

The First 47 GHz EME QSOs

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The First 47 GHz EME QSOs

- The Tests
- The Challenges
- The Technology
- Operating Results

First 47 GHz EME Echoes

- RW3BP on July 24, 2004
- “Outstanding Accomplishment ! ”
- >100 Watts Output, 2.4 m Offset Dish,
~ 50 MW ERP!
- ~4 dB NF “HB” Preamplifier,
~10 dB Sun, 1 dB Moon Noise
- Copied By AD6FP, VE4MA, VE7CLD, W5LUA

2.4 Meter Offset Fed Dish at RW3BP



2.4 Meter Offset Fed Dish at RW3BP

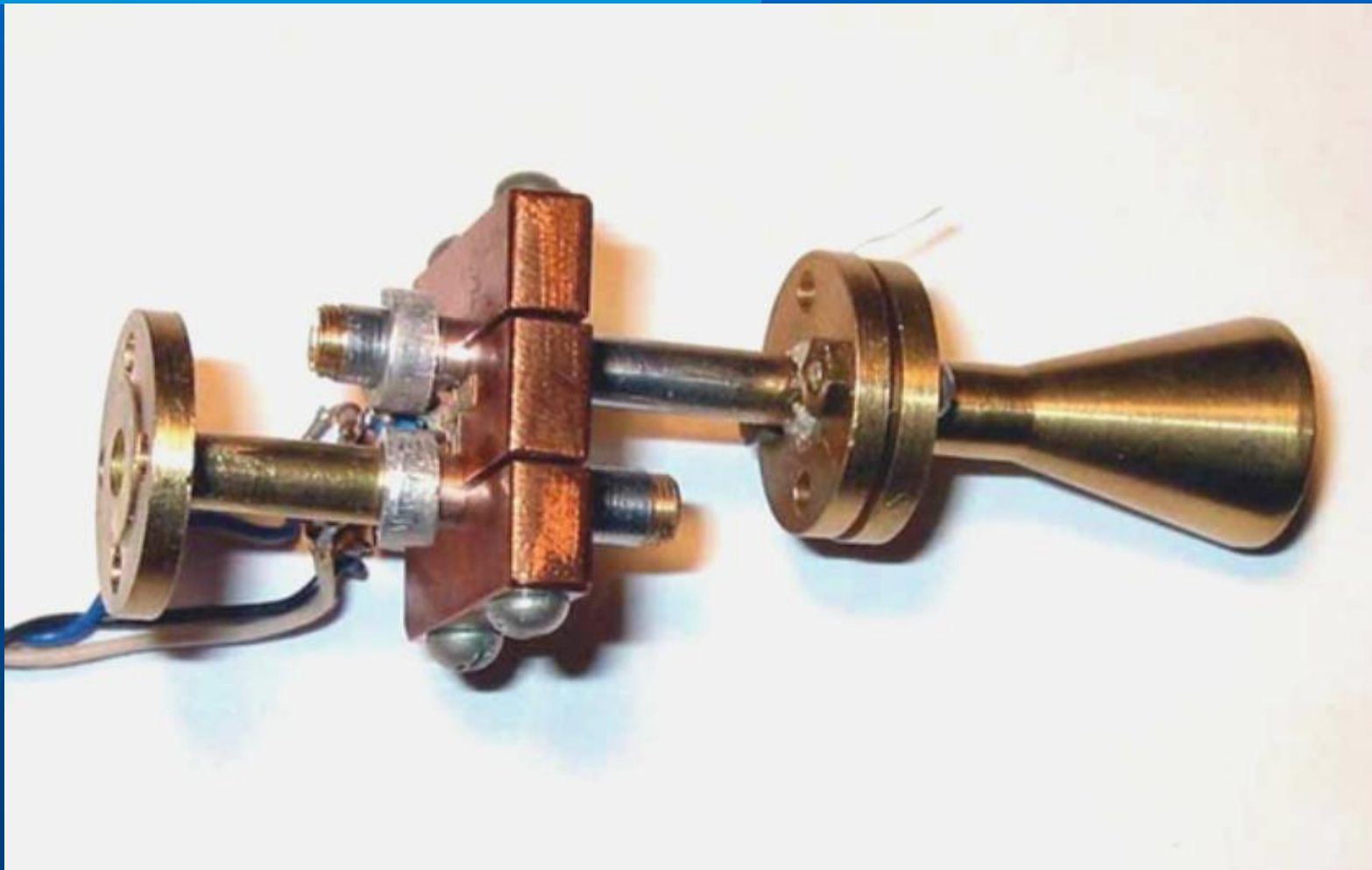


RW3BP 47 GHz EME

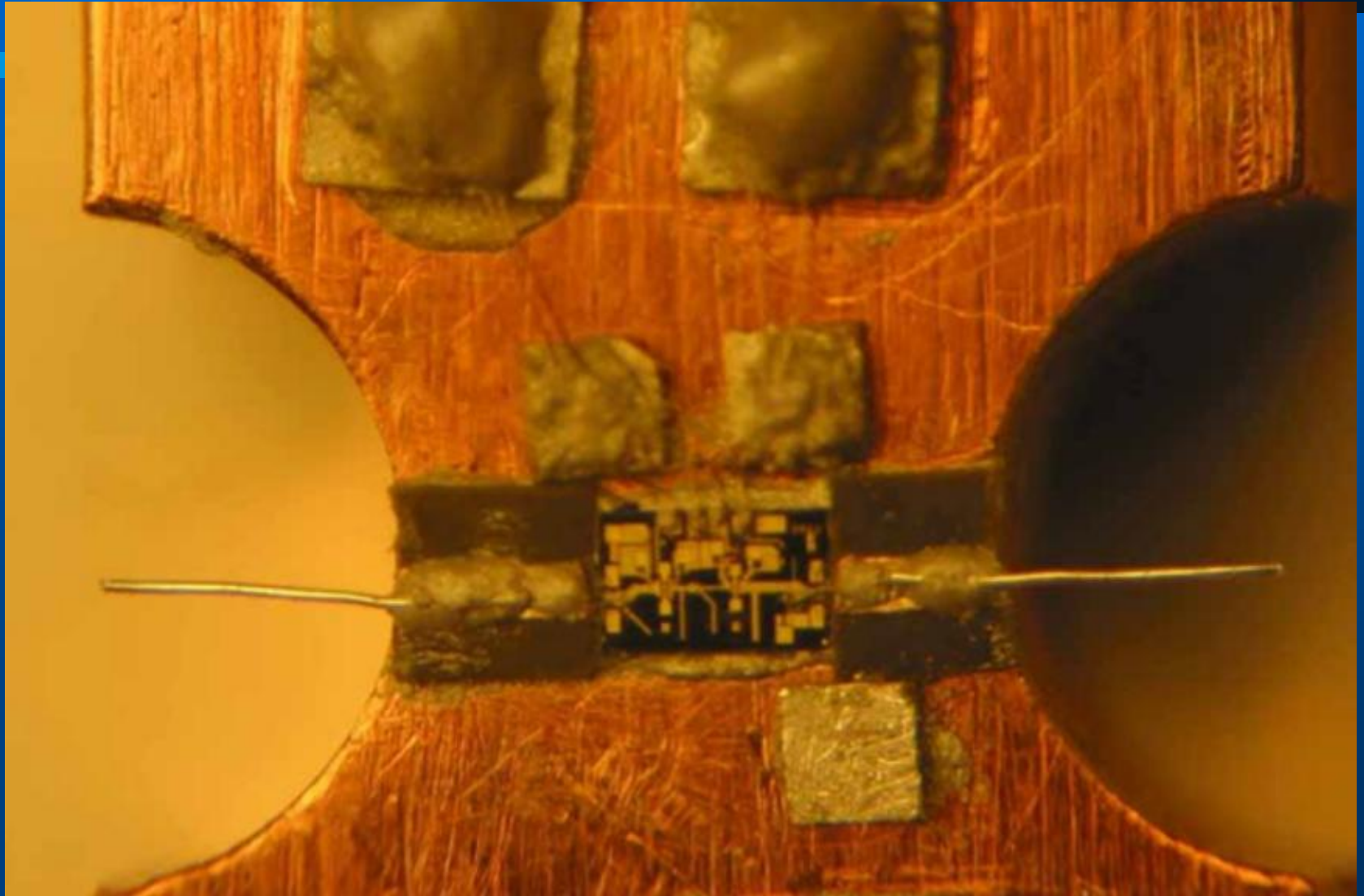
Two Feedhorns !



RW3BP 47 GHz EME HB Preamplifier



RW3BP 47 GHz EME HB Preamplifier



The Moon at 47 GHz

- Rough surface of moon produces very rough sounding note – like aurora
- Spreading can be several hundred Hz making the use of very narrow bandwidth IF filters impossible
- Doppler shift upwards of +120 kHz on rising moon and –120kHz on setting moon
- Antenna beamwidths less than half the 0.5° subtended angle of the moon

Additional 47 GHz Tests

- Gary AD6FP Operational
- ~30 W output Hughes 8901 TWT
- 1.8 m Offset Dish (~57 dB Gain)
- ~ 4 DB NF Preamps
- Tested for Possible QSO at “Low Power”
- **NO Signals Heard !**
- Predictions Said “More System Gain Needed” (NF or Ant Gain, TX Power)

AD6FP 47 GHz 1.8 Meter Dish



2.4 Meter Dish at W5LUA



2.4 Meter Dish at W5LUA



Atmospheric Effects at 47 GHz

- Unlike 24 GHz, 47 GHz is not significantly affected by Humidity
- Thick cloud cover has little effect
- Working through rain is certainly a test of your equipment capabilities
- Best conditions occur ?????....at Lowest Moon noise?

The First 47 GHz EME QSO?

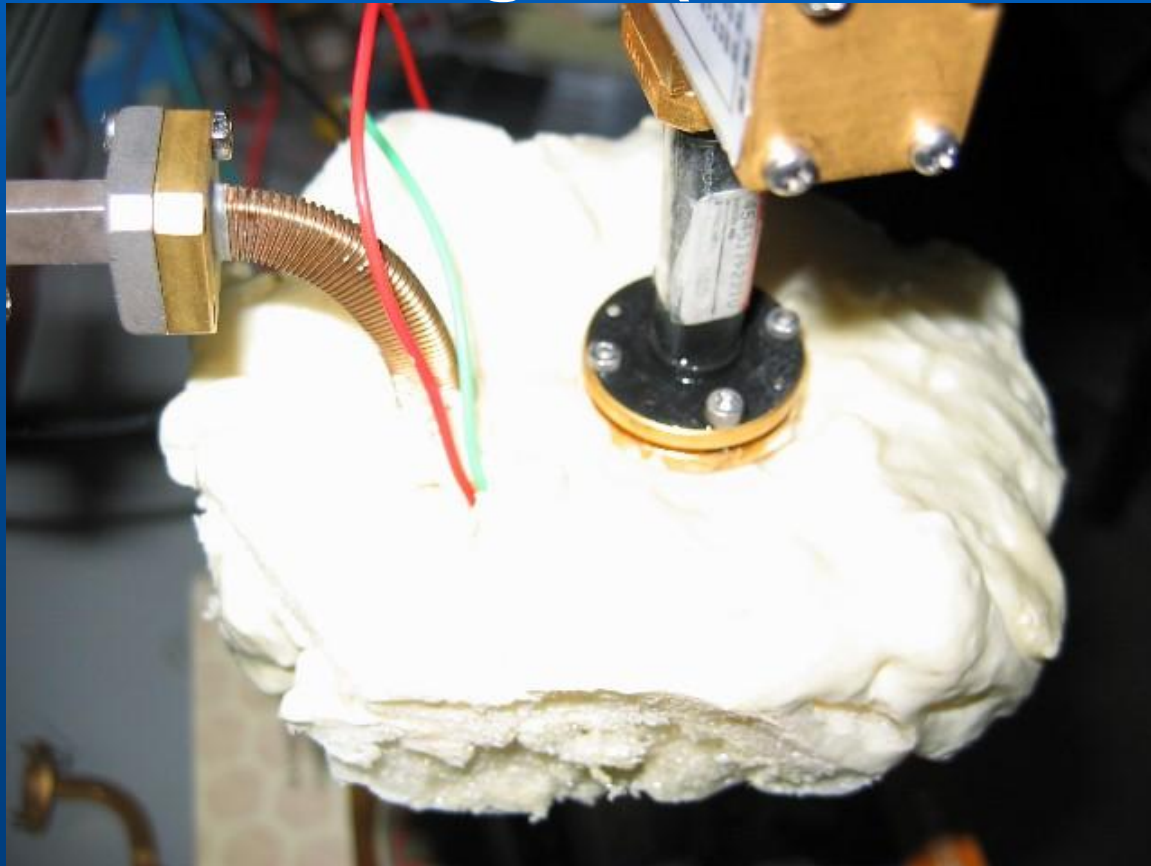
- **More System Gain is Required**
- **More TX Power/ Ant Gain Not Practical**
- **Better NF Available Thru Cooling!**
- **Test By Gary AD6FP with Liquid N2**

Better RX Performance With LN2?



Better RX Performance With Liquid Nitrogen Cooling?

- 1.5 NF @ 77 deg K (4 dB @ 290 K)



The First 47 GHz EME QSO ?

- Within a year ???
- 30 Watts is Available...need more
- 4 dB noise figure is available....need better
- Good 2.4m Dish (Performance is a concern)
- Stations working toward 47 GHz EME QSOs
AD6FP, RW3BP, VE4MA & W5LUA
- Lots of Work Still Required !

A Step Closer to 47 GHz EME QSO ?

- **RW3BP Produces Software to “Extends The Receive Threshold”**
 - Signal Spread from 300 to 450 Hz Wide
 - Long Transmission Periods
 - CW Transmission
 - BFSK & “Special” CW Modulation
- **Time Averaging Techniques to Extend Minimum RX Threshold**
- **CW Playback of Averaged Signal**
- **Many Technical Versions of Software**

47 GHz EME Software

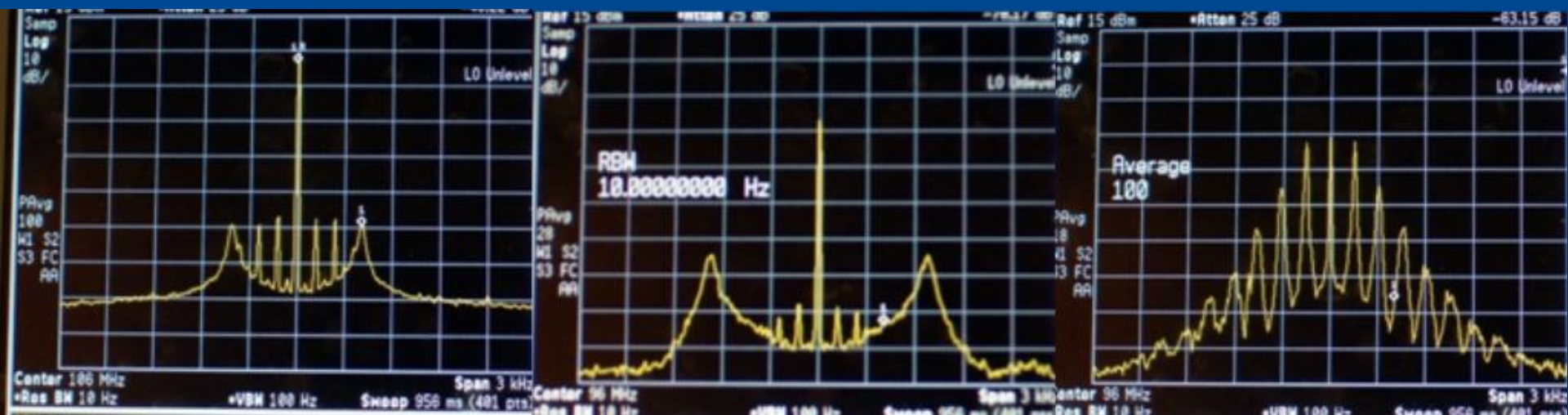


Software Technical Requirements

- **Hold Frequency Within 100 Hz for 10 Min**
 - Need To GPS Lock 47 GHz LOs
 - Need to Correct for DopplerExactly
- **Phase Locking Simple Now?**
- **Use Reflock...Simple Plug & Play**
- **Wrong !**

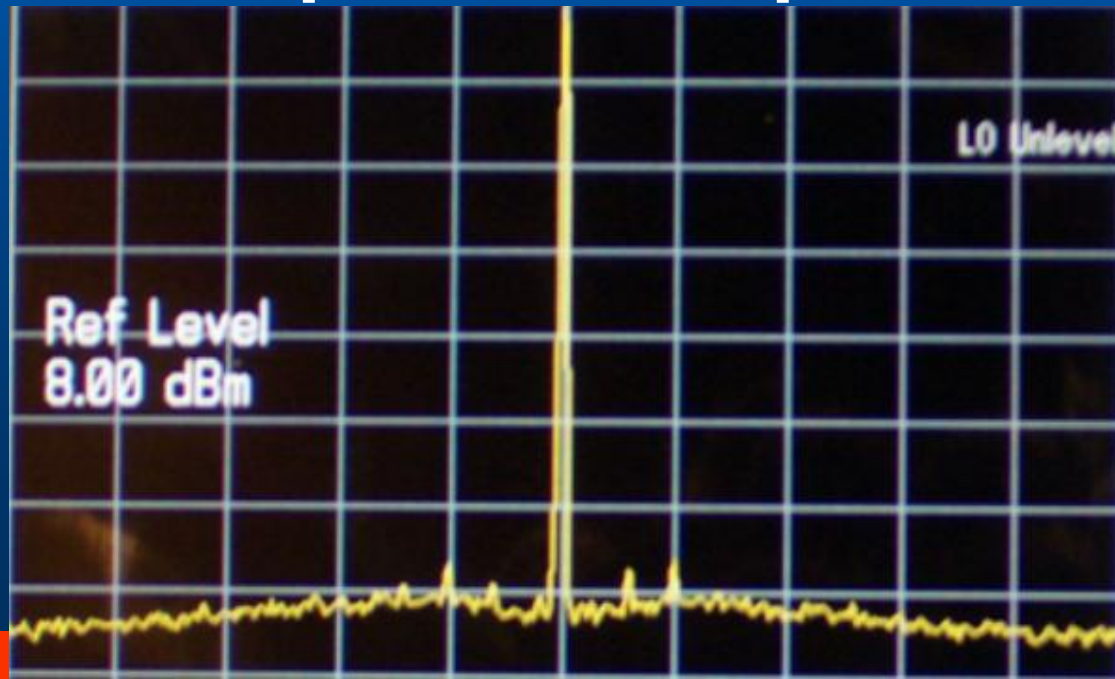
Phase Locking with Reflock Board

- High Phase Noise (See Spurs Below)
- Small Lock-in Range
- Need to Optimize Loop Filter Components (Unique to Each XTAL)



Phase Locking with Old VE1ALQ Board

- Low Phase Noise (See Below)
- Large Lock-in Range
- NO Need to Optimize Loop Filter



Phase Locking with VE1ALQ Board

- **New Board Created With CLPD Chip**
- **Low Phase Noise & Large Lock-in Range**
- **NO Need to Optimize Loop Filter**
- **Boards to be Made Available from DEMI**
- **Compatible With DEMI LOs !**

Doppler Calculation & RX Tuning



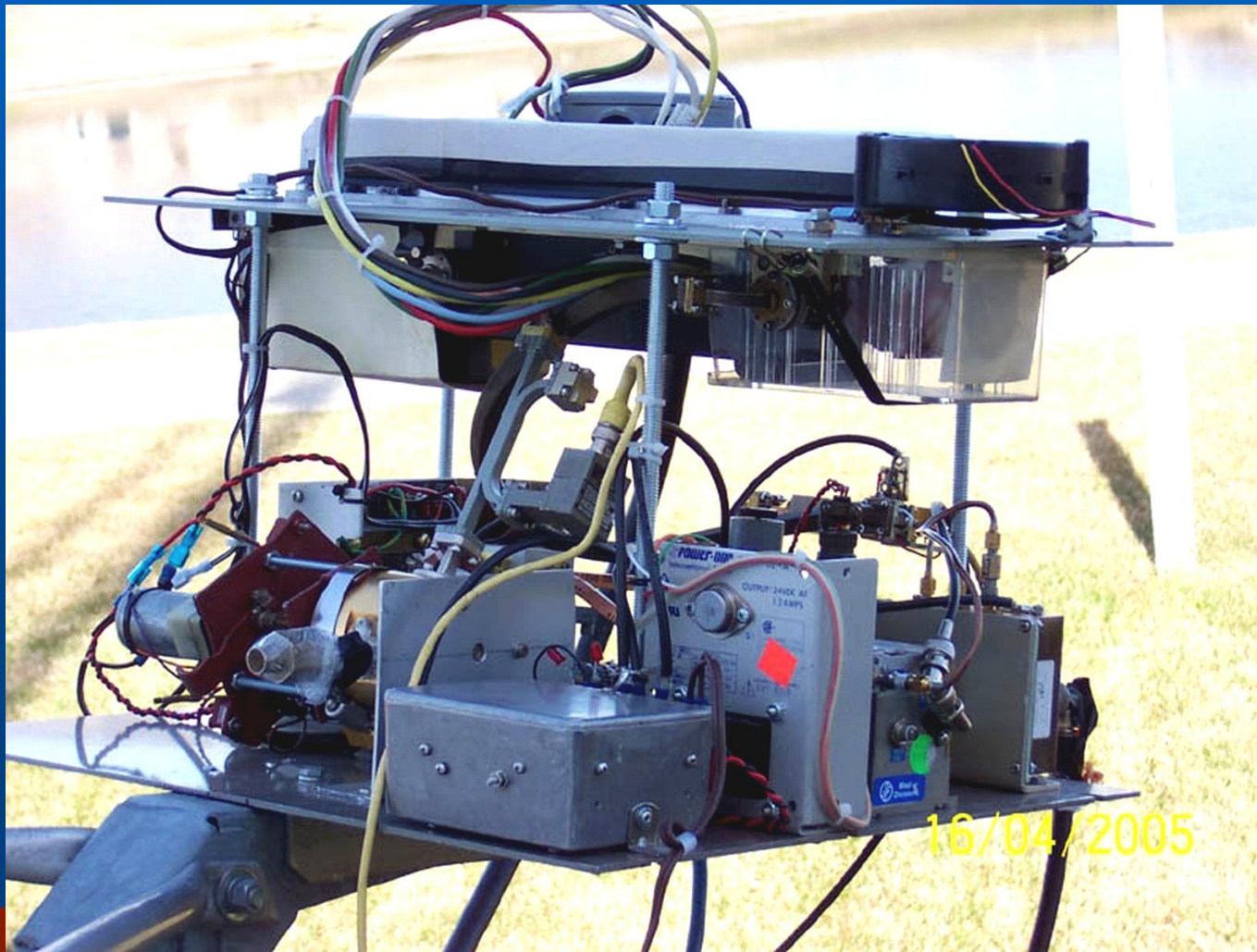
Doppler Calculation & RX Tuning

- **K5GW Software Has Approx 1.3 KHz Error at 47 GHz**
- **F1EHN Program Uses F2TU Precision Calculation Routine**
- **RW3BP, AD6FP Use F1EHN Program, W5LUA, VE4MA Use K5GW Program**
- **Manual Correction by LUA & MA until K5GW Program Update**

2.4m Dish at VE4MA



2.4m Dish at VE4MA

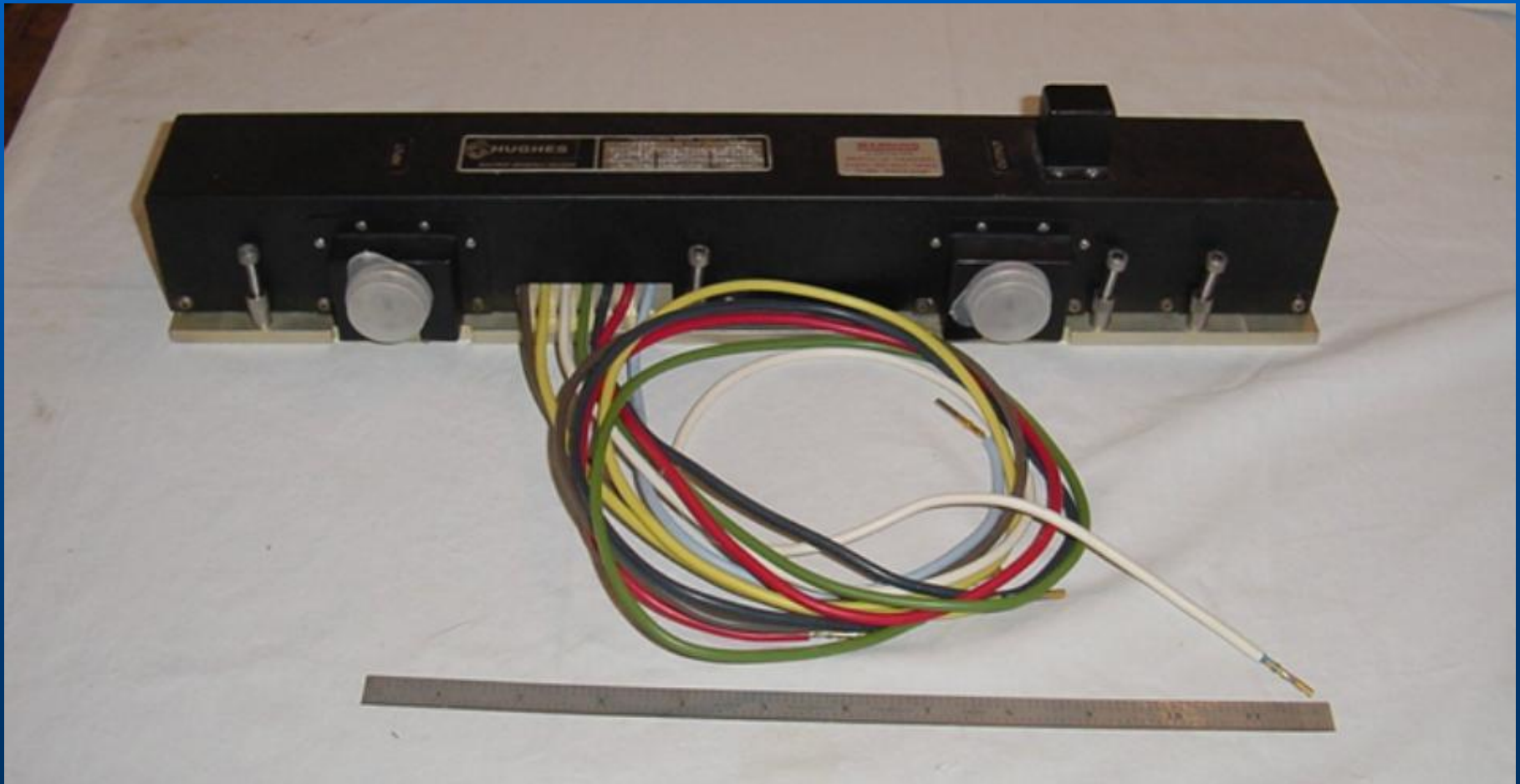


16/04/2005

“Dead” 30 Watt TWT for 45 GHz



W5LUA 32 Watt TWT for 45 GHz



Varian 13 kV Power Supply Mods



The First 47 GHz EME QSO !

- We have the Technology!
- Stations making 47 GHz EME QSOs with RW3BP: AD6FP, W5LUA & VE4MA
- Additional Tests scheduled for QSOs with AD6FP
- Lots of Work Still Required !

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Questions?