HCT CO.,LTD.
74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA
TEL: +82-31-645-6300 FAX: +82-31-645-6401

FCC / ISED REPORT

Certification

Applicant Name:
ADVANCED RF TECHNOLOGIES, INC

Address:
3116 WEST VANOWEN STREET, BURBANK,
CA 91505, USA

Date of Issue:
January 20, 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-1701-F015-1

HCT FRN: 0005866421

ISED Registration Number: 5944A-5

FCC ID:	**N52-PSR-VU-9537B**
IC:	**6416A-PSRVU9537B**
APPLICANT:	**ADVANCED RF TECHNOLOGIES, INC**

FCC/IC Model(s):	PSR-VU-9537B
EUT Type:	REPEATER
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: 0.25 W (24 dBm) / Downlink: 0.63 W (28 dBm)
	UHF - Uplink: 0.5 W (27 dBm) / Downlink: 5 W (37 dBm)
Date of Test:	April 23, 2016 ~ January 12, 2017
FCC Rule Part(s):	CFR 47 Part 2, Part 90
IC Rules:	RSS-Gen (Issue 4,November 2014), RSS-131 (Issue 2, July 2003)

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
Test engineer of RF Team

Approved by
: Jong Seok Lee
Manager of RF Team

Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-R-1701-F015	January 13, 2017	- First Approval Report
HCT-R-1701-F015-1	January 20, 2017	- revised IC ID and Model name.

Table of Contents

1. CLIENT INFORMATION

The EUT has been tested by request of

Company	ADVANCED RF TECHNOLOGIES, INC 3116 WEST VANOWEN STREET, BURBANK, CA 91505, USA

FCC ID:	N52-PSR-VU-9537B
IC:	6416A-PSRVU9537B
EUT Type:	REPEATER
FCC/IC Model(s):	PSR-VU-9537B
Power Supply:	110 ~ 220 VAC
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 (Uplink / Downlink for ISED)
Conducted Output Power:	VHF - Uplink: 0.25 W (24 dBm) / Downlink: 0.63 W (28 dBm) UHF - Uplink: 0.5 W (27 dBm) / Downlink: 5 W (37 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 2, July 2003)
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-131, Section 4.3 RSS-131, Section 6.2	Compliant
Occupied Bandwidth & Emission Masks	§2.1049; §90.210, §90.219(e)(4)	RSS-GEN, Sectin 4.6.1	Compliant
Passband Gain and Bandwidth & Out of Band Rejection	KDB 935210 D05 v01r01	RSS-131, Section 4.2 RSS-131, Section 6.1	Compliant
Noise Figure	§90.219(e)(2)	-	Compliant
Spurious Emissions at Antenna Terminals	§2.1051; §90.219(e)(3)	RSS-131, Section 4.4 RSS-131, Section 6.3 RSS-131, Section 6.4	Compliant
Radiated Spurious Emissions	§2.1053; §90.219(e)(3)	-	Compliant
Frequency Stability	§2.1055; §90.213	RSS-131, Section 4.5 RSS-131, Section 6.5	N/A The EUT does not perform frequency translation

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)
FCC: 406.1 ~ 470 MHz ISED: 406.1 ~ 430 MHz, 450 ~ 470 MHz	
FCC: 470 ~ 512 MHz ISED: 450 ~ 470 MHz	LMR450 (6.25 kHz)

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 ≤ 1 GHz f > 1 GHz	± 4.80 dB ± 6.07 dB

4. STANDARDS ENVIRONMENTAL TEST CONDITIONS

Temperature :	**+ 15 ℃ to + 35 ℃**
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	09/02/2016	Annual	MY42082646
Agilent	N5182A /Signal Generator	03/29/2016	Annual	MY50141649
Agilent	N5182A /Signal Generator	05/13/2016	Annual	MY47070230
Agilent	N9030A / Signal Analyzer	11/30/2016	Annual	MY49431210
Weinschel	67-30-33 / Fixed Attenuator	02/16/2016	Annual	BR5347
Weinschel	1506A / Power Divider	02/15/2016	Annual	MD793
DEAYOUNG ENT	DFSS60 / AC Power Supply	04/06/2016	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	02/23/2016	Biennial	1513-175
Schwarzbeck	VULB 9168 / Hybrid Antenna	04/15/2015	Biennial	255
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	04/11/2016	Annual	4
Wainwright Instruments	WHK3.0/18G-10EF / Highpass Filter	06/24/2016	Annual	8
CERNEX	CBLU1183540 / Power Amplifier	02/01/2016	Annual	24614
CERNEX	CBL06185030 / Power Amplifier	02/01/2016	Annual	24615
CERNEX	CBL18265035 / Power Amplifier	07/11/2016	Annual	22966

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.

Test Procedures:

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

a) Connect a signal generator to the input of the EUT.

b) Configure to generate the AWGN (broadband) test signal.

c) The frequency of the signal generator shall be set to the frequency of (f0) as determined from 3.3.

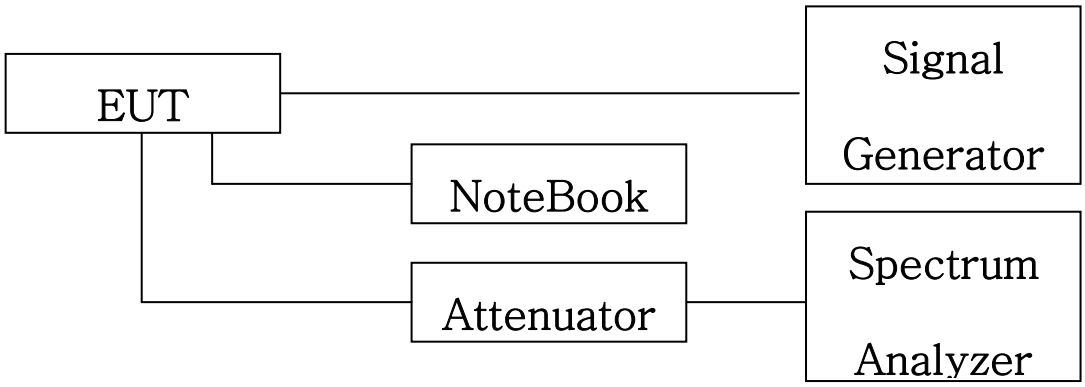
d) Connect a spectrum analyzer or power meter to the output of the EUT using appropriate attenuation as necessary.

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 the output power of the EUT and record (Power measurement with a spectrum analyzer).
g) Remove the EUT from the measurement setup and using the same signal generator settings, repeat the power measurement on the input signal to the EUT and record as input power.
h) Repeat the procedure with the narrowband test signal.
i) Repeat the procedure for both test signals with input signal amplitude set to 3 dB above the AGC threshold level.
j) Repeat 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(APCO25)	-57	-61	85	85
UHF(APCO25)	-48	-58	85	85
UHF(LMR450)	-58	-68	95	95

IC Rules

Test Requirements:

RSS-131

6.2 Output Power

The manufacturer's output power rating Prated MUST NOT be greater than Pmean for all types of enhancers.

Additional Power Back-off Condition for Multiple Carrier Operations:

An example of a single carrier operation is a band translator that incorporates an (IF) filter of a passband equal to one channel bandwidth. Another example of a single carrier operation is the use of an enhancer, before the connection to the antenna, to boost a low power transmitter (single carrier) to a higher power.

An example of a multiple carrier operation is the use of an enhancer to amplify off-air signals that contain the wanted carrier and two (or more) adjacent band carriers. If the enhancer passband is wide enough to pass more than the wanted channel bandwidth, the enhancer output stage will be loaded by the multiple carriers.

Examination: with 3 carrier signals (of assumed equal level), the peak voltage will be 3 times the single carrier voltage. The corresponding Peak Envelope Power (PEP) will be 3^2 times greater than a single carrier or 9/4 = 2.25 times greater than 2 tones PEP. Therefore the permissible wanted signal operating point has to be backed off by 3.5 dB (i.e. **Ppermissible = Prated - 3.5 dB**).

Note 1: All enhancers will be classified in the Radio Equipment List (REL) for a single carrier operation.

Note 2: For a multiple carrier operation, the rating must be reduced by 3.5 dB or more.

Note 3: If there are more than 3 carriers present at the amplifier input point, greater power back-off may be required. This can be examined on a case-by-case basis.

Test Procedures:

RSS-131

4.3.1 Multi-channel Enhancer

The following subscript "o" denotes a parameter at the enhancer output point.

Connect two signal generators to the input of the Device Under Test (DUT), via a proper impedance matching network (and preferably via a variable attenuator) so that the two input signals are equal sinusoids (and can be raised equally).

Connect a dummy load of suitable load rating to the enhancer output point. Connect also a spectrum analyser to this output point via a coupling network and attenuator, so that only a portion of the output signal is coupled to the spectrum analyser. The coupling attenuation shall be stated in the test report.

Set the two generator frequencies f1 and f2 such that they and their third-order intermodulation

product frequencies, f3= 2f1-f2 and f4 = 2f2 - f1, are all within the passband of the DUT.
Raise the input level to the DUT while observing the output tone levels, Po1 and Po2, and the intermodulation product levels, Po3 and Po4.

For enhancers rated 500 watts or less: Raise the input level to the DUT until the greater level of the intermodulation products at the enhancer output terminals, Po3 or Po4, equals -43 dBW.

For enhancers rated over 500 watts: Raise the input level to the DUT until the greater level of the intermodulation products at the enhancer output terminals, Po3 or Po4, is 67 dB below the level of either output tone level, Po1 or Po2.

Record all signal levels and their frequencies. Calculate the mean output power (Pmean) under this testing condition using Pmean = Po1 + 3 dB.

4.3.2 Single Channel Enhancer

A suitably modulated signal, representative of the technology for which certification is sought, is applied to the input of the amplifier. The input power level is increased until the manufacturer's rated input power level is achieved or until a 2 dB increase in input level results in a 1 dB increase in output level (i.e. compression begins). Record the output power in the 99% emission bandwidth using any suitable means.

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]

	Frequency (MHz)	Output Power	
		(dBm)	(W)
VHF(APCO25) _ AGC threshold	138.5	29.69	0.931
	150.5	29.62	0.916
	162.0	29.58	0.908
	173.5	29.64	0.920
VHF(APCO25) _ +3dB above AGC threshold	138.5	29.59	0.910
	150.5	29.51	0.893
	162.0	29.50	0.891
	173.5	29.55	0.902
UHF(APCO25)_ AGC threshold	406.6	37.55	5.689
	429.5	37.61	5.768
	450.5	37.55	5.689
	469.5	37.49	5.610
UHF(APCO25)_ +3dB above AGC threshold	406.6	37.29	5.358
	429.5	37.47	5.585
	450.5	37.44	5.546
	469.5	37.34	5.420

	Frequency (MHz)	Output Power	
		(dBm)	(W)
UHF(LMR450)_ AGC threshold	450.5	37.19	5.236
	469.5	37.33	5.408
	470.5	37.32	5.395
	491.0	37.13	5.164
	511.5	37.10	5.129
UHF(LMR450)_ +3dB above AGC threshold	450.5	37.28	5.346
	469.5	37.11	5.140
	470.5	37.13	5.164
	491.0	37.05	5.070
	511.5	37.14	5.176

[Uplink]

	Frequency (MHz)	Output Power	
		(dBm)	(W)
VHF(APCO25) _ AGC threshold	138.5	25.91	0.390
	150.5	25.80	0.380
	162.0	25.59	0.362
	173.5	25.59	0.362
VHF(APCO25) _ +3dB above AGC threshold	138.5	26.32	0.429
	150.5	26.17	0.414
	162.0	26.17	0.414
	173.5	25.97	0.395
UHF(APCO25)_ AGC threshold	406.6	27.95	0.624
	429.5	27.74	0.594
	450.5	27.78	0.600
	469.5	27.72	0.592
UHF(APCO25)_ +3dB above AGC threshold	406.6	28.00	0.631
	429.5	27.77	0.598
	450.5	27.74	0.594
	469.5	27.61	0.577

	Frequency (MHz)	Output Power	
		(dBm)	(W)
UHF(LMR450)_ AGC threshold	450.5	27.70	0.589
	469.5	27.45	0.556
	470.5	27.39	0.548
	491.0	27.24	0.530
	511.5	27.20	0.525
UHF(LMR450)_ +3dB above AGC threshold	450.5	27.81	0.604
	469.5	27.47	0.558
	470.5	27.52	0.565
	491.0	27.12	0.515
	511.5	27.06	0.508

Multi-channel Enhancer for IC

* Due to EUT's ALC function (Auto Level Control), even if input signal is increased,

The same output power is transmit.

[Downlink]

	Frequency (MHz)	Output Power	
		Po1(dBm)	Pmean(dBm)
VHF(APCO25) _ AGC threshold	138.5	26.509	29.509
	150.5	26.509	29.509
	162.0	26.507	29.507
	173.5	26.512	29.512
UHF(APCO25)_ AGC threshold	406.6	34.071	37.071
	429.5	34.044	37.044
	450.5	34.067	37.067
	469.5	34.046	37.046
UHF(LMR450)_ AGC threshold	450.5	34.040	37.040
	469.5	34.110	37.110
	470.5	34.095	37.095
	491.0	34.098	37.098
	511.5	34.207	37.207

[Uplink]

	Frequency (MHz)	Output Power	
		Po1(dBm)	Pmean(dBm)
VHF(APCO25)_ AGC threshold	138.5	22.587	25.587
	150.5	22.573	25.573
	162.0	22.586	25.586
	173.5	22.561	25.561
UHF(APCO25)_ AGC threshold	406.6	24.049	27.049
	429.5	24.055	27.055
	450.5	24.095	27.095
	469.5	24.171	27.171
UHF(LMR450)_ AGC threshold	450.5	24.098	27.098
	469.5	24.049	27.049
	470.5	24.058	27.058
	491.0	24.071	27.071
	511.5	24.070	27.070

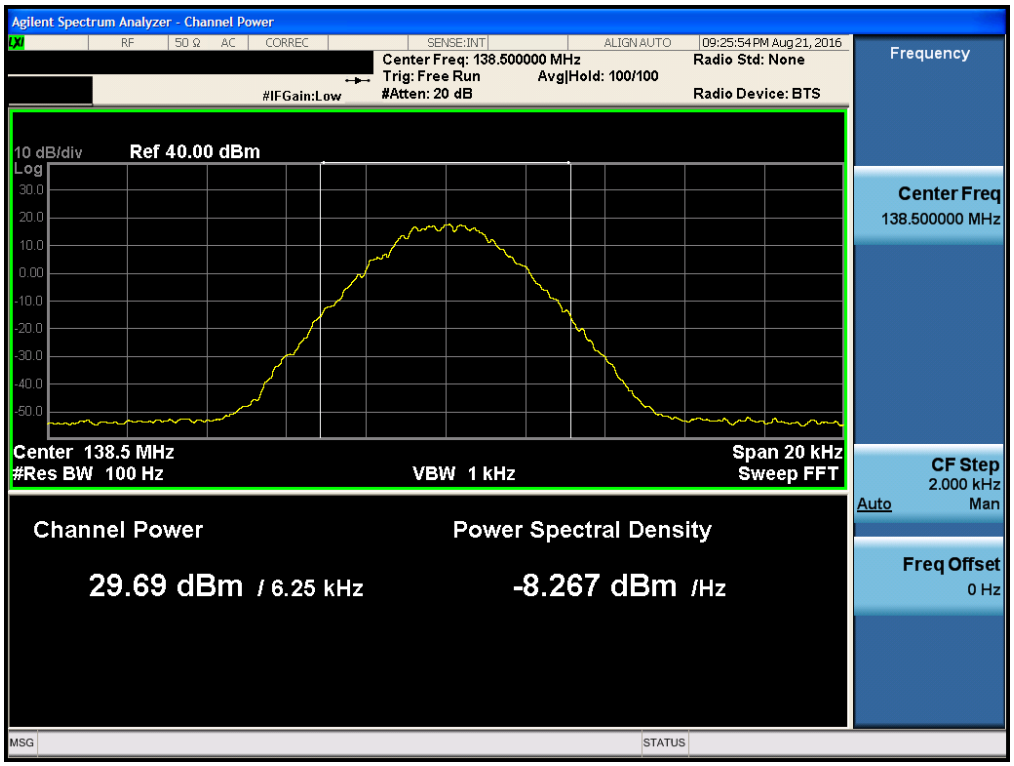
Additional Power Back-off Condition for Multiple Carrier Operations for IC

* This device operates at each of selected channel. Selected channel bandwidth is too narrow to test this section.

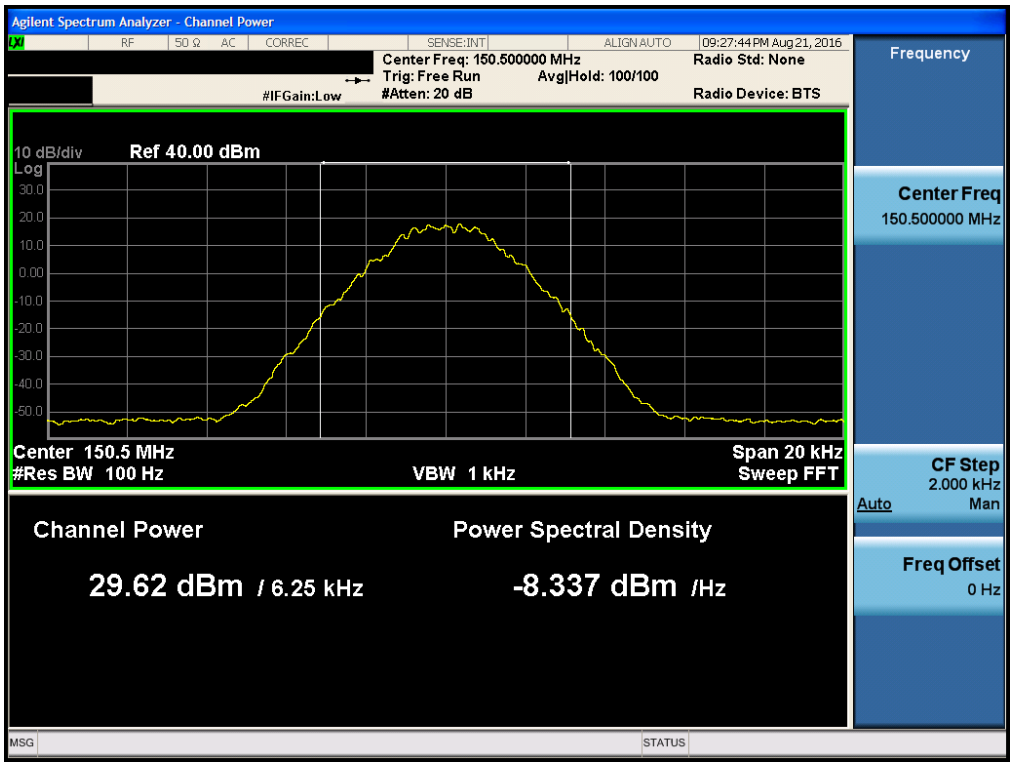
Single channel Enhancer Plots of RF Output Power

VHF(APCO25) DL

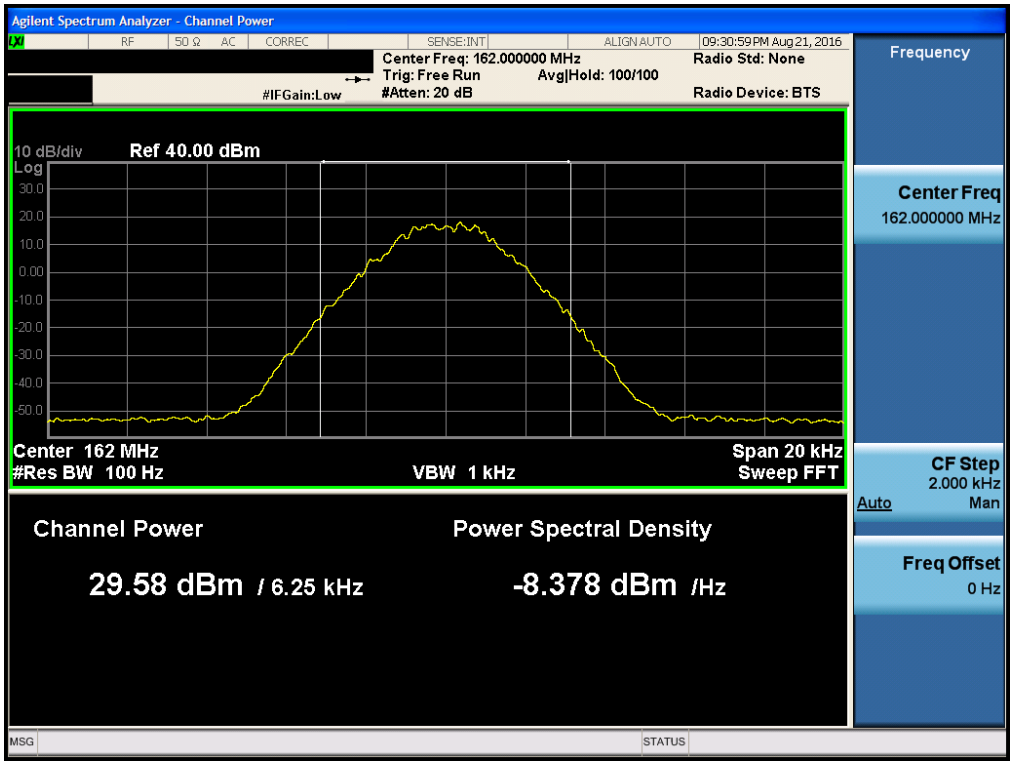
[VHF(APCO25) AGC threshold Downlink 138.5 MHz]



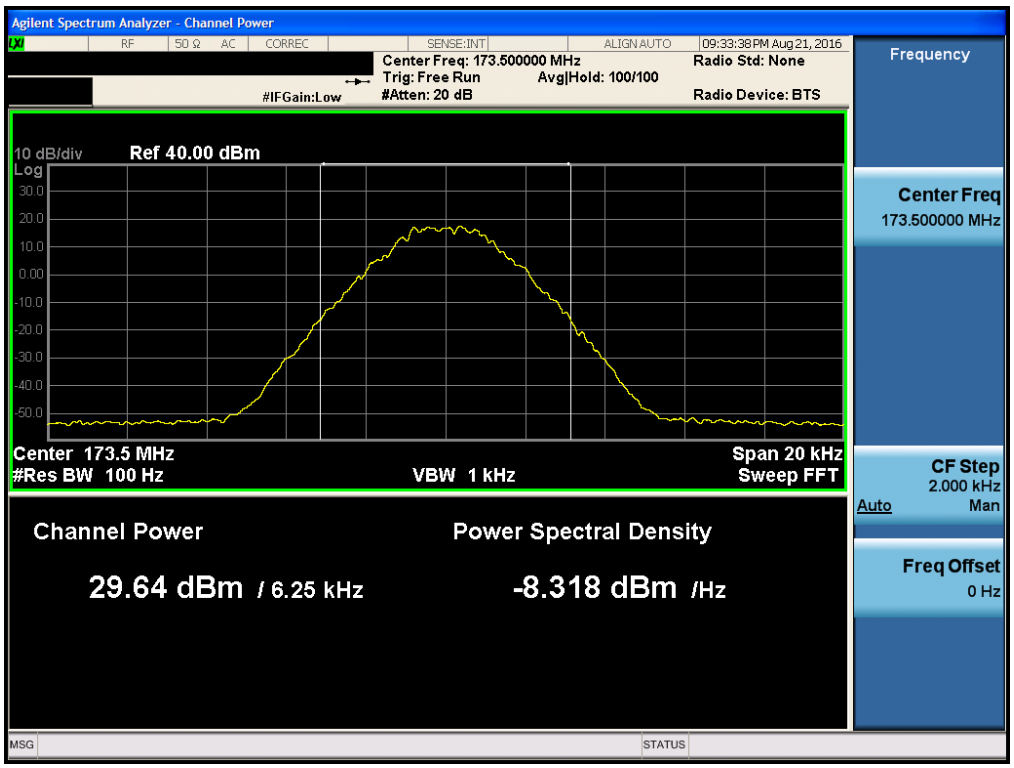
[VHF(APCO25) AGC threshold Downlink 150.5 MHz]



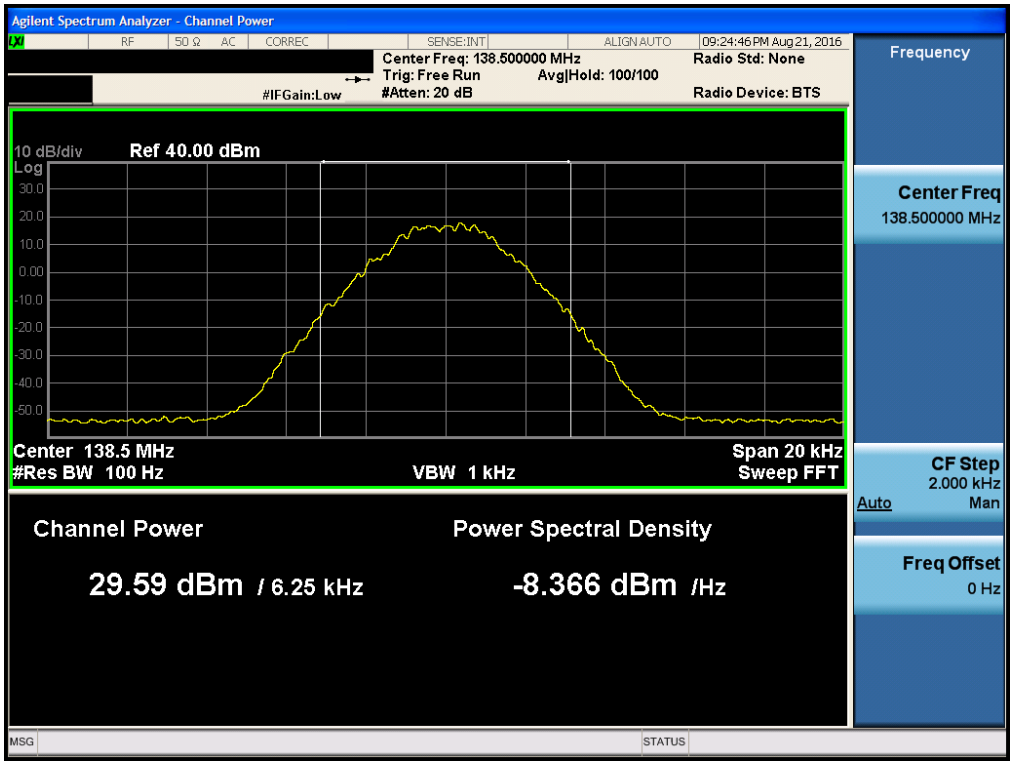
[VHF(APCO25) AGC threshold Downlink 162.0 MHz]



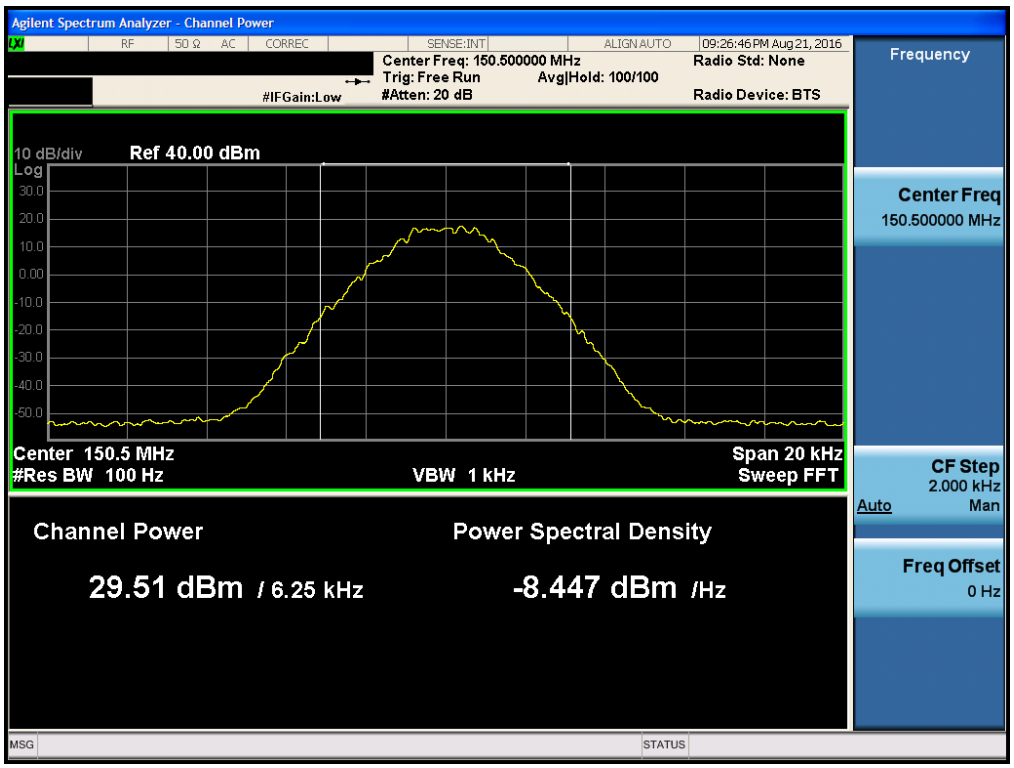
[VHF(APCO25) AGC threshold Downlink 173.5 MHz]



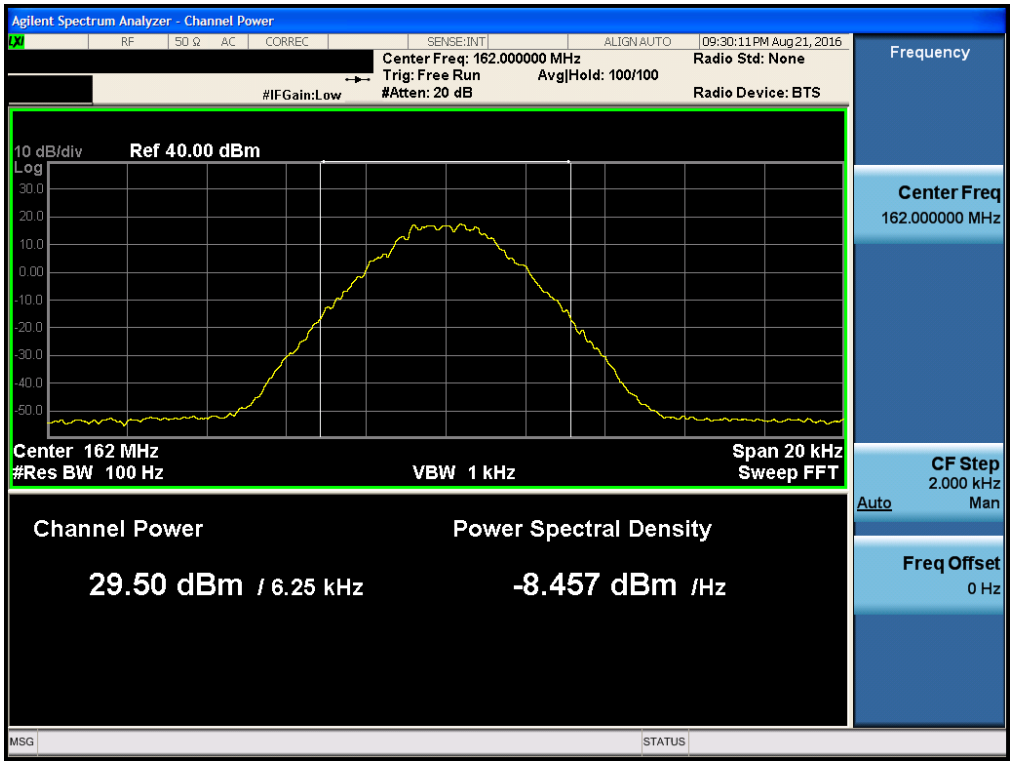
[VHF(APCO25) +3dB above the AGC threshold Downlink 138.5 MHz]



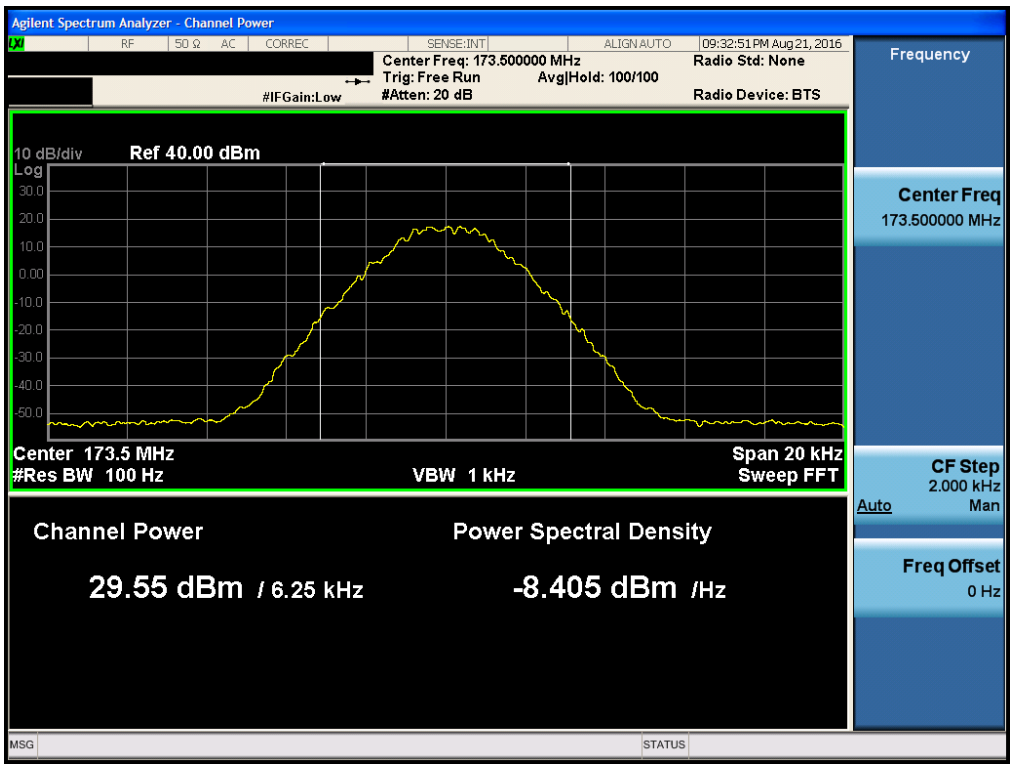
[VHF(APCO25) +3dB above the AGC threshold Downlink 150.5 MHz]



[VHF(APCO25) +3dB above the AGC threshold Downlink 162.0 MHz]

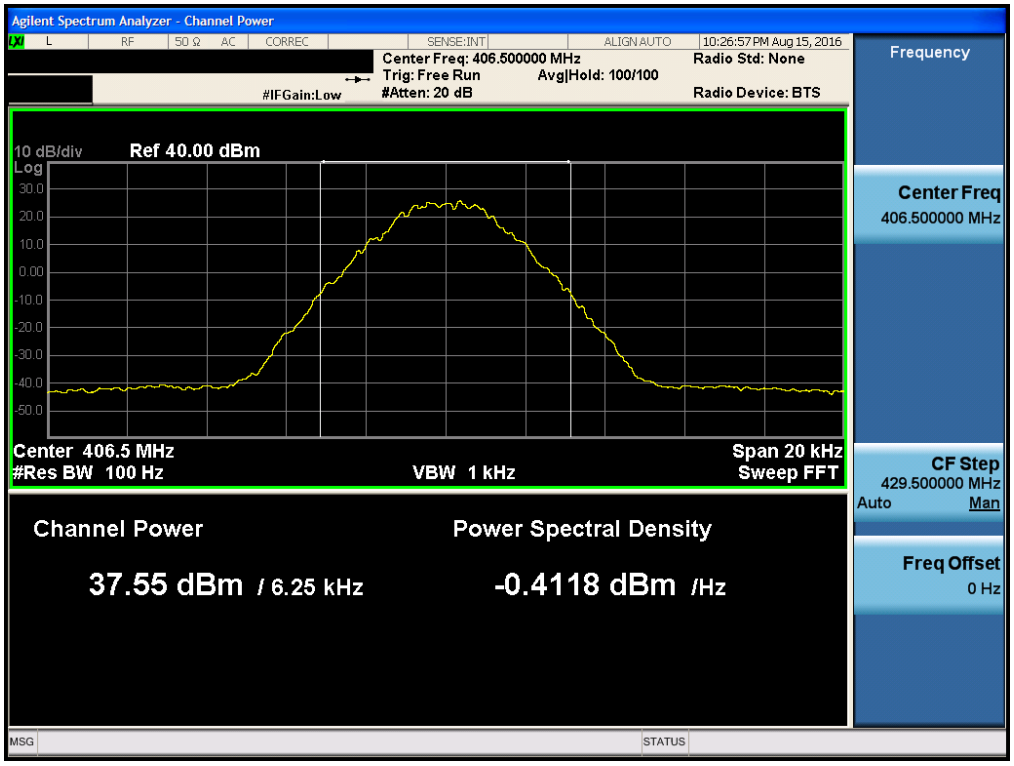


[VHF(APCO25) +3dB above the AGC threshold Downlink 173.5 MHz]

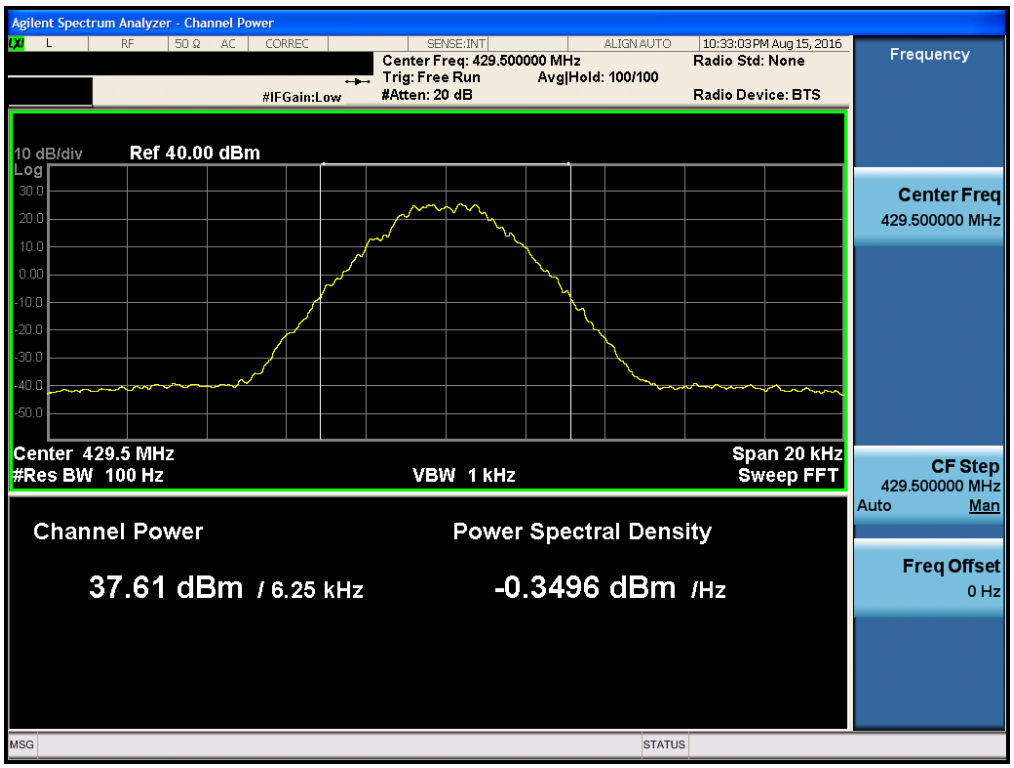


UHF(APCO25) DL

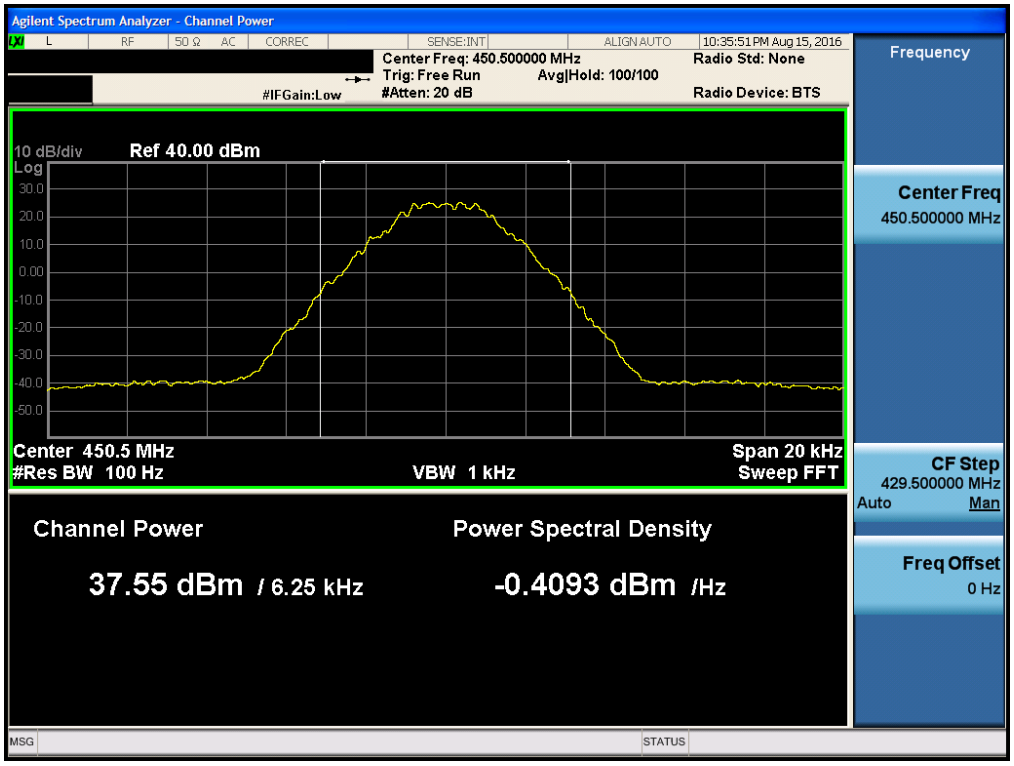
[UHF(APCO25) AGC threshold Downlink 406.6 MHz]



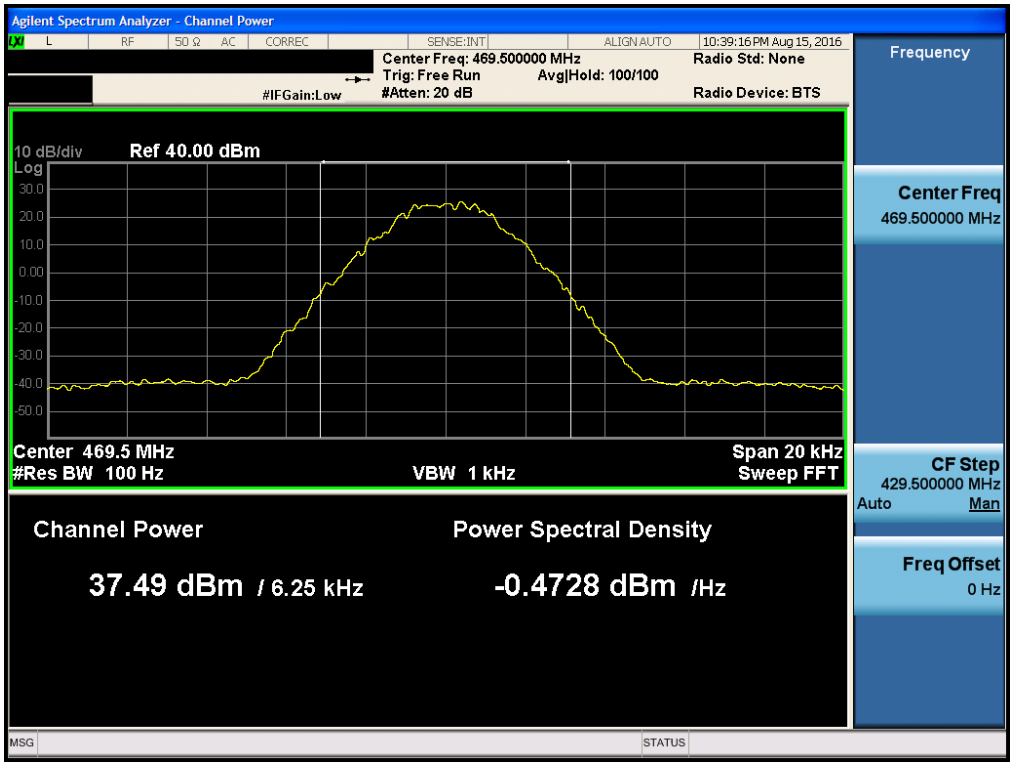
[UHF(APCO25) AGC threshold Downlink 429.5 MHz]



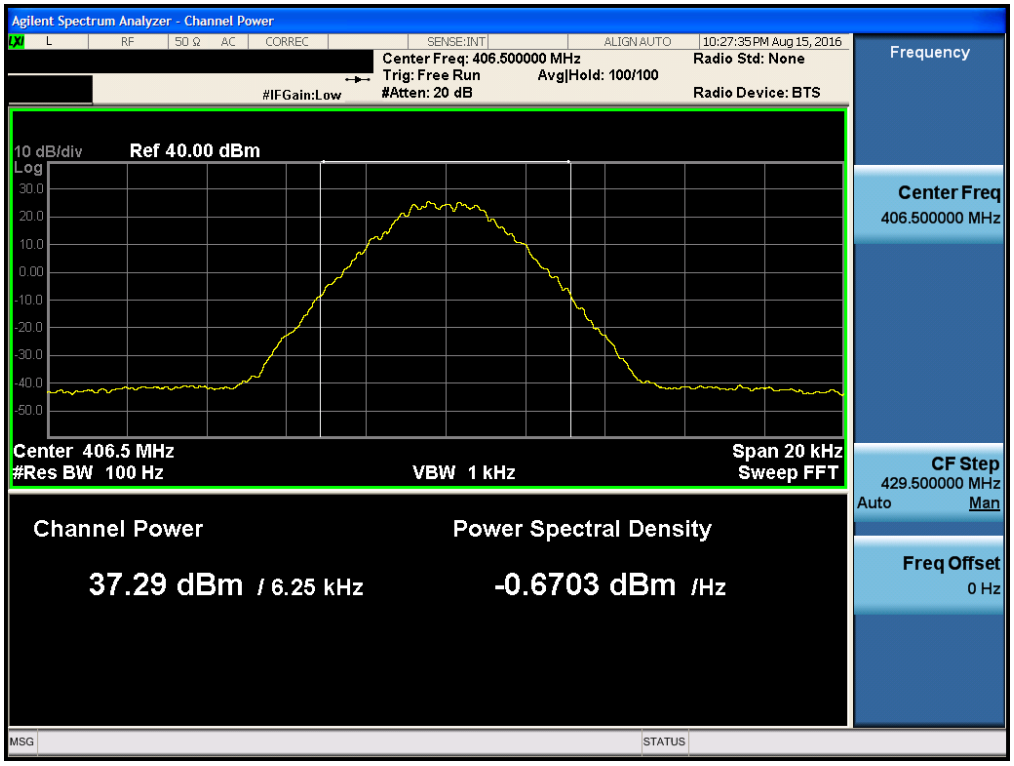
[UHF(APCO25) AGC threshold Downlink 450.5 MHz]



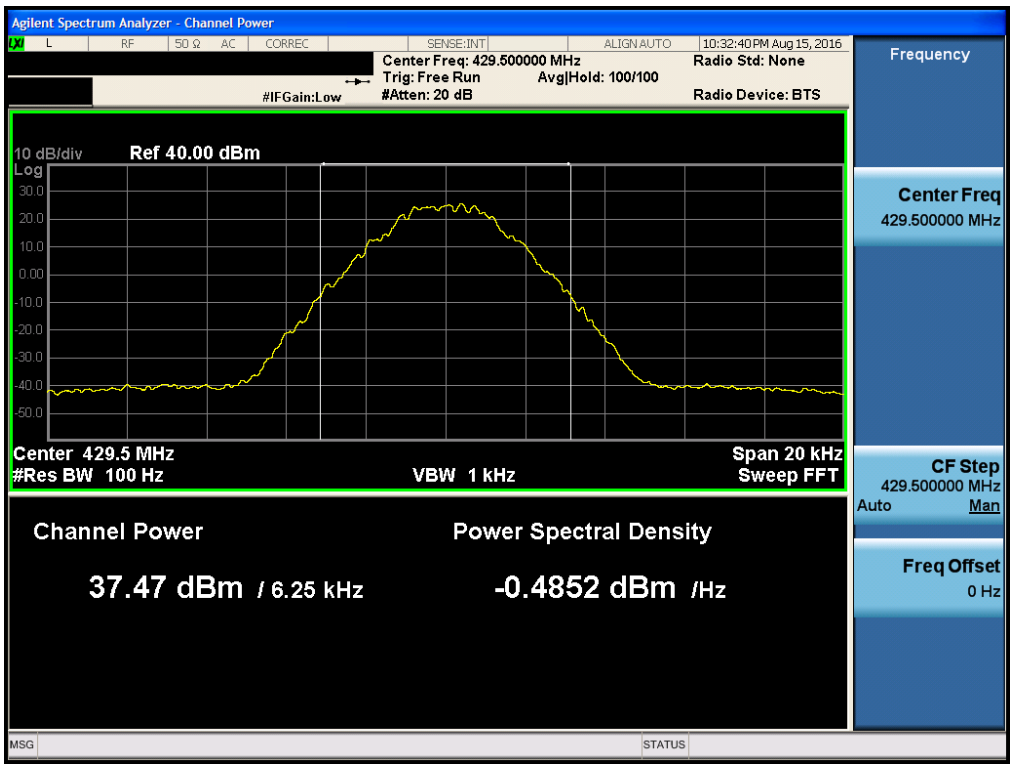
[UHF(APCO25) AGC threshold Downlink 469.5 MHz]



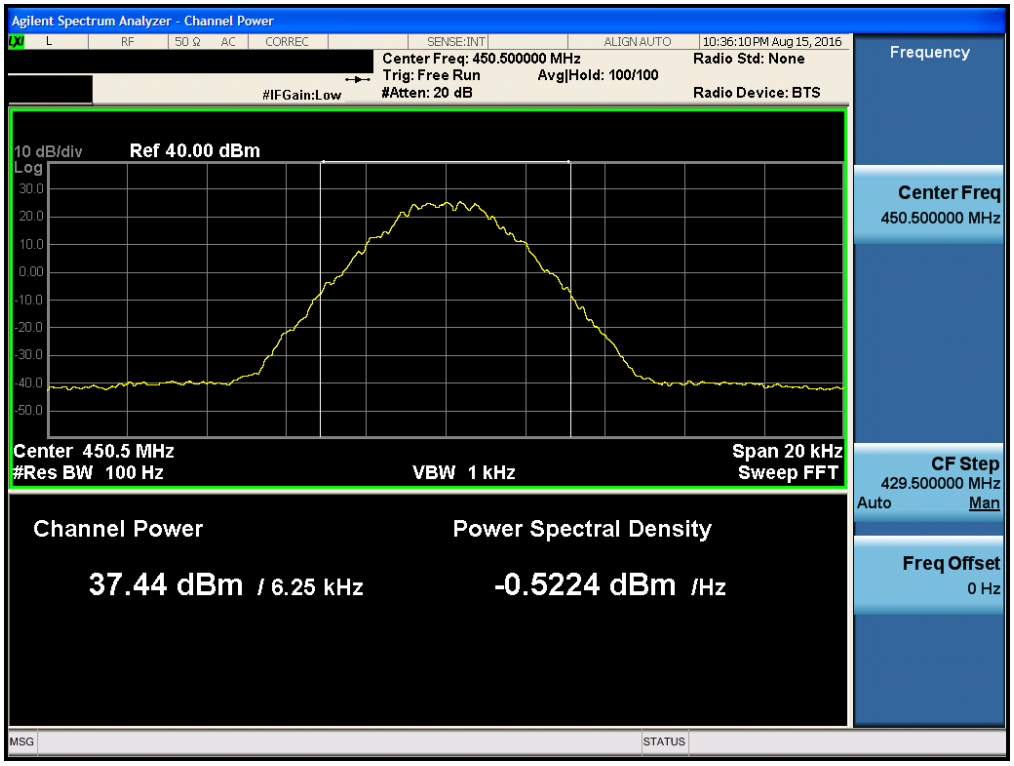
[UHF(APCO25) +3dB above the AGC threshold Downlink 406.6 MHz]



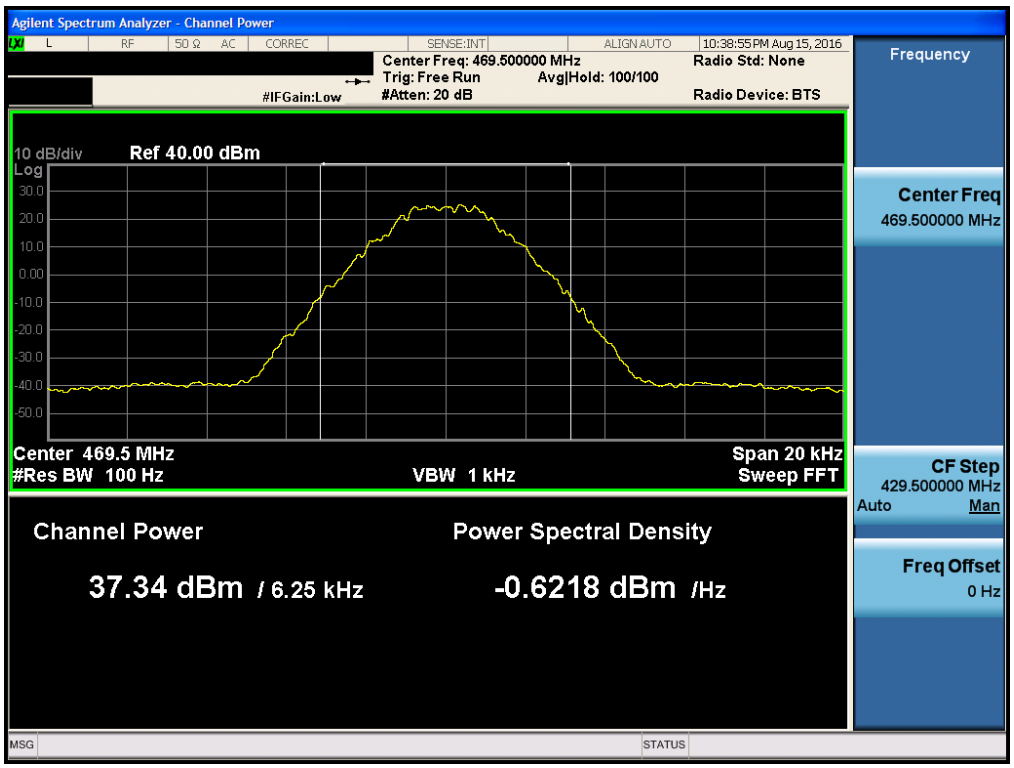
[UHF(APCO25) +3dB above the AGC threshold Downlink 429.5 MHz]



[UHF(APCO25) +3dB above the AGC threshold Downlink 450.5 MHz]

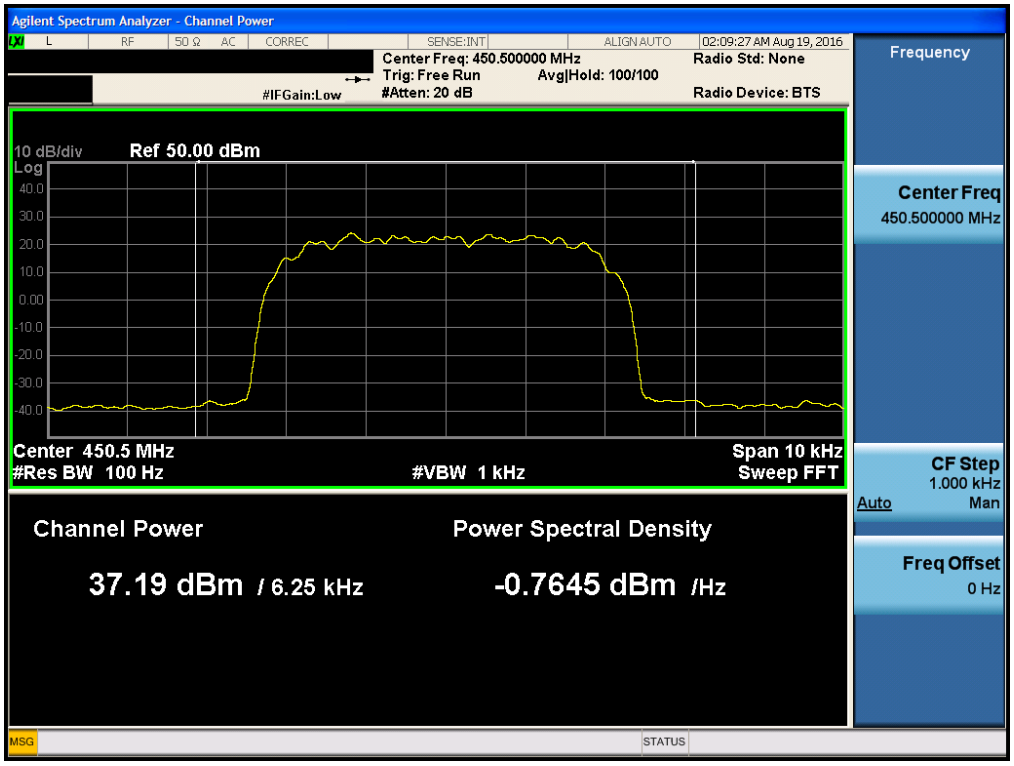


[UHF(APCO25) +3dB above the AGC threshold Downlink 469.5 MHz]

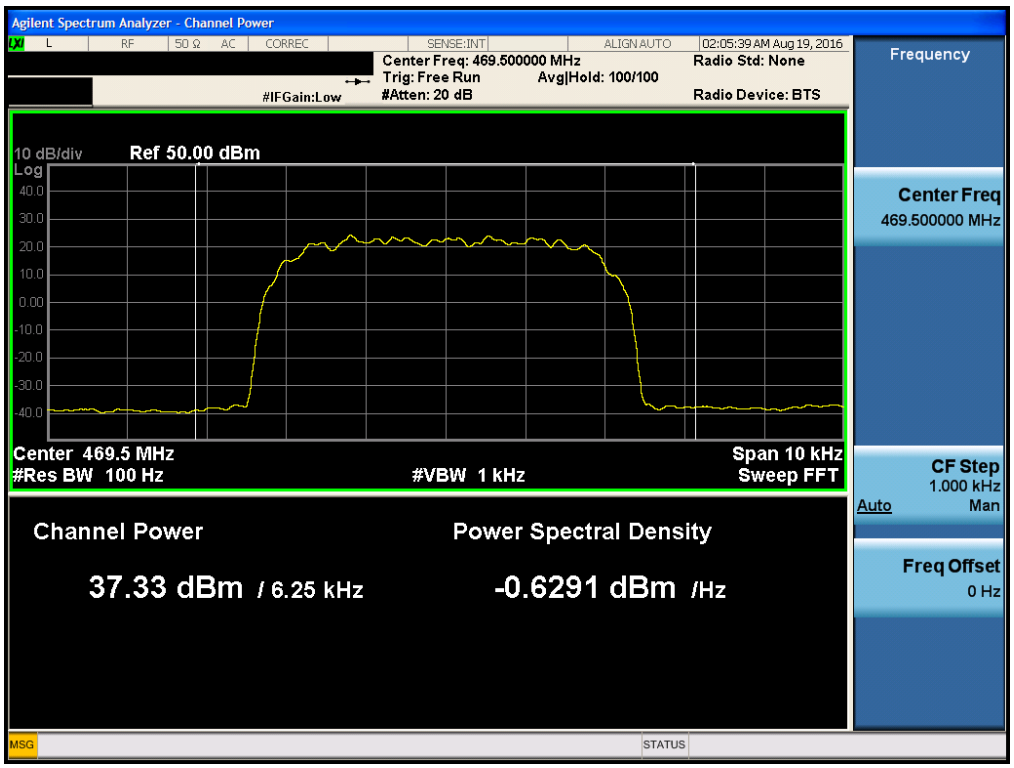


UHF(LMR450) DL

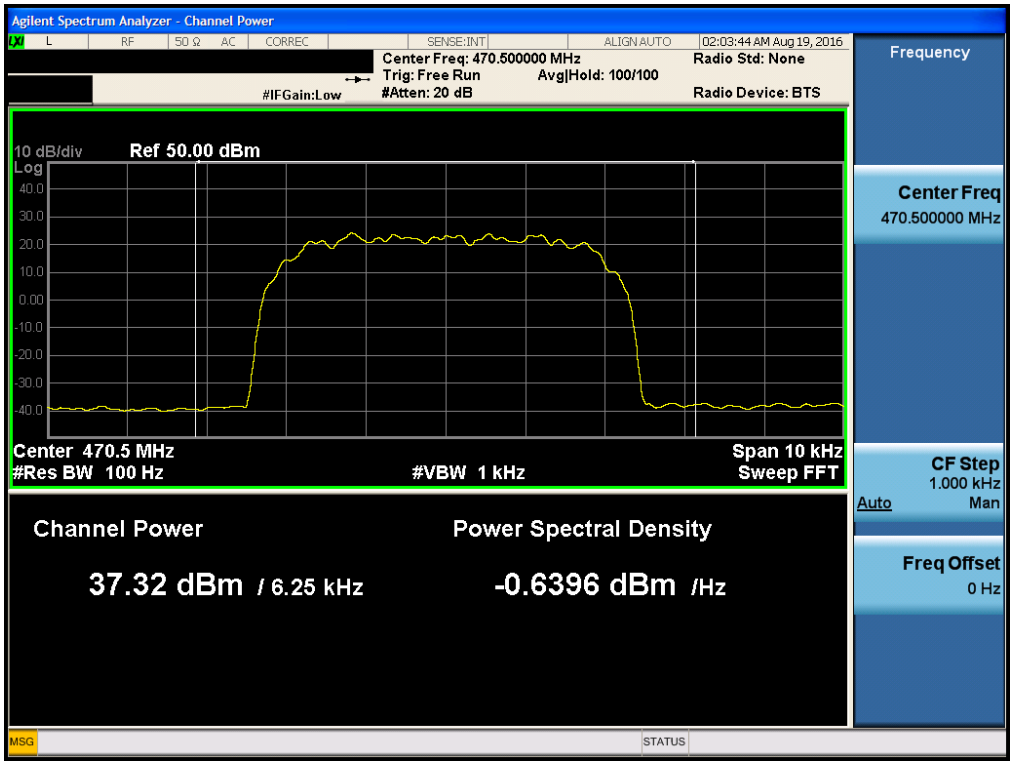
[UHF(LMR450) AGC threshold Downlink 450.5 MHz]



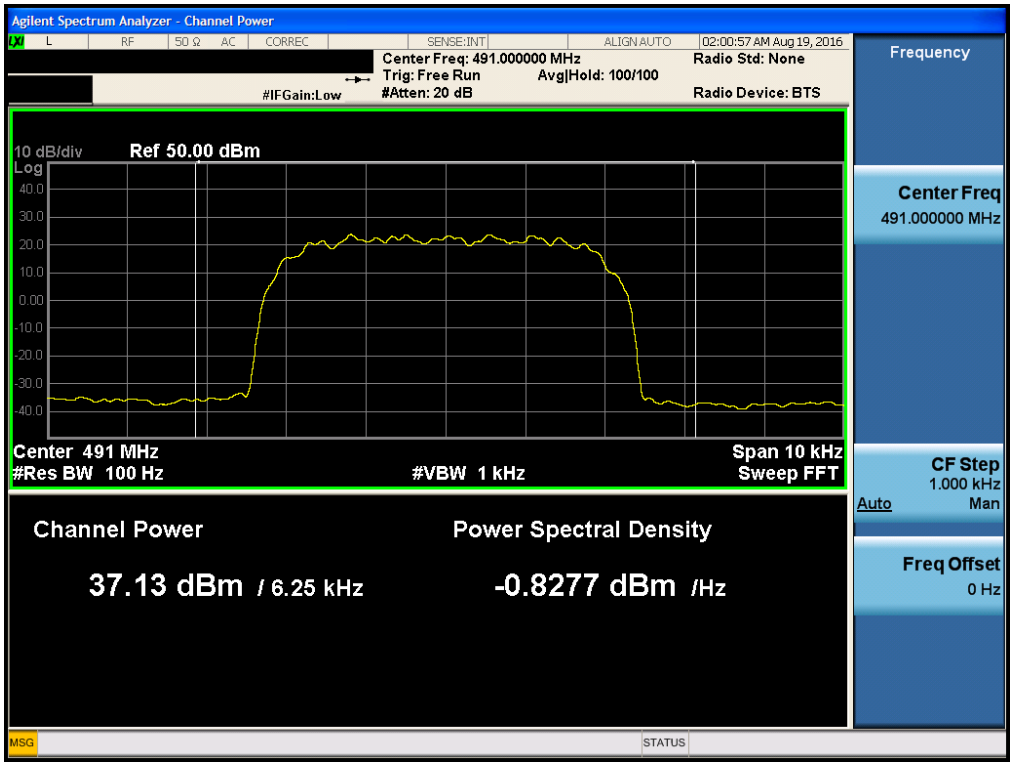
[UHF(LMR450) AGC threshold Downlink 469.5 MHz]



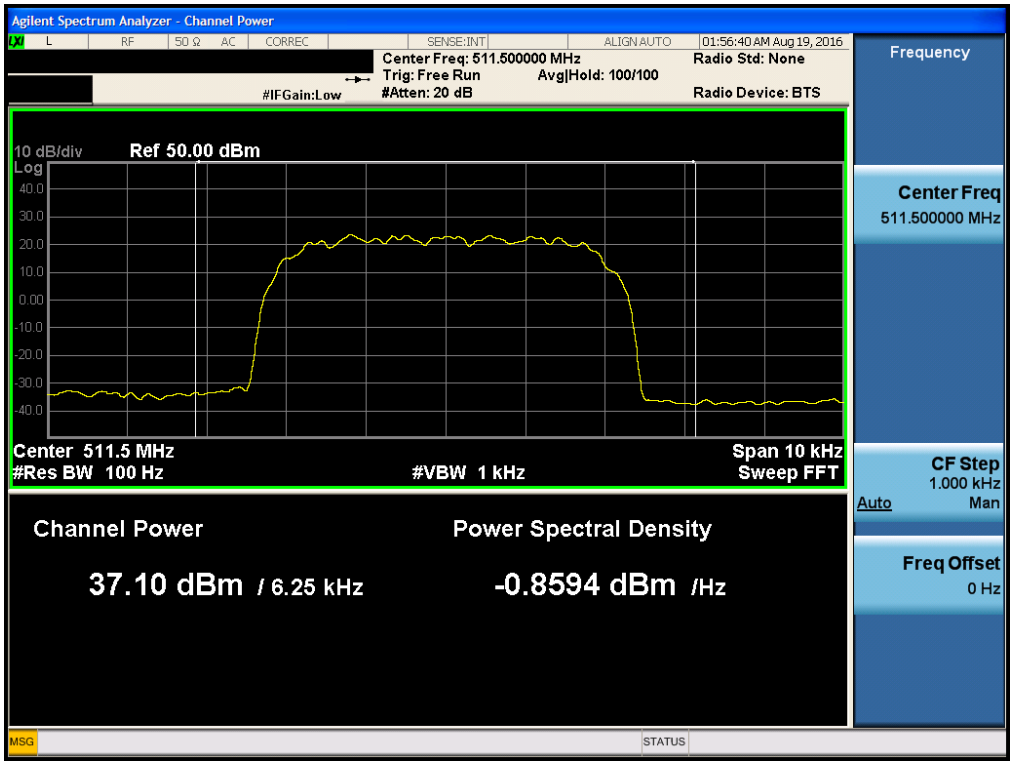
[UHF(LMR450) AGC threshold Downlink 470.5 MHz]



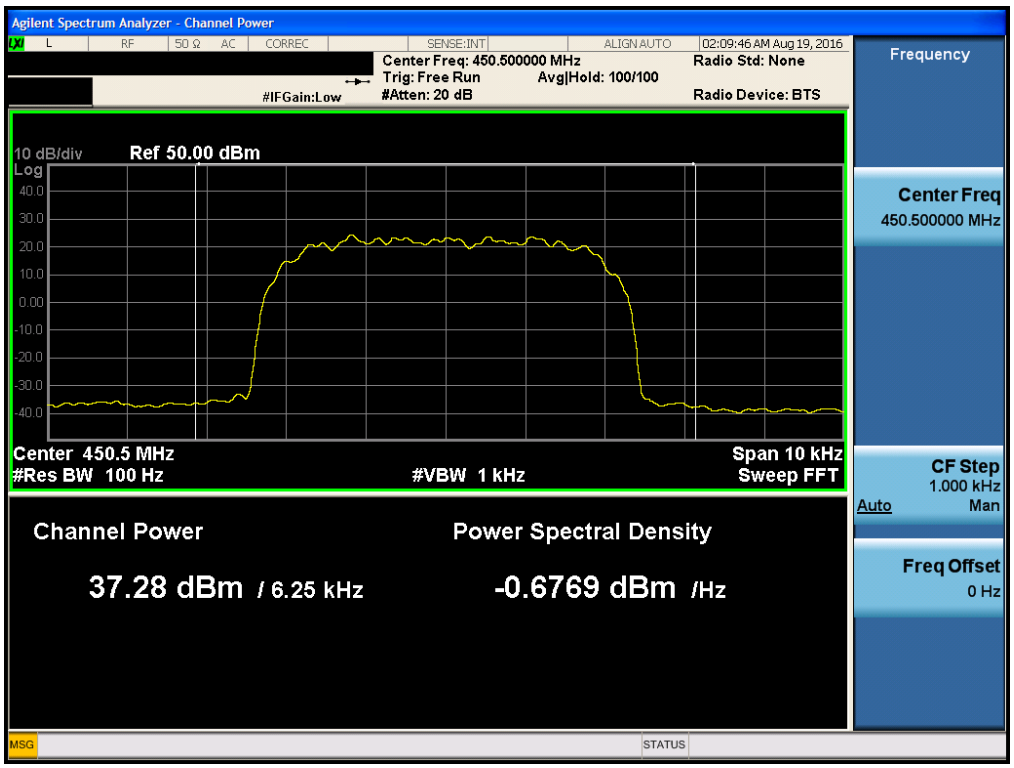
[UHF(LMR450) AGC threshold Downlink 491.0 MHz]



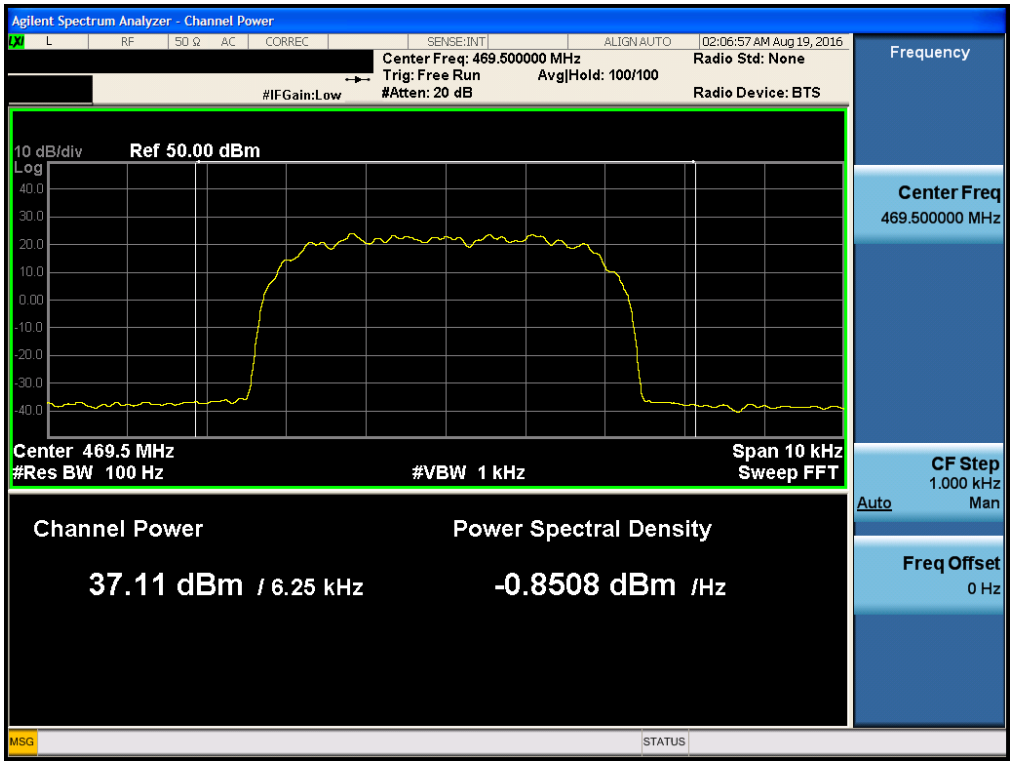
[UHF(LMR450) AGC threshold Downlink 511.5 MHz]



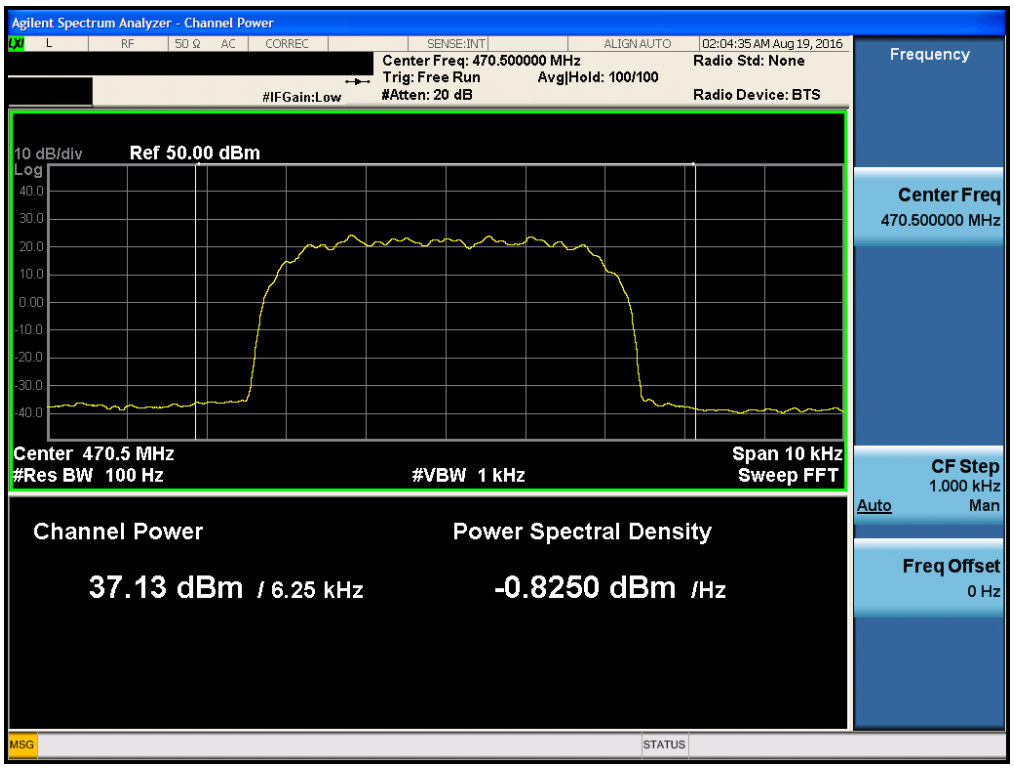
[UHF(LMR450) +3dB above the AGC threshold Downlink 450.5 MHz]



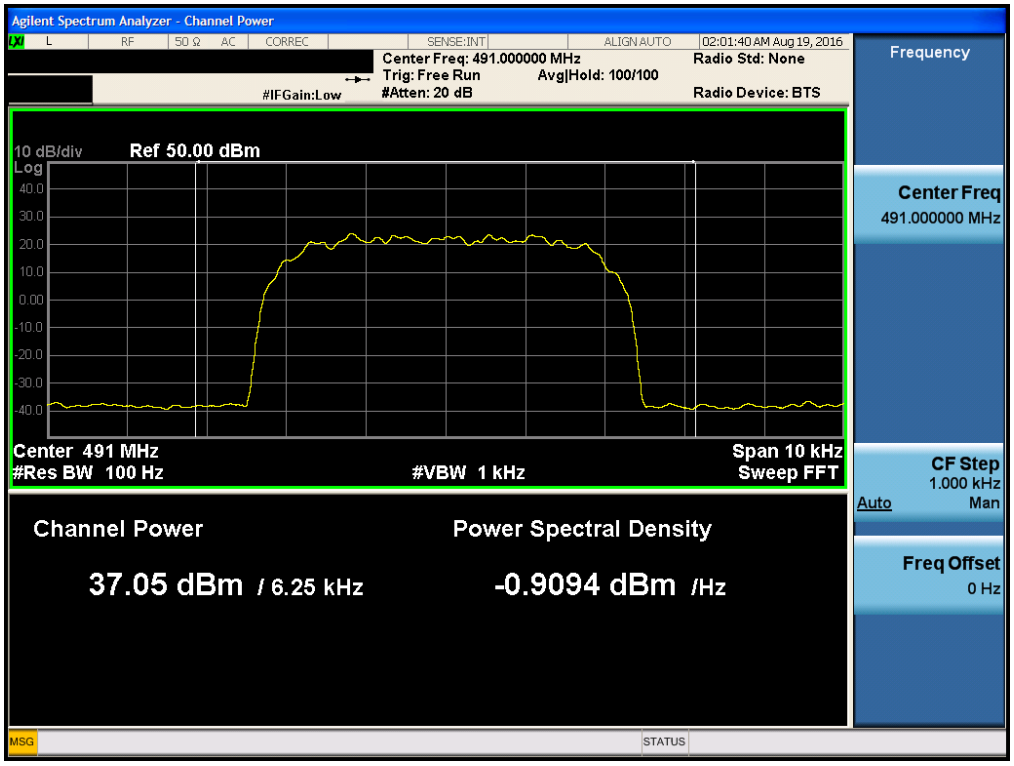
[UHF(LMR450) +3dB above the AGC threshold Downlink 469.5 MHz]



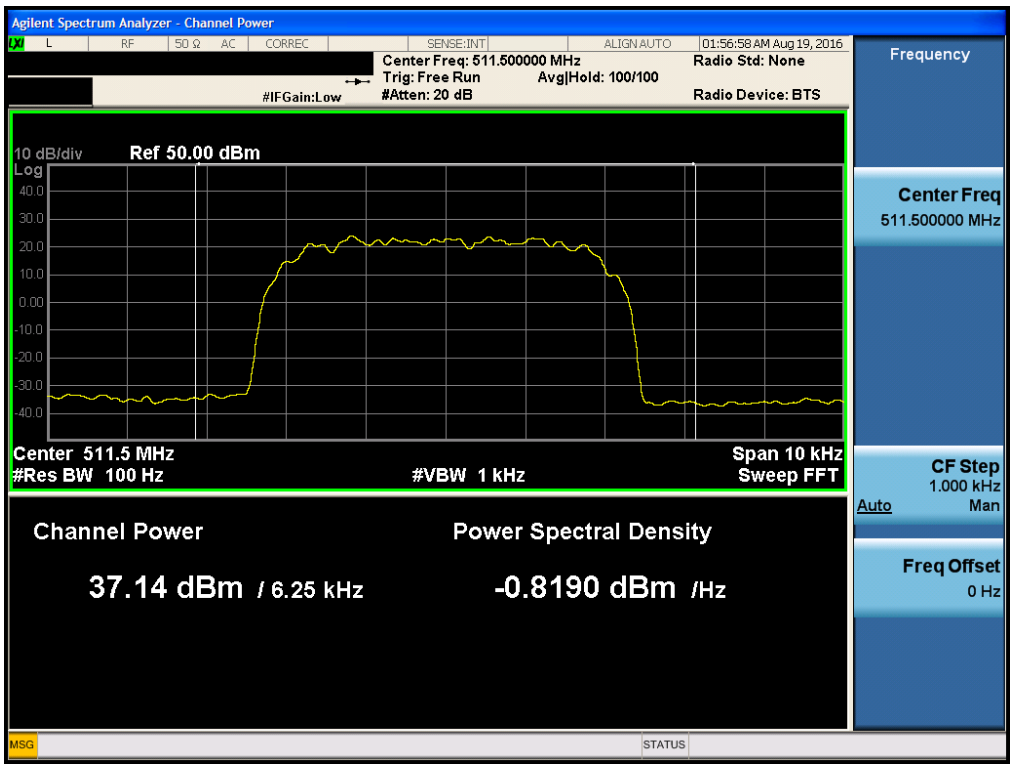
[UHF(LMR450) +3dB above the AGC threshold Downlink 470.5 MHz]



[UHF(LMR450) +3dB above the AGC threshold Downlink 491.0 MHz]

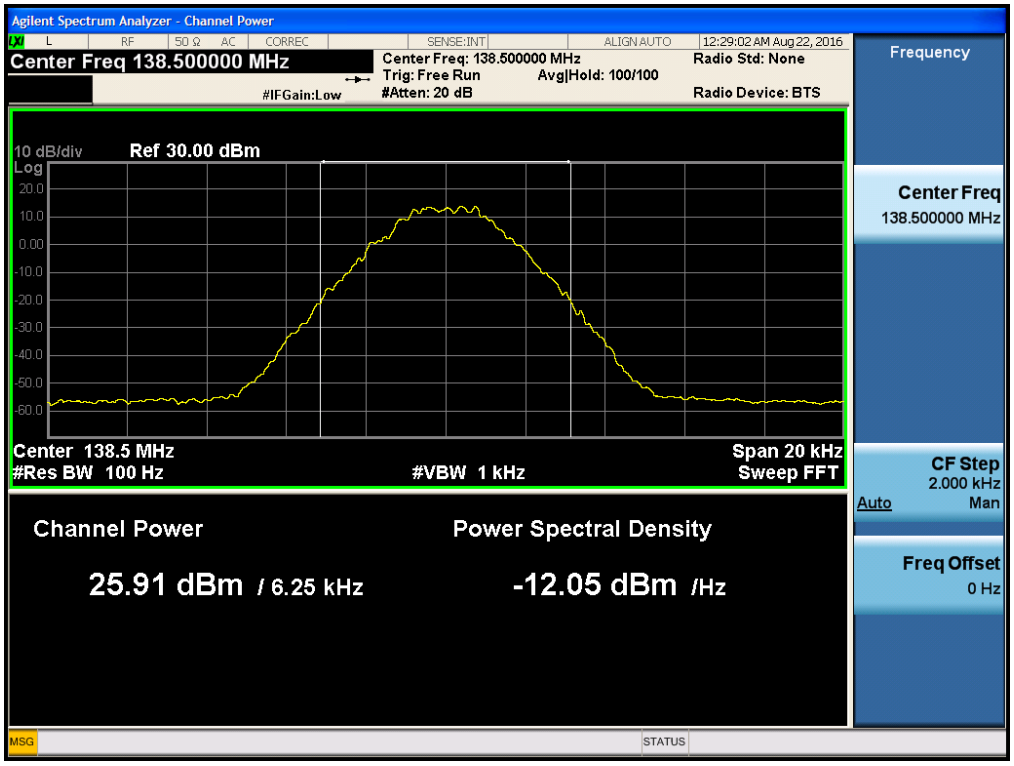


[UHF(LMR450) +3dB above the AGC threshold Downlink 511.5 MHz]

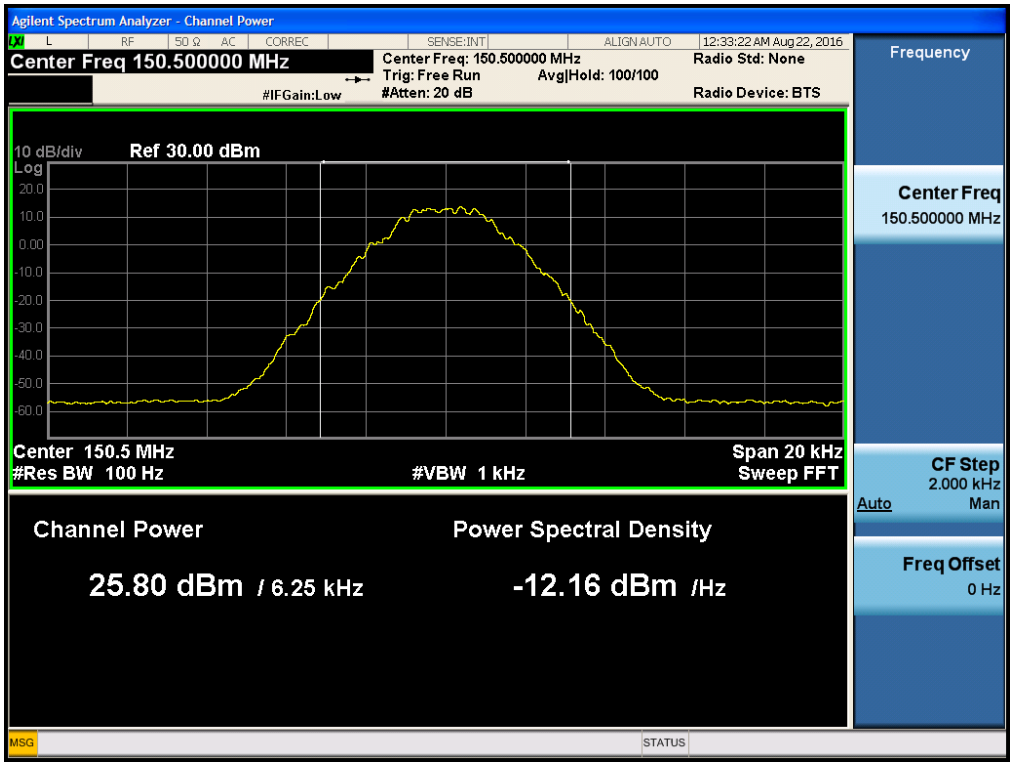


VHF(APCO25) UL

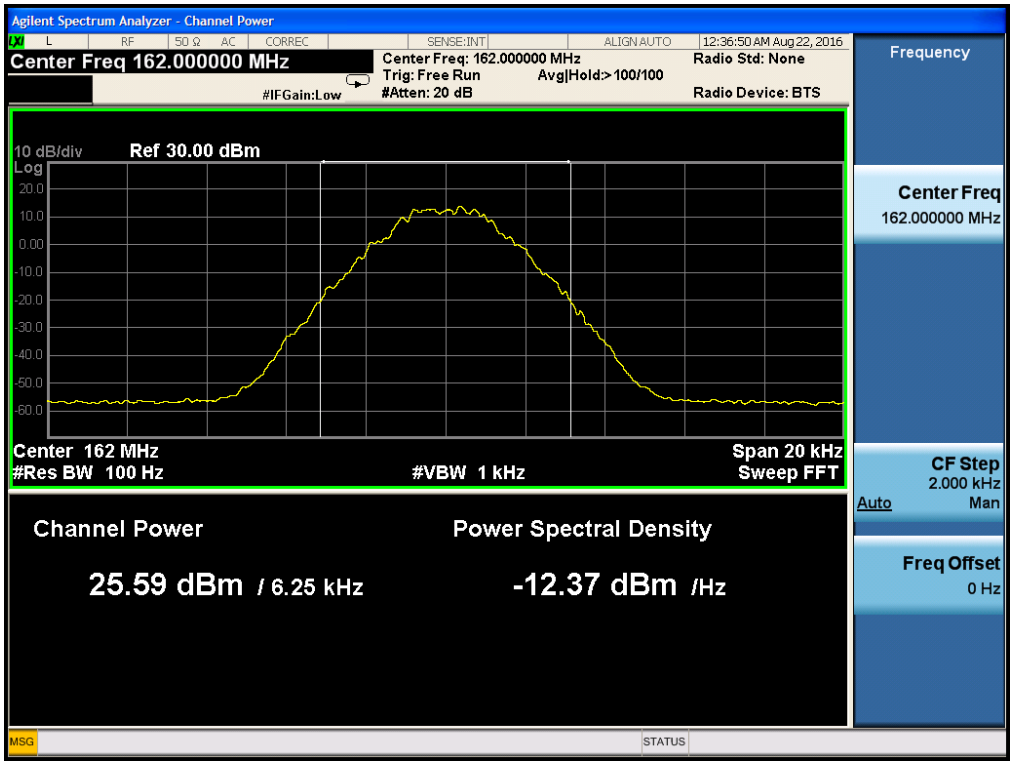
[VHF(APCO25) AGC threshold Uplink 138.5 MHz]



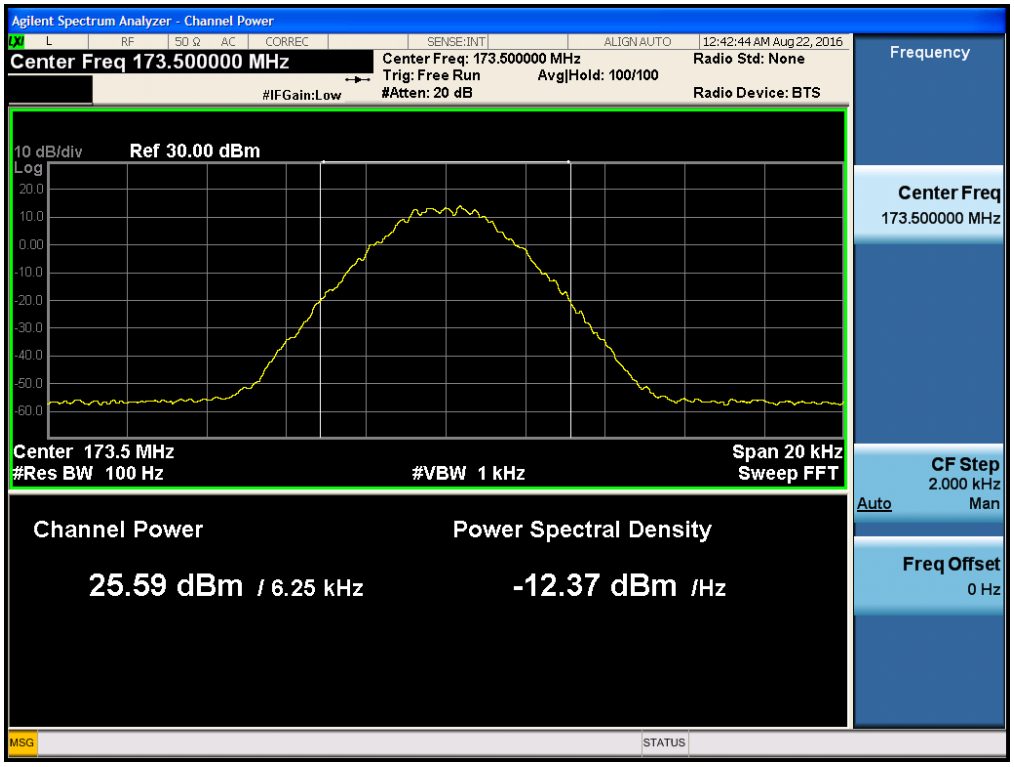
[VHF(APCO25) AGC threshold Uplink 150.5 MHz]



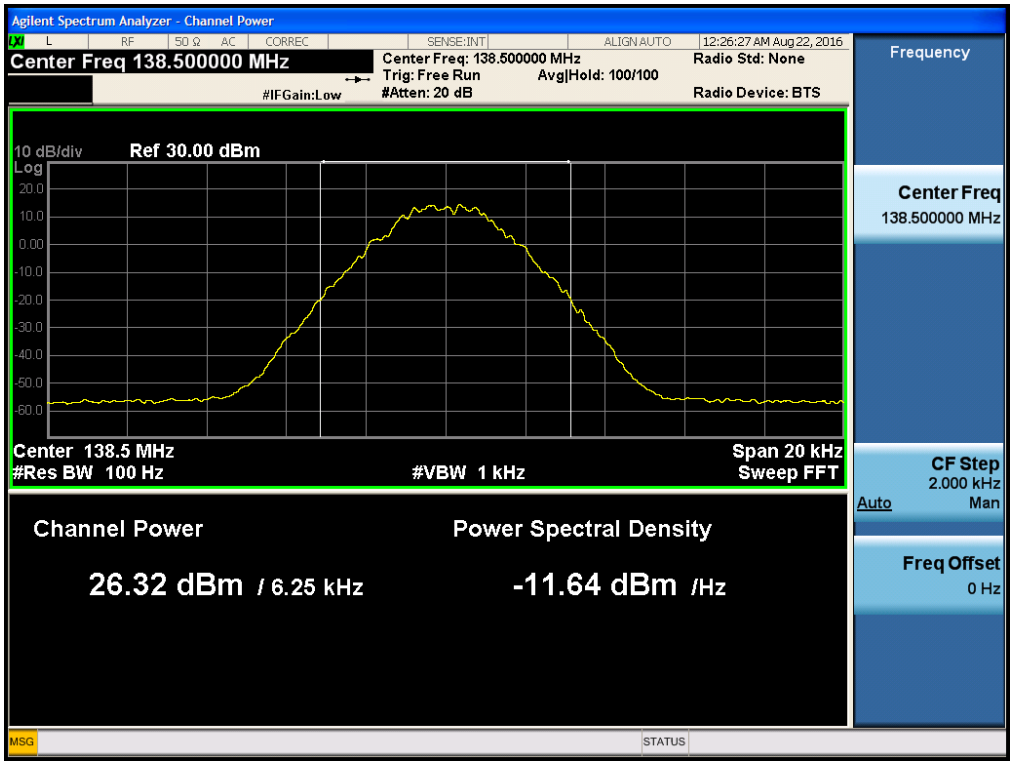
[VHF(APCO25) AGC threshold Uplink 162.0 MHz]



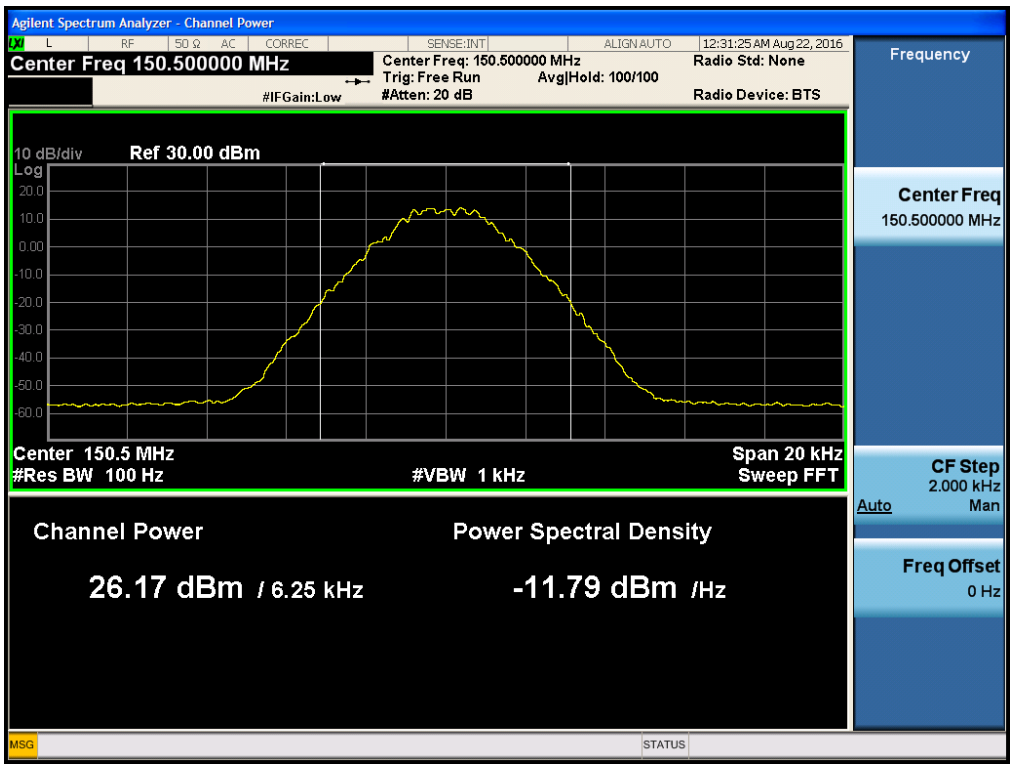
[VHF(APCO25) AGC threshold Uplink 173.5 MHz]



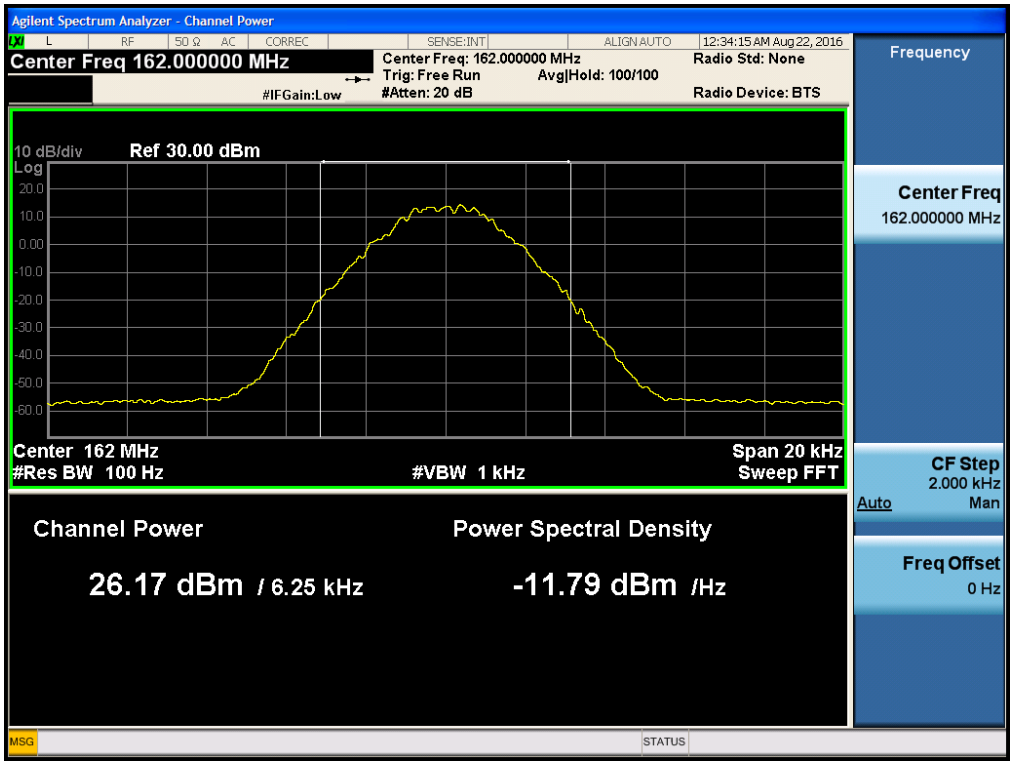
[VHF(APCO25) +3dB above the AGC threshold Uplink 138.5 MHz]



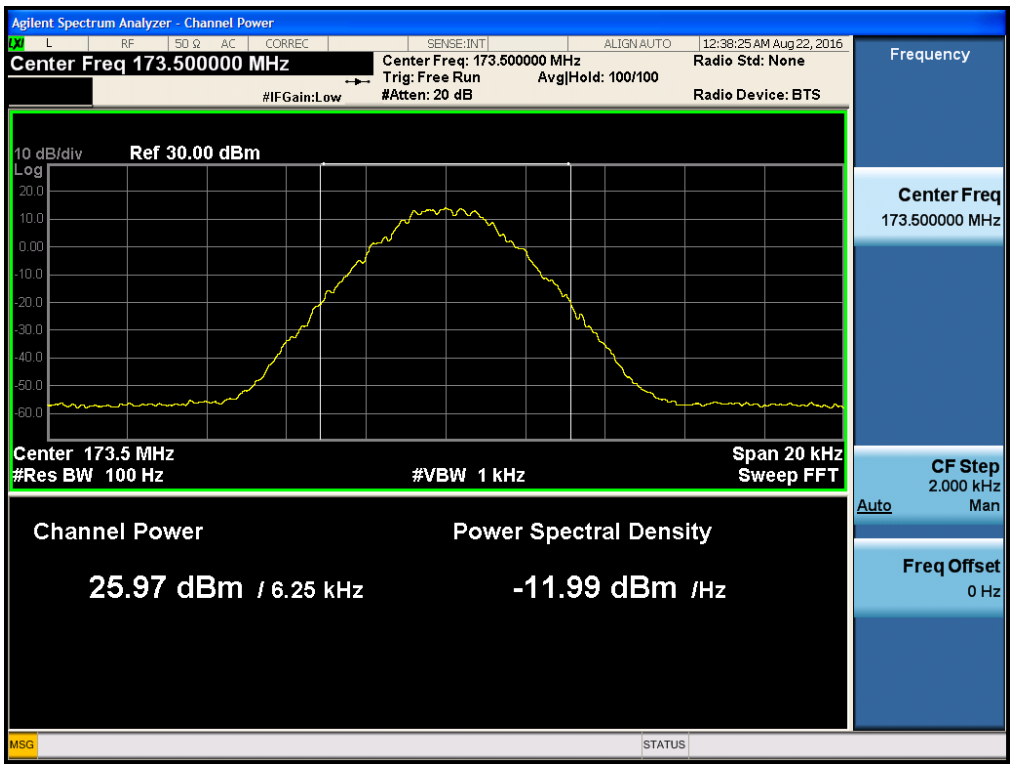
[VHF(APCO25) +3dB above the AGC threshold Uplink 150.5 MHz]



[VHF(APCO25) +3dB above the AGC threshold Uplink 162.0 MHz]

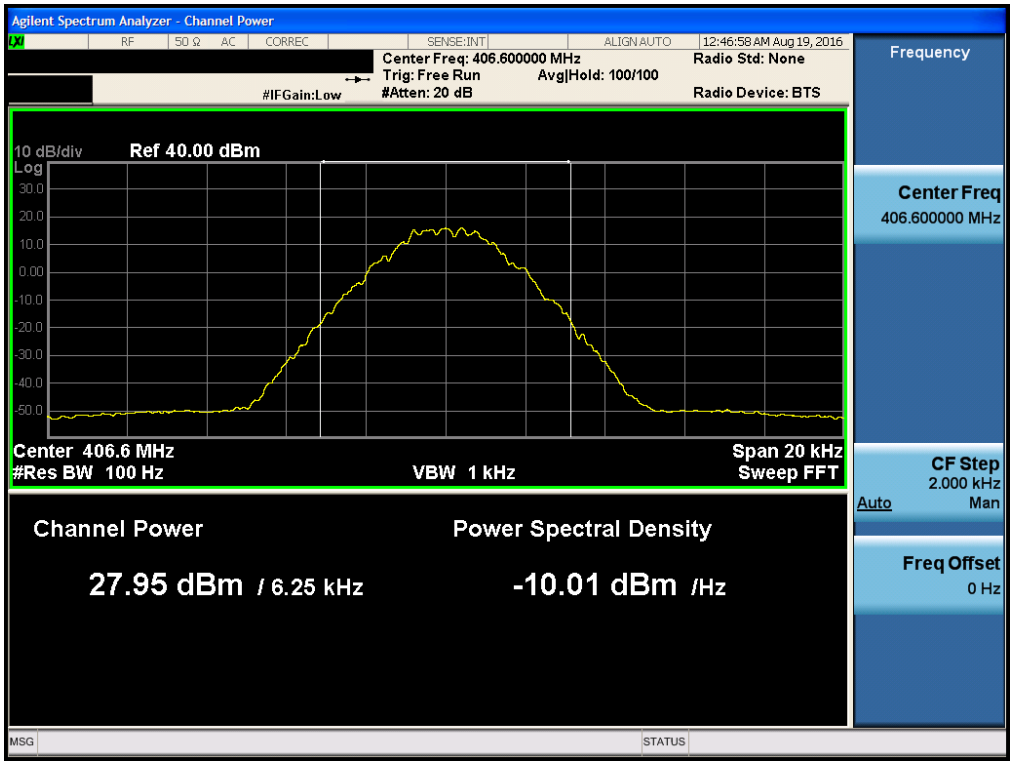


[VHF(APCO25) +3dB above the AGC threshold Uplink 173.5 MHz]

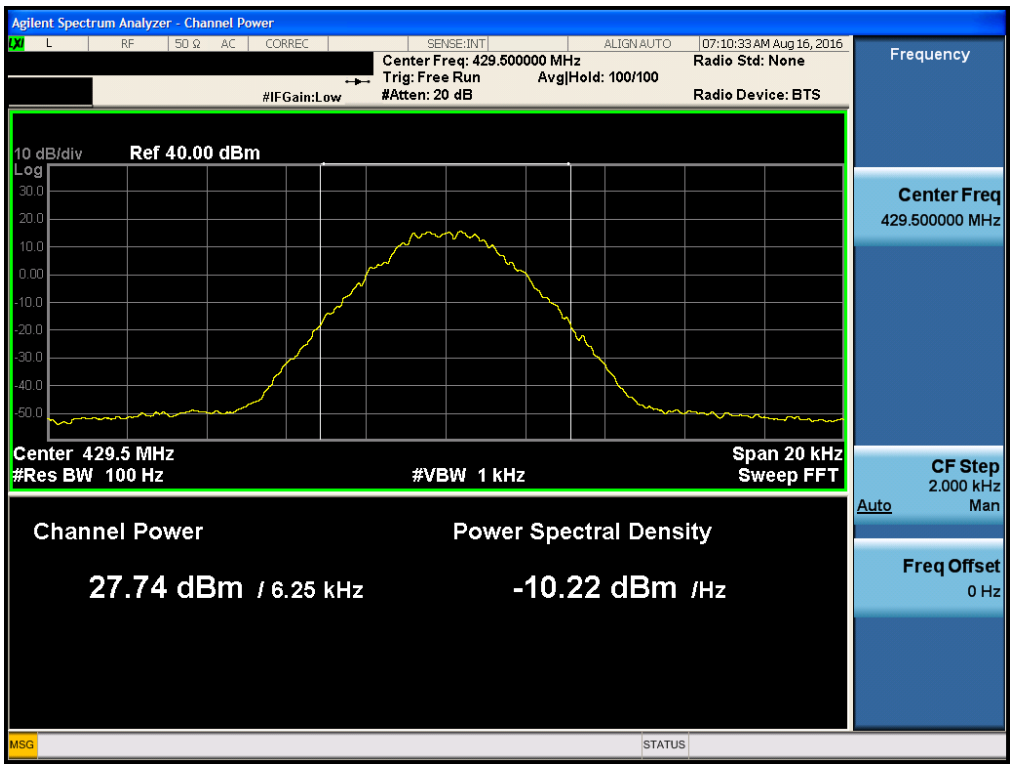


UHF(APCO25) UL

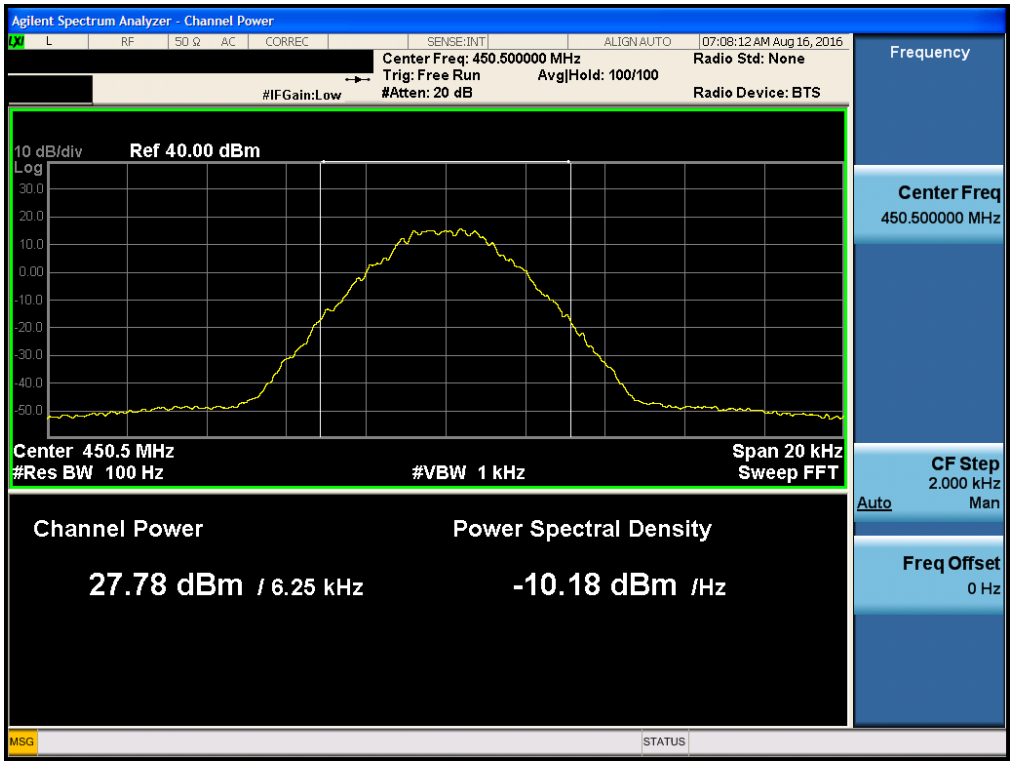
[UHF(APCO25) AGC threshold Uplink 406.6 MHz]



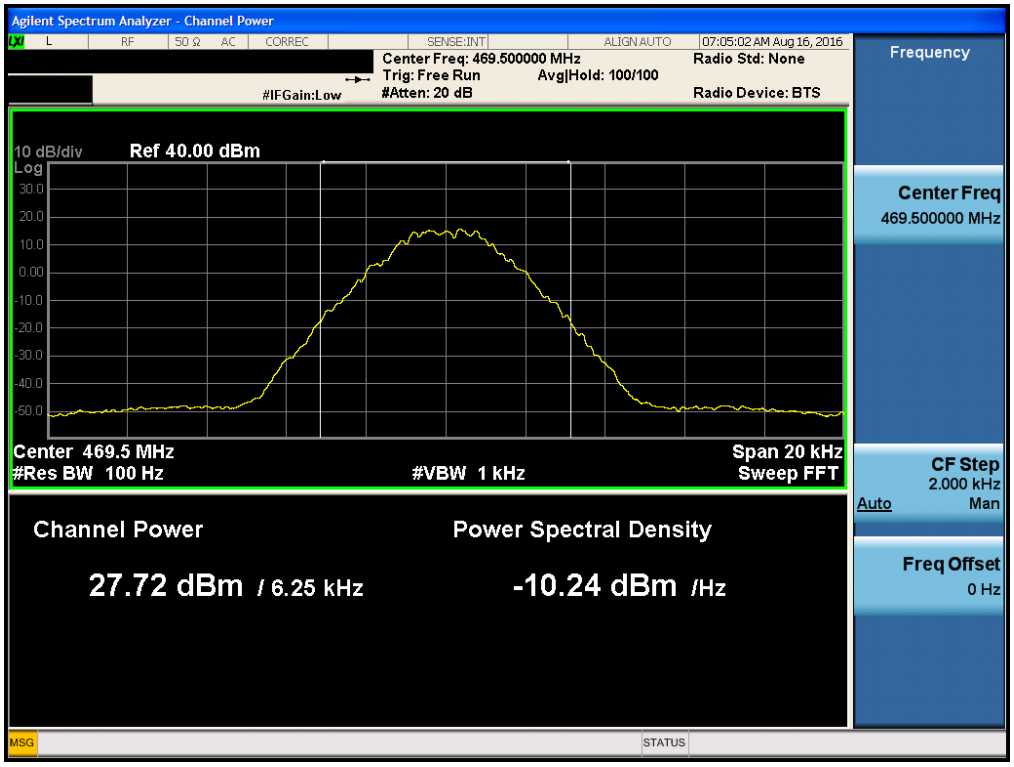
[UHF(APCO25) AGC threshold Uplink 429.5 MHz]



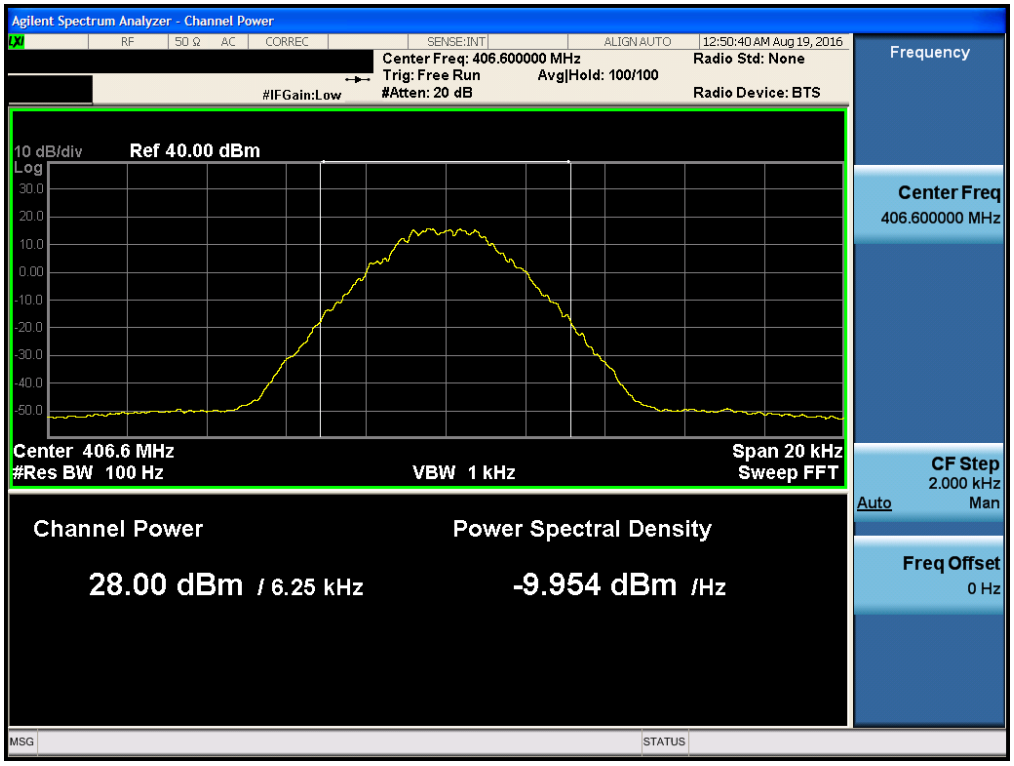
[UHF(APCO25) AGC threshold Uplink 450.5 MHz]



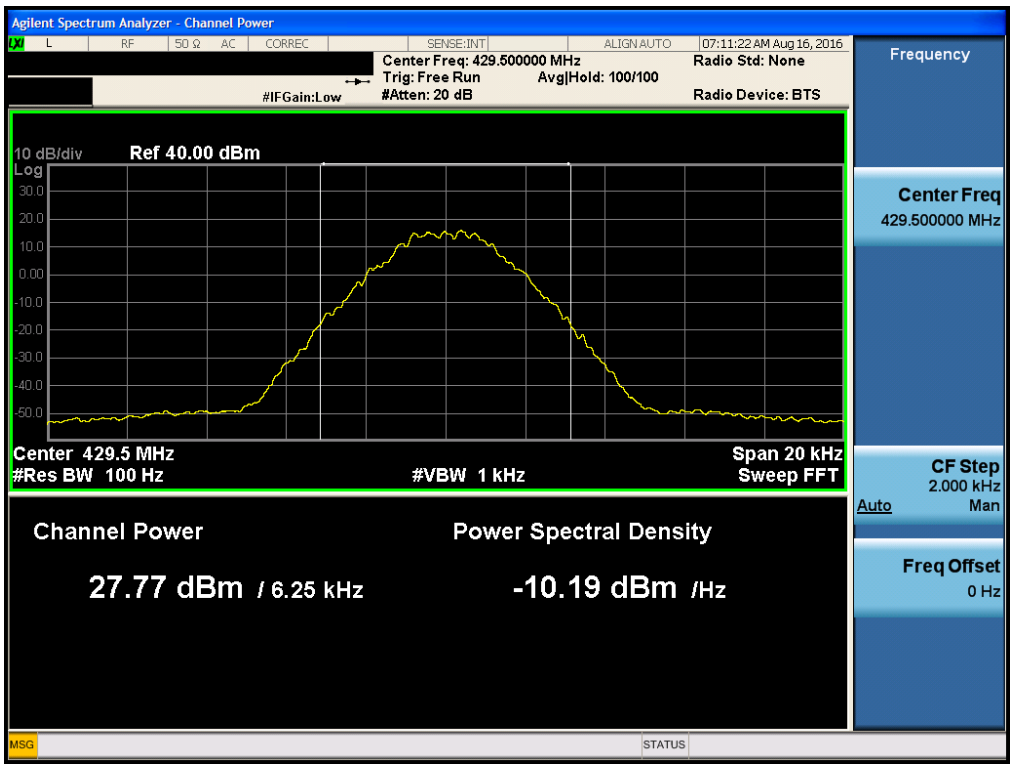
[UHF(APCO25) AGC threshold Uplink 469.5 MHz]



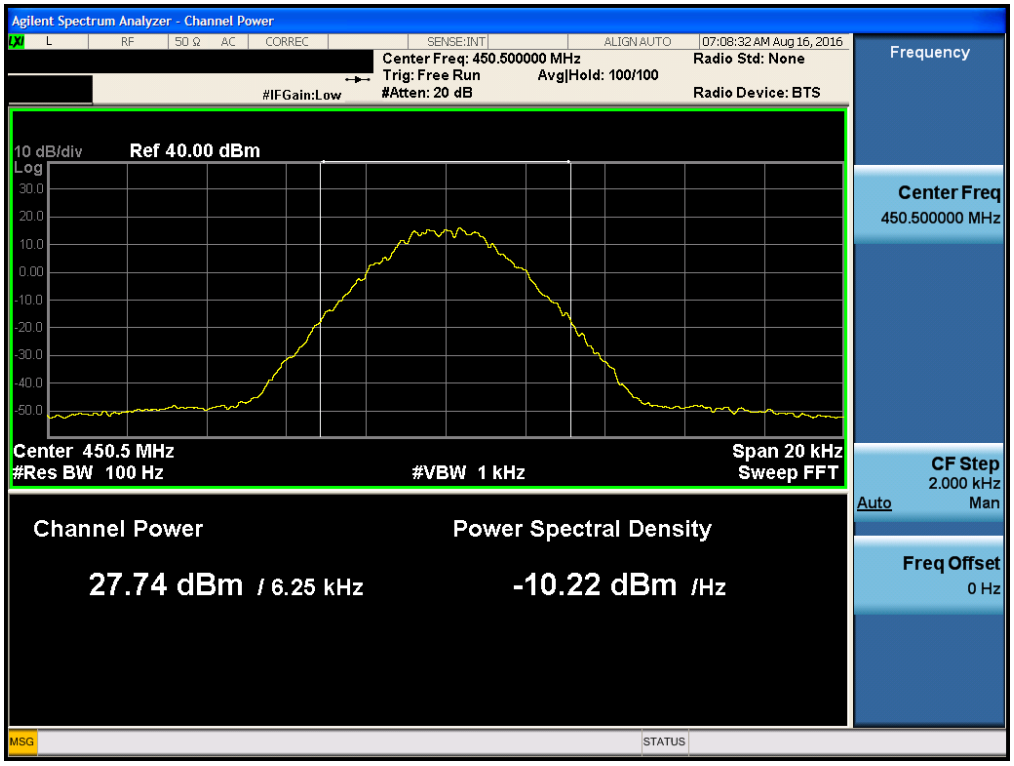
[UHF(APCO25) +3dB above the AGC threshold Uplink 406.6 MHz]



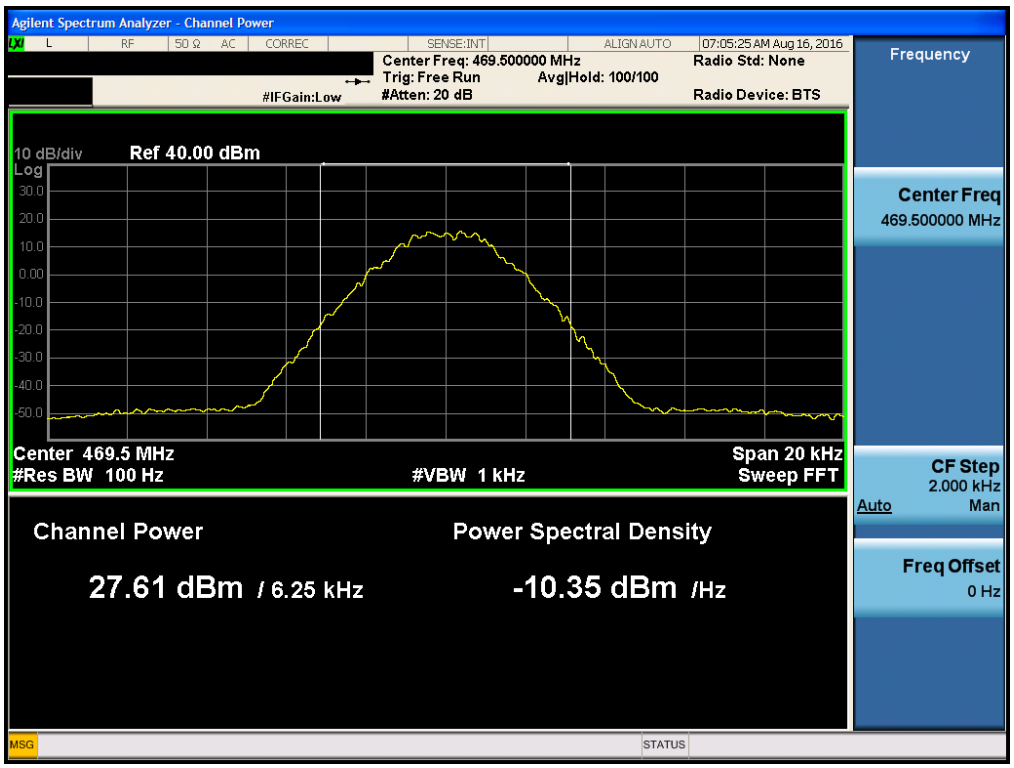
[UHF(APCO25) +3dB above the AGC threshold Uplink 429.5 MHz]



[UHF(APCO25) +3dB above the AGC threshold Uplink 450.5 MHz]

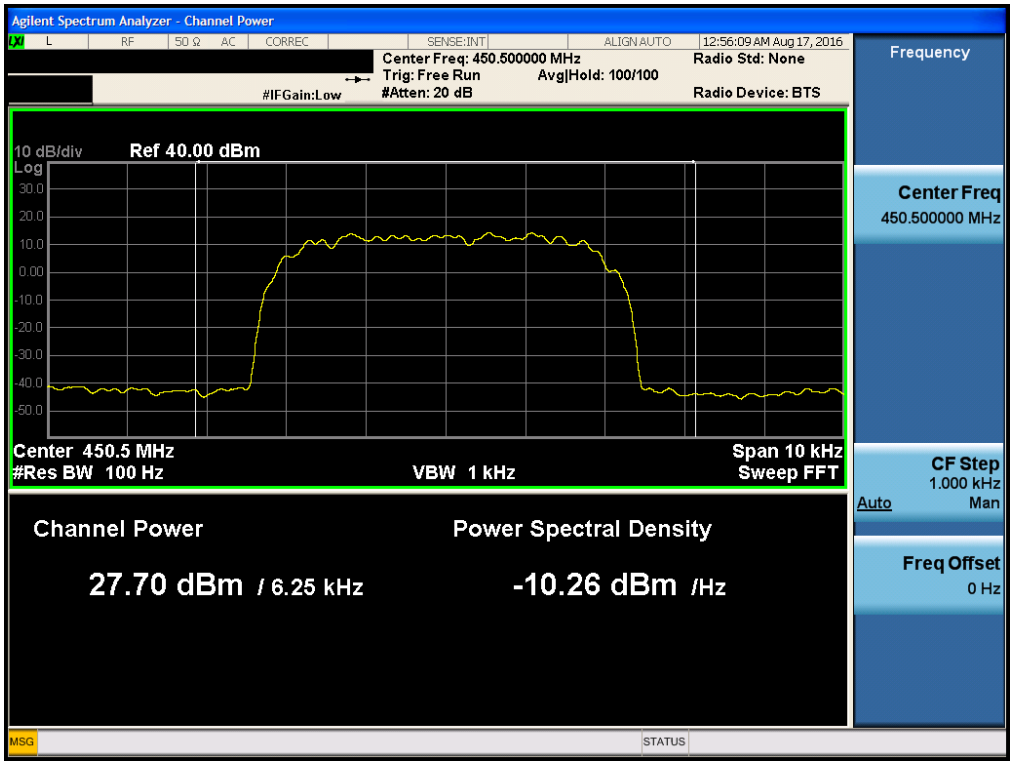


[UHF(APCO25) +3dB above the AGC threshold Uplink 469.5 MHz]

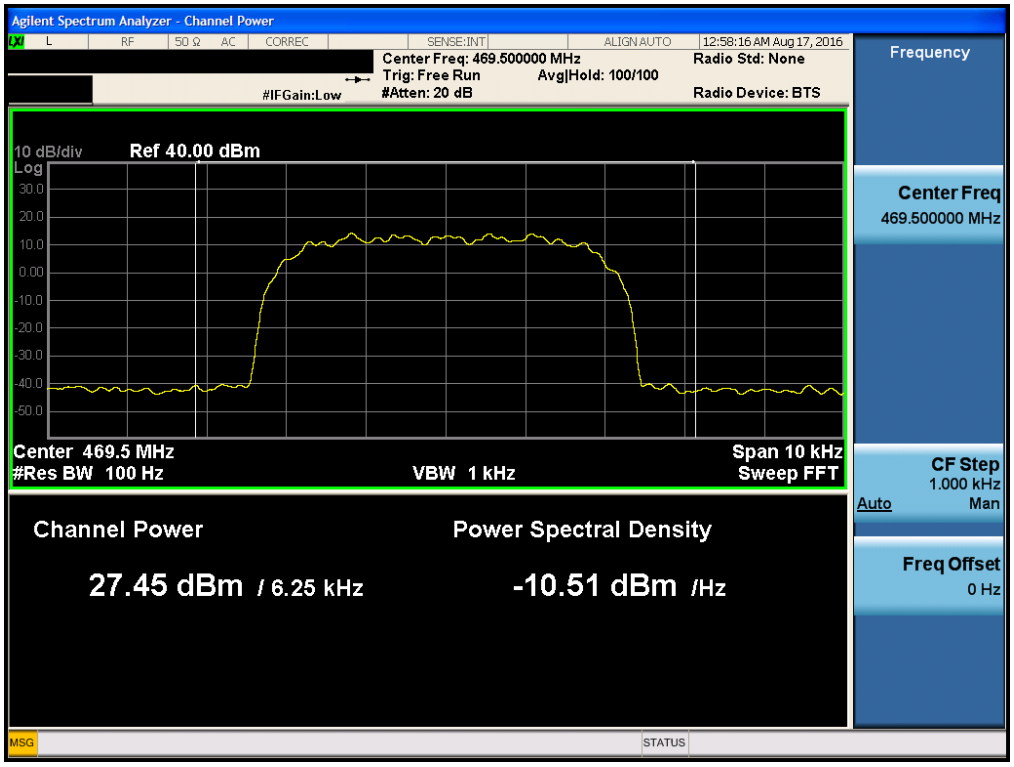


UHF(LMR450) UL

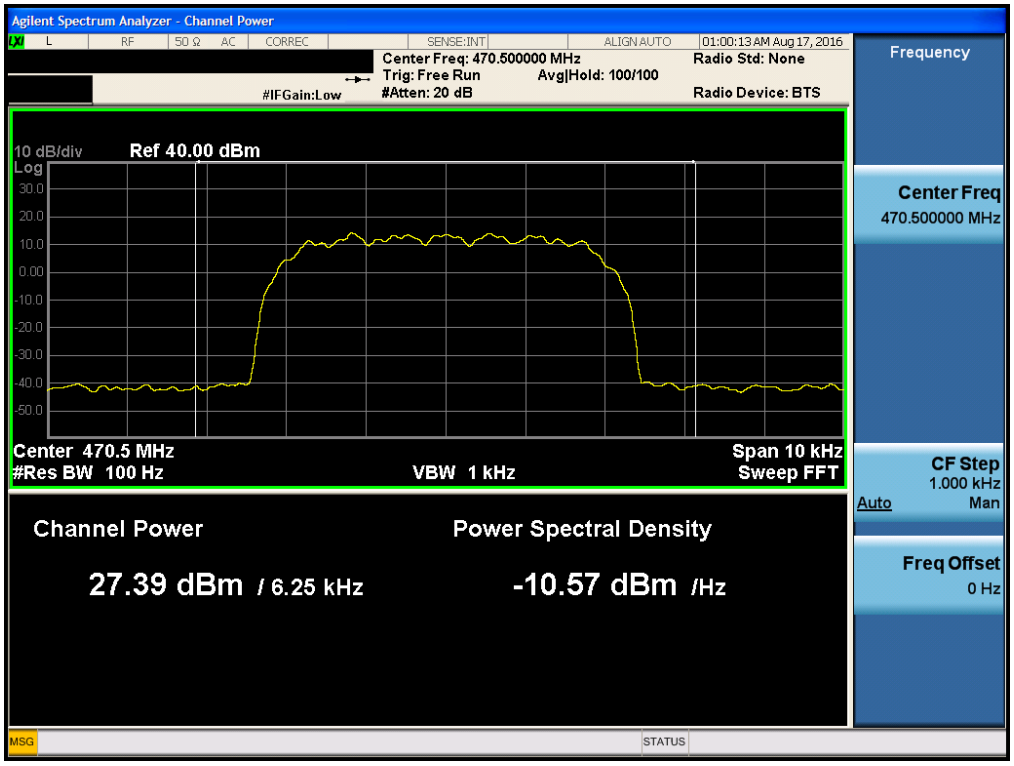
[UHF(LMR450) AGC threshold Uplink 450.5 MHz]



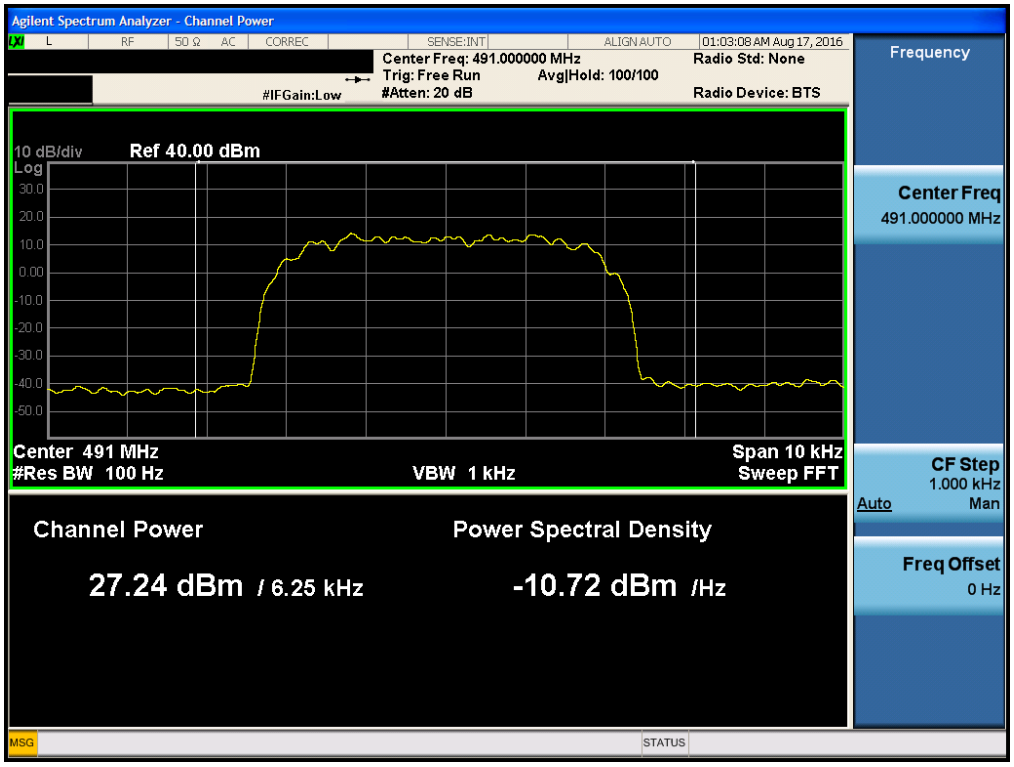
[UHF(LMR450) AGC threshold Uplink 469.5 MHz]



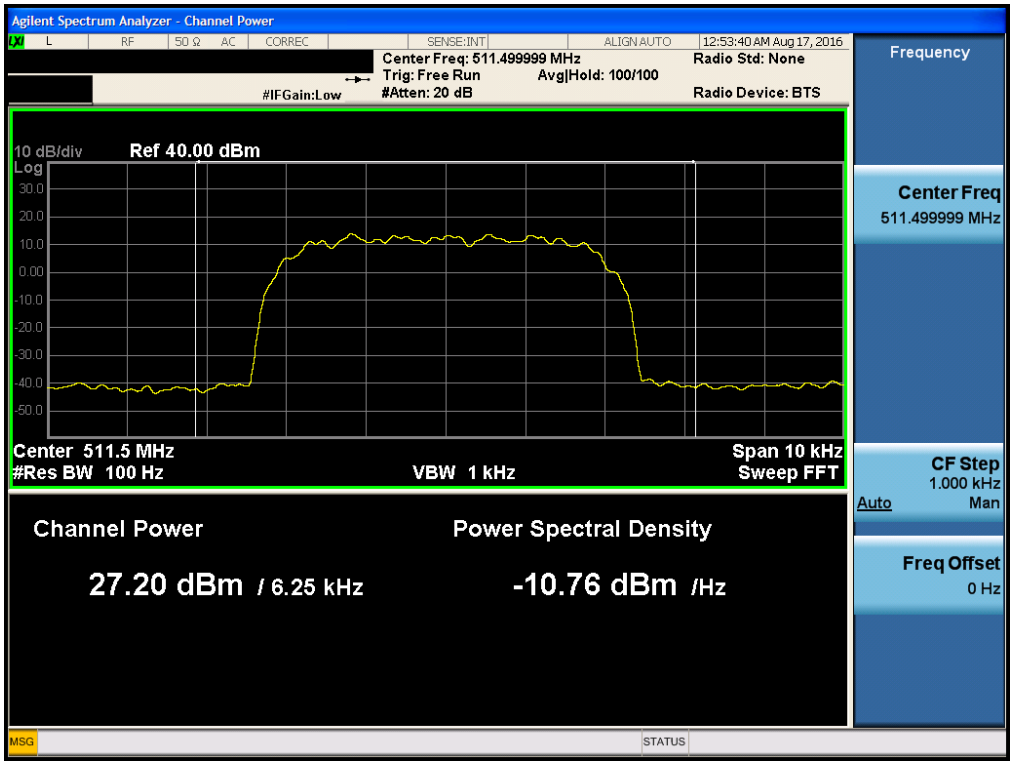
[UHF(LMR450) AGC threshold Uplink 470.5 MHz]



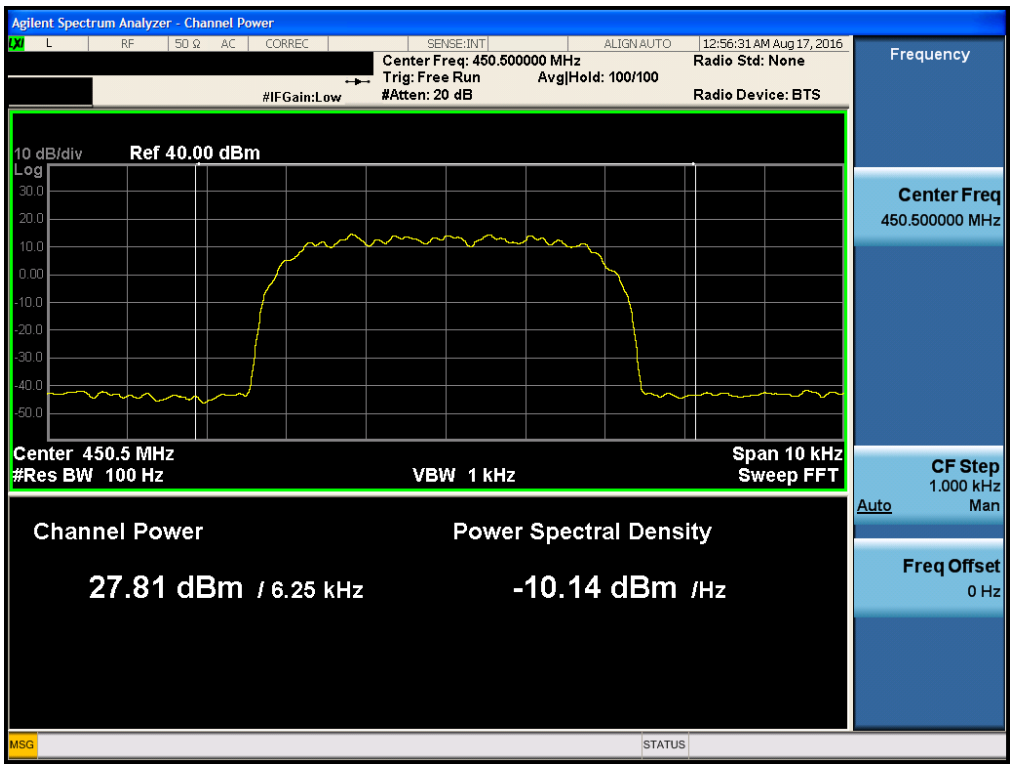
[UHF(LMR450) AGC threshold Uplink 491.0 MHz]



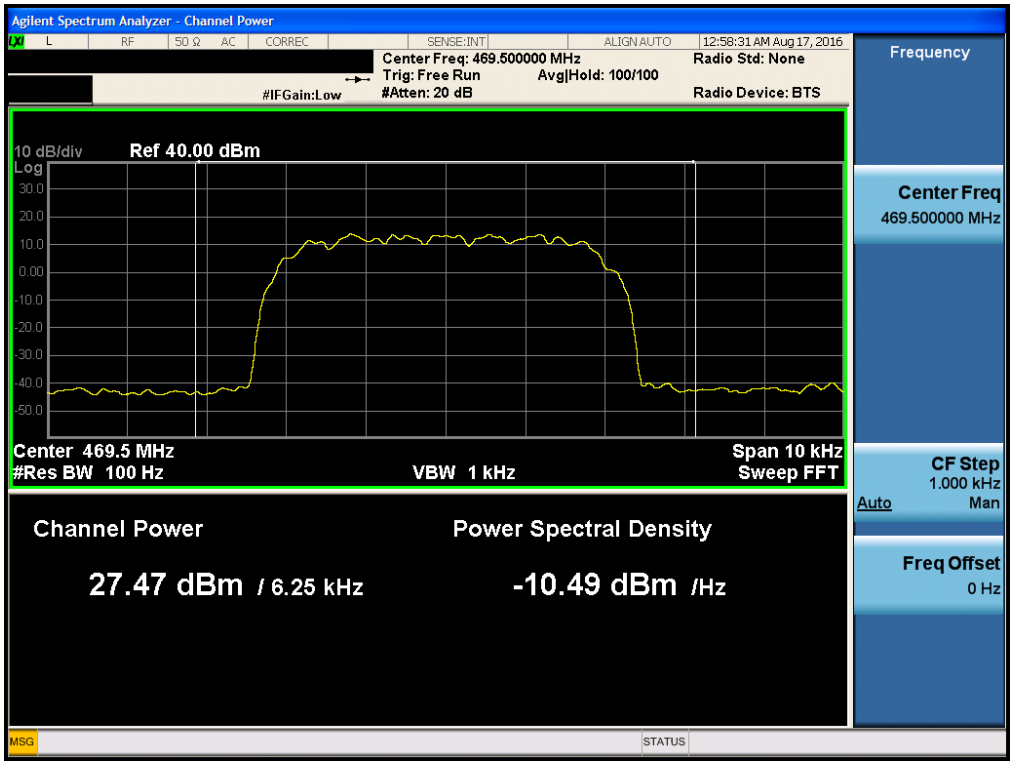
[UHF(LMR450) AGC threshold Uplink 511.5 MHz]



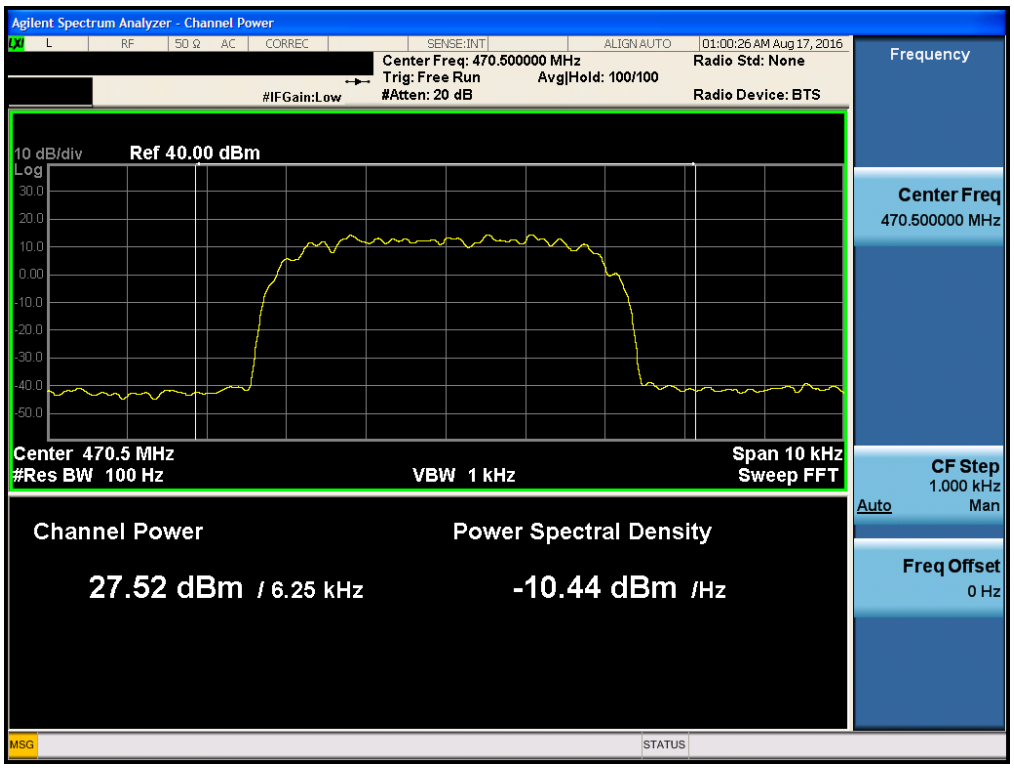
[UHF(LMR450) +3dB above the AGC threshold Uplink 450.5 MHz]



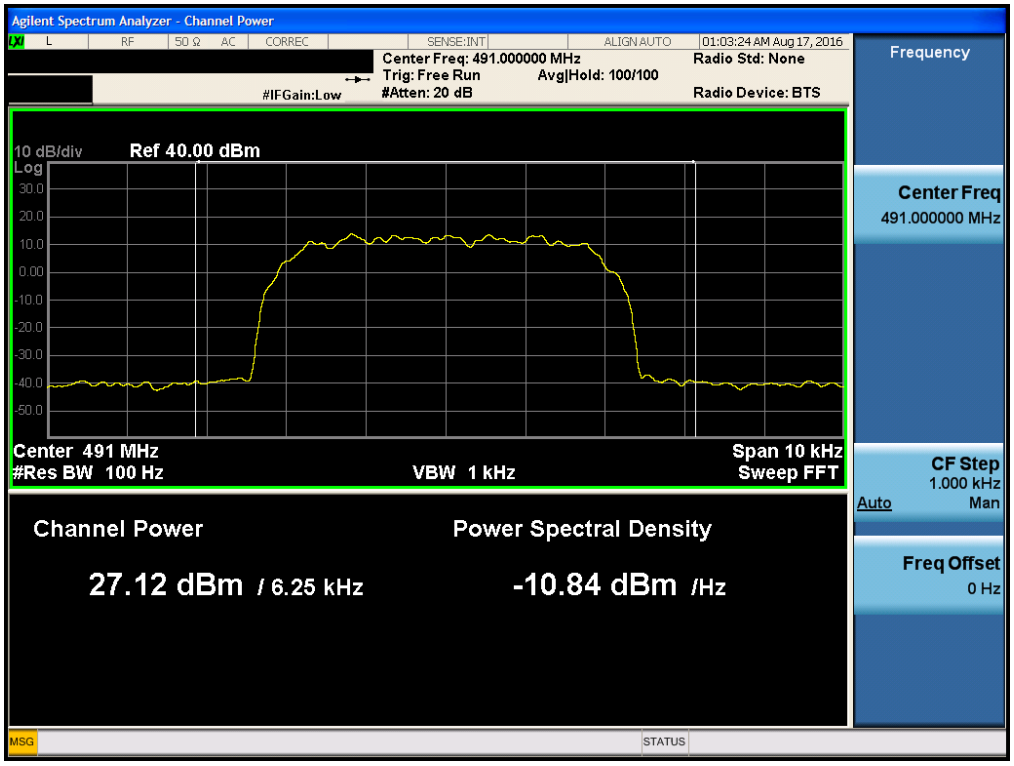
[UHF(LMR450) +3dB above the AGC threshold Uplink 469.5 MHz]



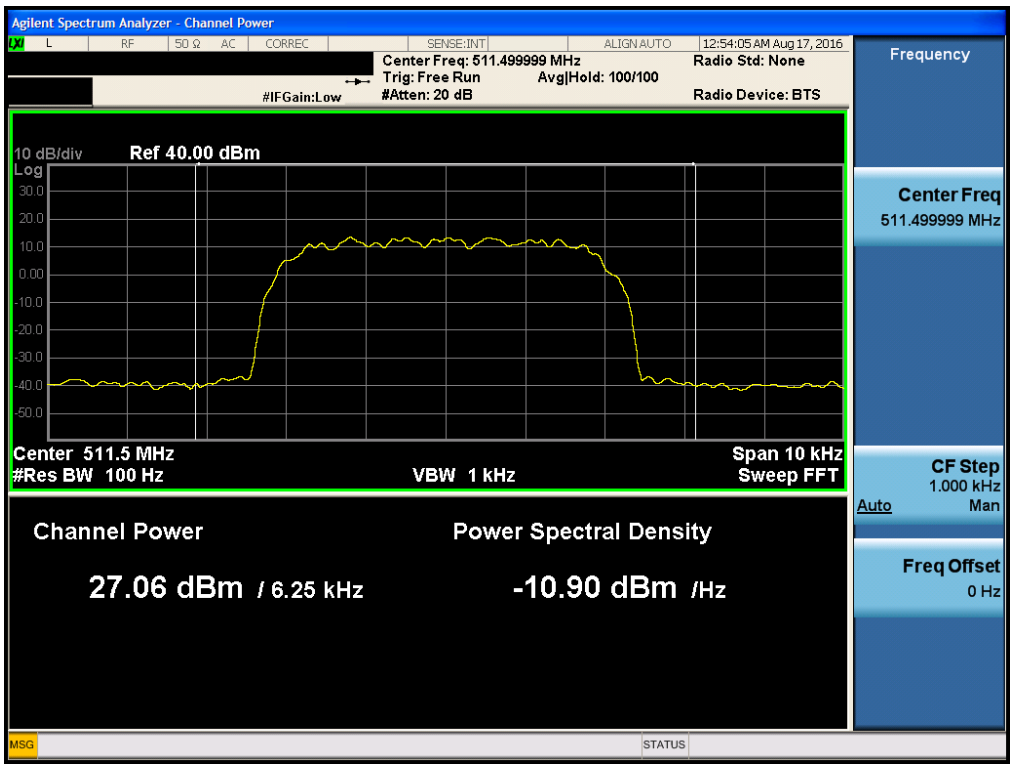
[UHF(LMR450) +3dB above the AGC threshold Uplink 470.5 MHz]



[UHF(LMR450) +3dB above the AGC threshold Uplink 491.0 MHz]



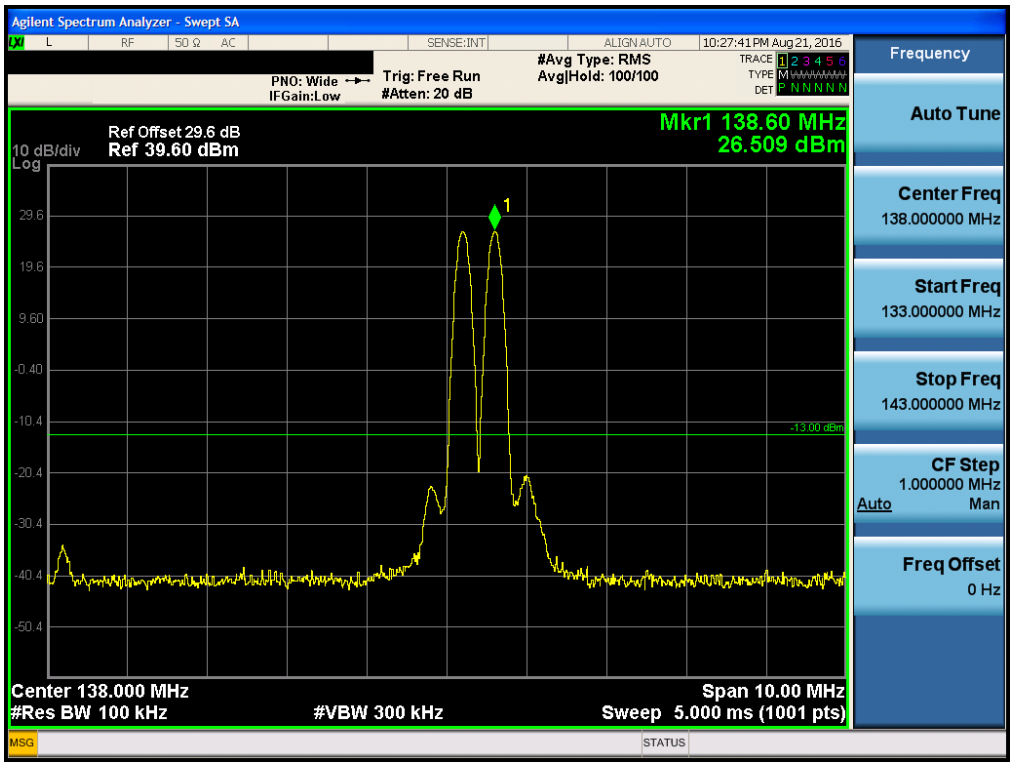
[UHF(LMR450) +3dB above the AGC threshold Uplink 511.5 MHz]



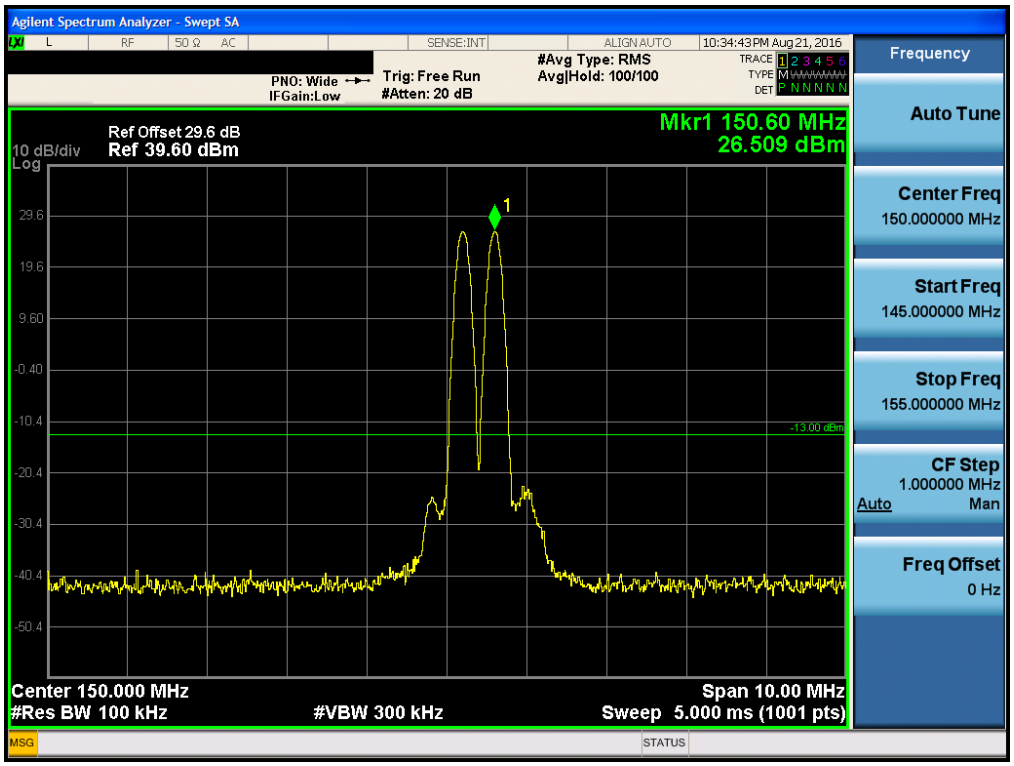
Multi-channel Enhancer for IC

VHF(APCO25) DL

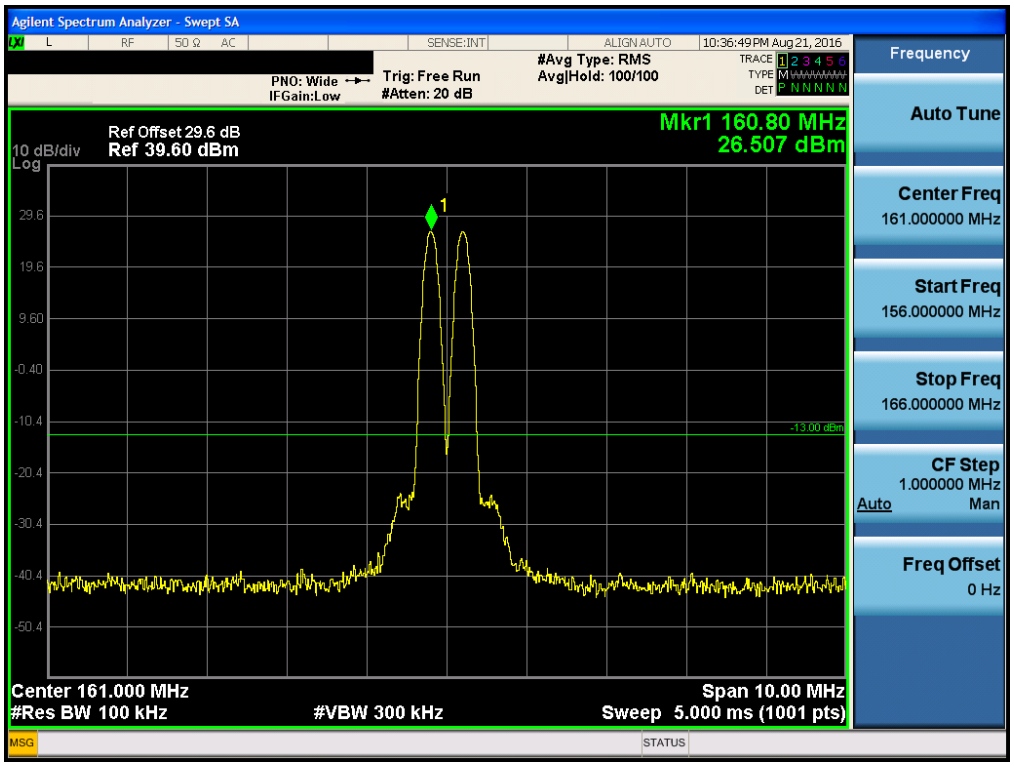
[VHF(APCO25) AGC threshold Downlink 138.5 MHz]



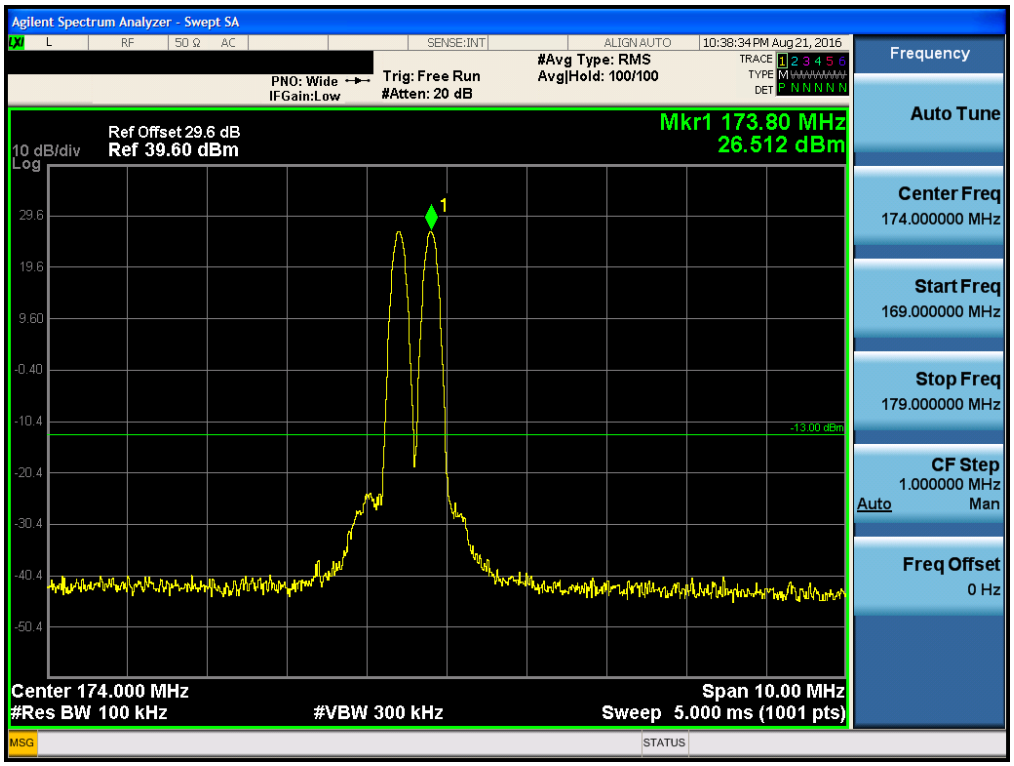
[VHF(APCO25) AGC threshold Downlink 150.5 MHz]



[VHF(APCO25) AGC threshold Downlink 162.0 MHz]

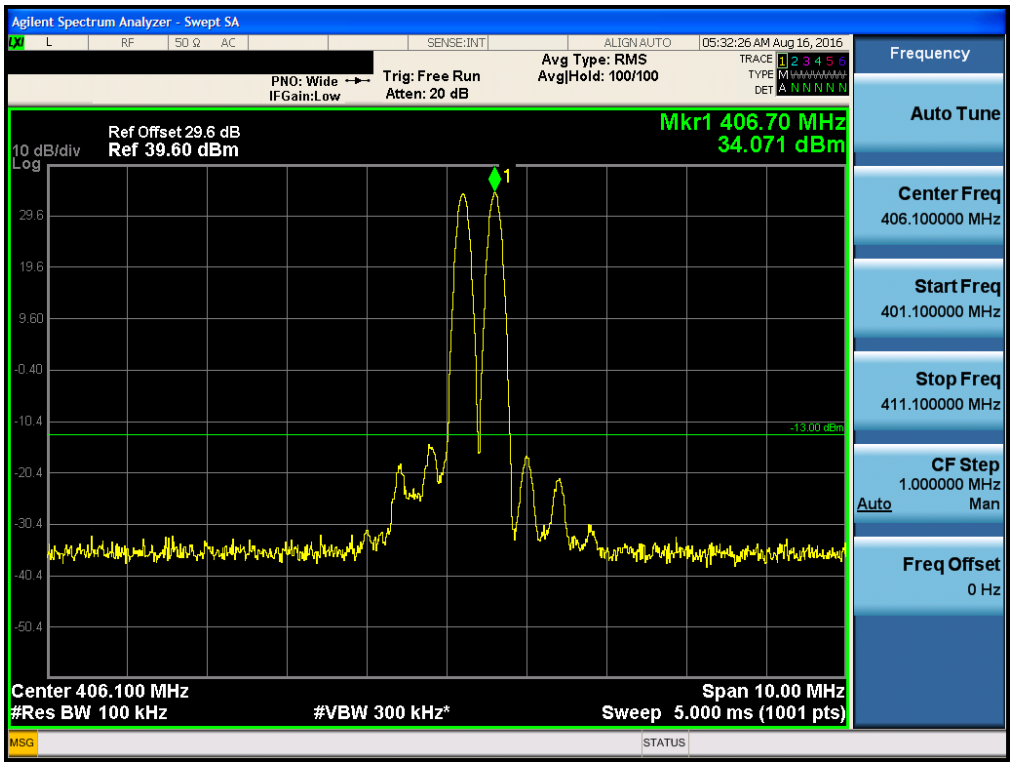


[VHF(APCO25) AGC threshold Downlink 173.5 MHz]

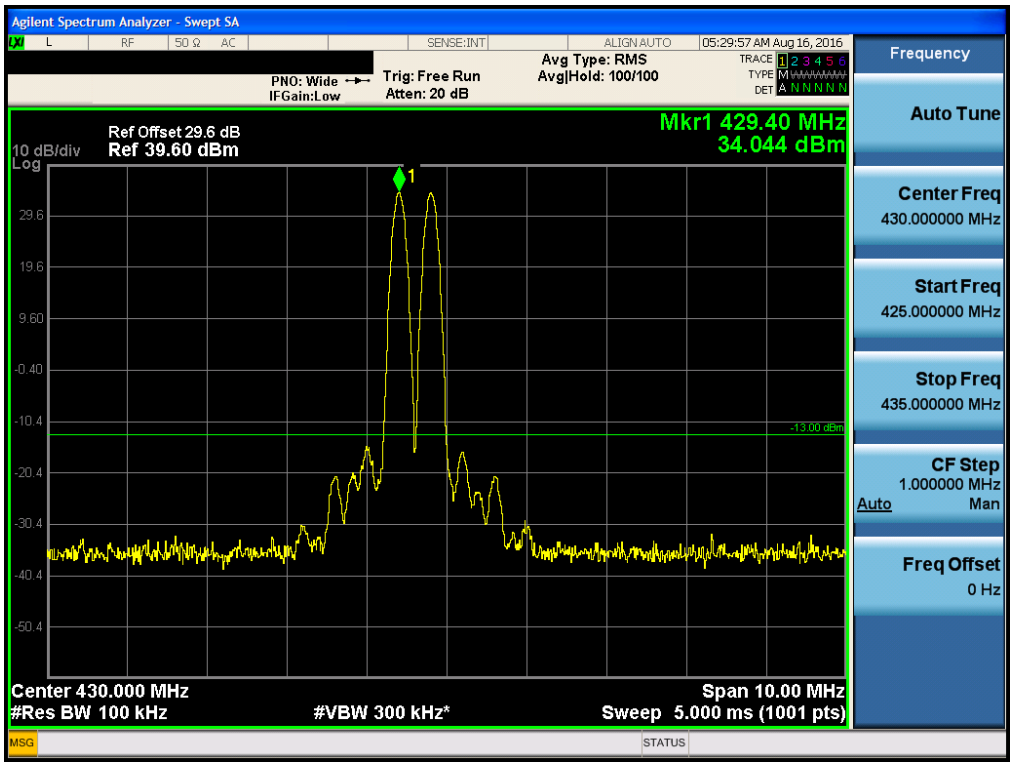


UHF(APCO25) DL

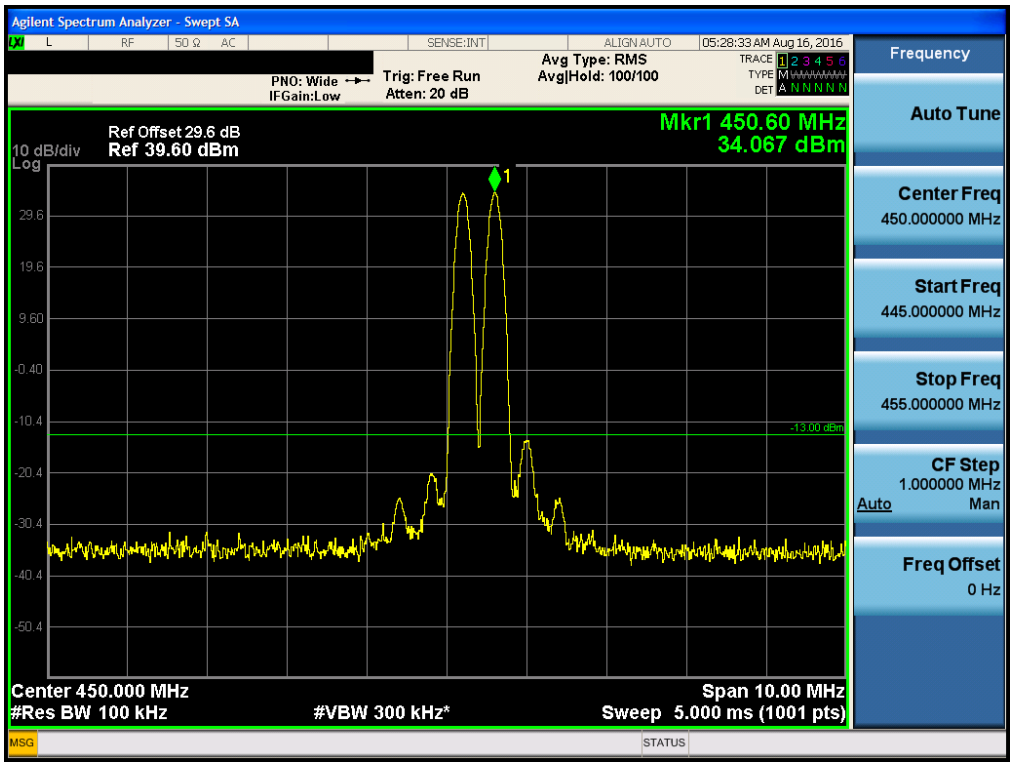
[UHF(APCO25) AGC threshold Downlink 406.6 MHz]



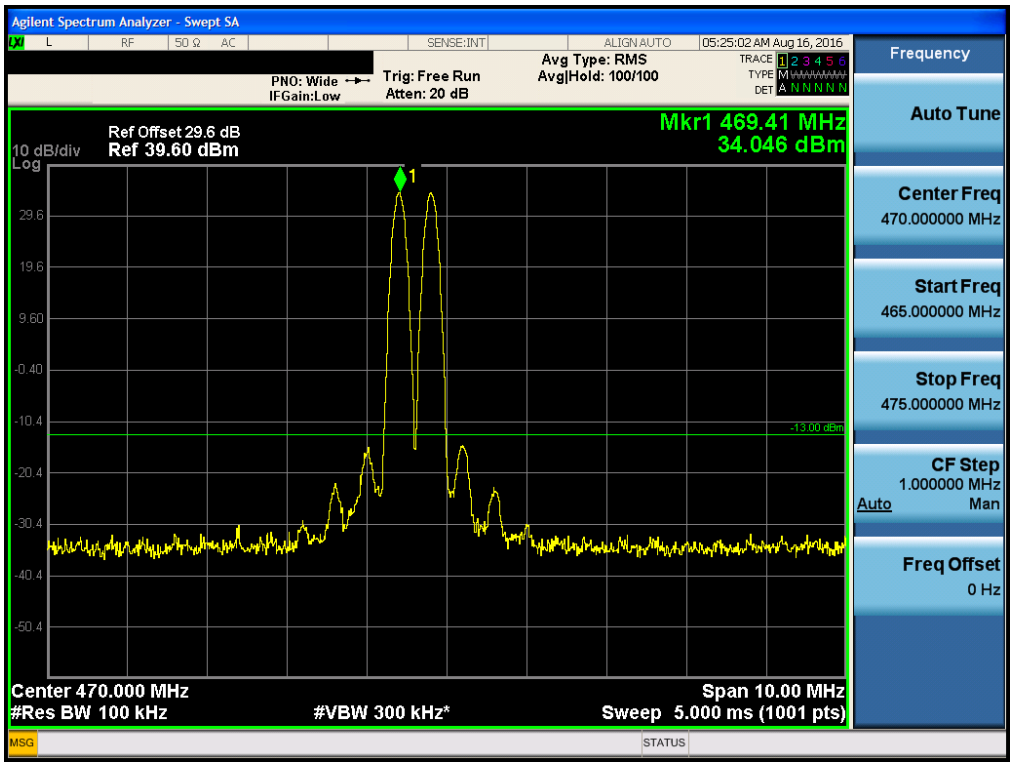
[UHF(APCO25) AGC threshold Downlink 429.5 MHz]



[UHF(APCO25) AGC threshold Downlink 450.5 MHz]

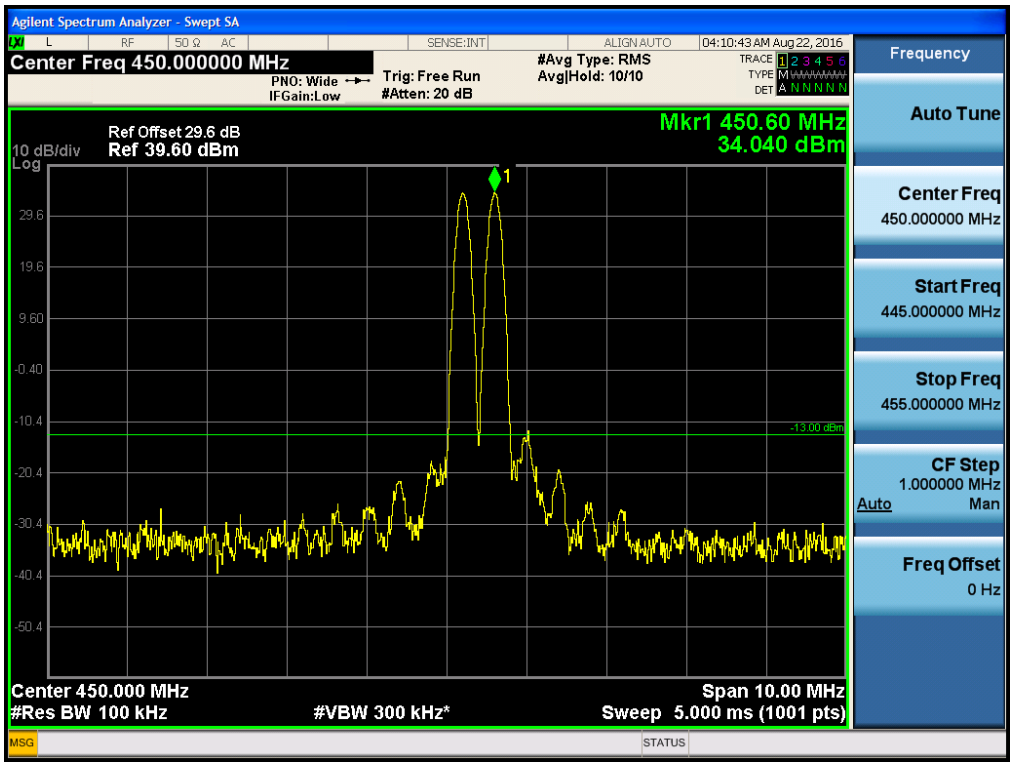


[UHF(APCO25) AGC threshold Downlink 469.5 MHz]

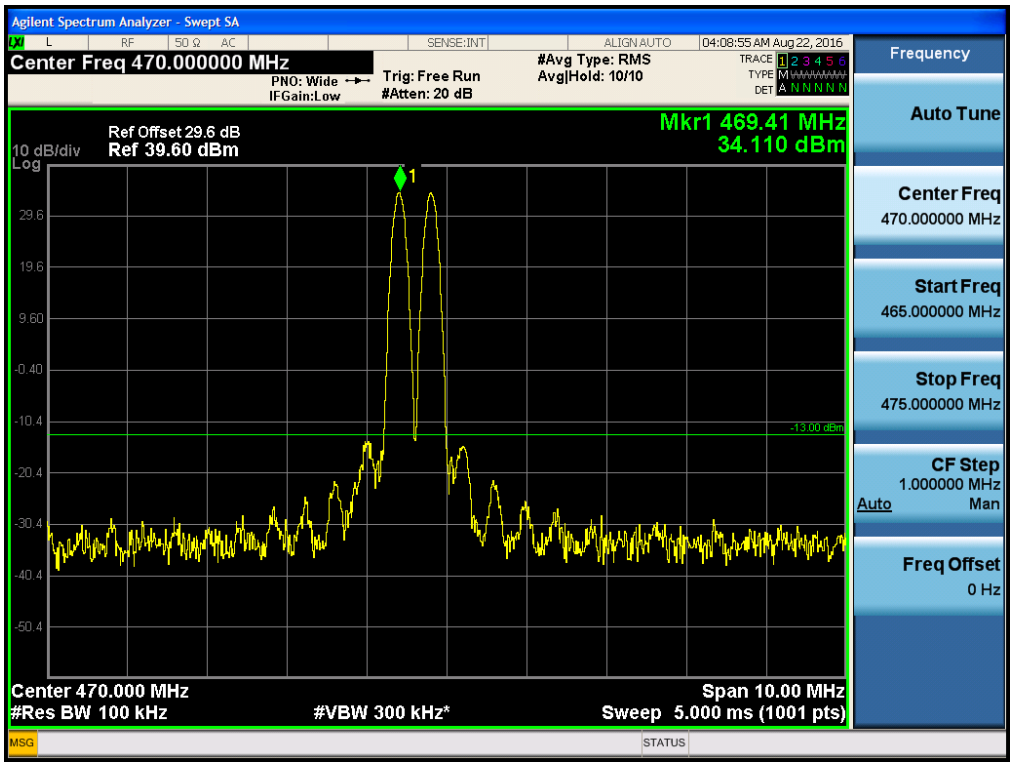


UHF(LMR450) DL

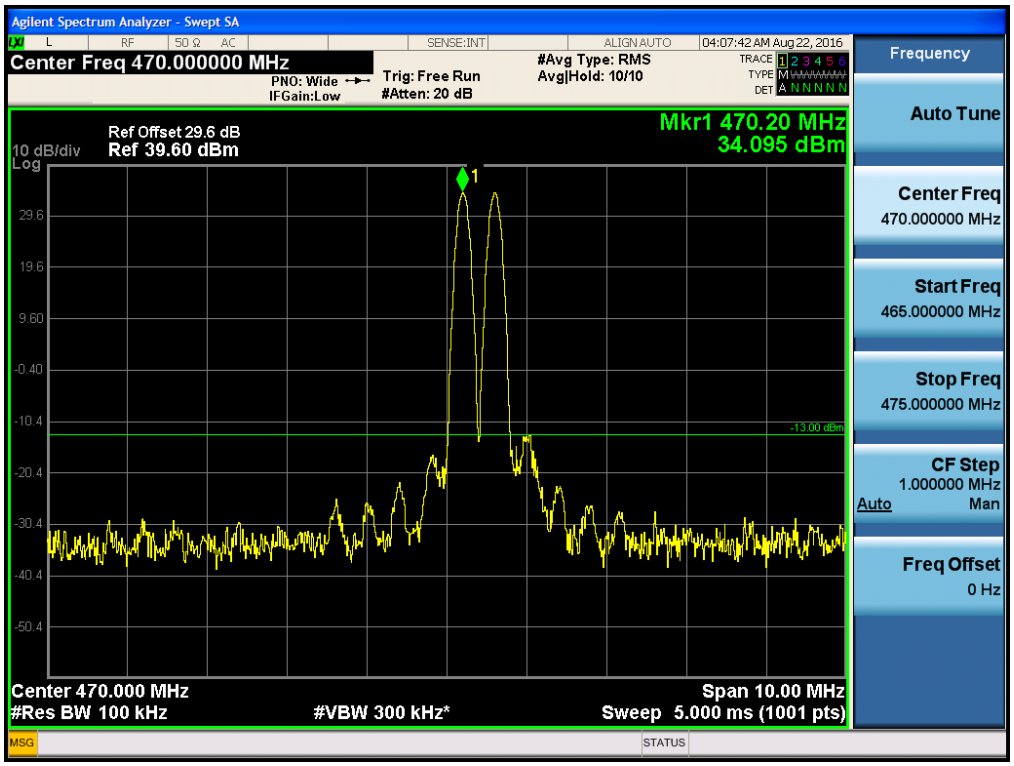
[UHF(LMR450) AGC threshold Downlink 450.5 MHz]



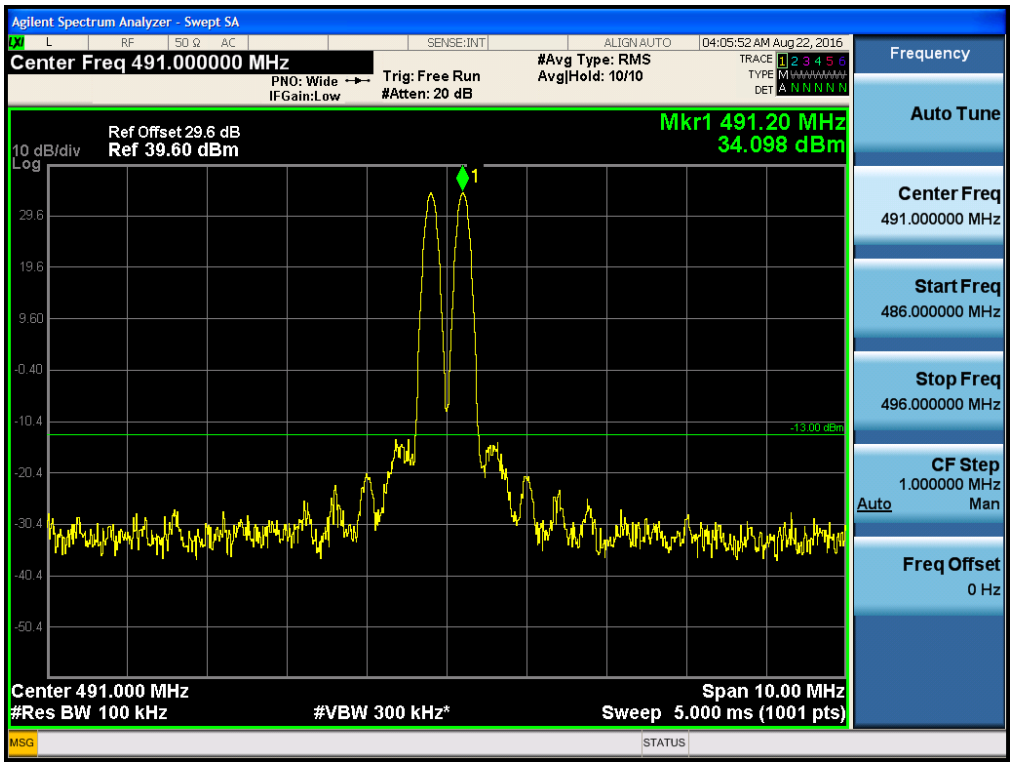
[UHF(LMR450) AGC threshold Downlink 469.5 MHz]



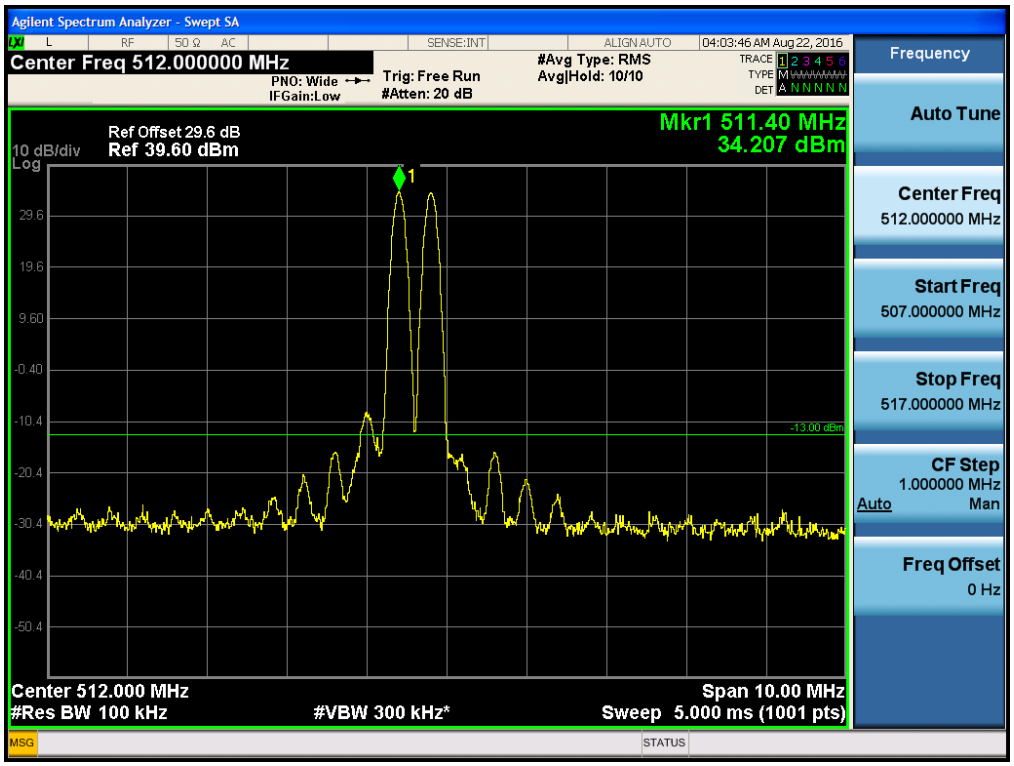
[UHF(LMR450) AGC threshold Downlink 470.5 MHz]



[UHF(LMR450) AGC threshold Downlink 491.0 MHz]

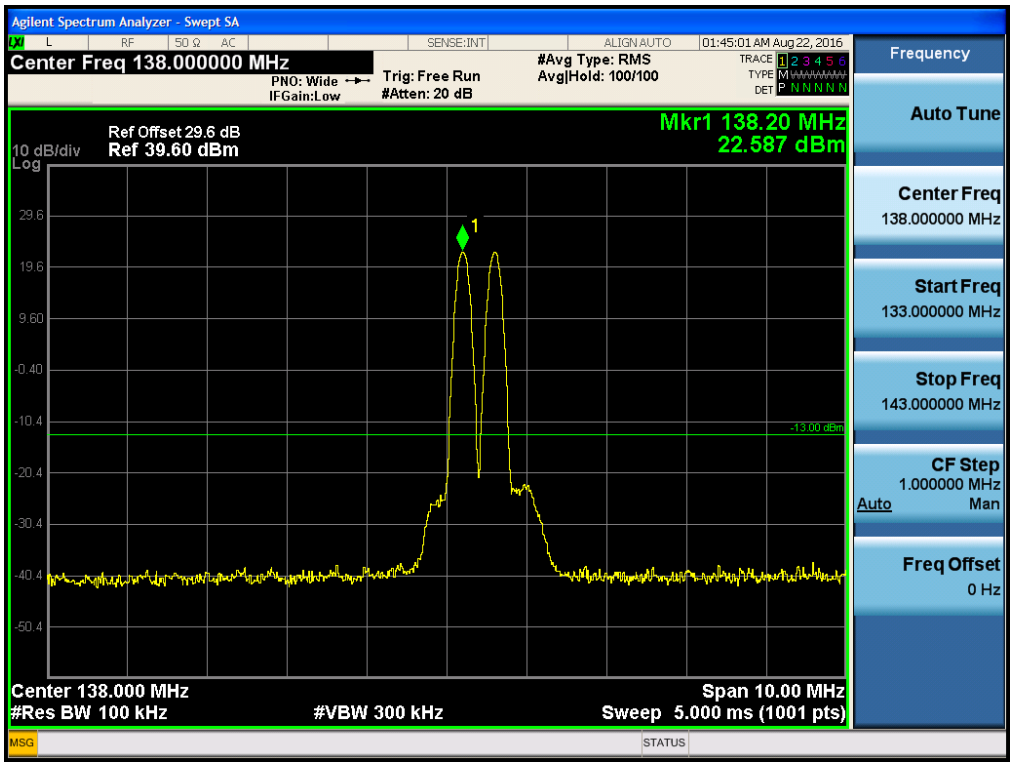


[UHF(LMR450) AGC threshold Downlink 511.5 MHz]

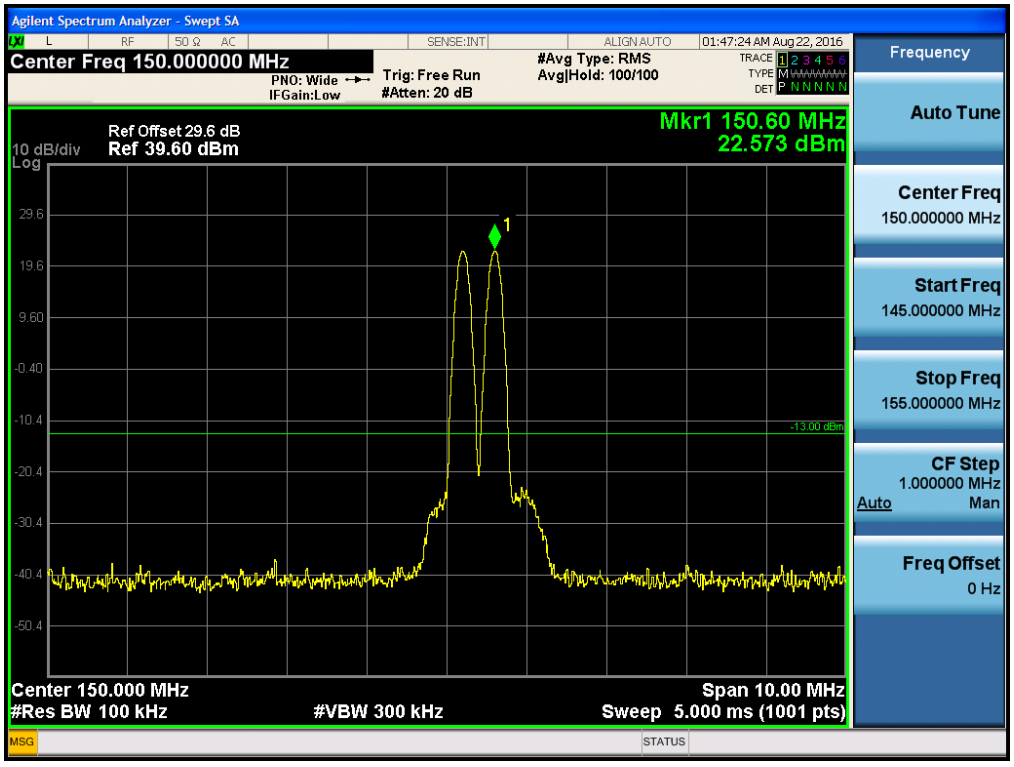


VHF(APCO25) UL

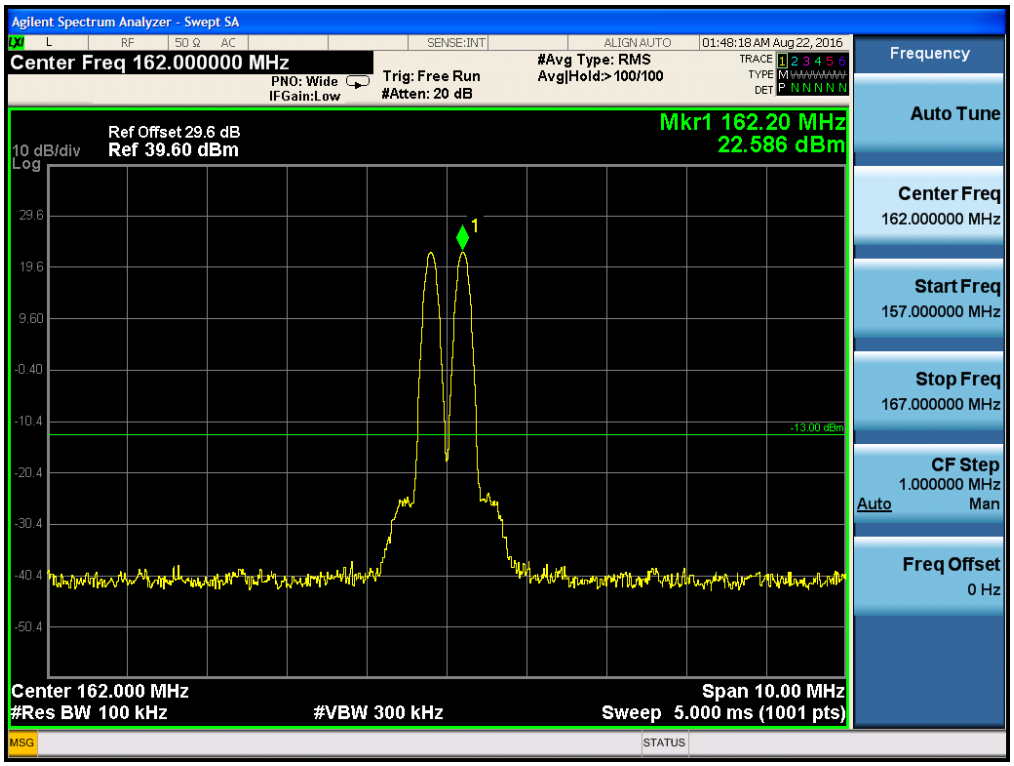
[VHF(APCO25) AGC threshold Uplink 138.5 MHz]



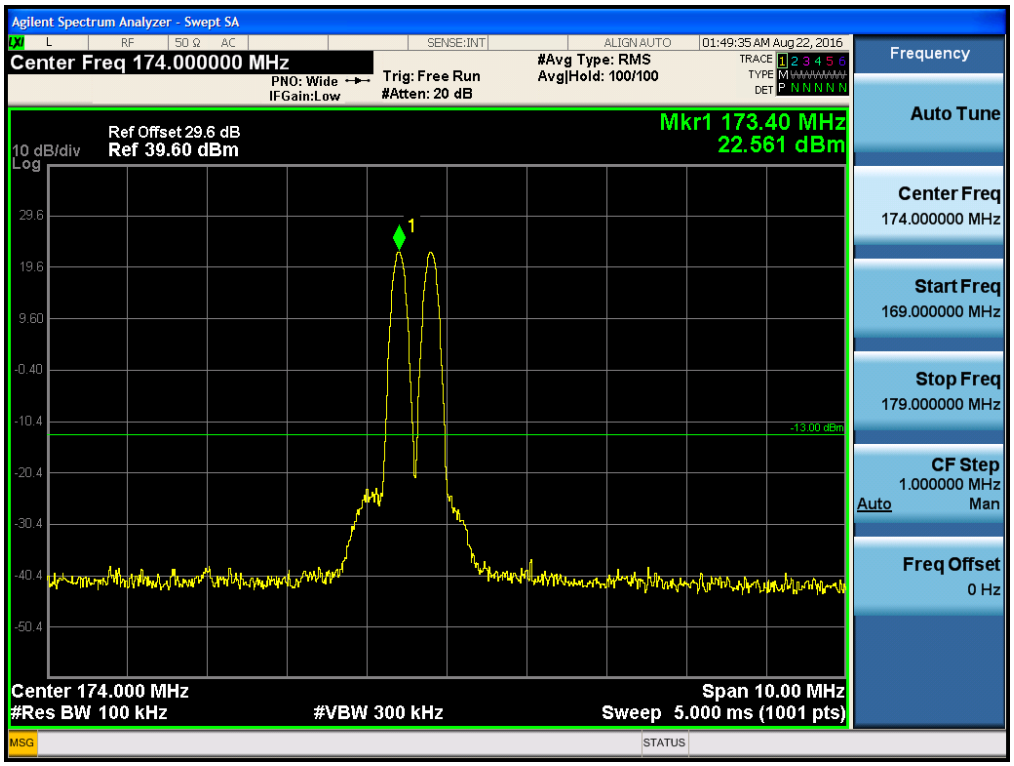
[VHF(APCO25) AGC threshold Uplink 150.5 MHz]



[VHF(APCO25) AGC threshold Uplink 162.0 MHz]

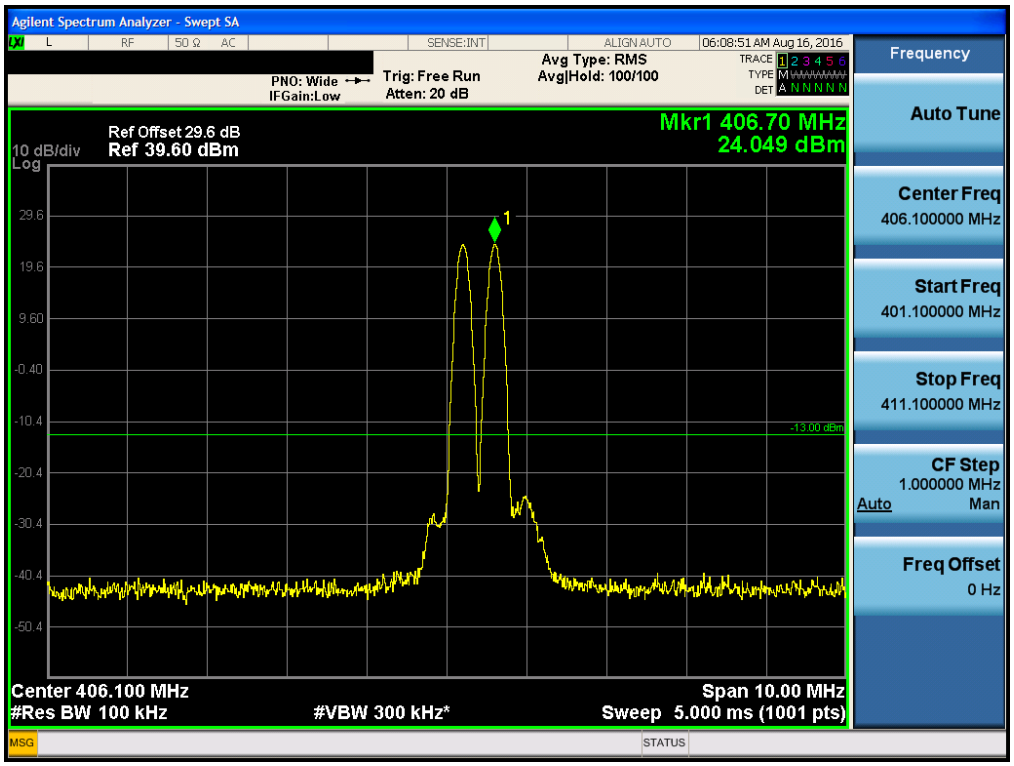


[VHF(APCO25) AGC threshold Uplink 173.5 MHz]

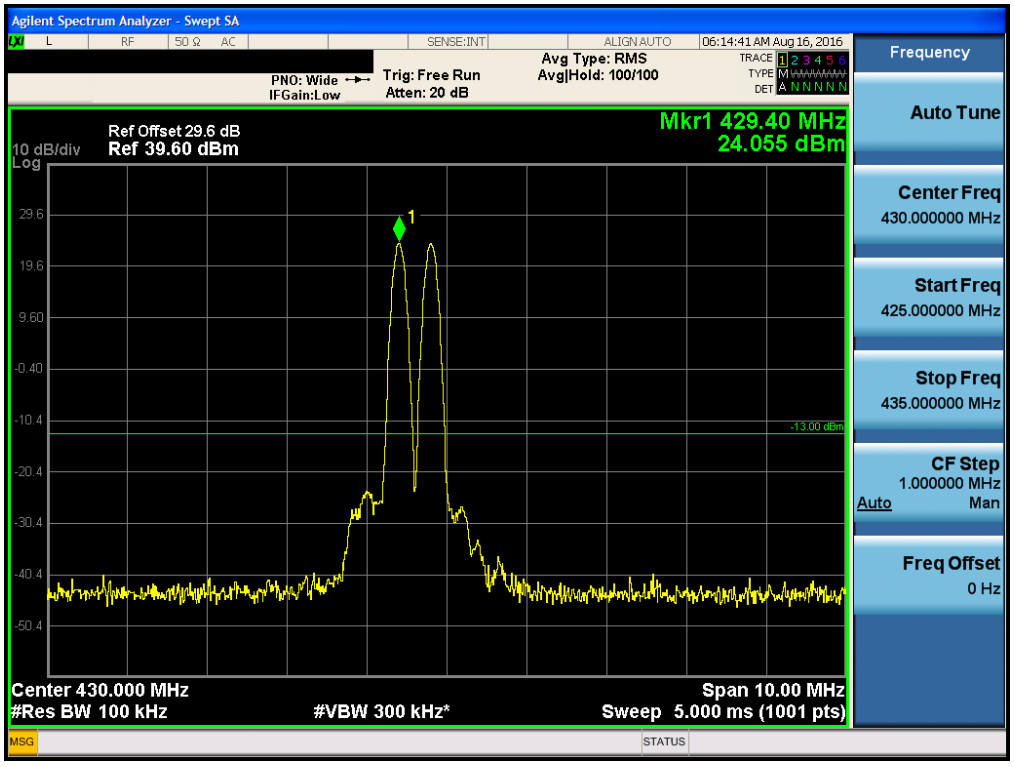


UHF(APCO25) UL

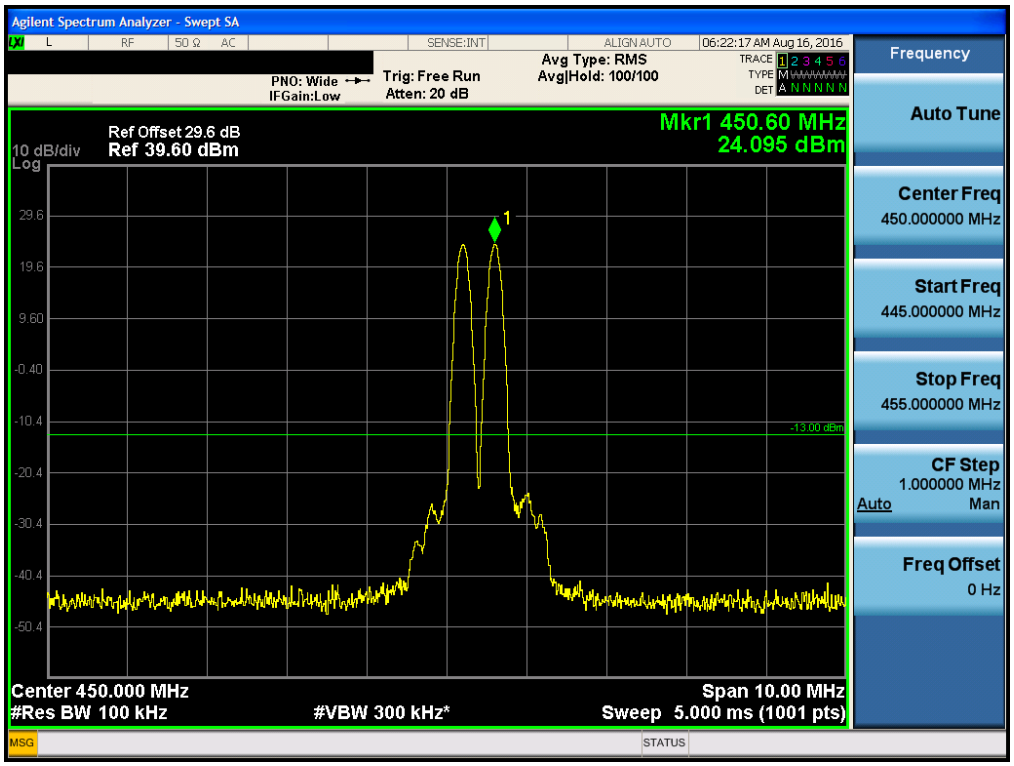
[UHF(APCO25) AGC threshold Uplink 406.6 MHz]



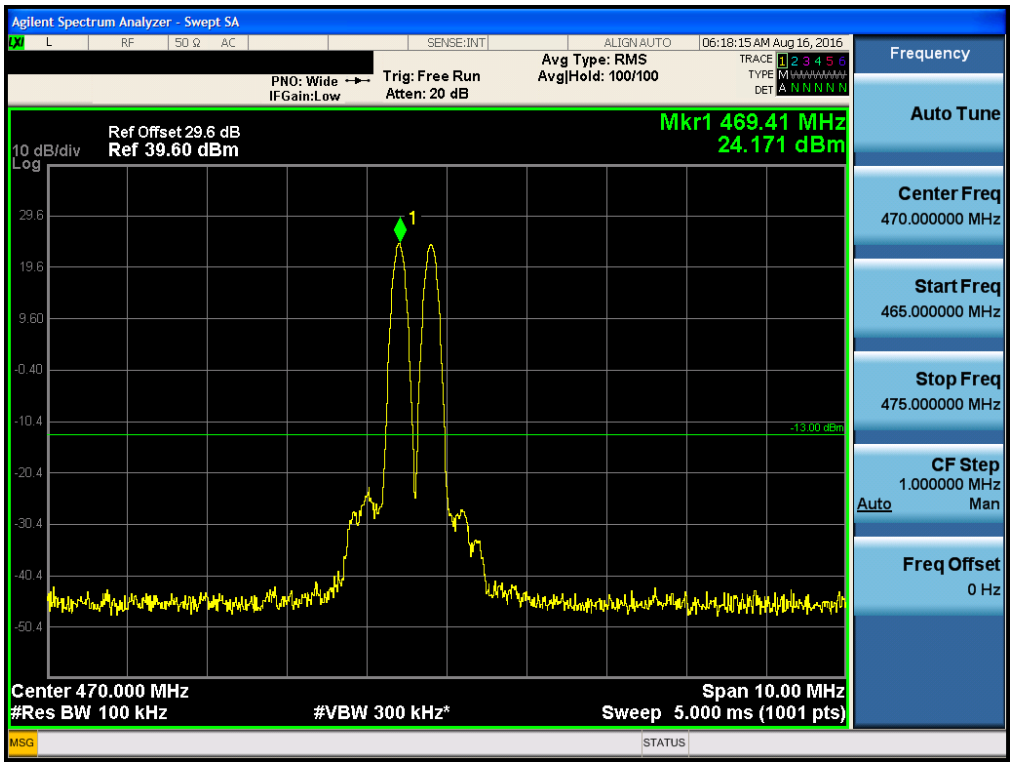
[UHF(APCO25) AGC threshold Uplink 429.5 MHz]



[UHF(APCO25) AGC threshold Uplink 450.5 MHz]

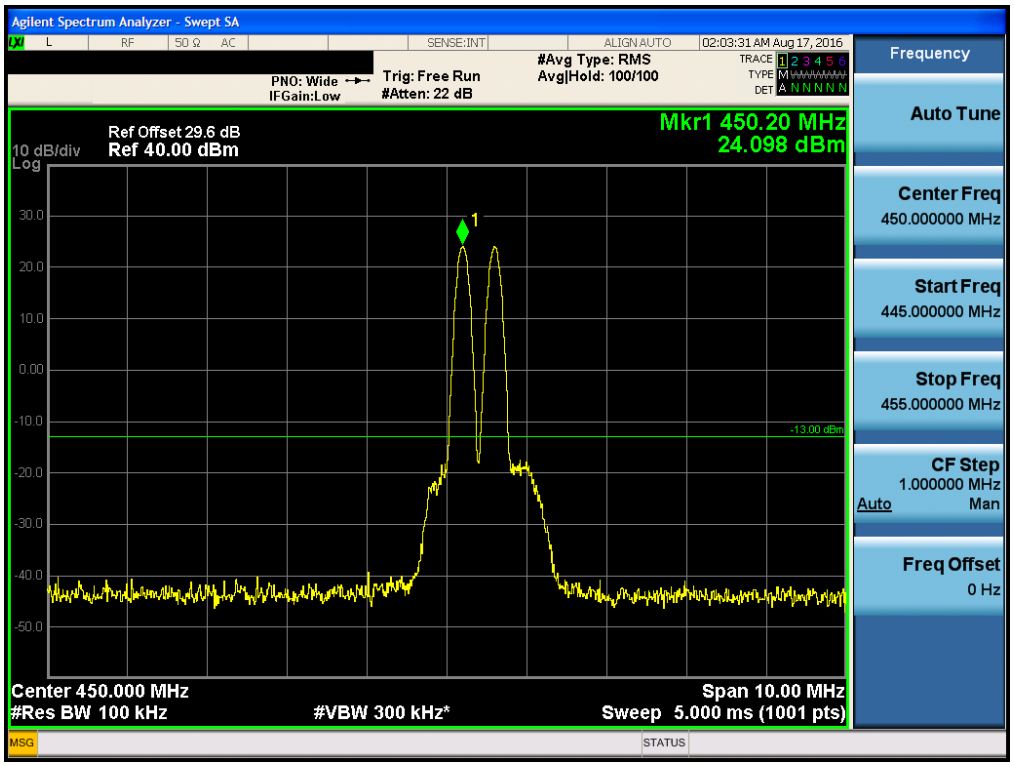


[UHF(APCO25) AGC threshold Uplink 469.5 MHz]

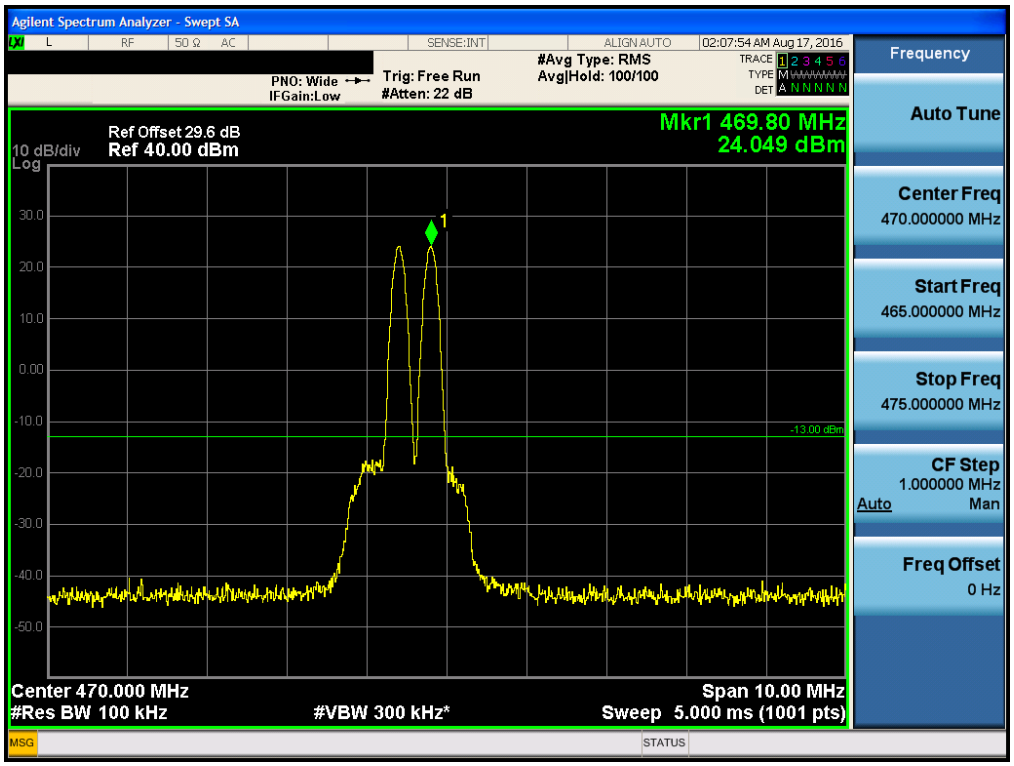


UHF(LMR450) UL

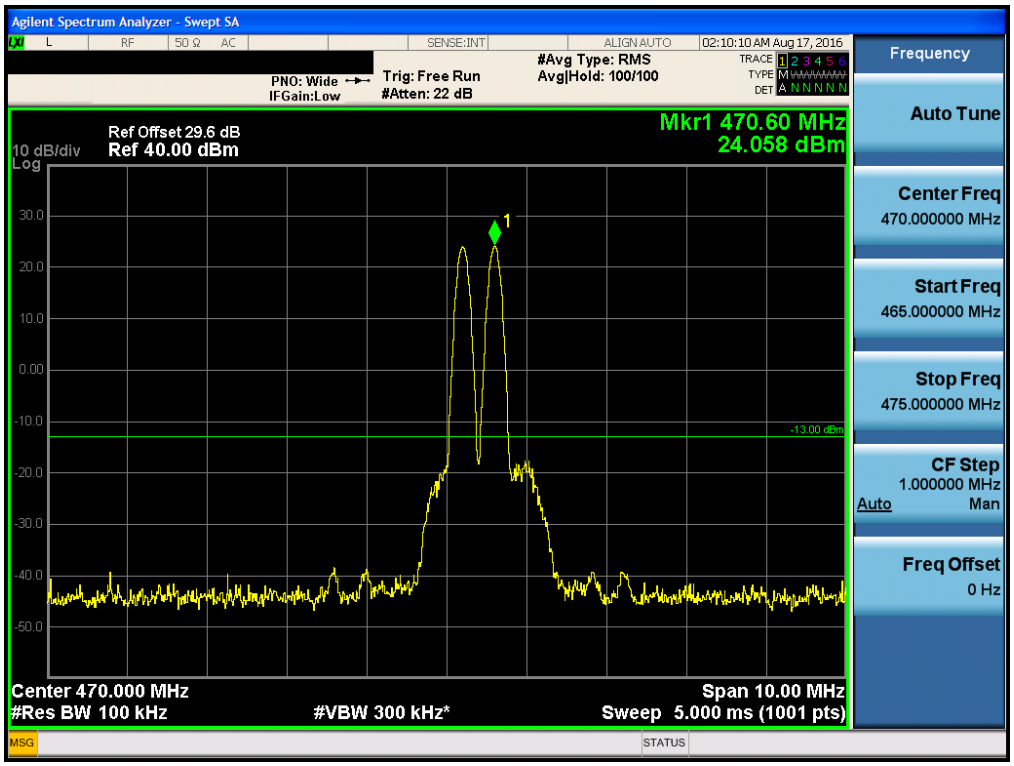
[UHF(LMR450) AGC threshold Uplink 450.5 MHz]



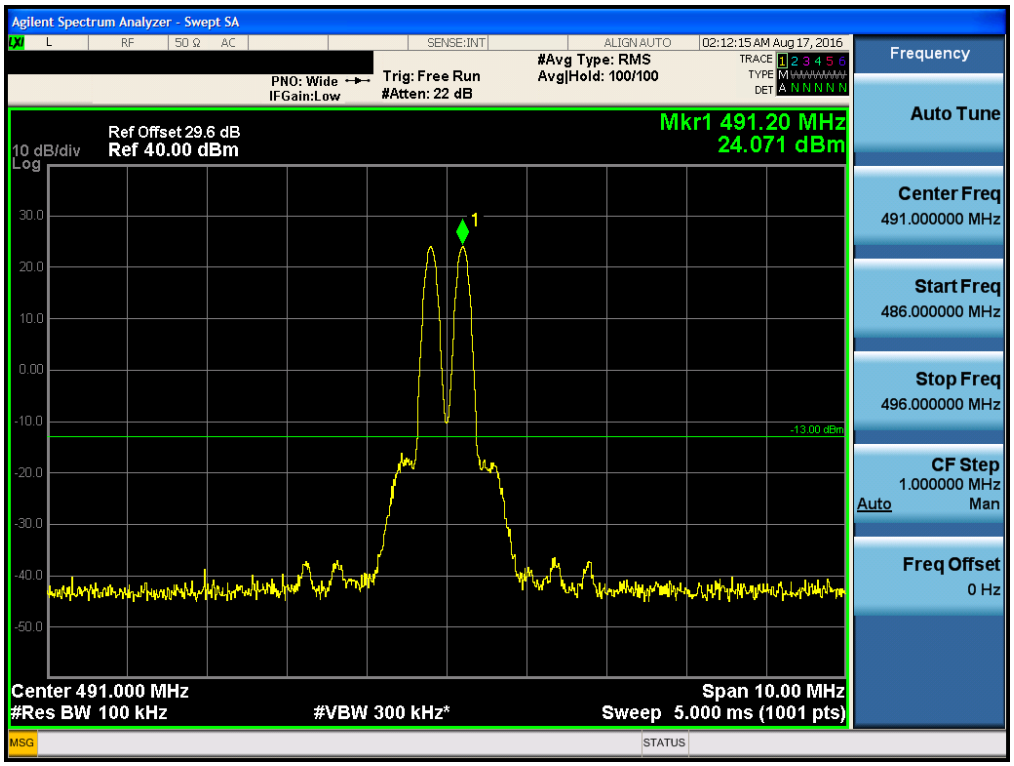
[UHF(LMR450) AGC threshold Uplink 469.5 MHz]



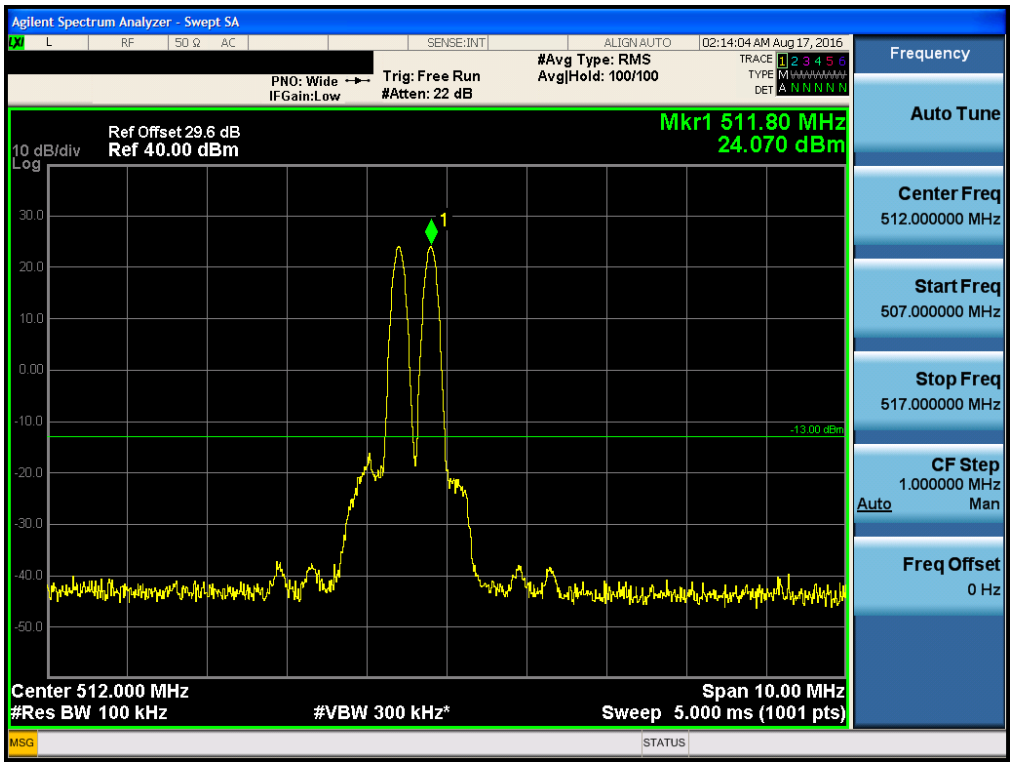
[UHF(LMR450) AGC threshold Uplink 470.5 MHz]



[UHF(LMR450) AGC threshold Uplink 491.0 MHz]



[UHF(LMR450) AGC threshold Uplink 511.5 MHz]



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.

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.

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 OBW.

f) The nominal resolution bandwidth (RBW) shall be in the range of 1% to 5 % of the anticipated OBW, and the VBW shall be ≥ 3 × 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 (OBW / RBW)] below the reference level.

NOTE—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) Use the 99 % power bandwidth function of the spectrum analyzer (if available) and report the measured bandwidth.

l) Repeat steps e) to k) with the input signal connected directly to the spectrum analyzer (i.e., input signal measurement).

m) Compare the spectral plot of the input signal (determined from step l) to the output signal (determined from step k) 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.
n) Repeat for all frequency bands authorized for use by the EUT.

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

Input Signal	Input Level (dBm)		Maximum Amp Gain	
	DL	UL	DL	UL
VHF(APCO25)	-57	-61	85	85
UHF(APCO25)	-48	-58	85	85
UHF(LMR450)	-58	-68	95	95

IC Rules

Test Requirements: RSS-GEN 4.6.1

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured.

Test Procedures: RSS-GEN 4.6.1

The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth.

Video averaging is not permitted. Where practical, a sampling detector shall be used given that a peak or peak hold may produce a wider bandwidth than actual.

The trace data points are recovered and directly summed in linear 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 and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded. The span between the two recorded frequencies is the occupied bandwidth.

[Downlink Output]

	Frequency (MHz)	OBW (kHz)
VHF(APCO25) AGC threshold	138.5	3.996
	150.5	3.998
	162.0	4.009
	173.5	4.011
VHF(APCO25) +3dB above AGC threshold	138.5	3.996
	150.5	4.013
	162.0	3.989
	173.5	4.009
UHF(APCO25) AGC threshold	406.6	3.997
	429.5	3.982
	450.5	3.985
	469.5	4.003
UHF(APCO25) +3dB above AGC threshold	406.6	4.017
	429.5	4.034
	450.5	4.007
	469.5	4.036

	Frequency (MHz)	OBW (kHz)
UHF(LMR450) AGC threshold	450.5	4.014
	469.5	4.014
	470.5	4.008
	491.0	4.009
	511.5	4.006
UHF(LMR450) +3dB above AGC threshold	450.5	4.014
	469.5	4.004
	470.5	4.012
	491.0	4.011
	511.5	4.010

[Uplink Output]

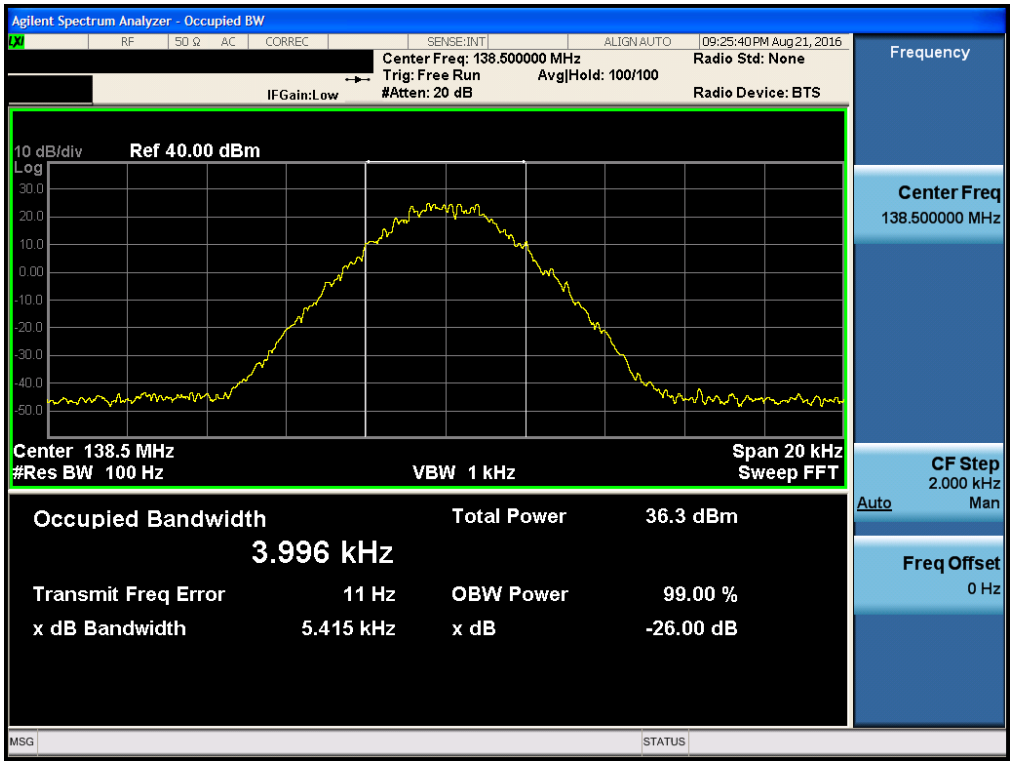
	Frequency (MHz)	OBW (kHz)
VHF(APCO25) AGC threshold	138.5	3.989
	150.5	3.989
	162.0	3.989
	173.5	3.988
VHF(APCO25) +3dB above AGC threshold	138.5	3.994
	150.5	3.993
	162.0	3.984
	173.5	3.986
UHF(APCO25) AGC threshold	406.6	4.038
	429.5	4.033
	450.5	4.015
	469.5	3.998
UHF(APCO25) +3dB above AGC threshold	406.6	4.003
	429.5	3.999
	450.5	4.033
	469.5	4.012

	Frequency (MHz)	OBW (kHz)
UHF(LMR450) AGC threshold	450.5	4.008
	469.5	4.009
	470.5	4.007
	491.0	4.010
	511.5	4.013
UHF(LMR450) +3dB above AGC threshold	450.5	4.001
	469.5	4.011
	470.5	4.016
	491.0	4.013
	511.5	4.011

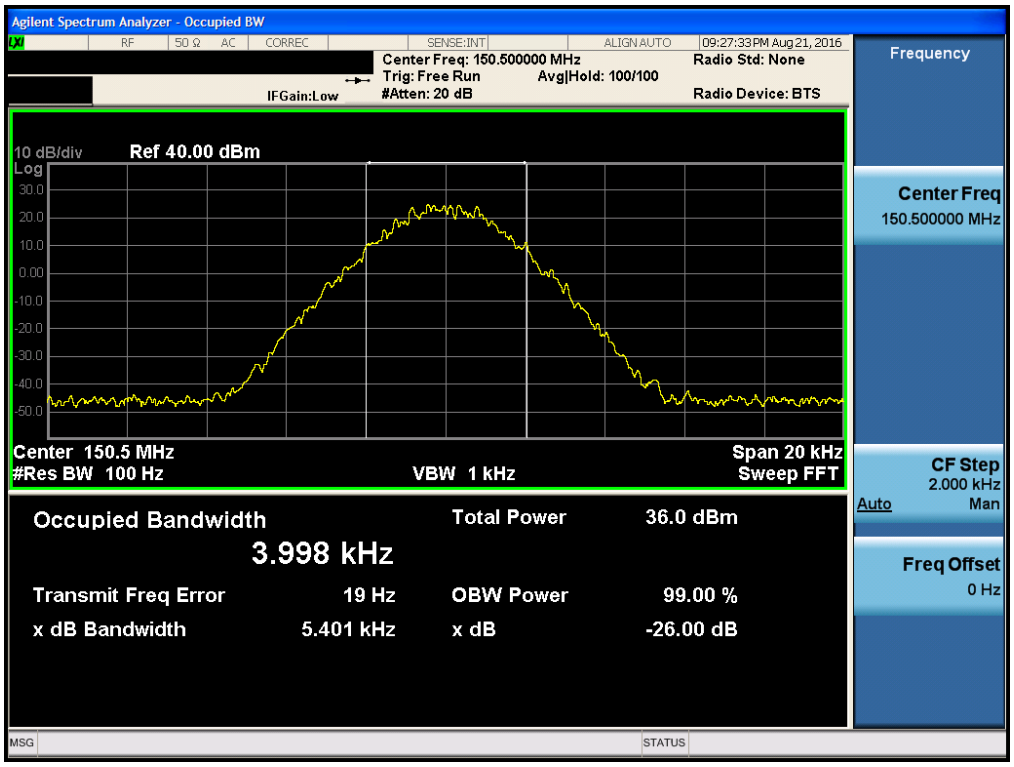
Plots of Occupied Bandwidth

VHF(APCO25) DL

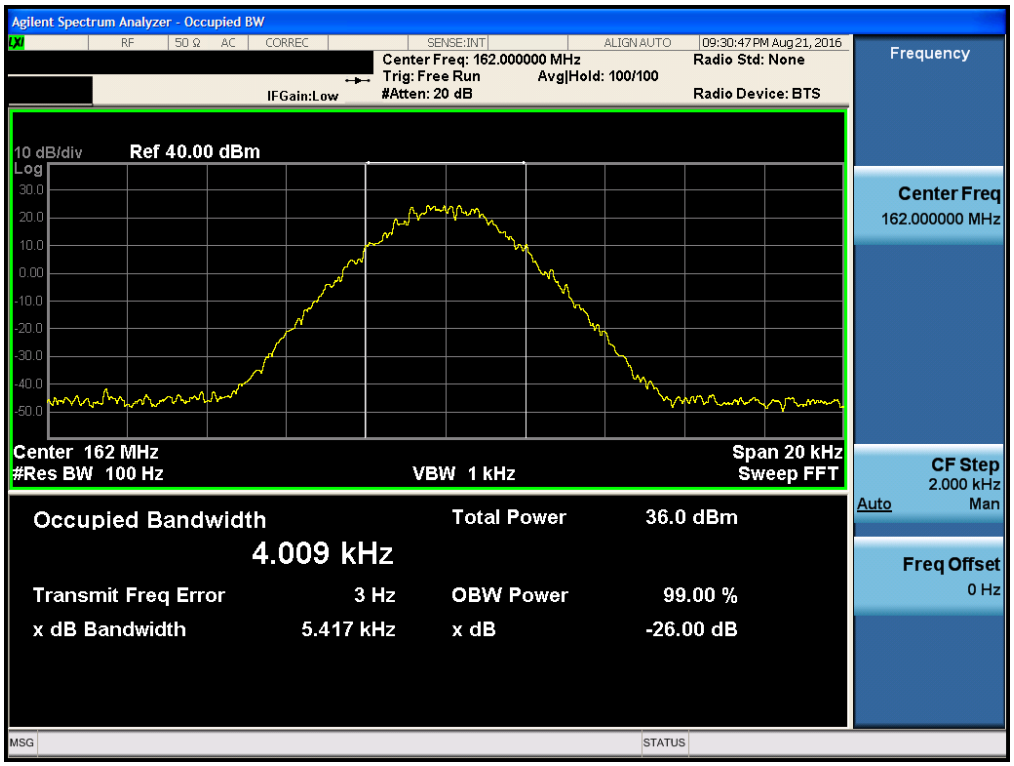
[VHF(APCO25) AGC threshold Downlink 138.5 MHz]



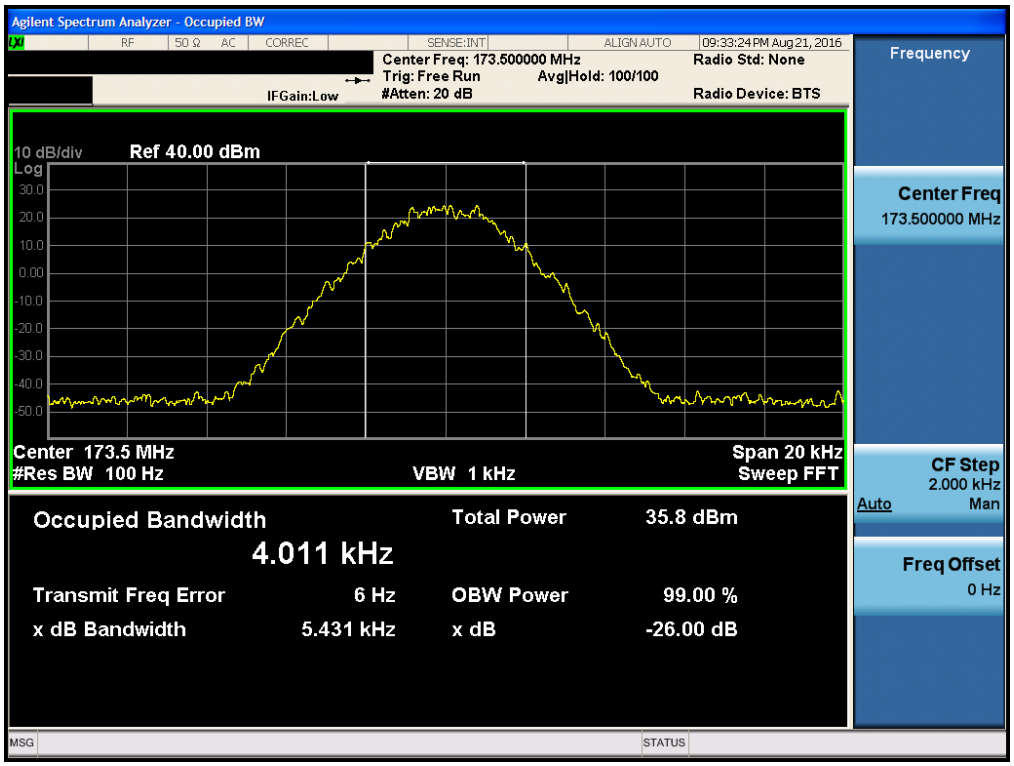
[VHF(APCO25) AGC threshold Downlink 150.5 MHz]



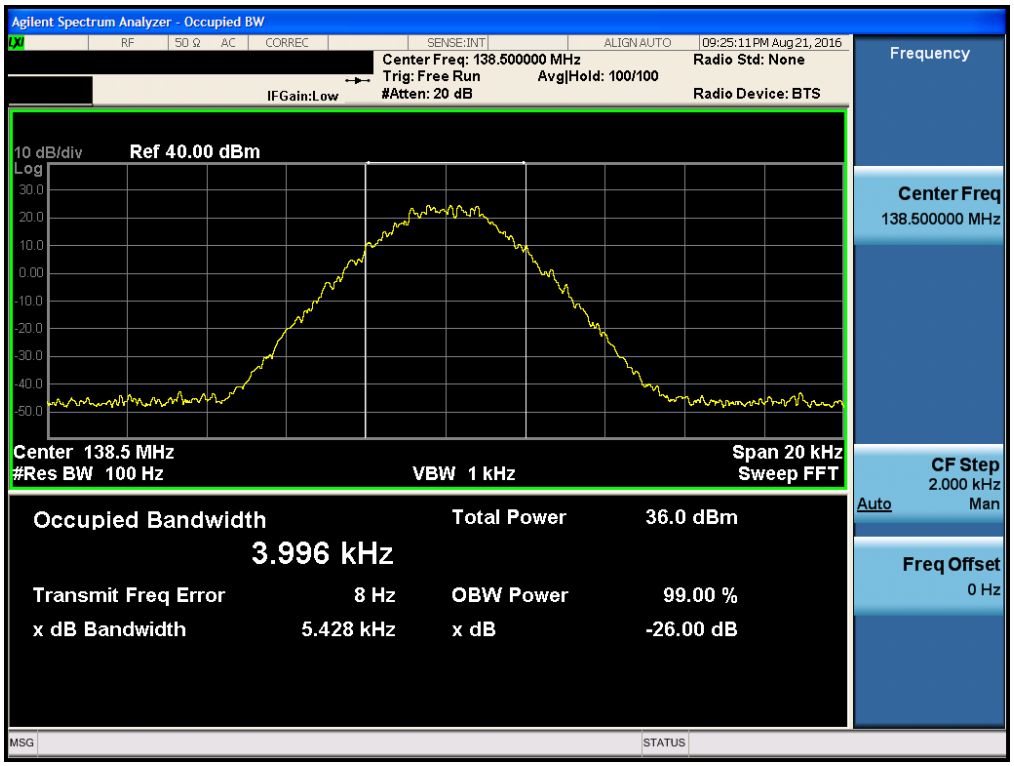
[VHF(APCO25) AGC threshold Downlink 162.0 MHz]



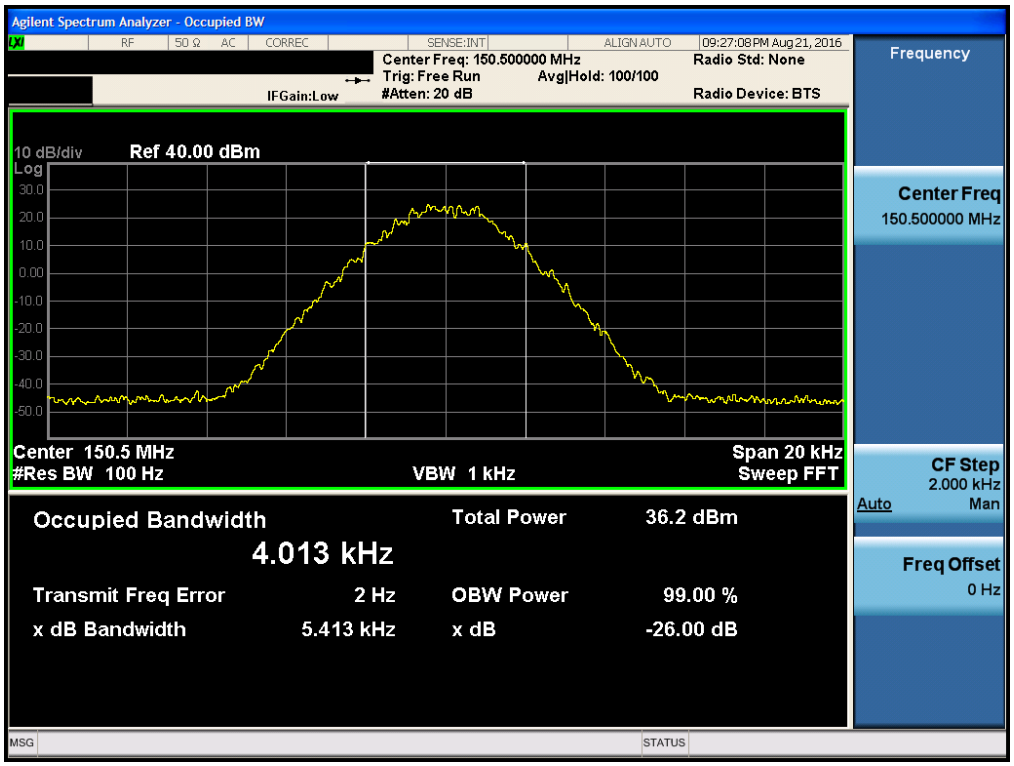
[VHF(APCO25) AGC threshold Downlink 173.5 MHz]



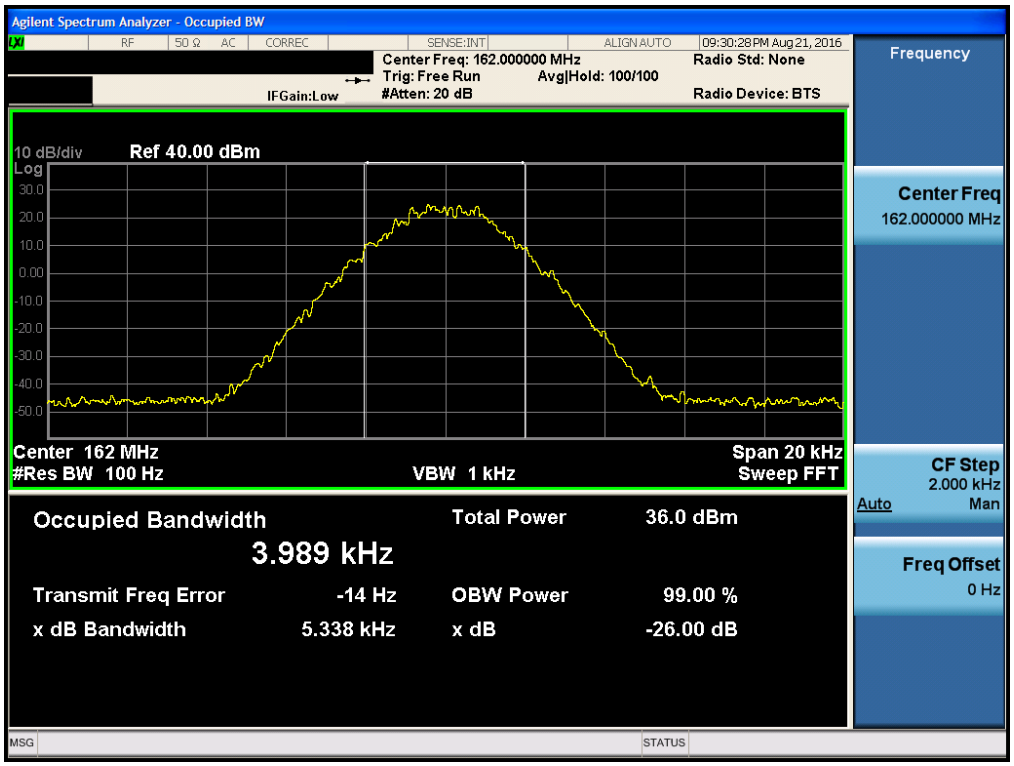
[VHF(APCO25) +3dB above the AGC threshold Downlink 138.5 MHz]



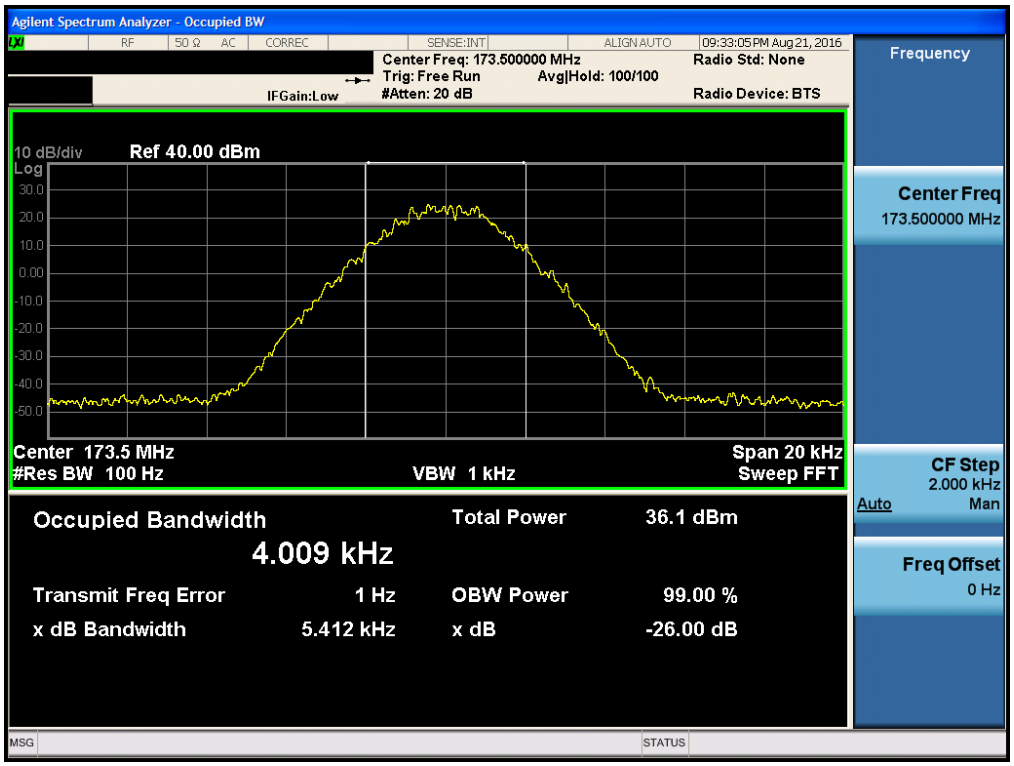
[VHF(APCO25) +3dB above the AGC threshold Downlink 150.5 MHz]



[VHF(APCO25) +3dB above the AGC threshold Downlink 162.0 MHz]



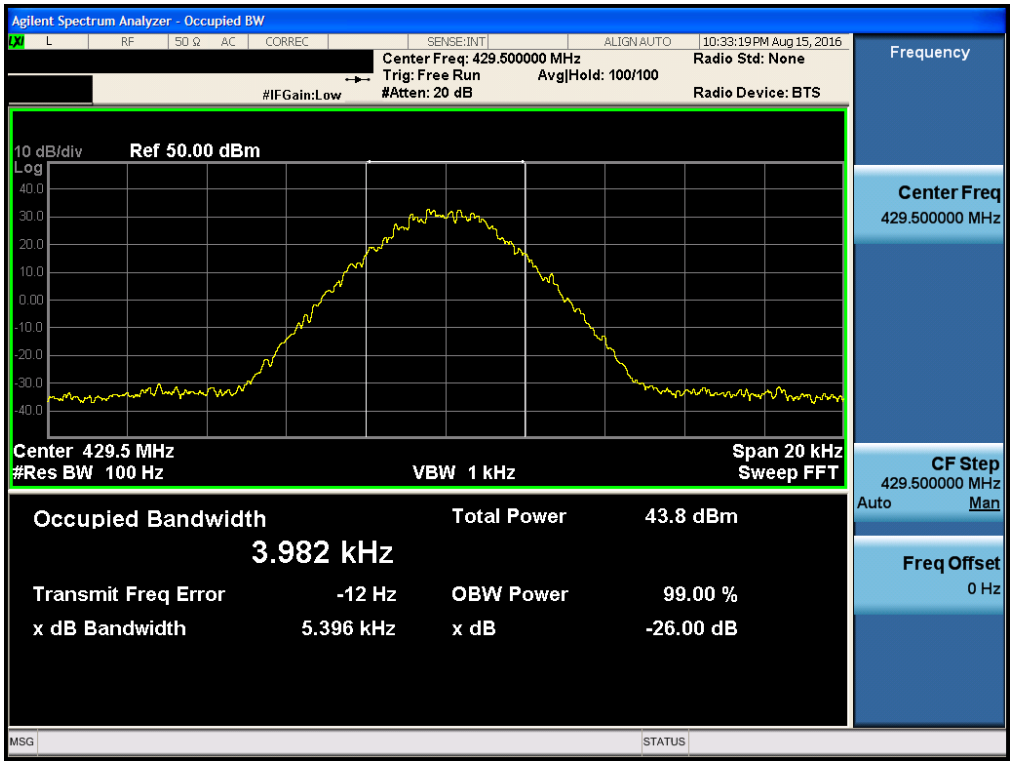
[VHF(APCO25) +3dB above the AGC threshold Downlink 173.5 MHz]



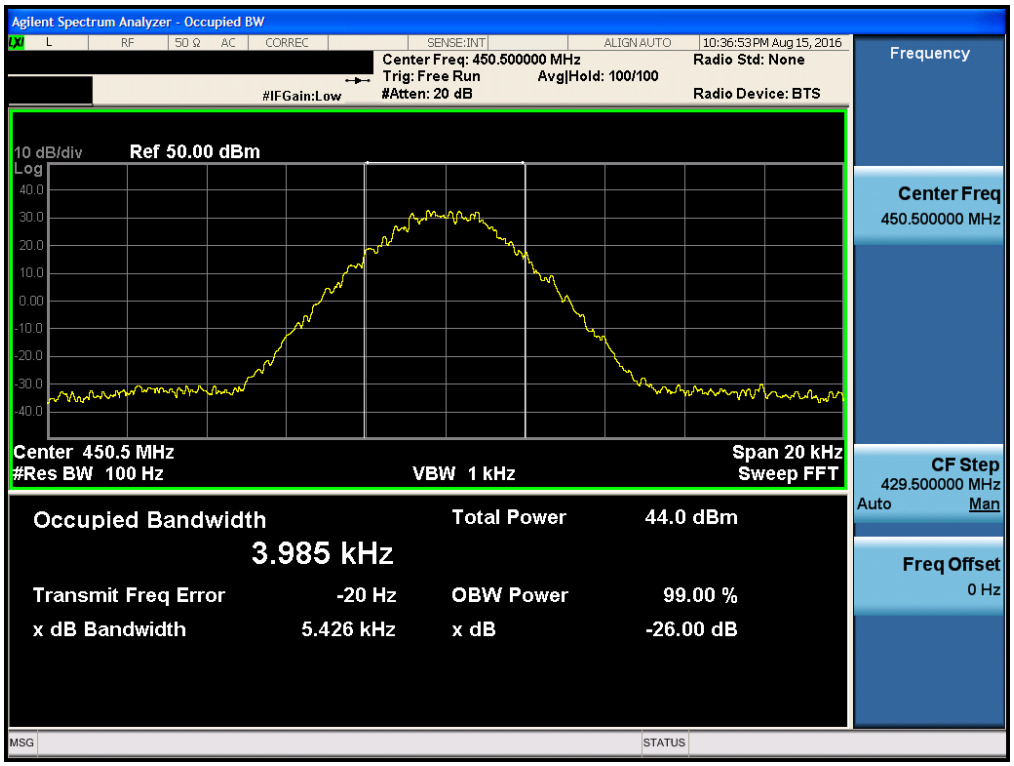
UHF(APCO25) DL

[UHF(APCO25) AGC threshold Downlink 406.6 MHz]

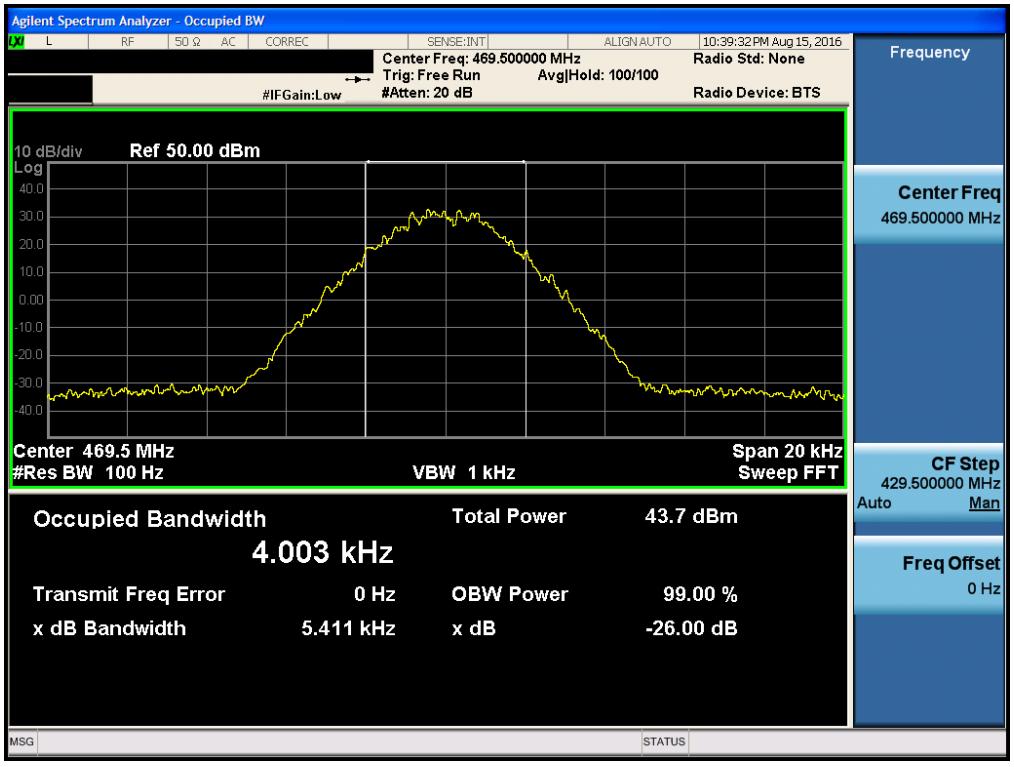
[UHF(APCO25) AGC threshold Downlink 429.5 MHz]



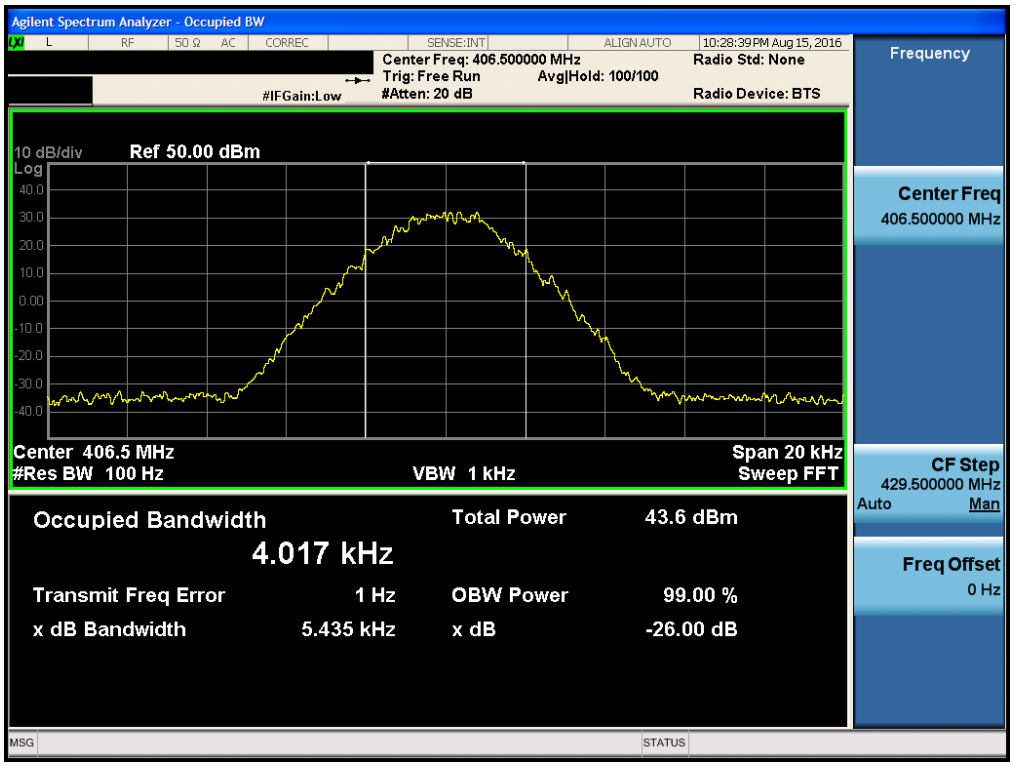
[UHF(APCO25) AGC threshold Downlink 450.5 MHz]



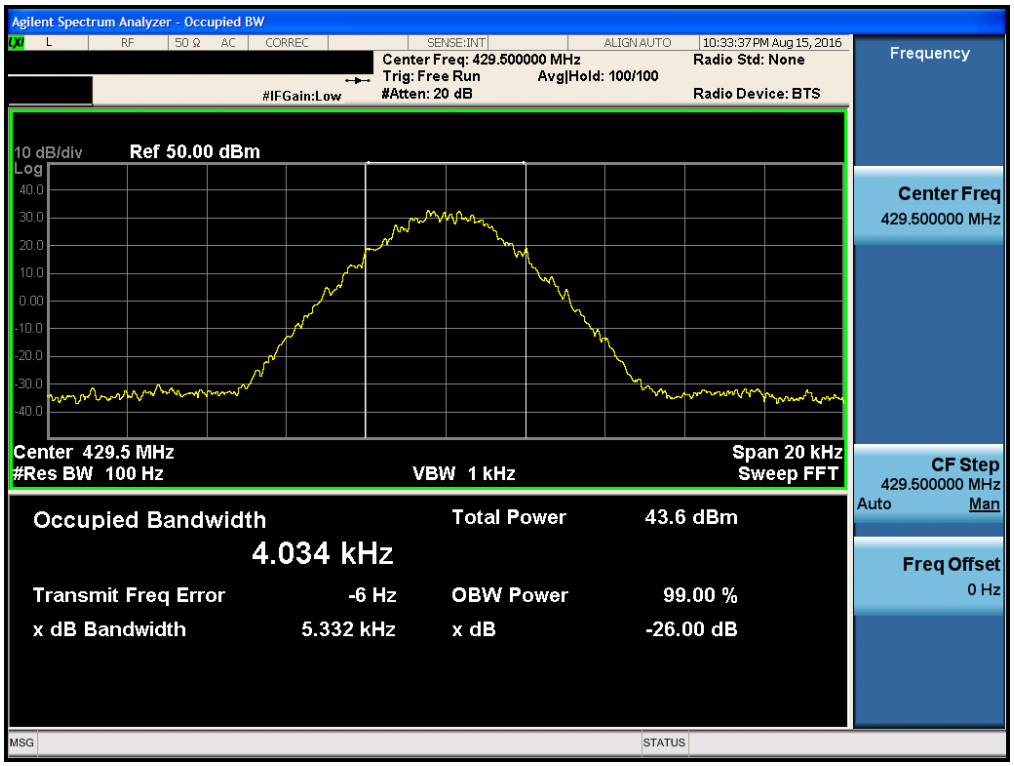
[UHF(APCO25) AGC threshold Downlink 469.5 MHz]



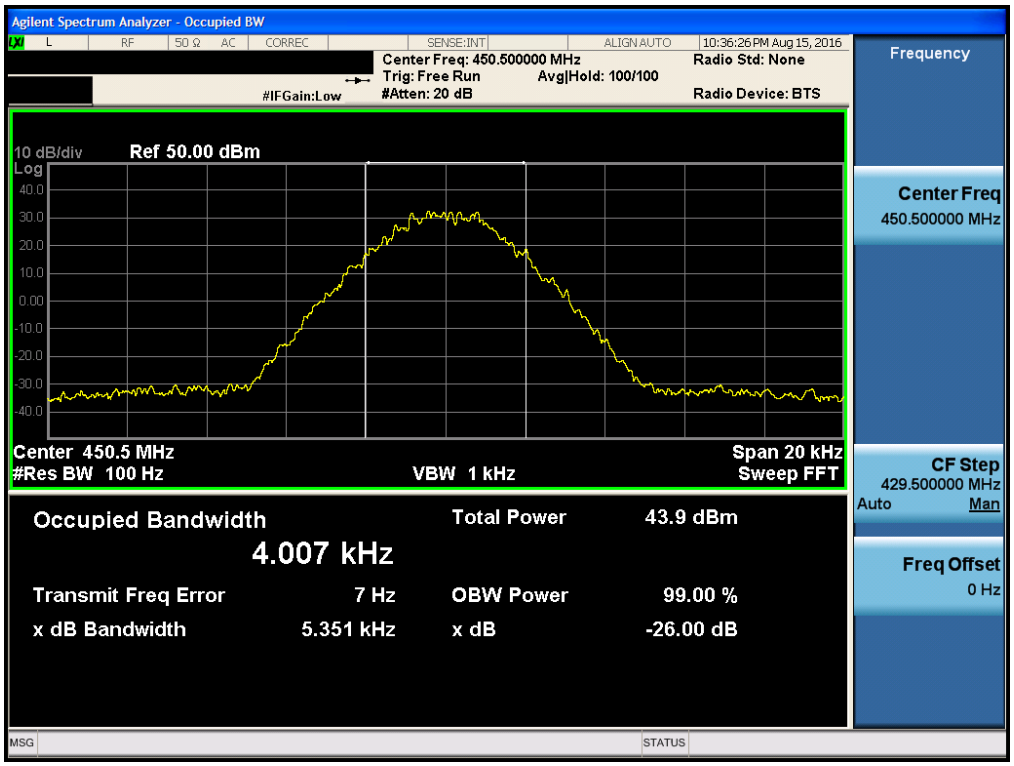
[UHF(APCO25) +3dB above the AGC threshold Downlink 406.6 MHz]



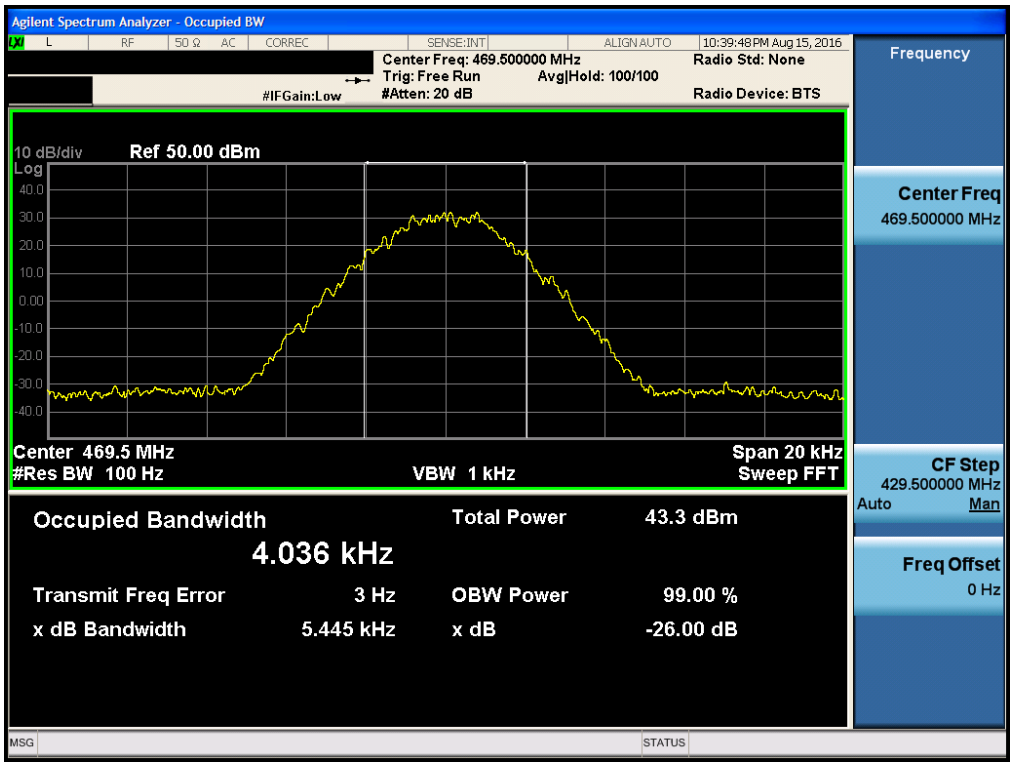
[UHF(APCO25) +3dB above the AGC threshold Downlink 429.5 MHz]



[UHF(APCO25) +3dB above the AGC threshold Downlink 450.5 MHz]

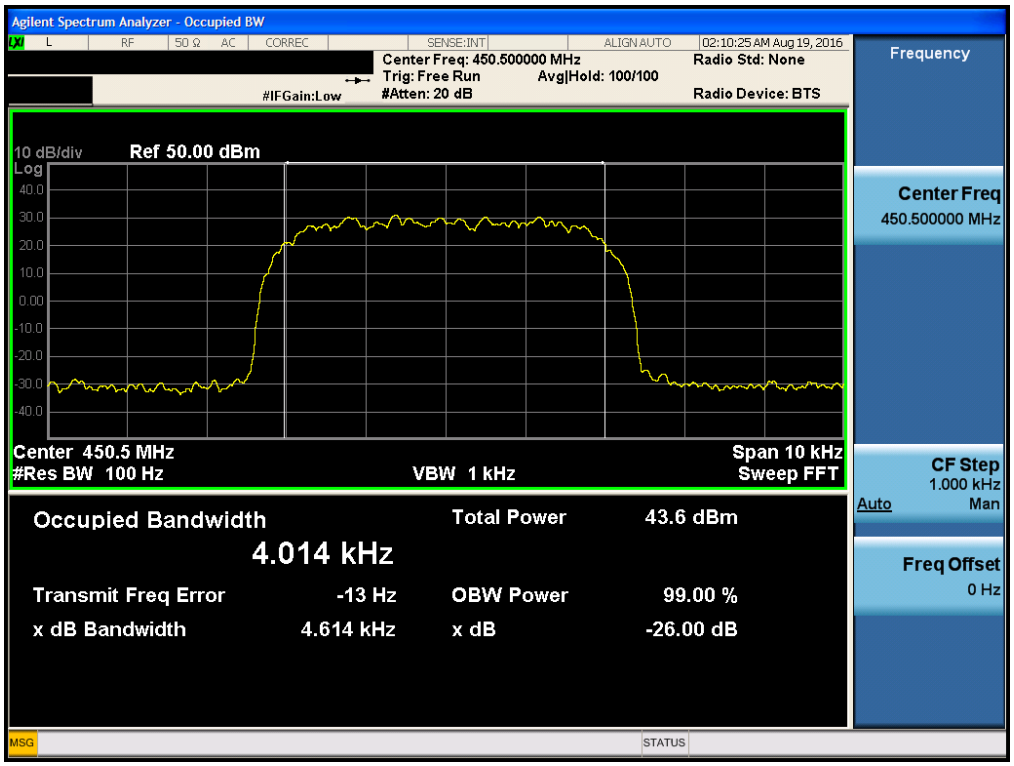


[UHF(APCO25) +3dB above the AGC threshold Downlink 469.5 MHz]

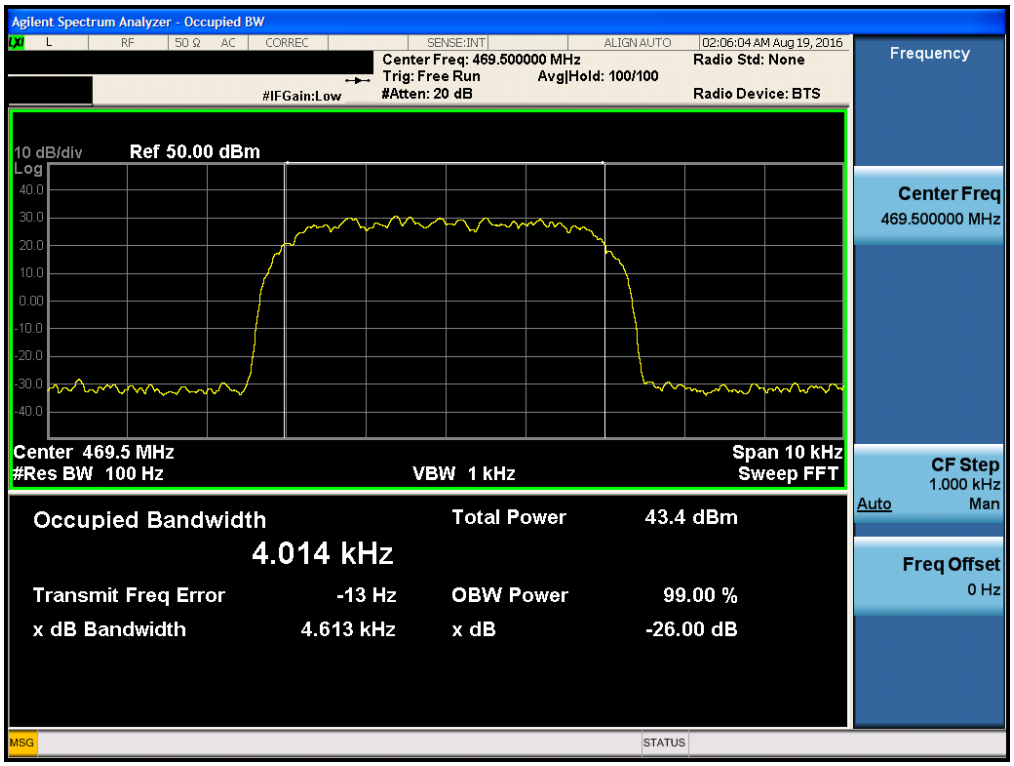


UHF(LMR450) DL

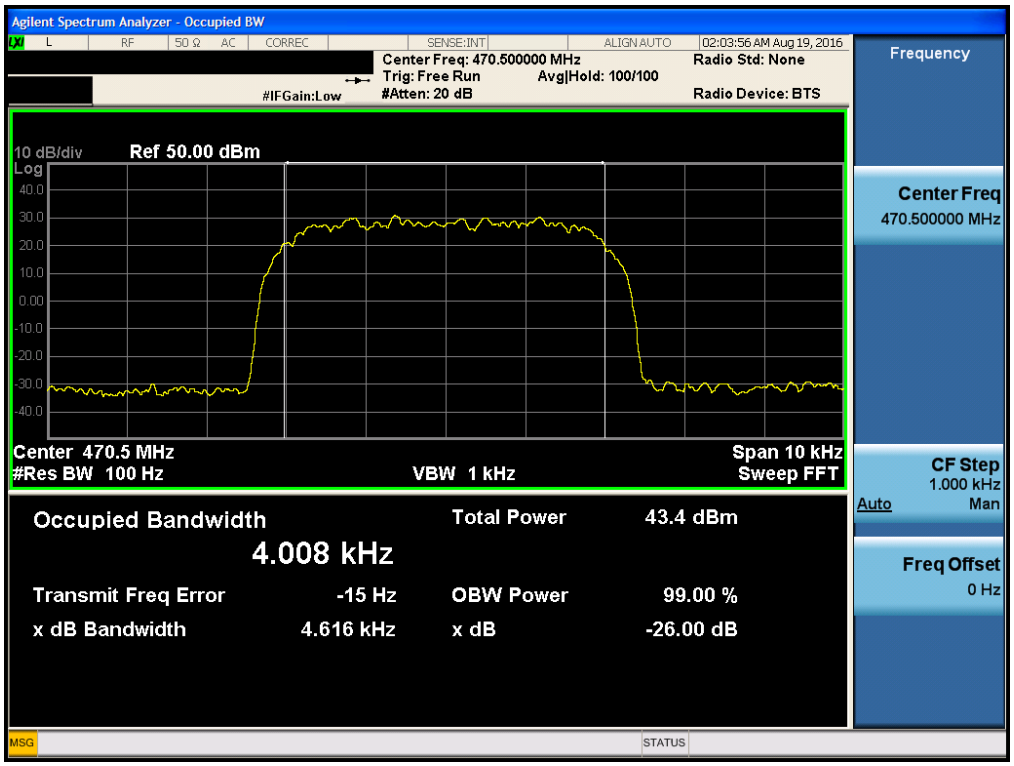
[UHF(LMR450) AGC threshold Downlink 450.5 MHz]



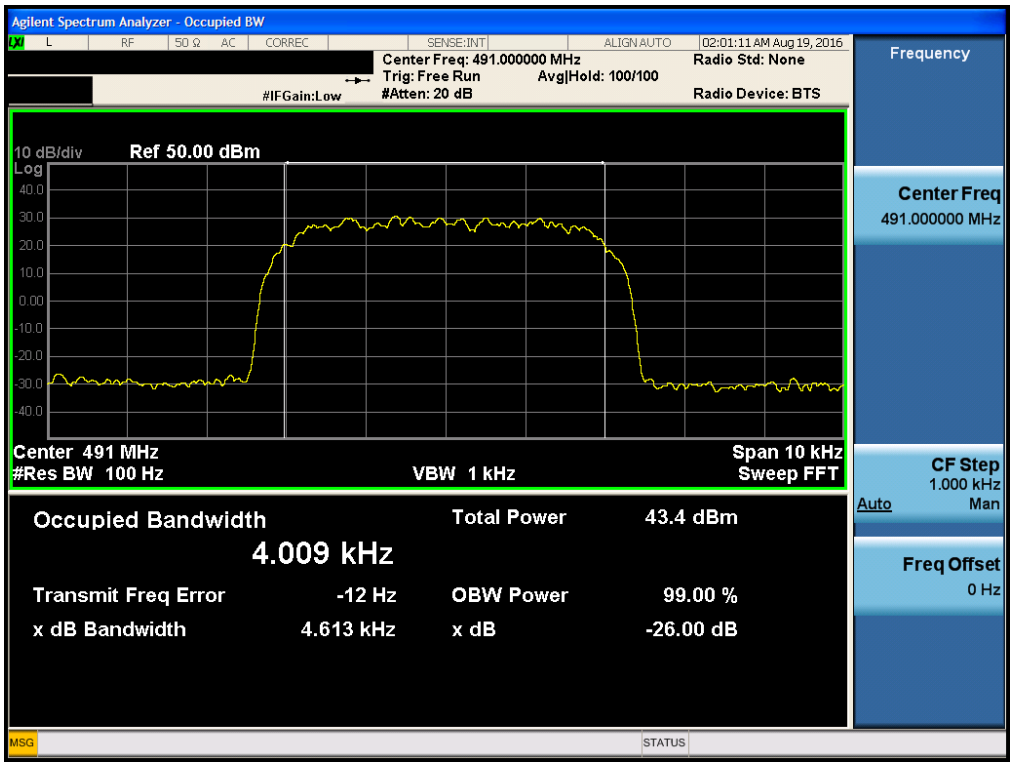
[UHF(LMR450) AGC threshold Downlink 469.5 MHz]



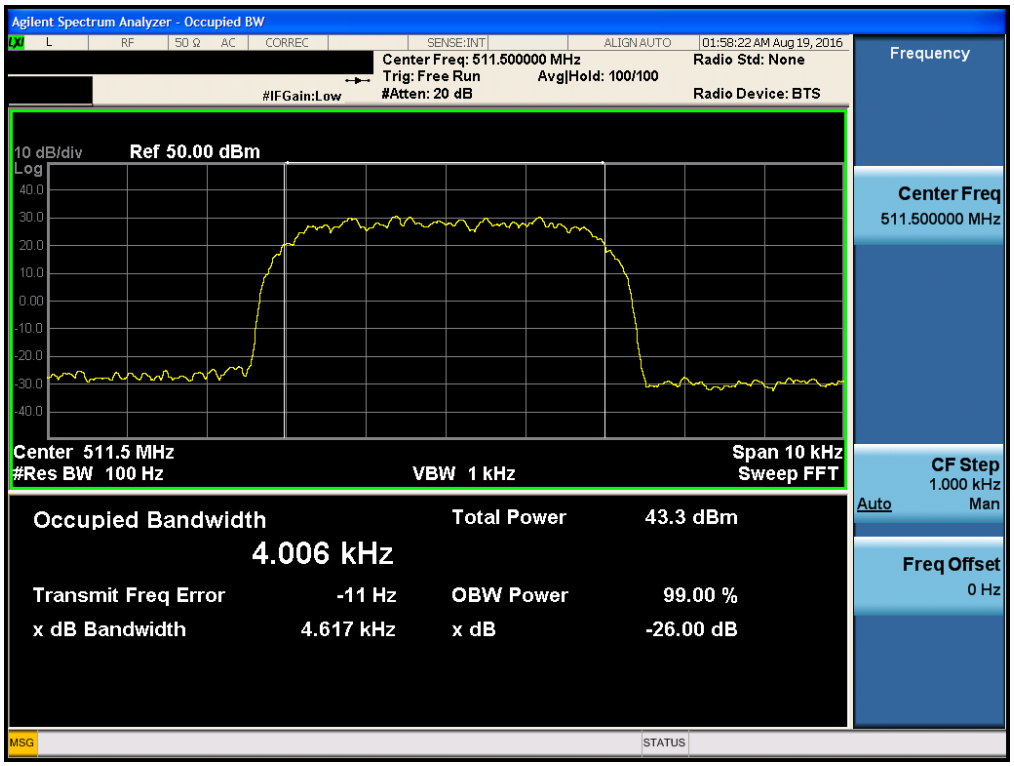
[UHF(LMR450) AGC threshold Downlink 470.5 MHz]



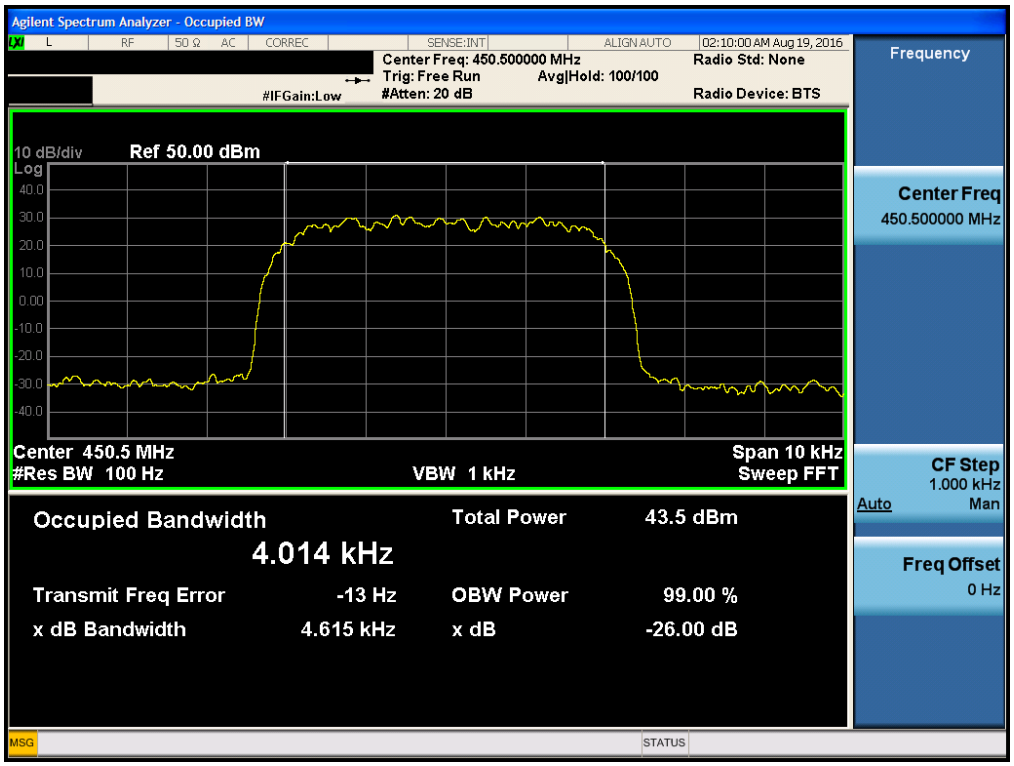
[UHF(LMR450) AGC threshold Downlink 491.0 MHz]



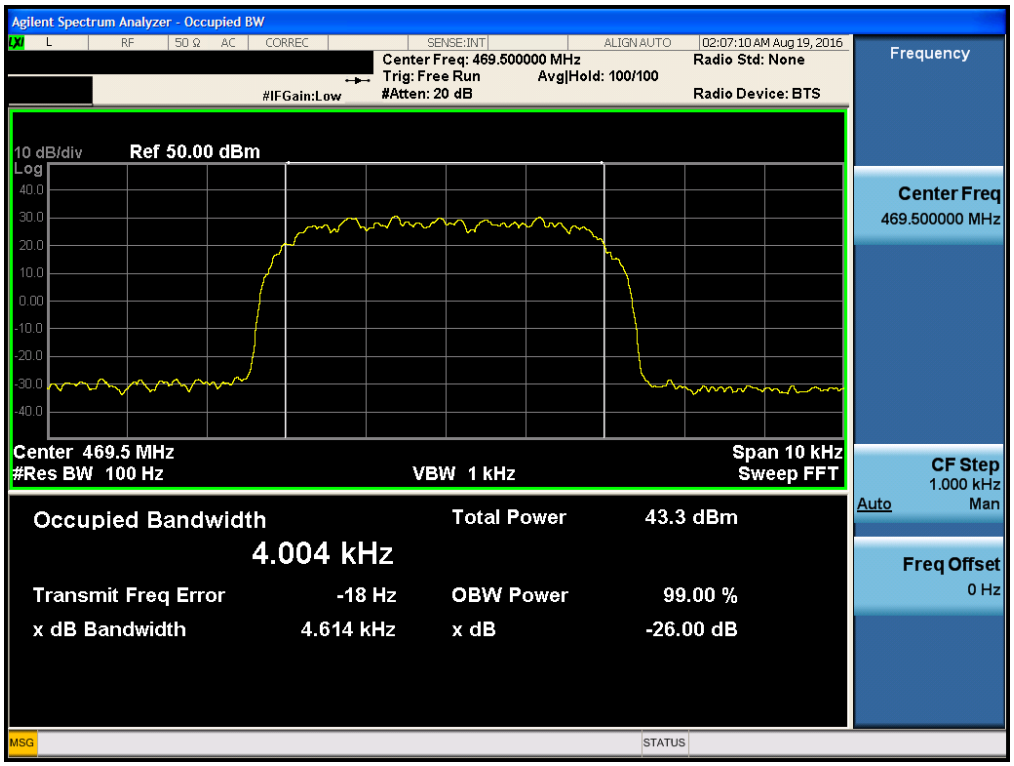
[UHF(LMR450) AGC threshold Downlink 511.5 MHz]



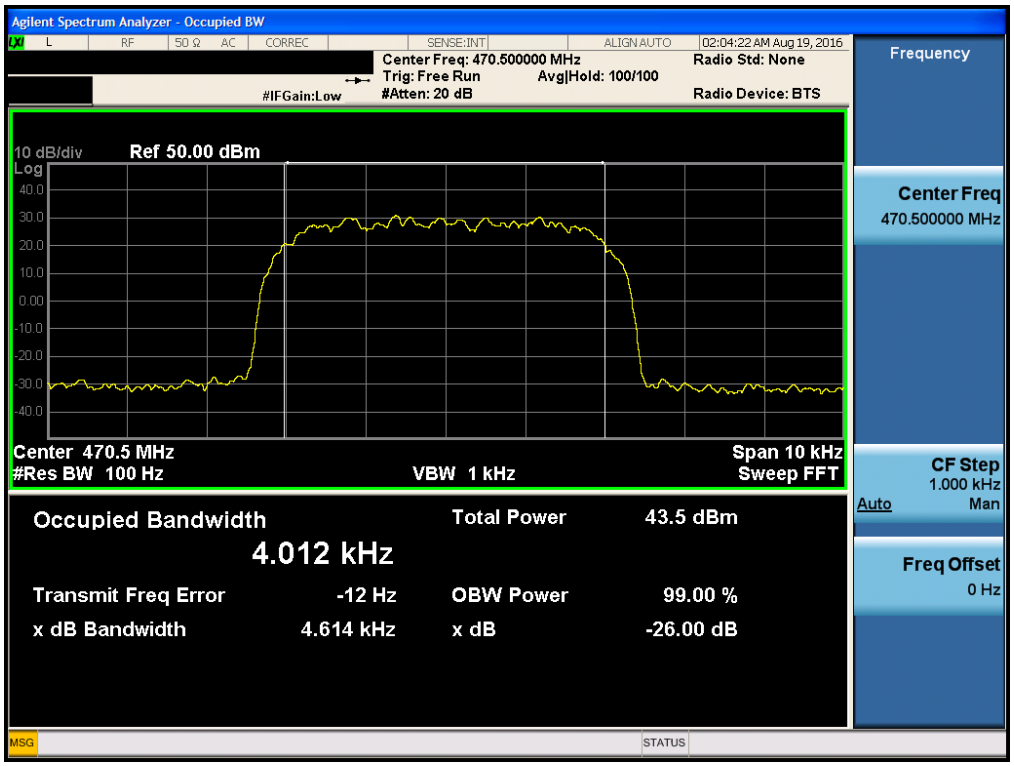
[UHF(LMR450) +3dB above the AGC threshold Downlink 450.5 MHz]



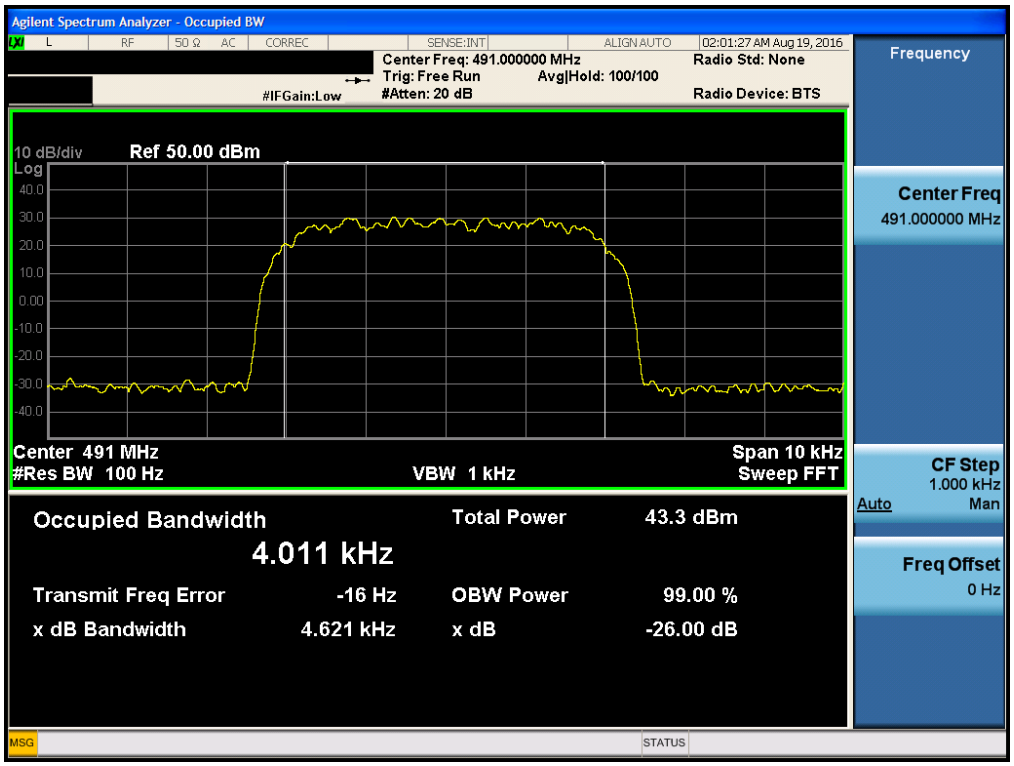
[UHF(LMR450) +3dB above the AGC threshold Downlink 469.5 MHz]



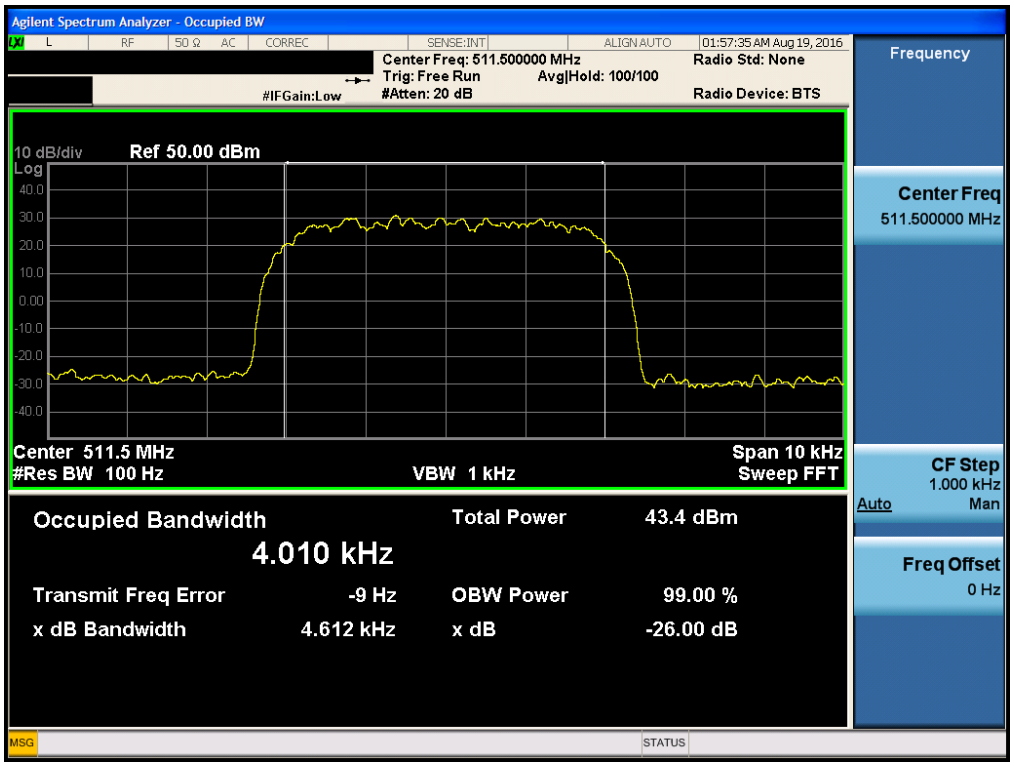
[UHF(LMR450) +3dB above the AGC threshold Downlink 470.5 MHz]



[UHF(LMR450) +3dB above the AGC threshold Downlink 491.0 MHz]

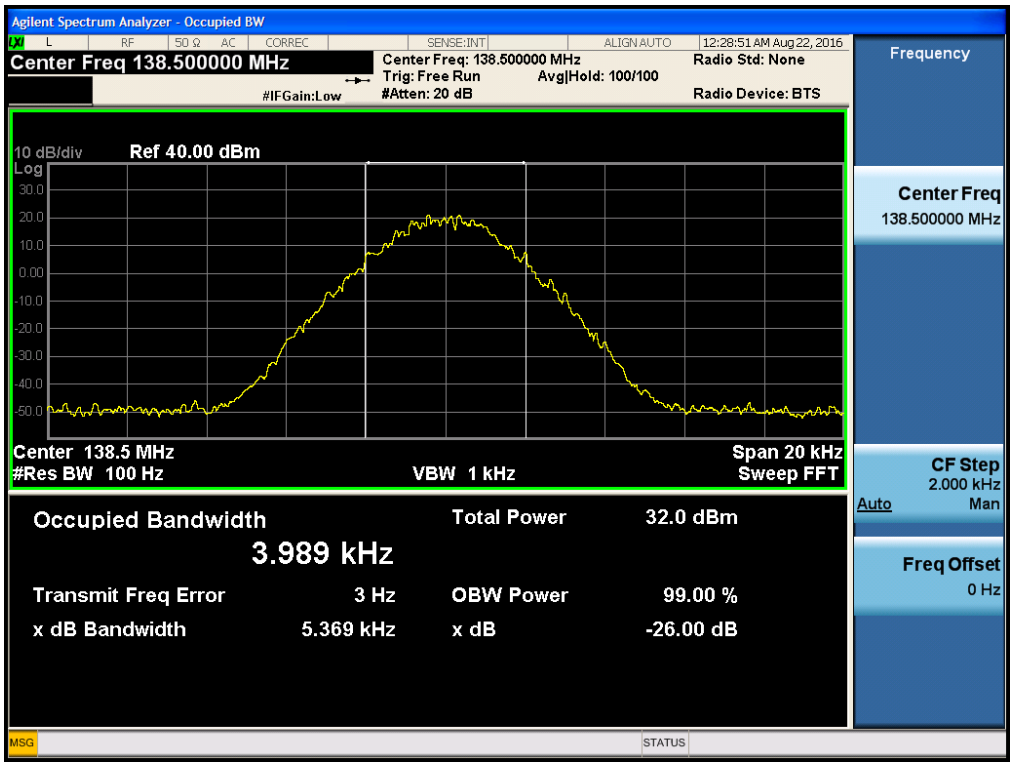


[UHF(LMR450) +3dB above the AGC threshold Downlink 511.5 MHz]

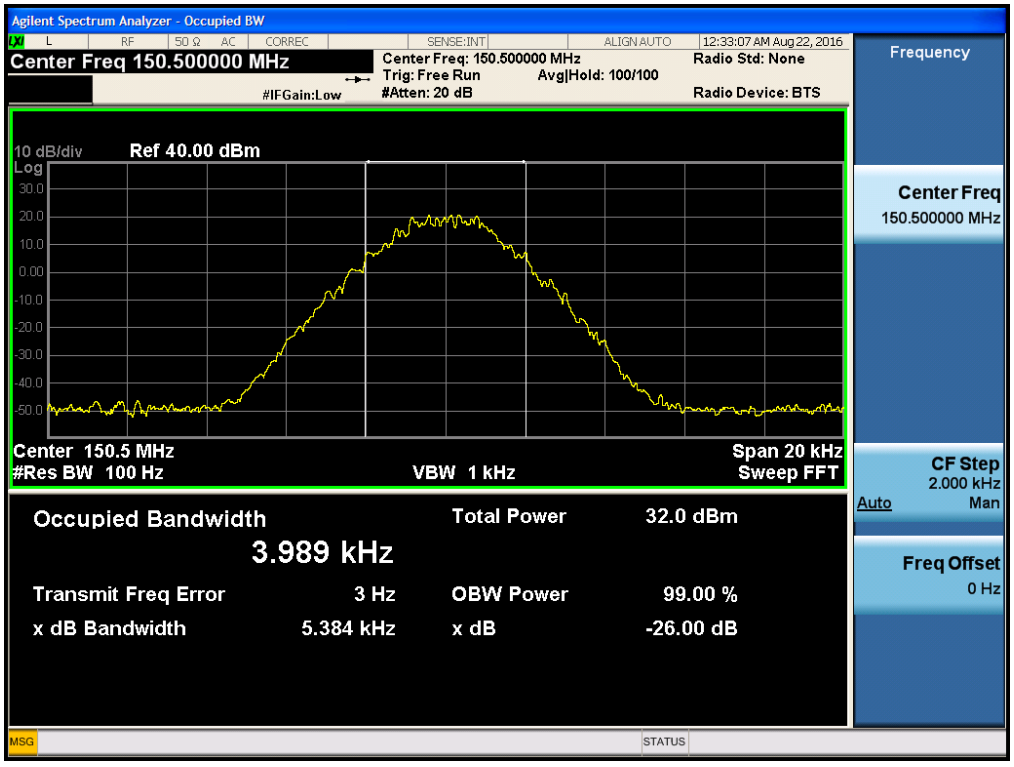


VHF(APCO25) UL

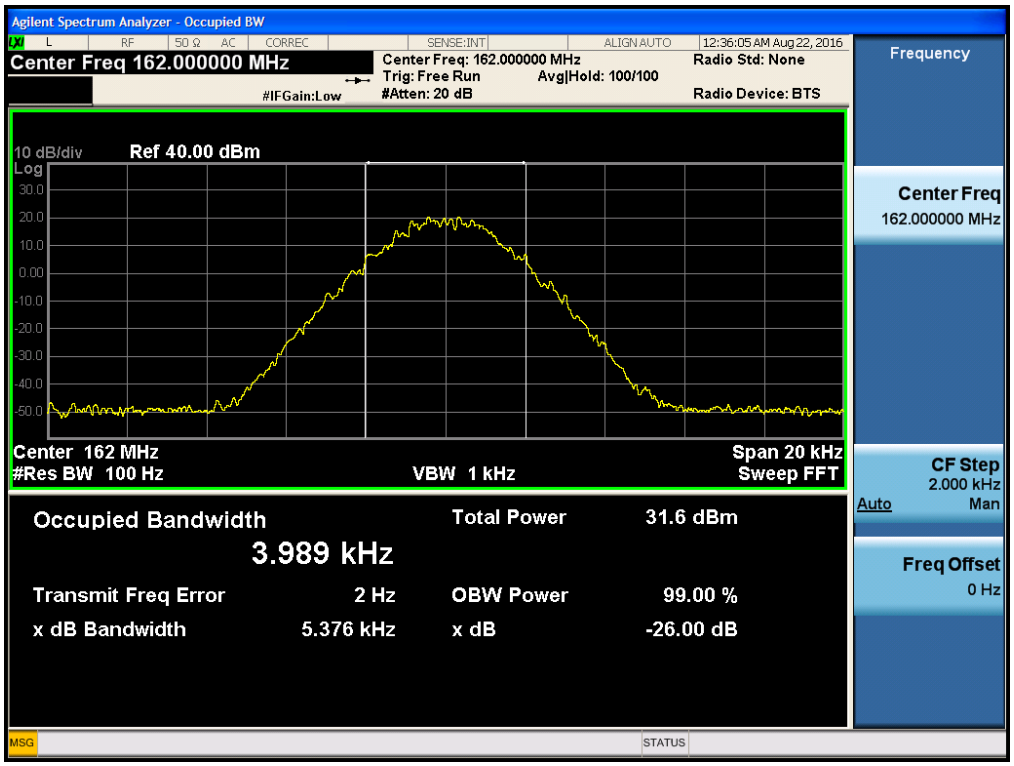
[VHF(APCO25) AGC threshold Uplink 138.5 MHz]



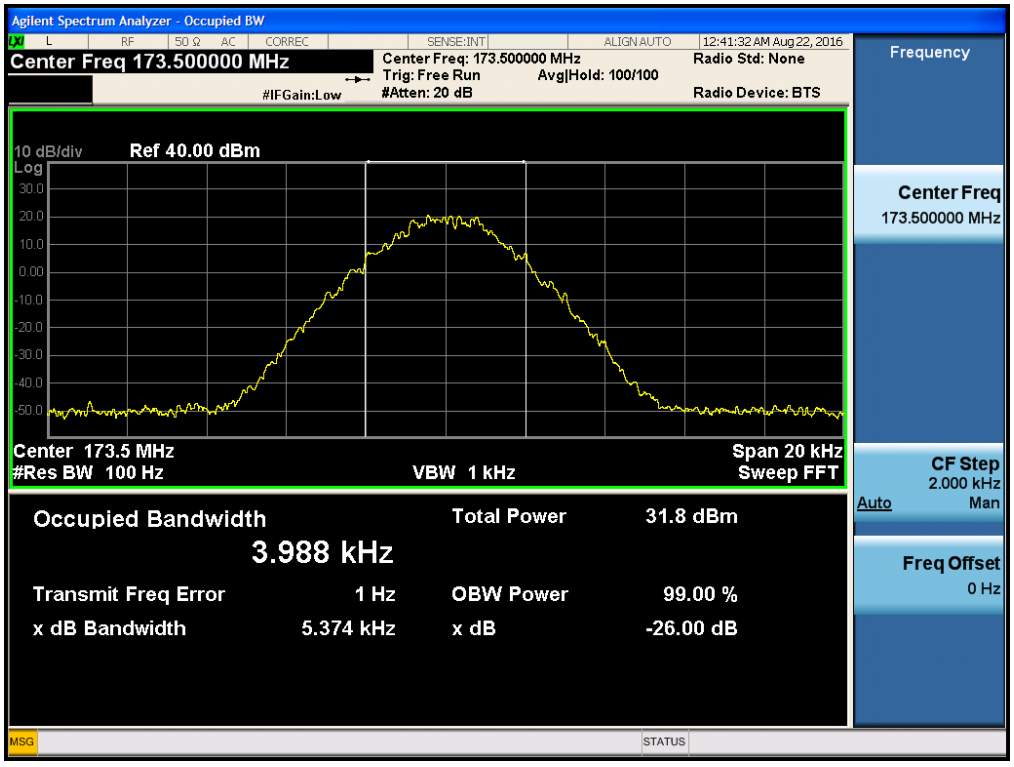
[VHF(APCO25) AGC threshold Uplink 150.5 MHz]



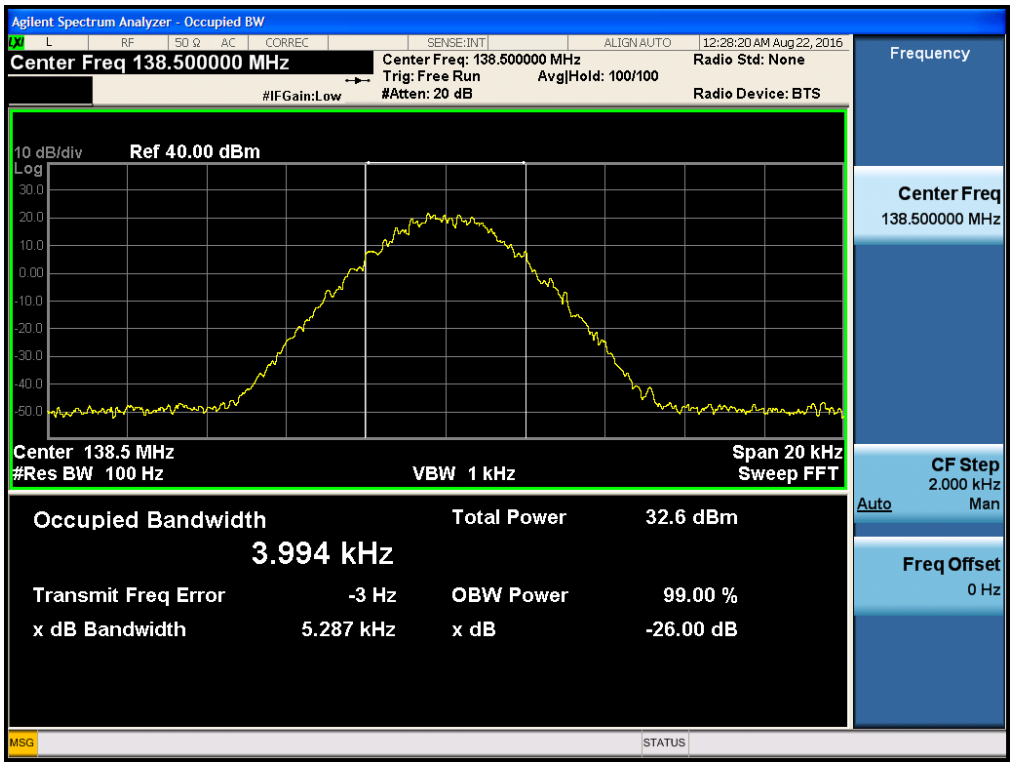
[VHF(APCO25) AGC threshold Uplink 162.0 MHz]



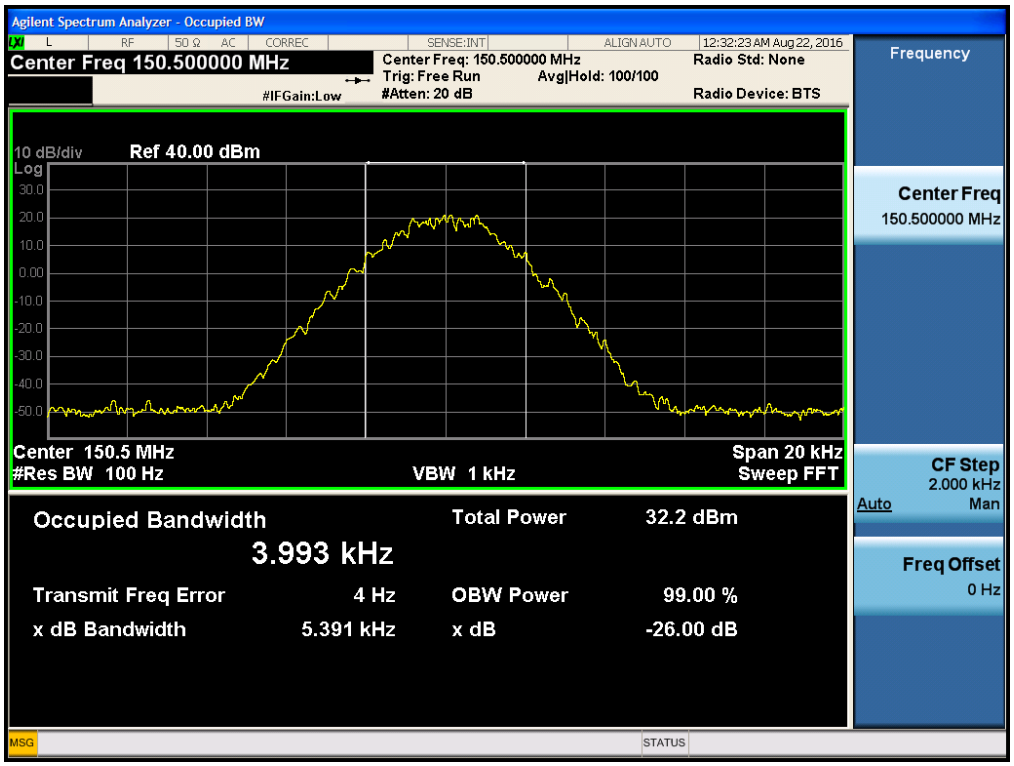
[VHF(APCO25) AGC threshold Uplink 173.5 MHz]



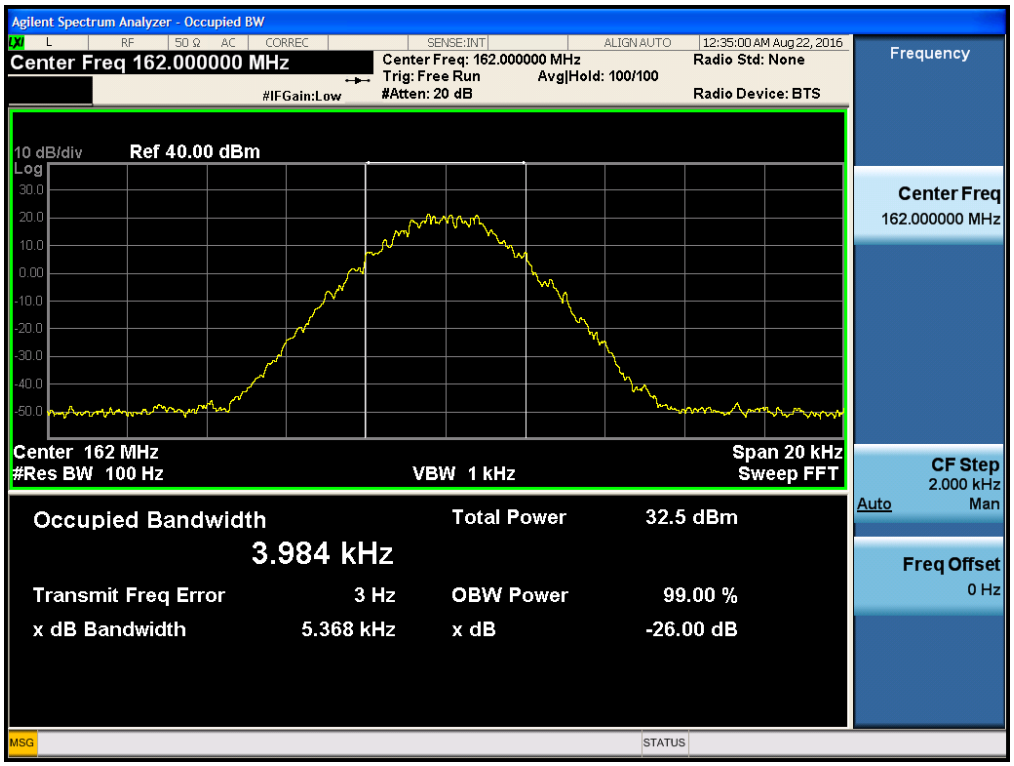
[VHF(APCO25) +3dB above the AGC threshold Uplink 138.5 MHz]



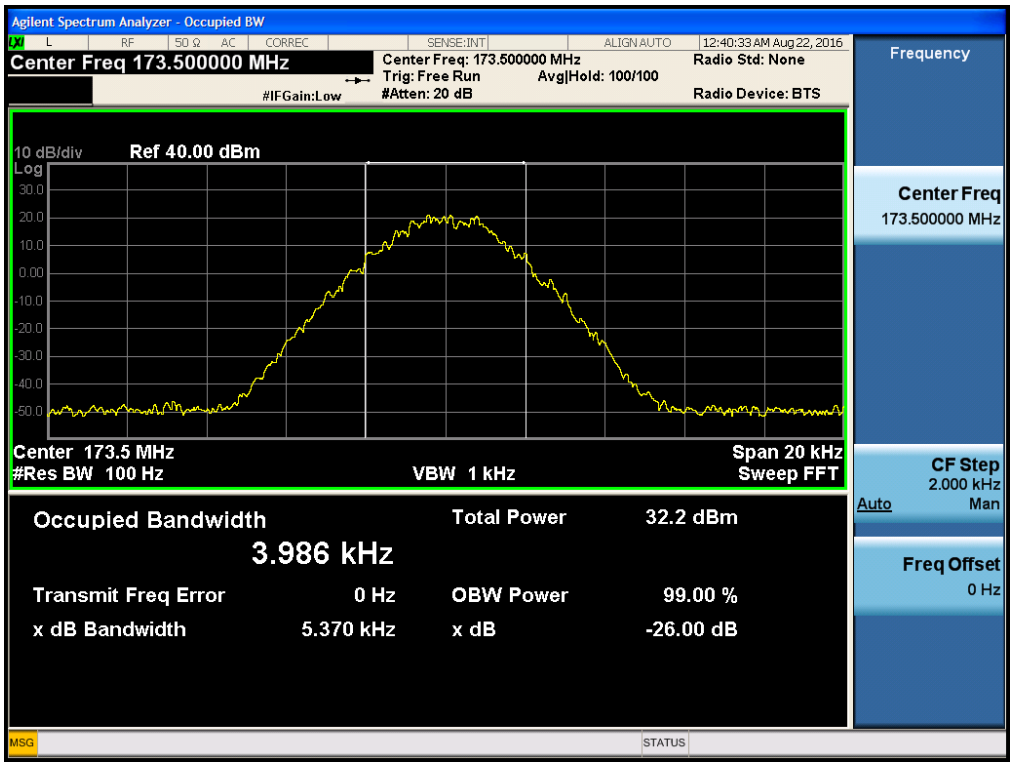
[VHF(APCO25) +3dB above the AGC threshold Uplink 150.5 MHz]



[VHF(APCO25) +3dB above the AGC threshold Uplink 162.0 MHz]

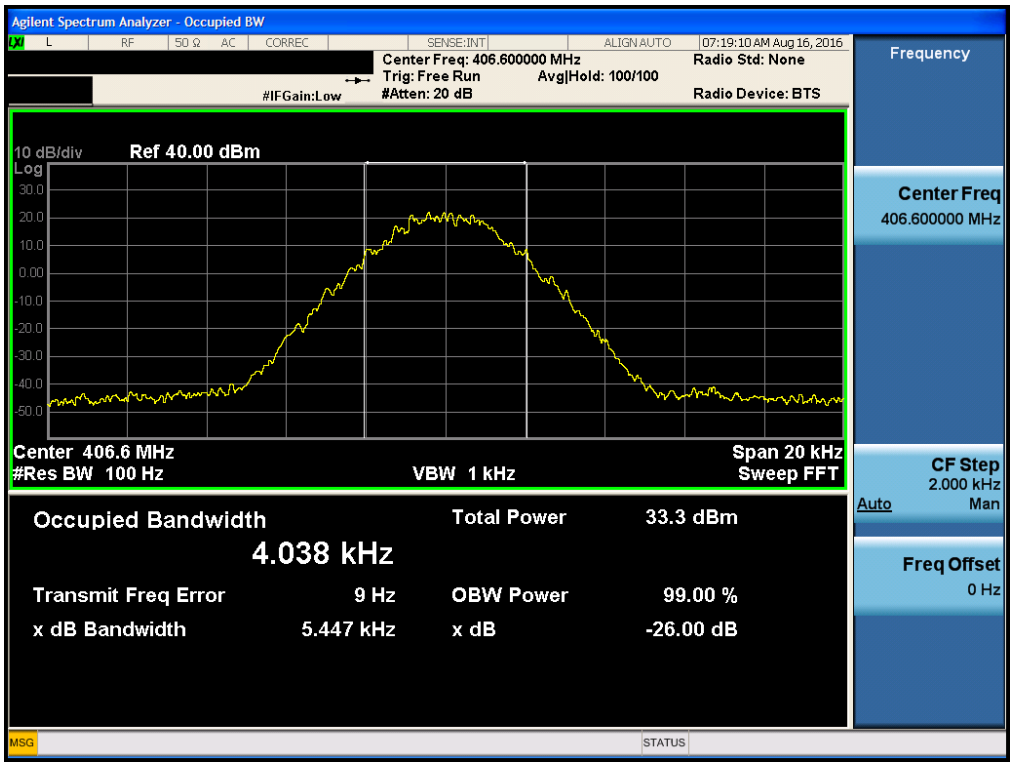


[VHF(APCO25) +3dB above the AGC threshold Uplink 173.5 MHz]

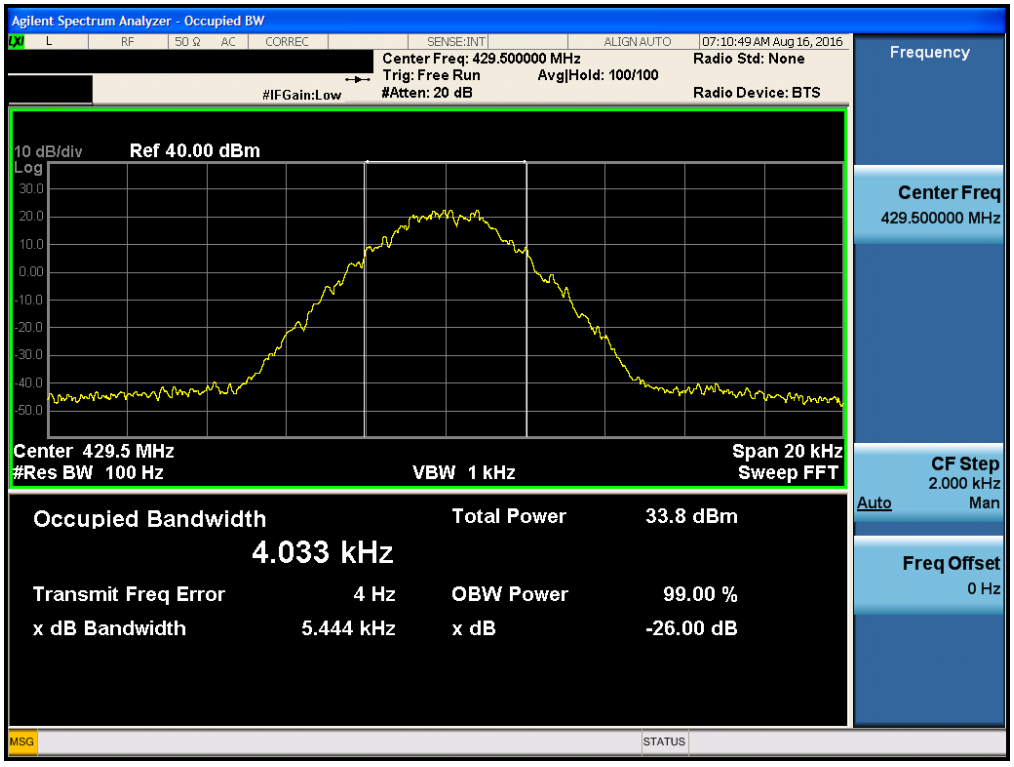


UHF(APCO25) UL

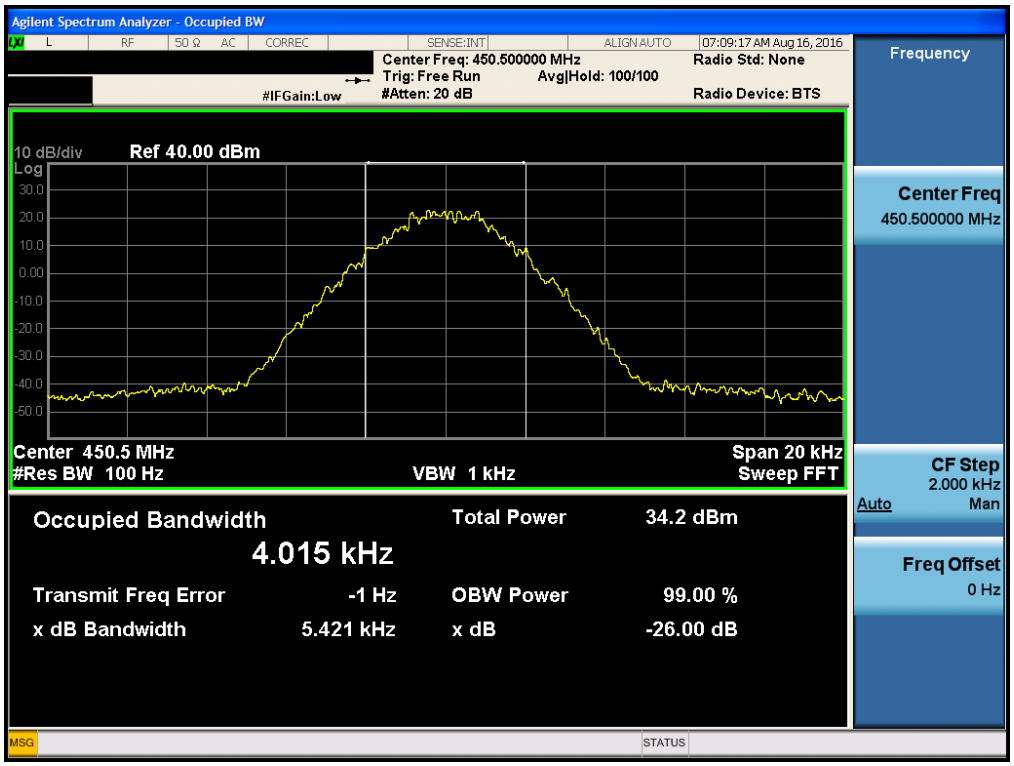
[UHF(APCO25) AGC threshold Uplink 406.6 MHz]



[UHF(APCO25) AGC threshold Uplink 429.5 MHz]

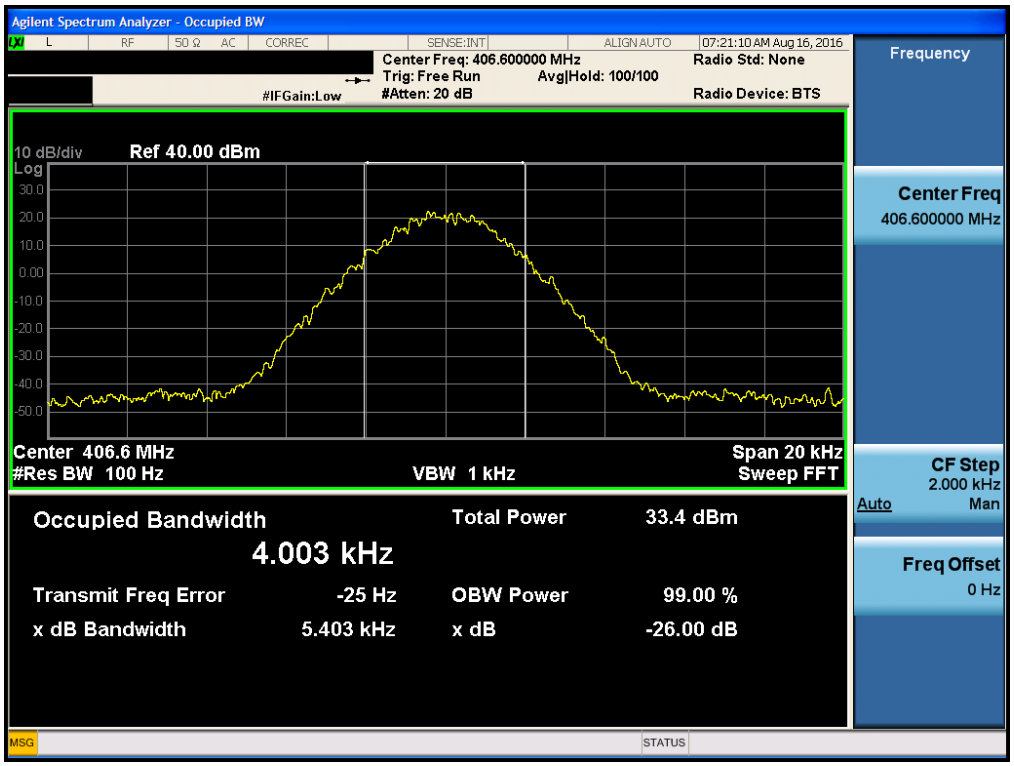


[UHF(APCO25) AGC threshold Uplink 450.5 MHz]



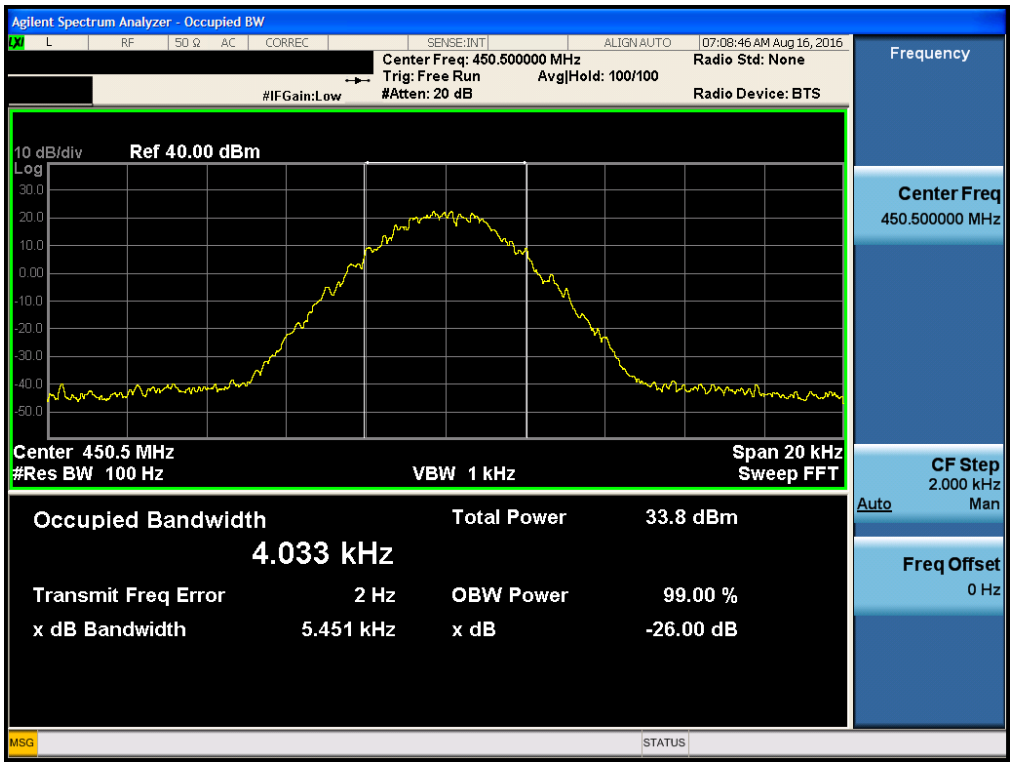
[UHF(APCO25) AGC threshold Uplink 469.5 MHz]

[UHF(APCO25) +3dB above the AGC threshold Uplink 406.6 MHz]

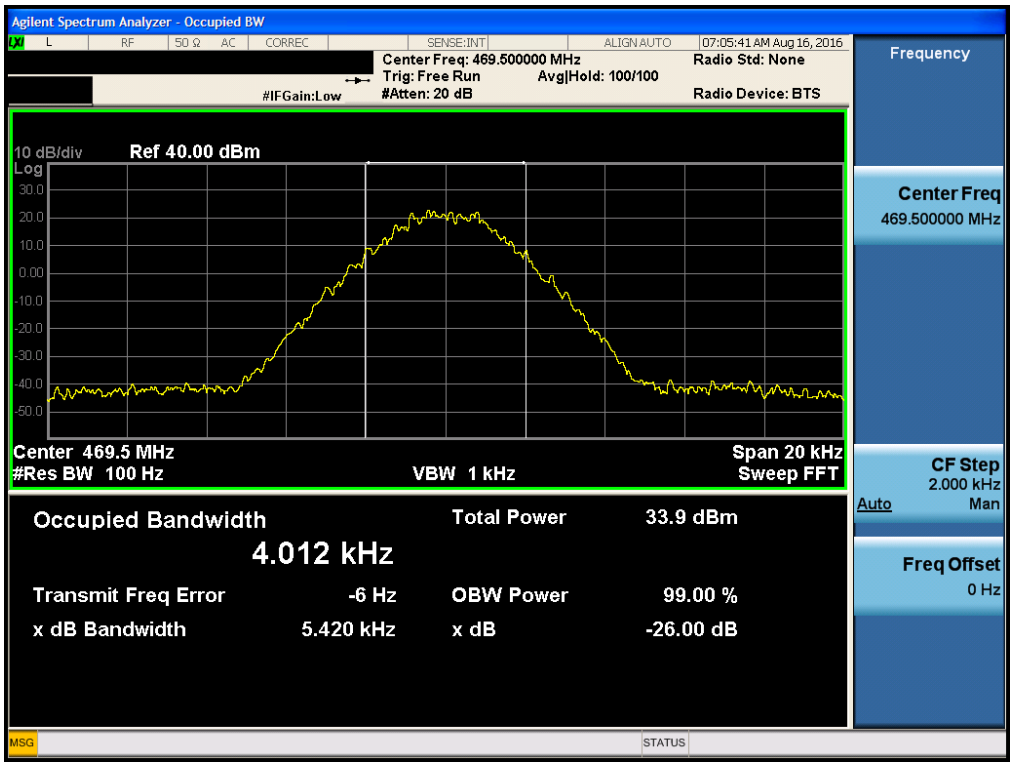


[UHF(APCO25) +3dB above the AGC threshold Uplink 429.5 MHz]

[UHF(APCO25) +3dB above the AGC threshold Uplink 450.5 MHz]

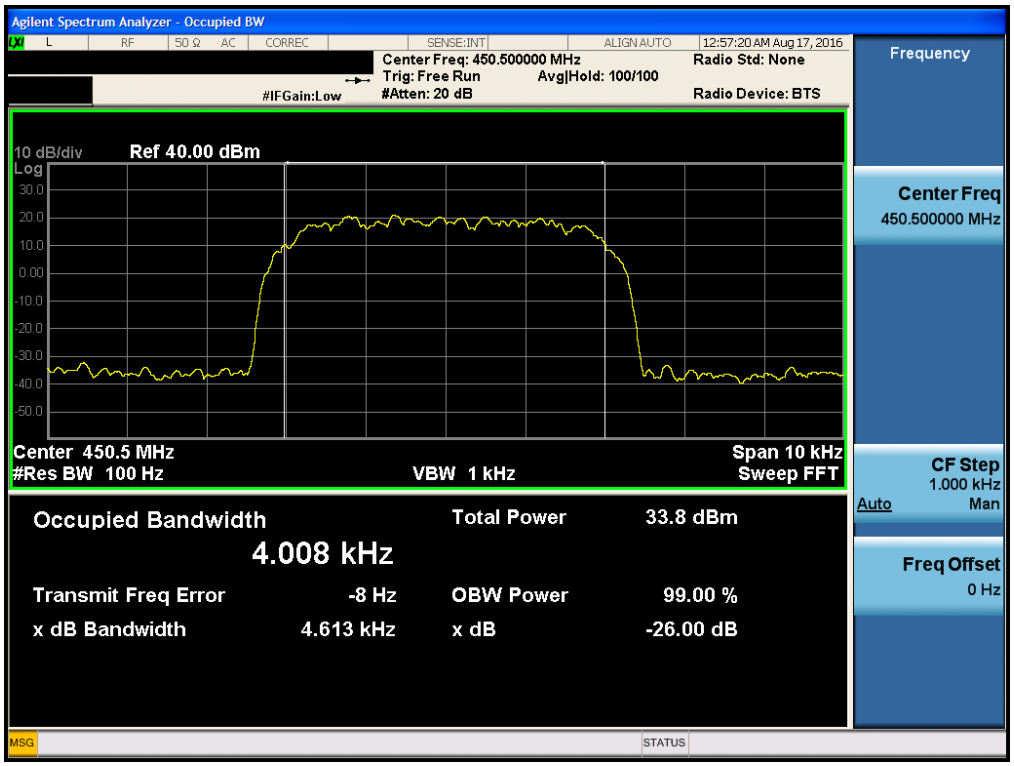


[UHF(APCO25) +3dB above the AGC threshold Uplink 469.5 MHz]

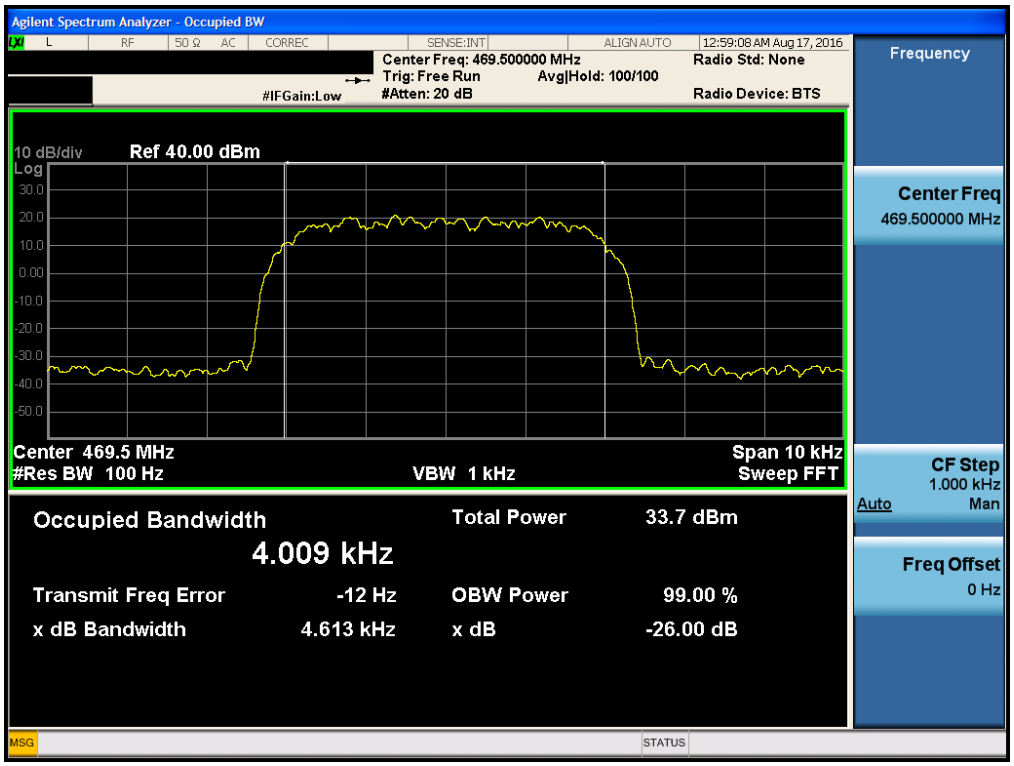


UHF(LMR450) UL

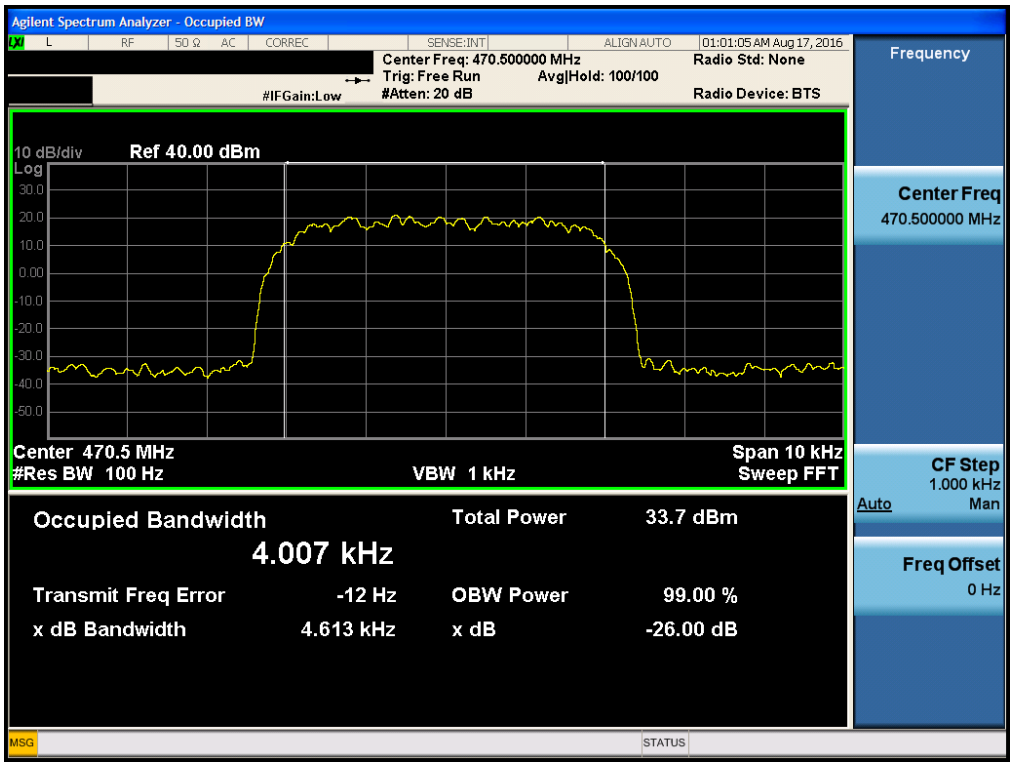
[UHF(LMR450) AGC threshold Uplink 450.5 MHz]



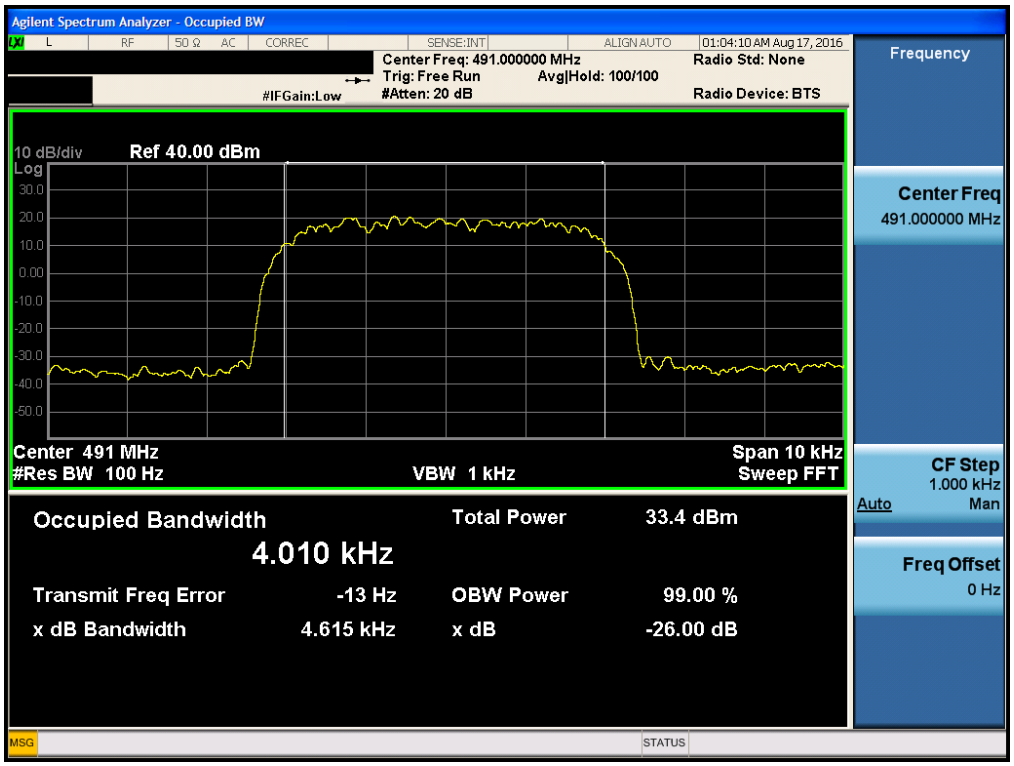
[UHF(LMR450) AGC threshold Uplink 469.5 MHz]



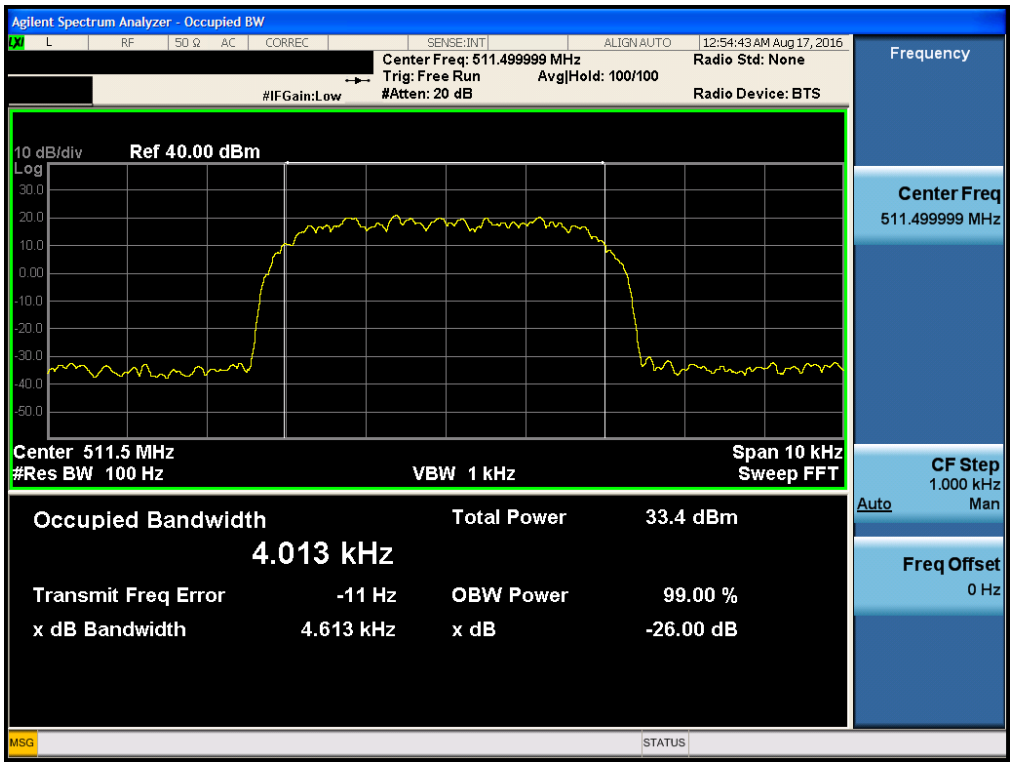
[UHF(LMR450) AGC threshold Uplink 470.5 MHz]



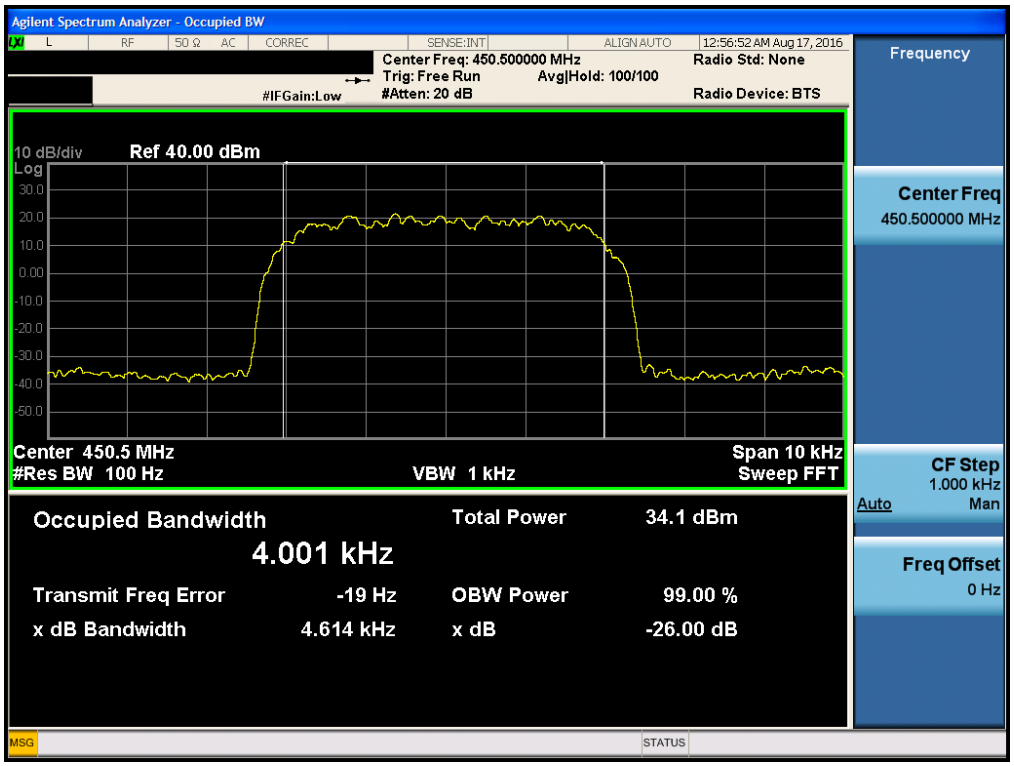
[UHF(LMR450) AGC threshold Uplink 491.0 MHz]



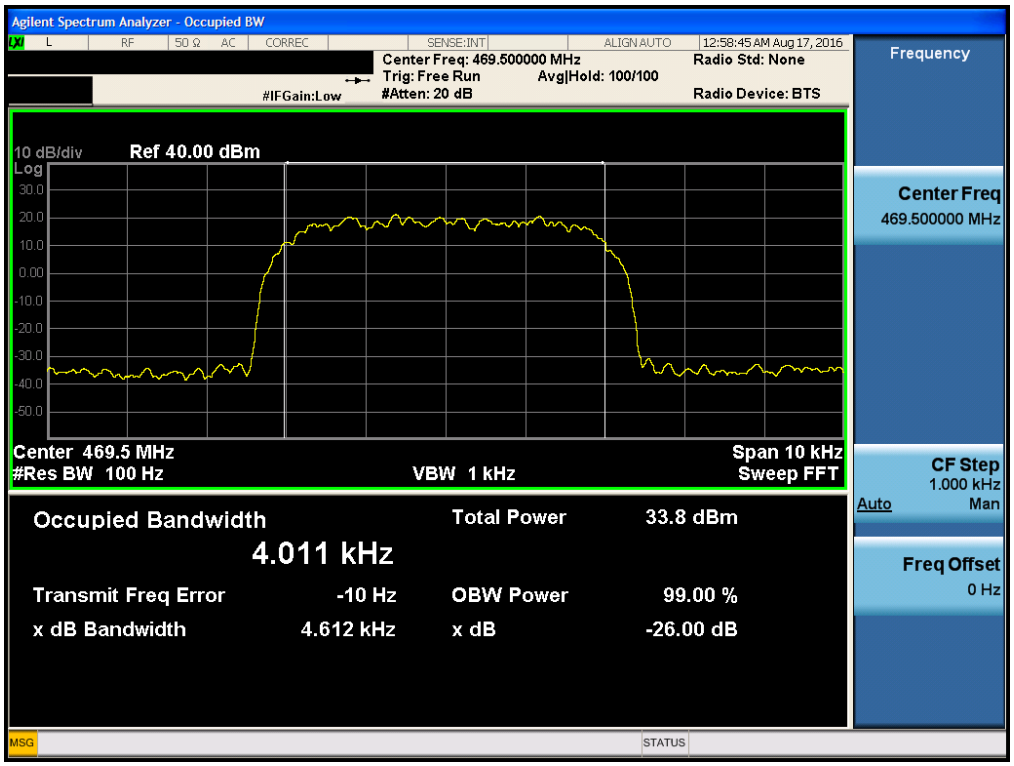
[UHF(LMR450) AGC threshold Uplink 511.5 MHz]



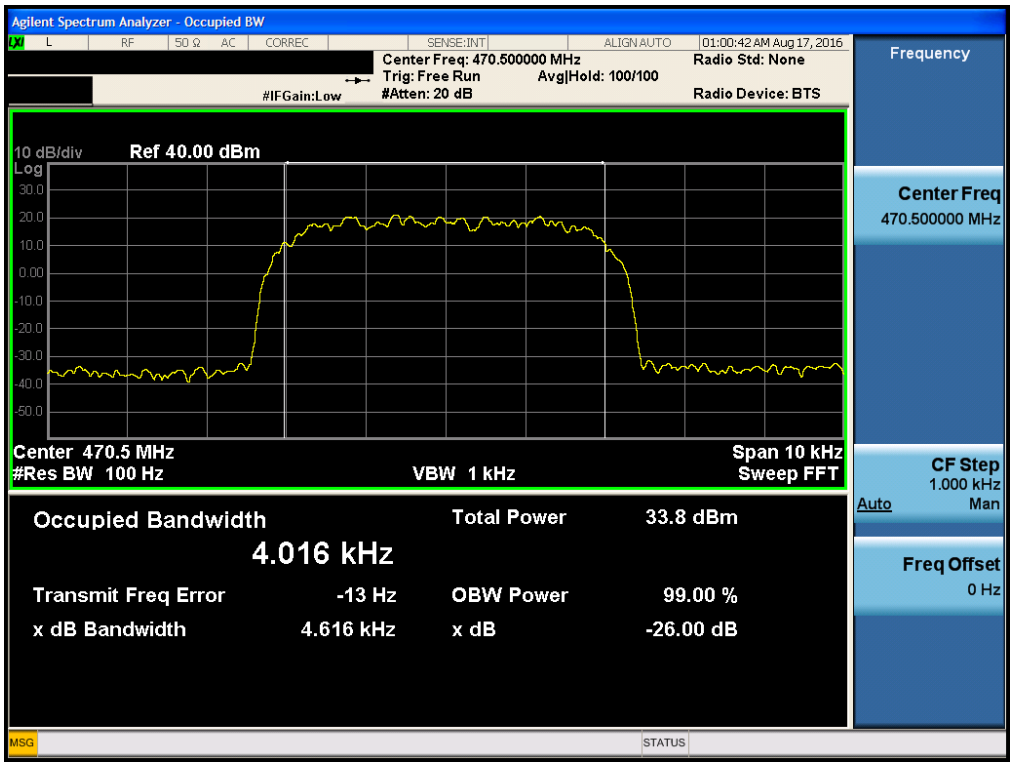
[UHF(LMR450) +3dB above the AGC threshold Uplink 450.5 MHz]



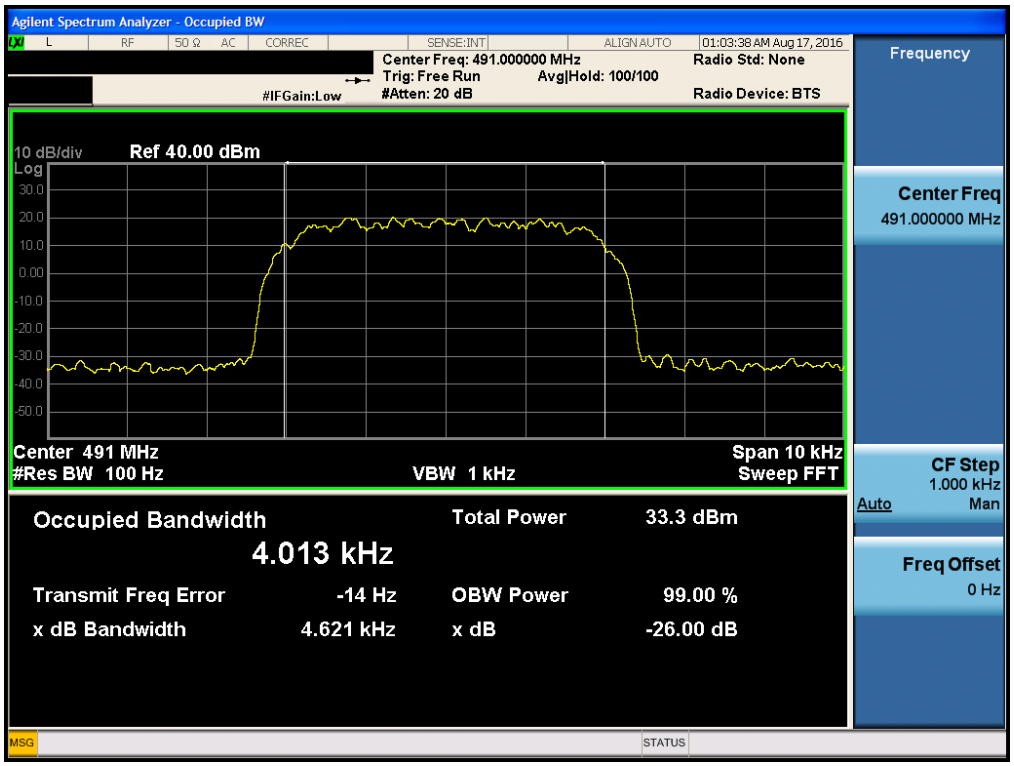
[UHF(LMR450) +3dB above the AGC threshold Uplink 469.5 MHz]



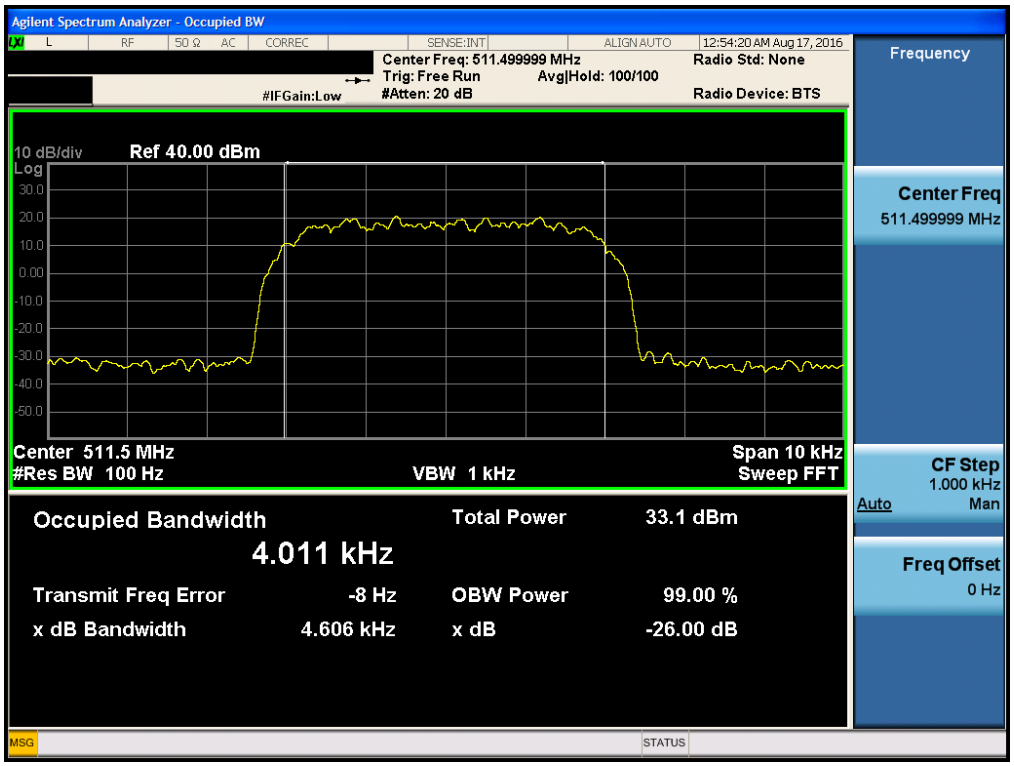
[UHF(LMR450) +3dB above the AGC threshold Uplink 470.5 MHz]



[UHF(LMR450) +3dB above the AGC threshold Uplink 491.0 MHz]



[UHF(LMR450) +3dB above the AGC threshold Uplink 511.5 MHz]



8. PASSBAND GAIN AND BANDWIDTH & OUT OF BAND REJECTION

FCC Rules

Test Requirement(s):

KDB 935210 D05 v01r01

Out of Band Rejection – Test for rejection of out of band signals. Filter freq. response plots are acceptable.

Test Procedures: Measurements were in accordance with the test methods section 3.3, 4.3 of KDB 935210 D05 v01r01.

3.3 EUT out-of-band rejection

a) Connect a signal generator to the input of the EUT.

b) Configure a swept CW signal with the following parameters:

1) Frequency range = ± 250 % of the passband from the center of the passband.

2) Level = a sufficient level to affirm that the out-of-band rejection is > 20 dB above the noise floor and will not engage the AGC during the entire sweep.

3) Dwell time = approx. 10 ms.

4) Number of points = SPAN/(RBW/2).

c) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.

d) Set the span of the spectrum analyzer to the same as the frequency range of the signal generator.

e) Set the resolution bandwidth of the spectrum analyzer to be 1 % to 5 % of the passband and the video bandwidth shall be set to ≥ 3 × RBW.

f) Set the detector to Peak Max-Hold and wait for the spectrum analyzer's spectral display to fill.

g) Place a marker to the peak of the frequency response and record this frequency as f0.

h) 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 −20 dB down amplitude to determine the 20 dB bandwidth. Capture the frequency response of the EUT.

4.3 PLMRS device out-of-band rejection

Adjust the internal gain control of the equipment under test to the maximum gain for which equipment certification is sought.

a) Connect a signal generator to the input of the EUT.

b) Configure a swept CW signal with the following parameters:

c) Frequency range = ± 250 % of the manufacturer's pass band.

d) The CW amplitude will be 3 dB below the AGC threshold (see 4.2) and but not activate the AGC threshold throughout the test.

e) Dwell time = approx. 10 ms.

f) Frequency step = 50 kHz.

g) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.

h) Set the resolution bandwidth of the spectrum analyzer between 1 % and 5 % of the manufacturer's pass band with the video bandwidth set to 3 × RBW.

i) Set the detector to Peak and the trace to Max-Hold.

j) After the trace is completely filled, place a marker at the peak amplitude, which is designated as f0, and with two additional markers (use the marker-delta method) at the 20 dB bandwidth (i.e., at the points where the gain has fallen by 20 dB).

k) Capture the frequency response plot and for inclusion in the test report.

IC Rules

Test Requirements: RSS-131 6.1

The passband gain shall not exceed the nominal gain by more than 1.0 dB. The 20 dB bandwidth shall not exceed the nominal bandwidth that is stated by the manufacturer. Outside of the 20 dB bandwidth, the gain shall not exceed the gain at the 20 dB point.

Test Procedures: RSS-131 4.2

Adjust the internal gain control of the equipment under test to the nominal gain for which equipment certification is sought.

With the aid of a signal generator and spectrum analyzer, measure the 20 dB bandwidth of the amplifier (i.e. at the point where the gain has fallen by 20 dB). Measure the gain-versus-frequency response of the amplifier from the midband frequency f0 of the passband up to at least f0 + 250% of the 20 dB bandwidth.

Signal generator sweep from the frequency more lower than the low frequency -250% to the frequency more higher than high frequency +250%.

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

Input Signal	Input Level (dBm)		Maximum Amp Gain	
	DL	UL	DL	UL
VHF(APCO25)	-57	-61	85	85
UHF(APCO25)	-48	-58	85	85
UHF(LMR450)	-58	-68	95	95

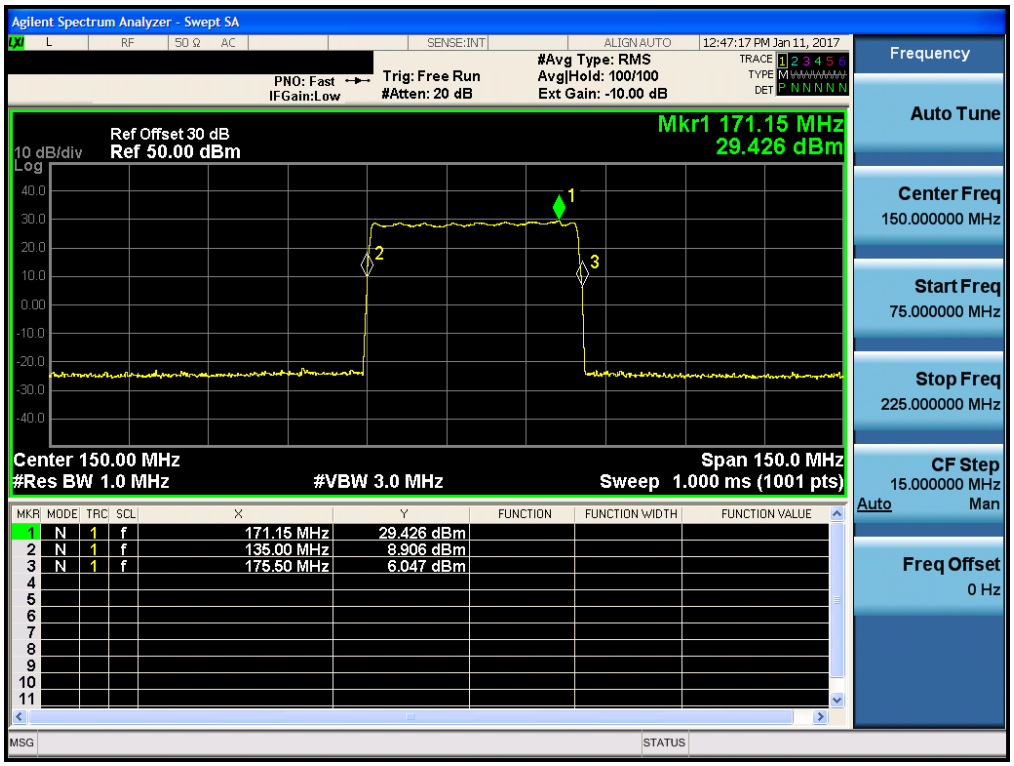
VHF(APCO25)

[Downlink]

20 dB point frequency (MHz)	Output power (dBm)	Gain (dB)
135.00 ~ 175.50	29.426	86.426

Plots of Passband Gain and Bandwidth & Out of Band Rejection

[VHF(APCO25) Downlink]

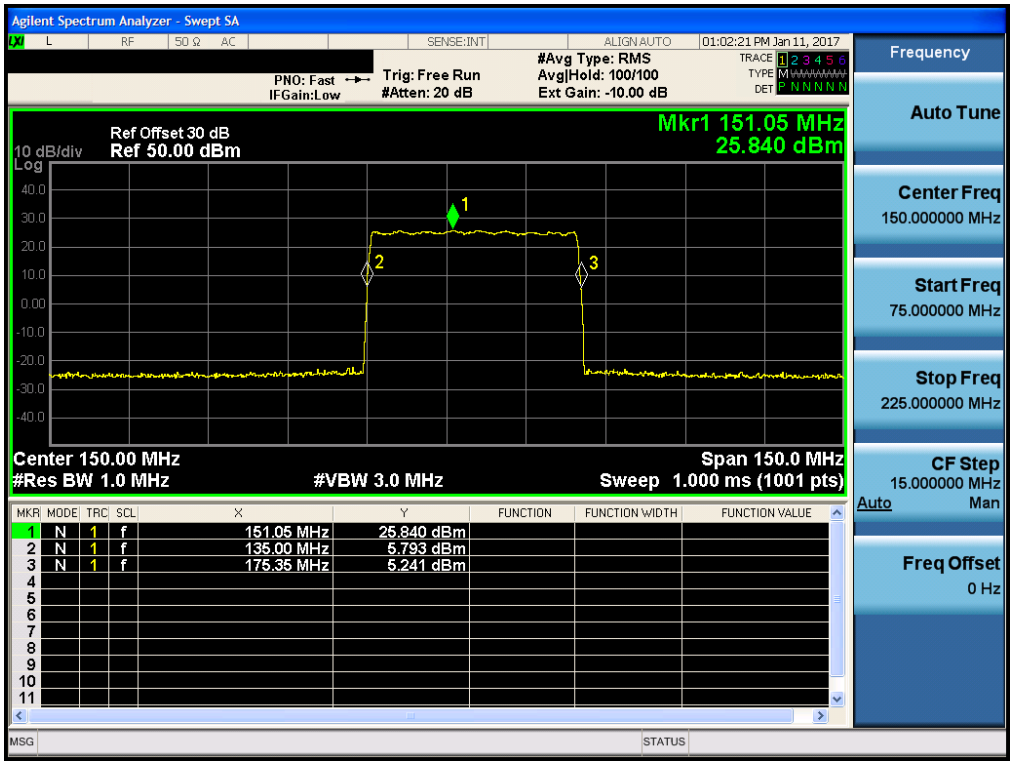


[Uplink]

20 dB point frequency (MHz)	Output power (dBm)	Gain (dB)
135.00 ~ 175.35	25.840	86.840

Plots of Passband Gain and Bandwidth & Out of Band Rejection

[VHF(APCO25) Uplink]



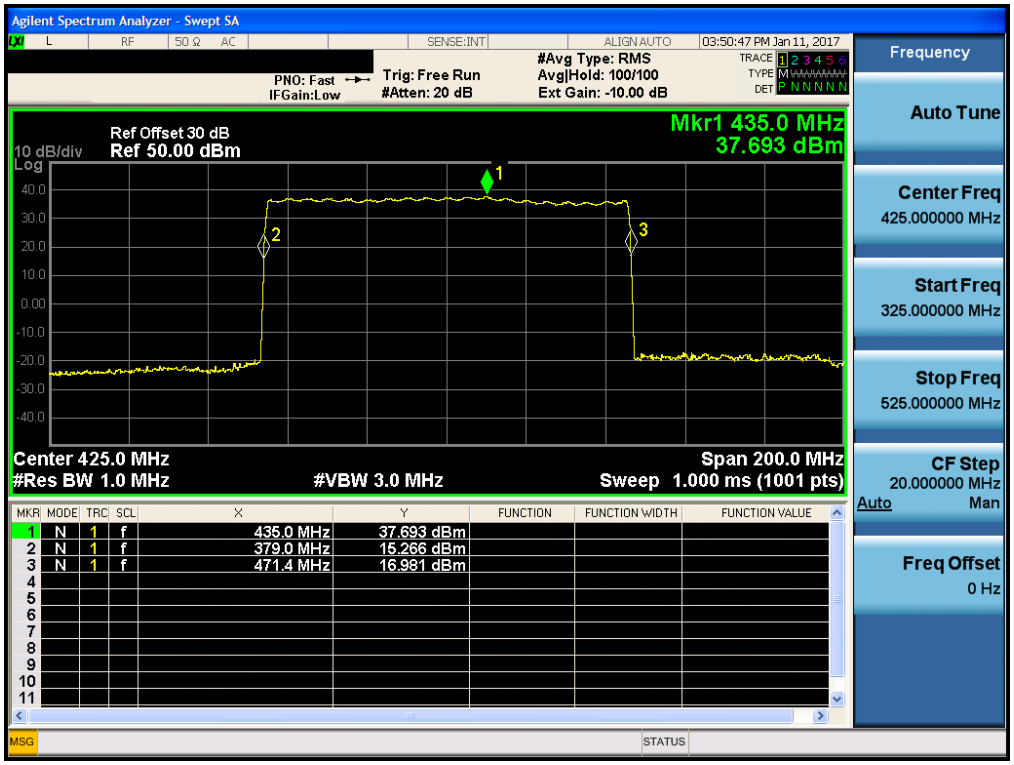
UHF(APCO25)

[Downlink]

20 dB point frequency (MHz)	Output power (dBm)	Gain (dB)
379.0 ~ 471.4	37.693	85.693

Plots of Passband Gain and Bandwidth & Out of Band Rejection

[UHF(APCO25) Downlink]

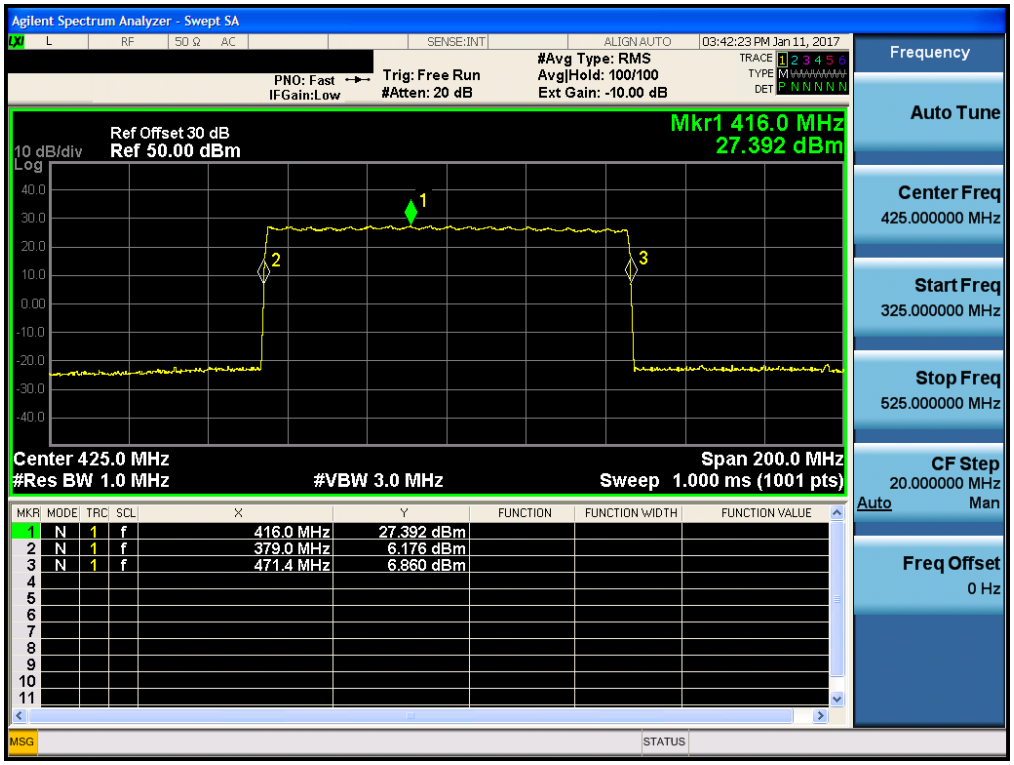


[Upnlink]

20 dB point frequency (MHz)	Output power (dBm)	Gain (dB)
379.0 ~ 471.4	27.392	85.392

Plots of Passband Gain and Bandwidth & Out of Band Rejection

[UHF(APCO25) Uplink]



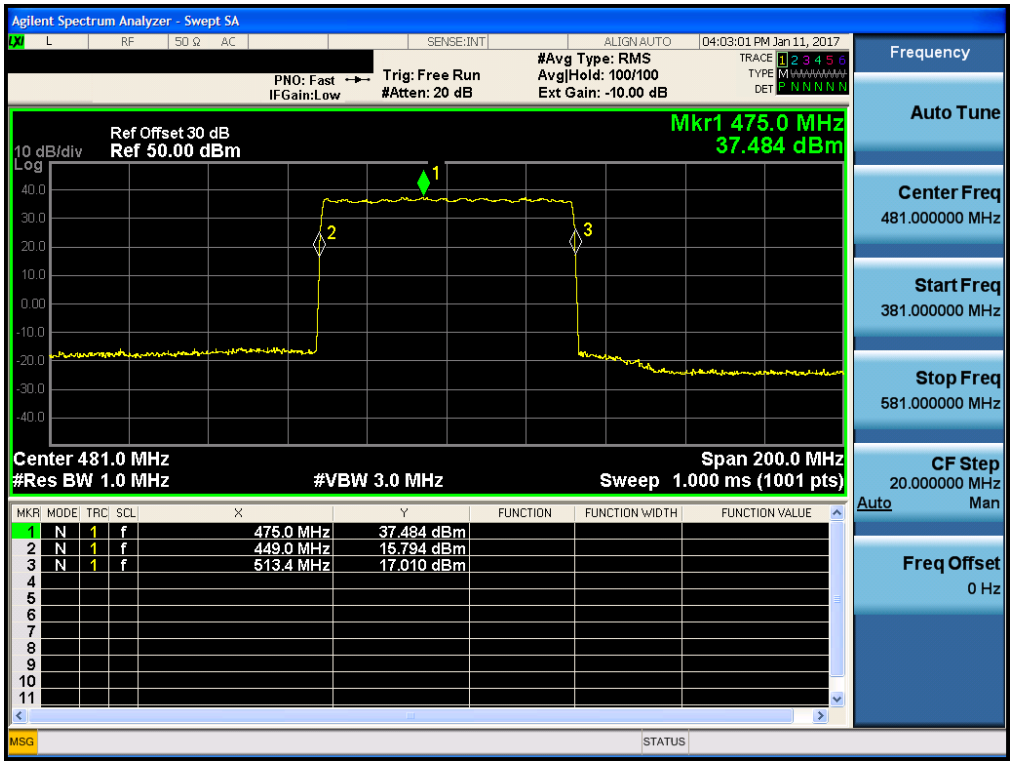
UHF(LMR450)

[Downlink]

20 dB point frequency (MHz)	Output power (dBm)	Gain (dB)
449. 0 ~ 513.4	37.484	95.484

Plots of Passband Gain and Bandwidth & Out of Band Rejection

[UHF(LMR450) Downlink]



[Upnlink]

20 dB point frequency (MHz)	Output power (dBm)	Gain (dB)
449.0 ~ 513.4	27.453	95.453

. Plots of Passband Gain and Bandwidth & Out of Band Rejection

[UHF(LMR450) Uplink 449.685 ~ 451.315 MHz]