

# Working Small Stations on 10 and 24 GHz EME with the help of WSJT

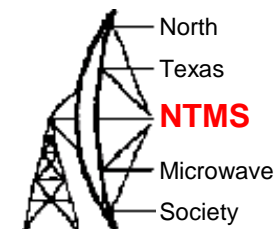
Al Ward

W5LUA

July 26, 2013

Central States VHF Society  
Elk Grove Village, Illinois

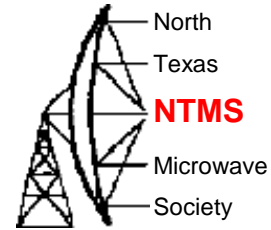
# The Microwave Bands



Band	Frequency Range	Weak signal work in NA
33 cm	902 to 928 MHz	902 MHz (Region II only NA & SA)
23 cm	1240 to 1300 MHz	1296 MHz
13 cm	2300 to 2310 MHz	2304 MHz (2301 VK, 2320 some Europe and VE – cross band required)
	2390 to 2450 MHz	2424 JA
9 cm	3300 to 3500 MHz	3456 MHz (3400 MHz used for EME)
6 cm	5650 to 5925 MHz	5760 MHz
3 cm	10000 to 10500 MHz	10368 MHz (10450 MHz used by JA)
1.25cm	24000 to 24250 MHz	24192 MHz (24048 MHz used for EME)
.6 cm	47000 to 47200 MHz	47088 MHz
.35 cm	77000 to 81000 MHz	78192 MHz (77184 MHz used by RW3BP, W5LUA, & VE4MA)

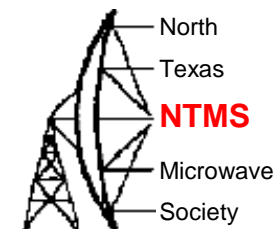
**The problem...Not all countries have same allocation as us.....**

# How long have hams been doing EME on the upper bands?



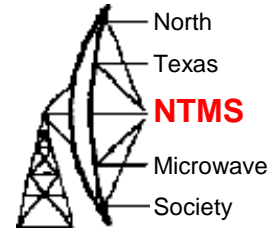
- First 902 MHz EME QSO on January 22, 1988 between K5JL and WA5ETV
- First 1296 MHz EME QSO in 1960 between W1BU and W6HB
- First 2304 MHz EME QSO in 1970 between W4HHK and W3GKP
- First 3456 MHz EME QSO on April 7, 1987 between W7CNK and KD5RO
- First 5760 MHz EME QSO on April 24, 1987 between W7CNK and WA5TNY
- First 10368 MHz EME QSO on August 27, 1988 between WA7CJO and WA5VJB
- First 24192 MHz EME QSO on August 18, 2000 between W5LUA and VE4MA
- First 47088 MHz EME QSO in January 2005 between RW3BP and AD6FP followed by W5LUA and RW3BP
- First 77184 MHz EME QSO TBD – RW3BP has heard echoes and was copied by W5LUA in June 2013, VE4MA also working towards EME.

# JT-65 for EME



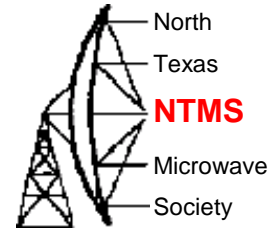
- Joe Taylor's (K1JT) WSJT digital modes have certainly revolutionized weak signal, meteor, and EME communications
- JT-65A used on 6M
- JT-65B used on 2M through 70 cm
- JT-65C used on 1296 MHz through 5760 MHz – Struggle at 5760 MHz due to excessive doppler shift during 1 minute transmission – Hand always on knob!
- Using JT-65C on 10 GHz and higher a struggle due to doppler shift being more than 200 Hz per minute!
- Additional challenge is that on 10 GHz and higher, the libration spreading can be as large as several hundred Hz which is much more than the 10.8 Hz tone spacing of JT65C – Signals sound aurora like

# JT-4 Mode



- The JT-4 mode uses 4 tones and offers a range of tone spacings up to 315 Hz.
- JT-4F was found to be optimum for 10 and 24 GHz based on normal spreading of the signal.
- Only disadvantage of JT-4F is that there is no sync pulse as power is divided equally among the 4 tones.

# Bandwidth Comparison between JT4 Modes and JT-65C



Mode	Expansion Factor N	Tone Spacing (Hz)	Bandwidth (Hz)
JT4A	1	4.375	17.5
JT4B	2	8.75	35
JT4C	4	17.5	70
JT4D	8	39.375	158
JT4E	18	78.75	315
JT4F	36	157.5	630
JT4G	72	315.0	1260

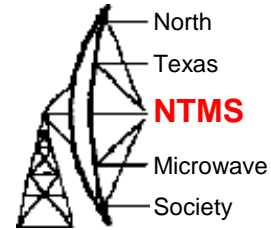
JT-65C

10.8 Hz

711 Hz

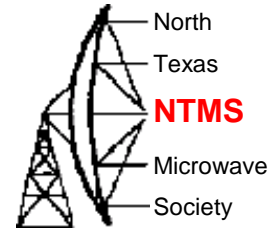
When libration spreading is low, contacts on 10 GHz are possible with JT-65C but our success rate went up with the JT-4 modes especially at 24 GHz where the spreading shows less peaking than seen at 10 GHz. Narrower antenna beamwidths also help to reduce the effective spreading of signals

# Keeping on Frequency



- The WSJT waterfall only has a several kHz wide passband.
- How do we keep our continuously doppler shifted signal within the pass band? Doppler can be as high as 25 kHz at moon rise on 10 GHz
- Answer...we must continuously correct our receive frequency to compensate for the mutual doppler between us and the station we are trying to work.
- Initially VK7MO was doing all the frequency correction at his end for both receive and transmit so all I had to do was set my Flex5000 to the sked frequency
- Recently K5GW wrote similar code for the Flex5000 to control both my receive and transmit frequencies so as to put my transmitted frequency precisely on the schedule frequency at any observer on earth by just knowing their 6 digit grid square.
- GPS frequency locking is a requirement for the microwave LO.

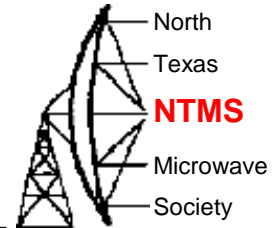
# Picking the best times



- Perigee (when the moon is closest to earth) is always best
- Need to pick times when spreading is lowest so that the tones can fall into the narrow spaced frequency bins required for both JT-65C and JT-4
- I use an EME tracking program by K5GW that predicts times of lowest libration spreading – other programs by VK3UM and F1EHN



# 5M and 2.4M Dishes at W5LUA

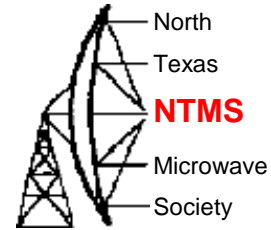


Used on 432 MHz through 10 GHz

Used on 24, 47 and 77 GHz



# VK7MO .7M Prime Focus Dish used on 10 GHz EME



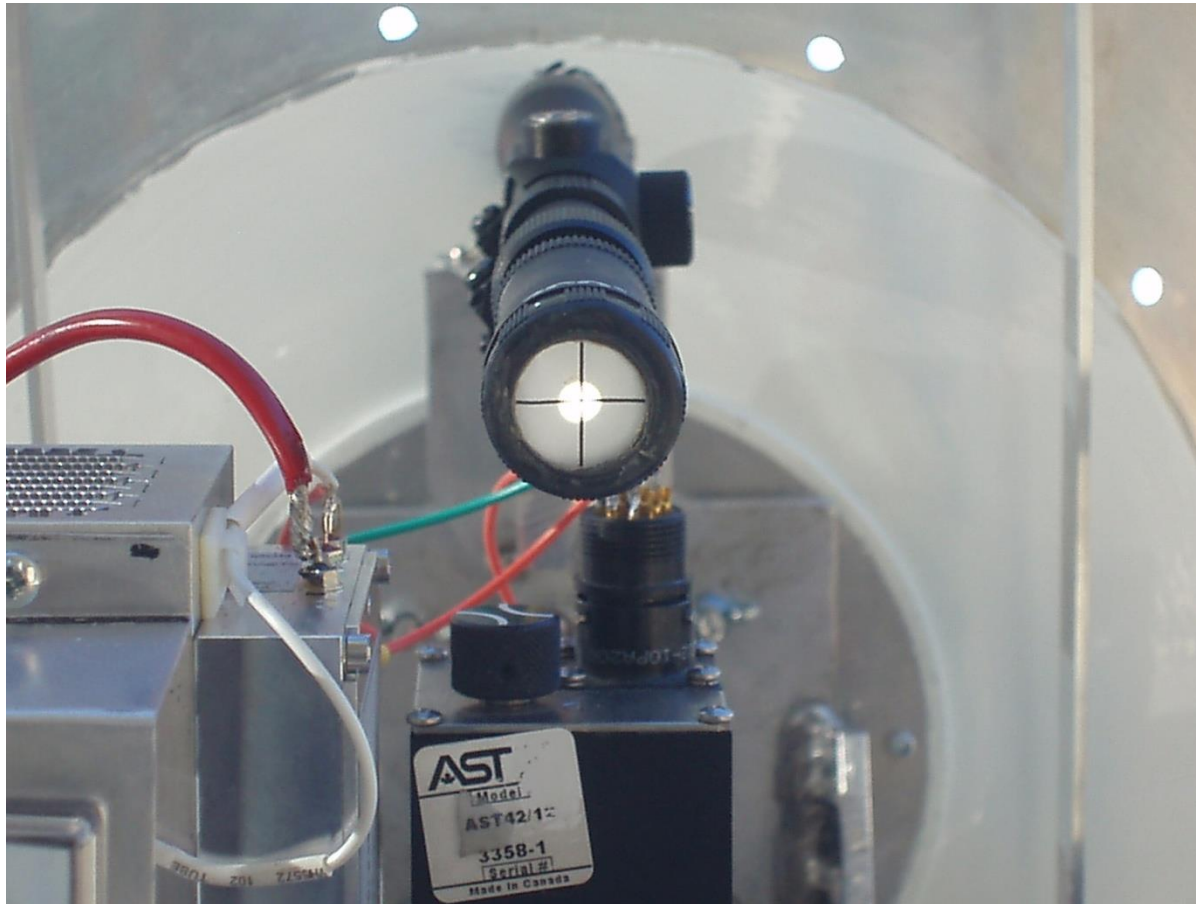
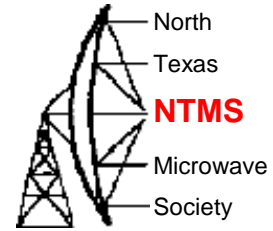
3dB Beamwidth  
=2.5 degrees

DB6NT Power  
amplifier 45 watts  
@ the feed

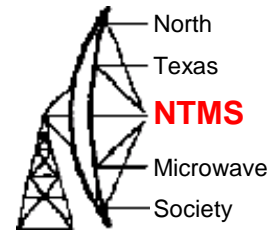
NF 1 dB



# VK7MO uses rifle scope for tracking



# VK7MO-W5LUA OCT 18 23:01Z



**K5GW Tracking program for W5LUA**

TIME	DATE	IGT	A/T	AZ	EL	AZC	ELC	DEC	AZ ERROR	EL
23:01:39	10/18/12	MOON	OFF	206.32	30.52	1.5	0.4	-20.9	-0.06	0.07

ANTENNA	AZIM	ELEV
1296	197.23	30.66
2304	207.24	27.30
3400	208.59	27.05
5760	210.85	29.48
10368	206.25	30.60
24048	120.05	45.94
47088	118.95	46.05
78192	118.95	45.68

OCT 18 2012	23:01:39						
SUN	1	2	3	4	5	6	
MON	7	8	9	10	11	12	13
TUE	14	15	16	17	18	19	20
WED	21	22	23	24	25	26	27
THU	28	29	30	31			
FRI							
SAT							

Band: 10368MHZ  
Doppler: -12128.1  
Sky Ten: 2.7  
Loss dB: 0.52  
Tdeg dB: 0.52  
Pol: -66  
Lib: 163.2

**WSJT 7 by K1JT**

File Setup View Mode Decode Save Band Help

Moon  
Az: 206.32  
El: 30.50  
Dop: 3402  
dgrd: -0.5

**FileD Sync dB DT DF W DF (Hz) VK7MO\_121018\_230000**

225300	0	-33	0.9	-307	46					
225400	3	-25	1.8	108	13		W5LUA	VK7MO	Q0E37	0 10
225600	4	-24	1.8	105	14	*	W5LUA	VK7MO	R-23	1 10
225800	2	-30	1.03	3	73	?				
225800	2	-30	1.03	3	73	?				
230000	5	-24	1.8	102	17	*	W5LUA	VK7MO	Q0E37	1 10

192500	1	1/51								
192500	2	1/48								

Log QSO Stop Monitor Save Decode Erase Clear Avg Include Exclude TxStp

To radio: VK7MO Lookup  
Grid: Q0E37pc Add  
Az: 239 0972 mi

2012 Oct 18 23:01:40

**FlexRadio Systems PowerSDR v2.3.5 FLEX-5000: 1708-2183**

STOP

VFO A: 10368.225 000  
10GHz General TX

VFO B: 3400.100 030  
TX Out of Band

RX1 Meter: 0 W

AF: 14  
AGC-T: 106  
Drive: 75  
AGC Preamp: On

SQL: -115

RX1-ANT1: Panafal  
TX: ANT1  
RX2: RX2 IN

Mic: 15  
DX: 3  
CPDR: 1  
VDX: 100  
DEXP: -40

Transmit Profile: Default

5.0k 4.4k 3.8k  
3.3k 2.9k 2.7k  
2.4k 2.1k 1.8k  
1.0k Var 1 Var 2  
Low 150 High 2850  
Width: T  
Shift: T Reset

**SpecJT by K1JT**

Options Freq: 746 DF: -524 (Hz) BW: 1200 Speed: 1 2 3 4 5 6 HI 0 HZ

220

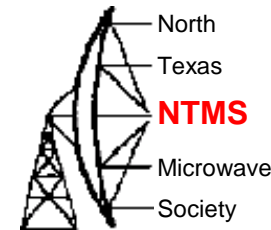
144.260 144.280 1

9.4dBm 144.280 422 MHz

Fixed 192 kHz Center

CPU %: 33.6  
AGC: Med

# VK7MO portable in OF89ai



The screenshot displays the WSJT-X software interface with several windows open:

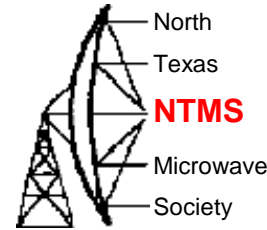
- WSJT-X Main Window:** Shows a spectrum plot with a peak at 10368.225 MHz. The Moon's position is displayed as Az: 282.30, El: 10.56, Dop: -8405, Dgrd: -2.3. A table of signal reports is visible below the plot.
- PowerSDR Window:** Shows the VFO A frequency at 10368.225 MHz and a spectrum plot with a peak at 10368.225 MHz.
- SpecJT Window:** Shows a spectrogram of the signal.
- Astronomical data Window:** Displays the following data:
 

Moon:	Az	282.30	El	10.56
Moon/DX:		31.06		24.05
Sun:		94.44		-34.01
Source:		290.88		-28.67
Doppler df/dt				
DX:		-8405		-42.20
Self:		-26137		-3.62
RA DEC				
Moon:		02:29		15.99
Source:		00:00		0.00
Freq: 10368 Tsky: 3				
MNR:		9.4	Dgrd:	-2.3
DPoI:		35	SD:	14.85
- K5GW Tracking program for WSJT-X Window:** Shows a table of tracking data:
 

TIME	DATE	IG	A/T	AZ	EL	AZC	ELC	DEC	AZ BRDN	EL
10:23:00	11/26/12	MOON	OFF	282.23	10.72	-1.7	0.2	16.4	-0.65	-0.60



# VK7MO Receiving W5LUA in Grid Square PF06 on 10 GHz



AZ E1  
 Moon: 73.33 20.95  
 Moon/DX: 265.59 7.48  
 Sun: 149.95 -27.52  
 Source: 263.01 -10.39

Doppler df/dt  
 DX: 3326 -32.72  
 Self: 28032 -48.96

RA DEC  
 Moon: 11:03 1.46  
 Source: 00:00 0.00

Freq: 10368 Tsky: 3  
 MNR: 0.1 Dgrd: -1.4  
 DPol: -3 SD: 15.67

VK7MO Doppler IC910 control V 1.23.....

A FREQ: 144225110  
 B FREQ: 144225110

OpFreq: 10368.00  
 DX Doppler: 3326.70  
 DXRate: -32.7  
 Self Doppler: 28033.00  
 Self Rate: -48.9  
 COMPORT: COM1  
 Applied: 144221783

SWAP: SWAP OFF  
 B ON EVEN  
 B ON ODD  
 Invert B

A FREQ:  Use DX  Use Self  No Corr  
 B FREQ:  Use DX  Use Self  No Corr

Read azel.dat@9 46:11

WSJT 7 by K1JT

Moon  
 Az: 73.33  
 E1: 20.96  
 Dop: 3326  
 Dgrd: -1.4

FileID	Sync	dB	DT	DF	W	
171500	0	-33	-1.6	-528	3	
171600	0	-33	7.5	237	2	
171700	0	-33	3.0	514	11	
171800	0	-33	-0.1	495	32	
171900	0	-33	-1.4	565	18	
172000	0	-33	3.1	460	45	
172100	0	-33	9.6	-385	40	
172200	0	-33	1.8	519	32	
172300	0	-25	7.0	-24	15 #	
172500	0	-24	5.5	-27	6 *	
172700	5	-24	2.7	-27	11 *	VK7MO WSLUA EM13 0 10
172900	4	-23	2.7	-27	17 *	VK7MO WSLUA EM13 0 10
173100	3	-26	2.7	-27	17 *	VK7MO WSLUA EM13 0 10
173300	1	-27	2.5	-32	11 *	VK7MO WSLUA EM13 ? 0 1
173500	0	-31	2.7	-22	23 *	VK7MO WSLUA EM13 0 10
173700	0	-33	6.1	-153	26	
173900	2	-25	3.1	-30	11 *	VK7MO WSLUA R-29 0 10
174100	0	-25	1.8	404	16 #	
174300	0	-33	-1.7	-27	6	
174500	0	-33	-1.0	100	63	

Log QSO Stop Monitor Save Decode Erase Clear Avg Include Exclude TxStp

To radio: WSLUA Grid: EM13qc Az: 81 16830 km

2012 Dec 06 17:46:11

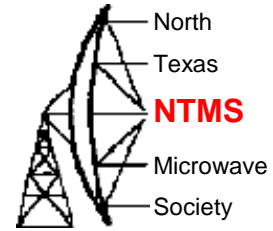
0.9992 0.9998 J765C Freeze DF: 0 Rx noise: 0 dB TR Period: 60 s 0 Receiving

SpecJT by K1JT

Options Freq: 735 DF: -535 (Hz) BW Speed: 1 2 3 4 5 H1 H2

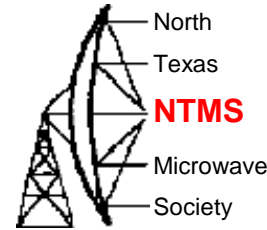
17:46:11 0 dB

# VK7MO working W5LUA from motel room on 10 GHz EME from Grid Square PF58kn





# Using JT-4G on 10 GHz



The screenshot displays three main software windows:

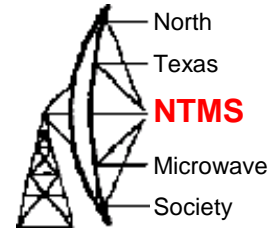
- SpecJT (top left):** A waterfall plot showing a signal at 10368.225 MHz. The frequency axis ranges from 10368.205 to 10368.235 MHz. The time axis shows 14:13:36.
- FlexRadio Systems PowerSDR (top right):** The main interface for the FLEX-5000. It shows the frequency 10368.225 MHz and a power level of 0 W. The interface includes various controls for tuning, AGC, and signal processing.
- WSJT 9.4 (bottom left):** The JT-4G software interface. It displays a graph of the signal and a table of decoded frames. The table shows a file ID of 45 and a sync time of 14:13:36. The decoded text includes:
 

FileID	Sync	dB	DT	DF	W	WSLUA	VK7MO	QE37	1	31	E
140200	1	-24	3.9	300	85	#					
140400	6	-19	4.0	-13	101	*	WSLUA	VK7MO	QE37	1	35
140600	5	-20	4.0	-15	94	*	WSLUA	VK7MO	QE37	1	35
140800	6	-19	4.2	-20	96	*	WSLUA	VK7MO	QE37	1	19
141000	6	-19	4.2	-18	105	*	WSLUA	VK7MO	QE37	1	31
141200	5	-20	4.2	-15	94	*	WSLUA	VK7MO	QE37	1	43

Working some issues with DT numbers that appear to be 1 to 2 seconds high compared to actual path delay prediction

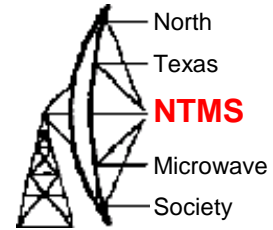


# QSO Procedure using JT-4F/G



- Both stations send 1270 Hz to help with alignment – usually for about 5 minutes
- Both calls are sent
- When both calls are received then send both calls and dB signal report as calculated by WSJT
- When both calls and report are received then send single tone @1500 Hz which designates R
- When R is received , then send single tone @1700 Hz which designates 73
- When signals are strong then text can be substituted for single tones

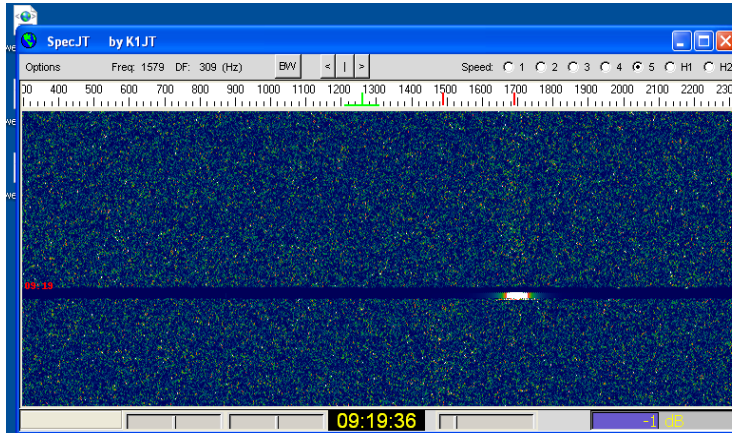
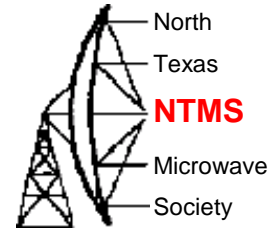
# 1.14M Prime Focus Dish used by VK7MO on 24 GHz EME



AZ-EL Mount Details



# 24 GHz QSO with VK7MO using JT-4F



FlexRadio Systems PowerSDR v2.5.3 FLEX-5000: 1708-2183

STOP VFO A: 24048.107 688 TX VFO B: 24048.092 312

VFO Sync Tune Step: 10Hz VFO Lock 78132.11256 Save Restore

MON TUN MOX MUT REC PLAY AF: 22 AGC-T: 101 Drive: 21 AGC Preamp Fast On

SQL: -81

RX1: ANT1 TX: ANT1 RX2: RX2-IN

4/25/2013 LOC: 09:19:36 CPU %: 27.3

AGC-T: 90

SPLIT A > B NR ANF Panadapter

NR ANF NB NB2 AVG Peak

IF > V A < B SR BIN TNF +TNF

XIT 0 RIT 0 VAC1 VAC2 MultiRX Swap

Mic 7 Transmit Profile: Default

DX 3 CPDR 1 Show TX Filter on Display

VOX 100 RX EQ TX EQ

DEXP -40

LSB USB DSB 5.0k 4.4k 3.8k

CWL CWU FM 3.3k 2.9k 2.7k

AM SAM SPEC 2.4k 2.1k 1.8k

DIGL DIGU DRM 1.0k Var 1 Var 2

Width: Shift: Reset

RX2 Meter Signal: 0.0 dBm

WSJT 9.5 r3033 by K1JT

File Setup View Mode Decode Save Band Help

Moon Az: 234.94 El: 22.89 Dop: -2110 Dgrd: -0.6

FileID	Sync	dB	DT	DF	VV	WSLUA_130425_091700
090900	0	-20	1.5	-300	4	#
090900	0	-21	3.6	-13	7	#
091100	0	-21	-0.8	9	4	*
091300	2	-19	3.7	-22	20	#
091500	0	-21	-0.4	-18	9	*
091700	0	-21	-1.0	-26	4	#

091700 2 8/8

Log QSO Stop Monitor Decode Erase Clear Avg Include Exclude TxStg

To radio: WSLUA Lookup Sync -2 Zep WSLUA WSLUA EM13 Tx1

Grid: EM13qc Add Tol 50 AFC WSLUA WSLUA -19 Tx2

Az: 0 0 mi MinW A Efreeze WSLUA WSLUA R-19 Tx3

2013 Apr 25 09:19:36 Tx First WSLUA WSLUA RRR Tx4

Dsec 0.0 Bpt: -20 WSLUA WSLUA 73 Tx5

Gen Msgs Auto to ON @1700 Tx6

0.9999 1.0001 JT4F Freeze DF: -10 Rf noise: 0 dB TR Period: 60 s Receiving

FlexM TO 30913

TIME	DATE	IGT	AZ	EL	AZC	ELC	DEC	AZ ERROR	EL
09:19:23	04/25/13	MOON	OFF	234.88	22.92131.9	0.1	-12.7	0.65	0.69

ANTENNA	AZIM	ELEV	Band:	24048MHZ
1296	66.85	88.42	Doppler:	-39864.0
2304	139.84	85.04	Sky Ten:	2.7
3400	149.28	85.00	Loss dB:	0.49
5760	189.20	87.50	Idag dB:	0.49
10368	131.87	80.42	Pol:	-45
24048	234.93	22.91	Lib:	242.5
47088	93.62	23.24		
77184	103.41	22.74		

APR 25 2013 09:19:23	THU	FRI	SAT
SUN MON TUE WED	4	5	6
1	2	3	4
7	8	9	10
14	15	16	17
21	22	23	24
28	29	30	25
			26
			27

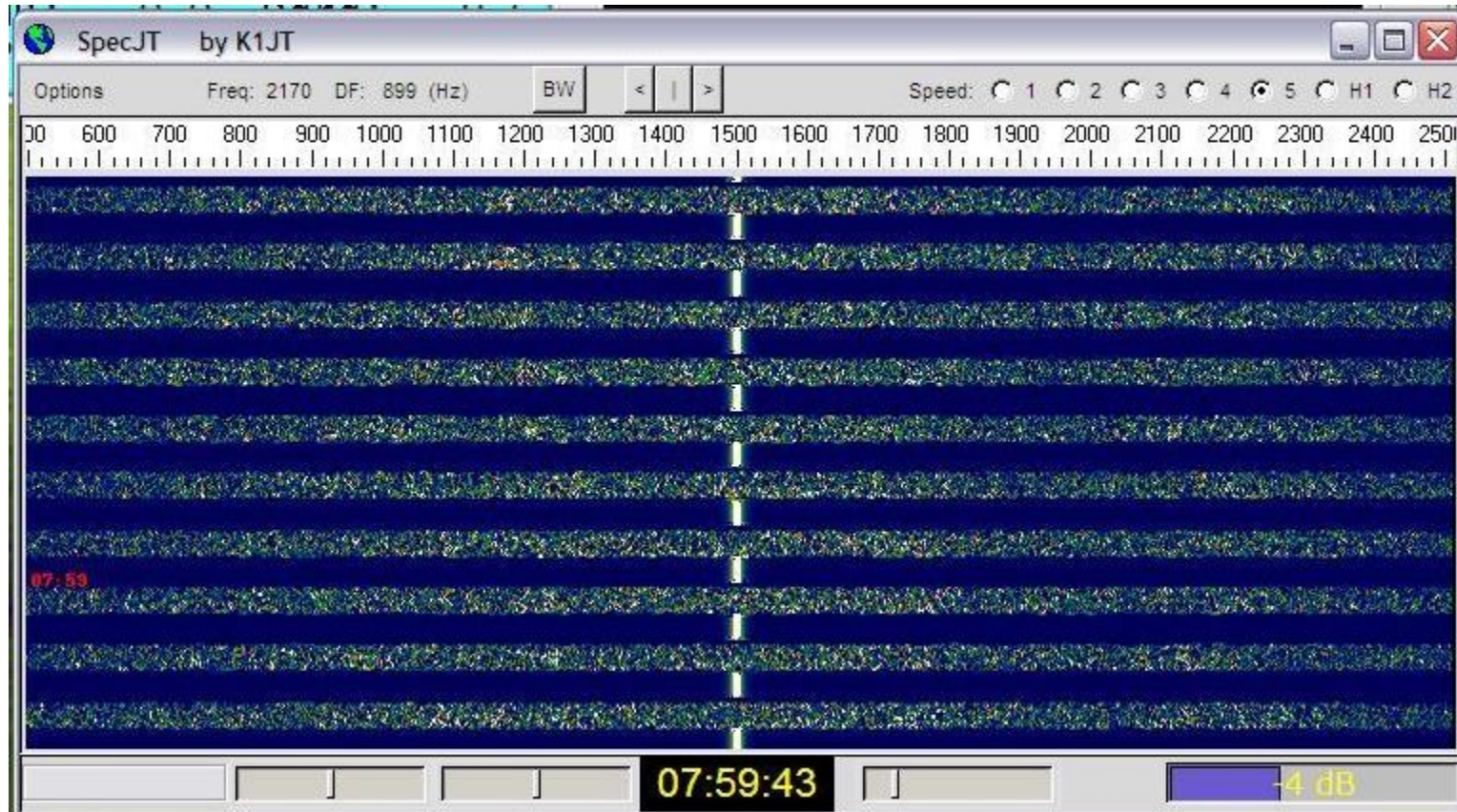
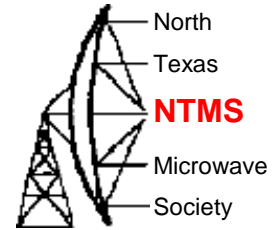
Rev:	AUTO ZERO	STATION B DATA
Rev:	24048.107690	Call: VK7MO
Enter:	24048.092310	Lat: -42.896
Shed:	24048.100000	Lon: 212.708
Stn2:	24048.100000	Az: 83.94
		El: 25.25
		Dop: 54440
		Mdop: 7688
		Pol: -42
		Mpol: 3
		Lib: 9
		Mlib: 126

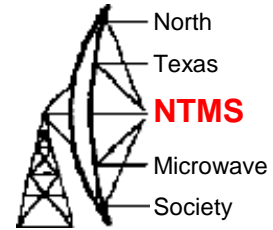
<esc> <E> <B/h> <T> <A> <M> <U> <Z> <C> <F> <O> <L> <P> +\* ->  
 exit hnd tgt a/t nan pos a/z cal f/t stnB lib plan

K5GW software controls Flex 5000 frequency



# VK7MO Seeing his Echoes on 24 GHz

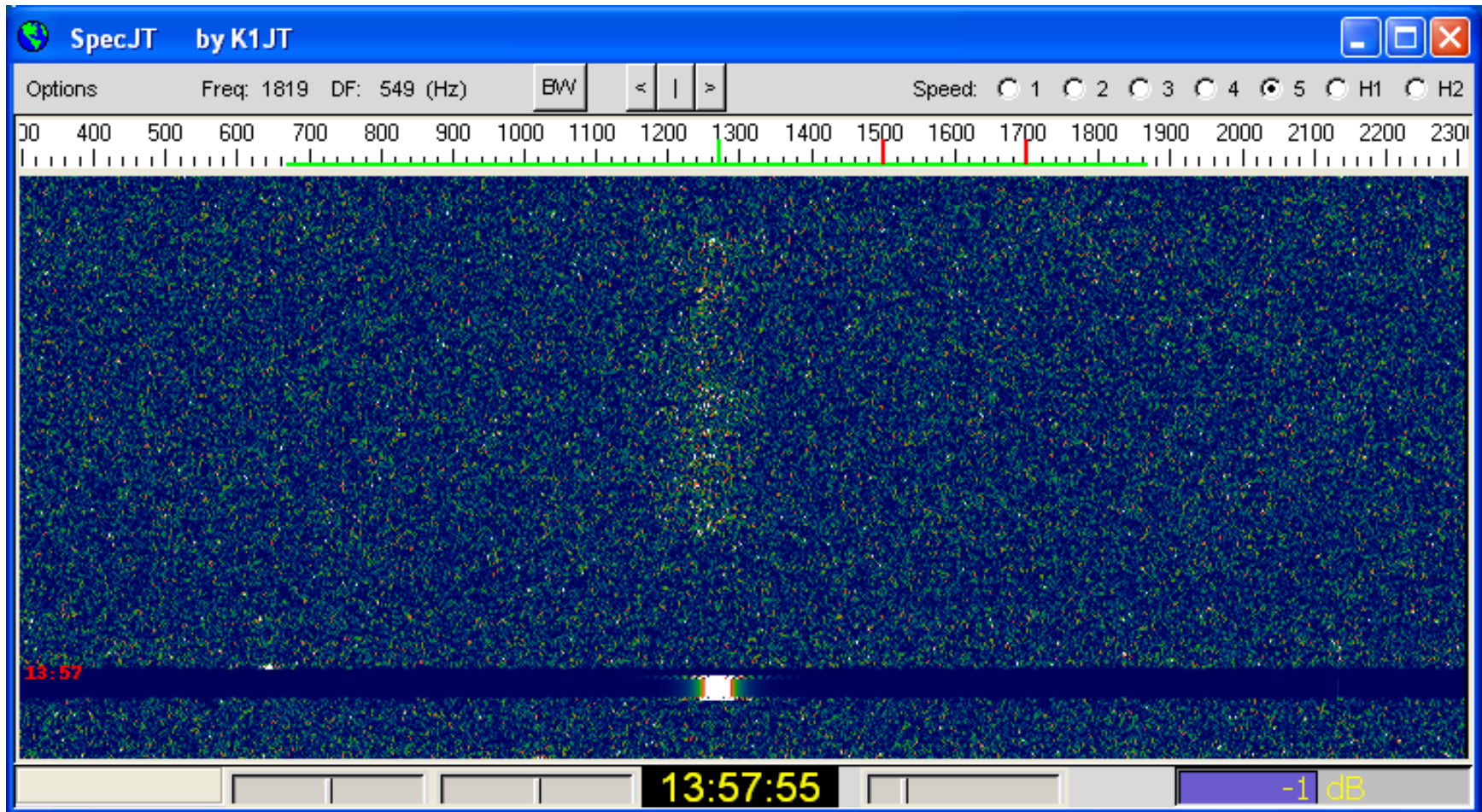
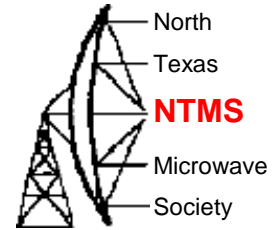




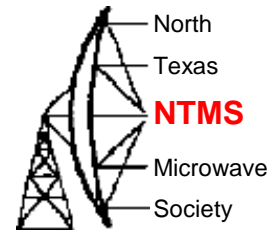
# 24 GHz EME QSO Between W5LUA and OZ1FF March 2013



# OZ1FF on 24 GHz – 1270 Hz



# OZ1FF on 24 GHz – 1270 Hz



**WSJT 9.5 r3033 by K1JT**

File Setup View Mode Decode Save Band Help

4.0 Time (s) OZ1FF\_130311\_135700

FileID	Sync	dB	DT	DF	W
134700	1	-19	-0.5	571	4 *
134900	2	-19	-1.3	-599	4 #
135100	0	-20	-0.6	324	4
135300	0	-21	4.6	486	7
135500	0	-21	-0.8	470	4
135700	1	-19	-0.9	-545	9 *

**Moon**

Az: 104.87  
 El: 19.45  
 Dop: 7958  
 Dgrd: -1.3

135700	1	7/7
135700	2	5/5

Log QSO
Stop
Monitor
Decode
Erase
Clear Avg
Include
Exclude
TxStgp

To radio:

Grid:

Az: 35      4898 mi

**2013 Mar 11**  
**13:58:19**

Dsec 0.0

Sync  1     Zap

Tol 400     AFC

MinW A     Freeze

Tx First

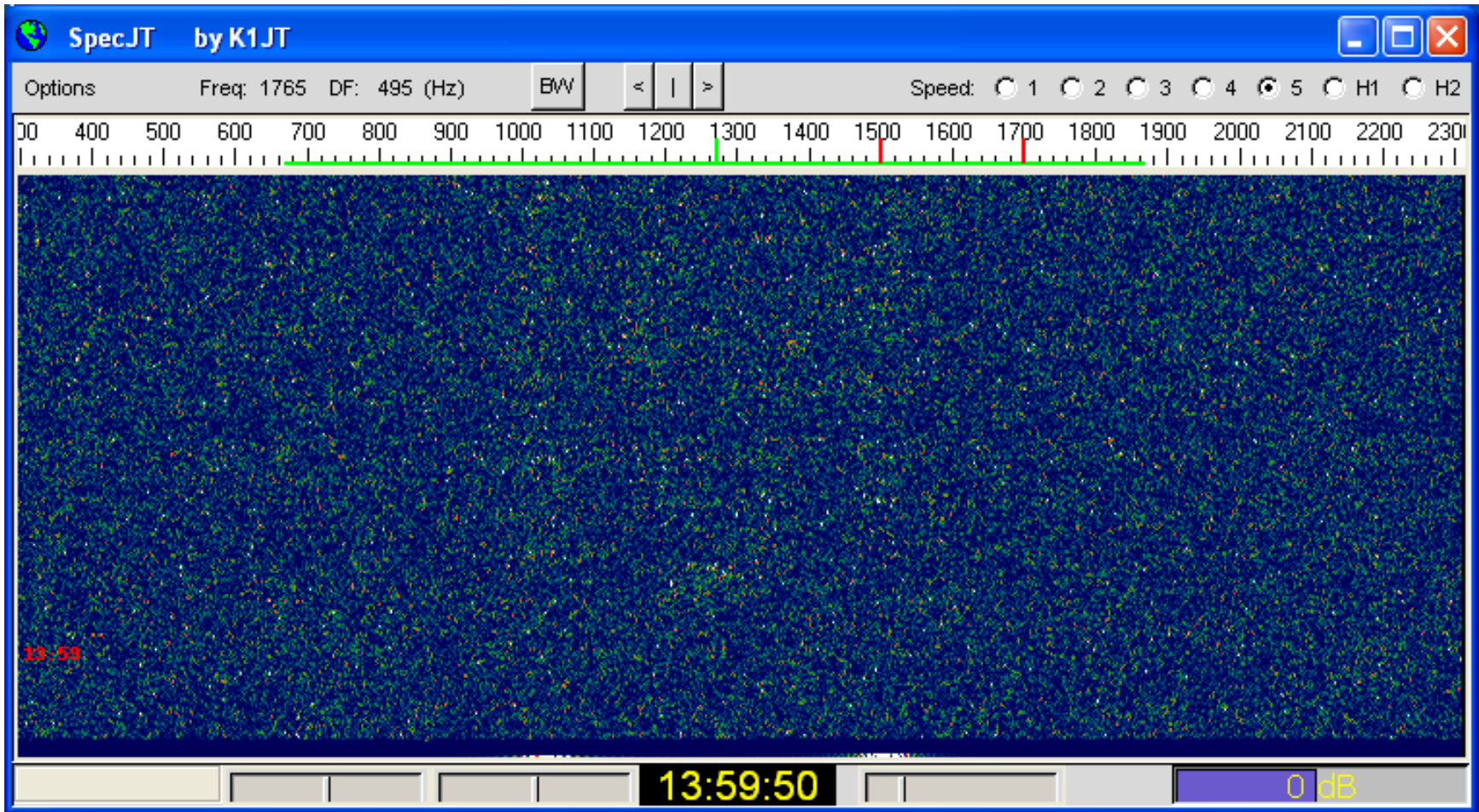
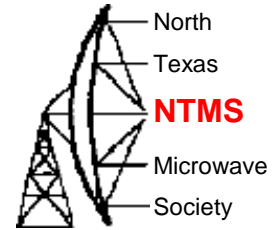
Rpt:

OZ1FF W5LUA EM13	<input checked="" type="radio"/>	Tx1
OZ1FF W5LUA -21	<input type="radio"/>	Tx2
OZ1FF W5LUA R-21	<input type="radio"/>	Tx3
@1500 (RRR)	<input type="radio"/>	Tx4
@1700 (73)	<input type="radio"/>	Tx5
@1270	<input type="radio"/>	Tx6

1.0000 0.9999
JT4F
Freeze DF: 0
Rx noise: 0 dB
T/R Period: 60 s
Txing: OZ1FF W5LUA EM13

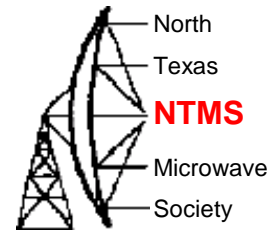


# OZ1FF on 24 GHz sending messages





# Calls Received



**WSJT 9.5 r3033 by K1JT**

File Setup View Mode Decode Save Band Help

**Moon**  
Az: 105.49  
El: 20.28  
Dop: 7458  
Dgrd: -1.3

3.4 Time (s) OZ1FF\_130311\_140100

FileID	Sync	dB	DT	DF	W	
135300	0	-21	4.6	486	7	
135500	0	-21	-0.8	470	4	
135700	1	-19	-0.9	-545	9 *	
135900	6	-15	4.9	-13	79 *	W5LUA OZ1FF 1 0 E
140100	2	-18	-0.8	-315	9 *	
140100	0	-21	-1.3	-155	4	

140100	1	7/7
140100	2	4/4

Log QSO
Stop
Monitor
Decode
Erase
Clear Avg
Include
Exclude
TxStgp

To radio:

Grid:

Az: 35      4898 mi

**2013 Mar 11**  
**14:02:29**

Dsec 0.0

Sync  1     Zap

Tol 50     AFC

MinW A     Freeze

Tx First

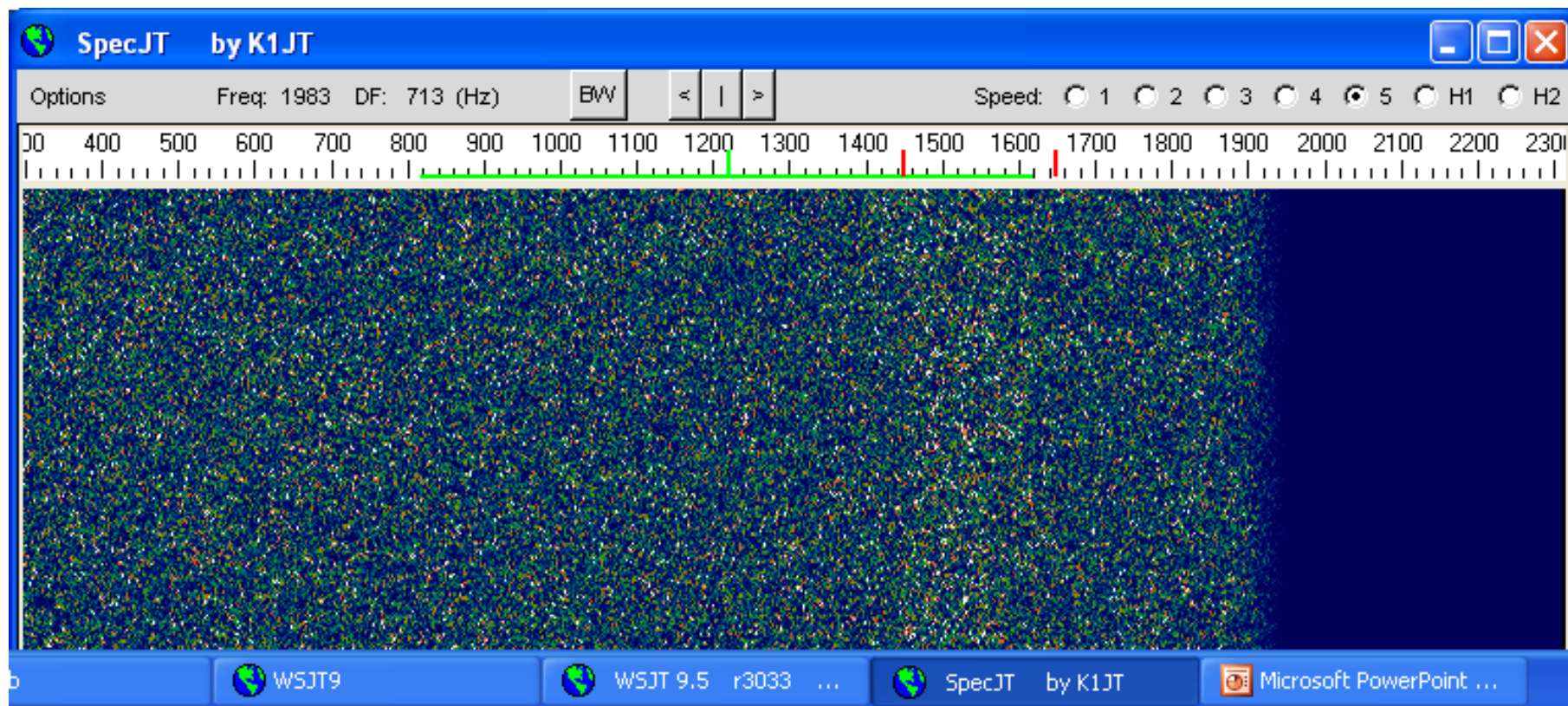
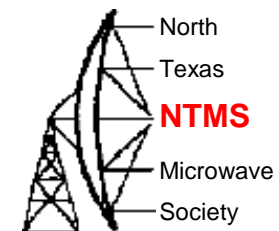
Rpt:

Gen Msgs     Auto is ON

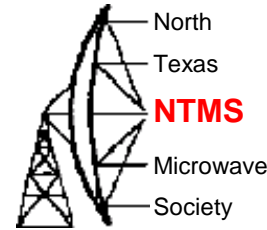
OZ1FF W5LUA EM13	<input type="radio"/>	Tx1
OZ1FF W5LUA -15	<input checked="" type="radio"/>	Tx2
OZ1FF W5LUA R-15	<input type="radio"/>	Tx3
@1500 (RRR)	<input type="radio"/>	Tx4
@1700 (73)	<input type="radio"/>	Tx5
CQ W5LUA EM13	<input type="radio"/>	Tx6

1.0000 1.0000
JT4F
Freeze DF: -104
Rx noise: 0 dB
T/R Period: 60 s
Txing: OZ1FF W5LUA -15

# Receiving single tone R from OZ1FF



# Receiving 73 from OZ1FF



**WSJT 9.5 r3033 by K1JT**

File Setup View Mode Decode Save Band Help

**Moon**

Az: 86.22  
 El: 23.01  
 Dop: 10381  
 Dgrd: -2.0

4.1 Time (s) OZ1FF\_130315\_163900

FileID	Sync	dB	DT	DF	W	
163300	0	-21	2.3	-182	4	
163300	0	-21	2.3	-182	4	#
163300	0	-20	0.1	-24	4	#
163500	5	-16	4.3	-24	77	# W5LUA OZ1FF -11 1 20 F
163700	1	-19	4.4	-15	4	#
163900	1	-20	-1.3	20	4	#

163900	1	7/7				
163900	2	12/12				W5LUA OZ1FF 73 ? 0 2

Log QSO Stop Monitor Decode Erase Clear Avg Include Exclude TxStgp

To radio:

Grid:

Az: 35 4898 mi

**2013 Mar 15**  
**16:40:37**

Dsec 0.0

Sync -2  Zap

Tol 400  AFC

MinW A  Freeze

Tx First

Rpt:

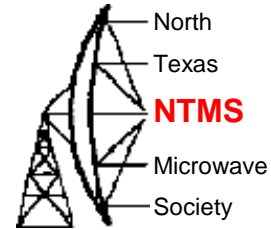
Gen Msgs

OZ1FF W5LUA EM13	<input type="radio"/>	Tx1
OZ1FF W5LUA -16	<input type="radio"/>	Tx2
OZ1FF W5LUA R-16	<input type="radio"/>	Tx3
@1500 (RRR)	<input type="radio"/>	Tx4
@1700 (73)	<input checked="" type="radio"/>	Tx5
CQ W5LUA EM13	<input type="radio"/>	Tx6

1.0000 1.0000 JT4F Freeze DF: -51 Rx noise: 0 dB T/R Period: 60 s

Txing: @1700 (73)

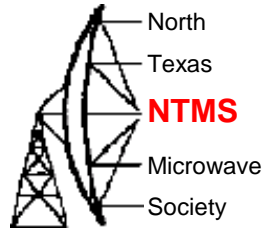
# 24 GHz Stations using JT-4



- VK7MO .7 M Prime focus dish and 9 watts
- W5LUA 2.4M Offset fed dish and 100 watts
- OK1KIR 4.5M Prime focus dish and 20 watts
- VK3XPD 3M Prime focus dish and 15 watts
- OZ1FF 1.8M Offset fed dish and 10 watts

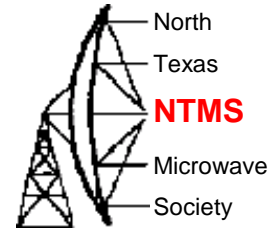
Other stations QRV on 24 GHz EME via CW include VE4MA, RW3BP, OK1UWA, LX1DB, G4NNS, DK7LJ, DF1OI, PA0EHG, DL7YC, IK2RTI, JA6CZD, F2CT, RK3WWF

# Coordination



- HB9Q Logger for schedule coordination and chat on 432 MHz and higher <http://hb9q.ch/version2/index.php>
- 432 MHz and Above newsletter published every month for over 30 years  
<http://www.nitehawk.com/rasmit/em70cm.html>
- Moon-Net Reflector <http://www.nlsa.com/nets/moon-net-help.html>
- Moon Reflector <http://lists.moonbounce.info/cgi-bin/mailman/listinfo/moon>
- Microwave Reflector <http://lists.valinet.com/cgi-bin/mailman/listinfo/microwave>

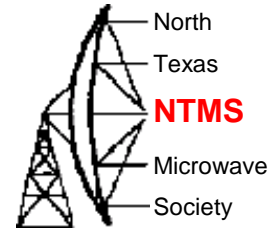
# You might very well be close with your tropo setup but..



- Are you GPS locked?
- Do you have the proper software for predicting the moon location?
- Can you track the moon? Remember a 36 inch dish has a 3dB beam width of 2.3 degrees and a 1 dB beam width of 1.3 degrees at 10 GHz
- Elevation is easy – Remote a Sears inclinometer as written up by WA8RJF
- Azimuth – Use either a US Digital absolute encoder or an incremental encoder and a W2DRZ system or an HB9DRI system for both az and el. Other option for US Digital absolute encoders is the use of a Weeder RS-232 controlled relay control board and K5GW software
- Calibration – use the sun
- Let's run!

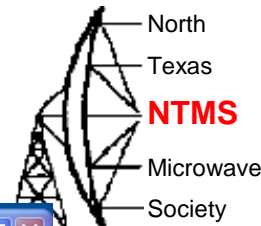


# Thanks to K1JT & VK7MO



- Thanks to Joe Taylor K1JT for taking inputs and comments from VK7MO to help optimize the JT-4 modes for 10 and 24 GHz EME
- Check out Dubus 2/2013 for the article “Small Station EME at 10 & 24 GHz by Rex Moncur, VK7MO, and Joe Taylor, K1JT

# EME has been conquered through 47 GHz Next Challenge – 77GHz EME



FlexRadio Systems™ PowerSDR™ v2.6.4 FLEX-5000: 1708-2183

Setup Memory Wave Equalizer XVRTS CWX Mixer Antenna FlexControl ESC Get Help Hergs About

**START**

MON TUN  
MOX  
MUT

VFO A: **77184.043 750**  
Out of Band TX

VFO Sync Tune Step: -10Hz  
VFO Lock 7.000000 Save Restore

VFO B: **77184.156 246**  
Out of Band

RX1 Meter TX Meter  
Signal Fwd Pwr  
**-97.8 dBm**

AF: 2  
AGC-T: 90  
Drive: 50  
AGC Preamp Fast On

SQL: -56

RX1: ANT1  
TX: ANT1  
RX2: RX1 Tap

6/6/2013  
LOC 16:57:59  
CPU %: 21.9

SPLIT A > B  
0 Beat A < B  
IF->V A <> B  
XIT 0 RIT 0  
0 VACT VAC2

NR ANF  
NB NB2  
SR BIN

Part: \_\_\_\_\_

77184.025.0 77184.030.0 77184.035.0 77184.040.0 77184.045.0 77184.050.0 77184.055.0 77184.060.0 77184.065.0

-75  
-85  
-95  
-105  
-115  
-125

77184.025.0 77184.030.0 77184.035.0 77184.040.0 77184.045.0 77184.050.0 77184.055.0 77184.060.0 77184.065.0

-19638.3Hz -104.1dBm 77184.024 116 MHz

zfm	zocm	902
1296	2304	3400
3456	5760	10368
24048	24192	47088
HF	78192	77184

LSB	USB	DSB
CWL	CWU	FM
AM	SAM	SPEC
DIGL	DIGU	DRM

ca FlexMT052313

TIME	DATE	TGT	A/T	AZ	EL	AZC	ELC	DEC	AZ ERROR	EL
16:57:59	06/06/13	MOON	OFF	181.92	74.78-19.2	-0.7		18.2	-99.48	-31.67

ANTENNA AZIM ELEU Band: 77184MHZ  
1296 71.93 86.89 Doppler:-13875.3  
2304 133.08 83.51 Sky Tem: 2.7  
3400 133.47 83.47 Loss dB: 2.13  
5760 168.05 85.94 Tdeg dB: 2.13  
10368 128.99 86.93 Pol: -88  
24048 213.70 43.67 Lib:1849.3  
47088 92.20 44.17  
77184 82.44 43.12

JUN 06 2013 16:57:59  
SUN MON TUE WED THU FRI SAT  
2 3 4 5 6 7 8  
9 10 11 12 13 14 15  
16 17 18 19 20 21 22  
23 24 25 26 27 28 29  
30

FTRACK  
Rcvr freq:77184.043754  
Xmtr freq:77184.156246  
Sked freq:77184.100000

STATION B DATA  
Call:WJ3BP Grid:K085MS  
Lat: 55.77 Lon: 322.125  
Az:317.51 El: -7.76  
Dop:-98624 Mdop:-56250  
Pol:-67 Mpol: 21  
Lib: 895 Mlib: 1372

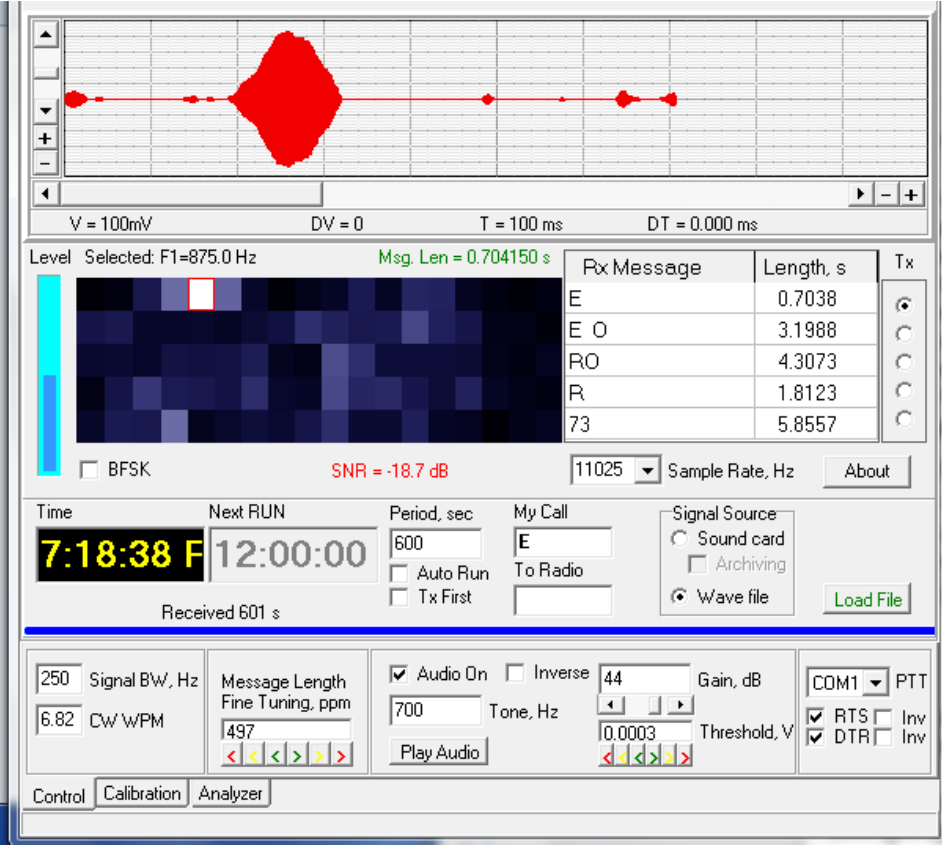
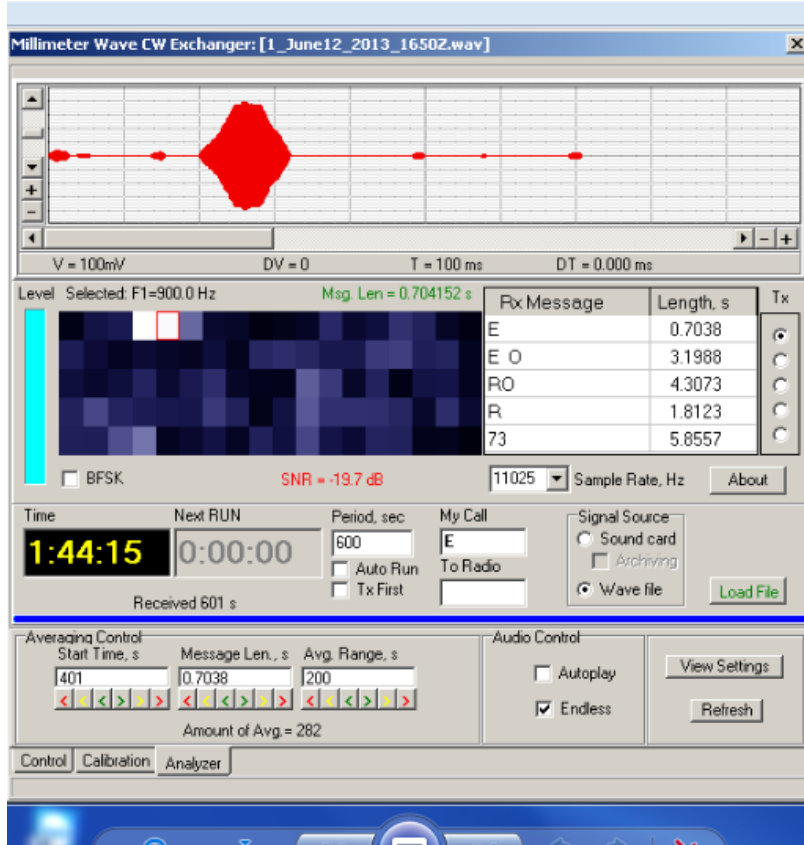
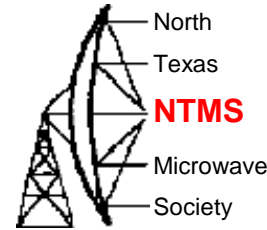
OPMODE:USB TMODE:3 REX

<esc> <E> <B/h> <T> <A> <M> <U> <Z> <C> <F> <O> <L> <P> <+> <->  
exit bnd tgt a/t man pos a/z cal f/t stnB lib plan

GE	HE	IE	JE	KE	LE	ME	NE	OE	PE
GD	HD	ID	JD	KD	LD	MD	ND	OD	PD
GC	HC	IC	JC	KC	LC	MC	NC	OC	PC
GB	HB	IB	JB	KB	LB	MB	NB	OB	PB
GA	HA	IA	JA	KA	LA	MA	NA	OA	PA



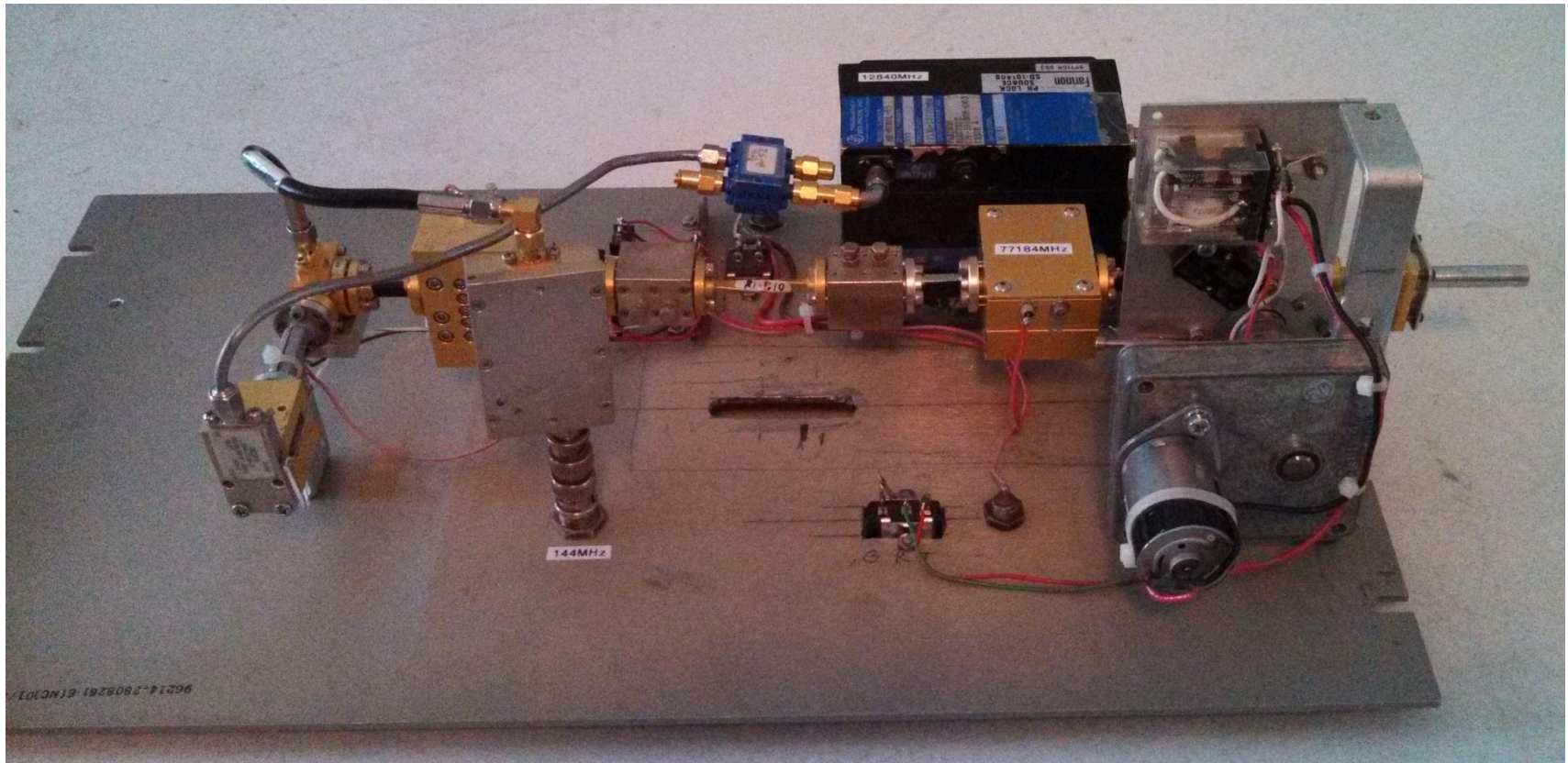
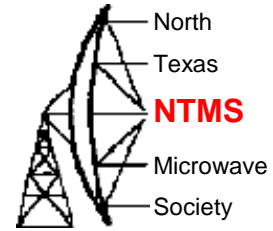
# Reception of RW3BP by W5LUA on 77184 MHz on June 12, 2013 using RW3BP's MMCW Program



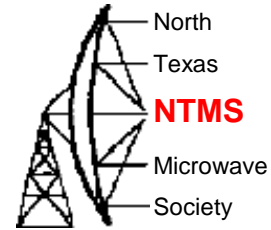
.wav file as replayed by RW3BP

Same .wav file as replayed by W5LUA with 497 ppm correction to message length

# W5LUA 77 GHz Assembly at Feed of 2.4 M Dish

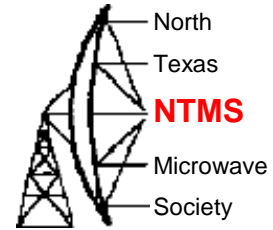


# 77 GHz Power Needed!



- Power needed – any leads on available power in the 77 to 81 GHz frequency range appreciated! My 47 GHz TWT is providing about 13 dB gain at 77 GHz but not sure of the power capability, also tuning is very touchy!

# Thanks for Listening!



- Any Questions?
- My presentation will be posted to [www.ntms.org](http://www.ntms.org) after the conference