



TEST REPORT

APPLICANT : MiMOMax Wireless Limited

PRODUCT NAME : 900MHz TornadoXR Transceiver

MODEL NAME : MWL-TORNADOX-*G*A/B/C

BRAND NAME : Ubiik Mimomax

FCC ID : XMK-MMXTRNXB007

STANDARD(S) : 47 CFR Part 2
: 47 CFR Part 24

RECEIPT DATE : 2024-02-01

TEST DATE : 2024-02-21 to 2024-02-28

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Gan Jing (Rapporteur)

Approved by: Shen Junsheng
Shen Junsheng(Supervisor)

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Change History		
Issue	Date	Reason for change
1.0	2024-03-13	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 TornadoXR Transceiver	
EUT Serial No:	(N/A, marked 1# by test site)	
Hardware Version:	P001	
Software Version:	TRN_04.08.04	
Operating Frequency Range:	901-902 MHz, 2Tx/2Rx	
Channel Bandwidth:	12.5kHz; 25kHz; 50kHz	
Modulation Type:	QPSK; 16QAM; 64QAM; 256QAM	
Operating Voltage:	10.5-60V	
Antenna Gain:	Omni Antenna	2.5 dBi
		4.0 dBi
		6.0 dBi
	Panel Antenna	8.0 dBi
		10.0 dBi
		12.0 dBi
Emission Designator:	BW(kHz)	Designator
	12.5kHz	10K0W1W
	25.0kHz	20K0W1W
	50.0kHz	42K0W1W



1.3. Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 2 and Part 24 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 24	Personal Communications 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 24.132	Transmitter Conducted Output Power and ERP/EIRP	Gan Jing	PASS	No deviation
2.1049	Occupied Bandwidth	Gan Jing	PASS	No deviation
2.1051 24.133	Conducted Spurious Emissions	Gan Jing	PASS	No deviation
2.1053 24.133	Radiated Spurious Emissions	Li Hanbin	PASS	No deviation
2.1055 24.135	Frequency stability	Gan Jing	PASS	No deviation

Note 1: The TornadoXR Transceiver complies with FCC 47 CFR Part 2 and Part 24 when tested in accordance with the test methods described in 47 CFR Part 2 and Part 24.

Note 2: The TornadoXR 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.

Note 5: The prototype has two kinds of power under different conditions, we define Type 1 in the case of 28dBm power and Type 2 in the case of 34dBm power



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 24 Requirements

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

2.1.1. Test result

Type 1:

Nominal Frequency: 901.5 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)		E.R.P. (ANT Gain = 12.0dBi)	
						dBm	Watt	dBm	Watt
12.5	QPSK	24	28.53	0.713	0.63	30.38	1.091	38.38	6.887
12.5	16QAM	24	28.19	0.659	0.63	30.04	1.009	38.04	6.368
12.5	64QAM	24	28.30	0.676	0.63	30.15	1.035	38.15	6.531
12.5	256QAM	24	28.57	0.719	0.63	30.42	1.102	38.42	6.950
25.0	QPSK	24	27.49	0.561	0.63	29.34	0.859	37.34	5.420
25.0	16QAM	24	27.39	0.548	0.63	29.24	0.839	37.24	5.297
25.0	64QAM	24	27.45	0.556	0.63	29.30	0.851	37.30	5.370
25.0	256QAM	24	27.53	0.566	0.63	29.38	0.867	37.38	5.470
50.0	QPSK	24	28.15	0.653	0.63	30.00	1.000	38.00	6.310
50.0	16QAM	24	28.42	0.695	0.63	30.27	1.064	38.27	6.714
50.0	64QAM	24	28.05	0.638	0.63	29.90	0.977	37.90	6.166
50.0	256QAM	24	28.42	0.695	0.63	30.27	1.064	38.27	6.714

Nominal Frequency: 901.5 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)		E.R.P. (ANT Gain = 12.0dBi)	
						dBm	Watt	dBm	Watt
12.5	QPSK	24	28.51	0.710	0.63	30.36	1.086	38.36	6.855
12.5	16QAM	24	28.55	0.716	0.63	30.40	1.096	38.40	6.918
12.5	64QAM	24	28.41	0.693	0.63	30.26	1.062	38.26	6.699
12.5	256QAM	24	28.47	0.703	0.63	30.32	1.076	38.32	6.792
25.0	QPSK	24	27.83	0.607	0.63	29.68	0.929	37.68	5.861



25.0	16QAM	24	27.53	0.566	0.63	29.38	0.867	37.38	5.470
25.0	64QAM	24	28.14	0.652	0.63	29.99	0.998	37.99	6.295
25.0	256QAM	24	28.26	0.670	0.63	30.11	1.026	38.11	6.471
50.0	QPSK	24	28.36	0.685	0.63	30.21	1.050	38.21	6.622
50.0	16QAM	24	28.04	0.637	0.63	29.89	0.975	37.89	6.152
50.0	64QAM	24	28.35	0.684	0.63	30.20	1.047	38.20	6.607
50.0	256QAM	24	28.68	0.738	0.63	30.53	1.130	38.53	7.129

Type 2:

Nominal Frequency: 901.5 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)		E.R.P. (ANT Gain = 6.0dBi)	
						dBm	Watt	dBm	Watt
12.5	QPSK	24	33.84	2.421	2.50	35.69	3.707	37.69	5.875
12.5	16QAM	24	33.61	2.296	2.50	35.46	3.516	37.46	5.572
12.5	64QAM	24	33.86	2.432	2.50	35.71	3.724	37.71	5.902
12.5	256QAM	24	34.01	2.518	2.50	35.86	3.855	37.86	6.109
25.0	QPSK	24	33.72	2.355	2.50	35.57	3.606	37.57	5.715
25.0	16QAM	24	33.61	2.296	2.50	35.46	3.516	37.46	5.572
25.0	64QAM	24	33.68	2.333	2.50	35.53	3.573	37.53	5.662
25.0	256QAM	24	34.03	2.529	2.50	35.88	3.873	37.88	6.138
50.0	QPSK	24	33.96	2.489	2.50	35.81	3.811	37.81	6.039
50.0	16QAM	24	33.90	2.455	2.50	35.75	3.758	37.75	5.957
50.0	64QAM	24	33.83	2.415	2.50	35.68	3.698	37.68	5.861
50.0	256QAM	24	34.11	2.576	2.50	35.96	3.945	37.96	6.252

Nominal Frequency: 901.5 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)		E.R.P. (ANT Gain = 6.0dBi)	
						dBm	Watt	dBm	Watt
12.5	QPSK	24	33.98	2.500	2.50	35.83	3.828	37.83	6.067
12.5	16QAM	24	33.98	2.500	2.50	35.83	3.828	37.83	6.067
12.5	64QAM	24	33.83	2.415	2.50	35.68	3.698	37.68	5.861
12.5	256QAM	24	34.06	2.547	2.50	35.91	3.899	37.91	6.180



25.0	QPSK	24	33.79	2.393	2.50	35.64	3.664	37.64	5.808
25.0	16QAM	24	33.81	2.404	2.50	35.66	3.681	37.66	5.834
25.0	64QAM	24	33.85	2.427	2.50	35.70	3.715	37.70	5.888
25.0	256QAM	24	34.11	2.576	2.50	35.96	3.945	37.96	6.252
50.0	QPSK	24	34.17	2.612	2.50	36.02	3.999	38.02	6.339
50.0	16QAM	24	33.84	2.421	2.50	35.69	3.707	37.69	5.875
50.0	64QAM	24	33.94	2.477	2.50	35.79	3.793	37.79	6.012
50.0	256QAM	24	34.18	2.618	2.50	36.03	4.009	38.03	6.353

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.

Note4: Part 24 does not specify the transmitter output power.

Stations transmitting in the 901-902 MHz band are limited to 7 watts e.r.p.

Note 5: 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 6: According to KDB 662911, the MIMO directional gain is the gain of an individual antenna.

Note 7: 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.

Note 8: This product is based on the interactive calculation of erp limits and conducted power. In the 901-902MHz range, an antenna with a maximum gain of 12dBi can be used when the conducted power is 28dBm, or an antenna with a maximum gain of 6dBi can be used when the conducted power is 34dBm to meet the erp requirements.



2.2. Occupied Bandwidth

2.2.1. Definition

Emission Designator:

Frequency (MHz)	BW(kHz)	Designator
901-902MHz	12.5kHz	10K0W1W
	25.0kHz	20K0W1W
	50.0kHz	42K0W1W

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.

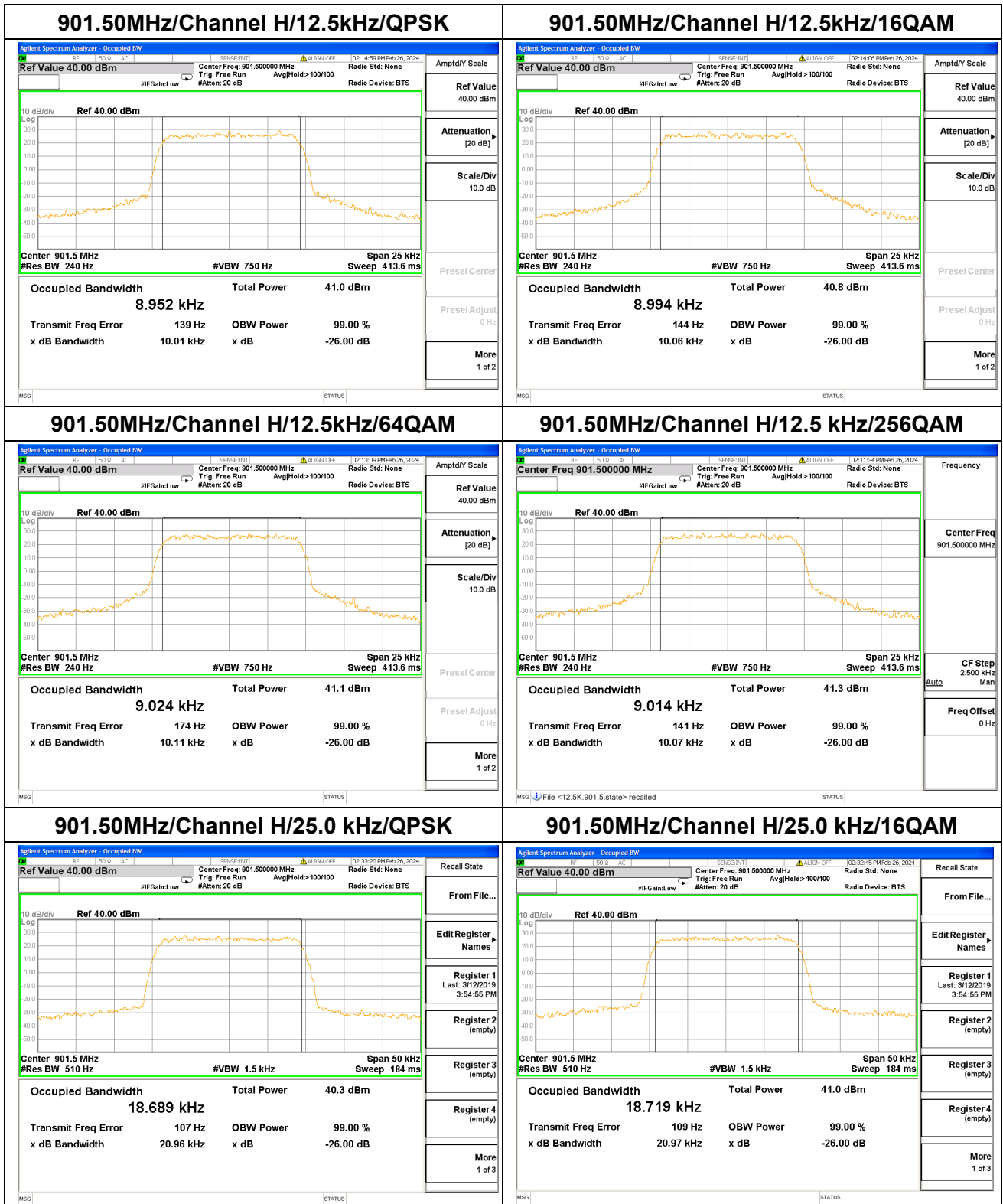
2.2.2. Test Description

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

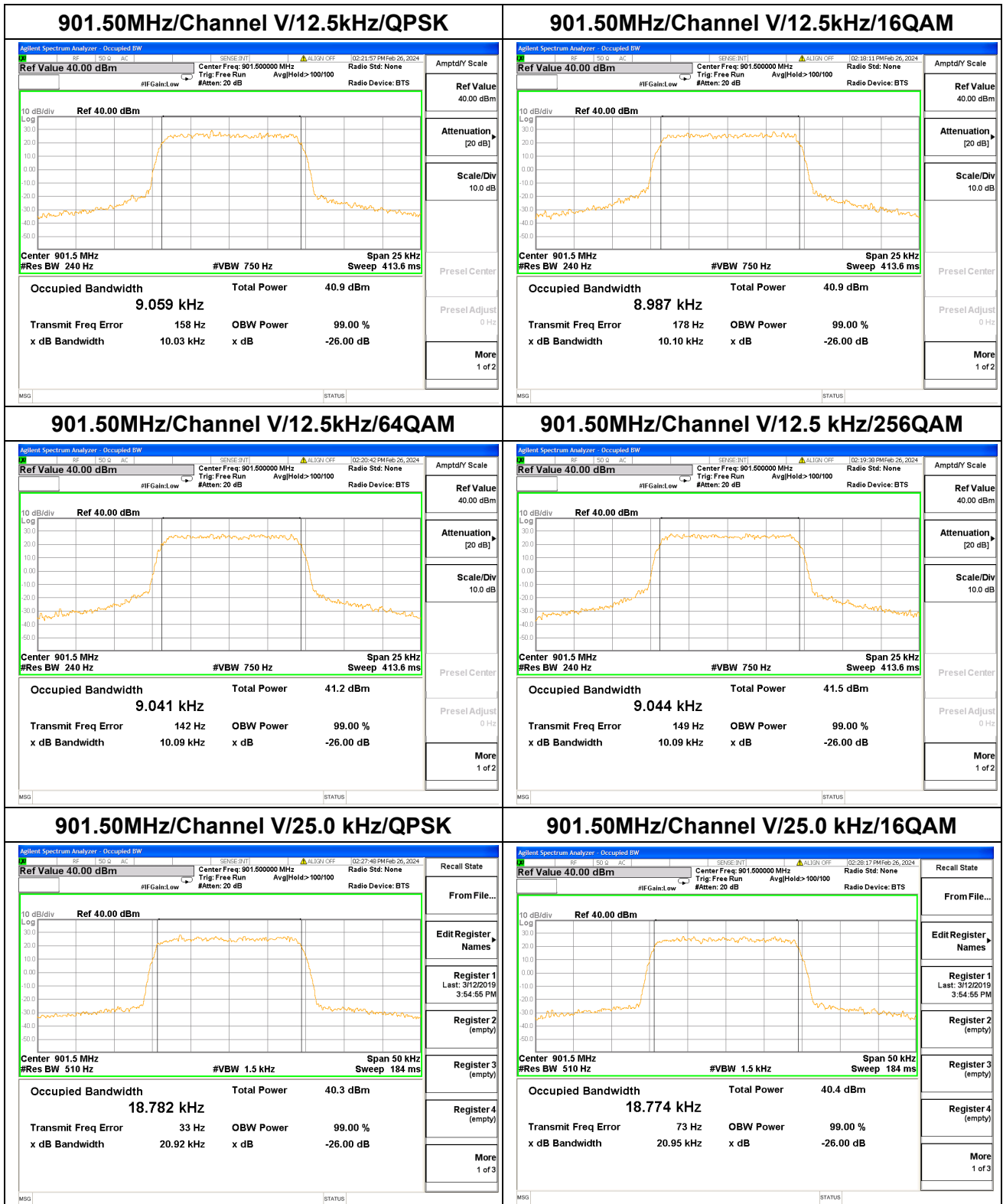


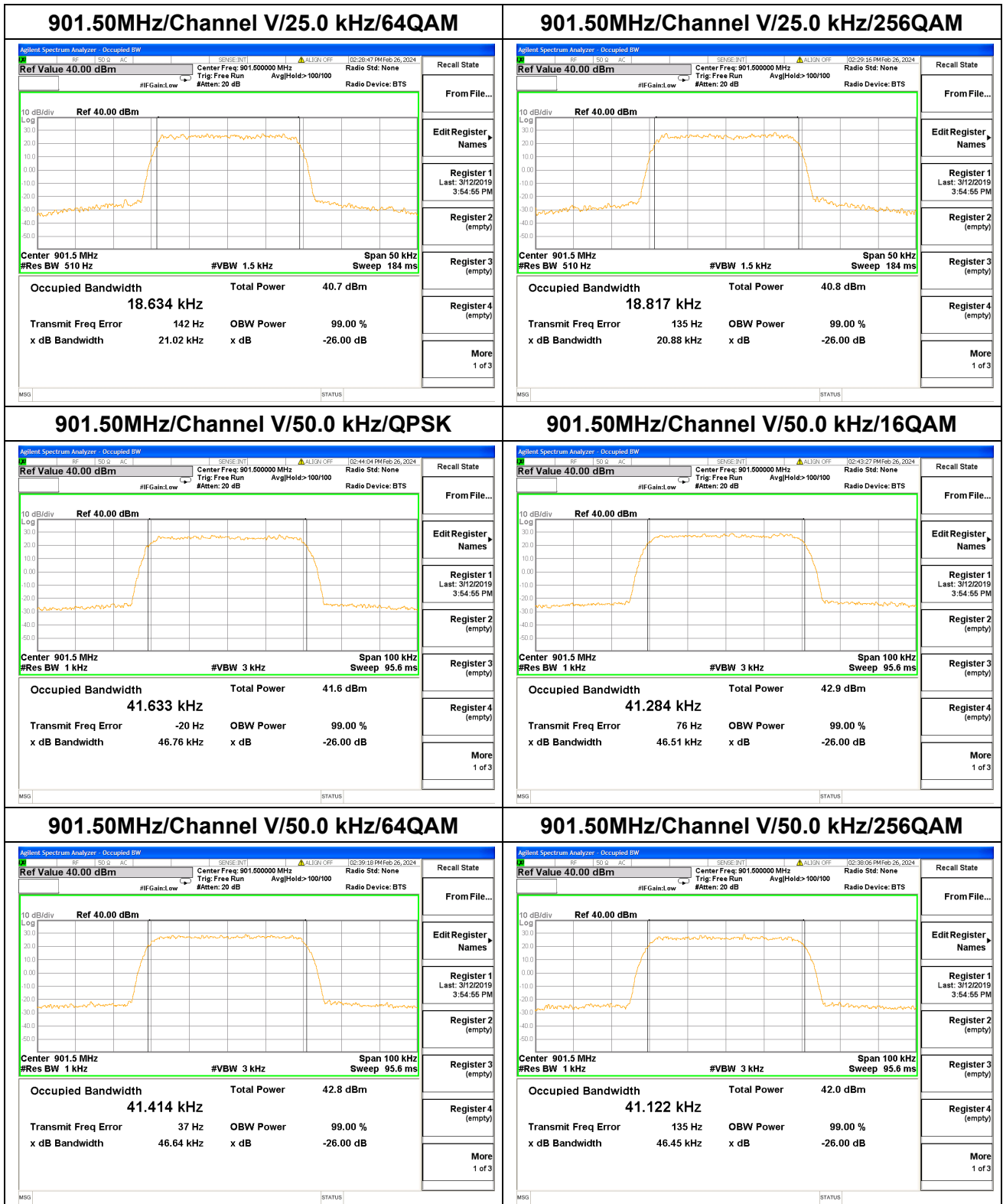
2.2.3. Test Result

901.50 MHz			
Tx Port	Channel Bandwidth(kHz)	Emission Type	Occupied Bandwidth(kHz)
H	12.5	QPSK	8.952
		16QAM	8.994
		64QAM	9.024
		256QAM	9.014
	25.0	QPSK	18.689
		16QAM	18.719
		64QAM	18.772
		256QAM	18.698
	50.0	QPSK	41.387
		16QAM	41.277
		64QAM	41.180
		256QAM	41.446
V	12.5	QPSK	9.059
		16QAM	8.987
		64QAM	9.041
		256QAM	9.044
	25.0	QPSK	18.782
		16QAM	18.774
		64QAM	18.634
		256QAM	18.817
	50.0	QPSK	41.633
		16QAM	41.284
		64QAM	41.414
		256QAM	41.122











2.3. Spurious Emissions At Antenna Terminals

2.3.1. Test Requirement

According to FCC section 2.1051, 24.131 and 24.133(a) section

The authorized bandwidth of narrowband PCS channels will be 10 kHz for 12.5 kHz channels and 45 kHz for 50 kHz channels. For aggregated adjacent channels, a maximum authorized bandwidth of 5 kHz less than the total aggregated channel width is permitted.

For transmitters authorized a bandwidth greater than 10 kHz:

1. On any frequency outside the authorized bandwidth and removed from the edge of the authorized bandwidth by a displacement frequency (f_d in kHz) of up to and including 40 kHz: at least $116 \text{ Log}_{10} ((f_d + 10)/6.1)$ decibels or $50 + 10 \text{ Log}_{10} (P)$ decibels or 70 decibels, whichever is the lesser attenuation;
2. On any frequency outside the authorized bandwidth and removed from the edge of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 40 kHz: at least $43 + 10 \text{ Log}_{10} (P)$ decibels or 80 decibels, whichever is the lesser attenuation;

For transmitters authorized a bandwidth of 10 kHz:

1. On any frequency outside the authorized bandwidth and removed from the edge of the authorized bandwidth by a displacement frequency (f_d in kHz) of up to and including 20 kHz: at least $116 \times \text{Log}_{10} ((f_d + 5)/3.05)$ decibels or $50 + 10 \times \text{Log}_{10} (P)$ decibels or 70 decibels, whichever is the lesser attenuation;
2. On any frequency outside the authorized bandwidth and removed from the edge of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 20 kHz: at least $43 + 10 \text{ Log}_{10} (P)$ decibels or 80 decibels, whichever is the lesser attenuation.

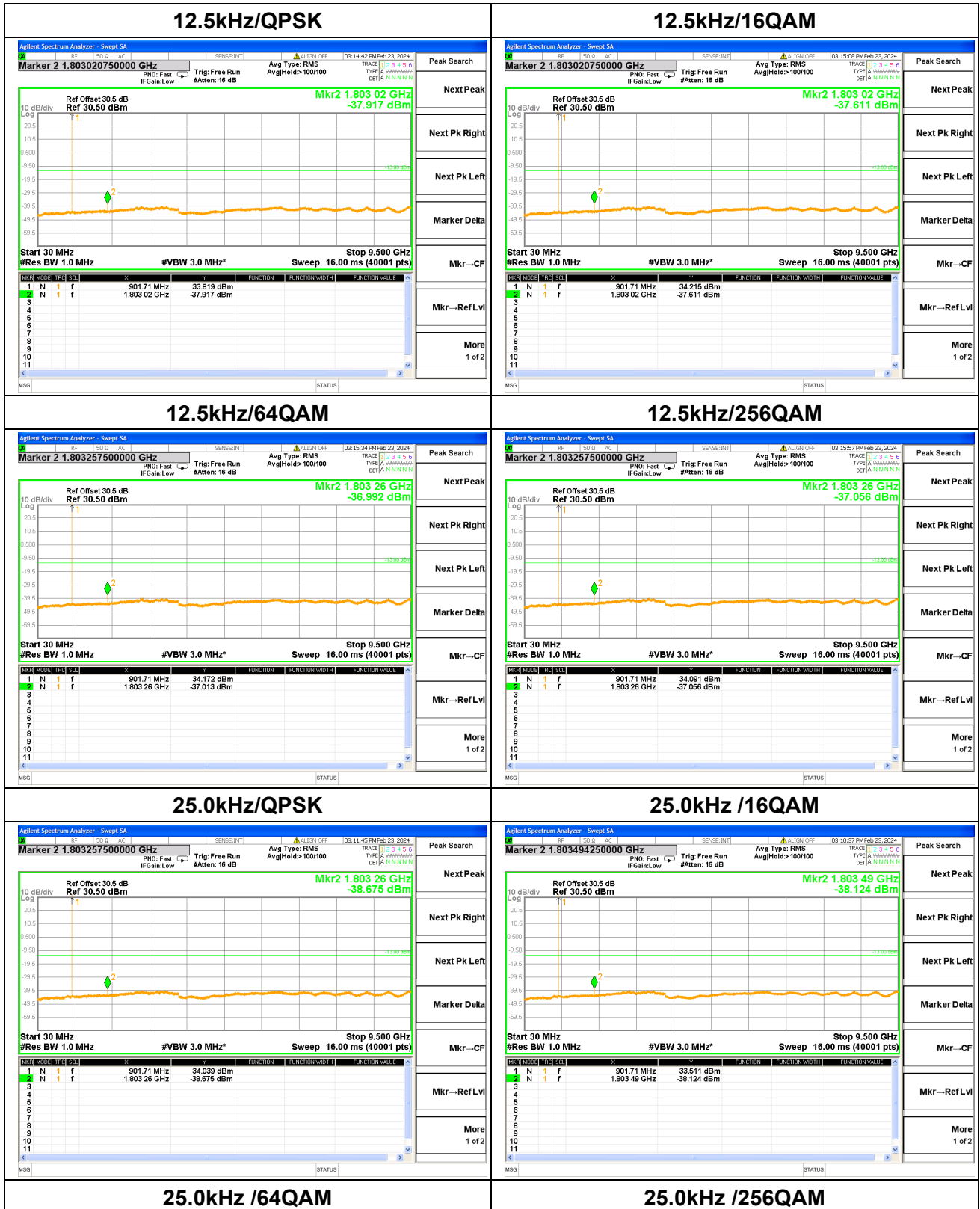
2.3.2. Test Result

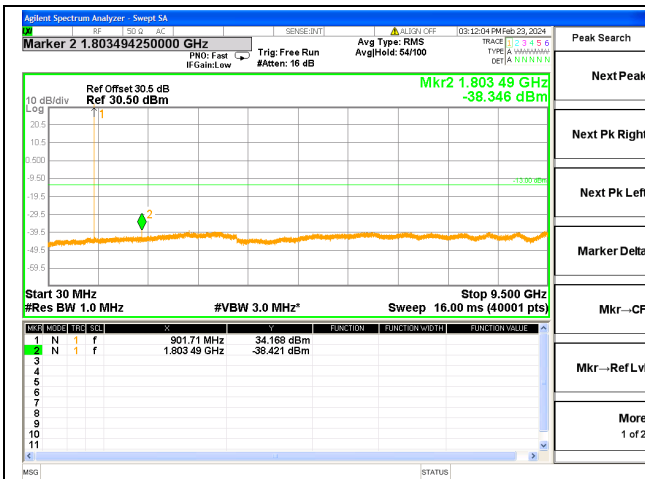




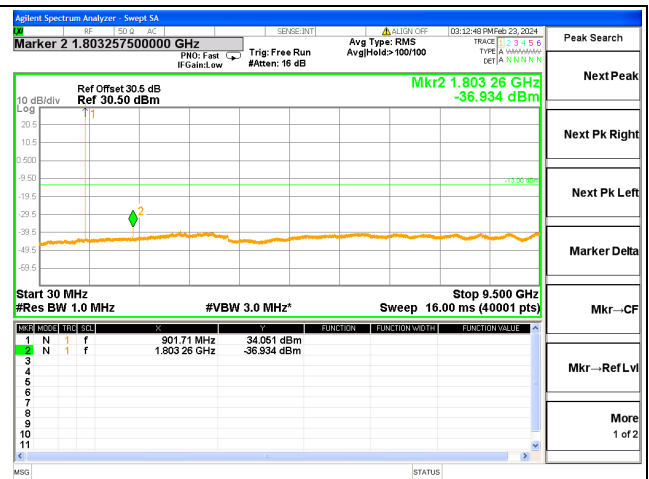


Nominal Frequency: 901.50 MHz Tx Port: Channel V

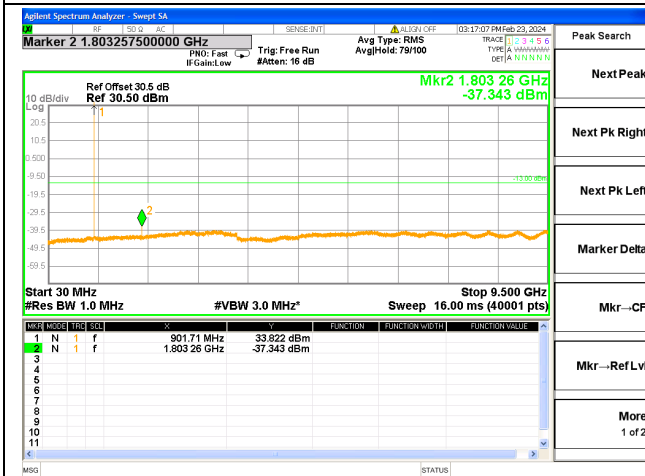




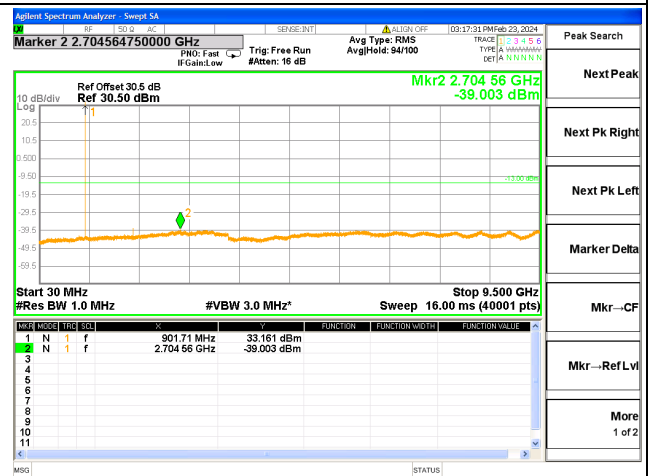
50.0kHz/QPSK



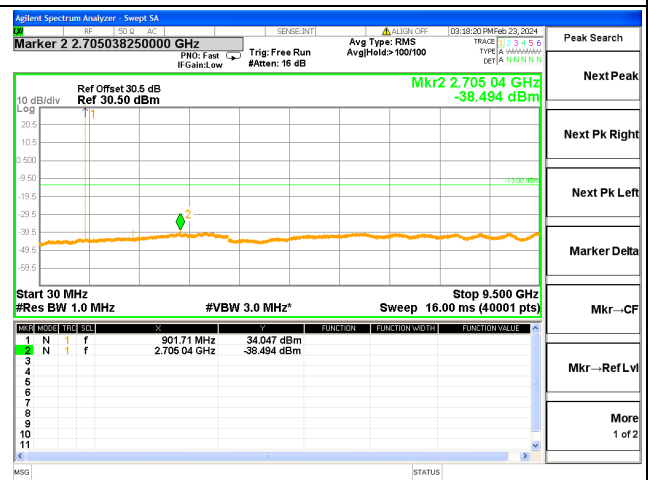
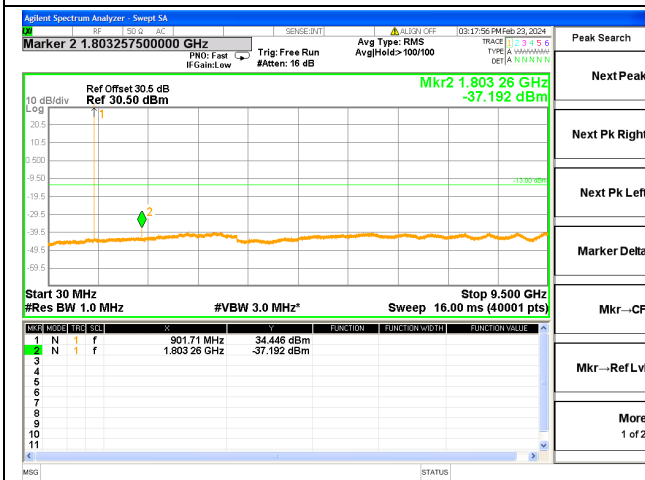
50.0kHz/16QAM



50.0kHz/64QAM

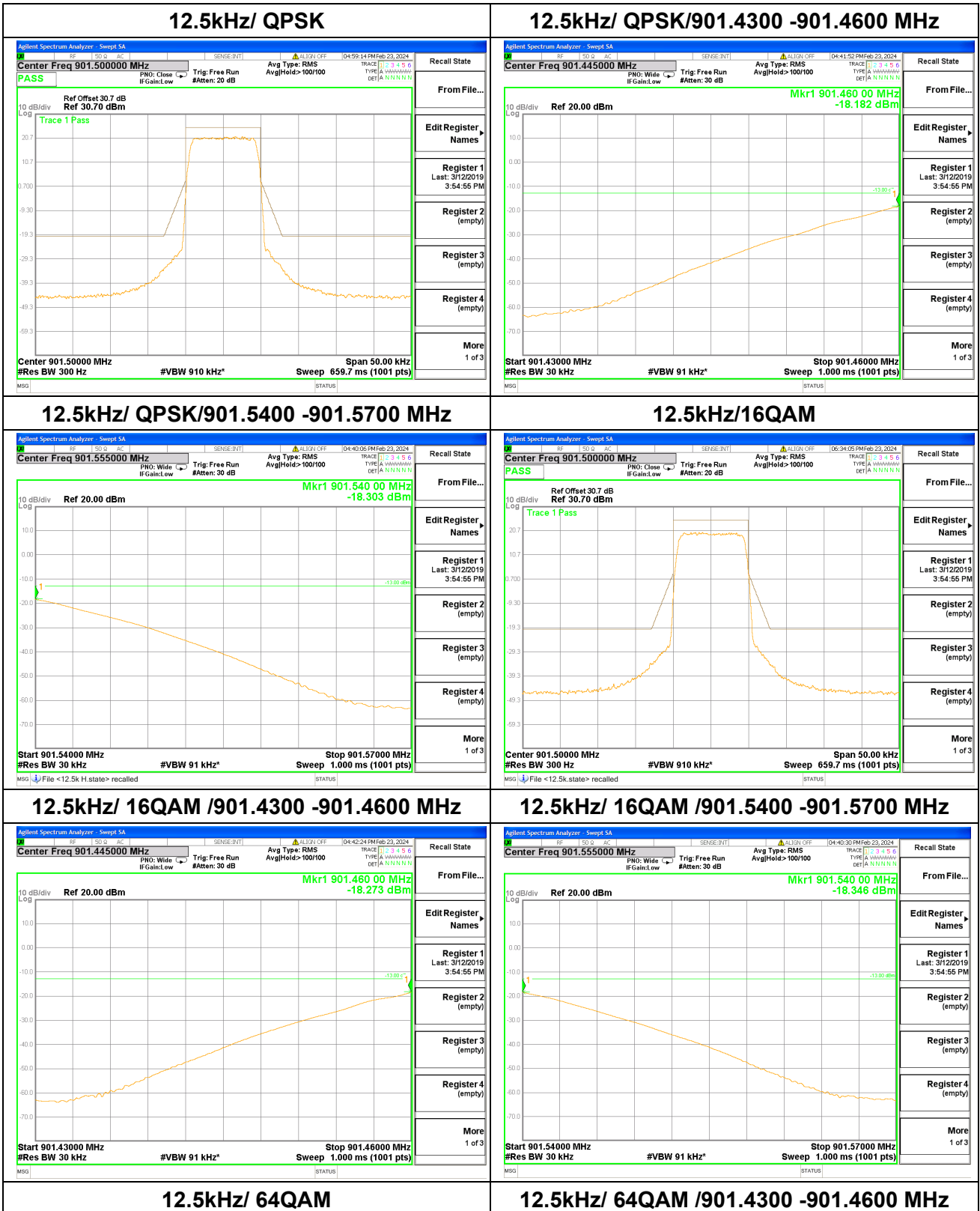


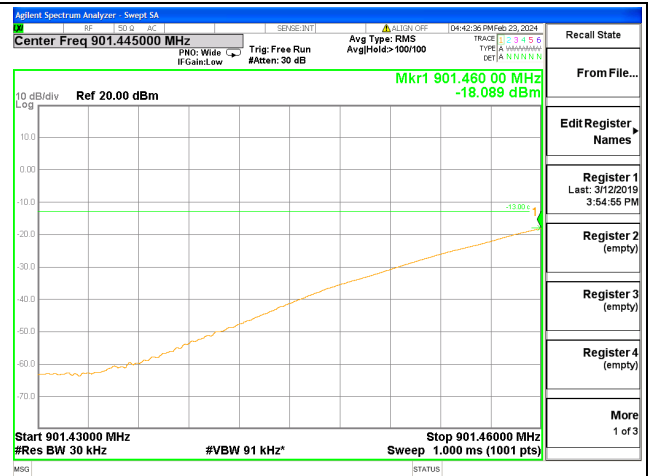
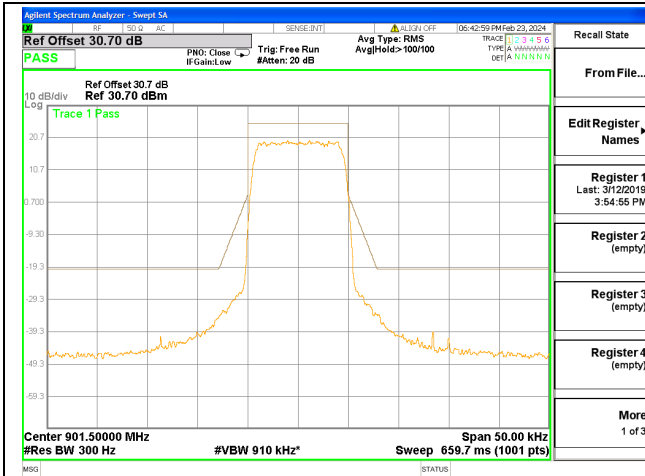
50.0kHz/256QAM





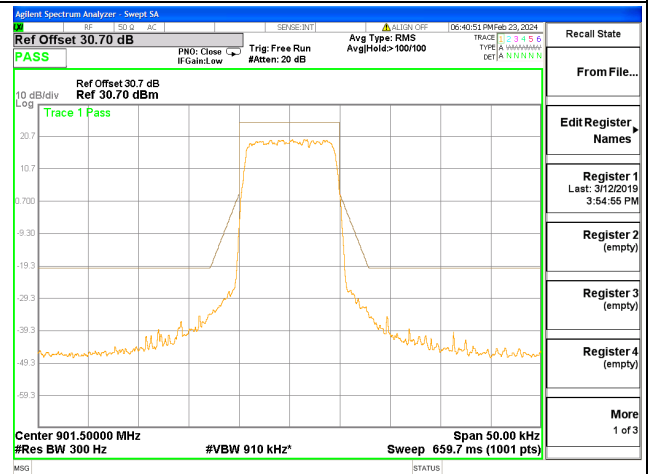
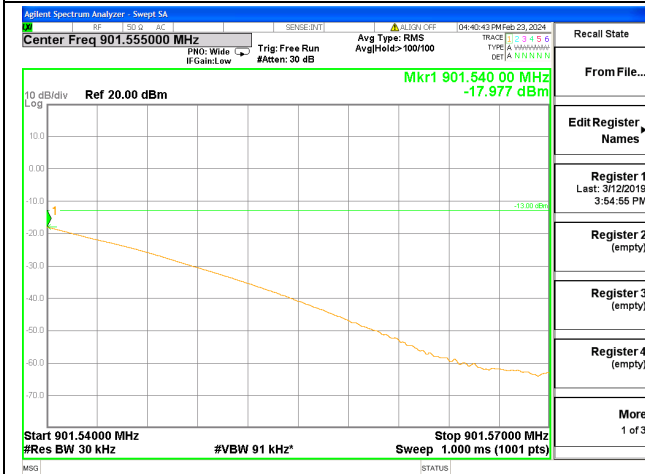
Nominal Frequency: 901.50 MHz Tx Port: Channel H





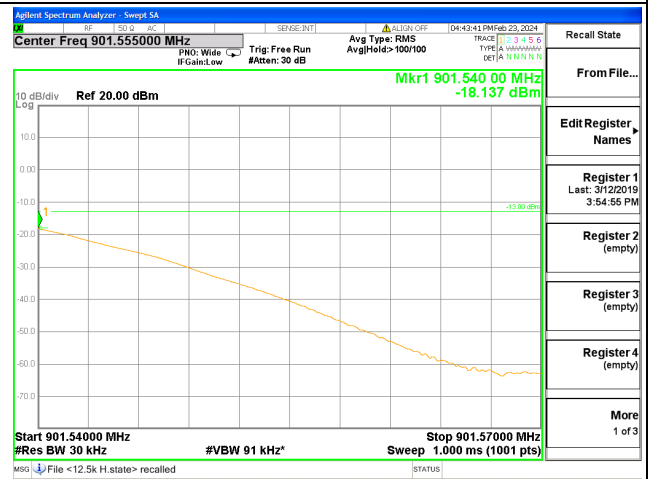
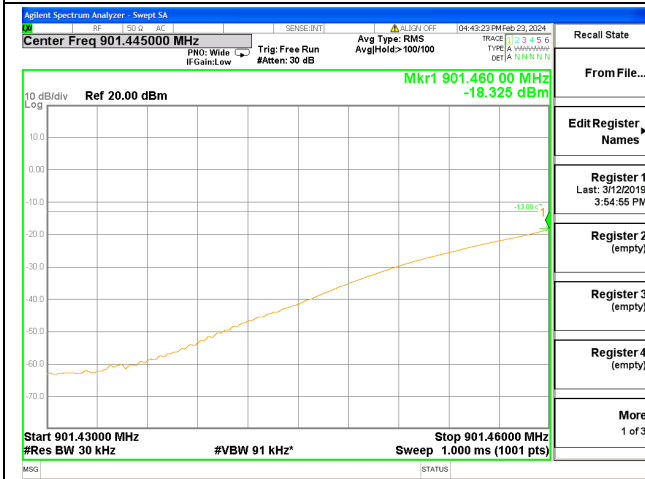
12.5kHz/ 64QAM /901.5400 -901.5700 MHz

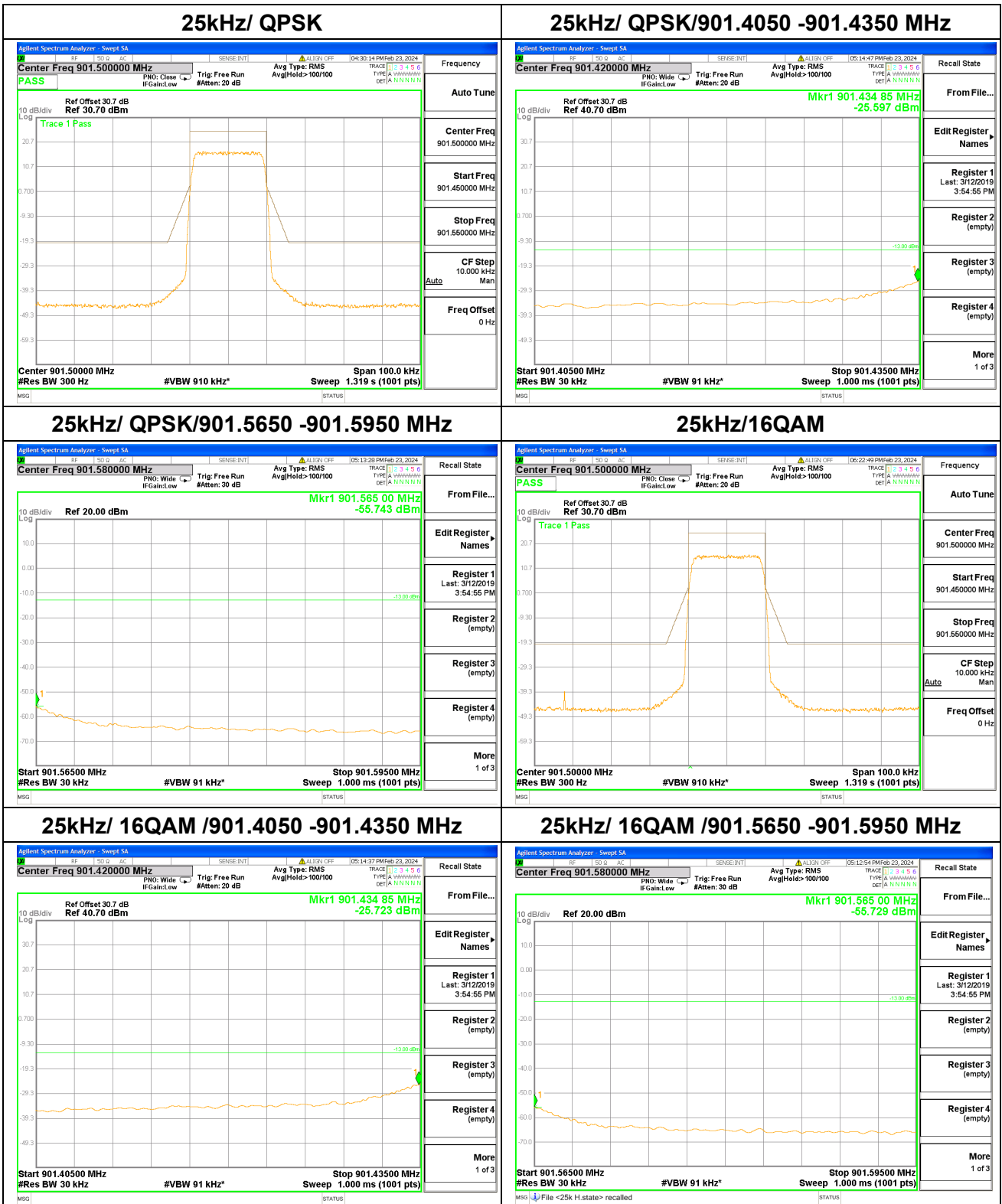
12.5kHz/256QAM

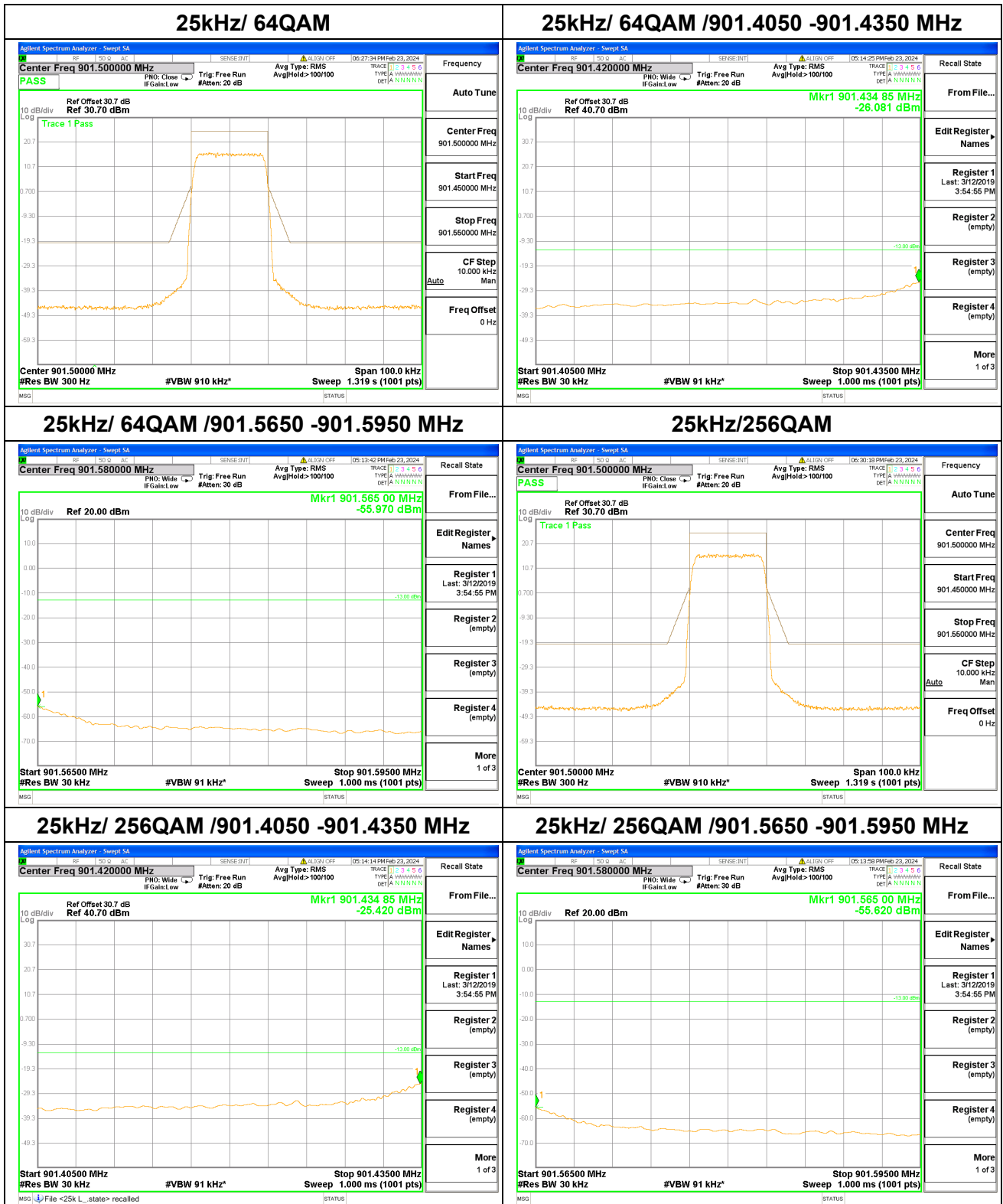


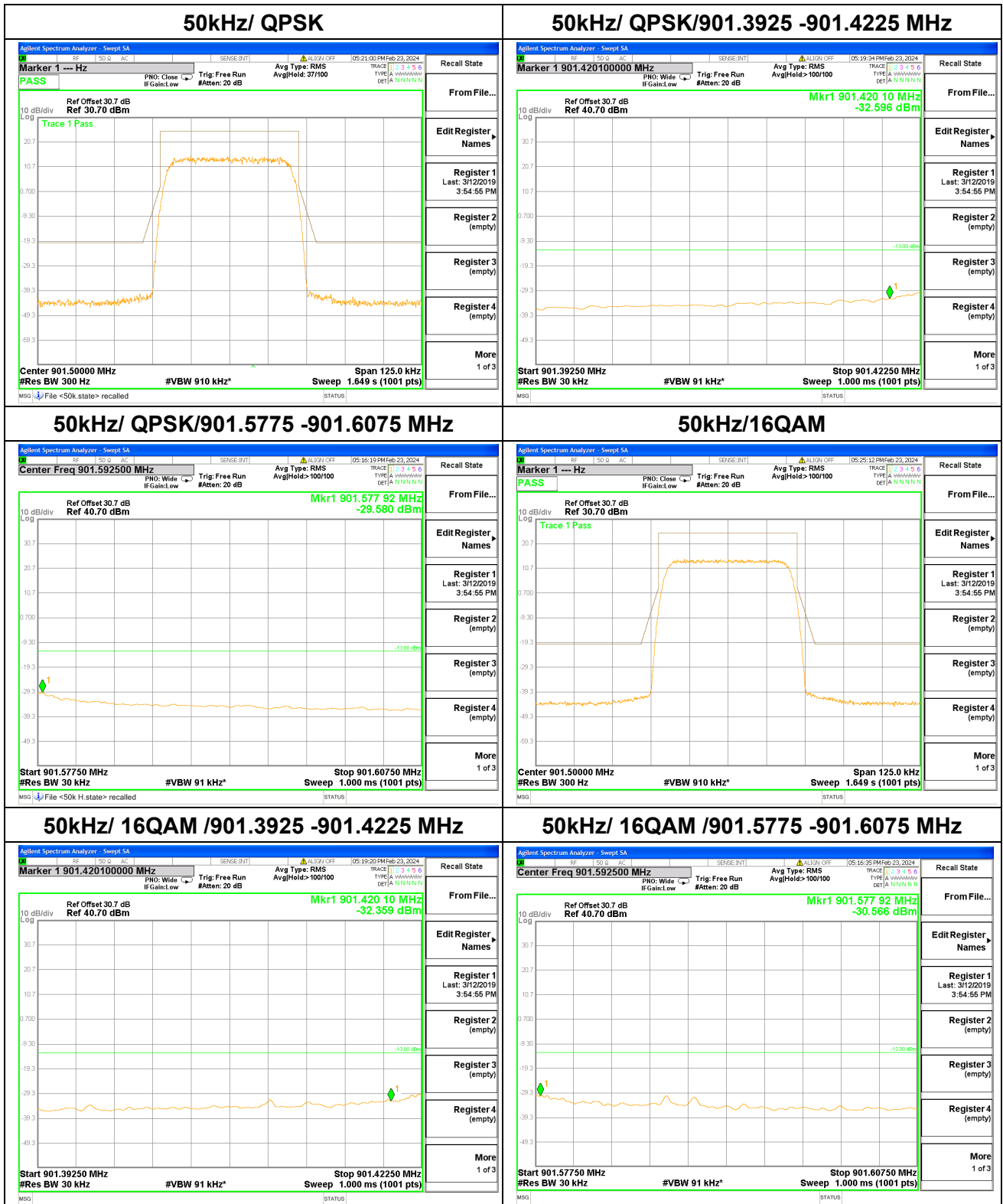
12.5kHz/ 256QAM /901.4300 -901.4600 MHz

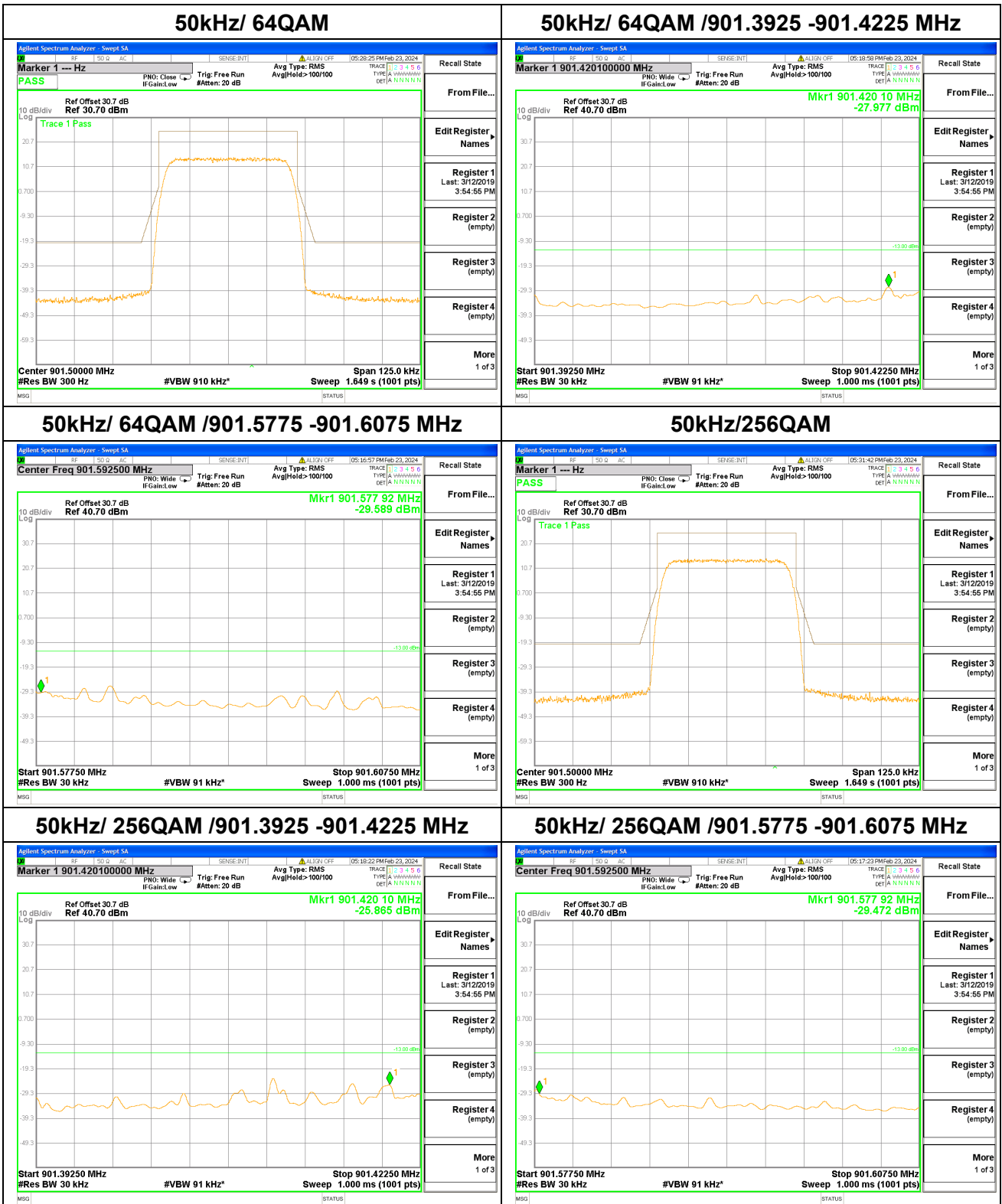
12.5kHz/ 256QAM /901.5400 -901.5700 MHz













Nominal Frequency: 901.50 MHz Tx Port: Channel V

