Welcome to The North Texas Microwave Society Hamcom June 8, 2019

- Introduction to the NTMS
- Building Equipment for the Microwave Frequencies
- VHF and Microwave Propagation
- Using Digital Modes on the Microwave Frequencies
- Roving
- Microwave Update Conference

The North Texas Microwave Society was formed in 1986

North Texas NTMS Microwave Society

Dedicated to Promoting Activity, the State of the Art in Equipment Design, and the Exchange of Ideas and Technology for the Amateur Bands Above 902 MHz

President – Al Ward W5LUA
Vice President – Kent Britain WA5VJB
Secretary – Eric Haskell KC4YOE
Treasurer - Wes Atchison WA5TKU
Web – Dave McCoy N5RIJ

NTMS web page www.ntms.org

Check out our reflector on NTMS Yahoo Groups

Calling Frequencies for Weak Signal Work on CW and SSB and EME

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Band	Weak Signal Calling Frequency
902-928 MHz	902.1 MHz
1240-1300 MHz	1296.1 MHz
2300-2310 MHz	2304.1 MHz
2390-2450 MHz	2400.1 MHz (used only for EME)
3300-3500 MHz	3456.1 MHz (3400.1 MHz used for EME
5650-5925 MHz	5760.1 MHz
10.0-10.5 GHz	10368.1 MHz (10450.1 MHz also used for EME)
24.0-24.25 GHz	24192.1 MHz (24048.1 MHz used for EME)
47.0-47.2 GHz	47088.1 MHz
76 - 81.0 GHz	78192.1 MHz and 76032.1 MHz
122.25 - 123 GHz	
134 - 141 GHz	
241-250 GHz	
All above 275 GHz	

NTMS Activities

- Monthly meetings (usually the first Saturday) with informal “bull and swap” session followed by technical presentations
- Noise figure and network analyzer test sessions at meetings or at members houses
- Antenna range for measuring antenna gain
- Equipment Construction
- Contesting
- Social events
- Sponsor Microwave Update conference

North Texas Beacons

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North Texas Microwave Society area Beacon Status updated January 16, 2019								
Outside temp = 55F								
Please send updates to w5lua@sbcglobal.net								
Freq (MHz)	Call	Grid	Power Output	Antenna	Height above Ground	Status	GPS Locked ?	Keying
50.072.7	W5HN/B	EM13sj	.5 W	Halo	180 ft	ON THE AIR	NO	on/off
144.280.2	W5HN/B	EM13sj	1.5 W	Halo	180 ft	ON THE AIR	NO	on/off
222.060	AA5C/B	EM13se	8 W	Folded Dipole	53 ft	ON THE AIR	NO	on/off
432.370	N5PYK/B	DM93bm	50 W	Yagi towards DFW	70 ft	ON THE AIR	NO	on/off
432.380	W5HN/B	EM13kf	.8 W	Halo	280 ft	ON THE AIR	NO	on/off
903.050	W5HN/B	EM13kf	9 W	Alford Slot	280 ft	ON THE AIR	NO	on/off
1296.375	W5HN/B	EM13kf	3 W	Alford Slot	280 ft	ON THE AIR	NO	on/off
2304.366	W5HN/B	EM13kf	4 W	Alford Slot	280 ft	ON THE AIR	NO	FSK
3456.382.5	W5HN/B	EM13kf	250 mW	Alford Slot	280 ft	ON THE AIR	NO	FSK
5760.364	W5HN/B	EM13kf	158 mW	Alford Slot	280 ft	ON THE AIR	NO	FSK
10368.368	W5HN/B	EM13kf	2.5 W	Alford Slot	280 ft	ON THE AIR	NO	FSK
24192.308	AA5C/B	EM13sf	500 mW	16-slot WR42	75 ft	ON THE AIR	NO	on/off
47088.300	Under construction							

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Tune-up Parties

NTMS Weekly Gatherings on the Radio

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- Sunday 8PM 144.260 MHz USB NET run by Ross K5ZSJ from the Carrollton area

- Monday 7:30PM 144.174 MHz FT-8 followed by FT-8 activity on 222.074 MHz and higher frequencies

Microwave Propagation

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- Terrestrial weak signal CW/SSB/WSJT modes – work up to 1000 miles plus under the right tropospheric conditions
- Rain & Snow Scatter CW/FM – work hundreds of miles
- EME (Earth – Moon - Earth) CW/SSB/WSJT Modes – JT-65, JT-4, QRA-64D

Getting on Microwave

- Conventional method is to use your favorite VHF Multiband SSB-CW Transceiver and connect to a Transverter.
- A transverter uses a local oscillator and mixers to upconvert from an IF like 2m to an RF frequency like 10368 MHz on transmit and the reciprocal on receive.
- As an example an LO of 10224 MHz can be used to mix with 144 MHz to achieve 10368 MHz
- Now to build or buy?

Various 10 GHz surplus items that could be used to build a transverter

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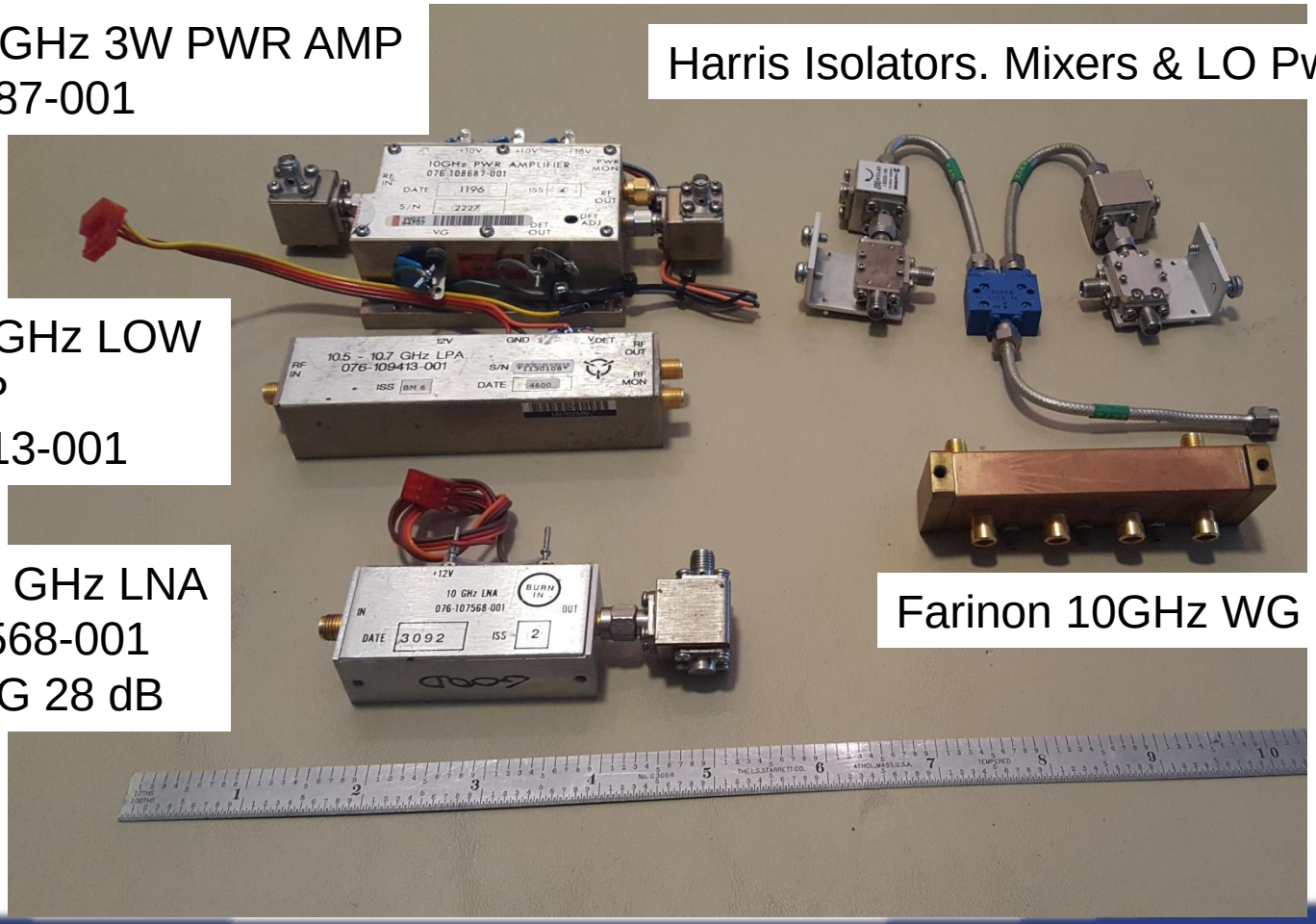
Harris 10 GHz 3W PWR AMP
076-108687-001

Harris Isolators. Mixers & LO Pwr Divider



Harris 10 GHz LOW
PWR AMP
076-109413-001

Harris 10 GHz LNA
076-107568-001
NF 2dB, G 28 dB

Farinon 10GHz WG Filter

www.w1ghz.org

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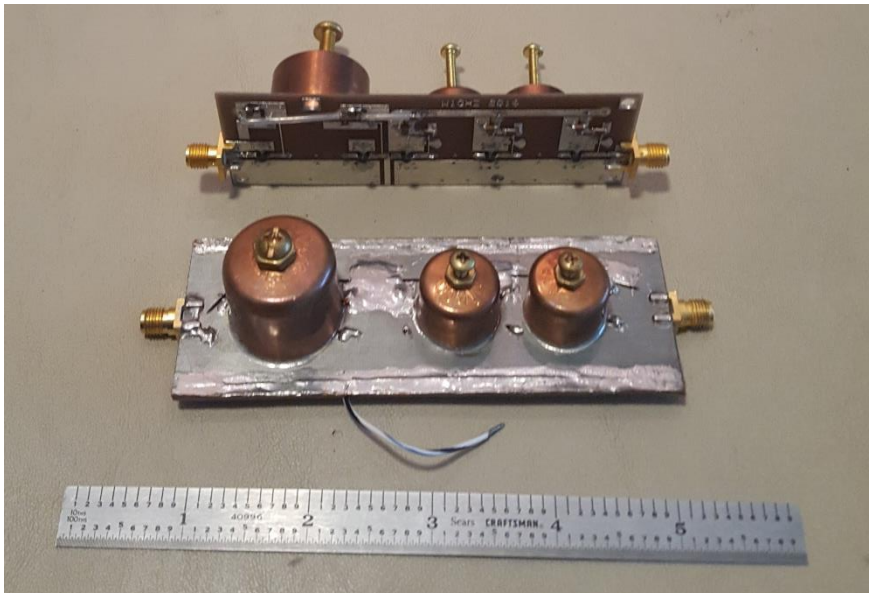
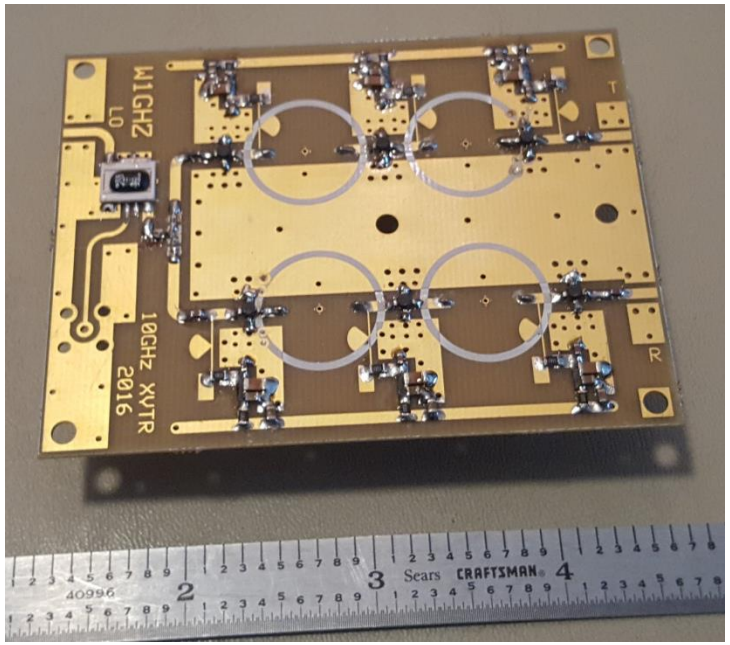
Paul Wade makes numerous circuit boards for many microwave projects.
Here are 2 PCBs for 10 GHz



X9 Multiplier
Fin=1136 MHz Fout=10224 MHz



10 GHz Transverter 10368 MHz to 144 MHz
LO in = 10224 MHz

Local Oscillator Boards

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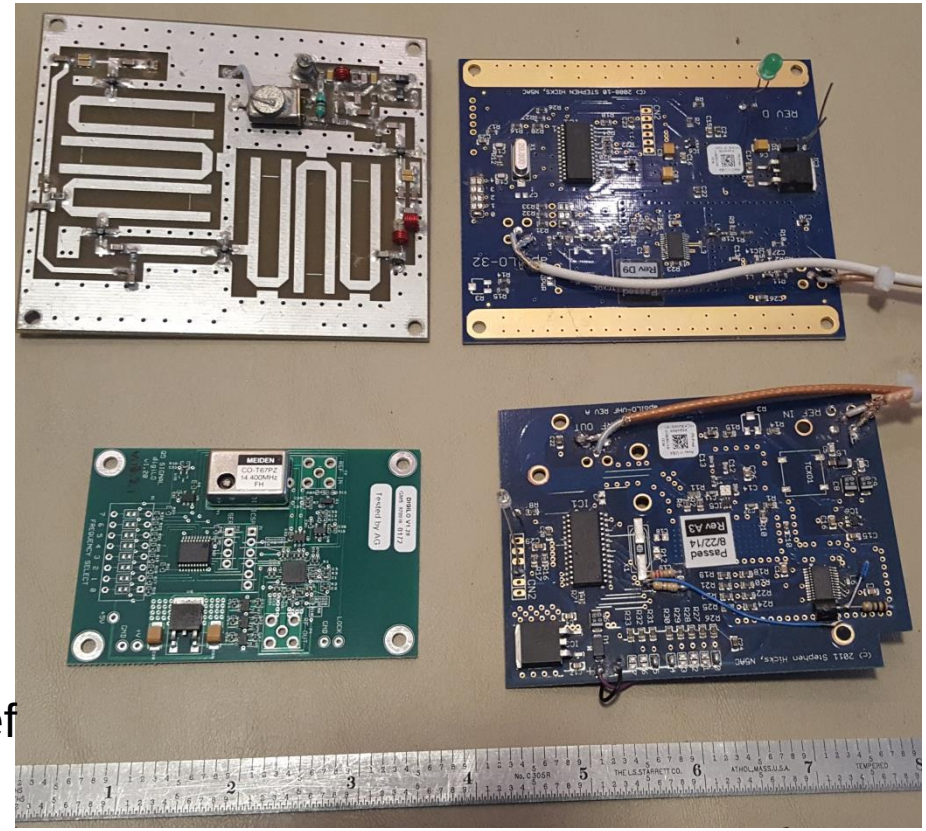
DEMI Micro LO
1080-1136 MHz
Crystal Controlled



DEMI N5AC ApolLO
900-1300 MHz
PLL 10 MHz Ref

DEMI/Q5Signal
DigiLO PLL
23.5MHz - 6GHz
Internal Ref or
External10 MHz Ref

DEMI N5AC VHF ApolLO
70-410 MHz
PLL 10 MHz Ref

ADF5355 PLL Synthesizer 54 MHz to 13.6 GHz

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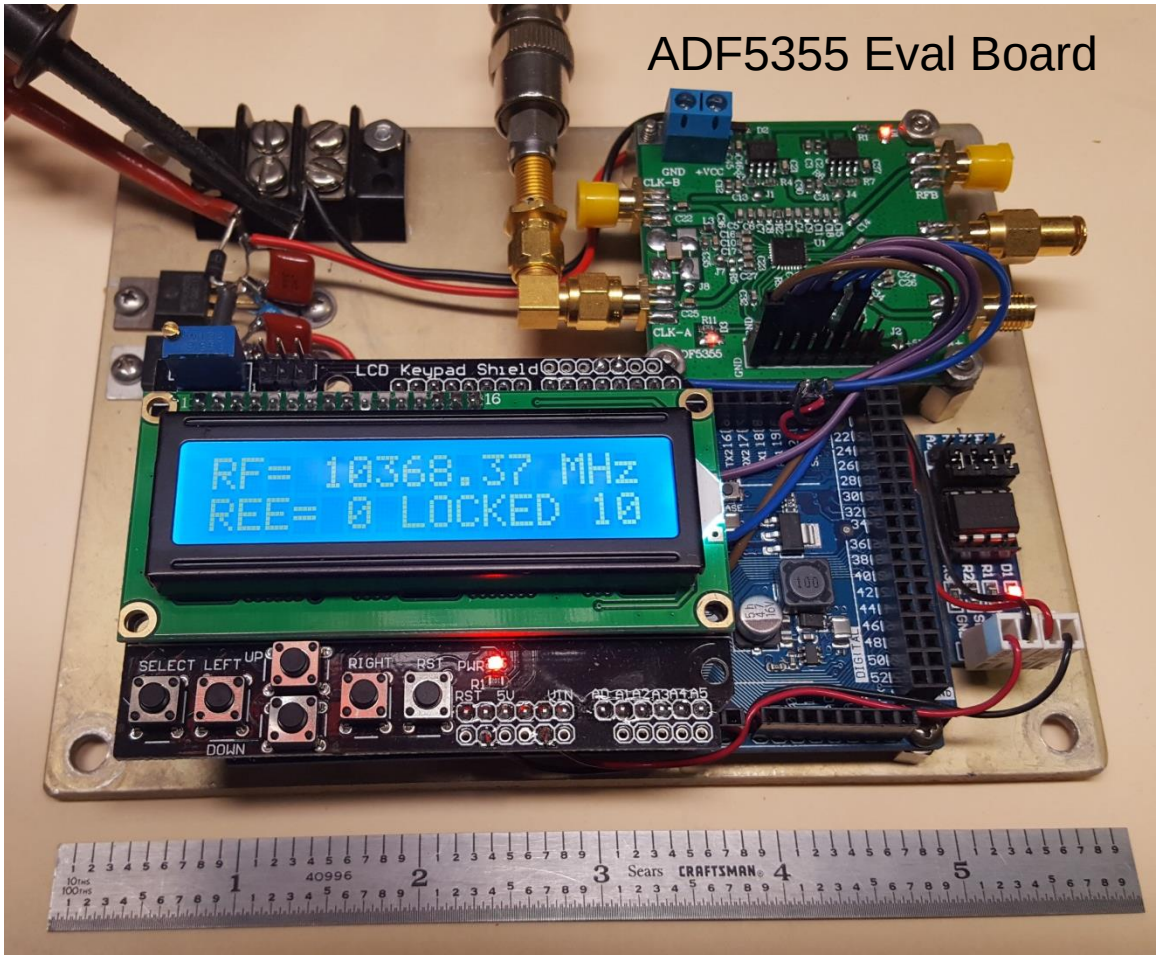

Presentation on
www.ntms.org
-Knowledge Base
-At the meetings
-September 2017
“ADF-4351 and ADF5355 Update by Greg McIntire AA5C

Arduino Due & LCD Shield & EEProm Board

Built by W5LUA

ZLPLL based on the ADF4351

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- **Specifications:**
- 31MHz to 4400MHz
- Fractional-N synthesizer capable of 1KHz (or better) frequency resolution
- 2 x RF outputs +7dBm from 500MHz to 2GHz
- 4 software programmable output levels at 2dB increments
- No Tuning required
- Frequency selection to one of 16 preset values (optional)
- RS232 interface for programing of frequency and power levels
- Frequency offset for TX (optional)
- Several reference frequency options:
  - Internal OCXO or VCXO reference
  - External Reference up to 100MHz
- Automatically switch from internal to external frequency reference
- CW Beacon firmware available
- Having 2 high level outputs is useful for applications sharing the same LO module between 2 transverters, or driving separate RX and TX stages.

115 USD

ZLPLL 14 GHz based on the ADF5355

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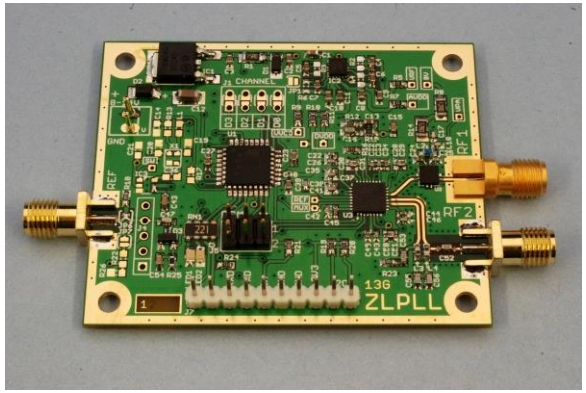
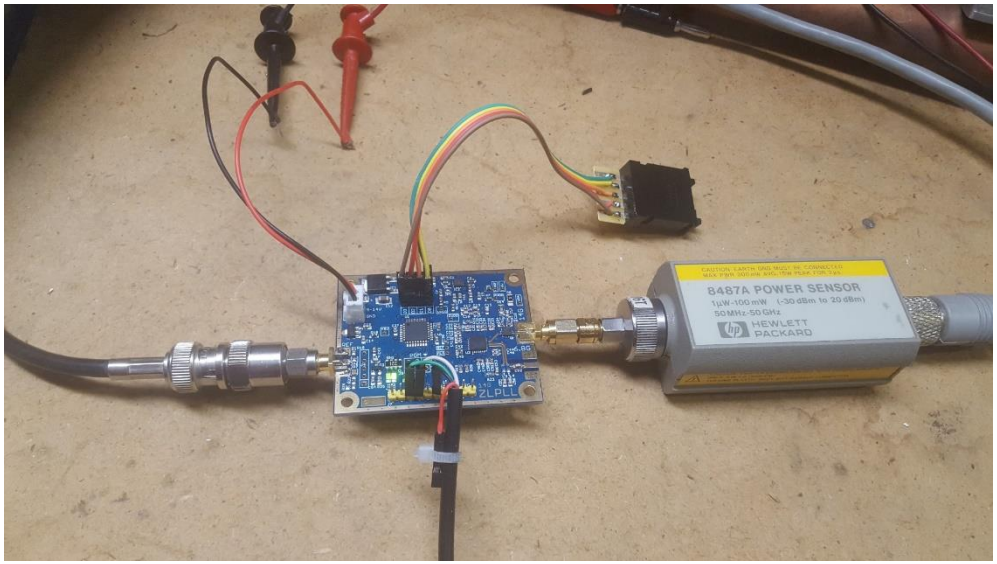
- **Specifications:**
- 54MHz to 13600MHz
- 2 x RF outputs 14G and 6.8G
- 4 software programmable output levels at 2dB increments
- No Tuning required
- RS232 interface for programing of frequency and power levels
- Requires external 10 MHz or higher reference
- CW Beacon firmware available
- +14 dBm Typical



190 USD



Most Popular Commercial XVTRs

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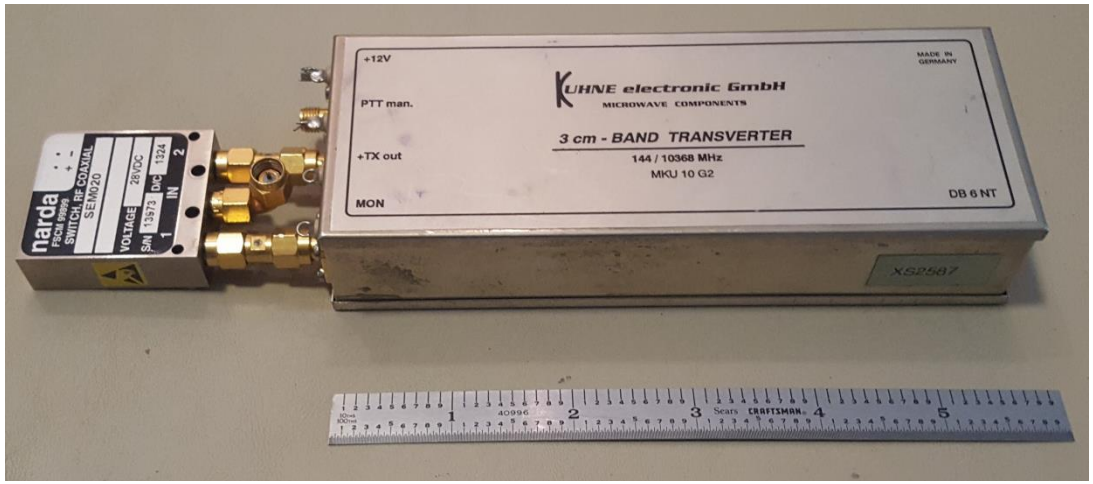
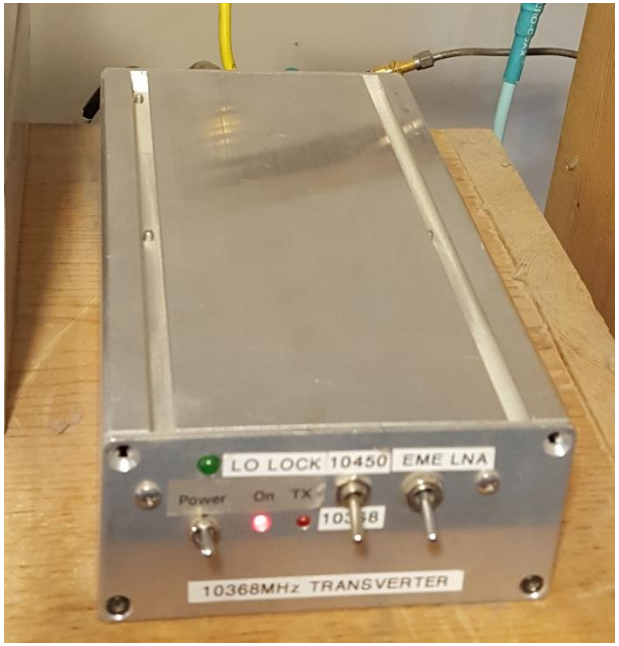
DB6NT



https://shop.kuhne-electronic.com/kuhne/en/shop/

DEMI



https://www.downeastmicrowave.com/

Others as well…

Antenna options for 10 GHz

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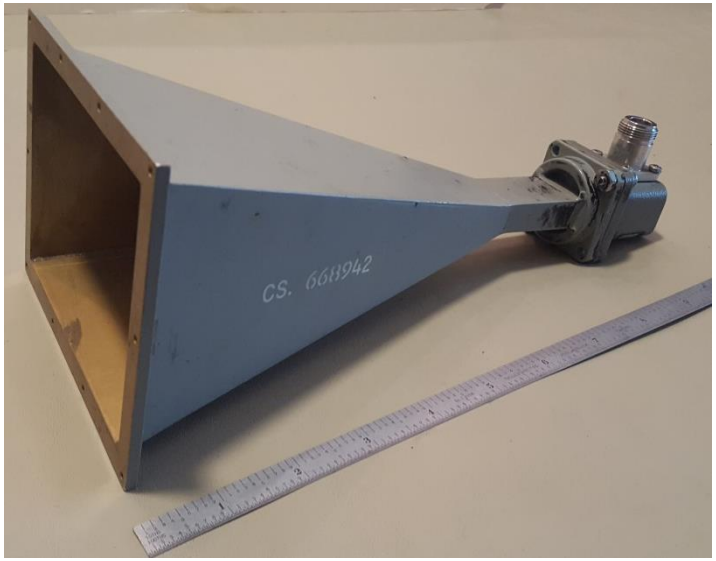

4.3” X 2.3” Horn
G = 20 dBi
3dB Beamwidth ~ 17 deg

8” Offset Fed Dish
G = 25 dBi
3dB Beamwidth ~ 9 deg

18” Offset Fed Dish
G = 32 dBi
3dB Beamwidth ~ 4.3 deg

Roving on 10 GHz

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- The major event for the NTMS is to participate in the ARRL 10 GHz and Up Contest in both August and September
- Some stations operate from home and a number of stations are rovers.
- The object of the contest is to work as many stations in as many 6 digit grid squares as possible. Rovers are required to move at least 16km (10 miles) before a station is reworked. Every contact has a distance multiplier in km. The sum of the distance multiplier plus 100 points for each unique call sign provides the total score.
- See Feb 2019 QST for results. Full report will be at www.arrl.org

WA5YWC (sk) in 2019 ARRL 10GHz Contest

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Operating position in cab of truck

2 ft prime focus dish in bed of truck

November 21, 1944 – October 21, 2018

WA5YWC & K8ZR Sept 2019

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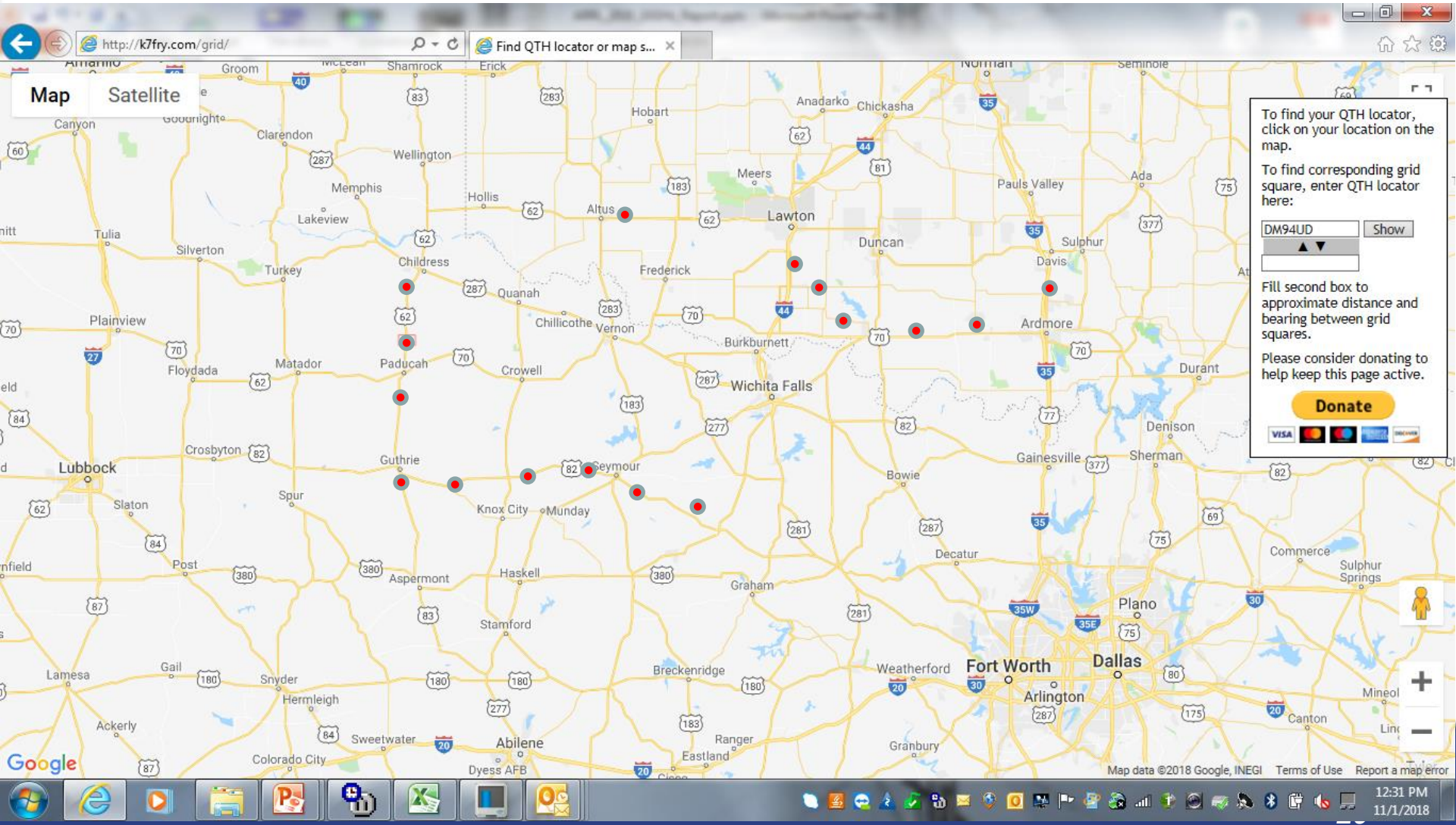

K8ZR/R 24 GHz EM24tq
Sept 16, 2017

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W5LUA Summary for both August and September 2018

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- I worked a total of 13 grids EM14, EM13, EM12, EM11, EM10, EM24, EM23, EM22, EM04, EM03, DM94, DM93, EM17
- I had 83 QSOs with 18 unique call signs on 10 GHz, and 3 QSOs on 24 GHz and 3 QSOs on 47 GHz
- Stations active on 10 GHz included WA5VJB, WA5YWC, K8ZR, WQ5S, WA5TKU, AA5C, AA5AM, K5LLL, W5AFY, N5BRG, K5SOP, W5RLG, AG4V, K5TRA, NM5M, AF5DM, KA5BOU, N0OY
- I worked WA5YWC 27 times, K8ZR 19 times, WQ5S 15 times, WA5TKU 7 times
- My best 10 GHz DX was 523 km or 324 miles to N0OY/R in EM17dr
- Best DX on 24 & 47 GHz was 24 km with AA5C and AA5AM
- Total score was 16937 points, my best ever
- Next year will be tough without Bob…..

Initial AA5AM 10 GHz Success

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Double Balanced Mixer and 8 inch offset fed dish
W5LUA worked at 13 miles
Scott also heard W5RLG at 68 miles
And N5WCO at 56 miles
Scott has since improved his station to a larger dish plus 1watt PA and LNA

K5TRA's Attic 10 GHz Antenna

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W5LUA worked K5TRA on 10 GHz at a distance of over 200 miles

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Flyswatter at W5LUA

Lower table with 47 GHz XVTR

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AA5C/R Beacon Rig at 47088.1 MHz

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EM13td to EM13qc on 47 GHz at 23 km or 14 miles

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W5LUA 76 GHz Transverter using DB6NT MKU 76 G2 Transverter & WA1MBA LNA

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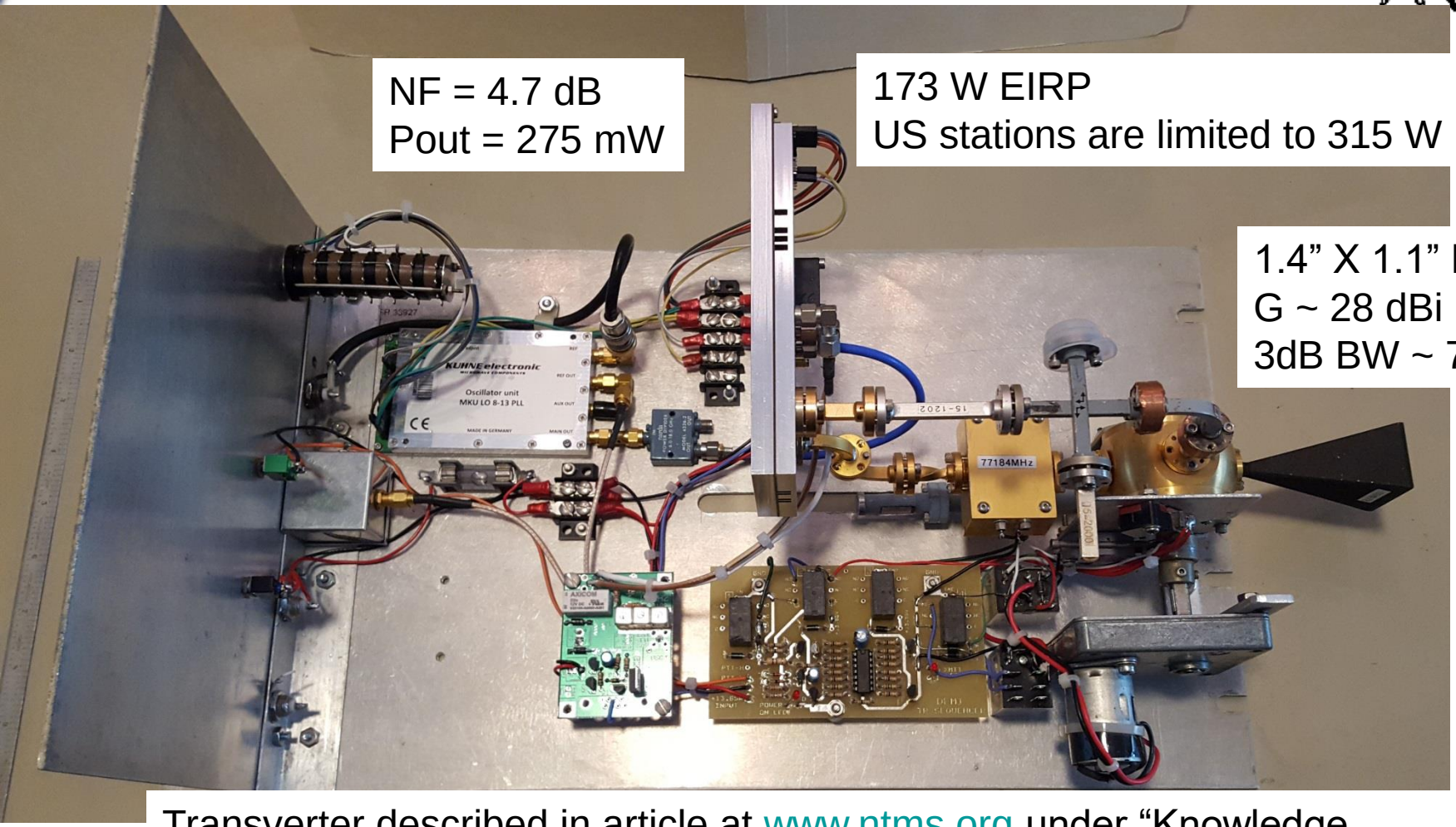

NF = 4.7 dB
Pout = 275 mW

173 W EIRP
US stations are limited to 315 W EIRP

1.4” X 1.1” Horn
G ~ 28 dBi
3dB BW ~ 7 deg

Transverter described in article at www.ntms.org under “Knowledge Base” then under “Tech Library” and then “Millimeter Wave”

At the corner of Skyline Dr and Wagon Wheel Rd, some town, AZ DM43ee15hr W5LUA & K8ZR setup

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View from DM43ee15hr to DM33wo
DX = 66 km on 47 and 78 GHz

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Mark N0IO operating from Shaw Butte DM33wo

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Next Attempt

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- K8ZR, VE4MA and I went to Mt. Lemmon at over 9000 ft in DM42ok56ig and N0IO and W7QQ went to DM33rn26sp on White Tanks
- QSOs completed at 207 km on 10, 47 and 78 GHz
- We were extremely happy!

Visual Horizon from Mt. Lemmon, AZ

https://www.heywhatsthat.com

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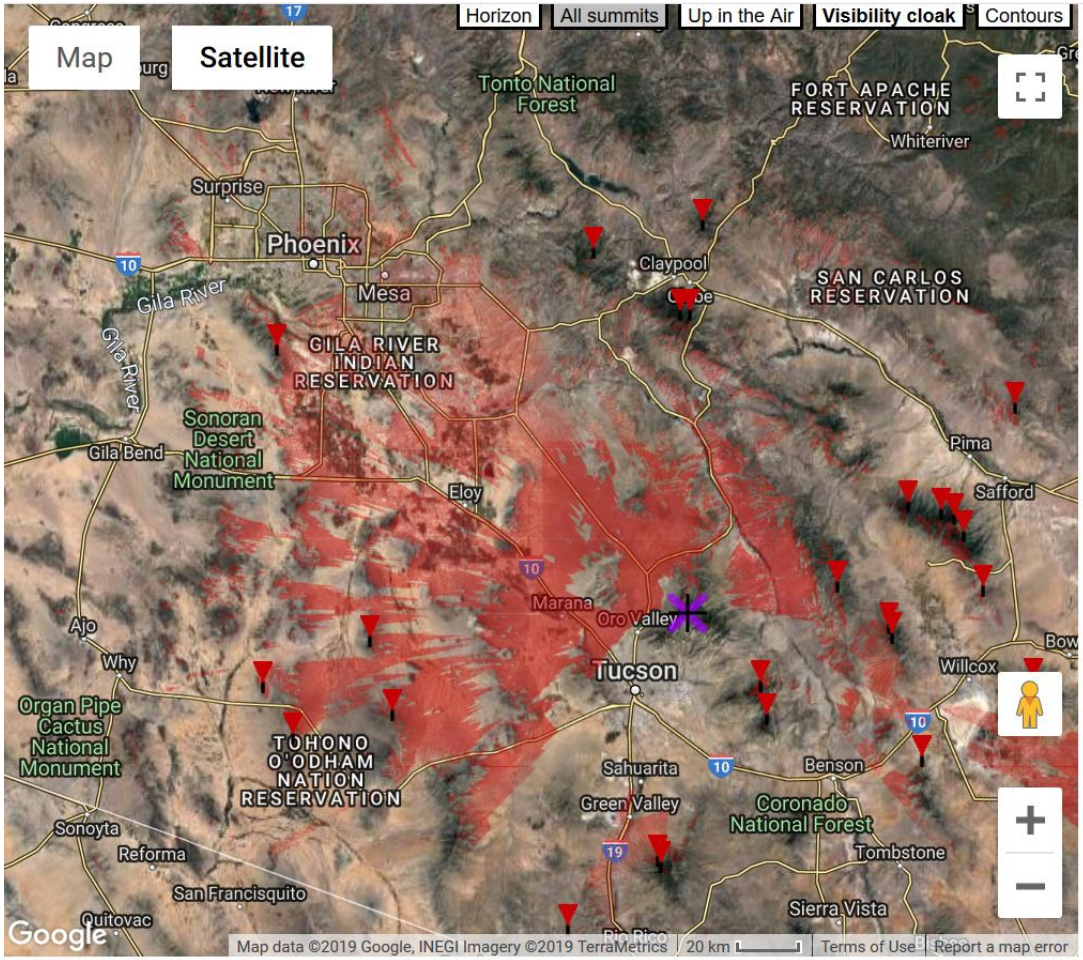

32.442708 N 110.788889 W 9160 ft

Click here to re-center map on Mt.Lemmon

0°	**East Mountain**	58 miles	6893 ft
2°	**Apache Peaks**	76 miles	6939 ft
50°	**Rose Peak**	107 miles	8783 ft
56°	**Grey Peak**	97 miles	7470 ft
58°	**Bryce Mountain**	76 miles	7280 ft
65°	**West Peak**	48 miles	8658 ft
70°	**Webb Peak**	54 miles	10007 ft
71°	**Hawk Peak**	56 miles	10614 ft
75°	**Heliograph Peak**	57 miles	10007 ft
81°	**Bassett Peak**	30 miles	7628 ft
86°	**Greasewood Mountain**	59 miles	7090 ft
95°	**Reiley Peak**	40 miles	7608 ft
98°	**Muskhog Mountain**	41 miles	7415 ft
102°	**Dos Cabezas Peaks**	71 miles	8314 ft
104°	**Wood Mountain**	88 miles	7303 ft
109°	**Sugarloaf Mountain**	91 miles	7290 ft
123°	**Dragoon Peak**	56 miles	6440 ft
137°	**Mica Mountain**	21 miles	8619 ft
145°	**Rincon Peak**	27 miles	8264 ft
150°	**Cerro San José**	94 miles	8353 ft
186°	**Mount Hopkins**	52 miles	8451 ft
187°	**Pete Mountain**	51 miles	7569 ft
201°	**Bartolo Mountain**	69 miles	5335 ft
250°	**Mount Devine**	63 miles	4777 ft
252°	**Ben Nevis Mountain**	84 miles	3432 ft
260°	**Sierra Blanca**	87 miles	3563 ft
264°	**Gu Achi Peak**	64 miles	4521 ft
302°	**Montezuma Peak**	97 miles	4308 ft
345°	**Pinto Peak**	73 miles	5906 ft
358°	**Pinal Mountains**	58 miles	7838 ft

(Bearings are true; for magnetic bearings

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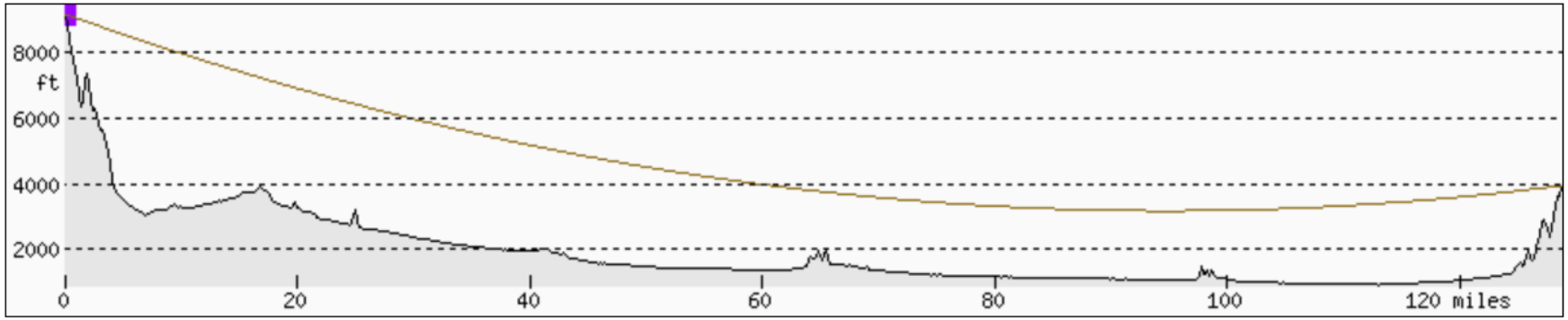
Mt. Lemmon to White Tank Mountain 207km (129 miles) Line of Sight Path



Parameters

DM42ok56ig
VE4MA Barry
W5LUA Al
K8ZR Tony

https://www.heywhatsthat.com

DM33rn26sp
N0IO Mark
W7QQ Bill

DM42ok56ig at University of Arizona Observatory at Mt. Lemmon, AZ

http://k7fry.com/grid/?qth

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W5LUA, K8ZR, VE4MA on 78 GHz

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View from Mt. Lemmon

White Tanks DM33rn26sp

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W7QQ 78GHz at DM33rn26sp

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Path Loss in the 4mm Band

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- Free Space Path Loss is defined as
  20 log (4πd/λ)
- 207km Path at 4mm = 176 dB loss
- Pout = +10 dBm into 1 ft dish at 45 dBi = +55 dBmi (Legal Limit)
- Power received = +55 - 176 dB path loss = -121dBm
- Adding in antenna gain of 45 dBi should result in a received signal level of -121 + 45dBi = -76dBm at receiver port
- Receiver noise floor in a 1 kHz BW = -144 dBm plus NF = -144 + 5dB NF = -139 dBm
- Therefore on a perfect day with no humidity and no oxygen, the received signal should have a signal to noise ratio of -76 dBm - -139dBm = 63dB S/N
- No problem, except we are not in outer space……..

Attenuation due to Moisture

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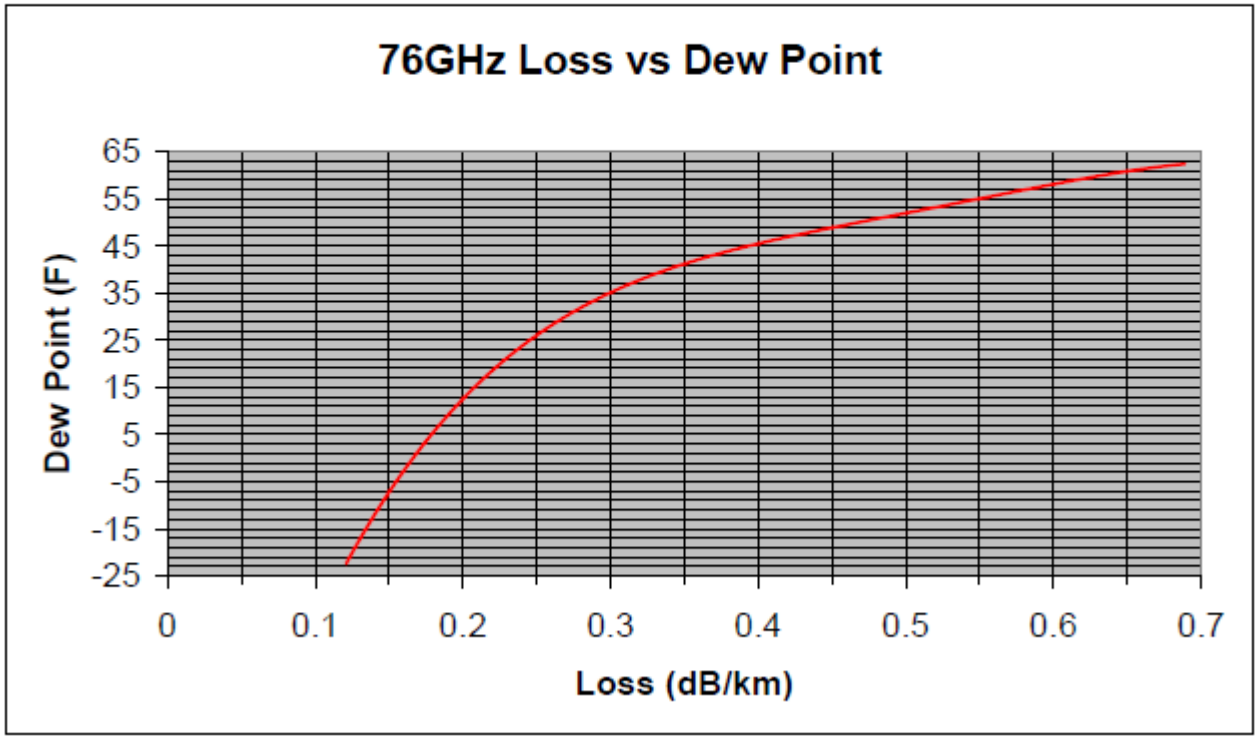
Path Loss Charts. This path loss is ONLY the part due to atmospheric attenuation/absorption. Based on Lieb formulations
Prepared by Brian Justin WA1ZMS. Calculated for Sea Level (standard pressure).



Attenuation vs Dew Point

Based on 207 km path

Date	Dew Point	Loss	S/N	
3/8/2019	30F	56 dB	7 dB	
3/9/2019	-8F	31 dB	32 dB	Success!
3/10/2019	25F	52 dB	11 dB	
Summer	65F	145 dB	-82 dB	

Microwave Update 2019

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- The North Texas Microwave Society will once again host Microwave Update which will be held at the Hilton Garden Inn in Lewisville (Dallas) on October 4th and 5th.
- Some of the top microwave enthusiasts will be there to present their papers, speakers include VK7MO, K8ZR, WA5TNY, W1GHZ, N5PYK, K6JEY, AA5C, N2CEI, WA5VJB, N5BRG, VE4MA, W5LUA, G4DDK, G4FRE, VE6BGT and more.
- We will also have antenna gain measuring, noise figure measurements and phase noise measurements.
- This is also a great social event allowing microwave enthusiasts to compare notes and learn from each other.
- Monitor www.ntms.org and www.microwaveupdate.org as details are available

MUD 2019
GNU Radio Workshop

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- Workshop focused on GNU Radio Planned for Thursday 10/3/19 3 PM till 6 PM
  - Installing GNU Radio on Windows 10
  - Learning how to use the tool
  - Radio exercises to provide hands-on experience
  - SDR theory and implementation in action
- Instructor/Presenter will be Tom McDermott N5EG
- Great opportunity to learn and see the software and hardware working together.

Analog Devices & Mathlab Workshop

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- Workshop well attended by NTMS
  - Eric KC4YOE, Pete KG5PGB, Chuck AF8Z,Jonathan KF5IDY, Bob N5BRG
- Focused on the AD ADALM-Pluto and the AD9363 (RadioVerse Chip)
- Pluto is a SDR type device intended to be an educational tool
- Pluto is available from electronic distributors like Mouser, Newark, and Arrow for a cost of ~$150
- Working to get perversion to include slides and other data with MUD GNR Radio Workshop Thumb drive.

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- The North Texas Microwave Society thanks you for attending
- www.ntms.org
- www.microwaveupdate.org
- Any Questions?