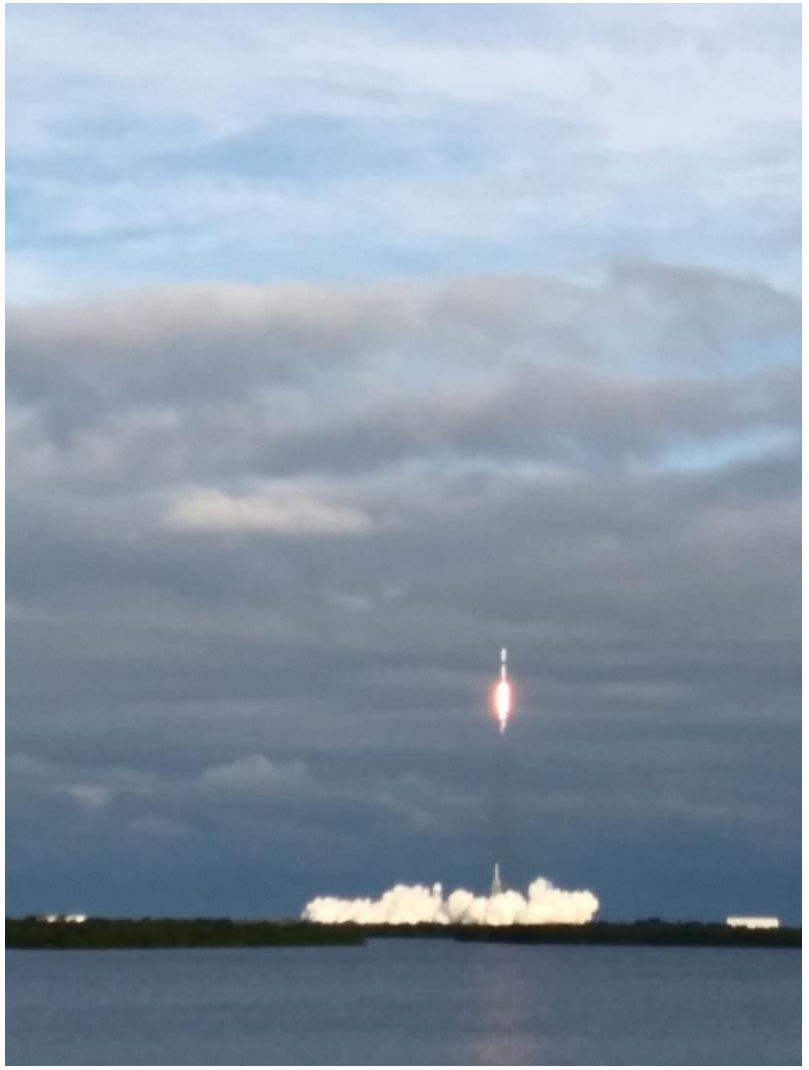
QO-100
Satellite Earth Station

Jen G4HIZ

Finningley BATC Meeting

29th June 2019

Es’hail 2 Satellite Launch 15th November 2018



Remember this ?
It was only 8 months ago !

Es’hail 2 Satellite Launch 15th November 2018

Everyone is happy and somewhat relieved !

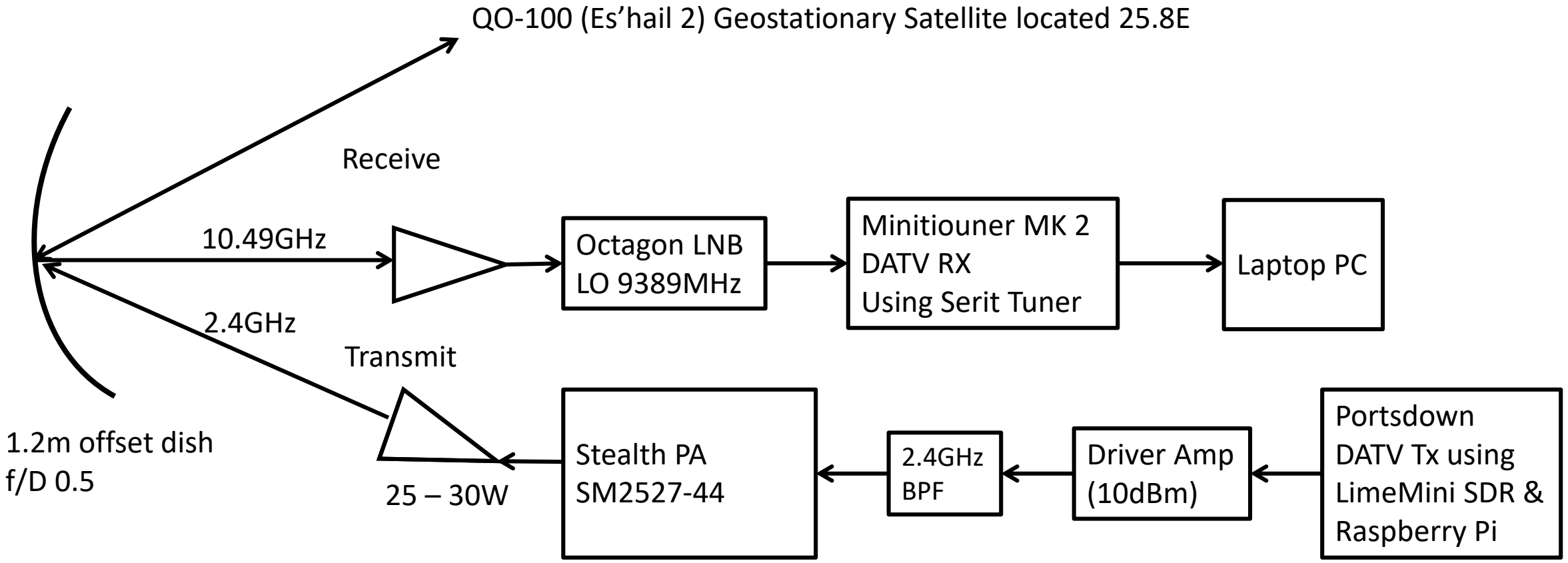
Es’hail 2

- 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

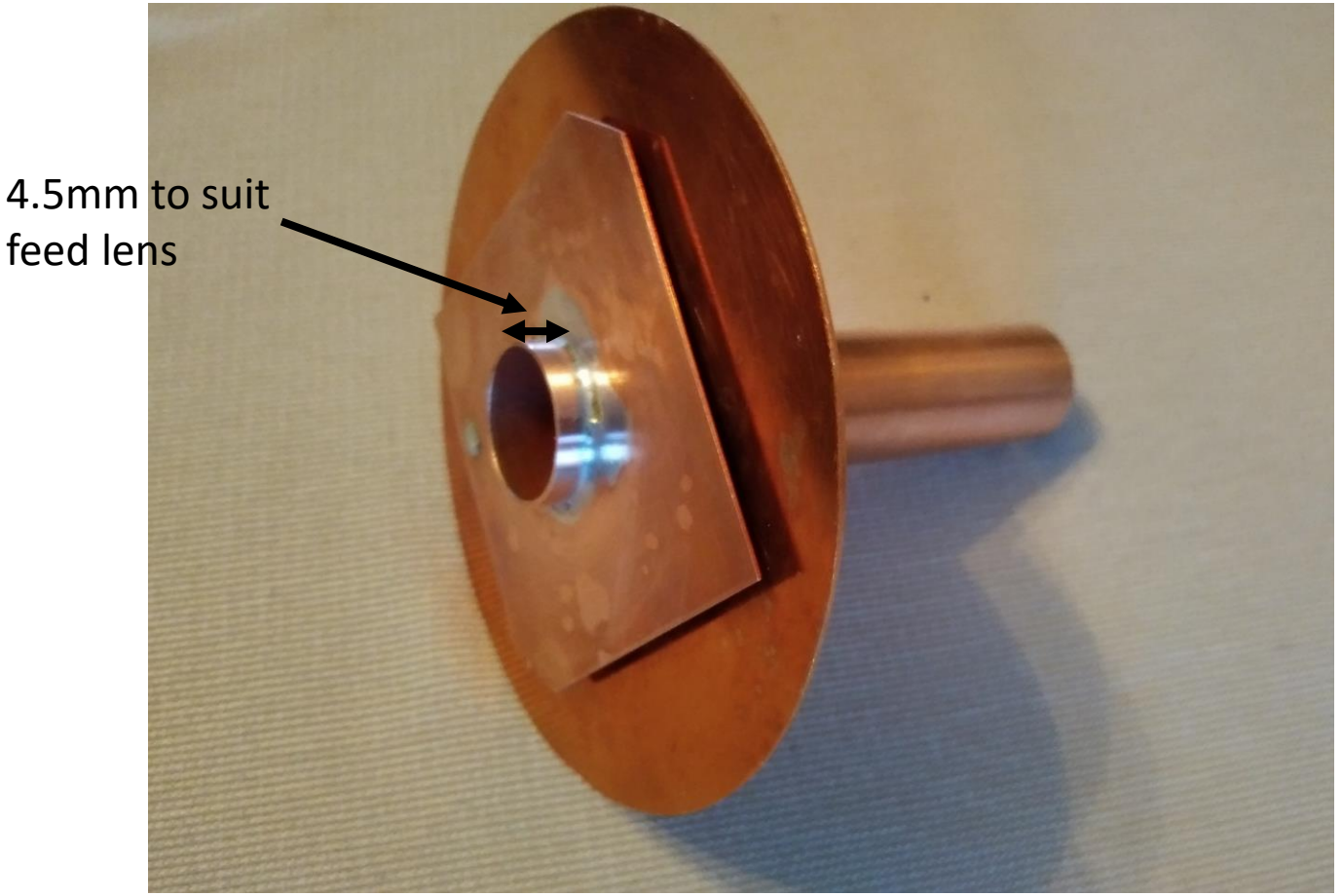
System Block Diagram



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

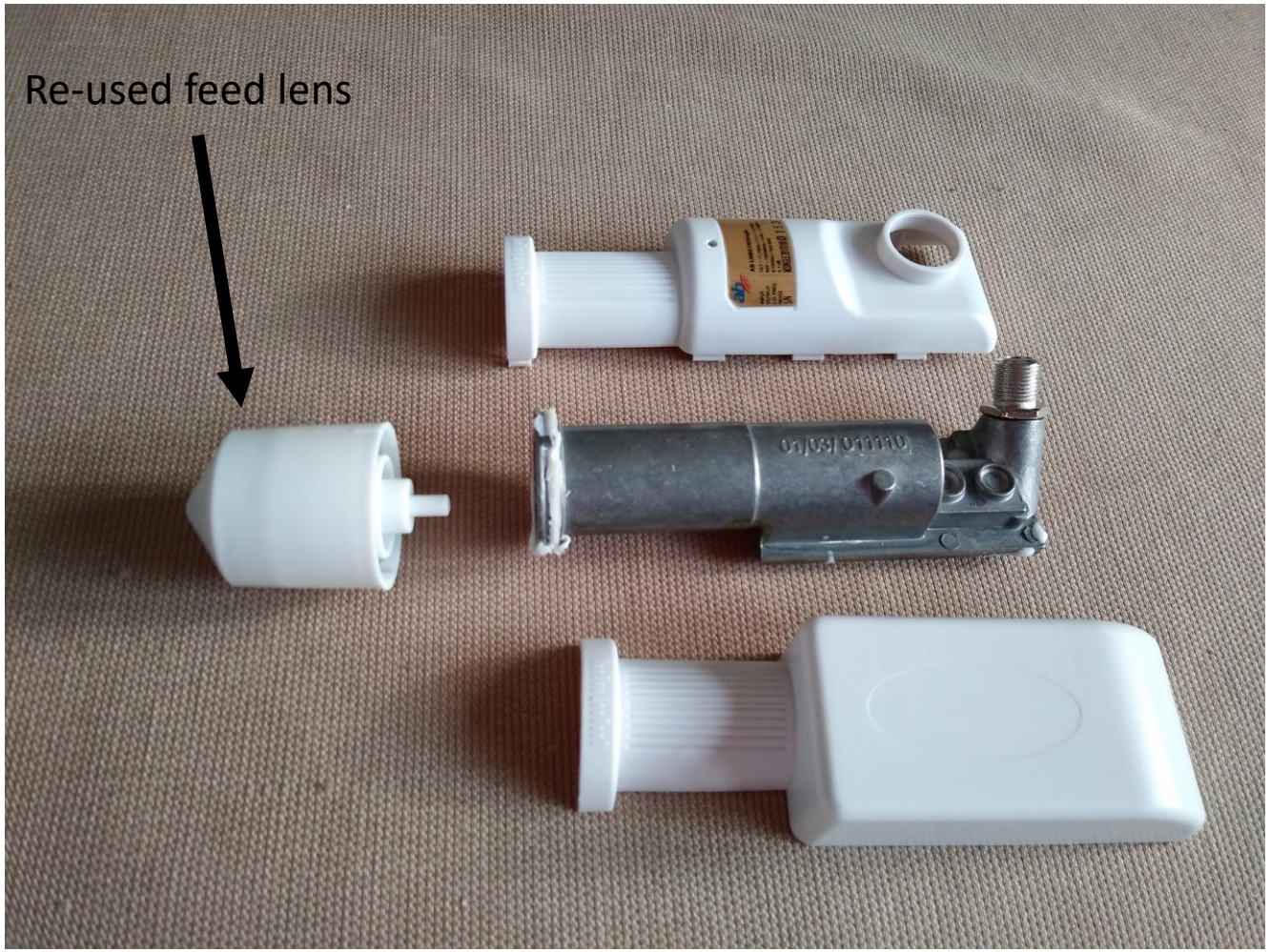
Feed as described in article by G0MJW et al



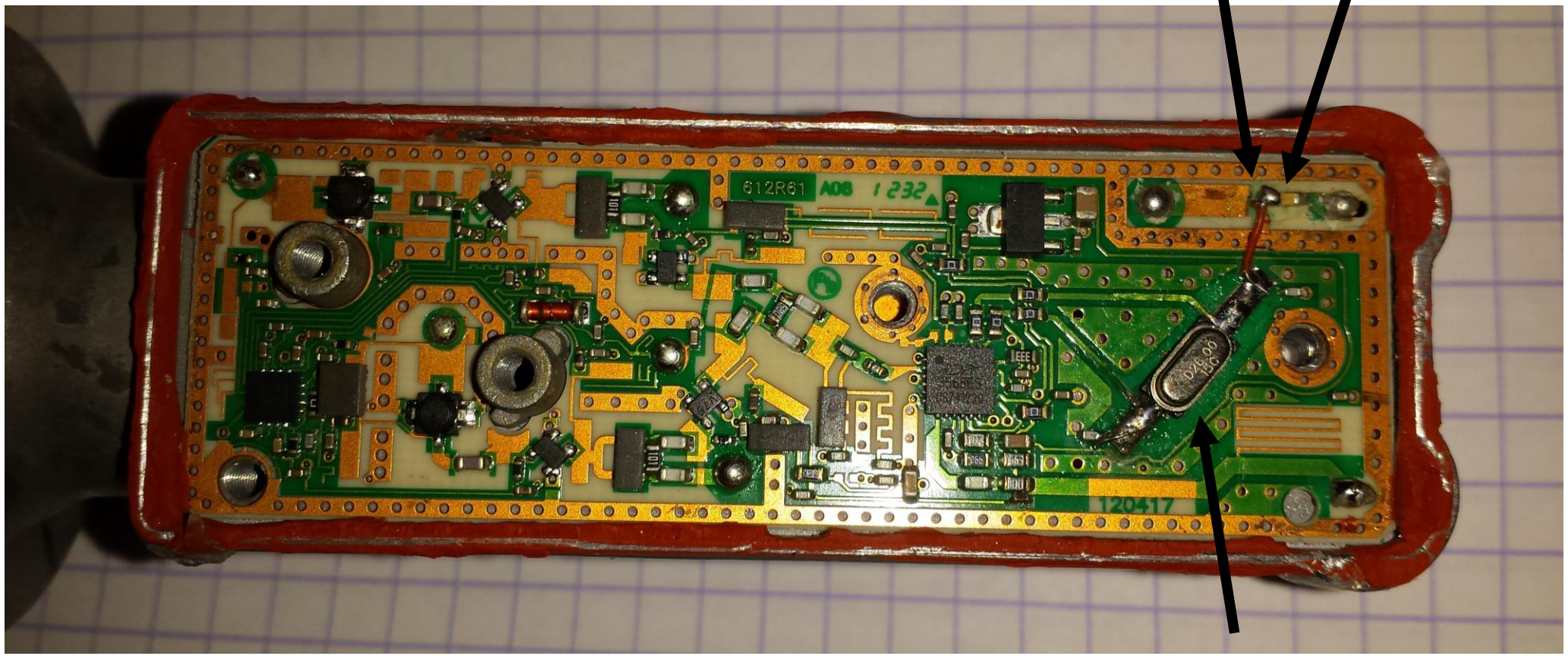
Feed in place on antenna during initial testing

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

Feed Lens from AB LNB 01



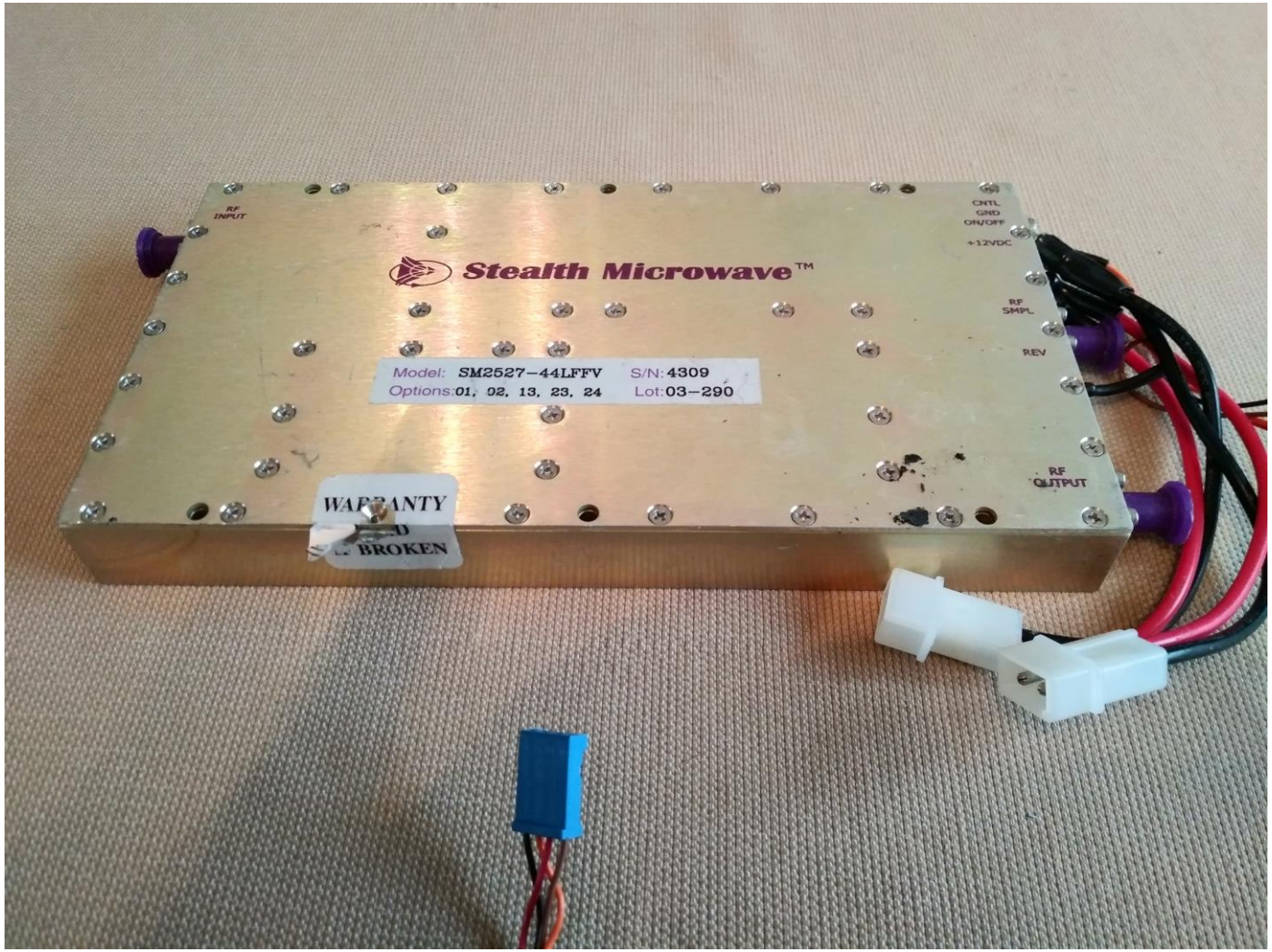
Modified Octagon LNB
(27MHz xtal changed to 26MHz)



Stealth PA

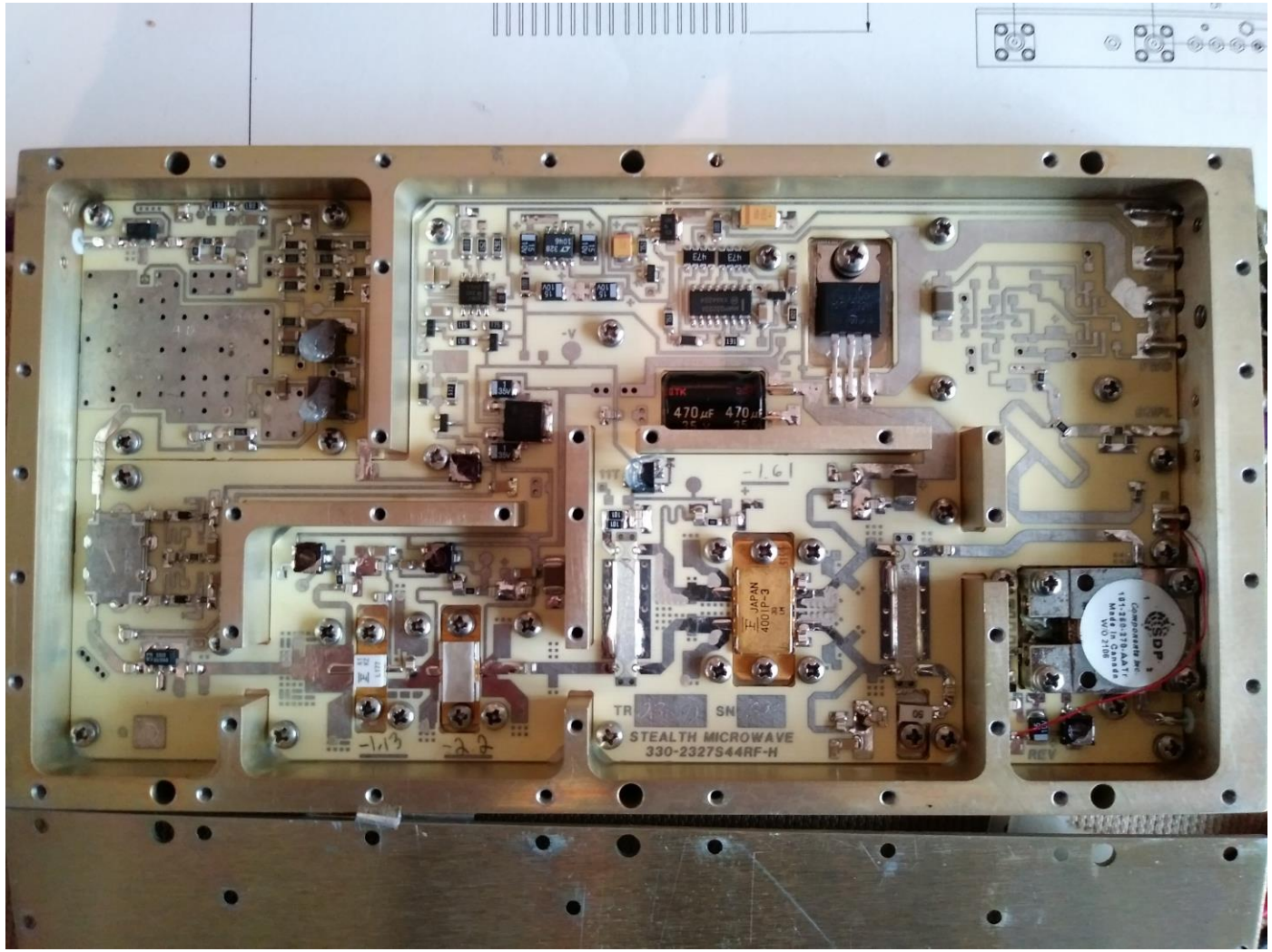
- Model number indicates intended frequency range and power o/p
- Eg SM2527-44 means:
  - 2.5 to 2.7GHz with 44dBm o/p (25W)
- As bought, o/p power approx. 20W at 2.4GHz
- Driver stages tuned using copper tuning stubs (roughly 2 to 3mm, rectangles)
  - Sometimes referred-to as ‘snowflaking’
- O/p power 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

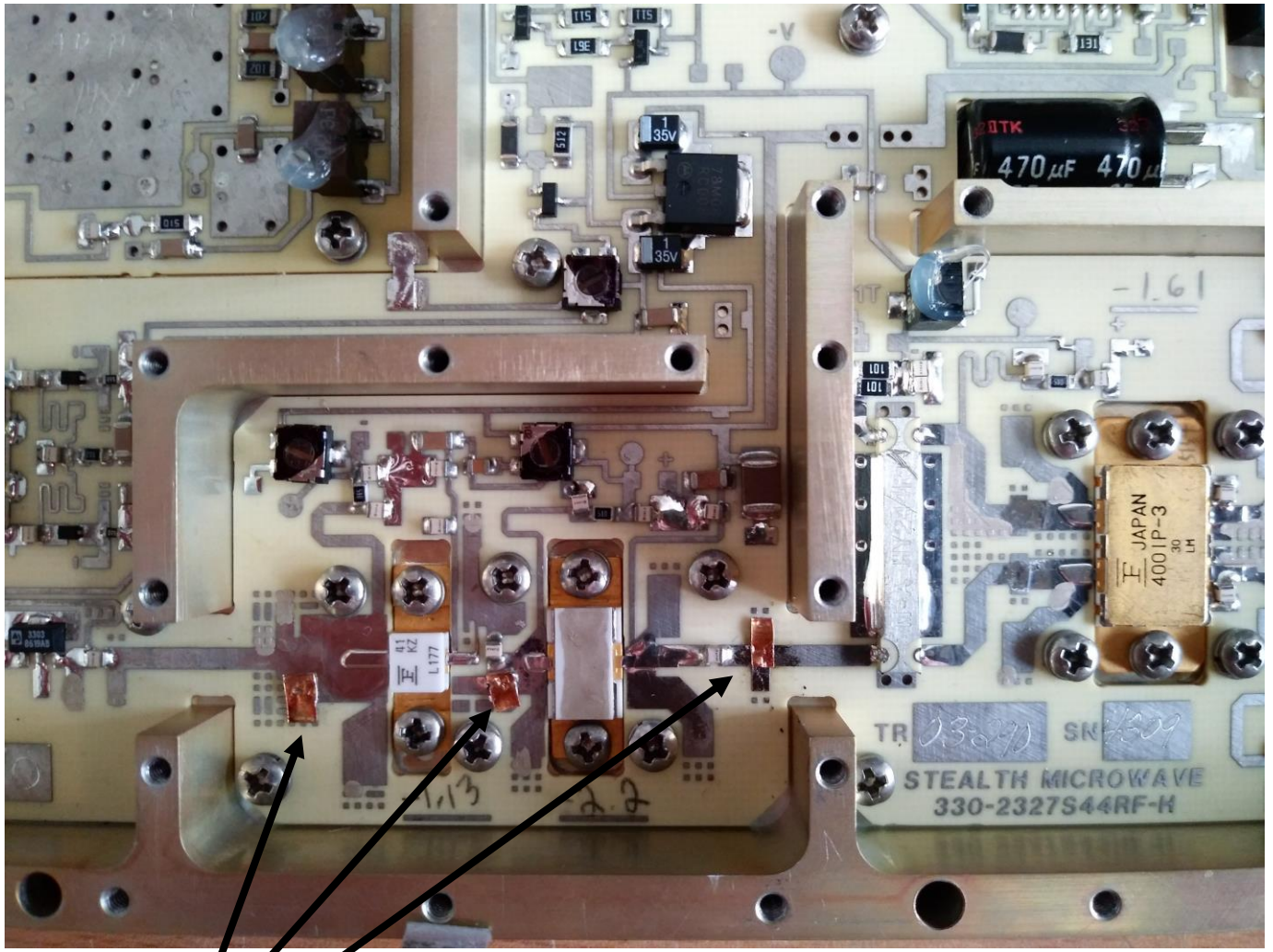


A number of different models of Stealth PA are suitable

Stealth PA inside – general view, unmodified

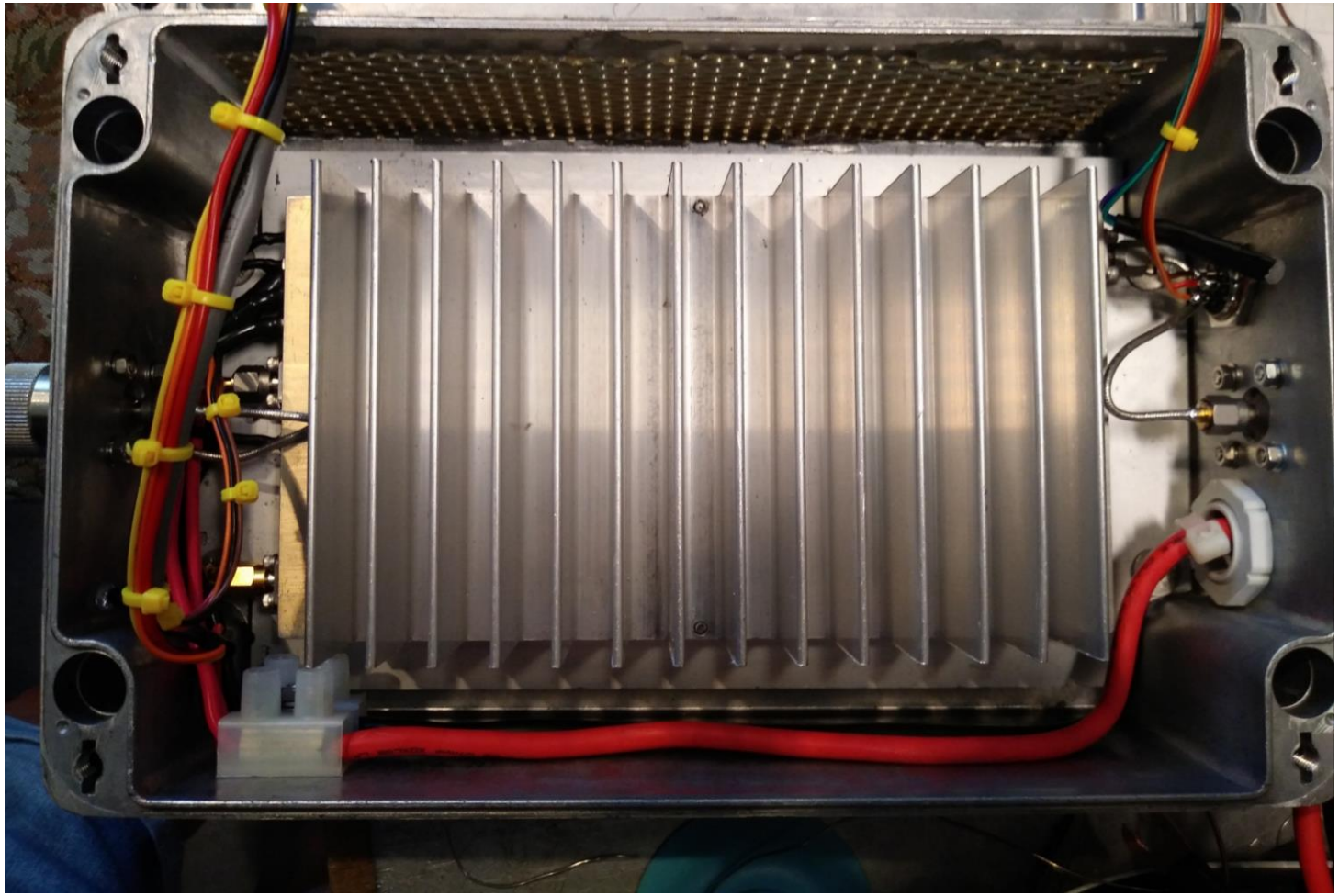


Stealth PA Mods to driver stages (‘snow flaking’)



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

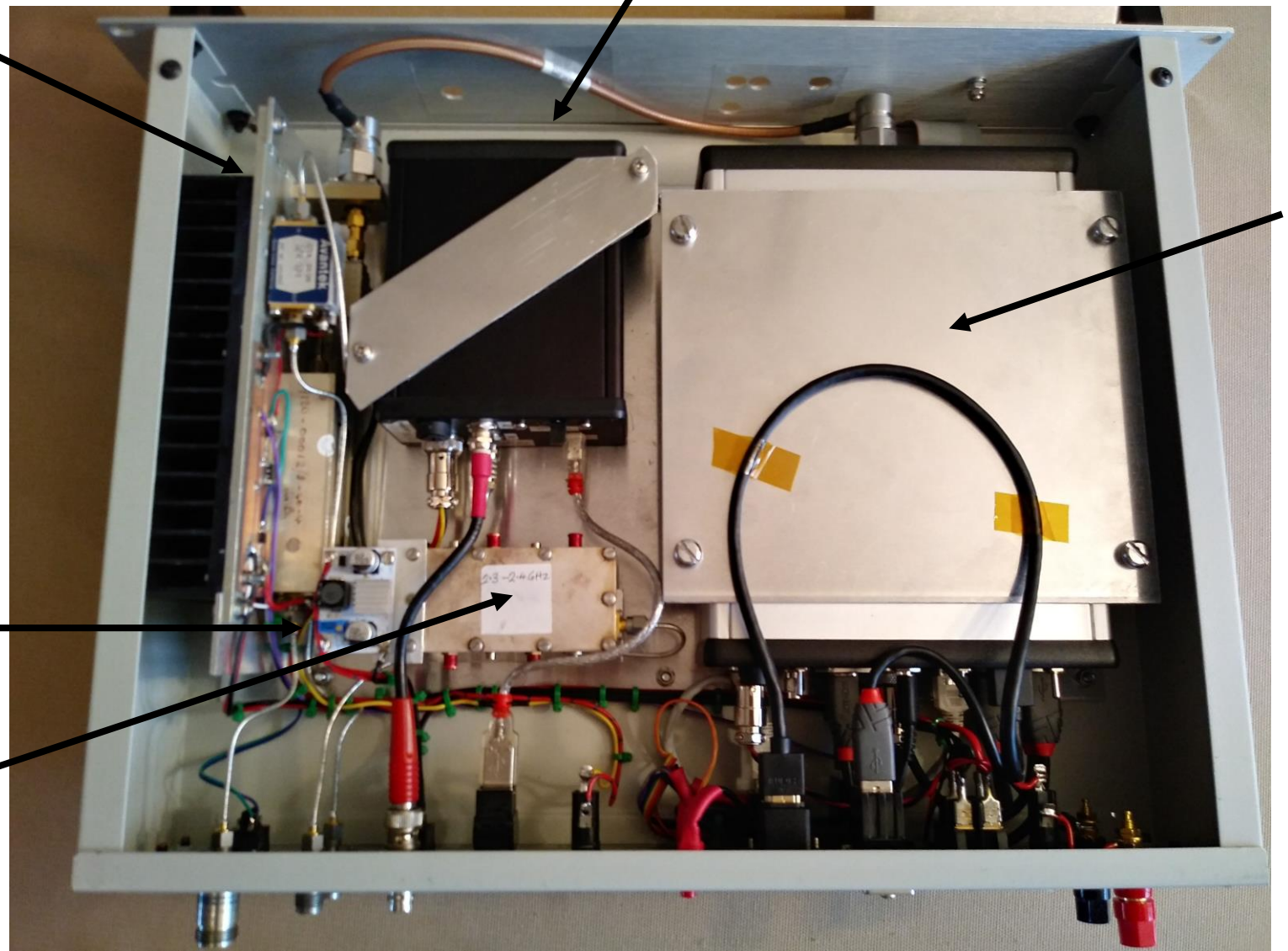
Touchscreen for Portsdown control

Windows provided for all indicators

QO-100 Transceiver

Minitiouner Mk 2 Rx

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



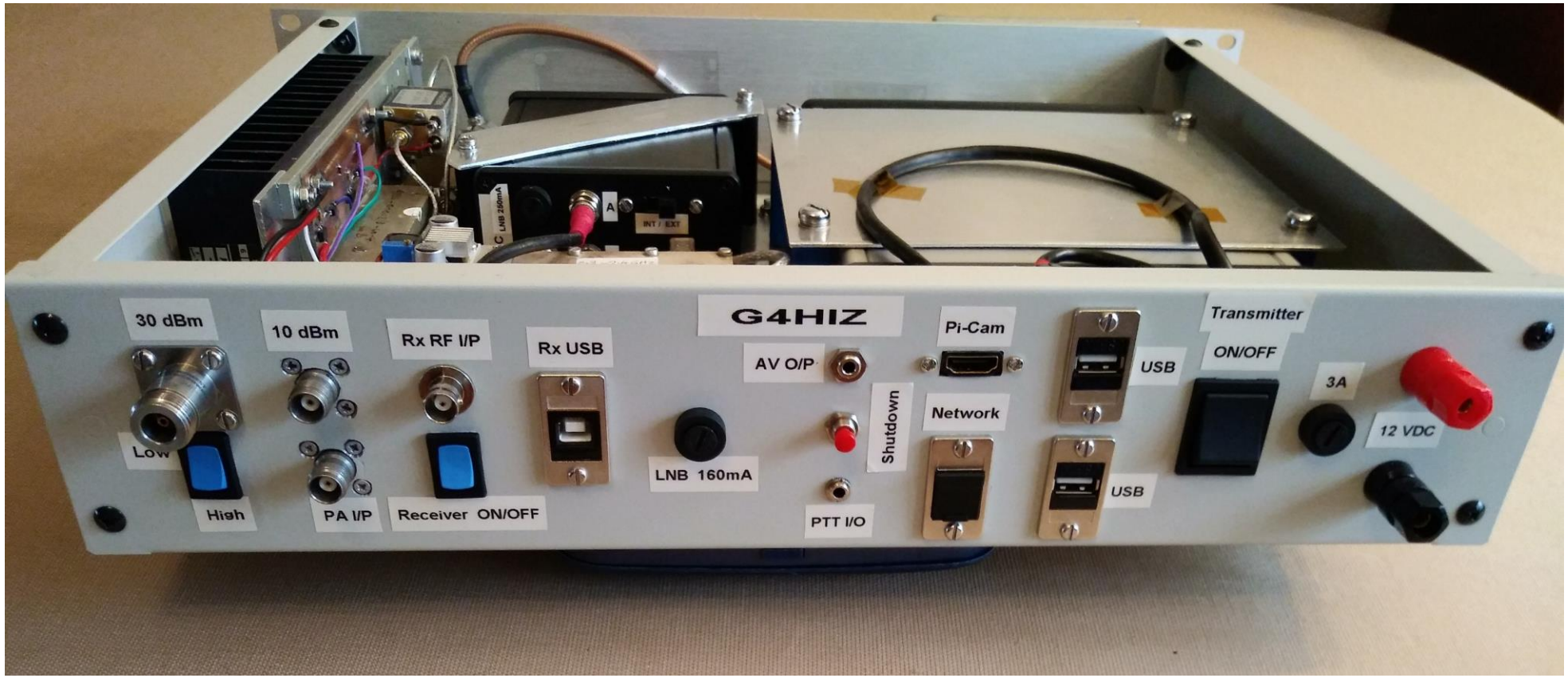
Portsdown Tx with internal programmable attenuator

DC/DC to give 18V for LNB

All units easily removed for upgrade/servicing

2.4GHz Band-pass filter

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