United Kingdom
Microwave Group

Scatterpoint – *Issue 1*

February 2000

www.microwavers.org

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About the UKuG

The United Kingdom Microwave Group was formed in Autumn 1999.

Membership subscriptions are currently UKP12.00 per year.

The committee comprises of the following:

Chairman	***Membership Secretary***	***Newsletter Editor***
Sam Jewell, G4DDK 56 Meadowlands Kirton Ipswich Suffolk IP10 0PP jewell@btinternet.com	Lehane Kellett G8KMH 43 Waverley Way Finchampstead Wokingham Berkshire RG40 4YD lehane@mm-wave.demon.co.uk	Martyn Kinder G0CZD 12 Jessop Way Haslington Crewe Cheshire CW1 5FU martyn@g0czd.clara.net Tel: 01270 505930

There are also six ordinary committee members;

Neil Whiting	G4BRK
Steve Davis	G4KNZ
Peter Blakeborough	G3PYB
David Wrigley	G6GKX
Alan Wyatt	G8LSD
Mike Willis	G0MJW

Membership enquiries and applications should be sent to the membership secretary.

A membership form is available at on http://www.microwavers.org/ukugmemb.htm

The UKuG web site is at http://www.microwavers.org

Contributions for Scatterpoint, letters, For Sale and Wanted should be addressed to the newsletter editor.

If you like what you see here, please tell others, if you don't like it, please tell me.
73, Martyn Kinder G0CZD

Editorial

A very happy New Year to all UKuG members. By the time read this the New Year festivities will be a just a memory and I wonder just how many new years resolutions are left intact?

Following a very successful inaugural meeting at BT's Adastral Park, the new group is now up and running and has it's first members. Around 30% of those present at Adastral Park signed up on the day and a consistent 7 to 10 new members have joined each week since that November meeting, putting us well on track to have our first 100 members by the time this issue of Scatterpoint is sent out.

The inaugural meeting wasn't without it's tensions. Several of those present questioned the need for such a group when the RSGB Microwave Committee had done such a Stirling job of supporting UK microwave activity for so many years. The answer is of course that the UKuG is not meant to replace the RSGB Microwave Committee, but rather to complement its work of spectrum planning and protection. I for one intend to continue playing my part on the RSGB Microwave Committee.

The UkuG will concentrate on those areas of the hobby where it can make an impact and a difference. Subject to your committee's approval we have some interesting ideas planned for the group including a chip component bank (based on that of the NTMS), access to surplus dishes and some construction projects. I personally would also like to see a concerted effort to get some more beacons in place, especially on the middle bands, so that a proper programme of propagation monitoring can be put in place. I would also like to see some experimental cross-band linear microwave transponders being deployed, possibly in conjunction with the beacon project. In additional to focusing activity and engendering interest, cross band transponders can be an effective way of allowing you to adjust your transmitter and receiver in real time and hear the difference.

2000 should see many changes to amateur microwaves in both the UK and elsewhere. I hear that there are plans to activate the UK 75GHz band for what may be the first time. If you know of previous 75GHz activity in the UK, please let us know. At least one UK station has been ready to operate on 75GHz for some time and is still looking for a QSO partner.

If the P3D satellite is successfully launched during 2000 then the dream of world-wide amateur microwave contacts (without using the moon) will become a reality and suddenly we will see a surge in interest in the higher bands from our friends who inhabit the lower reaches of the electromagnetic spectrum. Lots of new equipment designs will no doubt appear and I'm sure the amateur equipment manufacturers in the far east will quickly introduce some interesting new kit. The expertise of our members will be in high demand for club talks as well as for mentoring new comers to the 'exciting bands'.

If more surplus PCS1900 amplifiers can be found and converted to 2.3GHz then the increased power available will revolutionise this great band. For many years 2.3GHz has been regarded as the ideal backyard moonbounce band, but the lack of suitable amplifiers to produce the required 50 to 100W has been the stumbling block. Maybe not for much longer. 100W for less than £100 just has to be a big incentive. 2.3GHz is an ideal band for long-distance troposcatter communication, possibly better that 1.3GHz from an amateur point of view. With lots of stations equipped with high power solid state 100W amplifiers we should see the potential of 13cm at last realised.

So, an interesting year to come and the UkuG is well placed to play its part. I'm looking forward to working you all during the year on every one of the microwave bands.

Happy 2000

73 de Sam

The DC Bands

1.3 and 2.3GHz News by John Quarmby G3XDY

On the bands

1.3GHz & 2.3GHz Trophy Contests

Conditions and the weather were both poor for this, with gales and rain sweeping across the UK prior to the contest. It was a struggle to find any real DX as a result. However there was reasonable participation on 2.3GHz, with the Spalding group active from JO03 as G5B, and stations such as G3MEH making their first contacts on the band. I managed to cook my 2.3GHz PA after the first few contacts, but was still able to make 17 QSOs, with DK2MN in JO32 the best DX on both 1.3GHz and 2.3GHz at 416km. 1.3GHz produced 48QSOs for me but it was all hard work. The Parallel Lines group (G8P) were on 69 QSOs about an hour an half before the end, seemingly ahead of competition from M1CRO/P and G0EMG/P. Amongst the single op entrants Anthony G7LRQ was doing well on 1.3GHz.

IARU UHF Contest

Conditions improved after the Trophy contests to give some reasonable DX on Sunday on 1.3GHz. DL0UL/P in JN48UO was a welcome QSO at 715km, following a QSY from 432MHz, and a few other German stations were worked by setting up QSOs on the lower band. The all band UK Microwave contest running on the Sunday did not seem to add much activity on 1.3 or 2.3GHz.

1.3GHz & 2.3GHz Cumulatives

There were no spectacular openings to liven up the Cumulatives this year, but the activity levels for at least the first 3 or 4 sessions were good. Interest in 2.3GHz seems to be on the increase, with G3MEH and G4BRK both recently active on the band. Neil G4BRK has been doing very well from his QTH near Swindon, working PA5DD under flat conditions at >400km using just 4W and 0.9m dish, and making several other good distance contacts in each session. Neil had about 30 QSOs overall on 2.3GHz. Over here in East Anglia PA5DD was very consistent on 2.3GHz but there was no long DX to be found, others worked included G6XDI, G3MEH, G8ZQB, G8NEY and PE1JBK.

On 1.3GHz activity seemed quite good – G4BRK reports working about 100 stations overall, and from East Anglia I managed 34 QSOs in session 3, which also produced my best DX, DL8OBU in JO42XI at 597km. G8NEY and G7LRQ were also doing well, with G8OHM/P and G6SPS/P battling it out in the multi-op section. It was also good to hear Paul G0HNW/P active from Yorkshire in most of the sessions. PA5DD was very active , and Uffe worked well into the UK on most sessions, including at least one QSO with G0HNW/P at about 460km. DC9KU was also around for some sessions and worked several UK stations.

With the current levels of activity on the two bands it is now becoming more of a challenge to work everything in the 2.5 hours available. I think that sticking with the current format gives an incentive to be a bit slicker in completing the QSOs, rather than extending the period to 3 hours – what do you think?

Regular Activity

David GM4WLL/P now has a few watts on 23cm and has been out in IO85 testing the rig, making some local QSOs during the Sunday morning activity period. I was pleased to find Eddie G0EHV (IO94) on the band when I looked up that way during one of David's tests, as activity North of the

Humber seems quite sparse these days. GM4WLL tells me he has also been doing some testing of Rhombic antennas for 1.3GHz , it will be interesting to see how this fares.

Tropo opening s seem to have been sparse this autumn, with nothing into central Europe. Conditions were good from East Anglia and Kent to Scandinavia on the 11th and 12th of November, with OZ6OL (JO65), SM6EAN (JO57), SM6TZX (JO67), and SM7FMX (JO65) on 1.3GHz, and SM6EAN also worked on 2.3GHz. Although the Scandinavians were workable on 144MHz over a wide area of the UK, signals on the microwave bands did not seem to be going far inland.

Beacons

Ted G3YJX is looking for reports on GB3MCB on 1296.860 MHz. Please let him know if you hear the beacon, as he is looking at whether it is worth keeping the beacon running. Ted can be contacted QTHR or via email at ted@treryn.freeserve.co.uk

Using the DXCluster for Microwave DX

Thanks to Freddy ON6UG for pointing out that the URL for the Web Cluster given in the last column was incorrect – it should be: http://oh2aq.kolumbus.com/dxs/

Contests in 2000

The RSGB has recently published the 2000 Contest Calendar. The first event for 1.3/2.3GHz is not until the Fixed Station Contest on April 9th, however there are some other opportunities to stir up activity before then.

The RSGB Microwave committee promotes All Band activity days on the last Sunday of the month in January, February, and March.

In the UK the contest on the first weekend in March is on 144 and 432MHz only, but in the rest of Europe it is an all band event, running from 1400utc on the 4th to 1400 on the 5th . Again this is a good opportunity to dredge around in the noise for some DX as there should not be much UK QRM, and the continental stations will be delighted to get some points from the UK on the higher bands.

Power Amplifiers for 2.3GHz

There are an increasing number of ways to get significant power levels on 2.3GHz, as more solid state equipment becomes available both new and surplus. It is worth pursuing high power on this band as it is ideal for troposcatter (many commercial troposcatter systems operate around this frequency). An EIRP of 5-10kW will give 400km plus troposcatter range, so with a 23dBi antenna 25 to 50 Watts will meet the requirement. With the increasing activity on the band the investment in higher power pays off with more QSOs in flat conditions and the ability to snag the weaker stations at the edges of tropo openings.

Looking back a few years the usual PA was a 2C39A in a cavity consisting of two offset rings sandwiched between brass plates. The late G3VVB produced some nicely finished versions of this design, but they proved temperamental in practice and could be difficult to tune to 2320MHz. The most I ever saw was about 20W output, although others have achieved more.

A number of true coaxial cavity designs for 2C39As have appeared in QST and Dubus (VE4MA published one a few years ago). K9EK can supply the metalwork for an optimised cavity of this type. This can give very high gain and good output power – up to 60W out for 1W of drive is claimed, using a water cooled 2C39A. I have obtained 50W output from this design with an air cooled valve operating somewhat beyond its ratings (and with equally foreshortened life!). Some details can be found at http://downeastmicrowave.com/graphics/specs1.jpg K9EK can be contacted at: k9ek@amsat.org

The RSGB Microwave handbook includes designs by OZ9CR using single and dual 2C39As. I would be interested to know how these perform if any of our readers have built them.

For even higher power the Russian GI7B tube is claimed to be capable of operation on 2.3GHz. With 300W anode dissipation this tube should be good for well over 100W output in a suitable cavity.

However I think we are rapidly approaching the point where valve amplifiers will no longer be competitive with transistors at typical amateur levels on this band. There are a lot of transistor amplifiers available in kit form with outputs up to tens of watts. They have the great advantage that they do not need tuning as they warm up, and no high voltage supplies, making masthead mounting a practical proposition to get away from the substantial feeder losses that are a real problem at these frequencies.

Charlie G3WDG has a PA design using a PCS mobile phone MMIC to produce 1W output for 2 mW input. Charlie also has a very compact 10W output design using an MGF0907 GaAsFET. Contact the Microwave Committee Component Service for details of these kits at: http://www.g3wdg.free-online.co.uk/ , or contact Petra G4KGC on 01933 411446.

Going further afield there are three suppliers in Germany for 2.3GHz PA kits. DL2AM (Philipp Prinz) has a wide range of kits ranging from 1W to 80W output. I built his 3W amplifier using an MGF0905 GaAsFET with success, and Andrew G6SPS has one of his 40W amplifiers mounted at his antenna putting out a big signal. Details can be found at http://home.t-online.de/home/prinz.DL2AM/ or by phone at +49-(0)7567-294 , fax +49-(0)7567-1200 and via email at prinz.dl2am@t-online.de

Michael Kuhne DB6NT has a range of compact PA modules that can give 5W or 10W output. See http://www.db6nt.com or phone: +49-9288-8232, FAX: +49-9288-1768 for details. Michael takes credit cards which simplifies purchases from the UK.

DK2DB also has kits available via Eisch Electronics, Sam G4DDK has successfully built a 10W amplifier from this source. Eisch can be emailed at eisch-electronic@t-online.de : or contacted at: Tel: (+49)0730523208 Fax: (+49)0730523306

Reviews of the DL2AM 3W amp and the DK2DB 10W amplifier can be found on G4DDK's website http://www.btinternet.com/~jewell/techlink.htm

Some interesting surplus is now starting to appear as well. A number of PCS mobile phone amplifier units became available in Germany in late 1999, and a few have made their way to the UK. These were designed for use at about 1950 MHz, but thanks to some pioneering work by Guenter DL4MEA, they can be fairly easily modified to operate at 2.3GHz. The transistor in the output stage is rated at 60W output in the PCS band, Guenter has measured 40W output for 9W of drive from his modified amplifier, and 50W may be possible given more drive. It operates from a 26V, 6A DC supply. Guenter has details of the modifications on his web site at http://www.qsl.net/dl4mea/13ss/13ss.htm It is hoped that some more of these units can be obtained - if you are interested then please contact Sam G4DDK or myself for details.

Sign off

I hope you all have a happy and successful new year, with lots of activity on the lower microwave bands. Please let me have your news and views and I would also welcome details of construction projects. I can be contacted as below. Information for this column has come from G4DDK's "A View from East Anglia" web site, from the DX Cluster network, GM4WLL, G4BRK, G3YJX and the websites listed in the article, plus contacts on the bands.

73

John, G3XDY

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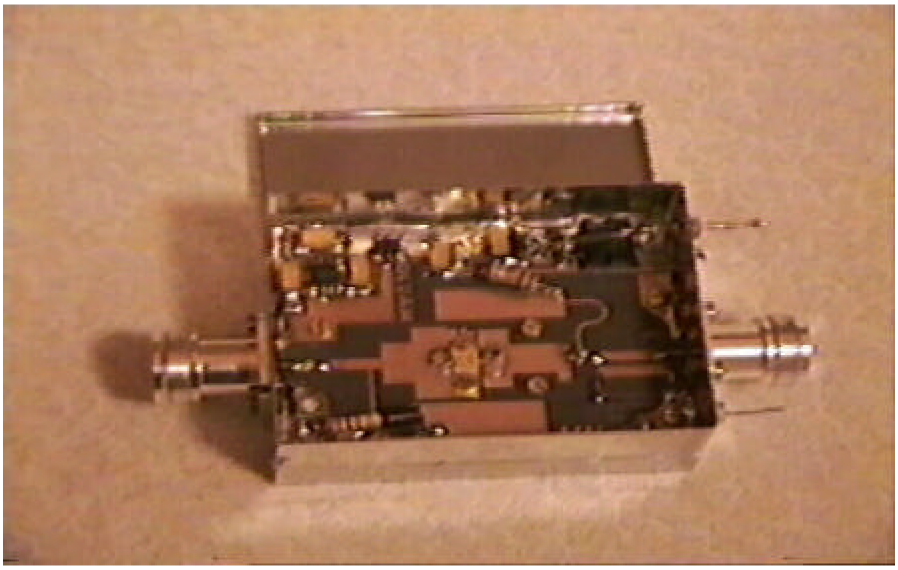
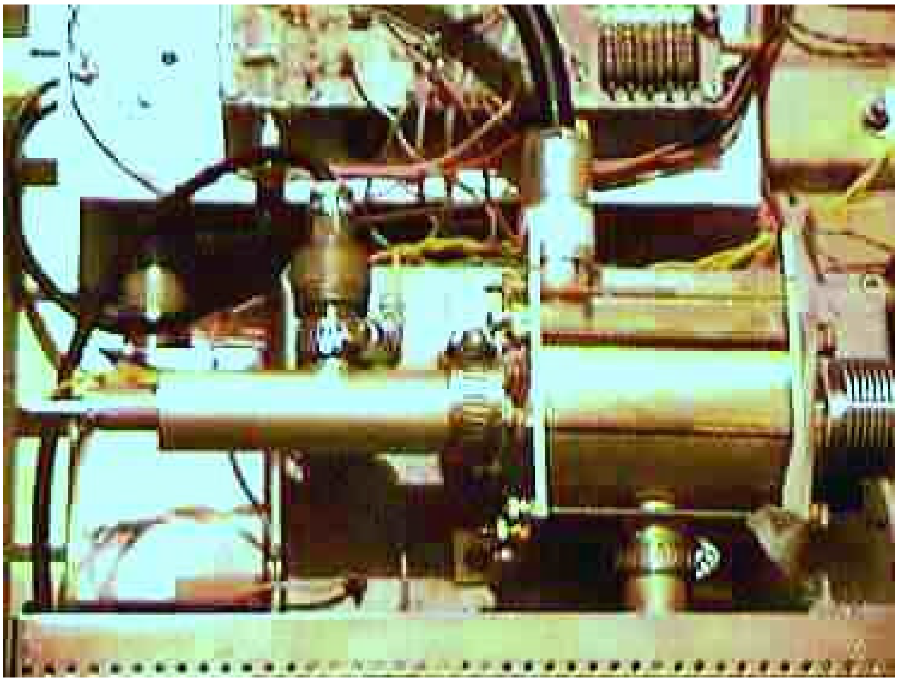
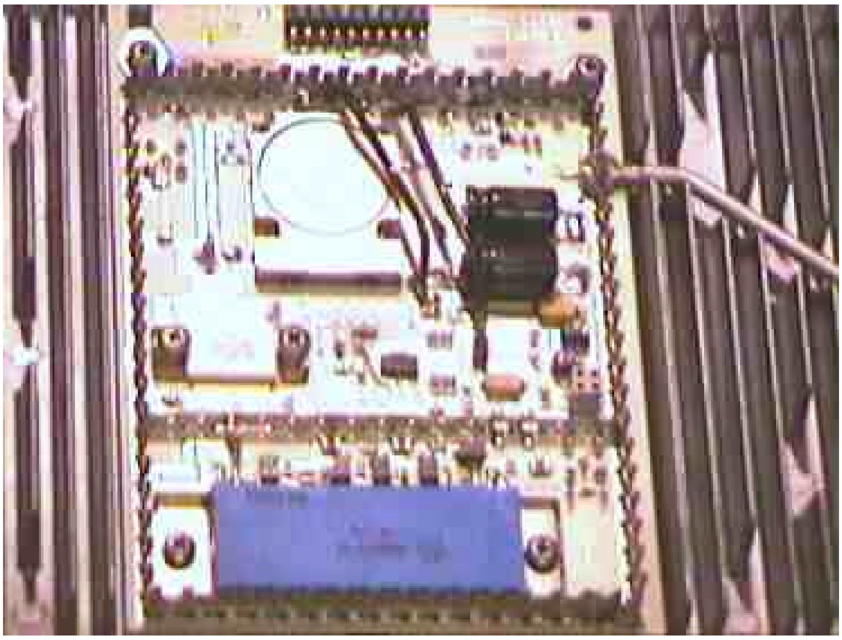
DL2AM MT2,3-E4W Amplifier as built by G3XDY.



K9EK Amplifier in G3XDY 2.3GHz Transverter



PCS Power Amplifier – before modification, PA Transistor above left end of blue power module



Microwaves – an American view of the UK Round Table

Kent Britain WA5VJB

I would certainly like to thank the UK uWave Group for inviting me to Martlesham last November

The fleamarket was small by our standards, but this was more than compensated for in quality. I was able to acquire several important bits for out 47 GHz antenna range and parts to upgrade the 24 GHz antenna range. It was also interesting to see the different range in prices.

Interesting note on the regional accents:
During the "Political" Discussions most of participants developed thick regional English accents. But just as soon at it was over, the regional accents went away!!?? Very Interesting.

Learning that a boot is at the back of a car rather than on the foot of a cowboy.
That “Top Shelf” does not mean a brand of frozen TV Dinners, Looking both ways before crossing the street (Opposite order), and proper use of the adjective "Brilliant" were but a few of the social variations I brought home.

Also interesting variations on home construction. Having been the contractor on the construction of my home, it was interesting to see the building techniques. In understand wood frame construction with integral insulation is considered junk in England. Yet I look at the typical English home and it would inhabitable 3 months out of the summer and inhabitable about 2 weeks out of the winter. A good Texas thunderstorm would fill several areas with water, and those slate roofs would have to be replaced every 3 to 5 years. Oh well, they seem to work fine in England.

And last but hardly least was observing the political discussions.
As they say, it was Deja Vu all over again! All I had to do was put different names to the faces, and the meeting could have been a Texas VHF FM Society meeting, or the Wellington VHF Group (NZ), an ARRL Contest Committee meeting, or a Central States VHF Society Board of Directors meeting. It must be part of the Homo sapian species. But now as a charter member of the UKuG I feel that we will be filling an important need in the UHF+ community and a positive sergethy to the traditional microwave societies.

Antenna Measuring Notes:

Kent Britain WA5VJB

Since 1987 I have set up my portable antenna range at 14 Conferences measuring well over 1000 antennas, mainly in the .9 to 24 GHz range. G4DDK has asked me to list some of my observations.

The Feed is not at the focus of the dish:

First off, I have NEVER been able to calculate the focal point of my dish, mount the feed, and have the antenna optimised. NEVER! It always seems I have to move the feed in towards the dish a bit to tweak things up.

But out of the antenna range things are far worse. About half of the dishes have the feed off by as much as 50% in distance!
A chap comes up with a 2 ft. dish and about a .35 f/d. The feed is sticking out 3 ft from dish! "But that's where I calculated the focus to be!" is always the answer. I haven't found out what in the d sq/16c equation throws them, but we see it all the time. Another problem is the rounded edge on most dishes. They measure the physical diameter of the dish, not the diameter of the actual parabolic surface. That outer cm or so is not usable and should not be used in the F/d calculations. And I won't even start on the complications of calculating the actual phase centre of the feed.

I have always been able to pick up a dB or two tweaking the focus and 6 dB or so has been the typical improvement at the conferences when the feed is movable and we can optimise it's position. And finally come the 25% or so really bad ones. The "dish" was not parabolic, the feed wasn't resonate in the ham band, the focus was miscalculated by 3 feet (on a 2 ft dish!), using a grid dish on 3cm (and 3cm spacing on the wires), and so on. As I said, typically 25% or so of the dish antennas tested at these conferences are just air cooled dummy loads.

Most of these really bad ones are usually the prime focus dishes. With the offset dishes, you usually have a pretty good idea where the feed was for a starting point if you had saved all the parts. But the ham feeds will usually have a different phase centre, so we're back to seeing several dB of improvement moving the feed around a few millimetres. The antenna range is also a good spot to figure out where the antenna is pointing. Build up some kind of mechanical sight, or mount a telescopic sight on the edge of the offset dish. (Top edge works well too) Peak up the signal, and sight in on the source. An optical sight can be very useful when portable.

On Yagi and Quadloop type antenna, the builder has often used a different diameter boom, or different size elements, or even replace a round boom with a square boom. In each case there was no attempt to use corrections factors. (50/50 chance they would have gone in the wrong direction anyway!) Again a large percentage of these antenna are not close to what the owners are expecting in the way of performance.

If you tested all the microwave antennas in England, I am sure very few of the antennas would have the dB's you have been optimistically using in your range calculations.

Interestingly both the UK and ZL groups left the Microwave Update antenna range saying, "This antenna measuring is not all that hard" and are both looking at setting up antenna ranges back home. Next month I will go more into the details of measuring antennas and some of the pitfalls that have given me extended headaches. It really is not all that difficult to set up a practical UHF + antenna range.

Last month we discussed the value of an antenna test range, now we will explain how it is not necessarily complicated to set up an antenna range.

Equipment:
RF Source
Source Antenna
Reference Antenna
Detector
Open Space

RF Source 1000Hz vs. CW:

Many of my first antenna range set-ups was just a CW source, a reference horn, and a power meter. Hold up the power sensor and horn, measure power, attach the antenna to be measured, and the difference is dB power is the difference in dB gain.
This works, but you really have some dynamic range problems. The power sensor is not very sensitive, so you have to run a fair amount of power and use a short range. But it does work.
Just make sure you have at lease 10 dB more power that the noise floor of the power meter, otherwise you run into (Signal + Noise) / Noise problems. I have been able to make pretty good measurements with 10 to 30 milliwatts sources into 20 dB gain antennas on 6cm and 3 cm. Horns were measured at about 5 Meters, dish antennas at about 10 Meters from the source.

Generating 1000 Hz:

I have a Wavetek 3001 500 MHz synthesised signal generator I haul to the antenna range. Most RF generators already have a 1000 Hz AM setting. So up to 500 MHz I just set the generator to max output, 1000 Hz AM and drive a source antenna with it. On 902 MHz, I set the generator to 451 MHz and drive two sides of a mixer, this doubles to 902 MHz which goes through a filter and into a 20 dB gain amp. This gives me about 100 milliwatts to work with. On 1296 MHz I set the generator to 432 MHz, horribly overdrive a small brick amp, filter the 3rd harmonic, and drive a second brick amp. Again about 100 milliwatts to work with. On 2304 MHz, I set the generator to 384 MHz, again horribly overdrive a small brick amp, filter the 6th harmonic, and drive a second brick amp. This gives me about 75 milliwatts to work with, and there is a second similar unit for 2400 MHz. For 3456 MHz I again use a brick amp (Hand picked this one) driven with 432 MHz and run the 8th harmonic through an interdigital filter. A second brick amp brings this up to 10 milliwatts or so. On 5.7 GHz, 10.3 GHz, and 24.1 GHz I use Gunn sources driving PIN Diodes.
Sometimes I use a 555 timer circuit AA5C built up for me, other times I just drag along a function generator and directly drive the PIN Diodes. On 47 GHz I have a 23.5 GHz Gunn source driving a doubler out of an old HP 940A . I modulate a PIN diode on the 23.5 GHz source.
So a lot of ways to generate a 1000 Hz modulated RF source. Of course if I had a Signal Generator actually on these frequencies, or even a sweeper with an external modulation input, I would use it.

Source Antenna

You will need an antenna at the source end. It's nice if the antenna has a fair amount of gain and over the years I have used everything from Coffee Can horns, to 2 ft dish antennas on 3 cm. Over the years I have migrated to multiband antennas at the source, just to speed set-up and less stuff to haul about. Ridged horns work well, some the multiband dish feeds work well too. While it is nice for the source antenna to have gain, it is not necessary and I am a firm believer is using what works. More on the type of antenna to use under Open Area.

Detectors/terminations

At the receiver end we need a simple diode detector to demodulate the 1000Hz AM signal. I normally use a standard Type N Input diode detector. Now, most of these detectors in the US do not contain any kind of terminations. So they don't look like a 50 load, but rather have a very complex input impedance. Just put a 6 dB pad on the input of the detector. 10 dB works better, 20 dB has too much loss, and the input is pretty much 50 ? . For the higher bands, the simple diode detector mounted in WG works well.

Receiver:

If you are using CW and a Power Meter, then this is your receiver. If you are using 1000 Hz, then you need an HP-415, HP416, or the Marconi Type 6593A. Many other companies also make these 1000 Hz "SWR Indicators". These are simply an audio meter tuned to 1000 Hz with a high accuracy meter scale. I have also used General Microwave and NARDA versions of the HP415 and they work just as well.

Note: The HP415E needs 9 Volts to run, 16 volts to run in the expanded scale mode. It only pulls about 5 ma, so I will wire in two 9volt dry cell batteries and can run it for hours and hours on the antenna range.

Reference Antenna:

The most important part of the antenna range is an antenna you know the gain of.
The hand of God, or someone with a crayon, has written the gain of the antenna on a calibration sticker, or Post-it-Note. We measure how much signal the Reference antenna collected, and if the antenna being tested collects 3.2 dB more signal, then it has 3.2 dB more gain than the Reference. On all bands above 1.3 GHz, I use horn antennas as the reference. In several cases I was fortunate to acquire Std. Gain Horns, and the gain of a horn antenna can be easily calculated with high accuracy. But like any ham activity, absolute gain numbers are not as important as optimising the antenna. We will spend hours tweaking the output of a power amp, or the NF of a Pre-amp, and we know the equipment is not calibrated for the frequency we are using. But Max Power Out is still Max Power Out weather it is 68 Milliwatts, or 92 Milliwatts, it's all we can squeeze out of that circuit. Same for the antennas. You move the feed around, try several feeds, and so on, even if the range errors are a dB or 2, we have maximised the performance of the antenna and been able to compare the relative performance of different antennas.
Again if the real gain of the antenna is 29.6 dBi or 30.4 dBi is all academic, we have squeezed everything we can out of the antenna. (Or thrown it in the rubbish bin!)

Audio out:

The HP-415 has a "Recorder Out" connector on the back. I usually connect a small audio amp with a speaker to this connector. The raw 1000 Hz can be amplified to drive a speaker. Several good reasons to listen to the audio signal. It's nice to peak the antenna on a audio signal, especially when you're holding the dish with one hand, moving the feed with another hand, and holding the detector with the third hand .... you know what I mean.
And it is especially good when there might be interference Some time back I was testing an L-Band Helix for possible use on Phase 3-D. The meter was jumping all over the scale, there were several peaks away from the source, an a constant erratic noise floor on the meter. After some time I connected the audio amp and figured out the problem in nano seconds. Loud video buzz! The long helix was acting like a 1/4 wave whip on TV Channel 4! All further testing included either a 1269 MHz filter or an isolator. I have had similar problems testing Log Periodics that do not have the back ends of the booms terminated. At our Central States VHF Conference we typically have the 50-450 MHz and the 900+ MHz ranges running at the same time. Listening to the tones lets us easily tell when that 1296 rhombic also working as a144 MHz antenna.
(Our 1000 Hz tones are hardly phased locked)

Open Area:

30 Meters is nice, but I have often set up in more confined areas of 10 to 20 Meters. But try to avoid areas near walls that might cause reflections. Given a choice, I set up on grass (easier on my feet) but parking lots can also be used.

The whole idea is to find an area where you have a consistent signal about the same size as the capture area of the antenna. i.e. a bit bigger than the biggest antenna you plan to test. Our greatest source of error is have the signal level on one edge of the dish stronger than on the other edge of the dish. Some of the English lads were looking at me pretty funny while I was waving a horn antenna all over the parking lot at uWave Update. (The US guys had seen me do this before.) Up, Down, Left, Right, Back up a bit. The antenna range is not pre-planned geometry, I am just looking for an area about 1 meter by 1 meter where the signal level varies less than 1 dB. When I find it, I put some kind of marker on the ground, then tell everyone how high to hold their antennas.

Over grass I will usually set the source antenna 2 or 3 meters off the ground. If the source antenna has 20 dB or so of gain, very little of the RF hits the ground at the 1/2 way point.
And what does hit the ground is higher than Brewester's angle, so the bounce is attenuated 10 to 15 dB. If I am on a parking lot, I will set the source on the ground and make a ground reflection range. Although there is no hard fast rule here, I just use what ever works best and it's a quick test just setting the source antenna on the ground. If there is a nice consistent signal area, we start measuring antennas!

Measurement technique:

Substitution: Measuring itself if simple and quick. Hold up the reference antenna, set the meter to a convenient sport, attach the sensor to the antenna to be tested, hold it at the same spot, take a reading, calculate the difference. I normally carry some kind of marking pen and write the results on the antenna. We usually have someone else standing around with pen and paper making a more complete record, but the guys seem to like having an "Official Result" right on the antenna rather than trying to remembering it, or waiting a month until someone publishes the results.

Dynamic Range: One pitfall is the dynamic range of the SWR Indicator or power meter. You like to keep less than 10 dB difference between the antennas under test. So don't use a dipole as the reference for a 30 dB gain antenna measurement. First of all the meters have errors the farther you stretch them. Second the capture areas of the two antennas will be quite different. A large number of secondary problems testing antenna with vastly different capture areas. With the 415's or 6593's you want to keep them down in the 30,40 or 50 dB ranges. Higher than 30 usually means the diode is driven out of the square law region, in the 60's the signal will be pretty noisy. These meters will also work with bolometer mounts. Now you could use all the scales with a bolo, but the bolo is less sensitive than a diode mount and you will need more signal.

The 6593 can be used to directly compare 2 antennas, but this means you will need to find a larger measurement area, bigger than both antennas, to make your measurements. This is easy enough on 50 MHz - 432 MHz, but much more difficult on the microwave bands. I haven't used a 6593, but going over one in G4DDK's garage, it sure looked like a natural for antenna ranges.

Results: Oh it was fun in the early years deflating egos. "Well, a 5 element Yagi would have 12 dB gain, using quad elements adds 2 dB, and a corner reflector would have 10 dB, so by combing a Yagi, Quad, and corner reflector, my super antenna has 24 dB GAIN!" Yea, sure, here's the detector. (6 dBi if he was lucky!).

Over the years the wild claims have died down, and better, more consistent designs are showing up. And we have developed a bit of a tradition of seeing what kind of strange antennas we can show up with and still get good results. And a sprit of experimentation has developed where guys are not afraid to show up with a dish, 8 feeds, and find out which one works best. Typically at the CSVHFS antenna contests we will measure 100 to 125 different combinations of antennas.

There have been a few fun ones, I particularly remember KB0HH spending several years trying to optimise a scalar feed. With excellent form, his cowboy boot set the feed over 30 meters down the range!

Circular Polarisation: We usually get a few CP antennas to test. Normally I just measure the gain, rotate the antenna 90 degrees, measure the gain, average the numbers add 3 dB, and label the gain dBiC. Ideally, the gain does not change as the test antenna is rotated. If gain only varies 1 dB I'll congratulate the builder, if it varies 3 dB I'll still call it CP, more than 3 dB and we'll start looking at ways to fix/repair/improve the antenna. This is especially a problem with some of the "Short" Helix dish feeds that have become popular lately. It is very difficult to properly generate a CP wave in only 2 turns of wire. At an AMSAT Conference we set up the antenna range and only 4 of the 8 Helix antennas had gain along the axis of the antenna! Of the 4 with gain, only 2 were within 3 dB of circularity. And yes, 1 of the 2 had been brought by James Miller G3RUH. The AMSAT lads have been passing around the idea that Helix antennas are easy to build and fool proof. Test of dozens of Helix antennas says they are WRONG.

AMSAT writers perhaps have the worse habit of coping articles.   A guy writes an article about a Helix, that is copied from and article, that was copied from and article ....   And over the last 5 generations of this design, each writer/builder has substituted materials, slightly changed dimensions, and NEVER tested the antenna.

Log Periodics: LP's can also be difficult to test, especially the ones that do not terminate the back of the booms. The antenna pick up fundamental and harmonic frequencies equally well. They also tend to pick up more local interference. A clean source, and monitoring the 1000 Hz audio will usually keep you out of trouble. The unterminated LP's tend to act like a big capacitor and pick up noise from the mains and a lot of other garbage. All my current LP designs terminate the back of the booms, it just cleans up so many problems.

Higher Bands: In my job, we have been doing some radiometry work between 90 and 110 GHz. Yes, I modulate the Impatt amp with 1000 Hz and do all sorts of tests with the HP 415. It's a system that works well for antenna testing on all bands.

Care and feeding of Minicircuits Lab ZHL42 amplifiers

Sam Jewell, G4DDK

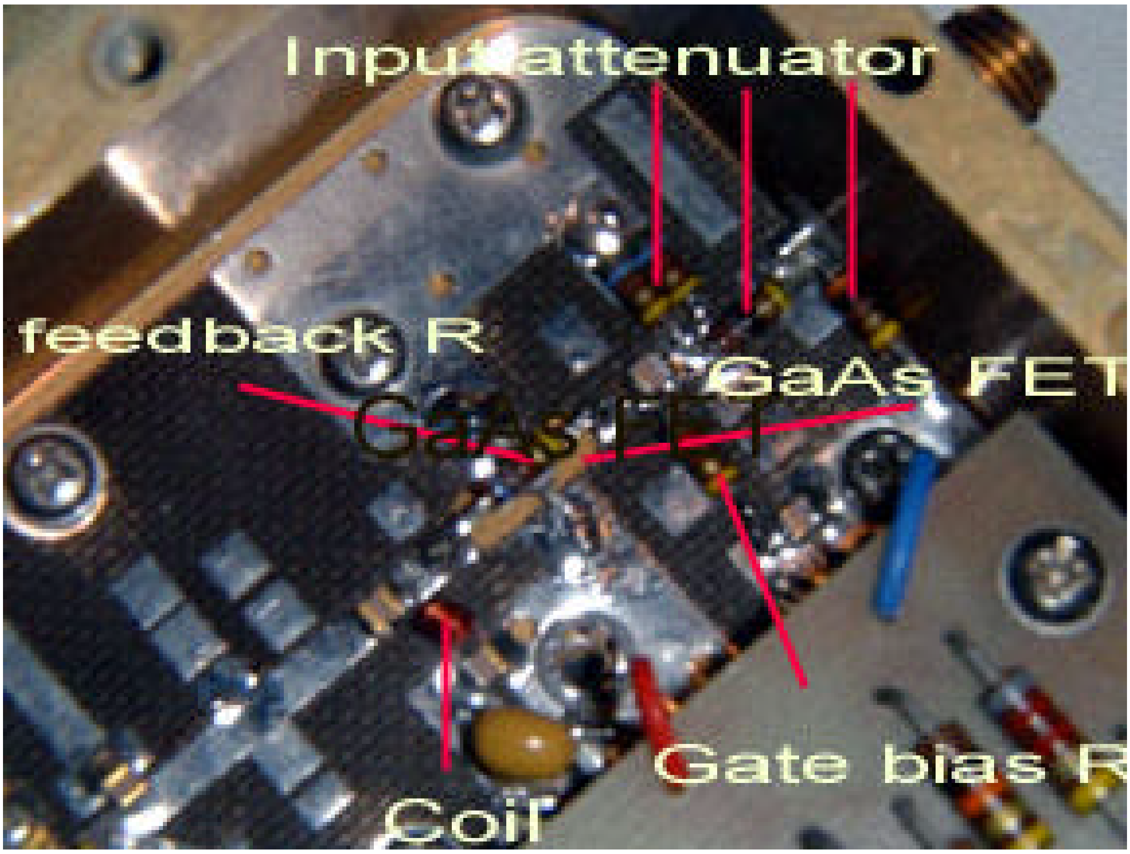
700MHz to 4.2GHz 1Watt output, 30dB gain, 1dB ripple broadband amplifiers.

Minicircuits Lab introduced these amplifiers in the late 1980s as high power, linear gain blocks for commercial and industrial lab use. They were quite expensive and used then new GaAs technology. A wide range of variants have since appeared including 10MHz to 4.2GHz types (ZHL-42W), 40dB gain types (ZHL-4240) and lower gain 100mW output amplifiers (ZHL-1042J). However, the GaAs FET input stage was very prone to being destroyed by too much signal. A very common failure situation was simply turning on signal generators that didn't remember the last set level and that would power up with maximum output of perhaps 50mW. This was almost certain to cause the amplifier to fail.

When they first appeared they were rated at +10dBm maximum input, this was later revised down to +5dBm and my own advice is to ensure the input doesn't exceed 0dBm. The purpose of this article is to show that these amplifiers can easily be made to work again and are (arguably) more useful to the amateur community after this simple repair than in their 'as new' condition. Why? How? Read on!

After trying unsuccessfully to replace the blown input FET I tried the more practical approach of merely strapping out the input stage. First, check this is where the fault is. (You can be better than 90% certain it will be). It is easy to prove this is the stage at fault as the bias condition around the device will be found to be inconsistent with, usually, the negative gate bias voltage on the first stage non existent.

Carefully remove the 820R gate bias feed resistor, 680R feedback resistor together with series chip capacitor, close-wound drain feed inductor and then the GaAs FET device. Cut a 1mm wide, 12mm long strip of thin copper tape to bridge between the gate and drain connection points. That's it!



With this 'repair' the gain of the amplifier will be found to have decreased by about 10dB. However, it is now possible to increase the input signal level significantly without fear of damaging the amplifier. I have applied up to 100mW without damage after making these changes. The great thing about this mod is that the achievable output power from the amplifier is now significantly increased.
The following table shows the results from one such amplifier 'repaired' in this way.

Frequency	432MHz	1.3GHz	2.32GHz	3.4GHz
Output power (sat)	1.4W	2.25W	1.7W	2.0W
For input power	Not measured	10mW	10mW	25mW
700mA at 15V	Rising to 875mA at saturated output power			

You will note that the frequency response is now noticeably less flat than 1dB. However, for amateur purposes this probably doesn't matter too much. Some additional gain can be obtained by removing the input 3dB attenuator and replacing it with another copper strap.

Expect to pay between £50 and £100 for fully working ZHL-42s and around £40 to £60 for a 'repaired unit. The high gain and extended bandwidth types will command a higher price.

These amplifiers are an ideal way to make a multi-band transverter or to boost the output of your PLL Brick oscillator to produce a useful output power for a 23 - 9cm, personal beacon.

YAMSHA

(Yet another Mode S Helical aerial)

Martyn Kinder G0CZD

Whilst on a trip to the plumbing department of our local B&Q hardware store before Christmas to prepare for a new kitchen sink, I spotted some semi-rigid 42mm plastic waste pipe. A quick calculation. 42mm dia. x pi = 13cms = mode S and I can fasten my newly converted Drake to this as well. End of design process. Well very nearly.

Clutching a 2m length of the waste pipe (along with the rest of the copper bends and valves for the kitchen sink) I rushed home and attacked a calculator, the ARRL "Satellite Experimenters Handbook" (1st Edition –1984) and the contents of an extensive junk box. I then put it all away neatly and read pages 6-16 to 6-18 several times over.

YAMSHA Mark 1 was conceived. Following many conceptions, nothing else happened for a couple of weeks (except the sink was installed).

One of the claimed benefits of Helical antennas is that they remain quite functional over a large bandwidth, typically 0.8*f*c to 1.2*f*c, with *f*c the "tuned centre frequency". This was just as well. The optimum frequency for an air spaced helical with an internal diameter of 42mm is 2273MHz. A little bit lower than the 2400MHz I really wanted.

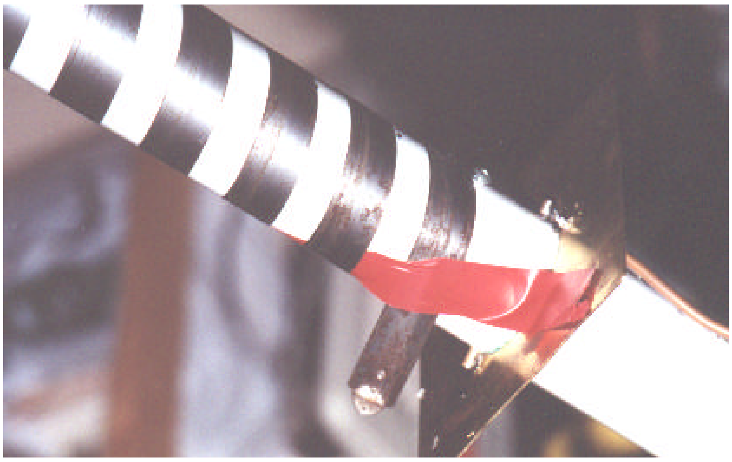
The remainder of the design parameters were calculated as follows;

The wavelength of an aerial with 42mm diameter helix is ? = 42 x 3.14 = 131.9mm.
To achieve efficient circularity, a pitch angle of 12.5 degrees is required.
The spacing between turns can be calculated as S = ? (tan 12.5) = 29.24mm.
Finally the reflector had to be a reasonable size, a minimum side length of 0.6?? is recommended, I settled on a nice round 100mm.

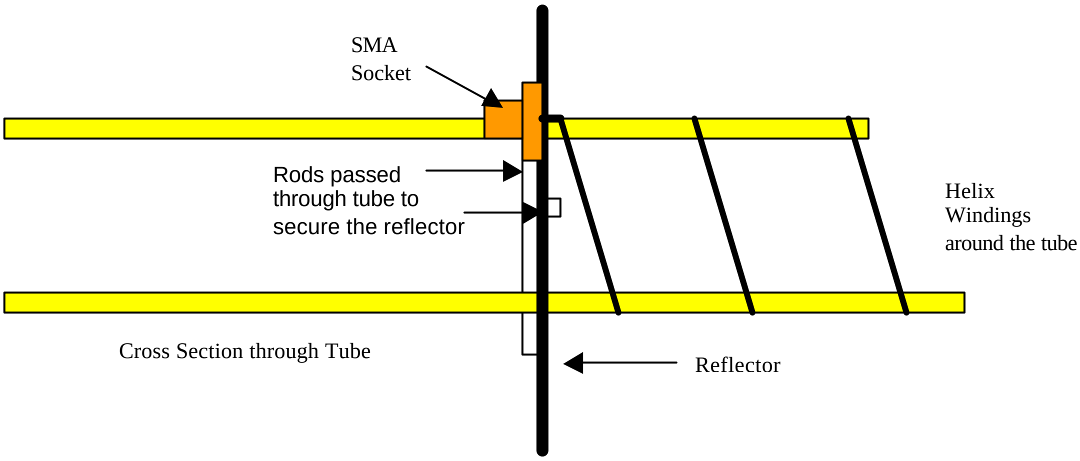
These numbers were starting to look silly. There was no way that I (or any other amateur) could measure 20 turns to an accuracy of 1/100mm. A little bit of creative thought was required.

But firstly, the reflector had to be manufactured and secured. I decided to use a two hole gold plated SMA socket as the termination/connection point. A 43mm hole was cut in the centre of the 24g brass sheet (available from your hobby shop or much cheaper from a scrap metal merchant), and the SMA connector mounted as near to the edge of the hole as possible, whilst still allowing an SMA plug to be screwed in. The Plastic pipe was marked up with the reflector 250mm from the mount end. This allows adequate space to mount the Drake and also an aerial mounting clamp. The reflector was located by two short lengths of 3mm brass rod passed through the tube and soldered, one on each side of the reflector. This secures the reflector very solidly. Next, mark on the tube, on the same side as the SMA connector three small pen marks, one 29mm from the SMA, one 88mm from the SMA, the other 585 mm up the tube. Drill a small hole into the tube at this point and cut the tube neatly about 5mm beyond this.

You will need a 3metre steel tape measure. Place the tape measure number side down at the first mark and wind two turns around the tube. Adjust the pitch of the measure so that both of the first two marks are on the same edge of the tape. Place some sticky tape over the start of the tape and wind out another 17 turns, keeping the tape absolutely flat against the tube. If you have got it right, you will use all 3 metres of steel tape and will terminate right on the final hole – and with no compound errors. Make sure that you wind the helix in the right direction. Phase 3D will have right hand polarised antennas,



this means that in the direction of radiation, the helix should be wound in a clockwise direction. Have a look at the photographs if you are unsure. Now secure the other end of the tape in place with some sticky tape. I used just over 3m of 16g hard drawn copper wire for the “element”. Clean the enamel off the end and solder to the protruding pin of the SMA socket. Now keeping the wire tight, twist the aerial one turn until the wire lines up with the correct edge of the tape. Keep winding for the remaining 19 turns using the tape as a guide and then finally push the wire through the hole. Pull tight with a pair of pliers, bend up and cut off any excess leaving about 6mmon the inside of the pipe. Now carefully cut the sticky tape securing the steel tape measure and unwind. Stand back and admire your perfect Helix.

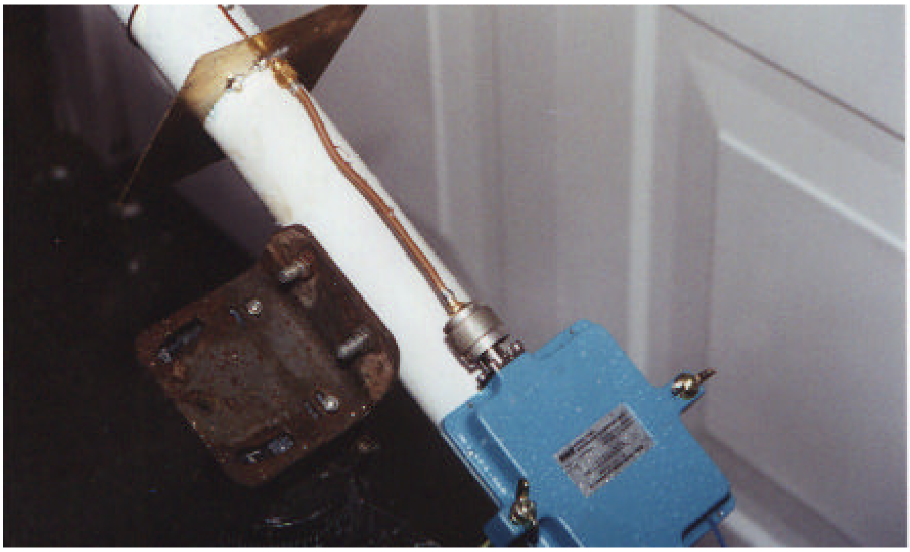


The original design had a slightly different feed point from this final aerial design.

At the time of writing (January 2000), there is only one active satellite with a Mode S beacon. (UO-11 transmits a weak unmodulated beacon but uses left hand circular polarisation). A second prototype was built using Left Hand circular polarisation. On the original design (following advice from the “Satellite Experimenters Handbook”, the start of the first helix was delayed by 29mm, i.e. the wire came straight from the SMA for 29mm before the windings started. This feed arrangement was designed to improve the match to 50 ohms. I spent around a week trying to hear UO-11 with absolutely no success. The Drake had been tested at the last Adastral park Microwave Round Table in November 1999, and exhibited < 2.0dB noise figure and just less than 40dB gain. It was working OK!.

Eventually, I decided that the problem was likely to be related to the feed point (no rational reasons – it just didn’t look right) of the Helix, and so I extended the spiral back all the way to the SMA and tried again. Jackpot! The satellite was picked up on the first pass, with the signal rising to a peak of about

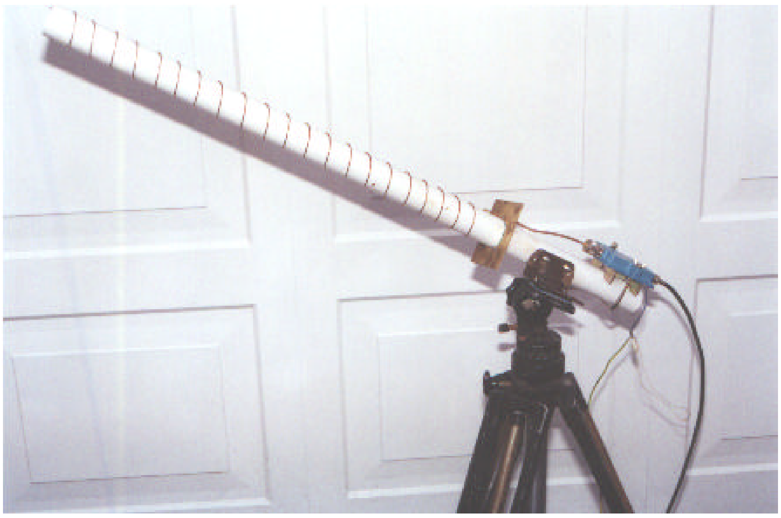
10dB above noise. Very satisfying. Note the photographs show the prototype Right Hand Circular Polarised antenna with the original and inefficient feed



The claimed calculated gain figure for this aerial is about
10 x log (15 x 20 (turns) x tan(12.5)) = 18.2dBi. It is generally accepted that these calculated gain figures are in the order of 1 to 2dB too high. (However read Kent Britains article above – no guarantees implied!)

3dB beamwidth is about 30 degrees.

A few other constructional points. The aerial is attached to an 'L' shaped bracket using two 10mm diameter bolts. These were not tightened unduly, but the nuts were secured with Loctite and the bolts "Araldited" into place. A standard ''U' bolt arrangement can be used to secure the aerial either to a vertical or horizontal pole. The size of the aerial is comparatively small and is unlikely to be unduly stressed in high winds. The Drake is attached to the SMA via a 150mm length of UT141 semi rigid coax with the other end terminated in an N plug. When it eventually goes up on the mast, the connectors will be weatherproofed, the rest of the unit including the Drake will remain out in the elements.



Postscript: There has been some discussion on the AMSAT-BB mailing list about the feed impedance of helical aerials. The nominal VSWR of this aerial is approximately 3:1. Several suggestions for improving the match have been suggested which will be subject to further tests and experiments. This high SWR does not appear to affect the stability of the Drake 2880, however, some preamplifiers may be inclined to take off with this level of mismatch.

Using the California Microwave 11-026700 transmitter assembly

Dave Robinson WW2R, G4FRE

Introduction

A considerable number of the California Microwave "Transmitter assembly 11-026700-08(h)" have been seen at rallies over the past 5 years. Many people have bought them, but it is hard to believe this, judging by the scarcity of "on-air" models. This paper details how to get them going on 3456MHz along with details of one method of incorporating it into a transverter and will hopefully encourage some to dust them off and help populate the band.

Equipment Description

In commercial use by AT&T for 3.7 - 4.2GHz microwave links, the amps were powered from positive ground 24Volts via a rack mounted California Microwave "Power supply 52-090095-0". The Power Amplifier unit consists of a 12.5 x 5.5 x 1.5 " aluminum can, containing the electronics, attached to a 13 x 6.75 x 1.5 " heatsink. The input connector is SMA, the output is via waveguide, but this is easily converted to SMA. A 6 core cable terminating in a 6 pin plastic plug supplies the operating voltages from the PSU.

The Power Supply unit consists of a 19 x 6.5 x2.5" box with one 2 pin connector, for applying -24V and a 6 pin connector for outputting the regulated voltages to the PA. It provides outputs of +10.25 and -5.3 Volts. It has an on/off switch and 4 test points.

The PSU is bigger than the PA, in addition it's -24 volt requirement makes using it portable a problem. The first problem to be tackled therefore is to build a PSU to build the amp off 12V. In its original state the amplifier's performance is poor at 3456MHz and will need retuning.

Power Supply Unit

If the 6 screws securing the aluminum can of the PA are removed, along with the 6 smaller screws securing the aluminum screen below, it will be seen that the 6 core cable is connected as follows:

Orange and Purple	Drain Supply
Brown and Blue	Gate Bias
grey	Ground
red	rectified RF Sample

The orange and purple wires supply +10.25V at 1.7 and 1.5A respectively from isolated sources in the PSU. The 10.25V requirement precludes the use of the 78H series of regulators when running the PA off a lead acid battery as they require a minimum of a 2.5 Volt drop across them. A better idea is to use one of the LT108X series of low dropout voltage regulators which typically require 0.5 to 1V across them to maintain regulation. A single LT1084 regulator, which has a short circuit current of 5A is used.

The brown and blue wires supplying the -5.3V need around 10mA with the 10.25V supply on , 20mA with no 10.25V applied. This can be supplied by a LT1044 IC. The DC-DC converter chip is supplied from a 7808 regulator. The more usual ICL7660 is not used as it has been found more prone to expiring. The output of the LT1044 feeds an LM337T adjustable negative voltage regulator set to give -5.3V. The resistors around the LM337 have been increased, without adverse effect, from the usual recommended values, to reduce the current loading on the LT1044 IC.

It was decided to include extra circuitry to protect the amplifier from the loss of the negative rail, which has been known to destroy the amplifier. The circuit used COMPLETELY removes the positive 10.25V supply in the absence of the gate bias, rather than the more often published design such as (1) and (2), which only shuts down the regulator to 1.2V output.

The complete circuit diagram is shown in Fig 1. A PCB was designed for the circuit, excluding the components for the 10.25V regulators which are mounted directly onto the heatsinks, and the power relay. The PCB layout Fig 2. and the component overlay in Fig 3. The component listing is shown in Table 1.

Correct operation of the PSU should be ensured before proceeding. Normally the relay should operate and +10.25V and -5.3V should be measured at the appropriate points. If the -5.3V rail is removed (for example by disconnecting pin 8 of IC2) the relay should drop out and +10.5V rail should disappear.

Power Amplifier

Firstly the output connector has to be changed, to allow the usual RF connectors to be used on the amplifier. Carefully unsolder the brass pin from the output track of the amplifier. With a hex wrench, undo the 6 set screws holding the waveguide assembly in place and the four screws holding the tube to the edge of the PCB. It is possible, with a careful saw cut to leave part of the waveguide assembly with the 5 feedthroughs and the earth lug and 4 mounting holes. For the faint hearted the safer option is to unsolder the 6 wires connected to the bracket and remove the whole assembly. This is replaced with a short length of 0.5" aluminum angle fitted with 4 bolt in feedthroughs and a ground lug. (The brown and purple wires are connected to a common feedthrough). This method also shrinks the amplifiers area, allowing a changeover relay to be connected directly to the output connector.
The mounting plate left on the edge of the PCB has the correct fixing centres for a 4 hole SMA chassis mount female socket of the type with the long centre pin and the extended ptfe insulation. The centre pin and insulation are cut to length. The two holes for the lower screws are tapped and four long screws and 2 nuts hold the connector in place.
As a guide to the correct operation of the onboard PA regulator board measure the gate and Drain voltages of the devices:-

Device	Vgs	Vds
TR1	-1.1V	7.3V
TR2	-1.1V	8.1V
TR3	-1.2V	9.8V
TR4/5	-1.5V	9.8V

These voltages, are approximate and vary slightly between amplifiers, but give good indications of potential problems, and are measured with a 50 ohm load connected to the input and output of the amplifier to avoid instability corrupting the results.
Connect 10W power meter rated at least to 4GHz to the PA output. If a 3.9GHz source is available (such as a Midwest microwave "brick" awaiting conversion to 3456) lower the output to 1mW using attenuators as required (beware, some models produce over 250mW!) and apply to the PA input. The PA output should be at least 7.5W
The next step is to apply a 1mW of 3456MHz to the amplifier. The output could be as low as 3W, so retuning is necessary. It will be observed that the board has extra printed stubs on the board, mostly on the inputs and outputs of the devices. These should be connected and disconnected with solder "blobs" AFTER DISCONNECTING THE POWER SUPPLY BEFORE EACH ADJUSTMENT to maximize the output power working in sequence TR1-5, optimizing the gate matching first then moving onto the Drain. If necessary extra pieces of copper foil, available from hobby shops may be added to the board. A recently discovered altemative to soldering the foil is to use adhesive backed copper foil which is available in various widths from stained glass craft shops. This was discovered to be the vital ingredient in my wife, Meg's N2NQI's newly mastered hobby and has meant many trips to supervise the correct widths being purchased. When properly tuned the amp should give at least 7W, it has been consistently found to give slightly less output at the lower frequency, despite repeated optimization efforts. Finally the inner cover should be replaced over the circuit boards, this has RF absorbing foam under it to maintain amplifier stability. The outer "can" was discarded.
The so far unused red wire drives the negative terminal of a 10mA meter via a series resistor to ground to indicate relative output.

Conclusions

Hopefully this article will encourage more activity on 3456 over longer distances. Remember the old adage of the ham bands "Use them or Lose them"

References

1. Power Amplifier for 13cm. E.Gobel, DUBUS 2/94 pp22-29

2. Dual power supplies for GaAsFets. B. Troetschel, Proceedings of 37th West Coast VHF/UHF Conference pp41-51

Figure 1. CIRCUIT DIAGRAM

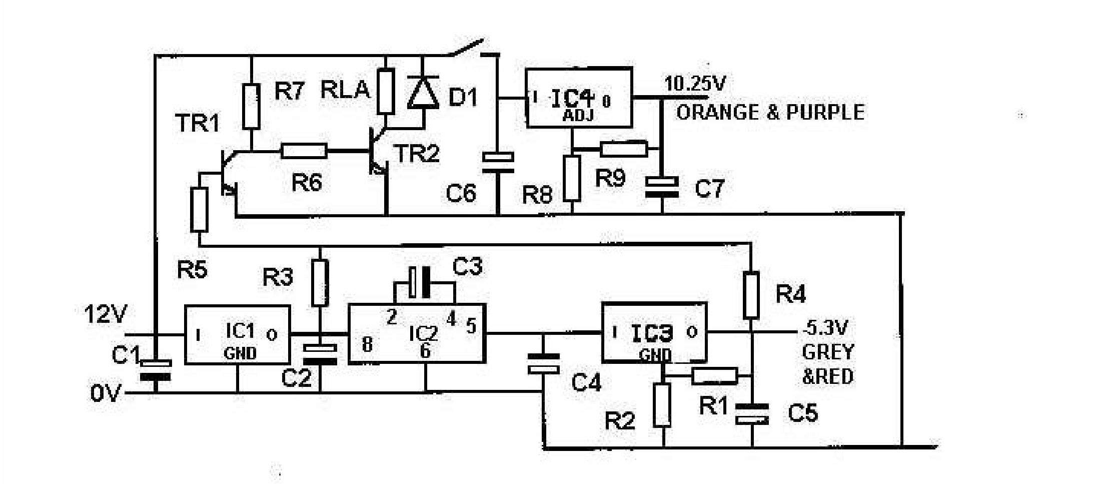


Figure 2. PCB TRACK LAYOUT

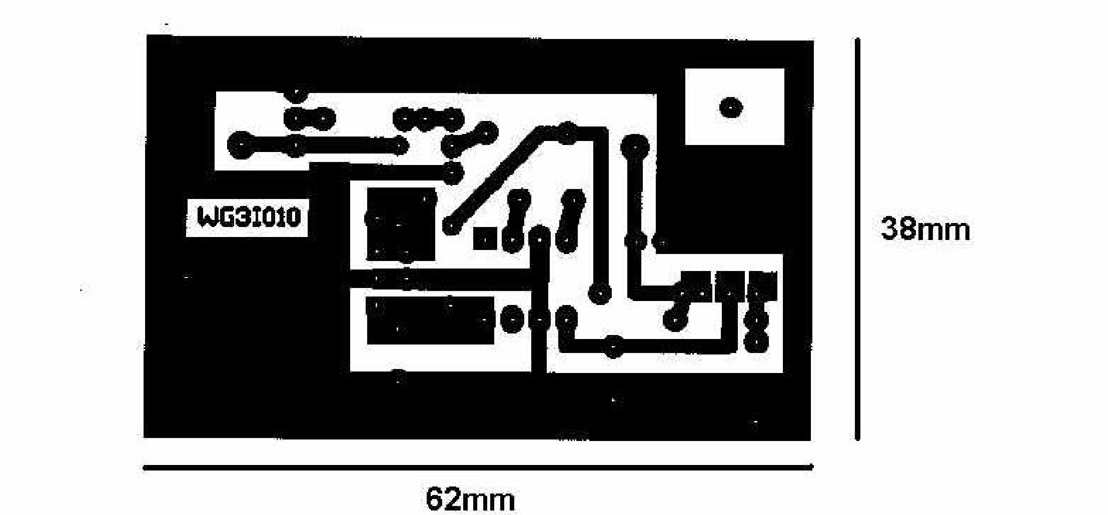


Figure 3. Component Overlay

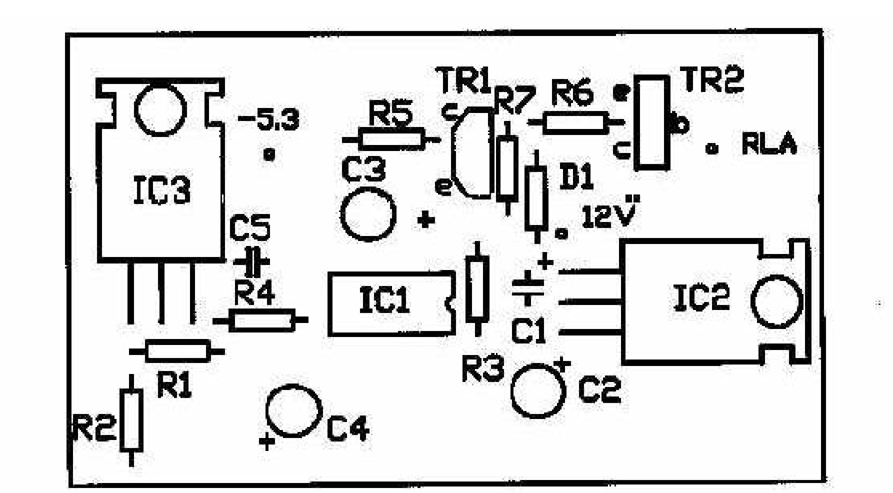


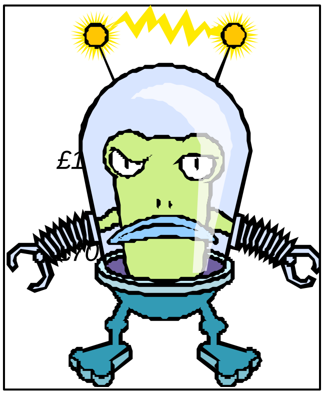
Table 1 Component Listing

Component	Value
C1	0.1uF 25V TANT
C2	1uF 16V TANT
C3,C4	22uF 10V TANT
C5	0.1uF Ceramic
C6	10uF 16V TANT
C7	22uF 16V TANT
D1	1N4001
IC1	7808
IC2	LTC1044
IC3	LM337T
IC4	LT1084CT
R1,R6	470
R2,R5,R7	1k2
R3	4k7
R4	3k3
R8	867(820+47 in series)
R9	120
TR1	2N3904 or similar
TR2	BD132 or similar
RL1	DPDT 12V coil 5A contacts

For Sale & Wanted

Grand Microwave Sale

G4PBP is not selling-up and leaving the planet. Just too many projects !!



23cms. amp, 2x3cx100a5, silver plated g3vvb type. New and unused — *£100*

13cms. amp, 1x3cx100a5, silver plated g3vvb type. Built on sub-chassis with screens + blower. Tested to 30w.

PSU to run both of the above. (~1KV). Neatly built into low profile case.

New Bob Platts 23cms, high gain, low noise pre-amp. — *£50*

24GHz transverter . This is the base transverter with no RX/TX amplifiers. G4DDK LO + G3WDG multiplier to 12.048GHz + DB6NT mixer. All stage built in an IP67 enclosure for masthead mounting. V. neat. — *£120*

3cms. G3WDG transverter . Add an IC202 and 12V and your away. Again in an IP67 box for masthead.

Basic unit 250mW	*£150*
Plus G3WDG 1W	*£250*

3cms TV TX housed as above for masthead mounting. Feed 15V + 1.5 - 4V from the modulator via sat-TV coax and your away. Currently on 10425MHz, tunes +/- 15MHz.

Basic 250mw unit.	*£75*
Plus G3WDG 1W	*£175*

G3WDG 10GHz multiplier — *£30*

250mw 10GHz repeater unit ex. 'White Boxes' Nice TX, circulators and filters. 140 / 70 MHz IF's — *£45*

10 + 12 GHz 3 cavity filters (professional), SMA. Very easy and predictable to tune. — *£25*

Sanders 5440c Noise meter. IF tuneable 10 - 250 MHz. Bought at Dallas but the head was DUFF !!! V. clean — *£50*

Hi-Gain HF vertical for when you get fed up of microwave Clean + not used much. Guess why ! — *£80*

IC202, good condition. — *£ offers*

Lots of WG16 components + Microwave coax relays etc. — *£ phone*

You can contact Russ on 01902 731502 or e-mail ***russ@g8bhh.demon .co.uk***

Membership News

This section of the newsletter is primarily concerned with news, developments and services that will be provided to members.

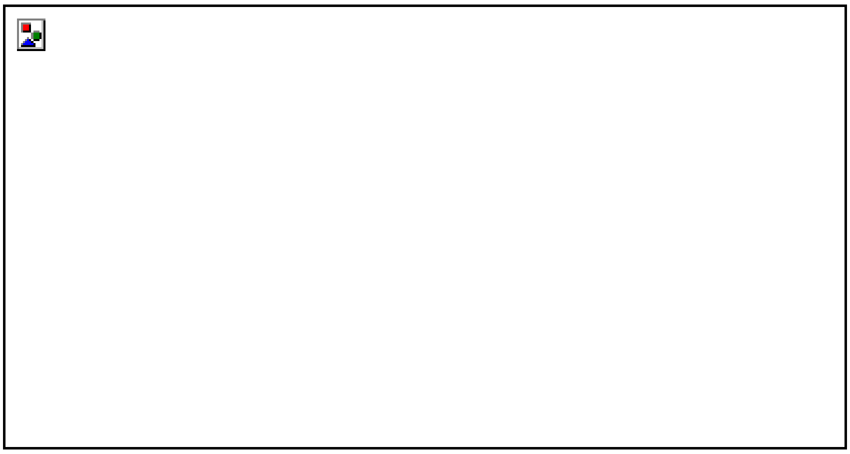
Chip Bank

The UKuG has just taken delivery of approximately 500,000 ship components for the Chip Bank. Alan, G8LSD has agreed to be banker. Details of the supply mechanism and charges will appear in the next few weeks.

STELAR

We have been approached by STELAR, the schools technology group to assist getting the proposed microwave digital packet backbone up and running. Antony Vintner, their Chairman has now secured funding to start the project. We have been invited to attend meetings to discuss their proposals. This subject really does need to be discussed before we commit as a group. Your comments are welcomed ASAP.

HS400's



As Sam anticipated he has taken delivery of a small quantity of PYE HS400 High stability drive units which contain a very high quality 5MHzTCXO (5 parts in 10>10 per day ageing and -10C to +55C ambient) The TCXO operates off 12V and is contained within the main unit which is 19" wide, 3.46" high and 8.35" wide. It can be mains or 24V dc powered. In case you don't know the unit, it is designed for use in quasi synch radio systems and provides drive for the usual list of PYE base stations T30 through T4012. In it's original condition it provides 2.7 to 4.0, 3.6 to 5.33, 10.8 to 16 and 21.6 to 32MHz output in various increments corresponding to the 6.25 and 25kHz channels spacing usually used in the UK. Sam can provide circuit details and operation notes and hopes to produce an article for the next issue of Scatterpoint. The units are in excellent condition, having just been taken out of service.

What's in a name?

I think that UKuG was always intended to be the working title or the "trading" name of the group. However, catchy it isn't and boring it may well be deemed to be. I still think that we are looking for a name that encapsulates what the group is all about (in your imagination). Suggestions to the editor and I'll consider printing those that are printable!

Current Membership List

January 2000

Dermot	EI2AK	Keith	G4FUF
Michael	EI5GG	Andrew	G4JNT
Eric	F1GHB	Steven	G4KNZ
Martyn	G0CZD	Paul	G4KZY
Chris	G0FDZ	Neil	G4LDR
Mike	G0MJW	Roger	G4PMK
Roger	G0SWC	P	G4TNM
Roger	G0UPU	David	G6GXK
Alan	G2HIO	Murray	G6YJB
Ray	G3DVQ	Richard	G7MFO
Roy	G3FYX	Brian	G8AOL
Robert	G3GNR	Lehane	G8KMH
Derek	G3GRO	Allan	G8LSD
Jack	G3JMB	Barry	G8NWM
Tony	G3KTV	Mike	G8OGO
Simon	G3LQR	Curwen	G8TTU
Michael	G3LYP	Robert	G8VOI
Geoffrey	G3NAQ	Samuel	GI8GJX
Ian	G3NTF	Allan	GM1SXX
Mike	G3PFR	Simon	GM4PLM
Peter	G3PHO	David	GM4WLL
Peter	G3PYB	Frank	GW8AWM
James	G3RUH	Wesley	GW8KZN
Martyn	G3UKV	John	LA2OAA
John	G3XDY	Freddy	ON6UG
Gus	G3ZEZ	Ian	PA4ZP
Chris	G4AYT	Uffe	PA5DD
Neil	G4BRK	John	PE1JBK
Sam	G4DDK	Bart	PE1PFW
Geoff	G4DED	Rod	VK4KZR
Graham	G4FSG	Kent	WA5VJB

Who is missing that should be on this list?

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