

FIRST TWO-WAY LIGHTWAVE CONTACTS BETWEEN ENGLAND AND WALES

The "Lightwave Bands", although not an official part of the amateur frequency allocations, are freely accessible to all, even to non-licenced operators. Nevertheless they are part of the spectrum in the "World Above 1000MHz" and are therefore a legitimate subject for this newsletter. It's very exciting to read of work being done on these THz frequencies and even more so to hear of new contacts and "firsts". David Bowman's account shown below is worthy of our applause especially as GOMRF is active and successful at both ends of the spectrum from 73kHz to lightwaves!

From: GOMRF@aol.com

First G - GW two way Laser QSO

Three amateurs teamed up to make the first laser QSOs between England and Wales this weekend, on Sunday, 11 March, 2000:

Steve Rawlings, GW4ALG, Paul Nicholls, GOONA and David Bowman GOMRF used modulated laser pointers at the heart of two CW transceivers operating at a wavelength of **670nm**.

On a day frustrated by heavy rain and access to sites prevented by Foot and Mouth restrictions, the first QSO was made between GW00NA/P and GOMRF/P across the River Wye over the modest distance of 100m.

Having made one QSO, the group then moved to the River Severn where the path length was a more challenging 5.1km. After 20 minutes and despite "QRM" from a full moon and lights on the Severn bridge, a two way QSO was completed between GWOMRF/P, who received a 589 report, and G00NA/P who was 569 on the Welsh side of the border.

[We hope to be able to publish more details of the equipment used for this contact in a future Newsletter — editor]

The All Time Squares/DX Ladder has hardly changed since the last time it was published. As a result we have deferred printing it in this month's issue of the Newsletter. All we need now is a week of tropospheric ducting across the North Sea and the scores will rocket up again!

News, views and article for next month's issue should be sent to G3PHO by the end of the first week of April



An Amateur Radio publication for the Microwave enthusiast

MICROWAVE NEWSLETTER

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FROM THE EDITOR

2001 – MARCH

As this issue is going to press, the British countryside is undergoing its worst trauma for almost 40 years. Foot and Mouth disease has reached what many might call epidemic proportions. Our thoughts are with all who are affected in some way by this tragedy.

How does FMD connect with microwavers? Most obvious is that our summer programme of contests is bound to be restricted. Already the RSGB has postponed all portable contests until further notice and we ask anyone contemplating operating portable during our microwave contests (which are open ones, not entirely portable) to think again, be responsible and operate either from home or from some convenient **urban** site, far removed from farms. This may not be possible in many cases and therefore some of us may have to miss a contest or two. The April Millimetre Wave Contest is essentially a portable affair and is likely to be badly affected by the access restrictions.

Sadly, we should also prepare for the worse ... the FMD outbreak in the 1960's took eight months before an all clear was sounded. If a similar situation prevails this time, our summer microwave activity could be badly affected. One spin off of this might be that we would then be able to find time to upgrade our equipment, build for new bands or even tend to our neglected domestic responsibilities such as spending more time with the family, doing

IN THIS ISSUE ...

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- Millimetre Mixer diode offer
- Microwave Update 2001 –call for papers
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- That 23cm antenna again – readers write in
- Ideas for "homebrewing" on 24GHz
- EME on 24GHz – success at last!
- G3BNL Trophy winners
- Activity News – including a

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



G3PHO: Peter Day 0114 2816701
G8AGN: Barry Chambers 0114 2304202



G3PHO, Peter Day,
146 Springvale Road,



G3PHO: Email: g3pho@geocities.com
or p.day@virgin.net

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

G3VVB TROPHY

A reminder that the G3VVB Trophy for the best home constructed microwave equipment made during the past 12 months will be awarded at the RSGB show at Bletchley, April 7/8. This trophy was formerly awarded at the Sandown VHF Convention, now replaced by the Bletchley event. Just turn up on the day to display your gear and/or illustrated write-up. A panel of judges will look at it and make up their minds before the day is out!

MIXER DIODES FOR 47GHZ AND UP

Paul Longstaff, G6UAJ, has ordered fifty HSCH9521 Beam Lead diodes for use in the DB6NT 47 and 76 GHz MK2 Mixer boards. They are available from Paul at the following prices:-

- 1 off £35
- 2 off £31 each
- 3 off £28 each
- 4 off £25 each
- 5 or more £23 each.

All prices include UK postage & packing.

The devices are on a 6 week lead time so delivery will be in April.

Please note:- Paul is taking a risk with some serious money, in the interest of UK microwave activity. This is not a profit making exercise! He needs to sell at about 35 of these devices to get his money back!

Paul has plenty of stock to spare!

Contact details:-
phone:- 07887 868070
email:- paul.longstaff@vf.vodafone.co.uk

FOR SALE and WANTED

For sale:

6' solid dish, f/d 0.44. Dismantles into 6 pieces. Complete with horn feed, mounting and elevation system. DC. Azi drive motor also available. Price: £50 for the lot. Contact: **Mr. W. Clinton**, 26 Aston Crescent, Newport, South Wales NP20 5RA e-mail: pamwes@globalnet.co.uk Phone: 01633 764652

For Sale:

Pye L700 1.5GHz analogue duplicated microwave terminal. Would make an ideal SETI rx! Price, complete with manual, £75 Jaybeam 7227 1.5GHz Shrouded Yagi, £25 Tel: **Richard, G8ZHA**, Walsall (01922) 865104

Wanted:

I am now looking for a 3 port circulator for 47G preferably in WG22 but, as 47G Hz is outside the WG22 preferred band, it may need to be a smaller WG size. It's vital that it has good directionality at 47GHz. A loan circulator to pursue the feasibility of an idea would be helpful.

John, G8ACE <hazell@cwcom.net>

For Sale:

For Sale due to double ordering, a **100.2MHz** crystal from Eisch, suitable for a 24GHz L.O. Price £12 inc. post. Dave **g3ztr@hotmail.com**

Move of ww2r web site

Due to difficulties getting any service from the new "owners" of my old ISP, the WW2R/N2NQI web pages have moved, with immediate effect to:-

<http://www.mesh.net/~g4fre/ww2r.htm>

Please alter your bookmarks/links accordingly

The power readings are taken with a Marconi 6460/3 power meter using a 100mW head, on the 10mW range, via a high quality, 20dB HP directional coupler plus sma/WG transition taken from a Teletra "White Box". In a check against a really good, modern power meter, the old Marconi came within 5 percent on the 100mW scale at 24GHz so the half watt from the PA might be a little above or below the measured figure ...still disappointing when GOHNNW's PA is giving around 720mW! Still, half a watt is a considerable improvement over the 65mW from the original transverter.

The PA is so easily driven! Just a whiff of drive saturates it. In fact the DB6NT MK2 mixer is embarrassingly QRO as a driver!! The mixer's 280 microwatts output feeds a cavity filter (ex-Teletra white box) which in turn feeds the input port of a 3dB splitter in WG20 (also ex-Teletra white box!). One output port of the splitter receives the DB6NT four stage HEMT preamp while the other drives the PA via a short length of coax and two sma/wg transitions taken from (you've guessed it!) the Teletra white box. Various lengths (up to 5 inches) and types of coax have been tried, from flexible to semi rigid, with a variety of sma connectors (including crimped types!) and in all cases there have been "oodles" of drive. The RX preamp and TX PA are switched to the antenna via a WG22 waveguide switch, both amps being mounted at their respective ports on the switch. The coax in the system was necessary to allow the waveguide loop of the old 65mW transverter to be retained. The primer mover is an IC202S at 144MHz.

Ralph, G4ALY (Cornwall) is presently setting up a home-based microwave station for 23cm and 10GHz. He has 50 watts on 23cm and 10 watts on 3cm (based on a German surplus SSPA). Ralph wisely took early retirement at the end of last year and so hopes to be a lot more active on microwaves than he has been to date. Many readers will have worked him when he has been portable at Kit Hill. Having a regular home station active on 3cm from Cornwall will certainly attract a deal of interest

10GHz LADDER: YEAR 2000 FINAL POSITIONS

This Ladder is calculated by means of the algorithm used to score the All Band League Table, of which it is a part.

Callsign	10G Wkd	10G Dx	10G Score
G4BRK		61	635 2312
G3PHO(/P)	65.5	449	1755
G3FYX(/P)	56	521	1741
G4ZXO/P	59	492	1732
G3XDY		46	595 1633
G4LDR		49	444 1298
G6UAJ(/P)	37	389	859
F1VBW	21.5	589	755
G3JMY		34	331 671
G8BKE/P	13	278	215
G4KNZ/P	12	263	188
G4DDK	6	268	95

The 2001 Microwave League Table is now open. There has only been one entry so far so we cannot yet start the Table in earnest. Hopefully there will be more contacts to report as the Spring comes along. Please end your entries to the G3PHO via the address shown on the front page.

The rules are the same as before. Just send in the numbers of different callsigns worked per band, plus your best DX for each band, and we will do the rest! Callsigns include such variations as G9XXX, GW/GM/GI/GU9XXX, G9XXX/P, GW9XXX/P, etc. In other words the same operator can be worked again and again provided his callsign exhibits a variation each time.



ACTIVITY NEWS FROM THE WORLD ABOVE 1000MHZ

Microwave news is a little thin on the ground this month so there's an extra special word of thanks to those of you who have sent in something! Even if you haven't been working much on the bands, we are sure you must have been building some "secret weapon" for this year's contest season! Why not write in with the details?

We'll start the ball rolling with an email report from **John, G3XDY**, in East Anglia, [g3xdy@btinternet.com]:

Tropo conditions so far this year have already beaten last year quite convincingly. Following the good Scandinavian opening in January there was another on 14th Feb where I worked OZ5KM in JO45 on 23cm, but was not able to spend much time on the bands (XYL QRM on Valentine's day!). On the 18th there was a lift into France, resulting in QSOs with stations in the Paris area (JN18) on 23cm, 13cm and 3cm, with very loud signals from F6DKW on 3cm.

The first weekend in March had an all band VHF/UHF/SHF contest in Europe, so I spent some time looking for continentals on the microwaves.

On 23cm I worked 20 stations, with DK0ES in JN48TN the best at 712km, a surprisingly good distance considering the flat conditions. On 13cm I worked 7 stations, the best being DK2MN (JO32) at 415km, although DL3YEE in JO42 at 500km heard me I heard nil from him. On 3cm I worked 8 stations in PA and ON, with PA6C at 372km the best DX. There was some evidence of ducting over the North Sea, as PA6NL right on the coast was very loud on all bands, but it did not extend far inland.

As a result of all the activity so far this year I would like to kick off my activity table entry for this year with scores of 32 stations and 1176km on 23cm, 10 stations and 1176km on 13cm, and 10 stations and 384km on 3cm. I have still to

work G on both 13 and 3cm so far this year!

Neil, G4LDR also emails a short report:

I became operational again in mid-February following the antenna damage in October last year due to high winds. I managed to get the job of removing all the aerials from the mast, bending the tower head unit back into shape and getting the stub mast straight and reassembling everything just in time for the good conditions in February.

On the 14th February I worked the following stations. On 23cm; PA0GRB (JO23), PA0JUS (JO22), PA5DD (JO22), DK3FB (JO31) and OZ2LD (JO54). On 13cm and 3cm; PA0JUS (JO22) and PA5DD (JO22). Unfortunately I had not re-installed 6cm otherwise I would have worked PA5DD on that band as well.

There's still some activity on Monday nights down here in the south. I worked Bob, G3GNR, for the first time in many months on the 5th March. I haven't worked north of Swindon on 3cm this year ... is there any activity in the Midlands or North of England or have conditions been so bad recently? (*editor's comment: G0HNNW and G3LRP are on almost nightly and most mornings from 0830 onwards, from West and South Yorkshire*)

I am currently getting bits together for 24GHz and hope to be QRV in a couple of months time. I'm also starting to put together the 6cm beacon which will join the old Isle of Purbeck (GB3SC* series) when the new site in Dorset becomes available.

I hope to see many of you on one band or another in a couple of months time.

Peter, G3PHO (Sheffield) has spent some of the past month experimenting with the Milliwave 24GHz PA recently acquired from the USA. First results were disappointing in that the output was more than 3dB down on the 800mW quoted in the original spec. However, some changes to the matching at various points in

SENIOR RADIO AND ELECTRONICS TECHNICIAN (MANAGER DESIGNATE) BASED IN DEVIZES, WILTSHIRE

We need a – resourceful, good communicator, who is self-motivated and can professionally liaise direct with our customers. You will also like travelling throughout the U.K., are quite happy working on your own and are not afraid to use your initiative.

Apart from being an experienced and highly competent electrical engineer it is essential that you have extensive practical knowledge of radio communication, preferably with microwave experience. Also it will be an advantage if you have some experience in CCTV as well as commissioning and assessing total projects rather than just individual components.

You are probably bored and under utilised in your present job: we can promise you that you won't be with us!

Location within one hours drive of Devizes an advantage.

We are – a small but growing specialist company that works in Radio Systems, CCTV, Automatic Number Plate Recognition and associated products. The time has come for us to create this new position which, for the right person, should lead to management responsibility and excellent rewards on top of a first class initial employment package.

If you feel you meet our person profile please send you CV to: -

Mr Barry Carter
Pathfinder Radio Systems Limited
Link House
5 Bath Road Business Centre
Bath Road
Devizes
Wiltshire
SN10 1XA
Email: sales@pathfinder-radio.com

Microwave Update 2001 Call for papers

Fellow Microwaver,

We are seeking talks and papers for Microwave Update 2001 which is being held September 27-30, 2001, in Sunnyvale California. The event is being hosted by The 50 MHz and Up Group of Northern California. Here is the web page: <http://www.qsl.net/50up/uwave2001/>

We are hoping that you will be able to present a talk or, if you can't attend, a paper for publication in the Proceedings. If you are willing to participate please reply to us. If you have a subject in mind now, that is great. If you are willing to participate but have no topic at this point, please contact us anyway. Myself, Rex Allers - KK6MK, and Gary Lauterbach - AD6FP, are coordinating the speakers and putting together the Proceedings. We plan to talk with people on the telephone, but wanted to start with this request first.

This request is also being sent to a list of people who have done presentations in the past or who have an active interest in microwave amateur radio.

If you have any suggestions for other presenters whom we could contact, please forward any ideas.

We look forward to seeing everyone at Microwave Update this September.

Paper titles and/or abstracts should be received by May 15, 2001 by either:

**Rex Allers, KK6MK <rexa@dnai.com>
Tel: USA (408) 377 6848**

**Gary Lauterbach, AD6FP
<AD6FP@pacbell.net>
Tel: USA (650) 941 5398 (home)
(650) 336 1001 (work)**

All papers need to be received by July 9, 2001 for inclusion in the proceedings

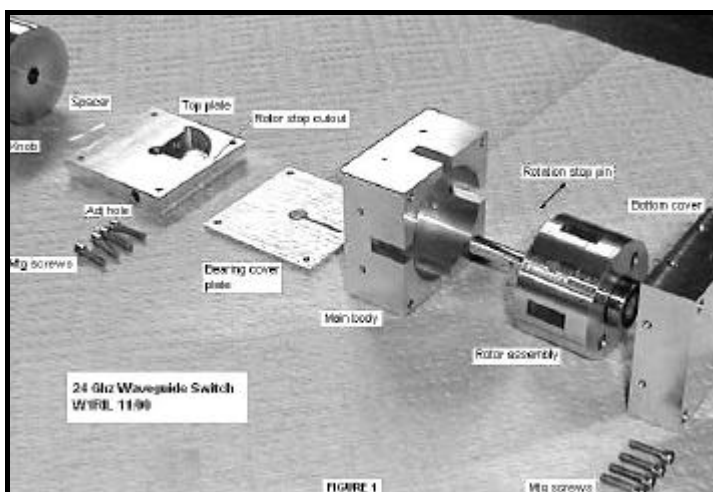
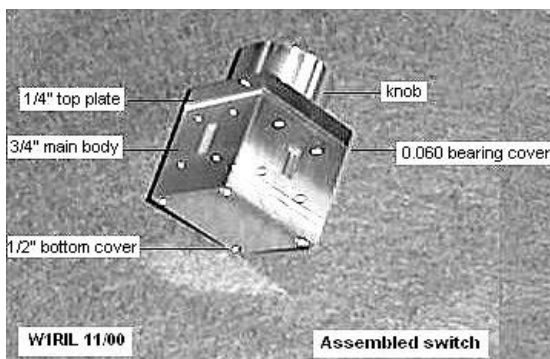
We look forward to seeing everyone at Microwave Update this September.

24GHz 4 port waveguide transfer switch

by Ken Schofield, W1RIL

The WR42, 24GHz, 4 port transfer switch is made up of several machined parts. The parts in figure 1 from left to right are: knob, tfe spacer, top plate, bearing cover plate, main body, rotation stop pin, rotor assembly, and bottom cover.

The rotor consists of an upper section with shaft and rotation stop pin and a lower section. Both upper and lower sections are fitted with ball bearing races. The upper section contains the arched waveguide slots on its bottom surface. The lower surface of the waveguide slots are formed by the addition of the lower section. Slots in the control knob, similar to those in the rotor, indicate the passages through the 4 ports of the switch.



Materials List

- 1 Pc 6061T6 Aluminum plate 3/4" X >1.5" square
- 1 Pc 6061T6 Aluminum plate 1/2" X >1.5" square
- 1 Pc 6061T6 Aluminum plate 0.060" X >1.5" square
- 1 Pc 6061T6 Aluminum plate 1/4" X ~1-1/4" X ~ 1-3/4" (for jig)
- 1 Pc 6061T6 Aluminum rod 1-1/4" dia X 3-1/4 long
- 2 Ea Bearings (from defunct computer hard drive) ID ~ 0.193", OD ~ 0.512, Thickness 0.156"
- 8 Ea Socket head cap screws, SS, 2-56 X 3/8" long
- 2 Ea Pan head screws, SS, 2-56 X 3/8" long
- 3 Ea 4-40 allen head set screws
- 3 Ea Flat head screws, 4-40 X 3/8" long (for jig)
- 1 Ea Pin 0.040" dia X 0.665" long

24 GHz EME by VE4MA

Tonight, at about 04:30 UTC March 10, the 24 GHz EME signals of W5LUA were heard at VE4MA. Signals were weak at both ends. AI's signal here was T-M copy.

I am using an 8 ft offset (14 /12 GHz) dish with a "large" diameter W2IMU feed into a DB6NT preamp at 1.55 dB NF. I see 15 dB on Sun noise and 2.3 dB of moon noise. I had no visual moon because of clouds, but this does not appear to have affected the moon noise. The beamwidth of the antenna appeared to be slightly less critical with clouds than with clear sky.

The WX here was about -1deg C (warm spell!) and about 80% humidity with snow expected overnight.

And now to make a QSO

Best 73 from Barry VE4MA < [ve4ma@home.com]>

CONGRATULATIONS



We are delighted to report that the recipients of the G3BNL Trophy for this year are Peter, G3PYB, John, G8ACE, Chris G8BKE and Roy, G3FYX. The Trophy has been awarded to this group of microwavers for their outstanding work on the 76GHz band. This involved a considerable amount of construction, experimentation and dedication, leading to the establishing of a new UK DX record for the band of 52km, as reported in last month's Microwave Newsletter.

The Trophy will be awarded to a representative of the group at the RSGB show at Bletchley, April 7/8 this year.

HAVE YOU JOINED THE UK MICROWAVE GROUP YET?

If not, you might to consider supporting microwaves in the UK by becoming a member. **Membership is open to anyone, anywhere in the world.**

The group produces a quarterly journal, "Scatterpoint", edited by Martyn, G0CZD, as well providing a useful component service and a website.

Subscriptions for 2001 are now due. Full details and a membership form can be obtained from the group's secretary, Steve Davies, G4KNZ by emailing him at: **steve.davies@nokia.com** or writing to him (enclose SAE) at:

S.Davies, 17 Haywood, Haversham Park, Bracknell, Berks., RG12 7WG

24GHz EME – is this the “final frontier?”

Just before this issue of the RSGB Microwave Newsletter went to press, the following emails were received, from North America, with the exciting news that a two-way amateur 24GHz microwave EME contact is almost imminent! Al Ward, W5LUA, of microwave preamplifier fame, has been experimenting with the mode for many years now so perhaps we should have known this news would first come from him. Barry, VE4MA, well-known for his work on microwave antenna feeds, must have had a tremendous thrill during the event he describes below! From these two emails it looks as if reception of 24GHz EME signals is a distinct possibility for anyone who can install an 8 foot dish since the receiving equipment required is now quite commonplace. All that AI needs now is someone else with 20 watts or so of 24GHz RF and we thought we were doing well by upgrading to half a

My first lunar echoes on 24 GHz, by W5LUA

I was finally able to hear and record my first earth-moon-earth echoes on 24192.1 MHz at 0816 GMT on March 7, 2001. My antenna is a 3 meter Andrews prime focus dish. According to Andrews, the 3 meter dish is rated to 30GHz, with proper back structuring to optimize the dish's surface. The dish really began to perform when I added a back structure which looks like a tic-tac-toe board mounted to the backside of the dish. The eight points of the back structure allowed me to optimize the dish's surface by pushing or pulling on the back of the dish to enhance the accuracy of the dish's surface.

The end result was improved sun and moon noise. I presently receive 12.5 dB of sun noise and 1.3 dB of moon noise. My feed is a scalar feed optimized per the "W1GHZ On-Line Antenna Handbook". My dish has an F/D of 0.3. My LNA is a 2 stage W5LUA homebrew design using a pair of Agilent Technologies PHEMT devices which provided a 2.25 dB system noise figure. My basic transverter is built around surplus 23 GHz modules which down-converts to a 2304 MHz IF which is then down-converted to a 144 MHz IF with a Down East Microwave transverter to an ICOM IC-271 transceiver. I was able to achieve about 20 watts at 24192 MHz by re-tuning a Varian VTU-6191 14.5 GHz TWT which I have been using on 10 GHz EME at about 80 watts output. Re-tuning consisted of lowering the Helix voltage and doing some tuning in the output waveguide section.

I was using Mike Owen's Realtrak Software to track the moon. I was concerned about the accuracy of the doppler calculation of the various moon tracking programs which I have used in the past. With an expected doppler of up to 50 kHz, there is not a lot of margin for error when tuning for echoes. I ran some echo tests on 10368 MHz and came to the conclusion that Mike's software was the most accurate at 10368 MHz. I therefore placed my confidence in his software at 24192 MHz. Based on the doppler shift of the received echoes, I believe Mike's software predicted the returns within a few hundred Hz.

On the evening of March 6 local time I had just installed my elevation rotator which allowed me to remote operate the dish from the hamshack. Previous attempts at echoes were with all equipment mounted in a shed near the dish. I had tried for echoes prior to zenith but only thought I had heard echoes. Some clouds were beginning to cover the moon so I decided to set my alarm clock for about 2AM and give it a shot on the setting moon.

The first discernable echoes were heard at 0816 GMT with the moon at an azimuth of 268.8 degrees and an elevation of 38.8 degrees. The doppler shift at this time was a negative 45.3 kHz. Echoes peaked very well at 0848 GMT where the elevation was down to 31.5 degrees and the doppler shift was a negative 49.1 degrees. At this point, I ran out of azimuth control with my present set-up.

My lunar echoes peaked Q5 (M copy) in a 2 kHz bandwidth and were easily identifiable on AF9Y's DSP software. This triumphant event came after several years of optimizing the system and many failed attempts at achieving lunar echoes. I was rather surprised to find that the echoes did not seem to be much broader than my 10 GHz echoes, maybe due to the 0.3 degree beam-width of my dish.

- 1 Ea Tolerance ring (may or may not be needed - see text)
- 1 Ea 4-40 hex head nylon nut and bolt 3/8 inch long

PROCEDURE:

Make facing cuts on both ends of the 1-1/4" OD aluminum bar and a 0.005 cut across the outside diameter to clean up and smooth the outer surface. This is cut into three pieces using a cutoff tool in the lathe. Cut off pieces to be finished to 3/4" long, 5/8" long and the remaining section approximately 1- 7/16" long. Make facing cuts on each rough end and finish to size with the exception of the 1-7/16" long piece which will be left long for now. This will be the rotor and will receive the waveguide cuts and upper bearing. The remaining length will become the rotor shaft. The 3/4" section will be the bottom of the rotor, forming the bottom of the waveguide slots and holding the lower bearing race. The remaining 5/8" piece will be used for the control knob.

Machine the 3/4" thick piece of 6061T6 aluminum to 1.5" square. It is important that it be exactly 1.5" on each side, and square. Waveguide slots will be cut in the exact center of all four sides after machining for the rotor and upper bearing. Cut the 0.060, 1/4", and 1/2" aluminum 6061T6 pieces to 1.510" square. Make a cleanup cut on the top and bottom faces of the 1/2" and 3/4" blocks. Usually a couple of thousandths cut with the flycutter will clean and smooth the surfaces really well. The 1/4" block will be done later after machining the rotor stop cutout. The 0.060 bearing cover plate I used was an anodized piece and did not require further finishing.

On all of the squared up pieces, find, and using a center drill, mark the exact center of each. Drill a pilot hole thru each with the exception of the 1/2" block. On this piece locate the center and drill the pilot hole only to a depth of 1/4" on one surface only.

SELECTING THE BEARINGS:

An old defunct 100 MB computer hard drive contained two bearings with the following dimensions: ID 0.198, OD 0.512, Thickness 0.156. If you use bearings of different dimensions appropriate changes will have to be made in the bearing seats, shaft diameter, etc.

MAIN BODY:

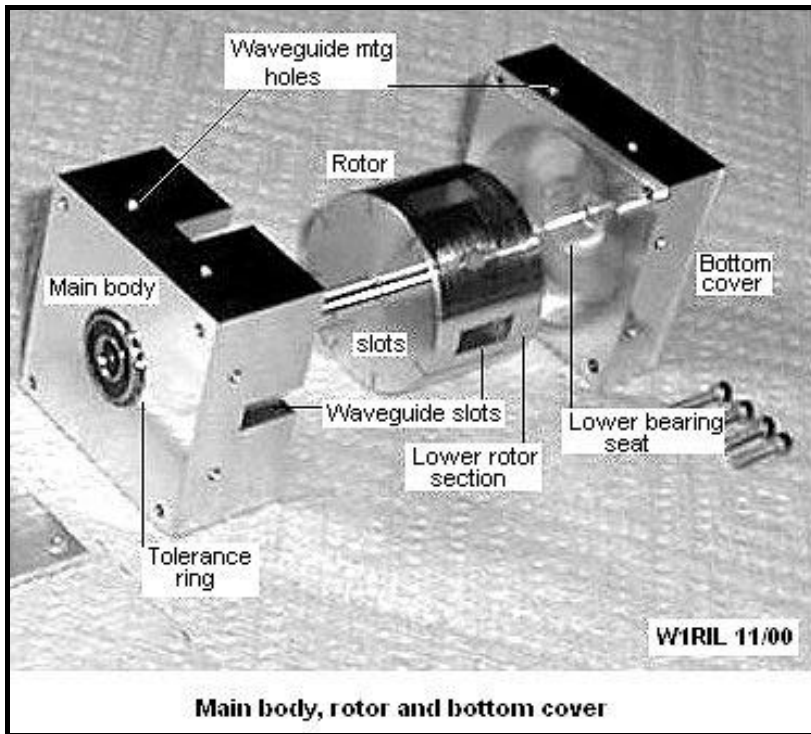
Open the center of the 3/4" block with a 1/2" drill. Chuck block in lathe, center up and enlarge the 1/2" hole with a boring bar to except the bearing with a push in fit. It should be snug but removable with moderate pressure. On one face of this block enlarge the hole to except the 1.240" rotor to a depth of 0.594". (The block thickness minus the bearing thickness 0.750 - 0.156 = 0.594) If your bearings are different change both of the above operations accordingly. Open the rotor hole in the main body until the rotor just fits. It should turn easily with no binding.

Mount the block in the milling machine with the large rotor opening at the top. Cut the waveguide slots, 0.420" deep and 0.170" wide, centered on each of the four sides. Clean up the edges after machining.

ROTOR:

Insert the rotor into the main body cavity and mark where the rotor is flush with the top of the block. On the opposite end drill a center hole in the rotor and tap for 4-40 screw approximately 1/4" deep. This area of the rotor will be cut down to the ID of the bearing and shaft after the waveguide slots are cut.

Using the piece of 1/4" X 1-1/4" X 1-3/4" aluminum plate make a jig for machining the rotor slots. Machine the 1-1/4" dimension to the exact diameter of the rotor body. (~1.240") Mark off



Main body, rotor and bottom cover

a square area at the end of the plate 1.240" by 1.240" and locate its center. Put the plate in the milling machine and, using a center drill, locate the center hole and two other holes 0.425" in line with and on opposite sides of the center. Drill a pilot hole with a #55 drill at these three locations. Open the center hole to just clear a 4-40 screw and countersink one side so screw

head will be just under flush with surface. Mount rotor to this plate with a 4-40 FH screw. The outside edges of the rotor should be flush with the plate edge on three sides. With the #55 drill locate the other two holes in the rotor. Remove from plate and drill and tap both holes for 4-40 screws. Drill out and countersink the two remaining holes in plate. Mount the rotor to the plate securely with three 4-40 flat head screws.

Mount the rotary table, set at "0" degrees, on the milling machine and locate the headstock to the center of the table. My rotary table has two "T" slots on it that divides the top into 4 equal segments. The slots are 0.248" wide. One half of the slot is 0.124". Set the jig, with rotor attached, in the lower right corner of the upper left quadrant of the table. Align to leave 0.124" on the "X" and "Y" axis of the "T" slots showing. The lower right corner of the jig should be at the table center. Clamp the corners of the jig securely to the table and set the cutter well above the rotor. Dial in 1/2 the rotor diameter on the "Y" axis. This puts the cutter in the center of and to the right side of the rotor. Back the cutter off a few degrees by turning the rotary table and bring the cutter down to the material. Cut the 90 degree arc in the surface of the switch rotor to a depth of 0.420". Check width and cut each side equally to a width of 0.170" maintaining the 0.420" depth. Remove the jig with rotor attached from the milling machine and rotate the rotor 180 degrees on the jig. Align as before and repeat for the slot on the other side of the rotor.

Remove jig and rotor from rotary table and remove the three screws holding the rotor to the jig. Insert the rotor into the main body block and recheck the depth line on the rotor previously made. Chuck the rotor in the lathe with the waveguide slots facing toward the chuck. Reduce the diameter of the exposed end to the depth line to 0.250". Leave a 0.002 segment next to the rotor and reduce the remaining shaft for a tight fit to the ID of the bearing. As before, if using different bearings, adjust dimensions accordingly. See rotor drawing.

Clean up rotor slot edges and insert the rotor shaft up thru the bearing seat hole in the main

24GHz home brew – Some ideas and notes by Lloyd Ellsworth, NE8I

Having obtained a couple of the 24GHz surplus Milliwave power amps, we found the problem of the WR34 (WG21) **waveguide**. Yes, one can simply bolt on some WR42 (WG20) and go from there. The losses are not all that bad but there are 2 basic problems. Firstly, if you use a DB6NT 24GHz xvtr unit, a filter is a really good idea! An example is the G3WDG version, detailed in the 1995 MUD proceedings, pp 171-177. Secondly, **transitions** for WR42, (or the more scarce WR34) tend to be a bit hard to find, and worse, expensive. The transitions are useful, because there are many surplus SMA relays, which will work just fine at 24GHz, along with various semi rigid coax type cables. **Waveguide switches** exist but it is easier to find the relays and not fight the plumbing!

Power testing all these at 24GHz, is a really good idea before use. The solution we (WA8HGX, WW8M, N1EAU and NE8I) found was staring at us in the face in our copper and brass junk boxes!..... homebrew the WR34 waveguide! Have you ever been at a hobby or hardware store, looking at all that nice hobby brass, at the nice rectangular tube pieces and thought, "Gee, look at all this nice waveguide" ? Too bad that it is all the wrong size! Looking at the 3/8" by 3/16" rectangular tube, then measuring it, it turns out to be something like +.001 and -.005 off from the correct WR34 (WG21) size. Gee whiz! Well, the main problem with the hobby brass is just that ... not quite the right vertical-to-horizontal ratio for waveguide use.

Anyway, we built up a couple of sma/WG transitions, tested them and guess what, they work! Results were no worse than using the WR42 transition on the WR34. It took about an hour per transition to build, plus some junk box stuff and about \$5 worth of parts from the hardware store. We built several.

Thick brass strap was used for the flange. **Fabricating the flange** is the worse part. It took about 20 minutes to mark and cut the rectangular flange hole to size ... another Dremmel tool project? No, not really. No special tools required. Once in place, cut off the strap to size, place against the amp and mark the

required holes.

One really great trick we learned years ago at a Central States VHF conference was in a presentation by a ham who was a dentist. He used **dental tools** and tricks to put a hole accurately where it was needed. He had a pile of these tools available there. Using that trick and tools, the holes for the transition were placed. One could either put in a smaller hole, and tap or a normal larger hole and use larger bolts and nuts. The next trick was **mounting the connector**. We cut the stub/centre pin to about 2mm and mounted it a quarter wavelength back from the back of the cavity, another 2 mm. In a few transitions, we put in some tuning screws, size 0-80. Yes, my local Lower Whoville hardware store stocks 0-80 and 1-72 hardware.

Now, a word about **taps**. These 0-80 critters are a bit fragile. They break easily. Be careful and patient with them and they will last.

Dimensions are a bit critical at 24GHz but not that much of an obstacle. It just takes more care and time. Solder it all together. Be careful about warping the thin hobby brass. I built 2 varieties of transition, one with an SMA connector, the other with a piece of semi rigid soldered right in. Eliminate a connector loss! If you have K type SMAs and 40GHz rated semi rigid great ... use them but don't let not having them stop you! UT.085 and SMAs with PTFE insulation will work at 24GHz. They just are more lossy and not work as well. It's a bit like using a PL259 UHF connector on 432MHz. In our case, we had some HP (Agilent) 26GHz rated relays we found at Dayton, and they work just fine.

If you need some **attenuation** at 24GHz, some conductive foam for ICs, stuffed in the waveguide, works pretty good.

Anyway, we currently are working on building some **waveguide filters** using homebrew WR34 wave guide and experimenting with them and also with a power detect trick to put the output of the amp to a microammeter, then possibly even homebrew a directional coupler. Bruce, WA8HGX, is busy writing up a formal paper, for the 2001 MUD Sunnyvale proceedings, with a pile more detail on this subject.

Good microwave home brewing and 73 from
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to the other. The nut is used to lock the bolt in position. This bolt assembly is not shown in any of the drawings as it was added when it was noted that the switch could get offset from the desired position too easily!

Clean all pieces thoroughly and wipe down with a solvent such as lacquer thinner. Assemble rotor into main body and press stop pin into shaft. Install bottom, bearing, and top covers and secure mounting screws. Place spacer and knob on shaft. Adjust indicator slots to the switch position and tighten the knob set screw. Check rotation and adjust set screws for proper rotational stops.

FINAL COMMENTS:

If you are a machinist by trade this probably took you much less than the 60 hours that it took me. The end results are however well worth the time and effort.

Editorial Comment:



**Feedback
~
comments
from our**

**The SHF2367 23cm
Aerial**

I refer to the articles in the Feb. Newsletter regarding the Wimo aerials. These were advertised in the October 2000 issue, whereupon I purchased the one with the 44 elements. It arrived within days and was up almost as quickly. I did not experience any of the problems detailed although, admittedly, I do have less elements.

My QTH is above 600 ft. in the Cotswolds so obviously the site is exposed. The aerial is on a Tennamast and if there is a gale warning the mast is wound down. You do not need me to tell you what a ghastly winter we have had, yet today the aerial is as pristine as the day it was erected. In fact the only worry I have is how to pronounce Wimo.

**From: David Dodds
[gm4wll@talisman.u-net.com]**

Perhaps I can throw some light on the comments in the Microwave Newsletter about the build quality of the WiMo 67 ele 23cm yagi?

By coincidence, my own yagi arrived from Germany the same day as the Microwave Newsletter, so I read the comments from Reg G8VHI and Simon GM4PLM with some interest before putting mine together!

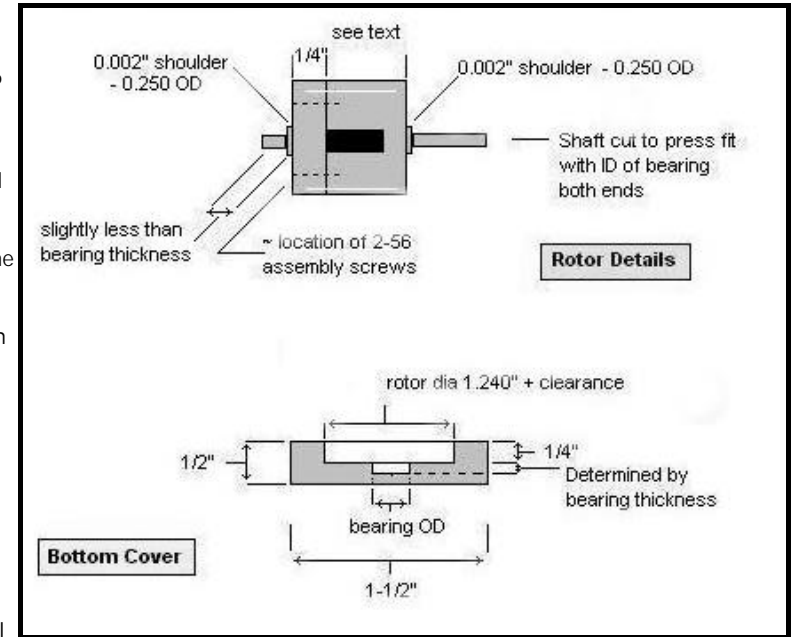
I've always been of the "play first, read the manual later" school of technology so I set about assembling my antenna, first attaching the reflectors to the boom, using the U-shaped bracket which Reg mentioned. In my customary way, I then realised I had to take it off again in order to attach the driven element to the boom! Having done this I attempted to re-attach the reflectors and found I now had the same problem as Reg: the holes on one side of the bracket were not aligned with those on the boom! A quick 180 degree flip and both sides were a perfect alignment once more. The holes do align but are not the same on each side! Why this should be I cannot say. Perhaps the manual would tell us, but I don't speak German!

I must say that I consider the build quality to be the finest I have ever seen. I've used antennas by Q-Tek, Jaybeam, MET, Tonna and Sandpiper and none of them are a patch on this. Yes, the antenna is a little flimsy, but it is also light, with relatively low wind-loading. How it performs in

body. The lower edge of the rotor should be flush with the bottom of the main body and when rotated the rotor waveguide cuts should line up with those on the four sides of the main body. If problems occur with upper bearing alignment the bearing seat can be opened and a tolerance ring installed. This will adjust for minor misalignments in rotor and bearing seats. Make sure "no drag rotation" is possible to at least two slots. If complete rotation is possible so much the better, however only 90 degrees of rotation will be necessary on final assembly.

TOP PLATE AND BEARING COVER PLATE:

Open center holes in the top plate and bearing cover plate with a #7 drill. Locate and drill pilot holes in the top plate, bearing cover plate and the top corners of the main body. These are to be 0.125" in from each edge in all four corners. Drill the top plate first and use as a template for the other two. Open the top plate corner holes for clearance of 2-56 screws and countersink the cap screw heads using a larger drill to 0.125". Drill and tap the corner holes in the top of the main body for 2-56 screws to a depth of 0.250".



BOTTOM COVER:

Locate and drill pilot holes in the four corners of the 1/2" block 0.125" in from each side. Drill all the way thru the block. Chuck block into lathe with the previously located center drilled side facing away from the chuck. Extend the center hole with a pilot drill to a depth of 0.400". Open hole with a 1/2" drill to this same depth, 0.400". Use the boring bar and open hole to ~0.510 for the lower bearing seat. This should be a snug fit. Leave 0.165" for the bearing seat and clearance and open outer 0.235" of hole to rotor diameter, 1.240". See pictures.

LOWER ROTOR:

Fit lower rotor section into the bottom cover, mark and turn to bearing ID. Leave 0.002" X 0.250" diameter shoulder for clearance. Cut shaft to 0.152" long and press bearing onto shaft. Drill two pilot holes with #55 drill for mounting to the upper rotor section. Place lower rotor section on bottom of upper rotor and locate holes. Drill and tap for 2-56 screws. Countersink heads in lower rotor at just below flush with rotor bottom. Using previously drilled pilot holes in

bottom cover, align, locate, drill and tap 2-56 corner holes in bottom of main body to a depth of ~ 0.300".

PREASSEMBLY AND CLEANUP:

Assemble rotor into main body and attach bottom cover and both top and bearing cover plates. Assure no drag rotation of rotor and snug up top and bottom mounting screws. Mount assembly in milling machine and with the fly cutter take a cut of 0.006 to 0.010" to get all plates and main body flat and even on all four sides. Using a prick punch make a witness mark on the upper corner of each plate on one side for future alignment. Flycut the bottom of the bottom cover for a clean smooth surface. Disassemble and remove top plate. Clean off top surface of top plate with fly cutter. On the bearing cover plate cut a 0.0625" slot centered on the center hole the length of the stop pin. This enables removal of the plate when the stop pin is installed in the rotor shaft. Once the stop pin is installed the rotor cannot be removed from the body without removing the pin. Locate the pin location on the shaft to fall in center of the thickness of the 1/4" top plate. Drill hole in shaft. The pin I used would just go thru a drill gage #59 hole. The shaft hole was made a #60 and the pin was pressed in. If you have trouble locating a pin a #59 drill shank will fill the bill nicely.

Locate a 90 degree segment, plus one half the diameter of the stop pin on the bottom side of the top plate for removal. Make sure of its location relative to rotor rotation if rotor only turns freely through a 90 degree segment. You don't want the 90 degree area to be where the rotor binds when the witness marks are aligned on assembly. Mill out this area to a depth of 0.215 to 0.220". See picture. Locate holes for end of rotation stops and drill #43 hole for taping with a 4-40 tap. Open clearance hole for the tap body to a depth of 0.500" with a #27 drill. Tap holes and insert 4-40 Allen head set screws flush with the 90 degree cutout edge. They will be adjusted later on final assembly.

WAVEGUIDE MOUNTING HOLES:

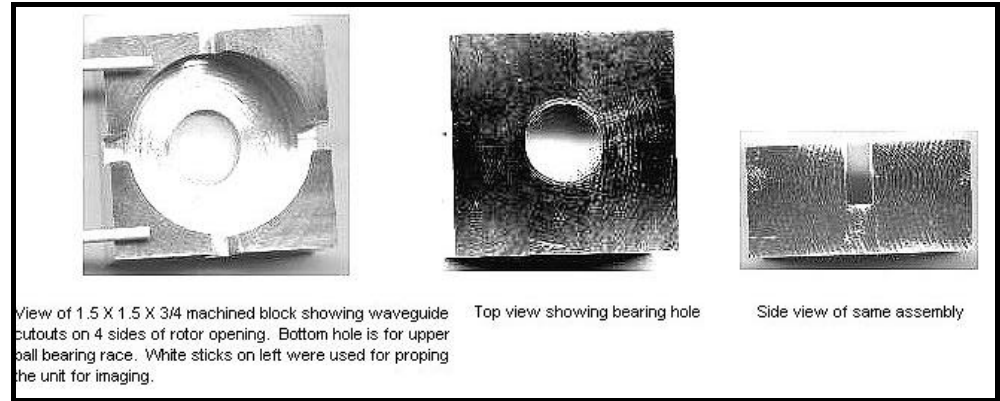
Remove the rotor assembly from the switch. Put the bottom cover back on and snug up the screws. Using a piece of hardwood (maple) shape a rectangular piece to the size of the internal dimensions of WR42 waveguide and about 2" long. Insert this through two opposite holes in the switch body. Lay the body on the workbench with one side down and the hardwood protruding through the waveguide slot on the top. Place a waveguide spacer (this is a block of metal with waveguide cutout and 4 mounting holes bored through it) on the exposed hardwood flush to the side of the switch body. Using a #32 drill bit with the shank end ground to a point insert the drill shank end into each of the 4 holes in the waveguide spacer and tap lightly with a piece of wood. Repeat this process until all four sides of the switch body have mounting hole locations around its waveguide slots. Prick punch these 16 holes and drill to a depth of 0.200" with a #50 drill. **Do Not** penetrate the rotor cavity wall - use caution. Tap all holes with a starter tap followed by a bottoming tap.

KNOB:

With the remaining 5/8" piece of 1-1/4" diameter aluminum make the knob. Locate and drill the hole for the rotor shaft. Drill and tap the side of the knob for a 4-40 Allen set screw. Mount knob on rotary table and make two 90 degree cuts about 0.010 deep on the knob top. These are used to indicate connecting ports on the switch. See picture. Cut a small 1/2" doughnut from 0.005" teflon sheet to be used as a spacer under the knob.

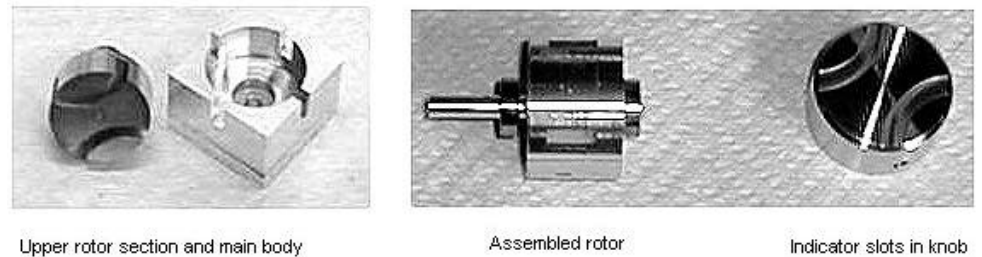
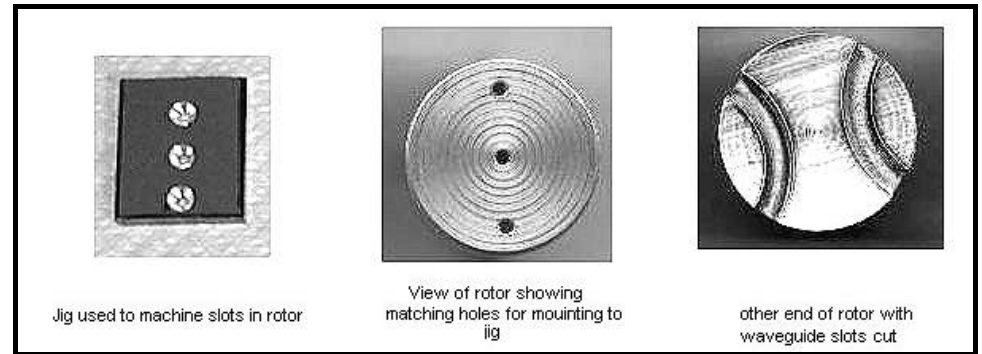
ROTOR ATTENUATION SLOTS AND FINAL ASSEMBLY:

Mount rotor onto milling machine and, with a slitting saw, cut 0.010 slots in the rotor parallel to



the long dimension of the waveguide openings. These are located 0.125" on each side of the waveguide openings and are 0.125" deep. They are cut the entire length of the rotor.

In the bottom cover drill a center hole with a number 43 drill. Tap this hole using a 4-40 tap and install the nylon hex head bolt with nut attached up thru the bottom hole. The nylon bolt is used to



put friction on the rotor to prevent accidental movement when switching from one position