



An Amateur Radio publication for the Microwave enthusiast

MICROWAVE NEWSLETTER

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FROM THE EDITOR

2003 – July/August



This issue is the summer bi-monthly one. **The next edition will appear in mid September.** Have a great summer holiday everyone! It's been yet another very good month on the UK microwave scene.

Activity in the June 6 and 3cm cumulatives was excellent, as you can read for yourself in the latter half of this issue. Several new callsigns have appeared this year, filling on the gaps left by those who have given up microwaves for some reason or other or are just too busy with other things to be able to come on the air. The result of all this is that we have had so much activity news emailed to us that nearly half the newsletter is made of it and we have had to really squeeze material into these pages! Thanks to all who have sent in reports.

Once again, we have John, G3OKA, to thank for a most interesting account of his experiments with high power klystrons. While few, if any, modern amateur microwave uses klystrons these days, we feel John's article is of interest to us all. It brings back memories of our early days on 9 and 3cm using the QRP 726 and 723A/B series klystrons ... happy times!

Thanks also to Paul, G8AYY for the useful notes on the G4ALN ("Penny" feed and to Jonathan, G4KLX for his report on the Kochelsberg microwave meeting. Alan, VK3XPD, shares some Aussie "savvy" with us!

The UK 24GHz scene had a recent injection of cheap, half watt amplifiers, bringing the total known number in the country to around 50! Where are they though? We don't seem to hear many of them on the air. If you have 24GHz gear please use it and be active.



In this issue ...

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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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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 and WANTED

TRIPOD WANTED ~ URGENT!

HAROLD GROVES, G3UYM,
[harold.groves@ntlworld.com]
desperately needs a tripod for his portable microwave gear. His other broke during the July 24GHz contest.

WANTED ..

By **David Robinson.WW2R**
[www2r@mgcf.org]

Does anyone have any **BLW96** transistors they are prepared to part with?

FREE TO A GOOD HOME ...

Peter Tunbridge G8DEK in Rowland's Castle has a 10ft dish looking for a new home. Dish is free to anyone willing to collect it.

Peter can be reached at 02392 412658

HELP A NEW MICROWAVER!

From: **Simon Lewis, GM4PLM,** [simon@creoch.freemove.co.uk]

I am helping a young man locally get on 3cm and have donated him a bare bones 3cm transverter. We need a PA! Does anyone know of any 1w PA for disposal? I think I might have a "whitebox" one with a couple FETs in it but we only have a bare WDG transverter to drive it!

Does anyone have a modified Qualcomm PA for disposal?

The only snag is is that the young man has no cash but I am keen to help him - he is very keen!

73 Simon



... by **G3ZTR**

- **IC 202S** with usual 3 crystals £75
- **Marconi Wattmeter** with 6440N power head £55
- **Sievers panoramic receiver PM 7800** 0.6 to 20GHz £120
- **MM 23cm Tvtr** 144 I.F. £50

Please contact **David** at: **g3ztr@hotmail.com**
(Location: Bridlington, East Yorkshire)

AUSSIE TECH KNOW HOW ...

Giddy Gents,

Here's some practical advice from "Down-Under" on the tuning waveguide feeds and cavities.

Aside from the usual 'Doco' that's around describing where to fit MULTIPLE adjustment screws on the WG Broadwall there's this suggestion from me!

To optimise a Transition or ANY WG coupling I use this method - locate/use a small STEEL Ball bearing of 1/8th inch OD & put it inside your WG fittings. Bolt it all up as per normal. Then get a smallish magnet & LOCATE (catch) the Ball Bearing through the Waveguide.

The technique is to simply move/drag the Ball Bearing around or along the full length of the Top or Bottom Broadwall (your choice) of the Waveguide section to be tuned.

The next step is also quite simple also but the mechanism depends on what you're trying to achieve.. i.e. a TX match or RX match !

For TX matching : monitor say a Power Meter while in TX mode. For RX matching : use a Sig Gen to generate a low level (noisy) FM Carrier while listening to this signal at your IF. Your aim of course is for best "quietening". Alternatively, for those with access to a Noise Figure Meter etc. then move the Ball Bearing around for BEST NOISE performance.

Once you have found a "sweet spot" on the Broadwall - mark it and this spot becomes the EXACT location for a SINGLE brass Screw. Solder a nut over the hole you drill in the WG, use another nut on the thread to lock the Brass screw in place once you have set it to it's optimised position.

Repeat the Magnet/Ball Bearing process again for fine tuning but it probably won't be necessary.

This technique saves hours of drilling/ tapping/optimising effort! Go to it !

Cheers Alan - VK3XPD



BEACON NEWS

RAINER, DF6NA send the following news:

DB0AJA is qrv from JN59AS 360masl. on:

2320.960MHz 10W 10dB NW

3400.945MHz 20W 3 x

120deg IONICA antennas (omni)

5760.945MHz 10W slotted waveguide (omni)

10368.945MHz 1W slotted waveguide (omni)

24192.945MHz 1W slotted waveguide (omni)

OZ1UHF is active again....

From: Nicholas Shaxted GM4OGI
[Nick.Shaxted@blueyonder.co.uk] ...

OZ1UHF/B in JO57FJ QRV again on 70/23/13/9/6/3 cms. 70 cm has moved to 432,449 MHz"

(Taken directly from:

http://home.tiscali.dk/dia00237/index_en.html)

GB3KBQ TAUNTON 10GHz BEACON

Beacon keeper Adrian, G4UVZ, advises us that the Taunton beacon 10GHz is back on the air after a refurbishment. It now sports a 1 watt Qualcom PA which should provide much stronger signals than the former output stage which had been giving low RF output for some time. GB3KBQ can be used as an accurate frequency reference. There is still minor problem with the "whitebox" driver stage but this should hopefully have been rectified by the July contest Sunday (27th) and the beacon should be working well by then.



G4ALN Waveguide Feed Revisited

By Paul Gaskin, G8AYY

This popular feed was originally described in Radio Communication, October 1976, 'Microwaves' p757 and was intended for use with short focal length dishes with an f/D in the region of 0.25-0.3. The use of an old penny coin for the disc on 10GHz came later.

The width of the $\frac{\lambda}{2}$ slots was specified as $\sim \frac{\lambda}{20}$. It was claimed that the length of the slots, and also the diameter of the disc, were probably not critical within a few per cent and the width of the slots even less so. This seems to overlook the fact the slots are located next to the reflector disc (splash plate) which theoretically has zero electric field strength at its surface in the waveguide. This could make the width of the slot quite critical. Matching screws or a sliding sleeve was suggested to improve the match but no thickness was actually specified for the disc which could be important.

The G4ALN 'penny' feed became popular with the 45 cm PW (Practical Wireless) dish, f/D 0.28, introduced in 1981 for a 10GHz project, and also other prime focus dishes, but did not always work as well as it should have done. I had two different versions of the 'penny' feed in 45cm PW dishes available for tests and found that one version did not work as well as the other with a Solfan head although it had the specified $\frac{\lambda}{20}$ slot width and an adjustable feedpoint position.

This 'penny' feed was modified as part of an investigation into its performance. The 1 mm thick brass disc was replaced with a thicker brass disc which was silver plated and the width of the slots was increased. The new disc was soldered to the wave guide, with heavier soldering at top and bottom for strength but fillets of solder were avoided near the slots in the broad faces. There was an improvement in performance which suggests that the problem could have been caused by the lack of matching screws and/or the illumination of the dish.

My version of the 'penny' feed seems to work well, is capable of being sharply focussed and cannot be improved with matching screws. The 2.5 mm thick discs were cut from an old silver plated brass chassis and filed to match an old penny in diameter. The waveguide slots were experimentally increased to 5mm ($\sim \frac{\lambda}{8}$) width which seems to give good illumination and matching. The clean silver plating on the 31 mm diameter discs probably improves their efficiency as reflectors.

Versions of the G4ALN feed have produced for the 5.7, 24 and 47GHz bands also (reference RSGB Microwave Handbook Volume 3). They all use the $\frac{\lambda}{20}$ slot width and it is suggested that it may be worthwhile increasing these slot widths also.

Incidentally if anyone is thinking of using an 'English' silver coin as a disc then he should be aware that British 'silver' coins have been made of cupro-nickel alloy since 1947.

A 750 Watt 8.2GHz Microwave Amplifier

John A. Share, G3OKA, Geomagnetism Laboratory, Oliver Lodge Building, University of Liverpool.
(jashare@liverpool.ac.uk).

Forward.

Many amateurs would just love to have the facilities provided in University Research Centres. there is the down side that with the toys comes the responsibility and whilst building a big amplifier might be fun for a hobby it takes on a rather serious aspect when its your role within the system and the amplifier in question is way above anything remotely legal on any amateur band.

Whilst most amateur microwave work is carried out using low power, with great reliance on antenna gain, there are research applications where there is no substitute for sheer power. The need for something in excess of 500 watts at 8GHz was not a problem to be under taken lightly with the implication of serious financial outlay. By good fortune, an old Varian Klystron was discovered in the laboratory of one my colleagues at McMaster University, Hamilton, Ontario. he brought it over on a visit and, later, arrangements were made for the device to be donated to the University of Liverpool for research purposes. Looking back over this particular project, an old saying should have been given greater credence a long time ago ... "Beware visitors bearing gifts!" Superficially the Klystron required a heater supply, some EHT and forced cooling. In reality, these requirements were not so simple to provide.

The Heater Supply.

As is common with these types of devices, the Anode is external and grounded. This places the cathode / heater at some enormous negative potential. Locating a heater transformer with many kV of insulation is dependent on luck and a suitable low voltage transformer of unknown age bearing a stamp "15 kV Insulated" was located in a scrap monster 'scope.

It would be foolish indeed to simply apply the full heater voltage to the Klystron; the in rush current would seriously reduce the life expectancy of the filament. Instead, a regulated DC supply was designed so that initially it provided a constant current on a slow ramp until such time as the voltage reached the correct value. Over volt protection was also incorporated and all this required linking to the EHT supply. Should the heater supply fail, with EHT applied, the Klystron would survive for about 20 seconds. Needless to state, the heater supply was rigorously tested using inexpensive car headlamp bulbs. They were far cheaper than replacing the Klystron (valued at around £15,000 !).

Forced Cooling.

Klystrons operate with a constant anode current, in this case about 300mA. The standing dissipation is therefore about 3Kw and must be removed by forced cooling. Thermal sensors which were built into the Anode fin had been set to trip above 35⁰C, requiring a serious application of cooling. All conventional blowers proved hopelessly inadequate and we resorted to a three stage blower with an inlet diameter of eight inches and used aluminium chimney liner as the duct. The exhaust is similar to a turbo room heater with the proviso that there is 100 times the quantity of air!

It is essential to ensure that there is forced cooling before the heater power is applied. To achieve this vacuum sensors are located in the blower manifold close to the Anode fin (air is sucked through the fin) and using some analogue comparator circuitry there are a number of pressure trip levels to operate safety interlocks.

The EHT Supply.

The design, construction and commissioning of a 10kV at 300mA power supply is not for the faint hearted. The transformer had to be custom wound from an old Parmeko 5KVA Isolation

transformer. We tested its rating by connecting a kettle to the output and noting temperature increases in the winding! Stripping this transformer, removing the secondary, rewinding a new secondary and reassembling took nearly two weeks of labour. It was not the most pleasant of tasks!

Not surprisingly, this was going to require something a little more exciting than a bridge rectifier. There is a penalty with strings of series connected rectifier diodes for they tend to conduct at slightly different times, leading to commutation spikes on the output. This is usually prevented by connecting a capacitor across each diode. Forward this is no problem but, however, in reverse the voltage is massive and the capacitors had to be rated at 1Kv. There is also the problem of equalising the reverse voltage across each diode and this called for parallel resistors. It is often forgotten that resistors have a maximum voltage rating, usually 450 volts and this necessitated two resistors in series across each diode to give a factor of safety.

Smoothing capacitors take on a whole new perspective when considering 10kV. Using the old rule of thumb of 100uF per Amp as being a guide for the required value, this was going to be a serious item. Four brand new 25uF, 15kV paper capacitors were discovered in a surplus list, they were expensive! However they eliminated that horror of horrors, a string of electrolytic capacitors, and we had a couple of spares.

Needless to add, that the bleed resistor was given inordinate consideration ... 50uF of charged capacitor is lethal! The run down time was designed for about 5 seconds, far shorter than the time taken to remove the covers and poke around inside the enclosure (Oh, yes people do!). You would think that you could use metal-jacketed high power resistors and seriously under run them in the interest of safety. Actually, there is a problem in that the jacket insulation is only 500 volts so if you bolt them down onto a heat sink they instantly flash over. Of course you can space them out on an insulator but then the rating is reduced. We used 10 watt carbon resistors mounted on 5mm fibreglass board, each resistor dissipating 1 watt.

To reduce the switch-on power surge, a slow start circuit was included in the transformer primary circuitry. This used a delay timer relay and the EHT comes on in two quite distinct steps.

Control and Interlocking.

At switch on, the blower runs up to speed, provided the vacuum sensors are satisfied the heater power supply is activated. Some time later, it signals that the heater is at voltage and a delay timer is activated. After about 30 seconds soft start circuitry for the EHT is activated. From switch on to ready, the process takes about 4 minutes.

The loss of vacuum on the blower causes an instant shut down of EHT and heater supply. A problem with the heater power supply shuts down the EHT supply.

Microwave aspects of using the Klystron.

These devices have a typical gain of 30dB. For 1kW this equates to 1 watt of drive and we use a broadband, no tune, Hewlett Packard Travelling Wave Tube Amplifier as a driver! A DC voltage applied to this amplifier controls its gain. We use this facility to control the output power of the system in a software feedback loop. The signal source is an aged Polarad signal generator, set for maximum output, and the operator manually tunes the frequency for minimum reflected power with low-level drive. (In a later system, operating at 14GHz, we use a top end HP8673 Signal Generator and remotely control the generator to auto tune and lock to minimum SWR.)

The output is in Wave Guide and we detect forward and reflected power with a -30dB dual directional coupler. For 1kW this provides 1 watt of sensed output, and this is attenuated using -30 db Coaxial attenuators so 1mW is measured by the pair of HP432A Power Meters. In practice we use far less attenuation in the reflected line and operate the reflected power meter at a far higher sensitivity. Analogue outputs from both power meters are digitised in a PC. Software takes into account any reflected power to determine the power reaching the load. It also determines the SWR and shuts the system down if the value exceeds 1.5:1.

During development, a Wave Guide isolator was installed immediately after the Klystron.

These passive units incorporate a large magnet that twists the forward wave so that any reflected power is likewise twisted and cannot return to the source. Roughly a 10cm cube, it was obviously designed with power in mind ... we burnt it out within days! (Next time read the specification!)

Conclusion

So what do we do with this high power set up? It is not connected to an antenna. Should it ever be, then there would be a real danger to any expensive front end within 100 miles of Liverpool! We use microwaves to attack spin waves within rocks thereby modifying their magnetic structures without heating them. If they were to become hot they would transform their chemical composition and the validity of the data would be very suspect, if not useless.

This amplifier was built as one part of a large project at the leading edge of research. Funding has come from NERC, BP Research, and the University of Liverpool Development Fund. The generosity of Varian is gratefully acknowledged.

(Dr J.A.Share, MSc, PhD is the Principal Experimental Officer at the Geomagnetism Laboratory, University of Liverpool.)

Photo (right):

The Klystron Amplifier

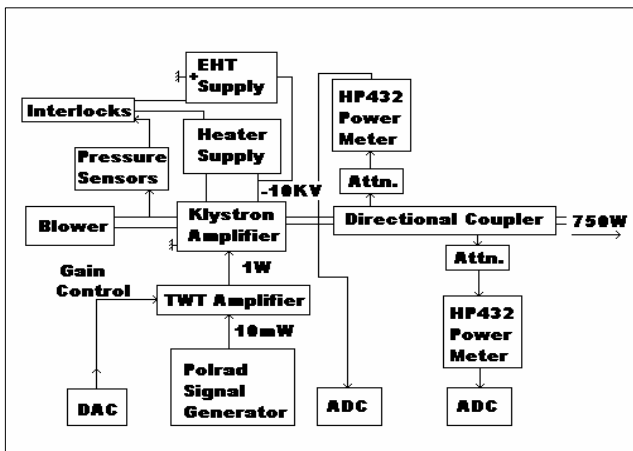
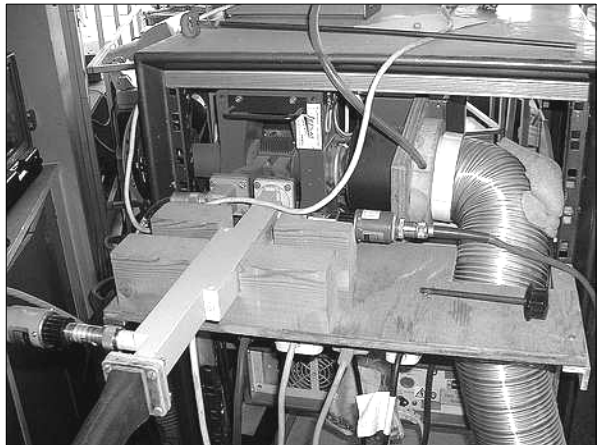


Diagram (left):

Block diagram of the amplifier assembly

Kochelsberg 2003

.. A report by Jonathan Naylor, G4KLX

Last year I went to the Kochelsberg microwave meeting for the first time. It is held at the site of the DKOPX club station (JN48JC) which is an old American radar site, on a hill and with no local trees and a set of permanent buildings which are used by the club. This year, I was back in Switzerland for other reasons so going was not a problem. I took Tobias, HB3YEV, with me and we drove the 60 miles to the site up the autobahn. The location of DKOPX is between Tutlingen and Rottweil (as per the dog breed) and is a pleasant enough drive that even XYLs would enjoy it!

When we got to the site and stopped the car, we were surrounded by the biggest mosquitoes that you can imagine ... you could have put saddles on them! Anyway, we ran from the car to the main event area and thankfully they didn't catch up. The Kochelsberg is a relatively small meeting. Usually between fifty and sixty amateurs attend, sometimes from as far afield as Austria and France, although this time attendance seemed down and a number of well known HB9 operators were missing. Outside, it was possible to set up small stands to sell equipment, one stand had a good selection of PTFE blocks. Most of the stands were by individual amateurs, although DL2AM (minus amplifiers), UKW-Berichte (VHF Communications), ID Elektroniks (ATV gear) and Micro-Mechanik were there. The last company specialises in hardware for 10 GHz up to and including 76 GHz. I picked up a couple of 12V to 24V converters (6 Euro each) and a few ATF10136 GaAs FETs (1 Euro each).

As usual at these meetings, most of the fun was in meeting people and discussing things. A number of the microwavers I met wondered why I hadn't been active in the rain scatter and were a little shocked when I said that I was now back in the UK permanently. One of the most interesting charts was with HB9BHU who is a 23cm and 3cms EME operator. He showed me pictures of his dish feed which could be flipped between the two bands with the unused band pointing 180 degrees away from the dish. However he was unhappy with this arrangement and is going to go exclusively onto 3cm EME in the near future. For this he uses 40W and a 3.7m solid dish.

There was a lecture stream in the afternoon, the first of which was by DK2DB of ID Elektroniks, describing his new OCXO design. This is a ready made unit which is claimed to out perform all others in purity (including the G8ACE design), it is certainly well made and the temperature insulation material was certainly very thick with a consistency similar to PTFE. The second lecture was about the design of 23cm pre-amplifiers based on the latest bipolar transistors. I didn't go to that one.

Between the two, was a demonstration by DL2AM (introduced as Prinz Phillip !) of how to use a laser pointer to deduce the location of a dishes focal point and to give an estimate of the accuracy of the dishes shape. The two dishes used gave very mediocre results and I am sure such a test on many peoples dishes would be quite revealing. After the last lecture, people started drifting away, just as a large thunder storm struck the site.

The journey home was spent mostly in this thunder storm and the autobahn was converted into a river in many places. Unfortunately the storm didn't really touch Zurich and I returned to temperatures in the mid 30s Celsius.



Jonathan Naylor, G4KLX, with his 10GHz and 5.7GHz portable station at Alport Height, IO93FB, during the May 2003 cumulative contest

G4DDK SUGGESTS IT'S TIME FOR A MICROWAVE DXCC

We must SERIOUSLY consider the microwave equivalent of DXCC. Many stations must be approaching the magic 100 squares on 3cm. Anyone achieving that milestone is at least as worthy as any HF operator obtaining DXCC. In fact I think it would be at least the same as Honour Role, although DXCC seems more appropriate as there is somewhere more to go (200?) It's not something that can be achieved in one weekend of good conditions. It's a lifetime achievement! I suggest a VERY prestigious RSGB award such as an excellent quality certificate or even a plaque?

WHAT DO READERS THINK?

EVEN MORE ON THE 24GHz QSY DEBATE

**From: Mike Dixon, G3PFR (mikeg3pfr@aol.com)
RSGB Microwave Manager**

I understand exactly what Martyn (G3UKV) (and others) are saying with regard to the 24GHz band and I also understand the intricacies of the Telford Group's LO generation system (this is going to have to change anyway, because of enforced changes to the bands above 72GHz - see later). Neither of these arguments is new, having been around for as long as I can remember!

There are two or three very good reasons why the change was introduced, debated and adopted nem. con. at San Marino. The changes were, indeed, "approved" (unofficially, because he was not there in person) by DB6NT, the DARC Microwave Manager - so this must mean something! Incidentally, the last time this change was mooted (several Triennial Meetings ago) resistance to the change came principally from DARC!

First, the bands above 72GHz are being changed by I TU/CEPT and we have no option to avoid these changes. IARU Region 1 foresees conflict with the Radio Astronomy Service if we consider using frequencies which are Amateur Secondary/RA Primary. The RA Services, being passive, professional and protected have enough clout to close down the amateur services if we cause so much as a whiff of interference.

Second, the 24GHz band is under threat from road vehicle anti-collision radar QRM (see G3RZP's remarks on p1 of the April N/LI). Region 1 again foresees problems if the Amateur Services do not "consolidate" ("harmonise" in Eurospeak) like activities. The best protection is to amalgamate all serious NB work - satellites (AMSAT), EME and terrestrial in one place and that is in the Amateur/Amateur Satellite Primary segment of the 24GHz band. This is much more likely to afford some sympathetic "protective" arguments in the CEPT/I TU meetings (which decide such matters) than the amateur services continuing to being spread about, apparently willy-nilly, in the Secondary segments, as is the case now.

The Amateur Services are much more likely to be listened-to in the WRC and other professional meetings if they present a reasoned argument for harmonised Primary (and preferably Exclusive) segments than if they try to preserve the "historic" segments harmonically related to 1152MHz. This has long been IARU policy, certainly for longer than I have represented RSGB microwave interests at IARU R1!

Martyn and many others (throughout IARU, worldwide) must be well aware of the huge losses of amateur microwave spectrum which have already taken place, are still taking place and will continue to take place well into the foreseeable future. It is not simply a case of "pushing it through", nor is it a case of "there is no problem with using the Secondary allocation" - there may not be today, but there certainly will be in the future. Nor was it anyone's "great idea to change" - it was a collective decision by Region 1 member Societies who are far more active than we, in the UK, are.

The only way to mitigate these losses is to consolidate, harmonise, call it what you will - as well as being prepared to admit that amateur activities, at their present levels, cannot continue to justify generous, wide, multi-band allocations such as we currently have.

Region 1's immediate solution to this was to unanimously adopt the plans which were drawn up before and during the San Marino meeting, and this is what I would recommend to all UK microwavers, regardless of their present levels of activity and their own personal "preferences".

**73 from Mike Dixon, G3PFR (mikeg3pfr@aol.com),
RSGB Microwave Manager**



ACTIVITY NEWS FROM THE WORLD ABOVE 1000MHZ

Lots of news has come in this month and reflects the healthy state of microwave activity in the UK this year. So, here we go straight into it!

June 5.7 and 10GHz Cumulatives

This contest was very well supported by UK micro-wavers and our friends from across the Channel. Perhaps the fact that there were three "rare" Locator Squares active, IO72, IN79 and IN99, brought many folk out of the woodwork! Many operators worked over 30 contacts on 10GHz, with at least one reaching the dizzy heights of 40 QSOs on that band!

Dave, G6KIE [david@banksd.fsnet.co.uk] emails the following:

Steve, G1MPW and myself, G6KIE, made a late start in the June cumulative because of uncertain weather. We chose a site on the Hog's Back near Guildford in Surrey after a look at the activity list -- although this site is not good to the south and east.

We didn't have the 2m mast up long before the first flashes of lightning occurred, but, apart from a few light showers, most of the heavy ones passed us by and we managed to stay dry.

Steve worked eleven stations during the contest but I struggled to work the first nine because of low TX output until I discovered that the battery was down. After connecting up the spare, we both went on to work Peter G4ZXO/P on the south coast whose signal was absolutely huge, almost end stop from any direction, and GW3PHO/P in North Wales at a very satisfying 325km.

Something we both noticed throughout the contest was that, although signal levels from stations were reasonable, the audio quality was often poor, making it slightly difficult to resolve.

(Editor's note ... this was most probably the effects of Rain Scatter which produces an almost auroral effect of audio ... try listening when there's no rain around Dave and you'll know what I mean!)

Steve, G1MPW, [scooke@tiscali.co.uk] adds the following to Dave's report ...

Dave G6KIE and myself G1MPW went to the Hogs Back just south of Guildford IO91QF. Because of the restricted access there, depending on which side of the ridge you are, you can either see north and east or

from the other side south and west -- its just a shame you can't do both together !!

We chose the north facing side first with the possibility of changing over sometime during the afternoon but in the event we didn't have to. Conditions seemed most strange with lots of rough sounding signals -- presumably due to rain scatter. *(Yes! ... editor)*

Despite the thunderstorms throughout the afternoon we managed to work 11 stations -- not an impressive number compared to some (one south coast op was up to 39 by the end of the day !!) but our 11 included 2 countries and 8 squares -- we only managed 9 in the whole of last year so it was quite a good day all in all.

From: G4BRK, Neil Whiting (IO91DP)

[neil@thewhitings.freeserve.co.uk]

The June 5.7/10GHz cumulatives started well, with good RS again to France and lots of interesting activity promised. By the end of a very busy day I was amazed to have managed 39 QSOs on 3cm (and 14 on 6cm). There were several gotaways too! G3ATM/P was worked for IN79 at last on 3cm (a bad direction for Me. I had to get the RS in the right place so it took 3 attempts). Six stations were worked in France, including F/GW8AWM/P, by RS, in the earlier part of the day. Then later there was a slight tropo enhancement, giving 4 QSOs with PA and DG1KJG (JO30) at 621km (very weak on CW). The RS came back at the end of the contest and F5HRY was worked on 6cm to give the best DX on that band at 439km.

That's still 28 G's in the 3cm log for that day - tremendous activity, thanks to all who came on.

From: MOEYR, Paul J. Marsh

[pjmarsh@frars.org.uk] operating as G4FRF/P:

Myself and John M5AHQ were up on **Bell Hill**

(IO80UU) as usual. The previous day we had thunder/lightening and very heavy rain so were looking forward to getting soaked up on the hill. On Sunday morning, the WX broke and we had a few hours of sunshine followed by thunder and lightening, then rain around 18:00 local. Needless to say, there was some interesting RS about.

We worked 35 stations, the best DX being F5HRY at 414Km - that is now our ODX. F5HRY was worked after we heard him cq'ing on 10368.100 - no 2m talkback was used, and we exchanged 57 and 55 reports which was reasonable. I have made some recordings of the 10GHz contacts which I have put on the FRARS website (<http://www.frars.org.uk>) along with the photos of the contest.

Again, it was nice to see some new callsigns up on 10GHz. We managed a total of 13 squares during this contest as opposed to 11 in the last one.

At times the pileup on the calling channel made it unusable for 10 - 15 minutes at a time. Perhaps we could nominate some other frequencies say in 5kHz steps either side of .175. The mobile phone was used a couple of times for link setup. The new tripod for the 10GHz dish has a calibration ring marked in degrees, but it's the opposite way to a compass!! The calibration

makes link setup a lot faster and is usually spot-on and doesn't require further adjustment - well worth adding if you haven't already.

Mike, G0JMI, <mike.karen1@tesco.net>

Emails the following ...

Here is a list of stations worked on 10GHz from my home QTH (Alton, Hants. IO91MD) during the Contest on 22nd June 2003:

G4LDR on SSB at 5/2, IO91EC

G4ZXO/P on SSB at 5/7, IO90WW

G8VOI/P on SSB at 5/2, IO90MX

G0API on CW at 5/2/9, IO80XS

G4NNS on SSB at 5/5, IO91FF

G3LTF on CW at 5/7/9, IO91GG

G4RFR/P on CW at 5/2/9, IO80UU (best DX on the day at approx 100km)

G8ACE (IO91JA) one way, received me at 3/1. Carrier received by me, but was too weak to make two-way

These were all not via rain scatter, so the QSO's were of real interest to me from my urban QTH.

From: G3XDY [g3xdy@btinternet.com]

The Cumulative on 22nd June was good here in

JO02OB. The best QSOs on 6cm were GW3PHO/P in IO72 (for my first GW on the band), G4ALY (IO70) and G3LRP (IO93) on rainscatter, plus PA0BAT (JO31). On 3cm GW3PHO/P again provided a new square, as did G4ALY (IO70) and F/GW8AWM/P (IO99), the latter two by rainscatter. I made 7 QSOs on 6cm and 20 on 3cm. The scatter was too far south at first but by mid-afternoon there were several good scatter points between southwest and west.

From: John Fell, G0API, (Corfe Mullen - IO80XS) <g0api@tesco.net>

Once in a while things work out, usually when you least expect and June 22nd seems to have been one of those rare events when it did. I intended to come on for just a bit to give away some points and keep in touch with old friends - the WX was humid and overcast with the ever present rumble of thunder following the "splat" via the rig speaker. Rain was in the air but held off until after lunch. Things started normally at 0917 with some broadening of the normal beamwidth and multipath distortion which was reduced by some dish elevation. I called our club station G4RFR/p, who were out on the beacon site at Bell Hill, 20km North west of me, at 1001 and Paul MOEYT said he could hear strong CW under my ssb transmission. I am blocked by close in rising ground towards the SE/SW sector so tentatively swung the dish in the general direction and called QRZ. This resulted in solid 2 way QSOs with F5HRY in JN18EQ, followed by F1HDF/P at 435kms and 3 more /P French stations - all in the space of 8mins! Further contacts followed on the same heading with G stations, all with considerable phase distortion due to the prevailing rain scatter. I guess the thunder storm clouds were located in the English channel and were productive for propagation - with approx

15 degrees elevation I could virtually restore signals to T9, ssb sounding normal (no audible Doppler). I reached 17 contacts by lunchtime, including several directly from CQ calls on 10GHz. As the WX was by then turning towards continuous rain I stayed a bit longer in the shack and by 1645 had worked **40 stations** - all 2 way - beating my previous best by some margin. A rough points check suggests about 6650 points or an average of 166km per QSO. Several contacts were firsts for me and included G4ACW/p, G3XDY, G6KIE/p and several of the 7 French stations worked. I do believe that having shack control of antenna elevation played a large role in this and would again recommend it - even if its just to take out the effects of a bent stub mast! Station details are: 60cm offset dish at 10m agl, masthead transverter (WDG), 8W TWT. **10GHz is alive and kicking!**

From: Jonathan Naylor G4KXP (Aport Height, IO93FB44) [g4kix@pop.agri.ch]

I managed to build my new transverter mount for my new tripod. It uses eight M8 bolts and is rock solid. For this contest I was joined by Matt G7OBR.

On site I had to put up with a lot of flying dust and an increasing wind, at least rain wasn't a problem. The new tripod was a joy to build up and set horizontal and the transverter slid onto the tripod and was locked down. My dish had become bent in its last fall in the previous cumulatives contest and so the angles needed to both put the feed in the right place and to ensure that the dish was pointing at the horizon were all mixed up. G8OHM/P was quickly worked on 6 and 3cm, but that proved nothing. A lot of time (some 2 hours) was spent trying to get everything right.

Matt's system was a barefoot DB6NT transverter and a 60cms Inmarsat dish with horn feed. His PTT consisted of two wires pressed together! He had problems with his 12 to 24V converter and had to run his car engine to get it to work. Matt had provided me with two large batteries so my power problems were a thing of the past. He was able to work G1SLE at 25km for his first 3cm QSO. On receive he was hearing almost as well as my system despite being lower, slightly obstructed and with a dish of dubious accuracy. I therefore think my dish was underperforming by many dBs.

Over the next few hours I was able to work eleven stations on 3cm and only three stations on 6cm. To me, it seemed like activity was much lower than the previous contest but I suppose people weren't beaming to the north on 2m. Paul MOEYT (as G4RFR/P) was his usual booming signal and was heard by Matt on his system also, for a half QSO. Later I got an MP3 file from Paul of my signals. The accuracy of my new tripod was a delight to use, I had a paper with all the known contest stations and their headings and this made QSOs very easy. A number of gotaways from the previous cumulatives were worked and that made me happy.

At around 1430 UTC disaster struck ... the wind had been getting stronger and stronger, Matt had already

dismantled his system for safety, and with one large gust my heavy tripod was over on its back. This is not your average tripod, its a large EMI broadcast job with an extremely heavy hub that one person can only lift with difficulty but it was over and my dish was bent. The decision to pack up was made and everything was put into the car quickly.

I have decided to go down to a 60cm dish, and Matt is looking to see if he can find an old Sky dish for me. Hopefully the reduced wind loading will ensure that this doesn't happen again, the reduced gain probably won't make a huge difference and the increased beamwidth could be a blessing.

Activity this time was quite definitely in the south.. However over 75% of my QSOs were over 200km so being in IO93 does have advantages in terms of points per QSO.

From: G4ALY, Ralph Bird

[Ralph.Bird@btinternet.com] IO7OVL (Cornwall)

This was my first experience of a good contest since I started 3 years ago. It was very exciting and quite a lift for my enthusiasm. Here is the list for entry in the News in order of contact:

3cm: G4NNS,G3ATM/P G4LDR,GDFYX,G3JMY, F/GWATM/P, GORRJ GW3PHO/P G4RFR/P. F6DKW, F5HRY, F1PYR/P, F1HDF/P, G8BKE/P G8ACE/P, M0GHZ/P G8LSD/P, G4BRK, G3LTF,G4EAT, G4EZP, G3ZXO/P G3LRP, G3XDY.

6cm: G4NNS, G4LDR, G3PHO/P, F1PYR/P, G8BKE, G8ACE/P, G3WYJ/P, G4BRK, G3LRP, G3XDY.

Total 24 on 3cm 10 on 6cm, 12 squares worked. Best DX F1HDF/P 548.4km A wonderful day. Thank you everyone.

Doug, G3ATM/P at the Lizard in Cornwall activated the rare square of IN79

for the period of the contest. He had 16 contacts on 10GHz, 3 countries and with a best DX of 569km (F5HRY). His log included five French stations. Thanks to rainscatter, it turned out to be a very enjoyable day. Because of high hedges in that area he decided to operate from a camp site next to his caravan. It meant a last minute lash up, with the transverter tied to the offset dish boom at 15 feet above ground. From his home near Chepstow, where he is GW3ATM, Doug is having good results with a flyswatter antenna on 3cm. His best DX so far from there is G3LRP (IO93HO). He can always hear the Cleeve Beacon (B3CCX) by reflection from police radio masts, on an opposite heading to that true one for Cleeve.

Peter, G3PHO, operated with 5.7GHz and 10GHz as GW3PHO/P from Rhiw Mountain in IO72QT.

Rhiw is on the western end of the Lleyen Peninsula in NW Wales. On arrival at 0900 local time he drove up the track into thick hill fog and things looked bad, with the gear getting damp in a short space of time. Conditions started out quite poor, even on 144MHz. It was frustrating to hear talk of rainscatter contacts between UK and the Continent when none could be heard in NW Wales! The mobile phone then started to go crazy as

one by one the French stations, who were finding the 2m band poor also, resorted to the mobile link to try to set up a microwave contact with IO72 square! Only one was fortunate enough, F/GW8AWM/P in IN99CP. Long periods of searching for F5HRY, and F1GHB proved fruitless. F6DKW's dots were heard on 10GHz and Peter's carrier heard in return but no contact was made. This would have been 659km!

By 1200GMT only 7 stations were in the log but during the rest of the afternoon things looked up (although the WX didn't!) and the day ended with 27 stations worked on 10GHz and 10 stations on 5.7GHz. At an average distance of 292km per contact on 10GHz, the advantage of operating from the periphery of the activity was again proved. It's not the **quantity** of contacts you make that gives a good score in the contests, rather it's the **quality** of them! At almost 8000 points for the day, Peter came away that night feeling well satisfied. Best DX on 10GHz was G4DDK (413km in JO02PA) and 405km on 5.7GHz (G3XDY, JO02OB). Half of the 27 contacts on 3cm were at distances in excess of 300km. Thanks are due to Doug, G3ATM/P and Frank (F/GW8AWM/P) for the rare squares they activated.

From: M0GHZ/P, David Millard

[Themillards@btinternet.com]

Having added a preamp to my WDG transverter (thanks to G4NNS) I ventured out to Hackpen Hill (IO91) on Sunday 22nd June to see how it performed. I have 750mW from a Qualcomm amplifier to a 60cm offset dish with a G3PHO/G3XDY feed. I missed the early rain scatter as I didn't get set up until 12.30 (must be more enthusiastic next time!) but delighted to work 21 stations: G8OHM/P IO82QL, G4UVZ IO80KX, G4RFR/P IO80UU, G4BRK IO91DP, G8LSD/P IO80WP, G4EAT JO01HR, G4ALY IO7OVL, G4ZXO/P IO90WV, G8VOI/P IO90MX, M0JTT/P IO90MX, G4ACW/P IO90MX, G8ACE/P IO91JA, G3PYB/P IO90LU, GOAPI IO80XS, G4LDR IO91EL, G4NNS IO91FF, G3LTF IO91GG, F/G8AWM/P IN99CP, G1JRU IO90HU, G3JMY IO81RM, G3FYX IO81RM. ODX was F/G8AWM/P @203km.

I am active for the 23cm cumulative on the 3rd Tuesday of the month from the home QTH, no 13cm aerial yet at the new QTH.

From: Brian Coleman, G4NNS (IO91FE)

[BrianColeman@compuserve.com]

Excellent conditions here... worked 32 on 10GHz and 14 on 5.7GHz both new records for me!

From: John Hazell, G8ACE

[hazell@dsl.pipex.com]

I worked 10 @2 way on 5.7GHz and 20 on 10GHz. I waited till rain had passed so I was on from 11am then when it rained at 4pm I called it a day.

From: Peter K. Blair, G3LTF, IO91GG,

[100633.1656@compuserve.com]

Sunday 22nd June was BUSY, with Es on 144 and Rain Scatter (RS) on 3cm for large parts of the day. I had

got my new 3cm system, 65cm offset, 800mw, 1.5dB NF, up on the tower, plus an extra section in it to bring the height to about 65 ft, thus clearing much of the surrounding tree line. The rebuild also included a home built, precision rotator with 1.5 degree accuracy and slow rotation capability. I worked the following G4BRK, GORRJ, GOAPI, G4ZXO/P, G8VOI/P, M0JJT/P, G4RFR/P, G8GTZ, G3XDY, G0JMI, G3PYB/P, F/GW8AWM/P, G4ALY, G4EAT, G4ECP, M0GHZ/P, F6DKW(one way), GW3PHO/P, G3FYX and G3LQR. This gave me 2 new countries and brought the squares total to 10. Most contacts were on RS. I was especially pleased to work GW3PHO/P (IO72QT) at 280km in the worst direction from this QTH, the first qso with IO72 on 2m let alone 3cm! On June 23rd I had a one way with G4ALY in normal conditions, ie no RS. I plan to add elevation control soon. Its been a long job getting a 3cm system up on the tower and I would like to acknowledge all the encouragement and help with this from my good friend Simon, G3LQR!

From Ted, G3JMY <EDWING3JMY@aol.com>

A 10 Gigs Revival! Things really got going on 10GHz when we had the opening at the beginning of June. Unfortunately for me my rotator broke down just as I was attempting to work Maurice, F6DKW and it took many hours to get it going again - too late for the DX.

However, a similar set of conditions was with us in the 2nd 10GHz Cumulative on 22nd June. I worked 26 stations that day, including 3 Fs. Maurice was S9 on SSB! They did not appear to stop coming in right through the day. The morning was a bit slow but after lunch it was a steady stream. Several desirable stations were "gotaways", mainly because others were quicker than me! I tell myself that their 2m beams were pointing somewhere else than in my direction - it softens the blow!

July 24GHz Cumulative Reports

Some ten operators came out for this event, a disappointing turnout when you reckon there are well over 30 stations with working half watt stations in England alone!

Peter, G3PHO, operated /P from three sites with his new 2 watt amplifier on the band. From **Beeley Moor (IO93FF)** he had an easy 5/9+ contact with G3LRP (IO93HO) but problems immediately came to light in the form of rapid frequency drift! This was one of the hottest days of the year (30 degrees C air temp) and the intense sunlight caused Peter's transverter to get hot. The internal temperature must have exceeded the 50 degrees C rating of the DF9LN OXCO as a rapid shift up the band of some 20kHz took place in the time it took to make the QSO with G3LRP! By the time he got to Alport (IO93FB) it was decided to take the lid off the transverter to get a little air cooling. This did the trick and good reports were exchanged with G4KNZ/P and G3FYX/P on Cleeve Common (IO81XW) at 131km as

well as nearby M0MRF/P (Merryton Low Triangle). G3UKV/P (Brown Cleve, IO82QL) was worked one way only as Martyn's coax relay was not working and he couldn't transmit as a result. The intrepid trio of G8ACE/P, G4LDR/P and G8BKE/P on Walbury (IO91GI) were tried in vain, the long 190km+ path being too obstructed for even the 2 watt 'PHO signal to penetrate, even though they received a good 10GHz signal from him. A 40 minute drive then took Peter to a site just north of Merryton Low from where the lads on Cleeve were again worked with ease over 139km and another QSO with G3LRP was secured under the "Rover rule" of the contest. All in all, a good day out with 8 24GHz contacts in the bag.

From: Steve, G4KNZ <steve.davies@nokia.com>
G4KNZ and G3FYX operated /portable from Cleeve, IO81XW, working a total of 7 contacts each on 24GHz: G8BKE/P, G8ACE/P and G4LDR/P all on Walbury (IO91GI, 73km), G3UKV/P on The Wrekin (IO82RQ, 93km), M0MRF/P at Merryton (IO93AD, 136km) and G3PHO/P first at Alport (IO93FB, 131km) and then near Merryton (IO92AD, 139km).

Signals were also exchanged with G8BKE/G8ACE on 47GHz, but no contacts made due to a combination of only the high power sources (10 & 20mW) being audible and equipment difficulties.

The wx was hot and humid and not very good for 24GHz or 47GHz, the signals generally somewhat lower in strength compared to previous occasions. However, it was nice to get out /P again, after missing the 2002 season.

Other Millimetre wave News ...

**From: G3PYB, Peter Blakeborough
[peter@papine.demon.co.uk]**

G8ACE, G8BKE & G3PYB took the 24, 47 and 76GHz gear out on 15 June just to see if the equipment still works. Distances were not great and temperature hit 30C at 3.30 pm. 24G signals were much to strong to use for pointing, and there was very good FM copy on 47GHz from all stations. G8BKE was at Walbury PMR, G8ACE on Lane End nr Winchester and G3PYB on Mercury/Salt Hill. ACE was easy FM copy to PYB on 76ghz, but no copy to BKE however on the shorter path from ACE to Walbury John's 76GHz was copied by BKE.

Part of the test was to confirm frequencies. Frequency keeping was excellent considering the equipment has not been out for more than six months. All credit goes to ACE and his excellent stabilised oscillators for such a good result.

From: Harold, G3UYM/P

[harold.groves@ntlworld.com] IO92XA: I arrived on site and started to erect the gear then found i had left a box of cables at home, So I drove back home again about 20miles away to collect them ... But worst was to come!

I mounted the 24G equipment on my tripod as usual then suddenly the whole lot tilted forward onto the ground- the tilting tightening arm had sheared off. So one of those days it was guess! However I was able to check GB3DUN with the transverter hand held and open wg. Unfortunately loss of the tripod will curtail my microwave activities. If anyone has a spare tripod I would appreciate hearing from them

GENERAL MICROWAVE ACTIVITY NEWS

Microwave band conditions have been very good over much of the past month or so

John, G3XDY [g3xdy@btinternet.com] in JO020B writes ... The VHF NFD weekend in the beginning of July is a multi-band contest including microwaves in Europe, I had a brief spell on Saturday and then a longer session, from early Sunday morning, hunting DX.

E19E/P in IO62 was a new square and country on 23cm, finally achieved after many years of looking for EI. Other good QSOs on 23cm were DL0GTH (JO50) and DF0BG (JO41). DL0GTH was also worked on 13cm for a best DX of 683km. On 9cm a difficult QSO was completed with DL3YEE for DX of just over 500km. 6cm and 3cm had no enhancements so DX was limited with PA0BAT (JO31) the best on both bands.

As I write there is a small tropo enhancement, with LX1DB worked on 23cm, and the DB0GHZ 3cm beacon (JO34) audible at 539 on peaks of QSB.

Neil, G4BRK [neil@thewhitings.freemove.co.uk] (IO91DP) emails this report ... The May 5.7/10GHz cumulative had excellent activity, a new record no. of QSOs for me (I think) of 34 on 3cm. The reliable PA0WWM was best DX at 428km. F6DKW and F1PYR/P were the other continentals - that means 32 G's were active, not counting the few gotaways I know I had. Activity as good as it's ever been. On 6cm, F1PYR/P was the best (393km) of 10 QSO's, so a very good turnout here too. I even managed to work YU/YO/LZ on 2m sporadic-E in between!

31 May brought a (very) little tropo - OZ1CTZ was only DX worked, but made it on 23cm and 3cm, 873km and a new square on 3cm. The very next day brought super RS in the Channel, giving plenty of QSOs with France and UK on 3cm and 6cm. Even made qsos on 9cm and 13cm, though I'm not sure if the 13cm was RS or some other scatter. It was nice to work F6APE (IN97) at last for a new square on 3 and 6cm. Scatter was noticed at 07.35z and was still going at 19.30z! 7/8 June was a contest weekend on the continent - F8BRK/P was worked on 3cm for a new square (IN98) with good signals (56/57). There was RS further East - the only thing I heard was a long CQ from DJ4AM in JO31, but he went back to a local and turned his dish (or the scatter died). More RS on 9 June brought in GW3ATM and G6DER - Doug was a huge signal. Also the 14th, and 17th June saw scatter to France and

Holland, though they were fairly small events.

Finally VHF NFD, which covers bands above 23cm in rest of Europe (very enlightened attitude). Conditions pretty poor throughout. PA6NL (JO21BX) was only 3cm and 9cm QSO. 13cm was a bit better and it was nice to work PA0WWMX in JO21XI (532 km), plus 5 other PAs and F1PYR. 23cm should have been good because I'd just commissioned the new PA - however there was no real DX due to conditions and some paths which would normally have worked didn't. The best of the 30 QSOs was DJ5BV in JO30KI at 618km. GM3SBC/P and E19E/P added to the interest. It was nice to work quite a few different callsigns (G stations doing NFD).

From: Simon, G3LQR <G3LQR@aol.com>, JO02QF: The 24GHz half watt amp from Endwave has arrived. The other still works on the tower with 350mW at the feed measured but, if it dies, I now have another for replacement. I've had many qsos with Wim, PA0WWM. on 24GHz this year and one good r/s contact using some elevation my end. Sadly, the trees here have grown higher and my window from S/W round to N/E is blocked so 24GHz will not go on those headings. Even so I did work GW3PHO/P (IO72QT) on 3cm in the June contest. It was interesting to hear Peter go from q5 on ssb with Sam and then coming in roughish after he moved his dish toward to me -- the difference between forward and some side scatter.

I've had some good RS again to EU with the 8th June giving 22 contacts, mostly into DL -- some new ones including OK1VAM/p. RS in late May gave contacts with OK1JKT/p, DM2AFN -- and DF2CK for best on RS at 879km in JO71AD. The opening on 1st of June to France was interesting with F6APE there on 3cm and 6cm. Rain scatter also provided G4NNS and F6DWG/p on 6cm, amazing in that I only had 1 watt available.

I've since improved my 6cm system a little and now have 2 watts at the feed with 13W in shack! I need to improve the 6 foot dish as its b/w is around 15 degrees and it should be 2 degrees. It's not easy to make a good 6cm dish but I'll get it down soon as things get quiet. It covers all bands from 23 to 6 with a ridged horn feed.

Regarding 24GHz, I will have to move down to 24.048GHz as Wim is moving after the October contest otherwise I will not have anybody to work on that band!

From: Reg, G8VHI <Regwoolley@aol.com>

I was out with G3SDC/P JO02 in VHF NFD and made over 60 QSOs in the restricted section! The Secret Weapon was to mount the 4 brick PA at the top of the mast. Then we used a short tail of FSJ4-50 to the antenna so what was put in came out, overcoming the feeder loss very well. I managed 1 OZ plus some nice Germans in JO50,40, etc. All worked very well on the band except for a blown preamp that had to be replaced, all from new and, as far as we know unused by any other group. I'm still looking for 23cm elements for a Bird 43!

THAT'S ALL WE HAVE SPACE FOR THIS MONTH ..

Microwave League 2003

	1.3G		2.3G		3.4G		5.7G		10G		24G		47G		76G		Grand Total
	Wkd	Dx	Wkd	Dx	Wkd	Dx	Wkg	Dx	Wkd	Dx	Wkd	Dx	Wkd	Dx	Wkd	Dx	
G3XDY	159	947	51	947	25	789	34	947	58	947	2	49	7	139	6	139	13210
G4BRK	109	1083	30	621	16	621	22	483	69	873	2072	2702	2702	2702	2702	2702	8012
G(W)3PHO(/P)	19	288	102		14.5	277	592	16	622	903	47.5	511	835				5134
G4KNZ(/P)																	2316
G4LDR(/P)	13	536	130		5	107	78	6.5	194	114	23	378	299				840
G3JMY											31	471	502				502

BAND	1.3G		2.3G		3.4G		5.7G		10G		24G		47G		76G		
	Wkd	Dx	Wkd	Dx	Wkd	Dx	Wkg	Dx	Wkd	Dx	Wkd	Dx	Wkd	Dx	Wkd	Dx	
SCORING CALLSIGNS	4		3		4		4		5		4		5		4		FALSE
AVERAGE DX	713		596		448		561		636		90		636		90		FALSE
AVERAGE CALLS	75.0		30.3		15.1		19.6		45.7		4.0		45.7		4.0		FALSE
TOTAL																	
SCORING CALLSIGNS	6																

BAND SCORE CALCULATED = No. OF STATIONS WORKED / AVERAGE No. OF STATIONS WORKED **X** MAX. PERSONAL DX WORKED / AVERAGE DX FOR THE BAND **X** 1000

See January 1999 Microwave Newsletter for Rules
and www.qsl.net/g3pho

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