The Rise and Rise of 6cm EME

Peter Blair G3LTF

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- G3LTF EME … a brief history
- Why 6cm EME?
- Some 6cm issues
- Current Systems, Dishes and Feeds
- Transverters, LNAs and Transmitters
- System measurement and optimisation

G3LTF EME- a brief history

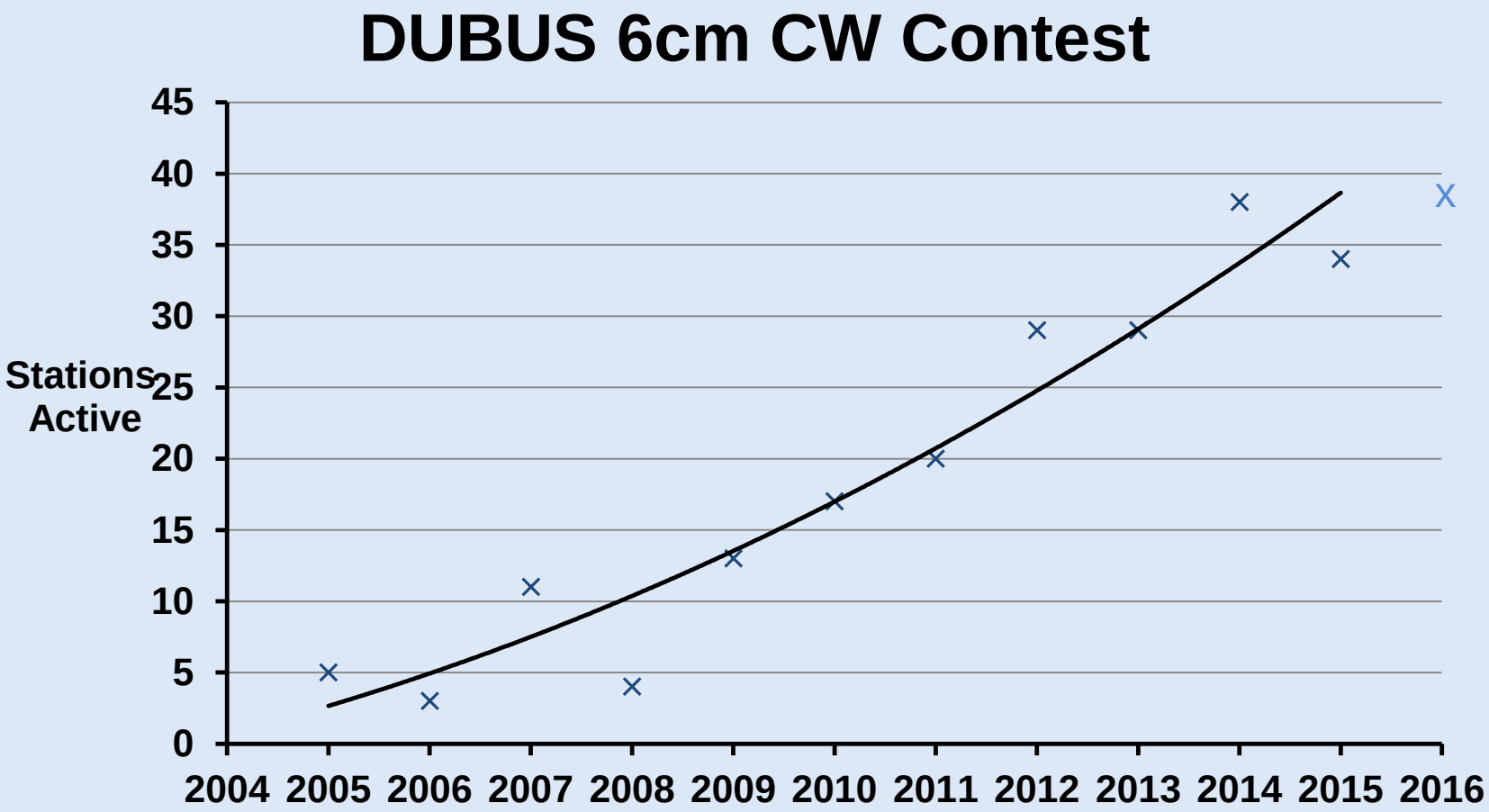
1964 70cm 456# 69 dxcc
1968 23cm 426# 64 dxcc
1992 13cm 130# 41 dxcc
2005 9cm 56# 26 dxcc
2007 6cm 62# 28 dxcc

= Initial contact

Why 6cm EME?

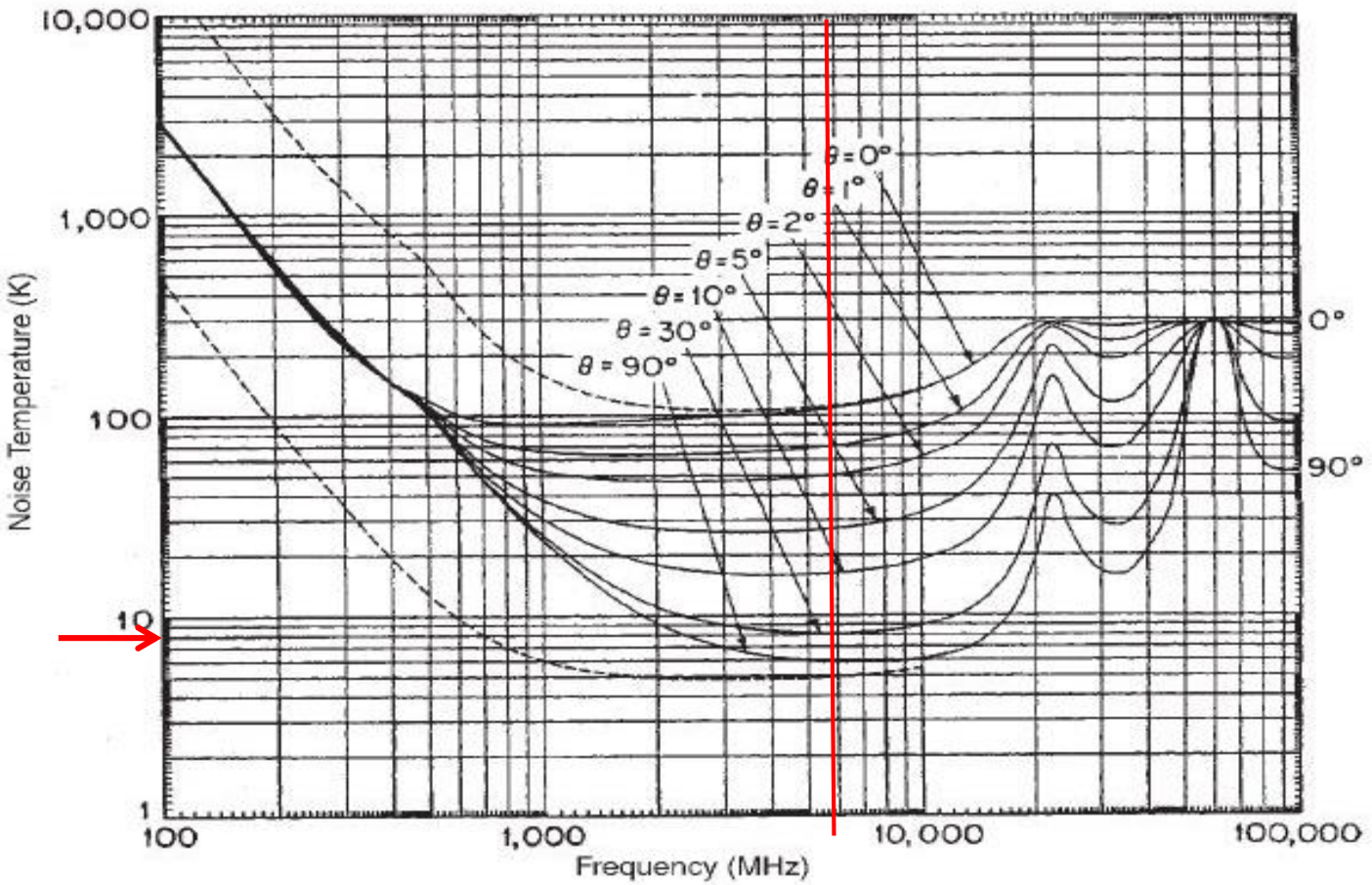
- Wide availability and common allocation
- Growing number of stations and activity

Dedicated weekend per band plus Activity Weekends boosts 6cm EME



Why 6cm EME?

- Wide availability and common allocation
- Growing number of stations and activity
- Good results possible with 1.8-3m dish
- A good engineering challenge and an experimenters playground
- Not too hard to get the components
- Some designs on the web
- “Plug and play” available…. (at a price)
- Low sky noise temperature

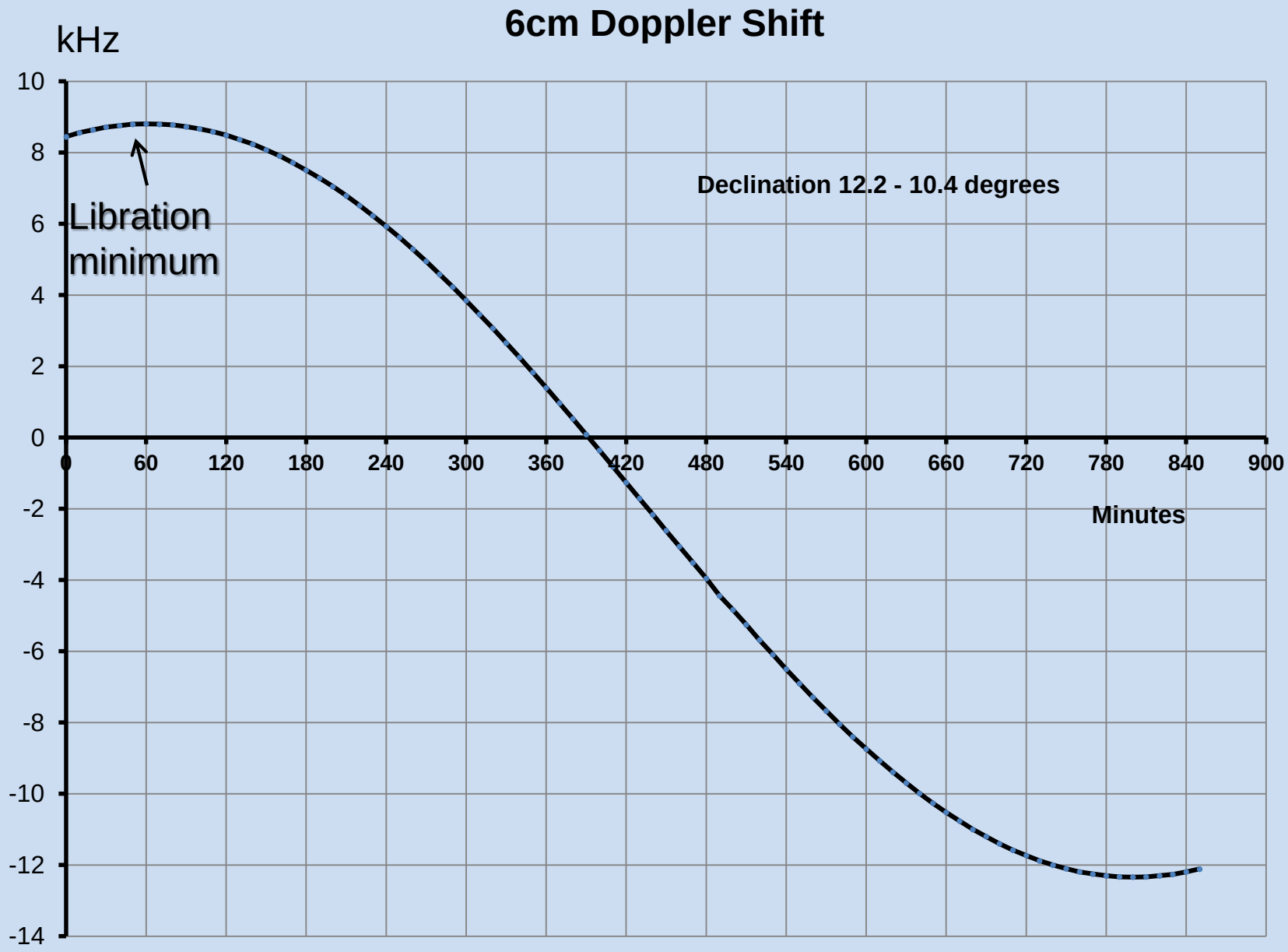


Sky Noise Temperature

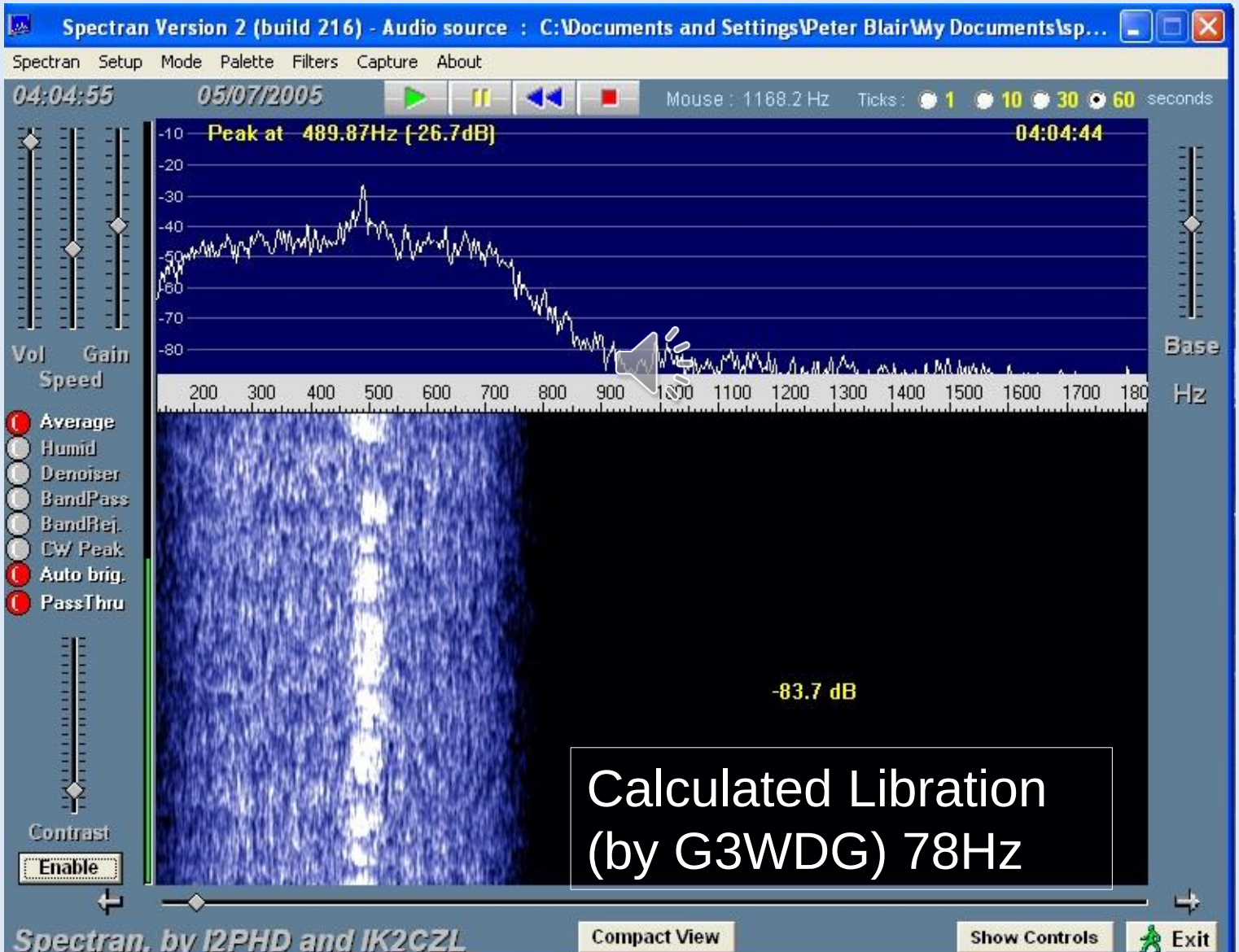
5.7GHz 30 deg. Elevation Tsky = 8K

Some 6 cm Issues

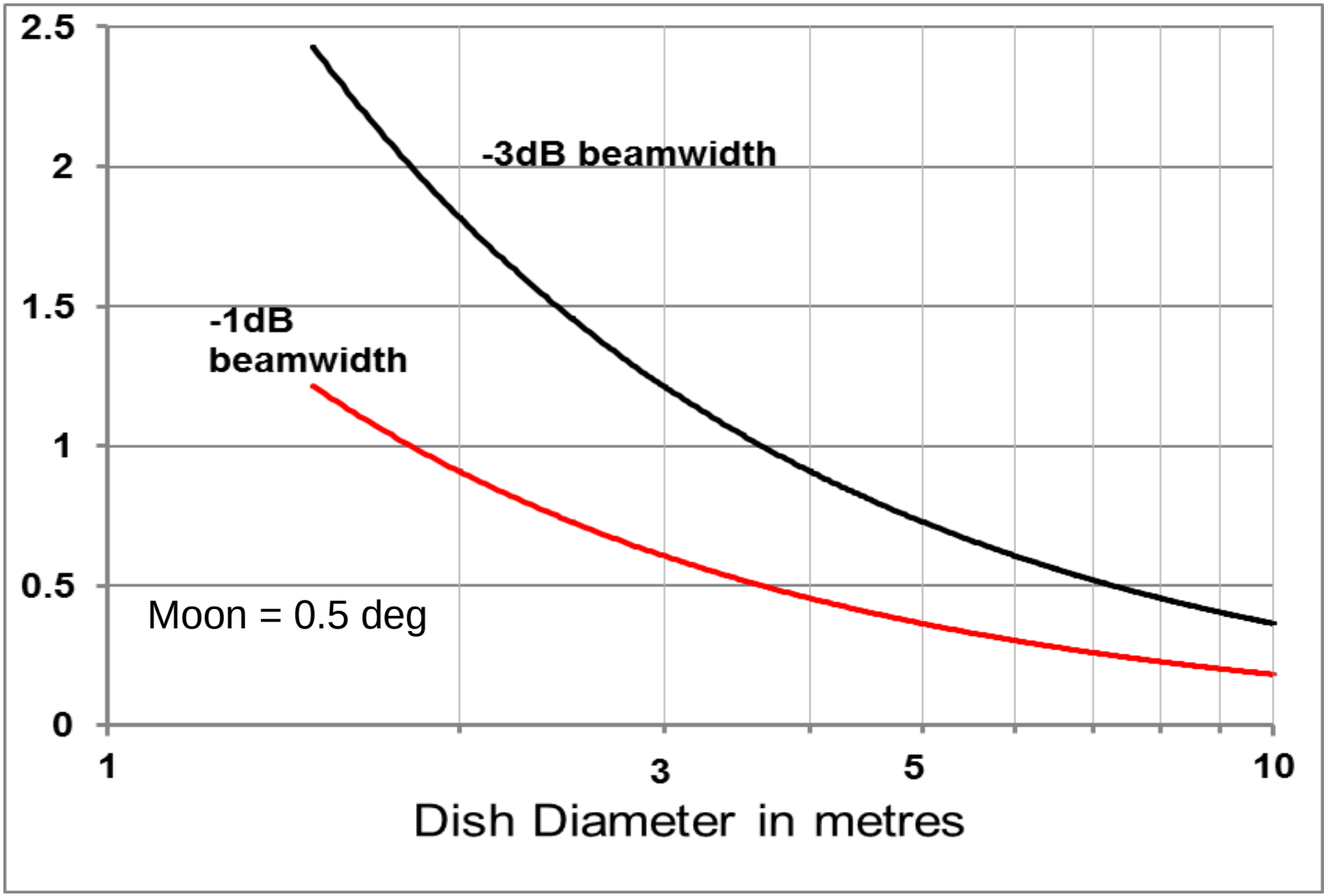
- Doppler Shift and Libration
- Antenna pointing
- Noise temperature & mesh dishes
- Mounting systems at the dish focus


6cm Doppler Shift
kHz
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
Libration minimum
Declination 12.2 - 10.4 degrees
0
60
120
180
240
300
360
420
480
540
600
660
720
780
840
900
Minutes

Libration Spreading OK1KIR 15-08-09



Antenna should point within the 1 dB beamwidth. (-3dB is -6dB on echoes)



Effect of Mesh size on Tsys and Gain

In a mesh dish the feed-horn “sees” the ground, 290K, through the mesh aperture

Mesh aperture	Wire thickness	Added Temp.	Gain loss dB
6 x 6 mm	1 mm	18K	0.3
6 x 6 mm	2 mm	4K	<0.1
6 x 8 mm	1 mm	33K	0.6
6 x 8 mm	2 mm	9K	0.15
8 x 8 mm	1 mm	51K	1.0
8 x 8 mm	2 mm	15K	0.3
10 x 10 mm	1mm	108K	3.0

A typical 6cm Tsys with a SOLID dish would be 85-95K

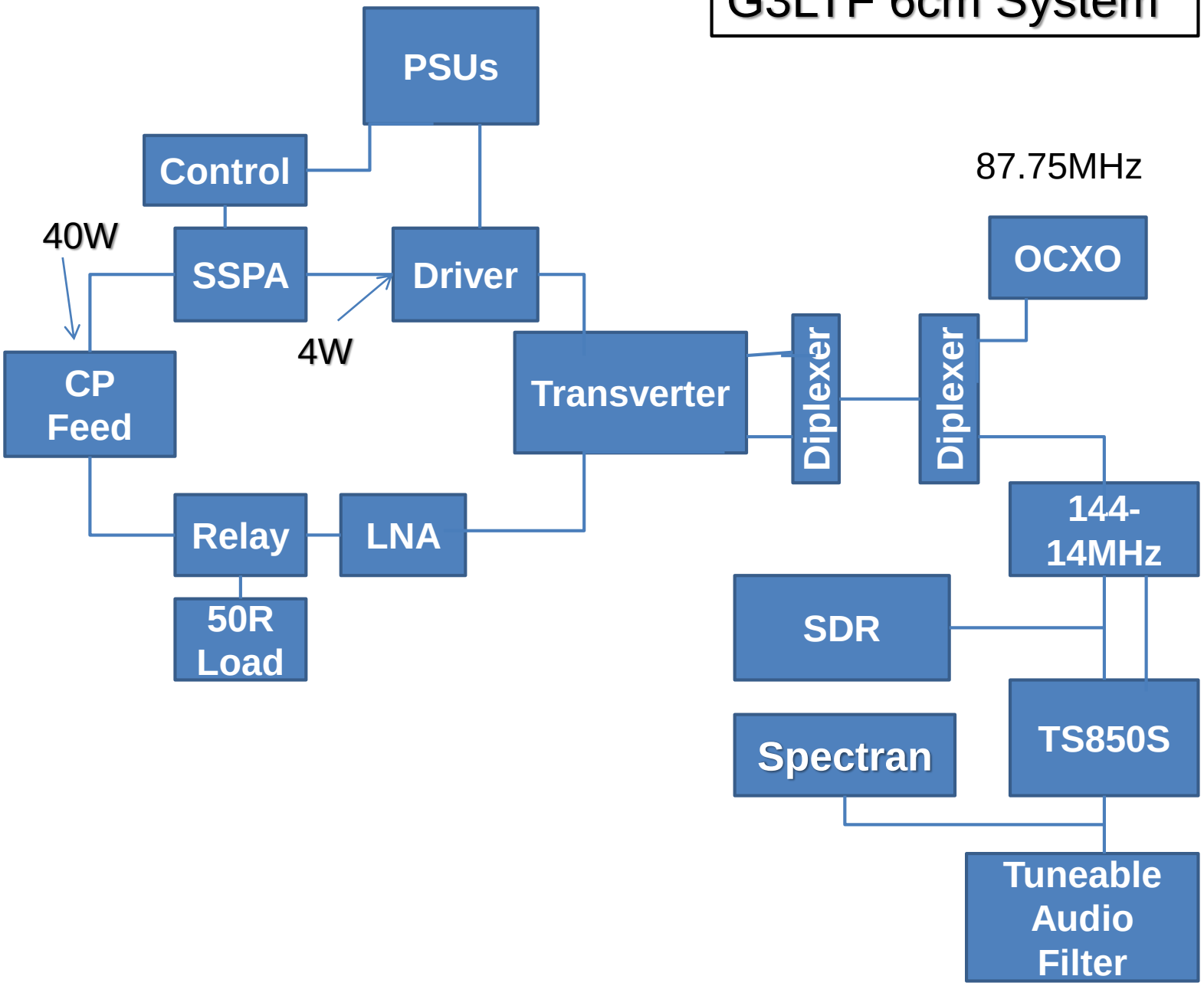
Spread-sheet in W1GHZ online Microwave antenna book

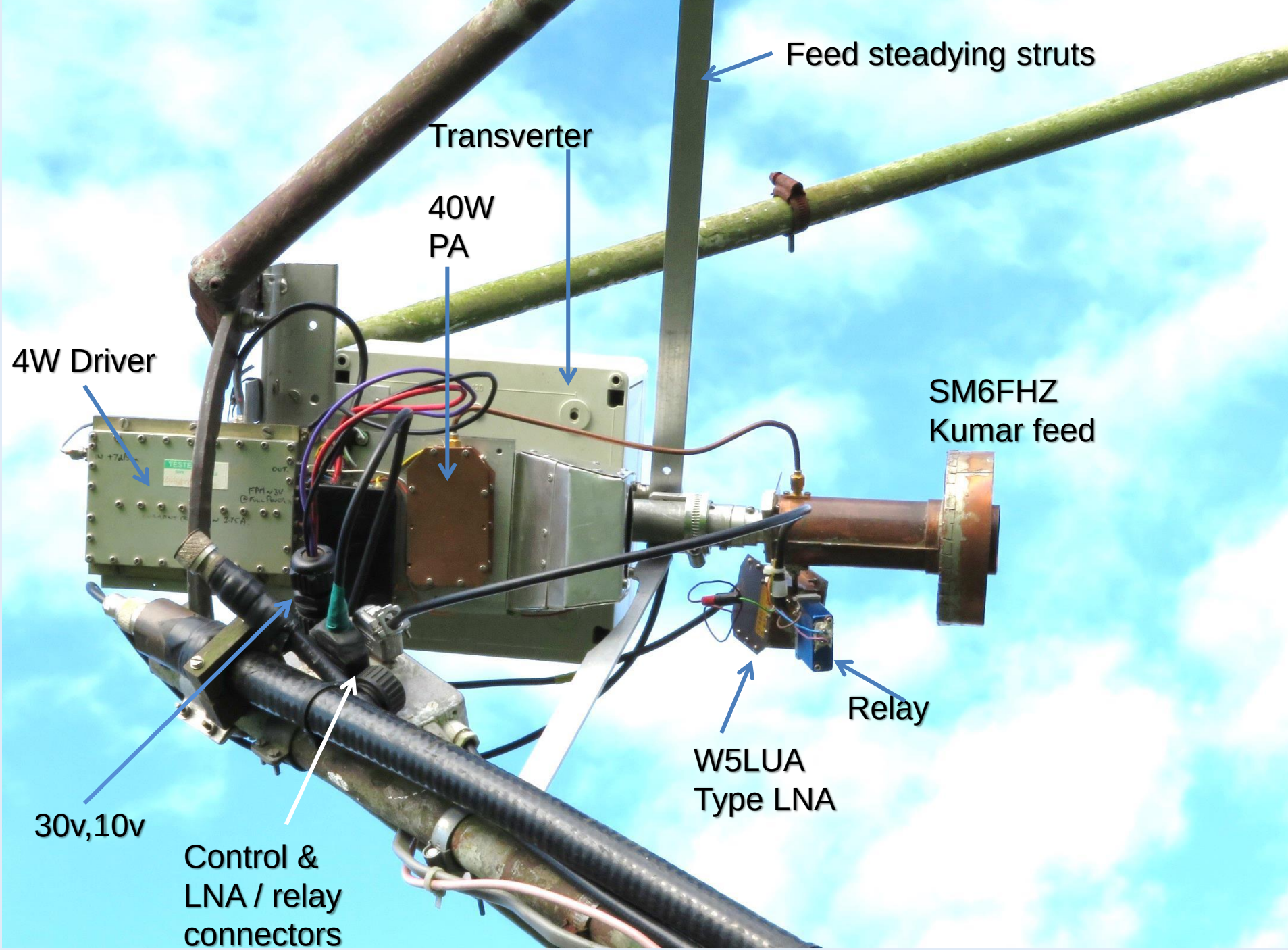
Mounting Systems at the focus

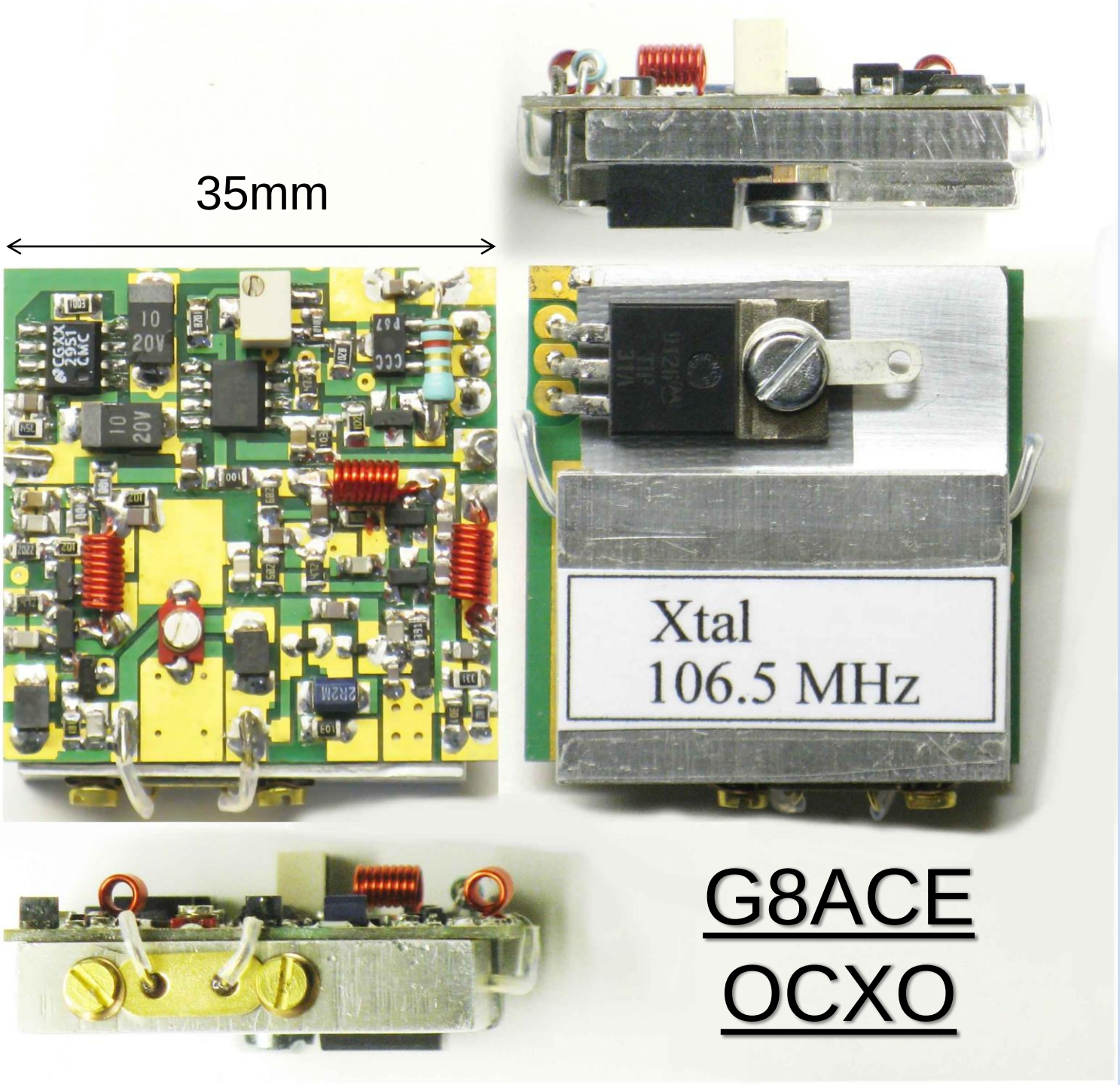
- RF Power is expensive at 6cm.
- Minimise feeder loss, mount PA at the dish focus or use waveguide.
- Minimise blockage in prime focus dishes.
- Allow for feed position adjustment
- Rigorous screening of all units
- Weather protection is not simple
- Multiway cable and weather proof sockets

Current Systems, Dishes and Feeds

G3LTF 6cm System




Feed steadying struts
Transverter
40W
PA
4W Driver
SM6FHZ
Kumar feed
Relay
W5LUA
Type LNA
30v,10v
Control &
LNA / relay
connectors

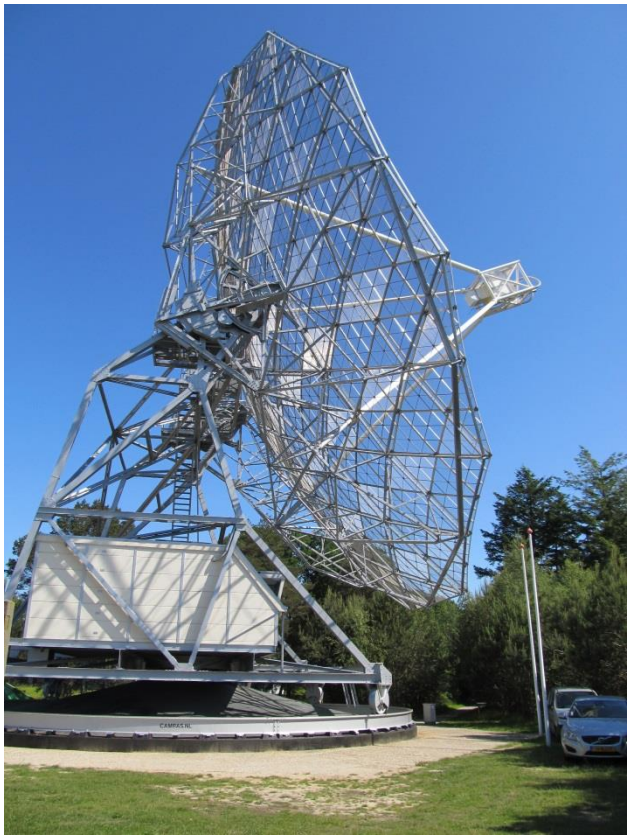


G8ACE OCXO

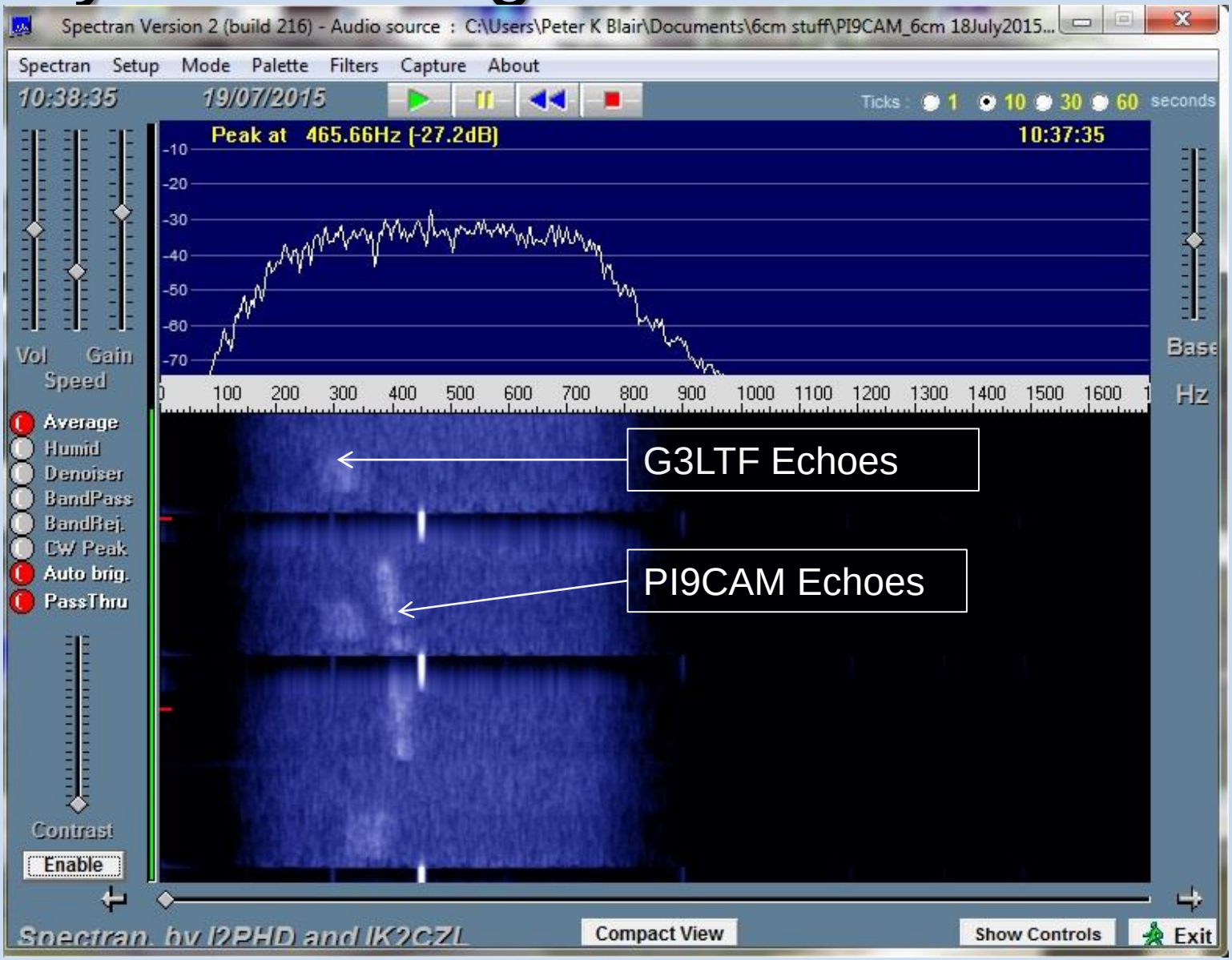
Two of the bigger dishes used on 6cm EME

HB9Q 10m 0.43f/D 100W

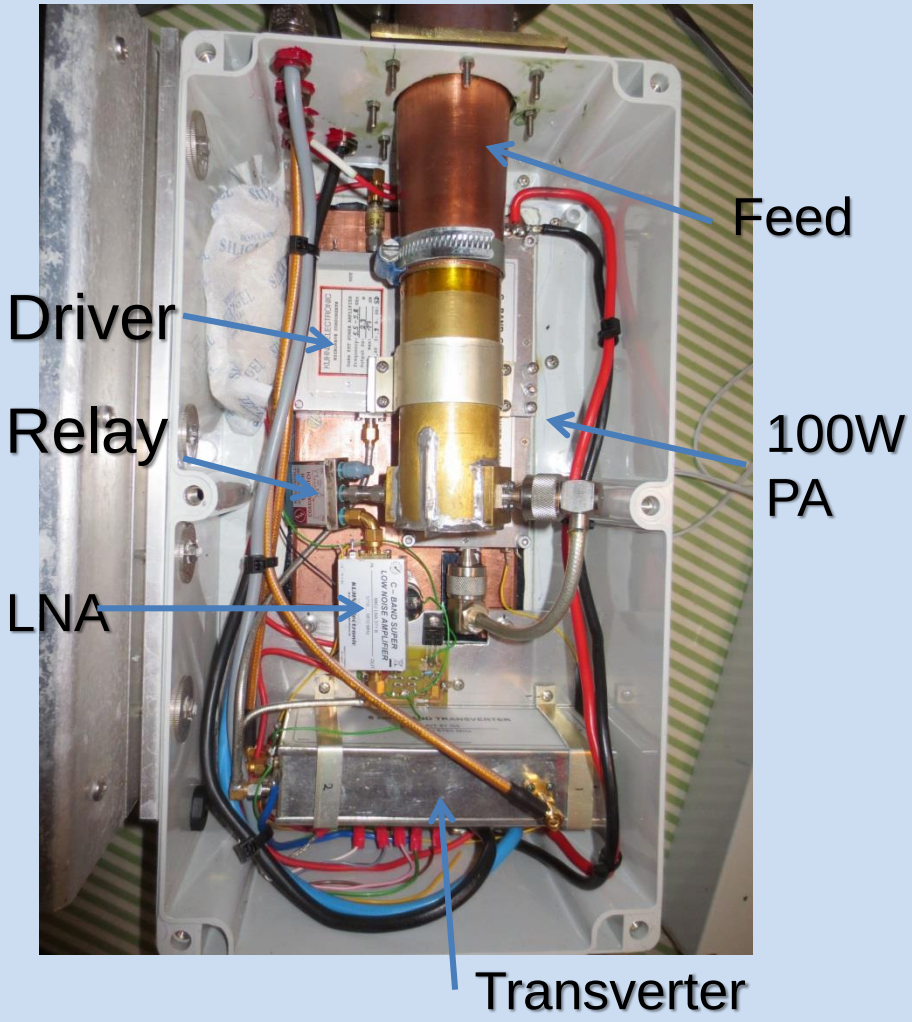
PI9CAM 25m 0.5f/D 10W



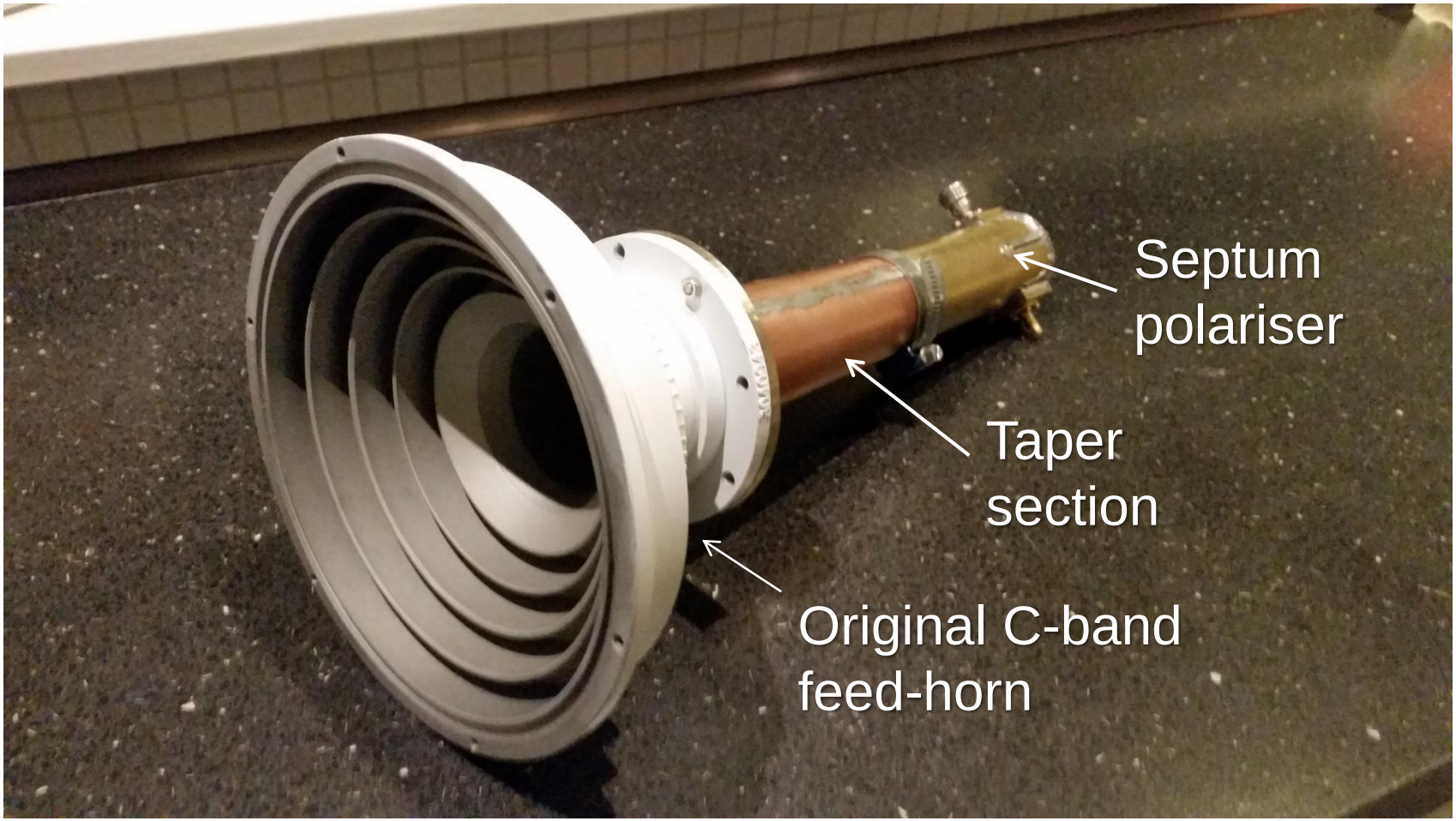
Very interesting test with PI9CAM



OZ1LPR 2.4m Offset dish 100W



Novel feed design by OZ1LPR

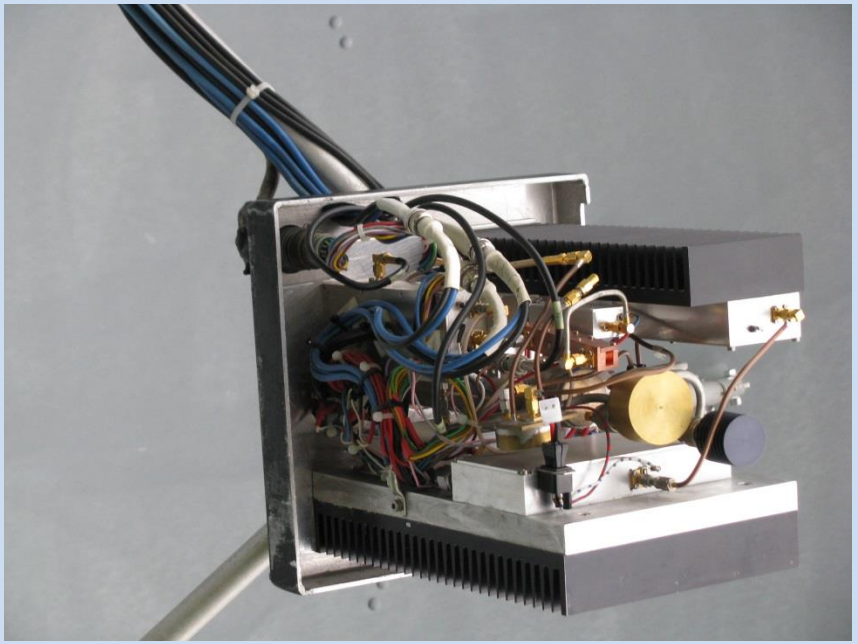


1.8m dishes with 100W make cw QSOs on 6cm

SM6PGP, Kumar feed

OK1DFC, Square Septum with Chaparral choke

LX1DB 3m dish 0.3f/D 225W




PA3DZL
5760 Mhz
5760 Mhz RA3AQ feed
Preamp 0.6dB NF
SSPA 100W @ feed
3.7m dish f/d 0.4

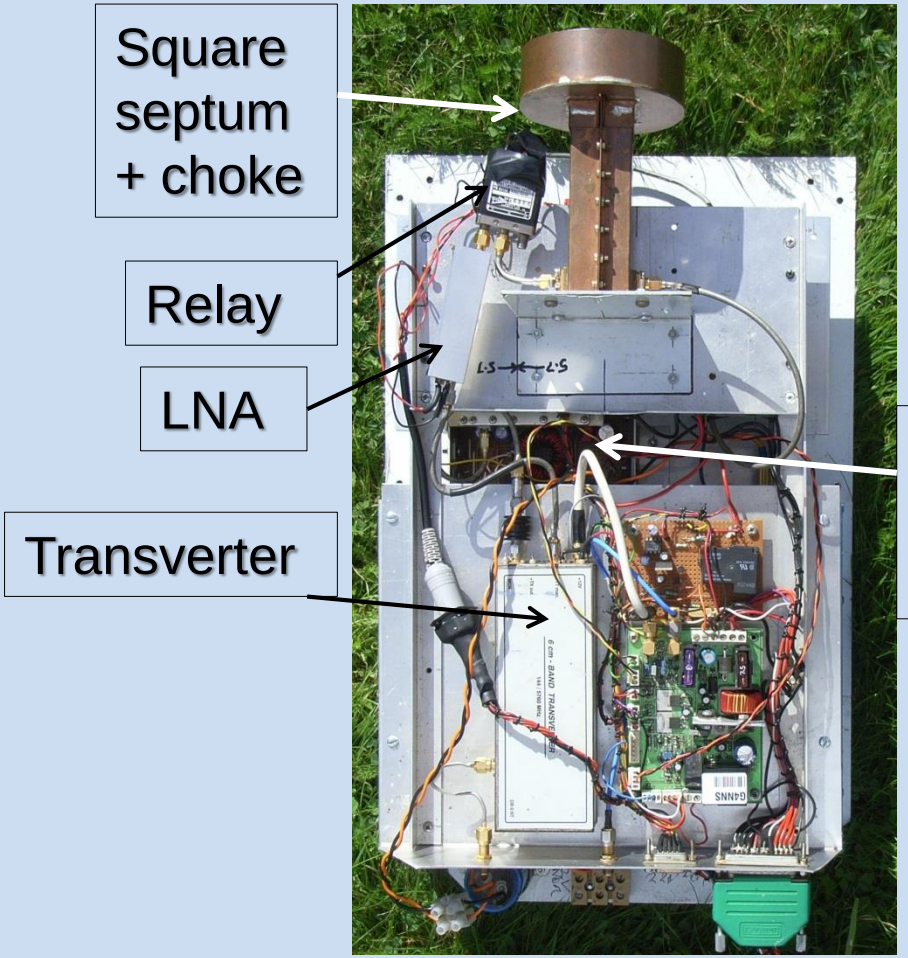
PA3DZL- New 3.7m solid dish

Chaparral Feed with squeezed WG polariser

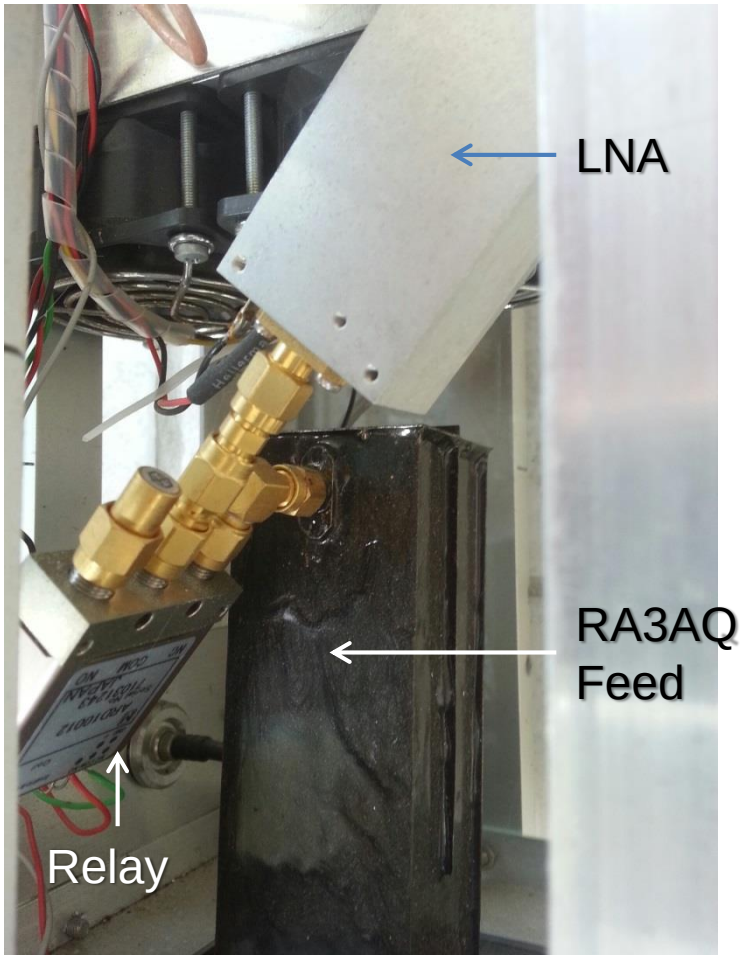
Good Feed adjustment system

CT1DMK Squeezed waveguide polariser built by PA7JB

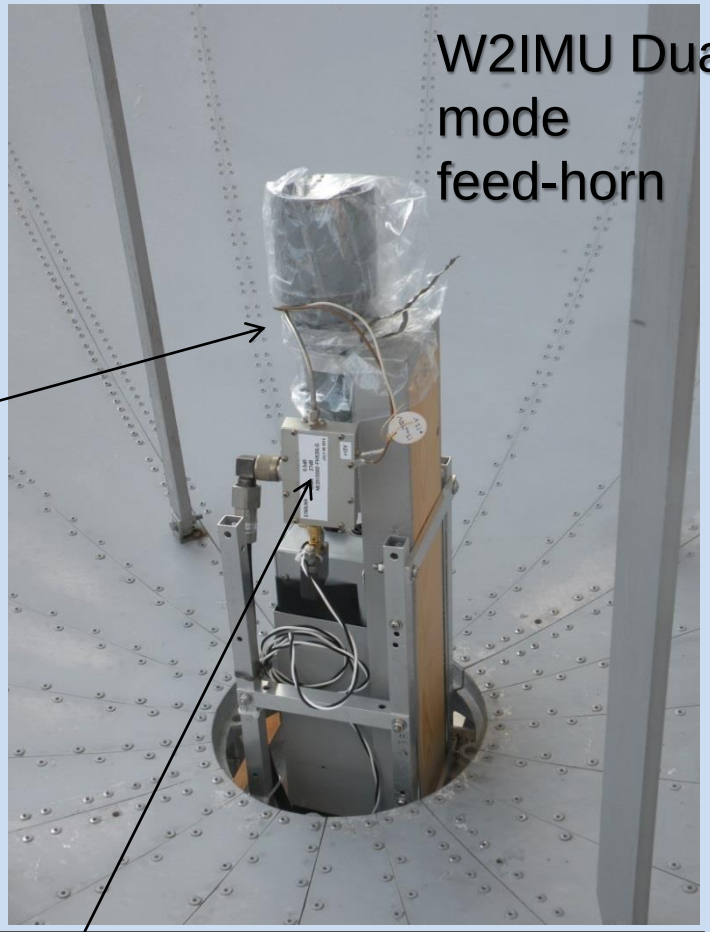
G4NNS 3.7m 0.4f/D solid dish, 40W



DL7YC HB 5m dish



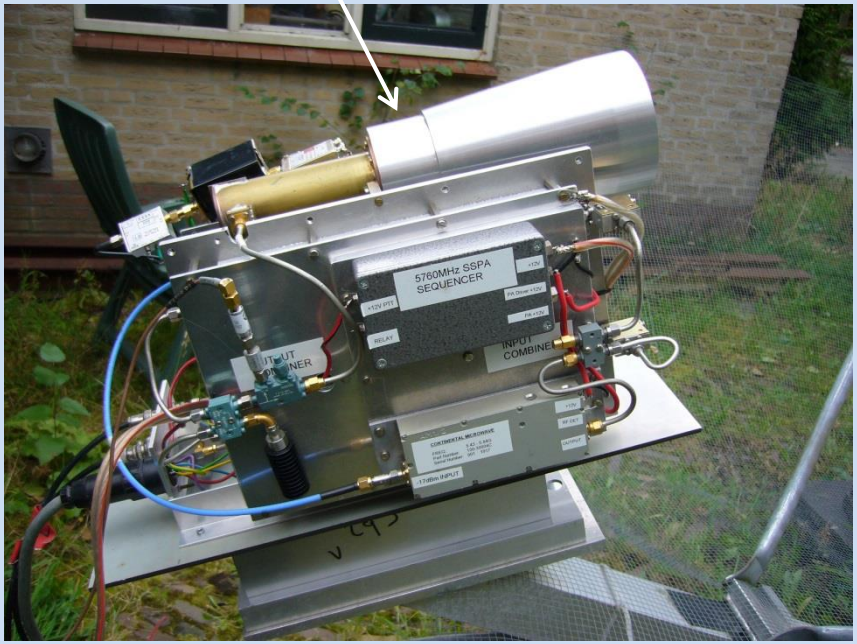
JA4BLC 3m 0.25f/D Cassegrain with 60cm sub-reflector. 100W



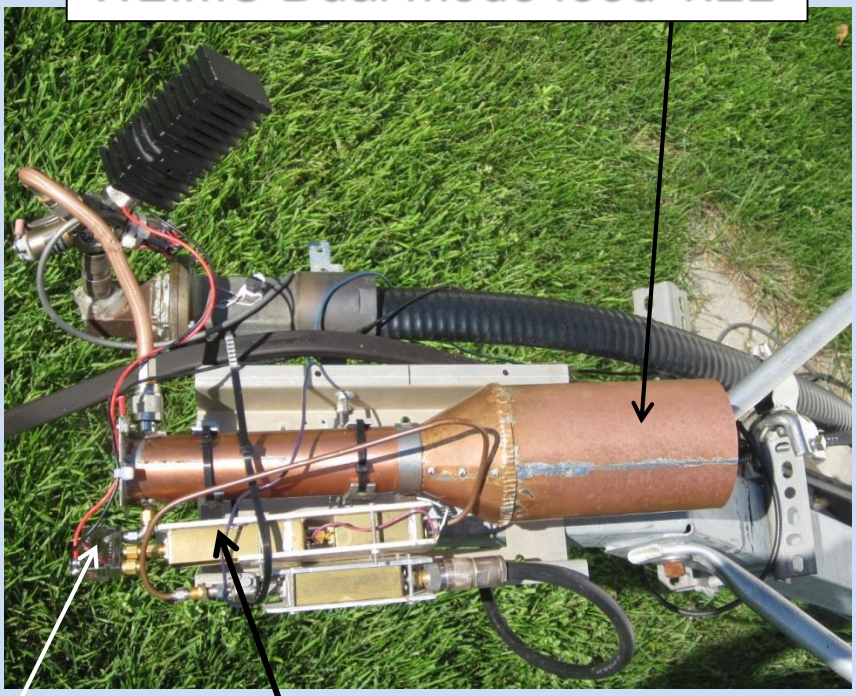
HB 0.5dB LNA NE3515

PA7JB 2.4m 30W 39# cw

Potter (or Skobolev) dual mode feedhorn



W7 / VE4MA 5ft Offset (3/8 of a 10ft dish!)



WA6PY 3.6m Dish with 35W TWTA

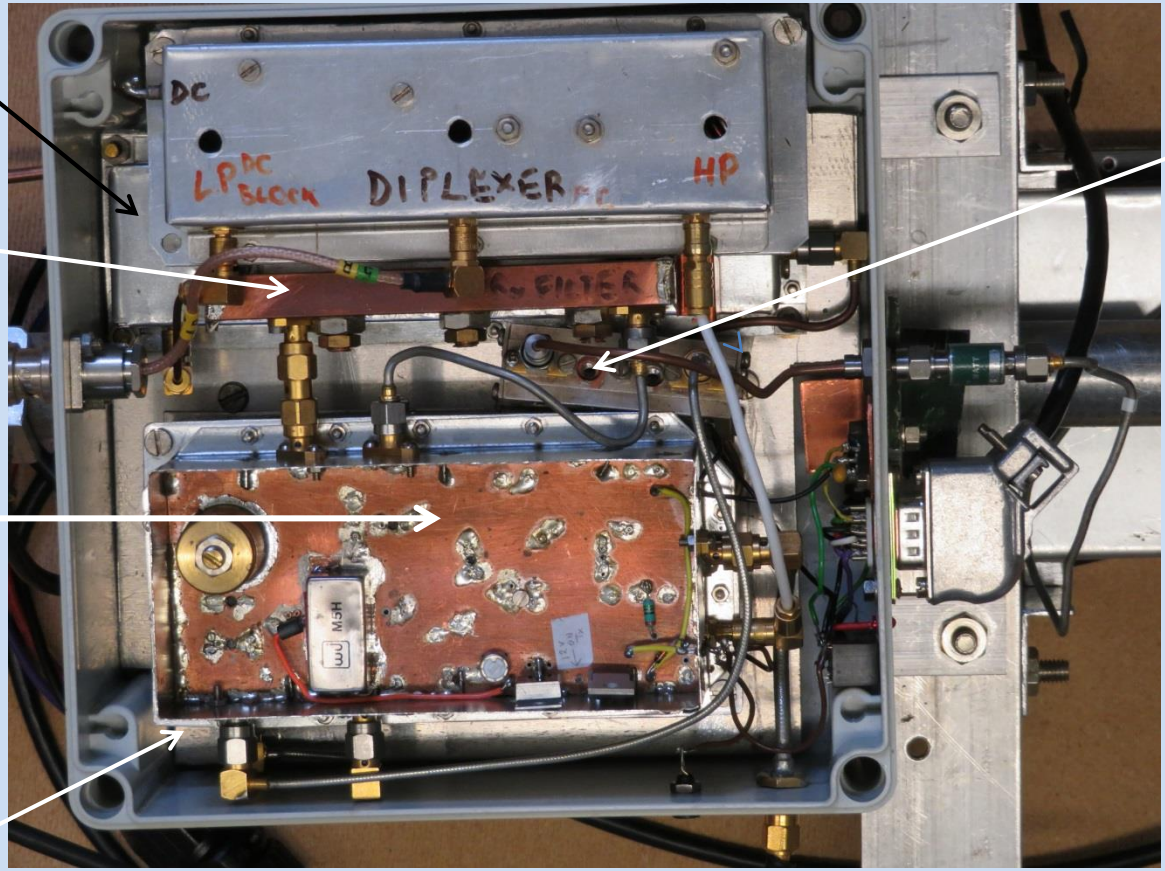
WA6PY uses WD5AGO design Chaparral feed with septum polariser

G4DDK
x16

3 section
Rx Filter
G4JNT

HB mixer &
tx-rx amps

F6BVA
doubler
(below)



3 section Tx
“clean up”
filter

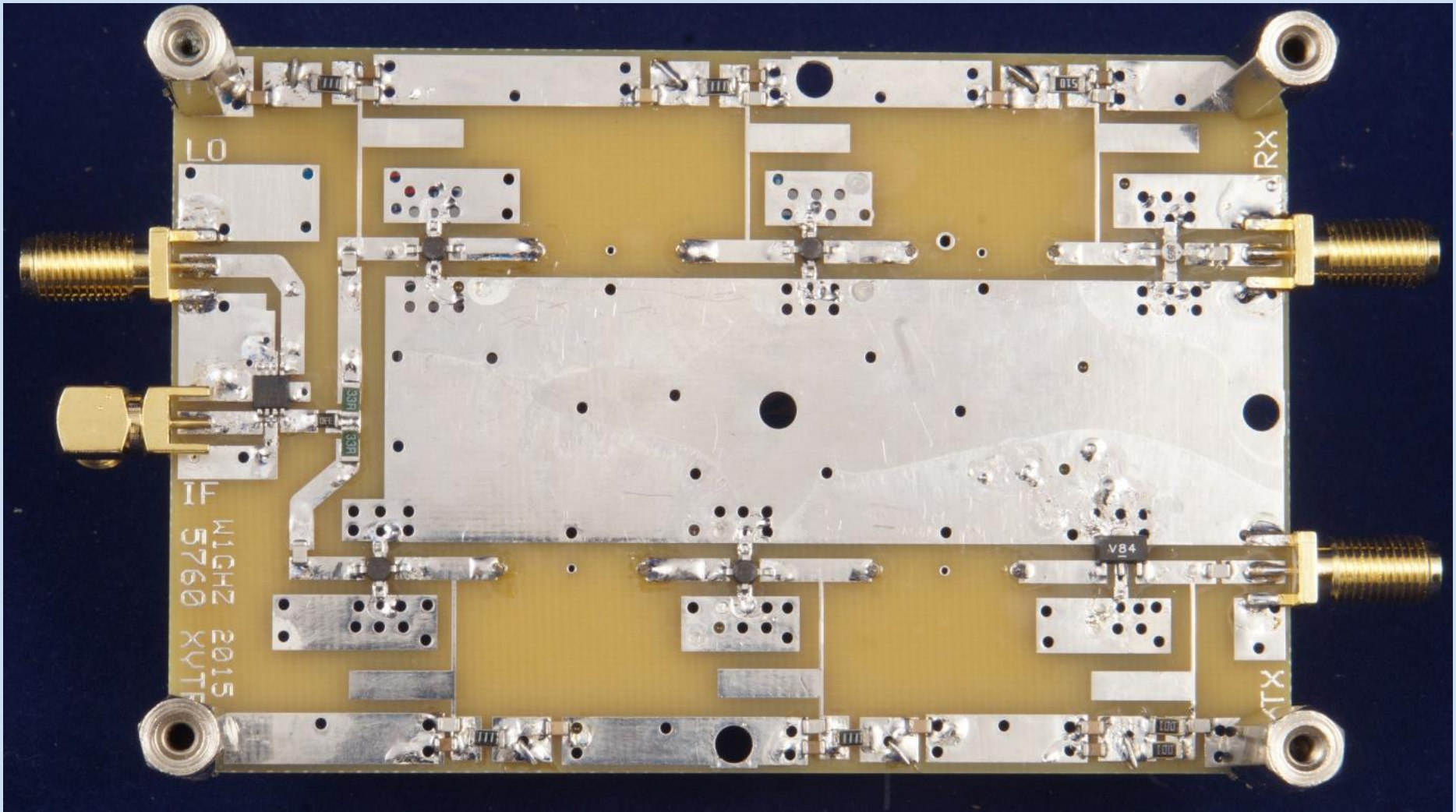
6cm Transverters

I built my own, but there are simpler versions…!

With 144MHz IF a good tx filter is needed

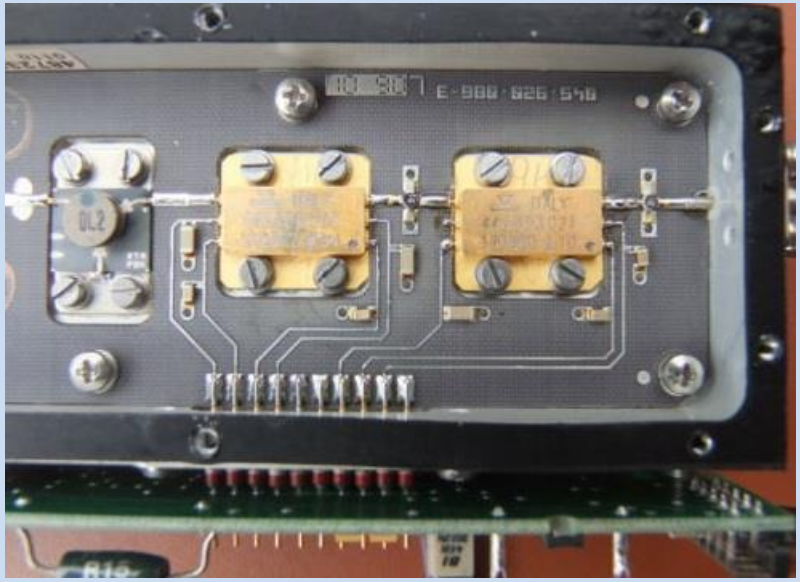
A good rx filter helps keep out the Wi-Fi

Simple, Low-cost, 6cm transverter on FR4 designed by W1GHZ using MMICs and “pipe-cap” filters. LO Synth or multiplier not shown.
See W1GHZ web site

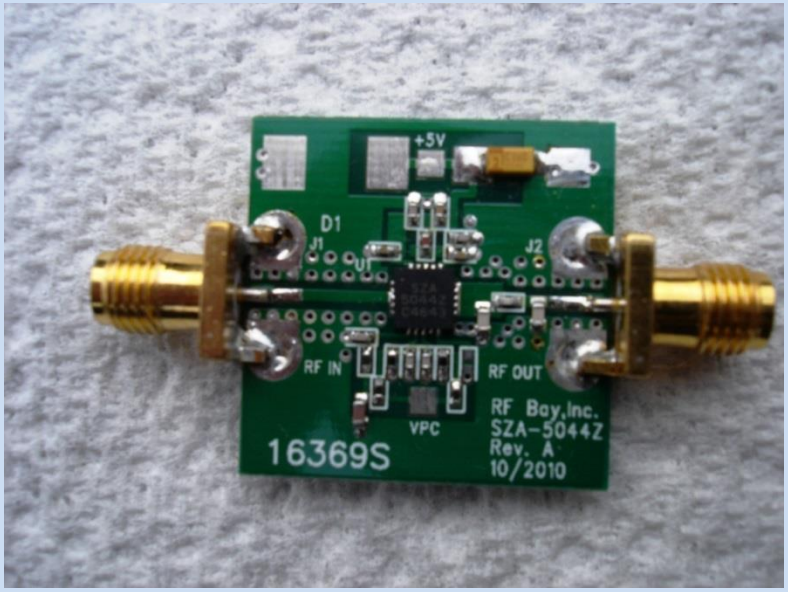


Lots of stuff on E-bay

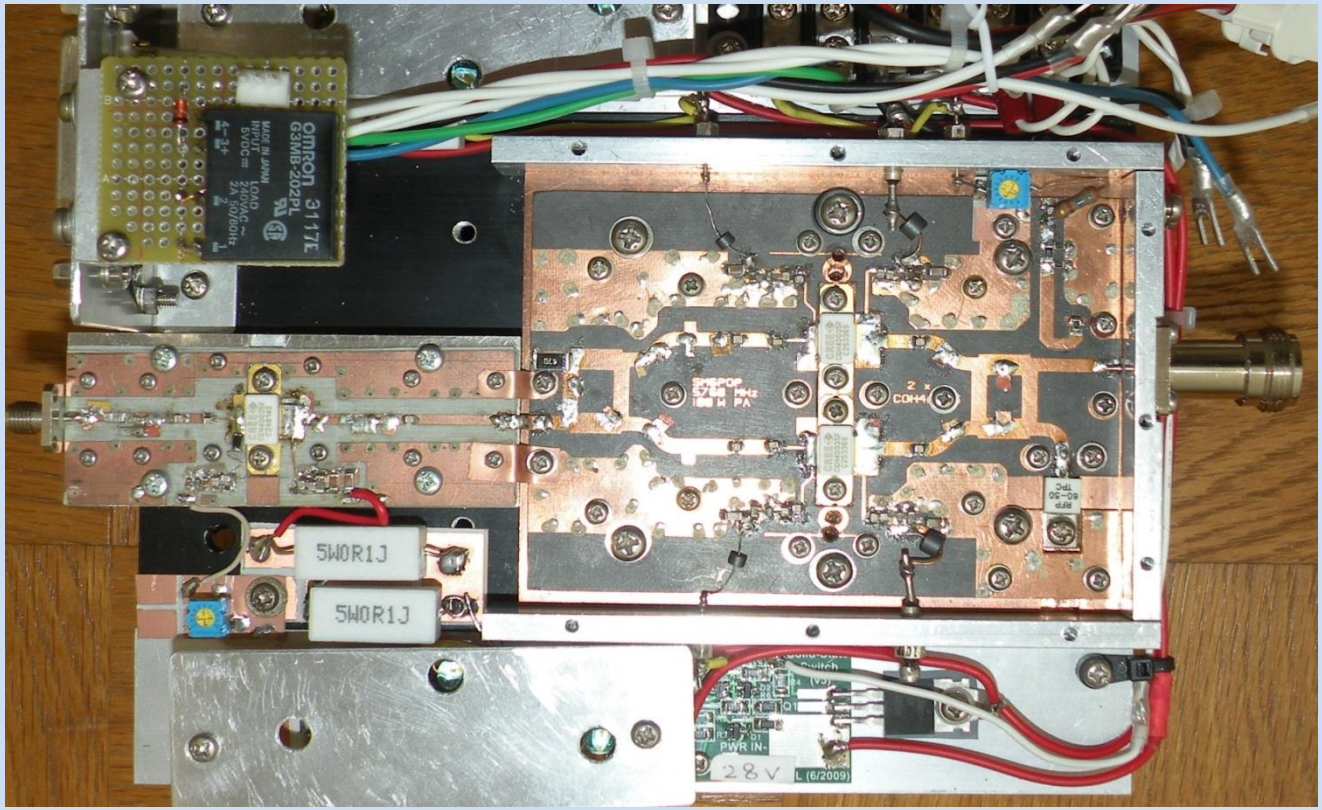
8-12W PA



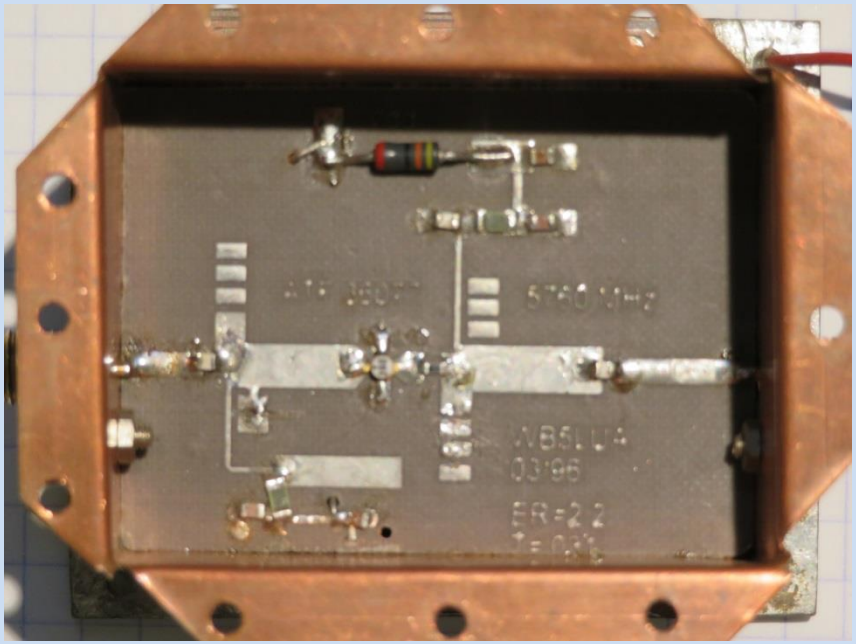
~1W amplifier

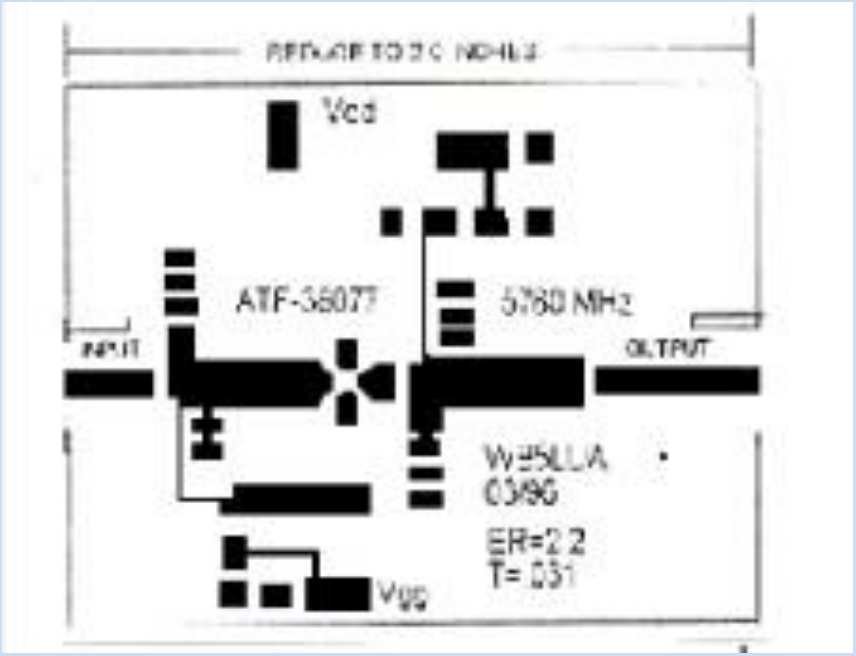


JA4BLC 100W PA SM6PGP design see www.moonbouncers.org
Also F6BVA 63W PA and F5JWF



“Low noise amplifiers for…5760.. WB5LUA” See www.N5DUX.com





G3LTF build 0.65dB NF ATF36077

System measurement and optimisation

- Sun noise measurement gives G/T estimate
- Moon noise can give more accuracy
- Ground to Cold Sky measurement useful but more complex than it first appears
- EMECalc programme can help analyse the results

My thanks to all who contributed material, sorry I couldn't use it all

G3WDG, G4CCH, G4NNS, G8ACE, HB9Q, IK3COJ, JA4BLC, K2UYH, LX1DB, OK1CA, OK1DFC, OK1KIR, OZ1LPR, PA3DZL, PA3FXB, PA7JB, SM6PGP, SM6FHZ, SP6JLW, VE4MA, WA9FWD

Find out more…

www.w1ghz.org/antbook/contents.htm

www.w1ghz.org www.N5DUX.com

www.moonbouncers.org

www.nitehawk.com/rasmit/em70cm.html (432 and up EME NL)

www.rsgb.org

RSGB 2016 Convention