# The Bodger's Guide to Es'hailSat / QO100



**AMSAT P4-A**

First geostationary amateur radio transponder (incl. DATV) on *Es'hail-2*

Launch: Q4 2018 – Position: 26 deg East – Lifetime: 15+ years

www.g4bao.com

# The Bodger's Guide to Es'hailSat

## What is Es'hailsat?

- **Es'hailSat2 is a Geostationary Satellite launched by SpaceX.**
- **It was funded by the Qatari government as part of the 2022 football World Cup preparations.**
- **It carries two Amateur radio transponders built by Amsat-de as part of the "Phase 4" project.**
- **A narrowband SSB/CW transponder**
- **A Wideband transponder for DATV and other high bandwidth modes**
- **It has the Amsat designation "QO100"**

# The Bodger's Guide to Es'hailSat

## Why the Name "Es'hailSat?

- The satellite is named after the star we know as "Canopus"
- In Arabic, Canopus is "Sohail"
- So the name of our satellite is 'The Canopus', or in Arabic 'ElSohail'
- Since Arabs find it hard to pronounce the combination of l and s, they drop the l, Leaving 'ESohail'.
- An apostrophe is added to emphasize the S 'ES'ohail'.
- And since the o (or u) will be pronounced anyway, it is almost allways dropped.

- So that is how we get 'Es'hail'. Pronounced 'ESohayl'

# The Bodger's Guide to Es'hailSat

## What is a Geostationary Satellite ?

- The orbital period of a Satellite is proportional to it's distance from the Earth.

- At only one distance, the orbital period equals the Earth's rotation period.

- In this orbit, Satellites appear to stay at the same point above the earth.

- This "Geostationary Orbit" is at approximately 36000km.

- This Orbit is known as the "Clarke Belt" After Arthur C Clarke



*Photo – Wikipedia*

# The Bodger's Guide to Es'hailSat

## *The Es'hailSat transponders*

Frequencies narrow band (**NB**) transponder    (bandwidth 250 kHz):

|          | lower end       | upper end       | polarisation |
|----------|-----------------|-----------------|--------------|
| Uplink   | 2400.050 MHz    | 2400.300 MHz    | RHCP         |
| Downlink | 10489.550 MHz   | 10489.800 MHz   | vertical     |

Frequencies wide band (**WB**) transponder    (bandwidth 8 MHz):

|          | lower end       | upper end       | polarisation |
|----------|-----------------|-----------------|--------------|
| Uplink   | 2401.500 MHz    | 2409.500 MHz    | RHCP         |
| Downlink | 10491.000 MHz   | 10499.000 MHz   | horizontal   |

*Amsat-DL*

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Coverage from orbital position of 26 deg East
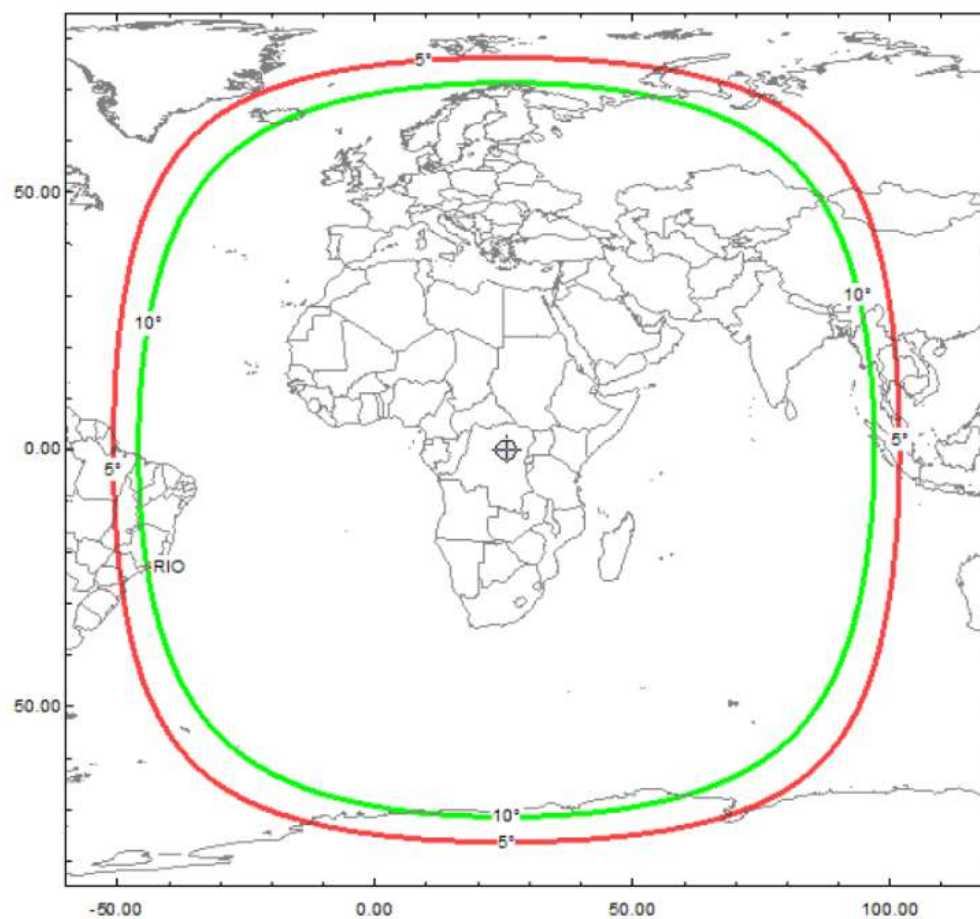
*Amsat-DL*

# The Bodger's Guide to Es'hailSat

## *System requirements as per Amsat - DL*

Minimum setup for **SSB** communications:

| | |
|---|---|
| RX Antenna | 60-90 cm SAT-TV dish |
| Receiver | LNB with power injector and DVB-T dongle + SDR software (for example SDR#)<br><br>OR<br><br>3 cm LNA with downconverter to 70cm |
| Transmitter | 10W PEP in 60-90 cm dish plus upconverter from 144 MHz |

Minimum setup for **DATV** (DVB-S2) communications:

| | |
|---|---|
| RX Antenna | 60-90 cm SAT-TV dish |
| Receiver | modified LNB with standard satellite receiver box (DVB-S2)<br><br>OR<br><br>modified LNB with PCI DVB-S2 cards for PC use |
| Transmitter | 25W PEP in 2.4m dish plus DVB-S2 modulator for a 2MSym/s videostream |

*Amsat-DL*

# The Bodger's Guide to Es'hailSat

*Getting Started.*
*No radio equipment required!*

- **Look at the Goonhilly Narrowband Web SDR**
- **https://eshail.batc.org.uk/nb/**



Qatar OSCAR-100 Narrowband WebSDR

This WebSDR, hosted at Goonhilly Earth Station in Cornwall, enables you to listen to the Qatar OSCAR-100 Narrow band transponder onboard the Es'hail-2

You can read more about the WebSDR & Spectrum Viewer station at wiki.batc.org.uk/Es'hail-2 Ground Station

- For more details on Qatar OSCAR-100 see amsat-dl.org/eshail-2-amsat-phase-4-a
- The QO-100 wideband spectrum monitor can be found here eshail.batc.org.uk/wb/
- More information about the WebSDR software can be found on www.websdr.org
- **New:** BPSK data on the Upper Beacon can be decoded with GNUradio by following this guide.
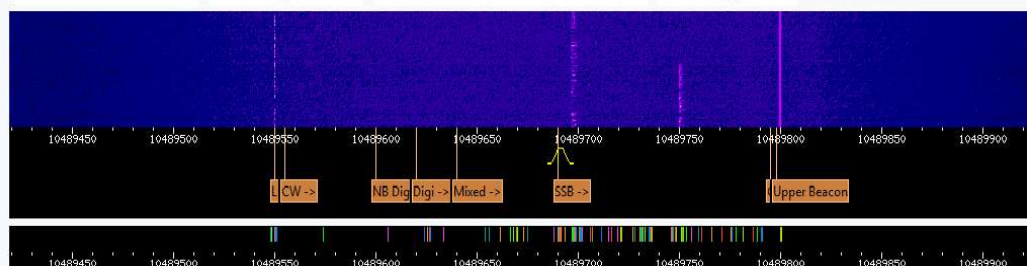
# The Bodger's Guide to Es'hailSat

## *Getting Started*
## *Simple receive setup for the Narrowband transponder*

- **45cm Sky dish and LNB – vertical polarisation.**
  - **Digitalis-direct on EBay do this dish and tripod for £40**

- **PC / Android phone + RTL-SDR ` dongle or Funcube Dongle in SSB-CW mode**

- **LNB has a LO of 9750, so 10489.55 to 10489.800 produces an IF of 739.550 – 739.800 MHz**

- **Find the Narrowband Data beacon on 10489.800, CW on 10489.550MHz**

*Photo digitalis-direct*

# The Bodger's Guide to Es'hailSat

## *Getting Started – Finding the Satellite*

- **Look on the https://www.dishpointer.com/ Website**

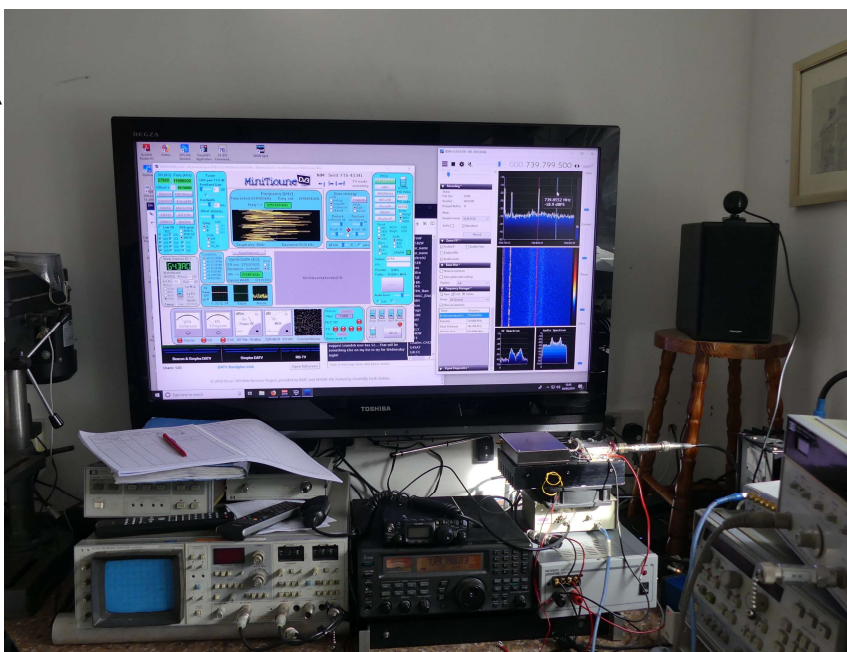# The Bodger's Guide to Es'hailSat

## *Getting Started – Finding the Satellite*

- **Satellite shares the 26 deg east Orbital Slot with Arabsat  BADR**

So for King's Lynn, Dishpointer.com calculates

- **Address**: King's Lynn
  **Latitude**: 52.7517°
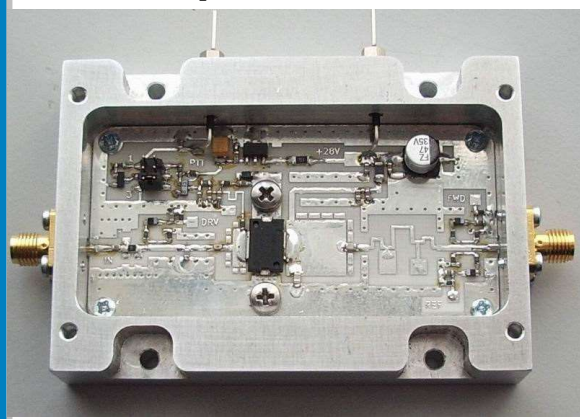  **Longitude**: 0.4023°
- **Satellite**: 26E ARABSAT
- 

**Elevation: 25.2°**
**Azimuth (true): 149.0°**
**Azimuth (magn.): 149.4°**

# The Bodger's Guide to Es'hailSat

### *Getting Started*
### *Transmitting SSB and CW*



- **SG Lab 432-2400 transverter**
- **http://www.sg-lab.com/TR2300/tr2300.html**

- **20W PA coming soon**

- **With a 1.2m dish I can access the**
- **transponder with 200mW!**

*Photos – SG-Lab*

# The Bodger's Guide to Es'hailSat

## *Getting Started – TX Dish feeds*

- **Simple Linear polarised Loop**

- **Dual band Circular Polarised patch feed designed by G0MJW**

- **With Modified LNB and dielectric lens**

*Photos – G4BAO*

# The Bodger's Guide to Es'hailSat

## *My Setup*

- **1.2m Offset dish + G0MJW 10.4/2.4 GHz patch feed**

- **Receive - Octagon PLL LNB locked to a 25MHz Leo Bodnar GPSDO**
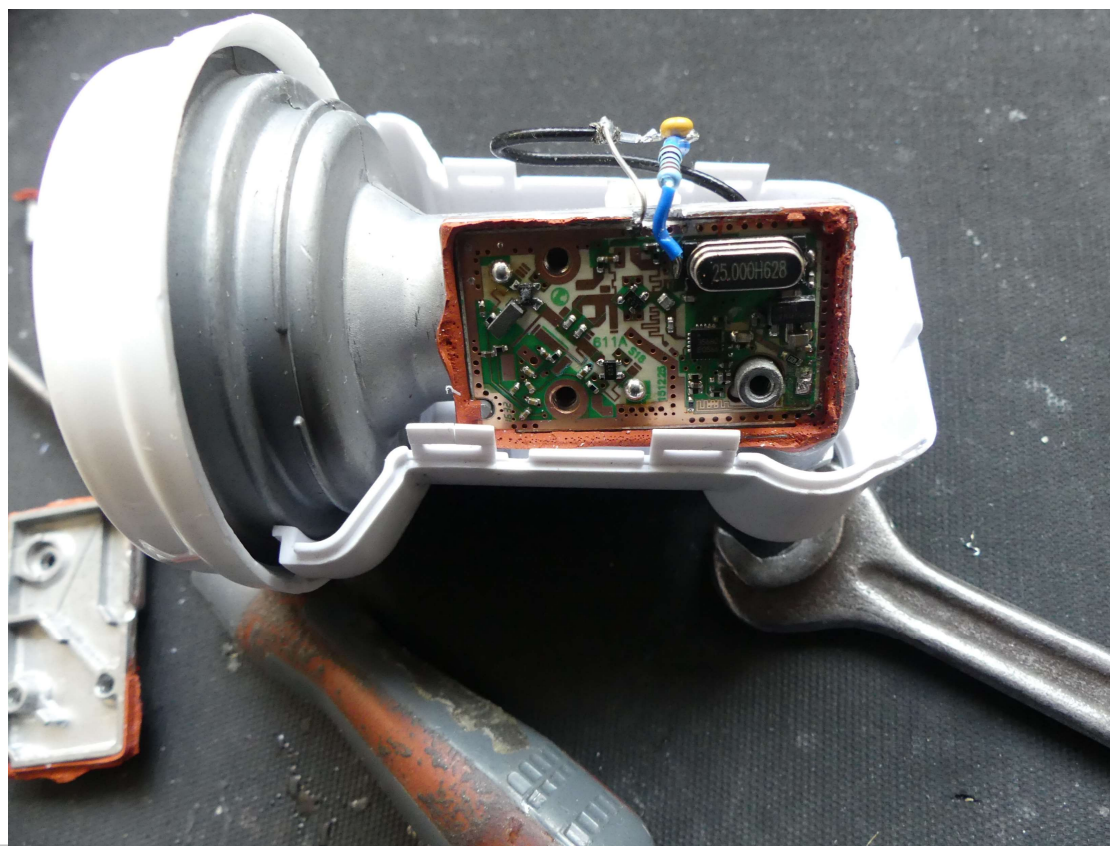
# The Bodger's Guide to Es'hailSat

## *My Setup*

- **SDR Sharp and Icom IC8500 tuning around 740MHz**

- **SSB/CW TX  - FT817 @432MHz, SG lab transverter 2W**

- **DATV TX – DATV express running on I5 GByte Brix PC with Lime-USB SDR**

- **25W PA – using retuned 1900MHz Cellular Module**
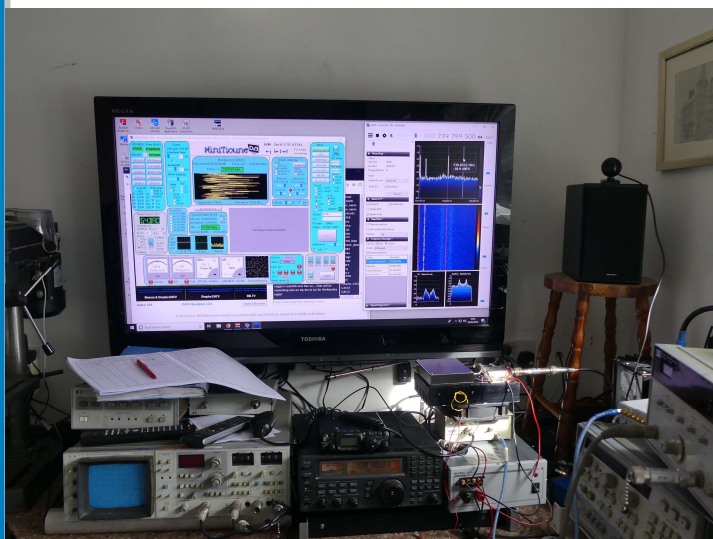
# The Bodger's Guide to Es'hailSat
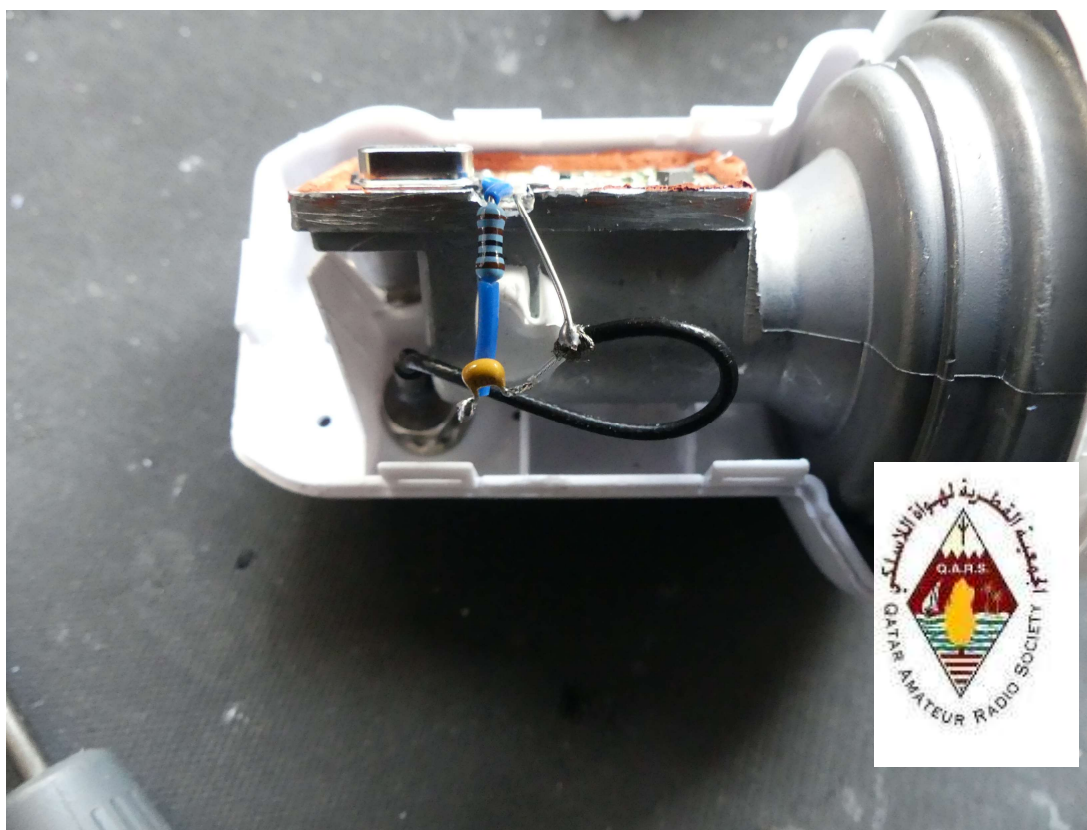
## *Advanced stuff – Injection Locking LNBs*

- **Octagon OSLO**

- **Feed 25 (27) MHz to one side of the crystal**

- **Via 1k and 1nF to ground**

- **Via small filed hole in the case**

# The Bodger's Guide to Es'hailSat

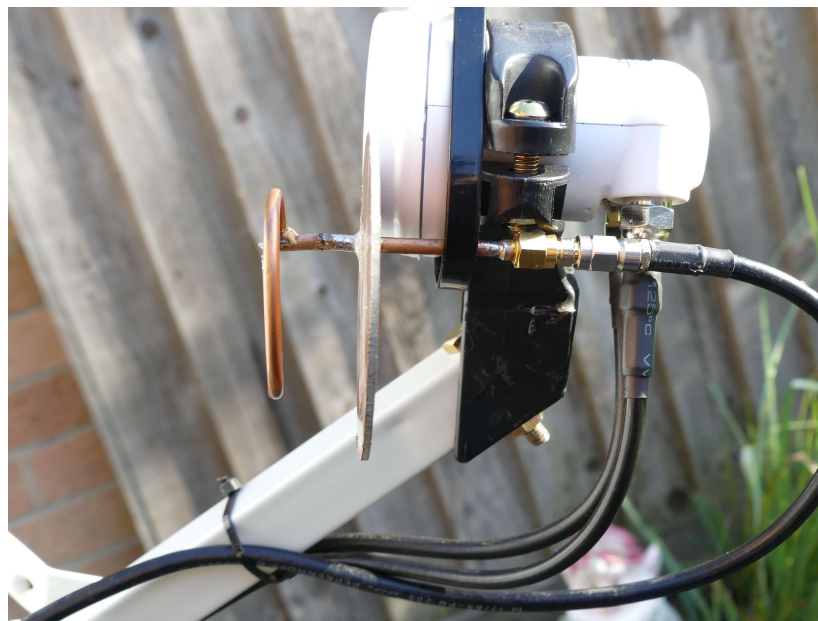## *Advanced stuff – Injection Locking LNBs*

- **Octagon OSLO**

- **Short coax to SMA socket through plastic case**

# The Bodger's Guide to Es'hailSat

## *Advanced stuff*

- – Adding a simple linear loop as a transmit feed

# The Bodger's Guide to Es'hailSat

## *Advanced stuff*
## *The wideband transponder – Digital TV*

- **QO100 uses DVBS2 at all rates up to 1000kS/s**

- **90cm dish minimum needed to receive - No LNB Lock required**

# The Bodger's Guide to Es'hailSat

## *Advanced stuff*
## *The wideband transponder – Digital TV*

- **Around 40W TX power at this dish size**

- **I can use the transponder at 25W / 500kS/s with 25 watts**

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# So That's it! Get receiving and take it from there!



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## Acknowledgements

Photos – M0DTS, M0EYC, ON4BHM

TX patch feed – Dr Mike Willis G0MJW

BATC and goonhilly.org for the WebSDR

Minitouner – F6DZP

DATV Express - G0GUO

The BATC shop

This presentation will be available on
www.g4bao.com in due course