An Amateur Radio publication for the Microwave Enthusiast

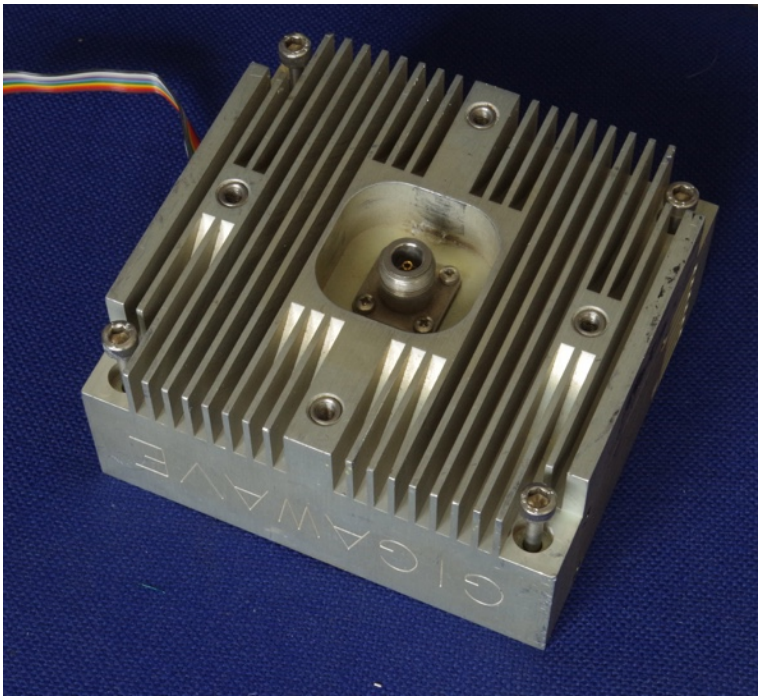
scatterpoint

April 2017

Published by the UK Microwave Group

GIGAWAVE Amplifiers – getting them going

By Andy Talbot G4JNT



In this Issue

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Loan Equipment

Don't forget, UKµG has loan kit in the form of portable transceivers available to members for use on the following bands:

5. 7GHz 10GHz 76GHz

Contact John G4BAO for more information.

Subscription Information

The following subscription rates apply.
UK £6.00 US $12.00 Europe €10.00

This basic sum is for **UKuG membership**. For this you receive Scatterpoint for **FREE** by electronic means (now internet only) via the Yahoo group and/or Dropbox. Also, free access to the Chip Bank.

Please make sure that you pay the stated amounts when you renew your subs next time. If the amount is not correct your subs will be allocated on a pro-rata basis and you could miss out on a newsletter or two!

You will have to make a quick check with the membership secretary if you have forgotten the renewal date. Please try to renew in good time so that continuity of newsletter issues is maintained.

Put a **renewal date reminder** somewhere prominent in your shack.

Please also note the payment methods and be meticulous with PayPal and cheque details.

PLEASE QUOTE YOUR CALLSIGN!

Payment can be made by: PayPal to

ukug@microwavers.org

or a cheque (drawn on a UK bank) payable to 'UK Microwave Group' and sent to the membership secretary (or, as a last resort, by cash sent to the Treasurer!)

Articles for Scatterpoint

News, views and articles for this newsletter are always welcome.

Please send them to

editor@microwavers.org

The CLOSING date is
the FIRST day of the month

if you want your material to be published in the next issue.

Please submit your articles in any of the following formats:

Text: txt, rtf, rtfd, doc, docx, odt, Pages

Spreadsheets: Excel, OpenOffice, Numbers

Images: tiff, png, jpg

Schematics: sch (Eagle preferred)

I can extract text and pictures from pdf files but tables can be a bit of a problem so please send these as separate files in one of the above formats.

Thank you for you co-operation.

Martin G8BHC

Reproducing articles from Scatterpoint

If you plan to reproduce an article exactly as in Scatterpoint then please contact the Editor – otherwise you need to seek permission from the original source/author.

You may not reproduce articles for profit or other commercial purpose.

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UKµG Chip Bank – A free service for members

The catalogue is on the UKµG web site at www. microwavers. org/chipbank. htm and has been updated to include the items from G4HUP's estate plus a few other additions and deletions.

Non members can join the UKuG by following the non-members link on the same page and members will be able to email Mike with requests for components. All will be subject to availability, and a listing of a component on the site will not be a guarantee of availability of that component. The service is run as a free benefit to all members and the UK Microwave Group will pick up the cost of packaging and postage.

Minimum quantity of small components supplied is 10. Some people have ordered a single smd resistor!

The service may be withdrawn at the discretion of the committee if abuse such as reselling of components is suspected.

There is an order form on the website with an address label which will slightly reduce what I have to do in dealing with orders so please could you use it. Also, as many of the components are from unknown sources, if you have the facility to check the value, particularly unmarked items such as capacitors, do so, and let me know if any items have been mislabelled.

Don't forget it is completely free, you don't even have to pay postage!

Mike Scott G3LYP

Mike G3LYP and Alan G8LSD (founder of the Chip Bank) at the Martlesham Round Table 2017

UKµG Project support

The UK Microwave Group is pleased to encourage and support microwave projects such as Beacons, Synthesiser development, etc. Collectively UKuG has a considerable pool of knowledge and experience available, and now we can financially support worthy projects to a modest degree.

Note that this is essentially a small scale grant scheme, based on 'cash-on-results'. We are unable to provide ongoing financial support for running costs – it is important that such issues are understood at the early stages along with site clearances/licensing, etc.

The application form has a number of guidance tips on it – or just ask us if in doubt! In summary:-

- Please apply in advance of your project
- We effectively reimburse costs - cash on results (eg Beacon on air)
- We regret we are unable to support running costs

Application forms below should be submitted to the UKuG Secretary, after which they are reviewed/ agreed by the committee

www. microwavers. org/proj-support. htm

UKµG Technical support

One of the great things about our hobby is the idea that we give our time freely to help and encourage others, and within the UKuG there are a number of people who are prepared to (within sensible limits!) share their knowledge and, what is more important, test equipment. Our friends in America refer to such amateurs as “Elmers” but that term tends to remind me too much of that rather bumbling nemesis of Bugs Bunny, Elmer Fudd, so let’s call them Tech Support volunteers.

While this is described as a “service to members” it is not a “right of membership!”

Please understand that you, as a user of this service, must expect to fit in with the timetable and lives of the volunteers. Without a doubt, the best way to make people withdraw the service is to hassle them and complain if they cannot fit in with YOUR timetable!

Please remember that a service like our support people can provide would cost lots of money per hour professionally and it’s costing you nothing and will probably include tea and biscuits!

If anyone would like to step forward and volunteer, especially in the regions where we have no representative, please email john@g4bao. com

The current list is available at

www. microwavers. org/tech-support. htm

Beacon Coordinator

At the AGM, **Denis Stanton G0OLX** volunteered to be the new Beacon Coordinator.to assist the group to coordinate UK microwave Band beacons.

The UKuG supports the UK beacon network with hardware finance (**see above**), technical help and beacon applications.

The RSGB ETC Committee and the RSGB Microwave Manager are responsible for the interface to OFCOM, specifying beacon frequency allocations and overseeing the issue of the NoV to the beacon keeper.

The beacon keeper (NoV holder) is responsible for the technical design and maintenance of their beacon, maintaining the close-down list details and ensuring that the NoV is renewed at the specified intervals.

Denis’s background (from QRZ.com)

Licenced as G8CUX in 1969 Took out A class licence 23 years later after getting into Microwaves, First on Wide band 10GHz then Narrow band using SSB transverter.

G8CUX Re applied for and taken out mainly for microwave contesting.

Now into 24 GHz. Also beacon keeper GB3SEE 10,368.850 MHz Reigate Surrey IO91VG.

Also Repeater Keeper re-licenced GB3NS located Banstead Surrey. 430.9250 MHz output 438.525 input frequency CTCSS 82.5 Hz

NOV Granted for 4 metre voice store and forward unit MB7NS Which is Co-sited at Banstead GB3NS Frequency 70.3875 MHZ carrier squelch

80m UK Microwavers net – Tuesdays 08:30 local on 3626 kHz (+/- QRM)

73 Martyn Vincent G3UKV

Chairman's Thoughts

Following the AGM at Martlesham I now find myself elected to the Committee of the Group and subsequently appointed Chairman. Thank you to the membership present at the AGM for bestowing this role on me.

I will serve a further year in this role, but from the next AGM I will be looking to hand over to a new Chairman. Groups such as ours benefit greatly from having a regular change of Chairman. New ideas are important in a hobby such as ours. As I have gotten older I have lost much of my initial enthusiasm for the higher bands. We need to have someone leading the Group who has this enthusiasm and, as important, good leadership skills at a time when 'our' bands are under strong threat from other radio users.

We are very fortunate to have an RSGB Spectrum manager and RSGB Microwave manager who have professional interests in spectrum management. Murray and Barry will ensure we are kept abreast of the threats, but it will be up to the Group to ensure we act to show we use 'our' bands in a responsible way. We can do this by supporting both our own contests, organised by John, G3XDY, and the RSGB organised contests. We all need to ensure that we all operate more often. Once a month on each microwave band plus a bimonthly entry in the international contests is really not enough!

A second way we can be seen to use 'our' bands is by supporting the various beacons. We have an excellent facility in Beaconspot, run by Robin, G8APZ. It would be nice to have all of our UK beacons shown as operational. I am informed that OFCOM uses the facility to check the status of the network. You can bet that other eyes also check the status of the network when looking for potential spectrum to use. Support for the beacons can usefully be by regularly reporting when you hear them. We also need a few new beacons and the Group is well enough financed to support the purchase of hardware for these new beacons. John, G4BAO, is our treasurer and he can supply advice on how to go about applying for the money.

I am pleased to announce that Denis, G0OLX, responded to your committee plea for someone to come forward as the Group's beacon coordinator. We welcome Denis to the Committee.

He has already made an impressive start in this role.

Another new member of your Committee is GM8IEM who has taken over from GM8OTI as the group's Scotland representative.

Your Committee will be holding a first meeting (by Skype) in the very near future.

Finally, I want to thank my fellow members of the Martlesham Radio Society (G4MRS) for allowing the UKuG to use the facilities of the Round Table to hold the AGM.

Sam Jewell, G4DDK

Chairman, UKuG

AGM Minutes

Chairman's Report

Sam Jewell G4DDK

Sam Jewell as Acting Chairman introduced his report. Sam welcomed Barry Lewis G4SJH, the RSGB Microwave Manager, as a corresponding member of the UK Microwave Group.

On spectrum issues, the Ofcom 5GHz consultation drew many responses, including from the UK Microwave Group. G4BAO attended the RSGB Spectrum Forum on behalf of the group. There is continuing pressure from commercial interests on our 47GHz allocation. Notices of Variation are now available for operation on frequencies above 275GHz. There has been increased activity on 134GHz during the past year. Ofcom is considering sharing of the remaining 2.3GHz band. More PR material for beginners and wideband datacomms is needed. A reminder goes to beacon keepers to renew their NoVs – several are outstanding. A new beacon on 47GHz is now active from Cleeve Common under the callsign GB3CCX. Funding for hardware for a new 1.3GHz beacon at the GB3NGI site has been agreed. A new PA has been donated to get GB3LEX back on the air.

Internationally the agenda for WRC-19 includes items on 5GHz WiFi expansion, 5G between 24.25 and 86GHz, and on allocations on bands above 275GHz.

The group has made a donation of £500 towards the running of YOTA2017. Micropwave Round Tables have been held at Martlesham, Finningley, Crawley and Burntisland, and a stand was manned at the RSGB Convention. Beaconspot continues to be the premier source of beacon info for microwaves and VHF.

The number of Twitter followers of the UKuG has more than doubled to 351, and there are 91 viewers of the You-Tube channel. 100+ viewers are needed to get a higher profile for the channel. More good beginners material is needed.

The judging schedule for the G3VVB Project Trophy has been changed to align with presenting the Trophy at Martlesham. The Crawley Amateur Radio club staged the first meeting about a UK Broadband Hamnet Mesh network. The rules for scoring in RSGB Activity contests have been changed to points per kilometre with no multipliers for 2017.

Treasurer's Report

John Worsnop G4BAO (Presented by Sam G4DDK in his absence)

UK Microwave Group Accounts **2016**

Covering period 01/Jan/2016 to 31/Dec/2016

Item	Income	Expenditure	Balance	Notes
Opening C/A+PayPal +Deposit + petty cash balance 01/Jan/16			19603.30	
Subscriptions	£2,856.41			
Chipbank donations	£25.92			
Interest	£8.00			
PayPal fees		£120.70		
RSGB Afilliation		£47.00		
Websites (inc beaconspot and EME2012)		£94.48		
Beacon Support		£128.60		
Trophies		£175.00		
Chipbank Expenses		£32.44		
Purchase of loan equipment		£200.00		
Loan equipment insurance		£176.11		
Sub-totals excluding transfers	**£2,890.33**	**£974.33**		
Closing C/A+PayPal +Deposit + petty cash balance 31/Dec/16			**£21,519.30**	

J C Worsnop G4BAO
Treasurer

Highlights

Group funds increased by ~£1916 (~10%) for a sub income of £2856

SO…. we are STILL looking for projects to fund! … Put forward your ideas to the Treasurer or at this AGM.

The group donated to the GB3USK beacon group.

We purchased the new G4EAT Trophy.

We supported beaconspot.eu paying the web fees.

Final payment made for EME2012 website.

Chipbank cost us just £6-50 this year, due to donations, justifying its continuation as a free service. Big thanks again to Mike G3LYP for running it!

The group purchased loan equipment for 24GHz to add to the 76, 10 and 5.7GHz equipment.

On next year's accounts, but the Group has donated £500 to YOTA 2017

Despite the treasurer's best efforts we still have too much money sitting in the accounts, so no subscription increase is proposed this year.

Thanks to Graham Philips G0KRB for again auditing the accounts free of charge.

Membership Report

Bryan Harber G8DKK

2016

460 Members (4/2016)

52 New Members (Jan to Dec 2016)

15 New Members (Jan to April 2016)

Yahoo Scatterpoint

463 members subscribed

25 pending

83.5% members pay by PayPal

2017

479 Members (4/2017)

55 New Members (January to December 2016)

18 New Members (January to April 2017)

Yahoo Scatterpoint

493 members subscribed

22 pending

85% members pay by PayPal

Election of Officers & Committee

The Acting Chairman was willing to stand for election to the role. Proposed by John G3XDY. Elected nem con.

New nominations for other committee posts were Martin Hall GM8IEM as GM representative (Proposed GW4DGU). Denis Stanton G0OLX volunteered for the beacon coordinator role. Mark Riley M5BOP proposed that the committee was elected en bloc, this was seconded by W5VJB and put to the meeting and approved nem con.

The current committee is now:

Chairman	Sam Jewell	G4DDK
Treasurer	John Worsnop	G4BAO
Secretary	John Quarmby	G3XDY
Membership Secretary	Bryan Harber	G8DKK
Activity News Column	Neil Underwood	G4LDR
Beacon Coordinator	Denis Stanton	G0OLX
Web Master	Murray Niman	G6JYB
Contests/Awards	John Quarmby	G3XDY
24GHz and Up	Barry Chambers	G8AGN
Graham Murchie	G4FSG	

Corresponding Members

USA Liaison	Kent Britain	WA5VJB/G8EMY
Northern Ireland	Gordon Curry	GI6ATZ

Scotland	Martin Hall	GM8IEM
Wales	Chris Bartram	GW4DGU
ATV	Noel Matthews	G8GTZ
Beaconspot	Robin Lucas	G8APZ
Trophies Manager	Mike & Ann Stevens	G8CUL/G8NVI
Scatterpoint Editor	Martin Richmond-Hardy	G8BHC
RSGB Microwave Manager	Barry Lewis	G4SJH

AOB

None

Contests & Awards

John Quarmby G3XDY

The high bands championship (5.7 and 10GHz) ran at a similar entry level to 2015.
The Low Band events (1.3/2.3/3.4GHz) enjoyed a 40% higher entry level in 2016.
The mmwave events continued to be well supported, with 6 entries in the 2016 mm-wave championship.
No major rule changes have been made for 2017.
Four Squares Certificates for 1.3GHz have been issued since the last AGM, two on 2.3GHz, and one on 10GHz.
Firsts certificates were issued to G0FDZ/P and G8CUB/P for their 134GHz and 241GHz contacts
Downloadable contest certificates will be available shortly

Awards

G3BNL: Not awarded

G3EEZ: To Mike Willis G0MJW for his path profile software which is recognised for its extreme effectiveness in the microwave field.

Fraser Shepherd Award: To Roger Ray G8CUB and Chris Whitmarsh G0FDZ for their pioneering mm-wave work, particularly on 241GHz.

G3KEU Trophy (5.7GHz)	Telford & DARS G(P)3ZME/P
G3JMB Trophy (10GHz)	Stewart Wilkinson G0LGS/P
G3RPE Trophy (10GHz)	Telford & DARS G(P)3ZME/P
G0RRJ Trophy (24GHz)	Roger Ray G8CUB/P
24GHz Trophy	Neil Underwood G4LDR/P
47GHz Trophy	Roger Ray G8CUB/P and Chris Whitmarsh G0FDZ/P
G4EAT Memorial Trophy (1.3GHz)	The Combe Gibberlets Group M0HNA/P

G3EEZ: To Mike Willis, G0MJW for his path profile software which is recognised for its extreme effectiveness in the microwave field. This was accepted on his behalf by Mike Stevens.

G3VVB: Jeff Easdown G4HIZ for his 24GHz signal generator.

RSGB Awards

(photos by G6JYB)

The Fraser-Shepherd Award for research into microwave applications to radio communication, in honour of Fraser Shepherd GM3EGW, goes to Roger Ray G8CUB and Chris Whitmarsh G0FDZ for their pioneering mm-wave work, particularly on 241GHz

The RSGB Wortley-Talbot Award is being presented to Andy G4JNT for his work on a Third Method narrowband direct up-converter for the LF/MF bands, RadCom Plus, Vol 2 No 2 p4

UKμG Operating Awards

A range of attractive trophies

For the leading entry in the 5.7GHz Cumulatives,in honour of Tim Leighfield G3KEU

Telford and District ARS, G(P)3ZME/P

Winner of the 10GHz Cumulatives Restricted Section (1 Watt max), in honour of Jack Brooker G3JMB, MBE

Stewart Wilkinson G0LGS/P (no picture)

Winner of the 10GHz Cumulatives Open Section, in honour of Dain S. Evans G3RPE, BSc, PhD, FIM - RSGB President 1978

Telford and District ARS, G(P)3ZME/P

24 GHz: Neil Underwood G4LDR

47GHz Roger Ray, G8CUB/P and Chris Whitmarsh G0FDZ/P

G0RRJ (24GHz) Roger Ray, G8CUB/P

New Award

This year we have a new trophy for the winner of the 1.3GHz band in the Low Band Championship, in memory of John Wood, G4EAT

For 2016 it is awarded to the Combe Gibberlets, M0HNA/P

Martlesham Round Table: 8 – 9 April

Programme

Saturday 8th April 2017

10:00	Breakfast at Harvest Moon Café, Capel St Mary.
12:00	Doors Open

Refreshments available from 12:00 (drinks, biscuits & sandwiches)

13:00	Welcome & opening
13:15	Afternoon Workshop
15:00	Refreshments
15:30	Peter Blair G3LTF “53 Years of EME, then and now”
16:30	Close
19:30	Meet for Dinner at 20:00

Sunday 9th April 2017

09:00	Doors Open
09:50	Welcome and Opening
10:00	UK Microwave Group AGM, Trophy Presentations
10:45	Refreshments & Judging of the Construction Contest
11:00	DL4OGI: Reflections on Aircraft Scatter
11:45	Dr David Kirkby G8WRB: How not to fool yourself with vector network analyser (VNA) measurements.
12:30	Lunch Break
13:30	G0EWN: A Mixer Block for the Millimetre Wave Bands.
14:15	G8AGN: Antenna modelling at 134 GHz and 241 GHz using openEMS
15:00	Refreshments
15:15	UKuG Contest Forum – John G3XDY
16:00	Close

117 people registered, plus 5 catering team.

Photos by Murray G6JYB and Martin G8BHC

Some Thank-yous

Thanks to all for organising another great event.I haven't missed one yet!

KRs Gus G3ZEZ

To all those Codgers who had a hand in organising the 2017 MRT... a big thank you. Also thanks to those manning the SK tables.

Best regards

Colin de G8LBS.

I second (or third?) that vote of thanks. Only sad I had to miss earlier ones due to work commitments. But my memory is failing and I keep forgetting to retire :(

73 Trev G3OAD

Photo album

SK sales 1

The G4HUP stall, manned by Malcolm G4CXT

SK sales 2

The G4BAH stand, manned by John G4SWX

Other stalls & customers

Kevin G2AAF

“I know there’s one somewhere under here”

Alan Melia G3NYK with a selection of tin-plate boxes and other goodies you know you need.

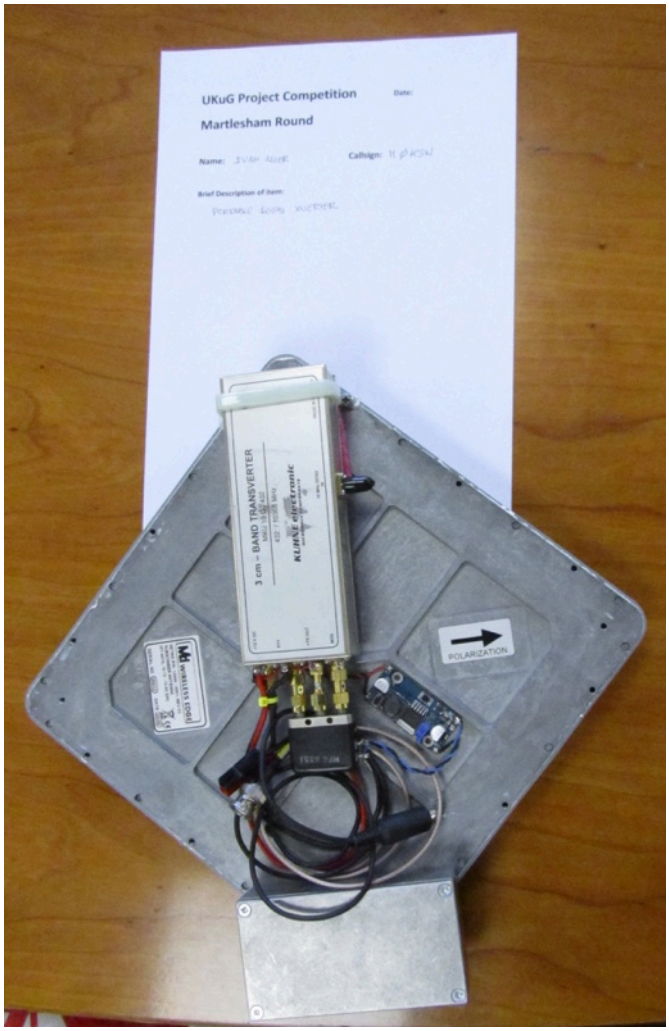
But decisions are always difficult with so much choice

Ned G4DKX

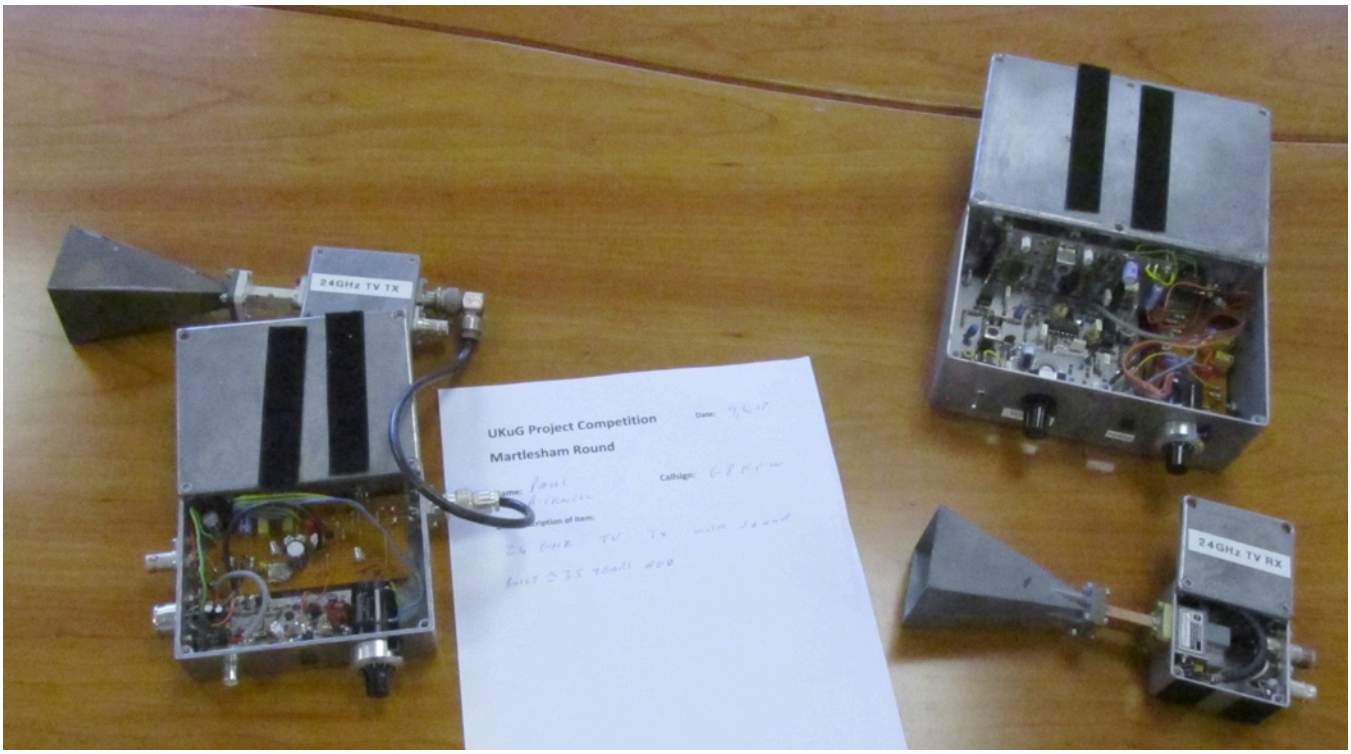
Perhaps a visit to the indoor test range?

or…..

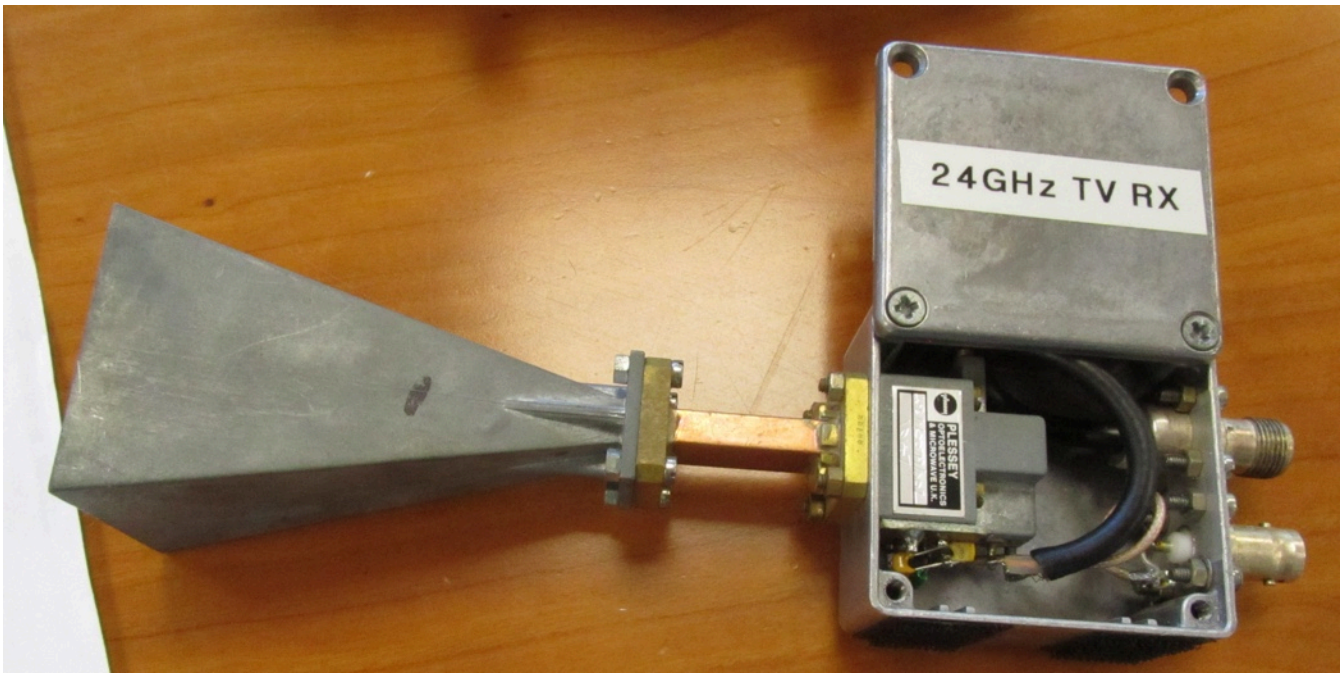
The Construction Competition



Portable 10GHz transverter by Ivan Aller M0KSW



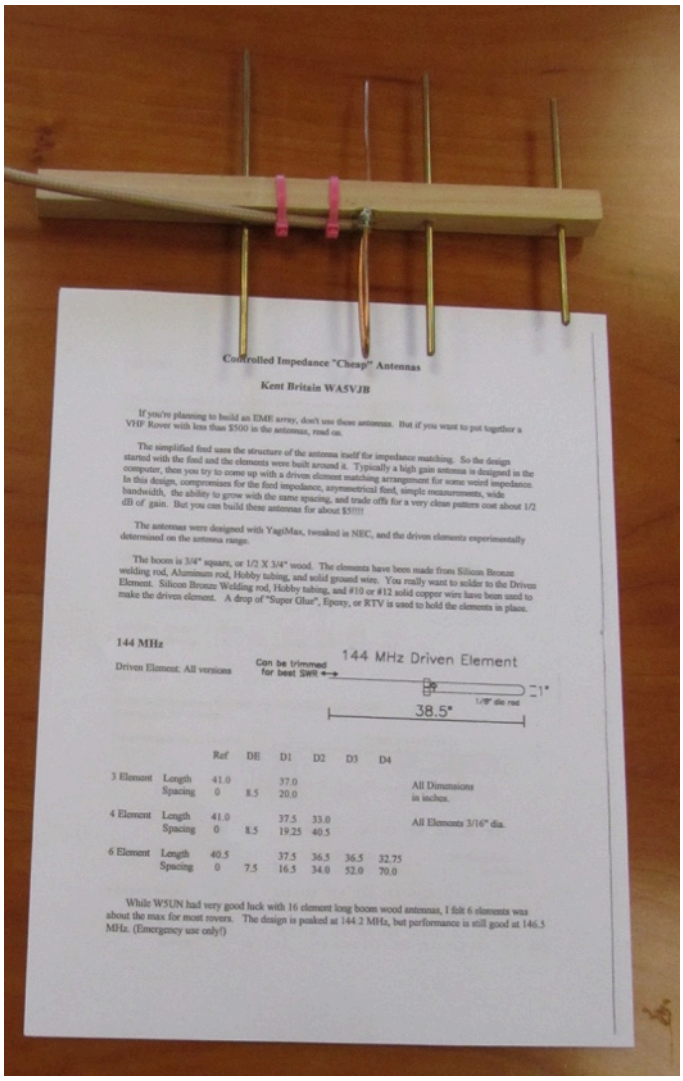
24GHz TV Tx with sound, built ~35 years ago by Paul Cracknell (??) G8KFW



Detail of the receiver

A small cheap antenna inspired by Kent WA5VJB designs ….

and entered by himself!



Controlled Impedance "Cheap" Antennas

Kent Britain WA5VJB

If you're planning to build an EME array, don't use these antennas. But if you want to put together a VHF Rover with less than $500 in the antennas, read on.

The simplified feed uses the structure of the antenna itself for impedance matching. So the design started with the feed and the elements were built around it. Typically a high gain antenna is designed in the computer, then you try to come up with a driven element matching arrangement for some weird impedance. In this design, compromises for the feed impedance, asymmetrical feed, simple measurements, wide bandwidth, the ability to grow with the same spacing, and trade offs for a very clean pattern cost about 1/2 dB of gain. But you can build these antennas for about $5!!!!

The antennas were designed with YagiMax, tweaked in NEC, and the driven elements experimentally determined on the antenna range.

The boom is 3/4" square, or 1/2 X 3/4" wood. The elements have been made from Silicon Bronze welding rod, Aluminum rod, Hobby tubing, and solid ground wire. You really want to solder to the Driven Element. Silicon Bronze Welding rod, Hobby tubing, and #10 or #12 solid copper wire have been used to make the driven element. A drop of "Super Glue", Epoxy, or RTV is used to hold the elements in place.

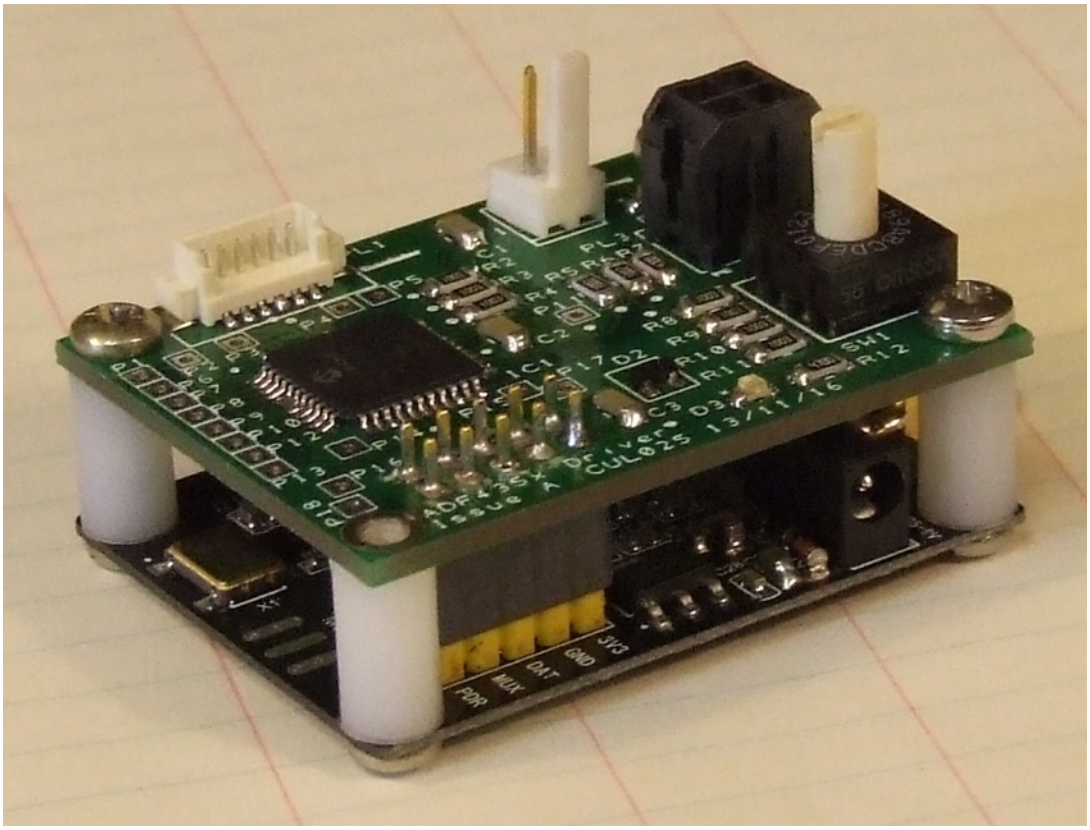
144 MHz

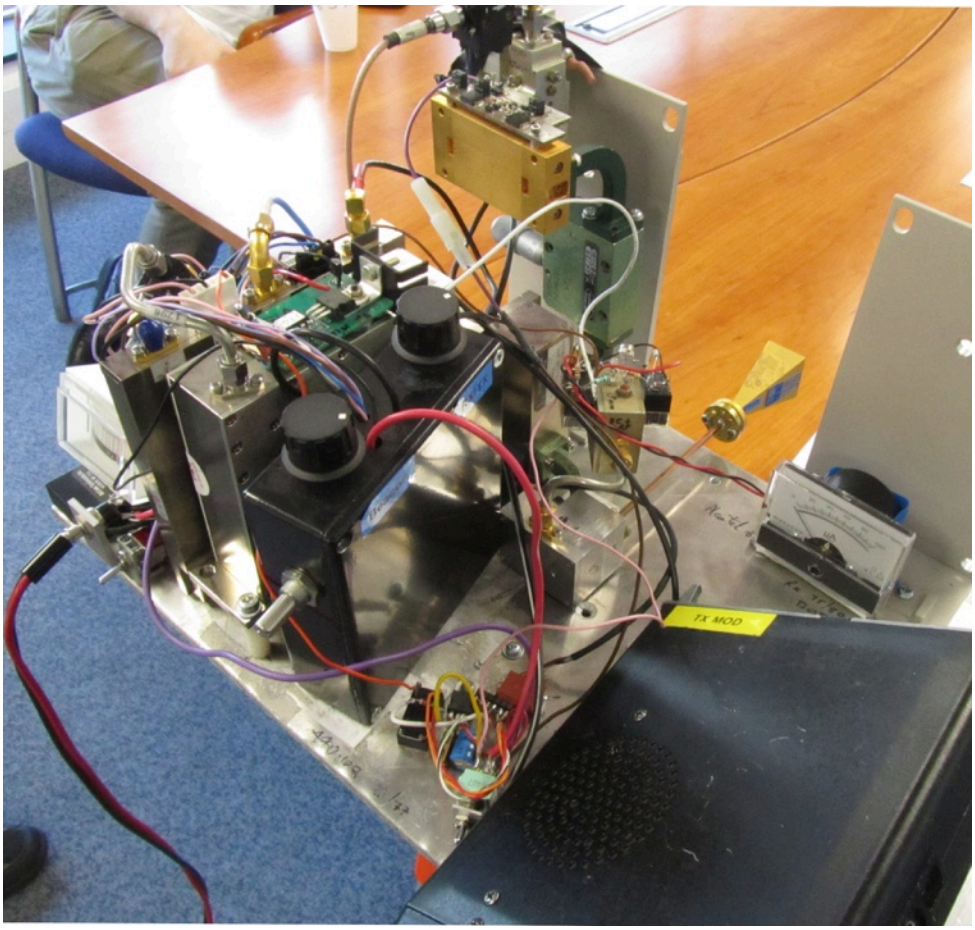
Driven Element: All versions

		Ref	DE	D1	D2	D3	D4	
3 Element	Length	41.0		37.0				All Dimensions in inches.
	Spacing	0	8.5	20.0				
4 Element	Length	41.0		37.5	33.0			All Elements 3/16" dia.
	Spacing	0	8.5	19.25	40.5			
6 Element	Length	40.5		37.5	36.5	36.5	32.75	
	Spacing	0	7.5	16.5	34.0	52.0	70.0	

While W5UN had very good luck with 16 element long boom wood antennas, I felt 6 elements was about the max for most rovers. The design is peaked at 144.2 MHz, but performance is still good at 146.5 MHz. (Emergency use only!)

The winner of the Construction Competition was Mike Stevens G8CUL with his ADF435X synthesiser controller board.





In the same room but not an entry into the competition is Roger G8CUB's 134.4GHz transceiver, being used as the receiver for Barry's (G8AGN) demonstration of AM by pulse width modulation.

Millimetre Power Measurements at Martlesham

By Roger G8CUB

76GHz

GW3TKH Transverter	+4.5 dBm
G4HQX Transverter	-3.0 dBm
G8AGN TX Beacon	+8.3 dBm
G8CUB TX Beacon	-2.9 dBm (Gunn off)
	+14.4 dBm (Gunn on)

122GHz

G8ACE TX1 (x3 final mult.)

122.255	5.9 dBm
122.400	-6.4 dBm
122.545	-6.8 dBm
122.829	-8.7 dBm

G8ACE TX2 (x5 final mult.)

122.255	-8.6 dBm
122.400	-8.8 dBm
122.545	-9.7 dBm
122.829	-11.5 dBm

G8CUB TX (x3 final mult.)

122.400	-5.1 dBm

A noise figure of ~5 dB was also made on Keith's (GW3TKH) transverter, but I expect that John will include that with his NF measurements.

Arduino–based PWM modulator for mm-wave transmitters

Barry Chambers, G8AGN

Acknowledgement

This article has benefitted from discussions with M0DTS and G8ACE and their contributions are gratefully acknowledged.

1 Introduction

A number of amateurs who are active on the higher mm-wave bands use transmitters which are based on Elcom PLL frequency synthesisers such as the DFS1201 and DFS1301. Although it is possible to build an s.s.b. transverter at these high frequencies, most operators prefer to maximise the transmitter output power by using c.w. and this can be achieved by using an on-off voltage to control the attenuation of a PIN diode modulator such as the General Microwave D1958. This is specified for operation over 8 to 18 GHz and is available on the surplus market. Typically, the modulator, shown in Figure 1, is placed between the r.f. output of an Elcom synthesiser and the first frequency multiplier in the transmit chain. The D1958 can provide a maximum attenuation of 60 dB for a control voltage of +6v and intermediate values of attenuation can be obtained at the rate of 10 dB per volt. Because of this logarithmic dependence of attenuation on applied voltage, it is not straightforward to use the attenuator approach to provide amplitude modulation directly; however, there is another approach which only requires the attenuator to be switched either fully 'on' or fully 'off' , thus giving rise to some form of pulse modulation.

In this article I will explore the use of pulse width modulation (PWM). In the PWM modulator described below, a train of square pulses with a duty cycle of around 25% is first generated. The frequency of these pulses should be at least high enough to satisfy the Nyquist criterion, i.e. the pulse frequency should be at least twice the highest frequency in the audio signal. The instantaneous amplitude of the audio signal is then used to alter the width of individual pulses in the pulse train and the resulting PWM signal, shown in Figure 2, has a spectrum which contains the original audio signal frequencies plus additional copies which are shifted by harmonics of the unmodulated pulse train frequency. Since the receiver has a very restricted audio bandwidth, it behaves as a low-pass filter and so only the original audio signal passes through to the headphones or loudspeaker.

The choice of a low unmodulated pulse duty cycle is governed in our application by the fact that the PIN modulator has minimum attenuation at 0v. Hence for much of each cycle the pulse voltage should ideally be close to 0v so as to maximise the mean transmitter output power. The modulated pulse duty cycle cannot be made too low, however, since this would reduce the depth of modulation and hence the S/N of the audio signal which is recovered in the receiver.

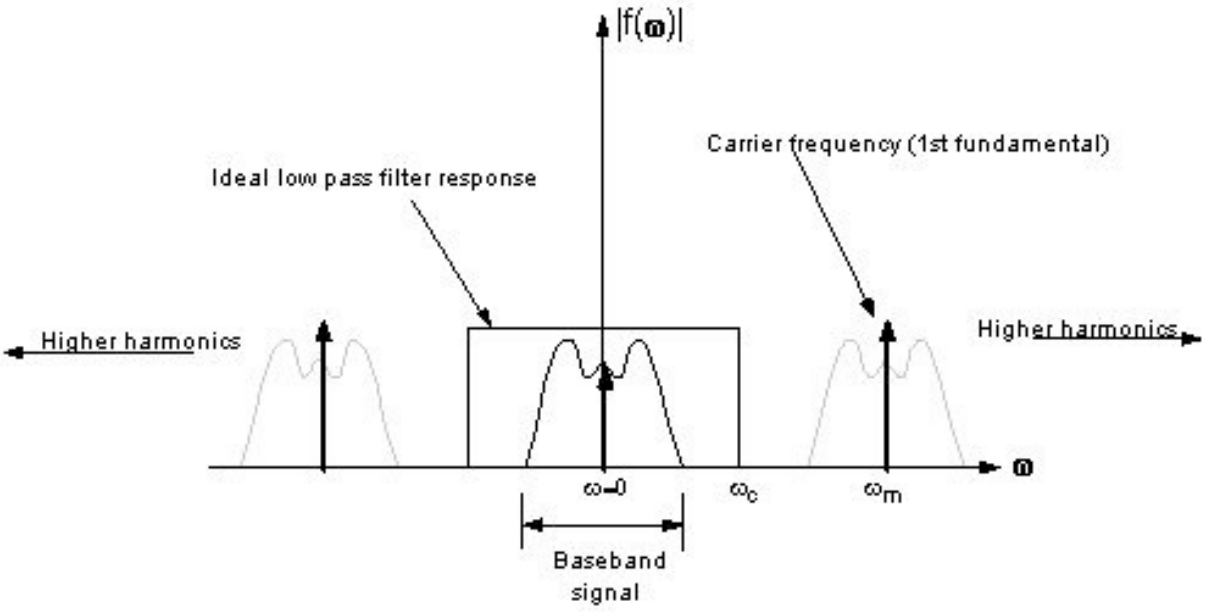


Figure 2

2 Implementation

In the early 2000s, when I first started to experiment with nanowave communications, one of my rigs used a red light laser pointer which was modulated with audio using a PWM circuit due to G7JTT. This was comprised of four integrated circuits and a handful of discrete components including an electret microphone. The sampling frequency was about 12 kHz and the resulting audio quality was excellent (G8AGN, UK Microwave Group Proceedings, 2004-5). Another PWM circuit using discrete components is described in KA7OEI's web pages on optical communications at http://modulatedlight.org/optical_comms/using_laser_pointers.html.

Since it is now possible to buy Arduino Nano microcontroller boards for about £3, I decided to utilise one as a software defined PWM modulator. There are at least two advantages to this approach. Firstly, it is easy to adjust the parameters of the modulation process by merely changing numerical values in the software; secondly, the same Nano software can be extended to provide alternative modulation schemes such as c.w., m.c.w., continuous tone etc. These alternative forms of modulation can then be selected as desired by a sequence of button pushes or even by using a touch sensitive TFT display.

In order to finalise the design of the PWM modulator, we need to look at the Nano board specification. The relevant items are:

Clock frequency:	16 MHz
ADC bit depth:	10 bits (1024 voltage levels)
Default PWM output bit depth:	8 bits (256 voltage levels)

Notice the mismatch between the ADC bit depth and the default PWM output bit depth which implies a loss of speech quality since only one quarter of the available voltage levels can be utilised. A solution to this problem will be found in the software to be discussed later. For the moment, however, let us assume that we will be using a bit depth of 10 bits. Then the maximum PWM sampling frequency will be

$$f_{sampling} = \frac{Clock\ frequency}{1024} = \frac{16000000}{1024} = 15.625\,kHz$$

This is comfortably above twice the expected maximum frequency in our audio signal, especially if we use some low-pass filtering between the electret microphone and the input to the Nano's ADC.

Figure 3 shows the simple configuration of the Arduino-based PWM modulator.

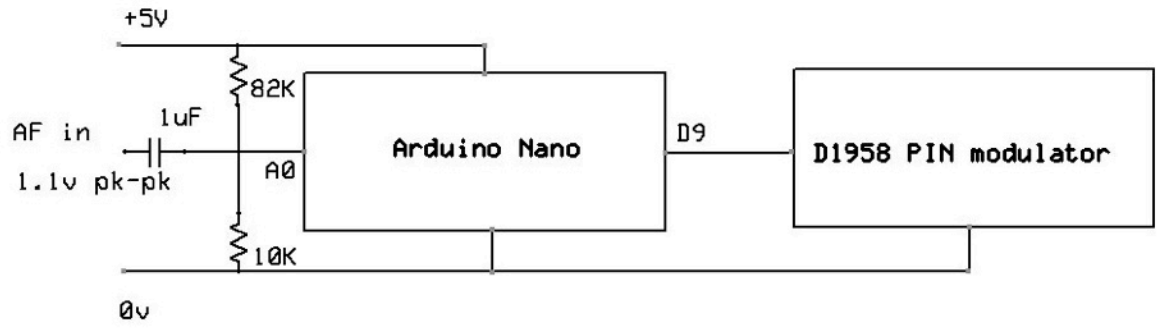


Figure 3

The ADC input pin used in the Arduino sketch is A0 and the PWM output pin is D9. The only other connections to the Arduino are for +5v and 0v. Since the sketch uses the Nano's internal 1.1v reference when reading the ADC, the latter's input is biased at +0.55v using a potential divider made from 82k and 10k resistors and which is fed from the +5v supply rail. The audio signal is fed in via a capacitor. The control pin on the D1958 has a high input impedance and so it may be connected directly to the PWM output pin D9 on the Nano. It should be noted that the D1958 PIN modulator is available in several options. One of these only needs a voltage in the range 0 to +6v to be applied to its single control pin; another option, however, requires additional supplies of +/- 12v at a maximum current of 100ma and this modulator may be identified by the three feed-thru capacitors on the outside of the enclosure rather than just one. Both options of modulator have identical r.f. characteristics.

The Arduino sketch for producing PWM is a slightly modified version of one discussed at

http://wiki.openmusiclabs.com/wiki/PWMDAC.

It is shown in Figures 4(a) and 4(b). Lines proceeded by a double slash, //, are comments and are inserted only to provide explanation. It should be noted that the Nano produces a default PWM frequency of about 490Hz but this value can be changed by reconfiguring the microcontroller's internal timer 1 which has a bit depth of 16.

3 Testing

The PWM modulator has been tested and optimised on-air using a short range link at 134 GHz. The transmitter comprises an Elcom 11.2GHz synthesised source, followed by a D1958 modulator, a Broadern 11.2 to 33.6 GHz tripler/PA and a DL2AM quadrupler. I used a speech source based on a Vellman kit, the MK195 voice recording/playback module. This uses an ISD1760 integrated circuit which can record up to 60 seconds of speech via an on-board electret microphone and then play it back either once or in a continuous-loop mode. The audio output from this board was then amplified and low-pass filtered using a simple active filter with a corner frequency of 3 kHz. The resulting audio signal was then fed into the Nano's ADC input as shown in Figure 3. On receive, I used a similar r.f. chain followed by an FT817 tuned to the 440 MHz IF frequency. The FT817 was set to receive AM signals. The received speech quality was very good. A similar PWM system has also been tried on-air at 134 GHz by M0DTS with comparable results.


```
// ADC to PWM software adapted from  http://wiki.openmusiclabs.com/wiki/PWMDAC
// added code to use internal 1.1v ADC reference voltage instead of 5v Vcc
// scaling of output bits changed to increase output voltage levels

#define PWM_FREQ 0x03FF // 15.6kHz,fast pwm,1 pwm channel,10 bits(to match ADC)
#define PWM_MODE 1 // Fast (1) or Phase Correct (0)
#define PWM_QTY 1 // number of pwms, either 1 or 2

void setup() {
  // setup ADC
  ADMUX = 0xE0;  // left adjust, adc0, internal 1.1v ref
  ADCSRA = 0xe5; // turn on adc, ck/32, auto trigger
  ADCSRB = 0x07; // t1 capture for trigger
  DIDR0 = 0x01; // turn off digital inputs for adc0

  // setup PWM
  TCCR1A = (((PWM_QTY - 1) << 5) | 0x80 | (PWM_MODE << 1));
  TCCR1B = ((PWM_MODE << 3) | 0x11); // ck/1
  TIMSK1 = 0x20; // interrupt on capture interrupt
  ICR1H = (PWM_FREQ >> 8);
  ICR1L = (PWM_FREQ & 0xff);
  DDRB |= ((PWM_QTY << 1) | 0x02); // turn on outputs

  sei(); // turn on interrupts - not really necessary with arduino
}
```

Figure 4(a)

```
void loop() {
  while (1); // gets rid of jitter
}

ISR(TIMER1_CAPT_vect) {
  // get ADC data
  unsigned int temp1 = ADCL; // you need to fetch the low byte first
  unsigned int temp2 = ADCH;

  // output high byte on OC1A
  OCR1AH = temp2 >> 7; // takes top 8 bits      was >>8
  OCR1AL = temp2 << 1; // takes bottom 8 bits   was just temp2

  // output low byte on OC1B
  OCR1BH = temp1 >> 7;  // was >> 8
  OCR1BL = temp1 << 1;  // was just temp1
}
```

Figure 4(b)

GIGAWAVE Amplifiers – getting them going

Andy Talbot G4JNT

At the Martlesham Roundtable I purchased a couple of power amplifiers from the South Birmingham G3OHM, Group. The amps were labelled as being rated at around 9 Watts and covered the 2.3 and 5.76GHz bands respectively. Interestingly, in spite of their very different frequency coverage, they look nearly identical at first sight, and the power supply requirements are similar, as we'll see.

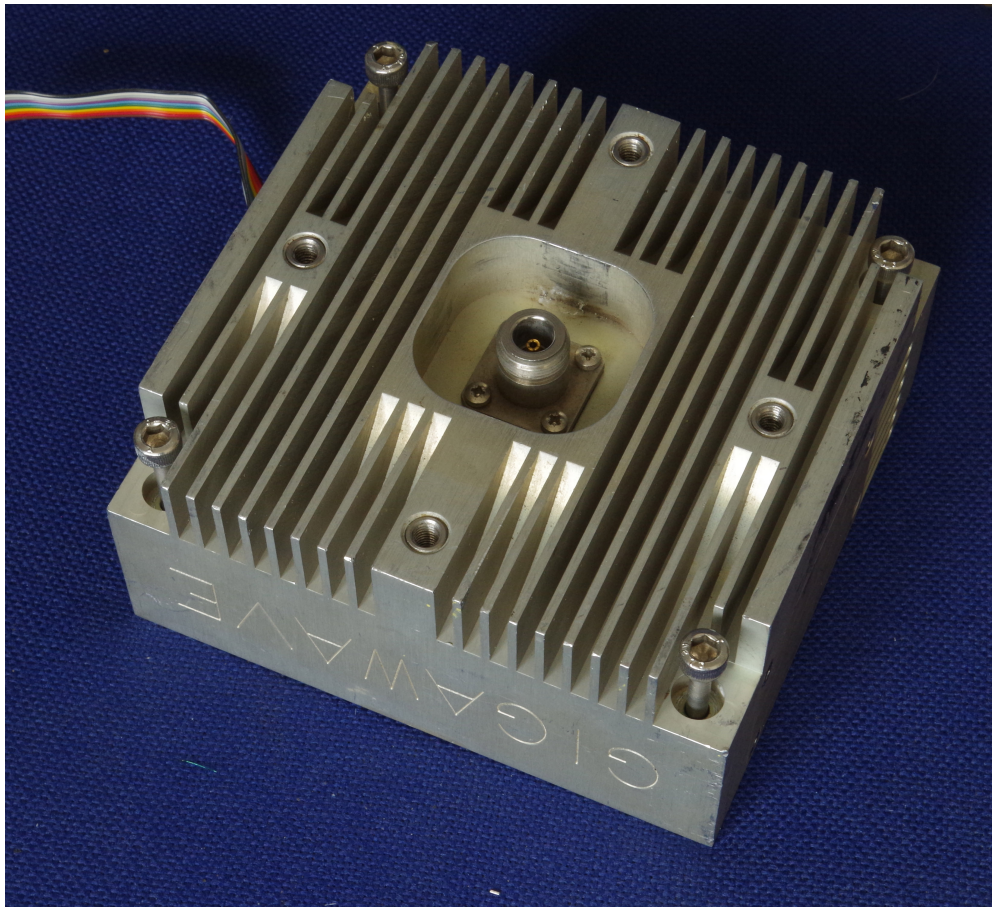
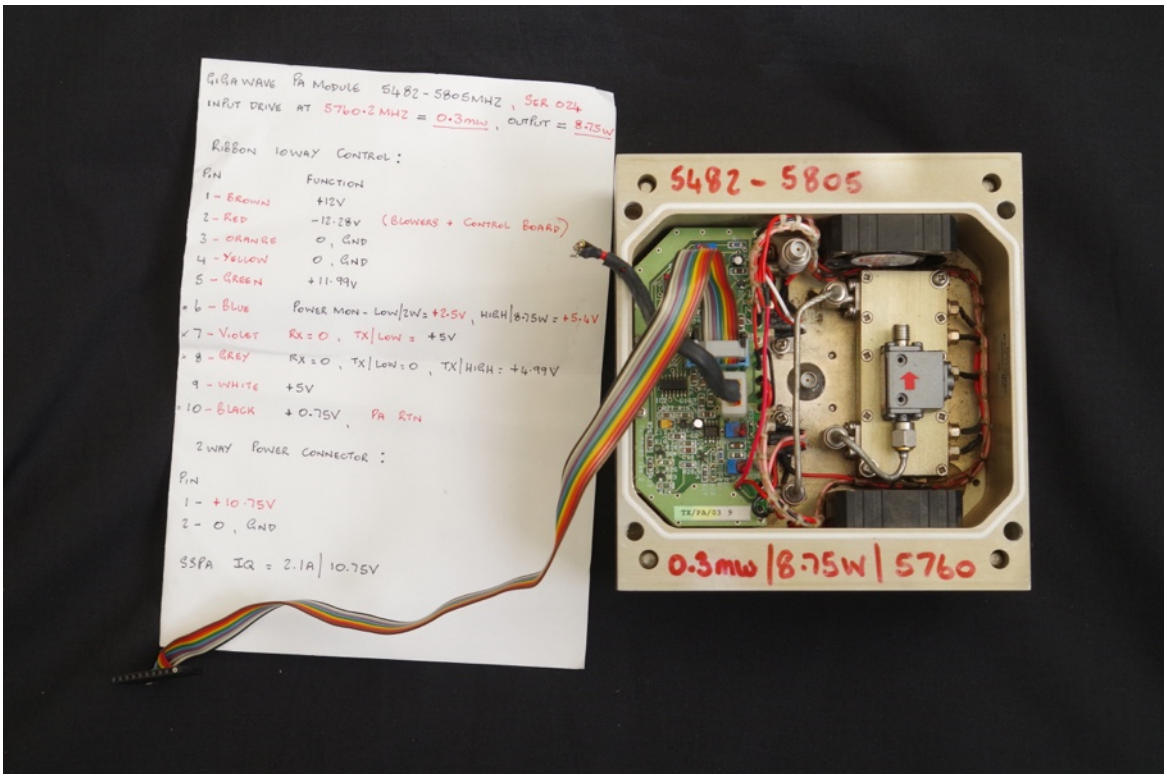


Photo 1 shows the front/top view of the 5.76GHz unit, and Photo 2 the innards with a few modifications to the fan wiring as will be described. A coax link from the transmitter output to the SMA-N-type connector has also been removed in that picture.



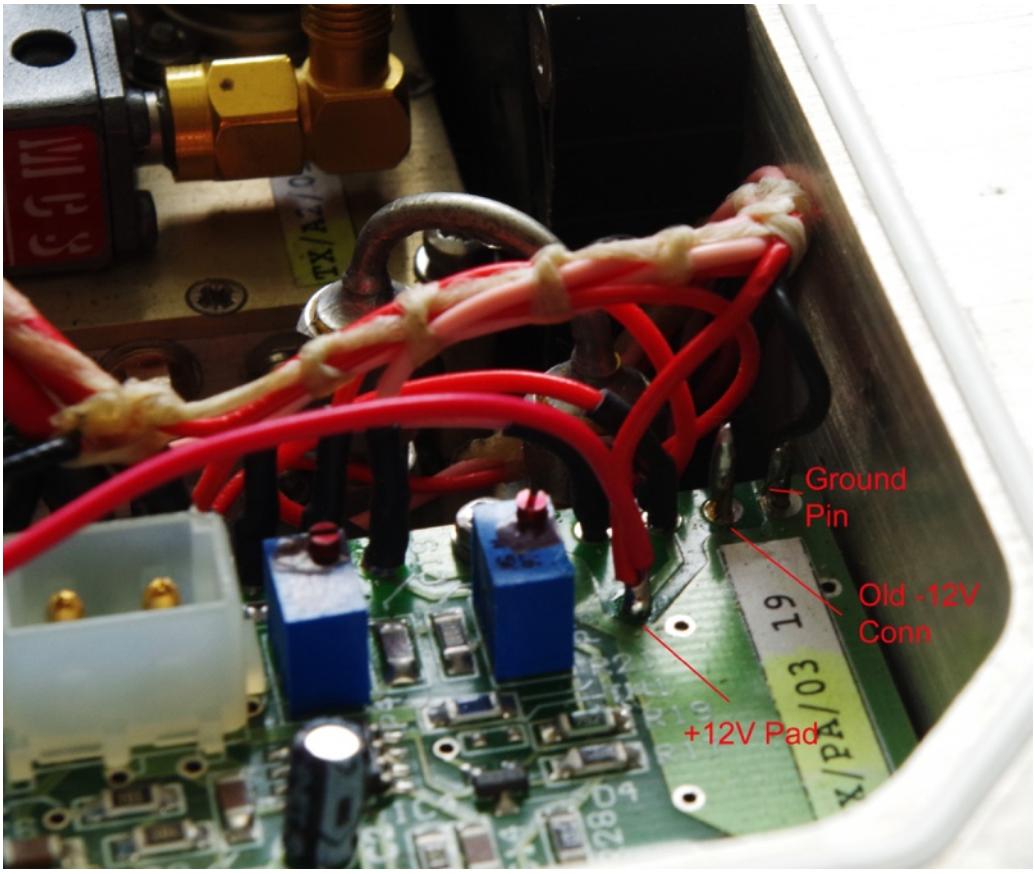
The data supplied suggested that four different voltage rails were needed to power the amplifier units as: 10.7V at several amps for the PA itself, + / - 12V and +5V. A quick look at the ICs on the control board showed a 74HC14 (presumably the main reason for the 5V supply) and a package that from its pinout was clearly a quad-opamp, with the +/-12V rails connected to it. The 12V rails presumably for the RF device bias and protection / monitoring and shouldn't need to be stabilised. For initial testing these

voltages were cobbled together from four separate PSUs. Although my 10.7V supply at 2A rating couldn't deliver full operational current, it was enough to shows the PAs both worked.

Power Conditioning Module

10.7V at several amps could be conveniently supplied from an LDO regulator like the LM1084 (about £3 from Farnell) which at 1.5V maximum dropout allows operation from a nominal 12V supply with some margin. (That cost around £3 each from Farnell whose efficient delivery chain meant I could order at 1600 on Monday afternoon and got them mid morning the next day).

+12V could come direct from the supply , and +5V via a small IC regulator. The -12V would have to be a switching inverter. I had a few 1 Watt modules , type NME1S-1212 which are basically unregulated Vout = -Vin types. The current draw on the -12V rails should only be a few tens of milliamps so any similar small DC-DC converter should suffice



BUT... Looking at the info sheet, the labelling suggested the two small integral fans were powered from the negative 12V rail, which was a bit annoying and a test confirmed that was the case. Studying the wiring to them them showed the red and black wires from each fan went to pins at each end of the controller PCB, with the red wire going to earth. Removing these wires from their pins, the black ones were reconnected to the ground pins and the two red ones to a convenient pad on the PCB that was found to be the +12V rail. Photo 3 shows the fan connection modifications in more detail. Fan current consumption is around 200mA.

Figure 1 shows the circuit diagram of the complete PSU module, and Photo 4 my PCB. Plenty of decoupling has been added - because it's never a bad thing - especially around the DC-DC converter module. An 'upside down' N-Channel Power FET serves as reverse polarity protection (See RadCom March 2016, page 68). And that's about it.

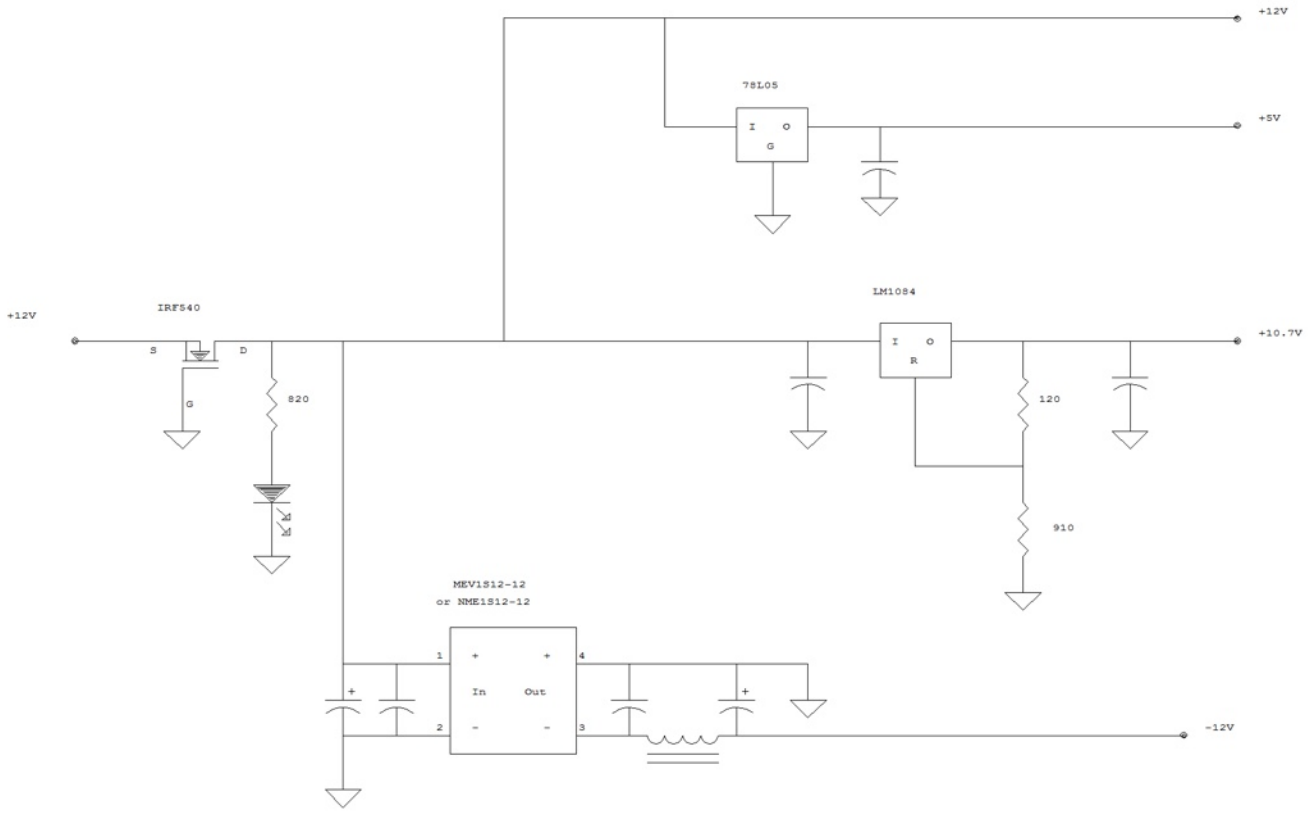


Figure 1 shows the circuit diagram of the complete PSU module

Results and Conclusions

Both modules were tested, and exceeded the performance summarised on the information sheet. The 2.3GHz unit delivered just over 11 watts at saturation, and reached full power with around -15dBm drive. The 5.76GHz unit saturated at just about 10 Watts with a similar level of drive. Current consumption of each was in the region of 3.5 to 4 Amps at full power, and rose when RF drive was removed, showing characteristics of class A, or at least AB, operation. No linearity or other testing has yet been performed, but during the course of initial testing there appeared to be a proper linear relationship between Pout and Pin – so these do look to be likely contenders for linear SSB operation.

According to G8GDZ, the G3OHM group still have several of these amplifier modules that will no-doubt appear at round tables and rallies. It appears that quite a few have already been sold.

UKuG Microwave Contest Calendar 2017

Dates	Time UTC	Contest name	Certificates
23-Apr	1000 - 1600	2nd Low band 1.3/2.3/3.4GHz	F, P,L
7-May	0800 - 1400	3rd Low band 1.3/2.3/3.4GHz	F, P,L
21-May	0900 – 1700	1st 24GHz Contest	
21-May	0900 – 1700	1st 47GHz Contest	
21-May	0900 – 1700	1st 76GHz Contest	
28-May	0600 - 1800	1st 5.7GHz Contest	F, P,L
28-May	0600 - 1800	1st 10GHz Contest	F, P,L
4-Jun	1000 - 1600	4th Low band 1.3/2.3/3.4GHz	F, P,L
18-Jun	0900 - 1700	24/47GHz Trophy / 76/122-248 GHz	
25-Jun	0600 - 1800	2nd 5.7GHz Contest	F, P,L
25-Jun	0600 - 1800	2nd 10GHz Contest	F, P,L
30 -Jul	0600 - 1800	3rd 5.7GHz Contest	F, P,L
30 -Jul	0600 - 1800	3rd 10GHz Contest	F, P,L
27-Aug	0600 - 1800	4th 5.7GHz Contest	F, P,L
27-Aug	0600 - 1800	4th 10GHz Contest	F, P,L
17- Sep	0900 - 1700	3rd 24GHz Contest	
17- Sep	0900 - 1700	3rd 47GHz Contest	
17- Sep	0900 – 1700	3rd 76GHz Contest	
24 -Sep	0600 - 1800	5th 5.7GHz Contest	F, P,L
24 -Sep	0600 - 1800	5th 10GHz Contest	F, P,L
22 -Oct	0900 - 1700	4th 24GHz Contest	
22 -Oct	0900 - 1700	4th 47GHz Contest	
22 -Oct	0900 – 1700	4th 76GHz Contest	
19 -Nov	1000 - 1400	5th Low band 1.3/2.3/3.4GHz	F, P,L
Key:	F	Fixed / home station	
	P	Portable	
	L	Low-power (<10W on 1.3-3.4GHz, <1W on 5.7/10GHz)	

March 2017 Lowband Contest Results

John Quarmby G3XDY

There was a modest increase in entries this year compared with March 2016. The coincident European contest offered some good opportunities for DX for some stations, despite poor radio conditions and some wet and windy weather.

On 1.3GHz John G4ZTR opened a good lead over the Combe Gibberlets group (M0HNA/P). His log included 9 German stations, and most of the leading stations managed some continental contacts on this band.

For the first time 2300MHz is treated distinctly from 2320MHz to encourage operation on this segment, but in practice this only resulted in one valid entry from M0HNA/P. More activity is needed!

DX on 2320MHz was more limited than on 1.3GHz, but in winning the band Combe Gibberlets did break the 400km mark with PE1CKK. Runner up on this band was Neil G4BRK.

M0HNA/P also worked PE1CKK for good DX on 3.4GHz, opening a substantial lead over Martyn G3UKV in the runner-up slot.

The Combe Gibberlets group were overall winners, with Neil G4BRK in overall runner-up position and leading fixed station.

1.3GHz	G4ZTR, M0HNA/P, G1DFL
2.3GHz	M0HNA/P, G4BRK, G1DFL
3.4GHz	M0HNA/P, G3UKV

Certificates go to M0HNA/P as overall winner, to G4BRK as runner-up and to the following band leaders, runners-up and leading portable and low power stations.

Normalised scores will be included in the overall championship table which will be published when the results of the next low band contest are available

Overall						
Pos	**Callsign**	**1296MHz**	**2300MHz**	**2320MHz**	**3400MHz**	**Overall**
1	M0HNA/P	646	1000	1000	1000	3646
2	G4BRK	314		615	322	1251
3	G3UKV	206		615	398	1219
4	G4ZTR	1000				1000
5	G4BAO	308		74	110	492
6	G4LDR	113		333		446
7	GM4BYF	385				385
8	G1DFL	113		34		147
9	G8EOP			57		57
10	GM4DIJ/A	8				8
1296MHz						
Pos	**Callsign**	**Locator**	**QSOs**	**Score**	**ODX Call**	**ODX km**
1	G4ZTR	JO01KW	28	9629	DF4IAO	744
2	M0HNA/P	IO91RF	24	6223	DF0MU	549
3	GM4BYF	IO85JV	9	3704	M0HNA/P	548
4	G4BRK	IO91HP	14	3023	DK2MN	580
5	G4BAO	JO02CG	7	2970	DK2ZF/P	661
6	G3UKV	IO82RR	10	1981	GM4BYF	355
7	G4LDR	IO91EC	6	1090	G8SFI	318
8	G1DFL	IO91NL	3	326	G3XDY	158
9	GM4DIJ/A	IO74MT	1	80	GI6ATZ	80
2300MHz						
Pos	**Callsign**	**Locator**	**QSOs**	**Score**	**ODX Call**	**ODX km**
1	M0HNA/P	IO91RF	1	174	G4ODA	174
2320MHz						
Pos	**Callsign**	**Locator**	**QSOs**	**Score**	**ODX Call**	**ODX km**
1	M0HNA/P	IO91RF	10	1726	PE1CKK	412
2	G4BRK	IO91HP	8	1062	G8SFI	256
3	G3UKV	IO82RR	5	888	G3XDY	265
4	G4LDR	IO91EC	4	575	G3XDY	223
5	G1DFL	IO91NL	2	195	G3XDY	158
6	G4BAO	JO02CG	1	127	M0HNA/P	127
7	G8EOP	IO93EQ	2	98	G4DBN	50
3400MHz						
Pos	**Callsign**	**Locator**	**QSOs**	**Score**	**ODX Call**	**ODX km**
1	M0HNA/P	IO91RF	6	1157	PE1CKK	412
2	G3UKV	IO82RR	3	460	M0HNA/P	216
3	G4BRK	IO91HP	3	372	G4ODA	152
4	G4BAO	JO02CG	1	127	M0HNA/P	127

Activity News : March 2017

By Neil Underwood G4LDR

Please send your activity news to:

scatterpoint@microwavers. org

Introduction

Just one report of activity this month.

1296 and 2320 MHz Bands

From Jim Davidson GM3UAG.

Towards the end of March high pressure produced a wee bit of DX.

PI7ALK on both 23 and 13cm was coming in, at S5 at times, consistently from about 2000 on the 25th March until about 0600 on the 26th. GB3MHZ on 23cm was popping in and out of the noise as well.

I was surprised to tune down from the beacon band on 1296.800 to the centre of activity (something I seldom do!) and find PI6ASD at S8 on 1296.639MHz. This is about the only vertically polarised beacon I've come across and it's ID at callsign, LT70/23 and locator CM55g a bit puzzling. Any info would be welcome.

EME: Dubus 23cm CW contest

From Peter Blair G3LTF (via moon-net)

An excellent weekend of random EME CW, the bottom 35kHz was full of stations for most of the two days, certainly until well into the NA window. At times there were at least 25 stations visible on the SDR screen. I worked 78 stations. Heard on the band but no CQ were PE1CHQ, G4CDN and VE4SA. CWNR were IK3GHY and JF3HUG.

Thanks to all for the enjoyable QSOs.

EA record on 47GHz

From Iban Cardona, EB3FRN

The past April 8th our microwave group traveled to the Ebro valley to do new contacts. Doing QSO at 10, 24 and 47GHz

Pascual EA5JF, Luis EA5DOM and Maxi EA5CV was in EA2 in the Nuestra Señora d'Herrera locator IN91KE70HJ and in the other side Jose EA3HMJ and me Iban EB3FRN in Creu del Godo, locator: JN02SD52UJ getting 245.5 of distance doing a new 47GHz EA record.

In the EA2 side the equipment was a 90cm offset dish and in the EA3 side was a 60cm offset dish, using the Kuhne pcb mixers over 1mW on the both sides. The humidity was over 35% and the temp over 17 celsius degree.

I attach some pictures.

.....and finally

The deadline for Activity News for the next edition of Scatterpoint is Monday 1st May 2017.

Getting on the air at 10GHz

From Murray Niman G6JVB

A nice example - and we need more of them...

Photo of Graham G8HAJ demoing 10GHz at the Chelmsford Amateur Radio Soc Essex Skills Night to 50+ attendees on Easter Monday (Apr-17) at Danbury Village Hall – the frontend uses a DB6NT transverter.

Events calendar

2017

Apr 22	RSGB AGM, Cardiff	rsgb.org/agm
April 22-23	17th Microwave Technical Meeting – Bydgoszcz	www.mikrofale.iq24.pl/default.asp?grupa=160446&temat=447910
May 19 – 21	Hamvention, Dayton	www.hamvention.org/
June 11	RAL @ Chiltern Village Hall OX11 0SH	
July 14 – 16	Ham Radio, Friedrichshafen	www.hamradio-friedrichshafen.de/
July 8 – 9	Finningley Roundtable	www.g0ghk.com/
August 18 – 20	SP VHF Convention and Technical Meeting - Poland	www.mikrofale.iq24.pl
Sept 8 – 10	62.UKW Tagung Weinheim	www.ukw-tagung.de/
Sept 10	Crawley Roundtable	carc.org.uk
Sept 17–21	IARU-R1 Conference, Landshut, Germany	www.iaru2017.org/
Sept 29–30	National Hamfest	www.nationalhamfest.org.uk/
Oct 13 – 15	RSGB Convention, Kents Hill Park Conference Centre, Milton Keynes	rsgb.org/convention/
Oct 14 – 15	Amsat-UK International Space Colloquium, Kents Hill Park Conference Centre, Milton Keynes	https://amsat-uk.org
Oct 8 – 13	European Microwave Week, Nürnberg	www.eumweek.com/
Nov 4 (tbc)	Scottish Round Table	www.gmroundtable.org.uk/
Oct 26 – 29	Microwave Update, Santa Clara, California	www.microwaveupdate.org

2018

June 22–24	Ham Radio, Friedrichshafen	www.hamradio-friedrichshafen.de/
August 17–19	EME2018, Egmond aan Zee,NL	https://www.eme2018.nl
Sept 23–28	European Microwave Week, Madrid	www.eumweek.com/

2019

June 28–30	Ham Radio, Friedrichshafen	www.hamradio-friedrichshafen.de/
Sept 15–20	European Microwave Week, Utrecht	www.eumweek.com/

NB Some of the 2017/18/19 event links may not be working/updated yet.

EME 2018

The website http://eme2018.nl/ is online. Only very basic info yet. More soon! Email info@eme2018.nl to register interest and for updates

There's also a Facebook page: https://www.facebook.com/EME2018/

73!
Jan
PA3FXB (team PI9CAM)
team EME 2018