM5QA	JO89WJ	501km
26/06/07	SM0DFP	JO89VL	505km
24/07/07	SM0DFP	JO89VL	505km
24/07/07	SM5QA	JO89WJ	501km
25/09/07	SM5QA	JO89WJ	501km
25/09/07	DL6NAA	JO50VF	614km
25/09/07	DB6NT	JO50TI	602km
25/09/07	SM0DFP	JO89VL	505km
23/10/07	PA3CEG	JO33FB	521km
23/10/07	SM0DFP	JO89VL	505km
23/10/07	DB6NT	JO50TI	602km
23/10/07	DL9GK	JO50TI	602km

6cm (>300km):

07/07/07	DM7A	JO60LK	586km
26/07/07	SM5QA	JO89WJ	501km
24/07/07	SM6HYG	JO58RG	305km
24/07/07	SM0SBI	JO99CF	498km
24/07/07	SM0DFP	JO89VL	505km
24/07/07	SA4Z	JO79MJ	428km
24/07/07	SM5QA	JO89WJ	501km
25/09/07	SM0SBI	JO99CF	498km
25/09/07	SM5QA	JO89WJ	501km
25/09/07	SM6HYG	JO58RG	305km
25/09/07	SM0DFP	JO89VL	505km
25/09/07	OZ1FF	JO45BO	314km
23/10/07	SM6HYG	JO58RG	305km
23/10/07	PA3CEG	JO33FB	521km
23/10/07	SM0SBI	JO99CF	498km
23/10/07	SM0DFP	JO89VL	505km
23/10/07	OZ1FF	JO45BO	314km

3cm (>300km):

26/07/07	SM5QA	JO89WJ	501km
26/07/07	OZ1FF	JO45BO	314km
24/07/07	SM6HYG	JO58RG	305km
24/07/07	SM0SBI	JO99CF	498km
24/07/07	SM0DFP	JO89VL	505km
24/07/07	SA4Z	JO79MJ	428km
24/07/07	SM5QA	JO89WJ	501km
24/07/07	OZ1FF	JO45BO	314km
25/09/07	SM0SBI	JO99CF	498km
23/10/07	OZ1FF	JO45BO	314km
23/10/07	SM0SBI	JO99CF	498km

Aurora Reports

GM4VVX, IO78ta wkd on 144 MHz in CW:

20071025

1714	OH4ND	KP00XL	55a	55a
1716	G7RUA	IO90IR	57a	57a
1719	SK7OA	JO65RL	55a	57a
1722	EI3IO	IO63WF	57a	57a
1723	?SLA	lost in qrm		
1725	SM7GVF	JO77GA	59a	59a
1729	OZ1JKF	JO47WL	55a	56a
1731	OZ1BNN	JO55PM	54a	55a
1740	OZ5AGJ	JO47IA	55a	55a
1744	G4CKH	JO02UK	33a	44a
1748	G4DEZ	JO03AE	59a	59a
1751	G4EAT	JO01HR	59a	55a
1754	EI5FK	IO51RT	57a	55a

- then some time on 70 mhz, all UK beacons auroral, no qso

1827	LA8NK	JO48KM	57a	56a

All the time BIG QRM on 144mhz, when I call CQ, many many calling. DK and SP heard calling.

Best 73s de Clive, 400w into long 10 ele

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

Transatlantic Result CT1HZE 2007

CT1HZE wkd in 2007 from May to August in total 878 transatlantic (NA, Caribbean and SA) multihop Es QSOs. This is 25% less than in 2006 when 1152 QSOs were worked. Considering 2006 as an outstanding season the result for 2007 is not so bad. There were quite nice openings in 2007, e.g. on June 25th K0GU (DN70) wkd most EUs ever in one day: 6 x F, 4 x I, 4 x G, 1 x GW and 1 x EA. In some years he only works 2 to 4 EUs all season... Interesting DX wkd from CT1HZE in June/July/Aug. 2007: N2IC DM52, HH4/W3CMP, V26HS, UT1FG/MM from FL30, GJ62, GL63, GK85, GM29 and GN12; N7CW DM34, K7NN DM42, K7JE DM33, W7RV DM43, K0YW DM67, N7KA DM65, K9RX DM41, K0JY DM68, K6GXO DM04, N0KE DM69, 4L9W LN12, XE3ARV EK59, VP2EDH, J79PAK, C52T, J8/W6JKV.

Expeditions & OPs

6W Senegal: T98A went qrt in the end of July as ST2A and is now qrv for about 2 years as 6W1SJ from IK14.

9M6 East Malaysia: JA1RJU plans to be qrv as 9M6JU on 6m EME in spring 1008.

9Q Kongo: 9Q1EK is qrv permanently. Loc. is JI75pq.

CY0 Sable: VE3IKV, K5AND, W4TAA and W3CMP plan to be qrv in June 2008, main station 800w + 7 ele in **FN93**, second station 100w + 5 ele from **GN03**. Sponsors needed!

C9 Mozambique: CT1BXT is qrv as C91R untill August 2008 with 100w and a small yagi.

DU Philippines: JA1RJU plans a 6m EME expedition in spring 2008.

HL South Korea: JA1RJU plans a 6m EME expedition in spring 2008.

T6 Afghanistan: VK1UN (ex EX1UN) is qrv untill at least May 2008 on 6m with 600w and 8 ele. Loc. MN57gc.

ZD7 St. Helena: KC0W is a new resident and got the call ZD7X. He plans to be qrv on 6m also. QSL via WØMM.

Beacons

BV2NT/B 50.001, PL05SA, 10 W, GP, qrv again since June.
CE3AA/B 50029.5, FF46, 30W, loop, qrv since Aug. 2007.
CS1RLA/B 50076, IM57PX, 2.5W, dipole, qrv since June.
D4C 50034, HK76MV, 10W, omni, proposal for 2008
D44DUB HK86NO, is a proposal for 2008 on 50029 MHz.
DB0HGW 50083, JP64QC, 2.5W, Magnet.-Loop, qrv.
EA2SIX 50020, IN91SR, qrv since June
J5SIX 50012, IK21EV, 30w, loop, qrv since Oct. 2007.
OH0SIX 50017.5,JP90XI, 65masl, 3W, dipole, qrv since June
PU3SIX 50050, GF49JW, 6W, H-Dipol, qrv since Sept.
ZP5AA/B 50025, GG14, qrv again since June.

Special prefix/call sign VF0X –

the 100th anniversary of the first successful crossing of the North-West Passage through Canadian arctic waters by Amundsen in 1907

Pete, VE3IKV and Bill, W4TAA using the call sign VF0X, activated rare 6m grid FO06 from the village of Sanikiluaq in the Belcher Islands (Hudson Bay), VY0 Nunavut Territory at the end of June. Pete said, "We wanted to give 6m ops four bangs for the buck: CQ Zone 02, Grid FO06 which had never been activated before on 6m, IOTA island group NA-196, and the brand-new special VY0 prefix/call sign VF0X". They arrived there 4 hours late on Friday June 29th due to fog delays, and after hooking up a 1/4 wave wire to the 6m radio, noticed that the 6m noise floor was S9 plus due to an ongoing auroral disturbance. By the time they put up the 40m dipole and made a few QSOs on that band, it was after midnight and they decided to see whether the noise floor was still high on 6m. The noise floor had dropped down to an S2 indicating that the aurora was subsiding - perfect conditions for Auroral-E propagation. Since 50MHz is the 7th harmonic of 40 meters, they decided to load up the 40m dipole to see if they could hear anyone. The dipole loaded up with a 1.5:1 SWR on six meters, and they called CQ on 50.125. Doug, VE5UF was first in the log on 6m, followed a few minutes later by Reg, VE7DUB in Fort Nelson, B.C. near the Alaska border! Several W0 beacons in Minnesota were heard as well as VE7FG/b, and for the next several hours, the path was open to VE7. John, VE7DAY in CO70 on Vancouver Island was worked at 0323 local time before they decided to call it quits for the night.

The 5-element 6m beam was put up early the next morning (Saturday) just in time, for the band opened up at 11 a.m. local for an hour, with single hop Es primarily to W8s, 9s, and 0s and a double-hop QSO with Justin N5BO in Florida. This was just a taste of things to come! At 1900 local, while they were on 20m, Bob, VE1YX called and said he was hearing 6m beacons from up north, so they quickly switched over to 6m and found it wide open. A 6m pileup quickly grew that had to be over 100 stations deep, so only the call signs and reports were exchanged – there was no time for grids! The Es opening continued for two solid hours to VE1, VE3, W1, 2, 3, 8, and 9s , and several pauses were taken for double hop QSOs to W4s, 5s, and 7s. The band finally closed two hours later, but not before over 350 QSOs were in the VF0X 6m log from Nova Scotia to Florida, Texas, Arizona, and New Mexico.

On Sunday evening July 1st, 6m opened up again via Es for several hours to W8, 9, and 0s finishing off at 1130 p.m. local with a QSO with VE3KRP in EN58. Monday and Tuesday were quiet except for brief scatter CW QSOs with W1JJ in Rhode Island, VE9AA, N1BUG in Maine, and Kevin, VE3EN the VF0X web site designer and host www.solarcycle24.com/vf0x. They packed up the gear on Wednesday July 4th and left Nunavut having had a great 6m DXpedition and having handed out a brand new grid to over 500 very happy 6m operators. 73, Pete VE3IKV

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

Italy, Sardina, SMOM and Vatican qrv

As a big surprise from mid July 2007 untill Dec. 31st 4m operation was permitted to the Italian amateurs on 3 spot QRGs, 70.1, 70.2 and 70.3 (all modes). In the meantime many first ever QSOs took place on Es, Tropo and MS from I, IS and even 1A0KM and 1A4A were qrv. From HV only locals were wkd so far via Tropo. Also T77NM from San Marino was supposed to be qrv any time. Further negotiations will show if there will be any chance to continue in 2008.

The beacon **GB3RAL/B** is qrv on **70.050, 40.050 and 60.050 MHz**, from IO91IN, running a few watts only.

DL qrv again on 4m after 50 years: DI2AL

by Joachim Kraft, DL8HCZ / DI2AL

After 4m became available temporarily in Portugal in 2006 and 2007 I was dreaming for a long time about a similar possibility to do the same from my mother country Germany. Several individual operators have asked for special 4m permits at the German PTT (now called BNetzA) over the last years without any success. Unfortunately the German amateur radio club DARC did not help either, even worse they did not want to support promoting any 4m amateur radio activities from DL as they recently had other "more important things" on their to do list e.g. an allocation for 500 kHz. In the past the problem for the German PTT was that the primary user of the 70 MHz band, the German military, always said strictly NO to any experimental amateur radio licences in this range as they did not want to open the door for a similar development as happened with the 6m band. The German military is primary user from 70.000 to over 74.000 MHz. So there was no chance to get a single kHz inside this range. Beiing used to work split from my operations from Portugal where we can TX only arround 70.620 MHz I started to have a closer look on the frequency allocations in DL just below 70.000 MHz and found that the range arround 69.950 to 69.999 is allocated to commercial users but almost not used at all. What a chance! Even better it turned out that exactly this range was intended for temporary use for scientifical and technical experiments of companies, universities etc. In Germany it is possible to apply for an experimental licence with a "DI" callsign for ANY frequency. The PTT will then check with the primary and secondary users and eventually grant a permit. So in the end of May I applied for a licence for 69.995 MHz as I thought the closer to the 4m amateur radio band the better. Later I learned that this was a mistake due to the birdie and QRM situation on this frequency in many other European countries. 10 to 20 kHz lower in frequency would have been much better. The licence was granted without any problem within a very short time. What a surprise! Just the usual 130,- Euro had to be paid for this "DI" licence. To be honest I did not really expect to get this licence so I had no 4m equipment in DL ready, of course. Also I had to book flights to travel from CT to DL and this can be quite expensive the main DL summer holiday season. Anyway I found some flights and went to DL on August 5th just in time to be ready for the Perseid meteor shower and the rest of the Es season. Thanks to WIMO I had a 5 element ZX yagi for 4m delivered to my QTH in JO53CN (east of the city of Hamburg) already before my arrival and started to assemble it on August 6th. I had brought my 4m Spectrum Transverter from CT and a FT817 as driver. In the evening of Aug. 6th everything was connected and I turned the beam to Danmark: OZ7IGY was 559 on 70.021, great! Then I went to the ON4KST chat – as OZ1DJJ was already waiting there. He was one of the very few who knew in advance about my 4m activity from DL. At 19:50 UTC we had completed a Tropo QSO in JT6M mode and this was the first 4m QSO from DL after about 50 years when a few DLs were qrv taking part in experiments for the international geophysical year (IGY) 1957/58. This was also the first ever OZ to DL contact on 4m. Untill Sept 8th I was able to work over 80 QSOs on 4m as DI2AL plus a few X-band QSOs. 68 different stations were worked on 4m, from 43 grid squares and 19 DXCCs. 18 first ever contacts were made. Thanks to all who worked me or listened for me! Klaus, DL3YEE, managed to get a similar licence valid from Sept. 1st to Oct. 31st. So another grid (JO42) was on the air on 4m from DL already.

DI2AL, JO53cn, list of QSOs:

6.8.	**1950**	**OZ1DJJ**	**JO65**	**26**	**26**	**JT6**	**T**	**FIRST OZ**
	2001	OZ1BNN	JO55	559	55	CW/JT	T	
7.8.	0835	OZ2LD	JO55	26	26	JT6	T	
	0917	**G7CNF**	**IO81**	**26**	**26**	**JT6**	**MS**	**FIRST G**
	0936	OZ3ZW	JO54	26	27	JT6	T	
	1000	**MW0HMV**	**IO71**	**26**	**26**	**JT6**	**Es**	**FIRST GW**
	1018	**GM4ISM**	**IO85**	**26**	**26**	**JT6**	**MS**	**FIRST GM**
	1040	G4FUF	JO01	26	26	JT6	MS	
8.8.	**0410**	**GU8FBO**	**IN89**	**26**	**26**	**JT6**	**MS**	**FIRST GU**
	0450	G4DEZ	JO03	26	26	JT6	MS	
	1716	**I0WTD**	**JN61**	**449**	**449**	**CW**	**Es**	**FIRST I**
	1734	I0JX	JN61	59	559	CW/SSB	Es	
	1842	**SV1DH**	**KM27**	**559**	**549**	**CW**	**Es**	**FIRST SV**
	1900	**9A6R**	**JN83**	**59**	**59**	**SSB**	**Es**	**FIRST 9A**
	1901	SV1DH	KM27	59	59	SSB	Es	
	1905	**SV9GPV**	**KM25**	**59**	**59**	**SSB**	**Es**	**FIRSTSV9**
	2023	G4IGO	IO80	26	26	JT6	Ms	
	2053	**GI4KSO**	**IO64**	**26**	**26**	**JT6**	**Ms**	**FIRST GI**
	2139	OZ7IS	JO65	529	559	CW	T	
	2140	OZ2M	JO65	559	529	CW	T	
	2142	OZ2LD	JO65	599	579	CW	T	
9.8.	**0500**	**S51DI**	**JN76**	**26**	**26**	**JT6**	**Ms**	**FIRST S5**
	0629	IK4PMB	JN54	26	26	JT6	Ms	
	0744	I6BQI	JN72	59	47	JT6	Es	
	0757	I6BQI	JN72	599	599	CW	Es	
	1030	G4PBP	IO82	26	26	JT6	MS	
	1816	OZ1HUF	JO54	26	26	JT6	T	
	1820	OZ3ZW	JO54	49	38	JT6	T	
	2130	G0CHE	IO90	26	26	JT6	MS	
	2133	DL3YEE	JO42	539	429	CW	T	X-band 6m
	2157	G0GMB	IO92	26	26	JT6	MS	
	2203	DL8LAQ	JO43	579	559	CW	T	X-band 2m
	2205	DL8LAQ	JO43	57	55	SSB	T	X-band 2m
10.8.	**0603**	**OY3JE**	**IP62**	**26**	**26**	**JT6**	**Ms**	**FIRST OY**
	0619	G0JHC	IO83	26	26	JT6	Ms	
11.8.	0713	GW8IZR	IO73	26	38	JT6	Ms	
12.8.	0546	G3SHK	IO90	26	26	JT6	Ms	
	0610	**GD0TEP**	**IO74**	**26**	**26**	**JT6**	**Ms**	**FIRST GD**
	0628	S51DI	JN76	26	37	JT6	MS	
	0700	S560L	JN75	26	37	JT6	MS	
	0959	MM0AJW	IO88	26	26	JT6	MS	
	1133	G4YTL	IO92	26	37	JT6	MS	
	1143	PA2V	JO22	559	419	CW	T	X-band 6m
	2133	OY4TN	IP62	26	26	JT6	MS	
13.8.	0404	G7RAU	IO90	26	27	CW	MS	
	0540	**LX1JX**	**JO30**	**529**	**529**	**CW**	**MS**	**FIRST LX**
	0605	G7CNF	IO81	26	26	FSK	MS	
	0900	IW0FFK	JN61	26	26	JT6	MS	

	1030	**GJ3YHU**	**IN89**	**26**	**26**	**SSB**	**MS**	**FIRST GJ**
	1133	G3WOS	IO91	26	26	JT6	MS	
15.8.	**0730**	**CT1HZE**	**IM57**	**559**	**559**	**JT6**	**Es**	**FIRST CT**
16.8.	0545	G4RGK	IO91	26	37	JT6	MS	
	0620	GW8ASD	IO83	26	26	JT6	MS	
	1721	OZ1DOQ/p	JO65	599	579	CW	T	
	1745	OZ3ZW	JO54	599	579	CW	T	
	1746	OZ2LD	JO55	599	579	CW	T	
	1753	OZ2PBS	JO55	579	559	CW	T	
17.8.	1205	G4IGO	IO80	59	59	SSB	Es	
	1208	G3WOS	IO91	55	55	SSB	Es	
	1211	G0JHC	IO83	57	55	SSB	Es	
	1228	G7CNF	IO81	59	59	SSB	Es	
	1228	G6ZGO	IO83	59	59	SSB	Es	
	1253	G3UVR	IO83	59	59	SSB	Es	
	1254	G8GXP	IO93	59	59	SSB	Es	
	1257	GM4ISM	IO85	59	59	SSB	Es	
	1301	G8BCG	IO70	59	57	SSB	Es	
	1309	GM3NKG	IO85	59	59	SSB	Es	
	1320	GM4FAM	IO77	59	59	SSB	Es	
	1326	GM4VVX	IO78	59	59	SSB	Es	
18.8.	1820	OZ2SYV	JO54	57	55	SSB	T	
19.8.	0735	G4CBW	IO83	26	26	FSK	MS	
	0804	LA4ANA	JO59	26	36	JT6	MS	X-band 6m
	1028	G0UWK	IO83	26	26	FSK	MS	
	2130	9A1Z	JN86	26	27	FSK	MS	
20.8.	0557	SP9HWY	JO90	26	26	JT6	MS	X-band 6m
21.8.	1052	9A2SB	JN95	59	57	SSB	Es	
23.8.	0736	G8HVY	IO90	58	42	SSB	Es	
	0737	G3LQR	JO02	59	59	SSB	Es	
	0738	G4FUF	JO01	599	59	CW/SSB	Es	
	0739	G3WOS	IO91	59	59	SSB	Es	
	0740	G3SHK	IO90	59	59	SSB	Es	
	0740	G3VYF	JO01	59	59	SSB	Es	
	0742	G4FUF	JO01	59	59	SSB	Es	
	0742	G8ZXO	IO90	59	59	SSB	Es	
	0743	G0CHE	IO90	57	57	SSB	Es	
25.8.	1856	OZ9F	JO45	59	55	SSB	T	
	1916	OZ2OE	JO45	59	57	SSB	T	
28.8.	1140	I6BQI	JN72	55	55	SSB	Es	
3.9.	1133	SV2DCD	KN00	59	59	SSB	Es	
6.9.	1758	DL3YEE	JO42	559	599	CW	T	on 69.995
	1843	DL3YEE	1843	57	59	SSB	T	on 69.995
8.9.	**0704**	**EI7IX**	**IO53**	**26**	**26**	**JT6**	**Ms**	**FIRST EI**
	0717	OZ3ZW	JO54	599	599	CW	T	
	0718	OZ3ZW	JO54	59	59	SSB	T	
	1255	**IS0/IK0BZY**	**JM48**	**26**	**26**	**JT6**	**MS**	**FIRST IS0**

DI2AL 4m – QSL from 2007

Appendix

The History of 4m in DL

A small group of 23 amateur radio operators from Germany took part in experiments for the International Geophysical Year (IGY) 1957 and was allowed to transmit from 70.300 to 70.400 MHz from July 1957 untill the end of 1959. Walter Staubach, DJ2LF, was one of the very first operators who was ready and qrv on 4m in November 1957 and on Nov. 19th he had a first 4m/2m-X-band QSO with PA0WO. Allthough PA0WO was also able to TX on 4m they did not manage a complete QSO. The first ever 4m QSO from DL was made by DJ2LF a few days later with DL3YBA in CW via Tropo over a distance of about 250km. Fritz Herbst, DL3YBA (later DL3YB, SK in 2007) was a very well known 2m DXer already at that time and he used his large 2m array for 4m also! In the first half of 1958 some other firsts took place with countries arround DL which also took part in the IGY experiments. See table below. DJ2LF worked PA0WO for a first on 4m on May 3rd 1958. Allthough from other countries like F and G it was worked on 4m into CN and FA (now 7X) via Sporadic-E obviously no stations from DL managed. At least there is no record at all in the German magazines from those old years. DJ2LF writes that in 1957/58 it was extremly difficult to find the possible QSO partners on 4m. There was no email or DX cluster and even a simple landline was rare for a private house in DL. It was strictly forbidden to use the phone from the QRL for private purposes. So most contacts took place after random contacts on 2m or 10m and then QSY to 4m.

24.11.1957	**DJ2LF - DL3YBA**	CW	**FIRST DL-DL** on 4m
11.2.1958	**DL3YF - HB9RG**		**FIRST HB9-DL** on 4m
	HB9RG transmitting on 71.1 MHz		
1.3.1958	**DL1EI - OE2JG/p**	AM	**FIRST OE-DL** on 4m
	1733h, 120km, 59 59 exchanged		
3.5.1958	**DJ2LF - PA0WO**		**FIRST PA-DL** on 4m
	at 2315h, AM		
3.5.1958	**DL6TU - F8ZW/p**	AM	**FIRST F-DL** on 4m

Table: DL firsts on 4m from 1957/1958

Details of the German 4m licences from 1957 to 1959:

QRG: 70.300 to 70.400 - Power: max. 10 W RF -
Modes: A1, A3, F3 - Date: 1. July 1957 to 31. December 1958, and then extended from Feb. 10th 1959 to Dec. 1959. - 4m permit holders: DL1AL, DL1CS, DL1EI, DL1FF, DL1LB, DL1SO, DL1YA, DL3BE, DL3FM, DL3GZ, DL3YB, DL3YF, DL6ET, DL6EZ, DL6FX, DL6MH, DL6SV, DL6TU, DL9GU, DL9RE, DJ1JF, DJ1ZG und DJ2LF. -

A bit funny – but typical German – was the procedure to get the 4m licence: Only approved and well known and successful VHF operators were invited by the DARC club to apply for such a licence at the DARC (not at the licence authority, the Deutsche Bundespost)! Then DARC forwared all to the Deutsche Bundespost and got the licences back and sent them to the individuals. May be this is the reason why so few operators applied and became qrv. Even worse, probably this is also the cause why 4m in DL did not make a similar development like in the U.K. Thanks to DJ2LF for providing all the interesting details from the old times! (DL8HCZ/CT1HZE)

News & Comments

Editor: Joachim Kraft, DL8HCZ
Funk-Telegramm@t-online.de

G0AFH who was qrv from IO43 and 54 last Dec/Jan. plans no expedtion for this winter as a little harmonic has arrived. Ian will activate may be IO55 later in 2008.

F1HDI (ex J79DI) plans to be qrv on 2m EME in 2008 from a rare DXCC in the Indian Ocean or Caribbean.

PE1L plans a 2m EME (and hopefully Es) expedition to a rare DXCC in northern Africa in summer 2008.

5T5SN is QRT and has left Mauretania. He is for 1 year in Paris now and will move to another country in AF or AS afterwards. Nicolas says that the beacons are still qrv.

9M6, DU, HL: JA1RJU plans to activate Eastern Malaysia, Philippines and South Korea on 2m and 6m EME in spring 2008.

D44TD has changed QTH but is still in same grid HK86no. He will be back on 6m and 2m soon and switch on the D44DUB beacons on 6m and 2m also.

7P Lesotho: ZS6WB plans to be qrv on 2m EME in spring.

CY0 Sable: K5AND, W3CMP will be qrv in June 08 on 6m with QRO, may be also 2m EME.

Pacific: DL2NUD plans a Pacific trip in the beginning of 2008. He will be active on 2m EME in JT65.

ET Ethiopia: ZL1RS is in ET3 untill about March. May be he will come on 2m EME.

KH6 Hawaii: W7EME will be qrv on 2m EME from BK29 in December and from BL02 in Feb./March.

R1M Malyj Vysotskyj – OH5LID considers a 2m FSK-MS expedition in June 2008.

T6 Afghanistan – VK1UN is qrv as T61AA untill at least May 2008. He plans to come on 2m EME. Loc. MN57gc.

UK Usbekistan – DL9LBH is there for a few years and will try to come on 2m EME.

UN Kazakh – UN6PD, MN69JM, is qrv with 1KW and 14 ele an 2m EME in JT65.

ZD8 Ascension: W1MRQ is for 2 years on ZD8 and plans to be qrv on 2m EME. From August 2009 he will be back as KC4/W1MRQ from McMordo / Antarctica.

RW1ZC/MM, Alex, will be qrv again off the south African coast (ZS1 area) from late December 2007 for about 7 months. He will be on 2m on 144.300 MHz looking for TEP in spring equinox. Also trying EME in JT65B with a 3wl and hopefully a PA this time. He will also try 23cm Tropo to ZS.

MWS 2008

The Most wanted square survey for 2008 will be organized again by Funk-Telegramm and DUBUS and MMMonVHF. Start is NOW! Please sent your entries untill February 5th to Funk-Telegramm@t-online.de

DM0HVL to succeed DL0UB

The DL0UB hardware (2m and 70cm) was moved to a new QTH in JO62KI. The beacon will be back soon with the call DM0HVL and 5W and corner dipole on 2m and 5 W and stacked big wheels on 70cm Sysop is DL7AIG. (DL7APV).

DB0NCO back on 24 GHz

DB0NCO is back on 24048.905 MHz with 0.8 W out from JN59JD. 16 x slot, omni, 550m a.s.l. Sysop is DL6NCO.

UA3MEZ on 23cm

UA3MEZ/B is qrv on 1296.870 from KO98JB with 1W and H omni. Reports pse to ua3mrs@mail.ru

OZ7IGY on 40 MHz

Since July 18th OZ7IGY/B is qrv as the first beacon worldwide on 40 MHz. QRG: 40.021 MHz, JO55WM, 25W, Omni.

UR0DMX on 10 GHz

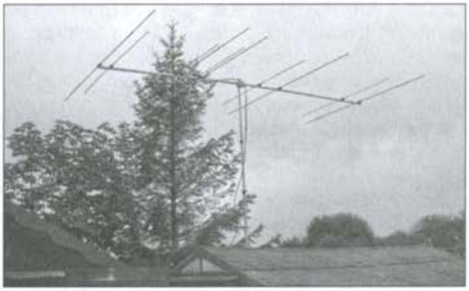
The ex DB0KI hardware is running now as UR0MDX/B from KN18DP with 1W and 2 x 8 slot. (DL6NCI)

J5FOUR: 4m Beacon from Guinea-Bissau

J5FOUR/B will be qrv soon on 70.010 MHz from IK21EV with 20W and a horizontal dipole. A 2m beacon J5TWO will follow with 20W and a vertical (unfortunately).

YU7EF Duoband Yagi – design confirmed!

G7CNF, Nige, has built the 5 ele version of the 4m/6m duoband yagi which was presented in last DUBUS issue. We know that several readers do not trust designs which have not been tested in practice at all. Thus we are happy that G7CNF confirms the good performance of this antenna.



YU7EF design 5 + 5 ele duo band yagi for 6m and 4m using a single feed @ G7CNF

He sweeped the antenna and found perfect matching on 50 MHz and 70 MHz. From 45 to 49 MHz SWR is still well below 1.7, so the antenna is perfect for monitoring TV carriers etc in this range. Surprisingly a dip was also found on the 2m band, SWR is about 1.3 over the whole band! Simulation showed that there is even about 1 dBD gain in forward direction and two sidelobes with 4.5 dBD gain. So this antenna can be used at least for local 2m traffic also and may be an emergency solution if there is huge Es or Tropo on 2m and no other antenna available. All diagrams and info is on the web at http://ham-radio.me.uk/ under "G7CNF stuff".

5B4AZ writes

I read with interest (and envy!) the Es articles in the latest DUBUS mag and I wish I had something to report myself. As my mother is very sick and she keeps me pretty busy, I have little time to go mountain topping etc but I have been monitoring 2m from time to time but always checking the DX robot (it sends me email alerts!) so I am well aware of the openings other have experienced in Europe. I agree with the observations of East Eu operators that there are fewer Es openings this year. For me there was only one weak and short opening to SV land but I could only hear one station working some 4x4's. Icalled but no result. Otherwise this year has been pretty dead for me. Being stuck at home in Limassol makes it worse, I have Mount Troodos as an obstacle (4-5 deg) in both the directions (north and north-west) that Es comes from to me. I also have some buildings as obstacles and these show in the reception of satellites, on UHF sats have to be 8 deg up sometimes before I hear them! I have also had your experience of back scatter via Es on 2m a few years ago. I was on the Western coast of Cyprus that is much better for the north-western path, and I heard 4X1IS (I think) talking to some UB5 stations via Es. I had a 4 elem portable Yagi and an FT290 rig (which gave me a QSO with an FC station using the built-in whip on another occasion!) but I could not hear the UB5's. I turned the Yagi to Israel trying to talk to 4X1IS but he disappeared so I turned back to North. I then heard him again and by rotating the Yagi I confirmed he was coming from the North by back scatter. What I remember from this event is that I thought I could not hear the UB5's because I was too close to the Es patch (this path opens by Es patch over Turkey usually) and so my angle of incidence was too large for forward reflection. But 4X1IS was further away from the patch so he could work UB5's and back-scatter to me also. I didn't think back scatter was very unusual because already I had heard at least an SV1 (Costas?) and possibly I4EAT via back scatter from TEP events. But I report it here now, better late than never! Another thing I want to report is my observations of Es openings in relation to weather over Europe. I am now much more positive of the correlation between cyclonic weather systems (bad weather with wind/rain) and the bigger Es events. I was in fact able to predict many Es events by watching these systems come in from the Atlantic and move over Europe, usually in latitudes between 40-50 deg. There have been also a few (4-5) smaller openings in areas with little cloud but I think there were disturbed conditions there but with only thin cloud. The arrival of hot and dry weather in Europe again put an end to Es and it is possible even that the reduction of Es in lower latitudes (30-35 deg) may be due to the unusually hot and dry weather due to global warming! Time will tell.... 73, Neoklis, 5B4AZ - http://5b4az.chronos.org.uk

SM5KI writes

I have for sale a never used ANRITSU model S120A SITEMASTER commercial antenna tester with some accesories covering 600 - 1200 MHz. For further details, please contact Hans-Alfred at megaphone@glocalnet.net.

EA8AK-UO5OGX Record QSO - Update

After the announcement of the world record 2m Es QSO over 4391km from EA8AK to UO5OGX (12. Aug. 1981, 1638z) by EA8AK in DUBUS Magazine last year, we have discovered that UO5OGX, Boris, is living in DL now and is qrv as DK5OX. He confirmed to us also that this QSO took place in 1981. BTW EA8AK is a member of the EU parlament.

Microwave Update 2008

Microwave Update 2008 will be held **October 17-19** in Bloomington, Minnesota. The site is near the Minneapolis airport and next to "Mall of America" The largest shopping mall in North America. In case you are bringing the XYL. In 2009, MUD will be hosted by W5LUA and WA5VJB in the Dallas area. Watch www.microwaveupdate.org for additional information.

UKW-Tagung Weinheim 2008

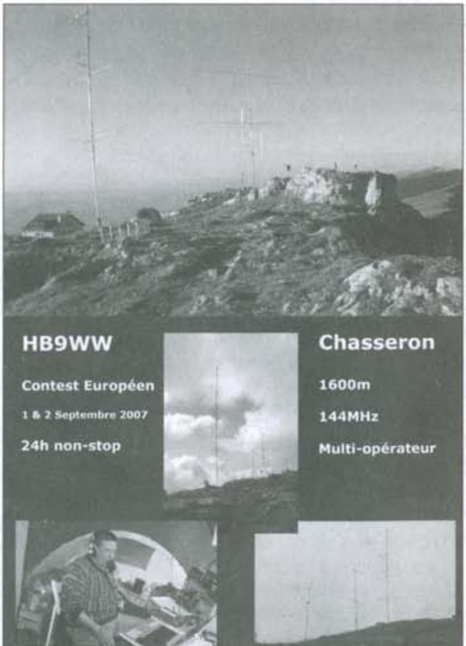
The next Weinheim VHF-Meeting will take place in Bensheim/Weinheim on **September 13/14 2008**. For more info see www.UKW-Tagung.de

Dorsten GHz-Meeting 2008

The next GHz Tagung Dorsten will take place on **February 9th 2008** in Dorsten, Volkshochschule. For more info see www.GHZ-Tagung.de

Heelweg Microwave Meeting

The fifth Microwave Meeting in Heelweg (Netherlands) will take place on **January 19th 2008**, 10-15Z. Location is Café "De Vos" Halseweg 2, 7054 BH Westendorp (10km from DL border near Bocholt). More infos via PA7JB@xs4all.nl and www.PAmicrowaves.nl



HB9WW- 1/2 Sept on 2m with >1000 QSOs, 112 grids and ODX to SM7 (JO65) and EA1 (IN52). (tnx to HB9HLM)

Redaktionsschluss für Aktivitätsberichte und redaktionelle Beiträge für DUBUS 1/2008 ist der 1. Februar 2008. - Deadline for reports etc. for DUBUS 1/2008 is February 1st 2008.

Inhalt / Contents 2007

Reports (Technique, Operation Technique, Propagation, Software)

Microwave Parts

News, Activity Reports, Expedition Reports, Contests etc.

on the web – check and register at www.DUBUS.org
Beacon Lists and Toplists ONLINE - free access for all DUBUS subscribers

I0JXX Yagi Antenna's

JXX Yagi's are made of high performance galvanized aluminium, boom is made of round aluminium.
2m & **70cm** type's are supplied with 5mm solid **round insulated** aluminium ele.
In this way of mounting there will be max. gain for a long time. (no corosion beteen two metals)
6m antennas are supplied with special element holders which are insulated mounted at the boom.
All yagi's comes with a heavy duty mast clamp, and can be Mounted up to 70mm pole.

70cm Yagi (T-Match)

Type	Band	El	Gain dB	L (m)	Euro
8JXX2	2m	8	12,2	4,25	115,-
12JXX2	2m	12	12,7	5,6	169,-
16JXX2	2m	16	14,5	9,3	219,-
25JXX70	70cm	25	16,5	5,5	175,-
39JXX70	70cm	39	18,1	9,4	239,-
5JXX6	6m	5	9	4,83	159,-
6JXX6	6m	6	10,2	7,35	239,-
7JXX6	6m	7	11,25	9,4	299,-

Parabolic MESH DISH Kit

Prime focus dish, available as a do-it-your self kit, it's easy to assemble, all material made of aluminium, mesh 6mm square and made of galvanized steel, you only need a hand driller, a hand riveter and some time to assemble this DISH KIT

Available diameters:
1, 1.2, 1.5, 1.9, 3 meter
Available F/D:
0.35 / 0.4 / 0.45 / 0.5

Price starts at: 215,00

Antenna power splitters

High power antenna power splitters for **2m, 70cm, 23cm & 13cm**. N-connector mounted **water proof**. On request input connector with **7/16 DIN (F)**!

Available power splitters:

2 way - 1/4wl
3 way - 1/4wl
4 way - 1/2wl or 1/4wl
6 way - 1/2wl
8 way - 1/2wl

All details can be found at: **www.rfhamdesign.com**

SPID Antenna rotators

AZIMUTH / ELEVATION rotator: type RAS
* High torque low voltage DC motor.
* Magnetic reed switch, 1 pulse per degree.
* Twin Green LED digital readout.
* Manual or computer control.
* Software available for **EME**

RAS inc controller, softw, interface.....**920,00**
BIG RAS inc contr, softw, interface...**1398,00**

AZIMUTH rotator: type RAK
* Double metal worm gear drive reduction for holding position in the wind.
* High torque low voltage DC motor.
* Magnetic reed switch 1 pulse per degree.
* Pole or tower mounting.
* Uses 4 wire cable
* Green LED digital readout

RAK inc controller, softw, interface......**595,00**
BIG RAK inc contr, softw, interface.....**845,00**

PA4FP **RF HAMDESIGN**
www.rfhamdesign.com

Weversburen 5, NL-9201 EG Drachten, The Netherlands.
Tel: +31 (0) 512 354 126, Fax +31 (0) 847 187 776
E-Mail: info@rfhamdesign.com

Microwave Transverters

Microwave Transverters

made by DB6NT

More information is available on our website

www.DB6NT.de

The new design of our Microwave Transverters features better performance and many new functions. Now, an external 10 MHz reference frequency can be connected to achieve highest frequency accuracy for EME and WSJT. The internal stabilized crystal oscillator can be used, if a 10 MHz reference frequency is not available. A bigger attenuator at the IF input port allows an input power up to 5 watts. Of course, all the well-tried functions of the old transverter version are kept in the new design!

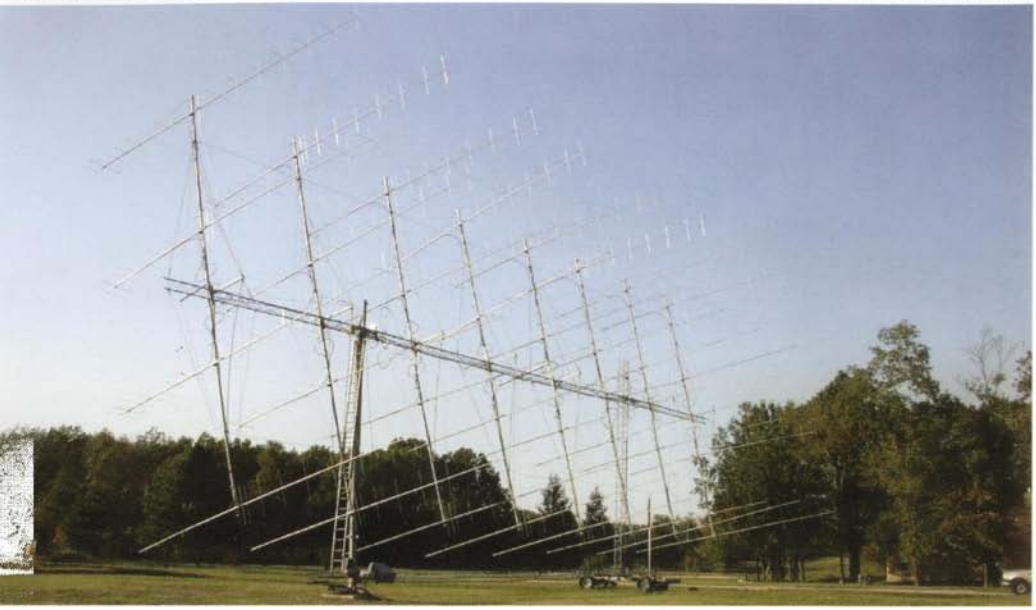
Type	**MKU 13 G3**	**MKU 23 G3**	**MKU 34 G3**	**MKU 57 G3**
Frequency range RF	1296 ... 1298 MHz	2320 ... 2322 MHz	3400 ... 3402 MHz	5760 ... 5762 MHz
Frequency range IF	144 ... 146 MHz	144 ... 146 MHz	144 ... 146 MHz	144 ... 146 MHz
Output power	typ. 2.5 W	typ. 1 W	typ. 400 mW	typ. 250 mW
RF input power	max. 5 W, adjustable (0.5 ... 5 W)	max. 5 W, adjustable (0.5 ... 5 W)	max. 5 W, adjustable (0.5 ... 5 W)	max. 5 W, adjustable (0.5 ... 5 W)
10 MHz reference freq. input	typ. 2 ... 10 mW	typ. 2 ... 10 mW	typ. 2 ... 10 mW	typ. 2 ... 10 mW
Noise figure @ 18 °C	max. 0.8 dB	max. 0.8 dB	typ. 0.9 dB	typ. 1 dB
Receive gain	min. 20 dB, adjustable	min. 20 dB, adjustable	min. 20 dB, adjustable	min. 20 dB, adjustable
Supply voltage	+12 ... 14 V	+12 ... 14 V	+12 ... 14 V	+12 ... 14 V

KUHNE electronic
MICROWAVE COMPONENTS

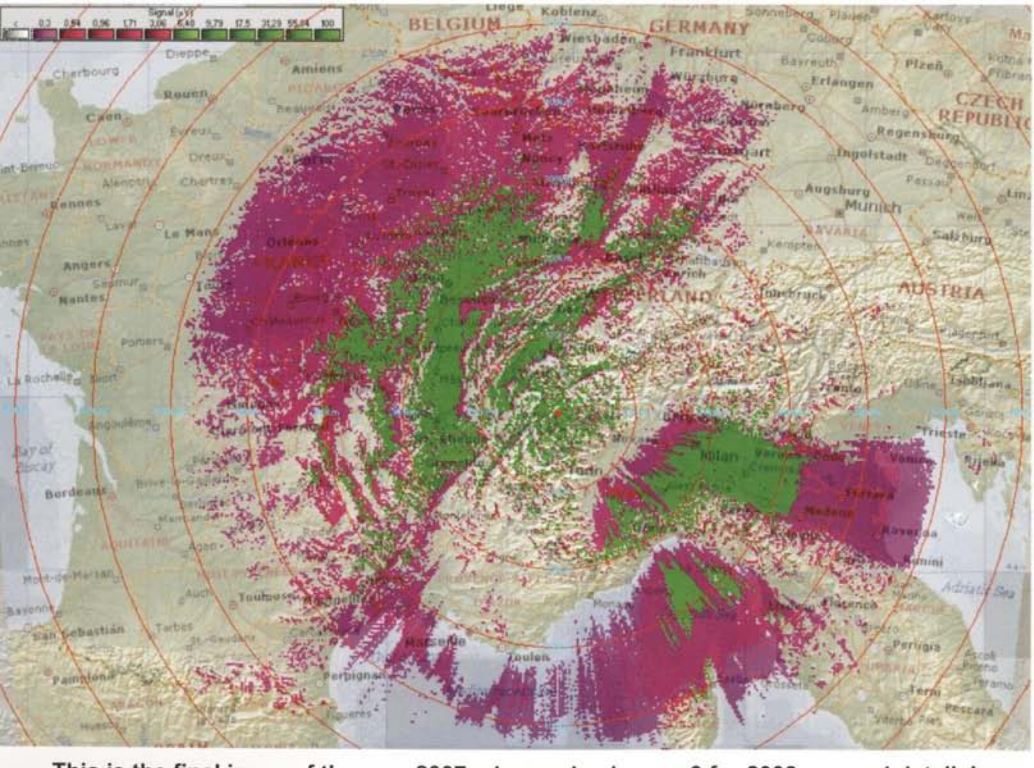
INNOVATIVE
MICROWAVE TECHNOLOGIES
FOR THE FUTURE

KUHNE electronic GmbH
Scheibenacker 3 · 95180 Berg
Phone: +49 (0) 92 93-800 939

W5UN 2m Array - 32 x 17 H and 32 x 10 V front mounted



Enhanced 10 GHz Scatter on Mt. Blanc, see p. 91



This is the final issue of the year 2007, please check page 3 for 2008 renewal details!