

Receiving 10 GHz EME with Small equipment



PA0EHG

DL0SHF beacon

- In December DL0SHF starts with the 10 GHz beacon
- Using 7.6 mtr dish and 50 W output
- 10368.025 MHz transmit
- Using vertical polarisation
- First start in CW only
- On request QRO power ~600 W out

My first RX test

- January 2014 my first RX test with my 3 mtr system
- Good signal and requested for QRO for a test with my portable 10 GHz station using 50 cm dish
- Per responded immediately
- QRO after 1 hr



Test with portable station

- Short preparation time
- Clouded, no visible moon
- Freq not stable
- Could hear QRO very strong on the 3 mtr dish
- Aiming the 50 cm dish to the moon was the most difficult part
- Heard the signal report M to O copy

Lessons learned

- Aiming dish to the moon is more difficult than expected
- Opening angle 5 degrees, so what !!
- Portable station not optimized for EME
- Mechanical construction was not easy for vertical polarization
- Needed an optimized EME setup

New system

- Found a small gearbox at very reasonable price, sold for astronomical purposes for mounting a small telescope
- Cost about \$200



Two version of gearbox

- Using GPS for position finding
- No GPS but about \$100 cheaper
- Started with GPS gearbox
- Worked fine but found that at startup elevation must be at 90 degrees so GPS will be blocked by the dish
- Decided to use the gearbox without GPS

The dish, 48 cm

- Procom dish, prime focus
- $F/D \sim 0.4$
- Feed needed using vertical polarization
- Weight as small as possible
- Found an AL taper from rectangular to square waveguide
- Almost optimal illumination for $F/D \sim 0.4$

Receive system

- Using DB6NT pre amp waveguide input with 0.7 dB noise figure
- Short cable to DB6NT transverter to 432 MHz IF
- Possibility to lock to 10 MHz reference

Mechanical setup

- Using a dovetail connection to the gearbox
- Dish over the centre of gearbox
- Needed a counterweight to balance the elevation drive

System testing

- First test measuring solar noise
- Measure 3.3 dB solar noise
- 4 dB ground noise



Using gearbox

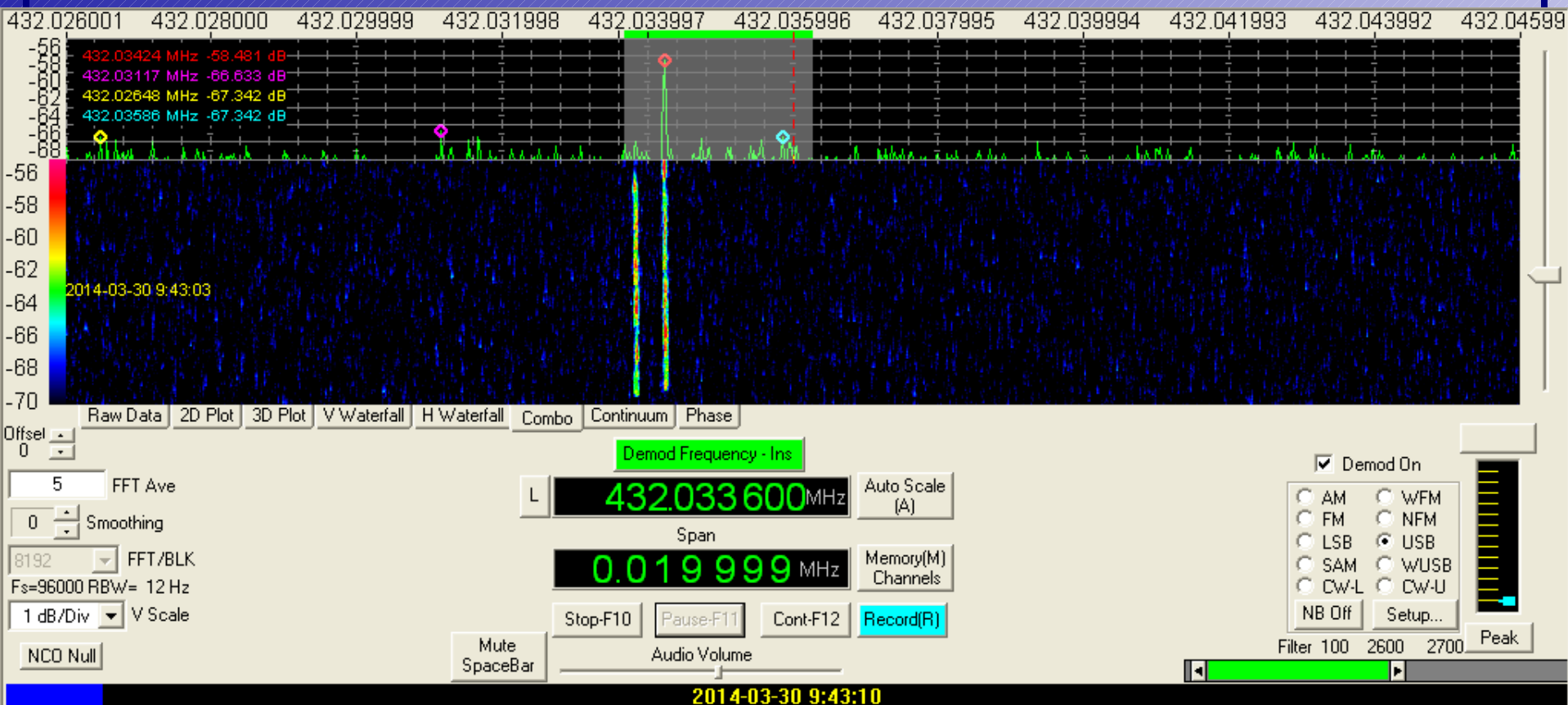
- At startup, First setup, at 90 degrees elevation and aiming south
- Enter location, Lat, Long
- Then enter the date and time into the computer
- Go to, sun or moon
- Possible to correct for line up errors
- First aim at the sun and optimize solar noise, then “go to Moon”, ready to listen

Receiving DL0SHF QRO

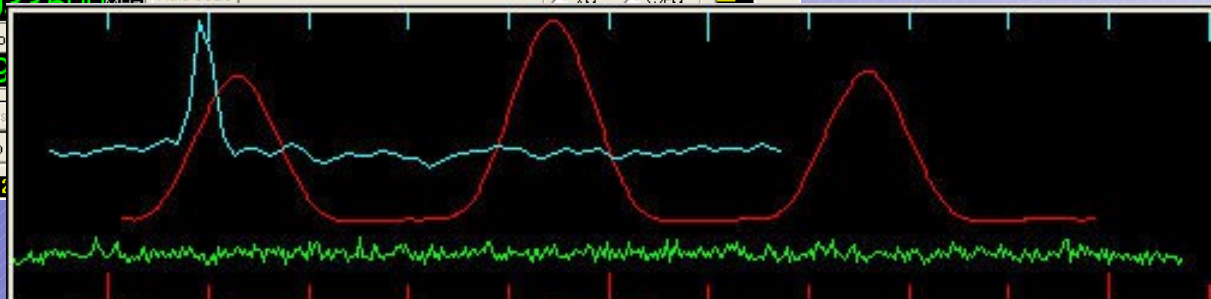
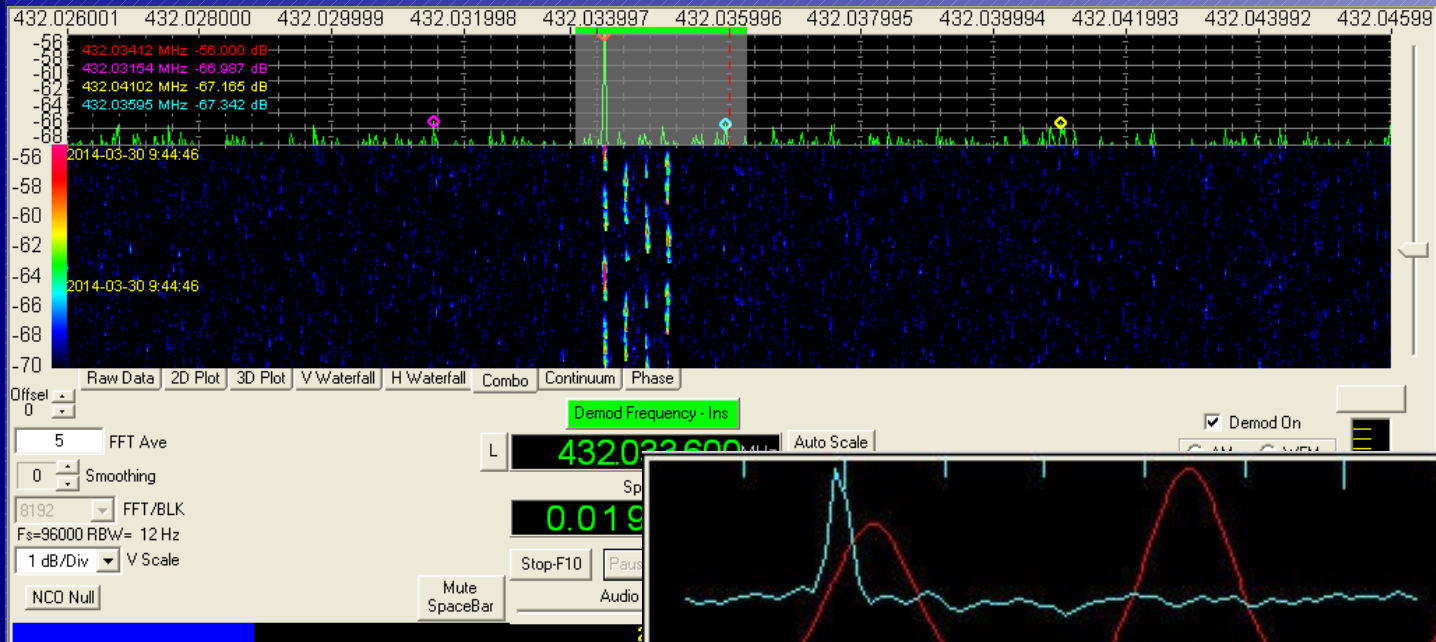
- 30-3-2014 DL0SHF in QRO
- This was the time for my test of the new system
- WX was fine
- First check and align gearbox on the sun
- Then to the moon

CW signal

- 2 dB/div 14 dB S/N in 12 Hz BW



WSJT JT4G



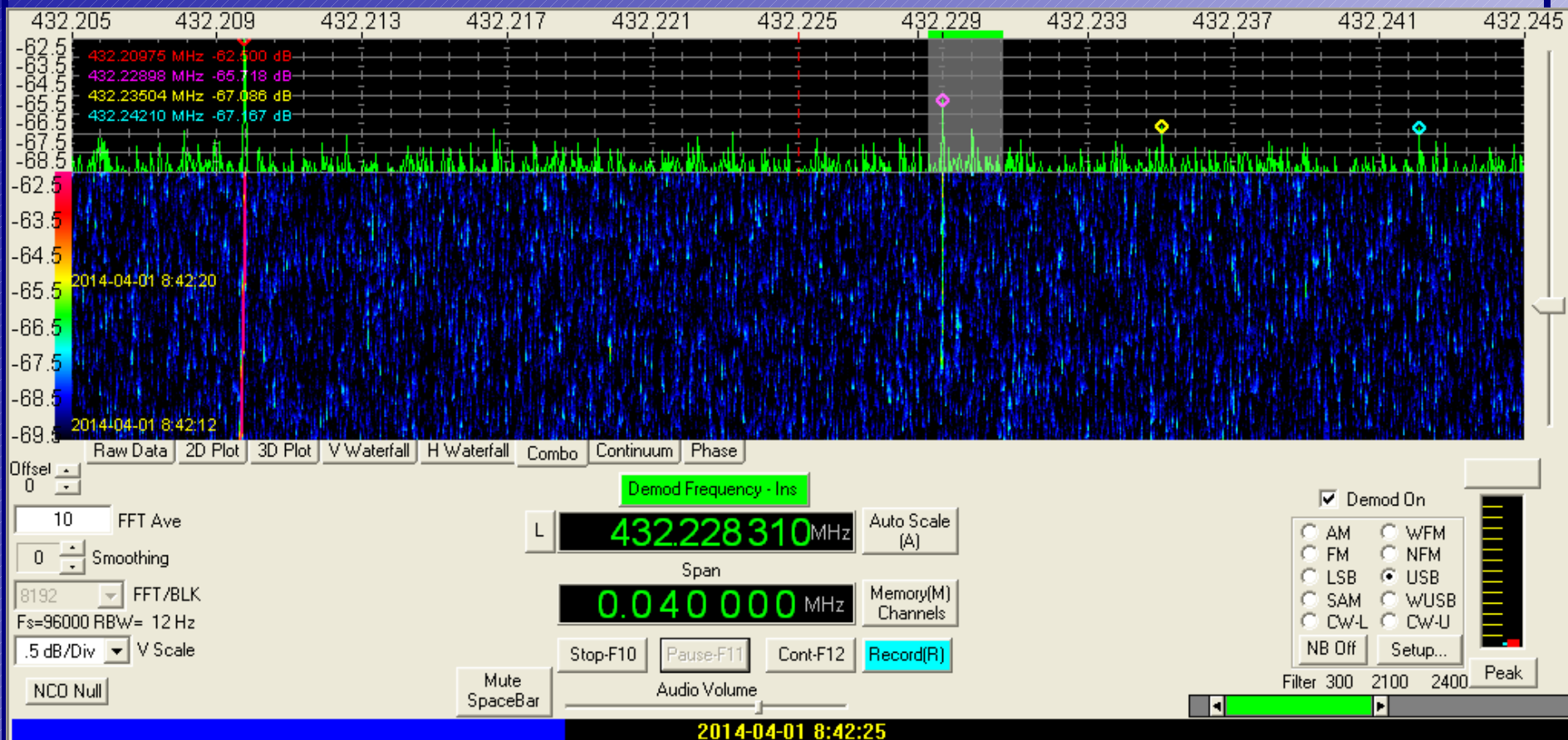
FileID	Sync	dB	DT	DF	W	DF (Hz)	Mon_140331_172200
170700	18	-24	-0.0	-105	24	*	DLOSHF 02NEW 1 0
170800	0	-33	-0.3	-503	2		
171900	0	-24	5.1	-144	24		
172000	19	-25	-0.1	184	46	*	DLOSHF 50DER 1 0
172100	0	-33	-1.0	-339	2		
172200	21	-25	-0.1	-57	44	*	DLOSHF 52COM 1 0

DL0SHF non QRO

- Test with low power, no result
- Should be possible to receive
- After contact with Per it was confirmed that power was down to 8 Watt instead of 50 Watt
- Test with G3WDG using 3 mtr dish and 50 Watt output

G3WDG

- Started with carrier, 1dB/div, 3 to 4 dB S/N

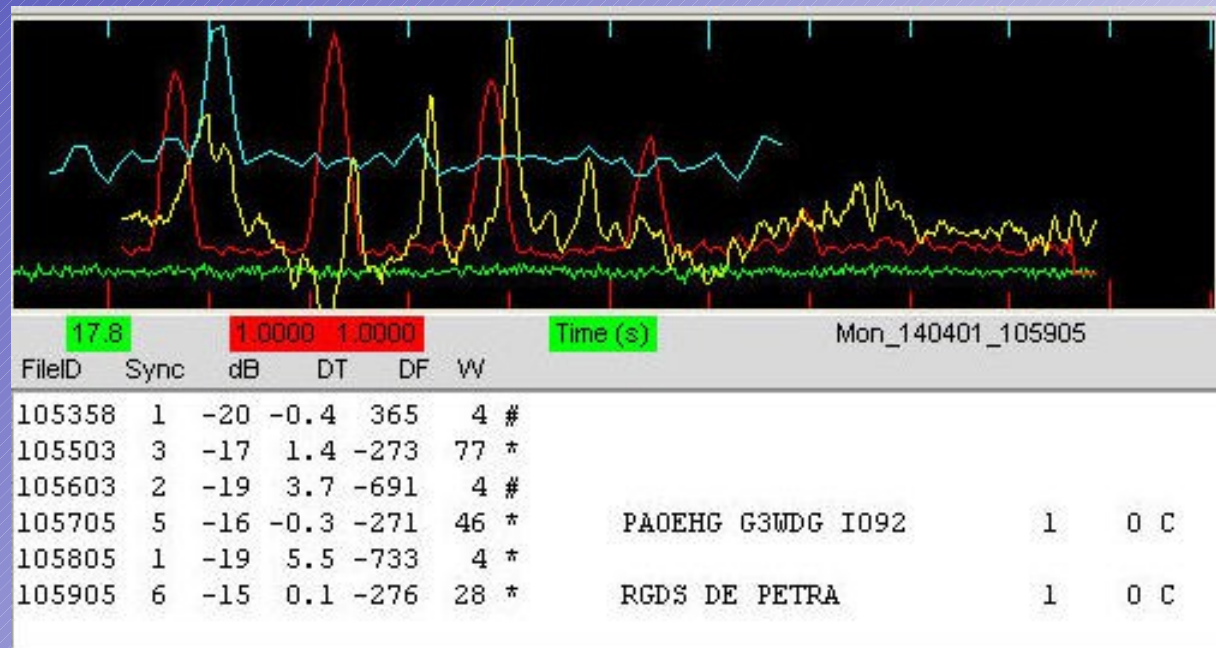


G3WDG on CW

- Easy visible on SDR
- Audible CW tone
- Just a bit to weak to copy the CW

G3WDG WSJT JT4F

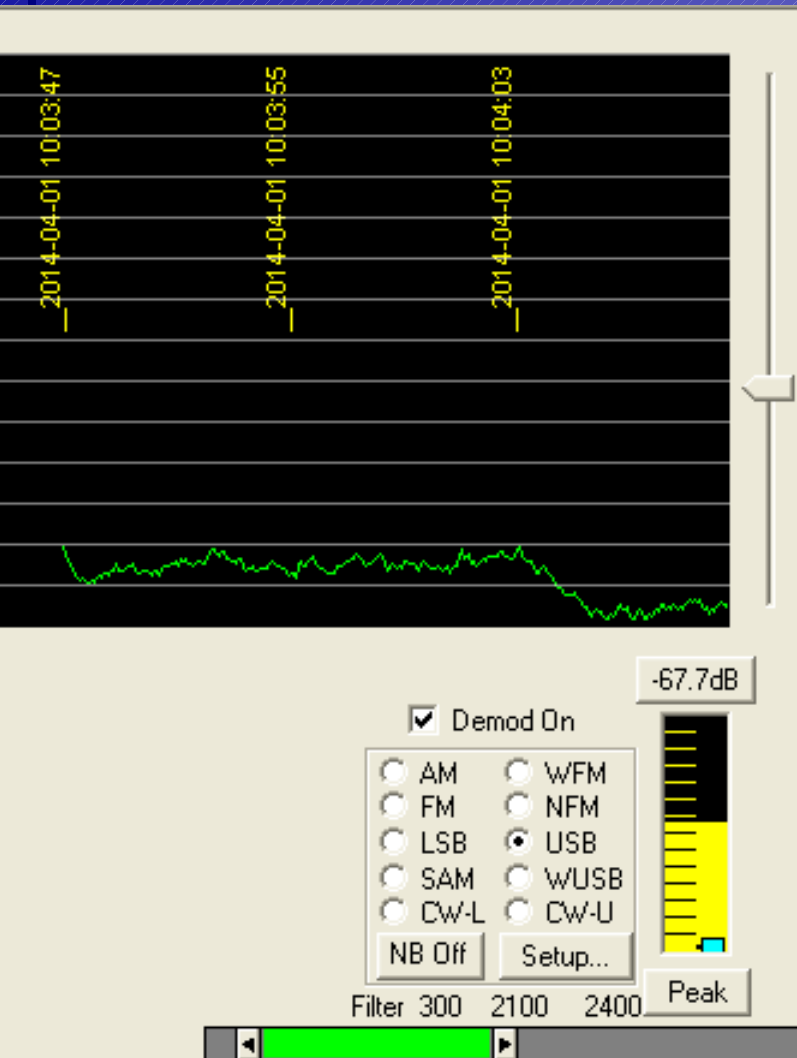
- Good direct decodes
- Test showed that with 3 dB degradation I still could get averaged decodes



SDR and weak signals

- Good experience with Spectravue
- Finding signals is easy when using FFT Averaging
- Using continuum mode for noise measurements
- Even possible to measure the 0.1 dB moon noise

Measure Moon noise



- 0.1 dB/div
- First on the moon
- Then turn away
- Using spectravue continuum mode

VK3UM calculation on DL0SHF

Two Station EME Receiver Performance Source Positions Planets x 10 Multiplier Note Pad Feed Type X ref Version History Help About Exit

Tx A (Home Station) n-dBm

10,368 GHz 287,92 dB 7 K 120 Hz Solid Dish -153,9 dBm 27,1 dB

Frequency Path Loss T Sky Rx BW Effective ground T_K283 °K

GET IPS SFU DATA << Your last sfu data record has been loaded.

6,8 °K 28,0 °K 11 °K 0 °K

80 0,10 dB 0,40 dB 33,0 dB 2,0 dB 1,0 dB 10 °K 18,2 dB

Solar Flux LNA Loss LNA NF LNA Gain Coax Loss Rx NF Spillover Feedline Sky Y

561 Watts 27,49 dBW 0,3 dB 524 Watts 27,19 dBW 82.881.954 W EIRP

Rx T_K 35,5 °K = 0,50 dB Receiver Noise Temperature

Ground Temperature 290 °K 17 °C Sys T_K 52,5 °K = 0,72 dB System Noise Temperature

Dx Station as received at Home Station ... -3,6 dB

Home Station as received at Dx Station ... 17,3 dB

Tx B (Dx Station) n-dBm

10,368 GHz 287,92 dB 7 K 12 Hz Solid Dish -163,5 dBm -13,4 dB

Frequency Path Loss T Sky Rx BW Effective ground T_K288 °K

GET IPS SFU DATA << Your last sfu data record has been loaded.

1,3 °K 50,7 °K 35 °K 0 °K

80 0,02 dB 0,70 dB 24,0 dB 3,6 dB 1,0 dB 34 °K 3,4 dB

Solar Flux LNA Loss LNA NF LNA Gain Coax Loss Rx NF Spillover Feedline Moon Y

50 Watts 16,99 dBW 1,0 dB 40 Watts 15,99 dBW 70.691 W EIRP

0,10 dB

Yagi Array Number of Yagis E 38,3 ° Array Gain

Single Yagi Gain in dBi 12,65 dBi 1 38,3 ° Beam Width 10,50 dBd 12,65 dBi

Parabolic Reflector Feed Type W2IMU dual-mode Linear Pol. Circular Pol.

Diameter Size f/D Efficiency Beam Width Gain Disk Gain

7,60 m Metric 0,40 23% 0,27° 158322 49,84 dBd 51,99 dBi

252,7 Lambda

Home Station ... Y Factor Calc Noise Flux Quiet Flux System T_K

Noise Source Quiet Source

Sagittarius Termination 290 °K 7 °K 52,5 °K

Cassiopeia

Cygnus Aquarius

Taurus A Leo

Virgo Taurus

Termination

Noise Information Y Figure Notes

Point Source Y Factor 7,42 dB

Accurate data is not available for this frequency or Noise Source. Approximate data has been used for the calculation.

Yagi Array Number of Yagis E 11,6 ° Array Gain

Single Yagi Gain in dBi 17,30 dBi 4 11,6 ° Beam Width 20,85 dBd 23,00 dBi

Parabolic Reflector Feed Type VE4MA (Open) Linear Pol. Circular Pol.

Diameter Size f/D Efficiency Beam Width Gain Disk Gain

0,48 m Metric 0,40 65% 4,22° 1780 30,35 dBd 32,50 dBi

16,6 Lambda

Effective Aperture 10,53 M² Beam Width Ratio 2,10

Moon Beam Fill Factor Sun Beam Fill Factor G/T Ratio Moon Temp @ 2,77cm Phase

Note.. Both Moon and Sun correction factors are applied to Home and Dx Station calculations.

Save Data Get Data

VK3UM calculation on G3WDG

Two Station EME Receiver Performance Source Positions Planets x 10 Multiplier Note Pad Feed Type X ref Version History Help About Exit

Tx A (Home Station) n-g3wdg

10,368 GHz 288,79 dB 7 K 120 Hz Solid Dish -155,6 dBm 8,8 dB

Frequency Path Loss T Sky Rx BW Effective ground T°K 283 °K C/S-ground → 7,4 dB

GET IPS SFU DATA << Your last sfu data record has been loaded.

6,8 °K 28,0 °K 11 °K 0 °K

80 0,10 dB 0,40 dB 33,0 dB 2,0 dB 1,0 dB 10 °K 0 °K 17,5 dB

Solar Flux LNA Loss LNA NF LNA Gain Coax Loss Rx NF Spillover Feedline Sky Y

50 Watts 16,99 dBW 0,3 dB 47 Watts 16,69 dBW 2,729.830 W EIRP

Ground Temperature 290 °K 17 °C Rx T°K 35,5 °K = 0,50 dB Receiver Noise Temperature Sys T°K 52,5 °K = 0,72 dB System Noise Temperature

Dx Station as received at Home Station ... -7,1 dB

Home Station as received at Dx Station ... 3,2 dB

Moon Distance 374360 kms

Tx B (Dx Station) n-g3wdg

10,368 GHz 288,79 dB 7 K 12 Hz Solid Dish -165,1 dBm -12,7 dB

Frequency Path Loss T Sky Rx BW Effective ground T°K 288 °K C/S-ground → 4,8 dB

GET IPS SFU DATA << Your last sfu data record has been loaded.

1,3 °K 50,7 °K 35 °K 0 °K

80 0,02 dB 0,70 dB 24,0 dB 3,6 dB 1,0 dB 34 °K 0 °K 3,4 dB

Solar Flux LNA Loss LNA NF LNA Gain Coax Loss Rx NF Spillover Feedline Sky Y

50 Watts 16,99 dBW 1,0 dB 40 Watts 15,99 dBW 70.691 W EIRP

Ground Temperature

Yagi Array Number of Yagis E 38,3 ° Array Gain Single Yagi Gain in dBi Beam Width 12,65 dBi 1 38,3 ° 10,50 dBd 12,65 dBi

Parabolic Reflector Feed Type W2MM dual-mode Linear Pol. Circular Pol. Diameter Size f/D Efficiency Beam Width Gain Dish Gain 3,00 m Metric 0,40 55% 0,68 ° 58507 45,52 dBd 47,67 dBi 103,6 Lambda

Home Station ... Y Factor Calc Noise Flux 290 °K Quiet Flux 7 °K System T 52,5 °K

Noise Source Sagittarius Cassiopeia Cygnus Taurus A Virgo Termination Quiet Source Termination Aquarius Leo Taurus

Point Source Y Factor 7,42 dB

Accurate data is not available for this frequency or Noise Source. Approximate data has been used for the calculation.

Yagi Array Number of Yagis E 11,6 ° Array Gain Single Yagi Gain in dBi Beam Width 17,30 dBi 4 11,6 ° 20,85 dBd 23,00 dBi

Parabolic Reflector Feed Type VE4MA (Super) Linear Pol. Circular Pol. Diameter Size f/D Efficiency Beam Width Gain Dish Gain 0,48 m Metric 0,40 65% 4,22 ° 1780 30,35 dBd 32,50 dBi 16,6 Lambda

Effective Aperture 3,89 m² Beam Width Ratio 0,79

Moon Beam Fill Factor 1,28 x 1,06 dB Sun Beam Fill Factor 1,29 x 1,09 dB G/T Ratio 1113,71

Moon Temp @ 2,77 cm 1113,71

Save Data Get Data Default

Conclusion

- It's possible to receive EME with a 50 cm dish
- For CW you need a real QRO station, DL0SHF QRO in CW is easy to copy
- For other stations you need better than 3 mtr dish and more than 50 W output
- JT4F gives good decodes using 3 mtr 50 Watt
- 2 Way QSO is possible in JT4F but not easy
- Using a small gearbox makes life much less complicated

The End

