

## FROM THE EDITORS

APRIL 1993

First of all we must apologise for the A4 format last month. Due to a technical problem at RSGB HQ, the Newsletter was not printed in the usual small booklet form. We hope the problem is rectified with this issue. We have a number of interesting items for you this month and still have further articles in the pipeline. If your contribution does not appear this time please be patient! Many thanks to all contributors.

## ROUND TABLE NEWS

The **NORTHERN GROUP** will host a Microwave Round Table on Saturday, **12th June 1993**, at the Electrical Engineering Department of the University of Sheffield. This venue has been arranged by G8AGN and will start at 10.30, to finish at 1700. A range of precision test equipment, including accurate noise figure evaluation, will be available. Attendance is by ticket only. These and an access map can be freely had from either G8AGN or G3PHO on receipt of a stamped, addressed envelope. This meeting will follow the pattern of previous ones held at Leeds or Sheffield. Please note that there are no internal facilities for refreshments. There are cafes within easy walking distance!

The **SOUTHERN GROUP** held a Round Table meeting at the Rutherford-Appleton Laboratory on the 21st March. Forty five amateurs attended what was a highly successful event, organised by G3NAQ and GW4LXO. Talks were given by G8ROU & G4FRE (Microwaves in the USA), G3WDG (10GHz modules update and EME), G4EML (A Control System for an Inexpensive Rotator) and G3LYP (Using BSB dishes at 10GHz). G4EML promised to write up his talk for the Newsletter. The other talks have already been published in these pages.

The next meetings of the Southern Group are as follows:

Sunday, 20th June 1993 at Crawley ARC  
Sunday, 24th Oct 1993 at Wimborne.

Contact G3GRO (tel. 0293 520424) regarding the June meeting. Full details can be found on the RSGB News Bulletins broadcast on Sunday mornings.

## WANTED

Andy, G4UQI is anxious to obtain a 20dB horn for 10GHz in order to complete his personal beacon. Any other form of aerial, other than a dish, would do provided it has low wind resistance. If you can help please contact him at 16, the Dingle, Fulwood, PRESTON, PR23EX or via tel. 0772 713849.

## MICROWAVE DIRECTORY UPDATE

Since the publication of the Directory in December 1992, we have received a number of late entries. Please add the following to your lists:

**G3BEX**, John Short, 26 Howard Crescent, Seer Green, Beaconsfield, Bucks., HP92XP. Tel: 0494 675097. He is active on 10GHz narrowband (850mW) home station and is QRV for skeds at any time.

**DJ7FJ**, Joe Fehrenbach, Schlattstr.1, D-W 7612, Haslach, Germany. Tel: Home 0049 7832 3884, Work 0049 7836 50237. He is portable only on 5.7GHz (5 watts), 10GHz (6W), 24GHz (100mW), all narrowband, and on lightwaves with 2mW phone. He can be contacted via packet mailbox DB0GE-8. QRV mainly in contests or for special tests.

**DL2GSG**, Gregor Storz, Mariazeller Str. 44, D-W 7230 Schramberg, Germany. Tel: Work 0049 7836 50113. Gregor is QRV narrowband 10GHz(100mW), 24GHz (20mW) and phone on lightwaves(2mW). All gear is portable.

**G3JMY**, Please amend Ted's telephone number to Bristol, 0454 772384.

NEWS, VIEWS AND ARTICLES FOR THE MICROWAVE NEWSLETTER SHOULD BE SENT (BY THE LAST FRIDAY OF EACH MONTH) TO EITHER:

Barry Chambers, G8AGN, 345 Redmires Road, Sheffield S10 4LD (tel. 0742 304888)

OR

Peter Day, G3PHO, 146 Springvale Road, Sheffield S6 3NU (tel. 0742 681216)

DUE TO PRESSURE ON SPACE THIS MONTH, WE ARE UNABLE TO INCLUDE RECENT ACTIVITY NEWS. WE WILL DO SO NEXT MONTH AND INCLUDE THE FIRST OF THE 1993 OPERATING LADDERS. MANY THANKS TO THOSE WHO HAVE SENT IN ITEMS FOR THIS FEATURE...PSE QRX A WHILE!

## Visit to the UK by Toshi Takamizawa JE1AAH

Toshi recently visited the UK and after some hasty arrangements Steve G4KNZ and Lehane G8KMH met him at the QTH of Cyril G4AAP. Toshi had brought with him some of his finished designs for 5.7 and 10GHz as well as beta test 24GHz PCB's and gave us an update on the microwave scene in Japan.

JA amateurs are only allowed 1W output on the microwave bands up to and including 10GHz and 100mW from 24GHz up. So EME operation without a special permit is out! The frequencies allocated on 10GHz are 10.000 to 10.250, and 10.450 to 10.500, with operation generally around 10.240GHz. TWTs are very uncommon on the microwave bands. On 24GHz, the allocation is 24.000 to 24.050GHz. Spurious emissions have to be very tightly controlled – and as Toshi commented, the German designs for some of the higher bands would not be allowed. This explains the multiple filters seen in his designs.

Most activity on 10GHz uses nbfm (and TV), with many amateurs having 1200MHz nbfm drivers. On 10GHz, there are maybe 100 or so active amateurs and on 24GHz, maybe 10 to 20. The distance record on 24GHz is 220km between two mountain sites, one of them Mt. Fuji (2000m asl), and like the UK record it took place during very cold weather. Talkback was on 10GHz and JE1AAH designs were used, of course!

The samples he had brought were extremely well made and the PCBs for up to 12GHz utilise PTHs. The beta test 24GHz boards look very useful, especially the LNA and HPA. These are produced on 0.25mm CUCLAD using photo-positive techniques. That included the 0.1mm gap he uses for coupling in the LNA. He has analysed and used standard Murata capacitors up to 24GHz and says that 1pF and below are fine. On the SMA front the ones he uses are a two hole Hirose type, which don't use an epoxy for retention, confirming discussions held at the RAL round table.

Toshi had also brought a selection of photographs of various modules and his workbench. He has at his disposal a wide range of test gear which would befit a professional lab! Prices in JA for used gear are no lower than here so it can be seen just how enthusiastic he is.

Lastly, we discussed active devices, and Toshi's stock is very comprehensive covering everything from MGF1303's through to the latest devices only just out of the development lab. Some of note are the frequently used FHX04/5/6 HEMT's, the FHX15 which can give 0.6dB NF at 10GHz (and costs only £9.00 in JA), the FHX35 which can be used on 24GHz and is VERY cheap (£2.50) and will give 20mW out if overrun, through to some 24GHz packaged amps at astronomical prices! Toshi expressed a desire to supply state of the art devices to other amateurs who may want them (see last month's newsletter).

With some regret we had to leave Toshi, but it was late. Toshi presented us with some sample PCBs and he was left with a copy of the Microwave Manual Vol. 3 to read on the plane home.

G8KMH and G4KNZ

### DO YOU HAVE ACCESS TO INTERNET MAIL?

IF SO YOU MIGHT LIKE TO NOTE THE FOLLOWING DETAILS, WHICH FORM THE BEGINNINGS OF AN INTERNET DIRECTORY BEING COMPILED BY STEVE, G4KNZ:

davies@mobira.nmp.nokia.com  
charles\_suckling@mcimail.com  
g8kmh@sni.co.uk  
whiting@cadence.com  
el1bc@primea.sheffield.ac.uk

!Steve Davies, G4KNZ  
!Charles Suckling, G3WDG  
!Lehane Kellet, G8KMH  
!Neil Whiting, G4BRK  
!Barry Chambers, G8AGN

Perhaps anyone else who has Internet mail facilities could send a mail to Steve Davies, (see above) and he can include you in any future update of the directory.

### A SIMPLE MICROWAVE ADAPTER FOR SPECTRUM ANALYZERS

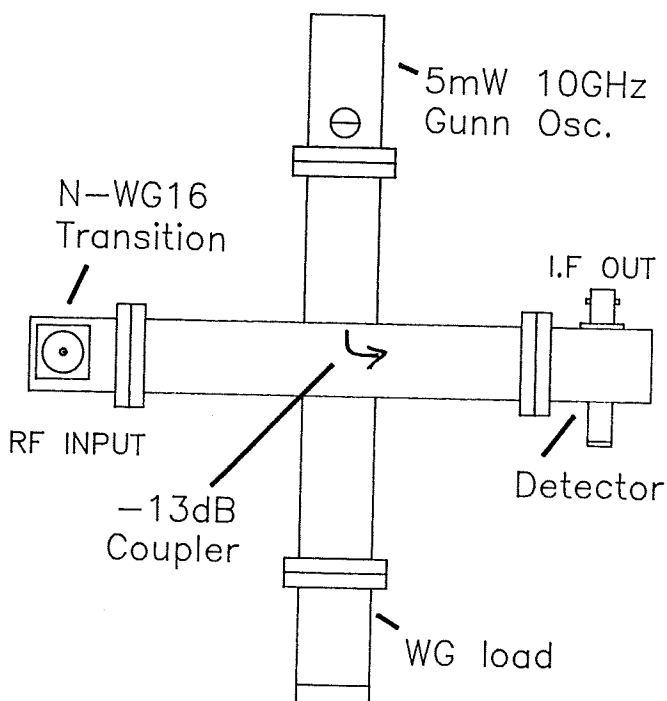
Here is a simple converter for use on 3 cm with any VHF/UHF spectrum analyzer. It certainly doesn't offer spectacular performance, but on the other hand it can be made from some retired WB 10 GHz waveguide parts with very little trouble. The diagram below shows what form the adapter takes. I used a home-brew cross-coupler with a coupling factor of about -13 dB. The Gunn oscillator was a standard iris type with a PTFE tuning screw giving about 5 mW output. The 'mixer' was a surplus T-bar type detector mount which had a CV7377 diode and a BNC output connector. This converter of course has an 'image' response, so for example a both a 9.5 and a 10.5 GHz signal with a 10 GHz LO will give an output at 500 MHz. This really isn't such a problem and the range of the adapter is effectively twice the frequency span of your spectrum analyzer.

The Gunn oscillator was set to a frequency of 10.3 GHz. For initial tests I used the prototype of the SSA (Radcom November 89) connected directly to the mixer socket. Stray coupling from the 10 GHz NB system was easily seen when transmitting. Some more formal measurements were made using a HP 8560A spectrum analyzer and a HP 8341B microwave source. The analyzer frequency span was set to 0 - 1.5 GHz. With the Gunn LO still at 10.3 GHz, an input of -20 dBm at 10.4 GHz gave a display on the analyzer about -64 dBm at a frequency of 100 MHz. Over the frequency range 9.5 - 11 GHz, the equivalent output for a -20 dBm input was  $-65 \pm 2$  dBm. The minimum detectable signal (10 kHz b/w) was about  $-45 \pm 2$  dBm. Performance was still useful from 9.0 to 11.5 GHz.

There are a number of significant shortcomings with this simple approach. As mentioned earlier, the image response isn't really a problem - if you have a 0 - 500 MHz analyzer available then the frequency band 9.8 to 10.8 GHz can be covered. The adapter does have a number of spurious responses, the most serious of which is the 2nd harmonic of the IF frequency. This can be easily identified by the more rapid tuning rate if the LO frequency is altered. This response was 15-20 dB below the wanted signal.

I'm sure that this design can be improved - optimising the drive level to the mixer and substitution of a more modern mixer diode are obvious candidates. Even so, the performance is quite good for something that took less than half an hour to get going, and found a new use for some old components!

73 Roger G4PMK



## MORE 10GHz E.M.E. TESTS

G3WDG and G4KGC were active again on 10GHz eme on 2/3 April. This weekend was chosen to coincide with perigee, with the moon at its closest point in the month. This reduced the path loss by about 1.5dB compared to the previous tests about 2 months ago. A new preamp was in use, a waveguide input version of the WDG004 preamp, this time with a non-damaged transistor fitted! Overall receiver noise figure was .85 to .9dB, about 0.4dB better than last time. Our own echoes were noticeably stronger with perigee and the better preamp. Power output from the twt measured at the changeover relay was 22W. We estimate echoes should have been audible with only 10W. During these tests moon noise was 2.0dB.

Ground noise checks with a 15dB horn connected to the receiver showed about 6.0dB cold sky to ground, and 6.5dB from cold sky to absorber. We have a 2ft square piece of microwave absorber with spikes on, the type used to fill anechoic chambers. This behaves as a well matched load when held in front of the horn. Calculating back to the noise figure confirmed the previously measured noise figure meter readings for the preamp.

Sun noise for the eme system was also measured over the weekend, at 15.5dB. With the old preamp it measured 15.0dB.

On 2 April we again worked SM4DHN with O reports. Unfortunately we ran out of window his end to do any more tests, but on 3 April we ran a long test with WA7CJO where he transmitted at different power levels - 300, 100, 50, 25 and 10W. We could still copy him down to 25W, ie 10.8dB down on his normal 300W level. He was barely detectable at 10W, nearly 15dB down on 300W. This means that it should be possible to receive him on a 4ft dish (8dB down on our 10ft dish). He also tried ssb at the 300W level, which was nearly Q5. Unfortunately the weather was poor for this test (wind and rain) and we did not want to risk getting the twt wet! It was interesting to note that moon noise still measured nearly 2dB even through the rain and clouds, showing then not to have any significant attenuation. Thus a visual moon is not necessary for 10GHz eme. Before the bad weather arrived, we had managed to rig up the elevation and azimuth readouts and had the comfort of being able to control the dish position from indoors!

73 de G3WDG and G4KGC.

### MAST MOUNTING HIGH POWER 10GHz EQUIPMENT -- By JOHN, G4BYV

Mounting a G3WDG system plus a TWT on a mast seems to present difficulties for some operators. The drawings overleaf show how it has been managed at G4BYV. All voltages for the TWT are produced in the shack and sent by cable up the mast. The low voltages (heaters, etc) are carried by thick mains cable to minimise voltage drop. The whole TX/RX unit slots into a bracket made of steel box section, thus facilitating easy removal for servicing. The whole unit is carefully sealed with masting and fibreglass matting. The drawings explain themselves.....

# THE G4BYV MAST MOUNTED 10GHZ SYSTEM

Fig.1 Mast head layout:

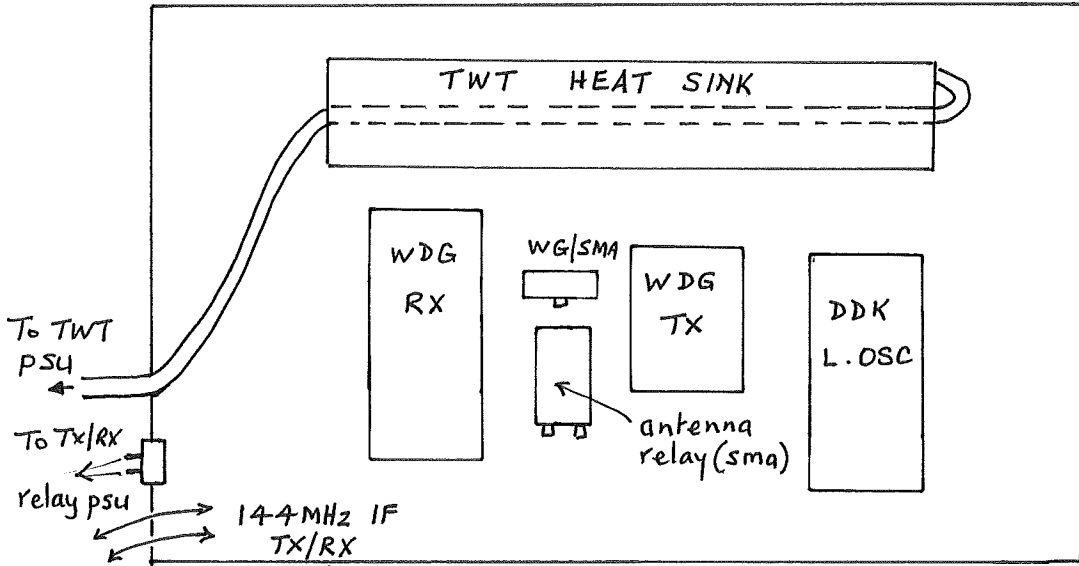
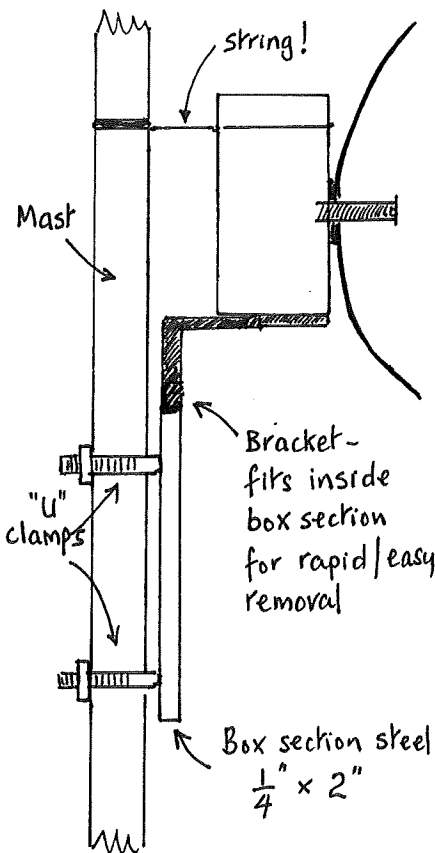


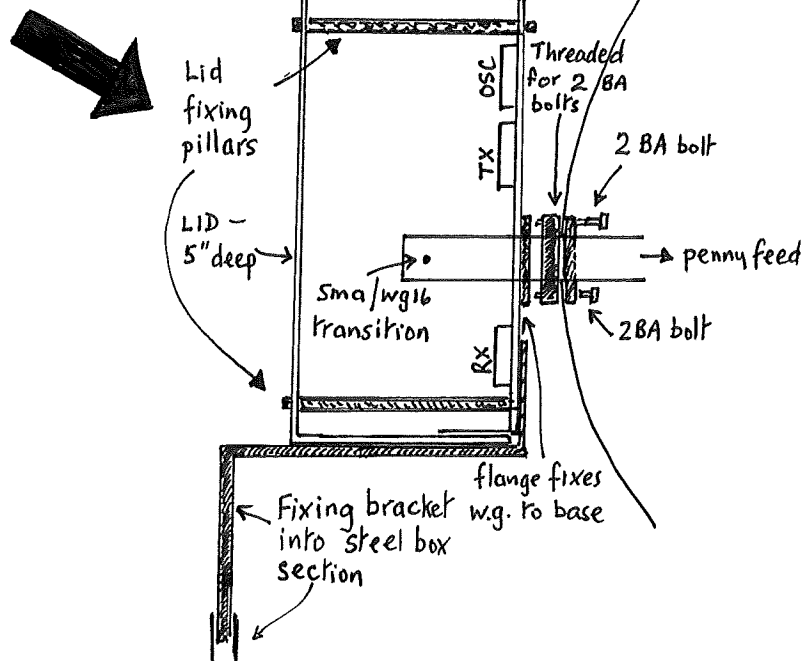
Fig.2.



TWT psu + IC202 in shack. Mast head equipment fed by multicore cable carrying TWT supplies. (Heater/ cathode is via 3 core mains cable to minimise voltage drop). Tx/Rx relay supplies also in shack. All P.T.T.

Fig.3

Cover + base of aluminium, covered with fibre glass mat + then painted. (Seal top with mastic) dish



# COMBINED TRANSITION AND WAVEGUIDE SWITCH FOR 10GHz

By Peter, G4BCH

The following pages detail a combined wg/sma transition and waveguide switch which I developed and used very successfully during 1992. It is based on an idea I saw, several years ago, in DUBUS, but I have simplified it somewhat. Hopefully this article will help to generate other ideas for simple but effective TR switches.

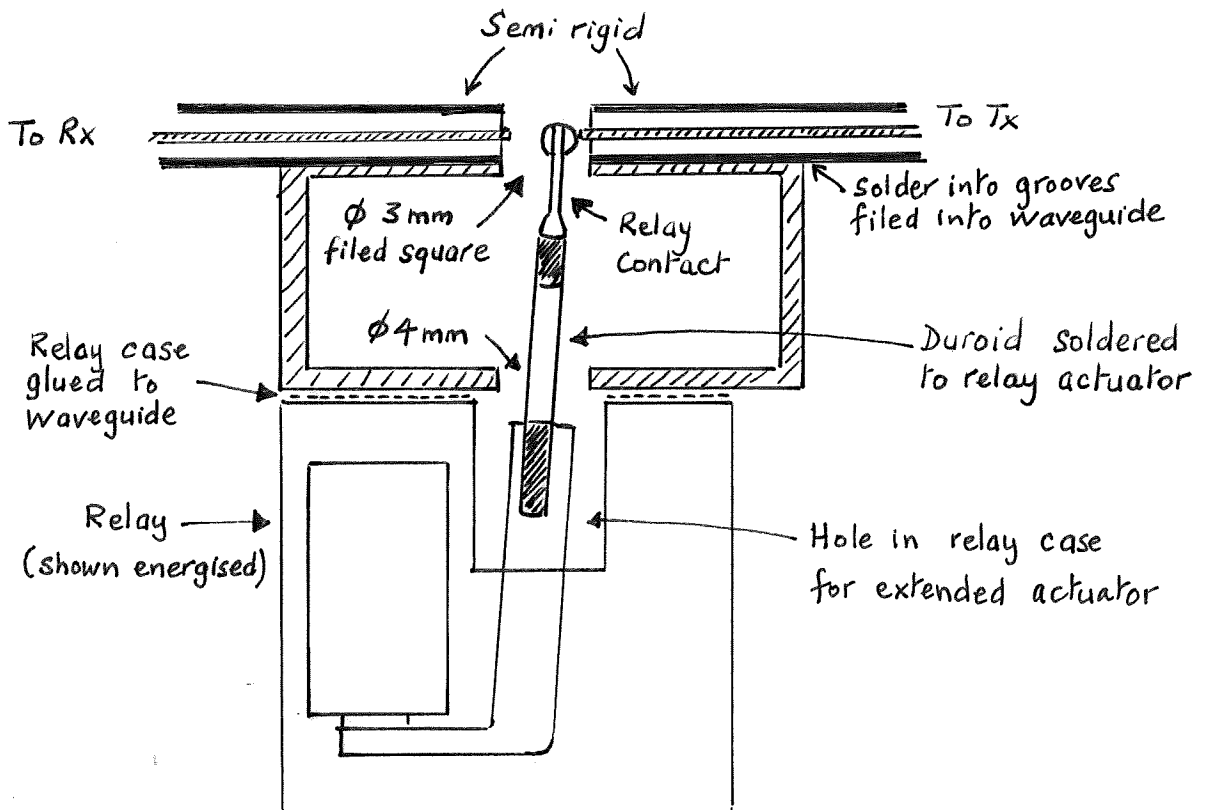
From the construction and testing of the prototype it seems the dimensions are not too critical. The drawings that follow are largely self-explanatory but are not drawn to scale!

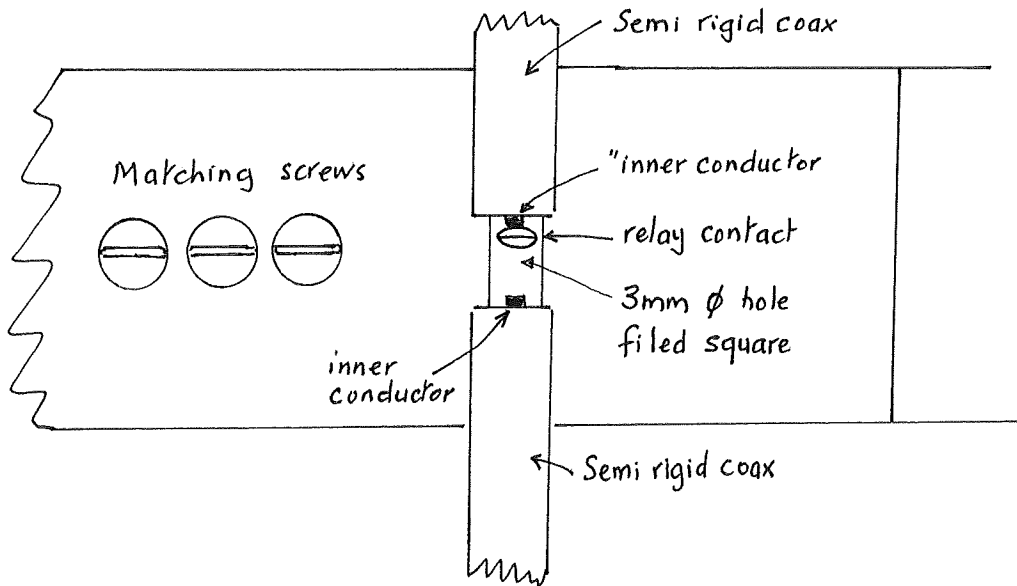
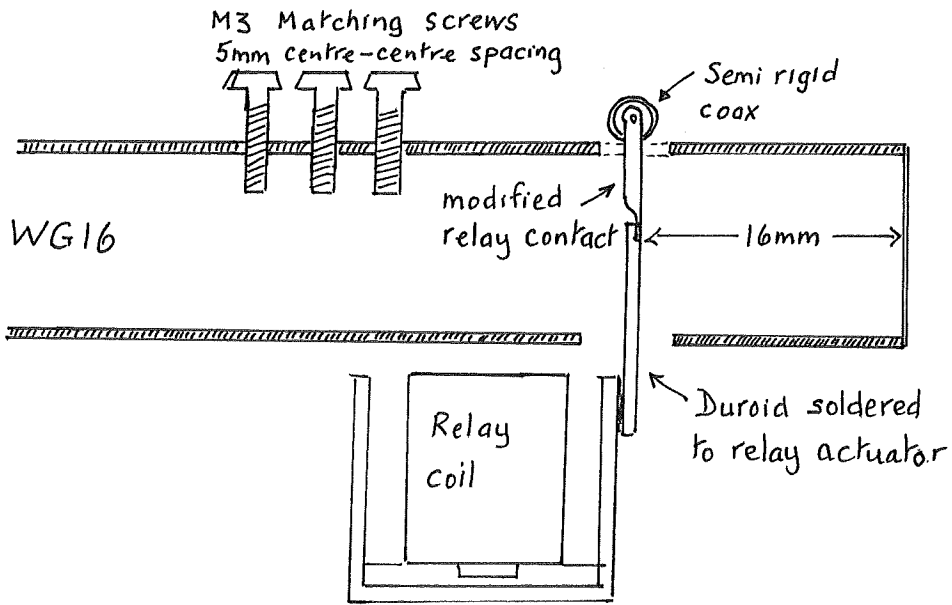
The semi-rigid cables are soldered into grooves filed into the broad face of the guide. The grooves should be as deep as possible without breaching the guide wall so that the distance between the end of the inner conductors and the interior of the waveguide is kept very small. The grooves also accurately locate the coax ready for soldering to the wall of the waveguide.

The cable ends should be trimmed such that the dielectric is flush with the outer and the inner JUST protrudes from the dielectric. It is advisable to temperature cycle the cable to soldering temperature a few times and re-trim the the PTFE inner as this will help when finally soldering the coax to the waveguide.

The only part of the construction likely to prove difficulty is the aligning of the relay contact with the cables so that it makes a positive contact in both RX and TX positions, without shorting.

Using an 18GHz coaxial load as a termination and a circulator as a directional coupler, no reflected power could be detected after adjustment of the matching screws. Isolation has not been directly measured at 10GHz but by extrapolating from the limit of available test equipment it should be around 35dB or so. Some experimenting with better test equipment may well improve this performance.





## ACTIVITY MAPS 1992 - 10GHz and 24GHz

Compiled by Peter, G3PHO

The following maps attempt to show the level of activity on the 10GHz and 24GHz bands during 1992. We have been very selective in that only paths exceeding 200km are shown on the 10GHz map only paths exceeding 300km are shown in the BEST DX column for that band. 24GHz is still worthy of all paths being shown however! Our thanks are due to all those who have sent in details of paths worked and in particular to Steve, G4KNZ, who provided us with a detailed list taken from an analysis of last year's Cumulative Contest entries. PLEASE SEND IN A CONTEST ENTRY THIS YEAR...EVEN IF YOU DO NOT WIN YOUR ENTRY WILL BE OF USE FOR NEXT YEAR'S MAPS!

### 10GHz

To fully appreciate the changes in activity over last year you will need to compare these maps with those from previous years. The 1991 maps showed paths over 150km but there were far fewer of those paths worked than the 200km+ paths worked during 1992. The incredible improvement in DX worked is due entirely to the widespread use of narrowband equipment and to the ever-increasing use of relatively high power outputs (i.e. 5 watts and above) from home stations. No wideband DX exceeding 200km has been reported.

The most interesting feature to emerge during 1992 is the excellent DX worked between certain G stations and the Continent. No less than fourteen paths between G and Scandinavia are recorded!! These include the present UK record of 1039km between G4FCD and SM6ESG (Richard was running 250mW for this contact!). Also worthy of note are the contacts with Switzerland at over 700km. This kind of DX would grace any 2 metre station! For such paths to be available it is vital to be operational from the home station. Tropo conditions never seem to occur during the Cumulative Contests and so the portable stations seem to be limited to paths of up to 340km or so.

As before, certain portable sites seem to offer much DX potential. 1992 saw the **Walbury Hill** location (IO91GI) generate over a dozen 200km+ contacts, including the excellent 390km path into F6DKW (JN18CS). Your scribe has been regularly using **Houndkirk Moor**, near Sheffield, to work paths in excess of 250km on a regular basis. Bill, G6XM/p has been achieving some outstanding results from his **Okement Hill**, Dartmoor site (IO80AQ). The far north of England has produced an excellent portable site in the shape of **Blakey Ridge** on the North York Moors. This has been used on a regular basis by G3PYB/P and G3NWU/P, with excellent Dx up to 400km being achieved. Other, excellent sites include Bell Hill, Dorset (IO80UU) and Radnor Forest (IO82JG). **If you intend to use any of these sites we would think it a courtesy to inform the regular users well in advance .**

On the home station front we now have a number of well-sited, high power 10GHz stations working excellent DX....G3JVL (IO90MS), G3WDG (IO92RG), G3LQR (JO02QF), G4DDK (JO02PA), G4FUF (JO01GN), G3BNL (IO92KA), G4PMK (IO93GT) to name only a handful. Several of these have EME potential as well!

### 24GHz

This band has followed the wideband pattern experienced on 10GHz during the 1970's and 80's. Operation is exclusively from portable sites and is 99% wideband, although a few stations are beginning to try narrowband techniques on a more regular basis. The 1992 Activity map resembles a 10GHz map of a few years ago and is a tremendous improvement over the activity of previous years. Some excellent DX has been worked, notably between the North York Moors and the SE Pennine area (G4KNZ/P, G3PHO/P, G3PYB/P, G8AGN/P being the users of the various sites). G4KNZ is to be congratulated on his outstanding activity...many of the sites shown have been activated by him.

### WANT TO BETA-TEST A WDG MODULE?

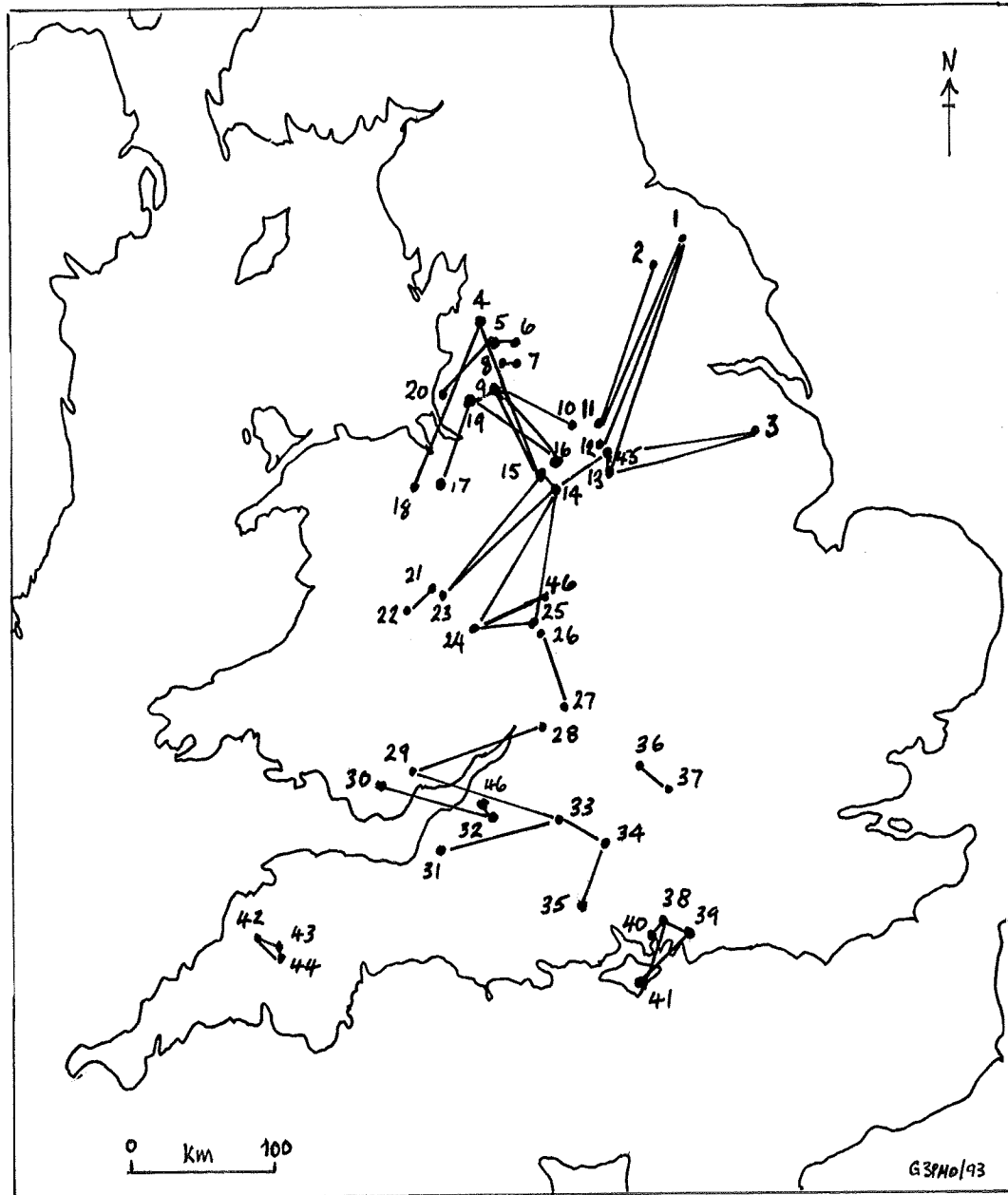
Charlie, G3WDG, is looking for volunteers to B-Test the 1 watt 10GHz amplifier module (G3WDG007). These units will not be "freebies" though, but will work out cheaper than the final, marketed product. Please contact Charlie for details:

C.W. Suckling, G3WDG, 314A Newton Road, Rushden, Northants

or telephone on 0933 411446.

## 24GHz PATHS WORKED DURING 1992

(FOR A KEY TO SITES SEE FOLLOWING PAGES)



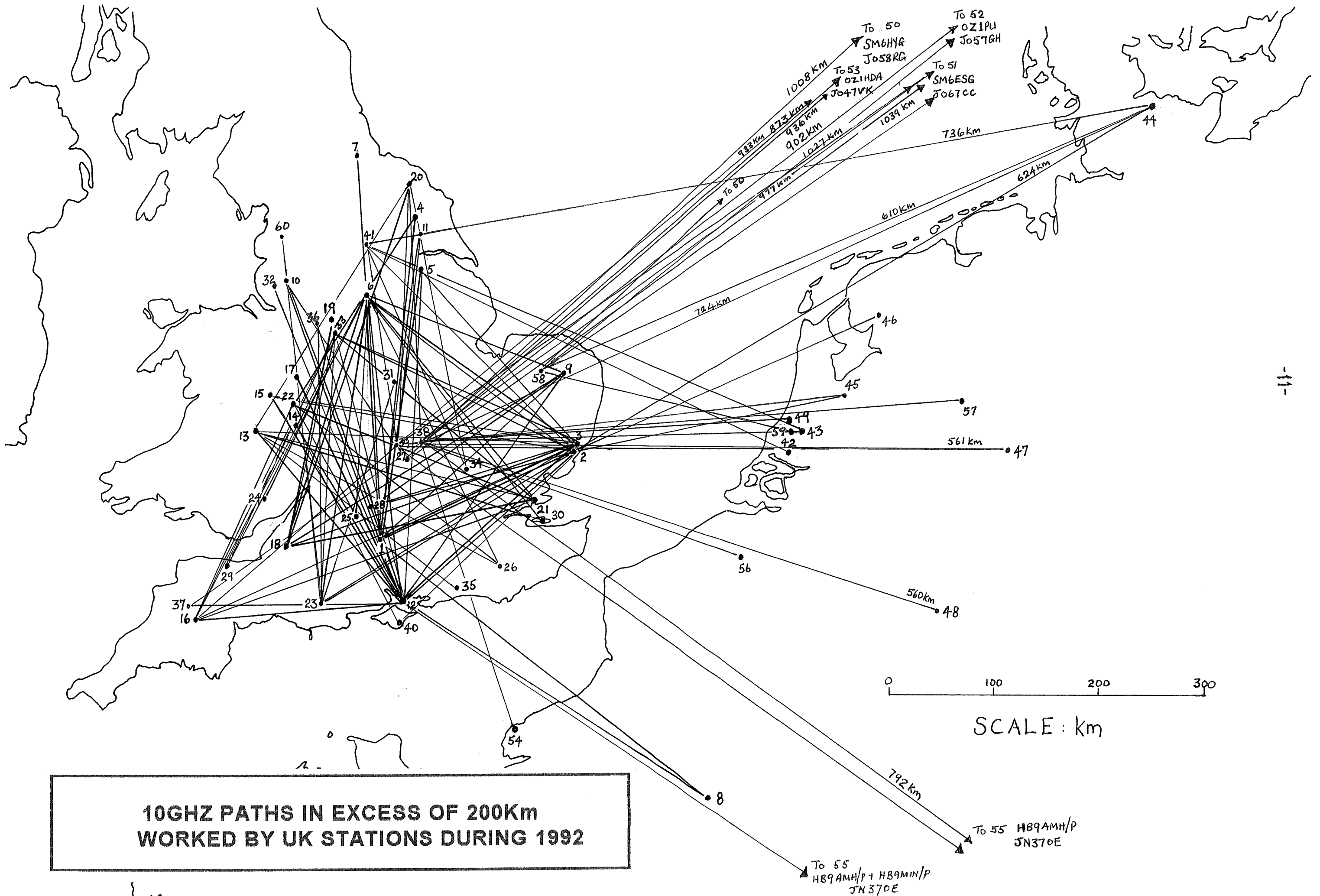
ALL CONTACTS SHOWN WERE ON WIDEBAND, WITH POWERS NO HIGHER THAN 50mW, THE USUAL LEVEL BEING 7mW OR LESS TO 45cm DISHES

KEY TO MICROWAVE ACTIVITY MAPS

10GHz (# = home stations)

Site No.	LOCATION	NGR	LOC.	SITE No.	LOCATION	NGR	LOC.
1	WALBURY HILL	SU373616	IO91GI	#45	PA0EZ		JO22OF
#2	G4DDK IPSWICH		JO02PA	#46	PA3FPQ		JO22VX
#2	G0BPU IPSWICH	TM19 45	JO02OB	#47	DC0DA		JO31SL
#3	G3LQR WOODBRIDGE	TM326637	JO02QF	#48	DJ5BV		JO30MR
4	GARRIBY HILL	SE813556	IO93OX	#49	PA0WWM		JO22FF
#5	G4EQD SCUNTHORPE	SE893083	IO93QN	#50	SM6HYG		JO58RG
6	HOUNDKIRK MOOR	SK274814	IO93EH	#51	SM6ESG		JO67CC
7	TRIMDEN, Co DURHAM	NZ358342	IO94GQ	#52	OZ1PU		JO57GH
#8	F6DKW, FRANCE		JN18CS	#53	OZ1HDA		JO47VK
#9	G4LOJ YELVERTON	TG295020	JO02QN	54	F1JEB/P		JN09CQ
10	WINTER HILL,LANCS.	SD667120	IO83RO	55	HB9AMH/P		JN37OE
11	POCKLINGTON,E.YKS		IO93PV	#56	ON5UI		JO11VB
#12	G3JVL HAYLING ISL.	SZ710992	IO90MS	#57	PA0BAT		JO32JG
13	RADNOR FOREST	SO196645	IO82JG	#58	G4BYV DEREHAM,NORFOLK		
14	TITTERSTONE CLEE	SO603773	IO82QJ	#59	PA0AWN		JO22GB
15	LONG MYNND,SALOP	SO415945	IO82NN	60	FAIRSHAPE	FELL	IO83QW
16	OKEMENT HILL	SX6189	IO80AQ				
17	THE WREKIN	SJ628082	IO82RQ				
18	CHARTERHOUSE	ST575485	IO91PH				
19	MERRYTON LOW	SK028595	IO93AD				
20	BLAKEY RIDGE NYM	SE681996	IO94MJ				
#21	G4FUF BENFLEET	TQ760880	JO01GN				
22	BROWN CLEE,SALOP	SO595865	IO82QL				
23	BELL HILL,DORSET	ST799081	IO80UU				
24	MYNYDD MAEN	ST260977	IO81LQ				
25	HACKPEN HILL	SU148763	IO91CL				
26	ASHDOWN FOREST	TQ473299	JO01BB				
#27	G4FCD OXFORD	SP562215	IO91JV				
28	WHITE HORSE HILL	SU302863	IO91FN				
29	DUNKERY BEACON	SS906421	IO81FD				
30	SHEPPEY		JO01KJ				
#31	G8FWA LEICESTER	SP643938	IO92LM				
32	ASHURST BEACON	SD511062	IO83PM				
33	WEAVER HILLS	SK095650	IO93BA				
#34	G8DKK LETCHWORTH	TL225313	IO91VX				
35	CHANCTONBURY	TQ134120	IO90TV				
#36	G4CBW NR.STOKE	SJ828513	IO83UB				
#37	G3GNR HIGHAMPTON		IO70WT				
#38	G3WDG RUSHDEN	SP980650	IO92RG				
#39	G3BNL BRACKLEY	SP585362	IO92KA				
40	VENTNOR I.O.WIGHT	SZ570787	IO90JO				
#41	G4PMK LEEDS	SE375371	IO93GT				
#42	PA0SQE, HOLLAND		JO21FW				
#43	PA0EHG, HOLLAND		JO22HB				

BEST DX OVER 300 Km			
Km	SITE	TO	SITE
1039	27 G4FCD	-----	51 SM6
1027	39 G3BNL	-----	51 SM6
1008	38 G3WDG	-----	50 SM6
977	38 G3WDG	-----	51 SM6
936	27 G4FCD	-----	53 OZ1
933	39 G3BNL	-----	53 OZ1
903	58 G4BYV	-----	50 SM6
902	38 G3WDG	-----	52 OZ1
873	38 G3WDG	-----	53 OZ1
792	38 G3WDG	-----	55 HB9
736	41 G4PMK	-----	44 DC6
724	38 G3WDG	-----	44 DC6
624	2 G4DDK	-----	44 DC6
610	58 G4BYV	-----	44 DC6
599	39 G3BNL	-----	47 DC0
561	38 G3WDG	-----	47 DC0
560	38 G3WDG	-----	48 DJ5
540	38 G3WDG	-----	57 PA0
452	41 G4PMK	-----	43 PA0
449	41 G4PMK	-----	42 PA0
391	38 G3WDG	-----	45 PA0
390	1 GOKQW/P	-----	8 F6



**10GHZ PATHS IN EXCESS OF 200Km  
WORKED BY UK STATIONS DURING 1992**

KEY TO MICROWAVE ACTIVITY MAPS

24GHz (All portable wideband stations except where indicated "nb")

SITE No.	LOCATION	NGR	LOCATOR	BEST PATH TO:	DISTANCE Km
1	BLAKEY RIDGE	SE683898	IO94MJ	13 BEELEY MOOR	136
2	SUTTON BANK	SE515811	IO94JF	11 BRADFIELD	91
3	CAISTOR	TF115966	IO93UK	13 BEELEY MOOR	86
4	FAIRSNAP	SD597472	IO83QW	18 ESCLUSHAM	102
5	LONGRIDGE	SD622388		20 CLIEVES HILL	39
6	PENDLE HILL	SD773391	IO83UU	5 LONGRIDGE	11
7	HIGHER CROFT	SD688256		8 DARWEN	?
8	DARWEN	SD672253		7 HIGHER CROFT	?
9	WINTER HILL	SD667120	IO83RO	15 SUTTON COMMON	52
10	SNAKE PASS	SK075925		9 WINTER HILL	45
11	BRADFIELD	SK277934	IO93FK	1 BLAKEY RIDGE	113
12	COWPER STONE	SK257826	IO93EI	1 BLAKEY RIDGE	124
13	BEELEY MOOR	SK304682	IO93FF	1 BLAKEY RIDGE	136
14	MERRYTON LOW	SK028595	IO93AD	24 TITTERSTONE	92.5
15	SUTTON COMMON	SJ934677	IO93WE	4 FAIRSNAP FELL	86
16	CAT & FIDDLE	SK001718		19 ASHURST BEACON	59
17	HOPE MOUNTAIN	SJ295570		19 ASHURST BEACON	55
18	ESCLUSHAM MT.	SJ254512	IO83KB	4 FAIRSNAP FELL	102
19	ASHURST B'CON	SD511062	IO83PN	16 CAT & FIDDLE	59
20	CLIEVES HILL	SD385082		5 LONGRIDGE	39
21	STIPERSTONES	SJ367987	IO82MN	22 CLUN FOREST	23
22	CLUN FOREST	SO225876	IO82JL	21 STIPERSTONES	23
23	LONG MYNND	SO415945	IO82NN	15 SUTTON COMMON	90
24	TITTERSTONE	SO592773	IO82QJ	14 MERRYTON LOW	92.5
25	CLENT HILLS	SO941795	IO82WJ	14 MERRYTON LOW	80
26	CLENT HILLS	SP960787		27 BROADWAY	45
27	BROADWAY	SP115364	IO92CA	26 CLENT HILLS	45
28	CLEEVE HILL	SO997246	IO81XW	29 MYNYDD MAEN	78
29	MYNYDD MAEN	ST260977	IO81LQ	33 HACKPEN HILL	90
30	EGLWYSLILAN	ST099903		32 TOG HILL	?
31	CHARTERHOUSE	ST498568	IO81PH	33 HACKPEN HILL	65
32	TOG HILL	ST737727	IO81TK	46 G3FYX BRISTOL	nb 10
33	HACKPEN HILL	SU129745	IO91CL	31 CHARTERHOUSE	65
34	WALBURY HILL	SU374617	IO91GI	35 G3YGF DEAN HILL	37
35	DEAN HILL	SU260260	IO91EA	34 WALBURY HILL	37
36	STOKENCHURCH	SU725956	IO91MP	37 SHOTOVER	19
37	SHOTOVER	SP574062		36 STOKENCHURCH	nb 19
38	BUTSER HILL	SU717204	IO90MX	41 VENTNOR IOW	44
39	THE TRUNDLE	SU877111	IO90OV	41 VENTNOR IOW	43
40	PORTSDOWN	SU650067	IO90LU	38 BUTSER HILL	10
41	VENTNOR IOW	SZ570764	IO90JO	38 BUTSER HILL	44
42	HIGHAMPTON	SS475042		44 OKEHAMPTON	15
43	OKEHAMPTON	SX572966		43 HIGHAMPTON	10
44	OKEHAMPTON	SX591936		43 HIGHAMPTON	5