

RF TEST REPORT



Report No.: FCC IC_SL16101901-RUC-037-DTS Rev 4.0
Supersede Report NoFCC IC_SL16101901-RUC-037-DTS Rev 3.0

Applicant	:	Ruckus Wireless, Inc.
Product Name	:	R720 Access Point
Model No.	:	R720
Test Standard	:	47 CFR 15.247 RSS 247 Iss 1: May 2015
Test Method	:	ANSI C63.10: 2013 RSS Gen Iss 4: Nov 2014 558074 D01 DTS Meas Guidance v03r05
FCC ID	:	S9GR720
IC ID	:	5912A-R720
Dates of test	:	12/05/2016 – 01/11/2017
Issue Date	:	01/16/2017
Test Result	:	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail
Equipment complied with the specification [X] Equipment did not comply with the specification []		

This Test Report is Issued Under the Authority of:	
Gary Chou	Chen Ge
Test Engineer	Engineer Reviewer

Issued By:
SIEMIC Laboratories
775 Montague Expressway, Milpitas, 95035 CA



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Laboratory Introduction

SIEMIC, headquartered in the heart of Silicon Valley, with superior facilities in US and Asia, is one of the leading independent testing and certification facilities providing customers with one-stop shop services for Compliance Testing and Global Certifications.



In addition to testing and certification, SIEMIC provides initial design reviews and compliance management throughout a project. Our extensive experience with China, Asia Pacific, North America, European, and International compliance requirements, assures the fastest, most cost effective way to attain regulatory compliance for the global markets.

Accreditations for Conformity Assessment

Country/Region	Accreditation Body	Scope
USA	FCC, A2LA	EMC, RF/Wireless, Telecom
Canada	IC, A2LA, NIST	EMC, RF/Wireless, Telecom
Taiwan	BSMI, NCC, NIST	EMC, RF, Telecom, Safety
Hong Kong	OFTA, NIST	RF/Wireless, Telecom
Australia	NATA, NIST	EMC, RF, Telecom, Safety
Korea	KCC/RRA, NIST	EMI, EMS, RF, Telecom, Safety
Japan	VCCI, JATE, TELEC, RFT	EMI, RF/Wireless, Telecom
Mexico	NOM, COFETEL, Caniety	Safety, EMC, RF/Wireless, Telecom
Europe	A2LA, NIST	EMC, RF, Telecom, Safety
Israel	MOC, NIST	EMC, RF, Telecom, Safety

Accreditations for Product Certifications

Country	Accreditation Body	Scope
USA	FCC TCB, NIST	EMC, RF, Telecom
Canada	IC FCB, NIST	EMC, RF, Telecom
Singapore	iDA, NIST	EMC, RF, Telecom
EU	NB	EMC & R&TTE Directive
Japan	MIC (RCB 208)	RF, Telecom
Hong Kong	OFTA (US002)	RF, Telecom

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1 Report Revision History

Report No.	Report Version	Description	Issue Date
FCC IC_SL16101901-RUC-037-DTS	None	Original	12/22/2016
FCC IC_SL16101901-RUC-037-DTS Rev 1.0	Rev 1.0	Updated power supply information	01/09/2017
FCC IC_SL16101901-RUC-037-DTS Rev 2.0	Rev 2.0	Updated conducted emission	01/11/2017
FCC IC_SL16101901-RUC-037-DTS Rev 3.0	Rev 3.0	Updated EUT information	01/12/2017
FCC IC_SL16101901-RUC-037-DTS Rev 4.0	Rev 4.0	Updated Beamforming	01/16/2017

2 Executive Summary

The purpose of this test program was to demonstrate compliance of following product

Company: Ruckus Wireless, Inc.
Product: R720 Access Point
Model: R720

against the current Stipulated Standards. The specified model product stated above has demonstrated compliance with the Stipulated Standard listed on 1st page.

3 Customer information

Applicant Name	:	Ruckus Wireless, Inc.
Applicant Address	:	350 West Java Drive, Sunnyvale, California 94089 U.S.A
Manufacturer Name	:	Ruckus Wireless, Inc.
Manufacturer Address	:	350 West Java Drive, Sunnyvale, California 94089 U.S.A

4 Test site information

Lab performing tests	SIEMIC Laboratories
Lab Address	775 Montague Expressway, Milpitas, CA 95035
FCC Test Site No.	881796
IC Test Site No.	4842D-2
VCCI Test Site No.	A0133

5 Modification

Index	Item	Description	Note
-	-	-	-

6 EUT Information

6.1 EUT Description

Product Name	R720 Access Point
Model No.	R720
Trade Name	Ruckus
Serial No.	451606000010
Host Model No.	N/A
Input Power	48VDC
Power Adapter Manu/Model	UMEC/UP0451H-54PP
Power Adapter SN	CQ112128
Date of EUT received	12/01/2016
Equipment Class/ Category	DTS, UNII
Port/Connectors	PoE, Ethernet

6.2 Radio Description

Radio Type	802.11b	802.11g	802.11n-20M	802.11n-40M
Operating Frequency	2412-2462MHz	2412-2462MHz	2412-2462MHz	2422-2452MHz
Modulation	DSSS (CCK, DQPSK, DBPSK)	OFDM-CCK (BPSK, QPSK, 16QAM, 64QAM)	OFDM (BPSK, QPSK, 16QAM, 64QAM)	OFDM (BPSK, QPSK, 16QAM, 64QAM)
Channel Spacing	5MHz	5MHz	5MHz	5MHz
Number of Channels	11	11	11	7
Antenna Type	Internal Omni PCB Antenna			
Antenna Gain (Peak)	2.4GHz: 2.5 dBi			
Antenna Connector Type	U.FL			
Note	2.4GHz and 5GHz Radio transmit simultaneously			

Note: The AP supports Beamforming mode and the power setting for Beamforming and Non-Beamforming modes are the same.

EUT Power level setting

Mode	Frequency (MHz)	Power setting
802.11-b	2412	23
802.11-b	2437	23
802.11-b	2462	23
802.11-g	2412	21
802.11-g	2437	23
802.11-g	2462	19
802.11-n-20	2412	21
802.11-n-20	2437	23
802.11-n-20	2462	19
802.11-n-40	2422	21
802.11-n-40	2437	23
802.11-n-40	2452	16

7 Supporting Equipment/Software and cabling Description

7.1 Supporting Equipment

Item	Supporting Equipment Description	Model	Serial Number	Manufacturer	Note
1	Laptop	PP01L Latitude E5440	F1WPF12	Dell	-
2	AC/DC power adapter	UP0451H-54PP	CQ2112128	UMEC	-

7.2 Cabling Description

Name	Connection Start		Connection Stop		Length / shielding Info		Note
	From	I/O Port	To	I/O Port	Length (m)	Shielding	

7.3 Test Software Description

Test Item	Software	Description
RF Testing	QCRT	Set the EUT to transmit continuously in diferent test mode

8 Test Summary

Test Item	Test standard		Test Method/Procedure		Pass / Fail
Restricted Band of Operation	FCC	15.205	FCC	ANSI C63.10:2013 558074 D01 DTS Meas Guidance v03r05	<input checked="" type="checkbox"/> Pass
	IC	RSS Gen 8.10	IC		<input type="checkbox"/> N/A
AC Conducted Emissions	FCC	15.207(a)	FCC	ANSI C63.10:2013	<input checked="" type="checkbox"/> Pass
	IC	RSS Gen 8.8	IC	RSS Gen Issue 4: 2014	<input type="checkbox"/> N/A

DTS Band Requirement

Test Item	Test standard		Test Method/Procedure		Pass / Fail
99% Occupied Bandwidth	-	-	-	-	<input checked="" type="checkbox"/> Pass
	IC	RSS Gen 6.6	IC	RSS Gen Issue 4: 2014 -	<input type="checkbox"/> N/A
6dB Bandwidth	FCC	15.247(a)(2)	FCC	558074 D01 DTS Meas Guidance v03r05	<input checked="" type="checkbox"/> Pass
	IC	RSS247 (5.2.1)	IC		<input type="checkbox"/> N/A
Band Edge and Radiated Spurious Emissions	FCC	15.247(d)	FCC	ANSI C63.10:2013 558074 D01 DTS Meas Guidance v03r05	<input checked="" type="checkbox"/> Pass
	IC	RSS247 (5.5)	IC		<input type="checkbox"/> N/A
Output Power	FCC	15.247(b)	FCC	558074 D01 DTS Meas Guidance v03r05	<input checked="" type="checkbox"/> Pass
	IC	RSS247 (5.4.4)	IC		<input type="checkbox"/> N/A
Receiver Spurious Emissions	IC	RSS Gen (4.8)	IC	RSS Gen Issue 4: 2014	<input type="checkbox"/> Pass <input checked="" type="checkbox"/> N/A
Antenna Gain > 6 dBi	FCC	15.247(e)	FCC	-	<input type="checkbox"/> Pass
	IC	-	IC	-	<input checked="" type="checkbox"/> N/A
Power Spectral Density	FCC	15.247(e)	FCC	558074 D01 DTS Meas Guidance v03r05	<input checked="" type="checkbox"/> Pass
	IC	RSS247 (5.2.2)	IC		<input type="checkbox"/> N/A
RF Exposure requirement	FCC	15.247(i)	FCC	-	<input type="checkbox"/> Pass
	IC	RSS Gen(5.5)	IC	RSS Gen Issue 4: 2014	<input checked="" type="checkbox"/> N/A
Remark	<ol style="list-style-type: none"> All measurement uncertainties do not take into consideration for all presented test results. The applicant shall ensure frequency stability by showing that an emission is maintained within the band of operation under all normal operating conditions as specified in the user's manual. 				

9 Measurement Uncertainty

Emissions			
Test Item	Frequency Range	Description	Uncertainty
Band Edge and Radiated Spurious Emissions	30MHz – 1GHz	Confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2 (for EUTs < 0.5m X 0.5m X 0.5m)	+5.6dB/-4.5dB
Band Edge and Radiated Spurious Emissions	1GHz – 40GHz	Confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2 (for EUTs < 0.5m X 0.5m X 0.5m)	+4.3dB/-4.1dB

10 Measurements, Examination and Derived Results

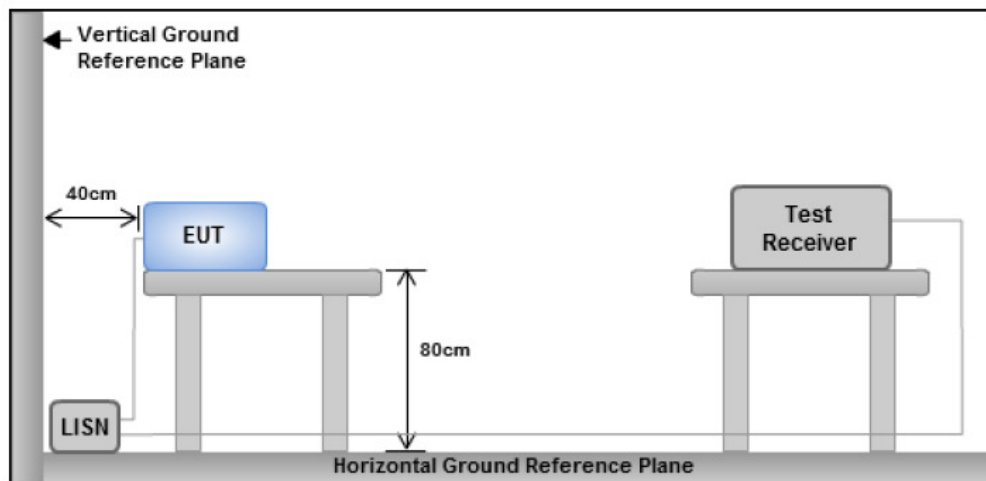
10.1 Conducted Emissions

Conducted Emission Limit

Frequency ranges (MHz)	Limit (dBuV)	
	QP	Average
0.15 ~ 0.5	66 – 56	56 – 46
0.5 ~ 5	56	46
5 ~ 30	60	50

Spec	Item	Requirement	Applicable
RSS247(A8.1)	a)	For Low-power radio-frequency devices that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). The lower limit applies at the boundary between the frequency ranges.	<input checked="" type="checkbox"/>

Test Setup



Note: 1. Support units were connected to second LISN.

2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

Procedure

- The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table, as shown in Annex B.
- The power supply for the EUT was fed through a 50 Ω /50 μ H EUT LISN, connected to filtered mains.
- The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss coaxial cable.
- All other supporting equipment was powered separately from another main supply.

Remark

EUT was tested at 120VAC, 60Hz

Result

Pass Fail

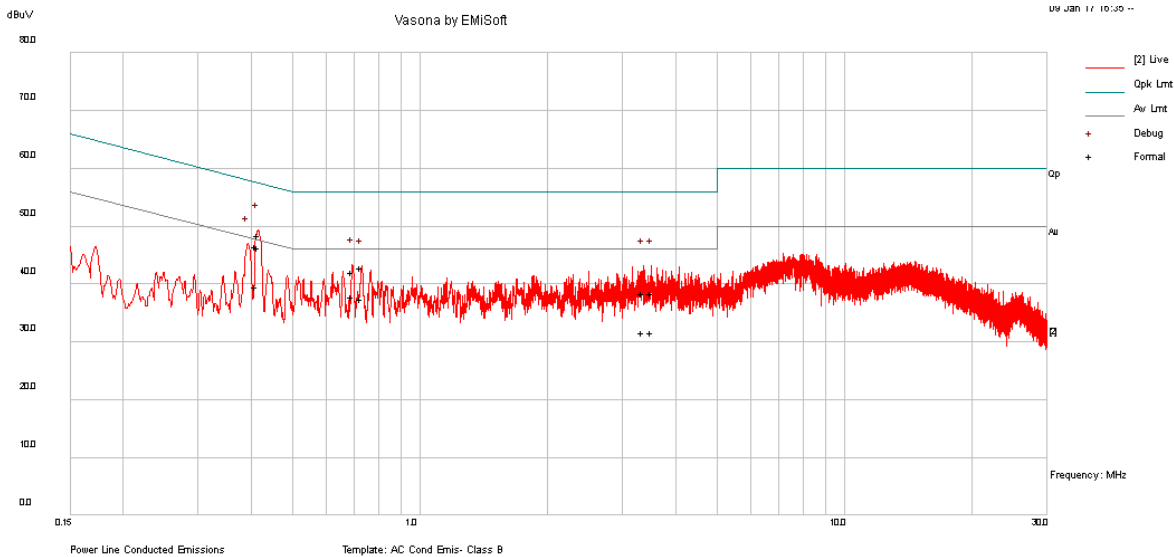
Test Data Yes N/A

Test Plot Yes (See below) N/A

Test was done by Gary Chou at Conducted Emission test site.

Conducted Emission Test Results

Test specification:	Conducted Emissions			Result:	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail
Environmental Conditions:	Temp(°C):	21			
	Humidity (%):	42			
	Atmospheric(mbar):	1021			
Mains Power:	120Vac, 60Hz				
Tested by:	Gary Chou				
Test Date:	01/09/2017				
Remarks	AC/DC adapter, Line				

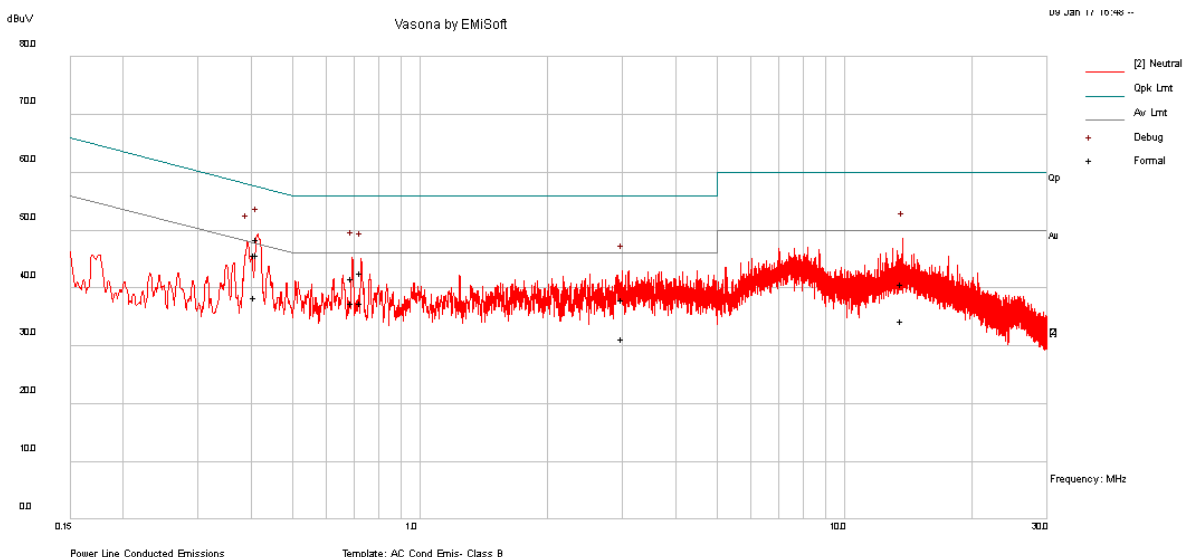


Line Plot at 120Vac, 60Hz

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Measurement Type	Line / Neutral	Limit (dBuV)	Margin (dB)	Pass /Fail
0.42	37.77	10.01	0.69	48.46	Quasi Peak	Live	57.55	-9.09	Pass
0.41	35.74	10.01	0.69	46.44	Quasi Peak	Live	57.65	-11.21	Pass
0.69	31.47	10.01	0.56	42.04	Quasi Peak	Live	56	-13.96	Pass
0.73	32.19	10.01	0.56	42.76	Quasi Peak	Live	56	-13.24	Pass
3.51	27.93	10.03	0.5	38.46	Quasi Peak	Live	56	-17.54	Pass
3.35	27.9	10.03	0.5	38.43	Quasi Peak	Live	56	-17.57	Pass
0.42	35.59	10.01	0.69	46.29	Average	Live	47.55	-1.26	Pass
0.41	28.91	10.01	0.69	39.61	Average	Live	47.65	-8.04	Pass
0.69	27.2	10.01	0.56	37.77	Average	Live	46	-8.23	Pass
0.73	26.95	10.01	0.56	37.52	Average	Live	46	-8.48	Pass
3.51	21.1	10.03	0.5	31.63	Average	Live	46	-14.37	Pass
3.35	21.14	10.03	0.5	31.67	Average	Live	46	-14.33	Pass

Conducted Emission Test Results

Test specification:	Conducted Emissions			
Environmental Conditions:	Temp(°C):	21	Result:	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail
	Humidity (%):	42		
	Atmospheric(mbar):	1021		
Mains Power:	120Vac, 60Hz			
Tested by:	Gary Chou			
Test Date:	01/09/2017			
Remarks	AC/DC adapter, Neutral			

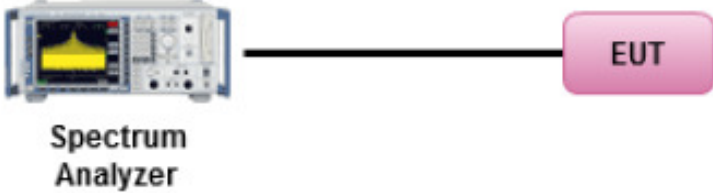


Neutral Plot at 120Vac, 60Hz

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Measurement Type	Line / Neutral	Limit (dBuV)	Margin (dB)	Pass /Fail
0.41	37.75	10.01	0.69	48.44	Quasi Peak	Neutral	57.58	-9.13	Pass
0.41	35.03	10.01	0.69	45.73	Quasi Peak	Neutral	57.67	-11.94	Pass
0.69	31.17	10.01	0.56	41.74	Quasi Peak	Neutral	56	-14.26	Pass
0.73	32.04	10.01	0.56	42.61	Quasi Peak	Neutral	56	-13.39	Pass
13.68	30.05	10.06	0.55	40.66	Quasi Peak	Neutral	60	-19.34	Pass
2.99	27.5	10.03	0.5	38.03	Quasi Peak	Neutral	56	-17.97	Pass
0.41	35.13	10.01	0.69	45.82	Average	Neutral	47.58	-1.75	Pass
0.41	27.73	10.01	0.69	38.43	Average	Neutral	47.67	-9.25	Pass
0.69	26.95	10.01	0.56	37.52	Average	Neutral	46	-8.48	Pass
0.73	26.88	10.01	0.56	37.45	Average	Neutral	46	-8.55	Pass
13.68	23.84	10.06	0.55	34.44	Average	Neutral	50	-15.56	Pass
2.99	20.72	10.03	0.5	31.25	Average	Neutral	46	-14.75	Pass

10.2 6dB & 99% Bandwidth

Requirement(s):

Spec	Requirement	Applicable
§ 15.247 RSS247 (5.2.1)	6dB BW≥500KHz;	<input checked="" type="checkbox"/>
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	<input checked="" type="checkbox"/>
Test Setup	 <p style="text-align: center;">Spectrum Analyzer</p>	
Test Procedure	558074 D01 DTS Meas Guidance v03r05, 8.1 DTS bandwidth <u>6dB Emission bandwidth measurement procedure</u> <ul style="list-style-type: none"> - Set RBW = 100 kHz. - Set the video bandwidth (VBW) ≥ 3 x RBW. - Detector = Peak. - Trace mode = max hold. - Sweep = auto couple. - Allow the trace to stabilize. - Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission. 	
Test Date	12/09/2016	Environmental condition Temperature 23°C Relative Humidity 42% Atmospheric Pressure 1021mbar
Remark	N/A	
Result	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail	

Test Data Yes N/A
Test Plot Yes N/A

Test was done by Shuo Zhang at RF test site.

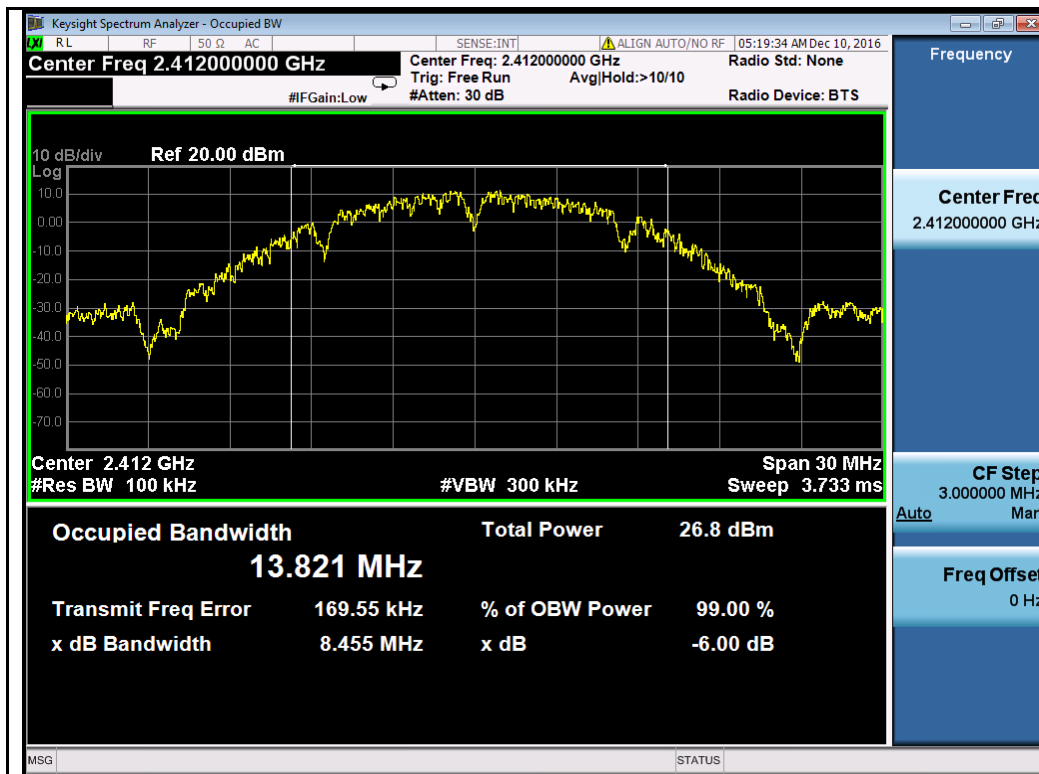
6dB Bandwidth measurement result for 2.4GHz

Type	Test mode	Freq (MHz)	CH	Result (MHz)	Limit (MHz)	Result
6dB BW	802.11b	2412	Low	8.45	≥0.5	Pass
		2437	Mid	8.57	≥0.5	Pass
		2462	High	9.40	≥0.5	Pass
	802.11g	2412	Low	16.35	≥0.5	Pass
		2437	Mid	16.30	≥0.5	Pass
		2462	High	16.36	≥0.5	Pass
	802.11n-20M	2412	Low	14.15	≥0.5	Pass
		2437	Mid	17.64	≥0.5	Pass
		2462	High	17.65	≥0.5	Pass
	802.11n-40M	2422	Low	31.33	≥0.5	Pass
		2437	Mid	35.54	≥0.5	Pass
		2452	High	35.69	≥0.5	Pass

99% OBW measurement result for 2.4GHz

Type	Test mode	Freq (MHz)	CH	Result (MHz)
99% OBW	802.11b	2412	Low	13.82
		2437	Mid	13.07
		2462	High	13.25
	802.11g	2412	Low	16.33
		2437	Mid	16.39
		2462	High	16.37
	802.11n-20M	2412	Low	17.54
		2437	Mid	17.61
		2462	High	17.61
	802.11n-40M	2422	Low	35.66
		2437	Mid	36.00
		2452	High	35.95

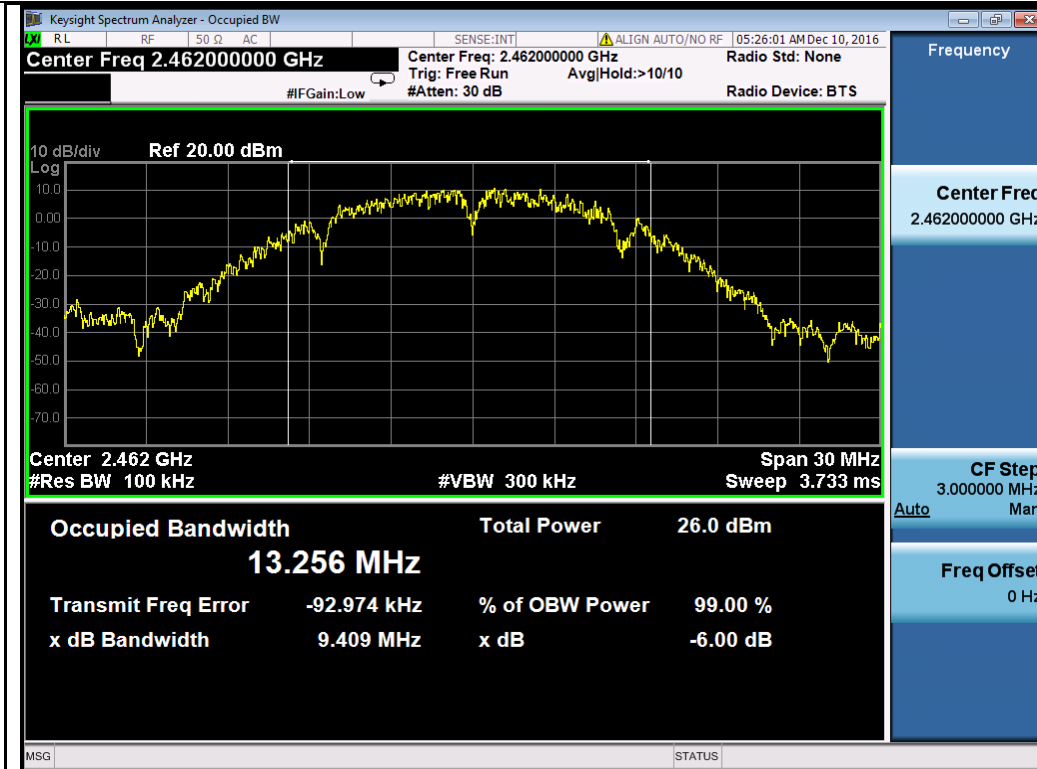
6dB & 99% Bandwidth Test Plots



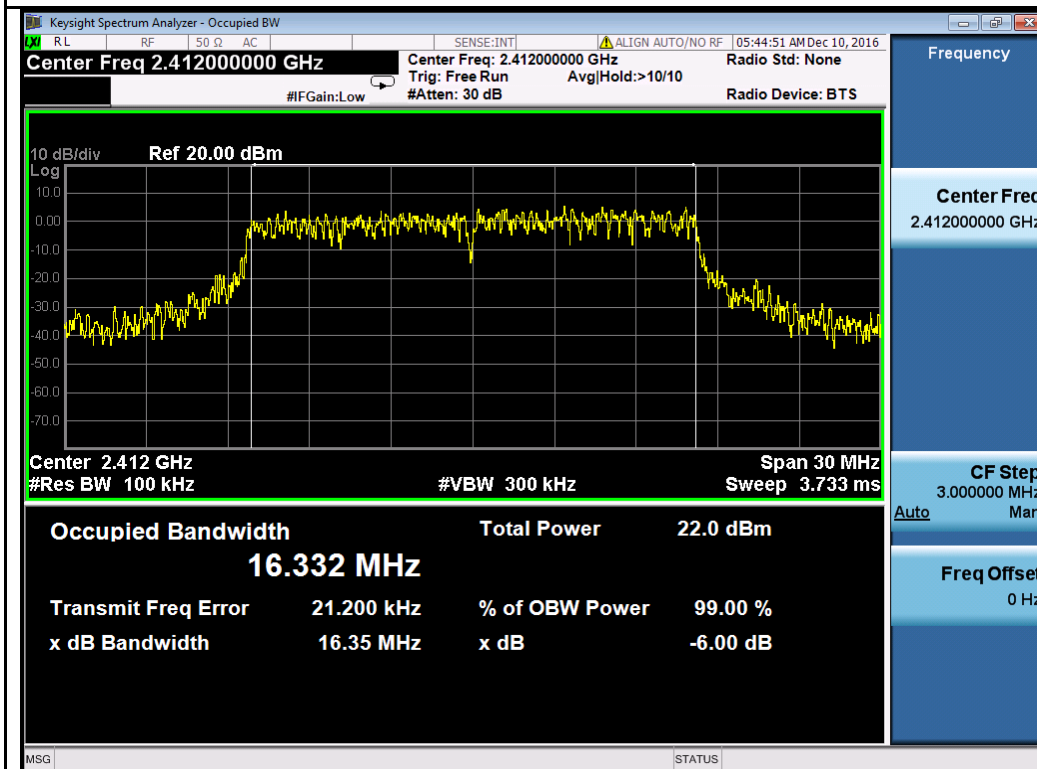
802.11b-2412MHz



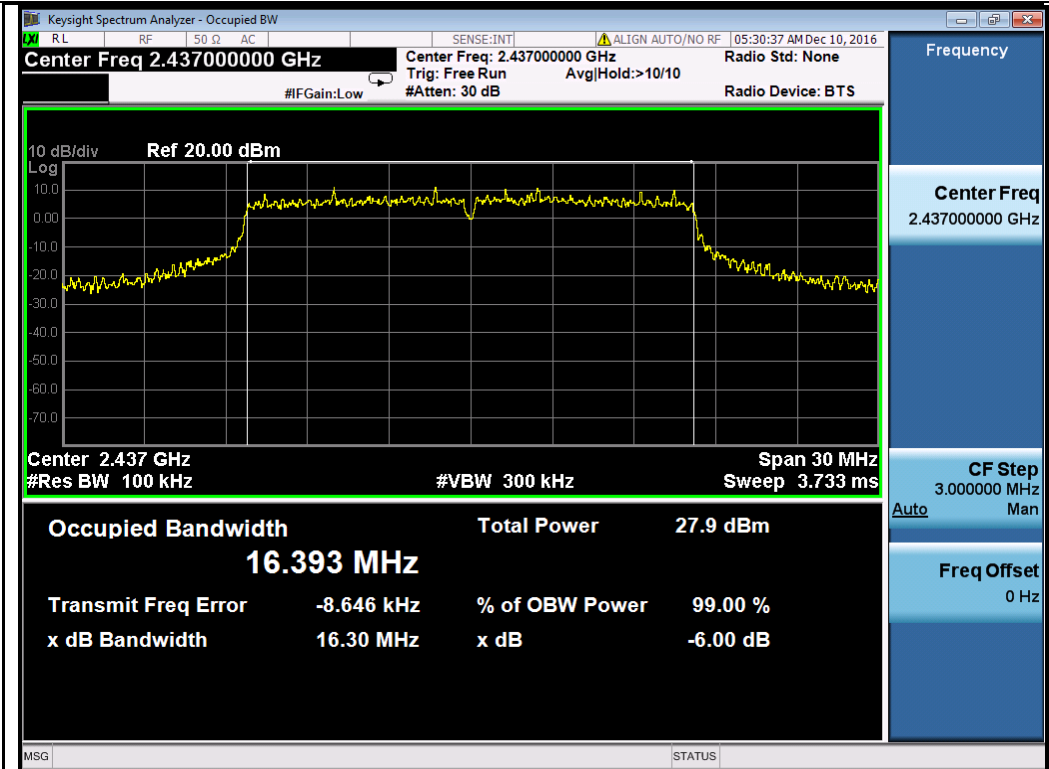
802.11b-2437MHz



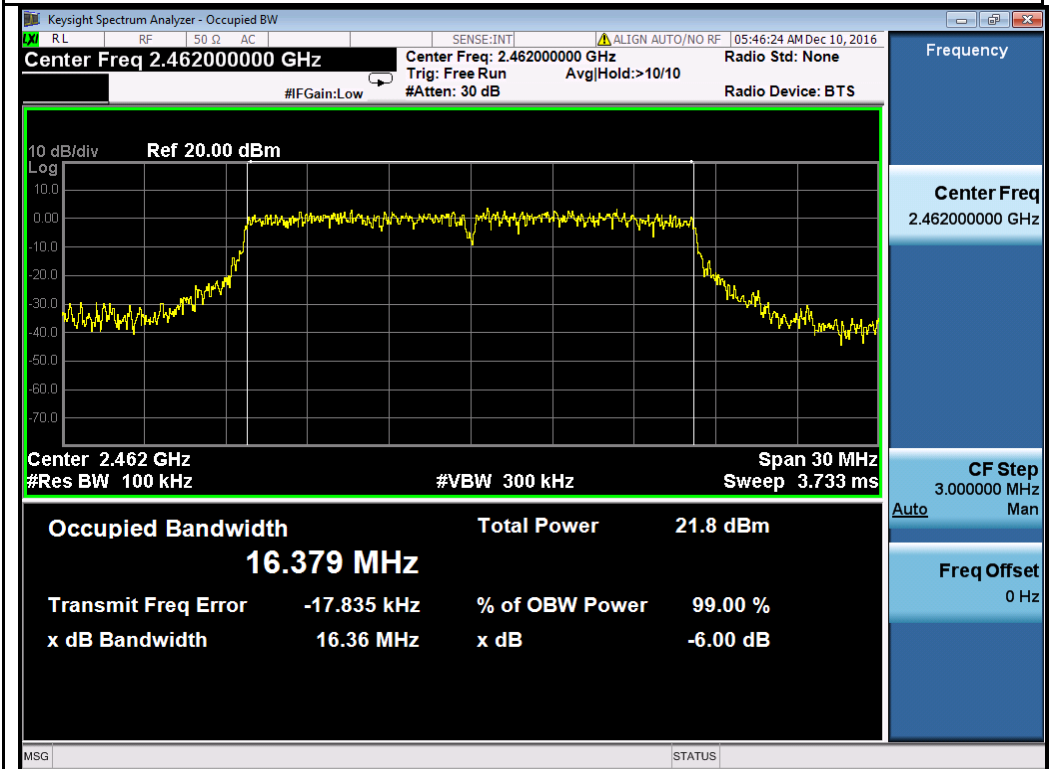
802.11b-2462MHz



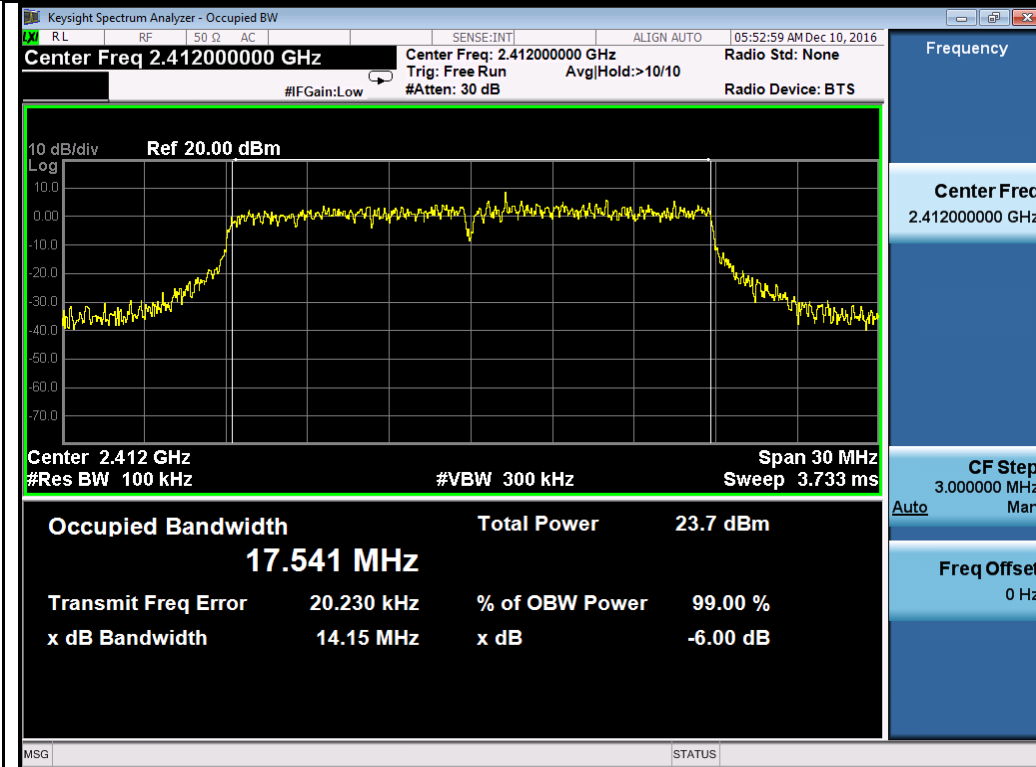
802.11g-2412MHz



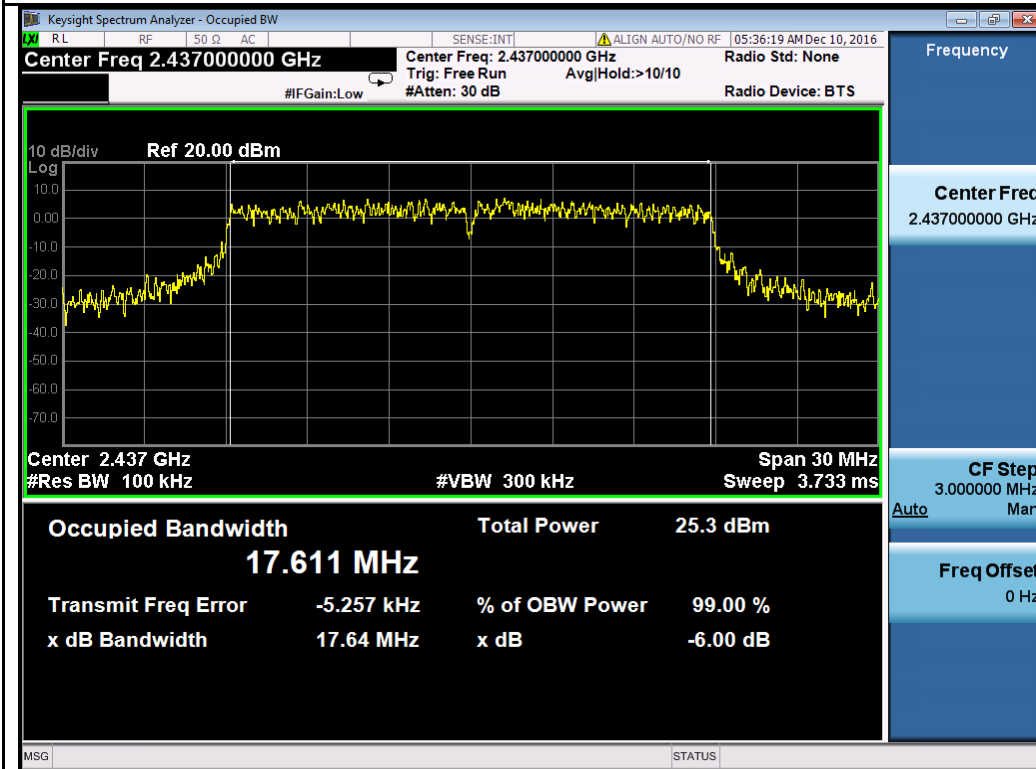
802.11g-2437MHz



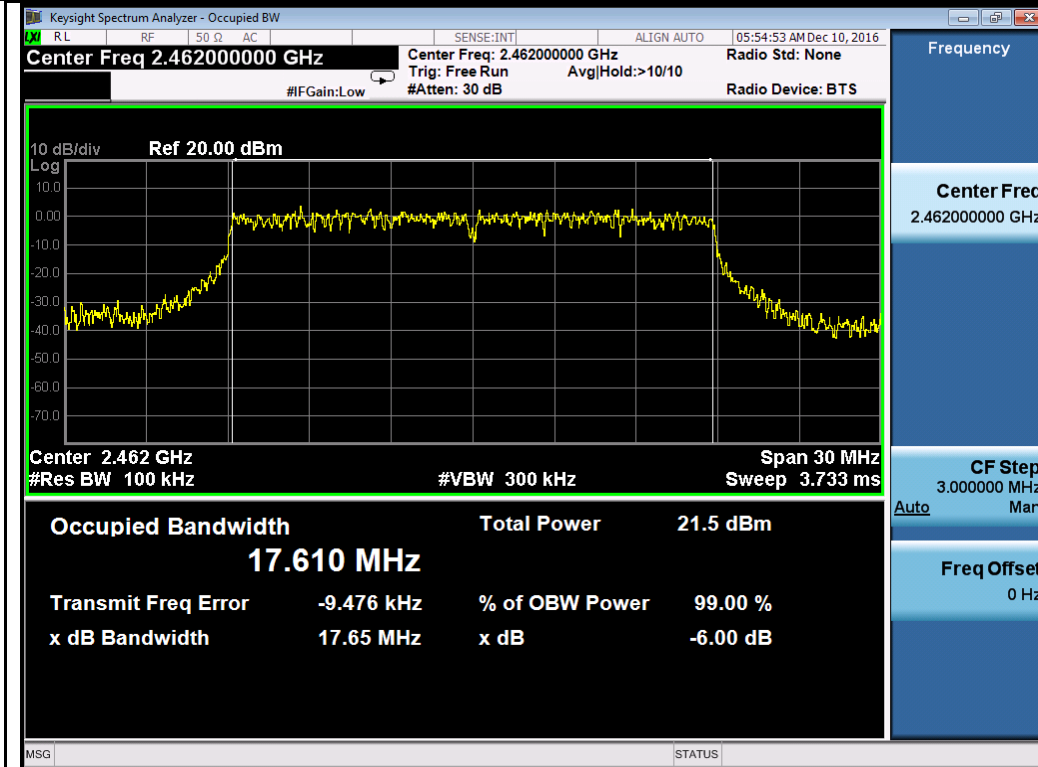
802.11g-2462MHz



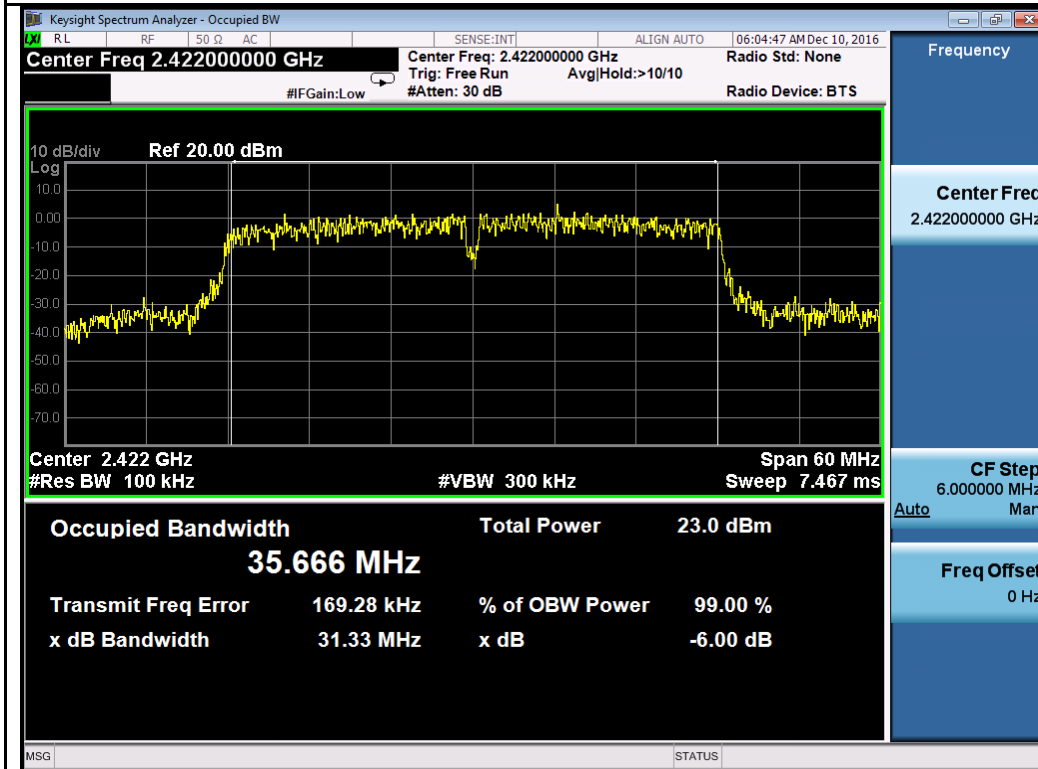
802.11n-HT20-2412MHz



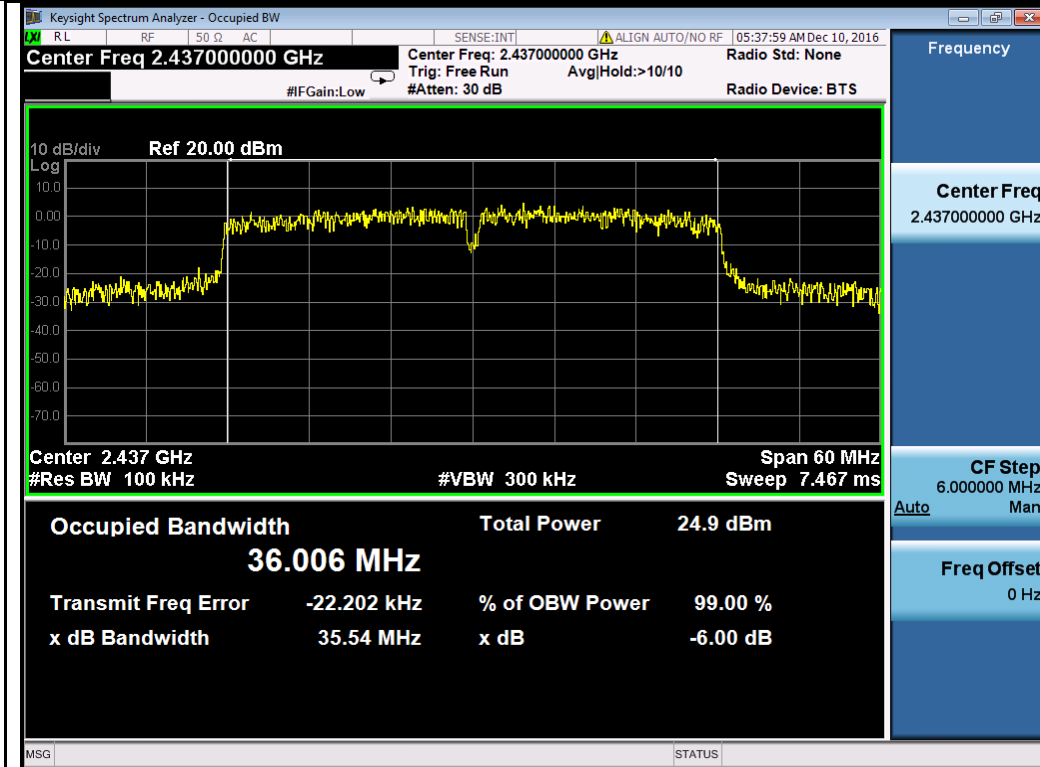
802.11n-HT20-2437MHz



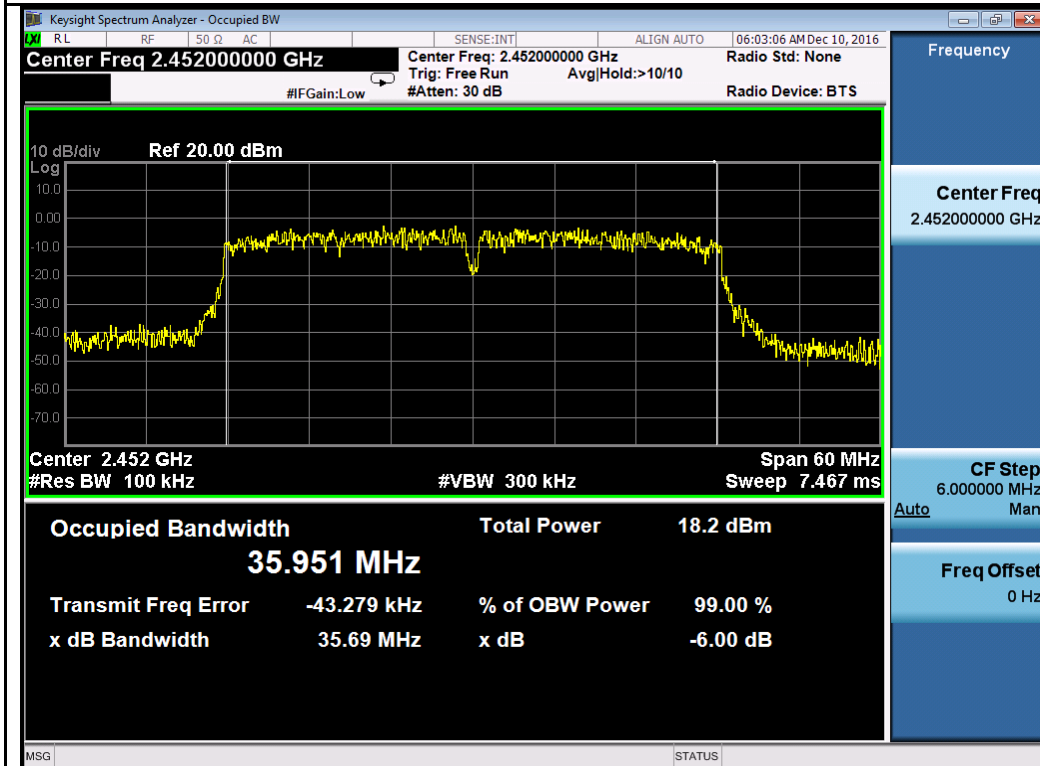
802.11n-HT20-2462MHz



802.11n-HT40-2412MHz



802.11n-HT40-2437MHz

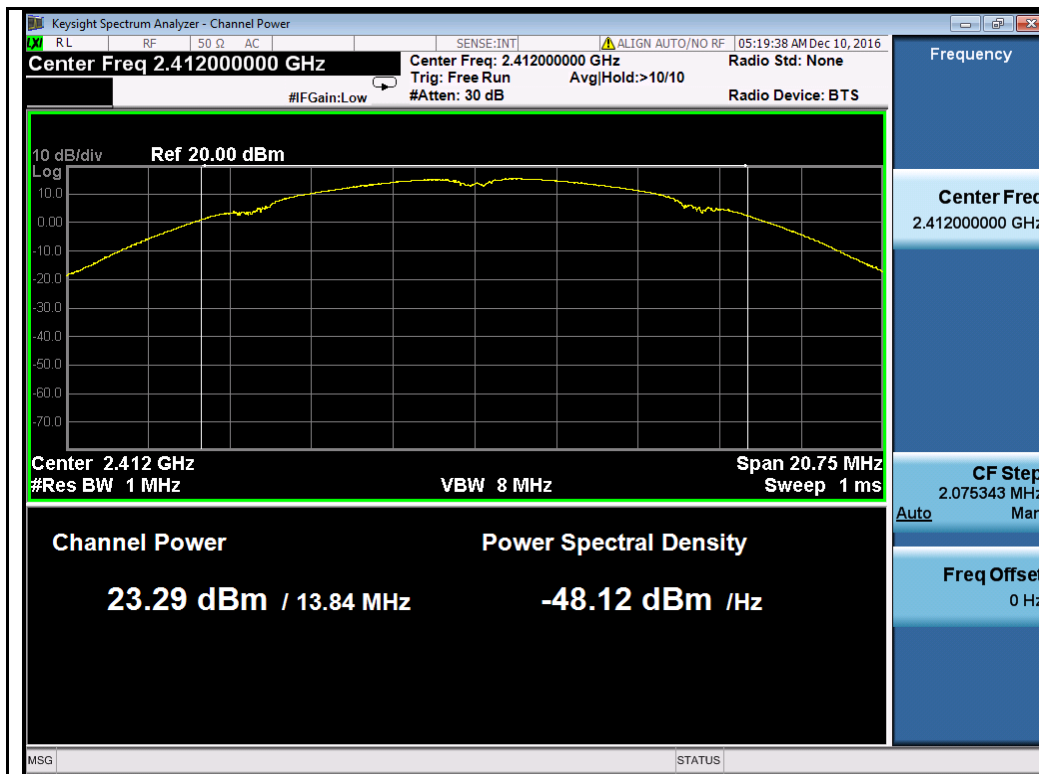


802.11n-HT40-2452MHz

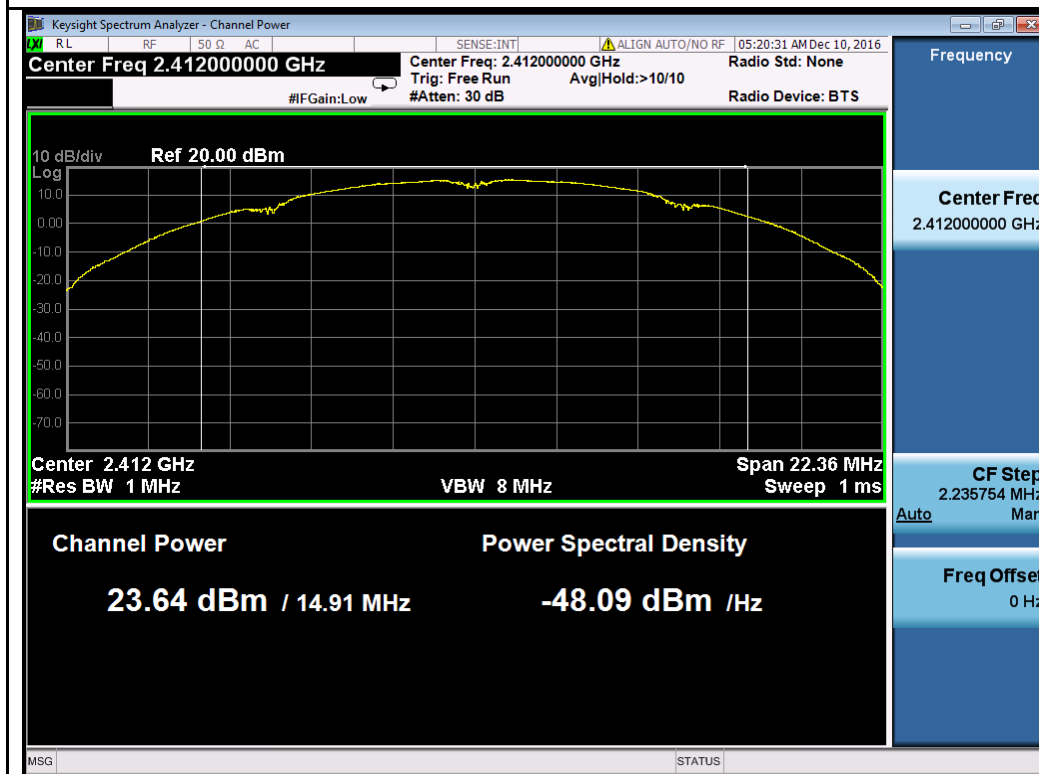
Output Power measurement result

Type	Test mode	Freq (MHz)	CH	Conducted Power (dBm)					Limit (dBm)	Result
				Chain1	Chain2	Chain3	Chain4	Combined Power		
Output Power	802.11b	2412	Low	23.29	23.64	23.65	22.87	29.39	30	Pass
		2437	Mid	22.88	23.14	22.82	24.14	29.30	30	Pass
		2462	High	22.72	22.83	22.80	22.86	28.82	30	Pass
	802.11g	2412	Low	20.06	20.17	20.24	20.00	26.14	30	Pass
		2437	Mid	22.06	22.09	22.02	22.05	28.08	30	Pass
		2462	High	18.11	18.13	18.12	18.20	24.16	30	Pass
	802.11n-20M	2412	Low	19.85	19.96	20.04	19.93	25.97	30	Pass
		2437	Mid	21.95	21.94	21.92	21.92	27.95	30	Pass
		2462	High	18.06	17.94	17.84	18.02	23.99	30	Pass
	802.11n-40M	2422	Low	21.21	21.05	20.83	21.03	27.05	30	Pass
		2437	Mid	22.66	22.76	22.53	22.75	28.70	30	Pass
		2452	High	15.90	15.81	15.85	15.86	21.88	30	Pass
Note	Directional gain of the EUT is 5.5dBi. No limit adjustment is needed.									

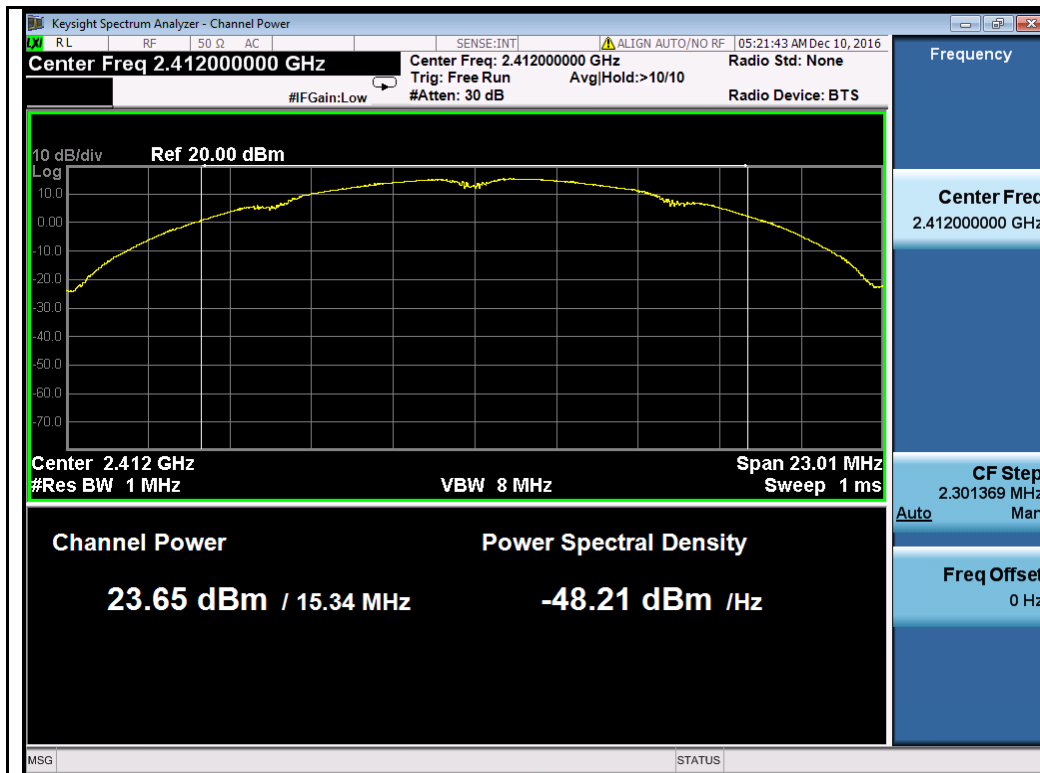
Test Plots:



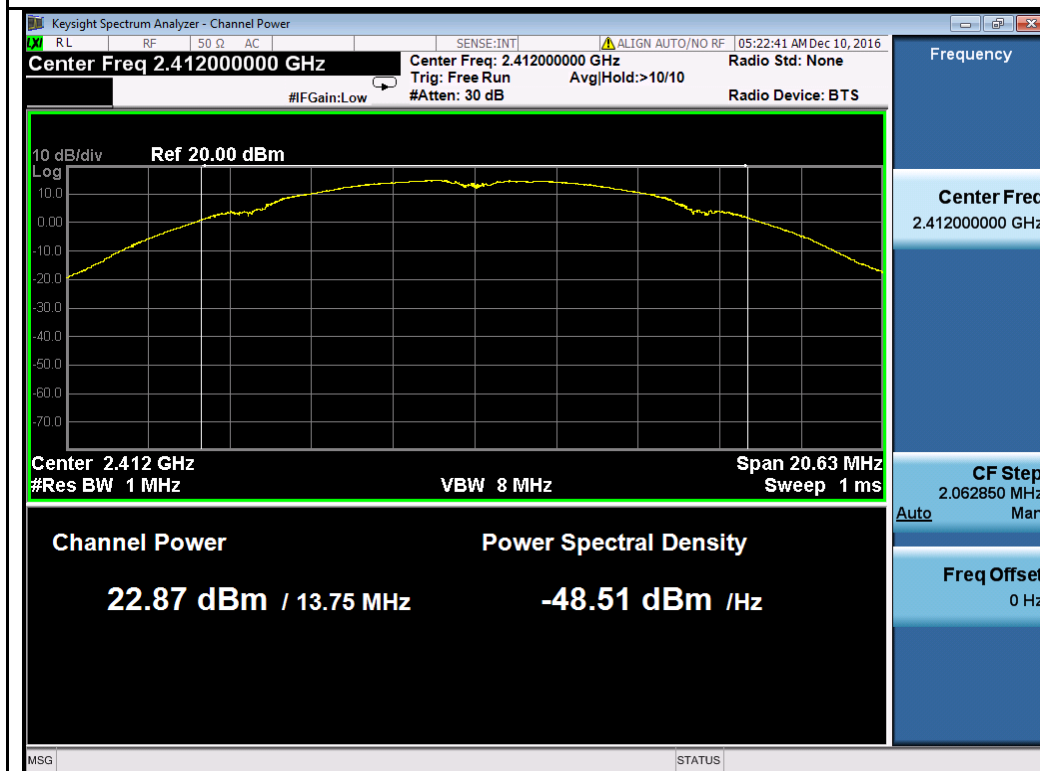
802.11b-2412MHz Chain 1



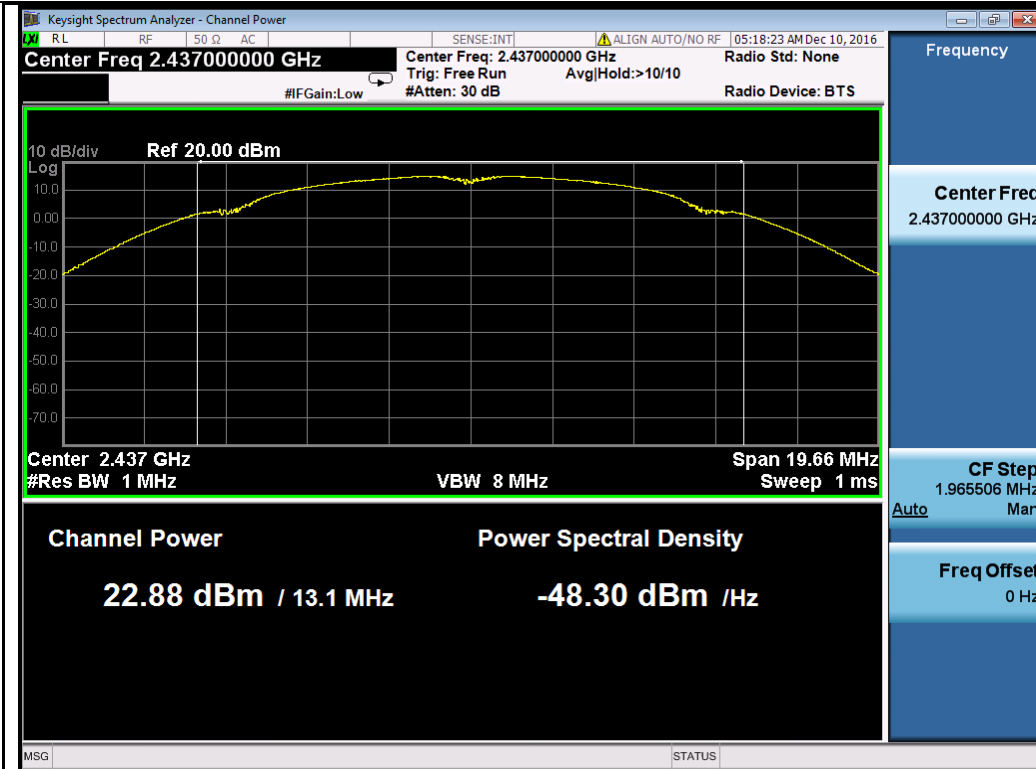
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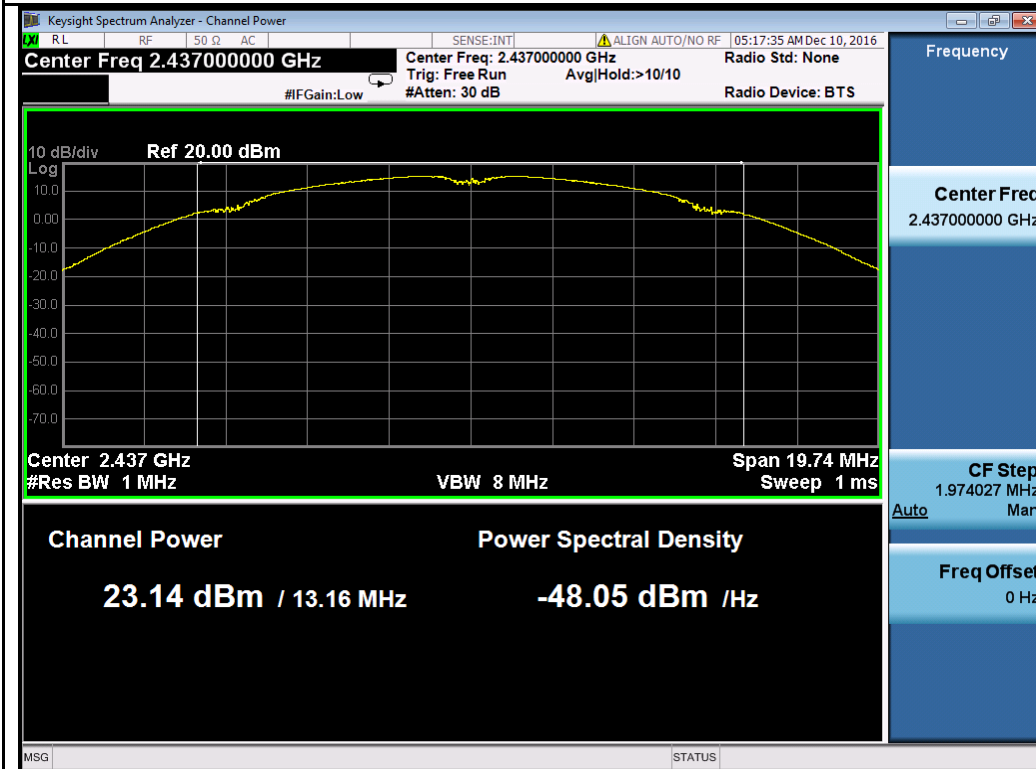
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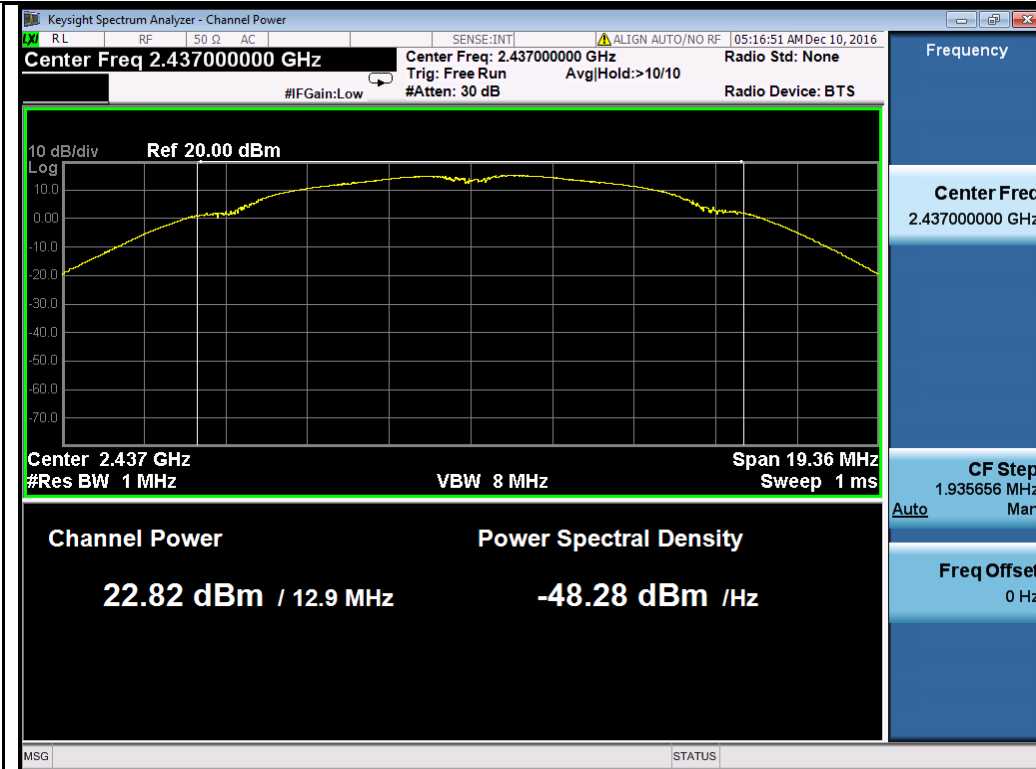
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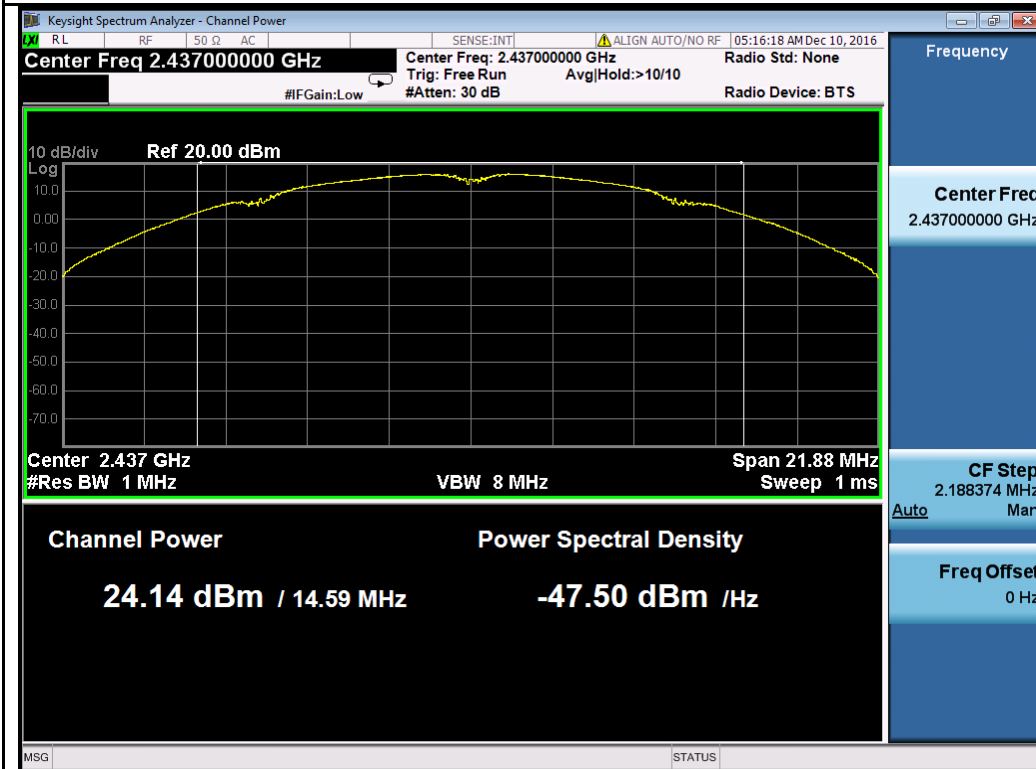
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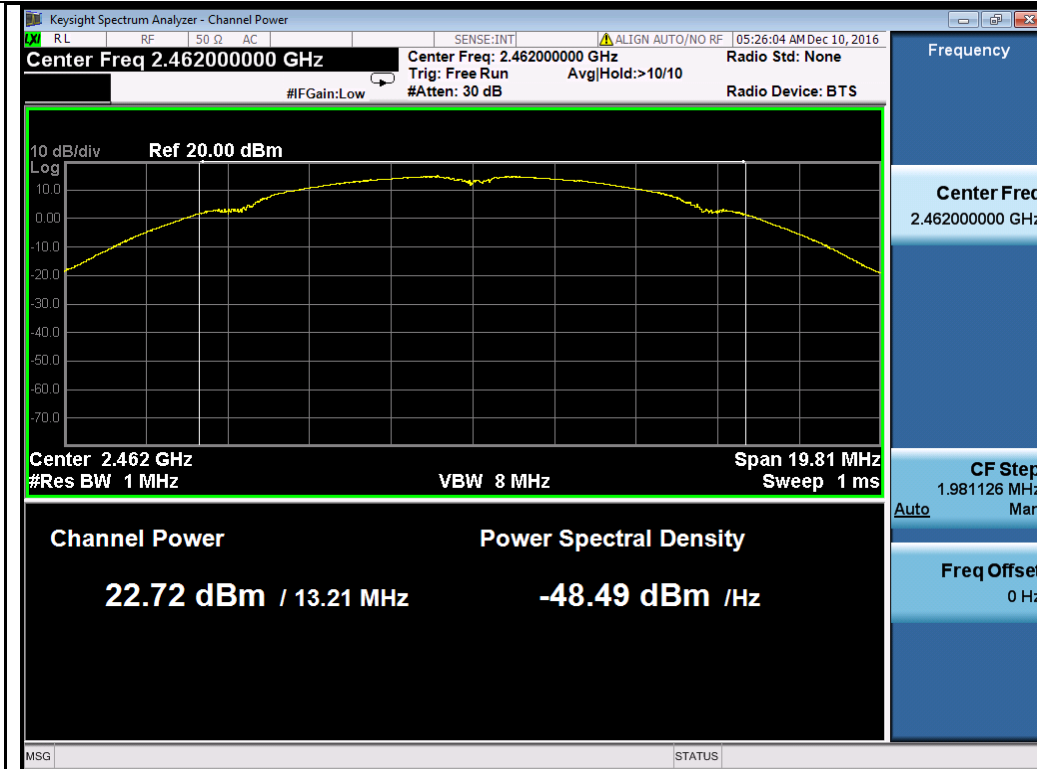
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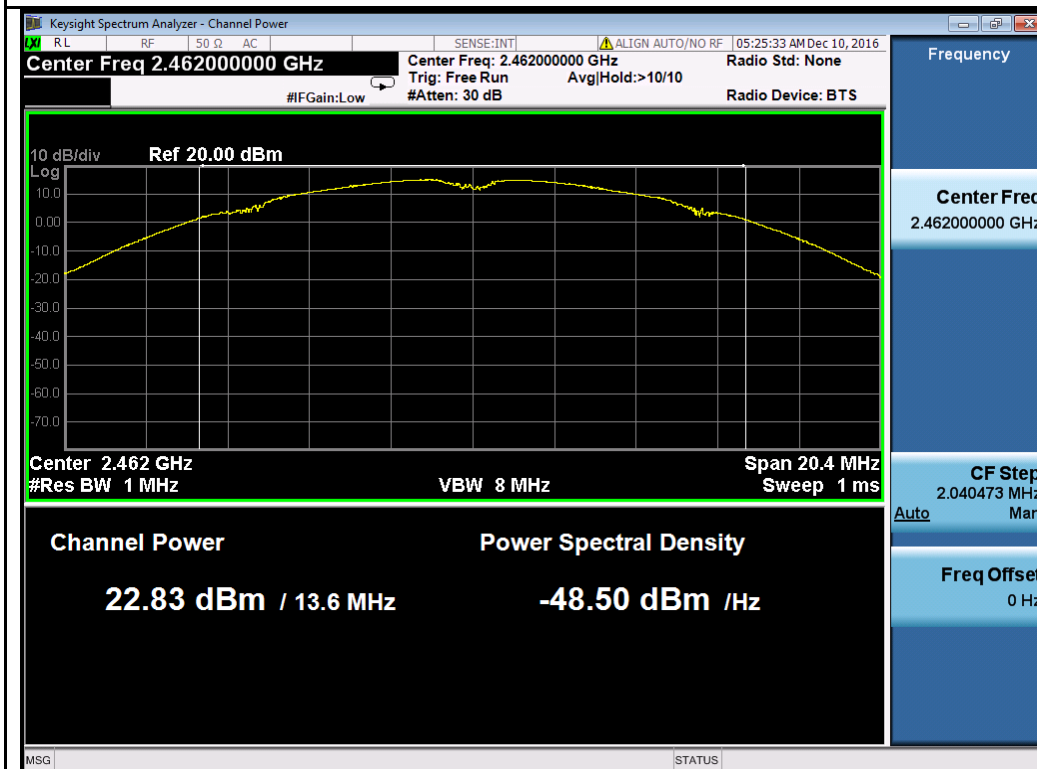
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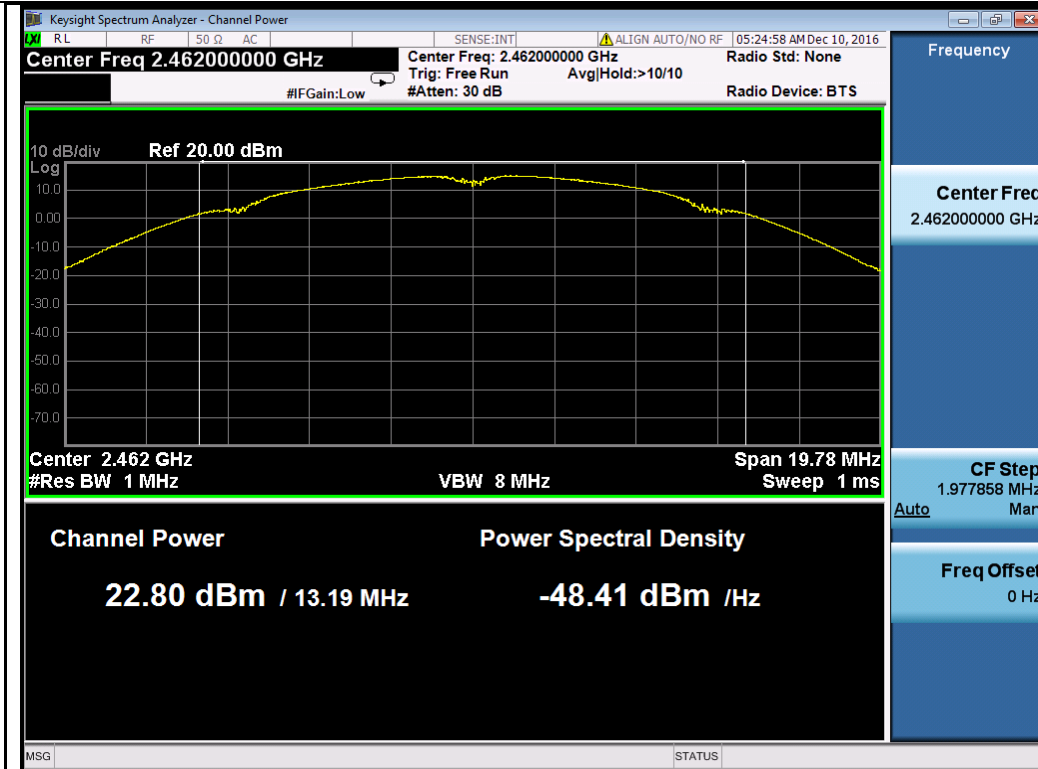
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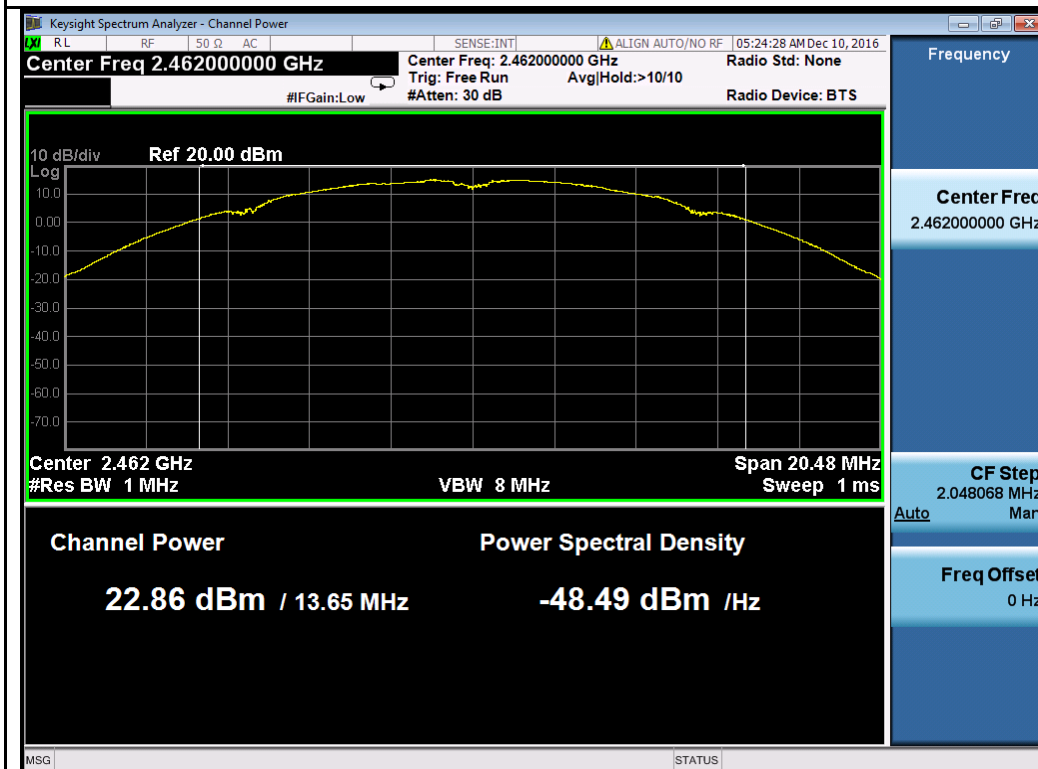
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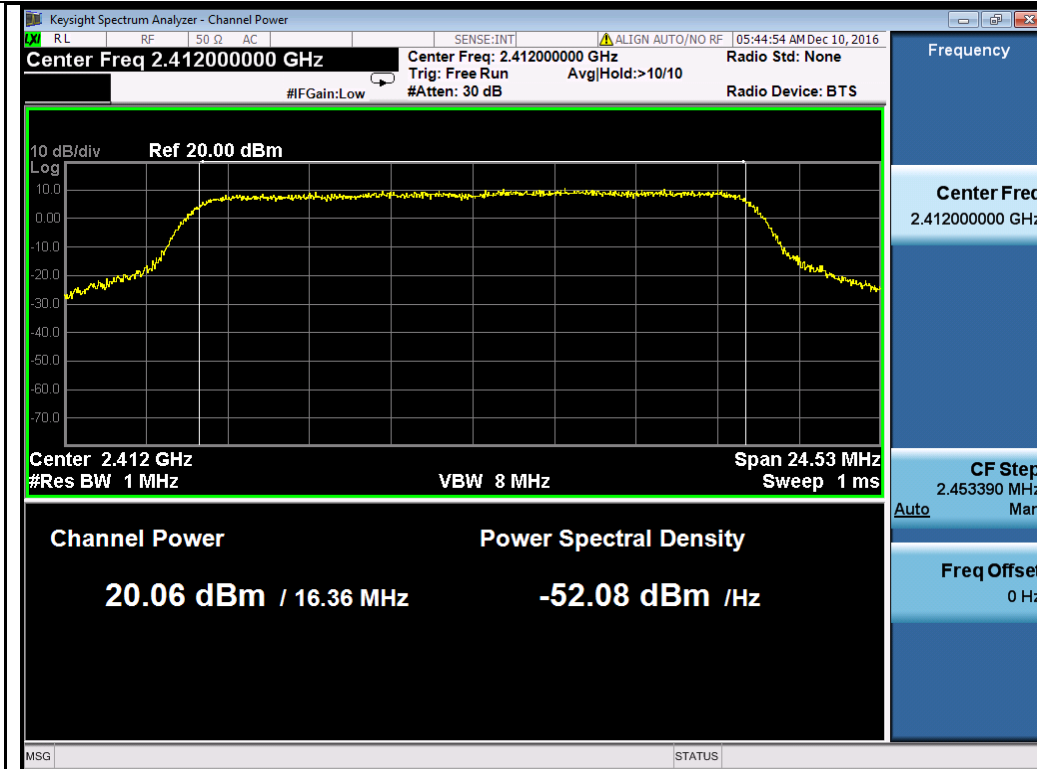
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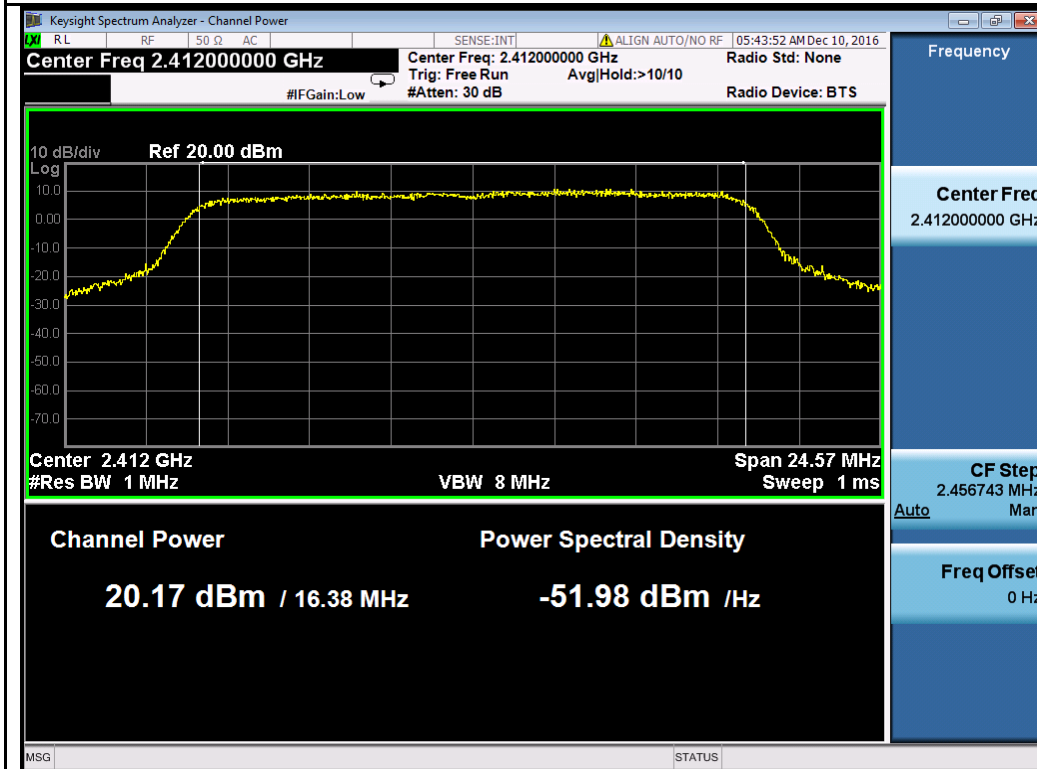
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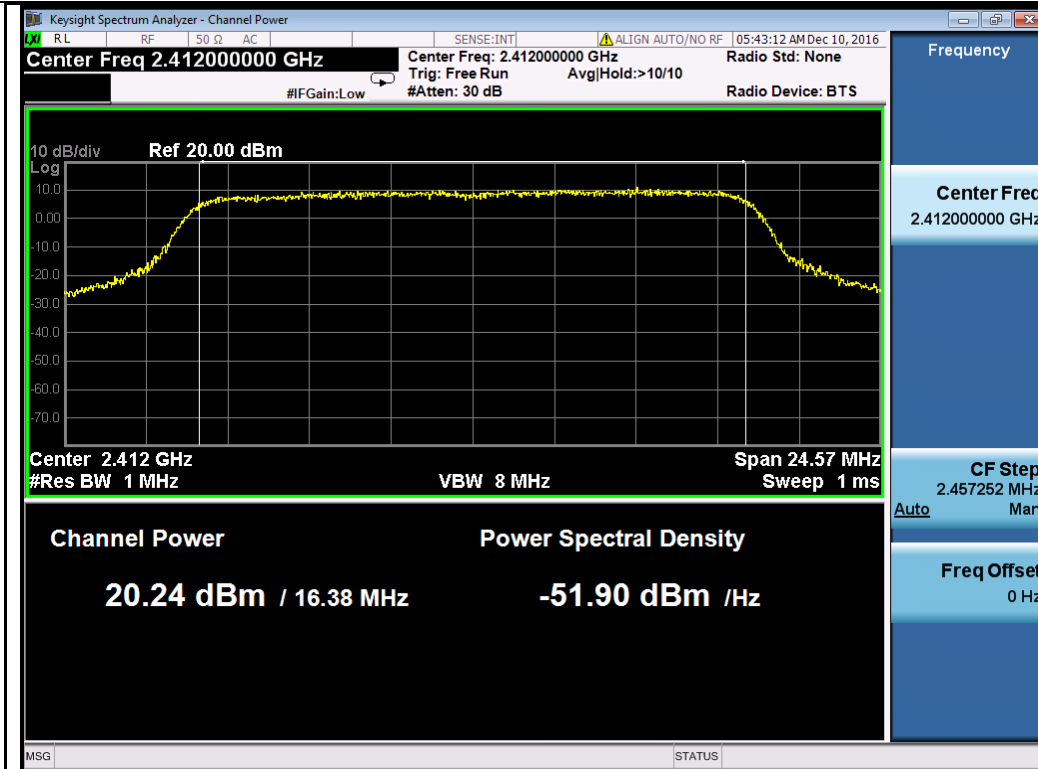
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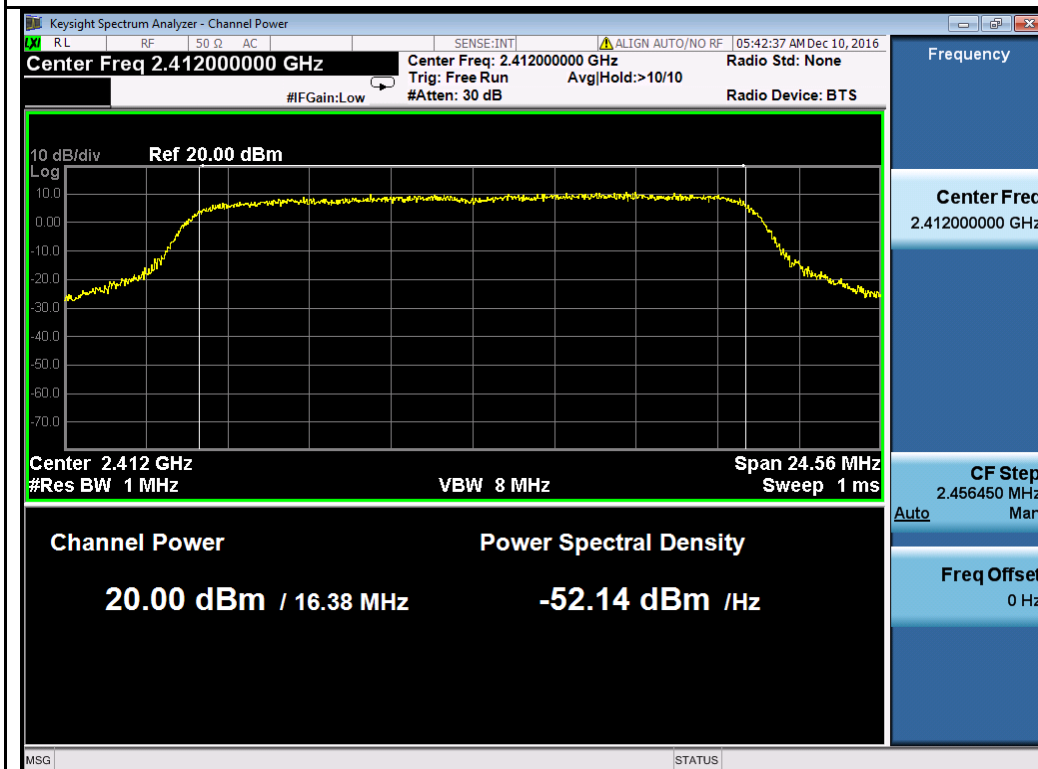
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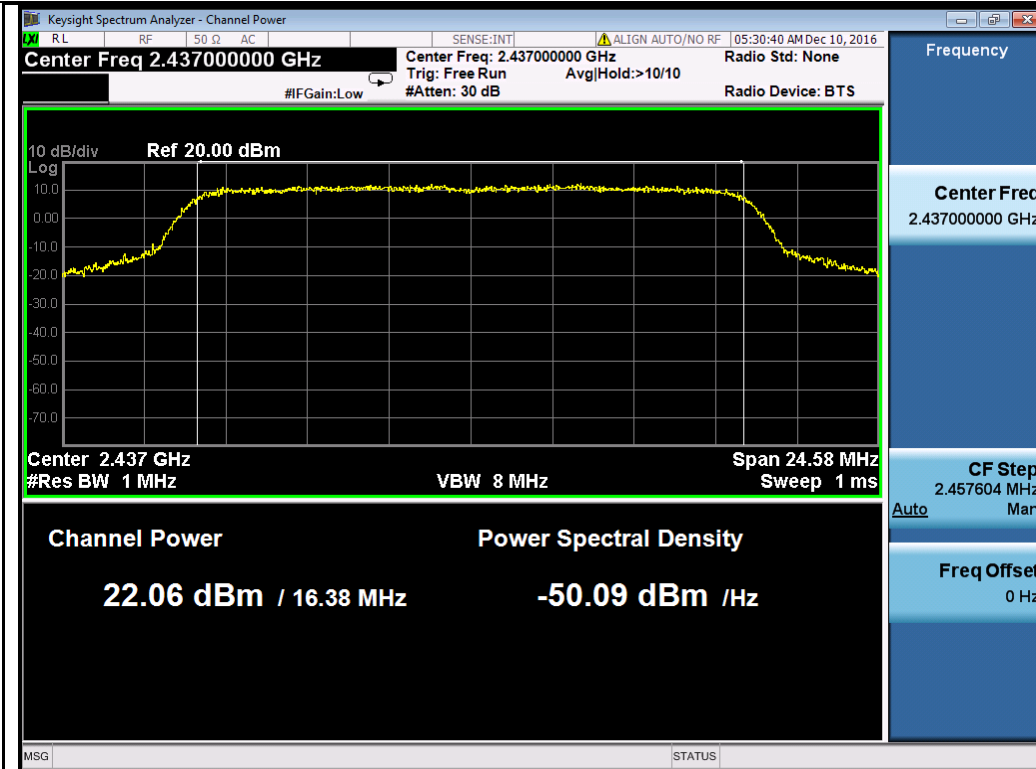
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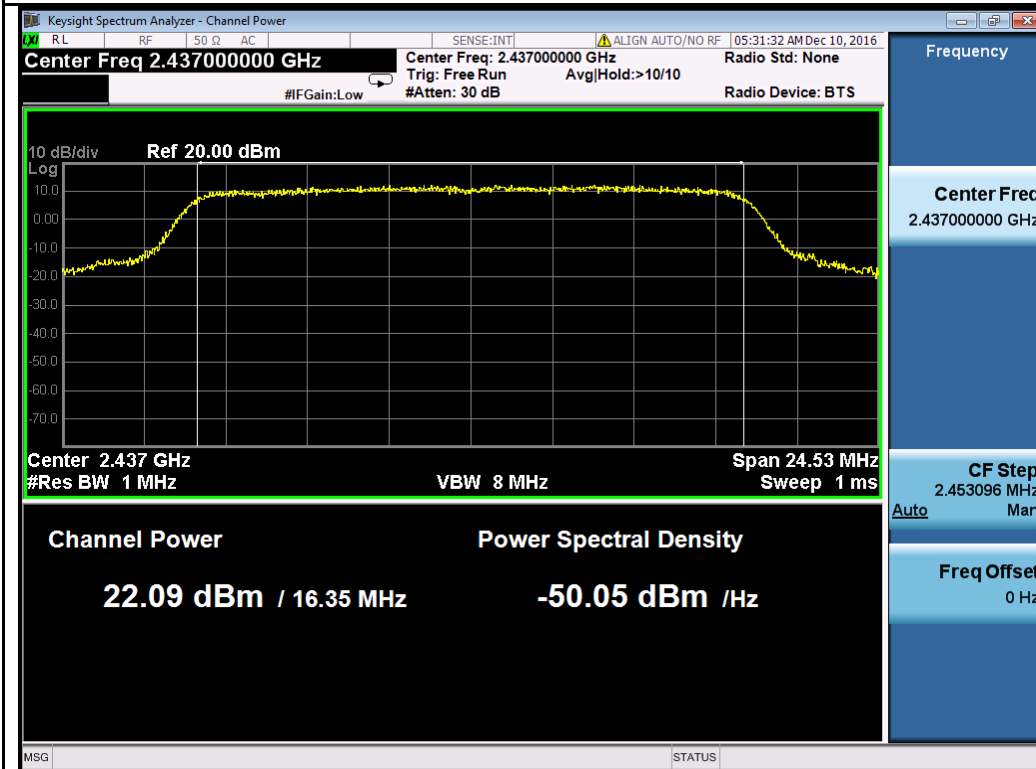
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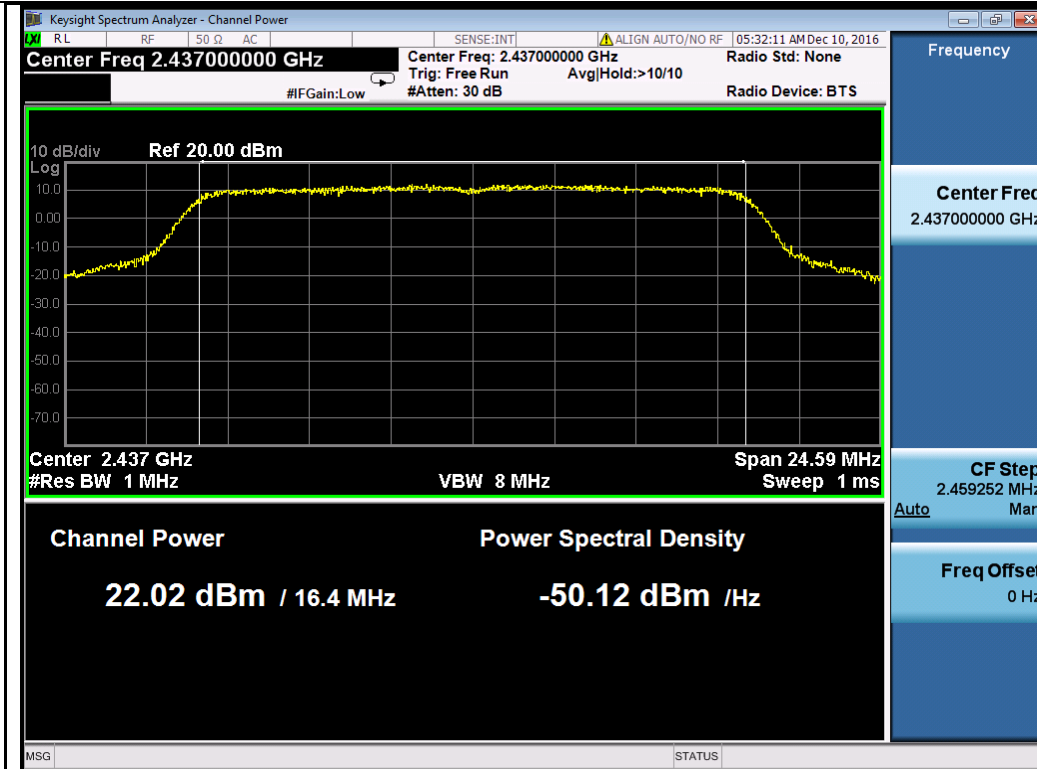
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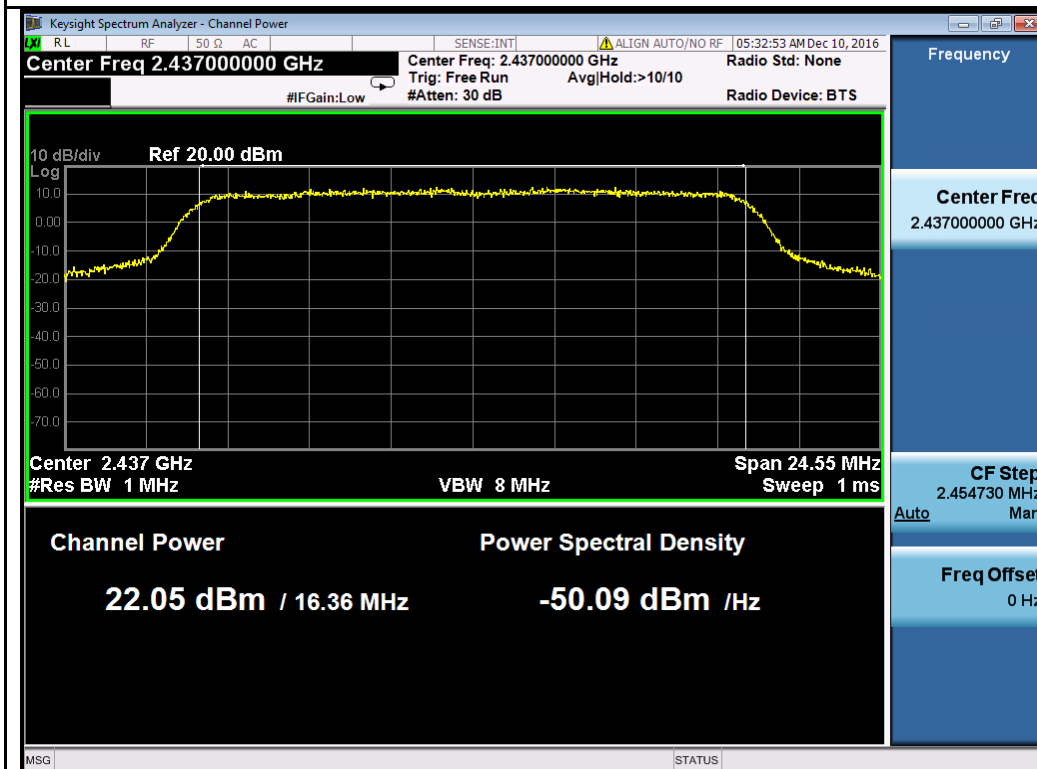
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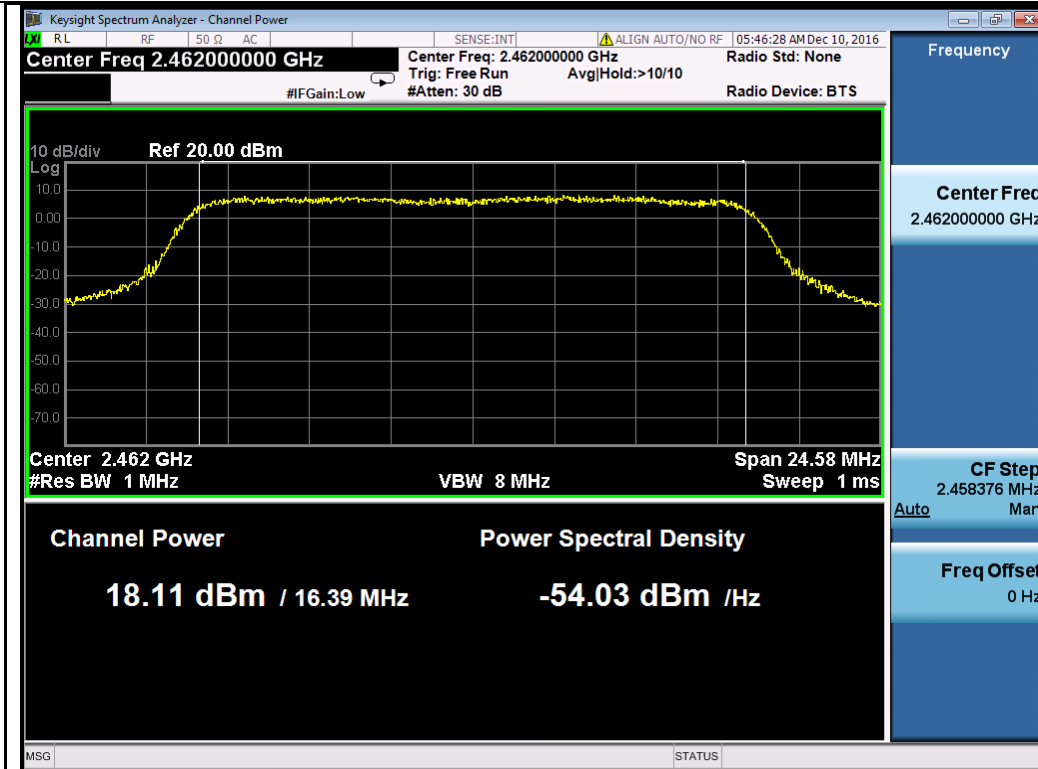
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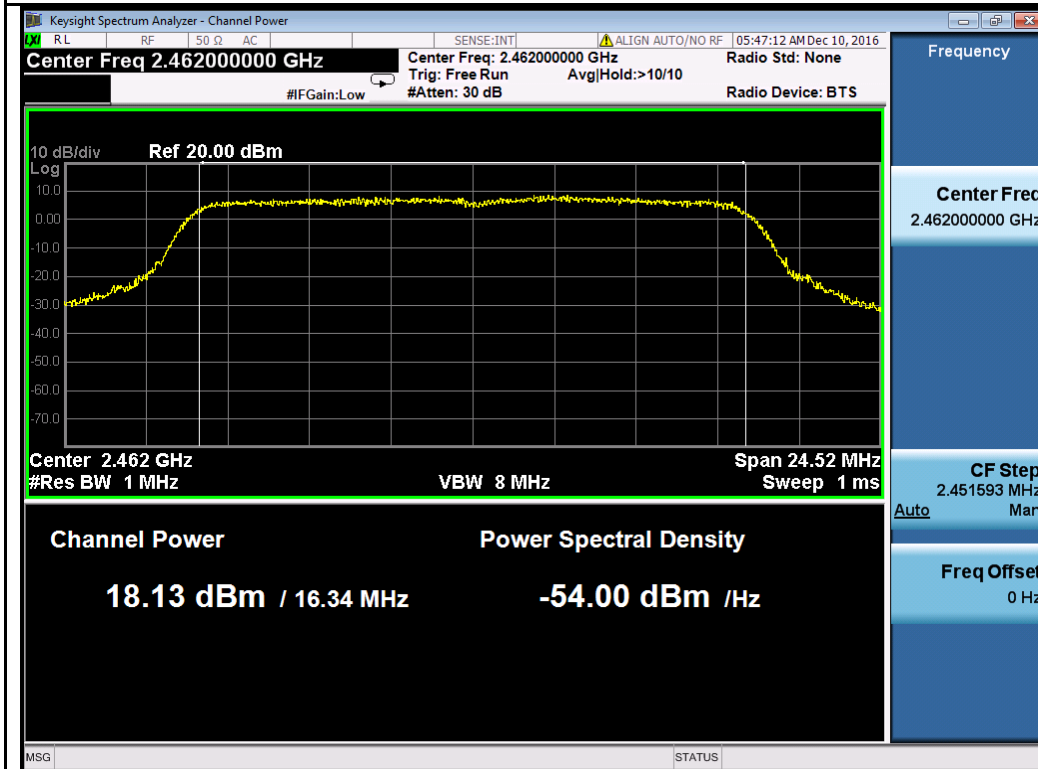
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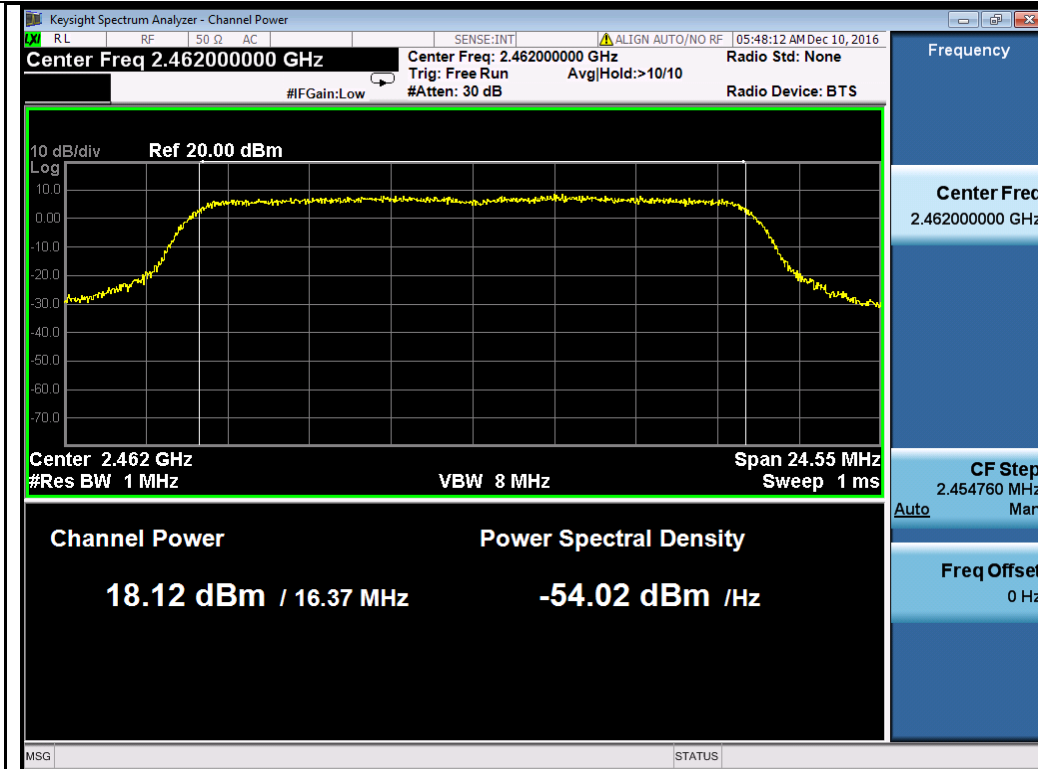
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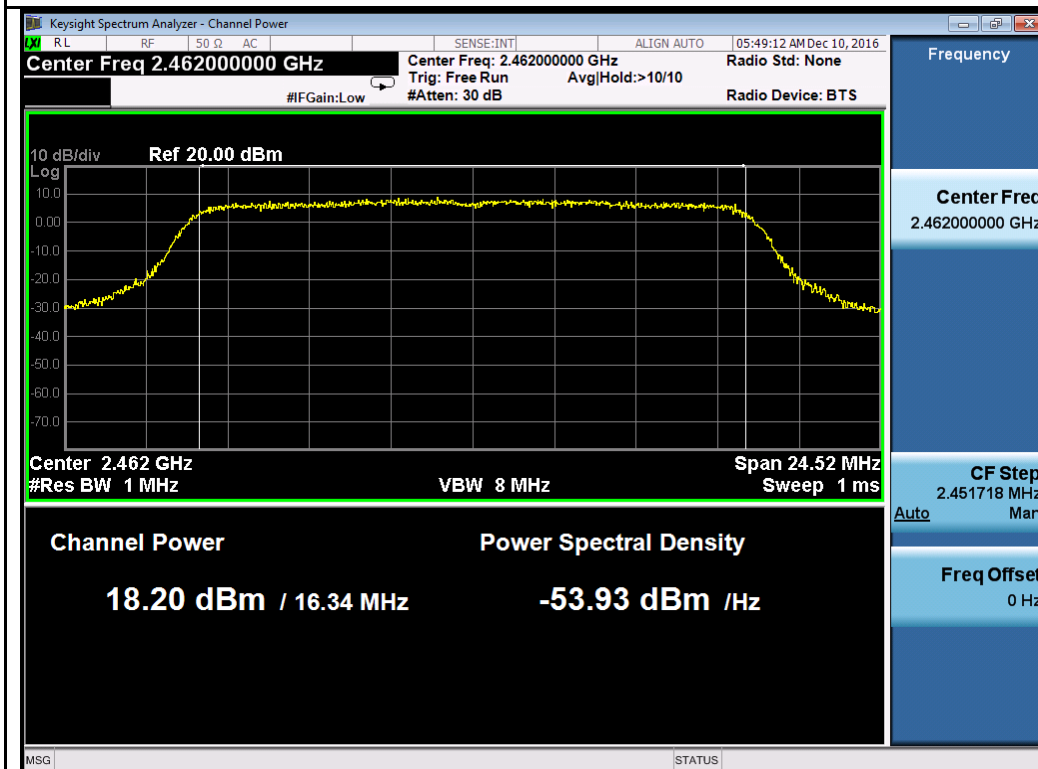
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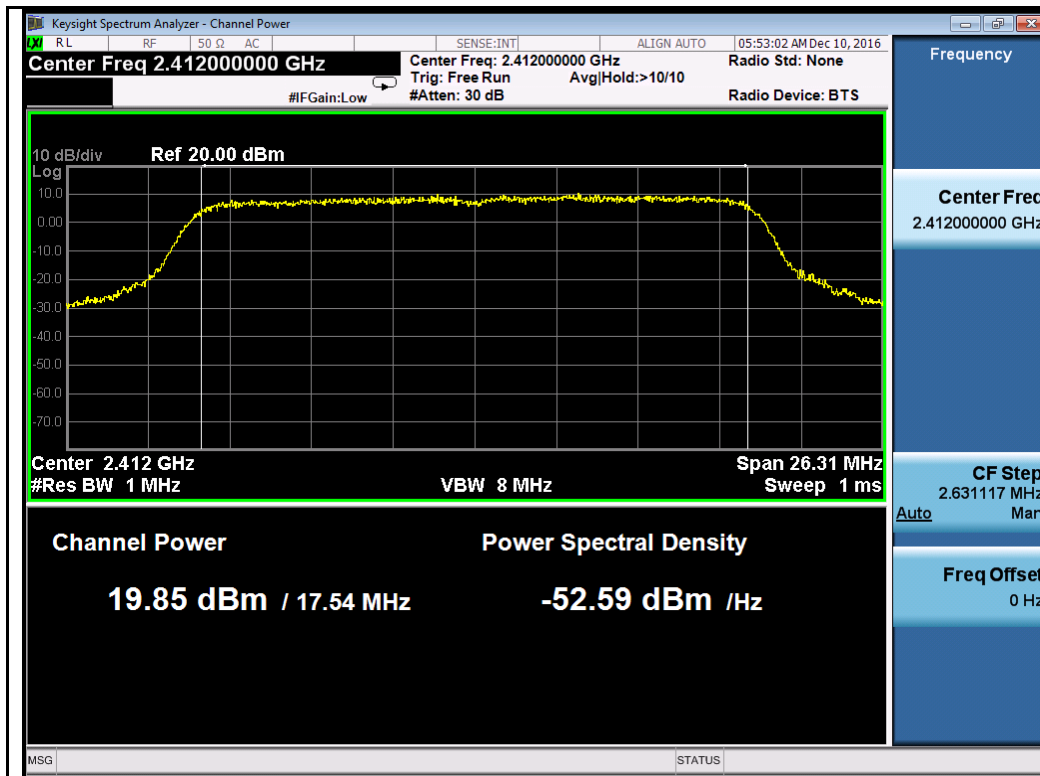
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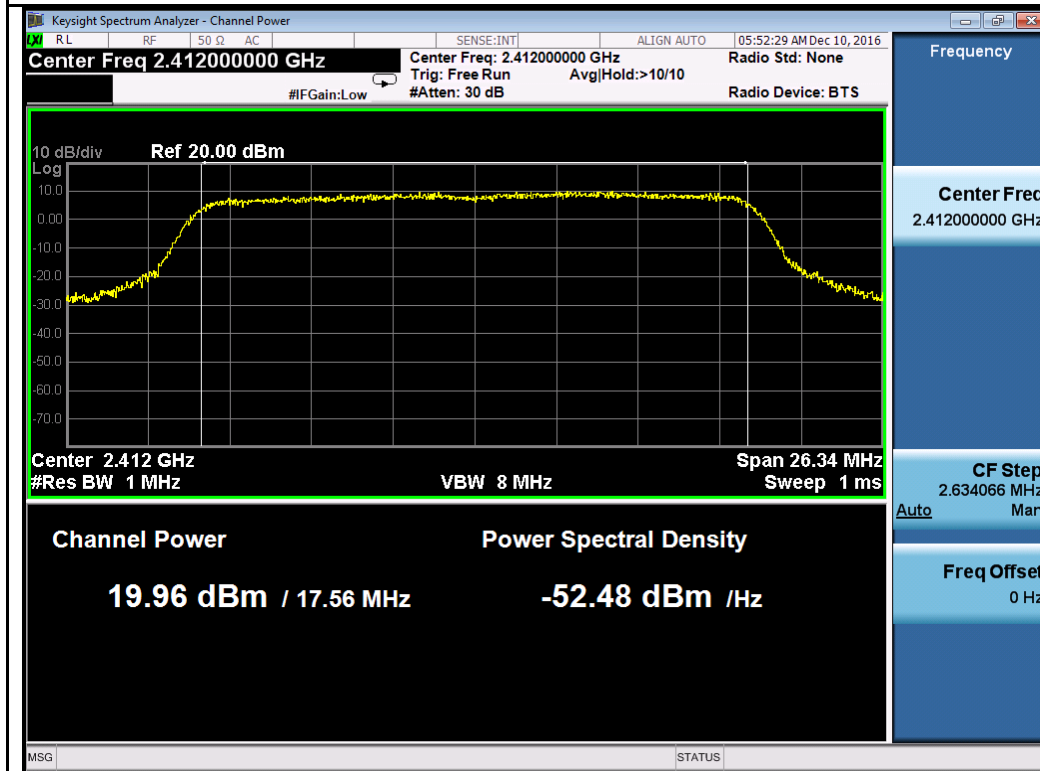
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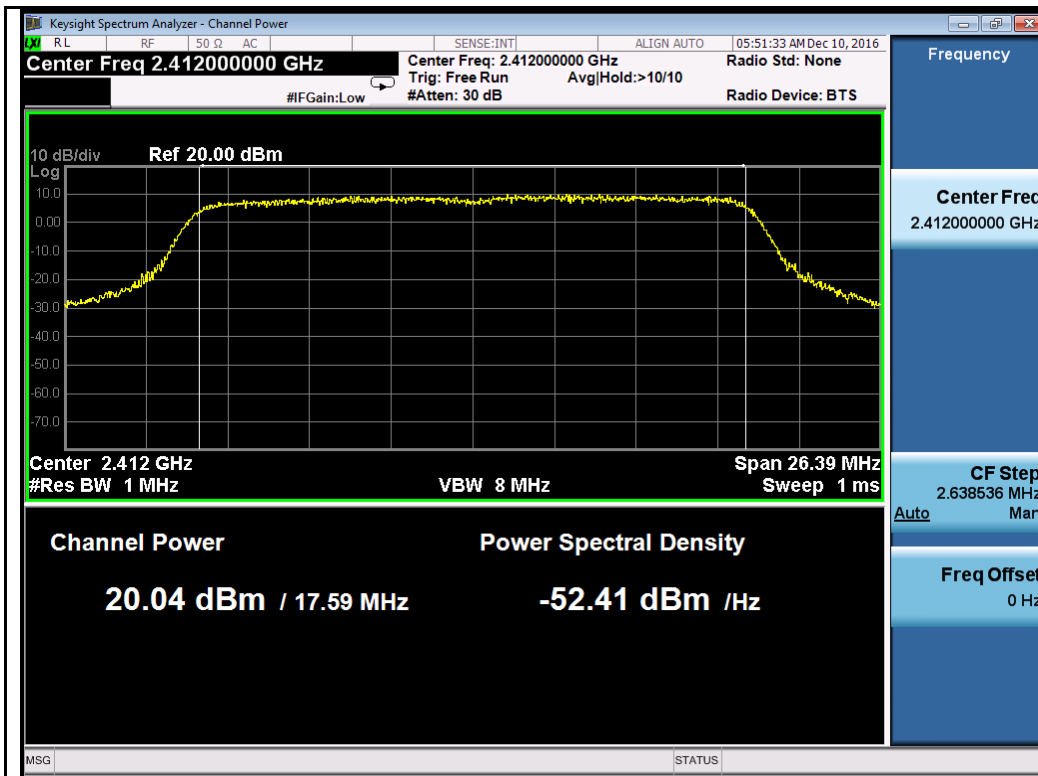
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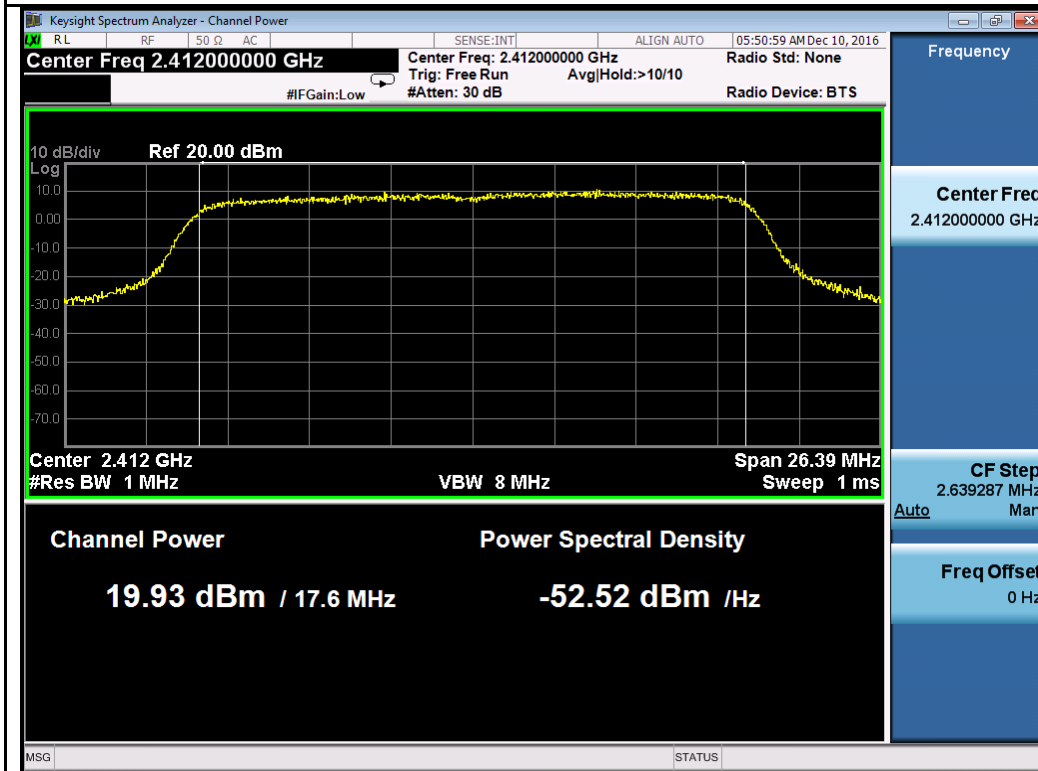
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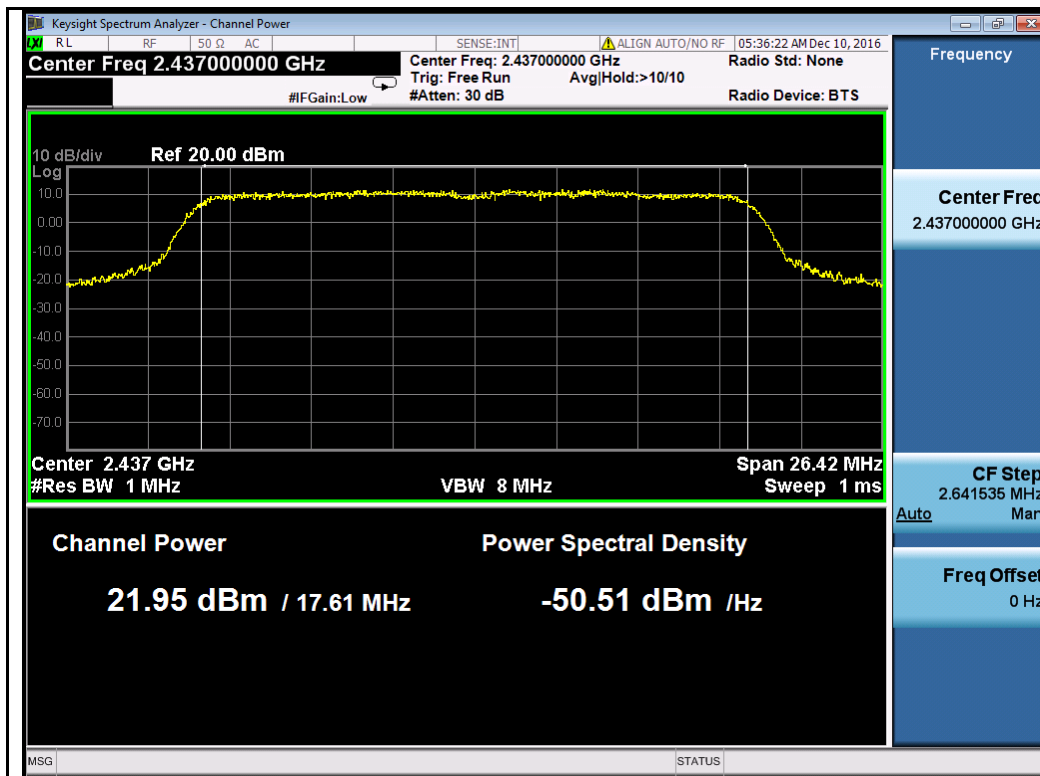
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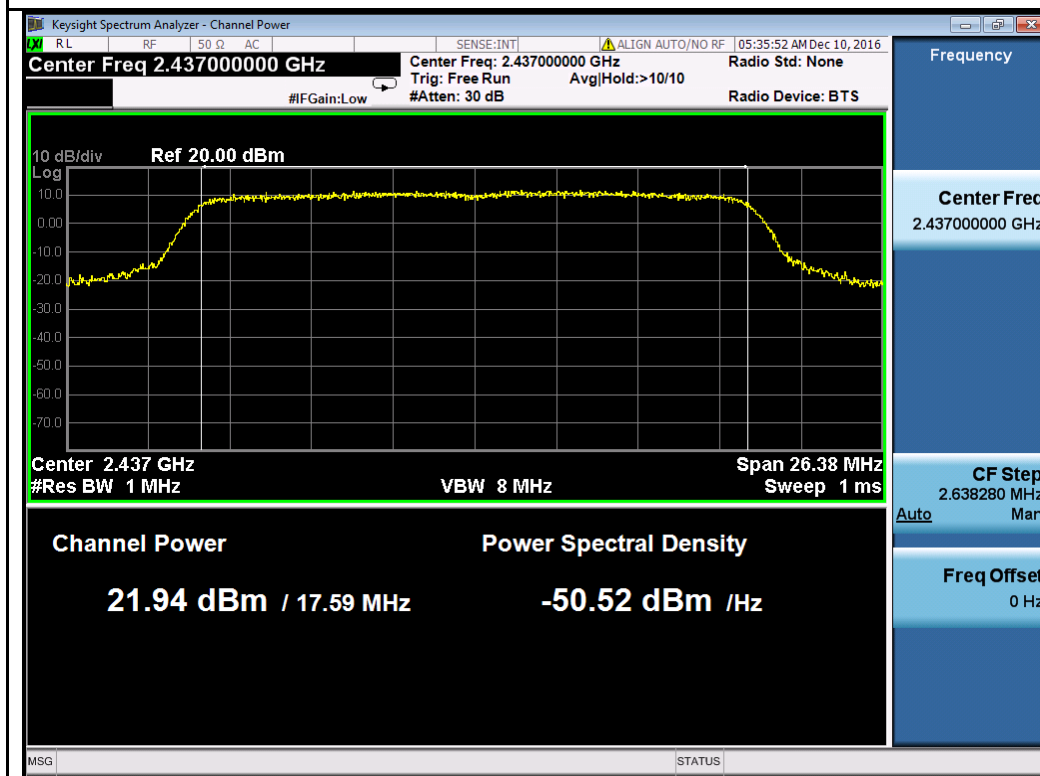
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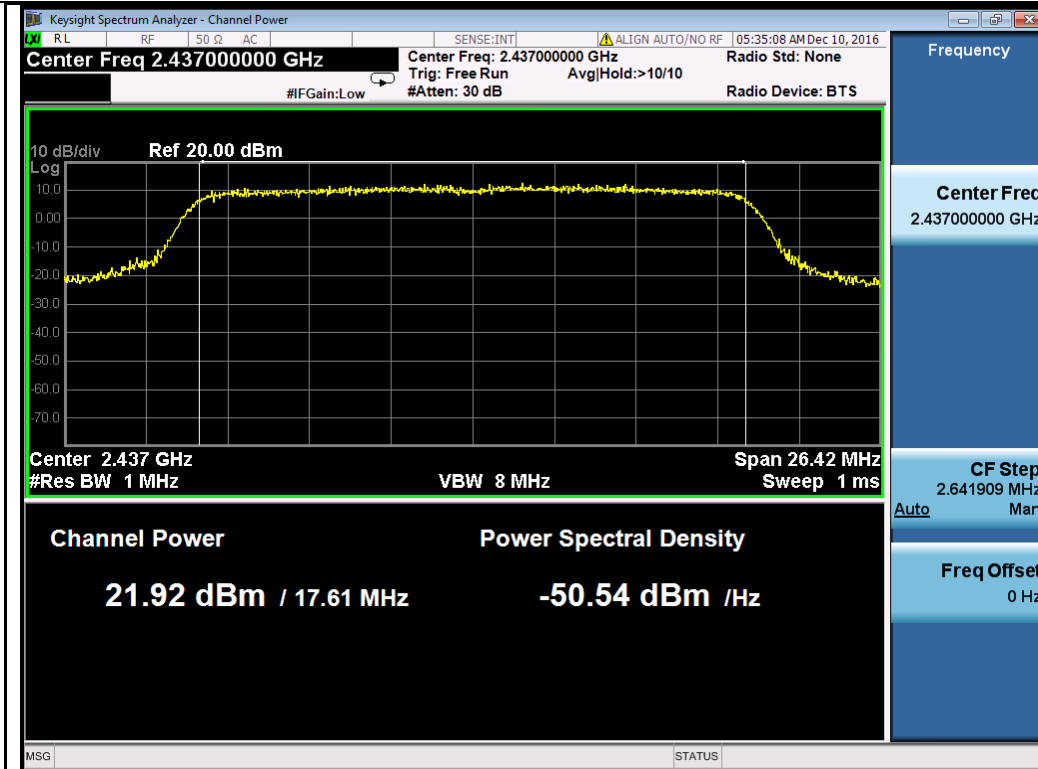
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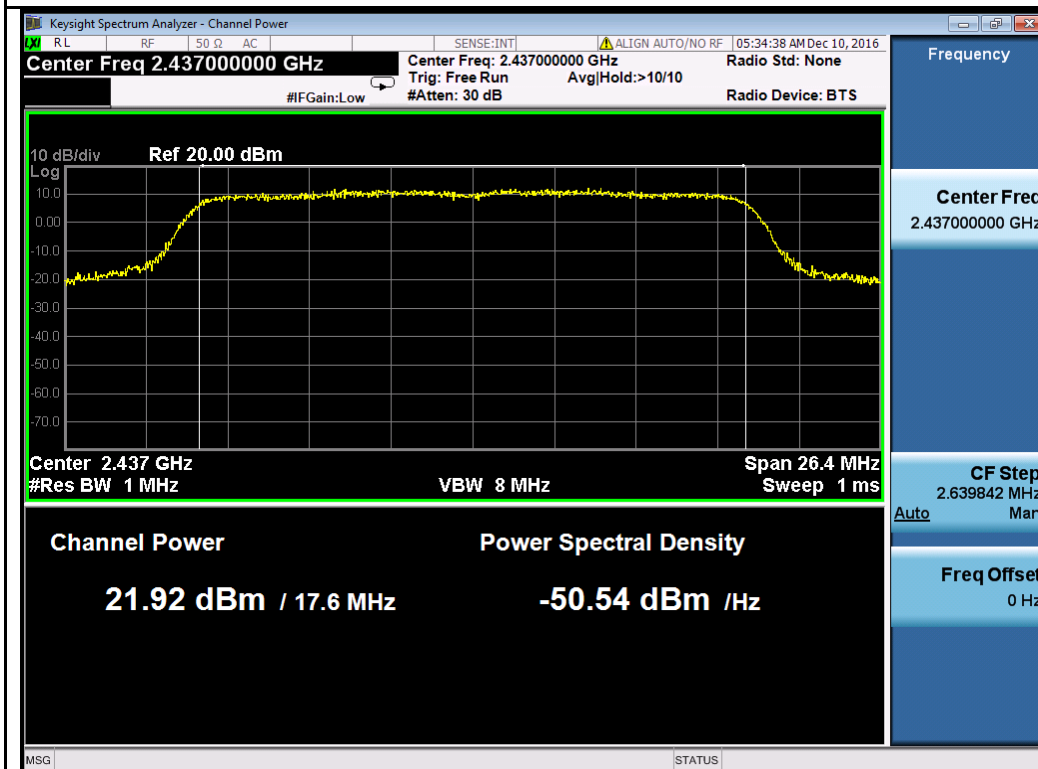
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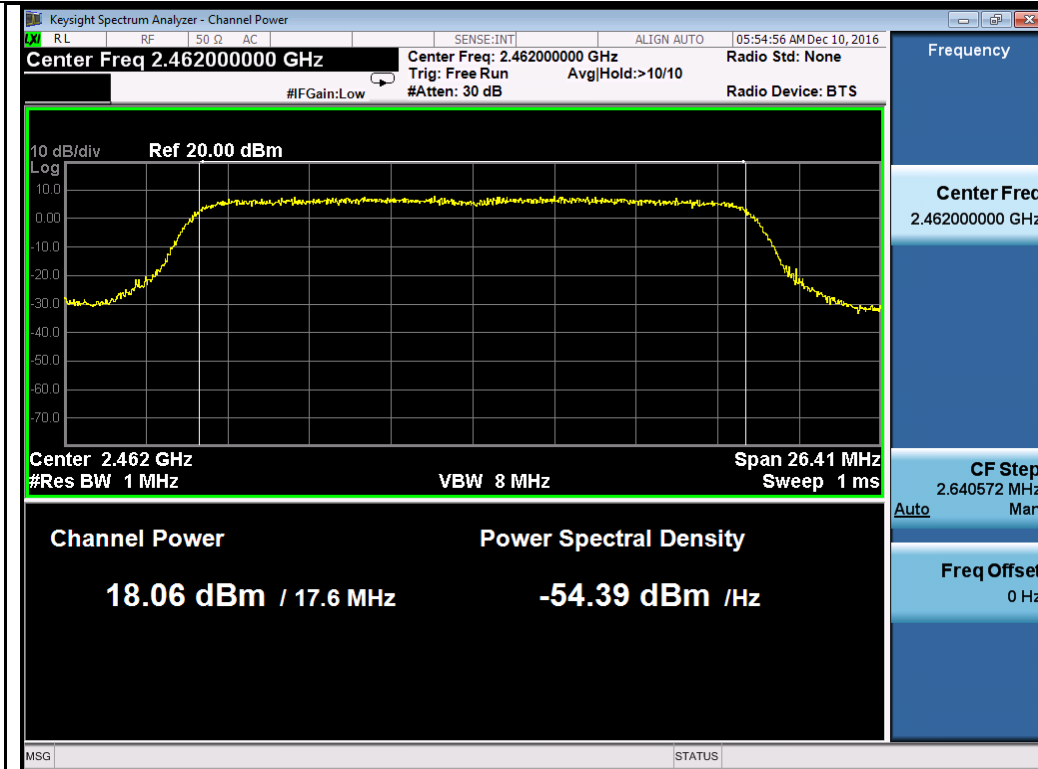
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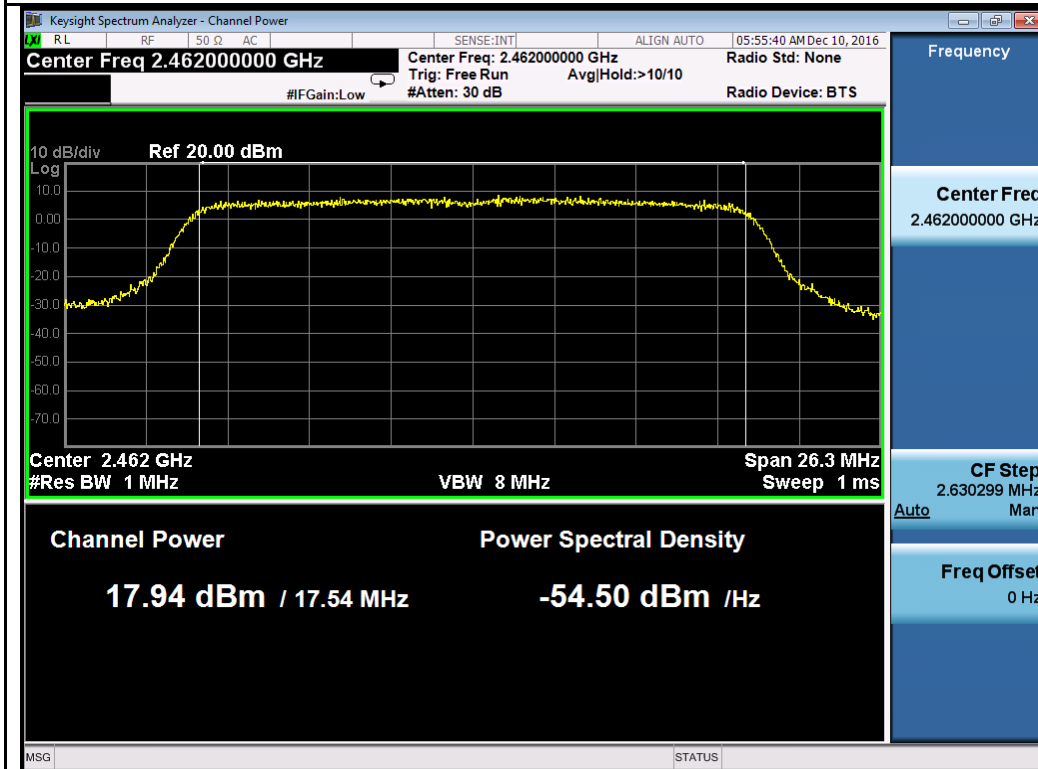
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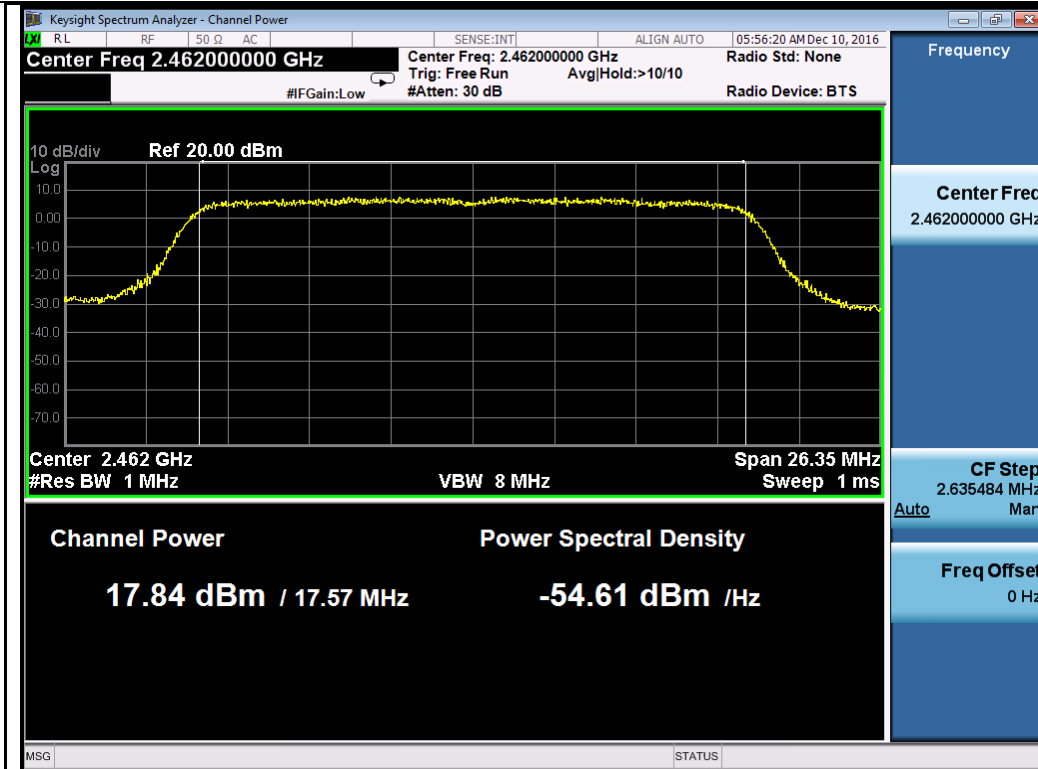
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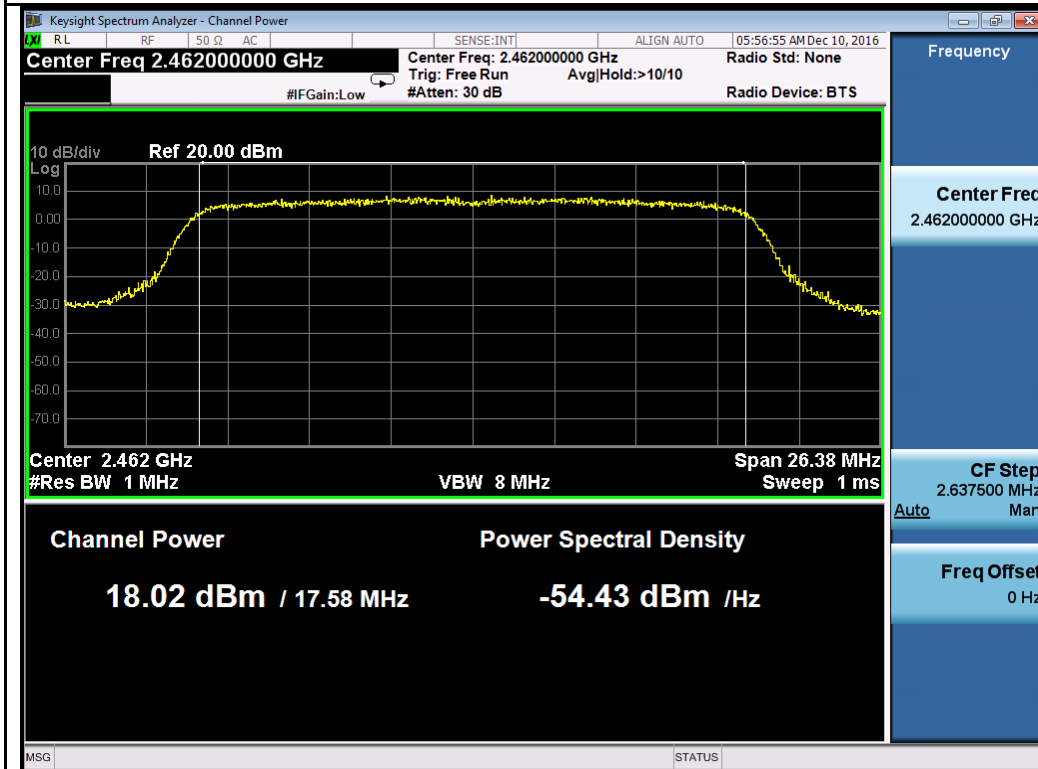
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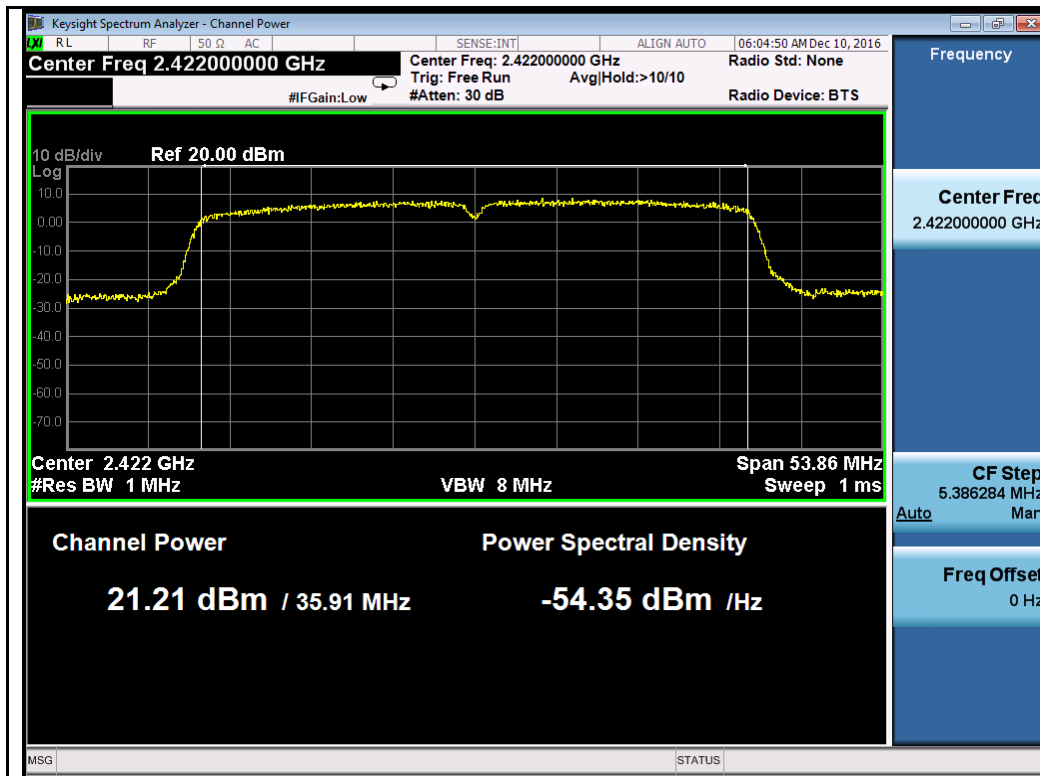
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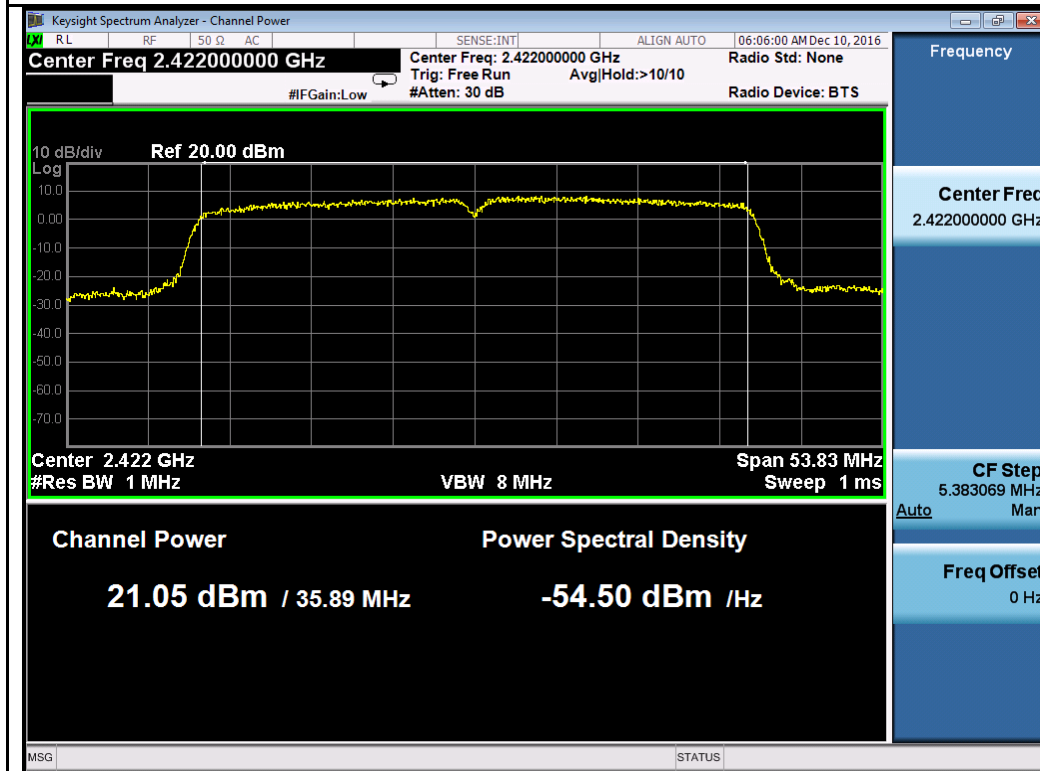
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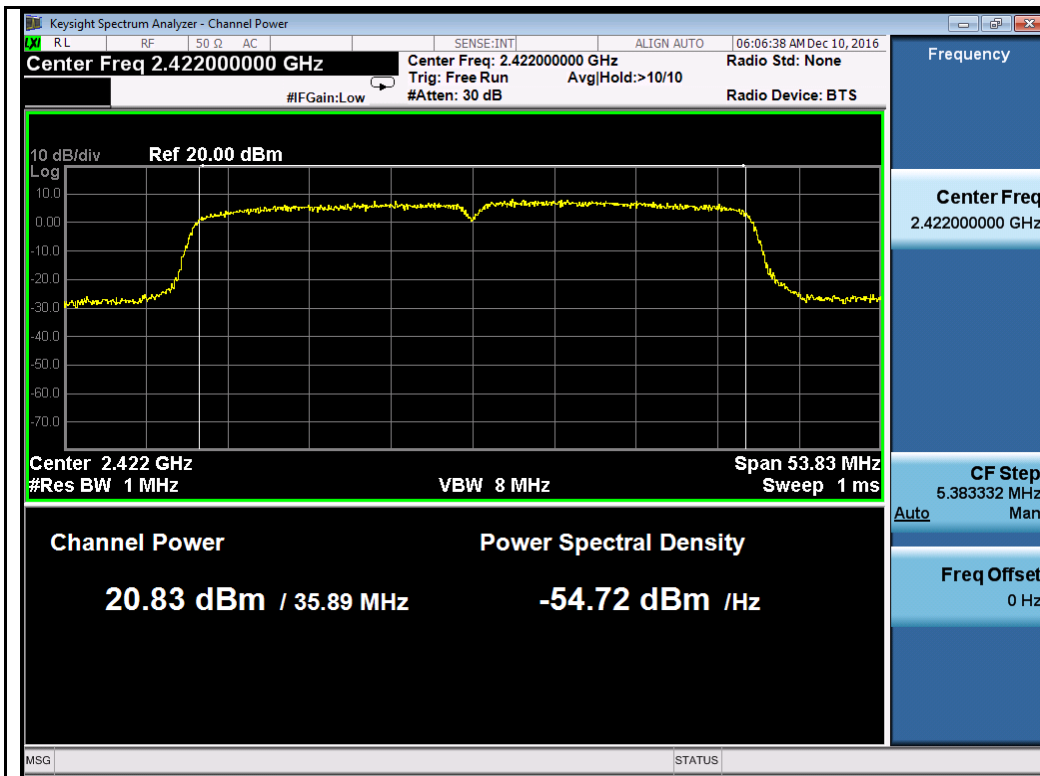
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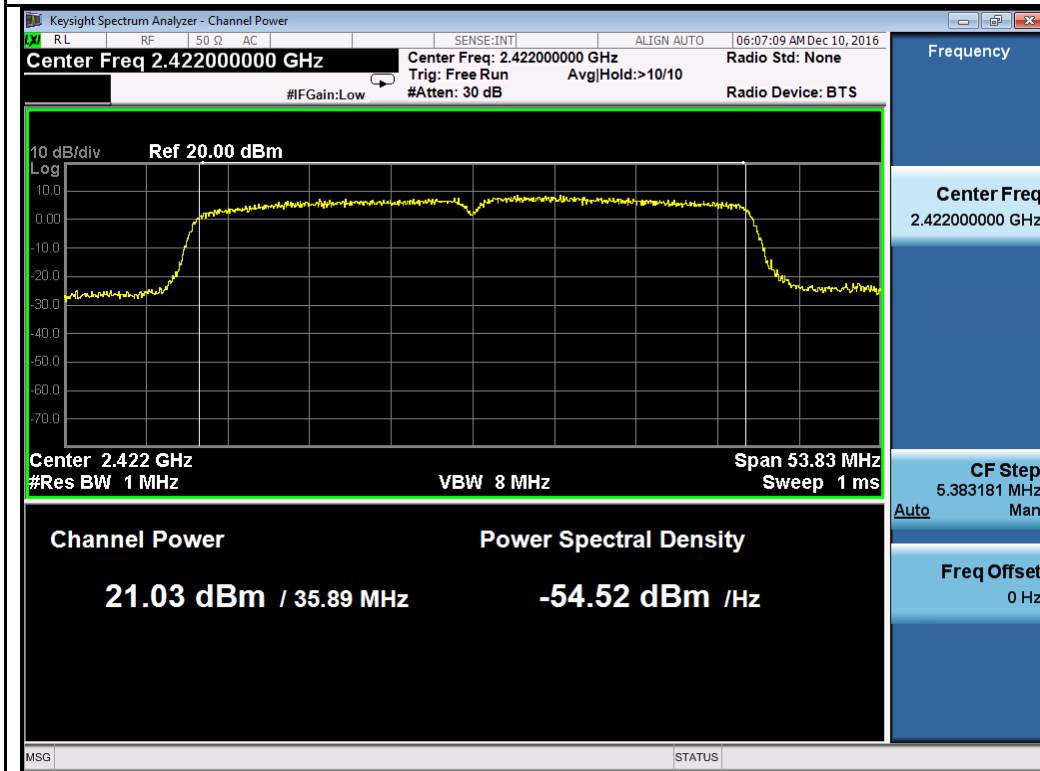
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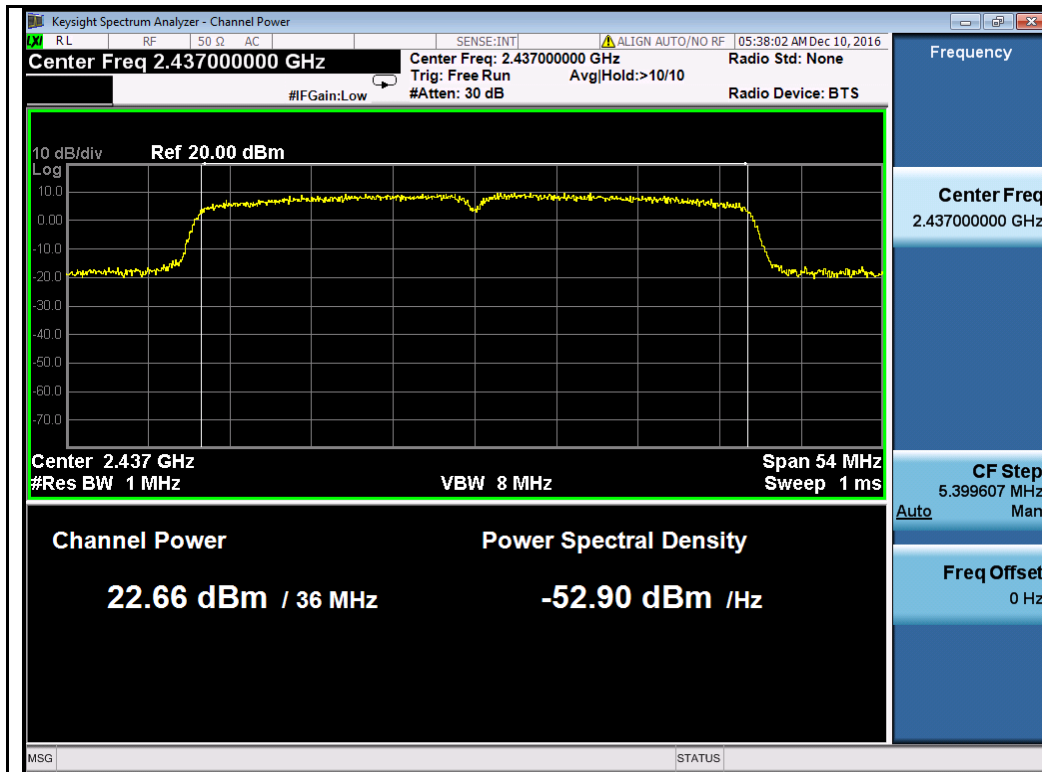
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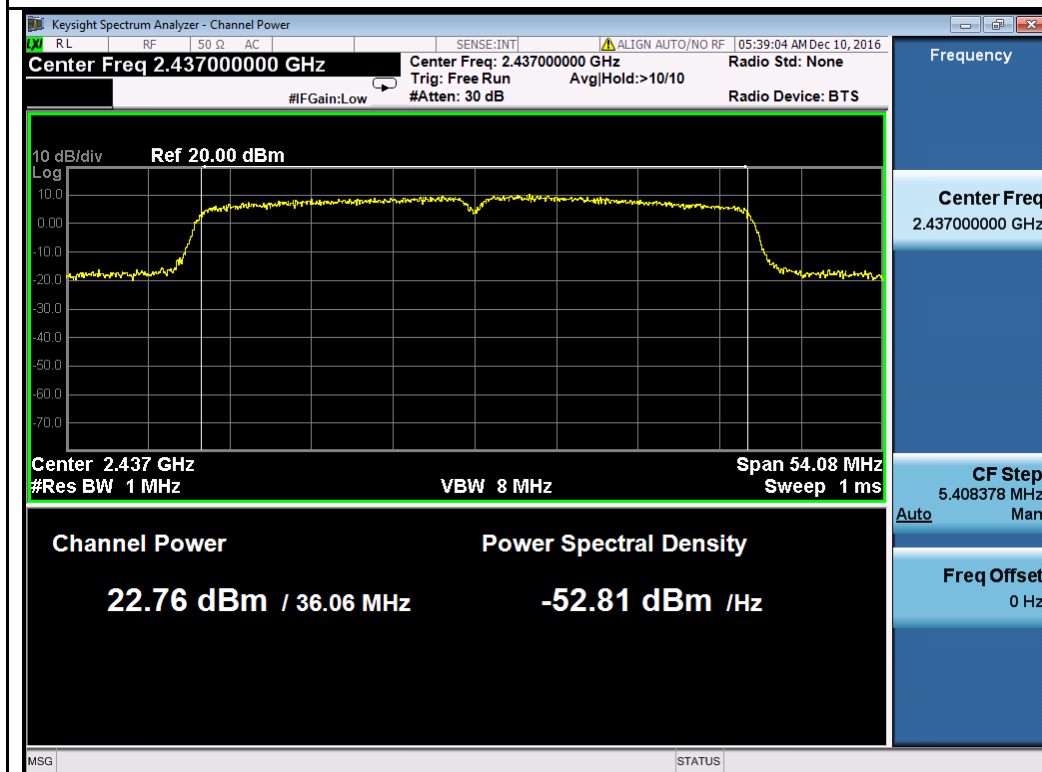
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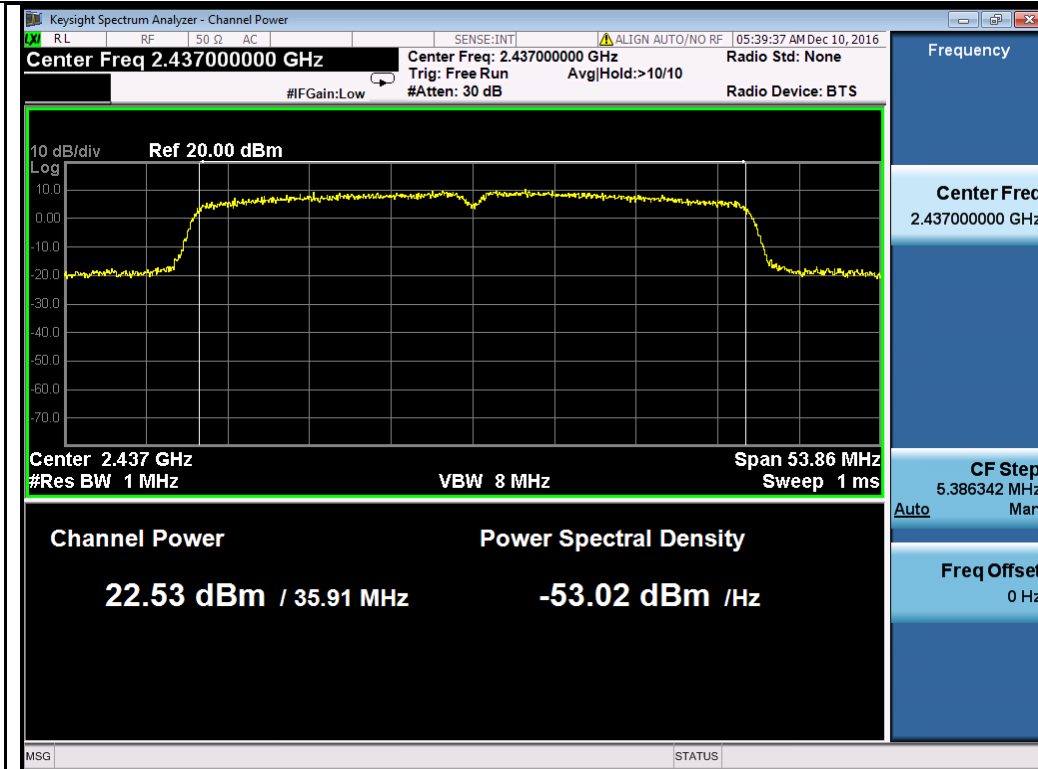
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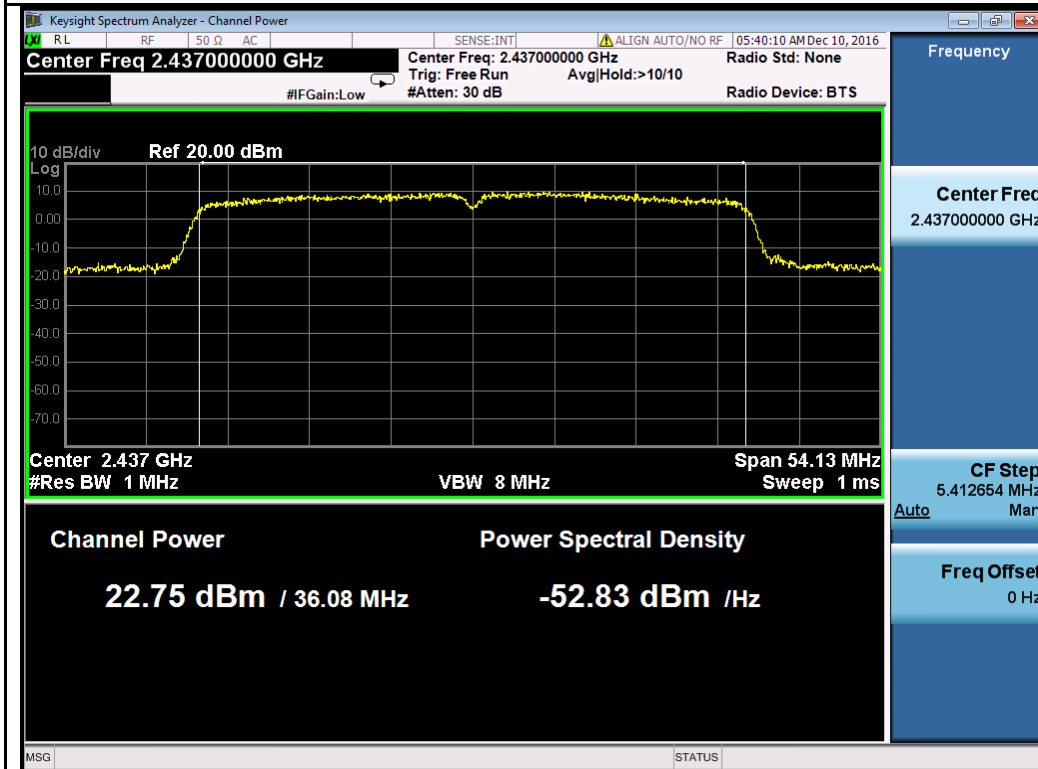
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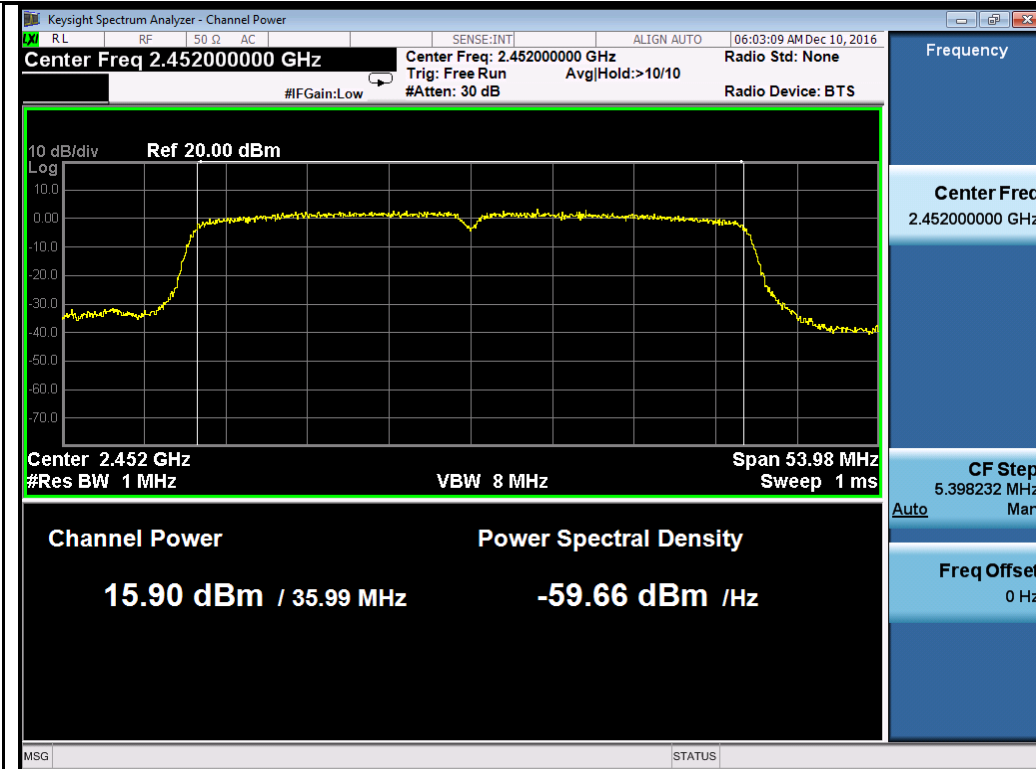
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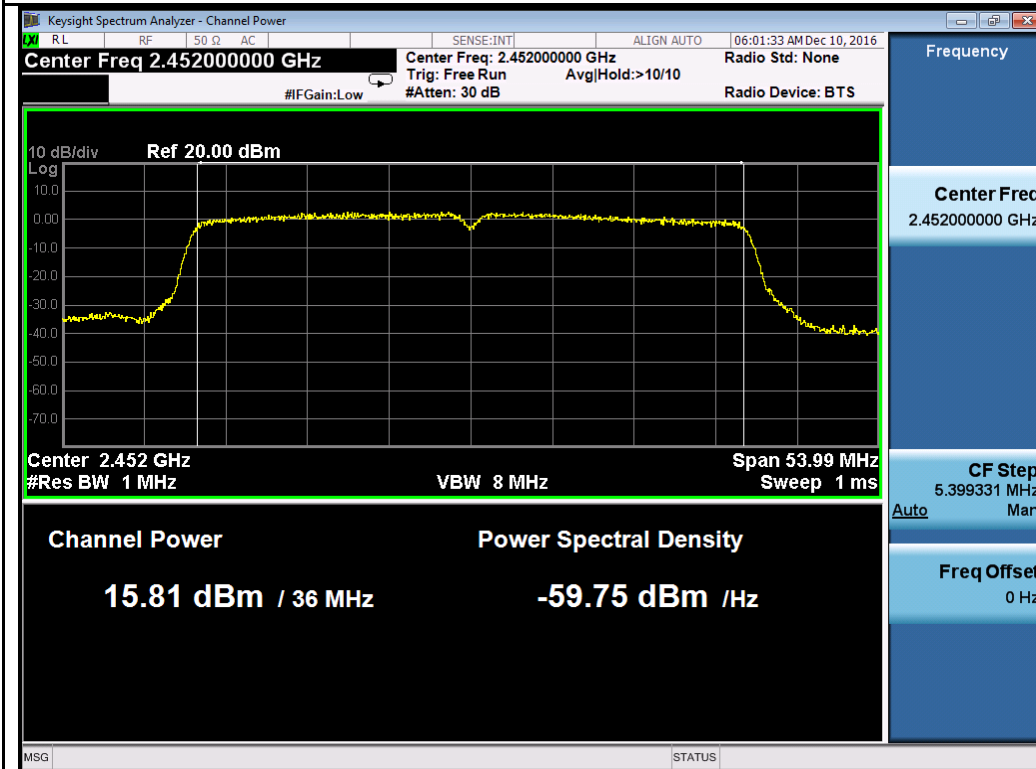
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802.11n-HT40 2437MHz Chain 4

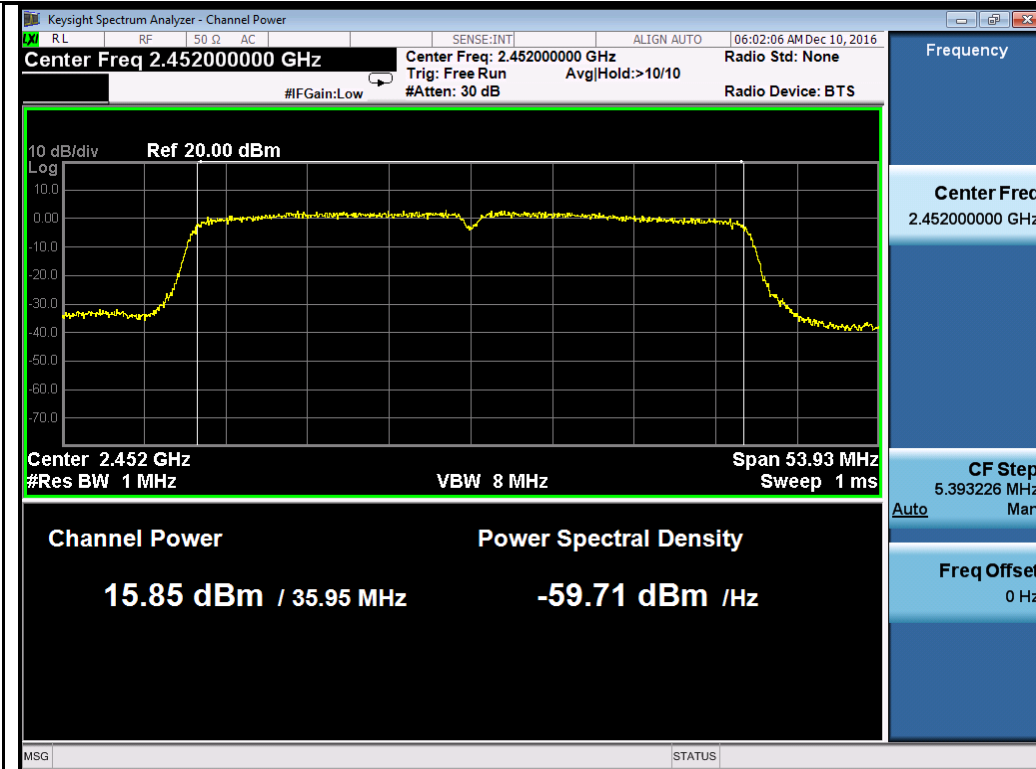


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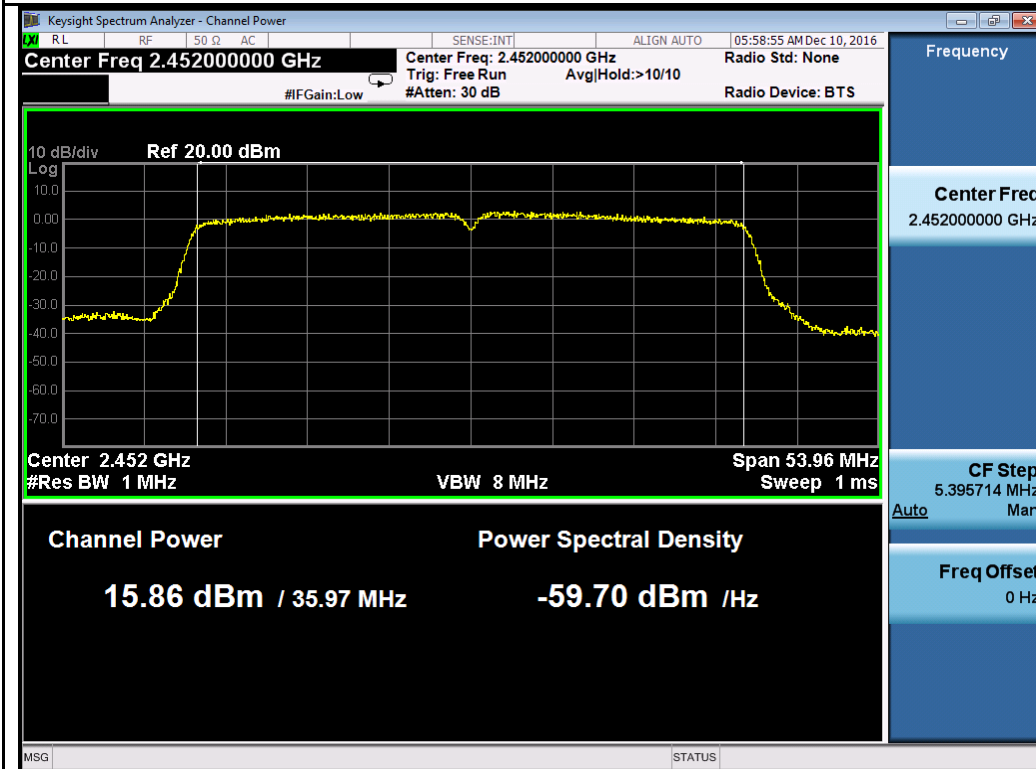


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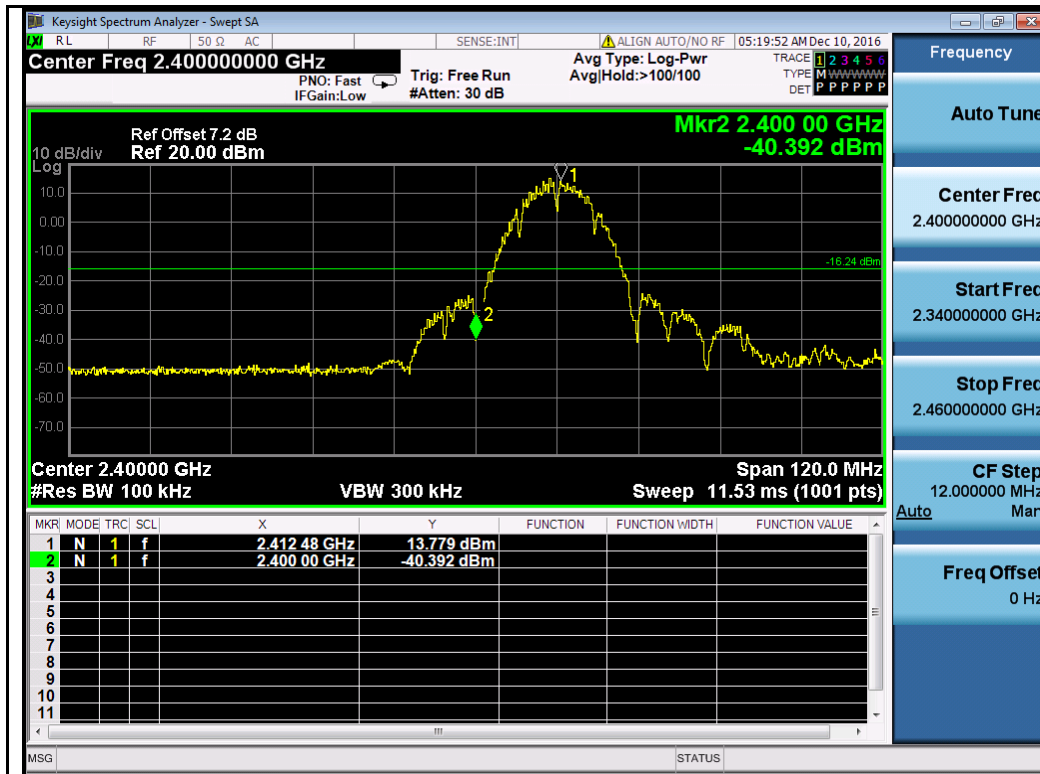


802.11n-HT40 2452MHz Chain 3

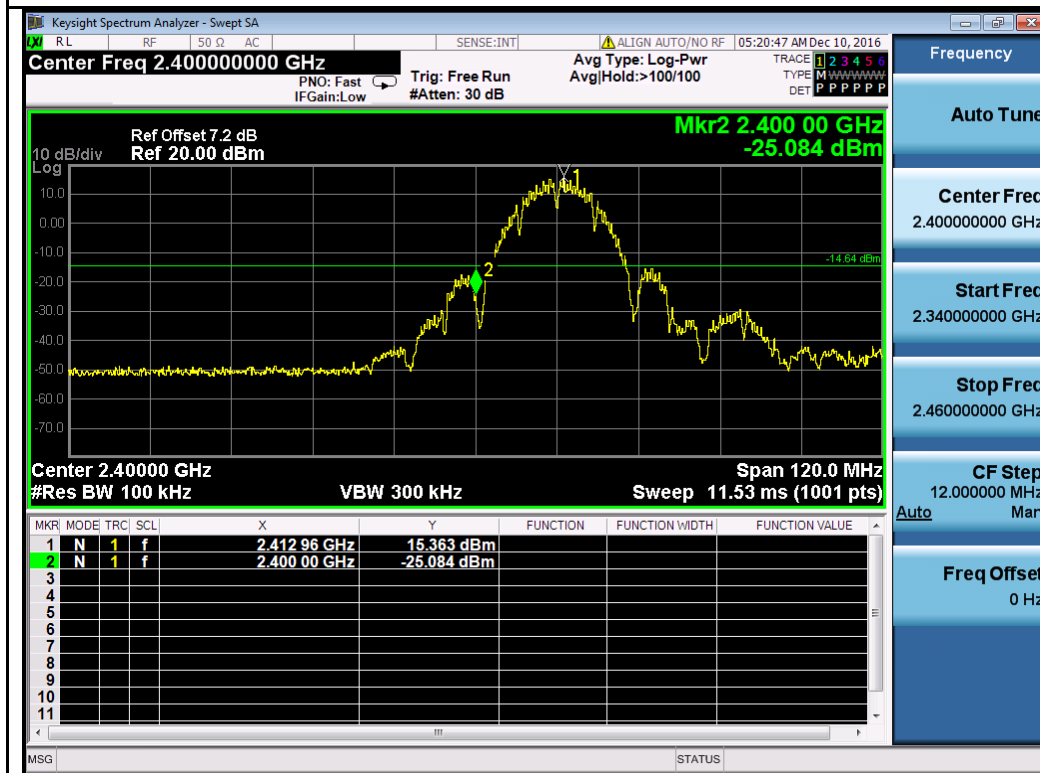


802.11n-HT40 2452MHz Chain 4

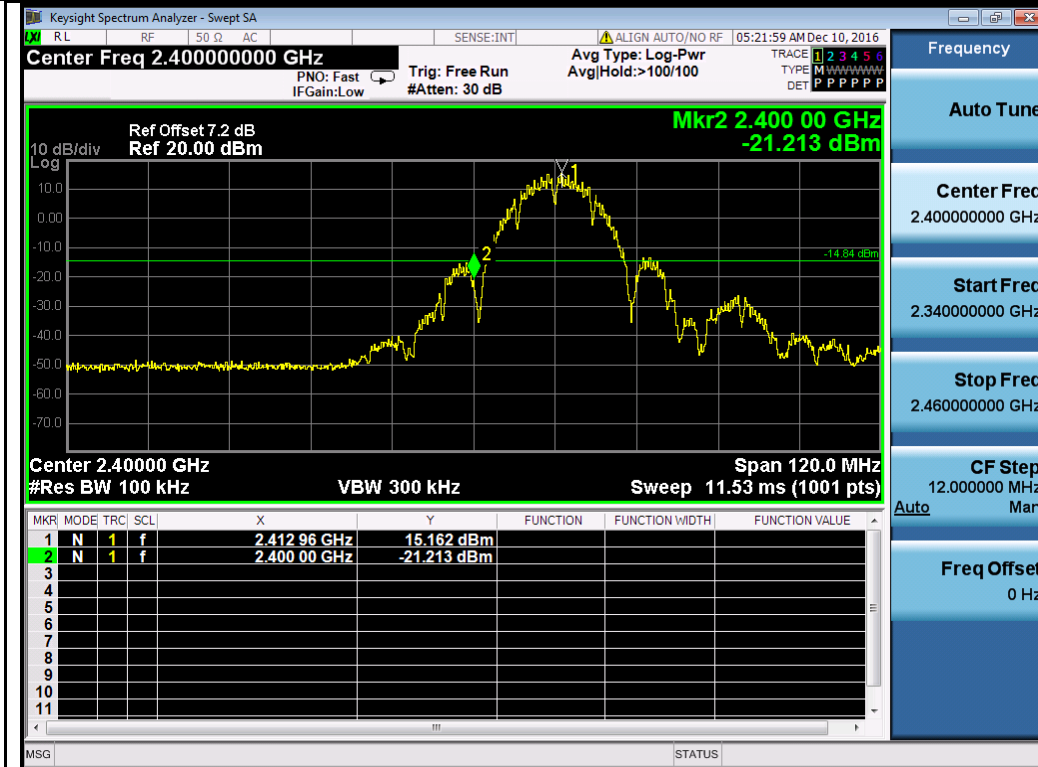
Test Plots



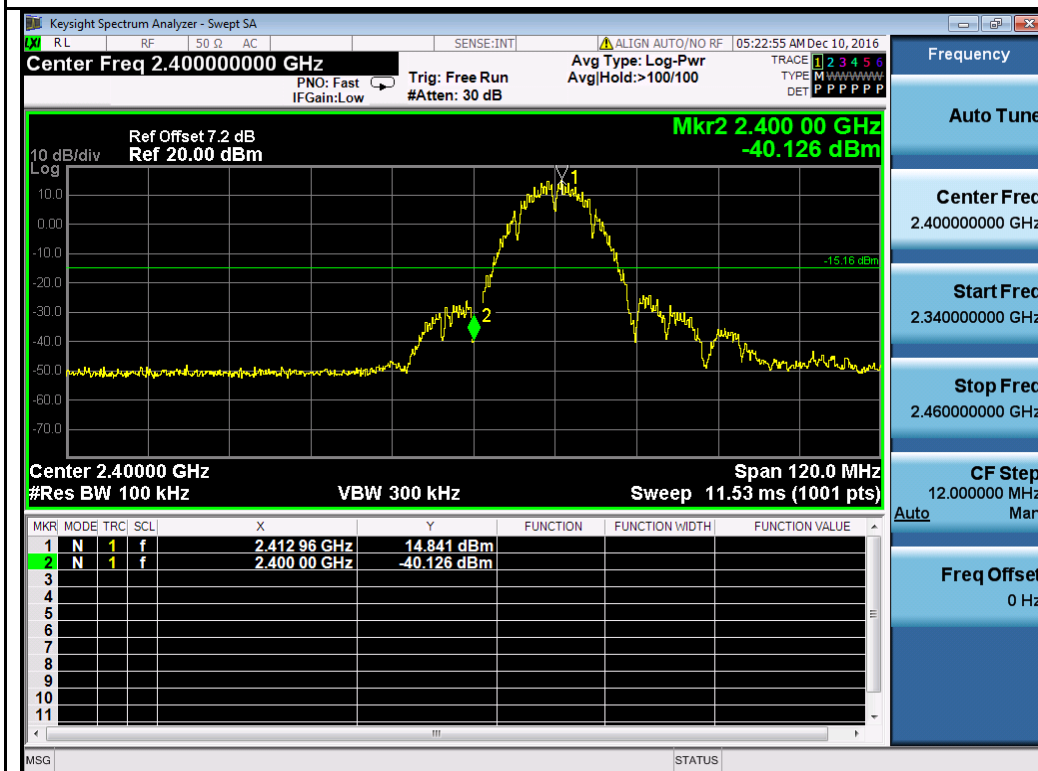
802.11b-2412MHz Chain 1



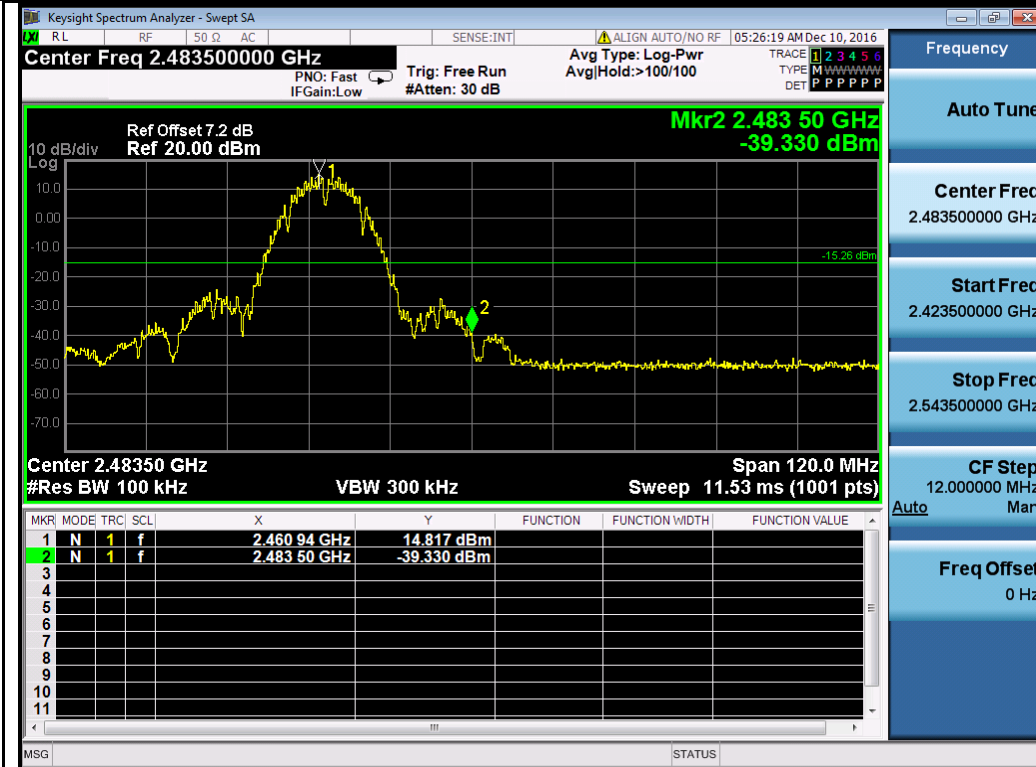
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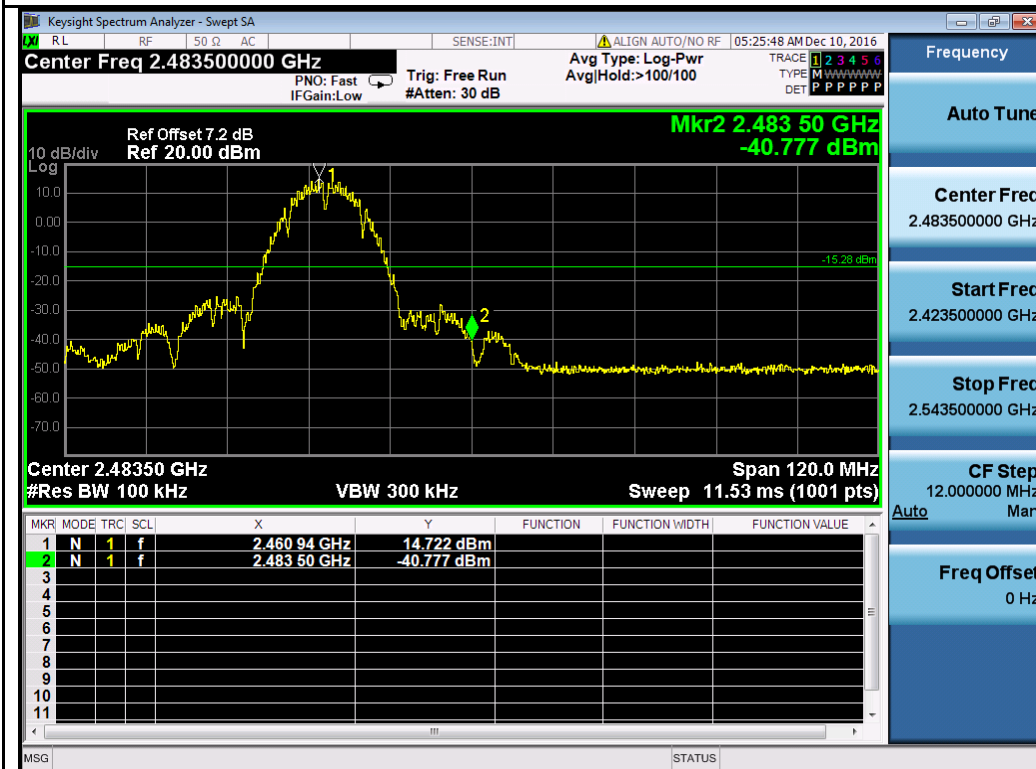
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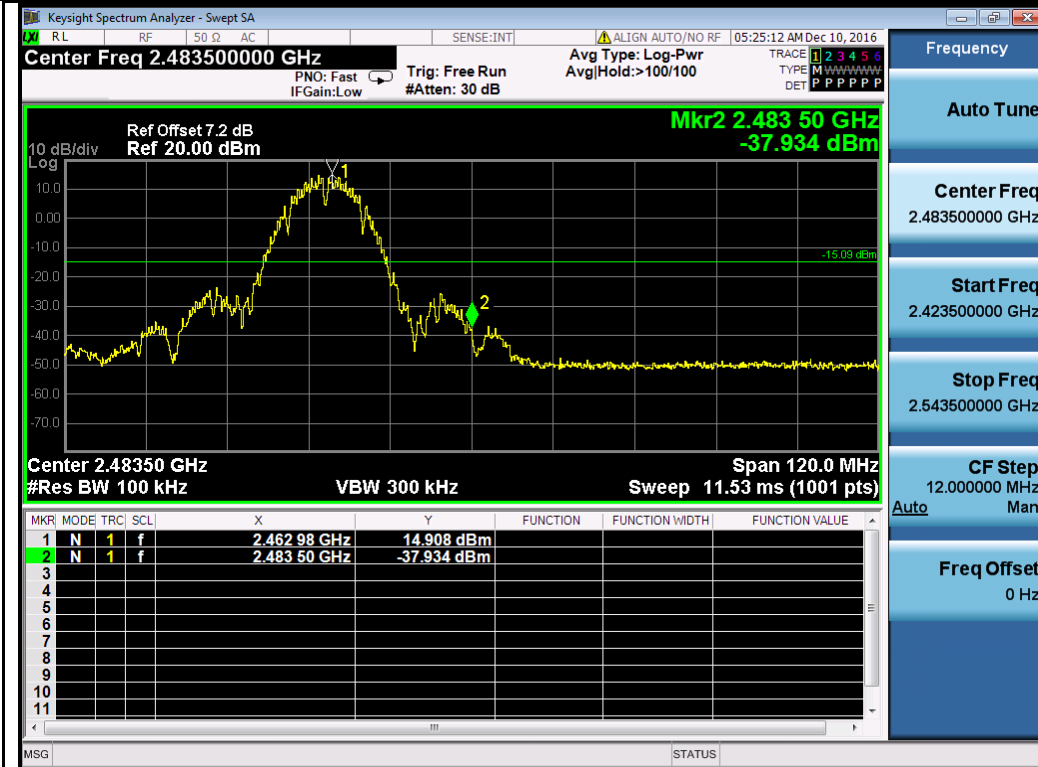
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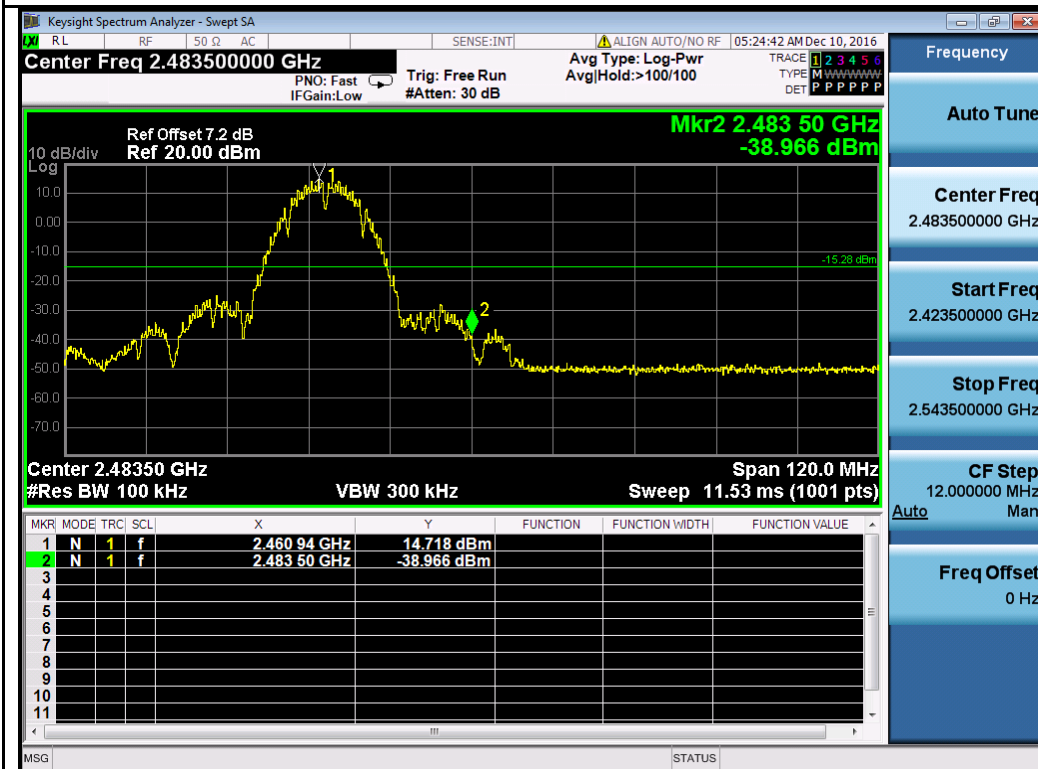
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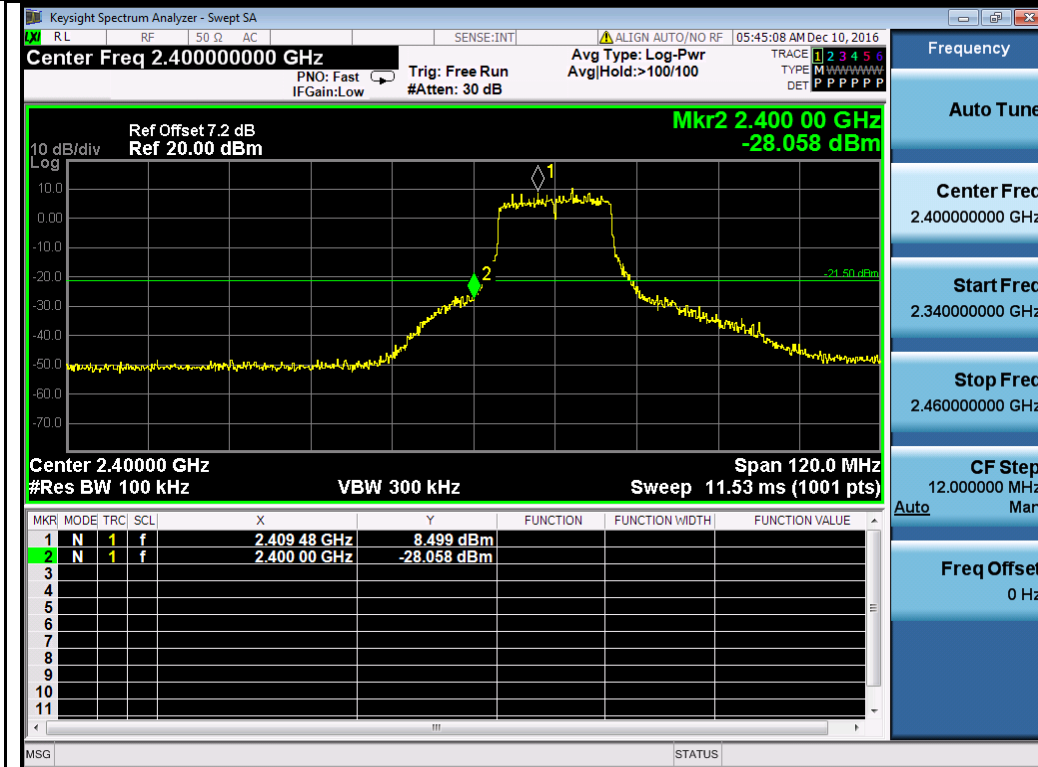
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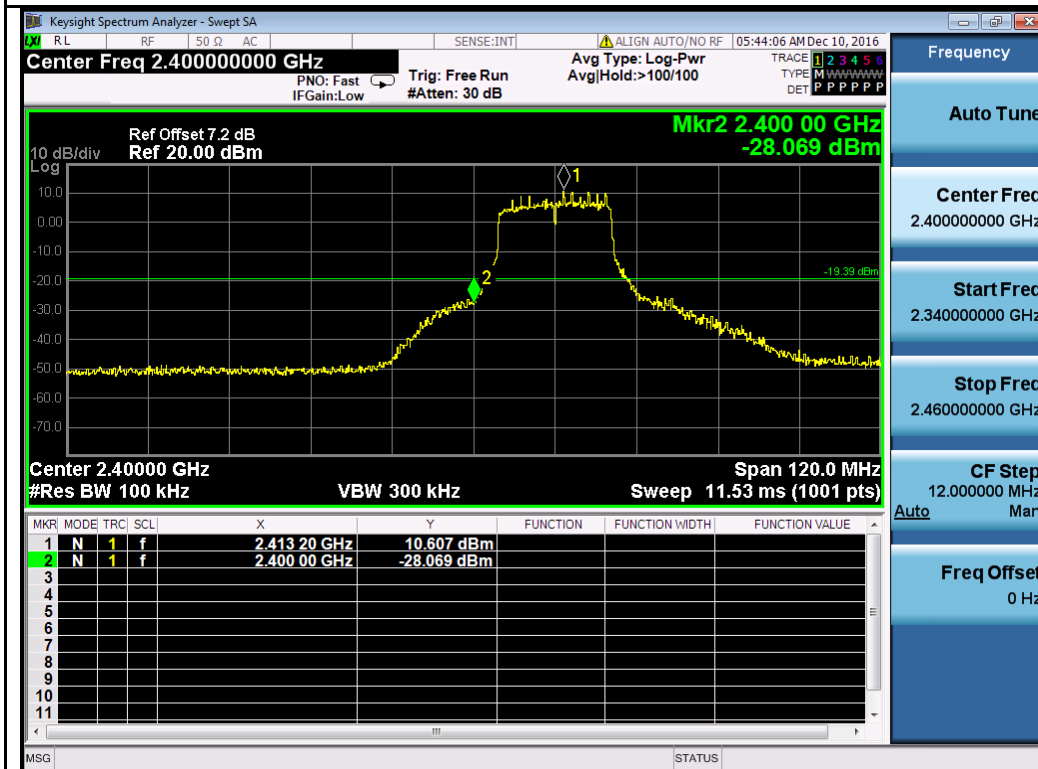
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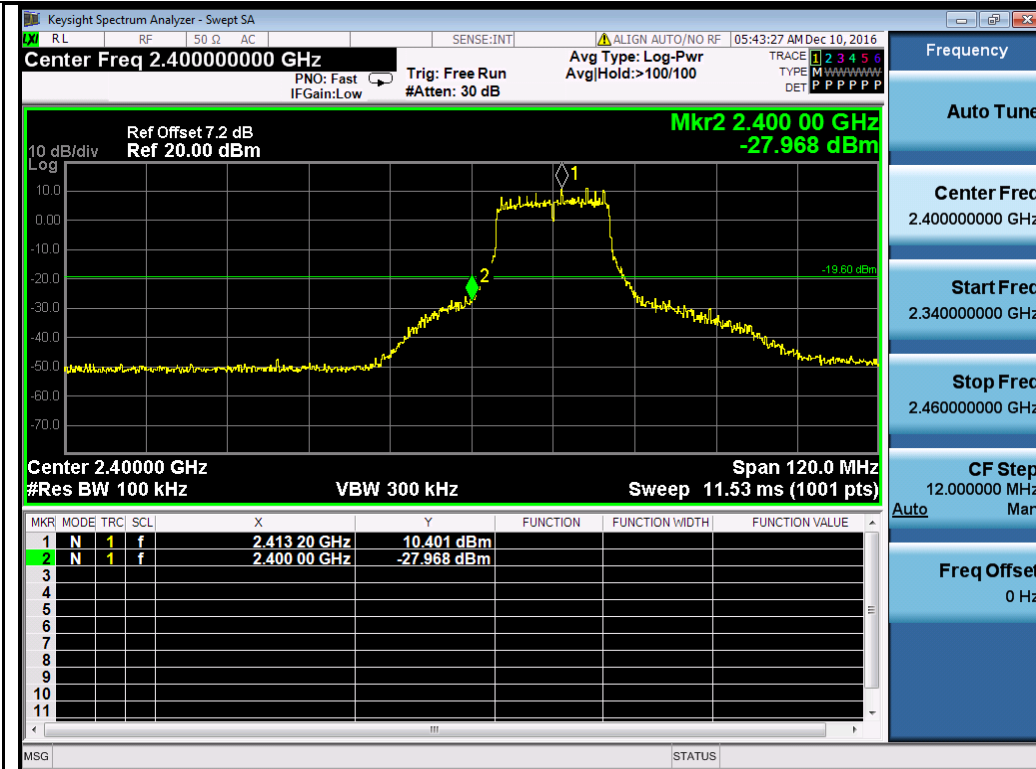
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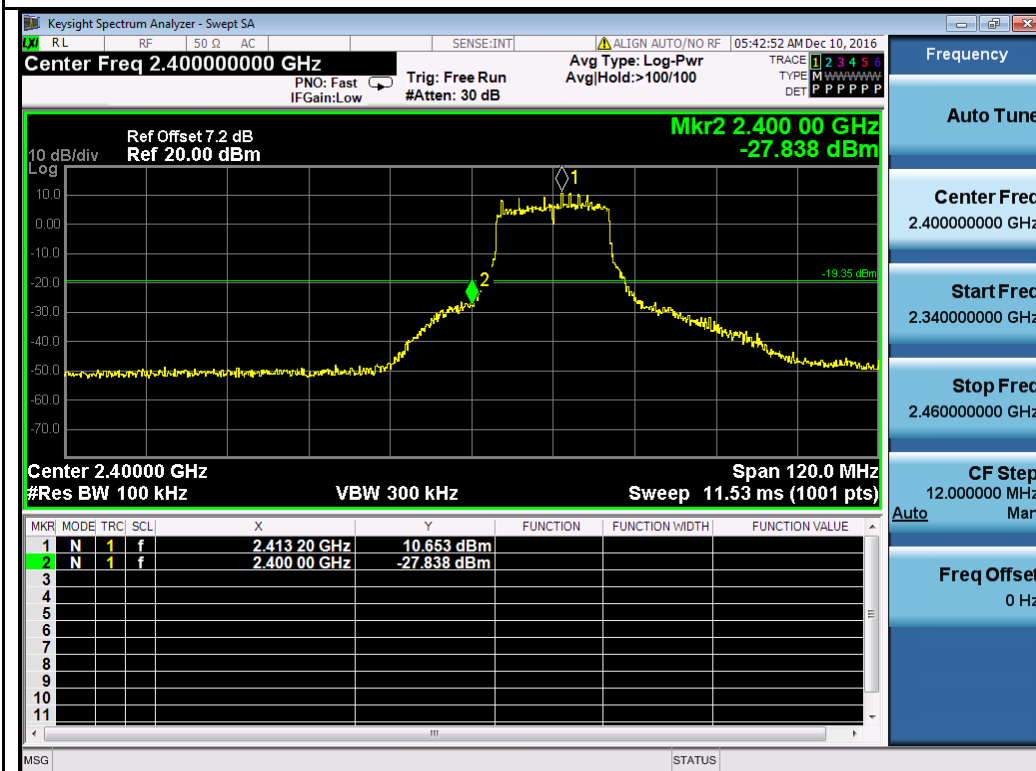
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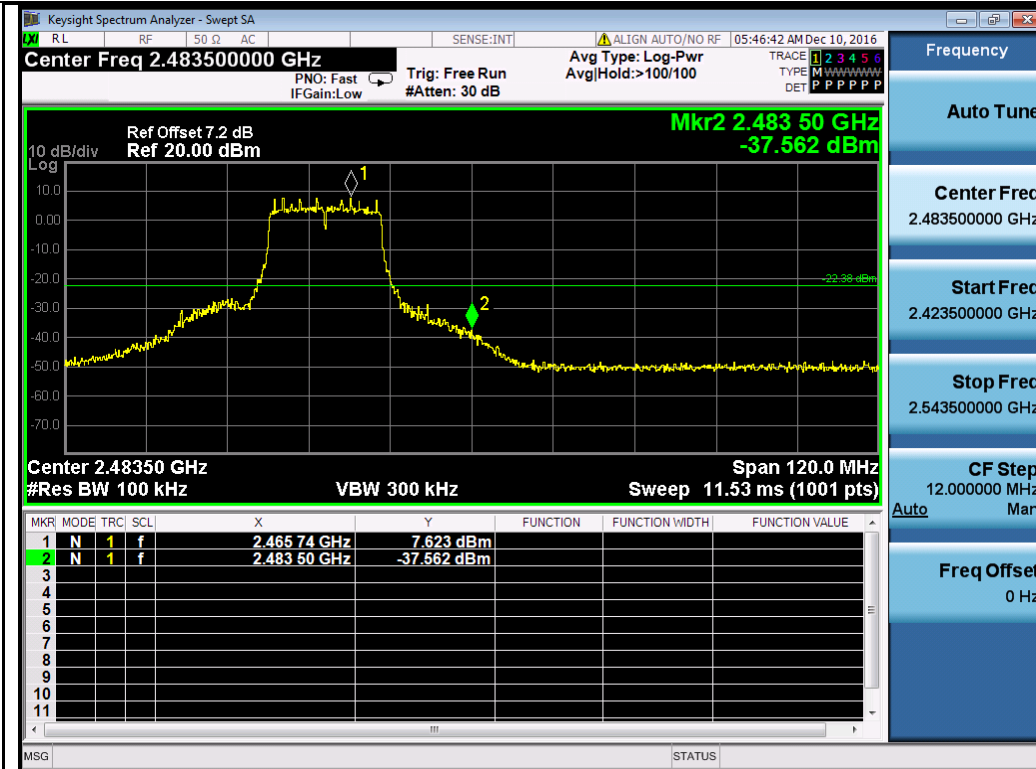
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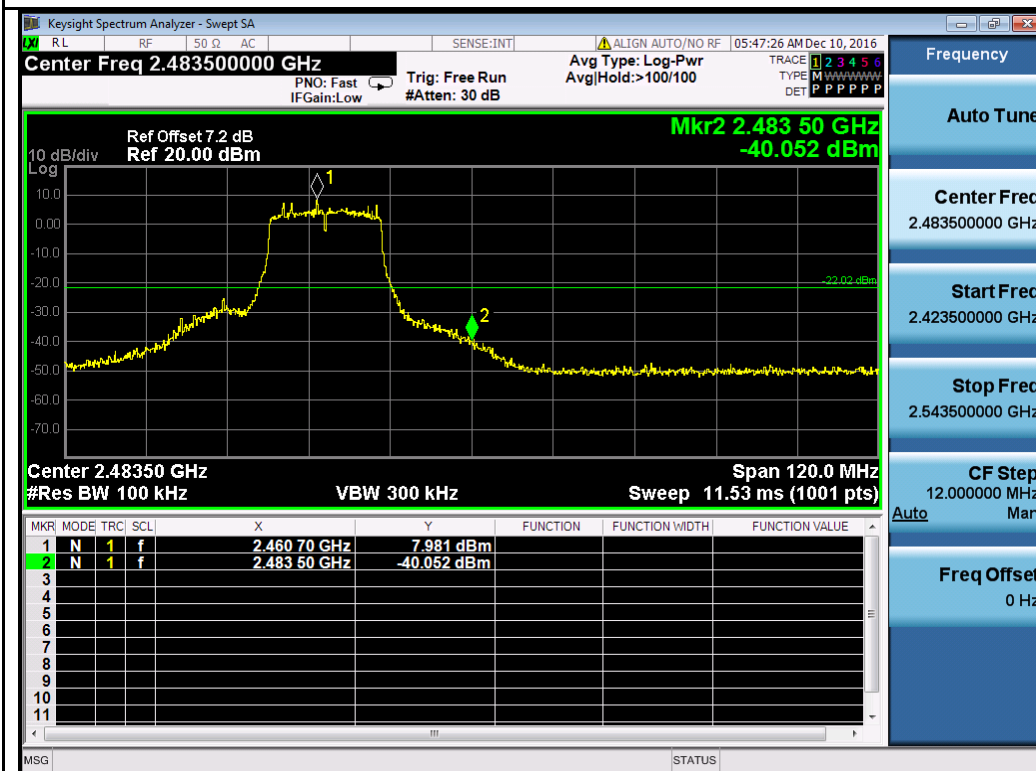
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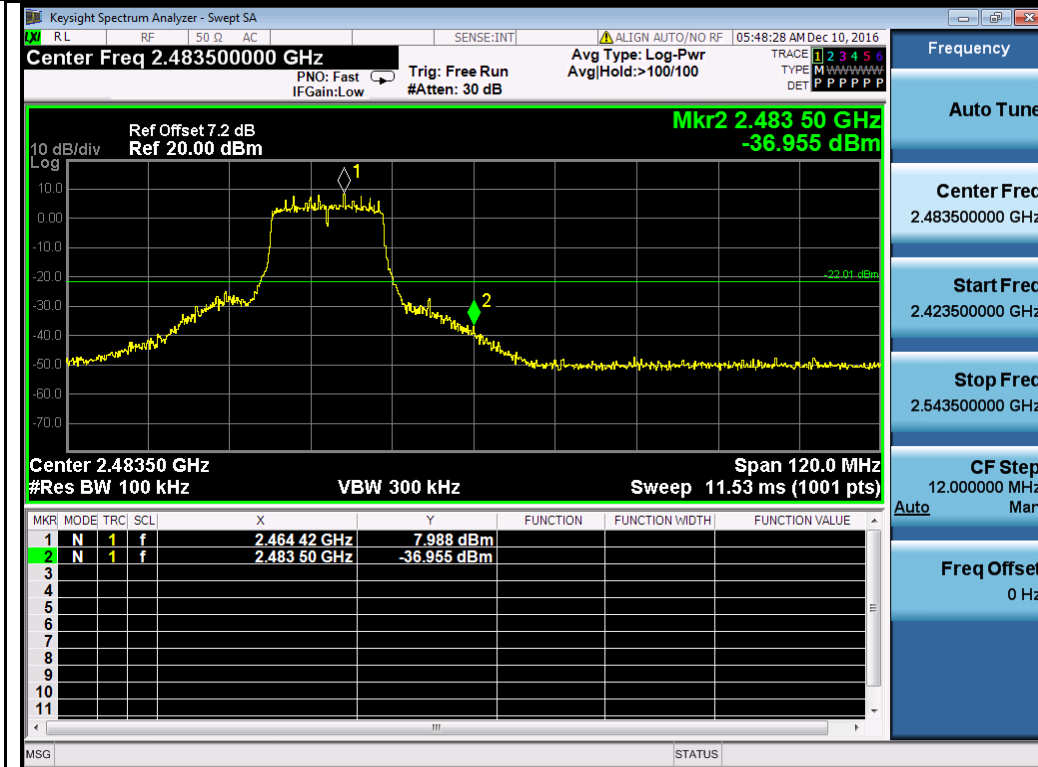
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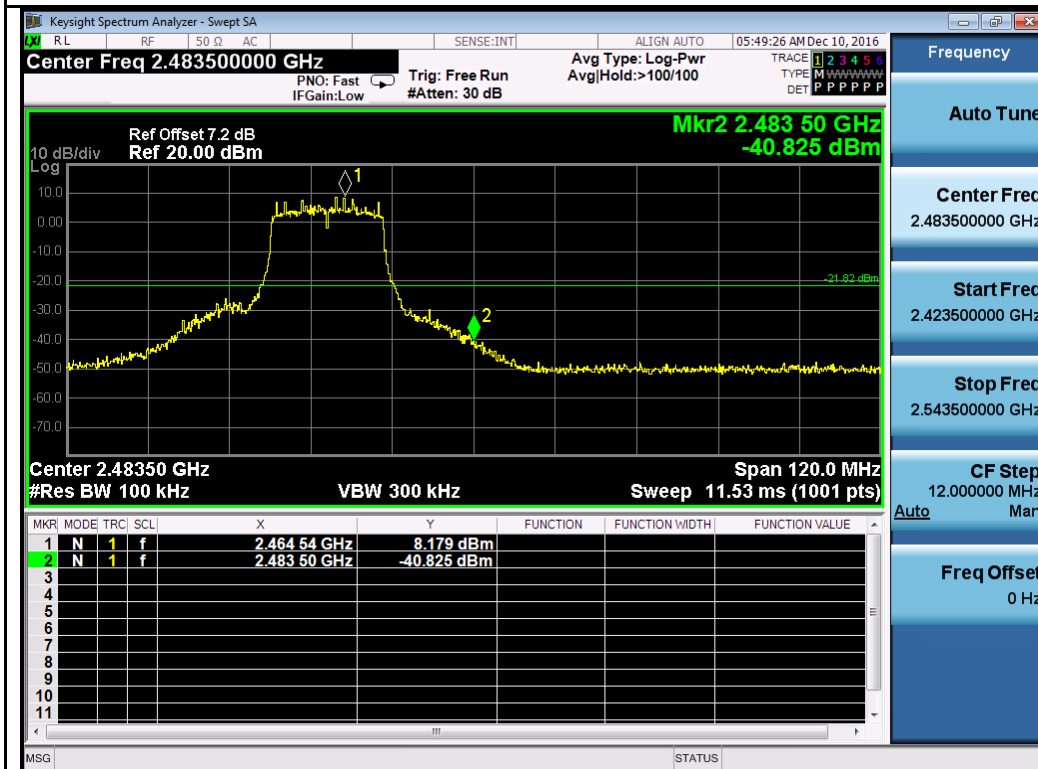
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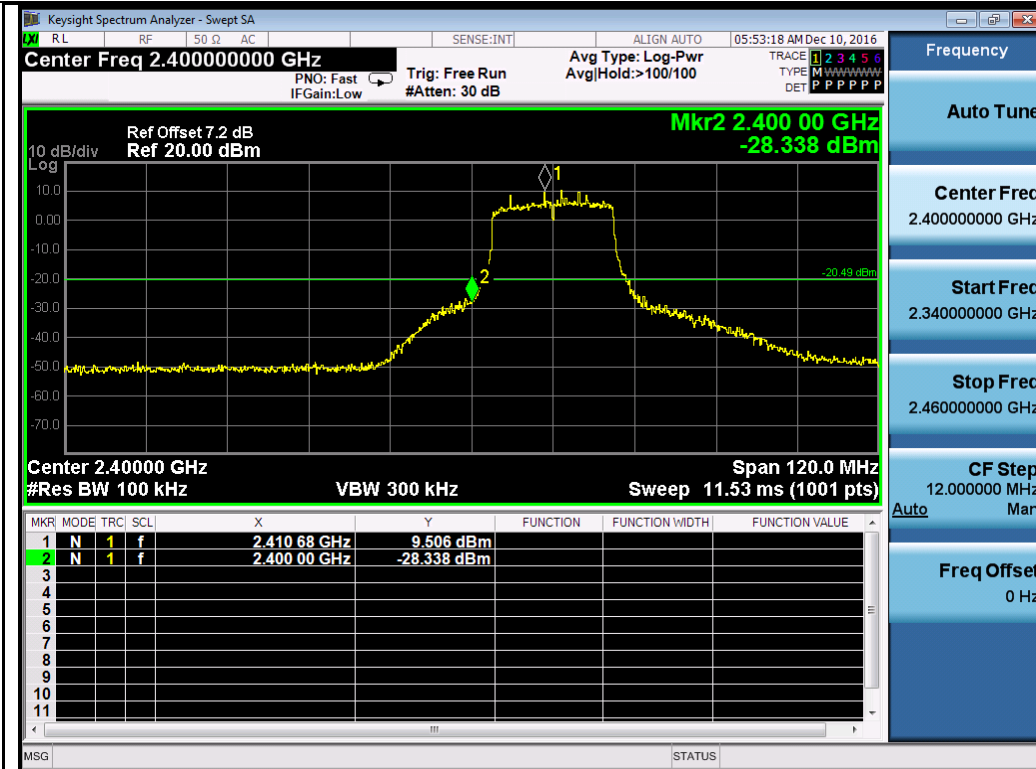
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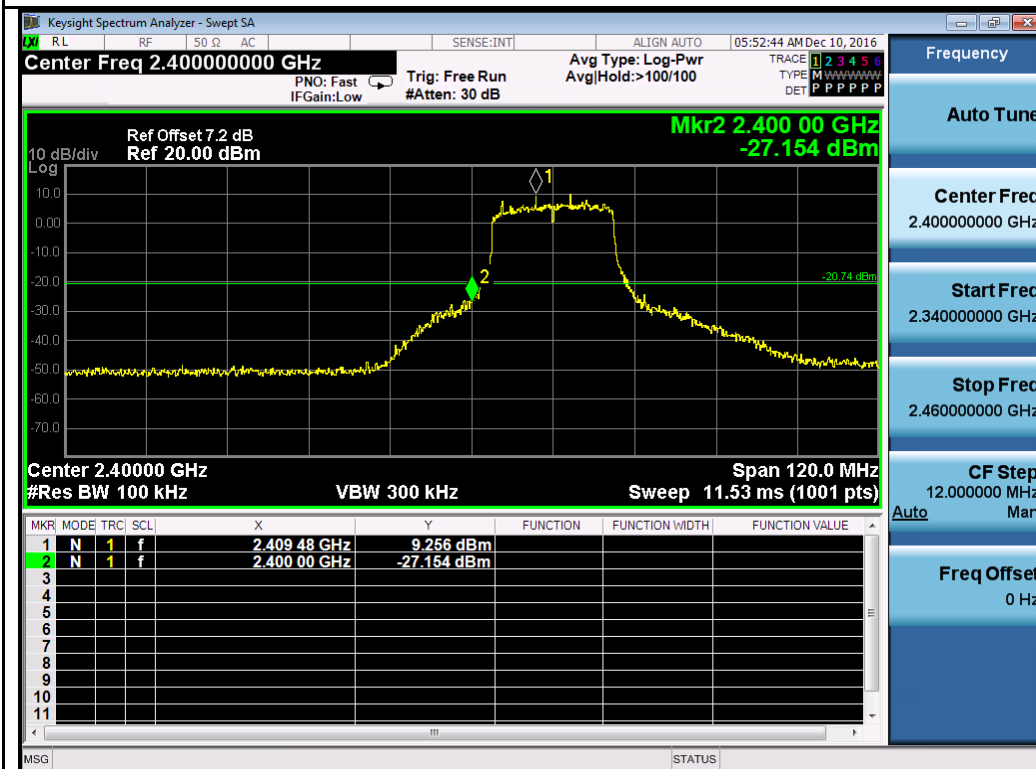
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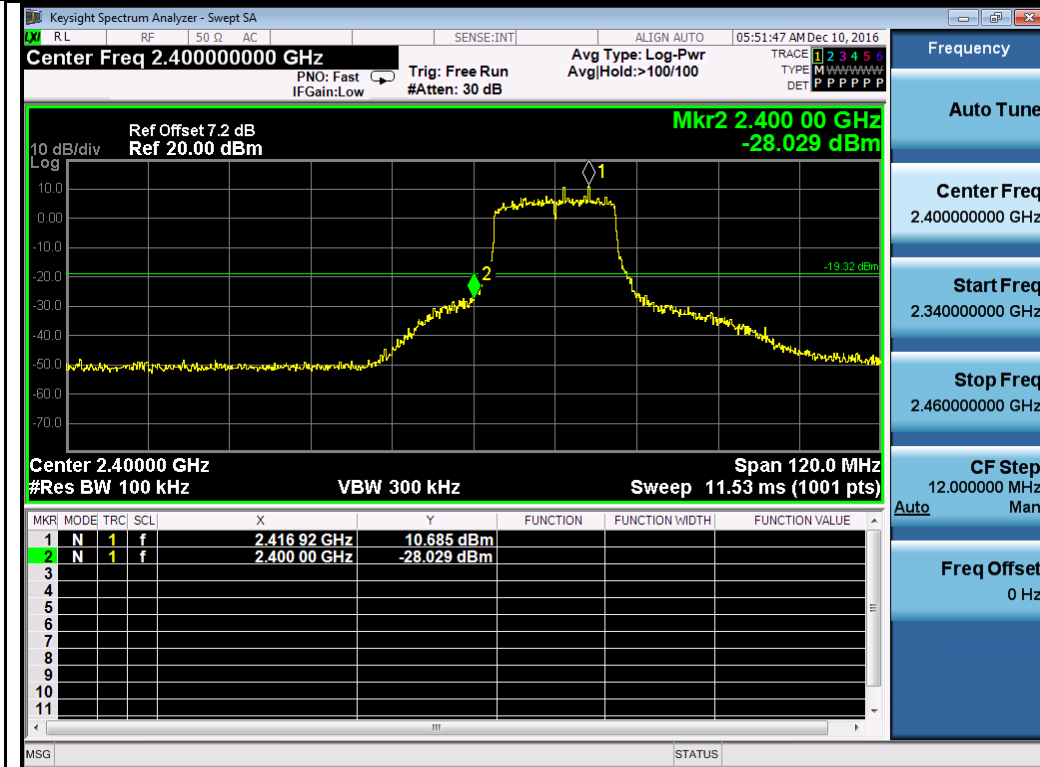
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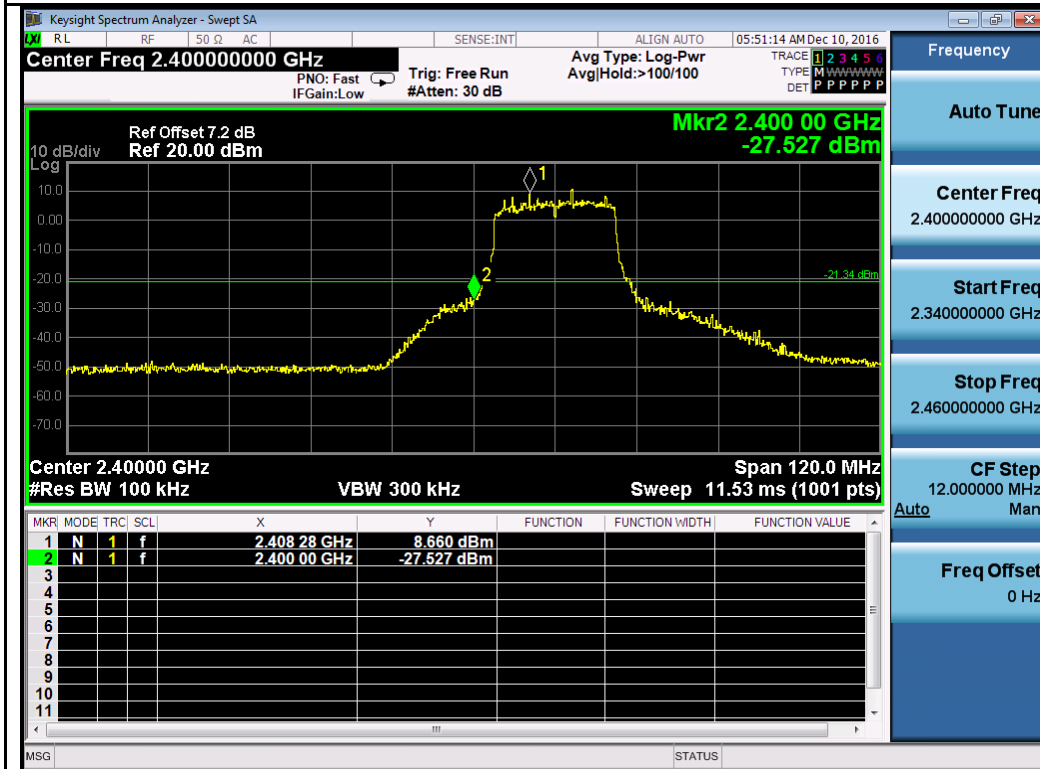
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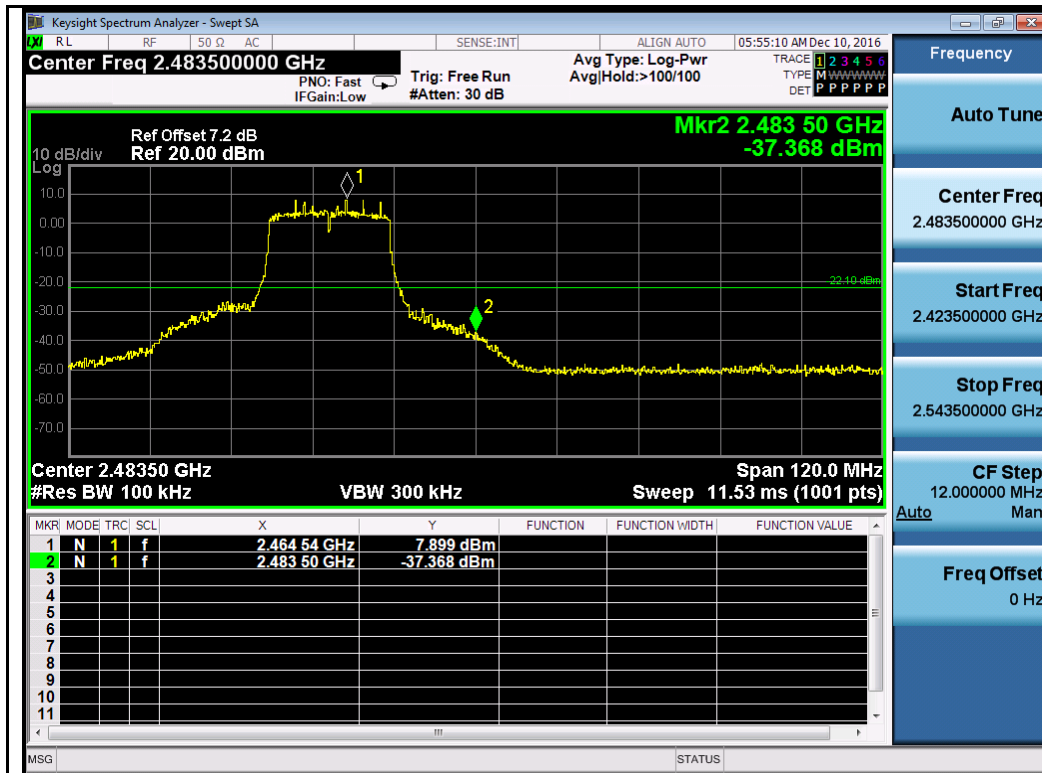
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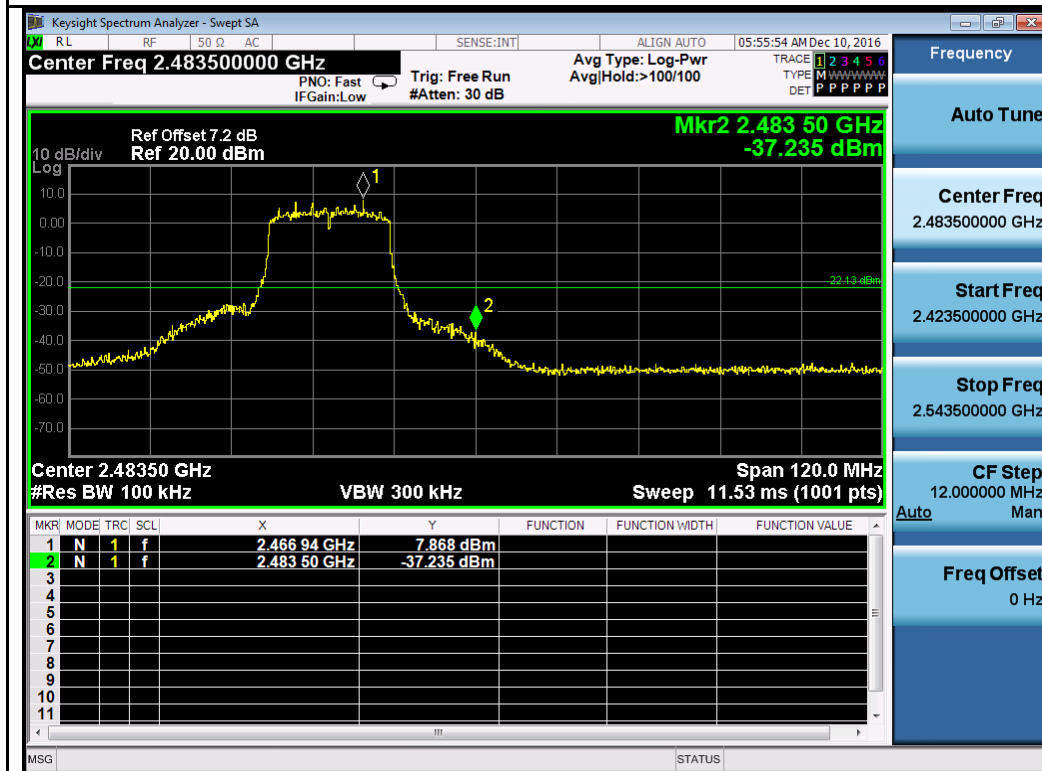
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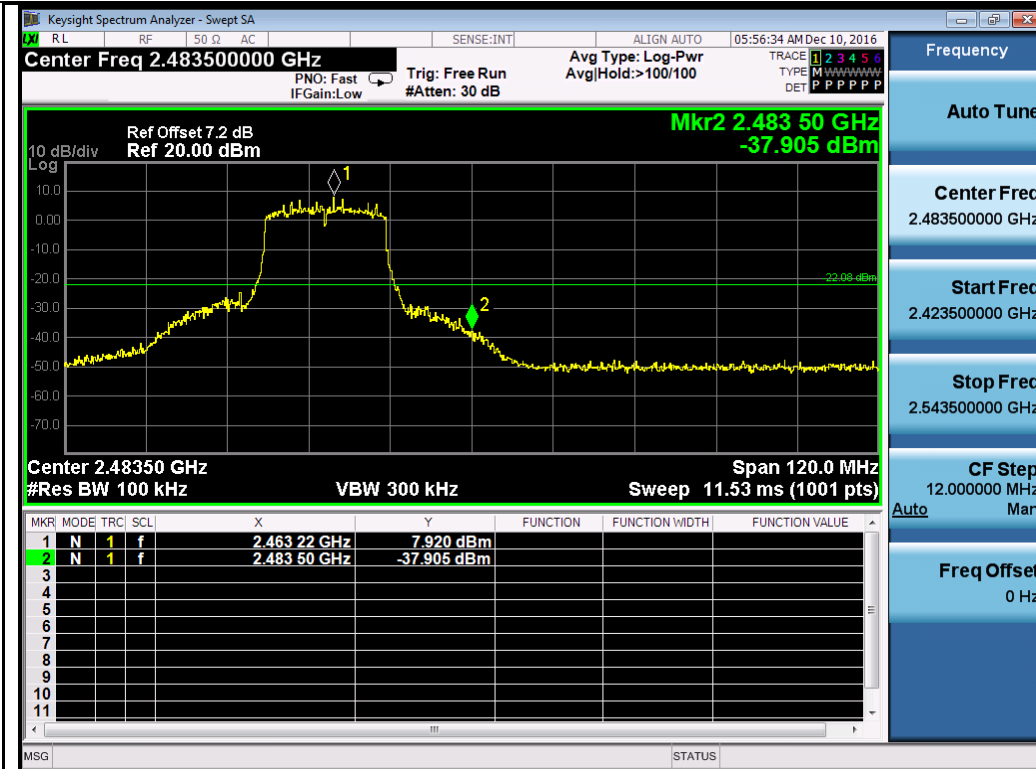
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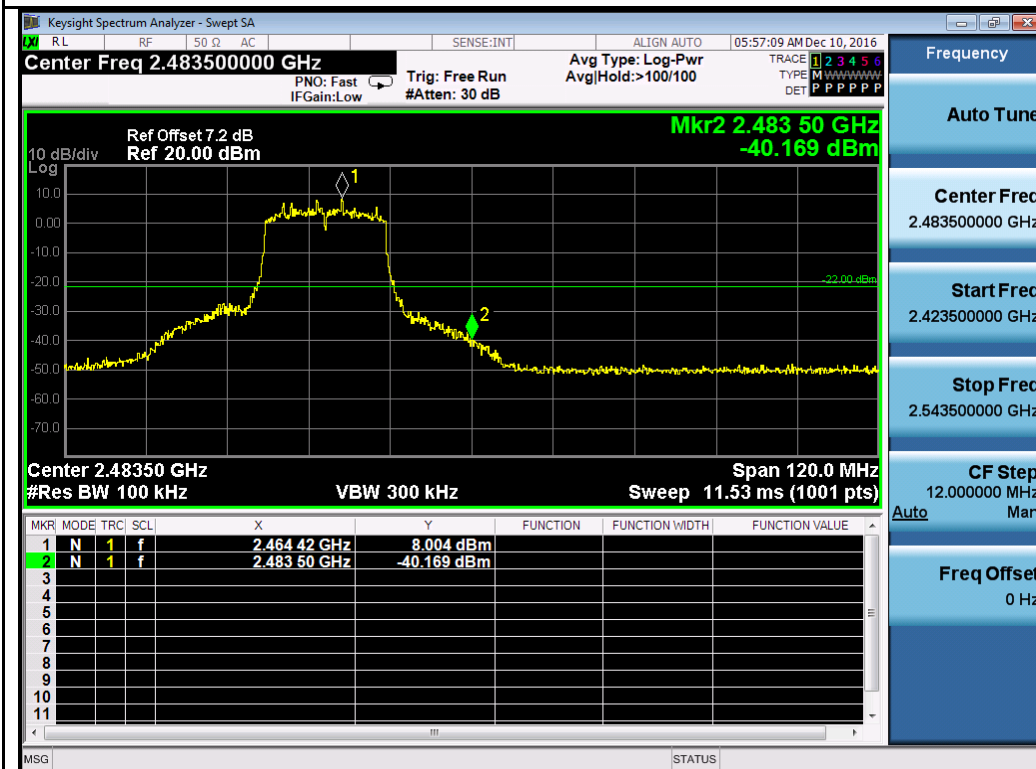
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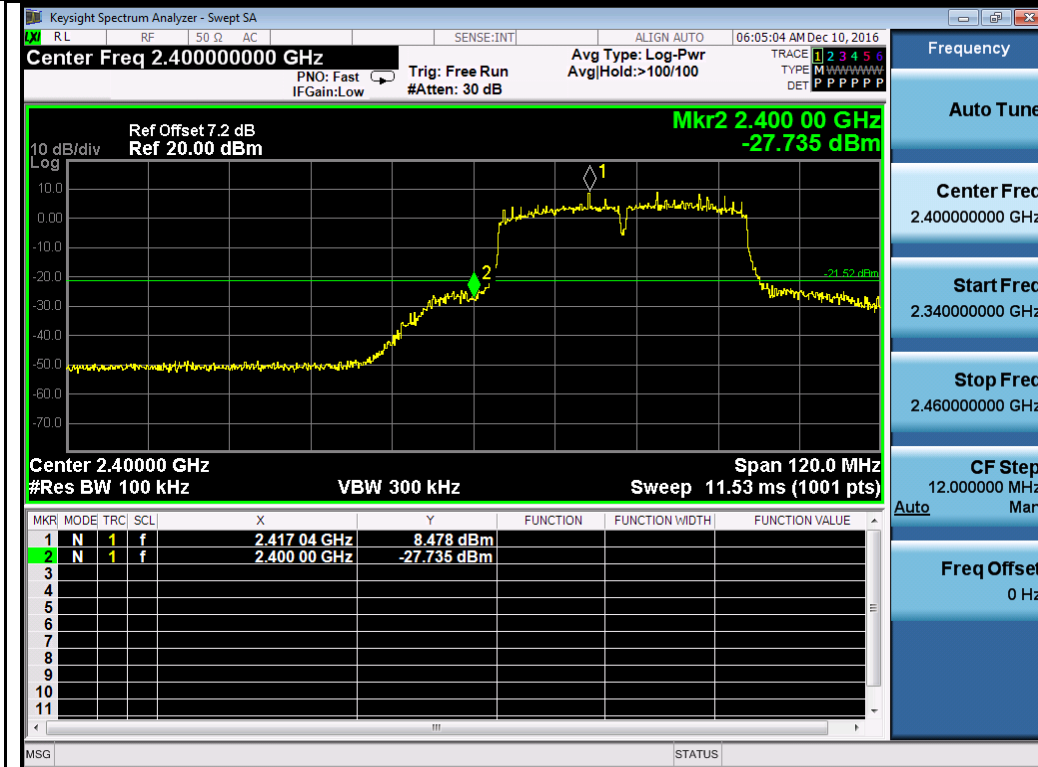
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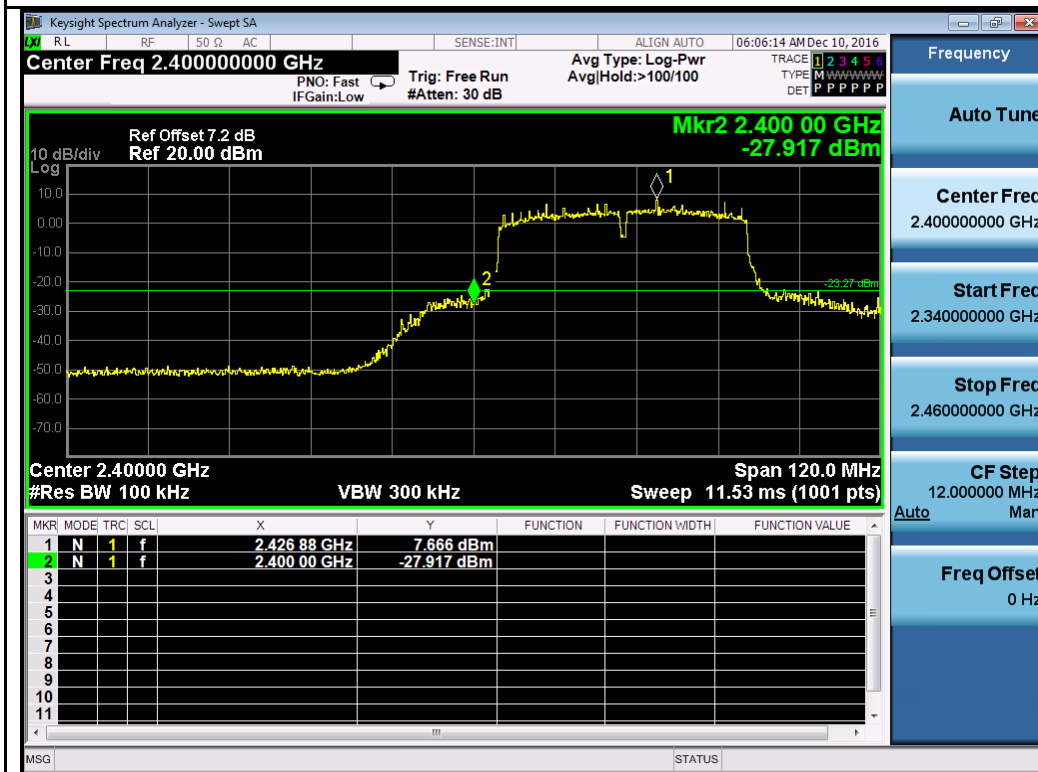
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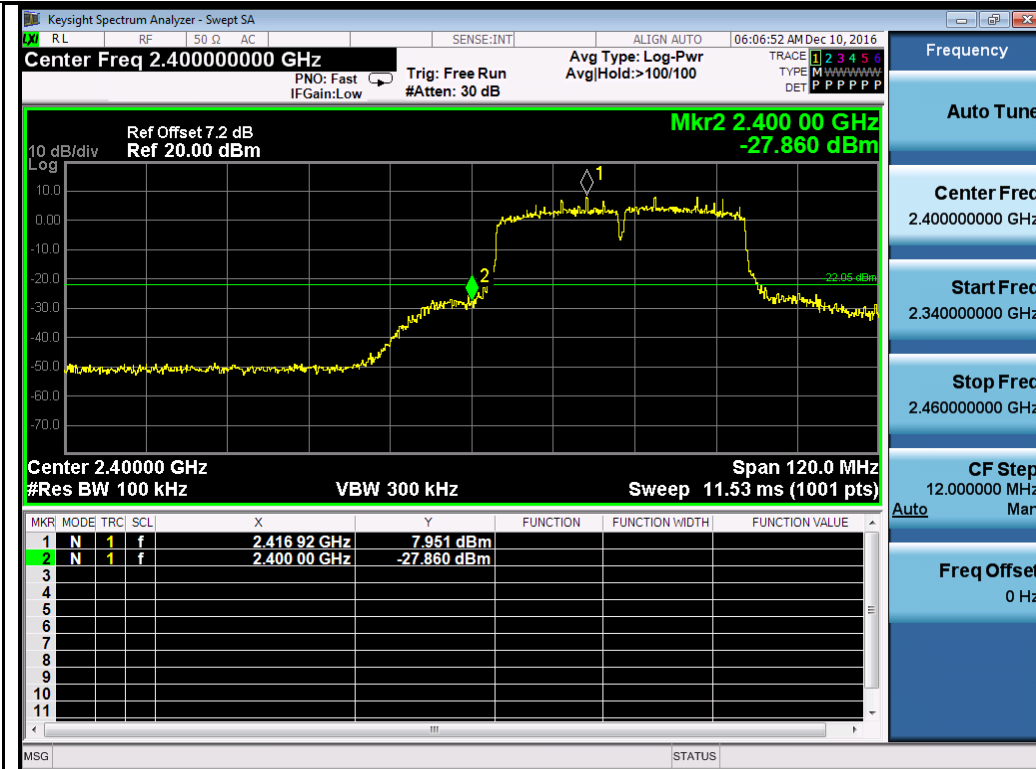
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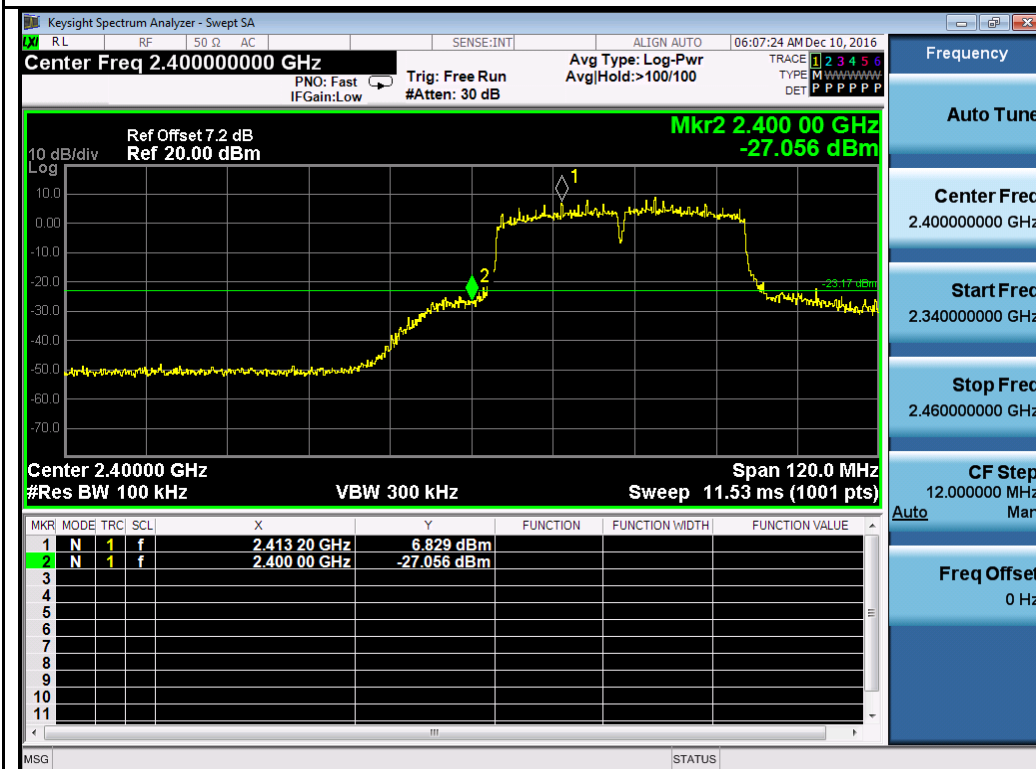
802.11n-HT40-2422MHz Chain 1



802.11n-HT40-2422MHz Chain 2



802.11n-HT40-2422MHz Chain 3



802.11n-HT40-2422MHz Chain 4