An Amateur Radio publication for the Microwave enthusiast

MICROWAVE NEWSLETTER

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FROM THE EDITOR

2002 – MARCH

More exciting things have been happening on the millimetric bands since the last issue of this Newsletter. They are documented elsewhere in this issue. It is quite amazing how quickly developments in amateur microwaves take place, once someone makes the first move. Of course, much is beyond the "average" microwaver, where bands such as 241 and 322GHz are concerned, as the equipment is often built around rare items of surplus and needs sophisticated test gear. Still, it's very nice to hear of the fine contacts made Brian Justin, WA1ZMS and Will Jensby, W0EOM.

You can hear these people in person if you make the "pilgrimage" to Microwave Update this year! Details were published in the Newsletter a couple of issues ago. Since Update 2002 will be held in New England, the cost of getting there will be as cheap as you'll ever get, so why not make the effort and come along? You'll receive a very friendly welcome from a large group of extremely enthusiastic American microwavers.

Nearer to home is the 6 metres to Microwave Convention to be held on the 6th April in Cheshire. Full details appeared here last month. The Microwave Committee would like to see as many of you as possible there! If you wish to stay overnight you should have already booked the "in house" accommodation but if not you'll no doubt be able find a suitable B&B in the near vicinity.

Finally, may I make a plea for more reader input to this Newsletter! Apart from our small, regular core of writers, three of whom supplied articles for this issue, we rarely hear from the rest of you. I can't believe that you are not doing something interesting out there! Please let the rest of the microwave fraternity know about it .... nothing is too small. What you think is "small beer" maybe just what some others have been looking for.

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 ..

So you thought you knew all about crystals?

The following discussion appeared on the WA1MBA Internet Microwave Reflector during August last year. We are very grateful to Bob, K3VOT, for allowing us to publish his email information in the form of this article. Bob really knows what he is talking about! While some of his comments are more relevant to American microwavers than to us in the UK, we have not omitted them as they still make interesting reading.

From: K3VOT [Bob@aurand.com]

My qualifications? 25+ years working in the crystal oscillator and microwave oscillator business, including custom microwave bricks, high stability OCXO's and TCXO's, synthesizers, etc. I currently work as engineering manager for a large international corporation in their crystal oscillator division. In a typical year we buy, oh ..... 400,000 to 500,000 crystals.

Crystal Suppliers:

First of all, I sometimes use International Crystal for home projects, consulting jobs and occasionally for projects with my current employer. I've had excellent success with them, their major shortcoming being lack of capacity-- they just can't deal with the kind of large orders we place. Their chief crystal engineer and a good contact there is Darell Brehm, WA3OPY. Darell has been around, having worked at McCoy and Reeves-Hoffman before ICM.

Some (all?) of the other crystal makers mentioned on this reflector are small outfits and I have no experience with them except Colorado Crystal. Colorado is probably in the top tier of crystal makers, worldwide, and they have an excellent hi-precision process. Contact is Tom Schulyer, KD0JP I believe. In the last 5 years or so, much consolidation and acquisition has occurred in the US crystal industry. Colorado has been one of the survivors and, as a result, has more work than they need or want. Lead times are very long ... for work, we are regularly quoted 30+ weeks.

A good resource for finding crystal and oscillator vendors is the IEEE Frequency Control Society. They have hotlinks on their web site to most of the major suppliers worldwide. Lots of good technical papers here too. I recommend John Vig's tutorial on crystals and oscillators as required reading for all experimenters. The IEEE web page that links to crystal and oscillator related information is:

http://www.ieee-uffc.org/index.asp?page=freqcontrol/freqmain.html&Part=5#top

Crash around in there and you will find lots of good stuff!

Crystal accuracy and behaviour:

Firstly, virtually no one makes solder seal crystals anymore. It's a dirty process, leaving splatters of solder and flux inside the can. Any contamination such as this will move around, eventually landing on the electrodes, changing the frequency. In the biz we call this the quartz to crud ratio. For various reasons the crud can subsequently leave the electrode area only to return later, changing the frequency every time. Additionally, solder sealing is intrinsically an "atmospheric" sealing operation. So, what ever contaminate (or moisture) was inside the building at the time gets sealed inside the can to do it's damage over time.

Modern crystals are invariably either resistance welded or cold welded. Resistance welding is far more common for several reasons: commercial welding equipment can be purchased -- cold welders are usually custom built. R-weld is faster and therefore more suitable for production environments. R-welders are easier to operate and maintain. Among oscillator engineers, it's generally believed that cold welding results in better performance, but some crystal engineers swear resistance welding can achieve the same performance. The jury is still out on that one, as far as I'm concerned.

All UM-1's are resistance welded. TO-3 and other 2 leaded crystals can be either R weld or cold weld. Look at the base ... if it's one large piece of glass with the crystal leads poking through, it's cold weld. If the base is mostly metal with matched glass eyelets for the leads, it's R weld.

No crystal maker can get the calibration right unless you, the user, supply the right information. For fixed frequency oscillators (not voltage

controlled) this is largely the load capacitance, sometimes called "finish point". "Series" is a legal load corresponding to infinite load cap. Series crystals vs. load crystals are all made the same way. The difference is made up in the finish plating, what someone on this reflector referred to as the final electro-deposition of electrode material and is strictly a matter of where on the reactance curve to put the frequency.

All crystal makers need some kind of tolerance on load cap (if used) and frequency tolerance. +/- 0.5 pF is typical for load and +/- 10 ppm for frequency. It's up to you to adjust your circuit to frequency (try **THAT** on 400,000 oscillators a year!). Remember, at 1296 MHz, 10 ppm is 12.96 KHz!

If the crystal is used in a oven, the operating temperature **must** be specified and given a tolerance. +/- 5 degrees Centigrade is typical. Usually, with OCXO's, the OSCILLATOR maker adjusts the temperature of each oven to match the turnover temperature of the crystal and each crystal in a batch will have slightly different turnover within the tolerance. Don't expect a well-centred process with a Gaussian distribution unless you are buying a VERY LARGE number of crystals.

In practice, this means, when you are replacing a crystal in an oven, say to change frequency of a brick, and the documentation says maybe 75 degrees, that's the NOMINAL design temperature for the crystal. Maybe the old crystal came in at 73.4 and the brick manufacturer set the temp on that individual oven there. Now you buy a crystal from say, International, and give them the 75 degree spec but they end up at 78 degrees. When this crystal is installed in the 73.4 degree oven, it will run high and on a slope. If the oven temperature creeps up over time, due to ageing of the thermistor or other components, the frequency will drop towards the turn and this change in frequency will be indistinguishable from ageing.

By the way, this oven setting information applies to AT cut crystals, only. SCs behave differently but are unlikely to show up in ham equipment. NEVER expect a crystal calibrated at room temperature to be on frequency when used in an OCXO. Expect a 20 to 30 ppm drop in frequency (for the same load) when the crystal gets to oven temperature.

Crystal Oscillators circuits:

No oscillator circuit is perfect but by far my favourite is the Butler. It can easily work from low MHz frequencies to VHF. It's easy to set-up, accommodates both fundamental and overtone crystals and can deliver very good phase noise. We run thousands of these using 155MHz fundamental crystals each week ... no problems.

Here's how to do it:

Select a high Ft transistor ... my favourite is the NE856 from NEC and available from Digikey. This transistor has low junction capacitances, low Rbb and good 1/f noise. In fact, I use this transistor in low level stages everywhere from audio to microwave.

If you are running from a +12 volt or there abouts supply, bias the base with 1K ohm to ground and 3.3 K ohm to +V. Chose the emitter resistor to be 1K at low frequencies and maybe as low as 330 ohm at 150MHz. Considerable variation in bias is possible. Bypass the base with a 0.1 uF chip cap close to the base lead.

For the tank, select the inductor value to be between 50 and 150 ohms reactance at the oscillation frequency. Wind the coil on a toroid core. Micro Metals T-25-6 or T-30-6 are good choices at 100MHz. Use a larger core at lower frequencies.

Calculate the capacitance to resonate with the chosen inductor. Split the cap in a 1:3 to 1:5 ratio. Again considerable variation is possible. You might need to go back and adjust the inductor value slightly to accommodate standard value caps. Use C0G chip caps at VHF. At lower frequencies where C0G are not practical you will need to go to a higher dielectric constant like X7R for at least one of the caps. Put the larger value cap (smaller reactance) to ground and the other cap to the collector.

Initially, take output from a one turn link wound on the toroid.

To set up, connect a jumper or small value resistor from the emitter to the junction of the two tank caps to make the circuit free-run. If necessary, adjust the tank to set the frequency roughly to value. Remove the jumper or resistor and connect the crystal. Observe the output frequency and level and squeeze or stretch the toroid windings if necessary to peak the output level.

Now adjust the output coupling by adding one

turn at a time to the previous one turn link, each time squeezing or stretching the toroid winding if needed. While adding turns you will find the output power to increase, level off and then decrease. Proper coupling is fewest number of turns to reach the peak output power. At VHF, one turn may be sufficient.

If you must adjust the oscillator frequency, put a setting capacitor in series with the crystal. If you need a VCXO, put a varactor diode in series with the setting capacitor and the crystal. In the case of a VCXO, the varactor anode goes to the tapped capacitors. A 10K resistor from this point to ground establishes the anode voltage at zero. Another 10K resistor from the cathode provides a tuning voltage input port. Resistor values are not critical ... just don't go too low or too high.

The Zetex ZC8xx series varactors, available from Digikey, work pretty well. If pullability is too low you can try some coil in series with the crystal and varactor. Again, wind it on a small toroid and you can have almost infinite adjustability. The general idea is to make the coil + varactor + setting cap combination approximately series resonant at the oscillation frequency. Pull range is also very dependent on crystal parameters and will ultimately limit the range. If reactances in the series leg get too large loop gain will drop below 1 and oscillation will cease.

Make this circuit small, shove it into a piece of 1" diameter copper water pipe, wind the outside of the pipe with insulated resistance wire and you have the basics of an OCXO.

I hope this makes sense. A two transistor Butler circuit is possible and has some advantages at low frequencies (like 10MHz). That will have to wait for my web page and real schematics!

Bob Aurand, K3VOT,
State College, PA, (FN10cs)

FOR SALE

High Power 3cm home station:
Russ, G4PBP, is rebuilding his entire station (HF, VHF and microwave) over the next few months and has the following 10GHz system for immediate sale:

G3WDG 3cm transvertersystem with preamp + 13 watt TWT + switched mode PSU (with digital voltmeter readout for the TWT. A spare TWT and a 60cm Andrew dish are also included.
The whole system is well built and "plug and play" .. i.e. ready to go. **Price £350 o.n.o**.

Russ has many other bits and pieces for sale. Just phone him after 6pm or at weekends on:

01902 731502

MICROWAVE CALENDAR APRIL 2002

Saturday 6th: 6m to Microwave Convention, Rease Heath, Cheshire

Sunday 21st: Millimetre Bands Contest

APOLOGIES FOR THE LATE NEWSLETTER ……

We are sorry that this issue is out later than normal but circumstances beyond the editor's control meant that he could not make a start on its production until the last week of March. The April issue will appear as normal.... ie around the 22nd of the month.

Fancy one of these beauties in your backyard?

A visit to the Stanford dish, located near San Jose, California, was one of the highlights of last year's Microwave Update. The 150 diameter antenna as used to make several 23cm EME contacts on the day of the visit. The whole antenna plus control room/shack rotate on a motorised turntable. Three large arms support the feedhorn, which is fixed to the arms when they have been lowered to ground level.

The photo left shows Paul Wade, W1GHZ, pointing out the 23cm feedhorn attached to the dish structure for the EME tests. A 100 watt PA was mounted inside a housing to the bottom right of the photo, with large diameter coaxial line run back to the control room and 23cm transverter.

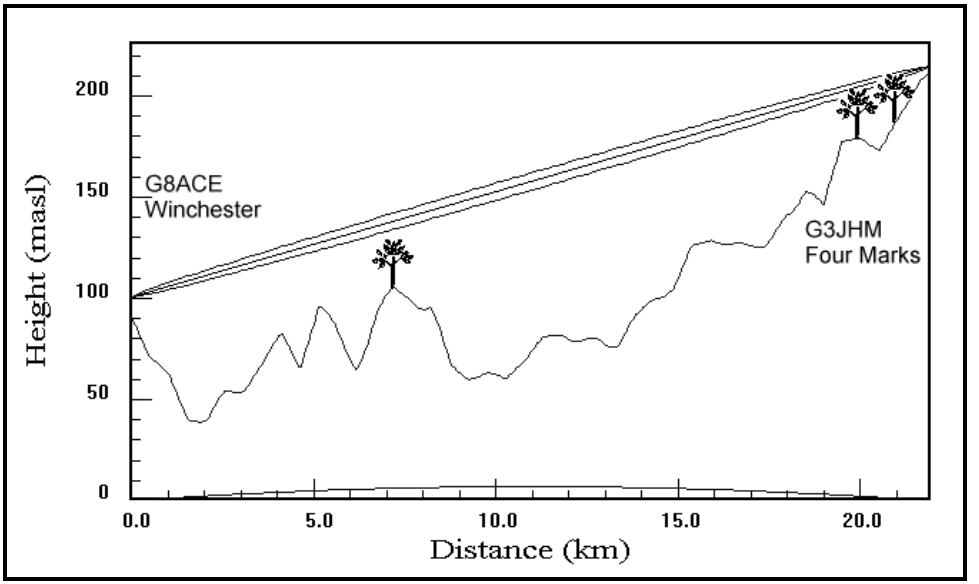
Unfortunately the RF output was several dB down on what was expected but nevertheless some impressive contacts were made at strengths approaching 599 both ways! In fact the signals received at Stanford on 23cm EME that day sounded more like a DX pile up on the 20 metre band!

47GHz Propagation Observations ... by John Hazell, G8ACE

Propagation at 47GHZ is interesting to the writer insofar that, even after doing all the path profile work, signal exchanges can be equally poor or remarkable! Monitoring signal levels between particular locations is often only for a few hours, then not again for perhaps some months or longer. A beacon could be a solution to studying propagation variations, if one existed that could be heard at the home QTH of a 47GHz equipped microwave station. Looking at the profiles from local beacon sites to equipped local stations quickly revealed this as much of a non-starter.

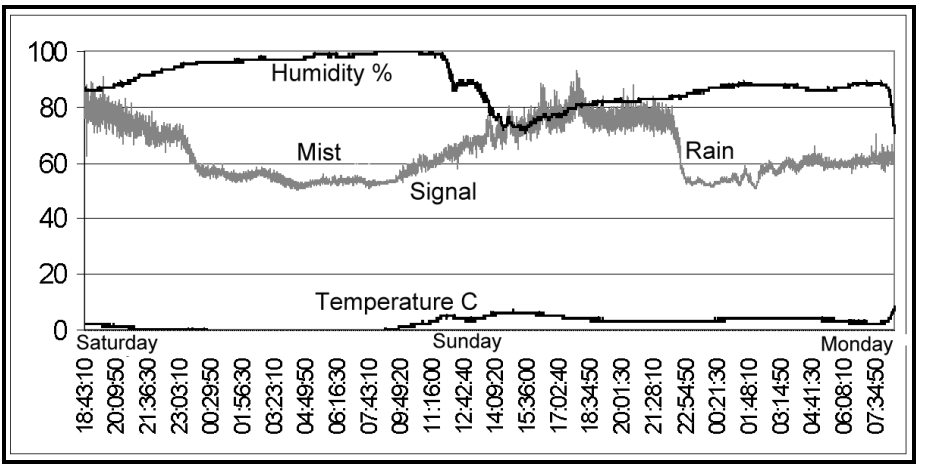
G3JHM at Four Marks is 22km distant from G8ACE in Winchester. Most of the path from G8ACE is good, as it sets off over the Itchen Valley, the Four Marks area being visible on most days. A QSO on 24GHz has already been conducted from dishes on tripods, garden to garden, so it looked optimistic for tests. G3JHM, having interests in propagation, was also keen to see if a 47GHz link could be established successfully.

The path profile showing the signal obstruction caused by vegetation clutter at G3JHM:



A personal beacon was constructed and installed on the chimney at G8ACE in Winchester. At Medstead, (home of GB2RS in the south) just to the north of Four Marks, an excellent signal was receivable on the transverter, without any aerial, the unit being hand held. This was a true LOS path from Winchester, G8ACE's nearby landmark/microwave reflector (HM Prison !) being clearly visible. Moving south to G3JHM, the results were quite disappointing. The signal could just be found using a 45cm dish. The signal was spread over an angle of around 10 degrees with multiple peaks dependant on the elevation used. This is due to the large amount of vegetation clutter from trees and bushes in the last kilometre of the path. The small horn initially used in the transmitter was replaced with a 30cm dish and the receiver for reception at G3JHM was constructed using a 60cm dish. This improved the signal so that good quieting can now be obtained using FM in "normal weather" conditions.

Signal level variation over a 36 hour period.



The RF Equipment:

The modules necessary for the transmitter and receiver were either specially built or already in the "cum-handy" box. The transmitter uses a G8ACE MKII ovened oscillator so that the frequency can be easily dc controlled with a multiturn pot. The FSK ident signal is added to this control voltage. My thanks go to Chris, G8BKE, for the building and programming the PIC ident generator. This drives a modified G4DDK multiplier to provide in excess of 20mw at 2.4GHz. With the enhanced 2.4GHz drive the multiplier to 11.7GHz uses just two GaAsFETs. The G3WDG009 is modified by removing the input mmic and replacing with a 3db pad. The multiplier GaAsFET is used as in the original design and the first amplifier is used alone to provide 10mW output at 11.7GHz. This simplified 2 GaAsFET version requires 7mW of 2.4GHz drive for full 10mW output using a 5v rail and recovered "Blue Cap" GaAsFETs. 10mW is more than adequate at this frequency for driving further multipliers. The 47GHz signal is achieved from three NE325 GaAsFETs. A doubler to 23.5GHz, then an amplifier is followed by further doubler. Between 5 and 10mW output can be achieved from this module for 2-3mW drive at 11.7GHz. Since the drive requirement is modest, the module is mounted behind the dish to minimise 47GHz losses and fed via 2m of 0.141 rigid coax at 11.7GHz from the original beacon unit now in the loft.

The receiver uses the same module arrangement as the transmitter to reach 11.7GHz. The 47GHz receive mixer is the original transverter built for the band by G8ACE and is similar to the DB6NT design. Now a spare, it is utilised to save construction time. All the modules are mounted in a weatherproof box behind the receive dish with the signal leaving at 145MHz, the first IF frequency.

The IF uses a simple FM strip containing a 10.7Mhz crystal filter. The 2nd local oscillator is fixed tuned with a crystal. Tuning of the 47GHz signal is achieved by DC control to the outdoor unit (97MHz) 1st ovened oscillator. The RSSI output from the FM demodulator is used to drive the data logging equipment.

Dishes.

Weather proof dish feeds needed to be created for this project and the arrangement is the result of some experimentation. It was found that 40mm Marley plastic waste pipe, slid over a splash plate feed, had negligible effect on the gain of the dish. The feed is constructed using 6mm o.d. copper tubing with a bore size similar to the usual 4mm circular waveguide used on 47GHz. This is fitted through a boss in the centre of the dish. The reflector is mounted at the far end of the plastic tube and the tube adjusted back and forth on the centre boss for focus. The tube is sealed with silicone sealant at either end. The wave guide then passes directly into the equipment box on the back of the dish.

Data logging:
A trawl of the Internet did not reveal any suitable software for signal logging purposes. Also the ability of G8ACE at writing PC software is non-existent. Equally, an A-D chip was not to be found in the cum-handy box. The BBC micro, long forgotten by most of us now, is easy to program and contains a four channel A-D. I should mention at this point a diversion into using the games port on a PC resulted only in wasted time as a practical test revealed each channel resolves only 16 levels ... fine for a joystick but no use here. The BBC was duly programmed to draw a graph of received signal strength and record the levels to file. By chance, a screen dump program was found, thus allowing the graph to be printed. The dot matrix printer used, howeve,r lacked the quality we have become accustomed to and the problem of how to extract the data from the BBC still existed. A further Web trawl only produced complex answers to this problem; maybe I use the wrong search criteria? Transferring serial data to the PC is easy, I finally discovered. Windows Hyper Terminal will log incoming Com Port data to a log file. Thus few lines of programme to the BBC and the data was leaving the BBC RS423 port to be easily transferred into Excel for a higher quality graphical display, analysis and print. A humidity detector and thermometer have been added to the data logging and three channels of data are now presented to the PC for saving to hard disk. A DOS terminal program was discovered so that data logging currently consists of the BBC for acquisition, sample interval selection and graphical display of signal in real time and an old 286PC for storing the files.

G3JHM has undertaken to analyse the data and will produce the long term conclusions about propagation on the path. Already it is possible to readily see the effects of rain and mist. Some deep fades being noted. The project has entailed about 4-5 months of precious construction time but is enabling some propagation monitoring, perhaps not done before on this amateur band.

60cm Rx dish used at G3JHM

The 30cm Tx dish

GB3SC# Beacon Progress

Some notes from Andy, G4JNT

Here are a few notes on the South Coast 2.3 to 24GHz microwave beacon project, which is now well underway. Last year, the possibility arose to take over an old disused PMR mast on Bell Hill, IO80UU59. After an initial site visit last August, we decided to take up the offer and agreed rental terms with the landowner. As well as the mast, the site comes with a concrete, enclosed building and a (metered) mains power.

By far the largest amount of work has gone into refurbishing the mast and cabin. The first working site visit in October revealed that the winch cable was very rusty and the winches themselves needed refurbishing. After dismantling and rebuilding these, our first attempt to lower the mast (probably the first time it had been moved in two decades) resulted in one of the old VHF dipole antennas that had broken off its mount jamming the winch mechanism. To free it, attempts were made to climb the mast by an SWL, Linda Holtby, who had previous mast climbing experience but this was fraught with danger, especially in view of the 'ticking' noises coming from the old lowest winch cable which was obviously under considerable stress and about to snap! Eventually it did break (with a loud bang) but fortunately the mast had been partly chocked and only slipped a few centimetres. Now, with the mast safely locked, Julian G3YGF climbed part way up the mast using a ladder and harness and, in cold wet weather, rethreaded a new winch cable onto the lower section. With the aid of a tree pruner tied to a long pole, we were able to cut the coax holding the old dipole and eventually lower the tower and winch it over. All winch cable could now be replaced and, by the end of November, we had a fully working Versatower on the site.

As the weather became colder, work then turned to the RF hardware itself. All the beacons were already built ... thanks to the 'subcontractors' G0JMI, G8BKE and G4LDR for the hardware for some of these. All were range tested on G0API's front drive and in his neighbour's garden just before Christmas, to measure antenna patterns and ERP. Unfortunately this measurement showed up major problems with the Alford slot antennas for the 2.3 and 3.4GHz units. The boresight beam, at zero elevation, was way down and gain peaked at elevations of plus / minus 30 - 40 degrees - no good for a beacon antenna ! It was obvious that the field distribution over the slot was incorrect, and this was confirmed using a near field probe and spectrum analyser to examine the Alford slot functioning in considerable detail.

We came to the conclusion that the diameter of the tube forming the antenna was a lot more critical than at first thought, and new antennas were built by G3YGF and G0API using the correct diameter copper tube - normal water pipe is not the right size at all. It became very clear that there is a lot more to Alford slots than just matching them. An article of our findings will probably eventually appear in this Newsletter. A few other electrical problems were found with some of the beacon hardware. The weirdest was probably a cavity mode resonance in a 19" rack mount causing spurious oscillations at 300 MHz when the lid was on but worked OK when operated without its lid ! I also built up the secure remote control link which will eventually be embedded with telemetry and remote monitoring facilities.

All five beacons are mounted around the head unit, by an arrangement of aluminium tubes and scaffold clamps. All beacons are fed with LDF450 coax and this, with the weight of the beacons themselves, is approaching the limit for the mast head unit. A quite complex system of intermediate coax support and feed for lowering the mast was devised by G0API and G3YGF involving rubber cable clamps and a running winch.

Meanwhile, the cabin was being weatherproofed, concreted, holes drilled for cables, painted, made secure plus cable ducting, benches, equipment racks and wiring, and all the other incidental little jobs needed for a remote site.

Mains power is fed from a farm at the bottom of the hill through approximately 1km of 1.5mm^2 armoured cable - its resistance is about 20 ohms. This makes the mains supply rather interesting! The whole beacon complex is likely to take less than 100 Watts so the voltage drop at this rating will only be about 10 V, no problem. However, our electric drill was 400 Watt rated and when drilling concrete the lamps dimmed considerably. (To make coffee we used a 2.5kW kettle which, if you do the sums, is acting very nearly as a matched load to the mains supply, which dropped to 120V).

Earthing and lightning protection is another big issue. Mains earthing is either non resistant or at least very poor. The mains supply cable armouring does not give a worthwhile earth connection, so we will need to install multiple earth stakes and radials. All metalwork coax feeders, the mast itself, equipment rack and mains input will be multiple bonded with short low resistance braid so that if lightning strikes nearby hopefully everything will jump together rather than having damaging transients induced.

At long last we are now at a stage where we can begin to install equipment. Hopefully this will take no more than three weekend visits to the site before the whole system is up and running. The funding so far has come from a combination of personal financing from the various team members, and contributions from the South Coast Repeater (and Beacon) Group. An appeal for donations at Martlesham resulted in a cheque arriving - thanks Ted - but we will be on the lookout for funds to keep the system operational over the years.

Apart from site rental and insurance, electricity will have to be paid for as well as routine maintenance so look out at roundtables and please dig deep to support this project. Also bear in mind, for two of us a site visit requires a 130 mile round trip each weekend.

Having a dedicated facility such as this will be invaluable as a base for remoting experiments; apart from the beacons themselves, we have tentative plans for a remote receiver facility for LF and HF with data sent back digitally over a UHF or Microwave link either direct or via an Internet connection, possibly a TV beacon / repeater and other projects. In fact a test bed for anything that would benefit from being located in an electrically very quiet location on a hill top site in Dorset. If anyone out there has any ideas for experiments that could be placed here, space can be made available, in return for a contribution ..

Watch this space.....

Main Beacon site team: G3YGF, G0API, G4JNT Beacons and other hardware built and supplied by : G0JMI, G8BKE, G4GHP, G4LDR

With assistance from several others from time to time: G3PFM and G3OBD and the Flight Refuelling Amateur Radio Society + G8ACE , G3PYB and M1BAI - all of whom have contributed funds and materials.

73 from Andy, G4JNT

Latest Beacon News ... as of 11 March 2002

The South Coast Beacon Complex for 2.3 to 24 GHz is now undergoing on air tests with all beacons currently at a reduced height of 6m AGL. GB3SCS, GB3SCF and GB3SCX, on 2.3, 3.4 and 10GHz respectively, are fully operational and GB3SCC on 5.6GHz is going but I suspect from listening tests may be down on power by a few dB. GB3SCK on 24GHz is not yet fully operational due to a suspected high loss in the feeder connections at 12GHz - although local listeners have reported hearing it at a few km distance suggesting some very low power signal is being radiated.

All beacons, apart from 3.4GHz, are on-off keyed. This mode has been used to permit an eventual upgrade to high stability frequency sources. GB3SCF will be converted to on-off keying 'before too long'.

GB3SCC operates on a time cycled sequence, with the callsign + locator details followed by 15 seconds of carrier, total transmission duration 45 seconds, followed by 45 seconds of no signal giving a total repeat time of approximately 1.5 minutes. This cycled operation giving 50% duty cycle is to prevent overheating of the masthead mounted PA which dissipates over 10 Watts in an enclosed plastic cylinder.

Andy G4JNT

ANNOUNCING A NEW MICROWAVE COLUMN ...

From the ARRL Letter, Vol 20, No 46

New microwave column to debut in January QST: QST is proud to present the debut of a new bi-monthly column, "Microwavelengths," starting in the January 2002 issue. The column editor is Tom Williams, WA1MBA. Williams holds a graduate degree in computer science and directs the development of imaging, software and millimeter-wave technologies as a consultant. His ham radio interests are primarily VHF, UHF and microwaves, and he is active on all bands from 144MHz to 10GHz from his home in Shutesbury, Massachusetts. He has done some pioneering work in the EHF bands of 120 and 145GHz.

Originally licensed as K1URO at the age of 15, Williams says he finds great satisfaction in getting on a new band and making a tough microwave contact.

Soldering 'pipe cap' filters on a DEM 10 GHz Xvtr board

I recently purchased the DEM (DownEast Microwave) 10GHz transverter through the North Texas Microwave Society project. During the assemby of the transverter, I came to the part about soldering the pipe cap filters to the pcb with a propane torch. I was a little uncomfortable with this method without first experimenting with a sample pipe cap. First, I cleaned a copper cap with Scotchbrite and decided to tin the open end with solder. The results, in my estimation, were unacceptable. The pipe cap didn't tin very well due to excessive heat from the torch and was all black and nasty. I was not about to destroy my transverter board with poor soldering and excessive heat from a torch!

I came up with a much friendlier solution: use a heat gun. I purchased a Paladin heat gun at the local electronics store. It comes with three different removable nozzles and variable heat range.

I also have a cheap, metal soup ladle (found in any grocery store kitchen gadget isle) I use for ladling hot solder for making fishing sinkers. By unwinding about six or seven feet of solder from the roll and placing it in the ladle, I heat the solder with the heat gun. It melts very quickly. Next, I heat a shiny pipe cap with the heat gun and dip the open end in solder paste. Quickly, I put the open end in the hot solder and apply more hot air from the heat gun. The solder tins the end of the pipe cap very uniformly, inside and out, to a height of approximately one-eighth inch. I clean the pipe cap with alcohol and it is still bright.

With this method, I prepared all nine pipe caps for the transverter. Now, it was time to solder them to the board. I followed DEM's instructions to mount the board to the aluminium pallet. With the heat gun, I pre-heated the pallet and board assembly. Taking a prepared pipe cap, I heated it for a few second to get the solder flowing. Then, I dipped the cap into the solder paste and dropped it in the appropriate hole in the pallet. Now, applying heat in a circular motion, and applying a small amount of solder in the corners of the pallet holes, the pipe cap was uniformly soldered in place. I continued with this method until all pipe caps were in place. After the assembly cooled, I removed the board from the pallet and found nine, perfectly soldered pipe caps. I cleaned the assembly in alcohol and baked it in the sun for a few hours.

I hope this information will be helpful for those intimidated by using a propane torch on this great microwave project.

73, Bob, WA5YWC

FOLLOW UP ....

I haven't had any problems soldering pipe cap filters. I haven't built the DEM/W1GHZ 10 GHz kit but I built his 5760MHz transverter and the W1VT 10 GHz transverter which use pipe cap filters. I made my own pc boards for these projects.

What I did was make sure I had a clean board to start (polishing it with some regular kitchen cleanser and water seems to work fine) and swiped the edges of the pipe caps with a file. Note the tuning of the pipe caps is primarily a function of diameter and changing the height of the cap by a few mils doesn't affect them.

I make a loop out of a twisted pair of lengths of solder that will just go around the bottom of the pipe cap, pinch it slightly so it will fit tightly around the base of the cap where it meets the board and then gently and slowly heat the pipe cap with a torch until the solder just starts to melt. I do that by just applying the flame to the pipe cap for a fraction of a second, then moving it away for a couple seconds, then repeating. Then I keep warming the pipe cap slightly until the solder flows uniformly around the pipe cap and onto the board.

This method has worked perfectly for me every time. If you haven't done it before, it's probably a good idea to practice it a few times with scrap pipe caps and board pieces so you can get the "feel" for how it works. Make sure the scrap pipe caps have a hole in the top to keep the expanding air from blowing out through the solder!

Zack, W9SZ

THOSE CALIFORNIAN MILLIMETRE MEN ARE AT IT AGAIN!

On Friday, March 1, we completed several QSOs that we believe set a new world record on 75GHz.

At 12:30pm PST W0EOM completed a QSO from Mt. St. Helena California (CM88QQ) to KF6KVG on Mt. Umunhum (CM97AE) on 47.040GHz. Signal levels were 20+dB out of the noise. Several minutes later W0EOM and AD6FP both completed QSOs from Mt. St. Helena to KF6KVG on Mt. Umunhum on 75.600GHz. Once again signal levels were 20+dB out of the noise. The mid grid to mid grid distance from CM88QQ to CM97AE is calculated as 172.2 km and 175.3km actual distance

After several false starts in arranging a record attempt, Will, W0EOM, finally got everyone to agree to go out on Friday March 1. Will and Gary, AD6FP, went to Mt. St. Helena, Bob , KF6KVG, went to Mt. Umunhum and Lars, AA6IW, was in Los Altos Hills. Previous tests indicated we might have difficulty with paths longer than 160km on 75GHz so Lars was positioned 156km from the Mt. St. Helena end.

Arriving at Mt. St. Helena Will and Gary found the traditional operating spot in disarray. High winds the previous evening had caused a tower to fall partially destroying the wooden deck that is usually used by the local microwave crowd. The winds were also still pretty high, estimated at 35 to 40 mph. After some exploration we were able to find a sheltered spot out of the wind and set up the radios.

A quick try of the 10GHz radio resulted in nothing heard from the local beacon or Lars' high power transmitter so we concluded the transverter had failed. We were hoping to use the 10GHz signals to determine bearings to Mt. Umunum so when the radio failed things were looking dismal. Luckily Will was able to find the signal from Bob on 47GHz with a bit of panning of the dish. Once peaked up on 47GHz we had a good optical target to use to sight the 75GHz dishes.

The 47GHz signal levels were sufficient to allow Bob to complete the exchange using NBFM rather than CW. After aligning the 75GHz dishes on the same heading as the 47GHz dish, the 75GHz signal from Bob was quickly located on the Mt. St. Helena end. To our surprise the 75GHz signal level was as good as the 47GHz level. The two 75GHz contacts were quickly completed from both W0EOM and AD6FP to KF6KVG. The 75GHz signal from Mt. Umunhum peaked 23dB out of the noise with 6-8dB fades.

After working Bob on 75GHz, Will and Gary repositioned their dishes and worked Lars AA6IW on 75GHz at 156km distance (this would have previously been a 1km increase in the 75GHz world record). Signal levels from Lars on the 156km path were comparable but slightly less than the levels from Bob on a 176km path.

The equipment used at each station is as follows:

W0EOM: 47GHz: 60mW xmit power, 2' cassegrain dish, 4db NF rcv. **76GHz:** 8mW xmit power, 18" cassegrain dish, 15dB NF receiver.

KF6KVG: 47GHz: >20dBm xmit power, 2' prime focus dish, 4dB NF receiver. **76GHz:** 10mW xmit power, 1 foot diameter prime focus dish, 15dB NF receiver.

AD6FP: 76GHz: 4 mW xmit power, 3ft cassegrain dish, 15dB NF receiver.

AA6IW: 76GHz: 4 mW xmit power, 18" cassegrain dish, 15dB NF receiver.

All the radios use LOs that are locked to either precision OCXOs or Rubidiums.

Weather conditions were very favourable for mm-wave propagation: 18% to 26% relative humidity along the path. 40 to 65 degree F temperatures

On the way down Mt. St. Helena we could easily see the snow capped peaks of the Sierras over 150 miles away. The unusually low humidity as well as the clear atmospheric conditions were major factors in making contacts on this record path.

Will W0EOM
Bob KF6KVG
Gary AD6FP

PUSHING THE LIMITS AT 241 AND 322GHz ...

THE STORY OF SOME REMARKABLE CONTACTS ON THE HIGHER MILLIMETRE BANDS TOLD THROUGH A SERIES OF FASCINATING EMAILS FROM THE USA ...

From: Brian Justin [wa1zms@worldnet.att.net]
Sent: 24 February 2002

Hi all-

I'd like to report what looks to be a new World, as well as North American DX record for the 241GHz band.

Earlier today, myself (WA1ZMS/4) and Pete, W4WWQ set several new DX records for the band. We first worked over a distance of 3.8km, then 6.1km, and finally 7.3km, at which point we ran out of signal margin for the WX conditions at the time. (The former world record was 2km, by DB6NT, and the NA record was 1km by W2SZ/4)

The details of the claimed 7.3km record are as follows:

Feb 23, 2002 19:45z
WA1ZMS/4 located at 37-22-56N 79-14-43W (FM07ji)
W4WWQ/4 located at 37-21-13N 79-10-15W (FM07ji)
a location to location distance of 7.3km

WX at time of QSO was:
Temperature 8.3 degs C
Dew Point -2.8 degs C
Relative Humidity 46%
Pressure 1017 millibars
Calculated loss of 1.70 dB/km

Photos and an audio file will be forthcoming and should be posted on **www.mgef.org** within the next few days.

The stations used are improved versions of the ones used in Dec of 2001 for the former North American DX record. The improvements involved the phase locking of the 80.6GHz Gunn sources back to homebrew ovenized crystal oscillators. This allowed the use of FSK keyed CW and the use of a narrow band receiver IF. The IF receivers were an Icom R-7000 and a Yaesu FT-817. The IF freq was 439.7MHz +/- some frequency drift. The ovenized crystal oscillator frequency is effectively multiplied some 2220 times to get to 241GHz! The stations were able to maintain better than 2kHz stability over several minutes. Frequency drift was still a problem however and with weak signals several repeats of the exchanges were needed to complete the 6.1km and 7.3km QSOs. If drier WX comes along, better DX may be achieved.

I'd like to thank Pete, W4WWQ for his roving efforts and to WA4RTS for the loan of an R-7000 in place of him being able to assist with this weekend's QSOs and to Jeffrey Hesler of VDI.

From: Brian Justin[wa1zms@worldnet.att.net]
Sent: 07 March 2002

Subject: A tiny bit more DX...

Hi again-

I'd like to give an update on our efforts at 322GHz.

On March 1st, 2002 at 02:25z WA1ZMS/4 worked W4WWQ over a new distance of 0.5km.

The details are:

WA1ZMS/4 37-21-24N 79-10-31W FM07ji
W4WWQ 37-21-14N 79-10-15W FM07ji
Mode used was FSK CW and gear is the same equipment that's been used of late for the 241GHz QSOs. (phase locked Gunns driving power multipliers)

WX at time of QSO:

Temp: -0.5C
Dew Point: -15.5C
Relative Humidity: 31%
Pres: 1024mb
Calculated loss: 4.56dB/km !

An audio file is posted at:
http://www.mgef.org/zms_322.htm

We tried a 1km path but just did not have enough margin. We'd need 6dB more for the distance and then an additional 2.2dB for atmospheric loss at the time of the QSO for a total of 8.2dB and that was just not to be.

I know for some people, even 0.5km is not real DX, but I felt since we did 10 times the distance we did last December that it was worth mentioning, and we are talking 322GHz here.

In other news, we did a one way QSO at 13km on 241GHz but not two-way. (very disappointing!!!) Maybe next time.

73 from Brian, WA1ZMS/4

Postscript ...

Once again, we congratulate Brian and his team on a very fine effort.

.... Editor

NOISE FIGURE MEASUREMENTS – MARTLESHAM 2001

This table has already been published in the UK Microwave Group's journal "Scatterpoint" but is include here for the benefit of those who may not have yet seen it. G3XDY, who kindly supplied the data, includes a "health warning" — the HP test equipment used was out of its calibration period so the figures should be considered indicative rather than absolute.

Band	Callsign	System	Gain (dB)	NF (dB)
144	DB6NT	Micom Preamp	24.3	0.28
432	DB6NT	Micom Preamp	20.2	0.36
1296	G3LTF	Mk8 Preamp	31.8	0.44
	G3LTF	Mk9 Preamp	34.8	0.40
	G8XIR	Preamp	19.1	0.58
2320	ON6UG	DJ9BV Preamp (2 stage)	41.5	0.44
	G8XIR	G8VR Preamp	7.5	3.14
	G3LQR	Preamp	14.7	0.49
	G3LTF	Preamp	21.4	2.33
		Preamp ATF54143	12.75	0.60
2400	G3RUH	DB6NT Converter	29.6	0.53
	G3RUH	DB6NT Converter with 1.3GHz notch filter	29.8	0.63
3400	G3XDY	DB6NT Mk2 Transverter inc relays	22.1	0.90
10368	G7JTT	Transverter	18.3	2.00
	G8GTZ	Transverter	17.6	1.75
10451	ON6UG	DB6NT Converter	17.3	0.93
24048	DB6NT	DB6NT Converter	23	2.63
24192	G4FUF	Transverter with DB6NT preamp	32	3.50
	G4LDR	DB6NT Mixer only	14.4	11.75
	G4LDR	Mixer plus DB6NT Preamp	27.4	2.28

ACTIVITY NEWS FROM THE WORLD ABOVE 1000MHz

Helping the newcomer…

The millimetric band happenings, described on the previous pages, make interesting reading don't they? How long will it be before a couple of UK amateurs make historic contacts on these high frequencies? Some of you may remember the "golden years" of microwaves when G3BNL and G3EEZ made the first narrowband records on all bands from 23cm to 24GHz, while the rest of us were still using 723A/B klystrons on 3cm! Now that most of us take narrowband on, say, 10GHz for granted we may have forgotten the thrill of our first microwave contacts so spare a thought then for today's newcomer who is faced with an array of expensive and complicated looking systems from which to choose. The simplicity of the gear in the 1960s, 70s and 80s allowed people to "have a go" with minimum financial risk Today, they are soon put off when the more experienced of us tell them that narrowband is the only way to go from the start!

Hopefully then you will dust the cobwebs from your old 10GHz wideband gear and come on with it during the June and July 10GHz Cumulative Contests. There will be a number of wideband only portables out then who would appreciate contacts. Most will have 144MHz ssb talkback but a few may be 2m FM only, so we suggest you check 144.525MHz FM from time to time as well as the 144.175MHz ssb calling channel. Remember, a contact with a wideband station brings you bonus points in the contest!

At the moment we have a few groups who have stated their willingness to come on with wideband during one or more cumulatives:
G3GRO and the West Sussex group,
G4AYT and a small group in Kent,
G3MWN and a group in South Yorkshire, including your editor!

Could others who plan to support this initiative please let the Newsletter know by next month's issue so that some degree of co-ordination of sites and paths may be achieved?

Reports from around the UK …

Very little news has been received over the past few weeks. It looks as if the UK has gone into hibernation microwave-wise! However the following few reports show that a few have been active and that our Dutch friends have also kept the pot boiling across the North Sea. Also. don't forget that Monday night is activity night!

From: David Cox , G0RRJ, [dave@andoverhampshire.freeserve.co.uk]
As a result of my wanted ad in last month's newsletter, someone anonymously sent me a pair of 2C39 valves, some finger stock and a water jacket. This kind person appeared not to wish to make himself known. Please would you pass on my thanks via the newsletter, it was a kind gesture and its really nice to know that in this day and age the true ham spirit lives on. As far as operating is concerned, I worked six PA stations on 1296MHz this week end (end of February) .They were PI4ZLD PA0WMX, PA0SQE, PA5DD, PI4TUE and PA0WWM. During the February 1296MHz activity contest I managed to work 15 stations with the best DX being GD0TEP & GD4GNH. I was on briefly during the microwave activity weekend in February, but I got distracted by a 50MHz opening! I did, however, manage to work G3FYX, G4NNS, G8JVM & G3YKI on 10GHz.

From: G3XDY [g3xdy@btinternet.com]
Sent: 07 March 2002 23:37
Things are starting to move after the winter doldrums - no significant tropo so far this year, but the European contest on the first weekend in March provided an opportunity to dust off the gear on various microwave bands. Conditions were pretty average, with no rainscatter or tropo enhancements. On 23cm, I tried a couple of tests with DL4MEA in JN58RI who was running his EME system pointing at the horizon but heard nothing. On the other hand, I did hear DF0MTL (JO60) briefly on CW via aircraft scatter but signals faded as their CQ call finished. Otherwise 23cm seemed rather poor here. On 13cm, I managed 13 QSOs over the weekend, with DK2MN the best at 416km. Activity on 9cm was limited but, out of 5 QSOs, PA0BAT (JO31) was the best DX at 360km. I was pleased to work Neil G4BRK for the first time on this band for a new square. On 3cm I had 8 QSOs with PA0BAT as best DX

I have also been on for the new style 23/13cm cumulative contests on the third Tuesday evening of the month, but activity and conditions have appeared mediocre so far.

Operating Ladders and League Table

The Microwave League Table for this year is now open for entries. So far, insufficient entries have been received to enable a meaningful table to be published. Hopefully we will see more input as we enter the "contest season". Meanwhile here is the All Time Squares/DX Table ….

ALL TIME SQUARES/DX LADDER

Entries ranked on squares. In cases of a tie the countries score determines the final order.
Entries must be from defined locations. An asterisk (*) denotes UK record.

BAND	CALL	LOC	SQ	COUNTRIES	DX
1.3GHz	G3XDY	JO02OB	123	23	1341
	G4DDK	JO02PA	73	16	1005
	G8VOI/P	IO90MX	66	18	1134
	G6XDI	IO91SM	30	8	945
	F1VBW	JN03SO	30	4	825
	G4LDR	IO91EC	22	6	593
	G0API	IO80XS	21	8	687
	G3FYX	IO81RM	16	8	1165
	GM4WLL/P	IO85NR	9	2	488
2.3GHz	G3XDY	JO02OB	42	10	1179
	G4DDK	JO02PA	28	8	1005
	G8VOI/P	IO90MX	18	6	770
	F1VBW	JN03SO	18	1	825
	G4LDR	IO91EC	10	2	444
	G3FYX	IO81RM	7	2	521
	G6XDI	IO91SM	6	1	183
	G8BKE/P	IO80RQ	1	1	114
3.4GHz	G3XDY	JO02OB	14	3	506
	G4DDK	JO02PA	9	5	754
	G8VOI/P	IO90MX	8	1	214
	G3FYX	IO81RM	4	3	487
	G3FYX/P	IO91GI	2	1	92
	G8BKE/P	IO80RQ	1	1	114
5.7GHz	G8VOI/P	IO90MX	17	5	730
	F1GHB/P	IN88IN	12	4	730
	G4LDR	IO91EC	11	3	436
	F1VBW	JN30SO	7	1	665
	G3FYX/P	IO91GI	6	2	335
	G4DDK	JO02PA	3	3	233
	G8BKE/P	IO80RQ	2	2	242

BAND	CALL	LOC	SQ	COUNTRIES	DX
10GHz	G3WDG	IO92RG	55	16	1135
	G4KGC	IO92RG	52	15	1135
	G4FCD	IO91KX	47	13	1062
	G4DDK	JO02PA	41	14	1005
	G4BRK	IO91DP	41	13	1115
	F1HDF/P	JN18GF	35	6	867
	G3GNR	IO70WT	34	11	*1275
	G3FYX/P	IO91GI	34	10	787
	G8VOI/P	IO90MX	33	8	753
	G3XDY	JO02OB	32	11	1012
	G8APZ	JO01DO	30	10	1026
	G4LDR	IO91EC	30	8	1118
	G3JMY	IO81RM	28	8	1137
	G4BCH/P	IO90JO	25	7	1177
	G3FYX	IO81RM	24	8	1137
	G3PHO/P	IO93EH	21	5	586
	G3JMB/P(I)	IO90TV	21	5	368
	G3UYM/P	IO92XA	20	5	522
	G8LSD/P(I)	IO90TV	20	5	384
	G0API	IO80XS	19	5	489
	F1GHB/P	IN88IN	19	3	431
	G8DKK	IO91VX	18	6	578
	G4KNZ	IO91PJ	17	6	1052
	G8LSD/P(ii)	IO80WP	16	4	385
	G3JMB/P(ii)	JO01BB	16	3	368
	G8LSD/P(iii)	JO01BB	16	3	368
	G4MAP	IO82WJ	16		309
	G3UKV	IO82RR	15	7	494
	G4JNT	IO90IV	14	4	339
	G4RFR/P	IO80UU	14		414
	G3ZME/P	IO82QL	13	4	357
	F1VBW	JNO3SO	13	1	665
	GW4MAP/P	IO82JG	11		311
	G0IVA/P	IO83XF	10	3	304
	G0API/P	IO80UU	8	2	277
	G0JDL	JO02UK	7	3	415
	G8BKE/P(ii)	IO80XP	7	2	248
	GM4JJJ	IO86GB	6	2	323
	G3PHO	IO93GJ	5	3	748
	G0WZV/P	JO??	5	3	279
	G8BKE/P(i)	IO80RQ	4	2	242
	G3JMB	IO91WA	4	1	87

BAND	CALL	LOC	SQ	COUNTRIES	DX
24GHz	G4DDK	JO02PA	7	3	268
	G3UYM/P	IO92CA	6	2	146
	G3WDG	IO92RG	5	2	*391
	G3FYX/P	IO82JG	5	1	141
	F1GHB/P	IN88IN	4	2	158
	G3PHO/P	IO93AD	4	2	128
	G4KNZ/P	JO02TD	3	2	173
	G4FCD	IO91KX	3	1	154
	G8VOI/P	IO90MX	3	1	88
	G3GNR/P	IO80AQ	2	2	154
	G8BKE/P(ii)	IO80WX	2	1	81
	G8BKE/P(I)	IO80RQ	1	1	100
47GHz	G3FYX/P	IO81XW	4	1	136
	G4KNZ/P	IO92CA	2	1	117
	G3UYM/P	IO92CA	2	1	65
	G8BKE/P	IO90MX	1	1	78
	G4DDK/P	JO????	1	1	39

Updated to 22nd March 2002

UPDATED:2002-03-22