An Amateur Radio publication for the Microwave enthusiast

MICROWAVE NEWSLETTER

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FROM THE EDITOR

2001 – MAY

Our thanks this month go to the contributors of the material found within these pages. Someone, somewhere, always seems to get this editor out of a jam when the next issue looks a little thin due to lack of material. This month we award the medals to Charlie, G3WDG, Mike, G3LYP and John, G8ACE. Thanks also to the rest of you who have provided activity news and little snippets of information from here and there. Keep it coming folks!

The contest season is now underway. Though Foot and Mouth problems continue to close down much of the countryside, it **is** possible to find the odd /P site. It's just that one has to accept a poorer take off in some directions and accept some restrictions on antennas, masts, etc. Nevertheless, there is no real excuse for not keeping the microwave activity going through these trying times.

The satellite formerly known as Phase 3D, now AO40, was switched on for a few days in early May for amateur use. G3WDG describes his early experiences with the "bird" elsewhere in this Newsletter. Paul, G0HNW in West Yorkshire also reports hearing amateur signals on the 2.4GHz downlink. A reasonable antenna system is required as the system is not yet optimised for the "wet string" antenna brigade! G8VR and G3VZV have been heard, using the 23cm up/ 13cm down mode, along with dozens of USA and Japanese operators. If you do get on please keep the ERP down to moderate levels or the satellite will just shut down!

IN THIS ISSUE ...

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

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

ERRATA

On the back page of last month's issue we mentioned the proposes millimetre wave frequency changes due to WRC2000. Under the heading THE 76GHz BAND we should have said .."newcomers to millimetre bands should now plan on building for 77.5 to 78GHz" and not the frequency range stated there, which is the present state of affairs.

How to make friends and influence people!

From: <name with held by editor!)
Sent: 11 May 2001
To: webmaster@g3pho.free-online.co.uk
Subject: Thanks for giving me "the uBug"!

Pete, my name is < name withheld> - I'm 28 years old, Living Down-Under in Melbourne, Victoria - and I just had to chuck an email to you...

Last night I was just "hawking-around" on the 'net, in particular, at a few Ham Radio Satellite sites...

Well, you know how it can get - ...a good read here, click - ...a good read there, click...

Then it happened! I stumbled into your site and mate - I've gotta say for a older bloke, (no insult intended!), you've come out on the top shelf when it comes to sharing your life's experiences and knowledge.

I can only hope that when I get a bit older myself - and have a lot more time on my hands - that I can also share my head with the rest of the world, as brilliantly as you have.

I'm especially impressed with the fact that you've managed to get an especially sharp grip on today's best method of sharing information - The Web.

Nevertheless, I'm not sure whether to thank or curse you. Your "Beginners guide to 10GHz" project has convinced my subconscious to finally go for my Amateur Licence!

I've been an RF head for almost 20 years - and worked professionally with almost every RF protocol for the last 12. However, microwave RF has always eluded my hands but not my curiosity...

I always assumed that microwave RF couldn't be "played" with, after all - when you "muck" around with RF, the higher in frequency you go, the "tighter" the skill set required - and therefore the less "experimental" the transceiver.

Thanks to you - my mind and wallet (!) now embark on an RF dream.....to "play" with microwave

Curse you? Thank you? I'll do both -

Thanks Pete, you bloody bastard!

Editor: DON'T YOU JUST LOVE THE WAY THEY

I HEARD IT ON THE GRAPEVINE .....

From: Paul Wade W1GHZ [wade@bicnet.net]
Sent: 28 April 2001
To: microwave@wa1mba.org
Subject: [Microwave] IEEE antenna CDs

The IEEE Antenna & Propagation Society is issuing an archive of all their publications since 1952 on a set of CD-ROMs (or DVD) for $100 .... not cheap but a bargain if you are serious about antennas, especially since it is getting hard to find anything very old in libraries.

This is an introductory price for AP members, but the lady on the order phone didn't seem particular.

Take a look at http://www.ieee.org

73 from Paul, W1GHZ

10GHz TWT with PSU
5 watts output (more if "tuned" with external magnets!). SMA in/ out. Mains psu – large! Complete & ready to go. Price £35. Buyer collect or arrange collection at rally, etc. Contact Peter, G3PHO, tel. 0114 2816701 or email: g3pho@qsl.net

WANTED SMA ported 28V d.c. change over relay suitable for 1W 10GHz transceiver. Email G0API at G0API@Tesco.net or tel 01202 691649 or jfell @crydom.com

WANTED info on the EEV TWT power amplifier Type: N 4238 with TWT EEV N 10038 . Contact F6DPH via E mail: PHILIPPE.MILLET15 @ wanadoo.fr . Thank you very much. 73 Philippe

hear much from the north. There were awful condx to work in... very cold and high winds. I worked a few on 2.3, 5.6 and 10GHz but when you consider there are at least 4 local stations who can be active on the middle bands and who did not appear it makes one wonder if building all the kit is worth it? However giving Neil, G4LDR his first contact on 24GHz made up for it to some extent. No serious DX was heard apart from the GD station but they were always setting up a contact when heard. I also tried to work Chris G4DGU/P in Devon who has been bitten by the 10GHz bug again but neither of us were too sure on our headings! He will be back on for further contests this year.

I also had a brief test with G8ACE on 47GHz over a partially obstructed path. John's 8mW source was about S1 with me.

And now some news of GM activity! From Iain, GM0ONN <iain.gm0onn@tinyworld.co.uk>
I am active 2m, 70cm, 23cm, 13cm and 3cm.
23cm 1.8m dish 230W.....
13cm 150mW 1.2m dish.....
3cm DB6NT 200mW and FHX 005 Rx. I am working on a 10W twt and using a 1.8m dish to do EME rx tests. I am a good friend of Mark GM4ISM. I hope to go /P this summer, if I can gather some interest, possibly to ZR square, (?? Editor) near Peterhead. This is probably my best site locally. **Regards from Iain.**
Editor's comment: This is indeed good news! We have been promised much from North of the Border in past years but little has actually come to fruition. All my GM microwave contacts have been due to portable expeditions by Sassenach operators! Come on yee Scottish operators!

Peter, G3PHO (IO93GJ, Sheffield) has rebuilt the 5.7GHz system, in addition to the recent 10GHz rebuild. The 6cm transverter sports a 1 watt amp but now a suitable 10V regulator has been obtained a 10W PA will be installed very soon. Both these new transverters, together with the recently upgraded 24GHz system, were air tested during the 432 up RSGB Contest over the first weekend in May. A few /P locations, free of Foot and Mouth problems have been discovered. On the Saturday evening, from the Cat and Fiddle (IO93AF) pub car park, GD0EMG was worked on 3 and 6cm with collossal S9++ reports both ways. At 200km it was a little to far for the 24GHz band, nothing being sign heard either way. However, G0HNW was worked from there on 24GHz, via reflection off the Holme Moss TV mast. Sunday morning saw Peter /P near Rivington Pike (Winter Hill) near Bolton, Lancs. After some initial dish alignment misunderstandings, GD0EMG was worked on cw over the 149.1km path. This is a non-LOS path, the earth's curvature being quite prominent on the profile. Peter had planned to operate the rest of the day from the southern side of Winter Hill but Foot and Mouth restrictions close all the lanes leading to the site on Matchmoor Lane. After two hours of endless driving around the region, a narrow grass verge near Delph (IO83XW) provided the chance of setting up a tripod based 10 and 24GHz system. From there, G0IVA was worked over a short 20km path on 24GHz. Dave's gear was inside the house, behind double glazing! G3KEU was then worked on 10GHz over 233km and a fascinating 4 way SSB net on 10GHz ensued between G3PHO, G0HNW (near Huddersfield), G3LRP (near Wakefield) and G6DER (near Barnsley)... all this via reflection off the Holme Moss TV mast!

On Monday night, 14 May, Peter worked G3LRP, G6DER and G0HNW on 10GHz from home... all via rainscatter and with an indoor antenna!

Doug, GW3ATM (Monmouthshire)
Now has a home station on 10GHz working quite well but his 2m talkback is hampered by the 200m hills all around him! He relies greatly on reflection for his microwaves contacts (either rainscatter or from radio towers) and has already worked GW8AWM, G4UVZ, G3GNR and G3JMY. G4UVZ and G3GNR were worked through Doug's window! He uses a 1 watt DB6NT/Qualcomm PA 3cm system.

John, G4BYV, (Norfolk) sent the editor a series of photocopied UHF/Microwave logsheets covering over 20 years from the late 1970s to the late 1990s. He also forwarded a IARU Region 1 contest summary from the 1970s. All this memorabilia makes most fascinating reading and we hope to include interesting extracts in coming issues. Many thanks indeed John!

Apart from the 2001 League Table on the next

OKs I worked? It is:
http://www.qsl.net/ok1jkt and it has lots of good information and pictures on it. Also the site **http://www.von-info.ch/hb9afo** is quite interesting, if you read French. HB9AFO came up to our /P site in the contest and did some ATV operation. If you follow the link that mentions HB9BHW you will see me, you can also see what the weather was like for the whole weekend.

My next job is integrating my IC706 as a tunable IF instead of the FT290R.

Now to the news from the UK....

Ted, G3JMY (Bristol) emails us about his recent visit to the Antipodes: I have recently returned from ZL, where my XYL and I enjoyed a 6-week holiday in the company of ZL1AVY and ZL1AZY. I gave a talk on 10 GHz to the Te Awamutu radio society, using that diagram (of my antenna system) which was published last year in the Newsletter.

Neil, G4LDR (Wiltshire) has been very active from home recently as the following report shows: Here is a short report on the 5th/6th May Contest.

It was good to hear a fair number of stations active but it was unfortunate that conditions did not allow contacts with the more distant ones on the higher bands. On 1296MHz I worked 11 stations PA6NL (JO21) being the best DX. On 2300 MHz 9 stations, G3XDY (JO02) was best DX. On 5760 MHz only three stations, G8BKE/P (IO80) being best DX. On 1036 MHz I worked 11 stations and after a difficult contact managed to work F6DKW (JN18). With only one hour to go to the end of the contest, this was F6DKW's first contact.

Having built a 12GHz LO and got the DB6NT 24GHz transverter going (the only test I could do was measure about 0.3 mW output), I decided to mount the 24GHz gear on the dish. I lashed the transverter to side of the 3cm feed and aimed the slot in the milled case at the dish. The 12GHz LO was slung under the 3cm feed. I didn't really expect to hear anyone from my home location let alone have a two way contact. I came across G8BKE/P at Povington, Dorset, in IO80. Having worked our way up from 2320 to 10368 MHz I asked him to send me a signal on 24GHz. Within a short time I was receiving a 59++++ signal from Chris over the 63 km path! I transmitted to him with my 0.3mW and he gave me a 41 report. John G8ACE/P then appeared and whilst he and Chris were having a contact I could still copy them despite the fact they had their dishes turned away from me. I next tried with John, again getting a 59++++ signal, who gave me a 57 report. John then proceeded to try just open waveguide and could just copy my 0.3 mW signal over the 32 km path. I am looking forward to getting the PA brick, a pre-amplifie, a TX/RX switching arrangement and a decent feed set up then I can really start to explore the potential of home operation on 24GHz.

Neil, G4BRK (near Swindon, Wilts.) emails a short report of home station operation during the early May contest weekend.

GD0EMG was 59+ whilst talking to G3PHO/P but the latter station was not heard. I was starting to get desperate for a 5.7G contact, but G3VKV and G4LDR eventually came to my rescue.

I had a good time, in general. 3cm pretty poor, with M1CRO as best DX, though 10W would have given me a bit more. I am missing the power this
year, whereas last year it didn't seem to make much difference.

23cm activity was good despite the conditions. The best of 30 contacts was PI4GN at 614km. 13cm was also OK with 3 x PA0 worked. 9cm only gave me GD0EMG, but I was pleased to work them on 3 bands 23/13/9. **73, Neil G4BRK**

From: Bryan Harber G8DKK [bryan@harber.f9.co.uk]
I met Ian, G8IFT at Bletchley. He tells me heard GB3DUN on 24GHz during the October 2000 microwave contest. He was located at IO92GB. This is quite an event to receive a report on the beacon!

On the 23cm front, I am waiting to purchase one of the new, re-designed 1W PAs from Charlie, G3WDG, to rebuild the failing 23cm beacon. It's ERP is now down to 100mW so coverage is rather limited at the moment.
73 from Bryan, G8DKK

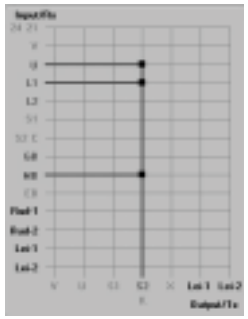
Chris, G8BKE (Hampshire) was one of the few /portable stations active during the May all band contest. Here's his report…

I was out /P on Sunday at Povington but didn't

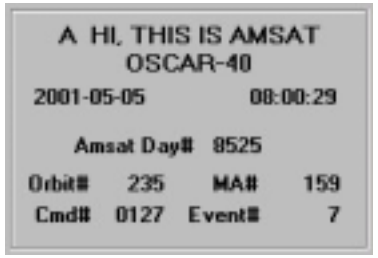
First Experiences with transponder operation on AO-40

By Charlie Suckling G3WDG

Having been involved with telemetry collection from the S-Band beacon on AO-40 for some months, it was a real treat for us when the command team announced that they planned to switch on the transponders for experimental use for ten days from 5 May. The days prior to this were spent adding a home-made elevation drive to the tropo 19 element F9FT and 45 element G3JVL loop yagi on the tower, digging out an old MM 435MHz transverter and retuning the WDG011 1296 transverter to 1269MHz (a simple job, details to be posted on the WDG website at www.g3wdg.free-online.co.uk). With a 45W brick available for 435 and an 18W one for 1269, all was tested on tropo with G3RUH and declared ready to go.



On the morning of the 5th, the beacon was coming in well on the 10ft dish and telemetry was logged as usual. Figs 1 (left) and 2 (right) show the magic moment when the transponder was switched on for the first time, with the 435 (U) and 1269 (L1) receivers connected to the 2401 (S2) transmitter. This was a configuration we had been looking forward to for some time!



Thus both 70cm and 23cm uplinks could be used and, for the first few minutes after switch-on, we were busy trying to find which worked best. We found our signals almost immediately but, unfortunately for us in Europe, the squint angle for the satellite (ie the amount the antennas are off boresight) was not as favourable as for North America, so we did not get such good signals on the downlink as did the U.S stations, (or the kilowatt merchants in Europe).

For our station, it turned out that the 1269 uplink worked better and we started looking for someone who could hear our relatively weak downlink signals. The first QSO was made at 0917z with I8CVS (57/53), then a partial one at 0935 with NN0V (539/579) followed by W3SZ at 1006 (559/439), AB9V at 1016 (559/339) and W1BFN at 1031 (559/559). G4KGC then also worked W1BFN just as the satellite was setting (559/519). Slightly disappointed with the level of our signals and down one M57762 brick due to overheating, we were nevertheless delighted to have been able to use the bird for the first time!

The remainder of the day was spent preparing for the next orbit, which looked much better for Europe with a much lower squint angle. Uncertain as to whether the loop yagi was working properly at 1269, we put up another (temporary) uplink antenna consisting of our old VHF NFD contest 1.5m dish (see photo left) with

disc and dipole feed and an old CCTV camera pan/tilt head for el/az positioning. No indicators were available unfortunately … just a compass and protractor to get the dish right for the beginning of the pass and adjust for maximum signal thereafter! We also fitted a decent heatsink (and blower!) to our prototype WDG019 2 x M57762 brick amplifier, which when run very conservatively, puts out about 30W at 1269MHz. We did not want to blow up any more of these expensive modules!

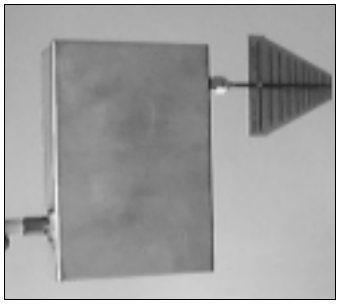
The next orbit started for us at about 0630z on the 6th. Before looking for contacts, we checked out the system and found that the new uplink equipment produced a much stronger signal (or was it the better squint angle?). We tried backing off the transmit power in stages. The 1W driver produced a perfectly readable signal on the downlink and, encouraged by this, we tried the WDG011 transverter barefoot. Its 5mW signal was just detectable in the noise. Having calibrated the uplink frequencies required to get a specific frequency on the downlink (it saves a lot of "swishing") we then set about trying to see who we could work and between 0630 and 0847 we worked OZ1MY, I7LIT, 4X1AS, KK5DO, DL6DBN, F6GBQ, I1CDB, W3PM, G4IIO, G3VZV, G2HIO, G0MRF, OK2AQK, DH5MK AND DL1FCU (mostly on ssb).

Later in the evening, the satellite was near apogee with a mutual window from UK to VK/JA, and a favourable squint angle. Owing to window restrictions with the 1.5m uplink antenna at the low elevation angle at the time, it was back to trying the loop yagi on the uplink, and soon after the satellite came over the horizon, our downlink signal appeared at good strength (not quite as strong as previously, but consistent and still good enough for solid copy ssb). QSOs followed with JA1BLC, JA5LG, OK2AQK, 7N1JVW, VK6ZKO and a near 1 hour long ragchew with I8CVS.

In conclusion, it appears that AO-40 is working extremely well and all our thanks are due to the fantastic efforts of the AO-40 management team and ground controllers in bringing this satellite on-line in a relatively short time, especially in view of the difficulties which have been encountered. We are looking forward to the test and commissioning of some of the other microwave beacons and transponders!

Editor's comment: *Our thanks to Charlie for this absorbing 'blow by blow' description of his first contacts on AO40. Following on from that we are delighted to announce that Charlie has developed a Mode S 2.4GHz converter and that it will soon be available through the Components Service (run by Charlie's wife Petra, G4KGC). For those readers who missed out on the surplus Drake 2880 downconverters a couple of years ago, the WDG converter should be the answer to your prayers!The following email from Charlie outlines the situation so far…*

G3WDG is in the process of developing a new downconverter for 2401MHz, which is planned to be sold as a kit via the Microwave Committee Components Service. The new converter is based on the well-proven WDG010 13cm transverter and includes local oscillator, mixer, HEMT LNA and all required DC circuitry, all on a single teflon pcb.



The prototype is yielding a noise figure of about 0.6dB, which means that an external preamplifier is definitely not needed with this design. The prototype was tested on a recent low elevation pass of AO-40, using just a simple WA5VJB wideband log periodic feed as the antenna, as shown in the photo. Signals were received a few dB above noise with this set up, not quite strong enough for telemetry to be decoded, but easily detectable.

It is planned to release the design for beta testing very soon, and anyone interested in trying out the design should contact Charlie at **charles.suckling@ntlworld.com** or telephone him at **01933 411446** . More technical details of the unit can be found at **www.g3wdg.free-online.co.uk** .

More interesting AO40 information can be found in this month's Activity News section …

ACTIVITY NEWS FROM THE WORLD ABOVE 1000MHz

There has been some increase in activity since our last issue but we have a long way to go before we reach last year's level. This time last year saw seven pages of Activity News in the May issue! Nevertheless it was pleasing to hear people on during the May RSGB 432 and up Contest, even if conditions were quite poor. Let's start with the overseas news first though …..

From **Finland** we received this email from **Michael Fletcher, OH2AUE [michael.fletcher@oh2aue.pp.fi]** :
Just a brief note to tell you of our latest conquest here in Finland: Ilkka, OH1KHH/P and myself, OH2AUE/P, established first ham radio contacts on the 76 GHz band on the 19th of April this year. A couple of days later we extended our workbench QSO to 1 km with 52/54 reports. This is a VERY interesting band propagation wise! There is more info, photos and sound file on my website at: **www.oh2aue.pp.fi/e_test**
I have also dedicated a page to my good friend, Masa, JA1ATI and his excellent equipment for 47 and 76 GHz at: **www.oh2aue.pp.fi/ja1ati.htm**
Masa has recently achieved 50 mW multiplied crystal controlled power at 76 GHz ! With his 45.7 dBi antenna, this computes to almost 2 kW EIRP...Kind regards from Finland, Michael Fletcher, OH2AUE www.oh2aue.pp.fi

Ilkka, OH1KHH, emails the 47GHz side of the Finnish story as well as more on the 76GHz contact described above…
You may be interested how I can measure power at 47GHz band. We (me and Michael) have use of an Anritsu power meter. The power detector is specified to 40GHz but error is low, hopefully. 47GHz power is -10dBm with an estimated error of about +/-2dB. The 47GHz mixer is balanced subharmonic and uses HP's HSCH9251 anti parallel diode pair. A 12GHz to 24GHz frequency doubler and mixer is my design. I succeeded to make Finland´s first 2 way SSB contact on 76GHz with Michael OH2AUE at 19 of April. Distance was short and just for checking our transvertter. On 21 April we made a 1km contact with 52/54 reports on SSB. My transverter is a crystal controlled subharmonic mixer, using the HSCH9251 diode
The mixer is my own design. Tripler 12GHz to 38GHz and attenuator, isolator, etc. are surplus parts. The antenna was a 30cm dish for 38GHz band including feed. Michael uses a cassegrain dish, with 45.7dBi gain ,made by JA1ATI.

Now I have started to design 145GHz parts. That band mixer is very challenging and interesting to design. The stable crystal oscillator with oven is the second main thing. Of course there are many other, several "minor" things...as you know. With best regards, ilkka, OH1KHH

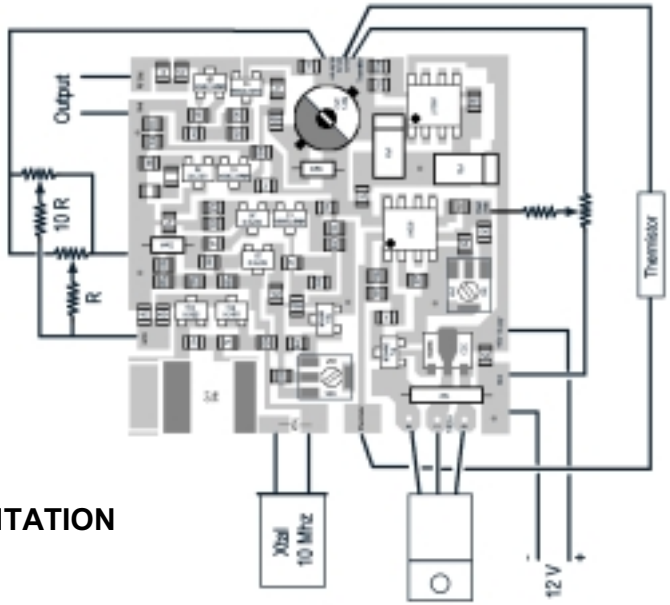
More 76GHz news comes via John, G8ACE. Just as this issue was being put together John informs us that **PA0EHG Hans and Harke ???HRK** have made the first PA contact on 76GHz. We haven't heard from Hans directly as yet but hope to have the full story in the next Newsletter.

From **Jonathan, G4KLX**, who lives in **Switzerland** comes this email with news of his recent house move…
From: **Jonathan Naylor [g4klx@pop.agri.ch]**
I have now moved into a new QTH with a good take-off to the north. It's wonderful to be QRV from home again.

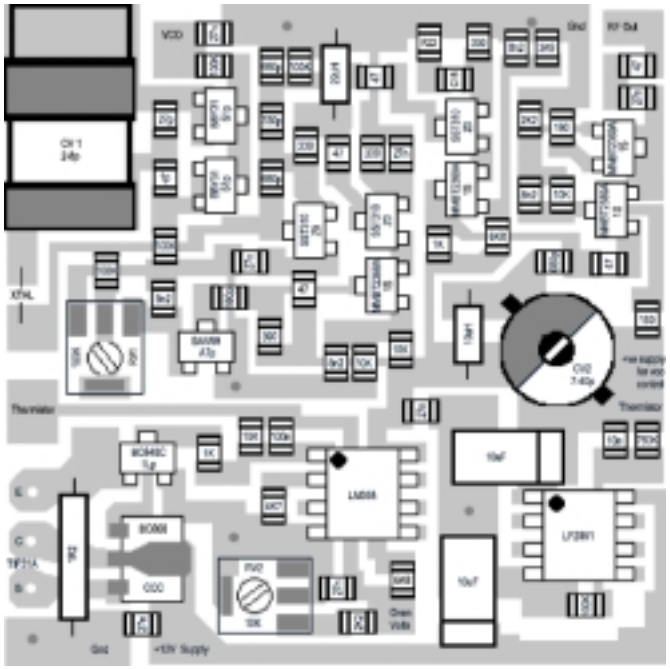
The May contest was not so good from the point of view of the higher bands and it wasn't helped by the lack of G activity. However our 2m station was good and we worked a few Gs and that was pleasing.

Before the contest there was a rain scatter opening and I was able to work a couple of OKs in JO60 and a DL in JN48. My wife held the dish in order to give me some elevation. What I didn't realise was that I had my driver on low power so all my QSOs were with less than one watt instead of the normal 2.5 !

Can I recommend the web page of one of the



PLL IMPLEMENTATION



PCB COMPONENT LAYOUT

THE G4JNT MSF LOCKED FREQUENCY STANDARD REVISITED ..... by Mike Scott,G3LYP

The original article for the MK1 MSF locked frequency standard was published in Radio Communication in April and May 1994. A MK11 version was published in the Microwave Newsletter in April 1996. Although I have built both versions, I prefer the MK1 because it generates harmonics directly on all the VHF, UHF and microwave bands, whereas the MK11 was designed to generate only 1MHz and 10MHz outputs. The MK1, as well as generating a VHF output, also generates 10MHz and many other frequencies if the divider circuit, published in the original article, is included in the unit.

I found two problems with the original design, which I have been meaning to address for some years but have only recently done so. The first of these was that it was difficult, or sometimes impossible, to get the VXO to lock with the MSF signal after dark and, if locked during the day, it would unlock at, or soon after, dusk. Looking at the MSF signal on an oscilloscope showed that the signal was quite noisy with the trace of the pulsating sine wave considerably thickened.

As commercial clocks locked to MSF, available cheaply from stores such as Argos, work quite happily through the hours of darkness, the problem must be soluble. From a discussion at a microwave roundtable, I learnt that these clocks probably use 60kHz crystal filters to provide adequate selectivity. My first thought was to see if these filters were available from any of the usual suppliers but without any success.

Those old enough to remember the days when most amateurs used surplus receivers such as the BC342 and BC348 will also remember the Q-Fiver which was a cheap way of turning the above receivers into double superhets with 85kHz second IFs. The surplus "Command" receiver, the BC453, was a cheap and convenient solution. This set-up provided quite adequate selectivity for SSB reception, and so it seemed probable that a number of tuned circuits on 60kHz would improve the performance of the MSF receiver in the MK1 (or MK1) frequency standard.

In the original design, all the selectivity is provided by the tuned circuit on the ferrite rod aerial. In the new design, four extra coils are added, two between the ferrite rod and the gate of the FET and two between the drain and the remaining amplifier and emitter follower. I used a dual gate MOSFET in place of the JFET in the original design because I had some available, but no doubt a JFET would work as well.

The coils were Toko units obtained from BEC (Bonex) and were available from stock. The coupling capacitors (C2, C4, and C10) were chosen so that all four coils tuned quite sharply to provide maximum selectivity. The coils were nominally 4.7mH and the tuning capacitors were chosen as the nearest preferred value to the calculated value to resonate at 60kHz. From C12 onwards, the circuit is as in the original design.

As I use this unit for other purposes as well as with the frequency standard, I chose to use a separate lead for the DC supply, but by inserting a choke between the output and the 12v rail, the supply could be fed up the coax from the main unit.

The circuit was constructed on a printed circuit board with the tracks on the lower side and a ground plane on the top. Artwork, on acetate film, is available free to anyone sending a stamped addressed envelope (G3LYP QTHR).

The PCB was mounted in a small plastic box with the ferrite rod mounted internally. The latter was salvaged from an old BC radio, the medium wave and long wave coils being joined to provide extra inductance. The box containing the front end needs to be kept about a metre from the main unit to prevent pick-up of the internally generated 60kHz signal.

The performance of the new front end is very satisfactory and, when viewed on the oscilloscope, the signal is a clean pulsating sine wave with no sign of noise when viewed during daytime or at night. Once locked, the unit stays in lock day and night.

The second problem, referred to above, was that when first switched on the phase lock loop failed to lock and it was necessary to adjust the trimmer (C1) to obtain lock. This was quite inconvenient as

it necessitated removing the lid from the box to get access to the trimmer which is mounted on the VXO PCB. The solution was to mount a small (10 pF) trimmer with a 3/16 inch shaft on the PCB adjacent to C1 and connected in parallel with it. Unfortunately, when I built my unit, I mounted the VXO board at the back of the box and so I had to extend the shaft of the new trimmer to bring it out to a small knob on the front panel This necessitated the repositioning a number of components. Anyone building from scratch should consider mounting the VXO near to the front panel and replacing C1 with a small variable capacitor mounted on the front panel.

After allowing some time for warm-up, it is simply a matter of adjusting the knob on the front panel while watching the meter until lock is obtained. It is quite useful to monitor the voltage at the cold end of the 220k resistor connected to the varicap, with a high resistance voltmeter permanently connected to this point. In his original article, Andy Talbot, G4JNT, suggests that this should be about 3.5 volts. In my experience this can vary from about 4 – 6 volts depending on how long the unit has been operating. This may be due to the particular BB105 I used being slightly different to the one in the prototype.

As a final note, a number of corrections were published in Rad.Com. of August 1994, p64. It should also be noted that the unused inverter in the 74HC14 chip and shown with its input grounded in Fig 4 should be connected in the lead to pin 13 of the 4066.

Editor's comment: *Our thanks to Mike for this very useful article. The circuit diagram appears on the following page. In view of the change over to digital TV in the UK (and we hear on the well known ZDF Astra satellite station) the use of TV-locked frequency standards may not be possible for much longer as the SPG stability of those stations will not be as good as when they were analogue. So it is back to MSF or Droitwich for many of us! However, there are also some very interesting GPS locked designs around which lend themselves to portable use.*

ANOTHER USEFUL FREEBIE ……

If you have a PC and want to do Smith Charts then this email should be of interest.

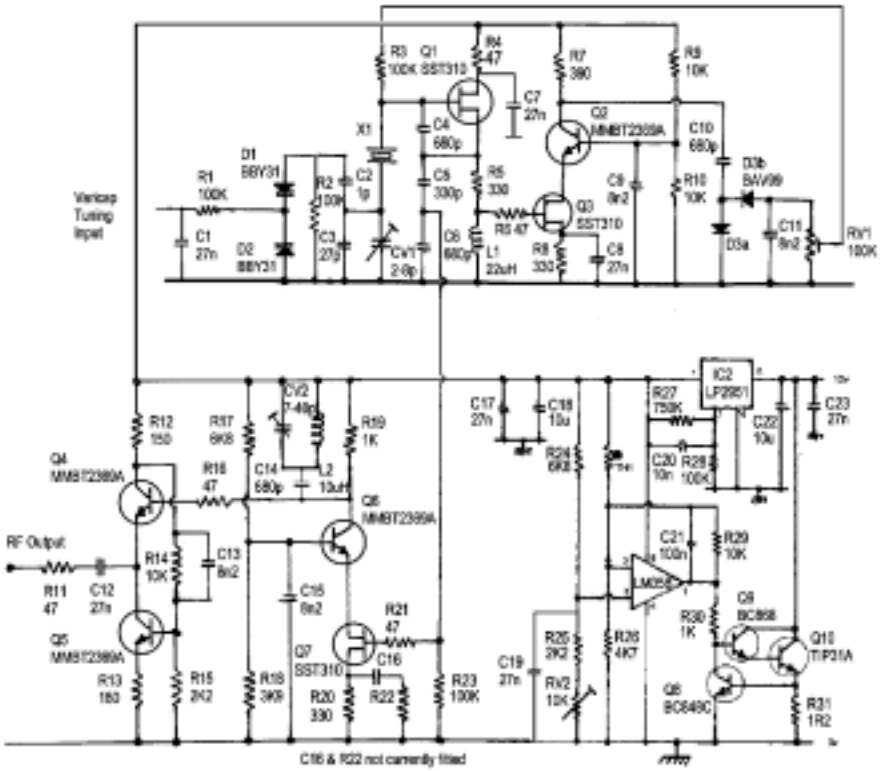
From Lance [LLascari@microwavedata.com]
Subject: [Microwave] free smith chart program

In case anyone is interested, I've posted a very preliminary version of my smith chart utility program for windows to my website.

It seems to work, but I would be interested in bug reports / quirks/ crashes. Of course constructive comments and suggestions are welcomed.

I will periodically be posting updates so keep that in mind if you do actually find it useful.

Look under LLsmith at **http://tools.rfdude.com**



Above: Oscillator circuitry. Below: Warm up current-v-time

usually a frequency minimum. Note the voltage at the TP2. Set the on board pot RV2 to achieve this voltage at TP1.

Subsequently, when finally boxed, voltage values can be set using the external temperature pot to accurately set the turnover temperature. Leave time for the oven temperature to re-stabilise after each adjustment has been made. Note slider voltages against frequency to enable final settings. The varactor diodes are used for accurately setting frequency so the trimmer is used only to set the oscillator within a hertz of the target frequency, the accurate setting being done with the dc control. In PLL applications, the trimmer is used for setting the desired centre operating voltage control range.

Operation

When used as a free running oscillator, this unit needs to be continuously powered. Otherwise the crystal ageing and retrace effects will affect the output frequency accuracy. A 13 amp plug style power supply is useful for powering. The inclusion of a 7812 regulator chip from this type of supply is beneficial.

Although it has not been implemented, diode steering between a battery input supply and the mains electricity derived supply will enable a unit to be moved whilst powered to another site for calibration. This would overcome the ageing and retrace effects affecting the accuracy of remote calibration.

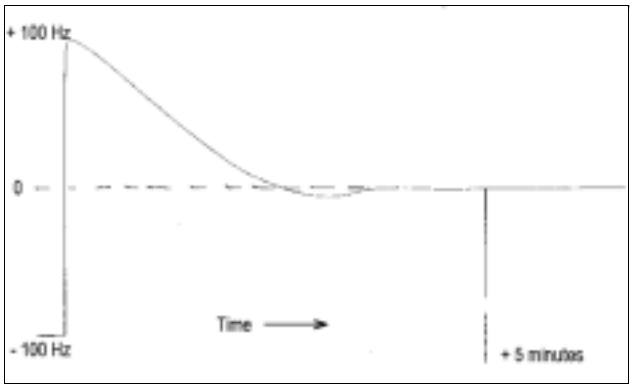
R30 sets the maximum heating current and maybe increased in value to perhaps a maximum of 4.7Ω which will minimise the current demand from a plug style PSU. For PLL applications, where the unit is powered on only when in use, the specified value of R30 should be retained to minimise PLL lock up time.

Crystal ageing will be considerable initially and is a continuous process but thankfully does slow down. Expect therefore to recalibrate the free running oscillator at intervals, particularly in the first year of use.

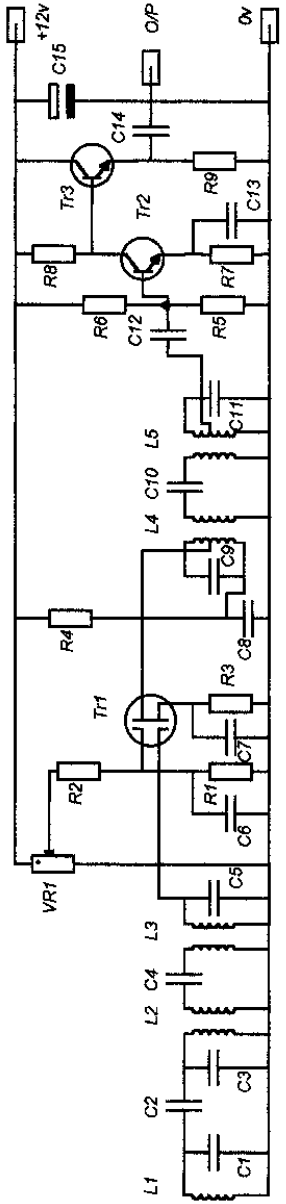
In the PLL applications the loop takes care of the ageing process. by changing the voltage applied to the varicaps. The frequency control provided by the varicaps is however quite small and re-tuning of the trimmer may be needed following the initial faster ageing. Fortunately varicap voltage monitoring shows the amount and speed of ageing taking place keeping you informed. The stability is also related to ambient temperature. Broadly, the insulation around the oscillator controls heat loss and therefore oven power for any given ambient temperature. In PLL applications if the varicap voltage follows a cycle related to ambient temperature then the turnover temperature setting or thermal insulation may be poor.

As with overtone oscillators, some crystals have been observed to have various peculiarities. Substitute the crystal if at all in doubt preferably with one from another supplier. G8ACE may be able to supply a kit of parts if there is sufficient interest.

Frequency drift –v– time during warm up



Modified MSF Frequency Standard "Front End" .. By G3LYP



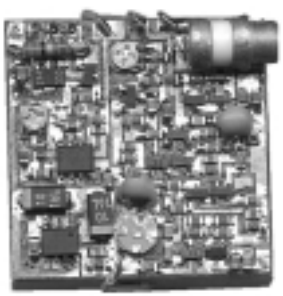
C1 1200pF Polystyrene
C2,C4,C10 100pF Ceramic
C3,C5,C9,C11 1500pF Polystyrene
C6,C7,C8 1uF Monolithic ceramic
C12,C13,C14 680nF Polyester
C15 22uF Tantalum
VR1 100k Multiturn

R1 33k
R2 68k
R3 220R
R4 100R
R5 8k2
R6 82k
R7 220R
R8 3k9
R9 1k

L1 BC Ferrite rod (Med + LW windings in series)
L2,L3,L4,L5 Toko 4.7mH CLN2A1048EK (Bonex)

Tr1 40673 or similar MOSFET
Tr2,Tr3 BC238 or similar

An Ovened Reference Oscillator



Oscillator Circuit Design by: Ian Lever, G8CPJ
Implementation by: John Hazell, G8ACE

Background

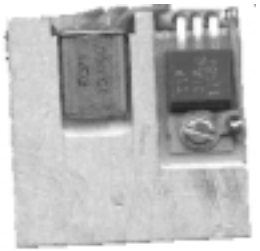
During 1999 the need for a stable 10Mhz source arose. In my case I chose to phase lock a 10MHz crystal to the Radio 4 198kHz transmission. MSF, DCF, GPS and TV are other possible PLL locking sources. It soon became apparent in my project that a non-stabilised oscillator circuit was not adequate, as the PLL spent most of its time chasing the crystal drift. Commercial oven references do appear at junk sales but often these are 5MHz units and do not always contain the control circuitry for phase locking. G8CPJ was also experimenting with locked sources for his own use and had developed the circuitry used here but without an oven. G8ACE built it with surface mount components in the form now used in this module. As suitable oven circuitry already existed in the overtone oscillator module it was just a case of substituting this oscillator circuitry to the existing overtone PCB. It's a fairly tight squeeze to fit it all onto the 35mm square board so is not considered a starter project for those wishing to venture into surface mount. However, anyone with experience in microwave construction should be able to build it. The oscillator is equally well suited to operating at 12MHz or 5MHz or to your own particular frequency requirement. It is equally suited to be used phase locked or as a free running reference oscillator.

Features and Performance

- Varicap diode fine frequency control adjustment for accurate manual frequency setting or PLL control input.
- AGC amplifier with crystal drive control and output signal level set.
- Output amplifier providing oscillator isolation and 50Ω terminated cable driving capability.
- Oven temperature control setting for optimum frequency stability.
- Stability, free running capability is better than 1 part in 108 per degree C of ambient temperature for a well aged crystal with the module housed in an insulated enclosure and oven set to within ±1°C of crystal turnover temperature.
- Output level 0dBm into 50Ω with typically 1% total harmonic distortion.

Construction

A single 35mm square PCB is used together with an attached heater plate. Dense foam insulates and supports the module within a suitable box. Grounding links for the PCB earth tracks are made by inserting L shaped tinned copper links through the board from the ground plane side and soldering initially only on the ground plane side. The wire is then clipped 1mm above the tracks and lightly tapped with a pin hammer to form a rivet shaped head which can be soldered, leaving a low finished profile so that components may be placed directly on top of the ground point if necessary. Circuit components are assembled to the PCB before it is glued with epoxy to the heater plate. This is because the heater plate will form an efficient heat sink and will make soldering difficult with a small size, low temperature soldering bit. Reference to the component layout diagram will show the individual component positions in relation to the tracks. Installing resistors first helps in navigation around the board for installation of the remaining parts. The frequency setting trimmer used is a ceramic piston type. To date, no UK source of new trimmers has not been found but fortunately



these trimmers can be found in equipment at surplus sales. A basic circuit function test should be done before completing construction with the plate and remaining components. Critical to proper operation is good thermal conductivity between the heating transistor, the thermistor and the crystal. The thermistor is best passed through a hole so it operates internally within the plate but fixing it to the plate surface also gives adequate results. Critically the crystal requires to be well thermally bonded to the plate. Good thermal insulation is also a prerequisite to ensuring a small thermal differential across the module. High temperature insulation is required on the lead out wires coming away from the module. The wire itself should be of small cross sectional area otherwise these wires will sink away heat from the module. When used as a free running oscillator, the use of a locking multi-turn clock dial pot is suggested for precision frequency setting. Two pots of the ordinary multi-turn type, coarse and fine, give good control. A further pot for accurate oven temperature setting is also advantageous.

Initial Testing

The module can be tested before glueing to the heater plate and before the thermistor and power transistor are fitted. The crystal, the dc supply and output will need temporary connections. A voltage applied to the varicaps and frequency monitoring with a counter will check these are working. The varicaps are lightly coupled to the crystal with less than 1Hz/volt sensitivity and so stepping the control between 0 and 10.5 volts is preferred at this stage to see a small frequency shift take place. When rf output is obtained and can be set correctly to frequency and amplitude the module can be completed. The circuit is designed for crystals requiring 30pf load capacitance. If you use crystals requiring another value then C3 will need to be adjusted.
Whilst incomplete the output of the oven control IC pin 1 will be around 8 volts.

Testing at Completion

The oven circuit operation can now be checked for heating. Temperature stabilisation to the set point is most easily seen by monitoring total current and watching it reduce as the set point is reached. RV2 sets actual temperature. If operation is satisfactory, reset the temperature to minimum to make the module easier to handle.

Use a 50Ω terminated oscilloscope to set the output amplitude to 650mv pp with RV1. Adjust CV2 to peak the signal. L2 must be selected according to the crystal frequency. RV1 may need re-adjusting after peaking CV2. Peaking CV2 is primarily to minimise distortion and unwanted products. Note that higher output levels can be set but distortion will be higher, also asymmetric clipping may occur into 50Ω loads and there will be a consequent higher drive level to the crystal. The use of a 50Ω termination is particularly recommended using longer output cables.

As previously discussed in the Newsletter pages, the crystal must be operated at its turnover temperature, ±1°C preferred to achieve the best stability. It is vital in this oven design that the turnover temperature for the crystal is known to be in the range, 50-70°C At 50°C turnover, operation will be satisfactory to up to 30°C ambient temperature. If the ambient temperature is likely to exceed this then a higher turnover temperature crystal should be used. To aid accurate setting of turnover temperature the on board pot can be set to the nominal temperature required and a fine adjustment multiturn pot added externally. The regulated supply for all additional pots being taken from the on board regulator at the point where the thermistor is attached, adjacent to the LP2951, IC2. Return the ground side of the adjustment pots directly back to the board. Do not include the ground side of the power supply leads in the dc return. The voltage setting for the turnover temperature for the crystal is obtained as follows. If an external pot is used leave it set it to mid range. Attach a voltage monitor wire to TP2. Heat the module above the expected temperature value, turn the on board pot to minimum heat, quickly thermally insulate the module and monitor the frequency. The point at which the frequency shift changes direction is the turnover point. This is