TEST REPORT

APPLICANT	:	MiMOMax Wireless Limited
PRODUCT NAME	:	900MHz TornadoX Transceiver
MODEL NAME	:	MWL-TORNADOX-BGGD
BRAND NAME	:	Ubiik Mimomax
FCC ID	:	XMK-MMXTRNXB008
STANDARD(S)	:	47 CFR Part 2 47 CFR Part 101
RECEIPT DATE	:	2024-07-29
TEST DATE	:	2024-08-15 to 2024-08-30
ISSUE DATE	:	2024-11-01

Tested by: Gan Jing (Rapporteur)

Approved by: Shen Junsheng (Supervisor)

NOTE: This document is issued by Shenzhen Morlab Communication Technology Co., Ltd., the test report shall not be reproduced except in full without prior written permission of the company. The test results apply only to the particular sample(s) tested and to the specific tests carried out which is available on request for validation and information confirmed at our website.

MORLAB
Shenzhen Morlab Communication Technology Co., Ltd.
FL.1-3, Building A, FeiYang Science Park, No.8 LongChang Road,
Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China
Tel: 86-755-36698555 Fax: 86-755-36698525
Http://www.morlab.cn E-mail: service@morlab.cn

DIRECTORY

1. Technical Information ····· 3
1.1. Applicant and Manufacturer Information ····· 3
1.2. Equipment Under Test (EUT) Description ····· 3
1.3. Test Standards and Results ····· 4
1.4. Environmental Conditions ····· 5
2. 47 CFR Part 2 and Part 101 Requirements ····· 6
2.1. Radio Frequency Power Output and E.R.P. ····· 6
2.2. Occupied Bandwidth ····· 12
2.3. Spurious Emissions at Antenna Terminals ····· 40
2.4. Radiated Spurious Emissions ····· 53
2.5. Frequency Stability ····· 57
Annex A Test Uncertainty ····· 59
Annex B Testing Laboratory Information ····· 60

Change History		
Issue	Date	Reason for change
1.0	2024-11-01	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:	900MHz TornadoX Transceiver	
EUT Serial No:	(N/A, marked 1# by test site)	
Hardware Version:	P001	
Software Version:	TRN_04.08.05	
Operating Frequency Range:	932.5 - 935 MHz, 941.5 - 944 MHz, 952 - 960 MHz, 2Tx/2Rx	
Channel Bandwidth:	50kHz, 75kHz, 100kHz, 150kHz, 200kHz	
Modulation Type:	QPSK; 16QAM; 64QAM; 256QAM	
Operating Voltage:	10.5-60V	
Antenna Gain:	Omni Antenna	8.0 dBi
	Panel Antenna	8.0 dBi
		10.0 dBi
		12.0 dBi
		16.0 dBi

1.3. Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 2 and Part 101 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 101	Fixed Microwave Services

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

Section	Description	Test Engineer	Result	Method Determination /Remark
2.1046 101.113	Transmitter Conducted Output Power and ERP/EIRP	Gan Jing	PASS	No deviation
2.1049 101.109	Occupied Bandwidth	Gan Jing	PASS	No deviation
2.1051 101.111	Conducted Spurious Emissions	Gan Jing	PASS	No deviation
2.1053 101.111	Radiated Spurious Emissions	Gao Jianrou	PASS	No deviation
2.1055 101.101	Frequency stability	Gan Jing	PASS	No deviation

Note 1: The 900MHz TornadoX Transceiver complies with FCC 47 CFR Part 2 and Part 101 when tested in accordance with the test methods described in 47 CFR Part 2 and Part 101.

Note 2: The 900MHz TornadoX 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 of 0.7dB and attenuator of 30.0dB.

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.

1.4. Environmental Conditions

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

Temperature (°C):	15 - 35
Relative Humidity (%):	30 -60

2. 47 CFR Part 2 and Part 101 Requirements

2.1. Radio Frequency Power Output and E.R.P.

2.1.1. Test result

Nominal Frequency: 933.5 MHz Tx Port: Channel H

Channel Bandwidth (kHz)	Modulation Type	Voltage (Vdc)	Measured Power (dBm)	Measured Power (Watt)	E.R.P.	
					dBm	Watt
50.0	QPSK	24	33.50	2.239	47.35	54.325
50.0	16QAM	24	33.77	2.382	47.62	57.810
50.0	64QAM	24	34.02	2.523	47.87	61.235
50.0	256QAM	24	33.71	2.350	47.56	57.016
75.0	QPSK	24	33.96	2.489	47.81	60.395
75.0	16QAM	24	33.93	2.472	47.78	59.979
75.0	64QAM	24	33.41	2.193	47.26	53.211
75.0	256QAM	24	34.04	2.535	47.89	61.518
100.0	QPSK	24	33.75	2.371	47.60	57.544
100.0	16QAM	24	33.53	2.254	47.38	54.702
100.0	64QAM	24	33.61	2.296	47.46	55.719
100.0	256QAM	24	33.87	2.438	47.72	59.156
150.0	QPSK	24	33.98	2.500	47.83	60.674
150.0	16QAM	24	33.99	2.506	47.84	60.814
150.0	64QAM	24	33.47	2.223	47.32	53.951
150.0	256QAM	24	33.87	2.438	47.72	59.156
200.0	QPSK	24	33.99	2.506	47.84	60.814
200.0	16QAM	24	34.05	2.541	47.90	61.660
200.0	64QAM	24	33.53	2.254	47.38	54.702
200.0	256QAM	24	33.69	2.339	47.54	56.754

Nominal Frequency: 933.5 MHz Tx Port: Channel V

Channel Bandwidth (kHz)	Modulation Type	Voltage (Vdc)	Measured Power (dBm)	Measured Power (Watt)	E.R.P.	
					dBm	Watt
50.0	QPSK	24	33.62	2.301	47.47	55.847
50.0	16QAM	24	33.86	2.432	47.71	59.020
50.0	64QAM	24	33.90	2.455	47.75	59.566
50.0	256QAM	24	33.56	2.270	47.41	55.081
75.0	QPSK	24	33.95	2.483	47.80	60.256
75.0	16QAM	24	33.86	2.432	47.71	59.020
75.0	64QAM	24	33.77	2.382	47.62	57.810
75.0	256QAM	24	34.08	2.559	47.93	62.087
100.0	QPSK	24	33.56	2.270	47.41	55.081
100.0	16QAM	24	33.67	2.328	47.52	56.494
100.0	64QAM	24	33.59	2.286	47.44	55.463
100.0	256QAM	24	33.78	2.388	47.63	57.943
150.0	QPSK	24	33.96	2.489	47.81	60.395
150.0	16QAM	24	33.84	2.421	47.69	58.749
150.0	64QAM	24	33.69	2.339	47.54	56.754
150.0	256QAM	24	33.95	2.483	47.80	60.256
200.0	QPSK	24	33.97	2.495	47.82	60.534
200.0	16QAM	24	33.82	2.410	47.67	58.479
200.0	64QAM	24	33.60	2.291	47.45	55.590
200.0	256QAM	24	33.73	2.360	47.58	57.280

Nominal Frequency: 942.5 MHz Tx Port: Channel H

Channel Bandwidth (kHz)	Modulation Type	Voltage (Vdc)	Measured Power (dBm)	Measured Power (Watt)	E.R.P.	
					dBm	Watt
50.0	QPSK	24	34.02	2.523	47.87	61.235
50.0	16QAM	24	33.52	2.249	47.37	54.576
50.0	64QAM	24	33.60	2.291	47.45	55.590
50.0	256QAM	24	34.08	2.559	47.93	62.087
75.0	QPSK	24	33.52	2.249	47.37	54.576
75.0	16QAM	24	33.97	2.495	47.82	60.534
75.0	64QAM	24	33.90	2.455	47.75	59.566
75.0	256QAM	24	34.02	2.523	47.87	61.235
100.0	QPSK	24	33.67	2.328	47.52	56.494
100.0	16QAM	24	33.72	2.355	47.57	57.148
100.0	64QAM	24	33.73	2.360	47.58	57.280
100.0	256QAM	24	34.03	2.529	47.88	61.376
150.0	QPSK	24	33.97	2.495	47.82	60.534
150.0	16QAM	24	33.69	2.339	47.54	56.754
150.0	64QAM	24	33.74	2.366	47.59	57.412
150.0	256QAM	24	34.01	2.518	47.86	61.094
200.0	QPSK	24	33.91	2.460	47.76	59.704
200.0	16QAM	24	33.77	2.382	47.62	57.810
200.0	64QAM	24	33.87	2.438	47.72	59.156
200.0	256QAM	24	33.89	2.449	47.74	59.429

Nominal Frequency: 942.5 MHz Tx Port: Channel V

Channel Bandwidth (kHz)	Modulation Type	Voltage (Vdc)	Measured Power (dBm)	Measured Power (Watt)	E.R.P.	
					dBm	Watt
50.0	QPSK	24	33.94	2.477	47.79	60.117
50.0	16QAM	24	33.68	2.333	47.53	56.624
50.0	64QAM	24	33.97	2.495	47.82	60.534
50.0	256QAM	24	33.88	2.443	47.73	59.293
75.0	QPSK	24	33.63	2.307	47.48	55.976
75.0	16QAM	24	33.87	2.438	47.72	59.156
75.0	64QAM	24	33.94	2.477	47.79	60.117
75.0	256QAM	24	33.82	2.410	47.67	58.479
100.0	QPSK	24	33.83	2.415	47.68	58.614
100.0	16QAM	24	33.64	2.312	47.49	56.105
100.0	64QAM	24	33.56	2.270	47.41	55.081
100.0	256QAM	24	33.90	2.455	47.75	59.566
150.0	QPSK	24	33.87	2.438	47.72	59.156
150.0	16QAM	24	33.79	2.393	47.64	58.076
150.0	64QAM	24	33.98	2.500	47.83	60.674
150.0	256QAM	24	33.94	2.477	47.79	60.117
200.0	QPSK	24	33.80	2.399	47.65	58.210
200.0	16QAM	24	33.90	2.455	47.75	59.566
200.0	64QAM	24	33.99	2.506	47.84	60.814
200.0	256QAM	24	34.00	2.512	47.85	60.954

Nominal Frequency: 952.5 MHz Tx Port: Channel H

Channel Bandwidth (kHz)	Modulation Type	Voltage (Vdc)	Measured Power (dBm)	Measured Power (Watt)	E.R.P.	
					dBm	Watt
50.0	QPSK	24	33.83	2.415	47.68	58.614
50.0	16QAM	24	33.81	2.404	47.66	58.345
50.0	64QAM	24	33.80	2.399	47.65	58.210
50.0	256QAM	24	33.97	2.495	47.82	60.534
75.0	QPSK	24	33.99	2.506	47.84	60.814
75.0	16QAM	24	33.77	2.382	47.62	57.810
75.0	64QAM	24	33.83	2.415	47.68	58.614
75.0	256QAM	24	33.94	2.477	47.79	60.117
100.0	QPSK	24	33.86	2.432	47.71	59.020
100.0	16QAM	24	33.71	2.350	47.56	57.016
100.0	64QAM	24	33.75	2.371	47.60	57.544
100.0	256QAM	24	33.98	2.500	47.83	60.674
150.0	QPSK	24	33.97	2.495	47.82	60.534
150.0	16QAM	24	33.68	2.333	47.53	56.624
150.0	64QAM	24	33.76	2.377	47.61	57.677
150.0	256QAM	24	34.04	2.535	47.89	61.518
200.0	QPSK	24	33.90	2.455	47.75	59.566
200.0	16QAM	24	33.58	2.280	47.43	55.335
200.0	64QAM	24	33.71	2.350	47.56	57.016
200.0	256QAM	24	33.83	2.415	47.68	58.614

Nominal Frequency: 952.5 MHz Tx Port: Channel V

Channel Bandwidth (kHz)	Modulation Type	Voltage (Vdc)	Measured Power (dBm)	Measured Power (Watt)	E.R.P.	
					dBm	Watt
50.0	QPSK	24	33.88	2.443	47.73	59.293
50.0	16QAM	24	33.75	2.371	47.60	57.544
50.0	64QAM	24	33.94	2.477	47.79	60.117
50.0	256QAM	24	34.04	2.535	47.89	61.518
75.0	QPSK	24	33.96	2.489	47.81	60.395
75.0	16QAM	24	33.93	2.472	47.78	59.979
75.0	64QAM	24	33.86	2.432	47.71	59.020
75.0	256QAM	24	34.02	2.523	47.87	61.235
100.0	QPSK	24	33.53	2.254	47.38	54.702
100.0	16QAM	24	33.87	2.438	47.72	59.156
100.0	64QAM	24	33.78	2.388	47.63	57.943
100.0	256QAM	24	34.03	2.529	47.88	61.376
150.0	QPSK	24	33.90	2.455	47.75	59.566
150.0	16QAM	24	33.84	2.421	47.69	58.749
150.0	64QAM	24	33.98	2.500	47.83	60.674
150.0	256QAM	24	34.01	2.518	47.86	61.094
200.0	QPSK	24	33.74	2.366	47.59	57.412
200.0	16QAM	24	33.96	2.489	47.81	60.395
200.0	64QAM	24	33.88	2.443	47.73	59.293
200.0	256QAM	24	33.95	2.483	47.80	60.256

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 of 0.7dB and attenuator of 30.0dB.

Note 2: The transmitter has a rated output power of .2.512 Watt (34dBm). The measured power has been shown to be within +/- 1 dB of the rated power.

Note3: E.I.R.P. (dBm) = Conducted Output Power (dBm) + Antenna Gain (dBi); E.R.P. (dBm) = E.I.R.P. (dBm) - 2.15.

Note 4: The product's antenna is a special MIMO antenna with cross-polarization which is able to transmit and receive on both the vertical and horizontal polarizations at the same time, the MIMO antennas are essentially two antennas in one.

Note 5: According to KDB 662911, the MIMO directional gain is the gain of an individual antenna.

Note 6: The DUT transmitter ports are completely uncorrelated. According to KDB 662911 the conducted power or E.R.P is measured on each port individually and it complies with the regulations.

2.2. Occupied Bandwidth

2.2.1. Definition

Emission Designator:

Frequency (MHz)	BW (kHz)	Designator
932.5-935MHz	50.0kHz	42K0W1W
	75.0kHz	63K0W1W
	100.0kHz	86K0W1W
	150.0kHz	128KW1W
	200.0kHz	174KW1W
941.5-944MHz	50.0kHz	42K0W1W
	75.0kHz	63K0W1W
	100.0kHz	86K0W1W
	150.0kHz	128KW1W
	200.0kHz	174KW1W
952-960MHz	50.0kHz	42K0W1W
	75.0kHz	63K0W1W
	100.0kHz	86K0W1W
	150.0kHz	128KW1W
	200.0kHz	174KW1W

Note: The above data combined with uncertainty and rounding calculations are consistent with the actual test data.

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

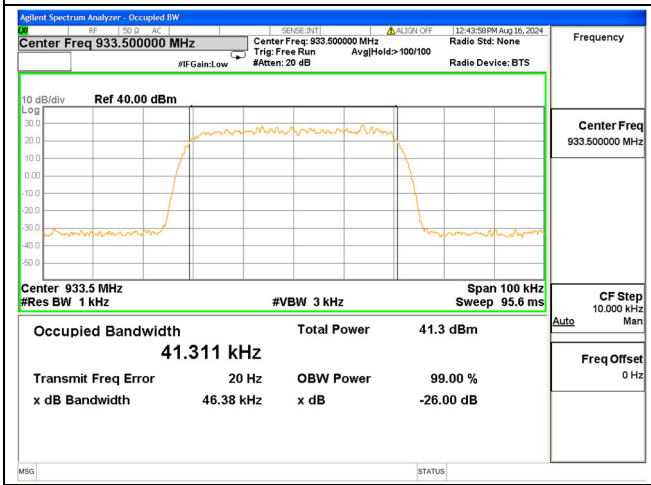
Measurements have been made of each modulation type using a spectrum analyzer operating in occupied bandwidth mode.

2.2.3. Test Result

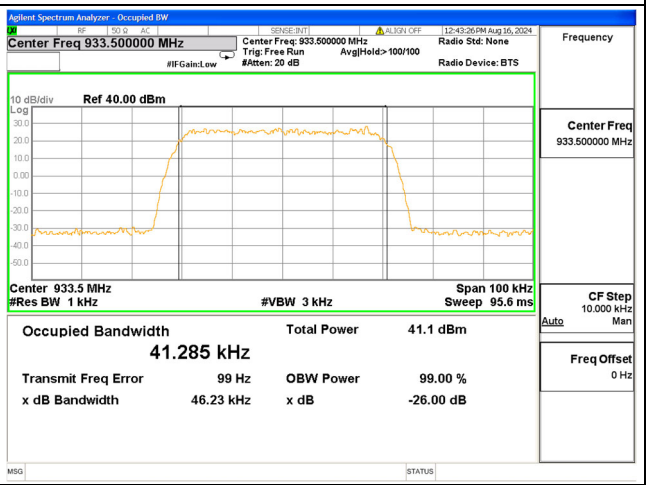
933.5 MHz			
Tx Port	**Channel Bandwidth(kHz)**	**Emission Type**	**Occupied Bandwidth(kHz)**
H	50.0	QPSK	41.311
		16QAM	41.285
		64QAM	41.225
		256QAM	41.525
	75.0	QPSK	61.834
		16QAM	62.101
		64QAM	61.968
		256QAM	61.733
	100.0	QPSK	84.372
		16QAM	84.375
		64QAM	84.708
		256QAM	85.346
	150.0	QPSK	127.20
		16QAM	126.93
		64QAM	127.46
		256QAM	126.83
	200.0	QPSK	172.22
		16QAM	172.64
		64QAM	171.97
		256QAM	173.10

V	50.0	QPSK	41.177
		16QAM	41.280
		64QAM	41.367
		256QAM	41.496
	75.0	QPSK	61.952
		16QAM	61.770
		64QAM	61.682
		256QAM	62.058
	100.0	QPSK	84.844
		16QAM	84.450
		64QAM	84.560
		256QAM	84.765
	150.0	QPSK	127.85
		16QAM	126.97
		64QAM	126.47
		256QAM	126.48
	200.0	QPSK	172.78
		16QAM	172.15
		64QAM	172.15
		256QAM	172.15

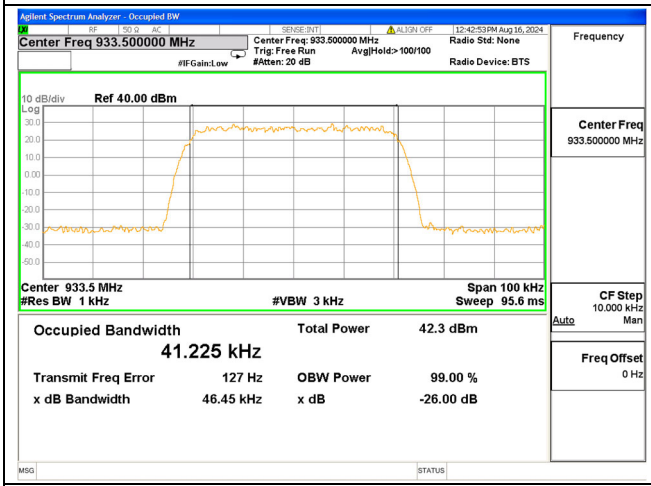
933.5MHz/Channel H/50kHz/QPSK



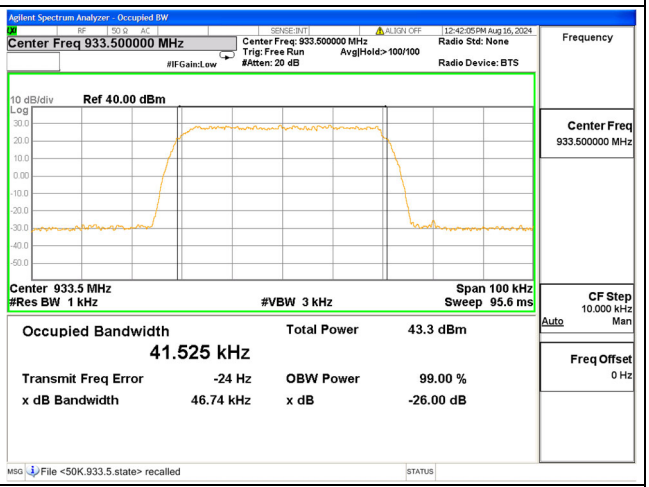
933.5MHz/Channel H/50kHz/16QAM



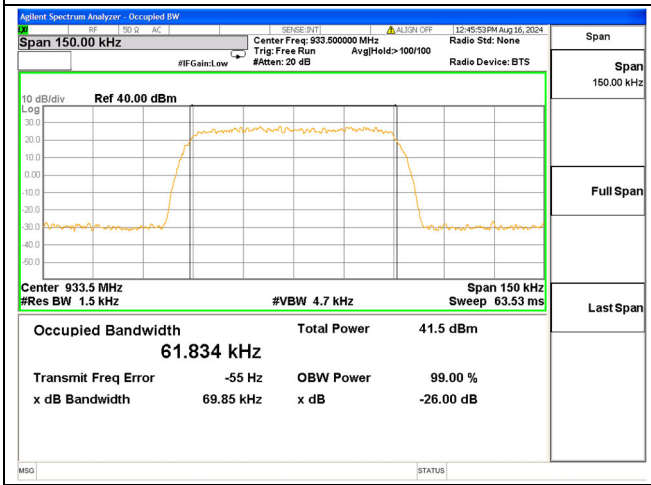
933.5MHz/Channel H/50kHz/64QAM



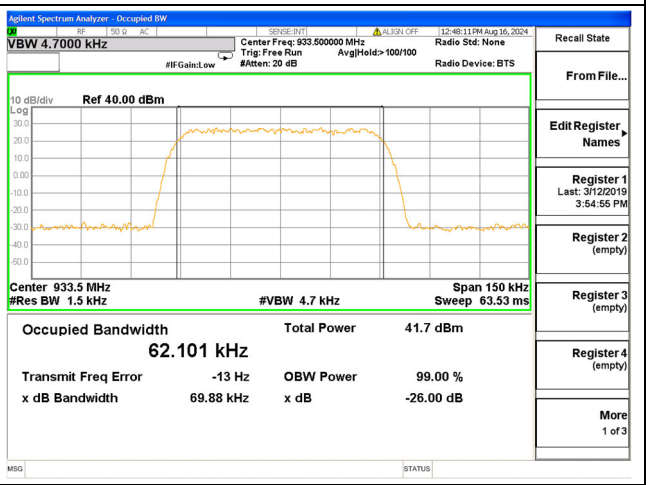
933.5MHz/Channel H/50kHz/256QAM



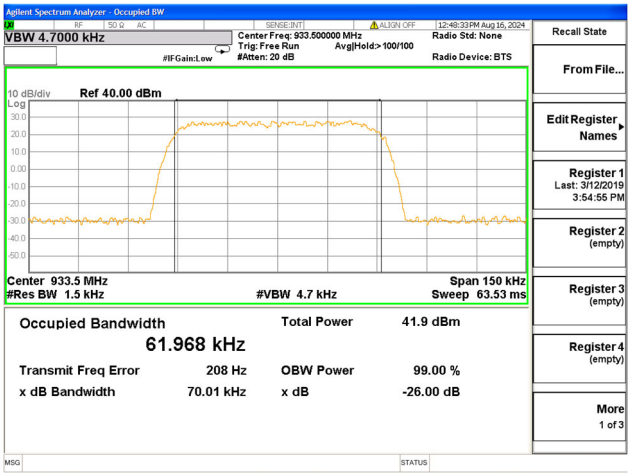
933.5MHz/Channel H/75.0kHz/QPSK



933.5MHz/Channel H/75.0 kHz/16QAM

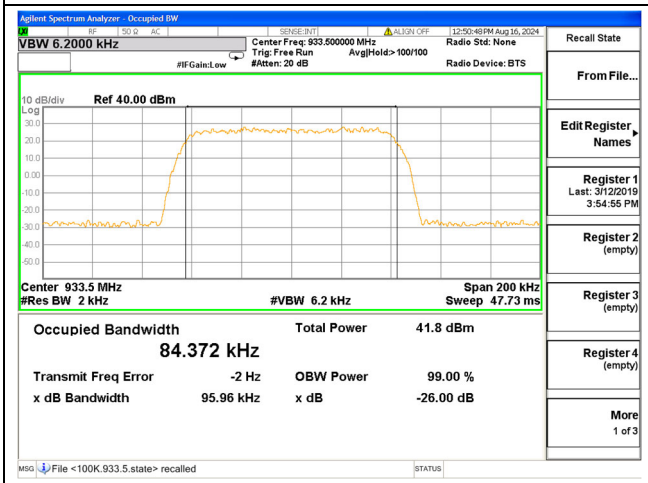


933.5MHz/Channel H/75.0 kHz/64QAM

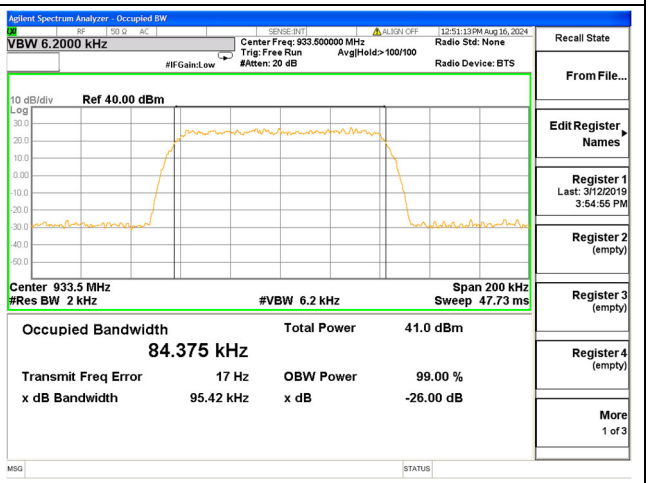


933.5MHz/Channel H/75.0 kHz/256QAM

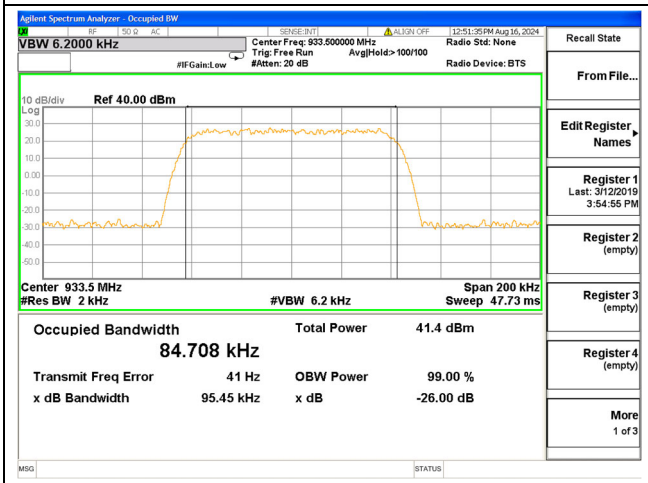
933.5MHz/Channel H/100.0 kHz/QPSK



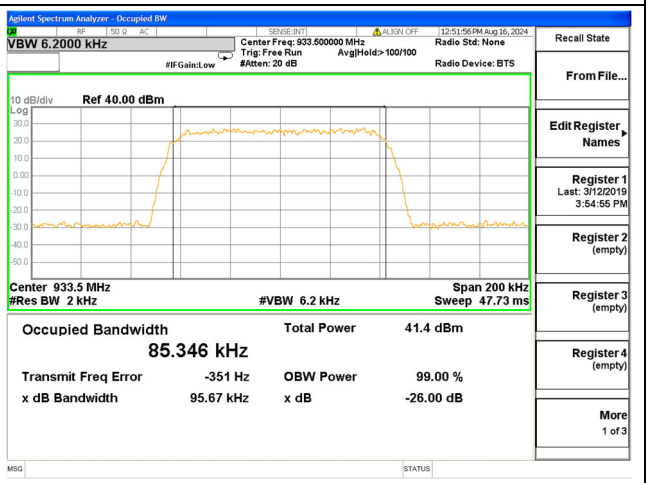
933.5MHz/Channel H/100.0 kHz/16QAM



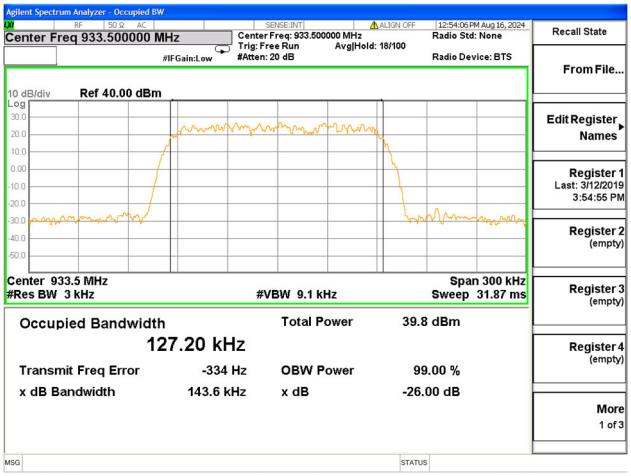
933.5MHz/Channel H/100.0 kHz/64QAM



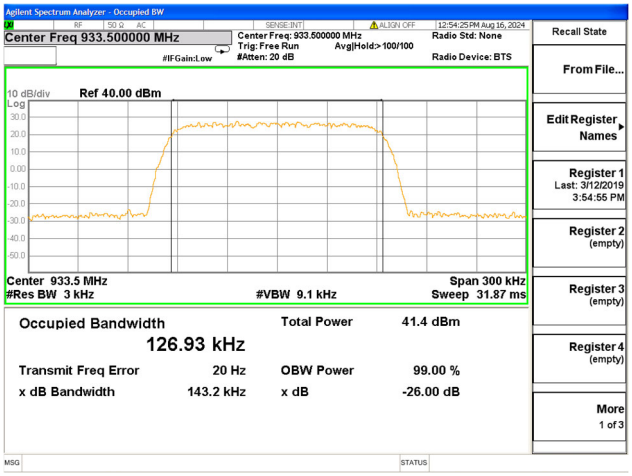
933.5MHz/Channel H/100.0 kHz/256QAM



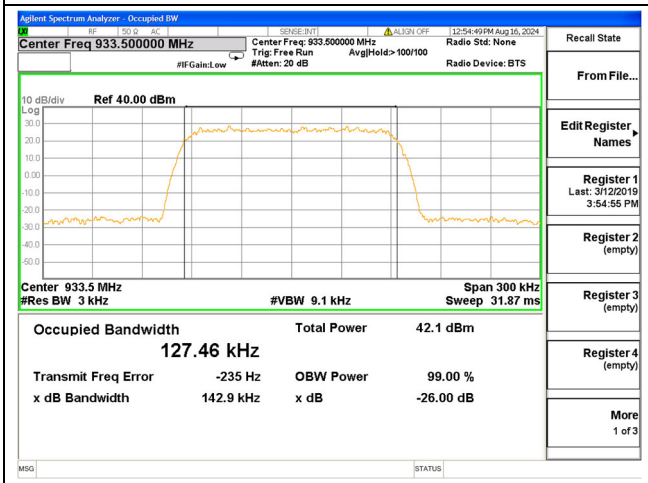
933.5MHz/Channel H/150.0 kHz/QPSK



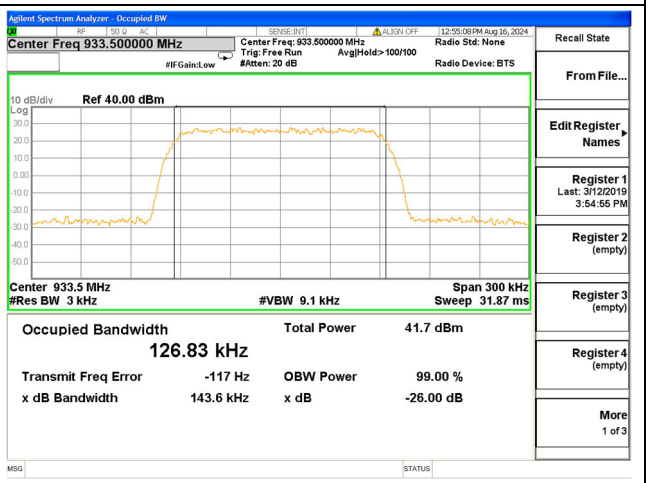
933.5MHz/Channel H/150.0 kHz/16QAM



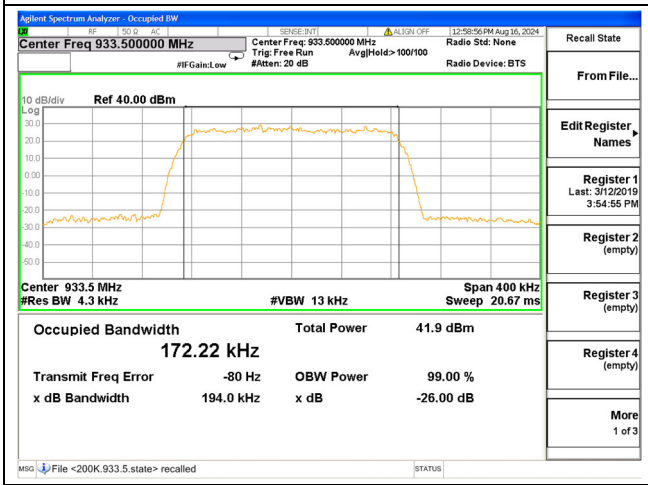
933.5MHz/Channel H/150.0 kHz/64QAM



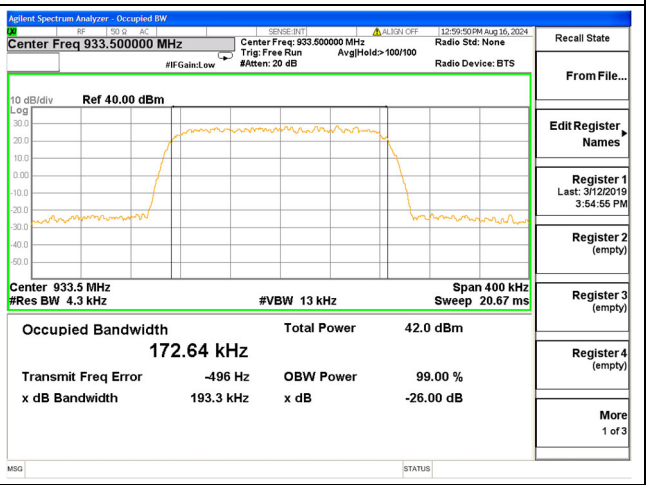
933.5MHz/Channel H/150.0 kHz/256QAM



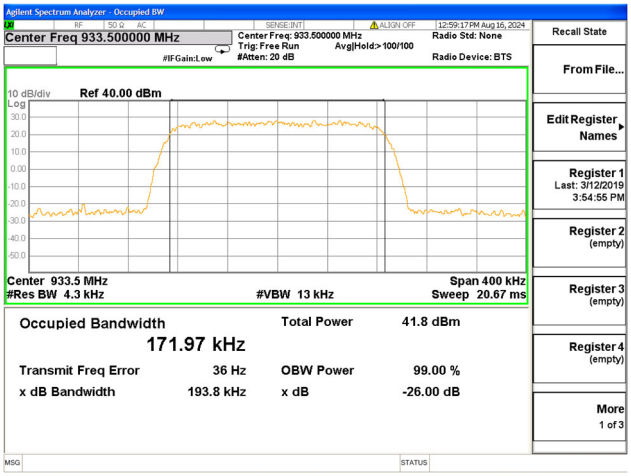
933.5MHz/Channel H/200.0 kHz/QPSK



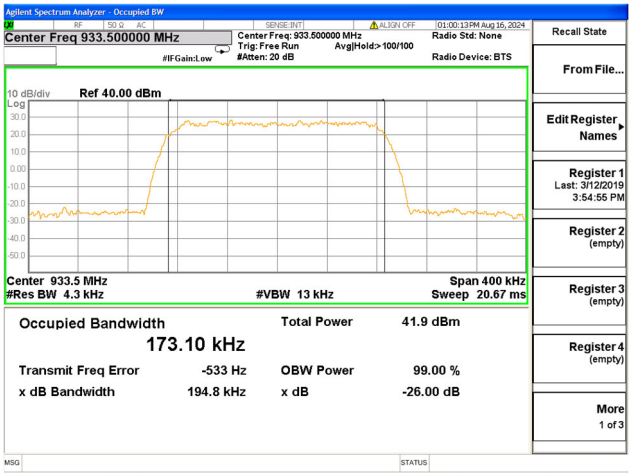
933.5MHz/Channel H/200.0 kHz/16QAM



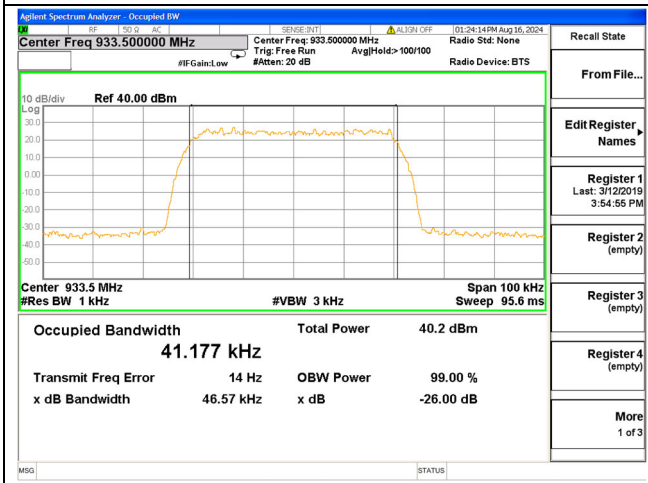
933.5MHz/Channel H/200.0 kHz/64QAM



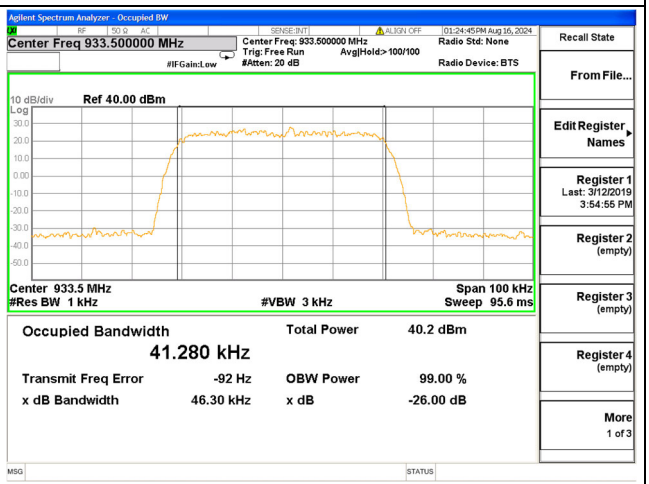
933.5MHz/Channel H/200.0 kHz/256QAM



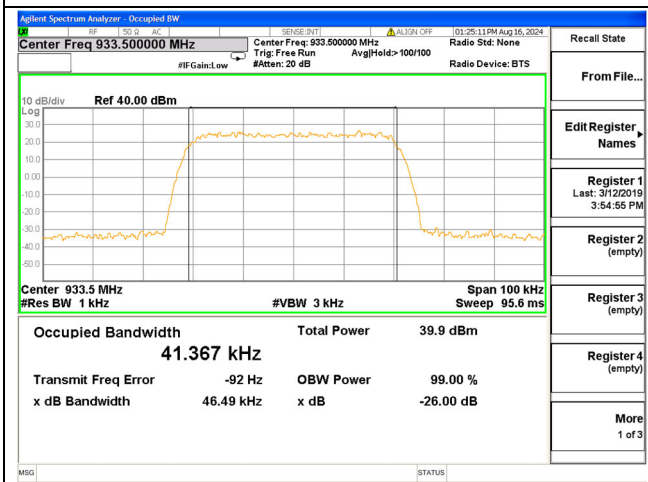
933.5MHz/Channel V/50kHz/QPSK



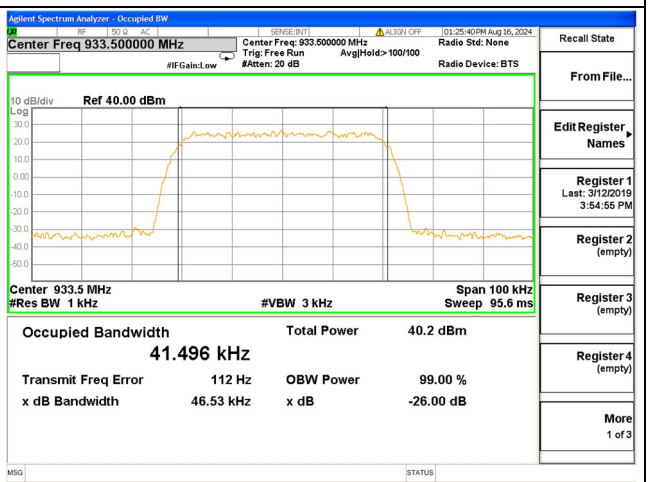
933.5MHz/Channel V/50kHz/16QAM



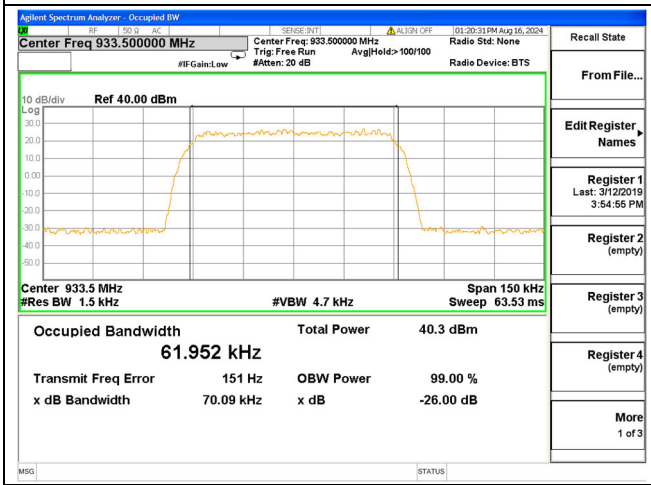
933.5MHz/Channel V/50kHz/64QAM



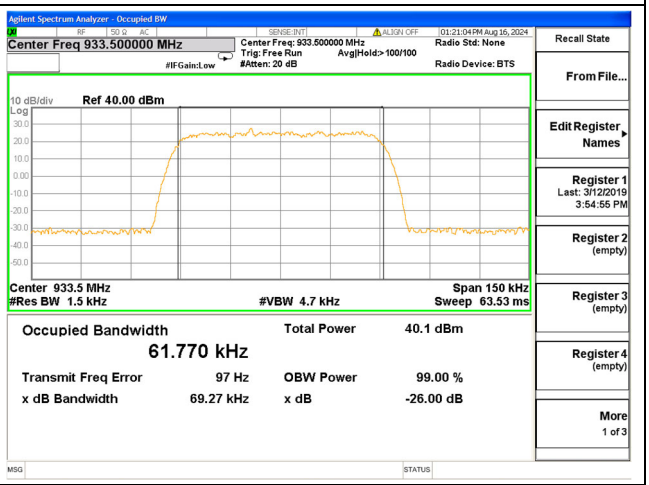
933.5MHz/Channel V/50kHz/256QAM



933.5MHz/Channel V/75.0kHz/QPSK

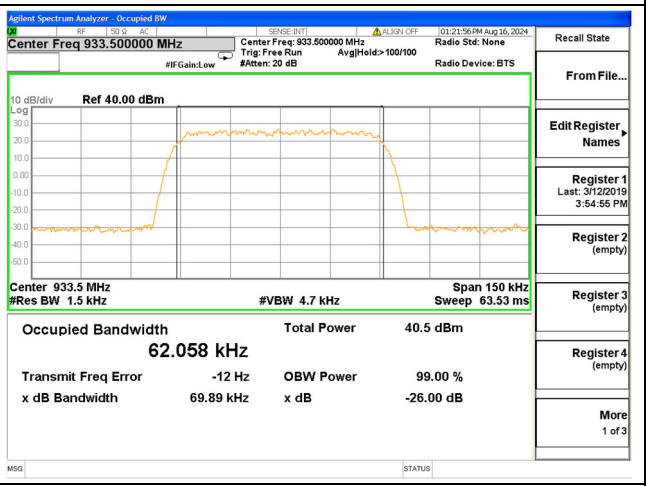


933.5MHz/Channel V/75.0 kHz/16QAM

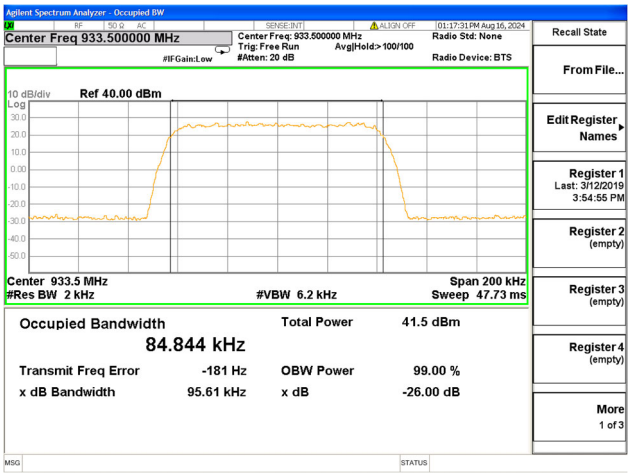
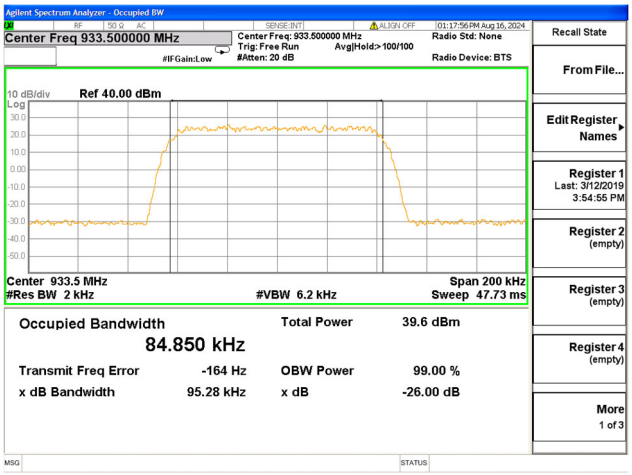


933.5MHz/Channel V/75.0 kHz/64QAM

933.5MHz/Channel V/75.0 kHz/256QAM



933.5MHz/Channel V/100.0 kHz/QPSK



933.5MHz/Channel V/100.0 kHz/16QAM