North Texas NTMS Microwave Society

Portable 3 cm EME

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October 15, 2016

Microwave Update

St. Louis, MO

10 GHz EME in EM10cf – July 2014

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W5LUA Portable 10 GHz Setup

WA5YWC built the dish mount and feed for the 35 inch (.89m) prime focus dish

W5LUA Portable 10 GHz System

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WB8BZK WA8RJF

GR-1216 for measuring sun and moon noise

Flex1500 W1GHZ Mini-verter IcoTemp 10 MHz VCXO

1 W 24 GHz XVTR

DEMI 10 GHz XVTR MFJ Keyer

WR-90 WG Relay ATF-36077 LNA

25 Watt TWT

WA5YWC / W5LUA
Portable 3 cm EME Station

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- W5LUA Rover Rig consisting of a 25 watt TWT and a system NF of 1 dB
- 2 m WR-90 Flexible waveguide with 0.5 dB loss, compare to 2m of flexible .25 inch cable which will have 2 to 3 dB loss!
- What really matters for EME is what is the performance at the feed.
- Measured performance at feed was 22 watts power and a noise figure of 1.5 dB
- Combined with WA5YWC's 35 inch prime focus dish with a VE4MA scalar feed resulted in 5 dB of sun noise.
- Moon noise = 0.2 to 0.25 dB, making it easy to track and or calibrate az/el by moon noise which is a plus.
- Net result was an easy JT-4F QSO with OK1KIR who was running a 4.6 m dish and 50 watts
- So what is next?

Next Generation IF

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- The Flex-1500 provided excellent performance plus a built-in panadapter and software controlled VAC (virtual audio cable) and VCOM (virtual com port) to connect to WSJT
- The only downside was the whole system is tied to a computer.
- I decided to try the Elecraft KX-3 and PX-3 combination for a rover/portable EME IF
- Laptop only used for WSJT

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KX-3 & PX-3 as MW IF

Next Generation EME Setup

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- No matter what size dish one uses for EME, there are a couple of things that should always be considered.
- Mounting the LNA at the feed is a major goal in building an EME station.
- Generating the most power possible at the feed is also important.
- I use TWTs at home in the shack but only so I can take advantage of having high power on both EME and tropo.
- Since my 25 watt rover TWT decided to “let the smoke out”, I figured it was time to try some “SSPA” power…..

New LNA / SSPA Feed Assembly

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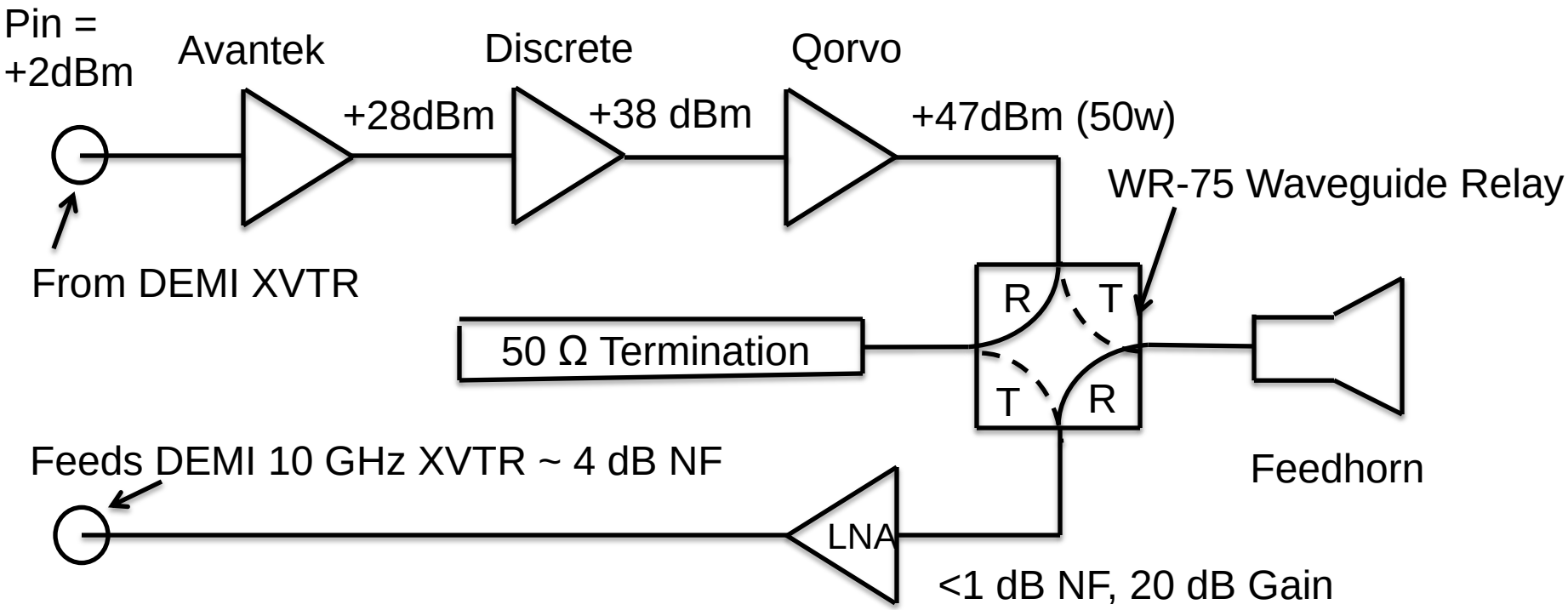
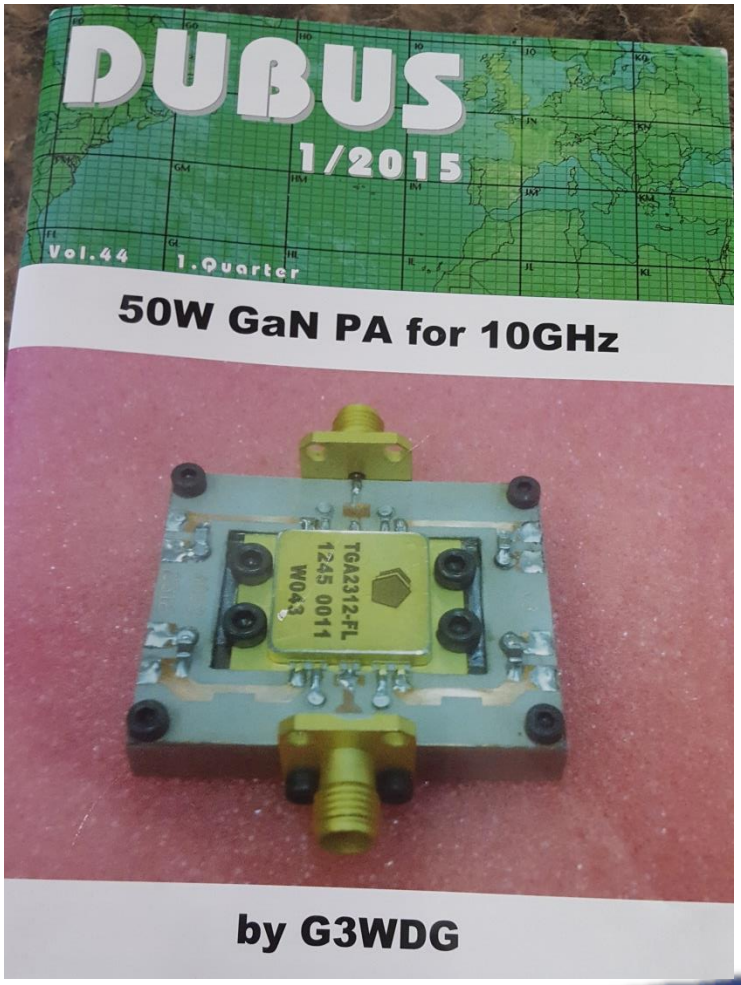


GaN Power

- Triquent (Qorvo) has some rather nice but pricey parts for 10 GHz.
- Charlie G3WDG did a nice write-up in DUBUS on a 50 w part for 10 GHz- I decided to give this part a try in the rover set-up



TGA2312-FL chip temp vs R

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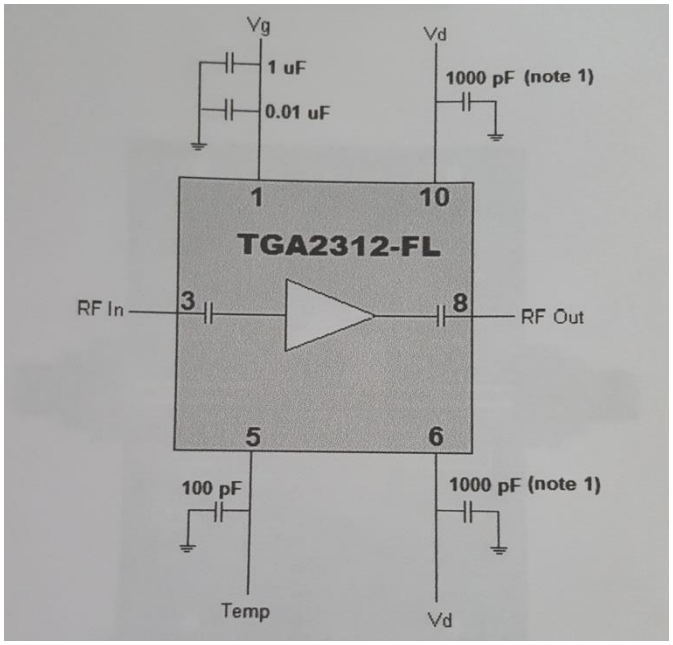

deg C	R (Kohm)	deg C	R (Kohm)
0	378.80	65	17.89
5	284.71	70	14.84
10	216.16	75	12.37
15	165.70	80	10.37
20	128.17	85	8.74
25	100.00	90	7.40
30	78.66	95	6.29
35	62.36	100	5.37
40	49.81	105	4.61
45	40.06	110	3.96
50	32.44	115	3.43
55	26.44	120	2.97
60	21.68	125	2.59

TGA2312-FL @ 10 GHz

50 watt device at 9 dB gain
Vdd = 24V
Idq ~ 2A
Id max = 4.5 to 5A

Device mounted to a copper or nickel plated aluminum block

G3WDG can help with the PCB

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G3WDG can help with the PCB

Cost $1050 from Mouser but compare at over $3500 for German made amplifiers

G3WDG FET Sequencer Board

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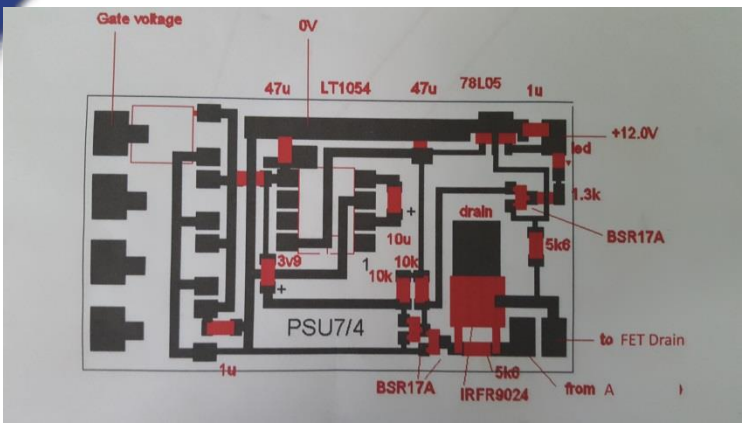

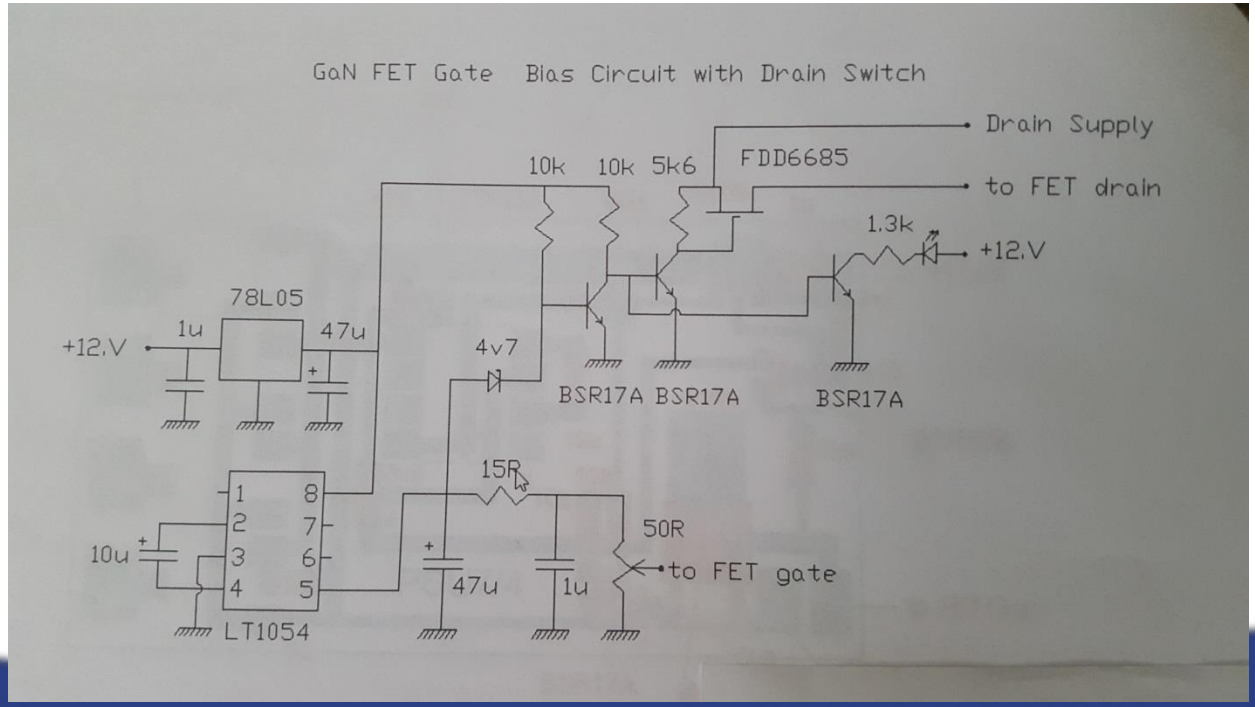

Surplus Corrugated Feed Horn

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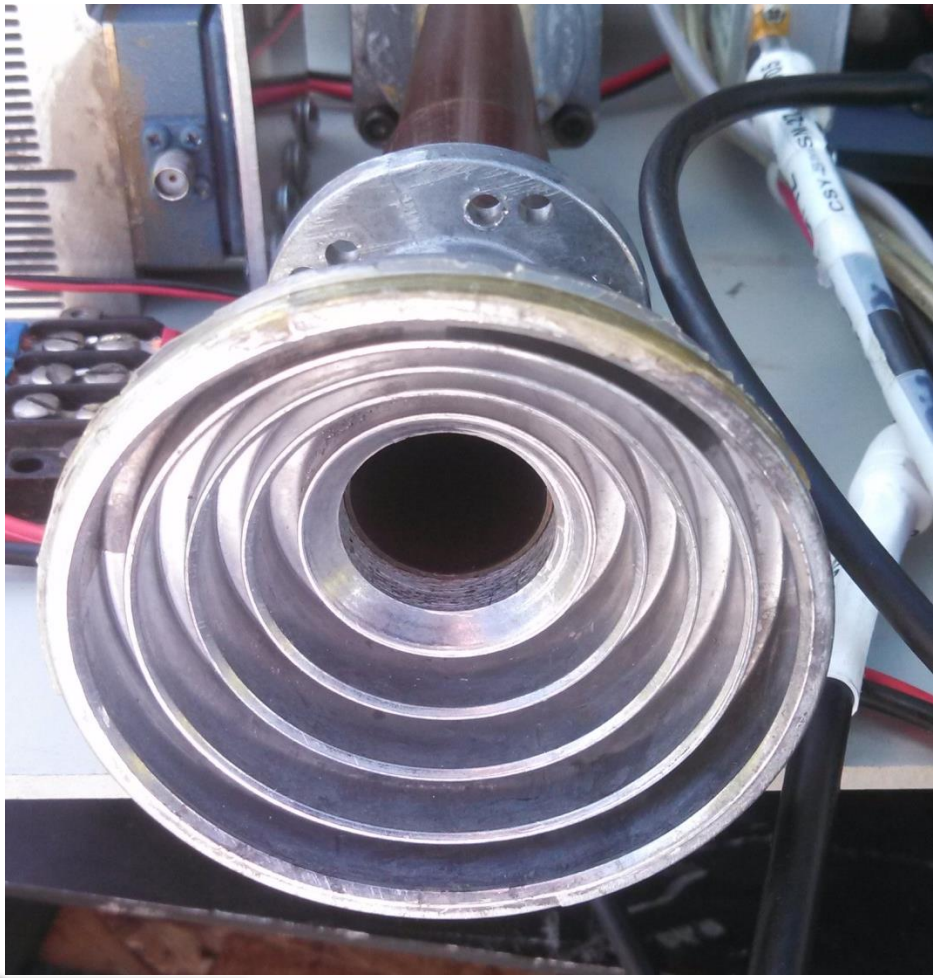

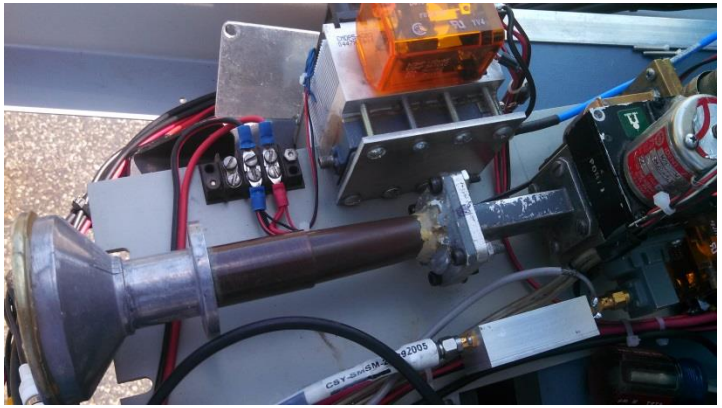

These are typically designed for 12 GHz

ID drilled out to .875 inch to accept the OD of standard .75 inch water pipe

.75 inch copper pipe can then be formed into WR-90 and then soldered to WR-90 flange

New Portable 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

Improved Feed Platform & Relocation of Feed Support Arms

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Manual EL over EL over AZ Portable Mount

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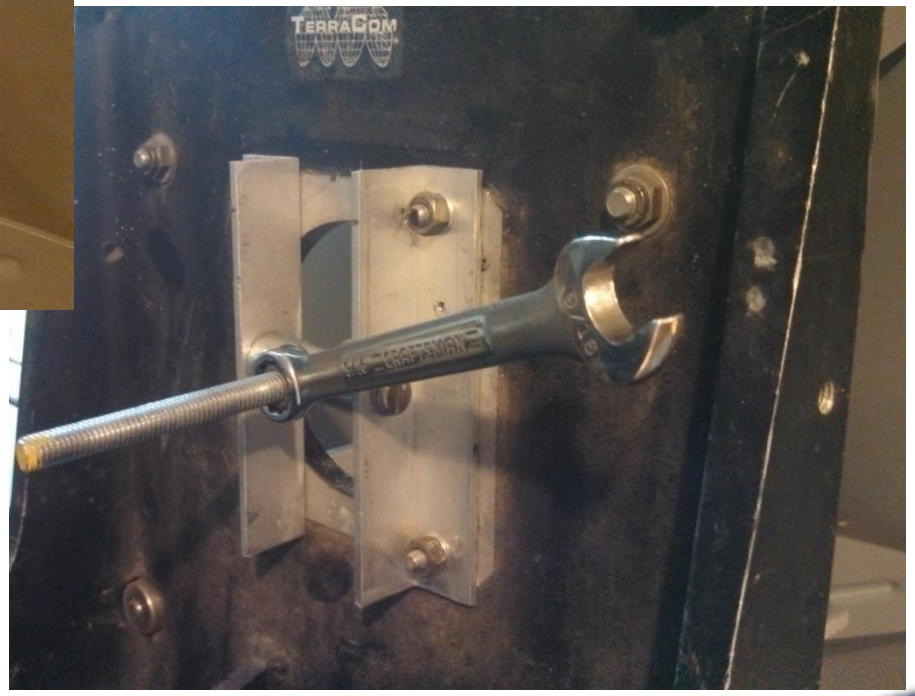

Plan to replace wrench with a small actuator

Feed/LNA/50W SSPA

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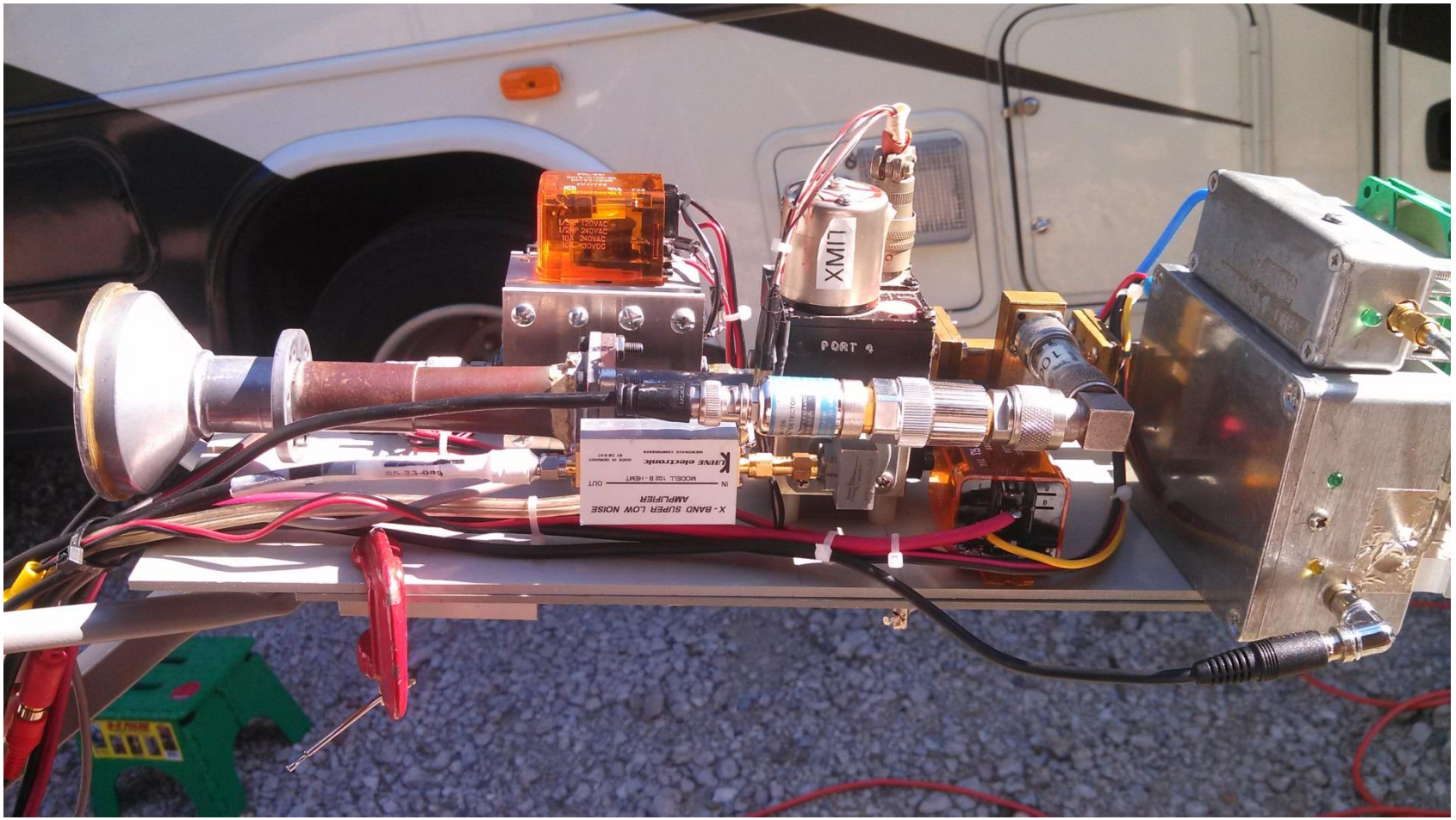

Feed/LNA/50W SSPA

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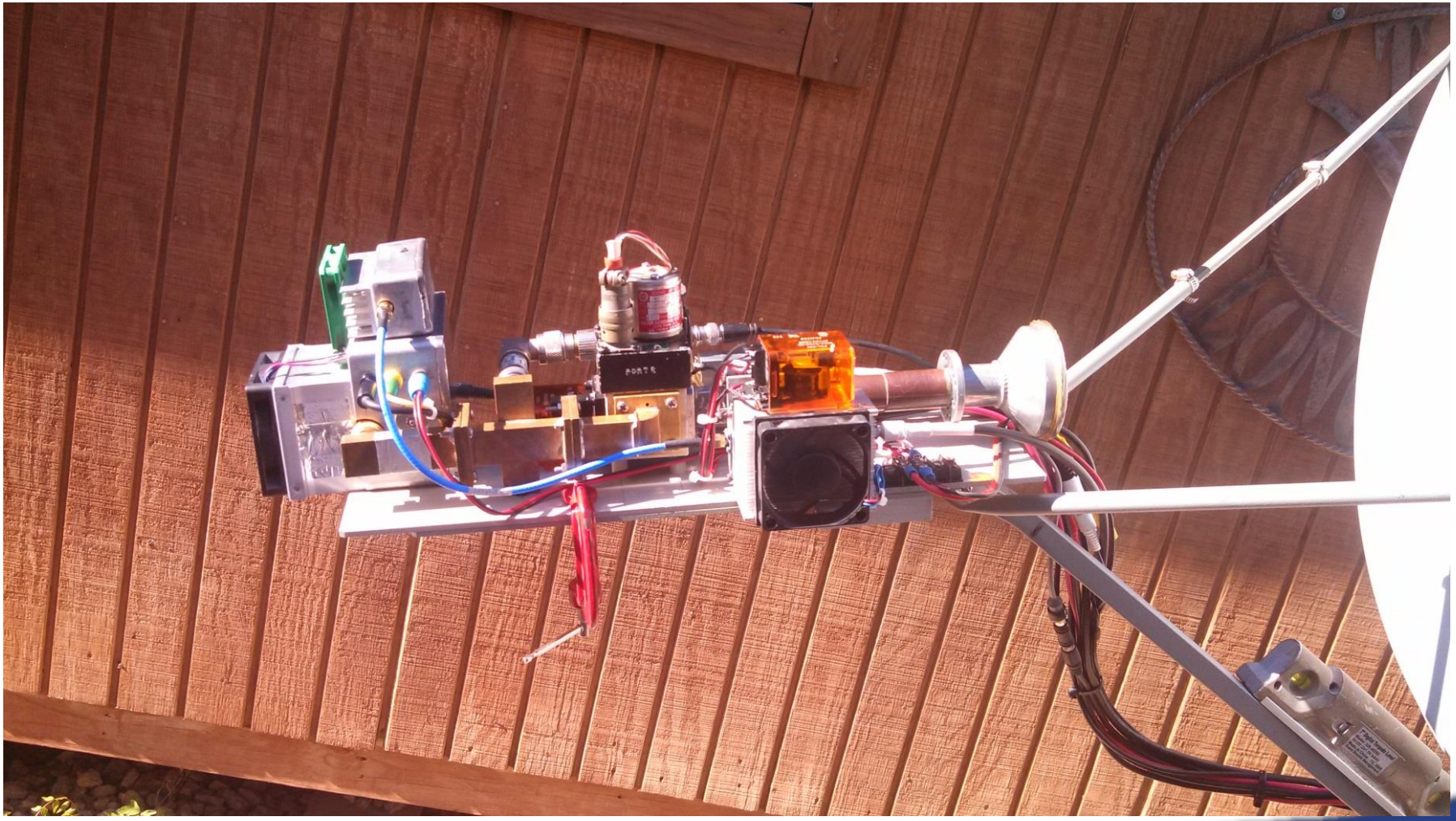

So WHY all the wires?

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- Since the LNA and PA are remoted….
- LNA to xvtr receive line
- Sequenced 12V to LNA
- DEMI xvtr RF power to PA assembly
- Sequenced 12V and 24V to amplifier assemblies
- Waveguide relay control
- Power output monitor
- PA heatsink temperature monitor

GR-1216 for Measuring Sun & Moon Noise

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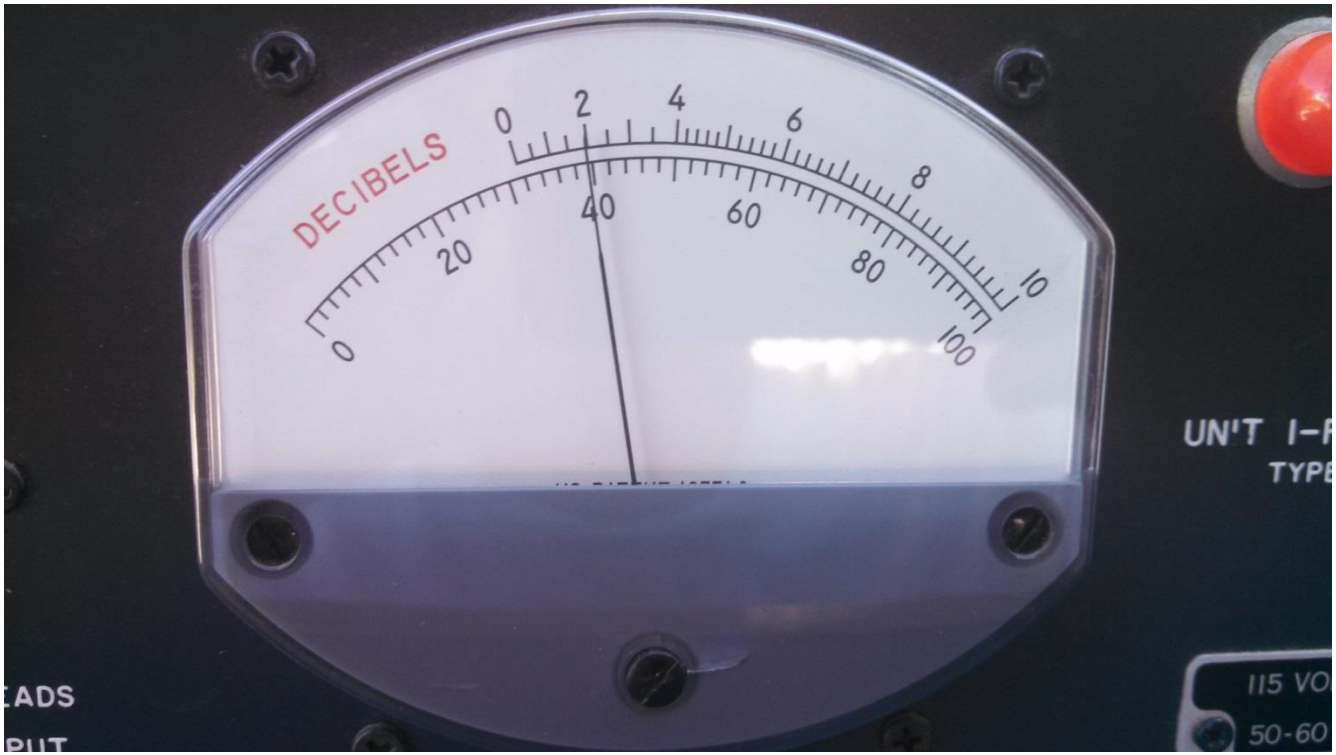

However, the only way (or the best way) to track the moon with a “field or portable setup” is by moon noise ……

But hold on…

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- In EM48ss we were having some interference issues, first thought to be caused by some commercial 10 GHz data links, now believe to be caused by the local 10 GHz beacon.
- But the beacon is operating at 10368.900 MHz!
- Was it the beacon's fault? Heck no!
- My GR IF amplifier is looking at a several MHz wide passband at the IF and it trying to average all the noise and everything else it sees! That is how we can see the several tenths of a dB of moon noise that we were going to peak on and get calibrated
- It did not effect the KX-3 down at 10368.050 because it has filtering
- Next time improve filtering
- But we needed plan B if this operation was going to be a success

Sears Digital Level Used to Calibrate System Elevation

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After calibrating elevation on “sun” noise, it was determined that the angle of the feed support arm was approximately 3 degrees below actual sun elevation on “my” offset fed dish – this value gets us close..

Azimuth Calibration

- Get out the compass!
- Others had suggested doing our homework on Google Earth to gain a calibrated azimuth heading of our operating location – maybe next time!
- Last resort – Listen for a strong station and get calibrated on azimuth and elevation.
- With our 2 degree 3 dB beamwidth , we needed to be within plus or minus a degree or so.
- Once calibrated, we needed to update about once a minute on the rising moon

K5GW DOS Tracking Program

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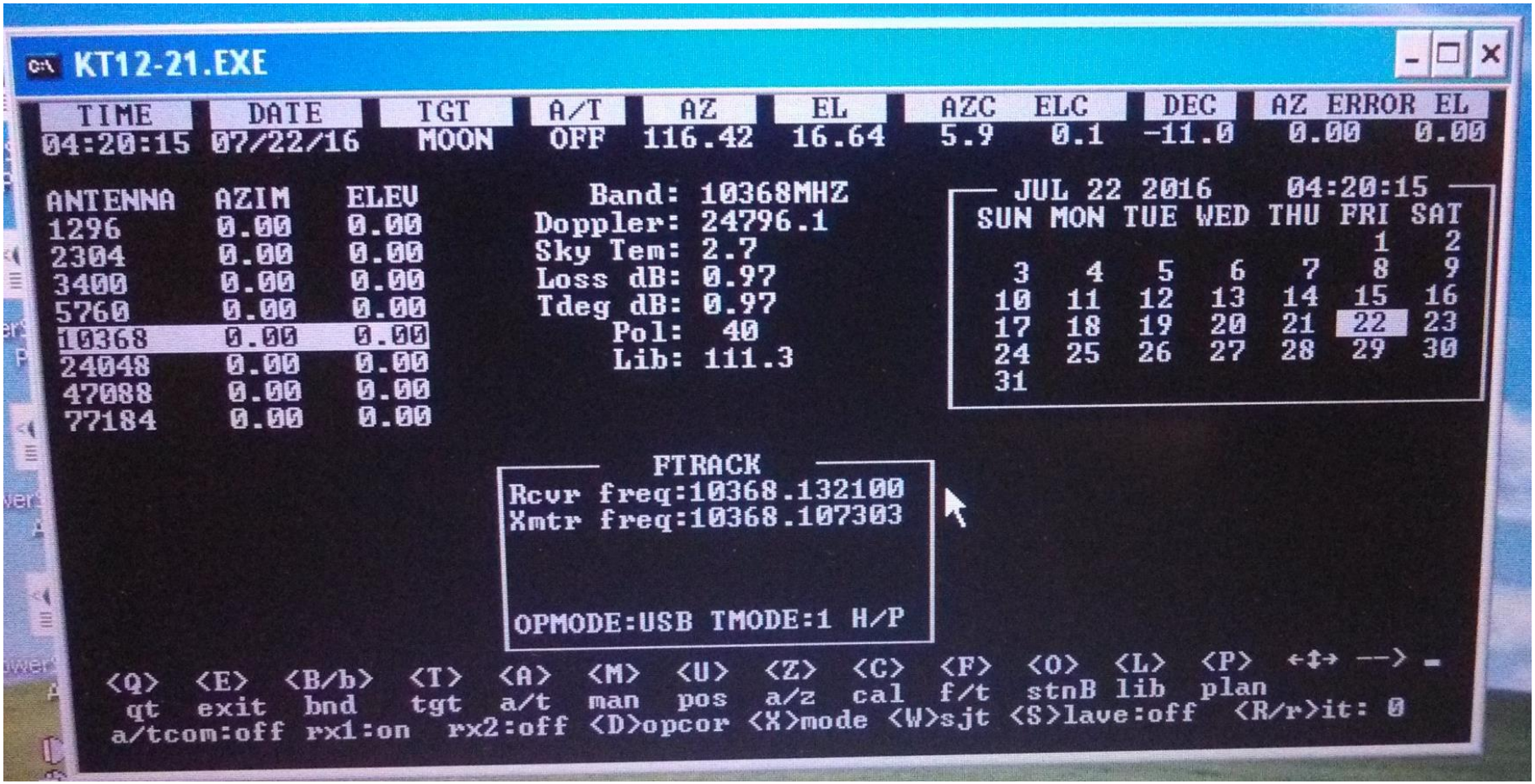

W5HN

HB9Q Logger

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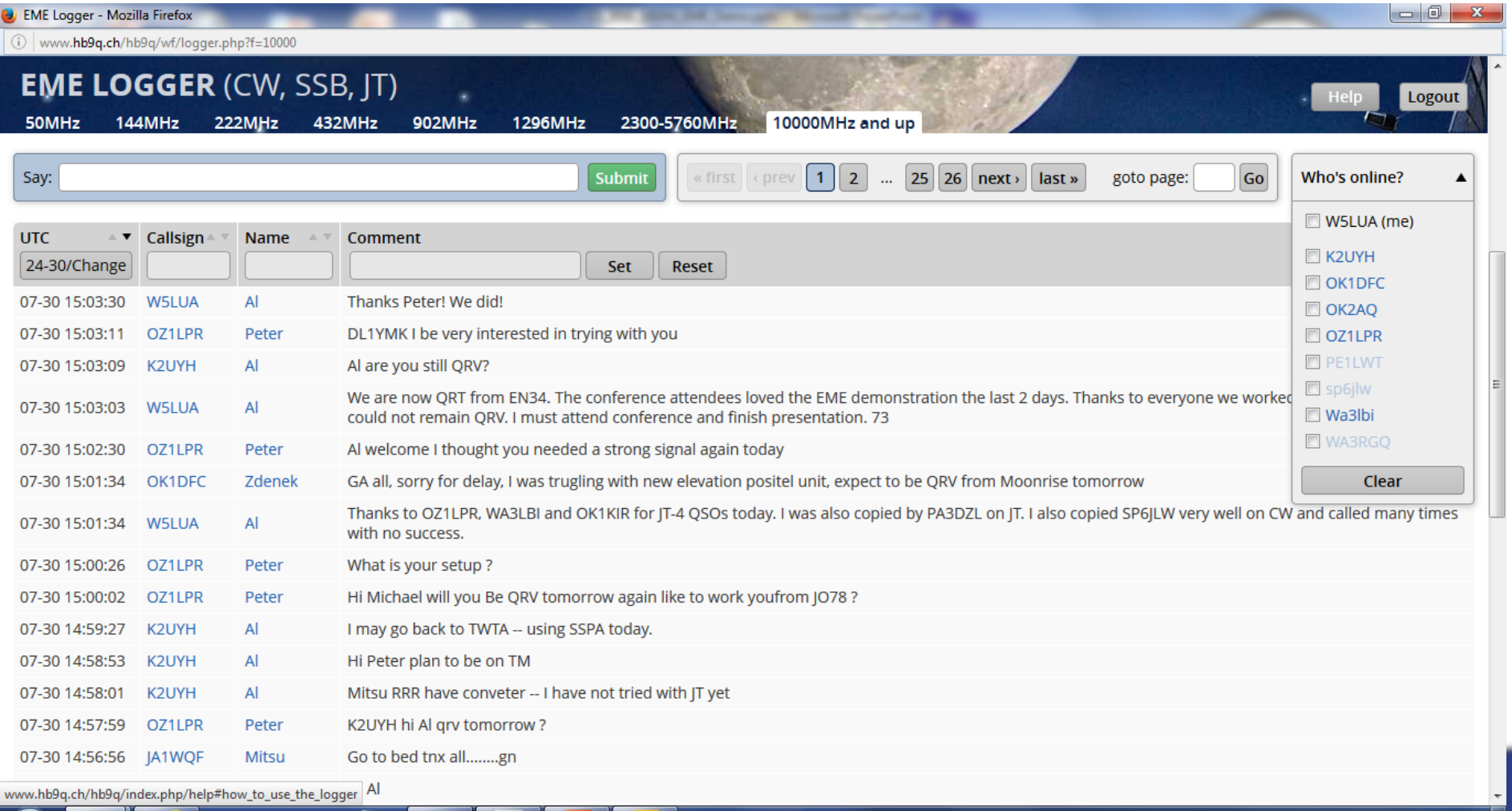

Results in Rochester, MN in July 2016

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- 8 QSOS on JT-4F
- Worked OZ1LPR, HB9Q, G3WDG, OK1KIR, WA3LBI
- Heard and called SP6JLW on CW with no success. SP6JLW was armchair copy most of the time calling CQ
- Now on to results at MUD in St. Louis….

Doppler Review

- Doppler scales with frequency
- Where doppler may be .3 kHz at 144 MHz, the equivalent doppler at 10368 MHz will be 10368/144 = 72 X .3 kHz = 21.6 kHz at 10368 MHz
- Plus there is your self doppler…where your echoes will be based on your transmit frequency
- And there is mutual doppler…where you will hear the other station based on your location and the other station's location

Options for us in EM48ss

- First Choice - we transmit and receive on prearranged frequency of 10368.050 MHz – works well if station calling us has capability to offset their transmit and receive frequency based on mutual doppler between his 6 digit grid square and our EM48ss location
- Second option – we do the mutual doppler correction on both receive and transmit for the other station
- Third option - listen on my self doppler frequency, i.e 10368.075 MHz as an example…
- Fourth option - listen on our mutual doppler frequency, i.e. 10368.053 MHz based on location of the station calling
- Fifth option – Frequency on the moon – a topic for another day…..

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Day 1
Microwave Update Conference
St. Louis, MO
October 13th, 2016

G3WDG at 2257Z

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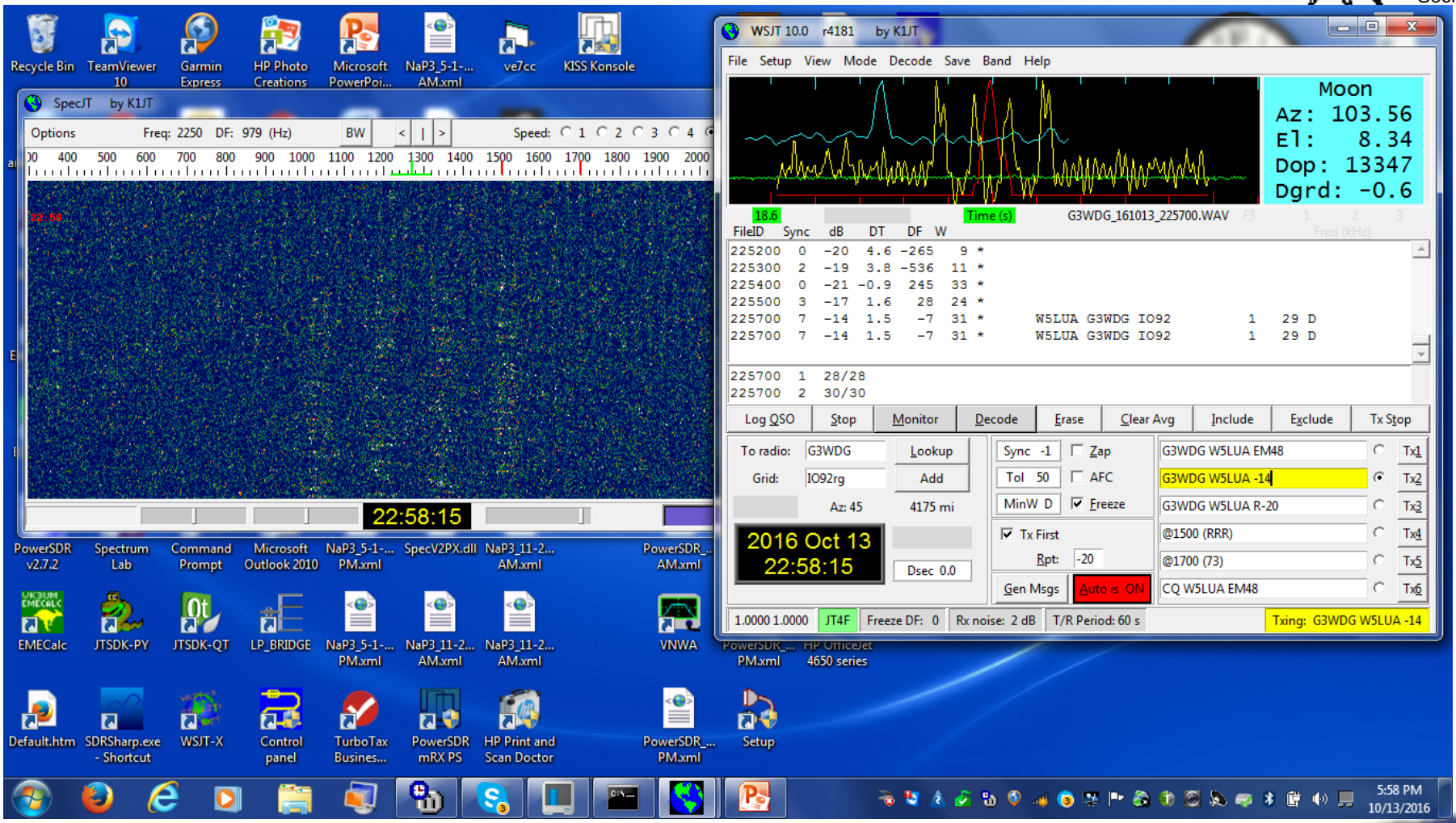

OZ1LPR at 2305Z

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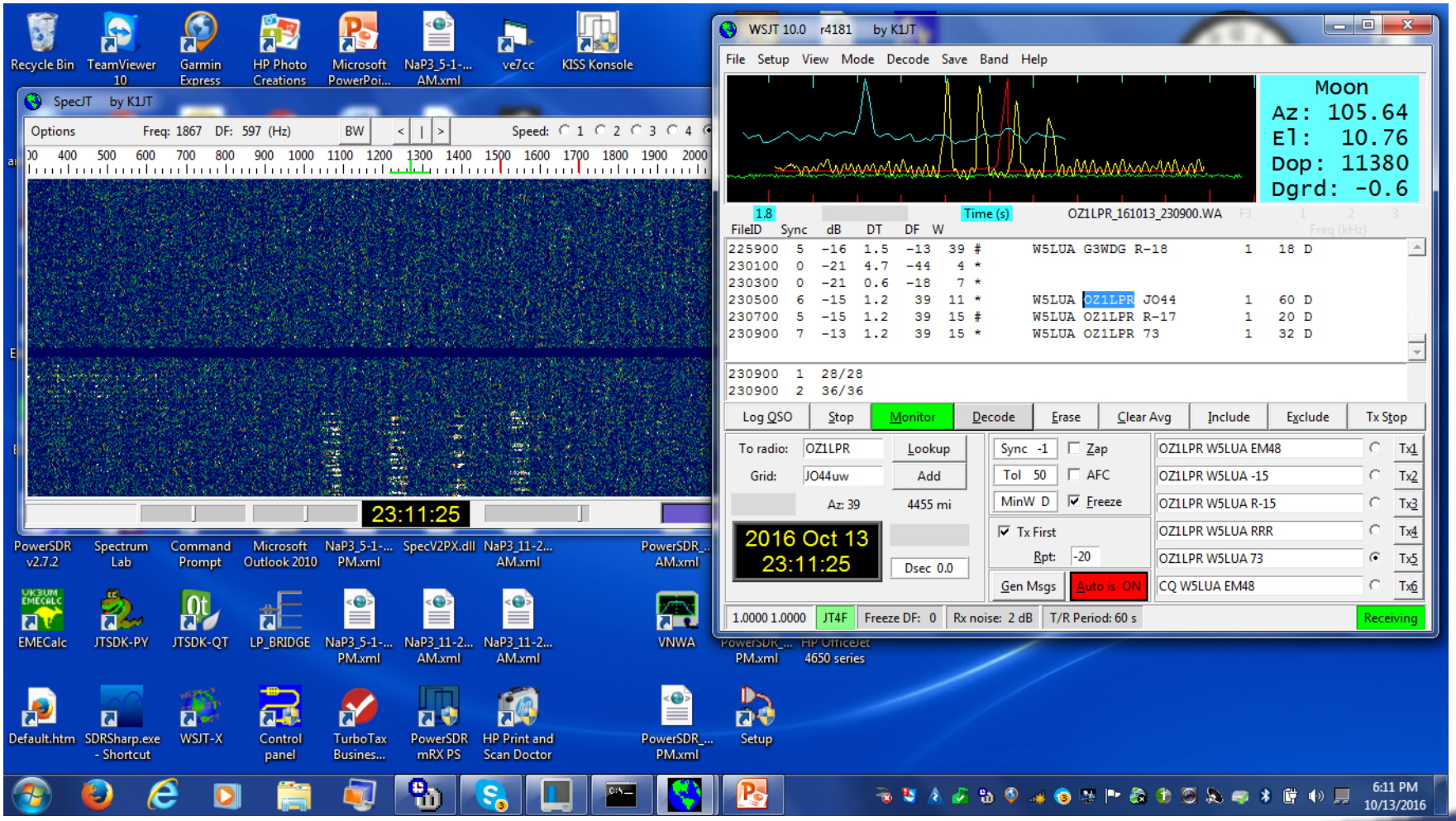

OK1KIR at 0033Z

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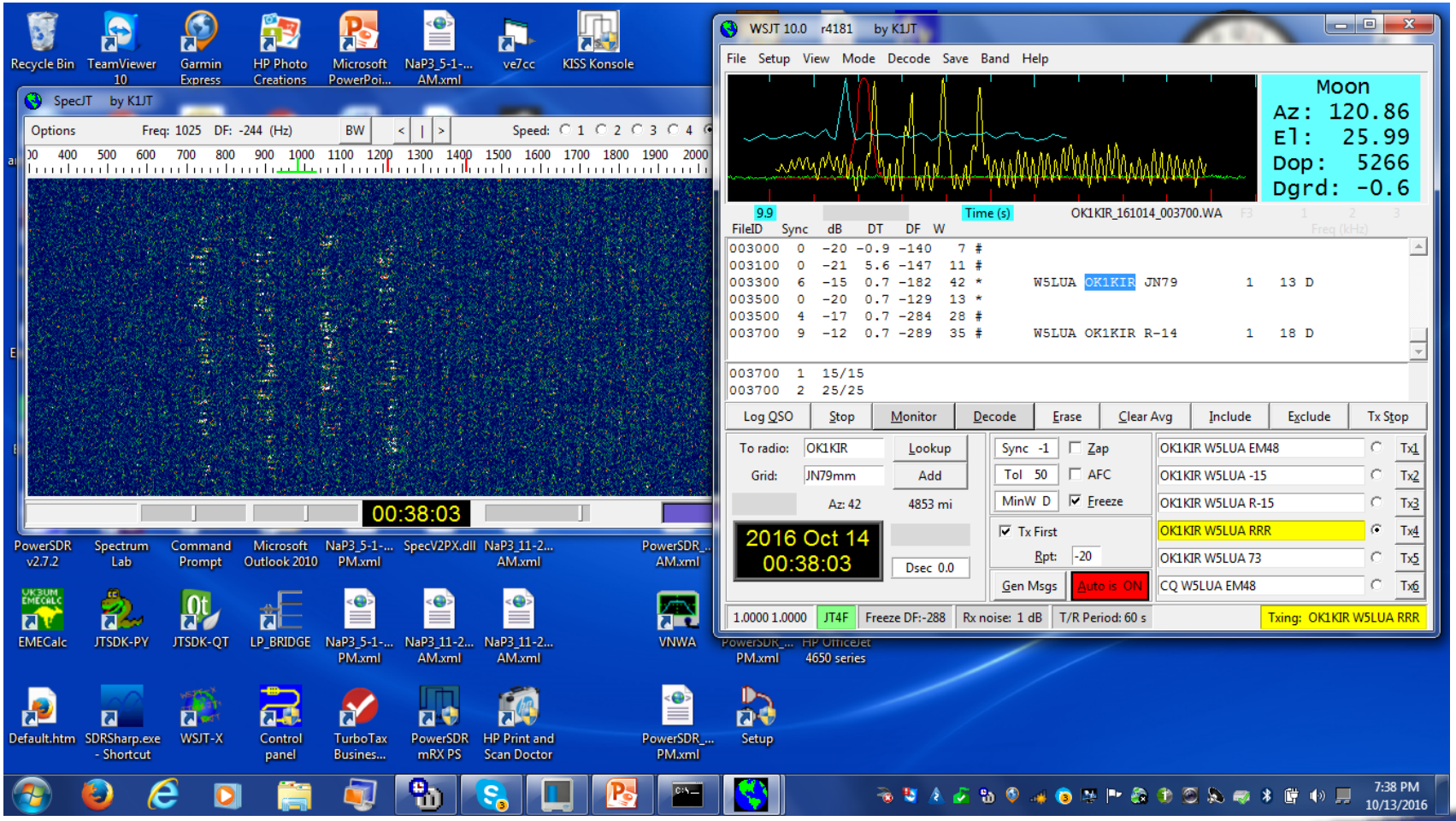

CW with K5GW

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- Gerald K5GW provided us with some listening enjoyment by calling us multiple times on CW
- But it seemed that he was not going to copy our 30 watts which was 10 dB down from his 300 watts so we decided to try a JT-4F sked the following day.
- We also learned from the HB9Q logger that other stations were seeing us including WA3LBI and G4CBW, plus OK1KIR had been calling us on CW

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Day 2
Microwave Update Conference
St. Louis, MO
October 14th, 2016

Second QSO with G3WDG

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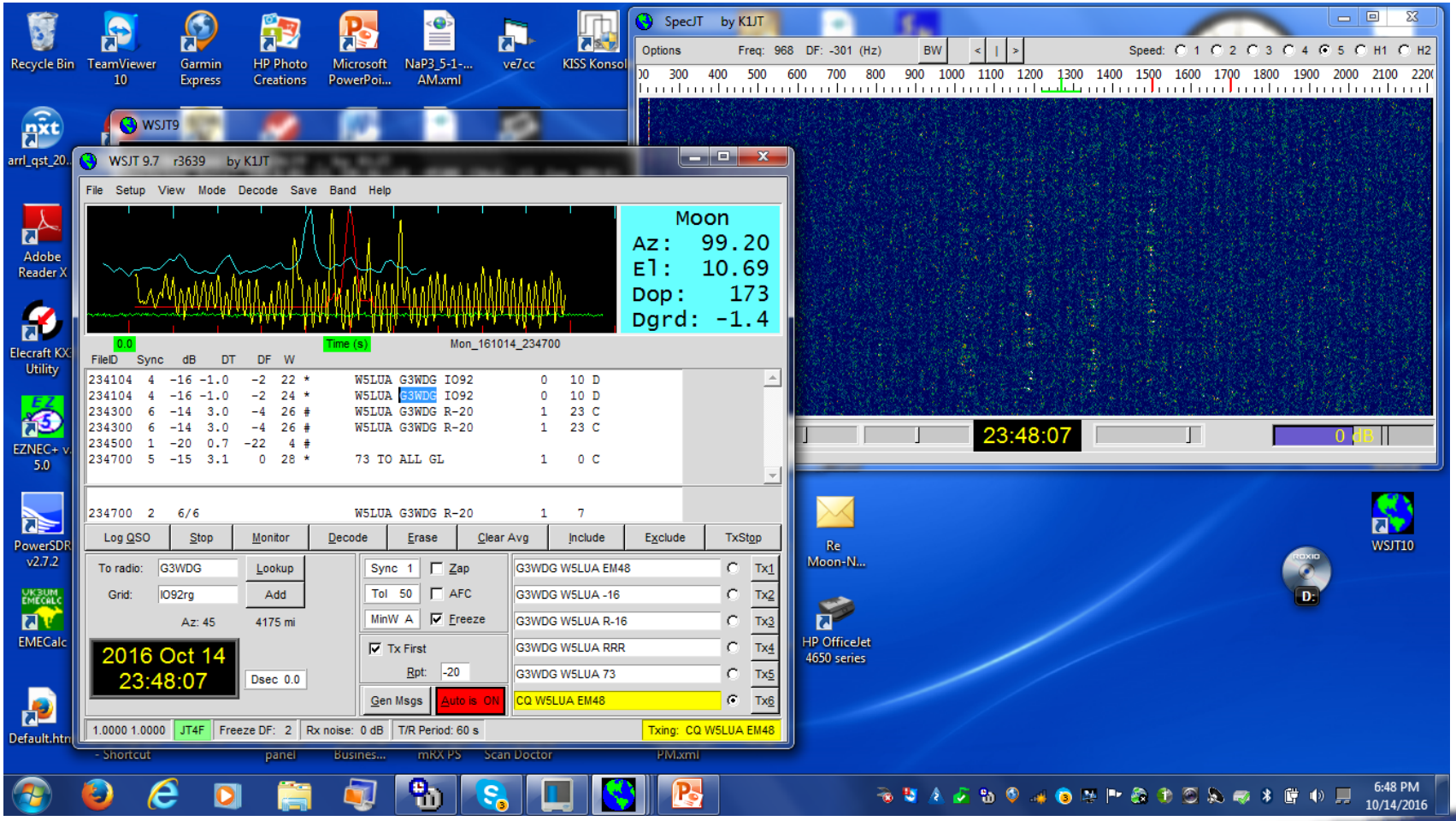

WA3LBI at 0023Z

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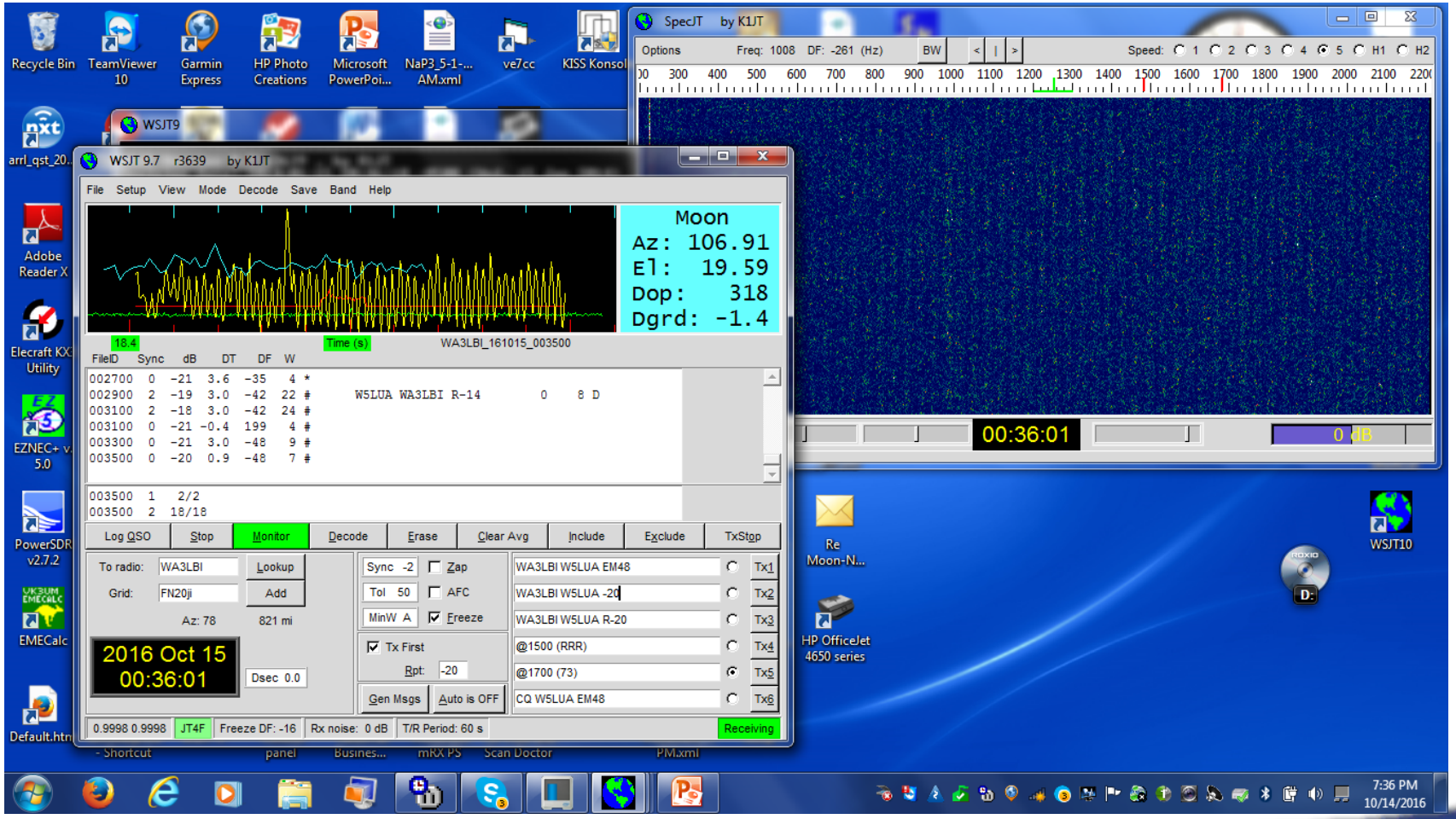

Working K5GW

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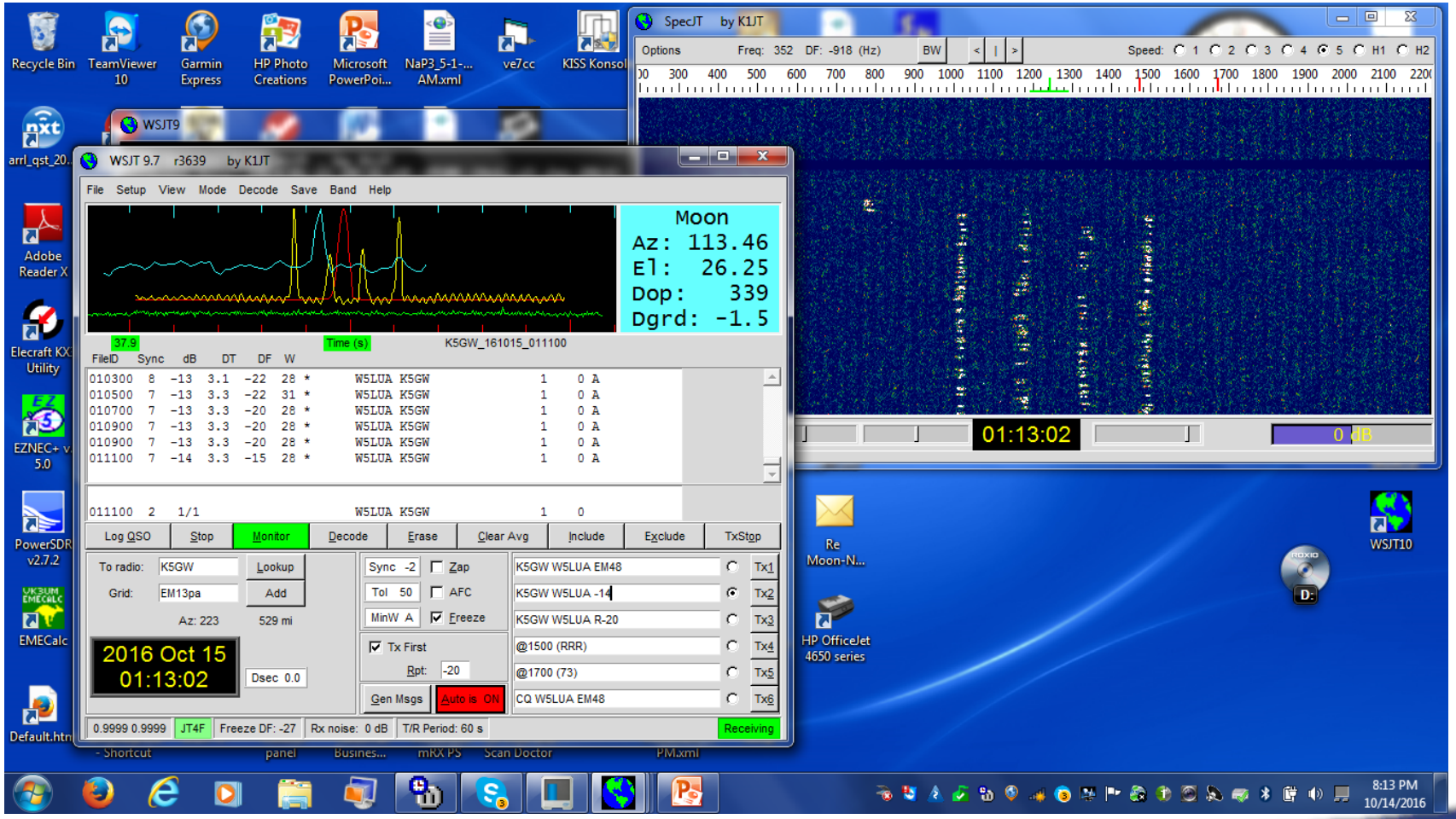

K5GW QSO completed!

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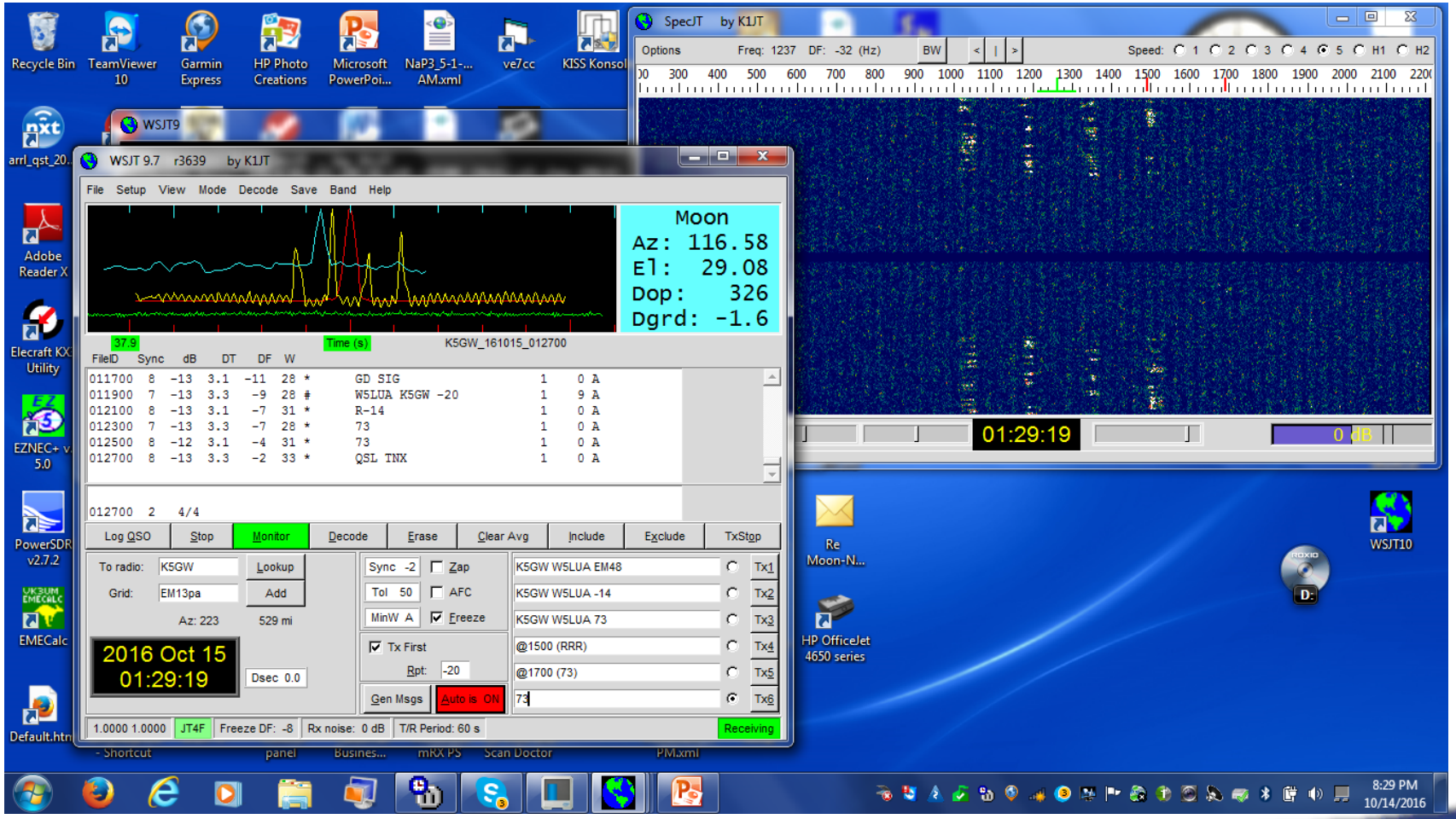

Big surprise – G4CBW called us!

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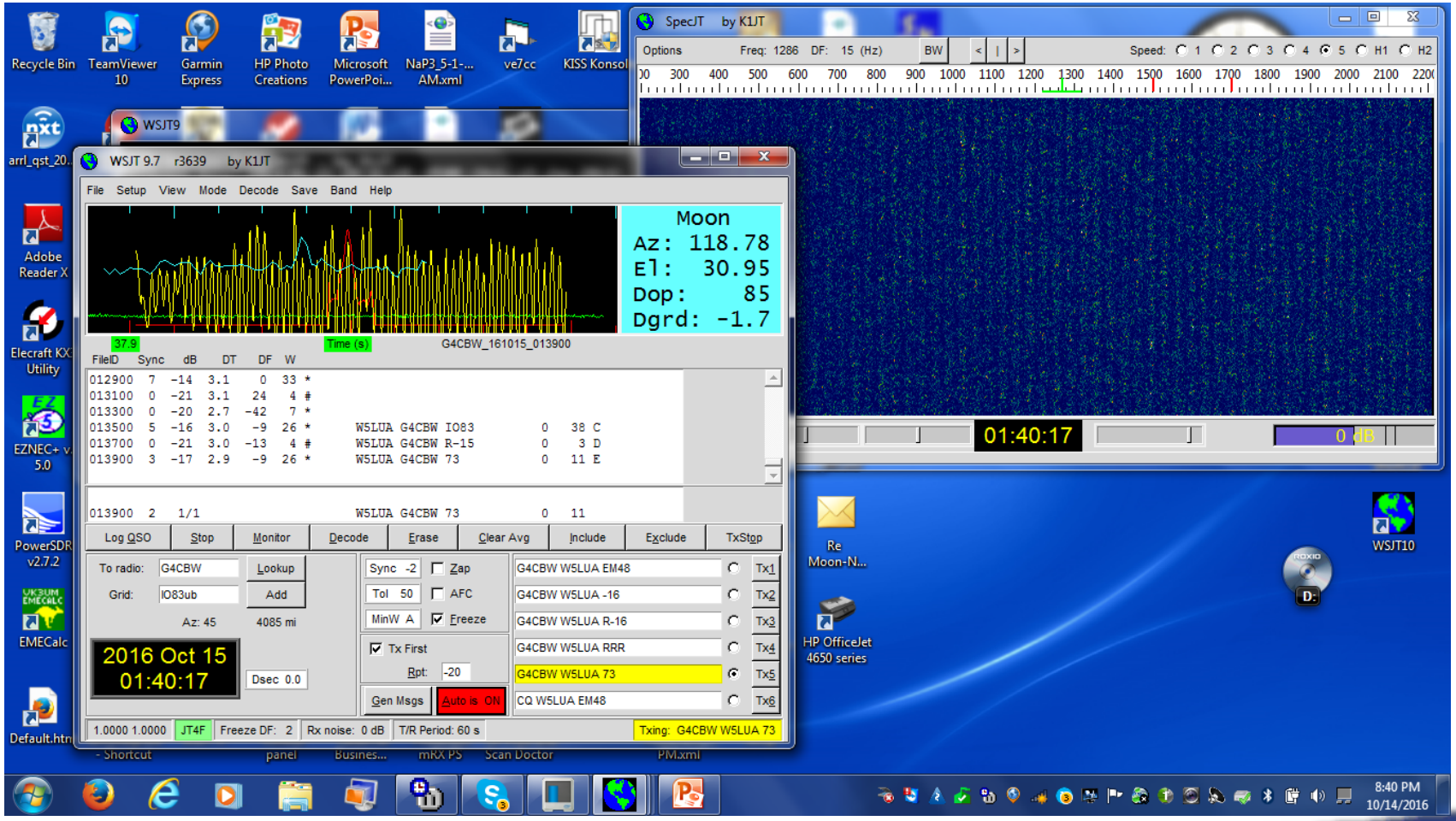

Screen at G4CBW – 1.5m dish/75W

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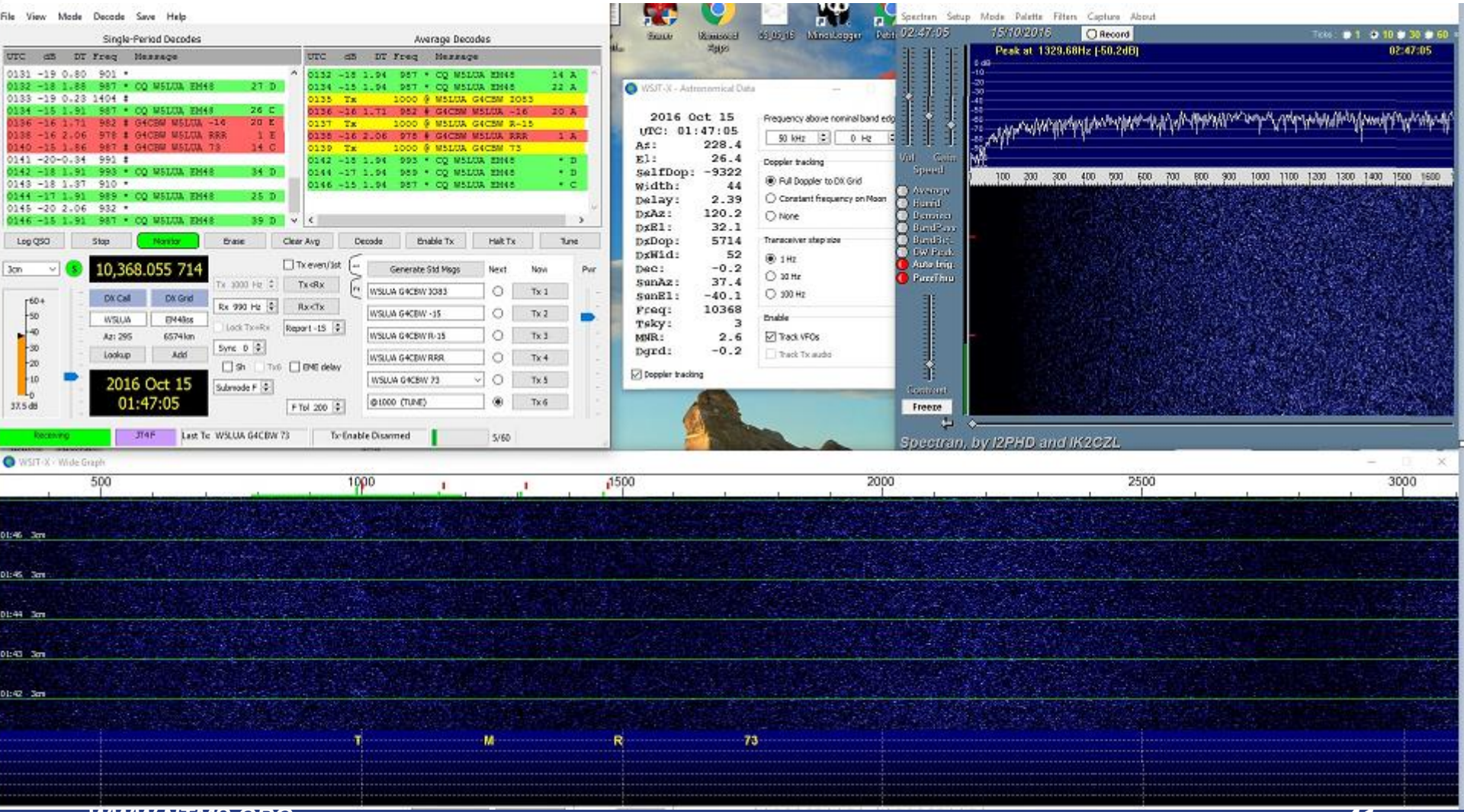

OK1CA QSO

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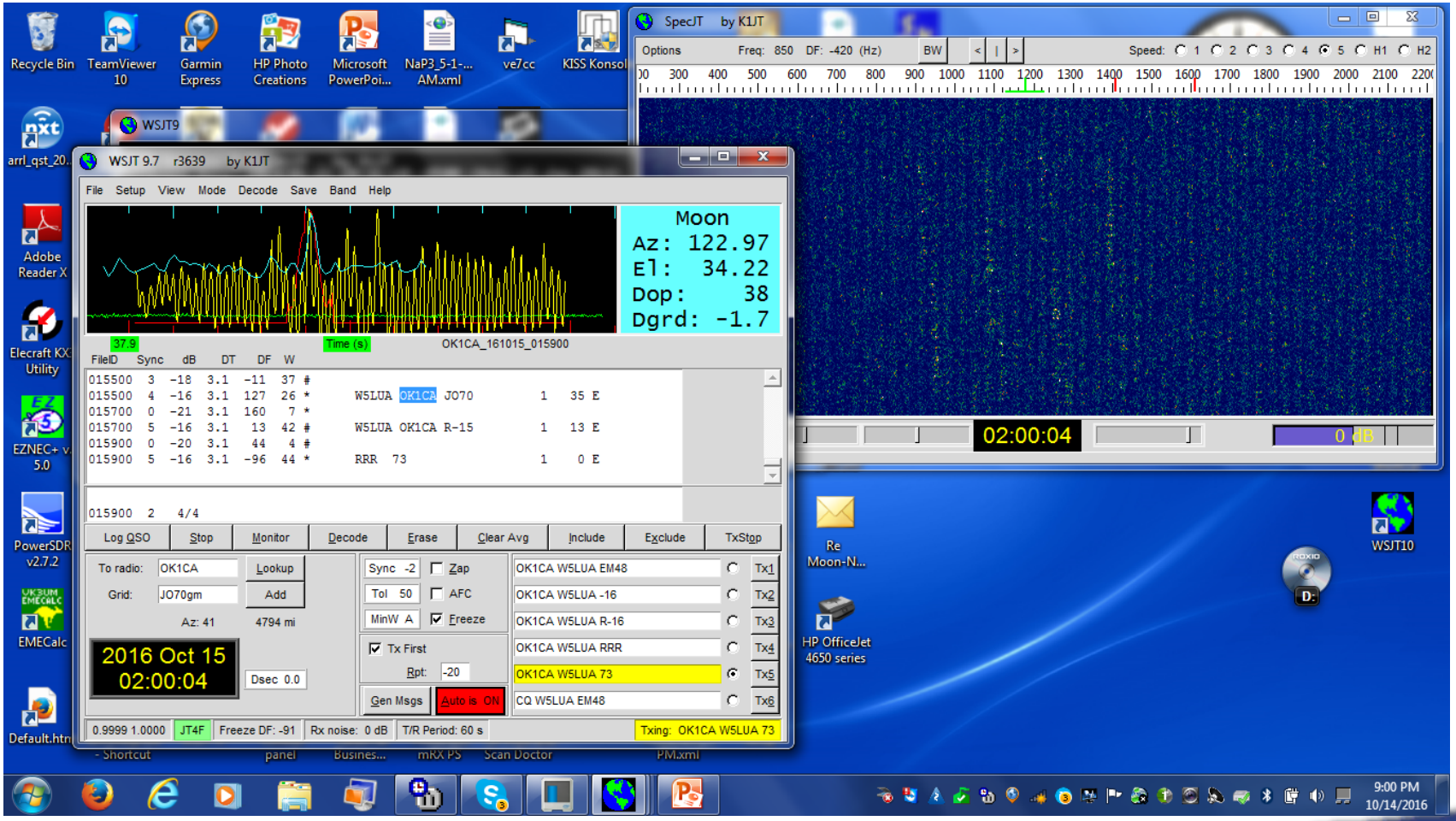

Results in EM48ss

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- 8 QSOs on JT-4F
- Worked G3WDG twice, OZ1LPR, OK1KIR, WA3LBI, K5GW, G4CBW, and OK1CA
- Highlight was working G4CBW who was running a 1.5 m dish and 75 watts
- CW provided by K5GW was copied by many in the audience

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- Any questions?
- I hope to put a pdf up on our www.ntms.org web site when I return.
- My email is w5lua@sbcglobal.net
- 73 and see you on the moon!