KNOWING QO-100 (ES'HAIL-2)
THE GEOSTATIONARY SATELLITE AT 26° EAST

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16/11/2019

Presentation summary

-The QO-100 satellite (Es'Hail-2) and its coverage

-What is a geostationary orbit

-The Band Plan of the NB and WB transponders

-History of Es'Hail-2 (Qo-100)

- What you need to receive QO-100

-How to listen to the converted LNB signal

- Listen to QO-100 with the SDR USB Stick

- Listen to QO-100 with a UHF receiver; the modification of the LNB

-How to feed the LNB, the Biast-Tee and the SAT divider

- How to connect the SDR USB Stick

- SDR software for SDR USB Stick

-How to connect a UHF SSB receiver

- How to connect all the elements of the system

- How to point the dish for QO-100

- How to transmit on the satellite QO-100; the dedicated antenna and combined antenna (Dual Feed)

- Transmission mode on QO-100; the NB and WB transponder

- Transponder WB; receiving DATV Hardware and Software

- Video management software for DATV transmission

- QO-100 NB / WB transponder activity

- Listening to QO-100 via Internet (WebSDR)

- ISoGRB WebSDR Project Diagram

The QO-100 satellite (Es'Hail-2)

Es'hail-2 is a satellite from Qatar, launched on a SpaceX Falcon 9 rocket on November 15, 2018.

The satellite was built in Japan by MELCO (Mitsubishi Electric Corporation) and was positioned at 26 ° East longitude on a geostationary orbit.

The purpose of Es'hail-2 is to provide television services for the Middle East and North Africa.

Es'Hail-2 hosts 24 Ku-band and 11 Ka-band transponders on board.

In addition to commercial transponders, Es'hail-2 also has 2 linear transponders with a bandwidth of 250 kHz (NB) and 8 MHz (WB) for the amateur radio traffic.

The uplink is on 2.4 GHz (S band) while the downlink is on 10.45 GHz (X band).
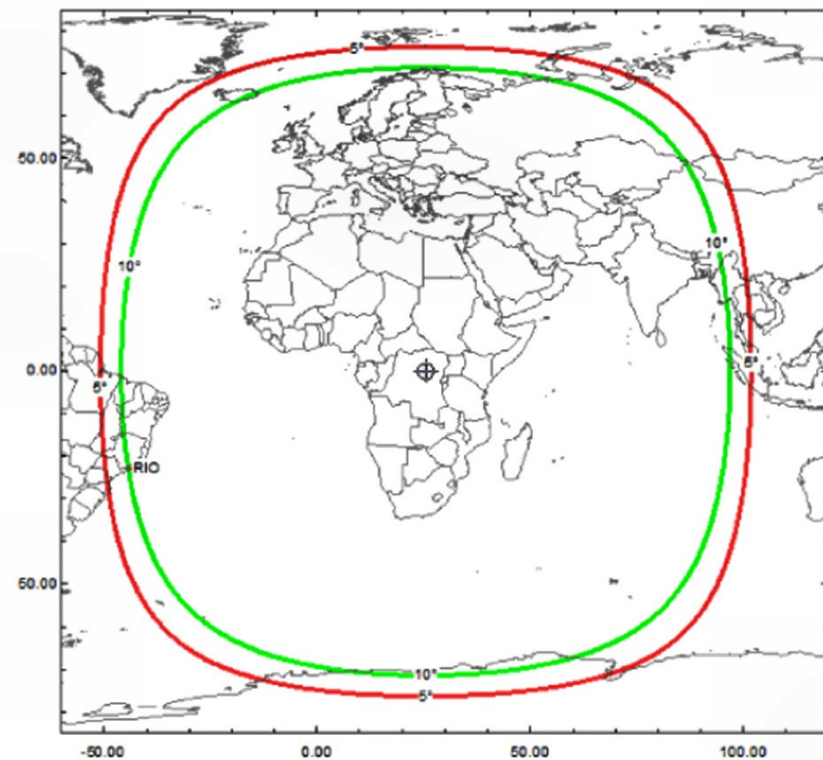
The QO-100 satellite (Es'Hail-2)

Es'hail-2 / AMSAT Fase 4-A

Es'Hail-2 (QO-100) is the first amateur geostationary radio transponder (P4-A).

The project was made possible through the agreement between the company Es'hailSat, the QARS association (Qatar Amateur Radio Society) and the AMSAT-DL (AMSAT Deutschland)

Coverage from orbital position of 26 deg East

The QO-100 satellite (Es'Hail-2)
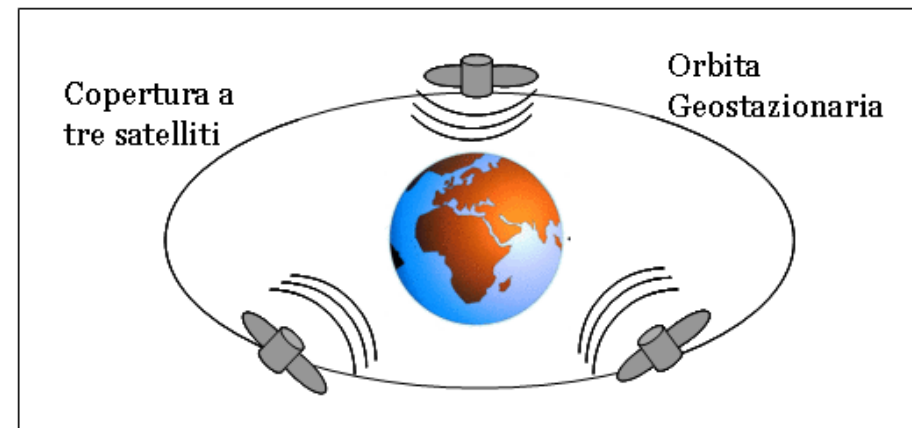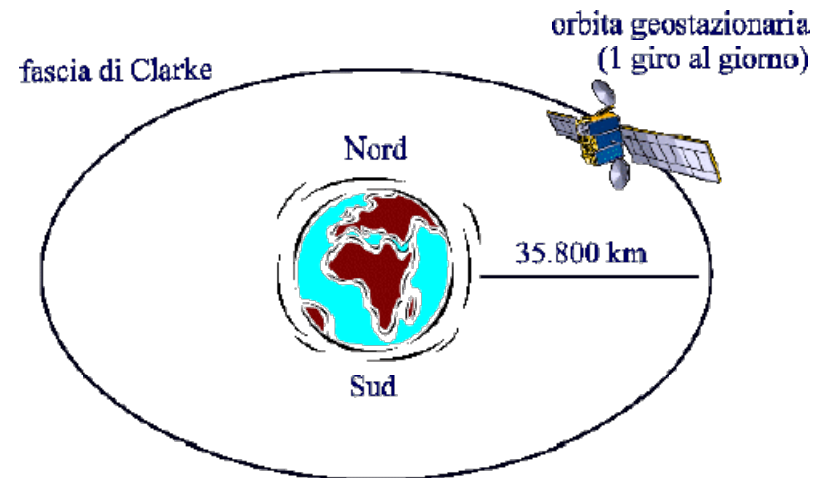# Coverage from Brazil to China
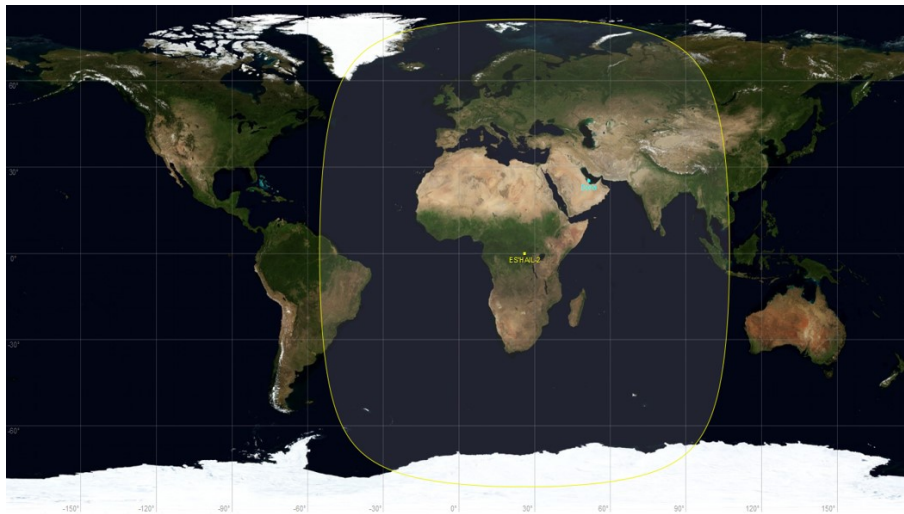
What is a geostationary orbit

The **geostationary orbit** is a circular and equatorial orbit located at such a height that the period of revolution of an artificial satellite that runs through it coincides with the period of rotation of the Earth.

The Earth's geostationary orbit is also called Clarke's Zone, named after Arthur C. Clarke that was the first to think of using a geostationary orbit for artificial satellites dedicated to telecommunications.

More commonly we use the term **"geostationary satellite"** when for an observer on Earth the satellite appears to be standing in the sky, because it rotates with a uniform circular motion at the same angular speed as the Earth.

For the Earth the artificial satellite must travel the circular orbit in a time equal to the sidereal day: T_{rot} = 23 h 56 min 4,09 s = 86 164,09

orbita geostazionaria
(1 giro al giorno)

fascia di Clarke

Nord

35.800 km

Sud

Copertura a tre satelliti

Orbita Geostazionaria

What is a geostationary orbit

The altitude of the geostationary orbit is fixed and this is due to the fact that orbits at different heights have different periods of revolution, always longer as we move away from the planet.

The orbit with a revolution period of 23 hours, 56 minutes and 4.09 seconds **(the sidereal day)** is at an altitude of 35.790 km and a satellite run across it moves at about 3 km / s, equal to 11,000 km / h.

The geostationary orbit is much sought after for artificial telecommunications satellites while for weather forecasts the satellites occupy an orbit much closer to the earth, so as to be able to acquire high resolution images.

Currently it is quite crowded and is divided into small pieces (orbital positions); there is a mapping of occupied positions.

At the end of its operational life, the satellite must give way to another satellite, moving to a higher or lower orbit.

A geostationary satellite is able to observe almost an entire earth hemisphere; its horizon is equivalent to a circle with a diameter of about 11,500 km.

© CCRS / CCT
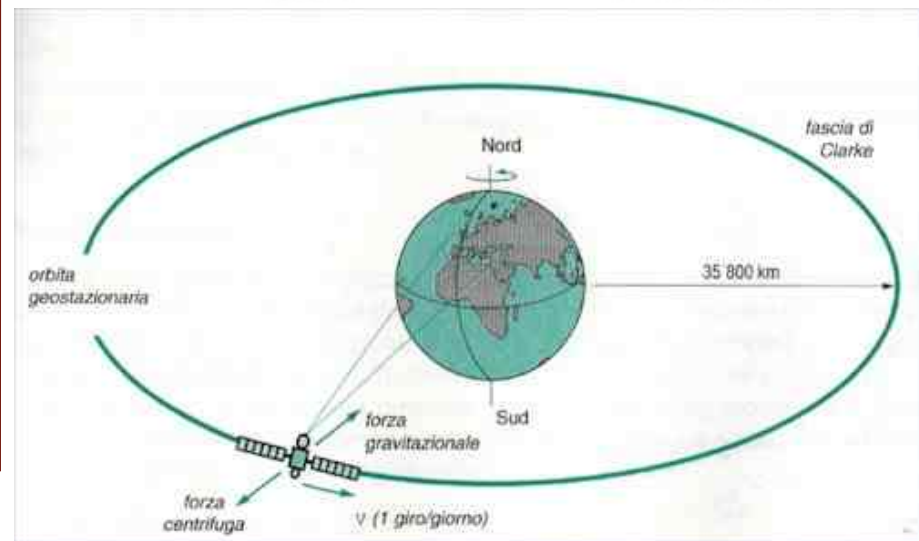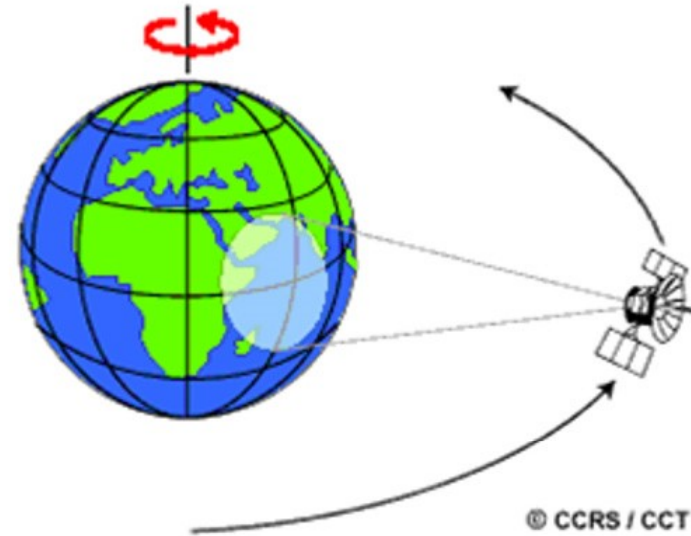
The QO-100 satellite (Es'Hail-2)

Es'hailSat, The Qatar Satellite Company was founded in 2010 and is based in Doha, Qatar; owns and operates satellites to serve broadcasters, companies and governments.

Before Es'Hail-2, Es'hail 1, launched on August 29, 2013, already shared a space platform with the European satellite operator Eutelsat

The QO-100 satellite (Es'Hail-2)

Who is the QARS

The **Qatar Amateur Radio Society (QARS)** is a non-profit national organization of amateur radio operators in Qatar and have alsp a QSL office for members group.
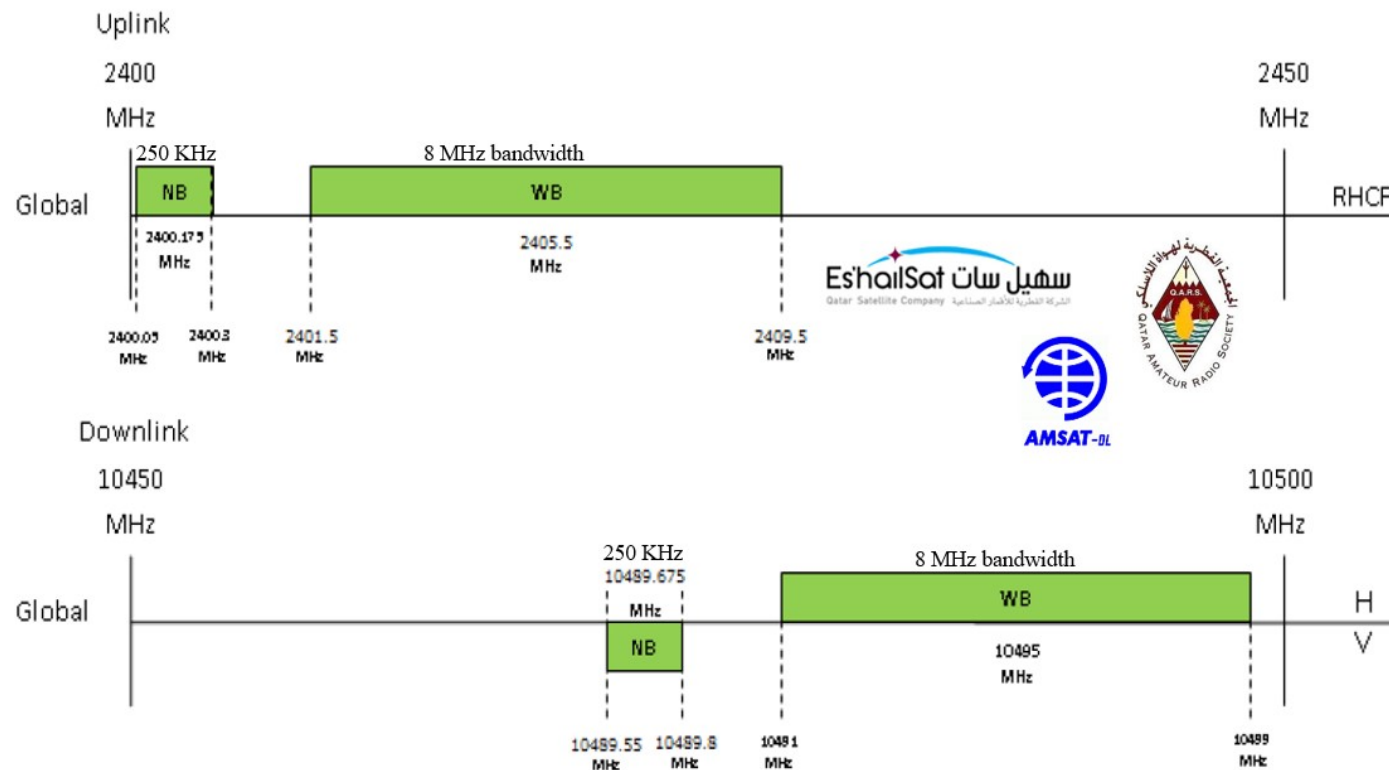
To promote the development of space technology in Qatar, Es'hailSat has started developing new technologies for QARS.

With the provision of two amateur radio transponders on the Es'hail-2 satellite, this project aims to provide an exciting new phase of activity for amateur radio operators in the 21st century.

Es'hail-2 allows you to carry out the first geostationary communications of the AMSAT and also allows you to carry out the first DATV tests with the DVB-S2 standard.

The Band Plan of the NB /WB transponders

Uplink

2400 MHz

2450 MHz

Global

250 KHz

8 MHz bandwidth

| NB | WB |

2400.175 MHz

2405.5 MHz

RHCP

2400.05 MHz   2400.3 MHz   2401.5 MHz   2409.5 MHz

EshailSat — Qatar Satellite Company

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

AMSAT-DL

Downlink

10450 MHz

10500 MHz

Global

250 KHz
10489.675 MHz

8 MHz bandwidth

| NB | WB |

10495 MHz

H
V

10489.55 MHz   10489.8 MHz   10491 MHz   10499 MHz

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

The fundamental advantage of the right circular polarization (RHCP) is that all the reflections change the direction of the polarization, inhibiting the sum or subtraction of the main and reflex signals. This allows for less fading when using circular polarization at each end of the link.

Band Plan of the NB transponder in detail
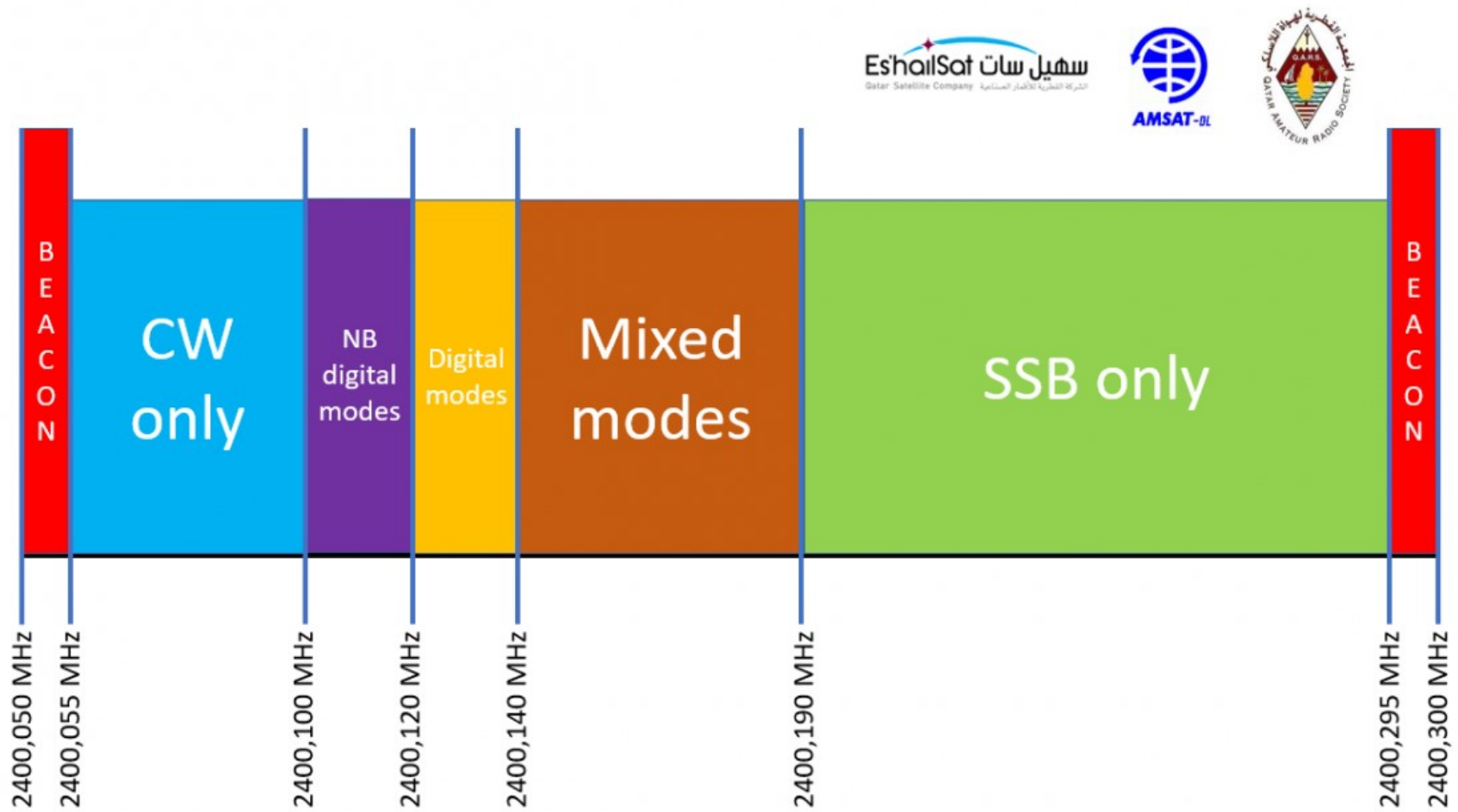
History of Es'Hail-2 (QO-100)

15/11/2018
Launch of the Es'hail-2 satellite
https://www.youtube.com/watch?v=PhTbzc-BqKs

16/01/2019
Several amateur radio operators receive some tests on
10489.650 in CW. Melco does not formalize these tests and it
is suspected that some OM transmissions have just received
an anomalous noise on the transponder frequency, due to the
switching on of the same, it has immediately carried out
transmissions still not allowed, even if the AMSAT-DL
communicated not to broadcast for no reason to allow
equipment calibrations.

16/01/2019
The Amsat-DL announces that it has sent all the equipment
in Qatar for the installation of the AMSAT ground
control station at Es'HailSat.

17/01/2019
At 06.00z the NB transponder is turned on for tests by Melco;
new CW signals are received on the frequency of 10489.635.
These signals also seem unofficial and do not come from the
ground control station, which is still not installed; many
amateurs were connected that morning on my websdr, the
first ever in that period, and i remember perfectly all the
messages received from amateur radio friends who informed
me of the switching on of the transponder.

The increase in the noise of the transponder on the slice was
clearly seen 10.489550 - 10489800
Also on the Amsat-DL forum many confirmation messages
appeared:
 https://forum.amsat-dl.org/index.php?thread/81-nb-
passband-monitoring/&postID=1097#post1097

History of Es'Hail-2 (QO-100)

24/01/2019

The first TV transponders are activated on 11230V and 11350H
The news is not confirmed, they are tests with 8 channels
MUX and colored bars.
Something then moves, there is excitement and the Ham
transponder is turned on.

03/02/2019

Es'Hail2 changes its name to amateurs radio and becomes
Qatar-OSCAR 100 (**QO-100**).
https://amsat-dl.org/en/qatar-oscar-100-qo-100/

09/02/2019

The AMSAT-DL announces that the transponder will be
inaugurated on February 14th 2019; there is expectation and
curiosity among all radio amateurs.
https://amsat-dl.org/en/eshail-2-qo-100-telepor

11/02/2019

The NB transponder is activated at 09.00z
I made several recordings of amateur radio operators who
carried out the first tests.
https://drive.google.com/drive/folders/1rXgh7SiDvHytOowBu
VULCEvfbQa1zILE?usp=sharing

History of Es'Hail-2 (QO-100)

12/02/2019
The announcement from Amsat-DL is given that the NB transponder of QO-100 is opened for experimentation. Very many stations in the air that day
https://amsat-dl.org/en/qo-100-nb-transponder-e

The very first QSOs are carried out between Italian stations (IW1DTU - I5YDI - IK8XLD) at 15.00z on 10489.670
https://drive.google.com/file/d/1RvXKt_1F2FXLtc_CKu94-pQPk8ZfxQ1I/view?usp=sharing

13/02/2019
The amateurs test and QSOs multiply.
Many other excellent stations present today.
Another Qso of Italian stations:
(**IW1DTU - IZ1ERR - IK8XLD**) at 18.12z on 10489.742
https://drive.google.com/file/d/1WvezYF5MnAhuuXSWIbliDbLX4-7ZNEAo/view?usp=sharing

14/02/2019
The amateur radio satellite and the official opening of the transponder are officially inaugurated. NB In Qatar, the special A71A station after the inauguration carries out many QSOs with all the amateurs of the world
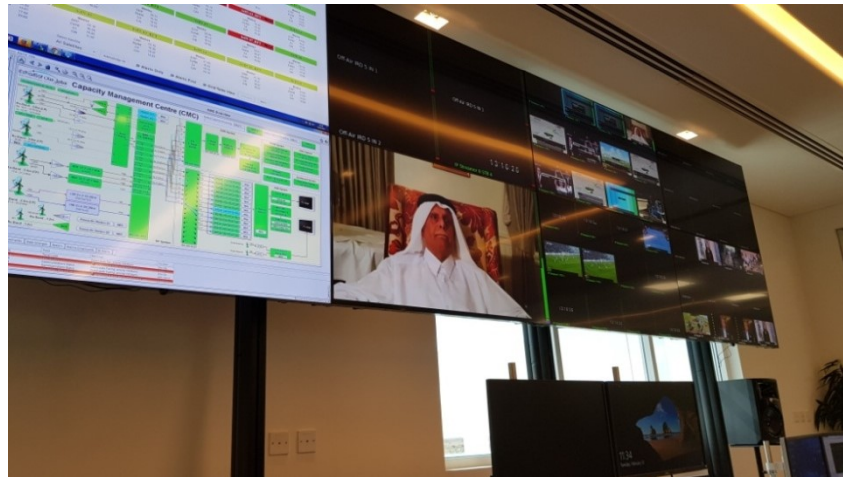
From this moment QO-100 is operative

LAUNCH: ES'HAIL-2
STARTUP   MECO   ENTRY BURN   SECO-1
LIFTOFF   SES-1   LANDING BURN   LANDING

History of Es'Hail-2 (QO-100)

15/02/2019

The QARS officially releases the two NB and WB transponders of Es'Hail-2 / P4-a / Qo-100 for amateur radio tests

https://amsat-dl.org/en/qo100-opening/

What is needed to listen QO-100

Antenna

Satellite TV reception dish of 60cm, better if 80cm, for perfect listening even of small signals.

LNB

Initially an unmodified commercial LNB is also fine, for better performance it will be necessary to modify one and insert an external reference at 25MHz / 24MHz.

The Fracarro LNB are easy to find in circulation and are a clone of the famous LNB Octagon.

In the picture a Fracarro LNB with 2 output; after the modification one of the outputs will become the input for the external reference signal, much more stable than the internal one, in order to avoid frequency slips and to guarantee a more precise listening of the SSB.

The LNB converts the received signal into the spectrum from 10489.550-10489.800 to 739.550-739800.

Various systems can be used to listen to the converted signal.

How to listen to the converted LNB signal

- **Scanner receiver** capable of receiving the 739 MHz band in SSB

- **SDR USB Stick RTL2832 / 2838 (R820T2)** with SDRSharp / SDRConsole software or other SDR software compatible with RTL2832

- **UHF SSB receiver** (requires a modified LNB to convert the 434MHz signal (not 432MHz for the problem of mismatched decimals)

Listen to QO-100 with SDR USB Stick

The SDR RTL2832 / RTL2838 (R820T2) Stick is available on the market for about 10 euros.

It covers the spectrum from 25 MHz to 1700 MHz.

To use it, you must first install the modified **ZADIG** driver (https://zadig.akeo.ie); then the SDRSharp or SDRConsole reception software must be installed.

Initially SDRSharp (AirSpy) was used (https://airspy.com/download/) as there were no other software that could be easily used and compatible, whereas today the SDRConsole software is used more (https://www.sdr-radio.com/Console/), which with all the implementations for QO-100 allows an easy and perfect reception even with unmodified LNBs; integrates a PSK telemetry beacon hooking function to 10489.800, able to automatically re-center all the in-band signals indicating the precise frequency and guaranteeing perfect listening without frequency slipping; this is clearly possible if the sender also has a precise external reference, DDS, TCXO, OCXO or GPS-DO.

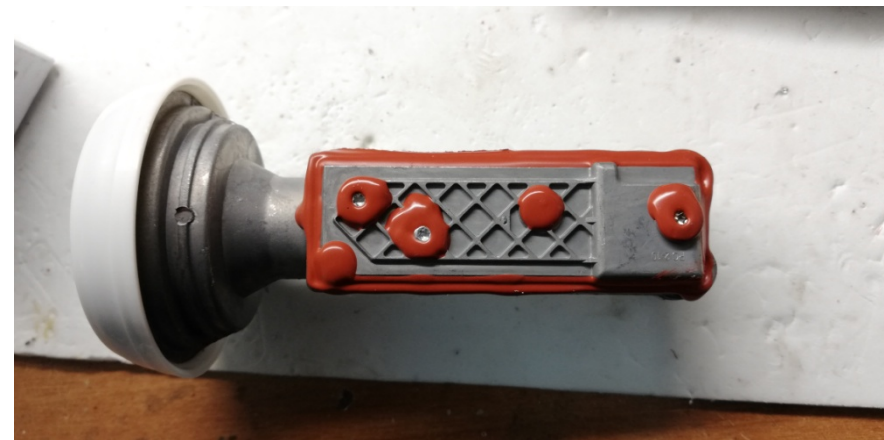# Listening to QO-100 with a UHF receiver LNB modification

Receiving QO-100 with a UHF SSB receiver / transceiver is only possible with a modified LNB, because normally the commercial LNB will convert the signal to **739** MHz.

The modification of an LNB for this purpose consists in replacing the internal xtal of type HC49 / U of 25MHz, not thermostated, (which generates the first local oscillator of 9750 MHz (**25 MHz x 390**), can be activated by powering the LNB with 13 , 8V (vertical polarization without 22kHz subtone for listening to the NB transponder) with another from:

10489.550 – 434.550 = 10055 MHz

10.055 MHz is the frequency of the local oscillator that we must obtain in order to convert the signal to 434 MHz.

To obtain this frequency it is necessary to replace the original 25MHz xtal with one from (**10.055 / 390 = 25,7820512 MHz**)

Listening to QO-100 with a UHF receiver LNB modification

To find an xtal with this frequency is not easy even if possible but at the same time it is not advantageous, since the LNB would move of frequency, not being a thermostated xtal and therefore it is preferred the insertion of a precise **signal at 25,7820512** coming from outside, for example from a DDS, with a maximum drift of 0.1ppm, from a TCXO, with a maximum drift of 0.1ppm, an OCXO, always with a maximum drift of 0.1ppm or better by a regulated GPS-DO oscillator, managed by the GPS signal.

To insert this more precise signal from the outside, it is necessary to modify the LNB, with the aim of disabling the second output of the LNB and using it as an input for the external reference signal, which will go to connect, with appropriate resistances and SMD capacitors, to the original xtal pad, which will first be removed. With this ploy we would have a perfectly stable LNB and the possibility of converting it into any frequency down to 430MHz.
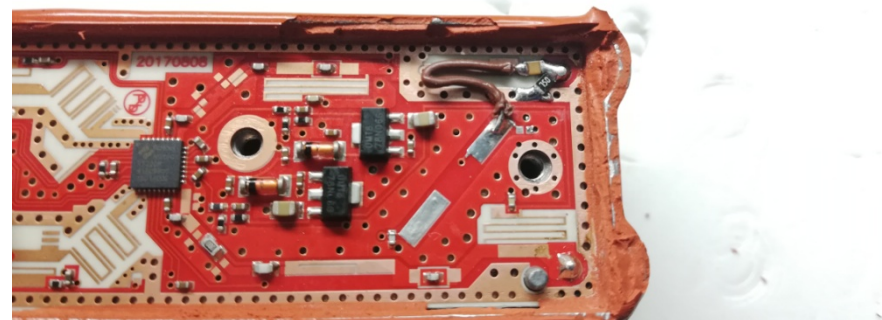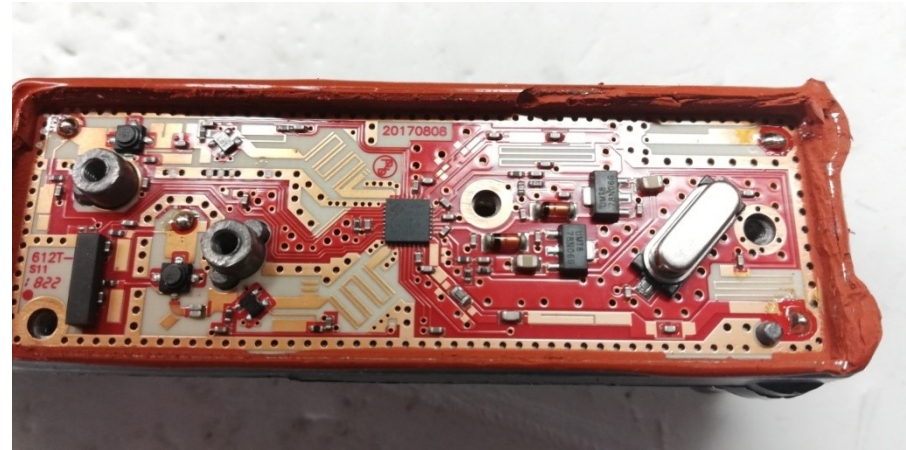
# Listening to QO-100 with a UHF receiver LNB modification

Criticality of this change for the converted signal

To convert the LNB signal to 434 MHz means to encounter a decrease of the converted signal of about 2-3dB, which however, being the strong signal, in the end we will have only a half point S decrease on the S-meter, practically negligible ; the decrease in the signal is caused by the filter inserted in the LNB which starts to cut below 900MHz.

The perfect change

The ideal modific is to convert the LNB signal instead of 739MHz or 434 MHz above 950 MHz, for example to **1129 MHz**, using an xtal or an exact 24 MHz external reference signal. This choice provides the advantage of not having attenuation on the signal, since the filter present in the LNB does not act and being converted in the frequency range from 950-2150MHz it is easily usable also for the DATV (Digital ATV practicable on the WB transponder), of which we will talk about later.

The 1129 MHz signal of the NB transponder would therefore be receivable only with an SDR USB Stick and unfortunately not with a normal amateur radio UHF receiver.
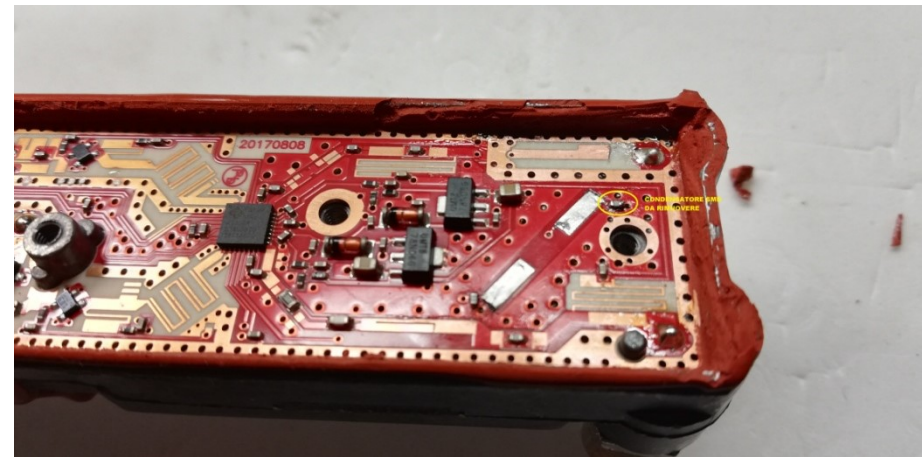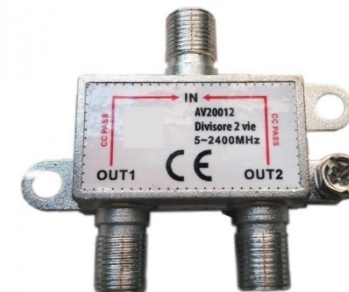
How to power the LNB

The LNB requires an external power supply to operate. Using the LNB with a normal satellite receiver the power is supplied directly from the receiver through the coaxial cable, on which the converted signal also passes, but in this case, by not using a satellite receiver for our purposes, we will have to power our LNB with a another system, always guaranteeing the possibility of obtaining the converted signal through the coaxial cable itself.

You can use different systems:

- **BIAS-Tee circuit**

- **2-way Sat divider**

How to power the LNB
The BIAS-Tee

 The Bias-Tee circuit is a 3-port circuit that allows the insertion of the 13V or 18V power supply required for the LNB to operate and at the same time allows the converted signal to be extracted from the LNB.

This method is sometimes preferred, compared to the SAT divider, as some Bias-Tee models allow to have a lower loss of about 0.5 / 1 dB compared to the SAT divider, but non-stardard connections sometimes cause the amateur to address to the SAT divider, which instead has the standard F connectors that can be used directly on the coaxial cable and that directly connects the LNB to the USB memory stick or to the UHF receiver (in the case of modified LNB) without adaptations of particular connectors.

However, the Bias-Tee circuit is not easy to find.

RemoteQTH.com | 10 GHz LNB WITH TCXO + DC BIAS TEE WITH ATT

How to power the LNB
The SAT divider

The connection of the SAT divider is quite simple:

- The **IN port** is connected directly to the LNB with the 75 ohm coaxial cable.

- The **OUT1 port** connects to the SDR or analogue receiver. On this port the LNB converter signal will be present and separate from the power supply.

- The **OUT2 port** connects directly to a 13.8V power supply. For convenience, connect a port of 75 ohm coaxial cable to this port and interface it with another **red** / **black** power cable, connecting the positive to the center of the coaxial cable and the negative to the shield of the coaxial cable itself. The OUT1 and OUT2 ports are identical and it is possible to reverse the connection of these ports.

The 2-way divider normally inserts a loss on the signal of about 2-3 dB on each OUT output, the 4-way one around 6 dB on each OUT output. We recommend, if not necessary, always use the 2-way one, to have a lower loss of the signal.
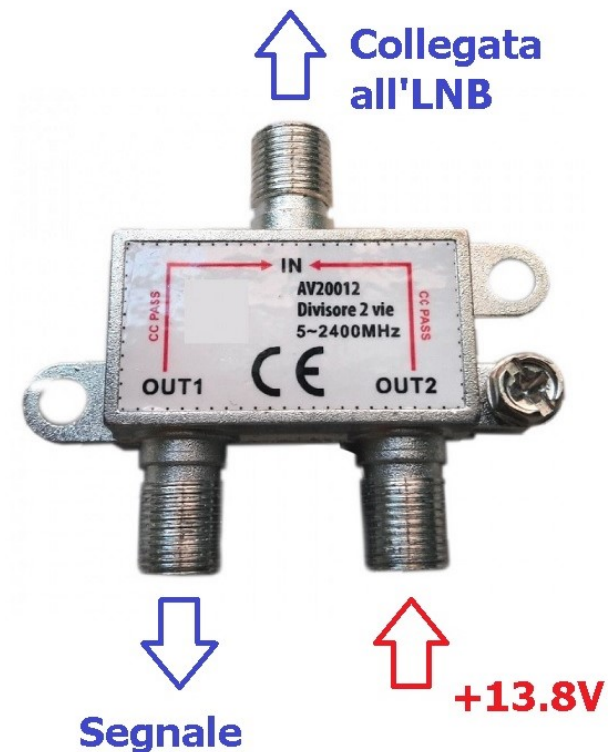
How to connect the SDR USB Stick

Connecting the SDR USB flash drive is equally simple:

Laterally to the USB stick, on the small MMX type connector, connect an adapter cable with MMX <-> F (female) connectors will be connected to the divider port (OUT1).

The USB connector will then be connected to a free USB port on the PC.

Segnale dell'LNB

Alla porta USB del PC

The SDR software for the USB Stick

To use any SDR software, you must first install the modified **ZADIG** driver, so that the PC correctly recognizes the USB Stick as an RTL2832 / 2838 interface
https://zadig.akeo.ie

SDRSharp
https://airspy.com/download/

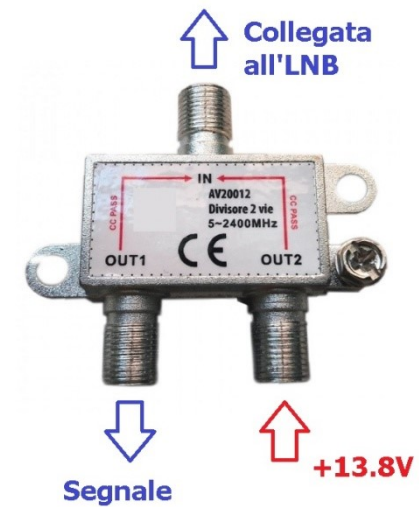**SDRConsole (il più completo)**

https://www.sdr-radio.com/Console
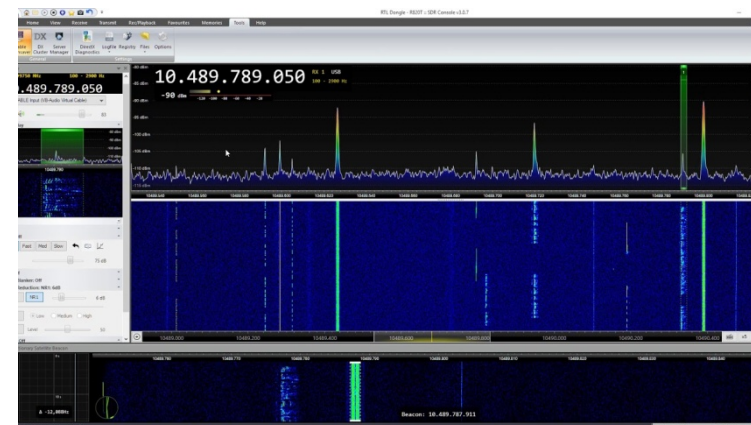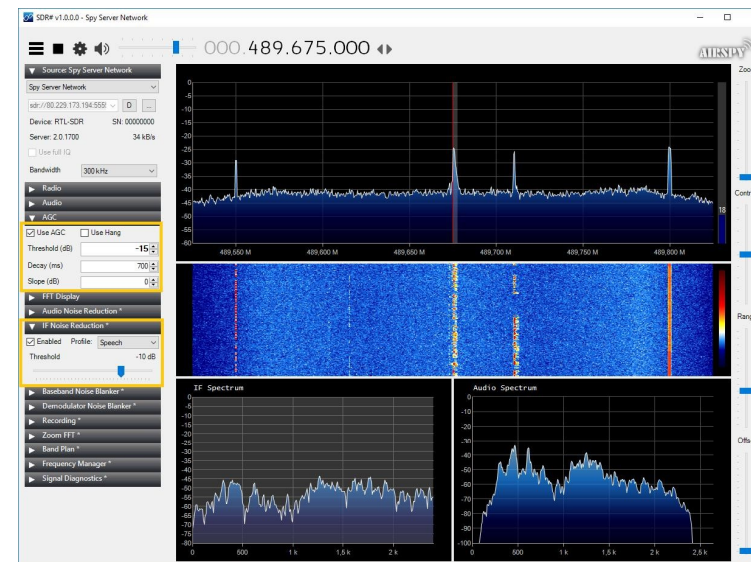
How to connect a UHF SSB receiver

To connect a UHF SSB receiver or transceiver to receive QO-100 satellite signals, simply **connect the OUT1 port** of the divider directly **to the UHF receiver's antenna input**.

If you use a transceiver be very careful not to transmit so as to destroy the LNB.

How to connect all the elements

In the image on the side it is possible to see the summary of the connections of a simple reception system, consisting of satellite dish + LNB + SAT divider, SDR USB Stick (R820T2) and PC.

How to point the dish for QO-100

The pointing of the dish is relatively easy.

Important: the bracket of the parabola or rather the piece of pipe of the bracket must be checked with the air bubble level so that it is straight, otherwise the elevation set on the rear bracket must be adjusted by +/- 1 degree.

First adjust the bracket of the dish to set the correct elevation of the place where you are; for Cagliari set 41 degrees and tighten the bolts, without tightening them completely, making sure that the dish does not change elevation slipping. Help yourself with this website:

Set the SDR software connected to the SDR stick at 739 Mhz (set a bandwidth of 1M on the software)
Now adjust the azimuth of the dish pointing to 26 ° East. With the compass take the south reference at 180 degrees and move the dish to the left, past the Sky position if you had this previous reference, and in any case until you see signals on the spectrum; you will immediately notice intermittent SSB and CW signals corresponding for example to the CW beacon at 739.550 (10489.550).

It is not possible to be wrong because the signals converted to 739 MHz are only those of QO-100; no other signal at 10489 MHz is present on the satellites in orbit and therefore moving the dish to the left you will almost immediately find the satellite QO-100.

Now optimize the elevation (the 41 degrees set previously) with very small adjustments, decreasing by 0.5 / 1 degree above or below and also the azimuth, to have the maximum signal, tuning for example to 739.800 (beacon PSK telemetry) which has a more constant transmission, so that it is easier to refine the aim by verifying the signal received on the SDR software.

How to transmit on the QO-100 satellite

To transmit on the QO-100 satellite it is necessary to have a converter that raises the signal, typically from VHF / UHF to 2400 MHz.

There are various ways to do this and different hardware in circulation that can be used:

1-**Up-Converter HiDes BU500** + series Wi-Fi amplifier
**Local Oscillator TK stability 2.5ppm(-30°...+75°C)**
Output power: 500mW

2-**SG-Labs Transverter** with external reference input
LO Accuracy at 20°C +/- 1ppm
LO temp. Stability +/- 2.5ppm
Output power: 2W

3-**DxPatrol MK2 Up-Converter** with external reference input + series Wi-Fi amplifier
Internal 10Mhz Reference TCXO 0,5PPM
External 10MHz GPSDO Input optional
Output power: 100mW

4-**Old UHF radios with 2400MHz module**, for example **IC-970H** with 1W output power

5- **Adalm Pluto SDR interface** + 2 series Wi-Fi amplifiers (widely used for DATV)
LO temp. Stability +/- 25ppm
Output power: +7dBm (5mW)

6- **SDR LimeSDR interface**
**Output power: +10dBm (10mW)**
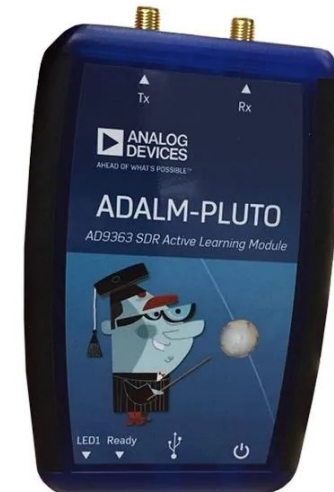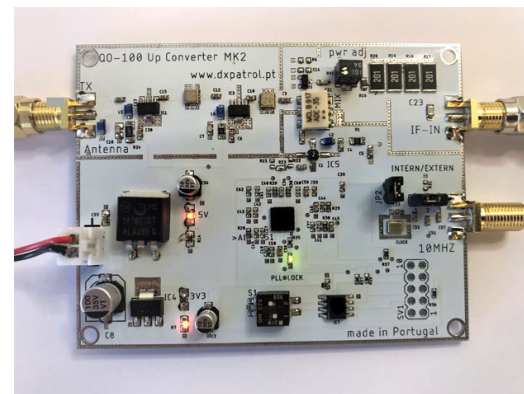
How to transmit on the satellite QO-100
The dedicated antenna in transmission

It is possible to radiate the 2400 MHz signal to the satellite using different types of antennas.

Below is a series of antennas dedicated only for transmission.

- 80cm Dish or greater with helix or patch illuminator

- Long multispire helix antenna (40 coils or more)

- Wi-Fi parabolic antenna 1m diameter from 24dB, horizontal polarization
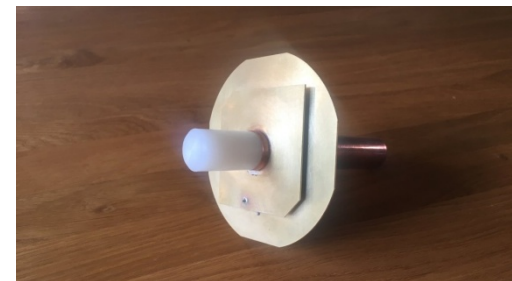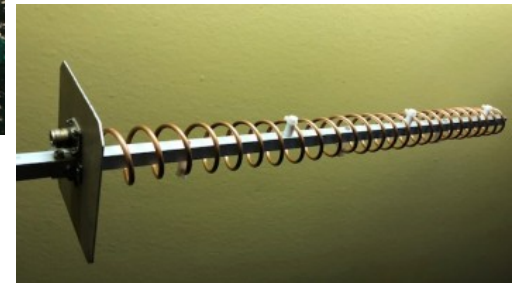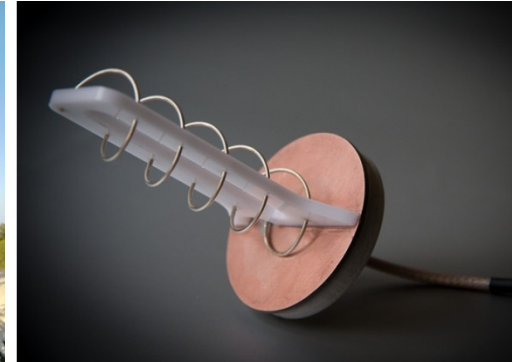
# How to transmit on the satellite QO-100
The combined antenna. Dual feed

The best performance is obtained by using 2 separate antennas, typically a dish in reception and one in transmission, with helix feeds or patches Poty-type.

When it is not possible to install 2 separate dishes, even if they are not too large (80cm), use a double feed, clearly a compromise, using an LNB together with a helix antenna or Poty patch.

The efficiency is not the same and much more lower, as the use of the horn (trumpet) of the LNB is omitted and also the position of the feed in transmission will never result in the exact focus of the dish, but sometimes compromises are also accepted in order to reach the goal.

In transmission to compensate for the losses it is however possible to use an additional 2.4GHz amplifier.
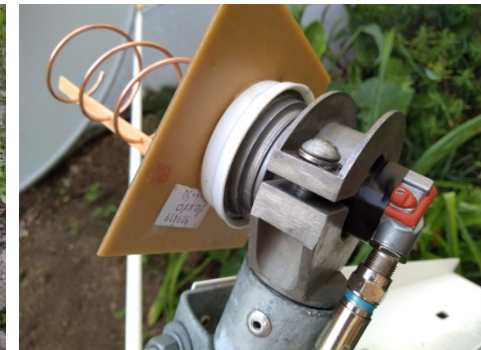
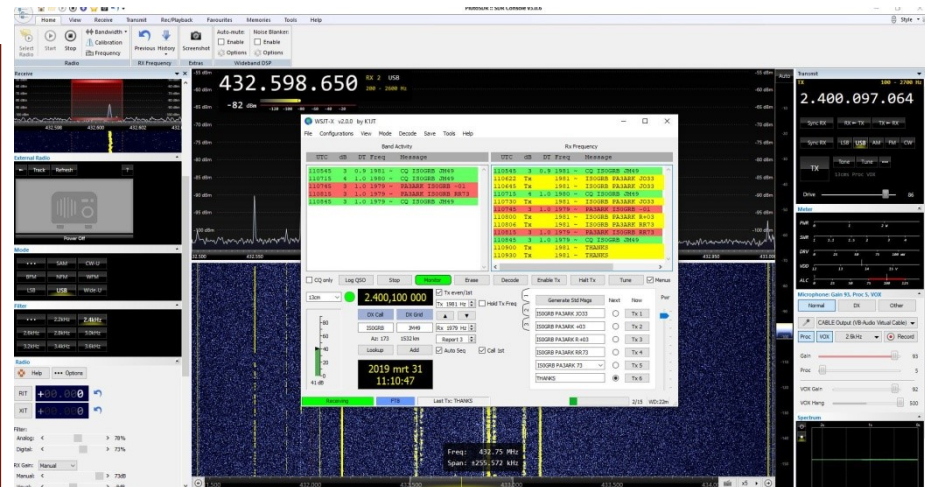# Transmission modes on QO-100
The NB transponder

On the NB transponder with a bandwidth of 250 kHz, only the use of SSB and CW is permitted.

NB Band Plan: https://amsat-dl.org/en/p4-a-nb-transponder-bandplan-and-operating-guidelines/

In USB there are so many transmission modes, from the analog SSB to the digital systems, FT8, SSTV, DSSTV (KG-STV), FREEDV, WINLINK EMAIL, and others.

The digital systems, those in connected mode, to work on QO-100 must be able to manage delays of at least 1.2 seconds, otherwise due to the delay entered by the distance of the geostationary satellite the system that must receive not receiving the response of the correspondent in the redefined time frame attempts retransmission, with the result that many collisions are generated and the connection is not successful.

For this reason i have personally requested support from the author of the modem VARA EA5HK and the American colleagues of the Winlink system, specifically to the authors of the modems Winmor and Ardop, asking for a modification to the modem reception / transmission software; the only modem that at the moment has been adapted and works correctly is the **VARA SAT MODEM,** Sat version of the famous VARA modem; in this way i was able to provide users with the service of sending and receiving e-mails via satellite with my IS0GRB server that relies on the worldwide Winlink network through the internet.
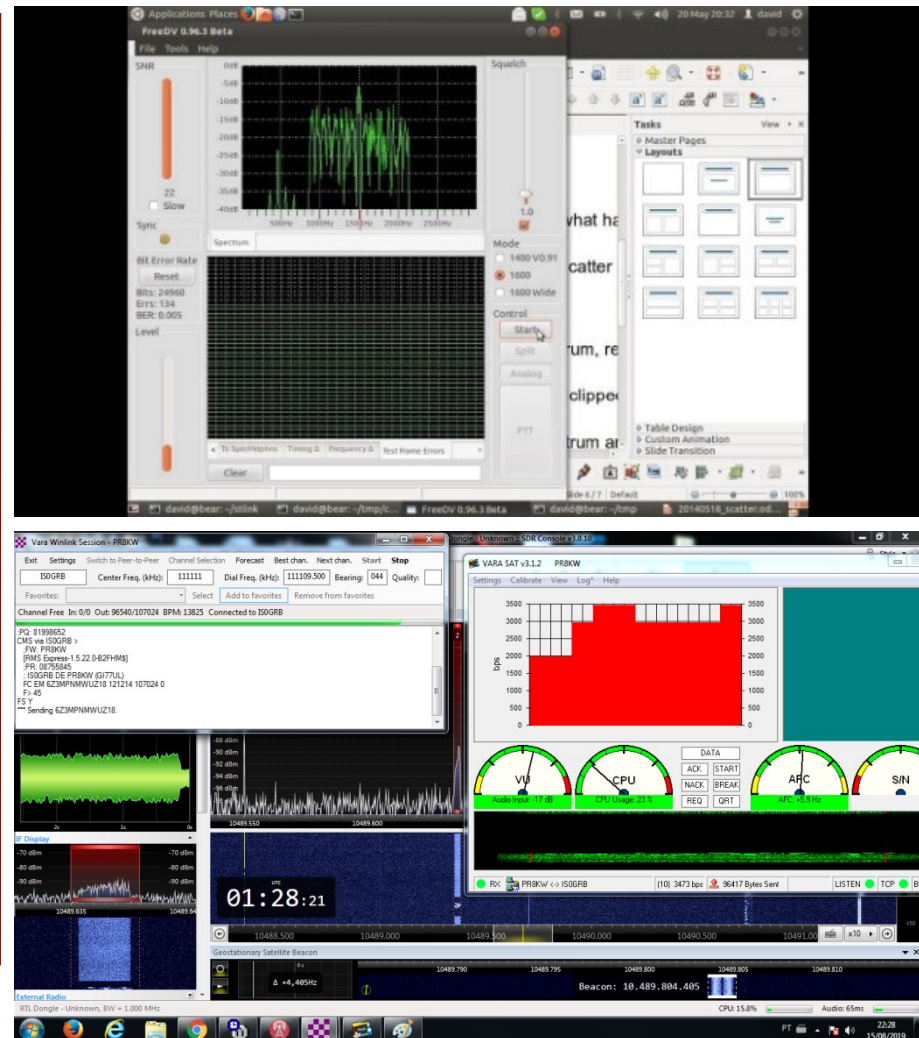
Transmission modes on QO-100
The NB transponder

Many tests have been carried out with the excellent stations of Oscar DJoMY and Gustavo PR8KW and with to their tests new interesting functions have also been implemented on VARA SAT MODEM, aimed at managing some QO-100 problems, such as the calibration of the frequency required by the server Winlink ISoGRB (GPS-controlled) which in response communicates to the client the frequency drift detected before starting the connection with the server. This ensures error-free data transfer due to slippage of the client frequency.

With the Winlink ISoGRB server and the VARA SAT modem with license, tests were performed in USB with a speed of 4.5 / 5 Kbps, allowing the transfer of a 100k file in about 7 minutes; soon, thanks to the granting of AMSAT-DL of a small slice of frequency on the WB transponder, DVB-S2 tests will be carried out with the use of specially developed software with data rates of 66Kbps.

On the transponder NB the FM transmission is absolutely prohibited and the respect of the band plan is strongly recommended.

Transmission modes on QO-100
The WB transponder

The WB transponder has a bandwidth of 8MHz and it is used exclusively for DATV transmissions.

WB Band Plan: https://amsat-dl.org/en/p4-a-wb-transponder-bandplan-and-operating-guidelines/

The standard used and allowed is the DVB-S2, but transmissions have also been seen in DVB-S and DVB-T.

In the WB transponder band plan, DATV channels have been defined, respectively of 2Mbps Symbol Rate, 1Mbps, 333kbps and 125kbps corresponding to certain frequencies of the WB transponder.

To operate on the WB transponder and to understand if the channels are busy, since the normal SDRs do not arrive at an 8MHz scan but stop at about 2.8M, the BATC site chat is supported so as to also view the spectrum and check which channels are occupied, to tune in to receive and / or transmit on a specific DATV channel, also having feedback from the participants of the quality of the transmission and the reception parameters such as the FEC, MER etc.

This is necessary as all commercially available DVB-S2 Free receivers are not able to tune DATV stations with Symbol Rates lower than 2M; some models are also capable of going down to 1M, but not certainly to 333 or 125kbps.

Transmission modes on QO-100
The WB transponder. DATV reception

To receive the QO-100 DATV it is therefore necessary to have appropriate receivers developed by radio amateurs, alternative decoding software or SDR interfaces, capable however of continuously scanning the band to intercept new stations in transmission.

Using a normal receiver, it is possible to receive only the 2Mbps QARS beacon that also defines the start of the WB transponder but is still not able to remain in continuous scan, absolutely necessary function for the DATV of amateur radio operators where the occupied frequencies are not constantly used, so you need a system that identifies them to present them to the listener.

To receive the Qo-100 DATV it is necessary to supply the LNB, instead of 13.8V (vertical polarization) with 18V (horizontal polarization).

Using an unmodified commercial LNB the frequency slice, between 10491 MHz and 10499 MHz will be converted between 741 and 749 MHz.

It is therefore not possible to receive this frequency range with a normal free satellite receiver, as the tuner is only capable of tuning between 950 and 2150 MHz, as for the satellite TV commercial standard.

Transmission modes on QO-100 Transponder WB. DATV HW / SW reception

With a modified LNB it is possible, however, also to move the conversion higher than 950 MHz, in order to receive the signals with a commercial receiver, but if it is not able to go below the 2Mbps of Symbol Rate from technical specifications all this is useless.

How to receive the QO-100 DATV more easily?

It is necessary to use hardware or software receivers specifically designed by amateur radio operators.

Hardware:

-**Octagon SF-8008 receiver**, capable of going down to 125kbps of Symbol Rate

-**MiniTiounerExpress receiver** of the DATV-Express in assembly kit

-**Decoding software developed by Markr092 SWL**, published on the AMSAT-DL forum, which allows the use of a normal SDR Stick RTL2832 (R820T2) for decoding the DATV signals of QO -100; for use, a Dual / Quad Core PC is required
https://forum.amsat-dl.org/index.php?thread/101-software-dvb-s-demodulator/
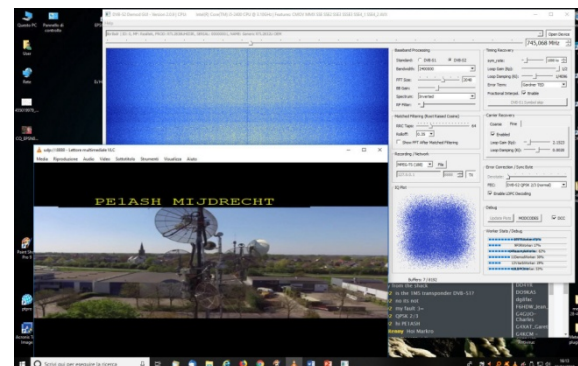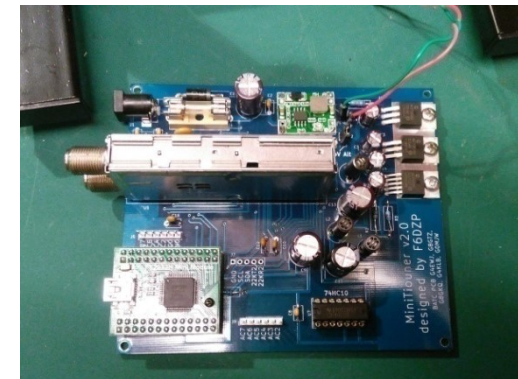
Transmission modes on QO-100 Transponder WB. DATV HW transmission

Transmitting in DATV on QO-100 is more complex and expensive compared to analogue transmission in the NB transponder, as a decidedly higher SNR is required on the receiver compared to SSB, being the widest transmission channel.

Hardware:

- **Adalm Pluto SDR interface** (the most used), to be used in addition to one or more 2.4GHz amplifiers that increase the power up to at least 100-120W

-**DVB-S2 transmitters from broadcasting sources**

-**DVB-S2 self-built transmitters**

After several months of testing by radio amateurs, standards were reached regarding power and equipment to be used; to be able to make transmissions of at least 333kbps or 1Mbps it is necessary to use a power of about 120W, in addition to a dish with a diameter of 120/150 or 180cm. With lower powers it is however possible to transmit in DATV at speeds of 125kbps or 66kbps S/R.
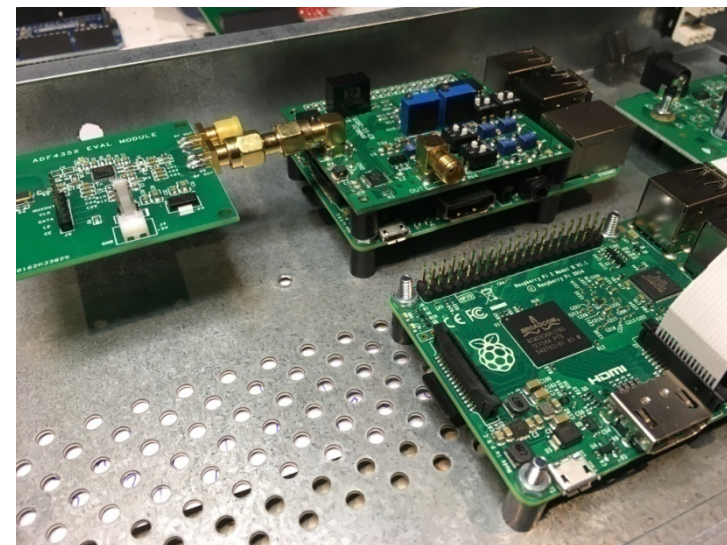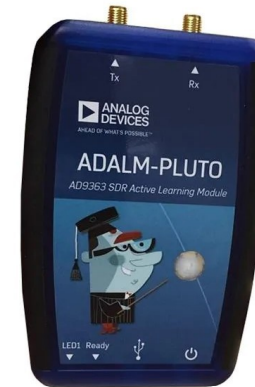
Transmission modes on QO-100
The WB transponder. Video software

In the use of SDR interfaces, such as the ADALM Pluto but also with self-built transmitters, it is necessary to use special software that allows the digitalization of the audio and video sources and the creation of a digital multiplexer, which will be modulated by the SDR interface , consisting of a digital I /Q digital modulator data inside it.

The Multiplexer (commonly called MUX) is a circuit, in this case a software, a data line selector, capable of selecting different analogue and digital input signals.
Once the data have been selected, the signals are collected and sent in a single data output line (data flow).

The data flow thus obtained is encoded on a sinusoidal wave; this process is called digital modulation.

The most used video preparation software for DATV on QO-100 are:

-**VMIX** (https://www.vmix.com/) for a fee

-**OBS Studio** (https://obsproject.com/) , free

These software, besides allowing a video direction, with special overlays and video effects, also allow the creation of a digital multiplexer, which will be sent to the I/Q modulator, for example an Adalm Pluto SDR or other type of digital I/Q modulator at high speed.
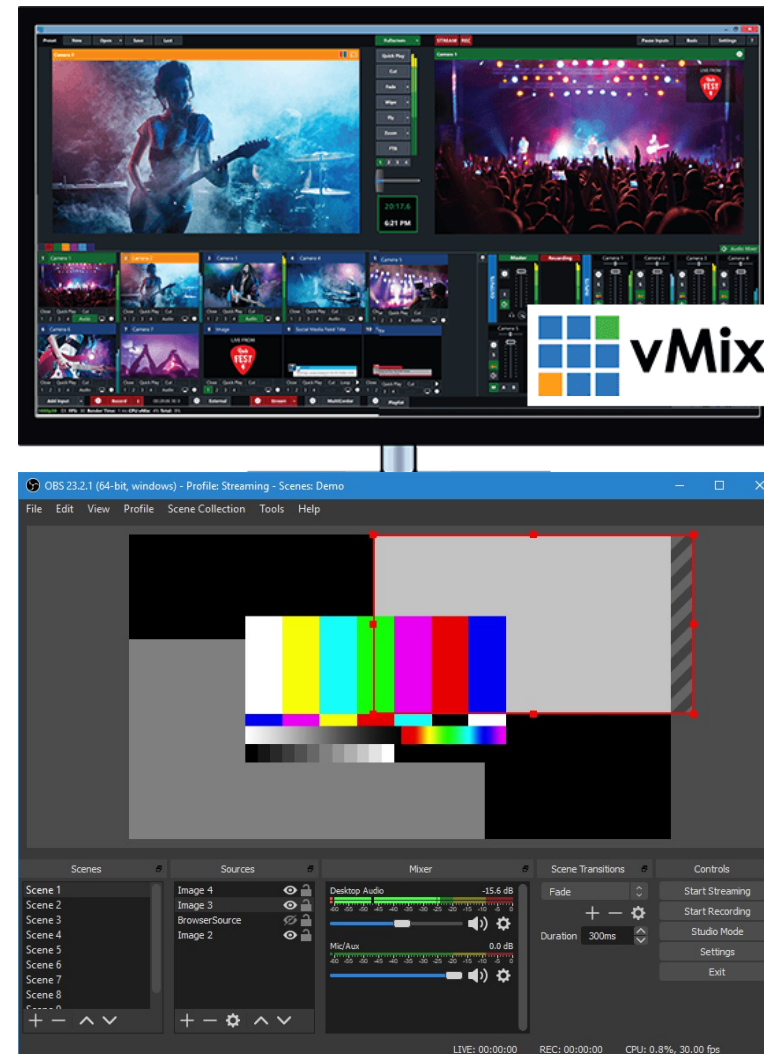
Activities on the NB / WB transponders of QO-100

There are many activities that are carried out every day on the NB and WB transponders.

- **DX connections in SSB**, from Brazil to China.

- **Activations of special stations**, at events, such as fairs, meetings, on board of boats, etc., both in SSB and DATV.

-**Miscellaneous digital communications** including sending and receiving emails from amateur radio at sea, in campers and / or in areas not covered by internet connection through the Winlink ISoGRB server.

-**Reception of the PSK telemetry beacon at 10489.800**, which provides a great deal of information on the status of the satellite, the various circuits' power supplies, on-board temperatures, operating circuits and more.

- **DATV transmissions with interesting technical contents**.
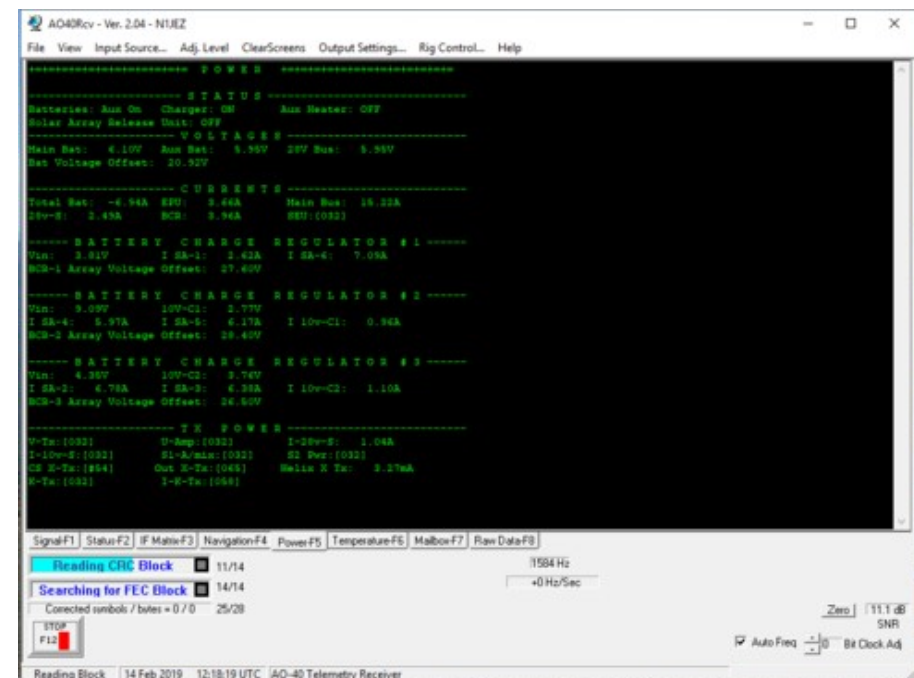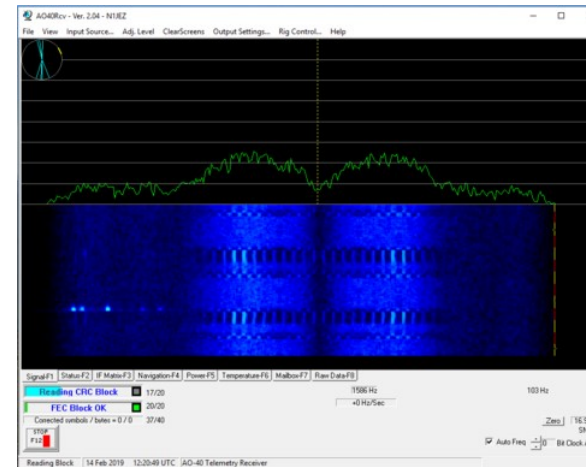
Listen to Qo-100 via the Internet (WebSDR)

Immediately after launching the ISoGRB has installed and make available a ground listening station with WebSDR on the internet, allowing the listening of the satellite and in particular the NB transponder to all fans of this project.

With this initiative, many amateur radio operators tuned in even before the satellite became operational, to intercept the very first tests of transmitters by Mitsubishi.

Since then many recordings have been made and immediately after the inauguration has allowed many amateur radio amateurs and not to listen to the traffic of QO-100.

With the passing of the months and with the experience matured the WebSDR ISoGRB has become a point of reference for many OMs in the world; in the meantime, other WebSDRs have also been turned on including that of BATC in England and others scattered around the world.

A point in favor of the ISoGRB WebSDR is the audio quality of the reception, with audio bandwidth starting from 100Hz in SSB, guaranteeing an excellent transmission reception.

Listen to Qo-100 via the Internet (WebSDR)

After a few months from the activation, the ISoGRB WebDR is equipped with a GPS-DO, in order to provide a very precise reference even on the reception frequency indicated.

Today it also integrates an automatic demodulator for DSSTV images, transmitted with the KG-STV software by various enthusiasts to 10489.625.

Users connected to the WebSDR also have the possibility of inserting DX spots of received stations, which are then displayed, through specially developed scripts and by querying the authorized QRZ database, on a world map with adjustable zoom, in order to immediately identify the position of the amateur radio in transmission.

http://websdr.isogrb.it:8901
(Desktop version - Official page)

http://websdr.isogrb.it:8901/m.html
(Mobile version for Android / IOS)
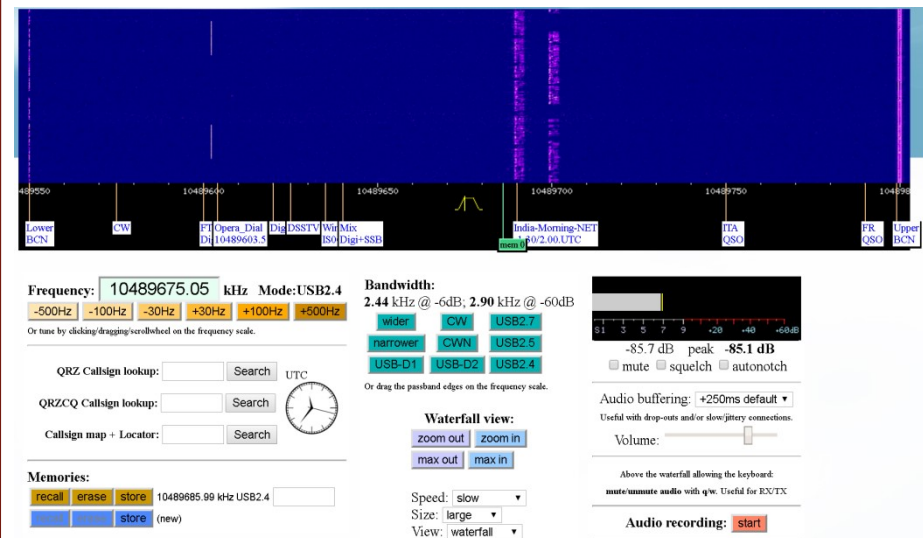
ISoGRB WebSDR Project Diagram

ISoGRB Es'Hail2 SAT 26°Est WEBSDR project diagram v.1.0 (28/01/2019)