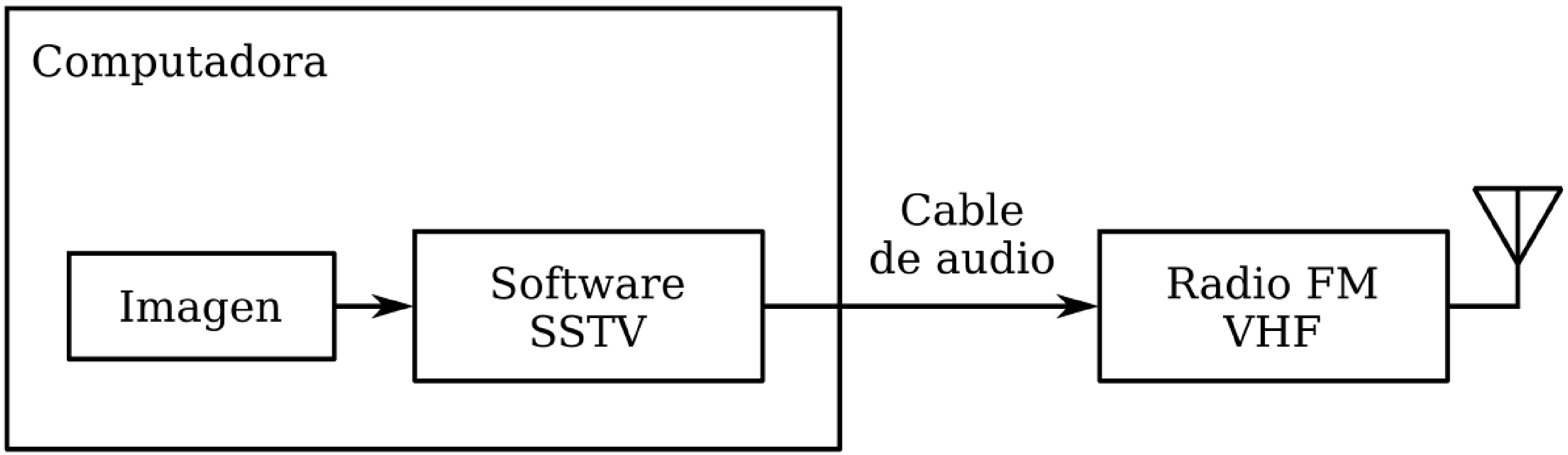
SSTV PD120

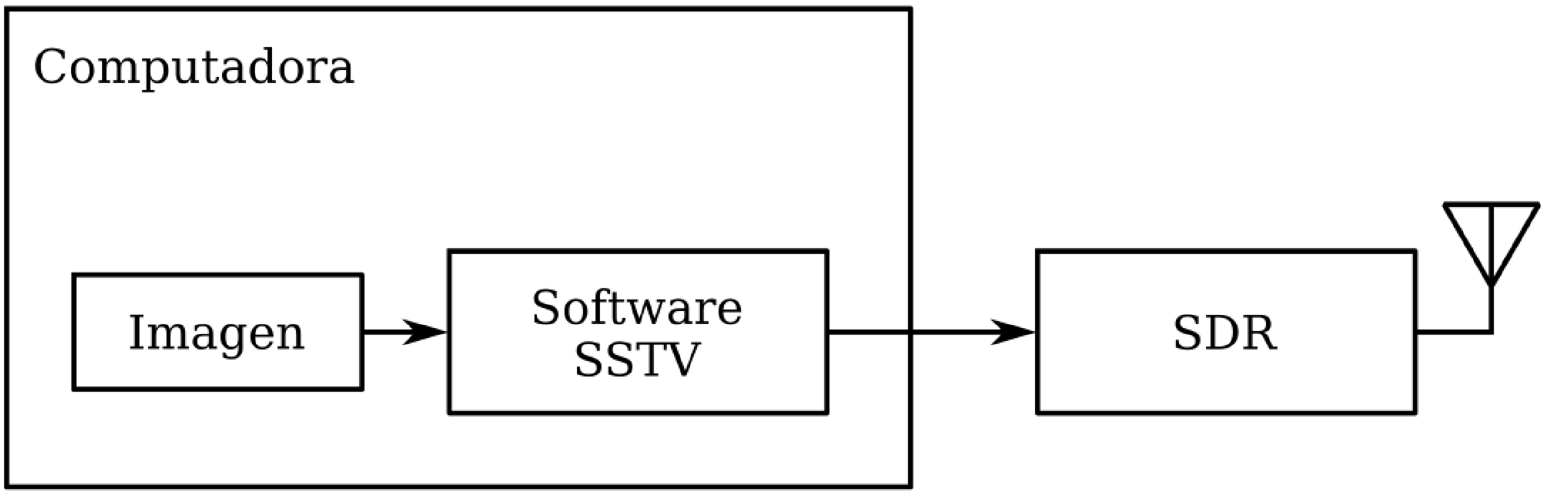
Bernardi Martín Gustavo
Remedi Augusto
Rittano Ignacio

SSTV

- Banda angosta
- Se puede usar en canales de voz
- FM que varía su frecuencia en función de cada píxel
- Luego modulado en FM de nuevo

Transmisión



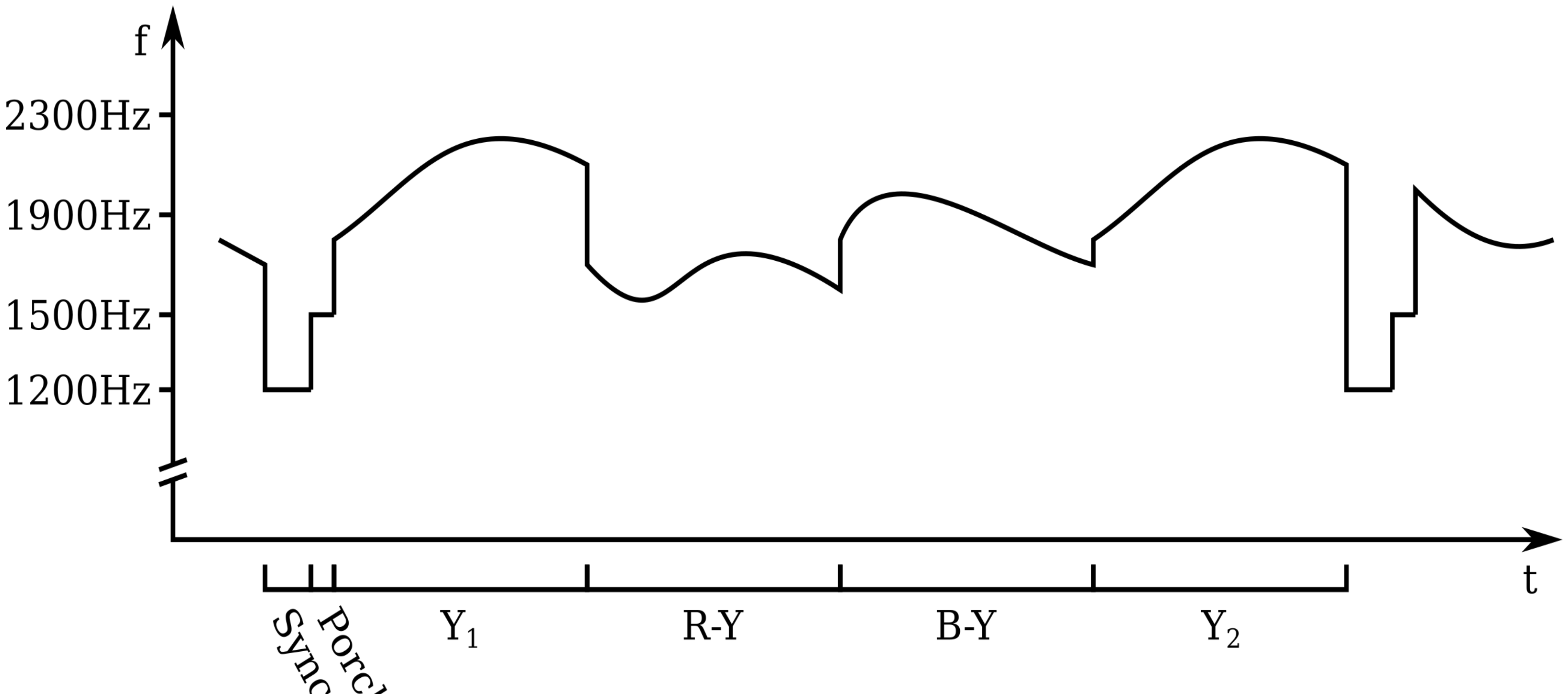


PD 120

- 640x496
- 126 segundos
- Sync de 1200Hz
- Colores de 1500Hz a 2300Hz

- Hay otros modos: 50/90/120/160/180/240/290.

Formato



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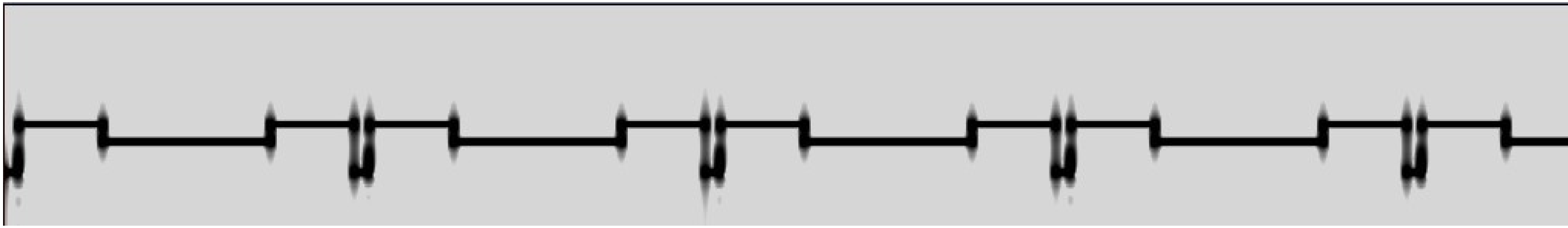

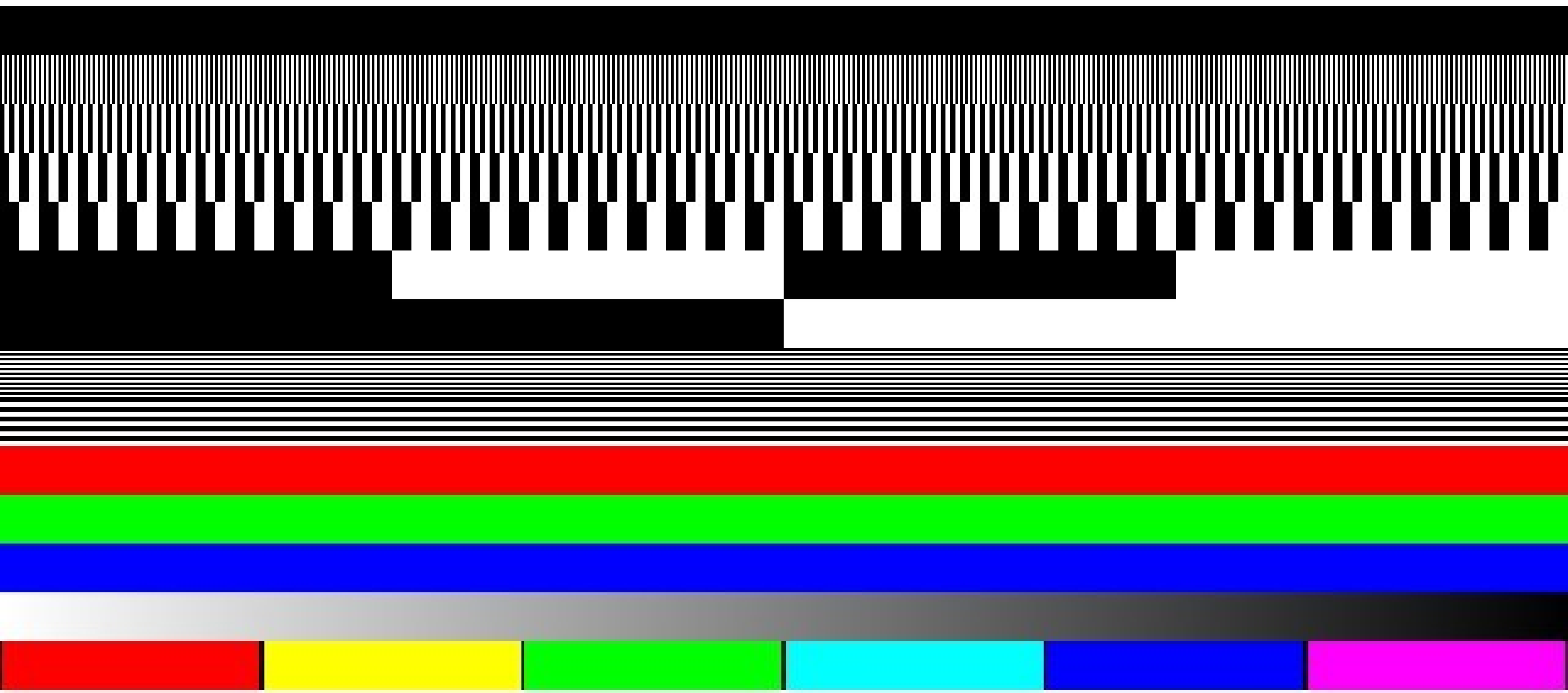

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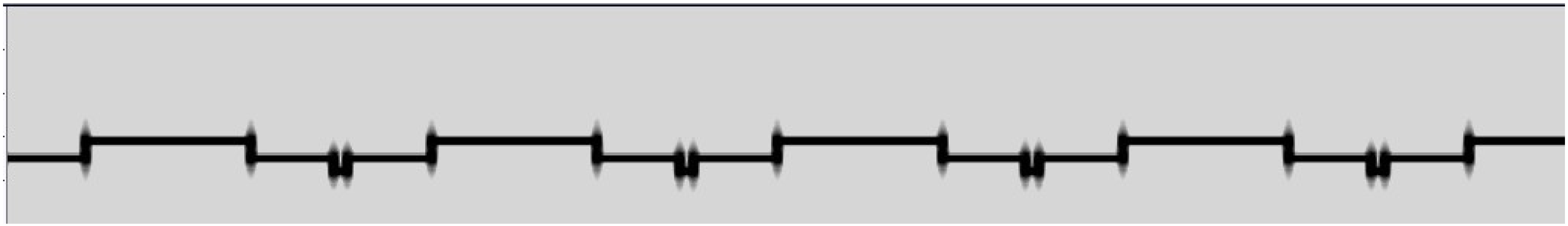

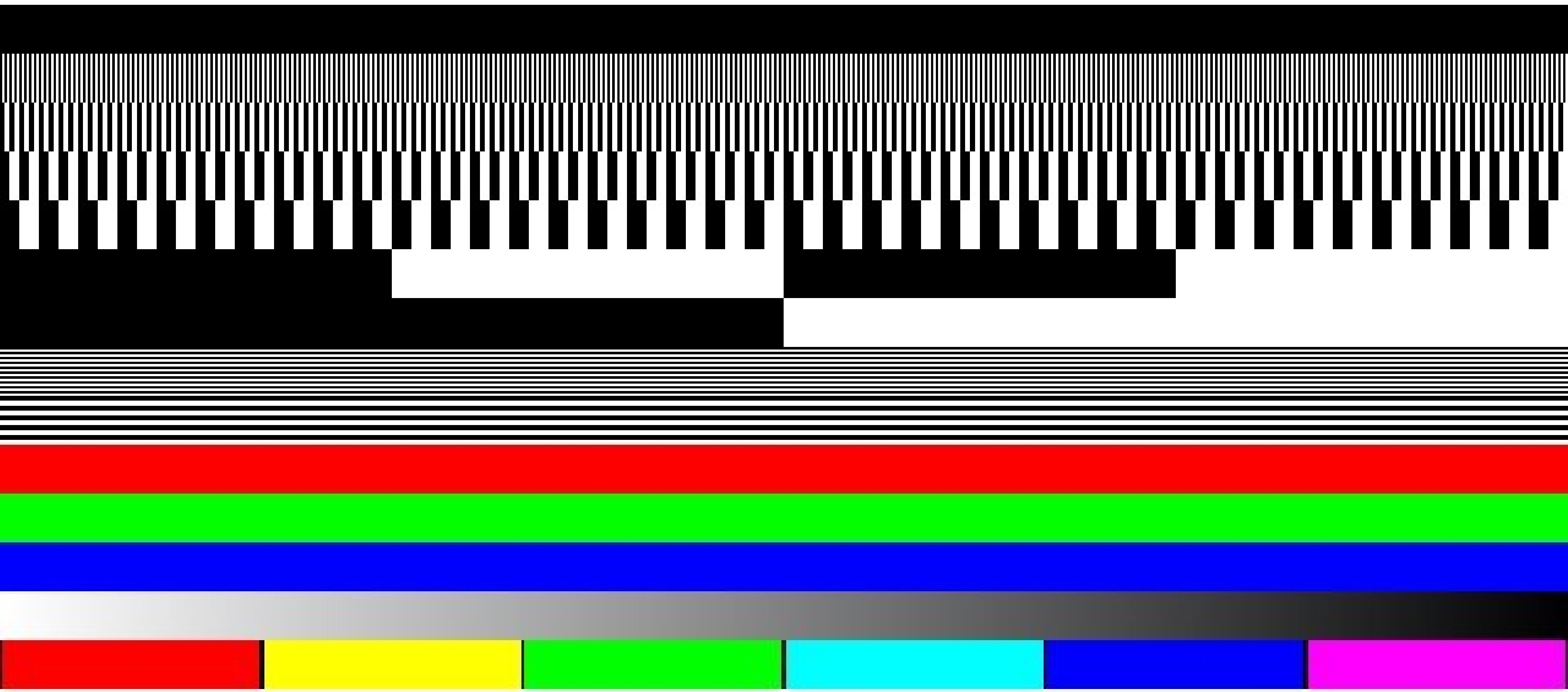

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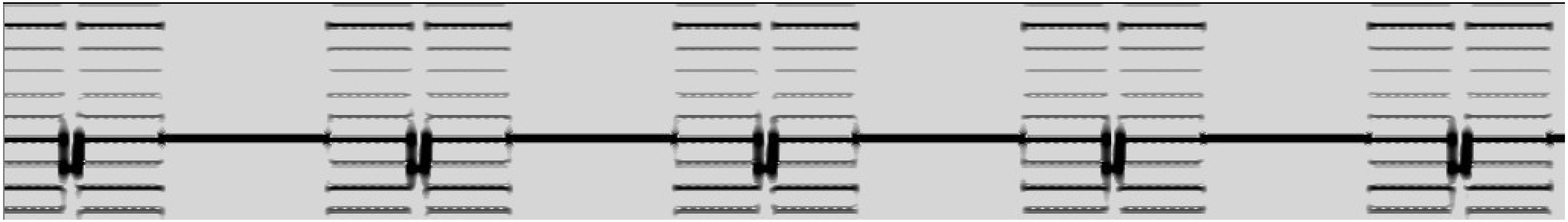

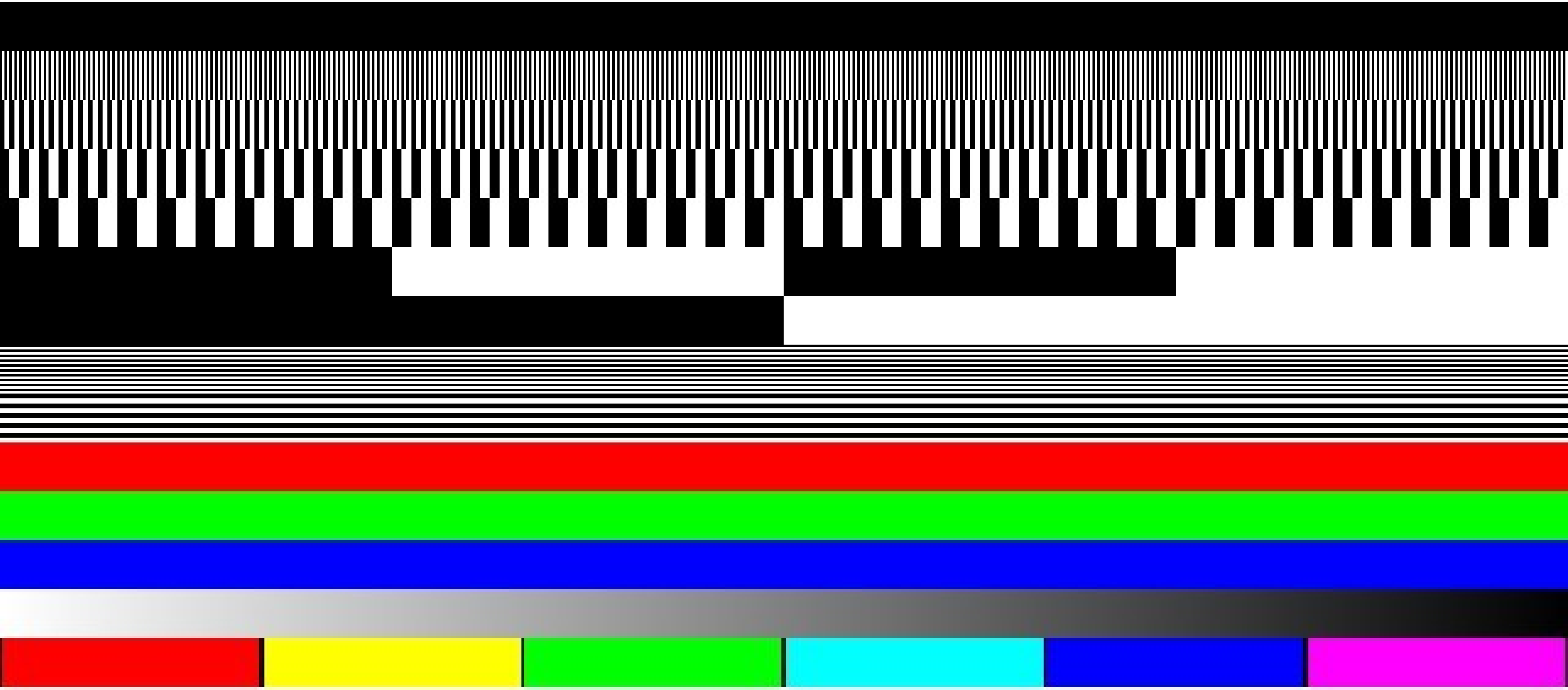

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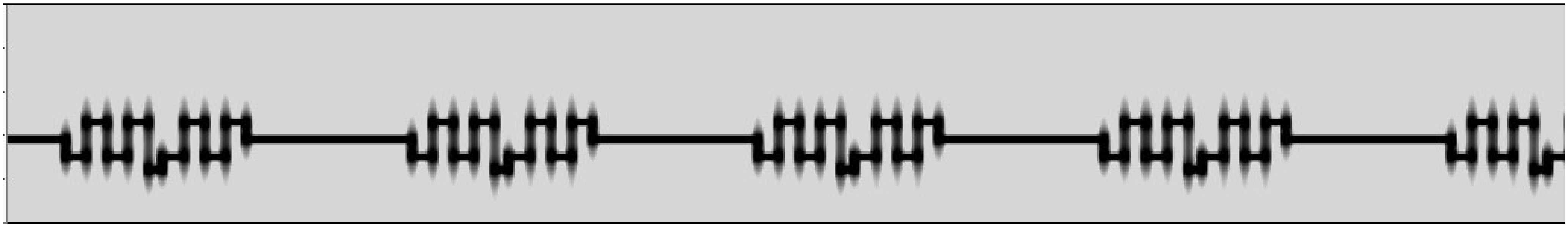

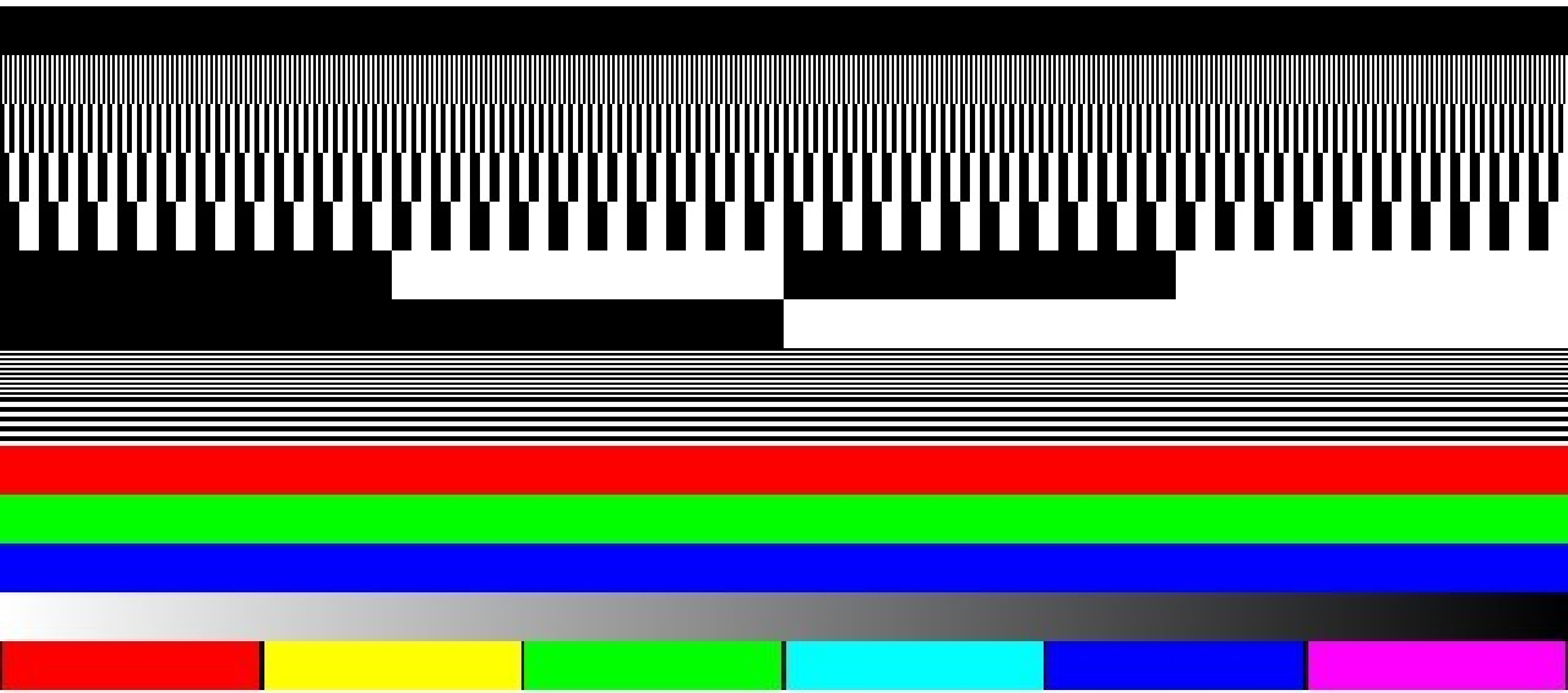

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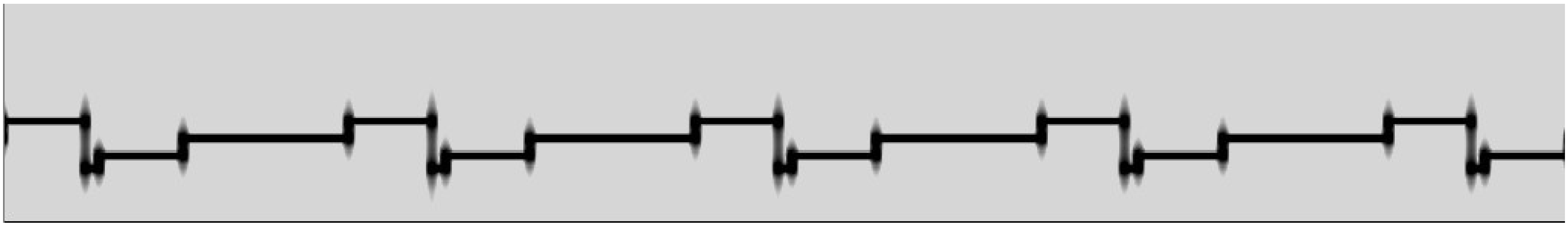

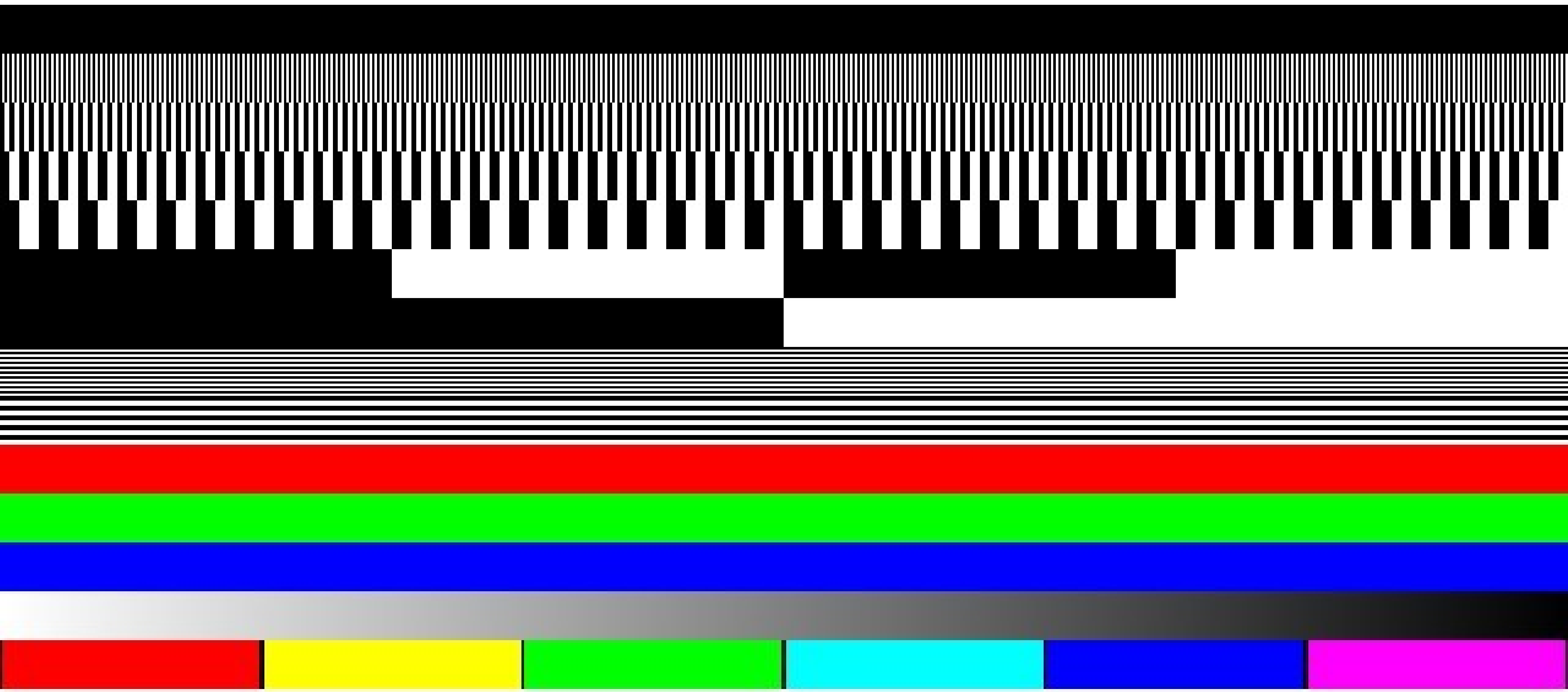

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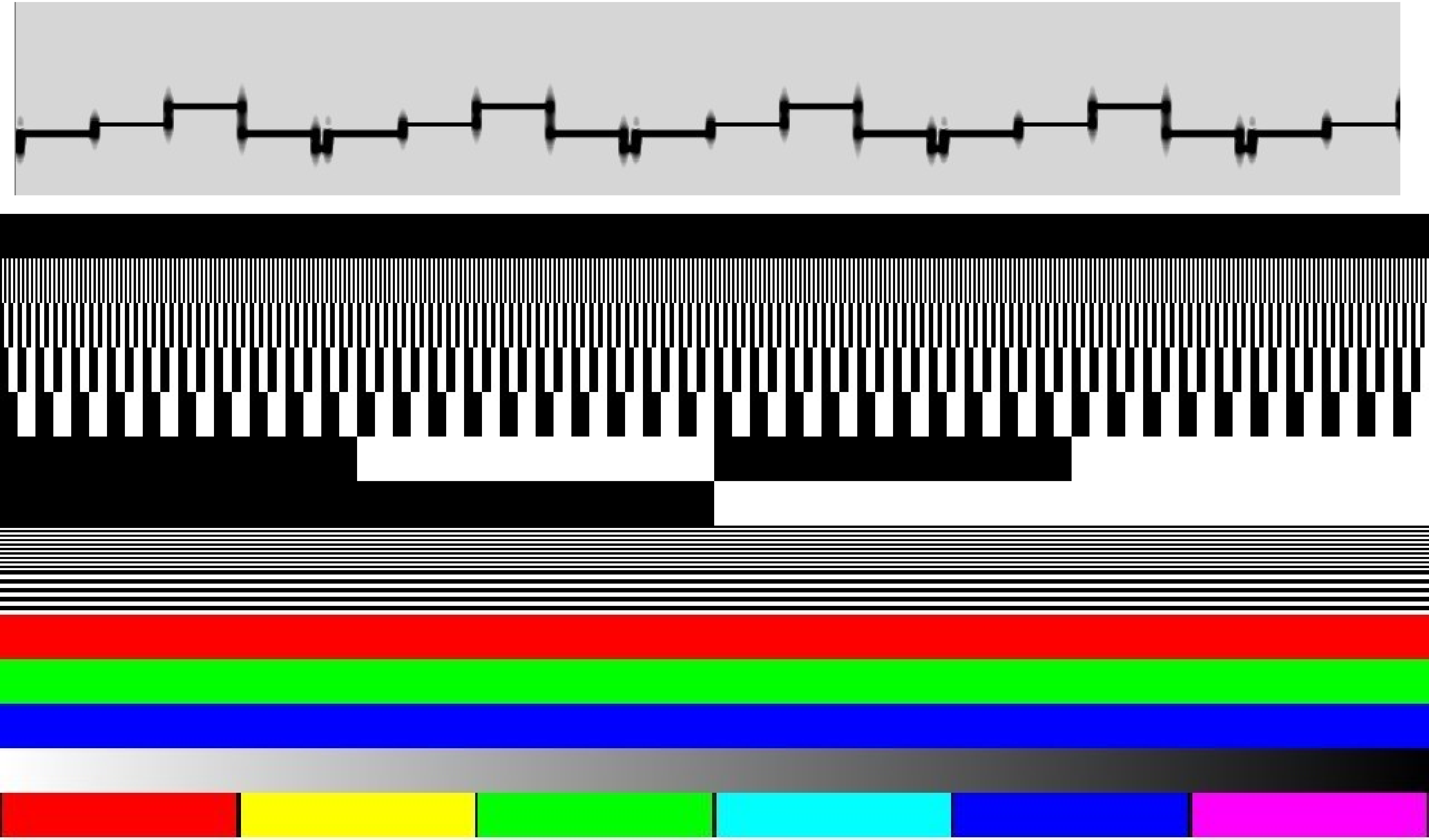

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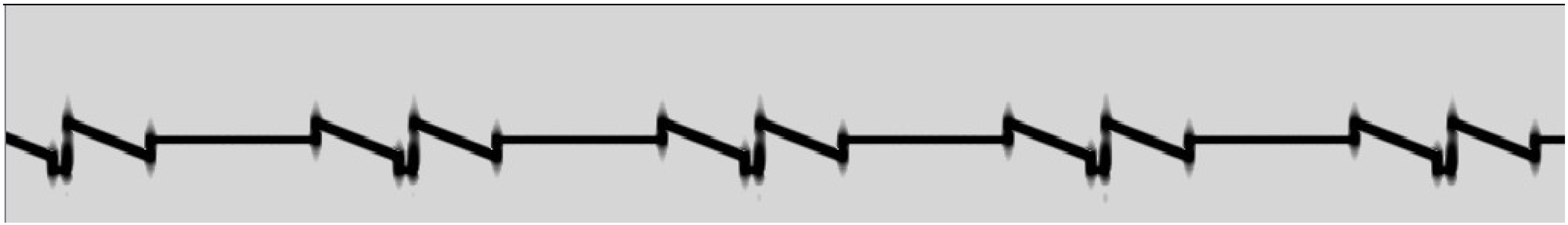

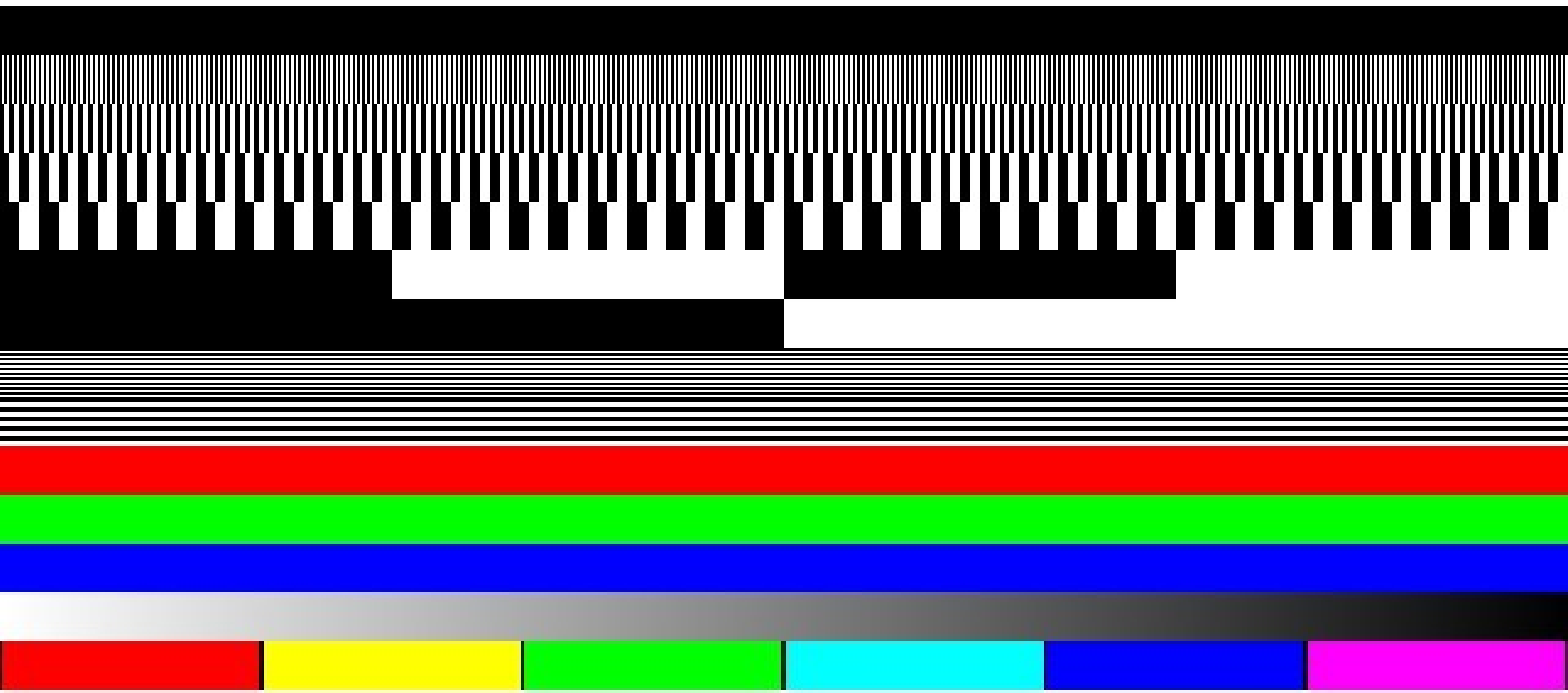

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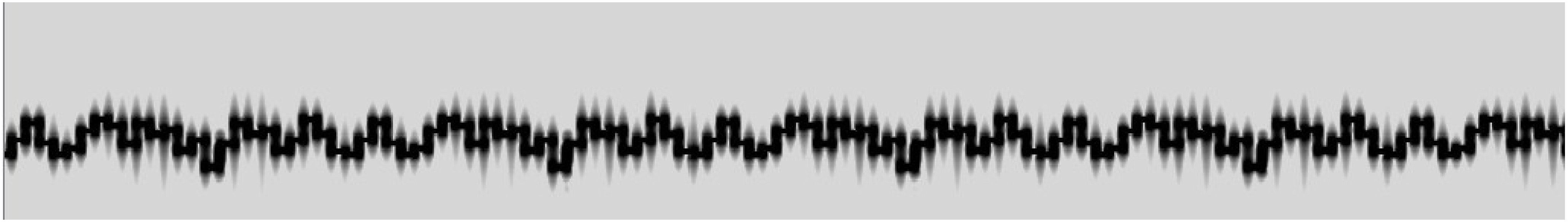
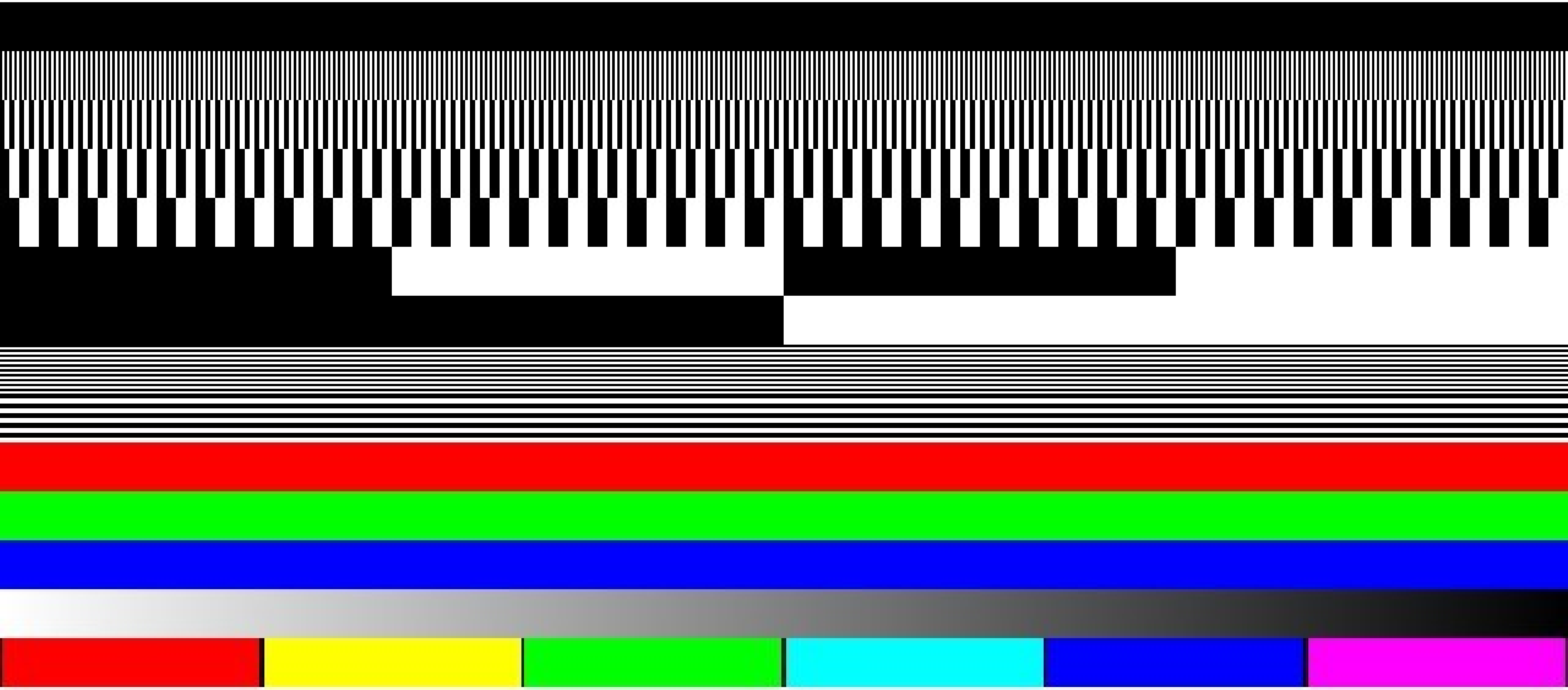
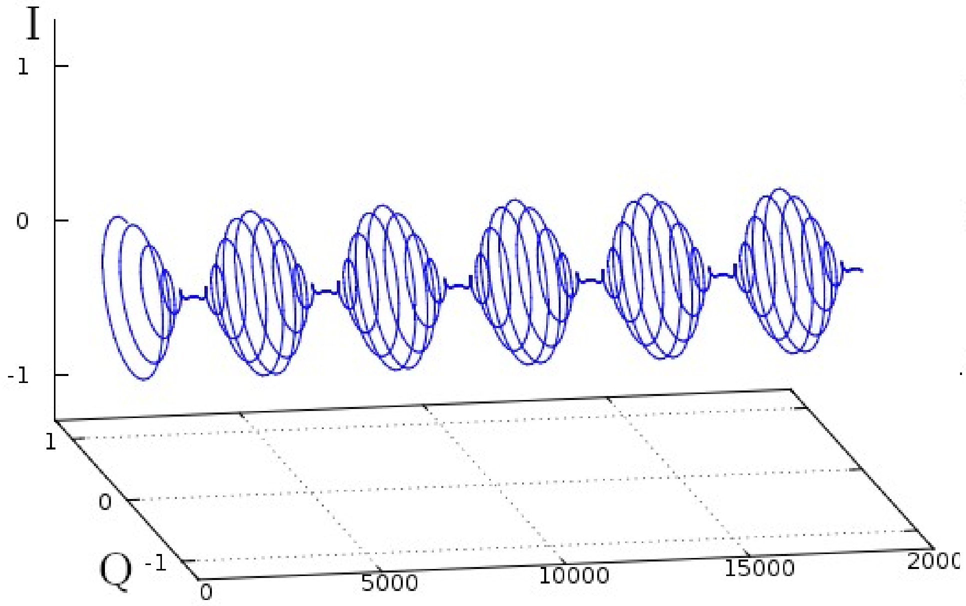




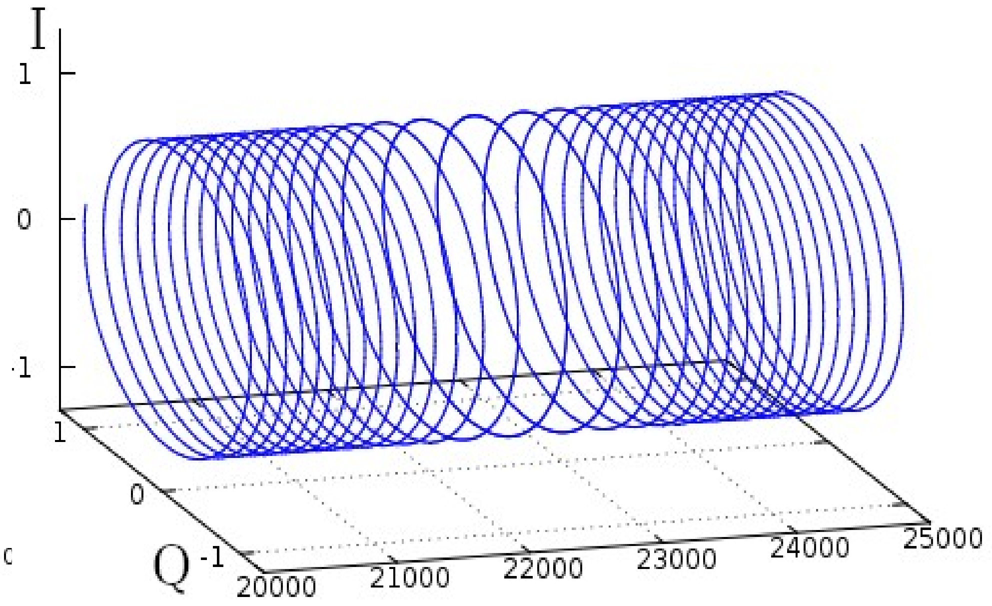
Compresión de color

Modulación y Demodulación

Señales I/Q



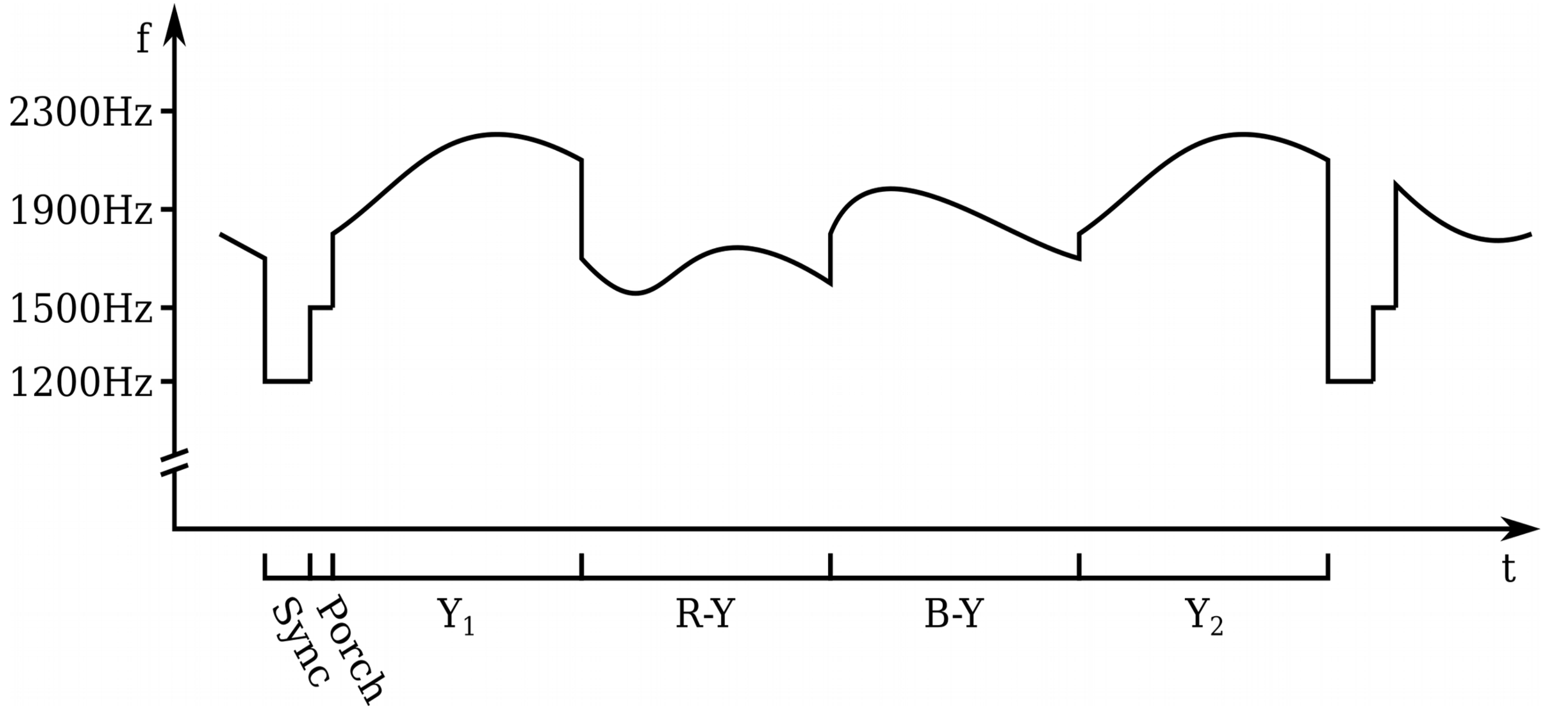
I
1
0
-1
Q
1
0
-1
0
5000
10000
15000
2000



I
1
0
-1
Q
1
0
-1
20000
21000
22000
23000
24000
25000

Modulación

- Abrir imagen
- Obtener frecuencias instantáneas línea por línea (f_s = 10kHz)



Modulación

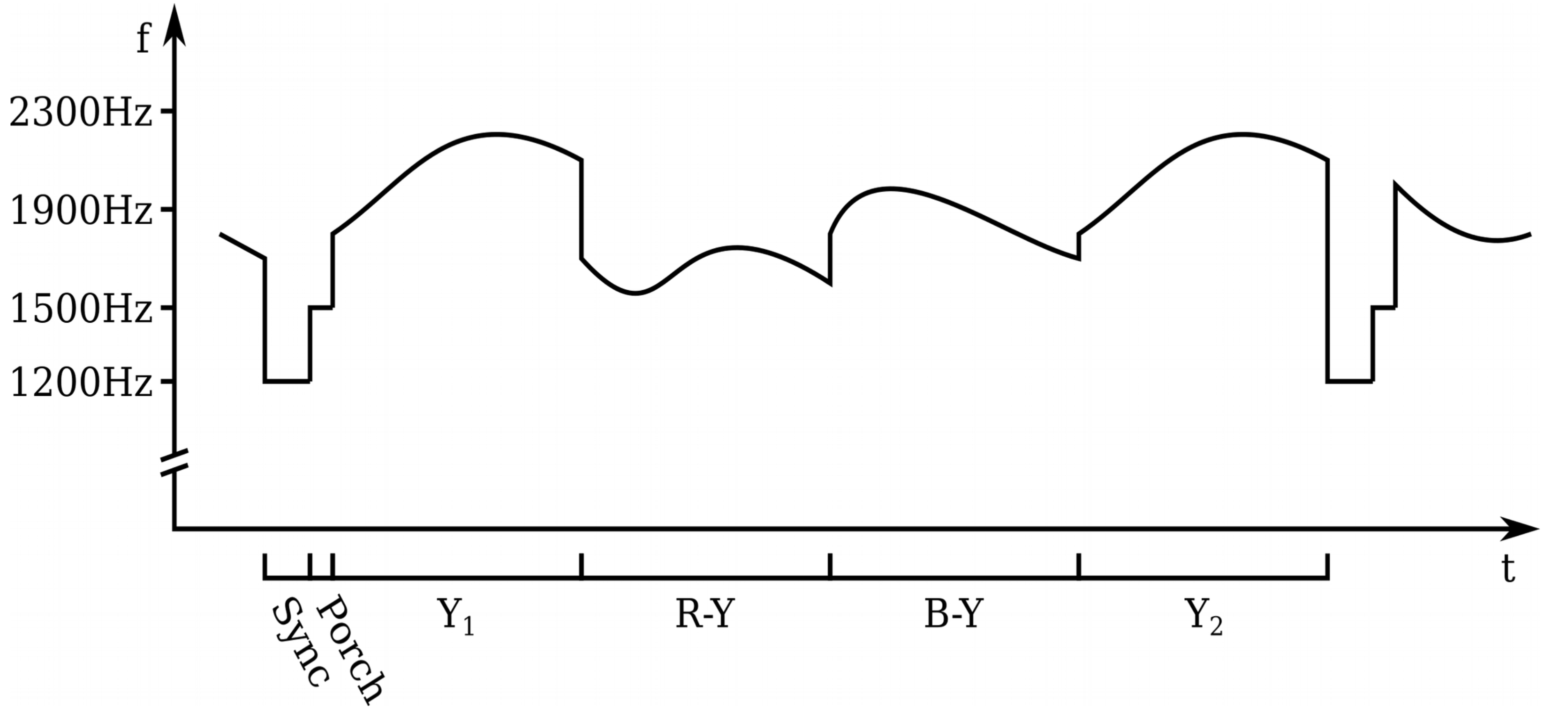
- Se parte de las frecuencias instantáneas (f_s = 10kHz)
- Generar SSTV (f = 1200Hz a 2300Hz)
- Modular en FM (f_c = 10kHz, f_s = 300kHz)
- Almacenar señal I/Q
- Enviar muestras a SDR
- SDR translada frecuencias (10kHz → 462.538MHz)

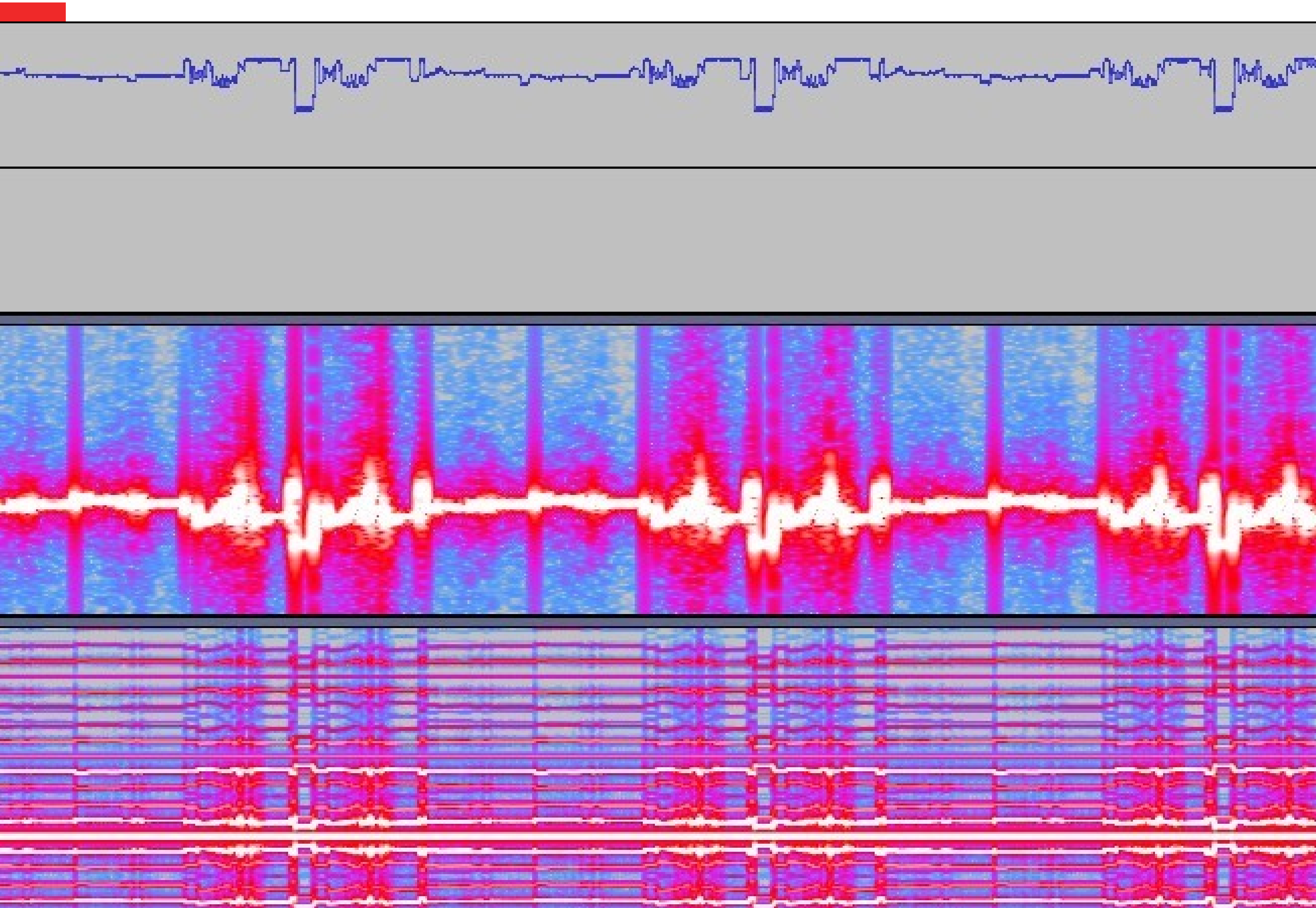
Demodulación

- SDR translada frecuencias (462.538MHz → ~0Hz)
- Almacenar muestras I/Q (f_s = 300kHz)
- Demodulación FM (se obtiene señal real)
  (f = 1200Hz a 2300Hz, f_s = 300kHz)
- Filtrado (de altas frecuencias y DC)
- Diezmado (f_s = 10kHz)
- Filtro de Hilbert (para obtener I/Q)
- Demodulación FM (se obtiene frec. instantánea)

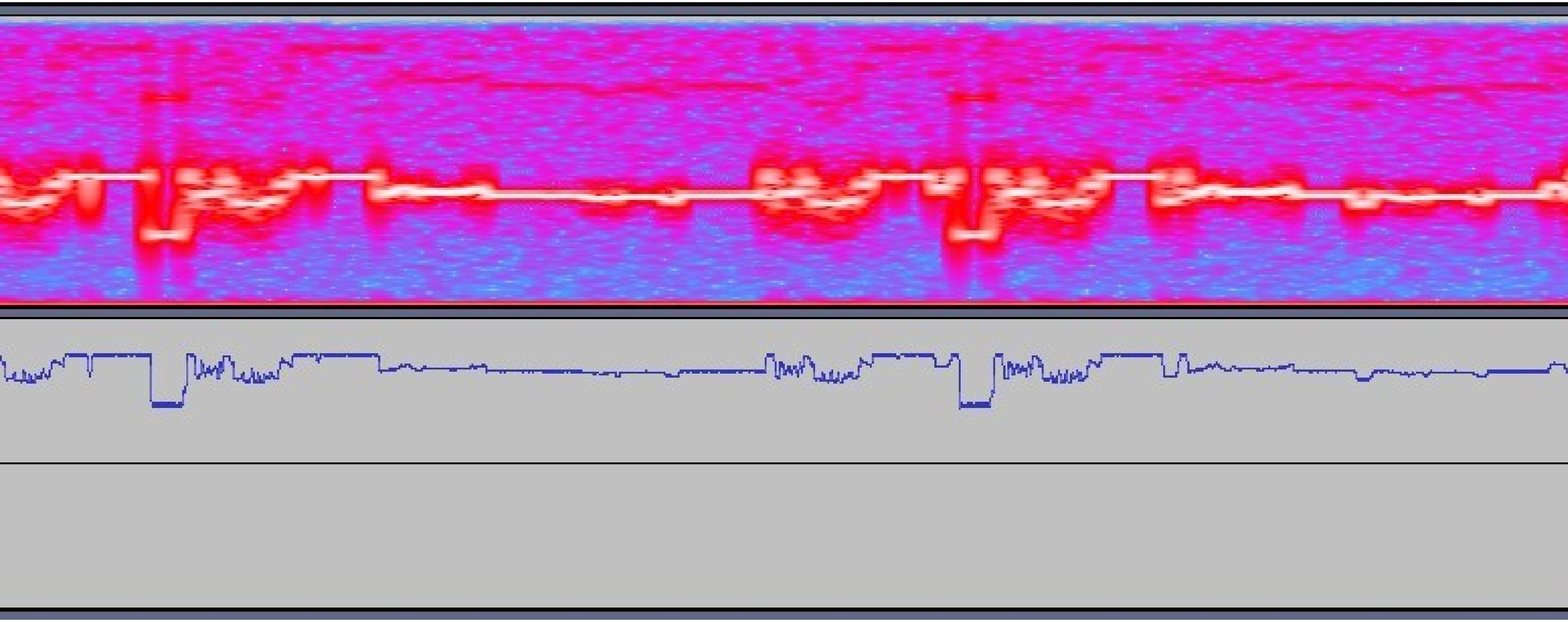
Demodulación

- Se parte de la demodulación FM (se obtiene frec. Instantánea)
- Buscar Sync (1200Hz por 20ms)
- Muestrear intervalos (640 píxeles)
- Generar imagen





Demodulación

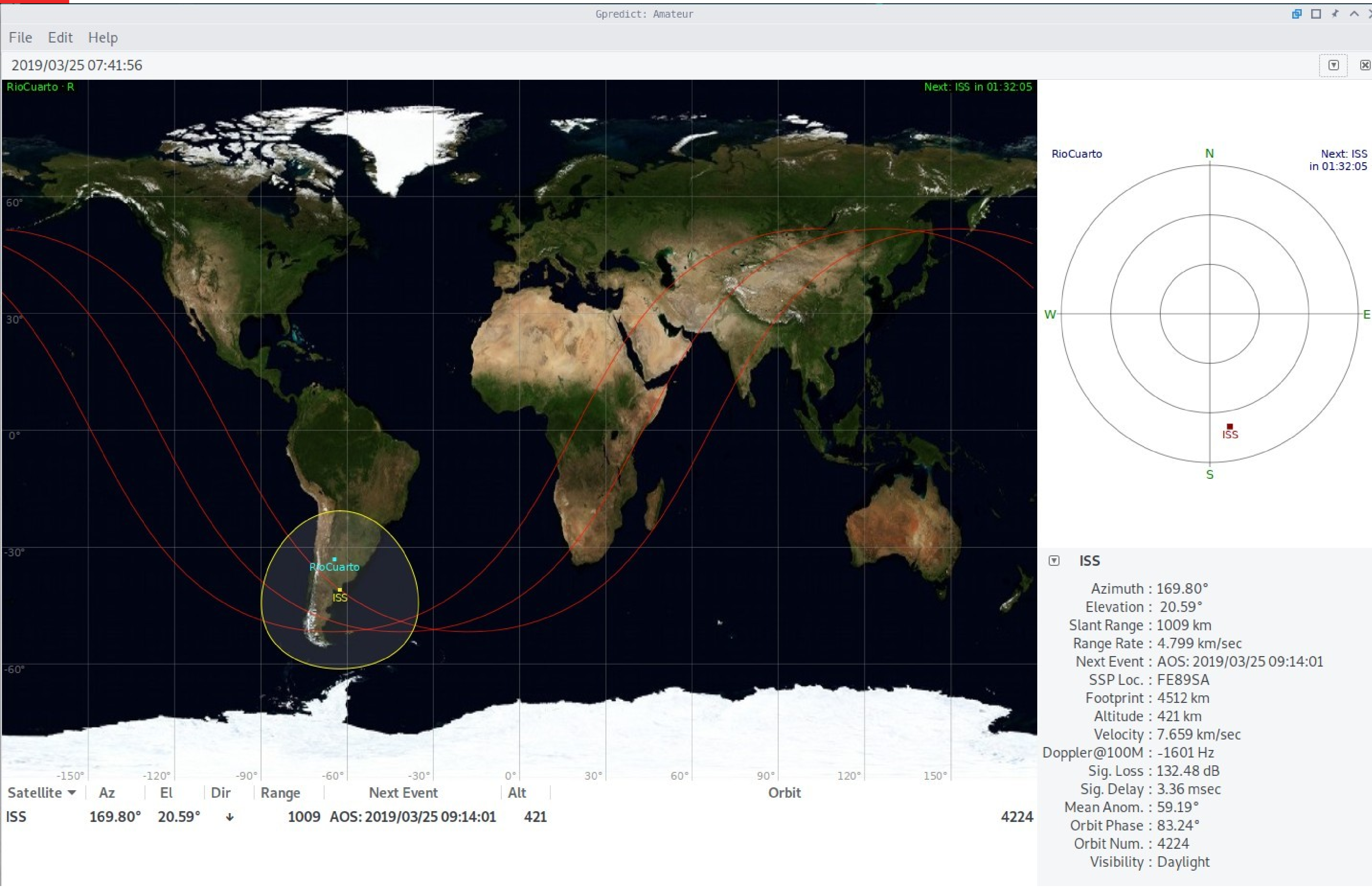


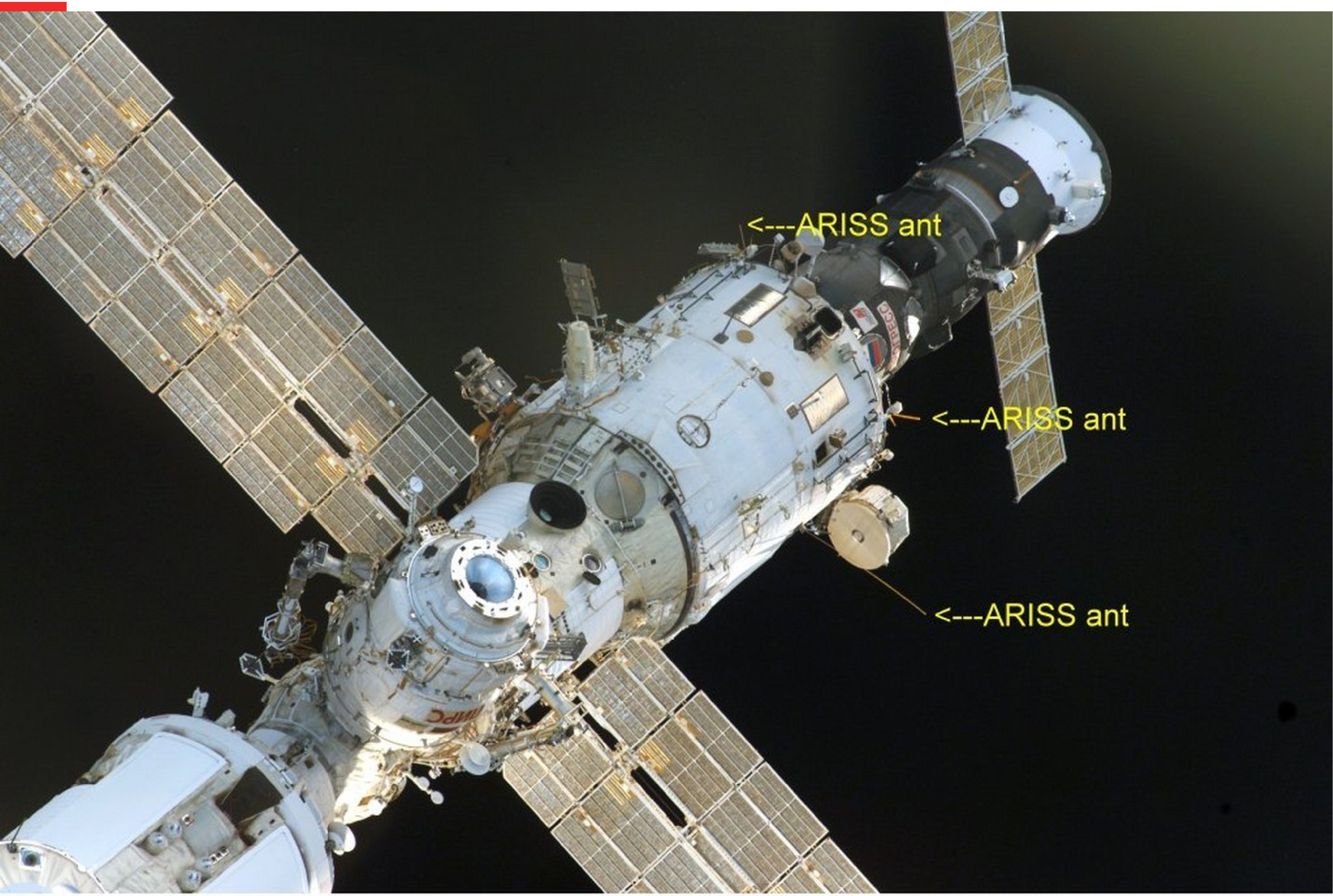
Estación Espacial Internacional

ISS

- 6 astronautas
- Habitada de forma continua desde el 2000
- 420000 kg
- 72x108m
- Entre 330 y 435 km de altura
- 51.64° de inclinación
- 27600 km/h
- Una órbita cada 90 minutos, 15 órbitas por día

S133E010451


Gpredict: Amateur
File Edit Help
2019/03/25 07:41:56
RioCuarto · R
Next: ISS in 01:32:05
60°
30°
0°
-30°
-60°
RioCuarto
ISS
-150° -120° -90° -60° -30° 0° 30° 60° 90° 120° 150°
RioCuarto
N
Next: ISS in 01:32:05
W
E
S
ISS
ISS
Azimuth : 169.80°
Elevation : 20.59°
Slant Range : 1009 km
Range Rate : 4.799 km/sec
Next Event : AOS: 2019/03/25 09:14:01
SSP Loc. : FE89SA
Footprint : 4512 km
Altitude : 421 km
Velocity : 7.659 km/sec
Doppler@100M : -1601 Hz
Sig. Loss : 132.48 dB
Sig. Delay : 3.36 msec
Mean Anom. : 59.19°
Orbit Phase : 83.24°
Orbit Num. : 4224
Visibility : Daylight
Satellite Az El Dir Range Next Event Alt Orbit
ISS 169.80° 20.59° ↓ 1009 AOS: 2019/03/25 09:14:01 421 4224



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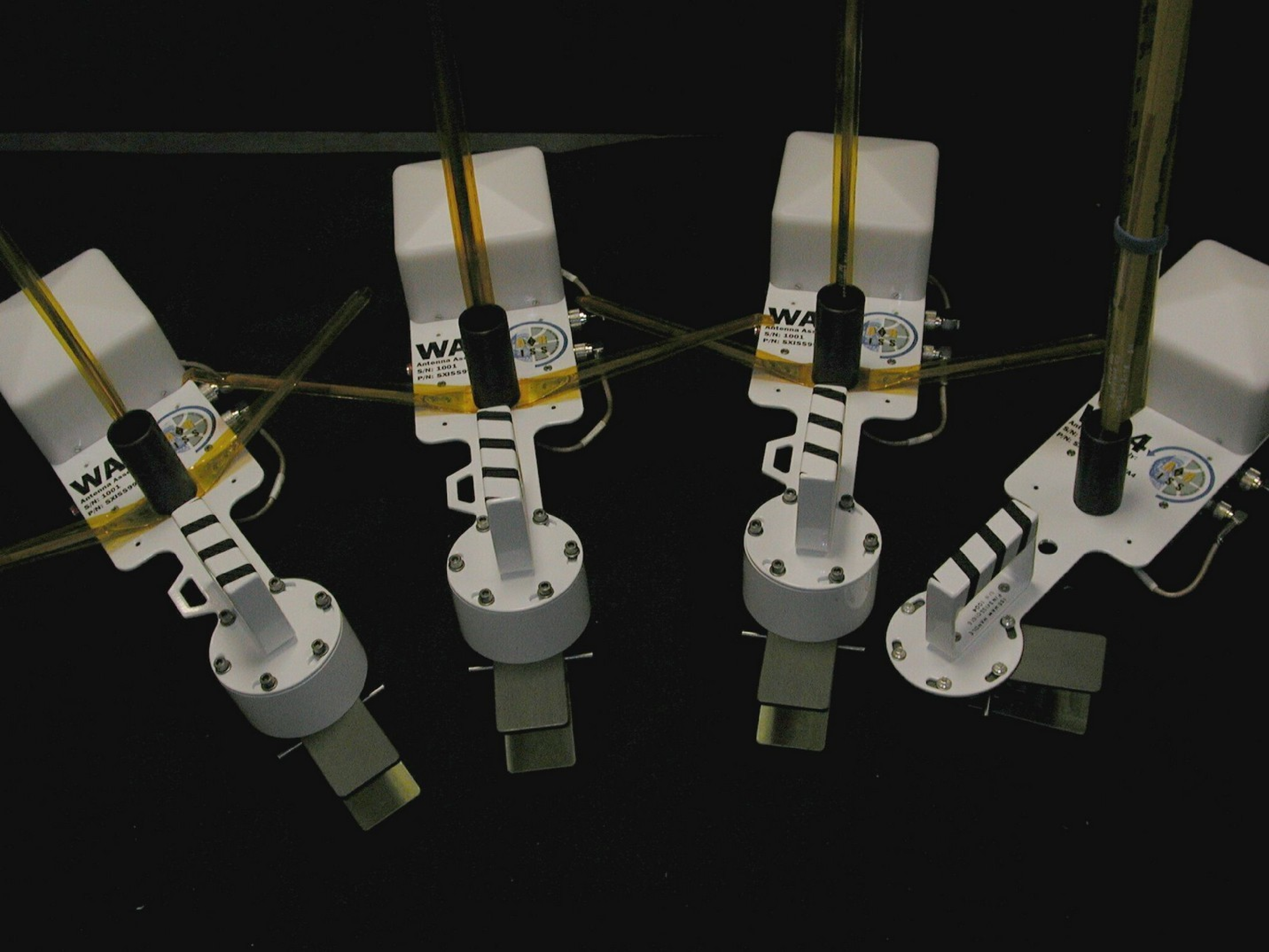
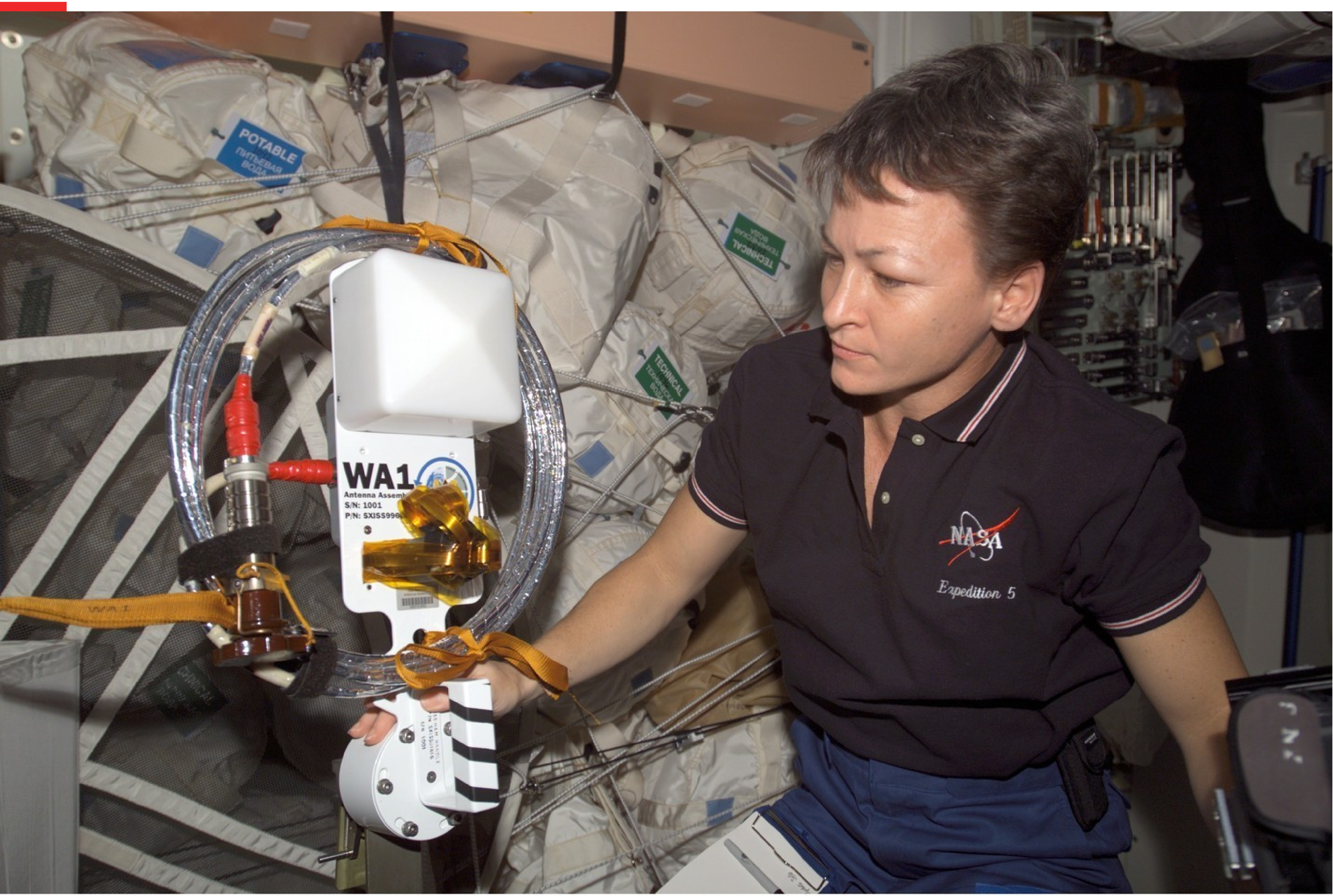
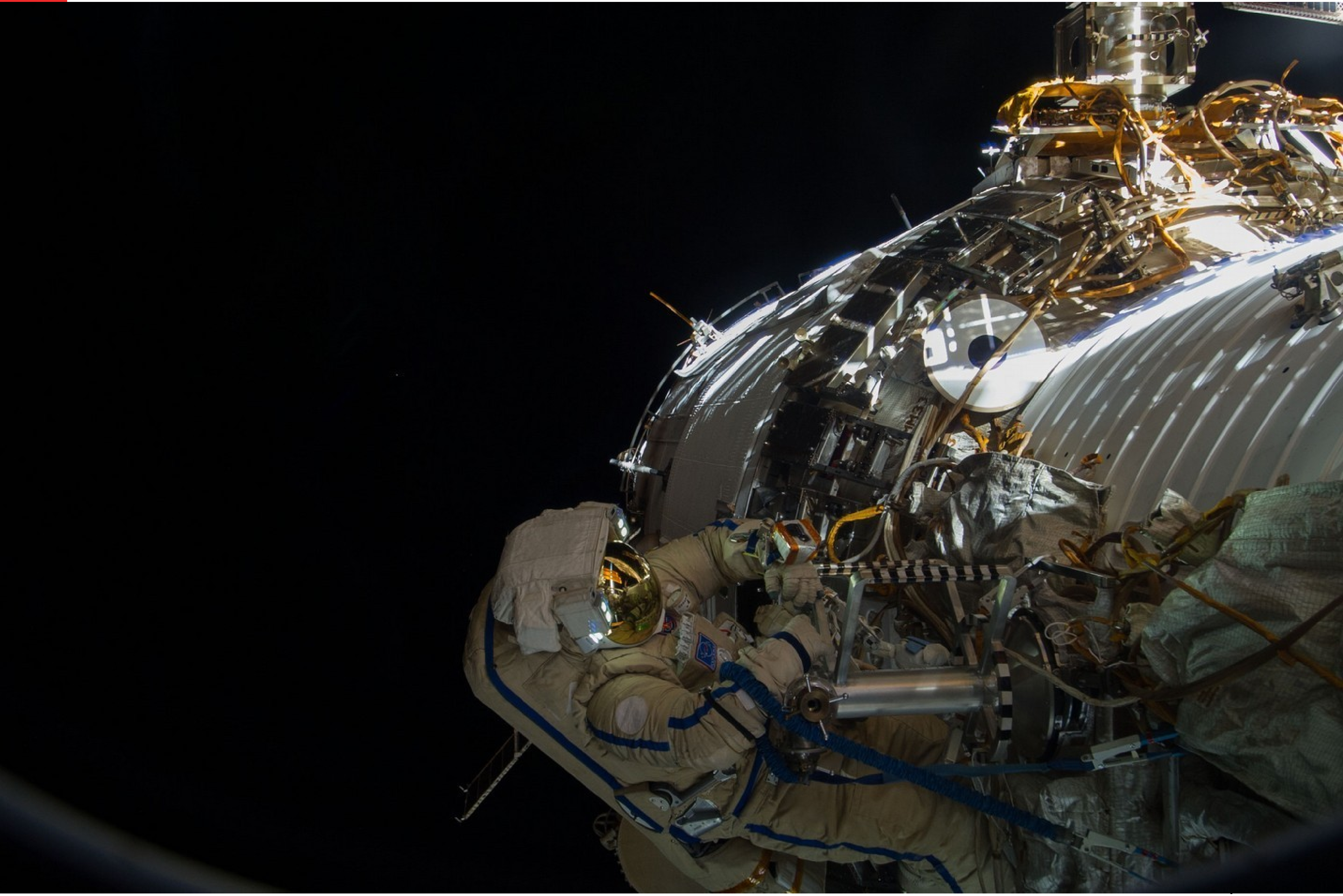
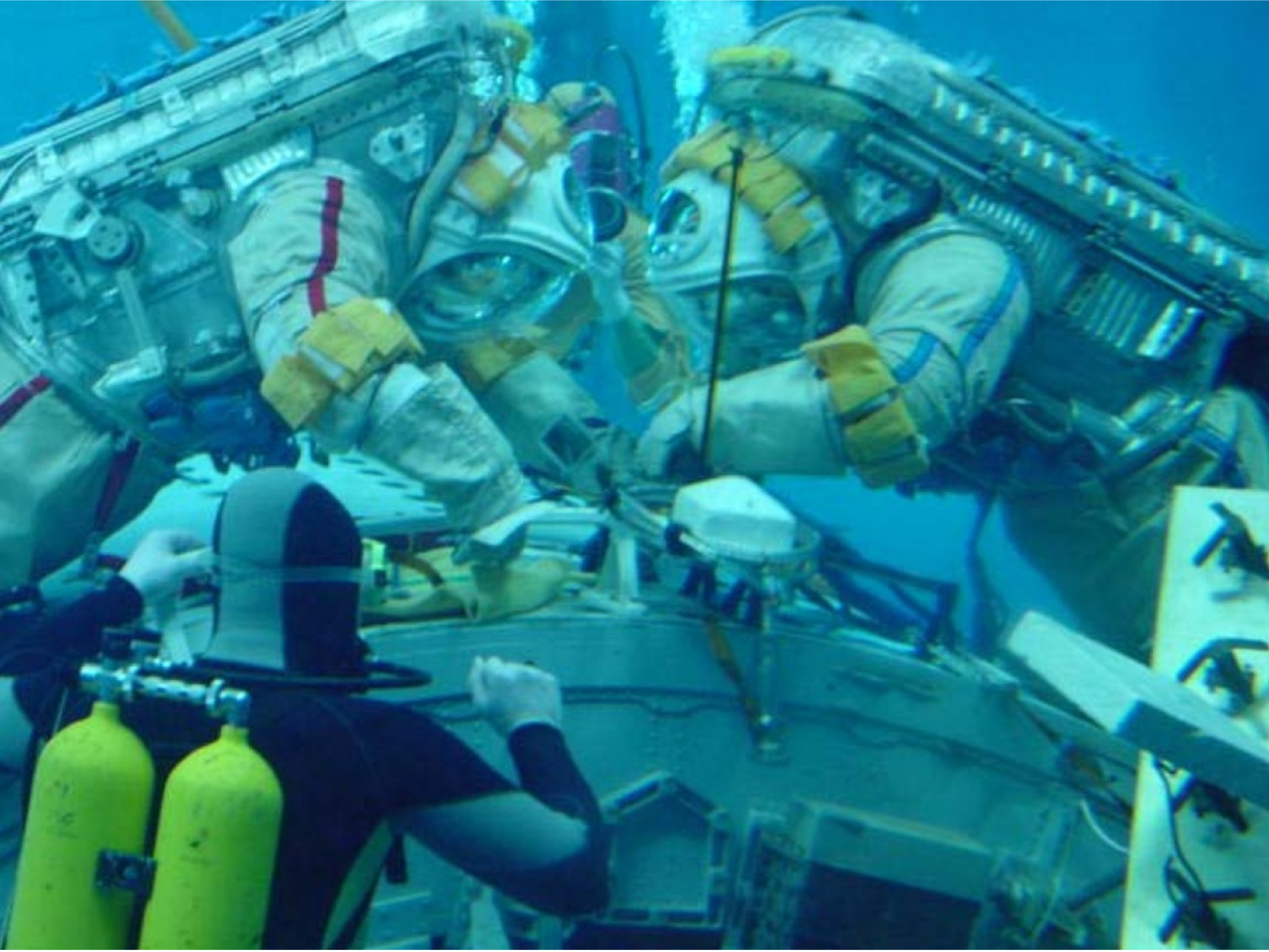

WA
Antenna Ass
S/N: 1001
P/N: SXISS9
ISS

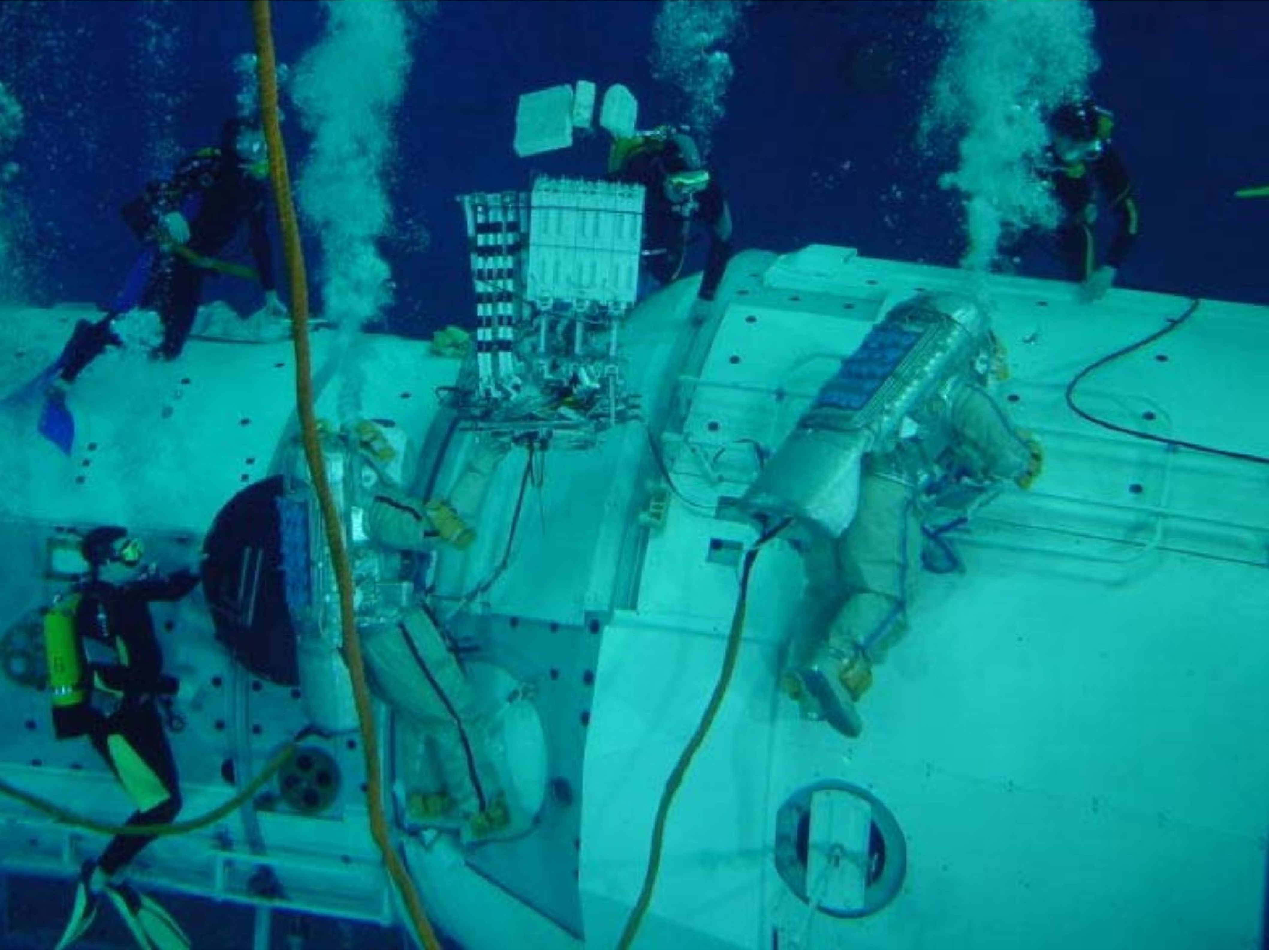


ISS005E08718

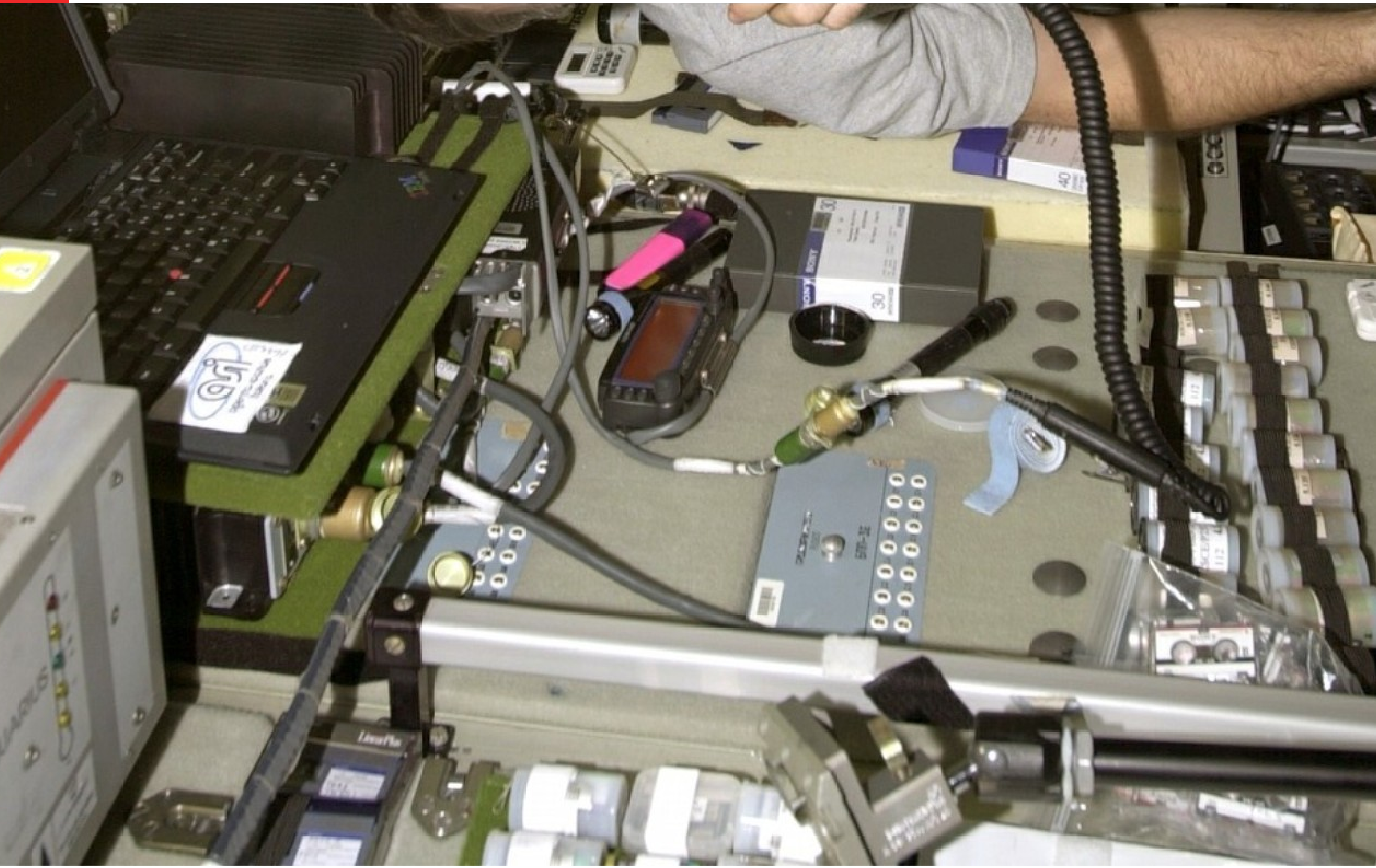



РОССИЯ





ISS008E07170



Antena Double Cross

Double Cross — A NOAA Satellite Downlink Antenna

An easy to build antenna for ground reception of NOAA weather or amateur satellite signals.

Gerald Martes, KD6JDJ

US National Oceanographic and Atmospheric Administration (NOAA) polar orbiting weather satellites (POES) transmit data for production of gray scale images of the ground below them.[1] These automatic picture transmissions (APT) signals are sent at 137 MHz and are available twice a day to anyone on the earth. There are many free programs available that can decode the satellite signals and then produce color images on a personal computer. I prefer *APTDecoder* by Patrik Tast, available on the Internet.[2]

Antennas for POES Satellite Reception

The NOAA weather satellites are polar orbiting, so they can and do appear at all azimuth and elevation directions from any ground location. An ideal ground-based antenna for reception of NOAA satellite signals would be right-hand circularly polarized (RHCP) and have no deep pattern minimums within the hemisphere. Figure 1 shows the ideal pattern shape of a ground-based antenna for APT reception. It would have a 12 dB minimum toward zenith since the satellites will be approximately 12 dB stronger when overhead as compared to their strength when at the horizon due to path loss.

This ideal pattern cannot quite be obtained for a ground-based receiving antenna for

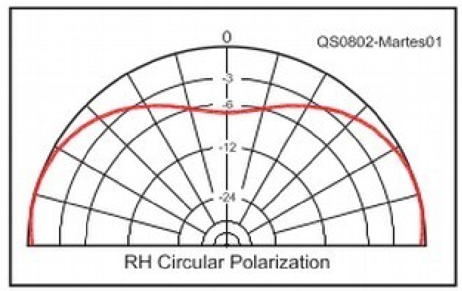


Figure 1 — Ideal radiation pattern for a ground-based antenna for reception of NOAA weather satellite images.

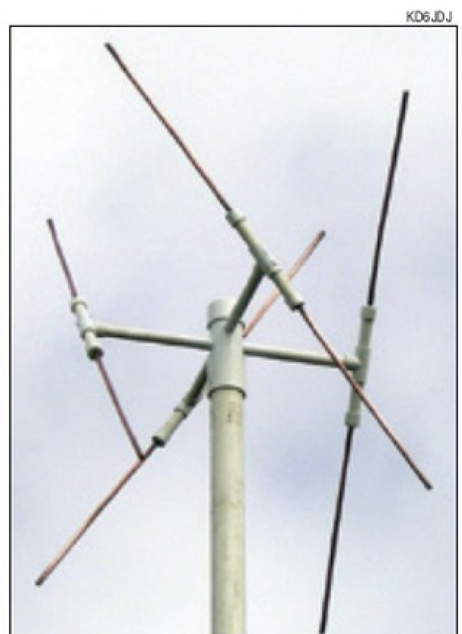


Figure 2 — The four dipoles that make up the Double Cross antenna prototype.

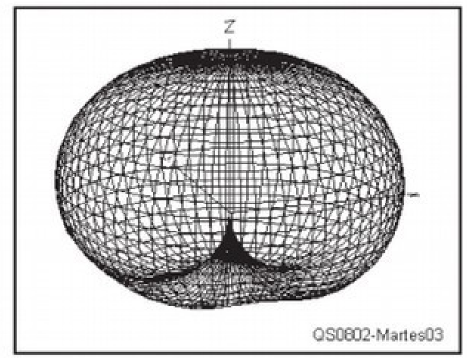


Figure 3 — The free space three dimensional pattern of the Double Cross closely matches our design goal.

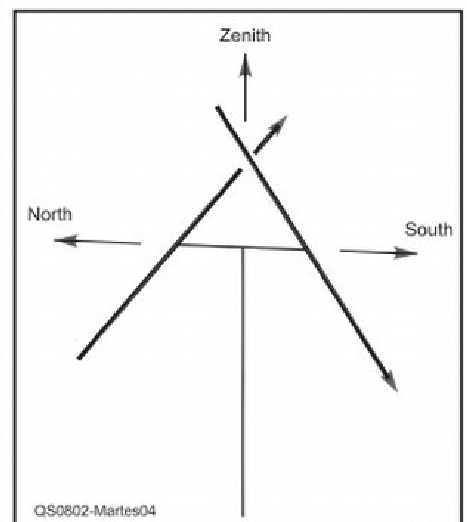


Figure 4 — One pair of crossed dipoles makes half a Double Cross.

Double Cross

- Dipolos de λ/2
- Separados λ/4
- Inclinados 30°
- Desfase de 90°

Double Cross

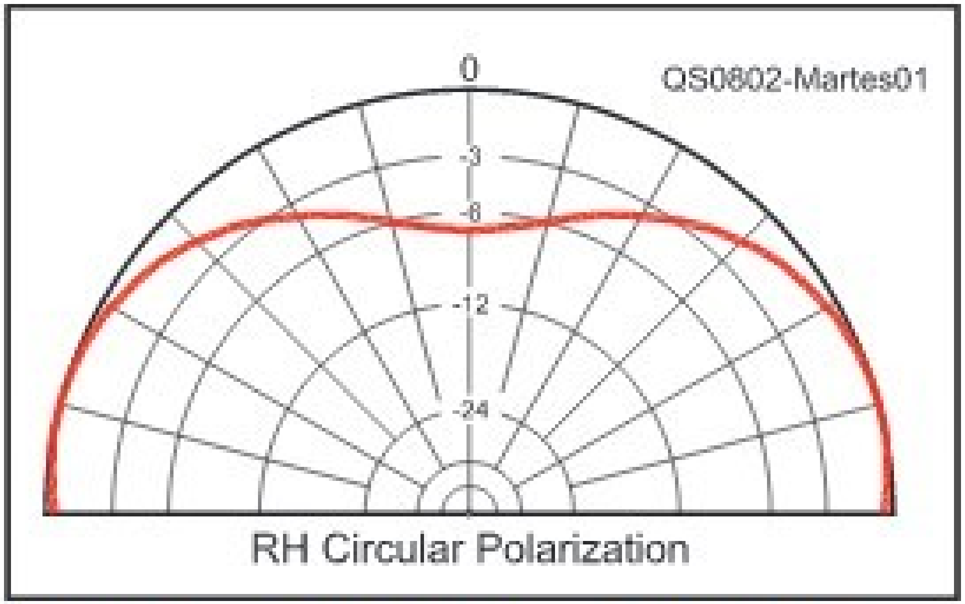


Figure 1 — Ideal radiation pattern for a ground-based antenna for reception of NOAA weather satellite images.

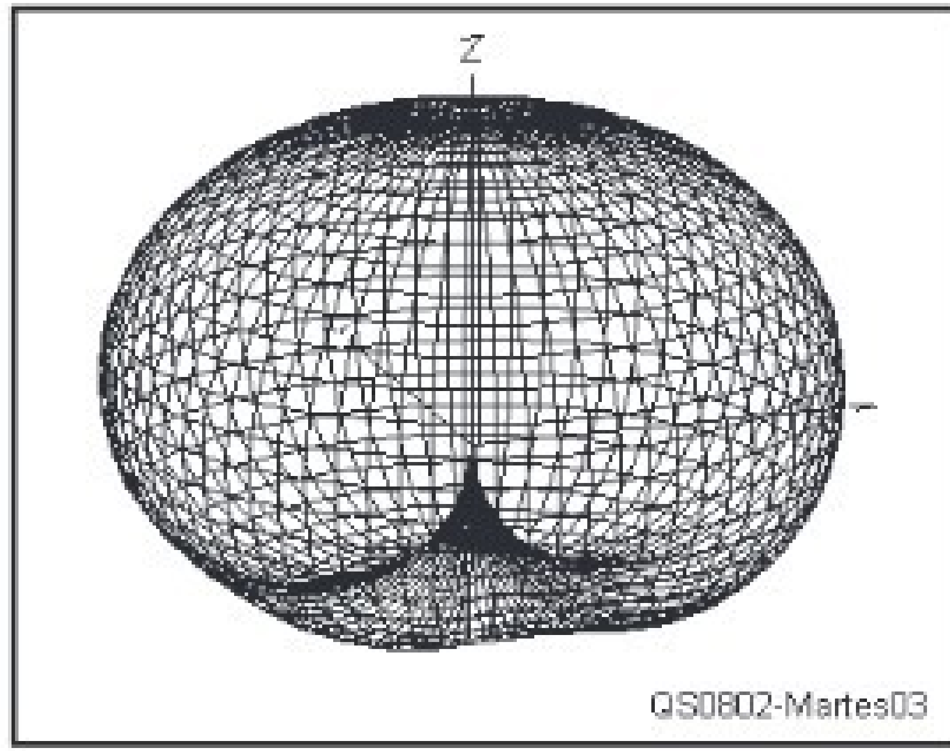
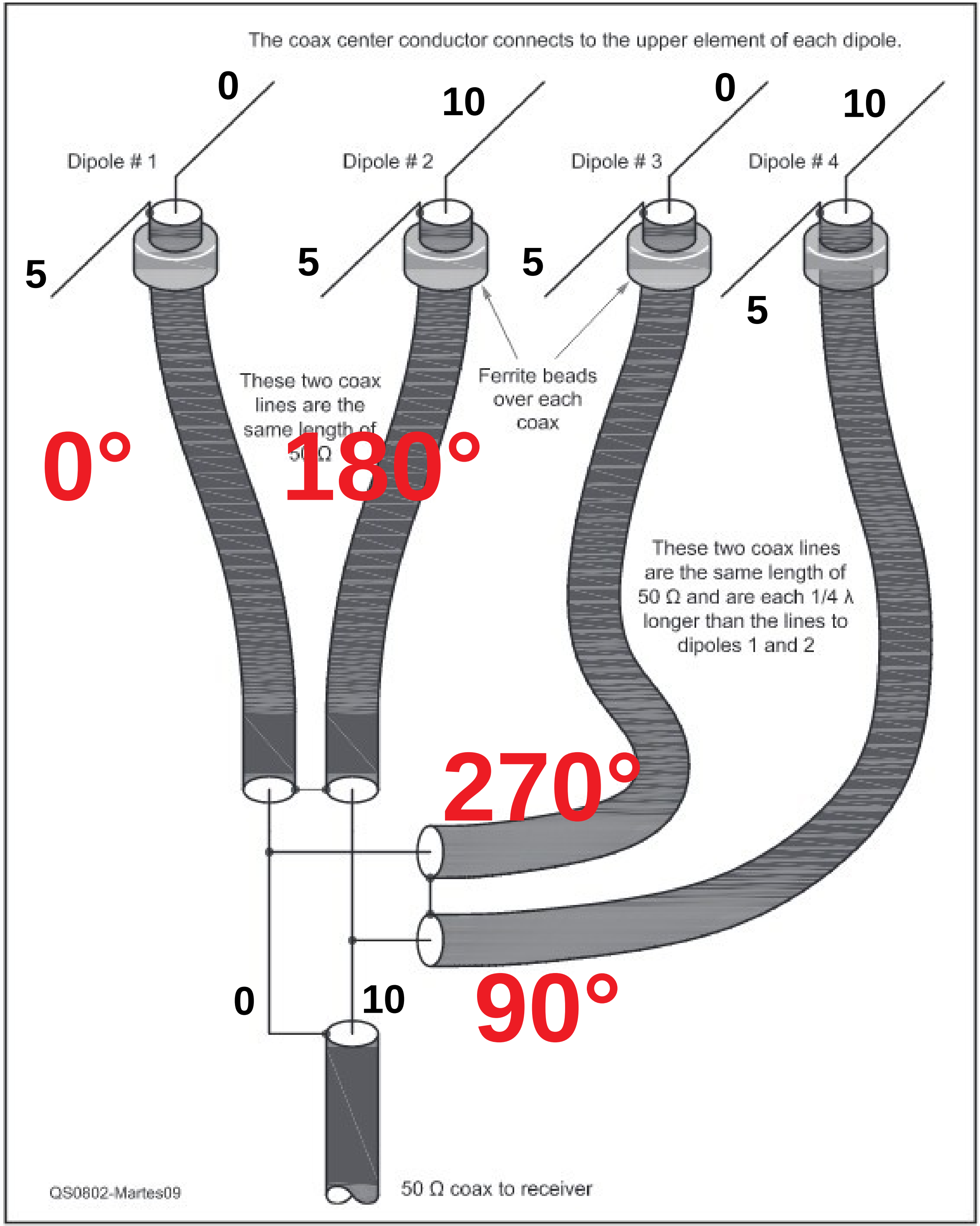
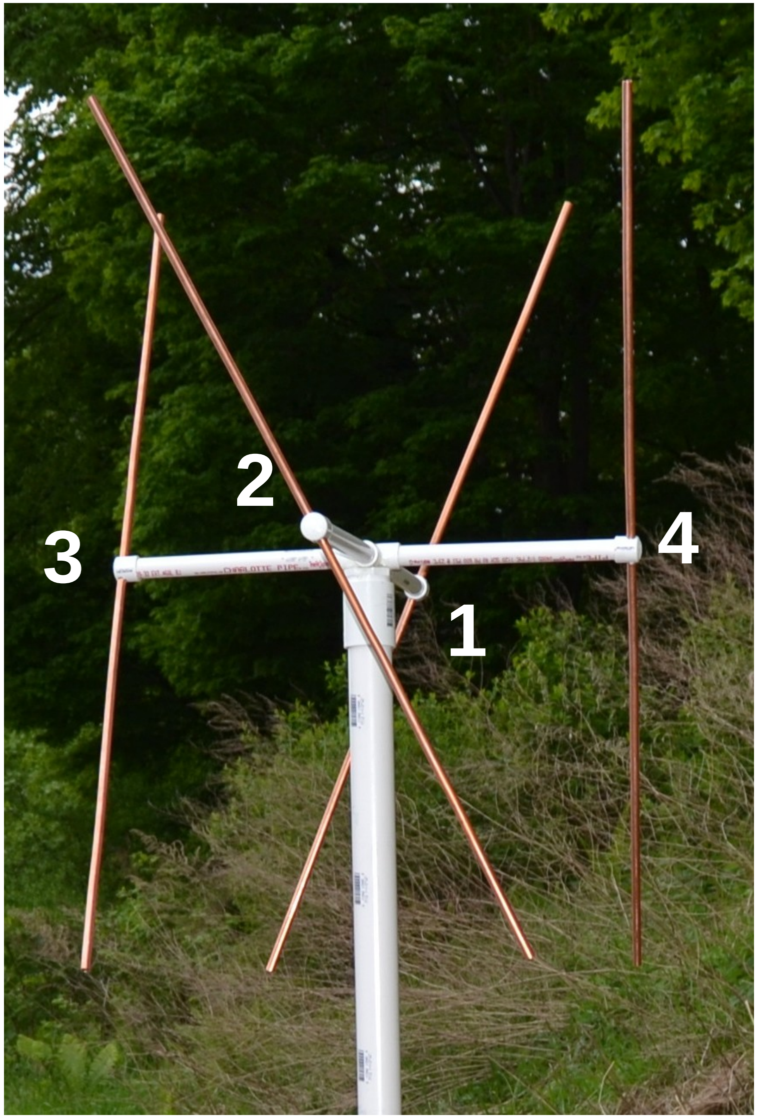
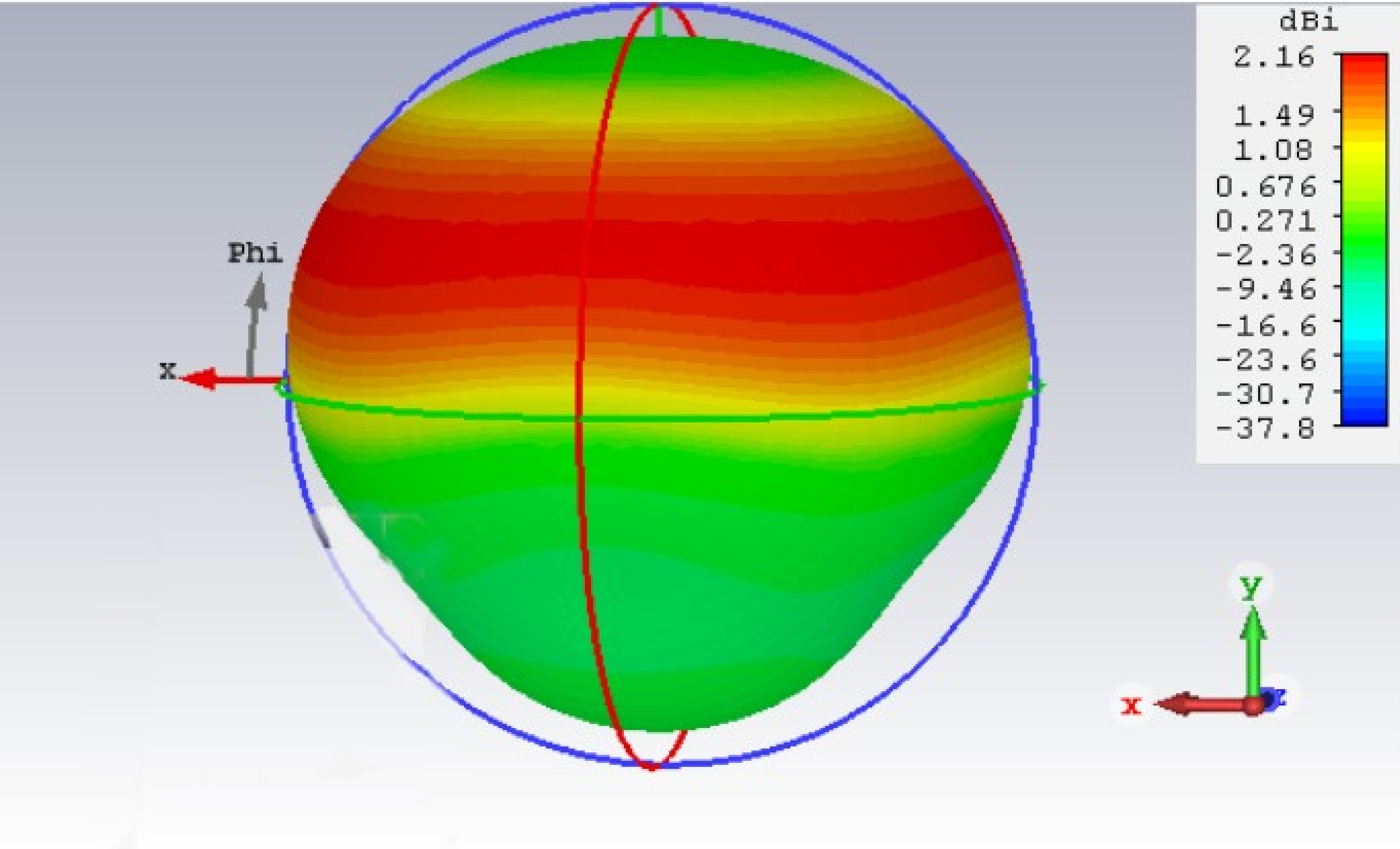


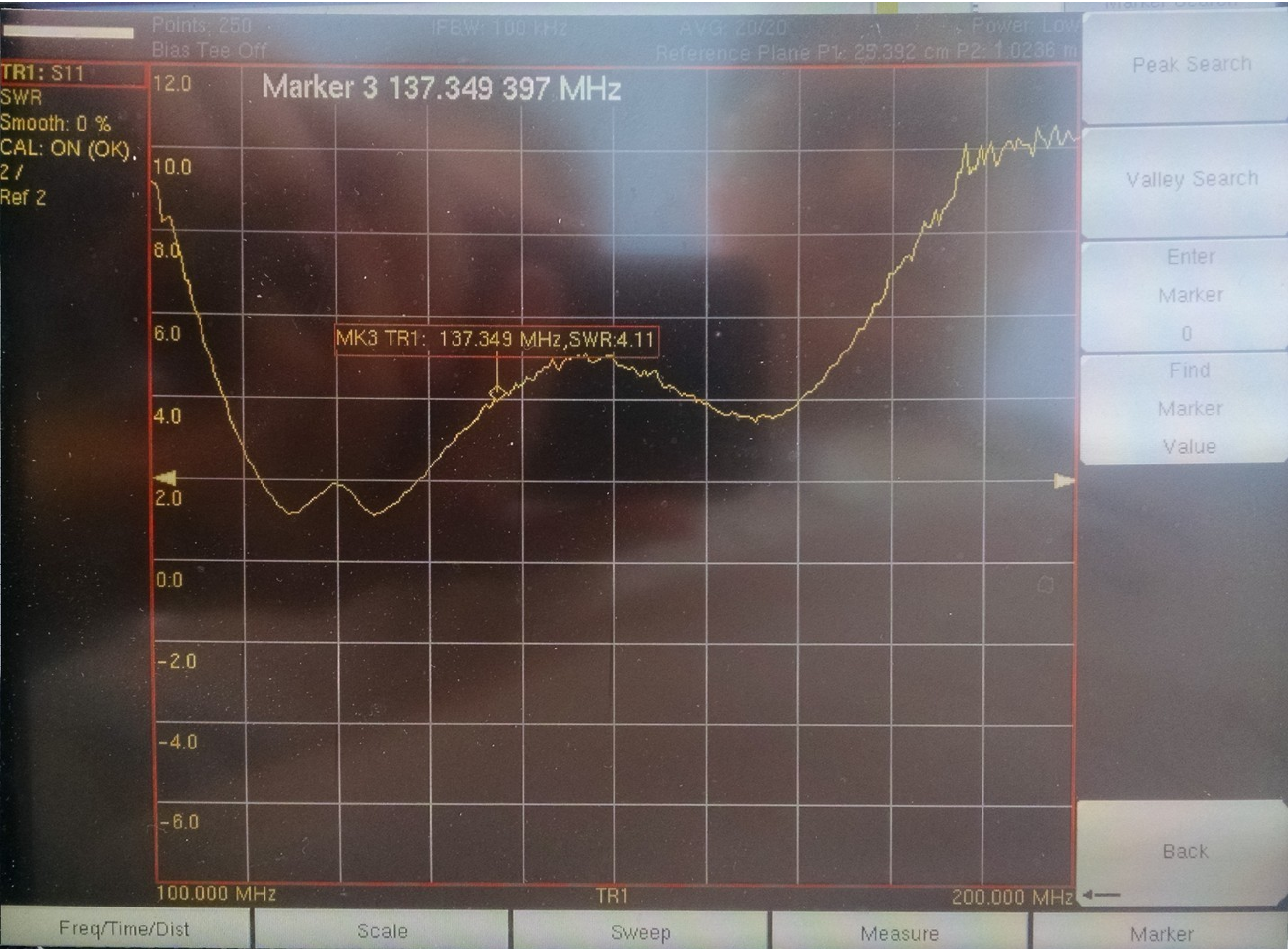
Figure 3 — The free space three dimensional pattern of the Double Cross closely matches our design goal.


The coax center conductor connects to the upper element of each dipole.
0
10
0
10
Dipole # 1
Dipole # 2
Dipole # 3
Dipole # 4
5
5
5
5
These two coax lines are the same length of 50 Ω
Ferrite beads over each coax
0°
180°
These two coax lines are the same length of 50 Ω and are each 1/4 λ longer than the lines to dipoles 1 and 2
270°
0
10
90°
50 Ω coax to receiver
QS0802-Martes09


2
3
4
1

Double Cross




Points: 250
IFBW: 100 kHz
AVG: 20/20
Power: Low
Bias Tee Off
Reference Plane P1: 25.392 cm P2: 1.0236 m
TR1: S11
SWR
Smooth: 0 %
CAL: ON (OK)
2 /
Ref 2
Marker 3 137.349 397 MHz
MK3 TR1: 137.349 MHz,SWR:4.11
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
100.000 MHz
TR1
200.000 MHz
Peak Search
Valley Search
Enter Marker 0
Find Marker Value
Back
Freq/Time/Dist
Scale
Sweep
Measure
Marker

Cálculo de enlace

ITU-R P.531-13

- Efectos a 500MHz y 30° (nosotros usamos 145.8MHz)
  - Rotación de Faraday: 1.2 rotaciones
  - Refracción: Menor a 2.4’
  - Absorción: Menor a 0.04dB en latitudes medias
  - Centelleo: Hasta 27.5dB. Fluctuaciones en el índice de refracción de la atmósfera.

Cálculo de enlace

- $P_t = 25W$
- $G_t = 2.15dBi$ (monopolo)
- $G_r = 0dBi$ a $2.16dBi$

- Consideramos
  - 10° Elevación
  - $G_t = 0dBi$
  - $G_r = 2.16dBi$

Elevación	Distancia
0°	2300km
10°	1500km
20°	1000km
30°	770km
45°	570km
90°	400km

Cálculo de enlace

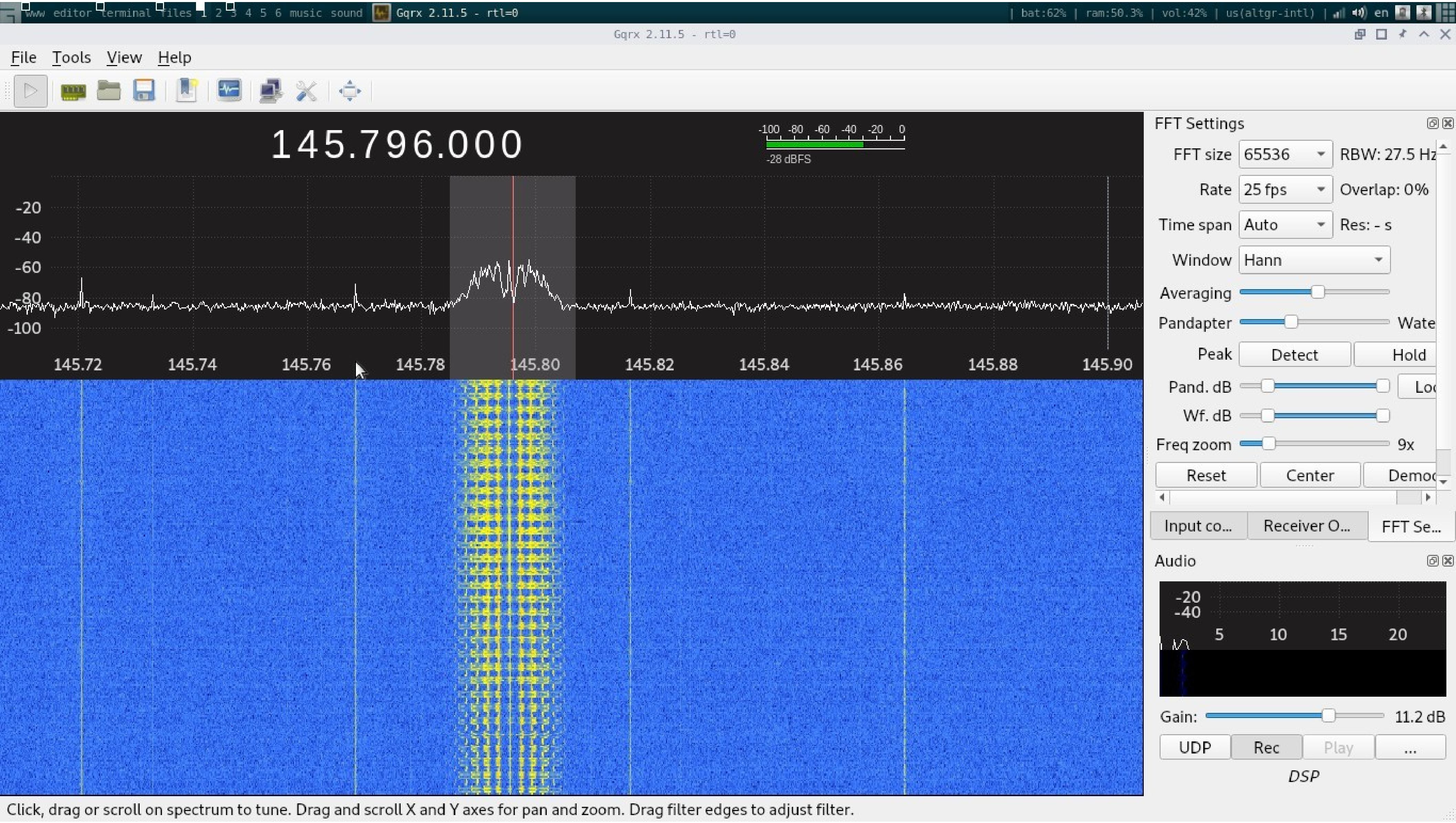
$$L_0 = 32{,}4 + 20log(d[km]) + 20log(f[MHz]) = 139{,}2dB$$

$$P_r = P_t + G_t + G_r - L_0 - 3dB - 27{,}5dB = -123{,}6dBm$$

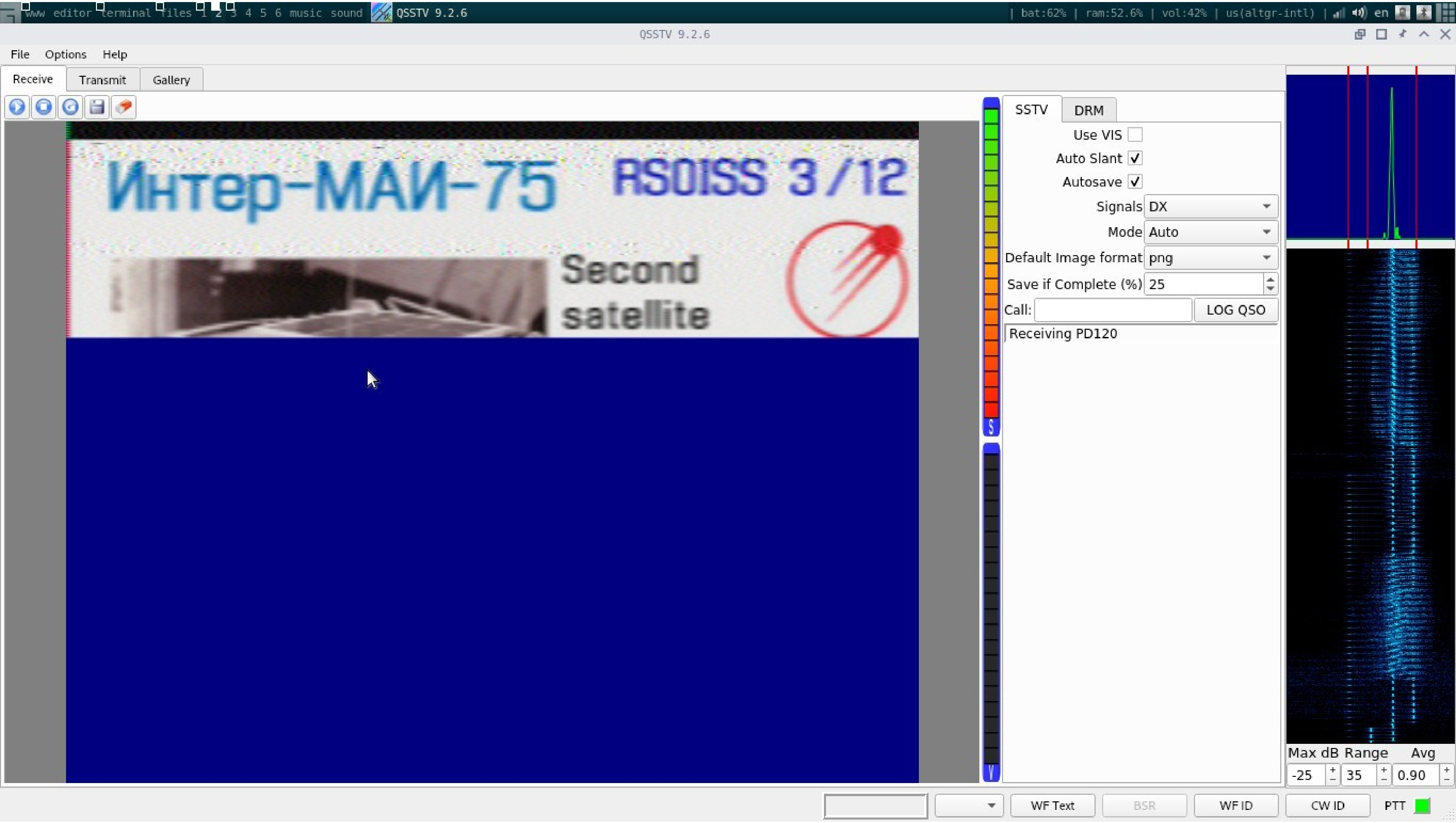
- -3dB por ser polarización lineal recibida con antena circular
- Sensibilidad de RTLSDR: -130dBm

Recepción

Recepción ISS (GQRX)

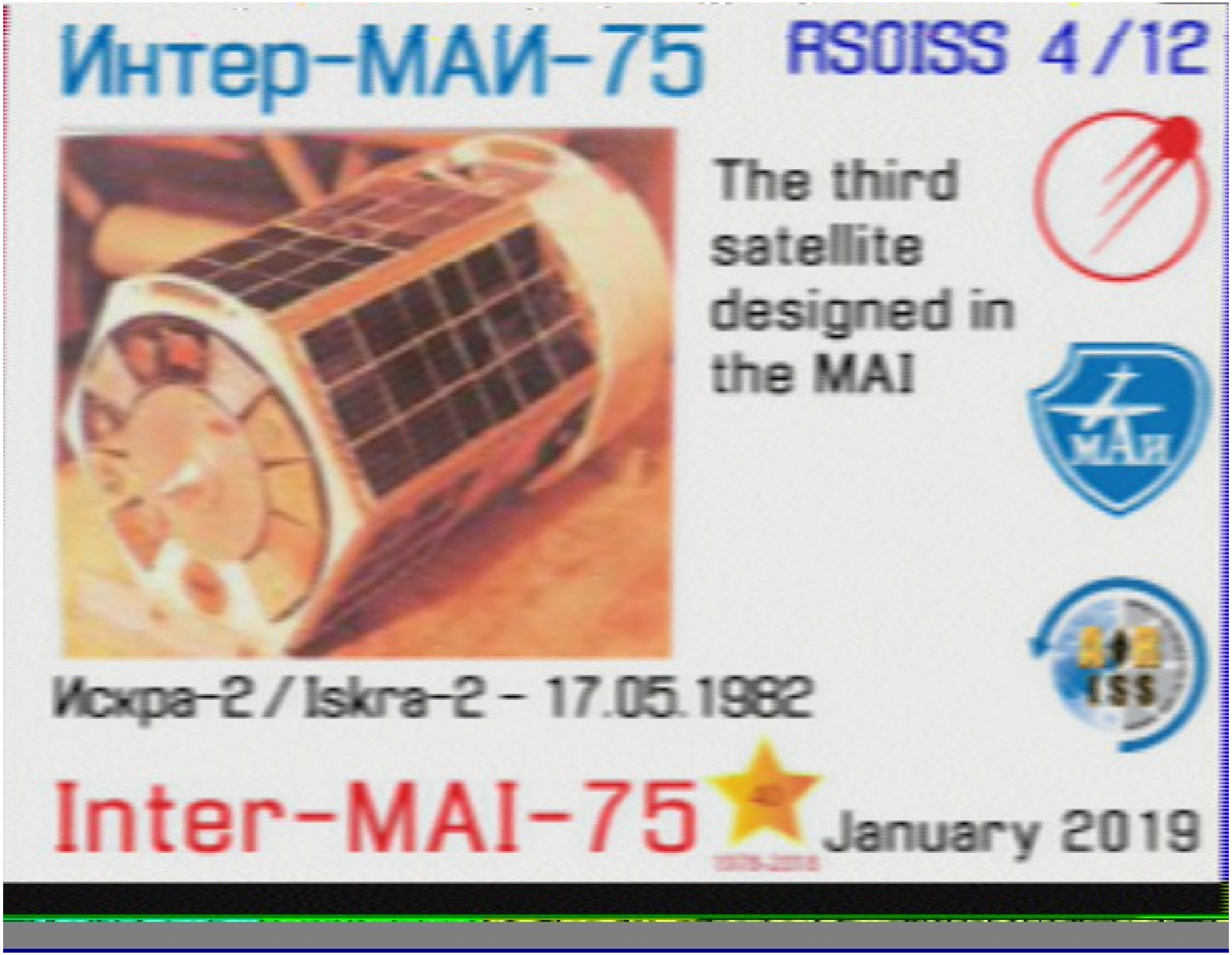


Recepción ISS (QSSTV)

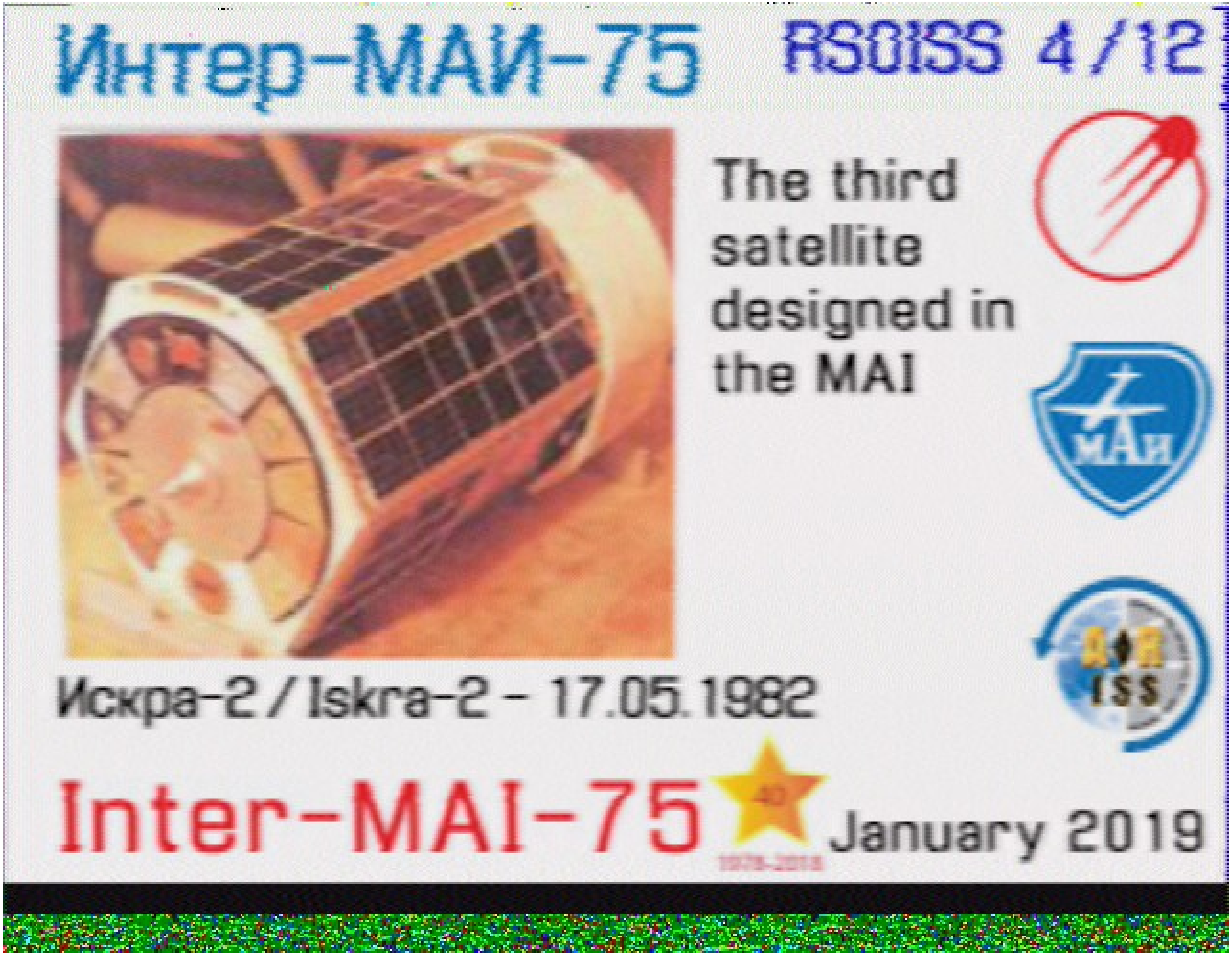


Recepción ISS (QSSTV)

Recepción ISS (QSSTV)



Recepción ISS (propia)




Original

Hacia y desde archivo


Transmitida


Original

Hacia y desde archivo


Transmitida

Conclusiones

- Menor costo usando SDR
- Mejorar sincronización
- Usar más ancho de banda
- Probar con condiciones desfavorables