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Emissions
Test Report

EUT Name: Wi-Fi Module

Model No.: NVG5X8AC

CFR 47 Part 15.407 2018 and RSS 247: 2017

Prepared for:

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Report/Issue Date: May 15, 2019
Job # 0000163939
Report Number: 31962243.001 Rev 0

Revisions

Revision No.	Date MM/DD/YYYY	Reason for Change	Author
1	05/15/2019	Original Document	N/A

Note: Latest revision report will replace all previous reports.

Statement of Compliance

Manufacturer:	ARRIS International plc 310 Providence Mine Road, Ste. 200 Nevada City, CA 95959 U.S.A (530) 274-5440
Requester / Applicant:	Mark Rieger
Name of Equipment:	Wi-Fi Module
Model No.	NVG5X8AC
Type of Equipment:	Intentional Radiator
Application of Regulations:	CFR 47 Part 15.407 2018 and RSS 247: 2017
Test Dates:	18 November 2018 to 16 Mar 2019

Guidance Documents:

Emissions: ANSI C63.10-2013, KDB 789033 D02 General UNII Test Procedures New Rules v02r01, KDB 662911 D02 Multiple Transmitter Output v02r01

Test Methods:

Emissions: ANSI C63.10-2013, KDB 789033 D02 General UNII Test Procedures New Rules v01, KDB 662911 D01 Multiple Transmitter Output v02r01

The electromagnetic compatibility test and documented data described in this report has been performed and recorded by TUV Rheinland, in accordance with the standards and procedures listed herein. As the responsible authorized agent of the EMC laboratory, I hereby declare that the equipment described above has been shown to be compliant with the EMC requirements of the stated regulations and standards based on these results. If any special accessories and/or modifications were required for compliance, they are listed in the Executive Summary of this report.

This report must not be used to claim product endorsement by A2LA or any agency of the U.S. Government. This report contains data that are not covered by A2LA accreditation. This report shall not be reproduced except in full, without the written authorization of TUV Rheinland of North America.

Kerwinn Corpuz		Richard Decker	
Test Engineer	Date May 15, 2019	A2LA Signatory	Date May 15, 2019

Testing Cert #3331.02 **US1131** **2932M**

1 Executive Summary

1.1 Scope

This report is intended to document the status of conformance with the requirements of the CFR 47 Part 15.407 2018 and RSS 247: 2017 based on the results of testing performed on 18 November 2018 to 16 Mar 2019 on the Wi-Fi Module Model NVG5X8AC manufactured by ARRIS International plc This report only applies to the specific samples tested under the stated test conditions. It is the responsibility of the manufacturer to assure that additional production units of this model are manufactured with identical or EMI equivalent electrical and mechanical components. This report is further intended to document changes and modifications to the EUT throughout its life cycle. All documentation will be included as a supplement.

1.2 Purpose

Testing was performed to evaluate the EMC performance of the EUT in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this report. The 5180 MHz to 5240 MHz frequency band is covered in this document.

1.3 Summary of Test Results

Table 1: Summary of Test Results

Test	Test Method ANSI C63.4	Test Parameters	Measured Value	Result
Duty Cycle	Information Only	N/A	11a: 98.5% HT20: 98.5% HT40: 96.3% VHT80: 91.1%	N/A
Spurious Emission in Transmitted Mode	CFR47 15.209, CFR47 15.407 (b) RSS-GEN Sect.8.9, RSS 247 Sect. 6.2.1.2	Class B	-0.19 dB Margin	**Complied**
Restricted Bands of Operation	CFR47 15.205, RSS GEN Sect.8.10	Class B		**Complied**
Out of Band Emission	CFR47 15.407 (b)(1) (2)(3) RSS 247 Sect.6.2.1 to 6.2.3	< -27 dBm/MHz	30 MHz - 40 GHz < -27 dBm/MHz	**Complied**
AC Power Conducted Emission	CFR47 15.207, RSS-GEN Sect.8.8	Class B	-19.47 dB Margin	**Complied**
Occupied Bandwidth	CFR47 15.407 (a), RSS GEN Sect.6.6	N/A	See plots	**Complied**
Maximum Output Power	CFR47 15.407 (a) [see note 2]	UNII1: 30 dBm w/ 6dBi	**Non-Beamforming** 11a: 22.97 dBm HT20: 23.96 dBm VHT20: 23.96 dBm HT40: 21.31 dBm VHT40: 21.31 dBm VHT80: 15.88 **Beamforming** HT20: 25.96 dBm VHT20: 25.96 dBm HT40: 26.01 dBm VHT40: 26.01 dBm VHT80: 20.20	**Complied**
Maximum Output Power	RSS 247 Sect.6.2.1.1 [see note 2]	UNII1: 23 dBm E.I.R.P	**Non-Beamforming** 11a: 15.50 dBm HT20: 15.72 dBm VHT20: 15.72 dBm HT40: 18.16 dBm VHT40: 18.16 dBm VHT80: 15.88 **Beamforming** HT20: 12.87 dBm VHT20: 12.87 dBm HT40: 14.77 dBm VHT40: 14.77 dBm VHT80: 14.78 dBm	**Complied**
Peak Power Spectral Density	CFR47 15.407 (a)	< 17 dBm/MHz	-0.04 dB Margin	**Complied**
Peak Power Spectral Density	RSS 247 Sect.6.2.1.1	< 10 dBm/MHz (e.i.r.p)	-0.09 dB Margin	**Complied**
Frequency Stability and Voltage Variation	CFR47 15.407 (g), 15.31(e), RSS GEN Sect. 6.11	±20 ppm	Declared by Manufacturer	**Complied**

Note: This test report covers 5150 MHz to 5250MHz band.

1.4 Special Accessories

No special accessories were necessary in order to achieve compliance.

1.5 Equipment Modifications

None

2 Laboratory Information

2.1 Accreditations & Endorsements

2.1.1 US Federal Communications Commission

TUV Rheinland of North America at 1279 Quarry Ln, Pleasanton, CA 94566 is recognized by the commission for performing testing services for the general public on a fee basis. These laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (US1131). The laboratory scope of accreditation includes: Title 47 CFR Parts 15, 18, and 90. The accreditation is updated every 3 years.

2.1.2 NIST / A2LA

TUV Rheinland of North America is accredited by the National Voluntary Laboratory Accreditation Program, which is administered under the auspices of the National Institute of Standards and Technology. The laboratory has been assessed and accredited in accordance with ISO Guide 17025:1999 and ISO 9002 (Lab Code Testing Cert #3331.02). The scope of laboratory accreditation includes emission and immunity testing. The accreditation is updated annually.

2.1.3 Canada – Industry Canada

TUV Rheinland of North America at the 1279 Quarry Ln, Pleasanton, CA 94566 address is accredited by Industry Canada for performing testing services for the general public on a fee basis. This laboratory test facilities have been fully described in reports submitted to and accepted by Industry Canada (File Number 2932M). This reference number is the indication to the Industry Canada Certification Officers that the site meets the requirements of RSS 212, Issue 1 (Provisional). The accreditation is updated every 3 years.

2.1.4 Japan – VCCI

The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) is a group that consists of Information Technology Equipment (ITE) manufacturers and EMC test laboratories. The purpose of the Council is to take voluntary control measures against electromagnetic interference from Information Technology Equipment, and thereby contribute to the development of a socially beneficial and responsible state of affairs in the realm of Information Technology Equipment in Japan. TUV Rheinland of North America at 1279 Quarry Ln, Pleasanton, CA 94566 has been assessed and approved in accordance with the Regulations for Voluntary Control Measures.

VCCI Registration No. for Pleasanton: A-0261

2.1.5 Acceptance by Mutual Recognition Arrangement

The United States has an established agreement with specific countries under the Asia Pacific Laboratory Accreditation Corporation (APLAC) Mutual Recognition Arrangement. Under this agreement, all TUV Rheinland at 1279 Quarry Ln, Pleasanton, CA 94566 test results and test reports within the scope of the laboratory NIST / A2LA accreditation will be accepted by each member country.

2.2 Test Facilities

All of the test facilities are located at 1279 Quarry Lane, Pleasanton, California 94566, USA. The 2305 Mission College, Santa Clara, 95054, USA location is considered a Pleasanton annex.

2.2.1 Emission Test Facility

The Semi-Anechoic chamber and AC Line Conducted measurement facility used to collect the radiated and conducted data has been constructed in accordance with ANSI C63.7:1992. The site has been measured in accordance with and verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4-2014, at a test distance of 3 and 5 meters. The site is listed with the FCC and accredited by A2LA (Lab Code Testing Cert #3331.02). The 3/5-meter semi-anechoic chamber used to collect the radiated data has been verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4-2014, at a test distance of 3 meter and 5 meters. A report detailing this site can be obtained from TUV Rheinland of North America.

2.2.2 Immunity Test Facility

ESD, EFT, Surge, PQF: These tests are performed in an environmentally controlled room with a 3.7 m x 4.8 m x 3.175 mm thick aluminum floor connected to PE ground.

For ESD testing, tabletop equipment is placed on an insulated mat with a surface resistivity of 10^9 Ohms/square on a 1.6 m x 0.8 m x 0.8 m high non-conductive table with a 3.175 mm aluminum top (Horizontal Coupling Plane). The HCP is connected to the main ground plane via a low impedance ground strap through two 470-kΩ resistors. The Vertical Coupling Plane consists of an aluminum plate 50 cm x 50 cm x 3.175 mm thick. The VCP is connected to the main ground plane via a low impedance ground strap through two 470-kΩ resistors.

For EFT, Surge, PQF, the HCP and VCP are removed.

RF Field Immunity testing is performed in a 7.3m x 4.3m x 4.1m anechoic chamber.

RF Conducted and Magnetic Field Immunity testing is performed on a 4.8m x 3.7m x 3.175mm thick aluminum ground plane.

All test areas allow a minimum distance of 1 meter from the EUT to walls or conducting objects.

2.3 Measurement Uncertainty

Two types of measurement uncertainty are expressed in this report, per *ISO Guide To The Expression Of Uncertainty In Measurement*, 1st Edition, 1995.

The Combined Standard Uncertainty is the standard uncertainty of the result of a measurement when that result is obtained from the values of a number of other quantities; it is equal to the positive square root of the sum of the variances or co-variances of these other quantities, weighted according to how the measurement result varies with changes in these quantities. The term *standard uncertainty* is the result of a measurement expressed as a standard deviation.

2.3.1 Sample Calculation – radiated & conducted emissions

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

Field Strength (dBμV/m) = RAW - AMP + CBL + ACF

Where: RAW = Measured level before correction (dBμV)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\mu V/m = 10^{\frac{dB\mu V/m}{20}}$$

Sample radiated emissions calculation @ 30 MHz

Measurement +Antenna Factor–Amplifier Gain+Cable loss=Radiated Emissions (dBuV/m)

25 dBuV/m + 17.5 dB – 20 dB + 1.0 dB = 23.5 dBuV/m

2.3.2 Measurement Uncertainty

Per CISPR 16-4-2	**U_{lab}**	**U_{cispr}**
Radiated Disturbance @ 10 meters		
30 – 1,000 MHz	2.25 dB	4.51 dB
Radiated Disturbance @ 3 meters		
30 – 1,000 MHz	2.26 dB	4.52 dB
1 – 6 GHz	2.12 dB	4.25 dB
6 – 18 GHz	2.47 dB	4.93 dB
Conducted Disturbance @ Mains Terminals		
150 kHz – 30 MHz	1.09 dB	2.18 dB
Disturbance Power		
30 MHz – 300 MHz	3.92 dB	4.3 dB

Voltech PM6000A

The estimated combined standard uncertainty for harmonic current and flicker measurements is ± 5.0%.	Per CISPR 16-4-2 Methods

2.3.3 Measurement Uncertainty Immunity

The estimated combined standard uncertainty for ESD immunity measurements is ± 8.2%.	Per IEC 61000-4-2
The estimated combined standard uncertainty for radiated immunity measurements is ± 4.10 dB.	Per IEC 61000-4-3
The estimated combined standard uncertainty for conducted immunity measurements with CDN is ± 3.66 dB	Per IEC 61000-4-6
The estimated combined standard uncertainty for power frequency magnetic field immunity is ± 2.9%.	Per IEC 61000-4-8

Thermo KeyTek EMC Pro

The estimated combined standard uncertainty for EFT fast transient immunity measurements is ± 2.6%.
The estimated combined standard uncertainty for surge immunity measurements is ± 2.6%.
The estimated combined standard uncertainty for voltage variation and interruption measurements is ± 1.74%.

Measurement Uncertainty – Radio Testing

The estimated combined standard uncertainty for radio frequency measurements is ± 6.62 x 10^{-8}
The estimated combined standard uncertainty for frequency error measurements is ± 3.88 Hz
The estimated combined standard uncertainty for carrier power measurements is ± 0.7 dB.
The estimated combined standard uncertainty for adjacent channel power measurements is ± 1.47 dB.
The estimated combined standard uncertainty for modulation frequency response measurements is ± 0.46 dB.
The estimated combined standard uncertainty for transmitter conducted emission measurements is ± 2.06 dB

The expanded uncertainty at a level of 95% confidence is obtained by multiplying the combined standard uncertainty by a coverage factor of 2. Compliance criteria are not based on measurement uncertainty.

2.4 Calibration Traceability

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Standard 17025:2005. Equipment calibration records are kept on file at the test facility.

3 Product Information

3.1 Product Description

The Model NVG5X8AC, Wi-Fi Module, is a Wi-Fi Module operating in the 2.4 GHz and 5 GHz frequency bands over 20 MHz, 40 MHz and 80 MHz channels.

3.2 Equipment Configuration

A description of the equipment configuration is given in the Test Plan Section. The EUT was tested as called for in the test standard and was configured and operated in a manner consistent with its intended use. The EUT was connected to rated power and allowed to reach intended operating conditions. The placement of the EUT system components was guided by the test standard and selected to represent typical installation conditions.

In the case of an EUT that can operate in more than one configuration, preliminary testing was performed to determine the configuration that produced maximum radiation.

The final configuration was selected to produce the worst case radiation for emissions testing and to place the EUT in the most susceptible state for immunity testing.

3.3 Operating Mode

A description of the operation mode is given in the Test Plan Section. In the case of an EUT that can operate in more than one state, preliminary testing was performed to determine the operating mode that produced maximum radiation.

The final operating mode was selected to produce the worst case radiation for emissions testing and to place the EUT in the most susceptible state for immunity testing.

3.4 Unique Antenna Connector

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of CFR47 Parts 15.211, 15.213, 15.217, 15.219, or 15.221.

3.4.1 Results

The Wi-Fi Module has 8 PCB antennas for both 2.4GHz and 5GHz ranges. The 5150 – 5250 MHz band uses four 5-GHz band Printed Circuit Board (PCB) dipole antennas; connecting to the module via U.FL connectors. The antenna gains are listed below;

Antenna Peak Gain for 5-GHz WiFi Antennas				
Frequency (MHz)	Ant 1 (dBi)	Ant 2 (dBi)	Ant 3 (dBi)	Ant 4 (dBi)
5150	4.8	4.6	4.0	4.0
5200	4.8	4.3	4.1	4.4
5300	4.8	4.4	4.3	4.7
5400	4.3	4.0	4.7	4.3
5500	4.1	4.0	4.8	4.7
5600	4.4	4.7	5.0	4.9
5700	4.6	4.9	5.6	5.0
5800	3.9	4.8	5.3	4.9
5850	4.4	4.7	4.9	5.2

Correlated Composite Peak Gain: 5-GHz WiFi Antennas			
Frequency (MHz)	Correlated Total Gain (dBi)	Correlated Phi Gain (dBi)	Correlated Theta Gain (dBi)
5150	8.1	4.8	6.5
5200	8.1	5.0	6.4
5300	8.3	5.2	6.8
5400	7.9	5.2	6.2
5500	7.8	5.0	6.1
5600	8.0	5.0	6.2
5700	8.6	4.7	6.9
5800	8.5	5.3	7.1
5850	8.8	5.6	7.3

3.5 Duty Cycle

The WiFi Module was measured for the duty cycle

3.5.1 Results

Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Factor (dB)
802.11a	2.057	2.087	98.50	0.00
802.11n HT20/ VHT20	1.922	1.952	98.50	0.00
802.11n HT40/ VHT40	0.942	0.978	96.30	0.16
802.11ac VHT80	0.437	0.479	91.10	0.41
Notes: EUT configured and measured for the duty cycle. Duty factor will be used toward RF measurement offset.				

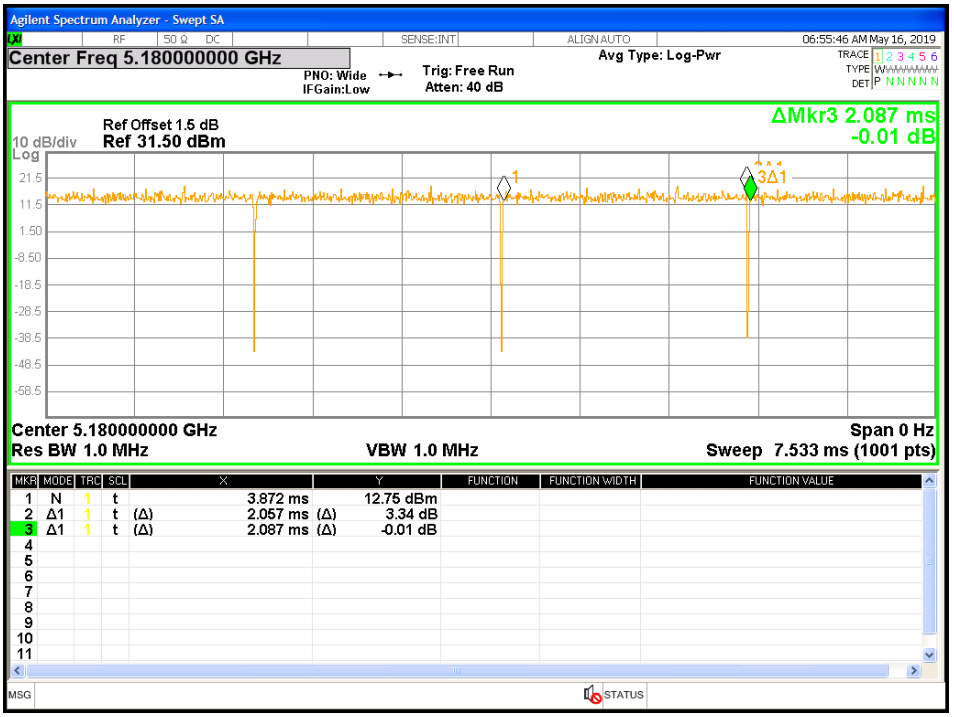


Figure 1: Duty Cycle at 5180 MHz at 802.11a

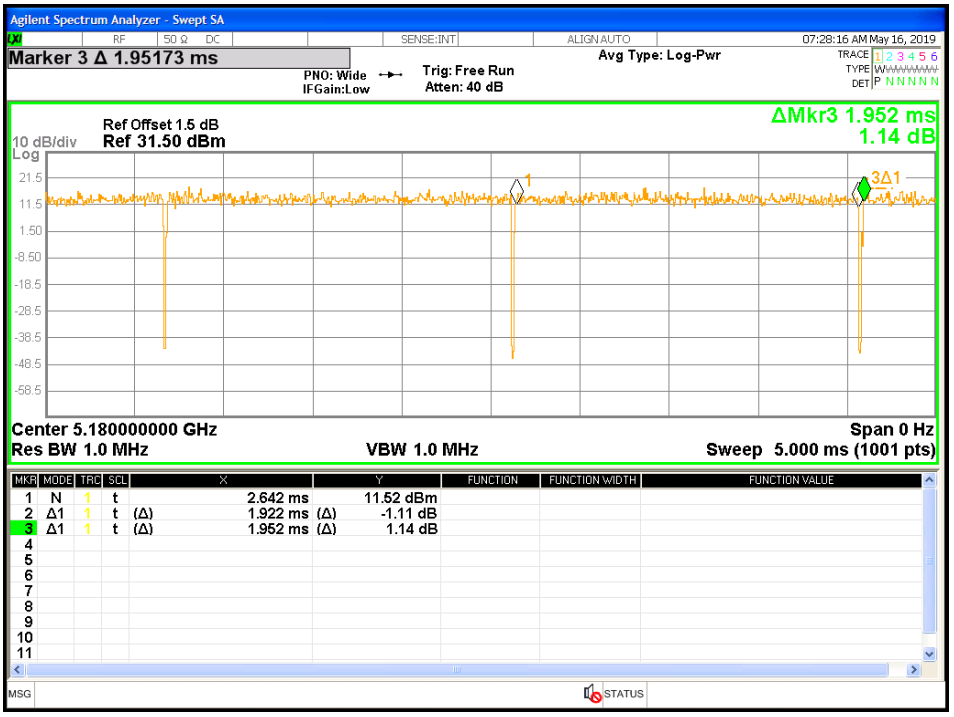


Figure 2: Duty Cycle at 5180 MHz for 802.11n HT20 and 802.11ac VHT20

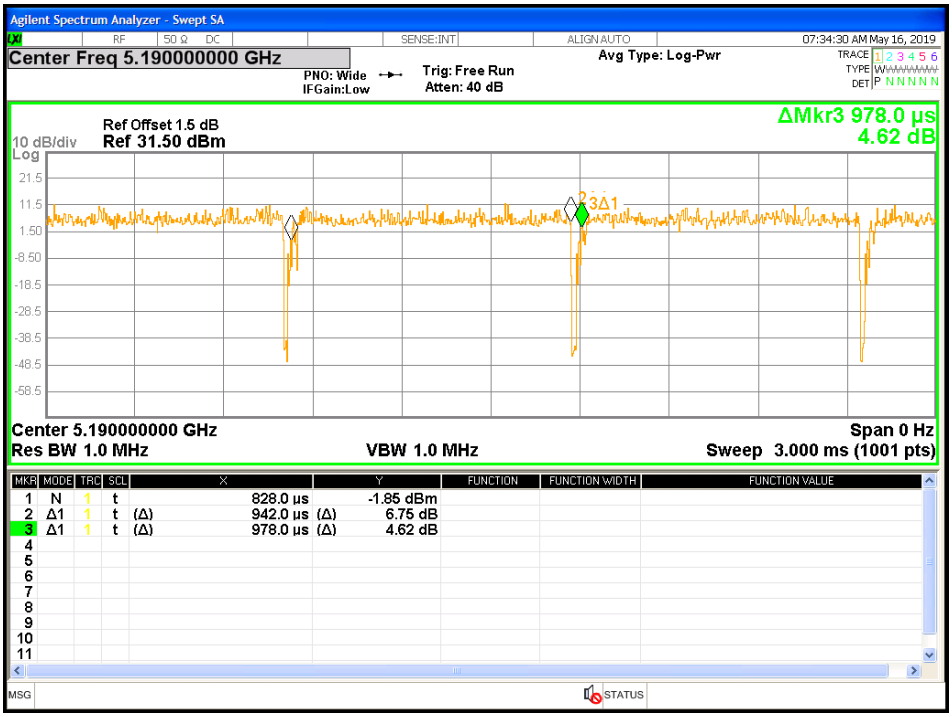


Figure 3: Duty Cycle at 5190 MHz for 802.11n HT40 and 802.11ac VHT40

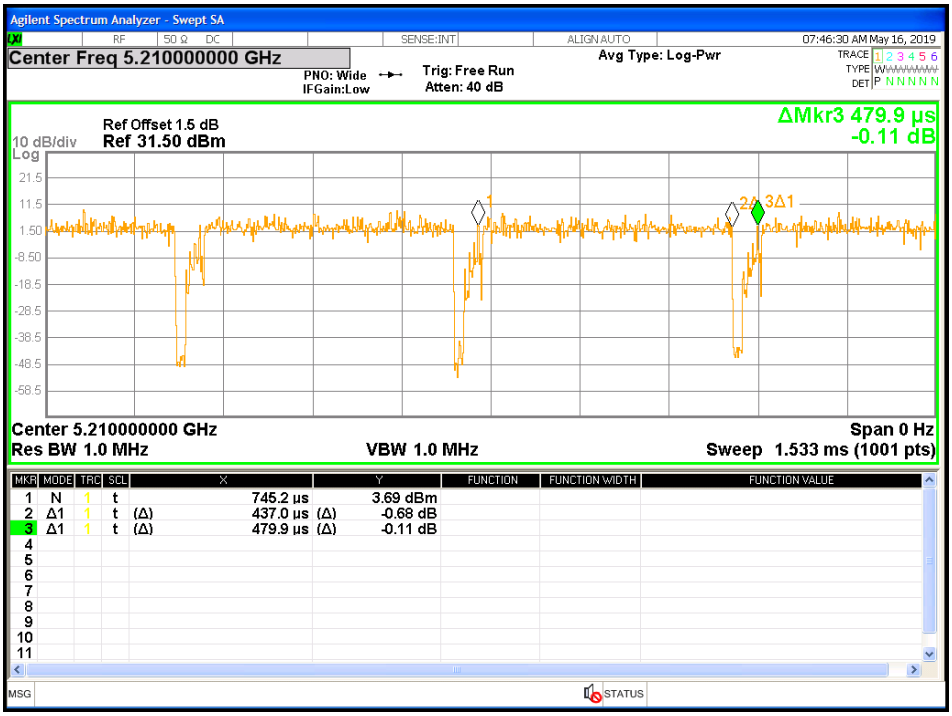


Figure 4: Duty Cycle at 5210 MHz for 802.11ac VHT80

4 Emissions

Testing was performed in accordance with CFR 47 Part 15.407: 2018 and RSS 247: 2017. These test methods are listed under the laboratory's A2LA Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices. Procedures described in section 8 of the standard were used.

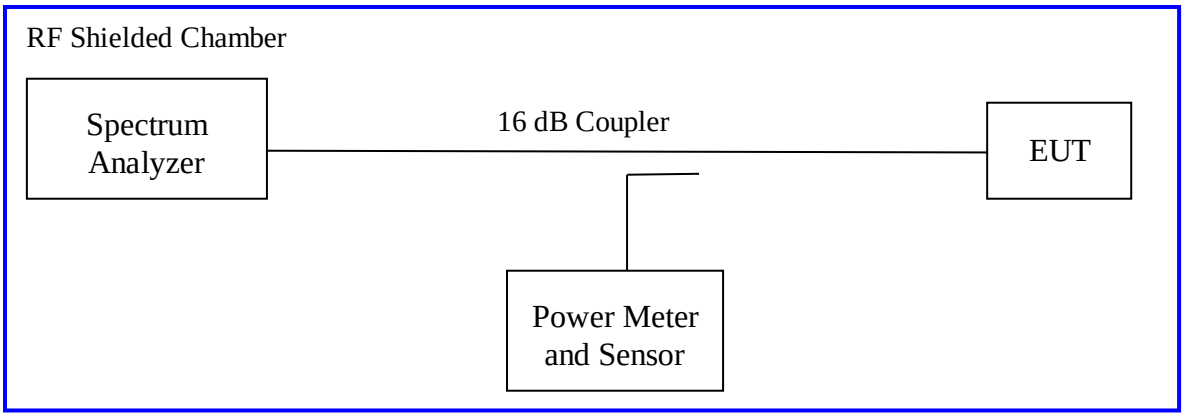
4.1 Output Power Requirements

The maximum output power requirement is the maximum equivalent isotropic radiated power delivering at the transmitting antenna under specified conditions of measurements in the presence of modulation.
The maximum output power and harmonics shall not exceed CFR47 Part 15.407 (a):2018 and RSS 247 Sect. 6.2.1.1: 2017.
The maximum transmitted powers are
Part 15.407(a)(ii) – Band 5150-5250 MHz (conducted output power) : 1 W with 6 dBi antenna gain. Since directional gain for beamforming/ correlated mode is +8.2 dBi, the FCC limit is +27.8 dBi.

RSS 247 – Band 5150-5250 MHz (e.i.r.p.): 200 mW or 10 + 10Log(B) where B is the 99% emission bandwidth.
In non-beamforming/ uncorrelated mode, the ISED limit is +18.20 dBm; where antenna gain is +4.8dBi.
In beamforming/ correlated mode, the ISED limit is +14.8 dBm; where antenna gain is +8.2 dBi.

4.1.1 Test Method

The ANSI C63.10-2013 Section 12.3.2.2 conducted method was used to measure the channel power output. The preliminary investigation was performed at different data rate/ chain to determine the highest power output for each mode. The worst findings were conducted on 3 channels in the operating range per CFR47 Part 15.407(a) and RSS 247 Sect. 6.2.1.1; 5150 MHz to 5250 MHz. The worst mode results indicated below.
Test Setup:



Method SA-1 of "KDB 789033 D02 – Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices" applies since the EUT continuously transmit; where duty cycle is greater than 98%. Sample detector was used.
Each chain was measured individually and applied the measure-and-sum approach per KDB662911.

4.1.2 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 2: RF Output Power at the Antenna Ports Test Results per FCC

Test Date: March 13, 2019	**Test By:** Kerwinn Corpus
Test Method: Conducted Measurements	**Power Setting:** See test plan
Antenna Type: PCB	**Max. Antenna Gain:** + 4.8 dBi
Operating Mode: Non Beamforming & Uncorrelated	**Signal State**: Modulated
Ambient Temp.: 22 °C	**Relative Humidity:**48%

802.11a, 1x4

Freq. (MHz)	Limit [dBm]	Ch0 [dBm]	Ch1 [dBm]	Ch2 [dBm]	Ch3 [dBm]	CF [dB]	RMS Power [dBm]	Margin [dB]
5180	30.00	20.46	20.64	19.77	19.91	0.00	20.64	-9.36
5200	30.00	20.71	20.84	20.25	19.70	0.00	20.84	-9.16
5240	30.00	22.56	21.65	22.51	22.97	0.00	22.97	-7.03

Note: The highest output power observed at 802.11a, 6Mbps, 4 Data Streams at 98.5% duty cycle.

802.11n HT20, 1x4

Freq. (MHz)	Limit [dBm]	Ch0 [dBm]	Ch1 [dBm]	Ch2 [dBm]	Ch3 [dBm]	CF [dB]	RMS Power [dBm]	Margin [dB]
5180	30.00	18.33	18.64	18.30	18.14	0.00	18.64	-11.36
5200	30.00	20.56	20.66	20.29	19.95	0.00	20.66	-9.34
5240	30.00	23.96	23.79	23.69	23.52	0.00	23.96	-6.04

Note: The highest output power observed at MCS0, 4 Data Streams at 98.5% duty cycle.

802.11n HT40, 1x4

Freq. (MHz)	Limit [dBm]	Ch0 [dBm]	Ch1 [dBm]	Ch2 [dBm]	Ch3 [dBm]	CF [dB]	RMS Power [dBm]	Margin [dB]
5190	30.00	14.51	15.18	15.56	15.63	0.16	15.79	-14.21
5230	30.00	20.77	21.13	20.66	21.15	0.16	21.31	-8.69

Note: The highest output power observed at MCS0, 4 Data Streams at 96.3% duty cycle.

802.11AC VHT80, 1x4

Freq. (MHz)	Limit [dBm]	Ch0 [dBm]	Ch1 [dBm]	Ch2 [dBm]	Ch3 [dBm]	CF [dB]	RMS Power [dBm]	Margin [dB]
5210	30.00	15.47	14.73	14.52	14.83	0.41	15.88	-14.12

Note: The highest output power observed at MCS0, 4 Data Streams at 91.1% duty cycle.

Table 3: RF Output Power at the Antenna Ports Test Results per RSS-247

Test Date: February 22, 2019	**Test By:** Kerwinn Corpus
Test Method: Conducted Measurements	**Power Setting:** See test plan
Antenna Type: PCB	**Max. Antenna Gain:** + 4.8 dBi
Operating Mode: Non Beamforming & Uncorrelated	**Signal State**: Modulated
Ambient Temp.: 22 °C	**Relative Humidity:**42%

802.11a, 1x4

Freq. (MHz)	Limit [dBm]	Ch0 [dBm]	Ch1 [dBm]	Ch2 [dBm]	Ch3 [dBm]	CF [dB]	RMS Power [dBm]	Margin [dB]
5180	18.20	15.22	15.28	14.82	15.07	0.00	15.28	-2.92
5200	18.20	15.05	15.43	14.22	15.08	0.00	15.43	-2.77
5240	18.20	15.11	15.50	14.41	15.23	0.00	15.50	-2.70

Note: The highest output power was observed at 802.11a, 6Mbps, 4 Data Streams at 98.5% duty cycle.

802.11n HT20, 1x4

Freq. (MHz)	Limit [dBm]	Ch0 [dBm]	Ch1 [dBm]	Ch2 [dBm]	Ch3 [dBm]	CF [dB]	RMS Power [dBm]	Margin [dB]
5180	18.20	15.71	15.72	15.50	15.08	0.00	15.72	-2.48
5200	18.20	15.60	15.68	15.07	14.31	0.00	15.68	-2.52
5240	18.20	14.91	15.50	15.05	15.28	0.00	15.50	-2.70

Note: The highest output power was observed at MCS0, 4 Data Streams at 98.5% duty cycle.

802.11n HT40, 1x4

Freq. (MHz)	Limit [dBm]	Ch0 [dBm]	Ch1 [dBm]	Ch2 [dBm]	Ch3 [dBm]	CF [dB]	RMS Power [dBm]	Margin [dB]
5190	18.20	14.51	15.81	15.56	15.63	0.16	15.97	-2.23
5230	18.20	17.46	18.00	17.32	18.00	0.16	18.16	-0.04

Note: The highest output power was observed at MCS0, 4 Data Streams at 96.3% duty cycle.

802.11AC VHT80, 1x4

Freq. (MHz)	Limit [dBm]	Ch0 [dBm]	Ch1 [dBm]	Ch2 [dBm]	Ch3 [dBm]	CF [dB]	RMS Power [dBm]	Margin [dB]
5210	18.20	15.47	14.73	14.52	14.83	0.41	15.88	-2.32

Note: The highest output power was observed at MCS0, 4 Data Streams at 91.1% duty cycle.

Table 4: RF Output Power at the Antenna Ports Test Results per FCC

Test Date: February 27, 2019	**Test By:** Kerwinn Corpus
Test Method: Conducted Measurements	**Power Setting:** See test plan
Antenna Type: PCB	**Directional Antenna Gain:** + 8.2 dBi
Operating Mode: Beamforming & Correlated	**Signal State**: Modulated
Ambient Temp.: 22 °C	**Relative Humidity:**42%

802.11a, 4x4

Freq. (MHz)	Limit [dBm]	Ch0 [dBm]	Ch1 [dBm]	Ch2 [dBm]	Ch3 [dBm]	CF [dB]	Total Power [dBm]	Margin [dB]
5180	27.80							
5200	27.80							
5240	27.80							

Note: 802.11a mode does not support beamforming mode or correlated.

802.11n HT20, 4x4

Freq. (MHz)	Limit [dBm]	Ch0 [dBm]	Ch1 [dBm]	Ch2 [dBm]	Ch3 [dBm]	CF [dB]	Total Power [dBm]	Margin [dB]
5180	27.80	17.80	18.12	17.80	17.47	0.0	23.83	-3.97
5200	27.80	20.04	19.70	19.73	19.19	0.0	25.70	-2.10
5240	27.80	20.31	20.00	19.85	19.57	0.0	25.96	-1.84

Note: The highest output power was observed at MCS0, 4 Data Streams at 98.5% duty cycle.

802.11n HT40, 4x4

Freq. (MHz)	Limit [dBm]	Ch0 [dBm]	Ch1 [dBm]	Ch2 [dBm]	Ch3 [dBm]	CF [dB]	Total Power [dBm]	Margin [dB]
5190	27.80	13.87	15.07	14.76	14.65	0.16	20.79	-7.01
5230	27.80	19.44	19.42	20.17	20.33	0.16	26.01	-1.79

Note: The highest output power was observed at MCS0, 4 Data Streams at 96.3% duty cycle.

802.11AC VHT80, 4x4

Freq. (MHz)	Limit [dBm]	Ch0 [dBm]	Ch1 [dBm]	Ch2 [dBm]	Ch3 [dBm]	CF [dB]	Total Power [dBm]	Margin [dB]
5210	27.80	14.48	12.94	13.48	14.01	0.41	20.20	-7.60

Note: The highest output power was observed at MCS0, 4 Data Streams at 91.1% duty cycle.

Table 5: RF Output Power at the Antenna Ports Test Results per RSS-247

Test Date: March 15, 2019	**Test By:** Kerwinn Corpus
Test Method: Conducted Measurements	**Power Setting:** See test plan
Antenna Type: PCB	**Directional Antenna Gain:** + 8.2 dBi
Operating Mode: Beamforming & Correlated	**Signal State**: Modulated
Ambient Temp.: 22 °C	**Relative Humidity:**35%

802.11a, 4x4

Freq. (MHz)	Limit [dBm]	Ch0 [dBm]	Ch1 [dBm]	Ch2 [dBm]	Ch3 [dBm]	CF [dB]	Total Power [dBm]	Margin [dB]
5180	14.80							
5200	14.80							
5240	14.80							

Note: The highest output power was observed at 802.11a, 6Mbps, 4 Data Streams at 99% duty cycle.

802.11n HT20, 4x4

Freq. (MHz)	Limit [dBm]	Ch0 [dBm]	Ch1 [dBm]	Ch2 [dBm]	Ch3 [dBm]	CF [dB]	Total Power [dBm]	Margin [dB]
5180	14.80	6.69	7.39	6.82	6.29	0.00	12.84	-1.96
5200	14.80	7.11	7.74	6.43	5.89	0.00	12.87	-1.93
5240	14.80	6.78	7.49	6.88	6.13	0.00	12.87	-1.93

Note: The highest output power was observed at MCS0, 4 Data Streams at 98% duty cycle.

802.11n HT40, 4x4

Freq. (MHz)	Limit [dBm]	Ch0 [dBm]	Ch1 [dBm]	Ch2 [dBm]	Ch3 [dBm]	CF [dB]	Total Power [dBm]	Margin [dB]
5190	14.80	8.31	8.91	8.48	8.63	0.16	14.77	-0.03
5230	14.80	8.15	8.85	8.42	8.61	0.16	14.70	-0.10

Note: The highest output power was observed at MCS0, 4 Data Streams at 96% duty cycle.

802.11AC VHT80, 4x4

Freq. (MHz)	Limit [dBm]	Ch0 [dBm]	Ch1 [dBm]	Ch2 [dBm]	Ch3 [dBm]	CF [dB]	Total Power [dBm]	Margin [dB]
5210	14.80	8.52	8.27	8.40	8.22	0.41	14.78	-0.02

Note: The highest output power was observed at MCS0, 4 Data Streams at 96% duty cycle.

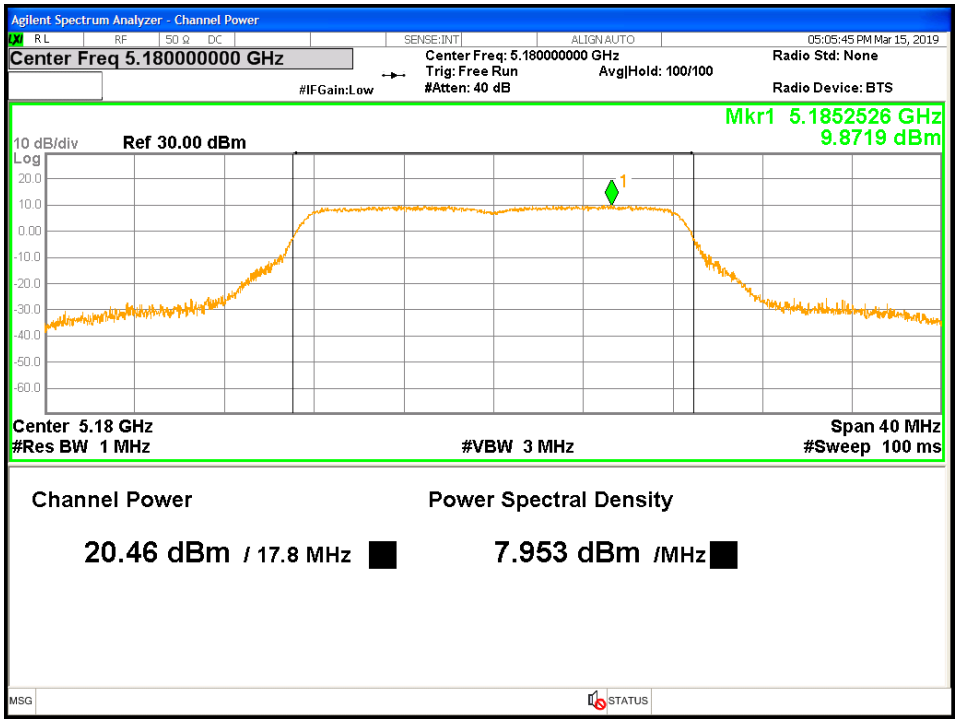


Figure 5: FCC RMS MAX. POWER-5180MHz-11a-1x4-q82-Ch0

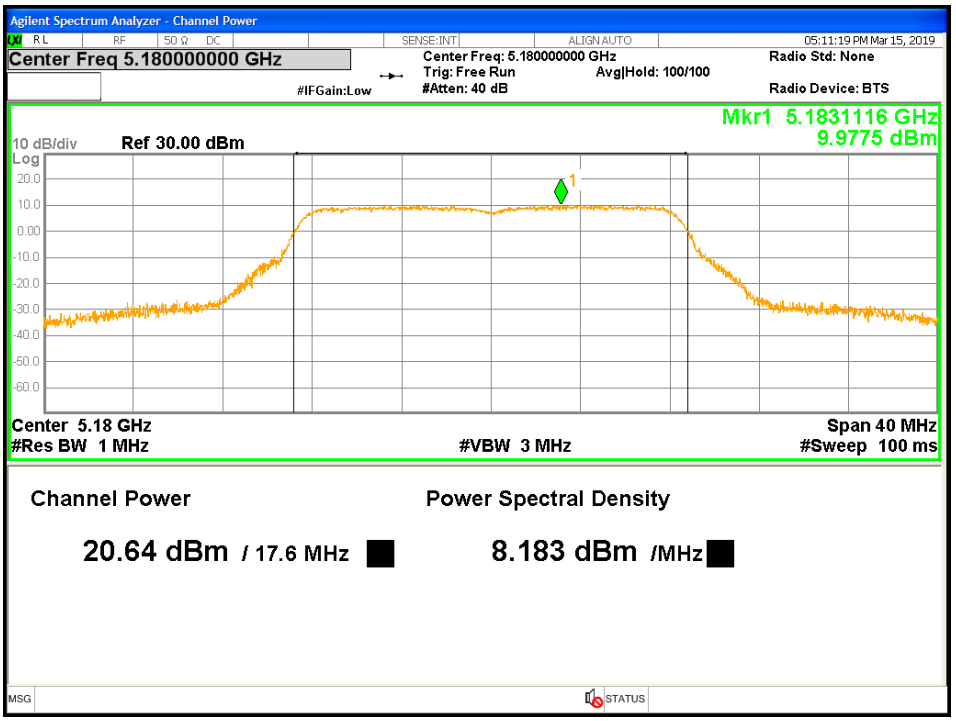


Figure 6: FCC RMS MAX. POWER-5180MHz-11a-1x4-q82-Ch1

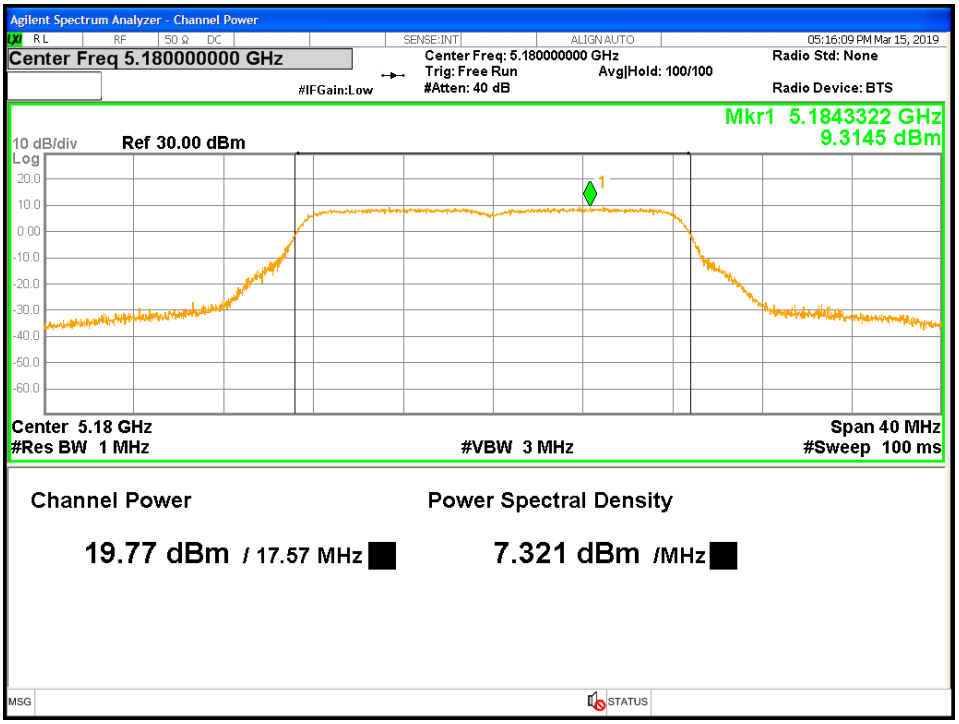


Figure 7: FCC RMS MAX. POWER-5180MHz-11a-1x4-q82-Ch2

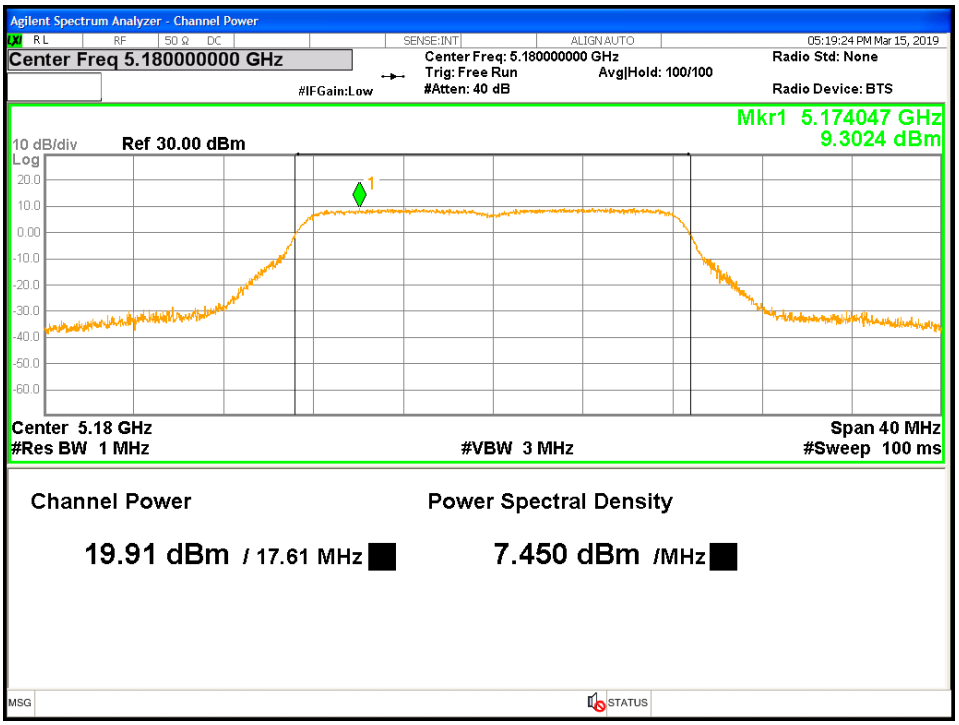


Figure 8: FCC RMS MAX. POWER-5180MHz-11a-1x4-q82-Ch3

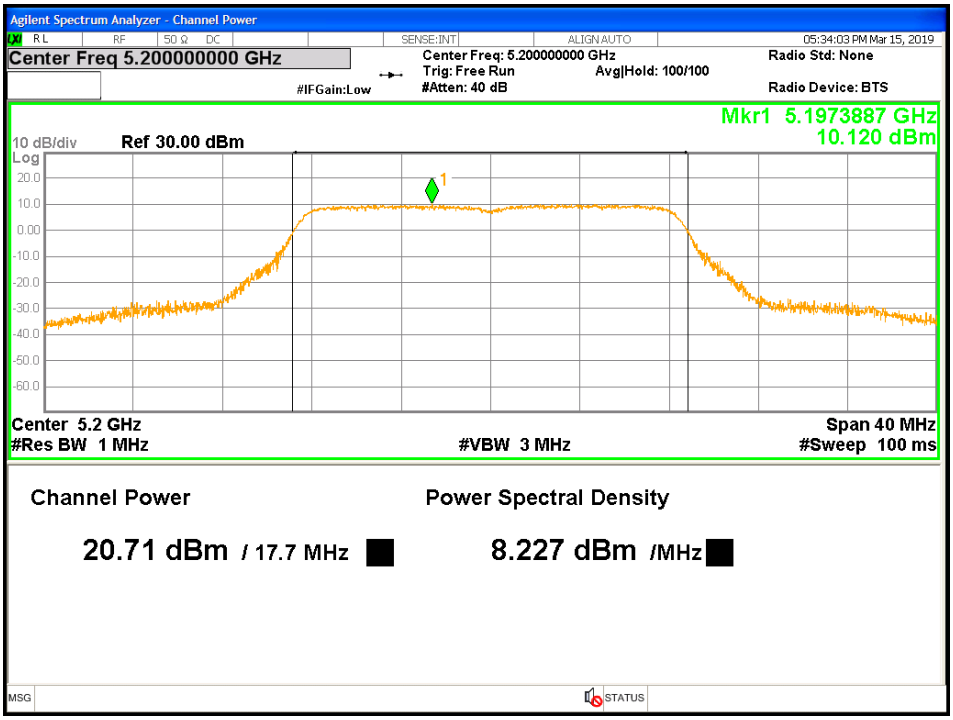


Figure 9: FCC RMS MAX. POWER-5200MHz-11a-1x4-q82-Ch0

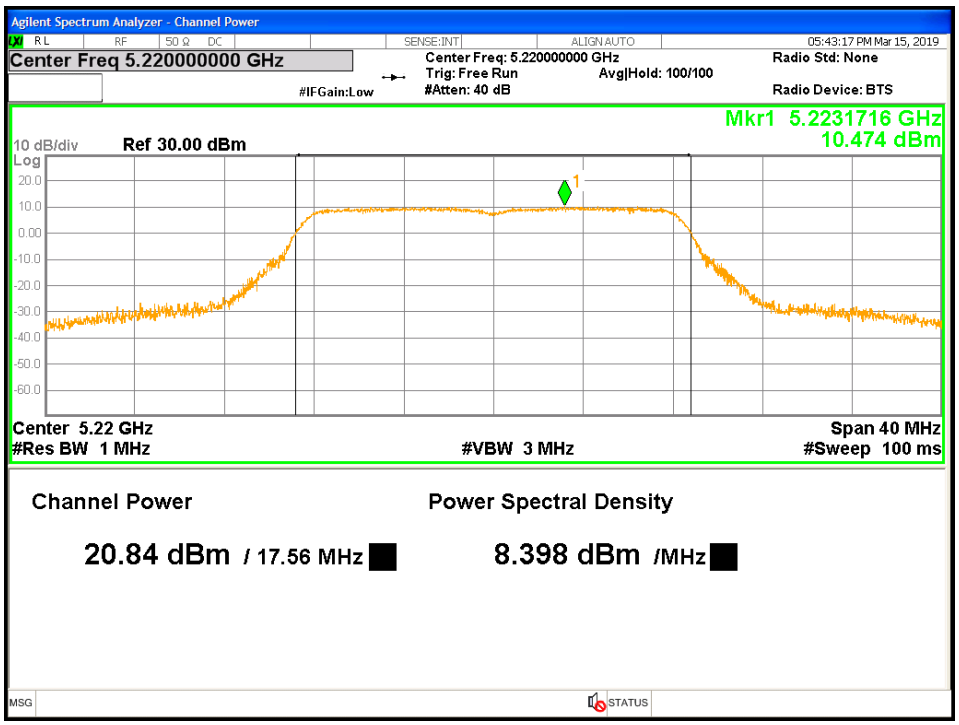


Figure 10: FCC RMS MAX. POWER-5200MHz-11a-1x4-q82-Ch1

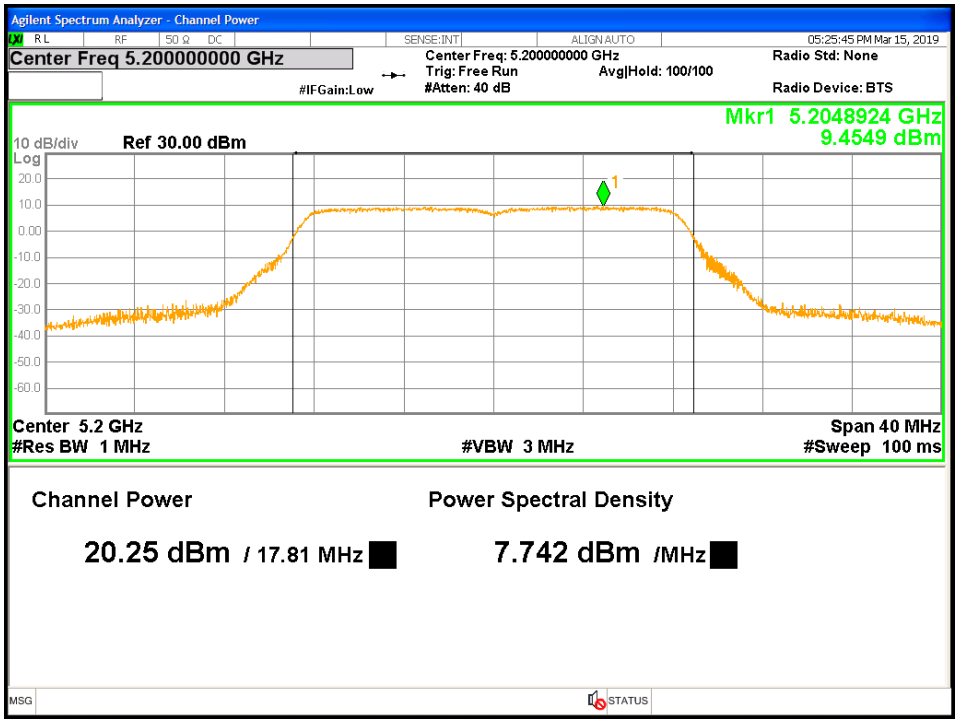


Figure 11: FCC RMS MAX. POWER-5200MHz-11a-1x4-q82-Ch2

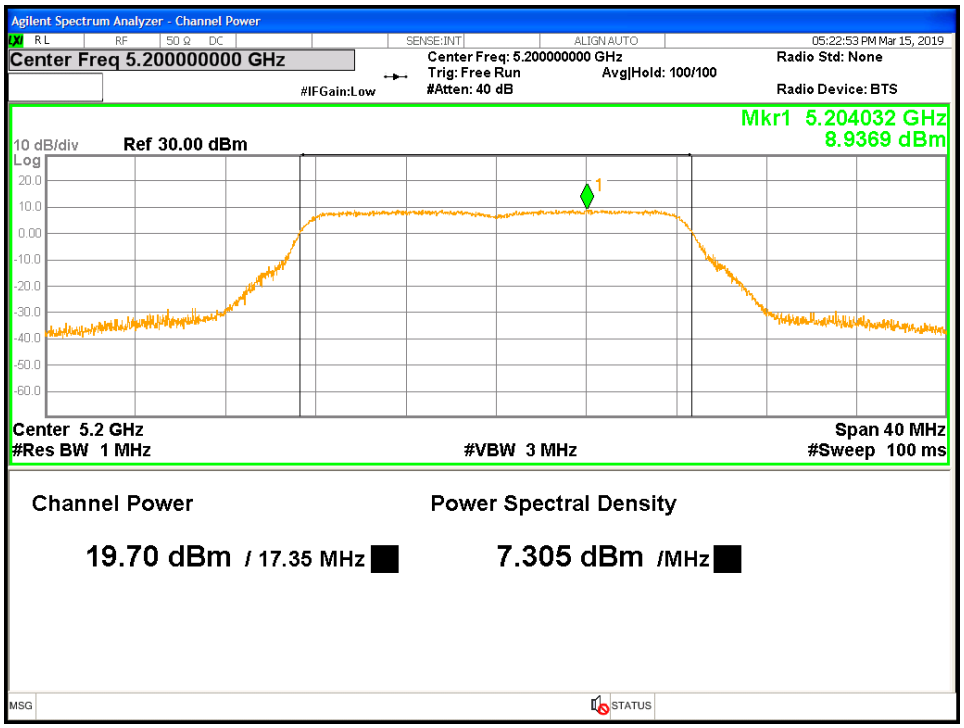


Figure 12: FCC RMS MAX. POWER-5200MHz-11a-1x4-q82-Ch3

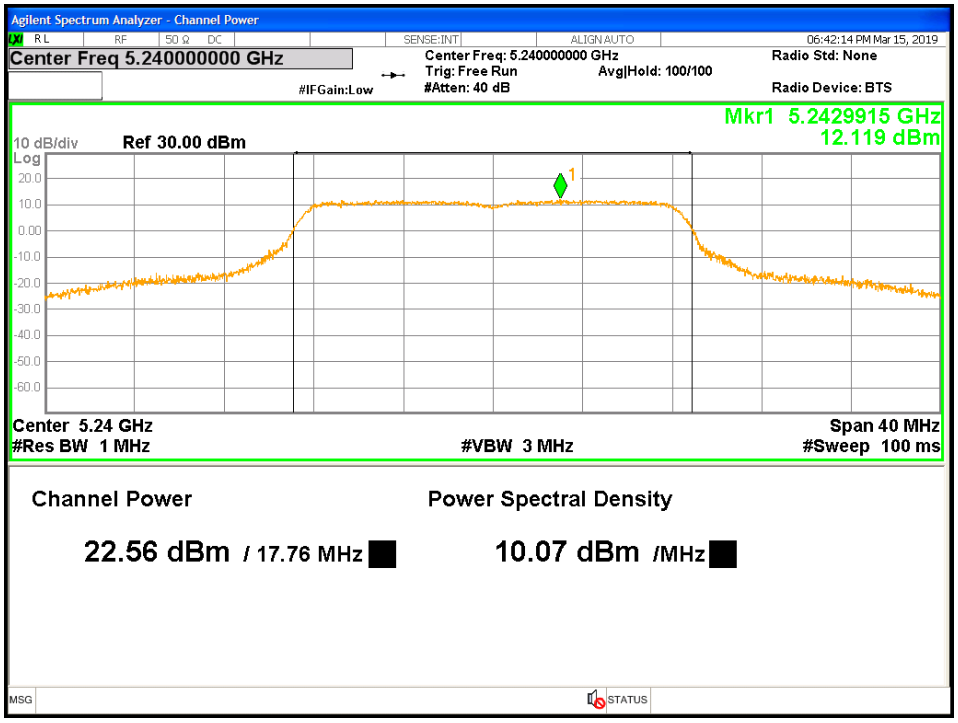


Figure 13: FCC RMS MAX. POWER-5240MHz-11a-1x4-q96-Ch0

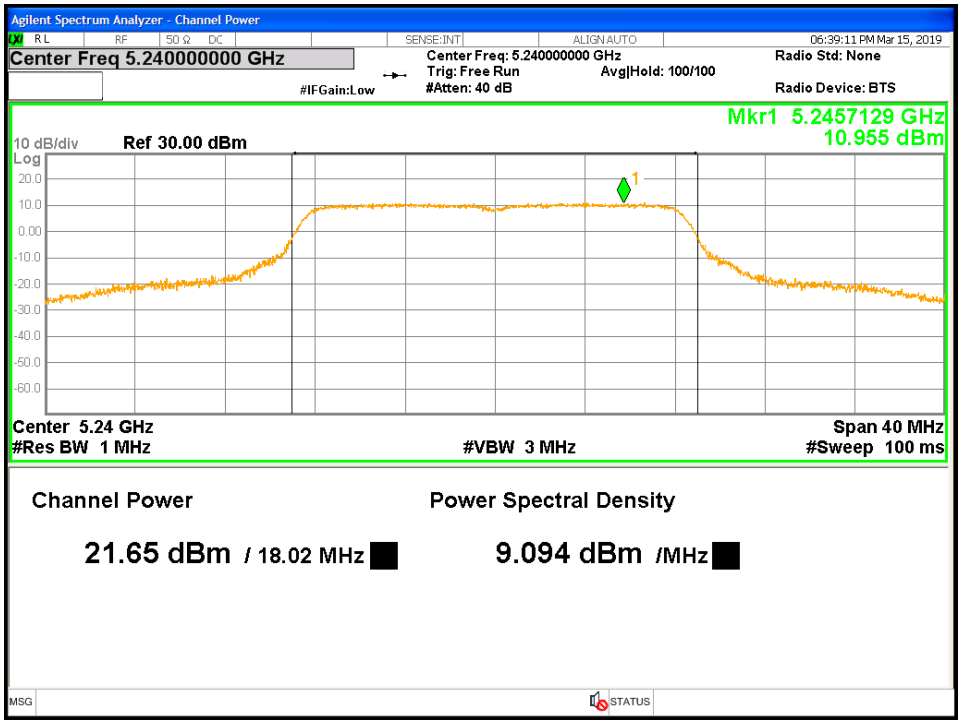


Figure 14: FCC RMS MAX. POWER-5240MHz-11a-1x4-q96-Ch1

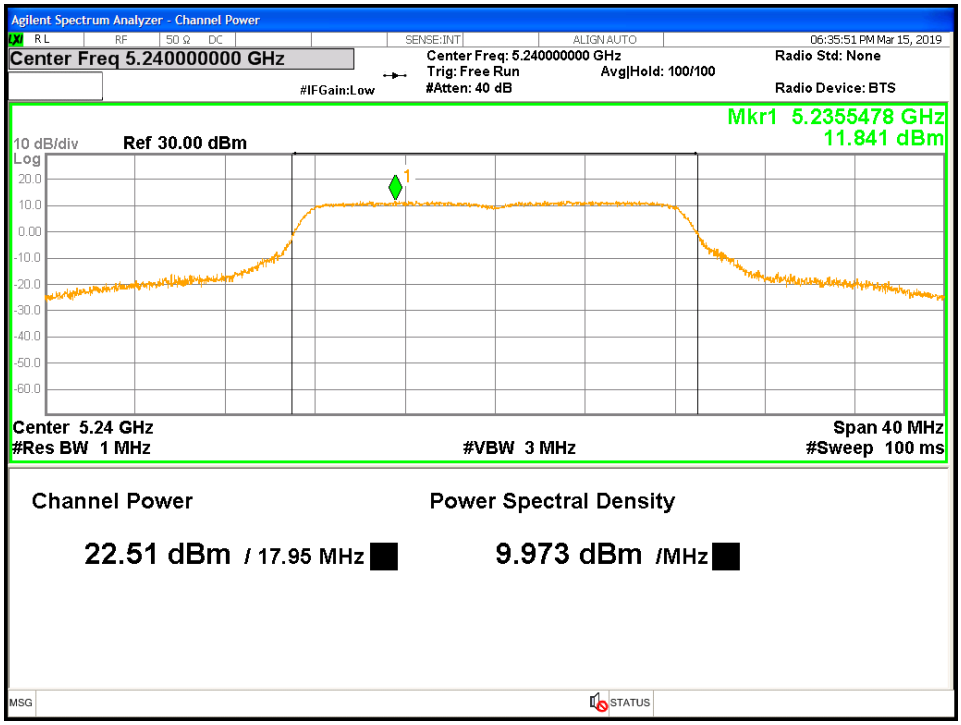


Figure 15: FCC RMS MAX. POWER-5240MHz-11a-1x4-q96-Ch2

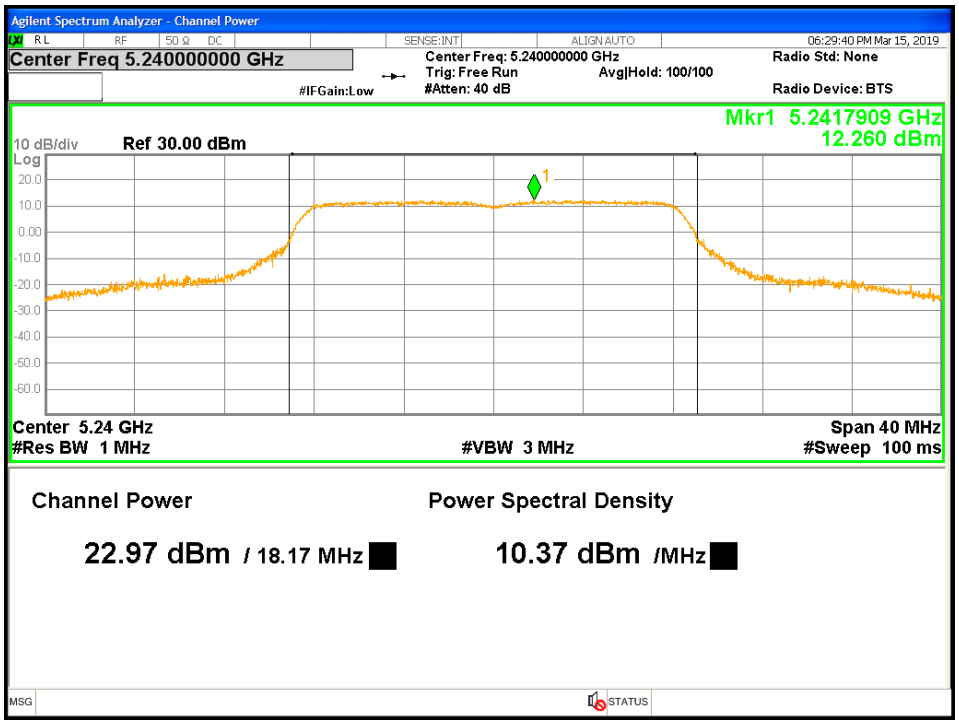


Figure 16: FCC RMS MAX. POWER-5240MHz-11a-1x4-q96-Ch3

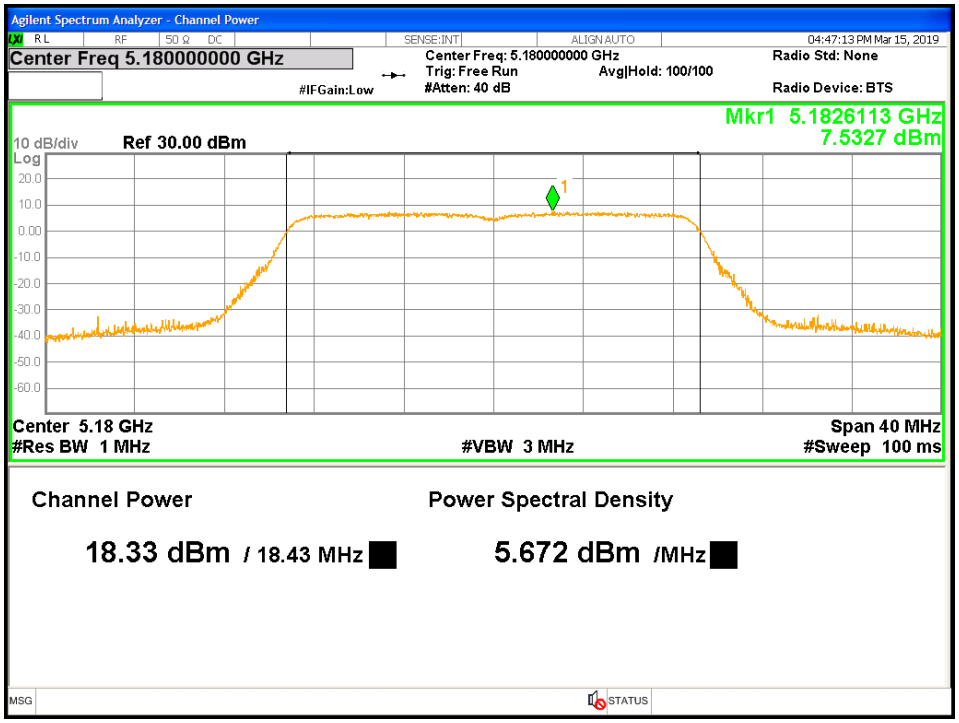


Figure 17: FCC RMS MAX. POWER-5180MHz-HT20-1x4-q74-Ch0

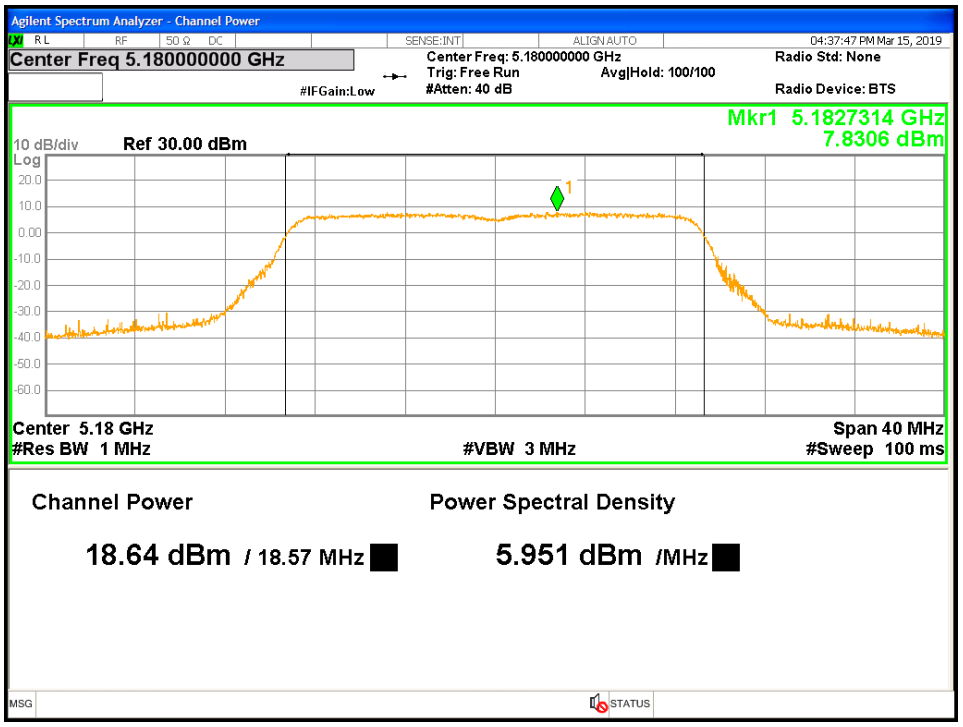


Figure 18: FCC RMS MAX. POWER-5180MHz-HT20-1x4-q74-Ch1

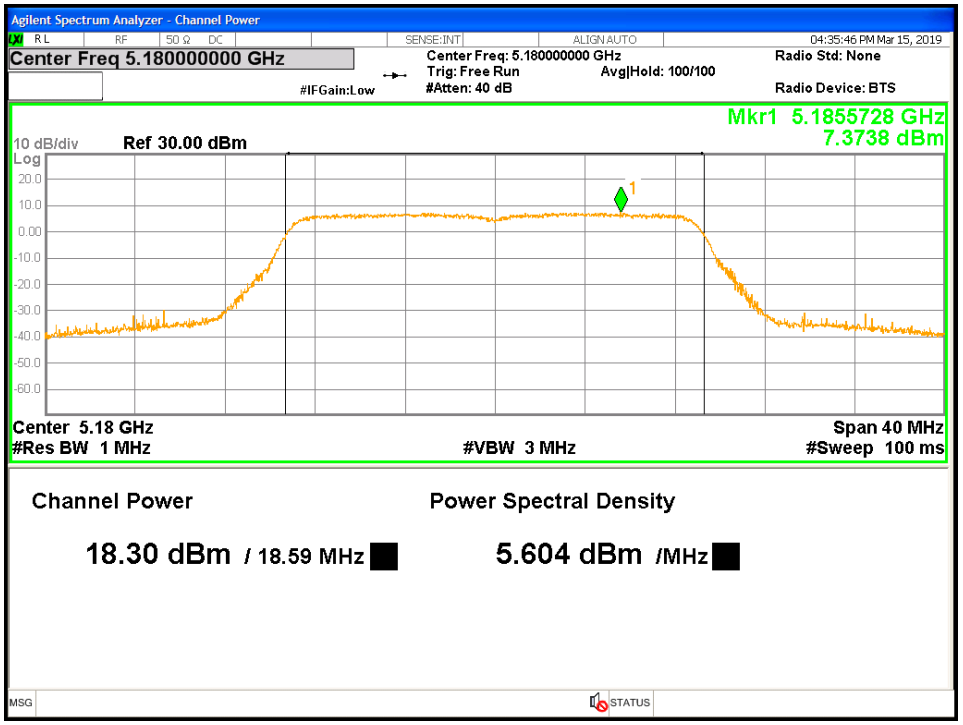


Figure 19: FCC RMS MAX. POWER-5180MHz-HT20-1x4-q74-Ch2

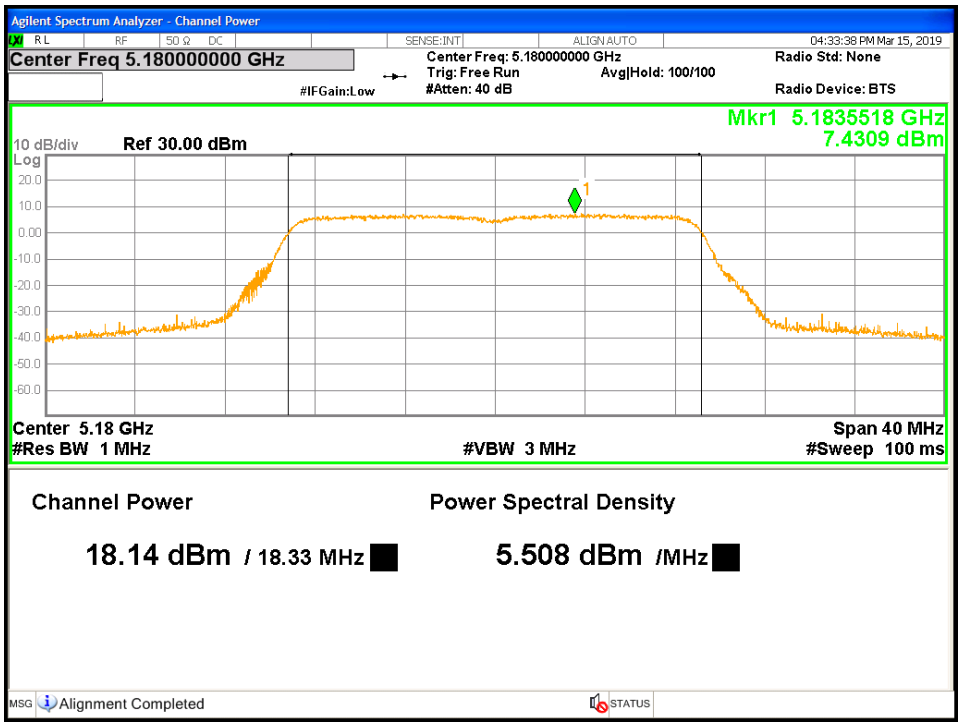


Figure 20: FCC RMS MAX. POWER-5180MHz-HT20-1x4-q74-Ch3

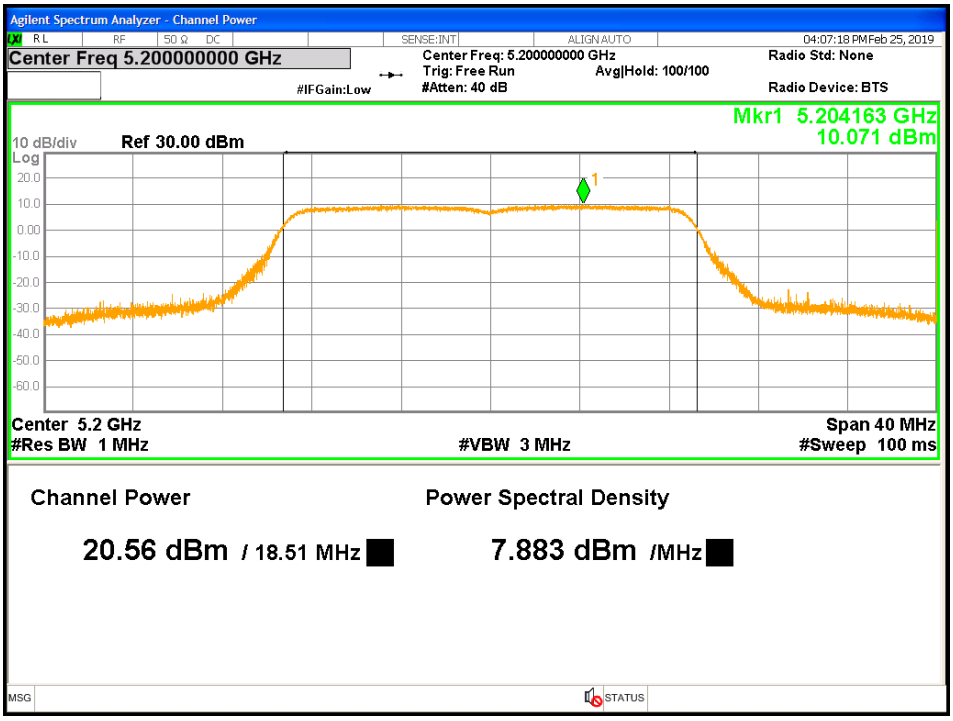


Figure 21: FCC RMS MAX. POWER-5200MHz-HT20-1x4-q82-Ch0

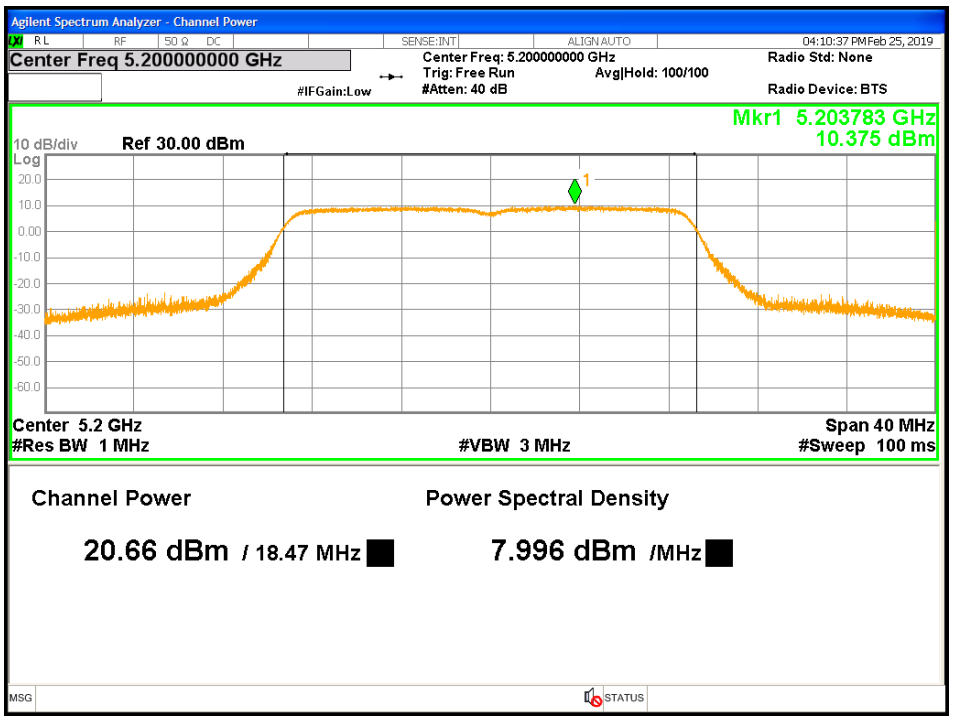


Figure 22: FCC RMS MAX. POWER-5200MHz-HT20-1x4-q82-Ch1

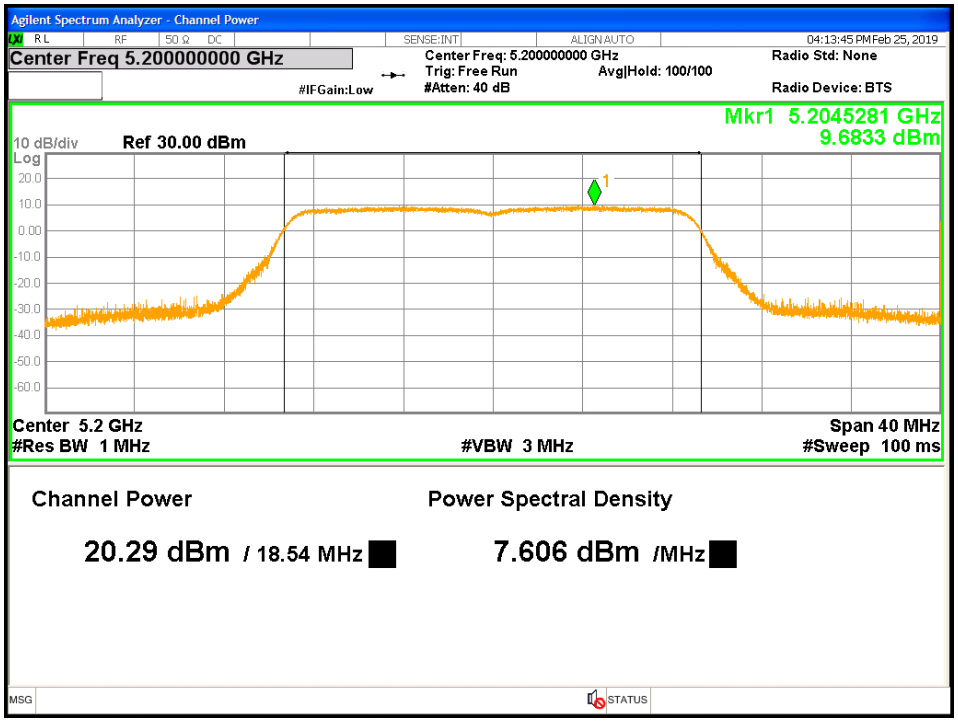


Figure 23: FCC RMS MAX. POWER-5200MHz-HT20-1x4-q82-Ch2

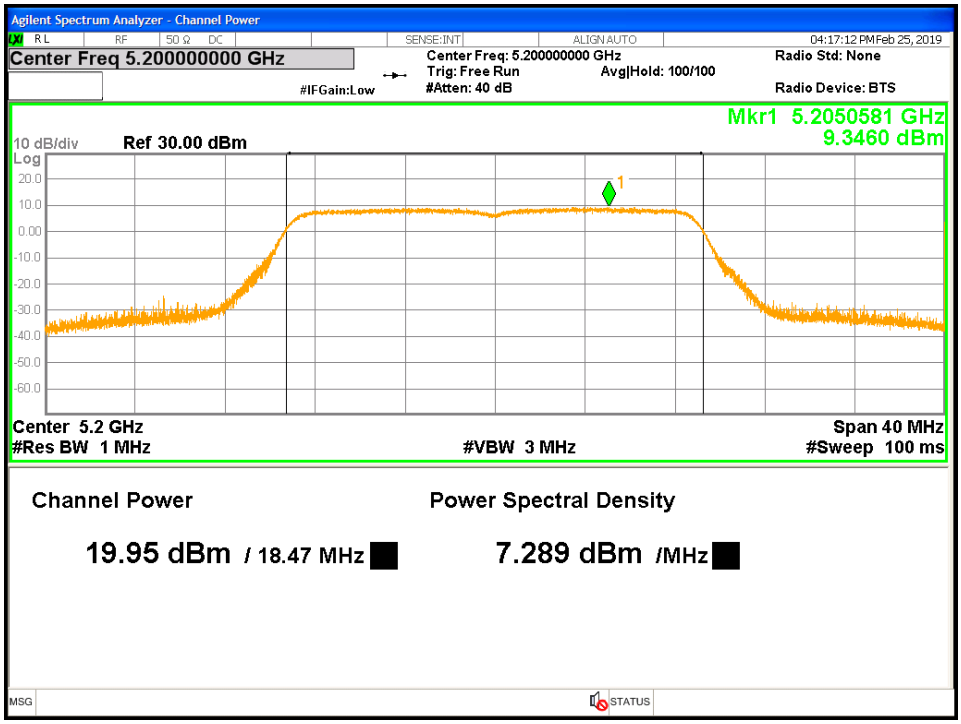


Figure 24: FCC RMS MAX. POWER-5200MHz-HT20-1x4-q82-Ch4

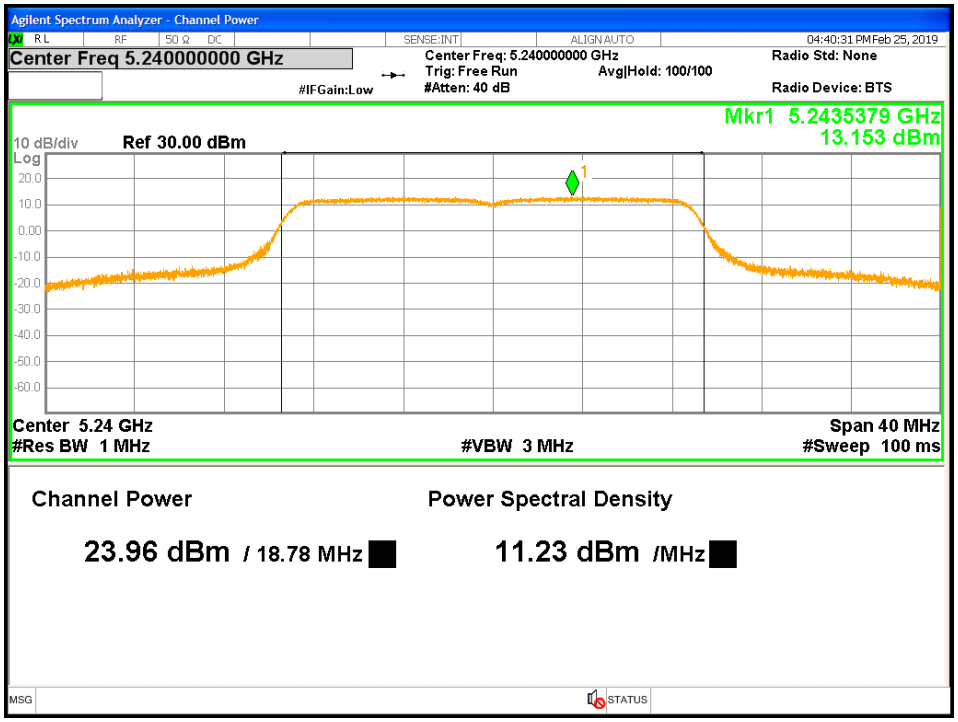


Figure 25: FCC RMS MAX. POWER-5240MHz-HT20-1x4-q96-Ch0

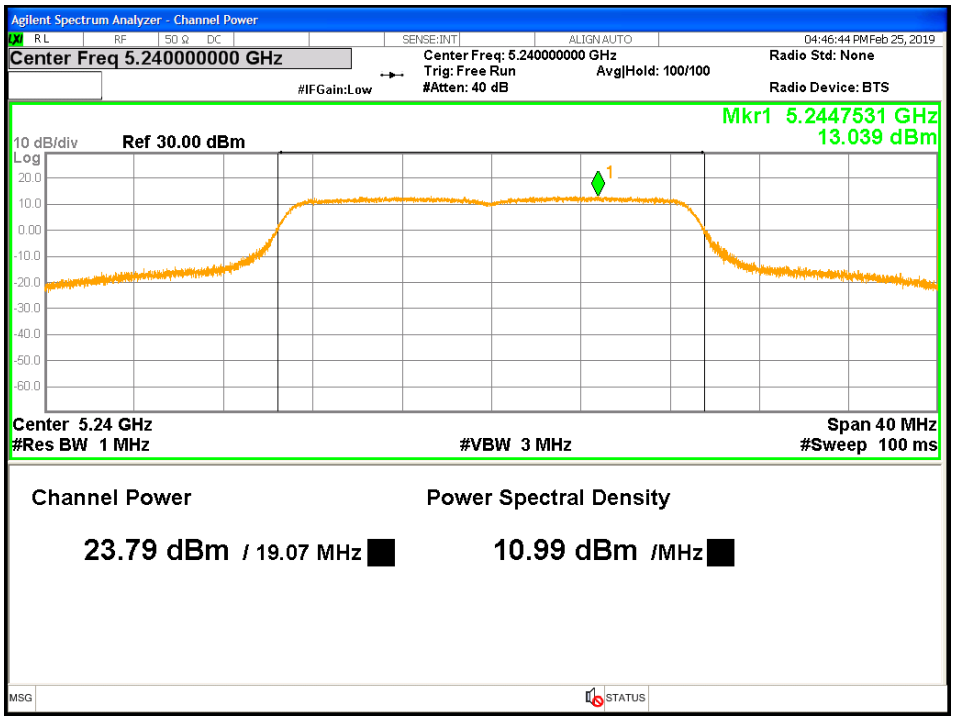


Figure 26: FCC RMS MAX. POWER-5240MHz-HT20-1x4-q96-Ch1

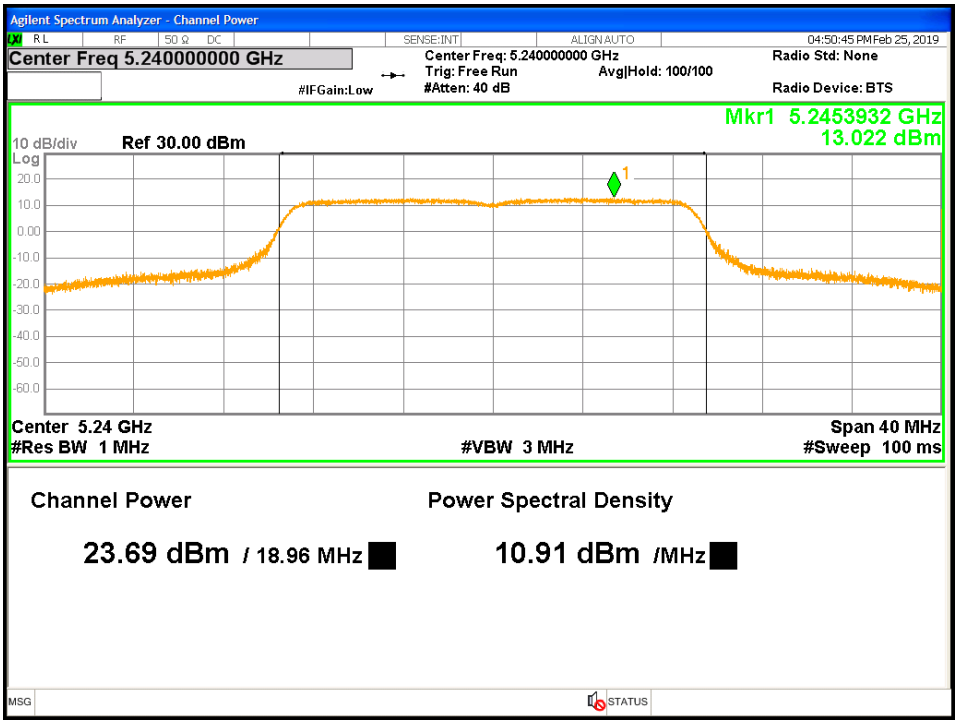


Figure 27: FCC RMS MAX. POWER-5240MHz-HT20-1x4-q96-Ch2

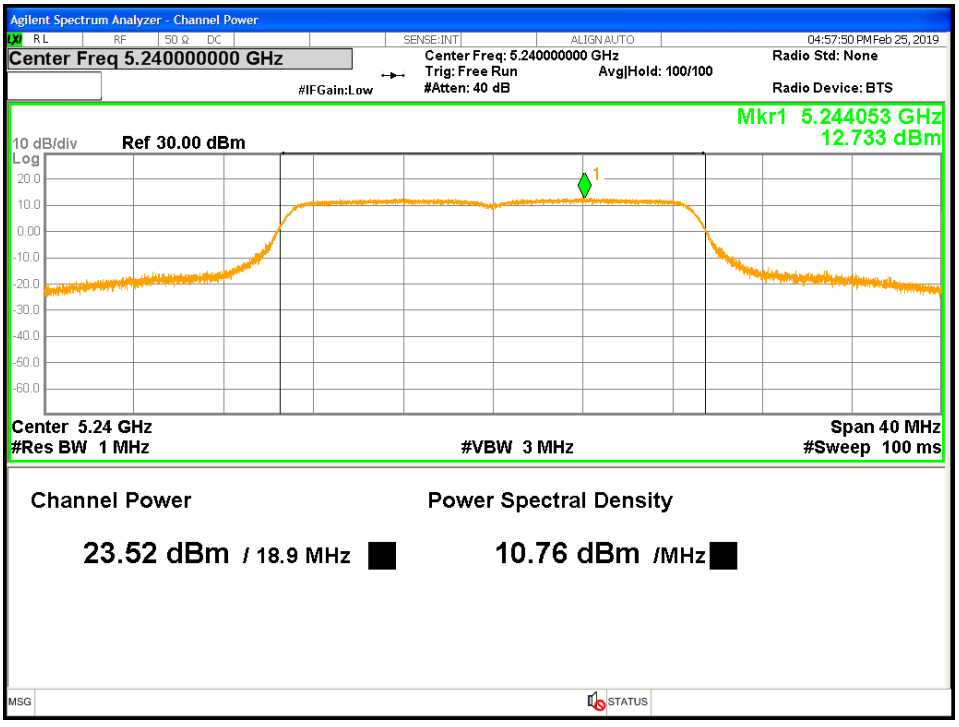


Figure 28: FCC RMS MAX. POWER-5240MHz-HT20-1x4-q96-Ch3

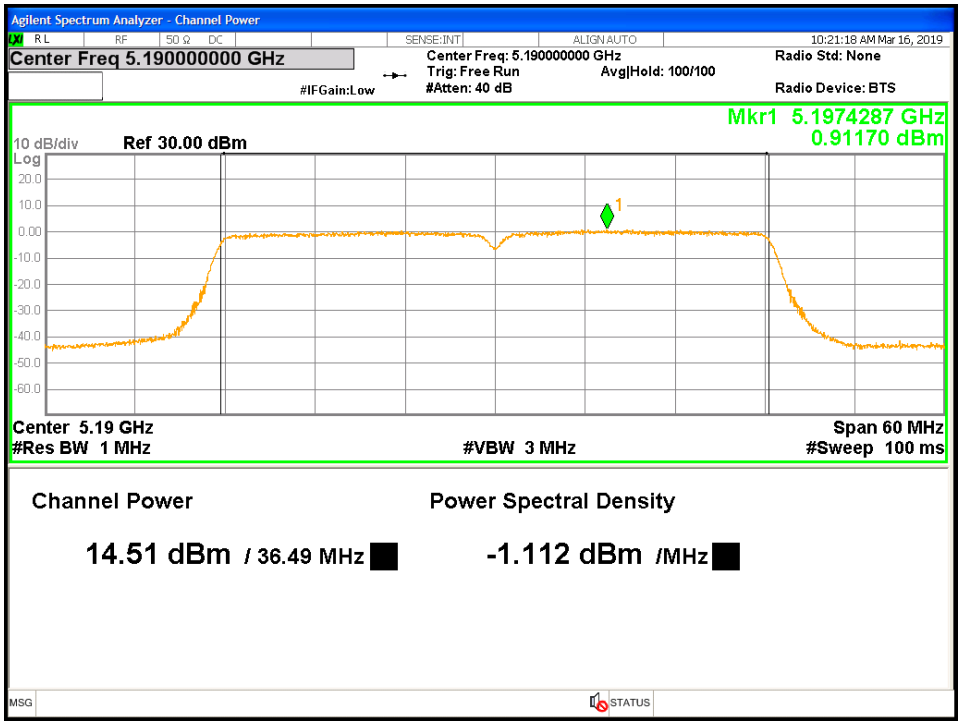


Figure 29: FCC RMS MAX. POWER-5190MHz-HT40-1x4-q61-Ch0

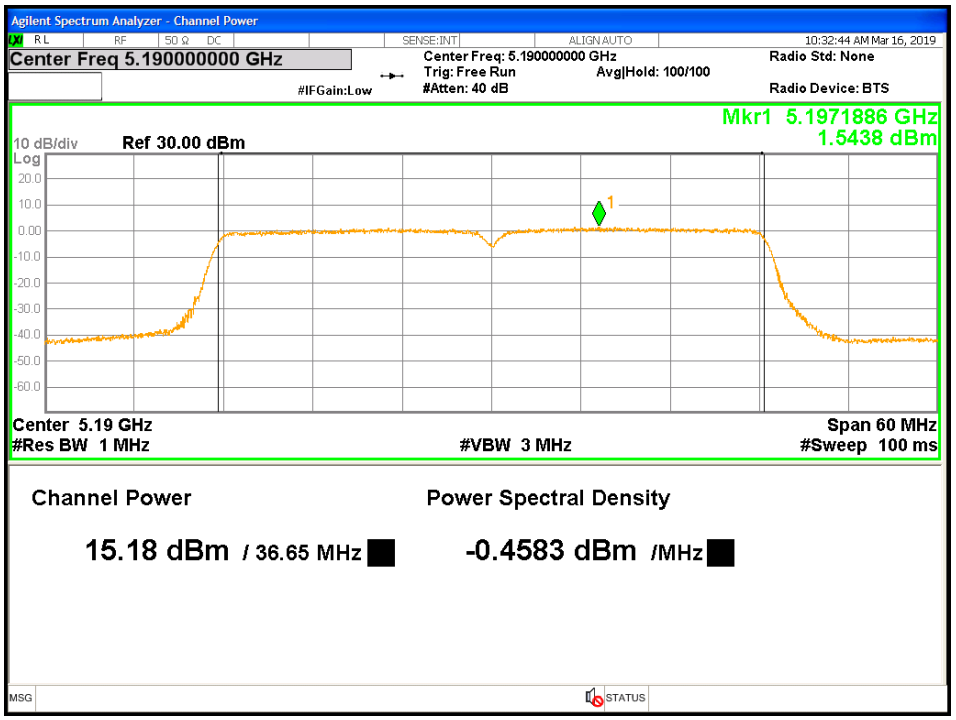


Figure 30: FCC RMS MAX. POWER-5190MHz-HT40-1x4-q61-Ch1

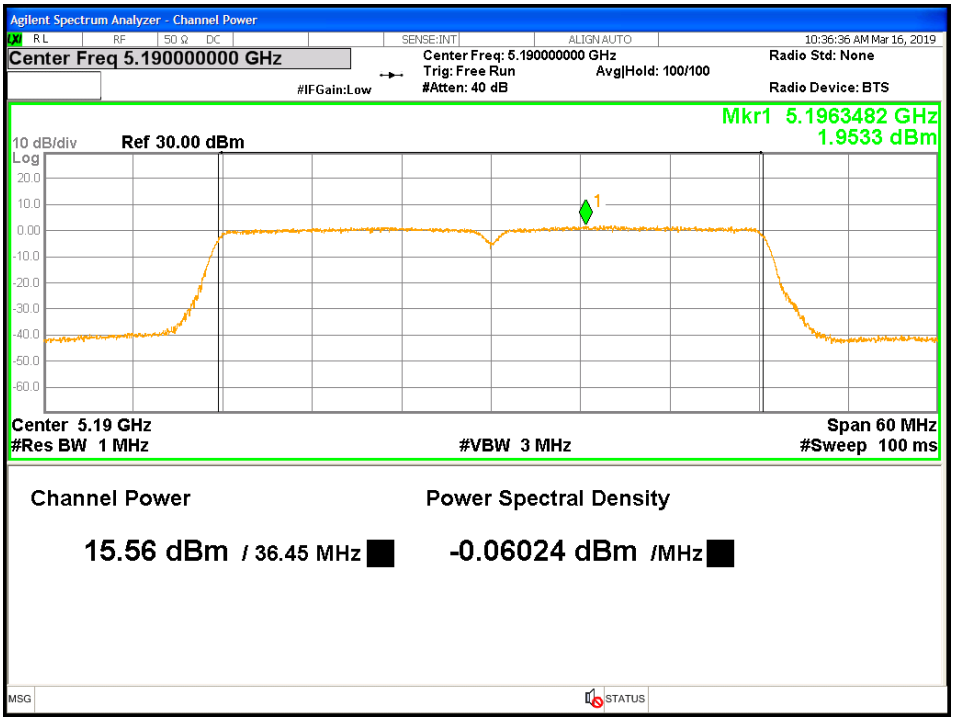


Figure 31: FCC RMS MAX. POWER-5190MHz-HT40-1x4-q61-Ch2

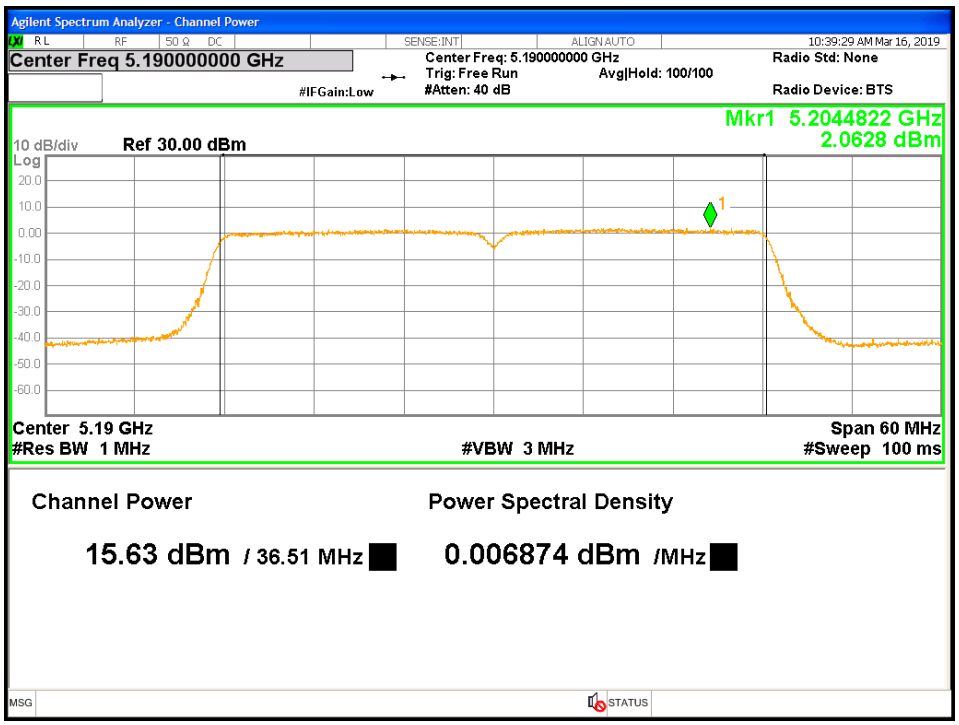


Figure 32: FCC RMS MAX. POWER-5190MHz-HT40-1x4-q61-Ch3

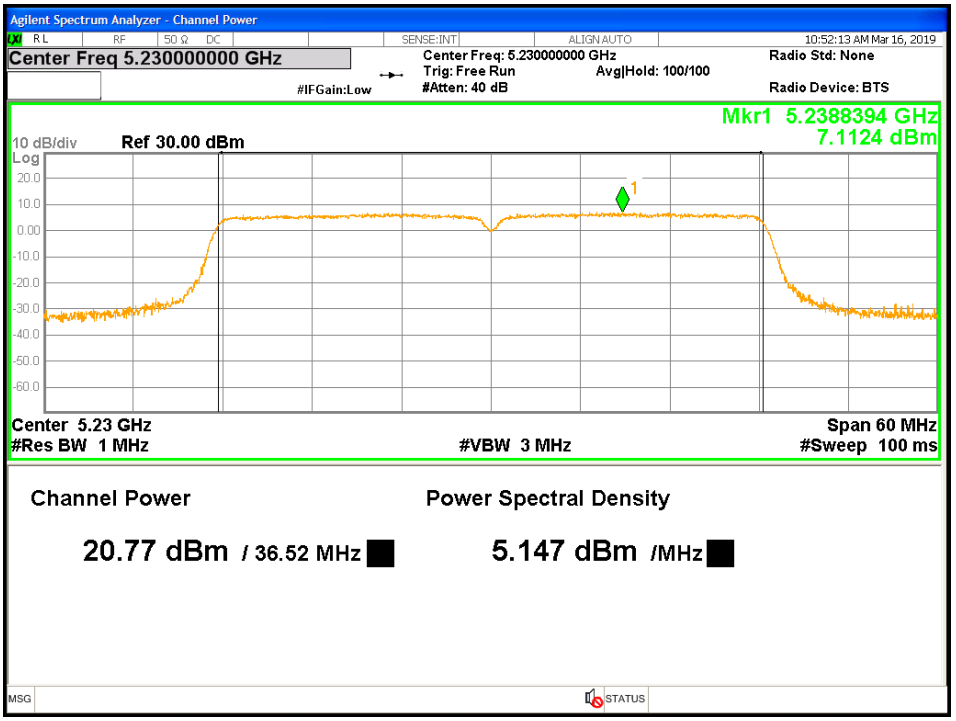


Figure 33: FCC RMS MAX. POWER-5230MHz-HT40-1x4-q82-Ch0

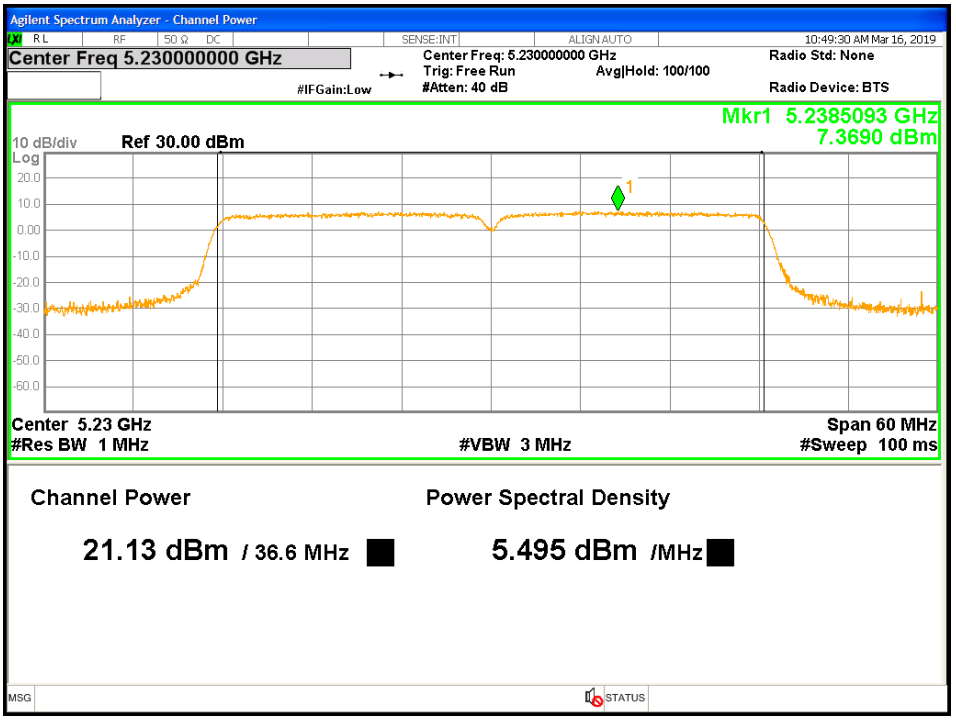


Figure 34: FCC RMS MAX. POWER-5230MHz-HT40-1x4-q82-Ch1

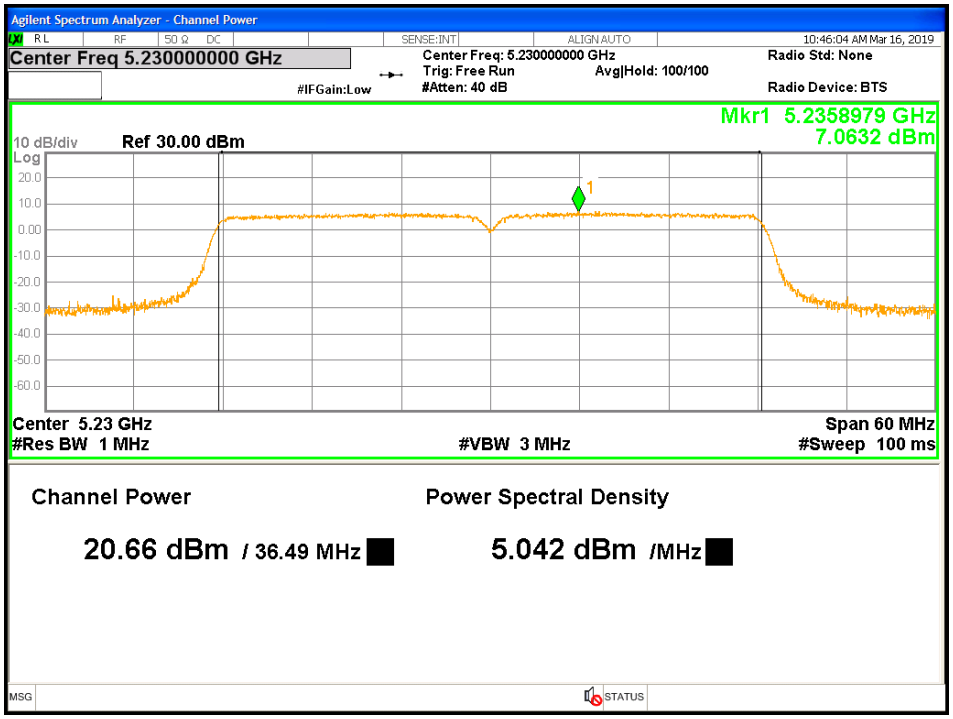


Figure 35: FCC RMS MAX. POWER-5230MHz-HT40-1x4-q82-Ch2

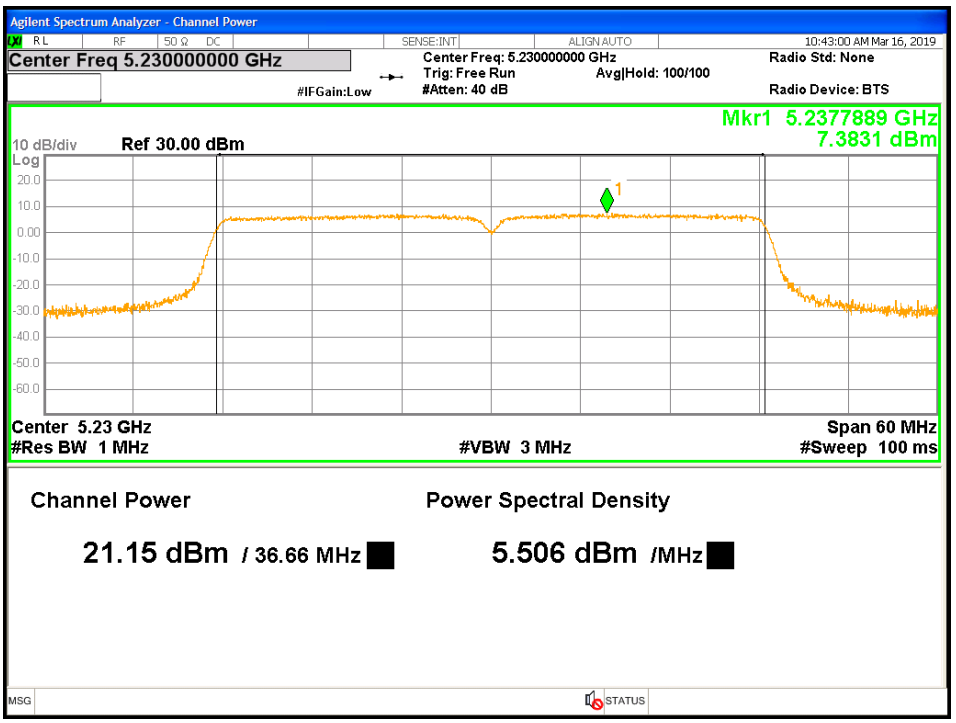


Figure 36: FCC RMS MAX. POWER-5230MHz-HT40-1x4-q82-Ch3

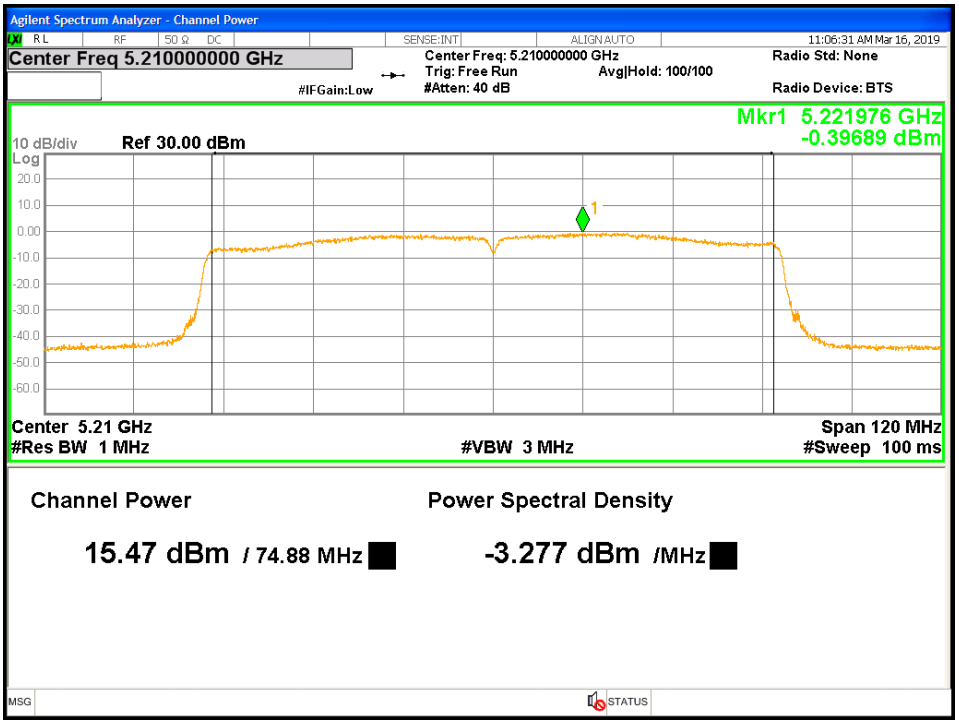


Figure 37: FCC RMS MAX. POWER-5210MHz-VHT80-1x4-q60-Ch0

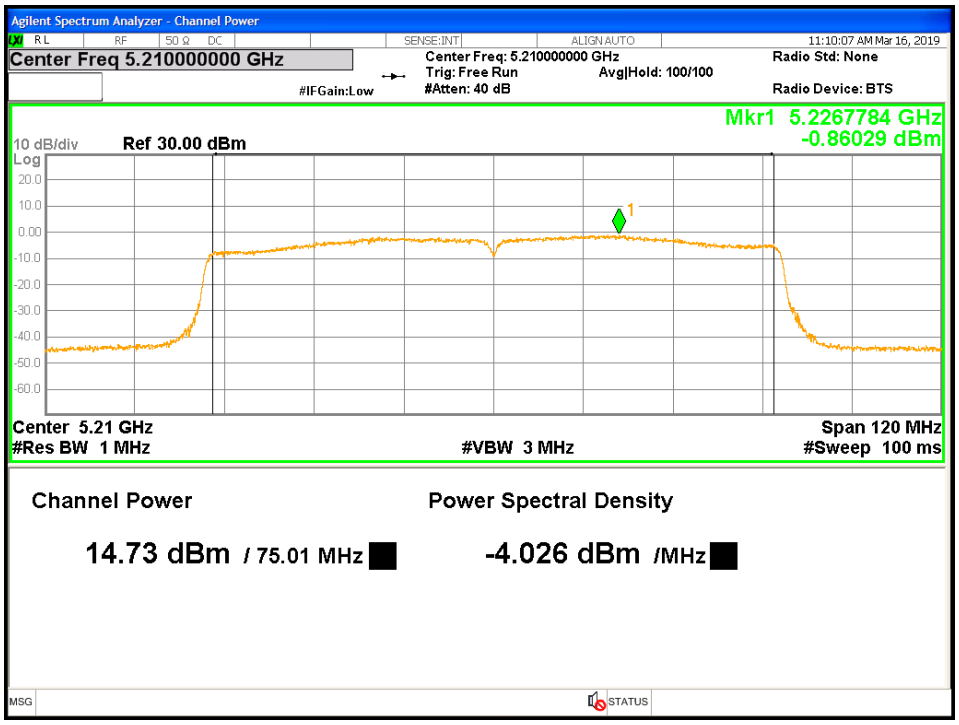


Figure 38: FCC RMS MAX. POWER-5210MHz-VHT80-1x4-q60-Ch1

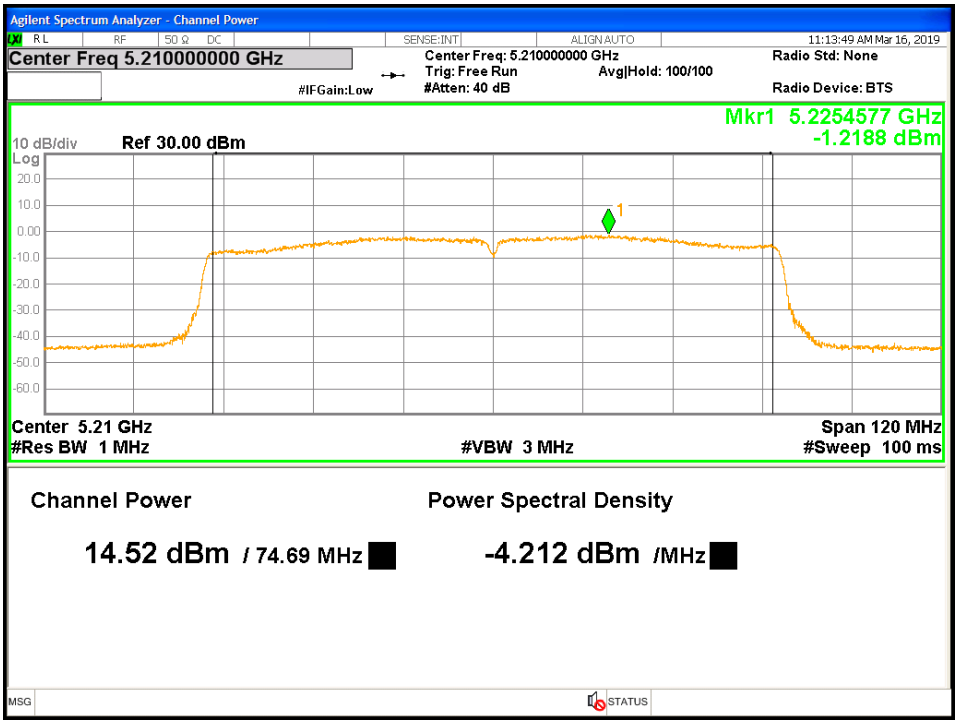


Figure 39: FCC RMS MAX. POWER-5210MHz-VHT80-1x4-q60-Ch2

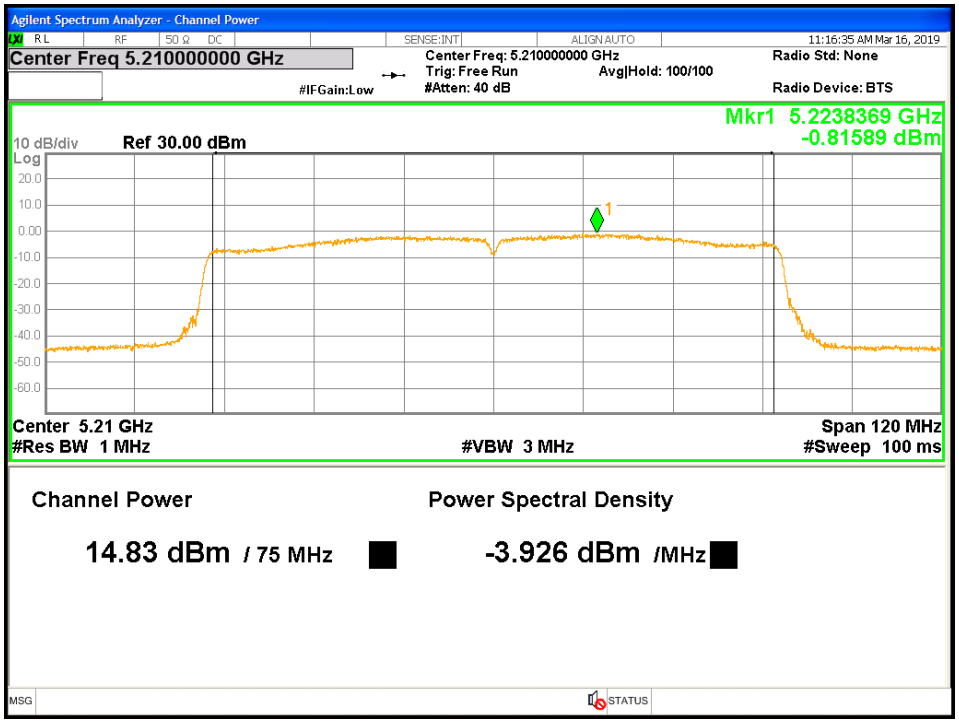


Figure 40: FCC RMS MAX. POWER-5210MHz-VHT80-1x4-q60-Ch3

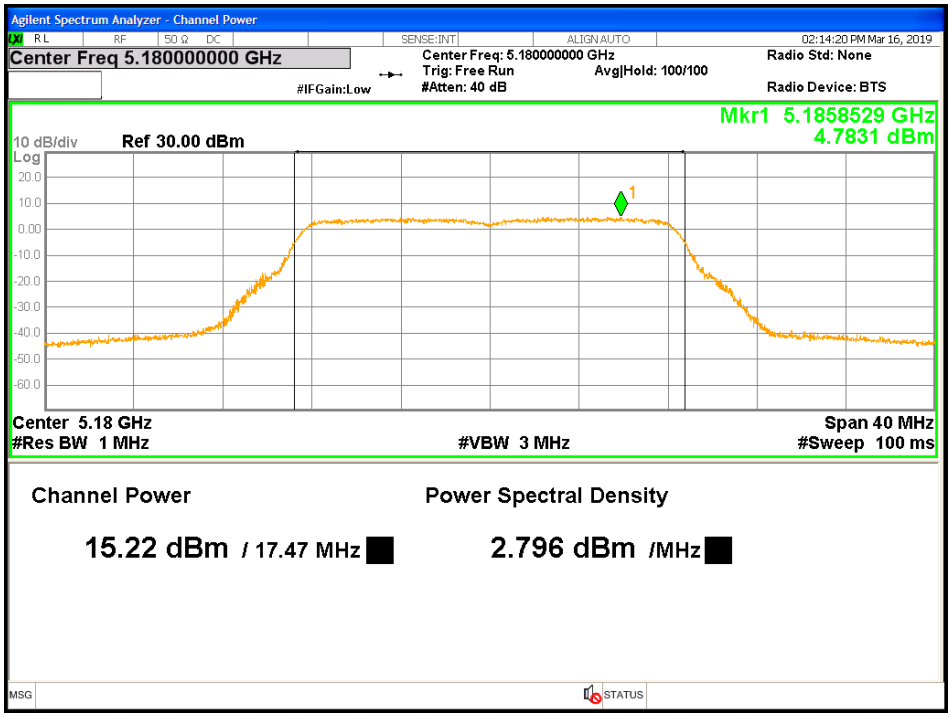


Figure 41: ISED RMS MAX. POWER-5180MHz-11a-1x4-q61-Ch0

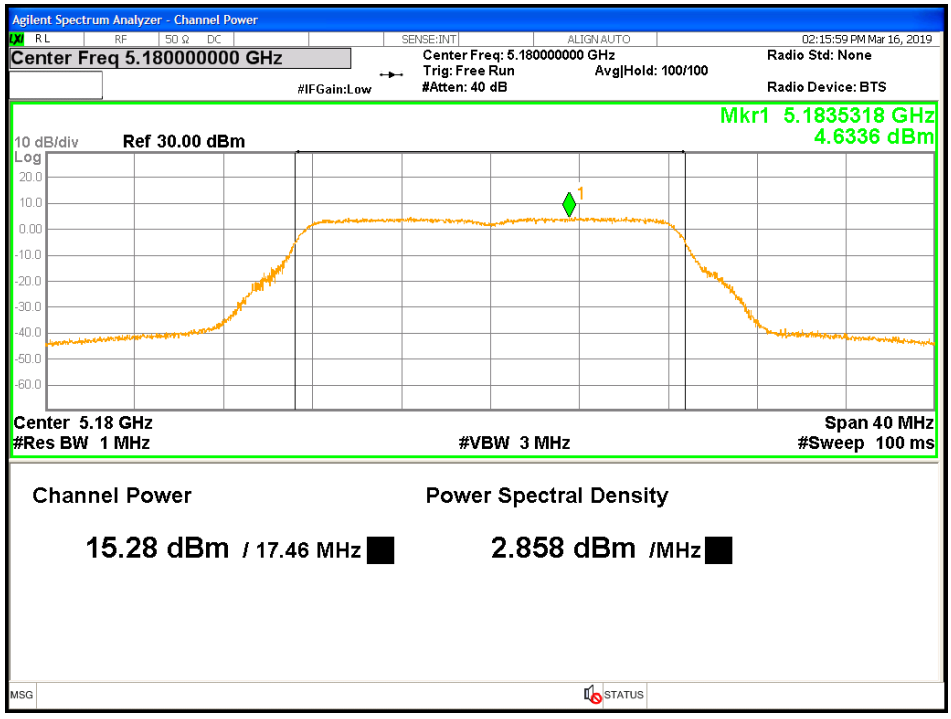


Figure 42: ISED RMS MAX. POWER-5180MHz-11a-1x4-q61-Ch1

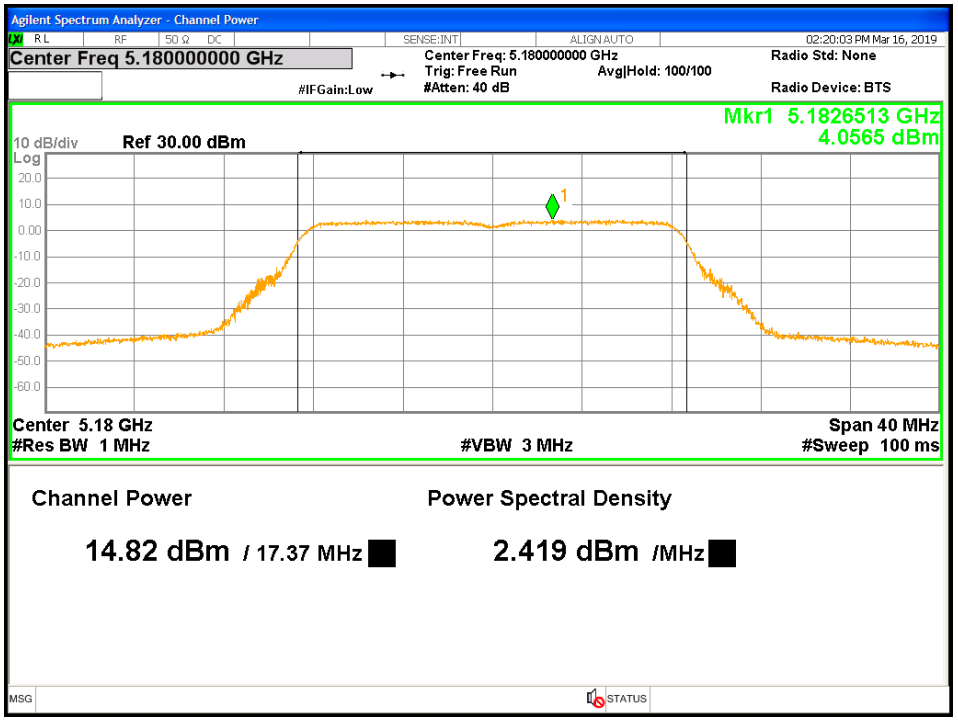


Figure 43: ISED RMS MAX. POWER-5180MHz-11a-1x4-q61-Ch2

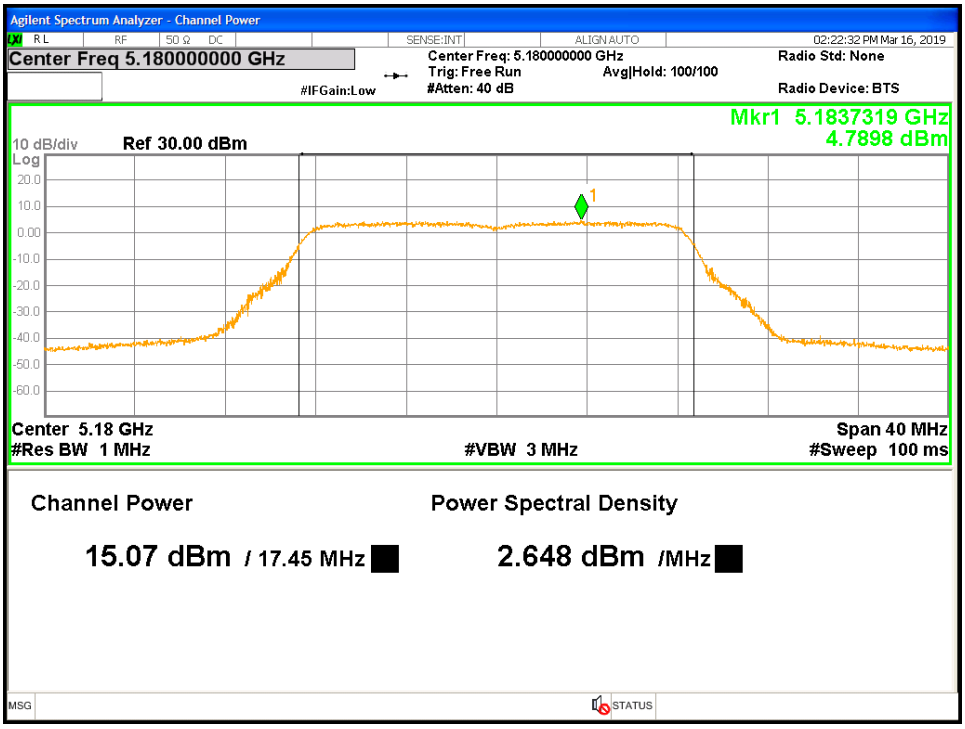


Figure 44: ISED RMS MAX. POWER-5180MHz-11a-1x4-q61-Ch3

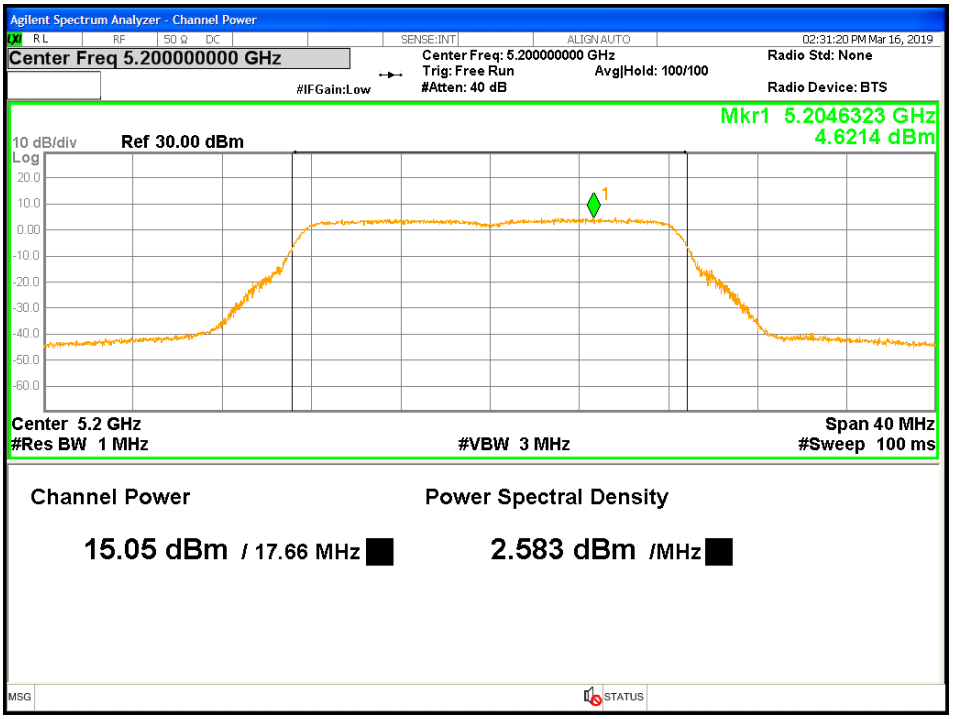


Figure 45: ISED RMS MAX. POWER-5200MHz-11a-1x4-q61-Ch0

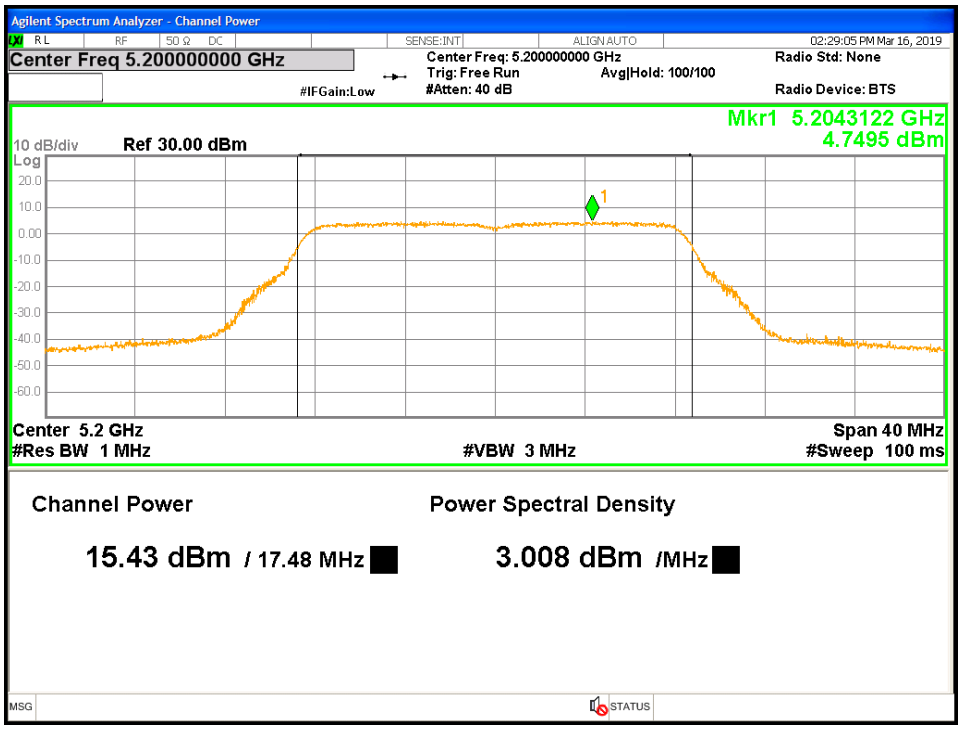


Figure 46: ISED RMS MAX. POWER-5200MHz-11a-1x4-q61-Ch1

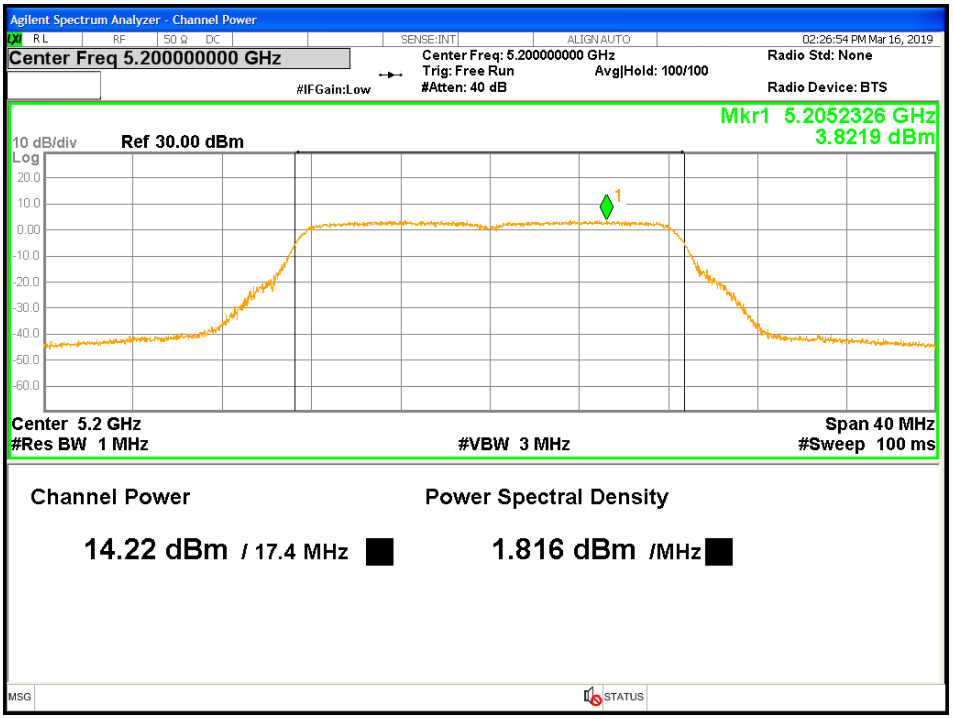


Figure 47: ISED RMS MAX. POWER-5200MHz-11a-1x4-q61-Ch2

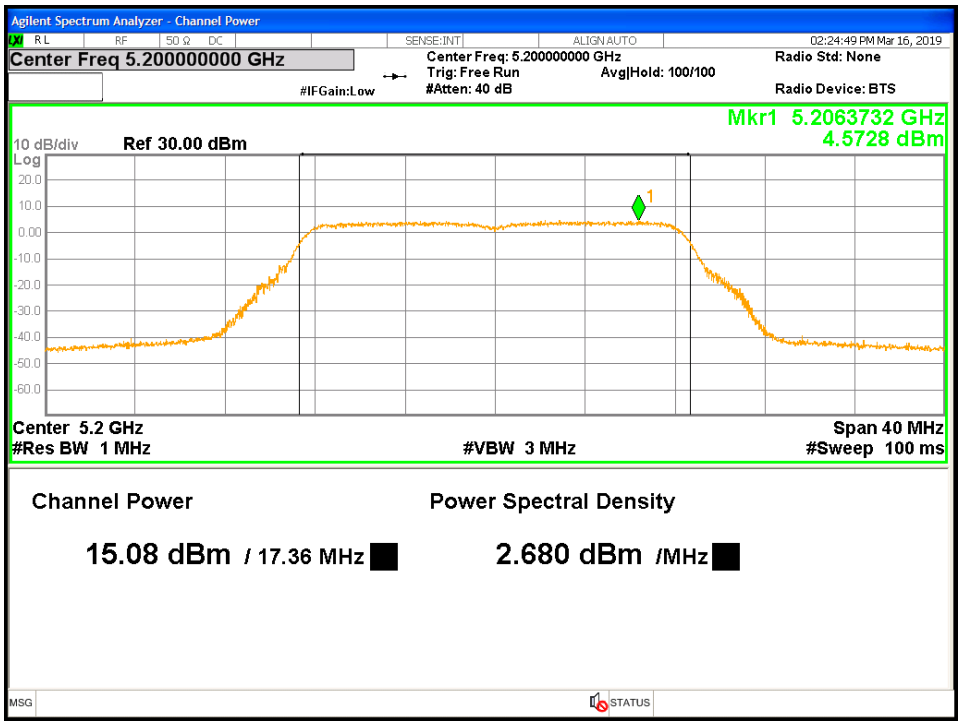


Figure 48: ISED RMS MAX. POWER-5200MHz-11a-1x4-q61-Ch3

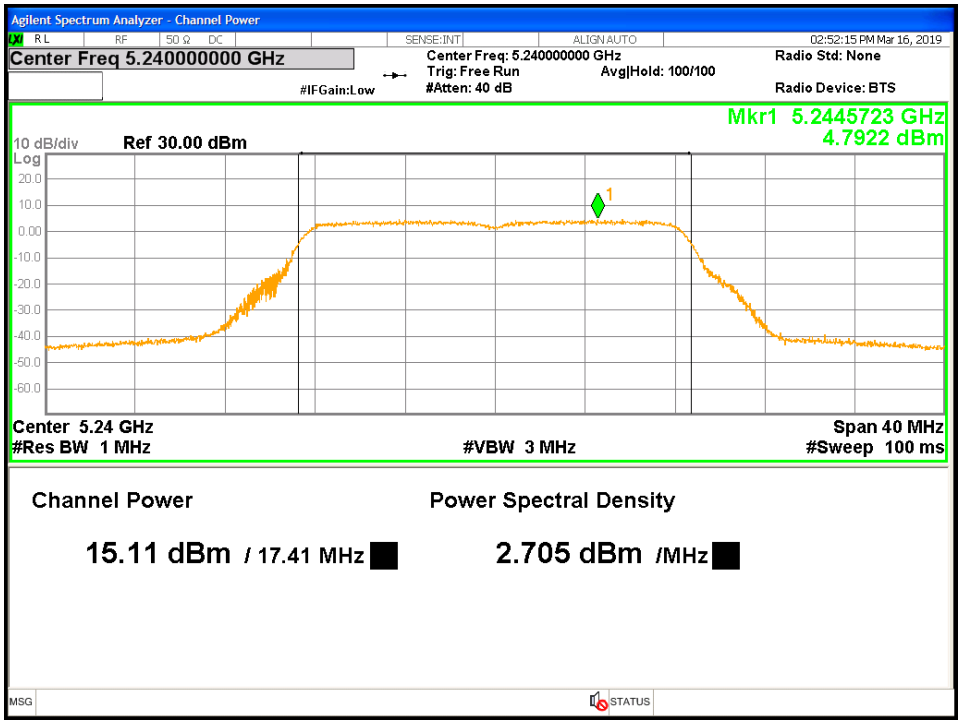


Figure 49: ISED RMS MAX. POWER-5240MHz-11a-1x4-q61-Ch0

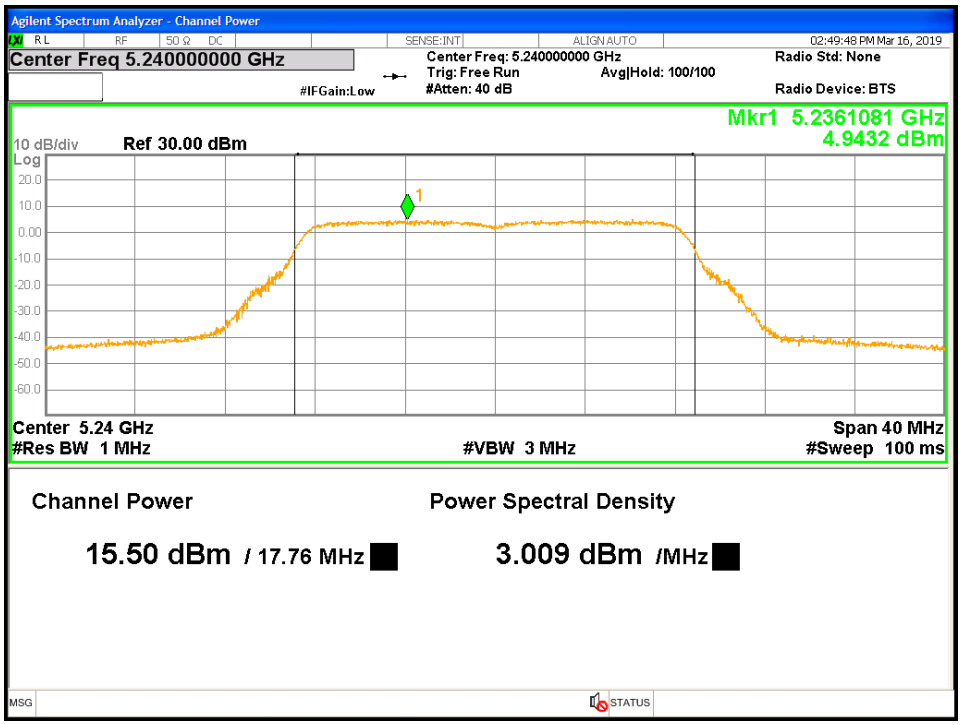


Figure 50: ISED RMS MAX. POWER-5240MHz-11a-1x4-q61-Ch1

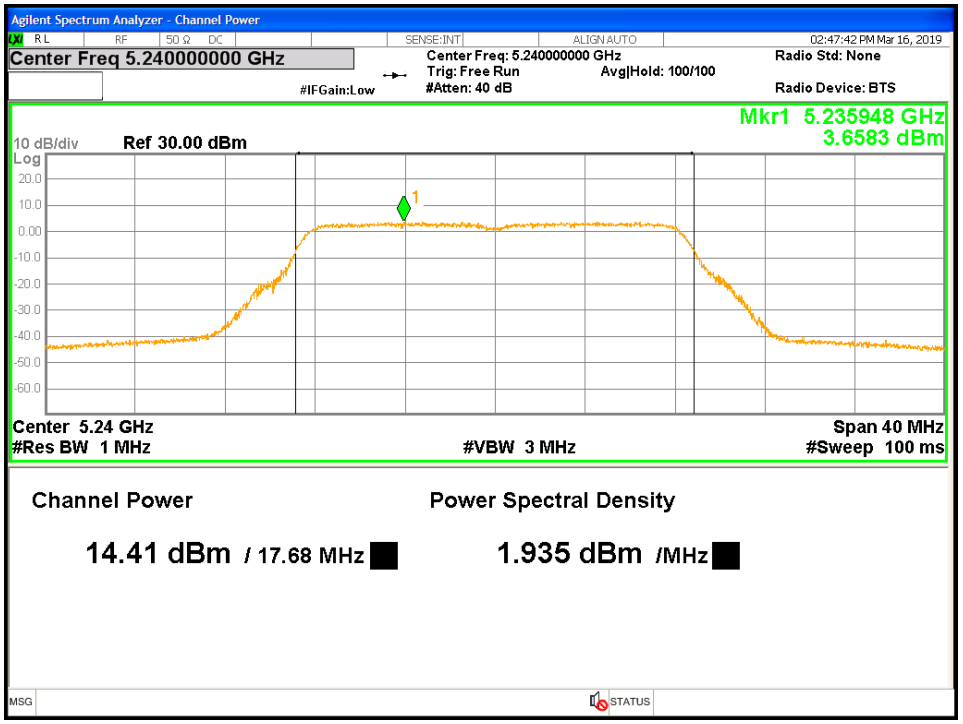


Figure 51: ISED RMS MAX. POWER-5240MHz-11a-1x4-q61-Ch2

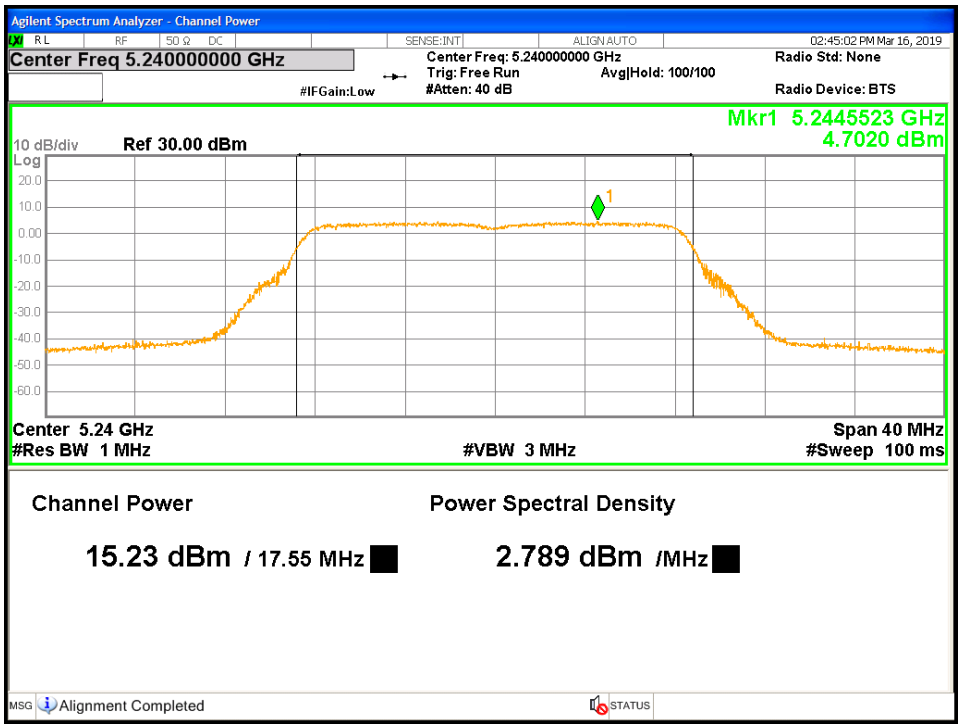


Figure 52: ISED RMS MAX. POWER-5240MHz-11a-1x4-q61-Ch3

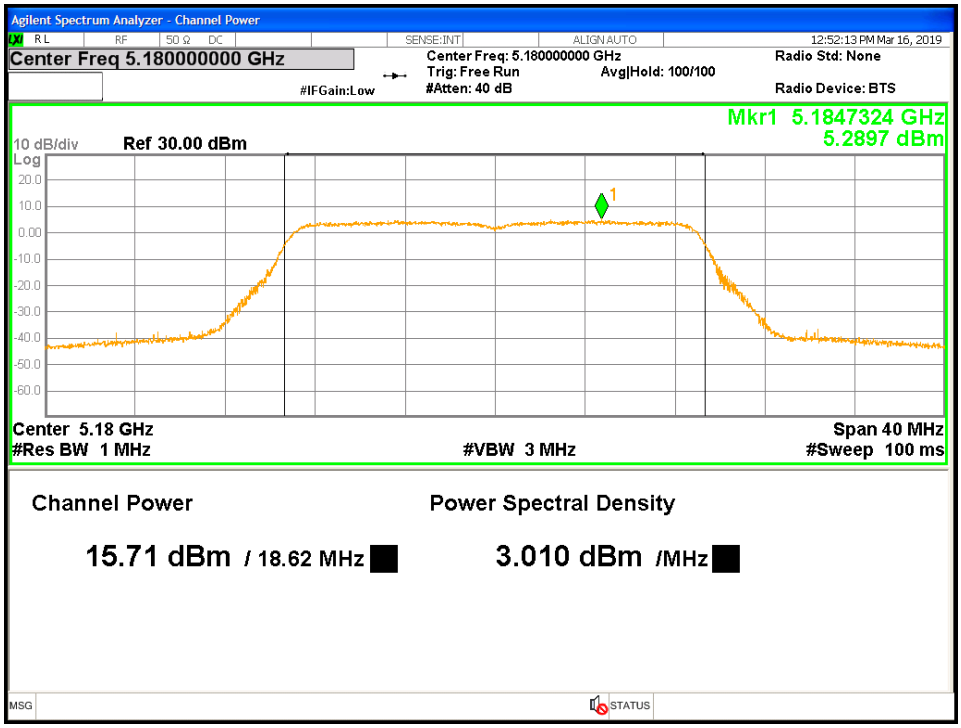


Figure 53: ISED RMS MAX. POWER-5180MHz-HT20-1x4-q63-Ch0

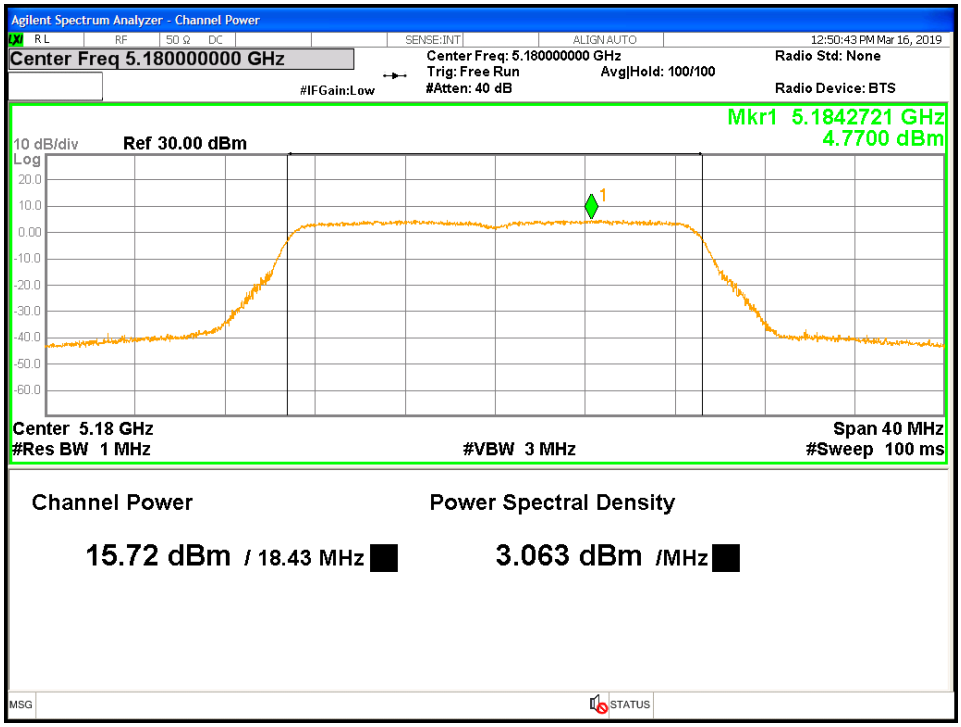


Figure 54: ISED RMS MAX. POWER-5180MHz-HT20-1x4-q63-Ch1

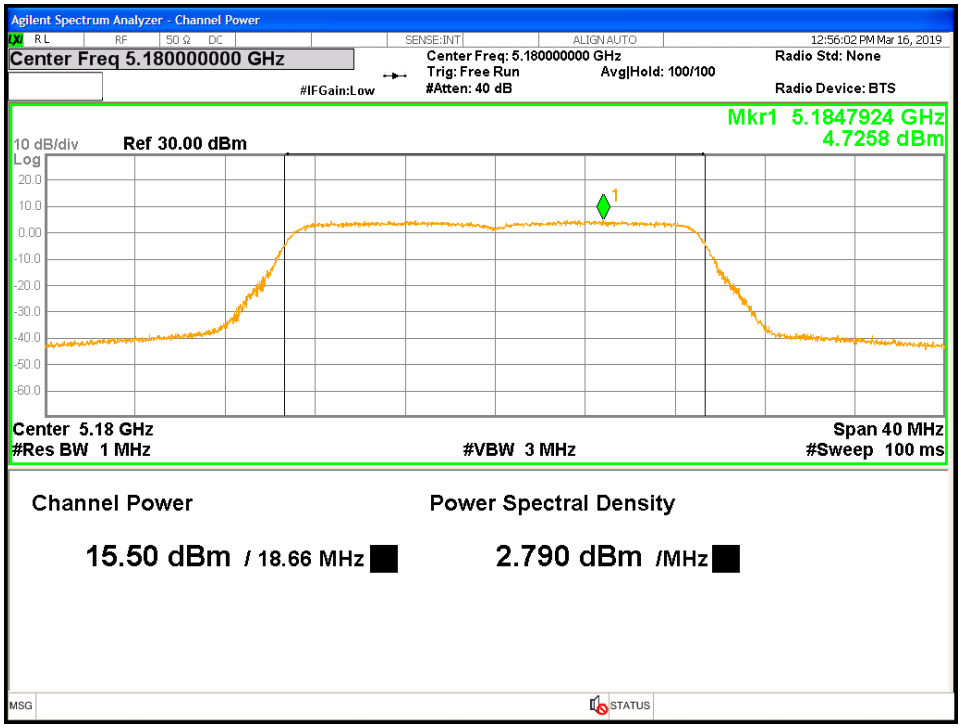


Figure 55: ISED RMS MAX. POWER-5180MHz-HT20-1x4-q63-Ch2

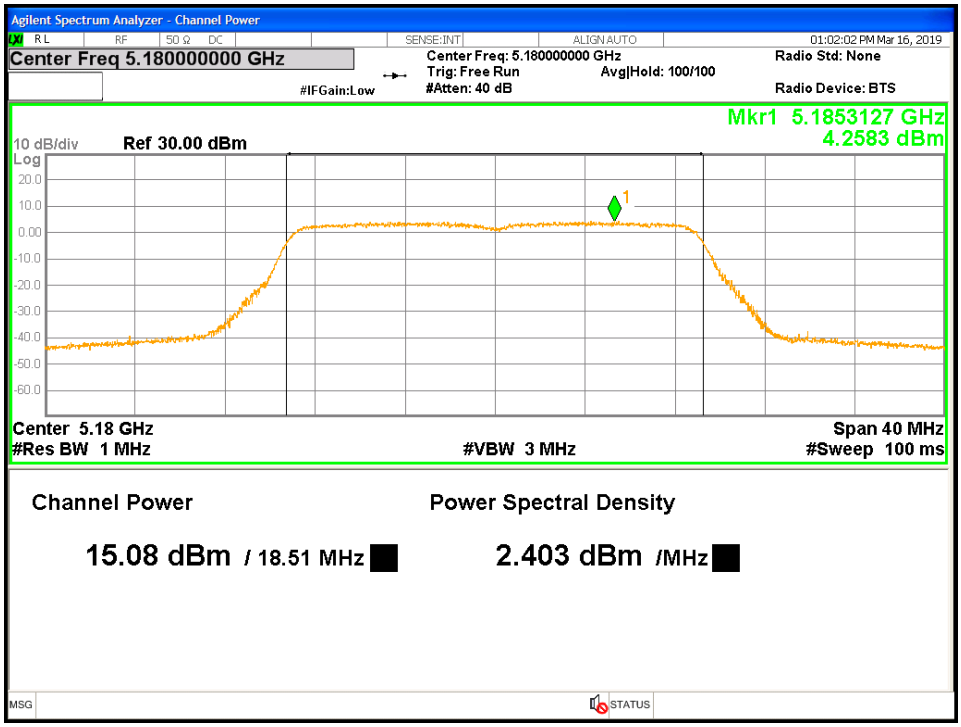


Figure 56: ISED RMS MAX. POWER-5180MHz-HT20-1x4-q63-Ch3

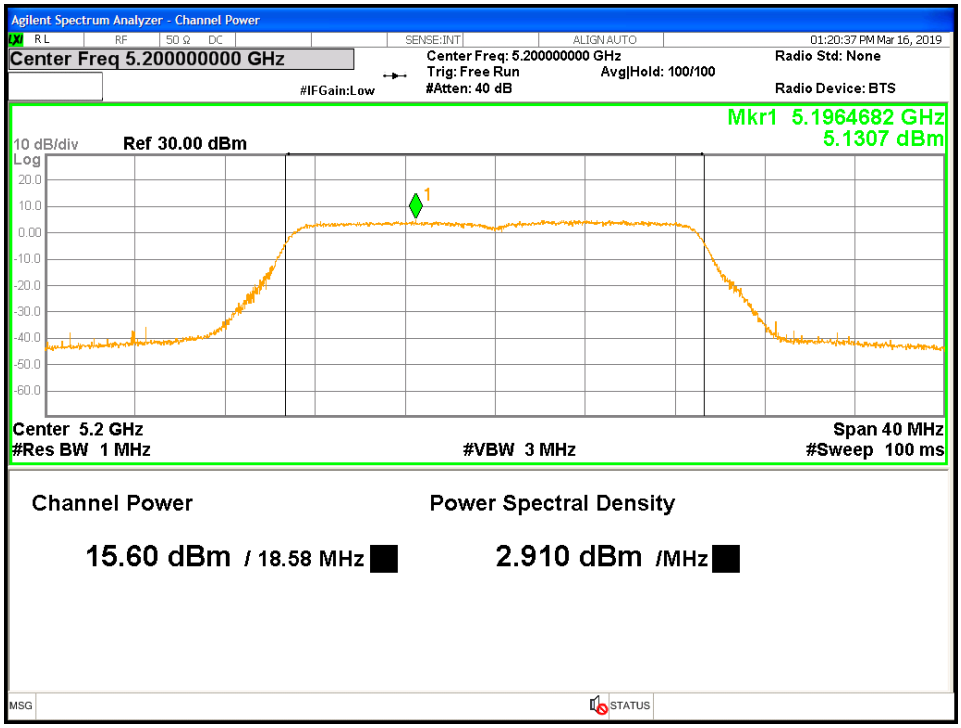


Figure 57: ISED RMS MAX. POWER-5200MHz-HT20-1x4-q62-Ch0

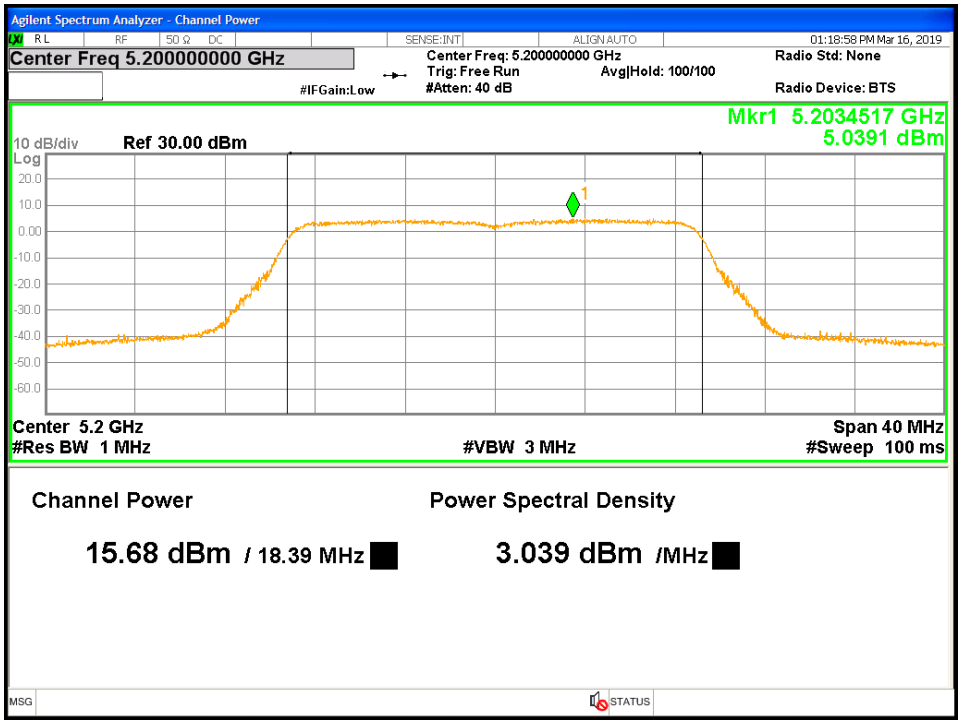


Figure 58: ISED RMS MAX. POWER-5200MHz-HT20-1x4-q62-Ch1

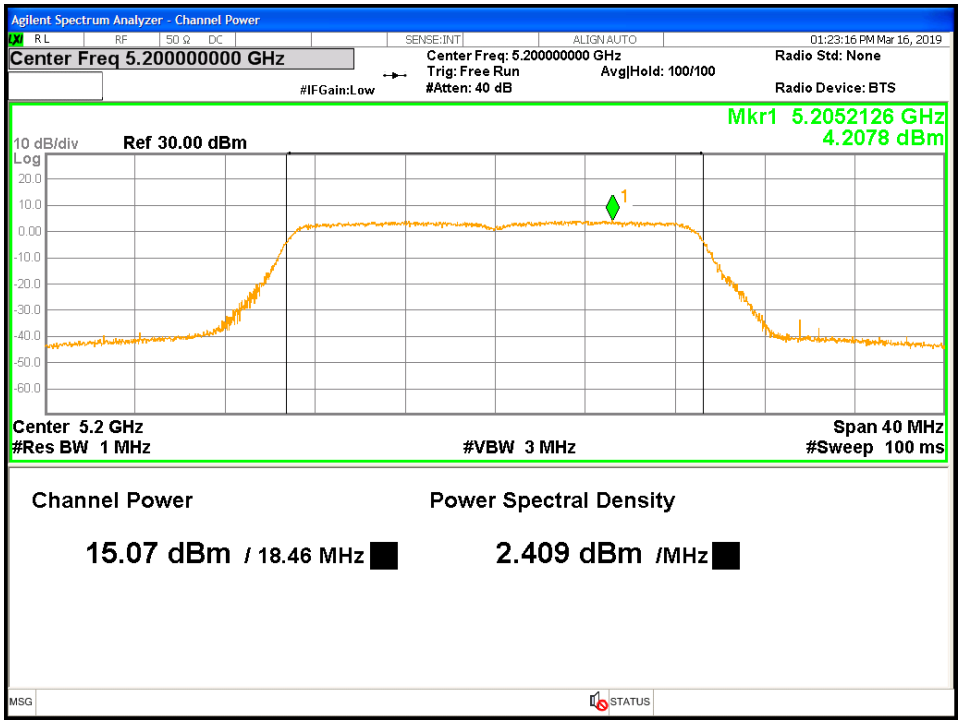


Figure 59: ISED RMS MAX. POWER-5200MHz-HT20-1x4-q62-Ch2

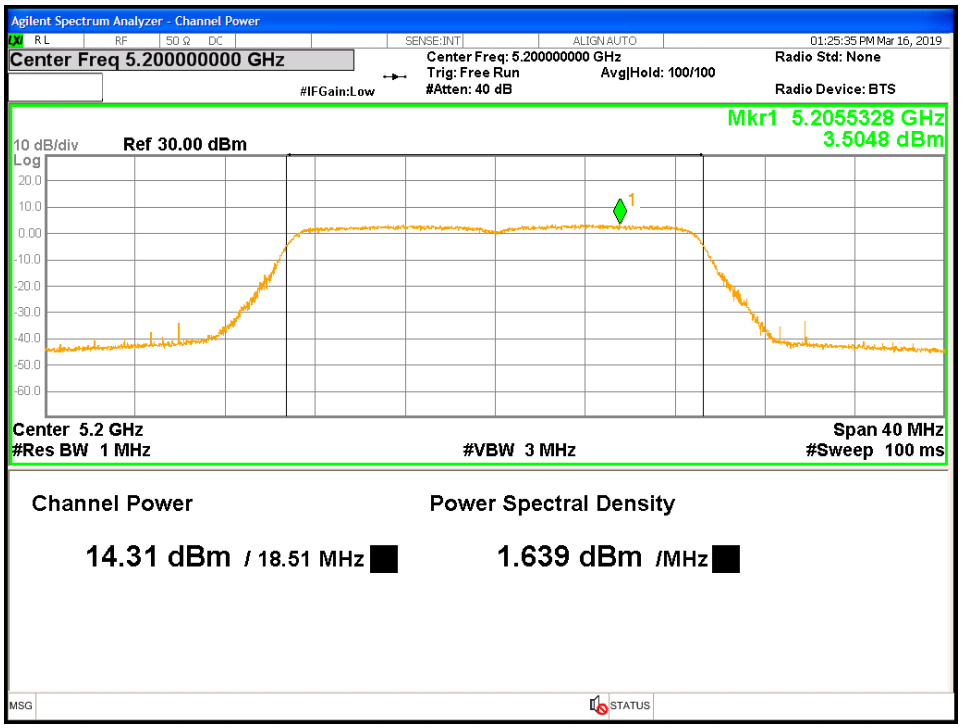


Figure 60: ISED RMS MAX. POWER-5200MHz-HT20-1x4-q62-Ch4

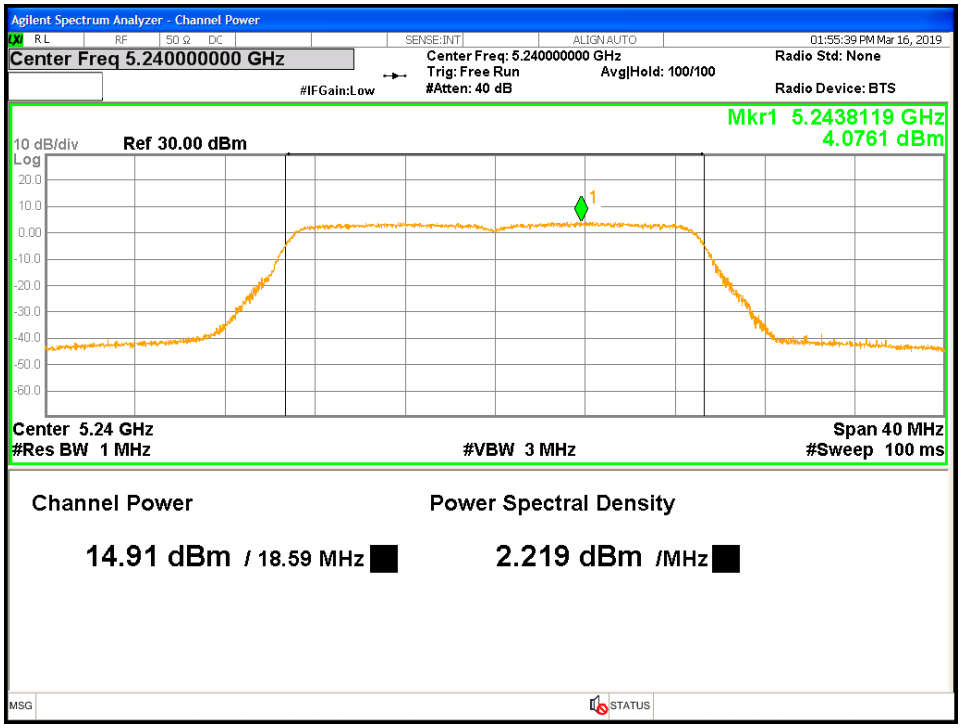


Figure 61: ISED RMS MAX. POWER-5240MHz-HT20-1x4-q62-Ch0

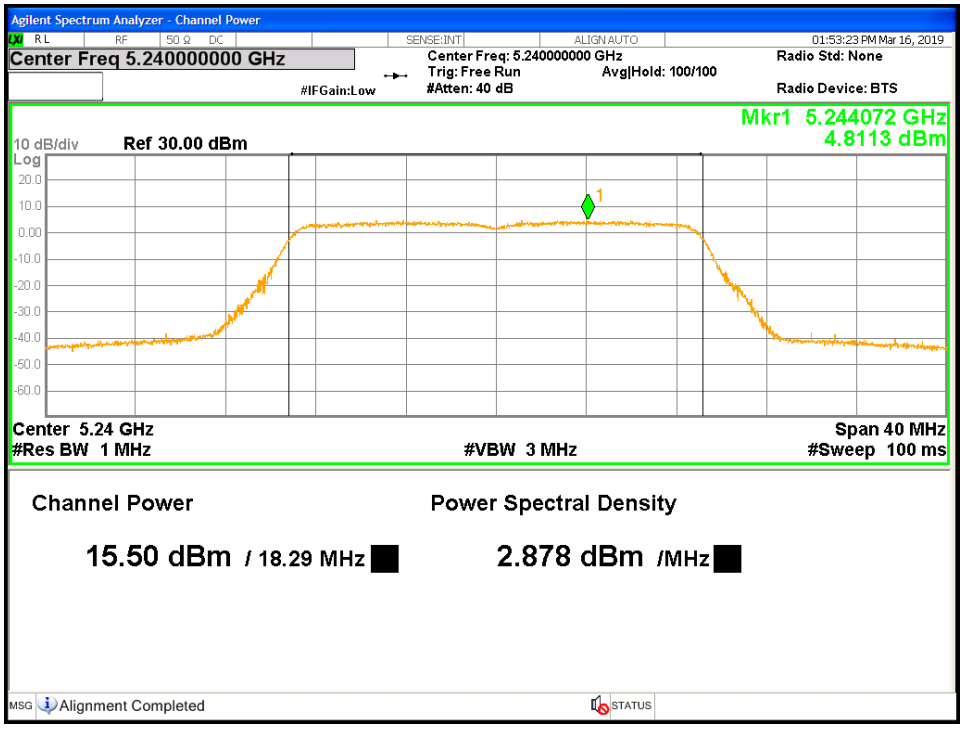


Figure 62: ISED RMS MAX. POWER-5240MHz-HT20-1x4-q62-Ch1

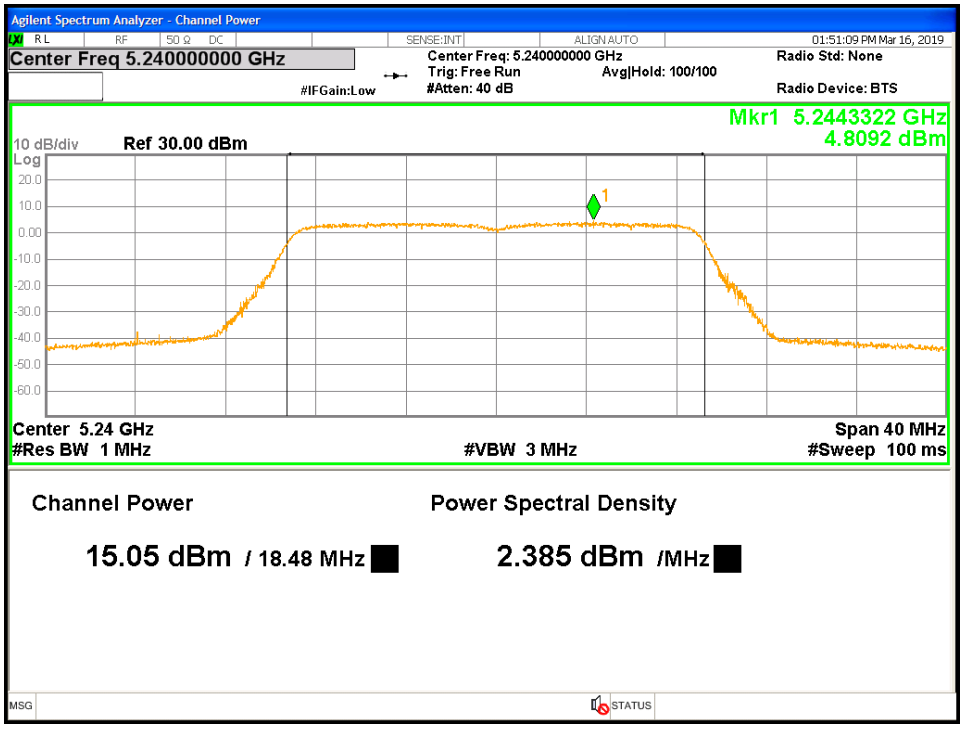


Figure 63: ISED RMS MAX. POWER-5240MHz-HT20-1x4-q62-Ch2

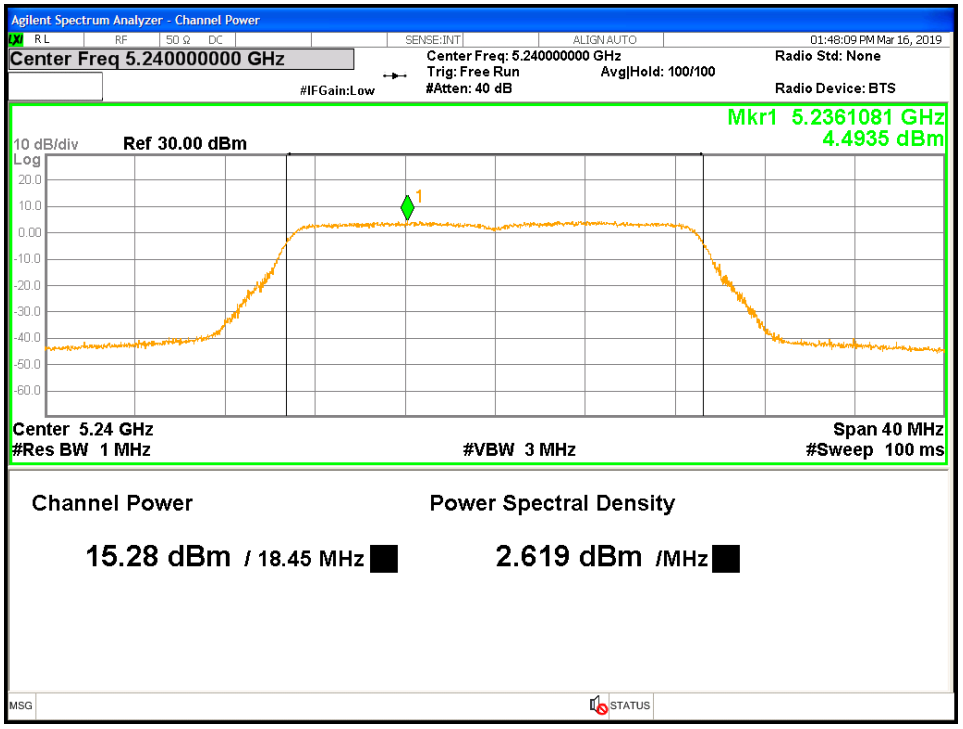


Figure 64: ISED RMS MAX. POWER-5240MHz-HT20-1x4-q62-Ch3

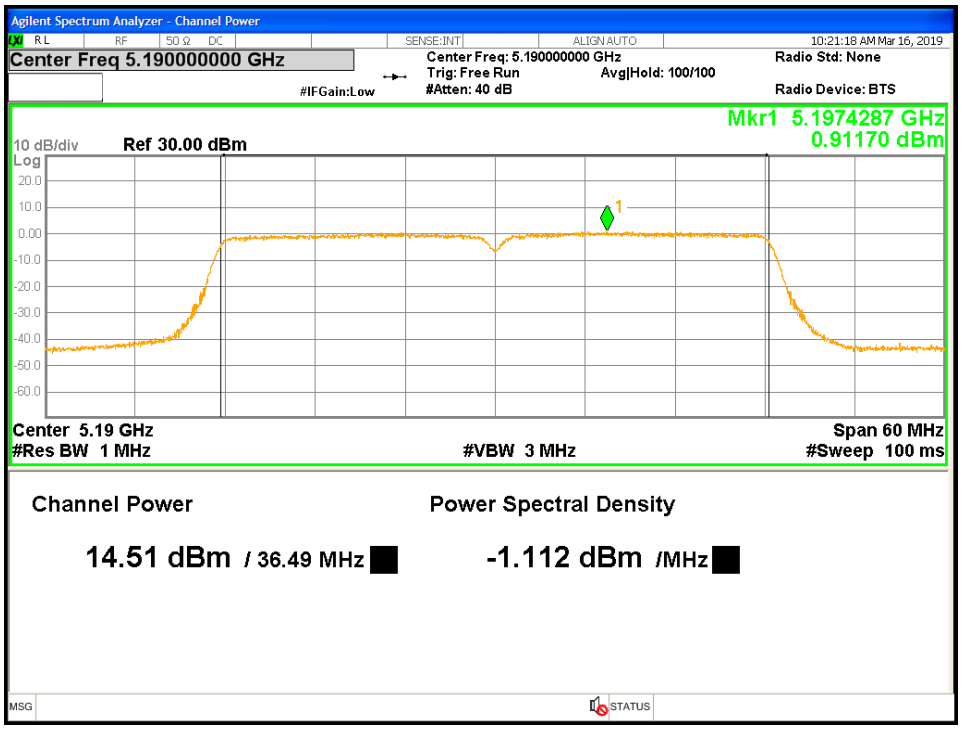


Figure 65: ISED RMS MAX. POWER-5190MHz-HT40-1x4-q61-Ch0

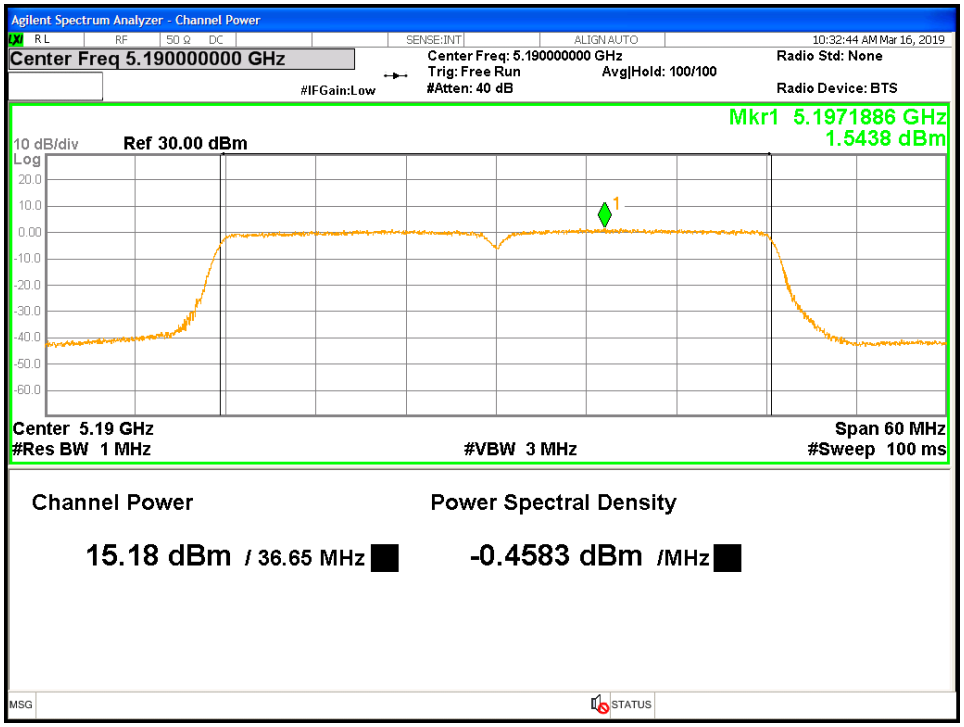


Figure 66: ISED RMS MAX. POWER-5190MHz-HT40-1x4-q61-Ch1

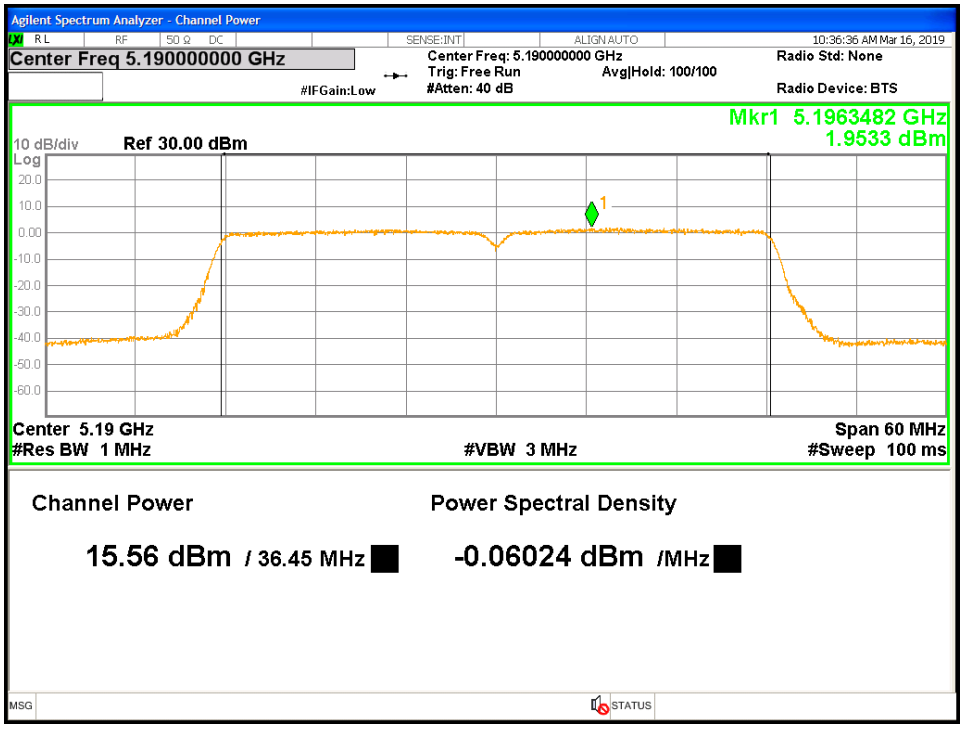


Figure 67: ISED RMS MAX. POWER-5190MHz-HT40-1x4-q61-Ch2

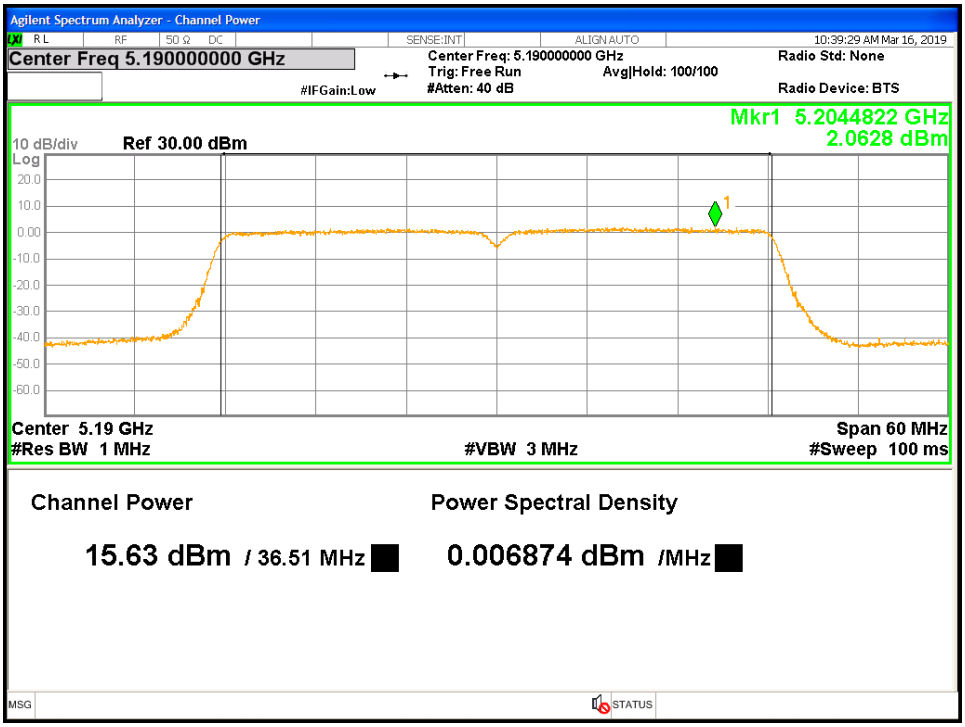


Figure 68: ISED RMS MAX. POWER-5190MHz-HT40-1x4-q61-Ch3

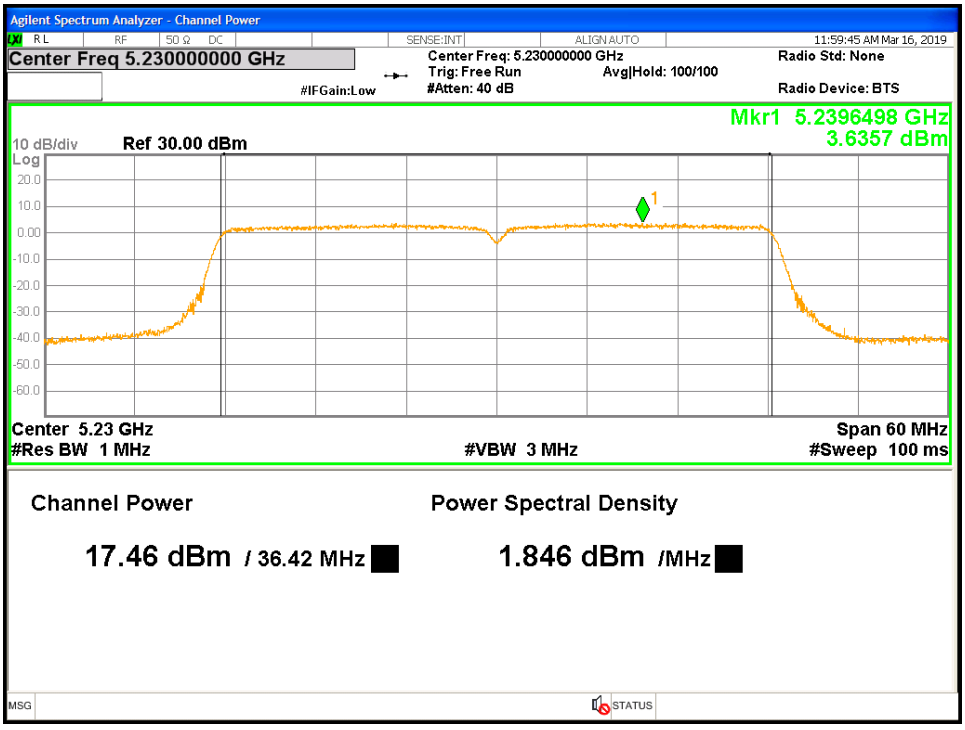


Figure 69: ISED RMS MAX. POWER-5230MHz-HT40-1x4-q69-Ch0

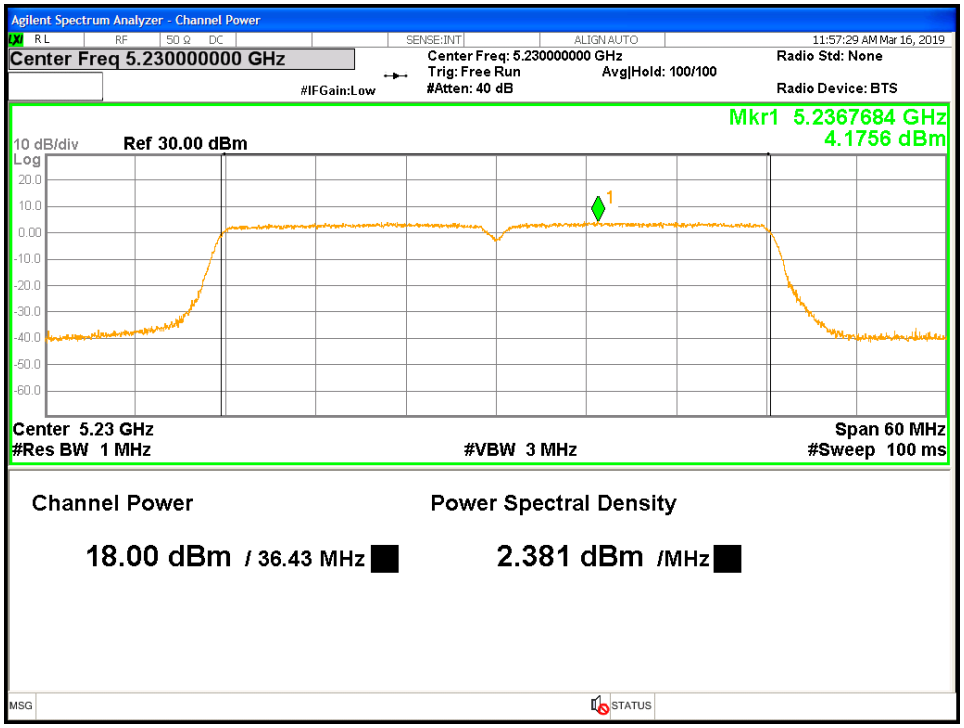


Figure 70: ISED RMS MAX. POWER-5230MHz-HT40-1x4-q69-Ch1

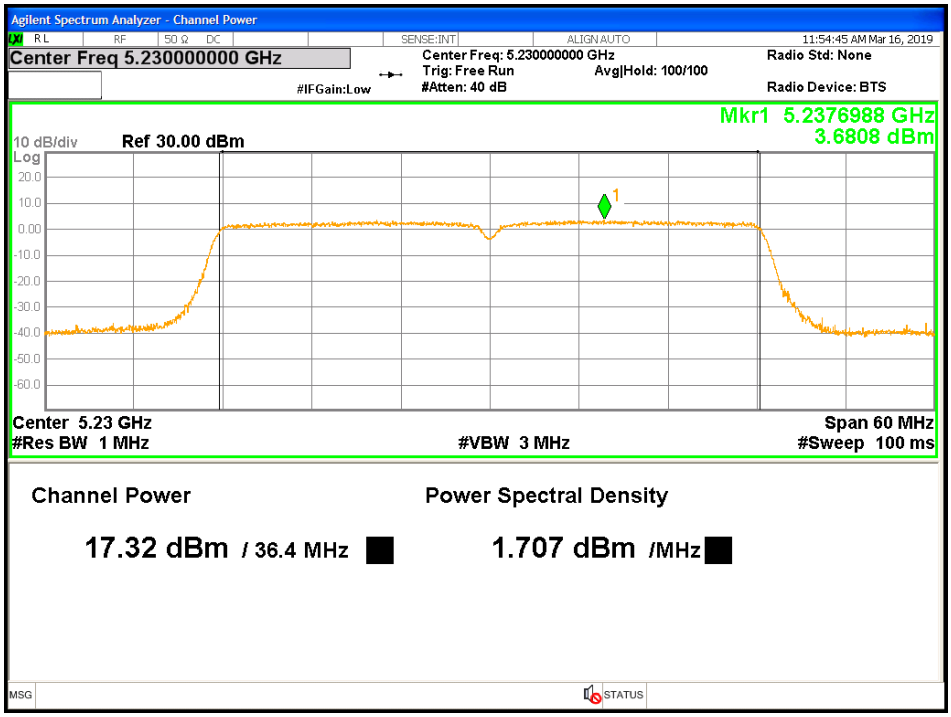


Figure 71: ISED RMS MAX. POWER-5230MHz-HT40-1x4-q69-Ch2

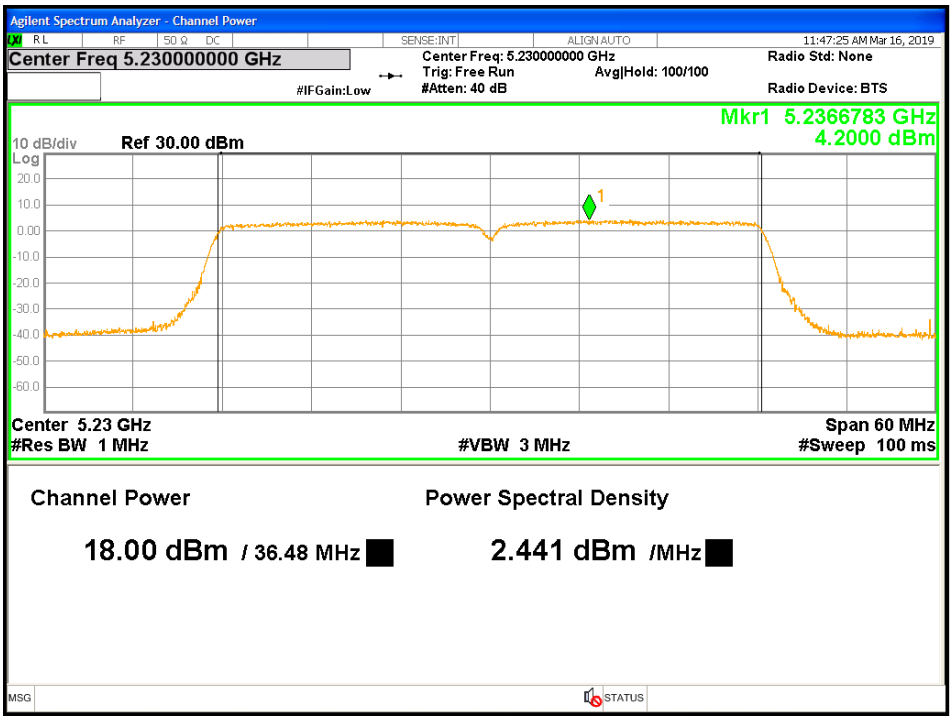


Figure 72: ISED RMS MAX. POWER-5230MHz-HT40-1x4-q69-Ch3

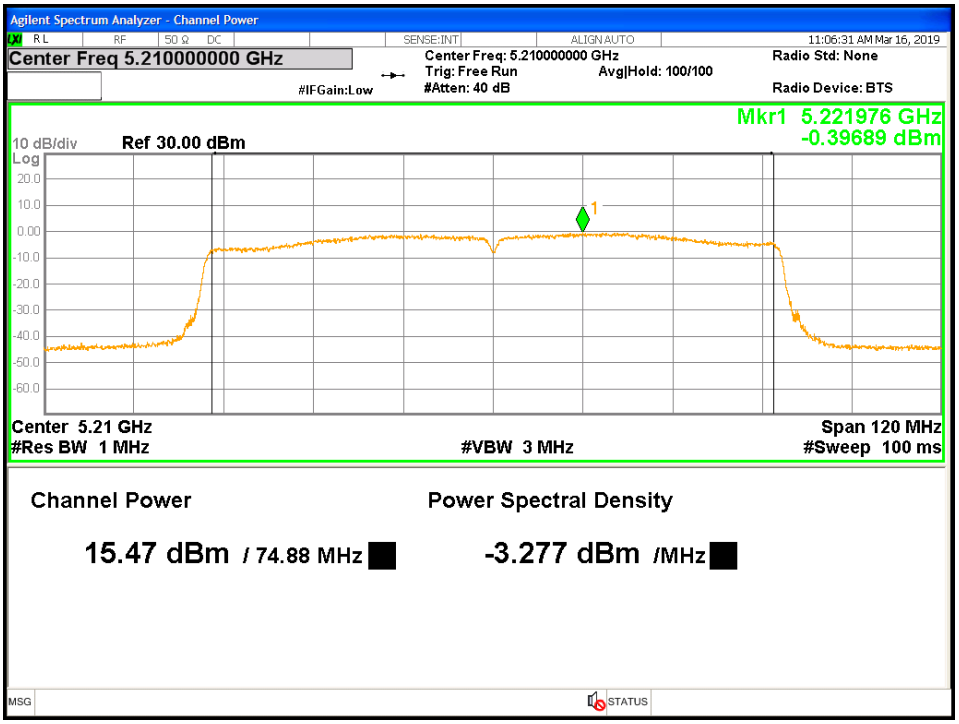


Figure 73: ISED RMS MAX. POWER-5210MHz-VHT80-1x4-q60-Ch0

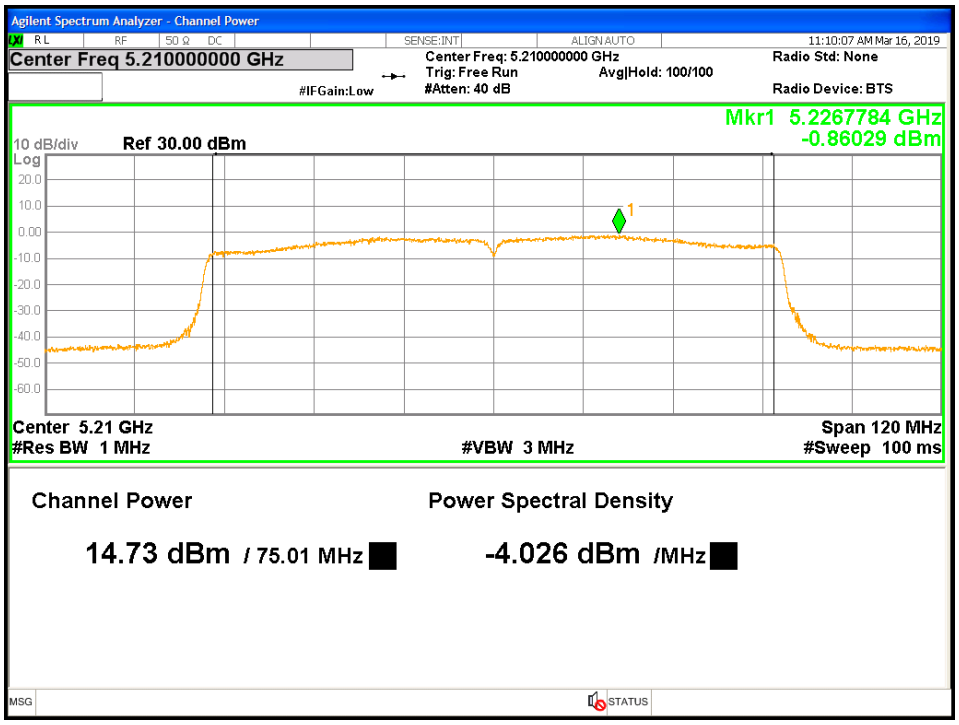


Figure 74: ISED RMS MAX. POWER-5210MHz-VHT80-1x4-q60-Ch1

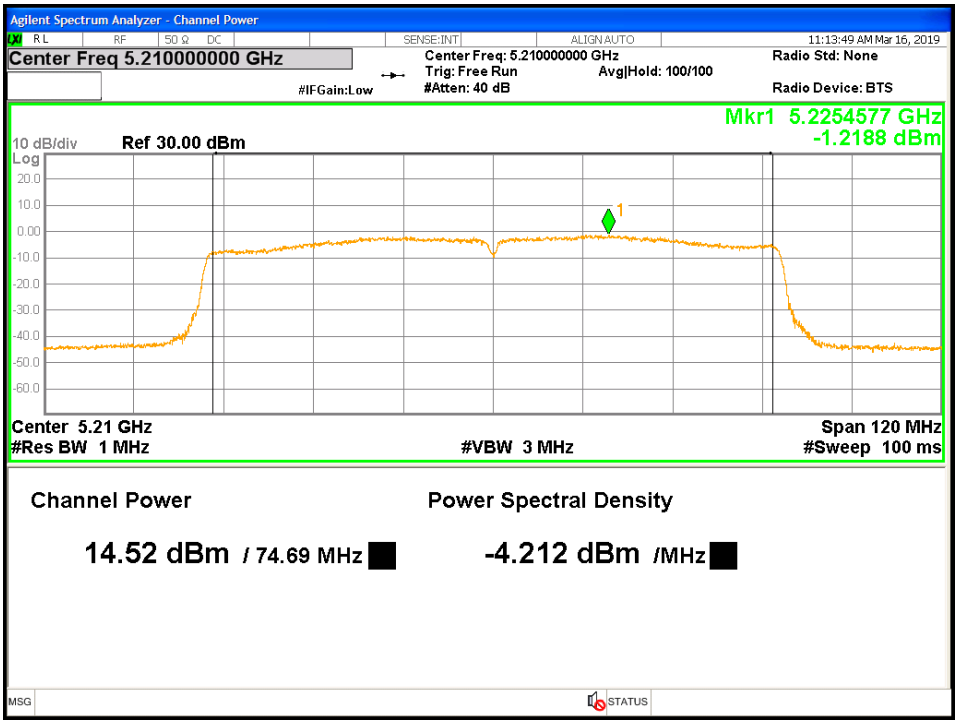


Figure 75: ISED RMS MAX. POWER-5210MHz-VHT80-1x4-q60-Ch2

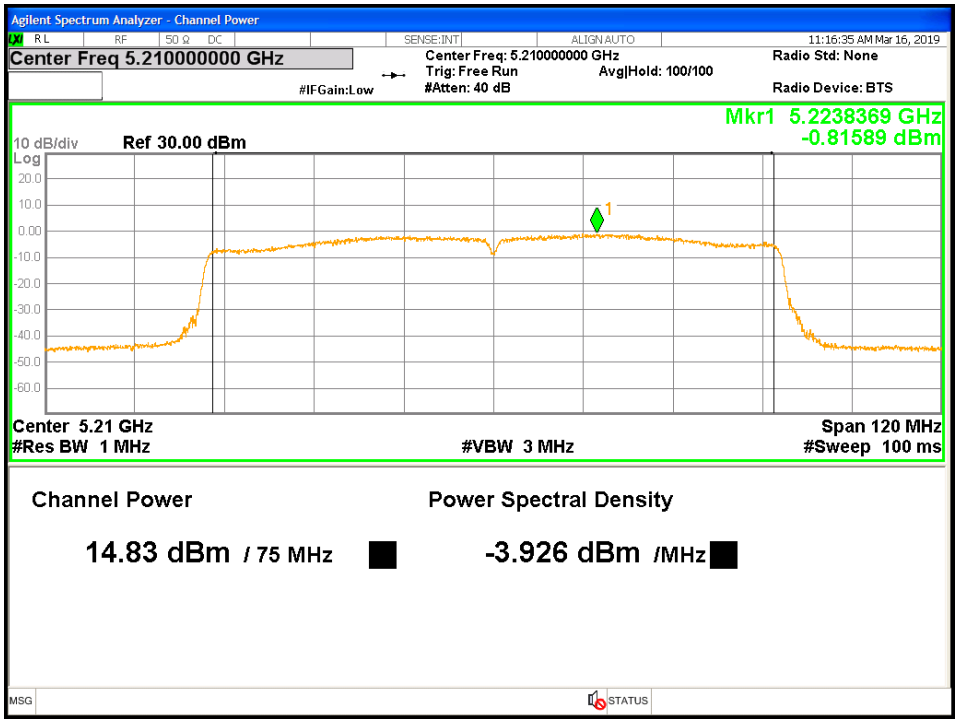


Figure 76: ISED RMS MAX. POWER-5210MHz-VHT80-1x4-q60-Ch3

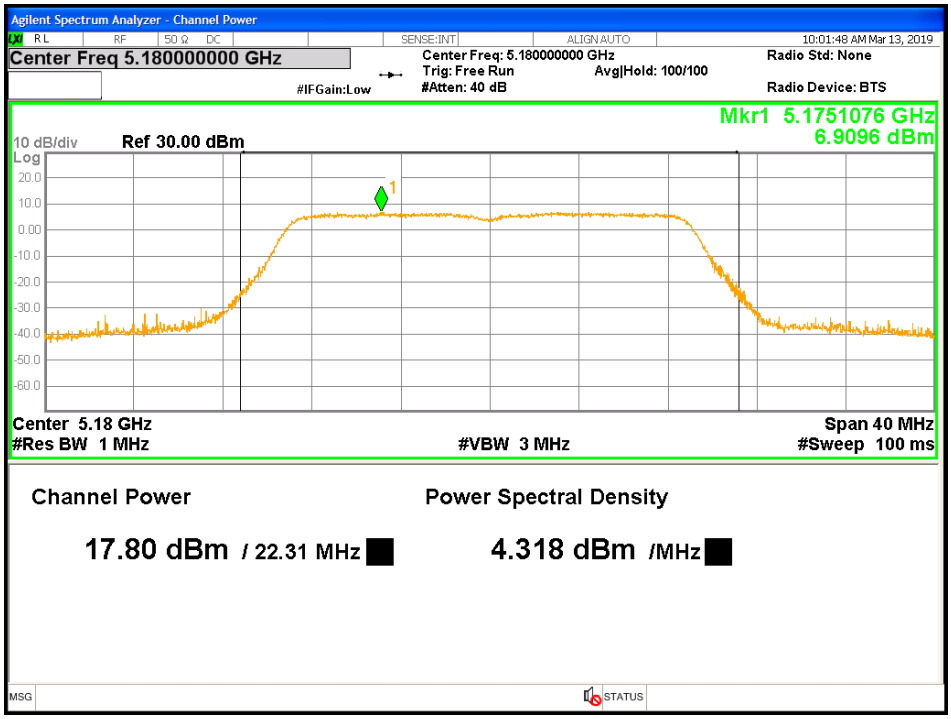


Figure 77: FCC RMS MAX. POWER-5180MHz-HT20-4x4-q74-Ch0

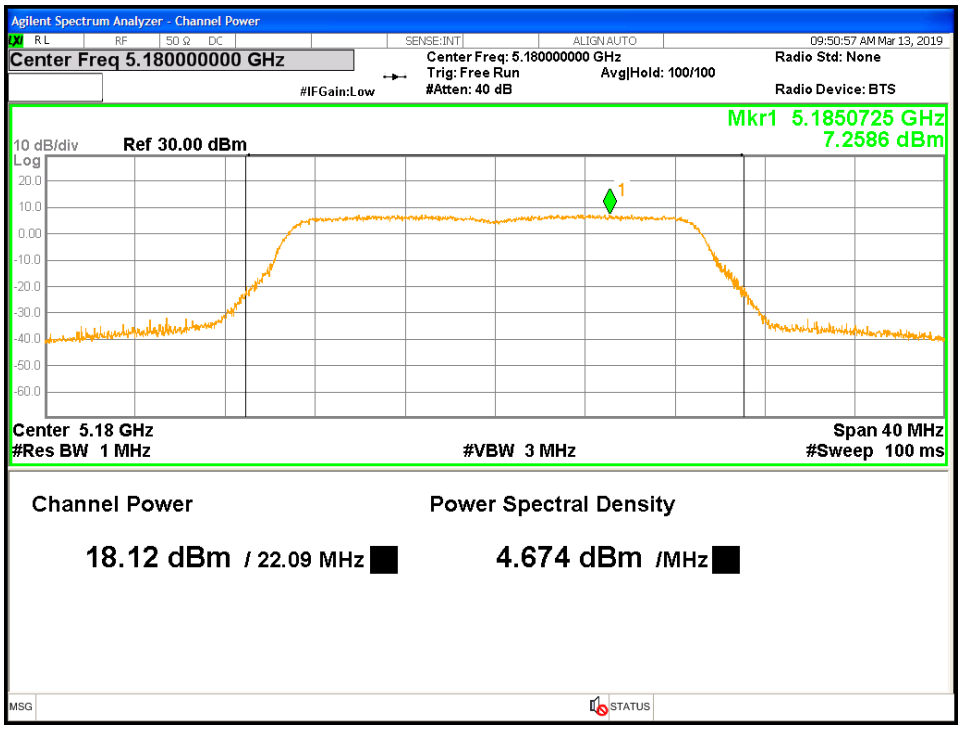


Figure 78: FCC RMS MAX. POWER-5180MHz-HT20-4x4-q74-Ch1

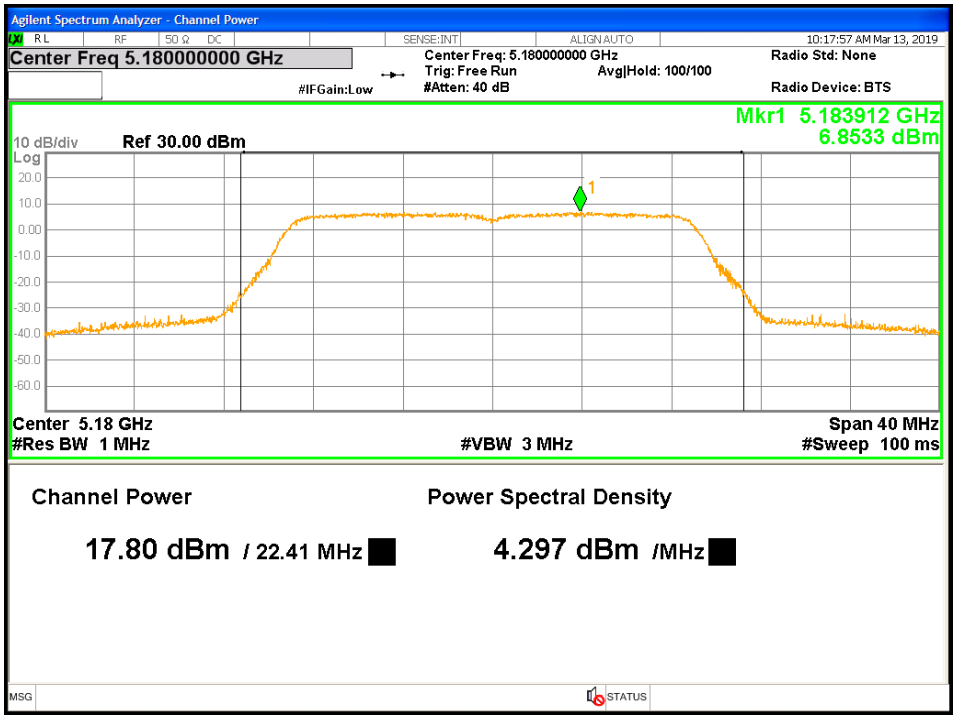


Figure 79: FCC RMS MAX. POWER-5180MHz-HT20-4x4-q74-Ch2

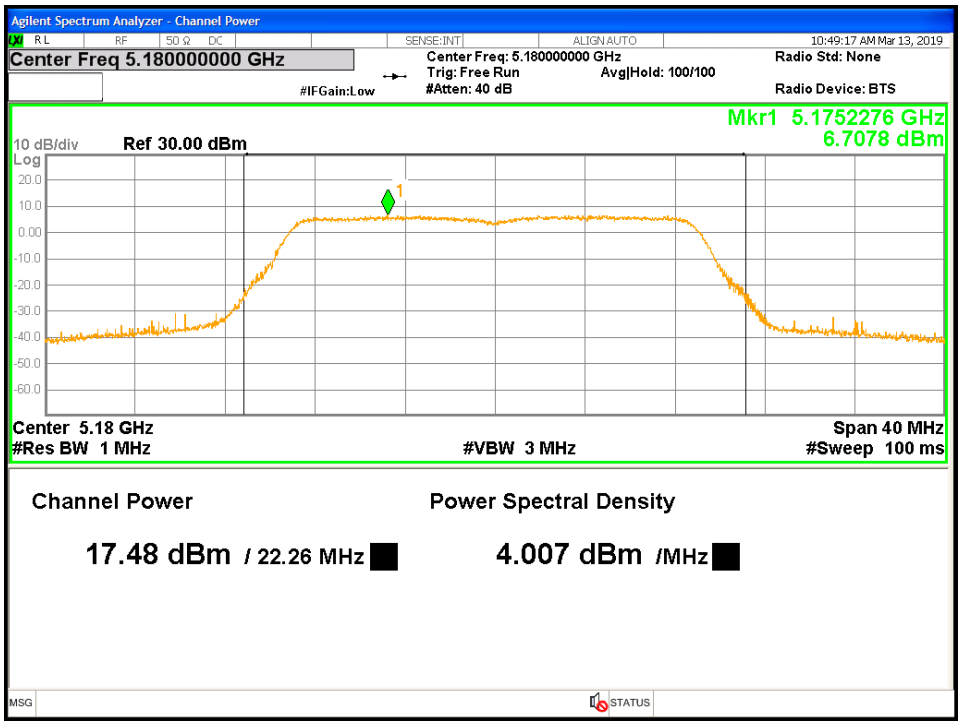


Figure 80: FCC RMS MAX. POWER-5180MHz-HT20-4x4-q74-Ch3

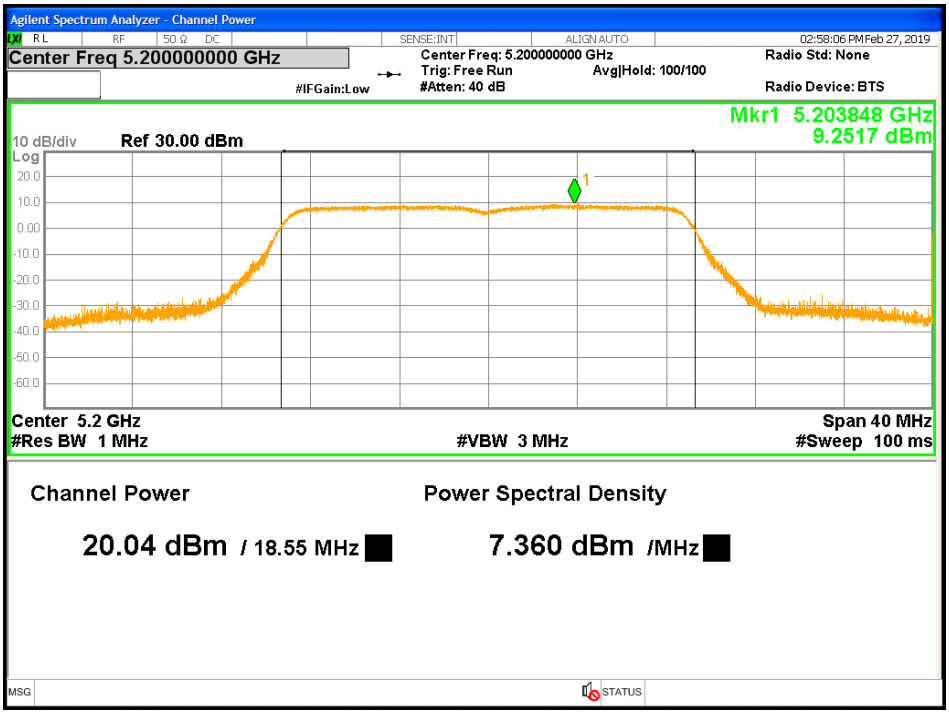


Figure 81: FCC RMS MAX. POWER-5200MHz-HT20-4x4-q80-Ch0

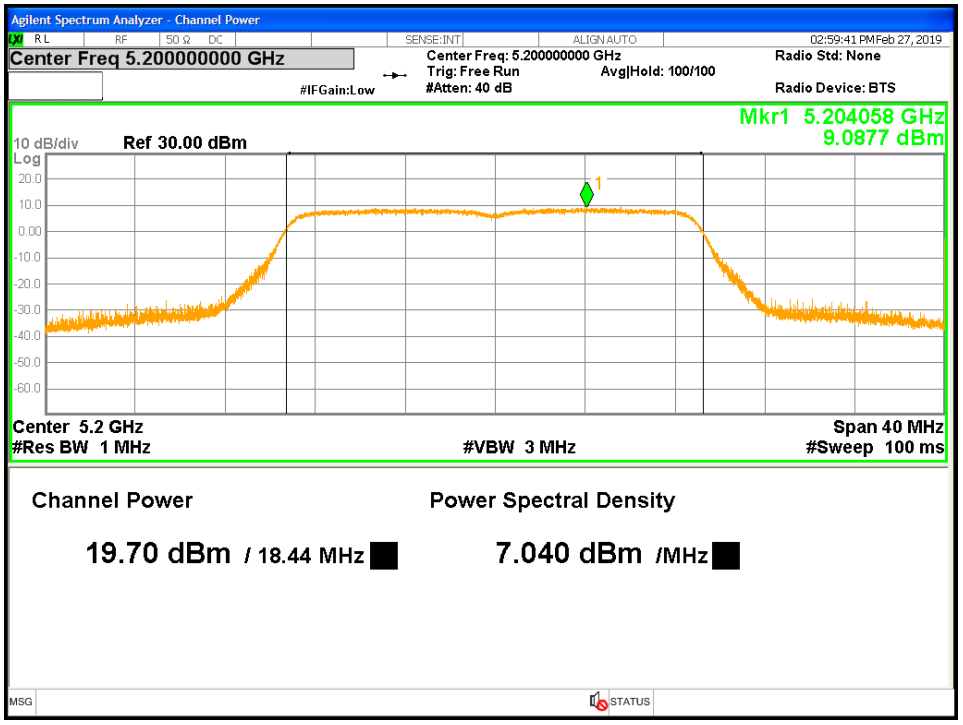


Figure 82: FCC RMS MAX. POWER-5200MHz-HT20-4x4-q80-Ch1

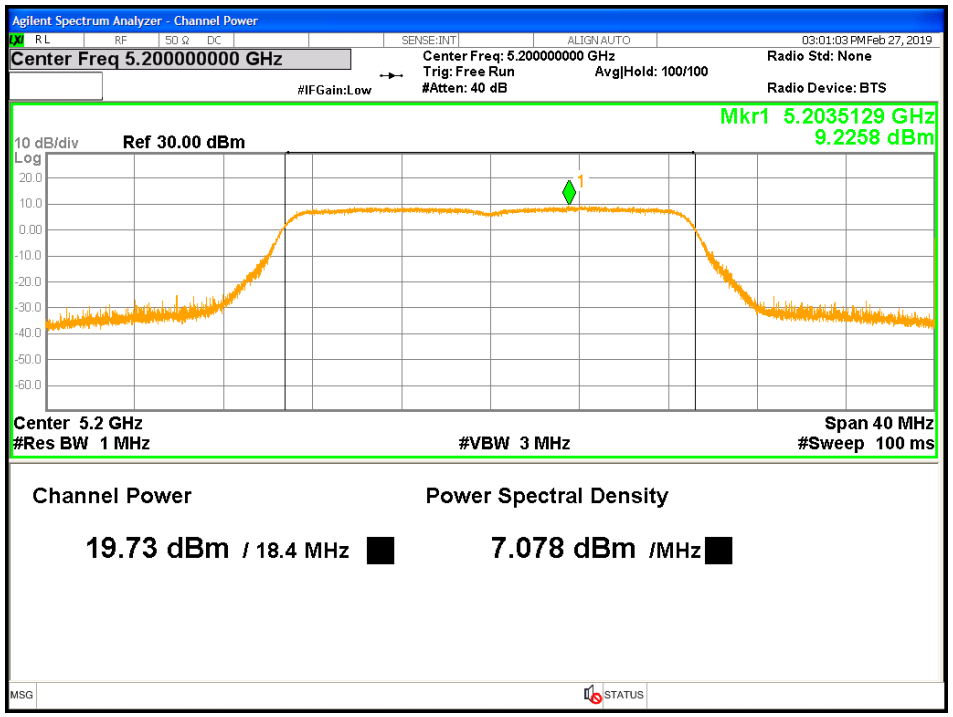


Figure 83: FCC RMS MAX. POWER-5200MHz-HT20-4x4-q80-Ch2

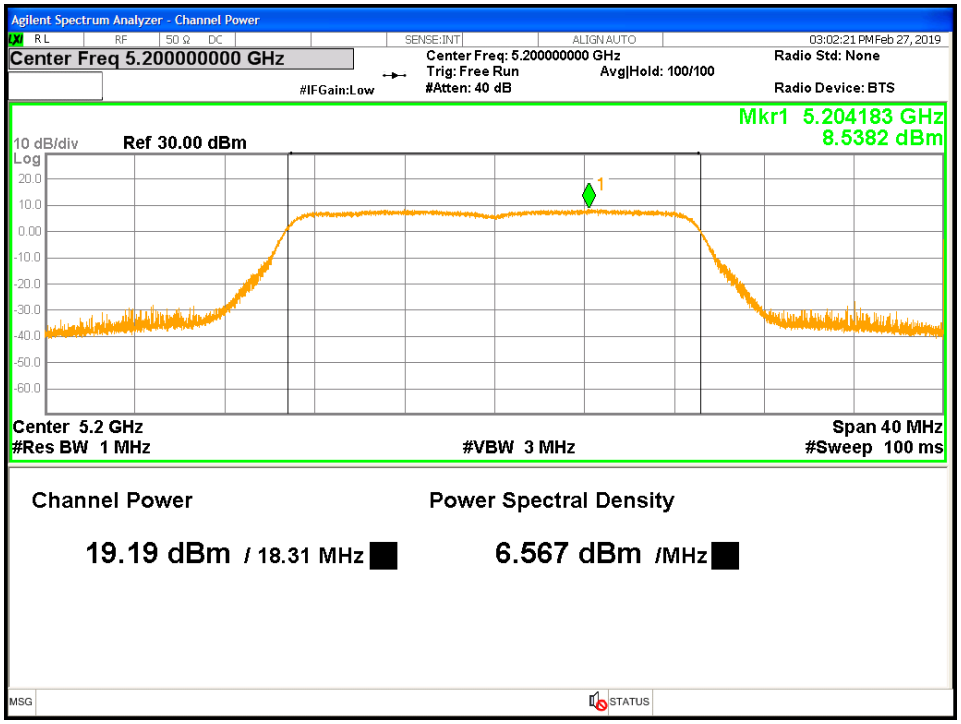


Figure 84: FCC RMS MAX. POWER-5200MHz-HT20-4x4-q80-Ch3

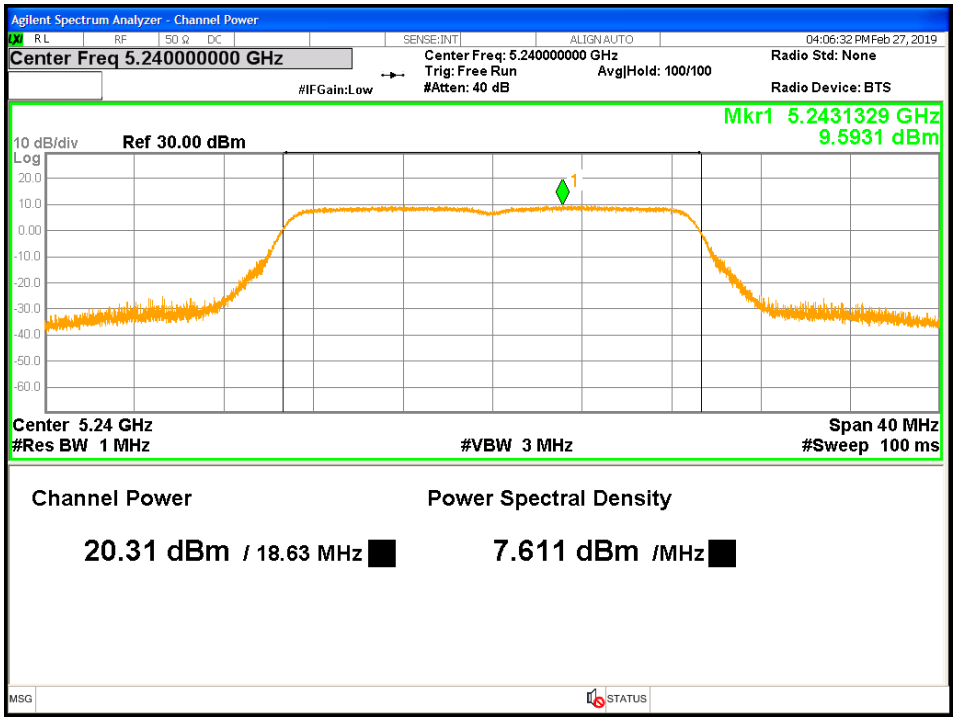


Figure 85: FCC RMS MAX. POWER-5240MHz-HT20-4x4-q80-Ch0

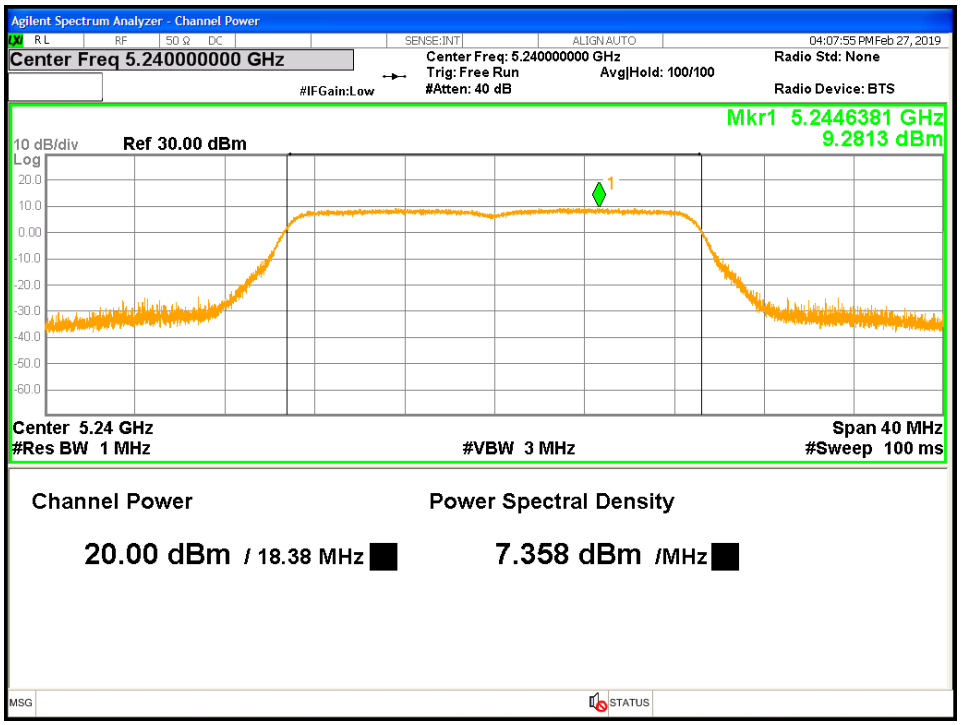


Figure 86: FCC RMS MAX. POWER-5240MHz-HT20-4x4-q80-Ch1

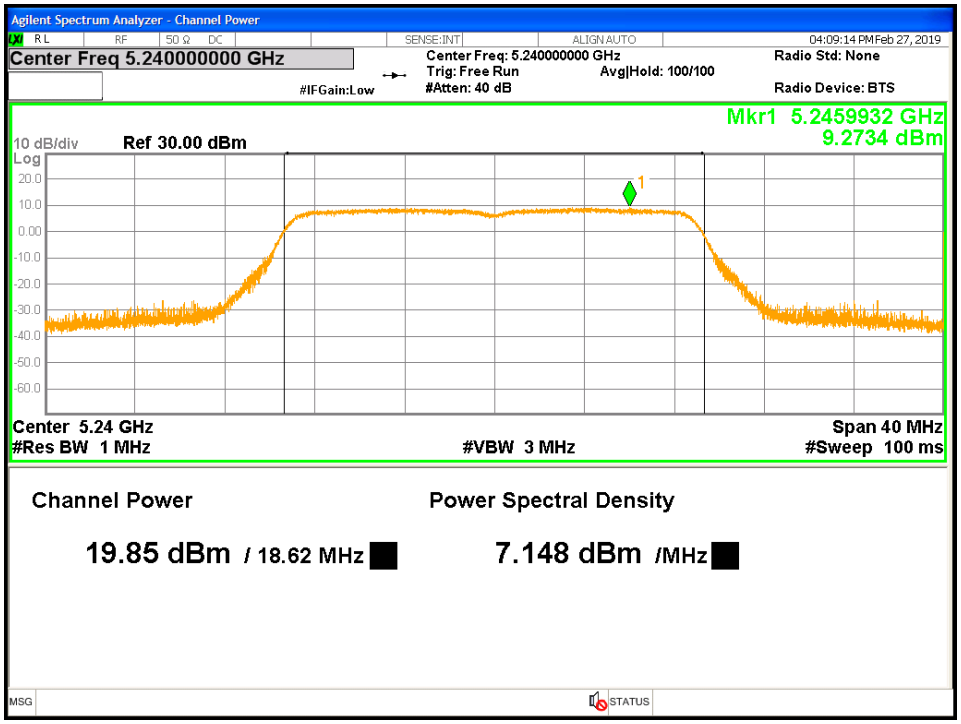


Figure 87: FCC RMS MAX. POWER-5240MHz-HT20-4x4-q80-Ch2

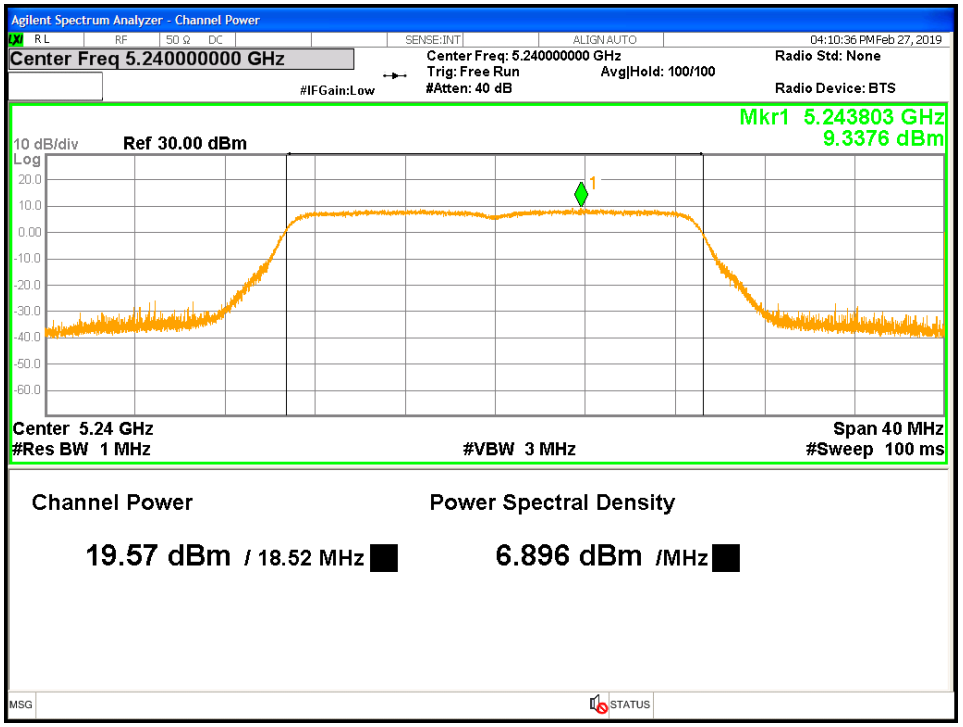


Figure 88: FCC RMS MAX. POWER-5240MHz-HT20-4x4-q80-Ch3

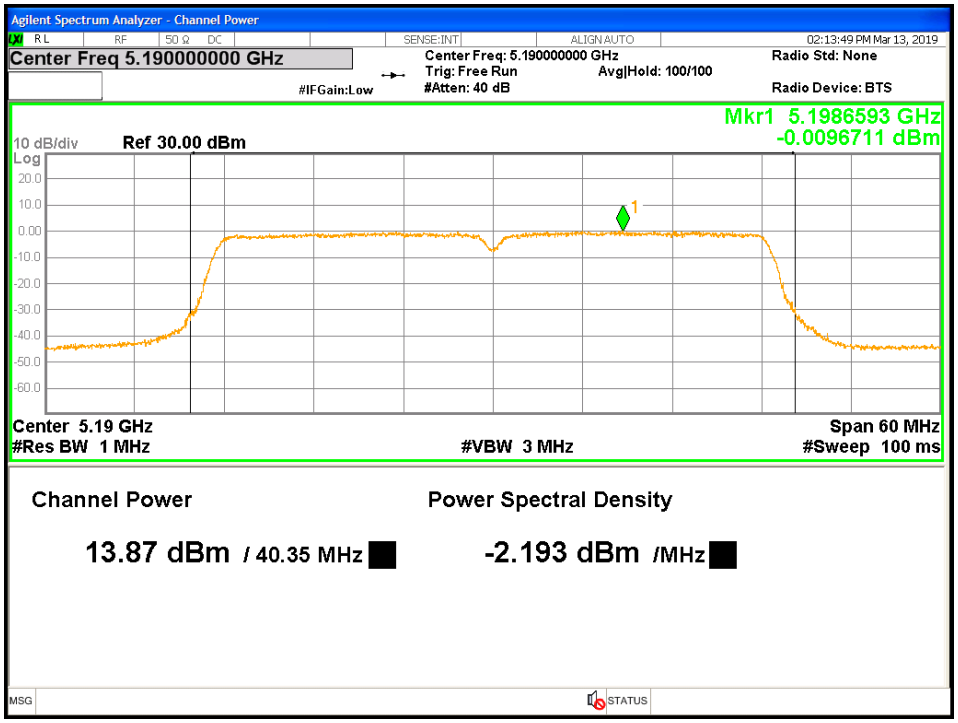


Figure 89: FCC RMS MAX. POWER-5190MHz-HT40-4x4-q58-Ch0

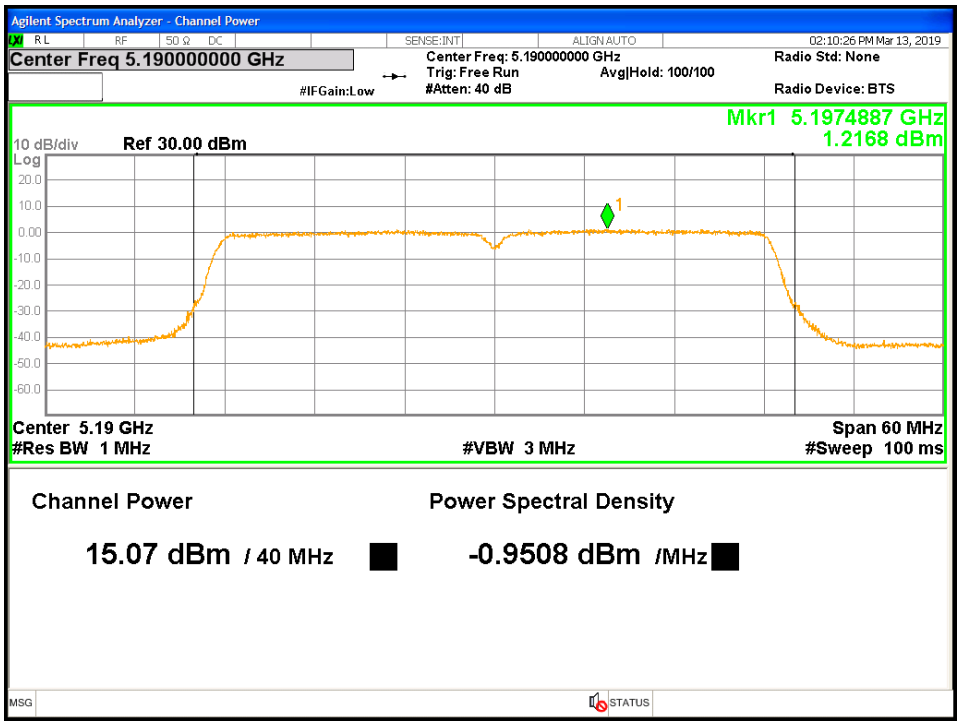


Figure 90: FCC RMS MAX. POWER-5190MHz-HT40-4x4-q58-Ch1

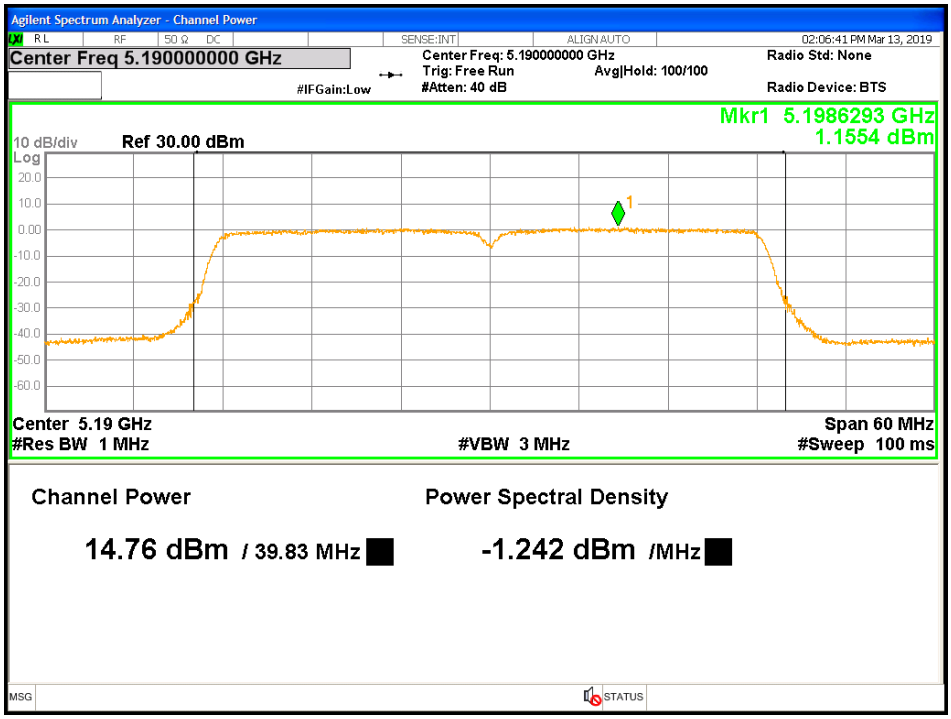


Figure 91: FCC RMS MAX. POWER-5190MHz-HT40-4x4-q58-Ch2

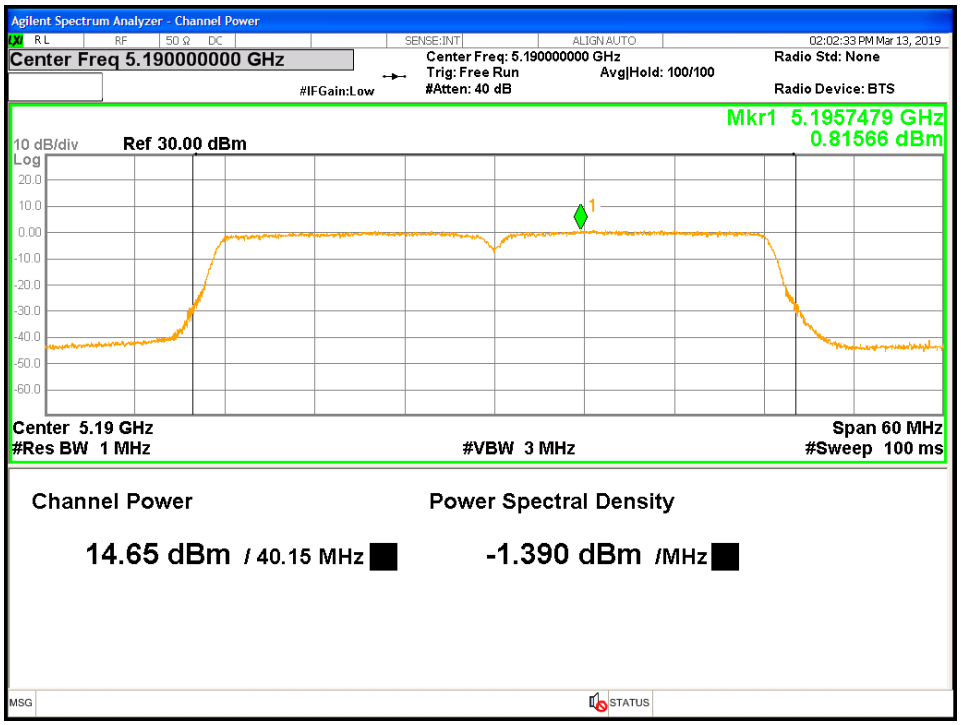


Figure 92: FCC RMS MAX. POWER-5190MHz-HT40-4x4-q58-Ch3

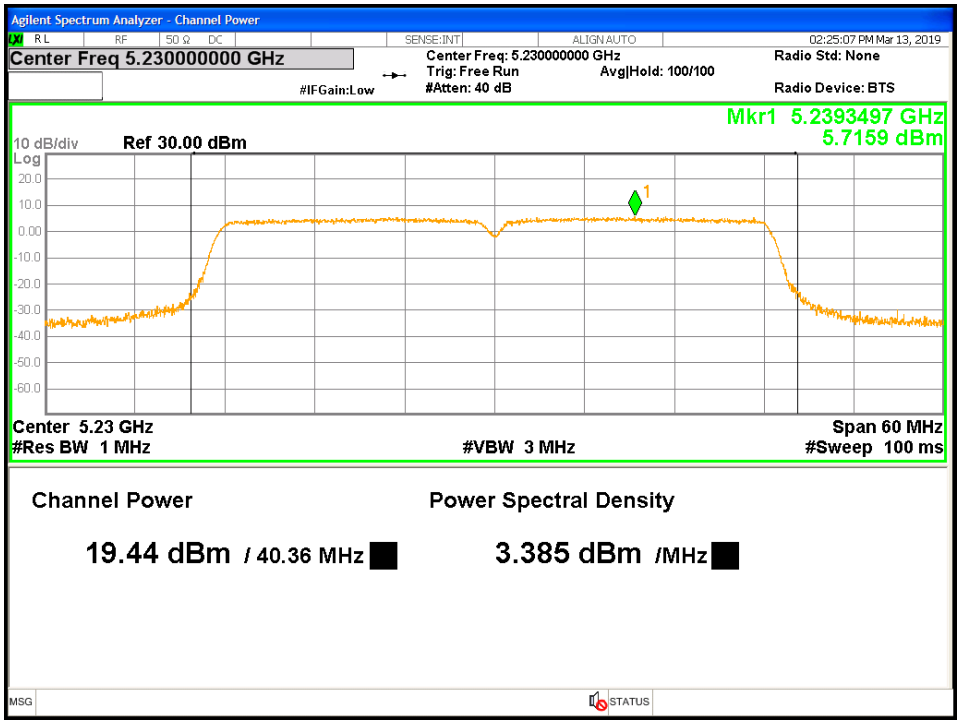


Figure 93: FCC RMS MAX. POWER-5230MHz-HT40-4x4-q80-Ch0

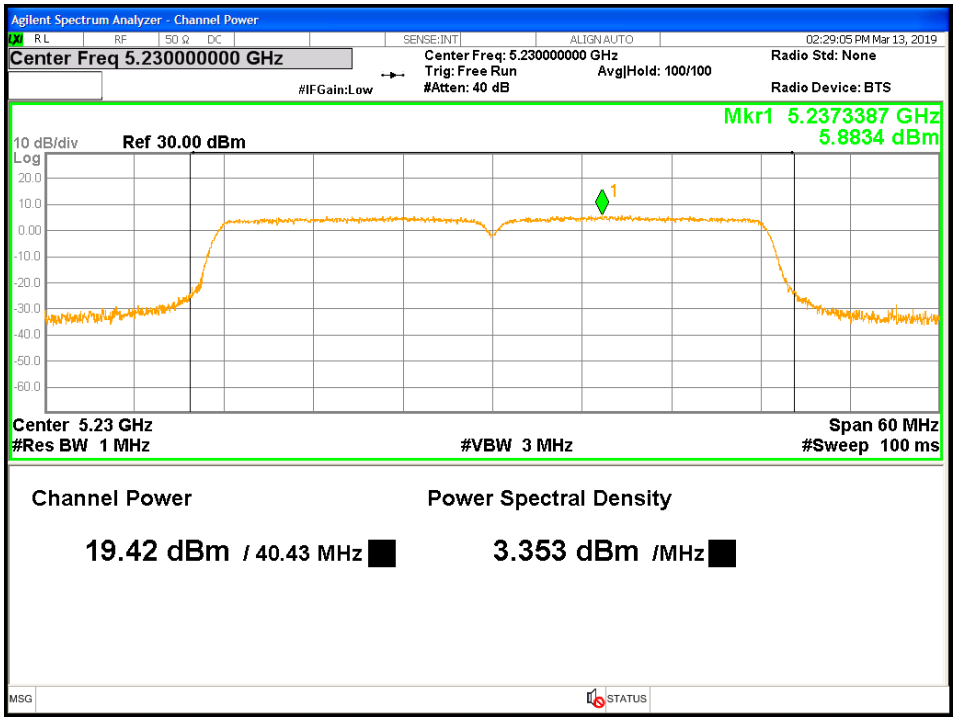


Figure 94: FCC RMS MAX. POWER-5230MHz-HT40-4x4-q80-Ch1

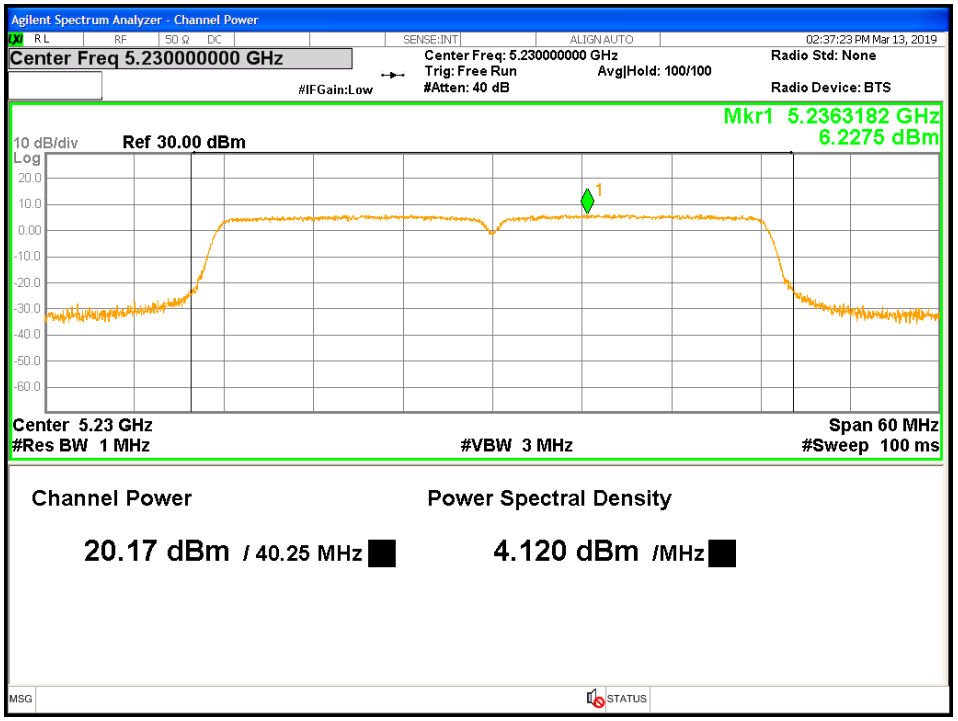


Figure 95: FCC RMS MAX. POWER-5230MHz-HT40-4x4-q80-Ch2

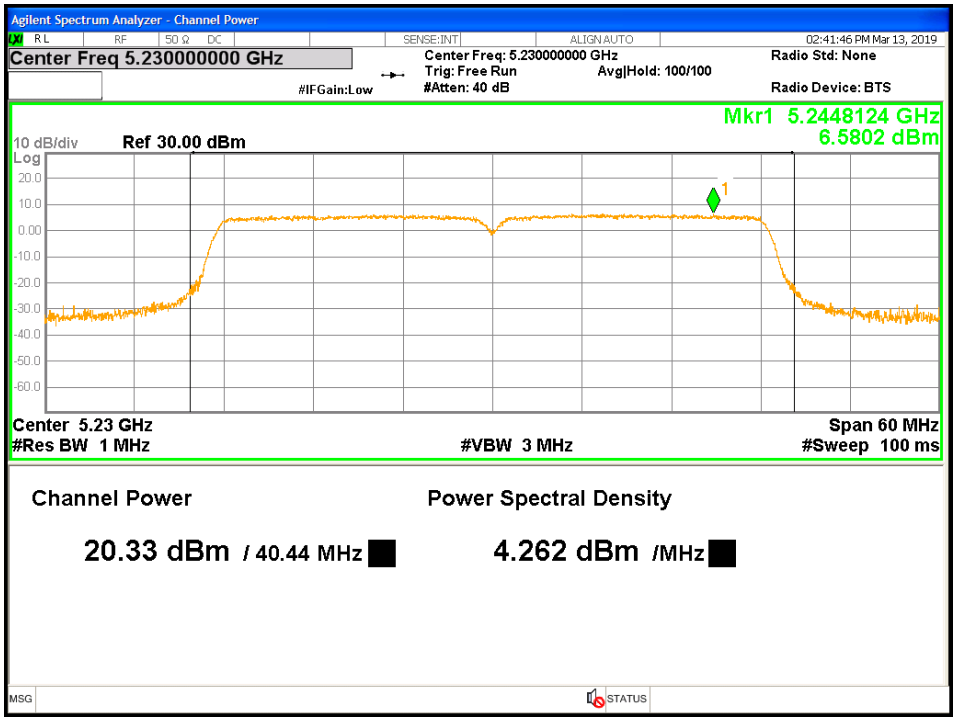


Figure 96: FCC RMS MAX. POWER-5230MHz-HT40-4x4-q80-Ch3

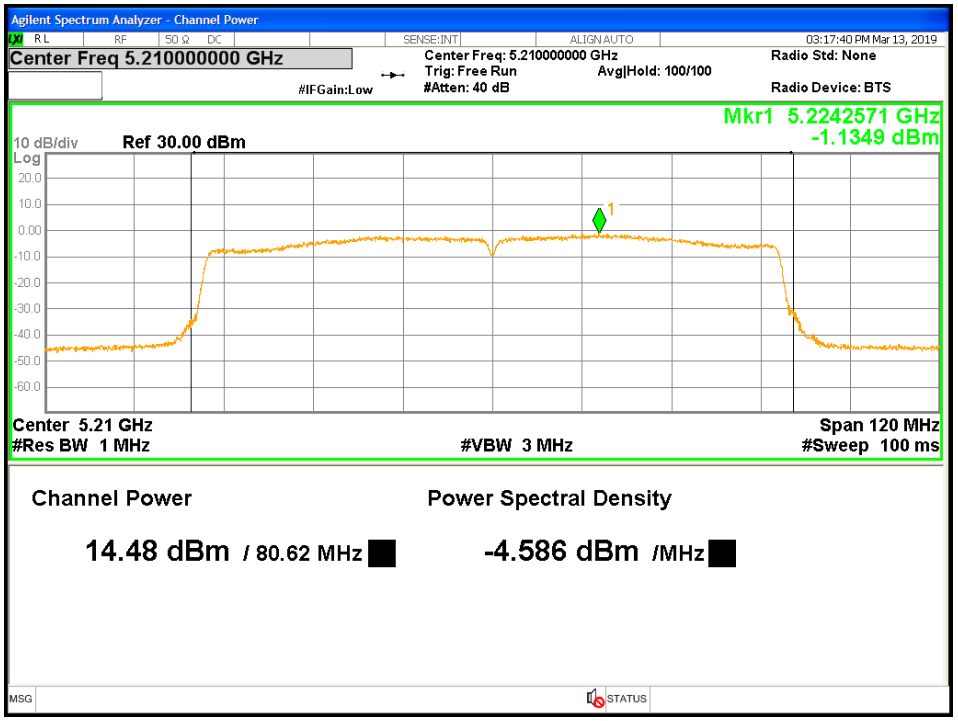


Figure 97: FCC RMS MAX. POWER-5210MHz-VHT80-4x4-q58-Ch0

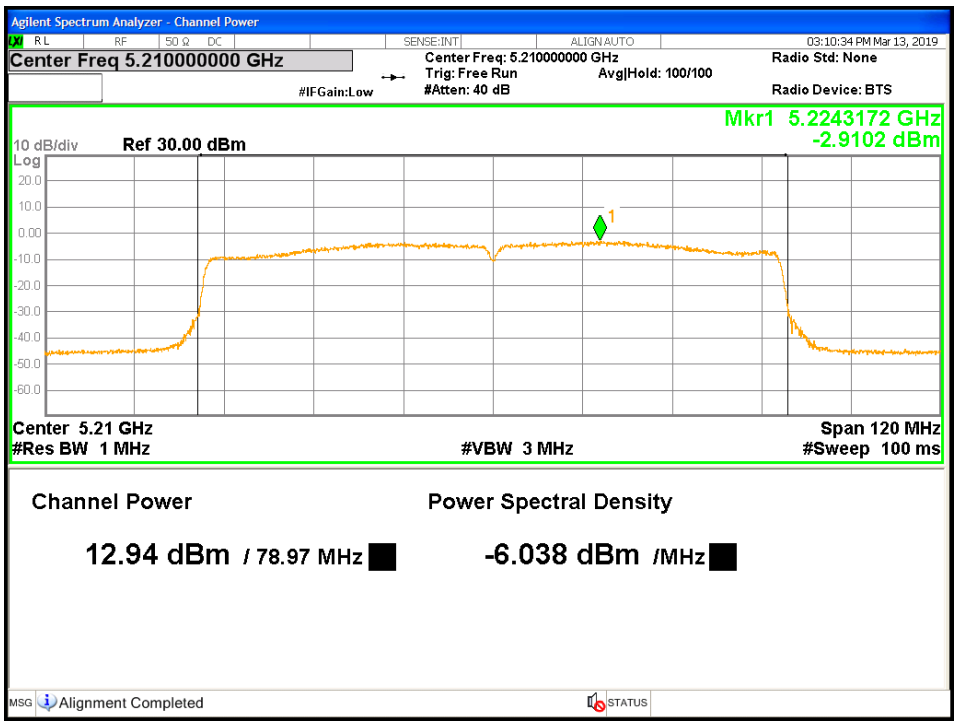


Figure 98: FCC RMS MAX. POWER-5210MHz-VHT80-4x4-q58-Ch1

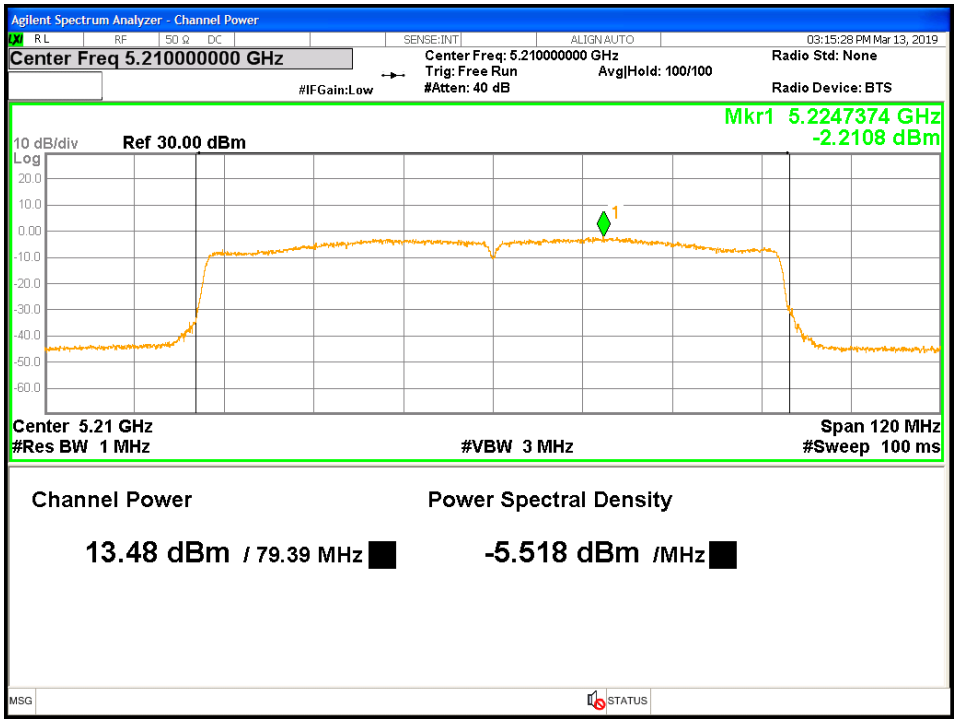


Figure 99: FCC RMS MAX. POWER-5210MHz-VHT80-4x4-q58-Ch2

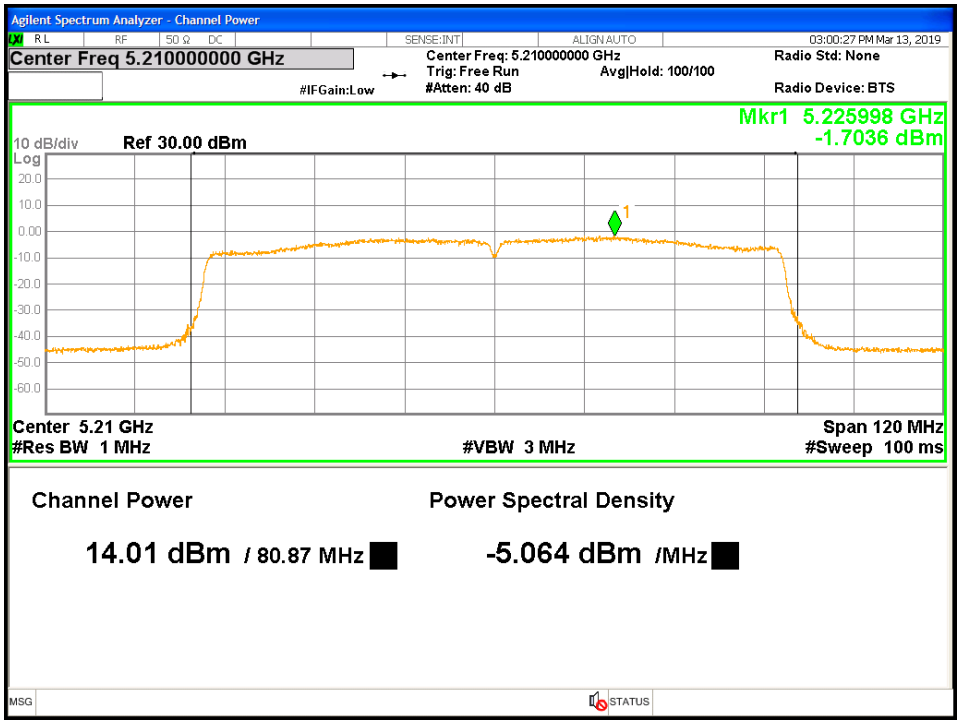


Figure 100: FCC RMS MAX. POWER-5210MHz-VHT80-4x4-q58-Ch3

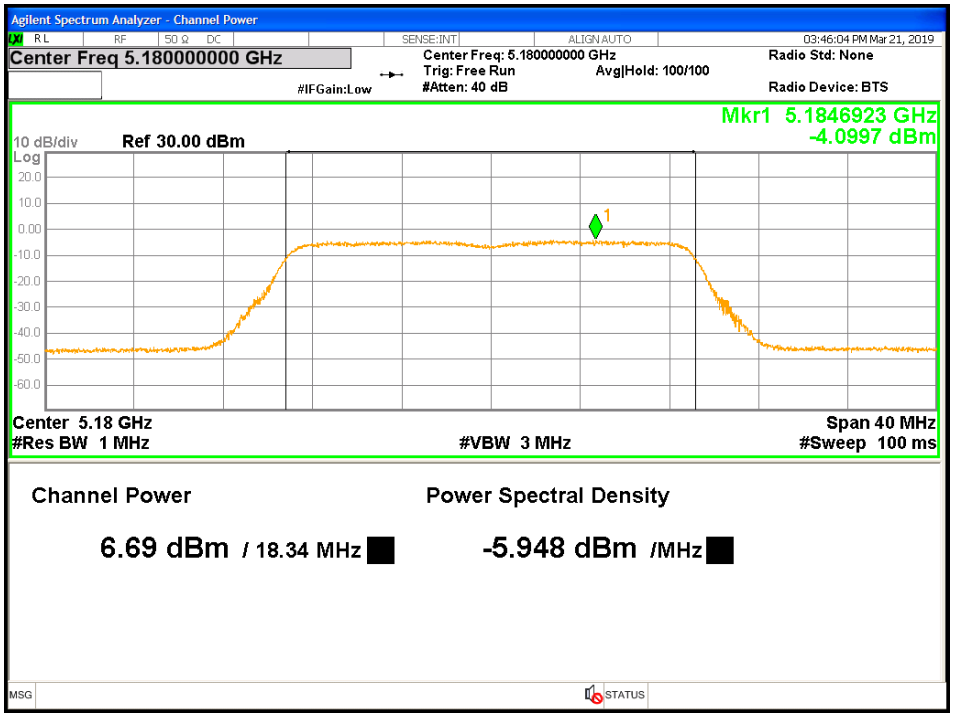


Figure 101: ISED RMS MAX. POWER-5180MHz-HT20-4x4-q28-Ch0

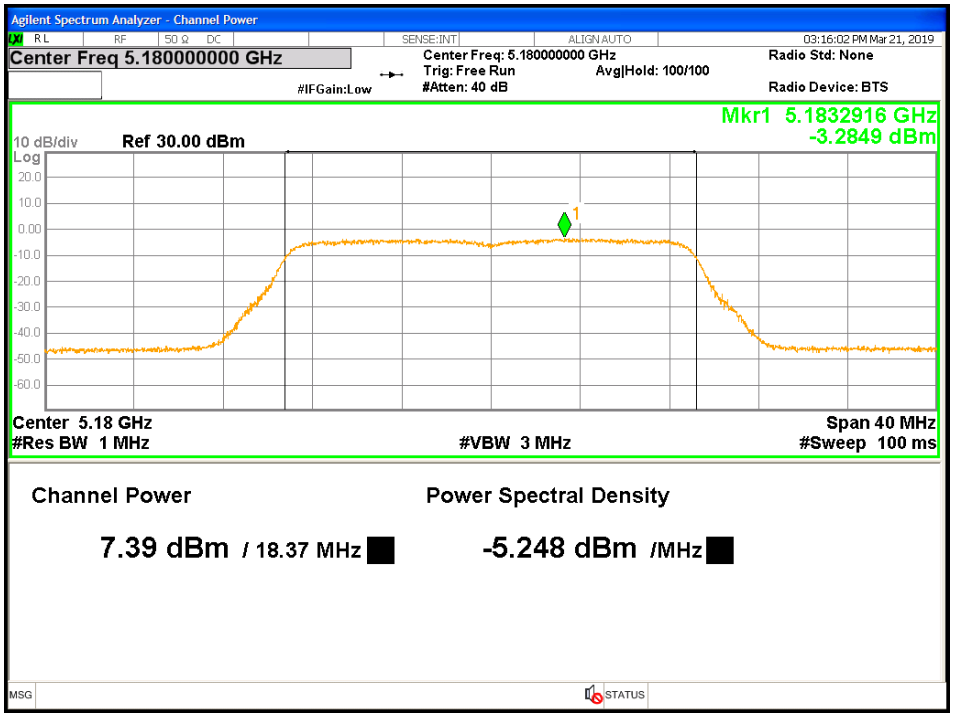


Figure 102: ISED RMS MAX. POWER-5180MHz-HT20-4x4-q28-Ch1

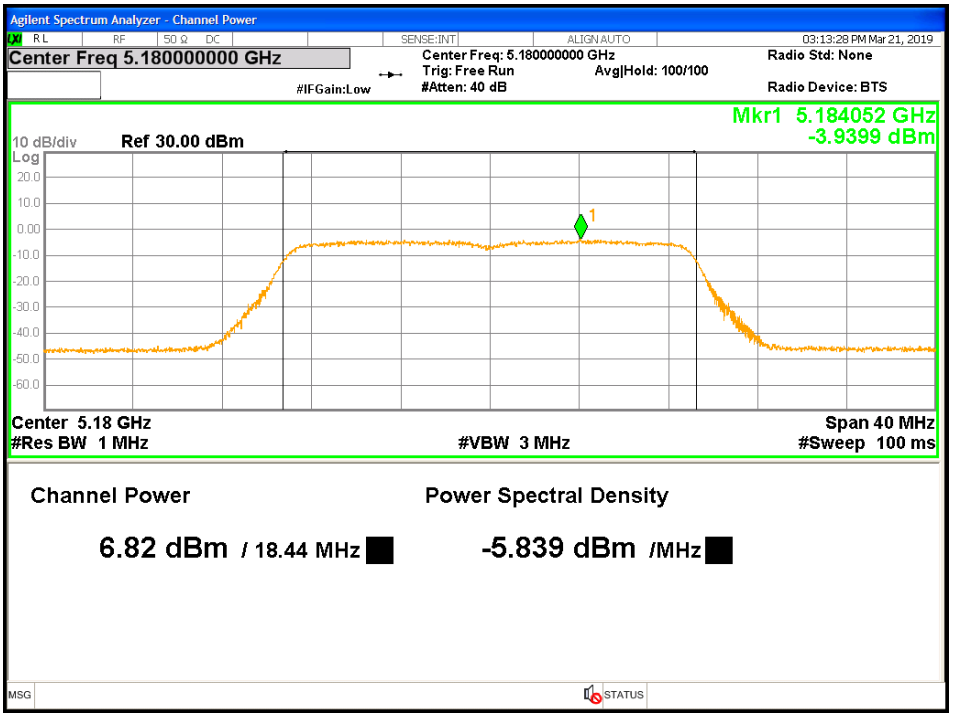


Figure 103: ISED RMS MAX. POWER-5180MHz-HT20-4x4-q28-Ch2

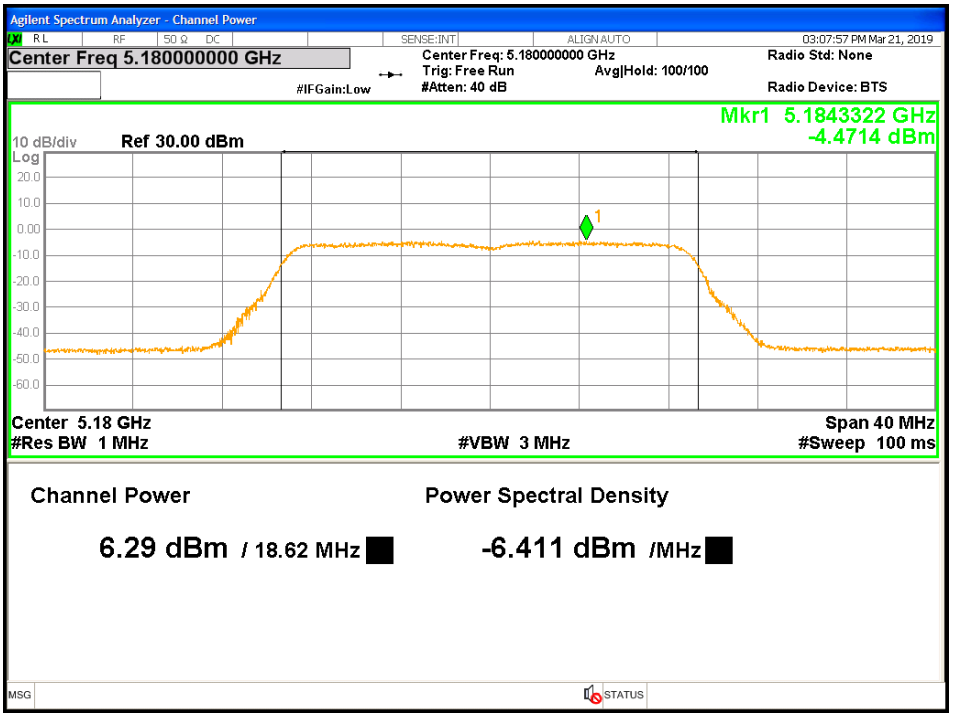


Figure 104: ISED RMS MAX. POWER-5180MHz-HT20-4x4-q28-Ch3

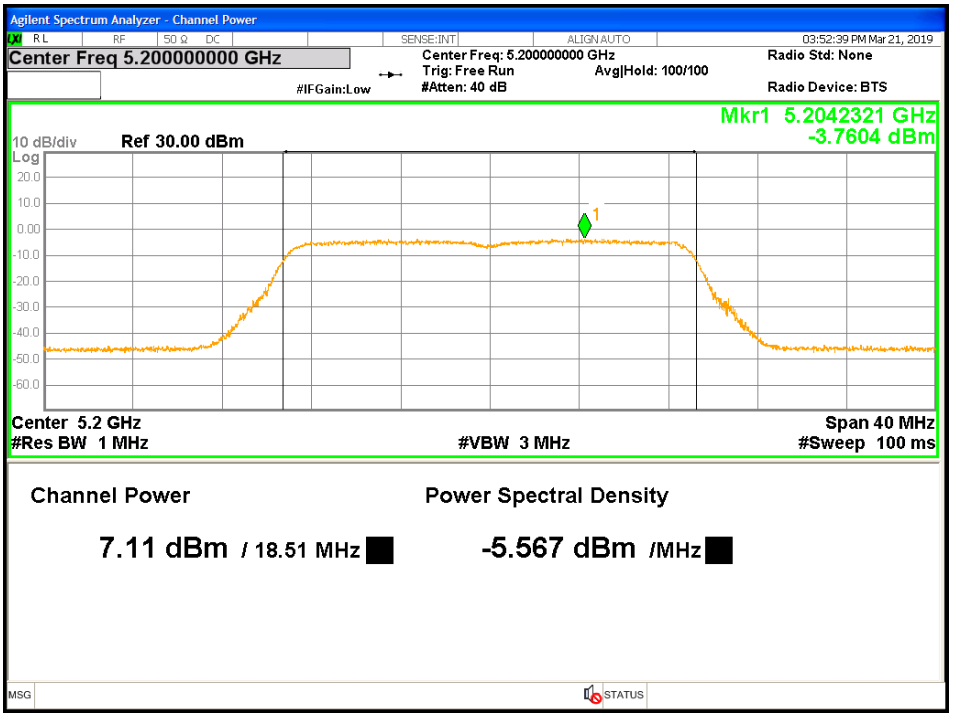


Figure 105: ISED RMS MAX. POWER-5200MHz-HT20-4x4-q28-Ch0

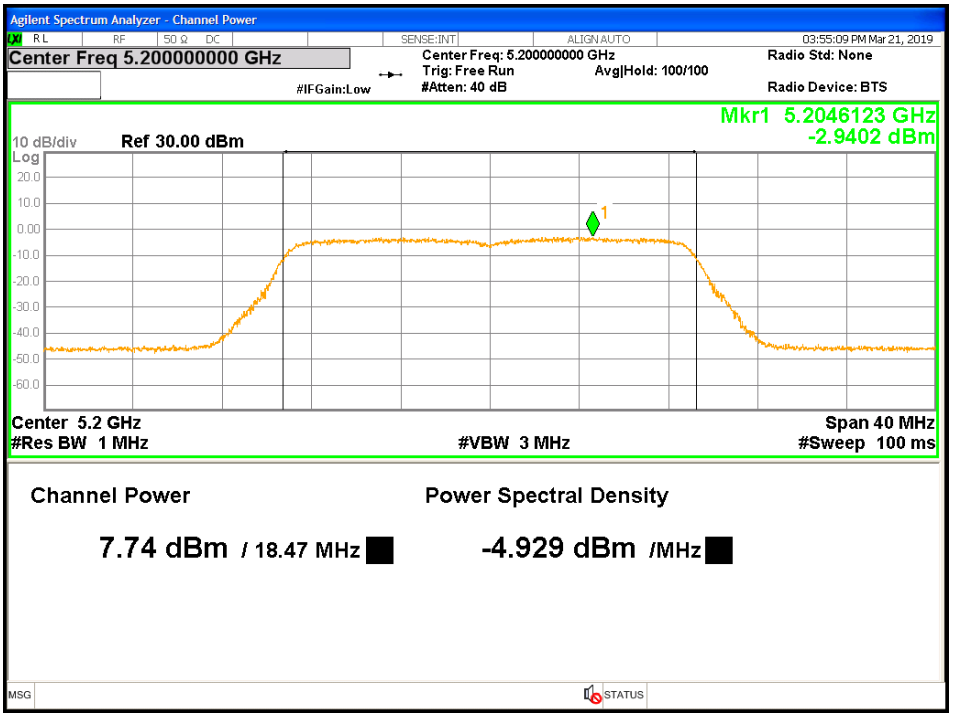


Figure 106: ISED RMS MAX. POWER-5200MHz-HT20-4x4-q28-Ch1

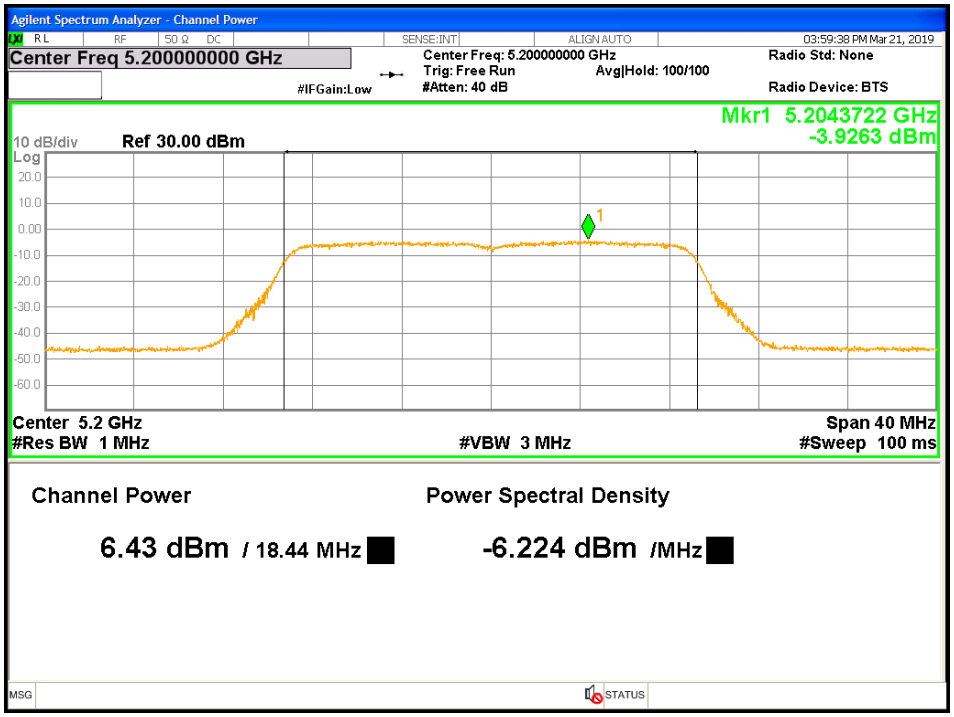


Figure 107: ISED RMS MAX. POWER-5200MHz-HT20-4x4-q28-Ch2

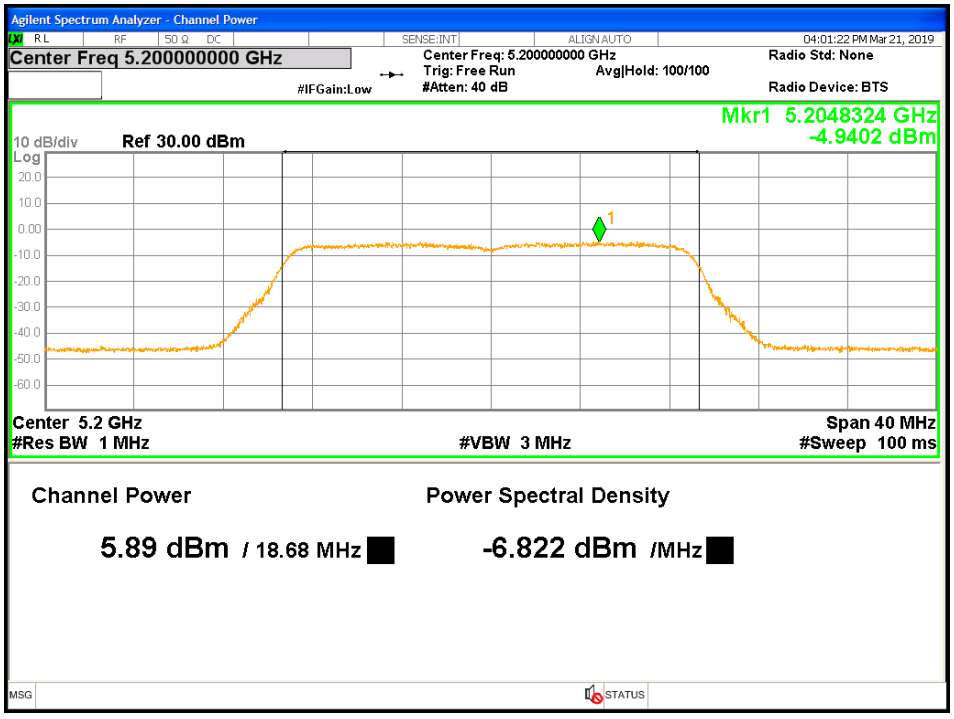


Figure 108: ISED RMS MAX. POWER-5200MHz-HT20-4x4-q28-Ch3

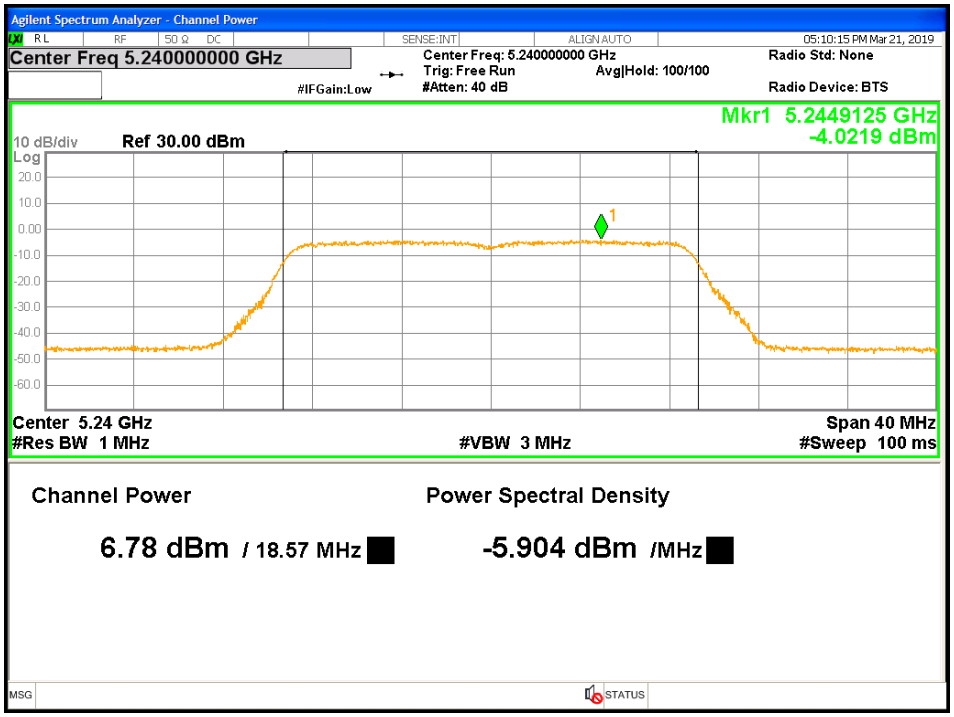


Figure 109: ISED RMS MAX. POWER-5240MHz-HT20-4x4-q28-Ch0

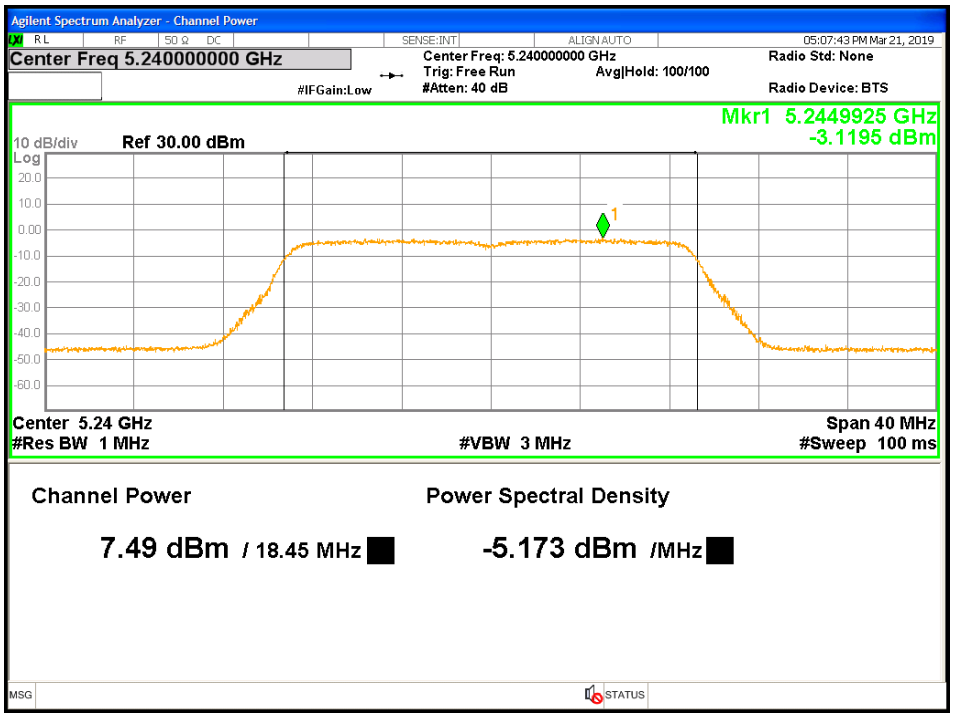


Figure 110: ISED RMS MAX. POWER-5240MHz-HT20-4x4-q28-Ch1

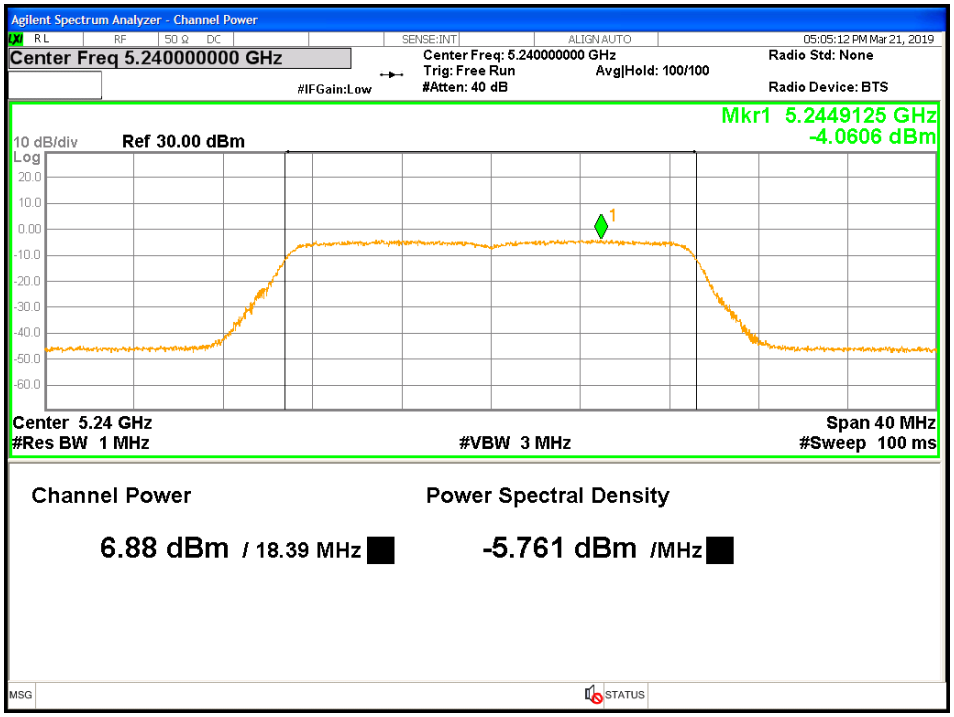


Figure 111: ISED RMS MAX. POWER-5240MHz-HT20-4x4-q28-Ch2

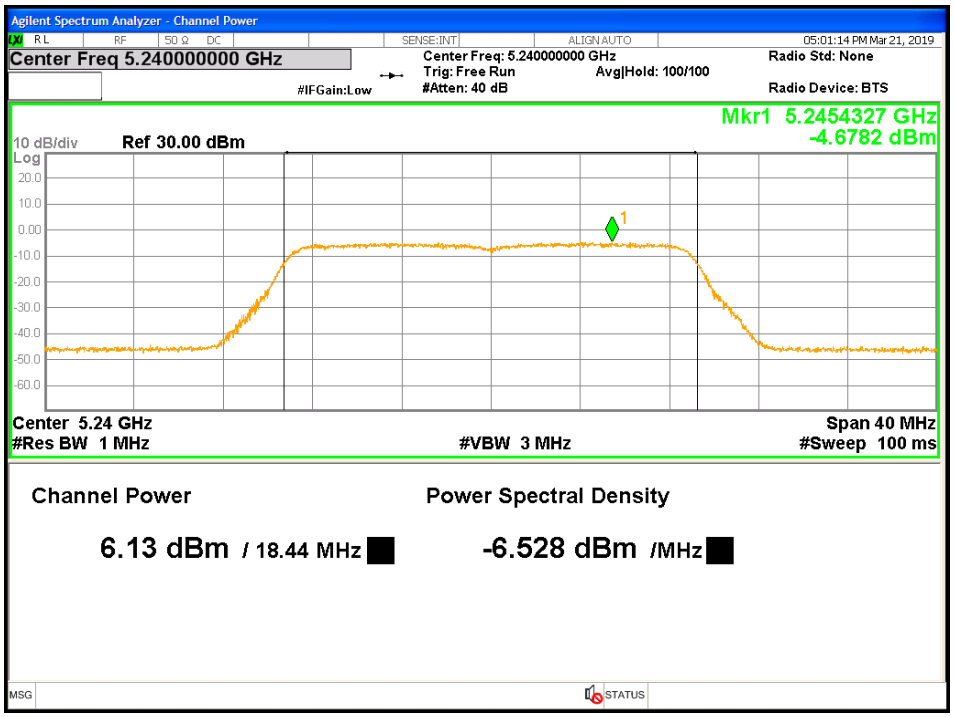


Figure 112: ISED RMS MAX. POWER-5240MHz-HT20-4x4-q28-Ch3

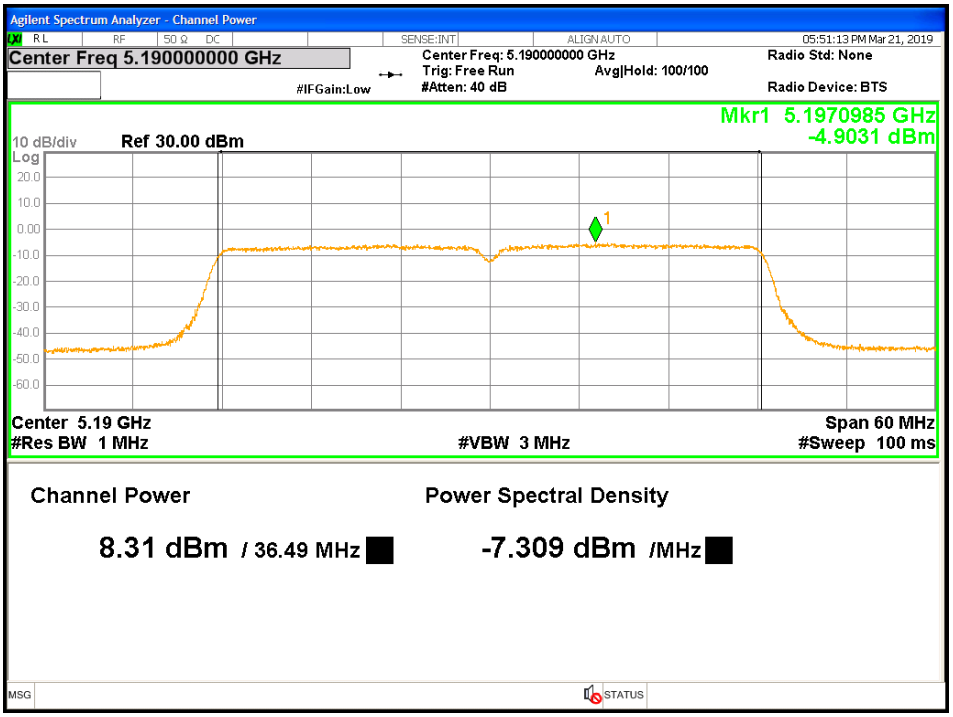


Figure 113: ISED RMS MAX. POWER-5190MHz-HT40-4x4-q32-Ch0

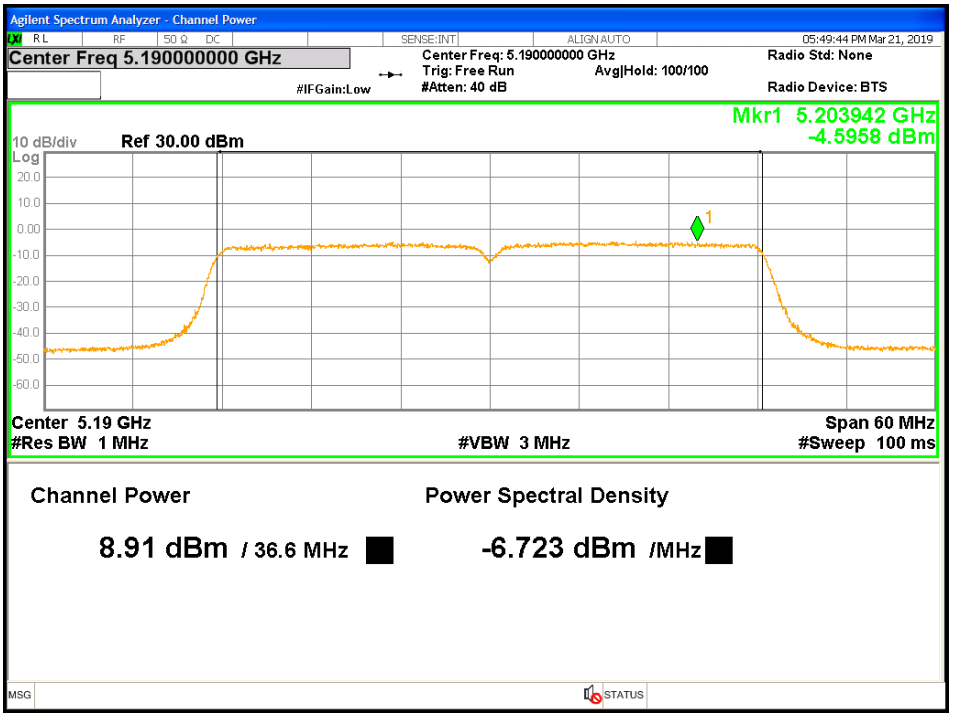


Figure 114: ISED RMS MAX. POWER-5190MHz-HT40-4x4-q32-Ch1

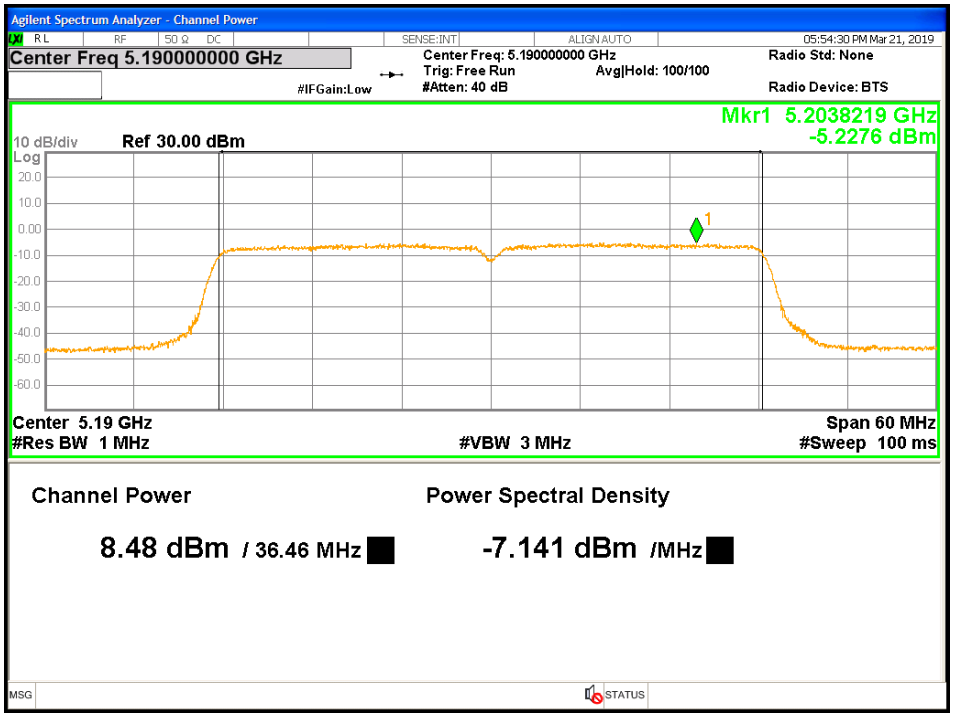


Figure 115: ISED RMS MAX. POWER-5190MHz-HT40-4x4-q32-Ch2

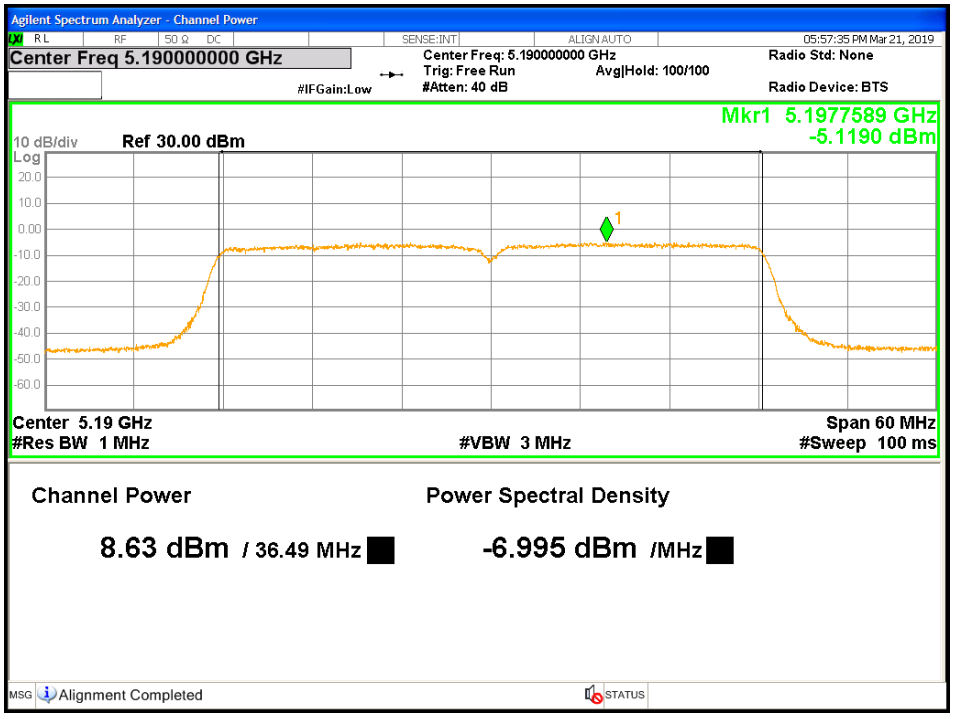


Figure 116: ISED RMS MAX. POWER-5190MHz-HT40-4x4-q32-Ch3

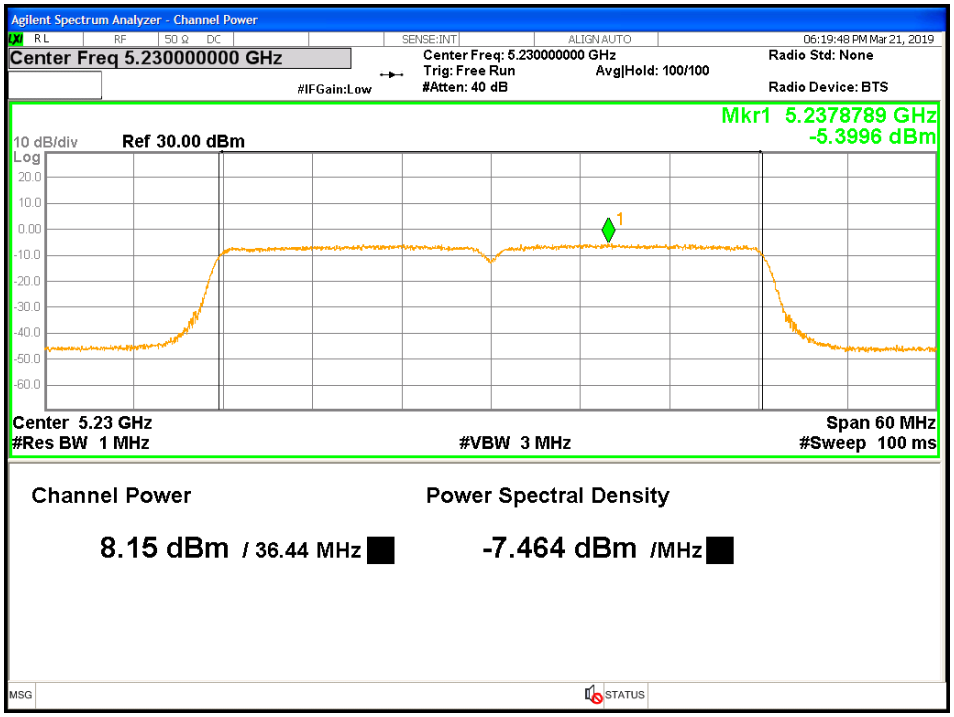


Figure 117: ISED RMS MAX. POWER-5230MHz-HT40-4x4-q32-Ch0

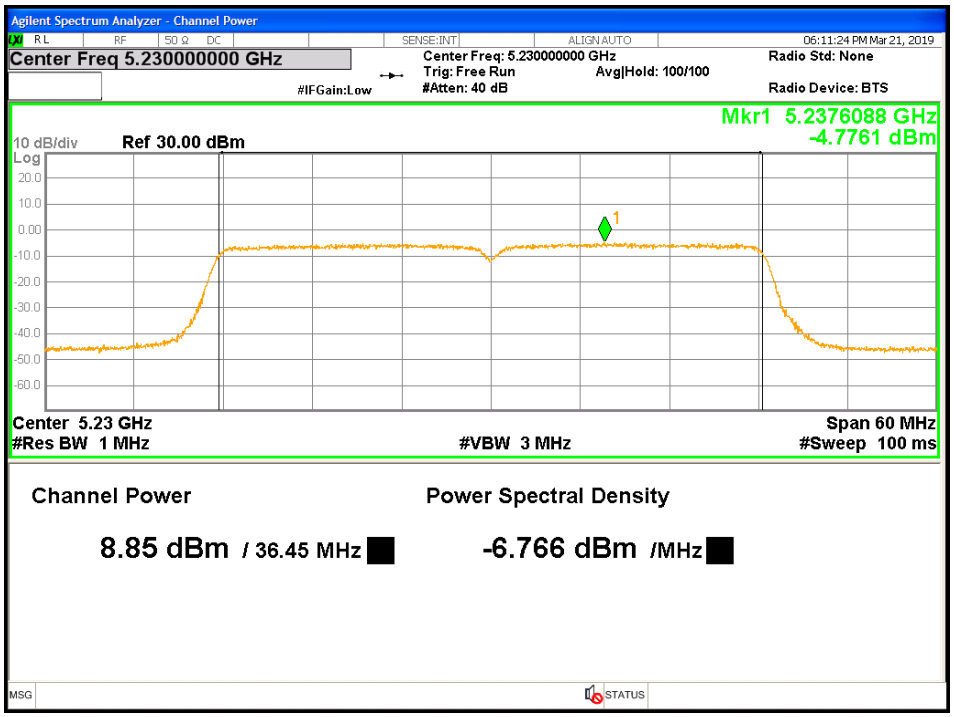


Figure 118: ISED RMS MAX. POWER-5230MHz-HT40-4x4-q32-Ch1

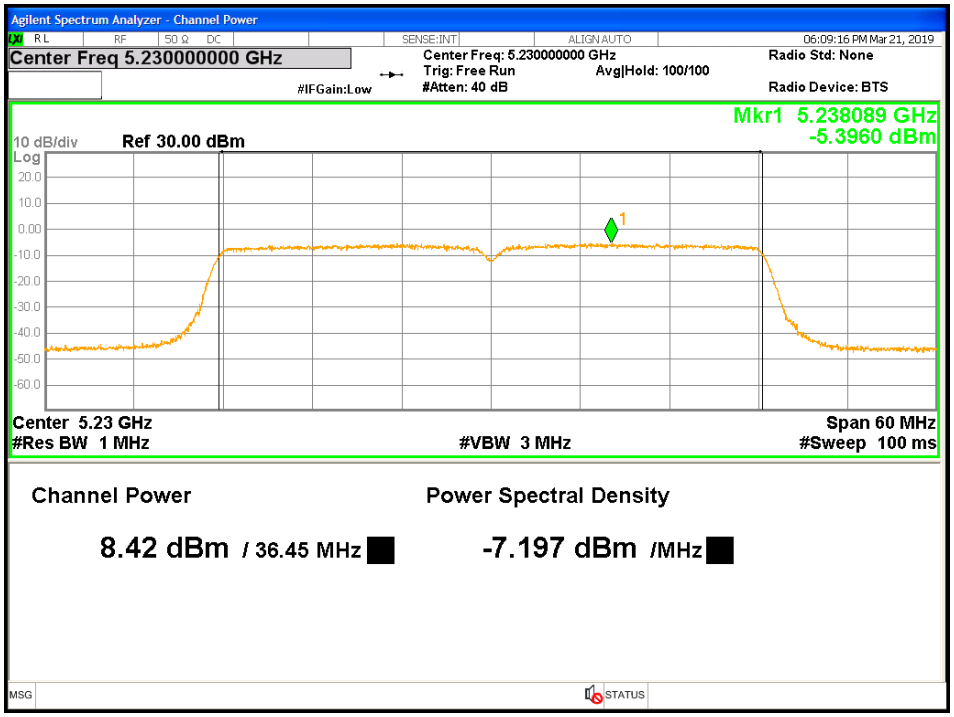


Figure 119: ISED RMS MAX. POWER-5230MHz-HT40-4x4-q32-Ch2

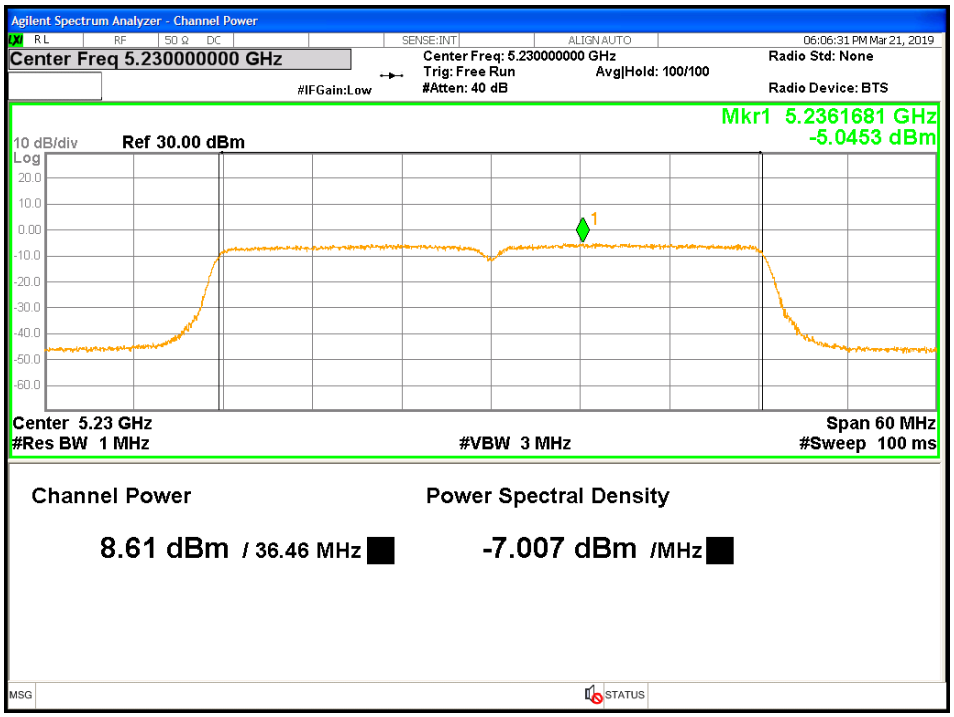


Figure 120: ISED RMS MAX. POWER-5230MHz-HT40-4x4-q32-Ch3

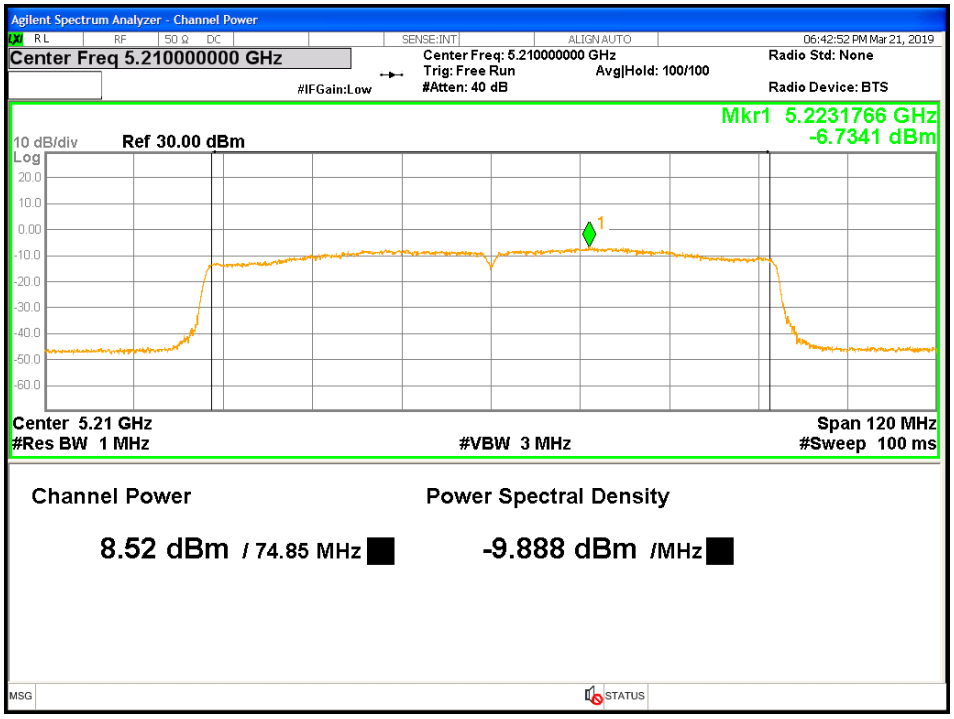


Figure 121: ISED RMS MAX. POWER-5210MHz-VHT80-4x4-q36-Ch0

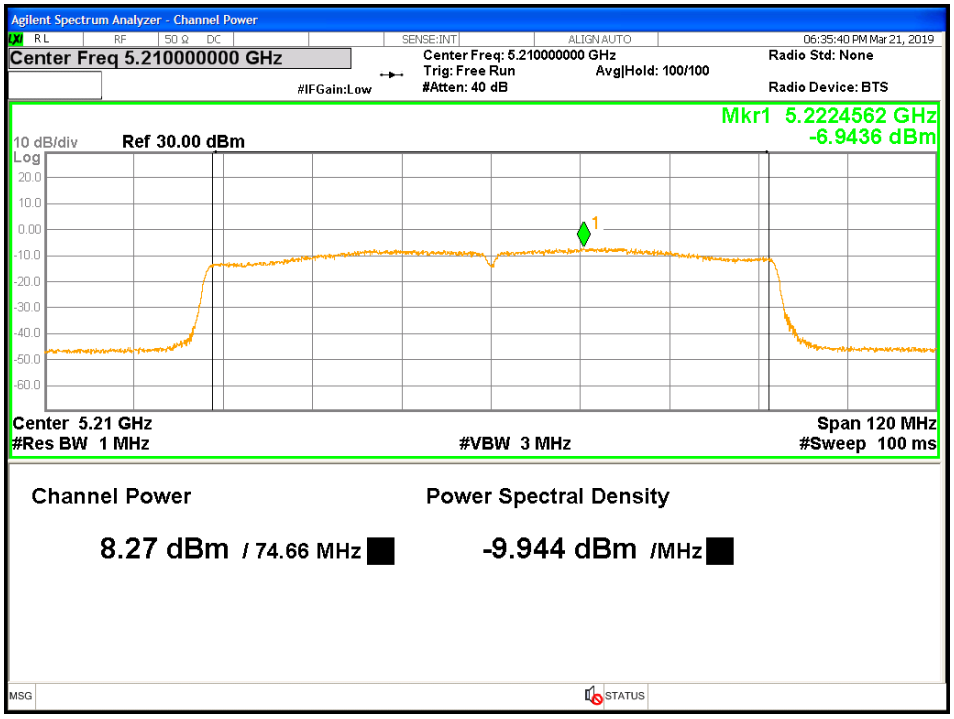


Figure 122: ISED RMS MAX. POWER-5210MHz-VHT80-4x4-q36-Ch1

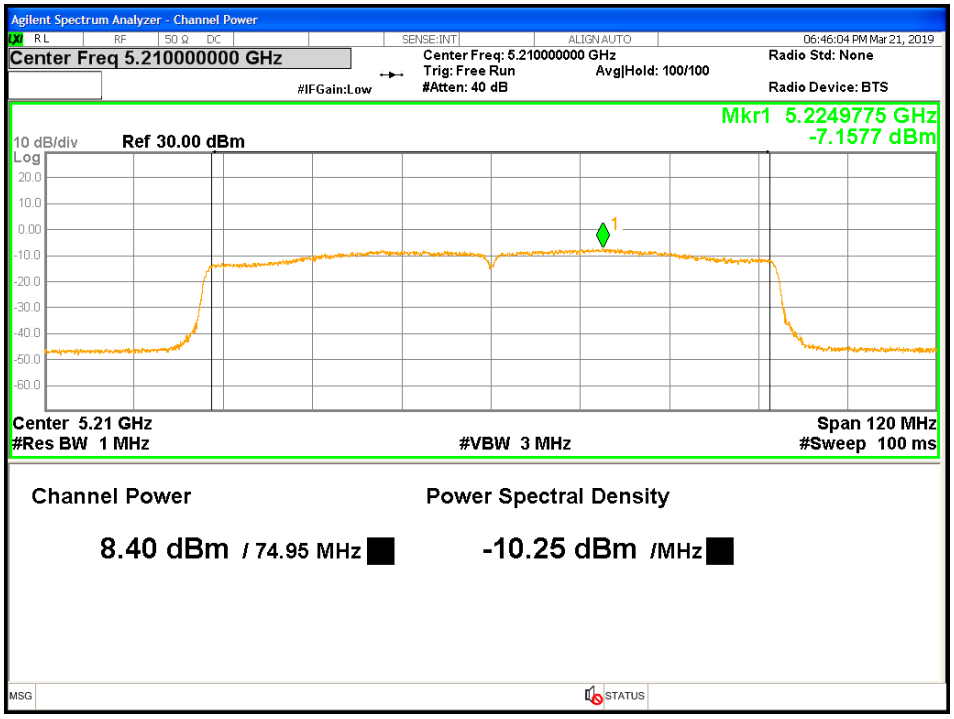


Figure 123: ISED RMS MAX. POWER-5210MHz-VHT80-4x4-q36-Ch2

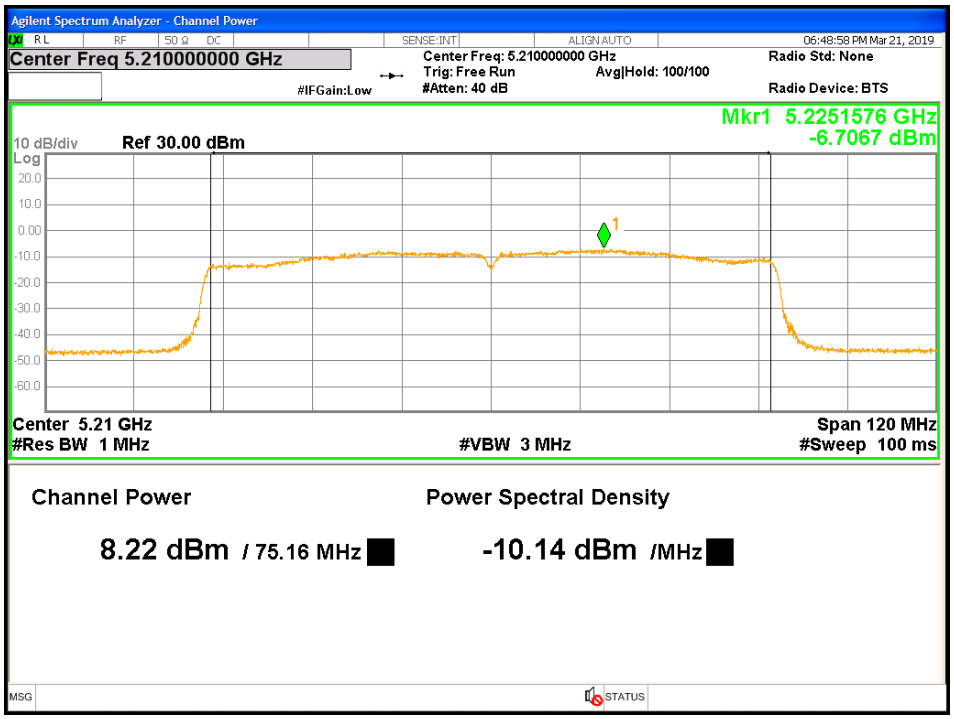


Figure 124: ISED RMS MAX. POWER-5210MHz-VHT80-4x4-q36-Ch3

4.2 Occupied Bandwidth

The occupied bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency.

The 99% bandwidth is the bandwidth in which 99% of the transmitted power occupied.

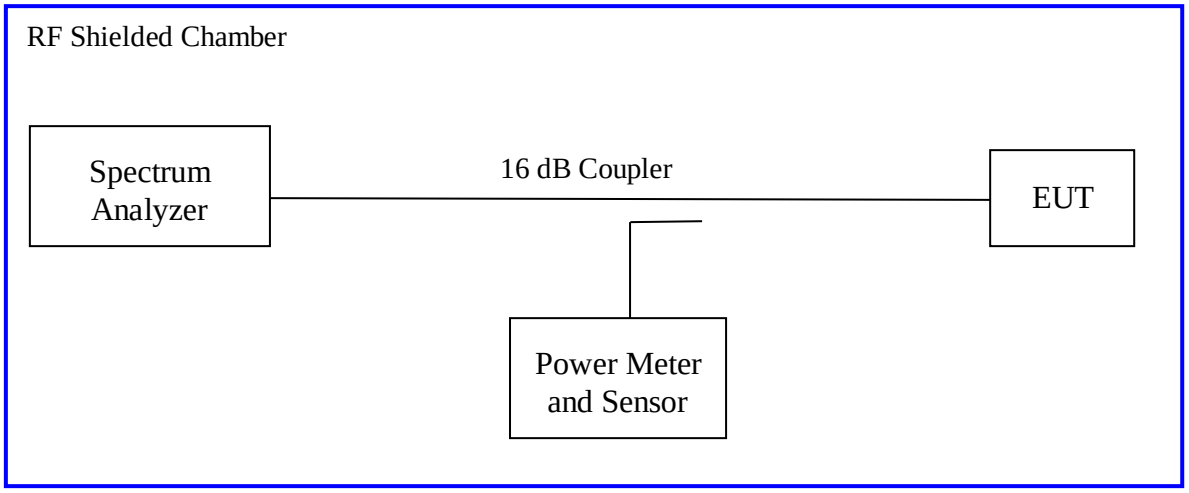
The 26 dB bandwidth is defined the bandwidth of 26 dBr from highest transmitted level of the fundamental frequency.

There is no restriction limits for the bandwidth. The 26 dB bandwidth was used to determine the limit for maximum conducted output power per CFR47 Part 15.407(a).

4.2.1 Test Method

The conducted method was used to measure the occupied bandwidth. The measurement was performed with modulation per CFR47 15.407(a) and RSS Gen Sect.6.7. The preliminary investigation was performed to find the narrowest 26 dB bandwidth for each operational mode at different data rates. This worst finding was performed on 3 channels in each operating frequency range; 5150 MHz to 5250 MHz. The worst results indicated below.

Test Setup:



4.2.2 Results

These occupied bandwidth measurements were taken for references only.

Table 6: Occupied Bandwidth – Test Results

Test Date: March 13, 2019	**Test By:** Kerwinn Corpus
Test Method: Conducted Measurements	**Power Setting:** See test plan
Antenna Type: PCB	**Max. Antenna Gain:** + 4.8 dBi
Operating Mode: Non Beamforming & Uncorrelated	**Signal State**: Modulated
Ambient Temp.: 22 °C	**Relative Humidity:**48%

Bandwidth for 802.11a

Freq. (MHz)	99% Bandwidth (MHz)				26dB Bandwidth (MHz)			
	Ch0	Ch1	Ch2	Ch3	Ch0	Ch1	Ch2	Ch3
5180	16.77	16.77	16.76	16.75	21.56	21.47	21.45	21.46
5200	16.78	16.78	16.77	16.76	21.54	21.54	21.41	21.42
5240	17.00	16.96	16.99	16.95	27.11	27.04	29.04	26.39

Note: The bandwidths measured at 6Mbps for 802.11a mode. Bandwidths verified that no outputs leaked into the DFS UNII-2a band.

Bandwidth for 802.11n HT20

Freq. (MHz)	99% Bandwidth (MHz)				26dB Bandwidth (MHz)			
	Ch0	Ch1	Ch2	Ch3	Ch0	Ch1	Ch2	Ch3
5180	17.87	17.88	17.87	17.88	21.71	21.63	21.72	21.59
5200	17.89	17.91	17.89	17.89	21394	22.18	22.16	21.86
5240	18.11	18.07	18.04	18.02	29.78	29.91	29.96	29.99

Note: The bandwidths measured at 802.11n HT20, MCS0. Bandwidths verified that no outputs leaked into the DFS UNII-2a band.

Bandwidth for 802.11n HT40

Freq. (MHz)	99% Bandwidth (MHz)				26dB Bandwidth (MHz)			
	Ch0	Ch1	Ch2	Ch3	Ch0	Ch1	Ch2	Ch3
5190	36.34	36.34	36.33	36.32	40.03	40.11	40.18	40.15
5230	36.39	36.41	36.38	36.42	56.16	59.11	52.04	57.87

Note: The bandwidths measured at 802.11n HT40 mode, MCS0. Bandwidths verified that no outputs leaked into the DFS UNII-2a band.

Bandwidth for 802.11ac VHT80

Freq. (MHz)	99% Bandwidth (MHz)				26dB Bandwidth (MHz)			
	Ch0	Ch1	Ch2	Ch3	Ch0	Ch1	Ch2	Ch3
5210	74.93	74.88	74.94	74.89	80.95	81.22	80.89	81.31

Note: The bandwidth was measured at 802.11ac VHT80, MCS0. Bandwidths verified that no outputs leaked into the DFS UNII-2a band.

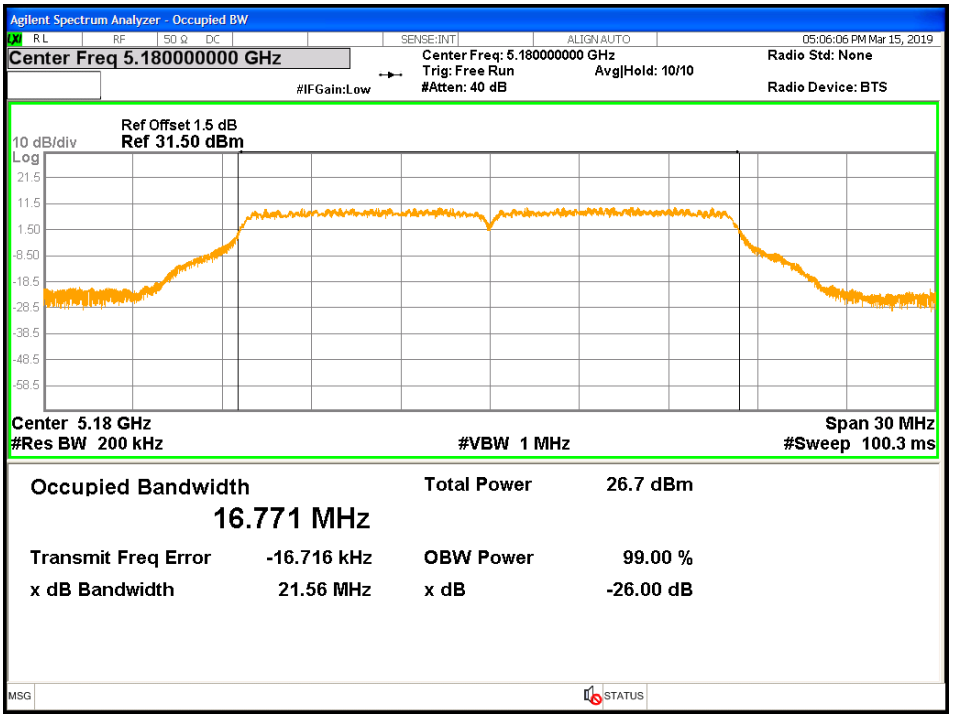


Figure 125: FCC-26dB and 99%-OBW-5180MHz-11a-1x4-q82-Ch0

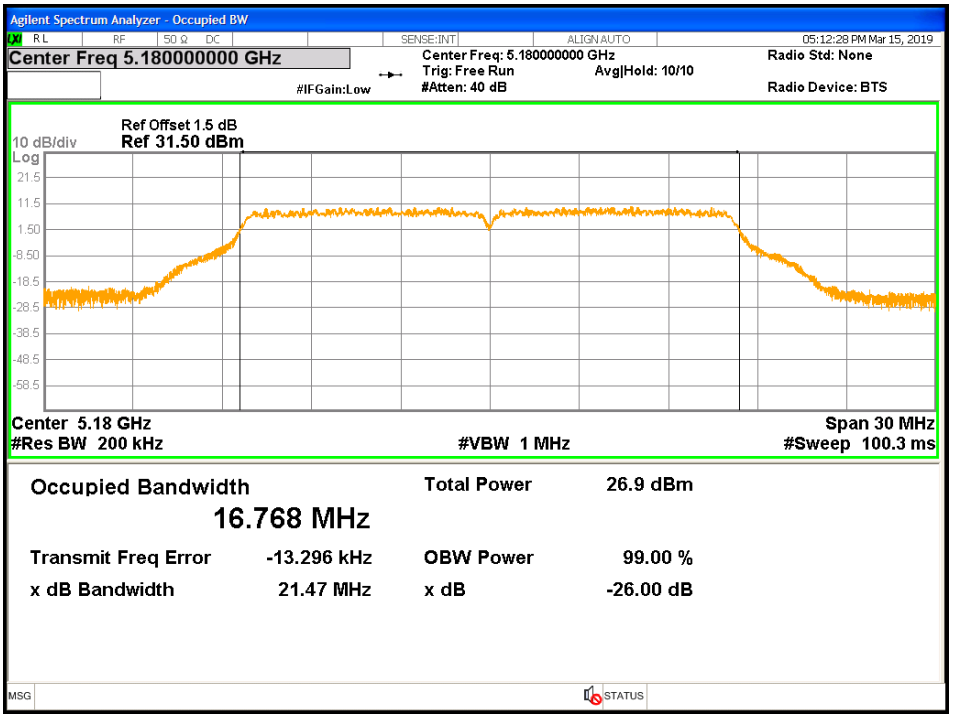


Figure 126: FCC-26dB and 99%-OBW-5180MHz-11a-1x4-q82-Ch1

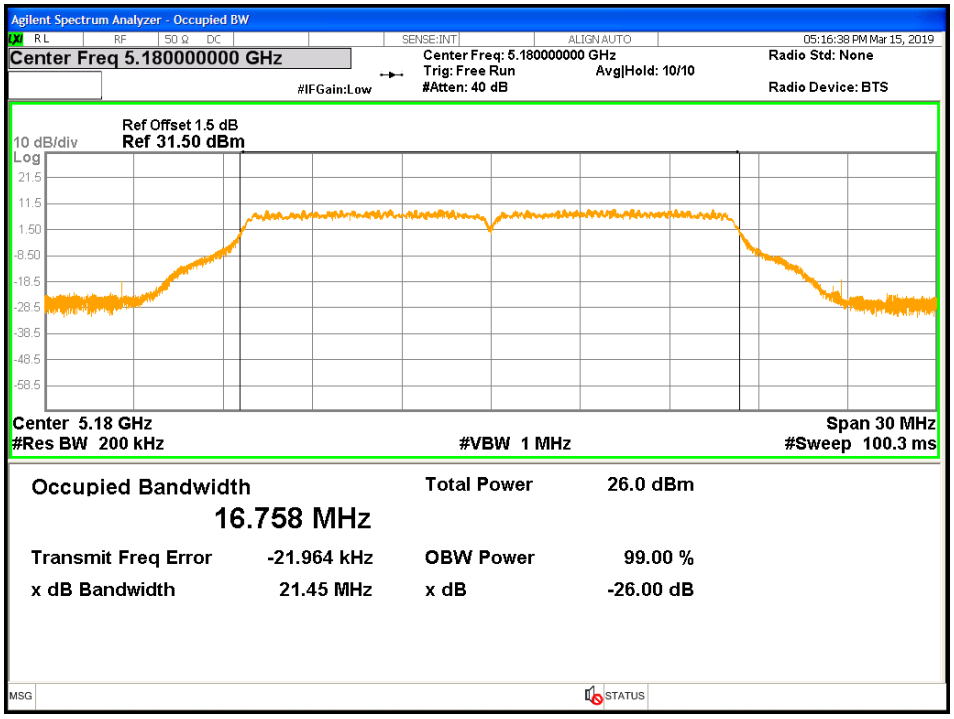


Figure 127: FCC-26dB and 99%-OBW-5180MHz-11a-1x4-q82-Ch2

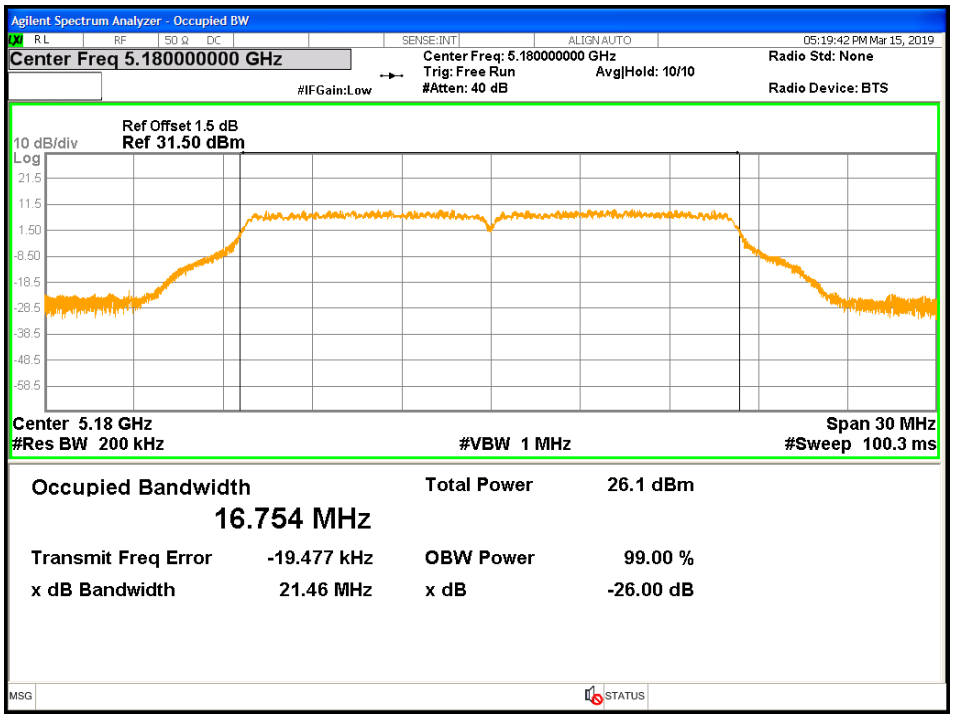


Figure 128: FCC-26dB and 99%-OBW-5180MHz-11a-1x4-q82-Ch3

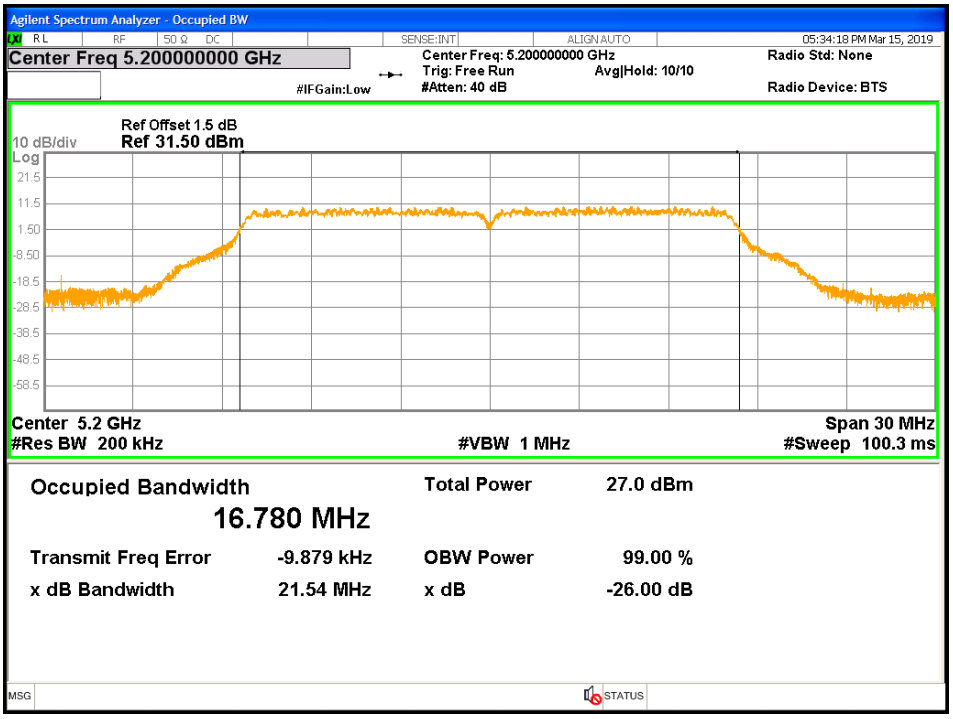


Figure 129: FCC-26dB and 99%-OBW-5200MHz-11a-1x4-q82-Ch0

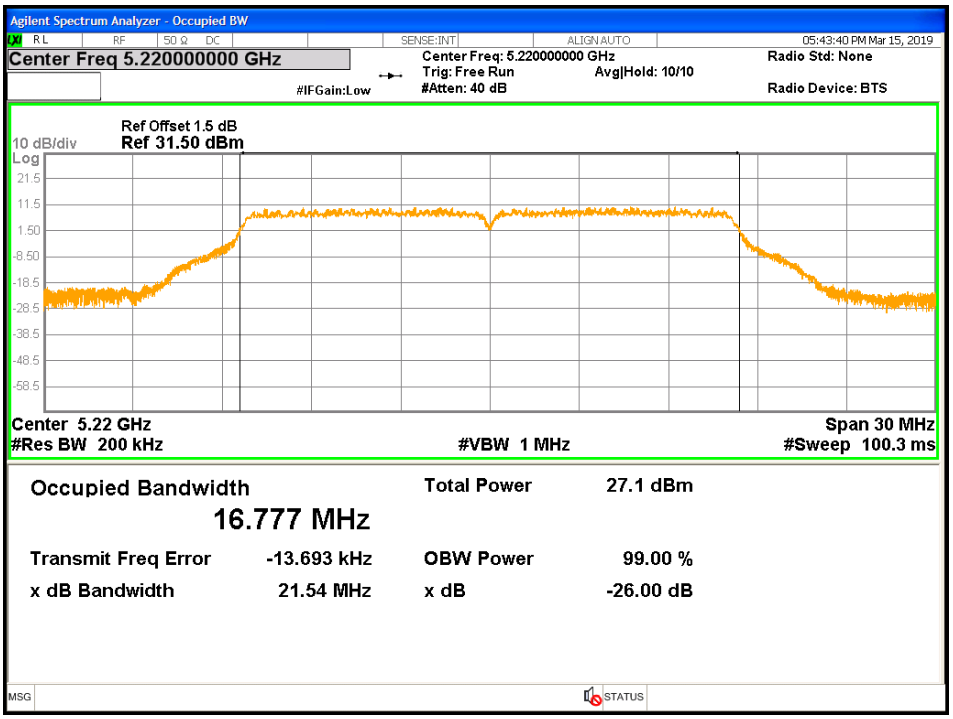


Figure 130: FCC-26dB and 99%-OBW-5200MHz-11a-1x4-q82-Ch1

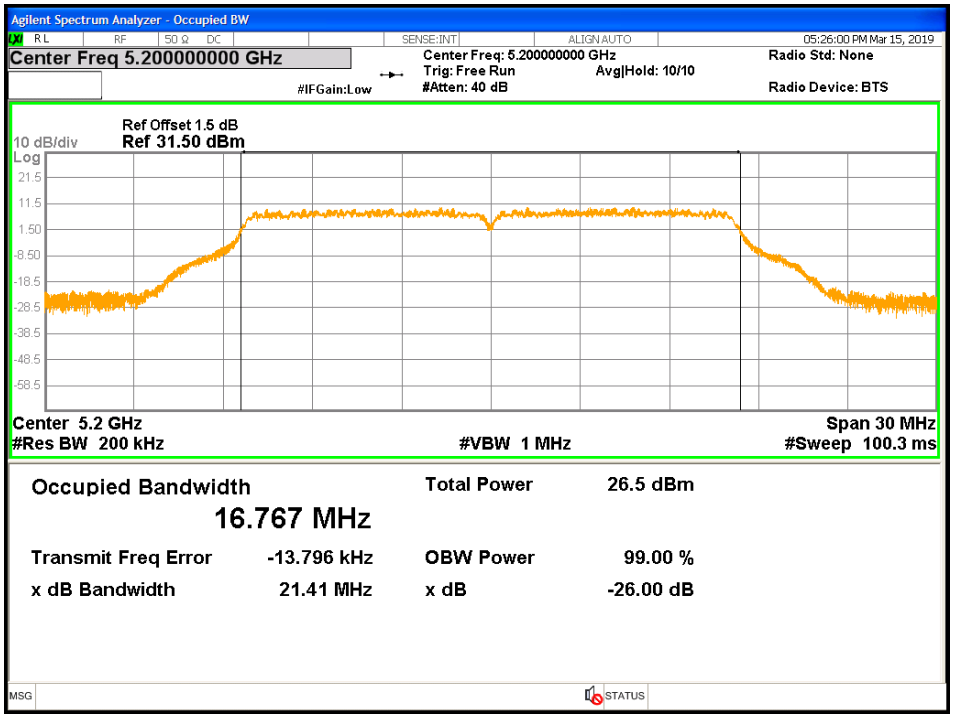


Figure 131: FCC-26dB and 99%-OBW-5200MHz-11a-1x4-q82-Ch2

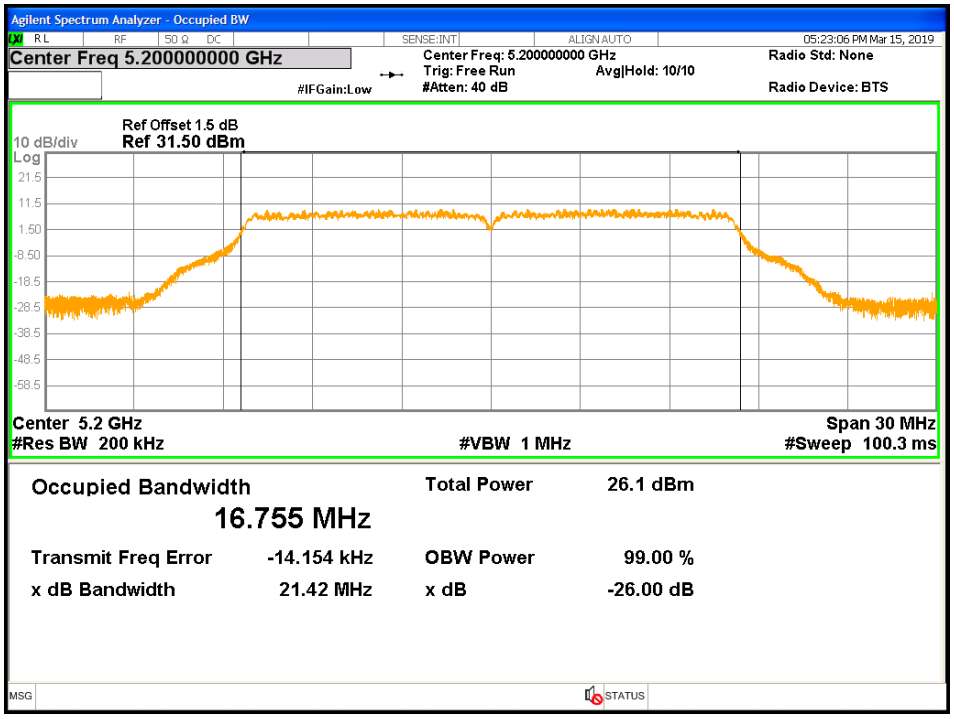


Figure 132: FCC-26dB and 99%-OBW-5200MHz-11a-1x4-q82-Ch3

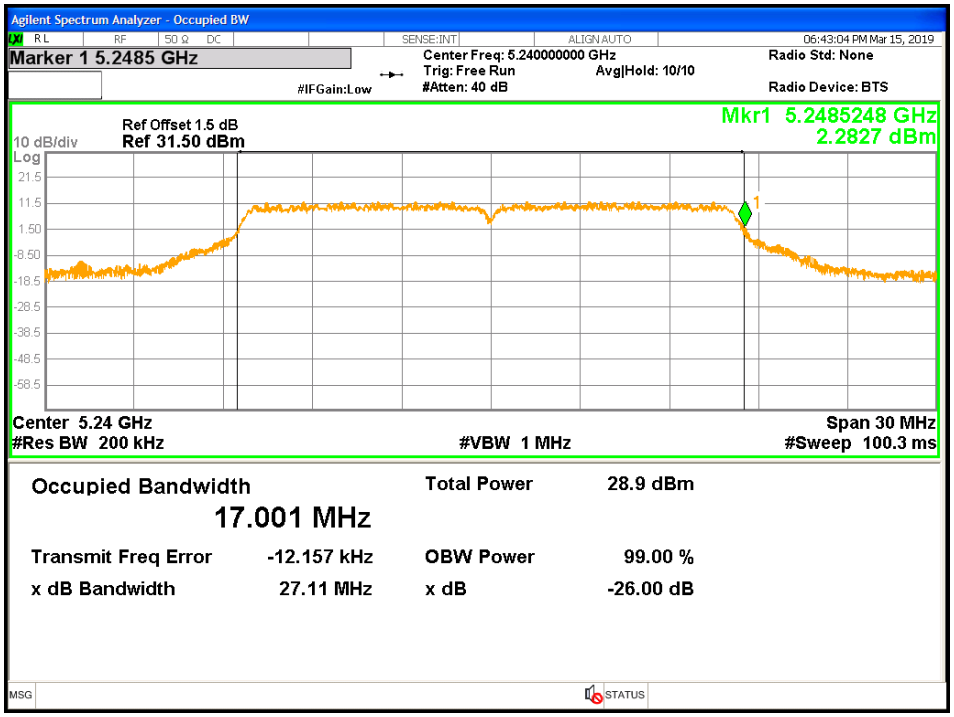


Figure 133: FCC-26dB and 99%-OBW-5240MHz-11a-1x4-q96-Ch0

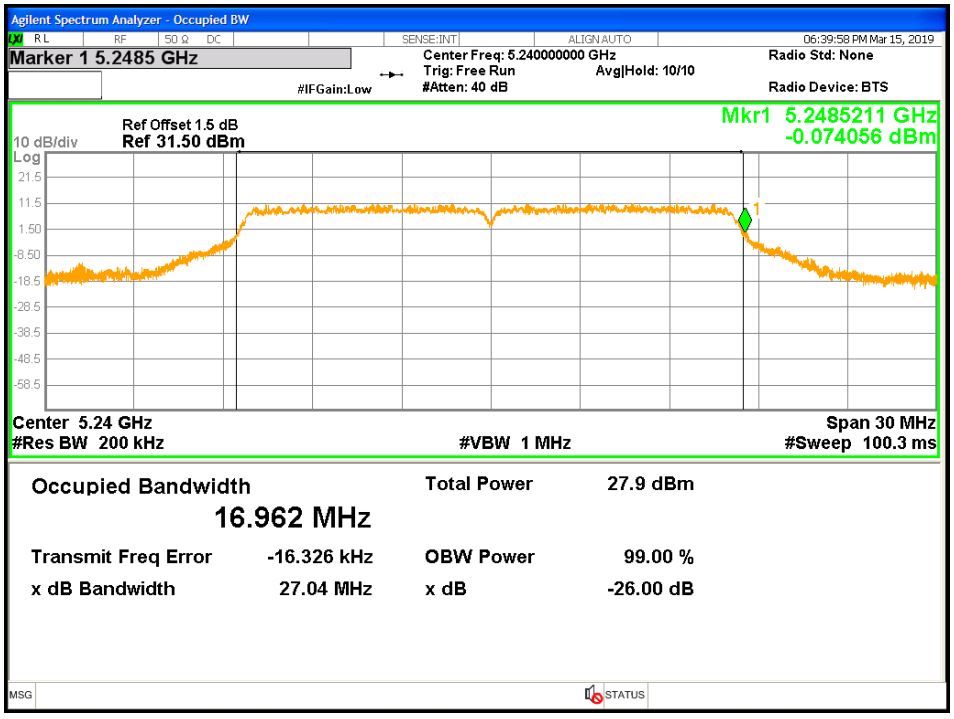


Figure 134: FCC-26dB and 99%-OBW-5240MHz-11a-1x4-q96-Ch1

Note: The upper edge of 99% bandwidths are less than 5250MHz. All emissions contain in 5150 – 5250 MHz band.

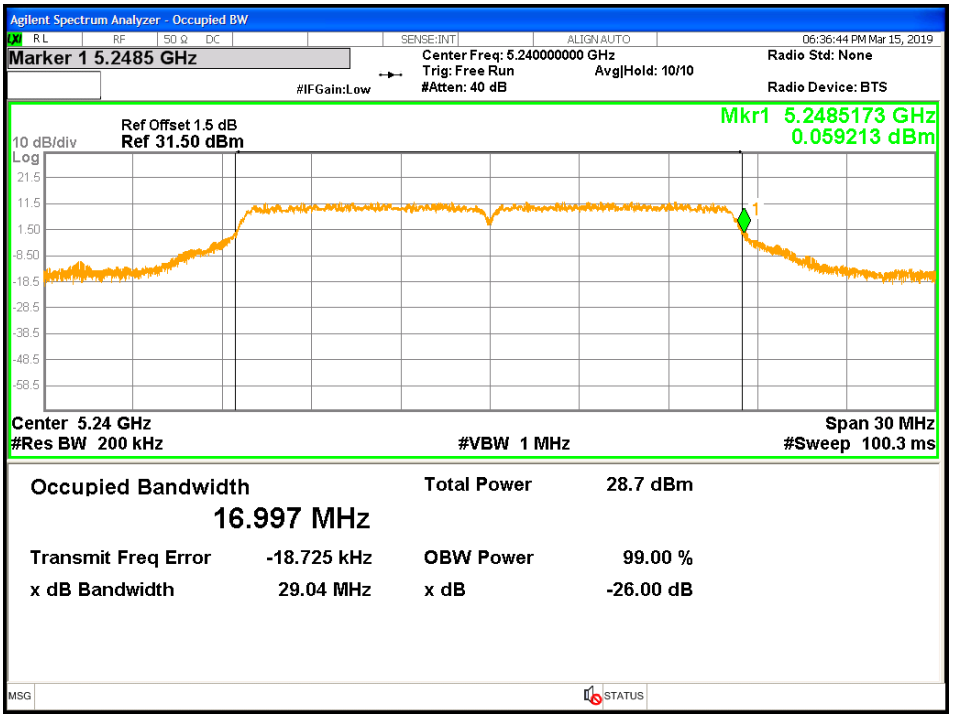


Figure 135: FCC-26dB and 99%-OBW-5240MHz-11a-1x4-q96-Ch2

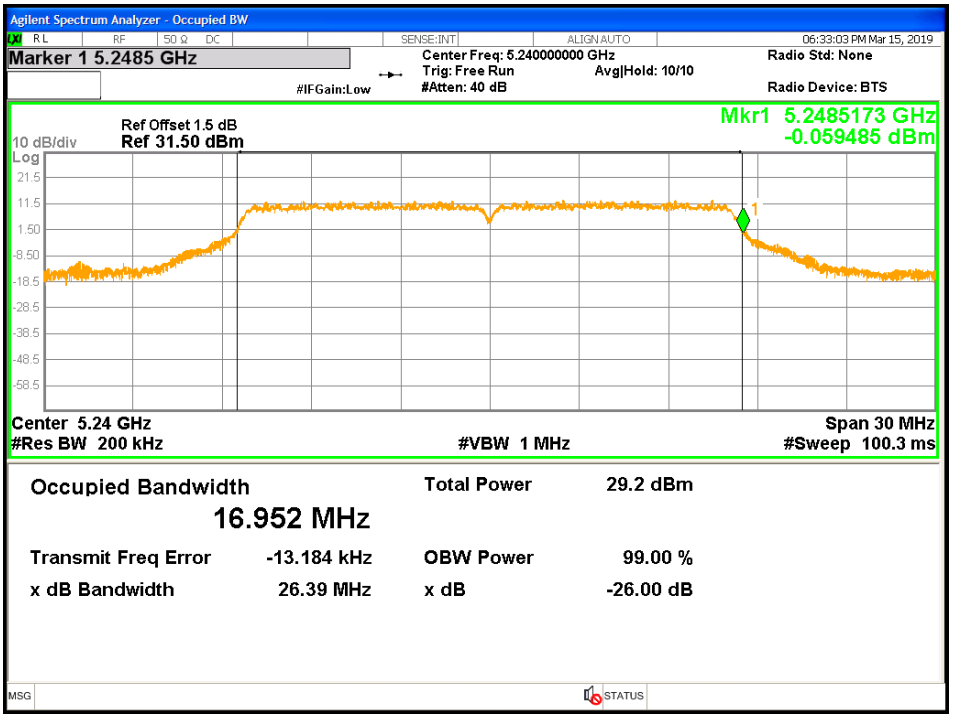


Figure 136: FCC-26dB and 99%-OBW-5240MHz-11a-1x4-q96-Ch3

Note: The upper edge of 99% bandwidths are less than 5250MHz. All emissions contain in 5150 – 5250 MHz band.

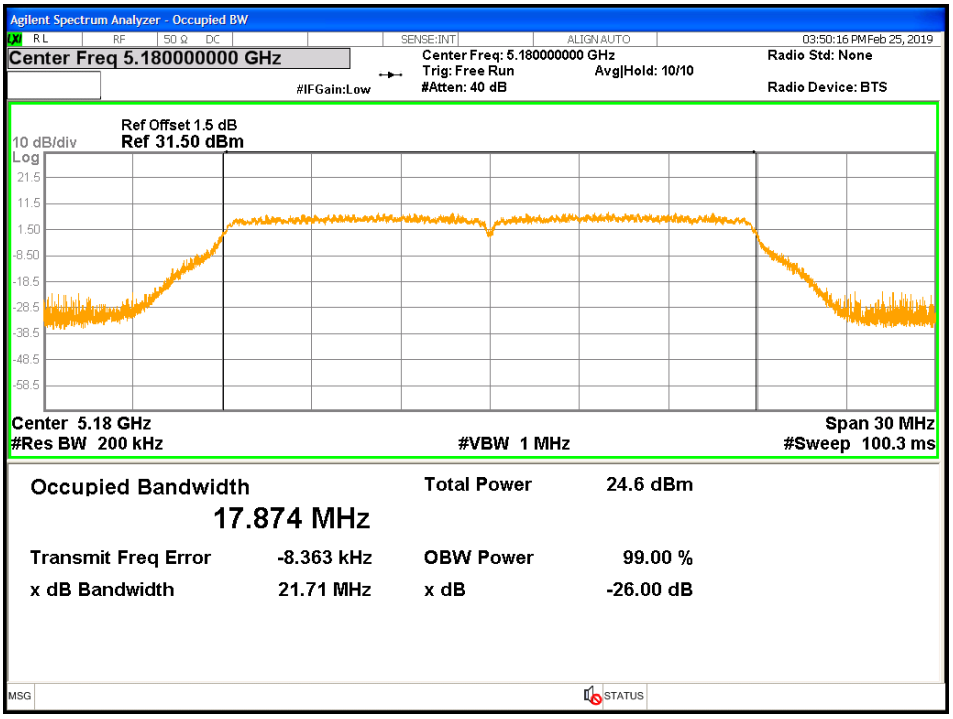


Figure 137: FCC-26dB and 99%-OBW-5180MHz-HT20-1x4-q73-Ch0

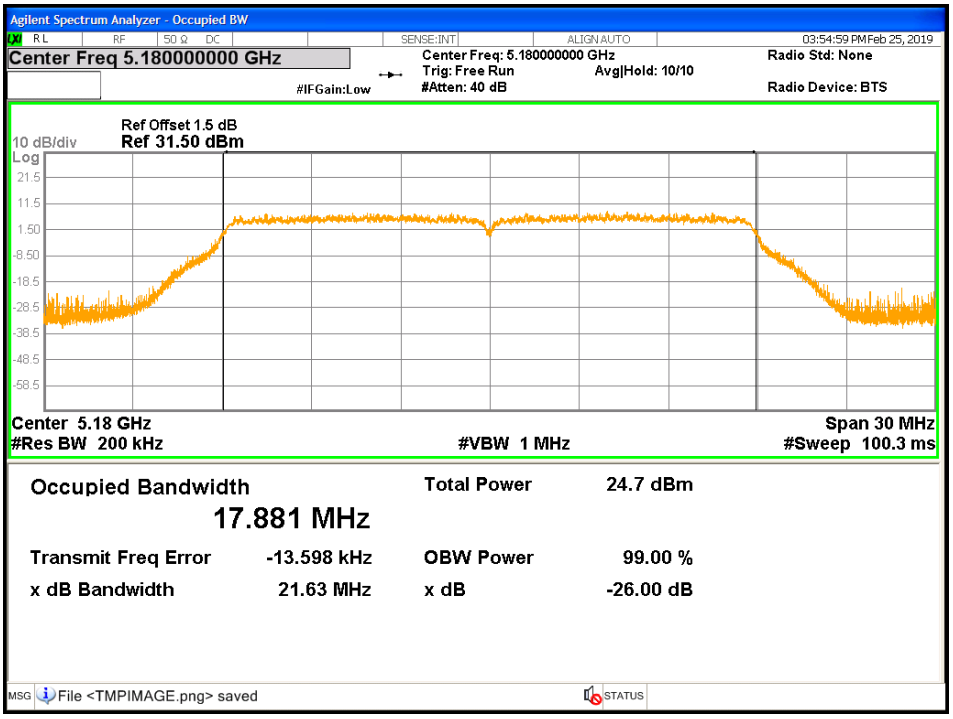


Figure 138: FCC-26dB and 99%-OBW-5180MHz-HT20-1x4-q73-Ch1

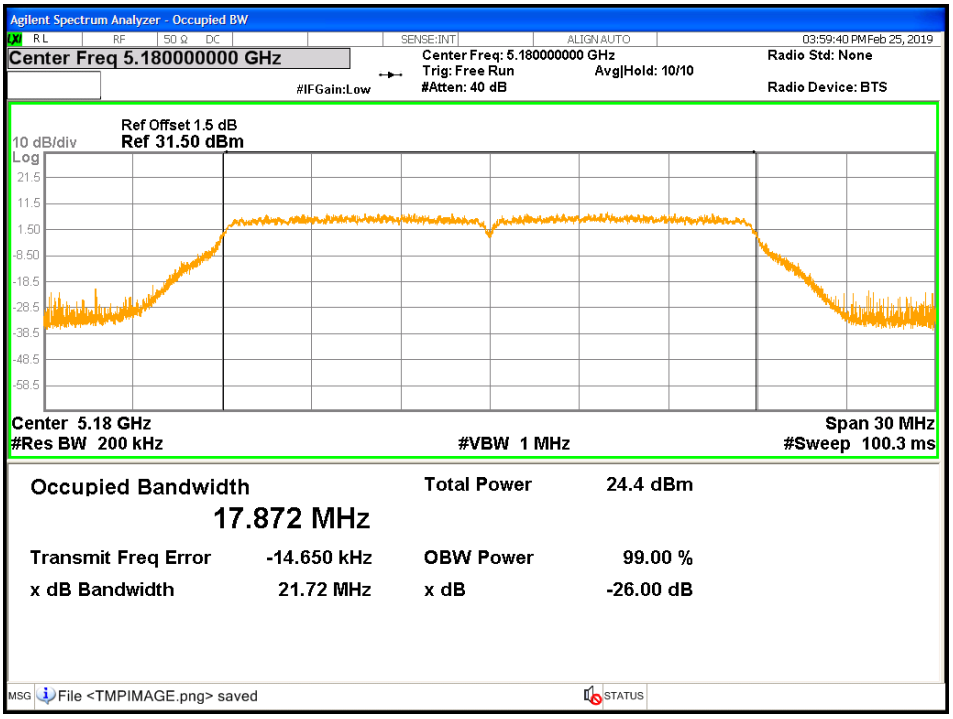


Figure 139: FCC-26dB and 99%-OBW-5180MHz-HT20-1x4-q73-Ch2

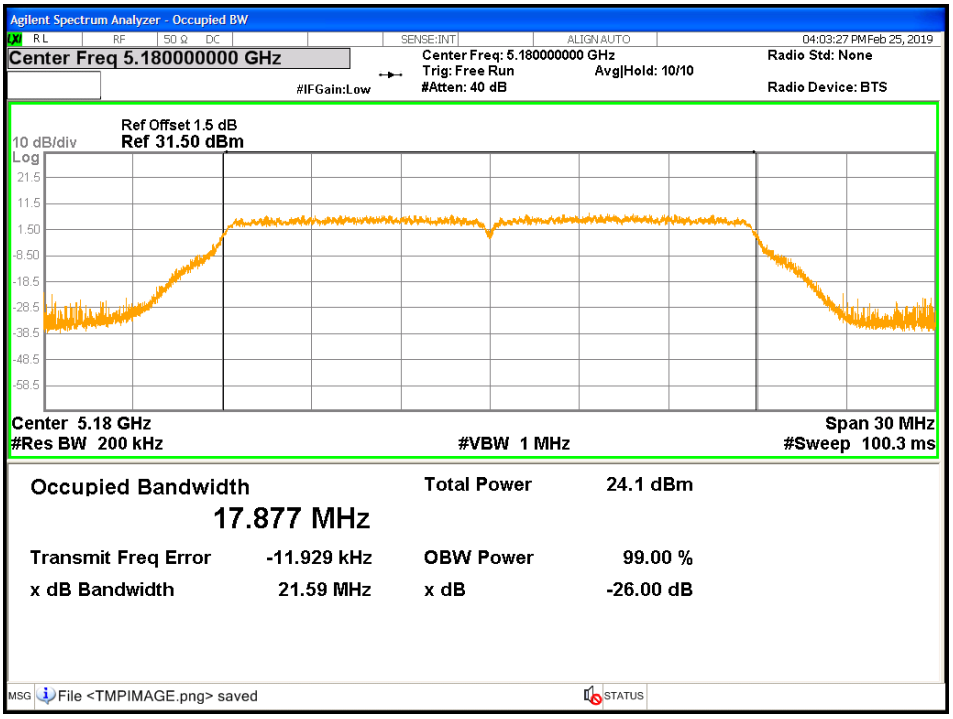


Figure 140: FCC-26dB and 99%-OBW-5180MHz-HT20-1x4-q73-Ch3

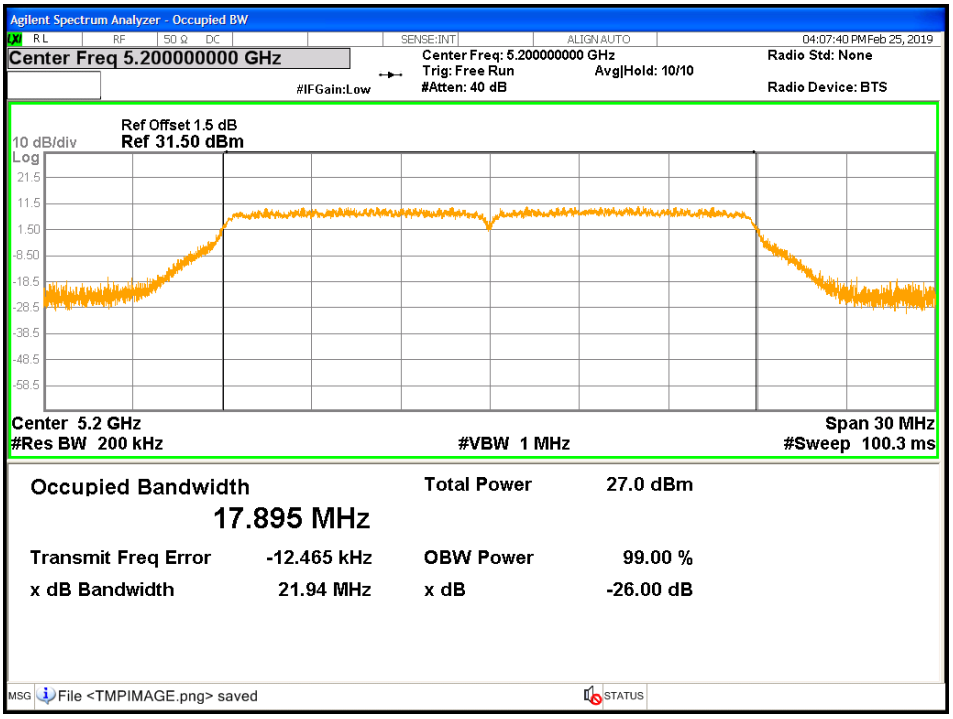


Figure 141: FCC-26dB and 99%-OBW-5200MHz-HT20-1x4-q82-Ch0

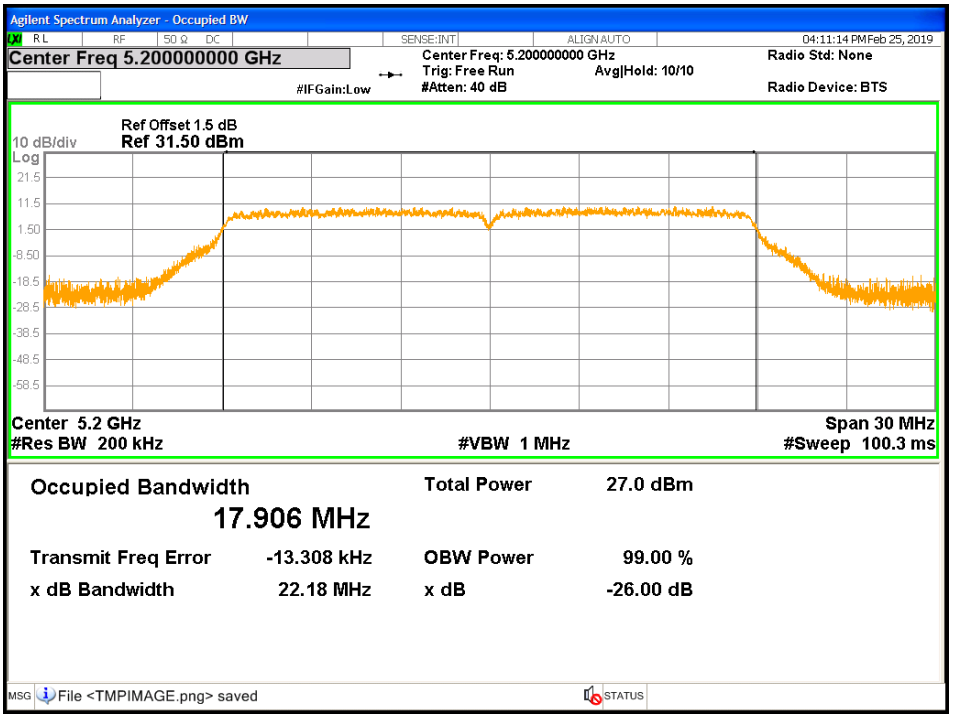


Figure 142: FCC-26dB and 99%-OBW-5200MHz-HT20-1x4-q82-Ch1

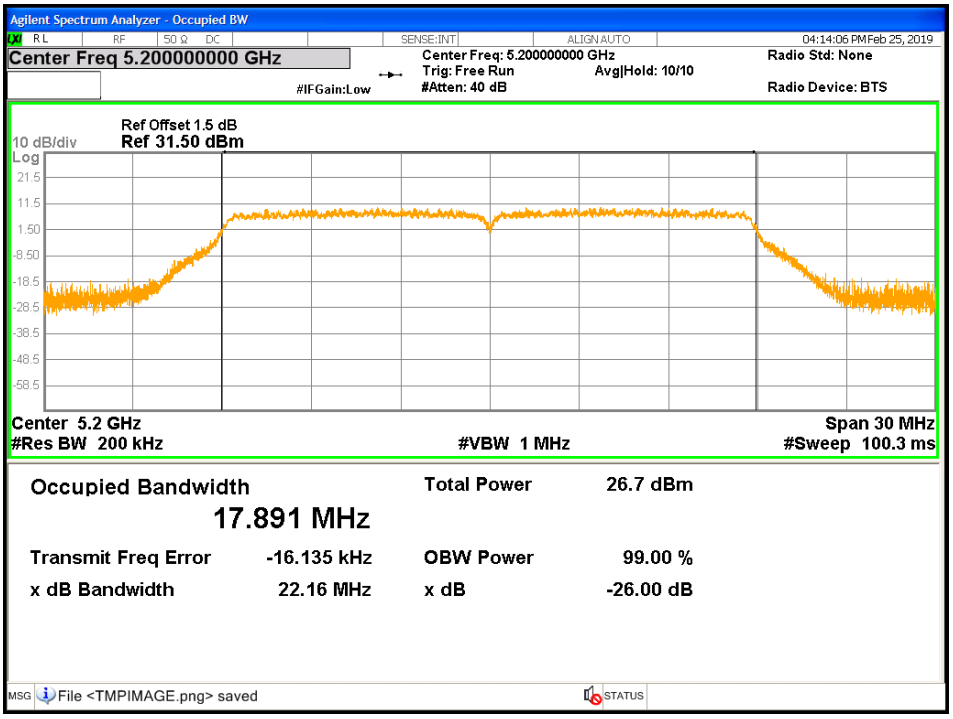


Figure 143: FCC-26dB and 99%-OBW-5200MHz-HT20-1x4-q82-Ch2

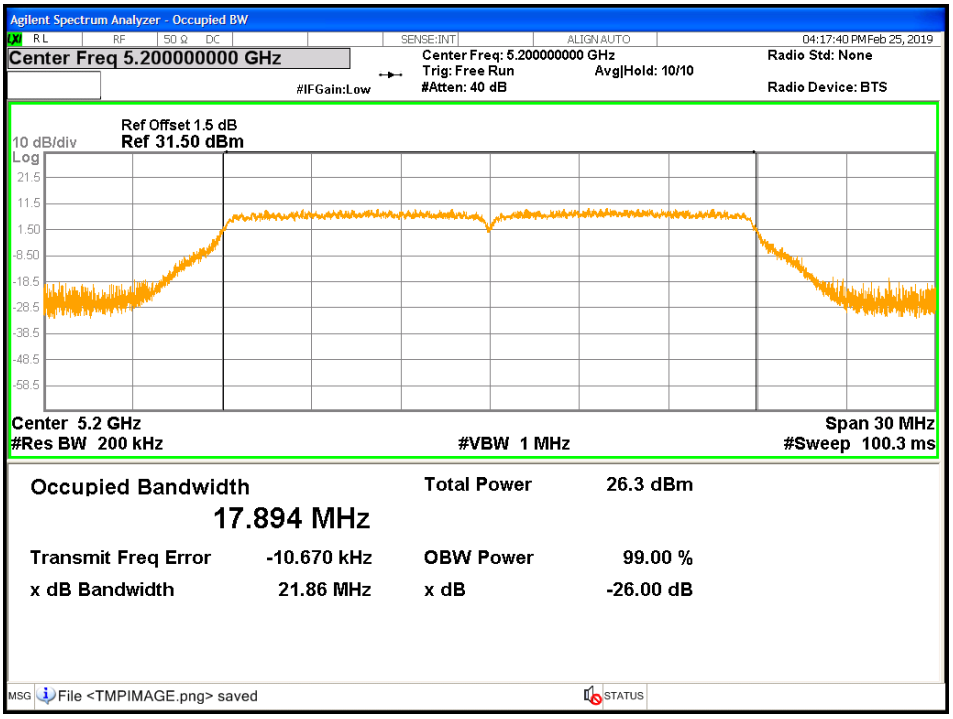


Figure 144: FCC-26dB and 99%-OBW-5200MHz-HT20-1x4-q82-Ch3

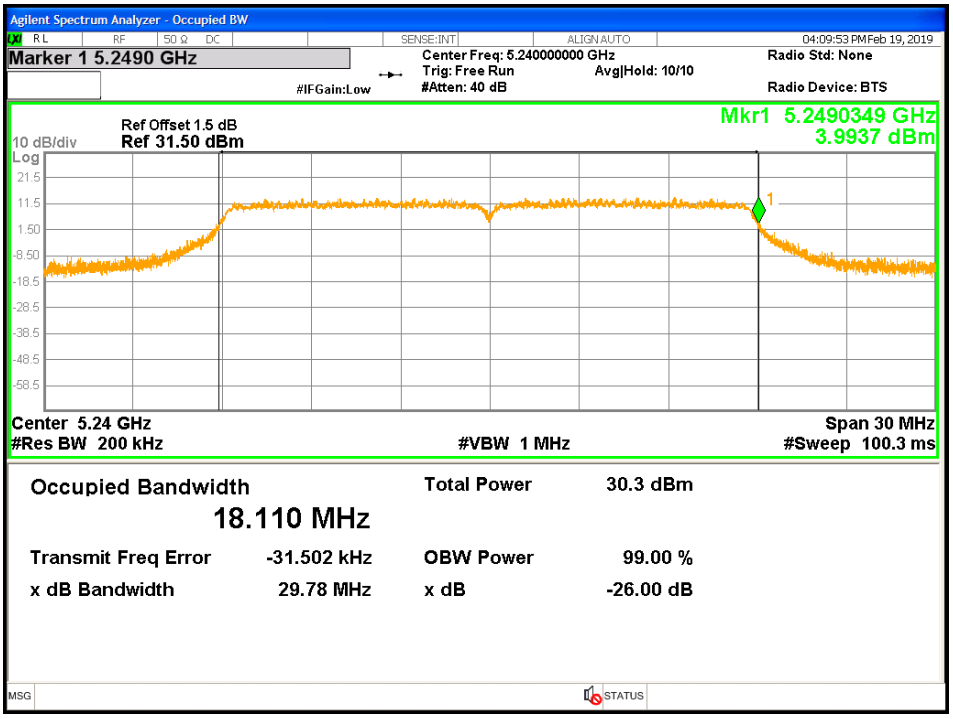


Figure 145: FCC-26dB and 99%-OBW-5240MHz-HT20-4x4-q96-Ch0

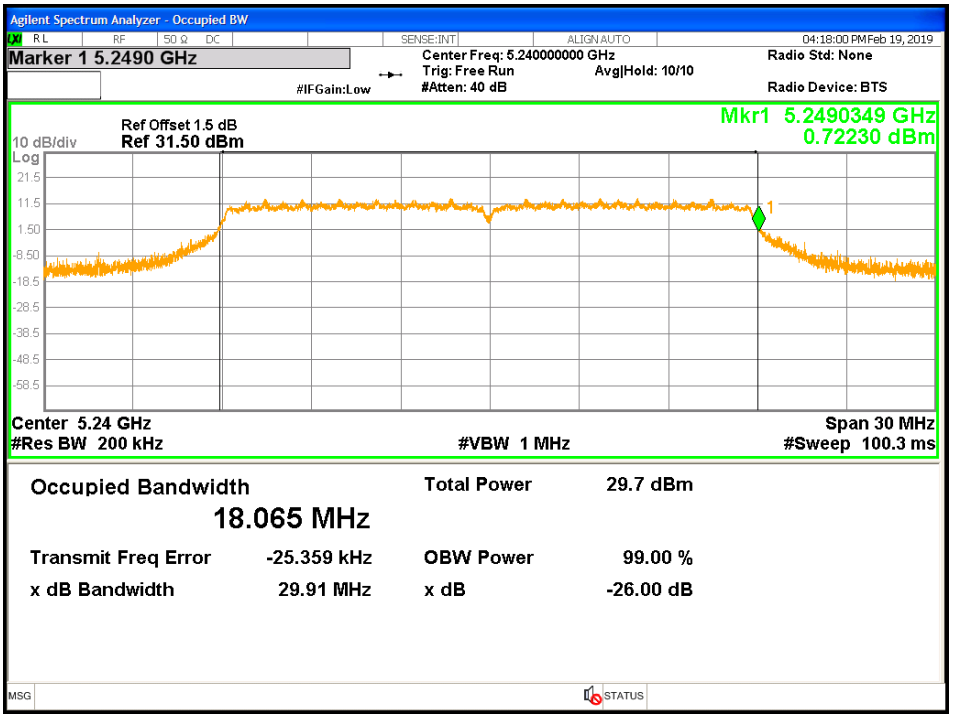


Figure 146: FCC-26dB and 99%-OBW-5240MHz-HT20-4x4-q96-Ch1

Note: The upper edge of 99% bandwidths are less than 5250MHz. All emissions contain in 5150 – 5250 MHz band.

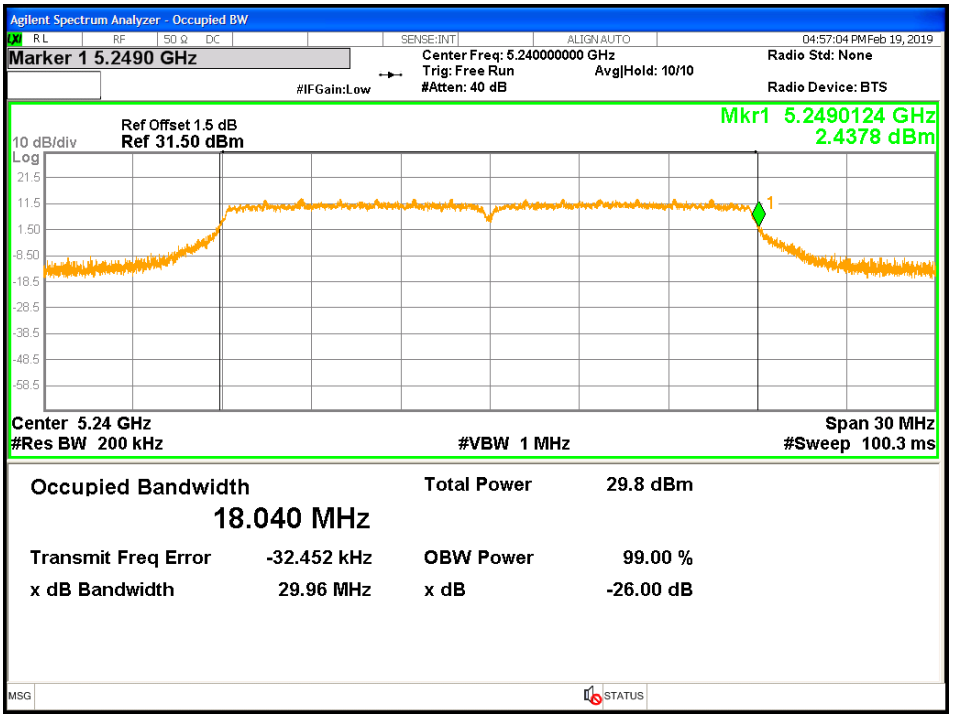


Figure 147: FCC-26dB and 99%-OBW-5240MHz-HT20-4x4-q96-Ch2

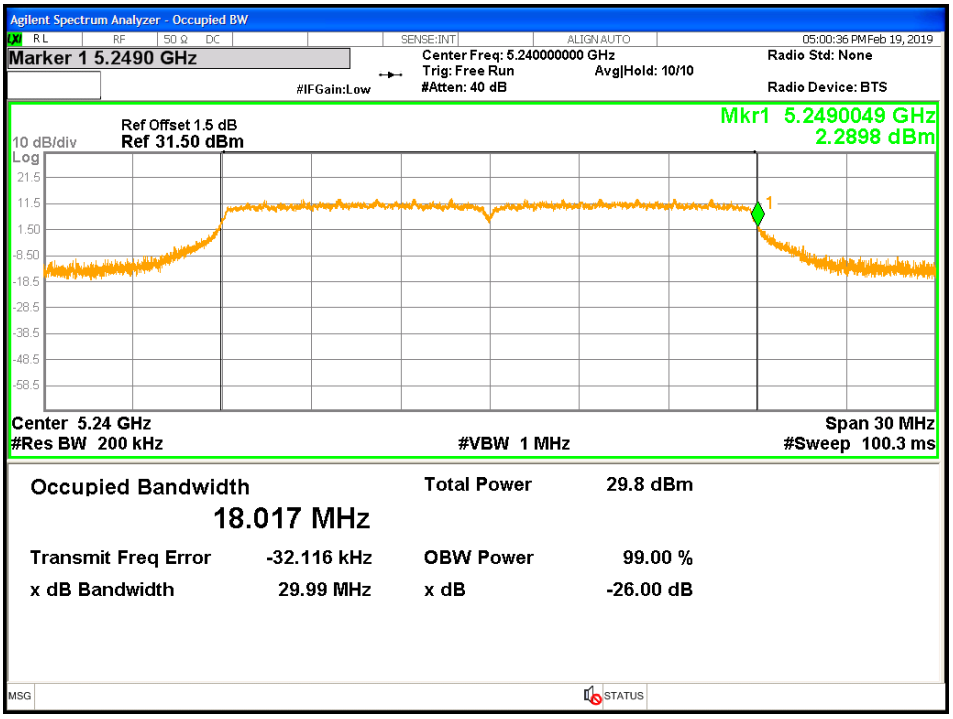


Figure 148: FCC-26dB and 99%-OBW-5240MHz-HT20-4x4-q96-Ch3

Note: The upper edge of 99% bandwidths are less than 5250MHz. All emissions contain in 5150 – 5250 MHz band.

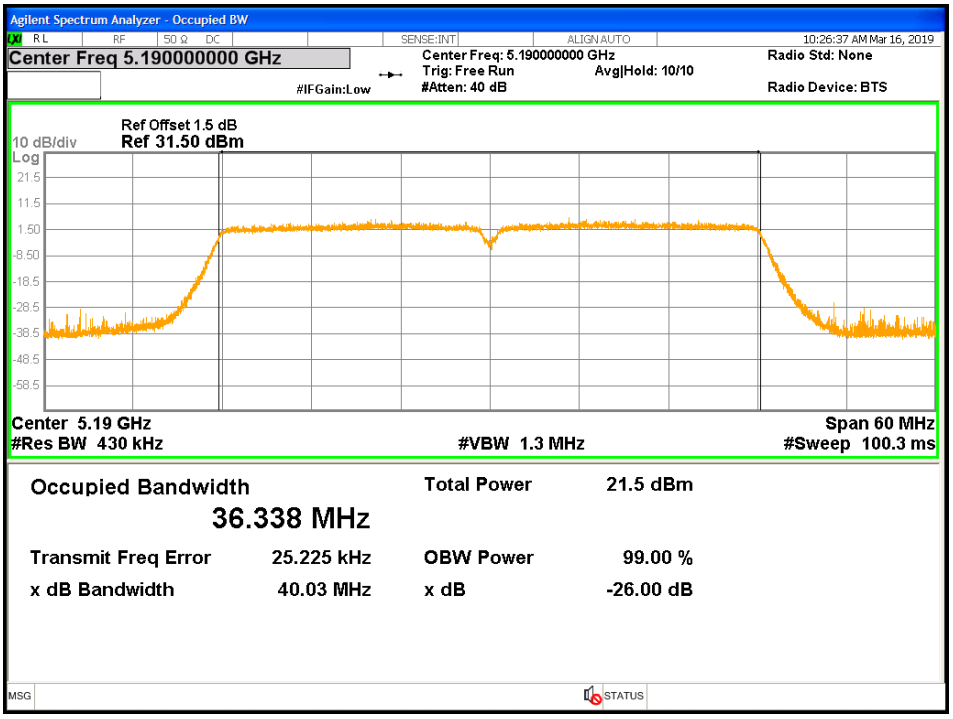


Figure 149: FCC-26dB and 99%-OBW-5190MHz-HT40-1x4-q61-Ch0

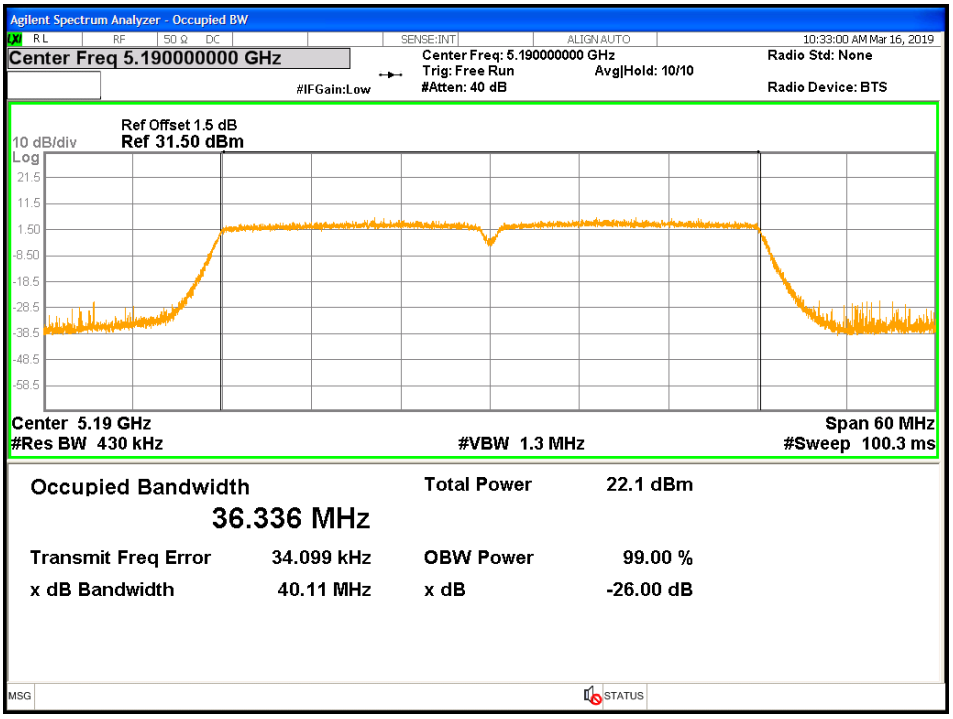


Figure 150: FCC-26dB and 99%-OBW-5190MHz-HT40-1x4-q61-Ch1

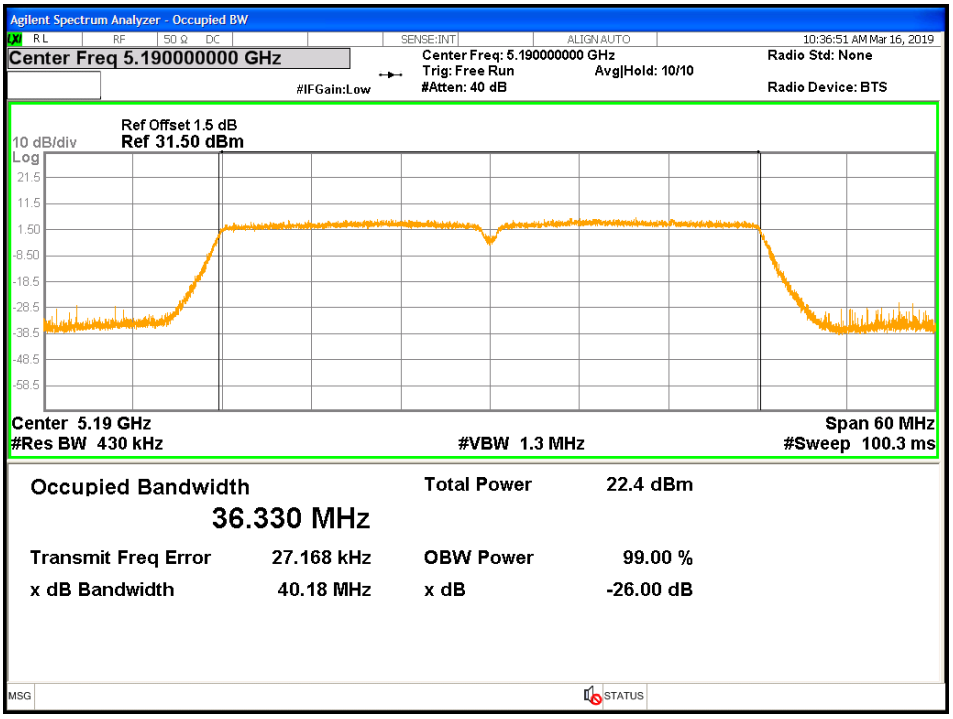


Figure 151: FCC-26dB and 99%-OBW-5190MHz-HT40-1x4-q61-Ch2

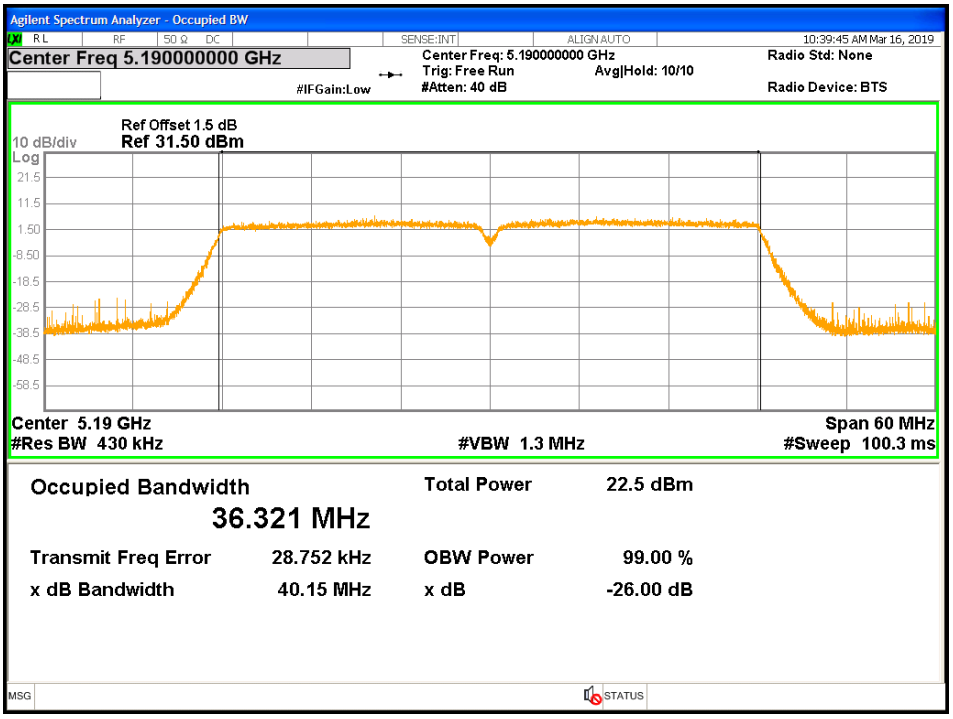


Figure 152: FCC-26dB and 99%-OBW-5190MHz-HT40-1x4-q61-Ch3

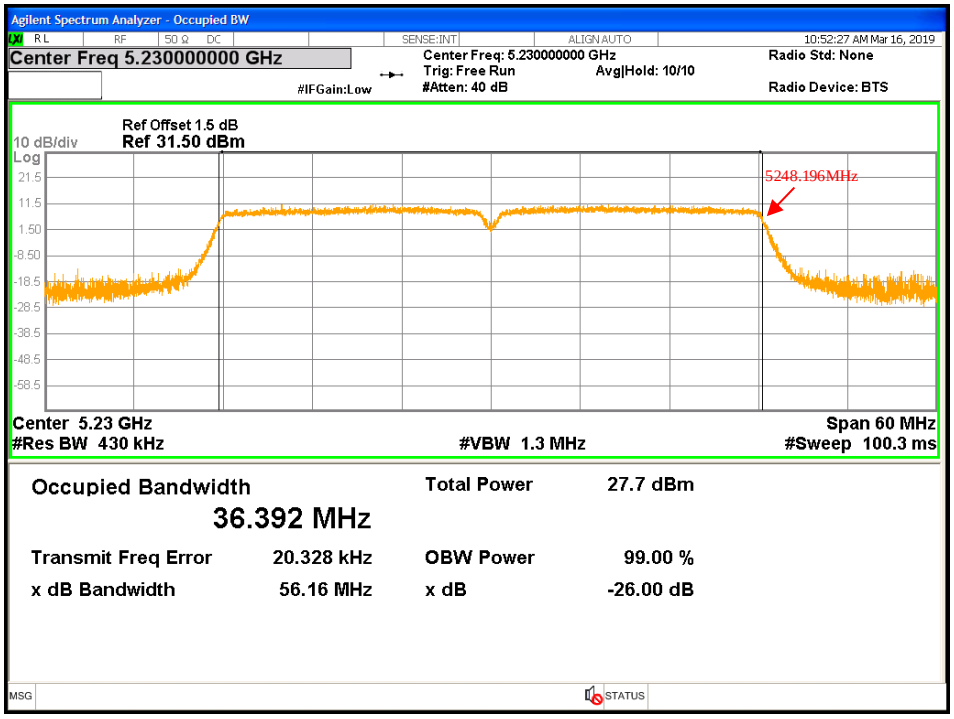


Figure 153: FCC-26dB and 99%-OBW-5230MHz-HT40-1x4-q82-Ch0

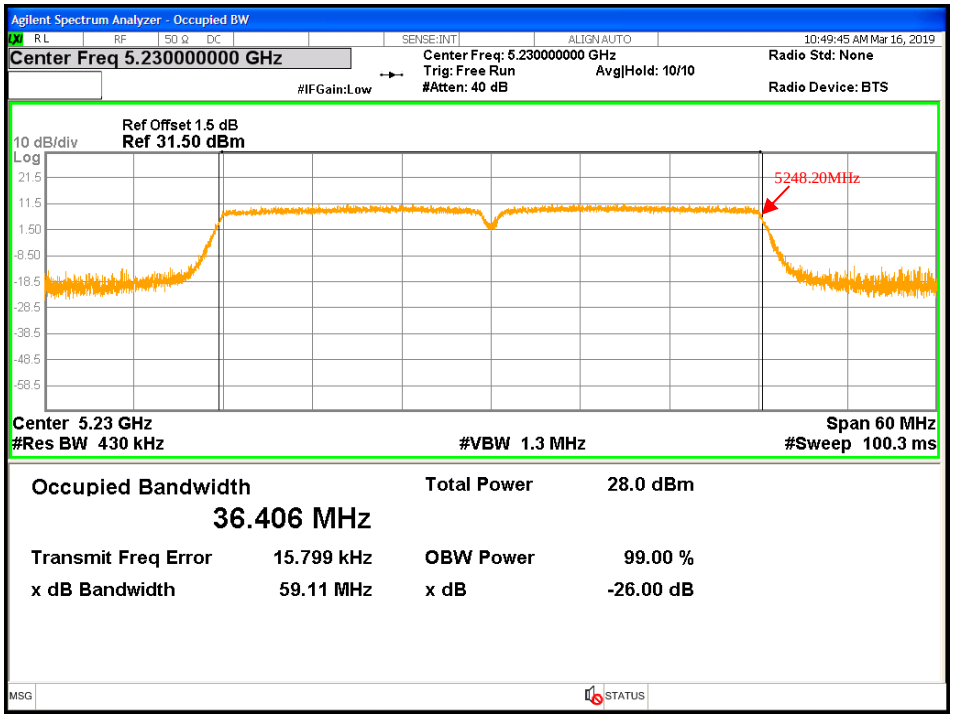


Figure 154: FCC-26dB and 99%-OBW-5230MHz-HT40-1x4-q82-Ch1

Note: The upper edge of 99% bandwidths are less than 5250MHz. All emissions contain in 5150 – 5250 MHz band.

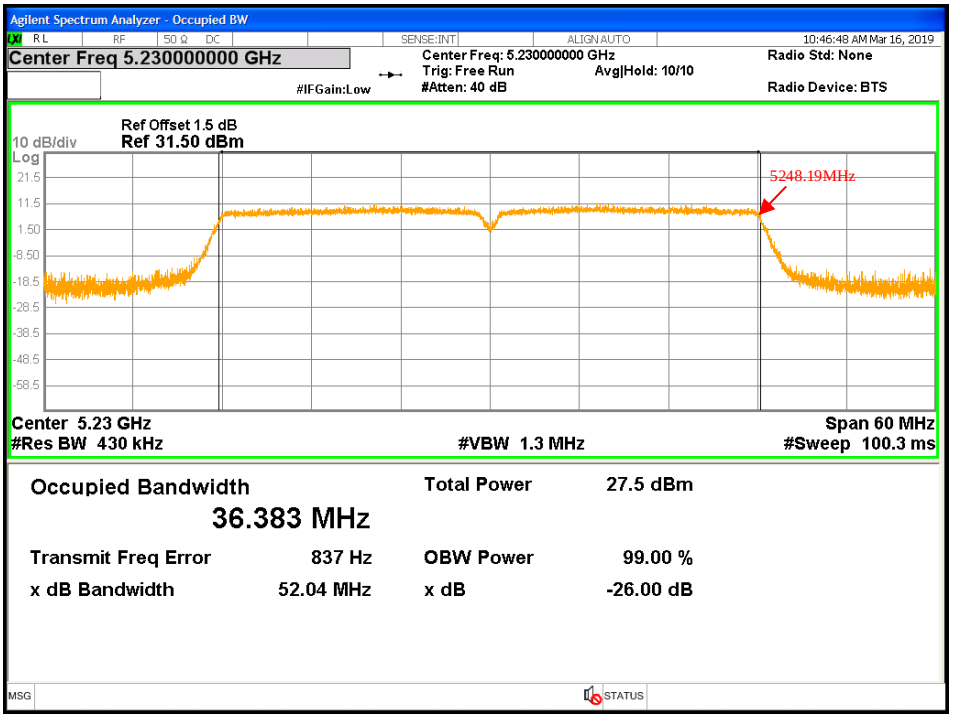


Figure 155: FCC-26dB and 99%-OBW-5230MHz-HT40-1x4-q82-Ch2

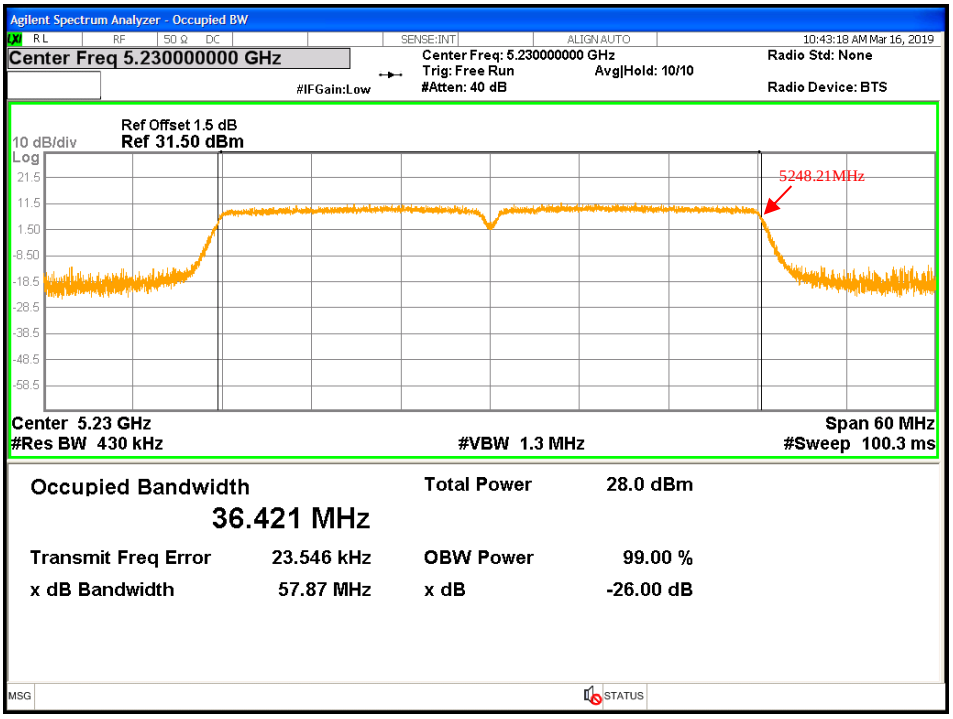


Figure 156: FCC-26dB and 99%-OBW-5230MHz-HT40-1x4-q82-Ch3

Note: The upper edge of 99% bandwidths are less than 5250MHz. All emissions contain in 5150 – 5250 MHz band.

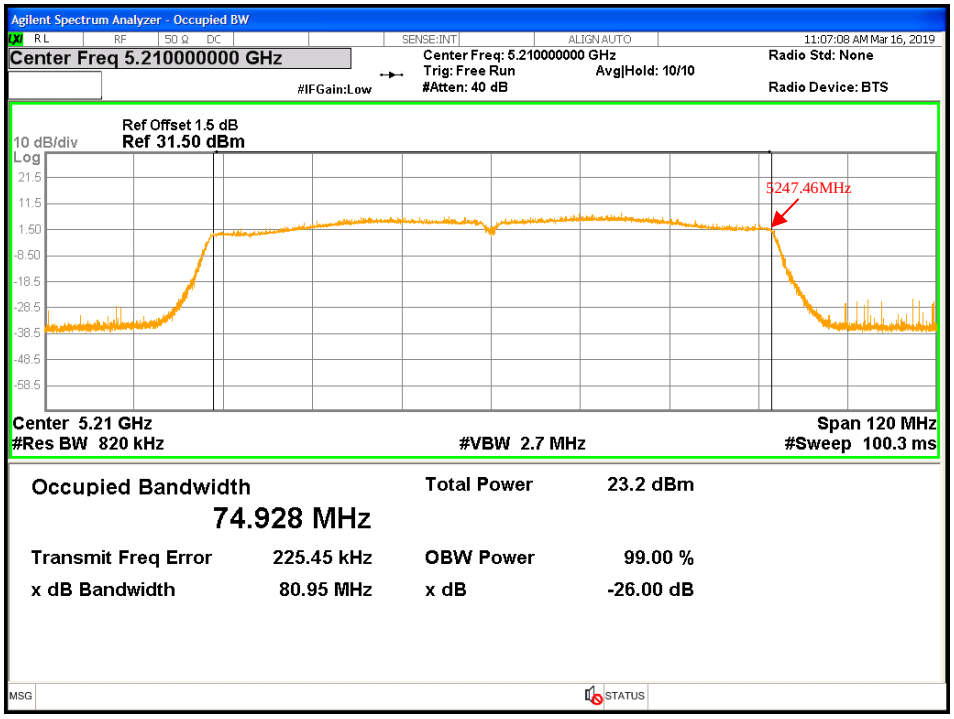


Figure 157: FCC-26dB and 99%-OBW-5210MHz-VHT80-1x4-q60-Ch0

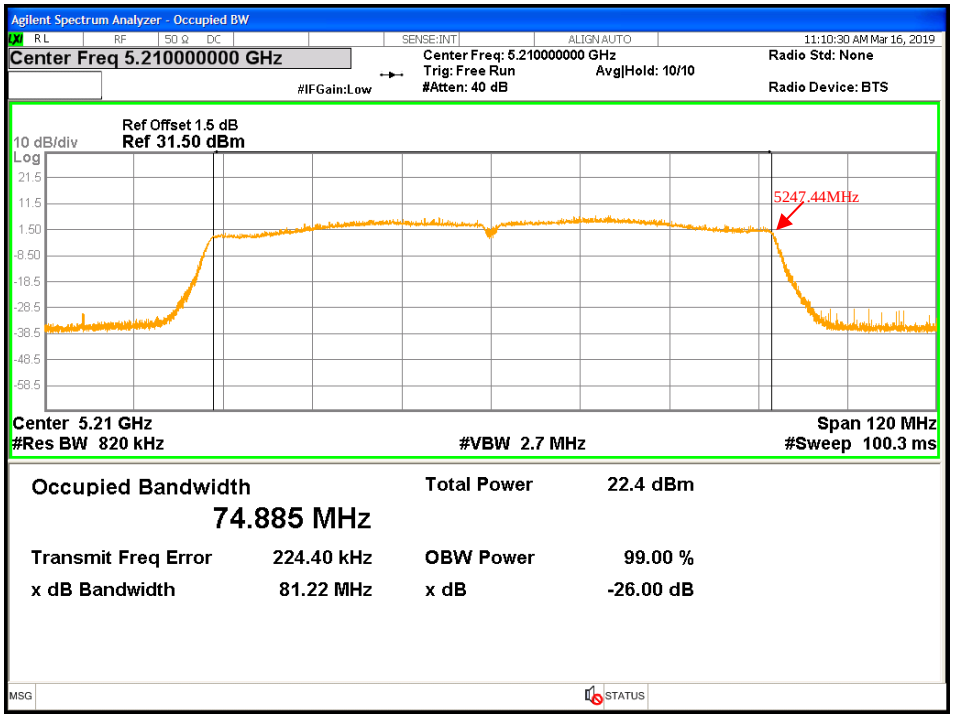


Figure 158: FCC-26dB and 99%-OBW-5210MHz-VHT80-1x4-q60-Ch1

Note: The upper edge of 99% bandwidths are less than 5250MHz. All emissions contain in 5150 – 5250 MHz band.

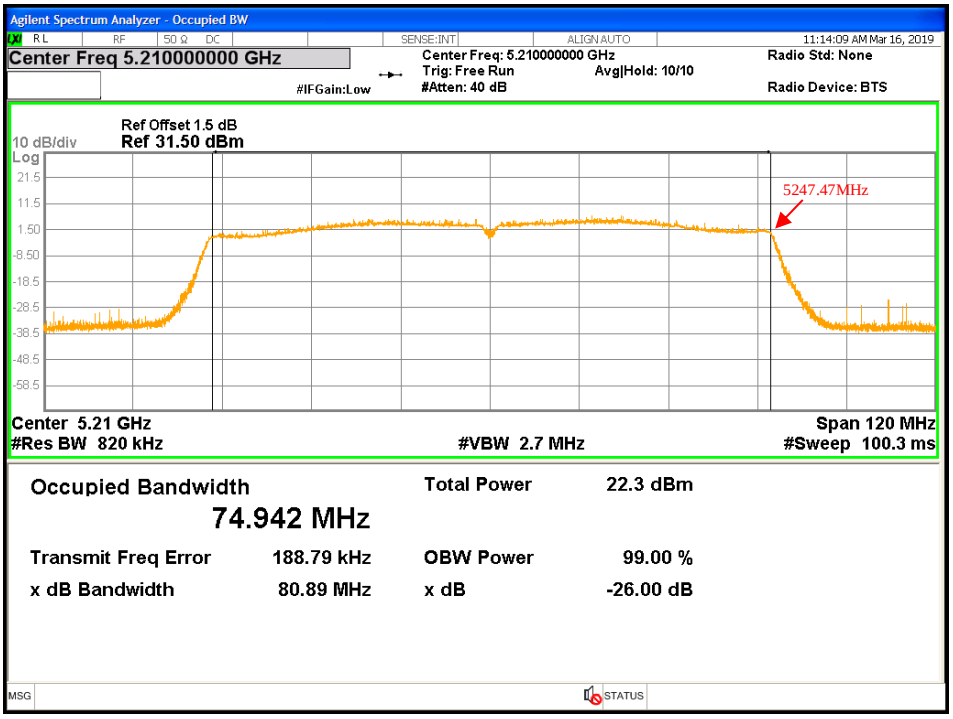


Figure 159: FCC-26dB and 99%-OBW-5210MHz-VHT80-1x4-q60-Ch2

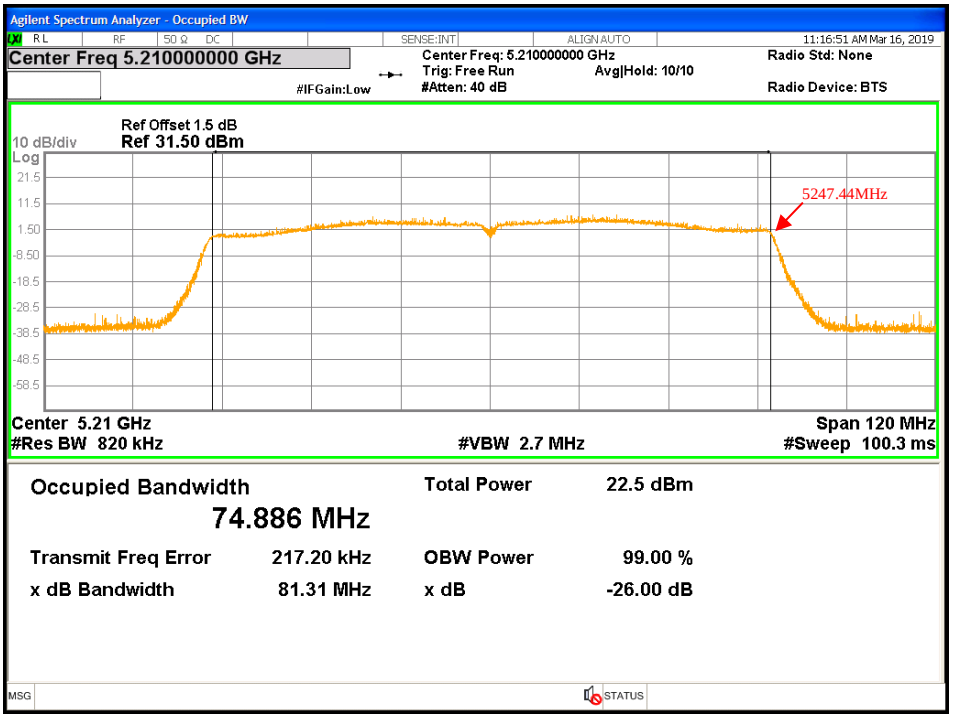


Figure 160: FCC-26dB and 99%-OBW-5210MHz-VHT80-1x4-q60-Ch3

Note: The upper edge of 99% bandwidths are less than 5250MHz. All emissions contain in 5150 – 5250 MHz band.

4.3 Peak Power Spectral Density

According to the CFR47 Part 15.407 (a) and RSS 247 Sect. 6.2.1.1 in the 5.15 – 5.25 GHz band, the spectral power density output of the antenna port shall be as followed listed below during any time interval of continuous transmission.

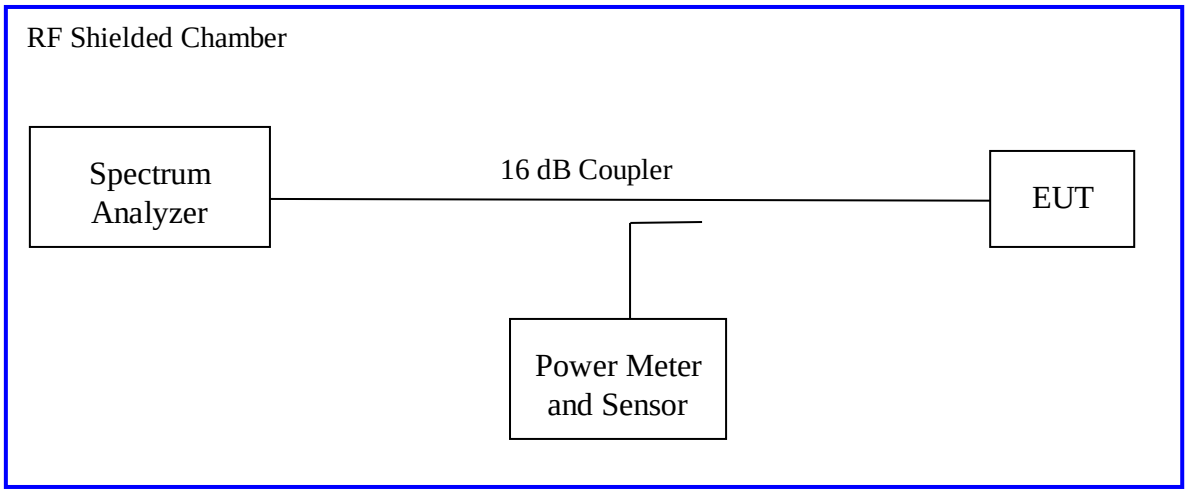
Part 15.407 (a): 17 dBm in any 1 MHz band

RSS 247 Section 6.2.1.1: 10 dBm in any 1 MHz band, E.I.R.P.

4.3.1 Test Method

The conducted method was used to measure the channel power output per ANSI C63.10-2013 Section 12.3.2.2. The measurement was performed with modulation per CFR47 Part 15.407 (a) and RSS 247 Sect. 6.2.1.1. The pre-evaluation was performed to find the worst modes. The worst findings were conducted on 3 channels in each operating frequency range of 5150 MHz to 5250 MHz. The worst sample result indicated below.

Test Setup:



4.3.2 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 7: Peak Power Spectral Density – 802.11a Test Results – Non Beamforming

Test Date: March 13, 2019	**Test By:** Kerwinn Corpus
Test Method: Conducted Measurements	**Power Setting:** See test plan
Antenna Type: PCB	**Max. Antenna Gain:** + 4.8 dBi
Operating Mode: Non Beamforming & Uncorrelated	**Signal State**: Modulated
Ambient Temp.: 22 °C	**Relative Humidity:**48%

802.11a (FCC Limit)

Freq. (MHz)	Ch0 [dBm]	Ch1 [dBm]	Ch2 [dBm]	Ch3 [dBm]	CF [dB]	Max. PSD [dBm]	Limit [dBm]	Margin [dB]
5180	10.17	10.33	9.28	9.47	0.00	10.33	17.00	-6.67
5200	10.43	10.17	9.94	9.36	0.00	10.43	17.00	-6.57
5240	12.16	11.14	12.18	12.60	0.00	12.60	17.00	-4.40

802.11a (RSS Limit)

Freq. (MHz)	Ch0 [dBm]	Ch1 [dBm]	Ch2 [dBm]	Ch3 [dBm]	CF [dB]	Max. PSD [dBm]	Limit [dBm]	Margin [dB]
5180	4.94	5.08	4.31	4.57	0.00	5.08	5.20	-0.12
5200	4.60	5.08	3.95	4.92	0.00	5.08	5.20	-0.12
5240	4.76	5.15	4.13	4.87	0.00	5.15	5.20	-0.05

Note: 1.The highest output power was observed at 6Mbps, 1 Data Stream.
2. FCC Limit = 17 dBm. Antenna gain is less than +6 dBi
3. RSS-247 Limit = 10 dBm – 4.80 dBi = 5.20 dBm.

Table 8: Peak Power Spectral Density – 802.11n HT20 Test Results – Non Beamforming Cont.

Test Date: March 13, 2019	**Test By:** Kerwinn Corpus
Test Method: Conducted Measurements	**Power Setting:** See test plan
Antenna Type: PCB	**Max. Antenna Gain:** + 4.8 dBi
Operating Mode: Non Beamforming & Uncorrelated	**Signal State**: Modulated
Ambient Temp.: 22 °C	**Relative Humidity:**48%

802.11n HT20 (FCC Limit)

Freq. (MHz)	Ch0 [dBm]	Ch1 [dBm]	Ch2 [dBm]	Ch3 [dBm]	CF [dB]	Max. PSD [dBm]	Limit [dBm]	Margin [dB]
5180	7.72	8.15	7.71	7.69	0.00	8.15	17.00	-8.85
5200	9.83	9.96	9.75	9.66	0.00	9.96	17.00	-7.04
5240	13.20	13.07	12.95	12.73	0.00	13.20	17.00	-3.80

802.11n HT20 (RSS Limit)

Freq. (MHz)	Ch0 [dBm]	Ch1 [dBm]	Ch2 [dBm]	Ch3 [dBm]	CF [dB]	Max. PSD [dBm]	Limit [dBm]	Margin [dB]
5180	4.96	5.06	4.78	4.47	0.00	5.06	5.20	-0.14
5200	5.06	5.09	4.34	3.83	0.00	5.09	5.20	-0.11
5240	4.18	4.79	4.28	4.66	0.00	4.79	5.20	-0.41

Note: 1.The highest output power was observed at HT20 MCS0, 1 Data Stream.
2. FCC Limit = 17 dBm. Antenna gain is less than +6 dBi
3. RSS-247 Limit = 10 dBm – 4.80 dBi = 5.20 dBm.

Table 9: Peak Power Spectral Density – 802.11n HT40 Test Results – Non Beamforming Cont.

Test Date: March 13, 2019	**Test By:** Kerwinn Corpus
Test Method: Conducted Measurements	**Power Setting:** See test plan
Antenna Type: PCB	**Max. Antenna Gain:** + 4.8 dBi
Operating Mode: Non Beamforming & Uncorrelated	**Signal State**: Modulated
Ambient Temp.: 22 °C	**Relative Humidity:**48%

802.11n HT40 (FCC Limit)

Freq. (MHz)	Ch0 [dBm]	Ch1 [dBm]	Ch2 [dBm]	Ch3 [dBm]	CF [dB]	Max. PSD [dBm]	Limit [dBm]	Margin [dB]
5190	1.21	1.81	2.16	2.25	0.16	2.41	17.00	-14.59
5230	7.09	7.89	6.93	7.56	0.16	8.05	17.00	-8.95

802.11n HT40 (RSS Limit)

Freq. (MHz)	Ch0 [dBm]	Ch1 [dBm]	Ch2 [dBm]	Ch3 [dBm]	CF [dB]	Max. PSD [dBm]	Limit [dBm]	Margin [dB]
5190	1.21	1.81	2.16	2.25	0.16	2.41	5.20	-2.79
5230	4.16	4.40	3.99	4.54	0.16	4.70	5.20	-0.50

Note: 1.The highest output power was observed at HT40 MCS0, 1 Data Stream.
2. FCC Limit = 17 dBm. Antenna gain is less than +6 dBi
3. RSS-247 Limit = 10 dBm – 4.80 dBi = 5.20 dBm.

Table 10: Peak Power Spectral Density – 802.11AC VHT80 Test Results – Non Beamforming Cont.

Test Date: March 13, 2019	**Test By:** Kerwinn Corpus
Test Method: Conducted Measurements	**Power Setting:** See test plan
Antenna Type: PCB	**Max. Antenna Gain:** + 4.8 dBi
Operating Mode: Non Beamforming & Uncorrelated	**Signal State**: Modulated
Ambient Temp.: 22 °C	**Relative Humidity:**48%

802.11ac VHT80 (FCC Limit)

Freq. (MHz)	Ch0 [dBm]	Ch1 [dBm]	Ch2 [dBm]	Ch3 [dBm]	CF [dB]	Max. PSD [dBm]	Limit [dBm]	Margin [dB]
5210	-0.21	-0.82	-0.71	-0.81	0.41	0.20	17.00	-16.80

802.11ac VHT80 (RSS Limit)

Freq. (MHz)	Ch0 [dBm]	Ch1 [dBm]	Ch2 [dBm]	Ch3 [dBm]	CF [dB]	Max. PSD [dBm]	Limit [dBm]	Margin [dB]
5210	-0.21	-0.82	-0.81	-0.81	0.41	0.20	5.20	-5.00

Note: 1.The highest output power was observed at VHT80 MCS0, 1 Data Stream.
2. FCC Limit = 17 dBm. Antenna gain is less than +6 dBi
3. RSS-247 Limit = 10 dBm – 4.80 dBi = 5.20 dBm.

Table 11: Peak Power Spectral Density – 802.11n HT20 Test Results – Beamforming

Test Date: March 13, 2019	**Test By:** Kerwinn Corpus
Test Method: Conducted Measurements	**Power Setting:** See test plan
Antenna Type: PCB	**Directional Antenna Gain:** + 8.2 dBi
Operating Mode: Beamforming & Correlated	**Signal State**: Modulated
Ambient Temp.: 22 °C	**Relative Humidity:**48%

802.11n HT20 (FCC Limit)

Freq. [MHz]	Spectra Σ [dBm]	CF [dB]	Total Spectra Σ [dBm]	Limit [dBm]	Margin [dB]
5180	12.53	0.00	12.53	14.80	-2.27
5200	14.44	0.00	14.44	14.80	-0.36
5240	14.76	0.00	14.76	14.80	-0.04

802.11n HT20 (RSS Limit)

Freq. [MHz]	Spectra Σ [dBm]	CF [dB]	Total Spectra Σ [dBm]	Limit [dBm]	Margin [dB]
5180	1.67	0.00	1.67	1.80	-0.13
5200	1.71	0.00	1.71	1.80	-0.09
5240	1.58	0.00	1.58	1.80	-0.22

Note: 1.The highest output power was observed at HT20 MCS0, 4 Data Streams.
2. The sum of Ch0 + Ch1 + Ch2 + Ch3 = Total PSD.
3. FCC Limit = 17 dBm – (8.2 dBi – 6 dBi) = 14.8 dBm.
4. RSS-247 Limit = 10 dBm – 8.2 dBi = 1.8 dBm.