AMSAT-DL

Satellites for Communication and Science
Satelliten für Kommunikation und Wissenschaft

P4-A / Es'hail-2

QO-100

Qatar-OSCAR 100

Peter Gülzow, DB2OS
2020-06-05

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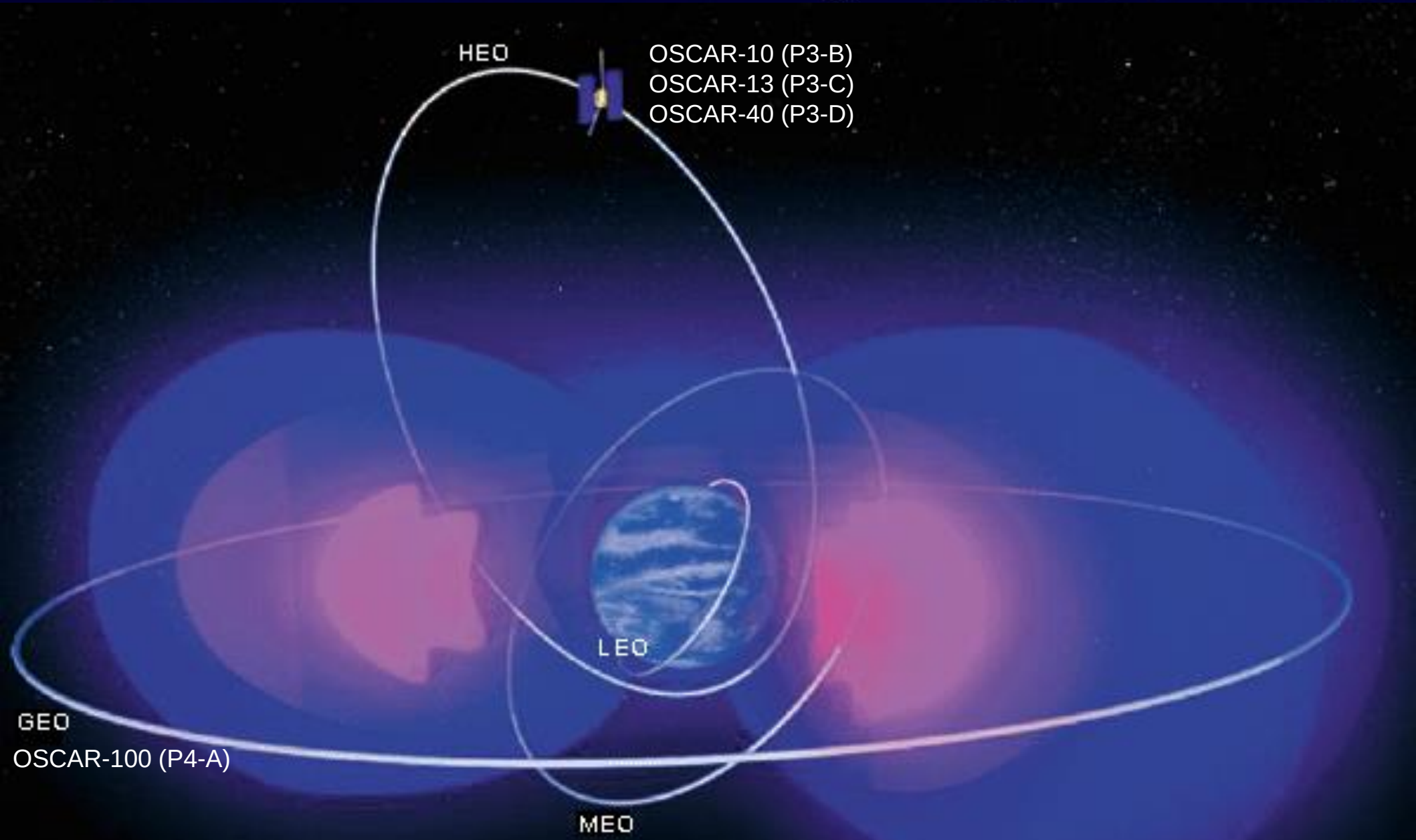
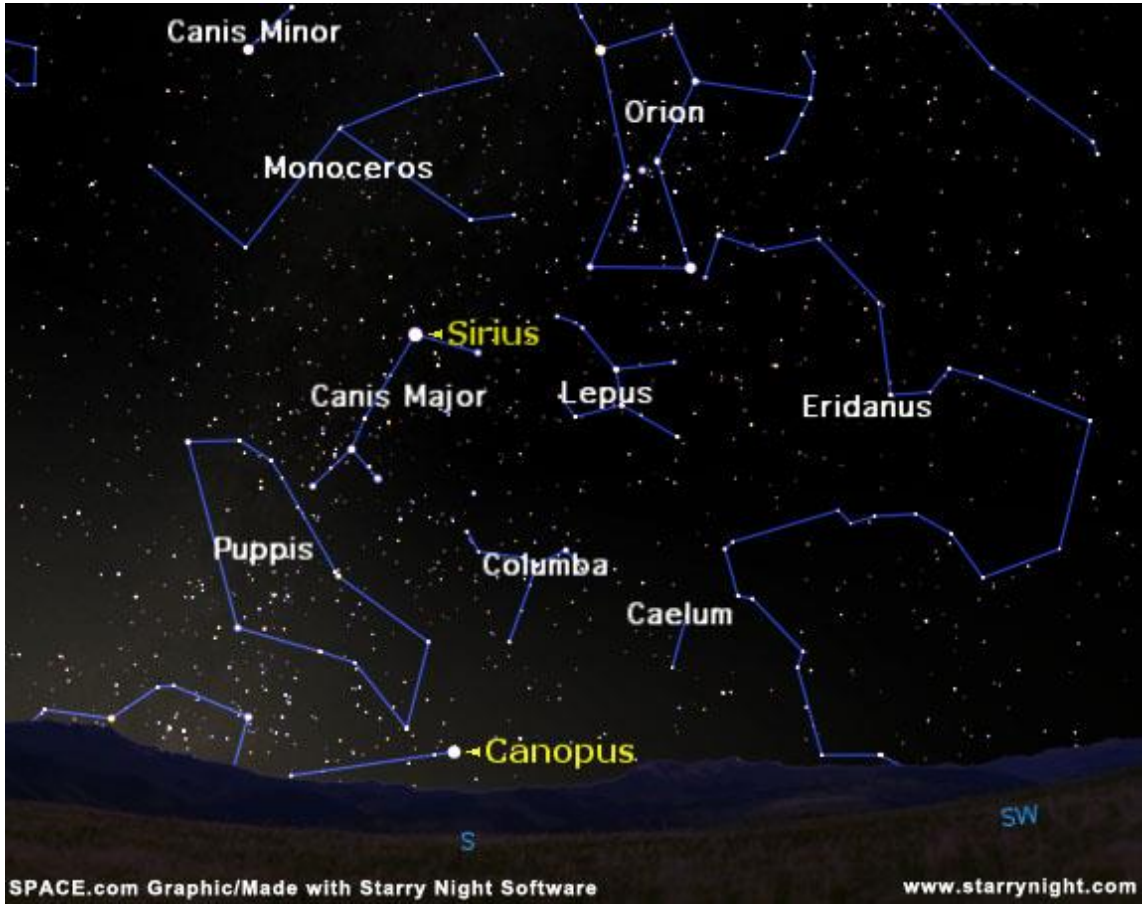


AMSAT Phase 4 = GEO

The meaning of Es'hail



“The story behind the name Es’hail (Canopus) is the name of a star which becomes visible in the night sky of the Middle East as summer turns to autumn. Traditionally, the sighting of Es’hail brings happiness as it means that winter is coming and that good weather will soon be with us. We hope that the arrival of Es’hailSat will equally be beneficial for the satellite community.”
(from Es’hailSat: *Follow the star*)

Canopus /kəˈnoʊpəs is the brightest star in the southern constellation of Carina, and is located near the western edge of the constellation around 310 light-years from the Sun. Its proper name is generally considered to originate from the mythological Canopus, who was a navigator for Menelaus, king of Sparta.

Time line

1001+ arabian nights…

H E Abdullah bin Hamad Al Attiyah, A71AU, Chairman of the Administrative Control and Transparency Authority, who is also the Chairman of the Qatar Amateur Radio Society (QARS) during the Qatar international amateur radio festival in December 2012.

2012 AMSAT-DL meets QARS

(DB2OS @ International Amateur Radio Festival in Qatar)

2013 Es'hailSat - Qatar Satellite Company

(idea, concept, design requirements, RFI, meetings with potential suppliers, RFP, finalisiation of requirements)

2016 Kick-Off at MELCO Japan

(Technical presentations, Requirements review, Critical Design Review, Design Validation)

2018 November 15th launch with SpaceX Falcon 9

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2012 Qatar Ham Radio Festival

visiting Qatar TV yesterday.

HH the Emir Sheikh Hamad bin Khalifa al-Thani, HH the Heir Apparent Sheikh Tamim bin Hamad al-Thani and HE the Prime Minister and Foreign Minister

bor al-Thani have sent congratulations to the president of Kazakhstan on his country's National Day.

bles Tahir al-Masri, n, secretary general of nber of the board of eral in Libya Dr Tarek , currently under way

Qatar to create platform for regional HAM broadcasters

By Zia Khan
Staff Reporter

Qatar will push for creating a common platform for amateur radio broadcasters from all over the Arab world to 'institutionalise' what currently is a hobby for individuals, HE the Chairman of Administrative Control and Transparency Authority, Abdullah bin Hamad al-Attiyah, said yesterday.

"We are looking into it and hope will be able to do that sometime next year," said al-Attiyah, at a news conference in Doha.

Al-Attiyah, who is also the chairman of Qatar Amateur Radio Society (QARS), hoped that the country would be hosting early next year such broadcasters at least from the Gulf Co-operation Council (GCC) member states.

"We are going to have a very strong Arab union and this initiative can help us achieve that goal," al-Attiyah added. He was talking to media after delivering a keynote speech at an international festival organised by the QARS.

Al-Attiyah said at least five mobile amateur radio stations would be set up on Qatar's National Day (tomorrow) to amuse people on the Corniche.

HE Abdullah bin Hamad al-Attiyyah speaking to media at a news conference.

These portable radio stations, he explained, would be moving up and down along the Corniche to reach out to as many people as they could.

Al-Attiyah said he was himself an amateur broadcaster in the 70s and used to cultivate friendships across the globe through his hobby.

He said that there were several hundred members associated with the QARS and they undergo extensive training and orientation sessions before getting a licence.

Al-Attiyah said the concept of amateur radio is different from the social media network because an individual can do 'whatever is on one's mind' on networking sites like the Facebook and Twitter.

One the other hand, he explained, the amateur radio stations in Qatar were not allowed to discuss politics, religion and business on the waves to avoid the 'negative' use of the facility and liberty available to them.

He added that there was no monitoring mechanism to check whether amateur broadcasters were stepping out of their mandated territory but a deep sense of the social responsibility kept them away from forbidden topics.

He said the amateur broadcasting has very strong social implications as those running such ventures in Qatar were on the forefront of relief efforts after earthquakes in Iran and Turkey in recent years by motivating people to donate for rehabilitation.

In some instances, he revealed, these broadcasters were helpful in establishing a link between victims in home countries and their relatives in Qatar when all other means of communication did not work properly.

Qatar

00 square metres and 23 permarkets, and 11 con- nience stores.

"Over the last three years, have grown rapidly with new branches coming in Qatar and outside. e have doubled our retail ace from 28,000 square etres in 2009 to more an 60,000 square metres the end of this year," said r al-Qahtani.

The deputy CEO added at his company's intention is to operate at least 0,000 square metres of tail space by 2017.

ts to be Qatar

04 The Peninsula MONDAY 17 DECEMBER 2012 www.thepeninsulaqatar.com

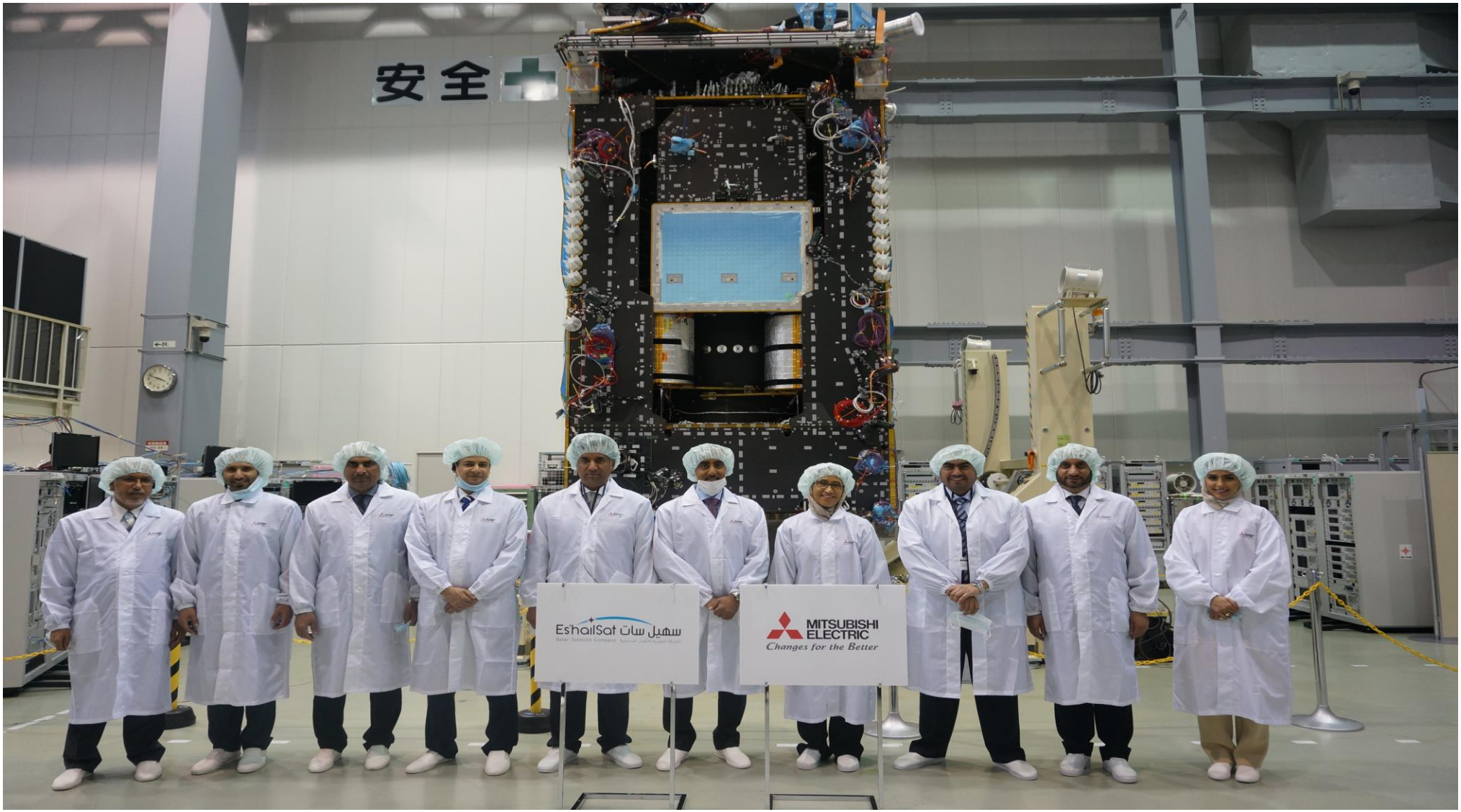
Global amateur radio fest begins

BY RAYNALD C RIVERA

DOHA: H E Abdullah bin Hamad Al Attiyah, Chairman of the Administrative Control and Transparency Authority, stressed the significant role amateur radio plays in the society during the opening of the Qatar international amateur radio festival yesterday at the Al Rayyan Theatre in Souq Waqif.

Al Attiyah, who is also the Chairman of the Qatar Amateur Radio Society (QARS), who are hosting the event for the first time in the Middle East addressed hundreds in the audience comprising officials of various amateur radio societies around the world and secondary students and

H E Abdullah bin Hamad Al Attiyah receiving a sword from Dr Ahmed Al Muhannadi, Vice-President of Qatar Amateur Radio Society (QARS), at Al



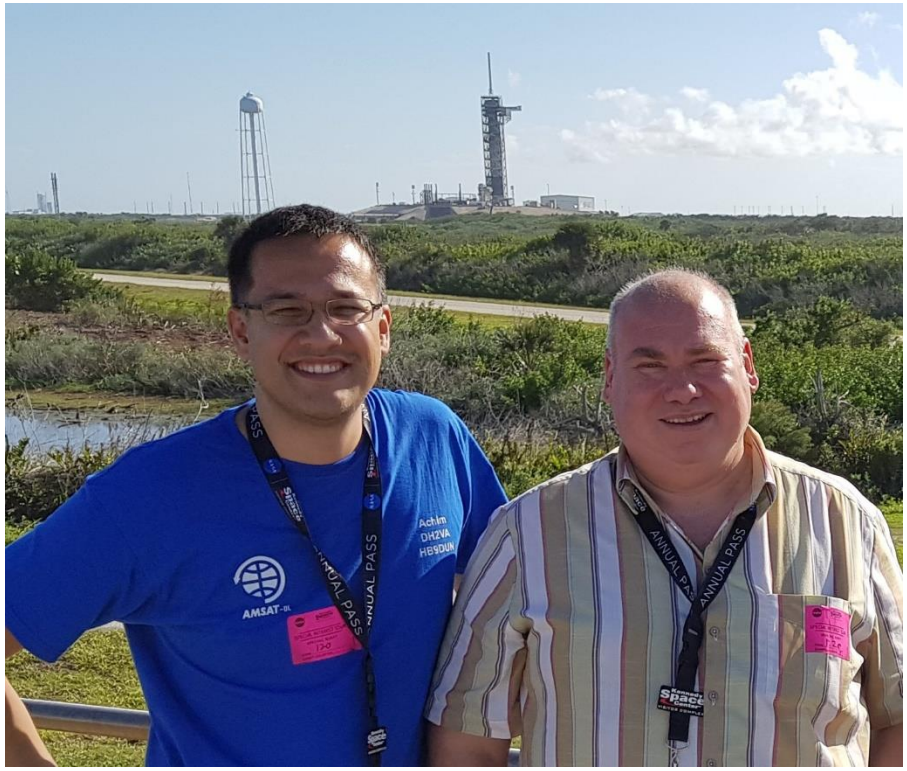
Executives from Qatar's Es'hailSat and Japan's Mitsubishi Electric Space Systems (MELCO) in Kamakura, outside of Tokyo, Japan, to observe the vacuum chamber test of Es'hail-2. Photograph courtesy of Es'hailSat, June 2016.

Melco DS-2000 Platform

- **Life:** 15+ yrs
- **Maximum Launch mass:** ~3,000 kg (3 – 5 tons class)
- **Launch Vehicle Compatibility:** Ariane-5, Proton Breeze M, Atlas, Falcon 9, H-IIA
- **Payload Heritage:** L, S, C, X, Ku and Ka frequency bands, 72 transponders (nominal)
- **EPS:** Electric Power Subsystem
  100v regulated bus, 12kW in sunlit and eclipse in maximum, automatic battery operation, 100-175Ah Li-Ion battery
- **SCS:** Satellite Control Subsystem
  Data handling of command/telemetry, satellite House-Keeping (battery, heater). MIL-STD-1553B processor and 64bit MPU (or HR5000) applied.
- **SPS:** Solar Power Subsystem
  12-13 kW total power generation (GaAs cells).
- **TC&R**: Telemetry Command and Ranging
  Maximum 4 command telemetry units. Standard bit rate 7.68 kbps for TLM, 500 bps for CMD. TLM, CMD and RNG operated simultaneously.
- **BPS:** Bi-Propellant Subsystem
  Fuel (MMH) and Oxygen (MON-3) Bipropellant, 1 Apogee Kick Motor + 12 Thrusters, Ion engine available on request.
- **AOCS:** Attitude and Orbit Control Subsystem
  Uses 4-skewed reaction wheel; standard highly accurate attitude control by with 0.03deg for three axis.

Launch on November 15th 2018

the launch took place at 20:46 UTC from the legendary launch pad 39A, from which Apollo 11 to the moon and the maiden flights of the first Space Shuttle Columbia and the SpaceX Falcon Heavy were launched. About half an hour after the launch, the satellite was placed by the launch vehicle into a geostationary transfer orbit. Only a few days later the Es'hail-2 was injected into a circular semi-geostationary orbit with its own propulsion system. Later parked at temporarily at 24°E for the In-Orbit-Testing (IOT) phase before it was shifted to its final position of 26 degrees East over Central Africa.



Launch on November 15th 2018

Official SpaceX Es'hail-2 Mission Patch

QARS Vice President: Dr Ahmed Hamad Al-Muhannadi, AMSAT-DL President & P4-A Project Leader: Peter Gülzow DB2OS, QARS General Secretary: Sabaan Musmar Al-Jassim A71BP, AMSAT-DL P4-A Project Manager: Dr. Achim Vollhardt DH2VA

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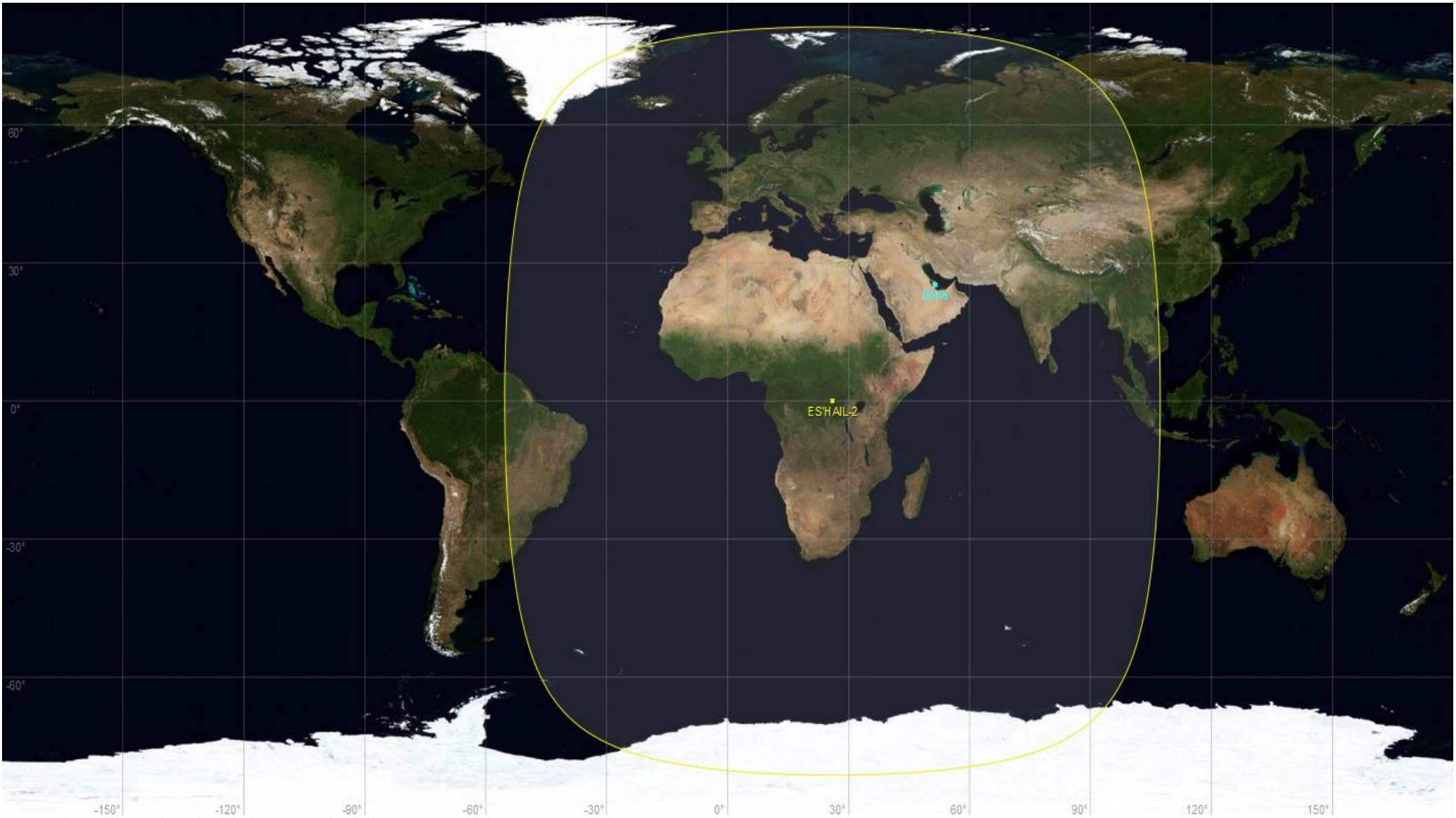
The earth as seen by Es'hail-2

Es'hailSat سهيل سات
Qatar Satellite Company الشركة القطرية للأقمار الصناعية

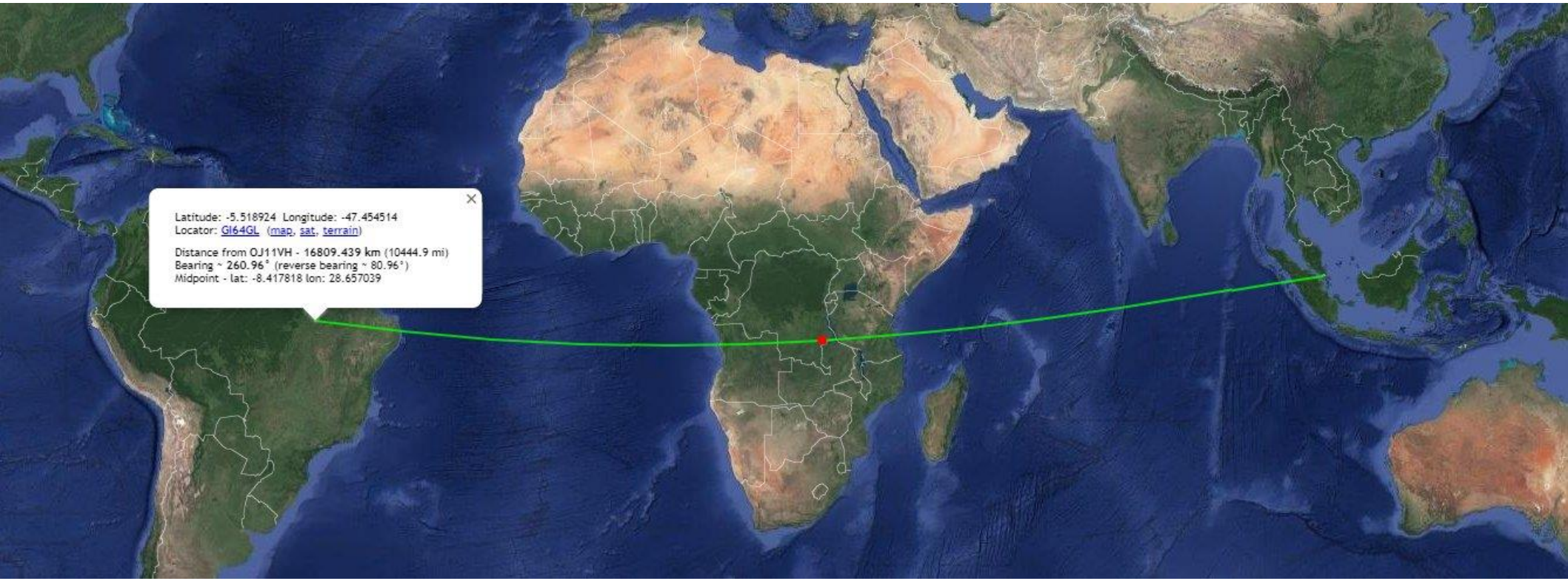
AMSAT-DL

الجمعية القطرية لهواة اللاسلكي
Q.A.R.S.
QATAR AMATEUR RADIO SOCIETY

Earth Coverage Es'hail-2



QO-100 Satellite Distance Record



QO-100 (NB) on 08-Feb-2020 at 11:47 UTC
Distance: 16,809 km.
9V1HY in Singapore (OJ11vh) ←→ PR8ZX in Brazil (GI64gl)

If you wish to claim a new record, see: https://www.amsat.org/satellite-distance-records/

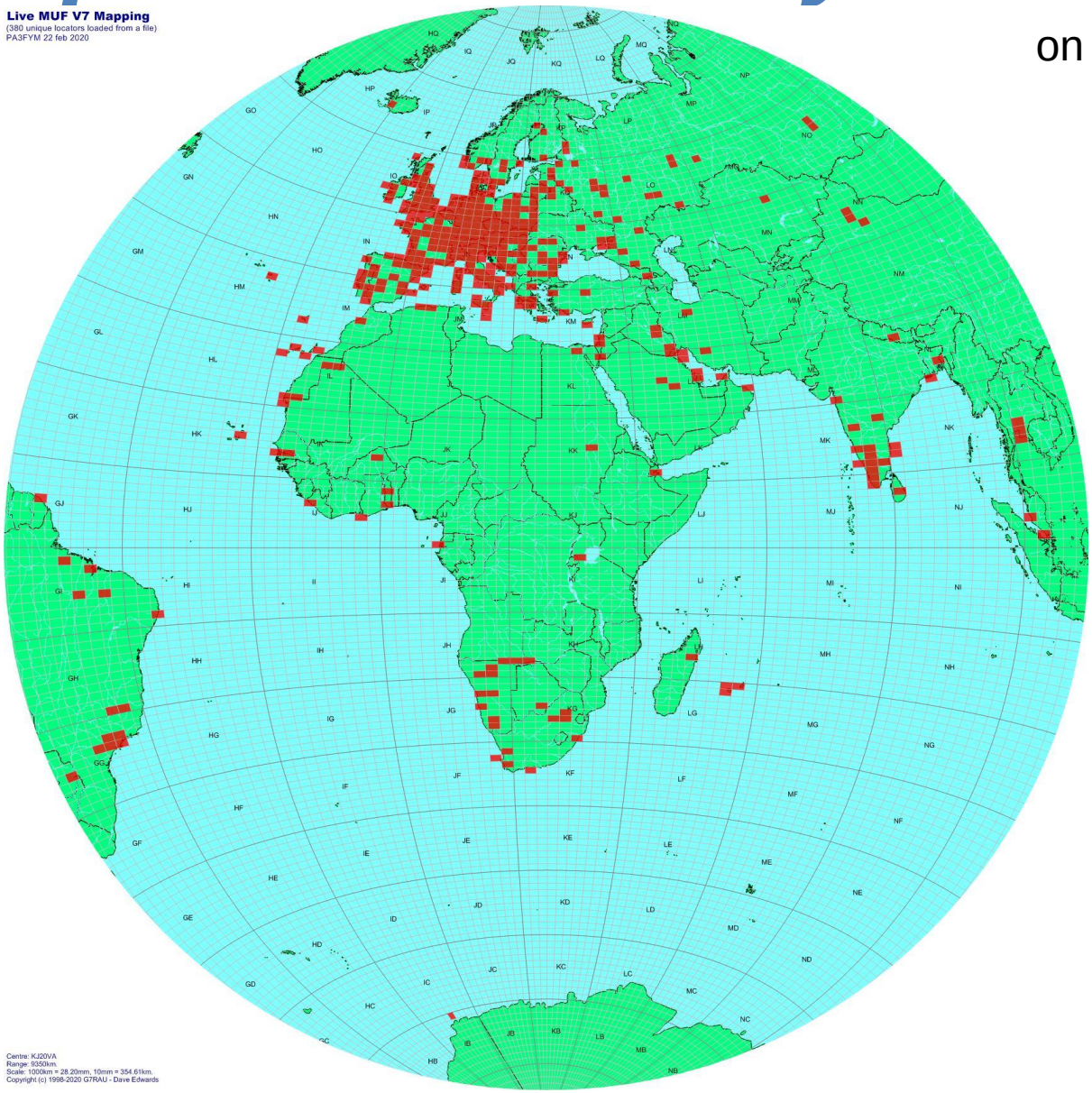
103 DXCC countries on QO-100

3A, 3B8, 4L, 4O, 4S, 4U, 4X, 5B, 5R, 5V7, 7X, 8Q, 9A, 9G, 9H, 9J, 9K, 9M2, 9N, 9V, 9X, A2, A4, A6, A7, A9, BY, C31, C5, CE9, CN, CT, CT3, CU, D4, DL, E7, EA, EA6, EA8, EI, EL, EP, ES, EU, F, FR, FY, G, GD, GI, GJ, GM, GU, GW, HA, HB, HB0, HS, HZ, I, IS0, J2, LA, LX, LY, LZ, OE, OH, OK, OM, ON, OZ, PA, PY, S0, S2, S5, SM, SP, ST, SU, SV, SV9, TA, TF, TK, TR, UA, UA0, UN, UR, V5, VU, XT, YI, YL, YO, YT, ZA, ZC4, ZS

MONACO, MAURITIUS ISLAND, GEORGIA, MONTENEGRO, SRI LANKA, ITU HQ, ISRAEL, CYPRUS, MADAGASCAR, TOGO, ALGERIA, MALDIVES, CROATIA, GHANA, MALTA, ZAMBIA, KUWAIT, WEST MALAYSIA, NEPAL, SINGAPORE, RWANDA, BOTSWANA, OMAN, UNITED ARAB EMIRATES, QATAR, BAHRAIN, CHINA, ANDORRA, THE, GAMBIA, ANTARCTICA, MOROCCO, PORTUGAL, MADEIRA ISLANDS, AZORES, CAPE VERDE, FEDERAL REPUBLIC OF GERMANY, BOSNIA-HERZEGOVINA, SPAIN, BALEARIC ISLANDS, CANARY ISLANDS, IRELAND, LIBERIA, IRAN, ESTONIA, BELARUS, FRANCE, REUNION ISLAND, FRENCH GUIANA, ENGLAND, ISLE OF MAN, NORTHERN IRELAND, JERSEY, SCOTLAND, GUERNSEY, WALES, HUNGARY, SWITZERLAND, LIECHTENSTEIN, THAILAND, SAUDI ARABIA, ITALY, SARDINIA, DJIBOUTI, NORWAY, LUXEMBOURG, LITHUANIA, BULGARIA, AUSTRIA, FINLAND, CZECH REPUBLIC, SLOVAK REPUBLIC, BELGIUM, DENMARK, NETHERLANDS, BRAZIL, WESTERN SAHARA, BANGLADESH, SLOVENIA, SWEDEN, POLAND, SUDAN, EGYPT, GREECE, CRETE, TURKEY, ICELAND, CORSICA, GABON, EUROPE, N RUSSIA, ASIATIC RUSSIA, KAZAKHSTAN, UKRAINE, NAMIBIA, INDIA, BURKINA FASO, IRAQ, LATVIA, ROMANIA, SERBIA, ALBANIA, UK BASES ON CYPRUS, REPUBLIC OF SOUTH AFRICA

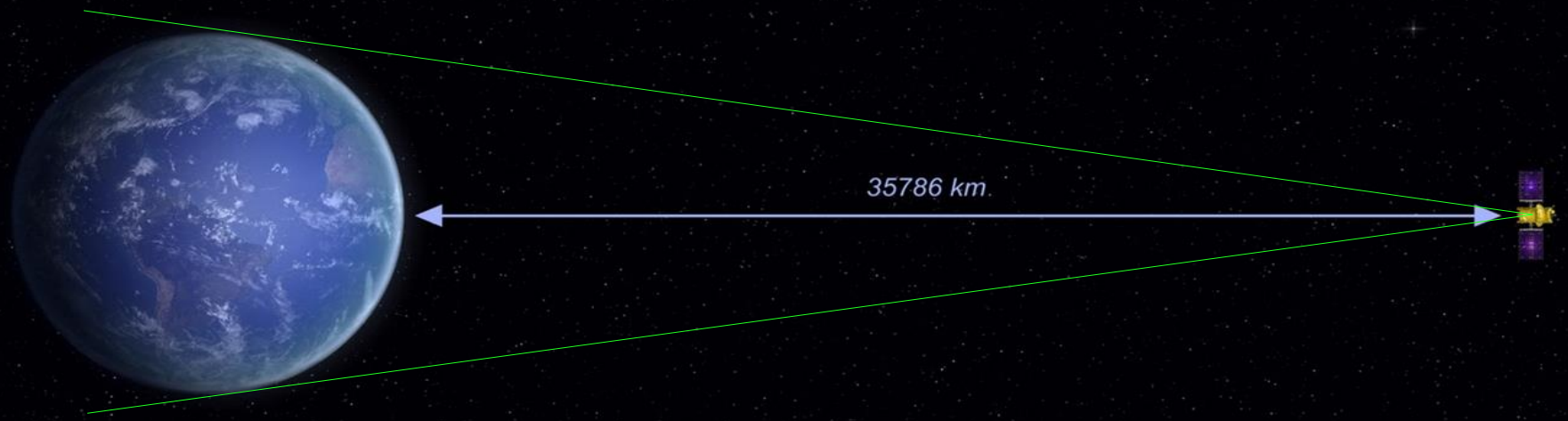
380 unique locations by PA3FYM

on 22 Feb 2020

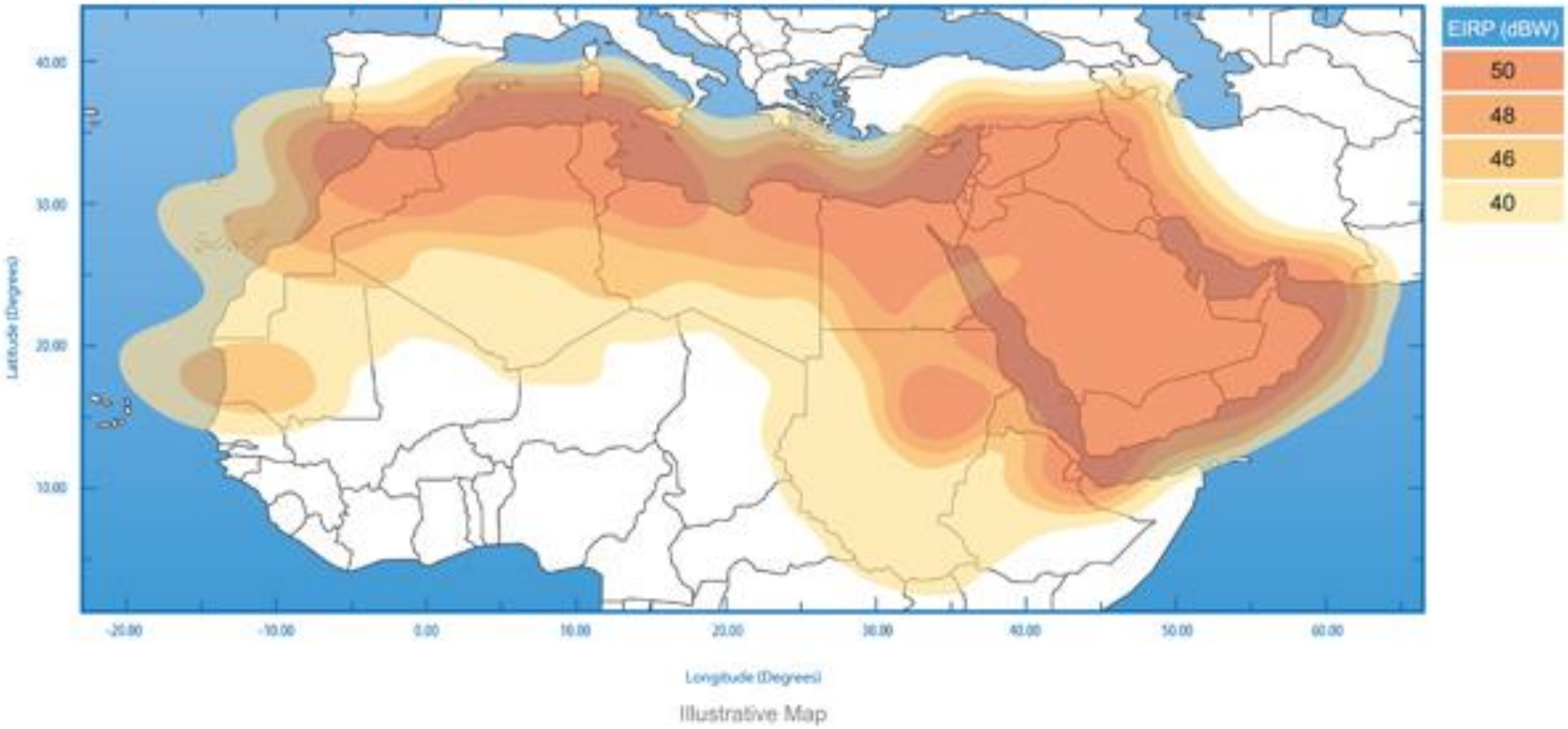


QO-100 Downlink Wide Beam

-3dB Beamwidth = 17.4° → ~20dB Antenna Gain !!



Es'hail-2 Ku-Band Downlink Coverage Over MENA



commercial SAT-TV Spot Beam!

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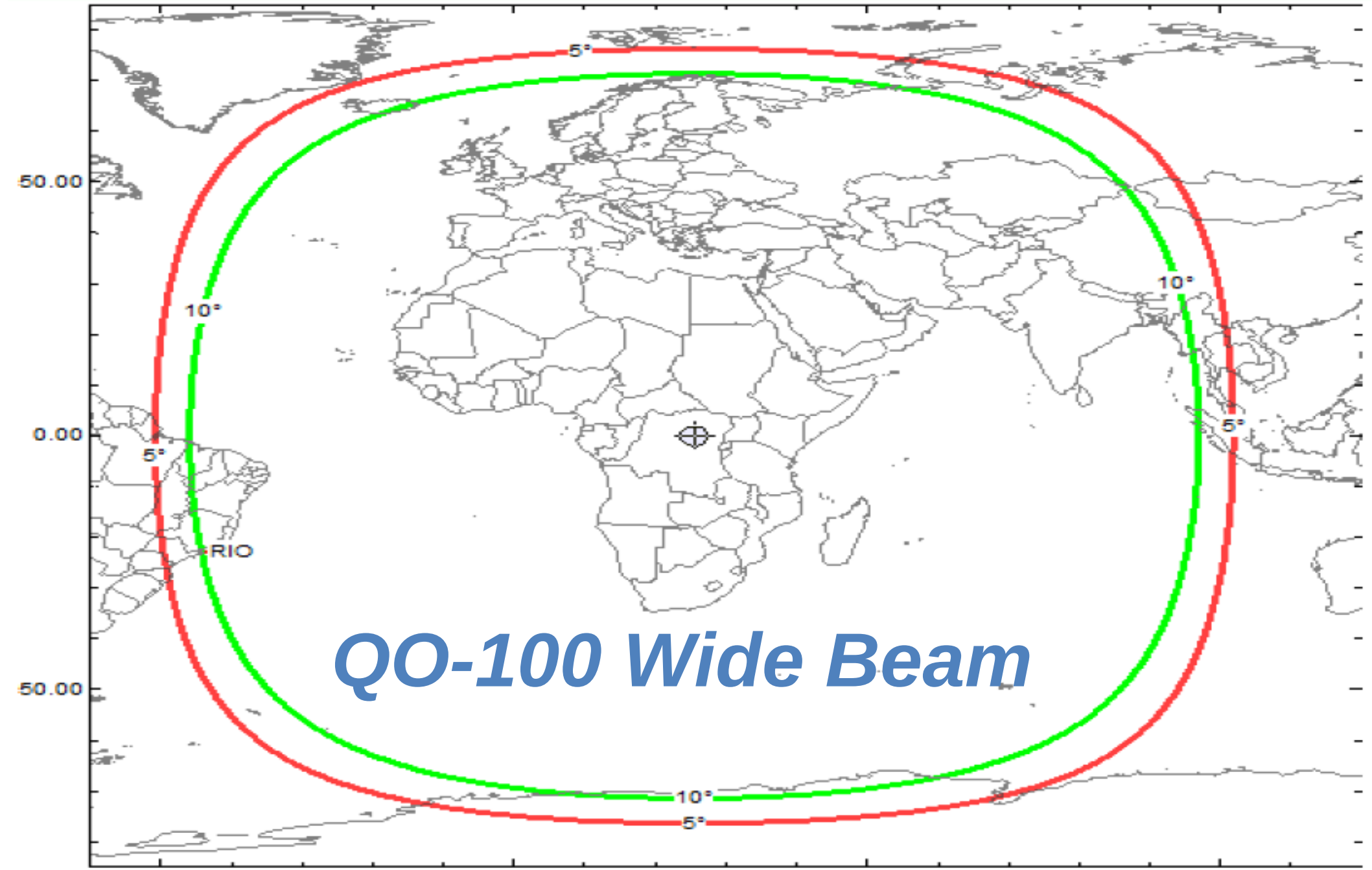
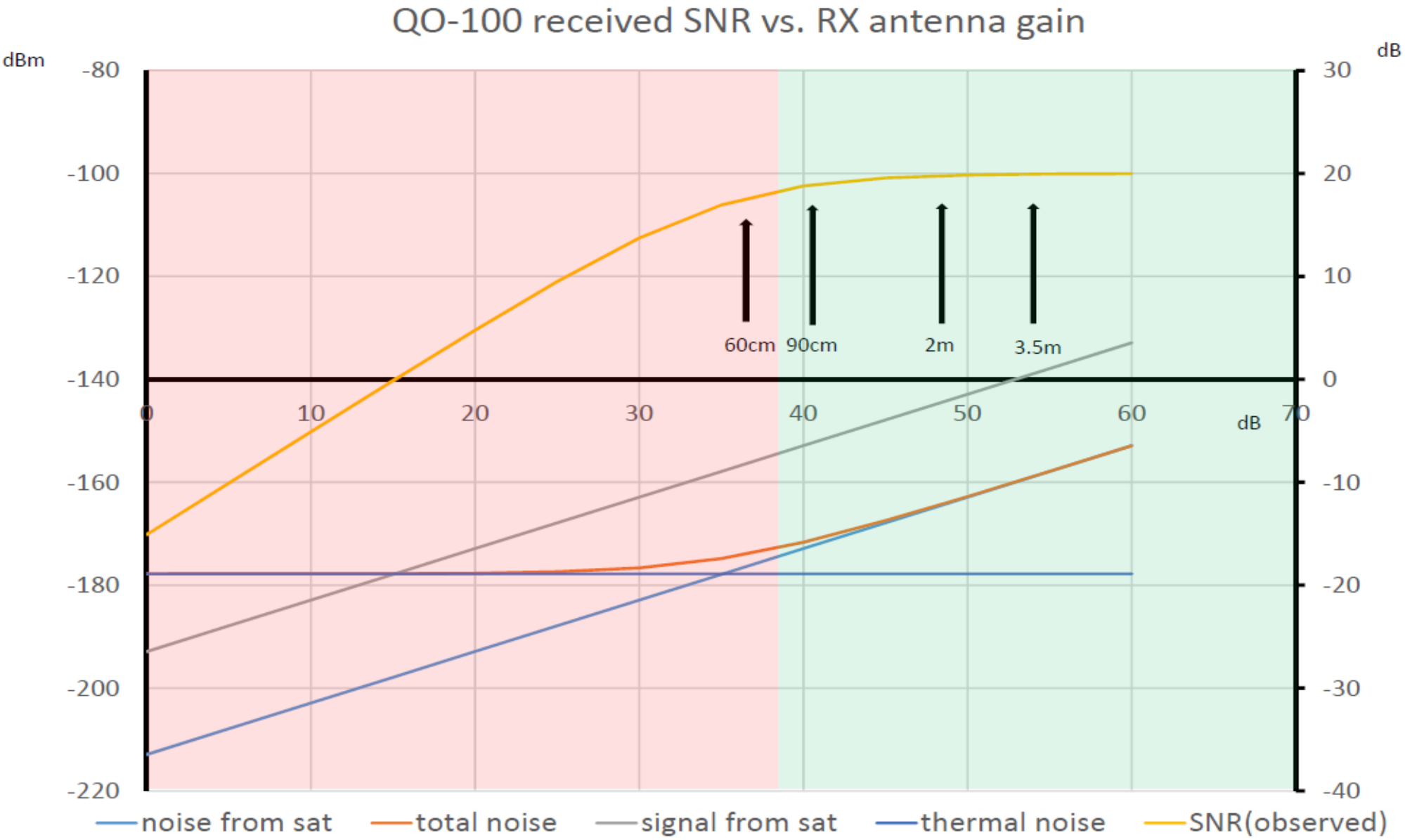
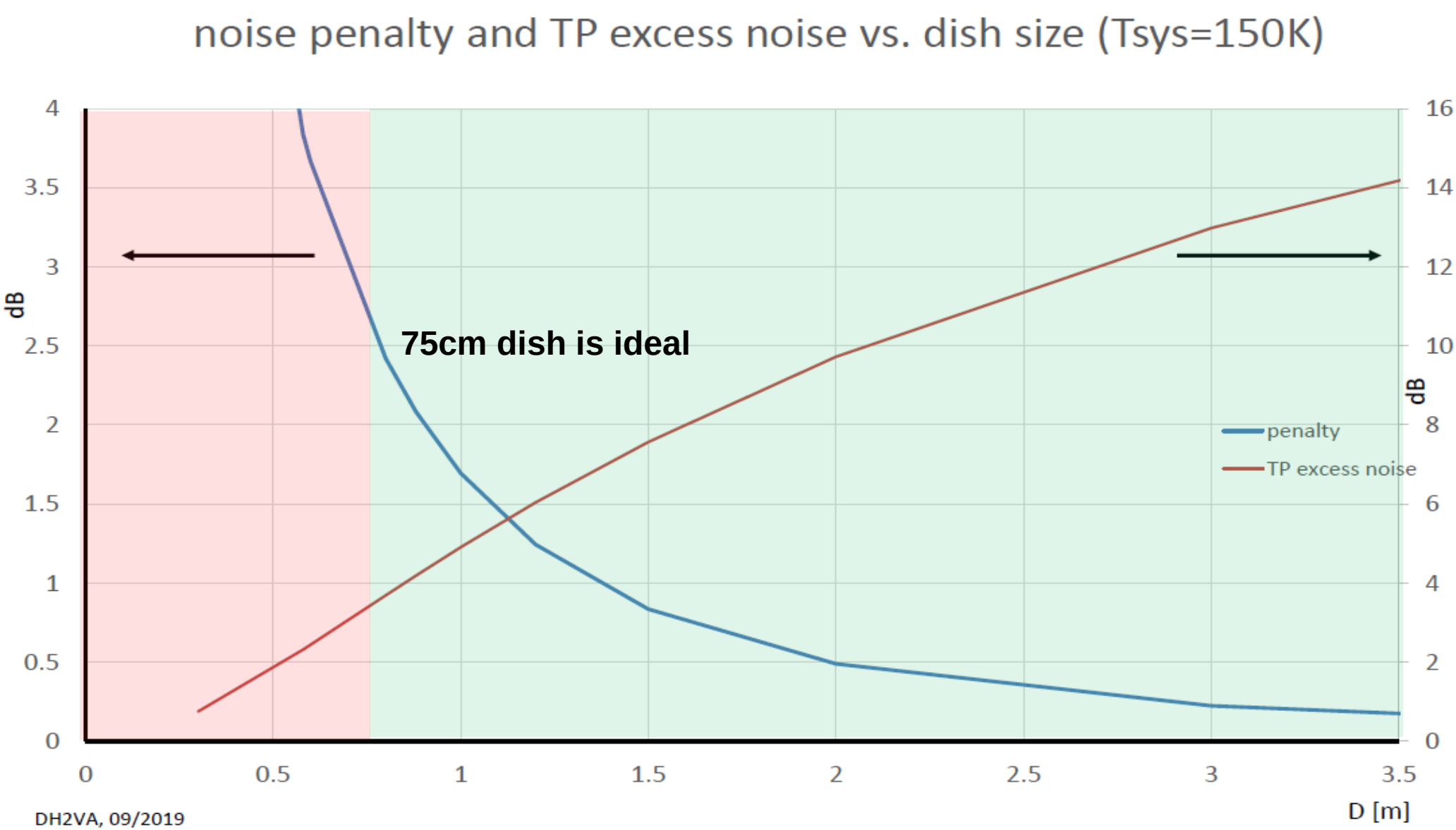


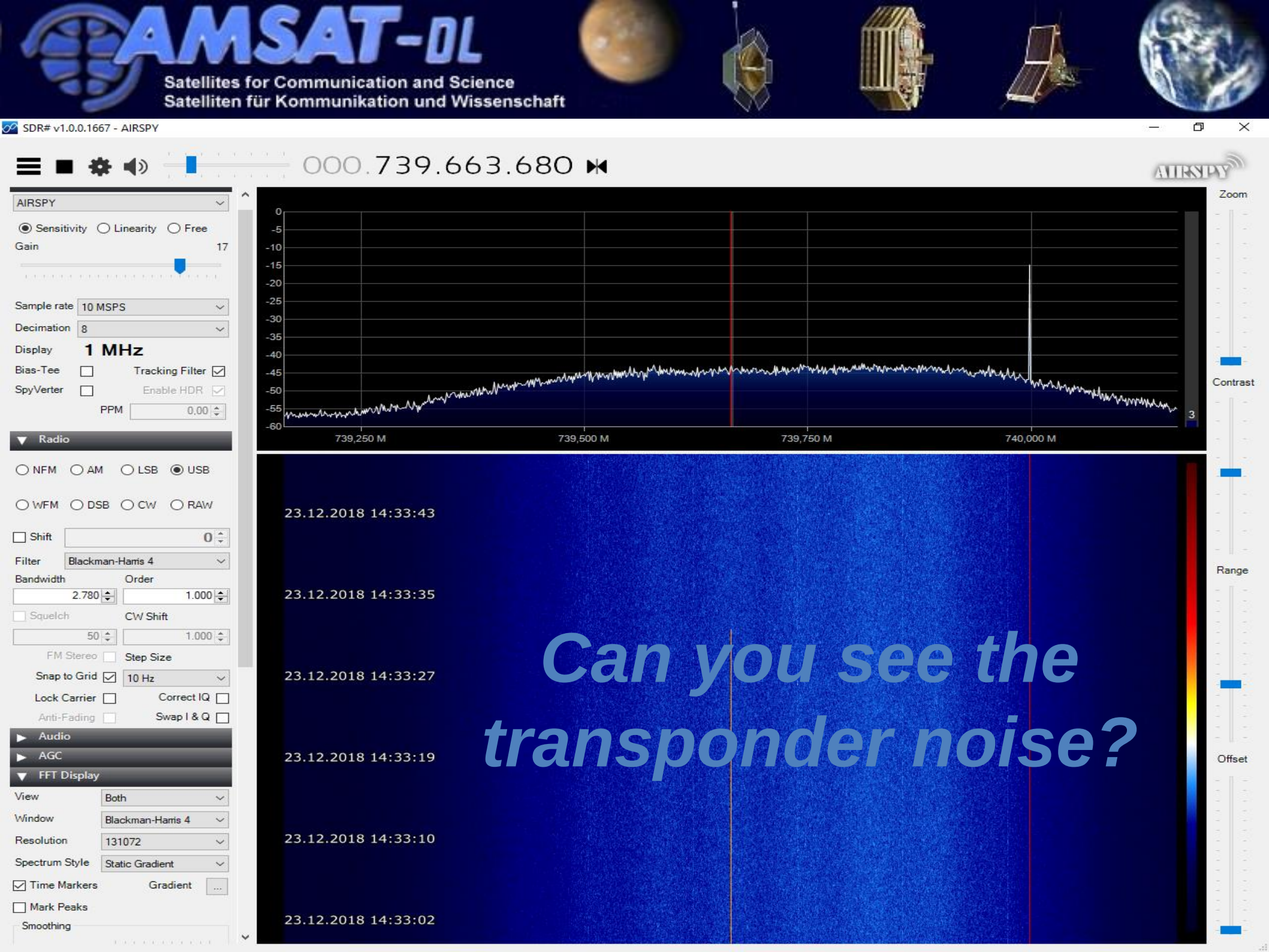
QO-100 Wide Beam

Is your dish big enough?



As good as necessary?

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Satelliten für Kommunikation und Wissenschaft
SDR# v1.0.0.1667 - AIRSPY
000.739.663.680
AIRSPY
Sensitivity
Linearity
Free
Gain
17
Sample rate
10 MSPS
Decimation
8
Display
1 MHz
Bias-Tee
Tracking Filter
SpyVerter
Enable HDR
PPM
0,00
Radio
NFM
AM
LSB
USB
WFM
DSB
CW
RAW
Shift
0
Filter
Blackman-Harris 4
Bandwidth
2.780
Order
1.000
Squelch
50
CW Shift
1.000
FM Stereo
Step Size
Snap to Grid
10 Hz
Lock Carrier
Correct IQ
Anti-Fading
Swap I & Q
Audio
AGC
FFT Display
View
Both
Window
Blackman-Harris 4
Resolution
131072
Spectrum Style
Static Gradient
Time Markers
Gradient
Mark Peaks
Smoothing
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
739,250 M
739,500 M
739,750 M
740,000 M
Zoom
Contrast
Range
Offset
23.12.2018 14:33:43
23.12.2018 14:33:35
23.12.2018 14:33:27
23.12.2018 14:33:19
23.12.2018 14:33:10
23.12.2018 14:33:02
Can you see the transponder noise?

Bochum

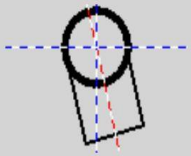
Your location:

Latitude:
51.48° N (51° 28' 47")

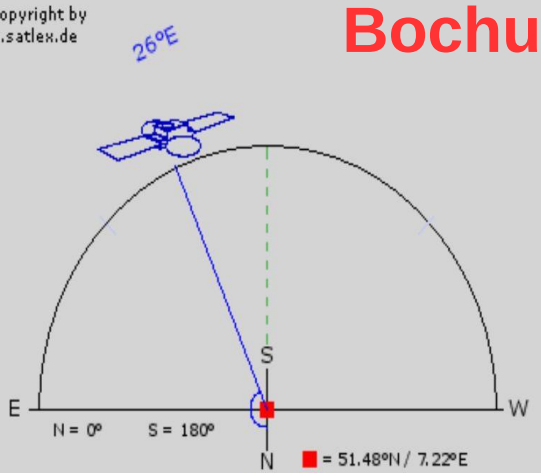
Longitude:
7.22° E (7° 13' 11")

City:
Bochum

Country:
Germany



LNB tilt (Skew)



Azimuth angle

Following values have been calculated for your location:

Azimuth angle:
156.51° *(True North)*

Elevation angle:
28.55°

LNB tilt (Skew):
-14.37°

Offset angle:
20.36°

Distance to satellite:
38747.37 Km

Signal delay:
258.32 ms *(Uplink + Downlink)*

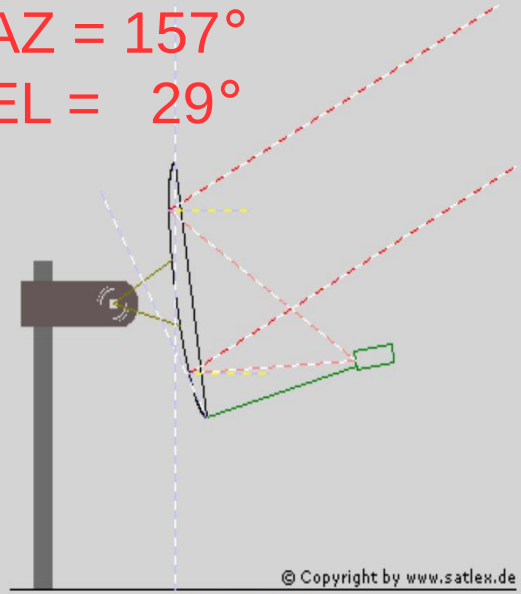
Declination angle:
-7.34°

Polarmount hour angle:
159.33°

Angle setting on motor:
20.67° East

Satellite:
Badr 4/5/6 (26° E = 334° W)

AZ = 157°
EL = 29°



Elevation angle

Doha

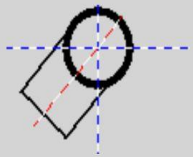
Your location:

Latitude:
25.25° N (25° 15' 0")

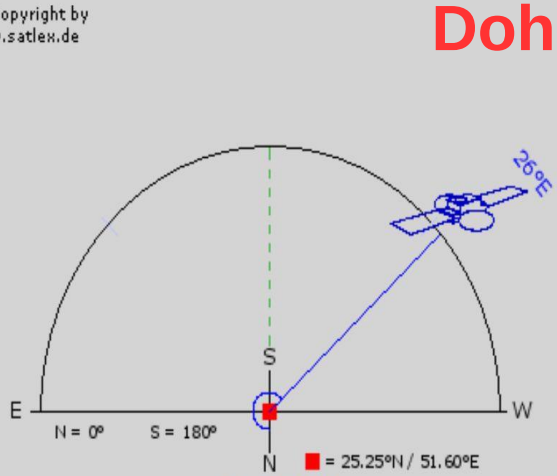
Longitude:
51.60° E (51° 36' 0")

City:
Doha

Country:
Qatar



LNB tilt (Skew)



Azimuth angle

Following values have been calculated for your location:

Azimuth angle:
228.32° *(True North)*

Elevation angle:
48.98°

LNB tilt (Skew):
42.49°

Offset angle:
20.36°

Distance to satellite:
37145.43 Km

Signal delay:
247.64 ms *(Uplink + Downlink)*

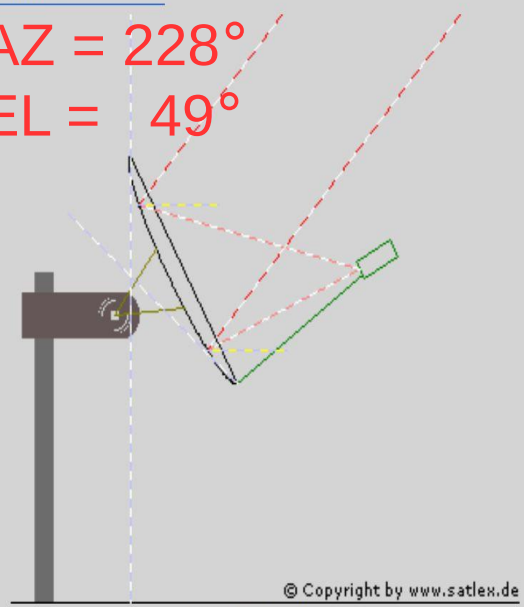
Declination angle:
-4.18°

Polarmount hour angle:
209.44°

Angle setting on motor:
29.44° West

Satellite:
Badr 4/5/6 (26° E = 334° W)

AZ = 228°
EL = 49°



Elevation angle

Rio de Janeiro

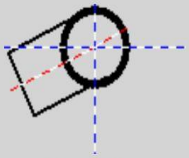
Your location:

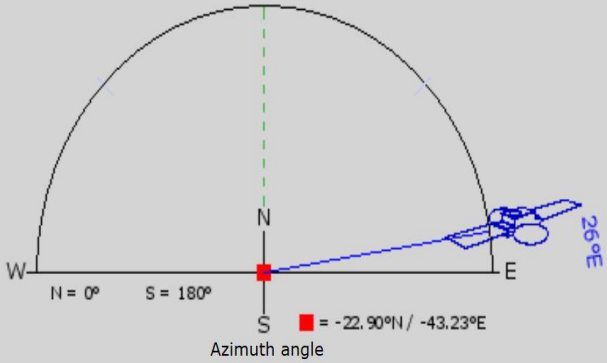
Latitude:
-22.90° N (22° 53' 59")

Longitude:
-43.23° E (43° 13' 47")

City:
Rio De Janeiro

Country:
Brazil





Following values have been calculated for your location:

Azimuth angle:
81.60° *(True North)*

Elevation angle:
10.61°

LNB tilt (Skew):
65.69°

Offset angle:
20.36°

Distance to satellite:
40531.41 Km

Signal delay:
270.21 ms *(Uplink + Downlink)*

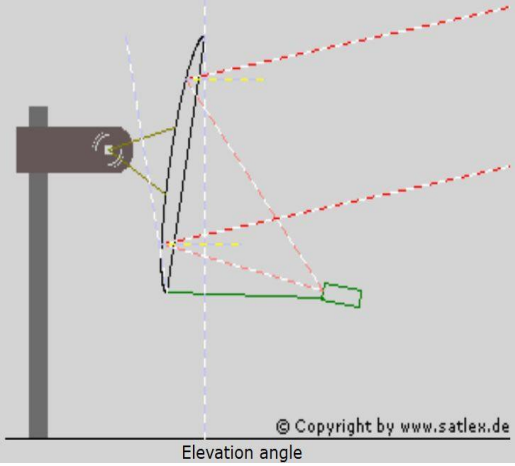
Declination angle:
3.48°

Polarmount hour angle:
76.94°

Angle setting on motor:
103.06° East

Satellite:
Badr 4/5/6 (26° E = 334° W)

AZ = 82°
EL = 11°



Penang

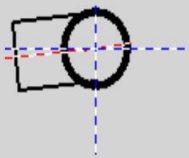
Your location:

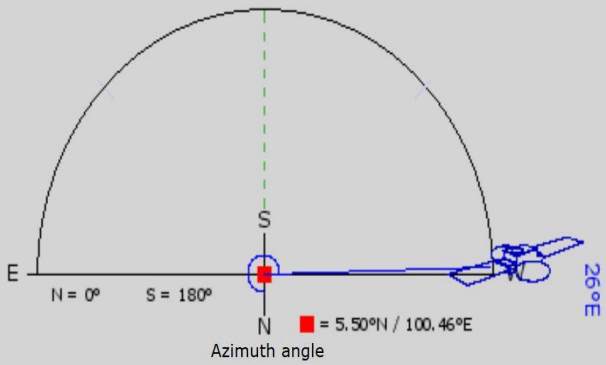
Latitude:
5.50° N (5° 30' 0")

Longitude:
100.46° E (100° 27' 35")

City:
Pinang

Country:
Malaysia





Following values have been calculated for your location:

Azimuth angle:
268.47° *(True North)*

Elevation angle:
6.95°

LNB tilt (Skew):
84.29°

Offset angle:
20.36°

Distance to satellite:
40927.52 Km

Signal delay:
272.85 ms *(Uplink + Downlink)*

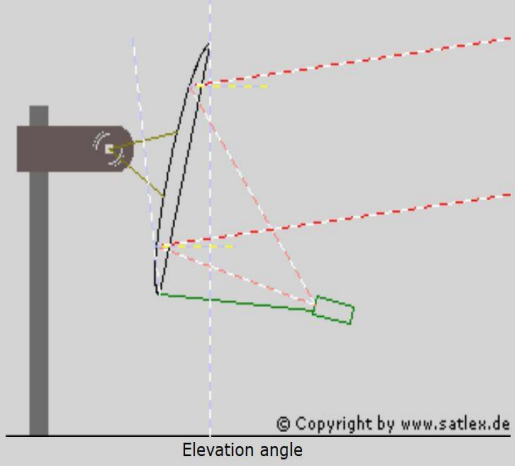
Declination angle:
-0.85°

Polarmount hour angle:
262.93°

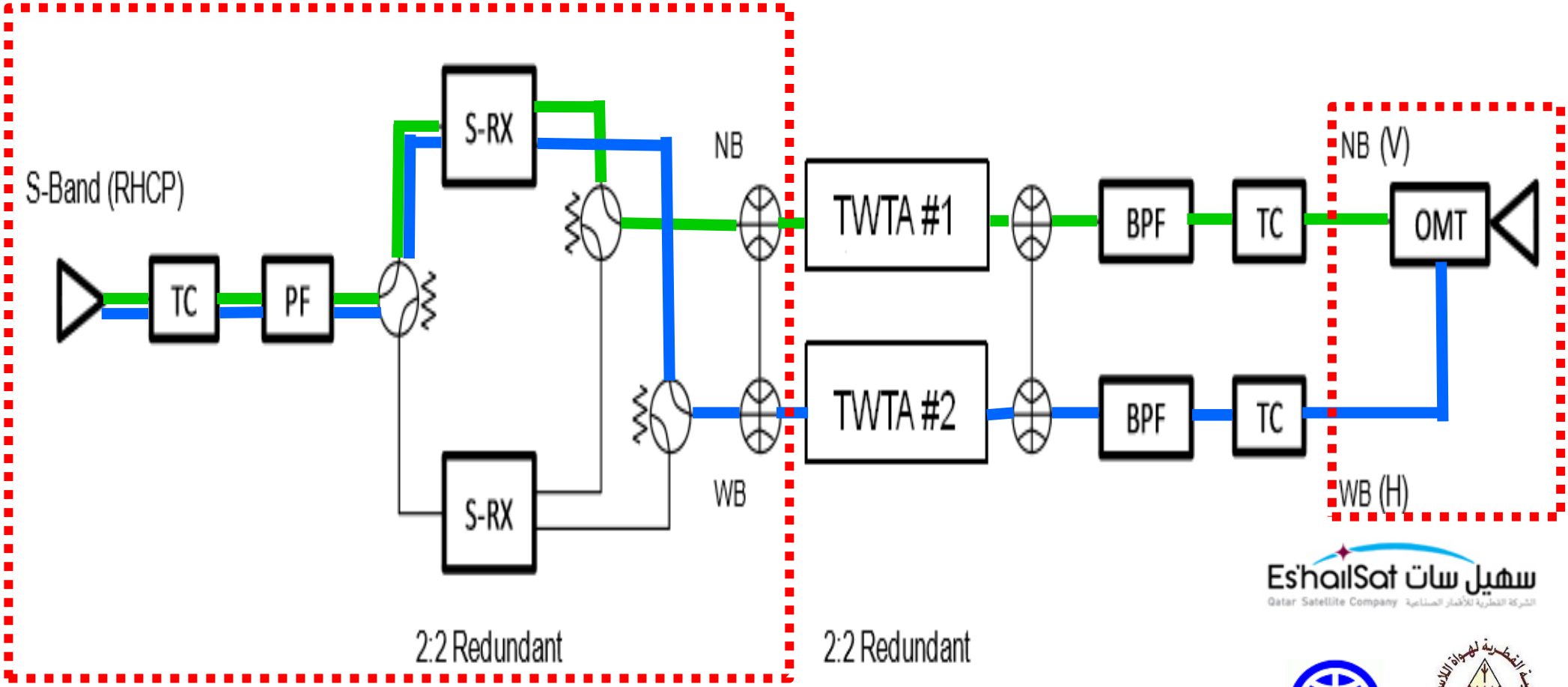
Angle setting on motor:
82.93° West

Satellite:
Badr 4/5/6 (26° E = 334° W)

AZ = 268°
EL = 7°



AMSAT Payload Block Diagram

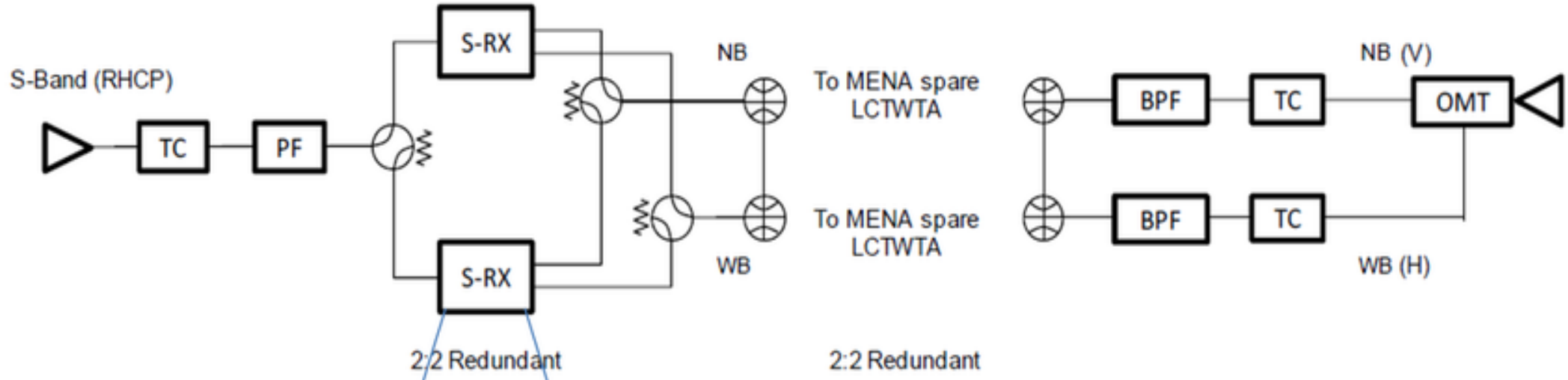


Custom design for AMSAT

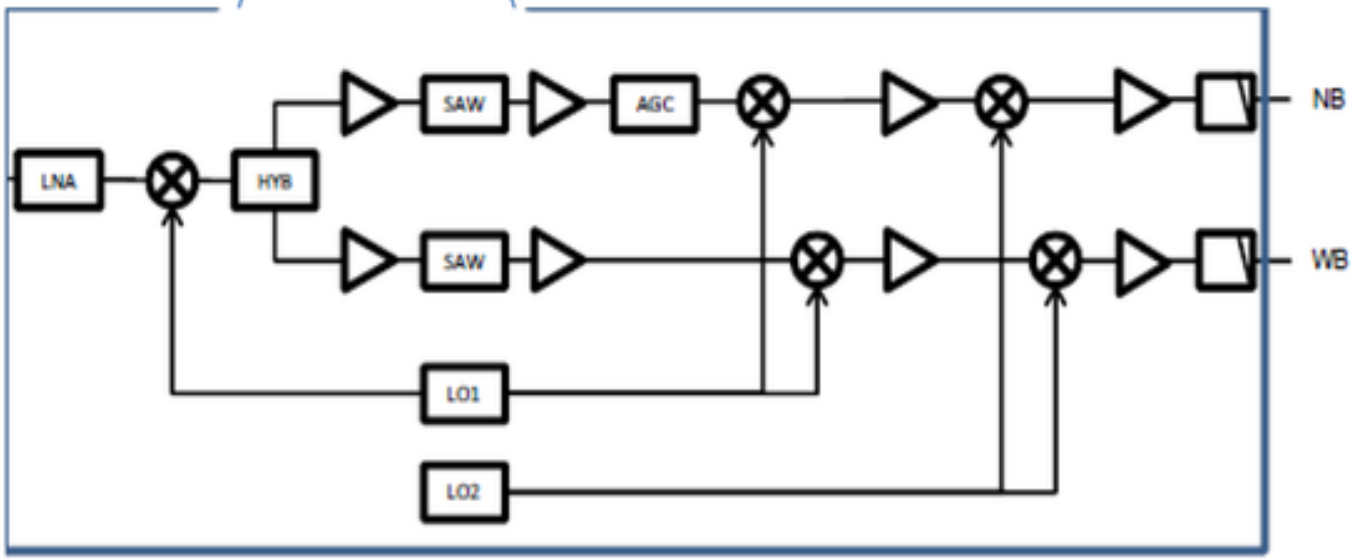
EshailSat سهيل سات
Qatar Satellite Company الشركة القطرية للأقمار الصناعية

AMSAT-DL

Q.A.R.S. QATAR AMATEUR RADIO SOCIETY



AMSAT Payload Block Diagram

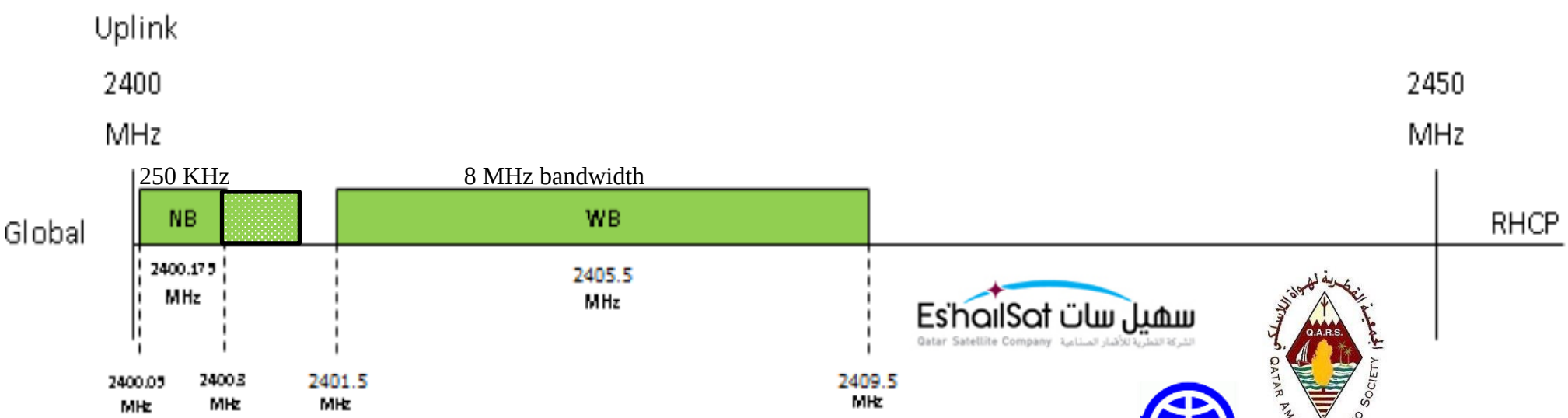


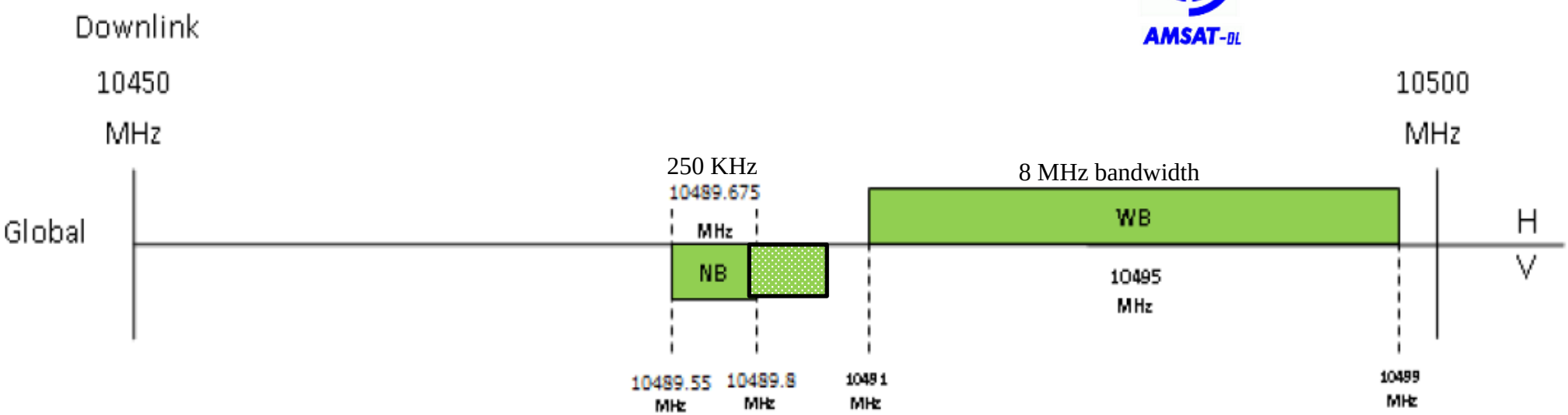
S-band Receiver/X-band Upconverter Assembly

EshailSat سهيل سات
Qatar Satellite Company الشركة القطرية للأقمار الصناعية

AMSAT-DL

QATAR AMATEUR RADIO SOCIETY
Q.A.R.S.





Xpdr	U/L FREQUENCY (MHz)				D/L FREQUENCY (MHz)				LO	BW
No	Pol	Begin	Center	End	Pol	Begin	Center	End	(MHz)	(MHz)
NB	RHCP	2400.05	2400.175	2400.3	V	10489.55	10489.675	10489.8	8089.5	0.25
WB	RHCP	2401.5	2405.5	2409.5	H	10491	10495	10499	8089.5	8

“NB” Transponder (narrow band)

Linear Transponder for low power narrow bandwidth voice, morse and digital communication

- preferred modes: narrow band modes like SSB and CW, PSK
  - → everything with less than 2.7 kHz Bandwidth!
  - → no FM (DSTAR, etc.)

- 250 kHz allocated bandwidth + a “little” reserve
- non-inverting bent-pipe transponder
- Assumes 50 simultaneous 2-way carriers to serve 100 Users

- X-Band Downlink (SAT-TV dish)

90 cm dishes in rainy areas at EOC like Brazil or Thailand
60 cm around around coverage peak
75 cm dishes at peak -2dB

- Downlink Polarisation on X-Band is Vertical !

- Uplink Polarisation on S-Band is RHCP
- Uplink transmitter ~~5-10W~~ PEP (22.5 dBi antenna gain, 75cm dish)

2-5W

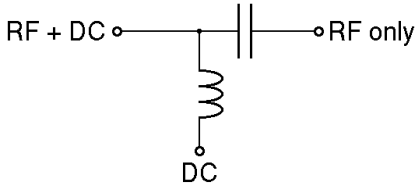
Easy Sat !
Ultra Cheap

20€

12€

There are two different kinds of LNB's:

- with DRO → bad
- with PLL → good



Bias-T (DC Power combiner)
NB → (V)ertical: 11…14 V
WB → (H)orizontal: 16…20 V

35€

Display Spectrum and listen with SDR# or similiar…

Dongles for NB Downlink:

- RTL-SDR or Funcube dongle
- free SDR software available

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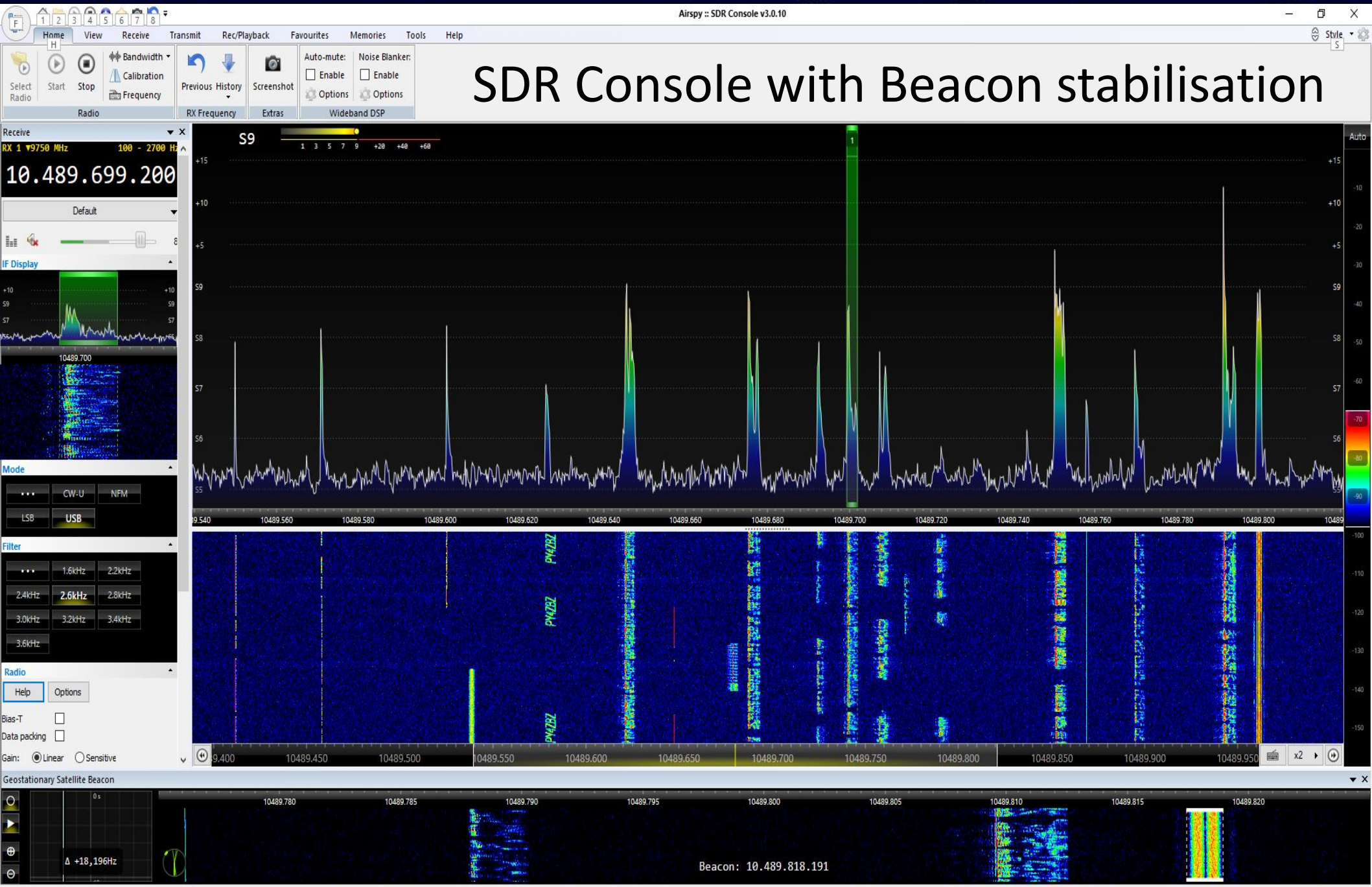
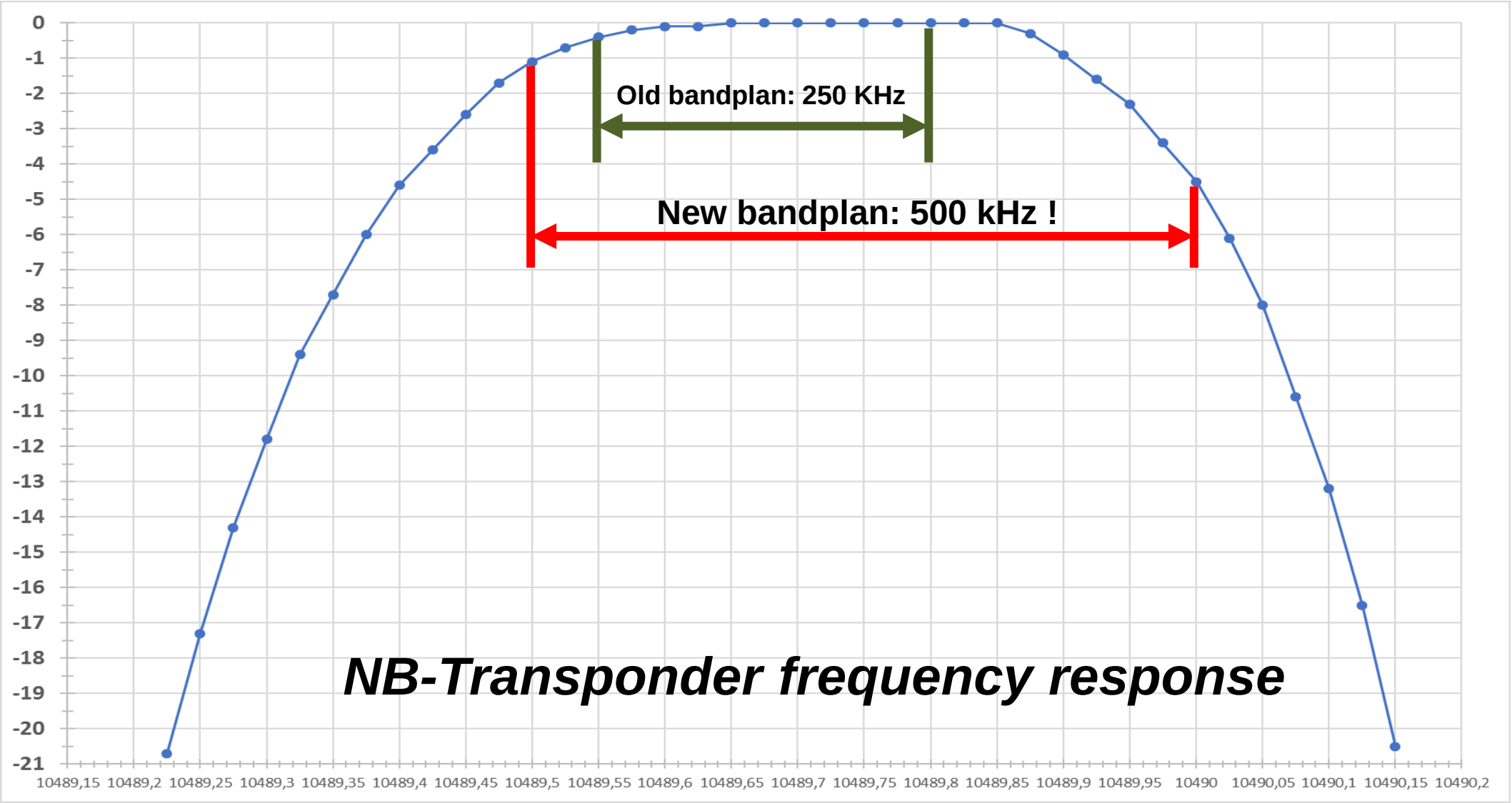
Satelliten für Kommunikation und Wissenschaft

SDR Console with Beacon stabilisation



Going to the "Edge



AMSAT QO-100 / P4A
NB Transponder Bandplan

AMSAT QO-100 / P4A
NB Transponder Bandplan

Uplink		Downlink			
Start [MHz]	End [MHz]	Start [MHz]	End [MHz]	Available [MHz]	Comment
		10489,500	10489,505	0,005	Lower Beacon 10489,500 MHz, CW F1A, + guard band
2400,005	2400,040	10489,505	10489,540	0,035	CW only
2400,040	2400,080	10489,540	10489,580	0,040	digimodes (500 Hz max. BW)
2400,080	2400,150	10489,580	10489,650	0,070	digimodes (2700 Hz max. BW)
2400,150	2400,245	10489,650	10489,745	0,095	SSB only (2700 Hz max. BW)
		10489,745	10489,755	0,010	Middle Beacon 10489,750 MHz, 400 Bit/s BPSK + guard band
2400,255	2400,350	10489,755	10489,850	0,095	SSB only (2700 Hz max. BW)
2400,350	2400,495	10489,850	10489,995	0,145	mixed modes (2700 Hz max. BW) & special purpose
		10489,995	10490,000	0,005	Experimental Beacon 10490,000 MHz, CW and other modulations + guard Band

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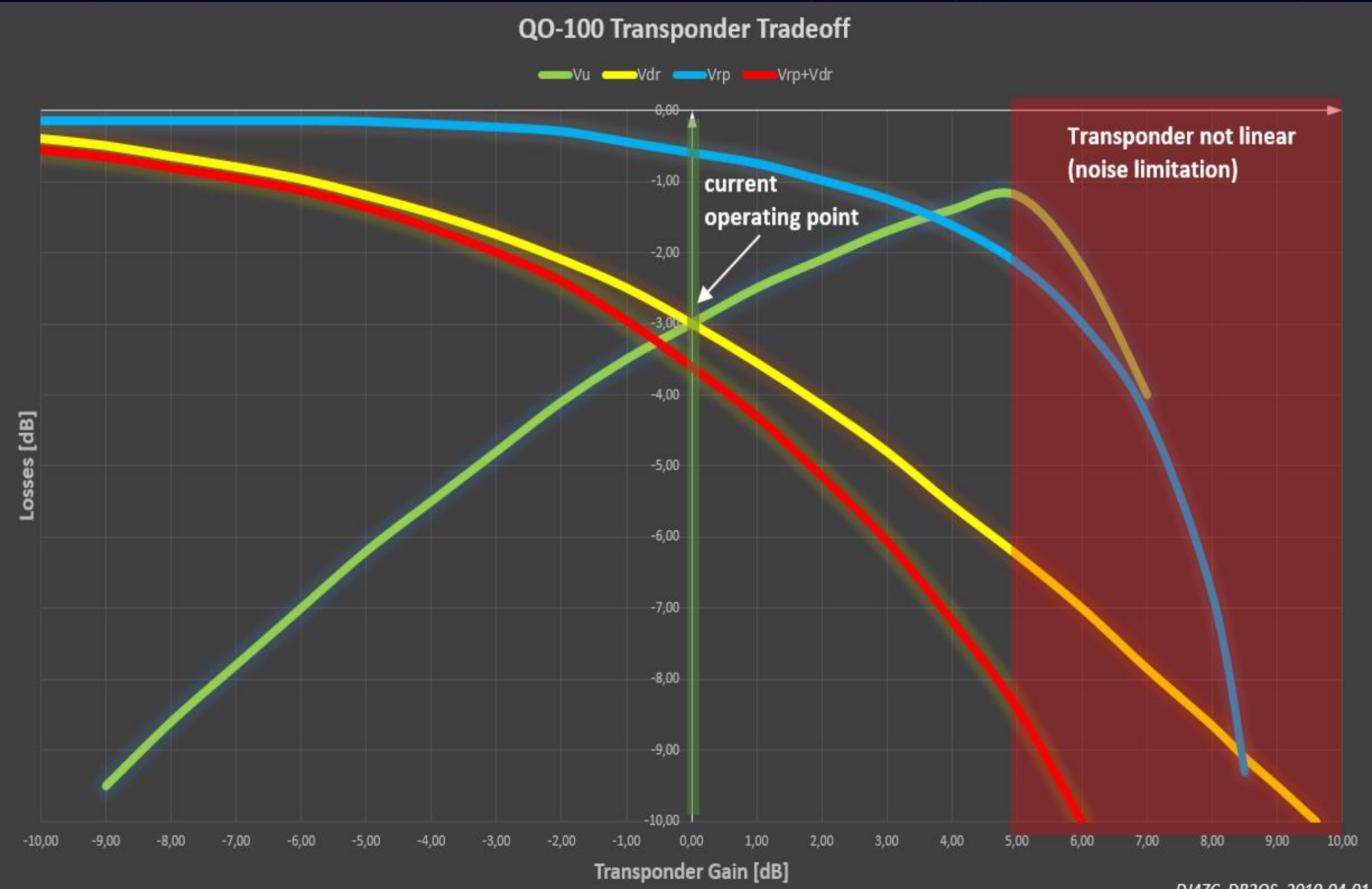


DJ4ZC, DB2OS, 2019-04-01

Es gibt im drei unvermeidliche Verlustquellen:

1.) Da die PEP-Leistung des Transponders fest gegeben ist, ist damit auch der höchstmögliche Pegel im Empfang gegeben. Die verfügbare Dynamik ergibt sich daraus, wie hoch der Rauschpegel ist. Wenn nur Bodenrauschen vorhanden ist, ist sie am höchsten; durch das Uplink-Rauschen wird der Rauschpegel im Rx am Boden erhöht und damit die Dynamik reduziert. Das ist die **Kurve Vdr**.

2.) Bei genügend großer Verstärkung im Transponder wird immer mehr Leistung als Rauschen abgestrahlt. Diese Leistung steht den Benutzern nicht mehr zur Verfügung. Dieser Verlust ist mit **Vrp** bezeichnet.

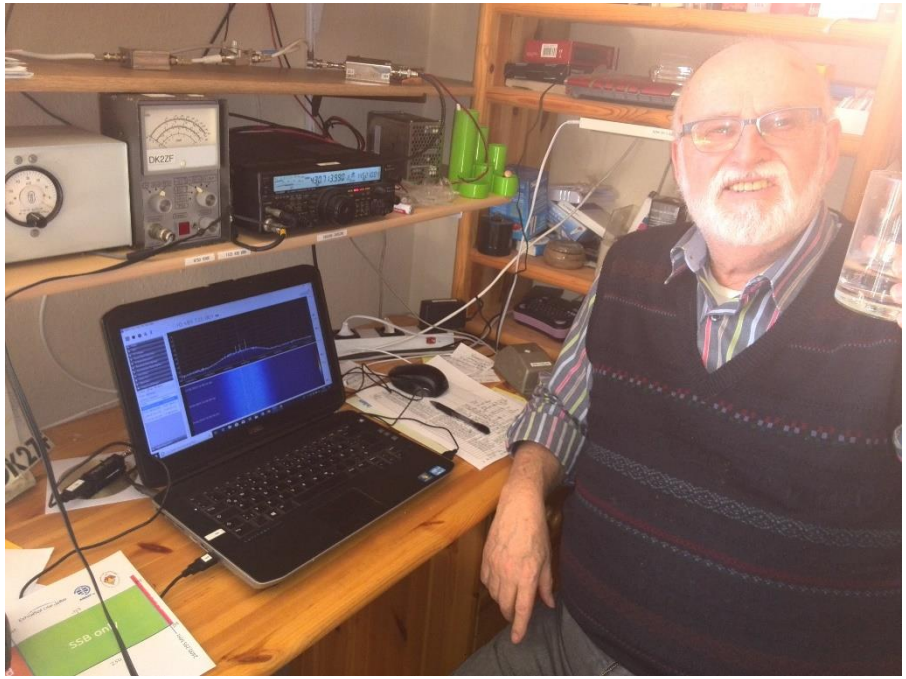
Die Downlinkverluste 1.) und 2.) zusammen ergeben die rote **Kurve Vdr+Vrp**.

3.) Die geringste Uplink-Leistung für einen gegebenen Rauschabstand wird benötigt, wenn nur das Uplink-Rauschen am Boden hörbar ist. Durch das hinzukommende Downlink-Rauschen erhöht sich die erforderliche Uplink-Leistung. Das ist in der grünen **Kurve Vu** dargestellt. Rechts der gestrichelten roten vertikalen Linie wird das Rauschen im Transponder begrenzt. Dadurch werden schwache Signale gegenüber dem Rauschen unterdrückt und daher kommt das scharfe Abknicken der grünen Linie im nichtlinearen Bereich.

Im Prinzip sind Fehler in der Verstärkung des Transponders zu kleineren Verstärkungen hin weniger schädlich, weil sie durch etwas mehr Uplink-Leistung ausgeglichen werden können. Für die Downlink-Verluste ist das nicht oder nur teilweise möglich (wenn man außerhalb des offiziellen Passbands arbeitet).

Wie man der Abbildung entnehmen kann, dürften wir sehr nahe am Optimum sein. Wenn man davon ausgeht, dass QRP-Stationen gleichzeitig eine kleinere Sende- und Empfangsantenne haben, verschieben sich die rote und die grüne Line entgegengesetzt auf der Abszisse. D.h. die Lage des Optimums für die Verstärkung des Transponders ändert sich dadurch nicht.

73s Karl, DJ4ZC



<u>Rolf, DK2ZF</u>: First QSO with A71A via QO-100 (OP: Sabaan A71BP and Peter DB2OS)

„Nachdem wir gleich zu Beginn feststellen mussten: ***5W HF am Spiegel sind schon zu viel****. So wurde in den ersten Tagen viel darüber gesprochen wie man die überschüssige HF wegbekommt...“*

„Meine Erfahrung ***2W HF an einem 60er Spiegel für SSB voll ausreichend****. Für CW reichen 1W HF für ein 579 Signal.“*

"NB" Operating Guidelines

- **No FM mode** or any other modulation exceeding 2700 Hz bandwidth.
- **No transmission below the lower CW beacon**:
  - the Amateur Satellites Service operate exclusively on a secondary basis in the band 2400-2450 MHz. **You are responsibly for you own transmissions!**
- **Respect the Guard-band around the CW/PSK beacons**

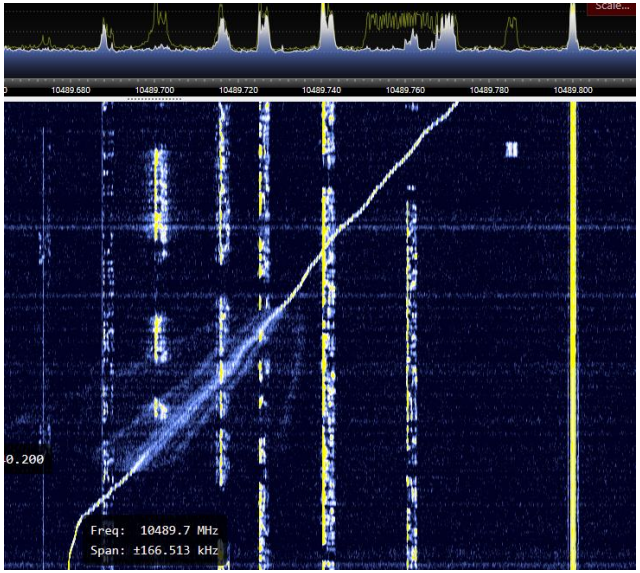
- Uplink polarisation is RHCP (right-hand circular polarization, the Feed must be LHCP!)
- Downlink polarisation for the **NB transponder is V** (vertical linear polarisation).
- You loose 3dB (half of your uplink power) with cheap WiFi-Antennas.

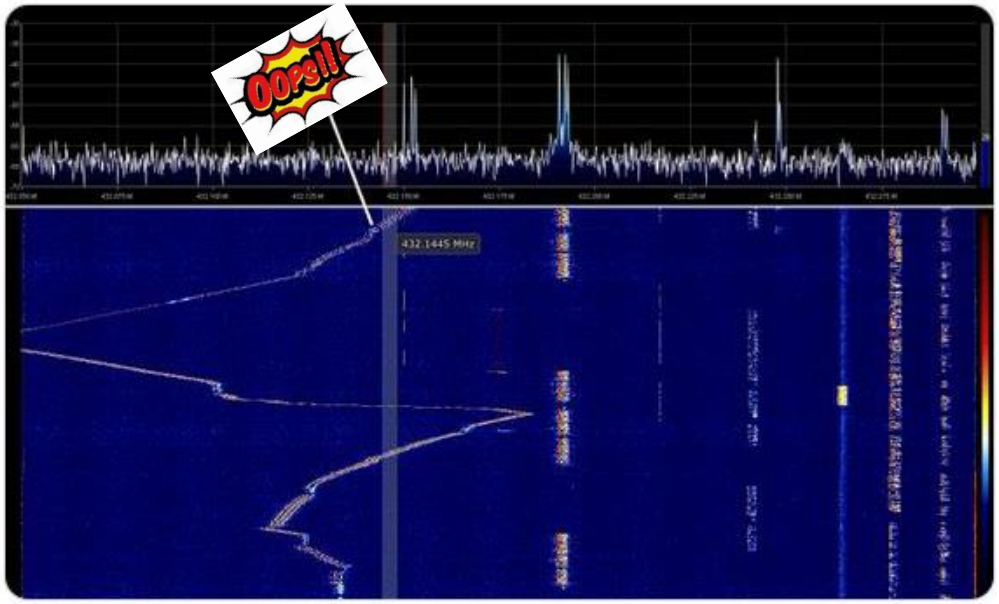
- AMSAT recommends to keep your own signal **in the same range as the CW beacon**
- Excessive signals might trigger LEILA warnings to remind you to reduce uplink power.

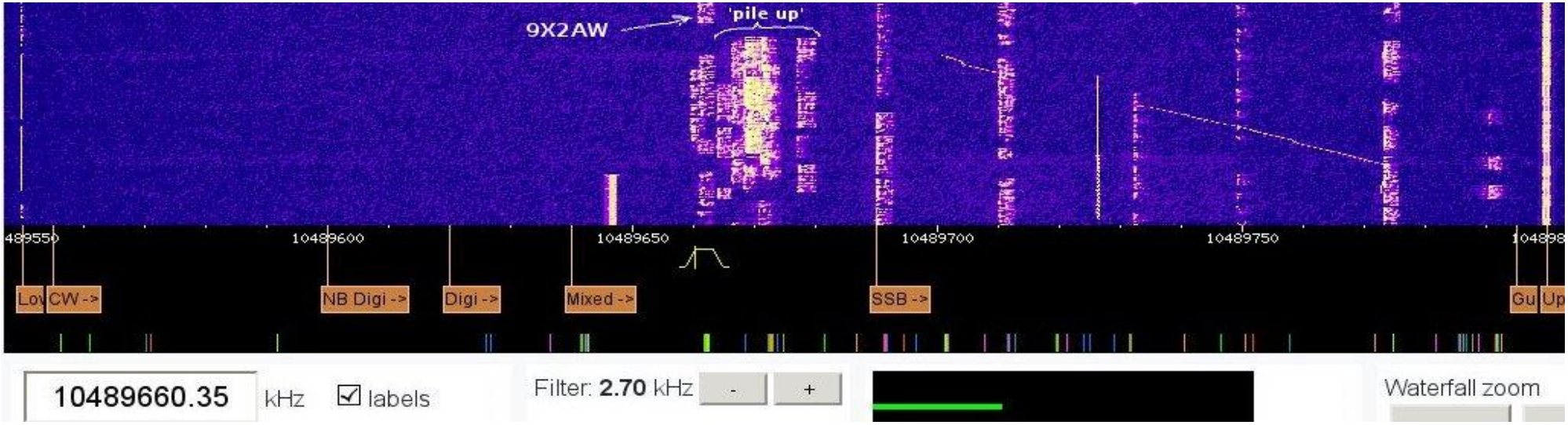
- **Full-Duplex operation is mandatory (you must be able to monitor your own downlink while transmitting!)**

- If you hear the transponder noise more than ~5dB above the LNB noise, everything is fine and a larger antenna will not subjectively increase the S/N.. Theoretical 3dB (S/N+N) improvement possible, but you need an EME style antenna to notice the difference..

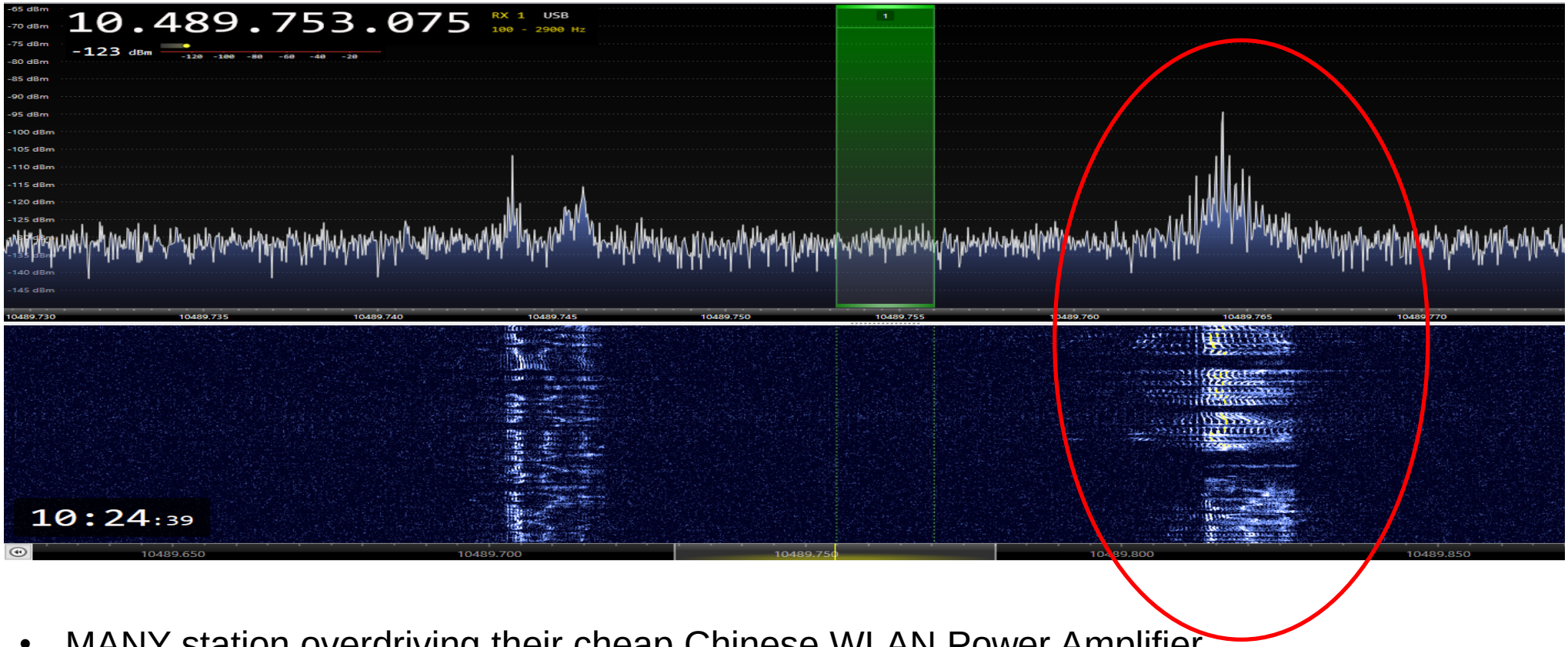
How to get “wet” in the waterfall display!







Huge signal ≠ good signal !



- MANY station overdriving their cheap Chinese WLAN Power Amplifier.
- Intermodulation widening SSB signal, but also distorting modulation leading to bad readability
- Sometimes less is more!

“WB” Transponder (wide band)

Linear Transponder for Digital Amateur Television (DATV) and other highspeed data transmissions.

First DATV transponder in space!!

- 8 MHz total bandwidth
- one or two DVB-S2 carrier in HD quality or more channels with SD or lower quality

- assumes S-Band Uplink peak EIRP of 53 dBW (100W PEP into 2.4m dish)

- **X-Band Downlink (SAT-TV dish):**
  - 90 cm dishes in rainy areas at EOC like Brazil or Thailand
  - 60 cm around around coverage peak
  - **75 cm dishes at peak -2dB**

- Uplink Polarisation on S-Band is RHCP

- Downlink Polarisation on X-Band is Horizontal !

- DVB-S2 “beacon” from Qatar with promotional video.

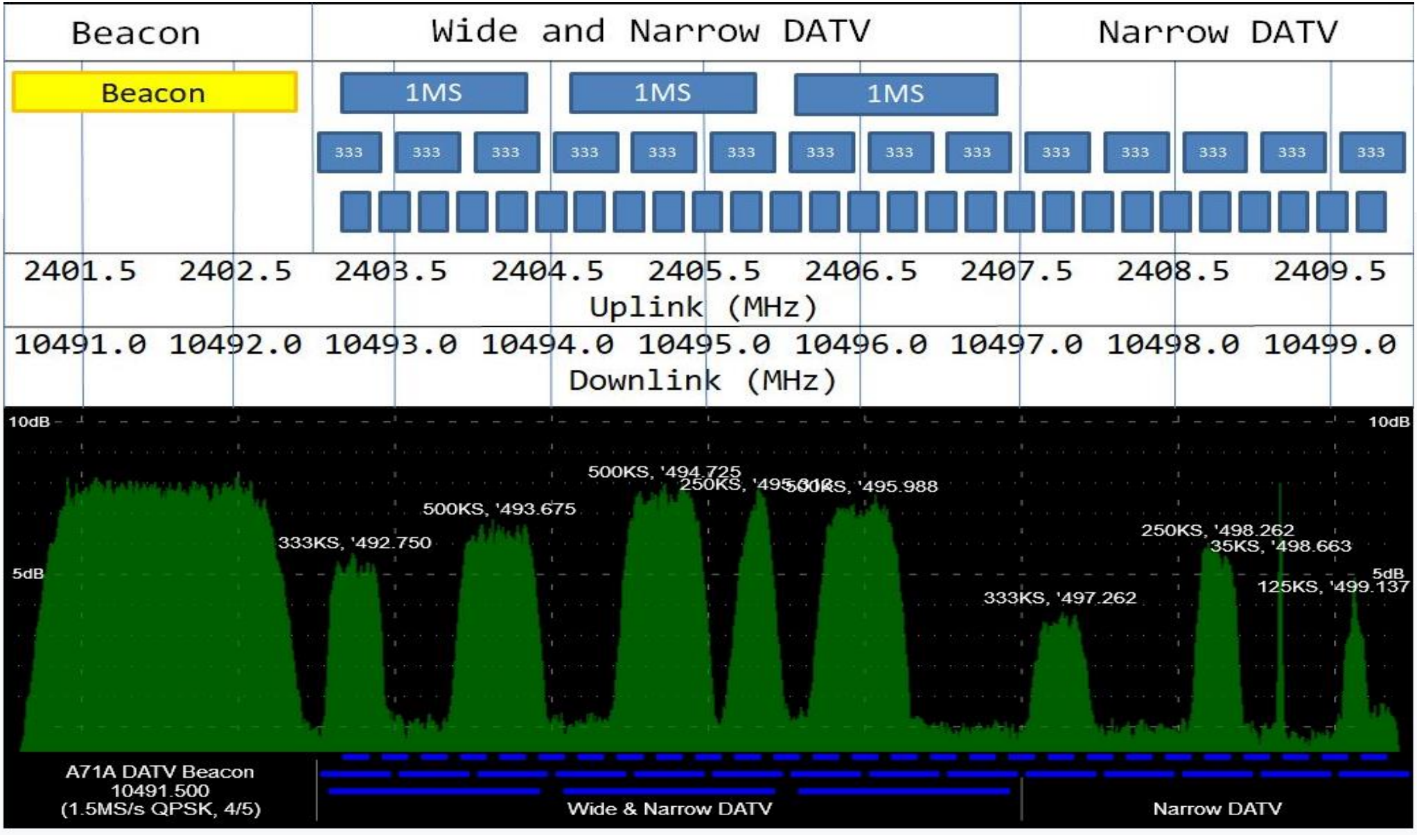
- RF Bandwidth = 1.33 x Symbol-Rate = 1.33 x 2.5 MSymbols/sec = 3.33 MHz signal

- ✓ **MiniTiouner or SW DVB-S2 decoder**
- ✓ **30W into 1.2m dish with RB-TV DVB-S2 modulator**

WB Bandplan (DATV)

Mode	Symbol Rate	Uplink Freq MHz	Downlink Freq MHz	Notes
Beacon	1500 kS	2402.0	10491.5	Beacon DVB-S2 FEC 4/5
Wide	1 MS	2403.75	10493.25	1.5 MS and 2 MS transmission should use this part of the band
Wide	1 MS	2405.25	10494.75	
Wide	1 MS	2406.75	10496.25	
Narrow	333 kS	2403.25	10492.75	Use these 14 frequencies for 500 kS, 333 kS and 250 kS Use frequencies above 10497.0 first
Then every 500 kHz until				
Narrow	333 kS	2409.75	10499.25	
Very Narrow	125 kS	2403.25	10492.75	Use these 27 frequencies for 125 kS, 66 kS and 33 kS Use frequencies above 10497.0 first
Then every 250 kHz until				
Very Narrow	125 kS	2409.75	10499.25	

WB Bandplan (DATV)



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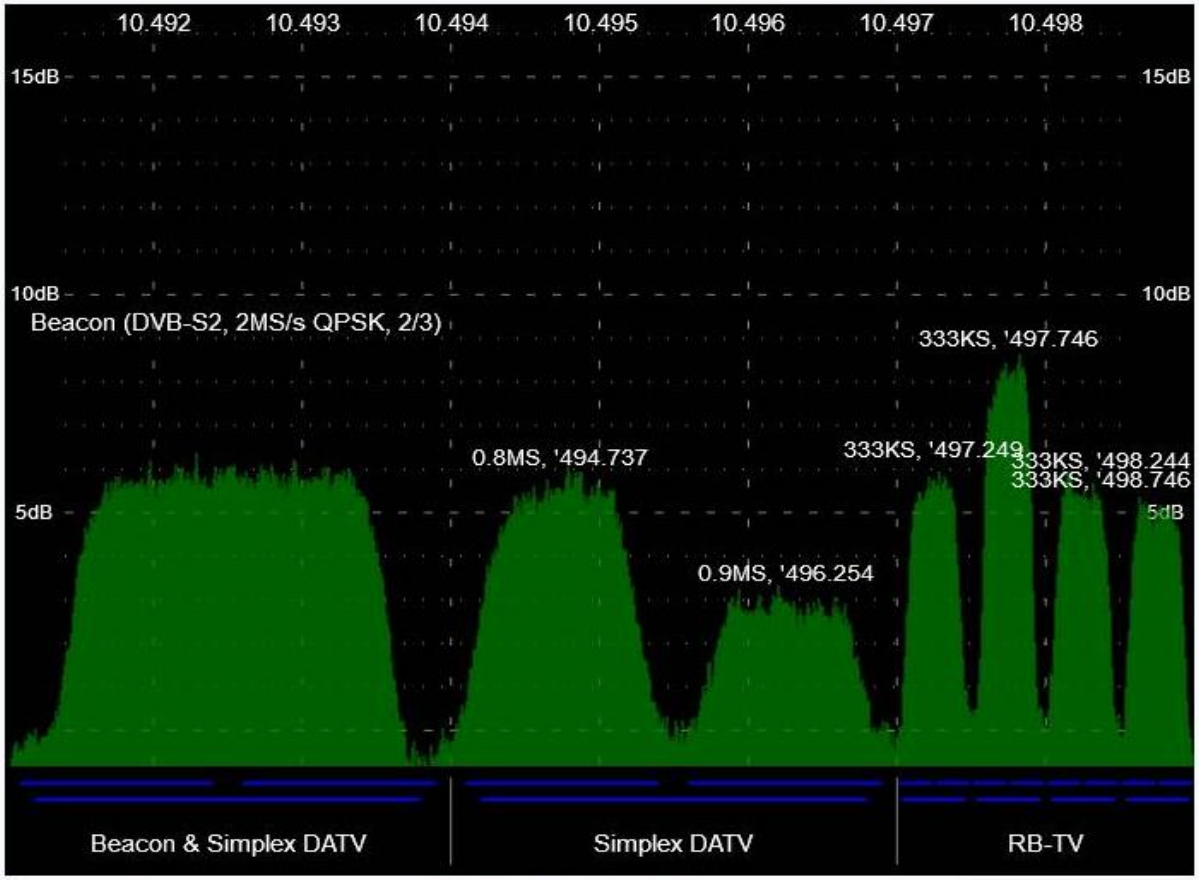
BATC | AMSAT-UK | AMSAT-DL Satelliten für Kommunikation, Wissenschaft und Bildung / Satellites for Communication, Science and Education | GOONHILLY EARTH STATION

Qatar OSCAR-100 Wideband Spectrum Monitor

This spectrum monitor, hosted at Goonhilly Earth Station in Cornwall, shows the Qatar OSCAR-100 wideband transponder onboard the Es'hail-2 satellite.

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 narrowband websdr can be found here eshail.batc.org.uk/nb/



Users: 165

DATV Bandplan Link

Open fullscreen

power at that symbol rate
22:00 G7NTG_JIM good pic though
22:00 G0MJW Me
22:00 f5oeo_evariste OK...too weak for lock at this FEC
22:00 G0MJW MER 6 here
22:01 G3NWR Txing 6.25 S2 1000 1/4
22:01 f5oeo_evariste MER 1.5 here..Mike
22:01 G3NWR Getting myself at 2dB.
22:01 G0MJW Fine Colin.
22:02 f5oeo_evariste MER 2.5, Mike now..locked, thx
22:02 G0MJW Added 2 on LIME power
22:03 G0MJW 2.5 V == 12 W
22:03 G0MJW I am on 82
22:03 G0MJW I was on 80
22:03 f5oeo_evariste Now unlocked as soon as 1Ms arrived, so was at limit
22:03 G7NTG_JIM g0mjw very good mer 5
22:04 G0MJW Get a bigger dish?
22:04 G0MJW Thanks Jim - Relaying Colin
22:04 f5oeo_evariste Think about Mike, sure !
22:04 G0MJW Colin is 3/4 rather than 2/3
22:04 f5oeo_evariste My dish maybe drift also

markro92
F4VSG Robert
g4bao
DH5DAX-Michael
OE3GBB
PE1BR-Marco
M1CDQ
G0MJW
G6OUA_Bob
F6GWE
PA0BOJ-Jack
G2DD_Lauren
dc6pd
Charles_G4GU
f6ciu
G7III
G8NOP-Pip
Keith G0KTD
Simon_G0FCU
F1FCO
Steve

Type '/nick your_name' and press enter to register.

Advantech Wireless

What is DVB-S2 ?

- **New DVB standard for digitial satellite communications**
- **Meant to replace DVB-S & DVB-DSNG**
- **Much better spectral efficiency**
  - –Up to 30% bandwidth saving
  - –Up to 2.5 dB margin gain
- New features such as
  - –Variable and Adaptive Coding and Modulation
  - –Generic Mode (no transport stream overhead)
  - –Support of multiple streams on a single carrier
- So close to the Shannon limit that it could be the last DVB-S standard!

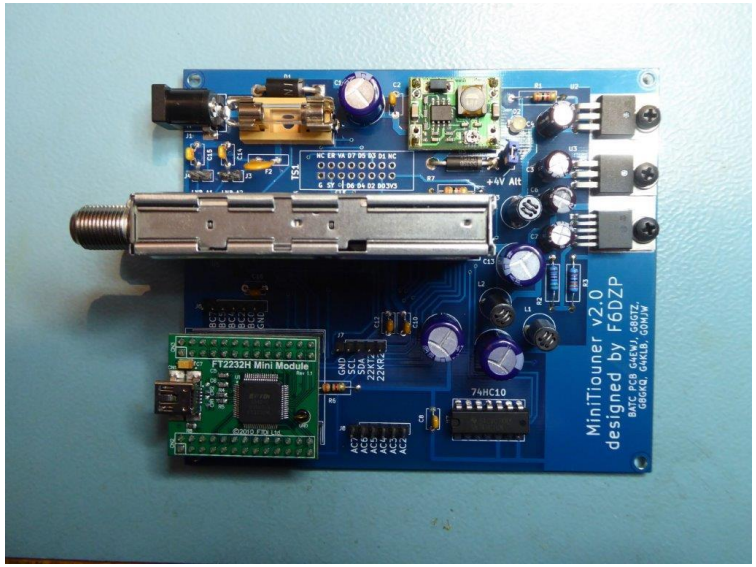
Uplink Power Budget

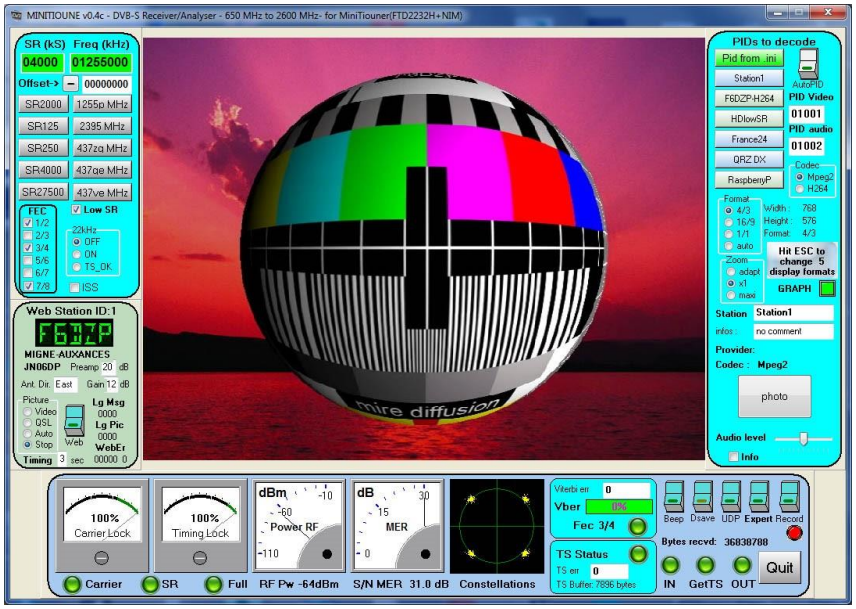
- Starting point is that an 8 MHz of DVB-S2 transmission will require 100W into a 2.4m dish

Power Budget (Watts)					
	8 MHz	4 MHz	2 MHz	1 MHz	0.5MHz
2.4m	100	50	25	12.5	6.25
1.7m	200	100	50	25	12.5
1.2m	400	200	100	50	25
0.85m	800	400	200	100	50

Credit M0DTS

MiniTioune



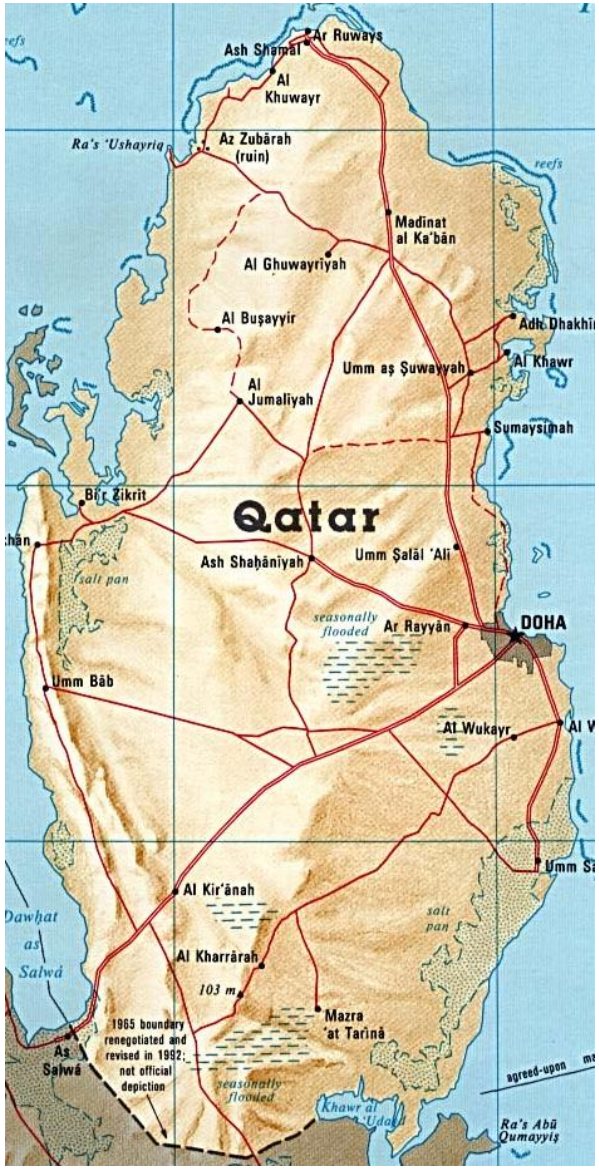


The MiniTioune receiver project, developed by Jean-Pierre F6DZP, interfaces via a standard USB 2.0 to a Windows PC running the MiniTioune software.

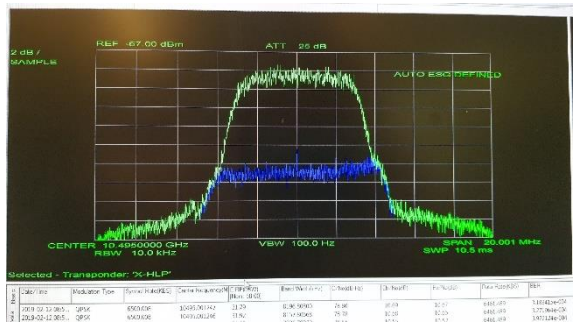
It will receive DVB-S QPSK and DVB-S2 QPSK, 8PSK, 16APSK, 32 APSK from broadcast and amateur TV transmissions with symbol rates (SR) from 30 Msymbols down to 120 Ksymbols per second. It is also capable of receiving Reduced Bandwidth (RB-TV) transmissions.

For more details: https://wiki.batc.org.uk/MiniTioune

Es'hailSat Satellite Control Center



Es'hailSat Satellite Control Center



Es'hailSat Groundstation in the Shelter

(developed and constructed by AMSAT-DL team)

QARS HQ, Doha


الجمعية القطرية لهواة اللاسلكي
QATAR AMATEUR RADIO SOCIETY
A 7 1 A


الجمعية القطرية لهواة اللاسلكي
Qatar Amateur Radio Society
A71A
www.qars.org.qa


www.qars.org.qa

AMSAT-DL HQ Bochum

- 3m antenna for 2.4 GHz Uplink with VE4MA septum feed
- 2.5m antenna for 10 GHz Downlink
- 20m dish available for emergency operations ☺

Inauguration Day, 2019-02-14

PM inaugurates Es'hailSat teleport

HE the Prime Minister and Interior Minister Sheikh Abdullah bin Nasser bin Khalifa al-Thani yesterday inaugurated the Teleport Control Station of Qatar Satellite Company (Es'hailSat) in Al Ghuwairiya area, north of Doha.

The ceremony, attended by HE the Minister of Transport and Communications Jassim Seif Ahmed al-Sulaiti, Es'hailSat chairperson Dr Hessa Sultan al-Jaber and a number of other dignitaries began with the screening of a documentary film about the company,

HE the Prime Minister and Interior Minister Sheikh Abdullah bin Nasser bin Khalifa al-Thani inaugurates the Teleport Control Station of Es'hailSat as HE the Minister of Transport and Communications Jassim Seif Ahmed al-Sulaiti, Es'hailSat chairperson Dr Hessa Sultan al-Jaber and CEO Ali bin Ahmed al-Kuwari look on

Teleport promotes Qatar's economic position

gency broadcasting centre.

Al-Kuwari said the company is currently evaluating various investment opportunities in order to support the sustainability of its economic plan in terms of diversifying the sources of income and achieving its strategic objectives. It is also in the process of submitting the Es'hail-3 project proposal which will guarantee coverage of the country's needs in broadband communications to support complete independence during the FIFA 2022 World Cup, he said.

The state-of-the-art control station, in the Al Ghuwairiya area, north of Doha, is designed to provide back-up studios for television channels as well as an emergency broadcasting centre where it will connect with the most important media in Qatar through fibre optics to the station.

Es'hailSat currently broadcasts a variety of best television channels such as Al Jazeera News, beIN channels and Qatar Media Corporation channels as Es'hail-1 and Es'hail-2 are designed with the latest anti-jamming technology.

Qatar Satellite Company was established in 2010 with the aim of owning satellites and operating rights, providing various services to the public and private sectors in the Mena region and achieving self-sufficiency through the development and acquisition of technologies related to satellite development, all whilst providing means, materials and infrastructure to achieve these objectives.

The Communications Regulatory Authority (CRA) president Mohamed Ali al-Mannai said the satellite control station is a major step forward after the launch of the Qatari satellites Es'hail-1 and Es'hail-2, which will be controlled by the station, in addition to its work on securing terrestrial communications, the Internet and other tasks.

In a statement to the press, he said Qatar currently has a large capacity of communication channels through submarine cables, which is sufficient to meet the current and future demand beyond 2022.

Dignitaries at the opening of the satellite control station yesterday.

A facility in the satellite control station.

AMSAT Ground Segment

Located at the Es'hailSat Satellite Control Center (SCC) near Doha in 'shelter' close to main Es'Hail 2 SCC uplink/downlink antennas

- unattended operations, but remote access to tweak LEILA-2 parameters.

- 2.4 Meter dedicated Uplink antenna for AMSAT on S-Band

- In-Orbit-Verification and Monitoring of the AMSAT transponder with FFT passband (NB+WB) displays for quick assessment of situation.

- LEILA-2 (LEIstungs Limit Anzeige) analyses passband of NB transponder and send Marker tones on all stations which use too much uplink power.

- LEILA-2 generates pseudobeacon(s) and add them to the uplink signal (400 Bit/s PSK Telemetry with FEC).

- Hamradio shack equipped with SSB equipment for Voice and with DVB-S2 equipment for DATV transmissions directly from Doha.

- Backup station for LEILA will be located at QARS HQ and in Bochum at AMSAT-DL HQ

Pseudobeacon

* A beacon signal to enable users a signal reference (frequency and level) to orient themself → SDR Console

* A beacon generated on ground, not inside spacecraft

* Same flight-proven Phase 3 format, 400 bit/s BPSK telemetry with FEC

* Pseudobeacons at both ends of the Passband (transmissions outside are not permitted)

LEILA

LEILA is an german acronym for ***"LEIstungs Limit Anzeige"***, which means: Power Limit Indicator.

The original concept of an hybrid analog/digital LEILA on AO-40 was developed by Dr. Karl Meinzer DJ4ZC and Dr. Matjaz Vidmar S53MV. It was the first time that such a system was used as part of an transponder with ***uncoordinated multiple access***.

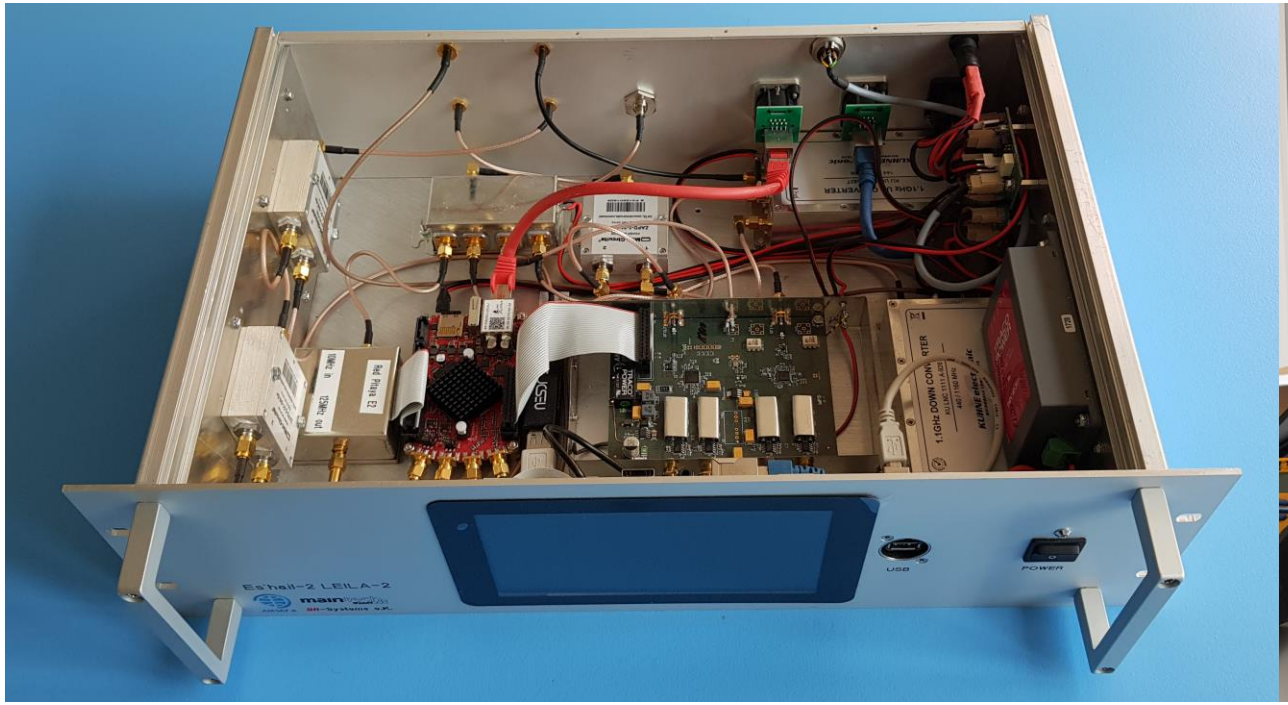
LEILA-2 on P4-A is ***ground-based !!***

- Siren marker (sufficient if operators work full duplex)
- Notch filter not possible because of delay

LEILA-2

redpitaya

- Analyzing the NB transponder passband (FFT) and generating individual siren markers.
- Encoding (FEC) and generation of pseudobeacons at upper and lower passband limit,
- Up-/downconversion boards developed by AMSAT-DL/UK (G6LVB, DH2VA).
- LEILA software by Mario DL5MLO
- installed at Es‘hailSat SCC, QARS backup and in Bochum at AMSAT-DL (currently active).



DATV - Groundstation

unmodified LNB with PLL

Works great with SDR-Console

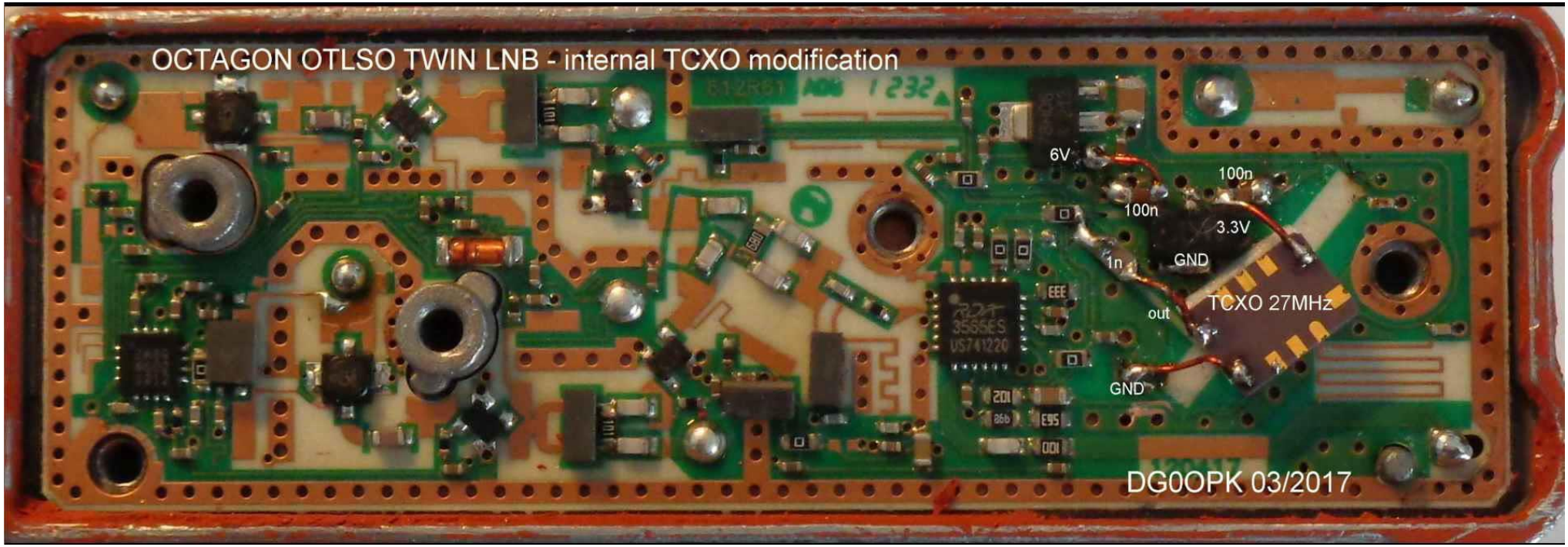
Frequency stability

Test Results from ZS6BTE
http://www.qsl.net/zs6bte/LNB%20Test%20Results.htm

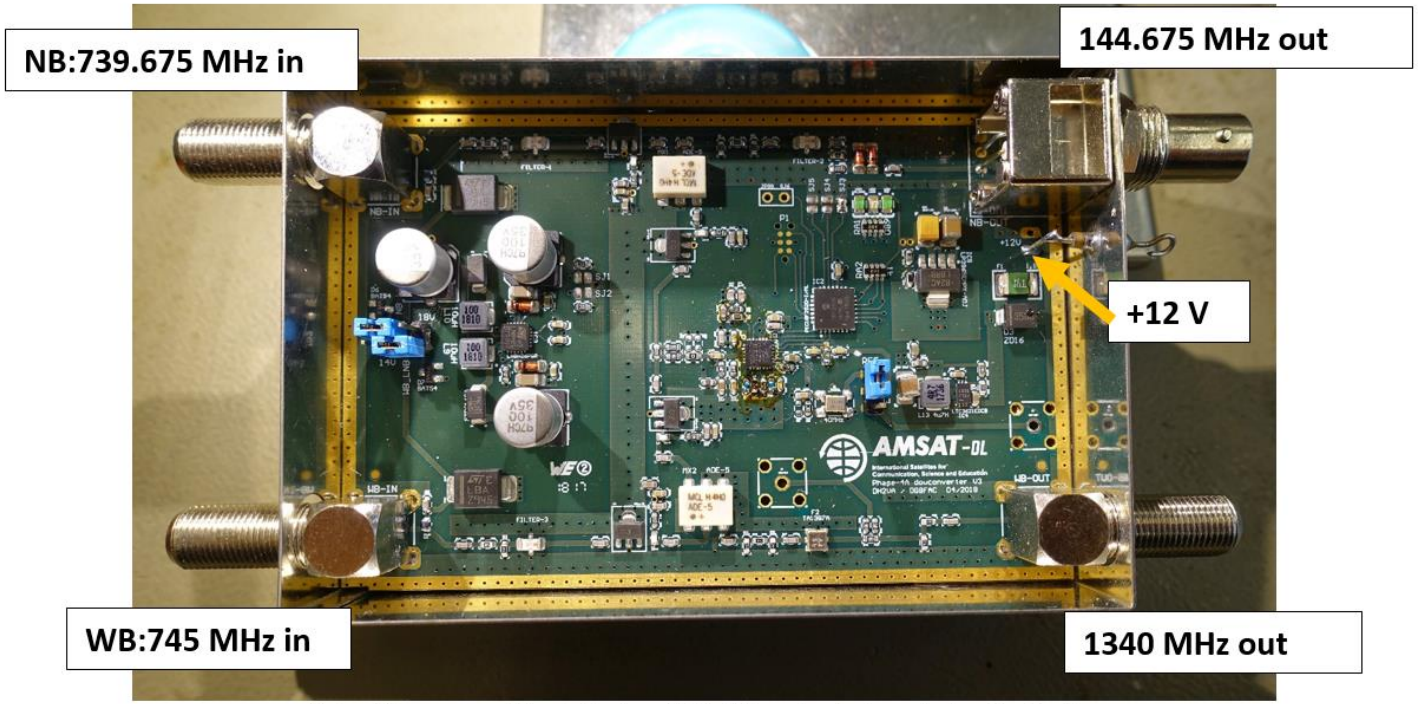
- Standard 27 MHz LO crystal is cheaply and drifts heavily during warm-up.
- **For the first 20 minutes the LNB is quite useless for narrow band working.**
- After 40-45 minutes (tested indoors), the LO frequency stabilizes to 1 Hz at 27 MHz per 5 minutes or 360 Hz per 5 minutes at RF (9750 MHz).
- The LO at 9750 MHz ended up 36 kHz low, and reset to this same value subsequently (again indoors) when restarted.
- **Once warmed up after 45 minutes it is thus very suitable for narrow-band working, provided time periods are not more than a minute or two.**

Modified LNB with TCXO

- D75F analog controlled TCXO from Conner Winfield
- with RDA356SES PLL chip
- 1 ppm stability over temperature range 0-70 degrees
- http://www.dg0opk.darc.de/Octagon_LNB_mod_March2017.html
- Suggested for SSB and other narrow band modes
- works with 27 MHz Quartz/TCXO



AMSAT QO-100 Down-Converter



Note: kit comes without tin box (111x74mm), photo only for illustration

- Published in AMSAT-DL Journal No. 3, September 2017 and on our Webpage.
- Kit is available at http://shop.amsat-dl.org

Easy Sat !

Analog version without computer…

20€

12€

H

V

NB → (V)ertical: 11…14 V
WB → (H)orizontal: 16…20 V

175€

145 MHz

0€

Existing 2m/VHF Transceiver

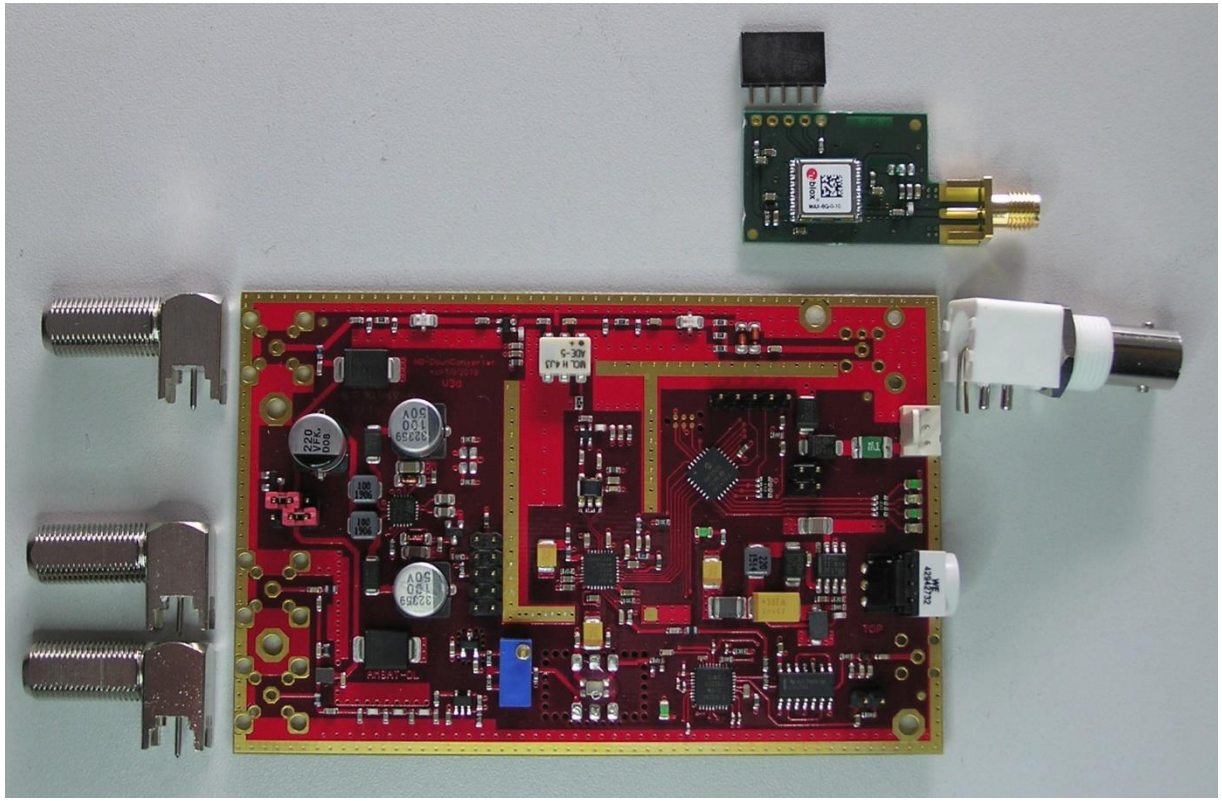
1339 MHz

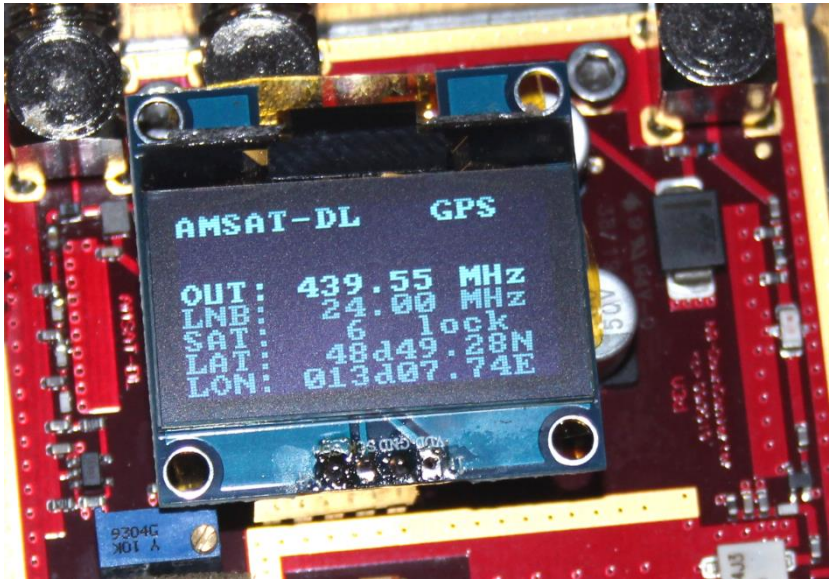
Universal Down-Converter for P4-A

40€

New AMSAT QO-100 Down-Converter

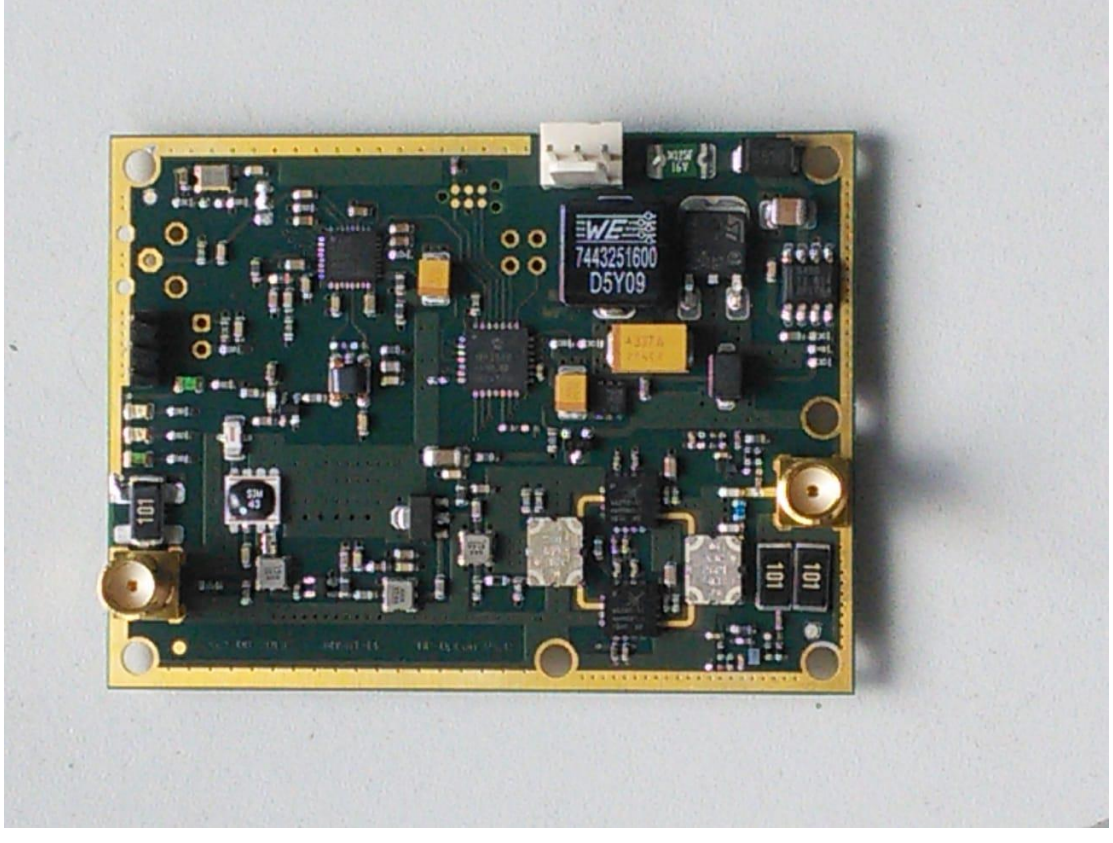
- two versions: OCXO (20ppb) or TCXO with GPSDO !!
- IF frequency for RX: 28 MHz, 50 MHz, 70 MHz, 144 MHz or 145 MHz
- 10 MHz and 40 MHz Reference Output for Up-Converter or Adalm Pluto
- Ultrastable LNB with programable external Ref clock: 24/25/26/27 MHz





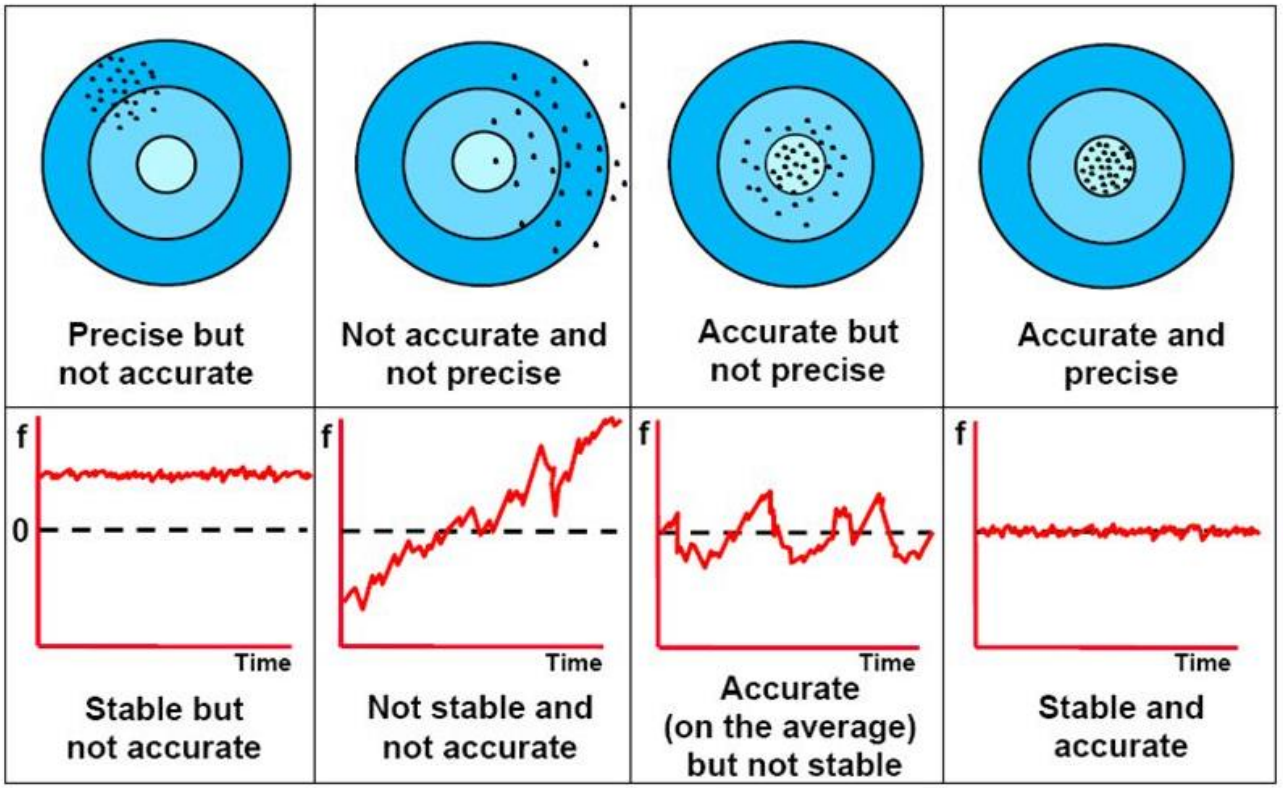
New AMSAT QO-100 Up-Converter

- 10 MHz Reference Input from Down-Converter
- OCXO (20ppb) or TCXO (500ppb)
- programable Uplink IF for TX: 433 MHz / 435 MHz / 833 MHz / 1293 MHz
- Build-in PA with **8 Watt RF Output!! (all you need!)**



Frequency Stability and Accuracy

- Long term Stability (drift, measured over periods of a day or more)
- Short term Stability (kind of random noise, „wobbling“)
- Phase Noise (affects digital modulation)
- Frequency stability: Δf/f (T)
  - TCXO
    - Standard: 1-2 ppm
    - Precision: 0.1-0.3 ppm
  - OCXO: 2-100 ppb
  - GPSDO
    - Longterm up to 1x10E-12
    - Shortterm depending on TCXO clock source..

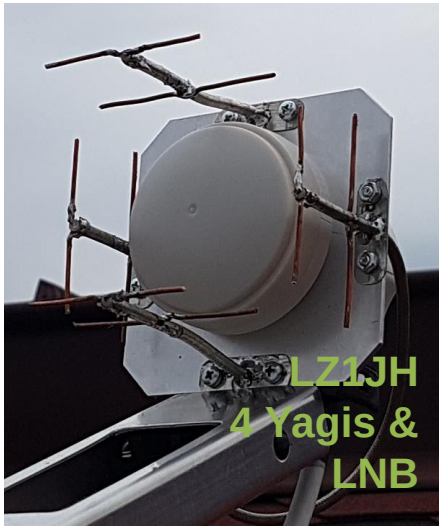


Courtesy John Vig

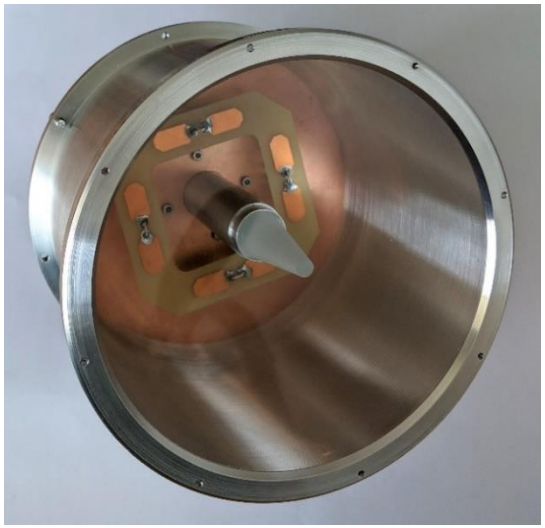
Antennas for QO-100

Antennas for QO-100

Dualband Feeds for QO-100

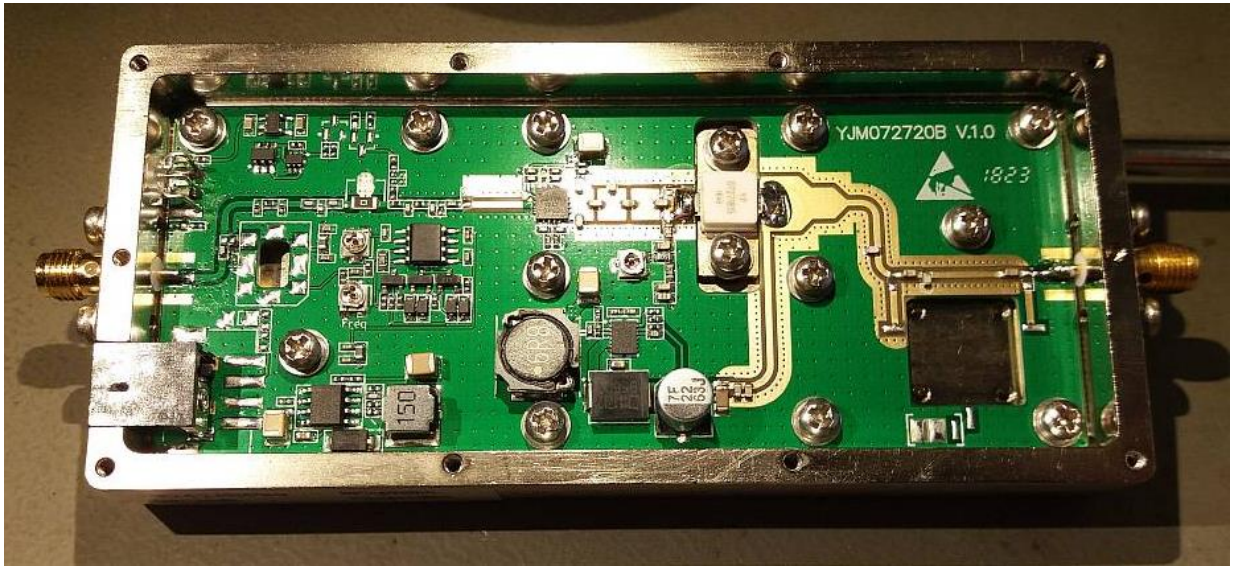


DJ7GP
Dual-band
Feed



HB9PZK
Dipole Array
&
Waveguide

WiFi Booster for 2.4 GHz

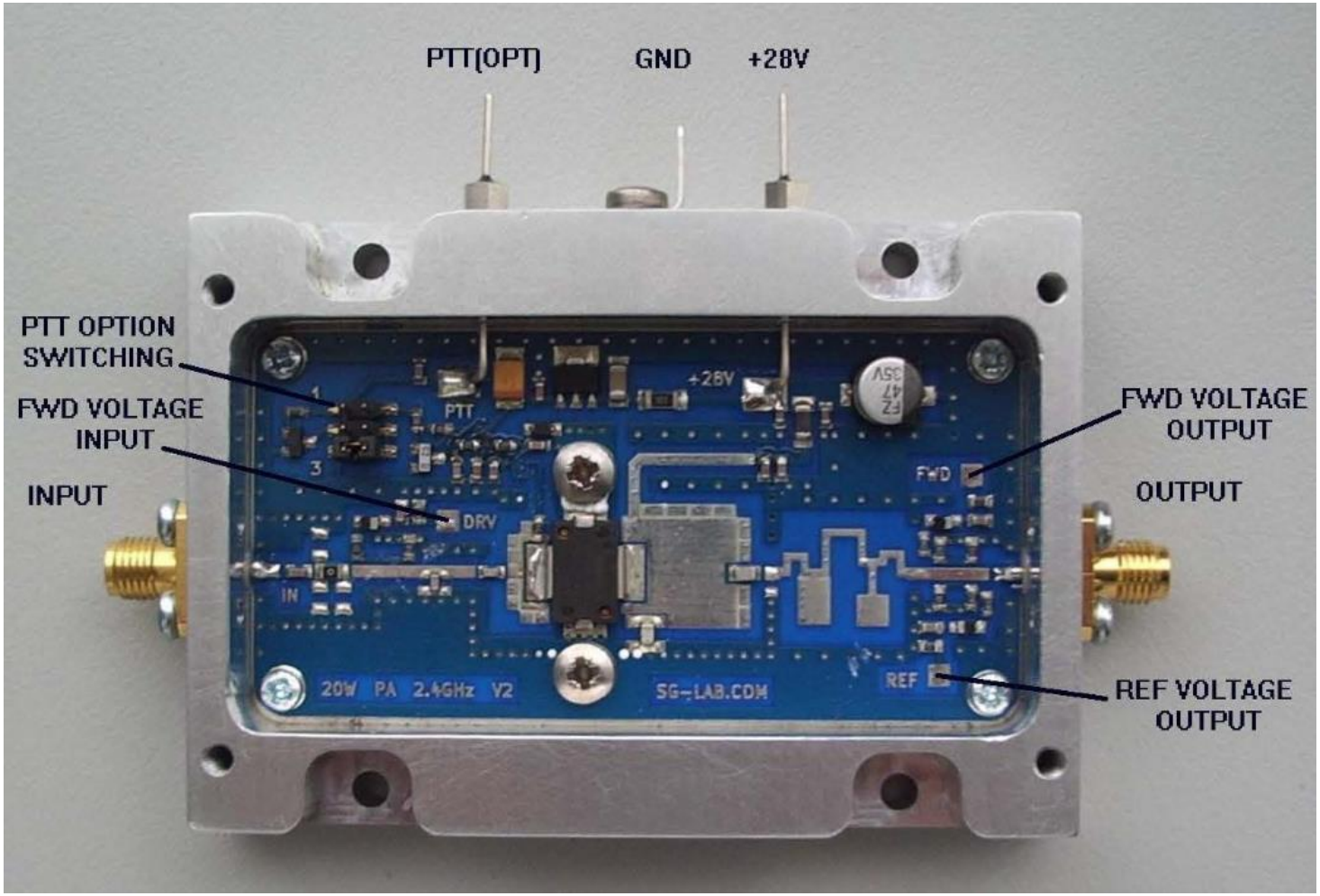


2.4 GHz 20W Wifi Booster from AliExpress (190€)

- Good for SSB
- 33dB gain, up to 15W
- 12V input, 5A max.
- see article from Achim DH2VA in AMSAT-DL Journal

SG Laboratory 2.4 GHz Amplifier

- Output Power: 20W
- Gain: 16 dB
- 24..28V, 1.5A
- Price: ~126€



All-in-one solution (DB6NT)

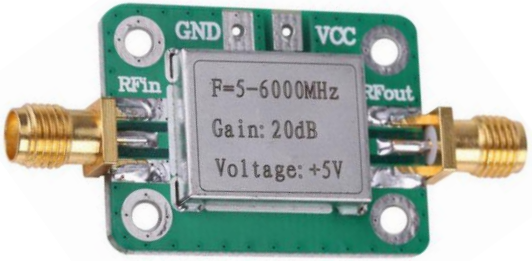
MKU UP 2424 A, Oscar Phase 4 Up-Converter

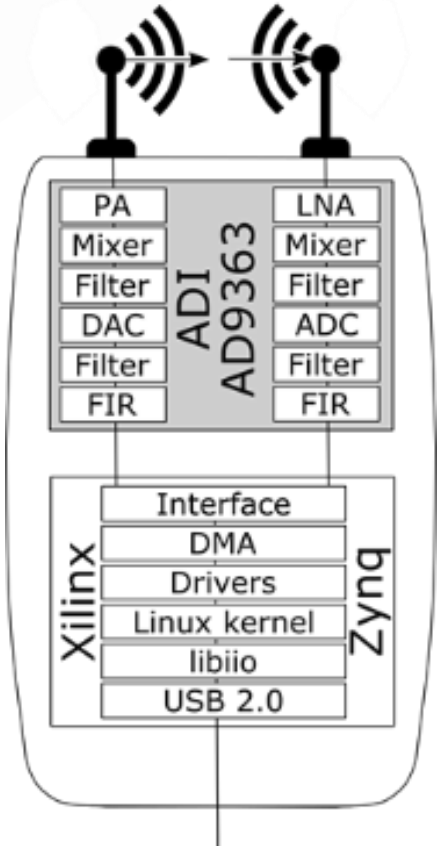
2400 ... 2402 MHz

Stand-alone up converter for the OSCAR PHASE 4 geostationary satellite
144 MHz IF
Fully remote controllable

Frequency range (IF)	144 ... 146 MHz
Input power (IF)	0.5 ... 5 W (adjustable)
Frequency range (RF)	2400 ... 2402 MHz
LO accuracy @ 18 °C	typ. +/-2 ppm, max. +/-3 ppm
LO frequency stability	typ. +/-2 ppm, max. +/-3 ppm
Output power (Psat)	min. 20 W

ADALM-PLUTO





Software-Defined Radio Active Learning Module

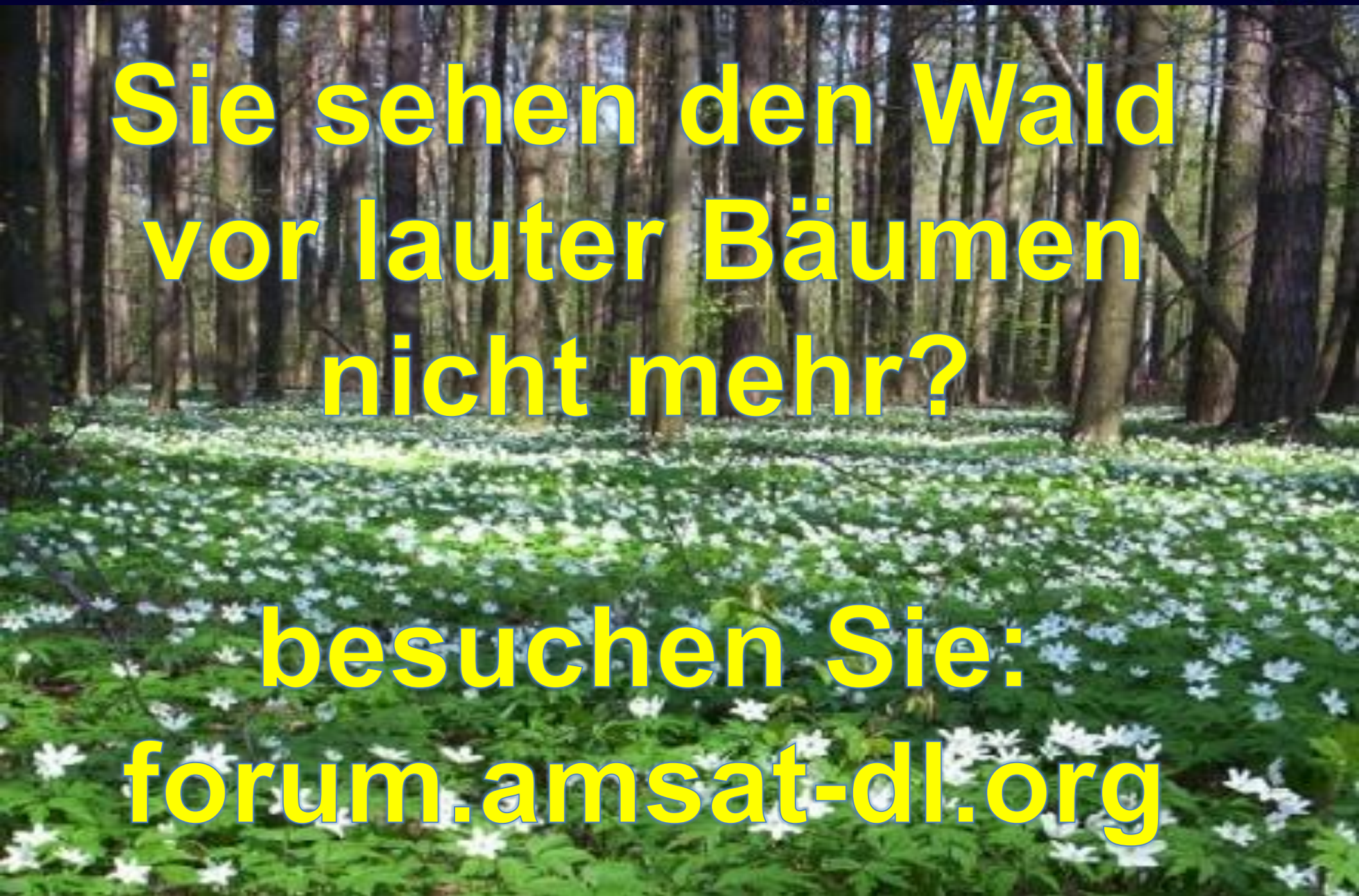
- RF coverage from 325 MHz to 3.8 GHz
- (extended range: 70 MHz to 6 GHz)
- Up to 20 MHz of instantaneous bandwidth

- Supports SSB (SDR-Radio)… DVB-S (TX)

- Price: ~120 € (Digi-Key, Mouser)

AMSAT-DL

Satellites for Communication and Science
Satelliten für Kommunikation und Wissenschaft



Sie sehen den Wald vor lauter Bäumen nicht mehr?

besuchen Sie: forum.amsat-dl.org

THANK YOU!

The first AMSAT **P4-A** transponder in **geostationary orbit** on Es'hail-2 was brought to you by Es'hailSat, QARS and AMSAT-DL

P4-A / Es'hail-2 is now called Qatar-OSCAR 100 (QO-100)

Please suppport AMSAT-DL

Visit our Website at: http://amsat-dl.org

Visit the QO-100 (Es'hail-2) Forum at: http://forum.amsat-dl.org

Partners

Es'hailSat سهيل سات
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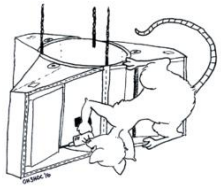
Q.A.R.S.
QATAR AMATEUR RADIO SOCIETY

KENWOOD

JAMSAT

AMSAT-UK

BATC



AMSAT-OH

maintech GmbH

SR-Systems