

# **“Multum in Parvo”**

## **The (updated) Bodger’s Guide to Patio Moonbounce**

or

**How to get “on the moon” when you don’t own a farm or a US-sized “Backyard”**

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- **Bodger – (noun)**
  - A highly skilled itinerant wood-turner, who worked in the beech woods on the chalk hills of the Chilterns, in England
- **Bodging (Br. Slang)**
  - an inexpertly or roughly done job, typically in the field of DIY.





## EME for Bodgers - some observations

- “Backyard Moonbounce” has been “done to death” at Microwave Round Tables.
  - So what am I doing here?
- My “USP” is that my backyard is not the size of Rutland
  - (Like some of our US colleagues)
- My “buzz” is making things work, not making QSOs!
- Microwave EME is not “easy”

# EME for Bodgers - some observations

- I got sick of going to “Backyard EME” talks where the first slide was:
- “first, find your obsolete 12ft TVRO dish and load it on to the back of your monster jeep and trailer.”
- or
- “even a small 2x19 element 144MHz array can give you good results”
  - These people must have no neighbours and very compliant XYLs
- Microwave EME theory and practice are close.
  - It is satisfyingly “predictable”
- There are no short cuts
- You never stop tweaking
- It takes time to make something work
- For me, 2 years from concept to first QSO.



# Which band?

- Determined by:
  - Tolerance threshold of XYL, Patio size, Dish size, HPA availability and cost
  - So how to decide?

SE



S



SW



The view from my dish site

## 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

The screenshot shows the VK3UM EME Performance Calculator software. The main window is titled "VK3UM EME Performance Calculator" and has several tabs: "Two Station EME", "Receiver Performance", "Source Positions", and "Planets". The "Two Station EME" tab is selected, showing a detailed interface for calculating moonbounce performance. It includes sections for "Tx A (Home Station)" and "Tx B (Dx Station)", each with fields for frequency, power, losses, and gains. There are also sections for "Yagi Array" and "Parabolic Reflector" calculations, and a "Home Station ... Y Factor Calc" section. The interface is complex with many buttons and dropdown menus.



## Which band? – here's how I decided

- **Starting point – 1.4m spun aluminium solid dish**



## Which band? – here's how I decided

- **Starting point – 1.4m spun aluminium solid dish**
  - Small enough to pick up and carry.
  - It cost me nothing!
  - No argument – anything bigger looks “ugly” and attracts too much attention





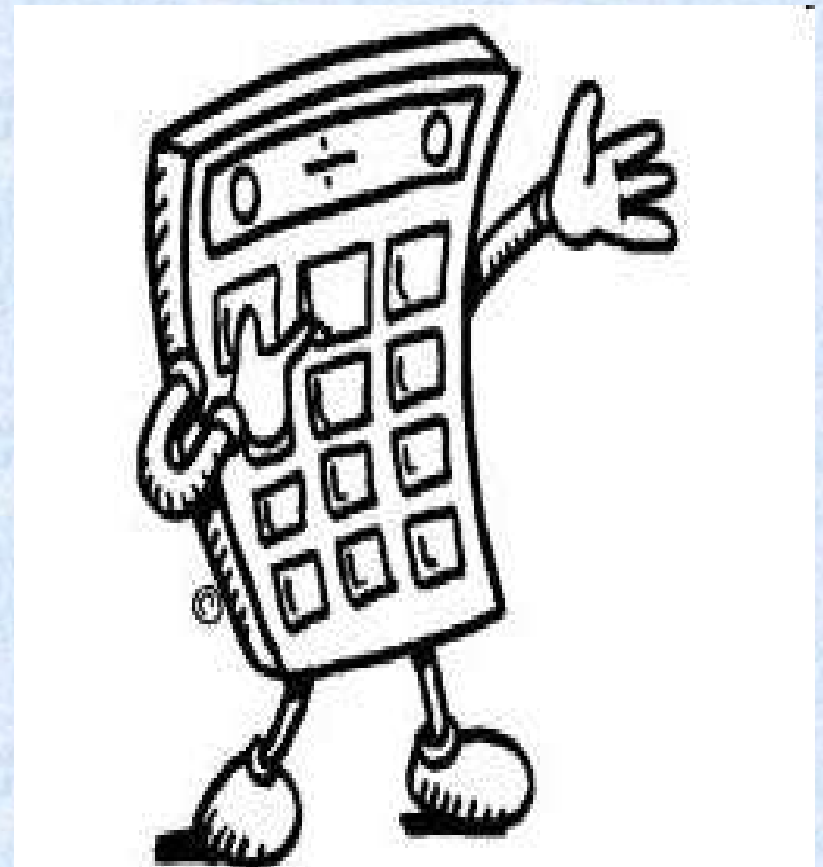
## Which band? – here's how I decided

- **Starting point – 1.4m spun aluminium solid dish**
  - Small enough to pick up and carry.
  - It cost me nothing!
  - No argument – anything bigger looks “ugly” and attracts too much attention
  - Can be easily disguised as “garden furniture” when not in use.



# Which band? – here's how I decided

- Objectives:
  - Mainly homebrew
  - Polar mount
  - No dangerous voltages outdoors
  - Good enough to work “big guns” on CW and for JT modes
  - **“Echoes” > -6dB in 120Hz RX bandwidth**
- From VK3UM EMECalc
  - 23cm?
    - NF 0.3dB, TX power 700W
  - 13cm?
    - NF 0.35dB, TX power 270W
  - 9cm?
    - NF 0.4dB, TX power 150W
  - 3cm?
    - NF 0.7dB, TX power 45W





## Which band?

- **23cm? NF 0.3dB, TX power 700W**
  - Too much power + poor dish illumination !!
- **9cm? NF 0.4dB, TX power 150W**
  - Do-able but PA could be expensive
- **3cm? NF 0.7dB, TX power 45W**
  - Very expensive SS PA, or outdoor TWT needed.
  - Too many high voltages for my liking!

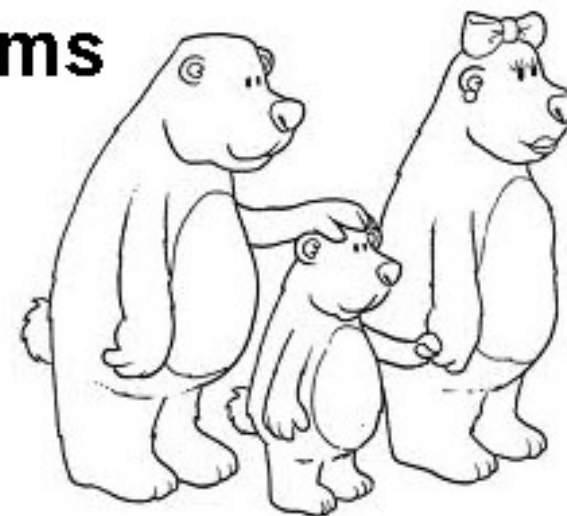


# The “Goldilocks band”?

- 23cm? NF 0.3dB, TX power 700W
  - Too much power + poor dish illumination!!
- 9cm? NF 0.4dB, TX power 150W
  - Do-able but PA could be expensive
- 3cm? NF 0.7dB, TX power 40W
  - Very expensive SS PA, or outdoor TWT needed
  - Too many high voltages for my liking
- **13cm?**
  - **NF 0.35dB, TX power 270W**
  - Surplus PAs and cheap LNAs (G4DDK) available,



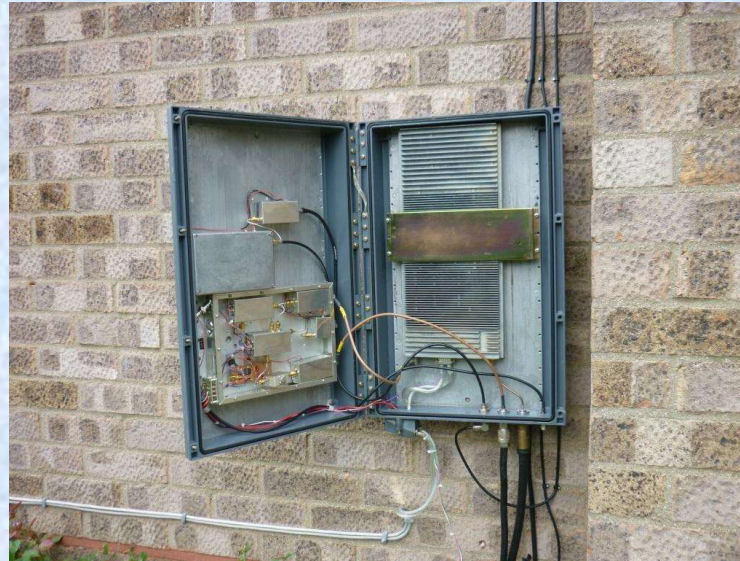
**Use 13cms  
my boy!**





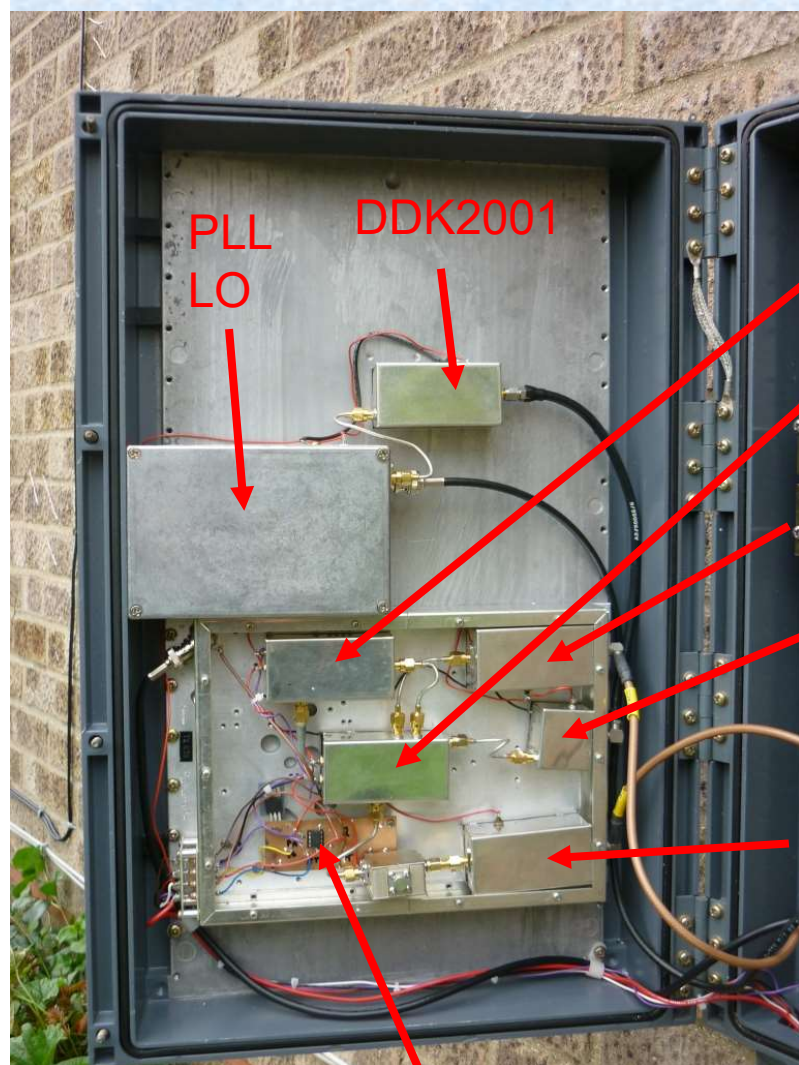
# The Hardware

- **Transverter requirements**
  - Remote from shack
    - 144MHz IF
  - Watertight
    - “Storno” base station cabinet
  - Close to dish
    - Minimise feeder losses
  - Locked
    - to 10MHz reference in shack
  - Low voltage
    - 28V DC (27Amps!) fed out from house via “Sky feeder” hole





# The Transverter



PLL  
LO

DDK2001

IF preamp  
and switch

Mixer

TX buffer

LO x2

2<sup>nd</sup> LNA

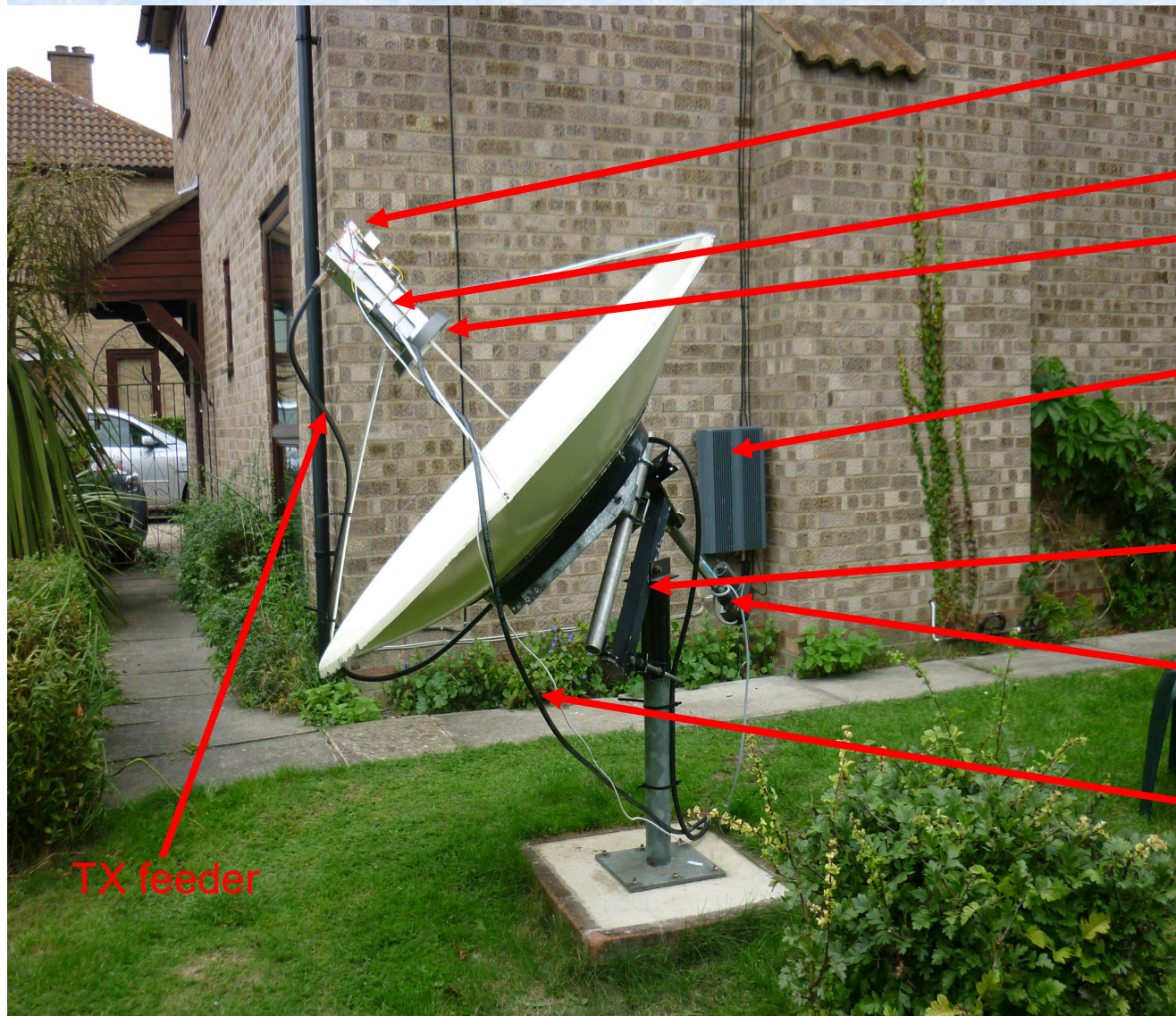
PIC sequencer + regulators



PA



# Original 1.4m dish system worked (just)



G4DDK VLNA2 and relay

OK1DFC Septum feed

"pie dish" choke ring

Transverter

Polar mount

Sat dish "jackarm"

RX feeder

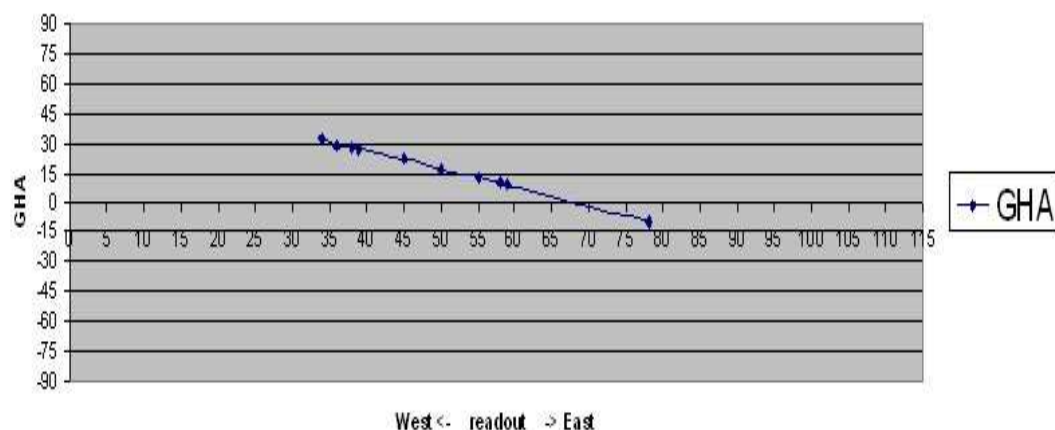
TX feeder



## Original dish system

- Modified TVRO mount
  - TVRO mounts have a fixed declination
- Add declination adjustment
  - Bodged from the latitude adjuster of an old TVRO dish and a short 2 inch pole!
  - Manual setting of declination each moon pass is adequate for such a small dish
- Controlled by Nokia ACU8152
  - Calibrated for GHA by plotting sun noise over a day

GHA vs positioner readout -> sun, dec = 23.2





# Then it got Bodged!

- Added B&Q chicken wire mesh to reduce ground noise pickup
- Gained around 1 dB sun/cold sky
- Allowed me to work LY/DL1YMK Dxpedition!



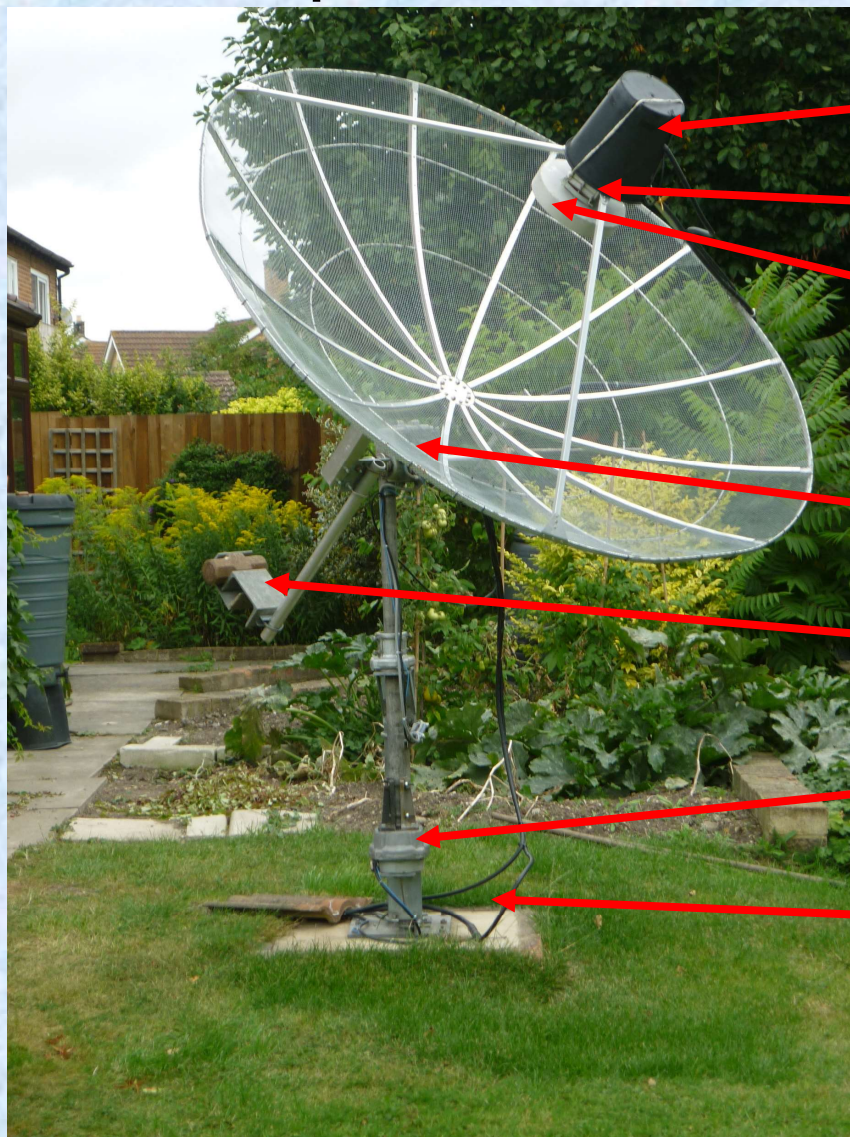


# Some results (1.4m dish)

Call	Locator	sent	received	mode
F2TU	JN38LG	O	549	CW
OK1CA	JO7ØGM	O	00	CW
G4CCH	IO93QL	m	m	CW
ES5PC	KO38HJ	O	O	CW
G3LTF	IO91GG	O	O	CW
OK1DFC	JN79GW	O	O	JT65c
PY2BS	GG76	O	O	JT65c
OK1KIR	JO6ØPM	O	O	JT65c
LY/DL1YMK	KO06mb	O	O	JT65c (dish "expanded")



## Updated 1.9m dish system (better)



G4DDK VLNA2, relay  
(under bucket! :)

OK1DFC Septum feed

redesigned choke ring

KR500 EI rotator

Counterbalance

KR400 Az rotator

RX +TX feeders

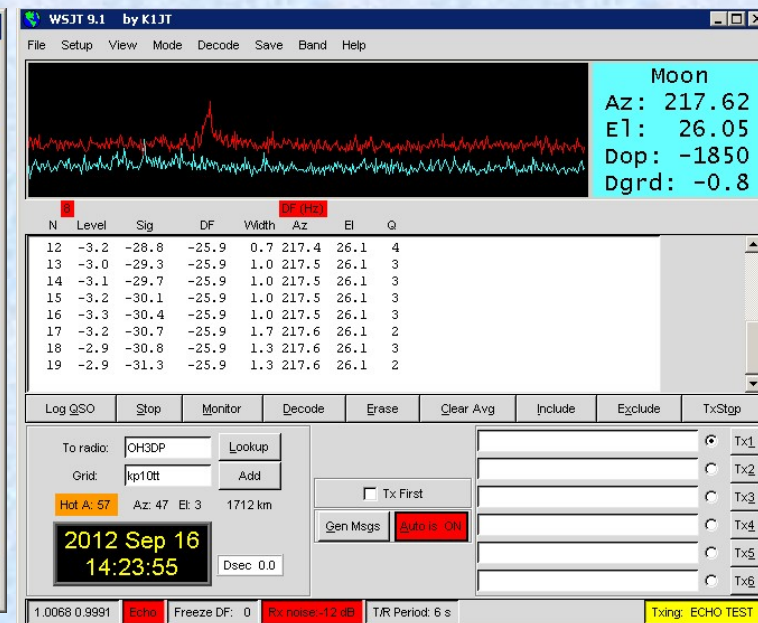
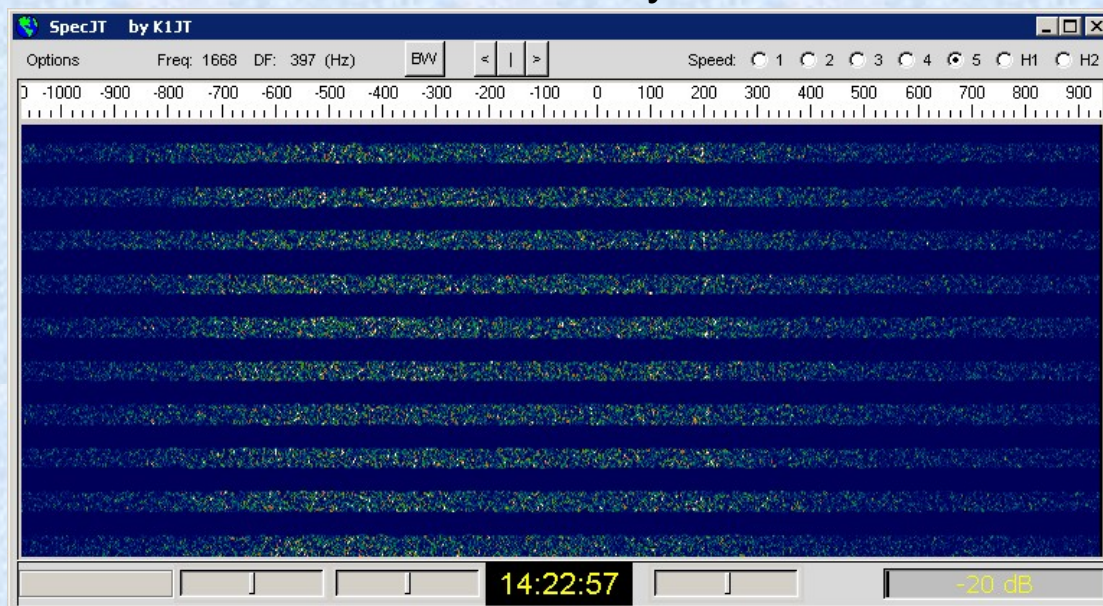


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## Latest results (1.9m dish)

I can now “see” my echoes on WSJT Echo mode..... Woo - Hoo!!!!



Call      Locator      sent received mode

OH2DG KP3ØCK      M      549      CW

G3LTF IO91GG      519      539      CW

F2TU JN38LG      539      539      CW

F2TU JN38LG      529      ???      SSB

Improved report both ways!

Improved report to F2TU

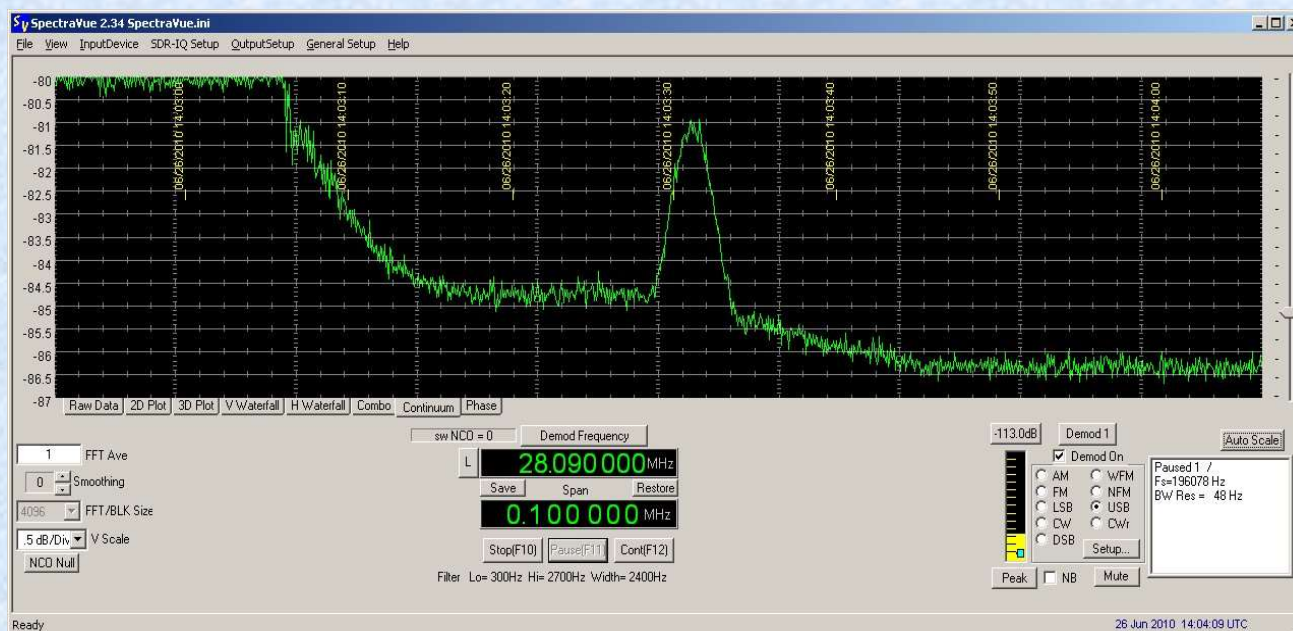
One way QSO on SSB!

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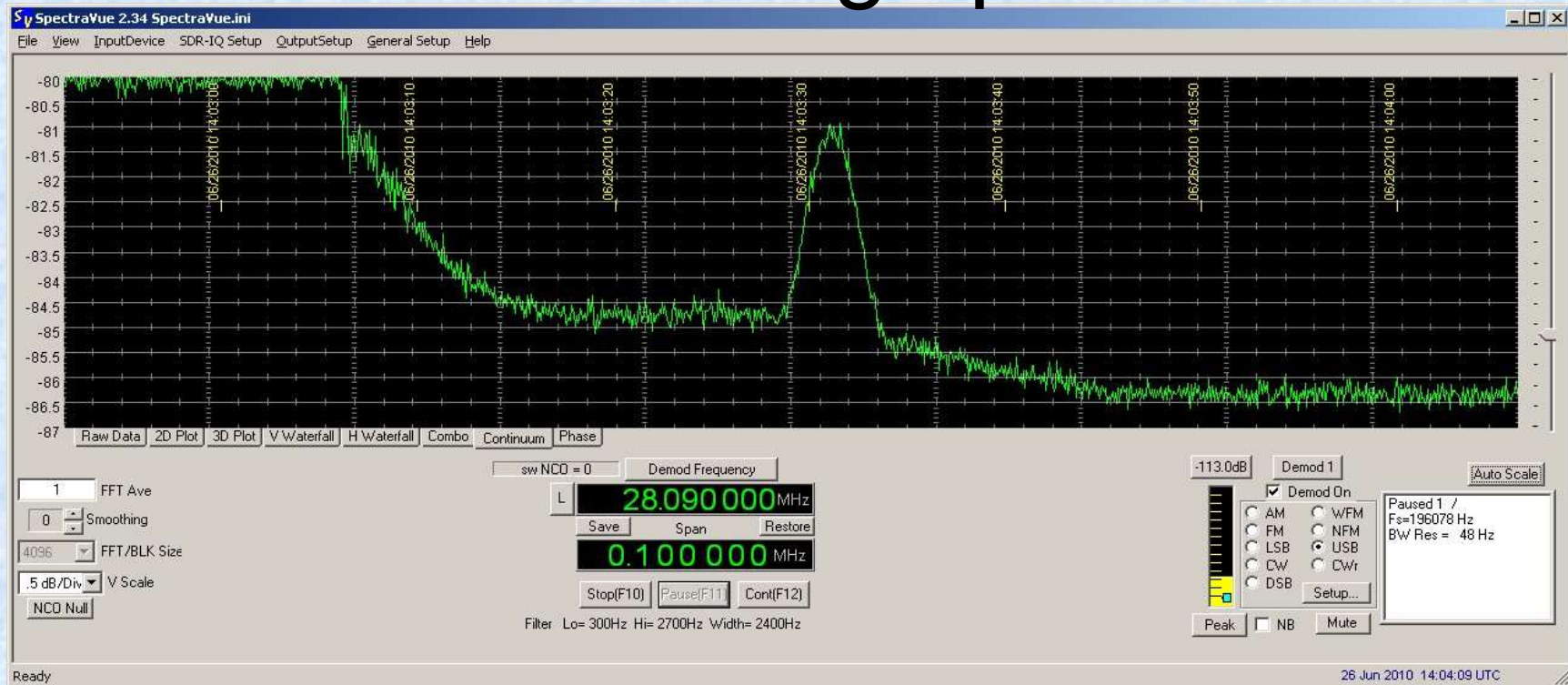


## Setting up

- Tune up the feed for best TX/RX VSWR and TX/RX isolation.
- Optimise the dish and feed
  - Measure ratio of sun to “cold sky” noise by:
    - Finding the position of the feed that gives best sun/cold sky
    - Adjusting the choke ring for same



## Setting up



- 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



# System Issues and improvements

- I got better reports than I sent.
  - QRO and a small dish makes me a bit of an “alligator”
  - The 1.9m dish is better on receive, a little quieter
- Finding and keeping on the moon
  - Original tracking was by “button press”
    - Easy to over compensate/forget/lose track of time&GHA.
  - New Az El tracking uses F1EHN Freeware and EA4TX “ARSWin” controller (already had this hardware)
- Further RX improvement
  - Fitted a “rim” to old dish to enable me to work YL/DL1YMK
  - Lowered dish noise by fitting (W1GHZ-designed) choke ring optimised for 1.9m dish
  - 1.9m dish now better than rimmed 1.4m can now “see” echoes on WSJT echo mode.
  - Improved system NF by improving second stage
- Added synthesised “ApOLLO” to allow listening on 2304MHz

## Acknowledgements

- Bernie G4HJW for giving me the dish that kicked the project off
- My XYL Vicki, for not saying anything when aforesaid dish appeared on our lawn one day!
- Sam G4DDK for encouragement, a free 300 Watt PA and allowing me to nag him until we got the VLNA performance spot-on!
- Leeds Central High School (now sadly long gone) for introducing a young lad to the wonders of technology and showing me that I could “make things”