GHz Bands EME from a "challenging" location

John Worsnop G4BAO









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EME for Bodgers - some observations

"Backyard Moonbounce" talks have been done to death at Microwave Round Tables, so why another one?

I got sick of going to "Backyard EME" talks where the first slide was:

- "First, find your obsolete 12ft TVRO dish and load it on to the back of your monster jeep and trailer."
 - or

"Even a small 2x19 element 144MHz array can give you good results"

These people must have no neighbours and very compliant partners





EME for Bodgers - some observations

GHz Bands EME is satisfyingly "predictable"

It takes time to make something work For me, 2 years from concept to first QSO.

There are no short cuts and you never stop "tweaking"





So, why is my QTH so "challenging?"

- "Fen Edge flatland" and 4m ASL
- Neighbours' houses
- No horizon view from ground level in any direction
- Trees
- Noise











Assessing your "Moon Window"

- Here I'm limited by (big) trees from Moonrise to Zenith at all but the highest declination.
- I cannot operate below 20 degrees elevation due to houses and EMR limitations.
- But you have to work around your QTH! I still make QSOs











Beware small trees!

How it started (2012)











Beware small trees!

How it's going (2022)





YouTube







Assessing your "Moon Window"

Like the Sun, the Moon rises in the East and sets in the West

Unlike the Sun, the Moon's DECLINATION and therefore it's track across the sky "repeats" over a lunar month not over a year

GM4JJJ "Moonsked" lets you do minute by minute predictions or look ahead and back



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Declination

- Moon declination varies between about +/-27 degrees over a lunar month.
- So, Moon Zenith varies from about +65 to just +9 degrees between max and min declination.
- Meaning the Moon is above the horizon between 25 and 6½ hours.



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Min Declination





YouTube







Assessing your Moon Window

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22-09-13 Tuesday	03.00	199º	+44°	1 dB	-11°	218°	+42°	13°	+8°	1.2dB	3°K	381761	-10968 Hz	195 Hz
022-09-13 Tuesday	03:30	208°	+42°	1 dB	-10°	227°	+39°	20°	+8°	1.2dB	3°K	381874	-13244 Hz	185 Hz
022-09-13 Tuesday	04:00	217°	+40°	0 dB	-9°	235°	+35°	28°	+8°	1.2dB	3°K	381987	-15357 Hz	173 Hz
022-09-13 Tuesday	04:30	226°	+37°	0 dB	-8*	242*	+31*	35*	+9*	1.2dB	3*K	382100	-17273 Hz	159 Hz
022-09-13 Tuesday	05:00	234°	+34°	0 dB	-6"	249"	+27*	42*	+9"	1.2dB	3"K	382214	-18958 Hz	142 Hz
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022-09-13 Tuesday	07:00	261°	+18°	0 dB	-2*	273*	+9*	71-	+9*	1.2dB	3°K	382668	-22949 Hz	68 Hz
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022-09-13 Tuesday	21:30	092°	+16°	0 dB	+1°	103°	+26°	282°	+13°	1.4dB	3°K	385966	+ 14132 Hz	136 Hz
022-09-13 Tuesday	22:00	098°	+21°	0 dB	0°	109°	+ 30°	289°	+13°	1.4dB	3°K	386079	+13218 Hz	149 Hz
022-09-13 Tuesday	22:30	104°	+25°	0 dB	0*	115°	+35*	297*	+13*	1.4dB	3°K	386192	+12018 Hz	163 Hz
022-09-13 Tuesday	23:00	110°	+30°	0 dB	-1*	123*	+ 39*	304*	+13*	1.4dB	3*K	386305	+10549 Hz	176 Hz
022-09-13 Tuesday	23:30	117°	+34°	0 dB	-3*	131*	+43°	311*	+13"	1.4dB	3°K	386418	+8834 Hz	189 Hz
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YouTube





What you can do on EME is determined by:

Budget (EME is not cheap)

Tolerance threshold of partner and neighbours, Patio size,

Moon Window

Dish size, equipment availability and cost





VouTube









My Starting point 2009

1.4m aluminium solid dish It cost me nothing!

Anything much bigger looks "ugly" and attracts too much attention

Can be easily disguised as "garden furniture" when not in use.





VouTuhe







Requirements:

Must be good enough to work "big guns" on CW and for JT modes



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I chose 2.3GHz first because...

Surplus PAs and cheap LNAs (G4DDK) available

NF 0.35dB, TX power 200W with 1.4m dish

But....Low activity



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Which band? The others

1.3GHz?

NF 0.3dB, TX power 200-400W, 1.9m dish minimum

Poor dish illumination so can be an alligator!!

Loads of digimode activity

















Which band? The others

3.4GHz and 5.7GHz?

Do-able but PA could be expensive

Low activity NF 0.4dB, TX power 50W

10GHz?

Expensive SSPA, or TWT needed Loads of digimode activity NF 0.7dB, TX power 45W 1.8m solid dish – or so "they" say?



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My start on 2.3GHz "back in the day"

All homebrew transverter remote from shack

Watertight "Storno" base station cabinet close to dish to minimise feeder losses Locked to 10MHz reference in shack

Low voltage 28V DC (27Amps!) fed out from house via "Sky feeder" hole





YouTube











YouTube



2.3GHz 1.4m dish system results

mode Call Locator F2TU JN38LG CW OK1CA CW JO7ØGM G4CCH 1093QL CW ES5PC KO38HJ CW CW G3I TF 1091GG OK1DFC JN79GW JT65c PY2BS **GG76** JT65c OK1KIR JO6ØPM JT65c IY/DI 1YMK KO06mb JT65c



YouTube





Updated 1.9m system (better)

Spid RAS rotator

Counterbalance

Optimised choke ring

Transverter+PSU moved closer to dish



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Updated 1.9m system (better)

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I could "see" my 2.3GHz echoes on WSJT Echo mode..... Woo - Hoo!!!!!

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It's all about the setting up

First tune up the feed for best TX/RX VSWR and TX/RX isolation.

Optimise the dish and feed by measuring ratio of sun to "cold sky" noise



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It's all about the setting up

Note that this is not the same as highest sun noise! Adjust LNA (in situ) for best sun/cold sky



Check for correct dish illumination on TX (overspill) Recheck sun/cold sky ratio This is an "iterative" process

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VK3UM EMECalc

Automates system calculations. "What if" analysis of

Band

Dish size and shape

Feed Type

Power and RX performance

Moon distance

Sun noise

👋 VK3UM EME Performance Calculator	
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What next?

By end of 2015 I had 26 initials on 13, but frustrated by low activity

1.3GHz is where the activity is, but my dish is getting "really small" at only 8λ

Dish blockage can be an issue with big waveguide feeds Answer? - SM6FHZ Patch feed

 Custom designed for 1.8m prime focus dish

heRSGB



SM6FHZ patch feed





Photos G4BAO & SM6PGP

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1.3GHz results 2015-2020

121 "initials" including 33 on CW





Worked all continents completed on 1.3GHz in 2017

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YouTube

Faraday the shack cat







What next?

I had an old 10GHz transverter.

From G4HUP's estate, I bought a 12W 10GHz PA, plus a 3.4GHz transverter.

I'd earlier bought a 5.7GHz transverter from G4BAH's estate.

Already had some Ferranti 18W 7GHz PAs

Real microwave EME!





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Going higher - System Issues

Dish mesh was 6mm so pushing it at 5.7GHz (0.1 λ criterion)

3 dB beamwidth at 2.3GHz = 5 degrees At 5.7GHz = 2 degrees At 10GHz = 1 degree

Spid's basic tracking readout to 1 degree just not good enough to find and keep the moon above 2.3GHz

Need to upgrade mesh and tracking







Going higher - System Issues

Dish mesh was upgraded to 2.7mm In theory, good to 10GHz?

OE9JFL/DRIACS controller Uses absolute 12 bit 0.1-degree az/el position sensors, not pots or pulse counters Standalone PWM speed controller No PC needed to track Need to fit new sensors to the Spid



Design by Hannes - OE5JFL, implementation by Alex - HB9DRI







Fitting absolute sensors to a SPID/RAS

Based on Work initially done by Andreas DJ5AR et al





Elevation relatively easy- fit the sensor on an "outrigger".

See my article in Dubus vol 49 2/2020 for details





YouTuhe



Going multiband – Electronics

Common mechanical and electrical interface





Quick Change – 4 wing nuts 5 band swappable Transverter and PAs in feed cage 1.3 – 10GHz















Results on 1.9m Mesh dish to 2017

16 initials on 3.4GHz – 8 on CW 18 initials on 5.7GHz – 5 on CW

On 10GHz QSOs with "big guns" HB9Q and OZ1LPR JT4F Running just 12 Watts

Poor QSO results and Moon noise on 10GHz.

Beginning to look as if neither the tracking nor the mesh dish was "up to the job" on 10GHz







- Decided to concentrate on 10GHz and try a 1.1m solid offset dish (Because I had one!)
- Whoah! outperformed the old 1.9m prime focus on Sun and Moon noise!
- No dish blockage Better dish illumination





YouTube





Latest 10GHz system

Built myself a 2x GASFET 25W PA using cloned DB6NT boards

Upgraded to a 1.2m offset dish.

Slightly better!

Now 33 JT initials

No CW QSO yet!





YouTube







Bucket List anyone? 24GHz EME

Working on a 24GHz system.

With a travelling wave tube to do around 25 Watts output

Scary high voltages involved

















Bucket List anyone? 24GHz EME

Have received the DL0SHF 24GHz Moon beacon in QRO mode

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YouTube

Acknowledgements

- Thanks to:
- Bernie G4HJW for giving me the 1.4m dish in the first place
- All those EME "experts" who said "Nah, you can't do EME with a 1.2m dish" and still sneer at "doodle modes"
- But especially to those who said "Give it a go," particularly
- G3LTF, G4DDK, the HB9Q team



YouTube

Find out more...

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www.rsgb.org



