

EME on the Microwave Bands

Presented to the
Six Meter BBQ

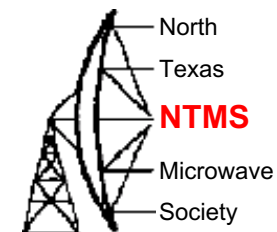
by

Al Ward

W5LUA

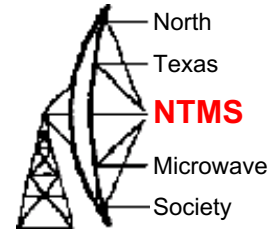
September 30, 2023

Motivation for building a moonbounce system



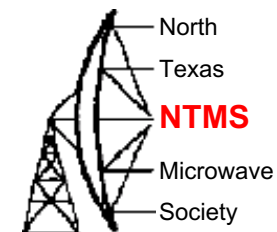
- My motivation was the pure excitement of hearing my echoes return from the moon.
- Average echo delay is 2.5 sec for the roughly 500,000 mi round trip to the moon.
- 6m is the only VHF band that does not require the use of EME to work WAS.
- Outside of tropospheric bending, Aurora, Es, If you lived in the center of the US, you could never work Alaska and Hawaii unless you had EME capability on 2m.
- My first 2m EME system used 4 Oliver Swan 14 element yagis AZ/EL at 50 ft with a pair of 4CX250b's about 550 watts output and a TI MS-175te preamp with about a 1.5 dB noise figure. I heard my first echoes in late 1974. What a thrill!

Some moon characteristics



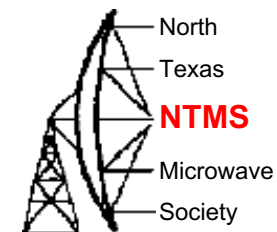
- The moon is on a 28 day cycle as it orbits the earth.
- The moon's declination varies from a max southerly declination of about -25 degrees to a maximum of about +25 degrees.
- For us in the DFW area, this means the maximum elevation at hi dec is approximately 82 deg and only 31 deg at max southerly declination
- Since the majority of EME operation occurs in the northern hemisphere, generally high declination is preferred as it provides more moon time for us in the northern hemisphere but makes it harder to find a common window for VK's and ZL's

More moon characteristics



- During each cycle, the moon cycles through its phases from new moon to full moon.
- Although one might think that a full moon would offer the strongest echo returns, it all depends on when perigee occurs.
- Perigee, when the moon is closest to the earth, provides a nominal 2 dB improvement in received signal strength. When signals are close to the noise this can make or break a contact.
- Perigee does not always occur at high declination. At the moment, perigee occurs at a declination of -19 degrees.

Two Way EME Path Loss

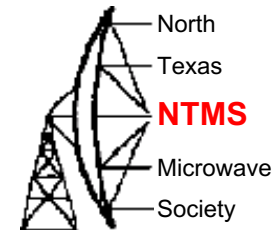


Frequency (MHz)	Average Path Loss
144	252.1 dB
432	261.6 dB
1296	271.1 dB
2300	276.1 dB
3400	279.5 dB
5700	283.9 dB
10368	289.1 dB

Mean distance to the moon of 238,000 statute miles

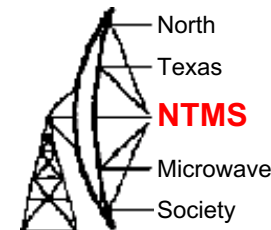
Assumes lunar reflectivity of .065 or a reflection loss of -11.9 dB

Path Loss



- According to the Radar equation, the path loss increases by 6 dB every time the frequency is doubled
- However, dish gain also increases by 6 dB every time frequency is doubled
- Since we gain the same 6dB on both receive and transmit and assuming we use the same power and the same NF as we go up in frequency, our echoes will improve as frequency is increased – this is in fact what we see!
- But there are obvious limitations as we go higher in frequency, like power is harder to generate and noise figures are higher
- Fortunately, there is a program written by Doug VK3UM (sk) that helps us evaluate the various system parameters.

VK3UM EME Calculator



VK3UM EME Performance Calculator Ver 11.11 UTC Date 21st March 2021

Two Station EME Rx Performance Source Pos. Planets Sky Map Home Data

Tx A (Home Station)

Frequency: 1296 MHz Path Loss: 271.96 dB Rx BW: 10 K Diam: 120 Hz Mesh: 2.92 mm Spacing H-V: 10.00 mm Sgs Sensitivity: -161.6 dBm Echo SIN: 24.57 dB

Your last sfu data record has been loaded.

10.7cm: 7.16 K 17.18 K Loss: 0.013 dB Mesh Gnd to Cold Sky: 8.26 dB

75 0.10 dB 0.25 dB 38.0 dB 2.0 dB 1.0 dB 7.08 K 0.42 K 21.95 dB

Get sfu LNA Loss: LNA NF: LNA Gain: Coax Loss: Rx NF: Spillover: Feedthrough derived from Mesh size: Sun Y

Tx A Output Power: 560 Watts 27.48 dBW Transmission Loss: 0.3 dB 523 Watts 27.18 dBW Power at Feed: 4,439,146 W EIRP

RxTK 24.39 K = 0.35 dB Receiver Noise Temperature 290K 17 C TSys 41.89 K = 0.59 dB System Noise Temperature

Dx Station as received at Home Station 1.41 dB

Change Moon Distance Moon noise included

Home Station as received at Dx Station 12.29 dB

Perigee 401,869 kms Apogee

Tx B (Dx Station)

Frequency: 1296 MHz Path Loss: 271.96 dB Rx BW: 10 K Diam: 120 Hz Mesh: 2.92 mm Spacing H-V: 10.00 mm Sgs Sensitivity: -159.0 dBm Echo SIN: -10.87 dB

Your last sfu data record has been loaded.

10.7cm: 7.32 K 24.34 K Loss: 0.013 dB Mesh Gnd to Cold Sky: 8.26 dB

75 0.10 dB 0.35 dB 33.0 dB 2.0 dB 1.0 dB 34.10 K 0.42 K 9.50 dB

Get sfu LNA Loss: LNA NF: LNA Gain: Coax Loss: Rx NF: Spillover: Feedthrough derived from Mesh size: Sun Y

Tx B Output Power: 30 Watts 14.77 dBW Transmission Loss: 0.3 dB 28 Watts 14.47 dBW Power at Feed: 21,440 W EIRP

RxTK 31.81 K = 0.45 dB Receiver Noise Temperature 290K 17 C TSys 76.33 K = 1.01 dB System Noise Temperature

Operating Frequency: 50 MHz 432 MHz 2304 MHz 10.368 GHz 70 MHz 144 MHz 900 MHz 3456 MHz 24.048 GHz 406 MHz 222 MHz 1296 MHz 5760 MHz 47.088 GHz 2295 MHz

Yagi Array

Single Yagi Gain in dBd: 16.00 dBd Number of Yagis: 1 G/T: 0.00 H 26.04 * 16.00 dBd 18.15 dBi

Parabolic Reflector

Focal length 3.68 m Diameter Size: 8.55 m Metric f/D: 0.43 Efficiency: 63.2% Beam Width: 1.89 * Gain: 8494 Dish Gain: 37.14 dBd 39.29 dBi

Home Station ... Y Factor Calc

Noise Source (Hot): Sagittarius A Cassiopeia A Cygnus A Centaurus A Taurus A Virgo A Termination

Noise [hot] Flux: 1718 Jy Quiet [cold] Sky: 10 K System TK: 41.89 K

Point Source Y Factor: 1.87 dB

YU1AW Aperture Source calculations. These are only valid for 144 and 432 MHz. Point Sources should be used for 1296 MHz and above.

Yagi Array

Single Yagi Gain in dBd: 12.00 dBd Number of Yagis: 1 G/T: 0.00 H 41.27 * 12.00 dBd 14.15 dBi

Parabolic Reflector

Focal length 1.07 m Diameter Size: 2.49 m Metric f/D: 0.43 Efficiency: 67.2% Beam Width: 6.50 * Gain: 766 Dish Gain: 26.69 dBd 28.84 dBi

Effective Aperture: TxA 36.17 M² TxB 3.26 M² Beam Width Ratio: 0.26 0.08 Set Current Moon: Update Moon Moon Data: Phase 0.25 Illum 51.3 %

Moon Beam Fill Factor: TxA 1.02 TxB 1.00 Sun Beam Fill Factor: 1.03 1.00 G/T Ratio: 202.77 23.07 dB 10.03 10.01 dBd 2nd Quarter P Angle 90 *

Moon Radar Eq. Current Moon Distance: 401,869 kms Moon Angular Diam: 0.496 * 29'44.1" Moon Temp: 225 K

Moon return Loss: 271.96 dB Moon Flux 10^-22 Sv = 0.07 Moon Declination: Dec. 25.38 * Frequency adjusted sfu: 51

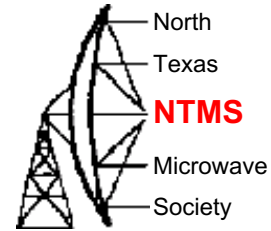
VK3UM Ver 11.11

Doug VK3UM passed away in 2016 but his high school friend VK5DJ is making the download available at

<https://www.vk5dj.com/doug.html>

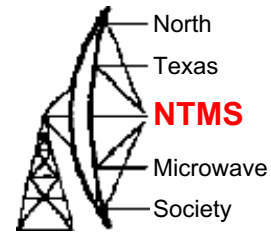
Also available is an EME planner / tracking program and other useful programs

Doppler Shift



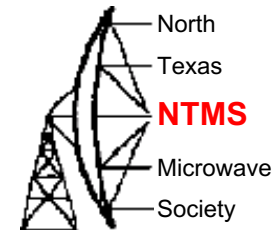
- The doppler shift is a change in frequency of the signal reflected off the moon and received back on earth.
- When the moon is rising the doppler will be positive and when the moon is setting the doppler will be negative. The doppler is at a maximum when the moon is on the horizon and at a minimum at zenith.
- Doppler shift scales with frequency
- While doppler may be several hundred Hz at 2M, it is over 3 kHz at 1296 MHz and can be greater than 100 kHz at 47 GHz!

Libration



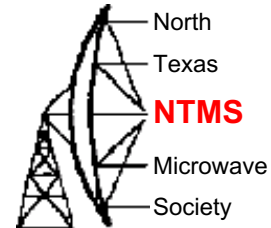
- Libration is caused by the wobble of the moon in its orbit (both latitude wise and longitude wise) and the relative motion of the moon with respect to an observer on earth.
- Libration can cause rapid fading on VHF signals causing parts of a signal to be missing while on microwave frequencies it can make signals sound rough or aurora like.
- Periods of minimum libration occur twice daily at moon elevations close to the horizon on both moon rise and moon set.
- Easily predicted with today's tracking programs

Faraday Rotation



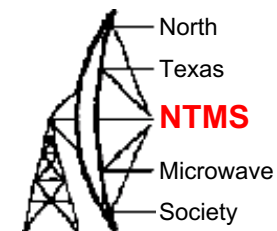
- According to Skolnik's Radar handbook.. "The Faraday rotation of the plane of polarization can be 2 to 5 revolutions in the UHF range, but since it scales as $1/f^2$, is negligible at and above L band"
- We know that time between signal peaks on 6M can be about 5 minutes, and 15 to 20 minutes on 2M and up to hours or days on 432 MHz.
- Having the capability to switch polarity on 902 MHz, I have observed some Faraday rotation at 902 MHz. However, it is very slow and does not have the deep fades as we have observed on the VHF/UHF bands.
- Faraday rotation is for the most part, non-existent at 1296 MHz and higher, but there are other obstacles that we must contend with.

Spatial Offset



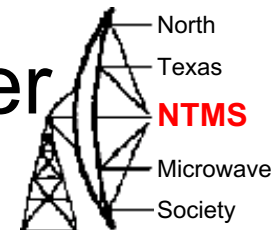
- One of the obstacles is spatial offset between 2 stations in distant parts of the globe. For example, if we send a 10 GHz horizontally polarized signal from the states, it will arrive at a nearly 90 degree offset or vertical in Europe.
- We get around this problem by running circular polarity on 1296 through 5760 MHz. Convention is transmit RHCP and receive LHCP. The sense is reversed as the signal is reflected off the moon.
- There has been much debate over the years regarding the use of CP on 10 GHz. Some stations use CP but for the most part NA is running horizontal and Europe vertical. Other parts of the world will vary. There is generally enough smearing of the reflected signal that the signal comes back at multiple angles anyway.

Atmospheric & Weather Effects



- Normally rain does not have a major impact on EME conditions through 5760 MHz – some effect on 10 GHz
- Humidity and heavy cloud cover cause increased absorption at 24 GHz – best conditions occur on a cold crisp night in the middle of winter!
- At 47 GHz oxygen absorption is another major contributor – there are no good times to operate other planning during periods of minimum libration!

K5GW Tracking Software with Doppler Calculation & RX Tuning



DOS Program run on a 32 bit Win 10 laptop

Besides providing the usual tracking information, the program allows me to input my offsets for my various feeds which are not all at the focal point. No other program allows me to do this.

I would like to convert this to a Windows program.

KT12-30.EXE

TIME	DATE	TGT	A/T	AZ	EL	AZC	ELC	DEC	AZ ERROR	EL
17:09:12	03/21/21	MOON	OFF	56.93	-3.44	2.0	-0.2	25.1	73.22	93.08

ANTENNA	AZIM	ELEV
1296	57.02	89.27
2304	130.39	86.10
3400	50.63	89.20
5760	212.01	89.38
10368	130.15	89.64
24048	-6.18	-1.04
47088	171.20	0.33
77184	-27.00	-0.71

MOON	56.93	-3.44
SUN	144.39	51.86
CAS	11.98	63.67
CYG	294.97	56.99
SAG	237.71	-3.01
LEO	14.28	-14.98
AQU	184.80	56.79

Band:	10368MHZ
Doppler:	25016.1
Sky Tem:	2.7
Loss dB:	1.91
Tdeg dB:	1.91
Pol:	39
Lib:	144.8

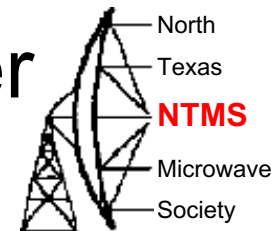
MAR 21 2021 17:09:12						
SUN	MON	TUE	WED	THU	FRI	SAT
	1	2	3	4	5	6
	7	8	9	10	11	12
	14	15	16	17	18	19
	21	22	23	24	25	26
	28	29	30	31		

STATION B DATA	
Call:	OK1KIR
Grid:	JN79dw
Lat:	51.27
Lon:	343.041
Az:	182.05
El:	63.37
Dop:	2996
Mdop:	14006
Pol:	-88
Mpol:	53
Lib:	201
Mlib:	173

<O> <E> <B/b> <T> <A> <M> <U> <Z> <C> <F> <O> <L> <P> ←→ -->
 qt exit bnd tgt a/t man pos a/z cal f/t stnB lib plan
 a/tcom:on rx1:off rx2:off <D>opcor <X>mode <W>sjt <S>lave:off <R/r>it: 0

Thanks Gerald for his fine work on this program

F1EHN Tracking Software with Doppler Calculation & RX Tuning



EME System - Tracking << >> W5LUA / Allen

File Display About ...

DX Station
 G4CCH England
 Lat 53.479 Lon -0.625
 Elev 59.91
 Azim 159.08
 Polar Offset -39.5

Distance 7.486
 Doppler 6.636
 Mutual Doppler 16.220

Buttons: Setup Sources Terrestrial Traffic Sky map World map

Moon
 Com
 Azimut 59.90 Elevation 0.16

UTC
 Sun 21 Mar 2021 17:31:25
 DST Summer time

Traffic : 1st / 2.5mn
 1
 2.5

Band (MHz) 10.368
 Echo
 Doppler (Hz) 25.804

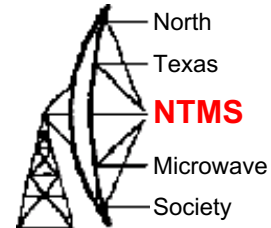
RF Frequency
 10368 150 000

RIG
 VFO Rx/Tx
 28 250 000
 Ref
 28.224.196

RIG
 Man => RIG
 Cont Offset Rx ----- Hz
 Auto Offset Tx ----- Hz

<http://www.f1ehn.org/>

5m and 2.4m Dishes at W5LUA

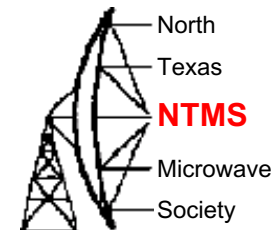


Used on 432 MHz through 10 GHz

Used on 24, 47 and 77 GHz



Multi-band Feed System



WD5AGO
Septum Feeds
for 2304 and
5760

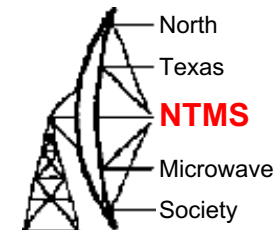


OK1DFC Septum Feed
For 1296

10 GHz Feed in Center

3400 and 432
Feeds slide in to
1296 feed

Main Operating Area

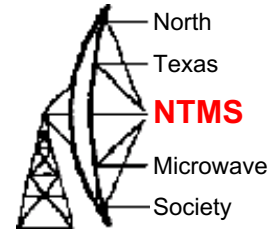


Flex-6600M for
microwave bands

K3 for 160 to 2m
and 432 MHz

Flex 6600 shows
reception of our 10
GHz beacon
located on top of
the TWU dorm in
Denton – height
180 ft

Various Amplifiers in the Shack



Trimble GPS

8877 for 2m
W6PO Design
KW + output

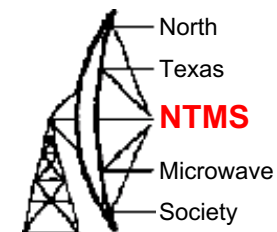
TH-327 for 1296 MHz
DL9EBL Design
1500 watts output

SSPA for 5760 MHz
150 watts output

8938 for 432 MHz
K1FO Design
KW + output

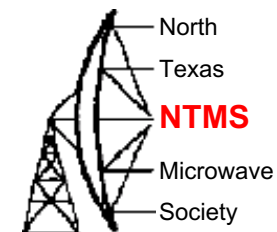
500W SSPA
for 902 MHz

902 to 928 MHz



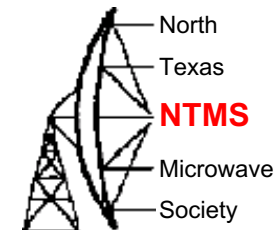
- The first 902 MHz EME contact took place on January 22, 1988 between K5JL and WA5ETV
- Shared by Region 2 only including North and South America
- Active and past active stations include K5JL, WA5ETV, W5LUA, K2DH, W0RAP (sk), WB0TEM, VE4MA, NU7Z, WA8WZG, AF1T, WA8RJF (K8ZR), WW2R, VE6TA, K2UYH, N8DJB, KL6M, PY2BS and K5DOG
- Since 2021, additional stations have been QRV, including AC0RA, N1AV, W2HRO, KA6U, K0DSP, W6TCP, W5AFY
- Station Requirements – 2.4m Dish with dual dipole or patch feed, 150/300/600 watt solid state amplifiers
- Interference from ISM and part 15 devices is a real problem on this band
- Linear polarity feed, either switchable or rotatable feed
- HB9Q logger used for sked coordination.

1240 to 1300 MHz



- World-wide allocation
- The first EME contact took place on July 21, 1960 between W1BU and W6HB
- Primary operation between 1296.0 and 1296.150 MHz
- CW and SSB between 1296.0 and 1296.050 MHz
- WSJT Q65 mode from 1296.050 to 1296.150 MHz
- 500 + stations operational over the years
- Minimum Station Requirements – 2.4m Dish with VE4MA or Septum type feed and 150 watts from 2C39s or GS15b or SSPAs
- Best to use circular polarity with a dish – receive LHCP and transmit RHCP
- Big stations run 7 or 8 meter dishes and kw plus from TH-327/347 or YL-1050, W6PQL SSPAs are very popular
- This is an excellent random CW band with a lot of digital operation as well – A good band to start on.
- EME Beacon – ON0EME beacon in JO21jg when the moon is up at least 10 degrees elevation in JO21jg-
<http://users.skynet.be/on0eme/ON0EME/Welcome.html>
- HB9Q logger used for sked coordination.

KA6U 70 cm and 23 cm portable EME



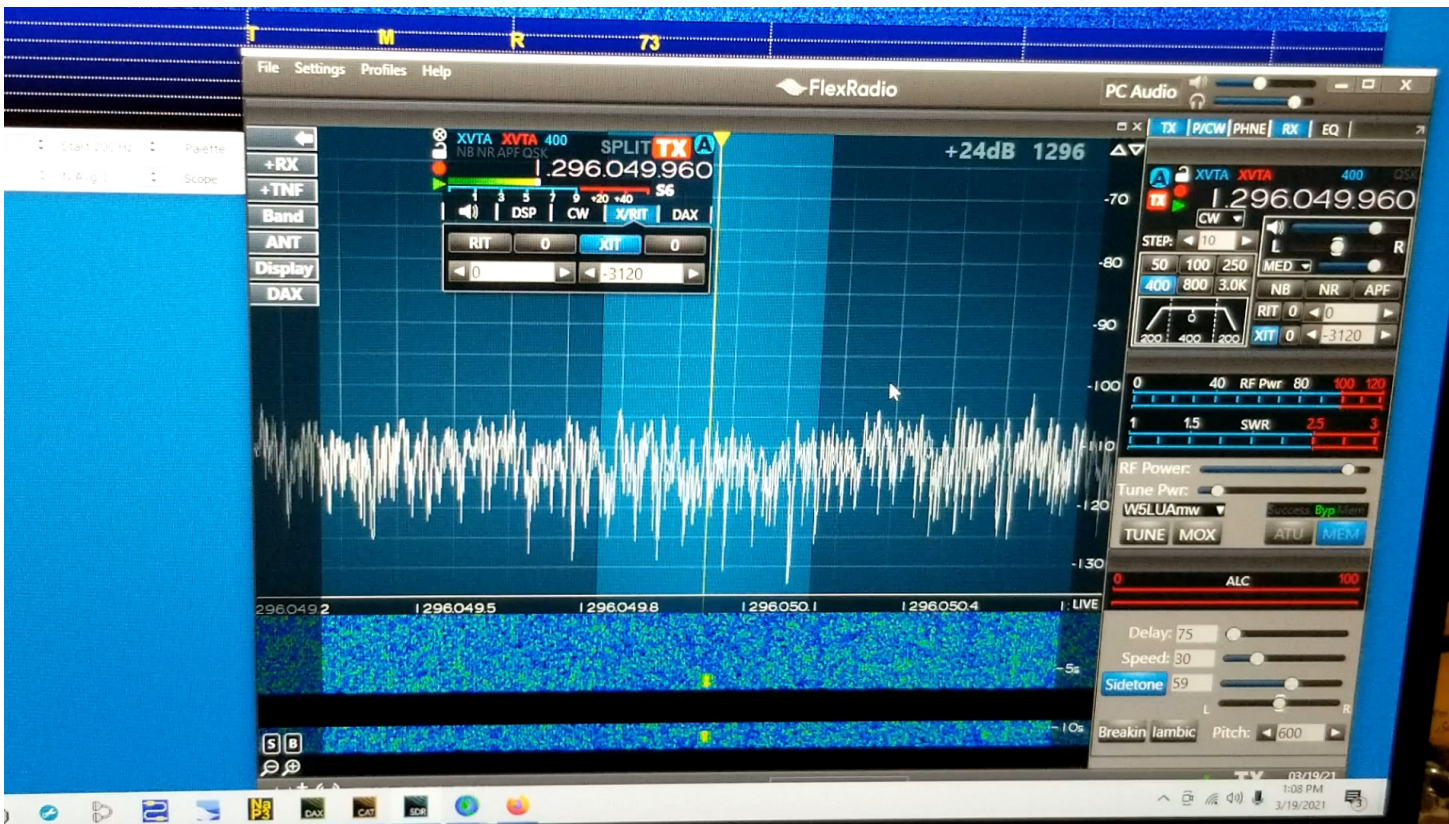
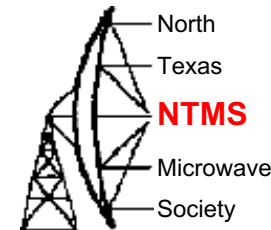
2.4m Folding Dish for
23 cm and 33 cm

<https://sub-lunar.com>

Yagi array on 70 cm

Check out
KA6U Blog

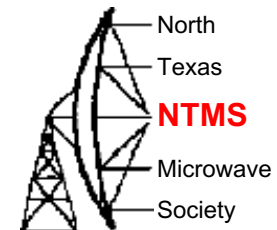
1296 MHz Echoes at W5LUA



Moon at Apogee
5m dish
Kw+ output in shack

HB9Q JT-65C 10m Dish

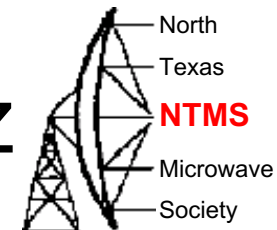
Moon at apogee



The screenshot displays a software interface for a radio station. At the top, a spectrum plot shows a signal at 1,296,100,330 Hz. Below the plot, there are several control panels and windows:

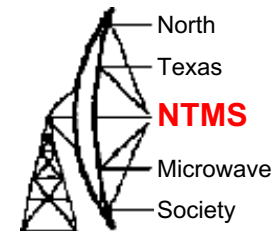
- Message Log:** A list of messages with columns for Freq, Message, UTC, dB, DT, Freq, and Message. The messages include:
 - 1428 C#
 - 1501 C*
 - 1595 C#
 - 1446 C#
 - 1540 C#
 - 1439 C#
 - 1472 C#
 - 1445 #
 - 1834 #* LA3EQ HB9Q -05
 - 1887 #
 - 1885 ## Z9 H76FMQ FI73 000 a1
- Message Generator:** A panel with a "Generate Std Msgs" button and a list of messages:
 - JA1WQF WSLUA EM
 - JA1WQF WSLUA EM
 - RO
 - RRR
 - 73
 - CQ WSLUA EM13
- Control Panels:** Various buttons and sliders for "Stop", "Monitor", "Erase", "Clear Avg", "Decode", "Enable Tx", "Halt Tx", "Tune", and "Menu". There are also fields for "Tx 1500 Hz", "F Tol 100", "Rx 1824 Hz", and "Report -15".
- System Information:** A panel showing "2021 Mar 19 18:32:28" and "JT65 C".
- Bottom Panel:** A panel with "The MorseMachine" logo and "MEMORY BANK A", "MEMORY BANK B", and "TRANSMIT" labels.

2300 - 2310 and 2390 - 2450 MHz



- The first EME contact took place on October 19, 1970 between W4HHK and W3GKP
- Most EME operation between 2304.0 and 2304.150 MHz
- Some of Europe including the UK can only operate at 2320 MHz - no allocation at 2304 MHz - cross band between 2304 and 2320 MHz. We lost 2310 to 2390 because of services like Sirius/XM
- Japanese operate at 2400 MHz - no allocation at 2304 MHz – cross band between 2304 and 2400 MHz or simplex 2400 MHz
- Crossband operation requires extra receive converters
- Over 150 stations operational over the years
- Station Requirements – 2.4m Dish, 100 watts
- Tubes, TWT, Klystron, or SSPAs
- Circular Polarity – same convention as 1296
- Coordinate activities on HB9Q logger

VA-802B Klystron for 2304 MHz



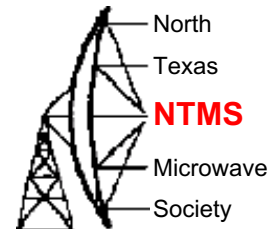
Runs about 400 watts output

Capable of a KW output

Originally used by W4HHK for
the first 2304 MHz EME
contact in 1970.

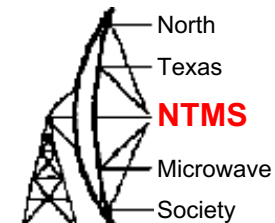
Still running fine in 2023!

3300 to 3500 MHz



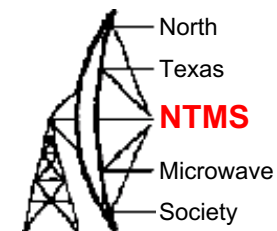
- The first 3456 MHz EME contact took place on April 7 1987 between KD5RO and W7CNK
- The 9 cm allocation is not a worldwide allocation yet all continents are represented. EME operation migrated from 3456 to 3400 MHz
- Approximately 100 stations have been active over the years.
- The US has recently ceased operation 3450 MHz to 3500 MHz due to 5G expansion. Primary weak signal operation now at 3400.1 MHz for both terrestrial and EME
- We have long been operating EME at 3400 MHz as a good number of countries have an allocation here. An exception are the VKs who have 3398 to 3400 MHz.
- Station Requirements – 2.4m Dish, 50 watts, Circular Polarity is used with same convention as 1296 and 2304 MHz.
- Coordinate activities on HB9Q logger

5650 to 5925 MHz



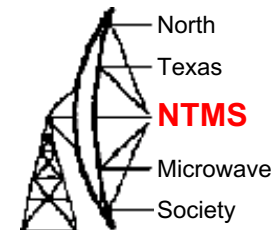
- The first EME contact on 5760 MHz took place on April 24, 1987 between WA5TNY and W7CNK
- The 6 cm band is an international allocation with all continents represented.
- Over 100 stations have been operational over the years.
- Most operation between 5760.050 and 5760.150 MHz
- WIFI interference can be very bad at times making the band a real challenge.
- Station Requirements – 2.4m Dish, 25 watts, Circular Polarity is used with same convention as 1296 and 2304 MHz.
- Coordination is on HB9Q logger

10000 to 10500 MHz



- The first 10368 MHz EME contact took place on August 27, 1988 between WA5VJB and WA7CJO (W7CJO)
- The 3 cm band is also an international allocation with all continents represented
- Most operation between 10368.050 and 10368.150 MHz
- JAs operational on 10450 MHz - another cross-band challenge –
- More than 150 stations operational over the years
- W.A.C has been achieved by many stations
- Minimum station requirements – .8m or 1m dish with 50 watts. Of course, more is always better!
- Coordinate activities on HB9Q logger

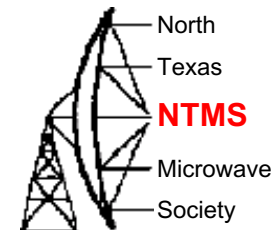
3cm during the EME Contest in Aug 2023



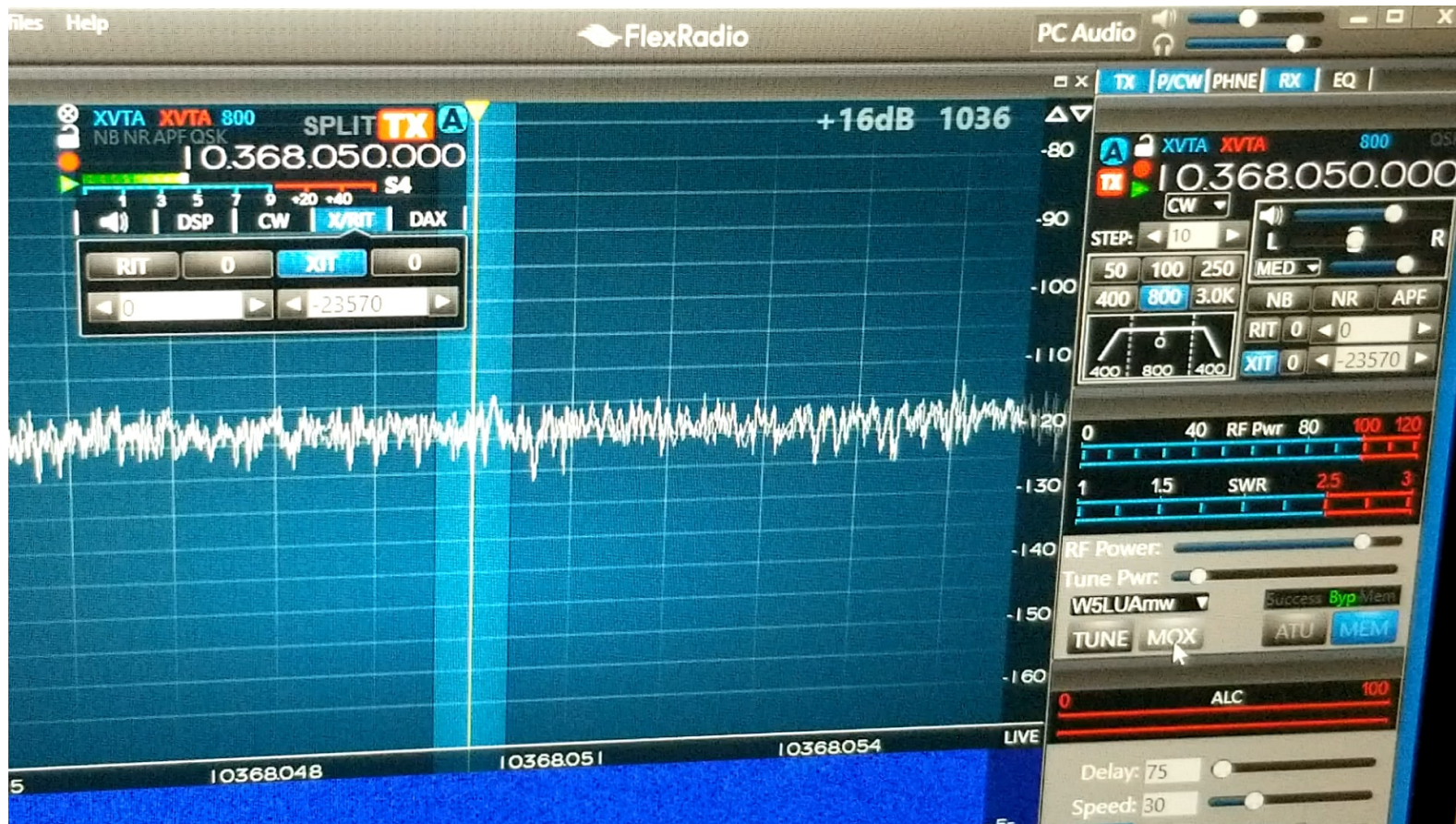
The screenshot displays a Windows desktop environment during an EME contest. The main window is FlexRadio, showing a spectrum display with a signal at 10,368,207.353 kHz. A chat window for the '#general' channel is open, showing messages from participants like AA5AM and Greg AA5C. A decoder window titled 'Single-Period Decodes' and 'Average Decodes' is visible, listing various stations and their call signs. The system tray shows the date and time as 2023 Aug 13 13:29:38.

<https://wsjt.sourceforge.io/wsjttx.html>

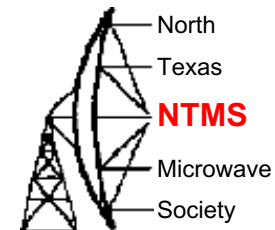
10 GHz Echos at W5LUA



5m Dish 250 w TWT in shack, 120 watts at feed – moon at apogee



W5LUA Portable EME Set-Up



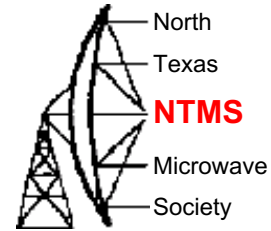
Heavy duty manual AZ-EL mount built by TerraCom that was originally used for portable point to point microwave link with a 4 ft fiberglass dish

Mounted a 1 m Winegard off set fed dish to mount
 Gain ~ 37 to 38 dBi
 3dB BW ~ 2.2 deg
 First null at 2.8 deg

Extended and raised feed support arms to handle weight of new feed/wg relay/LNA/SSPS

NF .7 dB from DB6NT LNA,
 Power out is 30 watts from a GaAn device

Behind the dish



GR1216 for measuring sun and moon noise

DEMI 10GHz XVTR

W1GHZ 2/10m XVTR

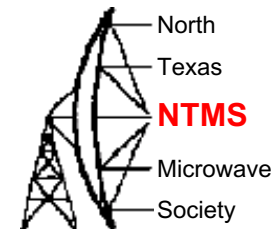
Power Meter

Sequencer

ISOTEMP 10 MHz TCXO

KX3/PX3 for IF

W5LUA/0 QSO with OZ1LPR



WSJT 10.0 r4181 by K1JT

File Setup View Mode Decode Save Band Help

Moon
Az: 105.64
E1: 10.76
Dop: 11380
Dgrd: -0.6

FileID	Sync	dB	DT	DF	W	Time (s)	OZ1LPR_161013_230900.WA	F3	1	2	3
225900	5	-16	1.5	-13	39	#	WSLUA G3WDG R-18	1	18	D	
230100	0	-21	4.7	-44	4	*					
230300	0	-21	0.6	-18	7	*					
230500	6	-15	1.2	39	11	*	WSLUA OZ1LPR JO44	1	60	D	
230700	5	-15	1.2	39	15	#	WSLUA OZ1LPR R-17	1	20	D	
230900	7	-13	1.2	39	15	*	WSLUA OZ1LPR 73	1	32	D	

Log QSO Stop Monitor Decode Erase Clear Avg Include Exclude Tx Stop

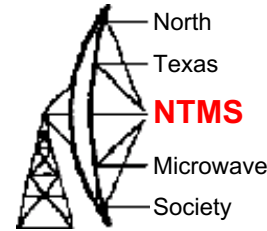
To radio: OZ1LPR Lookup Sync -1 Zap
Grid: JO44uw Add Tol 50 AFC
Az: 39 4455 mi MinW D Efreeze
Tx First
Rpt: -20
Gen Msgs Auto is ON

2016 Oct 13 23:11:25

1.0000 1.0000 JT4F Freeze DF: 0 Rx noise: 2 dB T/R Period: 60 s Receiving

QSO took place in St. Louis, MO at Microwave Update Conference in Oct 2016

Big surprise – G4CBW called us!

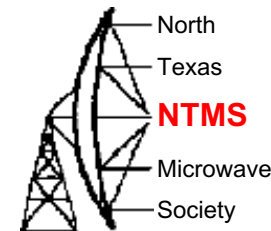


The screenshot shows a Windows desktop with several applications open. The primary focus is on the WSJT-X software interface, which displays a waterfall plot and a list of received signals. The 'Moon' call sign is visible in the top right of the WSJT-X window. The SpecJT software is also open, showing a frequency spectrum plot. The desktop background is blue with various icons, and the taskbar at the bottom shows the system clock as 8:40 PM on 10/14/2016.

FileID	Sync	dB	DT	DF	W			
012900	7	-14	3.1	0	33	*		
013100	0	-21	3.1	24	4	#		
013300	0	-20	2.7	-42	7	*		
013500	5	-16	3.0	-9	26	*	WSLUA G4CBW IO83	0 38 C
013700	0	-21	3.0	-13	4	#	WSLUA G4CBW R-15	0 3 D
013900	3	-17	2.9	-9	26	*	WSLUA G4CBW 73	0 11 E

I was having some difficulties with some low frequency spurs getting into my sound card

Screen at G4CBW – 1.5m dish/75W



File View Mode Decode Save Help

Single-Period Decodes Average Decodes

UTC	dS	DT	Freq	Message	UTC	dS	DT	Freq	Message
0131	-19	0.80	901	*	0132	-18	1.94	987	* CQ WSLJUA EH48 14 A
0132	-18	1.88	987	* CQ WSLJUA EH48 27 D	0134	-15	1.94	987	* CQ WSLJUA EH48 22 A
0133	-19	0.23	1404	#	0135	Tx	1000	# WSLJUA G4CBW 2053	
0134	-15	1.91	987	* CQ WSLJUA EH48 26 C	0136	-16	1.71	982	# G4CBW WSLJUA -16 20 A
0136	-16	1.71	982	# G4CBW WSLJUA -16 20 E	0137	Tx	1000	# WSLJUA G4CBW R-15	
0138	-16	2.06	978	# G4CBW WSLJUA RRR 1 E	0138	-16	2.06	978	# G4CBW WSLJUA RRR 1 A
0140	-15	1.86	987	# G4CBW WSLJUA 73 14 C	0139	Tx	1000	# WSLJUA G4CBW 73	
0141	-20	-0.34	991	#	0142	-18	1.94	993	* CQ WSLJUA EH48 * D
0142	-18	1.91	993	* CQ WSLJUA EH48 34 D	0144	-17	1.94	989	* CQ WSLJUA EH48 * D
0143	-18	1.87	910	*	0146	-15	1.94	987	* CQ WSLJUA EH48 * C
0144	-17	1.91	989	* CQ WSLJUA EH48 25 D					
0145	-20	2.06	932	*					
0146	-15	1.91	987	* CQ WSLJUA EH48 39 D					

Log QSO Stop Monitor Erase Clear Avg Decode Enable Tx Halt Tx Tune

3m 10,368.055 714

32.5 dB

2016 Oct 15 01:47:05

Receiving JT4F Last Tx: WSLJUA G4CBW 73 Tx-Enable Disabled 5/60

Generate Std Mlogs Next Nov

WSLJUA G4CBW 2053 Tx 1

WSLJUA G4CBW -15 Tx 2

WSLJUA G4CBW R-15 Tx 3

WSLJUA G4CBW RRR Tx 4

WSLJUA G4CBW 73 Tx 5

@1000 (TUNE) Tx 6

Spectran Setup Mode Palette Filters Capture About

15/10/2016 02:47:05 15/10/2016 Record

Peak at 1329.60Hz [50.2dB] 02:47:05

WSJT-X - Astronomical Data

2016 Oct 15
UTC: 01:47:05
Az: 228.4
El: 26.4
SelfDop: -9322
Width: 44
Delay: 2.39
DxAz: 120.2
DxE1: 32.1
DxDop: 5714
DxWid: 52
Dec: -0.2
SunAz: 37.4
SunEl: -40.1
Freq: 10368
Tsky: 3
MNR: 2.6
Dgrnd: -0.2

Frequency above nominal band edge
90 kHz 0 Hz

Doppler tracking
Full Doppler to DX Grid
Constant frequency on Moon
None

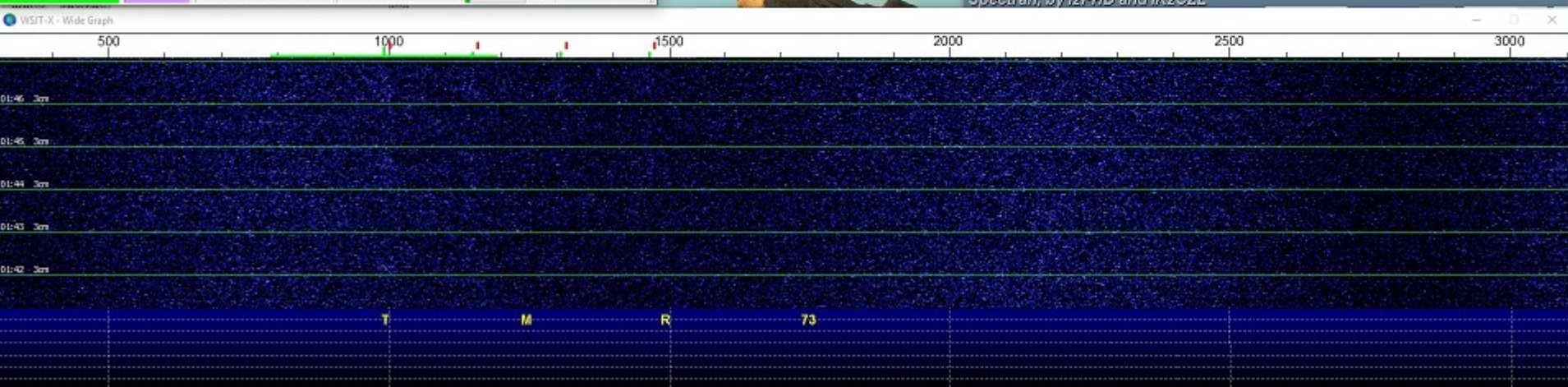
Transceiver step size
1 Hz
30 Hz
300 Hz

Enable
Track VFOs
Track Tx audio

Vol Gain
Speed

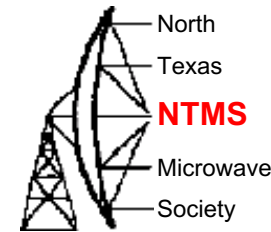
Control Freeze

Spectran, by I2PHD and IK2CZL



GB2FRA on 10 GHz EME

3.6m dish and 200 watts



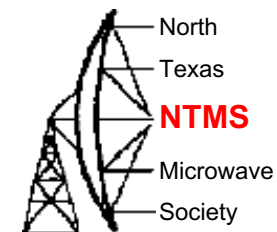
Constant Frequency on Moon

The screenshot displays a Windows desktop environment. On the left, a 'Doppler tracking' window is open, showing various parameters and a radio button for 'Constant Frequency on Moon', which is selected. A red arrow points from this option to a red circle on a waterfall plot in the FlexRadio software. The waterfall plot shows a constant frequency signal at 10,368,207,353 Hz. The FlexRadio interface also shows a 'Single-Period Decodes' window with a table of decoded messages.

UTC	dB	DI	Freq	Message	UTC	dB	DI	Freq	Message
1308	-13	3.1	1320	WSLUA GIBERY R-09	1315	Tx	845	10368207353	CG WSLUA EM13
1308	-14	3.1	844	WSLUA GAYTT T049	1318	-16	3.1	895	WSLUA OKSQC R-10
1309	-14	3.1	853	WSLUA GAYTT R-04	1320	Tx	845	OKSQC WSLUA R-10	
1309	-14	3.1	858	WSLUA GAYTT 73	1321	-16	3.1	890	WSLUA OKSQC R-11
1313	-11	3.0	890	WSLUA PEICKE 7020	1323	Tx	845	OKSQC WSLUA RR73	
1315	-10	3.0	888	WSLUA PEICKE R-10	1323	-16	3.1	890	TO AL RR73 8L
1317	-10	3.0	889	WSLUA PEICKE 73	1323	-15	3.1	890	TO AL RR73 8L
1319	-15	3.1	975	WSLUA OKSQC JN89	1324	Tx	845	OKSQC WSLUA 73	
1321	-9	3.0	890	WSLUA OKSQC R 11	1325	-1	3.0	892	WSLUA GIBERY 1099
1323	-9	3.1	890	TO AL RR73 8L	1326	Tx	845	WSLUA WSLUA 01	
1323	-1	3.0	892	WSLUA GIBERY 1099	1327	-1	2.9	887	WSLUA GIBERY R-08
1327	-1	2.9	887	WSLUA GIBERY R-08	1328	Tx	845	GIBERY WSLUA RR73	

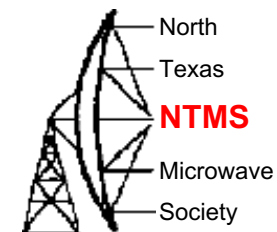
Q65-60D

24000 to 24250 MHz



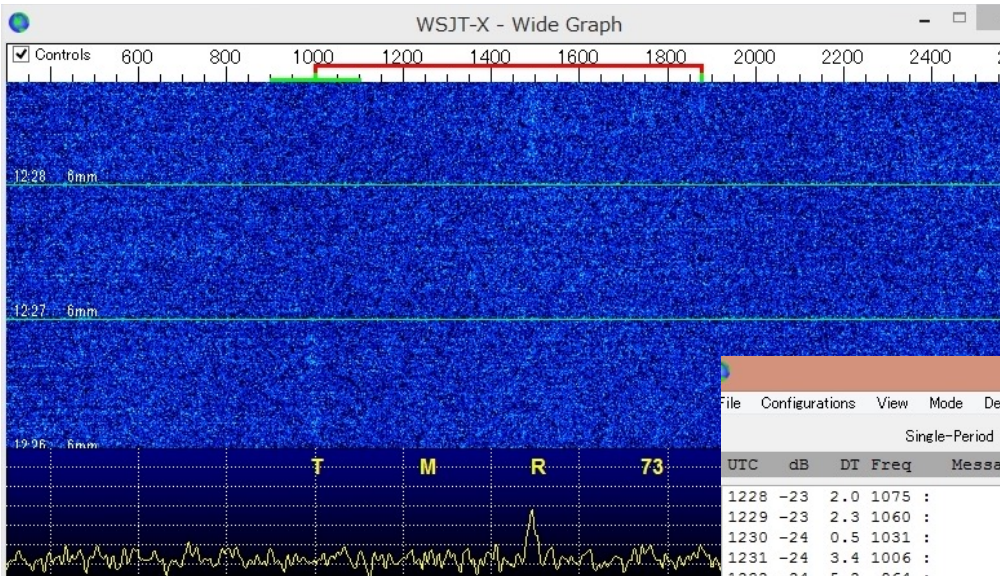
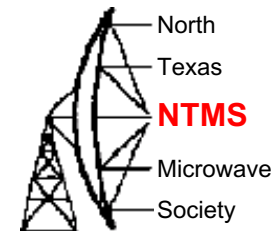
- Operation originally occurred at 24192.100 MHz – migrated to 24048.1 MHz which is an international allocation.
- VE4MA & W5LUA made the first 24 GHz EME QSO on Aug 18, 2001 with RW3BP, AA6IW, and VE7CLD becoming operational later in 2001 and 2002
- Presently there are more than several dozen stations active or have been active
- Minimum station requirements – 3m prime focus or 1.8m 2.4m offset fed dish and 20 watts

47000 to 47200 MHz



- The first 47 GHz EME QSO was made in January 2005 with AD6FP(K6MG) working RW3BP. This contact was followed up by RW3BP working W5LUA and VE4MA
- Operation at 47088.100 MHz
- Station Requirements – 1.8 or 2.4 M offset fed dish and W2IMU type feed and 30 watts minimum
- The first QSOs were made on CW using a program written by RW3BP that utilized 10 minute transmissions to take advantage of longer integration times.
- Recent tests utilizing WSJT modes like JT4F and QRA-64D have resulted in DL7YC and JA1WQF decoding W5LUA in 2020.
- Most recently DL7YC and DC7KY completed an EME contact on July 5, 2022 using the Q65-60E WSJT mode. Congrats!!

W5LUA received at JA1WQF 47088.1 MHz Feb 10, 2020

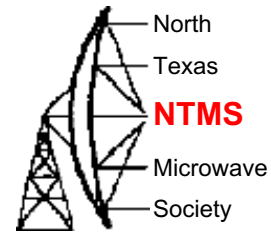


2.4m offset fed dishes
at both stations

W5LUA runs a 30 watt TWT

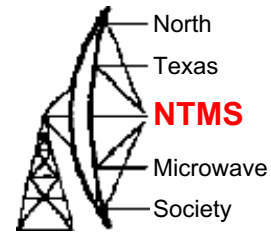
Single-Period Decodes				Average Decodes			
UTC	dB	DT Freq	Message	UTC	dB	DT Freq	Message
1228	-23	2.0	1075 :	1146	-23	2.7	994 :* JA1WQF W5LUA EM13
1229	-23	2.3	1060 :	1210	-24	-1.0	1008 :
1230	-24	0.5	1031 :	1214	-23	3.3	1003 :
1231	-24	3.4	1006 :	1220	-23	0.2	994 :
1232	-24	5.2	964 :	1221	-24	5.6	1001 :
1233	-23	5.0	1056 :	1231	-24	3.4	1006 :
1234	-25	2.8	987 :* JA1WQF W5LUA EM13				

76000 to 81000 MHz



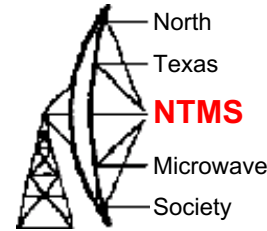
- Initial EME tests were run at 77184.1 MHz.
- RW3BP copied his echoes. Sergei was running a 100 watt pulse rated tube and a 2.4 m offset fed dish.
- W5LUA and VE4MA copied his weak signal via the moon.
- We did not and still do not have the power necessary to complete the contact.
- Even if we did, thanks to collision avoidance restrictions, we are limited to +55 dBmi or 316 mW EIRP.
- When we come up with enough power, we will have to ask the FCC for a waiver or special license.

Coordination



- N0UK Logger for 6m and 2m <https://www.chris.org/cgi-bin/jt65emeA>
- HB9Q Logger for schedule coordination and chat on 222 MHz and higher <https://logger.hb9q.ch/>
- 432 MHz and Above newsletter published every month for nearly 50 years by K2UYH <http://www.nitehawk.com/rasmit/em70cm.html>
- 2m EME Newsletter <http://www.df2zc.de/newsletter/>
- Moon-Net Reflector <http://mailman.pe1itr.com/mailman/listinfo/moon-net>
- Moon Reflector <http://moonbounce.info/mailman/listinfo/moon>
- Microwave Reflector <http://www.wa1mba.org/reflect.htm>

HB9Q Logger



The screenshot shows the HB9Q Logger web interface. At the top, there are call sign buttons: 50, 144, 222, 432, 902, 1296 (highlighted), 23xx, 3400, 5760, 10xxx, 24048, 47088, and 76032. Below these is a message input field with a dropdown menu set to '@call' and a 'write your message here...' prompt. A 'CQ' button is set to '1296' and a '1st' call sign button is selected. The main chat log shows a series of messages, including several 'CQ 1296.070 1st rx on my echo' messages from DL1RME (Ronald). A tooltip for DL1RME / Ronald is visible, listing 'Equipment 1296 MHz - 1,5 - 150' and 'Locator JO62LI'. On the right, a 'Who is online' list shows various call signs, with W5LUA (ME) at the top. A 'last seen on logger >1h' section lists other active users like DK3WG, G4CCH, etc. The footer of the interface reads '© 2021 by HB9Q, powered by a l o g i s a g'.

www.hb9q.ch

You must log in with a password

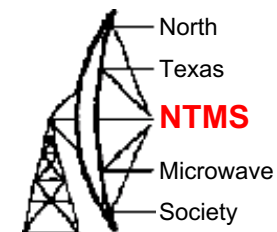
Very cordial group

Always interested in helping people out

Don't hesitate to ask a question

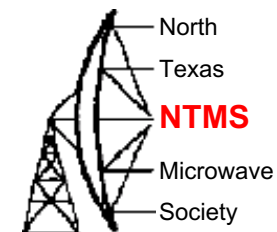
Left click on a call sign to see what the other station is running

EME Contests



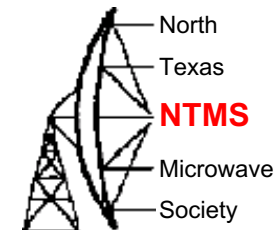
- **ARRL 2023**
Weekends 1 and 2: 2.3 GHz & Up - August 12-13, September 9-10
Weekends 3 and 4: 50 to 1296 MHz - October 28-29, November 25-26
- **European EME Contest – promoted by DUBUS and REF – promotes random CW and SSB contacts – 2024 dates have not been announced**

A few web sites to check out



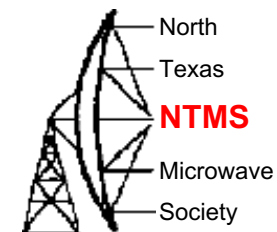
- Down East Microwave, <https://www.downeastmicrowave.com/>
- Q5 Signal, <http://www.q5signal.com/>
- Kuhne Electronic,
<https://shop.kuhne-electronic.com/kuhne/en/>
- Directive Systems,
<https://directivesystems.com/>
- W6PQL, <https://www.w6pql.com/>
- KA1GT, <http://bobatkings.com/radio/>
- W1GHZ, <http://www.w1ghz.org/>
- OK1DFC, <https://www.ok1dfc.com/>

North Texas Microwave Society



- The next NTMS meeting will be held on Saturday Oct 14 at the ranch of Bob Stricklin N5BRG in Valley View, Tx.
- BBQ - RSVP to bstrick at n5brg dot com
- Presentations, equipment demos, 122 GHz testing
- www.ntms.org
- Groups.io reflector <https://groups.io/g/NTMS>
apply for membership email: NTMS+subscribe at groups dot io
- NTMS slack – contact Brad WQ5S: southpaw1959 at gmail dot com
- Questions? w5lua at sbcglobal dot net

6m BBQ



- The presentation will be available shortly at www.ntms.org
- Questions?
- I thank Dick Hanson for inviting me to speak.
- See you off the moon de W5LUA