“Multum in Parvo…. part II”

Optimising a REALLY small microwave EME system

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It’s actually quite small

Small dish EME – the thoughts of Chairman Bao

- "Backyard Moonbounce" has been "done to death" at Microwave Round Tables.
- So what am I doing here (again)?
- Microwave EME is a challenge
- Microwave EME with a 15λ dish is a bigger challenge
- I'm in this hobby to learn things
- I've learned SO much since 2010

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  - 2320MHz
  - Polar mount TVRO positioner
  - Square Septum feed
  - Non – optimised “pie dish” choke ring

My First attempt

- 1.4m spun aluminium solid dish
  - It worked but the dish is noisy on RX due to overspill
  - So, I'm an alligator

- But, I Worked

Call	mode	system
F2TU	CW	8m dish
OK1CA	CW	4.2m dish
G4CCH	CW	5.4m dish
ES5PC	JT65c	4.5m dish
G3LTF	CW	6m dish
OK1DFC	JT65c	10m dish
PY2BS	JT65c	2.7m dish
OK1KIR	CW	4.5m dish

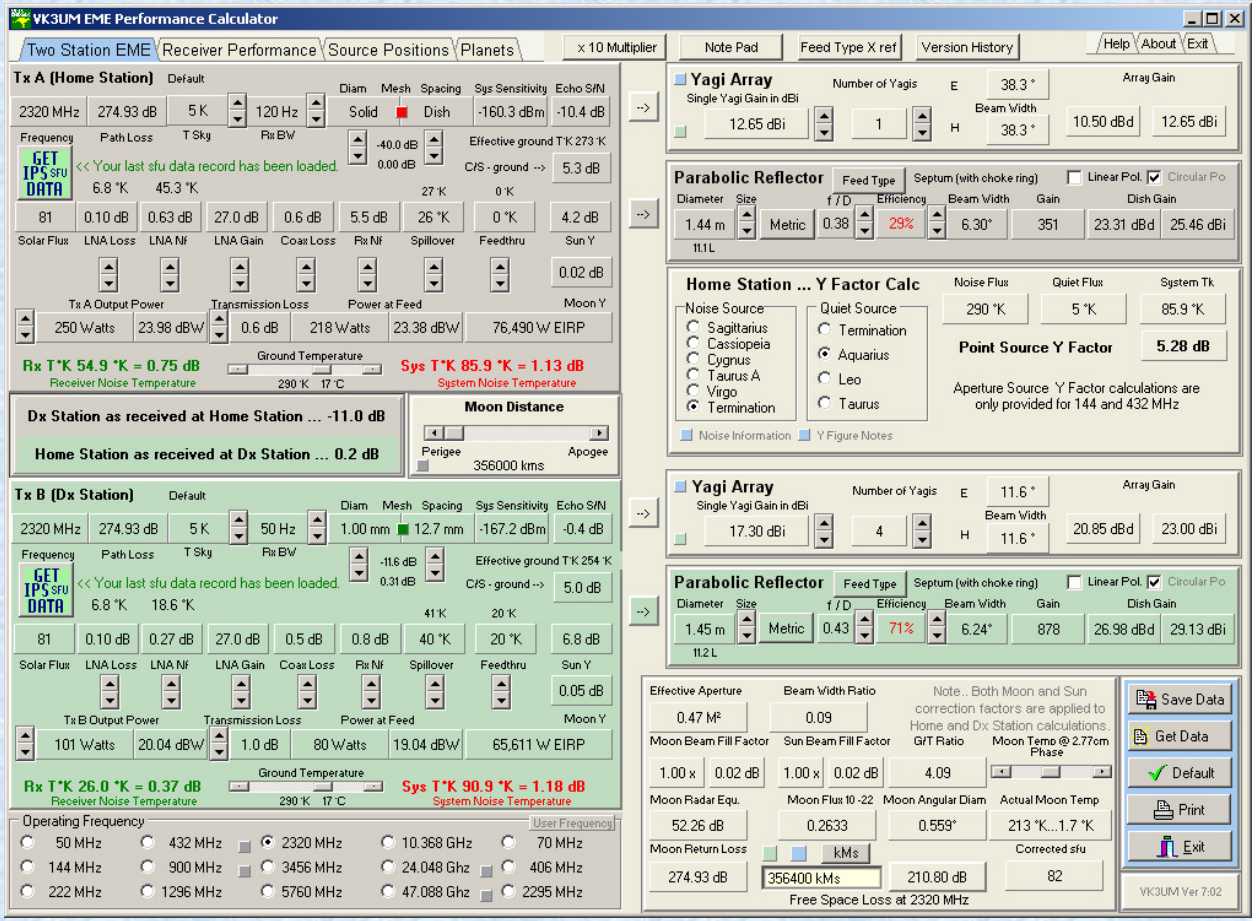
More power to the Monster Igor!

- I Visited B&Q to ***make sure*** I could work LY/DL1YMK

- Chicken wire "screen"
  - To reduce dish overspill
  - It worked!
  - Worked Michael on JT65c!
- Very low XYL support coefficient

VK3UM EMECalc

- "Must Have"
  - Automates system calculations.
  - Used for "What if" analysis of
    - Band
    - Dish size and shape
    - Feed Type
    - Power
    - Receiver performance
    - Moon distance
    - Sun noise



"Back to the drawing board"

- I already have
  - A top-notch preamp
    - (G4DDK VLNA2 sub 0.4dBNF)
  - More power than most
    - (250 Watts)
- Conclusion
- (to (mis) quote Chief Brodie in "Jaws"
- "I think you're gonna need a bigger dish"

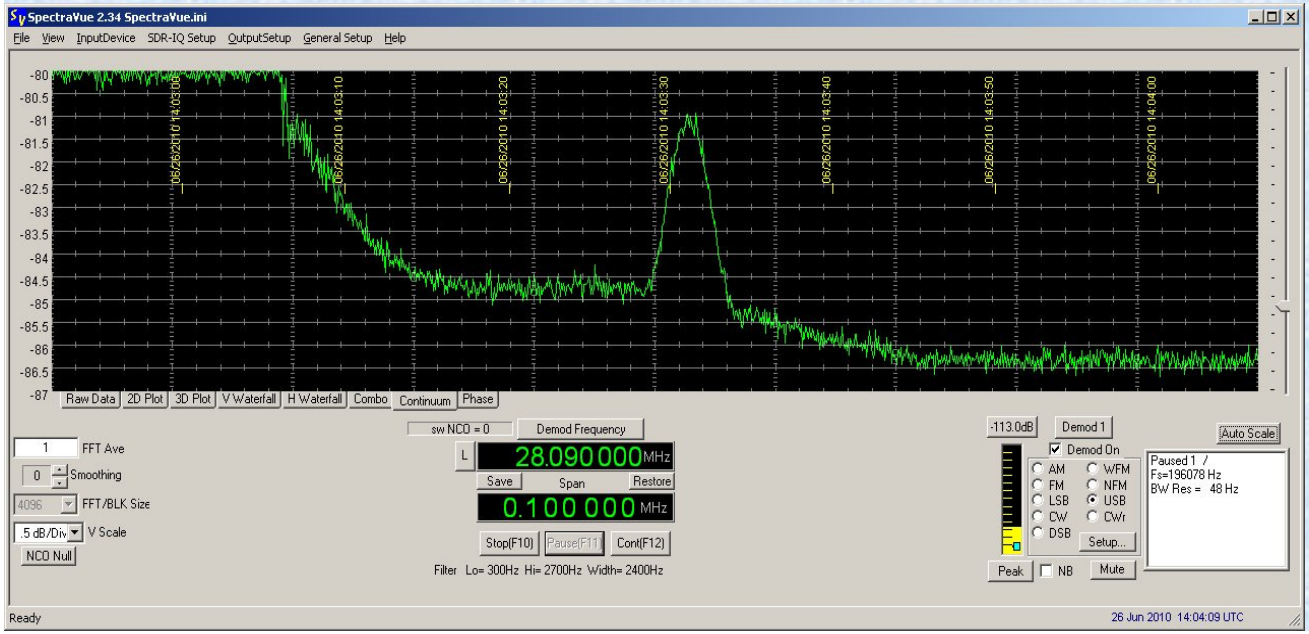
System Issues and improvements planned

- I got better reports than I sent.
  - Bigger dish - RF Ham design 1.9m mesh was the biggest I could get away with in my garden
  - Quieter feed (less overspill) - Optimise the choke ring
- Finding and keeping on the moon
  - Tracking was by “button press”
    - Easy to over compensate/forget/lose track of time & GHA.
    - Need a better rotator
- Secondary 128MHz IF RX feed to listen on 2304MHz

Setting up – lots of variables!

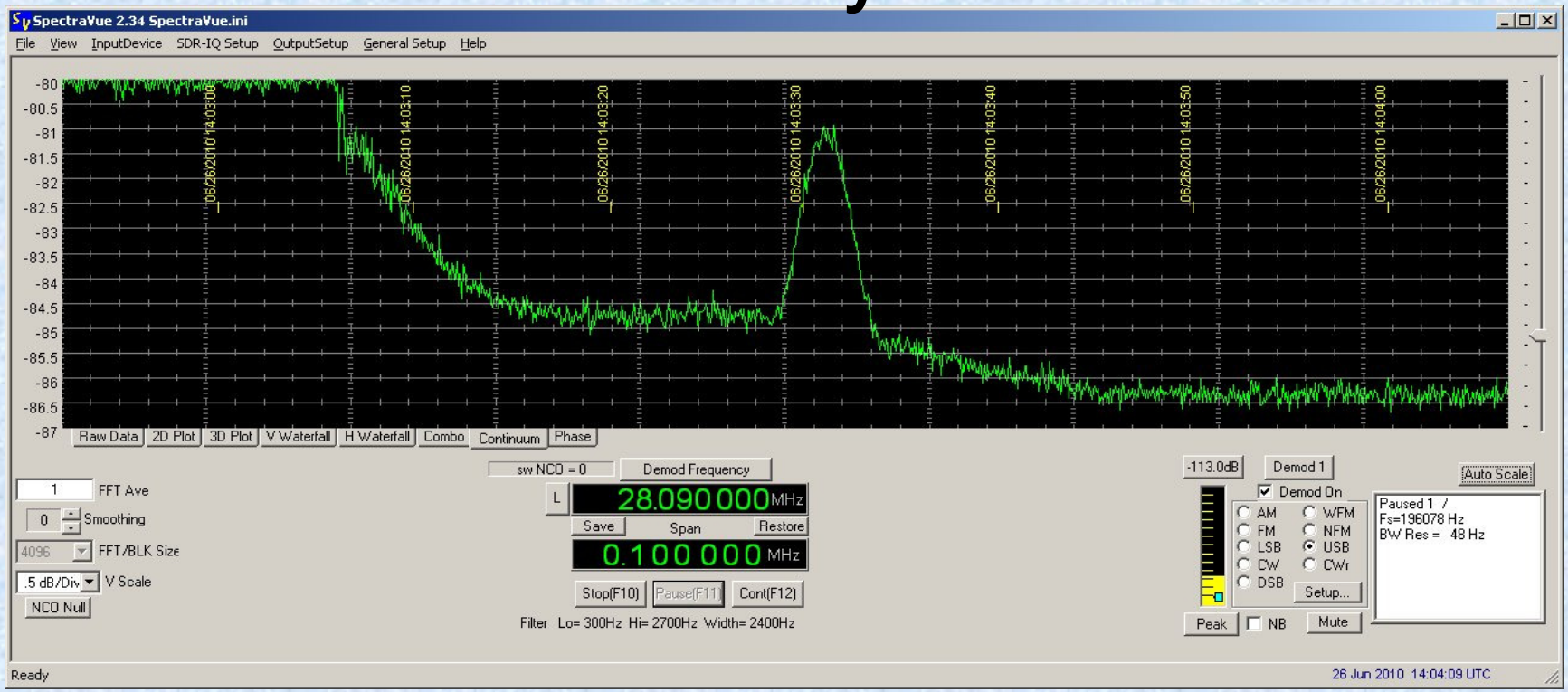
- **Tune up the feed for best TX/RX VSWR and TX/RX isolation.** ✓
- **Optimise the preamp** ✓
- **Optimise the dish and feed**
  - **Measure ratio of sun to "cold sky" noise** ✓
  - **Find the position of the feed that gives best sun/cold sky** ✓
  - **Adjust choke ring position** ✓
  - **Adjust the choke ring dimensions**

5-6dB sun/ cold sky noise



Spectravue "Continuum mode"

Sun to cold sky noise ratio

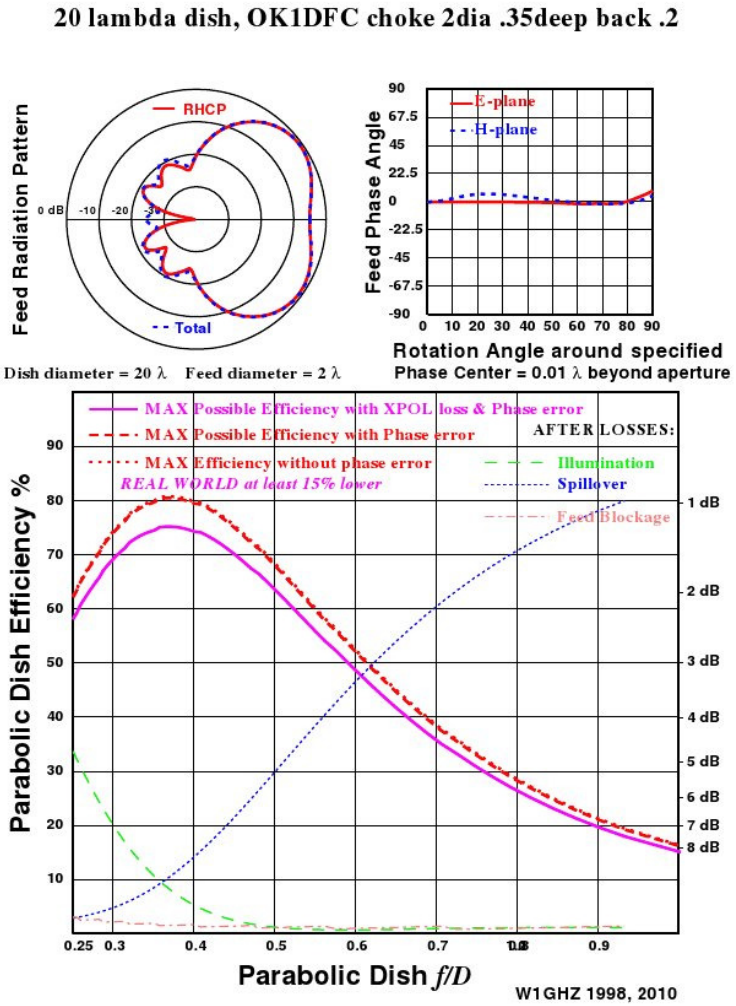


- **Note that this is not the same as highest sun noise!**
- **Adjust LNA (in situ) for best sun/cold sky**
- **Check for correct dish illumination on TX (overspill)**
- **Recheck sun/cold sky ratio**
- **This is an "iterative" process**

Optimising the choke ring

- Referred to Paul Wade, W1GHZ's excellent 2007 paper on Septum feeds
- "Enhancing the OK1DFC Square Septum Feed With a Choke Ring"
- http://www.w1ghz.org/antbook/conf/septum_feed_with_ring.pdf

- Ah…… but my dish is less than 20λ!
- Solution, - Email Paul



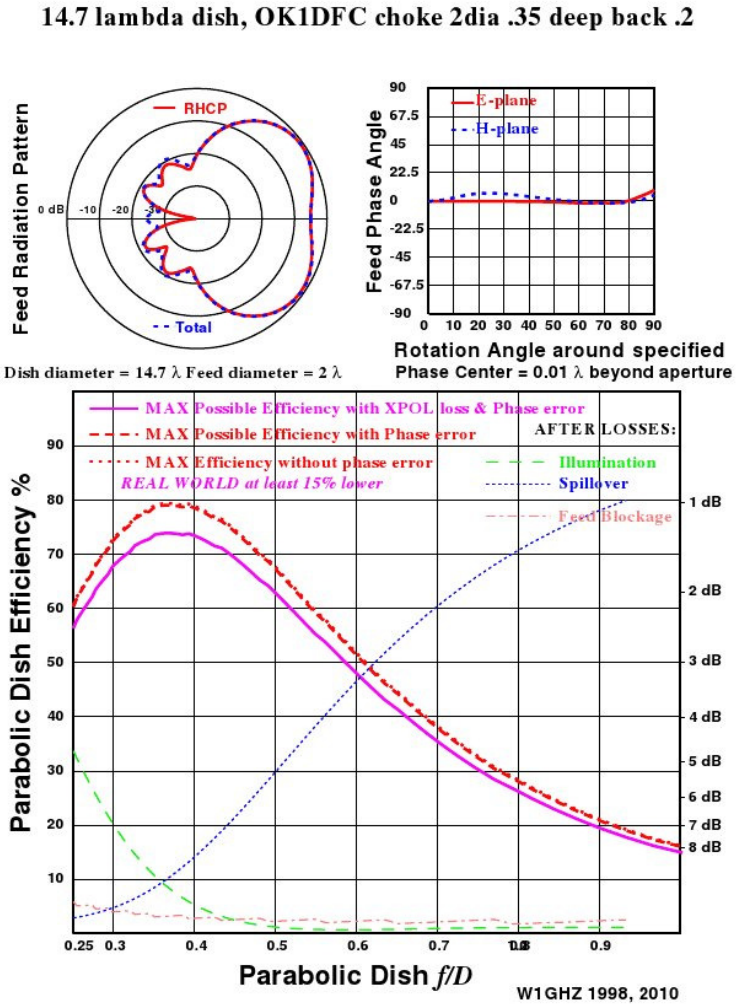
Optimising the choke ring

- Within 24hrs Paul had re- run the simulation and sent me this.
- A simulation for my exact dish size

- Don't you just LOVE our hobby and it's participants?

- Made up a 2 x 0.35λ choke ring, tried it, adjusted with Sun to cold sky
- I couldn't find a better position that Paul's theoretical prediction!

- Perfect!

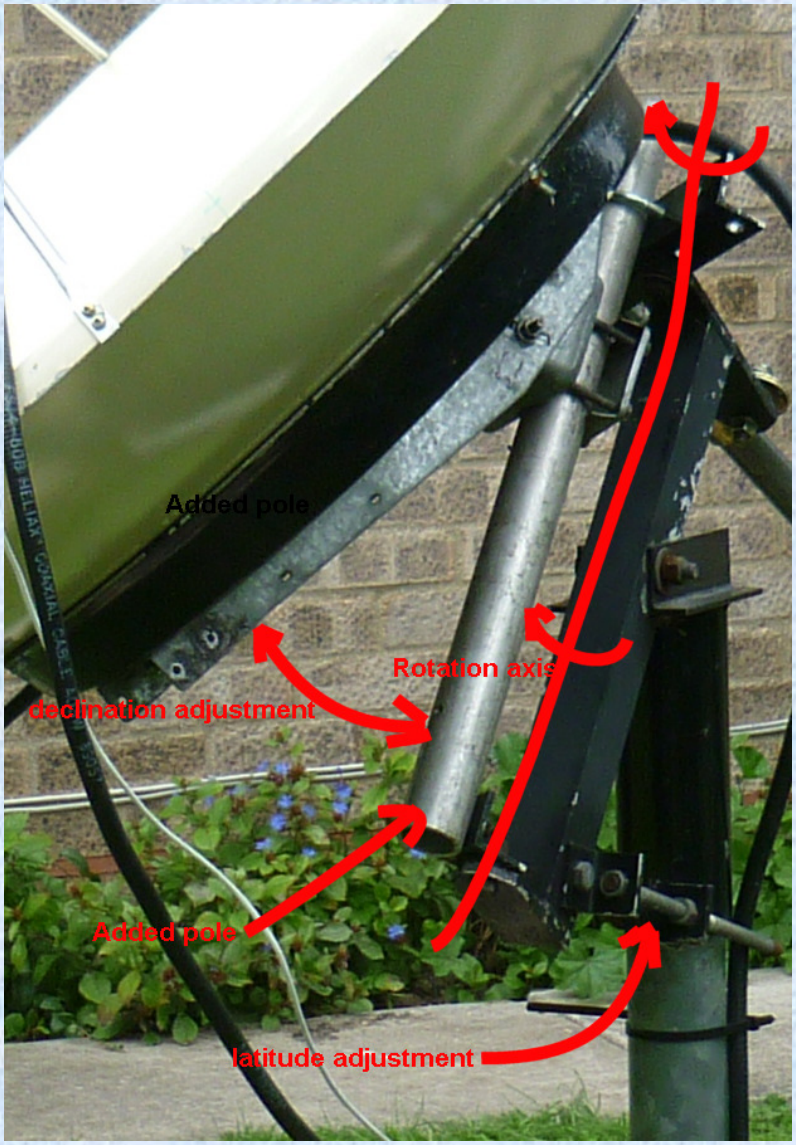


Optimising Illumination (direct method)

- I've focussed on RX improvement using sun/cold sky
- It's possible to measure illumination directly
- Feed low power to TX port and use a probe antenna to measure illumination.
  - For lowest noise aim for illumination of -14dB
  - For maximum gain aim for illumination of -10dB

Finding and keeping the Moon

- Options
- "Clockwork" Polar mount running at constant rate
  - Daily fixed declination change
  - Cheap, simple…. BUT
- With a system not good enough to see moon noise
  - I have no easy starting place (absolute reference)



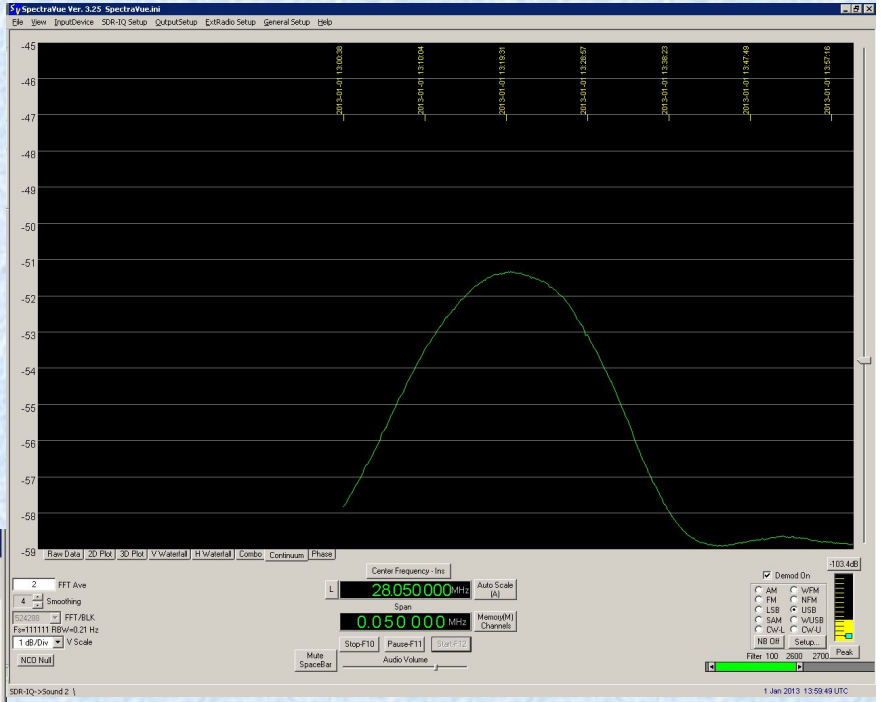
Finding and keeping the Moon

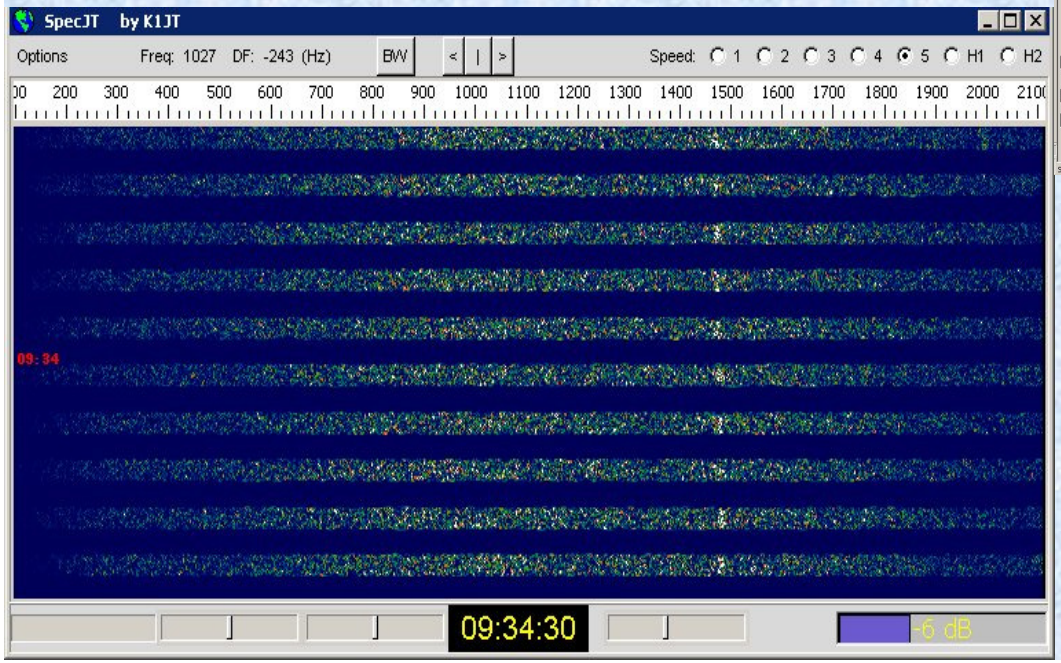
- Options
- Az-El mount
  - Absolute tracking on a small (5 degree beamwidth) dish
  - More expensive
  - Serious counterbalance needed
  - More computerised tracking support available

  - Tried "Standard" G500/G650 with Potentiometer feeback. They just won't hack it (non-linearity and slop)
  - SpiD RAS - 1 degree per pulse encoder + "Moonsked" with 30 second update.
  - Finds the Moon and tracks it to within 0.5dB or so

Some results

- Now typically 8dB sun to cold sky noise (SFI 110)
-
- -20 to -23 dB echoes in 2.5kHz (WSJT echo mode)





Some Results

- Easy to work 3m dish stations on JT65c
  - PA3FXB
- 3.5m upwards to make CW QSOs
  - PA3DZL, OH2DG
- Probably a dB or so short of “easy” QSOs
  - (But if you want easy QSOs, go on 40 metres)