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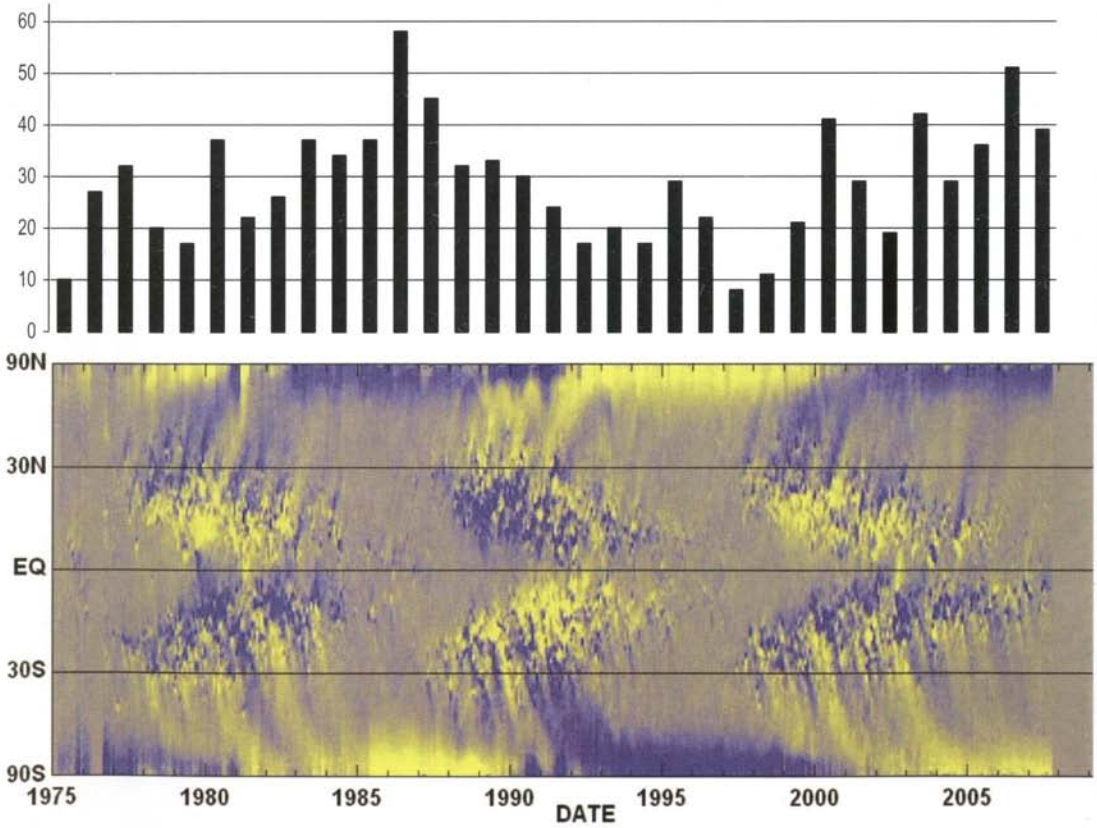
Mid-latitude Sporadic E on 144 MHz



and the 22-year Magnetic Cycle

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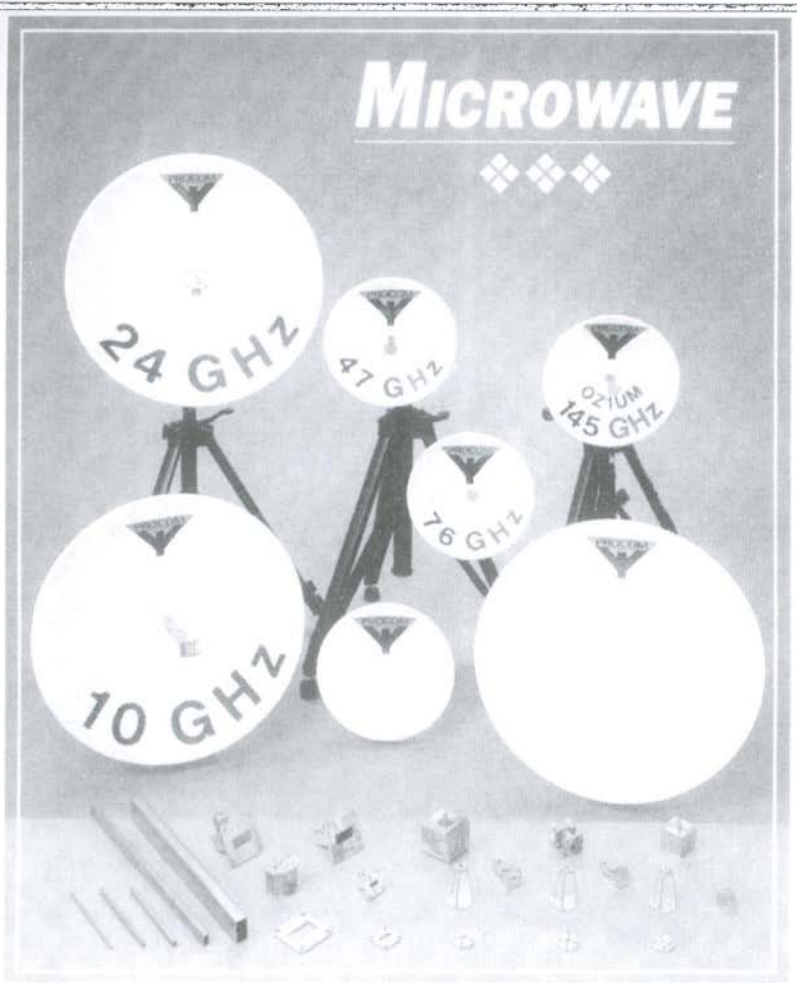

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Editorial

Dear DUBUS Reader!

we welcome you to the first DUBUS issue of 2008!

Hopefully you will like the variegated mixture of articles in this issue and if you have not yet renewed for 2008 please consider to do it now. We need your subscription to keep DUBUS alive.

This winter has been great in central Europe for Tropo on all bands and in December 2007 and January 2008 there were openings which remind sometimes more of Sporadic E when we look on the achieved distances. 2500km from England to Ukraine on Tropo is really remarkable. Even old stagers like G4DHF got a bit excited this time. See his report in the Tropo section.

We want to remind everybody of taking part in the remaining CW parts of the EU EME Contest in March, April and May. See rules in last DUBUS issue on p. 112 or on www.dubus.org.

Tne next EME conference will take place in August in Florence. More info on the web at: www.ari-crt.it/EME2008/

Please keep sending your reports and technical articles.
Thank you!

73

from Joe, DL8HCZ / CT1HZE
and the DUBUS team!

Liebe DUBUS Leser!

Willkommen zur ersten DUBUS-Ausgabe des Jahres 2008!

Wir hoffen, dass die bunte Mischung der Artikel in dieser Ausgabe gefällt und bitten um Verlängerung für das Abo 2008, falls noch nicht geschehen. Nur so kann die DUBUS erhalten bleiben.

Dieser Winter war phantastisch für Tropo in Mitteleuropa auf allen Bändern und im Dezember 2007 und Januar 2008 gab es Öffnungen, die mehr an Sporadic-E erinnern, wenn man sich die erreichten Entfernungen anschaut. 2500km von England in die Ukraine sind schon bemerkenswert. Selbst alte Hasen, wie G4DHF, wurden dabei etwas nervös. Siehe sein Bericht im Tropo-Teil.

Wir möchten nochmals alle erinnern, an den verbleibenden CW-Teilen des EU EME-Contests im März, April und Mai teilzunehmen. Die Regeln stehen in der letzten DUBUS-Ausgabe auf S. 112 und unter www.dubus.org.

Die nächste EME-Konferenz findet im August in Florenz statt. Mehr Info dazu im Netz unter: www.ari-crt.it/EME2008/

Für Aktivitätsberichte und besonders technische Artikel sind wir weiterhin sehr dankbar.

73

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

Midlatitude Sporadic E on VHF in correlation to the 22-year Magnetic Cycle of the Sun

by Joachim Kraft, DL8HCZ/CT1HZE – info@DUBUS.de

Introduction

Angel Nestorov (LZ1AG) suggested 10 years ago in [1] that there may be a correlation between the 22-year magnetic cycle of the sun and the number of sporadic E openings on 144 MHz. At that time only the data from 1974 to 1997 – in total 24 years – were available for examination, covering just a bit more than one solar magnetic cycle of 22 years. Now in 2008 we have additional data from another 10 years, so we can now make a better test of the hypothesis from LZ1AG. For clarification please note that the hypothesis and findings in this article relate only to "midlatitude" or "temperate zone" Es propagation on the 144 MHz band. "Equatorial Es" propagation and "Auroral Es" propagation are not the subject of this article, and propagation on other bands is only considered as it relates to 144 MHz.

A brief Sporadic E history for 144 MHz

"Regular" Sporadic E traffic on 144 MHz has been reported by European amateur radio stations since the early 1970s. It is difficult to find much material about openings from before 1974 as the main channel of information has been DUBUS magazine, which did not exist before this date. However, reports about single events have appeared in the different national amateur radio magazines, and with the help of "first ever" contact lists of many countries we can find that the very first recognized 2-way QSO by 144 MHz Es took place on June 14th 1959 between England and southern Italy.

The next remarkable date was July 4th 1965, when a major Es event took place during a contest. First ever contacts between OZ and I, PA and YU, LA and I, GI and YU, GU and OK, GM and I, and SM and I were all reported. Es contacts from SM to EA and F to SP were also reported for July 5th; this may be just a typo in the date or indeed a second opening on the next day.
Surprisingly, this spectacular event from July 1965 did not really stimulate the 2m operators to be more interested in catching Es propagation, as over the next 8 years only a very few openings were reported, e.g. Aug 8th 1966, PA to I; May 25th 1971, GD to I; July 7th 1973, IT9 to UB5.

These years from 1959 to 1973 produce a far too little data for a sufficient analysis. However, in 1974 the big breakthrough started with 12 days of Es reported between May 9th and August 12th. On June 23rd there took place the first ever 2m contact from DL to 9H (Malta), and thousands of Es QSOs from Malta were to follow over the next years.

In his analysis, LZ1AG evaluated DUBUS Magazine and some other sources and found 629 days with reported 2m Es openings from 1974 to 1997. These data have been checked again for the new analysis: the reports noted by LZ1AG have been confirmed, and a further 17 days were found when 2m Es events took place during the same period, making a total of 646 days in those 24 years.

New data

The new part of this study covers the following 10 years, 1998 to 2007. For this period a total of 318 days were found with 2m Es openings. The data sources have expanded enormously during this recent period, largely thanks to the Internet. The sources for the new part of the study have been DUBUS, DK5YA`s Es summaries, DM2SR`s Es summaries, the OH2BUA web cluster, personal logs and observations from DK1KO, DL8EBW and CT1HZE and about a dozen of national first-ever contact lists from different amateur radio societies. Thus over the entire 34-year period from 1974 to 2007, a total of 964 days with 2m Es openings were found. That is 28.35 days per year on average for the entire period. If we focus on what is commonly known as the "main Es season" from about mid-May to mid-August, which is 93 days, then during this period there has been at least one identified 2m sporadic-E opening somewhere over Europe on almost every third day ($p = 0.29$). This is quite an impressive number – but it is the long-term average over the entire 34 years, of course. Individual years can be very different as we will see.

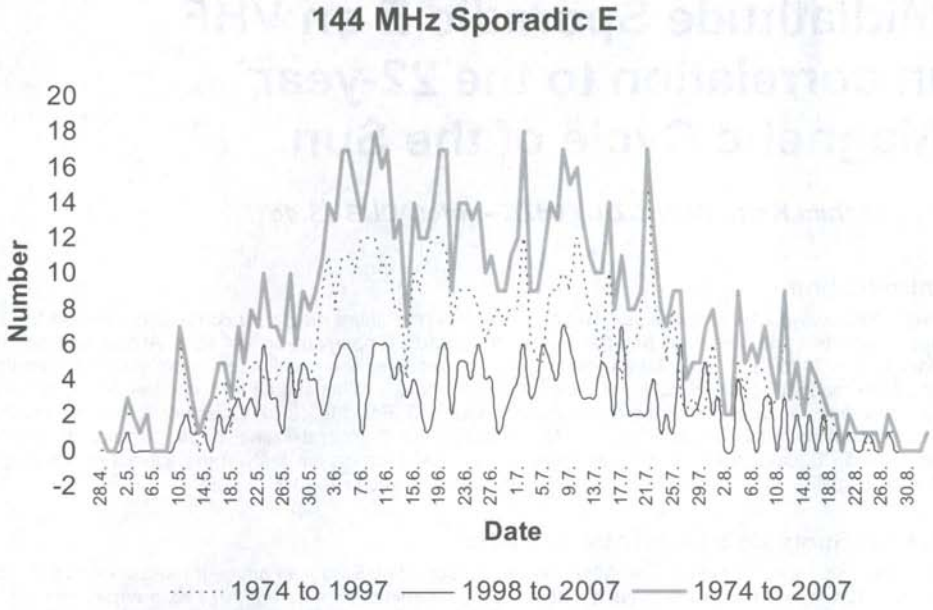


Fig. 1: Total numbers of days with at least one recorded 2m Es event in Europe, in the 'Es season' between April 28th and September 1st of each year. Data for 1974-1997 and 1998-2007 are shown separately, and the bold grey line is the 'grand total' from 1974 to 2007 (covering 946 days).

Daily distribution

Fig. 1 shows the distribution of 963 of the 964 2m Es events over the calendar days from April 28th to Sept 2nd over the years from 1974 to 2007 (bold grey line). One event, the outlier from Nov 10th 2004, is not shown in the diagram. For comparison graphs are also shown for the period from 1974 to 1997 (the dotted black line, data from LZ1AG adjusted by CT1HZE) and from 1998 to 2007 (the continuous black line, data from CT1HZE). Note that the data are not averaged per year in this figure; they are simply the total numbers of reported events for each calendar date over all the 34 years. The huge number of almost 1000 events allows for the first time to present a graph (the grey line) that shows quite well a Gaussian-like distribution. This distribution was not so clear in the data from either the first or the second period (the black graphs) but only emerges when all the 34 years of data are combined.

In the past there has been much speculation about the existence of certain always-repeating "good days" for Es events on 2m. From the first period one could conclude that e.g. June 8th, July 10th and July 21st are such days. However, after the data from the second 10-year period are added in, in most cases those original dates are no longer so prominent, while further small peaks appear on other dates. Therefore the new data leads us away from the idea of "special" calendar dates, and towards looking for periods of enhanced probability.

We can determine a period of very high probability for 2m Es from June 1st to July 22nd. This 52-day period is the peak season for 2m Es, and 671 of the total of 964 events during the 34-year period of observation took place in this time frame – about 70%! On average, the probability of 2m Es over Europe is nearly 40% any day in this period. The middle of this period is June 26, very close to summer solstice on June 21.

We can also see in Figure 1 an "early" season of 22 days from May 10th to 31st with 131 events (13.6% of all events) but the average daily probability in this period is down to 17.5%. And we can see a "late" season of 22 days from July 23rd to August 13th with 128 events (13.3%) with an average daily probability of 17.1%. Here one can see once more how symmetrically the 2m Es events are distributed.

An even smaller "pre-early" season of 12 days can be seen from April 28th to May 9th with just 12 events (1.2%) and a probability of 3%. There is correspondingly small "late-late" season of 20 days from August 14th to September 2nd with 29 events (3%) and a probability of 4%. An explanation of the slightly higher number in this period could be that some of the events counted as Es between August 13th and 16th have been E-layer reflections caused (or at least assisted) by the Perseid Meteor shower. It is well known that especially long MS bursts can occur on August 14-15-16th following the maximum on Aug12-13th.

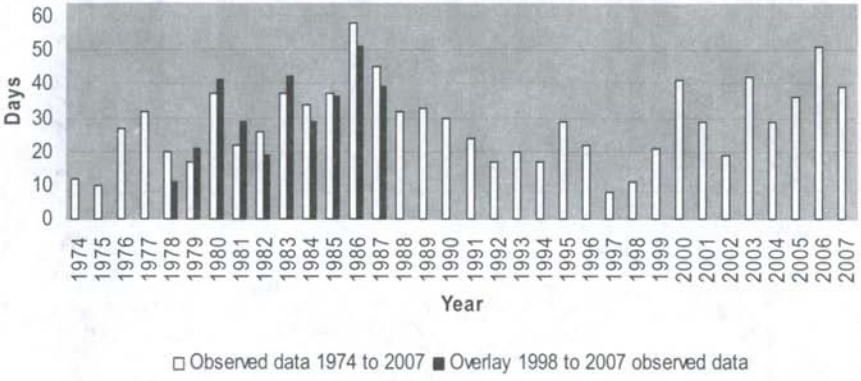


Fig. 2: 2m Es openings in Europe, days per year in the same 'Es season' as Figure 1. The bars from 1988 to 2007 are also CT1HZE's forecast for the years from 2008 to 2027!

Annual distribution

In Figure 2, the white bars show the annual distribution of days with 2m Es events, in the season between the beginning of May and the end of August. In total 964 2m Es days were recorded from 1974 to 2007. For the period from 1974 to 1997 the data are basing on the table of LZ1AG [1] adjusted by CT1HZE and from 1998 to 2007 on the data by CT1HZE. Note that here it is not counted if there took place several separate openings on the same day. In this analysis, a day with just one QSO report counts the same as a day with 2 or 3 big openings of several hours duration each.

On average 28.4 days with 2m Es per year were found. The worst years were 1975 with 10 and 1997 with just 8 days in the whole year. The best years have been 1986/1987 with 58/45 days and 2006/2007 with 51/39 days. Thus in the best years there has been a 2m Es opening every second day on average, over the entire "Es season", but in the worst years this number was down to one every 12th day!

When making this analysis it was questioned if it is legitimate to use only the number of days of Es openings instead of the exact count of the total minutes of the duration of the openings. For the early years of the observation period there are not enough data available to do this, and the finding and collection of such data would have taken several months of time, so it was decided to keep the simple approach of counting only the number of days. Furthermore the statistic for 3m FM BC Es openings over North America that was published by Pat Dyer, WA5IYX, shows a very good correlation between the number of days with openings and the count of the total minutes (Figure 3). There is no reason to assume that this in general would not be the case for 2m openings. Also there is no reason to assume that the lack of detailed data would change the important conclusion that will follow, about the correlation with the sunspot cycle.

Forecast and reality

LZ1AG predicted in [1] the number of days with 2m Es for the years 1998 to 2017 by the statement that the observed numbers from 1978 to 1997 will repeat exactly again after 20 years each. If this is true, the observed data (white vertical bars) from 1978 to 1997 should correspond with the predicted numbers for 20 years later, namely 1998 to 2007. To test this hypothesis, in Figure 2 the black vertical bars are the observed data for 1998 to 2007, copied 20 years backward in time and placed next to the corresponding white bars for 1978 to 1997. One can see clearly a nice congruence of both absolute numbers and tendency. With the exception of 1978 the forecast was nearly perfect for any year! This is remarkable.

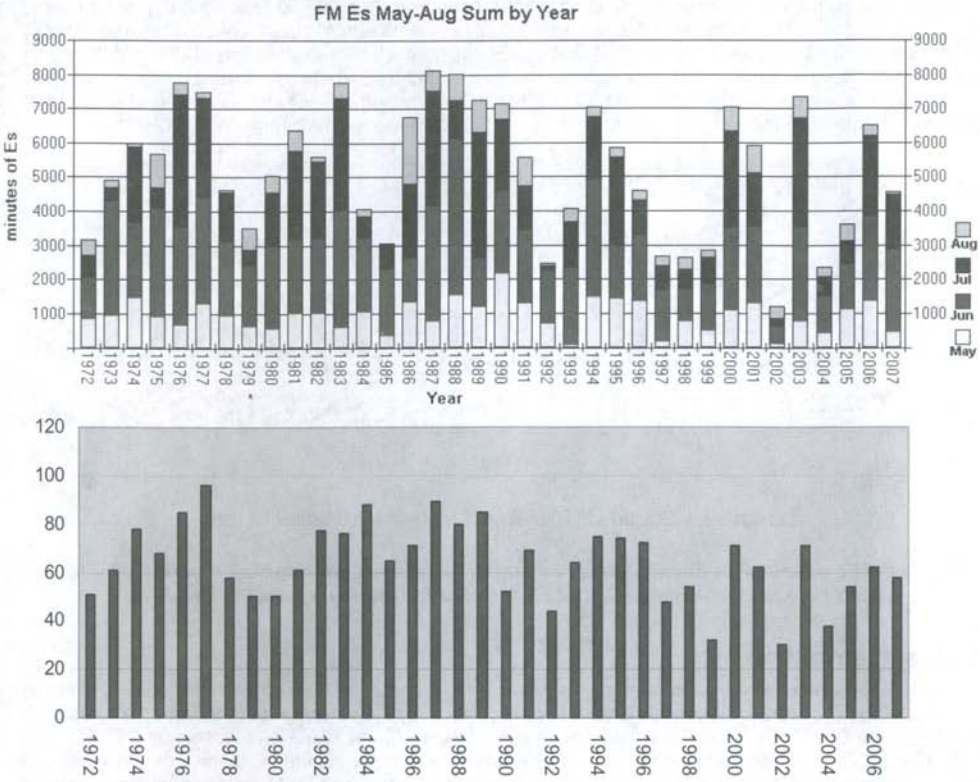


Fig. 3: 3m FM BC Es openings in North America, 1972-2007 (source: WA5IYX). Above: minutes per year, May–Aug. Below: days per year, Jan-Dec.

Correlation with the sunspot cycle

Although we still do not know what exactly is causing the occurrence of 2m Sporadic-E propagation, thanks to the new data from 1998 to 2007 it is evident already from Figure 2 that there is most probably a repetitive cycle.

Figure 4 is a comparison of 2m Es with various aspects of the sunspot cycle, over the entire period 1974-2007. The middle chart in Figure 5 gives the smoothed annual sunspot numbers, and shows the maxima and minima of the so-called "11-year cycle". Maximum years were 1979-80, 1989 and 2000, with minima in 1976, 1986, 1996 and 2007. At first view this does not show any connection with the Es, which obviously has a much longer cycle. But the polarity of the sun's magnetic field reverses in each 11-year period, so the complete solar cycle is also much longer – 22 years!

The lower part of Figure 4 (or better, the color image on the cover) shows the development of sunspots in more detail. Each 11-year period begins with new sunspots appearing at high latitudes (close to the geographic N and S poles). The earliest sunspots of an 11-year period begin to appear to at high latitudes. As the period advances, more and more sunspots tend to appear at lower latitudes, passing through the maximum number and then becoming less and less frequent. The earliest sunspots of the next 11-year period once again begin to appear to at high latitudes – but with opposite magnetic polarity from the period before. The color image on the cover shows these magnetic reversals very clearly. For example, from about 1991-2002 the magnetic North pole of the sun was at the geographical North pole; but then the polarity flipped and we are now ending a period where the sun's magnetic North pole has been at the geographical South pole. Therefore the **complete** solar cycle, including these magnetic reversals, actually takes place over **two** 11-year sunspot periods.

With this **22-year solar** cycle in mind, look again at the 2m Es data in the upper part of Figure 4. Sunspot polarity is defined as positive (+) when the sun's geographical and magnetic poles are the same, and negative (–) when they are opposite. We can now see a clear correlation between the maxima of 2m Es propagation and the sunspot minima in 1986-1987 and 2006-2007 when the sunspot polarity was negative. We can also see two minima in 2m Es propagation which correlate with the sunspot minima in 1974-1976 and 1996-1998 when the sunspot polarity was positive.

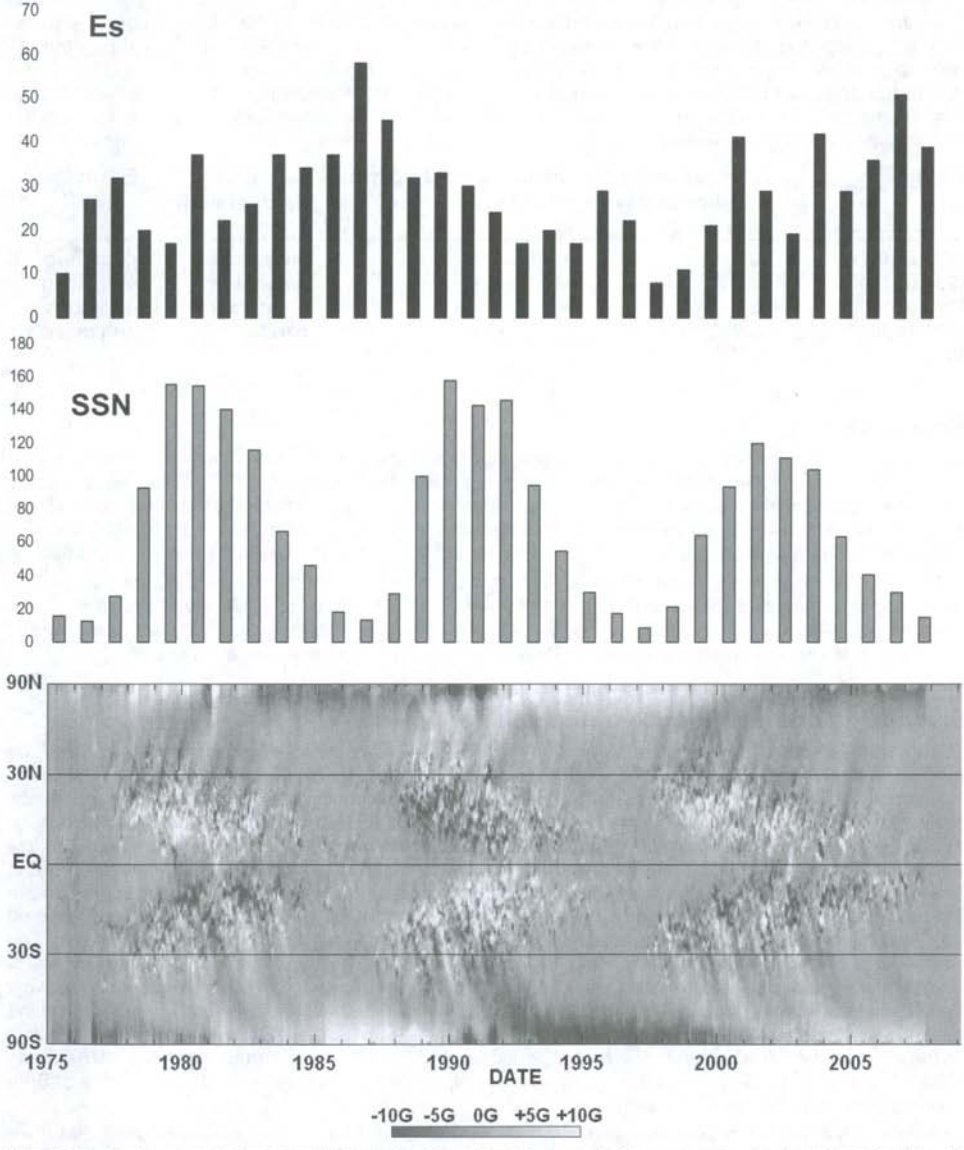


Fig. 4: Es and sunspot data for 1975-2007. Top: 2m Es days in Europe per year (same as in Fig. 1). Middle: annual sunspot numbers. Bottom: graphical display of sunspots, solar latitude and polarity of the sun's magnetic field. Source: David Hathaway (NASA). *See cover of this issue for full color picture but without SSN graph. Yellow (appears white on this page) = positive magnetic polarity; grey = zero; blue (appears deep grey) = negative magnetic polarity.*

Interpretation

The reversal of the sun's magnetic field takes place always in the peak of the solar sunspot cycle, e.g. 1980-81, 1990-1991 and 2000-2001. This is a process that needs several months (sometimes up to 2 years) and there are even differences between the geographical N and S pole, e.g. the most recent reversal began at the N pole at the start of 2000 and was completed at the N pole by March 2001, but it was not completed at the S pole until September 2001.

From the charts we can see that the year when the reversal starts to be visible at the N pole is also the start of a new period of enhanced or degraded Es, namely 1980, 1991 and 2000. Table 1 shows the average annual number of days with 2m Es for the different periods with reverse magnetic polarity on the sun. In the degraded periods, we see numbers of about 30% below average; and in the enhanced periods, numbers of about 25% above average. The worst years are down to 70% below average and the best are up to 100% above average.

Years	Average annual Number of days with 2m Es	Magnetic field polarity of the sun N	S	Sun-Earth field relation	Es on 2m
1974 to 1979	19.7	+	-	antiparallel	degraded
1980 to 1990	35.5	-	+	parallel	enhanced
1991 to 1999	18.8	+	-	antiparallel	degraded
2000 to 2007	35.8	-	+	parallel	enhanced
all	28.35				

Table 1

More details

Looking even more closely at Figure 4, we see that there are decent intermediate maxima of 2m Es propagation in the middle of the degraded periods, e.g. 1995-1996 and 1976-1977. These are the years when there are almost no sunspots observed (the uniform grey range between the sun's equator EQ and about 30 deg N and S). Thus we may also have detected a weaker correlation to the 11-year solar sunspot cycle, contrary to expectations. This correlation is not so obvious and has to be confirmed in 2015.

In 1981 we find an anomaly in the magnetic field on the sun's N pole: In the end of 1980 the field had already flipped to negative (blue/black) but in 1981 there was a flip back to positive (yellow/white) which changed finally back to – (blue/black) by the end of 1982. This could be the reason for the below average year 1981. For the corresponding weak year 2002 we do not find such an explanation though.

Discussion of the influence of the polarity

Scientists have shown that the solar magnetic field with the + (N) pole at the geographical N pole of the sun (i.e. antiparallel to the field of the earth) has a defocusing effect on the magnetic field of the earth. This causes also a lower impact of particles. That could be a reason for the effect of the rarer occurrence of Sporadic-E on the earth. Vice versa we have more Sporadic-E when the earth's magnetic field is focussed by the sun's field when the – (S) pole is at located at the geographical N pole of the sun. The key mechanism for this modulation is the impact of cosmic rays which is responsible for the ionization of the ions in the E layer. Figure 5 shows a graph with the annual variation of the cosmic ray impact in correlation to the solar cycle. One can clearly see the sharp maxima in 1986-1987 and 2006 (2007 not covered yet). Also there was such a sharp maximum in 1965 (remember the big opening, mentioned above). The cosmic rays show an inverse relationship to the sunspot cycle because the Sun's magnetic field is stronger during sunspot maximum and shields the Earth from cosmic rays. But the maxima of periods with high cosmic ray intensity during the solar cycle minima have a different shape. With N-/S+ polarity on the sun we see very sharp maxima with a short high peak like 1965, 1987 and 2006-07. With N+/S- polarity on the sun we see flat maxima over a longer period, and with a bit lower average level like 1975-76 and 1996-97. The author believes that this could be a key of the global modulation of the occurrence of Sporadic-E openings on higher VHF frequencies.

Until now, it has not been even possible to prove the existence of such a global modulation. But if we compare the results from Europe in Figure 2 and from North America in Figure 3, we can now begin to see a very impressive correlation over many years. This indicates the existence of a modulation source that has a global influence.

Unfortunately the number of 2m Es openings on other continents is much lower than in Europe for several reasons (this will be subject of another article). For example, in North America there have been years with

just 1 or 2 openings, and the best years maybe show a dozen openings. These relatively low numbers do not provide significant results when evaluated statistically. However, it is very interesting that according to those results from NA, peak years for 2m Es were reported for 2006 and 2007 with 10 and 13 openings and the last big 2m Es maximum is remembered to be 1987 when also the first ever 220 MHz Es contact took place! Sure, this is not too surprising when we look on the 3m FM BC results from NA in Figure 3. The data situation for 2m Es reports from South America (few reports) and South Africa (no reports) is even worse. However, we do have observations from the ZL/VK area where 2m Es openings have been observed regularly around summer solstice in December-January for about 25 years. Also from there we have numbers and comments indicating that the 2006-2007 season with about 7 openings was the best since – yes, 1986-87! – when a similar level of 2m Es openings was observed. This confirms again very well the above global modulation hypothesis of Es on VHF. Note that the results from NA and VK/ZL were reported to the author totally independently and without prior knowledge of the European results.

Note also that there are several other very important factors that cause and trigger midlatitude Sporadic-E. This means that there still can be good openings and even good years any time as the basic level of radiation even in solar maxima is still high enough to produce the necessary electrons in the E layer – but without some mechanism to concentrate those electrons, there will still be no 2m Es propagation! This will be subject of another article in one of the next *DUBUS* issues.

Discussion of the influence of the geomagnetic activity

The influence of the geomagnetic activity on midlatitude Sporadic-E has been discussed with controversy for a long time. Although radio amateurs know from their practical observations that Es openings on 6m, 4m and 2m occur preferably (again) after the earth's magnetic field has settled back to quiet conditions, e.g. often 1 or 2 days after a disturbance (with or without a radio aurora event), this could not be proved by a long-term statistical correlation. However, a connection with the magnetic field of the earth does exist in the formula that describes the wind shear mechanism in the upper atmosphere, which is believed to be one of the main causes for the concentration of the E-layer electrons into denser layers that enable the reflection of VHF radio waves.

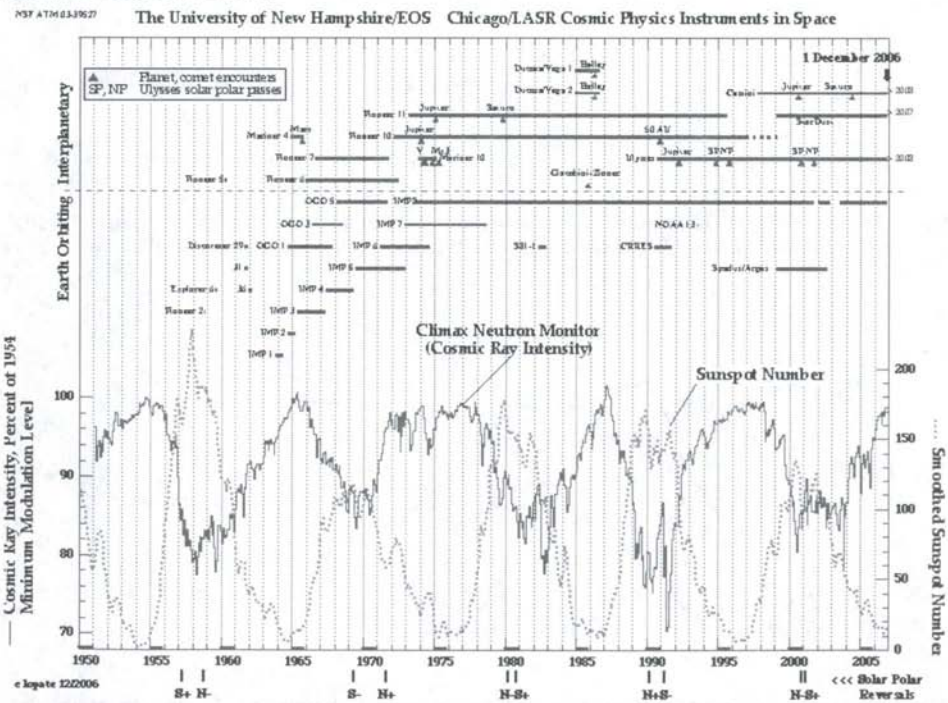


Fig. 5: Cosmic ray intensity (Climax, USA) and solar cycle

Figure 6 shows the semiannual variation of the geomagnetic activity in the years of antiparallel vs. parallel solar/terrestrial magnetic fields. One can clearly see that the magnetic field of the earth is quieter in absolute terms in parallel years. And the time frame with quieter conditions is prolonged into May and August. We have already shown above that we have significantly more Es in parallel years, so this is well in line with our conjecture. The question is if there could be also shown a prolongation into May and August from the data. To be able to show this, a finer resolution on the time scale was needed. Intervals of about 10 days were examined and the numbers of the raw data from Figure 1 were averaged per year and then separated by parallel and antiparallel periods. The result is shown in Figure 7. The upper two graphs show the parallel years and the two graphs at the bottom show the antiparallel years. One can see very well the extension and intensification of openings into May and August in the parallel years. The only two records for April and September also fall into the parallel period.

Figure 7 shows also another interesting detail. Compare the shapes of the graphs of the years 1974-1979 with the years 2000-2007. Then compare the shapes from 1980-1990 with 1991-1999. In both cases we can see a remarkable analogy of the shapes. Note that the analogies of the shapes are between parallel and antiparallel periods. We can only speculate about the reasons for this. But if we look to the shape of the sunspot number graphs in Figure 7 (the dotted line) we can see that the shape of the declining curve in the 1970s is similar to the curve in the 2000s, both coming from a lower-level maximum. The same is true for the shape in the 1980s and 1990s with both coming from a higher-peaking maximum. Only further future studies and statistics can show if this is a real correlation or just coincidence.

In the end it should be mentioned that the sunspot cycle length is 11.1 years on AVERAGE, and thus 22.2 years on AVERAGE for the magnetic cycle. In fact most cycles do not last 11 years, and the actual lengths may vary by as much as 2 years! This would complicate a direct forecast on a year by year number comparison. The tendency should still be the same though. We were just lucky that the last cycles were very close to 11 years.

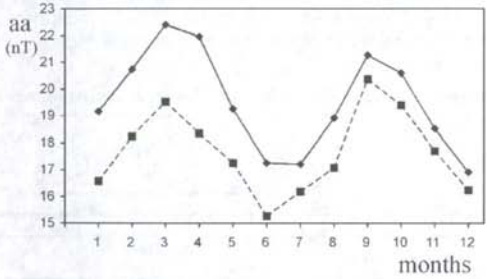


Fig. 6: The (mean) semiannual variation of geomagnetic activity in the years of antiparallel (solid line) vs parallel (dashed line) solar/terrestrial magnetic fields. Source: Baranyi/Ludmany

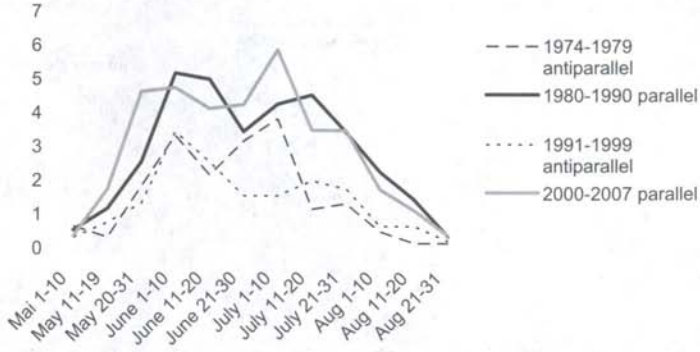


Fig. 7: The mean number of days with 2m Es averaged on 10 day intervals for periods of parallel and antiparallel years, based on the data from Fig. 1.

It should also be emphasized that it is very important to look also at the data of the highest possible MUF observations. This is the way to find out more about the multiple factors which cause and modulate the midlatitude Sporadic-E. Scientists usually look at VHF Es by means of the f0Es data from vertical ionosonde measurements at HF, from 3 MHz to up to 7 or maybe 10 MHz. The MUF is calculated from the f0Es data, but an f0Es value of 10 MHz hardly covers an MUF of 50 MHz. It rarely happens that f0Es immediately above an ionosonde site is >25 MHz, which is equivalent to MUF of >144 MHz, and with such a small amount of relevant data it would hardly be possible to come to any general conclusions. This shows how important the Es QSOs and reports of radio amateurs still are!

Also, the fine modulations in the f0Es data tend to be masked at lower VHF frequencies because Es is present for much more of the time. It is only at higher frequencies such as 144 MHz that fine modulations can make the difference between Es being either present or totally absent. One can see this masking on 3m if we look at the day data compared to the minutes data in Figure 3. If we would go lower in frequency this effect would be even stronger, and even with 50 MHz data it would be difficult to detect these correlations.

Conclusion

Finally it seems that we can look forward to another 3 good years of 2m Es propagation before we will reach the period of bad years starting from about 2012, if this theory is true…

Reference

[1] Nestorov, A., Es Openings on 2m, DUBUS Vol. 28, 1, p.34-39

Acknowledgement: I want to thank GM3SEK, G3NAQ, GM4PMK, ZS6WB, VK7MO, PY2ZX, W3EP, WA5IYX and ZL3MH for valuable data and comments and help.

VHF-Sporadic-E der mittleren Breiten in Korrelation zum 22-Jahreszyklus des Magnetfelds der Sonne

von Joachim Kraft, DL8HCZ/CT1HZE – info@DUBUS.de

Einleitung

Angel Nestorov (LZ1AG) hat vor 10 Jahren [1] postuliert, dass es eine Korrelation zwischen dem 22-Jahreszyklus des Magnetfelds der Sonne und der Anzahl der Sporadic-E-Öffnungen auf 144 MHz geben könnte. Zur der Zeit lagen Daten von 1974 bis 1997 – insgesamt für 24 Jahre – für Auswertungen vor, was gerade etwas mehr als einen 22-Jahreszyklus abdeckt. Jetzt im Jahr 2008 haben wir Daten von 10 weiteren Jahren von 1998 bis 2007 zur Verfügung. Dies sollte genug sein, um die Hypothese von LZ1AG verifizieren zu können. Es soll hier darauf hingewiesen werden, daß sich Hypothesen und Ergebnisse dieses Artikels ausschließlich auf die Sporadic-E-Phänomene mittlerer Breiten beziehen. Äquatoriales Sporadic-E und Aurora-E ist nicht Gegenstand dieses Artikels.

Eine kurze Geschichte der Sporadic-Eöffnungen auf 144 MHz

Regulärer Funkverkehr via Es auf 2m wurde von Europäischen Funkamateuren seit Anfang der 70er Jahre durchgeführt. Es ist schwierig, viel Material über Öffnungen auf der Zeit vor 1974 zu finden, da es die DUBUS noch nicht gab. Es gibt natürlich Berichte über einzelne Öffnungen in verschiedenen nationalen Amateurfunkmagazinen. Mit Hilfe der bekannten „Erstverbindungslisten" vieler Länder können wir feststellen, daß das erste komplette 2m Es-QSO in Europa am 14.4.1959 zwischen England und Süd-Italien gelaufen ist. Das nächste bemerkenswerte Datum war dann der 4. Juli 1965, als es eine ausgedehnte Öffnung während eines Kontests gab. Da sind die Erstverbindungen zwischen OZ und I, PA und YU, LA

und I, GI und YU, GU und OK, GM und I und SM und I gelaufen. Für den 5. Juli 1965 werden Erstverbindungen zwischen SM und EA sowie F und SP gelistet. Das könnte einfach ein Tippfehler sein und auch der 4.7. gewesen sein, oder es gab tatsächlich noch eine weitere Öffnung am nächsten Tag.
Überraschenderweise hat dieses Ereignis vom Juli 1965 die 2m-Funker nicht wirklich angeregt, gezielt nach solchen Öffnungen Ausschau zu halten. Über die nächsten 8 Jahre wurde nur über wenige Öffnungen berichtet, z.B. 8.8.1966 von PA nach I, 25.5.1971 von GD nach I und 7.7.1973 von IT9 nach UB5. Diese Jahre von 1959 bis 1973 liefern viel zu wenig Daten, um eine brauchbare Analyse machen zu können. 1974 kam aber der große Durchbruch: Vom 9.5. bis 12.8. wurden 12 Tage mit 2m Es-Öffnungen gezählt. Am 23.6.1974 gab es die Erstverbindung von DL nach 9H (Malta) auf 2m via Es. Tausende solcher QSOs sollten in den nächsten Jahren folgen. LZ1AG hat die DUBUS-Hefte und andere Quellen ausgewertet und fand 629 Tage mit 2m-Es-Öffnungen von 1974 bis 1997. Diese Daten wurden jetzt nochmals kontrolliert und bestätigt. Ausserdem wurden für diesen Zeitraum 17 weitere Tage gefunden, an denen es 2m Es-Öffnungen gab, so daß wir auf insgesamt 646 Tage kommen.

Neue Daten

Der neue Teil dieser Untersuchung erstreckt sich auf die Jahre von 1998 bis 2007. Für diesen Zeitraum konnten insgesamt 318 Tage mit 2m-Es-Öffnungen gefunden werden. Datenquellen hierfür waren DK5YAs Es-Zusammenfassungen, DM2SRs Es-Zusammenfassungen, der OH2BUA Web-Cluster, das DUBUS-Magazin, persönliche Logs und Beobachtungen von DK1KO, DL8EBW und CT1HZE und etwa ein Dutzend nationale Erstverbindungslisten von verschiedenen Amateurfunkclubs. Das summiert sich über die ganze 34-jährige Beobachtungsperiode von 1974 zu 2007 zu insgesamt 964 Tagen mit Es auf 2m. Das sind im Durchschnitt 28,35 Tage pro Jahr. Wenn wir die allgemein als Es-Hauptsaison geltende Periode von etwa Mitte Mai bis Mitte August betrachten, die 93 Tage umfaßt, sehen wir im Schnitt fast an jedem dritten Tag (p = 0.29) eine 2m-Es-Öffnung irgendwo in Europa. Das ist eine recht beeindruckende Zahl. Aber natürlich ist es der Durchschnitt. Die Jahre können sehr verschieden sein, wie wir sehen werden.

Tägliche Verteilung

Abb. 1 zeigt die Verteilung von 963 der 964 Es-Tage über die Kalendertage vom 28.4. bis 2.9. für die Jahre von 1974 bis 2007 (durchgezogene dicke graue Linie). Ein Ereignis, der Ausreisser vom 10.11.2004, wurde hier herausgelassen. Zum Vergleich wurden auch Kurven für die Zeiträume von 1974 bis 1997 (die gepunktete schwarze Linie, von CT1HZE modifizierte Daten von LZ1AG) und von 1998 bis 2007 (die durchgezogene schwarze Linie, Daten von CT1HZE) gezeigt. Man beachte, daß es sich in dieser Abbildung nicht um Jahresmittelwerte handelt. Die große Anzahl von fast 1000 Tagen ermöglicht es erstmalig einen Graphen zu zeigen, der ziemlich deutlich eine quasi Gaus`sche Verteilung zeigt. Aufgrund ungenügender Datenmengen war das bisher nicht wirklich gut mit den Daten von nur dem ersten bzw. nur dem zweiten Zeitabschnitt (die schwarzen Kurven) möglich. In der Vergangenheit wurde immer wieder viel über die Existenz bestimmer wiederkehrender Kalendertage spekuliert, die „besonders gut" für 2m-Es-Öffnungen sein sollten, wie z.B. 8.6., 10.7. oder 21.7. im Graphen des ersten Zeitabschnitts. Wenn man diese Spitzen der Kurve aber mit dem zweiten Graphen der neuen 10-Jahresperiode mittelt, sehen wir für die meisten Fälle, daß sich alles wieder ausgleicht. Wir können eine Periode mit sehr hoher 2m-Es-Häufigkeit vom 1. Juni bis 22. Juli ablesen, mit durchschnittlich 12.75 Ereignissen pro Kalendertag und Minima von 7 (meistens 8) und Maxima von 18 (zweimal) und 17 (viermal) Ereignissen. Diese 52-tägige Periode ist die Spitzensaison für 2m Es. 671 der gesamten 964 Ereignisse der 34 Jahre fanden in diesem Zeitabschnitt statt. Das sind etwa 70%! Das sind im Durchschnitt 0.38 Ereignisse pro Tag. Mit anderen Worten: Die Wahrscheinlichkeit für 2m Es über Europa beträgt fast 40% für jeden beliebigen Tag in diesem Zeitraum! Der Mittelpunkt dieses Abschnitts ist der 26. Juni, was sehr dicht am Jahrestags des Sonnenhöchststands, dem Sommeranfang am 21. Juni, liegt (man kann eigentlich sagen, daß beides nahezu übereinstimmt). Wir sehen in der Kurve eine Vorsaison von 22 Tagen vom 10. bis 31. Mai mit 131 Ereignissen (13.6%), wo die Wahrscheinlichkeit auf 17.5% sinkt und der Durchschnitt pro Tag bei etwa 6 (5.95) liegt. Auch können wir eine Nachsaison von 22 Tagen mit 128 Ereignissen sehen, die vom 23.7. bis 13.8. geht, mit einer Wahrscheinlichkeit von 17.1% und einem ähnlichen Tagesschnitt von 5.82. Hier können wir einmal mehr erkennen, wie schön symmetrisch die 2m-Es-Ereignisse verteilt sind.
Eine „frühe Vorsaison" von 12 Tagen kann man vom 28.4. bis 9.5. mit insgesamt nur 12 Ereignissen sehen (1.2%) und einer Wahrscheinlichkeit von 3%. Eine entsprechende „späte Nachsaison" von 20 Tagen finden wir vom 14.8. bis 2.9. mit 29 Ereignissen und einer Wahrscheinlichkeit von 4%. Eine Erklärung für die geringfügig höhere Zahl in dieser Periode könnte sein, daß einige der als Sporadic-E gemelde-

ten/gelisteten Ereignisse im Zeitraum vom 13. bis 16.8. tatsächlich Meteoritenbursts waren, die durch den Perseiden-Schauer verursacht wurden. Es ist allgemein bekannt, daß speziell die sehr langen Bursts in den Tagen nach dem Maximum der Perseiden (12./13.8.) auftreten, d.h. am 14.-16.8. Da wir für die 3 Tage vom 14.-16.8. alleine 11 Ereignisse gelistet haben, sollten wir annehmen, daß einige von diesen auf MS zurückgehen.

Jährliche Verteilung

Abb. 2 zeigt die jahrliche Verteilung der Tage mit 2m-Es-Öffnungen. Insgesamt wurden 964 Tage von 1974 bis 2007 erfasst. Anzumerken ist, daß nicht berücksichtigt wurde, ob z.B. an einem Tag mehrere verschiedene Öffnungen stattfanden. Jeder Tag mit nur einer kurzen Öffnung mit einem QSO zählt genauso wie ein Tag mit 2 oder 3 stundenlangen Öffnungen. Für die Zeit von 1974 bis 1997 basieren die Zahlen auf der Tabelle von LZ1AG in [1], die von CT1HZE modifiziert wurden und für 1998 bis 2007 auf den Daten von CT1HZE. Im Durchschnitt gab es 28,35 Tage mit 2m-Es-Öffnungen pro Kalenderjahr. Die schlechtesten Jahre waren 1975 mit 10 und 1997 mit nur 8 Tagen im ganzen Jahr. Die besten Jahre waren 1986/87 mit 58/45 Tagen und 2006/2007 mit 51/39 Tagen. Folglich gab es in den besten Jahren im Schnitt jeden 2. Tag eine Es-Öffnung über den gesamten Zeitraum von Anfang Mai bis Ende August! In den schlechtesten Jahren gab es vergleichsweise nur jeden 12. Tag eine Öffnung irgendwo in Europa. Beim Anfertigen dieser Analyse stellte sich die Frage, ob es zulässig ist, nur die Anzahl der Tage mit Es zu untersuchen, anstatt z.B. die genaue Anzahl der Minuten zu erfassen, die das 2m-Band auf war. Da für die frühen Jahre des Beobachtungszeitraums nicht genug solche Daten zur Verfügung stehen und das Finden und Sammeln dieser Daten viele Monate gedauert hätte, wurde entschieden, es bei der Auswertung der „Es-Tage" zu belassen. Bestätigt wurde dies durch die vorliegenden Statistiken für Es-Öffnungen im 3m-Rundfunkband in Nordamerika, die von Pat Dyer, WA5IYX, veröffentlicht wurden. Hier kann man eine sehr gute Korrelation zwischen der Anzahl von Tagen mit Es-Öffnungen und der aufsummierten Minutenzahlen erkennen. Siehe Abb. 3. Es gibt keinen Grund anzunehmen, daß dies generell nicht auch bei 2m-Öffnungen der Fall sein sollte.

Vorhersage und Realität

LZ1AG sagte in [1] die Anzahl der Tage mit 2m-Es-Öffungen für die Jahre 1998 bis 2017 vorher, in dem er die Bahauptung aufstellte, dass die beobachteten Zahlen von 1978 bis 1997 sich jeweils genau nach 20 Jahren wiederholen. Also entsprechen die beobachteten Zahlen von 1978 bis 1997 (weiße senkrechte Balken) in Abb. 2 den vorhergesagten Zahlen für 1998 bis 2007. Die beobachteten Daten von 1998 bis 2007 (weiße senkrechte Balken im rechten Teil der Abb.) wurden zum Vergleich neben die Daten von 1978 bis 1997 kopiert (schwarze senkrechte Balken). Man kann ganz klar eine schöne Übereinstimmung bei den absoluten Zahlen und der Tendenz erkennen. Mit Ausnahme von 1978 war die Vorhersage für jedes Jahr nahezu perfekt! Das ist bemerkenswert.

Korrelation

Obwohl wir immer noch nicht wissen, was genau das Auftreten von 2m-Spradic-E-Ausbreitung verursacht, ist es dank der neuen Daten von 1998 bis 2007 bereits aus Abb. 2 ersichtlich, daß es höchstwahrscheinlich einen sich wiederholenden Zyklus gibt. Ein Vergleich mit den Zahlen der Sonnenflecken des 11-Jahres-Sonnenfleckenzyklus (siehe Abb. 4) zeigt auf den ersten Blick keinen Zusammenhang, besonders ohne die Daten von 1998 bis 2007. Wenn man aber genauer hinschaut, sehen wir zwei Maxima für 2m-Es-Ausbreitung in den Jahren 1986/1987 und 2006/2007, die klar mit den Minima des Sonnenfleckenzyklus korrelieren. Aber dann gibt es zwei weitere Sonnenfleckenminima in den Jahren 1974 bis 1976 und 1996 bis 1998, wo wir auch Minima für die Es-Ausbreitung finden. Ein Widerspruch? Nein. Wenn wir uns die Polarität des Magnetfeldes der Sonne betrachten (siehe Abb. 4 unten), sehen wir klar eine Beziehung: Die untere Hälfte der Abbildung zeigt die wechselnde Polarität des Magnetfeldes der Sonne. Oben ist der geographische Nordpol der Sonne, unten der Südpol. Die gelben (weißen) und blauen (schwarzen) Bänder zeigen die aktuelle Polarität. Gelb (weiß) steht für magnetischen + (N) und blau (schwarz) für – (S) Pol. Man kann sehr gut das blaue (schwarze) Band am oberen Rand des Diagramms von 2001 bis Ende 2007 erkennen und für 1980 bis 1990, als der magnetische Südpol sich im Norden der Sonne befand. Dieses sind die Perioden mit angehobenen Es-Bedingungen und den Es-Maxima am Ende dieser Perioden, aber BEVOR die Sonnenflecken des nächsten Zyklus anfangen signifikant aufzutreten (und offensichtlich stören). Umgekehrt sehen wir die Beziehung für die Jahre mit dem magnetischen Nordpol im Norden der Sonne von 1992 bis 1998 und 1975 bis 1980. Diese Jahre sind durch die gelben (weißen) Bänder am oberen Rand gekennzeichnet und korrelieren mit den

Jahren, in denen die 2m-Es-Ausbreitung unterdurchschnittlich ist und die Minima auftreten. Die obere Hälfte der Abb. 4 zeigt wieder dieselben Zahlen der Tage mit 2m-Es-Ausbreitung pro Jahr, wie schon in Abb. 2 gezeigt, um einen direkten Vergleich mit der unteren Hälfte der Abbildung zu ermöglichen.

Interpretation

Wir können aus Abb. 4 ersehen, dass die Umkehrung des Magnetfelds der Sonne immer im Maximum des Sonnenfleckenzyklus erfolgt, z.B. 1980/81, 1990/91 und 2000/2001. Dies ist ein Prozeß, der mehrere Monate benötigt (manchmal bis zu 2 Jahre!) und es gibt sogar Unterschiede zwischen dem geographischen Nord- und Südpol, z.B. wurde die Umkehr des Feldes am Nordpol im März 2001 abgeschlossen, am Südpol aber erst im Spetember 2001. Und am Nordpol begann sie bereits Anfang 2000. Aus den Daten können wir erkennen, dass das Jahr, in dem die Umkehr sichtbar am Nordpol beginnt, das Jahr der „neuen" Periode angehobener oder abgeschwächter Es-Bedingungen ist, also 1980, 1991 und 2000.

Jahre	Durchschnittl. jährl. Tageszahl mit 2m Es	Polarität des Magnetfelds der Sonne N	S	Sonne-Erde Feldbeziehung	Es auf 2m
1974 bis 1979	19,7	+	-	antiparallel	schlechter
1980 bis 1990	35,5	-	+	parallel	angehoben
1991 bis 1999	18,8	+	-	antiparallel	schlechter
2000 bis 2007	35,8	-	+	parallel	angehoben
alle	28,35				

Tabelle 1

Tabelle 1 zeigt die durchschnittliche jährliche Zahl von Tagen mit 2m Es-Ausbreitung für verschiedene Zeitabschnitte mit entgegengesetzter magnetischer Polarität auf der Sonne. Wir sehen im Durchschnitt in den schlechteren Perioden Zahlen von etwa 30% unter dem Durchschnitt und in den angehobenen Perioden von etwa 25% über dem Durchschnitt. Die schlechtesten Jahre liegen 70% unter dem Durchschnitt, die besten Jahre bis zu 100% über dem Durchschnitt.

Mehr Details

Wenn man Abb. 4 ganz genau anschaut, sieht man, dass es kleine Zwischenmaxima von 2m-Es-Ausbreitung in der Mitte der schlechteren Perioden gibt, z.B. 1995/1996 und 1976/1977. Dies sind die Jahre, als es (fast) keine Sonnenflecken gab (der einheitlich graue Bereich zwischen dem Äquator der Sonne und etwa 30 Grad N und S). Also haben wir wahrscheinlich doch eine Korrelation zum 11-Jahres-Sonnenfleckenzyklus entdeckt, entgegen allen Erwartungen. Diese Korrelation ist nicht sehr ausgeprägt und muß 2015 bestätigt werden.
Im Jahr 1981 finden wir eine Anomalie im Magnetfeld der Sonne am Nordpol: Ende 1980 hatte sich das Feld dort bereits zu – (blau/schwarz) umgekehrt, aber 1981 kippte es wieder zurück zu + (gelb/weiß) und kehrte sich dann endgültig Ende 1982 wieder zu – (blau/schwarz) um. Das könnte der Grund für das unterdurchnittliche Jahr 1981 sein. Allerdings finden wir für das korrespondierende schwache Jahr 2002 keine solche Erklärung.

Diskussion des Einflusses der Polarität

Wissenschaftler haben nachgewiesen, dass das Magnetfeld der Sonne mit dem + (N) Pol im geographischen Norden der Sonne (d.h. antiparallel zum Magnetfeld der Erde) einen defokussierenden Effekt auf das Magnetfeld der Erde hat. Das bewirkt auch einen geringeren Einfall von Partikelstrahlung auf die Erde. Dies könnte ein Grund für den Effekt des geringeren Auftretens von Sporadic-E auf der Erde sein. Umgekehrt haben wir mehr Sporadic-E, wenn das Erdmagnetfeld durch das Magnetfeld der Sonne fokussiert wird, wenn deren – (S) Pol sich im geographischen Norden befindet. Der Schlüsselmechanismus dieser Modulation ist der Einfall der kosmischen Strahlung, der verantwortlich ist für die Photoionisierung der Atome in der E-Schicht. Abb. 5 zeigt eine Kurve mit der jährlichen Schwankung der kosmischen Strahlung in Korrelation zum Sonnenfleckenzyklus. Man kann gut die scharfen Maxima in 1986/1987 und 2006 (2007 ist noch nicht erfaßt) sehen. Solch ein scharfes Maximum gab es auch 1965 (man erinnere sich an die oben erwähnte große Öffnung). Die kosmische Strahlungsintensität zeigt einen umgekehrten Verlauf zu den Sonnenfleckenzahlen, weil das Magnetfeld der Sonne im Sonnenfleckenmaximum stärker ist und damit die Erde vor kosmischen Strahlen besser schützt. Die Maxima der Perioden mit hoher kosmischer Strahlung während der Sonnenfleckenminima haben aber eine unterschiedliche Form. Mit N-/S+

Polarität auf der Sonne sehen wir sehr scharfe Maxima mit kurzen hohen Spitzen, wie 1965, 1987 und 2006/07. Mit N+/S- Polarität auf der Sonne sehen wir flache Maxima über eine längere Periode auf einem durchnittlichen etwas niedriegerem Niveau, wie 1975/76 und 1996/97. Der Autor glaubt, daß dies ein Schlüssel für die globale Modulation des Auftretens von Sporadic-E-Öffnungen im höheren VHF-Bereich sein könnte.

Bis jetzt war es nicht einmal möglich, die Existenz einer solchen globalen Modulation nachzuweisen. Wenn man aber die Resultate von Europa in Abb. 2 mit denen von Nord-Amerika in Abb. 3 vergleicht, sehen wir eine beeindruckende Korrelation über viele Jahre, was auf eine Modulationsquelle mit globalem Einfluß hindeutet.

Leider ist die Anzahl von Es-Öffungen im 2-Meterband auf anderen Kontinenten aus verschiedenen Gründen (das wird Gegenstand eines weiteren Artikels) viel geringer als in Europa. Z.B. gibt es in ganz Nordamerika Jahre mit nur 1 oder 2 Öffnungen auf 2m und die besten Jahre bringen es auf etwa ein gutes Dutzend Öffnungen. Diese relativ niedrigen absoluten Zahlen liefern keine signifikanten Ergebnisse, wenn sie statistisch ausgewertet werden. Trotzdem ist es hochinteressant, daß im Einklang mit den Resultaten aus Europa aus Nordamerika Spitzenjahre für 2m Es für 2006 und 2007 mit 10 bzw. 13 Tagen gemeldet werden. Und das vergleichbar letzte ebenso gute 2m-Es-Maximum wird mit 1987 angegeben, als dort auch das überhaupt allererste Zweiweg-QSO auf 220 MHz via Es gelaufen ist. Sicherlich ist dies nicht allzu überraschend, wenn wir die Ergebnisse für Es beim 3m-FM-Rundfunk in Nordamerika betrachten (siehe Abb. 3). Für Südamerika (wenige) und Südafrika (keine!) ist die Datenlage für 2m Es noch viel schlechter. Aber wir haben Beobachtungen aus dem Bereich ZL/VK, wo 2m-Es-Öffnungen regelmäßig seit etwa 25 Jahren um den Sommeranfang herum (Dezember/Januar) genutzt werden. Auch von dort haben wir Zahlen und Kommentare, die aussagen, daß die Saison 2006/07 mit etwa 7 Es-Tagen die beste seit, ja, 1986/87 ist, als es eine vergleichbar gute Saison gab. Dies bestätigt sehr schön die obige Hypothese einer globalen Modulation von Es im VHF-Bereich. Erwähnenswert ist, daß die Ergebnisse aus Nordamerika und VK/ZL dem Autor völlig unabhängig voneinander und ohne vorheriges Wissen der Resultate aus Europa berichtet wurden.
Anzumerken ist noch, daß es verschiedene sehr wichtige andere Faktoren gibt, die Es in mittleren Breiten verursachen und beeinflussen. Das heißt, daß es gute Öffnungen und sogar gute Jahre immer geben kann, da das Niveau der kosmischen Strahlung auch im Sonnenfleckenmaximum immer noch hoch genug ist, um die nötigen Elektronen in der E-Schicht freisetzen zu können! Das wird Thema eines weiteren Artikels in einer der nächsten Ausgaben sein.

Diskussion des Einflusses der geomagnetischen Aktivität

Der Einfluß der geomagnetischen Aktivität auf Es in mittleren Breiten wird seit langem kontrovers diskutiert. Obwohl Funkamateure aus ihrer Praxis heraus wissen, daß Es-Öffnungen auf 6m, 4m und 2m vorzugsweise (wieder) auftreten, NACHDEM sich das Erdmagnetfeld wieder beruhigt hat, z.B. nach einer Störung mit oder ohne einer Radioaurora, oft 1 oder 2 Tage danach, konnte dies statistisch und langfristig nicht durch eine Korrelation bewiesen werden.

Der Windscherungmechanismus in der Athmosphäre, der einer der Hauptursachen für die Konzentration von Elektronen zu dichten Schichten ist, die die Reflektion von VHF-Radiowellen ermöglichen, wird durch eine Formel beschrieben, in der Größen des Erdmagnetfeldes eine Rolle spielen. Also gibt es hier einen Zusammenhang.

Abb. 6 zeigt die halbjährliche Variation der geomagnetischen Aktivität für Jahre mit antiparallelen gegenüber parallelen Magnetfeldern der Sonne und Erde. Man erkennt klar, daß das Magnetfeld der Erde im Schnitt in absoluten Zahlen ruhiger in parallelen Jahren ist. Der Zeitabschnitt mit ruhigen Bedingungen ist dann in den Mai und August hinein ausgedehnt. Bezüglich der absoluten Zahlen haben wir oben bereits gezeigt, daß wir signifikant mehr Es in parallelen Jahren haben. Das paßt also gut zusammen. Die Frage ist, ob man aus den Daten auch eine Ausdehnung in den Mai und August hinein ablesen kann. Um das zeigen zu können, mußte eine feinere Auflösung auf der Zeitachse gewählt werden. Intervalle von etwa 10 Tagen Länge wurden hierfür untersucht und die Rohdaten aus Abb. 1 wurden gemittelt pro Jahr und getrennt nach parallelen und antiparallelen Perioden. Das Ergebnis zeigt Abb. 7. Die oberen zwei Kurven zeigen die parallelen Jahre und die beiden unteren Kurven die antiparallelen Jahre. Man kann sehr gut die Ausdehnung und Intensivierung der Öffnungen in den Mai und August hinein in den parallelen Jahren sehen. Die beiden einzigen Ereignisse für den Monat April und September fallen ebenfalls in die parallele Periode.

Abb. 7 zeigt ein weiteres interessantes Detail: Man vergleiche die Form der Graphen für die Jahre 1974-1979 mit der Form von 2000-2007. Dann vergleiche man die Formen von 1980-1990 mit 1991-1999. In

beiden Fällen sieht man eine bemerkenswerte Analogie des Verlaufs. Man beachte, daß die Analogie der Formen zwischen parallelen und antiparallelen Perioden vorliegt. Über die Gründe hierfür kann man nur spekulieren. Wenn man aber die Form der Graphen der Sonnenfleckenzahlen in Abb. 5 (die gepunktete Linie) betrachtet, sehen wir, daß die Form der abfallenden Kurve in den 1970er Jahren ähnlich zu der Kurve in den 2000er Jahren ist, beide kommen von einem niedrigeren Maximum. Dasselbe gibt für die Form der Kurven in den 1980er und 1990er Jahren, beide gehen von einem höheren Maximum aus. Nur weitere zukünftige Studien und Statistiken können zeigen, ob hier eine echte Korrelation vorhanden ist, oder ob es nur Zufall ist.

Zum Schluss soll erwähnt werden, dass die Länge des Sonnenfleckencyclus 11.1 Jahre im DURCHSCHNITT beträgt, d.h. 22.2 Jahre für den Magnetfeldzyklus. Die Länge kann von +/- 6 Monaten bis zu 2 Jahre variieren! Tatsächlich dauern die meisten Zyklen nicht genau 11 Jahre. Dies kompliziert natürlich eine direkte Vorhersage auf Basis eines Zahlenübertrags von Jahr zu Jahr. Die Tendenz jedoch sollte immer stimmen. Bei den letzten Zyklen hatten wir Glück, dass die Länge sehr nahe bei 11 Jahren lag.

Fazit

Abschließend soll betont werden, dass es sehr wichtig ist, die Daten der Beobachtungen der höchsten möglichen MUF zu betrachten, solange dies genug Material für eine statistische Auswertung erbringt. Dies ist der Weg, um mehr über die vielen Faktoren herauszufinden, die Es in mittleren Breiten hervorrufen und modulieren. Wenn man vorzugsweise nur niedrige Frequenzen betrachtet, wie es Wissenschaftler üblicherweise tun – z.B. foEs-Verteilungen von 3 bis zu 7, vielleicht 10 MHz, was kaum eine MUF von 50 MHz abdeckt, werden die feinen Modulationen wahrscheinlich maskiert und unentdeckt bleiben. Man kann diesen maskierenden und angleichenden Effekt im 3m-Bereich bereits erkennen, wenn wir die Tages-Daten von Abb. 3 mit den Minuten-Daten in Abb. 3 vergleichen. Wenn wir in der Frequenz noch tiefer gehen, würde dieser Effekt noch ausgeprägter werden und sogar schon bei 50 MHz-Daten wäre es schwierig gewesen, diese Korrelationen zu finden. Mit den Ionosonden der Wissenschaftler werden nur lokal sehr begrenzte Areale über einen kurzen Zeitraum erfaßt. Es passiert nur selten, daß ein Diagramm einer Ionosonde f0Es von > 25 MHz zeigt, was zu einer MUF > 144 MHz äquivalent wäre. Mit diesen Daten wäre es schwierig, zu irgendwelchen Schlüssen zu kommen. Das zeigt, wie wichtig die Es-Verbindungen der Funkamateure und die Berichte darüber immer noch sind! Wir können uns nun auf 3 weitere Jahre mit guten 2m-Es-Bedingungen freuen, bevor wir ab etwa 2012 eine Periode schlechterer Jahre erreichen werden, sofern diese Theorie hier stimmt....

Bildunterschriften

Abb. 1: Nicht normalisierte jährliche Verteilung von 964 Tagen mit 2m Es in Europa von 1974 bis 2007 (dicke graue Linie), aus historischen Gründen werden auch die Verteilungen der Daten von 1974 bis 1997 und von 1998 bis 2007 getrennt gezeigt.

Abb. 2: 2m-Amateurfunköffnungen in Europa, Tage pro Jahr (Mai bis Aug., plus je ein Tag jeweils im September 2001 und April 2005). Man beachte, daß die Balken von 1988 bis 2007 der aktuellen Es-Vorhersage für die Jahre von 2008 bis 2027 entsprechen!

Abb. 3: Oben: 3m FM-BC Es-Öffnungen in Nordamerika, Minuten pro Jahr (Mai bis Aug.), Quelle WA5IYX; Unten: 3m FM-BC Es-Öffnungen in Nordamerika, Tage pro Jahr (Jan. bis Dez.), Quelle WA5IYX.

Abb. 4: Oben: 2m-Es-Tage in Europa pro Jahr (gleich wie in Abb. 1), Mitte: gemittelte Sonnenflekkenzahl; unten: graphische Darstellung der Sonnenflecken und ihrer Polarität ("Schmetterlingsform") und der Polarität des Magnetfelds der Sonne. Weiß = (+)-Polarität und dunkelgrau = (-)-Polarität. Quelle: David Hathaway (NASA) – Diese Abb. ist auch auf dem Titel in Farbe zu sehen, allerdings ohne den mittleren Graphen für die Sonnenfleckenzahl.

Abb. 5: Intensität der kosmischen Strahlung (Climax, USA) und Sonnenfleckenzyklus.

Abb. 6: Die (gemittelte) halbjährliche Variation der geomagnetischen Aktivität in den Jahren antiparalleler (durchgezogene Linie) gegenüber parallen (gestrichelte Linie) solarer und terrestischer Magnetfelder. Quelle: BARANYI/LUDMANY.

Abb. 7: Die gemittelte Anzahl von Tagen mit 2m-Es für 10-Tages-Intervalle für Perioden paralleler und antiparalleler Jahre, basierend auf den Daten von Abb. 1.

More about Oblongs (II) – more gain on 70cms

by Slobodan Bukvic, YU7XL, yu7xl@nadlanu.com

In the last Dubus issue, I described a super oblong antenna for 1296 MHz. I am now going to describe two models of oblong for 432 MHz. As I previously said, thinner element wire give better antenna performance. I have found that by comparing different models I made. Higher gain, better side lobe suppression, and a much wider frequency range are always seen with thin elements, if the boom is long enough. This is, unfortunately, only theoretical. In practice, the losses due to resistance of the material increases as element diameter gets smaller. Below a certain diameter, the losses become too high, and all theoretical performance benefits are lost.

I have made a better design for 1296 MHz, than I previously described. The same number of elements, and approximately the same boom length give even 0.5 dB more gain. However, the losses are so high, that this antenna is worse in reality.

We could also talk about antenna temperature. Higher losses involve higher temperature, and the situation is quite comparable with a dish antenna and it`s F/D ratio. Therefore, the higher gain antenna (with higher loss) could be better for transmitting purposes, but not for receive.

I do not intend to elaborate too much about this. My simple idea is: the better G/T ratio, the better the antenna. That philosophy has already been proven by YU7EF with his yagi antennas. This means: low temperature and low losses, combined with bigger bandwidth, though gain is a sacrificed a little. Let me mention the sky and earth temperatures are much lower on 432 compared to 144 MHz. Therefore, we adopt an average Tsky to be 15 Kelvin and Tearth 290 Kelvin. Derived from this, good antenna temperature is much more important on 432 MHz than it is on 144 MHz.

I have made nearly a hundred models of oblongs for 432 MHz, trying to discover the best ratio between oblong element height and width, and found the best value of the element height, h=0.05 to 0.1 wavelengths. I also discovered that the best oblongs can be achieved with a boomlength in the range of 10 to 20 wavelengths. In this area, the oblong is much better than the yagi! Here is the proof. The table shows performances of the original EF7032 yagi made by YU7EF versus my Q7032XL oblong. The oblong has got a better G/T of nearly 1 dB! It is modeled on the basis of the EF7032, though only the boomlengths are kept the same, in order to make comparison easier. Note: YU7EF yagis are probably the best in the world at the moment.

For comparison the results of the original YU7EF yagi versus my Q7032XL oblong are shown in table 1:

Antenna	Boomlength (mm)	Material	Gain (dBi)	TA (K)	G/T (dB)
Q7032XL	8670	No loss	20.55	18.0	+7.81
		Silver	20.51	21.8	+7.13
		Aluminum	**20.48**	23.4	+6.80
EF7032-5	8670	No loss	19.92	20.0	+6.91
		Silver	19.87	23.3	+6.19
		Aluminum	**19.84**	25.2	+5.83

Remarks: Same segmentation density used. Same frequency: 432.200 MHz

Table 1: YU7EF yagi versus Q7032XL oblong

Super Oblong Antenna Q7034XL for 432 MHz – by YU7XL

Now, let us see the 34 element oblong antenna Q7034XL for 432 MHz. Later one more oblong antenna for 432 MHz (shorter, for moderate requests) will be described. I made this model following the already shown, shorter model Q7032XL. It`s elements are made of aluminum rods of 5 mm diameter. Some can decide that silver plated rods can be worth of effort, because the difference is approx. 0.3 dB in G/T, for silver. The total boom length is 9385 milimetres. The impedance value is exactly 50±j0 Ohms on the center frequency of 432.300 MHz, and the bandwidth for SWR=1.5 is 430.170 to 433.380 MHz. The other parameters are given in the following tables:

Performance Data (No loss condition)

TYPE	ELE	L (mm)	G (dBi)	F/B (dB)	F/Sh (dBi)	F/Sv (dBi)	Hor (°)	Ver (°)	Temp (K)	G/T (dB)	ΔF * (MHz)
Q7034XL	34	9385	20.81	25.24	20.91	19.95	18.6	18.8	17.5	+8.38	3.25

*** ΔF given for SWR=1.**

Performance Data (Losses included)

Element material	G (dBi)	Temp (K)	G/T (dB)
Aluminum rods	20.74	22.1	+7.30
Silver plated copper rods	20.77	20.5	+7.66

Dimensions

	Ref	De	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11
Pos	**0**	**162**	**224**	**340**	**490**	**690**	**927**	**1201**	**1500**	**1803**	**2115**	**2436**	**2756**
Length	**314**	**292**	**284**	**262**	**259**	**254**	**250**	**244**	**239**	**235**	**231**	**229**	**226**

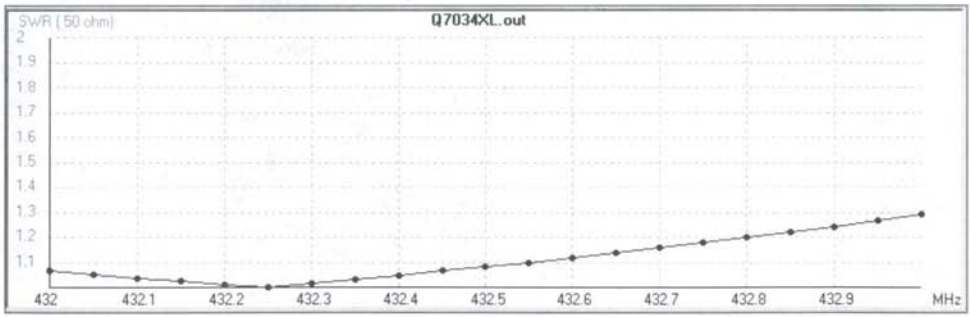
D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25
3085	**3405**	**3735**	**4060**	**4393**	**4686**	**5041**	**5358**	**5685**	**6011**	**6321**	**6649**	**6937**	**7198**
2230	**222**	**222**	**221**	**220**	**219**	**216**	**214**	**212**	**208**	**206**	**204**	**203**	**201**

D26	D27	D28	D29	D30	D31	D32
7493	**7823**	**8119**	**8463**	**8771**	**9076**	**9385**
199	**198**	**197**	**196**	**195**	**195**	**194**

REMARKS:
- All elements made of Al wire Ø5 mm
- The height of all rectangles is 50 mm
- All dimensions given in milimetres

Table 2: Q7034XL oblong – Simulated performance data and dimensions

Diagrams



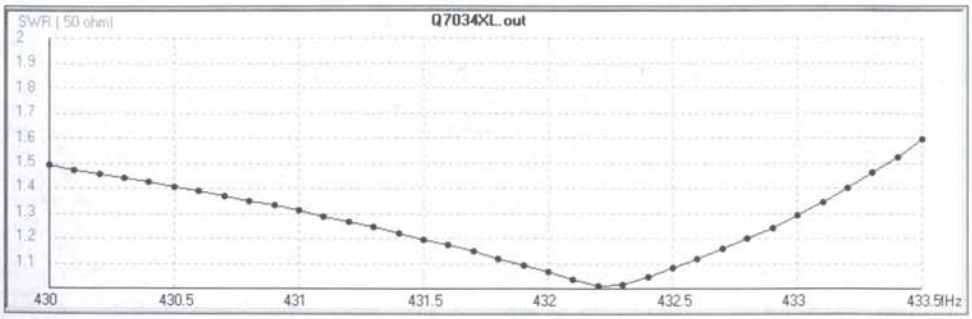


Fig. 1: SWR narrow (top) and wideband (bottom) sweep for the 34 ele 70cm oblong antenna (4NEC2 simulation)

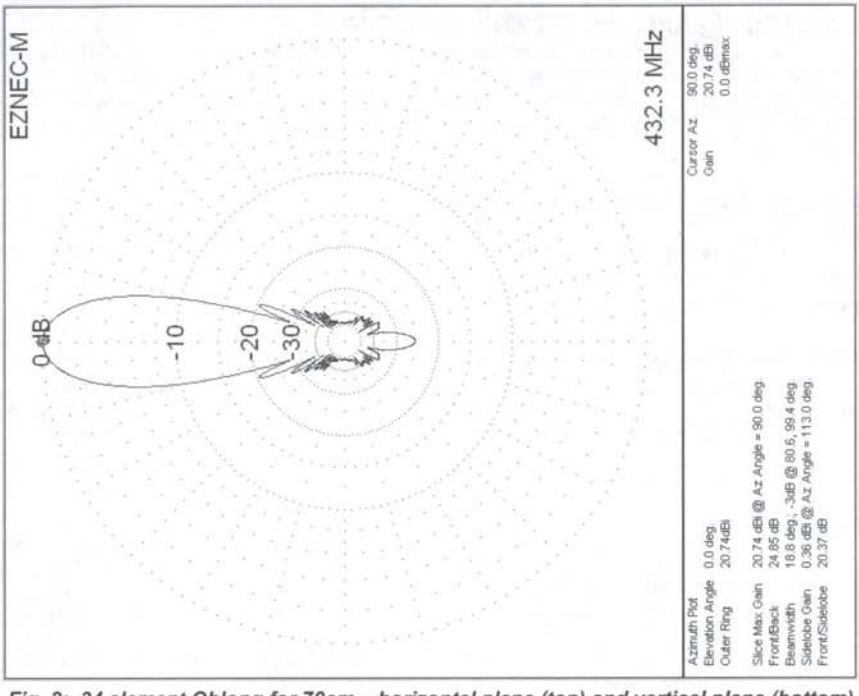
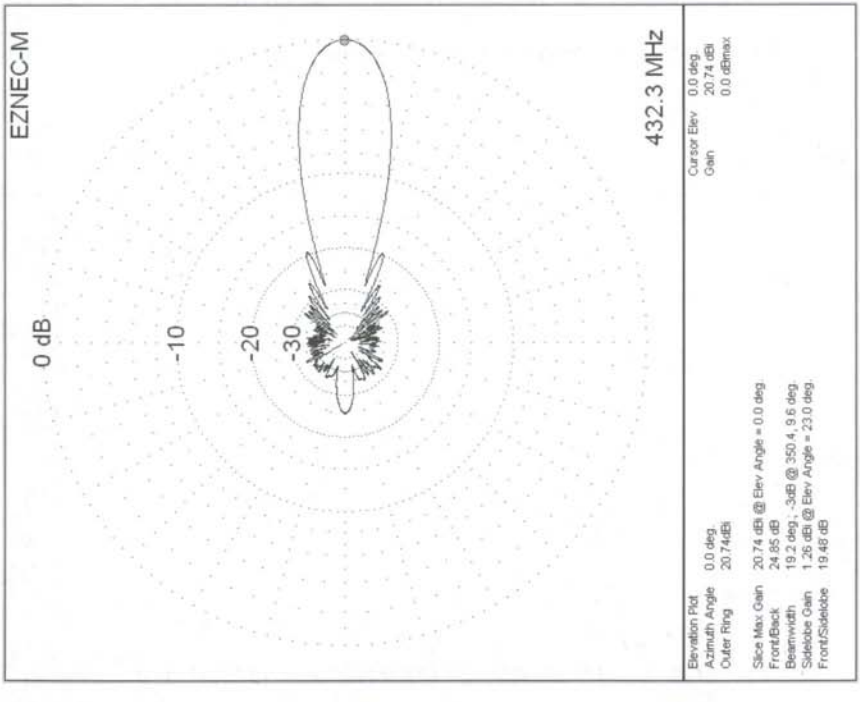


Fig. 2: 34 element Oblong for 70cm – horizontal plane (top) and vertical plane (bottom) (4NEC2 simulation)



Moderate Oblong Antenna Q7023XL for 432 MHz

Now here is an oblong antenna for "moderate" requirements. The boom is 5970 mm long, what is very suitable, because standard aluminum tubes for boom are supplied in 6 metres lengths. The system of 4 such antennas will provide around 25.0 dBi gain; more than enough for serious EME, and excellent for normal DX work. The central resonant frequency is 432.3 MHz, which will slightly slide down to 432.1 MHz when mounted in a system. The best stacking distance is 192 cm horizontally, and 189 cm vertically.

Performance Data (No loss condition)

TYPE	ELE	L (mm)	G (dBi)	F/B (dB)	F/Sh (dBi)	F/Sv (dBi)	Hor (°)	Ver (°)	Temp (K)	G/T (dB)	ΔF * (MHz)
Q7023XL	23	5970	19.33	29.31	18.62	17.28	21.6	22.2	17.7	+6.86	2.7

*** ΔF given for SWR=1.5**

Performance Data (Losses included)

Element material	G (dBi)	Temp (K)	G/T (dB)
Aluminum rods	19.27	21.9	+5.87
Silver plated copper rods	19.29	20.3	+6.21

Dimensions

	Ref	De	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11
Pos	**0**	**156**	**218**	**331**	**486**	**685**	**932**	**1198**	**1503**	**1805**	**2119**	**2444**	**2766**
Length	**314**	**291**	**285**	**264**	**260**	**254**	**250**	**244**	**240**	**236**	**230**	**228**	**227**

D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	
3085	**3415**	**3744**	**4058**	**4388**	**4708**	**5032**	**5359**	**5675**	**597**	- All elements Al wire Ø5 mm - The height of all rectangles is 48 mm
224	**223**	**221**	**220**	**218**	**216**	**212**	**210**	**206**	**202**	- All dimensions given in milimetres

Table 3: Q7023XL oblong – Simulated performance data and dimensions

Diagrams

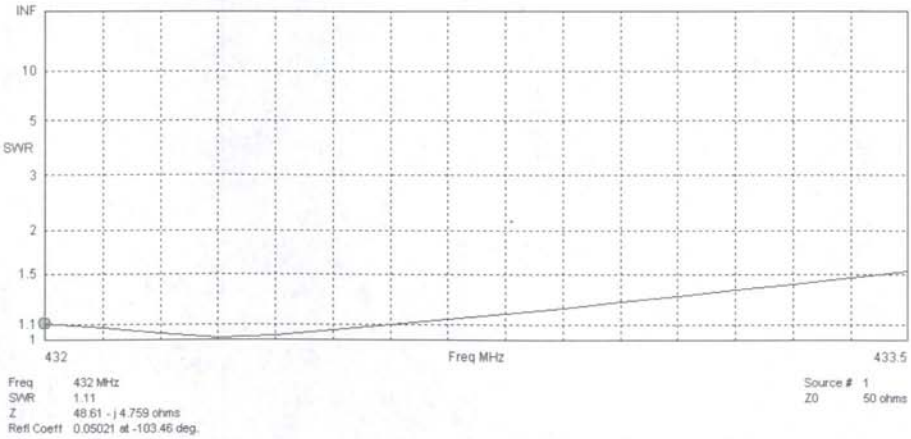


Fig. 3: SWR sweep for the 23 ele 70cm oblong antenna

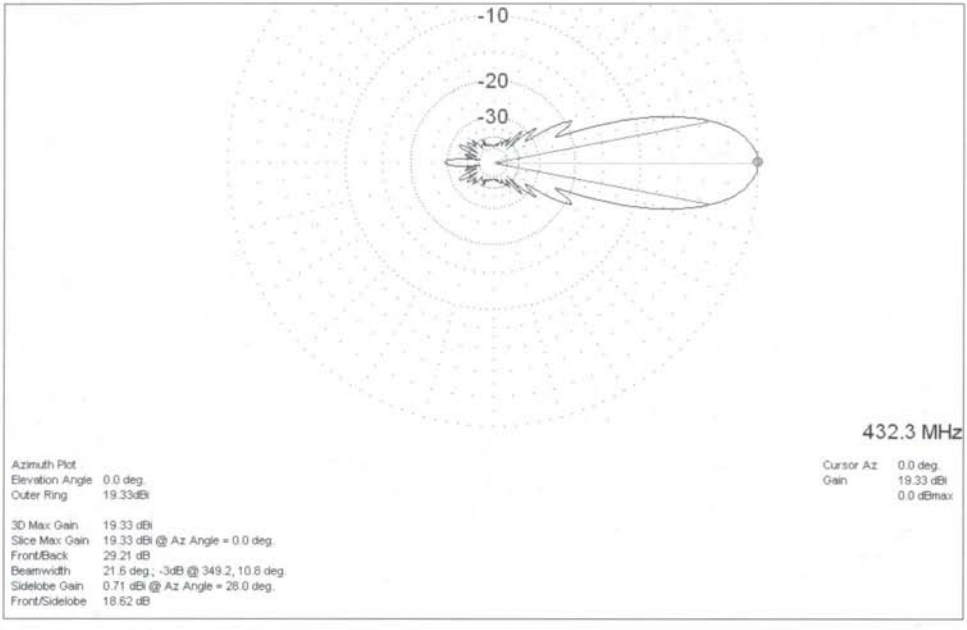
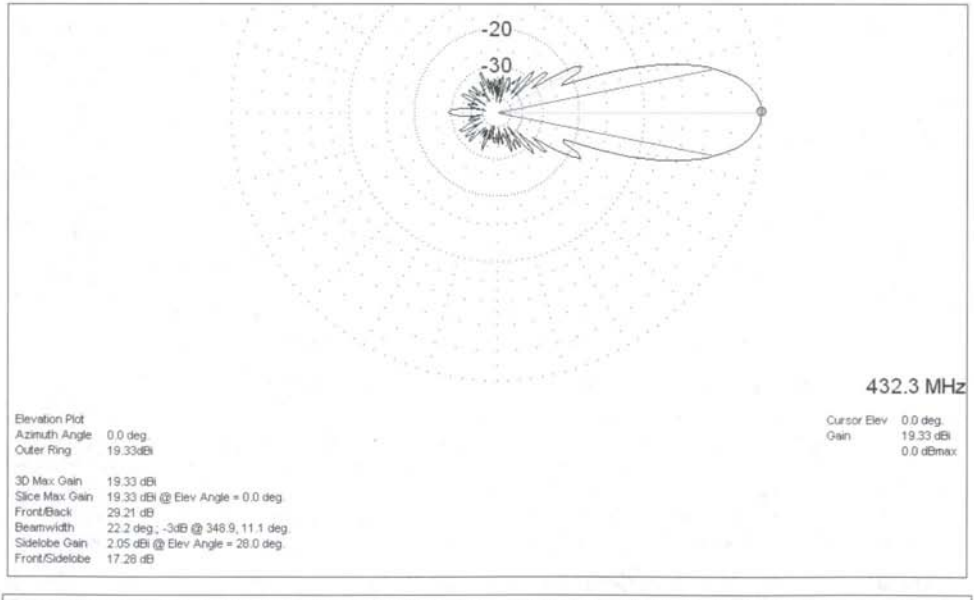


Fig. 4: 23 element Oblong for 70cm – horizontal plane (top) and vertical plane (bottom) (simulation)



Read what Lionel, VE7BQH writes about the 70cm Obongs: "This is really very impressive for several reasons. One, I have never seen a quad type antenna over about 4 elements ever even get close to a yagi. Two, it is the biggest single gain improvement I have seen in many, many years. A 4 bay on 70CM would be a very reasonable standalone antenna. Please pass along my "well done" to YU7XL. 73, Lionel, VE7BQH"

Mehr über Oblongs (II) – mehr Gewinn auf 70cm

von Slobodan Bukvic, YU7XL, yu7xl@nadlanu.com

In der letzten DUBUS-Ausgabe 1/2008 habe ich ein Design für eine super Oblong-Antenne für 296 MHz veröffentlicht. Nun beschreibe ich zwei Modelle von Oblongs für 70cm. Wie zuvor erwähnt, bringen dünnere Element-Durchmesser bessere Antennen-Leistungsdaten. Das habe ich durch Vergleich zwischen verschiedenen Versionen herausgefunden. Mehr Gewinn, bessere Nebenzipfelunterdrückung und breiterer Frequenzgang treten immer bei dünneren Elementen auf, sofern der Boom lang genug ist. Das ist unglücklicherweise natürlich nur die Theorie. In der Praxis werden die Verluste durch den Widerstand des Materials mit geringer werdendem Elementdurchmesser größer. Ab einem bestimmten Durchmesser werden die Verluste so hoch, daß alle Vorteile der Theorie verloren sind.
Für 23cm habe ich ein noch besseres Design, als beschrieben, entworfen. Gleiche Anzahl von Elementen und nahezu dieselbe Boomlänge geben 0.5 dB mehr Gewinn. Die Verluste werden aber so hoch, daß diese Antenne in der Realität schlechter ist.
Wir können auch die Rauschtemperatur der Antenne betrachten. Höhere Verluste bringen höhere Temperaturen mit sich; diese Situation ist vergleichbar mit der bei Spiegeln und dem F/D-Verhältnis. Deshalb könnten Antennen mit höherem Gewinn (mit höheren Verlusten) besser für Sendezwecke sein, aber nicht für den Empfang. Ich möchte hier nicht weiter in die Details gehen. Meine einfache Idee ist: Je besser das G/T-Verhältnis ist, desto besser die Antenne. Diese Philosophie wurde bereits von YU7EF mit seinen Yagi-Antennen bewiesen. Das bedeutet: Niedrige Temperatur und niedrige Verluste, verbunden mit größerer Bandbreite, bei etwas geopfertem Gewinn. Es soll erwähnt werden das die Rauschtemperaturen von Himmel und Erde auf 70cm viel geringer sind im Vergleich zu 2m. Deshalb nehmen wir eine durchschnittliche Tsky von 15 K und Tearth von 290 K an. Daraus abgeleitet sehen wir, daß eine gute Rauschtemperatur der Antenne auf 70cm viel wichtiger ist, als auf 2m.
Ich habe nahezu 100 Modelle von Oblong-Antennen für 70cm simuliert, um das beste Verhältnis von Elementhöhe zu Elementweite herauszufinden. Als besten Wert für die Elementhöhe h habe ich 0.05 bis 0.1 Lamda gefunden. Auch habe ich herausgefunden, daß die besten Oblongs mit Boomlängen von 10 bis 20 Lambda erreicht werden. In diesem Bereich sind die Oblongs viel besser als Yagis. Hier ist der Beweis. Die Tabelle zeigt die Daten der originalen EF7032 yagi von YU7EF im Vergleich zu meiner Q7032 Oblong. Die Oblong hat ein besseres G/T von nahezu 1 dB! Sie wurde auf Basis der EF7032 modelliert, obwohl nur die Boomlänge beibehalten wurde, um besser vergleichen zu können. Anmerkung: YU7EF-Yagis sind wahrscheinlich die besten auf der Welt zur Zeit. Zum Vergleich werden die Ergebnisse der originalen YU7EF-Yagi und der Q7032XL Oblong in Tabelle 1 gezeigt.

Antenne	Boomlänge (mm)	Material	Gewinn (dBi)	TA (K)	G/T (dB)
Q7032XL	8670	Kein Verlust	20,55	18,0	+7,81
		Silber	20,51	21,8	+7,13
		Aluminum	**20,48**	23,4	+6,80
EF7032-5	8670	Kein Verlust	19,92	20,0	+6,91
		Silber	19,87	23,3	+6,19
		Aluminum	**19,84**	25,2	+5,83

Anmerkung: Es wurde die gleiche Segmentierungsdichte und die gleiche Frequenz 432.200 MHz verwendet.

Table 1: YU7EF yagi versus Q7032XL oblong

Super Oblong Antenne Q7034XL für 432 MHz – von YU7XL

Nun betrachten wir die 34-Element-Oblong-Antenne Q7034XL für 432 MHz. Anschließend wird noch eine weitere Oblong für 70cm (kürzer, für moderatere Ansprüche) beschrieben. Diese Version wurde ausgehend von der oben gezeigten Q7032XL enwickelt. Die Elemente werden aus Aluminiumstäben von 5mm Durchmesser gefertigt. Man könnte sogar dazu neigen, daß versilberte Elemente die Mühe wert wären, da damit eine G/T-Differenz von nahezu 0.3 dB erreicht wird. Die gesamte Boomlänge beträgt 9385 Millimeter. Die Impedanz beträgt genau 50±j0 Ohm auf der Mittenfrequenz 432,300 MHz. Die Bandbreite für SWR=1,5 beträgt 430,170 bis 433,380 MHz. Die anderen Parameter sind in der Tabelle 2 (oben im engl. Text) angegeben.

Moderate Oblong Antenne Q7023XL für 432 MHz

Hier ist nun die Oblong-Antenne für „moderate" Anforderungen. Der Boom ist 5970mm lang, was sehr günstig ist, da normale Aluminium-Profile in 6m-Längen erhältlich sind. Ein System von 4 solchen Antennen liefert rund 25.0 dBi Gewinn, mehr als genug für ernsthaften EME-Betrieb und exzellent für normalen DX-Betrieb. Die Resonanzfrequenz ist 432.3 MHz, was leicht auf 432.1 MHz absinkt, wenn ein System realisiert wird. Die besten Stockungsabstände sind 192cm horizontal und 189 cm vertikal. Die anderen Parameter sind in der Tabelle 3 (oben im engl. Text) angegeben.

Simulation and Discussion of a Multiband Feed

by Joachim Kraft, CT1HZE

1. Introduction

A multiband feed (see Fig. 1) for the frequencies 1.296/2.320/3.400/5.760 MHz was developed by HB9MPU and presented at the Kochelsberg Meeting in 2005 and the BBT (Bayerischer Bergtag) construction contest in 2005. The construction details are published on the web for free use [1]. A sketch taken from [1] is shown in Fig. 2. It is claimed that the feed has a gain of about 3 to 4 dBD and should be optimal for parabolic dishes with F/D 0.5 but 0.4 to 0.6 may be possible. With the given dimensions a good SWR is approached on all bands by tuning the dipoles to minimum SWR. Tuning of the reflectors is not necessary. To prevent a squinting pattern and a radiating feedline two ferrite beads are slid onto the cable about 2 cm from the 23cm dipole. Rastislav Galuscak – OM6AA was asked by DUBUS to model this antenna in CST MW studio software to investigate its parameters.

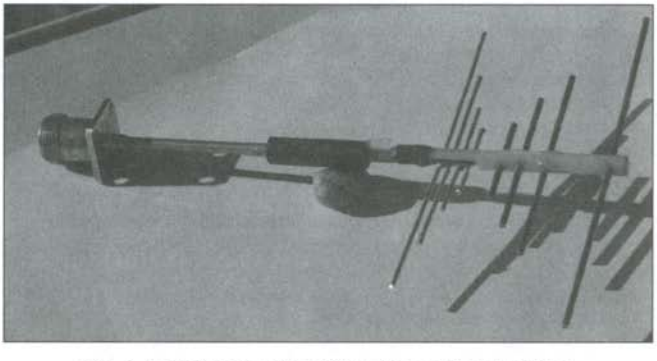


Fig. 1 HB9MPU feed for 23cm, 13cm, 9cm and 6cm

2. Simulation

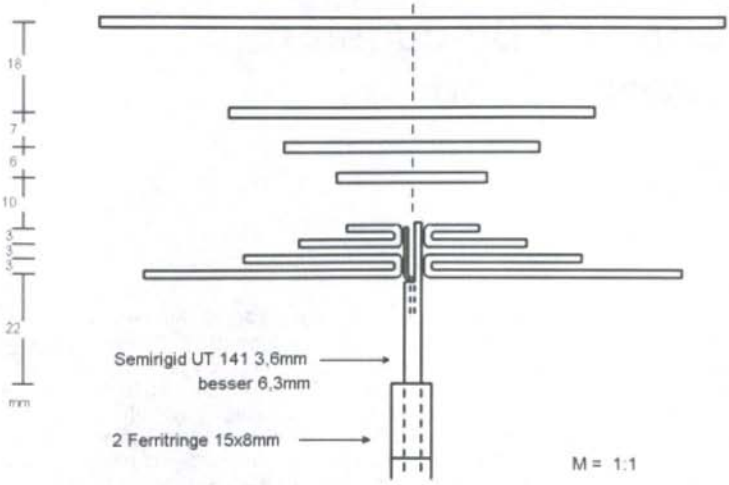
A simulation of the feed was realized with the CST Microwave Studio software based on the data from Fig. 2. The Ferrite beads were calculated with relative permeability of 63. Fig. 3 is the 3-D graphic of the simulated antenna.

3. Result

The results of the simulation are shown in Fig. 4 to Fig. 17.

4. Conclusion

It seems that the feed with actual dimensions is usable only for 23cm, but for higher frequencies it shows a very poor impedance match. Even on 23cm the impedance match is only just usable (input reflection -8.8dB, i.e. VSWR ≈ 2). Careful adjustment of the dipoles length may improve impedance match on higher bands. Unfortunately nobody has published actually achieved results so far. The graph of the antenna reflection vs. frequency shows not only quite sharp dips on frequencies related to the length of particular dipoles, but as well some parasitic dips, which will move with their frequency and depth with the dipoles and antenna cable length. Additional changes may result when placing this feed into a parabolic dish. The best way how to improve the impedance match on a particular frequency band would be to remove the other dipoles; but that, of course, would change its claimed multiband properties.



Länge der Reflektoren für 6 cm : 30mm
9 cm : 51mm
13 cm : 73mm
23 cm : 125mm

Länge der Dipolhälften für 6 cm : 11mm
9 cm : 19mm
13 cm : 30mm
23 cm : 50mm

Reflektoren AL oder MS 2mm

Dipole CuAg-Draht 1,5mm

Fig. 2 HB9MPU multiband feed - dimensions according to [1]

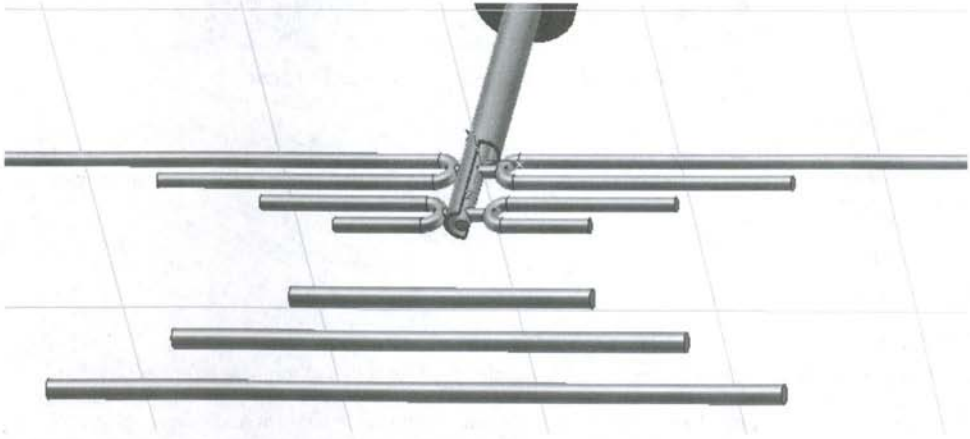


Fig. 3 The multiband feed in the CST Microwave software simulation

Reference

[1] http://www.bergtag.de/technik_9.html

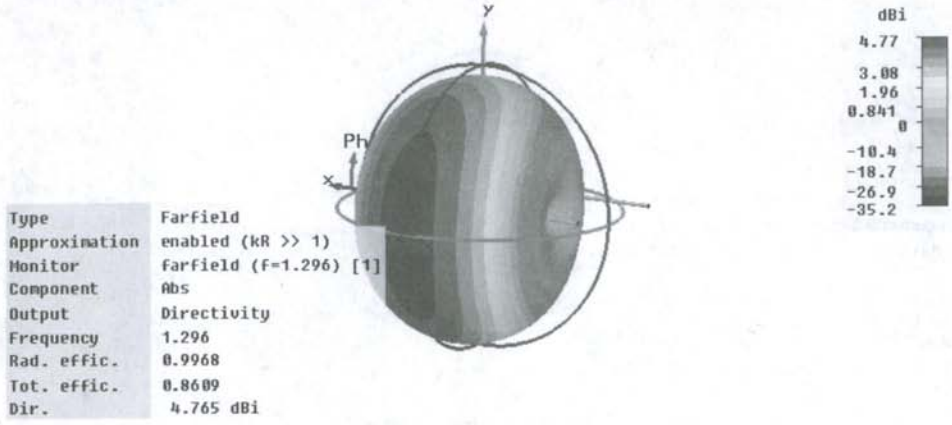


Fig. 4 Result 1296 MHz

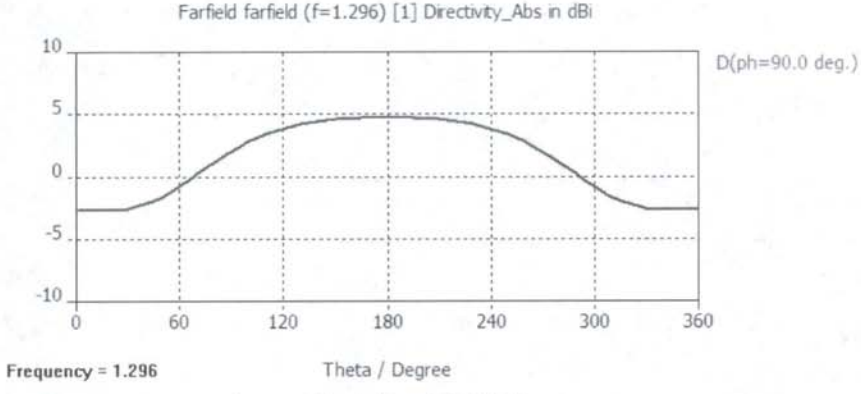


Fig. 5 Result 1296 MHz

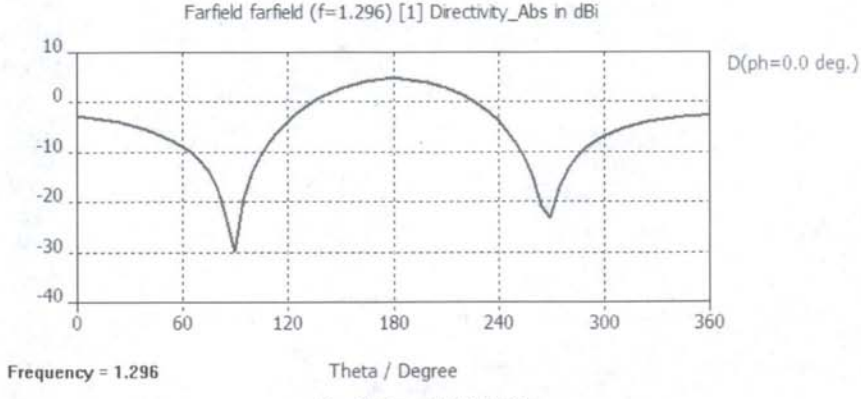


Fig. 6 Result 1296 MHz

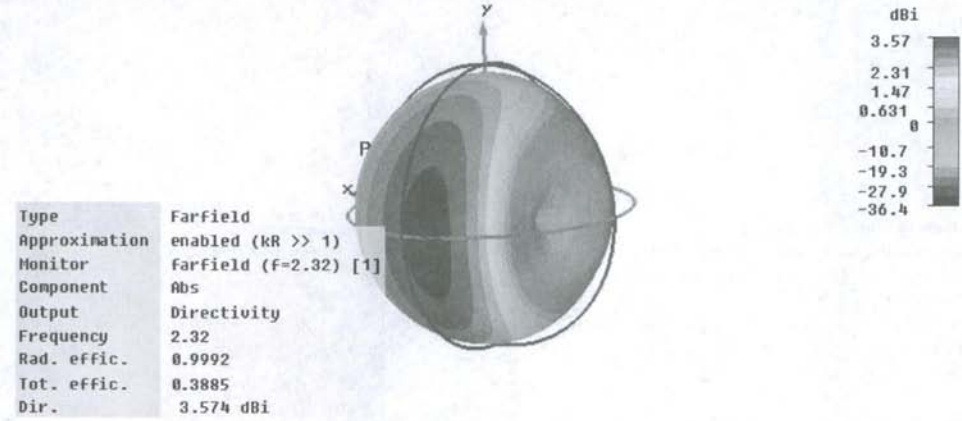


Fig. 7 Result 2320 MHz

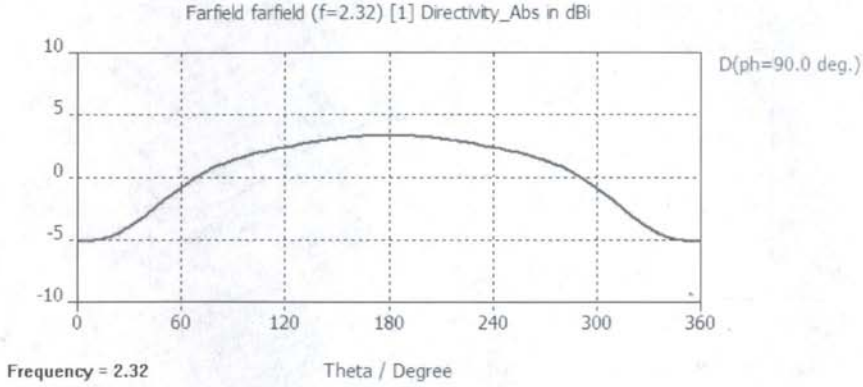


Fig. 8 Result 2320 MHz

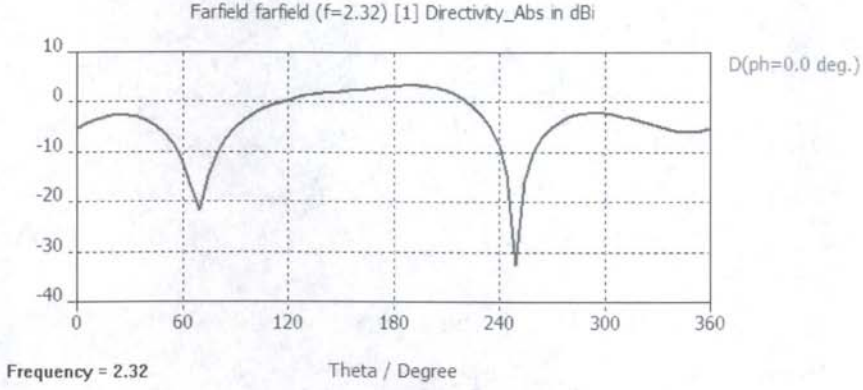
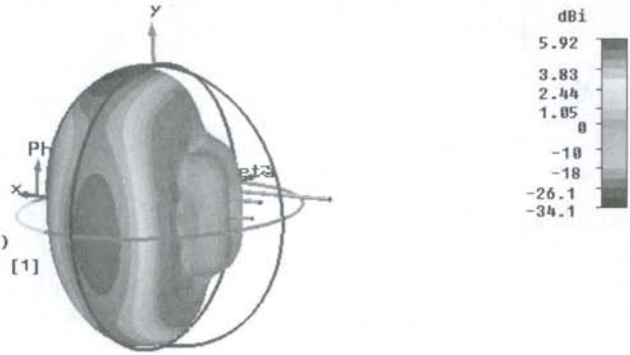


Fig. 9 Result 2320 MHz



Type	Farfield
Approximation	enabled (kR >> 1)
Monitor	farfield (f=3.4) [1]
Component	Abs
Output	Directivity
Frequency	3.4
Rad. effic.	0.9010
Tot. effic.	0.6213
Dir.	5.924 dBi

Fig. 10 Result 3400 MHz

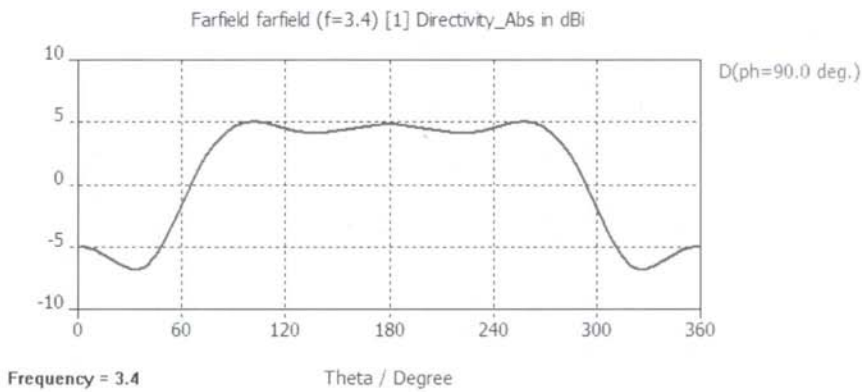


Fig. 11 Result 3400 MHz

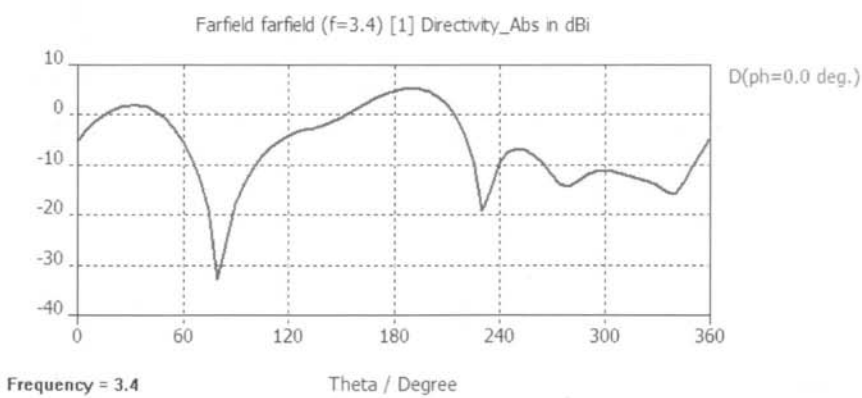


Fig. 12 Result 3400 MHz

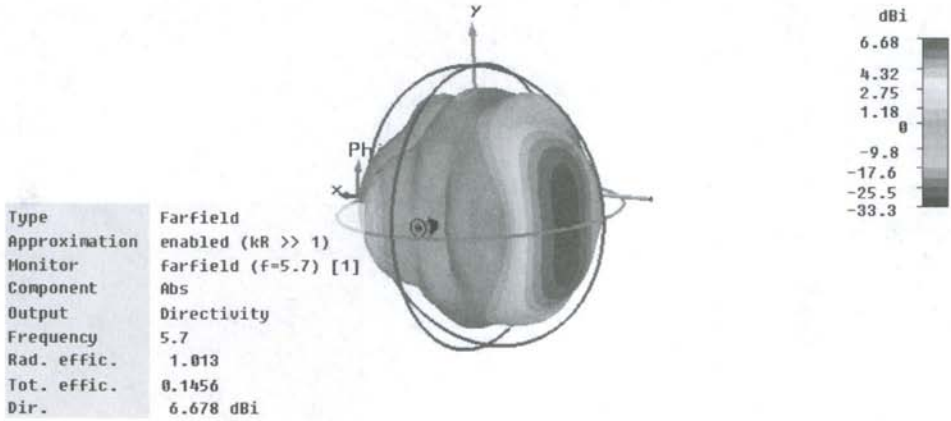


Fig. 13 Result 5700 MHz

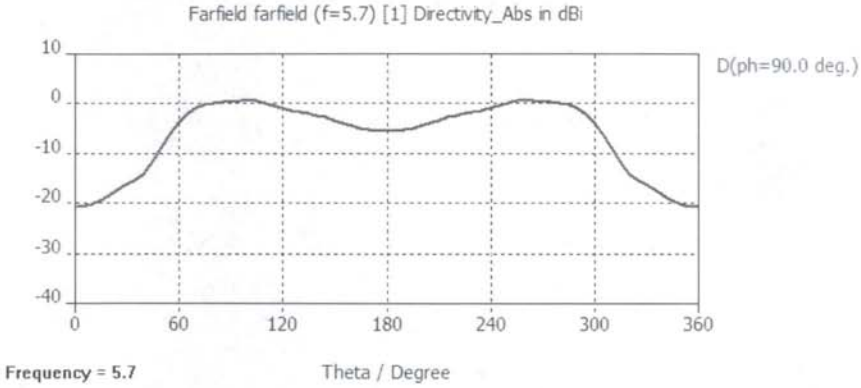


Fig. 14 Result 5700 MHz

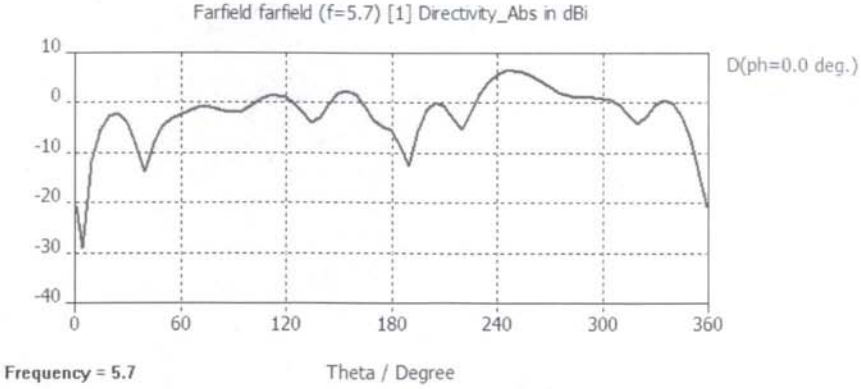


Fig. 15 Result 5700 MHz

Fig. 16 Return Loss 1 to 3 GHz

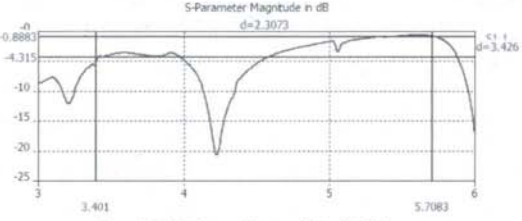


Fig. 17 Return Loss 3 to 6 GHz

Simulation und Diskussion eines Multiband-Feed

Joachim Kraft, CT1HZE

1. Einleitung

Ein Multiband-Strahler (Feed) (siehe Abb. 1) für die Frequenzen 1.296/2.320/3.400/5.760 MHz wurde von HB9MPU entwickelt und 2005 beim Kochelsberg-Teffen und BBT-Selbstbauwettbewerb vorgestellt. Die Details für den Nachbau sind im Web [1] zur freien Verwendung veröffentlicht. Die Zeichung (Abb. 2) wurde aus [1] entnommen. Es werden 3-4 dBD Gewinn angegeben und optimal sollen Spiegel mit F/D 0.5 sein (0.4 bis 0.6 soll möglich sein). Unter Verwendung der angegebenen Abmessungen soll es möglich sein, auf allen Bändern gutes SWR durch Feinjustierung der Dipollängen zu erreichen. Ein Ändern der Reflektorlängen soll nicht nötig sein. Um eine Schielen der Antenne und Mantelwellen auf dem Koaxkabel zu vermeiden werden 2 Ferritringe etwa 2cm vom 23cm Dipol entfernt auf das Semirigid-Kabel aufgeschoben. OM6AA wurde von DUBUS gebeten, das Feed mit der CST MW Studio Software zu simulieren.

2. Simulation

Es wurde eine Simulation des Feeds mit der Software CST Microwave Studio basierend auf den Daten aus Abb. 2 durchgeführt. Für die Ferritringe wurde eine relative Permeabilität von 63 genommen. Abb. 3 zeigt die 3D-Simulation der Antenne.

3. Ergebnis

Die Ergebnisse der Simulation werden in Abb. 4 bis 17 gezeigt.

4. Fazit

Es scheint, dass dieses Feed mit den angegebenen Bemaßungen nur auf 23cm brauchbar ist, da auf höheren Frequenzen nur eine schlechte Impedanzanpassung gegeben ist. Die Anpassung auf 23cm ist mit 8.8dB (VSWR = 2.12) auch nicht besonders gut. Das Ändern der Dipollängen könnte die Anpassung auf dem jeweiligen Band verändern. Leider hat bisher niemand die damit erreichten Ergebnisse publiziert. Einige der Dips im SWR-Verlauf sind parasitären Ursprungs und werden durch Variieren der Länge des Speisekabels und der Dipollänge ihre Frequenz verändern. Auch ist es zusätzlich möglich, daß sich die Impedanzanpassung verändert, wenn das Feed in einen Spiegel montiert word. Die beste Lösung, die Impedanz für ein Band zu verbessern, wäre wohl, die anderen Dipole und Reflektoren abzukneifen und daraus ein Monobandfeed zu machen.

The CWP-Receiver

by Klaus von der Heide, DJ5HG

In a previous article [1] the author proposed a digital CW-mode called CWP. The CWP-receiver completely is implemented by software. It takes a wavefile of 60 seconds or a signal directly read from the soundcard as its input. The interface is the same as with WSJT with the exception of the sampling frequency. WSJT uses 11025 samples/second while CWP uses 8000 samples per second which is decimated to 500 samples per second for further signal processing after a signal is found within the bandwidth 200 Hz ... 2400 Hz.

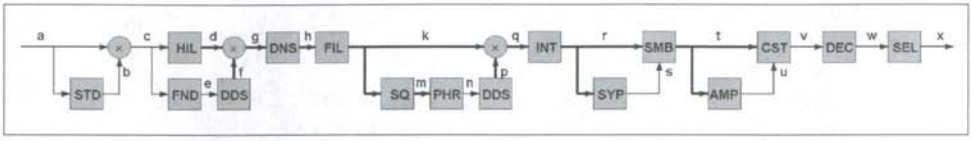


Figure 1. The structure of the CWP-receiver. Bold lines are complex arrays, normal lines are real arrays, scalar values, or decoded text. The three circles mean multiplication (real or complex).

STD	Standard deviation of the signal array
HIL	Hilbert transform
FND	Find signal frequencies
DDS	Direct Digital Synthesis of analytic wave
DNS	Downsampling from 8000 samples/s to 500 samples/s
FIL	Kernel filter of bandwidth 90 Hz (lowpass filter ±45 Hz)
SQ	Square of all samples
PHR	Drift reduction and lowpass filter with bandwidth of 0.25 Hz and phase detection
INT	Matched Filter (sum of last 30 complex samples)
SYP	Find phase of nibble clock
SMB	Symbol detection
AMP	Reconstruction of amplitude
CST	Cost of all Morse codes starting at all nibble clocks
DEC	Decoder
SEL	Select the decoded text of minimal cost
a	array of 480000 real samples of the input signal
b	reciprocal scalar value of the standard deviation of the input array
c	normalized real input array
d	complex form of the normalized input signal
e	frequency of a signal
f	analytic signal of that (negative) frequency
g	signal shifted down in frequency domain by the frequency given in e
h	same as g but sampled at 500 samples per second (array of 30000 samples)
k	complex signal filtered
m	all 30000 complex samples squared
n	phase of the squared signal divided by 2 to give the carrier of signal k
p	analytic wave with the negative phase of n
q	the signal at frequency 0.0 Hz
r	signal after matched filter (sum over last 30 samples)
s	the reconstructed binary clock
t	array of 1000 sums of 30 complex samples each representing the detected digital symbols
u	1000 corresponding real values of the reconstructed amplitude
v	44*500 cost values for all 44 Morse codes at all 500 possible starting indices (nibble clock)
w	6 decoded texts for the 6 possible repetitions and the corresponding total costs
x	the selected decoded text to display on the screen

1. The General Structure and it's Realization

Figure 1 shows the general structure of the receiver, and it very briefly explaines the different stages and the signals. All stages are programmed with Matlab. The high cost of the Matlab environment is compensated by its ease to realize prototypes of DSP software. As an example, the first stages from signal a to signal d can be written in Matlab using standard routines in one simple expression:

d = hilbert(a*(1/std(a)));

The main effort of implementation is concentrated in the stages FND, PHR, SYP, AMP, DEC. The rest is nearly trivial Matlab code. The author offers a compiled version of the CWP-transceiver. That is not a program translated to machine code, but an encrypted version of the original Matlab code that runs on an encrypted version of the Matlab environment which is called the Matlab Component Runtime (MCR). The MCR is supplied with the compiled program and may only be used in this combination.

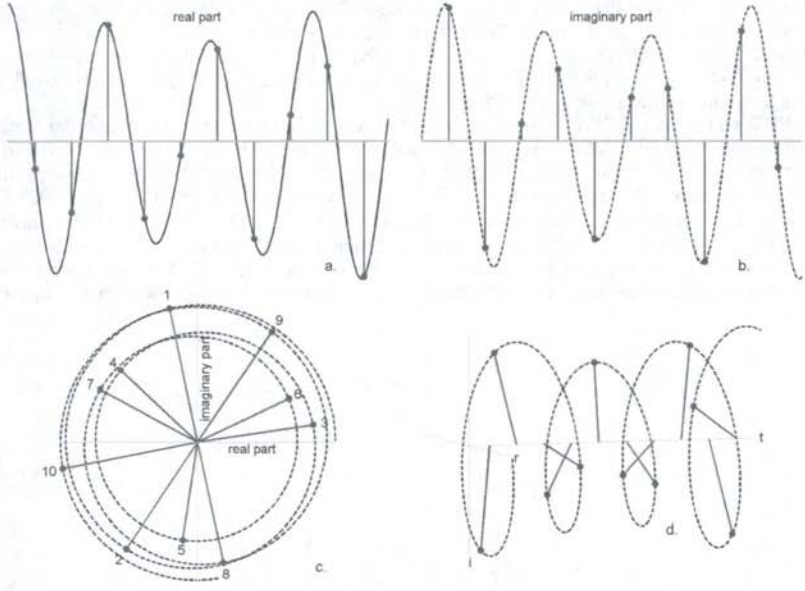


Figure 2. This figure shows an analog signal with two components of 2900 Hz and 3700 Hz as a line in 2.a. This signal is sampled at a rate of 8000 samples per second yielding the samples marked as dots in 2.a. The result of the Hilbert transform is shown in 2 b...d. The dashed line in these figures only shows what a Digital-to-Analog Converter (DAC) would produce from the given samples. The signal processing makes no use of it.

2.b: The imaginary part

2.c: The complex signal plane. Time is indicated here by the sample number. This demonstrates two of the many advantages of complex signal processing: (1) the actual signal amplitude is given by the absolute value of each complex sample (the distance between the dot and the origin), and (2) the actual signal frequency is given by the angle between two samples in sequence times the sampling frequency divided by the angle of a full circle (360° or 2π).

2.d: Projective view of the complex signal over time. To get a right-handed coordinate system (real, imaginary, time) the real part goes to the reader, the imaginary part goes down, and time goes to the right. This shows the helical form of analytic signals with a right screw for positive frequencies and a left screw for negative frequencies. Another advantage of complex processing is that a signal, for example an SSB transmission, can be shifted to zero frequency by a multiplication (which is called a mixer in HF-technology). The lower sideband then has negative frequencies and the upper sideband has positive frequencies. Both can be separated by a digital audio filter. Thus no filter in the HF band is neccessary. See the Software Defined Radios (SDR) for more information.

2. Discussion of Selected Stages

STD computes the standard deviation of the signal as a measure of the mean amplitude (which also could have been used here). The input signal a is divided by this value. Thus STD and the first multiplier are a realization of an Automatic Gain Control (AGC).

The Hilbert transformer HIL computes the imaginary part of the signal c and outputs a complex array with the input array as its real part. The imaginary part contains the same signal as the real part, but all phases are shifted by 90°. Such a signal is called an analytical signal. While the Hilbert transform in analog technology seldom is used because of its complexity (SSB generation by the phase method), it is one of the most important operations in digital signal processing. Some of the many advantages of complex signal processing are:

(1) The actual signal amplitude is given by the absolute value of a single complex sample.

(2) The actual signal frequency is given by the angle between two samples in sequence times the sampling frequency divided by the angle of a full circle (360° or 2π) (Fig. 2c.).

(3) If an analytical signal is shifted in frequency by multiplication with an analytical sine wave (instead of a real one) there will be no mirror. Thus no filter is neccessary to stop a sideband.

(4) Signals with positive frequencies (right helix) are different from those with negative frequencies (left helix), and they can well be separated. The principle of sampling a real analog signal and some aspects of analytic signals are demonstrated in figure 2.

The stage FND searches for CWP-signals. A problem here is that CWP-signals may have a frequency drift caused by the channel (EME) or by oscillator drift at both rigs. Therefore the signals would appear spreaded in the spectrum of the complete signal of one minute length, and they may be undetectable in the noise. FND computes 959 overlapping 1024-FFTs per input signal. The resolution of a 1024-FFT at a sample rate of 8000 samples per second is 8000/1024 Hz ≈ 8 Hz which is larger than the maximum allowed drift per minute in CWP (6 Hz/minute). Thus the simple sum of all these spectra is taken to search for local maxima. The method confidently works down to signals at -27 dB. Weaker signals cannot be decoded from a single pass anyway. A typical spectrum with three CWP-signals is shown in figure 3.

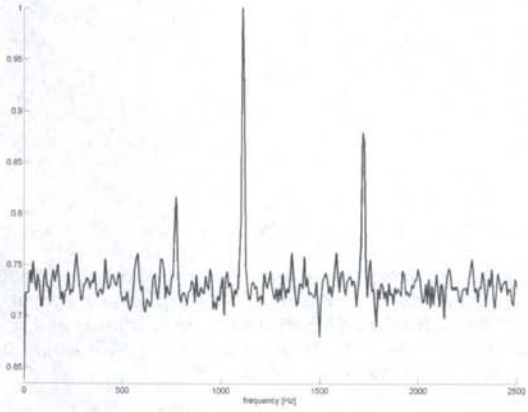


Figure 3. Spectrum of a signal with three CWP-signals at SNR-levels -27 dB, -22 dB, -24 dB (left to right). The drift is 0.0, -3.0, +1.8 Hz per minute, respectively.

When the stage FND found one or more signals that possibly could be decoded, the following stages are run in time-multiplex for all signals. The DDS stage generates the local oscillator for the multiplicative mixer by a statement like

```
locosc = exp(-i*2*pi*f(k)*t);
```

where the Euler-relation exp(x) = cos(x) + i*sin(x) is known to the Matlab-system. pi is π and f(k) is the frequency of the signal with number k. t is an array with all the clocktimes of the samples of the input signal. The Spurious Free Dynamic Range (SFDR) of such a software implementation of a DDS is 250 dB which by far is better than a hardware ever could be.

The element-wise multiplication of the signal d with the local oscillator (which unfortunately is named f in figure 1) shifts the signal down such that the frequency of signal g is nearly zero. Since we now are in baseband at zero frequency the filtering can be done by a lowpass filter. The filter DNS and FIL is realized as a series of 5 very simple Finite Impulse Response (FIR) filters. The frequency responses of all filters are drawn in figure 4a. Since the vertical scale of figure 4 is in dB the overall-frequency response of the series of all filters is the sum of these curves which is drawn in figure 4b. All filters are only computed at every second of its input samples with the exception of the last filter which is called the kernel filter. As a consequence, the sample rate at the output (signals h...r) is only 500 Hz. The computation of the filter in total only needs 7 multiply-accumulate instructions for every input sample. With sophisticated programming a modern computer could run 20000 of such filters in real time. Input and output of the DNS/FIL stages are complex samples. Because there are positive and negative frequencies the lowpass filter with a cutoff frequency of 45 Hz has a passband of -45 ... +45 Hz, i.e. a bandwidth of 90 Hz.

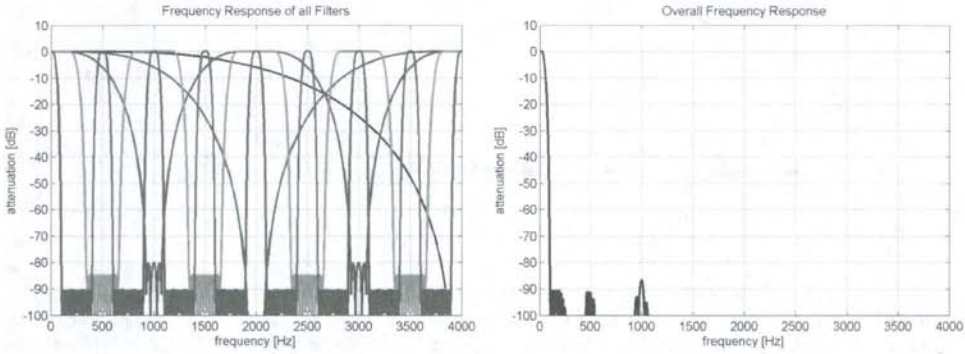


Figure 4. The digital filter of CWP is realized as a series of 5 simple individual FIR-filters with frequency responses shown left. The resulting overall frequency response is shown right. An implementation for real signals in time domain only needs 7 multiply-accumulate operations per input sample although it exactly corresponds to an FIR-filter with 603 coefficients. The bandwidth at -6 dB is 90 Hz (passband is -45 ... +45 Hz). A larger bandwidth would be better because the CWP-transmitter does not use such a narrow anti-click filter. But none-Gaussian noise like other stations sending CWP could interfere. The input of this filter is sampled at 8000 samples per second, the output is sampled at 500 samples per second.

Because of imprecision of the frequency measurement in stage FND the signal k will not be exactly at zero frequency. Also there will be a frequency drift caused by the rigs at both stations and another component in EME caused by a drifting Doppler shift. As a consequence, the signal may rotate in the complex plane (like fig. 2d) with up to 4 turns per second (left or right), and with rotation variing with time. In order to take advantage of the phase modulation, it is neccessary to shift the signal really to zero frequency such that there is no signal rotation. It is the task of the stage PHR to detect the phase of the signal k. Since we use a BPSK in CWP with 0° and 180° phase shift which must be retained for the demodulator we use the squared signal for phase detection (stage SQ). Squaring a complex value doubles its angle in the complex plane. As a consequence, 2*0° = 0° and 2*180°=360°⇔ 0°. So there is no longer a phase modulation on the squared signal which could trouble the carrier phase detection. The phase of signal k is shifted by a complex multiplier and a DDS, which generates only half of the detected phase n to correct for the squaring process. Figure 5a shows a CWP signal with typical EME-fading. The noise is removed here, otherwise the signal would be buried. Also, the signal has very slow rotation for better interpretation. The phase shifts of CWP cause that the signal looks like a twisted band. The squared signal in figure 5b is twisted at twice the frequency. But it is only one-sided. This is a classical CW signal without phase modulation. Figure 5c shows the signal after phase correction. There is still left a slight undulation which is caused by noise and fading. The next stage of the CWP-receiver is the matched filter. The purpose of the matched filter in a digital communication system is to reconstruct the digital symbols at an optimum SNR. In the case of Additive White Gaussian Noise (AWGN) the impulse response of a matched filter equals the pulse used at the transmitter, but mirrored in time.

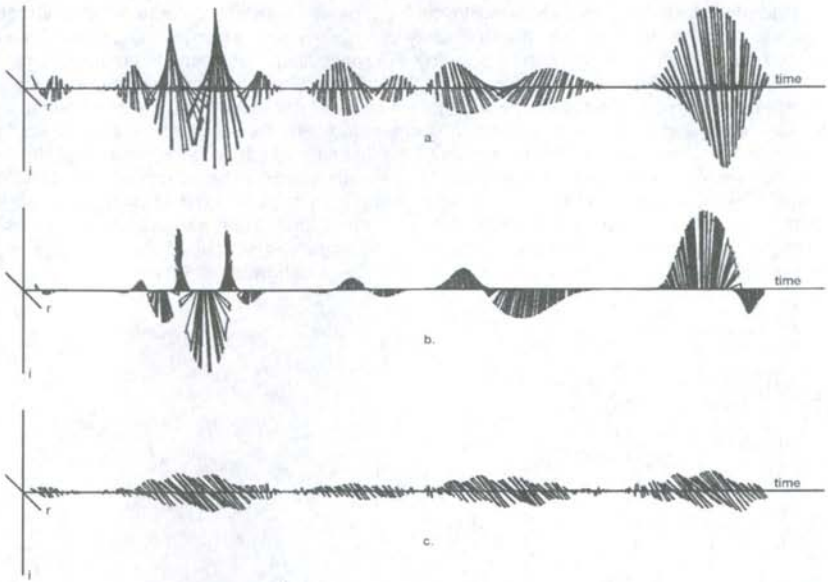


Figure 5. A complex CWP-signal at k with typical EME-fading (144 MHz) is shown in a. (drawing as in fig.2d). Also, this signal has a drift from a negative frequency (left) to a positive frequency (right). b. shows the squared signal which has no longer the phase shifts of CWP, but retaines the amplitude keying. This is the corresponding classical CW signal. While it is very difficult to read the Morse code from a. by eye it partly can be done with b. (the down-peak left in the image shows „DEF"). c. shows the signal after phase correction (signalq). There is still left a slight undulation which is caused by noise and fading. In practise, signal k (a.) usually has much more turns (up to 200), and the squared signal q has twice this number of turns.

Since CW and CWP are using a rectangular pulse (only slightly smoothed by an anti-click filter) the impulse response of the matched filter also has the rectangular shape of a CW-dot. This is a filter that simply sums the last n samples of the input where n is the length of a CW-dot in samples. In the CWP-receiver n = sample rate / basic clock rate = 500 Hz / 16.666 Hz = 30. Figure 6 demonstrates the situation with n = 5 for better resolution in the graphic. The output of the INT stage looks like the signal in figure 6b, but with noise of course. One sample of every n samples in sequence is the optimum readout of the actual symbol. But the basic clock until now is not retrieved. So we do'nt know which of the value is the best. See [1] for a definition of the different clocks in CWP. It is the task of the stage SYP to reconstruct the nibble clock from signal r. The method is relatively simple and is robust down to signals that cannot be decoded (-28dB). The sequence of all absolute values of signal r are arranged in groups with a length of a nibble, i.e. 60 samples. A graph that displays all groups in a single figure is called an eye diagram. It is shown in figure 7a and 7c for two different SNRs. The sum of all groups shows hopefully a significant maximum which marks the right index where to take the symbol values from. The output s of the stage SYP is not a signal, but only the index where to take the symbol value out of all groups. This selection is done by the trivial stage SMB. If the carrier phase reconstruction in stage PHR is perfect then the signals q, r, and t are pure real. But to cope with imperfections of the carrier phase reconstruction these values are complex. t now is an array of 1000 complex values that stand for the possible symbols 0, +1, -1. At this stage, indeed, it would be possible to convert the complex values into an array of these three symbols, i.e. to do the most important operation in a digital receiver: to make the decisions. The received text would immediately follow from the symbols. But it is very much better not to perform such a hard-decision with subsequent decoding. There is a considerable gain if the decoding is done with the real or complex input values. While digital signal processing in many aspects is similar to analog audio and HF techniques a decoder is quite a different thing. We therefore will discuss the stages CST, DEC with the soft-decoder for CWP, and SEL in a forthcoming paper.

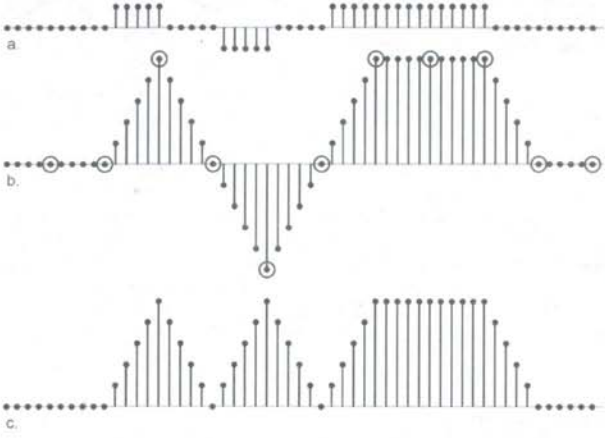


Figure 6. The upper signal (a.) is a „U" in CWP in front of the stage INT (signal q), but for better resolution only n = 5 samples per basic clock are shown instead of the n = 30 samples used in CWP. The signal in b. is the output of the stage INT that for every output clock sums the last n samples of the input signal (a.). The optimum method of detecting the symbol values is to read the output of the INT stage (b.) exactly at the last sample of the basic clock cycle. These values are marked by a circle. The absolute value of b. (signal shown in c.) is used to restore the nibble clock (see text & fig. 7).

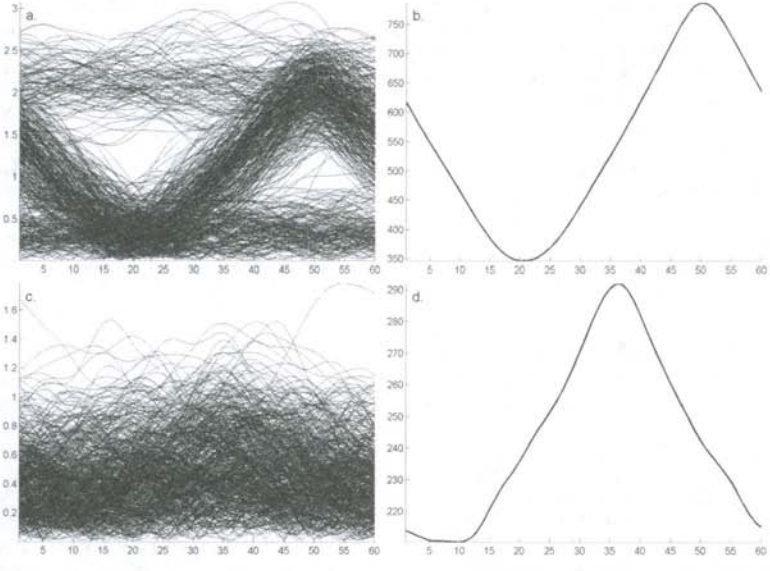


*Figure 7. a. and c. show eye diagrams. The horizontal axis is the sample number, the vertical axis is the absolut value of the signal r. The matched filter INT is an integrator over the length of a dot, i.e. the sum of the last 30 samples computed at each sample of signal q. These signal correspond to the theoretical signal of figure 6b. a. is for SNR = -12dB, c. for -24dB. b. and d. are the sums over all values at the same sample number in a. or c.. The eye diagram corresponds to the display of an oscilloscope taken at r with the horizontal repetition rate exactly adapted to the nibble clock, but no trigger. Although the individual dots obviously are buried by noise at SNR = -24dB (c.), the sum of all nibbles well establishes the nibble phase (d.) by it's maximum peak. The optimum readout of the symbols is at sample numbers 51 + k*30 for the example shown in a., and it is 37 + k*30 for c. where the numbers 51 and 37 are the sample number of the maximum in b. or d., respectively. k = 0 ... 415 is the running nibble number.*

References

[1] Klaus von der Heide, CW for Weak Signal Applications: CWP, DUBUS 3/2007, p. 52

Der CWP-Empfänger

von Klaus von der Heide, DJ5HG

In einer vorausgegangenen Schrift [1] hat der Autor eine CWP genannte digitale CW-Betriebsart vorgestellt. Auf diese Schrift wird fortan als Paper 1 verwiesen. Der CWP-Empfänger ist vollständig in Software realisiert. Er benötigt als Input eine Wave-Datei von 60 Sekunden oder das direkt von der Soundkarte digitalisierte Audiosignal. Das Interface ist wie bei WSJT. WSJT benutzt allerdings die Abtastrate 11025 Samples/Sekunde. CWP dagegen verwendet 8000 Samples pro Sekunde, was für jedes im Frequenzbereich von 200 Hz bis 2400 Hz gefundene Signal zur weiteren Verarbeitung auf 500 Samples pro Sekunde dezimiert wird.

1. Struktur und Realisierung des Empfängers

Figure 1 zeigt die generelle Struktur des Empfängers mit den einzelnen Stufen und den verschiedenen Signalen. Alle Stufen wurden in Matlab programmiert. Die hohen Kosten der Matlab-Umgebung werden aufgewogen durch die Einfachheit der Realisierung von DSP-Software. Sei a ein Array von Samples, dann können z.B. die ersten Stufen des Empfängers vom Signal a zum Signal d unter Verwendung von Matlab-Standardroutinen folgendermaßen formuliert werden, ohne dass irgendeine weitere Definition vonnöten wäre (d ist automatisch ein komplexes Array):

d = hilbert(a*(1/std(a)));

Der wesentliche Realisierungsaufwand steckt in den Teilen FND, PHR, SYP, AMP, DEC. Der Rest ist nahezu trivialer Matlab Code. Der Autor stellt eine compilierte Version des CWP-Transceivers zur Verfügung. Das ist aber nicht ein in Maschinencode übersetztes Programm sondern nur eine verschlüsselte Version des Quellcodes, der auf einer verschlüsselten Version der Matlab-Umgebung läuft, die als Matlab Component Runtime (MCR) bezeichnet wird. Die MCR wird mit dem compilierten Programm geliefert und darf nur in dieser Kombination benutzt werden.

2. Diskussion einiger Stufen

STD berechnet die Standardabweichung des Signals als ein Maß der mittleren Amplitude (die ebenfalls hier hätte benutzt werden können). Das Inputsignal wird durch diesen Wert dividiert. STD und der erste Multiplizierer realisieren also eine Amplitudenregelung (AGC). Der Hilbert-Transformator HIL berechnet zum reellen Signal c den passenden Imaginärteil und gibt das komplexe Signal aus. Der Imaginärteil entspricht dem Realteil, aber die Phasen aller Komponenten sind um 90° gedreht. Solch ein komplexes Signal wird analytisches Signal genannt.
Die Hilbert-Transformation wird in der Analogtechnik selten benutzt wegen hoher Anforderungen an Bauteiltoleranzen (z.B. SSB-Generierung nach der Phasenmethode). Dagegen ist sie eine der wichtigsten Operationen in digitaler Signalverarbeitung. Einige der vielen Vorteile der digitalen Verarbeitung komplexer Signale anstelle ihrer reellen Form sind:
(1) Die aktuelle Signalamplitude ist gegeben durch den Absolutwert eines komplexen Abtastwerts.
(2) Die aktuelle Signalfrequenz ist gegeben durch den Winkel zwischen zwei aufeinanderfolgenden komplexen Abtastwerten multipliziert mit der Abtastfrequenz und dividiert durch den Winkel des Vollkreises (360° bzw. 2π).
(3) Wenn ein analytisches Signal durch Multiplikation mit einer analytischen Sinushelix (anstelle der reellen Welle) in der Frequenz verschoben wird, so gibt es keinen Spiegel. Es ist also kein Filter zur Sperrung eines Seitenbandes nötig. (4) Signale mit positiver Frequenz (Rechtsschraube) unterscheiden sich von solchen mit negativer Frequenz (Linksschraube). Das Prinzip der Abtastung eines reellen analogen Signals und einige Aspekte analytischer Signale werden in Figure 2 erläutert. Die Stufe FND sucht nach CWP-Signalen. Diese Signale können eine Frequenzdrift aufweisen, die durch den EME-Kanal und Oszillator-Drift in den Transceivern beider Stationen verursacht wird. Damit sie nicht als Folge davon im Spektrum unsichtbar werden, berechnet FND 959 überlappende 1024-FFTs pro Inputsignal. Die Frequenzauflösung der 1024-FFT ist bei der Abtastrate 8000 Hz 8000/1024 Hz ≈ 8 Hz, was größer als die bei CWP maximal zulässige Drift pro Minute ist (6 Hz/Minute). Zur Suche nach lokalen Maxima wird die Summe

aller 959 Spektren verwendet. Das arbeitet zuverlässig bis hinunter zu Signalen von -27 dB. Schwächere Signale können sowieso nicht von einem einzigen Durchgang dekodiert werden. Figure 3 zeigt ein typisches Summenspektrum.
Wenn die Stufe FND mehr als ein möglicherweise dekodierbares Signal gefunden hat, werden alle nachfolgenden Stufen für jedes dieser Teilsignale getrennt im Time-Multiplex gerechnet. Die DDS-Stufe generiert ein analytisches Oszillatorsignal für den multiplikativen Mischer mit dem Matlab-Befehl

locosc = exp(-i*2*pi*f(k)*t);

Matlab kennt die Euler-Beziehung exp(x) = cos(x) + i*sin(x) . pi ist π und f(k) ist die Frequenz des Signals mit der Nummer k. t ist ein Array aller Taktzeiten der Samples des Inputsignals. Die Spurious Free Dynamic Range (SFDR) solch einer Softwarerealisierung einer DDS ist mit 250 dB viel besser als je benötigt und besser als Hardware je sein könnte. Die elementweise Multiplikation des Signals d mit dem lokalen Oszillatorsignal (das unglücklicherweise in Figure 1 als f bezeichnet wird) verschiebt das Signal, so dass die Frequenz des Signals g nahe Null ist.
Da das Signal g nun im Basisband bei Frequenz Null vorliegt, kann die Filterung durch ein Tiefpassfilter erfolgen. Das Filter aus den Stufen DNS und FIL ist realisiert durch eine Serie von 5 sehr einfachen FIR-Filtern. Die Frequenzgänge aller 5 Filter sind in Figure 4a angegeben. Da die Skalierung vertikal in dB vorliegt, ergibt sich der Frequenzgang der Hintereinanderschaltung aller Filter als Summe der individuellen Frequenzgänge (Figure 4 b). Die individuellen Filter mit Ausnahme des letzten Filters FIL, das Kernfilter genannt wird, werden jeweils nur für jeden zweiten Inputsampletakt gerechnet, so dass jedes der Filter DNS zugleich ein Downsampling realisiert. Die Abtastrate des Ausgangssignals h ist deshalb nur 500 Hz. Der Gesamtaufwand an erforderlichen Multiply-Accumulate-Operationen beträgt nur 7 Operationen pro Inputsample. Mit geschickter Programmierung könnte ein heutiger Standard-PC 20000 solcher Filter gleichzeitig in Realzeit rechnen.

Input- und Output der DNS/FIL-Stufen sind komplexe Samples. Das Tiefpassfilter der Grenzfrequenz 45 Hz realisiert deshalb einen Bandpass von -45 Hz bis +45 Hz. Die Bandbreite des CWP-Filters beträgt also 90 Hz. Wegen der Ungenauigkeit der Frequenzbestimmung in der Stufe FND liegt das Signal k nicht exakt auf der Frequenz Null. Auch die schon erwähnte Frequenzdrift ist hier ja noch vorhanden. Das Signal wird also in der komplexen Ebene mit bis zu 4 Umdrehungen pro Sekunde rotieren (siehe Figure 2) und zwar rechtsherum für positive Frequenz bzw. linksherum für negative Frequenz, und dies wird sich im Laufe der Minute verändern.
Um die Phasenumtastung von CWP nutzen zu können, muss das Signal über den gesamten Durchgang soweit auf Frequenz Null gebracht werden, dass es keine sichtbare Rotation mehr zeigt. Die Stufe PHR ermittelt die Phase des Trägers des Signals k . Das Signal k weist allerdings die Phasenumtastung zwischen 0° und 180° auf, die erhalten bleiben muss. Deshalb wird nicht die Phase des Signals k bestimmt sondern die des Quadrates von k . Quadrieren einer komplexen Zahl verdoppelt ihre Phase. Sei á die Trägerphase, dann ist die Phase von k á + 0° oder á + 180° und die des Quadrates von k 2 á oder 2 á + 2*180° = 2 á . Die Hälfte der Phase des Quadrates eines BPSK-Signals ist also die Phase des Trägers ohne die Modulation. Eine DDS-Stufe generiert dieses Trägersignal p mit umgekehrtem Vorzeichen der Frequenz. Die Multiplikation des Signals k mit dessen konjugiert-komplexen Trägersignal p bringt das Nutzsignal endgültig auf Phase Null.

Figure 5a zeigt ein CWP-Signal mit typischem EME-Fading. Das Rauschen wurde hier entfernt, weil es sonst dominiert. Auch ist die Rotation in diesem Bild der Übersichtlichkeit halber nur sehr langsam. Die Phasenumtastung von CWP lässt das Signal in 5a als verdrilltes Band erscheinen. Das quadrierte Signal in 5b dreht sich doppelt so schnell. Es ist aber nur einseitig, d.h. die eine Seite liegt immer auf Null. Dies ist das klassische CW-Signal ohne Phasenmodulation. Figure 5c zeigt das Signal nach der Phasenkorrektur. Aufgrund von Rauschen (hier nicht entfernt) und Fading verbleibt eine Restwelligkeit. Die nächste Stufe des CWP-Empfängers ist das Matched-Filter. Der Sinn des Matched-Filters in einem digitalen Kommunikationssystem ist es, das SNR für die übertragenen Symbole zu maximieren. Im Falle von additivem weißen Gauss-Rauschen (AWGN) muss die Impulsantwort des Matched -Filters gleich dem in der Zeit gespiegelten Sendeimpuls sein. CW und CWP benutzen Rechteckpulse, die nur sehr wenig zur Klick-Unterdrückung geglättet werden. Die Impulsantwort des Matched-Filters ist deshalb genau wie ein getasteter CW-Punkt. SeineRealisierung erfolgt einfach durch die Summe der jeweils letzten Samples über die Länge des CWPunktes.
Beim CWP-Empfänger sind das n = Abtastrate / Binärtaktrate = 500 Hz / 16.666 Hz = 30 Samples. Zur besseren Auflösung erläutert Figure 6 die Situation mit n = 5 anstelle von n = 30 . Der Output der Stufe INT sieht aus wie in Figure 6b, natürlich plus Rauschen. Noch haben wir 30 Samples pro Binärtakt (Länge des Morsepunktes in Samples, in Figure 6 nur 5). Nun ist festzulegen welcher der 30 Werte jeweils das Symbol (0, -1, +1) am besten repräsentiert (eingekreiste Werte in 6b). Die Sampleraten 8000/s werden

von Soundkarten gut genug eingehalten, so dass der Abstand der optimalen Abtastpunkte durchweg n beträgt. Es ist also nur die Verschiebung innerhalb eines Binärtaktes zu bestimmen. Die verschiedenen Takte sind in Paper 1 beschrieben. Die Stufe SYP rekonstruiert den Nibble-Takt aus dem Signal r . Die Methode ist einfach und zugleich robust herunter bis zu Signalen, die nicht mehr dekodiert werden können (-28 dB): Zunächst wird der Absolutbetrag aller Samples von r berechnet (die Amplitude, siehe Figure 6c). Dieses reelle nicht negative Signal wird beim ersten Sample beginnend durchweg im Nibble-Takt segmentiert und alle Segmente addiert. Zu den ersten 60 Samples werden also die Samples 61...120, 121...180, usw. addiert. Figure 7a und c zeigen die Segmente alle übereinander dargestellt (sog. Augendiagramme) und 7b und 7d die jeweilige Summe aller Segmente. Der Index des Maximums der Summen wird als bester Wert für die Position des Binärtaktes genommen. Die Stufe SMB selektiert aus den Samples von r entsprechend den komplexen Abtastwert für jeden Binärtakt.
Die Signale q, r und t sind reell, wenn die Phasenkorrektur in der Stufe PHR perfekt ist. Sie werden aber weiterhin als komplex betrachtet, um Mängel der Phasenrekonstruktion tolerieren zu können. t ist dann ein Array von 1000 komplexen Werten, die für die möglichen Symbole 0, +1, -1 stehen. Tatsächlich könnte man an dieser Stelle aus t die entsprechenden Symbole 0, -1, +1 durch harte Entscheidung gewinnen. Daraus würde dann der empfangene Text unmittelbar abzulesen sein. Es ist aber viel besser, die Dekodierung direkt aus den komplexen Werten t vorzunehmen. Analoge und digitale Signalverarbeitung sind in vielen Aspekten sehr ähnlich. Dagegen ist ein Dekodierer etwas gänzlich anderes. Deshalb sollen die Stufen CST, DEC und SEL in einer nachfolgenden Schrift skizziert werden.

BILDUNTERSCHRIFTEN:

Figure 1. Die Struktur des CWP-Empfängers. Fette Linien stellen komplexe Arrays dar, normale Linien sind reelle Arrays, skalare Werte oder dekodierter Text. Die drei Kreisflächen sind Multiplizierer (reell oder komplex).

STD	Standardabweichung des Signal-Arrays
HIL	Hilbert-Transformation
FND	Finden der Signalfrequenzen
DDS	Direkte Digitale Synthese analytischer Oszillatoren
DNS	Downsampling von 8000 Samples/s auf 500 Samples/s
FIL	Kernfilter der Bandbreite 90 Hz (Tiefpassfilter ±45 Hz)
SQ	Quadrat aller Samples
PHR	Driftreduktion und Tiefpassfilter mit Bandbreite 0.25 Hz und Phasendetektion
INT	Matched Filter (Summe über die jeweils letzten 30 komplexen Samples)
SYP	Lokalisierung des Nibbletaktes
SMB	Symbol-Detektion
AMP	Rekonstruktion der Amplitude
CST	Kosten für alle Morsezeichen beginnend an allen Nibbletakten
DEC	Decoder
SEL	Entscheidung für den decodierten Text nach minimalen Kosten
a	Array von 480000 reellen Samples des Inputsignals
b	reziproker skalarer Wert der Standardabweichung des Inputarrays
c	normalisiertes reelles Inputarray
d	komplexe Form des normalisierten Inputsignals
e	Frequenz eines gefundenen Signals
f	analytisches Signal für gegebene (negative) Frequenz
g	Signal im Frequenzbereich verschoben um die mit e gegebene Frequenz
h	Signal wie g aber abgetastet mit 500 samples pro Sekunde (Array von 30000 Samples)
k	komplexes Signal gefiltert
m	alle 30000 komplexen Samples quadriert
n	Phase des quadrierten Signals dividiert durch 2 (Phase des Trägers von Signal k)
p	analytisches Signal mit der negativen Phase des Signals n
q	das Nutzsignal auf der Frequenz 0.0 Hz
r	Signal nach dem Matched Filter (Summe der jeweils letzten 30 Samples)
s	der rekonstruierte Binärtakt
t	Array von 1000 Summen von je 30 komplexen Samples für die digitalen Symbole 0, +1, -1
u	1000 entsprechende reelle Werte der rekonstruierten Amplitude
v	44*500 Kosten für alle 44 Morsezeichen an allen 500 möglichen Startindices (Nibbletakt)
w	6 dekodierte Texte Für die 6 möglichen Wiederholungsmuster und die zugehörigen Kosten
x	der ausgewählte decodierte Text für die Darstellung auf dem Display

Figure 2. Dieses Bild zeigt ein analoges Signal aus zwei Komponenten mit 2900 Hz und 3700 Hz als Linie in 2a. Das Signal wird abgetastet mit 8000 Samples pro Sekunde. Die Abtastwerte sind als Punkte auf dem Signal gekennzeichnet. 2 b...d zeigen das Resultat der Hilbert-Transformation. Die strichlierte Linie deutet der Anschauung halber das Signal an, welches ein Digital-Analog-Wandler aus den Abtastwerten machen würde. Die digitale Signalverarbeitung kennt aber nur die diskreten Abtastwerte.

2b: Der Imaginärteil

2c: Die komplexe Ebene. Die Zeit wird hier angegeben durch die Sample-Nummer. Dies demonstriert zwei der vielen Vorteile komplexer Signalverarbeitung: (1) die aktuelle Signalamplitude ergibt sich aus dem Absolutwert jedes komplexen Samples und (2) die aktuelle Frequenz des Signals ist der Winkel zwischen zwei aufeinander folgenden komplexen Samples multipliziert mit der Abtastrate und dividiert durch den Winkel des Vollkreises (360° bzw. 2π).

2d: 3D-Blick auf das komplexe Signal über der Zeit. Um ein rechtshändiges System mit den Achsen Realteil, Imaginärteil und Zeit zu erreichen, zeigt hier der Realteil zum Betrachter, der Imaginärteil nach unten, und die Zeit nach rechts. 2d zeigt die Helix-Form analytischer Signale mit einer Rechtsschraube für positive Frequenzen und einer Linksschraube für negative Frequenzen. Ein weiterer Vorteil komplexer Verarbeitung ist, dass ein Signal durch eine einfache komplexe Multiplikation im Frequenzbereich verschoben werden kann, ohne dass dabei Spiegelfrequenzen entstehen. Das nach einem reellen Mischer notwendige Filtern entfällt also.

Figure 3. Spektrum eines Signals mit drei CWP-Signalen bei SNR-Werten von -27 dB, -22 dB, -24 dB (von links nach rechts). Die Frequenzdrift ist 0.0, -3.0, +1.8 Hz pro Minute.

Figure 4. Das digitale Filter des CWP-Empfängers ist als Kette von 5 individuellen FIR-Filtern realisiert, deren individuelle Frequenzgänge links abgebildet sind. Der Frequenzgang aller Filter hintereinander ist rechts dargestellt. Solche Filter sind außerordentlich effizient. Eine Implementierung für reelle Signale erfordert nur 7 Multiply-Accumulate-Operationen pro Inputsample, obwohl das Filter äquivalent zu einem FIR-Filter mit 603 Koeffizienten ist. Die Bandbreite für -6dB ist 90 Hz (Tiefpass für -45 ... +45 Hz). Dieses Filter dient ausschließlich der Unterdrückung von nicht-Gauss'schen Störungen wie anderen CW-Signalen und Birdies. Eine größere Bandbreite wäre bei sauberem Gauss-Rauschen etwas besser. Der Input des Filters ist mit 8000 Samples/s abgetastet, der Output nur mit 500 Samples/s.

Figure 5. Entsprechend Fig.2d zeigt 5a ein komplexes CWP-Signal k . Dieses Signal hat zugleich eine Frequenzdrift von negativer Frequenz (links) zu positiver Frequenz (rechts). 5b zeigt das quadrierte Signal, das keine Phasensprünge mehr aufweist, die Amplitudentastung aber erhält. Dies ist das klassische CW-Signal. Deshalb kann man hier den Morsecode teilweise allein durch Betrachtung decodieren (die links im Bild mit großer Amplitude unten herum gehende Drehung liefert „DEF"). 5c zeigt das Signal nach der Phasenkorrektur (Signal q). Hier wurde das Rauschen nicht entfernt, um zu zeigen, dass die Phasenkorrektur im realen Fall nicht perfekt ist. In der Praxis hat das Signal k (5a) meist wesentlich mehr Rotationen (bis zu 200) und das quadrierte Signal (5b) doppelt so viele.

Figure 6. Das obere Signal (6a) stellt das CWP-Morsezeichen für „U" dar am Input der Stufe INT (Signal q). Der Übersichtlichkeit wurden hier aber nur 5 Samples pro Binärtakt gewählt anstelle der 30 Samples in CWP. 6b zeigt den entsprechenden Output der Stufe INT, die für jeden Outputtakt die letzten n (hier n=5, bei CWP n=30) Samples des Inputs (Signal in 6a) addiert. Optimal ist es, die Symbolwerte hier jeweils beim letzten Sample des Binärtaktes abzulesen. Diese Werte sind durch Kreise markiert. Der Binärtakt muss aber zunächst rekonstruiert werden (siehe Text und Figure 7). Hierzu dient der Absolutbetrag des Signals (6c).

Figure 7. Das gesamte Signal r wurde in Segmente der Länge eines Nibbles (60 Samples) zerlegt. Alle Segmente werden links (7a bei SNR = -12 dB und 7c bei -24 dB) als Augendiagramm gezeigt. Horizontal ist die Sample-Nummer innerhalb der Segmente angegeben, vertikal der Absolutwert des Signals. Bei -24 dB gehen die individuellen Punkte des Morsecodes offensichtlich im Rauschen unter. Die Summe aller Segmente zeigt dennoch mit dem jeweiligen Maximum sehr deutlich, bei welchem Index man die Symbole in den Segmenten abtasten sollte (51 bzw 37 in 7b bzw. 7d).

Referenz

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RX Converter for 70MHz (or 50MHz)

by Dr. Peter Brumm, DL7HG - Dr.P.Brumm@gmx.de

Even if the 4m band is not (yet) available for transmit in your country, during the sporadic E season it is very interesting to monitor this band. Especially, monitoring of beacons allows one to make conclusions about the current propagation, MUF etc. The simple receive converter described here is also usable for 6m, with some changed parts. The schematic is shown in Figure 1.

Crystal Oscillator

For a 70MHz converter with an IF of 28MHz, the crystal oscillator is at 42.0MHz (or if the input frequency is 50MHz, the crystal must be at 22.0MHz). In this configuration the crystal's mounting capacitance does not necessarily need to be compensated by an inductor. The output is from the collector (L4), and in order to attenuate other frequencies from the oscillator sufficiently, another tuned circuit (L5-C10) is added, which is coupled sub-critically by a link line (LL). This line is visible in the upper part of Figure 2 as white twisted wire. This kind of coupling has the advantage that one can adjust the level of the coupling quite easily. Also the LC circuits do not need to be in a definite distance from each other. Further details can be found in [2]. The second LC circuit is connected directly to the gate 2 of the mixer transistor, without the normal positive bias voltage. The oscillator voltage after the filter is high enough to drive the mixer for class B operation without any problem.

Negative Feedback in Mixer and RF Amplifier

In the mixer, the source bypass capacitor C9 is 1nF, and should not be larger for a 28MHz output, as a low value allows some negative feedback to reduce the gain at lower frequencies. Also in the preamplifier stage a similar negative feedback was realised with a 470pF capacitor (C2).

Another negative feedback arrangement is at gate 2 of the preamplifier. The blocking capacitor C4 was not connected to ground, but to the cold end of the collector circuit, and also the collector bypass capacitor (C5) was reduced to 1nF. This small amount of negative feedback proved to be necessary after the converter was completed, because the preamplifier tended to self oscillation due to the high Q of the input circuit (L1-C1) at least if there was no antenna connected to load this circuit.

The numbers of turns for the coils that are given in Figure 1 are valid for a coil former of 6mm diameter. All cores must be suitable for VHF; HF cores have too large losses. The input circuit was designed for lowest losses, according to good VHF practice, so the inductor is not tuned by any core. After completion of my receive system, it became obvious that even on 70MHz the limiting factor for sensitivity is antenna noise, and a coil with a core and a fixed capacitor would have been easier (then use 9 turns for 70MHz or 12 turns for 50MHz). I have published my tests about antenna noise on the 6m band in [3] and [4], and the same conclusions are also valid for the 4m band.

The mixer is connected capacitively to the collector circuit of the preamplifier. If this converter is located close to a FM broadcast transmitter, a two-circuit filter would make sense here, to avid distortion in the mixer.

Construction

The assembly was constructed in a simplified chamber style on a single-sided board (Figure 3) [5]. It is convenient to fit all the components of each stage while at least two sides of the chamber are still open, and then to solder on the remaining sides. The soldering points on the board were milled with a small thin grinding disc and a drilling machine, or with a small hand milling machine (Dremel). These tools are also useful for amateurs who etch their boards themselves, because one can make easily alterations and corrections if necessary. The density of parts on the board is not really high, so alterations for tests and improvements are possible.

The overall measurements of 80 x 35 x 30mm are so handy that one can find a place for the converter in many kinds of existing equipment. Otherwise, there is no problem to mount the assembly into a small metal case together with a 9V battery.

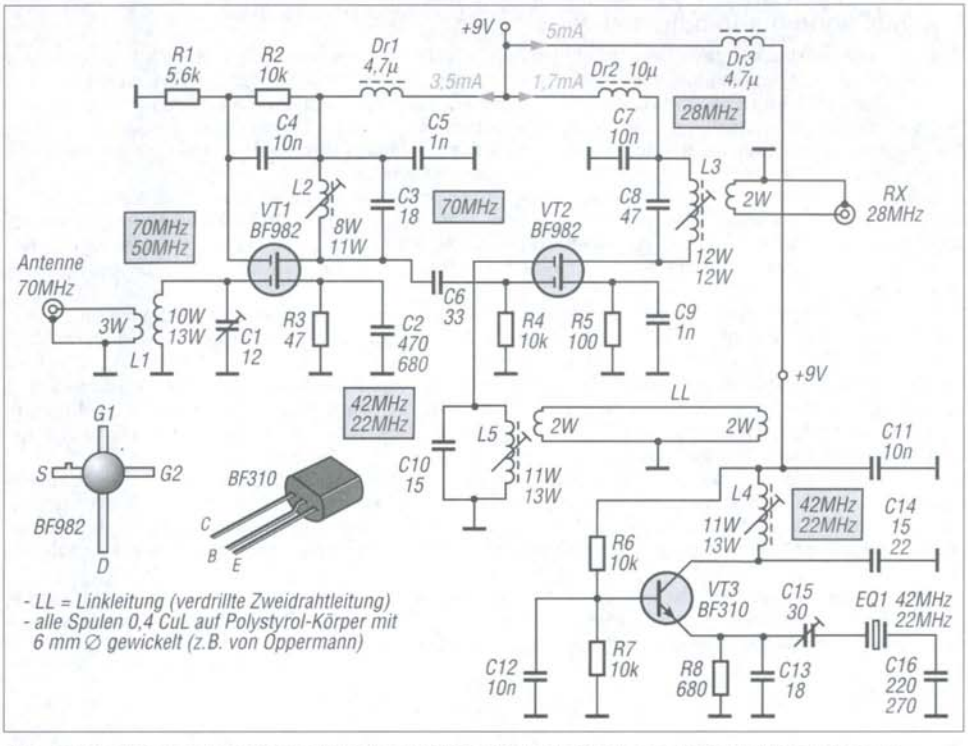

Fig. 1: Circuit diagram with values for 70MHz (upper value) and 50MHz (lower value); LL = Link wire (twisted two-wire line) - All coils from 0.4mm CuL on polystyrene former, 6mm diameter (e.g. from "Opperman"). W = number of turns. – Abb. 1: Schaltbild

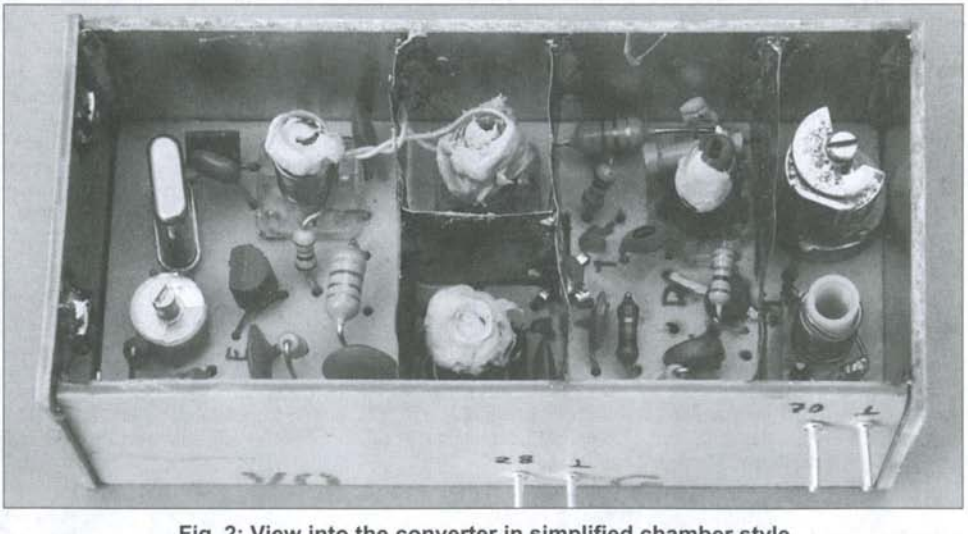

Fig. 2: View into the converter in simplified chamber style
Abb. 2: Blick in den in vereinfachter Kammerbauweise ausgeführten Konverter

Commissioning and adjustment

With any self-constructed equipment "Murphy's Law" is valid. Thus before switching on the power supply one should carefully check the complete circuit again for mistakes. (Hopefully all parts were also checked before mounting them.) Then the converter is connected to a power supply via a milliampere meter. I recommend to use an adjustable power supply where the voltage can be turned down to under 0.7V. Start the check at the smallest voltage, and carefully increase the voltage while watching the current meter. As shown in Figure 1, at 9V the total current should be close to 10mA.

After the check of all DC voltage values at the electrodes of the transistors we start with the AC check. An oscilloscope that displays 70MHz would be the best solution, although an RF voltmeter and a frequency counter will also do the work. It is very useful to use a piece of coaxial cable that ends with a coil of a few turns of insulated wire. With this as a probe, one can check very quickly which LC circuit oscillates on which frequency.

In most cases Murphy makes it happen that all amplifying stages oscillate instantly but the oscillator does not! By alternate tuning of C15 series with the crystal, and the collector LC circuit, one will find a state where the oscillator works stably and also starts to oscillate reliably.

For the final tuning a weak signal has to be supplied to the input. For this we need a signal source with a not too high amplitude on 70MHz. In case of need, a harmonic of any RF oscillator will also do. The output of the converter should be connected to any 28MHz receiver with an S meter, and all LC circuits except the oscillator are tuned for maximum S-meter reading.

It may be found that the core of L5 at gate 2 of the mixer has no influence on the output voltage over a wide range. This means that the link line is coupled too tightly, and transfers too much oscillator voltage. By slowly moving the coupling coil away from the LC circuit until the signal starts to drop, and then repeaking L5 to resonance, one can find the best adjustment for the mixer gain and spurious signal suppression.

Finally, all cores should be fixed with a small piece of modelling clay or chewing gum. One can see the pressed pieces of modelling clay as white spots in Figure 2. A strong adhesive would be fatal here because then the cores could never be adjusted again for a correction.

Antenna

The construction of a vertical antenna with 3, 4 or more radials has been described several times in the literature and does not need to be repeated extensively here [6]. Only some hints may be useful. As the length of the elements is about 1m, self-supporting tubes can be used without any problems. Length and bandwidth of the radiator depends very much from the diameter. The shortening factor can be determined from a diagram in [7]. A plastic cube (e.g. from PVC) of 5 to 8cm edge length may be used as the centre insulator. Then we can use 4 radials which fit in holes drilled into the sides. On the top, the radiator is also plugged into a drilled hole. All the tubes can then be fixed with screws in threaded holes. Length and diameter of the radials are not critical. With 5 to 10mm diameter the length should be about 105 to 107cm. The coaxial feedline can be connected simply with hose clamps on the tubes. My antenna has a vertical radiator of 18mm diameter and a bandwidth of 10MHz for a VSWR of 2 at maximum.

Amazingly my 10m GP, although highly mismatched, delivers the same signal levels. This is probably caused by the 2.5 x larger effective antenna area. So before building anything specifically for 70MHz, one should try any existing antennas. If there is one that produces a reasonable increase in noise when plugged into the converter (compared with a 50Ω termination at the input), then a new antenna may not be necessary for simple receiving at 70MHz. The only improvements would be gained from directional antennas.

First observations

At my QTH on the countryside, in most cases the antenna noise level on 70MHz is about 5dB over the noise of the converter. Sometimes it rises up to over 10dB. Also some weak carriers and snarling noises are detectable. When propagation is enhanced to the east (UA, UR) strong signals occur which are 100 to 150kHz wide and probably caused by wide FM BC stations. They are often S9 and stronger. Also I could hear amateur radio stations from SV and 9A via Es.

Also for the 6m Band!

With a few alterations the above described converter is also usable for the 6m band. This is not just inter-

esting for radio amateurs who are completely new to the band. Such a separate unit can be also useful as a second RX when waiting for an opening in the Es season (from May to August). The alterations are shown in Figure 1 under the value for 70MHz. A simple antenna can also be constructed for 6m in the same way as described above. The length of the radials then should be 150 to 155cm. The length of the radiator can be obtained again from [7].

With vertically polarized antennas one can hear signals via Es, MS and Aurora very well as the polarization is very often twisted in these modes. For monitoring tropo signals (e.g. the beacons OZ7IGY or LX0SIX) a horizontally polarized antenna is mandatory.

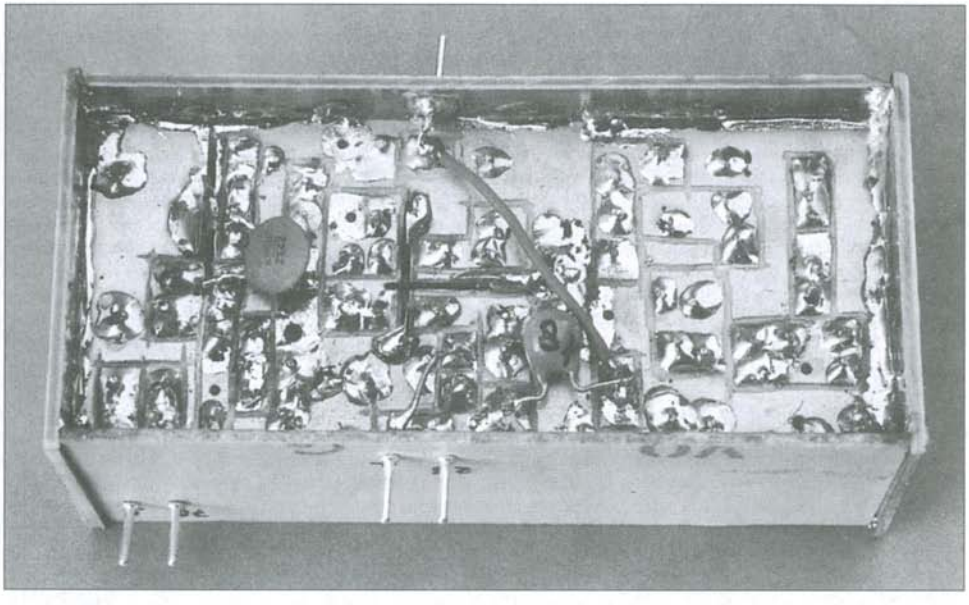

Fig. 3: Detailed view of the bottom side of the circuit board with milled lines.
Abb. 3: Detailansicht der Unterseite des Konverters mit gefrästen Leiterzügen

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Konverter für 70MHz – Rüsten für das 4-m-Band

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Egal, ob das 4-m-Band für uns sendemäßig freigegeben wird oder nicht – während der Es-Saison lohnt sich ein Hineinhören allemal. Besonders das Beobachten von Baken lässt Rückschlüsse auf Ausbreitungsbedingungen zu. Der hier gezeigte Empfangskonverter ist mit geänderter Bestückung auch im 6-m-Band einsetzbar.

Für meine Empfangsversuche habe ich mir einen einfachen Konverter und eine Groundplane-Antenne gebaut. Ersterer setzt von 70 auf 28 MHz um und passt daher vor jeden 10-m-Empfänger. Bild 1 zeigt eine einfache, auch auf anderen Frequenzen vielfach bewährte Schaltung. Sie enthält Vorverstärker, Mischer und einen Oberwellenquarzoszillator mit einem 42-MHz-Quarz [1]. Dessen Halterungskapazität braucht in dieser Anordnung nicht unbedingt durch eine Induktivität kompensiert werden.

Zweikreisfilter zum Verringern der Nebenwellen

Um die unvermeidlichen weiteren Frequenzen, die der Oszillator erzeugt, hinreichend zu dämpfen, ist dem Kollektorkreis ein weiterer Schwingkreis nachgeschaltet, der unterkritisch mit einer Linkleitung LL gekoppelt ist. Sie ist im Bild 2 als gelbe verdrillte Leitung zu erkennen. Diese Art der Kopplung hat den Vorteil, dass man den Kopplungsgrad leicht einstellen kann. Außerdem müssen die Schwingkreise nicht in bestimmtem Abstand beieinander stehen, weil die Länge der Linkleitung beliebig ist. Weitere Einzelheiten dazu sind in [2] nachzulesen. Der zweite Schwingkreis ist direkt mit dem zweiten Gate des Mischtransistors verbunden, ohne die sonst übliche Vorspannung. Die hohe Oszillatorspannung steuert den Mischer auch nach dem Filter noch ohne Weiteres im B-Betrieb durch. Der Kondensator C9 ist mit 1 nF nicht größer als unbedingt nötig für 28 MHz. So dämpft diese Gegenkopplung tiefere Frequenzen. Auch in der Vorstufe ist eine solche Gegenkopplung, dort mit C2 = 470 pF, realisiert.

Gegenkopplung über das zweite Gate

Eine weitere Gegenkopplung, diesmal für die Betriebsfrequenz, geht zum zweiten Gate des Vorstufentransistors. Der Abblockkondensator C4 wurde nicht auf Masse, sondern an das kalte Ende des Kollektorkreises gelegt und dessen Abblockkondensator C5 auf 1 nF verkleinert. Diese schwache Gegenkopplung erwies sich nach fertigem Aufbau als notwendig, weil die Stufe durch den auf hohe Güte gezüchteten Eingangskreis zu Schwingungen neigte, jedenfalls wenn keine Antenne den Kreis dämpfte. Dieser Schwingkreis wurde nämlich nach gutem UKW-Brauch ohne Kern auf möglichst geringe Verluste ausgelegt, um das Antennensignal vor der ersten Rauschquelle, dem Transistor, möglichst wenig zu dämpfen. Nach Fertigstellung der Empfangsanlage zeigte sich jedoch, dass das Antennenrauschen auch auf diesem Band die empfindlichkeitsbestimmende Größe ist und eine Kernspule mit Festkondensator wohl einfacher gewesen wäre (dann 9 bzw. 12 Wdg.). Über Untersuchungen des Antennenrauschens im 6-m-Band habe ich in [3] und [4] berichtet. Die dort gewonnenen Erkenntnisse gelten auch für das 4-m-Band. Der Mischer ist kapazitiv mit dem Kollektorkreis der Vorstufe verbunden. Falls das Gerät in der Nähe starker UKW-Rundfunksender betrieben werden soll, wäre hier ein Zweikreisfilter sinnvoll, das Störungen vom Mischer fernhält.

Vereinfachte Kammerbauweise

Der Aufbau erfolgte in der vereinfachten Kammerbauweise [5]. Dabei ist es zweckmäßig, zuerst die einseitig kaschierte Bauteilplatine zu bestücken und dann erst die Trennbleche und Wandungen einzulöten. Die Lötstützpunkte auf der Platine wurden bequemerweise mit einer kleinen dünnen Schleifscheibe und einer Multibohrmaschine oder Dremel herausgefräst (Bild 3). Diese Hilfsmittel sind selbst für diejenigen Bastler nützlich, die ihre Platinen ätzen, denn sie können für etwaige Änderungen nachträglich zum Einsatz gelangen. Die in Bild 1 genannten Windungszahlen gelten für Spulenkörper mit 6 mm Durchmesser. Alle Spulenkerne müssen UKW-tauglich sein; KW-Kerne haben zu große Verluste.
Die Bauteildichte ist nicht allzu groß, sodass auch hier nachträgliche Änderungen für Verbesserungsversuche etc. möglich sind. Trotzdem sind die Abmessungen mit 80 mm x 35 mm x 30 mm noch so handlich, dass sich in vielen Geräten ein Plätzchen zum nachträglichen Einbau findet. Anderenfalls ist der Einbau in ein kleines Metallgehäuse zusammen mit einer 9-V-Batterie ebenso unproblematisch.

Inbetriebnahme und Abgleich

Auch für jedes selbstgebaute Gerät gilt „Murphys Law". Deshalb vor dem Einschalten der Stromversorgung noch einmal die gesamte Schaltung auf Fehler durchgehen. (Die Bauteile selbst wurden hoffentlich vor dem Einbau auf Funktionstüchtigkeit geprüft.) Dann erst den Eigenbau mit der Stromversorgung über ein Milliamperemeter verbinden. Besonders empfehlenswert ist eine einstellbare Spannungsquelle, die bis unter 0,7 V einstellbar ist. Mit dem kleinsten Wert beginnt die Prüfung. Unter Beobachten des

Strommessers wird die Spannung langsam hochgedreht, bis 9 V erreicht sind.
Nach Kontrolle aller Gleichspannungswerte an den Transistor-Elektroden beginnt die Wechselstromprüfung. Dazu ist ein noch 70 MHz anzeigendes Oszilloskop am besten geeignet. Doch auch mit HF-Voltmeter und Frequenzzähler gelangt man ans Ziel. Sehr zweckmäßig ist ein Stück Koaxialkabel, das in einer Spule aus wenigen Windungen isolierten Drahtes endet. Mit ihr als Sonde lässt sich schnell feststellen, welcher Schwingkreis auf welcher Frequenz schwingt.
Meist sorgt Murphy dafür, dass die Verstärkerstufen auf Anhieb schwingen, während der Oszillator genau dieses nicht tut. Jedoch durch wechselseitiges Abstimmen der Serienkapazität und des Kollektor-Schwingkreises findet sich ein Schwingungszustand, bei dem der Oszillator stabil arbeitet und auch sicher anschwingt. Für den endgültigen Abgleich ist ein schwaches Signal am Eingang einzuspeisen. Dafür ist ein Signalgeber mit nicht zu hoher Amplitude bei 70 MHz erforderlich. Notfalls tut es die Oberwelle irgendeines Oszillators im KW-Bereich. Der Ausgang des Konverters wird mit einem 10-m-Empfänger verbunden, der ein S-Meter besitzt. Nun sind alle Schwingkreise, außer dem des Oszillators, auf maximalen S-Meter-Ausschlag abzustimmen.
Dabei zeigt sich möglicherweise, dass der Kern des Schwingkreises am zweiten Mischer-Gate über einen weiten Bereich keinen Einfluss auf die Ausgangsspannung hat. Dann ist die Linkleitung zu fest gekoppelt und überträgt zuviel Oszillatorspannung. Durch langsames Entfernen der Koppelspulen von den Schwingkreisspulen, bis das Signal abzusinken beginnt, und nachträgliches Abstimmen des Kreises auf Resonanz lässt sich der günstigste Punkt der Abstimmung sowohl in Hinblick auf die Mischverstärkung wie auch auf die Nebenwellenunterdrückung erreichen.
Zum Schluss sind alle Kerne mit je einem kleinen Kügelchen von Knete oder Kaugummi festzulegen. Die breitgedrückten Knetestückchen sind in Bild 2 als weiße Flecken sichtbar. Klebstoff wäre hier fatal, weil die festgeklebten Kerne keine nachträgliche Korrektur des Abgleich zulassen.

Die Antenne

Der Bau einer Vertikalantenne mit drei, vier oder noch mehr Radials ist in der Literatur wiederholt beschrieben und muss daher nicht in aller Ausführlichkeit wiederholt werden [6]. Lediglich einige Tipps sind vielleicht von Nutzen. Da die Länge der einzelnen Elemente bei 1 m liegt, lassen sich ohne Weiteres freitragende Rohre verwenden. Ein Kunststoffklotz (z.B. aus PVC) von 5 bis 8 cm Kantenlänge ist als tragender Isolator geeignet. Dabei ergeben sich vier Radials von selbst, die in passende seitliche Bohrungen gesteckt werden. Auf der Oberseite wird der Strahler ebenfalls in eine Bohrung gesteckt. Mit Schrauben in radialen Gewindelöchern lassen sich die Rohre festklemmen. Länge und Durchmesser der Radials sind nicht kritisch. Bei 5 bis 10 mm Durchmesser sollte die Länge 105 bis 107 cm betragen. Die Länge und die Bandbreite des vertikalen Strahlers hängt wesentlich vom Durchmesser ab. Der Verkürzungsfaktor lässt sich aus einem Diagramm in [7] bestimmen. Die koaxiale Zuleitung kann einfach mit Schlauchschellen an den Rohren befestigt werden.
Meine Antenne hat einen Vertikalstrahler mit 18 mm Durchmesser und weist eine Bandbreite von 10 MHz für ein Stehwellenverhältnis von höchstens s = 2 auf. Erstaunlicherweise liefert meine 10-m-Groundplane trotz starker Fehlanpassung die gleichen Signalspannungen. Das liegt vermutlich an der zweieinhalbmal höheren wirksamen Antennenfläche.
Probieren Sie deshalb erst einmal Ihre vorhandenen Antennen aus. Finden Sie eine, die ein merklich höheres Rauschen als das des Konverters (mit 50-Ω-Abschlusswiderstand am Eingang!) allein produziert, so erübrigt sich ein Neubau. Dann sind Verbesserungen nur noch mit gewinnbringenden Richtantennen möglich.

Erste Beobachtungen

Meistens liegt das Antennenrauschen bei 5 dB über dem Konverterrauschen, jedenfalls bei meinem QTH auf dem Lande. Allerdings steigt es machmal bis über 10 dB an. Außerdem sind einige schwache Träger und schmalbandige „Knurrlaute" zu vernehmen. Bei Überreichweiten nach Osten (UA, UR) erscheinen heftige Störungen, die 100 bis 150 kHz breit sind und offenbar von Rundfunkstationen mit Breitband-FM stammen. Sie erreichen leicht S9 und mehr. Bei einer ES-Wolke, die wohl über OK/OE lag, konnte ich Amateurstationen aus SV und 9A hören.

Und auch für das 6-m-Band!

Das oben beschriebene Gerät lässt sich mit wenigen Änderungen auch als 50-MHz-Konverter verwenden. Das ist nicht nur für Funkamateure interessant, die noch gar keine Tuchfühlung mit dem 6-m-Band genommen haben. In der ES-Saison (etwa Ende Mai bis Anfang August) kann so ein separates Gerät beim Warten auf die nächste Bandöffnung sehr nützlich sein! Die Änderungen sind in Bild 1 unter dem Wert für 70 MHz angegeben. Eine behelfsmäßige Antenne kann für 6 m ebenso einfach gebaut werden. Die Länge der Radials beträgt dann 150 bis 155 cm. Der Länge des Strahlers ergibt sich wiederum aus [7].
Mit vertikal polarisierten Antennen lassen sich gut ES-, MS- und Aurora-Signale hören, weil die Polarisationsebene bei diesen Ausbreitungsarten ohnehin verdreht wird. Zur Beobachtung von Troposignalen (z.B. der Baken OZ7IGY und LX0SIX) ist jedoch eine horizontal polarisierte Antenne erforderlich.

Literatur und Bezugsquellen

Siehe oben am Ende des englischen Textes.

The DUBUS Web Portal

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In 2007 a group of students from the Fachhochschule Münster led by Prof. Dr. Dirk Fischer developed and programmed a web portal for DUBUS. The main purpose was the creation of a database of active European microwave DXers, an online beacon database and an online toplist. Here I want to give a short introduction and show the features of the pages.

1. Registration and log in

If you go to the DUBUS website on www.DUBUS.org you will find a link to the DUBUS Portal. Please open this link in a NEW window. This is important as otherwise some browser versions do not allow a proper registration! You will see the entry page as shown in Fig. 1. Click on Registration and answer the questions (see Fig. 2) and you will get your password instantly via email. Then log in. If you have lost your password you can use the lost password function on the log in page or send an email to DUBUS asking for a new password.

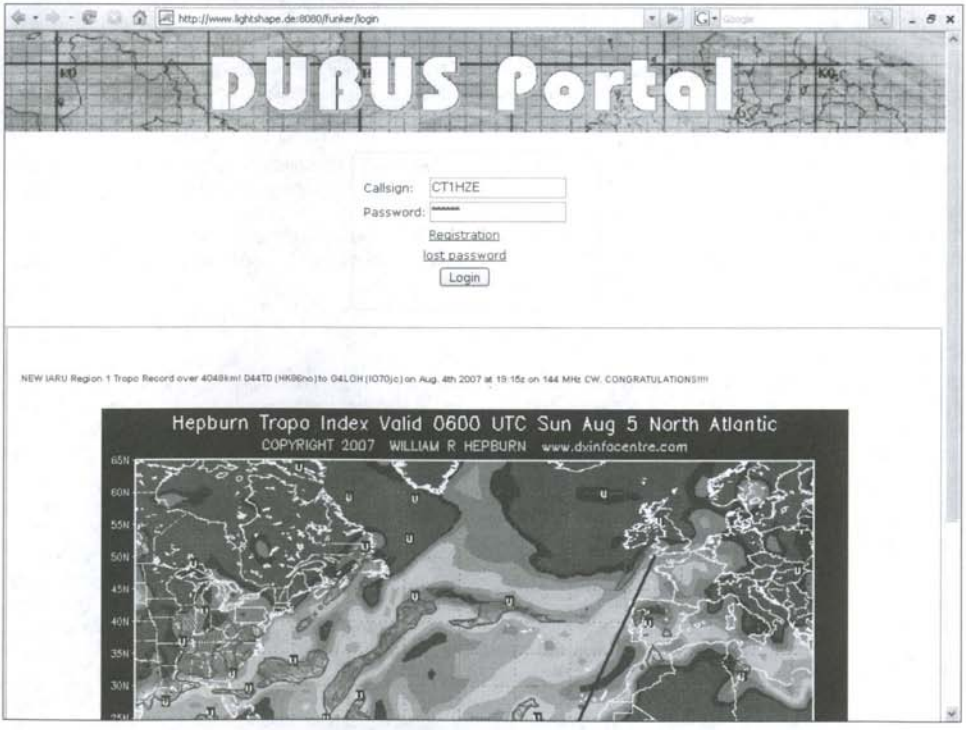


Fig. 1 DUBUS portal entry page

The picture on the entry page may change at times according to relevant events on VHF/UHF/SHF. If you have a nice picture for this page please submit it.

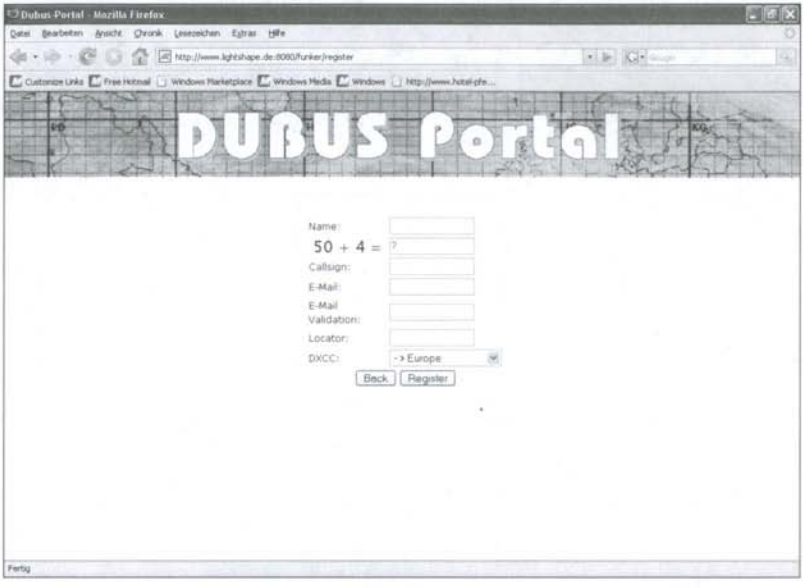


Fig. 2 DUBUS portal registration page

2. News Page

After logging in you will see the News Page (see Fig. 3) where general news is displayed. You can select other pages from the toolbar at the top.

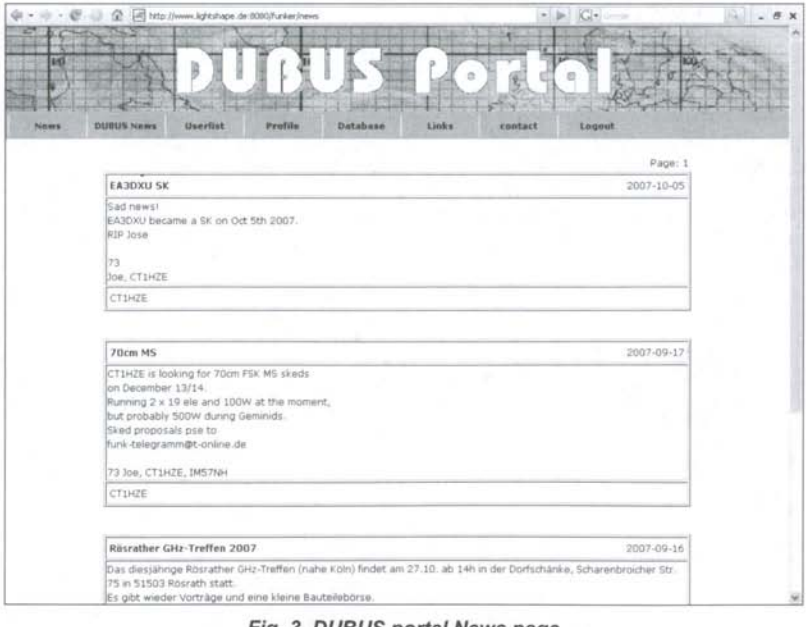


Fig. 3 DUBUS portal News page

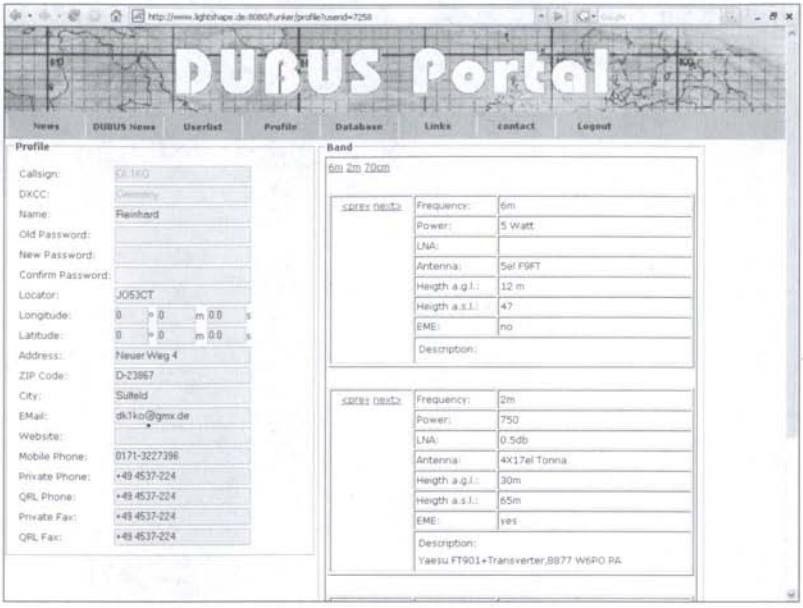


Fig. 4 DUBUS portal Profile page

3. Profile Page

Now go to Profile (see Fig. 4). Here you can complete your address and contact data and enter a new password. You can add your complete station description for any of the bands you are qrv on and even upload pictures. You can leave all necessary data in case you want to be called or alerted by someone if there are Tropo openings etc. Of course, EME stations are also welcome to register and there is a filter in the database to search for them. All this data is accessible to anyone who is registered at the DUBUS portal!

4. Database Page

Fig. 5 shows the initial database page. After registration you have instant access to the public database of registered VHF UHF SHF and EME operators. If you are a DUBUS subscriber, you will also have access to the Toplist and Beacon databases within 24 hours of registration. You will also be able to view the DUBUS News (see toolbar) where internal news for DUBUS subscribers is published. In the different databases for VHF UHF SHF and EME you can make searches with filters for different callsigns, locators, DXCC and band. See Fig. 6.

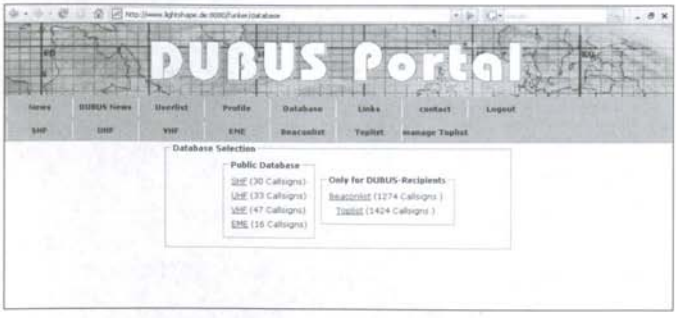


Fig. 5 DUBUS portal Database start page

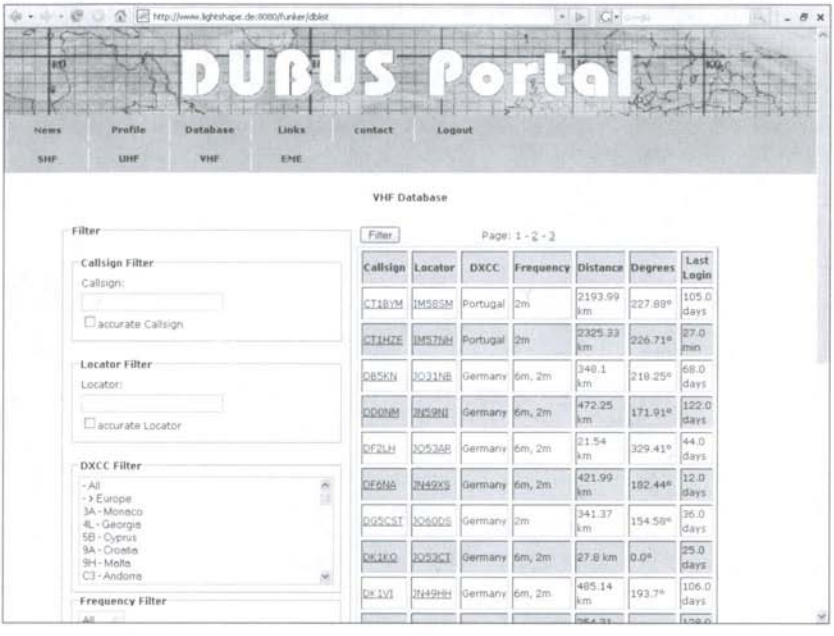


Fig. 6 DUBUS portal VHF Database with filters

5. Beacons

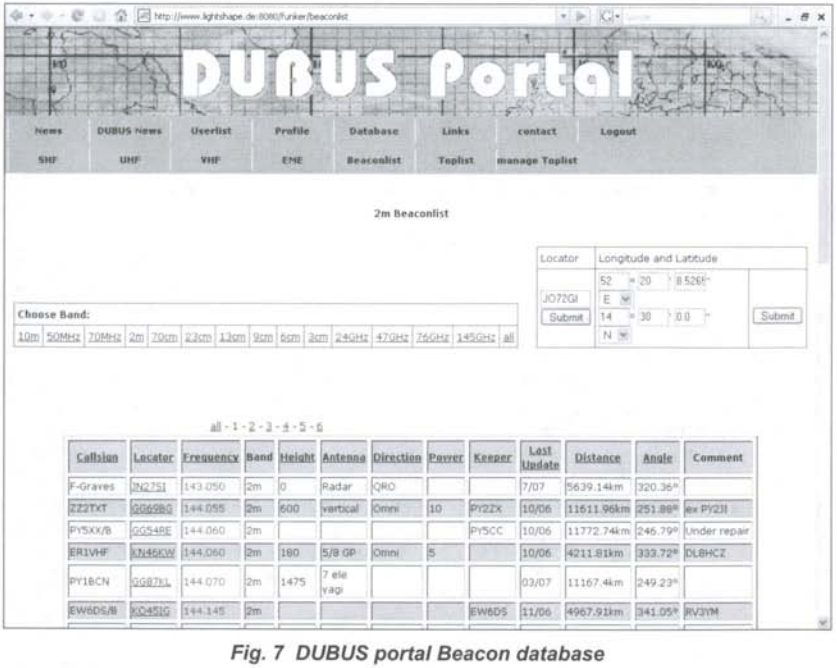


Fig. 7 DUBUS portal Beacon database

Fig. 7 shows the beacon database page. You can select a different database for each band from 50 MHz to 145 GHz. You can sort the complete list by any of the column titles. For example Callsign, Locator, Frequency, Height, Antenna, Direction, Power, Keeper, Distance (to your QTH), Azimuth (from your QTH). Distance and Azimuth are displayed correctly only if you have entered your correct locator in the Profile page, of course. If you click on any of the locators of the beacon entries you will see displayed a new window with a Google Map © that shows the path from your QTH to the beacon`s location. You can zoom into this map, of course. See Fig. 8.

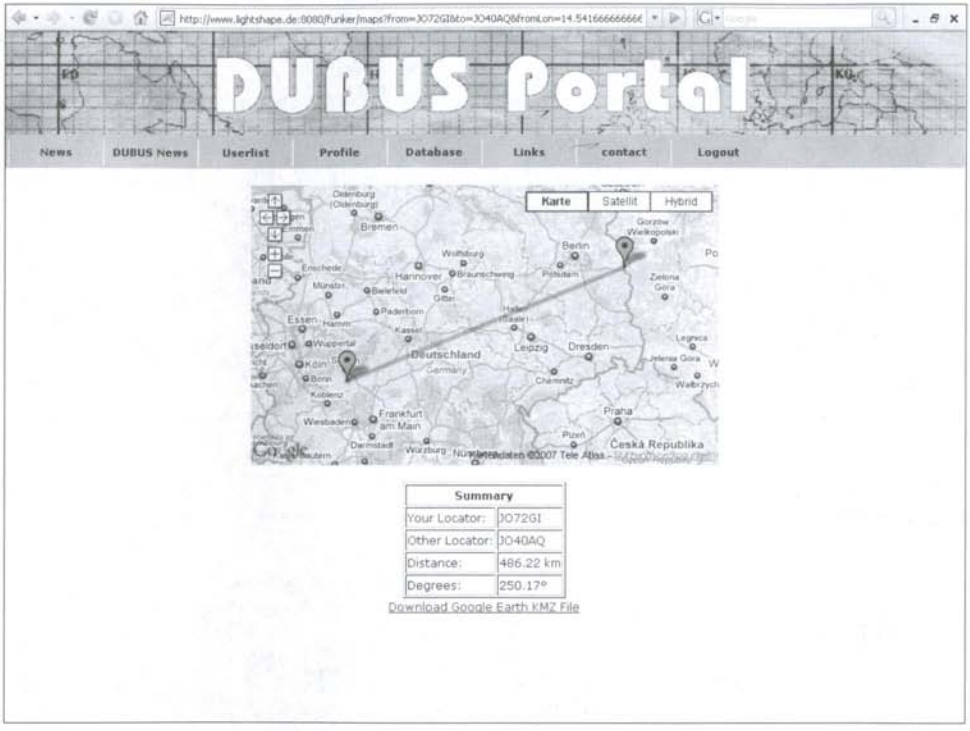


Fig. 8 DUBUS portal Beacon database – with Google Map ©

On the bottom of this page (see Fig. 8) you will find a link to a Google Earth © KMZ-file. By clicking on this link you can either download this file to your hard disk or directly start it with the Google Earth © software. You need Google Earth © installed on your PC if you want to use this KMZ-file. The result is a nice display of the real path between your QTH and the beacon`s QTH. You can zoom in and check the details of the path, look for path obstructions etc. This is quite nice for checking paths for microwave propagation etc. There is also the possiblilty of entering another locator of your choice on the bottom of the beacon list to display and check the path to other stations. Be aware that due to the type of map the paths in Google Maps © are not displayed properly, especially when east to west paths are chosen. The longer these paths are and the more they deviate from north south direction the worse is the error of the path in Google Maps ©! For checking the true path in detail you should always use Google Earth ©. See Fig. 9 as an example. In order to get very accurate maps you can enter your exact geographical coordinates in your profile. If they are entered they will be used automatically for map calculations. Also, the coordinates of a beacon can be entered by the webmaster in addition to the locator. We still need the GPS coordinates (deg., min, sec) for most of the beacons and hope that the keepers will send them to us soon. In the main toolbar there is a Contact button. You can use this form to send an instant email message to the webmaster if you want to send any corrections or additional information regarding the beacon lists (or anything else, of course) to DUBUS. Normally the lists are updated once per day! Please make use of this tool often!

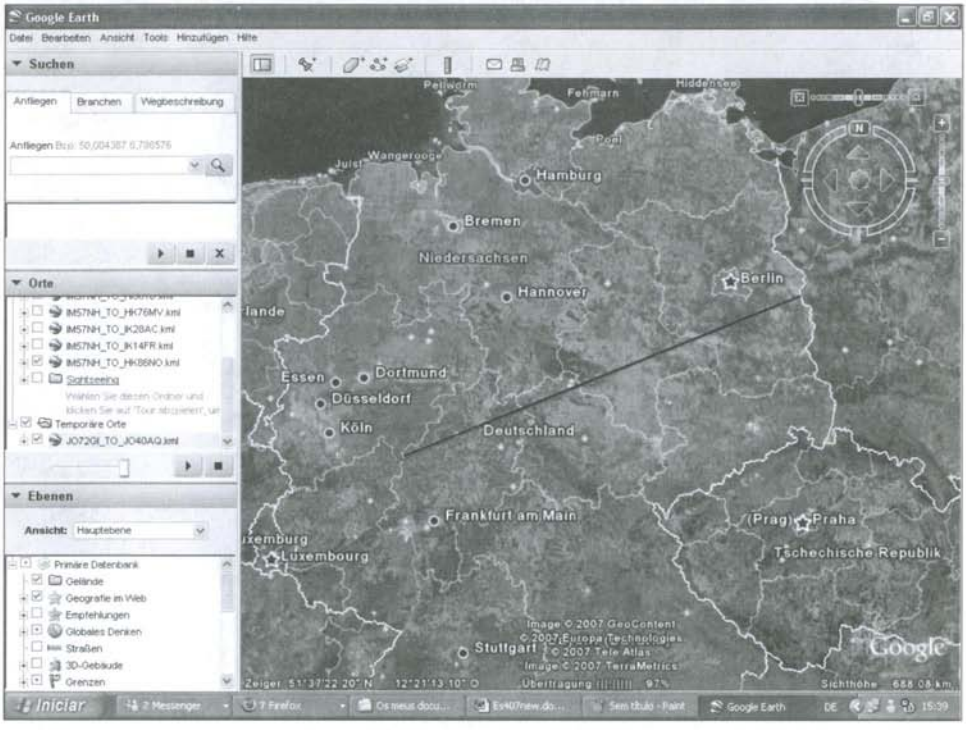


Fig. 9 Google Earth© map with a true path from JO40AQ (DA5DUB) to JO72GI (DK3WG)

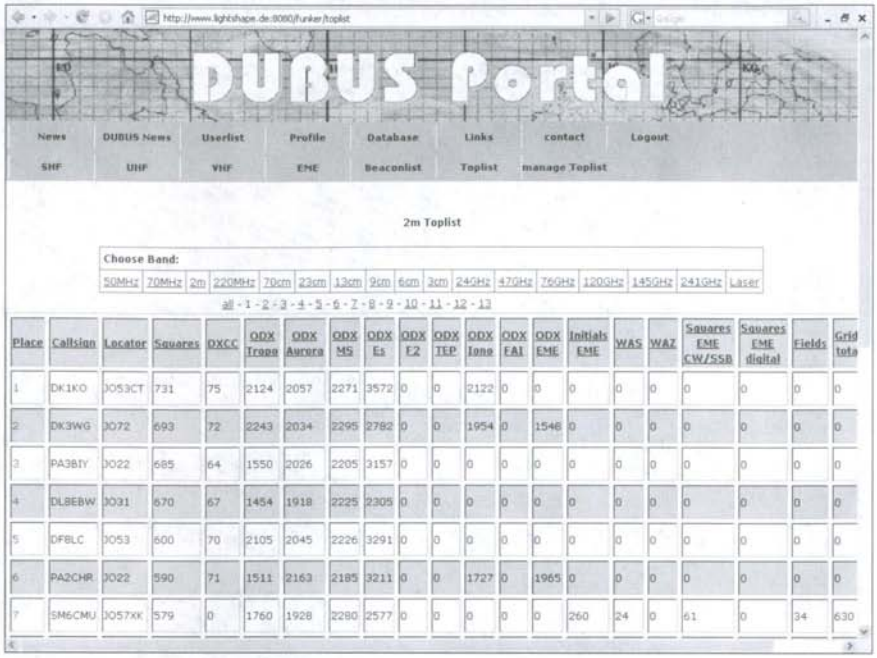
6. Toplists

If you choose Toplist on the toolbar you get the 2m toplist displayed, see Fig. 10. Now you can choose any other toplist from 50 MHz to Laser. You can sort the lists by any of the column headings like place, callsign, squares, DXCC, ODX etc. This can be quite informative if you look for special things. There is also a feature (see below) that allows you to include the specific QSO data for the listed ODX. If the ODX figure is shown in blue you can click on it and get the QSO data displayed.
You can include, change and update YOUR toplist entry and data yourself online by clicking on manage Toplist in the toolbar. Select band, then select edit, enter your data and finish again with edit. See Fig. 11. If you have any problems with this procedure you are always welcome to send your entry or updates with the contact form or via normal email, of course and we will update your entry.

7. What else?

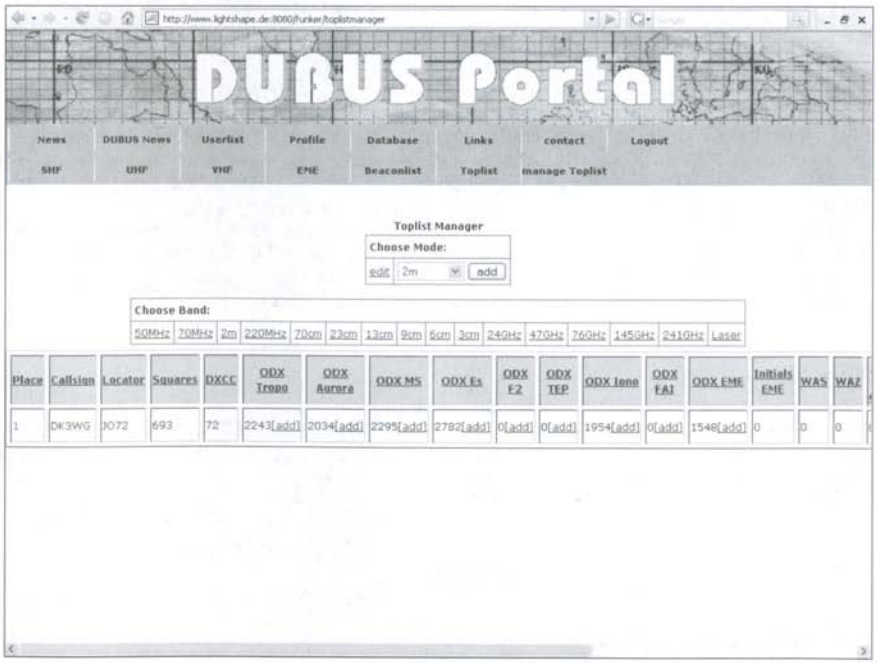
In the toolbar there is also a Links button. We have listed a few links which may be of interest. If you have more suggestions please send them to us via the contact form or via email. Thank you!
Of course, a lot of more features could be added to this portal. But first we want to get some feedback and see if there is really demand for such a portal or not.
Use it or lose it – no, we will be not that strict ☺.

73
Joe, CT1HZE/DL8HCZ funk-telegramm@t-online.de



Place	Callsign	Locator	Squares	DXCC	ODX Tropo	ODX Aurora	ODX MS	ODX Es	ODX E2	ODX TEP	ODX Ione	ODX FAI	ODX EME	Initials EME	WAS	WAZ	Squares EME CW/SSB	Squares EME digital	Fields	Grid tota
1	DK1KO	JO53CT	731	75	2124	2057	2271	3572	0	0	2122	0	0	0	0	0	0	0	0	0
2	DK3WG	JO72	693	72	2243	2034	2295	2782	0	0	1954	0	1546	0	0	0	0	0	0	0
3	PA3BIY	JO22	685	64	1550	2026	2205	3157	0	0	0	0	0	0	0	0	0	0	0	0
4	DL8EBW	JO31	670	67	1454	1918	2225	2305	0	0	0	0	0	0	0	0	0	0	0	0
5	DF8LC	JO53	600	70	2105	2045	2226	3291	0	0	0	0	0	0	0	0	0	0	0	0
6	PA2CHR	JO22	590	71	1511	2163	2185	3211	0	0	1727	0	1965	0	0	0	0	0	0	0
7	SM6CMU	JO57XK	579	0	1760	1928	2280	2577	0	0	0	0	0	260	24	0	61	0	34	630

Fig. 10 DUBUS portal Toplist database



Place	Callsign	Locator	Squares	DXCC	ODX Tropo	ODX Aurora	ODX MS	ODX Es	ODX E2	ODX TEP	ODX Ione	ODX FAI	ODX EME	Initials EME	WAS	WAZ
1	DK3WG	JO72	693	72	2243[add]	2034[add]	2295[add]	2782[add]	0[add]	0[add]	1954[add]	0[add]	1548[add]	0	0	0

Fig. 11 DUBUS portal Toplist manager

Das DUBUS Web-Portal

von Joachim Kraft, DL8HCZ/CT1HZE - funk-telegramm@t-online.de

Im Jahr 2007 hat eine Gruppe von Studenten der Fachhochschule Münster unter Anleitung von Prof. Dr. Dirk Fischer ein Web-Portal für DUBUS entwickelt und programmiert. Sinn des Portals sollte vor allem die Schaffung einer Datenbank der europäischen Mikrowellen-DXer, einer Online-Bakenliste und einer Online-Topliste sein. Hier soll eine kurze Einführung in die Seiten gegeben werden und die Möglichkeiten, die geboten werden, aufgezeigt werden.

1. Registrierung und Einloggen

Auf der DUBUS.org Webseite findet man einen Link auf das DUBUS-Portal. Bitte diesen Link in einem neuen Fenster öffnen. Das ist wichtig, weil es bei einigen Browser-Versionen sonst eventuell Probleme mit der Registrierung geben könnte. Die Seite Einlog-Seite ist in Abb. 1 gezeigt. Dann auf Registration klicken und die Fragen entsprechend beantworten, siehe Abb. 2. Man bekommt dann sofort ein Passwort per email zugeschickt. Dann kann man sich einloggen. Falls man sein Passwort verloren hat, kann man über die Lost-Password-Funktion ein neues Passwort anfordern, das an die hinterlassene Email-Adresse geschickt wird. Man kann auch bei DUBUS per normaler Email ein Passwort „von Hand" anfordern, falls es Probleme geben sollte.
Das Bild auf der Einlog-Seite kann sich von Zeit zu Zeit je nach aktuellem Anlaß ändern. Für die Zusendung von geeigneten Bildern dafür sind wir immer dankbar.

2. News Seite

Nach dem Einloggen erscheint als erstes die News Seite, siehe Abb. 3. Hier werden einige aktuelle Nachrichten angezeigt. Die anderen Seiten des Portals kann man in der Leiste oben anklicken.

3. Profile Seite

Nun klickt man auf Profile (siehe Abb. 4). Hier kann man seine Adress-Daten komplettieren und auch das eigene Passwort ändern. Man kann seine komplette Stationsbeschreibung eingeben, getrennt für jedes Band und sogar Fotos hochladen. Man kann alle nötigen Daten hinterlassen, falls man z.B. bei einer Tropo-Öffnung von einem potentiellen Skedpartner alarmiert werden will. Auch reine EME-Stationen können sich gerne eintragen. In der Datenbank gibt es eine Filterfunktion, um nach diesen gezielt zu suchen. Alle diese Daten sind nur sichtbar für Stationen, die sich auch im DUBUS-Portal angemeldet haben. Das hat u.a. den Vorteil, daß die eigene Email-Adresse und die persönlichen Daten vor Spamern und sonstigen Schnüfflern im Web geschützt sind.

4. Datenbank Seite

Abb. 5 zeigt die Anfangsseite der Datenbanken (Database). Nach der erfolgreichen Registrierung hat man sofort Zugriff auf die öffentliche Datenbank der registrierten VHF/UHF/SHF- und EME-OPs. Innerhalb 24 Stunden wird man auch für die Toplisten und Bakenlisten freigeschaltet, sofern man DUBUS-Bezieher ist. Dann kann man auch die Rubrik DUBUS-News sehen, in der interne Nachrichten für DUBUS-Abonennten angeboten werden. In den verschiedenen Datenbanken für VHF, UHF, SHF und EME kann man nach Rufzeichen, Locator, DXCC und QRG suchen und filtern. Siehe Abb. 6.

5. Baken

Abb. 7 zeigt die Seite der Bakendatenbank. Man kann die verschiedenen Listen der Bänder von 50 MHz bis 145 GHz anklicken. Man kann die Listen komplett neu sortieren nach den einzelnen Spalten, z.B. Ruf-

zeichen, Locator, QRG, Höhe, Antenne, Richtung, Leistung, Sysop, Entfernung zum eigenen QTH, Antennenrichtung vom eigenen QTH. Entfernung und Antennenrichtung werden natürlich nur korrekt angezeigt, wenn man im Profil den richtigen eigenen QTH-Locator eingetragen hat. Wenn man auf die Locatoren der Baken in der Liste klickt, erscheint ein neues Fenster mit einer Karte von Google Maps©, die den Pfad vom eigenen QTH zur Bake anzeigt. Man kann natürlich in die Karte hinein zoomen. Siehe Abb. 8. Unten auf dieser Seite (siehe Abb. 8) befindet sich ein Link auf eine Google Earth© KMZ-Datei. Wenn man darauf klickt, kann man diese Datei herunterladen bzw. mit der Google Earth©-Software direkt starten. Man muß natürlich Google Earth© auf dem Rechner installiert haben, wenn man dieses KMZ-File nutzen will. Das Ergebnis ist die schöne Anzeige der echten Strecke zwischen eigenem QTH und Baken-QTH. Man kann hinein zoomen und die Details des Funkpfades anschauen, nach Hindernissen gucken usw. Das ist ganz nett, wenn man die Pfade bei Mikrowellenausbreitung testen möchte. Auch gibt es die Möglichkeit, unten auf der Seite der Bakenlisten einen frei wählbaren Locator einzugeben, um z.B. den Pfad zu einer Gegenstation oder neuen Bake anzuschauen. Man sollte sich bewußt sein, daß aufgrund der Kartenprojektion die Darstellung des Pfades bei Google Maps© nicht korrekt erfolgt, insbesondere bei Pfaden in Ost-West-Richtung. Das liegt an der Art der Kartenprojektion. Je länger der Pfad ist und je mehr er von der Nord-Süd-Richtung abweicht, desto größer ist der Fehler in der Darstellung bei Google Maps©! Um den genauen Pfad im Detail zu sehen, muss man immer Google Earth© verwenden! Siehe als Beispiel Abb. 9. Um sehr genaue Karten zu bekommen, gibt es die Möglichkeit, im eigenen Profile auch die genauen geographischen Daten einzugeben. Diese werden dann automatisch bei der Erzeugung der Karten berücksichtigt. Auch können diese Koordinaten vom Webmaster bei jeder Bake eingegeben werden. Wir benötigen aber diese Koordinaten noch für viele der Baken und hoffen, daß die Sysops uns diese bald schicken (GPS-Koordinaten in Grad, Minuten, Sekunden). In der Leiste oben befindet sich auch ein Feld Contact. Damit kann direkt eine Mitteilung an DUBUS geschickt werden, um z.B. Korrekturen und Updates für die Bakenliste umgehend mitzuteilen. Wir hoffen, daß davon viel Gebrauch gemacht werden wird. Natürlich kann dieses Formular für Mitteilungen aller Art genutzt werden. Im Normalfall erfolgt eine tägliche Aktualisierung der Bakenliste, sofern Änderungen vorliegen.

6. Toplisten

Wenn man Toplist in der Auswahlleiste anklickt, bekommt man die 2m-Topliste angezeigt. Siehe Abb. 10. Nun kann man auch jede andere Topliste von 50 MHz bis Laser anklicken. Man kann in jeder der Listen sortieren nach jeder Spalte, wie Platz, Rufzeichen, Locator, DXCC, ODX usw. Das kann ganz informativ sein, wenn man nach speziellen Dingen suchen möchte. Auch gibt es die Möglichkeit (siehe unten), die genauen QSO-Daten für das jeweils eingetragene ODX einzutragen. Wenn die ODX-Zahl blau markiert ist, kann man diese QSO-Daten durch Anklicken aufrufen.

Man kann selbst seinen Toplisteneintrag neu anlegen, ändern und aktualisieren, wenn man in der Auswahlleiste „manage Toplist" anklickt. Dann das Band auswählen und dann „edit", dann die Daten eingeben und unten wieder mit „edit" beenden. Siehe Abb. 11. Falls bei diesem Vorgang Probleme auftreten sollten, kann man gerne seine Daten auch von Hand per email oder über das Contact-Formular an DUBUS senden und wir werden den Eintrag dann aktualisieren.

7. Was noch?

In der Auswahlleiste gibt es auch noch ein Feld mit "Links". Dort sind bereits einige interessante Links eingetragen. Für weitere Hinweise auf wirklich gute Links wären wir dankbar!

Natürlich kann man in solch einem Portal noch viele weitere Dinge aufbauen und anbieten. Aber erst wünschen wir uns etwas Resonanz und Kritik, um zu sehen, wie groß der Bedarf für solch ein Portal wirklich ist.

Ganz nach dem Motto „Use it or lose it".... nein, so streng werden wir natürlich nicht sein ☺.

73

Joe, CT1HZE/DL8HCZ funk-telegramm@t-online.de

A Tale of 2 Aerials

by Ken Osborne, G4IGO - g4igo@g4igo.co.uk

This is the story of how I came to build a pair of 6 ele yagis spaced horizontally on a wooden cross boom. I shall divide the article into 2 main parts – the wooden cross boom and the aerials. I hope it will be of help and inspiration to others. The photo on the left is of the finished array together with the 6 ele NBS for 70 MHz and the 16 ele I0JXX for 144 MHz.

First a brief history of how I came to this decision

I first started way back in 1986 when the band was released. First aerial was a dipole! Next was a 3 ele NBS. This served well at that qth. I moved in 1986 to this present qth. I was lucky that I could put up a mast well up the garden (150 feet/45m). I started with the 3 ele NBS for a while but quickly went to the 5 ele NBS, which I used with a Clemens match. This aerial was at about 35 feet (10.5m) for many years. I used this aerial to good effect through 2 solar cycles and working all over the world. As the last cycle started down and I wanted to increase the chances of getting more DXCC etc I needed to look into different modes and other ways of increasing the chances. I built a 6 ele NBS, also with the Clemens match which I again used to great effect. I changed to a 40 foot (12m) tilt over telescopic mast about 7 years ago – this increased my height to about 55 feet (16.5m). I worked my first EME with this 5 ele with Lance W7GJ.

I also tried stacking a pair of the 6 eles vertically (about 18 feet -5,5m- apart). At the same time Roger G4HBA also tried the same system. We both had them up for about one year and came to the conclusion that although there was probably a bit more gain we felt that they were limiting our activities – we both felt that the loss of the upper lobes on E's and MS (there was no F2 and little AUR) and the little or no advantage on other modes warranted the extra effort, metal work etc – so we both put our single 6 ele as high as we could – and these did us proud.
These setups enabled me to work over 200 DXCC and about 6 EME QSO's with only a single 4CX250B.

I ran with the 5 or 6 ele for a little while until , in a freak wind, my 2" Ally pole was snapped (it turned out to be a weakness in the tube). I was able to replace all that was damaged on my insurance. I took the opportunity to try another type of aerial. I settled for the I0JXX 7 ele on 50 MHz (and on 144 MHz the I0JXX 16 ele). This was setup and ran perfectly. With this aerial I worked the best DX qso so far from G on E /AUE to JA at over 9700 kilometers and had a few very good EME QSO's.

I then began to look to the future. It is clear that Non SSB / CW modes are becoming more common and will become an equal mode in the near future. Also until the next F cycle peaks the chances of improving DXCC and general activity is very small – and even then there is no guarantee that the cycle will be of much good to the majority (cue for another article?). I started to look how I could increase my aerial size – but with the limitations of a 30 foot (9m) wide garden (although it's over 400 feet -122m- long). I had already tried, as above, the stacked yagis and feel that they are only really useful for low angles – which are very restrictive.

I looked at baying aerials horizontally and came to the conclusion that I could build a pair of 5 element yagis fairly easily – and this would give me about another 1dB of gain over the 7 ele. Also I felt that it would be very useful top be able to elevate – not only for EME but for AUR and E's. Also the calculated reduction in azimuth beam width looked interesting as did leaving me with the 3 main vertical lobes for all other modes.

The Wooden cross boom

The above photo shows the ends of the wood booms – square and rounded ready for insertion into the 5 foot (1.5m) Aluminium tube protruding from the elevation rotator. Also visible to the left of the rotator on the mast is the top end of the power splitter. A boom clamp is also visible.

The aerial construction is no problem (see below). The elevation rotator I did take a chance on – and I acquired a G500a. The boom was the hardest. It clearly had to be Non metallic. This left Wood or composites. I looked back over various articles, and trolled the net to see what others had used – there is virtually nothing out there. I looked at the composites and was put off on 2 fronts – reliability and cost. So that left wood.

I am lucky that I have a large wood merchant / sawmill near to me who I went to for advice. On explaining my requirement I was advised that 3 types of wood would do the business – Sapele, Iroco and Oak (particularly American Oak). These woods are very close grained, do not split easily and are supple. They are used a lot in boat building for planking and the sides of the boat.

I looked at the feasibility of how far apart I should set the yagis and came up with 20 feet – about 1 wavelength, the fact that I could get 10 feet (3m) long pole, that, with the 10 feet (3m) of the elements the overall width would be 30 feet (9m). The length of the 5 ele yagis is around 16 feet (4,85m)

Next was the diameter of the pole. I could not get any round wood whatsoever – but only in Square section. As the bore of the rotator is 1.75" I felt that 1.75" square was sufficient. I obtained 5 feet of 1.75" Aluminium tubing – thin walled - about 16 SWG. (ca. 1.5mm) Initially I was nearly put off by the cost – to have the sawmill produce me two 10 feet (3m) lengths of 1.75" square pole would have cost around £80.00. I was lucky – they had an off-cuts store – and I found two 10 foot lengths of Iroco at about 2" square – each cost me £13.00! – and for the price of a couple of pints the saw man trimmed them to 1.75" square and true.

The next problem was that the Aluminium tube is round bore – so I had to get the first 2.5 feet (75cm) of the pole changed to round – this turned out to be the most difficult and therefore the most costly. Naively I thought that all that had to be done was for the pole to be placed in a lathe and the end turned – try finding a place that can do that – impossible. However luckily a solution came up. Next door to the Sawmill was a cabinet restorer – and he had a router. For a price he was able to round off the end of the pole such that it fitted the bore of the Aluminium tube. This was the biggest cost - £40 (manual labour of several hours) – however this still meant the cost of the 20 foot (6m) of Iroco made into a wooden cross boom was about £60 – not too bad.
The rest of the setup up was a piece of cake. I had to file some irregularity off the inside of the rotator casting for the 1.75" Aluminium tube to fit. The 10 feet (3m) Iroco poles were inserted and lined up and then fixed to the Aluminium tube, and to the Rotator casting by 3/8" bolts. I needed to make sure that one bolt either side went through the rotator casting as the rotator clamps were not strong enough to stop the Aluminium pole slipping. So far I have had no problem with this arrangement.
The aerials were mounted at the ends of the boom using some small Aluminium clamps that I have had a while – so far they have proven to be OK.

There is, as you would expect, droop on the pole, so I used 2 support guy wires from above the boom. I initially used a plastic based rope that stretched – however it kept stretching and I had to keep readjusting the turnbuckles. I changed these to a different rope and have had no problem since. The rope I used comes from B&Q – it is "polyester Rope – number 3156 150 – minimal stretch". I also use, at about 4 feet (1.22m) either side of the rotator, additional support in the form of 2 mm strimmer wire. (see photo later). That is it – simple.

The aerials

As I said above I felt that two 5 ele yagis would be ideal – I also thought that two 6 ele yagis would be great – but could they actually be work from the constructional point of view – weight, torque etc.
I have looked at many designs over the years, built and had other yagis as above, looked at many web pages and listened to comments on the chat pages etc. I came to the conclusion that if a yagi was built to an optimised design it would not necessarily work in a stacked or bayed configuration. I also have experience that those designs where the first director is close spaced to the radiator is very intolerant of rain and other such changes, and also intolerant of other yagis being present, particularly if the yagis are closed spaced. From my experience and looking at comments from other who run these optimised yagi arrays (2 or 4 yagis) that for a 5 ele yagi of about 16 feet (4.85m) length the spacing should not be less than 16 feet (4.85m), for a 6 ele yagi of about 24 feet (7.3m) length not less that 20 feet (6m) and therefore for longer yagis (30 feet (9m) and above) spacing's of at least 26 feet (8m) and greater should be employed. More on this a little later down.

At the end of the day I settled on an old but trusted design and one that I have used for many years – and all I can say is this design has served me well – 200+ DXCC. It is the well known NBS design. I did modify the standard design very slightly to get a little more forward gain at the expense of F/B. I have never found the F/B ratio to be a problem – all the design I have built give me about 15 to 20 db F/B – and again I have never had a problem. Also the designs, being not close spaced, have a wide bandwidth. The close spaced yagis I have used have exhibited 2 undesirable traits. 1 – they all move resonance in the rain, 2 – they all are narrow bandwidth.

My test of the bandwidth is quite defined. I use FSD on a bird and I go between the points where I can just see the needle move when in the "reverse" direction – as you can appreciate this is not a defined value but is certainly the easiest to monitor. I found that this "bandwidth" on a close spaced yagi is very narrow – only about 40 KHz and I found the SWR bandwidth for 1:1.2 was about 100 KHz. Also that if it rained the resonant frequency moved by 50 to 100 KHz – so not that good. With the wide spacing this is vastly better. The "bird" bandwidth was over 100 KHz and the 1:1.2 SWR bandwidth is greater than 300 KHz – so no retuning etc – and the rain effect is very minimal.

The NBS design is so simple and as long as you follow the rules you will build a Yagi that works time after time – and again all I can say is look at what I have achieved in the past – and what I am achieving today.

I started with a basic yagi consisting of a 16 feet (4.85m) 1" square 18 SWG (about 2.4mm) thick aluminium tube (2 pieces per aerial actually spliced together), 5 element clamps which I obtain from Chelcom (gone to Trident or Nevada I think) and 0.5" Aluminium tubing for the Elements. Initially I was going to build the radiating element with the Clemens match that I have used over

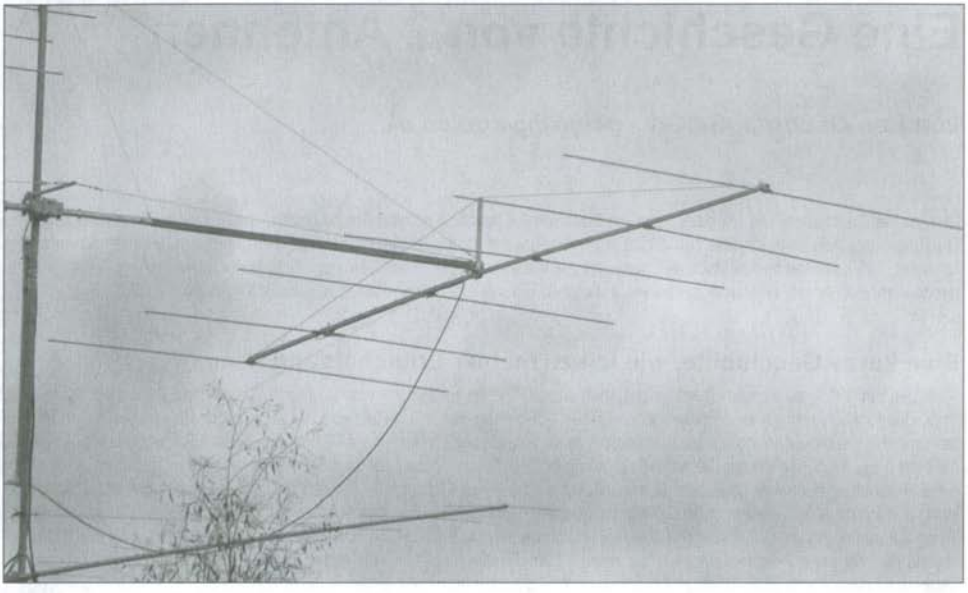
the years but I felt that it was too susceptible to weather in the configuration that I was building so I settled, again after much looking at the chat pages and the web for the hairpin match.
I had one reservation about the hairpin match – the fact that the radiating element was shortened a lot. I know that, according to the books etc that the length of the radiating element doesn't alter the gain etc. but I have always felt that a tidy design that looks good works well. When I built these yagis I experimented with various configurations of the radiator length versus hairpin size. I have to say that every time I came back to the same configuration – that the hairpin sides are about 5" to 6" (12,7 – 15.2cm) long, and about 1.5" (3.8cm) apart and that the radiator length is reduced by about 4" (10,3cm) per side from the standard.
I built both yagis in place on the wooden boom – both pointing skywards. I then tune the first yagi, at the end of its 20 foot (6m) feed cable of high quality UR67 feeder to the best swr I could get – once I found the knack it was easy – 1:1 flat from 50.100 to 50.200. This also gave a very useable area from 50.000 to 50.300 – better than I could have expected. I then tuned the other one the same.
Next was the power splitter. This was a standard design based on 1" square tube (same as the yagi boom) with an inner element constructed one of two ways. The intention of the inner is to be of the correct diameter in relation to the inside diameter of the tube so as to generate the correct impedance to match the two 50 ohm ports to one 50 ohm post – therefore 37.5 ohm. To achieve this meant that I had to generate a non standard dimension. I ended up achieving this in two ways. The first was to use a length of 10mm diameter aluminium tube (from B&Q) and I then added extra thickness to get nearer the correct diameter by using the outside covering of UR67 over the top (cut about 25% more that the length of the inner – push it over like a sock then draw it tight. Easy.) The second was to use a length of wooden dowel and also add the extra thickness as before. The final adjustment in both cases is to use nylon screw through the side wall of the outer tube to flex the inner to bring it nearer to the side wall and I was able to adjust the bandwidth of the power splitter to be, again on the "bird" test, from about 49 MHz to 51 MHz – so that at 50 MHz it was SWR of 1:1.
I then, through a short length of high quality UR67 tested the two yagis combine - it was great – there appeared to be no movement. I then raised the yagis up and again tested – no problem.

The aerial testing was made by using an MFJ 259. A word of warning. Make sure that the tester is accurate, or that you know where the 50 OHM point is – it may not be exactly on the 50 OHM point. I used several "50" OHM Dummy loads – they weren't all that accurate – some were 49.1 ohm and some were 50.9 ohm – and that make one hell of a difference. I used the most accurate DL's I could find from all that I had to set up the tester, and I also used them to set up the power splitter. I checked the setting on a regular basis as I went through the setting up of the whole array.
I used this array for about 6 weeks and made a couple of EME QSO's as well as some MS QSO's – all looked FB – most noticeable was the narrow azimuth beam width – about 25 degrees each side to a deep null. I had some E's and it was very useful for null out the TV sidebands without losing wanted signals.
I then took the bull by the horns – could I get up a pair of 6 ele NBS yagis – they are some 8 feet longer at around 24 feet boom length. – I thought I could and so set out to change over. Basically no problem – just move the element spacing for some of the directors and add the extra one. I had to put a support wire from end to end to accommodate the boom droop – I used the same polyester rope from B&Q.
There was one difference that was noticed when I came to pair the yagis though the power splitter – they interacted. The 5 eles did not appear to interact at 20 feet spacing – but the 6 eles dropped in resonance by about 100 kHz – this was rectified by taking about 0.25" (0,63cm) off the end of each radiator. The result was again a very wide bandwidth centred on 50.150. This is what convinces me that at 1 wavelength spacing the maximum boom length is about 16 feet (4.85m) – above that then the spacing should increase. I feel that for the least interaction for the 24 foot (7.3m) boom yagi that it should be more like 24 foot (7.3m) spacing - I can't do that so I will never be able to confirm it.

General construction notes

The elements are made as above – and are fully insulated from the boom by nylon feed through and washers etc. The radiator is a split one with a hairpin as above. I used a small metal box and used a bulkhead N type connector the wrong way round so that the centre of the UR67 came into the box and was connected directly to the one side of the radiator. See last picture at the end of the article. This is in fact one N type joint less to worry about re water ingress and also less system loss. I applied the same logic to the ends of the matching loop of URM76 (best quality) – again 2 less joints to worry about. This means that I have 2 less N type joints in the system and 4 less other problematical joints in other places. The tails from each aerial are about 20 feet (6m) long. It is extremely important that they are cut from the same roll of cable and that they are exactly the same length – but any length will do. It is also very important that the cable falls away from the boom at 90 degrees for a long as is possible to avoid interaction. I ran my cable along the boom from the radiator to the connection point to the wooden cross boom and then let it fall away. (I don't quite get the 90 degree drop off – but it works)

The junction of the two ends of the radiator gave me a bit of a headache – it needs to be strong enough not to droop when constructed – I tried various hard and strong plastic inserts in side the 0.5" (1.2cm) elements but failed until I tried a "plastic" from RS – catalogue number RS 3257136. This rod is extremely hard, inert and easy to file – and I have no droop on the radiator at all – also I have not seen any problems to date.



Conclusions

Well – it works absolutely fantastic – better than I had imagined. The whole array is very sound in wind – up to about 30 MPH when it does start to wobble a fair bit – but its still there. I tend to drop the mast to its lowest level if winds any higher are forecast and will drop the whole mast if it really looks like getting bad – but why not – I can live to work another day. The whole array has NOT been constructed the last forever and a day – it will require constant attention – but the rewards for this attention are worth it. The wooden boom needs to be oiled with linseed about 4 times a year. The fact that I have full elevation literally opens up a whole new world – particularly on EME. Since it was built in about late April I have had about 30 EME QSO's – with some excellent results. I have come to the conclusion that, on EME I have gained about 5 db over the 7 ele. OK – I hear you say but at best 3 db is the increase – yes – but don't forget the percentage increase (DX gain) that occurs due the reflector - the moon – being bigger in the aperture of the array. This has been consistent on virtually all the QSO's – and I even had the best signal ever from KJ9I at -13. The other main advantage is the very much narrower horizontal beam width – down to about +/- 20 degrees – it's really is extremely useful at the time I get power line or such noise – I can null it out. Many times on EME I have turned off the Moon by 10 or 15 degrees to loose the QRM – but not the Moon signals.

I tried elevation in the sporadic E season – only on 2 occasions did I see signals rise – and that was on openings to HB and IS0 when elevating to 45 degrees – at all other times raising the array did not seem to have any effect. The same applied to the noises being generated around my qth – elevation did not seem to have any noticeable effect – but as I said using the null did. With the 5 ele array I did on one AUR notice a peak in signals when I elevated – to about 30 degrees. The only other time I noticed an advantage to be able to elevate was on an FAI opening when signals at times where very much stronger at about 30 degrees – and I was also able to pinpoint the off direct beam heading which most others could not – a 5 ele yagi has a beam width of around +/-45 degrees.

In the above photo of the finished array you can clearly see all the elements I have mentioned to stop droop etc.
I can only say that it was well and truly worth all the time and effort I out into this array. The cost was not that great – and certainly not dearer than using aluminium tubing – and in any case the array would not have worked at all. I recommend this type of design to anybody – as an aerial with out the elevation for even the terrestrial modes its great – the main benefit will be the retention of the higher lobes over a stacked array of the same size aerials and also the much reduced horizontal beam width – even a pair of 3 eles would have a major benefit over even a 5 ele.

I hope more of you will feel inclined to look at wooden cross booms and if I can be of help please contact me. If you do build one please pass on your comments and observations. The last thing to remember is that any alteration of any kind to a station is only relevant to that station – and no others. My Email is g4igo@g4igo.co.uk.

My thanks to George G4PCI for running various setups through his software and also for his generous gift of his time in assisting me with his thoughts etc - and keeping me on the straight and narrow. Good luck.

Eine Geschichte von 2 Antennen

von Ken Osborne, G4IGO - g4igo@g4igo.co.uk

Dies ist die Geschichte, wie ich dazu kam, ein Paar von 6-Element Yagis für 6m zu bauen, die horizontal mit einem hölzernen Querträger gestockt sind. Ich teile den Artikel in zwei Hauptteile: den über den hölzernen Querträger und den über die Antennen. Ich hoffe, daß es für andere hilfreich sein wird und zur Inspiration dienlich ist. Das erste Foto (siehe oben im engl. Text) zeigt die fertige komplette Antennenanlage zusammen mit einer 6 Ele. NBS für 4m und einer 16 Ele. I0JXX für 2m.

Eine kurze Geschichte, wie ich zu meiner Entscheidung kam

Alles begann 1986, als das 6m-Band freigegeben wurde. Die erste Antenne war ein Dipol! Die nächste dann eine 3 Ele. NBS Yagi. Das funktionierte gut an dem damaligen QTH. 1986 bin ich dan an das jetzige QTH umgezogen. Ich war froh, dort im Garten einen bis maximal 45m hohen Mast aufstellen zu dürfen. Ich begann für eine Weile mit der 3 Ele. NBS wechselte aber schnell auf eine 5 Ele. NBS, die ich mit Clemens-Anpassung betrieb. Diese Antenne befand sich für viele Jahre in 10,5m Höhe. Ich habe diese Antenne wirkungsvoll über zwei Sonnenfleckenzyklen verwendet und die ganze Welt gearbeitet. Als der letzte Zyklus abklang und ich die Möglichkeiten neue DXCCs zu arbeiten, verbessern wollte, mußte ich mich um verschiedene Modes und andere Wege kümmern, um die Chancen dafür zu erhöhen. Ich baute eine 6 Ele. NBS, ebenfalls mit Clemens-Match, was wieder hervorragend lief. Vor etwa 7 Jahren stieg ich auf einen 12,2m-Telekopmast um, was meine Höhe auf insgesamt 16,7m brachte. Ich habe damit mein erstes EME-QSO auf 6m dann mit W7GJ gemacht.

Ich versuchte auch zwei der 6 Ele. Yagis vertikal gestockt (etwa 5,5m auseinander) zu verwenden. Gleichzeitig versuchte sich Roger, G4HBA, an einer gleichen Antennenanlage. Wir beide hatten diese Antennen für etwa 1 Jahr aufgebaut und kamen zu dem Ergebnis, daß, obwohl es wahrscheinlich ein bißchen mehr Gewinn gab, wir uns dennoch in unseren Aktivitäten eher eingeschränkt fühlten. Wir beide glauben, daß der Verlust der oberen Nebenzipfel bei Es und MS (Es gab kein F2 und nur wenig Aurora zu der Zeit) und wenig oder keine Vorteile bei anderen Modes, den zusätzlichen Aufwand,die Metallarbeiten etc. nicht rechtfertigen. Also haben wir beide nur unsere einzelnen 6 Ele. so hoch wie möglich aufgebaut – und damit waren wir stolz.

Dieses Setup ermöglichte mir über 200 DXCCs und etwa 6 EME QSOs mit nur einer einzelnen 4CX250B zu arbeiten. Ich arbeitete mit der 5 oder 6 Ele. für eine Weile, bis in einem ungewöhnlichem Wind mein 5cm-Mast zusammenklappte (es stellte sich heraus, daß es eine Schwachstelle im Rohr gab). Ich bekam alles, was beschädigt war, durch meine Versicherung ersetzt. Diese Möglichkeit nutzte ich, um eine andere Antennentype auszuprobieren. Ich nahm die I0JXX 7 Ele. Yagi für 6m (und die I0JXX 16 Ele. für 2m). Dies funktionierte perfekt. Mit dieser Antenne habe ich mein bisher bestes DX gearbeitet: von G über E/AU-E nach JA über 9700km und einige wenige sehr gute EME QSOs. Dann begann ich über die Zukunft nachzudenken. Es ist klar, daß die Nicht-SSB/CW-Betriebsarten mehr gebräuchlich werden und in der Zukunft gleich wichtig werden. Auch bis zum Maximum des nächsten Zyklus sind die Chancen den DXCC-Stand zu verbessern und die generelle Aktivität eher niedrig – und selbst im maximum gibt es keine Garantie, daß dieser Zyklus für die Mehrheit viel Gutes bringen wird (ein Thema für einen weiteren Artikel?). Ich begann darüber nachzudenken, wie ich meine Antenne – unter der Begrenzung eines 9m breiten Gartens - vergrößern könnte (er ist aber über 120m lang). Wie oeben erwähnt, hatte ich ja bereits die gestockten Yagis ausprobiert und glaube, daß sie wirklich nur für niedrige Winkel nützlich sind, was sehr einschränkend ist. Ich überlegte, wie man Yagis horizontal stocken könnte und errechnete, daß zwei der einfach zu bauenden 5 Ele. Yagis zusammen etwa 1 dB mehr Gewinn haben, als die einzelne 7 Ele. Auch war ich der Meinung, daß es sehr hilfreich sein würde, die Antenne elevieren zu können, nicht nur für EME, sondern auch bei Aurora und Es. Auch die berechnete Reduzierung des horizontalen Öffnungswinkels sah interessant aus, genauso wie das Verbleiben der 3 vertikalen Hauptkeulen für alle anderen Modes.

Der hölzerne Querträger

Auf dem zweiten Foto (siehe engl. Teil oben) sieht man die Enden des hölzernen eckigen Querträgers, die rund sind, um genau in die 1.5m langen Alurohre, die aus dem Elevationsrotor herausstehen, hineinzupassen. Links vom Rotor am Mast sieht man auch das obere Ende es Anpaßtopfs. Eine Mastklammer ist ebenfalls zu sehen. Als Elevationsrotor kommt ein G500A zum Einsatz. Das Problem mit dem Querträger war das schlimmste. Klar dürfte er nicht aus Metall sein. Ich habe verschiedene andere Artikel gelesen und das Web durchforstet, was andere benutzt haben – es gibt aber fast nichts darüber zu finden.

Ich habe die Verbundmaterialen betrachtet und bin an zwei Grenzen gestoßen: Zuverlässigkeit und Kosten. Somit blieb Holz übrig. Ich habe das Glück, dass ein großer Holzhändler mit Sägemühle bei mir in der Nähe ist, wo ich mir Rat holte. Als ich meine Bedürfnisse erklärt hatte, bekam ich als Rat, daß drei Typen von Holz dafür in frage kommen: Sapelli-Mahagoni, Afrikanisches Teak und Eiche (speziell die Amerikanische Eiche). Diese Hölzer haben eine sehr enge Faserung, splittern nicht leicht und sind

biegsam. Sie werden viel für die Planken im Bootsbau verwendet. Ich schaute wie weit auseinander die Yagis machbar montiert werden könnten und kam zu 6m – einer Wellenlänge. Ich konnte 3m lange Hölzer bekommen, die zusammen mit den 3m der Elemente dann eine Gesamtbreite von 9m ergeben. Die Länge der 5 Ele. Yagis ist etwa 4.85m.
Nun zum Durchmesser des Querträgers. Rundes Holz war nirgends zu bekommen, nur Vierkant. Das die Durchführung beim Rotor 1.75" (ca. 4.5cm) ist, sollte 1,75" im Quadrat auch reichen. Ich kaufte 1.5m von 1.75" Alu-Rohr mit dünner Wandung (16 SWG = ca. 1.5 mm). Anfangs war ich fast erschlagen von den Kosten: Der Holzhändler wollte 80 Pfund für die beiden 3m Längen von 1,75"x1,75" haben. Ich hatte Glück und fand in der Abteilung, wo Holzabschnitte verkauft werden, zwei 3m Längen aus Teak mit etwa 2 x 2" (5x5cm)– jede kostete 13 Pfund. Und für ein paar Bier hat mir der Zuschneider sie auf 1,75" geschnitten und gut.

Das nächste Problem war, daß das Alu-Rohr runden Querschnitt hat, so daß die ersten 75cm des Holzes rund sein mußten – dies sollte das schwierigste und teuerste überhaupt werden. Naiv dachte ich, daß man das Holz einfach in eine Drehbank einspannen und die Enden abrunden könnte. Einen geeigneten Platz dafür zu finden, war unmöglich. Zum Glück fand sich eine andere Lösung: Neben der Sägemühle gab es einen Möbelrestaurator und der hatte eine Fräse. Er konnte damit die Enden des Holzes so barbeiten, daß sie dann genau in die runden Öffnungen des Alu-Rohres paßten. Das waren die größten Kosten bisher: 40 Pfund (mehrere Stunden Handarbeit). Das bedeutete jedoch, daß die Kosten für den kompletten 6m Teak-Querträger bei etwa 60 Pfund lagen, was nicht so schlecht ist. Der Rest des Aufbaus war ein Klacks. Einige Unbenheiten im Inneren des Rotorgehäuses mußten noch glattgefeilt werden, damit die 1,75" Alurohre hineinpaßten. Die 13m Teakträger wurden eingeführt und ausgerichtet und dann mit 3/8" Bolzen mit dem Alurohr und dem Rotorgehäuse verbunden. Es mußte je ein Bolzen auf jeder Seite auch durch das Rotorgehäuse gehen, weil die Rotorklammern alleine nicht ausreichten, eine Verrutschen der Alurohre zu verhindern. Bislang hatte ich keine Probleme mit dieser Lösung. Die Antennen wurden an den Enden des Querbooms mit kleinen Alu-Klemmen befestigt, die ich noch hatte. Bisher funktioniert das o.k.
Es gibt erwartungsgemäß ein Durchhängen bei den Querträgern, weshalb ich 2 Abspannungen oberhalb anbrachte. Zuerst habe ich Kunsstoffseil benutzt, das sich dehnte und immer wieder dehnte, so daß ich die Seilspanner immer wieder nachstellen mußte. Ich habe dann ein anderes Seil genommen und seitdem keine Probleme mehr. Das Seil kommt von B&Q – es heisst "Polyester Seil – Nummer 3156 150 – minimale Dehnung". Auch verwende ich, etwa 1.2m zu jeder Seite vom Rotor weg, eine zusätzliche Stützabspannung aus 2mm Rasentrimmerschnur (siehe Foto Nr. 3). Das ist alles.

Die Antennen

Wie oben erwähnt, dachte ich, dass zwei 5 Ele. Yagis ideal wären, ich habe gedacht, dass zwei 6 Ele. klasse wären, aber ob das aus Sicht der Konstruktion und Gewicht und Drehmoment gut gehen würde?
Ich habe mir über die Jahre sehr viele Designs angeschaut, have gebaut und und noch andere Yagis gehabt, ich habe das Web durchforstet, die Chats verfolgt etc. Ich kam zum Schluß, daß wenn eine Yagi ein optimiertes Design aufweist, dieses nicht unbedingt gut in einer gestockten Anlage funktioniert. Auch habe ich die Erfahrung gemacht, daß bei den Designs, bei denen der erste Direktor dicht am Strahler positioniert ist, sehr empfindlich gegen Regen und andere derartige Einflüsse sind. Auch sind sie gegen andere Yagis in der Nähe intolerant, besonders, wenn die Yagis sich in engem Abstand befinden. Aus meiner Erfahrung und von Kommentaren von anderen, die diese optimierten Yagi-Gruppen (2 oder 4 Yagis) verwenden, sollte der Stockungsabstand einer 5 Ele. Yagi von 4.85m Länge nicht weniger als 4.85m betragen, für eine 6 Ele. Yagi von 7.3m Länge nicht weniger als 6m und für noch längere Yagis (9m und mehr) sind mindestens 8m oder mehr nötig. Mehr davon später.

Letztendlich bin ich bei einem alten und bewährten Design gelandet, das ich viele Jahre verwendet hatte, und ich muß sagen, daß es gut für mich war mit über 200 DXCC Ländern. Es ist das bekannte NBS-Design. Ich habe das Standard-Design leicht modifiziert und etwas mehr Vorwärts-Gewinn zu bekommen zu Lasten des F/B. Ich empfand das Vor-Rückverhältnis nie als problematisch, alle Designs, die ich nachgebaut habe, geben 15 bis 20 dB F/B – und wie gesagt, ich hatte damit nie ein Problem. Die Designs, bei denen die Elemente nicht eng angeordnet sind, hat man auch eine weitere Bandbreite. Die Yagis mit enger Anordnung zeigten zwei unerwünschte Eigenschaften: Erstens verändern sie ihre Resonanz im Regen und zweitens sind sie alle schmalbandig.

Mein Test der Bandbreite ist gut definiert. Ich verwende ein FSD mit einem Bird-Wattmeter und ich bestimme die Punkte, wo ich gerade sehen kann, daß der Zeiger ausschlägt, bei Richtung „reverse". Klar, das ist kein definierter Wert, aber so ist das sicher am einfachsten zu beobachten. Ich fand, daß diese „Bandreite" bei einer Yagi mit eng angeordneten Elementen sehr niedrig ist, nur etwa 40 kHz, und die SWR-Bandreite für 1:1.2 lag bei etwa 100 kHz. Bei Regen verschob sich die Resonanzfrequenz um 50 bis 100 kHz, also nicht so toll. Bei der Yagi mit weiter auseinander liegenden Elementen war das deutlich besser. Die „Bird-Bandbreite" war über 100 kHz und die 1:1.2-Bandbreite über 300 kHz, so daß ein Nachstimmen überflüssig ist. Die Verstimmung durch Regen ist sehr gering.

Das NBS-Desing ist ganz einfach und solange man die Regeln einhält, wir man eine Yagi bauen, die immer funktionieren wird – ich kann nur betonen, daß meine Ergebnisse auf 6m aus der Vergangenheit und Gegenwart das bestätigen.
Ich begann mit einer Yagi, die aus einem 4.85m Boom aus 1" x 1" (2.5x2.5cm) Aluprofil (18 SWG – ca. 2.4mm - Wandstärke, 2 Stücke pro Antenne, die zusammengefügt werden), 5 Elementhaltern, die ich von Chelcom bekam (jetzt Trident oder Nevada, glaube ich), und 0,5" (1.2cm) Alu-Rohren für die Elemente, bestand.

Anfangs wollte ich en Strahler mit dem Clemens-Match anpassen, das ich über Jahre schon benutzt habe, aber ich glaube, dass es in der neuen Konfiguration zu anfällig gegen die Witterung sein würde, so daß ich – wieder nach langem Studium von Web und Chats – bei der Haarnadelanpassung gelandet bin.

Ich hatte Bedenken in einem Punkt bei der Haarnadelanpassung, nämlich der Tatsache, daß der Strahler dabei deutlich gekürzt wird. Ich weiß aus der Literatur, daß die Länge des Strahlers den Gewinn nicht beeinflußt, aber ich war immer der Meinung, daß eine ordentliches Design, das auch gut aussieht, auch gut funktionieren wird.
Als ich diese Yagis gebaut habe, habe ich mit verschiedenen Konfigurationen von Strahlerlänge zu Haarnadelgröße experimentiert. Ich bin immer wieder bei der gleichen Anordnung gelandet: Die Haarnadel-Seiten sind etwa 12,7 bis 15,2cm lang und etwa 3,8 cm auseinander und die Länge des Strahlers wird um 10cm pro Seite bezüglich der Normallänge reduziert.
Ich habe beide Yagis auf dem hölzernen Querträger so angebracht, daß sie in den Himmel zeigten. Dann habe ich die erste Yagi am Ende der 6m Speiseleitung (UR67) auf bestes SWR abgestimmt. Wenn man erstmal den Kniff heraus hat, ist es einfach. 1:1 flach von 50.1 bis 50.2. Das ergab einen brauchbaren Bereich von 50.0 bis 50.3 – besser als ich erwarten konnte. Dann wurde die zweite Yagi genauso abgestimmt.

Als nächstes kommt der Anpasstopf (Leistungsteiler) dran. Das ist ein Standarddesign basierend auf 1" x 1" (2.5x2.5cm) Profil (das gleiche wie für den Boom der Antennen) mit einem inneren Element, das nach einer von zwei Möglichkeiten aufgebaut wurde. Der Zweck des Inneren besteht darin, die richtige Impedanzanpassung der beiden 50-Ohm-Eingänge auf einen 50-Ohm-Ausgang zu transformieren, also 37.5 Ohm. Dazu muß das Innere im korrekten Durchmesser im Verhältnis zum Innendurchmesser des Profils stehen. Um das zu erreichen, muß man Nicht-Standardmaße verwenden. Schließlich erreichte ich das auf zwei Wegen. Der erste war, ein Stück 10mm Alu-Rohr zu nehmen (von B&Q) und dann habe ich zusätzlichen Durchmesser generiert, um näher an den korrekten Durchmesser zu kommen, indem ich den Außenmantel von UR67-Koaxkabel darüber schob. (Dazu etwa 25% mehr zuschneiden als die Gesamtlänge des inneren Alurohrs – dann wie eine Socke darüberziehen und festzurren. Das geht einfach.) Der zweite Weg war eine Länge eines hölzernen Dübels zu verwenden und den extra Druchmesser wie eben zu erzeugen. Die Feinjustierung wird in beiden Fällen mittels einer Nylon-Schraube durch die Seitenwand des Gehäuses gemacht, so daß das Innere näher an die Innenwand gebogen wird. So war es mir möglich, die Bandbreite des Splitters – wieder mit dem „Bird-Test" auf etwa 49 bis 51 MHz zu bringen, so daß das SWR bei 50 MHz bei 1:1 lag.

Dann habe ich mit einer kurzen Länge von UR67 die beiden gekoppelten Yagis zusammen getestet – das war klasse: Es gab keinen Ausschlag. Dann habe ich die Yagis hochgebracht und wieder getestet: Keine Probleme.
Das Testen der Antennen wurde mit einem MFJ 259 durchgeführt. Eine Warnung: man versichere sich, daß das Gerät akurat arbeitet, bzw. wo genau der 50-Ohm-Punkt ist. Ich habe diverse „50"-Ohm-Dummyloads gesehen, die nicht alle ganz genau waren. Einige lagen bei 49.1 Ohm, andere bei 50.9 Ohm, und das kann viel ausmachen. Ich habe die genaueste Dummyload, die ich finden konnte genommen, um das Testgerät einzustellen, ebenso für das Einstellen des Anpaßtopfes. Das wurde mehrfach kontrolliert, während ich die ganze Anlage aufgebaut habe.

Ich habe diese Anlage ca. 6 Wochen benutzt und einige EME-QSOs gemacht, sowie einige MS-QSOs, alles sieht super aus, am meisten fällt der enge horizontale Öffnungswinkel auf, etwa 25 Grad zu jeder Seite bis zu einer tiefen Nullstelle. Ich hatte etwas Es und dann war das sehr nützlich, um die TV-Träger auszublenden, ohne das Nutzsignal zu verlieren.
Dann habe ich den Stier an den Hörnern gepackt: Konnte ich zwei 6-Ele-NBS-Yagis in die Luft bringen – sie sind etwa 2.5m länger bei insgesamt 7.2m Boomlänge? Ich glaubte, daß ich es könnte und bereitete den Wechsel vor. Grundsätzlich kein Problem – nur die Abstände zwischen einigen der Direktoren ändern und einen weiteren hinzufügen. Ich müßte eine Abspannung von Boomende zu Boomende anbringen, um das Durchhängen auszugleichen. Dafür habe ich dasselbe Polyester-Seil von B&Q verwendet.

Es gab einen Unterschied, den ich festgestellt habem als ich die Yagis über den Leistungsteiler gekoppelt habe: sie haben sich gegenseitig beeinflußt. Die 5 Ele. Yagis schienen bei 6m Stockungsabstand keine gegenseitige Beeinflussung zu zeigen, aber die 6 Ele. Yagis fielen in der Resonanz um etwa 100 kHz ab. Das wurde behoben durch Kürzen des Strahlers um etwa 0,6cm jeweils an beiden Enden. Das Ergebnis war wieder eine weite Bandbreite mit Mitte auf 50.150. Das bringt mich zu der Überzeugung, daß bei 1 Wellenlänge Stockungsabstand, die maximale Boomlänge etwa 4.85m ist – bei mehr sollte auch der Stockungsabstand vergrößert werden. Ich glaube, daß für geringstmögliche Wechselwirkung beim 7.2m Boom, der Stockungsabstand eher bei 7.2m Fuss liegen sollte. Ich kann das nicht realisieren, so daß ich das niemals verifizieren kann.

Allgemeine Hinweise für die Konstruktion

Die Elemente wurden wie oben beschrieben ausgeführt und werden voll vom Boom isoliert montiert mit Nylondurchführung, Scheiben etc. Der Strahler ist eine geteilte Ausführung mit Hairpin, wie oben beschrieben.
Ich habe ein kleines Metallkästchen benutzt und mit einer N-Gehäusedurchführung den Innenleiter des UR67-Kabel direkt in die Box bis zur einen Seite des Strahlers geführt. Das bedeutet, daß man einen N-Verbindungspunkt weniger hat, um den man sich wegen Wassereintritt sorgen machen muß und man hat auch weniger Verluste. Ich habe dasselbe auch mit den Enden der Anpassleitung, die aus URM76 (beste Qualität) besteht, gemacht. Wieder zwei Stoßstellen weniger, um die man sich sorgen muß.
Das bedeutet, dass ich 2 N-Verbindungsstellen und 4 weitere andere problematische Stellen weniger habe. Die Anpaßleitungen

von jeder Antenne sind etwa 6m lang. Es ist extrem wichtig, daß sie von der selben Rolle stammen und exakt dieselbe Länge haben – wobei aber jede Länge möglich ist. Esist auch sehr wichtig, daß die Kabel im 90-Grad-Winkel vom Boom weggehen, soweit es irgend möglich ist, um Wechselwirkungen zu vermeiden. Ich führe mein Kabel vom Strahler am Boom entlang bis zum Verbindungspunkt mit dem hölzernen Querträger und lasse es dann nach unten fallen. Ich bekommen die 90 Grad nicht ganz hin, aber es funktioniert.

Die Verbindung der beiden Strahlerhälften hat mir etwas Kopfschmerzen bereitet – sie muß stark genug sein, um ein Durchhängen der Konstruktion zu verhindern. Ich habe verschiedene harte und stabile Kunststoffeinlagen für das Innere der 0,5"-(1,2cm)-Elementrohre ausprobiert, die alle versagten, bis ich ein „Kunststoff" aus dem RS-Katalog mit der Nummer RS 3257136 fand. Dieser Stab ist extrem hart, inert und leicht zu bearbeiten. Ich habe absolut kein Durchhängen des Strahlers und bis jetzt sind keine Probleme aufgetreten.

Fazit

Also, alles funktioniert phantastisch – besser als ich erwartet hatte. Die Antennen verhalten sich gutmütig im Wind bis etwa 50 km/h, dann fangen sie an, sich etwas zu bewegen, aber harmlos. Ich tendiere dazu, den Mast einzufahren, wenn stärkerer Wind vorhergesagt ist, und lege dan ganzen Mast um, wenn es wirklich schlimm aussieht. Warum auch nicht, ich kann damit leben an einem anderen Tag qrv zu sein. Das ganze ist auch nicht so konstruiert, daß es für alle Zeiten halten muß, es ist immer eine dauernde Überwachung angebracht, aber der Lohn rechtfertigt das.

Der hölzerne Boom muß viermal im Jahr mit Leinöl behandelt werden. Die Tatsache, daß ich voll elevieren kann, öffnet mir buchstäblich eine neue Welt, speziell bei EME. Seit ich die Anlage Ende April 2007 aufgebaut habe, habe ich etwa 30 EME QSOs gefahren – mit einigen exzellenten Ergebnissen. Ich bin der Meinung, daß ich etwa 5 dB mehr Gewinn bei EME habe gegenüber der 7 Ele. Yagi. OK, ich höre schon die Stimmen, die sagen, daß bestenfalls 3 dB mehr möglich sein können, aber man darf den prozentualen Gewinn (DX Gewinn) durch den Reflektor, den Mond, nicht vergessen, der größer in der Öffnung des Systems ist. Das wurde bei allen der QSOs festgestellt und ich habe mein lautestes EME Signal überhaupt mit -13dB von KJ9I damit gehört.
Der andere große Vorteil ist der viel kleinere horizontale Öffnungswinkel, herunter bis etwa +/- 20 Grad. Das ist wirklich extrem nützlich, wenn man Störungen von Hochspannungsleitungen u.ä. bekommt, dann kann man die Störungen ausblenden. Bei EME habe ich oft 10 bis 15 Grad neben den Mond gedreht, um das QRM auzublenden, aber das Mondsignal blieb.

Ich habe Elevation in der Sporadic-E-Saison ausprobiert, nur bei 2 Gelegenheiten habe ich ein Ansteigen des Signals festgestellt und das war bei Öffnungen nach HB und IS0 mit 45 Grad Elevation. Bei allen anderen Gelegenheiten hatte das Elevieren keinen merkbaren Effekt. Das selbe gilt für Rauschquellen, die um mein QTH herum liegen: Elevation brachte keinen merkbaren Effekt, aber das horizontale Ausnullen –wie gesagt – schon.
Mit der 5 Ele.-Anlage habe ich einmal bei Aurora einen merkbaren Anstieg des Signals festgestellt, als ich 30 Grad eleviert habe. Das einzige andere Mal, daß ich das festgestellt habe, war bei einer FAI-Öffnung, als die Signale zeitweise mit 30 Grad Elevation viel stärker waren. Damit war ich in der Lage, den Offset der Antennenrichtung genau festzustellen, was die meisten anderen nicht können – eine einzelne 5 Ele.Yagi hat einen Öffnungswinkel von etwa +/- 45 Grad.

Auf dem letzten Foto des fertiggestellen Arrays kann man gut alle der erwähnten Maßnahmen sehen, die ein Durchhängen verhindern sollen. Ich kann nur sagen, daß sich die ganze Zeit und Mühe wirklich gelohnt hat, die ich in diese Anlage gesteckt habe. Die Kosten waren nicht riesig – und sicherlich nicht teurer als mit einer Alu-Konstruktion – und damit hätte ganz sicher hier nichts funktioniert. Ich empfehle diese Art von Design für alle. Es ist auch ohne Elevation für die terrestischen Modes großartig – der größte Vorteil ist das Beibehalten der höheren vertikalen Nebenzipfel gegenüber einem vertikal gestockten System geichlanger Antennen und der kleinere horizontale Öffnungswinkel. Sogar ein Paar von 3 Ele.-Yagis hat einen deutlichen Vorteil gegenüber einer einzelnen 5 Ele.

Ich hoffe, daß sich nun mehr Amateure geneigt fühlen, in Richtung hölzernem Querträger zu schauen. Wenn ich helfen kann, bitte ich um Kontaktaufnahme. Falls jemand so was nachbaut, bitte ich um Kommentare und Erfahrungen.
Das letzte, woran wir denken sollten, ist, daß jede Art von Veränderung bei einer Station nur für diese eine Station relevant ist und nicht für andere.

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Vielen Dank an George, G4PCI für das Simulieren diverser meiner Versionen auf seiner Software und sein grosszügiges Zurverfügungstellen seiner Zeit beim Einbringen seiner Gedanken – und dafür, daß er mich geradlinig geführt hat. Viel Erfolg!

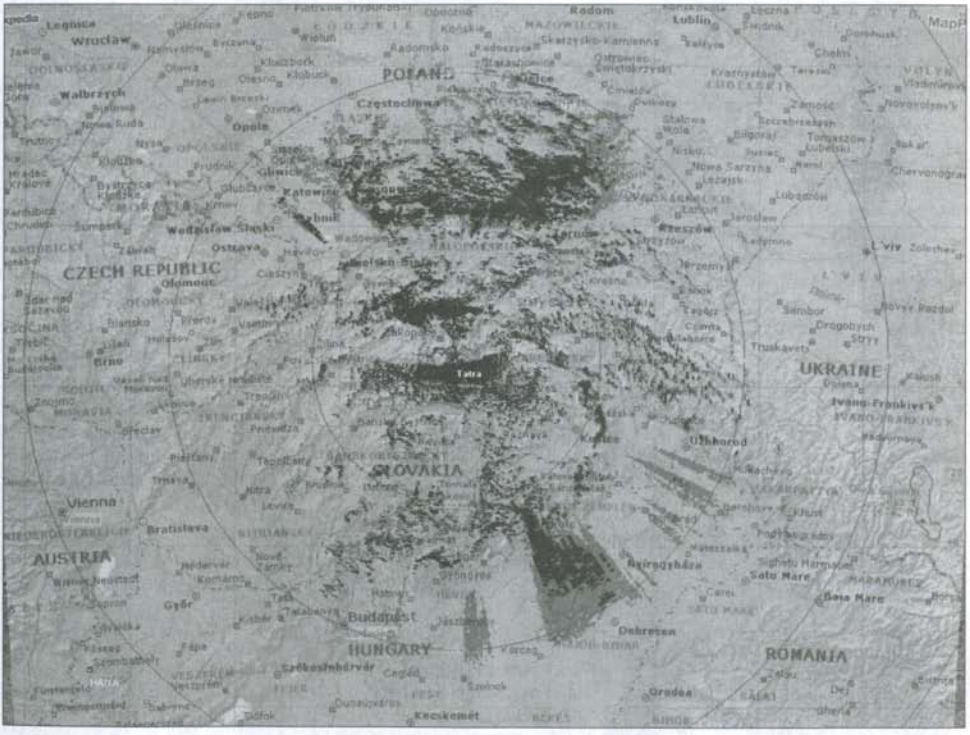
Abb.: Direkte Kabeleinführung in den Dipolkasten

Fig.: Feeding the dipole box with bulkhead N type connector

Mountain Scatter Possibilities - simulated with the Radio Mobile Software

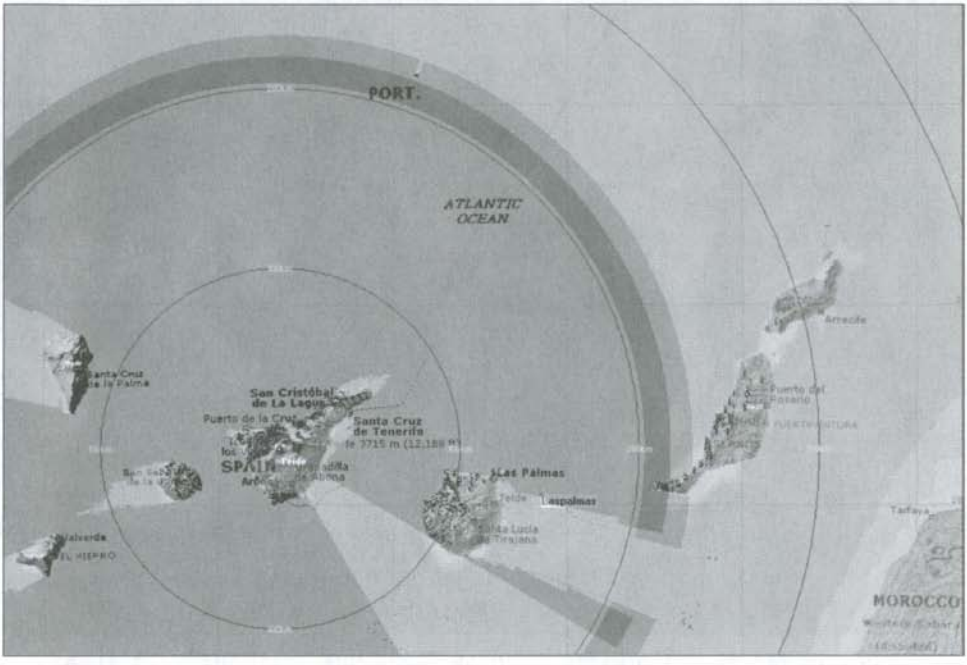
by Jens Held, DL7VTX

In previous maps which were published in DUBUS 1/2006 and 4/2007 the possibilities for microwave scatter on the Mt. Blanc (4810m a.s.l., locator JN35ku) were shown. The maps were generated with the Radio Mobile software and the practical results on 10 GHz over the Mt. Blanc show that the simulation is quite accurate for this case. QSOs over paths of several 100km distance are possible here. Unfortunately there are not too many high mountains in the neighbourhood of the areas where the population of microwave DXers is high. Thus some simulations for lower mountains in the 2800 to 4000m range were done and the results are shown here. All maps show the optical horizon (always the darker grey or black color) and additionally the radio horizon for 10 GHz (the slightly brighter color). Radio amateurs located in these regions should try scatter experiments with other radio amateurs from the same areas.



Mt. Tatra, KN09BE, 2600m a.s.l.

On the northern side SP9 stations north of Krakau should try to work each other. On the southern side OM stations should try with southeastern Hungary. The black areas within the 200km circle denote direct optical paths what means high probability for backscatter contacts. The grey areas denote the radio horizon on 10 GHz what means that there still is a certain but lower probability for a backscatter contact.



Mt. Pico del Teide, IL18QG, 3718m a.s.l., Tenerife, EA8

This is the map for the volcano Teide on Tenerife, Canary Islands. The black spots on the islands and the uniform grey areas on the water to about 220km distance denote the areas with an optical path to Mt. Teide. The additional grey circle from about 220 to 240km and some tiny grey spots on the western part of Lanzarote Island denote the radio horizon on 10 GHz. As the Teide consists of volcanic material the reflection characteristics will probably be different from the Mt. Blanc with a lot of snow and ice.
But experiments would be very interesting anyway! At least it has been shown on 144 MHz that scatter on the Teide is possible: G4LOH has worked CT1HZE over a 3800km path when Tropo ducts were backscattered on the Teide. CT1HZE can observe regularly backscatter signals from EA7 stations from Mt. Teide on 2m.

CT3 to EA8 on 10 GHz: Always open!

Just for fun also a 10 GHz path from Mt. Teide (EA8) to Mt. Pico Areiro (CT3, Madeira) was calculated with Radio Mobile. The path length is 560km. Calculating with 10 W output and 40 dBi dishes on both ends the result is S1 signal strength! Thus this path is open any time without any Tropo enhancement! Anyway to our knowledge no 10 GHz QSO has ever taken place from EA8 to CT3. Would be so easy to go there and make a first ever CT3-EA8 on 10 GHz (and BTW also most of the other GHz bands, of course). Note: This CT3-EA8 path is not shown on the map.

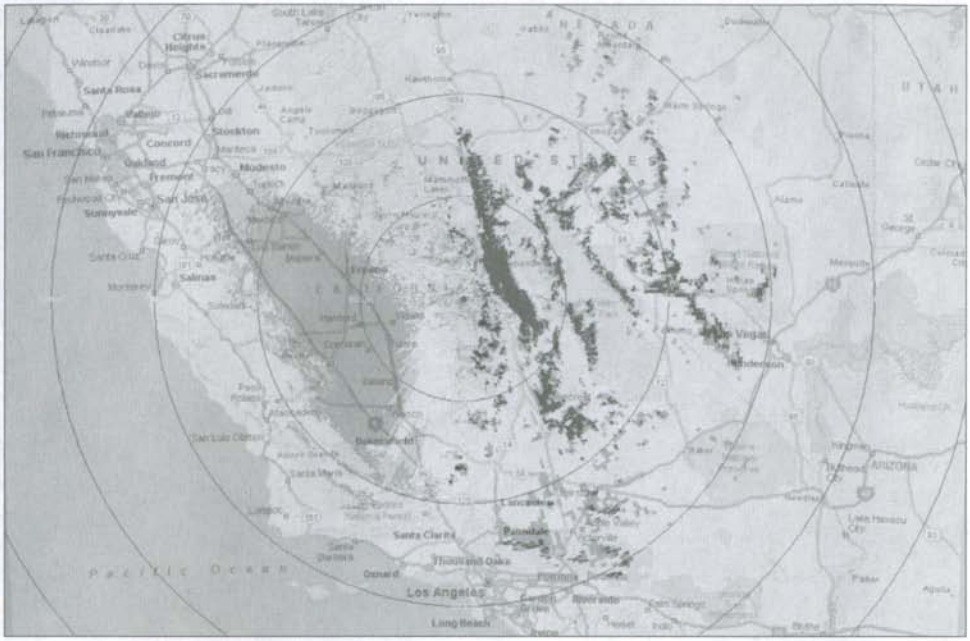
Two examples for USA, California

On the next page (top) we see the map for the Sequoia Mountains including Mt. Whitney. Mt. Whitney on it`s own brings not too promising results as it is located within a chain of 3700 m a.s.l. mountains. Anyway the complete chain looks promising (see map). Stations west of the chain within the grey area should try to scatter via these mountains and stations east of the chain (black area) also. Again the darker color denotes the optical path and the brighter areas the radio horizon for 10 GHz.

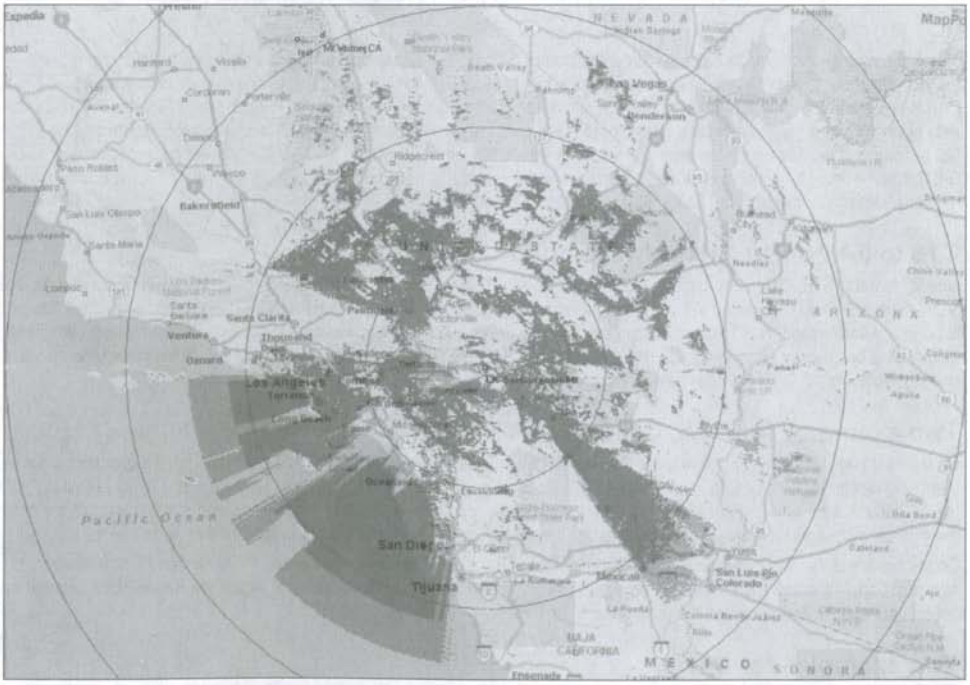
On the bottom of the next page we see the according map for the San Bernardino Mountains (> 3000m a.s.l.). Stations from Los Angeles, San Francisco and Las Vegas area all have an optical path to these mountains. Again the darker color denotes the optical path and the brighter areas the radio horizon for 10 GHz.

Two examples for Spain

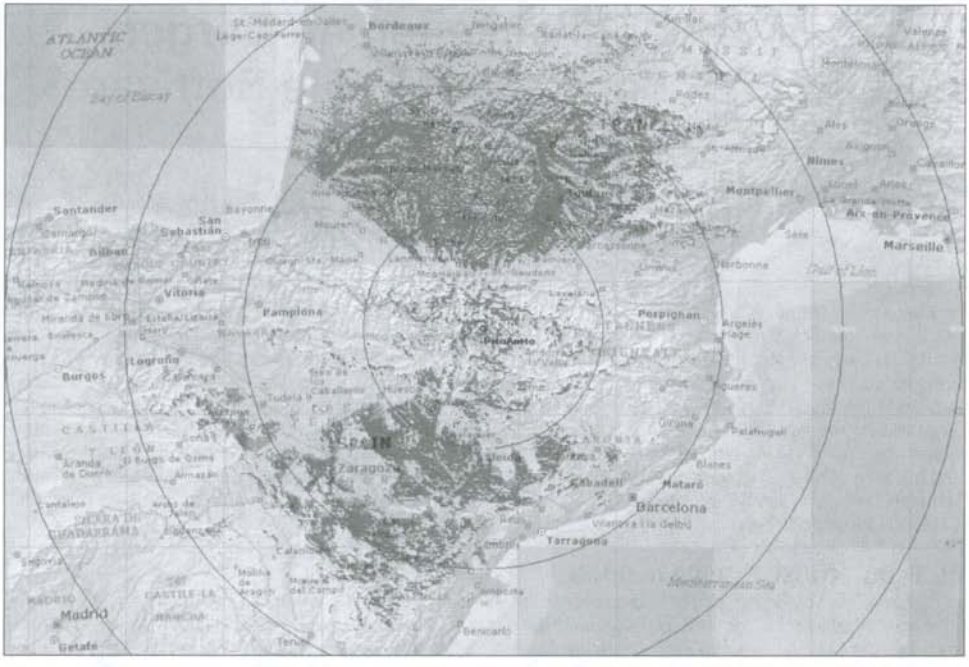
The Pico Aneto in the Pyrenees shows nice footprints for EA2, EA3 and southern France. The Mulhacen in the Sierra Nevada in southern Spain covers areas in EA7, EA5, CN and 7X where nobody is qrv on 10 GHz, unfortunately.



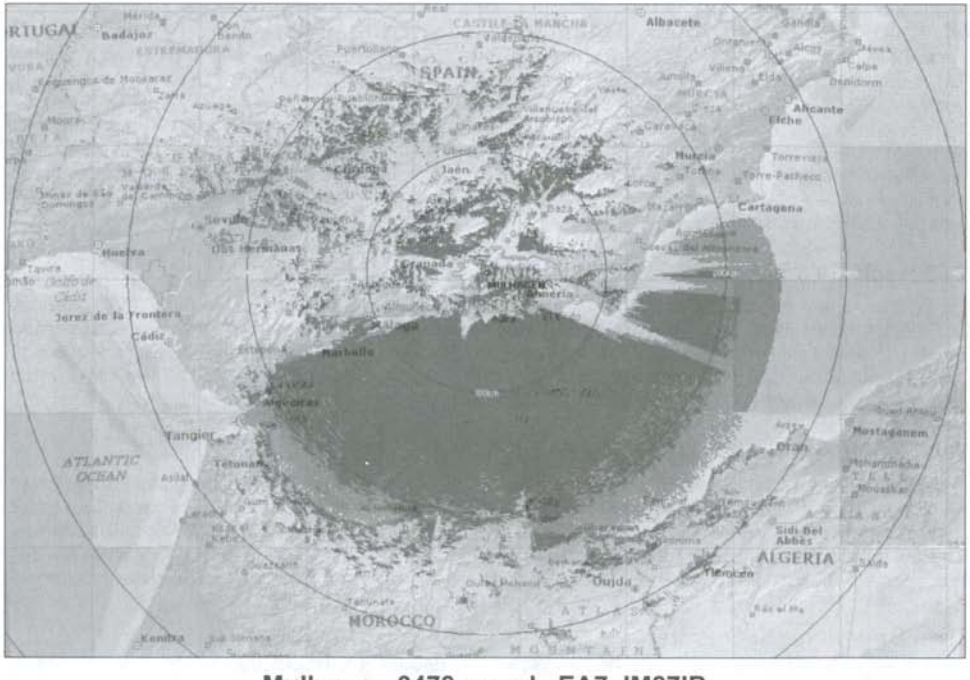
Sequoia Mountains and Mt. Whitney 4421m a.s.l, DM06UO, CA, USA



San Bernadino Mountains, DM14NC, California, USA, > 3000m a.s.l.



Pico Aneto, 3404m a.s.l., Pyrenees, JN02HP



Mulhacen, 3478m a.s.l., EA7, IM87IB

Backscatter-Möglichkeiten an Bergen - simuliert mit der Radio Mobile Software

von Jens Held, DL7VTX

In Karten, die zuvor bereits in DUBUS 1/2006 und 4/2007 veröffentlicht wurden, wurden die Möglichkeiten für Mikrowellen-Scatterverbindungen (speziell 10 GHz) über den Mt. Blanc (4810m ü. NN, Locator JN35ku) aufgezeigt. Die Karten wurden mit der Radio Mobile Software erstellt. Die bisherigen Resultate der Praxis zeigen eine gute Übereinstimmung mit den Simulationen. Es sind hier Verbindungen über Strecken von mehreren hundert Kilometern möglich. Leider gibt es nicht so viele sehr hohe weitere Berge dort, wo auch viele Mikrowellenamateure sind. Deshalb wurden Simulationen auch für etwas niedrigere Berge mit Höhen von 2800 bis 4000m durchgeführt und die Resultate werden hier vorgestellt. Alle Karten zeigen den optischen Horizont (immer die etwas dunklere graue oder schwarze Farbe) und zusätzlich den Funkhorizont für 10 GHz (der etwas hellere Farbton, weiter entfernt). Funkamateure, die sich in diesen Gebieten befinden, sollten einmal Scatter-Versuche mit anderen Stationen versuchen, die sich ebenfalls in diesen Gebieten befinden.

Mt. Tatra, KN09BE, 2600 m ü.N.N.

Auf der nördlichen Seite sollten sich SP9-Stationen nördlich von Krakau gegenseitig arbeiten können. Auf der südlichen Seite sollten es OM-Stationen mal mit Stationen in Südost-Ungarn versuchen. Die schwarzen Bereiche im 200km-Umkreis stellen die direkte optische Sicht dar, was eine hohe Wahrscheinlichkeit für Backscatter-Kontakte bedeutet. Die grauen Bereiche entsprechen dem Funkhorizont auf 10 GHz, was immer noch eine erhöhte Wahrscheinlichkeit für solche Kontakte bedeutet, wenn auch diese niedriger als in den schwarzen Bereichen ist.

Mt. Pico del Teide, IL18QG, 3718m ü.NN., Teneriffa, EA8

Hier wird eine Karte für den Vulkan Teide auf Teneriffa gezeigt. Die scharzen Flecken auf den Inseln und die monoton grauen Flächen über dem Wasser bis etwa 220km Entfernung entsprechen der optischen Sicht zum Teide. Der zusätzliche graue Bereich von etwa 220 bis 240km und einige graue Spots im Westen auf Lanzarote entsprechen dem Radiohorizont auf 10 GHz. Da der Teide vulkanischen Ursprungs ist, werden die Reflektionseigenschaften sicher anders sein, als beim Mt. Blanc, wo es sehr viel Schnee und Gletscher gibt. Experimente wären aber auf jeden Fall interessant. Zumindest hat es ja auf 144 MHz bereits ein Backscatter-QSO über den Teide zwischen G4LOH und CT1HZE über eine 3800km-Strecke gegeben, als Tropo-Ducts sich dort trafen und die Signale am Vulkan zurückreflektiert wurden. CT1HZE kann auf 2m regelmäßig Signale aus EA7 hören, die vom Teide zurückreflektiert werden.

CT3 nach EA8 auf 10 GHz: Immer offen!

Zum Spaß wurde auch mal eine 10-GHz-Strecke vom Teide (EA8) zum Pico Areiro (CT3, Madeira) mit Radio Mobile gerechnet. Die Entfernung beträgt 560km. Es wurden beidseitig 10 W Output und 40-dBi-Spiegel angenommen. Heraus kam eine Feldstärke von S1! D.h. dieser Pfad ist auch ohne angehobene Tropo-Bedingungen bereits offen! Soweit wir wissen, hat es noch kein 10 GHz-QSO von EA8 nach CT3 gegeben. Es wäre also leicht, dorthin zu fahren und die Erstverbindung CT3-EA8 auf 10 GHz (und übrigens auch diversen anderen GHz-Bändern) zu machen. Die CT3-EA8-Strecke ist nicht auf der Karte dargestellt.

Zwei Beispiele für die USA / Kalifornien

Im weiteren sind zwei Karten für die Sequoia Berge einschließl. Mt. Whitney (oben) dargestellt. Mt. Whitney alleine bringt nicht so viel, da er inmitten eine Kette von 3700ern liegt. Die komplette Bergkette jedoch ist lohnenswert. Stationen westl. der Kette (graue Bereiche) sollten es miteinander probieren und Stationen östlich davon (schwarze Flächen) ebenfalls. Wieder stellt die dunklere Farbe den optischen Pfad dar und die helleren Bereiche den Funkhorizont auf 10 GHz. – Darunter ist eine Karte für die San Bernardino Berge (> 3000m ü.N.N.). Stationen aus LA, San Francisco und Las Vegas haben alle optische Sicht zu diesen Bergen.

Zwei Beispiele für Spanien

Der Pico Aneto in den Pyrenäen zeigt schöne Möglichkeiten für EA2, EA3 und Südfrankreich. Der Mulhacen in der Sierra Nevada in Südspanien wäre für Bereiche in EA7, EA5, CN und 7X gut, wo natürlich auf 10 GHz leider keiner qrv ist....

SM5BSZ`s PIN Diode switch

- hints and comments

by Nanko de Vries, PA0V

Introduction

After having several times burned the contacts of my mechanical TX/RX relay, the PIN diode switch described by SM5BSZ in DUBUS 4/2004 was built. It worked fine but it took a lot of time to get enough isolation between TX and RX port, and at the best figure I could get was abt -60 dB. Therefore the coil with tap was replaced with a second 1/4 wave high Z transmission line. A half wave line reproduces the impedance regardless its impedance. It also gives the possibility to use a second pindiode in the RX branch. This way the isolation figures improved by >10 dB .

Powerhandling

The switch was tested with 1500 Watt carrier during 10 minutes. The PIN diode temperature stayed below 50 degrees C. As can be seen in the TX isolation plot, the second harmonic is only ~15 dB suppressed, the diodes are for 288MHz placed on a current maximum, so a shortcircuit is not as effective as on a voltage maximum. This can be dangerous for the preamp when P.A. harmonic suppression is poor. (Use low pass filter)

Sequencing

The switch is faster than a relay , when a relay operated transmitter still produces RF at the end of a transmission the switch will be already in RX position, this situation will undoubtedly smoke the preamp. A good sequencer is very important. Beeing a mechanic I used a "all relay" solution, with capacitors to create the correct delays, an electronic approach would be safer, when rapid switching happens the capacitors are not fully (dis)charged and the delay times will change.
Note: I use the voltage drop across one of the diode resistors as interlock for transverter and PA.

Construction

My choice was round center conductors in a square shield, the sizes of the square shield can be easily adapted to the available diameter coppertube/wire to get 50 resp ~100 Ohm. In my case center conductor diameter is 8 mm and hi Z branches 2.5 mm, both in square 17 mm. Distance between diodes and in/output connectors is 52 cm. For optimal heat transfer the pindiodes are soldered on a 3 mm brass screw

Power supply

In TX every diode should carry at least 500 mA forward current, more did not improve the isolation figures significantly, less however decreases the figure. In RX voltage should be at least - 24V (reverse bias voltage).

Aligning

With mWatt meter and RF source tune the piston trimmers for lowest loss in RX position. Or listen with RX in FM mode to a weak carrier and tune a voltmeter connected to the audio output to minimal deflection.

Final

The switch is used for 3 years without loosing a single preamp. Graham, F5VHX did some IMD tests, the switch performed too good for the somewhat limited test setup, no IMD was observed.

Reference

Read the original article from SM5BSZ for a more detailed explanation in DUBUS 4/2004, page 31-35 or on the web at:
http://www.nitehawk.com/sm5bsz/pindiode.htm

Addendum

SM5BSZ, Leif, comments: More isolation can be arranged on the rx side with series PIN diodes. It would however make the sequencing a bit more complex. A series diode at the 50 ohm output of the original design would give a large improvement and in the modified design the improvements would add. On the other hand, I never had any problems with the low isolation in the original design once I understood the significance of the cable length between the switch and the preamp. Series diodes on the RX side as well as parallel diodes at 50 ohms improve isolation but do not add any losses that are noticeable compared to the 0.1 dB given by the main switching diode.

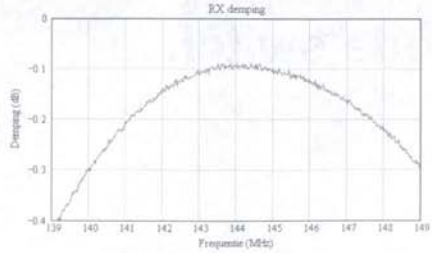


Fig. 1: RX insertion loss on 2m

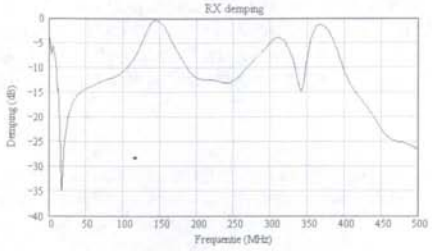


Fig. 2: RX insertion loss wideband

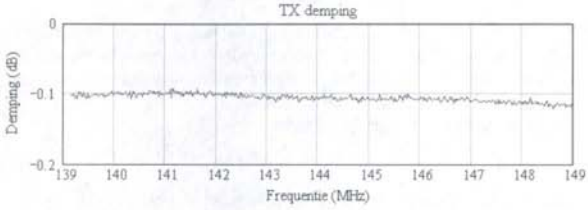


Fig. 3: TX insertion loss 2m

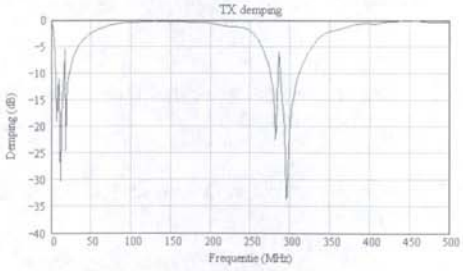


Fig. 4: TX insertion loss - wideband

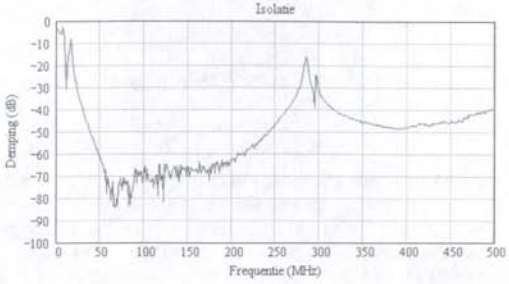
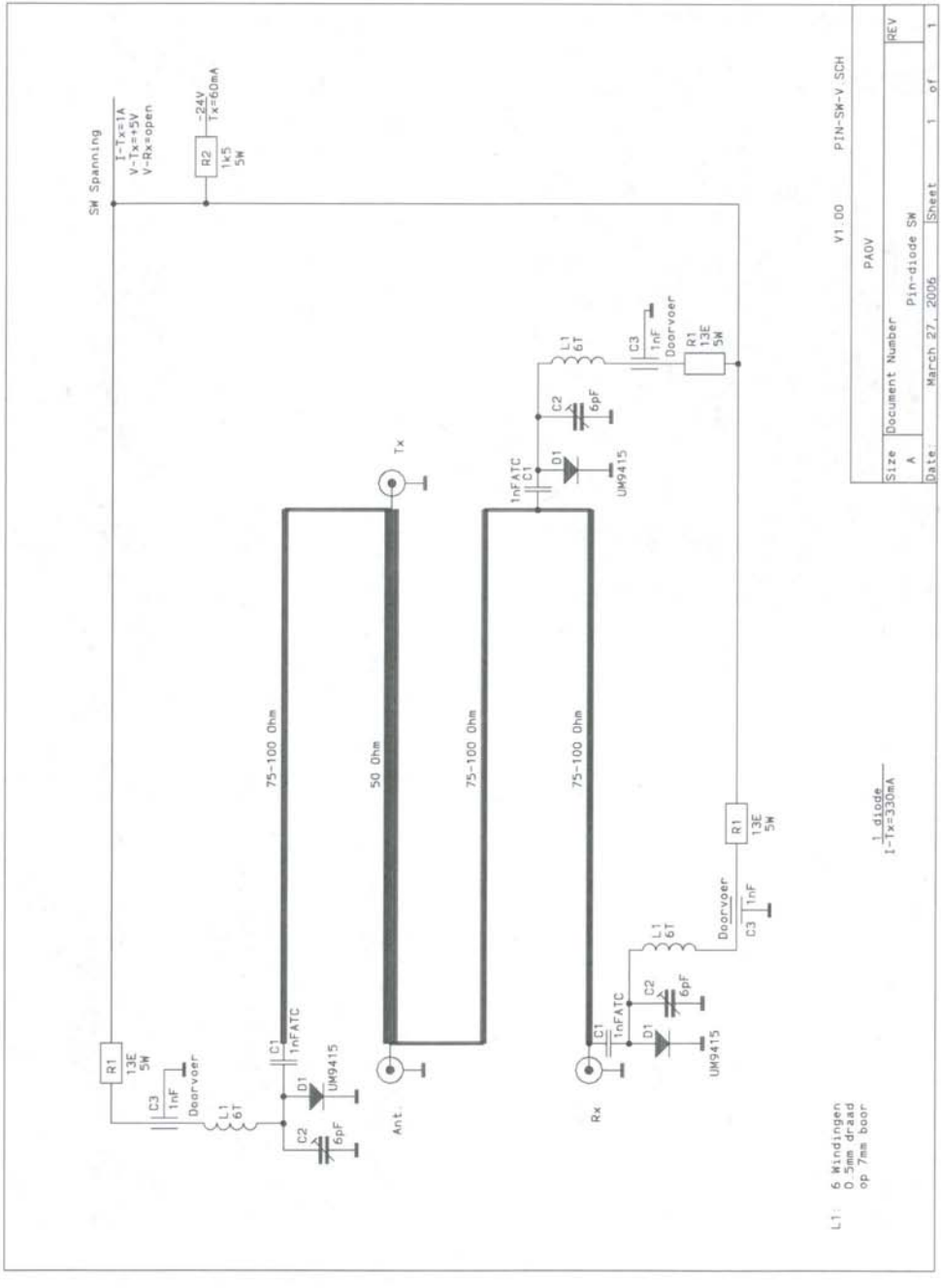


Fig. 5: Isolation



Drawing by Timo, PE1FOD

Fig. 6: Circuit diagram

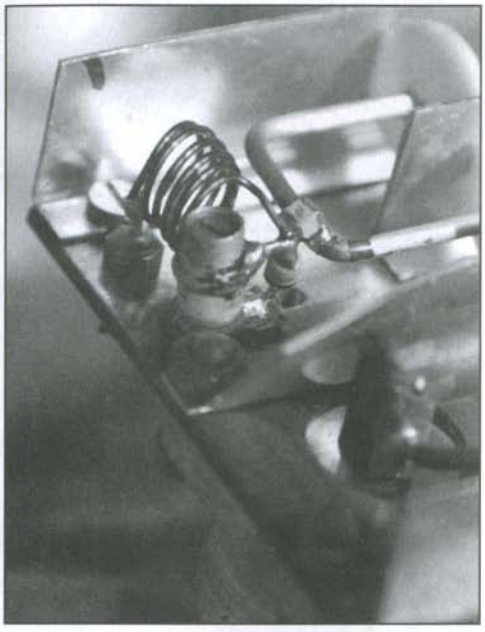


Fig. 7: PIN diode switch – close view

Pictures by A. Eveleens www.eveleens-fotografie.nl

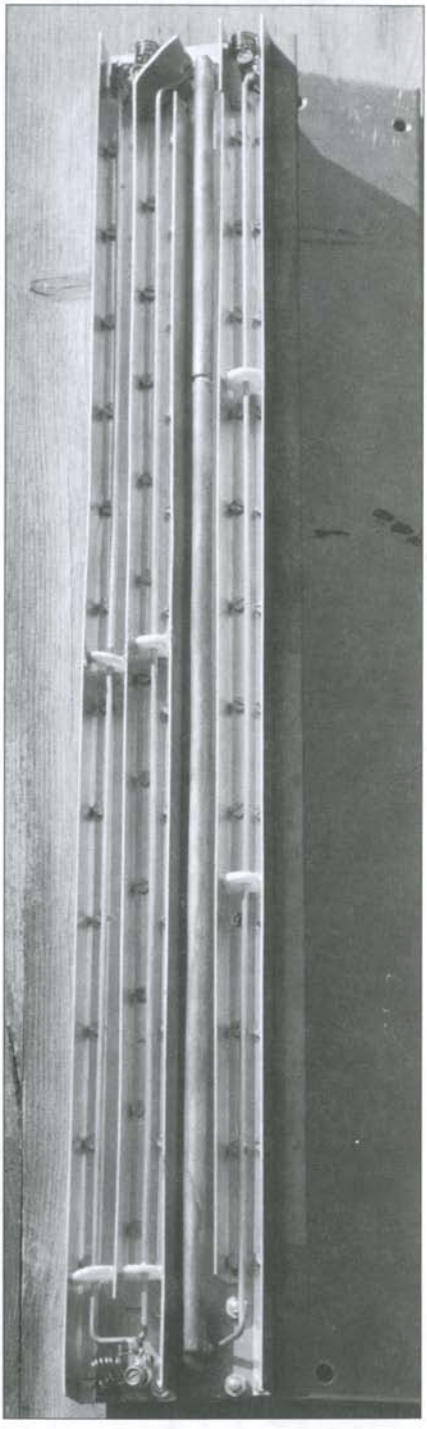


Fig. 8: PIN diode switch – complete assembly

SM5BSZ`s PIN-Diodenschalter

- Tipps und Anmerkungen

von Nanko de Vries, PA0V

Einleitung

Nachdem ich mir mehrfach die Kontake meines mechanischen TX/RX-Relais abgebrannt hatte, baute ich das PIN-Dioden-Relais, das SM5BSZ in DUBUS 4/2004 beschrieben hat. Es hat gut funktioniert, aber ich brauchte viel Zeit, um genügend Isolation zwischen RX- und TX-Eingang zu erhalten. Als bestes habe ich etwa -60dB erreicht. Dazu wurde die Spule mit der Anzapfung ersetzt durch eine zweite Lambda-Viertel-Leitung mit hohem Z. Eine Halbwellen-Leitung reproduziert die Impedanz unabhängig ihrer Impedanz. Das ermöglicht auch eine zweite PIN-Diode in der RX-Leitung zu verwenden. Dadurch kann die Isolation um >10dB verbessert werden.

Leistungsfähigkeit

Der Schalter wurde mit einem 1500-Watt-Träger über 10 Minuten getestet. Die Temperatur der PIN-Dioden blieb dabei unter 50 Grad Celsius. Wie im Plot der TX-Isolation zu sehen, ist die zweite Harmonische nur etwa 15 dB unterdrückt, die Dioden sind für 288MHz in ein Strommaximum gelegt. So ist ein Kurzschluß nicht so effektiv wie bei einem Spannungsmaximum. Das kann gefährlich sein für den Vorverstärker, wenn die Oberwellenunterdrückung der PA schlecht ist. (Also Tiefpaßfilter benutzen).

Sequenzer

Der Diodenschalter ist schneller als ein Relais. Wenn ein Sender, der mit einem Relais arbeitet, am Ende der Aussendung noch Leistung abgibt, wird der Diodenschalter schon in RX-Position sein. Das wird zweifelsfrei ein Abrauchen des Preamps zur Folge haben. Ein guter Sequenzer ist also sehr wichtig. Als Mechaniker habe ich eine Lösung aus mechanischen Relais gebaut, mit Kondensatoren, um die korrekten Verzögerungen zu erzeugen. Eine elektronische Lösung ist sicherer: Wenn schnelles Umschalten erfolgt, werden die Kondensatoren nicht voll ent-/geladen und die Verzögerungzeiten verändern sich. Hinweis: Ich nutze den Spannungsabfall über einem der Diodenwiderstände als Blockierung für den Transverter und die PA.

Konstruktion

Ich wählte runde Innenleiter in einem quadratischen Gehäuse. Die Größen des quadratischen Gehäuses können leicht angepaßt werden an die verfügbaren Duchmesser des Kupferrohres/drahtes, um 50 bzw. 100 Ohm zu erhalten. In meinem Fall hatte ich einen 8mm Innenleiter und 2.5mm Arme mit hohem Z, beides in einem 17mm Qudrat. Der Abstand zwischen den Dioden und Eingangs- und Ausgangsanschlüssen ist 52cm. Für optimale Wärmeableitung werden die PIN-Dioden auf eine 3mm Messingschraube gelötet.

Strom und Spannung

Bei TX soll durch jede Diode mindestens 500mA Vorwärtsstrom fließen. Mehr verbessert die Isolationswerte nicht signifikant, weniger jedoch verschlechtert die Werte. Bei RX soll die Spannung mindestens -24 V (umgekehrte Vorspannung) betragen.

Einstellung

Mit Milliwattmeter und einer HF-Quelle werden die Piston-Trimmer auf niedrigsten Verlust in der RX-Position justiert. Oder man hört in FM auf einen schwachen Träger und gleicht mit einem Voltmeter am Audioausgang des RX ab.

Schluss

Der PIN-Diodenschalter wird bei mir seit 3 Jahren verwendet ohne je einen Preamp zu verloren zu haben. Graham, F5VHX, hat IMD-Messungen durchgeführt. Bei seinem etwas begrenzten Meßaufbau konnte keinerlei IMD festgestellt werden.

Referenz

Der Original-Artikel von SM5BSZ mit mehr Details findet sich in DUBUS 4/2004, ab Seite 31 oder im Web unter:
http://www.nitehawk.com/sm5bsz/pindiode.htm

Nachtrag

SM5BSZ, Leif, merkt an, dass mehr Isolation durch PIN-Dioden in Serie auf der RX-Seite erreicht werden kann.

LT5575

800MHz to 2.7GHz High Linearity Direct Conversion Quadrature Demodulator

FEATURES

- **Input Frequency Range: 0.8GHz to 2.7GHz***
- **50Ω Single-Ended RF and LO Ports**
- **High IIP3: 28dBm at 900MHz, 22.6dBm at 1.9GHz**
- **High IIP2: 54.1dBm at 900MHz, 60dBm at 1.9GHz**
- **Input P1dB: 13.2dBm at 900MHz**
- **I/Q Gain Mismatch: 0.04dB Typical**
- **I/Q Phase Mismatch: 0.4° Typical**
- **Low Output DC Offsets**
- Noise Figure: 12.8dB at 900MHz, 12.7dB at 1.9GHz
- Conversion Gain: 3dB at 900MHz, 4.2dB at 1.9GHz
- Very Few External Components
- Shutdown Mode
- 16-Lead QFN 4mm × 4mm Package with Exposed Pad

APPLICATIONS

- Cellular/PCS/UMTS Infrastructure
- RFID Reader
- High Linearity Direct Conversion I/Q Receiver

DESCRIPTION

The LT®5575 is an 800MHz to 2.7GHz direct conversion quadrature demodulator optimized for high linearity receiver applications. It is suitable for communications receivers where an RF signal is directly converted into I and Q baseband signals with bandwidth up to 490MHz. The LT5575 incorporates balanced I and Q mixers, LO buffer amplifiers and a precision, high frequency quadrature phase shifter. The integrated on-chip broadband transformers provide 50Ω single-ended interfaces at the RF and LO inputs. Only a few external capacitors are needed for its application in an RF receiver system.

The high linearity of the LT5575 provides excellent spur-free dynamic range for the receiver. This direct conversion demodulator can eliminate the need for intermediate frequency (IF) signal processing, as well as the corresponding requirements for image filtering and IF filtering. Channel filtering can be performed directly at the outputs of the I and Q channels. These outputs can interface directly to channel-select filters (LPFs) or to baseband amplifiers.

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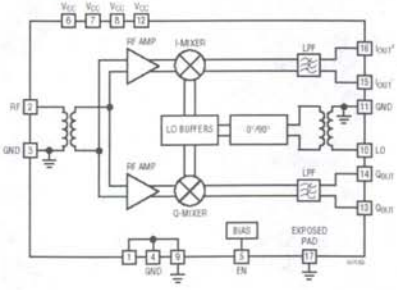
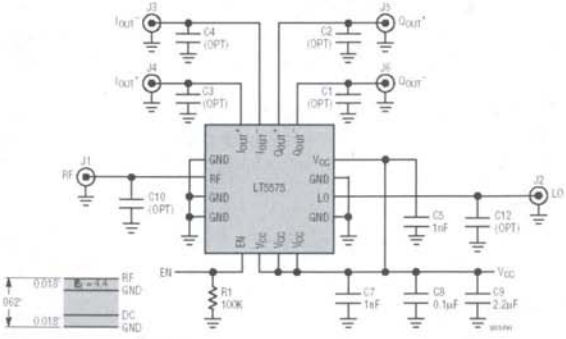
*Operation over a wider frequency range is possible with reduced performance. Consult the factory.

BLOCK DIAGRAMM



Test Circuit



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400MHz to 3.7GHz High Signal Level Downconverting Mixer

FEATURES

- **50Ω Single-Ended RF and LO Ports**
- **Wide RF Frequency Range: 400MHz to 3.7GHz***
- **High Input IP3: 24.5dBm at 900MHz**
  23.5dBm at 1900MHz
- **Conversion Gain: 3.2dB at 900MHz**
  2.3dB at 1900MHz
- **Integrated LO Buffer: Low LO Drive Level**
- **High LO-RF and LO-IF Isolation**
- Low Noise Figure: 11.6dB at 900MHz
  12.5dB at 1900MHz
- Very Few External Components
- Enable Function
- 4.5V to 5.25V Supply Voltage Range
- 16-Lead (4mm × 4mm) QFN Package

APPLICATIONS

- Cellular, WCDMA, TD-SCDMA and UMTS Infrastructure
- GSM900/GSM1800/GSM1900 Infrastructure
- 900MHz/2.4GHz/3.5GHz WLAN
- MMDS, WiMAX
- High Linearity Downmixer Applications

DESCRIPTION

The LT®5527 active mixer is optimized for high linearity, wide dynamic range downconverter applications. The IC includes a high speed differential LO buffer amplifier driving a double-balanced mixer. Broadband, integrated transformers on the RF and LO inputs provide single-ended 50Ω interfaces. The differential IF output allows convenient interfacing to differential IF filters and amplifiers, or is easily matched to drive 50Ω single-ended, with or without an external transformer.

The RF input is internally matched to 50Ω from 1.7GHz to 3GHz, and the LO input is internally matched to 50Ω from 1.2GHz to 5GHz. The frequency range of both ports is easily extended with simple external matching. The IF output is partially matched and usable for IF frequencies up to 600MHz.

The LT5527's high level of integration minimizes the total solution cost, board space and system-level variation.

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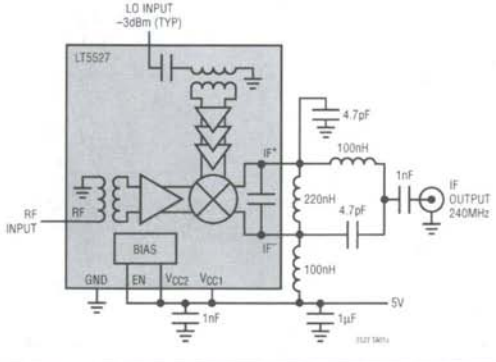
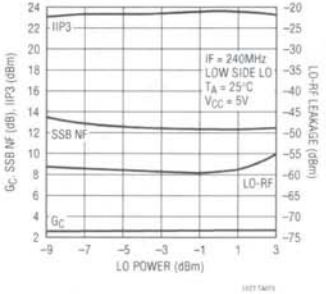
*Operation over a wider frequency range is possible with reduced performance. Consult factory for information and assistance.

TYPICAL APPLICATION

High Signal Level Downmixer for Multi-Carrier Wireless Infrastructure



1.9GHz Conversion Gain, IIP3, SSB NF and LO-RF Leakage vs LO Power



5527f

300MHz to 11GHz Precision Dual RF Power Detector

FEATURES

- **Two Independent Temperature Compensated Schottky Diode RF Peak Detectors**
- **45dB Channel-to-Channel Isolation at 2GHz**
- **Wide Input Frequency Range: 300MHz to 11GHz***
- **Wide Input Power Range: –32dBm to 12dBm**
- **Buffered Detector Outputs with Gain of 2x**
- **Adjustable V_{OUT} Starting Voltage**
- **Wide V_{CC} Range of 2.7V to 6V**
- Low Operating Current: <500μA/Channel
- Low Shutdown Current: <2μA/Channel
- 4mm × 3mm DFN Package

APPLICATIONS

- PA Forward and Reverse Power Monitor
- Dual PA Transmit Power Control
- 802.11a, b, g, 802.15, WiMAX
- PA Linearization
- Fixed Wireless Access
- RF Power Alarm
- Envelope Detector

DESCRIPTION

The LTC®5533 is a dual channel RF power detector for RF applications operating in the 300MHz to 11GHz range. Two independent temperature compensated Schottky diode peak detectors and buffer amplifiers are combined in a small 4mm × 3mm DFN package.

The RF input voltage is peak detected using on-chip Schottky diodes. The detected voltage is buffered and supplied to the V_{OUT} pins. A power saving shutdown mode reduces current to less than 2μA/channel. The initial output starting voltages can be precisely adjusted using the V_{OS} pins.

The LTC5533 operates with input power levels from –32dBm to 12dBm.

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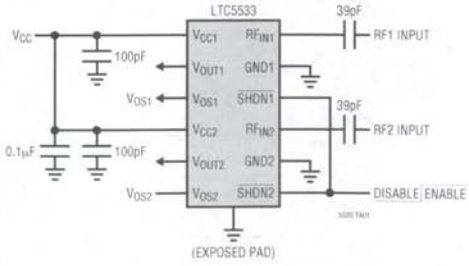
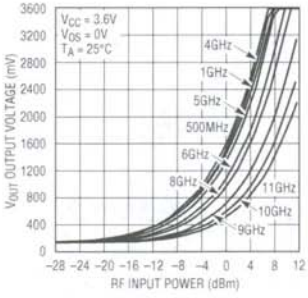
*Higher frequency operation is achievable with reduced performance. Consult factory for more information.

TYPICAL APPLICATION

300MHz to 11GHz RF Power Detectors



Output Voltage vs RF Input Power



1.8GHz Low Noise, Low Distortion Differential ADC Driver for 300MHz IF

FEATURES

- 1.8GHz –3dB Bandwidth
- Fixed Gain of 10V/V (20dB)
- –94dBc IMD_3 at 70MHz (Equivalent OIP3 = 51dBm)
- –65dBc IMD_3 at 300MHz (Equivalent OIP3 = 36.5dBm)
- 1nV/$\sqrt{Hz}$ Internal Op Amp Noise
- 2.1nV/$\sqrt{Hz}$ Total Input Noise
- 6.2dB Noise Figure
- Differential Inputs and Outputs
- 200Ω Input Impedance
- 2.85V to 3.5V Supply Voltage
- 90mA Supply Current (270mW)
- 1V to 1.6V Output Common Mode Voltage, Adjustable
- DC- or AC-Coupled Operation
- Max Differential Output Swing $4.4V_{P-P}$
- Small 16-Lead 3mm × 3mm × 0.75mm QFN Package

APPLICATIONS

- Differential ADC Driver
- Differential Driver/Receiver
- Single Ended to Differential Conversion
- IF Sampling Receivers
- SAW Filter Interfacing

DESCRIPTION

The LTC®6400-20 is a high-speed differential amplifier targeted at processing signals from DC to 300MHz. The part has been specifically designed to drive 12-, 14- and 16-bit ADCs with low noise and low distortion, but can also be used as a general-purpose broadband gain block.

The LTC6400-20 is easy to use, with minimal support circuitry required. The output common mode voltage is set using an external pin, independent of the inputs, which eliminates the need for transformers or AC-coupling capacitors in many applications. The gain is internally fixed at 20dB (10V/V).

The LTC6400-20 saves space and power compared to alternative solutions using IF gain blocks and transformers. The LTC6400-20 is packaged in a compact 16-lead 3mm × 3mm QFN package and operates over the –40°C to 85°C temperature range.

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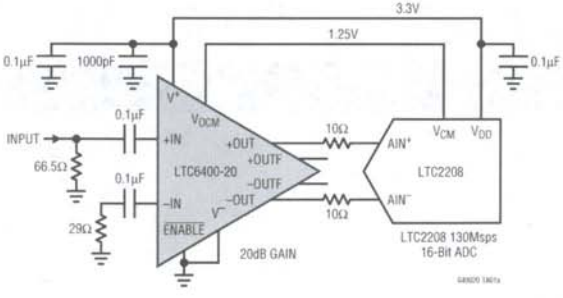
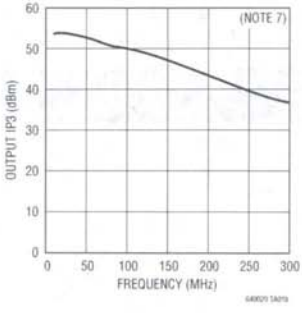
TYPICAL APPLICATION

Single-Ended to Differential ADC Driver



Equivalent Output IP3 vs Frequency



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SIRENZA MICRODEVICES

Preliminary Information

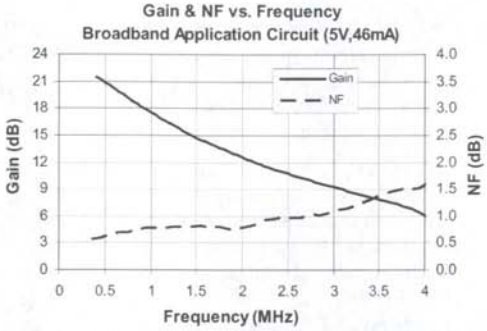
SPF-5043Z

100-4000 MHz, GaAs pHEMT Low Noise MMIC Amplifier

RoHS Compliant & Green Package

Product Description

The SPF-5043Z is a high performance pHEMT MMIC LNA designed for operation from 100-4000 MHz. The on-chip active bias network provides stable current over temperature and process threshold voltage variations. The SPF-5043Z offers ultra-low noise figure and high linearity performance in a gain block configuration. Its single-supply operation and integrated matching networks make implementation remarkably simple. A high maximum input power specification make it ideal for high dynamic range receivers.



Product Features

- Ultra-Low Noise Figure = 0.8 dB @ 900 MHz
- Gain = 18.2 dB @ 900 MHz
- High Linearity: OIP3 = 35 dBm @ 1900 MHz
- P1dB = 21 dBm @ 1900 MHz
- Single-supply operation: 5V @ Idq=46mA
- Flexible Biasing Options: 3-5V, Adjustable Current
- Broadband Internal Matching

Applications

- Cellular, PCS, W-CDMA, ISM, WiMAX Receivers
- Low noise, high linearity gain block applications

Symbol	Parameters	Units	Frequency	Min.	Typ.	Max.
S_{21}	Small Signal Power Gain	dB	0.9 GHz		18.2	
			1.9 GHz		12.9	
NF	Noise Figure	dB	0.9 GHz		0.80	
			1.9 GHz		0.80	
OIP_3	Output Third Order Intercept Point	dBm	0.9 GHz		33.0	
			1.9 GHz		35.0	
P1dB	Output Power at 1dB Compression	dBm	0.9 GHz		20.0	
			1.9 GHz		21.0	
S_{11}	Input Return Loss	dB	0.9 GHz		-16.0	
			1.9 GHz		-17.5	
S_{22}	Output Return Loss	dB	0.9 GHz		-17.5	
			1.9 GHz		-16.5	
S_{12}	Reverse Isolation	dB	0.9 GHz		-23.5	
			1.9 GHz		-19.0	
V_D	Device Operating Voltage	V			5.0	
I_{DQ}	Device Operating Current (Quiescent)	mA			46	
Rth, j-l	Thermal Resistance (junction-to-lead)	°C/W			125	

Test Conditions: V_D = 5.0V, I_{DQ} = 46mA, OIP_3 Tone Spacing = 1MHz, Pout per tone = 0 dBm
$Z_S = Z_L$ = 50 Ohms, 25C, Broadband Application Circuit

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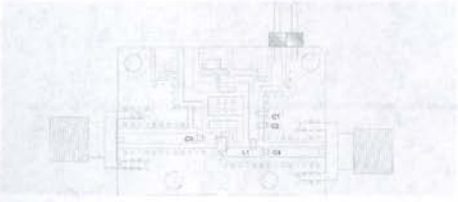
EDS-105475 Rev C



Evaluation Board Layout

SIRENZA MICRODEVICES

Preliminary Information

SPF-5122Z

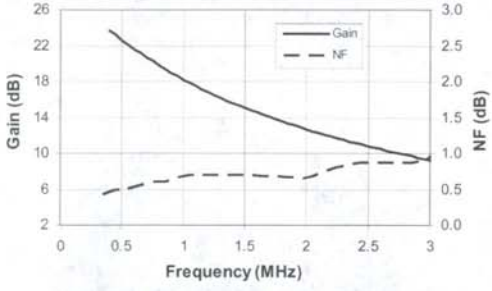
100-4000 MHz, GaAs pHEMT Low Noise MMIC Amplifier

RoHS Compliant & Green Package

Product Description

The SPF-5122Z is a high performance pHEMT MMIC LNA designed for operation from 100-4000 MHz. The on-chip active bias network provides stable current over temperature and process threshold voltage variations. The SPF-5122Z offers ultra-low noise figure and high linearity performance in a gain block configuration. Its single-supply operation and integrated matching networks make implementation remarkably simple. A high maximum input power specification make it ideal for high dynamic range receivers.

Gain & NF vs. Frequency
Broadband Application Circuit (5V,90mA)



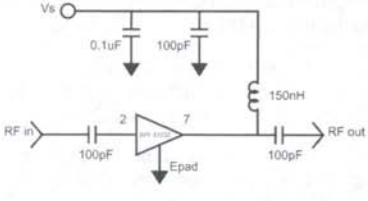
Product Features

- Ultra-Low Noise Figure = 0.60 dB @ 900 MHz
- Gain = 18.9 dB @ 900 MHz
- High Linearity: OIP3 = 40.5 dBm @ 1900 MHz
- Channel Power = 13.4 dBm (-65dBc IS95 ACPR, 880 MHz)
- P1dB = 23.4 dBm @ 1900 MHz
- Single-supply operation: 5V @ Idq=90mA
- Flexible Biasing Options: 3-5V, Adjustable Current
- Broadband Internal Matching

Applications

- Cellular, PCS, W-CDMA, ISM, WiMAX Receivers
- PA Driver Amplifier
- Low noise, high linearity gain block applications

Symbol	Parameters	Units	Frequency	Min.	Typ.	Max.
S_{21}	Small Signal Power Gain	dB	0.9 GHz		18.9	
			1.9 GHz		13.1	
NF	Noise Figure	dB	0.9 GHz		0.59	
			1.9 GHz		0.64	
OIP_3	Output Third Order Intercept Point	dBm	0.9 GHz		37.9	
			1.9 GHz		40.5	
P1dB	Output Power at 1dB Compression	dBm	0.9 GHz		23.0	
			1.9 GHz		23.4	
S_{11}	Input Return Loss	dB	0.9 GHz		-14.6	
			1.9 GHz		-21.0	
S_{22}	Output Return Loss	dB	0.9 GHz		-16.8	
			1.9 GHz		-13.0	
S_{12}	Reverse Isolation	dB	0.9 GHz		-24.1	
			1.9 GHz		-18.4	
V_D	Device Operating Voltage	V			5.0	
I_{DQ}	Device Operating Current (Quiescent)	mA			90	
Rth, j-l	Thermal Resistance (junction-to-lead)	°C/W			65	



Broadband Application Circuit Schematic 400-3000 MHz

Bill of Materials

C1	1x TAJB104KLRH Rohm 0.1uF
C2	1x MCH185A101JK Rohm 100pF
C3	1x MCH185A101JK Rohm 100pF
C4	1x MCH185A101JK Rohm 100pF
L1	1x LL1608-FSR15J Toko 150nH

VHF South America

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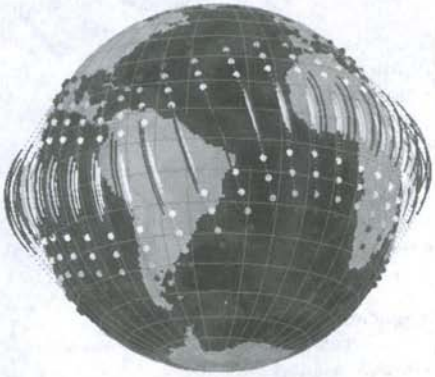
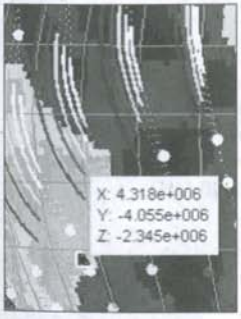
py2zx_dx@hotmail.com

Software for TEP simulation



The Transequatorial Propagation provides in every summer several international contacts with paths of more than 5.000 km between South America and Caribbean on high bands such as 144 and 432 MHz. The same is possible using other paths in the world allthough they differ in occurance and intensity. For each season new approaches, views and recent QSO data arise from the ham and scientific community. Dr. Klaus Boje von der Heide, DJ5HG, Professor of Computer Science at Universität Hamburg, Germany, produced one software to simulate on a 3D globe the images of the ducts based one of the models of TEP geometry and earth magnetic field. The years covered are: 1950, 1960, 1970, 1980, 1990, 2000 and 2010.

The author explains on the software: "the nature of the Transequatorial Propagation is not entirely understood. There are several hypotheses to explain this phenomenon. One of them is based on a duct along the magnetic field [...]



This program generates a 3-D image of the duct model. It is intended to raise interest and observation activity. The author does not prefer this model against others".

Fig.: Simulated TEP TEP paths for South America

The first map of this article is focused on South America for the year 2010. Each field per path represents five altitudes and their possible correlations on the opposite hemisphere. The globe view is rotable so all planet is available with zooms. In fact the yellow and blue dots (the second and third line from the right) are very near the reality of TEP contacts for at least one of the paths covering south Brazil and Uruguay. The shortest paths (white dots) seem to be too close and the two longest paths (red and pink dots) are too far from the Magnetic Equator for 144 MHz contacts in this case. For 50 MHz and 28 MHz, the TEP areas of QSOs are wider than 144 MHz. By clicking on any point of the globe, the X, Y, Z field components values are shown.

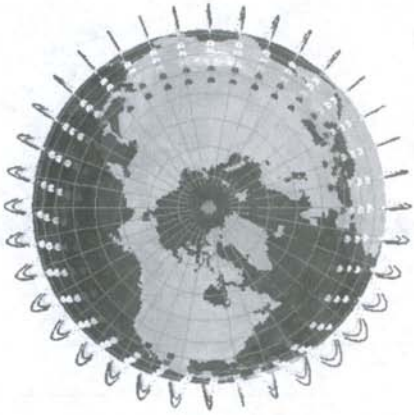


Fig.: X-Y projection showing the non parallel magnetic latitude - conventional geographic latitudes for 2010

The software is freely available on the internet and deserves the Matlab Component Runtime (around 100 MB) in your computer with WinXP. Both starts easily with "exe" install extensions.

Download of Matlab: **http://tinyurl.com/2zvogo**
Download of TEP Model Graph:
http://tinyurl.com/32p47a

The next page shows TEP path simulations for the European-African sector for different years (1960, 1980 and 2004) using the relevant IGMF data.

From the figures one can see that the TEP zone has moved to the north particulary for western Europe (see the dots over Spain) over the last decades whereas there are only marginal changes in the TA/SV/I area. This could result in better TEP results for EA, CT and F (on 2). For sure there is a slight changees in the optimal path geometry for these areas.

Contest´s schedule increases

For years the Brazilian contest scene was only occupied by the "CB144" traditional contest during the middle of the year. Now two more national contests will take place and the 3rd is on the way. The first is the "LABRE Sprints", one sequence of 4 sprints, one for each season, all VHF and up bands, to increase the DX presence for a longer period of time. The second is the "Araucaria VHF Contest", with the same rules as the CQWW VHF contest for the development of the sporting competition between the DX teams. LABRE is also planning one UHF only contest for October 2008. The QSOs with other countries are allowed, so check the calendar with the rules links. The next CQWW VHF 2008 also should have a good activity from South America.

Date	Contest	Band	Link
12-13 Jan.	LABRE Sprints	All	http://tinyurl.com/2xmbfy
05-07 April	LABRE Sprints	All	http://tinyurl.com/2xmbfy
03-04 May	Araucaria VHF	6m, 2m	http://tinyurl.com/373vu9
06-08 June	CB144	2m	http://www.gbvudx.qsl.br
05-07 July	LABRE Sprints	All	http://tinyurl.com/2xmbfy
19-20 July	CQWW VHF	6m, 2m	http://www.cqww-vhf.com/
02-03 Aug.	LABRE UHF	70cm	*Under planning*
04-06 Oct.	LABRE Sprints	All	http://tinyurl.com/2xmbfy

PY contest dates for 2008

Brazilian Ranking (Toplist)

Brazil finally promoted the counting for top announcements positions of their DXers per band. The project followed the QST/ARRL rankings but with more information for statistics and identification of the unexplored grids in Brazil. One of the objectives is to reinforce the counting of grids and countries worked for VUCC and DXCC chasers. Since Brazil has more than 430 grids, the tables clearly show that many of these must be the aim of future activations on more bands. The full list with specified countries, grids and states worked in **http://tinyurl.com/2m37nq**

50 MHz (no EME)

Call used	Grid	Countries	PY States	Grids worked
PY5CC, PP5XX	GG53	216	23	1058
PY2XAT, PU2XAT	GG66	107	18	350
PY2HN	GG66	107	14	215
PY5EW	GG46	81	10	86
PY2SRB	GG48	32	10	70
PY2DA	GG66	16	04	29
PY1ZV	GG87	14	07	10
PY2REK	GG65	08	02	10
PY4OG, PY4LOG	GG78	06	02	08
PY4AQA	GG88	04	03	10

144 MHz (no EME)

Call used	Grid	DXCC	PY States	Grids worked
PY5CC, PP5XX	GG53	08	06	24
PY5EW	GG46	05	06	27
PY2REK	GG65	02	06	14
PU2WDV	GG67	01	07	32
PY4AQA	GG88	01	07	27
PY4OG, PY4LOG	GG78	01	07	20
PY2DA	GG66	01	06	19
PY1ZV	GG87	01	06	13
PY2XAT, PU2XAT	GG66	01	05	21
PY4PTO	GG78	01	03	12
PP5KR, PU5LUC	GG42	01	03	07
PY2HN	GG66	01	03	06

144 MHz (EME)

Call used	Grid	DXCC	PY States	Grids worked
PY2SRB	GG48	46	--	155
PY4OG, PY4LOG	GG78	27	--	91
PR8ZX	GI64	08	--	13
PY5EW	GG46	01	--	02

432 MHz (no EME)

Call used	Grid	DXCC	PY States	Grids worked
PY5EW	GG46	01	03	06
PY2SRB	GG48	01	03	03
PU2WDV	GG67	01	02	08
PY1ZV	GG87	01	02	02
PY2DA	GG66	01	02	02
PY4OG, PY4LOG	GG78	01	01	02

432 MHz (EME)

Call used	Grid	DXCC	PY States	Grids worked
PY2SRB	GG48	01	--	01

1960

1980

2004

VHF News
Australia & New Zealand

144 MHz Es Reports

ZL3MH, RE66hl, report and comment for the 2006/2007 season:

9-12-06 VK2DVZ, VK2EI

23-12-06 VK2ZT, VK2KU, VK2DVZ, VK2FZ, VK2APG, VK2FAD, VK1BG, VK2AMD, VK2TP (The others worked VK7 too)

5-1-07 VK4WS QG62ok, VK4JMC QG62fi 2525km, VK2EI, heard VK4AFL at S9 but not worked. It's 20 years since VK4 has been worked in Christchurch. Last time it was 1986 to Rockhampton, North Queensland.

10-1-07 VK2BHO , VK2BZE (01.06-01.25 pm LT)

The fifth two meter opening to VK happened on 17/1/2007 at 11.00am NZDST to VK7AC. I heard VK7MO at 11.30 am NZDST.

This (**2006/2007** season) is a record year like **1995, 1986.**

Murray Hely, ZL3MH (12 Ele., 100W)
murrayhely@yahoo.co.nz

2007/2008 season:

Ron, **VK4KDD**, reports: On **18th December 2007,** finally the Es have started on 2 m. It was 9.35 am local time in Brisbane when I called CQ on 144.1, having the 6 m rig on as well. I heard VK7CEJ coming back to my call. I called on 2 m, he replied on 6 m. I called again on 2 m, but now like this: "CQ 2 metres, CQ 2 metres, this is VK4KDD". Bingo, this time VK7CEJ got it and the sound came out of my 2 m speaker. Signals came up from S3 to S9 when QSO was complete.
From than on things started to move quicker and one station after another made it into the log. Very short contacts where made, just time for callsign and report before they disappeared into the noise.
VK3 started to come in – VK3WRE, VK3PY, VK3UHF
Back to the VK7 – VK7FWAY, VK7MO
Then to VK5 (this opening would last for more than 2 hours) - VK5ZK, VK5BC, VK5BZK, VK5NY, VK5ACY, VK5EME, VK5DK, VK5DL, VK5UK
Finally another VK7 made it into the log - VK7XGW and VK7CEJ heard.

December 19th was pretty much a replay of the previous day, but with lots of excitement in other parts of the country. First openings from North VK4 to VK3 and VK7. Than the Es came down along the VK4 coast, from Rocky, McKay to Hervey Bay finally to Brisbane. VK3 and VK5 and VK7's were worked, pretty much the same stations as yesterday with a few new ones around. A notable contact - VK7MO to VK4BKP at 2429.6 km.
On the VK Logger, I noted that in the south of the country, 2 m had opened between VK5 and VK6 on ES. VK6WG worked VK5NY, VK5EME and possibly more. Was it possible for a VK4 to VK6 contact via double hop Es? I started calling towards VK6.
VK2DAG who was also on the Logger, followed the plan and also called, his situation made difficult by heavy Ch 5A QRM. Then **VK2DAG (QF56qp)** reported voices on 144.130. At 0332Z, he worked Wal **VK6WG (OF84wx) – a distance of 3146 km and new VK2 record.** He even had time to exchange QTH info and Merry Xmas with Wal. However, his record was not to stand for long.
Steve **VK2ZT (QF56)** who was following the Logger from work, thought it might be a good idea to head home for a break. At 0335Z, he worked **VK6BE (OF84) – a distance of 3207 km**, resetting the VK2 record once again. (Later update – Bob VK6BE was not sure of Steve's callsign and so he may not claim the VK6 record for that contact).
But the excitement was not over. VK6HK in Perth appeared on the Logger, while VK1ZQR and VK1BG commenced calling to the west on 144.1. At 0442Z, VK6HK reported that he heard a "BG" on 100 signing with a whistled "K". At 0501Z, VK1BG reported that he got clear copy of the VK6HK callsign. **At 0514Z, VK6BE worked VK2ADB** (QF56pm) very close to the VK1 border. Unfortunately, nothing further was heard, so no VK1 to VK6 QSO was achieved.

The following day – **December 20th** – was again lively. The band opened from VK5 to coastal VK2. VK5NY reported strong VK2's. VK5EME, VK5DL and others worked Ross VK2DVZ. VK5DL reported VK2AH 55 (829 km), which might not have been Es. ZL looked promising, but did not happen.

December 21st and yet another day of Es. 6 m was strong to ZL, and NZ FM stations started to appear. At 0015Z, ZL1AVZ was worked by VK2ZT and VK2DVZ via Es. In VK4, the MUF did not peak high enough. Otherwise, a relatively quiet day.

December 22nd, and more Es from VK5 to VK2 and VK1. That's the **5th day in a row with Es**. VK1VP worked VK5NY and VK5BC. VK5NY also worked VK2BHO and was heard by VK2DAG and VK2ZT, but gone before a contact was made.

December 23rd was a difficult day for Es on 2 m. The MUF went up and down several times during the day, but just a little short for Es on 2 m. The evening had already started and than there was a report about 500 km short skip on 6 m in VK2. At 0920Z, VK4BG worked VK7JG.

December 29th brought a day of records for ZL and I think the best Es we have had so far. The 2 m band was open for early morning to late evening from coastal VK2 to mid VK4 to far north VK4 with openings to VK5.
ZL was open to far north Queensland. At 0035Z, **ZL1IU (RF64vr) worked VK4FNQ (QG39ex) – a distance of 3171 km. VK4DMC (QH22rr) worked ZL1CN (RF73fp) for a new ZL record of 3549 km.**
My best DX for the day - walking in the street in front of my house as pedestrian mobile with the FT817, 5 W and 1/4 wave telescopic vertical. Worked VK4FNQ in Charters Towers (1050 km) receiving a 58 report.
Thanks to Ron VK4KDD for that very comprehensive report.

Further to the new ZL to VK record, Dale VK4DMC in Atherton sent the following:
During the recent 2 metre openings, I worked ZL1CN located in Wellsford, NZ. Murray, ZL1CN, contacted me a few days

later and said that the contact was a NZ VHF record and also the VK/ZL record distance worked (3549 km).
Conditions on the day were excellent and I owe a big thank-you to John VK4FNQ who rang me to let me know that the band was open to ZL and Southern VK areas.
Station details are: IC-7000 + 200 W linear into an 11-el yagi at 8 m above ground.

January 3rd at around 0330Z, there was a brief Es opening from VK4 to VK3 and VK7. VK4KDD worked VK7CEJ and VK4WS worked VK3ZYC, VK3XPD and VK3AFW.

January 8th saw another opening across to ZL, this time to the south island. Bob ZL3TY in Greymouth was hearing Ch 5A in Newcastle and pagers. At around 0200Z, he worked VK2ZT (5/9) and VK2AH (3/1) on 2 m. At 0420Z, he worked VK2DVZ (5/5), VK2KOL (5/3) and VK2ZT again, still at 5/9. At 0530Z, he worked VK2FZ and VK2ZCV (5/4) before the opening faded out.

January 9th dawned promisingly with early reports from ZL of VK2 FM broadcast stations being heard via Es. Tropo conditions across VK3 were also very good, with Terry Vk3ATS in Mildura reporting hearing the VK7RAE 2 m beacon in northern Tasmania. He then worked VK7HDX (917 km). At 2300Z, the Es then opened strongly between many stations in Brisbane and Adelaide. Phil VK5AKK reported working VK4WS, VK4KK, VK4XRA, VK4ASB, VK4OE, VK4ARN, VK4ARS and VK2ADY in a little over an hour. Brian VK5BC/P worked VK4's WS, ARN, XRA, OE, APG, ARS, KK, JMC, KR and VK2's ZT, ADY. Meanwhile, ZL had opened strongly to VK2 with ZL1BT reporting 2 m contacts with VK2ZT (5/8) then later VK2DVZ (5/9+20) and VK2DAG (5/9+40). VK2ZT also reported hearing VK5BC. Ross VK2DVZ reported that ZL signals seemed stronger when he was beaming at Adelaide. Brian **VK5BC/P (PF85mc)** at Corny Point takes up the story:
A little after 0130Z, out of the noise on 2 m comes David **ZL1BT (RF73lc)** calling CQ. David is 5/9 and an easy contact at a distance of approx **3402 km**. Several other VK5's including VK5AKK (PF94), UK, (95), GF (on a vertical!), DL (95) and EME work him. At times, at this QTH, he peaked an unbelievable 20 over S9 and at one stage went QRP (2.5 w) and was still 5/1. In between the mayhem, VK2's were popping in and out and I worked VK2ZT & VK2DVZ. David ZL1BT was a good signal for about 30 mins.
Approx 1 hour later the band came to life again with Steve **ZL1TWR, RF72XL,** in Katikati calling CQ at 5/6. Again a good contact was had at a distance of approx **3482 km** (I think a VK5-ZL record). Following this contact I worked VK2ARA & VK2KOL & VK1BG.
There has been some discussion as to the mode of propagation from VK5 to ZL. A VK2 station reported hearing both sides of the VK5/ZL contacts. ZL1BT reported that, at one stage, VK2DVZ was S9+20 when pointing Adelaide, but only S5 pointing ZL. There is no doubt that there was Tropo enhancement between VK2 and ZL. However, given the strength of some signals, there was also probably Es from VK2 to ZL. From VK5 to VK2, it was Es. The Spot map from the VK Logger shows an interesting pattern.

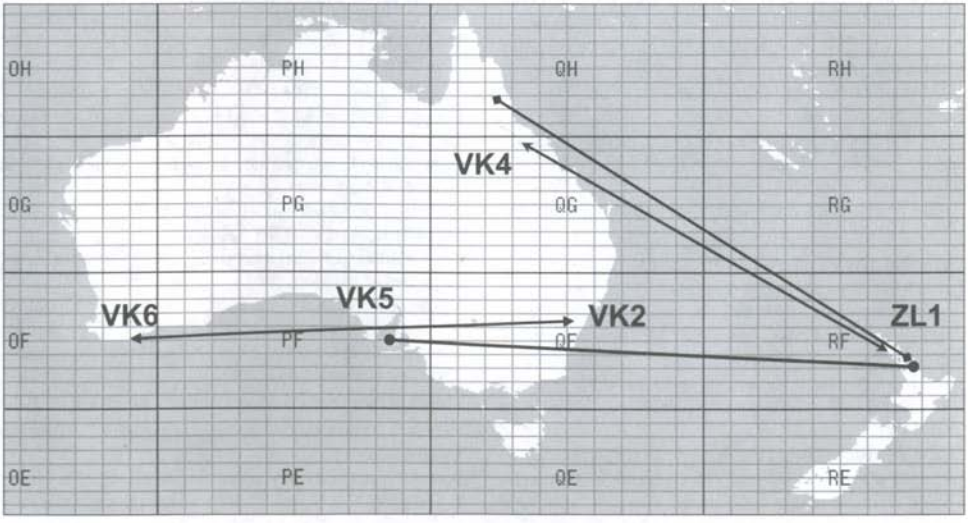
ZL3MH reports that January 9th was the first 2m Es opening for him this season starting 15.12 he wkd VK2EI, VK2DVZ and VK2ZT. He remarks that also ZL3NW and ZL3AUU worked the above stations. ZL3JT and ZL3OZ worked only VK2ZT.

10th January – Later that day, there was again a strong Es opening between VK4 and VK3, 5 & 7. Many stations at each end enjoyed some very loud signals.

(TNX to VK3HZ, VK7MO and ZL3MH for the reports!)

Map: > 3000km Es-QSOs in 2007/2008

Dec 19th	**VK6 to VK2**	**abt. 3200km**
Dec 29th	**VK4 to ZL1**	**abt. 3550km**
Jan 09th	**VK5 to ZL1**	**abt. 3400km**



Microwave Japan

Seiji Fukushima, Ph.D, JH6RTO

Portable rubidium reference oscillator

Yukio Masuda, JA8CMY

Improvement of C/N characteristics is quite important to extend the communication distance on millimetre-wave (mmw) bands as well as increase of transmitter power and antenna gain. From the view point of C/N ratio of received signals, either a fundamental-frequency mixer or an anti-parallel mixer is a good candidate since they show excellent C/N ratio. This is very true but it is also quite difficult to build a 120GHz local oscillator. Then, deployment of these devices is difficult on the mmw-bands like 249GHz. We have to use a 3rd-to-6th order harmonic mixer instead. A noise figure of the high-order-mixer is as high as 20-50dB then the C/N gets dramatically decreased at a receiver's first stage.

Another method to increase the C/N ratio is to reduce a receiver's bandwidth. This requires high stability of frequency of the transceivers. Simultaneous operation of finding frequencies and finding directions might be the last method in mmw DXing. This report shows the rubidium (Rb) reference oscillator for microwave DXers, especially for the people at portable sites.

Let us first calculate how stable the oscillator must be. A common oven-controlled crystal oscillator exhibits a frequency stability of 10-8 to 10-7, which is equivalent to 2.5 kHz or more on 249 GHz. A stability of 10-10 is necessary for the 100Hz-bandwidth receiver. This specification is available from a GPS receiver or the Rb oscillator. We go with Rb here. Note that the Rb oscillator itself is not an amateur's item. We use a commercial one and build the Rb reference oscillator with a power supply. My setup includes the oscillator, some seal lead acid batteries (SLAB), and their charger. Figure 1 is a block diagram.

Here are two reasons to use batteries, one is portability and another is voltage stability and low-noise characteristic. A Datum's Rb oscillator was picked up from junk (Model LPRO, No. 102500-001). I measured the applied voltages inside the oscillator in order to reduce the voltage, which would decrease the number of batteries. The highest voltage (18V) was supplied to the heater and the heater does not require 24V. A voltage to the oscillator was regulated inside. Then I tested the entire oscillator with only 18V and found no problems. I employed three SLABs with a capacity of 6V, 10Ah and connected them in series for 18V supply. The Rb oscillator consumes 1.5 and 0.8A when switching on and being stable, respectively. The switching circuit was not employed because it functions as a noise source. Figure 2 shows the entire circuit.

During charging the batteries, I apply 26V to the SLAB using a switching power supply and stabilize the current (approximately 1A) by a regulator, LMT350T. As can be seen in Fig. 2, the power circuit also includes an over-charge protector. The stop voltage is 22V and the floating voltage 19.8V. The voltages and current can be monitored through a meter. These batteries run for 13 hours and a charge interval is 13 hours. A LED exhibits lock of the Rb oscillator. The oscillator usually locks within four minutes from switching on. The C/N ratio of the 10MHz reference output seems very excellent although I could not measure it with my equipment. I could say 'Too excellent!'

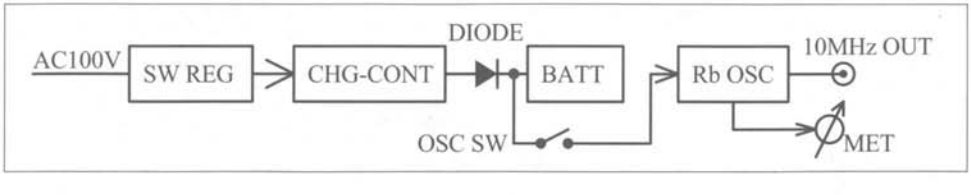
The developed oscillator is shown in Figs. 3(a) and (b). The size is 150 x 280 x 220mm.

For further information, email:
ja8cmy@io.ocn.ne.jp

Reference: http://www.datum.com.

(Ed.: Such Rubidium devices can also be found on ebay for about 250 USD. This price level should be well affordable for radio amateurs)

Fig. 1: Block diagram of the Rb reference oscillator



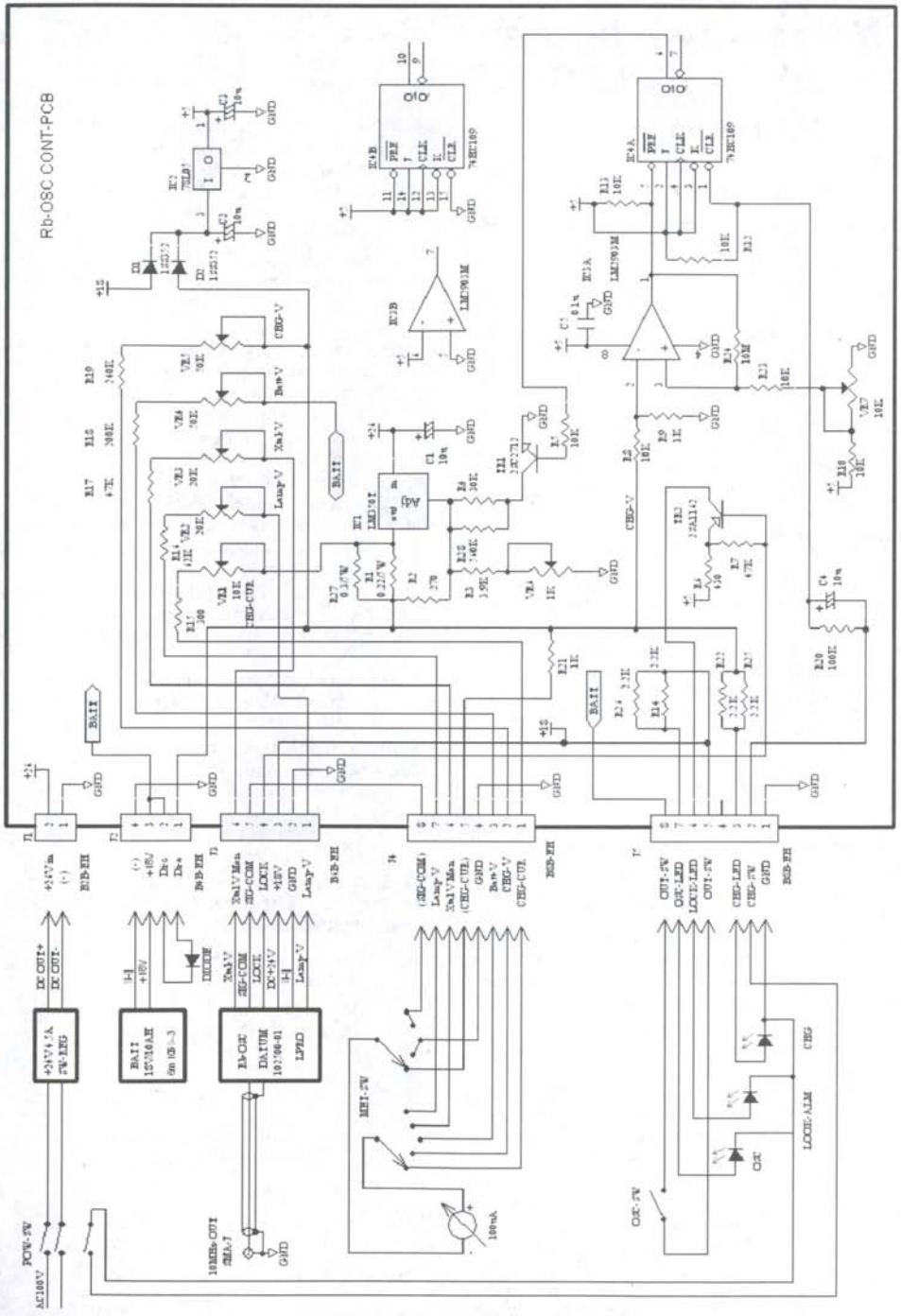


Fig. 2: Circuit diagramm

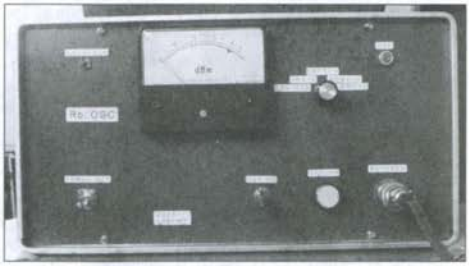


Fig. 3 a: External appearance

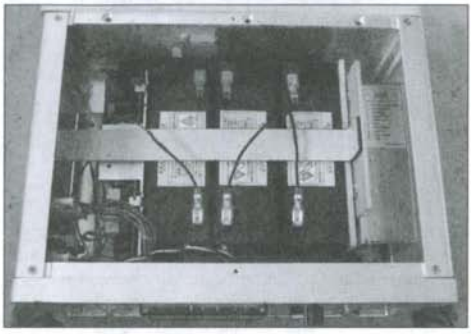


Fig. 3b: View inside

how a piece of RG-58 can become like a baton in such conditions.

Two hours into the efforts Brian lost feeling in his right toe from just standing around and had to resort to putting a chemical hand warmer in his shoe!

Brian lost a laptop battery. Li Ion batteries do not like to be charged and discharged at these temperatures. One 214 GHz mixer was several dB better than the other, the CW was easily copied by ear on the WA1ZMS end but Pete needed the aid of Spectran at the W4WWQ end of the QSO. This was during the ARRL January VHF contest. Thus Brian turned in a log with only one QSO and only one grid, but it was the best January contest he's ever had.

QSO details are:
Date: Jan 21st, 2008
Time: 01:24z
WA1ZMS/4 37-31-00N 79-30-35W FM07fm
W4WWQ/4 36-43-03N 80-19-23W EM96ur
Distance: 114.4km

WA1ZMS/4 WX:
Temp: -15C Dew Point: -26C
RH: 38% Wind: 32km/h
Wind chill: -26C
Time spent out in the wind: 5 hours
Pressure: 876mb
Atmos Loss: 0.29dB/km

W4WWQ/4 WX:
Temp: -11C Dew Point: -22C
RH: 40% Baro: 890mb
Atmos Loss: 0.41dB/km

Congratulations!

Microwave USA

Editor: Kent Britain, WA5VJB
WA5VJB@flash.net

New 241 GHz Word Record

Brian, WA1ZMS has claimed what should be a new world DX record of 114.4km for the 241GHz band. (The former DX record was 79km)

The QSO was between WA1ZMS/4 and W4WWQ/4 using CW.

This QSO was over 2 years in the making with several failed attempts at even shorter distances during that time period. The key to success was the very driest of winter air that may only take place one day per year in that part of the country. Oh and a wind chill factor of -26C at the WA1ZMS point!

The wind chill is said to have made for an interesting experience and as W4WWQ said, it's amazing

Pete, W4WWQ while testing gear on 241GHz

Microwave Europe

Editor: Simon Lewis, DL4PLM
GM4PLM@hotmail.com

Welcome to another Microwave Column

My daily job working for a global telecoms company takes me on regular trips to various interesting places, sometimes radio is a long way from my daily thoughts but sometimes it is when I am mid flight when my mind turns to microwaves. On my occasions it is when I am high about ground on an aircraft you really get to see our propagation driver at close hand, like seeing huge storm cells in the south of Germany when your crossing the North Sea between the UK and the Netherlands, or seeing the strong tropo ducts visible across large areas of the European mainland, clearly visible by the dirty air trapped below! Of course I am always on the look out for amateur antennas as we all do, and its very interesting to see where they turn up! As I write this Europe has a huge high pressure system over Europe providing some excellent propagation, of course, the fog and ice in the UK lead to some delays to my travels, but sitting in my apartment in Germany looking at the clear blue skies criss-crossed with aircraft vapour trails it struck me how busy are skies really are, yet do we really utilize aircraft scatter as much as we should? The attached images make interesting viewing.

Acknowledgement: Met Office UK

Extensive high pressure across Europe. (11.02.08)

New Perseus SDR Receiver with VHF Converters from SSB Electronics

I just had the pleasure to try out what will be the start of a converter series, especially developed for Perseus by its German dealer SSB Electronic. **They will start with a VHF one, converting 144 - 148 MHz to 28 to 32 MHz. A converter for 70 cm is due to follow, other converters - like for 23 cm, 6 m and INMARSAT - may be due to follow.** The converters do provide a sharp input bandpass filter, are really sensitive input, and do feature an excellent dynamic range. Thus they proof to extend the stunning quality of Perseus also to other frequency ranges. Production will start soon, and a price of about 150 Euro each had been suggested.

73 Nils, DK8OK

Further information on Perseus can be found on SSB Electronics webpage

http://www.ssb.de/amateur/englisch/perseus/perseus_e.shtml

PERSEUS is a so-called "software-defined receiver." This means central properties of reception, demodulation, use and usability are all controlled by the software. One example for this would be filters protecting the signal from interference. In place of just a few filters, each for only a specific narrow bandwidth, as has been standard so far, now the software itself filters the reception signal. This allows listeners to tailor bandwidth exactly to each interference condition, modulation and operating mode with no further need for purchasing additional filters or sacrificing reception quality during filter selection. But what makes Perseus truly revolutionary is a real-time frequency display capable of spanning a spectrum of up to 800 kHz. By clicking on individual stations within this spectrum, they can be selected for listening in unprecedented quality. What's more, the entire frequency spectrum can be saved to hard drive. In effect, this permits listening to anything within that spectrum of up to 800 kHz later on. On top of this, it is also possible to further adjust the spectrum after recording. Another part of Perseus is a waterfall diagram used for visual tracking of all activity within a spectrum of even up to 40 MHz over an extended period of time.

Perseus ships with three different software applications: The actual Perseus software is the centerpiece for configuring the receiver: At its core is an intuitive interface that allows easy selection of modulation and frequency. Besides a quick "click-in and-tune" function, it provides convenient settings for frequency bandwidth, noise reduction, noise-blanker controls, and saving frequencies, plus much, much more! In addition, it offers great new possibilities for visualizing variable bandwidth. This is achieved by a waterfall FFT display that allows seamless tracking of a frequency spectrum with a maximum bandwidth of up to 800 kHz in real time. Moreover, the entire bandwidth can be recorded. This means individual signals can also be analyzed and listened to at a later point. **Software HFSpan** This application permits real-time display of all 40 MHz of the entire HF signal spectrum.It is particularly useful for getting an impression of how HF transmission may vary during different times of the day and how such changes

affect specific frequencies. Of course, smaller bandwidths can also be analyzed in this fashion.

Software Winrad This is a stand-alone program that can communicate directly with Perseus. In addition to tools for displaying weakest signals and the like, it does have options for recording and playback as well. The signal is also available for other applications. All the Software is running under Windows 2000, XP and Vista. Mac-PC with Intel Processors may use XP or Vista under Boot Camp.

Frequency range: 10 kHz - 30 MHz

Modes: SSB, CW, AM, FMN, and countless more as software can define.

Sensitivity: 0,39µV SSB (S+N/N=10dB)

Selectivity: Software-defined

Dynamic range: 103 dB (@SSB, 2.4 kHz)

HF-Preselection:
1 x 3-pole-low pass(0 - 1,7 MHz)
9 x 6-pole bandpass (1,7 - 30 MHz)
Switch off for broadband view

Attenuator: 0, 10, 20, 30 dB

A/D-Conversion: 14-Bit, 80Ms/s

DDC: XC3S250E

PC-Interface: 480 MBit/s USB 2.0

Output Sampling Rate: switchable 125, 250, 500 ks/s

Cabinet: aluminium

Dimensions: 110 x 36 x 185 mm

New G3 version DB6NT Transverter for 10 GHz & new DB6NT webpage

The new DB6NT webpage announces the new "G3" design of DB6NTs transverter for microwaves are now available for 10 GHz and features better performance and many new functions from the older G2 kit version which now sadly seems that once stock is depleted, will no longer be available. Now, an external 10 MHz reference frequency can be connected to achieve highest frequency accuracy. This is necessary for EME, WSJT and Tropo DX. The frequency of 10 MHz can be supplied by a highly stable OCXO, a reference oscillator of a frequency counter, a rubidium frequency standard or a GPS controlled frequency source. If a 10 MHz reference frequency is not available, the internal crystal oscillator of the transverter can be used. This crystal oscillator is frequency stabilized by a 40 °C precision crystal heater QH40A. A bigger attenuator at the IF input port allows an input power of up to 5 watts. Self-resettable polyfuses prevent damages of the transverter module, especially if it is used in a portable station. Of course, all the well-tried functions of the old transverter version are kept in the new design! The small mechanical dimensions of the transverter, which is designed in SMD technology, allow the construction of a small portable station as well as a powerful home station.

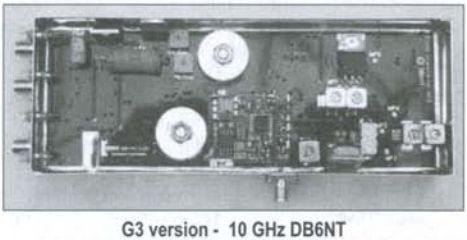
New features of the transverter MKU 10 G3

Additional input for 10 MHz reference frequency
Internal stabilized oscillator with precision crystal heater (can be used instead of 10 MHz reference frequency)
Bigger attenuator at the IF input for input power up to 5 watts
Fuses are self-resettable (polyfuses)

Well-tried functions and features - based on MKU 10 G2

Super low noise converter in the receive path
Transmit gain and receive gain separately adjustable
Control output for additional amplifier stages or a coaxial relay
PTT can be switched by voltage on the IF connector or by connecting the PTT pin to ground
Detector output (DC voltage) for monitoring the output power

Type	MKU 10 G3
Frequency range RF	10368...10370 MHz
Frequency range IF	144...146 MHz (432...434 MHz)
IF input power	max. 5 W, adjustable (0.5 ... 5 W)
RX Gain	min. 20 dB, adjustable
Noise figure @ 18 °C	typ. 1.2 dB
TX output power	min. 200 mW
Spurious rejection	min. 40 dB, typ. 50 dB
Harmonic rejection	typ. 30 dB
Ext. reference in	10 MHz / 2 ... 10 mW
PTT input	via IF-cable or contact to ground
12 V - Output	for antenna relay and PA, max. 0.6 A
Monitor output	output pwr monitoring typ. + 1.2V out
Supply voltage	12...14 V DC / typ. 350 mA @ TX
Dimensions (mm)	150 x 55 x 30
Coaxial connectors	SMA-female / 50 ohms
Weight	typ. 220 g



G3 version - 10 GHz DB6NT

Heelweg 2008 Microwave Meeting

The Dutch Heelweg 2008 Microwave Meeting took place in January with a record of 144 registered participitiants: DL 18x, G 1x, HB 1x, OE 1x, ON 15x, PA 108x.

First PA – DL on 76 GHz

On Janaury 27th 2008 the first ever 76 GHz QSO took place in SSB between PA0BAT/p and DL4BBU/p. The 59/59 reports were exchanged in SSB. QTH was at the PA/DL border Aalten/Bocholt. QRB 2km. Congratulations!

2m-EME News

Heinz Bordé, DM2BHG
h.borde@t-online.de

1. CONTEST RESULTS

ARRL 2007

ON4DPX (Kenny) I was qrv during the past weekend on 2m CW only for almost the complete contest time . Conditions where rather good except on sundayevening where I suffered a complete lockout due faraday . Saturdaymorning and evening where excellent loud signals from several European stations , pitty that I didn't managed to work US stations , I just couldn't hear them . Following stations where worked: SV1BTR, F0CXO, F1FLA, OK1VVP, RN6BN, F5JL, RU1AA, OK1MS, LZ2US, IK2DDR, SP7DCS, YO2AMU, LA8YB.

K3JYD (Fletch) Worked only the Big Guns, but not for want of trying. We got QRZs out of SV1BTR several times but were unable to go further. Special thanks to Finn, LA8YB for my first EME contact, also to RN6BN and RU1AA for numbers 2 and 3. Heard lots more, but we were very QRP for CW, running a pair of K1FO-15s, mast mounted LNA Tech cavity preamp, and a pair of CX800P5s loafing at 800W. Receiver was K2/XV-144 with Linrad and SDR-IQ as panadapter. This was a fully portable operation, and true to form, lots of stuff didn't work at first. Finally got most of the bugs ironed out but never got the driver amp working right, so no QRO. Oh well, next year.

YU7AA (Jozef) In last ARRL I worked next stn. W5UN, K9DX, DK3T, AO5SE, AD4TJ, W8PAT, WA3BZT, EA2AGZ, HB9Q, AA1YN, IK1UWL, K7MI, SV1BTR, DK5WL, WQ5S, RN6BN, RX1AS, OE3SJA, DH4FAJ, RU1AA, S52LM, DK1MAX, ZS6WB, UA9FAD, G4FUF, DC2MW, YO9FRS, F1FLA, UX2X, UA9YLU, OM3BC, IW4ARD, N6KK, K4SV, W0PT, K7MAC, W0HP K6MYC, K9MRI, WP4G, N6CW, LU1CGB, KB8RQ, SM5CUI, KA1VHF, W2CNS, N5KDA, KD3UY, DK5YA, K1CA, W3SZ, SV9GPV, JH0MHE, 7K3LGC, DL9MS, LY2BAW, RZ4HF, RA6DA, SM2A, DJ3VI, GW3XYW, EA3BB, EI4DQ.

DK3T (Ulli & Tom) 2nd. leg of arrl activity finished. We missed some hours of moon, but it was a great fun to find so good activity! In total we made 162 qso´s. SSB: W7GJ, RN6BN (57); CW: n5kda sv1btr f1fla k6pf oz1hne k6myc lz2us ik1uwl pa3cwn i3evk sp7dcs rw1aw rx1as ru1aa yo2amu rn6mt ok1kkd i5wbe yo9frj pa0jmv f0cxo jh5foq jh0wjf ok1ms ea2agz ra3ec jn1cso.

DL2FCN (Bodo) here the result of my activities:n
1. part: JT65 QSO's, in alphabetic order: AO5SE, AO6VQ, DK5EW, DK3BU, EB5EEO, EA2AGZ, EA3BB, EI4DQ, F5GHP, F8DO, HB9Q, HA6NQ, IK1UWL, IK7EZN, K4SV, K9MRI, KB8RQ, K9DX, OH4LA, OM3BC, RU1AA, RN6BN, RV3IG, RX1AS, RA6DA, RA0FCA, S52LM, SM5CUI, WW8M, W5UN, YO9FRJ, YU7AA, ZS6OB, 7K3LGC
2. Part: During second part I concentrated mainly on CW: SV1BTR, OK1MS, F3VS, RU1AA, RN6BN, YO2AMU, F1FLA. And following JT65 qsos: EB3JT, DK3T, CT1HZE, OK1UGA, K7MAC, PA3COB.

K6PF (Bob); I was QRV on 2m CW random, unassisted, for 4 hours on 24 Nov & worked only 4 stations with one being a dupe. On 25 Nov I was QRV for 3.5 hrs & worked 5 stations. Had 7dB noise level > 50 ohm termination into preamp on 25 Nov due to warm, dry winds. Didn't hear that many new stations this weekend compared with the 1st weekend of the contest. Here's the stations worked this weekend: 24 Nov: LZ2US (dupe), OK1KKD (#213), LA8YB (#214) & OZ1HNE. Called K9DX & RW1AW with no answer.
25 Nov: RU1AA, OK1VVP, RA6DA (#215), DK3T (#216) & W3SZ. Called K9DX with no answer.
Great signals fm LZ2US, LA8YB, RU1AA & DK3T who was 20dB SNR on FFT DSP.. Also, great signals from RN6BN & SV1BTR who I worked the 1st weekend.

EU DUBUS/REF Digital 2008

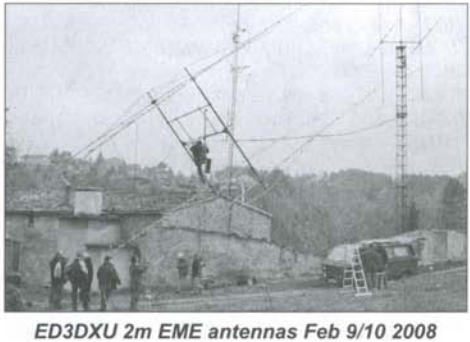
K1JT (Joe): European Digital EME Contest
Many thanks to all who responded to my calls on 2m EME over the weekend -- 68 of you in total. I was highly impressed with the skillful and efficient operating procedures used by nearly everybody in this all-random operating event. My log shows that activity in EU was good (49 QSOs) , befitting an EU contest. In other parts of the world, activity was not so good: I made only 14 Qs in NA, 2 each in SA and OC, 1 in AS, 0 in AF. I copied but did not work another ten stations or so. All but one of my QSOs was initiated by the "Search and Pounce" method at my end. In this regard, I will mention once again the importance for smaller stations to call CQ now and then during a contest. Those of us who are operating S&P with wideband panoramic receivers will find you -- and we will respond. Otherwise, our only chance of working you will be to "tail-end" on one of your QSOs. I made a few QSOs in this way over the weekend, calling the station who had responded to a CQ "up 300 Hz", from that QSO, say; but too often I find that operators do not stay on frequency after a QSO. (Yes, this is probably true of me, also.) An operating convention that might help us all -- even those

without wideband receivers -- would be to have an agreed-upon calling frequency, or a small range of frequencies, where QRP stations and others who are operating mostly S&P could go, from time to time, to call CQ. It was a special pleasure to see the memorial station ED3DXU so active throughout the contest, and making so many QSOs!
Thanks to DUBUS and REF for organizing this event. 73, Joe, K1JT

IK7EZN (Ermanno): The weekend of the contest has passed. Thanks to everybody. I have not been able to participate to full because of family appointments. In total 62 qso JT65B all random without use of internet cluster etc... I have called few times CQ with only 2 answers. All the remainders qso has been effected S&P looking for the stations that calling CQ or attending the end of qso in progress. I hope that all we learn to stay in listening on the frequency after a qsofor at least a pair of passages to give the possibility to effect more qso in tail. The use of Linrad and MAP65/WSJT on wideband make enthusiastically the random activity. A thanks to whom has organized the event and particular to the initiative in memory of EA3DXU.
73 Ermanno / IK7EZN 144MHz 4x14xpol Linrad rx/icom Ic275 tx

ED3DXU 2m EME shack Feb 9/10 2008

ED3DXU: In honour of Josep Prat, EA3DXU, who passed away in October 2007, EA3BB, EA3AYX, EA3EZG, EA3AEN, EB3JT, EA3XU organized an expedition to the initial location from where Jose Maria first worked EME in 1985, San Salvador de Guardiola, JN01vq, 70 kms from Barcelona. The expedition is supported by many EA operators working VHF-UHF and EME. Pau, EA3BB (Josep's brother) has rebuilt a part of Josep's original expedition station and it was operated in JT65 on 144.141MHz during the DUBUS and REF contest of Feb. 9 and 10, using the special call ED3DXU (QSL direct via EA3BB). Rig: 4x24 H Home made 5 WL 10.1 mtrs. Boom, TX Icom IC-910H + 2x4CX250B KW (home made by Josep Mª EA3DXU, now EA3BB station), RX Icom IC-736 + Converter SSB Electronics 144-28 (by EA3DXU)
Main Operators: EB3JT, EA3BB, EA3XU.
Supported by: EB5JTC, EA5CLH, EA5YB/3, EA3ABK, EA3ACS, EA3AE, EA3AEN, EA3AIR, EA3ALV, EA3AMP, EA3AN, EA3ATO, EA3AVW, EA3AYK, EA3BER, EA3CQQ , EA3DD, EA3DFZ, EA3DR, EA3DXR, EA3ECE, EA3EDU, EA3ESE, EA3EYO, EA3EZG, EA3FLX, EA3FOV, EA3GDQ, EA3GLB , EA3GLJ, EA3GTJ, EA3JA, EA3JW, EA3KP, EA3LL, EA3MD, EA3PL, EA3TJ, EA3UE, EA3XO, EA3XQ, EB3CWL, EB3DGV, EB3DYS, EB3FWV, EB3GLP, EB3GME, EB3GML, EB3SA, EA3AYX.
More than one hundred people came to the expedition.
Many thanks to Dubus & REF, organization by dedicating to Josep Mª, EA3DXU memory the JT65 Contest. 73s EA3BB & EA3XU



ED3DXU 2m EME antennas Feb 9/10 2008

2. AROUND 2m-EME

K7XQ (Jeff) Got on the last few weekends and worked the following: 144: W2DBL#, PJ4NX#, JA0BBW#, JH2COZ, K9MRI, JH0HME#, PA3DOL#, K5QE#, K7MI, YU7XL#, RA9YDL#, VK3AXH, RV9UV#, G4CBW, W9JN#, K9DX#, KN4SM#, W7GJ, W2TSL#, GM4VVX, AD4TJ#, ON7UC#, DK3EE, YO2AMU# HRD: OH6UW, EB3DYS

PE1BTX (Gerard): Was active a little bit on 2 mtr this evening (18-01). Worked the following stations: YU7AA best –18, PJ4NX best -21 new initial 219, SV1BTR best 529 CW new initial 220, IK2DDR heard 519 CW but strong birdie nagging me on his QRG.

SM2CKR (Mats): Was suddenly QRV on EME agn from my portable QTH. Only QRV for 1.5 hours in the second part of Dubus test. Still my old staff 8x15el. and 1.2kw. Did work the following stn: SP7DCS, OK1MS, SV1BTR, DK3EE.

W0PT (Bill) was QRV a few hours 24 and 25 Dec 07 and worked the following stations 2 meter JT65b: G4EZP, DJ3VI, PA3DOL, OH2LHE, KR7O, N5KDA, W2DBL, WQ5S, WA0KBZ, K1JT, I3LDP, EA3XU, RV9UV, NZ5N, K7XQ, DK3EE,

N4JH and HA8CE. At 0600 utc 25 Dec 07 I worked DK3EE for my first ever SSB QSO on 2 meters. Tom peaked at 5 X 5 during our qso. Conditions were good both nights however I seldom heard my echo.

WA0KBZ (Bill): Last night or should I say this morning I completed with HA6NQ for my 15th DXCC country and my 31st initial. All contacts have been made on moon rise running a single 17b2 and running what I consider low power 400 watts max. Now just running 300 w with a solid state amplifier Tokyo Hy Power HL350Vdx super nice little amp and it has a great preamp built in.

DK3WG (Jürgen) Hello EME friends, here the R/U-stn and my results from Dec/Jan.:

-RU1AA: - JT65B from KP40: PF30FRG, W2TSL, F5GHP, DL6NDK, DL0VV,WA2ODO, W9RM and KB8OZV, BY7PP

-RV3IG - JT65B initials N4JH, UA4LCF, G4EZP, W2TSL and JA0BBW. JK1KTY, DH8IAB and PJ4NX.

-RW3WR - JT65B with K2BLA, N5KDA, YO9HP, OH8K/0, F1FLA, PA5KM, IK2DDR, GW3XYW, OZ6ABA, G4EZP, G4FUF, OH6ZZ, F9HS, F5GHP, K1JT, N4JH, W8WN, DL6BF, SM5CFS, HB9Q, F1NWZ, G4CBW, I3MEK, F9HS, F6GRB, DK3BU, DL4DWA and KD3UY.

-UA3MBJ - JT65B with WP4G.

-RZ4HF - JT65B new OE3FVU, S54T and HA6NQ.

-UA4NX - JT65B had new K2BLA, IW4ARD and JR3REX.

-RA6DA - JT65B - with BY7PP.

-RN6MT - JT65B added DK5WL, DF1AN, EA3BB, W2TSL, K4SV, G4EZP,HA8CE, RV9UV, PE9DX, DC9YC, EB3JT, N4JH, AD4TJ, N6CW,OZ6ABA, PA4PS, KI4TZ, PA3DOL, HA6NQ, OH7HXH and OH2LHE. SM2A, WA2ODO, W7OJT and OH2BYJ.

-UN6PD - JT65B made JH0MHE, JH5FOQ, JR3REX, JM1GSH and UA9YLU.

-UA9FAD - JT65B with WA2ODO, W9JN, G4EZP, SM2A, DL1RNW, EA3BB and KR7O. W2TSL, PA3ECU, DK2ZF, VE5UF and RW3AC.

-RA9YDL - JT65B with 9H1PA, OE5MPL, VE5UF, K7MI, KD3UY, K7XQ, DK1CO, DD0VF, K1JT, K4SV, PA3COB, JM1GSH and HA0HO.

-UA9SL - JT65B give this news: KN4SM, W2TSL, EA3XU and PJ4NX.

-UA9YLU - JT65B new OZ6ABA, OK1YK, JE1TNL, YT3I, WA2ODO, PE1RLF, N4JH, PA4EME, W2TSL, KI4TZ, SV1BTR, VE2JWH, PJ4NX, OK2POI, F6GRB, F0CXO, JH0FOQ, PA0ZH, BY7PP, 9A3JH, UA4LCF, OH6KTL, DL0HOF, S52FO, SV8CS, UN6PD, RV3YM and DK2ZF.

- RV9UV - JT65B give this calls - JT65B give this calls: 9H1TX, OK1YK, 9H1PA, OE5MPL, K7XQ, W7GJ, WA7GSK and WA2ODO.

-DK3WG - JT65B wkd DK2ZF, DK5OX, AD4TJ #1111, OH8K/0, 9A3GE, PA3ECU, WA2ODO-nc (he missing RRR), W2TSL, JA0BBW and JE1TNL.

3. EXPEDITIONS

3X5A (IJ39DM) in Conakry, Guinea

This year, the VooDoo Contest Group started its adventure back in Bamako, Mali where they operated in November 2006. The ever-growing pile of contest and EME equipment was stored in Bamako following last year's event and this year it was time to move the contest equipment and not have to breathe dust like in the past years. Once the team arrived in Bamako on 15 November, 2007, they gathered their things from storage, added some new hardware, put it all in a bus and took a 900 km trip across the two- lane (sometimes), pot holed roads of West Africa.

After the two-day bus ride to Conakry, the HF contest station was assembled over the next several days. Luckily they were assigned the callsign 3X5A for both HF and VHF operation and not an "odd" callsign such as "3XT1" as they were told earlier. On Monday morning 26 November 2007 following a very successful DX contest, the entire HF station was disassembled and packed up ready to go back into storage until 2008. And then, it was EME time! The EME equipment was quickly assembled for four days of operation by AA7A and KC7V. Around 2100 Z at local moonrise everything was ready and after a first CQ the pile-up was there: After some NC QSOs the first complete contact was established with Joop (PA0JMV) followed by DF2ZC and another 15 QSOs until midnight UTC. During the dedicated CW time slots on 28 and 29 November W5UN (2x), KB8RQ, SV1BTR, RN6BN, RA6AX and OK1MS were worked. All in all Mike and Ned completed 125 EME QSOs combined on both JT65b and CW modes. EME QSLs are all via AA7A.

CN3A (IM52JJ)

CN3A was another station set up for the CQ WW DX contest. As Spiros (SV8CS) was a member of that contest group he became QRV on 6 m and 2 m, the latter via EME in JT65 with a 16 elements I0JXX and 350 watts out. Bad conditions made only 30 QSOs possible in the three days from 22 to 25 November 2007. It was very hard this time to work because at the QTH in IM52JJ there was very bad weather (cold, a lot of rain, strong wind and no electricity for long periods) all those days. Every 30 min also Spiros had to go to the roof to adjust the antennas to follow the moon (azimuth and elevation). Spiros hopes to be more successful next time with better conditions and better installations.

China on EME: Wong VR2KW and Terry BA7NQ were QRV on 2m EME from mainland China in Guangdong (OL63NA) for one day on 23 January 2008. With some 250 watts out and two 9 elements yagis they completed 42 QSOs in JT65 which is a rather good result. Terry BA7NQ might even become permanently QRV on EME later this year.

4. NEWs AND INFORMATION

HB9BBD (Dominique) I have in my shelter lots of blower noise by TH308 driver pa and TH347 final. All in all the blowers have to dissipate 4 - 5 KW. The noise level is high also caused by the metal shields of the shelter which create lots of reflections. I tried commercial noise cancelling headsets and Swissair first class noise cancelling headsets with insufficient results.Now I have a solution which almost completely solves the problem of noise.I bought the best ear protection headset in the Swiss market. Noise cancelling by isolation is 110dB. It is SUVA approved for working in the ugliest noise. It looks like a bulky headset but has no electronics. link: http://www.peltor.se/de/Product.asp?PageNumber=257&Product_Id=64&ProductCategory_Id=55
Disassembling the Swissair headset and installing the noise cancelling electronics into the ear protection headset silenced almost all noise. The IF TS870 from kenwood was modified to deliver DC 8V at the 3rd. pin of the headset connector.

HB9Q homepage (Dan, HB9CRQ)
We have updated our home-page with all logs and standings, see www.hb9q.ch .
Our photo-gallery with the "QRP stations worked" is continuously growing! If you have worked us and your photo is missing, please send us one immediately! Many thanks!

5. ONCE THERE WAS A CHAT ABOUT

(Chats of common interest in INTERNET)

-K4SV (Dave) I have a question that I would ask to have answered. I have just erected a new H frame festooned with 4 M2 2MXP20's. As I tweak this antenna system I thought it would be nice to know exactly how close must I track the Moon. The obvious question is, of course, right on the moon. But you and I both know not every antenna system tracks exactly, there is always some positioning error in the rotors ETC. Just so I am clear on this, what is the acceptable pointing accuracy so I can keep within the maximum gain? I have played a bit by jockeying the antenna around to see if I can peak the signal and it seems to be a bit broad.

KL7UW (Ed): I'm using four M2-Xpol-20's for several years now and find that I like to touch up the pointing about every 5 degrees and not let the Moon drift more than 10-degrees off point. That results in re-pointing about every 20-30 minutes. But I have seen signals of some of the big guns even 30-degrees off point to my astonishment. But if I am too far off-point my QRPp will not make to the other station.
PA5MS (John): Your -3dB beamwidth is about 18 deg I think... so few degrees off is no problem. I used to adjust my antenna only once every 15 minutes..

-The right (lowless) way to connect two 144 MHz receivers to a single antenna
(EA6VQ, Gabriel) Might be this is a silly question, but I can't find very much information about this subject using Google. What is the right (lowless) way to connect two 144 MHz receivers to a single antenna? I want to make some tests comparing the reception of my usual receiver against an SDR-IQ receiver. What kind of splitter should I use?
K0KP (Rex): A practical solution is the ZFSC-2-1 series by Mini-Circuits will net a loss of only 3.5 db. The device comes in BNC, SMA, and N connectors.
http://www.minicircuits.com/pdfs/ZFSC-2-1+.pdf
The "Gold Standard" is the "Magic Tee splitter / combiner, the loss is just 3 db. Due to the lowest loss characteristics this is the standard choice for high power VHF and UHF television broadcasters when combing two power amplifier cabinets.
http://michaelgellis.tripod.com/magict.html
A cheap solution would be to simply build a two-way resistive splitter housed in a small box. A two output resistive splitter, designed for lowest loss, would have a loss of 6 db. This could work if you have enough preamp gain to overcome the loss without affecting S/N at the receivers.
S57UUU (Marko): I still think the resistive divider (just make a triangle of 50 ohm resistors or a star of 50/3=16.6 ohm resistors...) is the best choice: 1. after the LNA low loss is not so important. Actually in measurement, loss can be beneficial (reduced ripple etc...). 2. with halfway sensibly designed receivers, the isolation is not really important - of course, if one of your RXes is a direct conversion type, it would be - but in that case, even the fanciest of hybrid couplers will not give you enough isolation.
KL7UW (Ed): I tee the output of my second preamp (which is in the shack) and run two RG-58 lines: one to the FT-847 and the other to the 2m/28 MHz converter in front of my SDR-IQ. The mismatch doesn't bother the sensitivity of the radios due to 31 dB gain of the two cascaded preamps that precede them. My mgf-1801 (0.15 dBNF, 16.8 dBgain) preamp is at the tower-top

and the ARR P144VDA (3SK48) (~1 dBNF, 14 dBgain) is in the shack with 170 feet of LMR-400 between the two preamps. My 2m converter is the DEMI 144/28 xvtr. with about 1 dBNF and 15 dBgain, followed by a 18 dB gain wide-band IF amp before the SDR-IQ.

– **Open-frame Relais** (K1JT, Joe) Does anyone have experience using heavy-duty open-frame relays for QRO T/R switching at 144 MHz? Obviously this can be a workable approach at HF, and even at 50 MHz, where the resulting "impedance lump" in the signal path exists over just a small fraction of a wavelength. I wouldn't want to try it at 70 cm; but what about 2m? Is it a foolish idea, and just asking for trouble?
WB9UWA (Jim) I have used these relays on 2M in a couple of different ways.The first way is to decrease the inductance by shorting two adjacent contact arms near the contact points. This reduces inductance substantially and increases isolation. Remove the then unneeded wire. I simply series resonate the remaining inductive reactance with a series capacitor if need be. You then have two contacts that are normally contacting each other. You also have a totally separate pair of contacts that connect when the relay is keyed. To do a DPDT, you need to start with the typical 4PDT. It's probably a good idea to use separate relays to improve any input/output isolation else you may have an unwanted oscillator.

--How to mount and feed a 2 x 2MXP32
(Bill NZ5N) We will be using 2x 2MXP32 for the Swan Island expedition and have a couple of questions:
1) Must the coax for each antenna be routed out behind the reflector, or is it OK to run the coax along the cross boom and configure the antennas in a X pattern,so that each antenna will be at a 45 degree angle from the coax?
2) Each antenna is 41' long and the cross boom is 180-190". Will a Yaesu GT-5500 rotor be able to handle this? If not, any recommendations for a suitable az-el rotor? I think someone mentioned on the reflector that the Yaesu can even handle a well-balanced 4x.
G4ZTR (John) I think that two of these aerials, given their considerable length and the length of the cross boom will be too much of a strain for the 5500 type rotator. Much will depend on the weather you encounter, especially the wind speed.A particular difficulty is ensuring that the cross boom is held firmly in the two U bolt clamps on the rotator. These clamps are really light-weight and it's easy to strip the thread while intending to get the fittings just tight enough. How do I know ? Also, with the 5500 rotator you are limited to a 1.5 inch diameter cross boom. With the length you need, that cross boom will turn out to be quite "droopy" and it will twist a little when torque is applied (by rotator or wind). So I would certainly advise looking for a more robust rotator.
KR7O: You can run the cables off the back and just let them droop for an expedition. It might be helpful to add a foot of material to the rear of the antenna to add some extra length to support the cable to remove any stress from the connectors. Don't forget that the feed blocks need to be on the same side/direction when stacking or they will end up out of phase when using a standard power divider and matched cables.
GM4JJJ (David) You cannot run it along the boom even in X pattern.Use another crossboom behind the DE to run the coax along. M2 show you where this would go if you use their T Brace.

- **GI0IJB** (Jim): new too eme, have worked some of the bigger stations with 1x9 400w. I am going to add a 2nd 9ele Should I go stacked for gain or set one Vertical for Xpol?
K4SV: (Dave I started EME using M2 2MXP20's (2) and have upgraded to 4 on an H frame now. I would not trade my Xpols for anything and here's why. During most QSO's I am running differential where I may receive V and Transmit H. But this varies from day to day and sometime from hour to hour in any one of 4 combinations. If you run one polarity its easy to get locked out for the day wasting your available time you have for the radio.
K2TXB (Russ): I'd go for the gain. With such a small antenna, getting more gain in a single polarization is more important than improving the amount of time that you can match polarization with the other stations. Another way of putting this is that adding a second antenna in opposite polarity will not allow you to work smaller stations than you already can.

6. TREASURY INTERNET

-EME monthly data for 2008
http://pagesperso-orange.fr/f1ehn/emedata.htm>

-LVB tracker box
http://wa4sxm.googlepages.com/home

-EME Planner 2008, EMR Calculator, Impedance Calculator and the Inter Digital Filter software has been updated and all is available from: www.sm2cew.com .... http://www.ve1alq.com/downloads/software/vk3um.htm and http://www.vk3bez.org/

-Types of Coax Cable and Line Loss Calculator
www.ocarc.ca/coax.htm

-RESULTS OF THE VOTING for the BEST VHF Expedition of 2007 are ready. Please check SPECIAL News at www.MMMonVHF.de

7. MISCELLANEOUS

DUBUS 2m CW EME Activity Weekends 2008

MAY 3 0400-0700 & 1130-1430 UTC

JUNE 7 0830-1130 & 1700-2000 UTC

JULY 5 0700-1000 & 1530-1830 UTC

AUGUST 22 2130-0030 &
AUGUST 23 0600-0900 UTC

DECEMBER 13 0030-0330 & 1730-2030 UTC

QRG: 144.040 – 144.060 MHz
Info:
http://www.sm2cew.com/dubus-aw.html

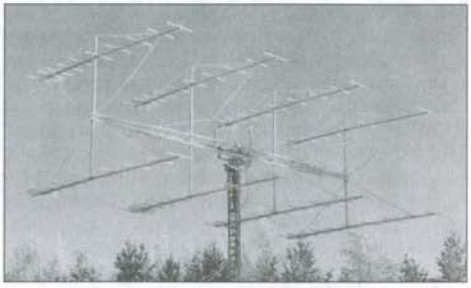
Want to be DXpeditioner?

Ned AA7A sent an email re the VooDoo contest groups plans for 2008: "The normal pattern of operation of the VooDoo Contest Group is to operate in a West African country for at least two years and then move on to another country. This practice adds considerable interest to the contest endeavour and gives the DX community some chances for some new band-countries in some of these exotic locales. So, we will once again be QRV in 3X in November 2008 and we will move on to another DXCC, likely 9L, in 2009.

Mike, KC7V, and I are somewhat convinced that there is not room for an EME effort from the VooDoo Contest team in 2008. As you may know, we nearly "ran the table" from 3X5A in 2007 and worked most of the active 2 meter EME'ers in our short effort. We have considered the idea of erecting the system again in 3X and work another dozen stations or so, but it does not seem like a reasonable return on our efforts. The EME activity tied to the contest effort adds almost another week away from our families and it is not high on our list of things to do. However, it seems a shame to have this FB EME system sitting idle in West Africa so close to some interesting DXCC. What I would like to offer is making the system available to other EME

DXpeditioners. If an EME team were to meet us in Guinea when the VooDoo Contest Group arrives to prepare for CQWW DX CW, the EME equipment could be put on the road to, say J5 or even another grid square within 3X, by an EME team. And, the EME DXpeditioners could simply return the EME stuff to the VooDoo Contest Group's pile when they were done to be ready for the 2009 trip to 9L.

The logistics for such a trip is much easier for a European team. The 36 hours of flights is a bit of a strain for us Arizona ops, but we have become used to it over the years. It's only a five-hour flight to Conakry from Paris CDG which makes it much more reasonable for any EU team. Is this idea of any interest? Just email Ned at aa7a@cox.net



OH7HXH 2m EME 8 x 11 Ele YU7EF iced version – no detuning!

70cm + up EME News

1. CONTEST RESULTS

EU DUBUS/REF Digital 2008

PA3FXB (Jan): (23cm) During the digital contest I had 12 QSO's. One more than last year. I had to split my activity between this contest and the PACC contest on HF. On saturday morning the moon was just high enough to be over my rooftop. During the afternoon I lost the moon because of the house. On sunday the moon was a few degrees higher and I had a good window. Worked: RD3DA, OK1DFC, G4CCH, LA2Z, OK1CA, JA6AHB, ES5PC, SM5LE, DF3RU, K2UYH, G4DZU, VA7MM. Heard/seen: VE7BBG, IW2FZR, OH2DG, WW2R, PA0BAT. Nice activity and happy with the performance of my small station: 3 m dish and 150 W @ feed.

My North-East window is blocked by a big tree. When receiving through the tree it often happens that there are good signal levels, but no decodes... So the tree does "something" with the signal. Thanks everybody for nice contest! 73 Jan

OK1DFC (Zdenek): (23cm) Hello EME gang, This is information about my activity during this weekend. I was participating on EME DUBUS contest 1296 MHz 8th and 9th of February 2008 and partly also work on CW and SSB. Weather was great and I had chance work with my dish. Claimed score in DUBUS contest I have 18 QSO and 17 multipliers, total 30.600 points. Activity was not so high. JT65c I have worked: JA6AHB, RD3DA, RK3WWF, PA3FXB, G4CCH, OK1CA, LA2Z, IW2FZR, OH2DG, K2UYH, OK1CA, VA7MM, SM5LE, PA0BAT, IW2FZR, UT3LL, RK3WWF, DF3RU, VE7BBG, W7UPF #35JT.

CW and SSB I have worked: F2TU, VK3UM 579/579, VK3UM 55/56 SSB, OZ4MM 579/576, VK3UM 569/579, RK3WWF O/RO peeking 529 #201, LA9NEA 579/559, G3LTF 569/579.

More info you can find on my 1296 MHz JT65 web site www.ok1dfc.com/EME/1296/jt65c/jt65c.htm

Still looks that DIGI mode is not so popular on higher bands like is on 144 MHz. What I can say is, that stations on 1296

MHz where exchanging reports in value in dB what is very nice and looks like little bit more complicate traffic. Also confirmation QSOs like TNX QSO or TNX ?18 BEST was very often. Thanks again for great fun and hope to catch more stations in next. Smallest station worked during contest was RK3WWF ? 2,1m dish, 70W RF, OK1DFC square septum feed and LNA with ATF54143. Worked him also CW very easy. Measured Sun noise during weekend 19dB with 76 flux number. New VLNA designed by Sam G4DDG working really great. Zdenek - OK1DFC
www.ok1dfc.com QRV 144 - 1296 MHz EME

3. EXPEDITIONS

DL1YMK EME Expedition to Uruguay, GF15

Hi Gang, just to let you know that everything is settled now for this year's EME DXpedition. Monika & myself will be operating from the 1st of May to the 12th of May from Uruguay using the callsign DL1YMK/CX, as licensed by the Uruguayan telecom authority URSEC. We have been struggling for nearly a year to get a fully legal high power permit for operating from CX on 70 cm, 23 cm and 13 cm moonbounce. As to our knowledge, CX has never been on the moon on these bands so far. The DXpedition only became feasable by the extremely constructive and ef-fective help of two local hams, which is even more appreciated by us knowing the 'normal' power limit to be 50W on UHF & up. To make things even more complicated, on 13cm there is no regular ham radio frequency alloca-tion in CX to be congruent with IARU-regions 1 & 2, but by courtesy of URSEC we got a unique permit to transmit on 2320 and on 2304 MHz. Unfortunately, URSEC refused a 9 cm operation because of mobile communication service, though.

Our stay timewise covers the European WW EME-contest (10th/11th of May), as well as an ATP on 70 cm (4th of May), so we will try to be on those bands in time, conditions permitting, of course.....so keep your fingers crossed.

For those interested a sked list will be handled again by Joe, K1RQG, as he kindly did for us in previous year's DXpeditions. I will provide a time frame to Joe within next week, indicating the planned slots of activation for each band. Please keep in mind that CX-land is at 30 degr South, so Mother Nature will confine our moon window to a certain extent (which is good for our touristic activities, hi). Hope that everything proceeds smoothly (still some problems to master with rig airlift...), so we can work many of you from CX. Here are the preliminary operation activities planned during our CX-DXpedition. Please keep in mind that our moon window is confined due to Southern latitude - and WX permitting...

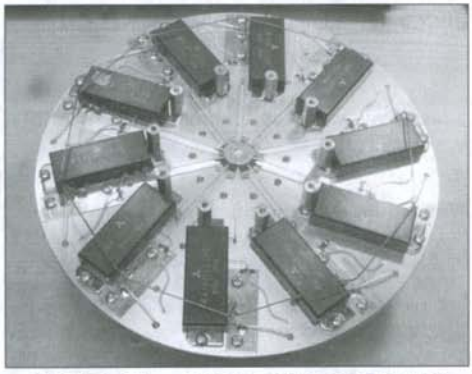
30.4.	ev. qrv 23 cm, not sure	
1.5.	23 cm	6.30-10.00 random
		10.00-16.60 skeds
2.5.	70 cm	7.30-11.00 random
		11.00-17.30 skeds
3.5.	13 cm	9.00-17.30 skeds
4.5.	70 cm	10-30-12.00 skeds
		12.00-14.00 activity day
		14.00-19.00 skeds
5.5.	23 cm	11.00-20.00 skeds
6.5.	23 cm	12.30-21.00 skeds, if needed
9.5.	13 cm	16.00-0.30 skeds
10./11.5.	23 cm	Dubus Contest

Hope to work many of you from CX. For skeds please write to K1RQG. 73/88 de Monika & Michael

4. NEWs AND INFORMATION

W7GBI Silent Key

It was with deep sadness to learn about Charlie's passing away and my sympathies are with his family. W7GBI was one of my first EME QSOs back in '79 and there were many more in the following years with his big signal. I was lucky to meet this wonderful man in person at one Thorn conference. RIP Charlie! Jan DL9KR.



RW3BP`s 23cm 700W multi module ring PA

RW3BP writes: I was surprised to get 70 W from the RA18H1213G Mitsubishi module that is rated at 18 W. My first attempt was to combine 6 modules. The second was to combine 10 modules. Finally I ended up with 700 W output (saturation power) at 16 V and 124 A. The RF to DC efficiency is about 35%. I water cool the amplifier. The main problem is the high thermal resistance of modules. To operate key down modes as JT, I need to reduce the voltage down to 12 or 13 V. At 13 V, the output power is still 500 W. I simply combine the modules with radial quarter wave air lines – see the picture. For the input divider, I use a combination of resistors and lines because I have too much drive from my transverter. I use two SE-1000-15 power supplies. For more information see www.vhfdx.ru/component/option,com_zoom/Itemid,99/catid,499/PageNo,1/. With this PA I hear good CW echoes and sometimes readable SSB echoes with my 2.8 m dish.

DUBUS 70cm CW EME Activity Weekends 2008

2nd Quarter

APRIL 12 2100-2300 & APRIL 13 1200-1400 z
MAY 4 0500-0700 & 1200-1400 z
JUNE 7 1700-1900 & JUNE 8 1100-1300 z

QRG: 432.005 – 432.030 MHz
www.sm2cew.com/dubus-aw-70.html

WINNERS & AWARDS
2007 DUBUS 2m CW EME ACTIVITY CONTEST

For the 2m EME stations who have participated in 2007 DUBUS 2m CW EME Activity Contest as described in DUBUS magazine and at http://www.sm2cew.com/aw_rules.html and who, as such, have sent logs to http://www.sm2cew.com/aw_logs.html and http://web.telia.com/~u37031777/ , below are the winners, prizes and awards.
Those are based on the best score for 6 weekends, out of 8, in the 2m cw eme activity events, as calculated for January 2007 - December 2007:

CLASS A: W5UWB with 1,5 points
(total antenna gain up to 15dbd)
CLASS B: PA3CWN with 131 points
(total antenna gain above 15 and until 18.5dbd)
CLASS C: SV1BTR with 1934 points
(total antenna gain above 18.5 and until 22dbd)
CLASS D: SP7DCS with 1148 points
(total antenna gain above 22 and up to 25.5dbd)
CLASS E: IK3MAC with 3682 points
(total antenna gain above 25.5dbd)

Winning Station from the Continents of Oceania, Latin America, Africa: PJ4EME with 50 points.

Each one of the winners above, will receive a free one-year subscription to DUBUS magazine, for 2008.

Certificates to commemorate the achievement for first 3 stations in each section:
CLASS A: W5UWB
CLASS B: PA3CWN, SV3AAF, PJ4EME
CLASS C: SV1BTR , YO2AMU , IK2DDR
CLASS D: SP7DCS , JH0WJF, DK3EE
CLASS E: IK3MAC

Special congratulations note for continuous participation in all 8 events of 2007 is given to YO2AMU! Prizes and certificates will be sent out in the 1st quarter of 2008.

Analytical results for all stations scores in all 8 activity events which were held from January 2007 to December 2007, as well as best 6 activity events' scores per station appear on the next page and at: http://www.sm2cew.com/aw_results.html and http://web.telia.com/~u37031777/

2008 DUBUS 2m CW EME Activity Contest continues with 8 monthly activity events. Details and dates are on the web at:

http://www.sm2cew.com/aw_rules.html

and

http://web.telia.com/~u37031777/

73,
Joe, CT1HZE/DL8HCZ
DUBUS Magazine

P.S.: I hope to meet YOU in the next CW activity events on 2m!

ANALYTICAL RESULTS & SCORES
DUBUS 2m CW EME ACTIVITY CONTEST 2007

CAT A:

CALLSIGN	BEST 6 EVENTS SCORE	JAN 07	FEB 07	MAR 07	MAY 07	JUN 07	JUL 07	AUG 07	DEC 07
W5UWB	**1,5**			1,5					

CAT B:

CALLSIGN	BEST 6 EVENTS SCORE	JAN 07	FEB 07	MAR 07	MAY 07	JUN 07	JUL 07	AUG 07	DEC 07
PA3CWN	**131**	4	1	16		4		1	105
SV3AAF	**97**				25	36	36		
PJ4EME	**50**					50			
SM7WSJ	**43**	25	9	9					
ON4DPX	**9**				9				
XE2AT	**2**		2						
YO5BIN	**2**		1	1					
ZL3TY	**2**						2		
PY4EME	**1**		1						

CAT C:

CALLSIGN	BEST 6 EVENTS SCORE	JAN 07	FEB 07	MAR 07	MAY 07	JUN 07	JUL 07	AUG 07	DEC 07
SV1BTR	**1934**		361	567		484	224		289
YO2AMU	**911**	64	196	49	49	289	169	36	144
IK2DDR	**678**	36	25	144	25		196	81	196
IK1FJI	**626**		36	196	81	165	144	4	
G4DHF	**333**		81	81	25	25	121		
OZ1HNE	**135**							135	
G3ZIG	**115**	90	25						
OH6CH	**110**	110							
SM2CEW	**107**			81	1		15		
SM7GVF	**105**	105							
LZ2US	**81**					81			
K1JT	**54**							54	

CAT D:

CALLSIGN	BEST 6 EVENTS SCORE	JAN 07	FEB 07	MAR 07	MAY 07	JUN 07	JUL 07	AUG 07	DEC 07
SP7DCS	**1148**	121	272	175		210	49	169	201
JH0WJF	**235.5**					54			181,5
DK3EE	**144**							144	
K9DX	**81**		81						

CAT E:

CALLSIGN	BEST 6 EVENTS SCORE	JAN 07	FEB 07	MAR 07	MAY 07	JUN 07	JUL 07	AUG 07	DEC 07
IK3MAC	**3682**	483	1156	930			441	672	

FAI News

Reports, Info, Theory - Editor: Dom Dehays, F6DRO - f6dro@aol.com

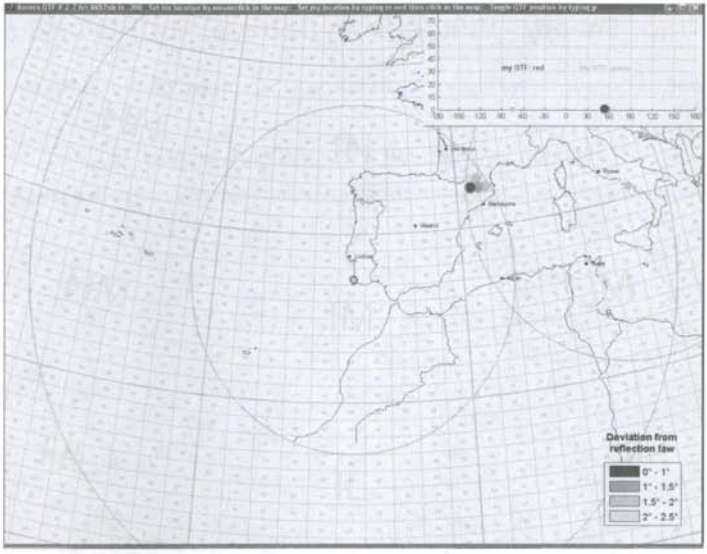
Here we present some interesting long distance QSO maps of the 2007 season, with Es map validation.

1955 km between F6FHP and SV2JL on May 12th

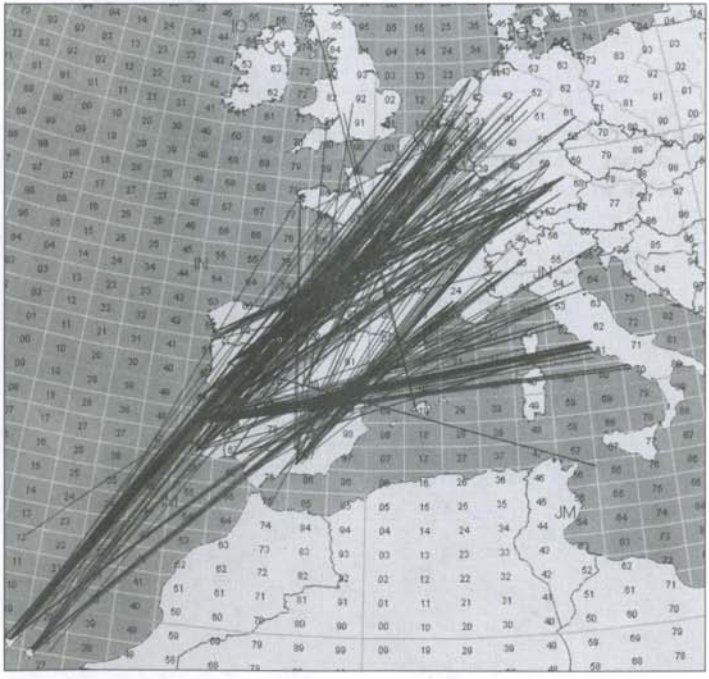
After some more in depth study, it is highly probable that this one is not an FAI QSO, but rather a weak signal Es qso (see the Es map for the same day). Possible scatterer position does not fit with F6FHP`s indicated QTF and an ES cloud was there, between Joel and SV.

2m Es map, May 12th

2052 km between CT1HZE and I8MPO on July 9th:

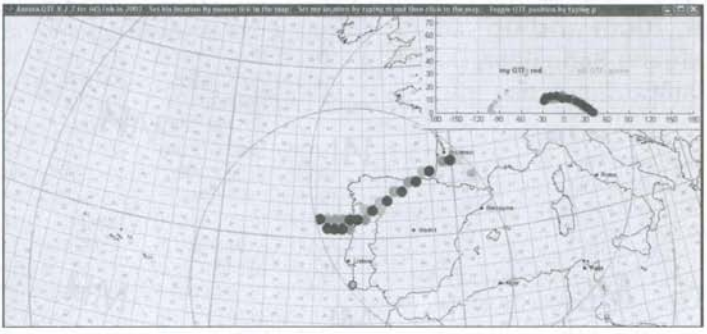


This time the FAI event fits OK with some Es reflection points. The FAI qso took place after the Es opening, wich is also a quite common situation.



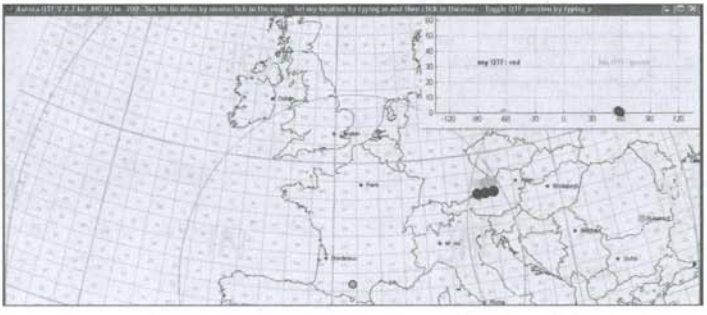
2m Es map, July 9th

Short distance: 1122 km CT1HZE to F6DRO on July 9th:

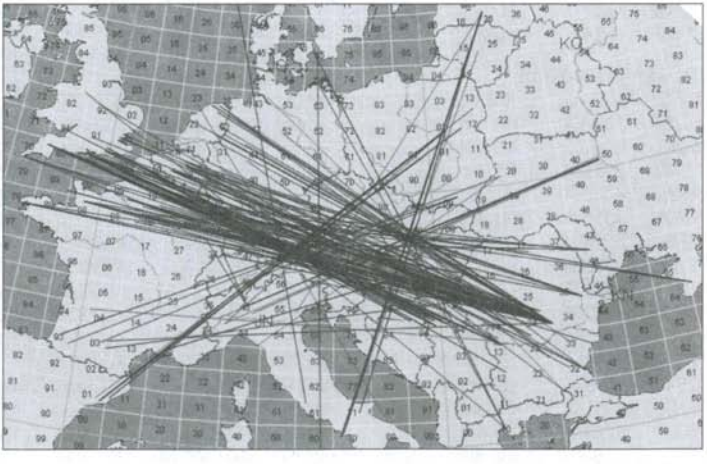


This one is special in the fact that it was my first QSO to the west. This day Joe worked via FAI into I8 as well. The Es map is very usefull to show what was going on (same map than previous reported QSO).

1959 km between YO3DMU and F6DRO on July 24th:



Once again this one is verified with the rigth Es at the right place and the right time:



2m Es map, July 24th

Tropo Reports

2m, 70cm and up

Editor: Wolfgang Schneider, DJ8ES
DJ8ES@gmx.de

2m 2m 2m

DL8BDU, JO43AA, wkd 16. – 22. Dec ´07:
OK2KJT (JN99aj, 805km); SM4BDQ (JP80fg, 956); OH1ND (KP00xl, 1183); UA2FL (KO04fq, 834); GM4WJA (IO87mn, 860); SP5QAT (KO02lb, 880); SP4BY (KO13od, 1012); SP8CUR (KO10cb, 1032); LY2BJ (KO25er, 1098); LY2LE (KO24oq, 1139); LY3OD (KO24or, 1139); SP9DSD (JO90kg, 807); SP9AVR (JO90kc, 816); MM0GPZ/P (IO76xa, 848); SP8CUR (KO10cb, 1033); US5UW (KO20di, 1157); OY9JDIP62oa, 133); SM4SCF (JO69ow, 832); SM5KQS (JO88it, 840); SO5AS (KO02jj, 862); SM0GWX (JO89xg, 927); SM5BMD (JO99af, 931); SM0NUE (JO99ce, 931); SM0KAK (JO89xk, 940); SM4BDQ (JP80fg, 956); SM0ITQ (JO99ao, 956); SM4HFI (JP70to, 961); SM4DXO (JP70vo, 966); SM4EFW (JP70ws, 984); UT2XQ (KO40ig, 1455); UA2FL (KO04fq, 835); SP4BY (KO13od, 1012) tnx Klaus

F2CT, IN93HG, wkd (>1000km) on 20. Jan ´08:
DL1GU (JN49), DL3IAS (JN49), DL0EE (JN49), DL2DR (JO31), DJ9DL (JO31), DG8YHH (JN49), DL8DAU (JO40), DL5YEE (JO42), DJ9DL (JO31), DC2IP (JN49), DK3T (JO41), DK1FG (JN59), DG9YIH (JO32), DL6WU (JN49), DF5HC (JN49), DL1NBM (JN49), DL6CB (JN49), DB5WC (JN49), DH3NAN (JO50), DK9TF (JO31), DF4OR (JN49), DK1VI (JN49), DK3EE (JO41), DJ9UX (JO31), DH4FAJ (JN49), DG7UAC (JN49), DL8II (JN49), G0UWK (IO83), G4HGI (IO83), I3MEK (JN55), IZ4BEH (JN54), IZ4GNE (JN64), IK0VWO (JN62), ON8WW (JO21), OP4A (JO21), PA2M (JO21), PE1AHX (JO22), PA5DD (JO22), PA3CWN (JO33), 9A5W (JN85), 9A3LFE (JN65). tnx for info Guy

G4DEZ, JO03AE, wkd:

20/12/2007 1233 US0GB	**KN67**	**2471km**
20/12/2007 1315 UY5HF	**KN66**	**2420km**

G4DHF, IO92UU, wkd (>1000km):

17/12/07 17:55 SM7WSJ	JO67WI	1028km
17/12/07 18:02 SM7DBD	JO77KA	1071km
17/12/07 18:07 SP5QAT	KO02LB	1437km
17/12/07 18:30 SP2IPK	JO93LR	1279km
17/12/07 18:40 SP4BY	KO13OD	1566km
17/12/07 18:56 SP1NQN	JO84ML	1153km
17/12/07 19:14 RA2FF	KO04GR	1379km
17/12/07 20:49 SP2JYR	JO92GP	1264km
17/12/07 21:03 SP2NJI	JO92OS	1307km
17/12/07 21:06 SP3MGM	JO73QE	1046km
17/12/07 21:24 SP3RBG	JO72RF	1065km
17/12/07 21:29 SP2CNW	JO93AI	1222km
18/12/07 17:00 SQ2SAT	JO93AC	1224km
18/12/07 17:02 SP6VGJ	JO81HU	1152km
18/12/07 17:10 UA2FL	KO04FQ	1374km
18/12/07 17:14 RA2FF	KO04GR	1379km
18/12/07 17:20 SP2BDR	JO83UA	1203km
18/12/07 17:21 SP1MWK	JO74SE	1055km
18/12/07 17:25 SQ1FYY	JO74PB	1038km
18/12/07 17:27 SQ1GU	JO74TE	1060km
18/12/07 17:58 SP1LOI	JO73RP	1049km
18/12/07 18:06 SP6RGB	JO71SF	1096km
18/12/07 18:07 DL9USA	JO71EN	1008km
18/12/07 18:15 SP3MIP	JO82HX	1132km
18/12/07 18:17 SP5WCK	KO02CJ	1380km
18/12/07 18:20 DG0DRF	JO71JJ	1040km
18/12/07 19:00 SP1FJZ	JO84EE	1109km
18/12/07 19:02 SP4JCQ	KO13NC	1561km
18/12/07 19:54 SQ1GPR	JO84PC	1169km
18/12/07 20:01 SP2AQB	JO93GA	1259km
18/12/07 20:04 SP3IYM	JO82KL	1156km
18/12/07 20:09 DG0UHF	JO71GO	1018km
18/12/07 20:18 SP8CUR	KO10CB	1583km
18/12/07 20:21 SP4SAS	JO93XN	1346km
18/12/07 22:55 DH2UAK	JO71FU	1006km
18/12/07 22:59 SP2FAV	JO94MA	1283km
18/12/07 23:02 SP2JVP	JO92CW	1238km
18/12/07 23:30 UT2XQ	**KO40IG**	**2011km**
18/12/07 23:56 US5WU	KO20DI	1712km
18/12/07 23:57 SP7VVB	JO91RR	1345km

G4DHF, IO92UU, 144 MHz Tropo (>1000km)

19/12/07 00:02 OK1NI	JO70QR	1101km
19/12/07 00:07 SP8UFT	KO11JI	1578km
19/12/07 00:11 SP2MKO	JO93CB	1236km
19/12/07 00:12 SP2JVT	JO92IW	1271km
19/12/07 00:15 SP2QVH	JO83XC	1219km
19/12/07 00:16 SO5AS	KP02JD	1424km
19/12/07 00:20 UT2XQ	KO40IG	2011km
19/12/07 00:24 DL3BRS	JO72GH	1002km
19/12/07 00:29 SP7HKK	JO91QI	1349km
19/12/07 00:42 OK1MIQ	JO70OR	1090km
19/12/07 07:44 SM5BMD	JO99AF	1335km
19/12/07 07:47 SM5HF	JO89WK	1336km
19/12/07 07:54 SM0GWX	JO89XG	1332km
19/12/07 07:56 SM7XWI	JO86EX	1156km
19/12/07 16:34 OH1ND	KP00XR	1601km
19/12/07 16:40 YL2OK	KO37AS	1741km
19/12/07 16:54 EW6FS	KO35LB	1788km
19/12/07 17:33 YL2GJW	KO06MM	1424km
19/12/07 17:36 YL3GDF	KO26XM	1724km
19/12/07 17:38 ES1MM	KO29KK	1708km
19/12/07 17:40 ES7GN	KO28TI	1726km
19/12/07 17:43 ES1ATE	KO29KK	1708km
19/12/07 17:44 SA7AGE	JO87FG	1170km
19/12/07 17:48 ES5PC	KO38HJ	1784km
19/12/07 18:00 SM7EBI	JO77BT	1062km
19/12/07 18:03 SK5EW	JO79XB	1220km

19/12/07 18:04	SM5KQS	JO88IT	1246km
19/12/07 18:06	SM4SCF	JO69OW	1141km
19/12/07 18:07	ES8TJM	KO18UM	1620km
19/12/07 18:08	SA6ADJ	JO68QM	1060km
19/12/07 18:09	SM5FND	JO79VC	1213km
19/12/07 18:10	SD5D	JO89JD	1266km
19/12/07 18:12	LY2BJ	KO25ER	1623km
19/12/07 18:22	ES2CM	KO29DJ	1675km
19/12/07 18:34	SK7HW	JO76JU	1060km
19/12/07 18:37	SM6FOV	JO78BR	1109km
19/12/07 18:41	SM5LXA	JO78SU	1188km
19/12/07 18:42	SM0EJY	JO89SC	1303km
19/12/07 18:53	ES3RF	KO29IF	1694km
19/12/07 19:07	LY2BAW	KO25KA	1656km
19/12/07 19:11	LY2R	KO15VR	1587km
19/12/07 19:33	SC300VL	JO68SD	1048km
19/12/07 21:06	**RA3LBW**	**KO64AT**	**2114km**
19/12/07 22:26	YL2LW	KO26CW	1621km
19/12/07 22:50	SM7DIE	JO76TH	1092km
20/12/07 15:19	SP8MMZ	KO11JI	1578km
20/12/07 15:29	SP8CUR	KO10CB	1583km
20/12/07 15:30	SQ9W	JO90SK	1390km
20/12/07 15:34	SP8CUW	KO10CB	1583km
20/12/07 16:02	SP7XIH	JO91RT	1343km
20/12/07 16:06	SP3JMZ	JO82KJ	1157km
20/12/07 16:38	SP2WHE	JO94HI	1255km
20/12/07 16:39	SP6CRZ	JO81AM	1121km
20/12/07 16:41	SP6PCL	JO81AM	1121km
20/12/07 16:51	SP5CCC	KO02NF	1445km
20/12/07 16:52	SP6MRM	JO81KG	1184km
20/12/07 16:55	SP3NNE	JO81XK	1252km
20/12/07 16:58	DL6UEF	JO71HO	1024km
20/12/07 17:06	SP6RT	JO81NG	1201km
20/12/07 17:18	DL6ULI	JO71HO	1024km
20/12/07 17:24	SP8BMF	KO00UN	1531km
20/12/07 17:34	SP7VC/2	JO83VA	1209km
20/12/07 17:42	SP6GZZ	JO80FX	1165km
20/12/07 23:52	SM7JQF	JO76SF	1085km
21/12/07 09:46	SM7DYD	JO77BV	1066km
21/12/07 10:15	SM7DBD	JO77KA	1071km
21/12/07 14:50	SK5EW	JO79XB	1220km
21/12/07 14:59	SM0NZY	JO89WI	1332km
21/12/07 15:17	SM5CUI	JO89WW	1360km
21/12/07 15:30	SM6WET	JO68SE	1050km
21/12/07 20:49	SM5FNU	JO89CL	1254km

Rig: IC-7000, 400W, 4x9ele. – G4DHF writes: Hello DUBUS, We've just experienced one of the best tropo lifts I can remember in over 30 years of operating. Certainly, stations to the N and E coast of GM had a wonderful time working the DX with far less equipment than myself. Stations were not overly strong and the duct appeared to have been over the heads of the nearer EU stations, which reduced the level of QRM. Thank goodness for good 'ol CW, which really made a difference when working the longer range stations. I did, however, have QRL and so I missed some of the best tropo when the duct moved across into the Ukraine. 73, Dave

GM4ILS, IO87AR, wkd:

17.12.2007 UA2FL KO04FQ, SP6IWQ JO80SK, SP2FAV JO94MA, OK1NI JO70QR, OK2AF JN89AR, DD0VF JO61WB, SP6GWB JO80SK, OK1MIQ JO70OR, SO5AS KO02AR, SP2CNW JO93AI, LA4WKA JP20PP, SF7WT JO65QQ, SM7RYO JO76DB, SM7VUK JO66LJ, RA2FF KO04GR

18.12.2007 SP1FJZ JO84EE, DL2DXA JO61VC, OK1TEH JO70FD, SP3IYM JO82KL, SP6VGJ JO81HU, DL5ON JO42, OZ5DL JO65FU, SP1MVG JO73JX, DL6ATI JO51DJ, SP9DSD JO93, SP2MKO JO93, SQ9CWO lost qsb, OZ1HXM JO45LT, SP6LTC JO70TV, OK1NI JO70QR, OK1GHZ JN79IX, DL7UK JO41SX, PA2JWN JO22QD, PA3AYD JO21UU, PA7TWO JO22JH, ON3EA JO10VU

19.12.2007 PA2CMR JO33PB, DC7BQ JO42FE, DL3WW JO60FL, DL3JFA JO60FL, 144.300 DC2OD JO42VQ, DB5YB JO42IE, DK2AR JO42UK, OK2BFH JN99GU, OK2AF JN89AK, DK5DQ JO31PQ

20.12.2007 SP6FXF JO70TV, DL7ANR JO62PM, DH8BQA JO73LE, SP6RT JO81ME

21.12.2007 OZ6YM JO65AT tnx for info Ron

EA2TO/1, IN83fe, wkd > 1400km:

20/01/2008 11-16z: **OK1TEH JO70FD 1570km**, OK2KKW JO70FD 1570km, OK1FD JO60CF 1428, OK1YA JO70GK 1588, OK1GHZ/P JN79FX 1563, OK1KZE JN79FX 1563, OK1COM JN79GX 1568, OK1VAV JN79FW 1561, DL4DWA JO61QH 1557km. Plus mni DL/ON/PA/F >1000km.
Rig: 1512m asl, 200w, 14 ele

MM5AJW, IO88KI, wkd:

20/12/2007 0040 UT2XQ KO40IG **2232km**

ON4PS/p, JO20KQ, wkd (>700km):

18/12/2007: SK6QA (JO58WB, 935km); SM6JDO (JO66GX, 860); OZ6YM (JO65AT, 742); SM7DBD (JO77KA, 989); SMØKAK (JO89XK, 1276); SM4BDQ (JP8ØFG, 1287); SM7GVF (JO77GA, 945); SM6FOV (JO78BR, 1071); SM4HNG (JO79MD, 114Ø); SM5FND (JO79VC, 1164); LA8NK (JO48, 9Ø7); SC3ØØVL (JO68SD, 999); LA2JKA (JO59CE, 8Ø2); SM5DIC (JO89JT, 126Ø); SM6RLB (JO66EW, 850); SM4AIQ (JO79BH, 1123)

19/12/2007: SMØNZV (JO89WI, 1266); SM4BDQ (JP8ØFG, 1287); SM4SCF (JO69OW, 1153); SMØAGP (JO89XF, 126Ø); SMØGWX (JO89XG, 1263); SMØNUE (JO99CE, 1267); LA2PHA (JO38IB, 828); SMØEZZ (JO89XG, 1263); SM7XWP (JO86EX, 1Ø26); SM5DIC (JO89JT, 126Ø); SM5FNU (JO89CR, 1232); LA5AKA (JO49UC, 984); SM4ATA (JO79BH, 1123); SM6FOV (JO78BR, 1Ø71); SMØNKZ (JO99IX, 1348); SM4QA (JO78HX, 1111); SM4DDY (JO69SH, 11Ø4); SM4FXR (JO79OF, 1153); OHØJFP (KPØØAB, 1409); SM3UFF (JP8ØHR, 1332); SLØCB (JO89WI, 1266); SM5CUI (JO89WW, 1312); SM5KQS (JO88IT, 176); OH1ND, (KPØØXL, 1522); SA7AGE (JO87FG, 1Ø5Ø); SK5EW (JO79XB, 1167); SM6OEQ/6 (JO58XI, 966); ES5PC (KO38HJ, 1633); GM4ODA/P (IP9ØEL, 1161); LA4LN (JP50JA, 11Ø2); OY9JD (IP62OA, 1445); SM6JCC (JO67FT, 931); SM6WET (JO68SE, 1ØØ3); SM1CIO (JO97HR, 1184); UA2FL (KOØ4FQ, 1137km)

20/12/2007: SM7DYD (JO77BV, 999km); OZ5AGJ (JO47IA, 747km); SP1FJZ (JO84EE, 869km); SM5BJU (JO88HF, 1128km); SM6FOV (JO78BR, Ø71km); SM4DYQ (JO79LN, 1173km). Rig: 100 W, 9 el, 150 m asl tnx for info Pierre

ON4ZN, JO21FB, wkd (>600km):

18/12/2007:

16:33 SK7OA	JO65RL	770km
19:25 OZ6ABA	JO57DJ	797km
19:35 SK6QA	JO58WB	910km
19:43 SM7RYO	JO76DB	851km
19:49 OZ1BNN	JO55PM	669km
20:50 SM6FOV	JO78BR	1048km
20:59 LA3BO	JO59CD	967km
21:04 SM6OPW	JO58RG	916km
21:16 SF7WT	JO65UQ	780km

19/12/2007:

10:28 SM5DIC	JO89JT	1239km
10:32 LA2JKA	JO59CE	927km
11:07 SM4FXR	JO79OX	1131km
11:13 SMØNZY	JO89WI	1248km
14:51 OH1ND	KPØØXL	1503km
15:10 LA5AKA	JO49UC	952km
19:40 SCØØVL	JO68SD	977km

20/12/2007:

08:52 GM4ODA/P	IP9ØEL	1112km
09:19 SM4DYQ	JO79LN	1150km
09:24 OZ6HY	JO45WA	567km
09:40 GM4ODA/P	IO9ØEL	1112km
20:27 LA8FK/P	JO59JX	1065km

21/12/2007:

19:10 GMØHTT	IO89JC	1017km tnx for info Walter

OY9JD, IP62OA, wkd:

17/12/2007 2210	DD0VF	JO61VB	1748km
17/12/2007 2230	OK1YA	JO70GC	
17/12/2007 2230	OK2AF	JN89AR	**2068km**

PA3CWN JO33ah wkd (>700km):

17/12/2007 SP5WCK (KO12cj, 1088km); SP5JTO (KO02lg, 1008km); SP4BY (KO13od, 1040km)

18/12/2007 LY2BUU (KO15xh, 1180km); SM4BDQ (JP80gm, 1021km); OY4TN (IP62nb, 1235km); OY9JD (IP62oa, 1225km); SP8UFT (KO11ji, 1156km); SP8CUR (KO10cb, 1169km); OH1ND (KP00xl, 1247km); SP8WJW (KN09sr, 1141km); UT2XQ (KO40ig, 1588km)

19/12/2007 SO5AS (KO02jd, 1000km); SM5CFS (JO99ig, 1022km); ES7GN (KO28ti, 1339km); OH0JFP (KP00ab, 1133km); ES6RQ (KO28wa, 1343km); OH1CO (KP10ek, 1264km); OF10AS (KP10lo, 1301km); YL2OK (KO37as, 1346km); EW6FS (KO35lb, 1370km); YL2GJW (KO06mm, 1020km); ES5PC (KO38hj, 1396km); ES2CM (KO29dj, 1306km); YL3GDF (KO26xm, 1317km); ES3RF (KO29if, 1320km); LY2R (KO15vr, 1173km); YL3GDR (KO26ht, 1241km); YL3AG (KO26aw, 1209km); YL2HA (KO26cv, 1218km); LY2BAW (KO25ka, 1237km); YL2LW (KO26cw, 1218km)

20/12/2007 YL2GDA (KO06mn, 1021km); LY2PU (KO14xw, 1178km)

20/01/2008 EA2TO/1 (IN83fe, 1328km); F2CT (IN93hg, 1242km) tnx for info Oene

UR5LX, KO50WK, wkd:

19/12/2007 2357 GM0TGE IO87TF 2591 km WOW!

BEST DX on 2m of the openings in Dec./Jan.

UT5JCW, KN64, wkd:

20/12/2007 1118 OZ1HNE JO65 **2150km**

70cm 70cm 70cm

DK1KR, JO43, wkd 17. – 21. Dec ´07:

OY9JD (JP62), YU1EV (KN04), GM4ILS (IO87), SP8CUW (KO10), SP1FJZ (JO84), GM4WWM (IO89), GM4WJA (IO87), YL2GDA (KO06), SP7OGP (KO01), SP4JCQ (KO13), US5WU (KO20). tnx for Info Walter

DK6AS, JO52JJ, wkd:

17.12.07: US5WU (KO20), RA2FF (KO04), SP5WCK (KO12), EW6FS (KO35)

18.12.07: SP8RHP (KO10), SP4JCQ (KO13), SP7OGP (KO01), SP5QAT (KO02)

19.12.07: RA3LE (KO64), LA4LN (JP50)

20.12.07: GM4ODA/P (IP90)

21.12.07: GM4WMM (IO89), OY4TN (IP61). tnx Andreas

DK3WG, JO72GI, wkd (>800km):

16. - 21. Dec 2007: OH1ND (KP00XL, 1014km); OF10AS (KP10LO, 1055km); YU7AA (JN95NS, 803km); OY4TN (IP62NB, 1668km); OY9JD (IP62OA, 1662km); GM4CXM (IO75TW, 1289km); RA3LE (KO64AR, 1186km); EW6FS (KO35LB, 873km); EW1OZ (KO33RV, 877km); LA8WF (JO59GV, 876km); GM4WMM (IO89LB, 1324km); GM4WJA (IO87MN, 1253km). tnx for info Jürgen

DL8BDU, JO43AA, wkd 16. – 22. Dec ´07:

OH1ND (KP00xl, 1183km); SP7VVB (JO91rr, 788km); RA2FF (KO04gr, 841km); SP5WCK (KO12cj, 956km); G4RGK (IO91on, 623km); SP2DDV (JO83ve, 651km); SP2MKO (JO93cb, 680km); SP7OGP (KO01am, 833km); GM4ILS (IO87ip, 881km); SP4JCQ (KO13nc, 1007km); SP8CUR (KO10cb, 1033km); SP8RHP (KO10ff, 1042km); US5WU (KO20di, 1157km); OY9JD (IP62oa, 1332km); SM7DIE (JO76th, 610km); SM7ATL (JO86eq, 671km); SP2DMB/3 (JO92cf, 692km); SM5SL (JO88cl, 793km); LA4LN (JP50ja, 797km); SM5HL (JO88cp, 807km); SM4IVE (JO79sd, 824km); SM4SCF (JO69ow, 832km); SM0EJY (JO89sc, 897km); MM5AJWIO88ki, 916km); YL2GDA (KO06mm, 919km); SM0GWX (JO89xg, 927km); SM0NZY (JO89wi, 930km); SM4BDQ (JP80fg, 956km); SM4EFW (JP70ws, 983km); LY2SA (KO14ll, 993km); SP4JCQ (KO13nc, 1007km); LY2BJ (KO25er, 1098km); YL2LW (KO26cj, 1102km); YL3AG (KO26aw, 1107km); ES3RF (KO29if, 1238km); EW6FS (KO35lb, 1253km); EW1OZ (KO33rv, 1286km); OY9JD (IP62oa, 1332km); G0XDI (IO91rq, 602km); SP9DSD (JO90kg, 807km); SQ9W (JO90sk, 842km); SP1JWY (JO84ml, 613km); SP2QBQ (JO94bf, 679km); SP2WPY (JO94fl, 704km); SP2CHY (JO94go, 712km); YL2IV (KO06mm, 919km); YL3GBF (KO06mm, 919km); SM0NZY (JO89wi, 930km); SM0EPO (JO89xm, 946km); LY2SA (KO14ll, 993km); LY3A (KO25db, 1084km); LY2BJ (KO25er, 1098km); YL2HA (KO26cv, 1116km); LY3UE (KO24op, 1139km); EW6FS (KO35lb, 1253km); EW1ST (KO33uw, 1304km). tnx for info Klaus

GM4ILS, IO87AR, wkd:

17.12.2007 DK3BU JO33NO, SM7ECM JO65NQ, SP1NQN

JO81ML, SP2IPK JO93LR, OZ1CTZ JO46DE, DJ8MS JO64AD, SP1MVG JO73JX, DL0VV JO64AD, SP1FJZ JO84EE, OZ6HY JO45WA, SP1O JO73GK, SP5WCK KO12CJ, DL7UHF JO62CL, DL7APV JO62JR, OZ1IEP JO55XU, SM7VUK JO66LJ, SM7FMX JO65KN, OZ4VW JO45UT

18.12.2007 OZ9PP JO47VA, DM2ECM JO62GJ, OZ5KM JO45VX, PA3FXB JO33AD, DL8BDU JO43AD, DB6NT JO50VJ

19.12.2007 SP6IWQ JO80HK, OK2BFH JN99GU, GM4ODA/p IP90EL, OZ6YM JO65AT, DK1KR JO53HW.

MM5AJW, IO88KI, wkd:

21/12/2007 0927 US5WU KO20DI 1967km
hrd UT0YW KN38CH.

ON4PS/p, JO20KQ, wkd (>700km):

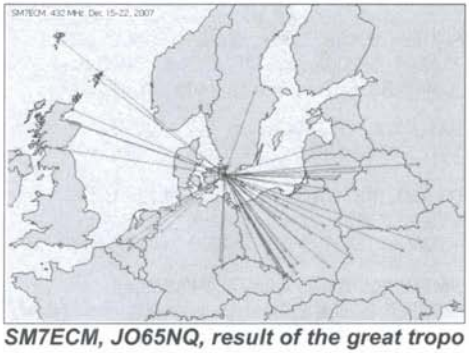
19/12/2007: SMØNZY (JO89WI, 1266km); SMØNUE (JO99CE, 1267km); SMØEZZ (JO89XG, 1263km); SM5DIC (JO89JT, 1260km); SM4BDQ (JP80FG, 1287km); SM4ATA (JO79BH, 1123km); SMØAGP (JO89XF, 1260km); SM5FNU (JO89CR, 1232km); SM1HOW (JO97GL, 1164km); SM4DXO (JP7ØVO, 1287km); SM4QA (JO78HX, 1111km); SMØDYP (JO99DO, 13Ø2km); SLØCB (JO89WI, 1266km); SM3BEI (JP81NG, 1396km); OH1ND (KPØØXL, 1520km); SMØNR (JO99AH, 127Ø km); SM6JMZ (JO66IR, 845km); SM6ENG (JO67CQ, 911km); SM4YMP (JP70VK, 1279km); SM6GYD (JO66GW, 856km); SMØNCL (JO99AK, 1275km); OZ4QA (JO65DN, 733km); SA7AGE (JO87FG, 1Ø5Ø km); LA4YGA (JO48BE, 859km); LA6MV (JO59EJ, 1Ø28km); SM6OEQ/6 (JO58XI, 966km); LY2SA (KO14LL, 1288km); ES5PC (KO38HJ, 1633km); SM7ATL (JO86BQ, 1ØØ6KM); YL3AG (KO26AW, 143Ø km); SM7CXI (JO76SE, 932km); SK6QA (JO58WB, 935km); SMØEPO (JO89XM, 1282km); ES3RF (KO29IF, 1572km); GM4ODA/P (IP9ØEL, 1161km); LA4LN (JP50JA, 11Ø2km); LA2PHA (JO38IB, 828km); SM4IVE (JO79SD, 1158km); SM7DIE (JO76TH, 945km); OY9JD (IP62OA, 1455km); YL3AG (KO26AW, 143Ø km); SM7VUK (JO66LC, 8Ø5km); SP3MGM (JO73QE, 77Ø km); SM7EBI (JO77BT, 992km); SP1JWY (JO84ML, 922km); OY4TN (IP62NB, 1452km); SP1FJZ (JO84EE, 869km); SM5EFP (JO79WJ, 1132km).

Rig: 100W, 21 el, 150 masl. tnx for info Pierre

SM7ECM, JO65NQ, wkd (>600km):

16/12/2007 EW6FS	KO35LB	878km
16/12/2007 RA3LE	KO64AR	1201km
16/12/2007 YL3AG	KO26AW	689km
17/12/2007 GM4WJA	IO87MN	1006km
17/12/2007 SP5WCK	KO12CJ	698km
17/12/2007 GM4ILS	IO87IP	1027km
17/12/2007 SP5QAT	KO02LB	654km
17/12/2007 SP7OGP	KO01AM	652km
17/12/2007 SQ9W	JO90SK	726km
17/12/2007 SP9APC	JN99QU	775km
17/12/2007 SP8CUR	KO10CB	875km
18/12/2007 MM5AJW	IO88KI	1028km
19/12/2007 PA9RZ	JO22GF	682km
19/12/2007 GM4CXM	IO75TW	1095km
20/12/2007 ON7WP	JO21IC	757km
21/12/2007 OY4TN	IP62NB	1346km
21/12/2007 OK2BMU/P	JN99CT	739km
21/12/2007 OK2BPB	JN99CQ	752km
21/12/2007 US5WU	KO20DI	955km
21/12/2007 SQ9QU	JO90KH	713km
21/12/2007 OK2BRD	JN99ET	745km
21/12/2007 OK2BDQ	JN99GR	758km
21/12/2007 SP6GWB	JO80HK	631km
21/12/2007 SP9BGS	JO90MG	723km
21/12/2007 SP7FDV	JO91GF	613km
21/12/2007 SQ9W	JO90SK	726km
21/12/2007 SP9KUP	JN99QU	775km
21/12/2007 OK2VWB	JN99FS	751km
21/12/2007 PA2M	JO21IP	715km
21/12/2007 MM5AJW	IO88KI	1028km
21/12/2007 GM4ODA/P	IP90EL	1018km
21/12/2007 GM4WJA	IO87MN	1007km
22/12/2007 LY2PU	KO14XW	692km
22/12/2007 LY2SA	KO14LL	642km
22/12/2007 LY2BJ	KO25ER	706km
22/12/2007 UT2XQ	KO40IG	1204km
22/12/2007 LY3A	KO25DB	711km
22/12/2007 UX5UL	KO50FL	1294km

tnx for info Andy



SM7ECM, JO65NQ, result of the great tropo opening in December 2007 on 70cm

23cm + up

DK1KR, JO43, wkd 17. – 21. Dec ´07:

SP4MPG (KO03), G0GJA (IO93), G4KIY (IO92), G8XP (IO93), G0DPS (IO93), G0FNP (IO94), US5WU (KO20), SP9BGS (jo90). tnx Walter

DK3WG, JO72GI, wkd (>600km):

18. - 21. Dec 2007: GM4CXM (IO75TW, 1289km); G0EWN (IO93FK, 1081km); PA3AWJ (JO21GW, 681km); SM6EAN (JO57WQ, 619km); SM6QA (JO78FM, 688km); SA4Z (JO79OF, 768km); SM6HYG (JO58RG, 688km); SM3LBN (JP80IO, 930km); EW6FS (KO35LB, 873km); RA3LE (KO64AR, 1186km); LA6MV (JO59EJ, 826km); US5WU (KO20DI, 714km); G4BAO (JO02BG, 976km); G0EWN (IO93FK, 1081km); G4EAT (JO01HR, 950km); G8APZ (JO01DO, 975km); G0DJA (IO93IF, 1065km); PE1EWR (JO11SL, 757km); GM4LBV (IO86RQ, 1198km); G4KIY

(IO92WN, 990km); SM6HYG (JO58RG, 688km); G4RGK (IO91ON, 1050km); G8GXP (IO93FQ, 1082km). tnx Jürgen

DK6AS, JO52JJ, wkd:
23cm: 17.12.07: SP7TEE (JO91), SP4MPB (KO03), GM4LBV (IO86) 18.12.07: US5WU (KO20), LA1KHA (JO49), OZ9GE (JO66), SP8RHP (KO10)
19.12.07: EW6FS (KO35), SM3BEI (JP81), SM3LBN (JP80), GM3UAG (IO87), GM4JTJ (IO86)
20.12.07: GM4ODA/P (IP90), SM4DHN (JP60),G4ALY (IO70)
13cm: 18.12.07: SM4DHN (JP60), SA4Z (JO79)
19.12.07: SM3BEI (JP81), SM3LBN (JP80), GM4JTJ (IO86)
20.12.07: LA6LCA (JO59), SP3TL (JO72). tnx Andreas!

DK7QX, JO42KH, wkd (>600km):
18.12.07: SP4MPB (KO03HT, 802km); GM4CXM (IO75TW, 951km); G0EWN (IO93FK, 710km); LA2Z (JO59EJ, 793km); SA4Z (JO79OF, 864km); SM4DHN (JP60VA, 909km); SM6AFV (JO67GQ, 642km); SM6EAN (JO57WQ, 627km); SM7LCB (JO86GH, 667km); SM7GEP (JO77IP, 700km); SM6QA (JO78FM, 774km); G8PNN (IO95EF, 761km); GM4LBV (IO86RQ, 882km); GM4JTJ (IO86RP, 879km)
19.12.07: SM6HYG (JO58RG, 682km); LA6MV (JO59EJ, 793); SM7LCB (JO86GH, 666); GM4LBV (IO86RQ, 882km)
20.12.07: SM7LCB (JO86GH, 666km); G8GXP (IO93FQ, 713km); G4KIY (IO92WN, 610km); G1LPS (IO94EQ, 742km); SP7TEE (JO91QR, 720km); SP4MPB (KO03HT, 802km)
21.12.07: SP2DDX (JO83VE, 607km); SM3LBN (JP80IO, 1038km) Rig: 65W, 44 Ele Yagi. tnx for info Eckhard

GM4CXM, IO75TW, wkd:

17/12/2007 SP4MPB	KO03HT	1608km

OY9JD, IP62OA, wkd (10w + 11 Ele.):

17/12/2007 0830 DL7YC	JO62PK	1604km
17/12/2007 1127 OZ1FF	JN45BO	1115km **1st OY-OZ!**

SM3BEI, JP81NG wkd on 19/12/2007:
OE5VRL/5 JN78DK on 23cm, 13cm and 9cm in cw. 1438km
On 9cm this is still the IARU reg. 1 record of both.

SM7ECM, JO65NQ, wkd:
23cm (>500km):

16/12/2007 OK1DFC	JN79GW	648km
17/12/2007 SP4MPB	KO03HT	526km
18/12/2007 OK1KZE	JN79FX	643km
18/12/2007 OK7RA	JO60LJ	590km
18/12/2007 M0GHZ	IO81VK	1118km
18/12/2007 OK1MAC	JN79IO	687km
18/12/2007 G4PBP	IO82WO	1052km
18/12/2007 SQ6EMM	JO81LD	567km
18/12/2007 OK1TEH	JO70FD	624km
19/12/2007 G0EWN	IO93FK	979km
19/12/2007 EW6FS	KO35LB	878km
19/12/2007 GM0UHC	IO85FW	1043km
20/12/2007 G4BAO	JO02CG	927km
21/12/2007 US5WU	KO20DI	955km
21/12/2007 GM4ODA/P	IP90EL	1018km
22/12/2007 PA3AWJ	JO21GW	702km

13cm (>400km):

19/12/2007 GM0UHC	IO85FW	1043km	tnx Andy!

SM7LCB, JO86GH, wkd 18. – 21. Dec ´07:
23cm: GM4CXM (IO75TW, 1293); G4BRK (IO91HP, 1277); G0EWN (IO93FK, 1197); G8GXP (IO93FQ, 1186); G8APZ (JO01DO, 1182); GM4JTJ (IO86RP, 1169); GM4LBV (IO86RQ, 1169); G4EAT (JO01HR, 1155); G4KIY (IO92WN, 1153); 2M0FYG (IO87WE, 1139); G3ZEZ (JO01NT, 1121); G3XDY (JO02OB, 1101); G4DDK (JO02PA, 1099); G4FSG (JO02PC, 1094); ON4POO (JO20DP, 1025); ON/OM1TF (JO20EU, 1005); PA0GHB (JO11WH, 999); DF6IY (JN48EU, 995); DF9IC (JN48IW, 975); ON6TM (JO21TC, 922); PA3AWJ (JO21GW, 920); PA7DW (JO30AV, 917); PA3N (JO22FD, 911); OE5VRL/5 (JN78DK, 889); DK3RV (JO31DG, 875); PA3BFK (JO22LI, 869); PA0EZ (JO22OF, 864); DB1EPO (JO31HG, 858); DL4EBV (JO31HK, 846); PA0JUS (JO22OO, 840); DK1VC (JO31RG, 818); DJ5VW (JO31RJ, 808); DJ5VW (JO31RJ, 808); DK1PZ (JO31TH, 807); PE1CQQ (JO22UR, 804); PE2TV (JO32GH, 786); PA3FHY (JO22WW, 782); PE1IWT (JO32KF, 774); DF8XR (JO32MF, 765); DF6YL (JO31WS, 758); DB6NT (JO50TI, 739); DL9GK (JO50TI, 739); SP9SOO (JN99OV, 736); DG0ONW (JO50LP, 730); SP9JDP (JN99HW, 723); SP9KJU (JN99HW, 723); SP9PRO (JN99HW, 723); SP9KJT (JN99HW, 723); PA3FXB (JO33KC, 716); DK5QN (JO42FA, 710); DL3WW (JO60FL, 703); OK1TEH (JO70FD, 700); DL1ATI (JO50QU, 696); DF9QX (JO42HD, 692); SP9BGS (JO90MG, 692); DL5YEE (JO42GF, 690); DK3BU (JO33NO, 672); EW6FS (KO35LB, 667); DK7QX (JO42KH, 667); DK7QX (JO42KH, 667); DK7BT (JO43CE, 638); DC2OD (JO42VG, 628); DH7OT (JO52FF, 602); DK6AJ (JO52GH, 591); SQ6EMM (JO81LD, 576); DK6AS (JO52JJ, 573); DL4OL (JO53BC, 545); DF1HF (JO43WJ, 536); DK4VF (JO43US, 519); DL7YC (JO62PK, 480); DL6ABC (JO62OM, 474); DL9GBH (JO62SK, 473); DK3WG (JO72GI, 459); OZ1CTZ (JO46OE, 454); OZ1DLD (JO45RL, 452); PA2M (JO21IP, 930); PA0S (JO21FW, 924); PA3AWJ (JO21GW, 920); PA0EZ (JO22OF, 864); OK2POI (JN99AJ, 776); OK1YA (JN79IO, 756); DB6NT (JO50TI, 739); DL6NCI (JO50VI, 734); OK1KZE (JN79FX, 718); DK7QX (JO42KH, 667); DJ3AK (JO52GJ, 584); DK6AS (JO52JJ, 573); SM3BEI (JP81NG, 553); SK4AO (JP70TO, 481); SM3LBN (JP80IO, 478); OZ1CTZ (JO46OE, 454); OZ9KY (JO45VX, 420km)
3cm: GM4LBV (IO86RQ, 1169); PA3AWJ (JO21GW, 920); PA0BAT (JO31FX, 814); DB6NT (JO50TI, 739); DK1ZD (JO44WE, 484); DL7YC (JO62PK, 480); DC6UW (JO44VJ, 477); OZ2LD (JO54TU, 349km)

DK8ZP, Cäcilia, dxing on 24 GHz from JO40

GM4ODA/p, IP90EL Expedition Report

Location on Shetland Island

Tropo-QSOs on 2m, *70cm* and **23cm:**

ODX QSOs underlined

19/12/2007

Time	Call	Sent	Rcvd	Loc	band	km
15.36	G4DEZ	59	59	JO03ae	2	817
16.24	DO9PKG	59	57	JO31lw	2	1086
16.30	G4DHF	59	59	IO92uu	2	852
16.31	DC9YC	59	59	JO31ql	2	1146
18.28	*PA2M*	*54/9*	*55/9*	*JO21ip*	*70*	*1057*
19.00	PA5WT	59	59	JO22hg	2	991
19.19	G0KPW	59	59	JO02rf	2	938
19.24	DF1LON/P	57	59	JO31lh	2	1151
19.46	PH2A	53	42	JO21fm	2	1066
19.42	DL3ANK	57	57	JO50nl	2	1369
19.47	G4RQI	58	57	IO93ir	2	752
19.52	GM1JNS	57	55	IO87xc	2	377
19.55	ON7CD	59	59	JO21ig	2	1098
19.58	*ON4PS/P*	*59*	*59*	*JO20kq*	*70*	*1163*
20.03	"	59	59	"	2	1163
20.08	PA3N	54	55	JO22fd	2	1000
20.10	*"*	*53*	*53*	*"*	*70*	*1000*
20.13	G4RNI	56	55	IO94	2	
20.13	DL8YE	59	51/2	JO31mh	2	1153
20.18	MM5DWW	59	59	IO89id	2	176
20.13	DL2ARD	552	52	JO60ar	2	1380
20.32	GM0HTT	59	59	IO89jc	2	177
20.36	ON7GB	53	57	JO21ia	2	1124
20.42	*PA3DOL*	*59*	*59*	*JO22mt*	*70*	*946*
21.30	DB8KJ	58	55	JO30cm	2	1212
21.44	*G4DEZ*	*53*	*59*	*JO03ae*	*70*	*817*
21.56	DL1YAW	58	56	JO41dx	2	1126
21.59	DF8AE	52	52	JO41gx	2	1134
22.05	ON4KHG	59	57	JO10xo	2	1154
22.07	DD0VF	559	52	JO61wx	2	1443
22.09	DL4OAJ	59	59	JO30bs	2	1184
22.10	DK2BJ	59	59	JO30bs	2	1184
22.11	M0HKB	57	57	JO02ob	2	953
22.11	PA3CBI	59	58	JO22jw	2	926
22.12	PD0HNL	57	52	JO21jo	2	1065
22.13	DK4U	59	59	JO42fd	2	1127
22.13	PA4EME	59	59	JO20wx	2	1156
22.14	PA3CWN	59	59	JO33ah	2	923
22.15	DG3FK	59	59	JO41pg	2	1229
22.16	PA2CHR	58	55	JO32db	2	
22.18	OK2AF	559	53	JN89ar	2	1634
22.19	PA3C	59	59	JO33jb	2	
22.19	DR1F	59	59	JO41pg	2	
22.20	OR0A	59	59	JO20kw	2	
22.20	DH5MK	59	59	JO41iv	2	
22.21	PE1LWT	59	59	JO22va	2	
22.22	LA2PHA	59	59	JO38ib	2	
22.23	DL3BQA	55	52	JO73cf	2	1253
22.23	PA3DTM	59	57	JO22ia	2	
22.23	PA2DB	59	59	JO22md	2	
22.25	ON6TM	59	59	JO21tc	2	
22.26	ON7EH	599	58	JO20fv	2	
22.26	PD7ES	59	57	JO22hs	2	
22.27	PD0MAR	59	59	JO22jw	2	
22.28	OK1NI	54	55	JO70qr	2	1517
22.28	DL6BF	59	57	JO32qi	2	
22.29	DL5ME	57	55	JO52sg	2	1219
22.30	PA0DVM	59	59	JO21hx	2	
22.31	DK5DQ	59	57	JO31pg	2	
22.32	PA5A	59	59	JO21ms	2	
22.33	ON5VU	59	59	JO30ap	2	
22.34	OK1MIQ	55	55	JO70oa	2	1573
22.37	*PA0DVM*	*59*	*59*	*JO21hx*	*70*	
22.40	*DL1KDA*	*59*	*59*	*JO30fq*	*70*	
22.45	*DL8YE*	*55*	*57*	*JO31mh*	*70*	
22.48	*GM4ILS*	*59*	*59*	*IO87ip*	*70*	
22.52	*PA0GHB*	*59*	*59*	*JO11wh*	*70*	
23.02	PH2CV	59	55	JO21gw	2	
23.22	DL1KWS	57	59	JO31cc	2	
23.22	DC0DHD	57	59	"	2	
23.33	DH6SN	59	59	JO30bu	2	

20/12/2007

00.01	OK1GHZ	57	57	JN79ix	2	1556
00.03	PE1HWO	59	59	JO21gv	2	
00.07	OQ4U	59	59	JO20kv	2	
00.09	PA3EZN	58	58	JO22hj	2	
00.09	PF7M	58	58	JO33ba	2	
00.12	ON6ZK	59	59	JO20kw	2	
00.16	*"*	*57*	*59*	*"*	*70*	
08.10	DL4YY	59	59	JO60hn	2	1418
08.14	DJ5NU	59	59	JO31qh	2	
08.16	SP6FXF	59	59	JO70tv	2	1513
08.17	DL5ON	59	59	JO42uu	2	
08.18	DO1CTL	59	59	JO60lt	2	1408
08.19	OK2BFH	58	59	JN99gu	2	1734
08.20	DG1VR	59	59	JO70ju	2	1481
08.20	DF7AP	59	59	JO51fi	2	
08.21	DL5OG	59	59	JO51ew	2	
08.22	DG1KOH	59	59	JO30hr	2	
08.23	DJ2QV	59	57	JN59dw	2	1393
08.24	DD9EN	59	59	JO31jg	2	
08.25	DL6ATI	58	59	JO51dj	2	
08.25	DL2JIC	59	59	JO60ju	2	1398
08.26	SP9AI	58	58	JN99mt	2	1760
08.27	OK2BPR	58	59	JN99fu	2	1730
08.28	DJ5VW	59	59	JO31rj	2	

08.29	DN3UL	59	59	JO60ux	2	1424
08.30	DM5CT	55	54	JO50dt	2	
08.32	DB8AH	59	59	JO31fo	2	
08.33	DL1JDU	59	59	JO60fl	2	1419
08.34	DL3JXN	59	59	JO60hr	2	1403
08.34	DG5YIL	59	59	JO32kb	2	
08.36	DL4OL	59	59	JO52bc	2	
08.37	*DL4OL*	*57*	*55*	*JO52bs*	*70*	
08.38	*DF8IK*	*59*	*57*	*JO30jt*	*70*	
08.39	*DL8QS*	*59*	*59*	*JO43kh*	*70*	
08.39	*DL5DAV*	*59*	*59*	*JO31oi*	*70*	
08.42	*DK1PZ*	*54*	*55*	*JO41th*	*70*	
08.44	DL6BBR	58	59	JO43cc	2	
08.45	DL2NS	58	58	JO43ld	2	
08.46	DK1PZ	55	55	JO41th	2	
08.47	F6KIF/P	59	59	JN19xh	2	1293
08.49	ON5TA	58	55	JO20et	2	
08.51	DG1YCF	59	59	JO42kg	2	
08.52	ON4ZN	59	59	JO21fb	2	
08.53	DJ9CZ	59	59	JO31bc	2	
08.54	DL1RNW	59	59	JO62gh	2	1257
08.55	DJ9DL	59	59	JO31nc	2	
08.56	DF8IK	59	59	JO30jt	2	
08.56	DF3AR	59	59	JO52gg	2	
08.57	PE1GNP	59	59	JO31ix	2	
08.58	DF6YL	59	59	JO31ws	2	
08.59	DH3UN	59	59	JO31tl	2	
09.00	DH1HR	59	59	JO31lk	2	
09.01	DL4AO	59	59	JO42nx	2	
09.01	DL3AT	58	57	JO50nw	2	1326
09.02	DL3JIN	59	59	JO60lx	2	1393
09.02	DL4YR	59	59	JO31ks	2	
09.04	DL2DXA	59	59	JO61vc	2	1416
09.05	*DL2DXA*	*57*	*57*	*JO61VC*	*70*	*1416*
09.06	*DJ9DL*	*59*	*59*	*JO31nc*	*70*	
09.06	*DK9TF*	*59*	*59*	*JO31nf*	*70*	
09.07	*DF6YL*	*59*	*59*	*JO31ws*	*70*	
09.07	*DB5YB*	*58*	*58*	*JO42ie*	*70*	
09.08	*DB3LO*	*57*	*56*	*JO51mv*	*70*	
09.09	*PE1GNP*	*59*	*59*	*JO31ix*	*70*	
09.09	*DL5ON*	*56*	*59*	*JO42uu*	*70*	
09.10	*DG0EWQ*	*57*	*57*	*JO60mp*	*70*	*1427*
09.11	*DL2JCD*	*54*	*53*	*JO60lx*	*70*	*1393*
09.13	*DJ9EH*	*59*	*58*	*JO43id*	*70*	
09.14	*DH3UN*	*59*	*59*	*JO31tl*	*70*	
09.15	*DL3JIN*	*57*	*57*	*JO60lx*	*70*	*1393*
09.17	*DL1EFD*	*59*	*59*	*JO33vn*	*70*	
09.19	*ON/OM1TF*	*59*	*59*	*JO20eu*	*70*	
09.21	*DJ5NU*	*59*	*59*	*JO31qh*	*70*	
09.22	*DL5DWF*	*57*	*56*	*JO71aa*	*70*	*1434*
09.25	*DK5DC*	*58*	*58*	*JO31sm*	*70*	
09.26	*OZ5KM*	*57*	*56*	*JO45vx*	*70*	*835*
09.28	*DL5AX*	*53*	*53*	*JO52gf*	*70*	
09.31	*DG3LSM/P*	*539*	*539*	*JO61eg*	*70*	*1343*
09.35	*DL9EAJ*	*59*	*59*	*JO31dh*	*70*	
09.39	*ON4ZN*	*59*	*59*	*JO21fb*	*70*	
09.41	*DC6LN*	*55*	*55*	*JO43jb*	*70*	
09.43	*DF0CI*	*53*	*55*	*JO51ch*	*70*	
09.44	*PD0EBF*	*55*	*57*	*JO21lq*	*70*	
09.46	*DH5FS*	*529*	*55*	*JO61ua*	*70*	*1420*
09.46	*DL5NTA*	*53*	*53*	*JO60qp*	*70*	*1440*
11.49	*DH8IAB*	*59*	*59*	*JO30no*	*70*	
11.51	*DJ5BV*	*59*	*59*	*JO30ki*	*70*	
12.15	DM2BHG	54	58	JO51mw	2	
12.15	DF7VX	59	59	JO41kp	2	
12.18	*"*	*59*	*59*	*"*	*70*	
12.20	*DF1VB*	*57*	*59*	*JO31sk*	*70*	
12.23	"	59	59	"	2	
12.31	DG1VL	59	59	JO61wc	2	1420
12.31	DL4WO	59	59	JO61wc	2	1420
12.32	DL4DXL	59	59	JO61og	2	1377
12.34	*DG1VL*	*42*	*55*	*JO61wc*	*70*	*1420*
12.35	*DJ6XV*	*57*	*57*	*JO31lq*	*70*	
12.36	"	59	59	"	2	
12.37	PA0DDB	59	59	JO32ke	2	
12.40	DK2EA	59	59	JO50uf	2	
12.43	*DL4WO*	*54*	*55*	*JO61wc*	*70*	*1420*
12.46	DD7DL	59	59	JO31pm	2	
12.46	PA3AYD	59	59	JO21uu	2	
12.48	DB3LO	59	59	JO51mv	2	
12.49	DL8KBJ	59	59	JO30jw	2	
12.50	DL3WW	59	59	JO60fl	2	1419
12.50	ON6NL	59	59	JO21ue	2	
12.51	DL9EAJ	59	59	JO31dh	2	
12.52	DL0VLA	59	59	JO60el	2	1416
12.52	DB6NT	59	59	JO50vj	2	
12.53	ON8AB	59	59	JO10tw	2	
12.54	*DB6NT*	*52*	*52*	*JO50vj*	*70*	
12.54	*DL3WW*	*57*	*59*	*JO60gl*	*70*	*1423*
12.55	*ON8AB*	*59*	*55*	*JO10tw*	*70*	
12.58	**DL3WW**	**539**	**539**	**JO60gl**	**23**	**1423**
14.32	OK1AJY	59	57	JO70po	2	
14.35	DG5CST	59	59	JO60ds	2	
14.39	DG5AAG	59	59	JO51	2	
14.40	DJ5BV	57	55	JO30ki	2	
14.41	DK2CF	59	59	JO41gg	2	
14.42	DK6AS	59	59	JO52jj	2	1178
14.44	*DK6AS*	*59*	*59*	*JO52jj*	*70*	*1178*
14.45	**"**	**57**	**54**	**"**	**23**	**1178**
14.48	DK1FG	59	59	JN59hp	2	1433
14.51	DG3FK	59	59	JO51ct	2	
14.51	DF2ZC	59	59	JO30rn	2	
14.59	DH2UAK	57	57	JO71fu	2	1379
15.00	DK5YA	57	57	JN49nx	2	
15.01	DG0JMB	59	59	JO60lv	2	
15.02	DB8AT	55	53	JO51cp	2	
15.02	DJ7OF	57	59	JO51hq	2	
15.03	DL5BBF	56	57	JO42lt	2	
15.03	DL9ABF	57	58	JO51ix	2	
15.05	DF0CI	54	54	JO51ch	2	
15.06	DH4FAJ	57	57	JN49ex	2	1351
15.07	DL5ZA	56	55	JO51ek	2	
15.08	DK1QC	54	54	JO51cr	2	
15.08	DL4DWA	55	55	JO61qh	2	1380
15.09	DK1FUN	54	57	JN49mr	2	
15.10	DL6ZAU	56	54	JO40jf	2	
15.10	DC0KK	54	58	JO41kq	2	
15.11	DO1WUP	58	57	JO31of	2	

15.12	DL1QH	57	59	JO31np	2	
15.12	OK1GHZ	55	55	JN79ix	2	1556
15.13	PD0HCV	58	59	JO31fw	2	
15.14	DK0WP	57	57	JO31of	2	
16.24	DL8AKI/P	59	59	JO51ch	2	
16.29	PA9RZ	529	55	JO22gf	2	
16.52	F2YT	59	59	JO10gk	2	

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10.36	G3KEQ	59	59	JO01bh	2	
10.44	G4DHF	59	59	IO92uu	2	
10.45	G7RAU	58	58	IO90ir	2	
10.46	G8GXP	59	59	IO93fq	2	
10.53	G4FUF	59	59	JO01gn	2	
10.54	G3LTF	59	59	IO91gg	2	
10.57	ON4AAK	57	59	JO11od	2	
10.57	G8LZG	59	59	IO93sr	2	
10.58	*G3LTF*	*58*	*57*	*IO91gg*	*70*	
10.59	G4ZTR	59	59	JO01kw	2	
10.59	SP9AI	59	59	JN99mt	2	
11.00	DO4BG	57	58	JO42bi	2	
11.03	DL4KUG	56	55	JO64pb	2	1145
11.04	G4CBW	57	55	IO83ub	2	
11.06	DL9USA	559	55	JO71en	2	1400
11.07	DG0UHF	57	57	JO71go	2	1404
11.08	DL5YEE	59	59	JO42gf	2	1110
11.09	*"*	*55*	*55*	*"*	*70*	*1110*
11.12	**"**	**519**	**529**	**"**	**23**	**1110**
11.15	*OK2BRD*	*56*	*57*	*JN99et*	*70*	*1730*
11.15	*G3LQR*	*59*	*59*	*JO02qf*	*70*	
11.19	**"**	**559**	**579**	**"**	**23**	
11.22	DL7UCW	549	57	JO63hg	2	
11.23	DF9QX	59	59	JO42hd	2	1121
11.24	*"*	*59*	*57*	*"*	*70*	*1121*
11.33	**"**	**529**	**559**	**"**	**23**	**1121**
11.40	PA1TNO	59	59	JO22li	2	
11.40	DL6CGC	57	57	JO52mb	2	
11.41	PA4PS	59	59	JO33gh	2	
11.42	DL1DBR	59	59	JO41bn	2	
11.43	OK2PVF	579	59	JN99gu	2	
11.44	DG6ISR	59	59	JO61pk	2	
11.47	DK9OY	59	59	JO52ck	2	
11.46	G0UYC	59	59	JO02mr	2	
11.47	PA2M	59	59	JO21ip	2	
11.53	OR4J	59	59	JO20eu	2	
11.51	**PA2M**	**559**	**579**	**JO21ip**	**23**	**1059**
11.55	OK2BRD	55	57	JN99et	2	1730
11.56	DL3WW	57	57	JO60fl	2	1419
11.56	DF8JD	58	59	JO30oo	2	
11.57	DL9MS	58	59	JO54wc	2	
11.59	F6FEO	59	59	JN09nw	2	1186
12.01	DL8WF	59	59	JO61du	2	1287
12.02	ON4POO	59	59	JO20dp	2	1156
12.05	*"*	*59*	*59*	*"*	*70*	*1156*
12.10	**"**	**54**	**51-54**	**"**	**23**	**1156**
12.23	DL9OBD	59	59	JO42qn	2	
12.24	SP6GZZ	59	59	JO80fx	2	1543
12.25	DJ9MS	59	59	JO64ad	2	
12.26	PF2T	59	57	JO22jt	2	
12.27	PA3ECU	59	59	JO32cf	2	
12.28	G3YYD	59	59	IO91tr	2	
12.29	DL5DF	59	59	JO51ju	2	
12.30	PE1BIW	59	59	JO32bt	2	
12.30	G4AJC	59	59	IO91vj	2	
12.33	*G4AGE*	*53*	*53*	*IO93if*	*70*	
12.35	*G4AJC*	*529*	*52*	*IO91vj*	*70*	
12.36	*PE1KXH*	*59*	*52*	*JO21xd*	*70*	
12.38	*G4EZP*	*55*	*55*	*JO01gn*	*70*	
12.47	*G4FUF*	*549*	*55*	*JO01gn*	*70*	
12.49	*OK2UYZ*	*52*	*53*	*JN99fs*	*70*	*1737*
12.52	*DJ6JJ*	*59*	*58*	*JO31lg*	*70*	*1155*
13.01	**"**	**529**	**529**	**"**	**23**	**1155**
13.04	*OZ2OE*	*54*	*54*	*JO45vv*	*70*	
13.08	*DK3BU*	*59*	*59*	*JO33no*	*70*	*930*
13.11	"	559	539	"	23	930
13.16	**DJ5BV**	**529**	**519**	**JO30ci**	**23**	**1230**
14.02	*G4EAT*	*57*	*57*	*JO01hr*	*70*	*984*
14.11	**"**	**52**	**52**	**"**	**23**	**984**
14.17	*F5APQ*	*59*	*59*	*JO00xu*	*70*	*1095*
14.21	ON4CHP	59	59	JO21jd	2	
14.23	PA4AR	59	59	JO32hm	2	
14.25	DK9LB	59	59	JO41es	2	
14.26	G0WYY	58	57	IO94dx	2	
14.27	ON6YF	57	56	JO20kc	2	
14.28	PE1KXH	57	55	JO21xd	2	
14.33	**PA0EZ**	**54**	**54**	**JO32of**	**23**	**1067**
14.43	**G4DDK**	**539**	**539**	**JO02pa**	**23**	**959**
14.47	G8VHI	59	59	IO92fm	2	
14.49	*"*	*59*	*59*	*"*	*70*	
14.50	*G8APZ*	*59*	*59*	*JO01do*	*70*	
14.59	*G3BNE*	*57*	*55*	*JO01bj*	*70*	
15.11	*PA9RZ*	*57*	*57*	*JO22gf*	*70*	
15.12	*PA2BEN*	*55*	*53*	*JO*	*70*	
15.14	*G4KIY*	*53*	*55*	*IO92WN*	*70*	*886*
15.20	**"**	**52**	**51**	**"**	**23**	**886**
15.33	"	58	59	"	2	886
17.02	DL8AAV	59	57	JO52dh	2	
17.04	DL8OAZ	59	57	JO42uj	2	
17.06	F6KIF/P	59	59	JN19xh	2	
17.07	*"*	*59*	*59*	*"*	*70*	
17.10	*PA2JWN*	*59*	*59*	*JO22qd*	*70*	
17.12	*G8VYK*	*57*	*59*	*JO01fo*	*70*	
17.13	*PA0AKN*	*59*	*59*	*JO21bt*	*70*	
17.14	*F4EMG*	*59*	*59*	*JO00wu*	*70*	
17.15	*G0JBQ*	*57*	*59*	*JO01ck*	*70*	
17.16	*DK6JL*	*59*	*56*	*JO31dh*	*70*	
17.18	*DB2KA*	*53*	*53*	*JO30jt*	*70*	
17.21	F4EMG	59	59	JO00wu	2	
17.45	G8VYK	59	59	JO01fo	2	
17.48	DL1BME	58	55	JO43ib	2	
17.56	*OK2MWR*	*57*	*57*	*JN99gr*	*70*	*1744*
18.02	"	56	57	"	2	
19.38	G3KEQ	59	59	JO01bh	2	
19.48	ON4BG	57	57	JO10wm	2	
20.01	PA2DW	59	59	JO22gd	2	
20.08	PC5M	59	59	JO22qe	2	
20.13	ON3VW	59	59	JO20rr	2	
20.17	PH0V	59	57	JO22jp	2	
20.20	*"*	*52*	*52*	*"*	*70*	

20.21	*DL7APV*	*55*	*53-55*	*JO62JR*	*70*	*1221*
20.23	PA3BIY	59	59	JO22eb	2	
20.23	ON4KHG	59	59	JO10xo	2	
20.26	DM2AML	54	33	JO60sx	2	1417
20.28	PA3PAL	58	57	JO21gw	2	
20.31	PA7MM	55	59	JO23se	2	
20.33	G0BXP	59	59	JO02jp	2	
20.40	G1ZJP	59	57	IO92wv	2	
20.43	G3XDY	57	57	JO02ob	2	
20.45	*"*	*53*	*53*	*"*	*70*	
21.06	G4KUX	57	57	IO94	2	
21.13	PE1GUR	59	59	JO22th	2	
21.44	SP9AI	59	59	JN99mt	2	1760
21.47	SP3TYF	539	59	JO82fh	2	
21.49	DL3KUM	54	55	JO64gd	2	
21.51	SP9EML	52	55	JN99mt	2	1760
21.52	SQ9CWO	57	58	JO90fv	2	
21.53	SP6ARE	56	58	JO81ik	2	1515
21.55	SP9AVR	59	59	JO90kk	2	1699
21.58	SP1LOI	53	55	JO73tp	2	1288
22.00	OK2BFH	59	59	JN99gu	2	1734
22.03	OK2OV	42	59	JN79ql	2	1629
22.04	SP3NNE	55	55	JO81xk	2	1574
22.06	DD3SP	58	59	JO72en	2	1315
22.07	SP7HKK	55	57	JO91qi	2	1648
22.08	OZ8ZS	54	57	JO55rt	2	
22.11	*OZ1BEF*	*58*	*59*	*JO46oe*	*70*	
22.16	*SP9JDP*	*58*	*59*	*JN99hw*	*70*	*1730*
22.19	*SM7ECM*	*57*	*57*	*JO65nq*	*70*	*1017*
22.24	**"**	**549**	**539**	**"**	**23**	**1017**
22.34	SQ9S	54	41	JO54tu	2	
22.36	OZ2M	59	59	JO65fr	2	
22.37	DH8BQA	58	58	JO73ce	2	
22.38	SP3OCV	54	55	JO82ch	2	1420
22.43	*SM7FMX*	*59*	*57*	*JO65kn*	*70*	*1014*
22.45	**"**	**539**	**559**	**"**	**23**	**1014**
22.57	*DG0KW*	*59*	*59*	*JO64mh*	*70*	*1114*
23.00	*OZ1FKZ*	*59*	*59*	*JO56aa*	*70*	*844*
23.02	*DJ4TC*	*59*	*55*	*JO63pn*	*70*	*1184*
23.08	DL1SUN	529	55	JO53pn	2	

22/12/2007

00.05	OZ1BNN	59	59	JO55pm	2	
00.13	*"*	*419*	*319*	*JO55pm*	*70*	
00.15	*OZ8ZS*	*319*	*519*	*JO55rt*	*70*	
00.20	PD2BNH	54	55	JO21LK	2	
00.23	DG1NOE	59	55	JO63mi	2	
00.36	OZ3K	59	59	JO45tl	2	
00.38	SP9QMP	58	59	JO90fb	2	1712
00.40	SP9HVW	54	55	JN99gw	2	1726
00.43	DL3BRS	55	56	JO72gh	2	1344
00.48	DM2CNE	56	56	JO73db	2	1271
00.50	DB8KJ	55	55	JO30cm	2	
00.51	DK5QN	52	55	JO42fa	2	
00.53	DK2JP	56	55	JO73db	2	1271
00.53	DK1CO	55	58	JO63sx	2	
00.54	SQ9GAI	56	55	JO90eb	2	1708
00.55	OZ8FR	58	58	JO55sk	2	
00.56	OZ9FW	57	55	JO65co	2	
00.58	PA5KM	559	55	JO11wl	2	

No many stations worked on **4m** but wkd the following QSOs (all on MS, JT6M, save OY on tropo):

29/12/2007

11.03	G4IGO	26/26	IO80
11.33	G0CHE	26/27	IO90
11.45	EI7IX	26/26	IO53
11.57	GW8ASD	26/26	IO81

30/12/2007

10.03	G7CNF	26/26	IO81
10.30	G4ZTR	26/26	JO01
11.32	OY3JE	52/41	IP62
11.38	OZ3ZW	28/26	JO54
12.03	OZ2LD	27/28	JO55

1/1/2008

10.34	G7CNF	36/36	IO81

I did not have time to set the 6/4 kit up until the tropo event closed, shame as it would have been interesting to see what was on tropo on 4. I had planned to QSY to 4/6 as the Quadrantids started to drop out on 2. I think, apart for the boat trip home, 4/1 was the worst weather I had. It was very cold and windy. I managed to get some emergency guys up to stabilize the aerials and put on several layers of clothes but by 6am I was thwarted by continuous snow static at 24dB plus over noise floor and had to give up so 4 was abandoned. The snow was blowing horizontally across the aerials and it was quite difficult to walk back from the shack to the lighthouse where I was staying.

Eshaness Lighthouse = GM4ODA/p location

GM4ODA/P, IP90EL, Shetland Isl. in Dec. 2007/ Jan. 2008

No major expedition planned for 2008 but may be some short activities from semi rare squares in GM.

73, Keith, G4ODA

6m News

Reports, Expeditions, Infos

Editor: Joachim Kraft, DL8HCZ

Winter Es

N0JK, Jon writes on Jan 9th 2008: Some Es yesterday and today in the states. I had the W9DR/b in west Florida EL86 in for over an hour this morning. VE1YX made a double hop Es QSO with a station in Louisana, and I saw a station in Iowa reported a 2x Es QSO with KP4EIT Jan 8. Best Es of the winter season since mid December. An on Jan 10th: An extensive Es opening this afternoon favoring the northeast states and eastern Canada. VE1YX had over 3 1/2 hours of Es. Bob spotted the NØLL/b EM09 2,830 km at 2127 UTC. I heard Bob a few minutes later. I worked K2PS FM29 for my first Es QSO of 2008.

Also in EU there was 2x Es on 6m.: On Dec. 27th at 19z CT1HZE IM57 wkd GM4ODA/p IP90.

In the southern hemisphere the summer Es brought some very nice multihop Es openings. **A35RK (Tonga, AH20)** wkd on Dec 31st at 04z with VK8MS (5000km) and VK6JJ (7000km). On several other days he wkd into the eastern parts of Australia. Also ZL wkd into VK6 over 5000km, e.g. ZL3JT to VK6RO on Feb. 11th. Other interesting stations wkd from VK/ZL were 3D2AG/p RH87 from Rotuma (last week of December) and 9M6XRO OJ85 (in the first week of February).

Paul, A35RK, on Lifuka Isl, Tonga, Loc. AH20TE

On January 18th in the cluster the following spot appeared: LW3EX-@ 50110.2 ZL1RD RE44>GF05 0005z. This would be Es over 10.000 km. However the RE44 locator seems to be incorrect as ZL1RD on qrz.com is listed with RF73. So most likely this was a fake spot, unfortunately.

Expeditions & OPs

3V DL8YHR + EA7KW plan to activate JM47 + 57 from Tunesia for one week in June. Trip is not confirmed yet.

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 May 2008.

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

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

CY0 Sable: VE3IKV, K5AND, W4TAA and W3CMP plan to be qrv from June 25 to July 6, main station 800w + 7 ele in **FN93XW CY0X 50.117**, second station 100w + 5 ele from **GN03CX CY0RA 50155**.

FP St. Pierre&Miquelon: FP/KV1J and FP/W1MAT will be qrv on 6m from July 9-14th from GN17. 100 watts into verticals QSL via their home callsigns, info www.kv1j.com/fp/

HB0 Liechtenstein: HB0/ON4IPA ist qrv from 28.6. to 5.7. from JN47qf also on 6m.

HK0 San Andres: K7BV is qrv on 6m from 28.6. to 6.7. with 1 KW + 7Ele for EU. Loc. EK92DM. See also V3.

IM86 EA7/DH6DAO will be qrv from IM86ar on 6m from Juen 25th to July 9th.

IN99 F/DL8YHR is qrv from 27.7. to 10.8. on 6m. Also **GU and GJ** are on the plan for 1 day each.

JX Jan Mayen: JX/G7VJR + SQ4MP are qrv from 25.6.- to 6.7. on 6m in CW. Info: www.jx08.eu

LA9JKA is qrv from 27.3. to 8.10. as JX9JKA on 6m in SSB and Digi. QSL via Homecall.

KL7 Alaska: KL7/W6JKV ist qrv on 6m from 18. to 30.6. with 800w and long yagi for EU. Loc.: BP64

KM15 SV9/OZ8ZS is qrv on 6m from May 8 to 22 from KM15wm.

/MM UT1FG/MM Yuri is on the way from Panama were he started in the beginning of March to Algeria. He is qrv on 50.110 in USB only. He will be on the ship untill July but destination after 7X is still open.

T6 Afghanistan: VK1UN (ex EX1UN) is qrv as T61AA untill at least March 2009 on 6m with 8 Ele.-Yagi and 600W. Loc. MN57gc.

V3 Belize: K7BV is qrv on 6m from 20. to 26.6. with 1 KW + 7 ele. on 6m as V31BV. Loc. EK57xr.

Infos: www.qth.com/k7bv/caribe2008 See also HK0.

VP5 Turks&Caicos: VP5/K0OK ist qrv from May 21 to 28 with 100W + 7 ele from FL31.

ZD7 St. Helena: KC0W will go QRT again as ZD7X before June. He plans to move to another very rare DXCC he says. QSL via WØMM.

ZF Cayman Isl.: K4BI + K2ZD are qrv on 6m as ZF2BI or ZF2ZD from 29.6. to 8.7. with 1KW + 5 ele yagi. Loc.: EK99GI. Take off to EU is perfect. Beacon on 50.095 MHz.

Beacons

D4C 50034, HK76MV, 10W, omni, is QRV since November!

D44DUB HK86NO, is cancelled.

EA4Q/B 50060.0 MHz, IN80WC, 5W, GP, qrv since 1/08

J5SIX 50012, IK21EV, 30w, loop, qrv since Oct. 2007.

PY0FF/B 50006, HI36TD, 30W, Ringo Vertikal. QRV again.

SK6QW/B 50060.0 MHz, JO68WR, 2W, 5 Ele. Yagi, QTF 180, A1A, qrv since 12/07.

CT1FFU plans future 6m beacons for C9 Mocambique and D2 Angola.

W6JKV-K5AND Six Meter BBQ

Another 6m BBQ will take place on September 26-27 in Austin, Texas at the QTH of W6JKV.

4m News

Reports, Expeditions, Infos

Editor: Joachim Kraft, DL8HCZ

Czech Republik on 4m in 2008

In 2008 there will be issued 20 experimental licences for 4m operation. QRG range is 70.200 to 70.300 all modes and 10 W ERP. The licences are valid untill Dec 31st 2008. After checking the interference situation for 2009 there is a good chance for a general release.

Italy, Sardinia, SMOM and Vatican

At deadline in mid February it was not clear if Italy will be back on 4m in 2008. 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). However, we got word that it is looking promising for this year.

Estonia with permanent 4m allocation

On Dec. 23rd Estonia got a secondary allocation for amateur radio on 70.140 to 70.300 MHz. Max. TX power is 100W. All modes are permitted. Foreigners even can operate under the CEPT licence rules. It took some weeks but then **ES3RF showed up from KO29IF** with 60W and a 5 ele yagi on February 8th 2008. He wkd the following FIRST EVER QSOs on MS in JT6M mode:

1012 UT OZ3ZW JO54
1210 UT DI2PM JO30 26 26 1501km
1232 UT G4DEZ JO03 1659 km
1506 UT S51DI JN76

also OZ1DJJ JO65 and OZ2LD JO54 were worked.

On Feb 11th the first ever with Wales and Croatia was worked and also G0CHE came into the log:

1256 UT GW8ASD IO83 1839 km
1736 UT 9A1Z JN86

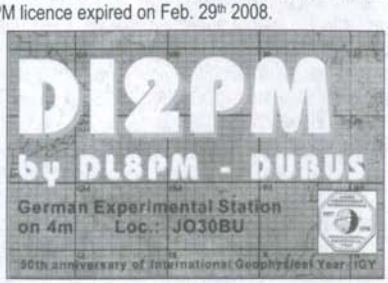
On Feb 12th the first ever with Scotland was worked:

0555 UT GM4ISM IO85

ES5AM from KO38, was expected to be ready on 4m also very soon.

DL again on 4m: DI2PM

Hans, DL8PM, was qrv as DI2PM on 69.950 MHz with < 10 EIRP and worked stations from U.K., OZ etc. via MS on JT6M. Also Tropo was wkd to G and LX. On Feb 12th 2008 Hans worked ES3RF for the first ever DL-ES on 4m. The DI2PM licence expired on Feb. 29th 2008.



Poland on 4m

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

More OY on 4m

OY4TN and OY3JE (both IP62) are very active on 4m with good rigs. They also work MS on digital modes.

Guinea-Bissau 4m Beacon

J5FOUR/B will be on the air soon on 70.010 MHz with 20w and 4 ele yagi to N. Loc. IK21EV at the capitals airport. TNX fo CT1FFU & group for this great beacon!

Portugal on 4m in 2008

The CT PTT ANACOM considers to issue new special 4m licences for a period of 6 months in 2008. New allocation will be two segments: 70.156 - 70.219 & 70.231 – 70.294 MHz.

4m Transatlantic History

G4ASR has collected a brief history of the 4m transatlantic observations and contracts. All from 1957 to 1981 was F2 propagation. The June 2007 contact was Es.

JAN 1957: W2ZKE heard G3EHY on 4m
NOV 1957: W2IDZ heard UK signals on 4m
NOV 1980: VE1ASJ (6M) worked xband G4BPY (4M)
NOV 1981: VE1ASJ (10M) worked xband G4JCC (4M) & GW4HXO (4M)
DEC 1981: VE1ASJ (6M) worked xband the following 4M stations: EI6AS, EI6DT, G2AOK, G3APY & GW3MHW.
JUNE 2007: VE9AA (6M) worked xband G7CNF (4M).

HA First ever QSOs on 4m

HA5PT has send a list with the Hungarian first ever QSOs that take place in summer 2007:

9A1HCD	01/07/2007 06:57	70M5PT
CT1HZE	05/07/2007 16:56	70M1FV
CT3HF	05/07/2007 17:37	70M5PT
EI3IO	04/07/2007 18:10	70M5PT
G4DEZ	30/06/2007 22:19	70M1YA
GD0TEP	04/07/2007 18:15	70M5PT
GI0GDP	15/07/2007 11:18	70M1YA
MM5AJW	10/07/2007 20:07	70M1YA
GU6EFB	14/07/2007 17:09	70M1YA
GW8ASD	04/07/2007 18:03	70M8BR
70M8BI2	30/06/2007 22:16	70M5HRK
IW0FFK	27/07/2007 07:02	70M5PT
LX1JX	14/07/2007 17:22	70M1XY
OZ1DJJ	30/06/2007 22:50	70M1YA
S51DI	30/06/2007 22:00	70M1YA
SP9HWY	15/07/2007 13:54	70M1YA
SV1DH	01/07/2007 13:52	70M1FV

And X-band 4m/6m:

F5DQK	24/07/2007 17:27	70M5PT
OH2MFE	15/07/2007 16:54	70M1YA

GB3JJ beacons

G0KSC plans to build a 4m and 6m beacon that will be lo-

cated in JO01GN. It could be on the air by the end of this year.

Finland on 4m in 2008

The OH radio club RATS (Radio Amateur Technical Society) has decided to apply for a 4m special licence for the Scandinavian VHF meeting (June 13th to 15th 2008). The location of the station will be in KP20. Also a 4m beacon will be installed that should be activated already in May.

CT1HZE, IM57nh, 4m Report for 2007

13.6.2007 GU8FBO IN89, G3LQR JO02, GW8ASD IO83, MW0CXH IO71, G3WXC IO90, G4DEZ JO03, G0PQF JO01, G3RHH IO90, G3VXM IO90, MW0CUA IO71, G8HVY IO90, GD0TEP IO74, GJZS IO91, M0MGH IO93, G3JHM IO91, G4AFJ IO92, SV1DH KM27, G0CHE IO90, G3VYF JO01 **1950z GJ7DNI/A IN89 FIRST EVER GJ-CT, EI2IP IO61 #,** G6ION IO70.

16.6.2007 G7RAU IO90, G4YTL IO92, G4FVP IO94, G8HVY IO90, G3JHM IO91, G4EZT IO92, G0CHE IO90, G8BKE IO90.

22.6.2007 GM4ISM IO85, GW8ASD IO83, MW0HMV IO71, MM5AJW IO88, G4YTL IO92, G7RAU IO90, G6HIE IO90, G3SHK IO90, G4FVP IO94, G3LVP, G4GFD, GI0BFD IO64, G4ZXN IO92.

23.6.2007 **GM4LUD IO86 #**

24.6.2007 G0HOF IO92, G1OAR IO82.

25.6.2007 **LX1DB JN39 #,** GM4LUD IO86.

4.7.2007 CT1JAD IM57 (Tropo), G3SHK G8HVY, G4FUF, MM5AJW, G8GXP IO93, GW8ASD IO83, LX1JX JO30, GI0BFD IO64, G4HGI IO83, G0JJL IO83.

5.7.2007 1656 **HA1FV/70M1FV JN87 # FIRST HA-CT,** EI2IP IO61, 70M5PT/HA5PT JN97 #, EI3IO, G8XVJ IO83, G0MJW IO91, G8GXP.

6.7.2007 G8VYK JO01, GD0TEP IO74, G0PQF JO01, G4FVP IO94, **GM6VXB IO97 #,** G7RAU IO90, G0MJW.

8.7.2007 **EI9E/p IO62 #**, G3CKR/p IO93, G8BCG IO70, G5XV/p IO91, GM3HAM/p IO74, G3GHN/p JO01, G7RAU IO90, G4YTL IO92, GM3TAL/p IO75, GW8ASD IO83, GW8IZR IO73, G3UKV/p IO82, GI0RQK/p IO74, MW0CUA, G0OLE/p IO93, G0ROC/p IO83, GI4KSO IO64, MM0CPS/p IO84, G4ADV/p, MW0CXH IO71, G6HIE IO90, G4HGI IO83. This opening was during UK 4m contest as one can see from the many portable calls. It was fun to have 4m open during this event. However, it was very difficult at times to get the U.K. operators working split on the CT QRGs. Obviously many of the contest operators were not familiar with the current frequency situation on 4m in Europe. Some of them were even interested in working only other UK stations on Tropo. Another unpleasant effect due to the UK contest rules is that there is on the first day 6m only and no 4m. The latter takes place only on the second day. When there were super 4m condx from CT to GM on the first day and I asked a GM on 6m to make a quick QSO with me on 4m because he was a new square for me, he answered "NO, I will work you tomorrow" allthough his station was ready. That was no fun.....

9.7.2007 **1450 SV9/DL9XAT KM25 FIRST EVER SV9-CT**

13.7.2007 **1158 IW0FFK JN61# FIRST EVER I-CT**, I0QM JN61.

14.7.2007 70M1YA/HA1YA JN87.

17.7.2007 IZ0AEG JN61.

18.7.2007 IZ0AEG JN61, **1254z IS0GQX JM49# FIRST IS0-CT**, I0JX JN61.

20.7.2007 IZ0AEG JN61, **1511z 1A0KM JN61 FIRST 1A-CT,** I0JX JN61, 9A6R, **IZ5EME JN52 #**, G7RAU IO90, G3JHM IO91, GM3TAL IO86, GI4SNA IO64, G1SWH, G3SHK, G4CBW IO83, G8BCG IO70, G0UWK IO83, MW0HMV.

21.7.2007 **IZ1DYE JN45 #, IK5MEJ JN53 #,** I0QM JN61, IZ0AEG JN61, 9A6R, IZ5EME JN52, 9A2ZH JN73.

30.7.2007 MW0HMV MS JT6M, G7CNF MS JT6M, CT1FJC JT6M Tropo IM57.

1.8.2007 G0CHE, G4PBP IO82, G3VYF, MW0CUA.

15.8.2007 **DI2AL JO53 FIRST CT-DL** (CT1HZE operated by second OP).

70 MHz Initiative

The CEPT Working Group on Frequency Management, WGFM, was being asked at its meeting in mid February in Athens, to consider a secondary allocation to the Amateur service at 70 MHz.

This arose from an initiative by Irish Radio Transmitters Society based on a technical paper drafted by Dave EI3IO.

Arising from this, the Irish regulator ComReg has submitted a proposal inviting the WGFM to consider a secondary allocation to the Amateur Service in the band 70.0 to 70.5 MHz. This is in the context of the post WRC '07 revision of the ECA (European Table of Common Frequency Allocations) that will take place shortly.

There are allocations at 70 MHz in Croatia, Denmark, Estonia, Greece, Ireland, Luxembourg, Monaco, Slovenia and the UK. Other countries are reluctant to release the band for experimentation and research until it is formalised either in Article 5 of the ITU Radio Regulations or in the European Common Allocations Table.

The ComReg initiative would give effective recognition to the de facto situation in these countries and more importantly insert a provision for a secondary allocation at 70 MHz to the Amateur Service in the ECA as an enabling provision to Administrations.

This would greatly assist National Societies in countries that do not have a 70 MHz allocation in negotiating such a facility with their Administrations. Work is ongoing through IARU Region 1, its National Societies and others in seeking support for the ComReg proposal. We all hope for a successful outcome. Source: IRTS

Last minute news from the conference was that there were about the same number of countries in favour and against the 4m proposal and the topic was supposed to be decided at the next conference in May. Good news was that there were countries in favour which have no 4m allocation yet.

Aurora Reports

LA/PA5DD, JP55UB wkd on 144 MHz:

10th August 2007

1512 SM5CUI	JO89WW	57A	59A	653
1513 OH7MA	KP52BN	53A	55A	942
1514 SM2JEB	KP05QI	56A	57A	452
1515 OH4LA	KP20LG	57A	57A	860
1516 SM2CEW	KP15CR	57A	59A	491
1517 OH3AWW	KP11VJ	56A	57A	729
1517 SM5EFP	JO79WJ	55A	58A	668
1519 ES7GN	KO28TI	55A	57A	1043
1520 OH6UW	KP22WH	52A	53A	761
1521 ES7GM	KO28TI	57A	57A	1043
1528 OH6QU	KP03SD	55A	55A	523
1532 SM6OEQ/6	JO58UF	57A	52A	762
1533 OH2BNH	KP20LG	59A	59A	860
1535 OH7SQ	KP33TO	53A	57A	782
1542 OH7PI	KP42HF	55A	57A	890
1547 OH3KLJ	KP21PH	57A	59A	798
1550 LA7XK	JO59LC	54A	54A	666

LA/PA5DD, JP41VM, wkd on 144 MHz:

10th December 2007

2212 SM5CUI	JO89WW	54A	55A	473
2222 ES3RF	KO29IF	52A	53A	856

11th December 2007

1706 OZ6OL	JO65DJ	52A	54A	695
1708 SM7GVF	JO77GA	55A	55A	567

LA/PA5DD, JP41VM

Beacon Reports via Aurora on 2m:

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

Date	UTC	Beacon heard from area / loc.
3.7.	1550-1650	SM2 (KP03), (KP15)
11.7.	1615-1620	LA (JP33), UA1 (KO59)
14.7.	1315-1800	UA1 (KO59), OH6 (KP02)
		SM7 (JO66)
	2300	SM0 (JO89)
26.7.	2200	OH1 (KP01)
1.8.	1600	LA (JP33)
2.8.	1535	SM2 (KP03)
6.8.	2130	OH6 (KP02)
7.8.	1635-1655	OH6 (KP02), SM2 (KP04)
	2120	SM2 (KP15)
10.8.	1500-1740	OH6 (KP02), LA (JO59),
		OZ (JO65), UA1 (KO59)
11.8.	1755	SM7 (JO65)
26.8.*	1800	SM2 (KP15)
27.8.	1945	SM2 (KP15), ES (KO28)
1.9.* +	2145	OH1 (KP01)
2.9.	1250-1615	OH1 (KP01), SM2 (KP15),
		SM2 (KP03), SP2 (JO93)
6.9.+	1625	SM7 (JO77)
	2000	SM2 (KP03)
+	2200	SM7 (JO77)
14.9.	2140	SM2 (KP15)
20.9.	1800-1900	SM7 (JO77), YL (KO37), OH6
21.9.+	1810	SM7 (JO77)
23.9.+	2230	SM7 (JO77)
27.9.+	1700	SM7 (JO77)
28.9.	2255	SM0 (JO89)
29.9.	1300-1430	SM2 (KP15), OH6 (KP02)
	1745	YL (KO37)
3.10.	1350	OH6 (KP02)
19.10	1350-1430	SM2 (KP15), OH6 (KP02)
		ES2 (KO28)
+	1645	SM7 (JO77)
	2110	SM7 (JO77)
25.10.	1340	SM2 (KP03)
	1630-1930	DL (JO53, 44), PA (JO22),
		G (IO93), OH6 (KP02)
26.10.	1305-1400	LA (JP33), OH6 (KP02)
27.10.*	1625	SM2 (KP15)
29.10.	2040-2100	SM3 (JP82),
+	2100	SM7 (JO77), OH6 (KP34)
13.11.	1840-1910	SM2 (KP03), OH1 (KP20)
20.11.	1310-1740	SM2 (KP03), OH1 (KP20),
		UA1, OZ (JO65), PA (JO22)
22.11.	1640-1830	SM7 (JO77), OH6 (KP02),
		DL (JO53)
	2200-2250	SM2 (JP93), SM7 (JO65)
24.11.	1610	OH6 (KP02)
25.11.	1630	OH6 (KP02)
11.12.	1520	OH6 (KP02)
17.12.	1545	SM2 (KP03)
18.12.	1400-1445	OH6 (KP02)
20.12.	1755	OH6 (KP02)
22.12.	2010	OH6 (KP02)
5.1.	1420-1430	OH6 (KP02), SM2 (KP15)
	1920-2030	OH6 (KP02), DL (JO53)
	2135-	SM2 (KP15)
6.1.	1330	SM2 (KP15)
	1600-1647	ES7 (KO28)
	2120-2145	OH6 (KP02), ES7 (KO28)
8.1.	1815-1925	OH6 (KP02), SM2 (KP15)
12.1.	1650-1740	OH6 (KP02), DL (JO73)
13.1.	1635-1755	SM2 (KP02), SP4 (KO03), UA1
14.1.	1735-2005	LA (JP33), DL (JO53),LY (KO15)
17.1.	1405	OH6 (KP02)
18.1.	1515	SM2 (KP15)
31.1.	1830	OH6 (KP02)
	2120	LA (JP33)
1.2.	1810-1840	SM2 (KP15), SP2 (JO93)
2.2.	2000	UA1 (KO59)
3.2.	1915	OH6 (KP34)
5.2.	1930	SM2 (KP03)
8.2.	2055	SM2 (KP15)
10.2.	1220-1645	SM2 (KP15), OZ (JO47),
		LA (JP33), OH6 (KP02)
12.2.	1500+2015	LA (JP33)

News & Comments

Editor: Joachim Kraft, DL8HCZ
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Expeditions and DX

F1HDI (ex J79DI) plans to be qrv on 2m EME in Sept./Oct. 2008 from S9 Sao Tome.

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 JA1RJU plans to activate Eastern Malaysia as 9M6JU in May on 2m and 6m EME.

7P Lesotho: ZS6WB plans to be qrv on 2m EME in April.

H4 DL2NUD ist qrv until April 4th as H44HP from Solomon Isl. On 2m EME in JT65. Loc. QI90XN. Rig: 1KW and 18 Ele. Also the grid RI00 will be activated if possible.

HP Panama: HP3XUG (ex KG6UH/DU1, HL9UH) plans to be back soon on 2m EME with 4 x 17 ele Xpol + KW, 70cm EME with 4 x 28 ele + 8874 and also 6m EME. Loc. EJ88SK.

R1M Malyj Vysotskyj – OH5LID considers a 2m FSK-MS expedition in June 2008.

T6 Afghanistan – VK1UN is qrv as T61AA untill at least March 2009 on 6m. He plans also to come on 2m EME. Loc. MN57gc.

UK Usbekistan – DL9LBH is there for a few years and will try to come on 2m EME.

ZD8 Ascension: W1MRQ is now on ZD8 and plans to be qrv for a few months this year on 2m EME. From August 2009 he will be back as KC4/W1MRQ from McMurdo / Antarctica.

RW1ZC/MM, Alex, is qrv again now off the south African coast (ZS1 area) untill about May. He already worked ZS6WB and ZS6OB from severals rare wet grids via FSK-MS. Also some ZS2 stations were worked on Tropo.

UT1FG/MM is qrv arround mid March in the 7X area on 6m (50.110 USB) and may be 144.300 MHz. He will be on his ship untill July but destionation after 7X is not confirmed yet.

IM86 EA7/DH6DAO is qrv from June 26th to July 9th from IM86AR on 6m and 2m in SSB/CW for Es/Tropo.

IN69 M/F8ATS is qrv from May 15 to 23 from IN69UV on 2m and 70cm for Tropo. For one day also IN79 will be activated. May be also digi modes. QSLs via F8ATS.

IP62 OY4TN is qrv permanently on 2m with 300W + 8 Ele on FSK-MS and EME (JT65).

JO47 OZ/DL1TM + DJ4MG are qrv from March 24 to April 10 on 2m in SSB with 100w and + 11 ele from JO47uh qrv.

KM15 SV9/OZ8ZS is qrv from May 8 to 25 on 6m (and may be 2m) via Es qrv. Loc.: KM15wm.

3V DL8YHR + EA7KW plan to be qrv for 1 week in June from JM47 + 57 on 2m and 6m on MS and EME.

CX Uruguay: DL1YMK/CX will be qrv from May 1 to 12 on 70, 23 + 13cm in CW-EME.

CN Marocco: DL2NUD plans to be qrv in April on 2m via EME in JT65 and on MS is FSK441. He will be also qrv from EA from some squares.

ZB2 ZB2/DH7FB & DF2ZC will be qrv from May 29 to June 1. on 2m via EME + MS. Loc. IM76HD.

D4 Cabo Verde: The D4C HF contest group is considering to erect also 6m and 2m DX station there. Loc. HM76MV. The D4C 6m beacon is running already. 2m beacon will follow.

JT Mongolia: PA4EME will be qrv in August 2009 as JT1EME on 2m EME (JT65). Rig: 1k + 2x16

IN99 F/DL8YHR will be qrv from July 27 to Aug. 10 on 6m, 2m, 70cm via MS and EME qrv. Frank plans also to be qrv 1 day each from **GU and GJ.**

JP42 LA/PA5DD plans to be qrv in Perseids on 2m FSK-MS.

/MM OZ2JFV/MM will be qrv west of the U.K. from April on 6m running a dipole and 100w.

Beacons

CU2VHF 144.401 MHz, HM77DT, 30W, 2 x Ele, EU + USA, 835m a.s.l., proposal for spring 2008.

DM0HVL 144.450 MHz JO62KI, 5W, corner dipole, qrv since 1/08. (ex DL0UB)

DM0HVL 432.450 MHz, JO62KI, 5W, stacked Big Wheel, qrv since 12/07. (ex DL0UB)

EA5VHF 144.465 MHz, IM98VX, 12W, 3 Ele, N. qrv from new location since Dec. 7th 2007.

HG5BVB/B 144.420 MHz, JN97LM, 3.5W, omni, 485m a.s.l., qrv since Jan. 20th 2008.

IK5WJD/B JN53SR, Slot, omni, 1450 m a.s.l., 1296.850 (1W) & 2320.850 MHz (1.5W) qrv since 8/07. (tnx IK5WJD)

IW1AVR/B 144.404 MHz, JN35PA, 1,5W, Big Wheel, 1310 m a.s.l., qrv since 1/08. (IZ1DYE/IW1AVR)

J5TWO/B 144.450 MHz, IK21EV, Vertical Collinear, 20W, CW, proposal for March 2008. (tnx CT1FFU)

PI7EHG 10368.180 MHz, JO22HC, 50 W erp, omni, 10m a.g.l. was running in test mode in January 2008 from the QTH of PA0EHG. Hans plans to let the beacon run permanently from his home QTH in the future. When 10 GHz is running stable he will also add the beacons for 13cm and 6cm, then for 24 GHz and may be later also for 9cm.

RA3YR/B 144.445 MHz, KO73EG, 5W, CW, qrv since 1/08.

RN6BN/B 144.435 MHz, KN95LC, 10 W, dipole, N/S, 10m a.g.l., USB JT65B 1st min., qrv since 1/08.

SR2XHM JO94FK, 10368.930 GHz, 1W, omni, 150m a.s.l. qrv since Dec. 29th 2007.

SR9VHD 144.456 MHz, JN99MS, new since 12/07

2m Beacons in ZS

ZS6JON, John, writes: I was fortunate enough to be in the UK visiting family over the December period. I was lucky enough to have access to a radio hams shack who is actively involved in VHF and UHF contacts. Tuning around the band I was amazed by the amount of beacons one could hear from a couple of miles away to several hundred miles. On returning to SA I contacted ZS6EF who was involved in the HF beacon

project and John has kindly made the keyers used in the HF beacon project available. I built the first prototype beacon and it seems to work fine. The systems employs a basic commercial FM rig interfaced with the keyer. It will be heard on both SSB and FM. Output power is about 5watts with a muffin fan for cooling. I will have about 10 beacons running. The OK was given by both Icasa and the league for the project to go ahead. What I would like to appeal for Amateur stations that are willing to accommodate a beacon. We have some power supplies and antennas but the main thing is the beacon. It would require about a 5A power supply and a dipole antenna that could be used in a horizontal/vertical position. The beacon would send out the call sign of the station it is located at including a grid locator. Once the beacons are operational a list can be made up so that one could access it off the web site to locate the position of the beacon. If anyone has any power supplies or dipole antennas to donate they would be used on the sites where nothing is available. I am looking in to putting the beacon at possibly the following locations:
Johannesburg, Cape Town, Port Elizabeth, Durban, Bloemfontein, Springbok, Kuruman, Mussina, somewhere in the Karoo, Namibia. Once they are going one can expand on them. Each beacon will be spaced 5 kHz apart starting with 144.400 upwards to 144.490 MHz (According to the band plan). If you are interested please contact me via email or on 0825541401. 73, John ZS6JON

News

Vote on best VHF expedition 2007

The web portal MMMonVHF let the people vote from January 1st to 20th 2008 on the best VHF expedition of the year 2007. 82 OM from 30 DXCCs took part and chose between 68 different expeditions. Here the results:
1. OH8K & OH8K/0 (25) 2. PJ4EME (15)
3. 3X5A (12) 4. LA/PA5DD (10) 5. 1A4A (9) 6. 1A0KM (7)
7. 3DA0DC & 3DA0HL und ZB2/DH7FB & ZB2/DF2ZC und SM/OH9TT & SM/OH6JW and HH4/W3CMP and TF&OY/G4ODA/G1GSN and A25HL & A25OB (all 6 each).
The first three will get prizes and the winner will get a special Trophy sponsored by DL8YHR. More on www.MMMonVHF.de
73 from DL8YHR and the MMMonVHF-Team

430-433 MHz forbidden in Moscow area

RA3AH wrote on the KST chat that amateur radio operation from 430-433 MHz around Moscow with a radius of about 350km is forbidden since 2006 as this range is used by the military.

Linear Amp U.K. Info

Notice to all our customers: From January 31st 2008 we are stopping the manufacture of our range of linear amplifiers - RANGER, CHALLENGER and DISCOVERY. We will, of course, honour existing warranties on all our amplifiers. We will be continuing to do repairs on amplifiers - any known make of valve amplifier can be fixed (within reason!!). We are also going to continue to supply parts for amplifiers. We are moving both house and business premises at the beginning of February so there will be a period when we will be totally unavailable by phone, fax or e-mail. We will make an announcement on this page when we become available and how to contact us. In the meantime, we would like to take this opportunity to thank all our past customers for their loyal support over the years. Peter & Gwen Rodmell G3ZRS M0GWA (Sourse Linear Amp UK website)

9H1AW Silent Key

Alan Wright, 9H1AW (ex GW3LDH) has gone SK in the end of January. Alan fell off his antenna tower when he tried to repair his antennas. He was 71 years old. Alan was very active on 6m and 2m DX from Malty in the past years. RIP

BATC Info

BATC have reduced the cost of their Cyber subscription of CQ-TV magazine from £10 to £4 which has got be good value, You can subscribe on line and then as each magazine goes to press you will be emailed a link where you can download your own personal copy from. The magazine is in full colour and is in the form of a PDF file of around 8 to 10Mb. If you think its for you why not go and have a look at some of the back issues on the site they can all be down loaded for free with the exception of the last 4 issues.
See www.batc.org.uk or www.cq-tv.com
Trevor Brown, G8CJS trevor@video-vault.co.uk

Dates

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

VERON VHF Day 2008

This years VERON VHF/UHF/SHF day takes place on May 17th in Budel.

CJ 2008

The annual French VHF/UHF/Microwave meeting in Seigy will take place on March 29th. Info: http://cj.ref-union.org/index.htm

The Scandinavian VHF Meeting 2008

will take place from June 13 to 15 in Finland in the area of Espoo (KP20if). Organizer is Erik, OH2LAK. www.rats.fi

MS Contest in Perseids

There will take place a new 2m MS contest in the peak of the Perseids. Complete details in next issue.

Redaktionsschluss für Aktivitätsberichte und redaktionelle Beiträge für DUBUS 2/2008 ist der 1. Mai 2008. - Deadline for reports etc. for DUBUS 2/2008 is May 1st 2008.

DUBUS Toplists

50 MHz Toplist

NR	Call	WW Loc	Wkd Sqr	DXCC	Tropo	Aurora MS		Es F2	(ODX)
1	K1TOL	FN44	1320	173	0	0	0	0	0
2	ON4GG	JO20	1170	221	813	0	0	0	0
3	VE1YX	FN74	1160	173	0	0	0	0	0
4	ON4IQ	JO20	1151	212	1180	0	0	0	0
5	ON4KST	JO20	1143	216	801	0	0	0	0
6	DL7QY	JN59	1130	220	845	1948	2239	13267	16348
7	SM7FJE	JO65	1123	207	0	0	0	0	0
8	IK0FTA	JN61	1117	233	0	0	0	0	0
9	G0JHC	IO83	1117	211	0	0	0	0	0
10	W3EP	FN31	1102	147	0	0	0	0	0
11	LU1DMA	GF05	1090	189	0	0	0	0	0
12	PA0HIP	JO21	1083	215	0	0	0	0	0
13	EA7AH	IM66	1073	140	0	0	0	0	0
14	PY5CC	GG54	1061	219	0	0	0	0	0
15	IK2GSO	JN45	1051	215	0	0	0	0	0
16	W5OZI	EM00	1040	152	0	0	0	0	0
17	G4IGO	IO80	1028	208	578	0	0	0	0
18	PA0RDY	JO22	1027	192	750	0	0	0	0
19	SM7AED	JO65	1025	198	0	0	0	0	0
20	K1SIX	FN43	1000	162	0	0	0	0	0
21	PA4PA	JO22	981	199	0	0	0	0	0
22	SV1DH	KM17	977	235	0	0	0	0	0
23	DL9USA	JO71	976	202	0	0	0	0	0
24	EH8BPX	IL18	968	178	0	0	0	0	0
25	G3WOS	IO91	965	213	0	0	0	0	0
26	G4UPS	IO80	965	191	0	0	0	0	0
27	OZ1LO	JO55	954	191	0	0	0	0	0
28	I0JX	JN61	953	224	0	0	0	0	0
29	SP6GZZ	JO81	939	173	515	0	0	0	0
30	F8OP	JN26	934	185	631	0	0	0	0
31	ON4AOI	JO21	932	205	0	0	0	0	0
32	DL7AV	JN58	928	202	0	0	0	0	0
33	DL8PM	JO40	912	194	0	0	0	0	0
34	OZ3K	JO45	901	200	0	0	0	0	0
35	F6HRP	IN88	899	184	0	0	0	0	0
36	I0WTD	JN61	898	218	0	0	0	0	0
37	F5JKK	IN87	898	189	0	0	0	0	0
38	SP6GWB	JO80	890	182	696	0	0	0	0
39	IZ5EME	JN52	889	188	583	0	0	0	0
40	OZ3ZW	JO54	874	173	0	0	0	0	0
41	DL6AMI	JO50	872	185	0	0	0	0	0
42	PA7MH	JO22	872	182	0	0	0	0	0
43	SM6CMU	JO57	871	180	762	0	0	0	0
44	F5LNU	JN04	869	198	0	0	0	0	0
45	TI5KD	EJ79	866	135	0	0	0	0	0
46	ON4PS	JO20	857	170	752	0	0	0	0
47	OZ8ABE	JO45	854	171	0	0	0	0	0
48	ZF1DC	EK99	852	123	0	0	0	0	0
49	SP4MPB	KO03	851	189	710	0	0	0	0
50	N3DB	FM18	850	131	0	0	0	0	0
51	DL3LFA	JN67	845	145	0	0	0	0	0
52	OK1DDO	JO60	843	169	620	0	0	0	0
53	G3IMV	IO91	842	185	0	0	0	0	0
54	9H1BT	JM75	824	235	0	0	0	0	0
55	PA7FM	JO21	817	167	0	0	0	0	0
56	DL8HCZ	JO53	777	115	365	0	0	0	0
57	DL6BF	JO32	771	164	1193	0	0	0	0
58	DL1EJA	JO31	770	169	0	0	0	0	0
59	DL3AMA(sk)	JO51	770	160	519	0	0	0	0
60	PA2V	JO22	764	155	0	0	0	0	0
61	IZ1EPM	JN35	761	194	0	0	0	0	0
62	GJ4ICD	IN89	758	167	0	0	0	0	0
63	YO7VS	KN14	755	170	0	0	0	0	0
64	DJ6MB	JO30	754	162	0	0	0	0	0
65	OZ1IEP	JO65	753	147	1986	0	0	0	0
66	G4DEZ	JO03	734	132	0	0	0	0	0
67	F8DBF	IN78	731	138	0	0	0	0	0
68	EI3IO	IO63	730	150	0	0	0	0	0
69	F5DE	JN05	728	163	860	1074	1651	3638	15789
70	DL7ARM	JO62	727	157	0	0	0	0	0
71	OZ1DPR	JO45	722	147	0	0	0	0	0
72	G3ZYY	IO70	720	185	0	0	0	0	0
73	IW1AZJ	JN35	720	180	445	0	0	0	0
74	PA9KT	JO33	715	177	0	0	0	0	0
75	WA1ECF	FN41	714	108	0	0	0	0	0
76	EH3LL	JN01	709	169	0	0	0	0	0
77	PE9DX	JO33	700	167	0	0	0	0	0
78	PE1HWO	JO21	699	153	835	0	0	0	0
79	EH9IB	IM85	696	161	0	0	0	0	0
80	F9DI	JN23	695	179	284	0	0	0	0
81	LZ1AG	KN22	680	173	375	0	0	0	0
82	S52SK	JN76	670	188	0	0	0	0	0
83	PA2TAB	JO32	659	152	857	0	0	0	0
84	CT1EEB	IN50	654	189	0	0	0	0	0
85	OK1FFD	JO60	654	148	580	0	0	0	0
86	OK1KT	JO70	650	144	0	0	0	0	0
87	DF7RG	JN68	643	136	652	0	0	0	0
88	YL3AG	KO26	631	140	691	0	0	0	0
89	I4XCC	JN63	630	140	707	0	0	0	0
90	F5PAU	IN88	624	108	0	0	0	0	0
91	CT1HZE	IM57	620	137	0	0	0	0	0
92	OK2ZW	JN89	618	138	1681	0	0	0	0
93	PA3ECU	JO32	618	137	0	0	0	0	0
94	IK5JWQ	JN52	616	151	820	0	0	0	0
95	DJ6XV	JO31	604	122	512	0	0	0	0
96	DL2DR	JO31	602	120	1003	0	0	0	0
97	PA5DD	JO22	594	151	0	0	0	0	0
98	DL6NCI	JO50	570	157	708	0	0	0	0
99	DL7HG	JO62	568	115	0	0	0	0	0
100	ES6RQ	KO28	557	107	393	0	0	0	0
101	YO2IS	KN05	552	131	425	0	0	0	0
102	7Q7RM sk	KH74	548	119	0	0	0	0	0
103	SP2IQW	JO94	535	113	0	0	0	0	0
104	HB9SJV	JN26	518	140	527	0	0	0	0
105	OK1VBN	JN78	512	92	455	0	0	0	0
106	DG1VL	JO61	505	101	430	1386	0	4697	14635
107	ES1CW	KO29	503	104	959	0	0	0	0
108	LY2SA	KO14	478	107	407	0	0	0	0
109	PA2CHR	JO22	475	127	1026	0	0	0	0
110	OZ7IS	JO65	475	126	410	0	0	0	0
111	S53J	JN75	462	89	0	0	0	0	0
112	ES2RJ	KO29	458	88	971	0	0	0	0
113	ON1IM	JO11	456	106	223	0	0	0	0
114	OK1FAV	JO60	444	96	0	0	0	0	0
115	ES2WX	KO29	443	85	562	0	0	0	0
116	ES1AJ	KO29	439	94	415	0	0	0	0
117	ES1RF	KO29	438	95	340	0	0	0	0
118	ES2QN	KO29	437	81	848	0	0	0	0
119	YO4FRJ	KN34	436	116	250	0	0	0	0
120	DL4ALI	JO50	431	87	464	0	0	0	0
121	DG9YIH	JO32	426	117	0	0	0	0	0
122	OE1SOW	JN88	424	103	0	0	0	0	0
123	DL9GU (sk)	JN49	402	0	721	0	0	0	0
124	VK3SIX	QF12	400	130	0	0	0	0	0
125	DL3YEE	JO42	396	88	540	0	0	0	0
126	ES2NA	KO29	393	80	883	0	0	0	0
127	OK1MP	JO70	390	82	1125	0	0	0	0
128	ES2RW	KO29	382	55	410	0	0	0	0
129	OK1IBL	JO60	377	77	530	0	0	0	0
130	ES1II	KO29	367	81	335	0	0	0	0
131	DL8GAP	JN48	365	73	365	0	0	0	0
132	HB9AOF	JN36	350	82	500	0	0	0	0
133	DK9KX	JO30	341	190	0	0	0	0	0
134	I3ZVN	JN55	339	84	1137	0	0	5742	8422
135	DL1SUZ	JO53	338	71	546	0	0	0	0
136	SM3BIU	JP73	336	77	907	0	0	0	0

144 MHz Toplist (without EME)

NR	Call	WW Loc	Wkd Sqr	DXCC	Tropo	Aurora	MS	Es	(ODX) Iono / AE
1	DK1KO	JO53	731	75	2124	2057	2271	3572	2122
2	DK3WG	JO72	693	72	2243	2034	2295	2782	1954
3	PA3BIY	JO22	690	64	1940	2026	2205	3157	0
4	DL8EBW	JO31	674	68	1454	1918	2225	3237	0
5	DF8LC	JO53	600	70	2105	2045	2226	3291	0
6	PA2CHR	JO22	590	71	1511	2163	2185	3211	1727
7	SM6CMU	JO57	579	0	1760	1928	2280	2577	0
8	PA0RDY	JO22	568	67	1582	1979	2272	2819	0
9	DL8HCZ	JO53	566	60	1615	1976	2096	3527	1500
10	OH5LK	KP30	551	0	1962	2041	2235	2891	0
11	SP4MPB	KO03	544	59	1886	1959	2090	2689	2108
12	SP6GWB	JO80	538	55	1780	1768	2057	2437	0
13	YU7EW	KN05	538	71	1404	1868	2179	2613	2082
14	I4XCC	JN63	538	78	1188	1826	2364	3248	1746
15	I2FAK	JN45	535	0	1935	1512	2405	2995	1645
16	SP6GZZ	JO81	530	0	1670	1794	2017	2717	0
17	HA1YA	JN87	529	75	1548	1941	2183	2885	2010
18	PA3FOC	JO21	522	59	1373	2010	2209	2326	0
19	DD0VF	JO61	521	64	1743	1702	2044	2617	0
20	SP9EWU	JO90	517	63	1710	1927	2154	2871	0
21	DK6AS	JO52	516	0	1460	1885	2510	2260	0
22	DK0OG	JN68	510	67	1708	1975	2172	3322	1543
23	PA5DD	JO22	510	64	1452	2054	2145	3162	1667
24	PA3ECU	JO32	508	58	1721	2106	2018	3238	0
25	DL3AMA	JO51	505	61	1785	1803	1925	2403	0
26	PA3DZL	JO21	504	62	1405	1851	2167	3107	0
27	DH3YAK	JO31	498	61	1424	1162	2105	2650	0
28	DJ7OF	JO51	489	63	1512	1518	2152	2156	0
29	LY2WR	KO24	483	57	2051	2075	2347	3007	0
30	PE1HWO	JO21	483	65	1500	1618	2279	2618	0
31	YU7MS	KN05	481	62	1319	1856	2160	2438	2130
32	SK6HD	JO68	472	0	1911	1857	2172	2479	0
33	ON4IQ	JO20	469	67	1420	1965	2150	2725	0
34	DL8LAQ	JO43	465	50	1377	1858	2104	3304	0
35	ON4GG	JO20	464	68	1420	1965	2150	2124	0
36	IZ5EME	JN52	458	65	1590	0	2090	2893	2030
37	RA3LE	KO64	455	1	2137	2134	2173	2524	1516
38	OE6IWG	JN77	453	68	1221	1110	2220	2126	1214
39	OH7PI	KP32	451	0	1902	1926	2151	2489	0
40	OK2ZW	JN89	445	56	1417	1775	2113	2471	0
41	ES6RQ	KO37	438	49	1500	1982	2518	1842	0
42	F8OP	JN26	434	63	1228	1196	2028	2720	0
43	OK2VMD	JN89	428	58	1662	1765	2031	3605	0
44	HB9DFG	JN37	426	65	1367	1471	2028	2987	1450
45	YO2IS	KN05	425	67	1360	1934	2130	2556	0
46	I4YNO	JN54	423	67	1357	1065	2242	2250	0
47	OK1KT	JO70	421	58	1411	1545	1900	2808	0
48	PA4VHF	JO32	416	0	1536	1337	2085	2086	0
49	ES2WX	KO29	415	40	1370	1950	2270	2071	0
50	IW1AZJ	JN35	411	62	1115	1188	2151	2780	0
51	OK1FM	JN69	403	56	1843	1438	2200	2150	0
52	LY2SA	KO14	402	51	1906	1846	2220	2372	0
53	LA0BY/p	JO59	399	45	2050	1661	2198	2676	0
54	YU1PV	JN94	398	65	1319	1650	2137	2440	1982
55	DL1SUZ	JO53	394	47	1238	1661	1963	2309	0
56	HB9Q	JN47	391	66	1404	1288	2060	2959	0
57	OK1JKT/P	JO60	389	52	1701	1764	2121	2269	0
58	F8CS	JN27	387	54	1161	1468	2124	3231	0
59	F6DKW	JN18	383	53	1805	1823	2051	2780	0
60	ON4KHG	JO10	376	54	1507	1936	2247	2348	0
61	YL3AG	KO26	374	39	1552	1912	0	2452	0
62	UT5ER	KN78	370	0	1975	2014	2135	2525	1634
63	DG9YIH	JO32	370	58	0	0	0	0	0
64	S50C	JN76	369	62	1463	1817	2233	3356	1608
65	DG1VL	JO61	368	51	1419	1223	1817	2325	0
66	DL1KDA	JO30	366	59	1388	1924	2101	2339	0
67	SM7JUQ	JO65	365	41	1902	1646	1921	2332	0
68	DL6BF	JO32	363	50	1542	1932	1814	2332	0
69	YT1VV	JN94	361	51	1407	826	1727	2294	1982
70	IK1PAG	JN35	361	57	1186	0	2254	2725	0
71	DJ8ES	JO43	360	46	1815	1721	2103	2318	0
72	DL7YS	JO62	360	53	1512	1528	1826	2136	0
73	PA0WWM	JO22	359	56	1303	1839	1997	2394	0
74	ES2RJ	KO29	358	40	1190	1861	2000	2127	0
75	9A4EW	JN95	358	54	1069	1871	2100	2280	0
76	OE3OKS	JN87	356	59	1441	1273	1867	2788	0
77	YU7VA	KN05	355	61	1316	1399	1954	2446	0
78	SM3BIU	JP73	353	32	1460	1844	2260	2242	7
79	UR5BAE	KN29	351	53	1994	1924	1866	2492	0
80	F1FIH	JN23	350	58	1305	999	1926	2934	0
81	G8VHI	IO92	349	0	0	0	0	0	0
82	YU1WP (sk)	JN94	346	53	1422	1850	2236	2825	1953
83	DK1KR	JO53	345	0	1481	2103	0	2375	0
84	PA2DW	JO22	345	59	1230	1950	2150	2250	0
85	YU7EF	KN05	345	58	1135	987	2248	2440	2373
86	OK2BFH	JN99	340	46	2092	1929	1699	3790	0
87	OZ1IEP	JO65	339	52	1638	1542	2177	2328	0
88	PE1OGF	JO21	338	58	1391	1602	1959	2259	1856
89	G3LQR	JO02	337	0	1776	2031	0	2406	0
90	YT1W	JN94	337	50	1407	826	1727	2294	1982
91	PA0BAT	JO31	336	54	1535	2041	2498	2366	0
92	OK1DKS	JO70	334	56	1230	1308	0	3530	0
93	F5HRY	JN18	331	55	1276	1695	2038	2758	0
94	ON4PS	JO20	323	53	1449	1878	2082	2364	0
95	DL0UL	JN48	322	37	1534	0	2149	3188	0
96	OK1FFD	JO60	322	54	1388	1808	1991	2197	0
97	DB6BX	JO32	321	55	1534	1541	1921	2126	0
98	ON1IM	JO11	320	42	1420	1310	1865	2306	0
99	IK4PMB	JN54	320	61	1150	1442	2181	2446	0
100	OK1MG	JO70	319	50	1522	1685	1549	2631	0
101	ON4KST	JO20	314	54	1435	1612	1940	2383	0
102	PA2TAB	JO32	312	53	1302	1239	2103	2183	0
103	OK1DFC/P	JO60	310	52	1775	2453	2289	2453	0
104	G3LTF	JO02	309	0	2842	1842	2277	3032	1382
105	ES2XM	KO29	308	37	1389	2198	0	2222	0
106	OM7AQ	JN98	307	50	1484	1982	2085	2483	0
107	RW3PF	KO93	306	39	2039	2171	2605	2543	0
108	G4LOH	IO94	304	46	3130	2143	2045	2480	1831
109	ES4EQ	KO39	302	39	1541	1840	2240	2245	0
110	OK1AXH	JO70	300	0	2142	1486	1366	1768	0
111	DF1IAZ	JN49	299	54	1038	1177	2069	1996	0
112	HA8V	KN06	296	43	1062	1807	2062	2162	0
113	LZ1AG	KN22	292	44	915	1868	1779	2901	0
114	YU7KB	JN94	290	43	1072	1704	2137	2367	1634
115	SP2JXN	JO94	289	41	1650	1690	0	2634	0
116	YO4FRJ	KN34	289	49	908	0	0	2215	0
117	DG3XA	JO43	288	42	1371	965	1832	2333	0
118	DK2BJ	JO30	287	49	1476	1934	1593	2231	0
119	YZ7MON	JN95	287	47	1004	816	1976	2315	1536
120	DH0GHU	JN38	284	49	1170	1170	2117	3067	0
121	ES3GZ	KO28	281	35	1495	1720	2134	2101	0
122	ES5WE	KO38	278	32	1406	1695	1934	2530	0
123	CT1HZE	IM57	273	30	2681	0	2190	4079	2049
124	DH8GV	JO33	273	42	1565	1102	1102	2450	0
125	PA0ZM	JO32	268	45	1156	1771	2061	2246	0
126	OK1IBL	JO60	266	50	1438	1462	2003	3398	0
127	YZ1KU	KN04	264	49	1039	1214	1849	2572	1634
128	GM4JJJ	IO86	261	44	3253	1804	1868	2858	0
129	F5HGO	JN05	260	46	1782	781	2104	2486	0
130	G3XDY	JO02	255	42	1693	2049	1835	2135	0
131	RK3AF	KO85	253	35	1244	1870	2202	2605	0
132	YU1GT	KN04	252	42	1650	1410	1310	2160	0
133	ES1RF	KO29	252	30	1184	1820	1978	2084	0
134	DK1VI	JN49	251	50	1270	1215	1604	3165	0
135	DH9NBB	JN49	249	54	1363	1228	1846	2039	0
136	F5DE	JN05	248	45	1891	1671	2456	2399	0
137	DC9YC	JO31	247	44	1548	1724	1849	1822	0
138	OK1VMS	JO70	246	51	1692	1423	0	2587	0

139	F5PAU	IN88	246	46	1630	0	0	2425	0	
140	YU7BCL	KN05	246	49	968	1712	2110	2293	1958	
141	HA8MV	KN06	245	38	1062	1736	2026	2162	0	
142	OK1PG	JO70	243	50	1773	1243	0	3488	0	
143	YU7BCX	KN05	242	42	1017	1172	1965	2425	1868	
144	OK2QI	JO80	238	50	1475	1686	1380	2050	0	
145	OK1KEI	JO70	236	36	1861	1259	1482	2067	0	
146	DL2DR	JO31	231	39	1158	980	0	2057	0	
147	OK1VBN	JN78	225	45	1578	1682	1915	2209	0	
148	DL7QY	JN59	224	50	1422	1619	1679	3250	0	
149	ES5EJ	KO38	218	30	1422	1804	0	2070	0	
150	OK1DDO	JO60	218	46	1329	1500	1720	2418	0	
151	ES0IW	KO19	216	32	1545	1687	0	1861	0	
152	OE5VRL/5	JN78	215	0	1663	1750	1990	2157	0	
153	CT1DYX	IN51	211	0	0	0	0	0	0	
154	DL3YEE	JO42	210	45	1574	1450	1690	2348	0	
155	OK1DIG	JO60	208	42	1420	1684	1840	2218	0	
156	ES0NW	KO19	207	30	1060	1720	1797	1965	0	
157	OK1IAS	JO60	205	41	1392	1957	0	2466	0	
158	DK2DB	JN48	205	0	1239	1136	0	3106	0	
159	OK1SC	JO70	204	0	1490	1673	0	1729	0	
160	YU7ON	KN04	203	37	914	0	1897	2273	1485	
161	OH0NC	JP90	201	26	1544	1982	1647	2493	0	
162	PA0JUS	JO22	200	38	1409	1050	0	2167	0	
163	ES8RO	KO28	199	27	1802	1800	0	1780	0	
164	UA4AQL	LO20	199	23	1124	1994	2158	2195	0	
165	IT9VDQ	JM68	197	45	1676	0	2169	2491	0	
166	ES0SM	KO08	196	31	1578	1767	1991	0	0	
167	F1HDF/P	JN18	194	0	1452	0	0	2425	0	
168	ON4ZN	JO21	194	36	1390	1183	0	2194	0	
169	ES1OX	KO29	194	18	1016	1449	1158	2121	0	
170	PA3AOH	JO31	191	41	1457	1341	1722	2345	0	
171	ES7RDR	KO27	189	31	1200	1750	1000	2101	0	
172	ES0HD	KO18	187	23	1550	1918	0	0	0	
173	HB9MIO/P	JN37	185	0	1316	975	0	2183	0	
174	DG3HS	JO53	184	35	1152	1091	0	2306	0	
175	ES5RY	KO38	183	32	1198	1695	2002	1409	0	
176	DK5WO	JO30	177	35	1474	1219	0	1993	0	
177	SP2IQW	JO94	174	28	1611	1611	997	1877	0	
178	OK1KOK	JO80	173	27	1486	1062	0	1920	0	
179	HB9AOF	JN36	173	45	1201	670	1675	2166	0	
180	OK1VEI	JO70	170	32	1677	1197	1398	0	0	
181	ES1AO	KO29	169	25	1162	1176	1792	2136	0	
182	SP9FG	JN99	167	31	1647	1283	0	1798	0	
183	DL3IAS	JN49	167	43	988	1123	1829	2171	0	
184	OK1KRY	JN69	166	40	1437	977	0	1830	0	
185	ES1JL	KO29	163	17	1379	1596	0	0	0	
186	YU7DP	KN05	162	38	958	1110	1882	2417	1599	
187	OK1CDJ	JO70	159	42	1580	0	2066	2655	0	
188	DL9MCC	JN58	159	36	1248	1414	2063	2095	0	
189	ES1AW	KO29	158	25	1230	1680	0	1924	0	
190	OK1CA	JO70	156	0	1540	1065	950	2096	0	
191	DJ6XV	JO31	156	34	1337	992	0	2007	0	
192	S59GS	JN76	156	33	849	867	974	2168		
193	ES0BI	KO18	154	21	1439	1823	1528	0	0	
194	ES2QN	KO29	152	22	1175	1460	0	2116	0	
195	OZ7IS	JO65	152	38	1128	1294	1901	1845	0	
196	ES6PZ	KO38	151	20	1101	0	0	2532	0	
197	CT1FAK	IN50	149	25	2129	0	2250	2488	968	
198	DK0PX	JN48	147	0	1161	0	1815	1649	0	
199	ES1CW	KO29	142	21	1192	1570	0	2143	0	
200	DL0GTH	JO50	139	23	1124	0	0	0	0	
201	YT1VP	JN94	137	36	1451	1743	2317	2364	0	
202	F1PYR	JN19	137	34	1450	0	0	2113	0	
203	OK2UFB	JN99	136	27	1526	0	0	1983	0	
204	RW4AK (sk)	LO20	136	0	1126	1480	2158	2301	0	
205	ES5QA	KO38	135	35	1665	1788	1555	2236	0	
206	F1CXX	JN18	133	1	1168	914	1985	2112	0	
207	OK1DTG/P	JO70	127	27	1351	1352	0	0	0	
208	YU7AZX	KN04	126	30	914	0	1389	2173	1484	
209	OZ1FF	JO45	125	35	974	1239	1520	2357	0	
210	OV4VW	JO45	124	28	1275	1007	1400	2225	0	
211	F1PYW	JN38	124	30	936	888	1522	1958	0	
212	HB9S/P	JN36	123	24	1135	0	0	0	0	
213	S53J	JN75	123	27	1123	1036	983	1984	0	
214	OK1VDA	JO70	123	30	938	641	0	2220	0	
215	F6FGO	JN25	118	31	1390	0	0	2218	0	
216	OL5Z	JN89	118	26	1061	1621	0	0	0	
217	OK2KJU	JN89	115	32	1318	1766	0	1494	0	
218	DL0SP/P	JO62	115	23	1315	785	0	1608	0	
219	OK2KKW	JO60	115	24	1040	0	0	0	0	
220	OE1SOW	JN88	112	32	0	1286	0	2250	0	
221	4N1NB	KN04	106	30	914	1389	0	2173	0	
222	DL5NEN	JN59	106	30	748	0	1767	1640	0	
223	I3ZVN	JN55	104	37	1212	0	0	2237	0	
224	OK1TEH	JO70	103	30	1191	1474	0	2058	0	
225	OE8GVK/3	JN88	97	21	910	0	0	1982	0	
226	OK2PHM	JN89	97	20	829	1265	0	2262	0	
227	CT1DDW	IN60	95	20	2100	0	0	2500	0	
228	YU1EBC	JN94	94	28	907	0	1427	2179	1766	
229	LA/DL7YS/P	JO37	93	22	1207	0	1673	0	0	
230	DK0FLT	JN59	93	18	975	0	0	0	0	
231	CT1DIN	IN60	91	18	1218	0	0	2338	0	
232	OK1UDX	JN79	91	19	537	0	0	0	2197	
233	DK2MN	JO32	87	19	858	0	0	0	0	
234	CT1CAD	IM67	85	18	1304	0	0	2249	0	
235	YU1AAV	KN04	71	21	828	0	0	2031	0	
236	OK1HRR	JO70	66	16	762	0	0	1890	0	
237	G7LRQ	IO91	60	19	1088	0	0	0	0	
238	OK2DTF	JN79	60	16	805	0	1607	1533	0	
239	SP6MLK/P	JO80	58	16	853	756	0	1446	0	
240	DG7SFL	JN49	57	11	759	0	0	1750	0	
241	OK1VVW	JO70	55	15	913	0	1339	1096	0	
242	YZ1EW	JN94	53	21	811	0	0	2182	0	

432 MHz Toplist (without EME)

NR	Call	WW Loc	Wkd Sqr	DXCC	Tropo	Aurora	MS	(ODX)
1	RA3LE	KO64	261	1	2031	1855	1440	
2	DJ9BV	JO43	219	1	2154	1863	1440	
3	PA0EZ	JO22	211	37	1787	1445	0	
4	PA0RDY	JO22	207	38	1979	1807	1376	
5	G3LQR	JO02	206	0	2031	1613	0	
6	DL7QY	JN59	204	41	1640	1848	1292	
7	PA0WWM	JO22	202	38	1547	1836	0	
8	DB6NT	JO50	199	36	1823	0	0	
9	OZ7IS	JO65	199	33	1663	1048	1294	
10	HA1YA	JN87	192	43	1438	1221	0	
11	DL8QS	JO43	189	35	1513	1513	0	
12	G3XDY	JO02	185	32	1589	1626	0	
13	DL1SUN	JO53	182	32	1663	1757	1480	
14	OK1AXH	JO70	181	0	1861	1239	0	
15	PA3DZL	JO21	181	36	1405	1851	1864	
16	SM7ECM	JO65	178	30	1901	1073	0	
17	OZ1IEP	JO65	177	28	1854	0	1226	
18	DB6BX	JO32	174	34	1550	662	0	
19	DK1KO	JO53	173	31	1861	694	0	
20	F6DKW	JN18	173	24	1605	0	0	
21	DJ6MB	JO30	171	0	1278	1733	0	
22	DK1KR	JO53	170	0	1400	1831	0	
23	LY2WR	KO24	169	26	1995	1593	1935	
24	DL3YEE	JO42	167	35	1574	1728	0	
25	PA2CHR	JO22	165	35	1441	1745	1337	
26	DK6AS	JO52	164	0	1569	775	0	
27	SP6MLK/P	JO80	162	31	1780	0	0	
28	DF8LC	JO53	161	0	1615	1361	0	
29	PA5DD	JO22	157	31	1501	1828	1808	
30	PA4FP	JO33	156	32	2114	1010	0	
31	OZ2OE	JO45	156	27	2216	1020	0	
32	ON4PS	JO20	156	27	1637	721	0	
33	F6APE	IN97	155	28	1810	0	0	

34	SP6GWB	JO80	155	30	1780	759	0
35	SM6ESG	JO67	154	26	1436	712	0
36	OK2BFH	JN99	153	31	1914	0	0
37	YL3AG	KO26	150	20	1571	1041	0
38	OH5LK	KP30	150	0	1496	1196	0
39	PA3AOH	JO31	148	27	1530	573	0
40	DH3NAN	JO50	147	0	1437	1008	0
41	OK1CA	JO70	146	0	1670	0	0
42	G8VHI	IO92	143	23	2966	0	0
43	PA0BAT	JO31	143	29	1535	890	0
44	ES2WX	KO29	140	17	1232	1415	0
45	OK1KEI	JO70	138	27	1682	1185	0
46	OE5VRL/5	JN78	138	1	1663	1031	0
47	OK1VEI	JO70	138	22	1532	811	0
48	SP9FG	JN99	137	26	1660	0	0
49	OH0NC	KP00	136	20	1598	920	0
50	SP9EWU	JO90	135	30	1589	1558	1664
51	OK2KKW	JO60	134	29	1459	0	0
52	OK1KIR/P	JO60	133	28	1773	0	0
53	PA3ECU	JO32	133	31	1407	1721	0
54	PA0JUS	JO22	133	26	1340	0	0
55	DL1SUZ	JO53	132	30	1218	1730	0
56	OK1VMS	JO70	131	32	1434	972	0
57	G3LTF	JO01	131	0	2842	1769	0
58	SM6CMU	JO57	124	23	1640	670	0
59	LY2SA	KO14	123	20	1669	946	0
60	DF4UE	JN48	123	1	1350	0	0
61	PA0ZM	JO32	122	25	1358	1693	0
62	DJ6XV	JO31	122	20	1128	976	0
63	DK0OG	JN68	121	32	1493	901	0
64	ON4ZN	JO21	120	22	1173	0	0
65	F5PAU	IN88	119	24	1630	0	0
66	DK5WO	JO30	119	22	1280	0	0
67	DL0UL	JN48	119	22	1238	0	0
68	LA0BY	JO59	118	16	1837	964	0
69	OZ1FF	JO45	115	23	1398	1138	0
70	OK2QI	JO80	114	25	1410	0	0
71	DL3AMA	JO51	114	22	1015	1219	0
72	DL6BCT	JO43	113	0	1152	0	0
73	SP6GZZ	JO81	112	0	1549	870	0
74	PE1OGF	JO21	112	18	1288	0	0
75	PE1HWO	JO21	109	22	1516	369	0
76	DH9NBB	JN49	109	24	1363	0	0
77	F1HDF/P	JN18	108	0	1204	0	0
78	DL0GTH	JO50	106	20	1113	0	0
79	DL4KG	JO31	105	21	1273	0	0
80	DG3XA	JO43	105	17	1131	0	0
81	ES6RQ	KO37	104	24	1452	1148	0
82	F5HRY	JN18	104	18	1222	583	0
83	OK1DFC/P	JO60	104	22	1179	0	0
84	DJ8ES	JO43	104	16	1160	681	0
85	DL2DR	JO31	104	21	1158	0	0
86	DC4XH	JO43	104	20	1133	808	0
87	OK1AIY/P	JO70	102	0	1490	0	0
88	ON1IM	JO11	102	20	1410	0	0
89	DL1KDA	JO30	102	22	1286	999	1334
90	OK1DKS/P	JO60	102	23	1118	0	0
91	F5HGO	JN05	101	18	1237	0	0
92	ON4GG	JO20	98	23	1407	0	0
93	ON4IQ	JO20	96	23	1407	0	0
94	DH8GV	JO33	95	19	1259	0	0
95	DL6BF	JO32	94	15	882	894	0
96	OK1KRY	JN69	93	23	1350	0	0
97	DK2DB	JN48	93	0	1331	0	0
98	DG1VL	JO61	92	17	1419	0	0
99	ES2XM	KO29	92	11	1271	1259	0
100	S50C	JN76	91	18	977	0	0
101	OK1KPA	JN79	89	0	1176	0	0
102	DK0PX	JN48	89	0	1168	0	0
103	OK1OKL	JO60	88	0	1199	0	0
104	ES2RJ	KO29	87	17	1261	1123	0
105	DK1VI	JN49	87	21	1125	936	0
106	F1PYR	JN19	87	15	1035	0	0
107	IZ5EME	JN52	86	20	1458	1670	374
108	HB9MIO/P	JN37	84	0	1096	0	0
109	HB9AOF	JN36	84	15	926	0	0
110	ES0HD	KO18	83	19	1565	614	0
111	OK1KOK	JO80	81	22	1486	0	0
112	OK1MG	JO70	81	21	1329	691	0
113	DL7YS	JO62	81	18	1100	0	0
114	I4YNO/4	JO54	81	17	897	0	0
115	DL9MCC	JN58	80	20	1338	0	0
116	DF1EQ	JO31	80	0	1249	0	0
117	ES4EQ	KO39	80	16	1160	907	0
118	ES0IW	KO19	79	17	1342	906	0
119	DL5NEN/P	JN59	76	16	964	0	0
120	OM7AQ	JN98	76	17	922	1503	0
121	DH3YAK	JO31	75	13	1165	0	0
122	F6HTJ	JN12	75	8	1238	0	0
123	OK1FFD	JO60	74	23	1339	0	0
124	G0RRJ	IO91	74	18	1174	1388	0
125	DG6GP	JN48	74	13	1024	0	0
126	DF5JJ	JO43	74	13	680	1437	1511
127	OK1KRQ/P	JN69	73	16	1091	0	0
128	OK1SC	JO70	71	0	1310	758	0
129	OK2PWY	JN89	70	17	1135	0	0
130	OL5Z	JN89	70	15	761	0	0
131	DK2MN	JO32	70	13	715	0	0
132	DL0SP/P	JO62	69	13	1018	0	0
133	YO4FRJ	KN34	69	26	746	0	0
134	OK1DTG/P	JO70	68	14	1436	0	0
135	OZ4VW	JO45	66	16	1245	0	0
136	DD0VF	JO60	66	18	1106	0	0
137	RW3PF	KO93	66	15	678	1875	0
138	SM7JUQ	JO65	65	15	1232	0	0
139	UR5BAE	KN29	64	18	1517	0	0
140	HB9CRQ	JN47	63	16	1010	0	0
141	DL3IAS	JN49	63	12	886	0	0
142	ES5WE	KO38	62	11	1406	0	0
143	SK6HD	JO68	62	0	811	0	0
144	F5DE	JN05	62	10	752	0	0
145	DG7SFL	JN49	61	10	947	0	0
146	F6FGO	JN25	60	11	1016	0	0
147	ES0NW	KO29	59	17	1213	675	0
148	ES0SM	KO08	59	20	1202	925	0
149	DK2BJ	JO30	59	16	1053	0	0
150	OK2UFB	JN99	56	20	1232	0	0
151	DH0GHU	JN38	56	12	852	0	0
152	HA8MV	KN06	56	15	831	1500	0
153	OK1VBN	JN78	56	14	723	753	0
154	YO2IS	KN05	55	15	1020	1741	1030
155	LA/DB1DI/P	JO37	55	12	1013	0	0
156	OK1PG	JO70	54	18	1773	0	0
157	ES3GZ	KO28	52	10	1035	0	0
158	RB5EF	KN78	50	0	1805	0	0
159	SP2JXN	JO94	49	15	1149	0	0
160	OK1TEH	JO70	49	15	912	0	0
161	S53J	JN75	49	9	688	0	0
162	ES1JL	KO29	48	11	1324	0	0
163	DK0FLT	JN49	48	14	695	0	0
164	I3ZVN	JN55	47	14	1197	0	0
165	ES1RF	KO29	47	10	875	682	0
166	F5OIH/P	JN08	46	5	651	0	0
167	DL5NEN	JN59	46	13	630	0	0
168	SM3BIU	JP73	45	3	917	763	0
169	GM4JJJ	IO86	44	15	1457	297	0
170	OE1PLW	JN88	42	12	1114	0	0
171	OK2KJU	JN89	42	13	731	0	0
172	OK1KT	JO70	40	7	1289	757	0
173	OK1HRR	JO70	40	13	765	0	0
174	OK2PHM	JN89	39	9	746	0	0
175	G7LRQ	IO91	37	15	1208	0	0
176	CT1HZE	IM57	36	8	2674	0	0
177	OK2VMU/P	JN99	36	11	880	0	0

1296 MHz Toplist

NR	Call	WW	Wkd	DXCC	ODX
1	PA0EZ	JO22	152	25	1461
2	DB6NT	JO50	144	27	1283
3	G3XDY	JO02	140	25	1561
4	F6DKW	JN18	136	23	1605
5	SM7ECM	JO65	136	23	1541
6	PA0WWM	JO22	136	24	1298
7	PA0RDY	JO22	124	27	1286
8	OK1AXH	JO70	118	1	1444
9	G3LQR	JO02	118	1	1274
10	HB9AMH/P	JN37	114	1	1351
11	DL3YEE	JO42	112	19	1136
12	PA0BAT	JO31	108	22	1368
13	DK1KR	JO53	108	1	1121
14	F5HRY	JN18	105	16	1575
15	F1PYR/p	JN19	105	17	1523
16	OE5VRL/5	JN78	104	23	1524
17	DL1SUN	JO53	103	18	1368
18	PA5DD	JO22	102	18	1302
19	SP6GWB	JO80	101	24	1580
20	SM6ESG	JO67	101	19	1445
21	G4EAT	JO01	100	20	1394
22	DK3WG	JO72	100	24	1289
23	DB6BX	JO32	99	25	1125
24	OZ1FF	JO45	98	19	1245
25	OZ3ZW	JO54	98	17	1195
26	F6APE	IN97	97	14	1540
27	OZ2OE	JO45	96	17	1425
28	DL7QY	JN59	95	20	1261
29	DF9IC	JN48	95	19	1235
30	OZ7IS	JO65	95	19	1205
31	G4RGK	IO91	94	21	1378
32	PA3DZL	JO21	94	21	1254
33	SM0DFP	JO89	93	14	1558
34	SP6MLK/P	JO80	92	23	1580
35	OK1KIR/P	JO60	92	22	1208
36	OK2BFH	JN99	91	20	1713
37	G3UVR	IO93	91	19	1545
38	F5PAU	IN88	89	19	1630
39	G6DER	IO93	89	20	1306
40	PA5AO	JO31	88	21	1376
41	OK1DFC/P	JO60	86	17	1177
42	PA4FP	JO33	86	17	957
43	G3LTF	JO01	85	1	1417
44	DL1SUZ	JO53	85	16	1041
45	OK1VEI	JO70	83	14	1313
46	DK0OG	JN68	83	19	1161
47	DK6AS	JO52	81	17	1421
48	OK1KEI	JO70	81	16	1316
49	OZ1IPU	JO57	81	16	1096
50	F1HDF/P	JN18	80	9	886
51	PA2CHR	JO22	77	19	1348
52	HB9AOF	JN36	77	15	975
53	DL6NAQ	JO40	76	20	1252
54	OZ2LD	JO54	75	17	1220
55	DL0UL	JN48	75	17	962
56	DC9YC	JO31	74	16	1046
57	DL1BKK	JO43	74	16	995
58	OK1AIY/P	JO70	73	1	1490
59	OK1VMS	JO70	73	19	1302
60	DK5WO	JO30	73	16	1137
61	G4DDK	JO02	73	16	1005
62	PA0JUS	JO22	72	16	1265
63	HB9MIO/P	JN37	72	1	1000
64	DH3NAN	JO50	71	1	1143
65	ON7YK	JO20	71	16	1111
66	DH9NBB	JN49	71	13	1016
67	OK1CA	JO70	70	1	1421
68	OK2KKW	JO60	70	19	1128
69	PA0ZM (sk)	JO32	69	16	1329
70	DL2DR	JO31	69	13	1251
71	DK9TF	JO31	69	14	1029
72	S51ZO	JN86	69	19	989
73	DL2DR	JO31	68	13	1158
74	DL8BDU	JO43	68	15	905
75	G8VHI	IO92	67	14	1240
76	DC4XH	JO43	67	14	1090
77	DL0GTH	JO50	67	16	1073
78	DJ8ES	JO43	67	10	1025
79	DL4OL	JO52	67	16	995
80	DF1EQ	JO31	67	1	908
81	ON4PS	JO20	65	14	1098
82	RA3LE	KO64	64	1	1618
83	OK1OKL	JO60	63	1	1177
84	DH9NBB	JN49	63	13	1016
85	DJ6XV	JO31	63	11	946
86	DF5JJ	JO43	63	13	897
87	SP9FG	JN99	62	19	1492
88	OK1DKS/P	JO60	62	13	1207
89	DK2MN	JO32	62	12	933
90	G4BRK	IO91	61	14	1194
91	DK5WO	JO30	61	15	1079
92	G0RRJ	IO91	60	15	1174
93	OK1FFD	JO60	60	14	1058
94	ON4GG	JO20	60	10	982
95	OH0NC	KP00	57	13	1592
96	DK3RV	JO31	57	14	1252
97	DL3IAS	JN49	57	13	1097
98	ON4ANT	JO20	57	9	914
99	DC8UG	JO30	56	10	900
100	DG5NEX	JN49	55	11	1061
101	DC0DA	JO31	55	1	1034
102	F6HTJ	JN12	54	6	1186
103	DJ1KP	JO40	54	15	766
104	LY2WR	KO24	53	14	1026
105	PE1HWO	JO21	52	14	1315
106	G1HWY	IO90	51	13	1188
107	DL7APV	JO62	51	12	1112
108	DL3NQ	JN49	51	10	920
109	DK0FLT	JN59	51	12	684
110	DL1KDA	JO30	50	12	940
111	DK3FB	JO31	50	13	922
112	DF1EQ	JO31	50	11	887
113	SP9EWU	JO90	48	12	946
114	DK0PX	JN48	47	1	942
115	F6CGB	JN18	46	1	700
116	DL4EAU/p	JO51	45	10	882
117	ES6RQ	KO37	45	21	600
118	HA1YA	JN87	44	14	862
119	DK2DB	JN48	43	1	873
120	S50C	JN76	43	12	626
121	IZ5EME	JN52	42	10	1036
122	YL3AG	KO26	42	11	867
123	DJ6MB	JO30	42	1	876
124	F5HGO	JN05	42	5	796
125	DL3NI	JO31	41	12	798
126	OK1KEI/P	JN79	41	10	740
127	ES2RJ	KO29	40	9	765
128	OH5LK	KP30	39	1	1496
129	DG0CAL	JO52	39	9	1160
130	OK1KRQ/P	JN69	39	11	962
131	LA/DB1DI/P	JO37	38	9	1013
132	DG1VL	JO61	38	9	923
133	DK2BJ	JO30	38	10	886
134	LA0BY/p	JO59	37	8	1235
135	ON4KHG	JO10	37	6	642
136	I0LVA/0	JN62	35	1	1152
137	G7LRQ	IO91	35	10	746
138	ES2WX	KO29	35	9	692
139	DG9NCL	JO50	35	11	630
140	HA8V	KN06	34	11	670
141	OK1VEI	JN79	34	8	561
142	DG6GP	JN48	33	7	732
143	DH3YAK	JO31	33	5	715
144	ES4EQ	KO39	33	9	636
145	I3ZVN	JN55	32	10	1197
146	I4YNO/4	JN54	30	9	754
147	DK1VI	JN49	30	10	717
148	DL7YS	JO62	29	7	535
149	ES5WE	KO38	29	7	1249
150	IW3FZQ/4	JN54	27	7	732
151	F1CXX	JN18	27	1	711
152	DL1EJA	JO31	27	6	551
153	ES0SM	KO08	26	8	873
154	F6FGO	JN25	26	5	839
155	SP3JBI	JO91	25	6	752
156	OK1DTG/P	JO70	24	8	742
157	F5DE	JN05	24	3	538
158	OK2QI	JO80	23	7	1275
159	F1FIH	JN23	23	6	605
160	OK1VBN	JN78	22	9	950
161	G4LDR	IO91	22	5	593
162	HA8MV	KN06	22	9	576
163	OK1PG	JO70	21	9	985
164	PE1OGF	JO21	21	6	588
165	OK2BFF/P	JO80	21	8	536
166	ON1IM	JO11	20	5	650
167	OK2VMU/P	JN99	20	7	570
168	DL0SP/P	JO62	20	5	430
169	OK1KRY	JN69	19	7	865
170	IW3HTU	JN55	19	4	838
171	OK1KPA	JN79	19	1	783
172	DG3YEV	JO31	19	5	616
173	OK2BBF	JN89	19	8	563
174	OL5Z	JN89	18	6	694
175	OZ4VW	JO45	18	6	676
176	DL8EBW	JO31	18	1	453
177	F5OIH/P	JN08	17	5	517
178	S53J	JN75	16	6	410
179	DL5NEN	JN59	16	16	320
180	ES1RF	KO29	15	5	506
181	DG7SFL	JN49	15	3	358
182	OK1TEH	JO70	15	4	343
183	CT1HZE	IM57	14	5	1953
184	DF8PR	JO40	14	4	561
185	ES1AJ	KO29	14	5	531
186	ES2XM	KO29	14	5	478
187	DF0RU	JO62	14	3	373
188	ES2WR	KO29	13	5	694
189	ES0Z	KO18	13	5	453
190	YO4FRJ	KN34	13	4	382
191	SM7JUQ	JO65	12	7	1061
192	ES1NJ	KO29	12	4	507
193	OM7AQ	JN98	12	5	426
194	ES1MW	KO29	11	4	507
195	ES0W	KO18	11	5	443
196	OK1SC	JO70	10	1	440
197	OK2PWY	JN89	10	6	357
198	OK2KJU	JN89	10	6	347
199	OK2PHM	JN89	10	1	341
200	IT9VDQ	JN68	9	1	899
201	ES1OX	KO29	9	5	772
202	ES1DW	KO29	9	5	330
203	DG3XA/P	JO43	8	4	664
204	YO2IS	KN05	8	5	472
205	OK1HRR	JO70	8	2	292
206	DL3AMA	JO51	8	3	162
207	ES1TCA	KO29	7	2	246
208	ES2NA	KO29	6	4	349
209	OK1ZVP	JO60	6	1	263
210	ES0NW	KO19	5	2	190
211	ES1AW	KO29	3	2	269
212	OK2UFB	JN89	3	2	142
213	ES1WQ	KO29	2	2	337

2320 MHz Toplist

Nr	Call	Loc	Sqr	Dxcc	ODX Tropo/RS
1	DB6NT	JO50	90	15	1119
2	PA0EZ	JO22	89	15	1236
3	PA0WWM	JO22	74	16	1155
4	G3XDY	JO02	72	14	1325/470
5	SM7ECM	JO65	67	14	1073
6	OE5VRL/5	JN78	66	17	1438/682
7	F1PYR	JN19	65	13	1523/635
8	PA0RDY	JO22	65	15	1000
9	PA0BAT	JO31	62	14	1013/682
10	G3LQR	JO02	58	1	1006
11	DL1SUN	JO53	58	10	943/609
12	F5HRY	JN18	57	9	1555
13	PA5DD	JO22	56	12	1155/397
14	DF9IC	JN48	56	11	1145
15	SM6ESG	JO67	56	8	1085
16	OZ1FF	JO55	54	11	863
17	OK1KIR/P	JO60	51	10	1115
18	F6APE	IN97	50	5	1027
19	DL7QY	JN59	50	12	1018
20	OK1AIY/P	JO70	47	1	1296
21	DL7YC	JO62	47	11	1125
22	DL3YEE	JO42	47	14	993/584
23	F6DWG/P	JN19	46	10	1507
24	G6DER	IO93	46	18	1265
25	G4EAT	JO01	46	11	1238
26	DL6NAQ	JO50	44	11	860
27	PA4FP	JO33	44	12	727
28	DL0GTH	JO50	42	7	1052
29	DL1BKK	JO43	42	10	760
30	DJ1KP	JO40	41	13	766
31	G0RRJ	IO91	40	11	1174
32	DK2MN	JO32	40	10	734
33	DL0UL/P	JN48	36	11	961
34	PA3DZL	JO21	36	11	928
35	OZ2OE	JO45	36	8	914
36	DK1KR	JO53	36	8	864
37	G4BRK	IO91	35	10	1194
38	DC8UG	JO30	35	8	900
39	DL1SUZ	JO53	35	8	747
40	DF1EQ	JO31	34	6	889
41	OK1OKL	JO60	34	1	830
42	G3LTF	JO01	33	1	1170
43	DK0OG	JN68	33	8	721
44	SM0DFP	JO89	32	6	1249
45	HB9MIO/P	JN37	32	1	744
46	OZ7IS	JO65	31	9	860
47	DC0DA	JO31	31	1	775
48	DC9YC	JO31	30	10	858
49	DL3NQ	JN49	29	8	890
50	DL3YEE	JO42	29	10	520
51	G4FUF	JO01	28	11	1052
52	DJ8ES	JO43	28	7	1025
53	G4DDK	JO02	28	8	1005
54	DL2DR	JO31	28	7	823
55	DH9NBB	JN49	27	7	654
56	DL4OL	JO52	27	5	433
57	DK0PX	JN48	26	1	853
58	DL4EAU/p	JO51	26	7	845
59	I0LVA/0	JN62	25	1	612
60	S51ZO	JN86	25	11	594/242
61	OK2BFH	JN99	24	9	1026
62	DL3IAS	JN49	24	6	604
63	G4RGK	IO91	23	6	1095
64	DK2DB	JN48	23	1	873
65	PA5AO	JO31	23	7	785
66	OK1KEI/P	JN79	23	7	740
67	SP6GWB	JO80	23	5	650
68	DL8BDU	JO43	22	5	635
69	OK1DKS/P	JO60	22	4	602
70	DL3NI	JO31	21	5	788
71	I3ZVN	JN55	21	7	785
72	OK1VEI	JN79	21	6	447
73	F1HDF/P	JN18	20	3	621
74	OK1DFC/P	JO60	20	6	549
75	G4HUP	JO02	19	6	950
76	ON4PS	JO20	19	6	574
77	DJ6XV	JO31	19	3	396
78	HB9AMH/P	JN37	18	1	933
79	LA/DB1DI/P	JO37	17	7	825
80	S51WI	JN75	17	5	533
81	OK1AIY/P	JO70	16	1	768
82	DG5NEX	JN49	16	4	455
83	F6HTJ	JN02	15	1	1186
84	DM2AFM	JO61	15	4	612
85	HA1YA	JN87	15	5	476
86	DF6VB	JO31	15	4	415
87	OK1KRQ/P	JN69	15	4	350
88	DK6AS	JO52	14	4	620
89	PA0JUS	JO22	13	5	800
90	SP9FG	JN99	13	5	747
91	OK2BFF/P	JO80	13	6	418
92	IW3HTU	JN55	11	2	542
93	F5NXU	IN97	11	1	522
94	IZ5EME	JN52	10	3	552
95	G4LDR	IO91	10	2	444
96	IW3FZQ/4	JN54	10	3	403
97	OK1KEI	JO70	9	4	786
98	OK2VMU/P	JN99	9	4	376
99	S50C	JN76	8	5	346
100	SP6MLK/P	JO80	8	3	272
101	F6CGB	JN18	8	1	407
102	OK1CA	JO70	8	1	291
103	F1FIH	JN23	8	1	239
104	DB1BX	JO32	7	3	422
105	OM7AQ	JN98	7	4	412
106	DG6GP	JN48	7	2	388
107	DG1VL/P	JO61	7	2	262
108	OK1PG	JO70	6	4	855
109	OV4VW	JO45	6	2	548
110	DL7APV	JO62	5	4	529
111	OK1KRY	JN69	5	3	189
112	OK2QI	JO80	4	2	305
113	OL5Z	JN89	4	3	158
114	F5PAU	IN88	4	1	260
115	OK1VBN	JN78	3	3	158
116	DL1KDA	JO30	3	2	98
117	G8BKE/P	IO80	1	1	114

3400 MHz Toplist

1	DB6NT	JO50	46	11	986
2	G3XDY	JO02	36	12	980/213
3	PA0EZ	JO22	32	8	835
4	PA5DD	JO22	30	9	867/645
5	PA0BAT	JO31	29	6	738/729
6	PA0WWM	JO22	28	6	850/660
7	DL1SUN	JO53	28	5	697/609
8	DL6NAQ	JO40	25	4	8600
9	G3LQR	JO02	23	1	924
10	DL6NCI	JO50	23	6	567/521
11	DL4EAU/p	JO51	22	4	845/420
12	DL3YEE	JO42	22	5	705/488
13	DL7QY	JN59	21	4	565
14	PA0RDY	JO22	19	4	643
15	DK2MN	JO32	19	3	501
16	G4BRK	IO91	17	4	828
17	DC0DA	JO31	17	1	660
18	G6DER	IO93	16	7	859
19	PA4FP	JO33	16	5	733
20	DL1SUZ	JO53	15	6	724
21	DL1BKK	JO43	15	3	703
22	DL3NQ	JN49	15	5	641
23	DF1EQ	JO31	14	3	532
24	DK0OG	JN68	14	3	476
25	DC8UG	JO30	13	6	724
26	DL2DR	JO31	13	3	470
27	G0RRJ	IO91	13	3	442
28	HB9MIO/P	JN37	12	1	463
29	S51ZO	JN86	11	5	530/521
30	DK2DB	JN48	11	1	331
31	DL3IAS	JN49	10	2	414
32	DK0PX	JN48	9	1	632
33	DL0UL	JN48	9	1	239
34	DM2AFN	JO61	8	2	662
35	DJ8ES	JO43	8	4	578
36	OK1VEI	JN79	8	3	309
37	DL0GTH	JO50	7	2	466
38	DB1BX	JO32	7	3	438
39	DJ6XV	JO31	7	3	396
40	DG1VL/P	JO61	7	2	320
41	OZ2OE	JO45	6	4	772
42	G4ALY	IO70	6	3	415
43	OK1KEI/P	JN79	6	2	306
44	OZ8AFC	JO45	5	3	720
45	S51WI	JN75	3	1	98
46	OK1DFC	JO60	2	2	59
47	G8BKE/P	IO80	1	1	114
48	OZ4VW	JO45	1	1	20
49	SP6GWB	JO80	1	2	1
49	SP6MLK/P	JO80	1	2	1

5760 MHz Toplist

1	F1PYR/P	JN19	70	12	1174/695
2	DB6NT	JO50	69	16	1091/570
3	F6DWG/p	JN19	63	11	1151/668
4	F5HRY	JN18	62	10	1204/563
5	SM7ECM	JO65	57	13	1043/647
6	OE5VRL/5	JN78	56	14	1438/683
7	PA0EZ	JO22	55	9	1026
8	G3XDY	JO02	54	14	1240/759
9	HB9AMH/P	JN37	51	13	929/655
10	F1HDF/P	JN18	49	9	672
11	PA0BAT	JO31	45	13	884/729
12	F6APE	IN97	44	8	1390
13	PA5DD	JO22	43	10	867/599
14	DL1SUN	JO53	38	8	789/609
15	SM6ESG	JO67	37	7	1390
16	DL6NCI	JO50	37	10	817/521
17	PA0WWM	JO22	36	9	863/589
18	DL3YEE	JO42	35	10	993/604
19	HB9MIO/P	JN37	34	1	694
20	F1GHB/P	IN88	29	5	779
21	G0RRJ	IO91	26	7	775/460
22	G4BRK	IO91	25	6	1083
23	DL7QY	JN59	24	6	820/587
24	G3LQR	JO02	23	1	949
25	I3ZVN	JN55	23	78	573/468
26	SM0DFP	JO89	22	8	1249
27	OK1AIY/P	JO70	22	1	768
28	DK2MN	JO32	22	5	705
29	F6DRO	JN03	20	3	904
30	DL1SUZ	JO53	19	6	813/517
31	DL1BKK	JO43	18	8	689
32	DK0OG	JN68	18	4	476
33	OK1KEI/P	JN79	18	7	466
34	SP6GWB	JO80	17	5	1024
35	OK1KIR/P	JO60	17	3	393
36	OK1UWA/P	JO70	16	1	998
37	S51JN/P	JN65	16	5	557
38	S51WI	JN75	15	4	586
39	HA1YA	JN87	15	6	461

40	DL3IAS	JN49	15	5	458
41	G6DER	IO93	14	8	947
42	DL0UL	JN48	14	5	660
43	I0LVA/0	JN62	14	1	557
44	G4LDR	IO91	13	4	444
45	PA4FP	JO33	12	4	733
46	DC0DA	JO31	12	1	660
47	OZ7IS	JO65	12	4	593
48	IW3HTU	JN55	12	3	542
49	DM2AFN	JO61	12	6	524
50	DL3NQ	JN49	12	4	383
51	DK2DB	JN48	12	1	315
52	OK2BFH	JN99	11	5	756
53	DC8UG	JO30	11	5	724
54	DJ8ES	JO43	10	6	578/431
55	DG1VL/P	JO61	10	4	525
56	DL2DR	JO31	10	3	224
57	OK1OKL	JO60	9	1	611
58	DK0PX	JN48	9	1	409
59	S57EA	JN76	9	5	316/397
60	IW3FZQ/4	JN54	9	4	291
61	DJ6XV	JO31	9	2	176
62	LA/DB1DI/P	JO37	7	5	746
63	DL0GTH	JO50	7	2	674
64	F6CGB	JN18	7	1	407
65	SP6MLK/P	JO80	6	4	339
66	OK1DKS/P	JO60	6	1	318
67	DC8EC/P	JN57	6	1	278
68	OE5BKL/5	JN78	6	3	270
69	OZ2OE	JO45	5	5	679
70	DF1EQ	JO31	5	3	461
71	DB1BX	JO32	5	2	150
72	OK2VMU/P	JN99	4	2	376
73	OK1KRY	JN69	3	2	175
74	S50C	JN76	3	1	126
75	ES2WX	KO29	2	2	89
76	F6CGB/P	JN24	2	1	375
77	G8BKE/P	IO80	2	1	242
78	OK2QI	JO80	2	1	108
79	OK1KRQ/P	JN69	1	1	96
80	OK1SC	JO70	1	1	10

10368 MHz Toplist

1	F6DKW	JN18	104	18	1452/933
2	DB6NT	JO50	88	20	1083/670
3	OE5VRL/5	JN78	83	19	1249/786
4	F5HRY	JN18	83	13	1055/917
5	PA0EZ	JO22	83	14	1026
6	OK1JKT/P	JO60	82	17	1073/889
7	F1PYR/p	JN19	82	15	1060/811
8	SM7ECM	JO65	78	12	1110/711
9	HB9AMH/P	JN37	78	16	998/790
10	F6DWG/p	JN19	76	12	902/826
11	PA0BAT	JO31	73	14	884/729
12	PA0WWM	JO22	73	14	850/811
13	DL6NCI	JO50	72	17	817/959
14	DK1KR	JO53	70	13	860/868
15	G4EAT	JO01	69	15	1233/922
16	DM2AFN	JO61	69	18	923
17	F1HDF/P	JN18	69	11	867
18	G3XDY	JO02	68	14	1240/881
19	I6XCK/6	JN63	68	14	702/918
20	PA5DD	JO22	63	13	867/681
21	OZ1FF	JO45	62	13	1089/861
22	DK8ZP	JO40	62	16	777
23	DJ1KP	JO40	61	15	835
24	DF2CK	JO71	60	15	479/881
25	DL1SUN	JO53	58	9	789/711
26	G4BRK	IO91	56	13	1115
27	DL3YEE	JO42	56	13	993/700
28	DG1KJG	JO30	56	12	659/644
29	G3WDG	IO92	55	1	1135
30	DL4EAU/P	JO51	55	13	827/480
31	G4KGC	IO92	53	1	1135
32	DF5JJ	JO43	53	11	611/761
32	G3LQR	JO02	52	1	1006
33	I6CXB/6	JN63	52	1	751
35	PA5AO	JO31	52	9	724/721
36	DL4WO	JO60	50	15	797
37	DL7QY	JN59	50	14	580/705
38	S51ZO	JN86	50	13	538/691
39	OK1VAM/P	JO60	50	15	404/830
40	IW6CVN/6	JN63	48	14	836/824
41	DG1VL/P	JO61	48	11	400/807
42	G4DDK	JO02	47	12	1005/654
43	I4XCC	JN63	46	12	729/870
44	DK0OG	JN68	46	13	563/761
45	DL3IAS	JN49	45	11	690
46	HB9MIN/P	JN37	45	1	939
47	OK1AIY/P	JO70	45	1	848
48	SP6GWB	JO80	45	10	829/753
49	SM6ESG	JO67	44	7	1275
50	OK1DIG	JO60	44	12	551/689
51	DJ5BV	JO31	44	12	684
52	DL3NQ	JN49	43	9	715
53	DK2MN	JO32	43	12	705/603
54	DL1SUZ	JO53	41	8	849/572
55	DC8EC	JN57	41	12	661
56	HB9MIO/P	JN37	40	1	744
57	DK0FLT	JN59	39	10	683
58	S51JN/P	JN65	39	14	637
59	I0LVA/0	JN62	37	8	850
60	LX1DU	JN29	37	1	700
61	DL0UL	JN48	37	8	658
62	OK1KEI/P	JN79	37	10	639
63	S50C	JN76	37	10	626/626
64	HA1YA	JN87	36	7	794
65	F1GHB/P	IN88	36	6	669
66	DH9NBB	JN49	36	9	654
67	SM0DFP	JO89	35	8	1249/536
68	SP6MLK/P	JO80	35	11	1067/352
69	G0RRJ	IO91	35	9	770/593
70	SP3JBI	JO91	35	8	520/668
71	G3GNR	IO70	34	1	1275
72	HB9RG	JN47	34	1	761
73	F6DRO	JN03	33	6	904/668
74	OK2BFH	JN99	33	7	769/669
75	G4LDR	IO91	32	9	1118
76	DL6NAQ/P	JO40	32	8	656
77	DC9YC	JO31	32	9	599
78	G4DDK	JO02	31	1	901
79	DJ8ES	JO43	31	7	798/575
80	DL1BKK	JO43	30	9	844
81	OK1DFC/P	JO60	30	7	668
82	I3ZVN	JN55	30	12	573/559
83	DL0GTH	JO50	30	7	240
84	EA6/DF5JJ	JM19	29	7	1090
85	OZ1IPU	JO57	28	7	941
86	G3LTF	JO01	28	1	902/775
87	IW6AEG/6	JN63	29	1	751
88	OK1KIR/P	JO60	28	6	658
89	OK1OKL	JO60	27	1	795
90	F6CGB	JN18	27	1	677
91	OZ2OE	JO45	26	6	789
92	DL2DR	JO31	26	7	603/402
93	ON4KHG	JO10	26	6	565/496
94	PA4FP	JO33	25	8	865
95	OK1VAM	JN79	25	6	630
96	DK0PX	JN48	25	1	567
97	S51WI	JN75	24	6	586/343
98	DK4GD/P	JN48	24	1	566
99	ON7WR	JO20	23	9	756
100	G8DKK	IO91	23	8	577/522
101	OK1DST	JN79	23	7	402
102	OK2KKW	JO60	22	4	416/336
103	DC0DA	JO31	22	1	816
104	DL1CF	JO42	22	6	0
105	DJ5VW	JO31	21	5	474
106	DK2DB	JN48	21	1	453
107	DC8UG	JO30	20	6	753
108	DB1BX	JO32	20	7	705
109	DL4VCG	JN39	20	1	533
110	PA2DW	JO22	19	6	700
111	DF9QX	JO42	19	1	504
112	LA/DB1DI/P	JO37	18	6	825
113	S57EA	JN76	18	8	361/626
114	DL5NEN/P	JN49	18	6	466
115	F6HTJ/p	JN12	17	1	1175
116	ON7YK	JO20	17	5	489
117	DJ6XV	JO31	17	3	285
118	EA3XU/p	JN11	16	7	1344
119	OK2PWY	JO80	16	5	558/594
120	IW3FZQ/4	JN54	16	5	557
121	F5PAU	IN88	16	2	430
122	OK1KRQ/P	JN69	16	3	325
123	OV1VEI	JN79	16	5	309
124	SP6BTV	JO80	15	5	1064/319
125	HB9AMH	JN37	15	1	567
126	OK1UWA/P	JO70	15	1	434
127	F6CGB/P	JN12	14	1	1191
128	IW5ADB	JN53	14	1	1053
129	OZ1FF	JO45	14	7	740
130	G4PMK	IO93	14	1	958
131	IW3HTU	JN55	14	4	542
132	SP9FG	JN99	13	5	611/518
133	OZ1DOQ	JO65	13	5	472
134	SP6RYL	JO80	12	5	1064/319
135	DF1IAZ	JN49	12	2	515
136	GW4LXO	IO81	12	1	309
137	OH0NC	KP00	12	4	269
138	G4KNZ	IO91	12	1	247
139	OK1DKS/P	JO60	11	2	616
140	G4LRT	IO92	8	1	824
141	IW3QCV	JN65	8	2	532
142	DL1KDA	JO30	8	4	477
143	F5HRY/P	JN08	8	2	491
144	DG5NEX	JN49	7	2	426
145	DF6VB	JO31	7	2	336
146	DJ4YJ/p	JN57	7	2	293
147	DF1EQ	JO31	7	1	283
148	DF1EQ/P	JO31	7	1	283
149	DG0CAL/p	JO52	7	1	255
150	DL1JIN/p	JO60	6	3	345
151	ES0SM	KO08	5	2	384
152	LA8AK (sk)	JO38	5	1	212
153	OK2QI	JO80	4	1	303
154	G8BKE/P	IO80	4	1	242
155	F5OIH/P	JN08	4	1	149
156	OK2VMU/P	JN99	3	2	376
157	PA0JUS	JO22	3	2	245
158	DH3NAN	JO50	3	1	134
159	OZ4VW	JO45	3	1	52
160	LA0BY	JO59	2	1	276
161	OK1KRY	JN69	1	1	78
162	SM4SJY	JP70	1	1	160
163	GM0ICF	IO75	1	1	53
164	DL0SP/P	JO62	1	1	28

24 GHz Toplist

1	HB9AMH/P	JN37	16	3	454/74
2	DB6NT	JO50	16	7	368/411
3	DL6NCI	JO50	16	4	280/280
4	OE5VRL/5	JN78	14	5	317/293
5	PA0BAT	JO31	13	3	195

6	DJ1KP	JO40	11	4	375
7	G4EAT	JO01	11	3	348
8	F1PYR/P	JN19	10	2	422
9	F6DKW	JN18	10	3	412
10	PA0EZ	JO22	10	4	391
11	DC8EC/P	JN57	10	4	304
12	HB9MIO/P	JN37	10	2	172
13	F6DWG/p	JN19	9	4	454/68
14	IW3EHQ/P	JN66	8	1	461
15	I0LVA/0	JN62	8	3	444
16	SM6AFV	JO67	8	2	357/129
17	OZ1FF	JO45	8	3	357
18	DL7QY	JN59	8	3	317
19	OK1AIY/P	JO70	8	2	281
20	PA5DD	JO22	8	3	204
21	I3ZVN	JN55	8	2	300
22	DC0DA/P	JO41	8	1	132
23	DK8ZP	JO40	7	3	375
24	S51JN/P	JN65	7	3	293
25	G4DDK	JO02	7	3	268/112
26	SM6ESG	JO67	7	3	242
27	EA6/DF5JJ	JM19	7	2	226
28	DL3YEE/P	JO42	7	2	197/98
29	DK0OG	JN68	7	2	193
30	DL3NQ	JN49	6	3	287
31	IW3FZQ/4	JN54	6	3	250
32	SM7ECM	JO65	6	3	226/168
33	PA0WWM	JO22	6	4	210/210
34	DK2MN	JO32	6	2	177
34	PA5AO	JO31	6	2	166
35	OK2BFF/p	JO80	6	2	160
36	F5HRY	JN18	6	1	164
38	DH9YAU/p	JO41	6	1	132
39	SP6MLK/P	JO80	5	4	356
40	IW3HTU	JN55	5	2	300
41	SP6BTV	JO80	5	2	272
42	OZ8AFC	JO45	5	1	265
43	G3LQR	JO02	5	1	261
44	F1HDF/P	JN18	5	1	230
45	OK1KIR/P	JO60	5	2	227
46	OK1UEI	JO70	5	2	186
47	DL4WO/p	JO61	5	2	184
48	OK1OKL	JO60	5	1	185
49	DM2AFN	JO61	5	3	177
50	OK1JKT	JO60	5	2	167/63
51	DF2CA/p	JN58	5	1	143
52	G4BRK	IO91	5	2	112
53	SP6RYL	JO80	4	2	272
54	DJ4YJ/p	JN57	4	1	243
55	OK1UWA/P	JO70	4	1	188
56	OK1DFC/P	JO60	4	2	185
57	DK0PX	JN48	4	1	168
58	F1GHB/P	IN88	4	1	158
59	G3GNR	IO70	4	1	154
60	DF6VB	JO31	4	1	120
61	DG1VL/P	JO61	4	2	113
62	DK3RV/p	JO42	4	2	108
63	DL2DR	JO31	4	2	98/106
64	DG2MF/p	JN58	4	1	32
65	OK1KEI/P	JN79	3	2	189
66	G4KNZ/P	JO02	3	1	173
67	SP9MX/p	JO90	3	2	140
68	OE5BKL/5	JN78	3	2	132
69	OK1VEI	JN79	3	2	130
70	DL0GTH	JO50	3	1	108
71	DL1SUN	JO53	3	1	88
72	G0RRJ	IO91	3	1	38
73	SP6GWB/P	JO80	2	3	250
74	GW8BKE/P	IO71	2	1	170
75	DF1EQ	JO31	2	1	133
76	F6CGB/P	JN37	2	1	91
77	DC9YC	JO31	2	2	87
78	F6DRO	JN03	2	1	60
79	DL1JIN/p	JO60	2	2	59
80	DF5JJ	JO43	2	1	55/55
81	OZ2OE	JO45	2	1	52
82	DK2DB	JN48	2	1	48
83	SM0DFP	JO89	2	1	36
84	ON7YK	JO20	2	2	34
85	SP9FG	JN99	2	1	33
86	G8BKE/P	IO80	1	1	139
87	F5OIH/P	JN08	1	1	90
88	CT1DMK	IN50	1	1	84
89	CT1FP	IN50	1	1	82
90	DJ6XV	JO31	1	1	75
91	DJ5VW	JO31	1	1	61
92	OK1OGS/P	JN69	1	1	60
93	DK1KR	JO53	1	1	50
94	F6CGB	JN18	1	1	55
95	DF1EQ/p	JO31	1	1	29

47 GHz Toplist

1	HB9MIO/P	JN37	8	1	166
2	DC0DA/P	JO41	7	1	131
3	OE5VRL/5	JN78	6	3	266
4	IW3FZQ/4	JN54	6	1	188
5	I3ZVN	JN55	5	2	179
6	HB9AMH/P	JN37	5	3	166
7	DF6VB/p	JO31	4	1	120
8	DH9YAU/p	JO41	4	1	108
9	DF6VB/p	JO42	4	1	105
10	DG2MF/p	JN58	4	1	14
10	DF2CA/p	JN58	4	1	14
12	OK1AIY-P	JO60	3	1	266
13	SP6BTV	JO80	3	2	128
13	SP6RYL	JO80	3	2	128
15	IW3EHQ/P	JN65	3	1	111
16	DK3RV/p	JO42	3	1	108
17	DL2DR	JO31	3	1	98
18	G0EWN	IO93	2	1	98
19	OK1OKL	JO60	2	2	96
20	OK1UWA/P	JO70	2	1	96
21	DB6NT	JO50	2	2	95
22	DL6NCI	JO50	2	2	83
23	DK0OG	JN68	2	2	74
24	DK0PX	JN48	2	1	62
25	DK2MN	JO32	2	2	56
26	PA0BAT	JO31	2	2	51
27	DL3YEE	JO42	2	1	48
28	DC8EC/P	JN57	2	1	29
29	PA5DD	JO22	2	1	20
30	SP6MLK/P	JO80	2	2	19
31	DF1EQ/P	JO30	2	1	10
32	DL/HB9AMH/p	JN48	1	1	184
33	GW8BKE/P	IO71	1	1	93
34	IW3HTU	JN55	1	1	87
35	G8BKE/P	IO90	1	1	79
36	DL1JIN	JO60	1	1	59
37	F6DWG/p	JN19	1	1	47
38	F1PYR/P	JN19	1	1	47
39	F1GHB/p	IN88	1	1	39
39	G4DDK/p	JO01	1	1	39
41	OK1KIR/P	JO60	1	1	5
41	OK1AIY/P	JO70	1	1	5
43	SP6GWB/p	JO70	1	3	4
44	SP6BTV	JO80	1	1	4
45	DF1EQ/p	JO30	1	1	2
46	CT1DMK	IN50	1	1	1
46	CT1FP	IN50	1	1	1

76 GHz Toplist

1	HB9MIO/P	JN37	4	1	114
2	DF2CA/p	JN58	4	1	4
2	DG2MF/p	JN58	4	1	4
4	DF6VB/p	JO31	3	1	57
5	DB6NT	JO50	2	1	77
6	DC0DA/P	JO50	2	1	48
7	G8BKE/p	IO80	1	1	79
8	G8BKE/P	IO91	1	1	33
9	DH9YAU/p	JO41	1	1	15
10	OK1AIY/P	JO70	1	1	13
11	OE5VRL/5	JN78	1	1	12
12	DC8EC/P	JN57	1	1	5
13	SP6GWB/p	JO70	1	3	4
14	SP6BTV	JO80	1	1	4
15	F1GHB/p	IN88	1	1	1
15	HB9AMH/P	JN37	1	1	1

122 GHz Toplist

1	OK1AIY/p	JO70	1	1	1

145 GHz Toplist

1	DB6NT	JO50	2	1	3
2	DL6NCI/p	JO50	1	1	58
3	IW3EHQ/P	JN65	1	1	2
4	DC0DA/P	JO41	1	1	1
5	DL1JIN/p	JO50	1	1	1
6	G4FRE	JO01	1	1	1
7	G4FRE/P	JO01	1	1	1

241 GHz Toplist

1	DB6NT	JO50	1	1	2
2	HB9MIO/P	JN37	1	1	1
3	OK1AIY/p	JO70	1	1	0.04

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Ranking on 6m:
1.) Squares 2.) DXCCs

Ranking on 2m and above:
1.) Squares 2.) Tropo-ODX (on 23cm and up: Tropo/ RS-ODX)

DXCC entry on GHz was set to 1 when no info was sent.

The DUBUS toplists are alltime tables and entries will not be deleted anymore.

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Microwave Transverters

Microwave Transverters

made by DB6NT

More information is available on our website

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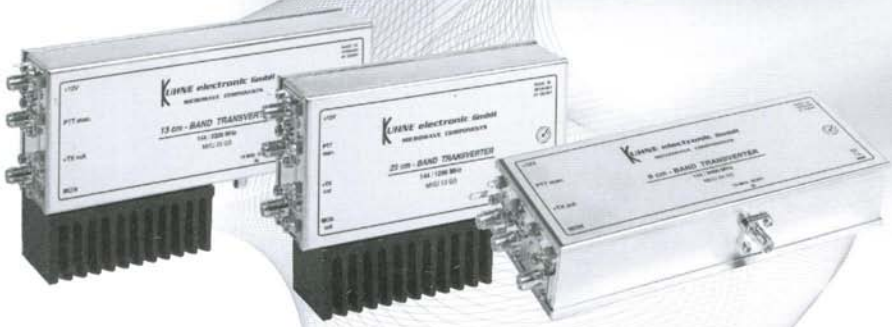

The new design of our Microwave Transverters features better performance and many new functions. Now, an external 10 MHz reference frequency can be connected to achieve highest frequency accuracy for EME and WSJT. The internal stabilized crystal oscillator can be used, if a 10 MHz reference frequency 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	MKU 10 G3
Frequency range RF	1296 ... 1298 MHz	2320 ... 2322 MHz	3400 ... 3402 MHz	5760 ... 5762 MHz	10368 ... 10370 MHz
Frequency range IF	144 ... 146 MHz	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	typ. 200 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)	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	typ. 2 ... 10 mW
Noise figure @18 °C	max. 0.8 dB	max. 0.8 dB	typ. 0.9 dB	typ. 1 dB	typ. 1.2 dB
Receive gain	min. 20 dB, adjustable	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	+12 ... 14 V

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LA8YB 2m EME Array - 32 x 17 H

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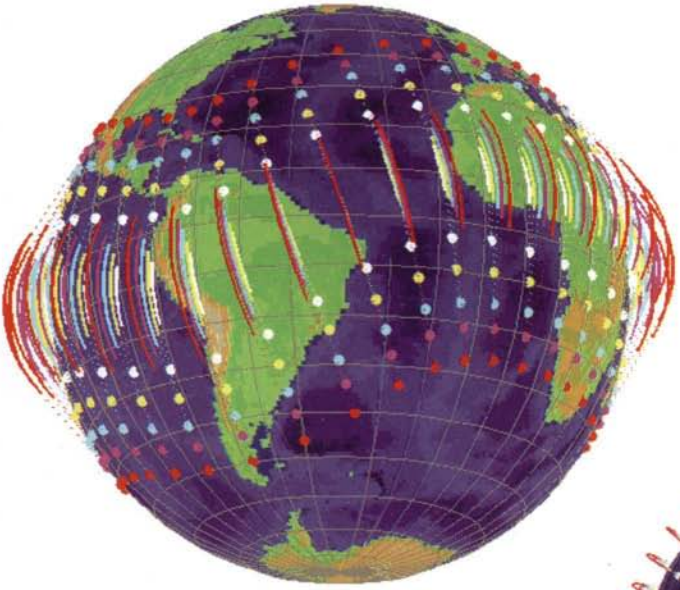

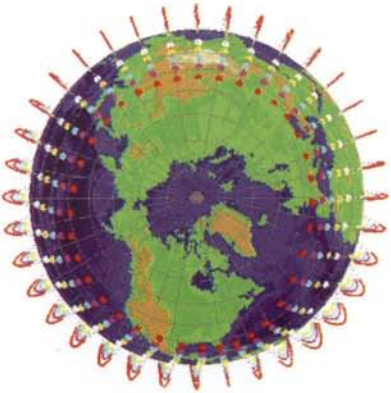

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