

FCC / ISED REPORT

Certification

Applicant Name:

ADVANCED RF TECHNOLOGIES, INC

Address:

3116 WEST VANOWEN STREET, BURBANK,
CA 91505, USA

Date of Issue:

August 14, 2017

Test Site/Location:

HCT CO., LTD., 74, Seoicheon-ro 578beon-gil,
Majang-myeon, Icheon-si, Gyeonggi-do, 17383,
Rep. of KOREA

Report No.: HCT-R-1707-F018-3

HCT FRN: 0005866421

ISED Registration Number: 5944A-5

FCC ID:

N52-ADXV-R-25VUNA

IC:

6416A-ADXVR25VUNA

APPLICANT:

ADVANCED RF TECHNOLOGIES, INC

FCC/IC Model:

ADXV-R-25VU-N4X-A

EUT Type:

DAS (DISTRIBUTED ANTENNA SYSTEM)

Frequency Ranges :

VHF - 150 ~ 174 MHz (Uplink / Downlink for FCC)

138 ~ 144, 148 ~ 174 MHz (Uplink / Downlink for ISED)

UHF - 406.1 ~ 512 MHz (Uplink / Downlink for FCC)

406.1 ~ 430 MHz, 450 ~ 470 MHz (Uplink / Downlink for ISED)

Conducted Output Power:

VHF - Uplink: 0.03 mW (-15 dBm) / Downlink: 0.32 W (25 dBm)

UHF - Uplink: 0.03 mW (-15 dBm) / Downlink: 0.32 W (25 dBm)

Date of Test:

June 23, 2017 ~ August 09, 2017

FCC Rule Part(s):

CFR 47 Part 2, Part 90

IC Rules:

RSS-Gen (Issue 4, November 2014), RSS-131 (Issue 3, May 2017)

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Part 90 of the FCC Rules under normal use and maintenance.



Report prepared by : Kyung Soo Kang
Engineer of Telecommunication testing center



Approved by : Jong Seok Lee
Manager of Telecommunication testing center

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Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-R-1707-F018	July 25, 2017	- First Approval Report
HCT-R-1707-F018-1	August 03, 2017	- Revised the Noise Figure on Page 96-98
HCT-R-1707-F018-2	August 09, 2017	- Updated to the latest version of test items, standards and test procedures. - Added the test according to RSS-131 6.3(Intermodulation on Section 11) and 6.4(Noise on Section 9).
HCT-R-1707-F018-3	August 14, 2017	- Added the note about the test results in Section 8. - Removed the expression(12.5 k) of the channel BW from each band title in the test results in Section 8. - Revised the FCC ID.

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1. CLIENT INFORMATION

The EUT has been tested by request of

Company	ADVANCED RF TECHNOLOGIES, INC 3116 WEST VANOWEN STREET, BURBANK, CA 91505, USA
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FCC ID:	N52-ADXV-R-25VUNA
IC:	6416A-ADXVR25VUNA
EUT Type:	DAS (DISTRIBUTED ANTENNA SYSTEM)
FCC/IC Model(s):	ADXV-R-25VU-N4X-A
Power Supply:	100 ~ 240 VAC
Frequency Ranges :	VHF - 150 ~ 174 MHz (Uplink / Downlink for FCC) 138 ~ 144, 148 ~ 174 MHz (Uplink / Downlink for ISSED) UHF - 406.1 ~ 512 MHz (Uplink / Downlink for FCC) 406.1 ~ 430 MHz, 450 ~ 470 (Uplink / Downlink for ISSED)
Conducted Output Power:	VHF - Uplink: 0.03 mW (-15 dBm) / Downlink: 0.32 W (25 dBm) UHF - Uplink: 0.03 mW (-15 dBm) / Downlink: 0.32 W (25 dBm)
Antenna Gain(s):	Manufacturer does not provide an antenna.
Measurement standard(s):	ANSI/TIA-603-C-2004, KDB 971168 D01 v02r02 KDB 935210 D02 v03r02, KDB 935210 D05 v01r01 RSS-Gen, RSS-131
FCC Rule Part(s):	CFR 47 Part 2, Part 90
IC Rules:	RSS-Gen (Issue 4, November 2014), RSS-131 (Issue 3, May 2017)
Place of Tests:	HCT CO., LTD., 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA (ISED Registration Number : 5944A-5)

2. FACILITIES AND ACCREDITATIONS

2.1. FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA. The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2003) and CISPR Publication 22. Detailed description of test facility was submitted to the Commission and accepted dated July 07, 2015 (Registration Number: 90661).

2.2. EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

3. TEST SPECIFICATIONS

3.1. STANDARDS

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 2, Part 90, RSS-Gen, RSS-131.

Description	Reference (FCC)	Reference (IC)	Results
Conducted RF Output Power	§2.1046; §90.219(e)(1)	RSS-119, Section 5.4 RSS-131, Section 6.2	Compliant
Occupied Bandwidth	§2.1049	RSS-Gen, Section 6.6	Compliant
Out of Band Rejection	KDB 935210 D05 v01r01	RSS-131, Section 5.2.3	Compliant
Noise Figure	§90.219(e)(2)	RSS-131, Section 6.4	Compliant
Emission Masks	§90.210, §90.219(e)(4)	RSS-119, Section 5.5 RSS-119, Section 5.8	Compliant
Spurious Emissions at Antenna Terminals	§2.1051; §90.219(e)(3)	RSS-119, Section 5.8 RSS-131, Section 6.3, 6.4, 6.5	Compliant
Radiated Spurious Emissions	§2.1053; §90.219(e)(3)	RSS-Gen, Section 7.1.2	Compliant
Frequency Stability	§2.1055; §90.213	RSS-119, Section 5.3 RSS-131, Section 4.5	Compliant

3.2. MODE OF OPERATION DURING THE TEST

The EUT was operated in a manner representative of the typical usage of the equipment.

During all testing, system components were manipulated within the confines of typical usage to maximize each emission.

The device does not supply antenna(s) with the system, so the dummy loads were connected to the RF output ports for radiated spurious emission testing.

Frequency	Modulation
FCC: 150 ~ 174 MHz ISED: 138 ~ 144, 148 ~ 174 MHz	APCO25 (6.25 kHz) TETRA (12.5 kHz)
FCC: 406.1 ~ 470 MHz ISED: 406.1 ~ 430 MHz, 450 ~ 470 MHz	
FCC: 470 ~ 512 MHz ISED: 450 ~ 470 MHz	

* Note: This EUT is supported power supply both of AC and DC. Test results are only attached worst cases.

* The tests results in plots are already including the actual value of loss for the attenuator and cable combination. Please check correction factors below table.

■ Correction Factor

Freq(MHz)	Factor(dB)
30	30.504
100	29.246
200	29.578
300	29.551
400	29.859
500	29.924
600	29.983
700	29.946
800	30.056
900	30.200
1000	30.263
2000	30.864
3000	32.243
4000	32.456
5000	30.504

6000	29.246
7000	33.210
8000	33.429
9000	34.210
10000	34.597
11000	35.485
12000	36.128
13000	37.014
14000	37.524
15000	38.070
16000	41.191
17000	41.070
18000	42.726
19000	41.312
20000	41.964
21000	42.616
22000	43.268
23000	43.920
24000	44.572
25000	45.225

3.3. MAXIMUM MEASUREMENT UNCERTAINTY

The value of the measurement uncertainty for the measurement of each parameter.

Coverage factor $k = 2$, Confidence levels of 95 %

Description	Condition	Uncertainty
Conducted RF Output Power	-	± 0.72 dB
Occupied Bandwidth	OBW ≤ 20 MHz	± 52 kHz
Passband Gain and Bandwidth & Out of Band Rejection	Gain 20 dB bandwidth	± 0.89 dB ± 0.58 MHz
Spurious Emissions at Antenna Terminals	-	± 1.08 dB
Noise Figure, Emission Masks	-	± 0.89 dB
Radiated Spurious Emissions	$f \leq 1$ GHz $f > 1$ GHz	± 4.80 dB ± 6.07 dB

4. STANDARDS ENVIRONMENTAL TEST CONDITIONS

Temperature :	+ 15 °C to + 35 °C
Relative humidity:	30 % to 60 %
Air pressure	860 mbar to 1 060 mbar

5. TEST EQUIPMENT

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Agilent	E4438C /Signal Generator	12/21/2016	Annual	MY42082646
Agilent	E4438C /Signal Generator	01/24/2017	Annual	US41460432
Agilent	N9020A / Signal Analyzer	07/18/2017	Annual	MY49100060
Weinschel	WA67-30-33 / Fixed Attenuator	09/22/2016	Annual	WA67-30-33-1
Weinschel	2-10 / 10 dB Attenuator	02/22/2017	Annual	BR0554
DEAYOUNG ENT	DFSS60 / AC Power Supply	04/05/2017	Annual	1003030-1
NANGYEUL CO., LTD.	NY-THR18750 / Temperature and Humidity Chamber	10/21/2016	Annual	NY-2009012201A
Innco system	MA4000-EP / Antenna Position Tower	N/A	N/A	N/A
Innco system	CT0800 / Turn Table	N/A	N/A	N/A
Innco system	CO3000 / Controller(Antenna mast)	N/A	N/A	CO3000-4p
ETS	2090 / Controller(Turn table)	N/A	N/A	1646
Rohde&Schwarz	Loop Antenna	04/19/2017	Biennial	1513-175
Schwarzbeck	VULB 9160 / Trilog Antenna	10/14/2016	Biennial	9160-3368
Schwarzbeck	BBHA 9120D / Horn Antenna	12/11/2015	Biennial	9120D-1191
Rohde & Schwarz	FSP / Spectrum Analyzer	09/29/2016	Annual	836650/016
Rohde & Schwarz	FSV40-N / Spectrum Analyzer	09/23/2016	Annual	101068-SZ
Wainwright Instruments	WHK1.2/15G-10EF / Highpass Filter	04/10/2017	Annual	4
CERNEX	CBLU1183540 / Power Amplifier	01/25/2017	Annual	24614

6. RF OUTPUT POWER

FCC Rules

Test Requirements:

§ 2.1046 Measurements required: RF power output:

- (a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in § 2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.
- (b) For single sideband, independent sideband, and single channel, controlled carrier radio telephone transmitters, the procedure specified in paragraph (a) of this section shall be employed and, in addition, the transmitter shall be modulated during the test as specified and as applicable in § 2.1046 (b) (1-5). In all tests, the input level of the modulating signal shall be such as to develop rated peak envelope power or carrier power, as appropriate, for the transmitter.
- (c) For measurements conducted pursuant to paragraphs (a) and (b) of this section, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output terminals shall be shown. Under the test conditions specified, no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth or emission limitations.

§ 90.219 Use of signal boosters.

- (e) *Device Specifications.* In addition to the general rules for equipment certification in §90.203(a)(2) and part 2, subpart J of this chapter, a signal booster must also meet the rules in this paragraph.

IC Rules

Test Requirements:

RSS-119

5. Transmitter and Receiver Specifications

5.4 Transmitter Output Power

The output power shall be within ± 1 dB of the manufacturer's rated power listed in the equipment specifications.

The transmitter output power limits set forth in Table 2 will come into force upon the publication of Issue 12 of this standard and will apply to newly certified equipment.

Table 2 —Transmitter Output Power

Frequency Bands (MHz)	Transmitter Output Power (W)	
	Base/Fixed Equipment	Mobile Equipment
27.41-28 and 29.7-50	300	30
72-76	No limit	1
138-174	110	60
217-218 and 219-220	110	30
220-222	See SRSP-512 for ERP limit	50
406.1-430 and 450-470	110	60
768-776 and 798-806	See SRSP-511 for ERP limit	30 3 W ERP for portable equipment
806-821/851-866 and 821-824/866-869	110	30
896-901/935-940	110	60
929-930/931-932	110	30
928-929/952-953 and 932-932.5/941-941.5	110	30
932.5-935/941.5-944	110	30

RSS-131

6. Equipment standard specifications for zone enhancers working with equipment certified under RSS-119

6.2 Output power

The output power of the zone enhancer shall comply with the transmitter output power of the equipment with which it is to be used (as specified in RSS-119) and shall be within ± 1.0 dB of the zone enhancer manufacturer's rated output power.

Test Procedures:

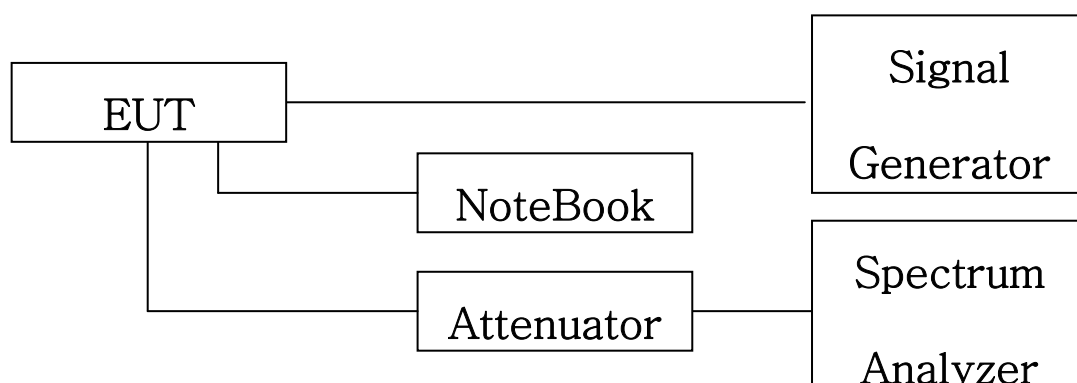
Measurements were in accordance with the test methods section 3.5.2 of KDB 935210 D05 v01r01.

- Connect a signal generator to the input of the EUT.
- Configure to generate the AWGN (broadband) test signal.
- The frequency of the signal generator shall be set to the frequency f_0 as determined from 3.3
- Connect a spectrum analyzer or power meter to the output of the EUT using appropriate attenuation as necessary

- e) Set the signal generator output power to a level that produces an EUT output level that is just below the AGC threshold (see 3.2), but not more than 0.5 dB below.
- f) Measure and record the output power of the EUT; use 3.5.3 or 3.5.4 for power measurement.
- g) Remove the EUT from the measurement setup. Using the same signal generator settings, repeat the power measurement at the signal generator port, which was used as the input signal to the EUT, and record as the input power. EUT gain may be calculated as described in 3.5.5
- h) Repeat steps f) and g) with input signal amplitude set to 3 dB above the AGC threshold level.
- i) Repeat steps e) to h) with the narrowband test signal.
- j) Repeat steps e) to i) for all frequency bands authorized for use by the EUT.

Power measurement Method :

Guidance for performing input/output power measurements using a spectrum or signal analyzer is provided in 5.2 of KDB Publication 971168.



Block Diagram 1. RF Power Output Test Setup

Test Results:

Input Signal	Input Level (dBm)		Maximum Amp Gain	
	DL	UL	DL	UL
VHF	-15	-45	40	30
UHF	-15	-45	40	30

Single channel Enhancer

* Due to EUT's ALC function (Auto Level Control), even if input signal is increased, The same output power is transmit.

[Downlink]

	Channel	Frequency (MHz)	Output Power	
			(dBm)	(W)
VHF(APCO25)_ 138 MHz AGC threshold	Low	138.003125	25.02	0.318
	Middle	-	-	-
	High	-	-	-
VHF(APCO25)_ 138 MHz +3dB above AGC threshold	Low	138.003125	25.71	0.372
	Middle	-	-	-
	High	-	-	-
VHF(APCO25)_ 150 ~ 174 MHz AGC threshold	Low	150.003125	25.15	0.327
	Middle	162.000	25.07	0.321
	High	173.996875	25.05	0.320
VHF(APCO25)_ 150 ~ 174 MHz +3dB above AGC threshold	Low	150.003125	25.11	0.324
	Middle	162.000	25.11	0.324
	High	173.996875	25.21	0.332

	Channel	Frequency (MHz)	Output Power	
			(dBm)	(W)
UHF(APCO) _ 406.1 ~ 430 MHz AGC threshold	Low	406.103125	25.05	0.320
	Middle	-	-	-
	High	429.996875	25.04	0.319
UHF(APCO) _ 406.1 ~ 430 MHz +3dB above AGC threshold	Low	406.103125	25.07	0.321
	Middle	-	-	-
	High	429.996875	25.06	0.321
UHF(APCO) _ 450 ~ 470 MHz AGC threshold	Low	450.003125	24.92	0.310
	Middle	-	-	-
	High	469.996875	25.11	0.324
UHF(APCO) _ 450 ~ 470 MHz +3dB above AGC threshold	Low	450.003125	24.96	0.313
	Middle	-	-	-
	High	469.996875	25.10	0.324

	Channel	Frequency (MHz)	Output Power	
			(dBm)	(W)
UHF(TETRA)_ 450 ~ 470 MHz AGC threshold	Low	450.00625	24.97	0.314
	Middle	-	-	-
	High	469.99375	25.07	0.321
UHF(TETRA)_ 450 ~ 470 MHz +3dB above AGC threshold	Low	450.00625	24.98	0.315
	Middle	-	-	-
	High	469.99375	25.06	0.321
UHF(TETRA)_ 470 ~ 512 MHz AGC threshold	Low	470.00625	25.10	0.324
	Middle	491.00000	24.98	0.315
	High	511.99375	25.05	0.320
UHF(TETRA)_ 470 ~ 512 MHz +3dB above AGC threshold	Low	470.00625	25.09	0.323
	Middle	491.00000	24.95	0.313
	High	511.99375	25.04	0.319

[Uplink]

	Channel	Frequency (MHz)	Output Power	
			(dBm)	(W)
VHF(APCO25)_ 138 MHz AGC threshold	Low	138.003125	-15.07	0.000
	Middle	-	-	-
	High			
VHF(APCO25)_ 138 MHz +3dB above AGC threshold	Low	138.003125	-14.97	0.000
	Middle	-	-	-
	High	-	-	-
VHF(APCO25)_ 150 ~ 174 MHz AGC threshold	Low	150.003125	-15.05	0.000
	Middle	162.000	-15.01	0.000
	High	173.996875	-15.02	0.000
VHF(APCO25)_ 150 ~ 174 MHz +3dB above AGC threshold	Low	150.003125	-15.08	0.000
	Middle	162.000	-15.06	0.000
	High	173.996875	-15.03	0.000

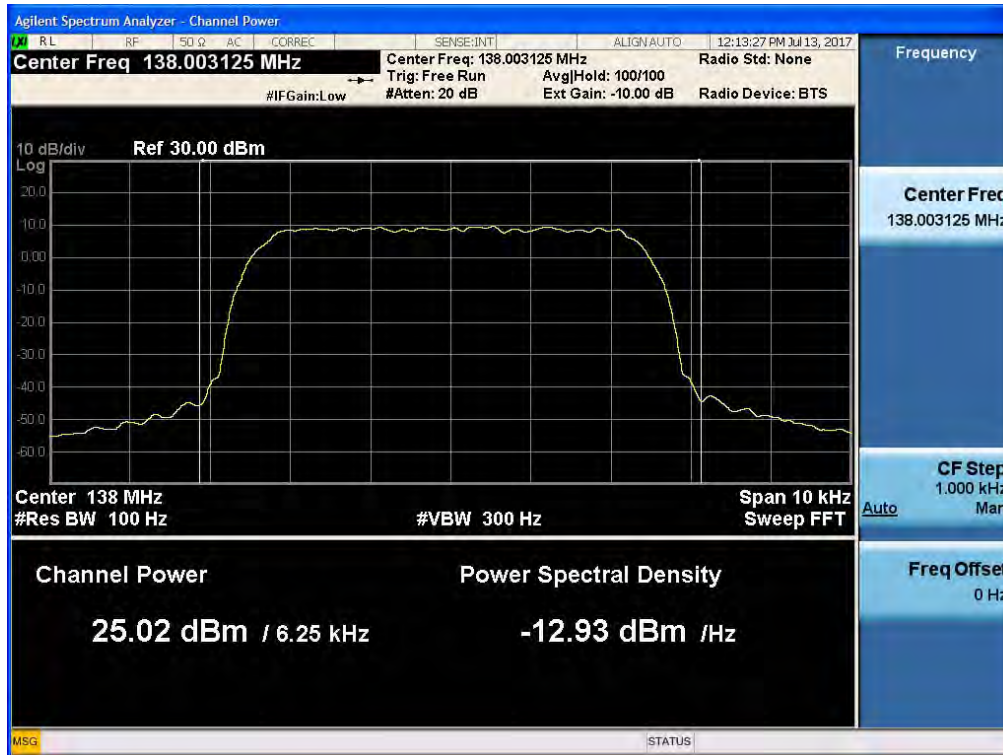
	Channel	Frequency (MHz)	Output Power	
			(dBm)	(W)
UHF(APCO) _ 406.1 ~ 430 MHz AGC threshold	Low	406.103125	-14.97	0.000
	Middle	-	-	-
	High	429.996875	-15.10	0.000
UHF(APCO) _ 406.1 ~ 430 MHz +3dB above AGC threshold	Low	406.103125	-14.71	0.000
	Middle	-	-	-
	High	429.996875	-14.96	0.000
UHF(APCO) _ 450 ~ 470 MHz AGC threshold	Low	450.003125	-15.04	0.000
	Middle	-	-	-
	High	469.996875	-15.06	0.000
UHF(APCO) _ 450 ~ 470 MHz +3dB above AGC threshold	Low	450.003125	-14.97	0.000
	Middle	-	-	-
	High	469.996875	-15.03	0.000

	Channel	Frequency (MHz)	Output Power	
			(dBm)	(W)
UHF(TETRA)_ 450 ~ 470 MHz AGC threshold	Low	450.00625	-15.04	0.000
	Middle	-	-	-
	High	469.99375	-15.07	0.000
UHF(TETRA)_ 450 ~ 470 MHz +3dB above AGC threshold	Low	450.00625	-15.03	0.000
	Middle	-	-	-
	High	469.99375	-14.99	0.000
UHF(TETRA)_ 470 ~ 512 MHz AGC threshold	Low	470.00625	-14.75	0.000
	Middle	491.00000	-14.99	0.000
	High	511.99375	-15.01	0.000
UHF(TETRA)_ 470 ~ 512 MHz +3dB above AGC threshold	Low	470.00625	-14.82	0.000
	Middle	491.00000	-14.95	0.000
	High	511.99375	-14.90	0.000

Single channel Enhancer Plots of RF Output Power

VHF(APCO25_138 MHz) DL

[VHF AGC threshold Downlink - Low]

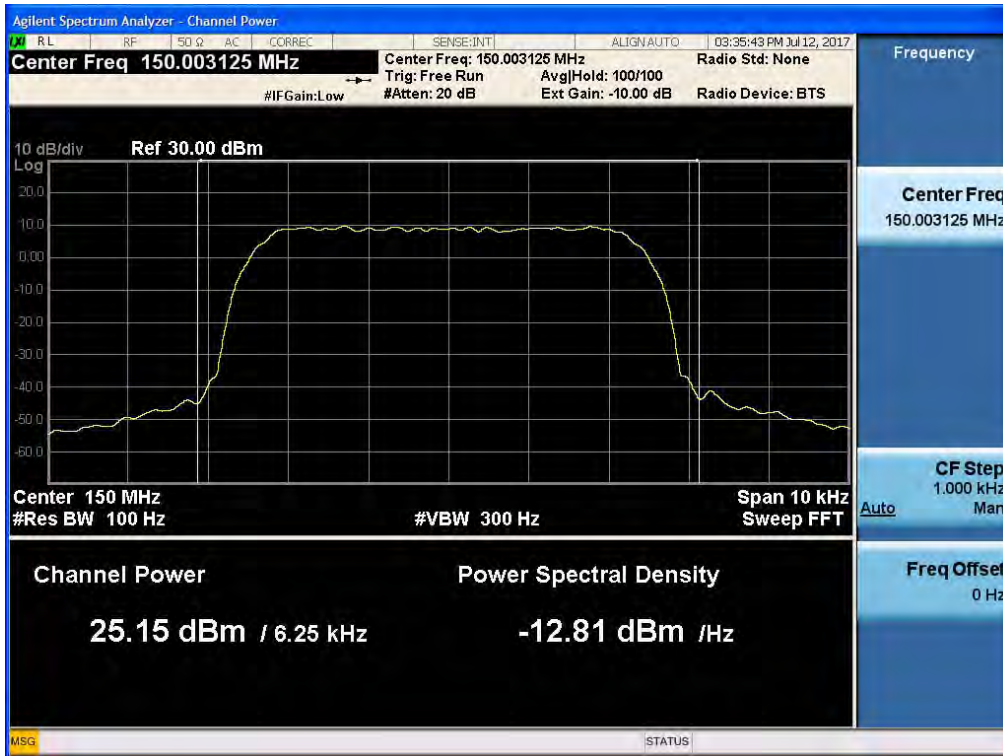


[VHF +3dB above the AGC threshold Downlink - Low]

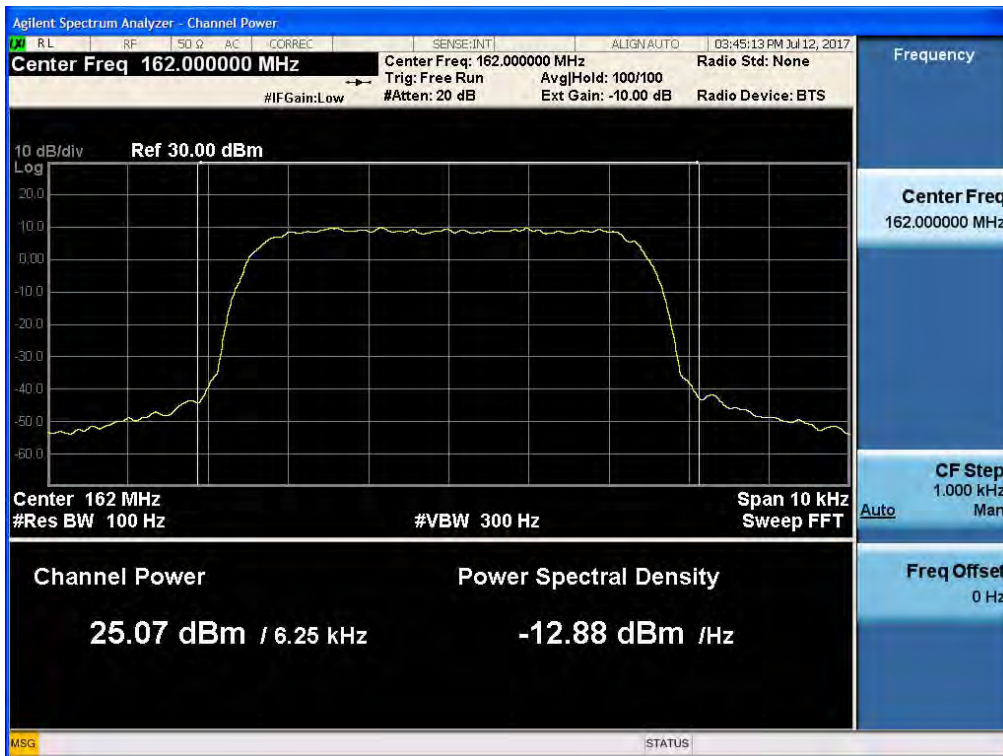


VHF(APCO25_150 ~ 174 MHz) DL

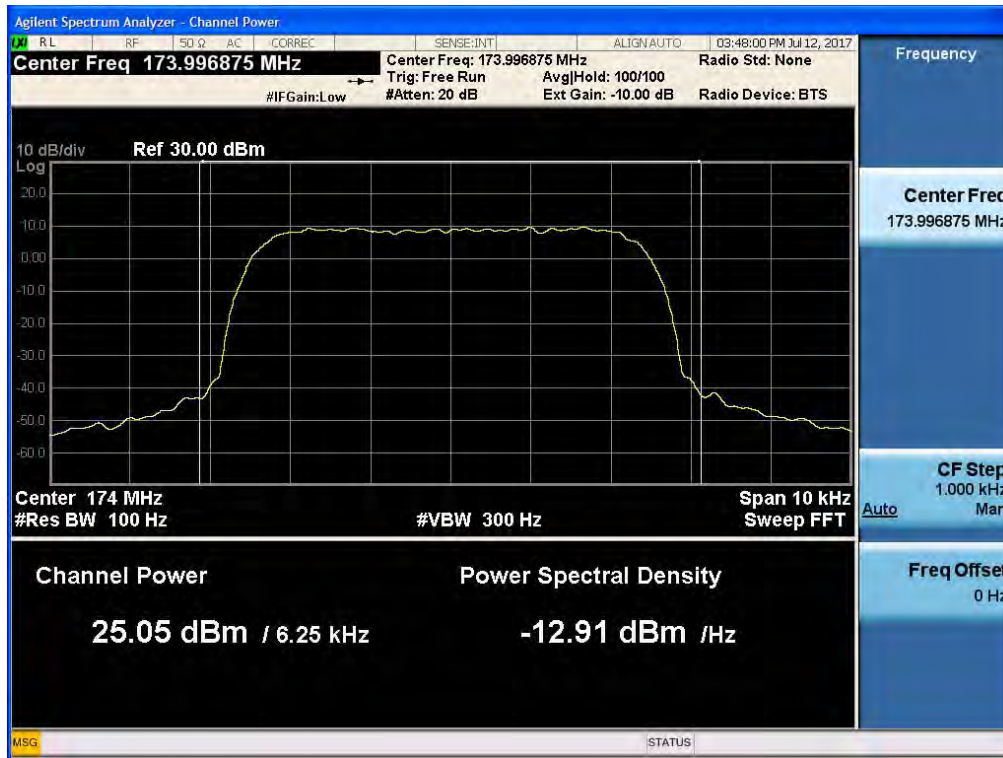
[VHF AGC threshold Downlink - Low]



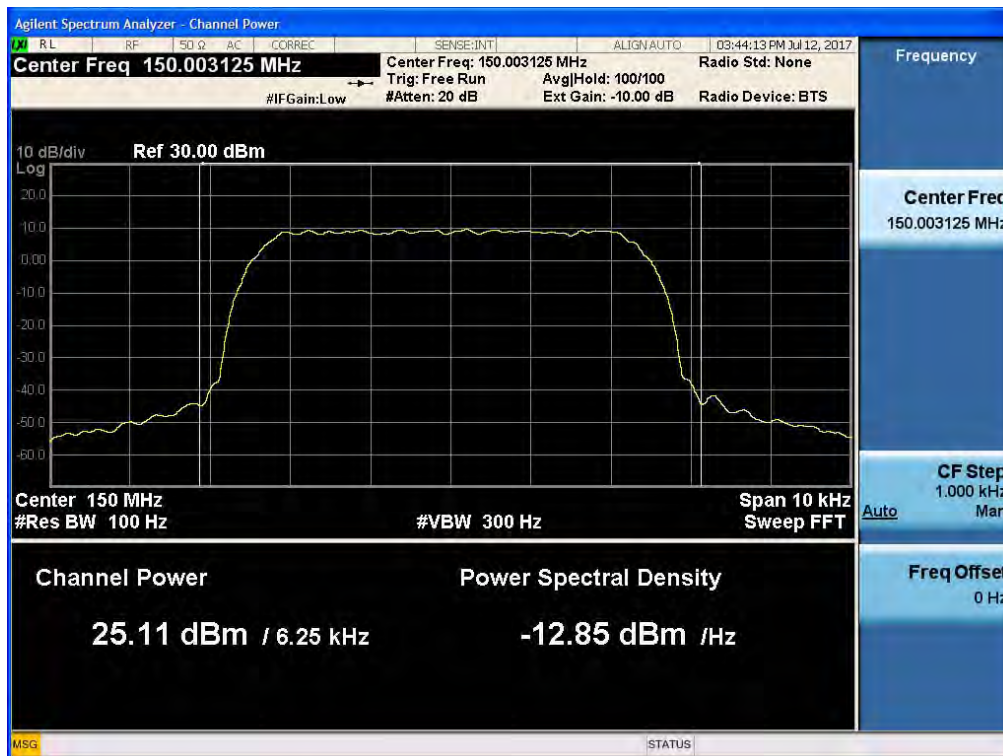
[VHF AGC threshold Downlink - Middle]



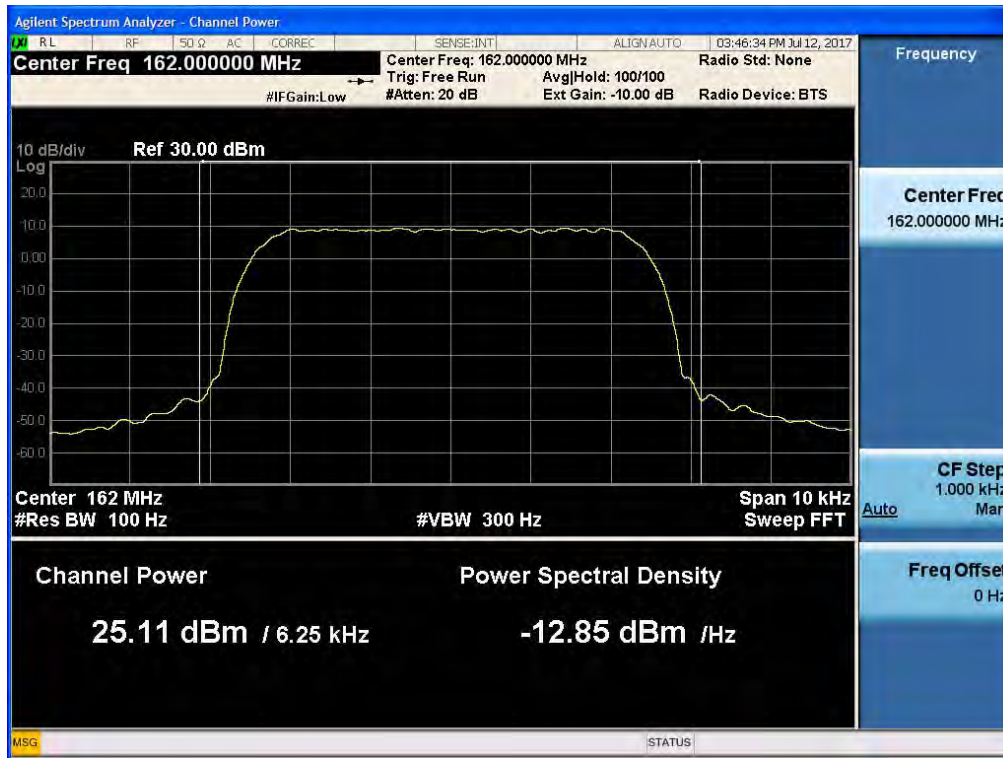
[VHF AGC threshold Downlink - High]



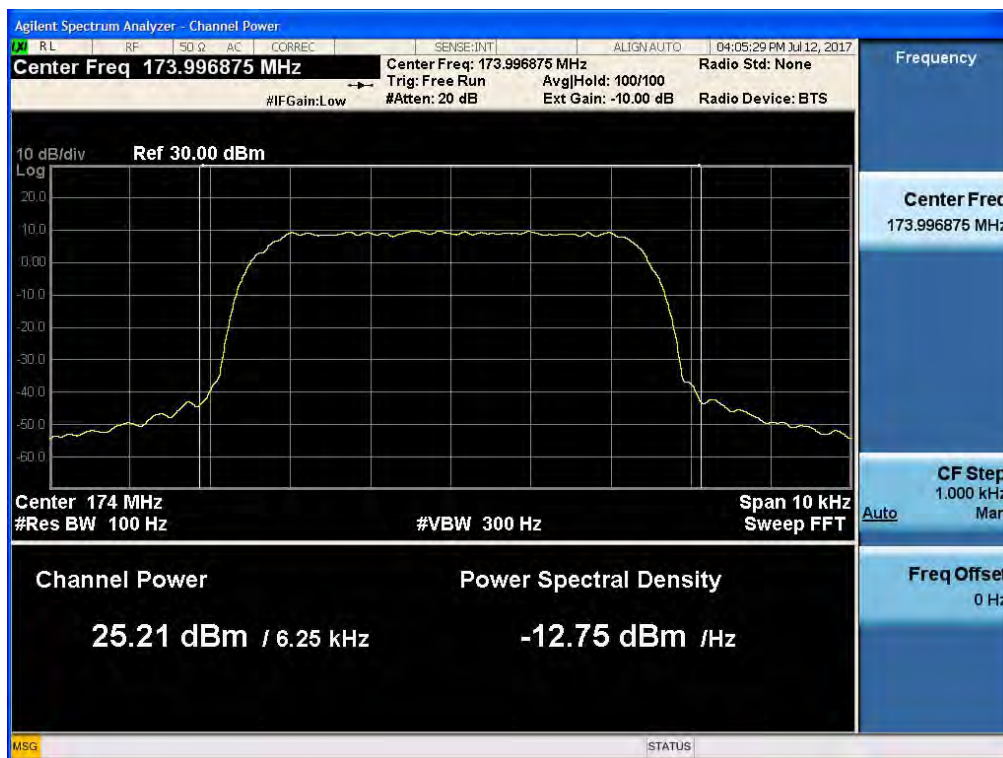
[VHF +3dB above the AGC threshold Downlink - Low]



[VHF +3dB above the AGC threshold Downlink - Middle]



[VHF +3dB above the AGC threshold Downlink - High]

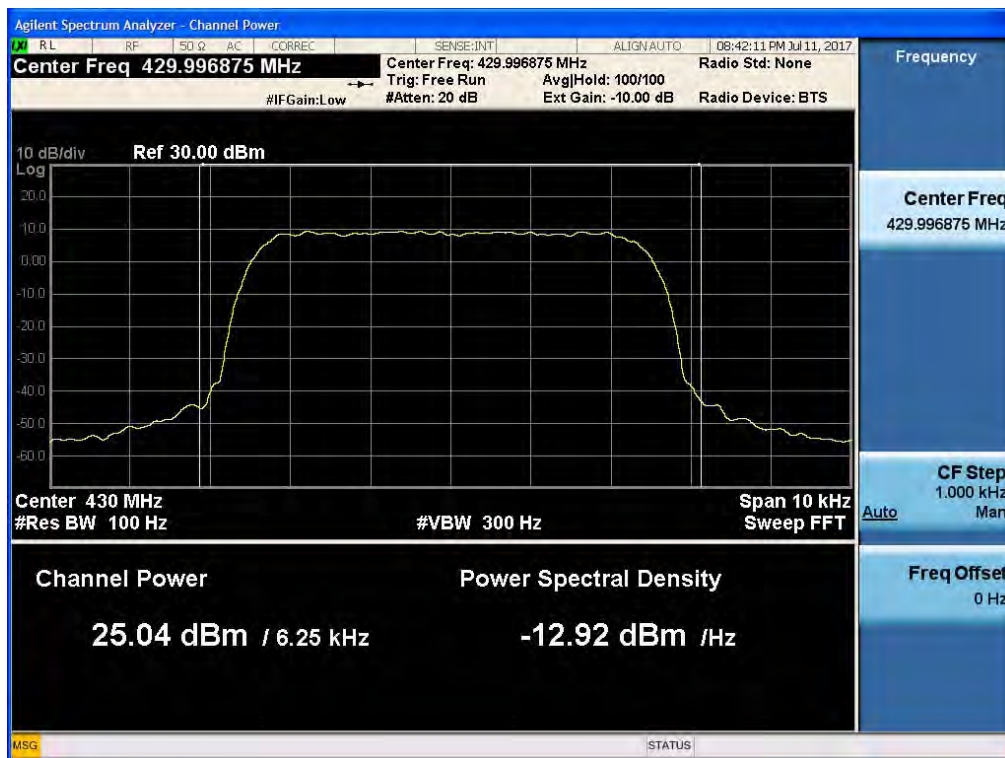


UHF(APCO_406.1 ~ 430 MHz) DL

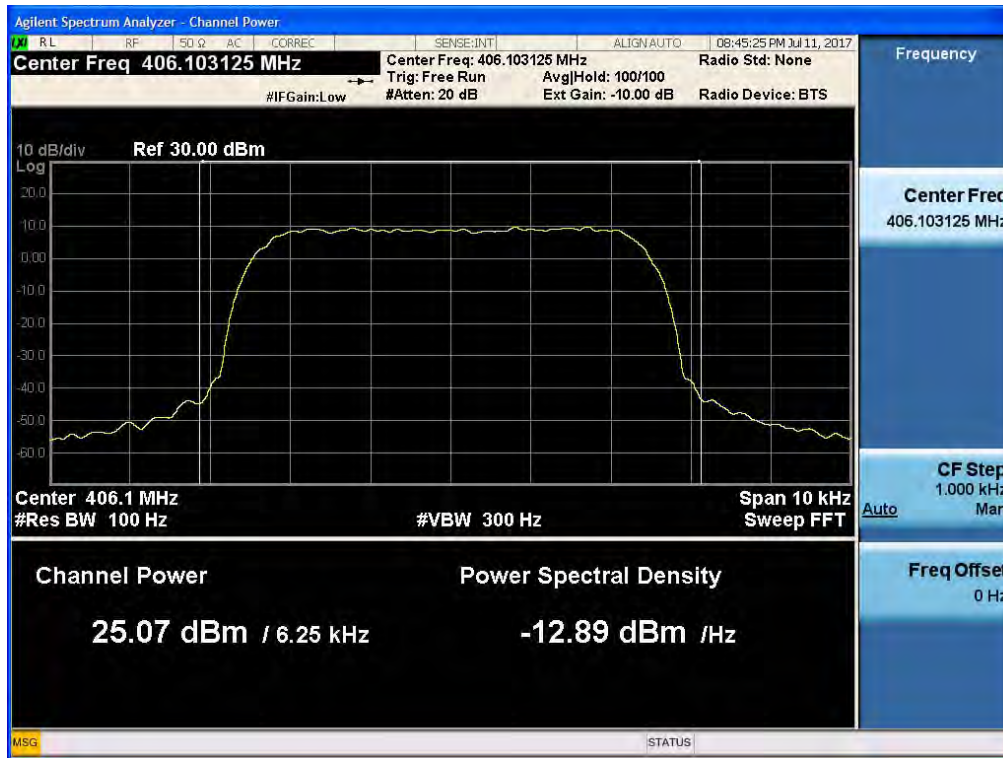
[UHF AGC threshold Downlink - Low]



[UHF AGC threshold Downlink - High]



[UHF +3dB above the AGC threshold Downlink - Low]

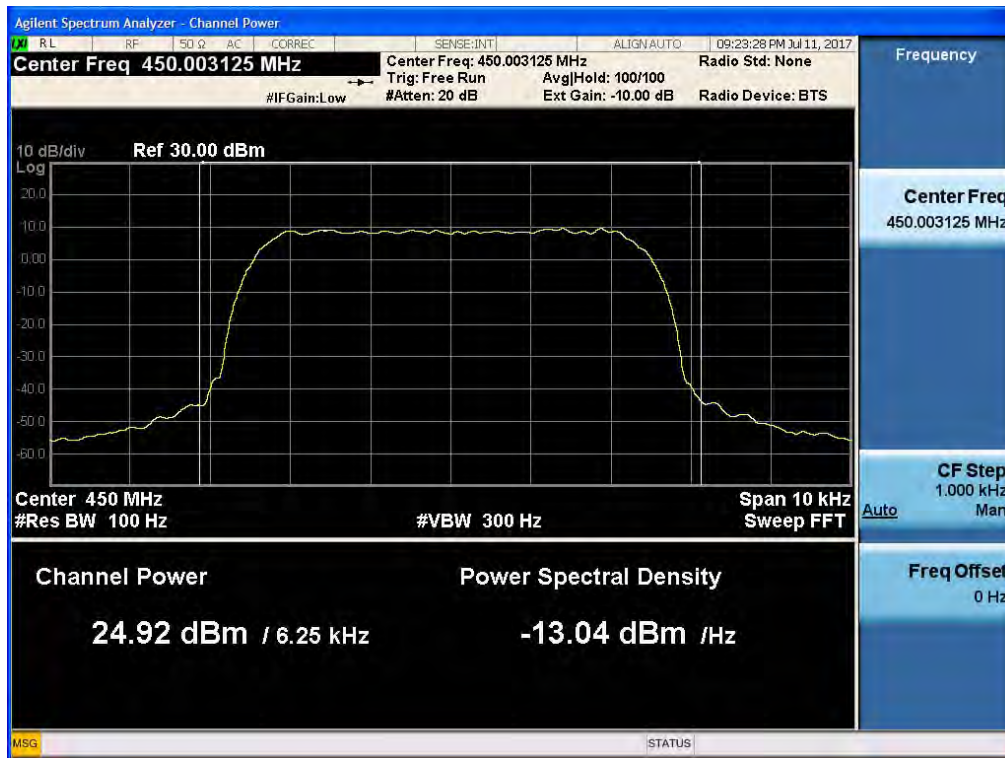


[UHF +3dB above the AGC threshold Downlink - High]

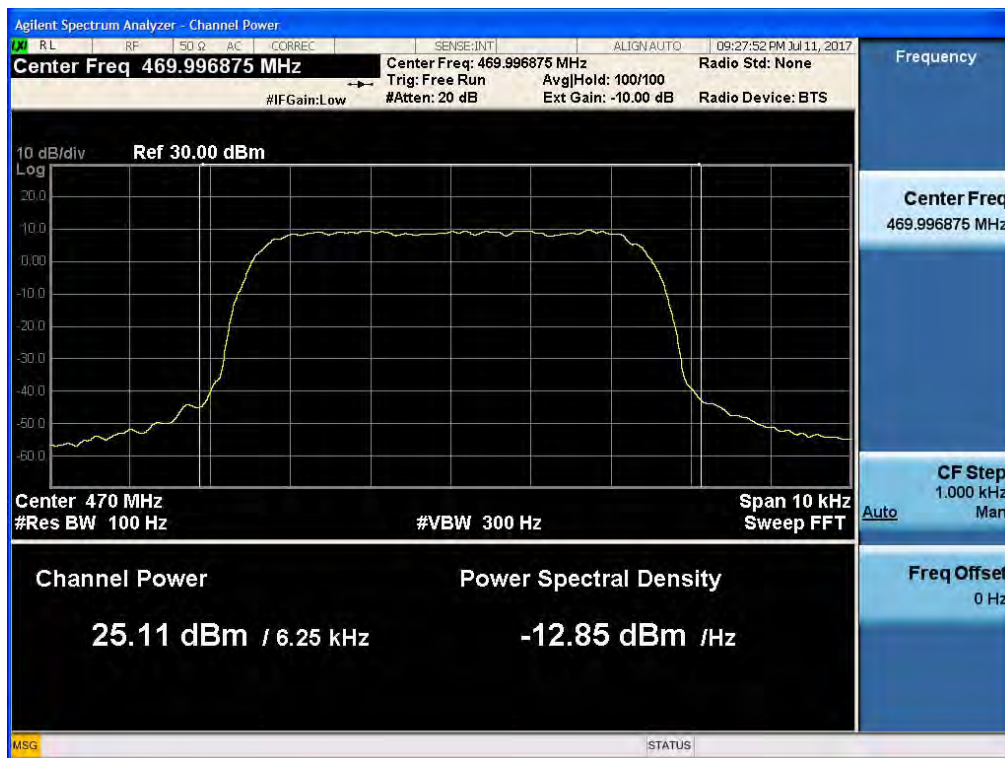


UHF(APCO_450 ~ 470 MHz) DL

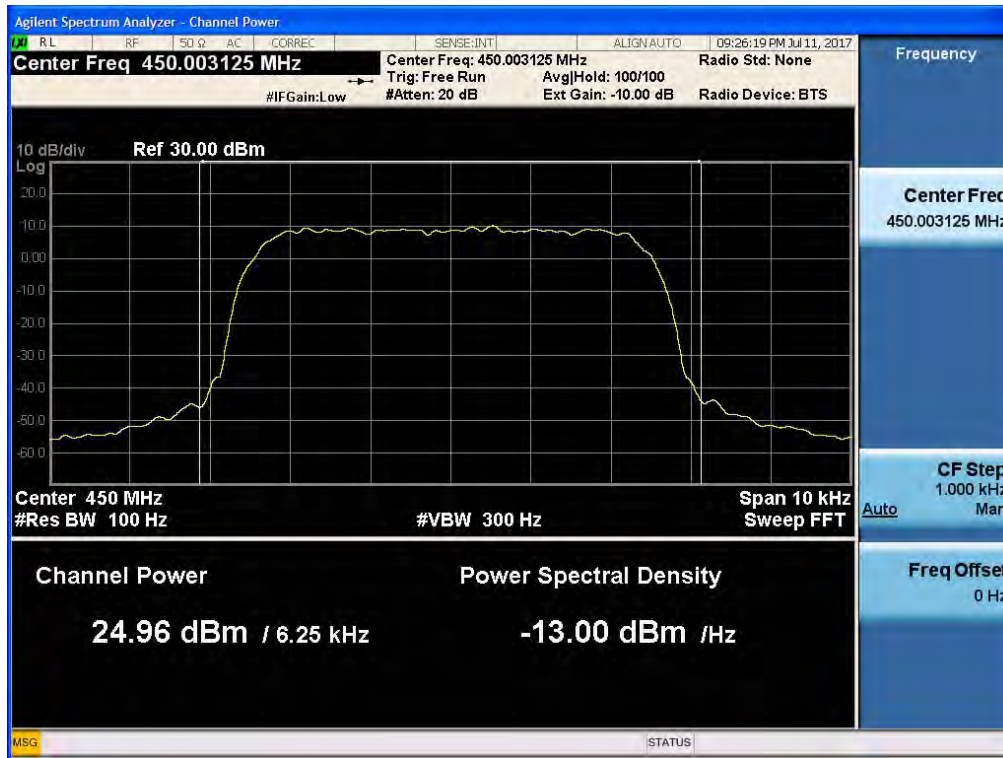
[UHF AGC threshold Downlink - Low]



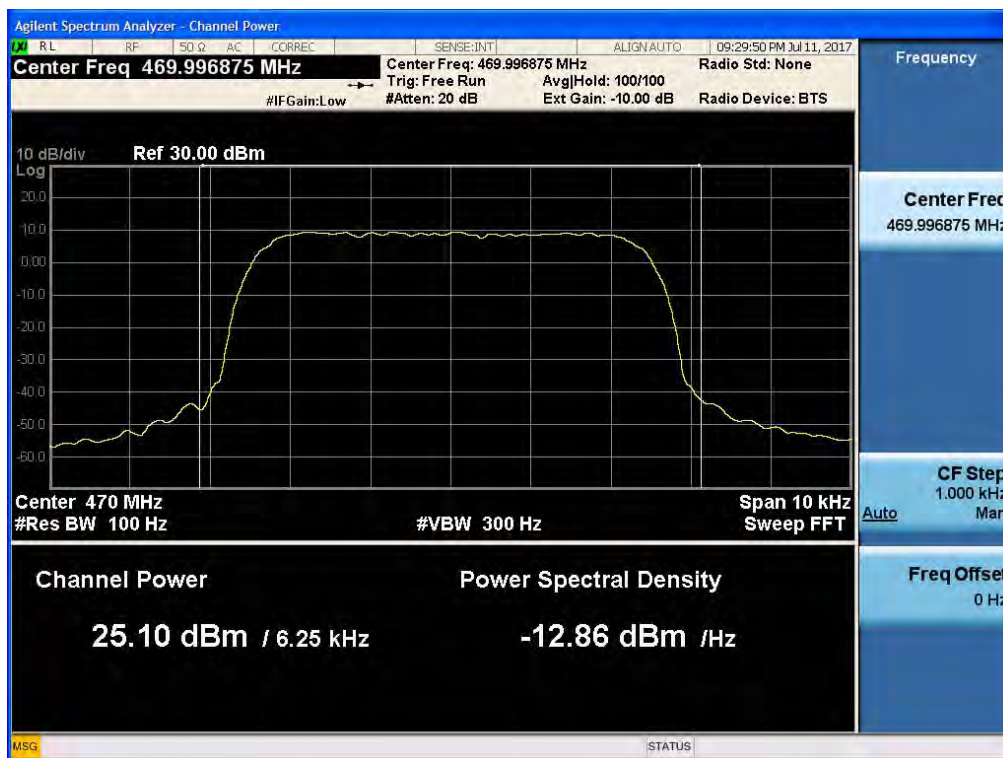
[UHF AGC threshold Downlink - High]



[UHF +3dB above the AGC threshold Downlink - Low]

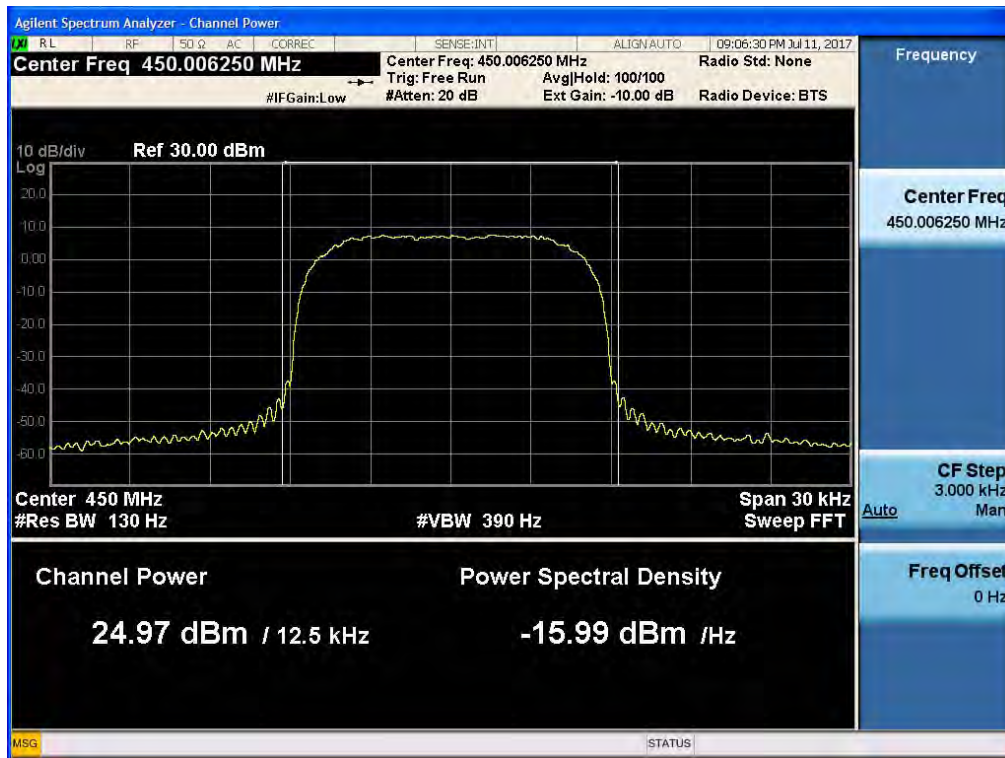


[UHF +3dB above the AGC threshold Downlink - High]

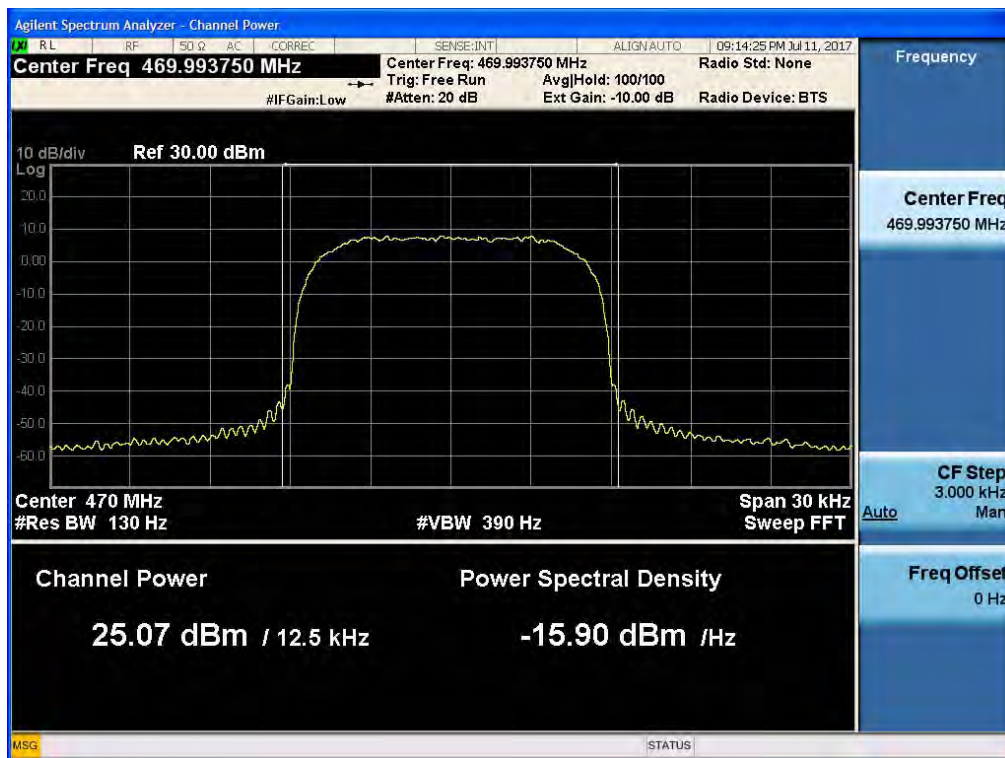


UHF(TETRA_450 ~ 470 MHz) DL

[UHF AGC threshold Downlink - Low]



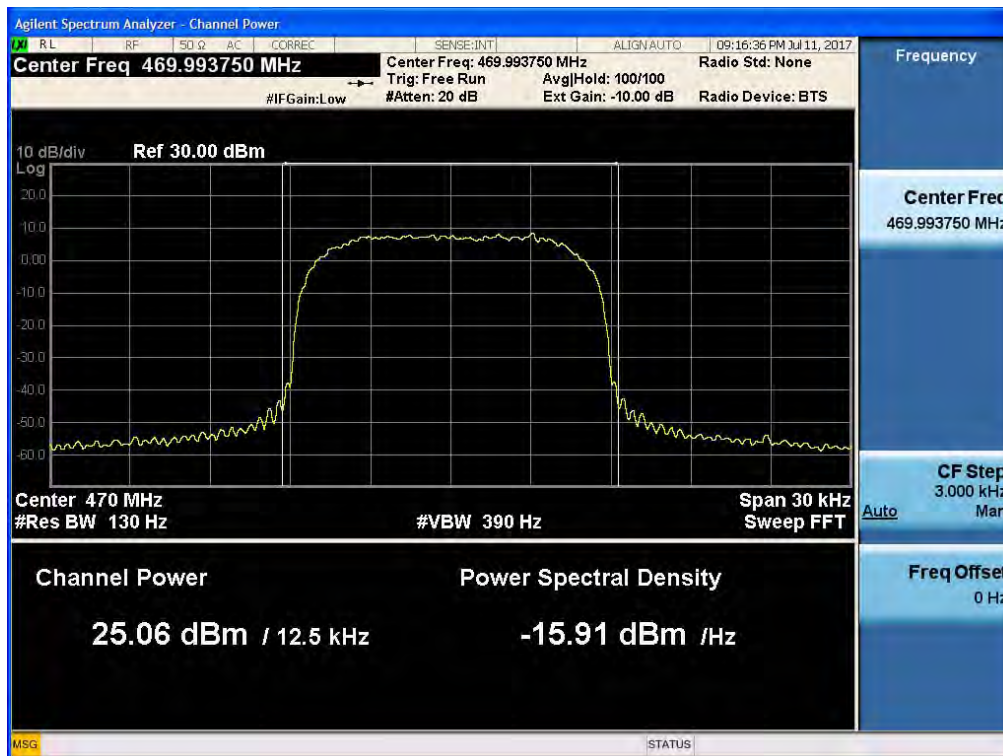
[UHF AGC threshold Downlink - High]



[UHF +3dB above the AGC threshold Downlink - Low]

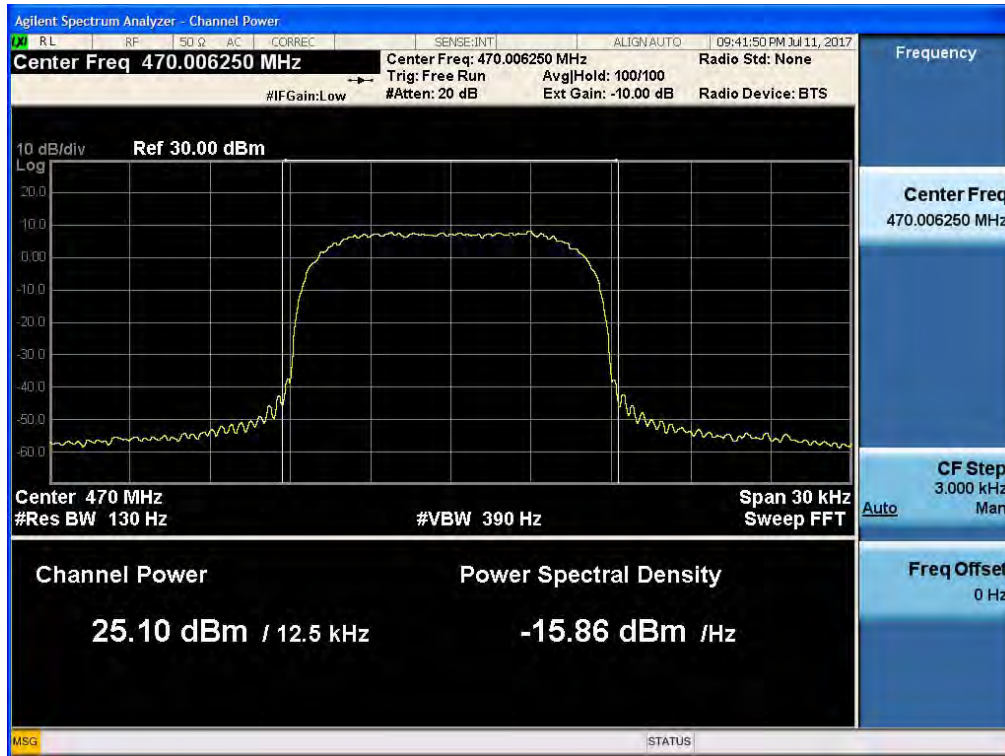


[UHF +3dB above the AGC threshold Downlink - High]

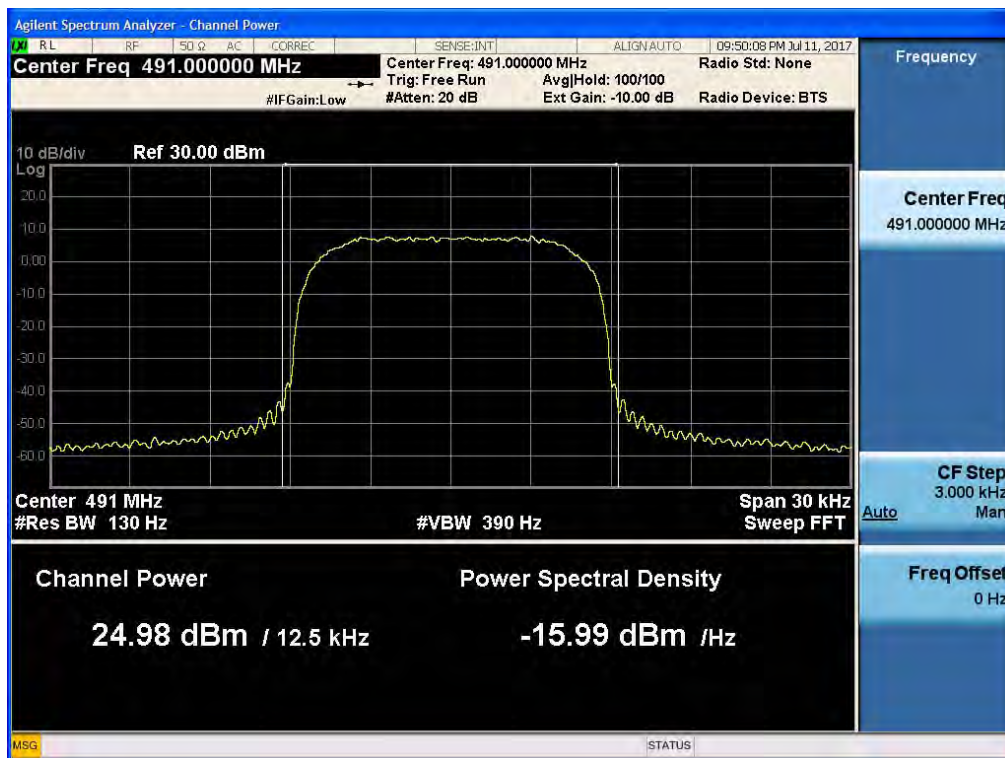


UHF(TETRA_470 ~ 512 MHz) DL

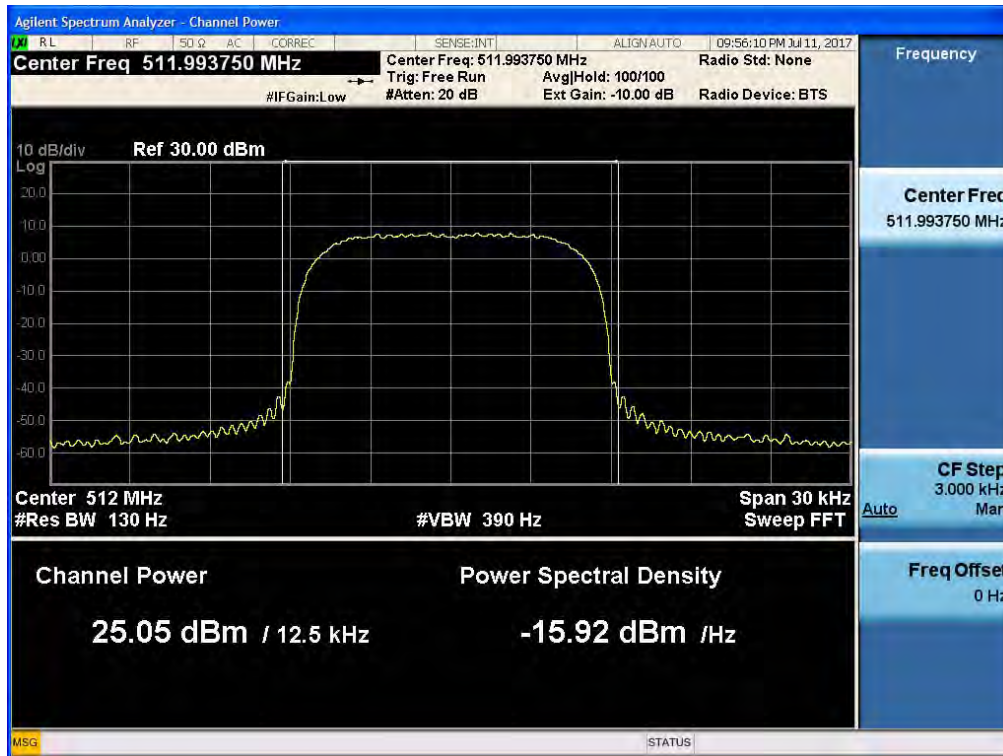
[UHF AGC threshold Downlink - Low]



[UHF AGC threshold Downlink - Middle]



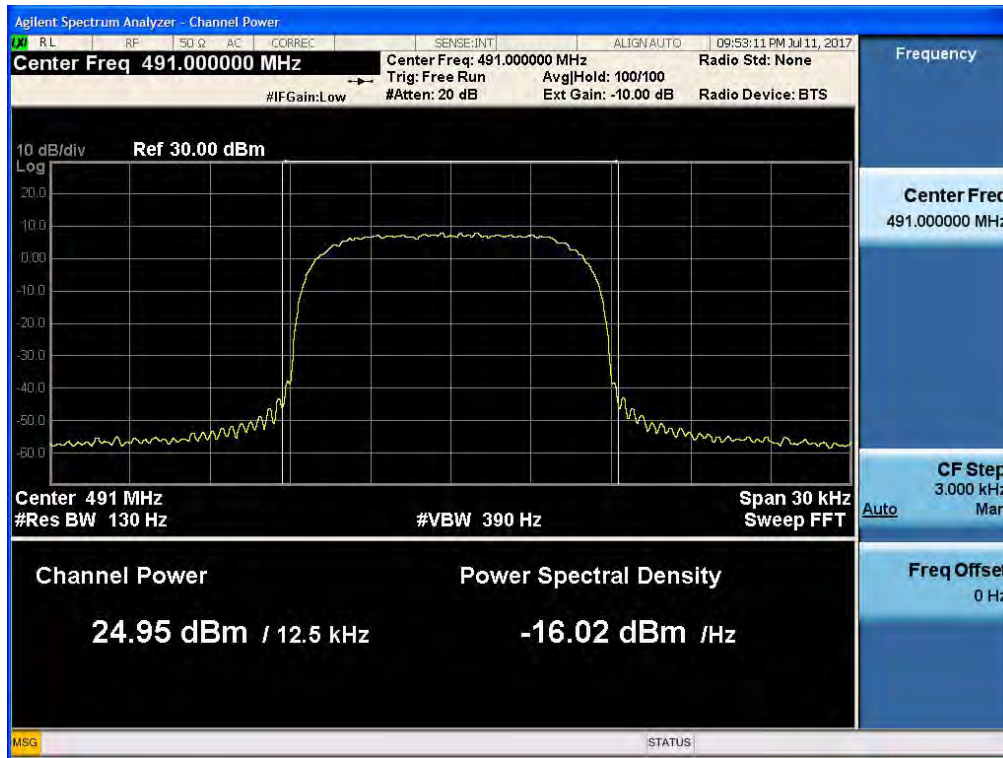
[UHF AGC threshold Downlink - High]



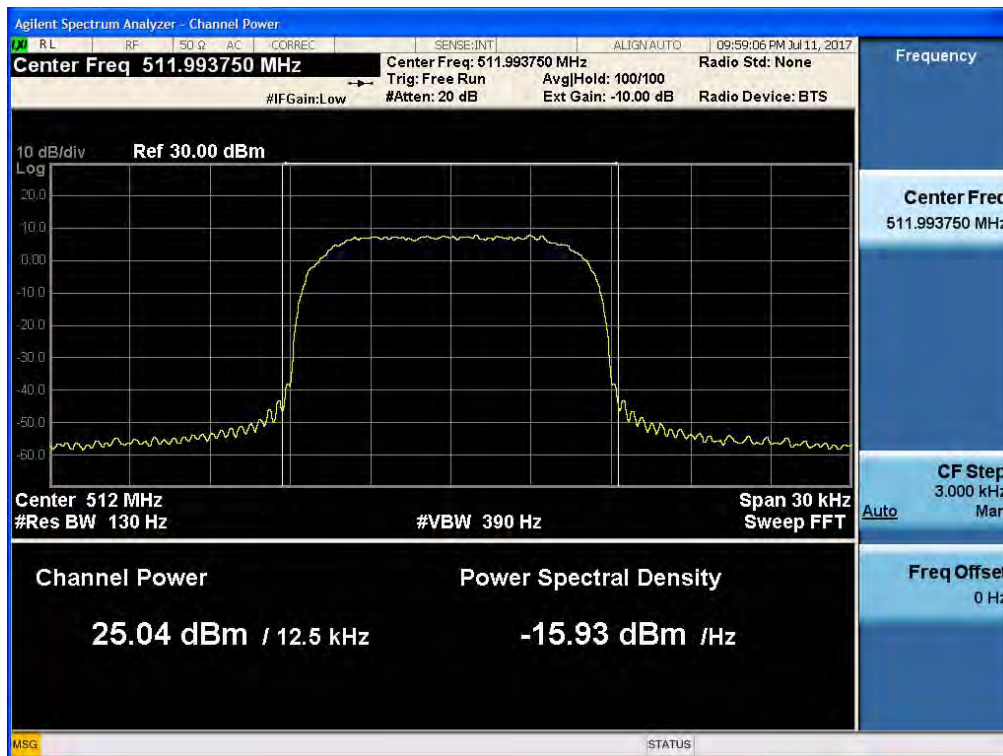
[UHF +3dB above the AGC threshold Downlink - Low]



[UHF +3dB above the AGC threshold Downlink - Middle]



[UHF +3dB above the AGC threshold Downlink - High]



VHF(APCO25_138 MHz) UL

[VHF AGC threshold Uplink - Low]



[VHF +3dB above the AGC threshold Uplink - Low]



VHF(APCO25_150 ~ 174 MHz) UL

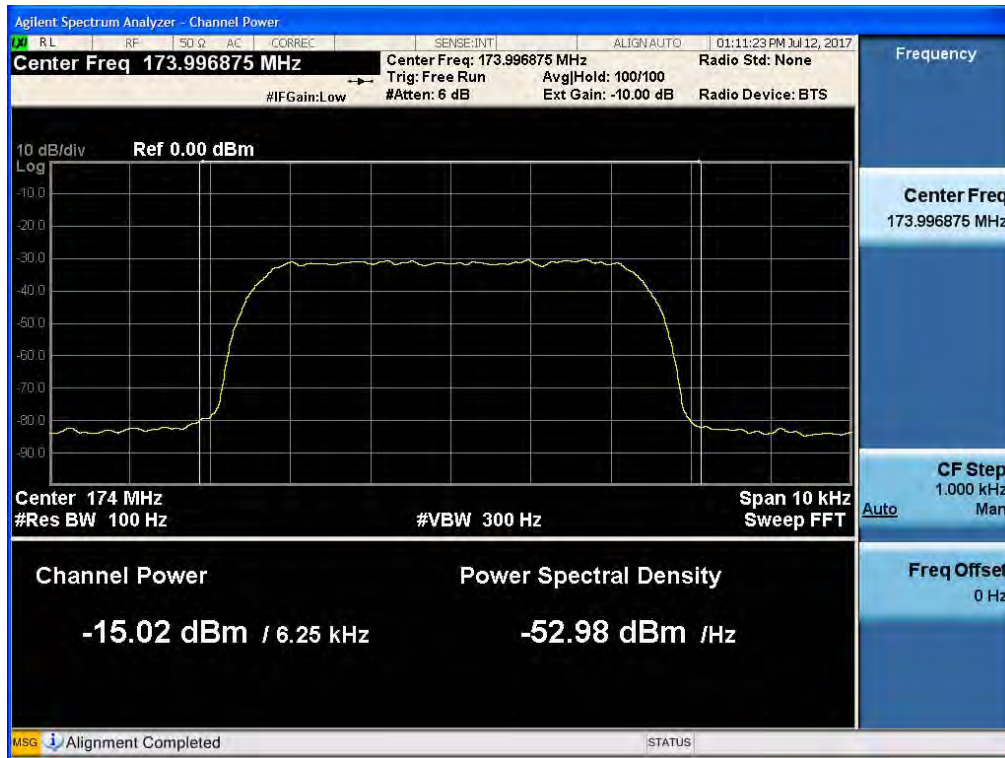
[VHF AGC threshold Uplink - Low]



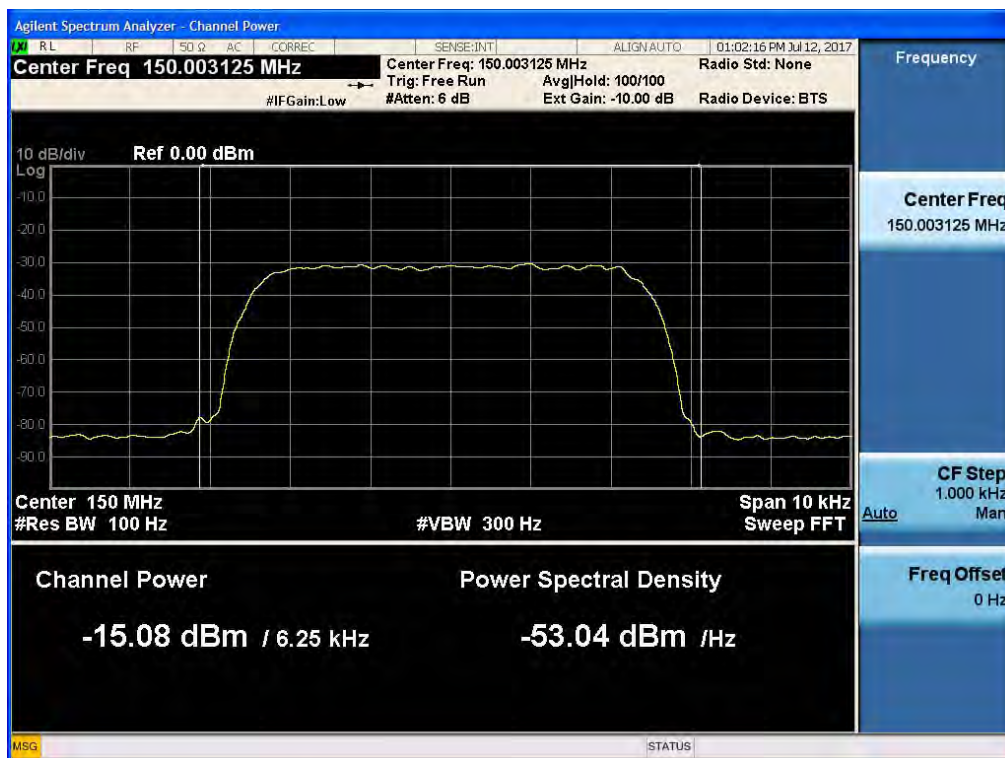
[VHF AGC threshold Uplink - Middle]



[VHF AGC threshold Uplink - High]



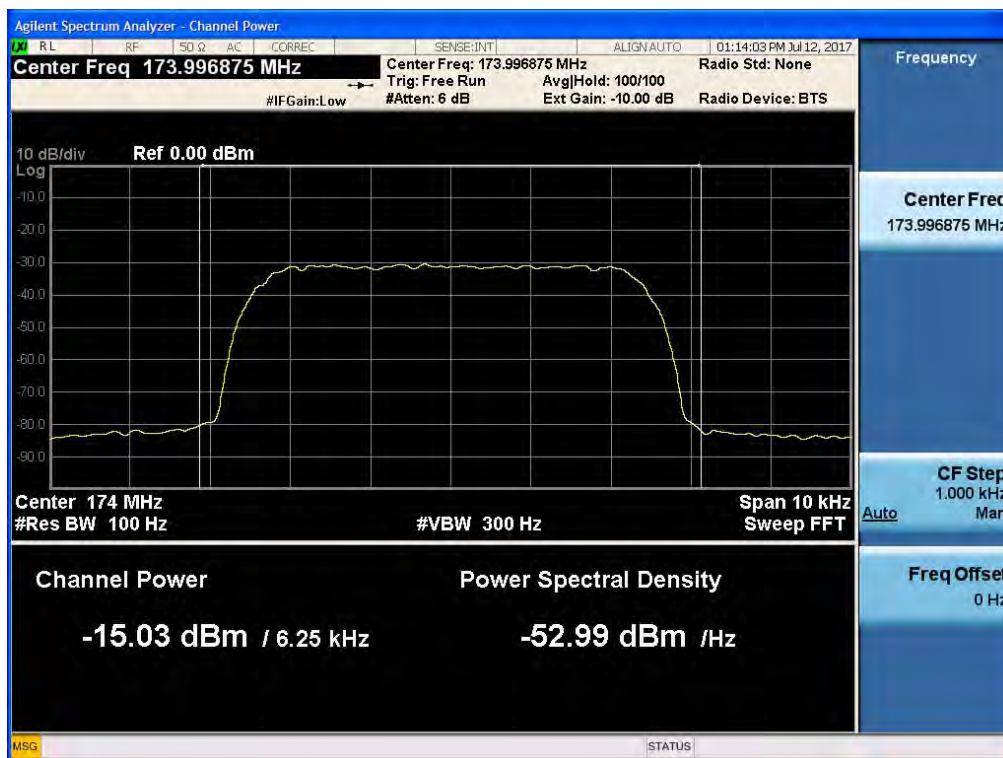
[VHF +3dB above the AGC threshold Uplink - Low]



[VHF +3dB above the AGC threshold Uplink - Middle]



[VHF +3dB above the AGC threshold Uplink - High]



UHF(APCO_406.1 ~ 430 MHz) UL

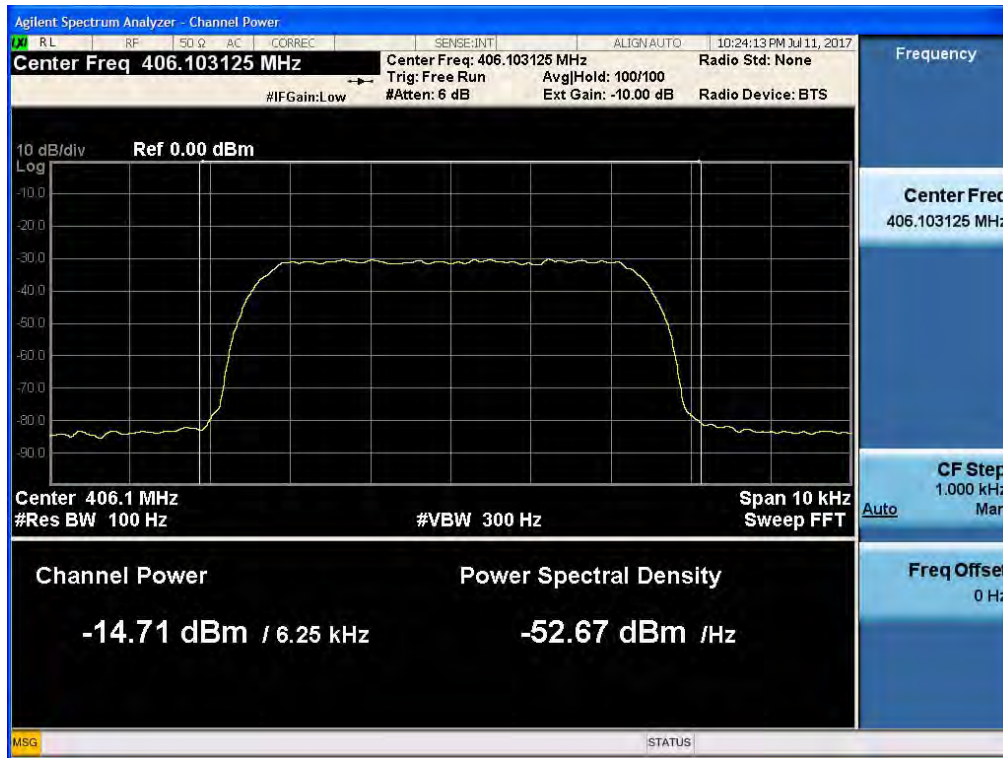
[UHF AGC threshold Uplink - Low]



[UHF AGC threshold Uplink - High]



[UHF +3dB above the AGC threshold Uplink - Low]

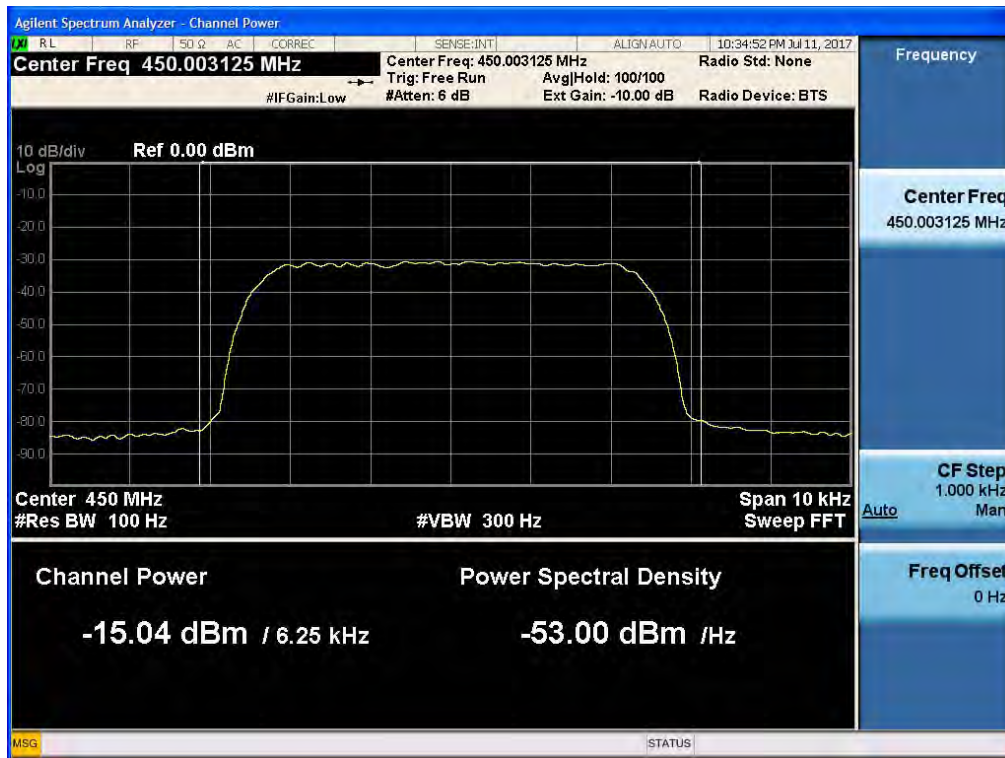


[UHF +3dB above the AGC threshold Uplink - High]

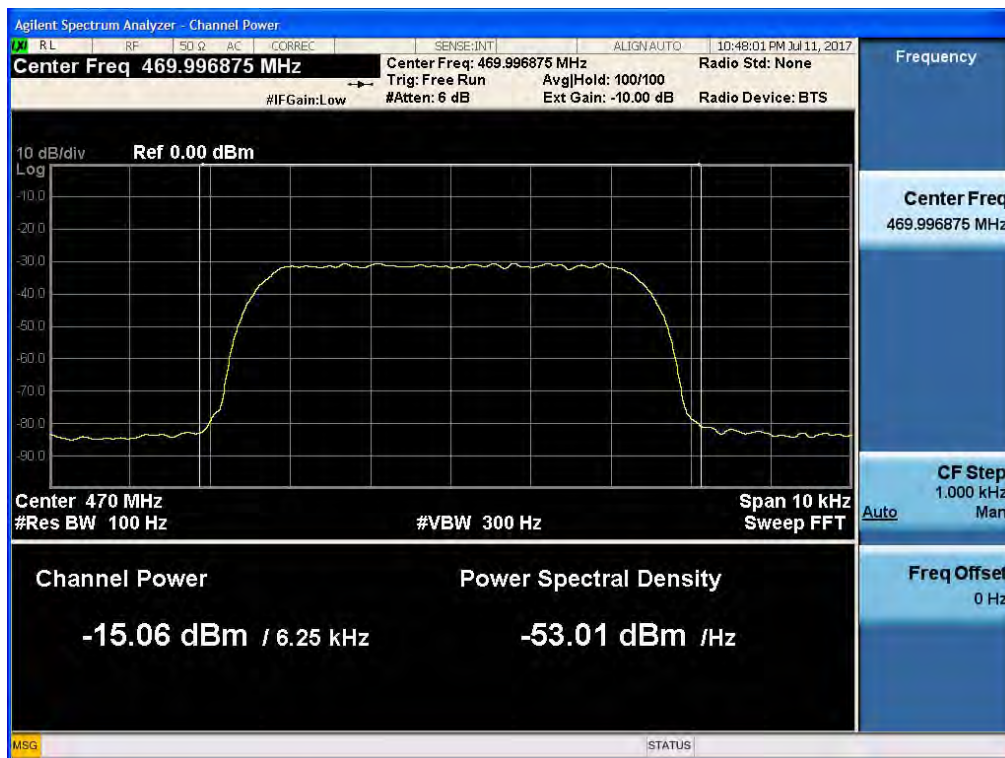


UHF(APCO_450 ~ 470 MHz) UL

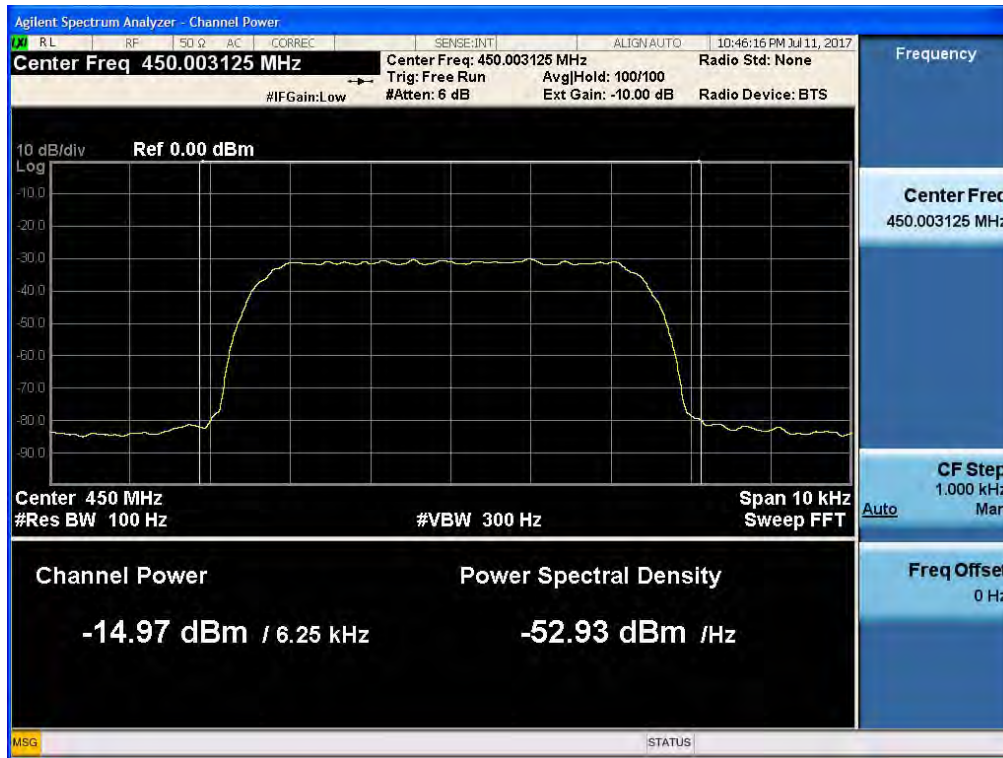
[UHF AGC threshold Uplink - Low]



[UHF AGC threshold Uplink - High]



[UHF +3dB above the AGC threshold Uplink - Low]



[UHF +3dB above the AGC threshold Uplink - High]



UHF(TETRA_450 ~ 470 MHz) UL

[UHF AGC threshold Uplink - Low]



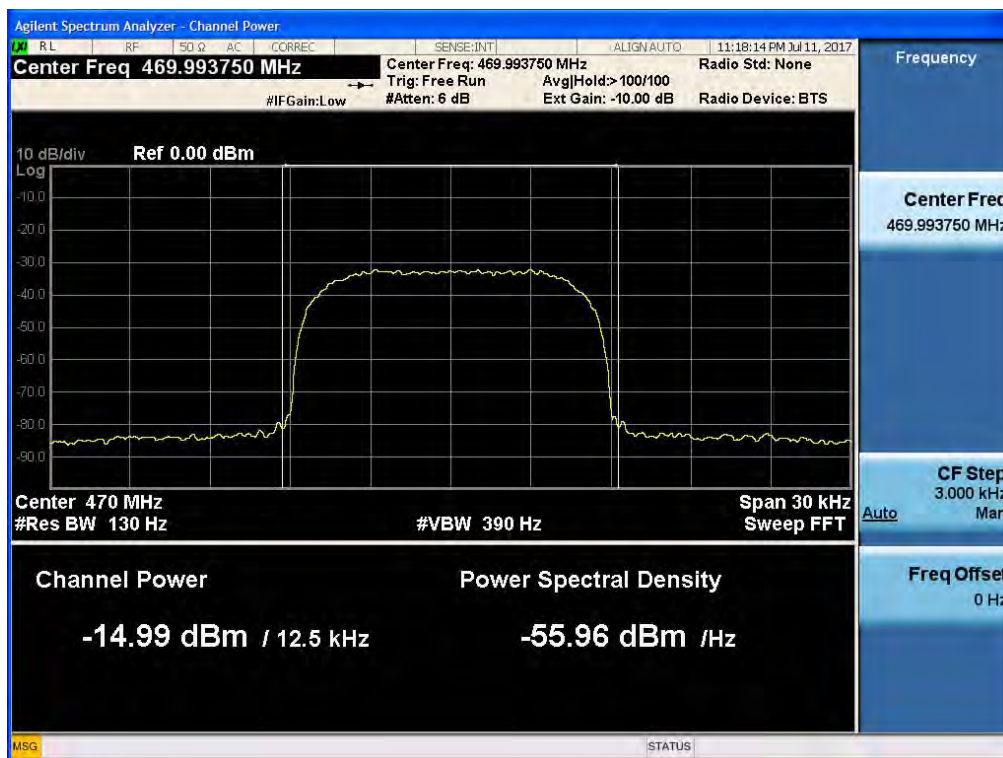
[UHF AGC threshold Uplink - High]



[UHF +3dB above the AGC threshold Uplink - Low]



[UHF +3dB above the AGC threshold Uplink - High]



UHF(TETRA_470 ~ 512 MHz) UL

[UHF AGC threshold Uplink - Low]



[UHF AGC threshold Uplink - Middle]



[UHF AGC threshold Uplink - High]



[UHF +3dB above the AGC threshold Uplink - Low]



[UHF +3dB above the AGC threshold Uplink - Middle]



[UHF +3dB above the AGC threshold Uplink - High]



7. OCCUPIED BANDWIDTH

FCC Rules

Test Requirement(s):

§ 2.1049 Measurements required: Occupied bandwidth:

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the specified conditions of § 2.1049 (a) through (i) as applicable.

IC Rules

Test Requirements:

RSS-Gen

6 Technical Requirements

6.6 Occupied Bandwidth

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99 % emission bandwidth, as calculated or measured.

Test Procedures:

Measurements were in accordance with the test methods section 3.4 of KDB 935210 D05 v01r01 and section 4.2 of KDB 971168 D01 v02r02.

Test is 99% OBW measured and used.

3.4 of KDB 935210 D05 v01r01

- a) Connect a signal generator to the input of the EUT.
- b) Configure the signal generator to transmit the AWGN signal.
- c) Configure the signal amplitude to be just below the AGC threshold level (see 3.2), but not more than 0.5 dB below.
- d) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.
- e) Set the spectrum analyzer center frequency to the center frequency of the operational band under test. The span range of the spectrum analyzer shall be between 2 times to 5 times the emission bandwidth (EBW) or alternatively, the OBW.
- f) The nominal RBW shall be in the range of 1 % to 5 % of the anticipated OBW, and the VBW shall be $\geq 3 \times \text{RBW}$.
- g) Set the reference level of the instrument as required to preclude the signal from exceeding the maximum spectrum analyzer input mixer level for linear operation. In general, the peak of the spectral envelope must be more than $[10 \log (\text{OBW} / \text{RBW})]$ below the reference level. Steps f) and g) may require iteration to enable adjustments within the specified tolerances.

- h) The noise floor of the spectrum analyzer at the selected RBW shall be at least 36 dB below the reference level.
- i) Set spectrum analyzer detection function to positive peak.
- j) Set the trace mode to max hold.
- k) Determine the reference value: Allow the trace to stabilize. Set the spectrum analyzer marker to the highest amplitude level of the displayed trace (this is the reference value) and record the associated frequency as f_0 .
- l) Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the -26 dB down amplitude. The 26 dB EBW (alternatively OBW) is the positive frequency difference between the two markers. If the spectral envelope crosses the -26 dB down amplitude at multiple points, the lowest or highest frequency shall be selected as the frequencies that are the furthest removed from the center frequency at which the spectral envelope crosses the -26 dB down amplitude point.
- m) Repeat steps e) to l) with the input signal connected directly to the spectrum analyzer (i.e., input signal measurement).
- n) Compare the spectral plot of the input signal (determined from step m) to the output signal (determined from step l) to affirm that they are similar (in passband and rolloff characteristic features and relative spectral locations), and include plot(s) and descriptions in test report.
- (o) Repeat the procedure [steps e) to n)] with the input signal amplitude set to 3 dB above the AGC threshold.
- p) Repeat steps e) to o) with the signal generator set to the narrowband signal.
- q) Repeat steps e) to p) for all frequency bands authorized for use by the EUT.

4.2 of KDB 971168 D01 v02r02

- a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts (i.e., two to five times the OBW).
- b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1 to 5 % of the anticipated OBW, and the VBW shall be at least 3 times the RBW.
- c) Set the reference level of the instrument as required to keep the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope must be at least $10\log(\text{OBW} / \text{RBW})$ below the reference level.
- d) NOTE—Steps a) through c) may require iteration to adjust within the specified tolerances.
- e) Set the detection mode to peak, and the trace mode to max hold..
- f) Use the 99 % power bandwidth function of the spectrum analyzer (if available) and report the measured bandwidth.
- g) If the instrument does not have a 99 % power bandwidth function, the trace data points are to be recovered and directly summed in linear power terms. The recovered amplitude data points,

beginning at the lowest frequency, are placed in a running sum until 0.5 % of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5 % of the total is reached; that frequency is recorded as the upper frequency. The 99 % power bandwidth is the difference between these two frequencies.

h) The OBW shall be reported by providing plot(s) of the measuring instrument display. The frequency and amplitude axes and scale shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

Test Results: The EUT complies with the requirements of this section.

Input Signal	Input Level (dBm)		Maximum Amp Gain	
	DL	UL	DL	UL
VHF	-15	-45	40	30
UHF	-15	-45	40	30

[Downlink Output]

	Channel	Frequency (MHz)	OBW (kHz)
VHF(APCO25)_ 138 MHz AGC threshold	Low	138.003125	4.856
	Middle	-	-
	High	-	-
VHF(APCO25)_ 138 MHz +3dB above AGC threshold	Low	138.003125	4.836
	Middle	-	-
	High	-	-
VHF(APCO25)_ 150 ~ 174 MHz AGC threshold	Low	150.003125	4.859
	Middle	162.000	4.853
	High	173.996875	4.838
VHF(APCO25)_ 150 ~ 174 MHz +3dB above AGC threshold	Low	150.003125	4.837
	Middle	162.000	4.876
	High	173.996875	4.831

	Channel	Frequency (MHz)	OBW (kHz)
UHF(APCO) _ 406.1 ~ 430 MHz AGC threshold	Low	406.103125	4.865
	Middle	-	-
	High	429.996875	4.820
UHF(APCO) _ 406.1 ~ 430 MHz +3dB above AGC threshold	Low	406.103125	4.831
	Middle	-	-
	High	429.996875	4.825
UHF(APCO) _ 450 ~ 470 MHz AGC threshold	Low	450.003125	4.828
	Middle	-	-
	High	469.996875	4.808
UHF(APCO) _ 450 ~ 470 MHz +3dB above AGC threshold	Low	450.003125	4.820
	Middle	-	-
	High	469.996875	4.837

	Channel	Frequency (MHz)	OBW (kHz)
UHF(TETRA)_ 450 ~ 470 MHz AGC threshold	Low	450.00625	10.180
	Middle	-	-
	High	469.99375	10.174
UHF(TETRA)_ 450 ~ 470 MHz +3dB above AGC threshold	Low	450.00625	10.155
	Middle	-	-
	High	469.99375	10.189
UHF(TETRA)_ 470 ~ 512 MHz AGC threshold	Low	470.00625	10.151
	Middle	491.00000	10.151
	High	511.99375	10.130
UHF(TETRA)_ 470 ~ 512 MHz +3dB above AGC threshold	Low	470.00625	10.135
	Middle	491.00000	10.144
	High	511.99375	10.140

[Uplink Output]

	Channel	Frequency (MHz)	OBW (kHz)
VHF(APCO25)_ 138 MHz AGC threshold	Low	138.003125	4.848
	Middle	-	-
	High	-	-
VHF(APCO25)_ 138 MHz +3dB above AGC threshold	Low	138.003125	4.828
	Middle	-	-
	High	-	-
VHF(APCO25)_ 150 ~ 174 MHz AGC threshold	Low	150.003125	4.836
	Middle	162.000	4.847
	High	173.996875	4.835
VHF(APCO25)_ 150 ~ 174 MHz +3dB above AGC threshold	Low	150.003125	4.826
	Middle	162.000	4.871
	High	173.996875	4.849

	Channel	Frequency (MHz)	OBW (kHz)
UHF(APCO) _ 406.1 ~ 430 MHz AGC threshold	Low	406.103125	4.837
	Middle	-	-
	High	429.996875	4.836
UHF(APCO) _ 406.1 ~ 430 MHz +3dB above AGC threshold	Low	406.103125	4.835
	Middle	-	-
	High	429.996875	4.840
UHF(APCO) _ 450 ~ 470 MHz AGC threshold	Low	450.003125	4.872
	Middle	-	-
	High	469.996875	4.823
UHF(APCO) _ 450 ~ 470 MHz +3dB above AGC threshold	Low	450.003125	4.850
	Middle	-	-
	High	469.996875	4.869

	Channel	Frequency (MHz)	OBW (kHz)
UHF(TETRA)_ 450 ~ 470 MHz AGC threshold	Low	450.00625	10.123
	Middle	-	-
	High	469.99375	10.146
UHF(TETRA)_ 450 ~ 470 MHz +3dB above AGC threshold	Low	450.00625	10.178
	Middle	-	-
	High	469.99375	10.073
UHF(TETRA)_ 470 ~ 512 MHz AGC threshold	Low	470.00625	10.184
	Middle	491.00000	10.109
	High	511.99375	10.114
UHF(TETRA)_ 470 ~ 512 MHz +3dB above AGC threshold	Low	470.00625	10.147
	Middle	491.00000	10.154
	High	511.99375	10.111

[Downlink Input]

	Channel	Frequency (MHz)	OBW (kHz)
VHF(6.25 k) AGC threshold	Low	138.003125	4.823
	Middle	-	-
	High	-	-
VHF(6.25 k) AGC threshold	Low	150.003125	4.804
	Middle	162.000	4.877
	High	173.996875	4.832
UHF(6.25 k) AGC threshold	Low	406.103125	4.870
	Middle	-	-
	High	429.996875	4.839
UHF(6.25 k) AGC threshold	Low	450.003125	4.864
	Middle	-	-
	High	469.996875	4.863
UHF(12.5 k) AGC threshold	Low	450.00625	10.166
	Middle	-	-
	High	469.99375	10.175
UHF(12.5 k) AGC threshold	Low	470.00625	10.216
	Middle	491.00000	10.162
	High	511.99375	10.138

Plots of Occupied Bandwidth

VHF(APCO25_138 MHz) DL_Output

[VHF AGC threshold Downlink - Low]

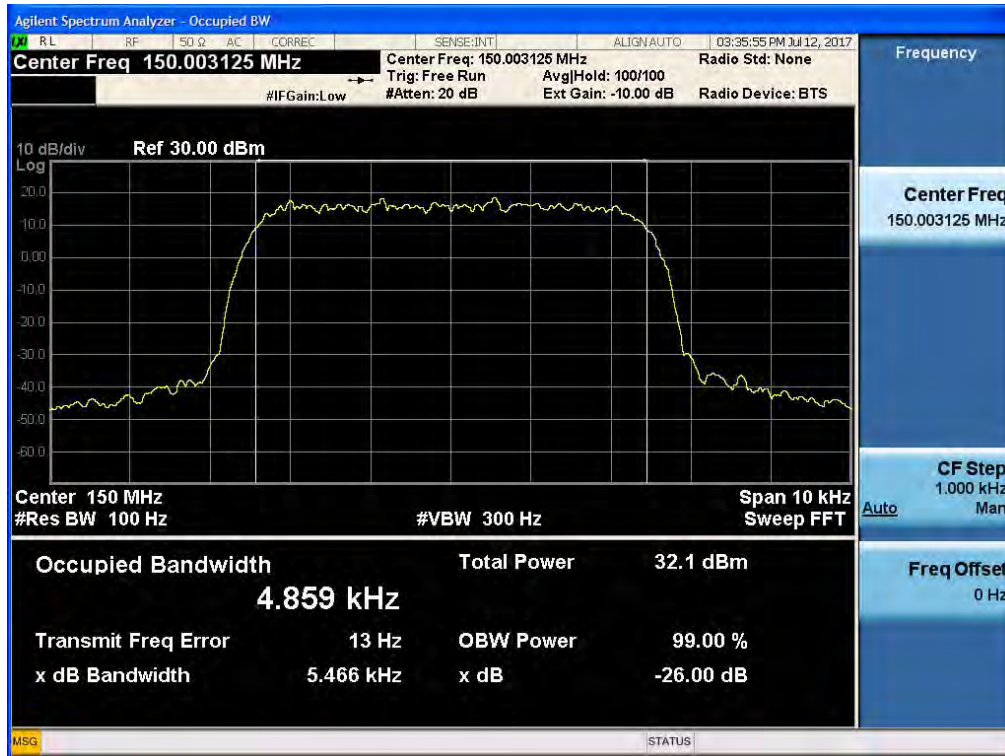


[VHF +3dB above the AGC threshold Downlink - Low]

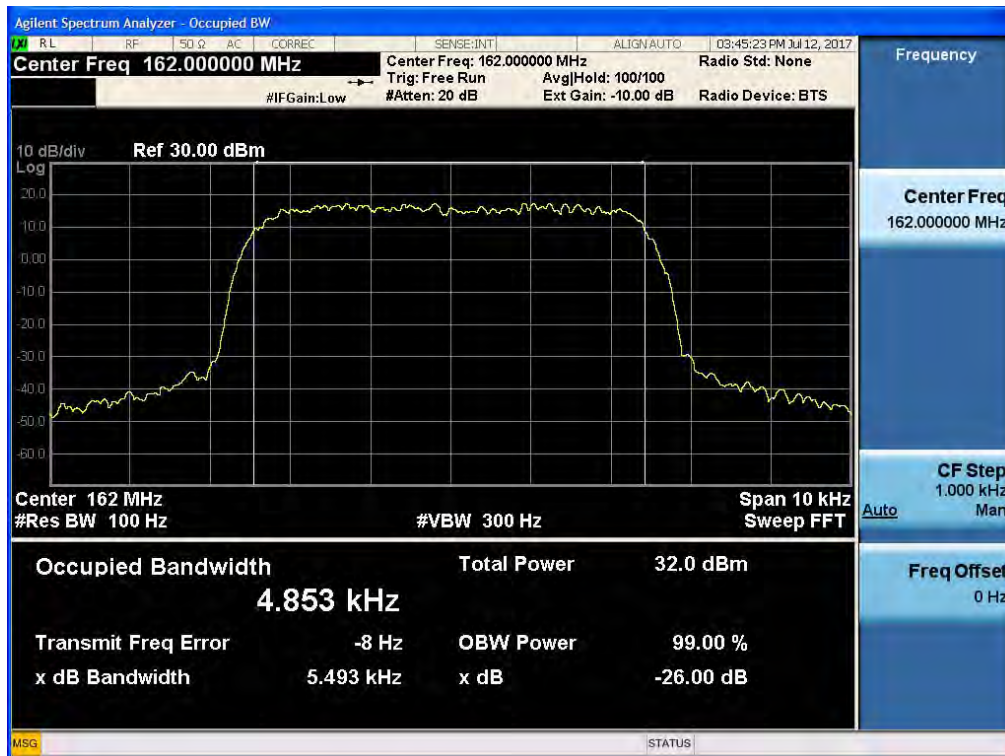


VHF(APCO25_150 ~ 174 MHz) DL_Output

[VHF AGC threshold Downlink - Low]



[VHF AGC threshold Downlink - Middle]



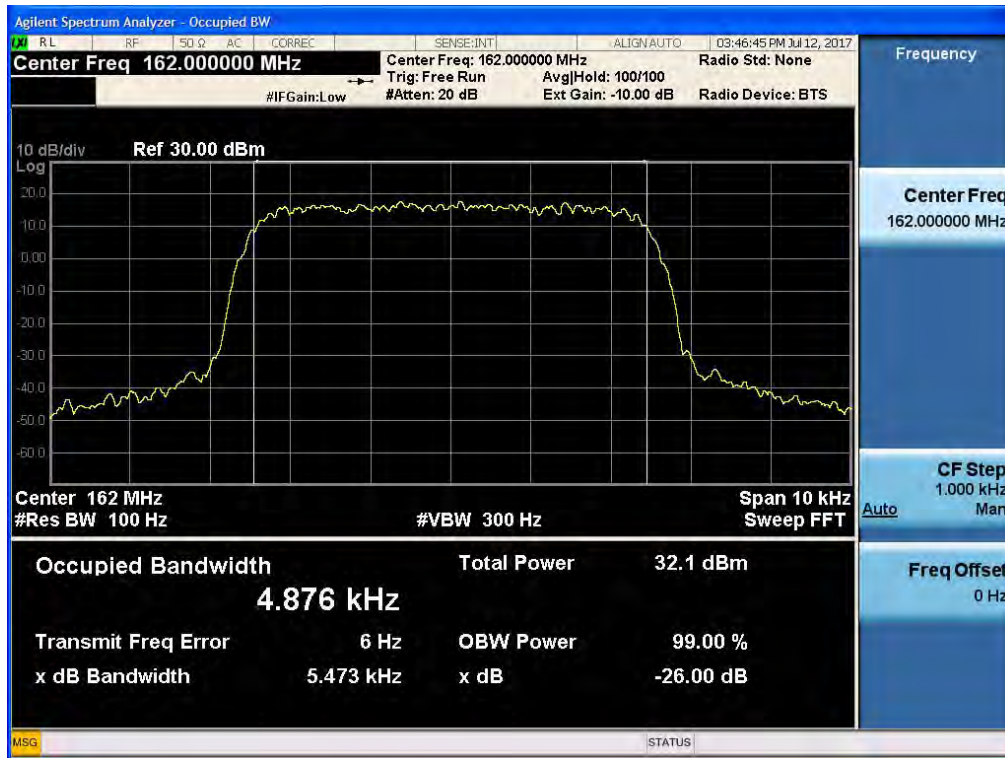
[VHF AGC threshold Downlink - High]



[VHF +3dB above the AGC threshold Downlink - Low]



[VHF +3dB above the AGC threshold Downlink - Middle]



[VHF +3dB above the AGC threshold Downlink - High]

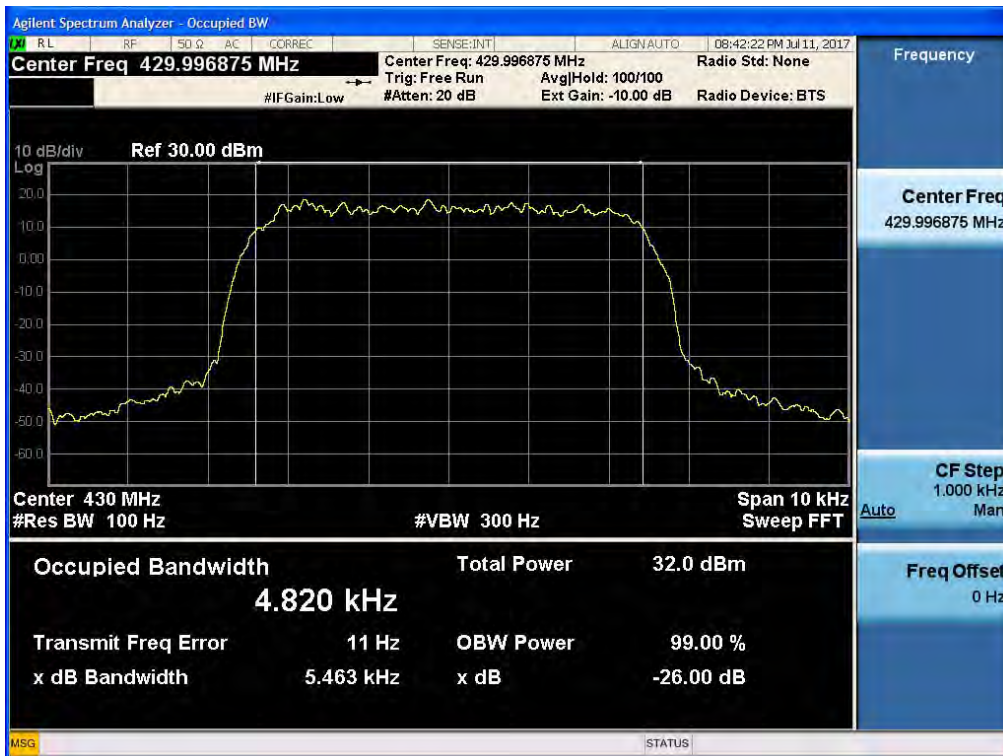


UHF(APCO_406.1 ~ 430 MHz) DL_Output

[UHF AGC threshold Downlink - Low]



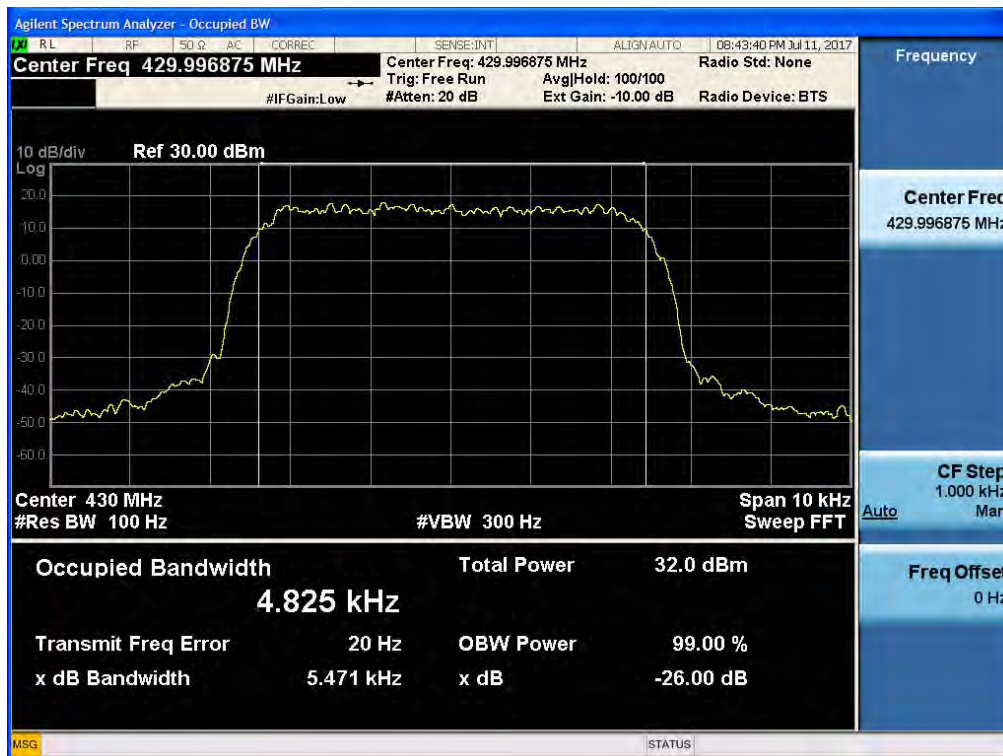
[UHF AGC threshold Downlink - High]



[UHF +3dB above the AGC threshold Downlink - Low]



[UHF +3dB above the AGC threshold Downlink - High]

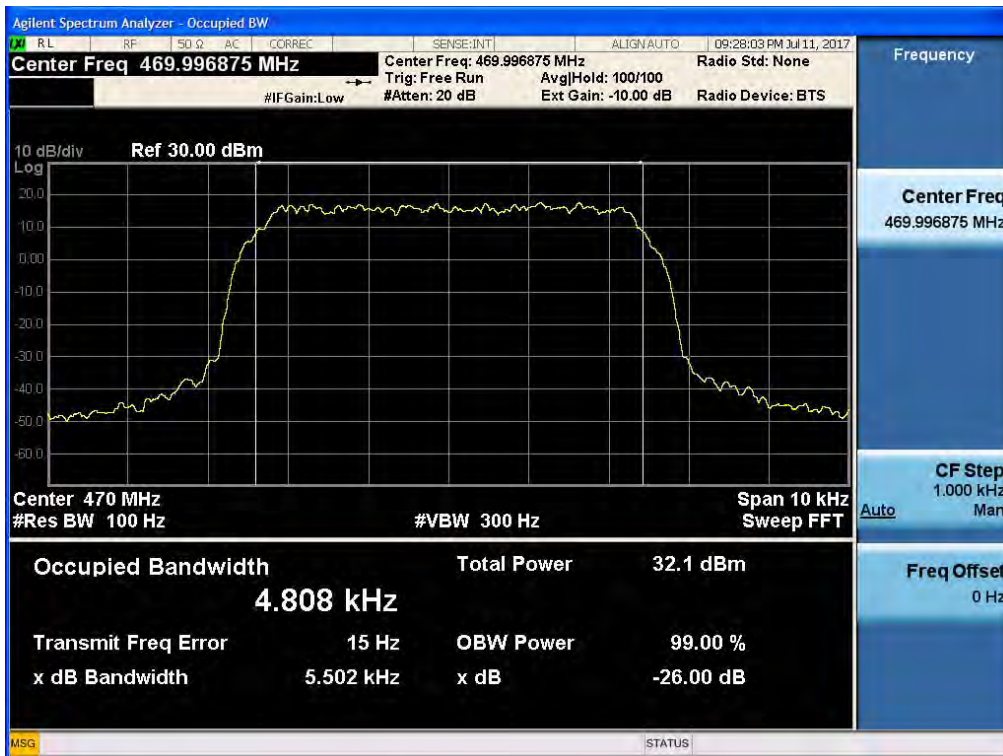


UHF(APCO_450 ~ 470 MHz) DL_Output

[UHF AGC threshold Downlink - Low]



[UHF AGC threshold Downlink - High]



[UHF +3dB above the AGC threshold Downlink - Low]

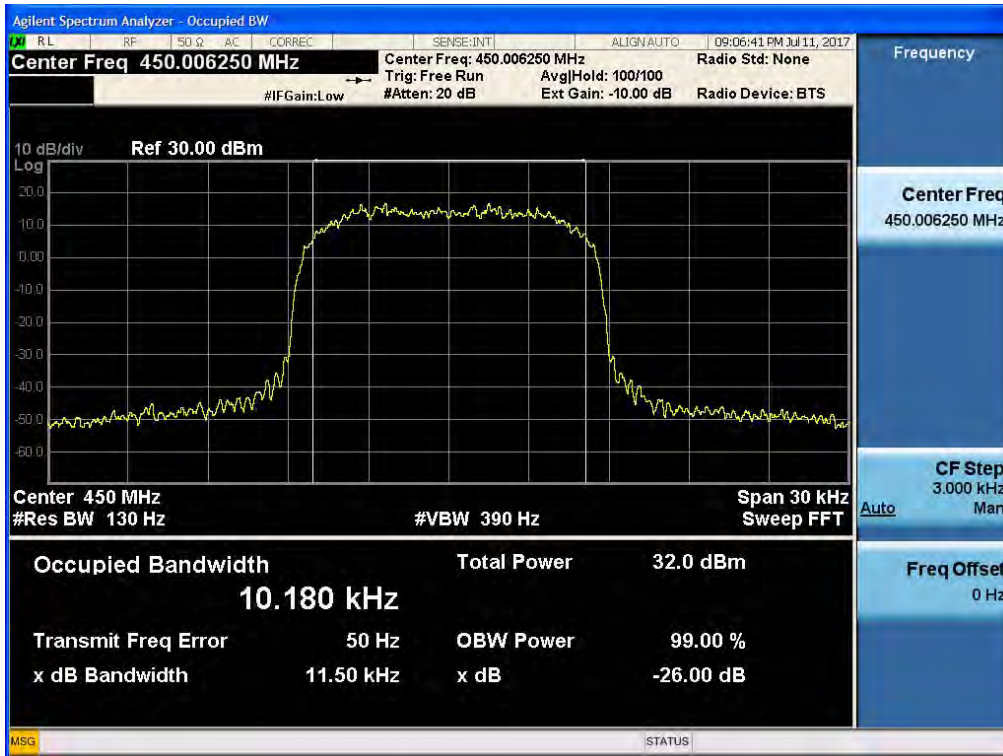


[UHF +3dB above the AGC threshold Downlink - High]

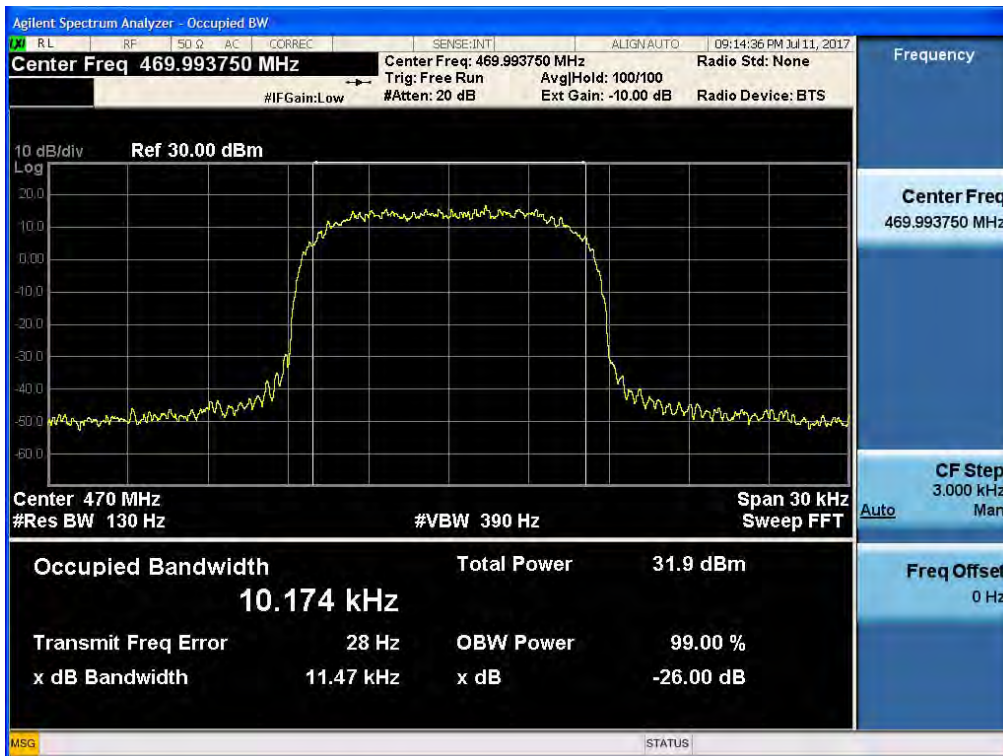


UHF(TETRA_450 ~ 470 MHz) DL_Output

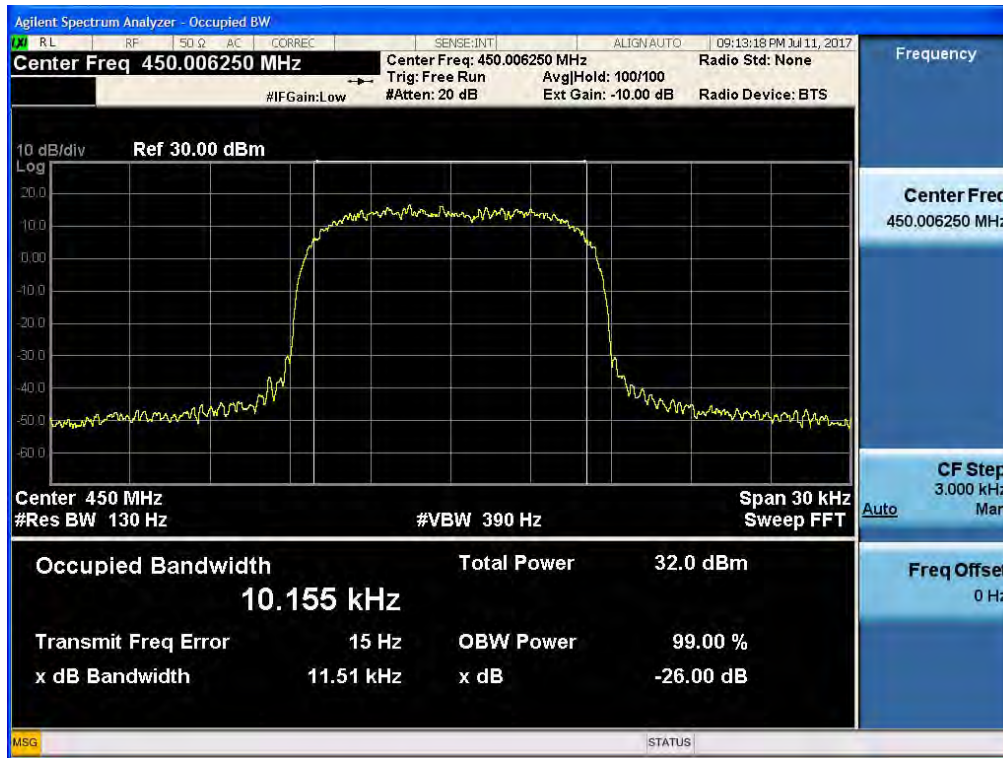
[UHF AGC threshold Downlink - Low]



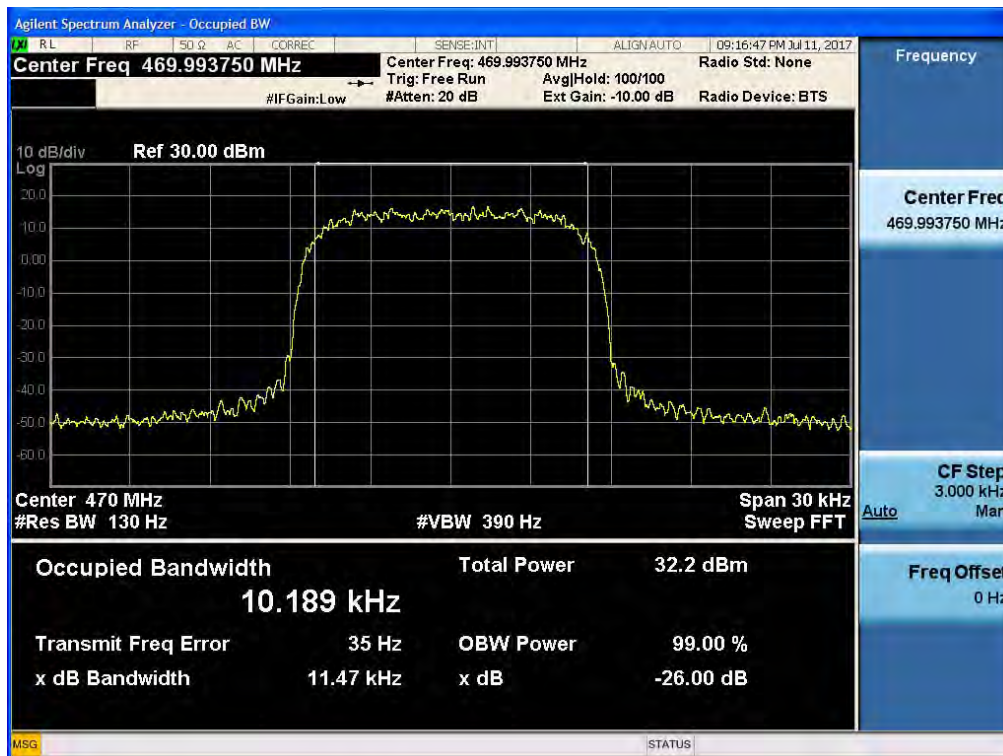
[UHF AGC threshold Downlink - High]



[UHF +3dB above the AGC threshold Downlink - Low]

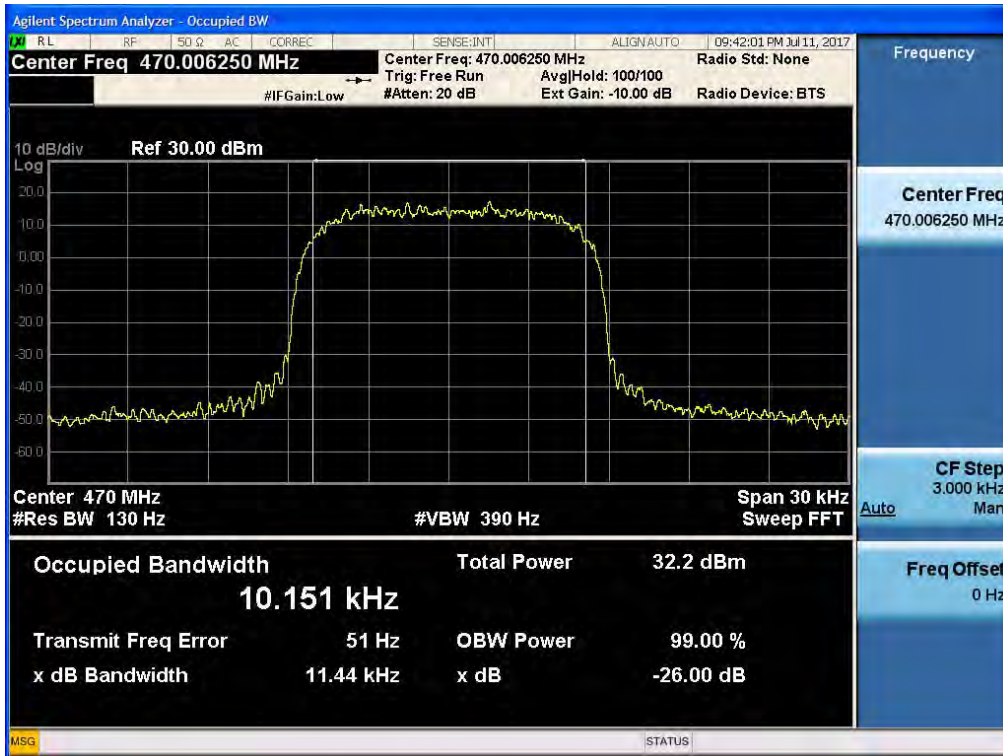


[UHF +3dB above the AGC threshold Downlink - High]

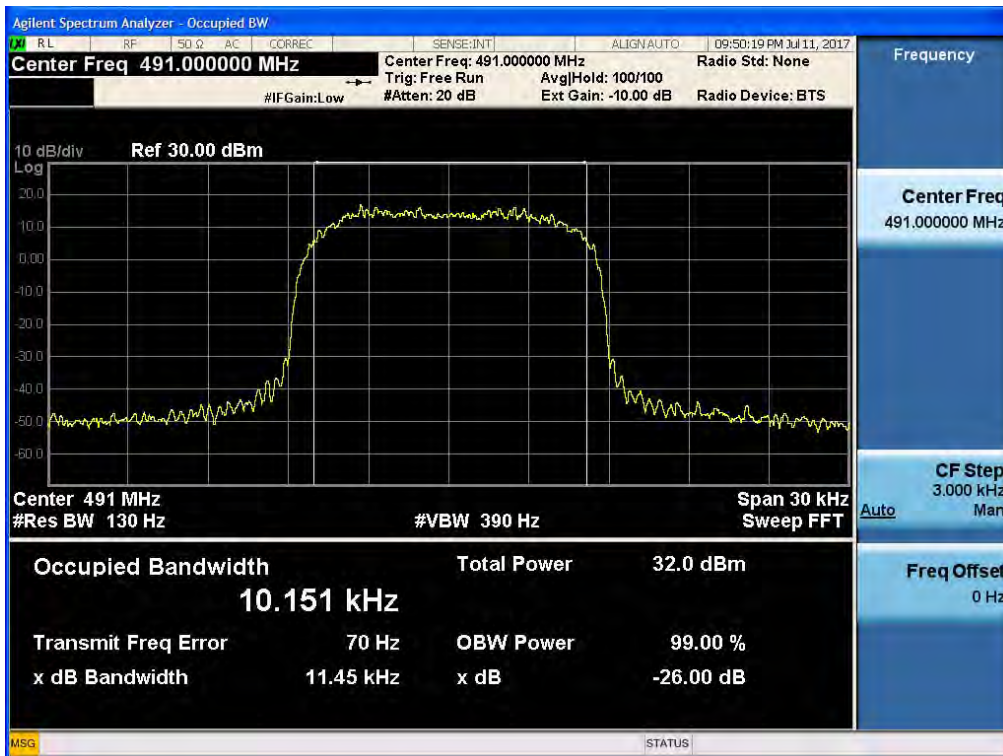


UHF(TETRA_470 ~ 512 MHz) DL_Output

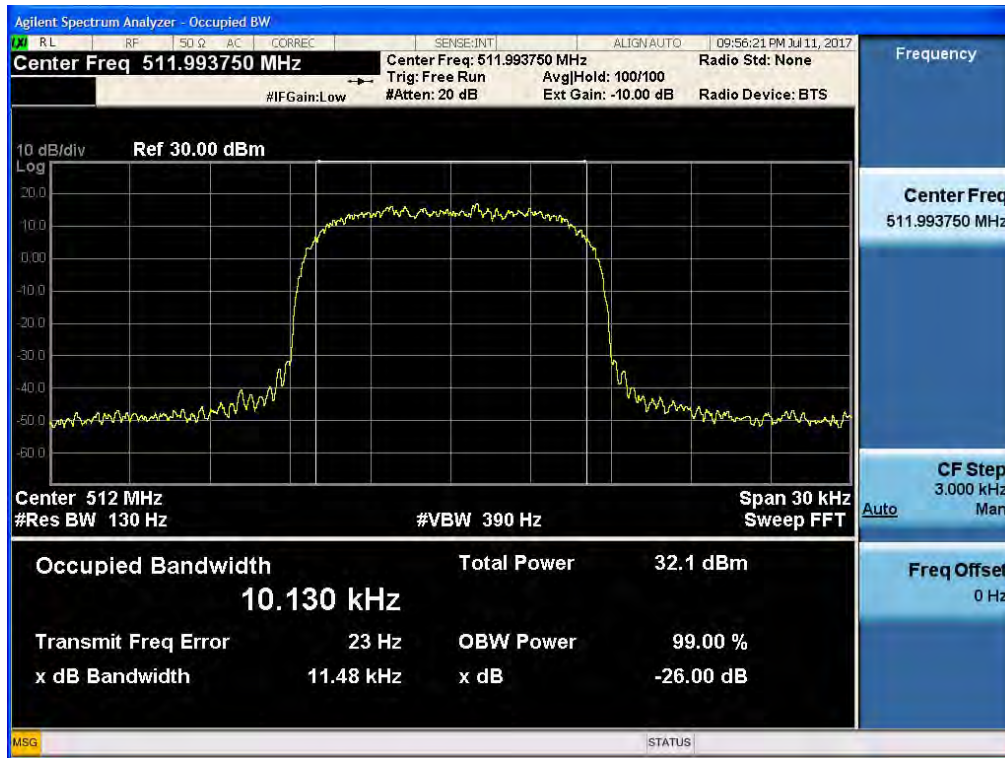
[UHF AGC threshold Downlink - Low]



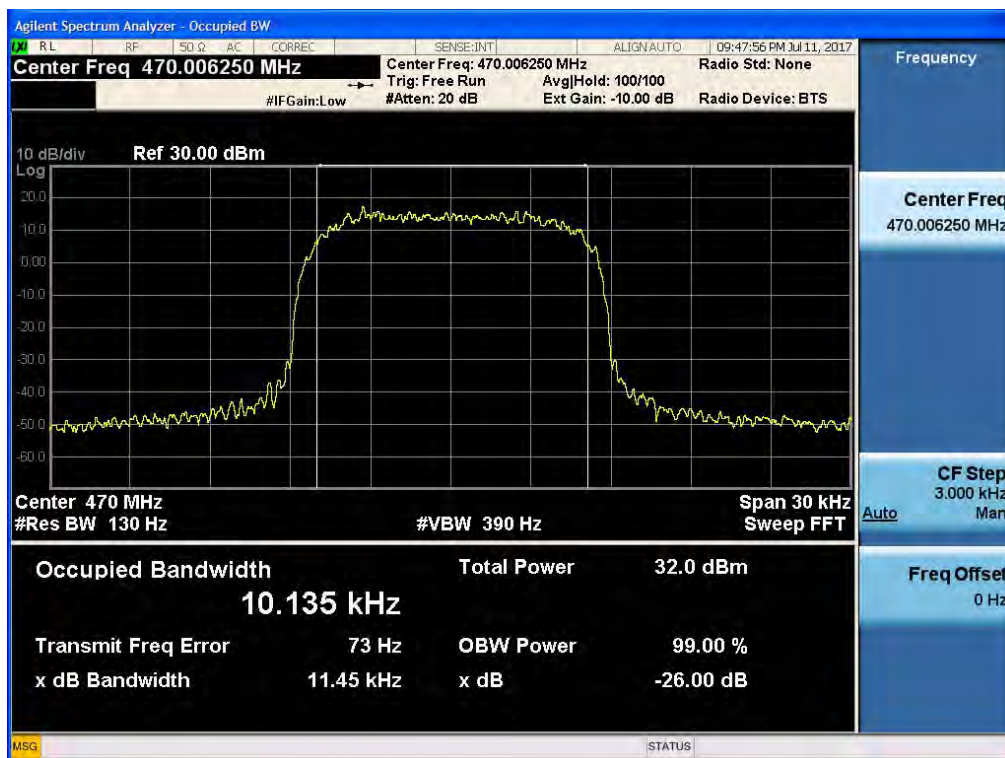
[UHF AGC threshold Downlink - Middle]



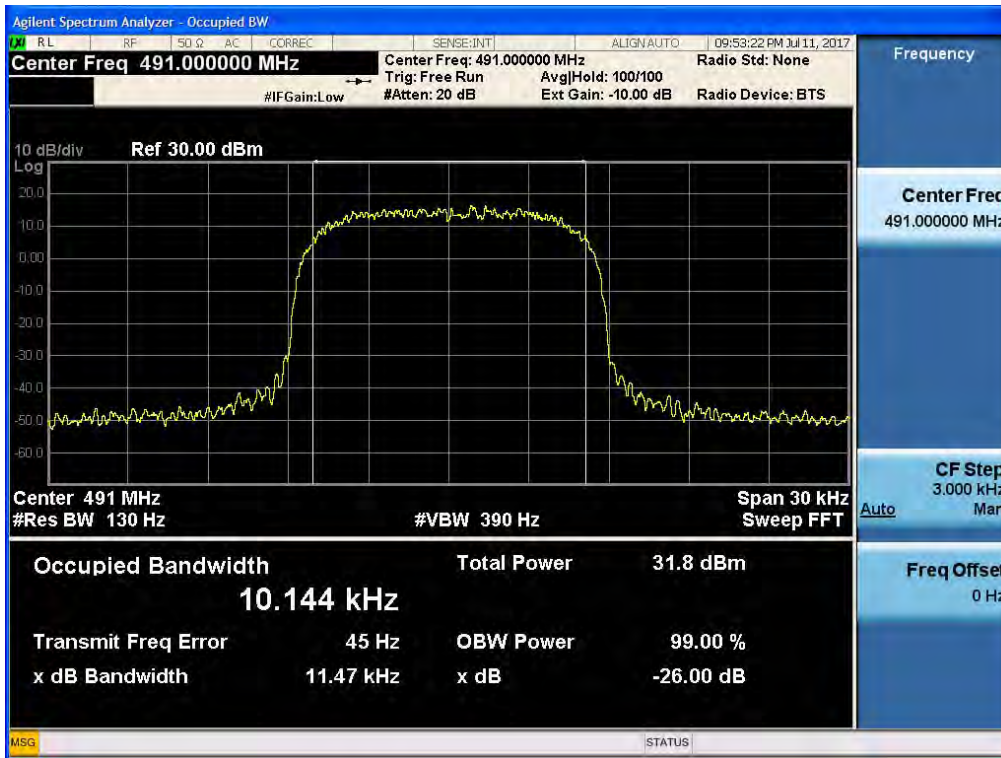
[UHF AGC threshold Downlink - High]



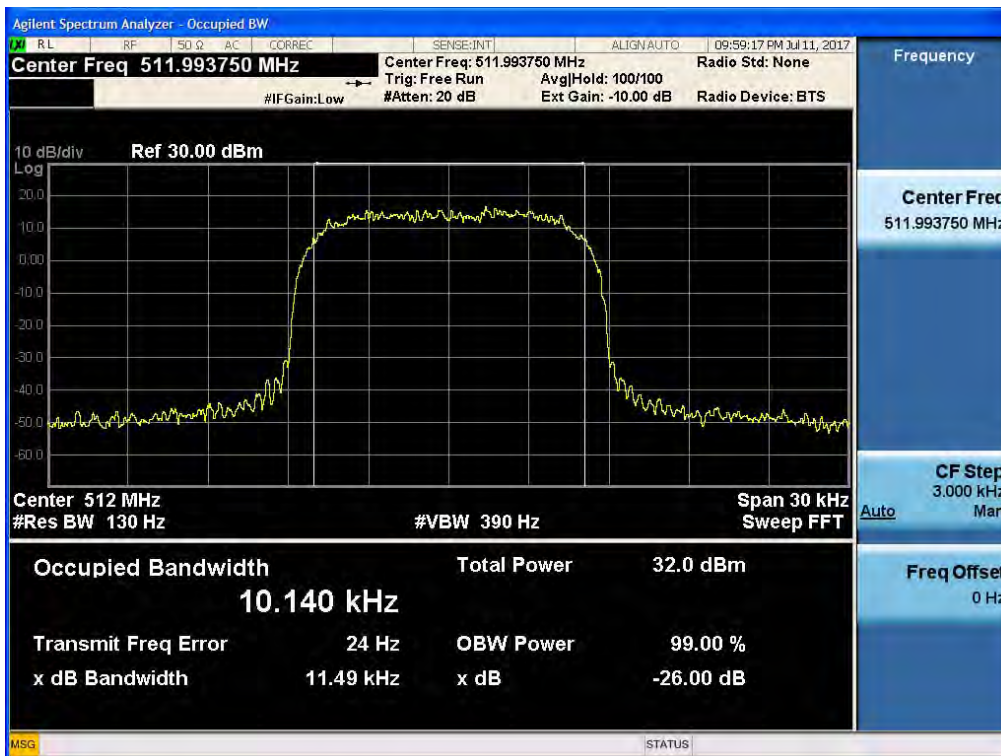
[UHF +3dB above the AGC threshold Downlink - Low]



[UHF +3dB above the AGC threshold Downlink - Middle]

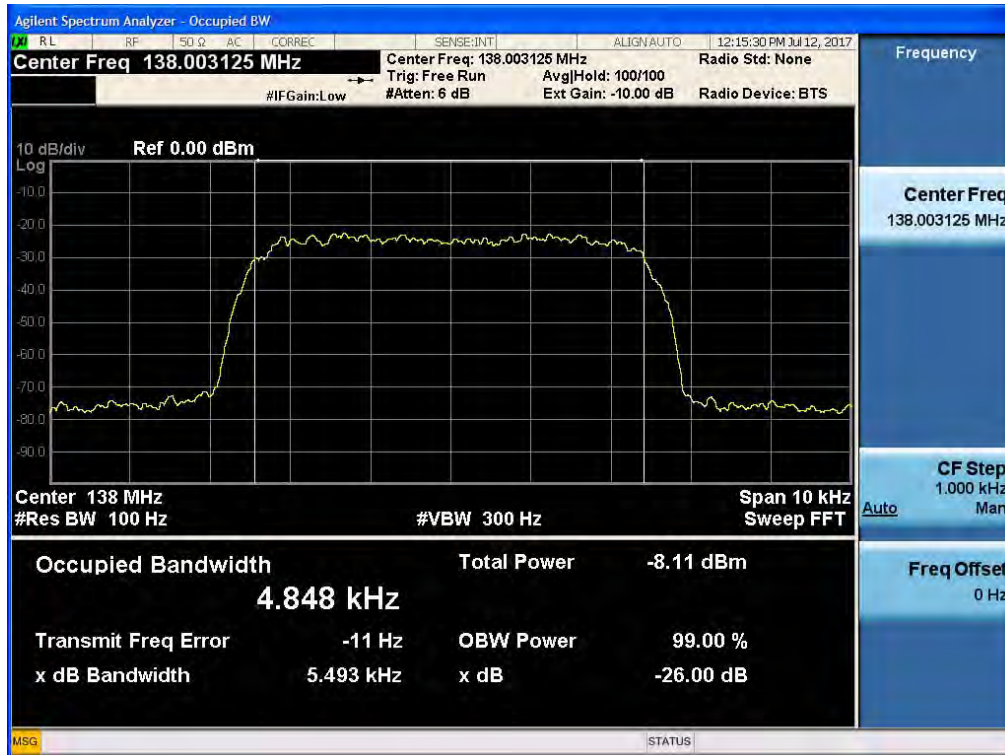


[UHF +3dB above the AGC threshold Downlink - High]



VHF(APCO25_138 MHz) UL_Output

[VHF AGC threshold Uplink - Low]



[VHF +3dB above the AGC threshold Uplink - Low]



VHF(APCO25_150 ~ 174 MHz) UL_Output

[VHF AGC threshold Uplink - Low]



[VHF AGC threshold Uplink - Middle]



[VHF AGC threshold Uplink - High]



[VHF +3dB above the AGC threshold Uplink - Low]



[VHF +3dB above the AGC threshold Uplink - Middle]



[VHF +3dB above the AGC threshold Uplink - High]



UHF(APCO_406.1 ~ 430 MHz) UL_Output

[UHF AGC threshold Uplink - Low]



[UHF AGC threshold Uplink - High]



[UHF +3dB above the AGC threshold Uplink - Low]

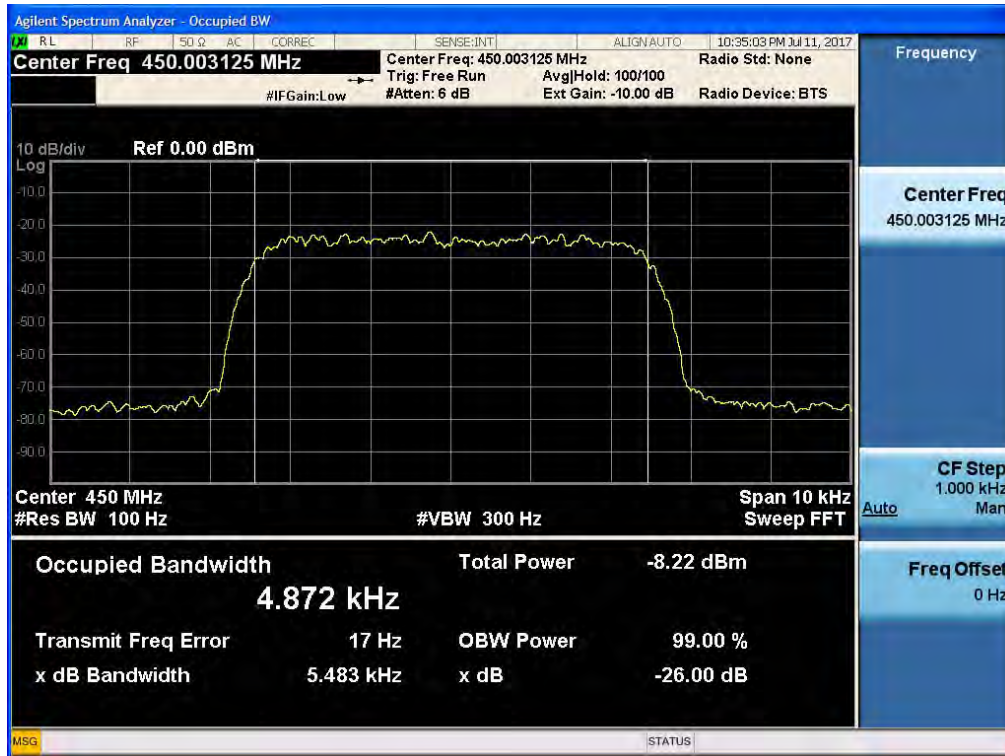


[UHF +3dB above the AGC threshold Uplink - High]



UHF(APCO_450 ~ 470 MHz) UL_Output

[UHF AGC threshold Uplink - Low]



[UHF AGC threshold Uplink - High]



[UHF +3dB above the AGC threshold Uplink - Low]

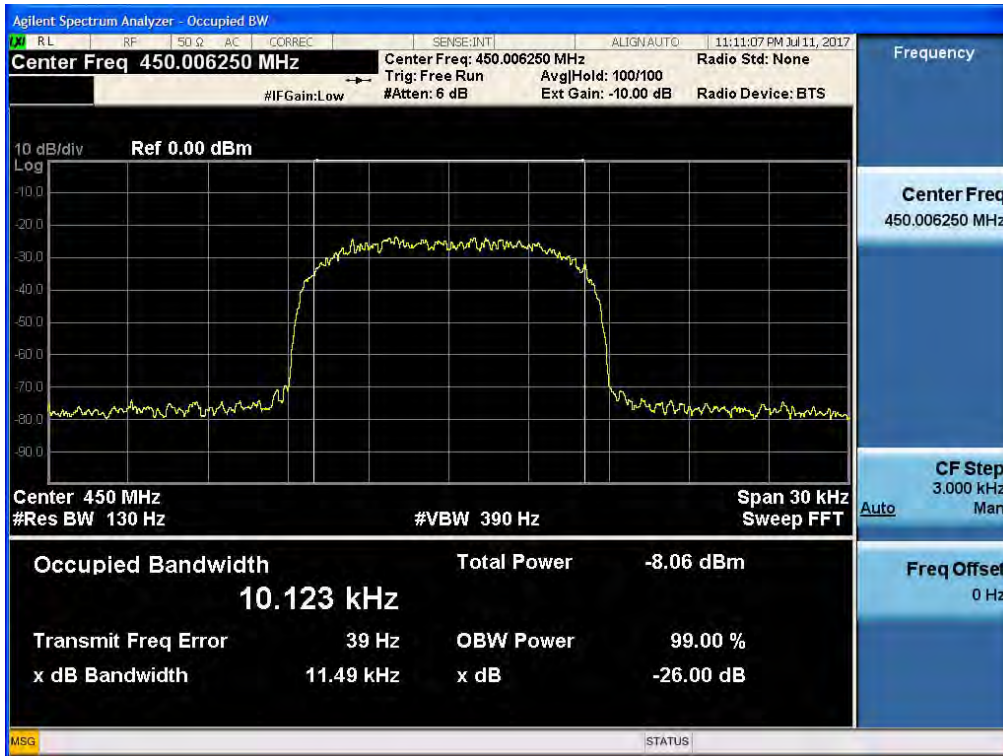


[UHF +3dB above the AGC threshold Uplink - High]

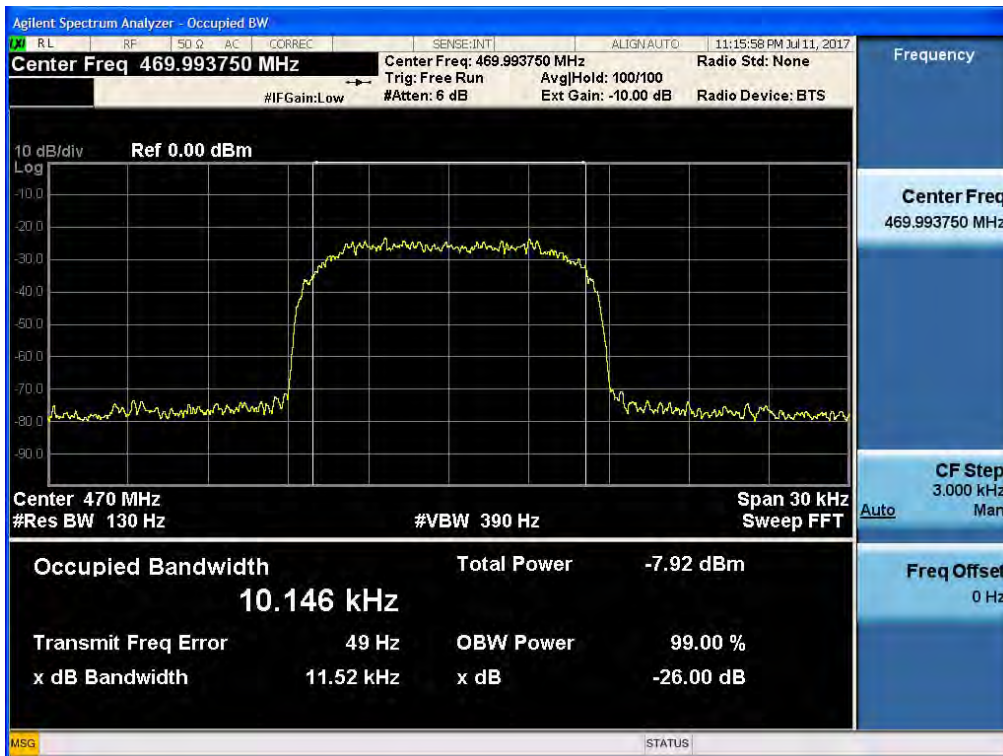


UHF(TETRA_450 ~ 470 MHz) UL_Output

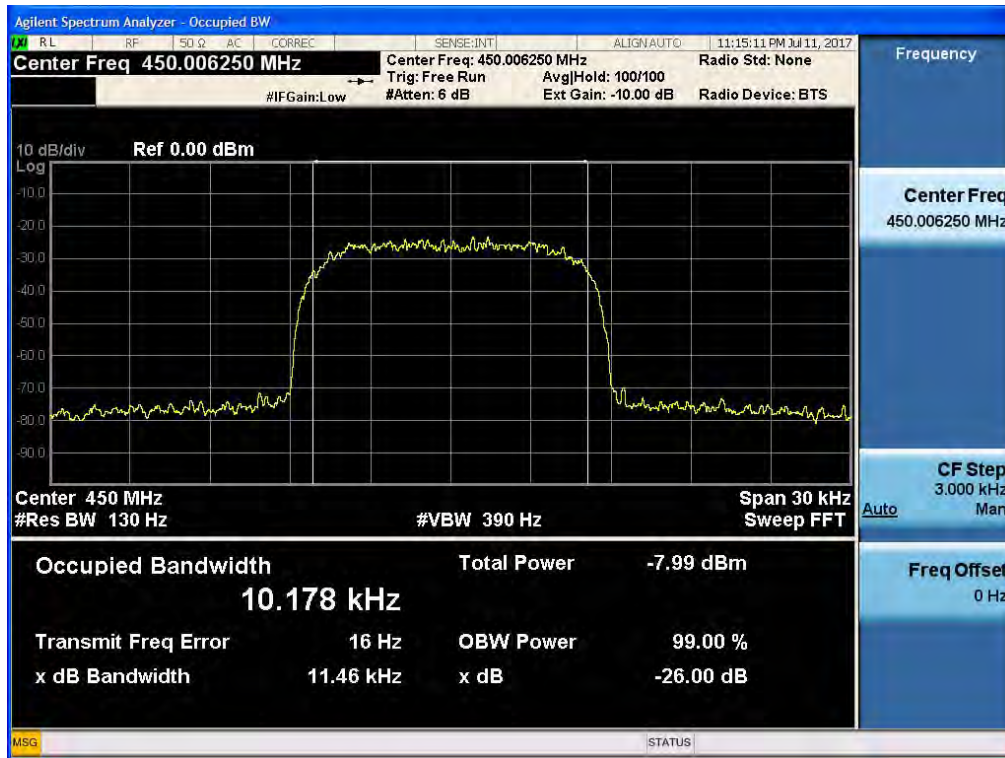
[UHF AGC threshold Uplink - Low]



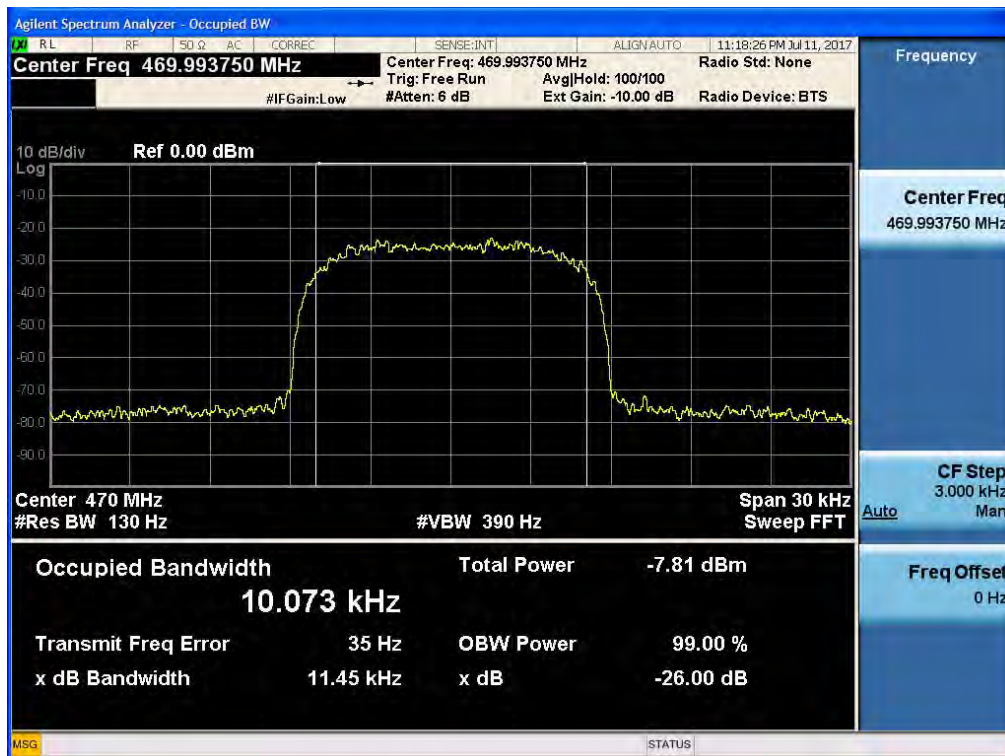
[UHF AGC threshold Uplink - High]



[UHF +3dB above the AGC threshold Uplink - Low]

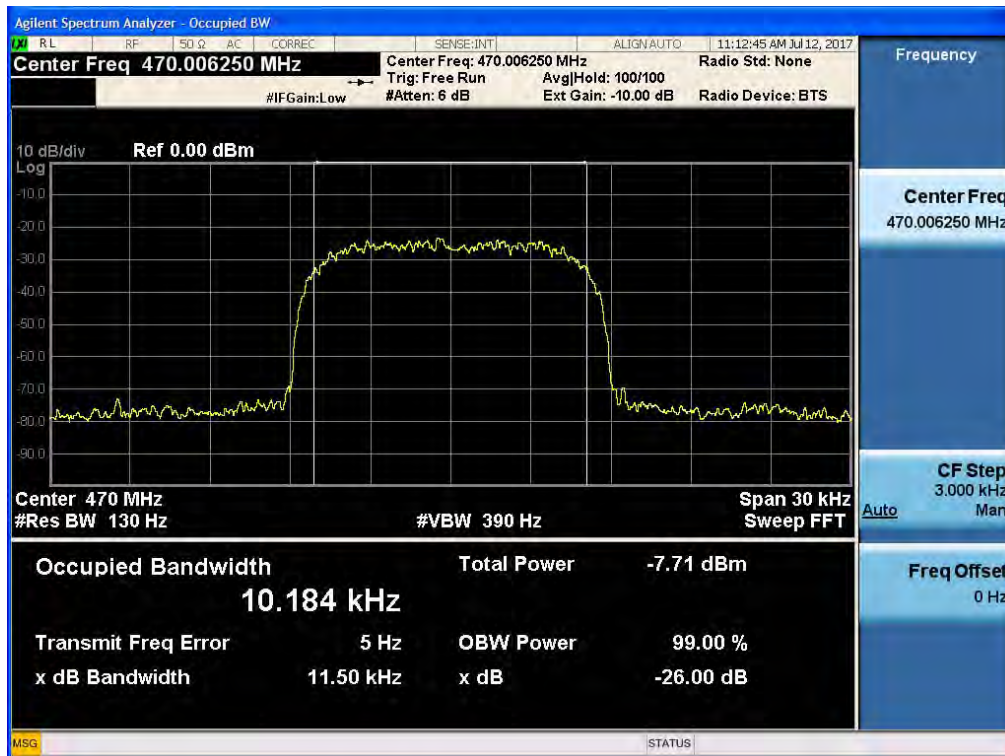


[UHF +3dB above the AGC threshold Uplink - High]

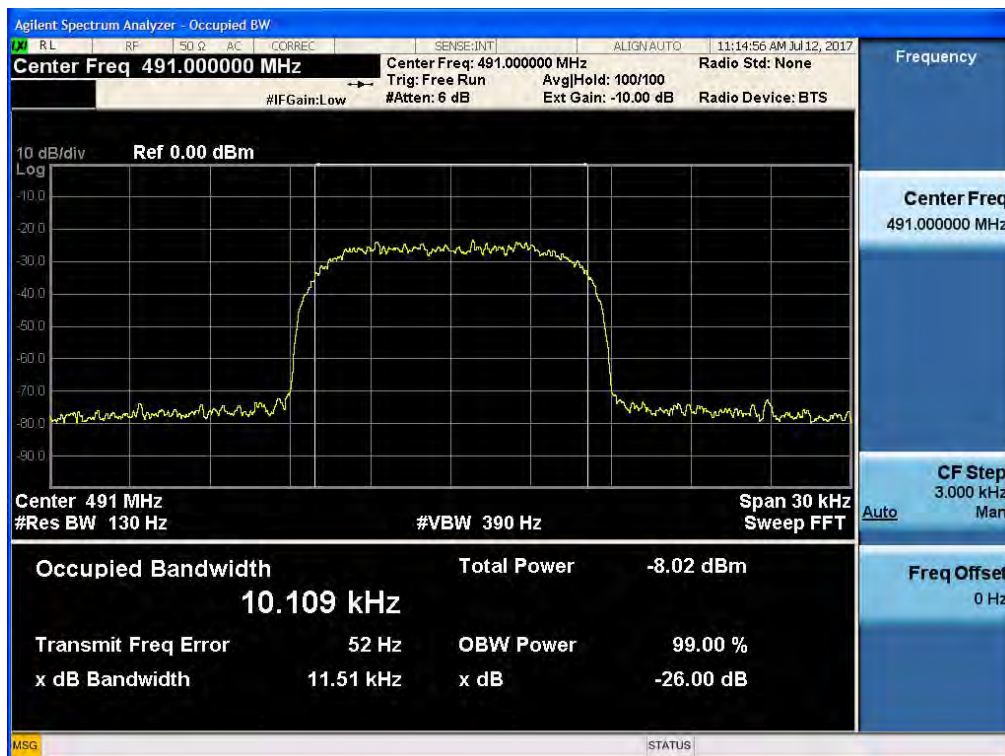


UHF(TETRA_470 ~ 512 MHz) UL_Output

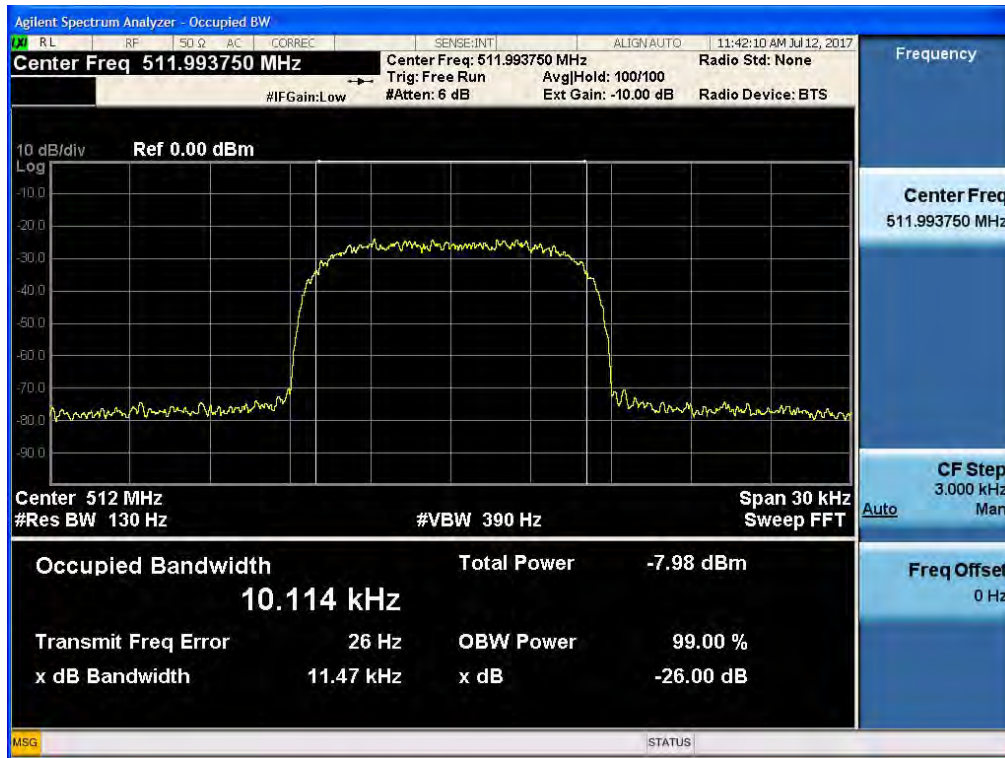
[UHF AGC threshold Uplink - Low]



[UHF AGC threshold Uplink - Middle]



[UHF AGC threshold Uplink - High]



[UHF +3dB above the AGC threshold Uplink - Low]

