Deep space spacecrafts op de amateur banden

VHF-DAG EN SAT-DAG 25 APRIL 2015

ROB HARDENBERG, PE1ITR

Onderwerpen

- Inleiding
- MRO (2005)
- LX0OHB-4M (2014)
- Shin-en2 (2014)
- Artsat2::Despatch (2014)

- Deep Space Satellite Tracking
- Doppler
- Signaal sterkte
- Antenne (Groundgain, Gain en G/T)
- Ontvanger en SDR

PE1ITR

- QRV sinds 1981
- VHF – UHF
- DX-ing
- Satellieten (Oscar-10 .en verder.)
- Contesten
- Moonbounce

Mars Reconnaissance Orbiter

Gelanceerd op 12 augustus 2005 11:43UTC

Van: "John L. Callas" <John.L.Callas@jpl.nasa.gov>

Aan: <mars-net@alum.WPI.EDU>

CC: <jfitzgerald@alum.WPI.EDU>; <setho@mindspring.com>; <andrew_bachler@msn.com>

Onderwerp: [mars-net] MRO In Flight UHF Checkout

Datum: woensdag 17 augustus 2005 21:37

Dear Radio Amateurs,

The Mars Reconnaissance Orbiter (MRO) is on her way to Mars. As has been done before, we are planning an in-flight checkout of the UHF relay system (Electra) on board MRO using the SRI 46-meter antenna at Stanford University. The tests are planned for 2005-09-21 between approximately 14:30 and 16:00 UTC and 2005-09-22 between approximately 03:30 and 14:00 UTC. A revised and detailed timeline will be provided later. The testing will involve only reception at Stanford at two UHF frequencies; no transmission from Stanford is planned. The two frequencies to be exercised during these tests are 437.1 MHz and 401.585625 MHz. The signals will be continuous wave (CW) with right circular polarization (RCP). Part of the test objectives will be to map out the pattern of the UHF antenna on MRO, so signal levels will be varying. As a rough, "back of the envelope", the estimated gain of the MRO UHF antenna will vary about 0 dBi and the UHF transmit power will be approximately 10 watts.

As for the position, range and range rate for MRO, you can use the Solar System Dynamics "Horizons" web page at: http://ssd.jpl.nasa.gov/horizons.html

You can select MRO from the list of target spacecraft and specify your own location. The tool allows you to select various time intervals and output quantities (e.g., RA/Dec, Az/El, etc). More details about the tests will follow, but I wanted to give you some information to get started thinking about listening in.

As always, thank you for your interest. Sincerely, John

Electra UHF Transceiver MRO (1)

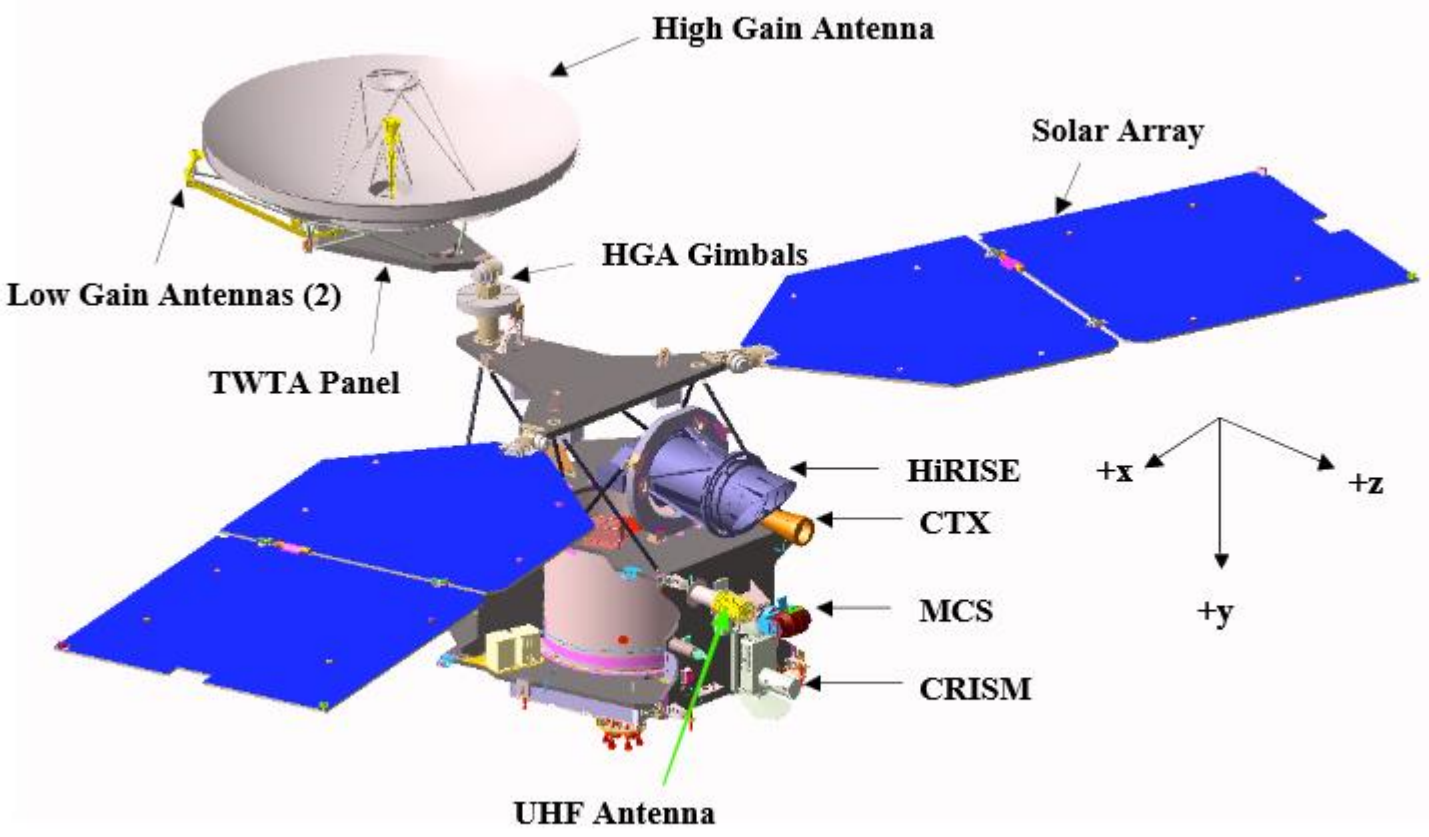


Figure 1-1. Sketch of the MRO spacecraft with coordinate directions.

Electra UHF Transceiver MRO (2)

Electra UHF Transceiver

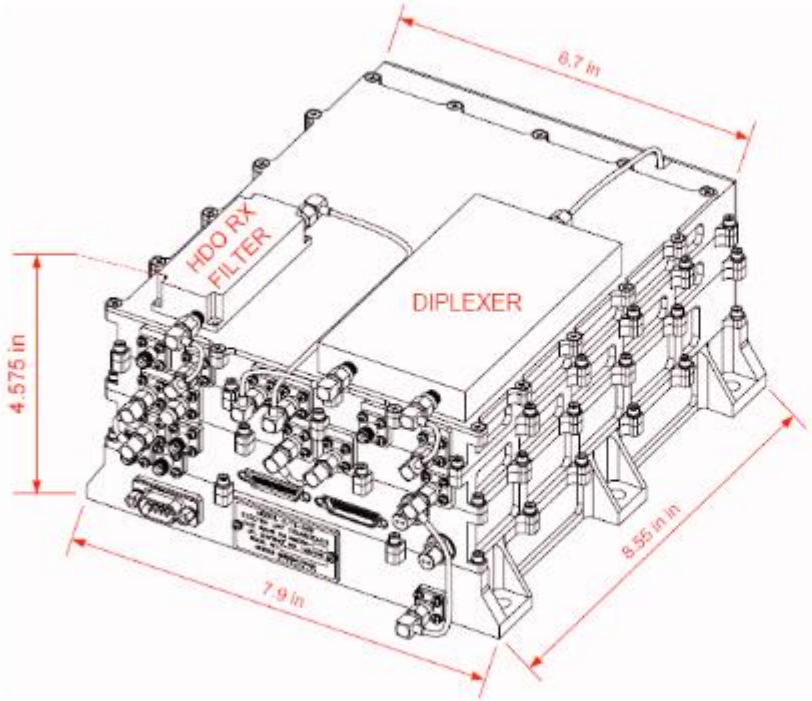
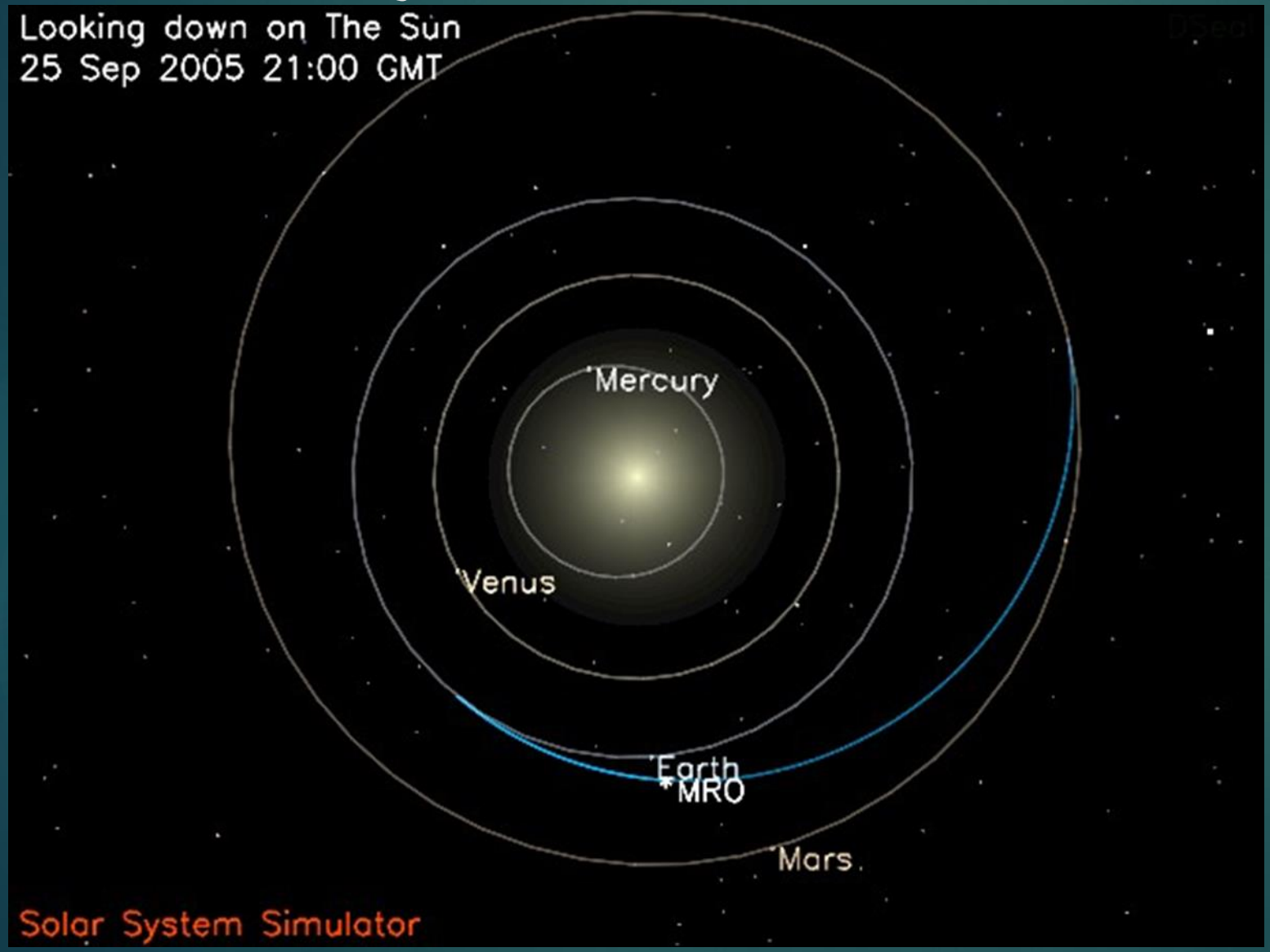


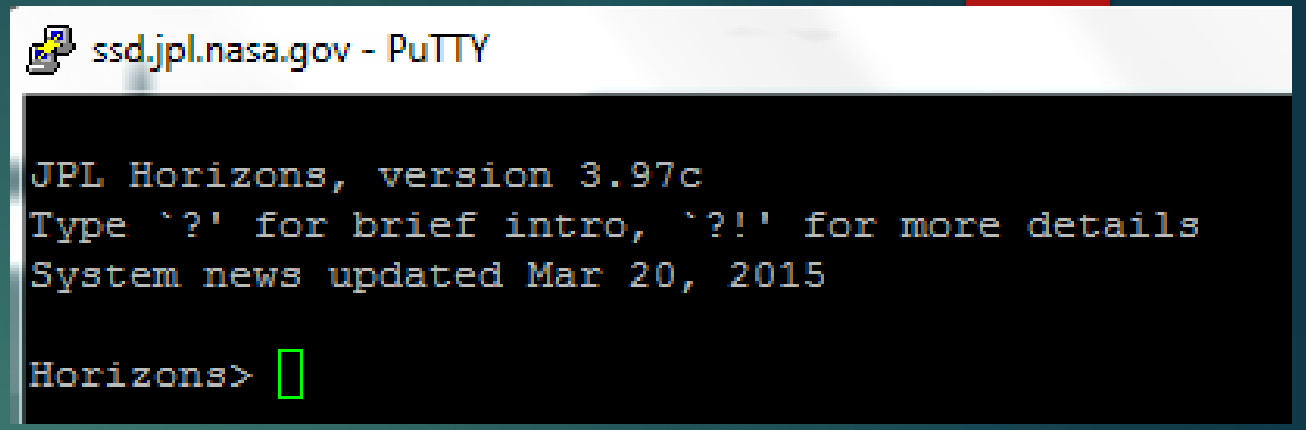
Figure 2-8. Electra UHF transceiver (EUT) assembly.

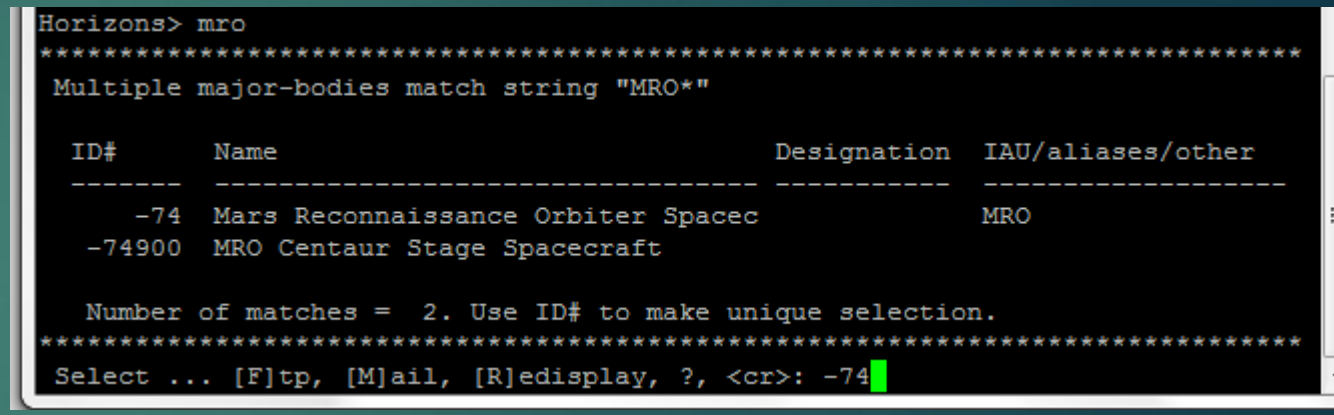
MRO Traject

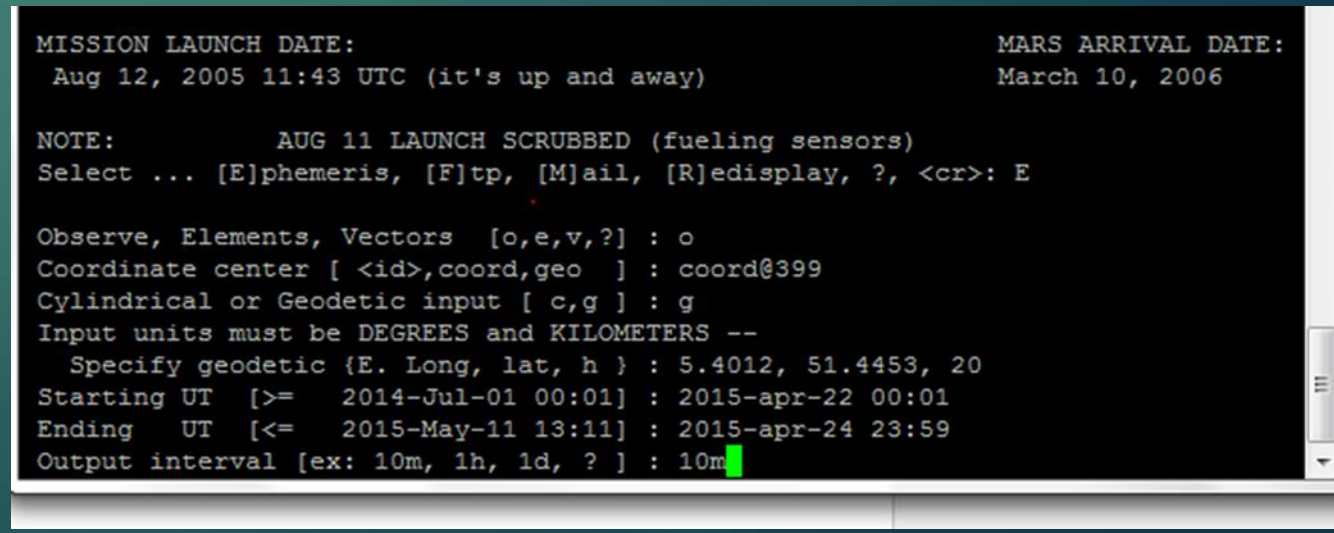

Looking down on The Sun
25 Sep 2005 21:00 GMT
Mercury
Venus
Earth
MRO
Mars
Solar System Simulator

JPL Horizons

- Telnet: horizons.jpl.nasa.gov : 6775
- Procedure:
  - Select body -> MRO
  - select Ephemeris (E),
  - select observer coord@399,
  - 5.4012, 51.4453, 20
  - select starttijd, eindtijd en interval
  - Select soort lijst
  - Mail naar je email adres







MRO Schedule

MRO trajectory from QTH PE1ITR									
Date	Time		AZ	EL	KM	Delta	QRG	Delay (SEC)	
2005-Sep-22	3:00	m	224,6	70,9	13961922	4,11997	437,09399	46,57	
2005-Sep-22	3:15	m	231,8	69,1	13965638	4,13468	437,09397	46,58	
2005-Sep-22	3:30	m	238,1	67,2	13969367	4,14905	437,09395	46,60	Event 1
2005-Sep-22	3:45	m	243,7	65,1	13973108	4,16301	437,09393	46,61	
2005-Sep-22	4:00	m	248,6	63,0	13976862	4,17650	437,09391	46,62	
2005-Sep-22	4:15	Am	252,9	60,8	13980629	4,18947	437,09389	46,63	
2005-Sep-22	4:30	Am	256,9	58,5	13984406	4,20185	437,09387	46,65	
2005-Sep-22	4:45	Am	260,6	56,2	13988195	4,21361	437,09386	46,66	
2005-Sep-22	5:00	Nm	264,0	53,9	13991994	4,22469	437,09384	46,67	
2005-Sep-22	5:15	Nm	267,1	51,5	13995803	4,23503	437,09383	46,68	Event 2
2005-Sep-22	5:30	Nm	270,2	49,2	13999621	4,24461	437,09381	46,70	
2005-Sep-22	5:45	Cm	273,0	46,8	14003448	4,25338	437,09380	46,71	
2005-Sep-22	6:00	Cm	275,8	44,5	14007282	4,26130	437,09379	46,72	
2005-Sep-22	6:15	*m	278,4	42,2	14011123	4,26834	437,09378	46,74	
2005-Sep-22	6:30	*m	281,0	39,9	14014970	4,27448	437,09377	46,75	
2005-Sep-22	6:45	*m	283,6	37,6	14018822	4,27968	437,09376	46,76	
2005-Sep-22	7:00	*m	286,1	35,3	14022678	4,28392	437,09375	46,77	Event 3
2005-Sep-22	7:15	*m	288,5	33,1	14026538	4,28720	437,09375	46,79	
2005-Sep-22	7:30	*m	291,0	30,8	14030401	4,28949	437,09375	46,80	
2005-Sep-22	7:45	*m	293,4	28,7	14034265	4,29079	437,09374	46,81	
2005-Sep-22	8:00	*m	295,9	26,5	14038130	4,29109	437,09374	46,83	
2005-Sep-22	8:15	*m	298,3	24,4	14041995	4,29040	437,09374	46,84	
2005-Sep-22	8:30	*m	300,7	22,4	14045858	4,28871	437,09375	46,85	Event 4
2005-Sep-22	8:45	*m	303,2	20,4	14049720	4,28604	437,09375	46,86	
2005-Sep-22	9:00	*m	305,6	18,5	14053579	4,28240	437,09376	46,88	
2005-Sep-22	9:15	*m	308,1	16,6	14057434	4,27780	437,09376	46,89	
2005-Sep-22	9:30	*m	310,7	14,8	14061285	4,27228	437,09377	46,90	
2005-Sep-22	9:45	*m	313,2	13,0	14065130	4,26584	437,09378	46,92	
2005-Sep-22	10:00	*m	315,8	11,4	14068969	4,25853	437,09379	46,93	

wo 22-4-2015 10:44

Horizons Ephemeris System <horizons@ssd.jpl.nasa.gov>

SPACECRAFT #C(usr={5.4012,51.4453,20.^G}@399)_T(-074) (1/1)

Aan

Er zijn extra regeleinden verwijderd in dit bericht.

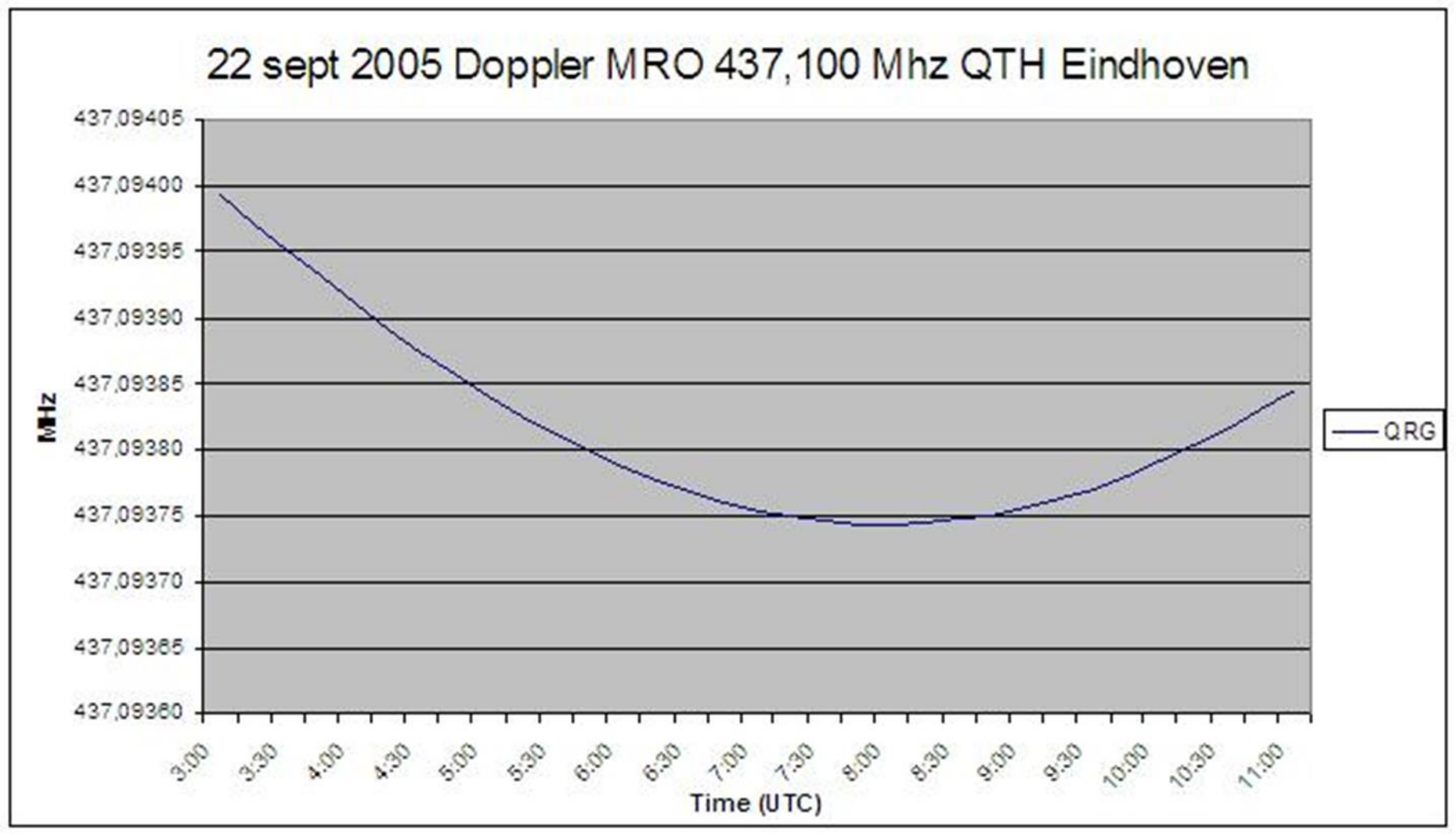
Units conversion: 1 au= 149597870.700 km, c= 299792.458 km/s, 1 day= 86400.0 s Tal
(NO) Table cut-offs 2: Solar Elongation (0.0,180.0=NO),Local Hour Angle(0.0=NO)
****

Date__(UT)__HR:MN Azi_(a-appr)_Elev
****

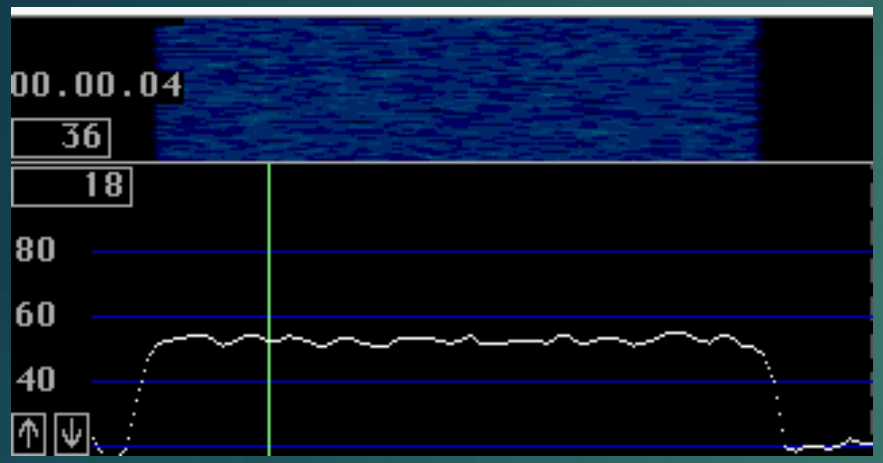
$$SOE

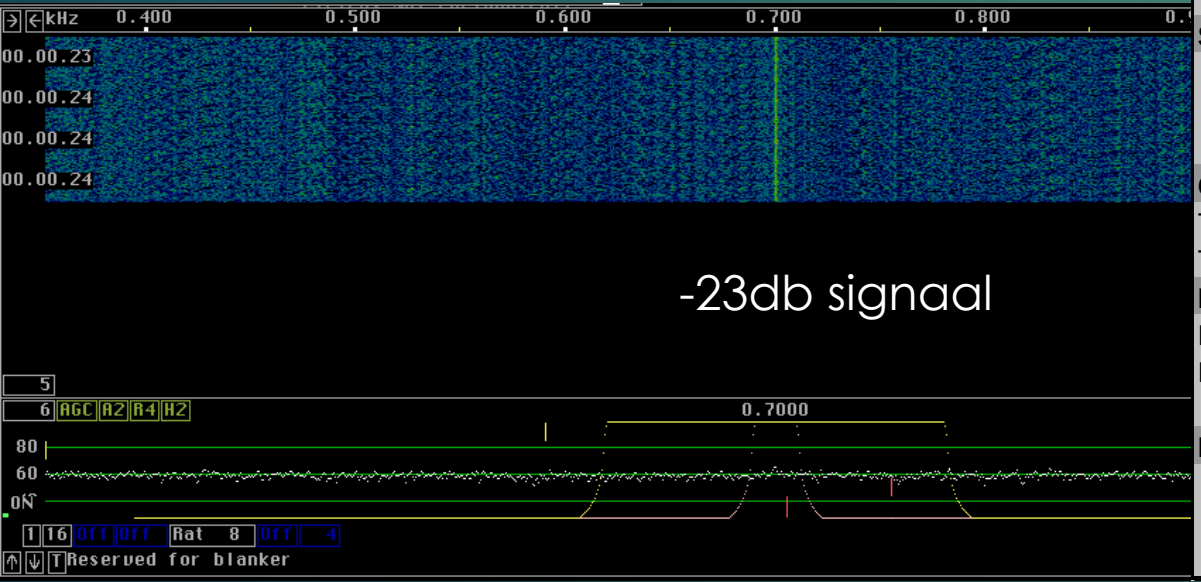
2015-Apr-22 00:01 352.0306 -21.6070
2015-Apr-22 00:11 354.6034 -21.7872
2015-Apr-22 00:21 357.1835 -21.8975
2015-Apr-22 00:31 359.7676 -21.9376

MRO Doppler


22 sept 2005 Doppler MRO 437,100 Mhz QTH Eindhoven
437,09405
437,09400
437,09395
437,09390
437,09385
437,09380
437,09375
437,09370
437,09365
437,09360
MHz
3:00
3:30
4:00
4:30
5:00
5:30
6:00
6:30
7:00
7:30
8:00
8:30
9:00
9:30
10:00
10:30
11:00
Time (UTC)
QRG

MRO Signaalsterkte Theoretisch





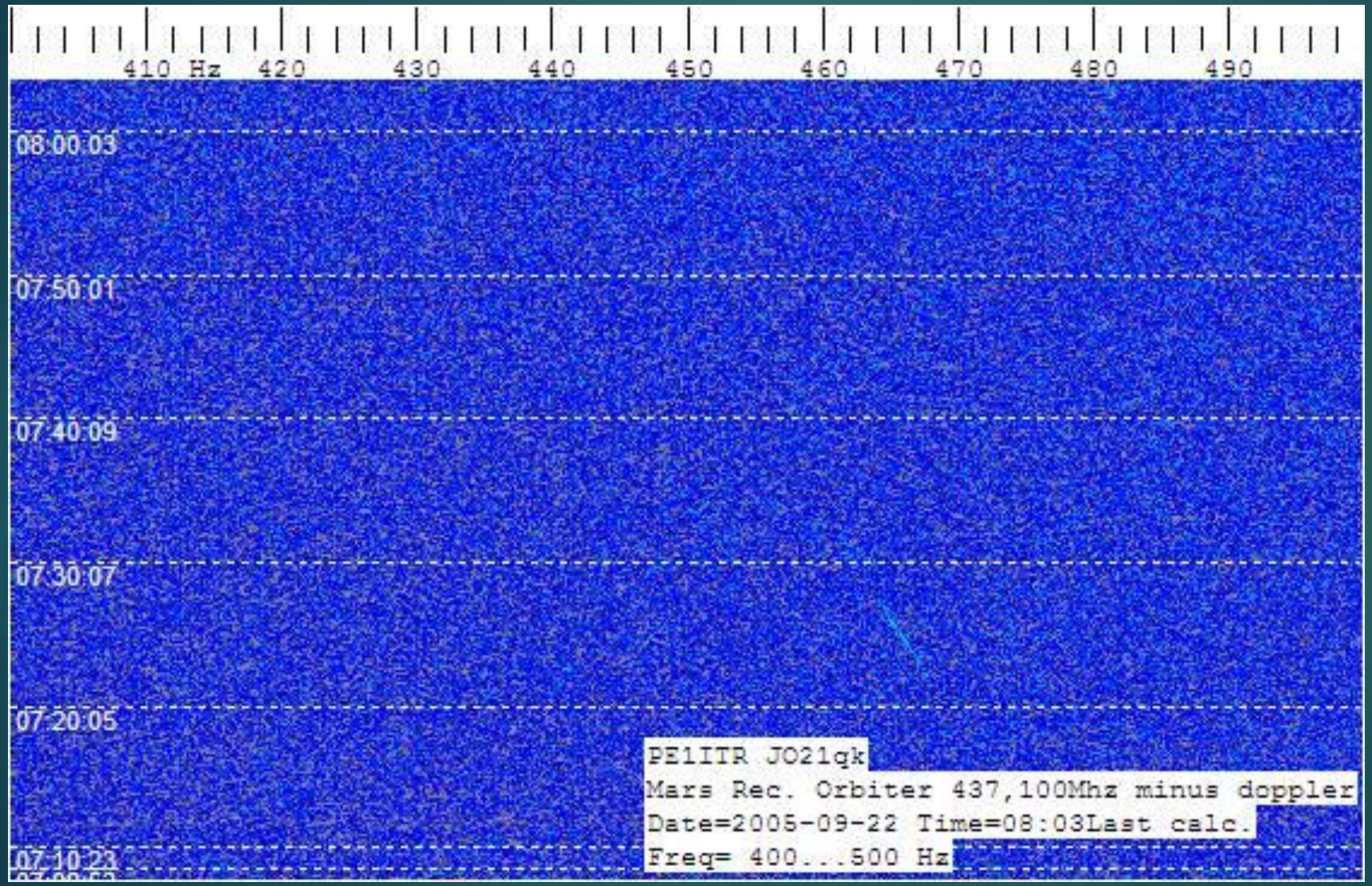
-23db signaal

PE1ITR Satellite link calculation

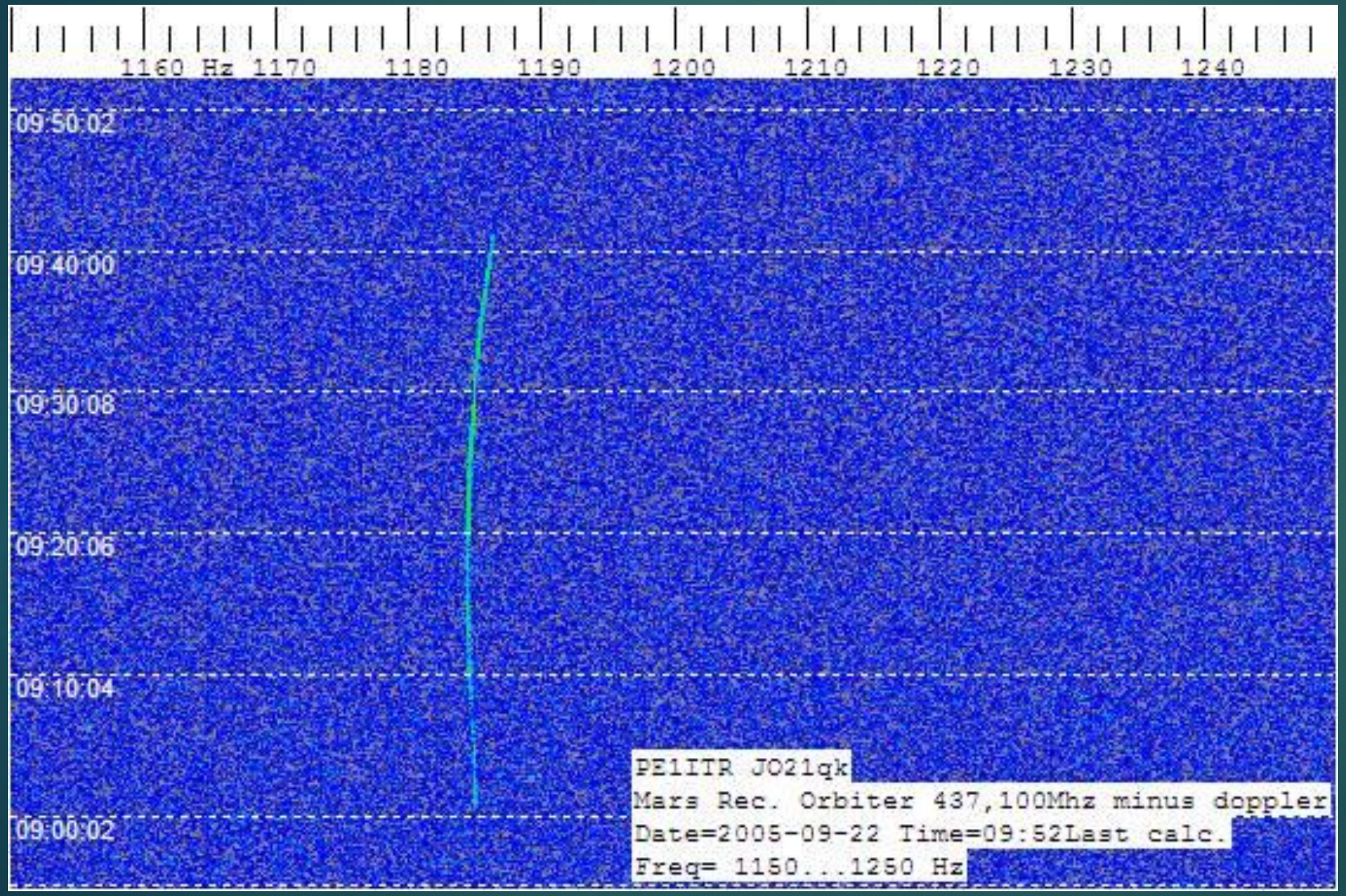
v20060310

Parameters			Link Calculation	
Transmitter				
tx power	10	W	Beacon TX level	40,00 dbm
tx ant gain	0	dbi	Beacon Ant Gain	0,00 dbi
Pathloss				
F	437	Mhz	Pathloss	230,13 db
D	14000000	Km		
Receiver				
Antenne gain	24	dbi		24,00 dbi
NF	0,7	db		
Signal at preamp				
			Signal at Preamp	**-166,13** dbm
Conversion from NF (db) to Noise Power from Pre-amp				
Temp Preamp	50,72	K		
Temp at Sky	70,00	K		
Noise Power				
Bolzman (Joule/Kelvin)	1,38E-23	k		
Bandbreedte	2500	Hz	**Noise Power**	-143,80 dbm
Expected Signal Level				
			Signal above Noise	**-22,33** db
			in	2500 Hz

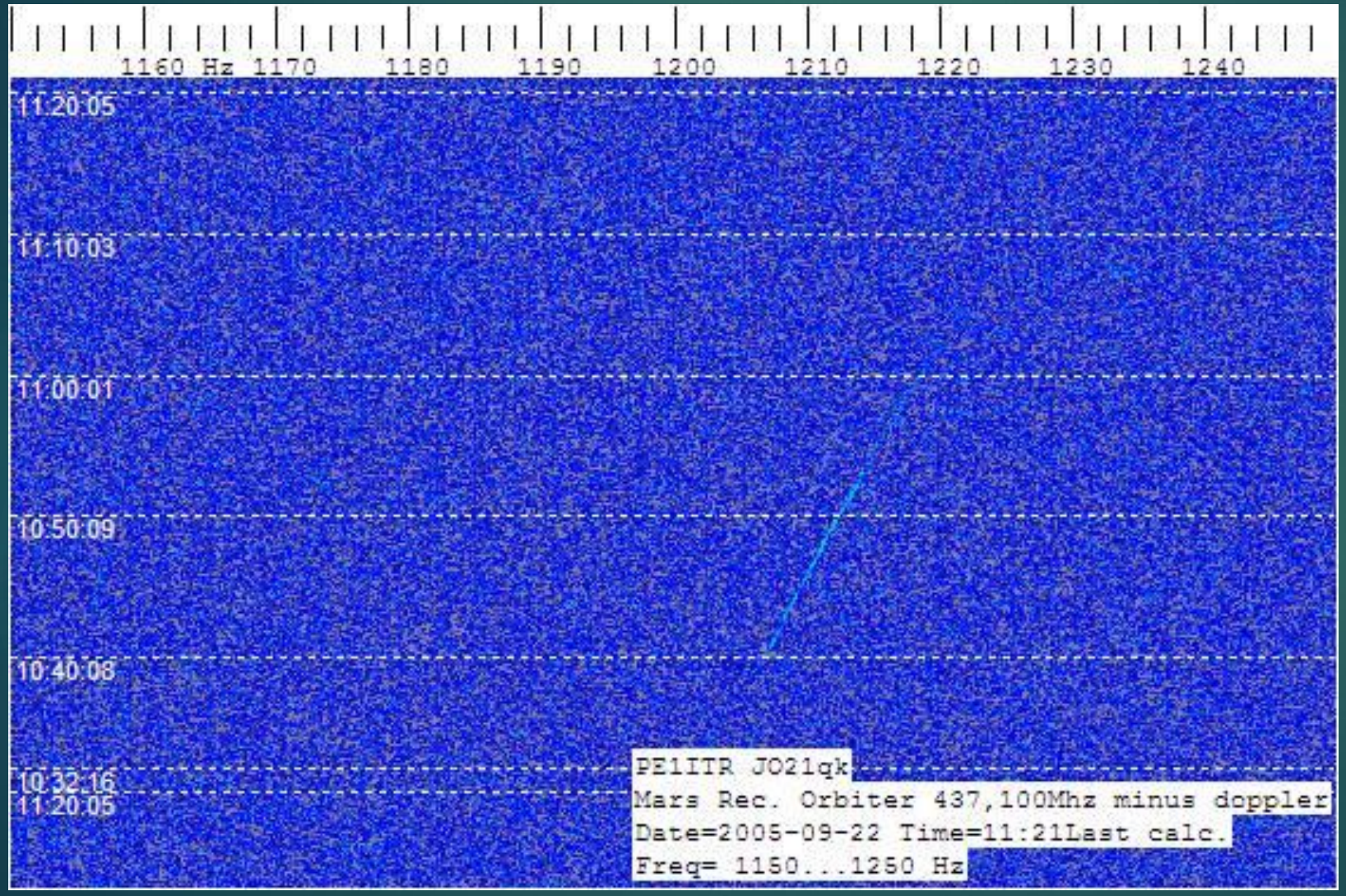
MRO Event 2 14 miljoen km



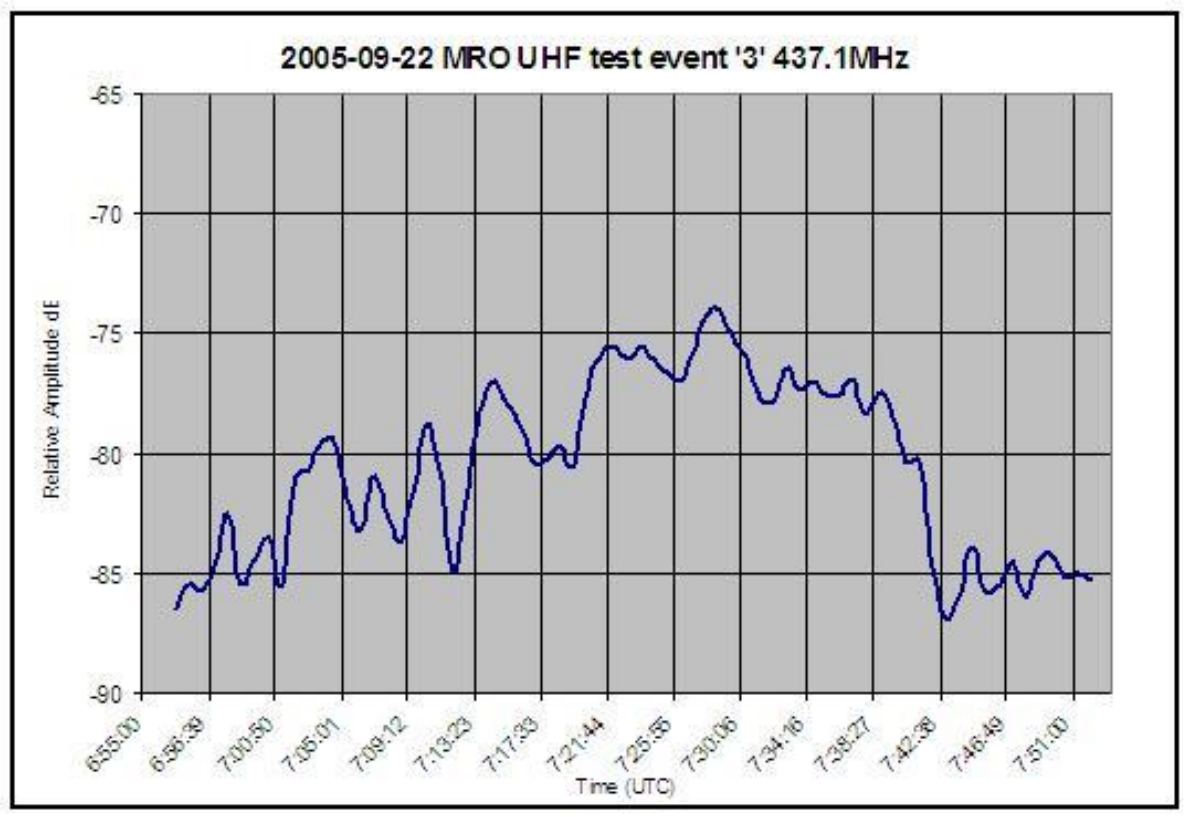
MRO Event 3 14 miljoen km



MRO Event 4 14 miljoen km



MRO UHF test 437.100MHz



@ PE1ITR

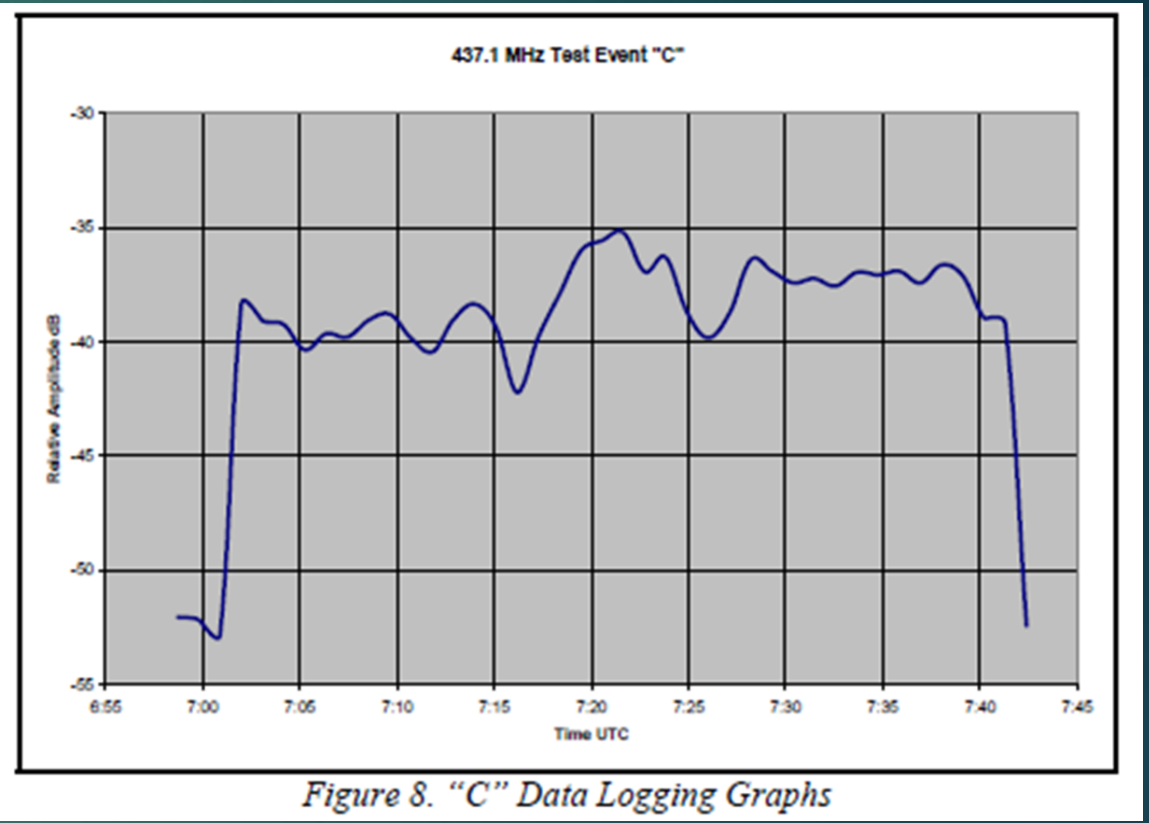
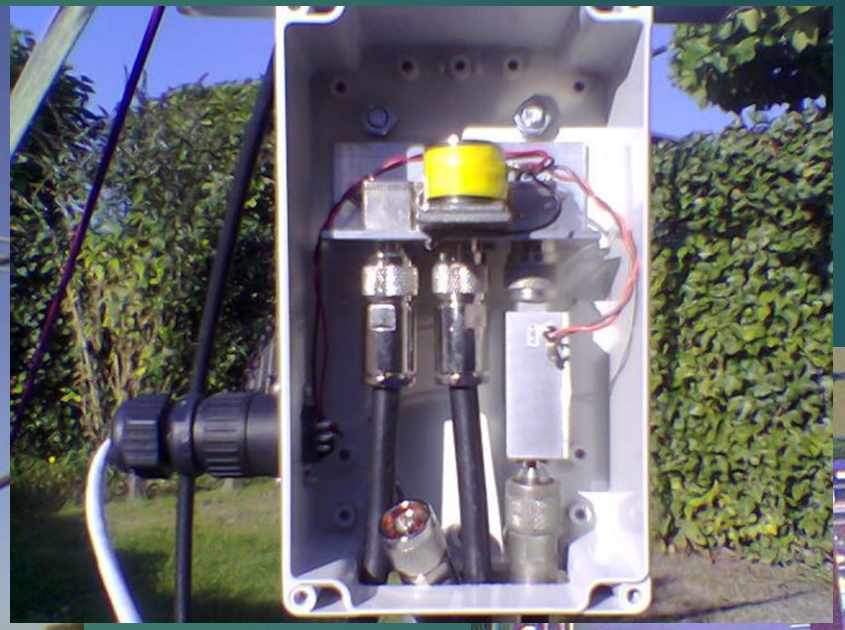


Figure 8. "C" Data Logging Graphs

@ N9AB

MRO ontvangst setup

2x 28 el DL6WU



DB6NT 0.35db PRE-AMP

MRO QSL Kaart

award

GOOD WORK, ROB!

SETI LEAGUE

ExtraTerrestrial QSL

The SETI League, Inc. hereby confirms reception
by ROB PE1ITR
of an Extra-Terrestrial Signal ~~from~~ MRO
on 437.4 ~~MHz~~ (frequency) 22 SEP 2005 (date)

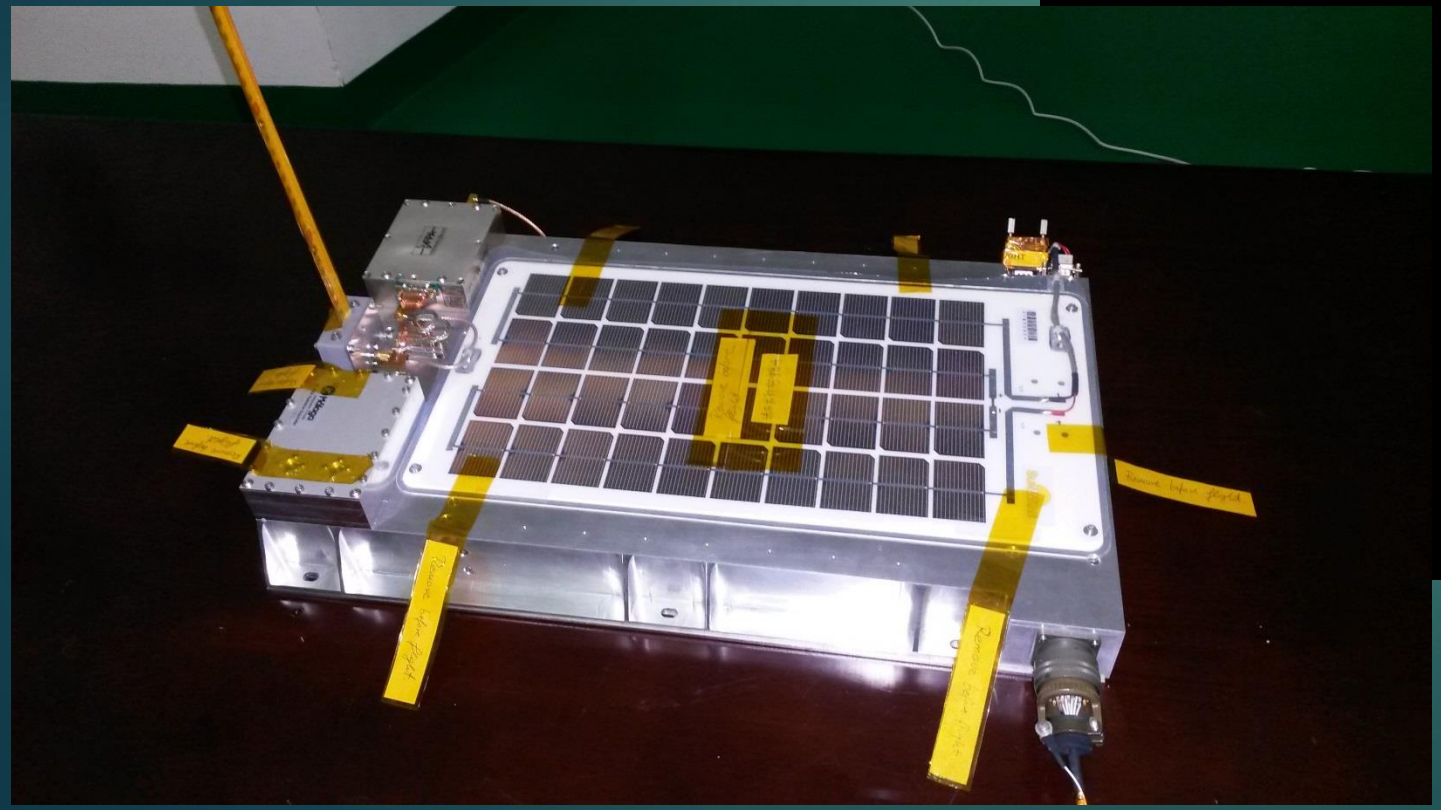
- ☼ Natural
- ☼ Alien
- ☒ Human
- ☼ Moonbounce

Signed: 73, PAUL N6TX

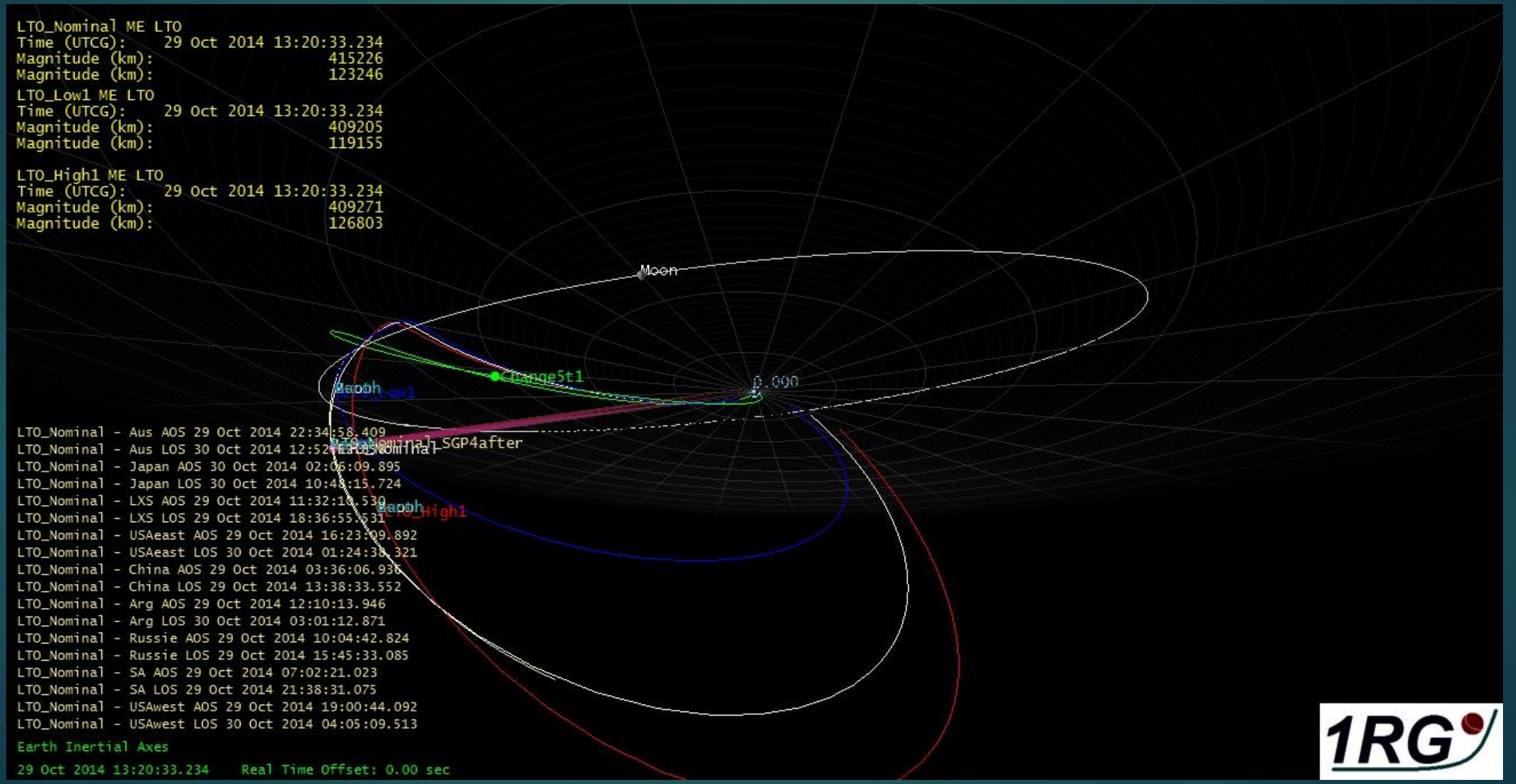
QSL Manager

LX0OHB-4M

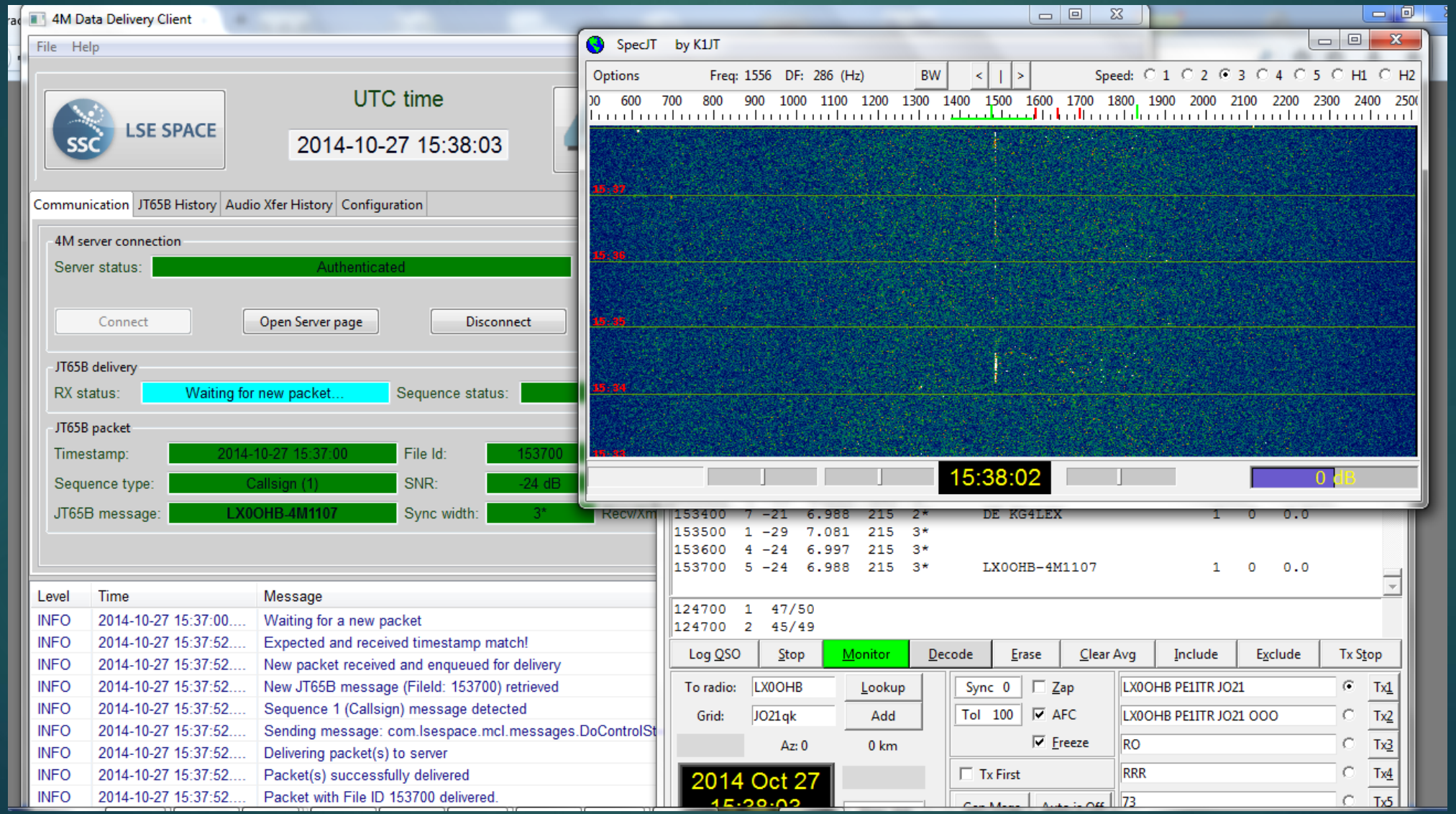
145.980 MHz
1w
JT65b modulatie



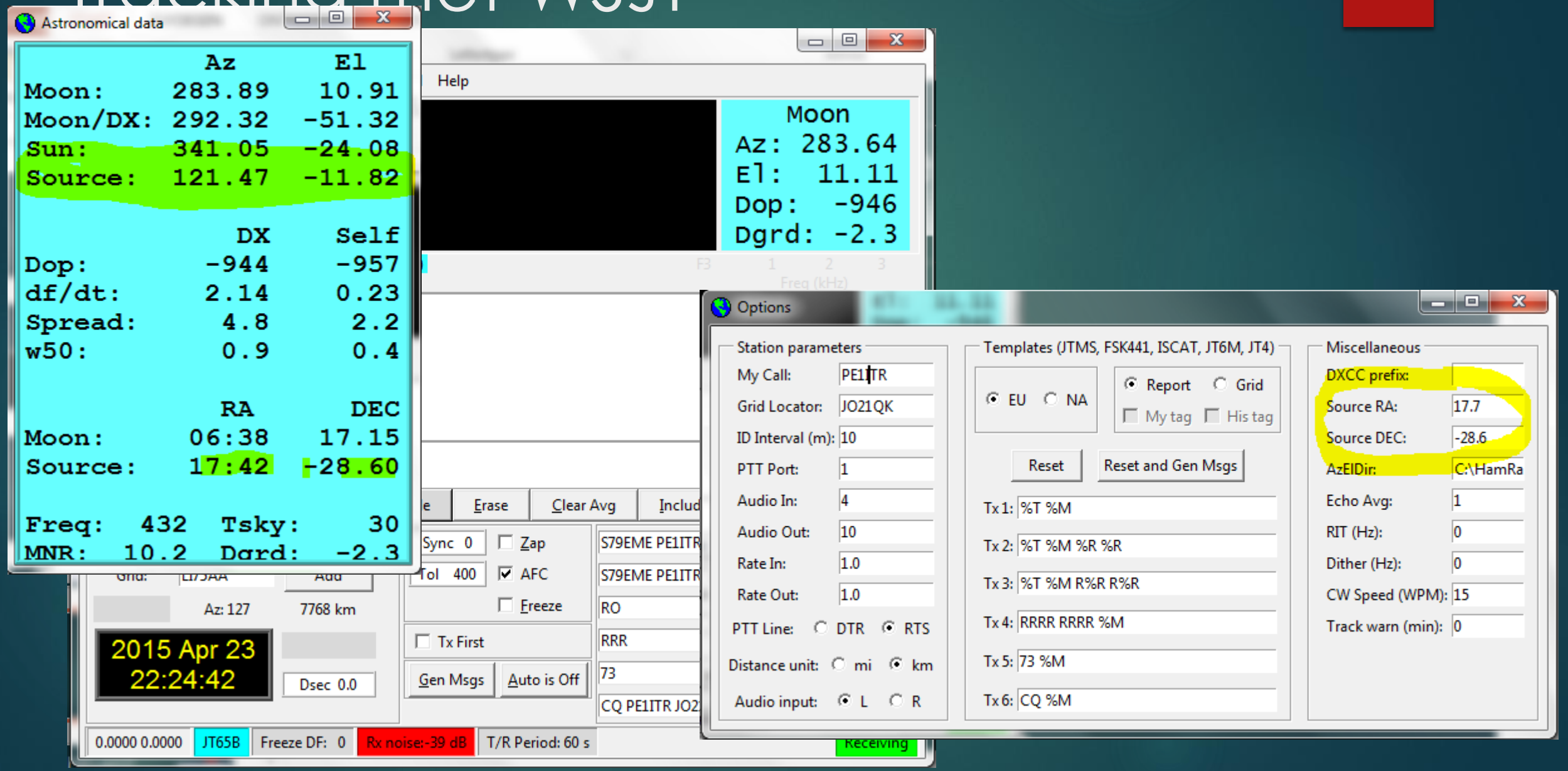
LX0OHB-4M


LTO_Nominal ME LTO
Time (UTCG): 29 Oct 2014 13:20:33.234
Magnitude (km): 415226
Magnitude (km): 123246
LTO_Low1 ME LTO
Time (UTCG): 29 Oct 2014 13:20:33.234
Magnitude (km): 409205
Magnitude (km): 119155
LTO_High1 ME LTO
Time (UTCG): 29 Oct 2014 13:20:33.234
Magnitude (km): 409271
Magnitude (km): 126803
Moon
Charge5t1
LTO_Nominal - Aus AOS 29 Oct 2014 22:34:58.409
LTO_Nominal - Aus LOS 30 Oct 2014 12:52:
LTO_Nominal - Japan AOS 30 Oct 2014 02:06:09.895
LTO_Nominal - Japan LOS 30 Oct 2014 10:48:15.724
LTO_Nominal - LXS AOS 29 Oct 2014 11:32:10.530
LTO_Nominal - LXS LOS 29 Oct 2014 18:36:55.531
LTO_Nominal - USAeast AOS 29 Oct 2014 16:23:09.892
LTO_Nominal - USAeast LOS 30 Oct 2014 01:24:38.321
LTO_Nominal - China AOS 29 Oct 2014 03:36:06.936
LTO_Nominal - China LOS 29 Oct 2014 13:38:33.552
LTO_Nominal - Arg AOS 29 Oct 2014 12:10:13.946
LTO_Nominal - Arg LOS 30 Oct 2014 03:01:12.871
LTO_Nominal - Russie AOS 29 Oct 2014 10:04:42.824
LTO_Nominal - Russie LOS 29 Oct 2014 15:45:33.085
LTO_Nominal - SA AOS 29 Oct 2014 07:02:21.023
LTO_Nominal - SA LOS 29 Oct 2014 21:38:31.075
LTO_Nominal - USAwest AOS 29 Oct 2014 19:00:44.092
LTO_Nominal - USAwest LOS 30 Oct 2014 04:05:09.513
Earth Inertial Axes
29 Oct 2014 13:20:33.234 Real Time Offset: 0.00 sec
SGP4after
1RG

LX0OHB-4M


4M Data Delivery Client
File Help
LSE SPACE
UTC time
2014-10-27 15:38:03
Communication
JT65B History
Audio Xfer History
Configuration
4M server connection
Server status:
Authenticated
Connect
Open Server page
Disconnect
JT65B delivery
RX status:
Waiting for new packet...
Sequence status:
JT65B packet
Timestamp:
2014-10-27 15:37:00
File Id:
153700
Sequence type:
Callsign (1)
SNR:
-24 dB
JT65B message:
LX0OHB-4M1107
Sync width:
3*
Level
Time
Message
INFO 2014-10-27 15:37:00.... Waiting for a new packet
INFO 2014-10-27 15:37:52.... Expected and received timestamp match!
INFO 2014-10-27 15:37:52.... New packet received and enqueued for delivery
INFO 2014-10-27 15:37:52.... New JT65B message (FileId: 153700) retrieved
INFO 2014-10-27 15:37:52.... Sequence 1 (Callsign) message detected
INFO 2014-10-27 15:37:52.... Sending message: com.lsespace.mcl.messages.DoControlSt
INFO 2014-10-27 15:37:52.... Delivering packet(s) to server
INFO 2014-10-27 15:37:52.... Packet(s) successfully delivered
INFO 2014-10-27 15:37:52.... Packet with File ID 153700 delivered.
SpecJT by K1JT
Options
Freq: 1556 DF: 286 (Hz)
BW
Speed: 1 2 3 4 5 H1 H2
600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100 2200 2300 2400
15:37
15:36
15:35
15:34
15:38:02
0 dB
153400 7 -21 6.988 215 2* DE KG4LEX 1 0 0.0
153500 1 -29 7.081 215 3*
153600 4 -24 6.997 215 3*
153700 5 -24 6.988 215 3* LX0OHB-4M1107 1 0 0.0
124700 1 47/50
124700 2 45/49
Log QSO
Stop
Monitor
Decode
Erase
Clear Avg
Include
Exclude
Tx Stop
To radio: LX0OHB
Lookup
Grid: JO21qk
Add
Az: 0
0 km
2014 Oct 27
Sync 0
Zap
Tol 100
AFC
Freeze
Tx First
LX0OHB PE1ITR JO21
LX0OHB PE1ITR JO21 OOO
RO
RRR
73
Tx1
Tx2
Tx3
Tx4
Tx5

Tracking met WSJT

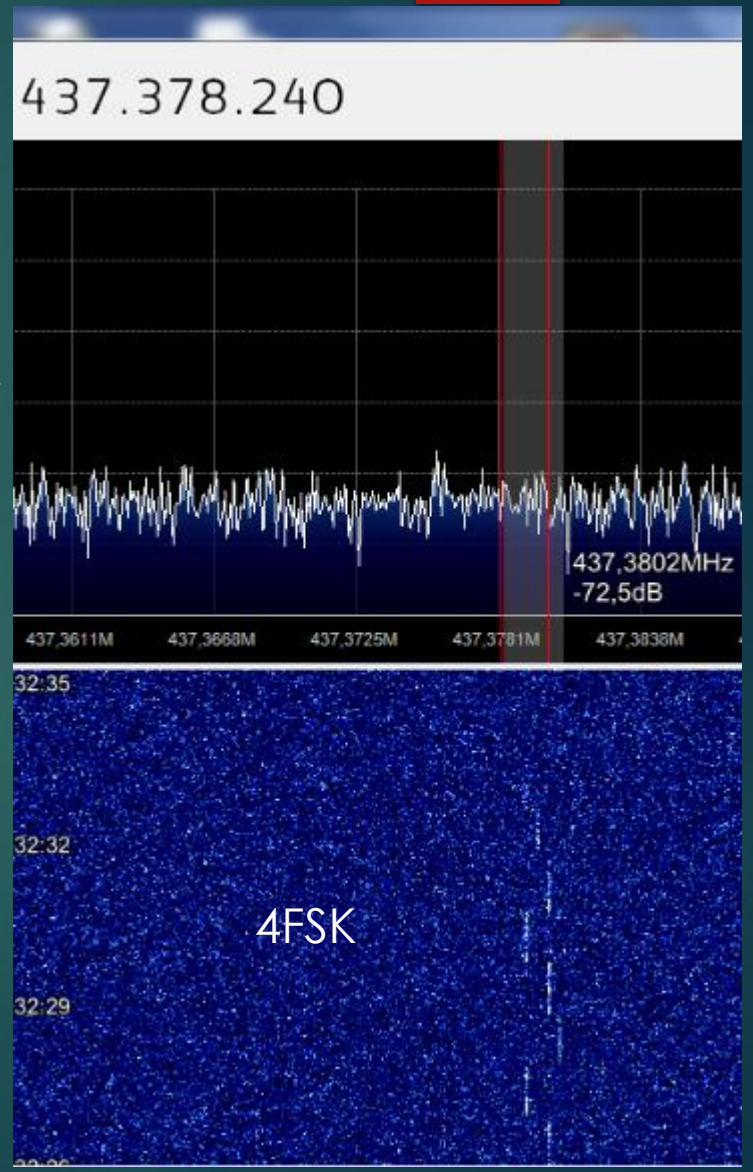


Shin-en2

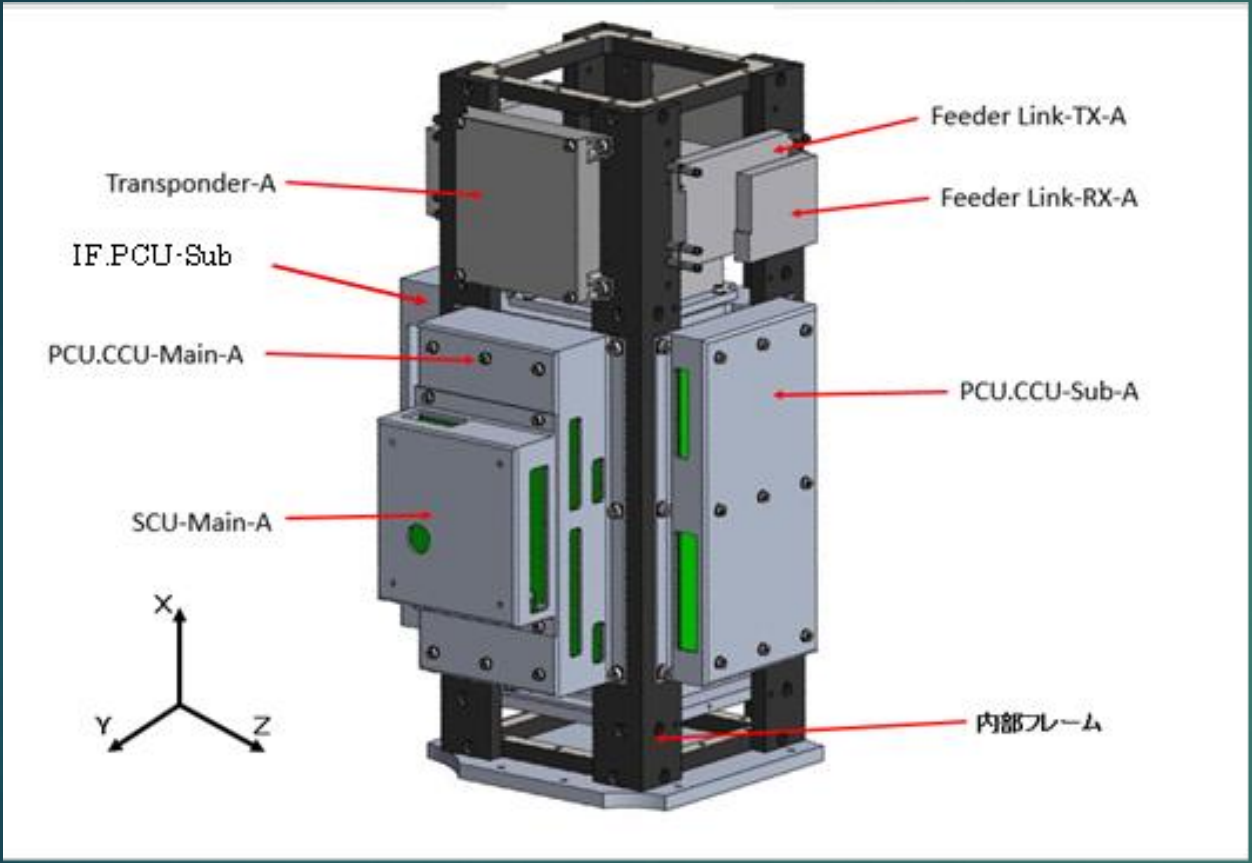
Gelanceerd op 2014-12-03 samen met de Hayabusa 2.
Gebouwd door Kyushu Institute of Technology & Kagoshima University

Telemetrie Downlink 437.385MHz.
Output 0.8 Watts F1D Modulation
4FSK Signaal

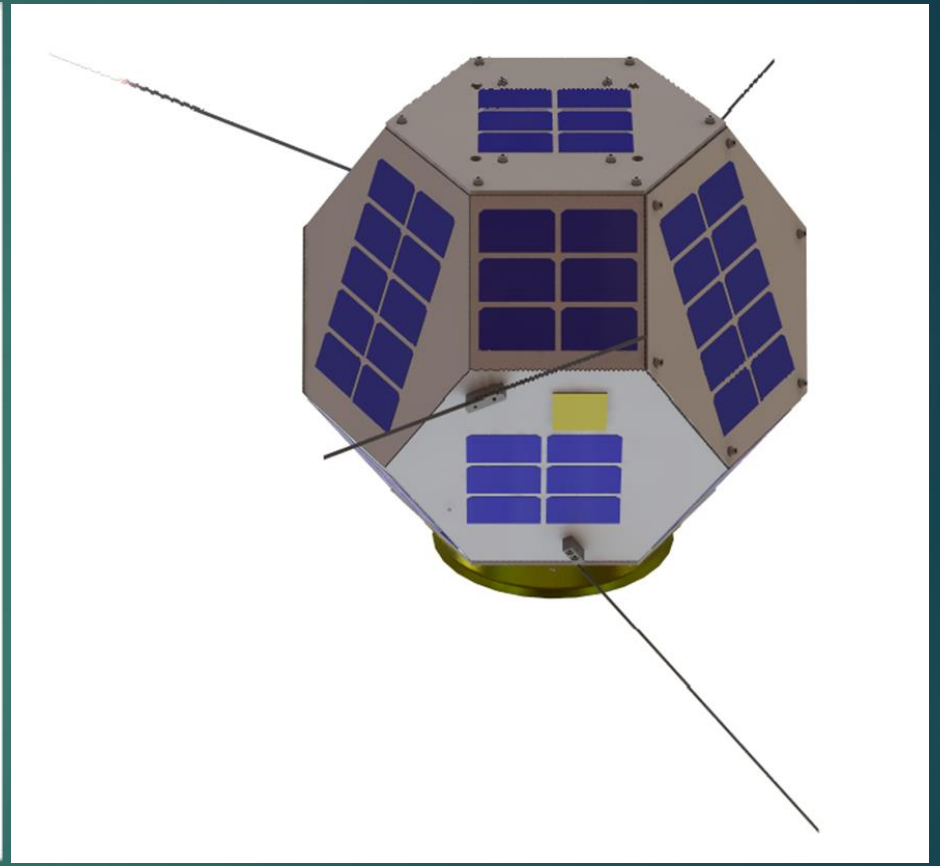
Ook
437.505 MHz 0.1 W A1A baken (niet gehoord)
145.942 -> 435.270MHz.



Deep Space Communication Experiment Probe "Shin-En2"

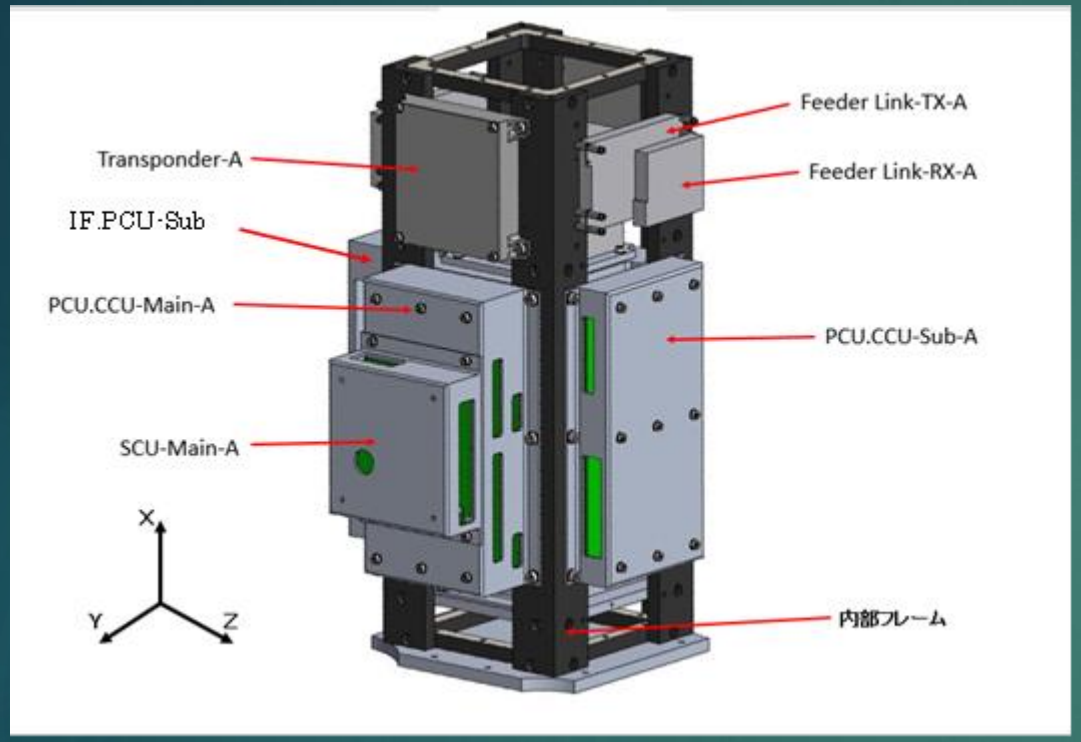


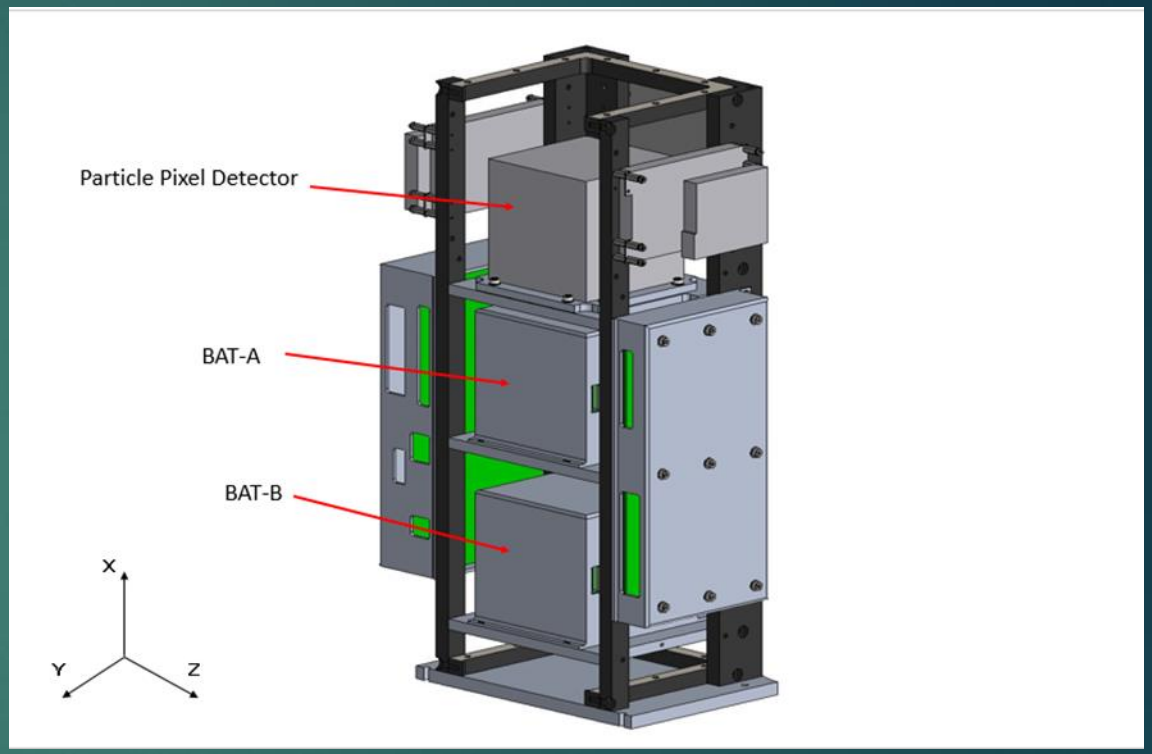
Internal structure of the Probe



Appearance of the Probe

Deep Space Communication Experiment Probe "Shin-En2"





The particle pixel detector was equipped in the upper center of the internal structure.
It was covered with the transmitters and the receivers of the transponder system, the feeder link system.

Appearance of Shin-En2

Inside of Shin-En2

4 70cm Antennes

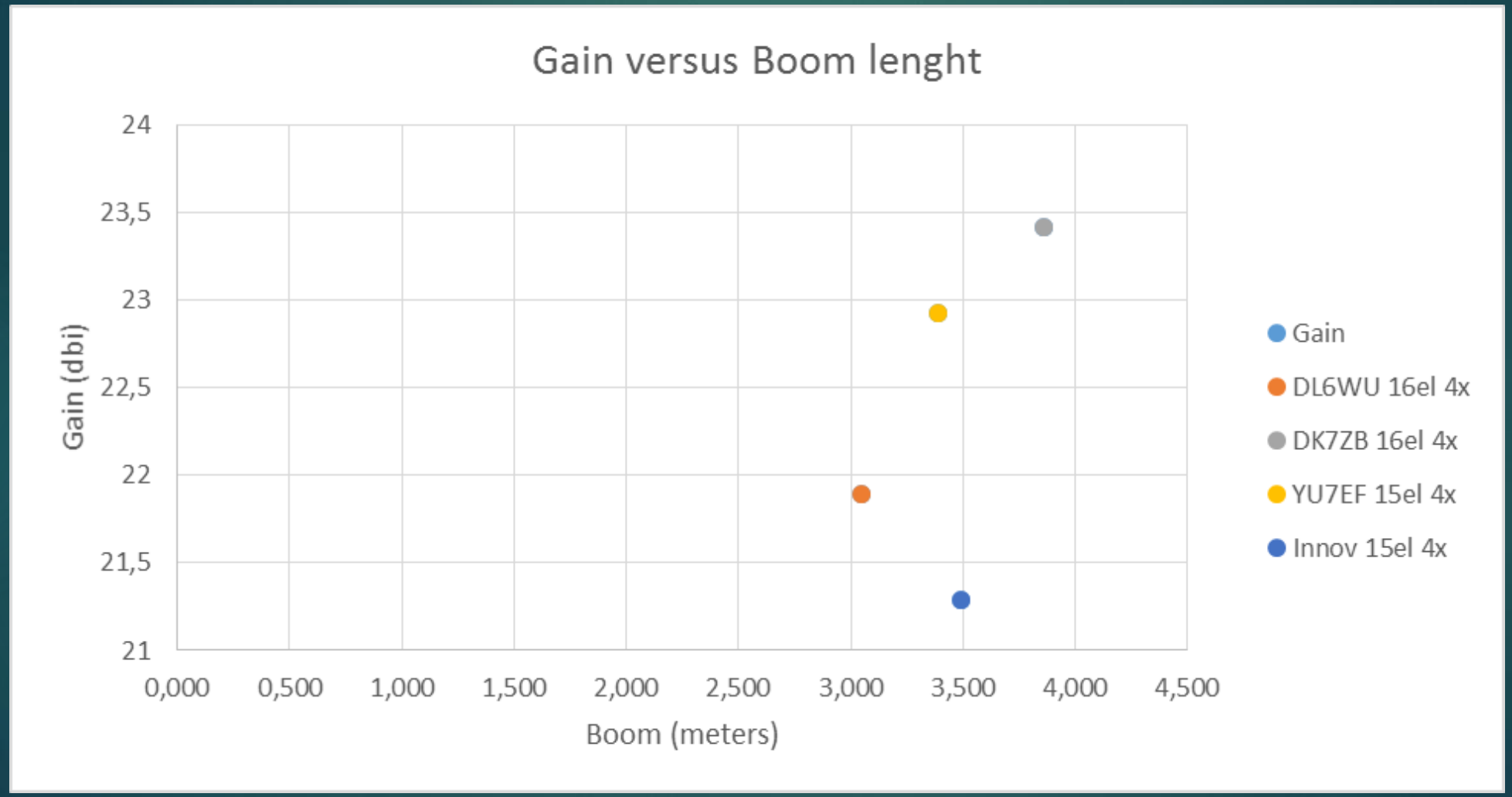
Van links naar rechts:

- 16 el DK7ZB
- 15 el YU7EF
- 16 el LFA (G0KSC)

- 16el DL6WU (niet op foto)

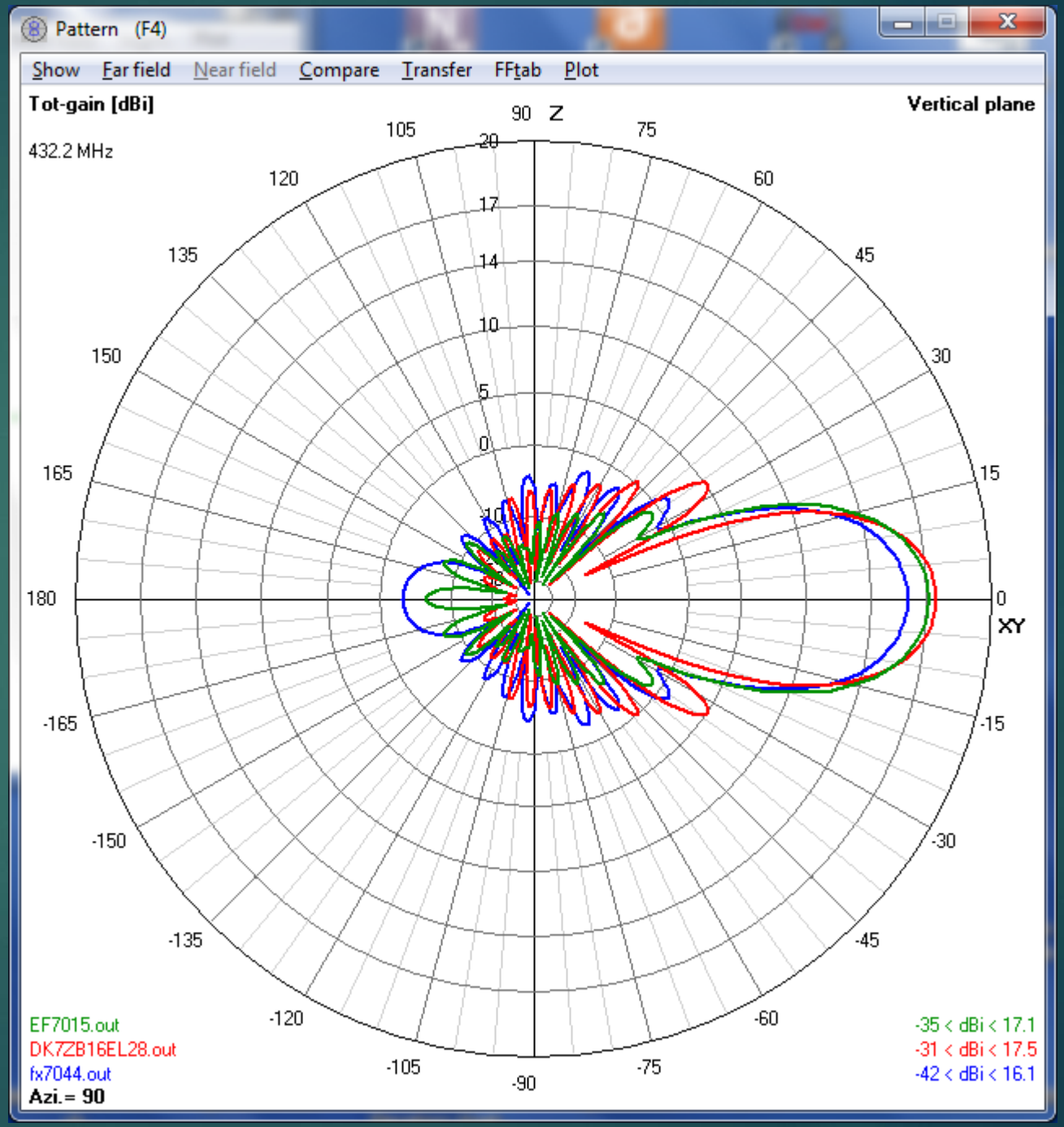
- Gain en G/T (gain temperature)

70cm antennes



Vertical plane Pattern

Groen: 15el YU7EF
Rood: 16el DK7ZB
Blauw: 16el DL6WU

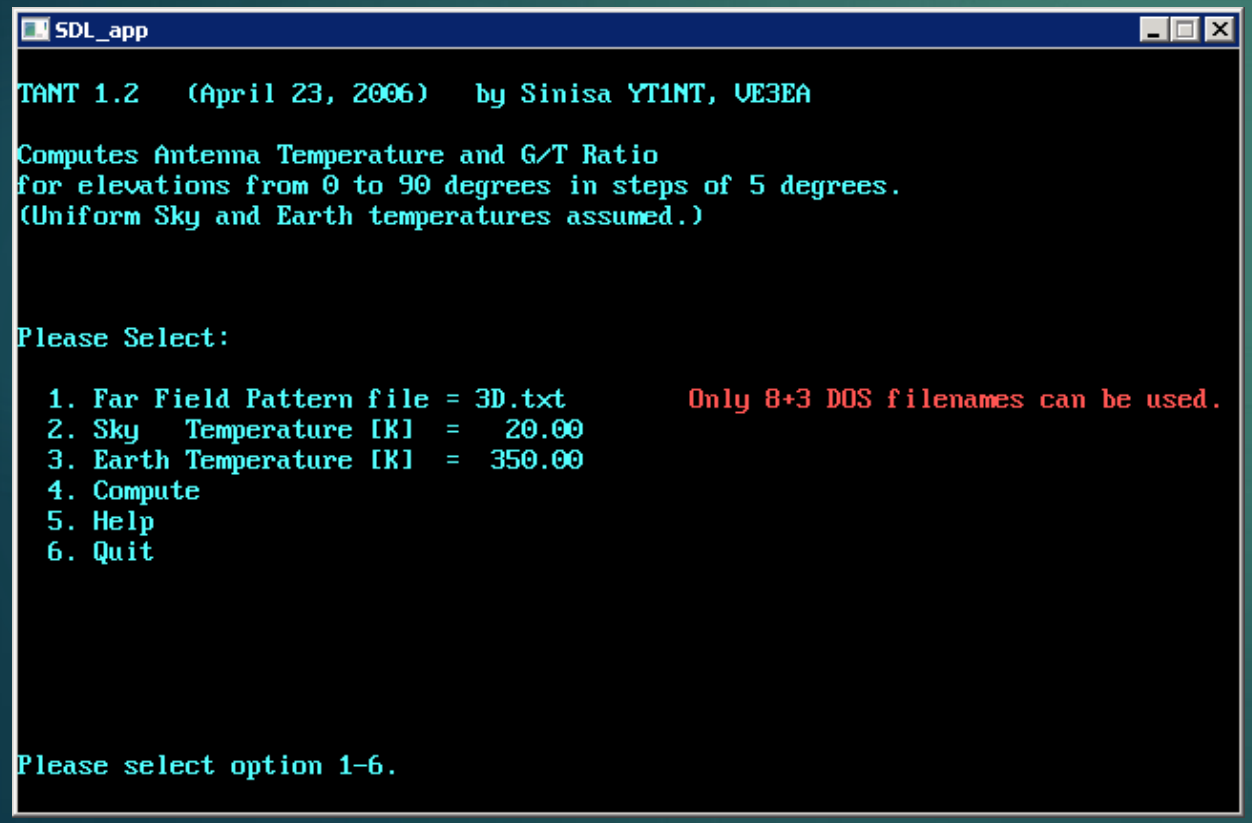


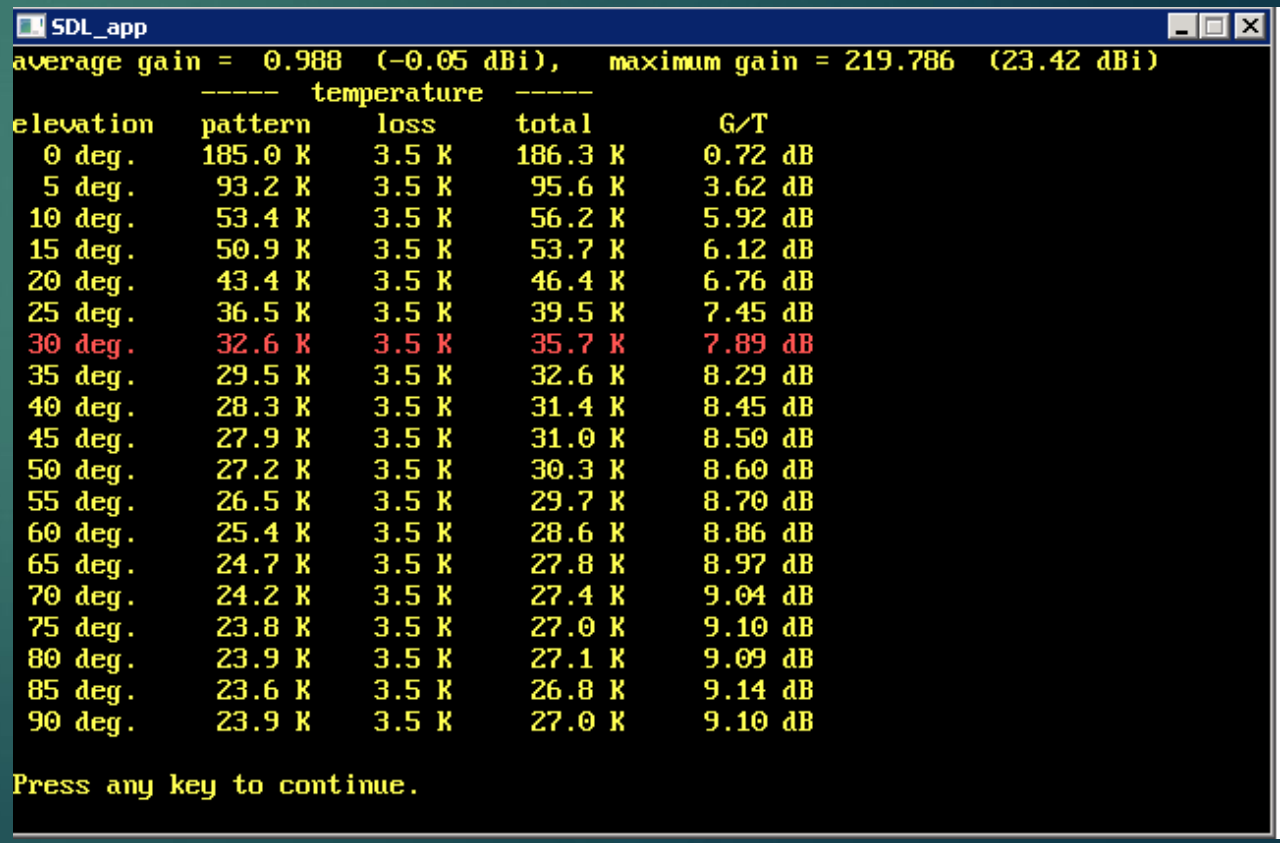
G/T Ratio

G/T = vergelijkingsgetal voor de deugdelijkheid. Dit wordt gebruikt om de ontvang eigenschappen van een antenne systeem aan te duiden.

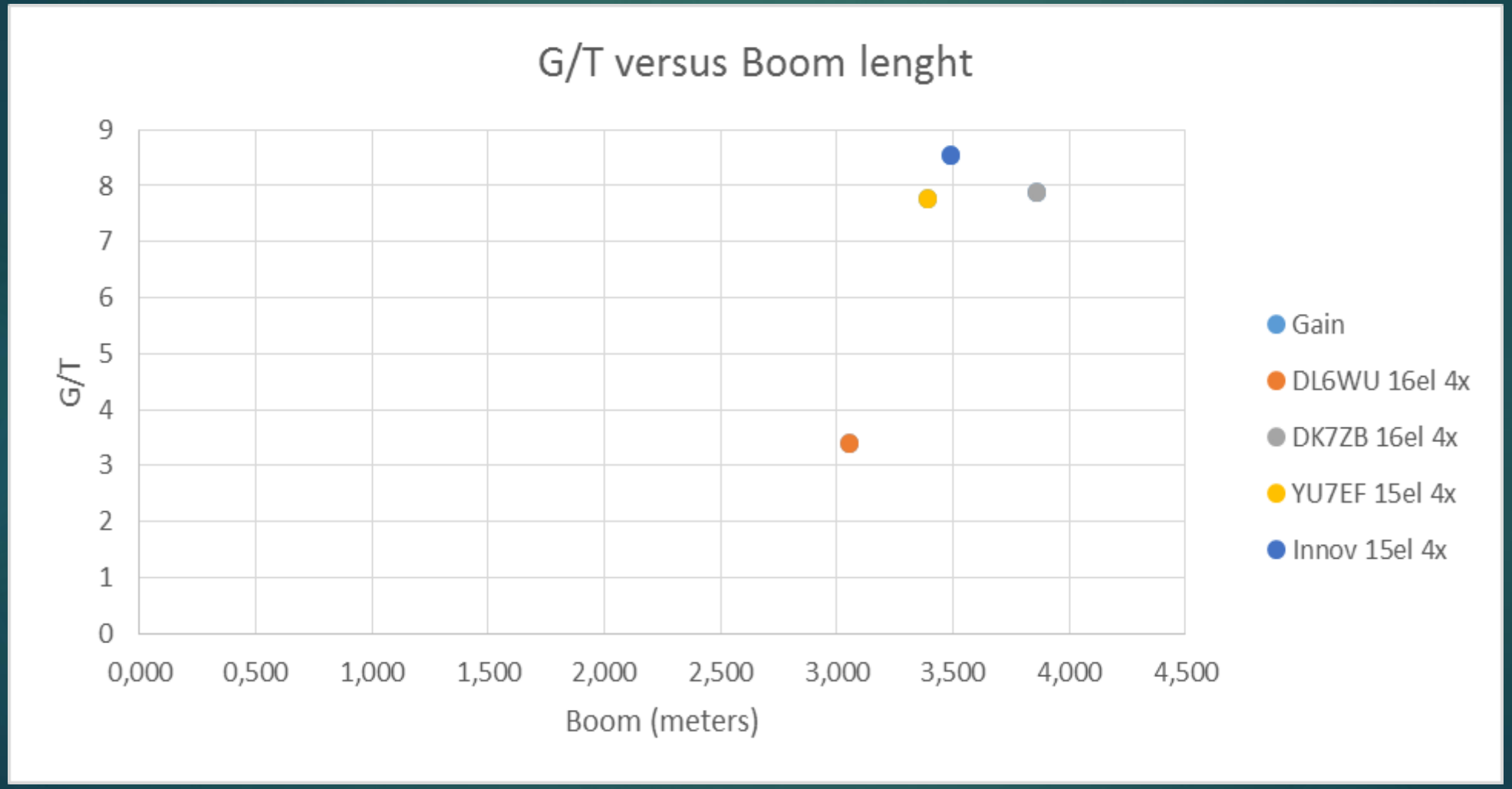
Formule: G/T = (Ga) - (10*log Ta)

Hoe positiever de G/T is, des te beter is de antenne. De afspraak (DJ9BV) is om de ruistemperatuur op 30 graden elevatie te berekenen

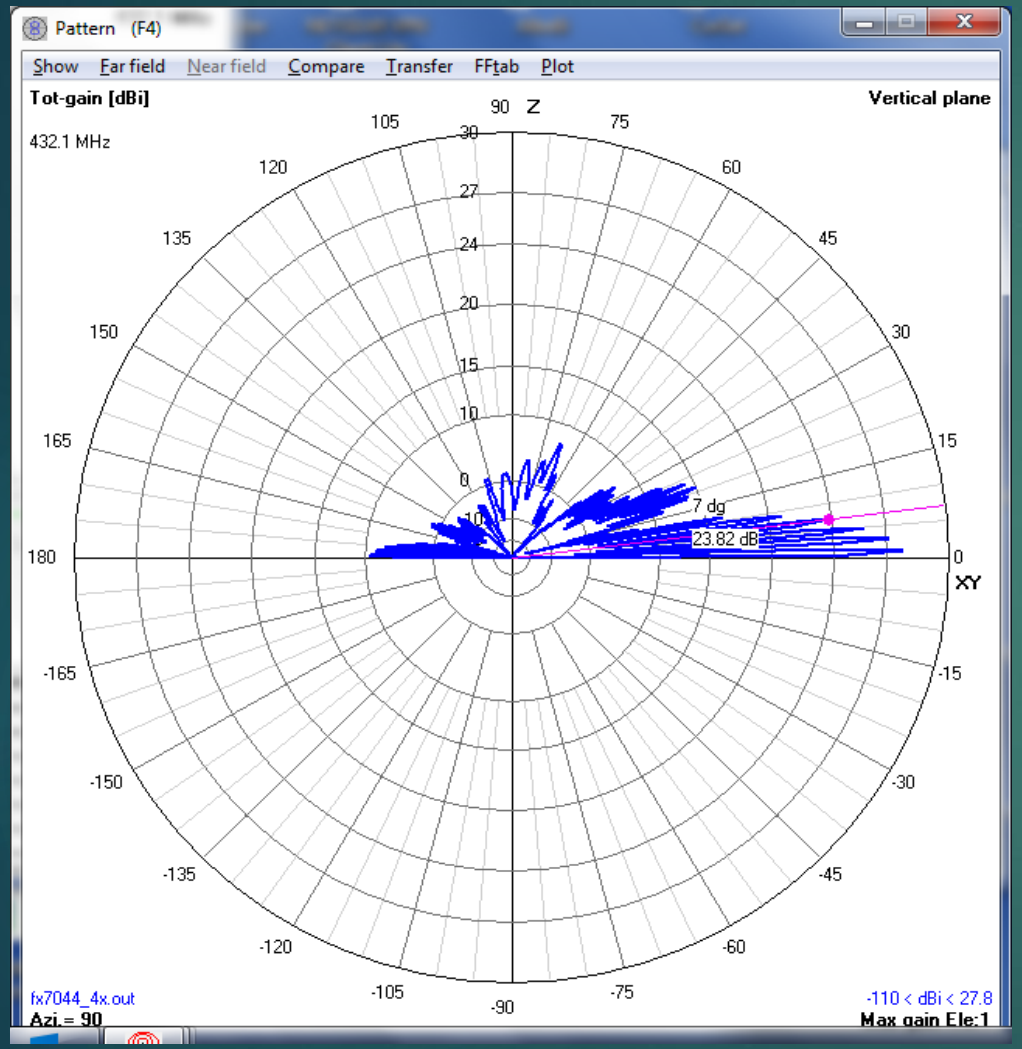




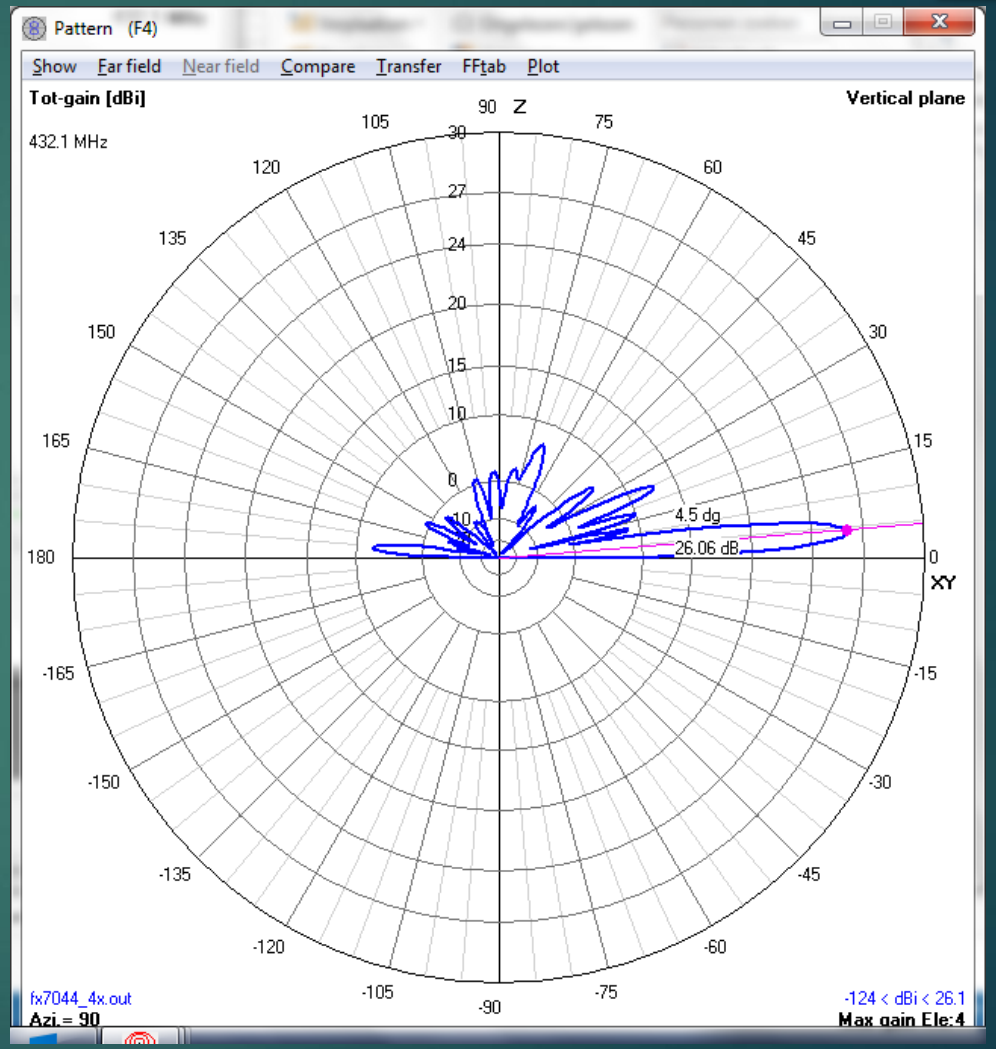
70cm antennes



Groundgain

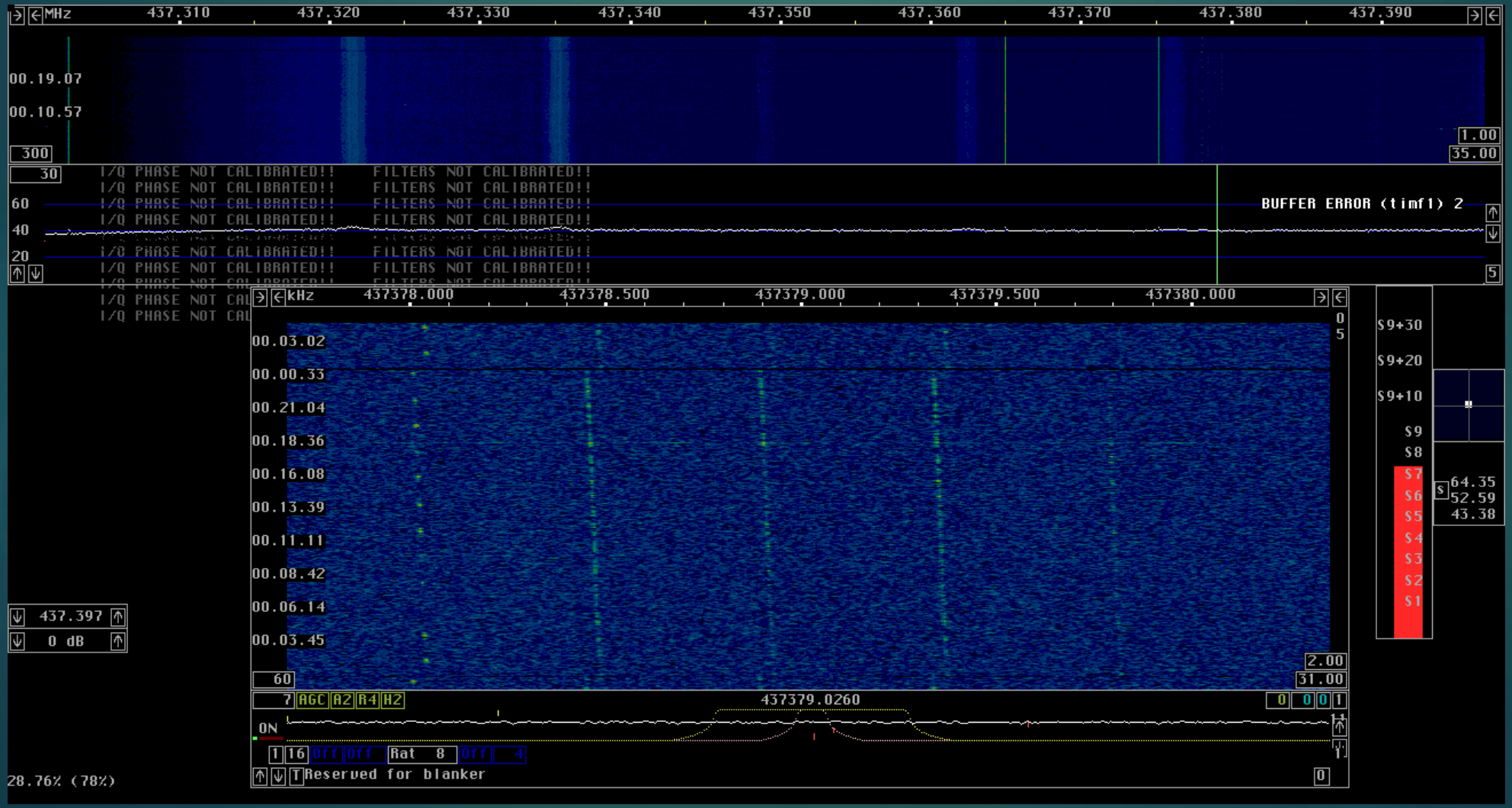


10m AGL



2m AGL

Shin-en2 – 750.000km



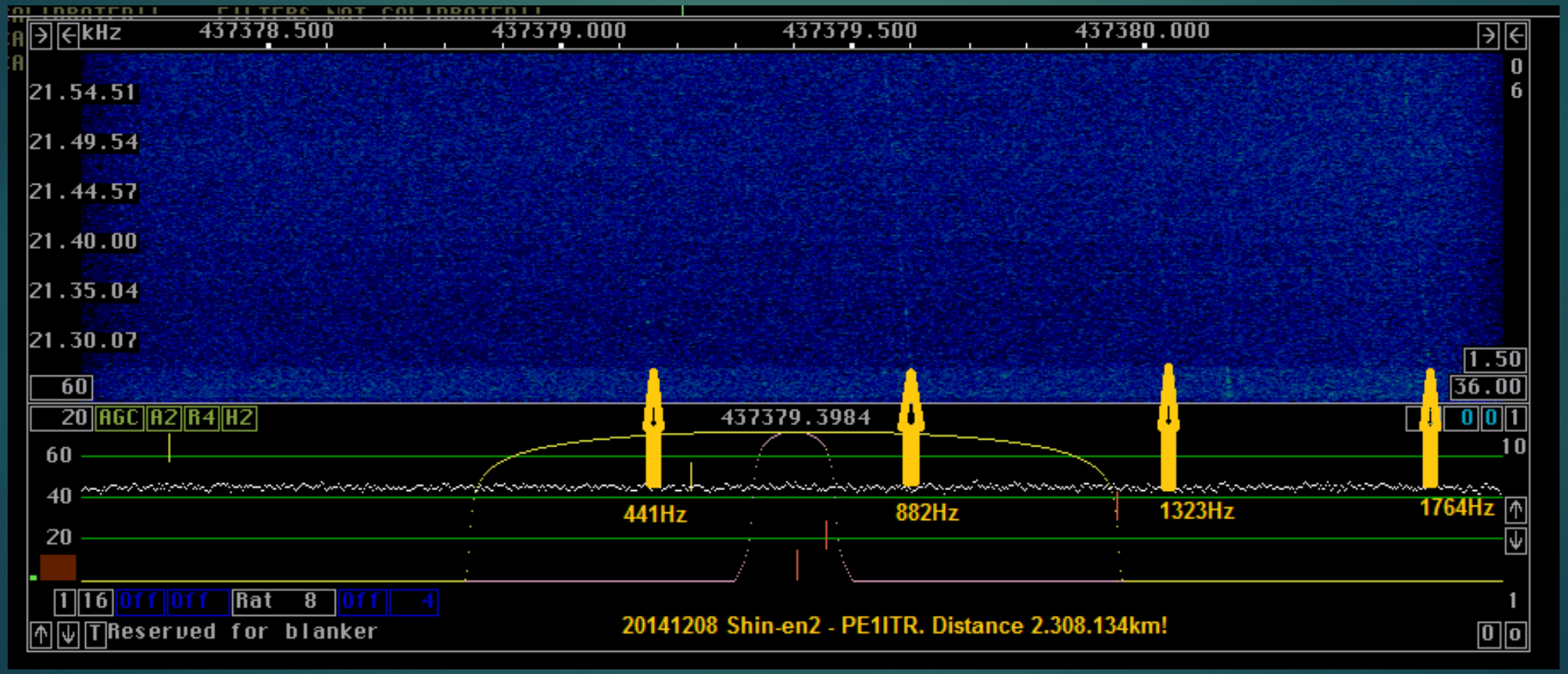
Shinen2

PE1ITR Satellite link calculation

v20060310

Parameters			Link Calculation		
Transmitter					
tx power	0,8	W	Beacon TX level	29,03	dbm
tx ant gain	0	dbi	Beacon Ant Gain	0,00	dbi
Pathloss					
F	437	Mhz	Pathloss	214,47	db
D	2308134	Km			
Receiver					
Antenne gain	24	dbi		24,00	dbi
NF	0,7	db			
Signal at preamp					
			Signal at Preamp	**-161,44**	dbm
Conversion from NF (db) to Noise Power from Pre-amp					
Temp Preamp	50,72	K			
Temp at Sky	70,00	K			
Noise Power					
Bolzman (Joule/Kelvin)	1,38E-23	k			
Bandbreedte	2500	Hz	**Noise Power**	-143,80	dbm
Expected Signal Level					
			Signal above Noise	**-17,64**	db
			in	2500	Hz

Shin-en2 - 2.308.134 km



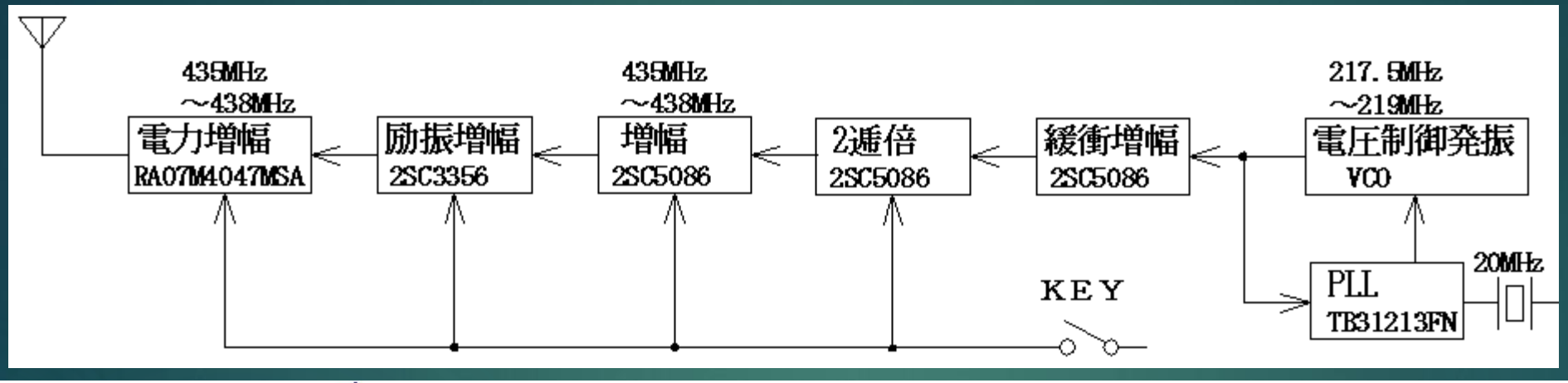
ARTSAT2::DESPATCH

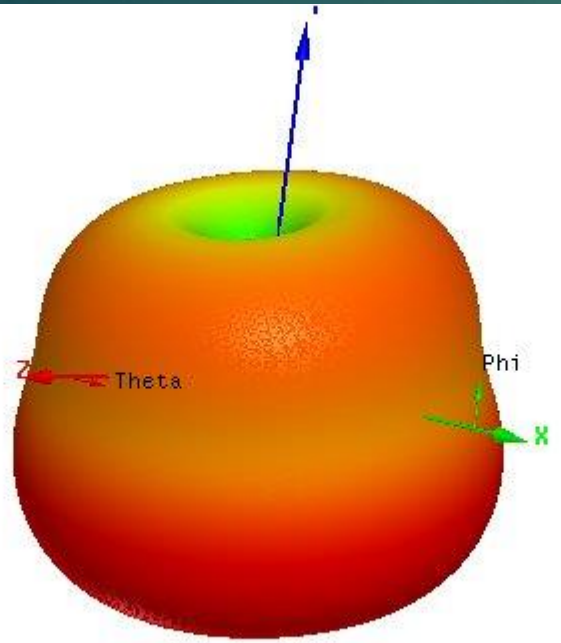
Gelanceerd op 2014-12-03 samen met de Hayabusa 2.

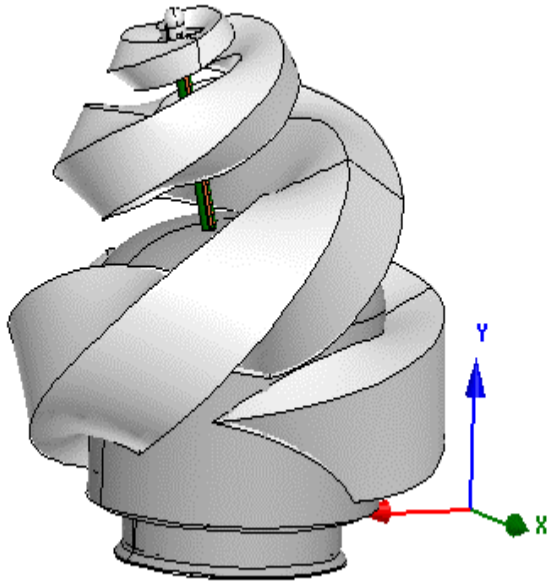
CW Downlink 437.325MHz.
Output 7w A1A Modulation.

Het baken is niet continue actief. Uitzendschema op Artsat webpagina.
Baken op batterijen. Niet meer Operationeel.

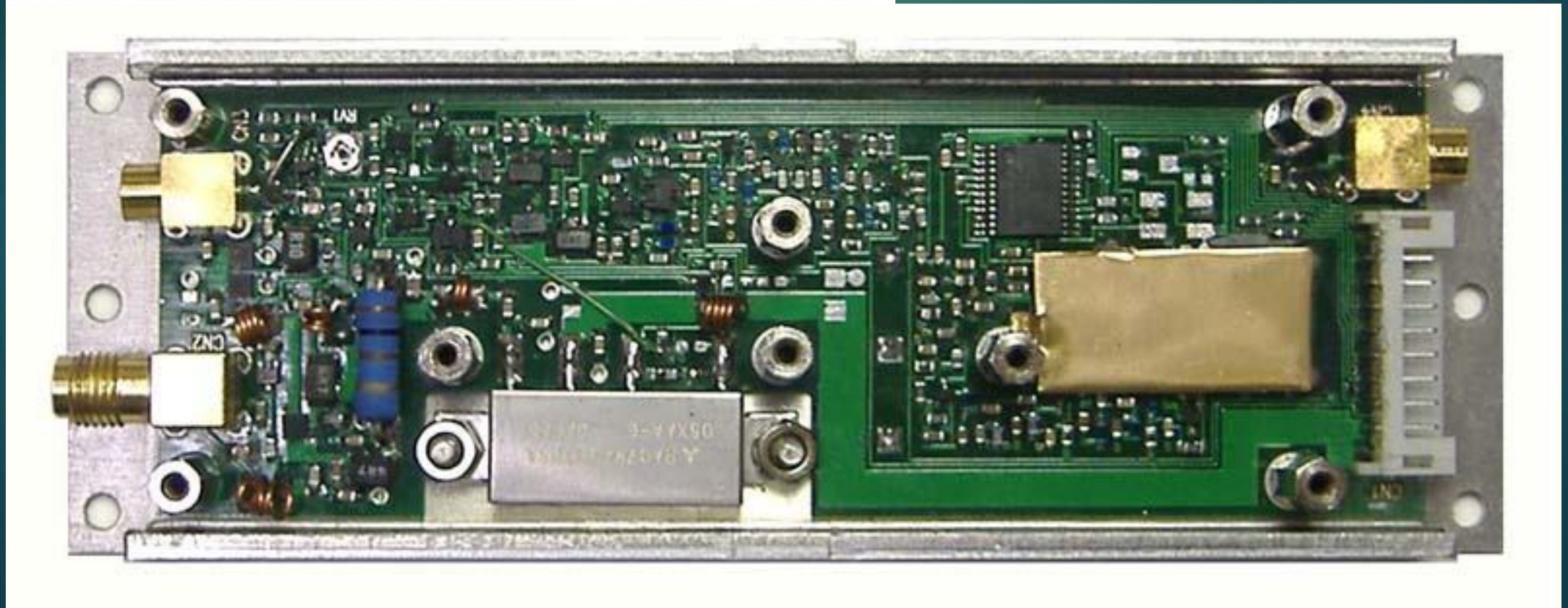
Artsat2::Despatch



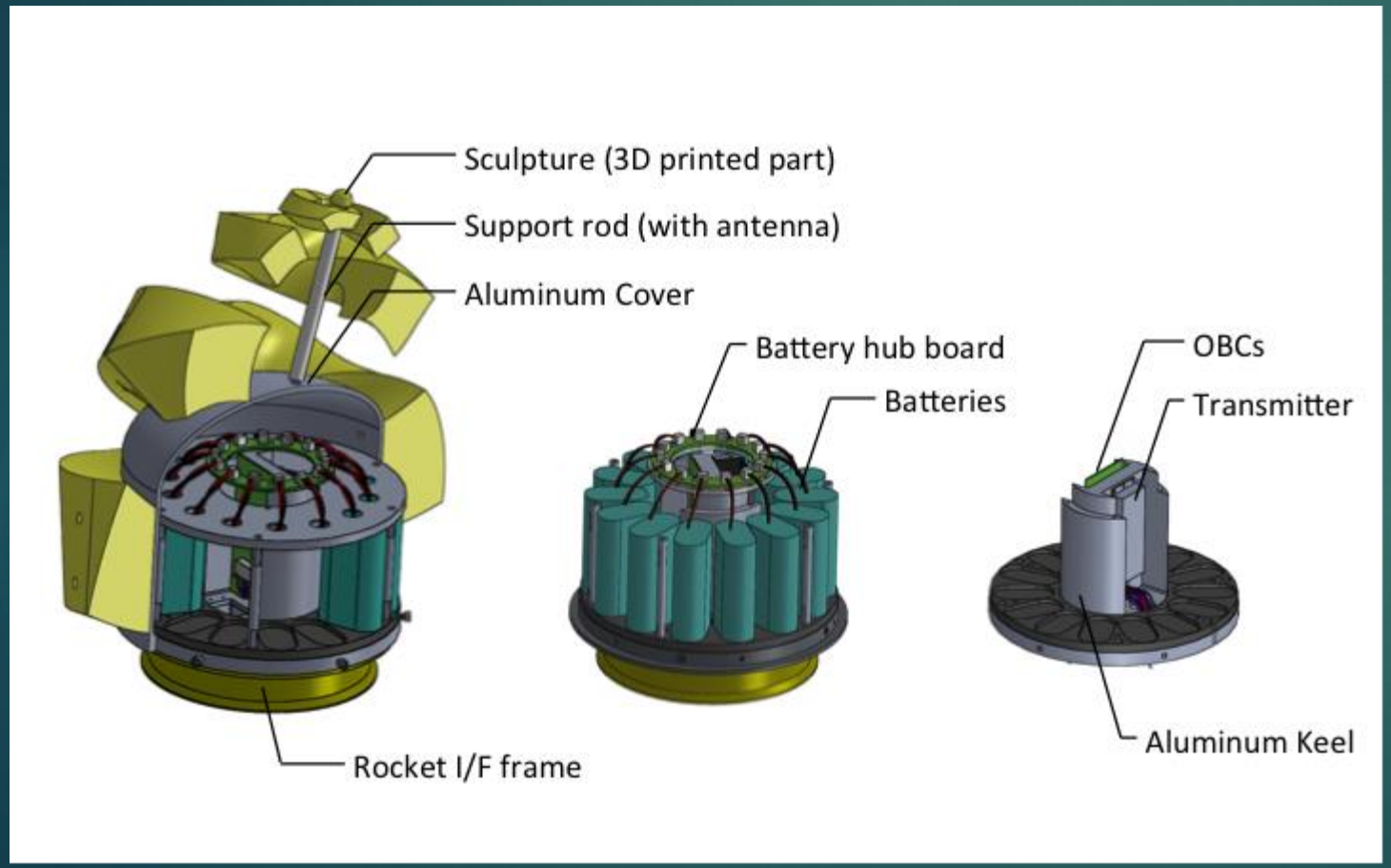




Artsat::Despatch



Artsat2:Despatch



8w
437.325MHz

Tracking Artsat2::Despatch

```
[rhardenb@R300A ~]$ cat trackdespatch.sh
#!/bin/bash

t=`date +%s`;
echo $t;
wget -q -O /dev/stdout http://api.artsat.jp/despatch/track.json?time=$t\&lat=51.
4454\&lon=5.4006\&alt=20;
[rhardenb@R300A ~]$
```

```
[rhardenb@R300A ~]$ ./trackdespatch.sh
1429908335
{
  "time": 1429908335,
  "elevation": 28.494779786246966,
  "azimuth": 235.94250607471054,
  "doppler_down": 0.9999853706912191,
  "doppler_up": 1.000014629308781,
  "distance": 59653588981,
  "declination": 3.807469184210197,
  "right_ascension": 122.49663060946989,
  "phase": "radio_stop"
}[rhardenb@R300A ~]$
```

Antennesystemen

432MHz Ontvanger

- DB6NT Pre-amp
- Funcube dongle

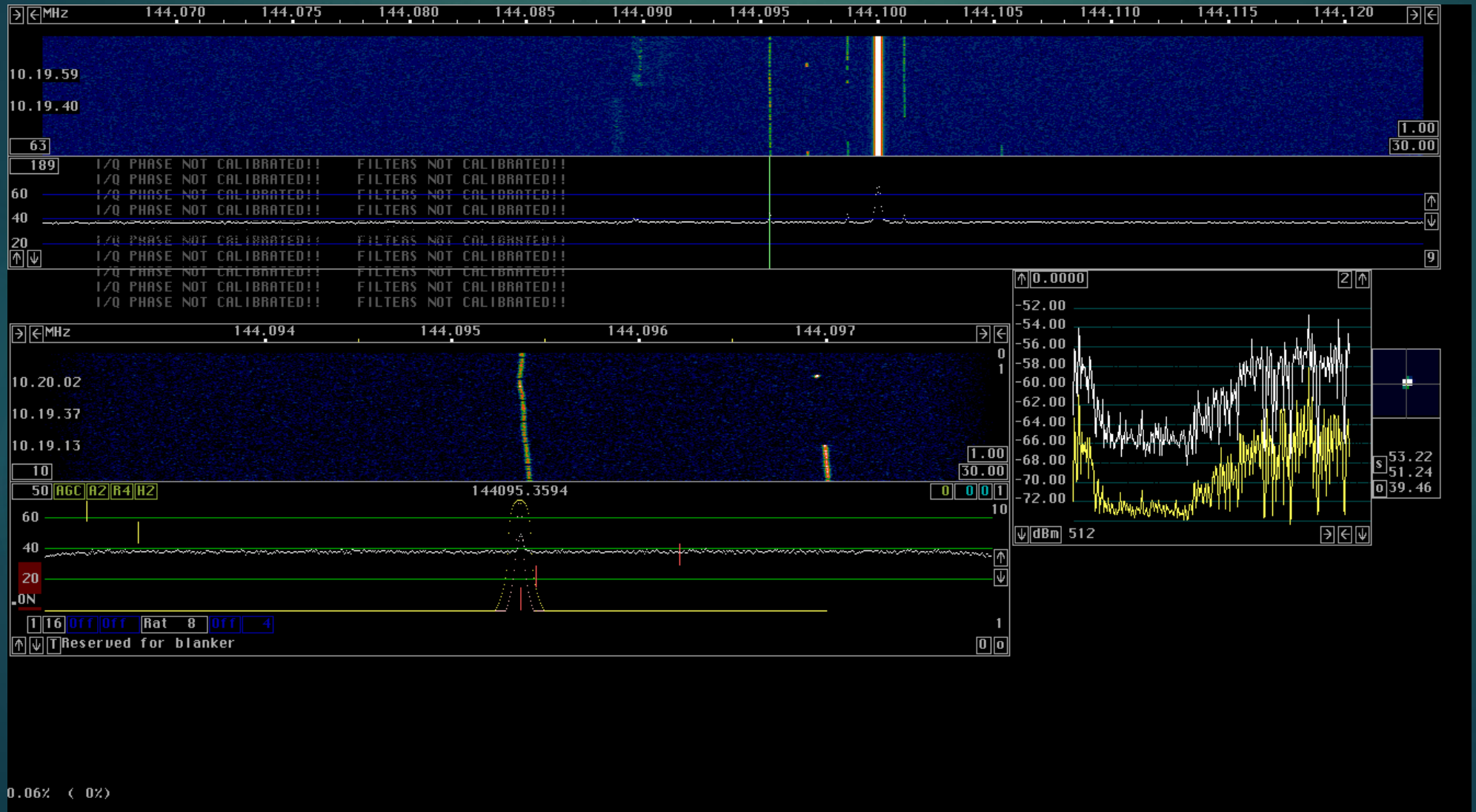
SDR

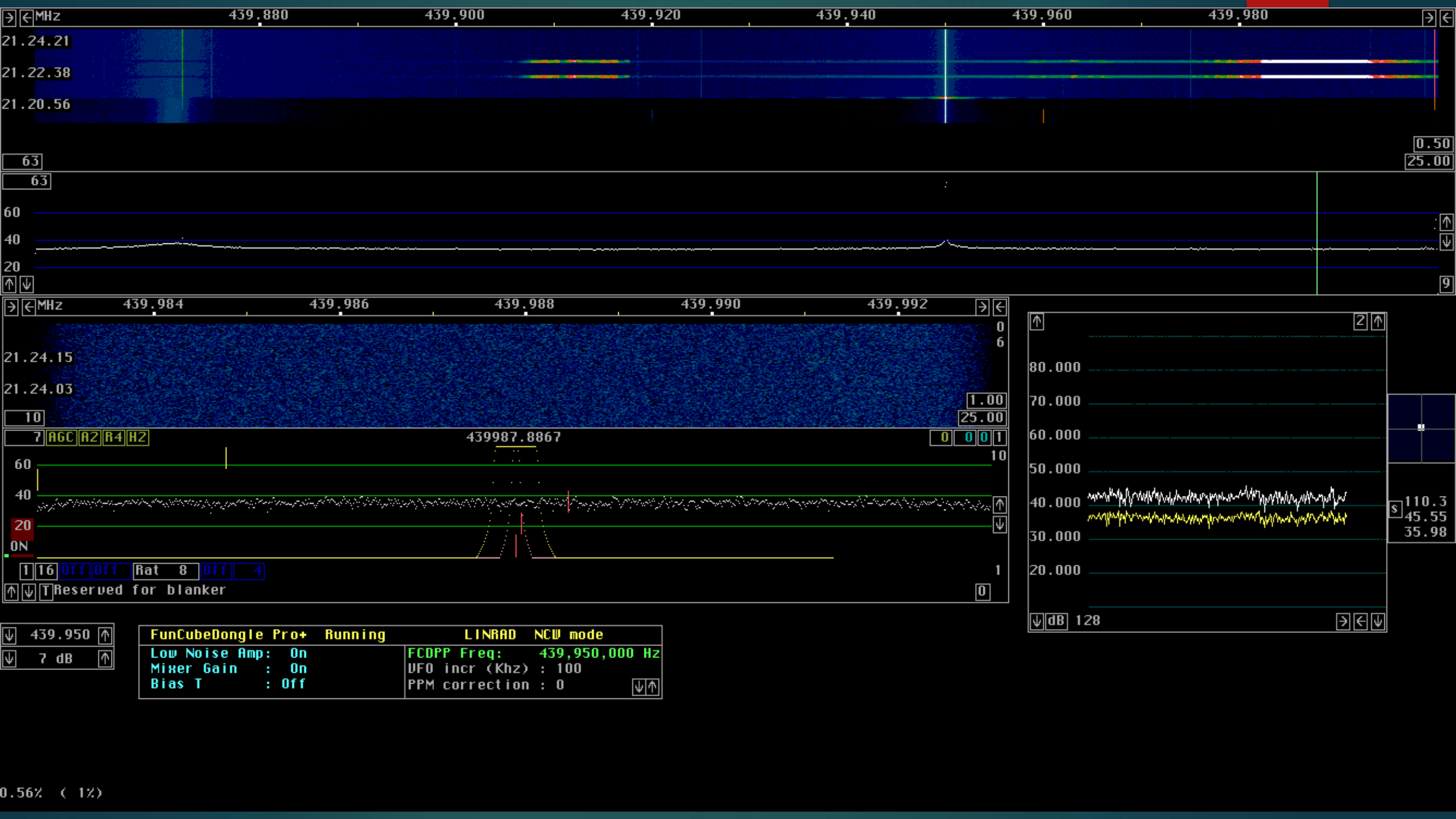
Linrad: SM5BSZ http://www.sm5bsz.com/linuxdsp/linrad.htm

Spectrumlab DL4YHF http://www.qsl.net/dl4yhf/spectra1.html

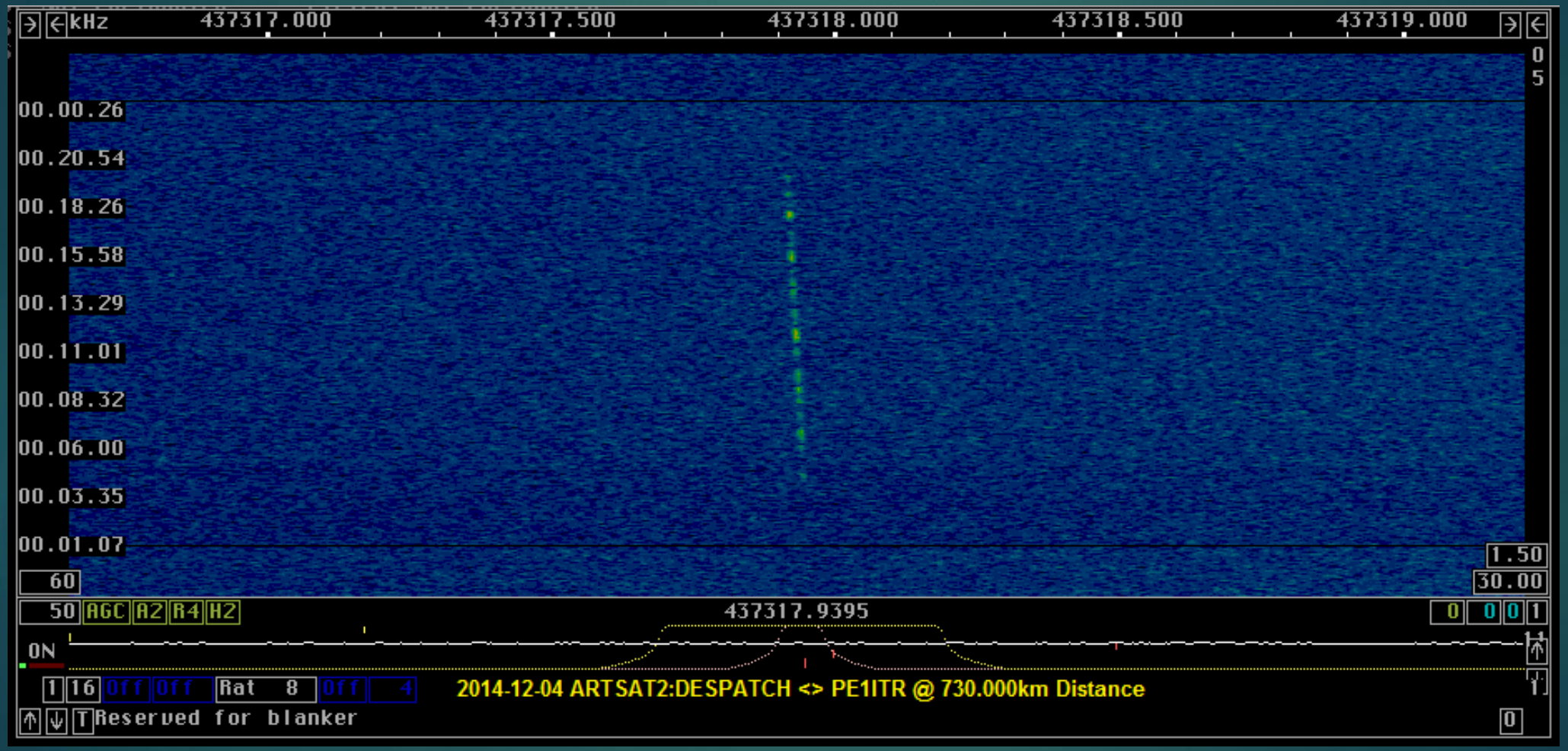
SDRsharp http://sdrsharp.com/

Linrad

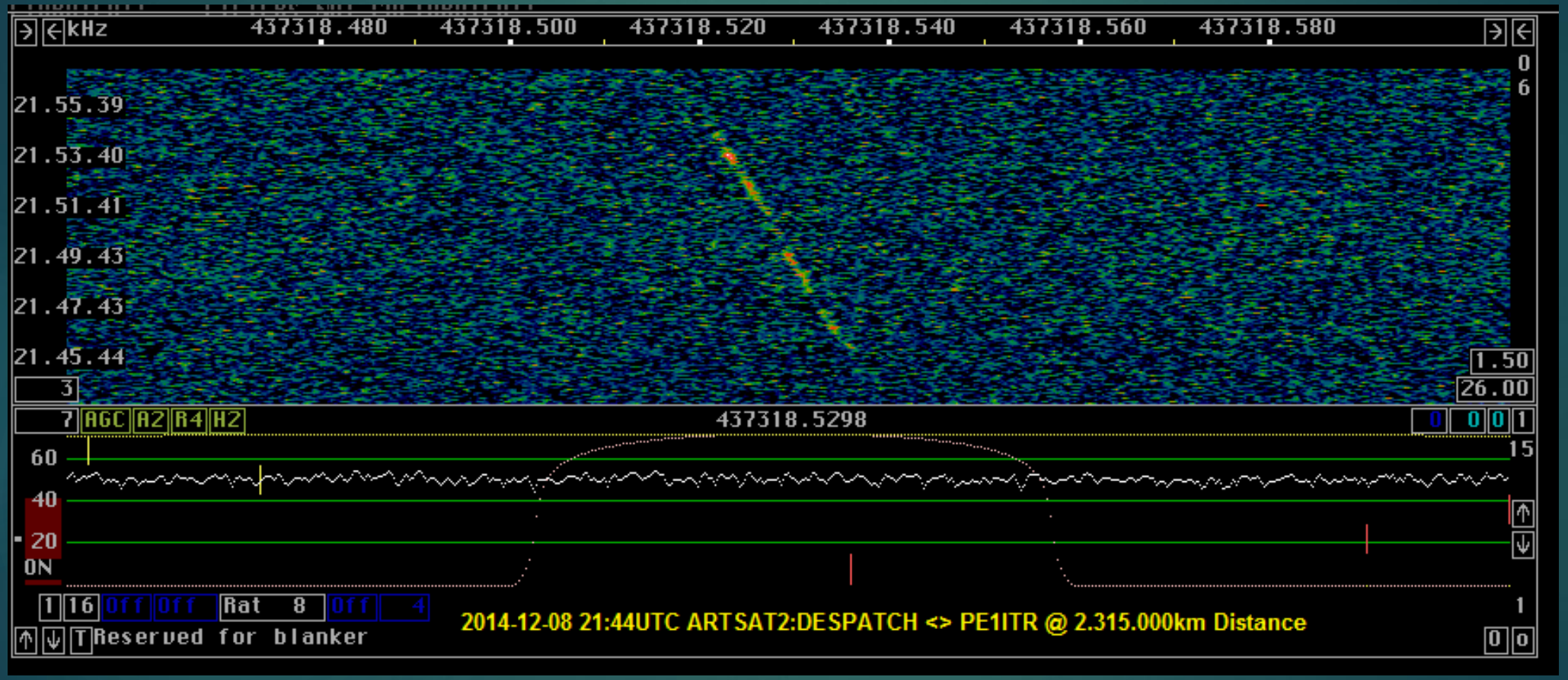

MHz
144.070
144.075
144.080
144.085
144.090
144.095
144.100
144.105
144.110
144.115
144.120
10.19.59
10.19.40
63
1.00
30.00
189
I/Q PHASE NOT CALIBRATED!! FILTERS NOT CALIBRATED!!
60
40
20
9
MHz
144.094
144.095
144.096
144.097
10.20.02
10.19.37
10.19.13
10
1.00
30.00
50 AGC A2 R4 H2
144095.3594
10
60
40
20
ON
1 16 Off Off Rat 8 Off 4
T Reserved for blanker
0.0000
-52.00
-54.00
-56.00
-58.00
-60.00
-62.00
-64.00
-66.00
-68.00
-70.00
-72.00
dBm 512
S 53.22
51.24
0 39.46
0.06% (0%)


MHz
439.880
439.900
439.920
439.940
439.960
439.980
21.24.21
21.22.38
21.20.56
0.50
25.00
63
63
60
40
20
9
MHz
439.984
439.986
439.988
439.990
439.992
0
6
21.24.15
21.24.03
1.00
25.00
10
7 AGC A2 R4 H2
439987.8867
0 0 0 1
10
60
40
20
ON
1 16 Off Off Rat 8 Off 4
1
T Reserved for blanker
0
2
80.000
70.000
60.000
50.000
40.000
30.000
20.000
dB 128
S
110.3
45.55
35.98
439.950
7 dB
FunCubeDongle Pro+ Running LINRAD NCW mode
Low Noise Amp: On
Mixer Gain : On
Bias T : Off
FCDPP Freq: 439,950,000 Hz
VFO incr (Khz) : 100
PPM correction : 0
0.56% (1%)

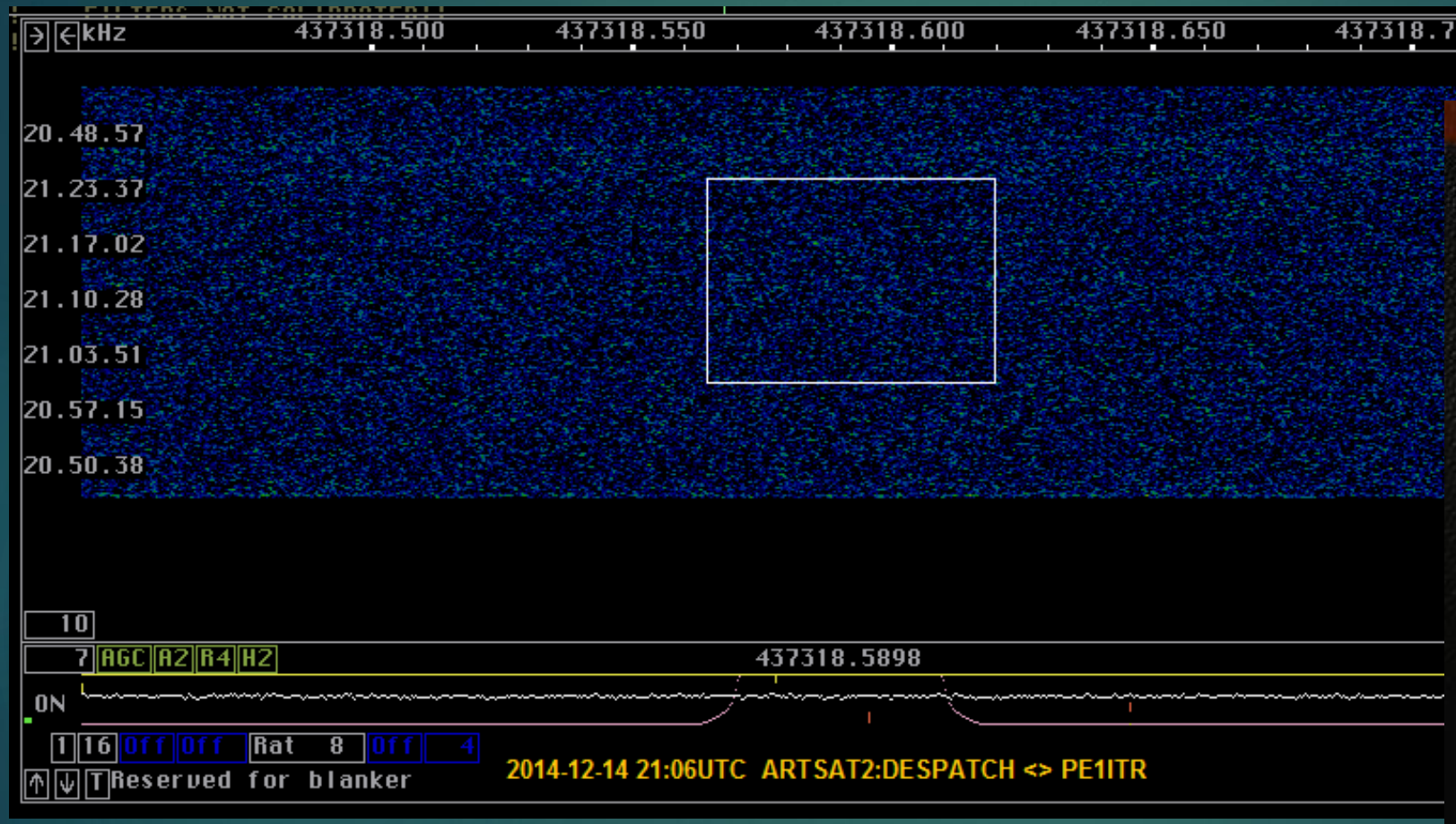
Artsat2::Despatch 750000km

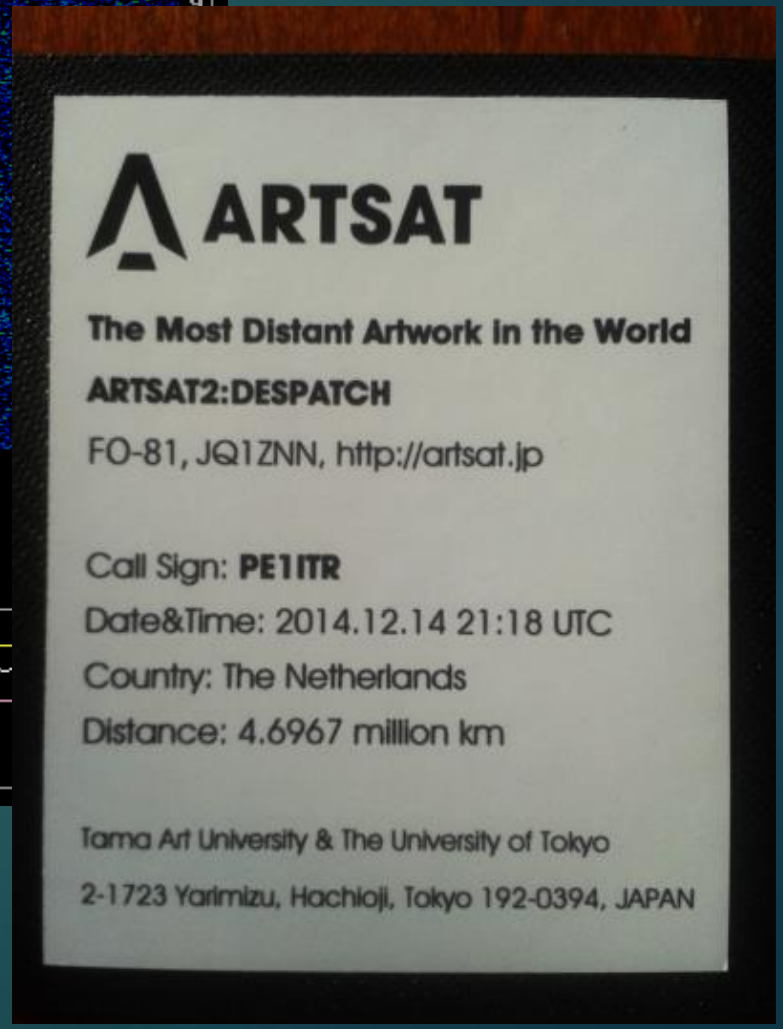


Artsat2::Despatch 2.215 miljoen km



Artsat2::Despatch 4.6967 miljoen km





Einde

Dank voor uw aandacht!

Vragen?