

mm-band Microwave Activity Day  
22nd August 2012

# mm-band Activity Day

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# mm-band Activity Day

## Participants:

G4EAT - John Wood  
G8CUB - Roger Ray  
G0FDZ - Chris Whitmarsh  
G8BJG - Alan Grove  
G3PYB - Peter Blakeborough  
G8BKE - Chris Towns  
G8ACE - John Hazell  
G8KQW - Ian Lamb  
G1MPW - Steve Cook

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## Objectives:

- Have fun
- Prove equipment
- Attempt new paths on 76GHz
- Assess results achieved on 76GHz versus predicted propagation calculations
- Attempt to further the existing UK 76GHz distance record
- Identify subsequent system improvements to be made prior to the next activity day

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## Operational Site Data:

<b>Callsign</b>	<b>/P QTH 1</b>		<b>/P QTH 2</b>	
G3PYB/P	Ventnor	IO90JO75	n/a	n/a
G8KQW/P	Ventnor	IO90JO75	n/a	n/a
G8BKE/P	Ocknells	IO90EV27	n/a	n/a
G8ACE/P	Lane End Down	IO91JA37	n/a	n/a
G4EAT/P	Bignor Hill	IO90QV78	Ditchling Beacon	IO90WV76
G0FDZ/P	Bignor Hill	IO90QV78	Ditchling Beacon	IO90WV76
G8CUB/P	Bignor Hill	IO90QV78	Ditchling Beacon	IO90WV76
G1MPW/P	Tatsfield	JO01AG49	n/a	n/a

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## Results:

### Paths Worked

- Ventnor > G4NNS - 24GHz
- Ventnor > Lane End Down - 24GHz
- Ventnor > Bignor - 24, 47 & 76GHz
- Ditchling > Tatsfield - 24GHz NBFM
- Bignor > Tatsfield - 24GHz
- Ventnor > Ditchling Beacon - 24 & 47GHz + 1-way on 76GHz

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## Assessment of Results / Initial Comments:

### G3PYB

- A good very good three band day, 24GHz signal were all too big to be used for accurate pointing, even with no dish and just the feed horn.
- 76GHz on the 53Km path has some scintillation but nothing compared to the de-correlation Ian heard on the 83km path. Listening to Ian's beacon TX signal relayed on 2m it was also de-correlated.
- Ian had to elevate by about 3deg at one point, do not understand this, unless the common volume on the horns at each end was above the LOS path.
- 47GHz went well on the 50 and 83Km paths. The scintillation was also apparent on this band but the beam heading was not spread.
- Not a hint of signal on Ian's larger 76GHz RX or my 45cm RX dish and nothing heard of my TX or Ian's transverter system on larger dish.
- What the characteristics of the 83Km path were I am not sure. We had poor visibility of Selsey Bill , the sea path must have been about 35to 40% of the path.

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## Assessment of Results / Initial Comments:

### G4EAT

- Calculations based on hearing KQW beacon S2 from Ditching at 83.5km.
- TX +10dBm, TX antenna +38dBi, RX antenna +38dBi, RX threshold 10dB NF CW 1kHz - 134dBm. Equipment system gain: +220dB. FSPL -168dB
- Vapour losses (biggest unknown) best guess 0.5dB/km so -42dB
- Total path losses -210dB so KQW signal 10dB above noise and appeared S2.
- So given huge variance possible in unknown losses somewhat close to theory.
- Reverse path from EAT to KQW equipment system gain +7, +38, +44, -125 (assuming mixer 9dB worse) = +214dB. So expected signal 4dB above noise but searching with narrower beam width antenna on separate tripod. Unknown LO freq jumping RX-TX did not help either!
- Bignor calculations 190dB total path loss so 30dB margin hence S7. Reverse path 24dB hence S5.(not going to argue the S system versus dB scale since all reading audio based!)
- In my experience with testing on 76GHz, a high power source on a lower gain antenna (38dBi max) reduces chance of pointing errors when setting up. If heard it then provides a reference heading to improve confidence in finding signals with higher gain antennas.



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## Assessment of Results / Initial Comments:

G4EAT continued ...

- If we assume everyone had NT transverters with 120mm Lens Horn antennas then the system gain is 195dB. Given the FSPL Ventnor to Ditchling of 168dB then if the water vapour attenuation is 27dB we can just about hear each other. So  $27\text{db}/84\text{km} = 0.32\text{dB}/\text{km}$  so we need a Dew Point of 38F. Well above freezing!
- Tests with Roger and Chris in April gave us 0.3dB/km paths over 48km and it was a balmy 7C ! (Dew point +2C) Reports of 569/589 with high power beacons.
- So given higher powers and bigger dishes many non-freezing days should work. August clearly not the best month for mm-band microwave.

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## G4EAT 76GHz Equipment in use:

### RX

- 130mm 57GHz horn estimated gain +38dBi at 76GHz
- DB6NT 13GHz local oscillator + 38GHz multiplier + MA416 multiplier to 76GHz
- MEDL fundamental mixer quartz substrate diode DC bias est. Conv. loss 8dB
- 144MHz IF amp 1dB NF

### TX

- Common LO as above fed from 3dB splitter to another 38GHz multiplier
- Mixer 6NT SHM with both Upper and lower sidebands
- (working on image rejection solution)
- WA1MBA design SSPA giving  $G=30\text{dB}$  and  $P_{\text{out}} +7\text{dBm}$ . (not in saturation)
- Antenna, a second 130mm 57GHz horn.

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## G8KQW 76GHz Equipment in use:

### RX/TX

- 260mm lens horn antenna, estimated gain +44dBi at 76GHz
- DB6NT 12.6GHz local oscillator + 38GHz multiplier
- DL2AM mixer
- Pout 0.4mW
- 144MHz IF amp 1dB NF

### TX

- 130mm lens horn antenna, estimated gain +38dbi at 76GHz
- Non locked G8ACE OCXO and x 96 multiplier to 9.5GHz, 100mW
- DL2AM multiplier to 76GHz, Pout 10mW

# mm-band Activity Day

## G3PYB 76GHz Equipment in use:

### RX

- 45cm c/f deep dish with cassegrain sub reflection on a treated Russian toilet roll originally intended for a 65GHz TV link, estimated  $> 45\text{dbd}$  gain and  $< 1\text{deg}$  to  $-3\text{db}$  points at 76GHz
- G8ACE OCXO free running + multiplier to 12.6GHz + x3 multiplier to 38GHz
- DB6NT mixer
- 144MHz IF amp

### TX

- G8ACE OCXO free running
- 200mW x 10 from 7.5GHz with 19v DC to Impatt diode Pout estimated 40mW
- Second 45cm c/f deep dish as above

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## G8BKE 76GHz Equipment in use:

### RX/TX

- 30cm cassegrain dish
- DB6BT h/brew transverter
- LO multipliers to 9.5 GHz followed by a 38GHz multiplier. LO locked to a 5Mhz internal reference via a RDDS.
- Overall NF ~13dB?

### TX

- 30cm cassegrain dish
- Non locked OXCO and multipliers to 9.5GHz with FM and CW capability driving a DL2AM 38 GHz multiplier driving a chip diode
- Pout circa 4mW

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## G8CUB 76GHz Equipment in use:

### RX/TX

- 40dBi Flann horn
- Elcom synthesiser internal reference 38G multiplier block
- DB6NT mixer PCB MA4E1318 sub-harmonic mixer  
IF 436 - 438(440)MHz  
Pout circa 200uW

### TX

- 40dBi Flann horn
- Elcom synthesiser internal reference 38G multiplier block
- Honeywell mixer as x2 multiplier providing injection lock signal via circulator to  
WR12 gunn oscillator
- Pout circa 10mW

# mm-band Activity Day

## G0FDZ 76GHz Equipment in use:

### RX/TX

- 40dBi Flann horn
- DB6BT transverter
- LO DDK004 and WDG multiplier to 9.5 GHz
- DL2AM 38 GHz multiplier
- Pout ~250uW

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## G8ACE 76GHz Equipment in use:

### RX/TX

- RDDS locked OCXOs 10Mc/s ref
- 400Hz shift available for the TX OCXO Mandraulic Keyer or TTL Keyer
- G8ACE x24 Multiplier + G8ACE x5 Multiplier
- 38GHz tripler ex-Alcatel link 150mW driving G8ACE built single diode mixer/doubler
- 144 Mc/s IF with bias switching to obtain best diode performance according to TX/RX
- This Rx with a single diode is poorer performance than anti-parallel diode but TX power is best so far and 12db more than the Impatt TX on range comparison test.
- Dish 30cm Cassegrain shared with Impatt TX as use either one or the other TX.



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## G8ACE 76GHz Equipment in use:

### RX/TX 2 – transverter

- G8ACE OCXO WA6CGR PLL locked 10 Mc/s ref
- This must be 15 years old now hence ancient PLL
- Usual ACE multipliers.
- Home built DB6NT transverter head as per Dubious but with NE325 to 38GHz.
- Dish 45cm Andrews with dual concentric wave guide feeds to accept 47GHz for alignment
- This system now used for RX only 144 MHz IF

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## G8ACE 76GHz Equipment in use:

### TX

- 76GHz Impatt Transmitter
- G8ACE OCXO
- 7.5GHz brick multiplier
- 7.5GHz amplifier to drive Impatt diode.
- 10th harmonic selected by hi pass wave guide output filter to cassegrain dish 30cm as above and optimised at 76GHz with the sliding shorts within the diode block. Diode DC bias 22v

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## G8KQW 47 and 24GHz Equipment in use:

### 47GHz RX/TX

- 0.3m Precision Antenna dish
- DB6NT SLNA / 30mW SSPA which is mechanically switched for TX-RX
- Mikro Mechanik Image filter tuned by G8DKK
- DB6BT LO and mixer

### 24GHz RX/TX

- 0.6m P-Com j-feed dish
- DB6NT co-axial based system with sma c/o relay and final WG transition
- DB6NT SLNA + G4NNS image filter
- W2PED 3W SSPA

# mm-band Activity Day

## G3PYB 47 and 24GHz Equipment in use:

### 47GHz RX/TX

- 0.32m offset dish believed to be 42dbd gain
- TX FM, varactor multiplier from 12GHz 15mW out via WG switch
- RX DB6NT single diode transceiver antenna 32cm
- ACE oven oscillator

### 24GHz RX/TX

- Horn antenna
- 700mW home built TX
- DB6NT RX pre amp <1dbnf
- 432 IF with an internal beacon unit on 432.12MHz

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## G8BKE 24 and 47GHz Equipment in use:

### 47GHz RX/TX

- 30cm cassegrain dish
- DB6NT h/brew transverter and integral 24GHz LO multiplier LO multipliers to 12 GHz Locked to an external 10Mhz Rubidium standard – system noise figure ~9dB?

### TX

- non locked OCXO and multipliers with FM and CW capability to 12Ghz driving a GaAs FET 4mW multiplier

### 24GHz RX/TX

- DB6NT transverter
- LO OCXO and multipliers to 12GHz locked to external 10Mhz rubidium standard 400mW PA Rx LNA. Overall NF ~3dB. Antenna 30cm cassegrain dish or horn

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## G0FDZ 24 and 47GHz Equipment in use:

### 47GHz RX/TX

- Procom dish
- DB6NT transverter and final 24GHz LO multiplier LO DDK004 and WDG multiplier to 12 GHz. Pout ~ 250uW

### 24GHz RX/TX

- DB6NT transverter LO DDK004 and WDG multiplier to 12GHz
- WG image filter
- 2W HPA
- HEMT LNA 22dB Horn

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## G8CUB 47GHz Equipment in use:

### 47GHz RX/TX

- 0.32m offset dish with WR28 feed horn
- Elcom synthesiser, with offset reference (9.999MHz crystal in miniature oven for TX)
- Compressor chip for FM mod. pin switch for CW.
- LO amp driving ex-Pasolink x 4 multiplier at +23dBm
- WR28 WG switch, giving 'LO' direct out, or into WR28 Honeywell mixer / IF amp on RX  
IF 434.7 - 436.7MHz - FT817
- ACE oven oscillator

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## G8ACE 47GHz Equipment in use:

### 47GHz RX/TX – 1<sup>st</sup> System

- G8ACE OCXO
- Luis Cupido PLL ref 10 Mc/s
- ACE x24 Multiplier
- ACE x5 Multiplier
- ACE x2 Multiplier
- ACE Built DB6NT anti parallel HP diode Mixer 144 IF
- WG22 Switch to Andrews WG22 35cm Dish J feed
- TX G8ACE OCXO not locked to same x 24 & x 5 multipliers as RX via changeover relay
- G8ACE Doubler 3 stages NE325 to give 10mW on TX 47.088GHz



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## G8ACE 47GHz Equipment in use:

### 47GHz RX/TX – 2<sup>nd</sup> System

- 2nd 47GHz system transverter as above built to connect to the 76G Rx dish for path alignment Free running OXCO. 145 MHz IF

### 47GHz RX/TX – 3<sup>rd</sup> System

- 3rd 47GHz system much as 2nd system but built with integral 20cm 38G dish this is a quick plug and pray rig for short path work and is physically smaller than the other systems.
- Useful for loan when others are interested in a 47G contact. 145 MHz IF