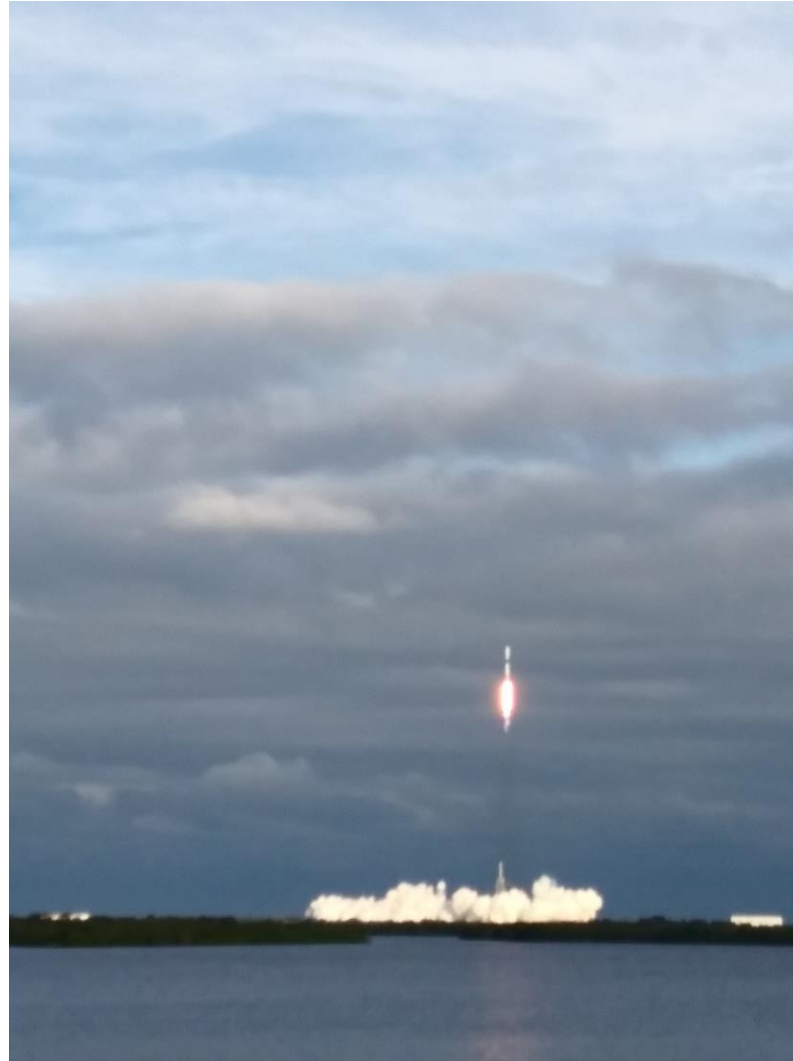


# QO-100

# Satellite Earth Station

Jen G4HIZ  
Finningley BATC Meeting  
29<sup>th</sup> June 2019

# Es'hail 2 Satellite Launch 15<sup>th</sup> November 2018



*Remember this ?  
It was only 8  
months ago !*

# Es'hail 2 Satellite Launch 15<sup>th</sup> November 2018



*Everyone is happy and somewhat relieved !*

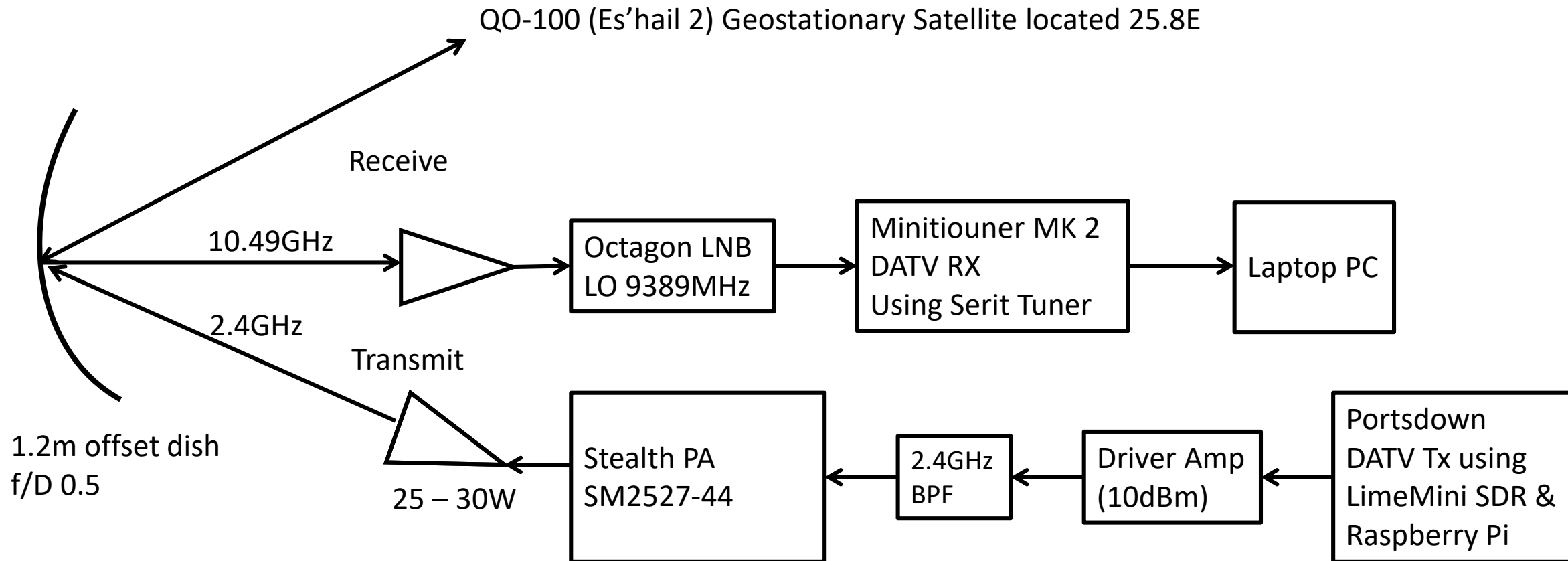
# Es'hail 2

- Final position 25.8 degrees East
- Amateur radio transponders designated Qatar Oscar 100 (QO-100)
  - One transponder 250kHz wide for narrow-band transmissions
  - One transponder 8MHz wide for wide-band digital transmissions
    - Digital TV has been the main user

# System Design Aims

- Digital video Tx & Rx
- Tx Symbol rate up 500ks/s or greater, using Portsdown
- Dish size 1.2m offset
- 12V operation
- Transportable

# System Block Diagram

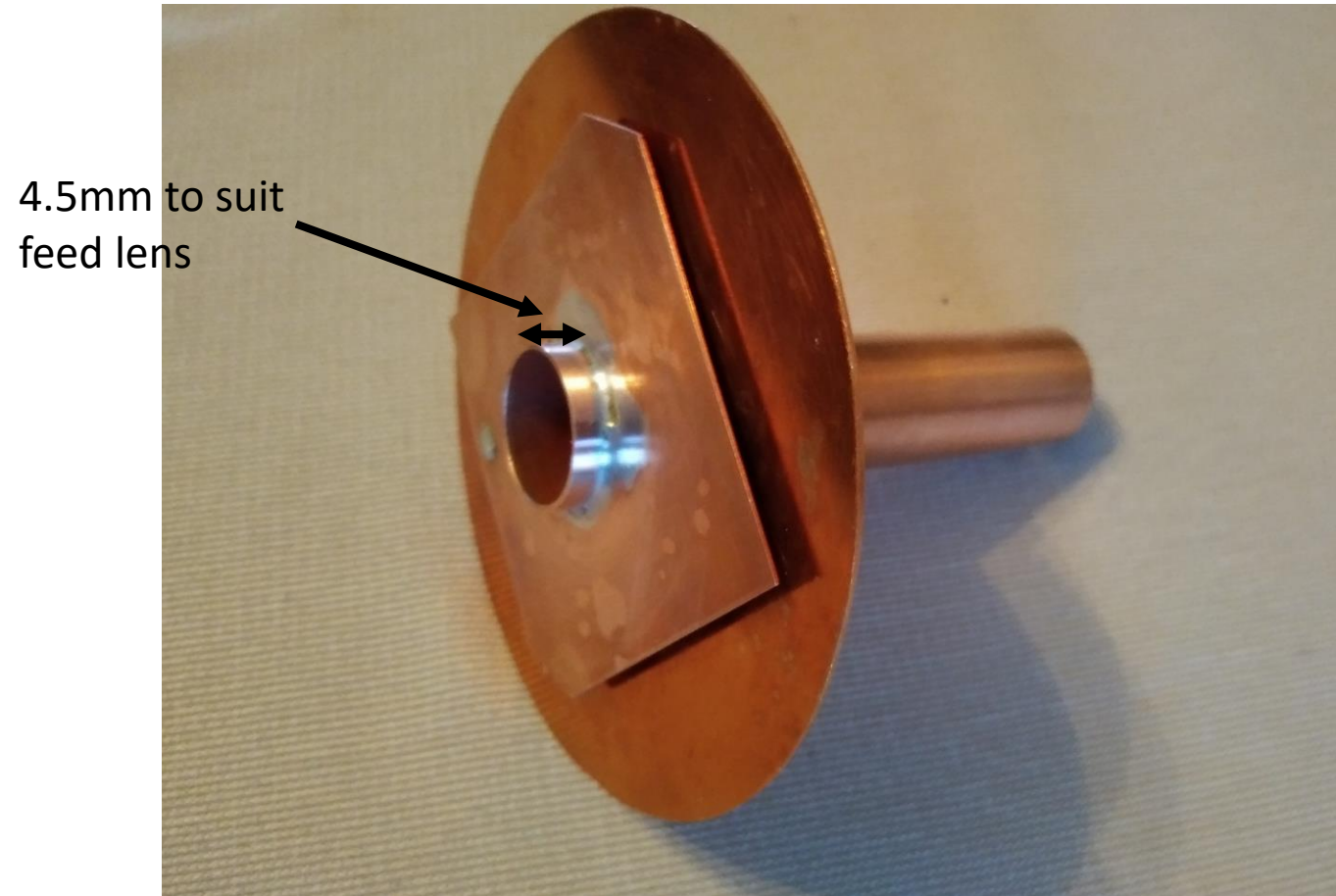


# System Elements

- Link Budget indicated that about 30W was needed with a 1.2m dish for 333/500ks/s
- 1.2m reflector, f/D 0.5, unknown make. Feed arms etc were fabricated
- G0MJW dual-band feed chosen, easily constructed, many built
- Stealth PA model SM2527-44 (up to 333/500ks/s) - modified
  - Andrew PA available for higher symbol rates (up to 2Ms/s)
- For receive, Octagon LNB used with xtal changed from 27MHz to 26MHz
  - LO now 9389MHz (was 9750MHz)
  - QO-100 Downlink now shifted into L-band; LNB gain maintained
  - LNB 'horizontal' polarisation gave better results than 'vertical' polarization, requiring 18V supply



Feed as described in article by GOMJW et al



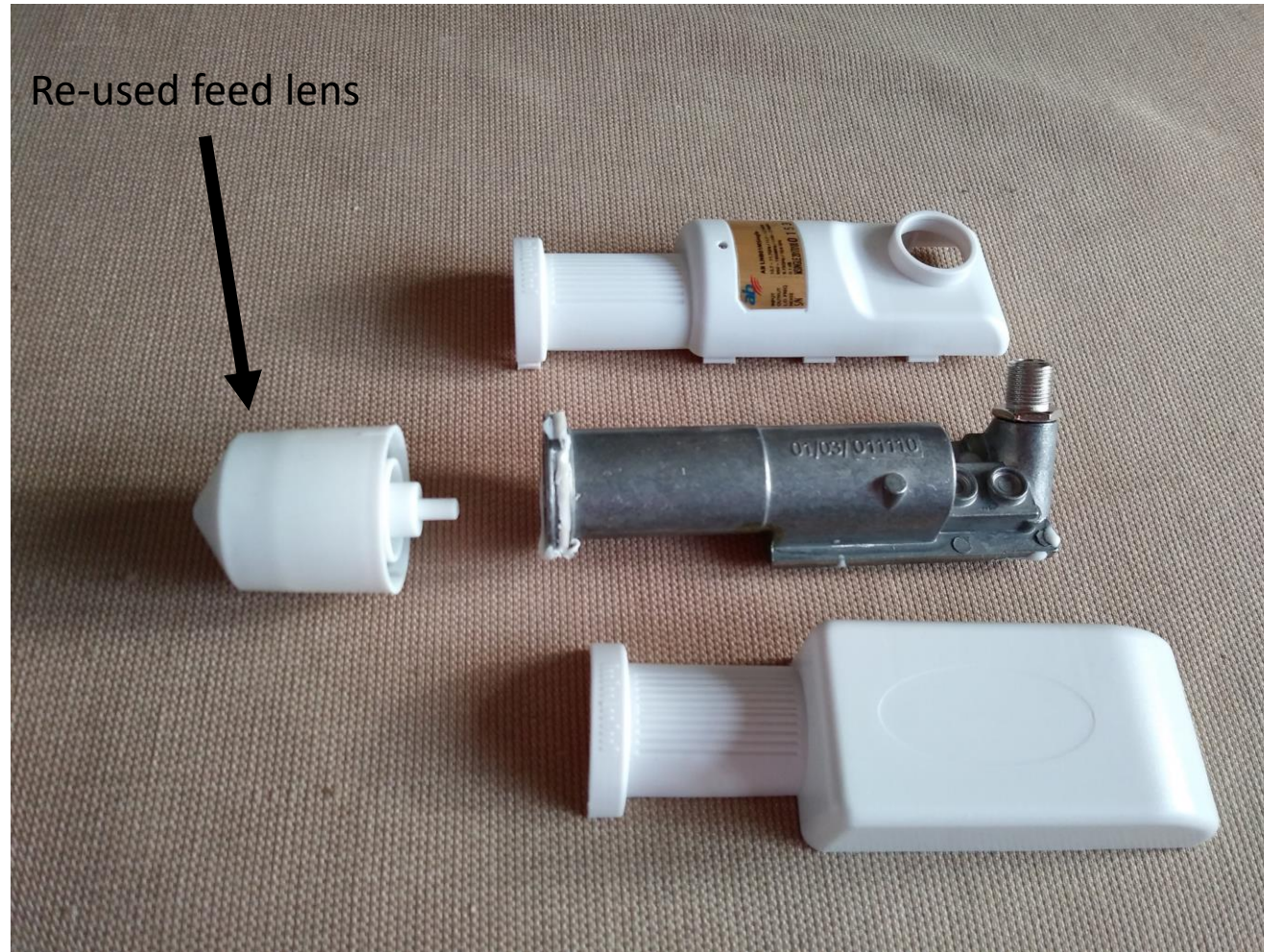


# Feed in place on antenna during initial testing



The feed arm was lengthened  
and patch feed moved back  
for final positioning

# Feed Lens from AB LNB 01





# Modified Octagon LNB

(27MHz xtal changed to 26MHz)



2 x track cut 10nF

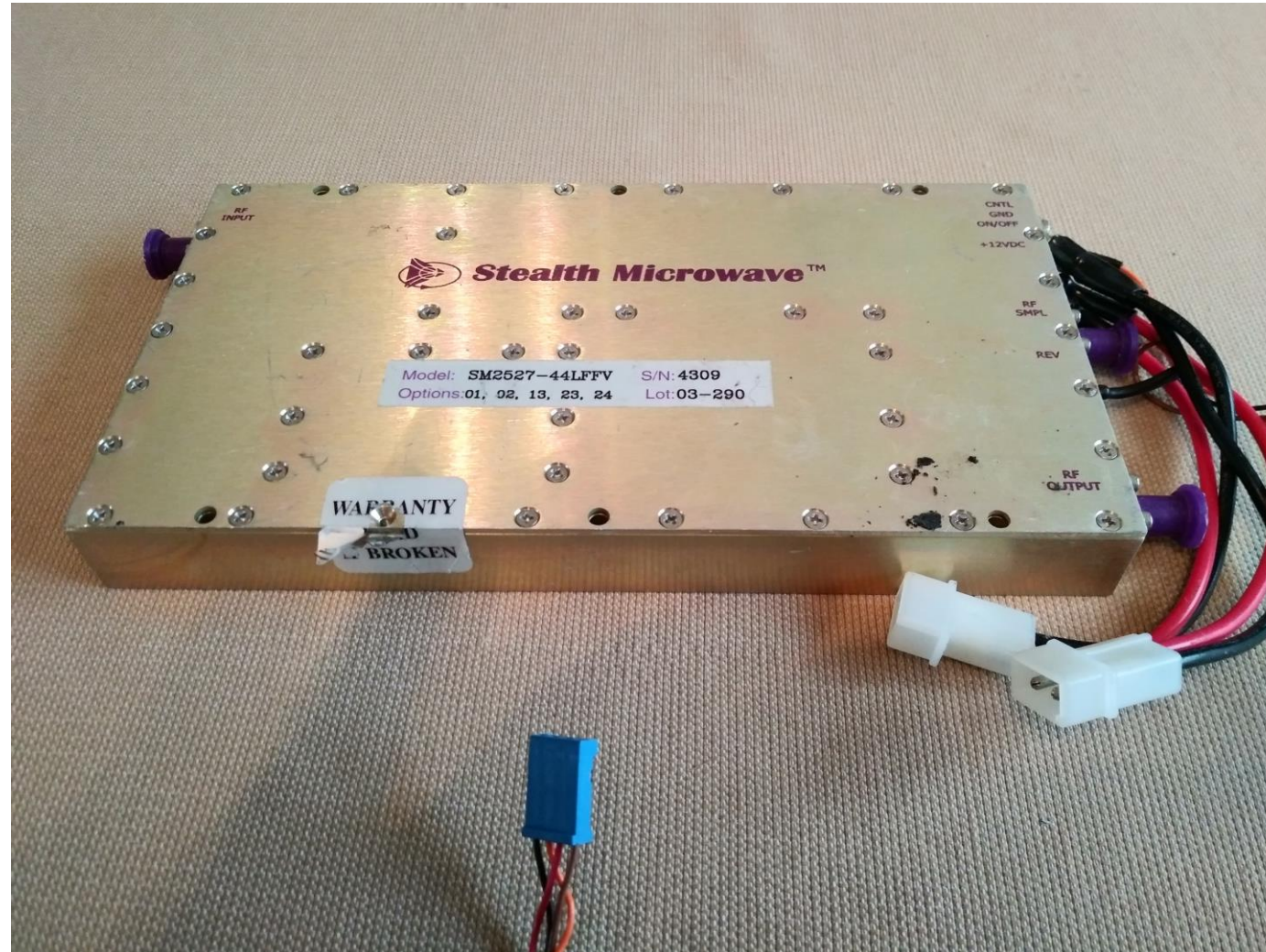
26MHz Xtal replaces  
27MHz original

# Stealth PA

- Model number indicates intended frequency range and power o/p
- Eg SM2527-44 means:
  - 2.5 to 2.7GHz with 44dBm o/p (25W)
- As bought, o/p power approx. 20W at 2.4GHz
- Driver stages tuned using copper tuning stubs (roughly 2 to 3mm, rectangles)
  - Sometimes referred-to as 'snowflaking'
- O/p power now ~34W max at 2.4GHz
  - Comfortable 27W
- Requires 2 control inputs to be taken to TTL high (5V through 5k6) to transmit; small control circuit constructed (78L05 and few transistors)
- Transmit current 7.5A (90W DC input); in standby mA drawn
- PA mounted in heavy diecast box with side ventilation and 2 fans mounted on lid, in order to keep the temperature down

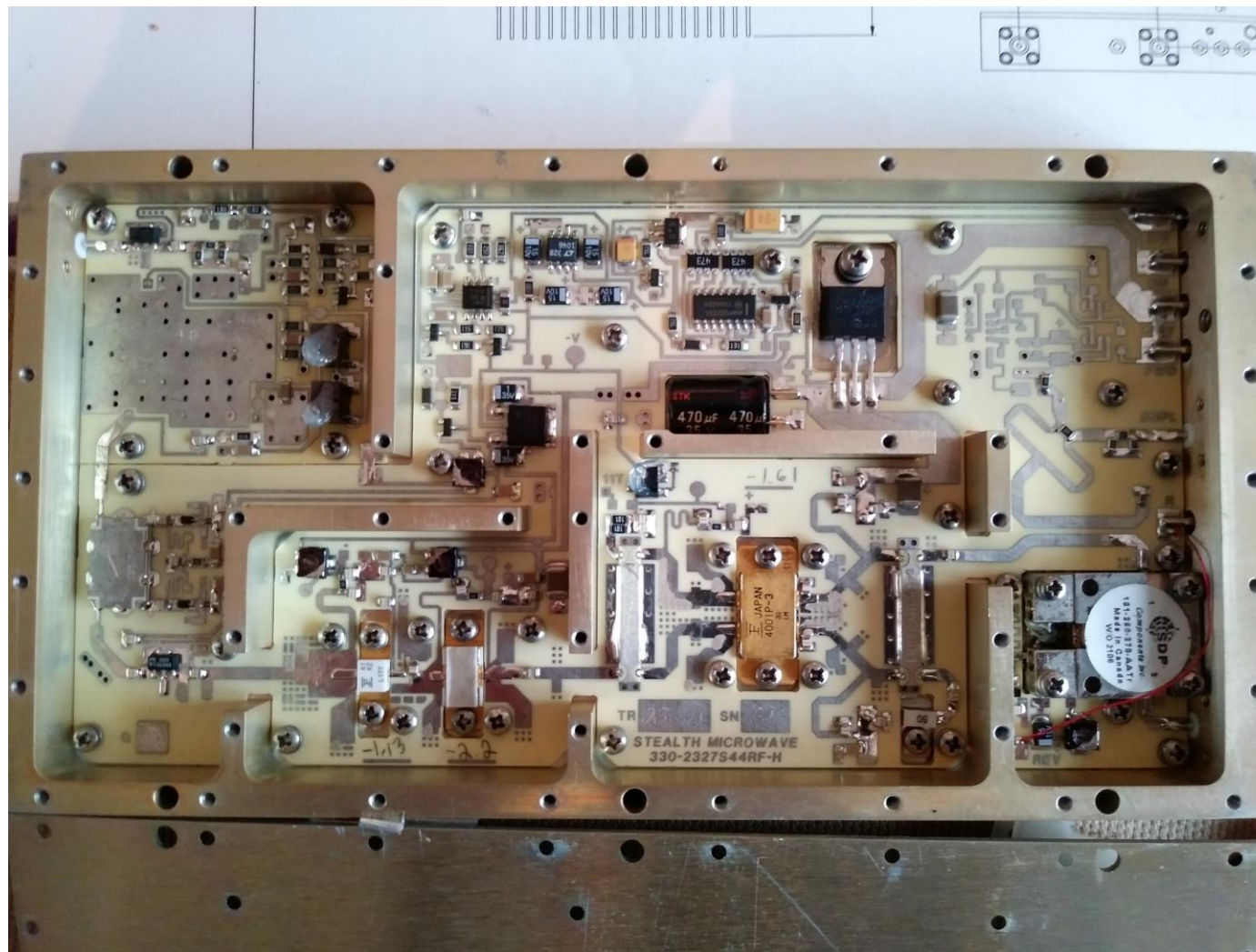


# Stealth PA Used - External View



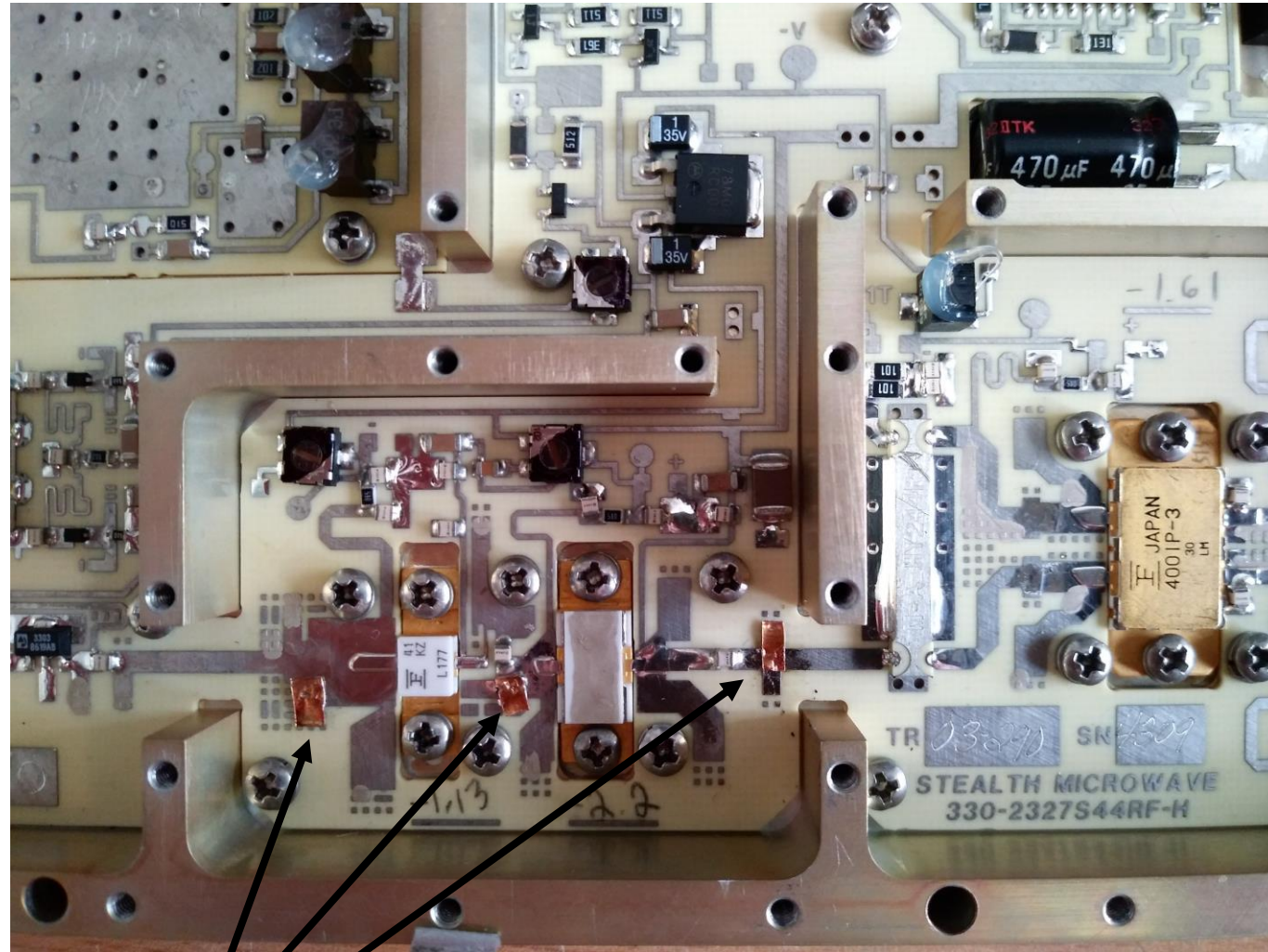
A number of different models of Stealth PA are suitable

# Stealth PA inside – general view, unmodified





# Stealth PA Mods to driver stages ('snow flaking')

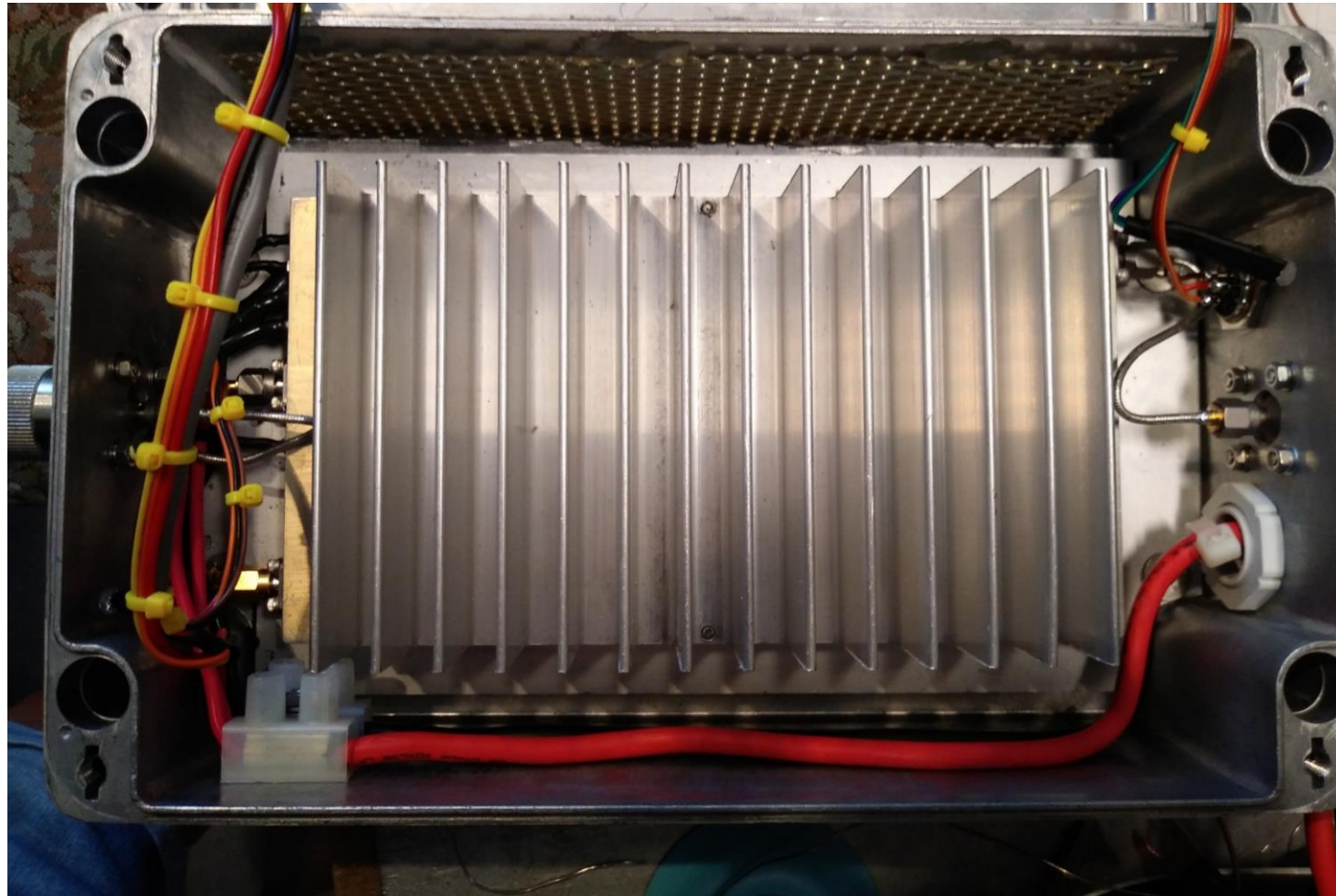


Tuning stub

Tuned at low power output. Stubs soldered in place with battery powered iron and amp supply off.



Stealth PA mounted in heavy die-cast box  
with 2 fans on lid



# QO-100 Transceiver



Touchscreen for Portsdown control

Windows provided for all indicators



# QO-100 Transceiver

2-stage PA  
(10mW/1W o/p)  
with coupler feeding  
'B' input of Rx to  
monitor Tx signal

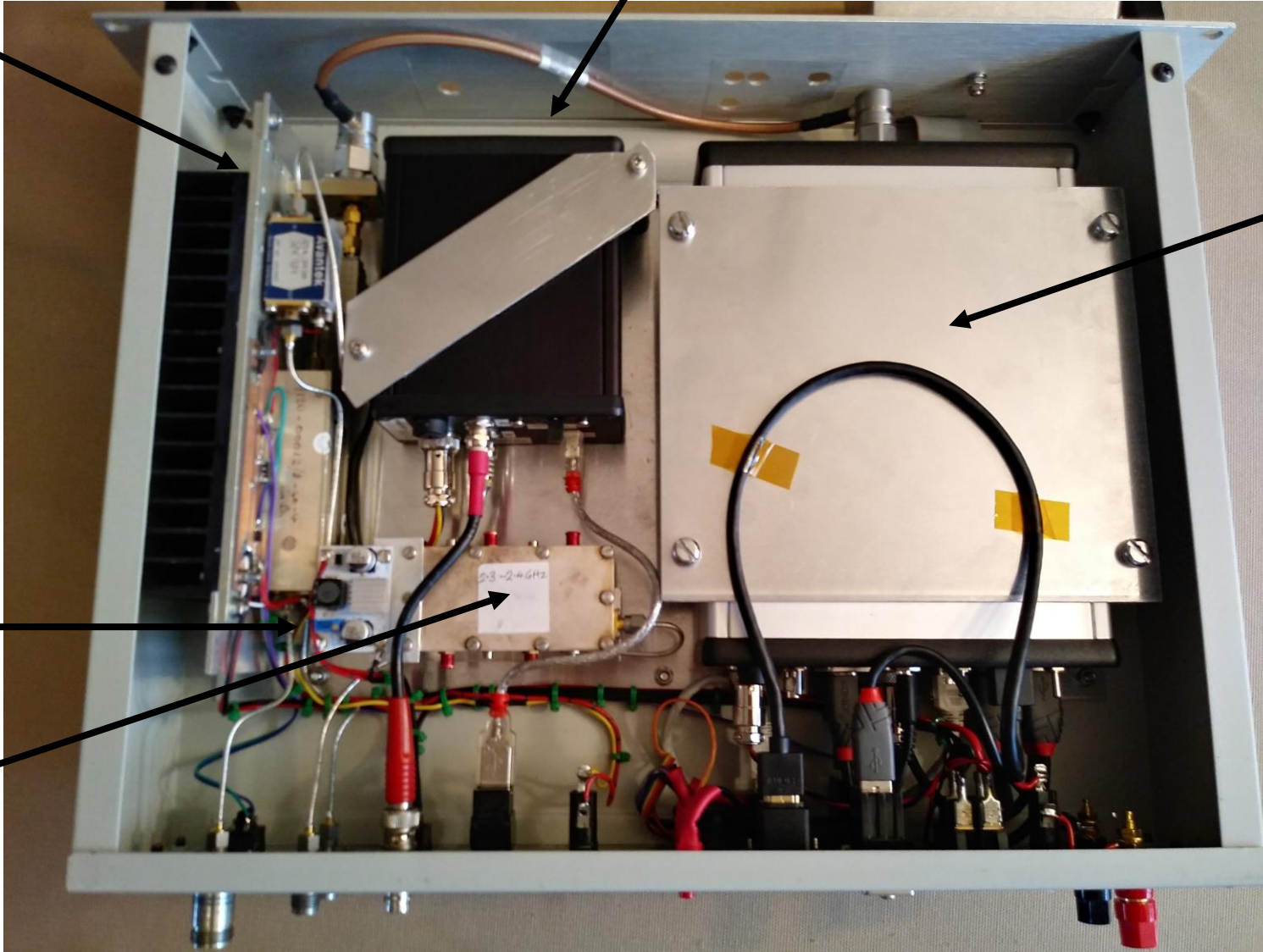
DC/DC to give 18V  
for LNB

2.4GHz Band-pass  
filter

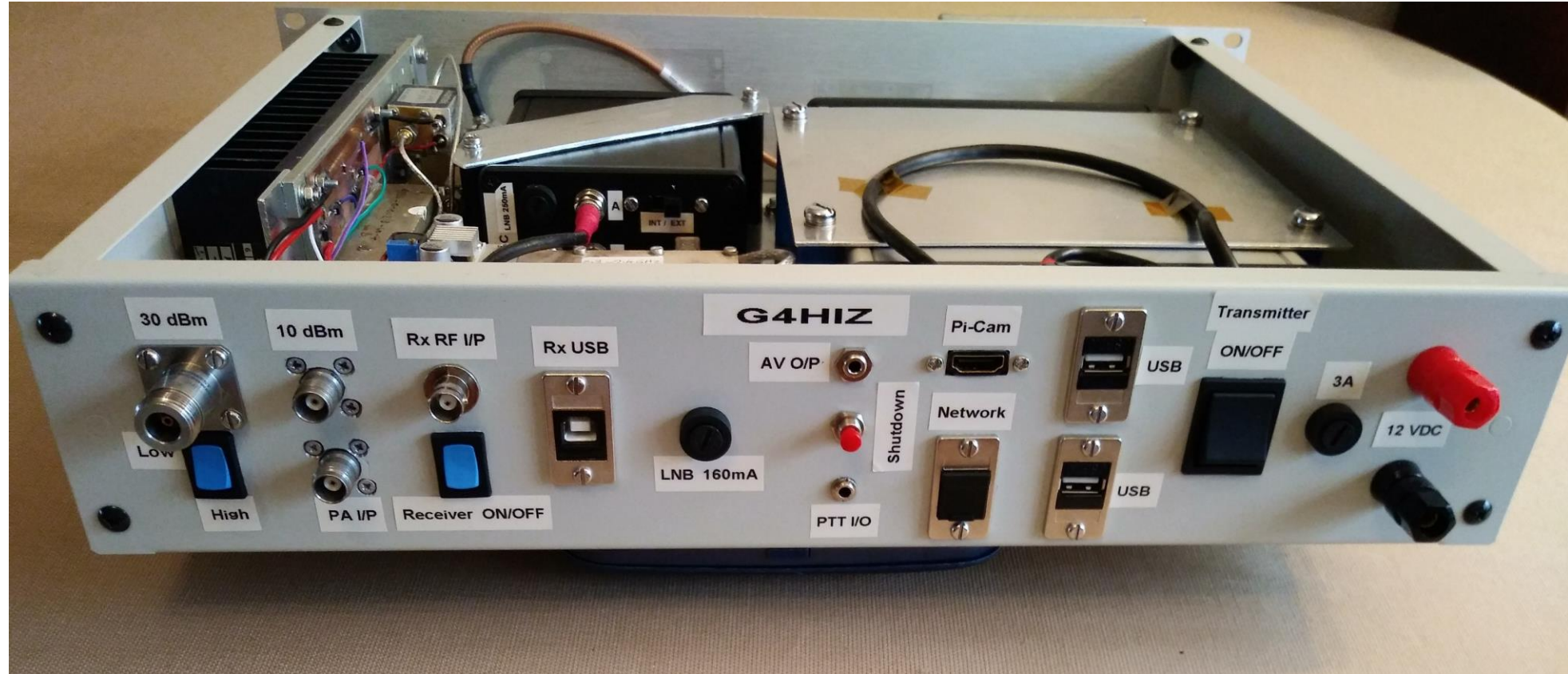
Minitiouner Mk 2 Rx

Portsdown Tx  
with internal  
programmable  
attenuator

All units easily  
removed for  
upgrade/servicing



# QO-100 Transceiver – inputs/outputs



# Results

- Receiving own signal on same 1.2m dish
  - using Minitiouner s/w v0.9 beta8\_9
  - WB Beacon typical MER 9.5dB (2Ms/s, DVB-S2, QPSK 2/3)
- Tested at 333 and 500ks/s, DVB-S2, QPSK 2/3
  - 333ks/s typ. MER 8.8dB, D6
  - 500ks/s typ. MER 7.2, D4
    - Note D number indicates dB margin over threshold for modulation type  
(D number available with above s/w & Serit tuner)



# Reception of Beacon



# Example of own transmission/reception

MINITIOUNE v0.9beta8\_9 - Receiver/Analyser DVB-S/S2 144 MHz to 2450 MHz - SRmini=32 kS/s - for MiniTouner/MiniTouner-Pro

SR2000 Q-beacon

SR1000 Q-4.75MHz

SR500 Q-6.25MHz

SR333 Q-7.25MHz

SR250 Q-7.75 MHz

SR125 Q-8.25 MHz

SR66 Q-8.75 MHz

SR27500 11996MHz

Oscar 100

DVB mode ☒ M1 ☐ M2 ☐ M3

☐ DVB-S ☐ All

☒ DVB-S2 ☐ 1/2 ☐ 2/3 ☐ 3/4

☐ Auto ☐ 5/6 ☐ 6/7 ☐ 7/8

☐ Wide scan

☐ Low SR

Fplug ☒ A ☐ B

LNB volt: ☐ 0 ☐ 13(V) ☐ 18(H)

☐ OFF ☐ ON ☐ TS

Store into Memory

M1 M2 M3

Symblate (Ks)

SR set: 250011S

Deviation: 21S

SR → 250 kS/s

LNA gain: 0.9 dB

Derotator Search

Reset

Carrier Width: 338 KHz

TV mode: DVB-S2

Frequency (KHz)

Freq asked: 10497125kHz

☐ doppler/ISS

Freq → 10497146 kHz

IF 1109125kHz

Copy Freq found

Adapt Offset

☐ keep it

Noise

I: 146 Q: 145

Web Station ID: 1

MYCALL

MY CITY

JJ00XX

Preamp 20 dB

Ant. Dir. East

Gain 12 dB

Picture ☐ Video ☐ QSL ☐ Auto ☒ Stop

Lg Msg

Lg Pic 0000

WebEr 0 00000

Timing 3 sec

G4HIZ

photo

Extern. Request

Apply

☒ auto

232.0.0.11:6789

Format ☒ 4/3 ☐ 16/9 ☐ 1/1 ☐ auto

Width: 352

Height: 288

Audio ☒ MPA ☐ AAC ☐ AC3

Zoom ☐ adapt ☒ x1 ☐ maxi

GRAPH

Reset

Program G4HIZ

infos: DVB-S2

Provider: G4HIZ

Codec: VMpeg2 + MPA

photo

Audio level

Info

Carrier Loc

SR Lock

RF Power

C/N MER

Constellations

BCH errors 0

LDPC 5% 395

FEC 2/3 QPSK\_L35

C/N must be > 3.10 dB

D5

TS

err 0

Bytes recvd: 363 kb/s

184ms

Beep

Dsave

UDP

Record

Quit

Expert

Web