An Amateur Radio publication for the Microwave enthusiast

RSGB

MICROWAVE NEWSLETTER

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FROM THE EDITOR

2004 - APRIL

This issue may reach you before the Microwave Roundtable at RAL on April 25th. Organised jointly by the staff at RAL and the UK Microwave Group, it promises to be a "top" event. At the time of writing this column, there are 57 amateurs on the attendee list, with the registration date due to close before you receive this Newsletter. We are very pleased to see this excellent microwave event take place once again.

Further news about the transfer of the Newsletter to the UK Microwave group is now available. The changeover will take place with the July-August issue (due out around the end of July). By then the transfer of existing RSGB subscriptions, plus the subscriber database, will be complete and all that you, the reader, will notice will be a newsletter with a new logo. All existing subscriptions current at the time, will be honoured until 31 December this year. After that date there will be a single renewal date for all readers ...January 1st ... but if you still have an RSGB subscription still in credit by then, your UKuW Group sub will be reduced by that amount when you renew in January 2005. By the 2006 renewal date all readers will be on the same rate … simple isn't it! A more detailed explanation will be given at the RAL roundtable and in this Newsletter very soon.

Meanwhile, you will also be contacted directly, by RSGB, regarding the transfer of your address and other information to the UKuW Group. This is a very necessary procedure under the Data Protection Act. From the July-August issue onwards, you will all be full members of the UK Microwave Group, at least until you receive your sub renewals in late December!

Finally we must thank all who have contributed material to this issue. You, the readers make this Newsletter what it is …..

In this issue ...

News, views and articles for this newsletter are always welcome. Please send them to G3PHO (preferably by email) to the address shown below. The closing date is the Friday at the end of the first full week of the month if you want your material to be published in the next issue.

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146 Springvale Road,
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SUBSCRIPTION ENQUIRIES SHOULD BE SENT TO RSGB HEADQUARTERS AT THE ADDRESS SHOWN AT THE TOP OF THIS PAGE AND NOT TO THE EDITOR ..

FOR SALE

5 metre precision satellite ground station

Due to relocation and emigration to DL land (and a smaller property) I have the following for sale. I would prefer this to go to a GM station but I think that's highly unlikely! So, it's available to any interested party!

This sale will "kill" me as it took a huge amount of effort to get the dish from its original home in Zurich to Scotland.

This is a once in a life time opportunity - don't miss it! You get a 5 metre precision parabolic dish made by Pioneer in Japan. Its surface is good to 12GHz! F/D is 0.3 so it's easily fed! Tripod arms handle the centre mount and the feed is protected by a big plastic cover. The dish assembly comprises 12 arms - strengthener/ spreaders and mesh surface.

Coming with the tower is the complete mounting and positioning system comprising a 3m triangular tower in two parts (needs welding together - had to cut it for transport!) On top comes a gun turret type mounting with worm driven motor for azimuth movement. This could turn a battleship! The centre mount has a huge bearing and you can easily turn the whole dish by one hand when mounted.

Elevation is with the largest screw jack motor I have seen - two large counter weights mount to the back of the dish to balance it all. Dish position readout is by two US Digital position encoders.

These read out position in serial format to an accuracy of 0.1deg and I will also throw in the controller software and RS232 interface to test and align the encoder units.

I hate to part with this but I cannot transport this to DL land. Buyer must collect but a large van could carry it all! The price is set only to recoup the transport costs when I moved this to the UK from HB land. Pictures are available but please only call me if you're a seriously interested party. Due to relocation I dont have enough time to deal with time wasters or tyre kickers! Dish and mount are ready, dismantled, in IO75 - you will not be disappointed when you see this baby!

I'm looking for around **£650** which is a give away for what your getting (the encoders are worth that!). The lucky buyer will also receive a special treat that will allow complete auto control of the dish too!

Simon Lewis, GM4PLM / DL4PLM
Email: gm4plm@hotmail.com

GB3SEE 10 GHz Beacon Off Air

From: Denis STANTON, G0OLX
[denis@procom-pescot.co.uk]
Sent: 02 April 2004

The antenna system has been damaged by either a UFO or Antenna riggers! Waveguide, feeding the slotted antenna, was bent over 10 degrees from vertical but the plastic cover was undamaged and there are no signs of damage to the antenna inside.

The said damage also broke the water-proof seal into the box containing the equipment, allowing about 2 inches of water to settle at bottom of the box. The silica gel could not cope with this amount of water so there it stayed until I opened the box and the water came gushing out.

I'm in the process of trying to improve beacon stability before putting it back on the air.

Denis Stanton, G0OLX,
Beacon keeper GB3SEE

BELGIAN 10GHz BEACON BACK ON AIR

This mail is to inform the microwave community that the ON4KUL 10GHz beacon is back on the air after being out-of-service for a more than a year. QRG is 10368.965MHz +/- , Pout +31.5dBm, antenna = 2*10 slots. Hardware is unchanged. Information can be found at: **www.on4cp.org.**

"ON" times are UTC 3pm-7am weekdays, and all weekend, for the time being.

The location, unfortunately, is not as good as the previous one but remains JO20IV.

Reports are appreciated to: on4iy@qsl.net.

In the field of microwaves it is unfortunately too easy to lose decibels in interconnecting circuits and penalise both emission and reception.

10GHz losses in connections between circuits

~ by André Jamet F9HX Michel Métroz F1EER

What's the problem ?

We need to have connections between circuits in the chain of a transmission-reception system, especially for the antenna. Their losses are very penalising as they can ruin the output power as well the actual receive sensitivity. Between intermediate circuits, it is less crucial since the losses can usually be compensated for. As the frequency is increased, interconnection losses are higher due to the increase in component losses. We have to take care to minimise interconnections lengths and to not use lousy components!

What arrangements do we have to do ?

At 10GHz and *a fortiori,* the rule above is to use wave guides as they have minimal losses as shown in **Table 1** which also gives losses for commonly used conductors and components, as well their SWRs. The data is valid for **new / in good condition components** but is not generally the case for second hand ones. It's wise to invest in new connectors for the more critical connections in the same way as it is to use high quality capacitors (typically ATC ones) for the PA output and the preamplifier input.

If the connection to the parabolic feed is made by a wave guide and if we are lucky to get a wave guide relay, we will obtain the minimum of losses. If the PA and the preamplifier are also wave guide connected, we will get the best solution but if they are SMA connected we will need a transition to go the antenna wave guide.

If we do not have that kind of relay but only a coaxial one, we'll need SMA connectors to go to the PA and the preamplifier. In order to have a short connection we can use a straight coupler SMA-SMA. If we need a longer connection and angles we'll need a very good quality cable (for example a semi-rigid one) with two connectors.

So that we have two routes, one for transmission and one for reception, we can compute the total losses from the individual components losses.

SWR effect

Standing waves are created by a lack of impedance matching between various circuits and by components themselves. When the SWR increases significantly the losses also increase, as shown in **Table 2.**

Moreover, we are not sure that the antenna, the PA and the preamplifier are well optimised to comply with a purely resistive 50 ohms impedance. Very often, the preamplifier requires a reactive source to get the weaker noise factor. That means a 3 to 1.5 SWR (return loss 6 to 14 dB). An advantage of the all wave guide connection is the chance to put independent matching screws in both transmission and reception routes so we can adjust them separately (which is impossible when the wave guide is common for both routes and in the case of coaxial connections). Of course it is essential to use very finely adjustable matching screws, without bad contacts and locked up in the best position.

Measurements

In order to verify data given by the manufacturers, some measurements were done at 10GHz on several components at our disposal.

Loss measurement was simply done with a 10GHz source and an 18GHz spectrum analyser (HP141T). The validity of the method was tested by the measurement of a 3 dB attenuator.

Others measurements for losses and SWR were done with a vectorial analyser, ANRITSU 37269A, (40GHz) and some with a test bench equipped with a sweep oscillator (HP8350B) with a 2-18GHz HP 86290A, an 18GHz detector (HP11664) and an 18GHz SWR bridge (Wiltron 87A50-1).
The results are given in **Table 3.**

In addition, curves for two SMA attenuators were drawn up to 40GHz. It is obvious that, above 18GHz, losses and SWR grow rapidly and this is normal for this kind of connector.

EXAMPLE

Two examples of connections will show how we can lose decibels and QSOs !

First case: wave guide entirely

- connection feed, parabolic to SPDT relay:	10cm waveguide WR90	0.01dB
	flange	0.01dB
- SPDT wave guide relay		0.05dB
- connection to PA or preamplifier:	10 cm wave guide WR 90	0.01dB
	flange	0.01dB
total losses:		**0.09dB**

Second case: SPDT SMA relay

- connection feed parabolic to relay:	10 cm wave guide WR90	0.01 dB
- adapter wave guide/SMA		0.30 dB
- SPDT SMA relay		0.40 dB
- connection to PA or preamplifier:	10 cm coaxial cable .141	0.20 dB
-**total losses:**		**1.21 dB**

The 1.12 dB difference between the above cases could be regarded as negligible but if we make an effort to afford a 0.7 dB noise factor preamplifier, home made or bought, we will have an 1.98 dB in the second case. During transmission, the difference should be to appear more negligible. However for a 10W PA (+40 dBm) we start from + 39.91 dBm to + 38.99 dBm that is to say 1.87W excess loss.

In practice **it is certain that the coaxial connection case is worse than already calculated**. A high SWR will increases losses and the difference with the wave guide solution. The SWR of the SMA relay alone can reach 1.4. Moreover, if the SMA connectors are not tightened with a torque wrench, losses could be worse. Coaxial cables can be damaged if they are bent with too short a radius. So losses can be fatal in relation to a difficult QSO, especially in EME applications.

Conclusion

Microwave watts are very expensive (that it is currently known!) owing to the price of transistors. In reception, lowest noise factors are expensive too. So do not spill precious decibels because they make or break a possible QSO.

It is obvious that those remarks apply to other microwave bands than 10GHz, as the problem grows very fast when the frequency is increased.

Documentation

RADIALL, www.radiall.com
M/A-COM, www.macom.com/
Continental Microwave & Tool Company, Inc, www.contmicro.com
Microtech, Inc, www.microtech-inc.com
Sector Microwave Industries, www.sectormicrowave.com
Waveline Inc, www.wavelininc.com
Coaxial Components Corp, www.coaxicom.com
ARRA, www.arra.com
Channel Microwave Corporation, www.channelmicrowave.com
FERRITE DOMEN CO, www.ferrite-domen.com

DMT Products, www.ductech.com
Harbour Industries, www.harbourind.com
Micro-Coax, www.micro-coax.com
Amphenol, www.amphenolrf.com
Lighthorse Technologies, Inc, www.rfconnector.com
TELEDYNE, www.rfswitches.com

APPENDICE

The additional losses dues to the SWR is calculated (see ARRL HANDBOOK) by :

$$\text{total losses for a line} = 10 \log (B^2 - C^2) / B (1 - C^2)$$

where :
$B = 10^{\text{(line loss in dB) / 10}}$
$C = (SWR - 1) / (SWR + 1)$

SWR is that we can measure at the load, for example :

For a 2 dB line losses when the SWR = 1
if the SWR is reaching 5, we have :
$B = 10^{(2/10)} = 1.585$ et $C= (5-1)/(5+1) = 0.6666$ and :
losses with SWR = 5 : $10 \log(1.585^2 - 0.666^2) / (1.585 (1-0.666^2) = 3.74$ dB

TABLE 1

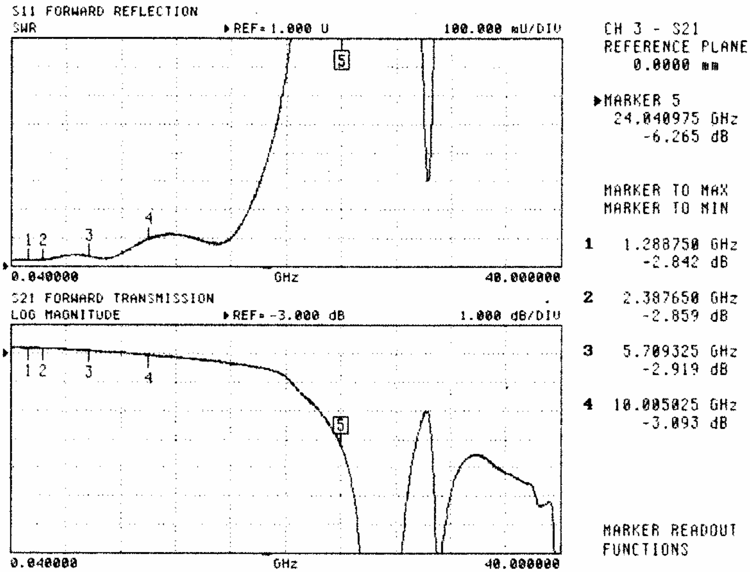
COMPONENT	DATA at 10 GHz
wave guide W90/R100 (copper)	-0.12dB/m SWR ≤1.03
semi-rigid coax .141 RG 402 Ø 3.58 mm	-1.52dB/m SWR ≤1.04
SHF 3 cable	-1.88dB/m
RG 58	-1.50dB/m @ 3GHz
RG 174 / KX3 cable	-0.56dB/m @ 400MHz
SMA straight connector semi-rigid cable	-0.10dB SWR 1.15
SMA straight with flexible cable	-0.20dB SWR 1.20
SMA right angle with semi-rigid cable	-0.15dB SWR1.20
SMA right angle with flexible cable	-0.25dB SWR 1.35
relay SPDT with SMA females	≤0.40dB SWR ≤1.40 isolation ≥60 dB
relay SPDT in wave guide	-0.05dB SWR ≤1.10 isolation ≥70 dB
flange for W90 guide	-0.01dB
adapter guide/SMA f right angle	≤-1.10dB SWR ≤1.5
adapter guide/N female	-0.30dB SWR 1.15
straight coupler SMA m/m	-0.10dB SWR 1.05
straight coupler SMA f/f	-0.20dB SWR 1.1
right angle coupler SMA m/f	-0.25dB SWR 1.5
right angle coupler SMA f/f	-0.25dB SWR 1.7
transition wave guide/SMA f straight	-0.30dB SWR 1.15

TABLE 2

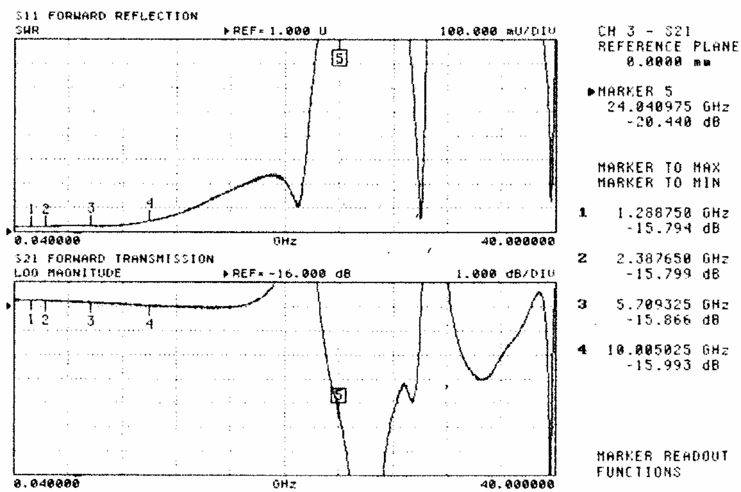
SWR	losses in dB									
1	0.2	0.5	1	1.5	2	2.5	3	3.5	4	5	6
1.5	0.2	0.5	1	1.5	2.1	2.65	3.15	3.65	4.2	5.2	6.2
2	0.28	0.65	1.2	1.8	2.3	2.9	3.4	3.9	4.4	5.5	6.5
2.5	0.3	0.7	1.3	1.9	2.5	3	3.6	4.2	4.7	5.8	6.8
3	0.32	0.8	1.5	2.1	2.8	3.4	4	4.5	5.1	6.3	7.3
4	0.4	0.9	1.8	2.5	3.3	3.9	4.5	5.1	5.4	6.7	7.8
5	0.5	1.2	2.2	3	3.8	4.5	5	5.7	6.2	7.3	8.4
10	1.2	2	3.5	5	5.5	6.2	7	7.5	8.2	9.5	10.6

TABLE 3

COMPONENT	MEASURED AT 10 GHz
straight coupler SMA m/m # 1	-0.07dB SWR 1.04
straight coupler SMA m/m # 2	-0.08dB SWR 1.1
straight coupler SMA m/f stain steel	-0.07dB SWR 1.02
straight coupler SMA m/f gilded brass	-0.06dB SWR 1.02
right angle coupler SMA f/f	-0.25dB SWR 1.45
adapterguide/SMA f (homemade with SWR screws not adjusted)	-3.30dB SWR 1.48
As above (but screws adjusted)	-0.5dB
adapter wave guide/SMA f (on a side)	-0.28dB SWR 1.15
adapter wave guide/N f (at the end)	-0.27dB SWR 1.03
black flexible cable KX3/RG 174 325 mm with SMA m	-5.08dB SWR 1.86
As above but 192 mm	-3dB
brown flexible cable PTFE SR142B 500 mm Ø 5 mm with two SMA male	-0.85dB SWR 1.06
re-shapable cable .141 red braid 925 mm Suhner SUCOFORM 141 CUPE with right angle SMA m and SMA N f panel mount	-1.52dB SWR 1.12
Re-shapable.141 59,5 mm with SMA m and SMA m	-0.91dB SWR 1.07
conformable cable .085 237 mm avec deux SMA m	-0.70dB SWR 1.19
semi-rigid .141 (6 bents) 220 mm with SMA m and f	-0.32dB SWR 1.04
semi-rigid .085 (5 bents) 347 mm with SMA m and f	-0.82dB SWR 1.1
semi-rigid .085 (6 bents) 374 mm with SMA m and f	-0.92dB SWR 1.14
semi-rigid .141 65 mm with two SMA m	-0.50dB SWR 1.18
semi-rigid .141 72 mm with two SMA m	-0.12dB SWR 1.12
semi-rigid .141 273 mm with two SMA m	-0.41dB SWR 1.04
semi-rigid .141 120 mm ? shaped with two SMA m	-0.80dB SWR 1.09
semi-rigid .141 300 mm trombone shaped with right angle SMA m and right angle SMA f	-0.56dB SWR 1.22



atténuateur 3 dB 18 GHz



atténuateur 15 dB 15 GHz

A simple way of phase locking microwave local oscillators .... Andy Talbot G4JNT

In the article on 'Locked Oscillator Sources for Microwave Use' published in the last Microwave Newsletter, I made the throwaway comment, in the first paragraph, that phase locking local oscillators with nice round frequencies of integer MHz was simpler than producing an arbitrary value for beacons, etc. Well, after saying that I had to come up with something and here are a few notes on a simple breadboard method of phase locking these crystal oscillators to a reference source. The circuit is presented as a starting point - there will be some experimentation needed for each individual case.

For the popular microwave bands the LOs are usually generated from overtone crystal oscillators followed by multipliers, with the following table showing the usual LO frequencies for the narrowband segments along with the associated crystal frequency. The final columns show the highest frequency that is a submultiple of both this and a 10MHz reference, the highest common factor or HCF, and the associated division. This HCF can become the comparison frequency in a phase locked loop, and is the highest frequency that is possible here.

Band	IF	LO	RF mult	Crystal	Division N	HCF(kHz) for 10MHz F_{ref}	Div R
1296	144	1152	12	96.00000	96	1000.00*	10
1296	28	1268	12	105.66667	317	333.333	30
2320	144	2176	24	90.666667	136	666.667	15
3400	144	3256	36	90.444444	407	222.222	45
5760	144	5616	54	104.000000	104	1000.00*	10
10368	144	10224	96	106.500000	213	500.000	20
10368	144	10224	108	94.666667	142	666.666	15
24048	144	23904	240	99.600000	249	400.000	25
24048	432	23616	240	98.400000	246	400.000*	25
47088	144	46944	432	108.66667	163	666.666	15
47088	432	46656	432	108.000000	108	1000.00*	10

Two things become obvious:
All the comparison frequencies can be derived from a 10MHz reference by making use of simple logic divider chips to give the divide by R function (all could be derived from 2MHz in fact)
All the comparison frequencies are over 200kHz, so phase locked loops can be made with wide loop bandwidths. For those marked with a *, an even higher comparison frequency is possible, but the values stated keep the frequencies within a narrower band for a common design. So now the only difficulty is providing the divide by N from the crystal frequency. An off the shelf synthesiser chip such as the MC145170, or those from other manufacturers, would make an easy job of this but there is an even simpler solution providing you are prepared to do a bit more adjustment and optimisation.

Anyone who has studied the 'brick' range of microwave sources will have seen how a high Q cavity oscillator is locked to a reference oscillator in the 100MHz region by a sampling phase detector. This device combines the functions of frequency multiplier and phase in one network. In the bricks, a snap varactor diode is hit with about 200mW of reference signal and so generates sharp sub-nanosecond pulses at this rate. These pulses are applied across a pair of microwave diodes, forming one input to a single balanced mixer whose other RF ports is fed with a portion of the cavity oscillator signal picked off via a small probe.

This sampling mixer approach to PLL design makes for considerable simplicity as it inherently removes any need for a high frequency divide by N circuit - but has two major drawbacks. Firstly, the VCO can lock to ANY harmonic of the reference, and in the brick designs this is prevented by restricting the electrical tuning range of the VCO to less than half of the comparison frequency - sometimes a pull in range of only 5 - 10MHz (at the fundamental L-Band frequency) can be observed. Secondly, the output from the phase detector is at a very low level - typically a few tens of millivolts per radian rather than the 1.6V/radian of normal logic. In effect, the complete voltage range that would have been possible for the drive power is having to be shared over every one of the comb frequencies. However, a low noise op- amp can easily provide DC gains of the hundred or so required here, and differential amp doing this job inside the bricks is clearly visible when the side cover is removed.

So, lets try this idea at lower frequencies to lock a VCXO - the very restricted tuning range of crystal oscillators means that drawback 1 is not an issue. Look at the circuit of Figure 1, a two chip R divider (programmable for any value from 1 to 256) generates the reference. This is applied to an impulse generator using the propagation delay inherent in three high speed logic gates plus an additional capacitor to generate a series of negative going impulses of a few nanoseconds in width. If you look at the output at this point on a spectrum analyser, the spectrum will show the classic sin(x)/x shape with a null corresponding to the pulse width. The extra 100pF capacitor in the delay can be adjusted to ensure this null does not fall at the wanted crystal frequency - it can get a bit unpleasantly close with 74AC series gates in this position.

These impulses are at a level sufficient to directly drive a diode ring mixer, so all that is now necessary is to apply a portion of the VCXO to the other mixer port, amplify and filter the IF output and feed back to the VCXO for a complete PLL. As in all the microwave sources I've discussed so far, the PLL needs to have as wide a bandwidth as possible to remove VCXO close in phase noise and jitter, so there is not much effort that has to go into filtering, *apart from removing the fundamental comparison frequency component*. This last point is significant, don't go too low with the reference frequency as filtering it out will be more difficult, as well as the fact that the voltage swing available from the diode ring will be even less.

The pair of 74HC161 devices forming the R divider could be replaced by appropriate sections of a 74HC390 chip, or an 'HC90 with feedback in some cases, but this solution gives a generalised divider allowing factors for R divisions not in the table, such as those with 7, 11, or 27 in them that couldn't be obtained from a simple configuration. It works be preloading in the number set on the links, then counting up to 256 where it overflows and loads in the preset value again repeating the process. So, the wire links have to be configured to load in a value of (256 - R). With HC CMOS, a logic '1' must not be generated by leaving an input as an open circuit, as could be done in the old days of TTL (and even then it was unethical!), so each input must be tied to either +5V or ground.

Results:

My breadboard was not exactly as shown in Figure 1. Instead, I started off with a 1MHz signal rather than 10MHz and divided by 3 in a single chip to give 333.333kHz which was used to lock the 94.666MHz crystal in my 'JVL based 10GHz system. Figure 1 has been built, and just committed to PCB, but not yet into any finalised system. The first version for 10GHz worked fine, except for the fact that the VCXO drive level to the mixer was rather critical - this has to be kept at about 1mW for the mixer to remain linear, whilst maximising the DC output level from the IF. If drive level is increased too much, the mixer saturates and, surprisingly, IF output falls off in this usage. I'm not too sure why this should happen, but is probably due to the short pulse forming the pseudo-LO, and its very low means value. Real experimenters may like to try replacing the packaged DBM with a pair of diodes plus transformer/balun for a single balanced design as in the bricks. This may give more sensitivity and less dependence on RF drive level, but I couldn't be bothered with this level of fine tuning once the DBM had proved itself.

Note that the mixer also has to be one where both sides of the IF port are accessible. Most devices like the SRA-1 and SBL-1 offer this, but higher frequency mixers sometimes ground one side of the IF so in this event the op-amp will need to cope with a negative input voltage.   The DC gain in the OP-amp circuitry is what was required for this 333kHz reference - other higher comparison frequencies will allow proportionately lower gains. The exact circuit configuration is not a completely true differential amplifier as this is not essential, it also has to transfer the 5V reference through to the output. As *true* differential operation is not necessary, to change the gain it is only really necessary to alter the single resistor shown as 330k in Figure 1. An easy way to set up the necessary DC gain is to look at the op-amp output on a scope with both reference and VCXO signal applied, but with the input to the VCXO tuning diode clamped to the 5V centre value. Then by manually tuning the VCXO through its range a beat at the difference frequency will be seen, this will be centred on exactly 5 Volts and its peak to peak value must be wide enough to be able to tune the VCXO at all ranges of temperature and drift …. a value of 2 - 5 volts peak-to-peak will probably suffice for most VCXO designs. The op amp gain may need adjusting to get to this figure, and the value also depends to some extent on the RF level to the mixer. With no reference applied, the VCXO needs to be adjusted to the wanted frequency with 5V on its tuning line …. try to get as close as possible as the tuning range is not very wide once temperature and crystal ageing are taken into account.

My breadboard locks up near instantly when connecting the reference, provided the crystal heater has been pre-warmed!   If a crystal heater is used, the initial cold start frequency will probably be outside the PLL lock range; in my case it takes about 10 seconds for warm-up before the PLL will lock from a cold start.

Now, the only drawback to getting within 0.1Hz on my 10GHz system (and yes, I can get 10^{-11} on the reference) is the accuracy of the 144MHz IF.   The IC202 LO is derived from a DDS (more about this another day) controlled from a bog-standard packaged 100MHz crystal oscillator and rotary up-down counter plus LCD display to 10Hz resolution and 100Hz readout. The DDS could have been driven from the 10MHz reference multiplied up, but there is still the inherent accuracy of the carrier crystal inside the IC202, so I can only get to within tens of Hz of the wanted frequency at 144MHz without doing some pre-calibration of the IF, and even then it will drift a few more Hz over the day. When I designed the digital IC202 LO I hadn't anticipated wanting a better accuracy for microwaves than this, but some recent tests between G8ACE and G3NNS make this assumption invalid now …

NEWS FROM THE OSCILLATOR MAN ....

From: John Hazell, G8ACE [hazell@dsl.pipex.com]

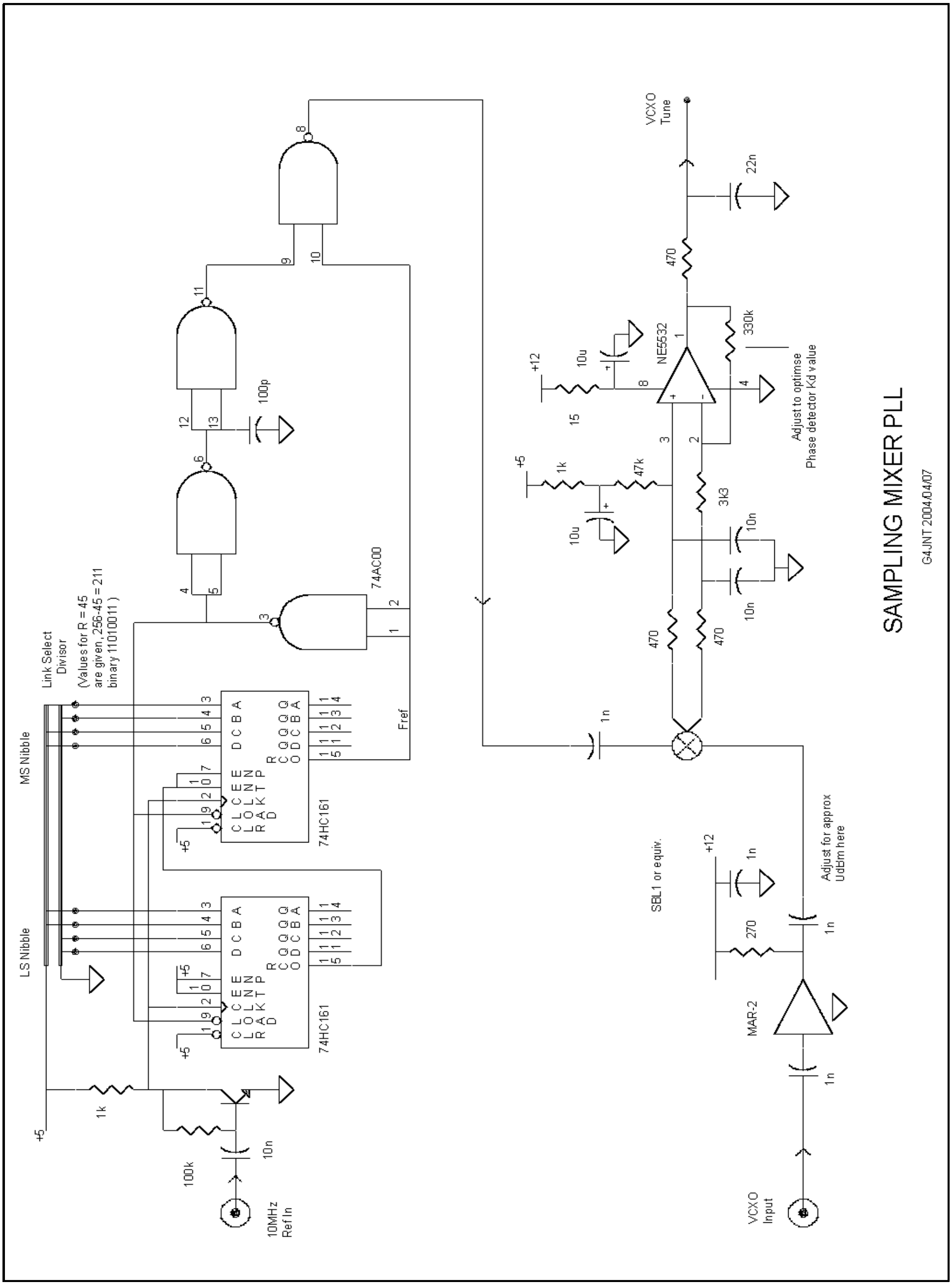
I have been speculating on posh PCBs for my x24 2.5GHz multiplier board. These have now arrived and have printed inductors and otherwise it's mostly surface mount. The pcb has almost 90 through-plated holes. It is 100 x 55 x 30mm boxed, all connections being at one end. It seems to operate with 2.2-2.6GHz output reasonably well. If you tweak it to death, it will do 50mW out at 2556MHz. Generally the multiplier will do 30mW over that frequency span. My end intention is to do either board and box available or as a complete kit. It's early days in calculating the cost however. The board is useful as a driver board or as a signal source for up to 47GHz, from harmonics. The 10GHz harmonic is easily audible on my rooftop dish with the pcb on the bench indoors at ground level. 47GHz harmonics are audible for a few feet LOS. I operate with the lid off the box, as a source. The 'this is it' CAD drawings of the PCB are at:

http://www.microwaves.mcmail.com/pcb%20boards/multiplier.htm

It's a slow loader page, not built for speed!

I anticipate having kits ready for RAL.

Thanks and 73 John.


SAMPLING MIXER PLL
G4JNT 2004/04/07
Link Select Divisor
(Values for R = 45 are given, 256-45 = 211 binary 11010011)
MS Nibble
LS Nibble
74HC161
74HC161
74AC00
Fref
10MHz Ref In
VCXO Input
VCXO Tune
MAR-2
SBL1 or equiv.
NE5532
Adjust for approx UdBm here
Adjust to optimse Phase detector Kd value
100k
10n
1k
+5
+12
100p
1n
270
470
3k3
47k
15
10u
330k
22n

23cm Circulator notes

.... D. Jones [gw3xyw@thersgb.net]

I was given an item obtained at a Midlands radio rally. It had an input N socket and an output N plug on a short coax lead. On one side it had a small dummy load and also a larger 50 ohm flat ceramic pack mounted on a heat sink. There was also a BNC socket, apparently for a "sniffer" output for a counter. It turned out to consist of two circulators in series with a spec. of 913MHz to 950MHz and testing with a Marconi signal source confirmed that transmission from input to output was virtually lossless within these frequencies. However, in the reverse direction, attenuation was very high. i.e. a perfect isolator. A test on 1296MHz showed no directional properties so I wondered if the unit could be modified. First, two large side panels were carefully and gently prised off - they were held in place by a combination of impact adhesive and strong magnetic field. On testing it was found that the pass band had shifted LF to around 550MHz. I therefore made some panels from thick (3mm) mild steel and these were gently mounted onto the unit, held in place by the magnetic field. A check with the signal source found that the pass band was now around 1.1GHz. Further work with top, bottom and side panels shifted the frequency up beyond 1.2GHz.

For years I've driven my OZ9CR (Ring of six) P.A. with a 2C39BA driver. This has been unsatisfactory because driving a grounded grid P.A. with a grounded grid driver can cause instability. The only way to stabilise the system was to partially isolate the two units with an attenuator, negating to some extent the reason for a driver amp. The modified circulator was installed between the driver and the P.A. in place of a 5db attenuator. The results were beyond my expectations - more P.A. output for less R.F. into the driver and, more importantly, no problems with any instability. The new system has been fully tested during the DUBUS/REF EME contest.

The units are apparently surplus items from analogue mobile phone transmitters and are available if you can spot them at rallies. Mild steel was the only magnetic material readily to hand. Soft iron, mu-metal or ferrite (of suitable shape) might yield interesting results.

Best 73 and Good DX from Stuart GW3XYW

Experiences with the HP Z3801A

... Notes from Brian Coleman, G4NNS [brian-coleman@tiscali.co.uk]

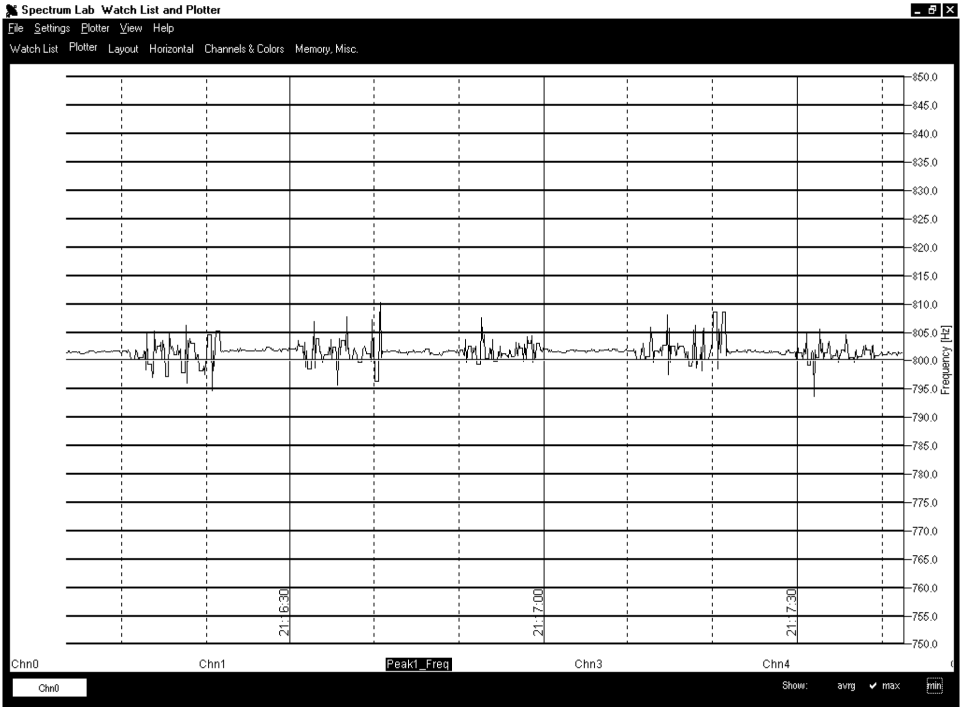
John, G8ACE, and I have recently purchased HP Z3801 GPS disciplined oscillators and have started to conduct some "frequency setting" tests with them. On the bench, the two systems produce a lissajous figure at 10MHz which remains stable for hours at a time and certainly more than 1000 seconds suggesting a repeatability of 1 part in 10^10 or better. As the final objective was accurate frequency setting at Microwave frequencies, perhaps opening up the possibility of using digital modes such as JT65, we devised a test to evaluate this. Unfortunately the path between us is obstructed and we had to use a reflector and some Doppler was introduced probably because of moving trees but the attached plot (see next page) gives an indication of the results. For the tests, we are switching between the 2m IF systems direct on 2m and then via our 10GHz transverters thus introducing any errors in local oscillator frequencies.

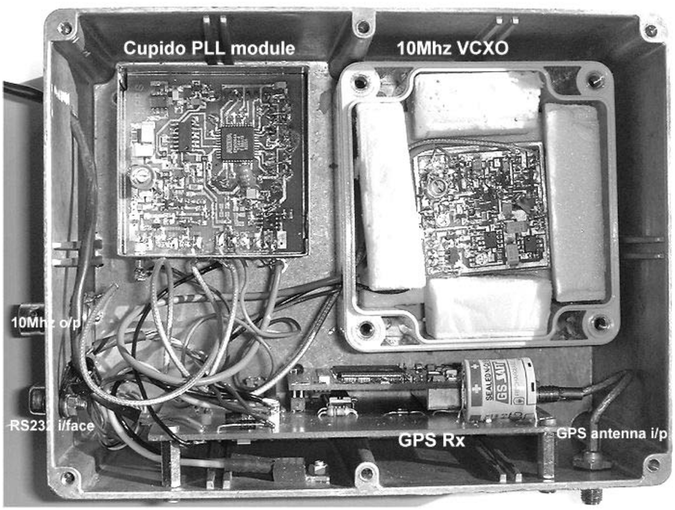
The plot which clearly shows the Doppler shifts introduced on 10GHz shows these errors to be negligible as the average on 10GHz is almost exactly the same as the direct 2m signal.

We did confirm that, so long as the 2m prime mover's frequency display is accurate, it is possible to QSY to 10GHz and receive SSB without any need to touch the RIT.

Unfortunately BuyLegacy.com (the source of these units) have raised the price of the surplus HP units from $249 to $349 so I am not sure how popular this approach will be. It may be possible to find them on Ebay though. Next, John and I would like to compare these results with the Jupiter T system described by Andy Talbot in last month's newsletter.

73 Brian G4NNS





The photo on the left shows the 24GHz GPS locked system used by Chris, G8BKE, and described on his interesting webpage. Take a look for yourself at: **http://homepages.tesco.net/ctowns/gps.htm**

This month sees an increase in the input to this column. Many thanks indeed to all who have emailed or phoned in their news.

First of all there are encouraging reports of several new callsigns appearing on sever of our microwave bands ...

Keith, GW3TKH (Cardiff, South Wales) writes ...

I have built a DB6NT 3.4GHz transverter which, after a few problems, is now working very well. This required another dish and construction of a feedhorn. Phil (PPF), loaned me a 5.7GHz transverter which also required an antenna. I built the WB5LUA dual band feed (3cm & 6cm) and this works OK. It improved the received signal on 3cm by 1-2dB over the original single band feed! So more work is required.

I now receive the south coast beacons (GB3SC*) 24/7. 6cm is the strongest at S1-2 under flat conditions.

I had a go in the Low-B and microwave contest recently working 5 stations on 23cm and hearing several on 9cm .. no 13cm yet! I was quite pleased with the result, considering the poor uWave location in the depths of Cardiff.

At the moment I am duplicating the antennas to enable portable operation without de-rigging the the home system. The aim is to take the equipment to Flatholm again this year during the IOTA contest period. I will contact you nearer the time with details.

Regards from Keith, GW3TKH.

Gordon, G0EWN, (IO93FK) North Sheffield<gfiander@compustream.net> very recently completed a DB6NT 10GHz transverter system, the final connections being made in G3PHO's shack where the gear was tested and found to be working well and producing some 280mW output. The following day, April 13th, he made his first ever microwave narrowband contact … with Peter, G3PHO (IO93GJ) ... over a reflected path and using nothing more than a small feedhorn. This was followed 30 minutes later by a QSO with G3LRP near Wakefield (IO93HO08), again by reflection and using the same tower in Rotherham that he and G3PHO employed. An interesting three way QSO resulted.

Gordon plans to be active in most of the 10GHz cumulatives this year (Restricted Section) once he gets the gear set up on a tripod. He'll have the quarter watt feeding a 60cm offset dish. *(At last, another active operator in Sheffield! .. editor).*

From: G4BAO [g4bao@ntlworld.com]
To: ukmicrowaves@yahoogroups.com
RE: DB6NT 10GHz LO drift

My DB6NT doesn't seem to have a crystal heater, or if it has, it's well hidden. Maybe they are only fitted on the version in the milled aluminium box. I've seen mine move 5 kHz or so at 10GHz from inside the shack to on the windowsill with the window open.

I'm back on 23cm again, after a bit of an absence, with 4x23 elements with Az and El, 2 watts and a WDG masthead HEMT. I'm working (slowly) on a 2C39 PA. I heard G4CCH off the moon (well saw him on a waterfall diagram actually!) and heard an OE in the last EME contest. If anyone wants a tropo sked with JO02cg, email me. I've started a Sunday 0900 GMT sked on 1296.220 at with G8VR down in Kent and we have made it with good signals so far.

We're also trying to stir up some 10GHz activity round here. The plan for me in a month or so is to put the DB6NT 10GHz on a minidish on the mast, so I'll be QRV on 10GHz narrowband from home soon. G4HJW is building gear and a number of the Cambridge Club "widebanders" are thinking seriously about NB. **73 from John, G4BAO**

Chris, G0FDZ [chris@chrisfdz.fsnet.co.uk] reports on the Crawley Lightwave (Laser) workshop which was very successful and proved to be a most useful session. A full photo report can be found at:

http://www.lasercomms.org.uk/crawley2.htm

On the 24GHz front, Chris is now QRV on 24048MHz but found that the waveguide filter that he was using would not tune down far enough so he had to make a new one, of a different design, which tuned without problems. **Regards from Chris G0FDZ**

CONTEST REPORTS ...

The so-called contest "season", now organised and administered by the UK Microwave Group, started off at the end of March with the **Low Band Microwave Contest**. Conditions were quite poor, particularly on the 2m talkback links which often saw normally powerful signals disappear into the background noise! This was quite evident on the NW/SE paths but much less of a problem on the east/west ones.

Peter, G3PHO/P (Houndkirk Moor, IO93EH98) had 15W of 3.4GHz to a 1.2m dish and 18W of 23cm to a 23 element yagi at 5m agl. The former brought eight 9cm contacts, the best of which was with G1JRU in Southampton. It was estimated that around 11 stations in the UK were QRV on 9cm that day. Seventeen stations were worked on 23cm and few others were heard. Best DX on this band was G4WYJ/P in IO90WV. No Continental stations were heard on any band.

Peter has just bought an FT817 to replace the IC202 transceivers used to date as prime movers for his various microwave transverters. A purpose built interface, containing a bias T, variable attenuator and switching relays, had to be built and first impressions are very good … it's so nice to have a proper digital readout instead of the 10kHz per division analogue dial of the IC202s ! The interface can be switched to look like either an IC202 or an FT290 in so far as the uW transverters are concerned...more details next month.

From: Andrew Hutley, M0SPS, [andrew@m0sps.fsnet.co.uk]
During the LowBand uW Contest I managed 4 QSOs on 23cm and 1 QSO on 13cm, from a non ideal location in Crick, with G3PHO/P, G8AIM, M0GHZ & GW8AWM/P for the best dx. I'm grateful to George - G8AIM - for making me aware that I have wasps in the loft (I can already hear him laughing)! I haven't got any antennas for 13cm on the house at present so I resorted to temporarily hanging a yagi from a loft beam for a shot at a QSO, which yielded a 58/52 report. After arranging the antenna and descending the ladder back into the shack, it was some 3 hours before I found another likely QSO opportunity and having ventured back up the ladder I was greeted by a great deal of QRW(asp) which I had obviously disturbed during the previous antenna turning session! Discretion being the better part of valour, I decided to deal with the "interference" but this took longer than expected so I made no more QSOs. **Regards, Andrew - M0SPS**

April 24GHz & 47GHz Cumulative Reports ...

These two under-rated bands deserve better! In spite of having had the whole winter to QSY equipment down to 24.048GHz, there are still some in both UK and on the Continent who haven't yet done so or even installed their half watt PAs bought almost a year ago! There are at least 35 potentially active 24GHz stations in England alone so where were they all for the first contest of the year in early April?

Those that did come on for this event (G3UKV/P, G3PHO/P, G3UYM/P, G8ACE/P, G0MJW/P, G1JRU, G8BKE/P, G3LRP, G4EAT) were treated to some interesting conditions. The heavy rain showers produced excellent **24GHz rainscatter** propagation. It was this that enabled **Peter, G3PHO/P,** located at **Alport Height, IO93FB44,** to finally break the 150km distance "barrier". He had a nice 154km cw QSO with G3UYM/P who was located at Thirfield, IO92XA. This path had been tried many times in the past but it took bad weather to make it succeed! Peter was also very pleased to work G3LRP (IO93HO08) from the same site as the 154km QSO.This path had also been attempted many times in the past but it went this time .. by rainscatter of course! Does anyone know if this is a 24GHz rainscatter record for the UK? No doubt it has been exceeded outside the UK! A further RS contact with LRP took place later in the day on Peter's way home. For 24GHz, Peter is now using a 60cm offset dish, acquired at Martlesham last year, and it appears to be doing well, the two watt PA also helping a bit of course! He hopes to have his 47GHz gear and dish mounted by the next millimetre cumulative. For the foreseeable future, this band will be his upper limit!

Harold, G3UYM/P (Thirfield, IO92XA) emails the following report ...
I operated from Therfield, IO92XA, for the 24/47GHz contest. What a day … strong winds, rain, hail and sunshine but the rain paid off in the early afternoon with a fb rain scatter contact with Peter G3PHO/P at Alport Height IO93FB a distance of 154Km.This was my first rain scatter contact on 24GHz.
Rig: 500mW PA. Dish:45cm with Procom feed.

Mike, G0MJW/P, is a very welcome new callsign on 24GHz. He built up his system over the winter and this was his first time out with it. After unsuccessful attempts to work G3PHO/P, G3UYM/P and G3UKV/P from a site at IO91IN, he moved later in the day to the PMR site at Walbury (IO91GI) and easily worked G8ACE/P at Lane end (IO91JA) as well as G8BKE/P in the New Forest, no doubt via rainscatter.

John, G8ACE/P emailed his report on this contest … I worked G0MJW/P (IO91GI) easily S9+++ with a 20db horn over the LOS path. Raincatter saw G8BKE/P give me an excellent RS signal from **due north** whilst he was working G0MJW/P ! I then worked Chris, G8BKE/P and also Del, G1JRU. Del had awful troubles with the wind waving his pump up mast so he didn't work 'BKE or 'MJW though should have done. I got three QSOs but all short distance. I packed up before rain got me after about 2hrs in all at Lane End. During the morning I copied G1JRU, with my dish outside the shack, via reflection off the Winchester prison Tower (!) but for some reason Del was not copying me.

Other microwave news….

From: Chris Towns,G8BKE [ctowns@care4free.net]
I've just converted my 24GHz LO to be locked off GPS. You can read all about it on my website at:
http://homepages.tesco.net/ctowns/gps.htm
It's quite impressive looking for our 24GHz beacon (GB3SCK) in obscure locations now. Just dial in the IF frequency and point the antenna and listen for it in the noise. Maybe if we all had this facility when out /P we would manage longer paths on the band, with less frequency uncertainty at both ends.

From outer space ….

We have reports of reception of the Rosetta spacecraft by amateurs in Europe. From the Amsat DL website comes the following:

AMSAT P5-A groundstation, DJ9PC and G3WDG receive successfully ESA's spacecraft ROSETTA.

On 2 March 2004 ROSETTA was launched on its long journey into deep space and we tried to receive signals from the spacecraft. On 20 March 2004, Freddy de Guchteneire, ON6UG, received strong data and carrier signals . The distance to the spacecraft was 5.8 Million km.

But it can be done much more simply as Peter Griebel, EA8BFK (DJ9PC) on Fuerteventura, Canary Islands (IL38BO) has proven. Using an 1m offset dish, with a 5.5 turns helix feed, he was able to receive ROSETTA on 19 March at 08:48 UTC on 8421.631 MHz. The distance to the spacecraft was then 5.515 Million km.

Likewise, Charlie Suckling, G3WDG, used a 3m dish for similar results; he pointed the dish in "more or less the right direction" and heard it immediately. Rosetta offers a superb strong microwave beacon for many hours each day. Its maximum range will be about 77 million km at the end of 2004 August, returning to about 16 million km in 2005 March for its Earth fly-by to pick up energy. Check
www.amsat-dl.org/p5a/rosetta.htm
for details.

Charlie Suckling, G3WDG, has also been busy listening to this "bird" and has posted very interesting information on his personal webpage:
www.sucklingfamily.free-online.co.uk/

That's all the news for this month ...
73 fromPeter, G3PHO