REPORT No.: SZ23100077W01

TEST REPORT

APPLICANT	:	MiMOMax Wireless Limited
PRODUCT NAME	:	TORNADO TRANSCEIVER
MODEL NAME	:	MWL-TORNADO-BH A/B/C *
BRAND NAME	:	MiMOMaxWireless
FCC ID	:	XMK-MMXTRNB006
STANDARD(S)	:	47 CFR Part 2 47 CFR Part 27
RECEIPT DATE	:	2023-10-16
TEST DATE	:	2023-10-23 to 2023-10-26
ISSUE DATE	:	2023-11-21

Tested by: Li Huaijie (Rapporteur)

Approved by: Shen Junsheng (Supervisor)

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Change History		
Issue	Date	Reason for change
1.0	2023-11-21	First edition

1. Technical Information

Note: Provide by applicant.

1.1. Applicant and Manufacturer Information

Applicant:	MiMOMax Wireless Limited
Applicant Address:	540 Wairakei Road, Christchurch, 8053 New Zealand
Manufacturer:	MiMOMax Wireless Limited
Manufacturer Address:	540 Wairakei Road, Christchurch, 8053 New Zealand

1.2. Equipment Under Test (EUT) Description

Product Name:	TORNADO TRANSCEIVER
Hardware Version:	P001
Software Version:	TRN-04.06.02
Operating Frequency Range:	757-758 MHz&787-788 MHz, 2Tx/2Rx
Channel Bandwidth:	12.5kHz; 25kHz; 50kHz; 75kHz
Modulation Type:	QPSK; 16QAM; 64QAM; 256QAM
Operating Voltage:	10.5-60Vdc
Antenna Type:	Omni Antenna
Antenna Gain:	4.0dBi
Emission Designator:	12.5kHz:10K3W1W 25.0kHz:21K1W1W 50.0kHz:42K0W1W 75.0kHz: 62K2W1W

1.3. Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 2 and Part 27 for the EUT FCC ID Certification:

No.	Identity	Document Title
1	47 CFR Part 2	Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
2	47 CFR Part 27	Miscellaneous Wireless Communications Services

Test detailed items/section required by FCC rules and results are listed as below:

No.	Section	Description	Test Date	Test Engineer	Result
1	27.50 2.1046	Transmitter Conducted Output Power and ERP/EIRP	2023/10/26	Li Huaijie Gan Jing	Complies
2	2.1049	Occupied bandwidth	2023/10/26	Li Huaijie Gan Jing	PASS
3	2.1051 27.53 27.53(c) 27.53(c)(1) 27.53(c)(2) 27.53(c)(3) 27.53(c)(5) 27.53(c)(6)	Conducted spurious emissions at antenna terminals with DUT Operations in the 746 - 758 MHz band 776 - 788 MHz band emissions in763 - 775 MHz and 793 – 805MHz band	2023/10/26	Li Huaijie Gan Jing	PASS
4	2.1053 27.53 27.53(c) 27.53(c)(1) 27.53(c)(2) 27.53(c)(3) 27.53(c)(5) 27.53(c)(6)	Field strength of radiated spurious emissions with DUT Operations in the 746 - 758 MHz band 776 - 788 MHz band Emissions in 763 - 775 MHz and 793 – 805MHz band	2021/03/04	Gao Jianrou	PASS
5	27.53(f)	Additional emission requirement in 1559 -1610 MHz band	2021/03/15	Gao Jianrou	PASS
6	27.54 2.1055	Frequency stability	2021/03/07- 2023/10/26	Li Huaijie Gan Jing	PASS

Note 1: The TORNADO TRANSCEIVER complies with FCC 47 CFR Part 2 and Part 27 when tested in-accordance with the test methods described in 47 CFR Part 2 and Part 27.
Note 2: The TORNADO TRANSCEIVER supports 2 Tx antenna ports, which was defined as Channel H &Channel V separately.
Note 3: The path loss during the conducted RF test is calibrated to correct the results by the Ext Gain setting. The Ext Gain contains two parts that cable loss 0.8dB and Attenuator 29.0dB.
Note 4: When the test result is a critical value, we will use the measurement uncertainty give the judgment result based on the 95% confidence intervals.
Note 5: This is a variant report of original report (Report No.: SZ21010246W01, FCC ID: XMK-MMXTRNB006). Based on the original product, one bandwidth (75 kHz) is added by software, and other changes are unchanged. This bandwidth data has been added to this report.

1.4. Environmental Conditions

During the measurement, the environmental conditions were within the listed ranges:

Temperature (°C):	15 - 35
Relative Humidity (%):	30 -60
Atmospheric Pressure (kPa):	86-106

2. Summary Test Results And Description

2.1. Radio Frequency Power Output

2.1.1. Test result

Nominal Frequency: 757.050 MHz Tx Port: Channel H

Channel Bandwidth (kHz)	Modulation Type	Voltage (Vdc)	Measured Power (dBm)	Measured Power (Watt)	Rated Power (Watt)	E.R.P. (ANT Gain = 4.0dBi)	
						dBm	Watt
12.5	QPSK	24	24.04	0.254	0.25	25.89	0.388
12.5	16QAM	24	24.02	0.252	0.25	25.87	0.386
12.5	64QAM	24	24.08	0.256	0.25	25.93	0.392
12.5	256QAM	24	24.09	0.256	0.25	25.94	0.393
25.0	QPSK	24	24.04	0.254	0.25	25.89	0.388
25.0	16QAM	24	24.05	0.254	0.25	25.90	0.389
25.0	64QAM	24	24.07	0.255	0.25	25.92	0.391
25.0	256QAM	24	24.09	0.256	0.25	25.94	0.393
50.0	QPSK	24	23.99	0.251	0.25	25.84	0.384
50.0	16QAM	24	24.01	0.252	0.25	25.86	0.385
50.0	64QAM	24	24.08	0.256	0.25	25.93	0.392
50.0	256QAM	24	24.08	0.256	0.25	25.93	0.392
75.0	QPSK	24	23.86	0.243	0.25	25.71	0.372
75.0	16QAM	24	23.82	0.241	0.25	25.67	0.369
75.0	64QAM	24	24.04	0.254	0.25	25.89	0.388
75.0	256QAM	24	24.05	0.254	0.25	25.90	0.389

Nominal Frequency: 757.050 MHz Tx Port: Channel V

Channel Bandwidth (kHz)	Modulation Type	Voltage (Vdc)	Measured Power (dBm)	Measured Power (Watt)	Rated Power (Watt)	E.R.P. (ANT Gain = 4.0dBi)	
						dBm	Watt
12.5	QPSK	24	23.97	0.249	0.25	25.82	0.382
12.5	16QAM	24	23.94	0.248	0.25	25.79	0.379
12.5	64QAM	24	24.01	0.252	0.25	25.86	0.385
12.5	256QAM	24	24.08	0.256	0.25	25.93	0.392
25.0	QPSK	24	23.96	0.249	0.25	25.81	0.381
25.0	16QAM	24	24.01	0.252	0.25	25.86	0.385
25.0	64QAM	24	24.08	0.256	0.25	25.93	0.392
25.0	256QAM	24	24.07	0.255	0.25	25.92	0.391
50.0	QPSK	24	24.00	0.251	0.25	25.85	0.385
50.0	16QAM	24	23.95	0.248	0.25	25.80	0.380
50.0	64QAM	24	23.98	0.250	0.25	25.83	0.383
50.0	256QAM	24	24.04	0.254	0.25	25.89	0.388
75.0	QPSK	24	23.98	0.250	0.25	25.83	0.383
75.0	16QAM	24	23.88	0.244	0.25	25.73	0.374
75.0	64QAM	24	24.02	0.252	0.25	25.87	0.386
75.0	256QAM	24	24.06	0.255	0.25	25.91	0.390

Nominal Frequency: 787.950 MHzTx Port: Channel H

Channel Bandwidth (kHz)	Modulation Type	Voltage (Vdc)	Measured Power (dBm)	Measured Power (Watt)	Rated Power (Watt)	E.R.P. (ANT Gain = 4.0dBi)	
						dBm	Watt
12.5	QPSK	24	23.96	0.249	0.25	25.81	0.381
12.5	16QAM	24	23.93	0.247	0.25	25.78	0.378
12.5	64QAM	24	24.02	0.252	0.25	25.87	0.386
12.5	256QAM	24	24.03	0.253	0.25	25.88	0.387
25.0	QPSK	24	23.97	0.249	0.25	25.82	0.382
25.0	16QAM	24	23.93	0.247	0.25	25.78	0.378
25.0	64QAM	24	23.97	0.249	0.25	25.82	0.382
25.0	256QAM	24	24.04	0.254	0.25	25.89	0.388
50.0	QPSK	24	24.06	0.255	0.25	25.91	0.390
50.0	16QAM	24	24.01	0.252	0.25	25.86	0.385
50.0	64QAM	24	24.05	0.254	0.25	25.90	0.389
50.0	256QAM	24	24.08	0.256	0.25	25.93	0.392
75.0	QPSK	24	23.81	0.240	0.25	25.66	0.368
75.0	16QAM	24	23.75	0.237	0.25	25.60	0.363
75.0	64QAM	24	23.94	0.248	0.25	25.79	0.379
75.0	256QAM	24	24.07	0.255	0.25	25.92	0.391

Nominal Frequency: 787.950 MHzTx Port: Channel V

Channel Bandwidth (kHz)	Modulation Type	Voltage (Vdc)	Measured Power (dBm)	Measured Power (Watt)	Rated Power (Watt)	E.R.P. (ANT Gain = 4.0dBi)	
						dBm	Watt
12.5	QPSK	24	23.94	0.248	0.25	25.79	0.379
12.5	16QAM	24	23.95	0.248	0.25	25.80	0.380
12.5	64QAM	24	23.93	0.247	0.25	25.78	0.378
12.5	256QAM	24	24.02	0.252	0.25	25.87	0.386
25.0	QPSK	24	24.01	0.252	0.25	25.86	0.385
25.0	16QAM	24	23.91	0.246	0.25	25.76	0.377

25.0	64QAM	24	23.98	0.250	0.25	25.83	0.383
25.0	256QAM	24	23.94	0.248	0.25	25.79	0.379
50.0	QPSK	24	23.97	0.249	0.25	25.82	0.382
50.0	16QAM	24	23.96	0.249	0.25	25.81	0.381
50.0	64QAM	24	23.98	0.250	0.25	25.83	0.383
50.0	256QAM	24	24.05	0.254	0.25	25.90	0.389
75.0	QPSK	24	23.89	0.245	0.25	25.74	0.375
75.0	16QAM	24	23.85	0.243	0.25	25.70	0.372
75.0	64QAM	24	24.01	0.252	0.25	25.86	0.385
75.0	256QAM	24	24.03	0.253	0.25	25.88	0.387

Note1: Measurements were carried out at the RF output terminals of the transmitter using spectrum analyzer. The path loss during the conducted RF test is calibrated to correct the results by the Ext Gain setting. The Ext Gain contains two parts that cable loss 0.8dB and Attenuator 29.0dB.

Note 2: The transmitter has a rated output power of 0.25 watt(24dBm).The measured power has been shown to be within +/- 1 dB of the rated power.

Note3: Part 27 does not specify the transmitter output power.

Subpart C Section 27.50 (b)(1) states that fixed and base station transmitters in the 757 - 758 MHz band must not exceed 1000 watts ERP.

Subpart C Section 27.50 (b)(9) states that fixed stations transmitting in the 787-788 MHz and 805-806 MHz bands are limited to 30 watts ERP.

2.2. Occupied Bandwidth

2.2.1. Definition

The client has declared the following occupied bandwidths for each channel bandwidth:

Frequency(MHz)	Channel Bandwidth(kHz)	Occupied Bandwidth(kHz)
757.050	12.5, 25.0, 50.0, 75.0	10.3, 21.0, 42.0, 62.2
787.950	12.5, 25.0, 50.0, 75.0	10.3, 21.0, 42.0, 62.2

According to FCC section 2.1049, the occupied bandwidth 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.
Occupied bandwidth is also known as the 99% emission bandwidth.

2.2.2. Test Description

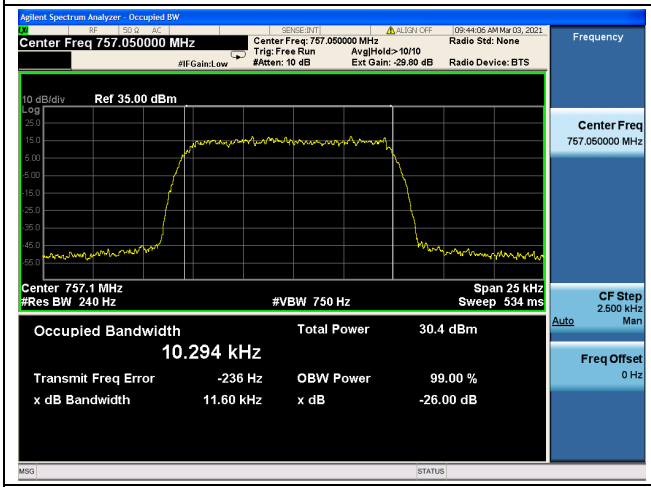
Measurements have been made to verify these declared bandwidths using the generic frequencies that are listed in the table above.
The occupied bandwidth has been measured and compared against the occupied bandwidth declared by the client.
Measurements have been made of each modulation type using a spectrum analyzer operating in occupied bandwidth mode.

2.2.3. Test Result

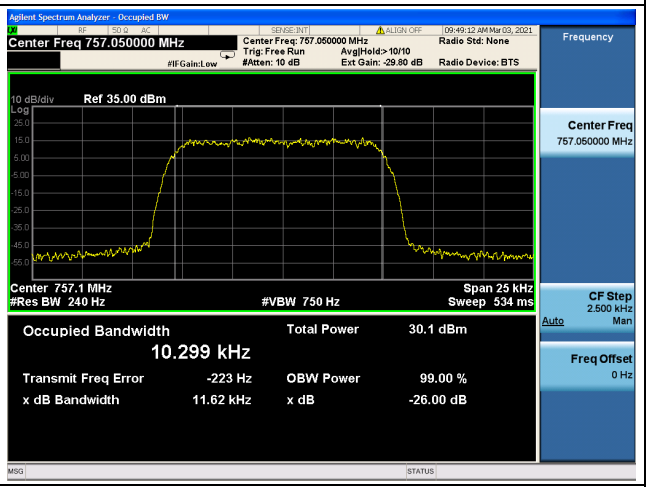
Nominal Frequency: 757.050 MHz

Tx Port	Channel Bandwidth(kHz)	Emission Type	Occupied Bandwidth(kHz)
H	12.5	QPSK	10.294
		16QAM	10.299
		64QAM	10.292
		256QAM	10.293
	25.0	QPSK	20.680
		16QAM	20.700
		64QAM	20.892
		256QAM	20.807
	50.0	QPSK	41.153
		16QAM	41.435
		64QAM	41.126
		256QAM	41.327
	75.0	QPSK	62.004
		16QAM	61.786
		64QAM	61.976
		256QAM	62.043
V	12.5	QPSK	10.297
		16QAM	10.293
		64QAM	10.288
		256QAM	10.278
	25.0	QPSK	20.608
		16QAM	20.624
		64QAM	20.765
		256QAM	20.630
	50.0	QPSK	41.331
		16QAM	41.344
		64QAM	41.194
		256QAM	41.192
	75.0	QPSK	61.844
		16QAM	62.163
		64QAM	61.811
		256QAM	61.913

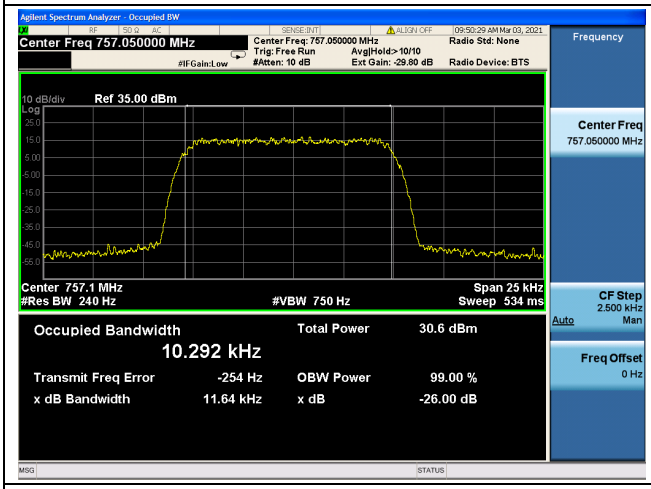
757.050MHz/Channel H/12.5kHz/QPSK



757.050MHz/Channel H/12.5kHz/16QAM



757.050MHz/Channel H/12.5kHz/64QAM



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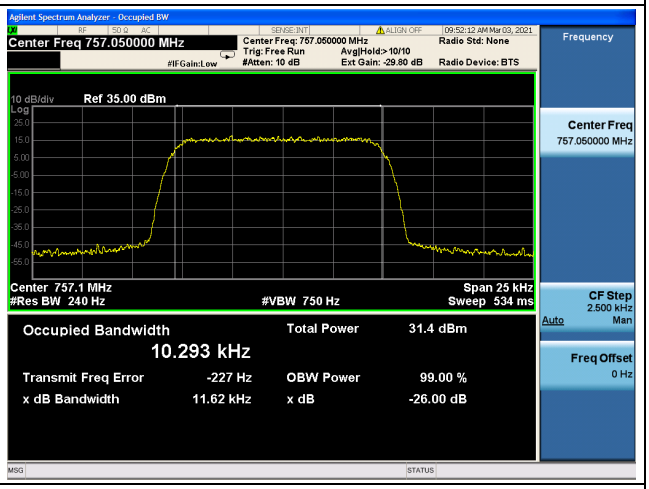
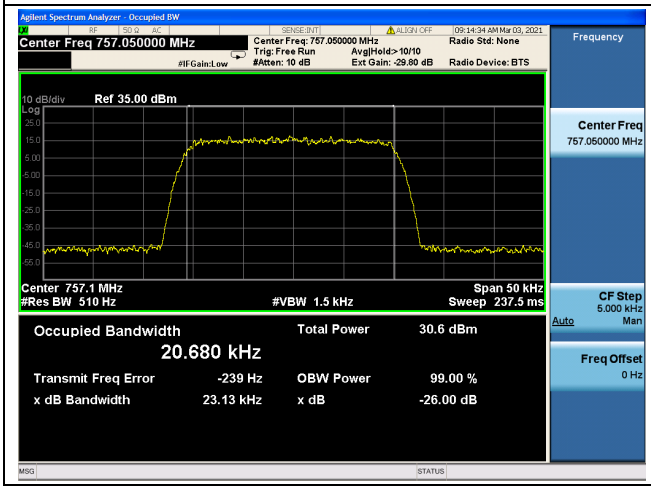


757.050MHz/Channel H/25.0 kHz/QPSK



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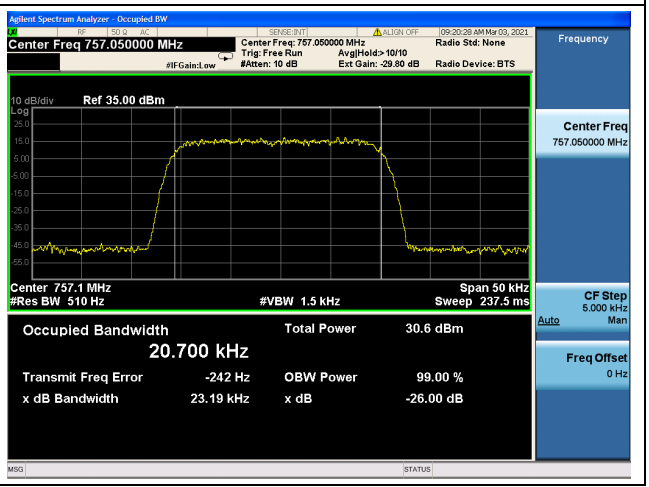

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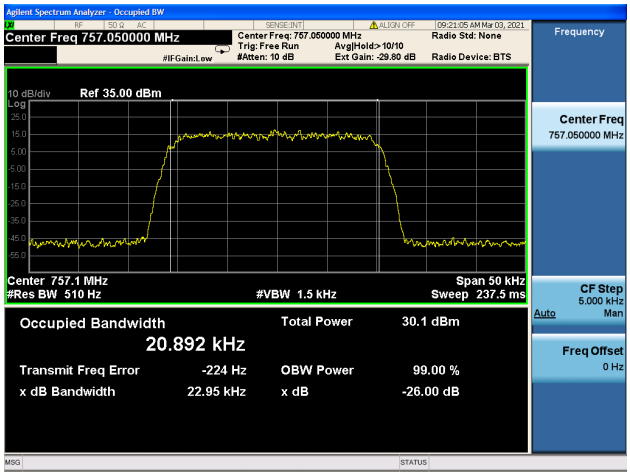

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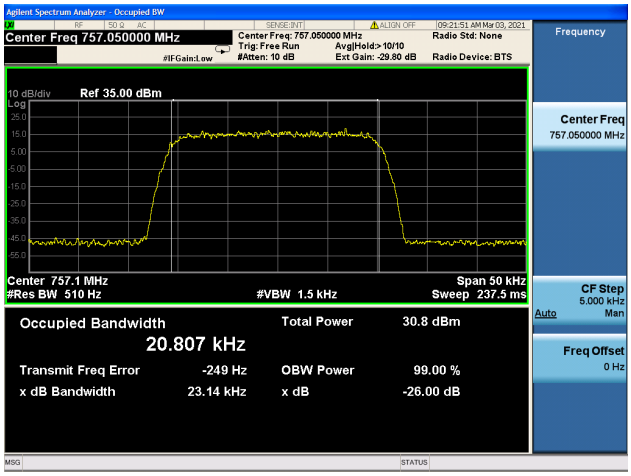
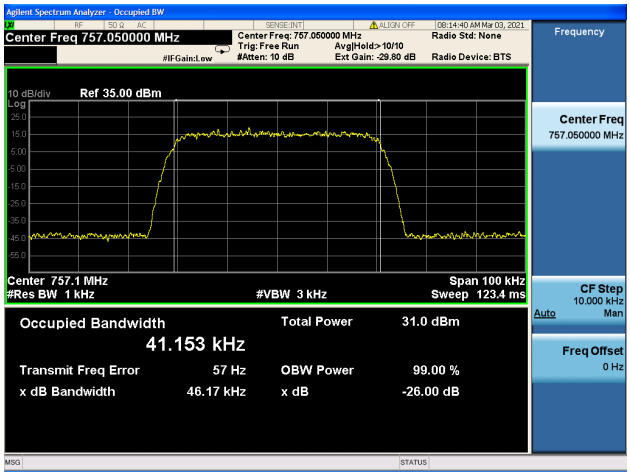


757.050MHz/Channel H/50.0 kHz/QPSK



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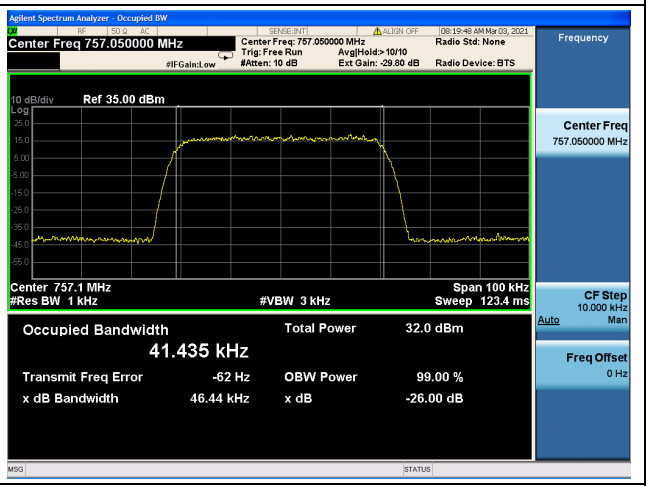

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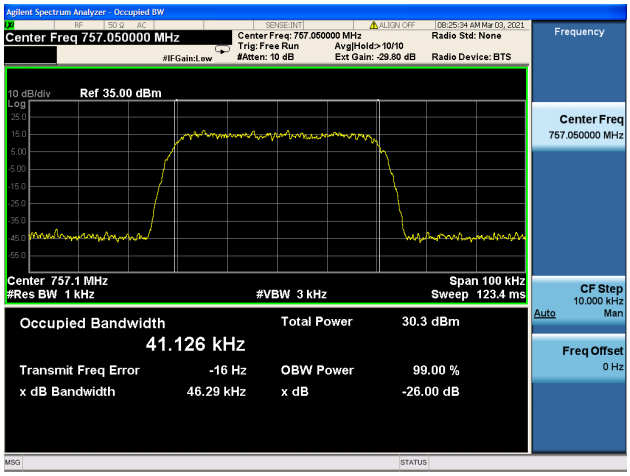

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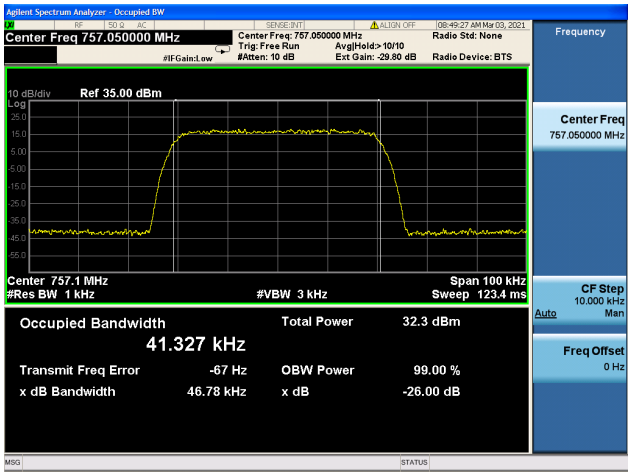

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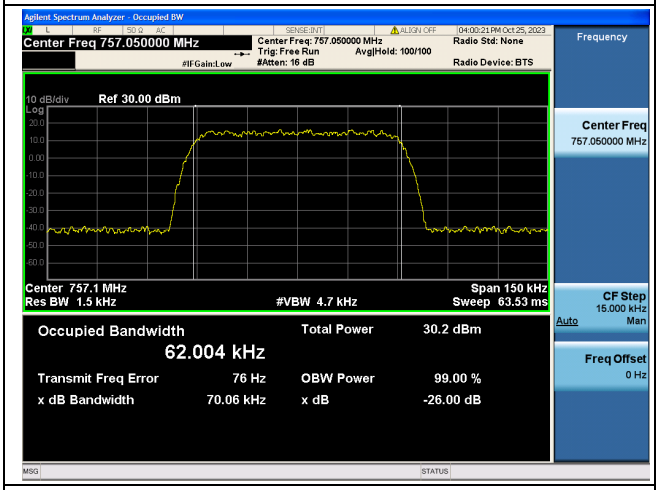
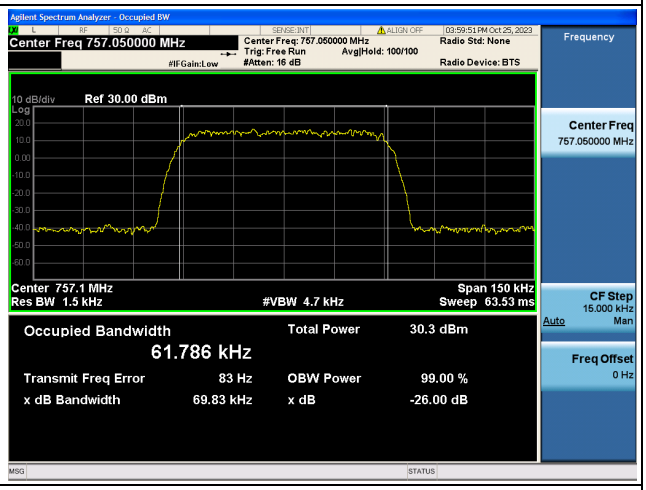
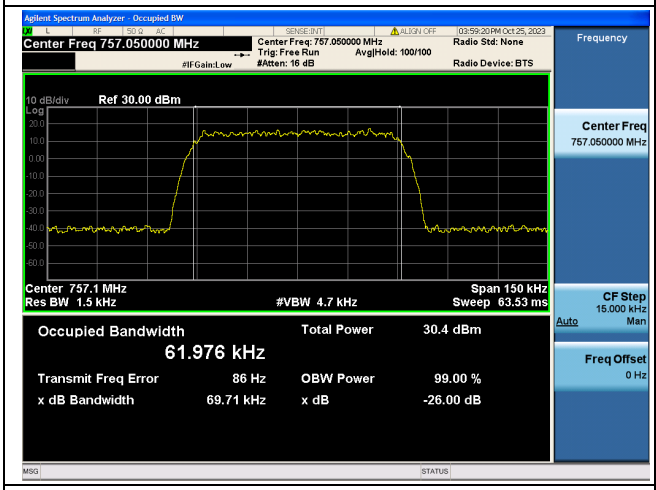


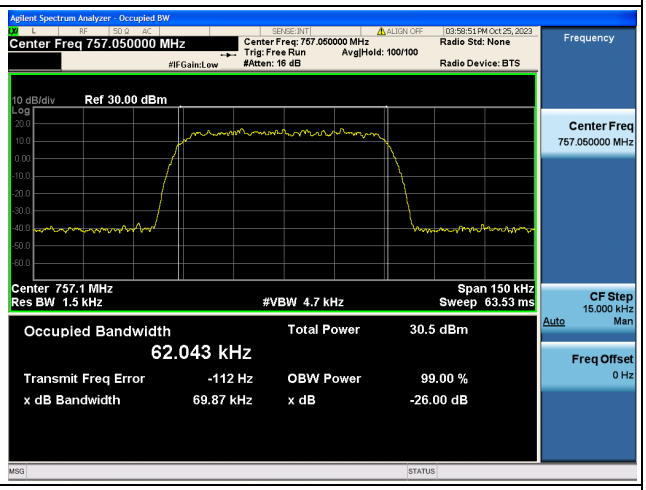
757.050MHz/Channel H/75.0kHz /16QAM



757.050MHz/Channel H/75.0kHz /64QAM



757.050MHz/Channel H/75.0kHz /256QAM



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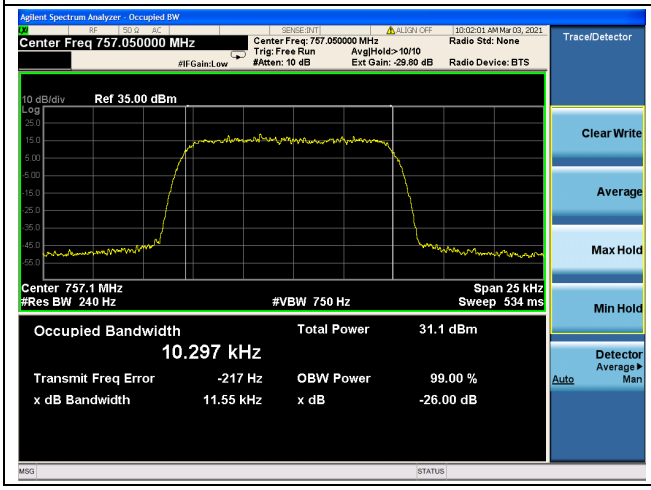

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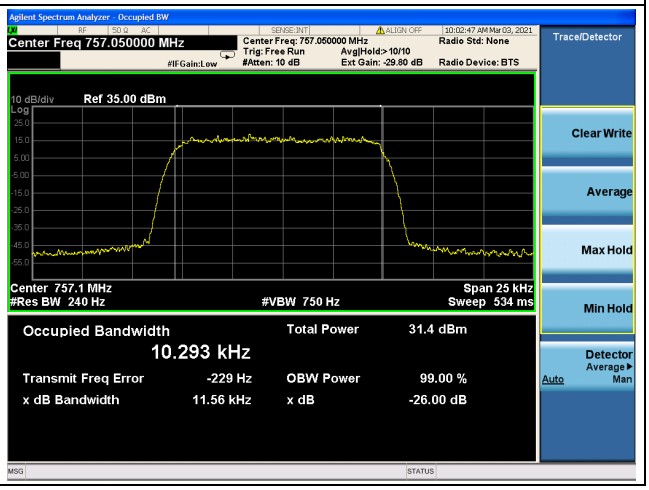

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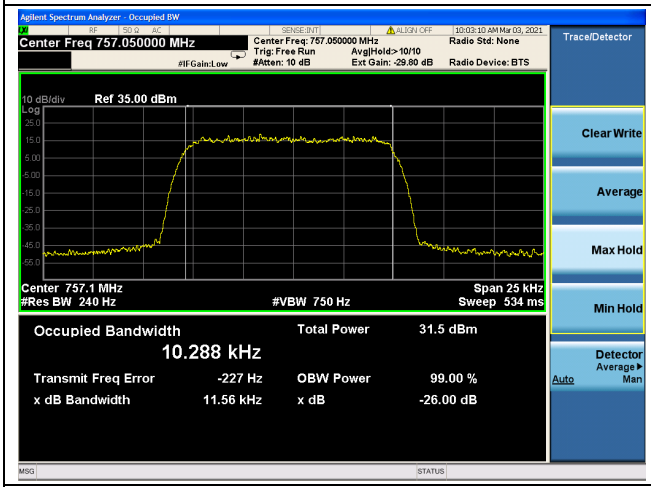
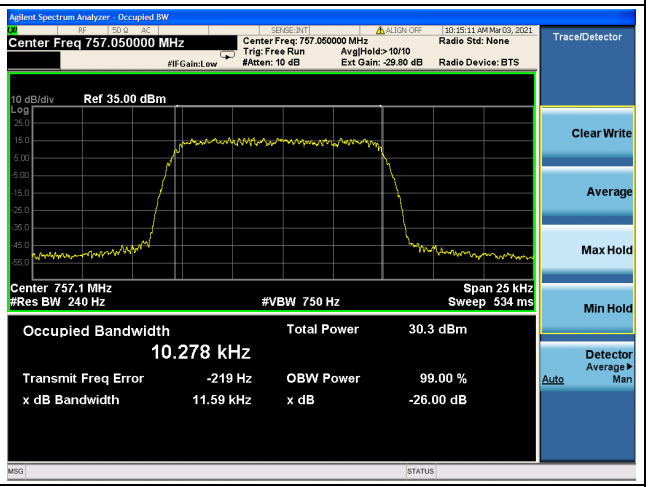


757.050MHz/Channel V/12.5 kHz/256QAM



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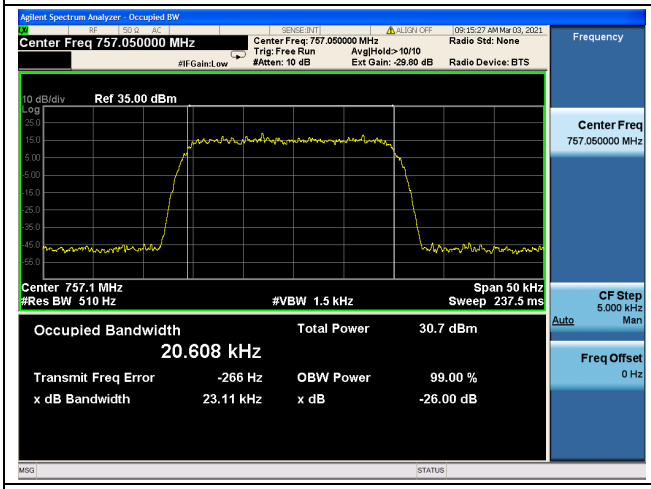

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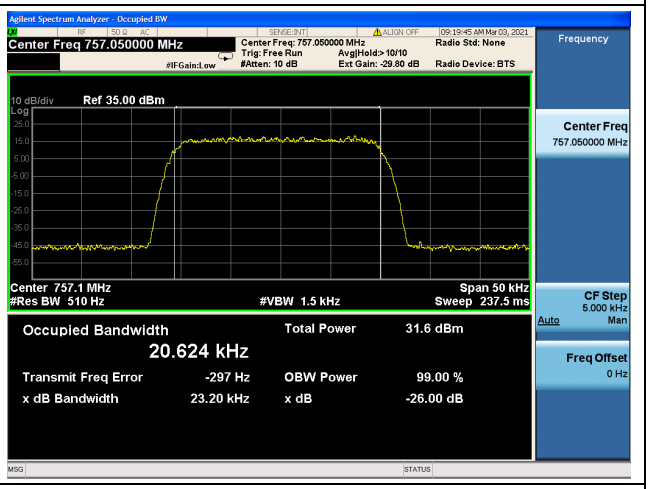

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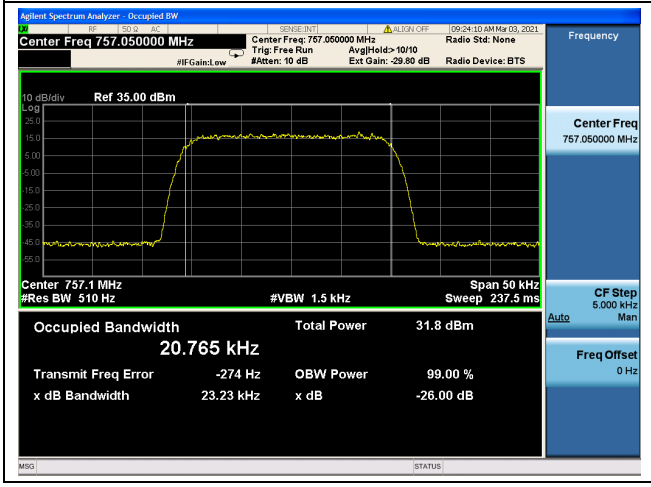

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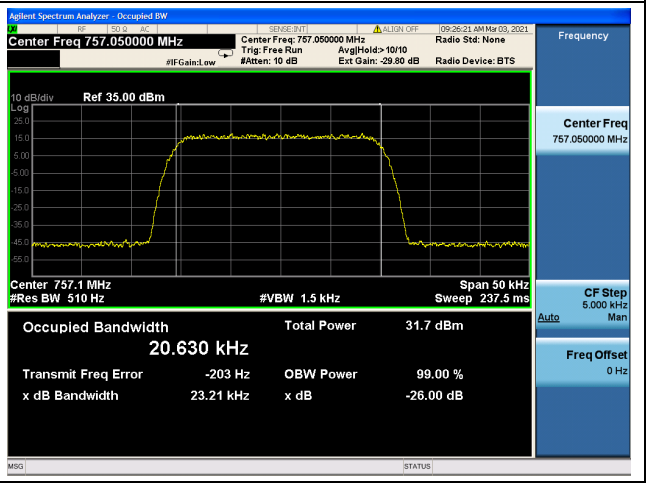

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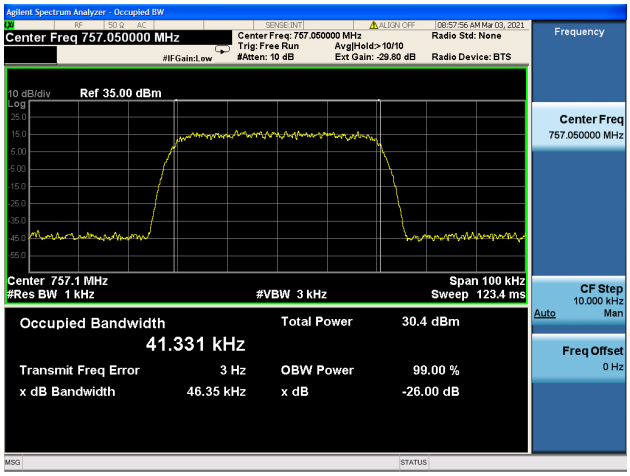

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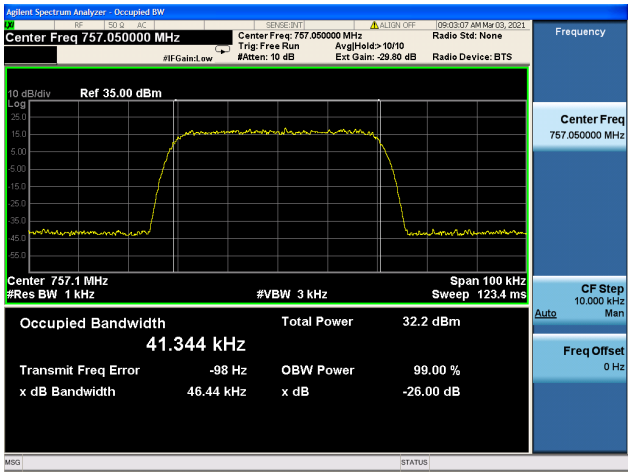

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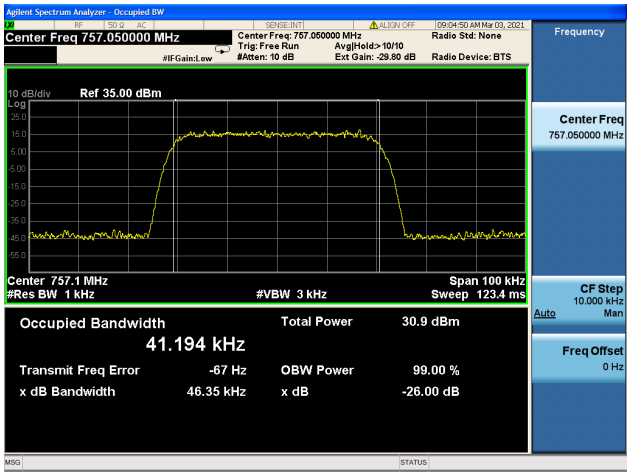

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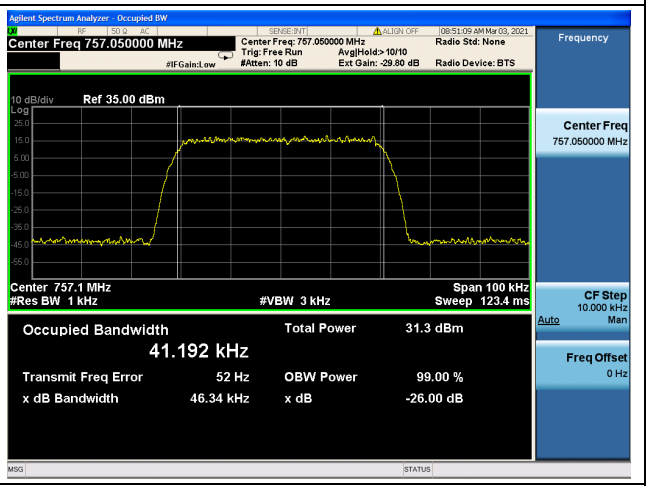

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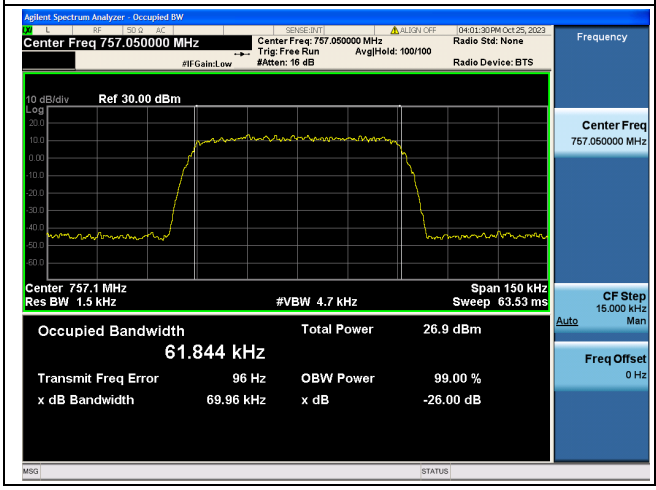

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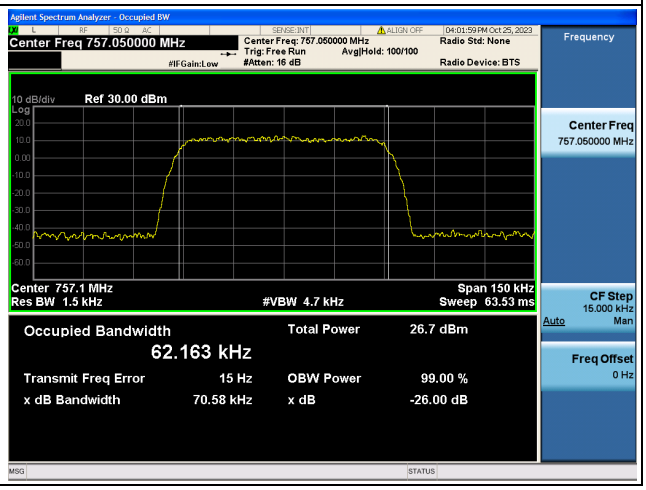
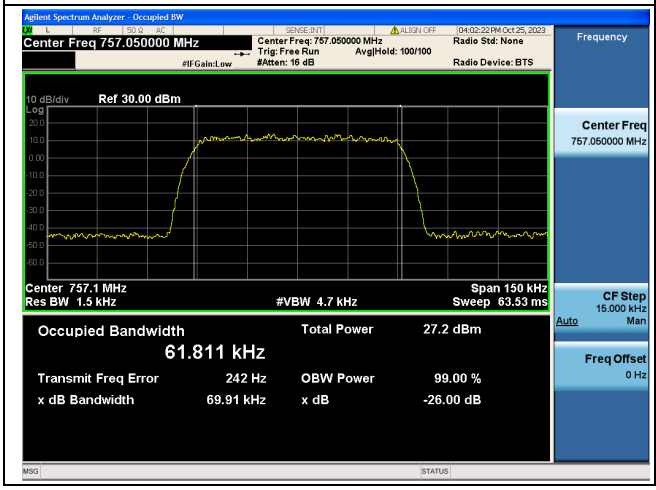
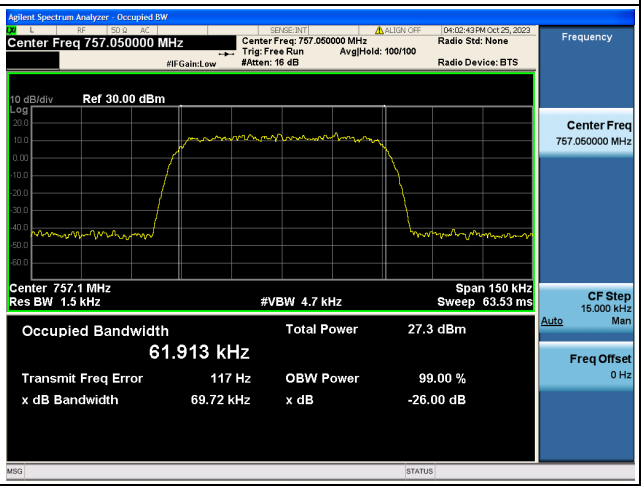
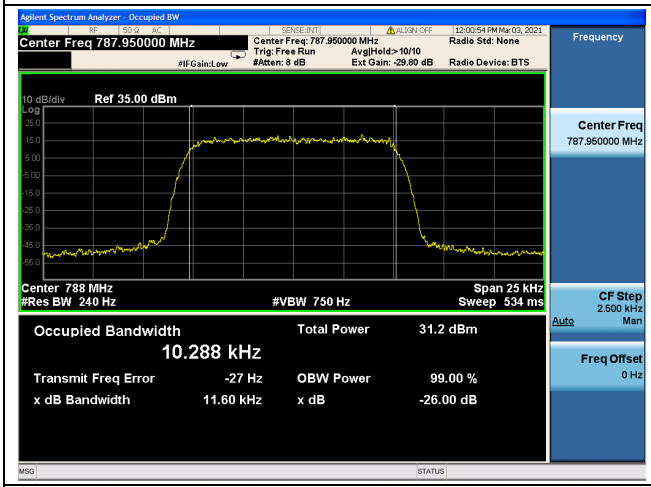


757.050MHz/Channel V /75.0kHz /64QAM	757.050MHz/Channel V /75.0kHz /256QAM
	

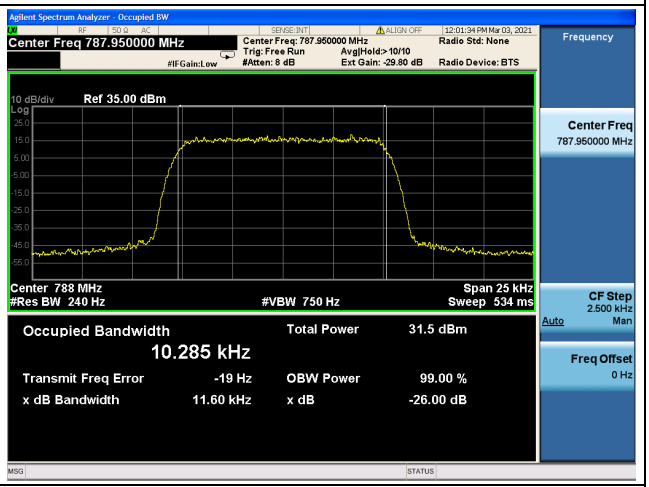
Nominal Frequency: 787.950 MHz

Tx Port	Channel Bandwidth(kHz)	Emission Type	Occupied Bandwidth(kHz)
H	12.5	QPSK	10.288
		16QAM	10.285
		64QAM	10.294
		256QAM	10.299
	25.0	QPSK	20.763
		16QAM	20.519
		64QAM	20.669
		256QAM	20.733
	50.0	QPSK	41.208
		16QAM	41.427
		64QAM	41.173
		256QAM	41.312
	75	QPSK	61.925
		16QAM	61.641
		64QAM	62.248
		256QAM	61.989
V	12.5	QPSK	10.308
		16QAM	10.306
		64QAM	10.292
		256QAM	10.300
	25.0	QPSK	20.672
		16QAM	20.559
		64QAM	20.631
		256QAM	20.686
	50.0	QPSK	41.255
		16QAM	41.598
		64QAM	41.143
		256QAM	41.268
	75	QPSK	61.842
		16QAM	61.965
		64QAM	62.244
		256QAM	61.898

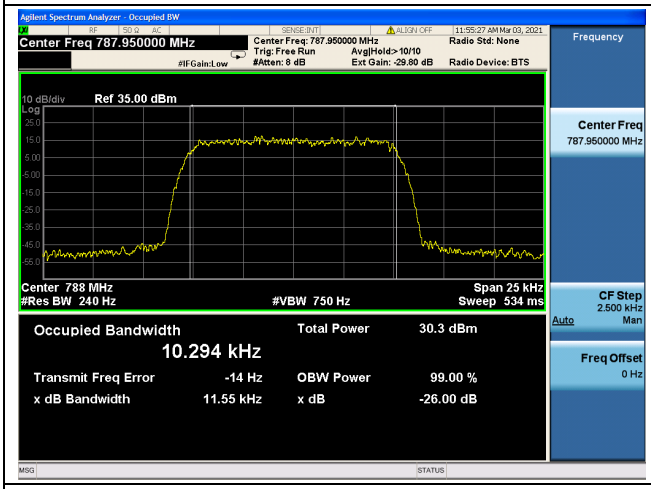
787.950MHz/Channel H/12.5kHz/QPSK



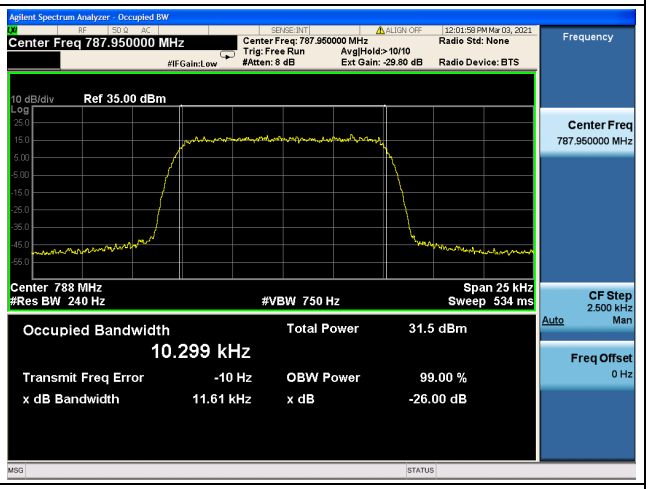
787.950MHz/Channel H/12.5kHz/16QAM



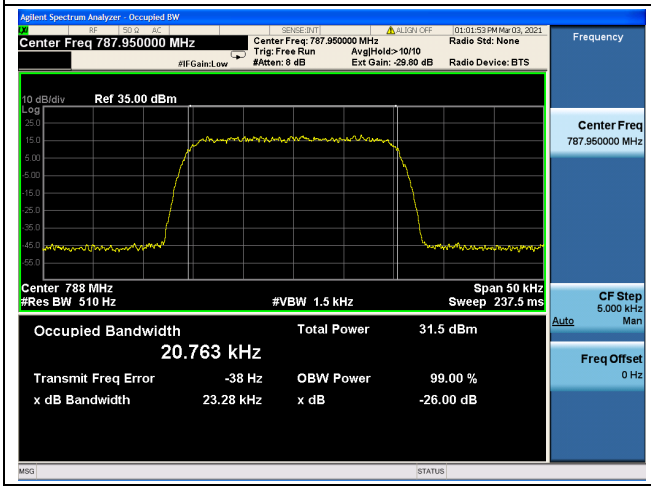
787.950MHz/Channel H/12.5kHz/64QAM



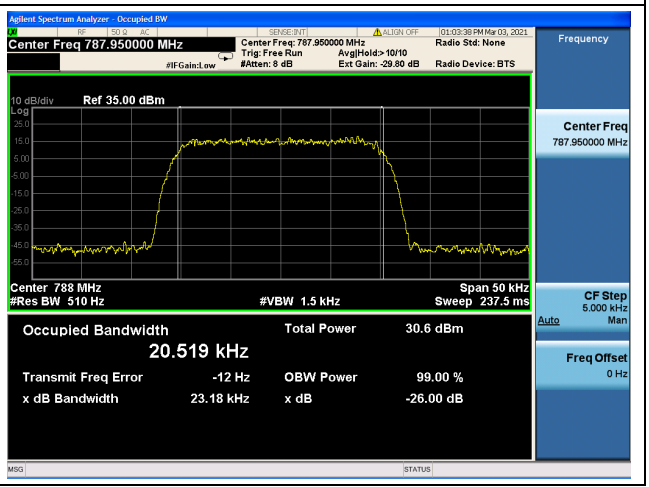
787.950MHz/Channel H/12.5 kHz/256QAM



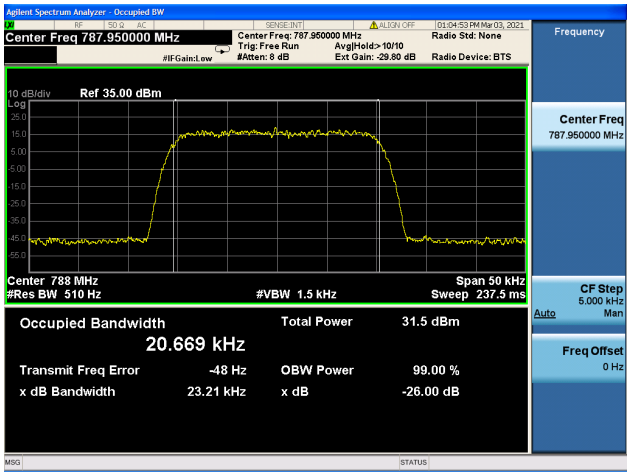
787.950MHz/Channel H/25.0 kHz/QPSK



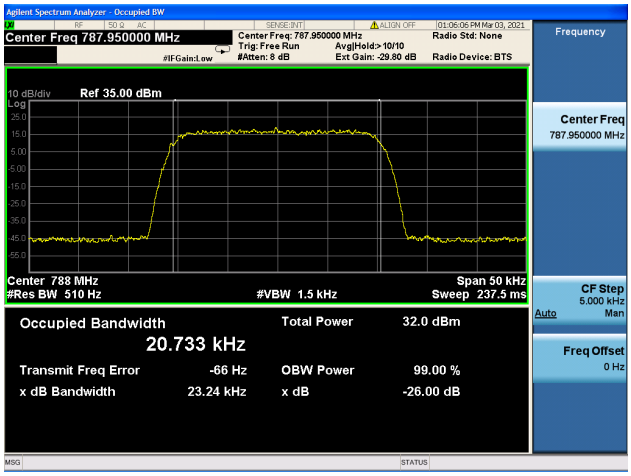
787.950MHz/Channel H/25.0 kHz/16QAM



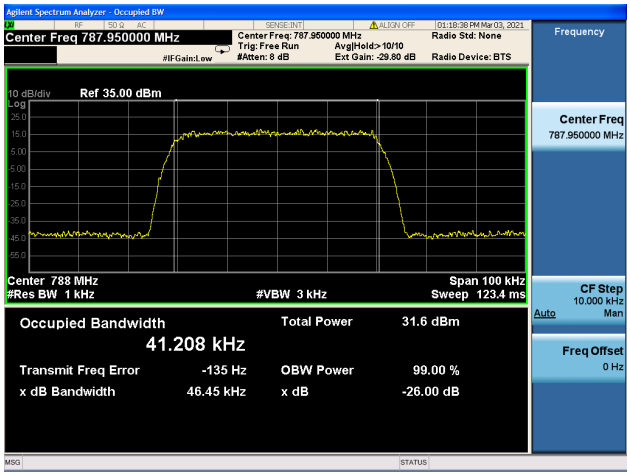
787.950MHz/Channel H/25.0 kHz/64QAM



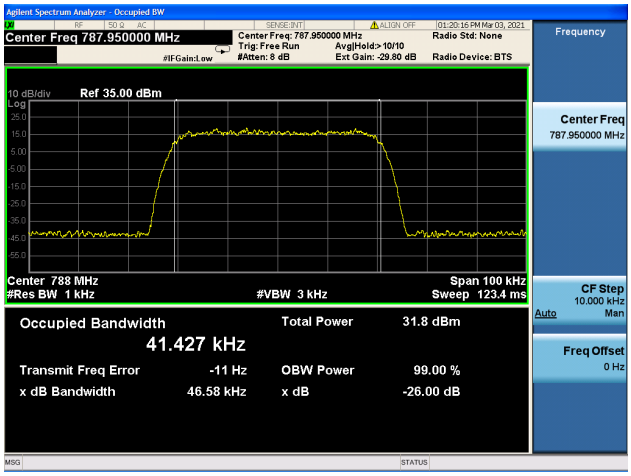
787.950MHz/Channel H/25.0 kHz/256QAM



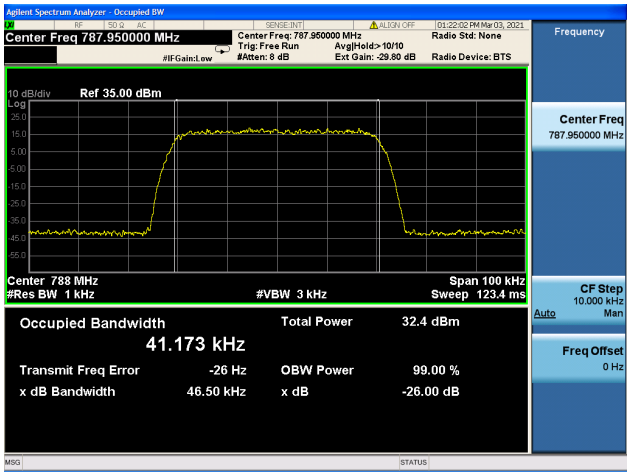
787.950MHz/Channel H/50.0 kHz/QPSK



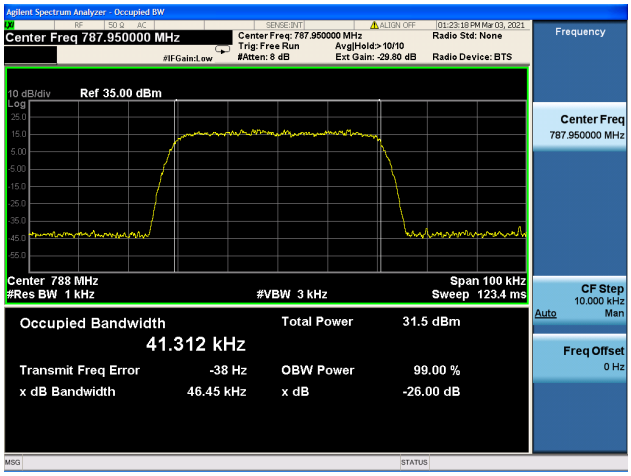
787.950MHz/Channel H/50.0 kHz/16QAM



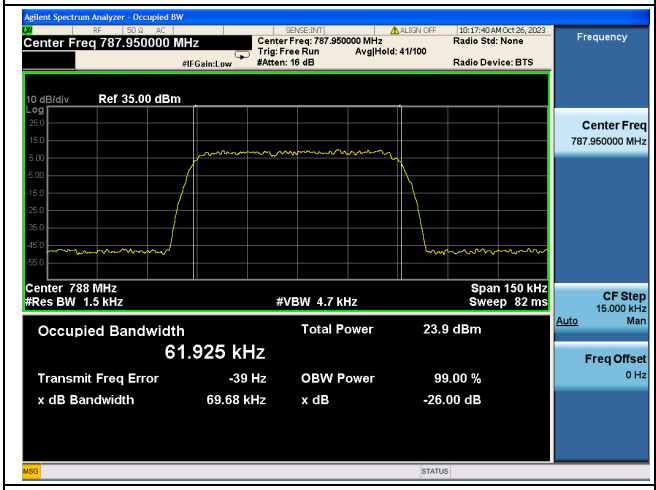
787.950MHz/Channel H/50.0 kHz/64QAM



787.950MHz/Channel H/50.0 kHz/256QAM



787.950MHz/Channel H/75.0kHz/QPSK



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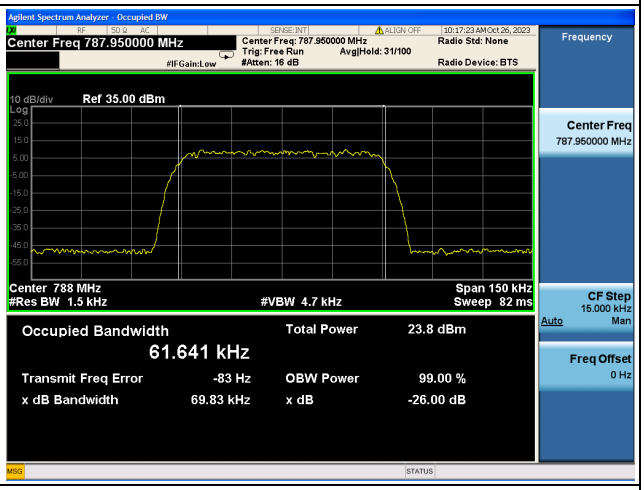

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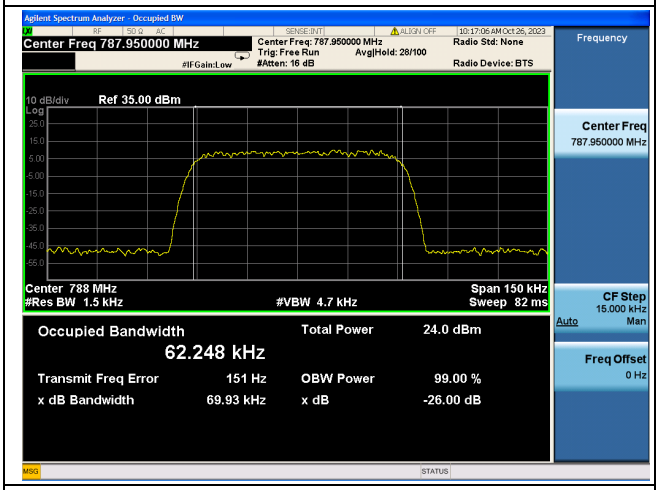

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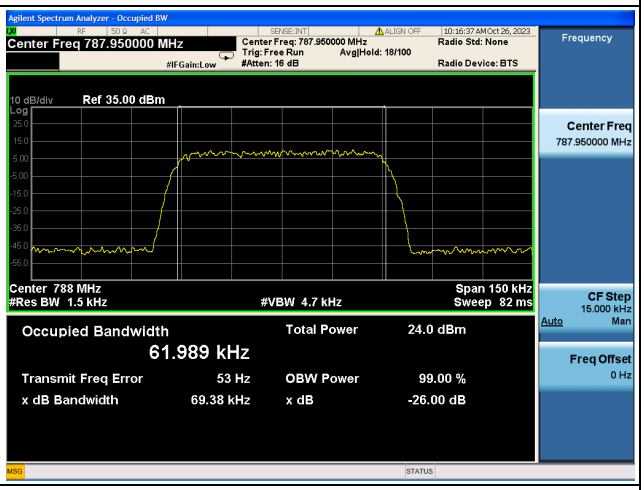
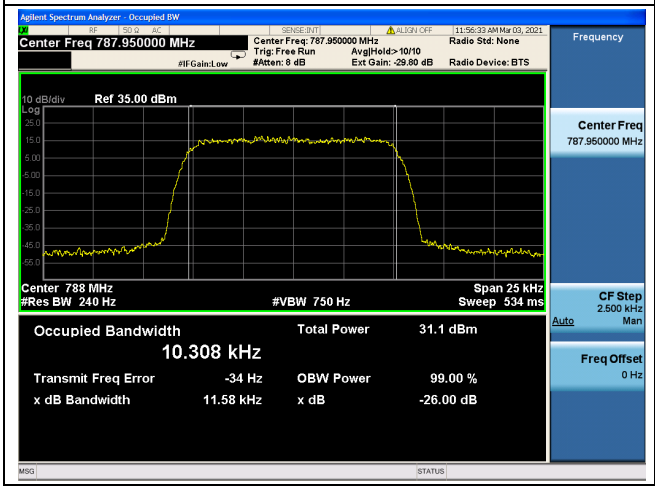
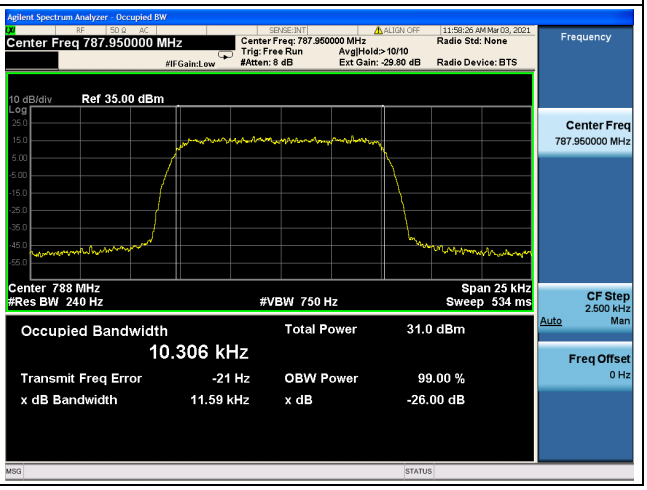


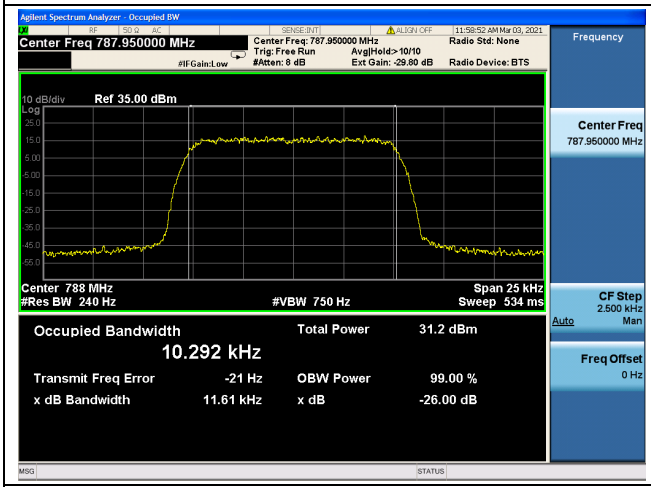
787.950MHz/Channel V/12.5kHz/QPSK



787.950MHz/Channel V/12.5kHz/16QAM



787.950MHz/Channel V/12.5kHz/64QAM



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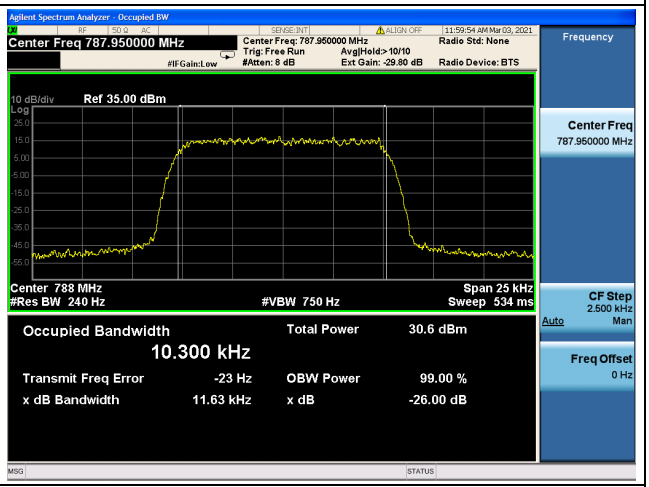
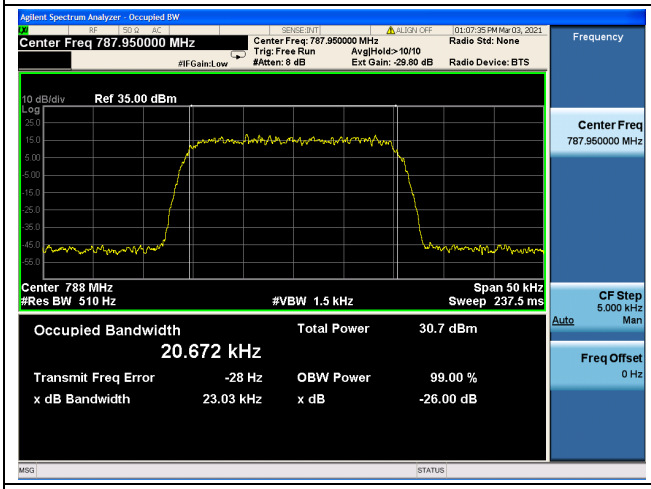


787.950MHz/Channel V/25.0 kHz/QPSK



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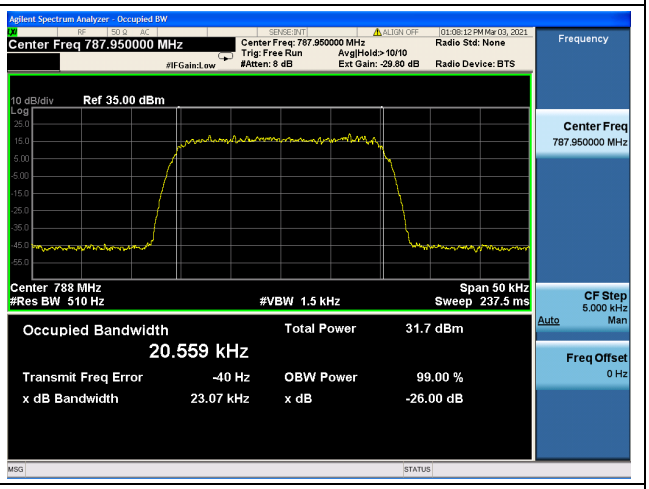
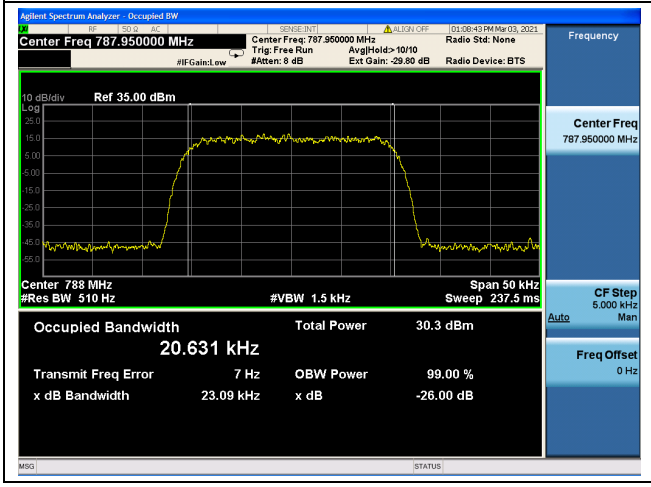
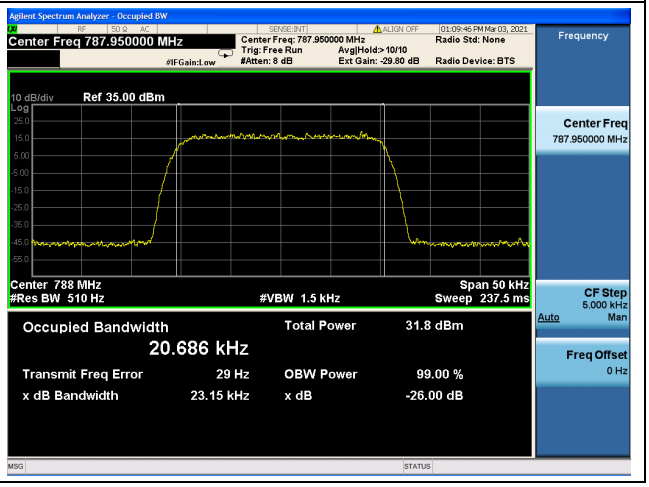


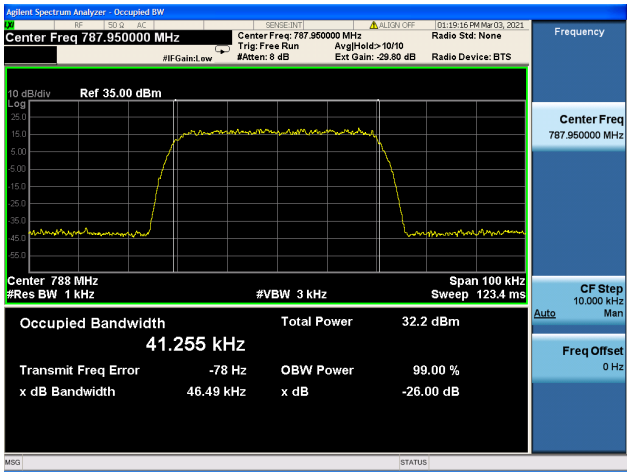
787.950MHz/Channel V/25.0 kHz/64QAM



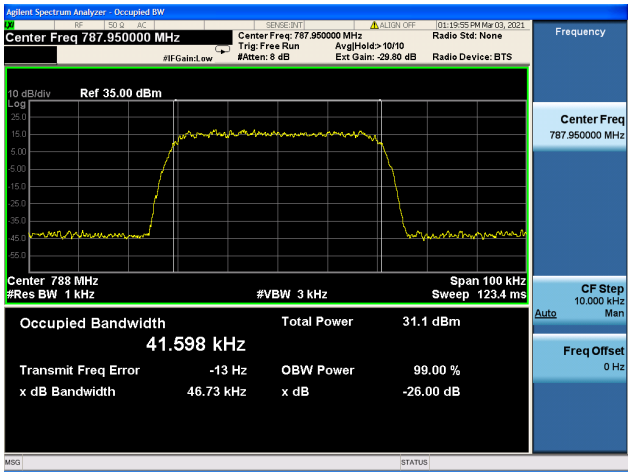
787.950MHz/Channel V/25.0 kHz/256QAM



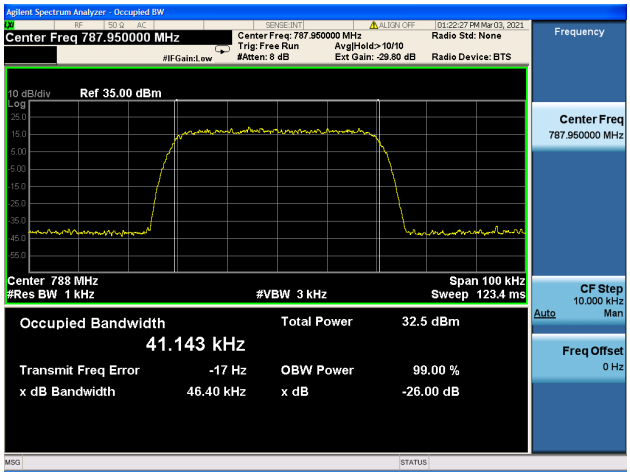
787.950MHz/Channel V/50.0 kHz/QPSK



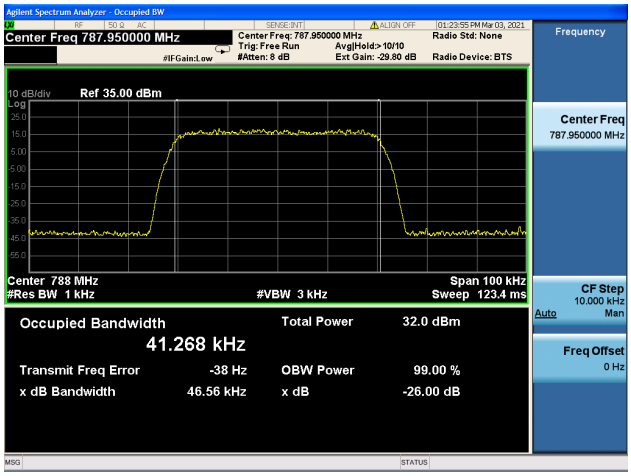
787.950MHz/Channel V/50.0 kHz/16QAM



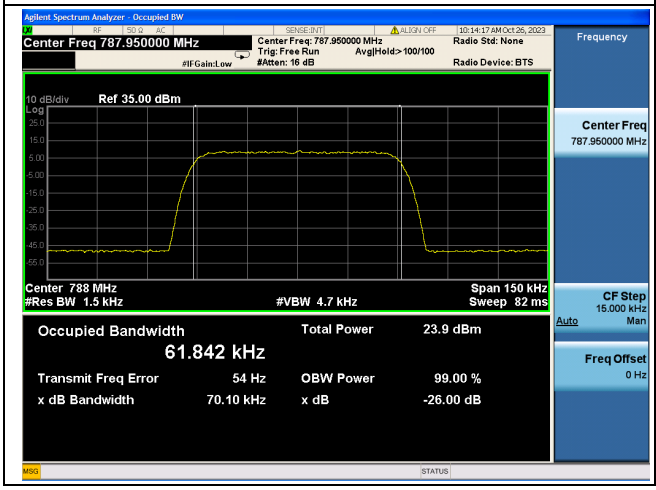
787.950MHz/Channel V/50.0 kHz/64QAM



787.950MHz/Channel V/50.0 kHz/256QAM



787.950MHz/Channel V/75.0kHz/QPSK



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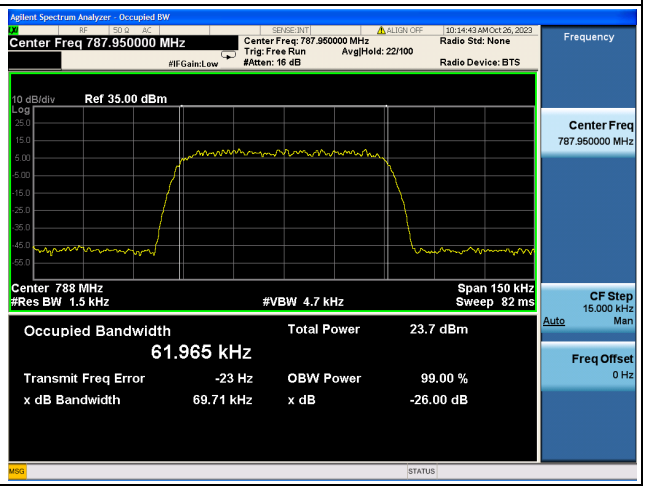
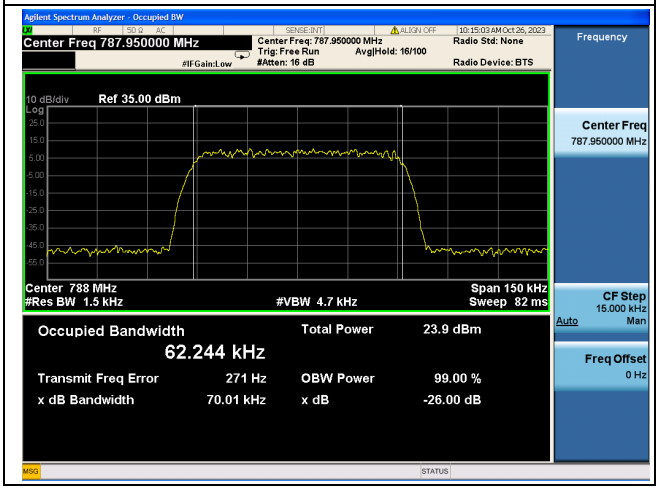
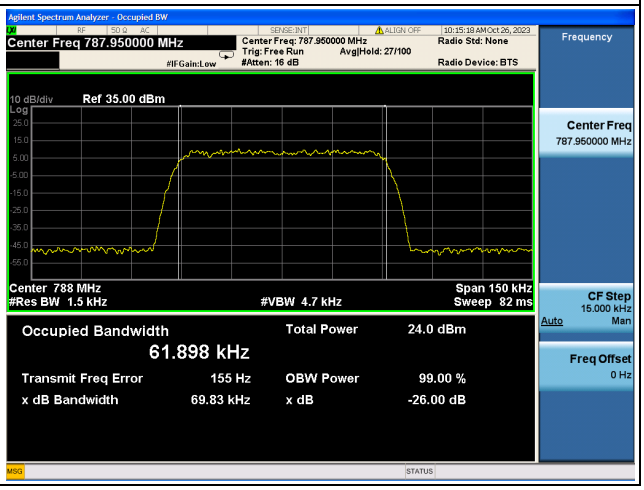


787.950MHz/Channel V/75.0kHz/64QAM	787.950MHz/Channel V/75.0kHz/256QAM
	

2.3. Spurious Emissions At Antenna Terminals

2.3.1. Test Requirement

According to FCC section 2.1051 and section 27.53(c).For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

(3) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations;

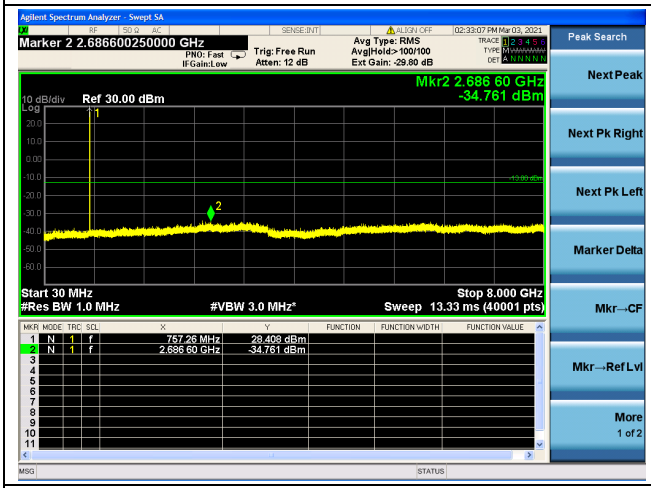
(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;

(6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

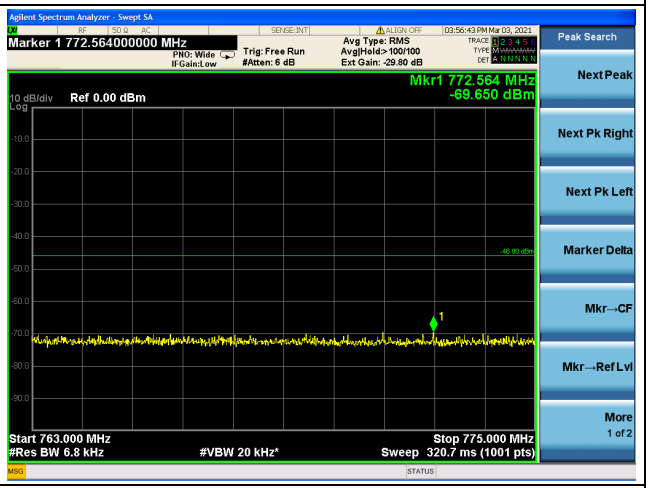
2.3.2. Test Result

Nominal Frequency: 757.050 MHz Tx Port: Channel H

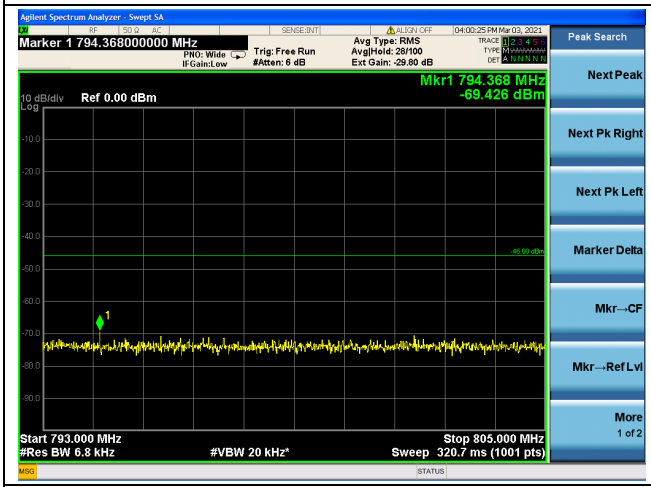
12.5kHz/QPSK



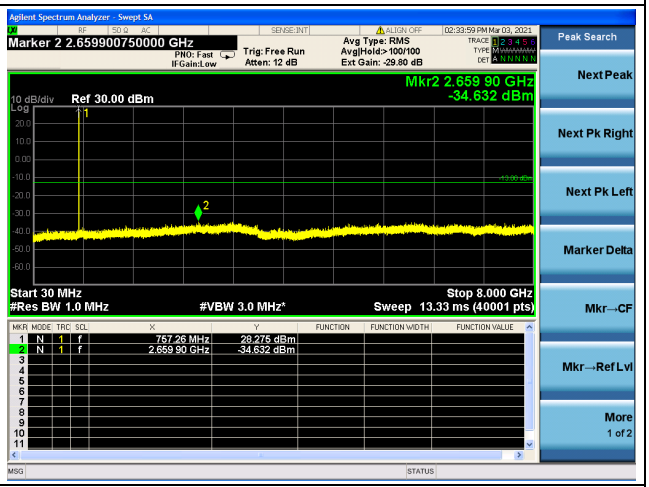
12.5kHz/QPSK 763-775MHz



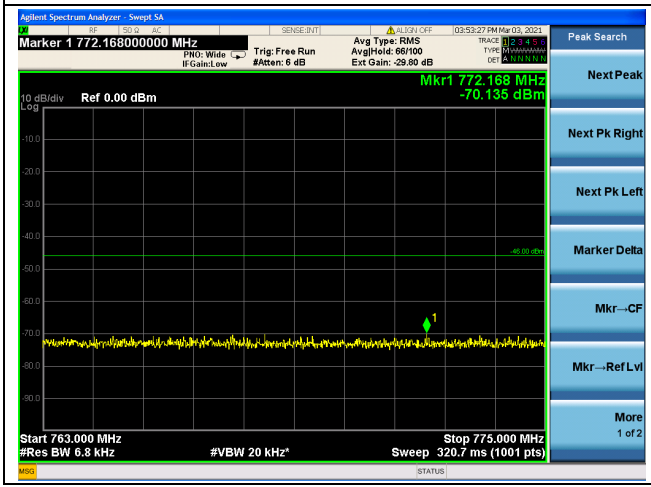
12.5kHz/QPSK 793-805MHz



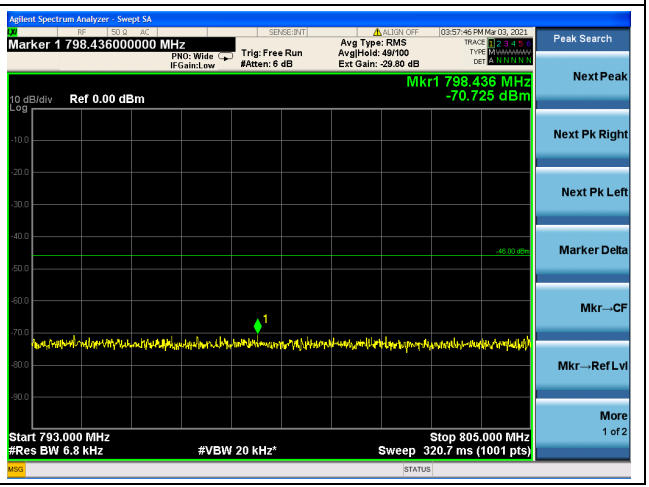
12.5kHz/16QAM



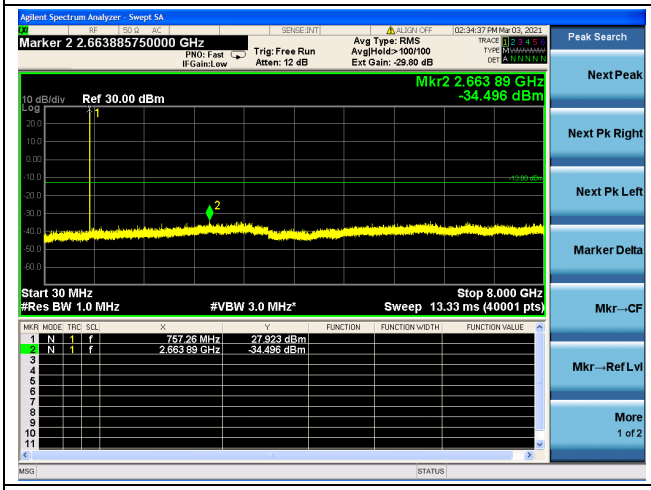
12.5kHz/16QAM 763-775MHz



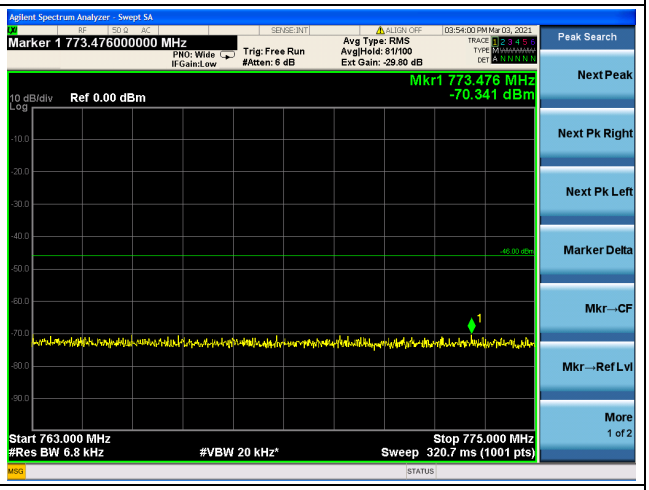
12.5kHz/16QAM 793-805MHz



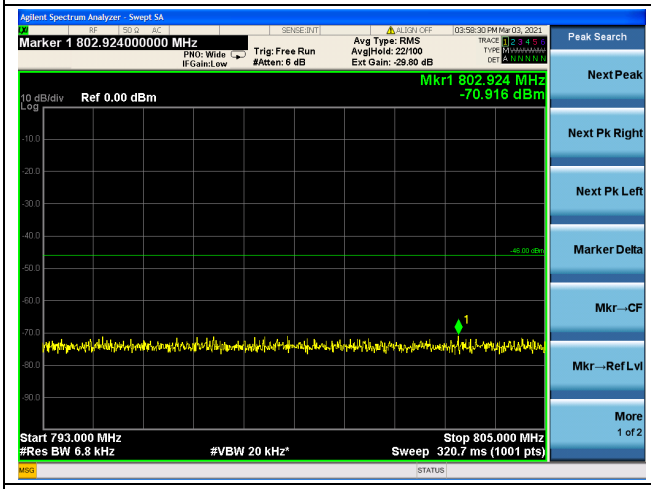
12.5kHz/64QAM



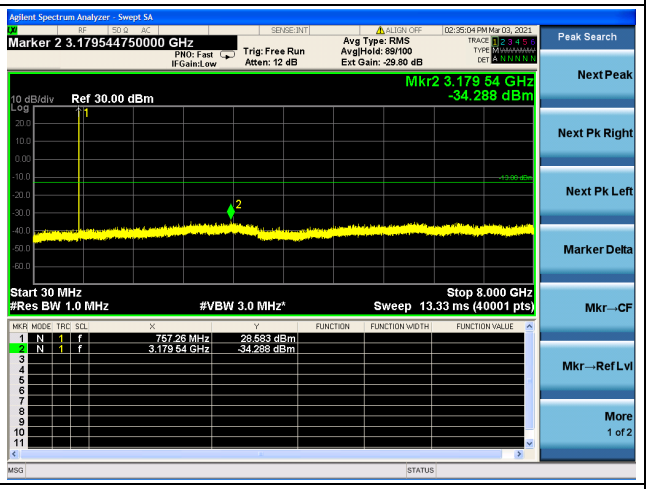
12.5kHz/64QAM 763-775MHz



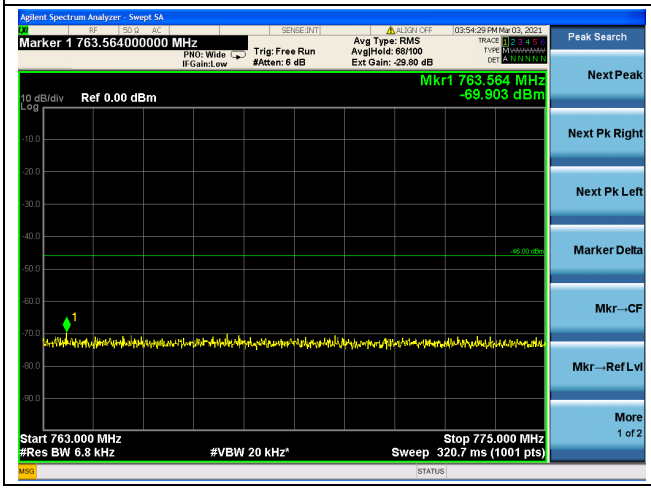
12.5kHz/64QAM 793-805MHz



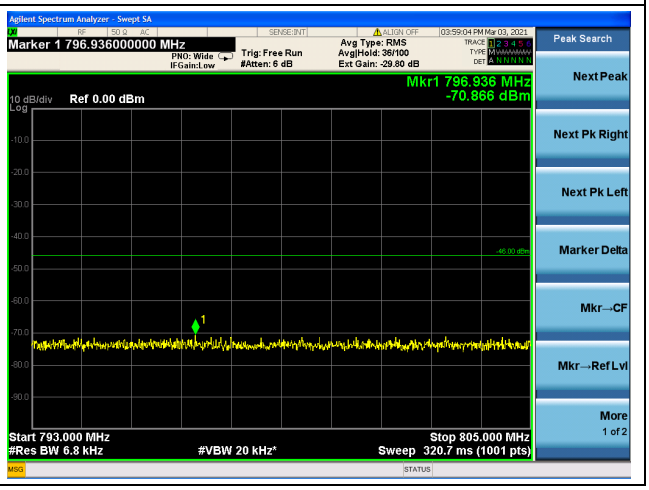
12.5kHz/256QAM



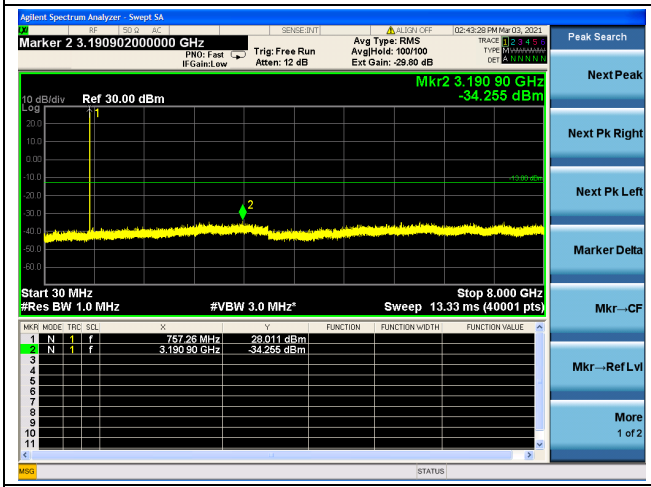
12.5kHz/256QAM 763-775MHz



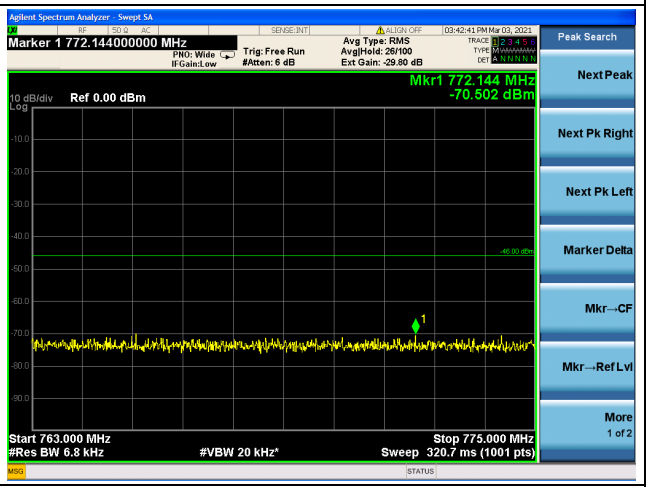
12.5kHz/256QAM 793-805MHz



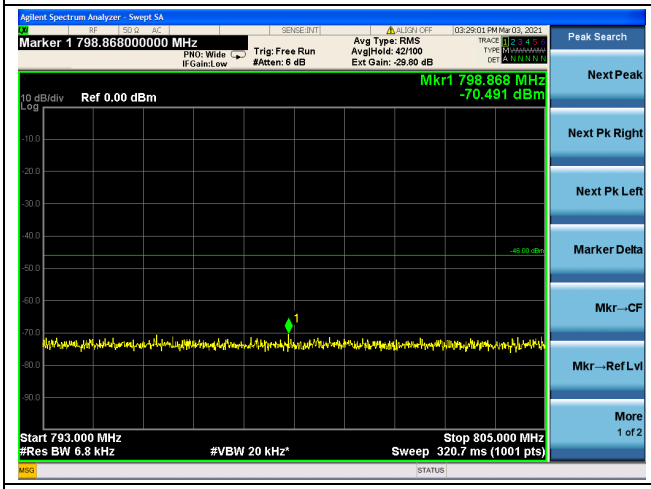
25kHz/QPSK



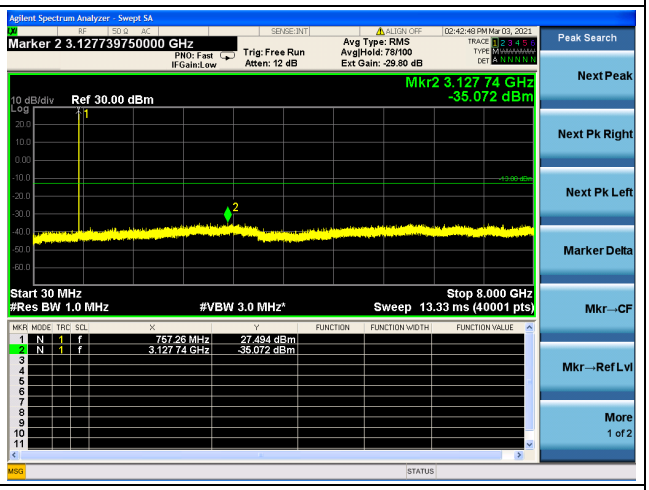
25kHz/QPSK 763-775MHz



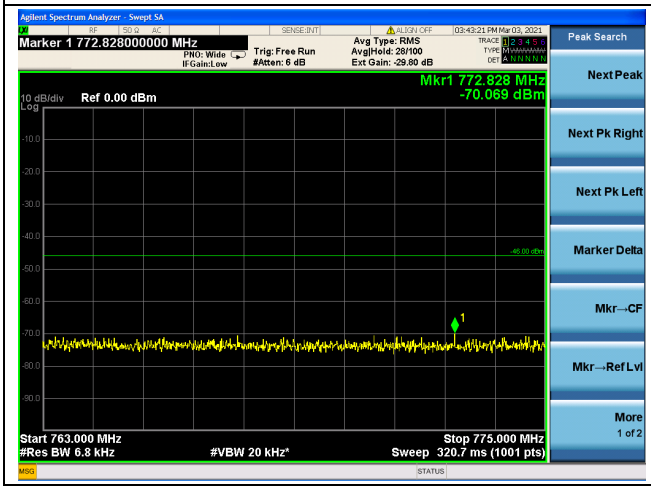
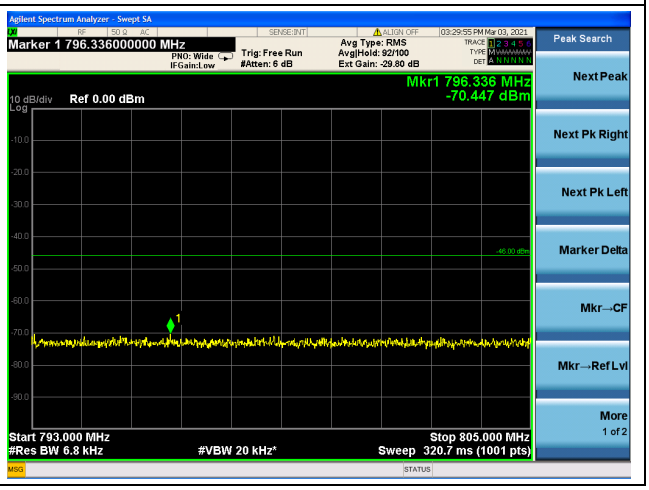
25kHz/QPSK 793-805MHz



25kHz/16QAM



25kHz/16QAM 763-775MHz



25kHz/16QAM 793-805MHz