

TEST REPORT



CTK Co., Ltd.

(Ho-dong), 113, Yejik-ro, Cheoin-gu,
Yongin-si, Gyeonggi-do, Korea
Tel: +82-31-339-9970
Fax: +82-31-624-9501

Report No.:
CTK-2020-01890
Page (1) / (146) Pages

1. Client

- Name : Samsung Electronics Co Ltd
- Address : 19 Chapin Rd, Building D. Pine Brook, New Jersey, United States
- Date of Receipt : 2020-04-13

2. Manufacturer

- Name : Samsung Electronics Co., Ltd.
- Address : 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Republic of Korea

3. Use of Report : For FCC Certification

4. Test Sample / Model: RF4420d-D1A

5. Date of Test : 2020-04-13 to 2020-05-19

6. Test Standard(method) used : FCC 47 CFR Part 2, 27

7. Testing Environment: Temp.: (24 ± 1) °C, Humidity: (43 ± 1) % R.H.

8. Test Results : Compliance

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This Test Report cannot be reproduced, except in full.

Affirmation	Tested by	Technical Manager
	Bong-jun, Jang: (Signature)	Young-taek, Lee: (Signature)

2019-05-20

Republic of KOREA **CTK Co., Ltd.**



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REPORT REVISION HISTORY

Date	Revision	Page No
2019-05-20	Issued (CTK-2020-01890)	all

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1. General Information

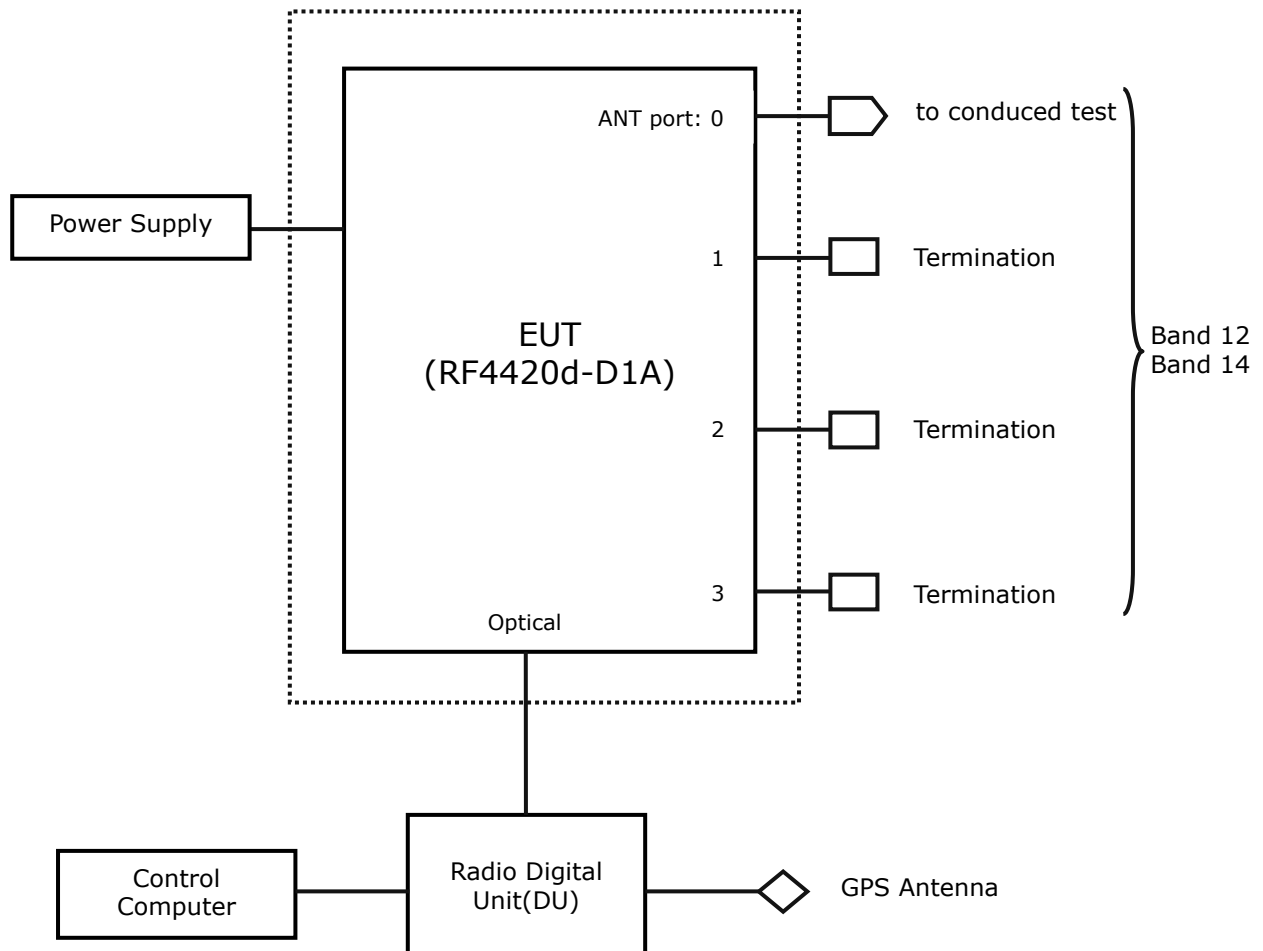
1.1 Client Information

Company	Samsung Electronics Co., Ltd.
Contact Point	129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Republic of Korea
Contact Person	Name : Kim, Jong-in E-mail : jered.kim@samsung.com Tel : +82-31-279-3096

1.2 Product Information

FCC ID	A3LRF4420D-D1A
Product Description	RRU(RF4420d)
Model name	RF4420d-D1A
Power Supply	-48 Vdc
Operating Frequency	- Band 12 DL : 729 MHz- 744 MHz, UL : 699 MHz - 714 MHz - Band 14 DL : 758 MHz- 768 MHz, UL : 788 MHz - 798 MHz
RF Output Power	- Band 12 BW 5 MHz : 20 W / path(Total 4 path = 80 W) BW 10 MHz : 40 W / path(Total 4 path = 160 W) BW 15 MHz : 40 W / path(Total 4 path = 160 W) - Band 14 BW 10 MHz : 40 W / path(Total 4 path =160 W) - Band 12 + Band 14 BW 5 MHz + BW 10 MHz : 60 W / path(Total 4 path = 240 W) BW 10 MHz + BW 10 MHz : 80 W / path(Total 4 path = 320 W) BW 15 MHz + BW 10 MHz : 80 W / path(Total 4 path = 320 W)
Channel Bandwidth	- Band 12 : 5 MHz, 10 MHz, 15 MHz - Band 14 : 10 MHz
Modulation Type	QPSK, 16QAM, 64QAM, 256QAM
FCC Rule	Part 2 : FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS Part 27 : MISCELLANEOUS WIRELESS COMMUNICATIONS SERVICES Part 90 : PRIVATE LAND MOBILE RADIO SERVICES KDB Publication 662911 D01 Multiple Transmitter Output v02r01

1.3 Configurations



2. Facility and Accreditations

2.1 Test Facility

The measurement facility is located at (Ho-dong), 113, Yejik-ro, Cheoin-gu, Yong-in-si, Gyeonggi-do, Korea.

2.2 Laboratory Accreditations and Listings

Country	Agency	Registration Number
USA	FCC	805871
CANADA	ISED	8737A-2
KOREA	NRRA	KR0025

2.3 Calibration Details of Equipment Used for Measurement

Test equipment and test accessories are calibrated on regular basis. The maximum time between calibrations is one year or what is recommended by the manufacturer, whichever is less. All test equipment calibrations are traceable to the Korea Research Institute of Standards and Science (KRISS), therefore, all test data recorded in this report is traceable to KRISS.

3. Test Specifications

3.1 Standards

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 2, Part 27.

Section	Test Items	Results
§2.1046, §27.50(c)(3)	RF output power	Compliant
§2.1049	Occupied bandwidth	Compliant
§2.1051, §27.53(h)	Spurious Emissions at Antenna Terminals	Compliant
§2.1051, §27.53(h)	Band edge	Compliant
§2.1053, §27.53(h)	Spurious Radiated Emissions	Compliant
§2.1055(a)(1), §27.54	Frequency Stability over Temperature variation	Compliant
§2.1055(d), §27.54	Frequency Stability over Voltage variation	Compliant

3.2 Mode of operation during the test

The EUT is operated in a manner representative of the typical of the equipments. During at testing, system components were manipulated within the confines of typical usage to maximize each emission. All modulation(QPSK, 16QAM, 64QAM, 256QAM) modes were tests. The results are only attached worst cases.



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Operating band and Frequency range

Band 12	Transmit	729 MHz - 744 MHz
	Receive	699 MHz - 714 MHz

Operating Configurations

Supported configurations	Single carrier
Spectrum Operation	-

Single carrier rated total output power as a sum of all carriers

Band type	Bandwidth	Positions	Frequency [MHz]	Power [W]	Output port	Total Power(sum)[W]
Band 12	5 MHz	Bottom	731.5	20	4 TX	80
		Middle	736.5			
		Top	741.5			
	10 MHz	Bottom	734	40	4 TX	160
		Middle	736.5			
		Top	739			
	15 MHz	Middle	736.5	40	4 TX	160

3.3 Maximum Measurement Uncertainty

The value of the measurement uncertainty for the measurement of each parameter.
Coverage factor $k = 2$, Confidence levels of 95 %

Description	Uncertainty
Conducted RF output power	1.5 dB
Occupied bandwidth	0.1 MHz
Spurious emission at antenna terminals	3.0 dB
Radiated spurious emissions ($f \leq 1$ GHz)	4.0 dB
Radiated spurious emissions ($f > 1$ GHz)	5.0 dB
Frequency stability	0.1 kHz

3.4 Standards Environmental Test conditions

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

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4. RF output power

Test Requirements :

§ 2.1046 Measurements required : RF power output :

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

§ 27.50 Power limits and duty cycle.

- (c) The following power and antenna height requirements apply to stations transmitting in the 600 MHz band and the 698-746 MHz band:
 - (3) Fixed and base stations transmitting a signal with an emission bandwidth greater than 1 MHz must not exceed an ERP of 1000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts/MHz ERP in accordance with Table 3 of this section;

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Test Procedures :

According to FCC §2.1046 (a), for transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in §2.1033(c). The electrical characteristics of the radio frequency load attached to the output terminals when this is made shall be stated.

- 1) The radio frequency load attached to the EUT antenna terminal was 50 Ohm. The loss of the cables the test system is calibrated to correct the reading.
- 2) The spectrum analyzer was set to RMS Detector function and Average mode.
- 3) The resolution bandwidth of the spectrum analyzer was comparable to the emission bandwidth.
- 4) The conducted emission level is measured at each antenna port and then summed mathematically to determine the total emission level from the device.

Note 1 : The conducted emission level is measured at each antenna port and then summed mathematically to determine the total emission level from the device.

Note 2: Maximum ERP is sufficient level to pass the limit.

Note 3 : Sum data is in a tolerance of specification provided from manufacturer.

Maximum output power for one port :

BW 5 MHz : **43.01 dBm (20 W)**

BW 10, 15, 20 MHz : **46.02 dBm (40 W)**

Maximum output sum power :

BW 5 MHz : 20 W *4 = **49.03 dBm (80 W)**

BW 10, 15, 20 MHz : 40 W *4 = **52.04 dBm (160 W)**

Measured sum maximum power : **52.63 dBm (183.23 W)**

Test Results :

Test Data :BW 5MHz

Channel	Modulation	Output Power [dBm]				Total Power	
		Test antenna port				[dBm]	[W]
		0	1	2	3		
Bottom	QPSK	43.10	43.60	43.56	43.46	49.46	88.31
	16QAM	43.31	43.77	43.58	43.45	49.55	90.16
	64QAM	43.36	43.56	43.53	43.22	49.44	87.90
	256QAM	43.29	43.86	43.57	43.47	49.57	90.57
Middle	QPSK	43.14	43.57	43.53	43.43	49.44	87.90
	16QAM	43.27	43.73	43.63	43.54	49.57	90.57
	64QAM	43.24	43.55	43.51	43.23	49.41	87.30
	256QAM	43.24	43.77	43.62	43.51	49.56	90.36
Top	QPSK	43.13	43.53	43.52	43.41	49.42	87.50
	16QAM	43.18	43.77	43.56	43.48	49.52	89.54
	64QAM	43.42	43.54	43.50	43.22	49.44	87.90
	256QAM	43.21	43.72	43.54	43.46	49.51	89.33

Test Data : BW 10MHz

Channel	Modulation	Output Power [dBm]				Total Power	
		Test antenna port				[dBm]	[W]
		0	1	2	3		
Bottom	QPSK	46.44	46.54	46.46	46.27	52.45	175.79
	16QAM	46.33	46.77	46.53	46.38	52.53	179.06
	64QAM	46.06	46.70	46.49	46.40	52.44	175.39
	256QAM	46.19	46.70	46.49	46.40	52.47	176.60
Middle	QPSK	46.20	46.61	46.51	46.27	52.42	174.58
	16QAM	46.56	46.59	46.49	46.40	52.53	179.06
	64QAM	46.18	46.70	46.52	46.39	52.47	176.60
	256QAM	46.17	46.65	46.46	46.35	52.43	174.98
Top	QPSK	46.08	46.63	46.47	46.27	52.39	173.38
	16QAM	46.18	46.60	46.51	46.27	52.41	174.18
	64QAM	46.17	46.79	46.58	46.51	52.54	179.47
	256QAM	46.06	46.64	46.43	46.36	52.40	173.78

Test Data : BW 15MHz

Channel	Modulation	Output Power [dBm]				Total Power	
		Test antenna port				[dBm]	[W]
		0	1	2	3		
Middle	QPSK	46.34	46.91	46.61	46.57	52.63	183.23
	16QAM	46.09	46.70	46.59	46.50	52.50	177.83
	64QAM	46.26	46.71	46.51	46.45	52.51	178.24
	256QAM	46.13	46.67	46.57	46.43	52.48	177.01

Test Plot at Output Power

**BW 5MHz, Bottom
ANT0**

QPSK



16QAM



64QAM



256QAM



ANT1

QPSK



16QAM



64QAM



256QAM



ANT2

QPSK



16QAM



64QAM



256QAM



ANT3

QPSK



16QAM



64QAM



256QAM



**BW 5MHz, Middle
ANT0**

QPSK



16QAM



64QAM



256QAM



ANT1

QPSK



16QAM



64QAM



256QAM



ANT2

QPSK



16QAM



64QAM



256QAM



ANT3

QPSK



16QAM



64QAM



256QAM



**BW 5MHz, Top
ANT0**

QPSK



16QAM



64QAM



256QAM



ANT1

QPSK



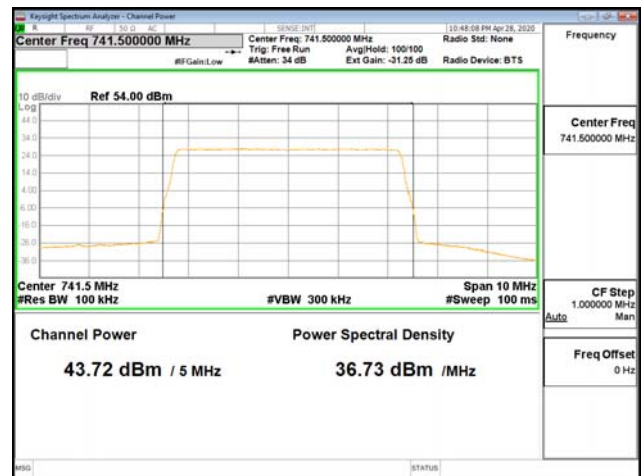
16QAM



64QAM



256QAM



ANT2

QPSK



16QAM



64QAM



256QAM



ANT3

QPSK



16QAM



64QAM



256QAM

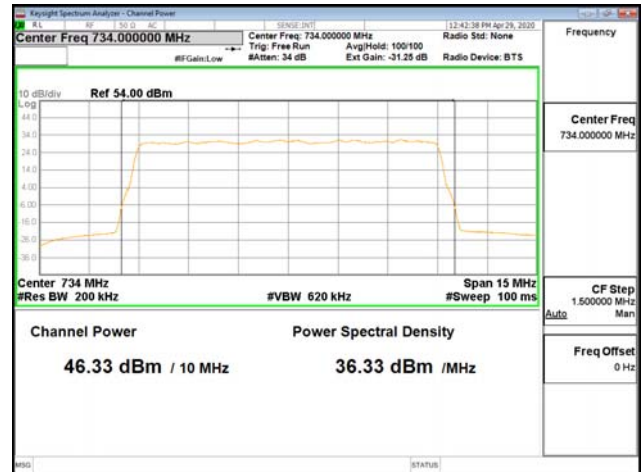


**BW 10MHz, Bottom
ANT0**

QPSK



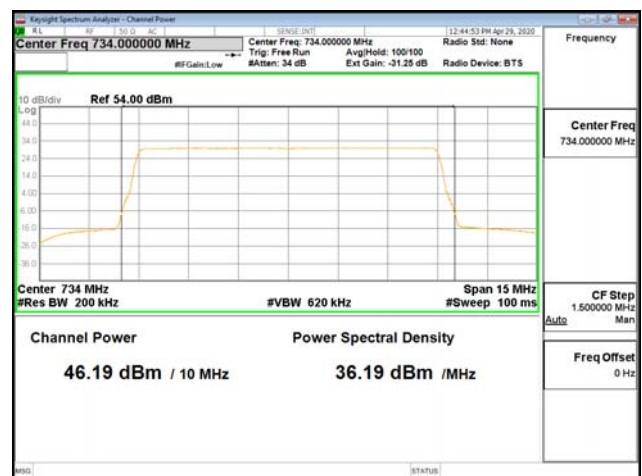
16QAM



64QAM

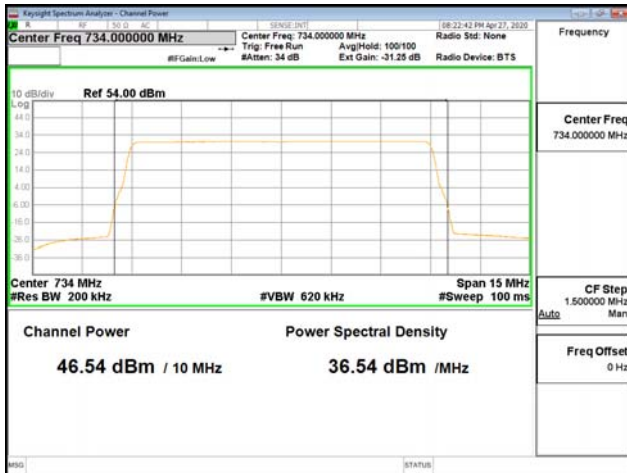


256QAM

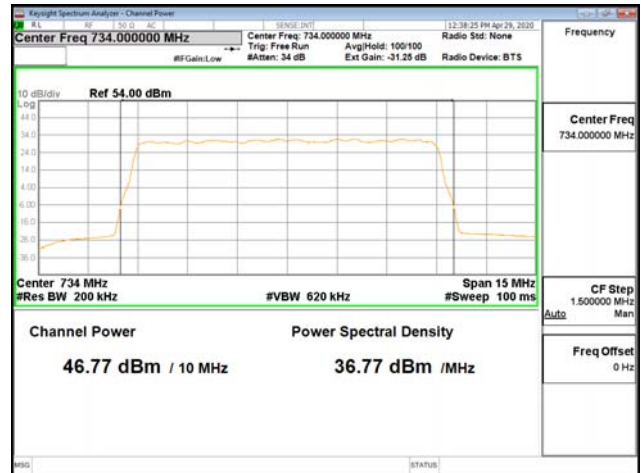


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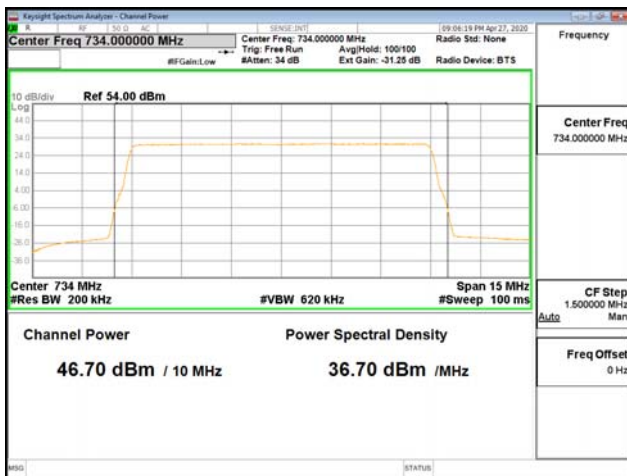
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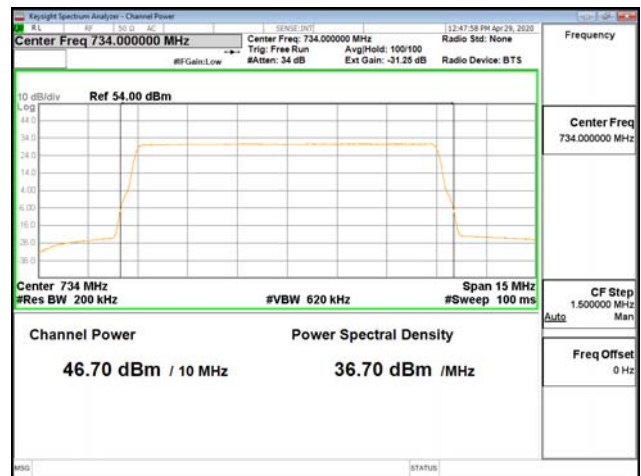
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64QAM

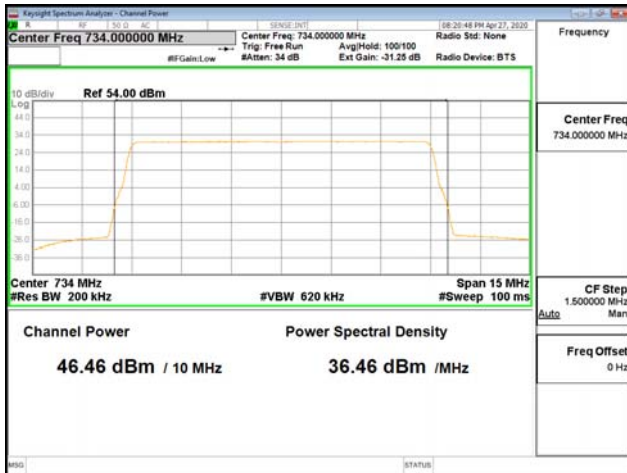


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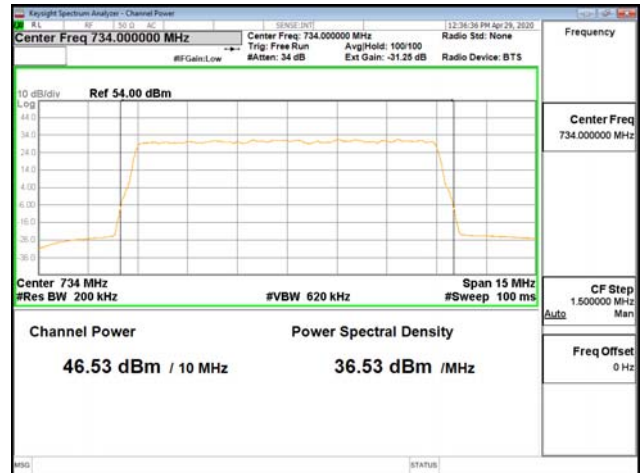


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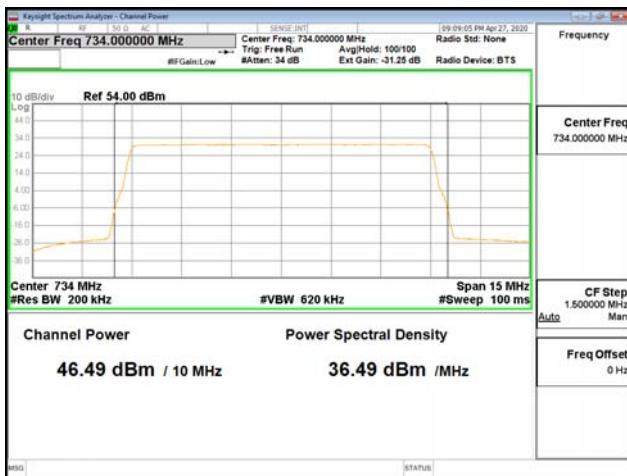
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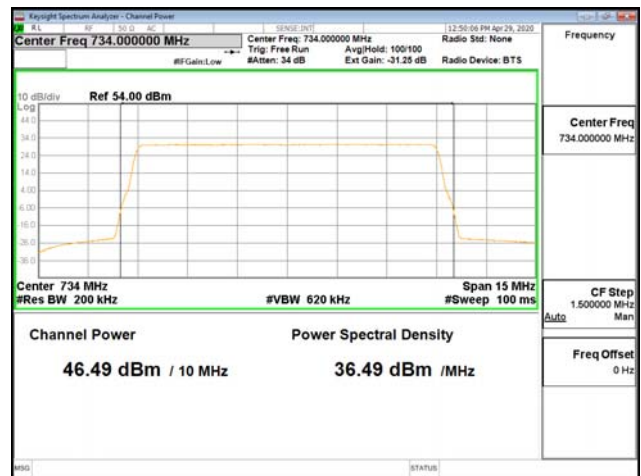
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64QAM

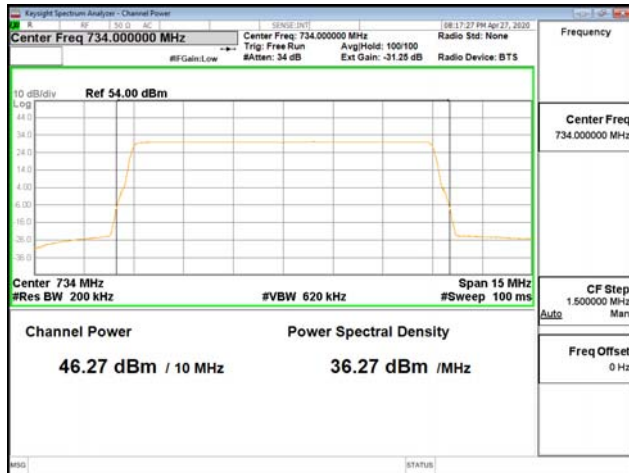


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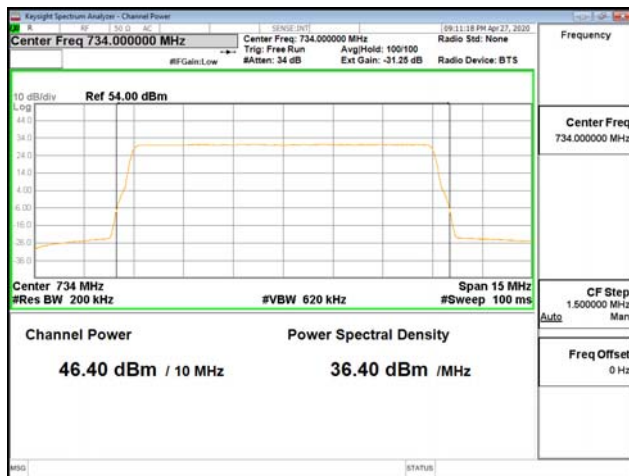
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16QAM



64QAM

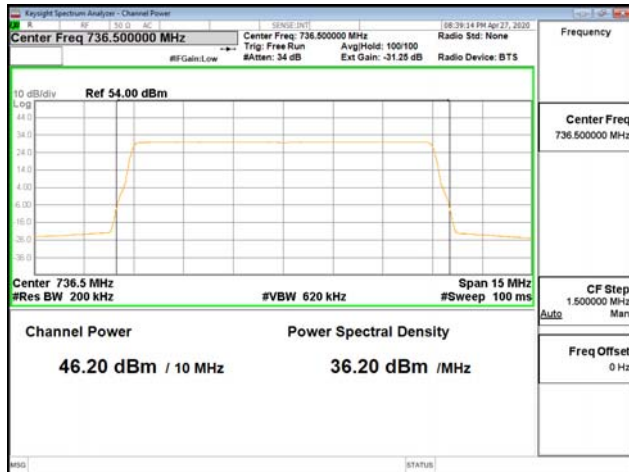


256QAM



**BW 10MHz, Middle
ANT0**

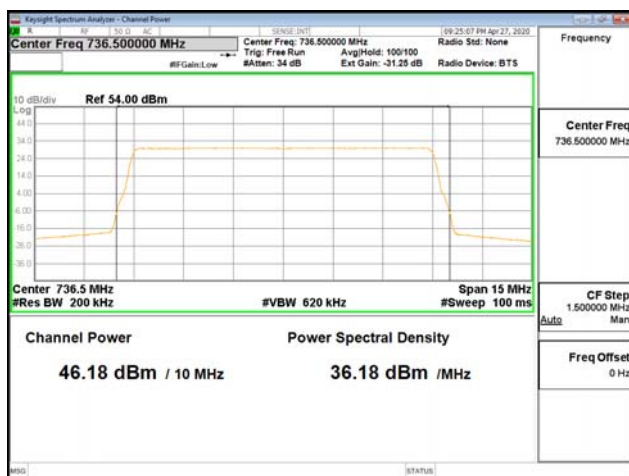
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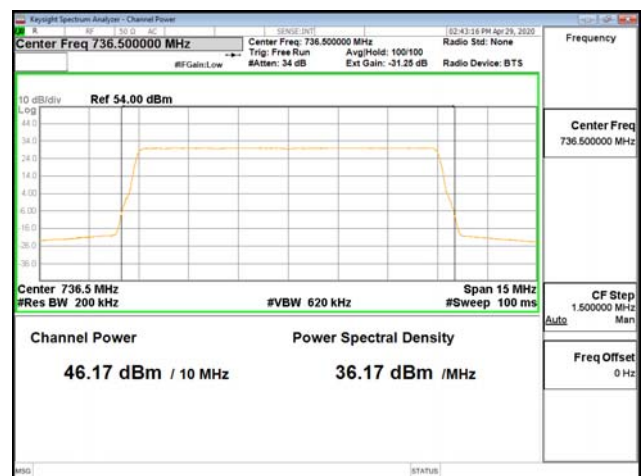
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64QAM

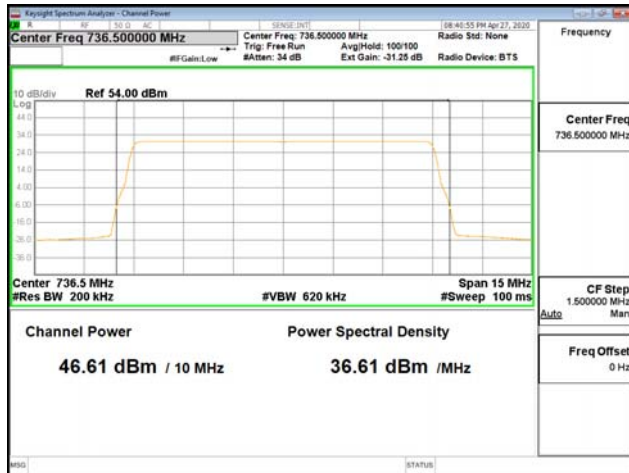


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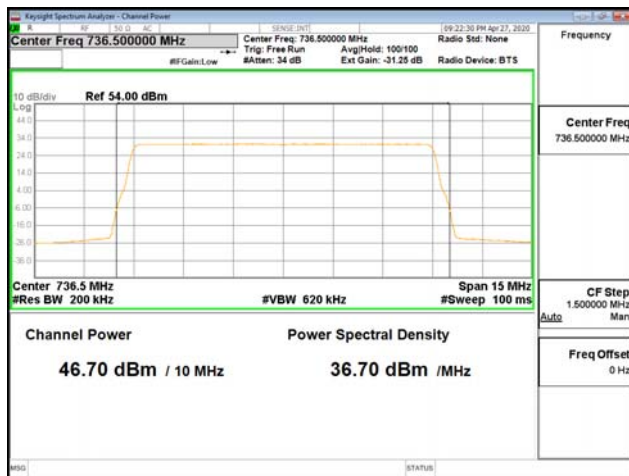
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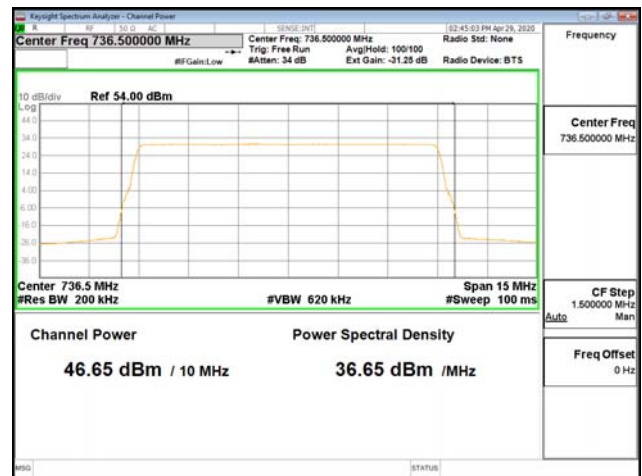
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64QAM

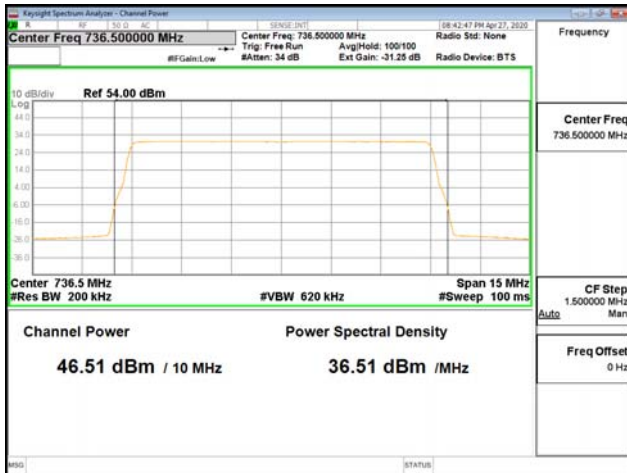


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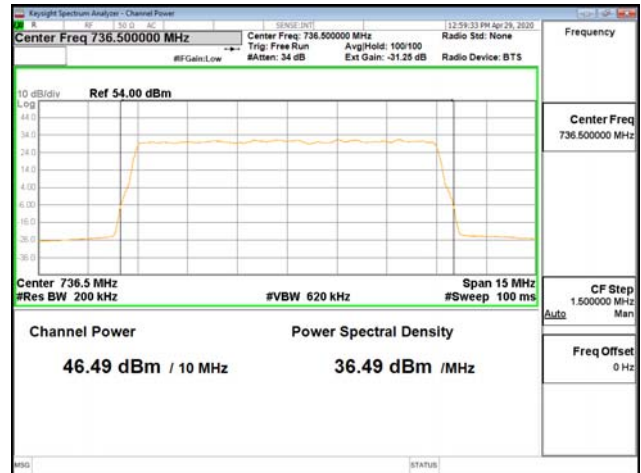


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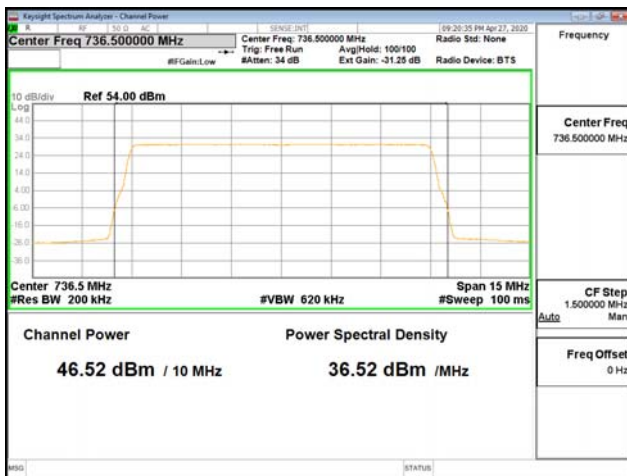
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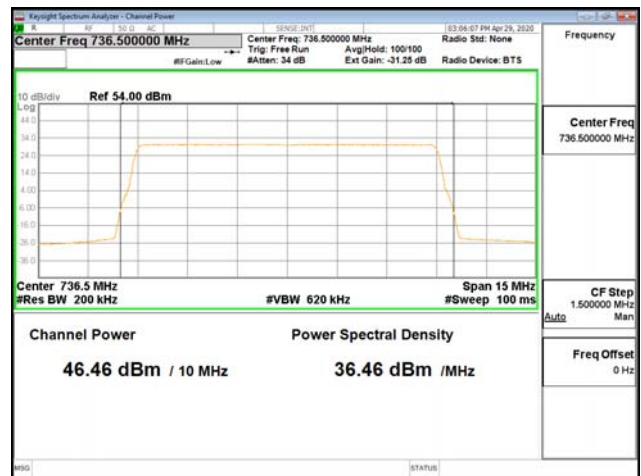
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64QAM



256QAM

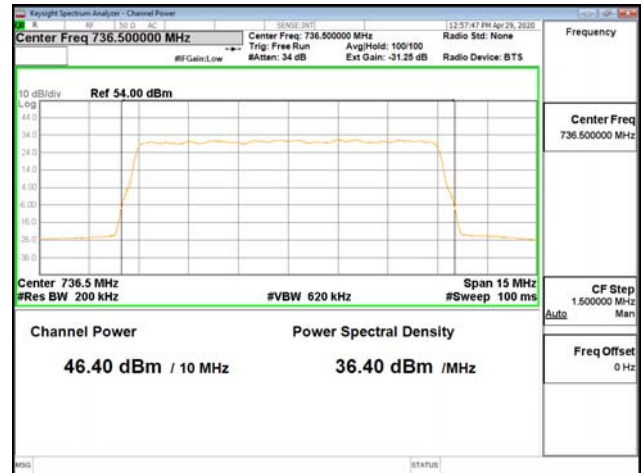


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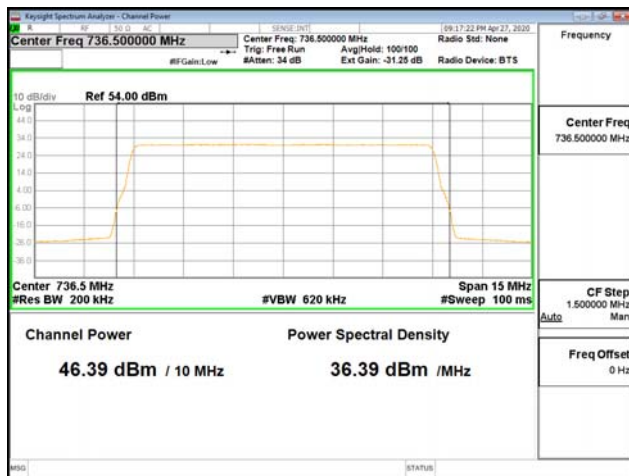
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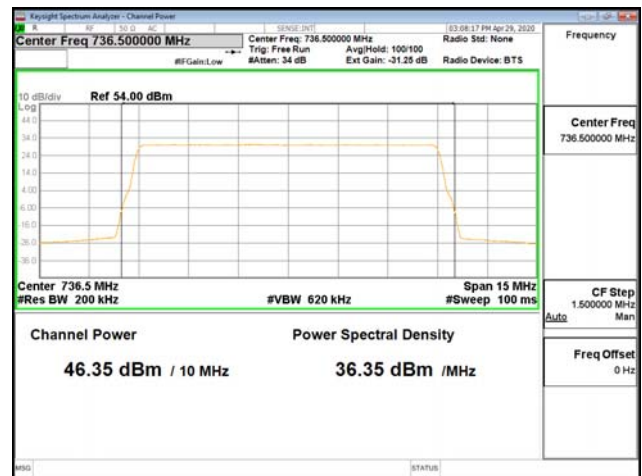
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64QAM

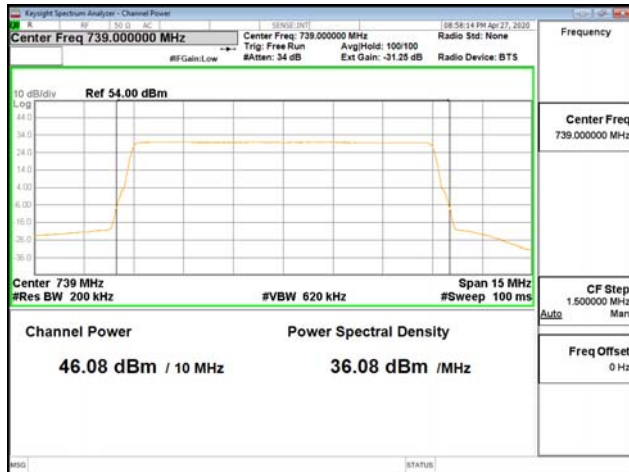


256QAM



**BW 10MHz, Top
ANT0**

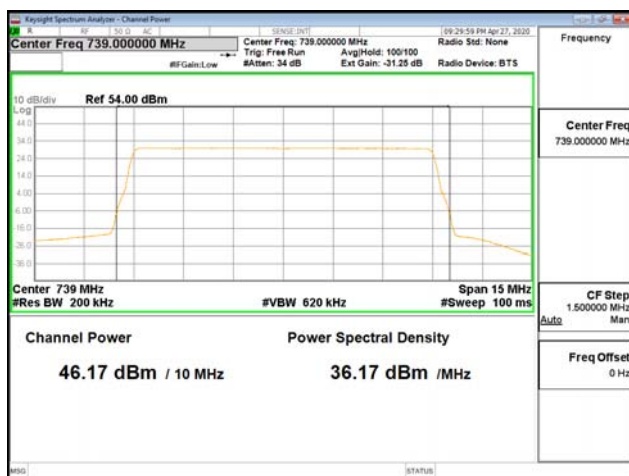
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16QAM



64QAM

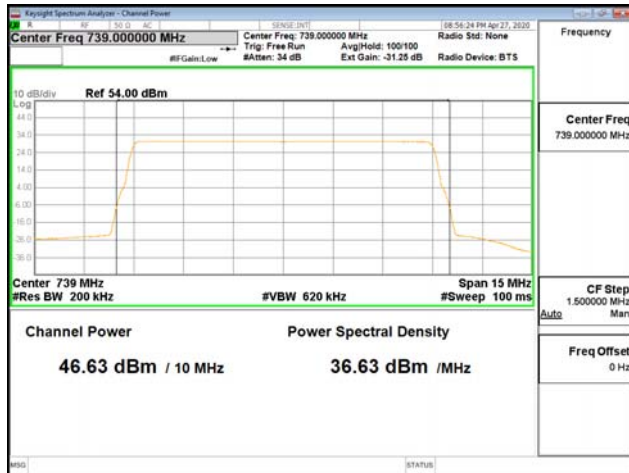


256QAM



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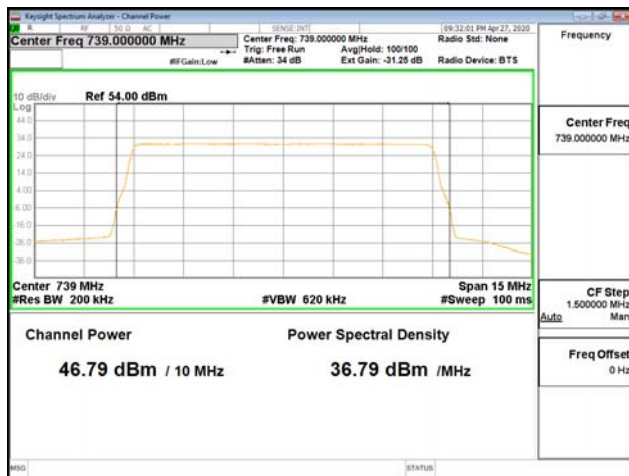
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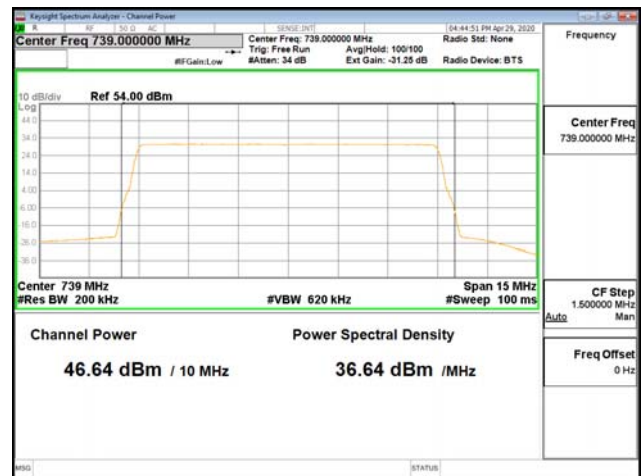
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64QAM

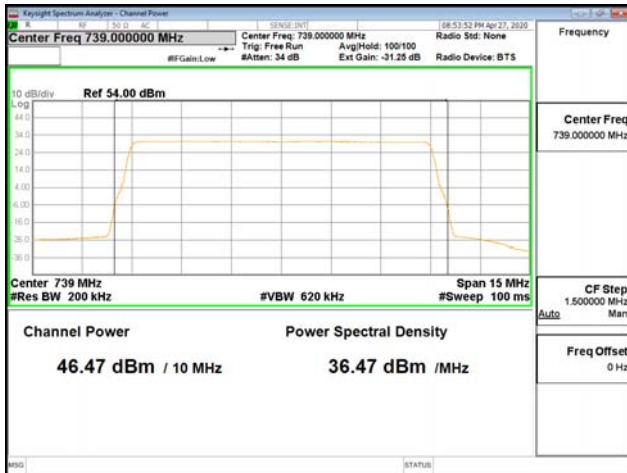


256QAM

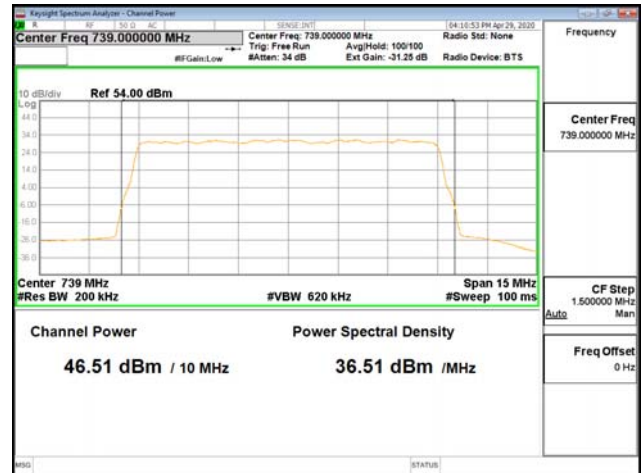


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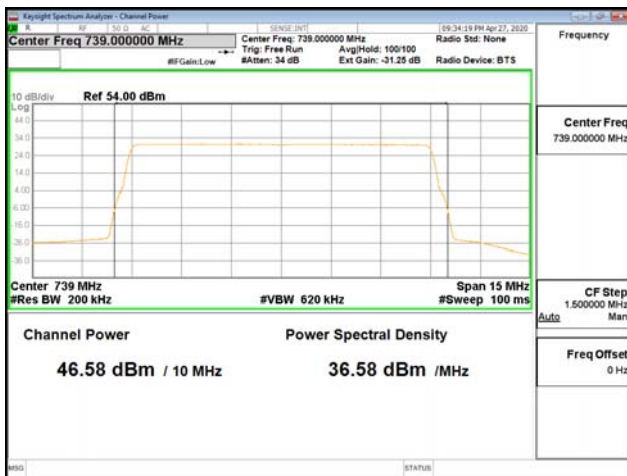
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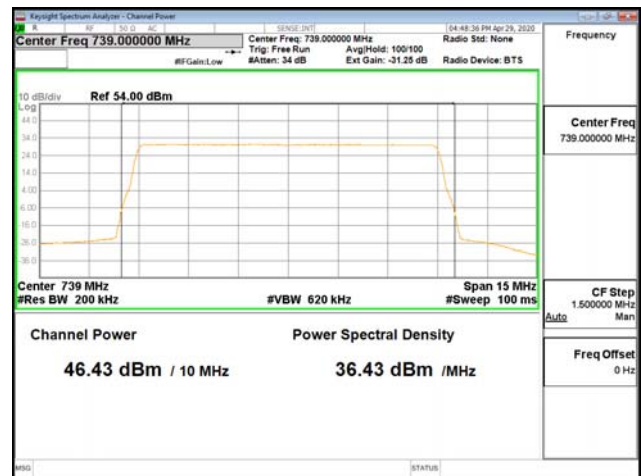
16QAM



64QAM

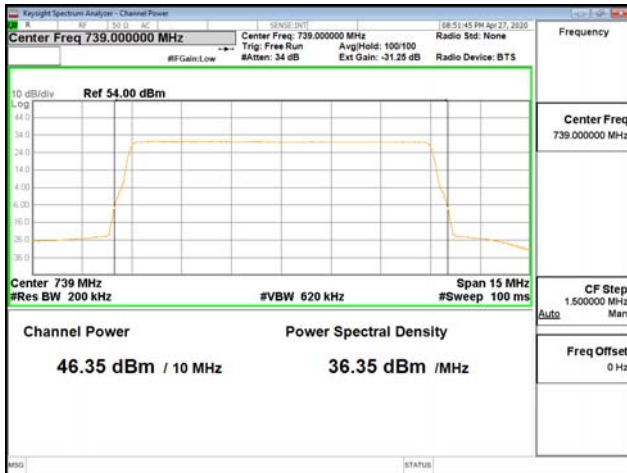


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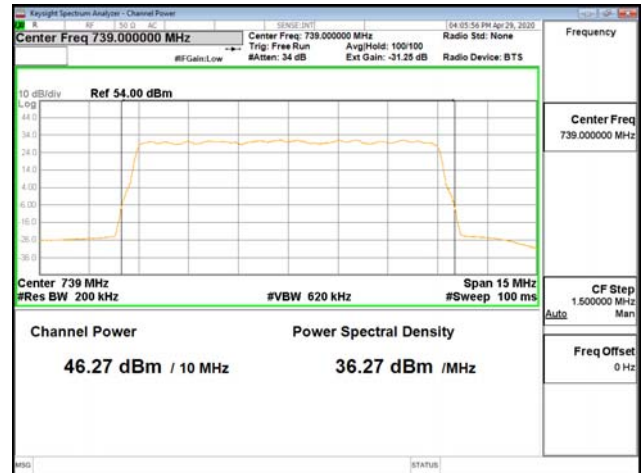


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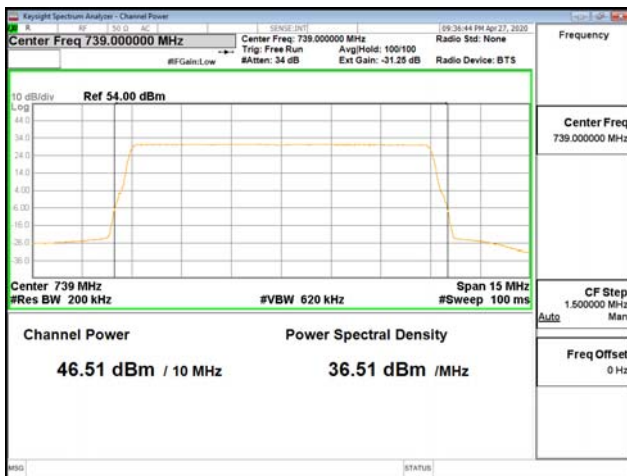
QPSK



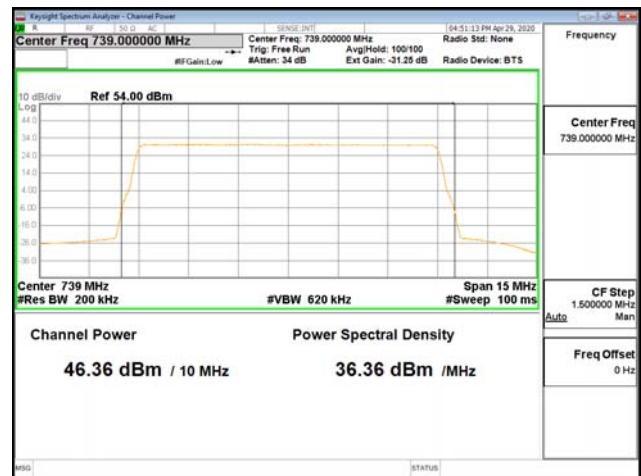
16QAM



64QAM



256QAM

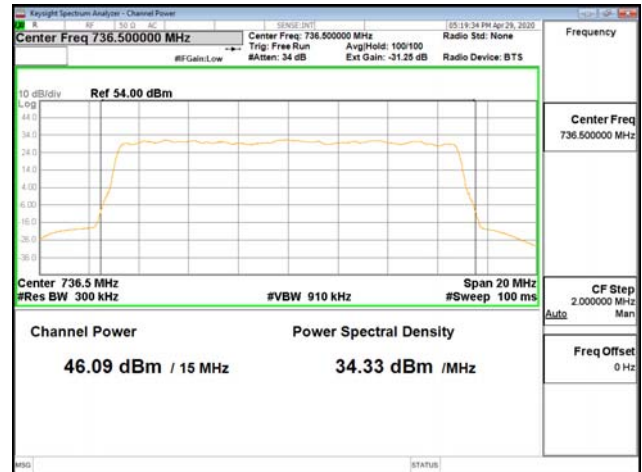


**BW 15MHz, Middle
ANT0**

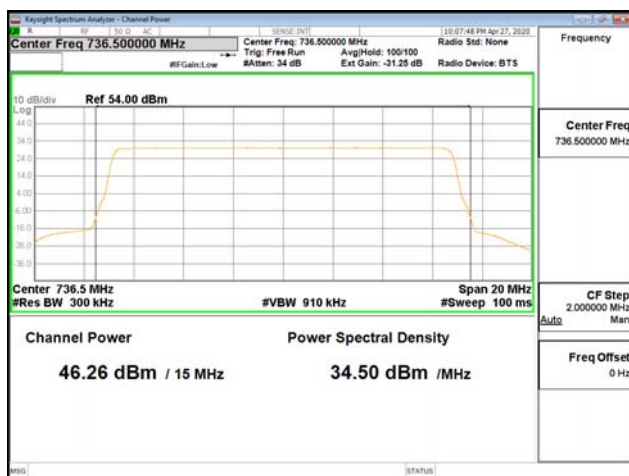
QPSK



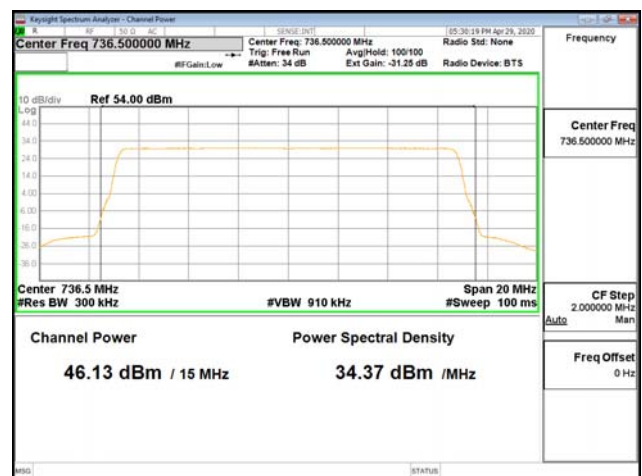
16QAM



64QAM



256QAM



ANT1

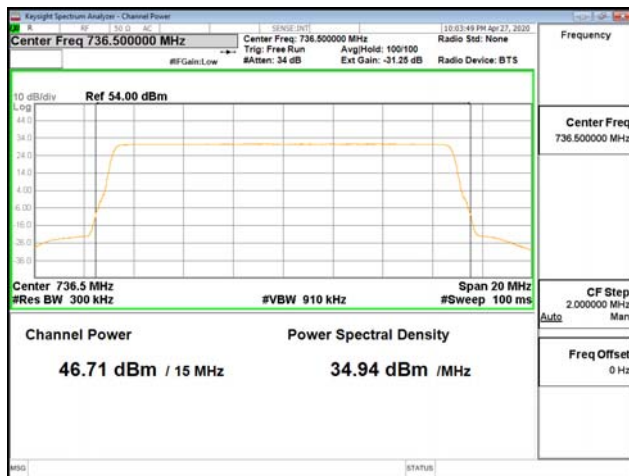
QPSK



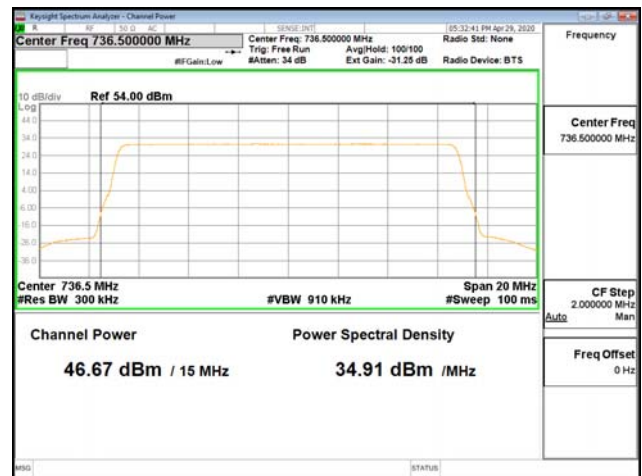
16QAM



64QAM

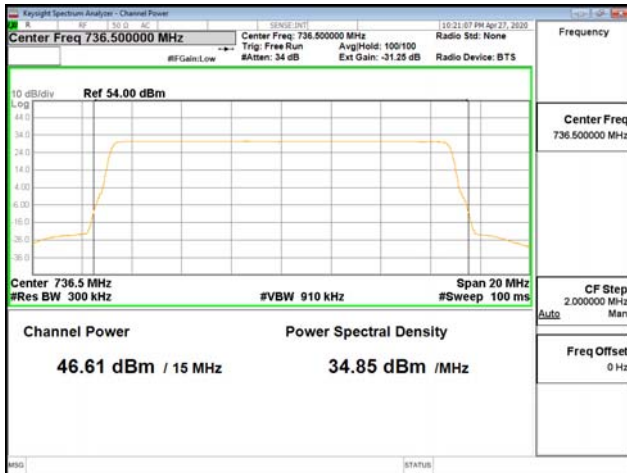


256QAM



ANT2

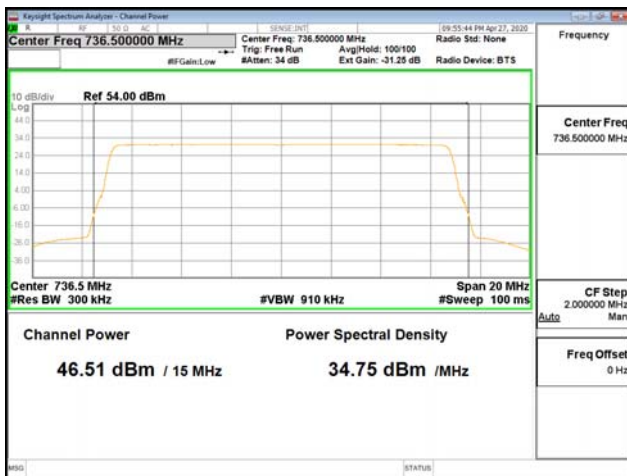
QPSK



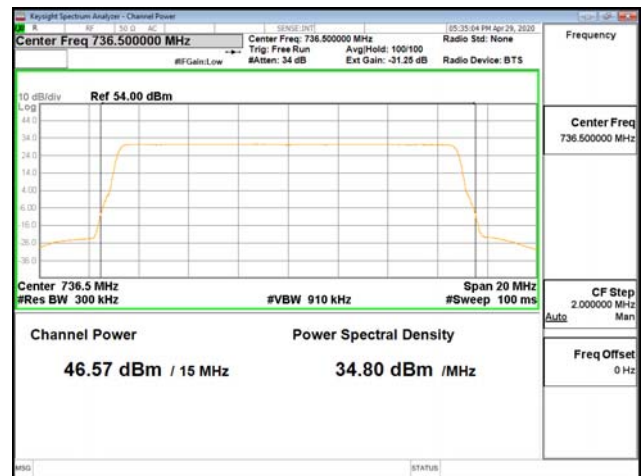
16QAM



64QAM



256QAM



ANT3

QPSK



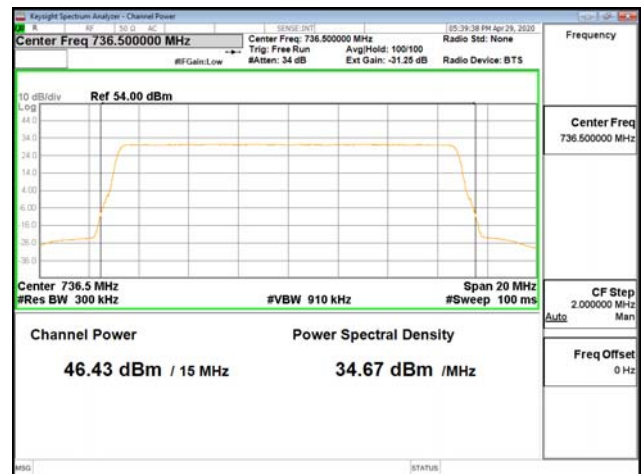
16QAM



64QAM



256QAM



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5. Occupied Bandwidth

Test Requirements :

§ 2.1049 Measurements required : Occupied bandwidth

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

Test Procedures :

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation. The EUT was connected to a spectrum analyzer enabled with an occupied bandwidth in accordance with FCC Part 2.1049. The occupied bandwidth was measured from the fundamental emission at the bottom, middle and top channels. The occupied bandwidth was measured using the built in occupied bandwidth function of the spectrum analyzer. It was set to measure the bandwidth where 99% of the signal power was contained. The analyzer automatically configures the measurement bandwidths to make an accurate measurement based on the channel bandwidth and channel spacing of the EUT.

Test Results :

Test Data : BW 5MHz

Channel	Modulation	Occupied Bandwidth(MHz)			
		Test antenna port			
		0	1	2	3
Bottom	QPSK	4.50	4.50	4.50	4.50
	16QAM	4.48	4.48	4.47	4.48
	64QAM	4.50	4.50	4.50	4.50
	256QAM	4.50	4.50	4.50	4.50
Middle	QPSK	4.50	4.50	4.50	4.50
	16QAM	4.48	4.48	4.47	4.48
	64QAM	4.50	4.50	4.50	4.50
	256QAM	4.50	4.50	4.50	4.50
Top	QPSK	4.50	4.50	4.50	4.50
	16QAM	4.48	4.48	4.48	4.48
	64QAM	4.48	4.50	4.50	4.50
	256QAM	4.50	4.50	4.50	4.50

Test Data : BW 10MHz

Channel	Modulation	Occupied Bandwidth(MHz)			
		Test antenna port			
		0	1	2	3
Bottom	QPSK	8.97	8.97	8.98	8.98
	16QAM	8.97	8.96	8.96	8.97
	64QAM	8.97	8.97	8.97	8.97
	256QAM	8.98	8.98	8.98	8.98
Middle	QPSK	8.98	8.98	8.98	8.98
	16QAM	8.97	8.96	8.97	8.97
	64QAM	8.97	8.97	8.98	8.98
	256QAM	8.98	8.98	8.98	8.98
Top	QPSK	8.98	8.97	8.97	8.98
	16QAM	8.97	8.96	8.96	8.97
	64QAM	8.97	8.97	8.97	8.97
	256QAM	8.98	8.98	8.98	8.98

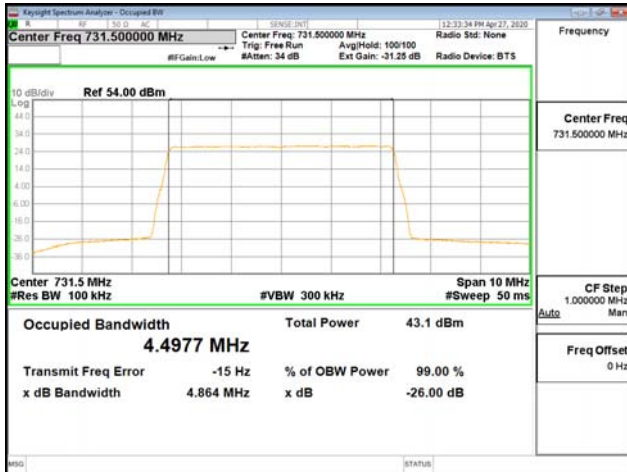
Test Data : BW 15MHz

Channel	Modulation	Occupied Bandwidth(MHz)			
		Test antenna port			
		0	1	2	3
Middle	QPSK	13.45	13.45	13.45	13.45
	16QAM	13.45	13.45	13.45	13.44
	64QAM	13.45	13.45	13.45	13.45
	256QAM	13.45	13.45	13.45	13.45

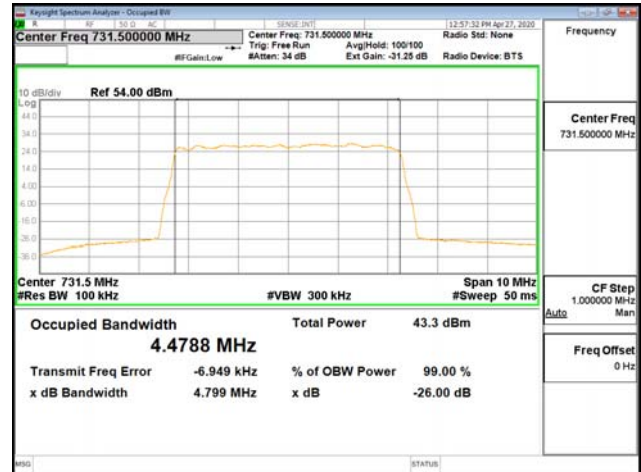
Test Plot at Occupied Bandwidth

**BW 5MHz, Bottom
ANT0**

QPSK



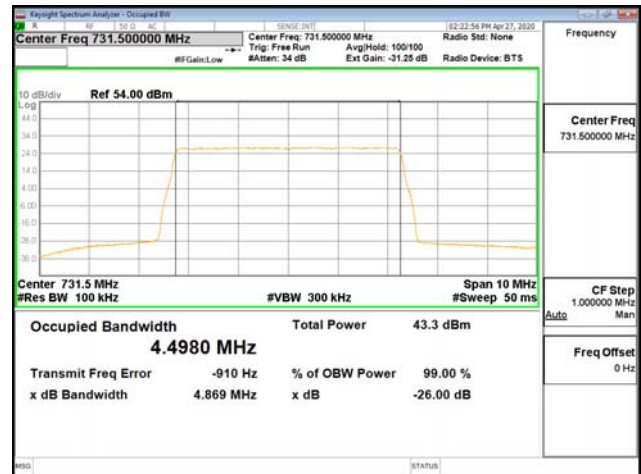
16QAM



64QAM

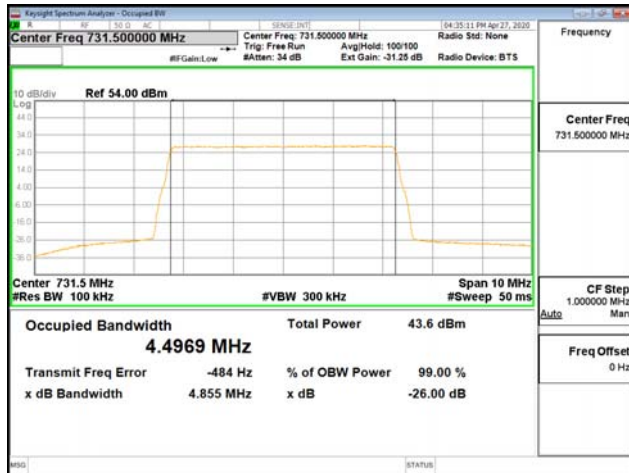


256QAM



ANT1

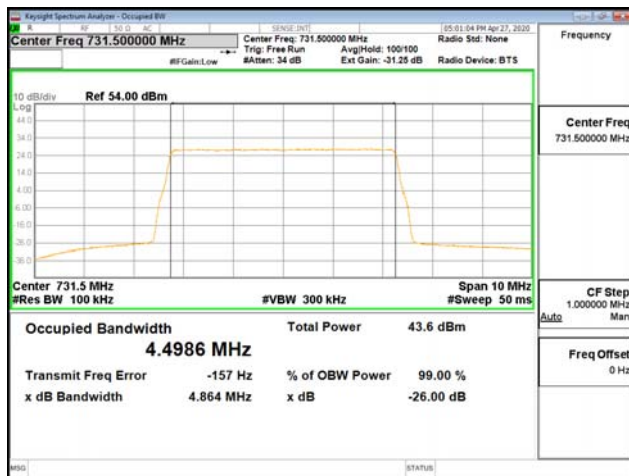
QPSK



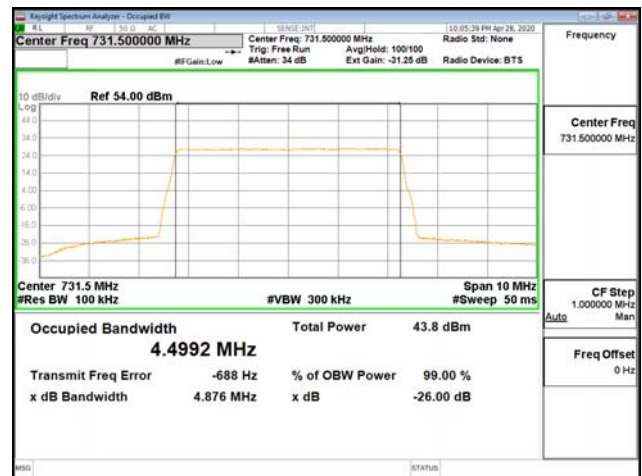
16QAM



64QAM

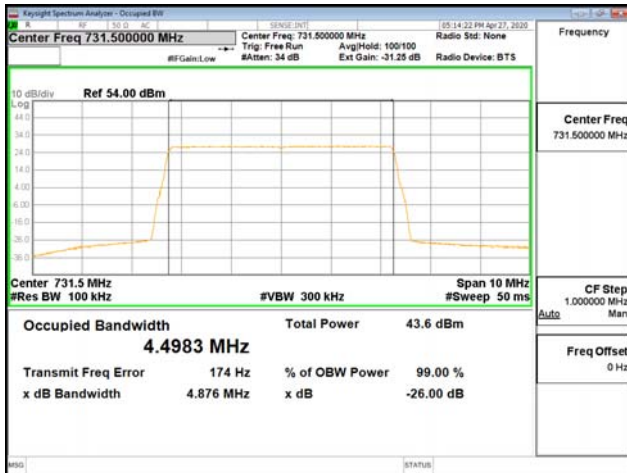


256QAM

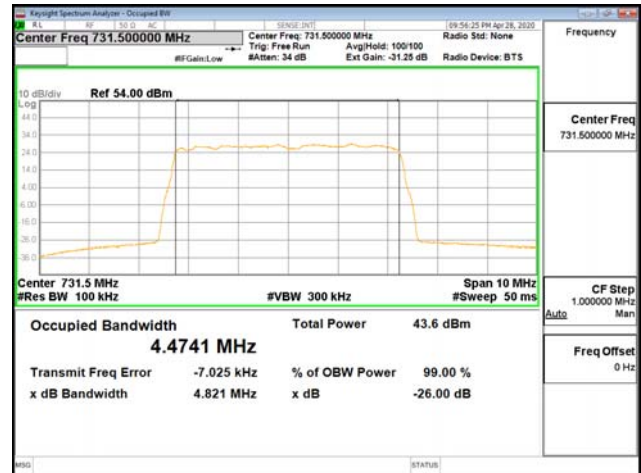


ANT2

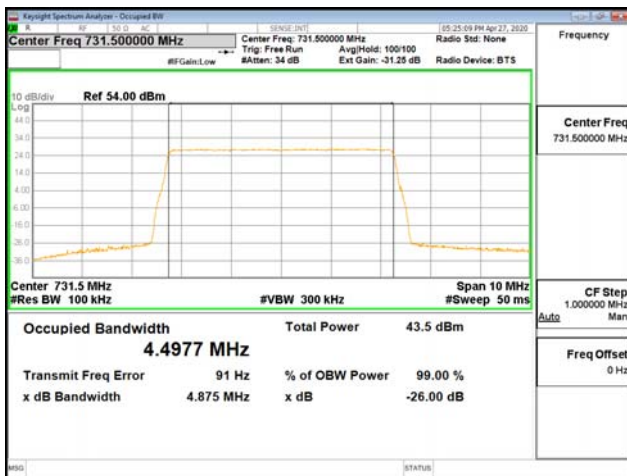
QPSK



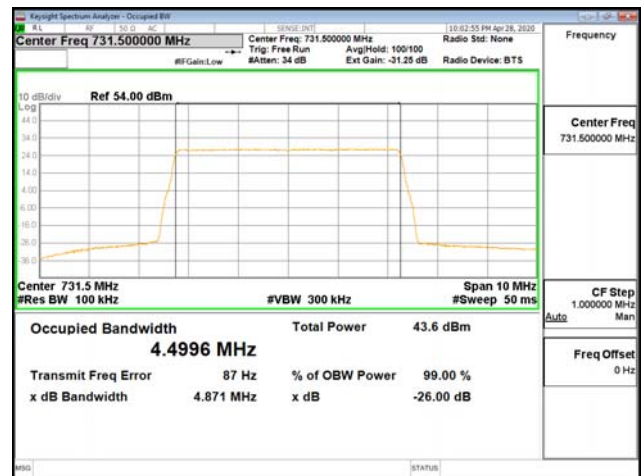
16QAM



64QAM

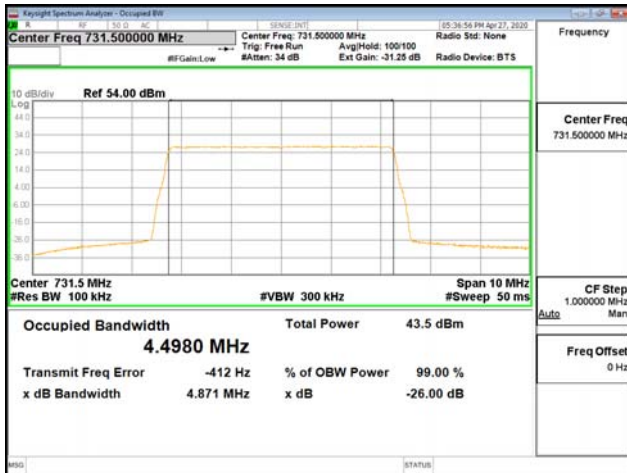


256QAM



ANT3

QPSK



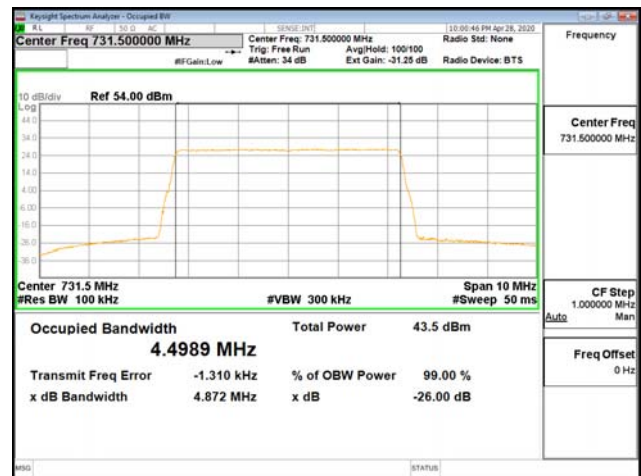
16QAM



64QAM

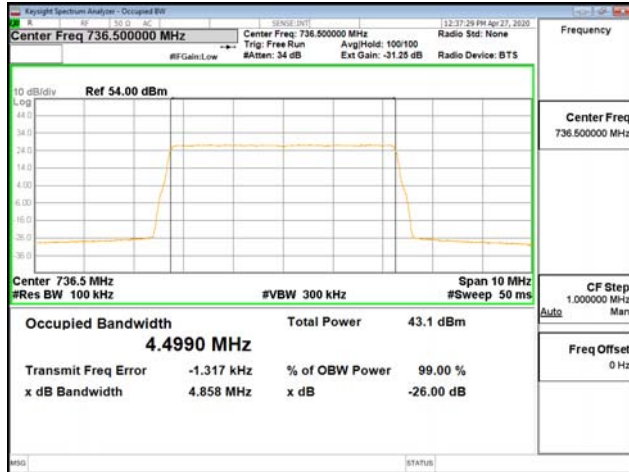


256QAM

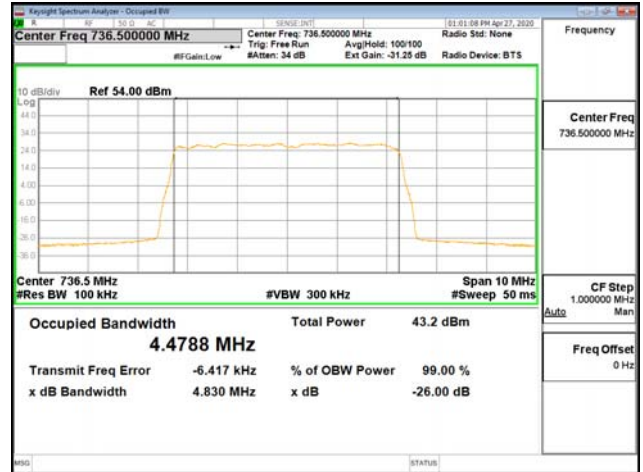


**BW 5MHz, Middle
ANT0**

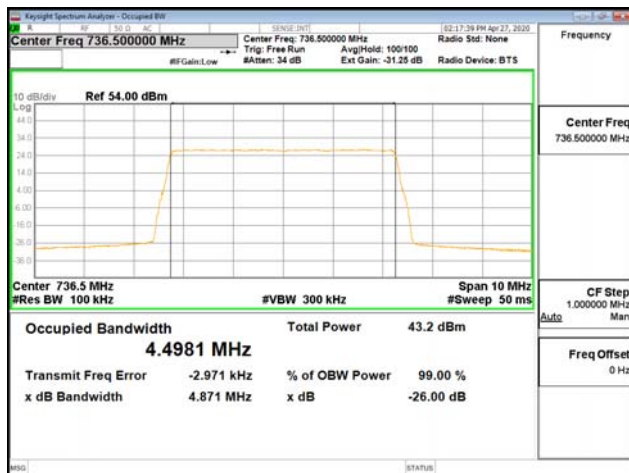
QPSK



16QAM



64QAM

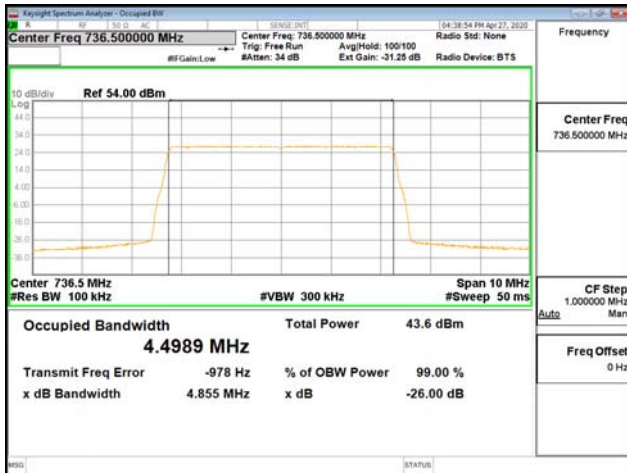


256QAM

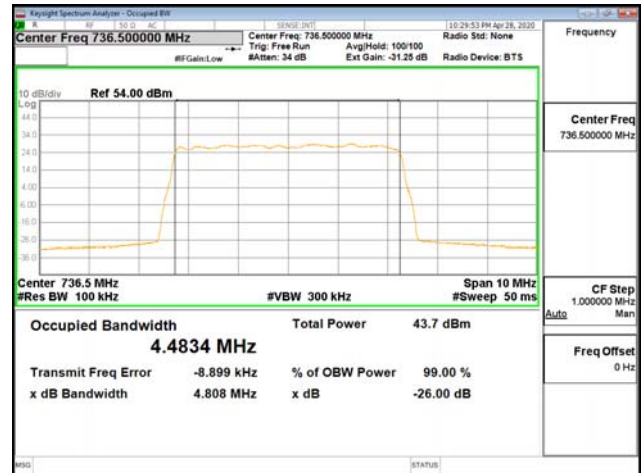


ANT1

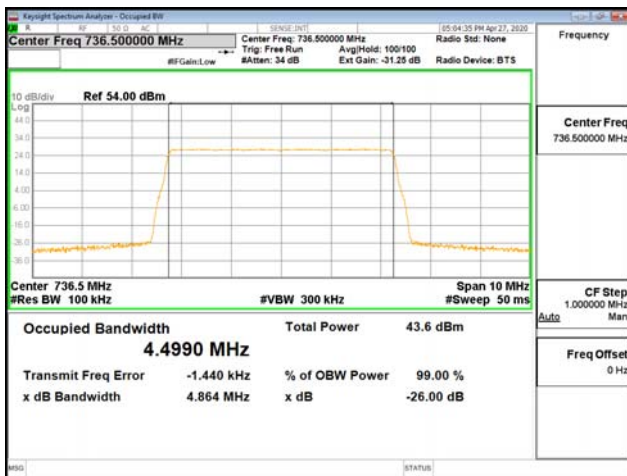
QPSK



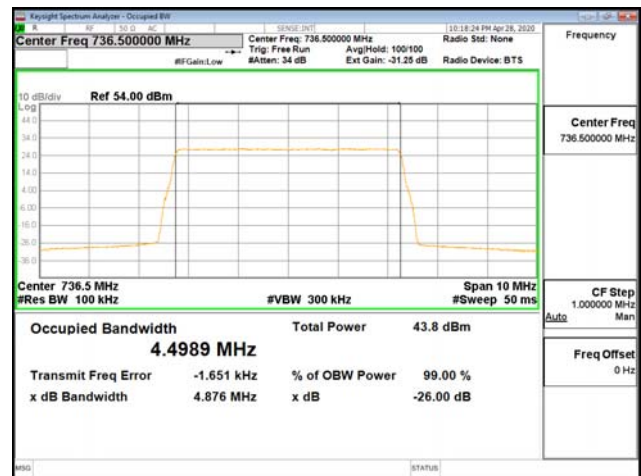
16QAM



64QAM



256QAM



ANT2

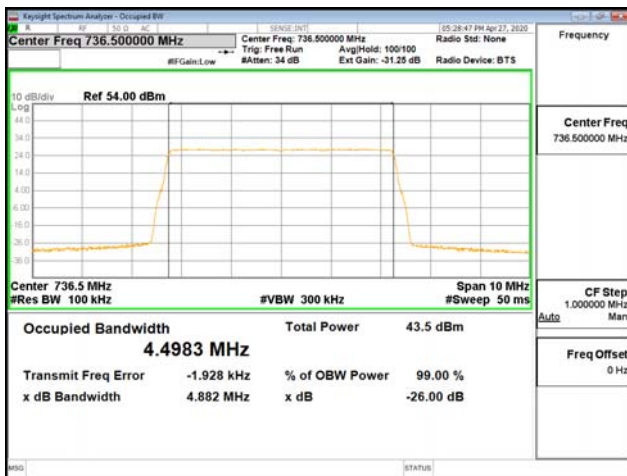
QPSK



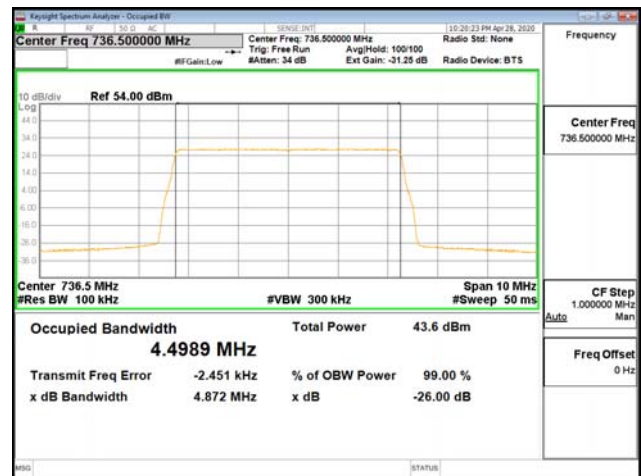
16QAM



64QAM



256QAM

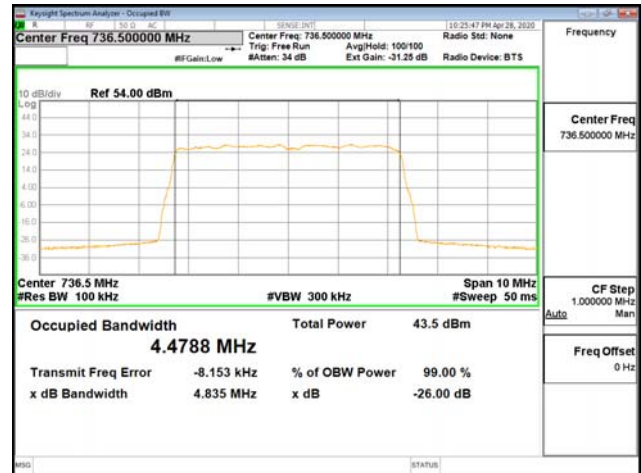


ANT3

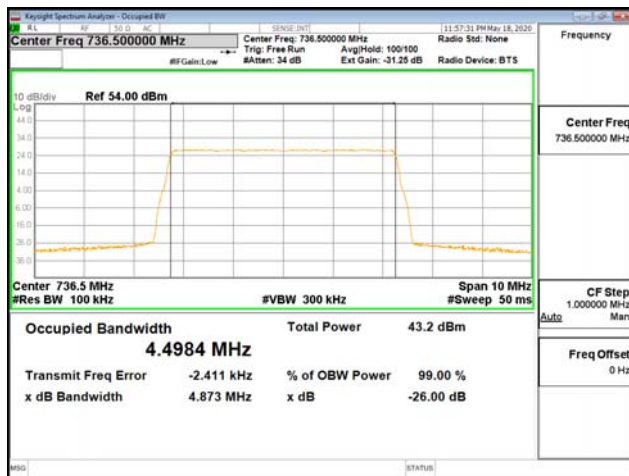
QPSK



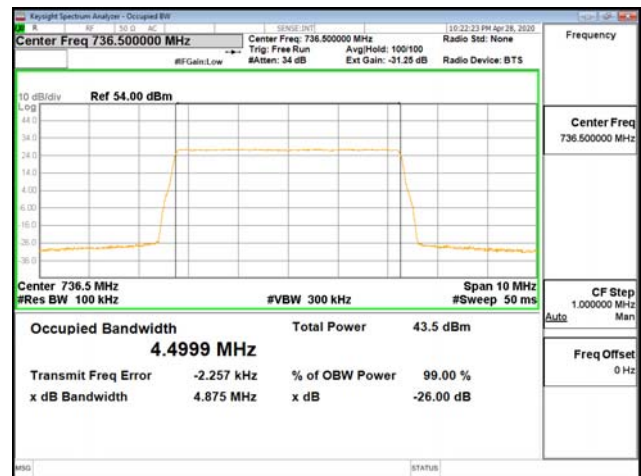
16QAM



64QAM

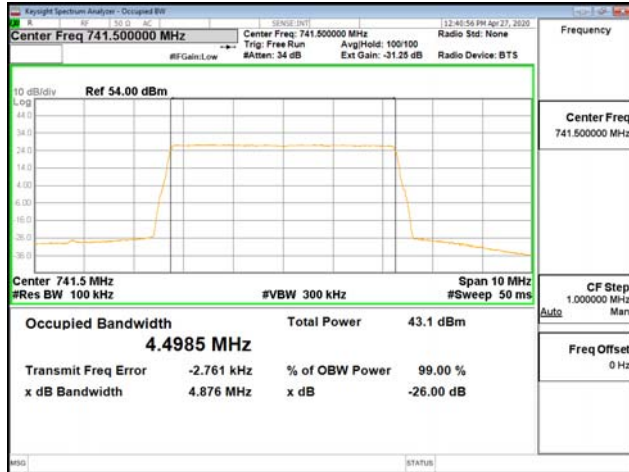


256QAM

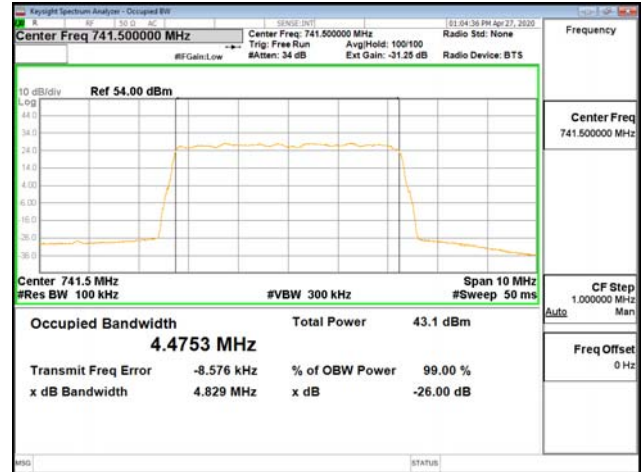


**BW 5MHz, Top
ANT0**

QPSK



16QAM



64QAM



256QAM

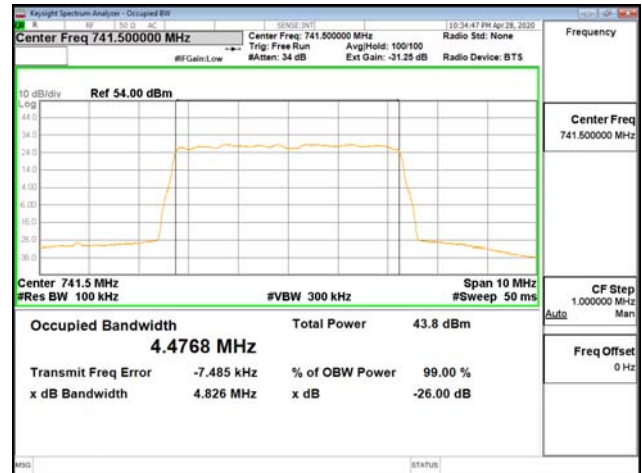


ANT1

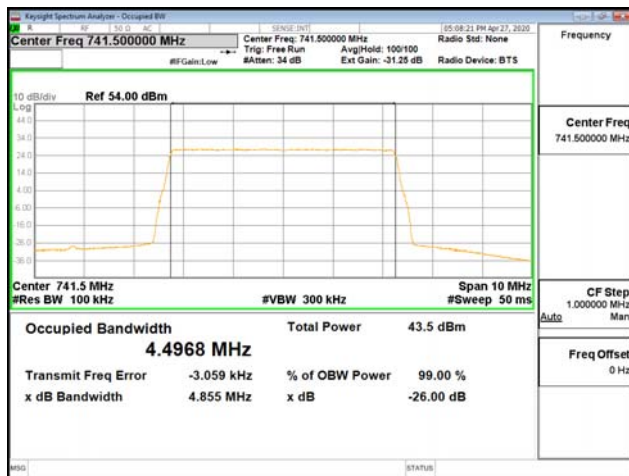
QPSK



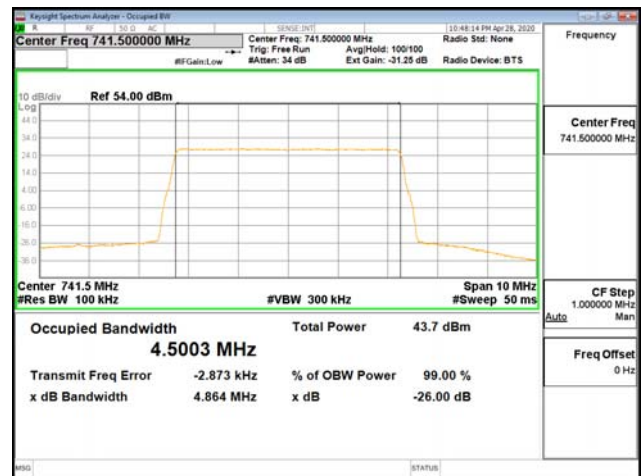
16QAM



64QAM



256QAM



ANT2

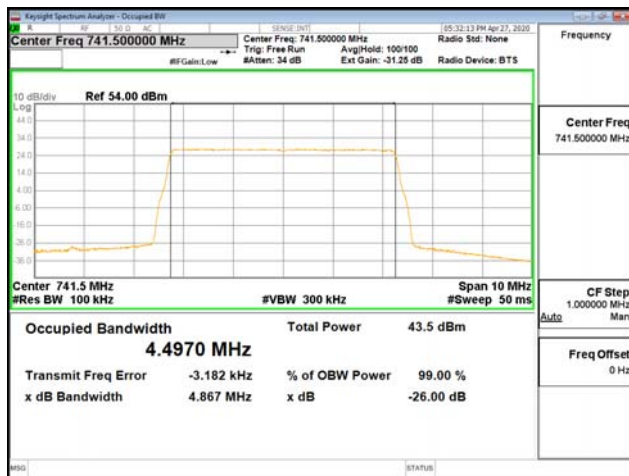
QPSK



16QAM



64QAM



256QAM



ANT3

QPSK



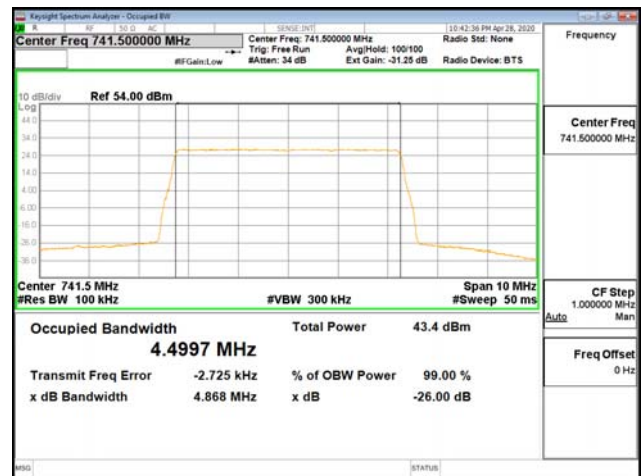
16QAM



64QAM

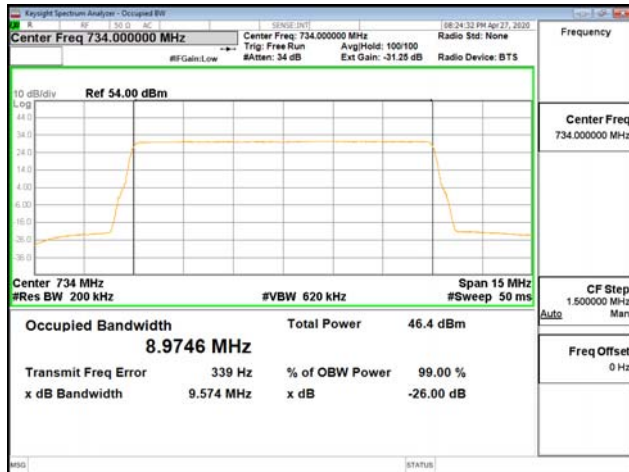


256QAM

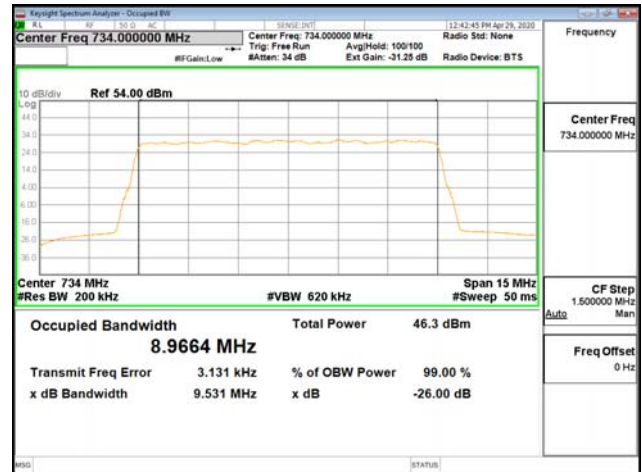


**BW 10MHz, Bottom
ANT0**

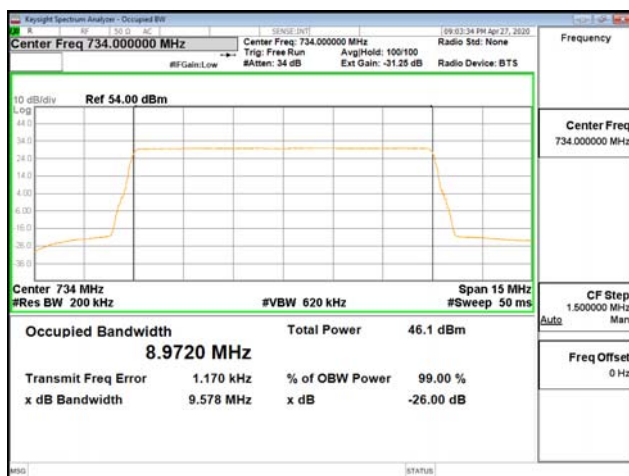
QPSK



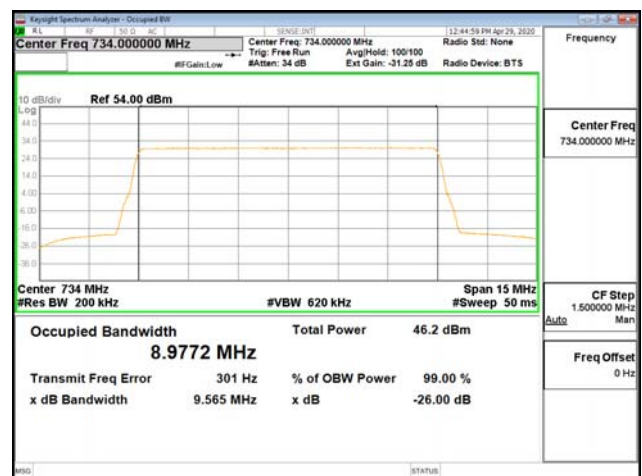
16QAM



64QAM

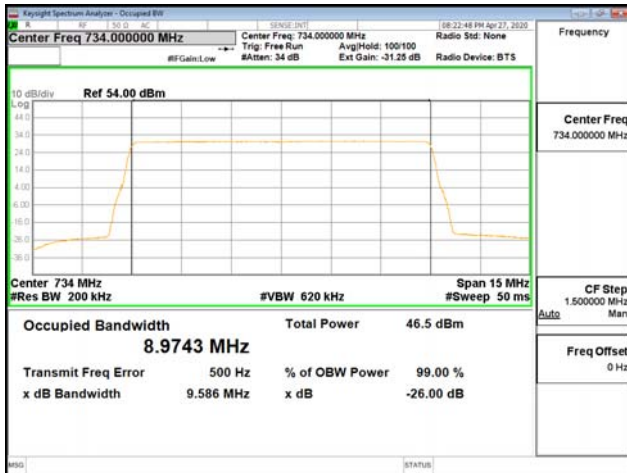


256QAM

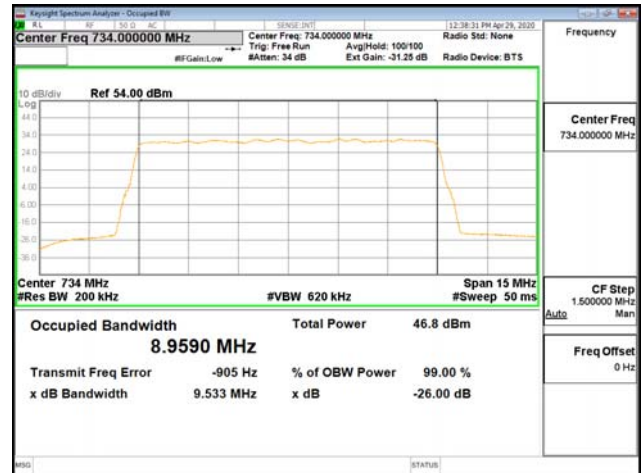


ANT1

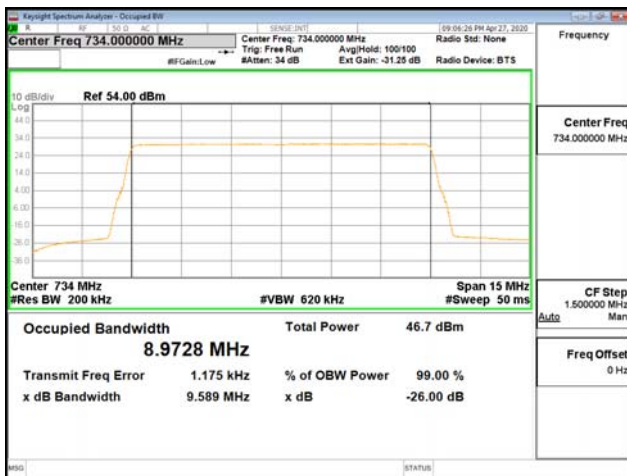
QPSK



16QAM



64QAM



256QAM

