



FCC RF Test Report

APPLICANT : MTRLC LLC
EQUIPMENT : AX3000 Dual-band Mesh WiFi
BRAND NAME : Motorola
MODEL NAME : Q11
FCC ID : 2AF5PQ11
STANDARD : FCC Part 15 Subpart C §15.247
CLASSIFICATION : (DTS) Digital Transmission System
TEST DATE(S) : Dec. 20, 2021 ~ Jan. 05, 2022

We, Sporton International Inc. (Kunshan), would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. (Kunshan), the test report shall not be reproduced except in full.

Jason Jia

Reviewed by: Jason Jia / Supervisor

Alex Wang

Approved by: Alex Wang / Manager



Sporton International Inc. (Kunshan)

**No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300
People's Republic of China**



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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR1D0112A	Rev. 01	Initial issue of report	Mar. 18, 2022



SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.1	15.247(a)(2)	6dB Bandwidth	≥ 0.5MHz	Pass	-
3.1	-	99% Bandwidth	-	Report Only	-
3.2	15.247(b)	Power Output Measurement	≤ 30dBm	Pass	-
3.3	15.247(e)	Power Spectral Density	≤ 8dBm/3kHz	Pass	-
3.4	15.247(d)	Conducted Band Edges	≤ 30dBc	Pass	-
		Conducted Spurious Emission		Pass	-
3.5	15.247(d)	Radiated Band Edges and Radiated Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 0.65 dB at 2388.13 MHz
3.6	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 5.45 dB at 0.611 MHz
3.7	15.203 & 15.247(b)	Antenna Requirement	15.203 & 15.247(b)	Pass	-

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits.
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.



1 General Description

1.1 Applicant

MTRLC LLC
275 Turnpike Street Suite 101 Canton, MA 02021

1.2 Manufacturer

MTRLC LLC
275 Turnpike Street Suite 101 Canton, MA 02021

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	AX3000 Dual-band Mesh WiFi
Brand Name	Motorola
Model Name	Q11
FCC ID	2AF5PQ11
HW Version	REV1.0
SW Version	REV1.0
EUT Stage	Identical Prototype

Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

1.4 Product Specification of Equipment Under Test

Standards-related Product Specification										
Tx/Rx Channel Frequency Range	2412 MHz ~ 2462 MHz									
Maximum (Peak) Output Power to antenna	<CDD Mode> 802.11b : 29.96 dBm (0.9908 W) 802.11g : 29.04 dBm (0.8017 W) 802.11n HT20 : 28.70 dBm (0.7413 W) 802.11n HT40 : 23.76 dBm (0.2377 W) 802.11ax HE20 : 28.76 dBm (0.7516 W) 802.11ax HE40 : 23.83 dBm (0.2415 W)									
99% Occupied Bandwidth	802.11b : 11.34MHz 802.11g : 19.58MHz 802.11ax HE20 : 20.33MHz 802.11ax HE40 : 37.76MHz									
Antenna Type / Gain	<Ant. 1>: Dipole Antenna with gain 3.40 dBi <Ant. 2>: Dipole Antenna with gain 3.40 dBi									
Antenna Function Description	<table border="1"> <thead> <tr> <th></th> <th>Ant. 1</th> <th>Ant. 2</th> </tr> </thead> <tbody> <tr> <td>802.11 b/g/n/ax SISO</td> <td>V</td> <td>V</td> </tr> <tr> <td>802.11 b/g/n/ax CDD/Beamforming</td> <td colspan="2">V</td> </tr> </tbody> </table>		Ant. 1	Ant. 2	802.11 b/g/n/ax SISO	V	V	802.11 b/g/n/ax CDD/Beamforming	V	
	Ant. 1	Ant. 2								
802.11 b/g/n/ax SISO	V	V								
802.11 b/g/n/ax CDD/Beamforming	V									



Type of Modulation	802.11b : DSSS (DBPSK / DQPSK / CCK) 802.11g/n/ax : OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM / 1024QAM)
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Note:

1. For SISO&MIMO mode, the whole testing has assessed only MIMO mode by referring to their higher conducted power.
2. For 802.11n HT20 / ax HE20 and 802.11n HT40 / ax HE40 mode, the whole testing have assessed only 802.11ax HE20 / ax HE40 by referring to the higher output power.
3. The TxBF Power/EIRP of EUT will less than CDD mode power/EIRP when Beamforming mode is active. So we only evaluate CDD mode by referring to their maximum conducted power/EIRP.
4. The device does not support partial RU for 802.11ax mode

1.5 Modification of EUT

No modifications are made to the EUT during all test items.

1.6 Testing Location

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Test Firm	Sporton International Inc. (Kunshan)		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158 FAX : +86-512-57900958		
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.
	CO01-KS 03CH05-KS TH01-KS	CN1257	314309



1.7 Test Software

Item	Site	Manufacturer	Name	Version
1.	03CH05-KS	AUDIX	E3	6.2009-8-24al
2.	CO01-KS	AUDIX	E3	6.2009-8-24

1.8 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ 47 CFR Part 15 Subpart C §15.247
- ♦ FCC KDB 558074 D01 15.247 Meas Guidance v05r02
- ♦ FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- ♦ ANSI C63.10-2013

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.



2 Test Configuration of Equipment Under Test

- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower).
- b. AC power line Conducted Emission was tested under maximum output power.

2.1 Carrier Frequency and Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
2400-2483.5 MHz	1	2412	7	2442
	2	2417	8	2447
	3	2422	9	2452
	4	2427	10	2457
	5	2432	11	2462
	6	2437		

2.2 Test Mode

Final test modes are considering the modulation and worse data rates as below table.

MIMO Antenna

CDD Mode

Modulation	Data Rate
802.11b	1 Mbps
802.11g	6 Mbps
802.11ax HE20	MCS0
802.11ax HE40	MCS0

Test Modes: Radiated Spurious Emission	
802.11b	802.11g
CH01 (2412MHz) CH06 (2437MHz) CH11 (2462MHz)	CH01 (2412MHz) CH02 (2417MHz) CH03 (2422MHz) CH06 (2437MHz) CH09 (2452MHz) CH10 (2457MHz) CH11 (2462MHz)

802.11ax HE20	802.11ax HE40
CH01 (2412MHz)	CH03 (2422MHz)
CH02 (2417MHz)	CH04 (2427MHz)
CH03 (2422MHz)	CH05 (2432MHz)
CH06 (2437MHz)	CH06 (2437MHz)
CH09 (2452MHz)	CH07 (2442MHz)
CH10 (2457MHz)	CH08 (2447MHz)
CH11 (2462MHz)	CH09 (2452MHz)

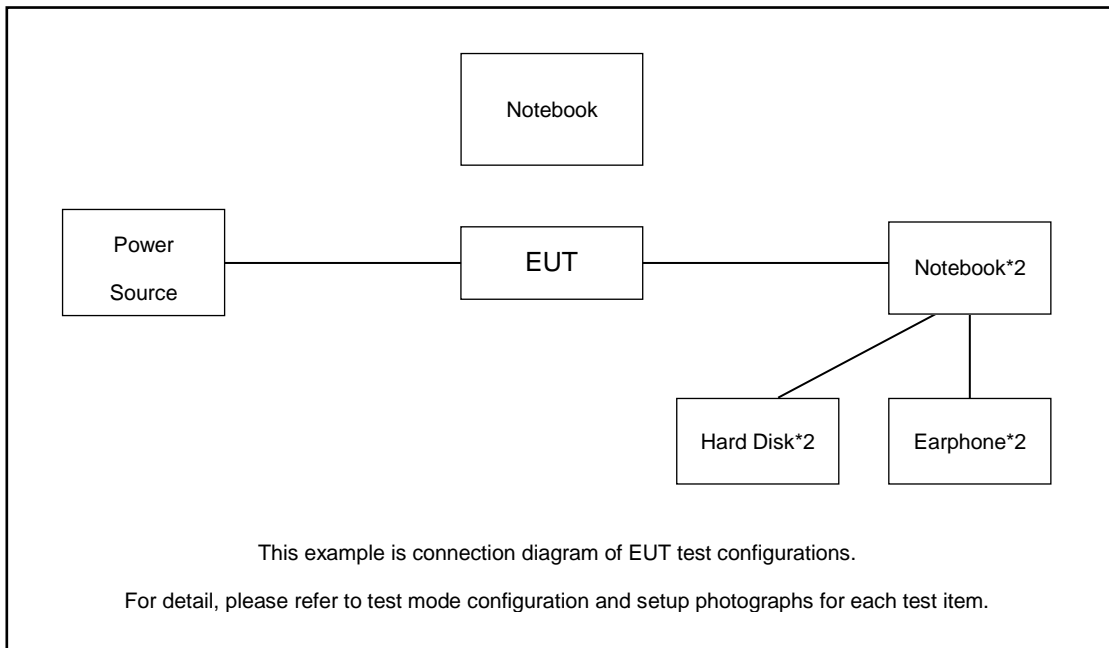
Remark:

1. For Radiated Test Cases, The tests were performance with Adapter.
2. All test modes of the Radiated Spurious Emission (RSE) were tested; only the worse data in each bandwidth shown in bold for these modes is reported.

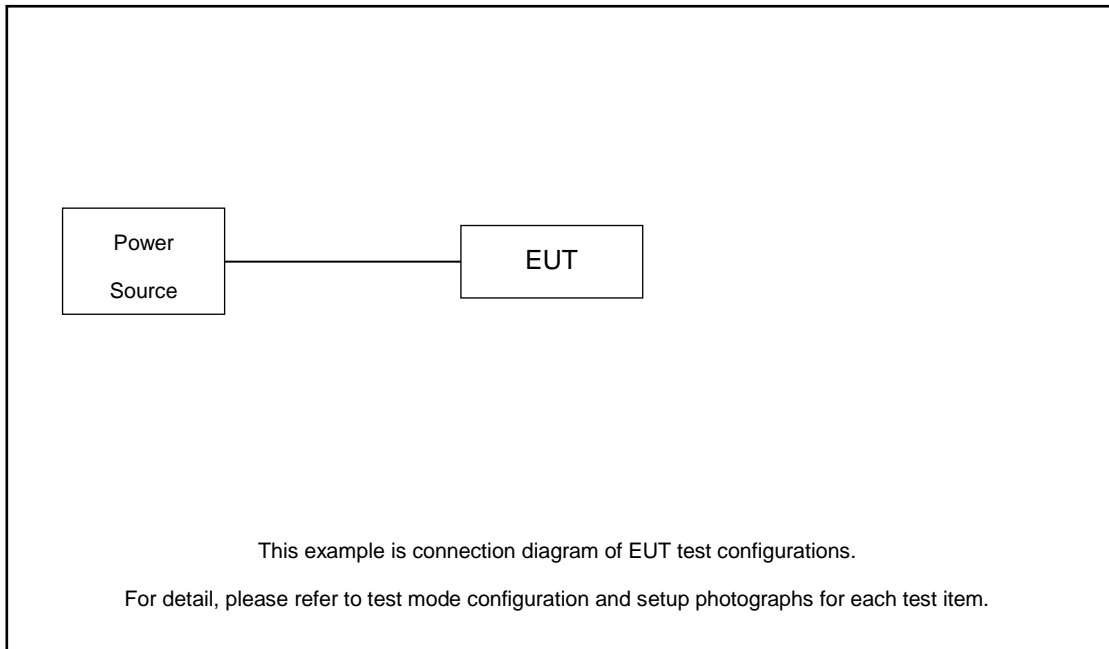
Test Modes: AC Conducted Emission
Mode 1 :WLAN (2.4G) Link+LAN Link+WAN Link+Power from Adapter

2.3 Connection Diagram of Test System

For Conducted Emission:



For Radiated Emission:



2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Notebook	Lenovo	V130-15IKB005	N/A	N/A	AC I/P: Unshielded, 1.8 m DC O/P: Shielded, 1.8 m
2.	Hard Disk	WD	C6B	N/A	N/A	N/A
3.	Earphone	Lenovo	P121	N/A	N/A	Unshielded, 1.2m

2.5 EUT Operation Test Setup

For WLAN RF test items, an engineering test program was provided and enabled to make EUT continuous transmit.

For AC power line conducted emissions, the EUT was set to connect with the notebook under large package sizes transmission.



2.6 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example:

The spectrum analyzer offset is derived from RF cable loss.

Offset = RF cable loss.

Following shows an offset computation example with cable loss 5.6 dB.

$$\begin{aligned} \text{Offset(dB)} &= \text{RF cable loss(dB)}. \\ &= 5.6 \text{ (dB)} \end{aligned}$$

3 Test Result

3.1 6dB and 99% Bandwidth Measurement

3.1.1 Limit of 6dB and 99% Bandwidth

The minimum 6 dB bandwidth shall be at least 500 kHz.

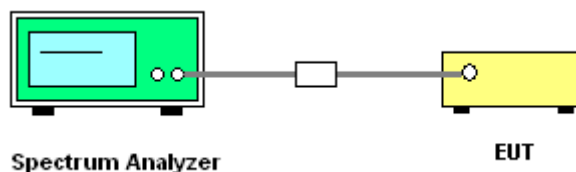
3.1.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.1.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 11.8
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6 dB bandwidth must be greater than 500 kHz.
5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) = 1MHz and set the Video bandwidth (VBW) = 3MHz.
6. Measure and record the results in the test report.

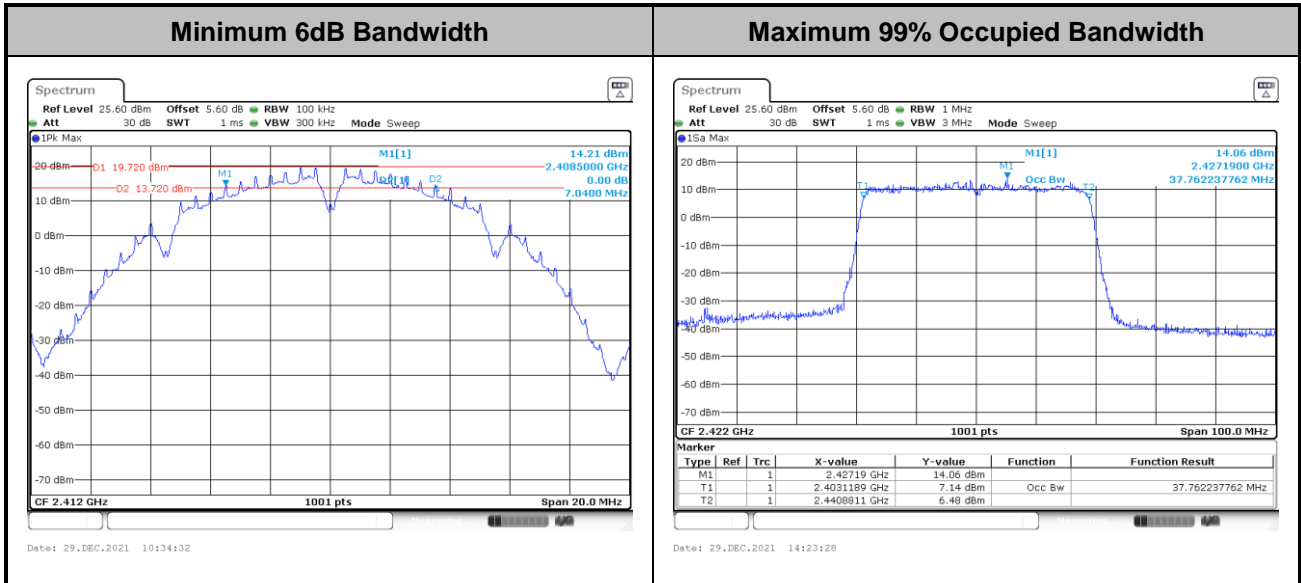
3.1.4 Test Setup





3.1.5 Test Result of 6dB and 99% Occupied Bandwidth

Please refer to Appendix A.



Note : The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

3.2 Output Power Measurement

3.2.1 Limit of Output Power

For systems using digital modulation in the 2400-2483.5MHz, the limit for average output power is 30dBm. If transmitting antenna with directional gain greater than 6dBi is used, the output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

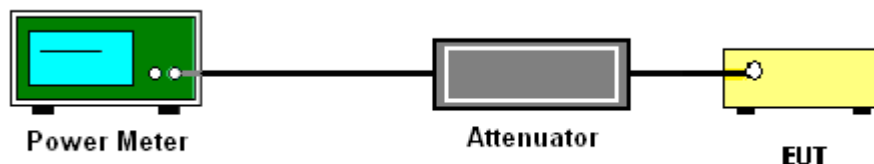
3.2.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.2.3 Test Procedures

1. The testing follows the Measurement Procedure of ANSI C63.10-2013 clause 11.9.2.3.2 Method AVGPM-G method.
2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Measure the conducted output power and record the results in the test report.
5. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

3.2.4 Test Setup



3.2.5 Test Result of Average Output Power

Please refer to Appendix A.



3.3 Power Spectral Density Measurement

3.3.1 Limit of Power Spectral Density

The peak power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.

3.3.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

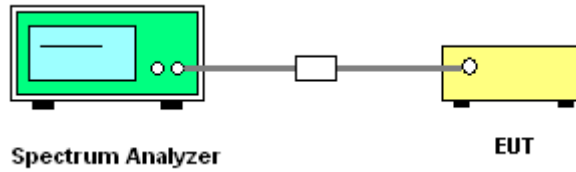
3.3.3 Test Procedures

1. The testing follows Measurement Procedure of ANSI C63.10-2013 clause 11.10.5 Method AVGPSD-2.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz. Video bandwidth VBW = 10 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)
5. Detector = RMS, Sweep time = auto couple, Trace mode = max hold, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level.
6. Employ trace averaging (rms) mode over a minimum of 100 traces.
7. Measure and record the results in the test report.
8. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

Method (c): Measure and add $10 \log(N_{ANT})$ dB, where N_{ANT} is the number of outputs. (N=2)

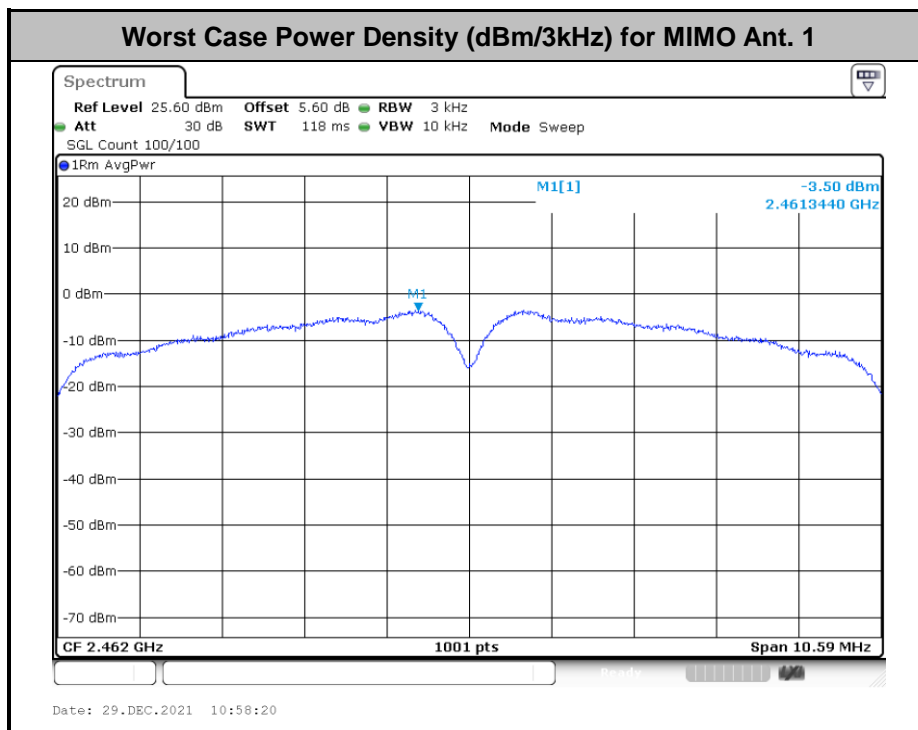
With this technique, spectrum measurements are performed at each output of the device, but rather than summing the spectra or the spectral peaks across the outputs, the quantity $10 \log(N_{ANT})$ dB is added to each spectrum value before comparing to the emission limit. The addition of $10 \log(N_{ANT})$ dB serves to apportion the emission limit among the N_{ANT} outputs so that each output is permitted to contribute no more than $1/N_{ANT}^{th}$ of the PSD limit

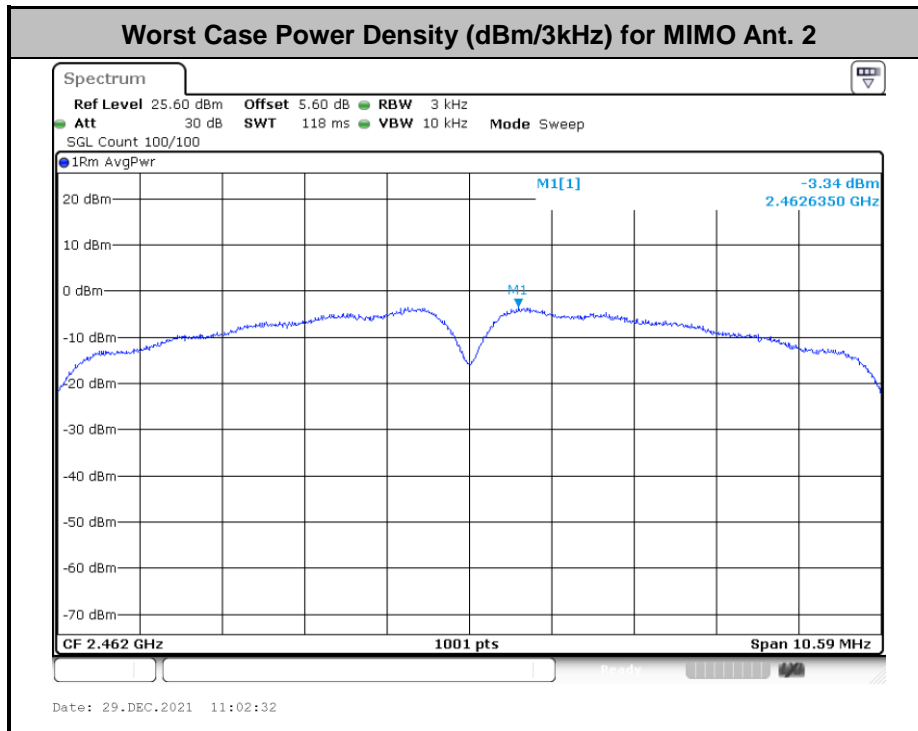
3.3.4 Test Setup



3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.





Note: Average Power Density (dB) = Measured value+ Duty Factor

3.4 Conducted Band Edges and Spurious Emission Measurement

3.4.1 Limit of Conducted Band Edges and Spurious Emission Measurement

In any 100 kHz bandwidth outside of the authorized frequency band, the emissions which fall in the non-restricted bands shall be attenuated at least 30dB relative to the maximum PSD level in 100 kHz by RF conducted measurement.

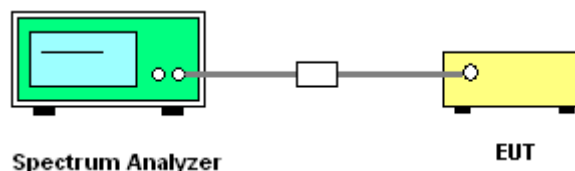
3.4.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.4.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 11.13
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB per 15.247(d).
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

3.4.4 Test Setup



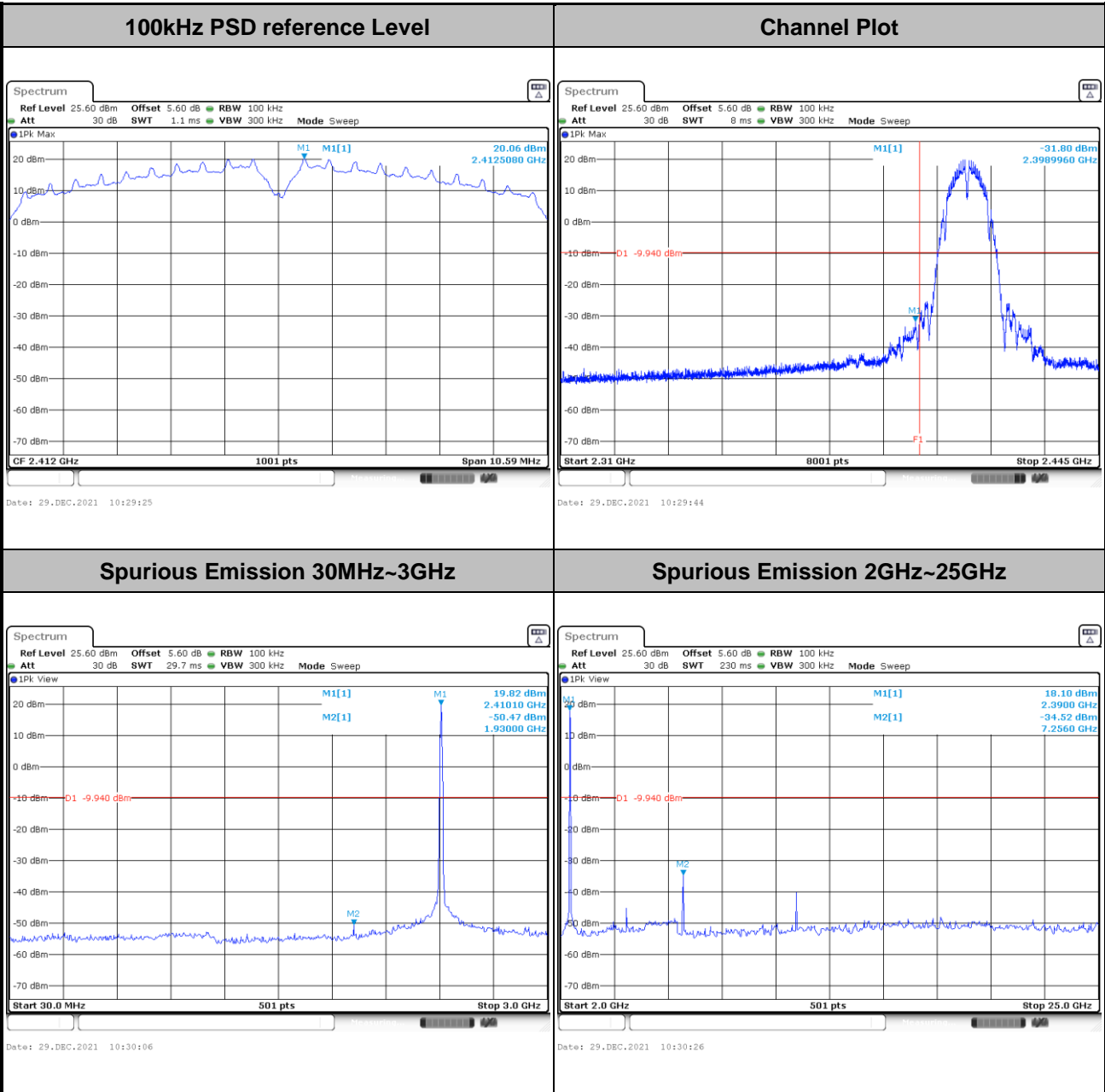


3.4.5 Test Result of Conducted Band Edges and Spurious Emission

Test Engineer : Jiang Jun	Temperature :	21~25°C
	Relative Humidity :	51~54%

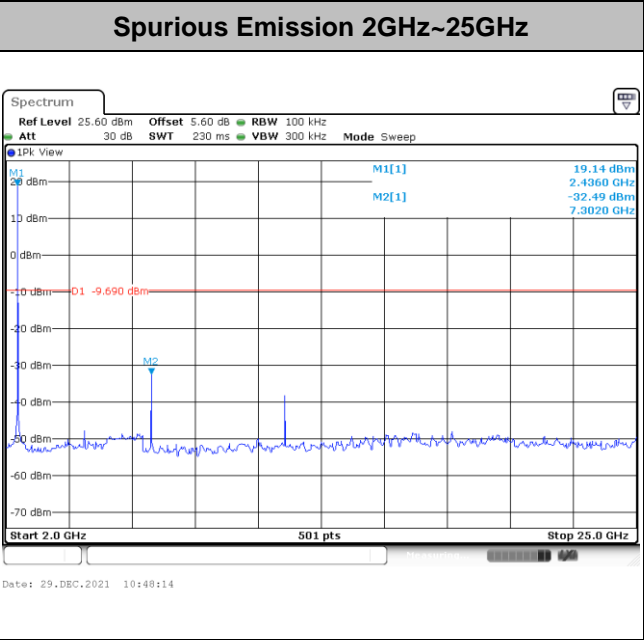
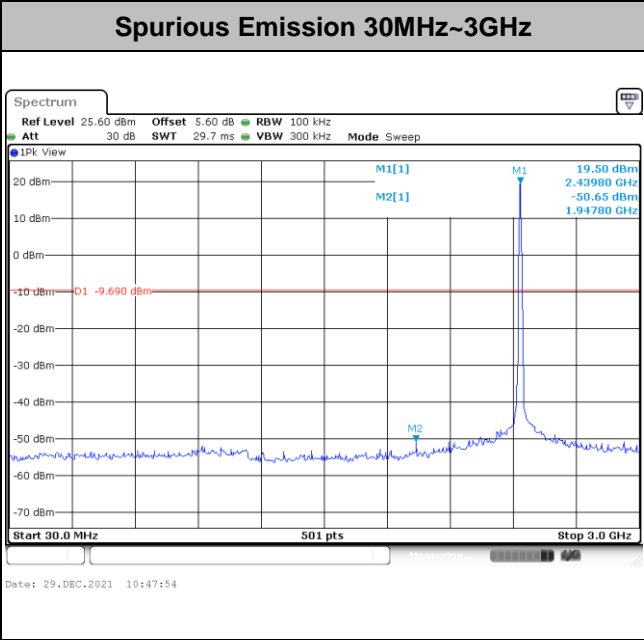
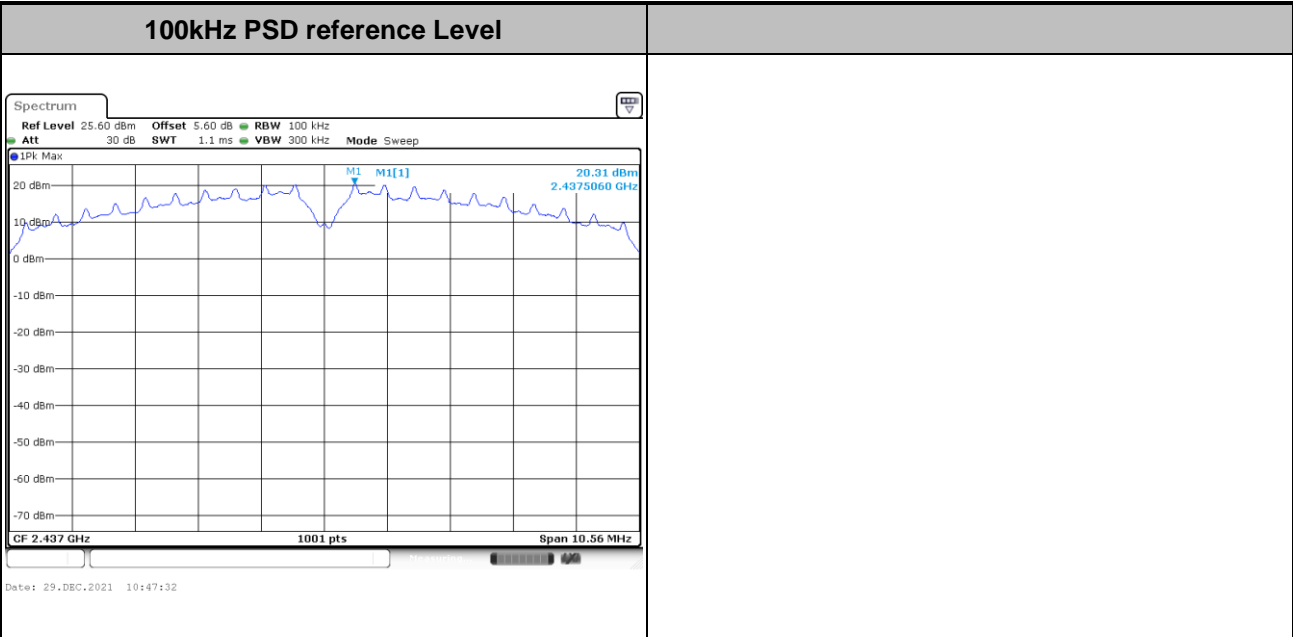
Number of TX = 2, Ant. 1 (Measured)

Test Mode :	802.11b	Test Channel :	01
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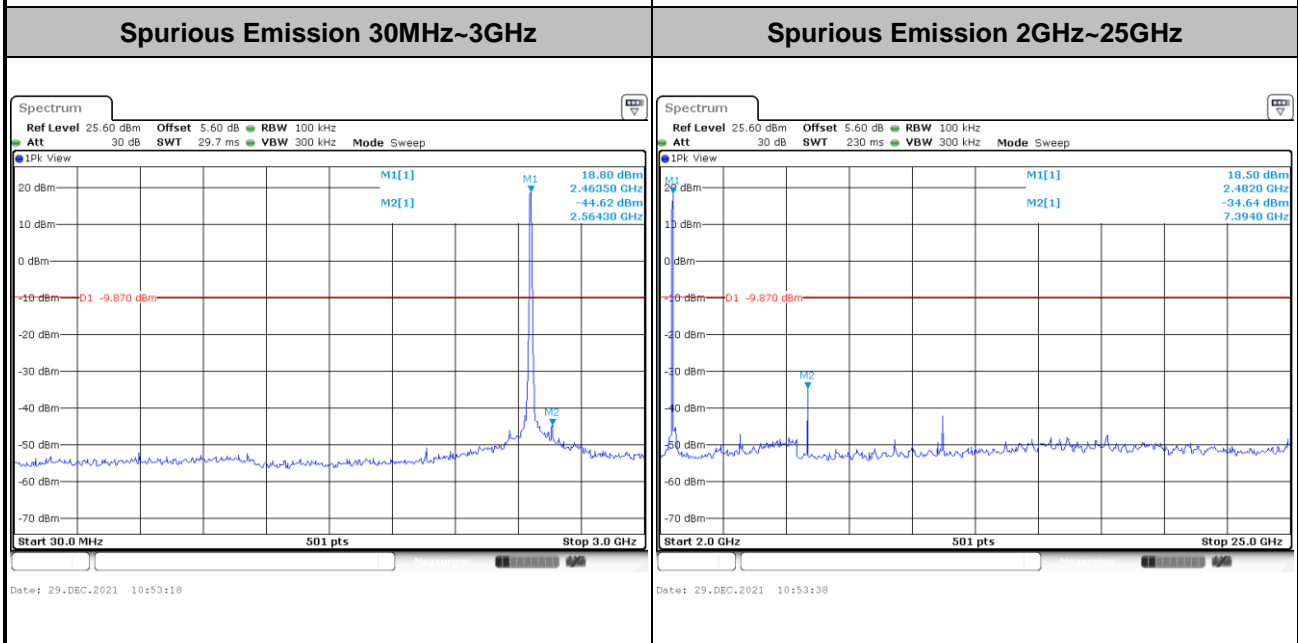
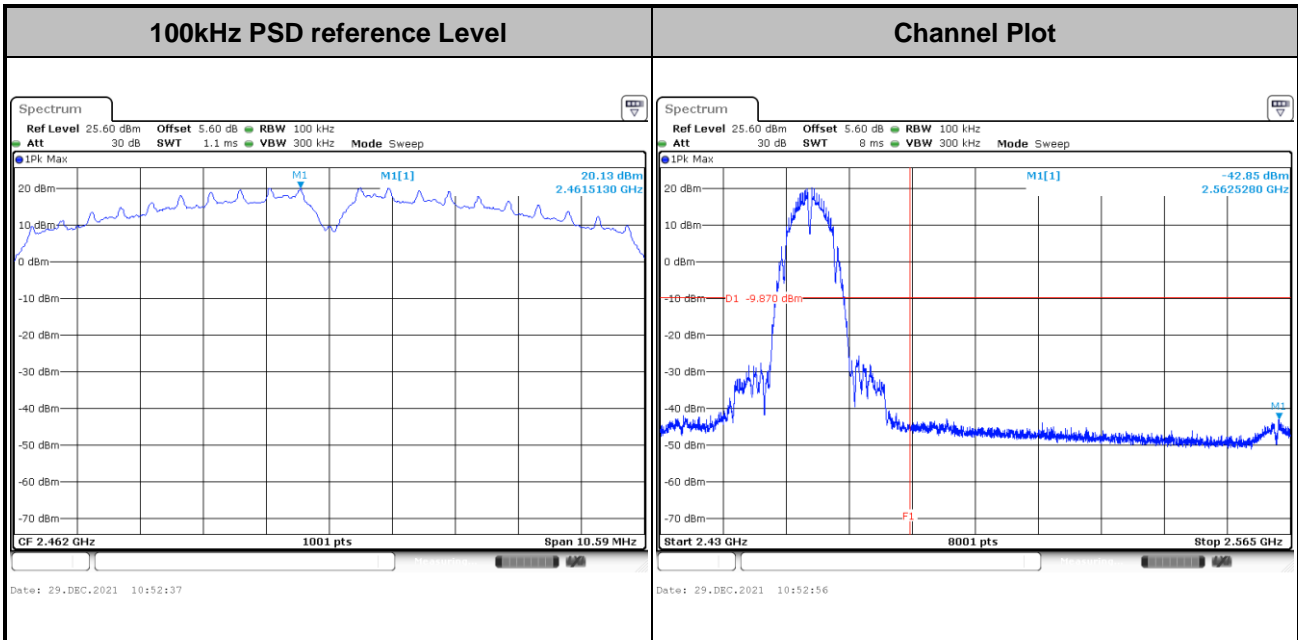


Test Mode :	802.11b	Test Channel :	06
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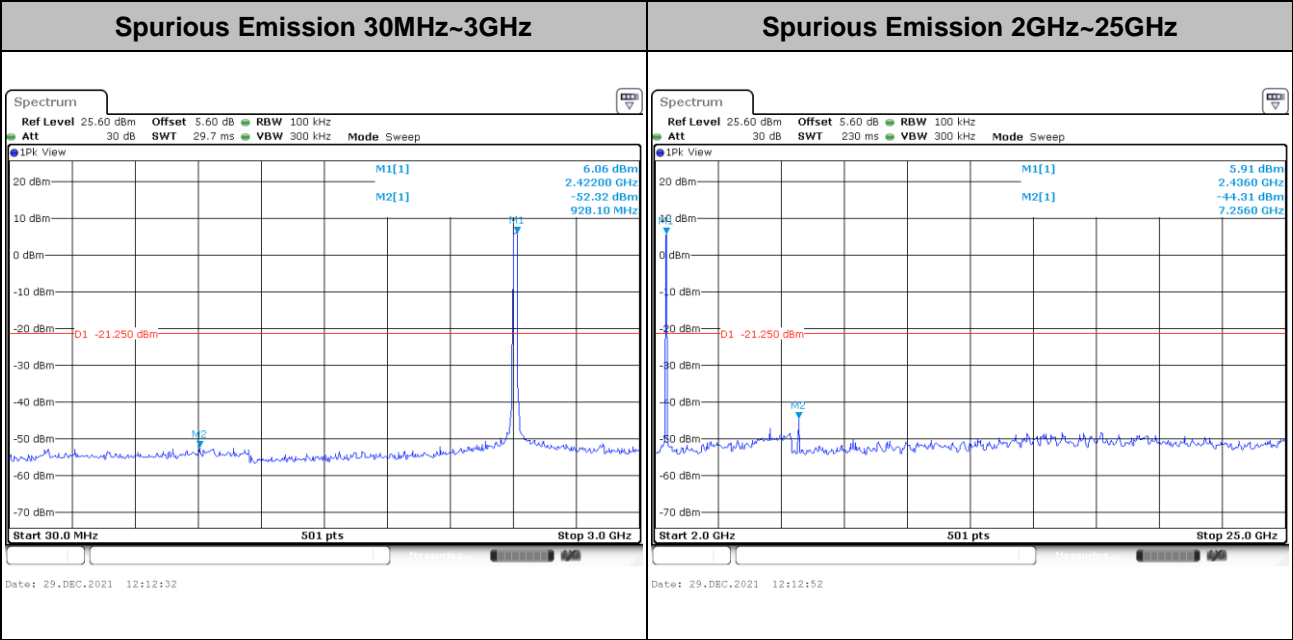
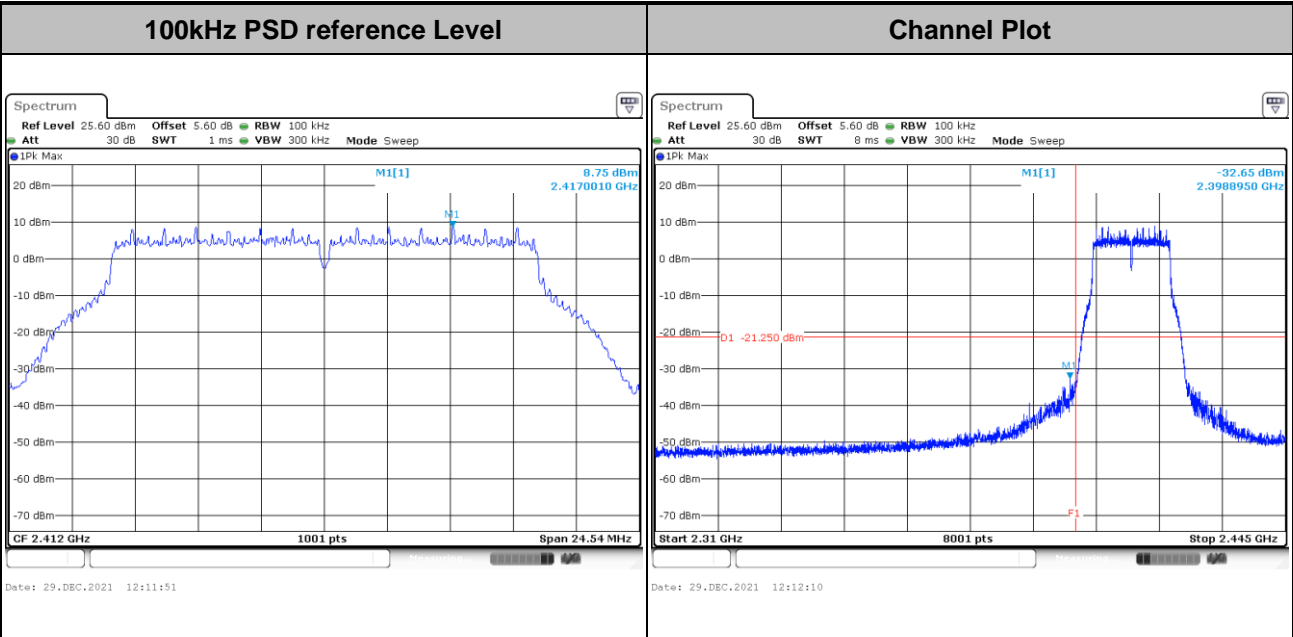


Test Mode :	802.11b	Test Channel :	11
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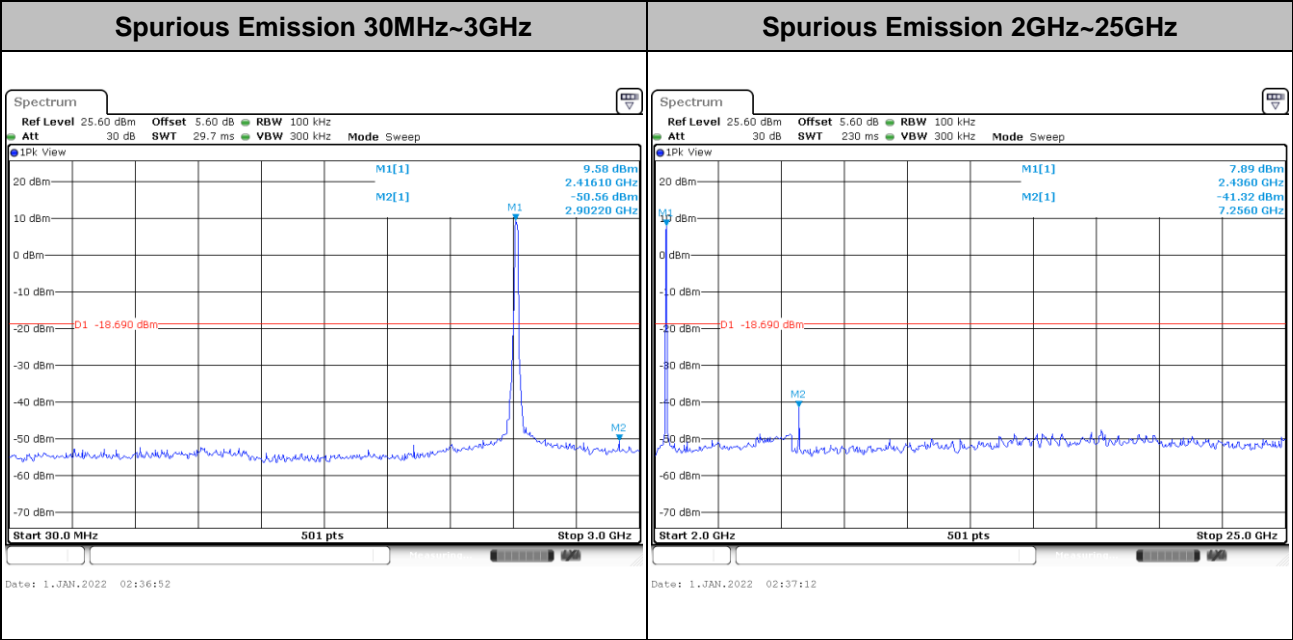
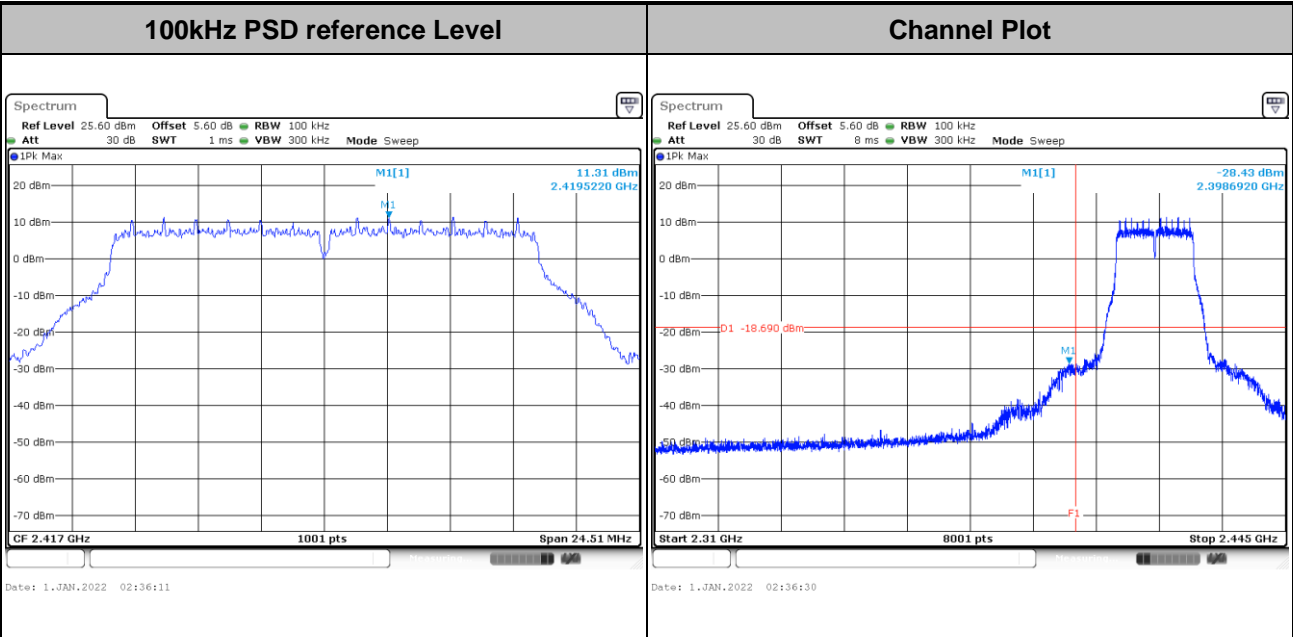


Test Mode : 802.11g Test Channel : 01



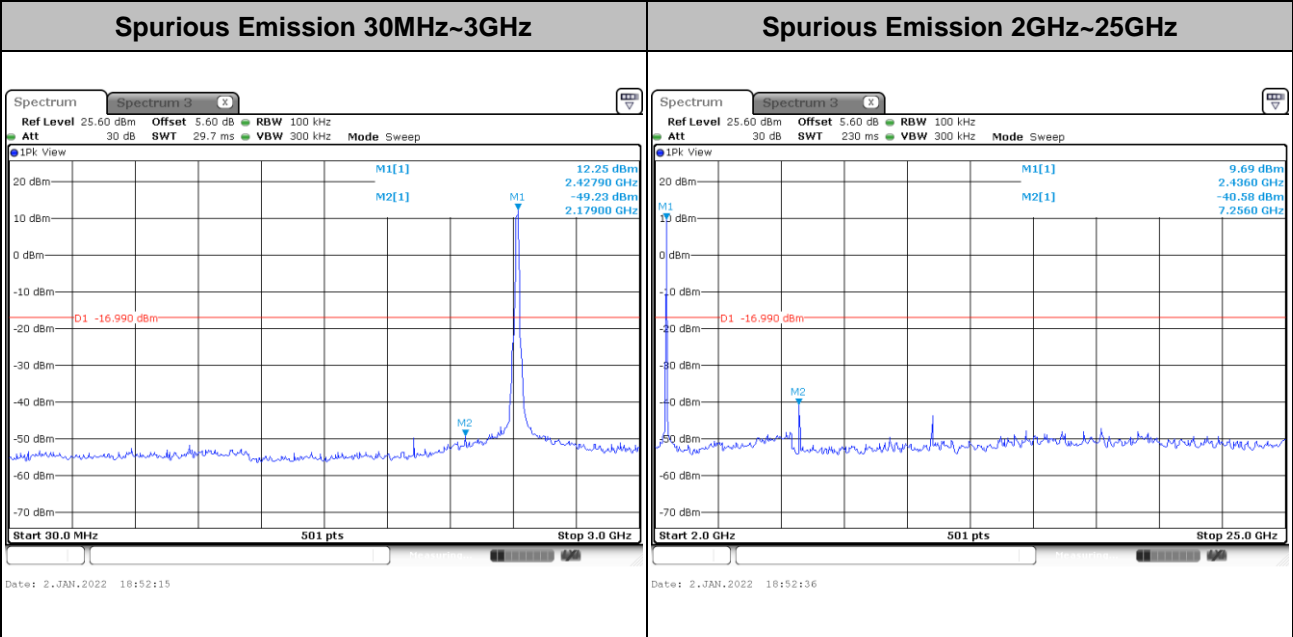
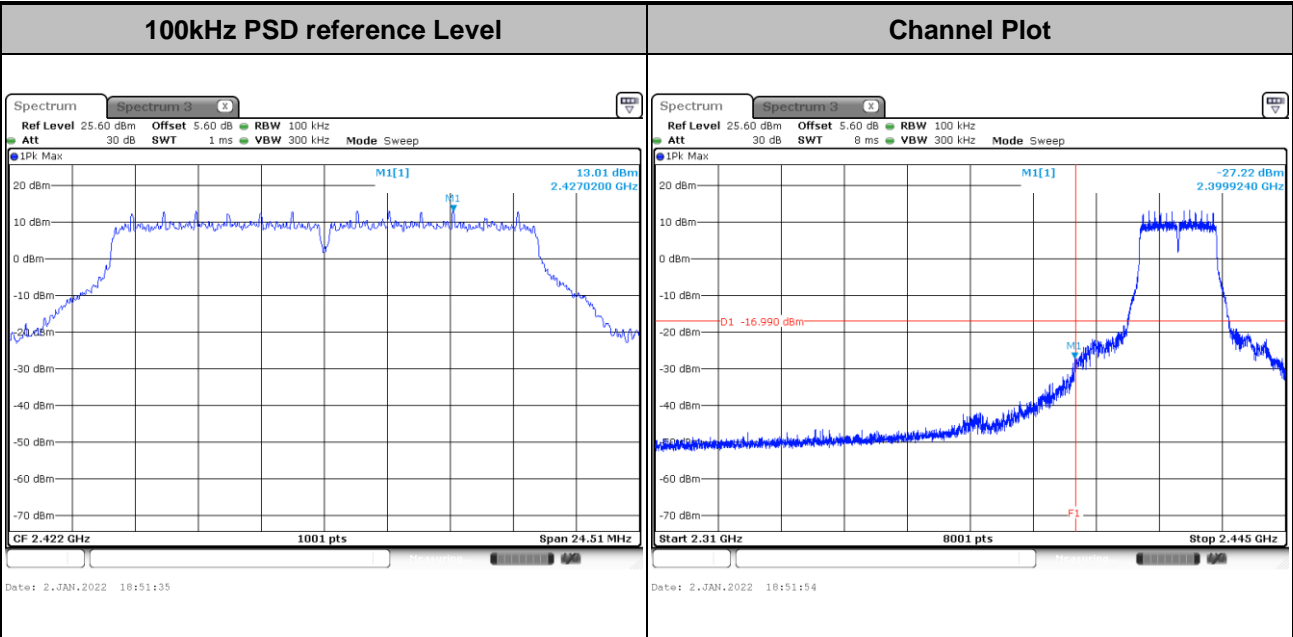


Test Mode : 802.11g Test Channel : 02



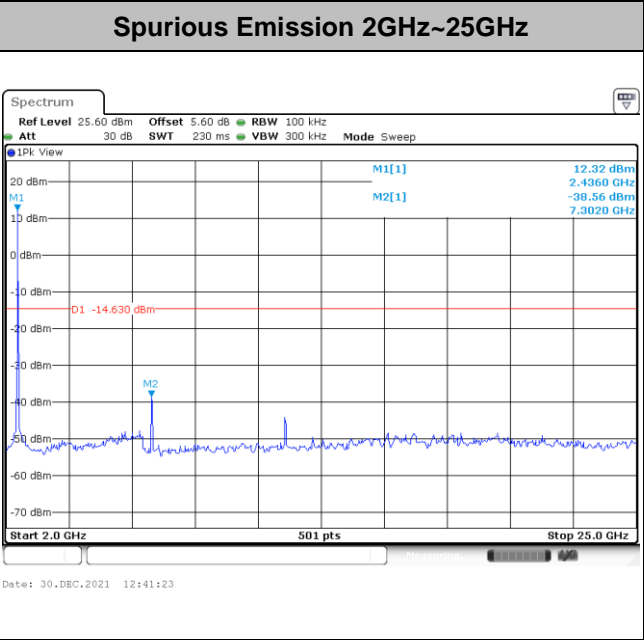
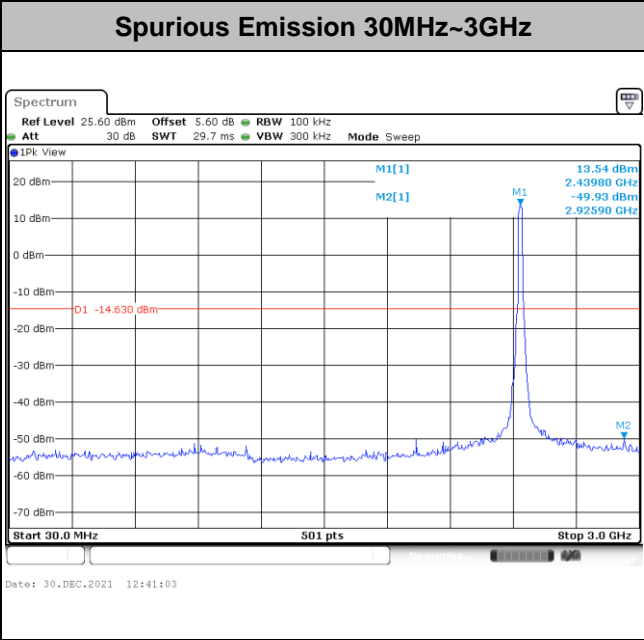
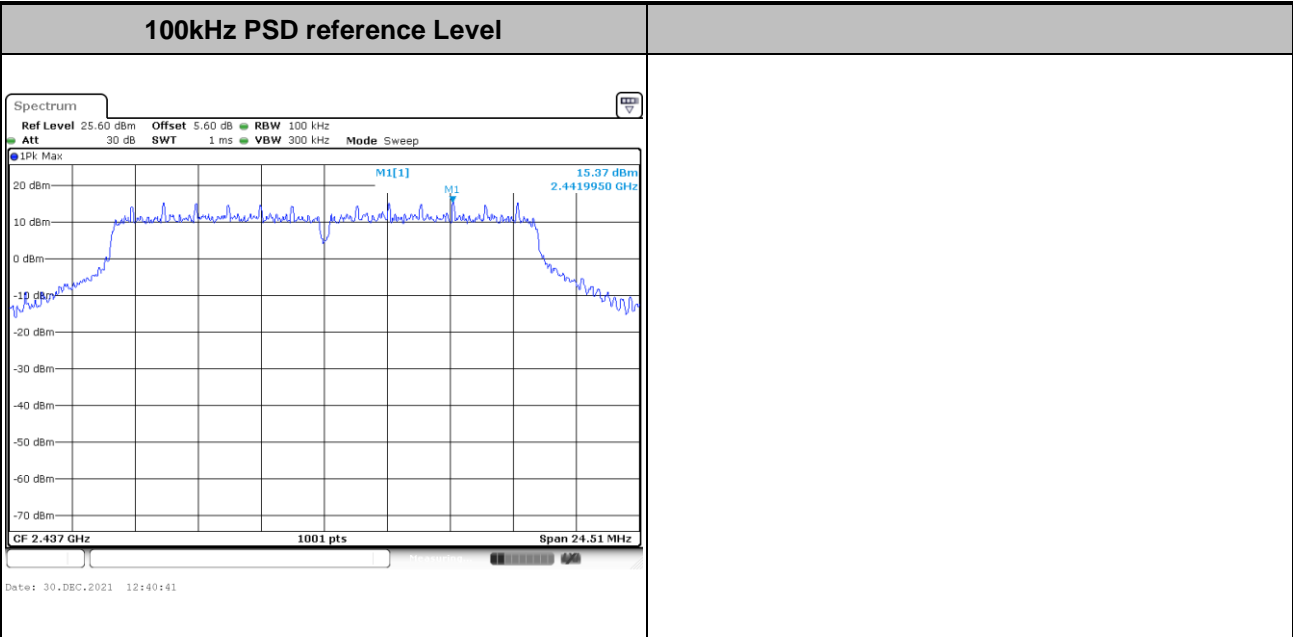


Test Mode : 802.11g Test Channel : 03



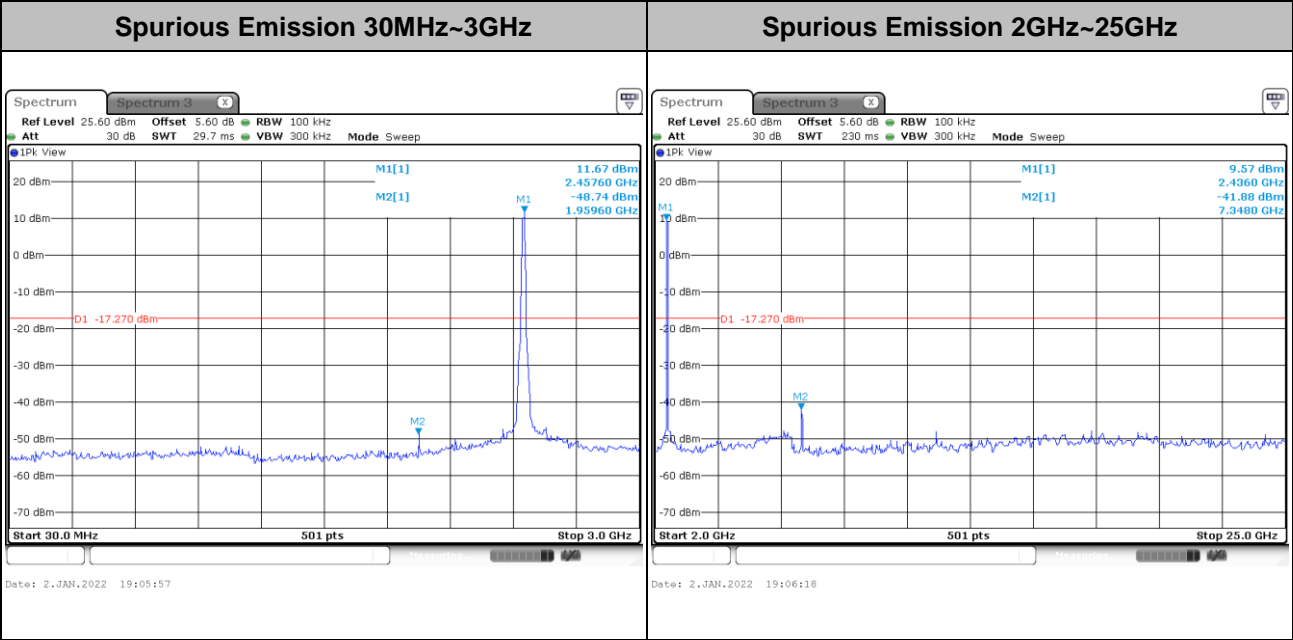
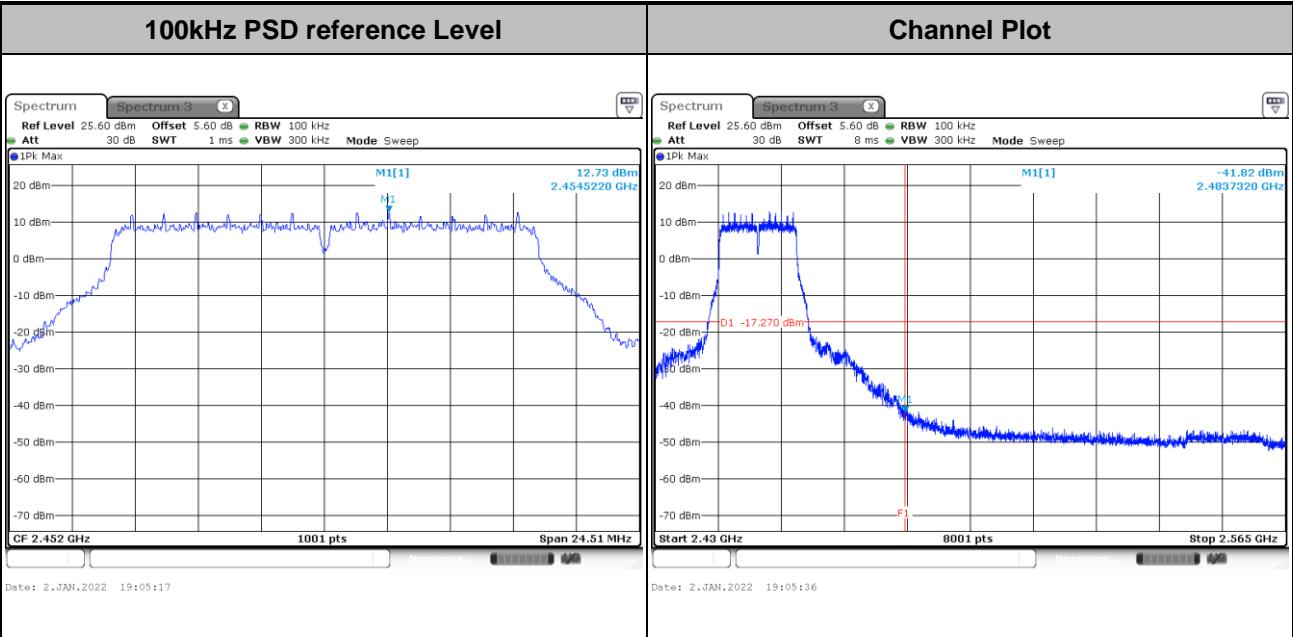


Test Mode :	802.11g	Test Channel :	06
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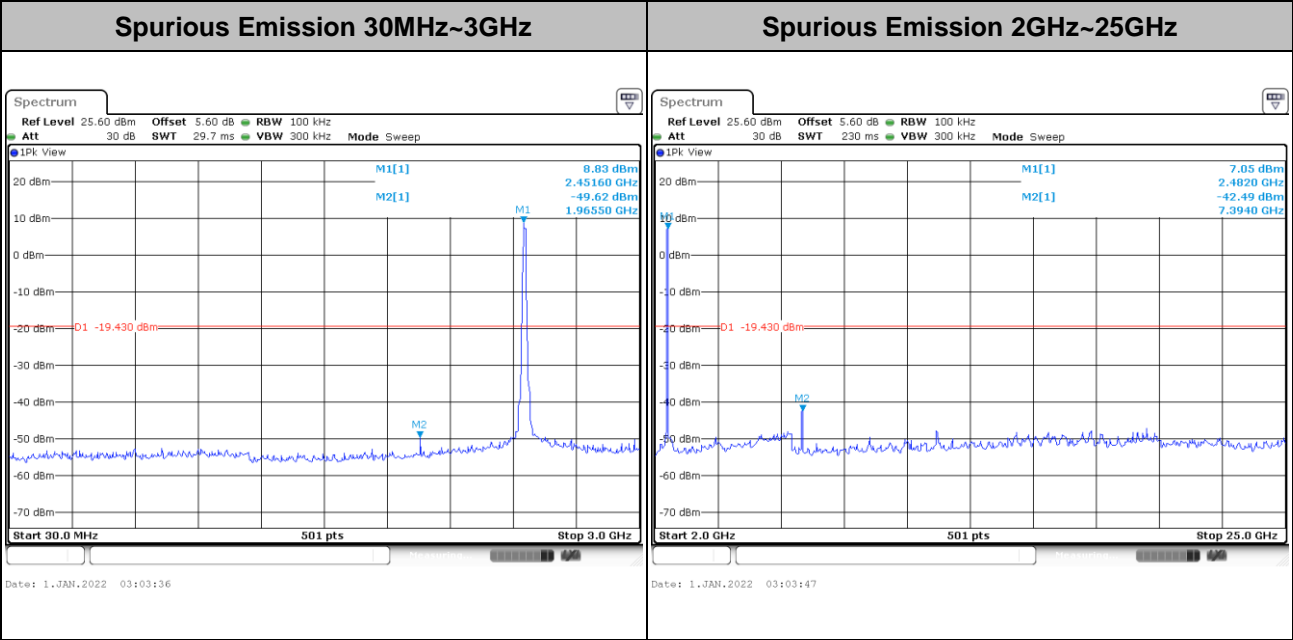
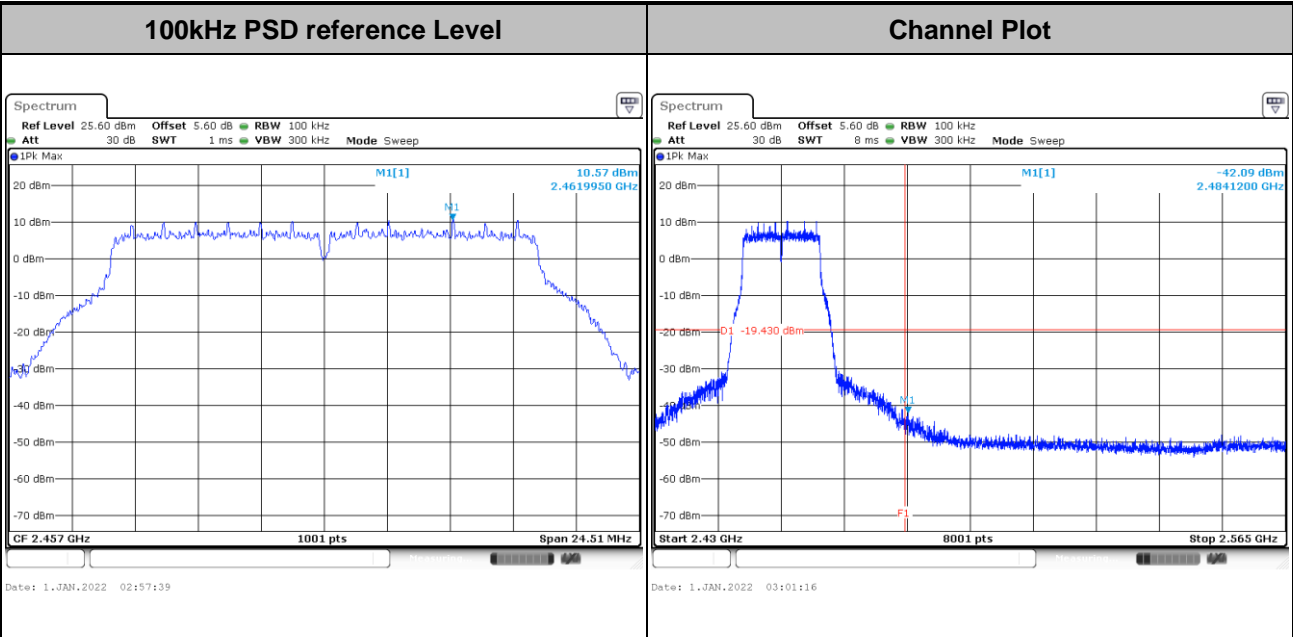


Test Mode : 802.11g Test Channel : 9



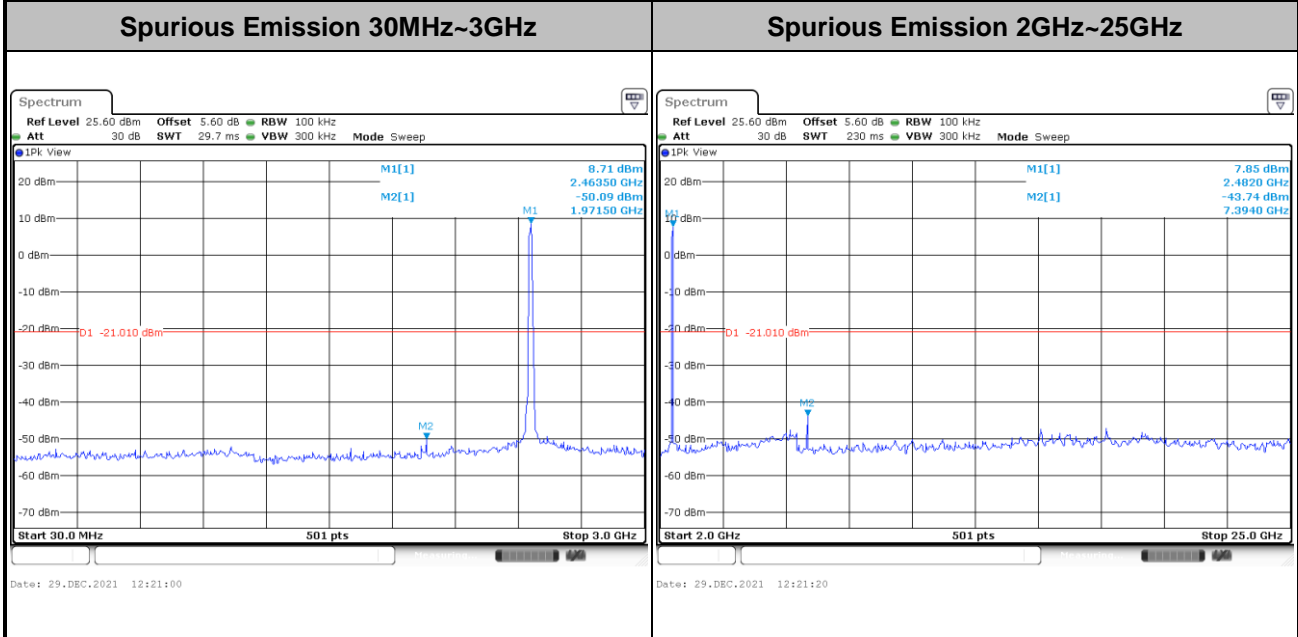
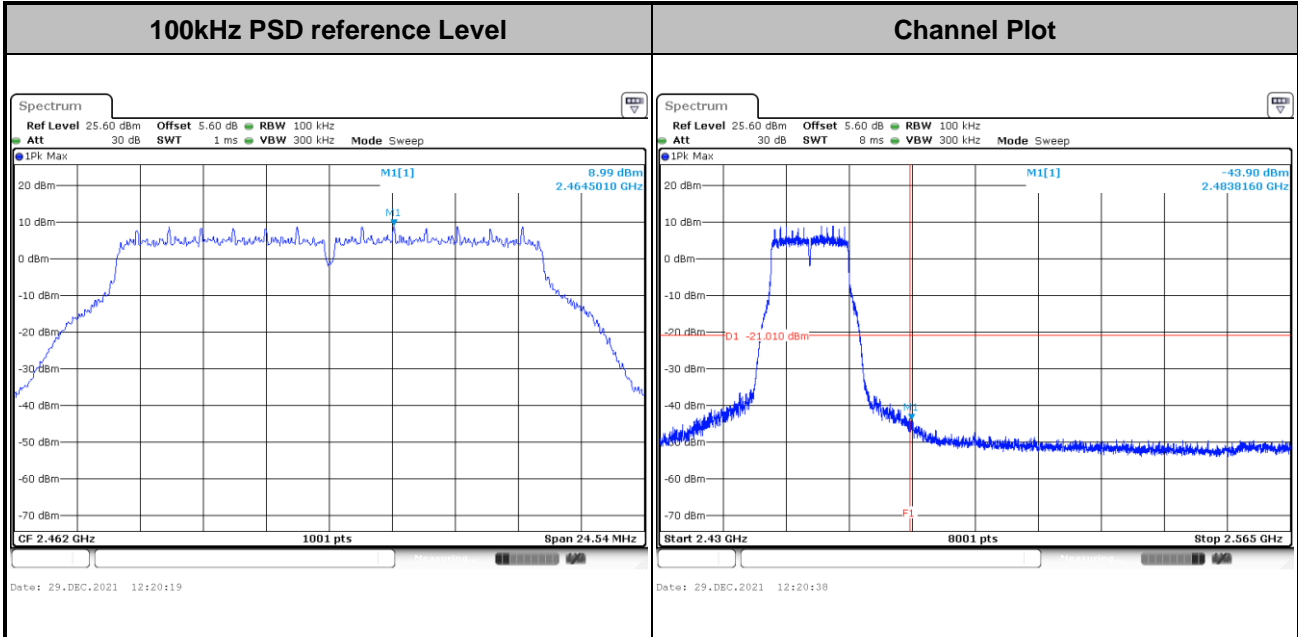


Test Mode : 802.11g Test Channel : 10



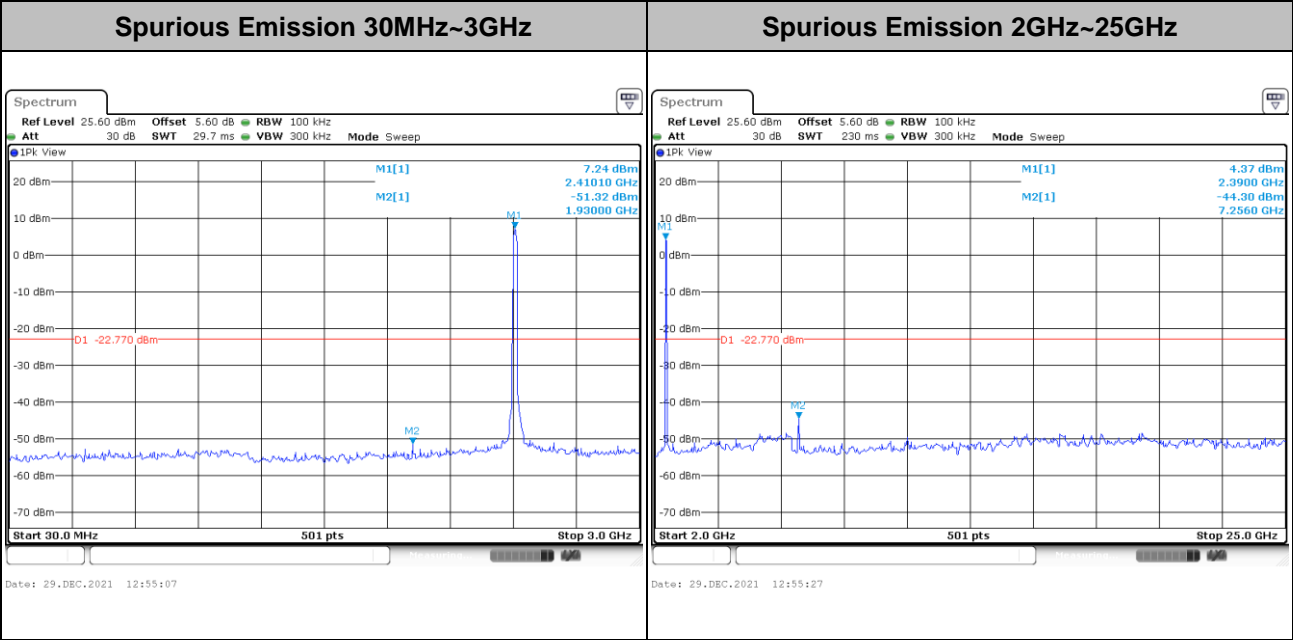
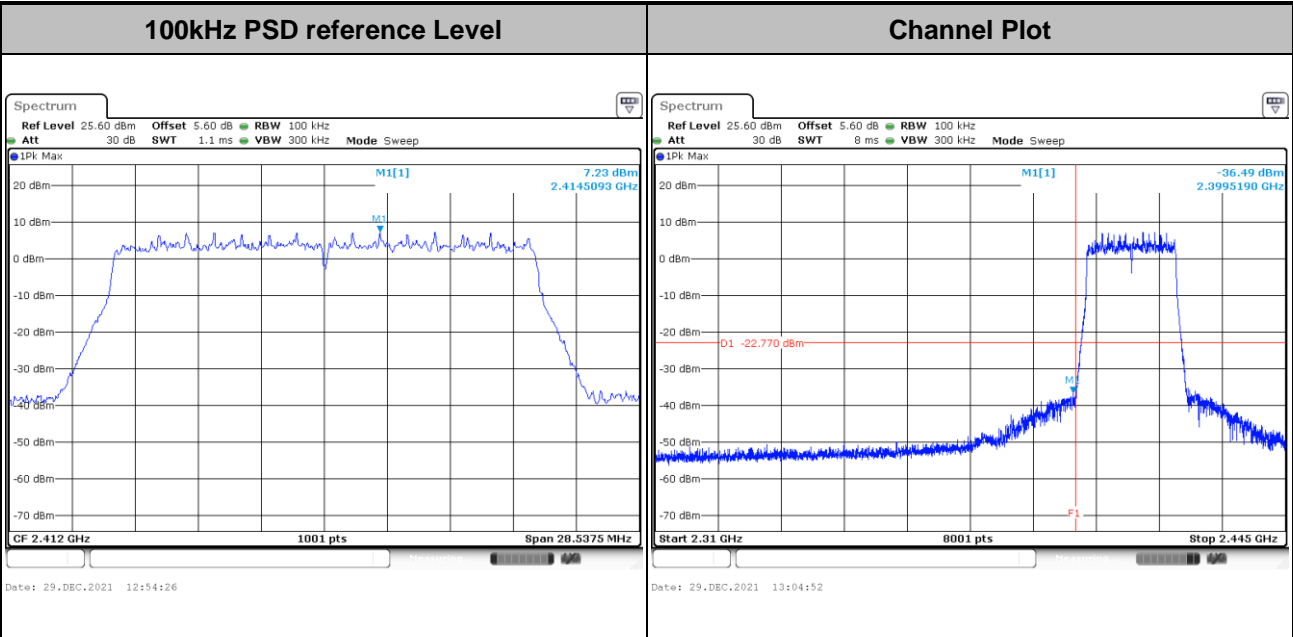


Test Mode :	802.11g	Test Channel :	11
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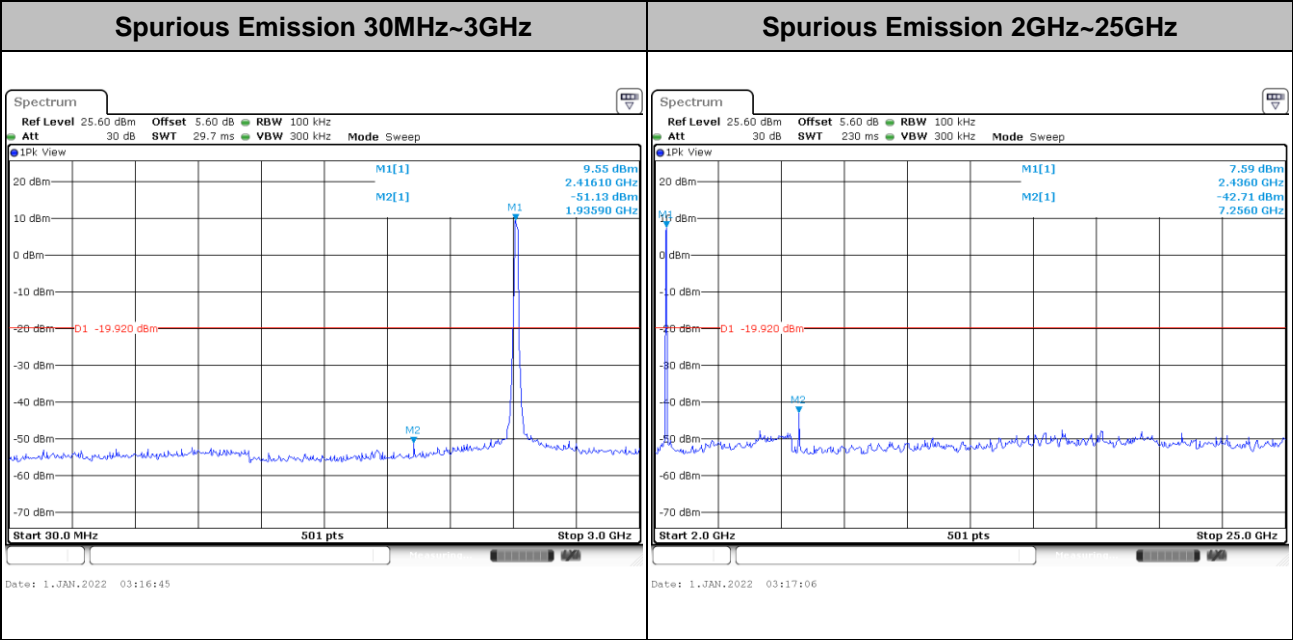
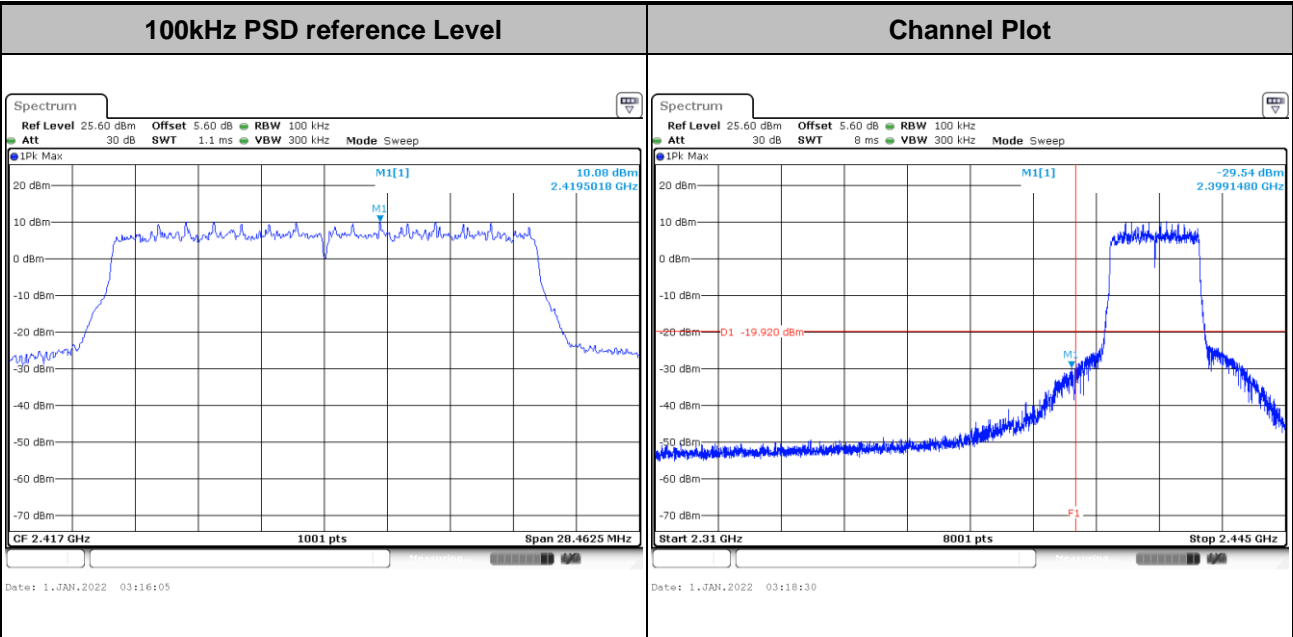


Test Mode :	802.11ax HE20	Test Channel :	01
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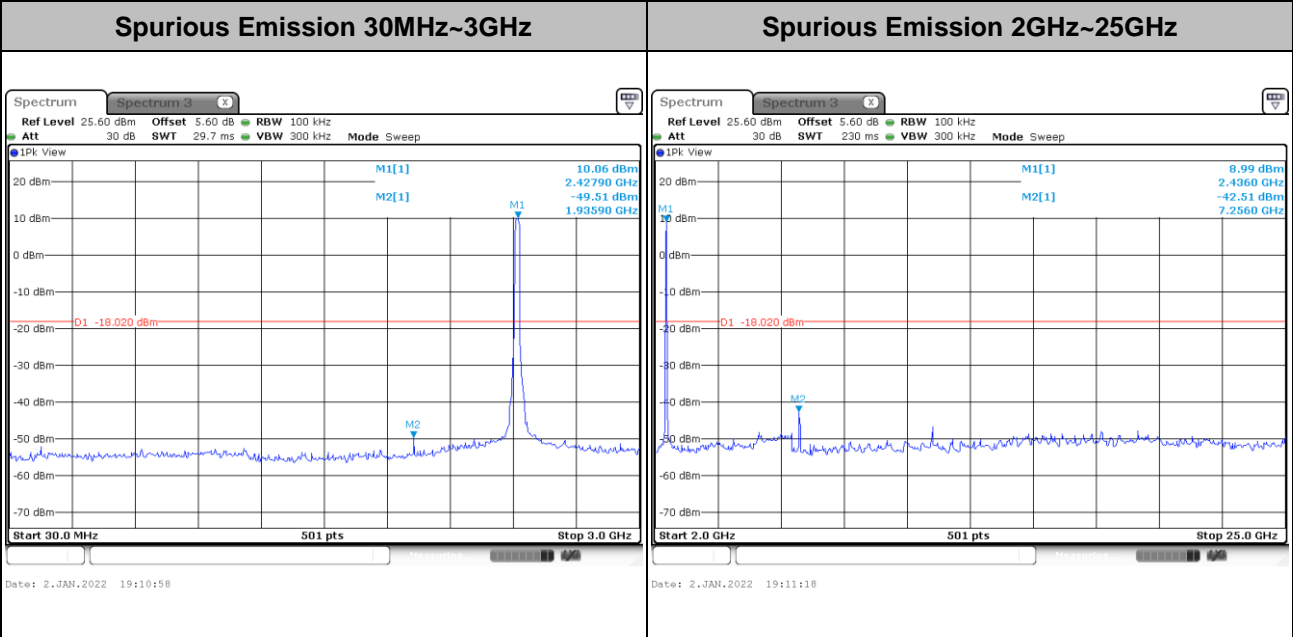
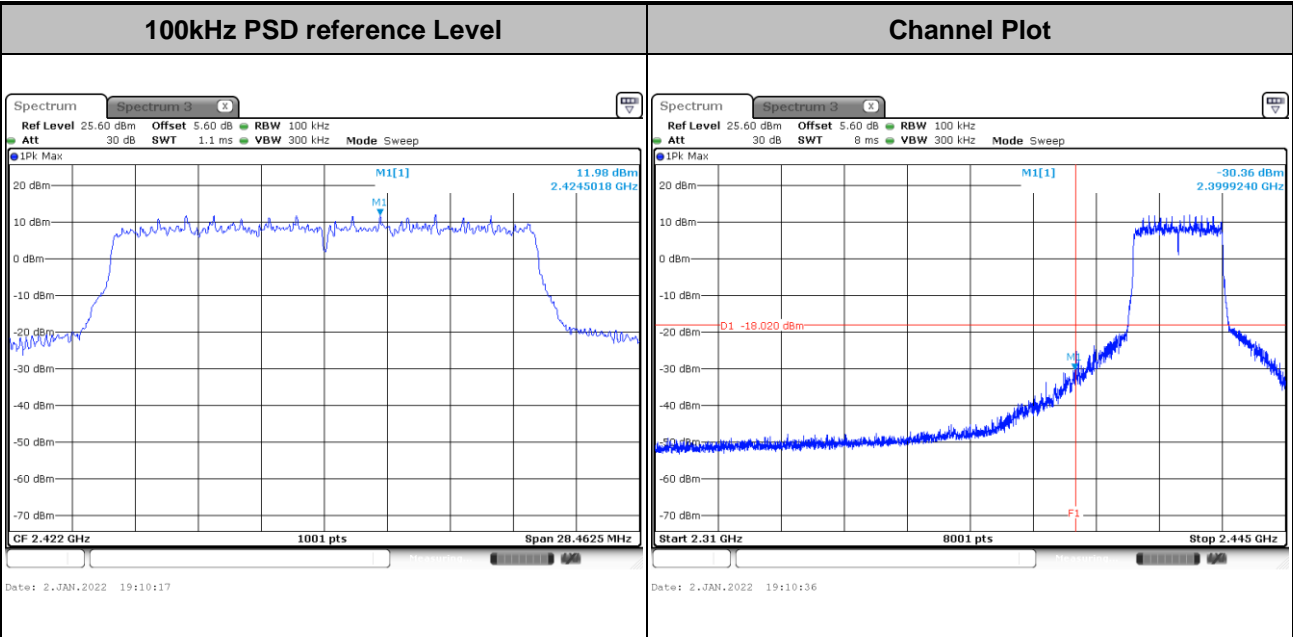


Test Mode : 802.11ax HE20 Test Channel : 02



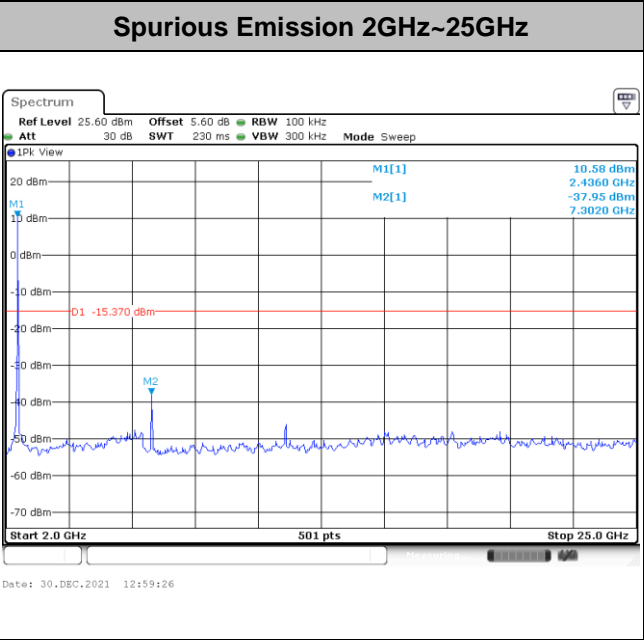
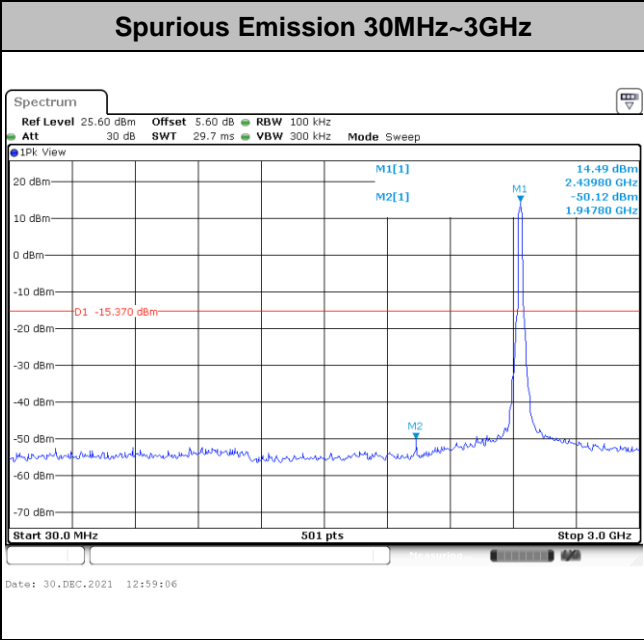
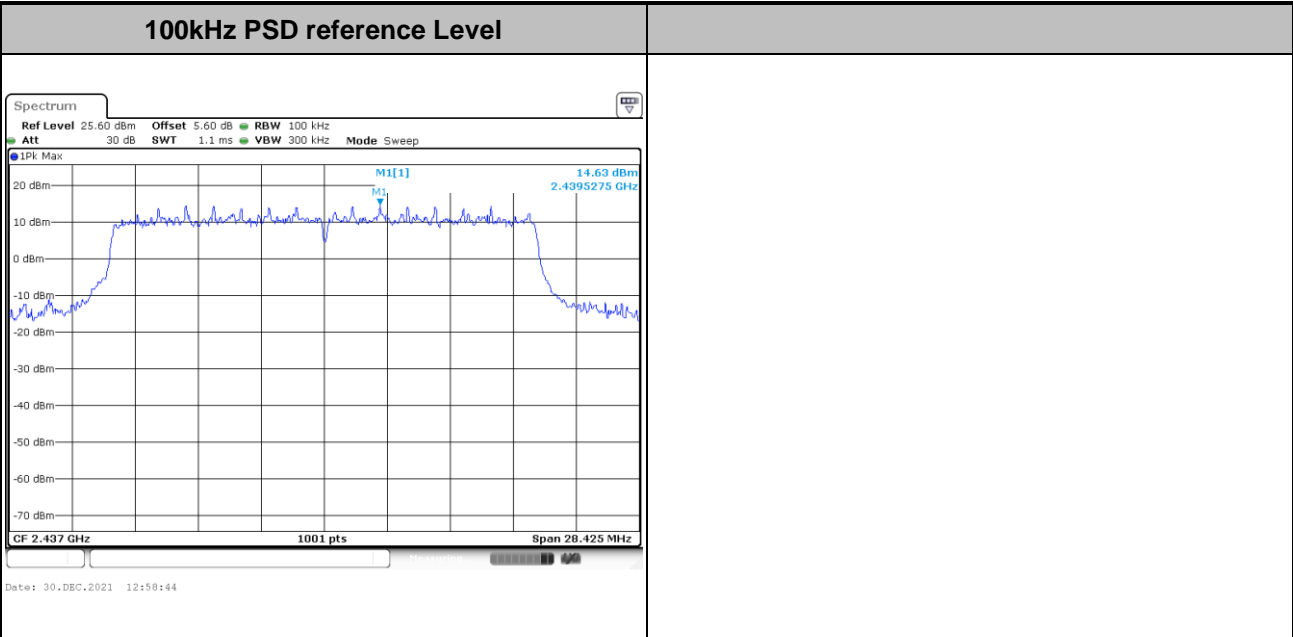


Test Mode : 802.11ax HE20 Test Channel : 03



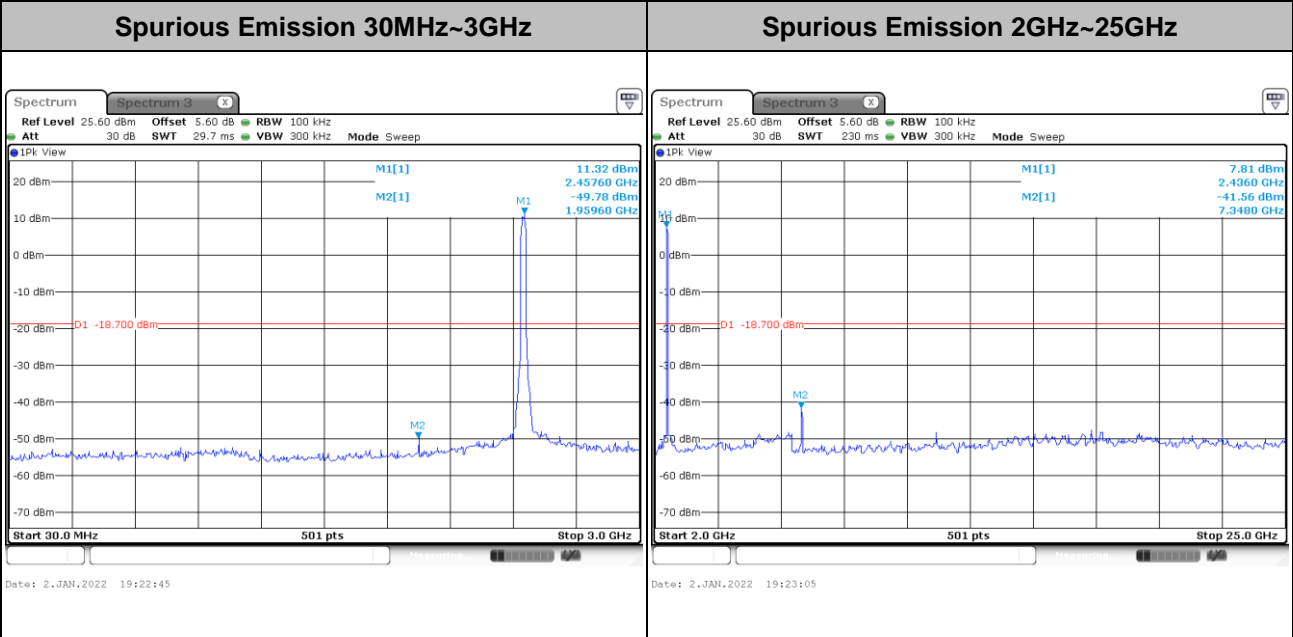
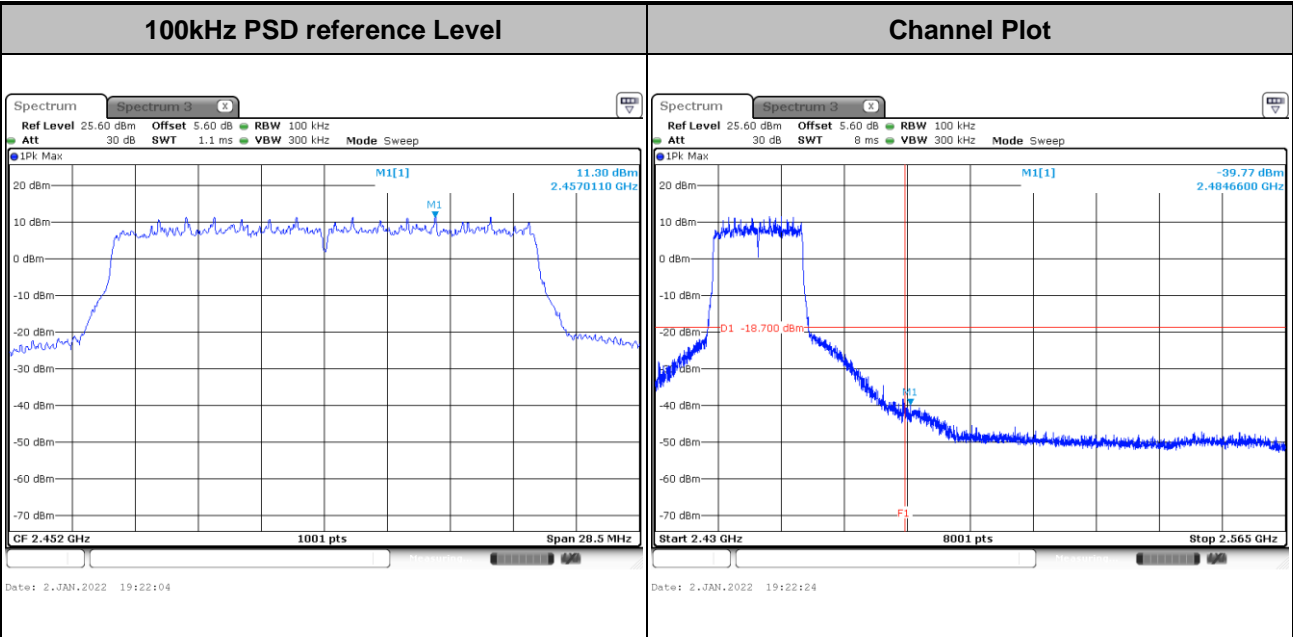


Test Mode :	802.11ax HE20	Test Channel :	06
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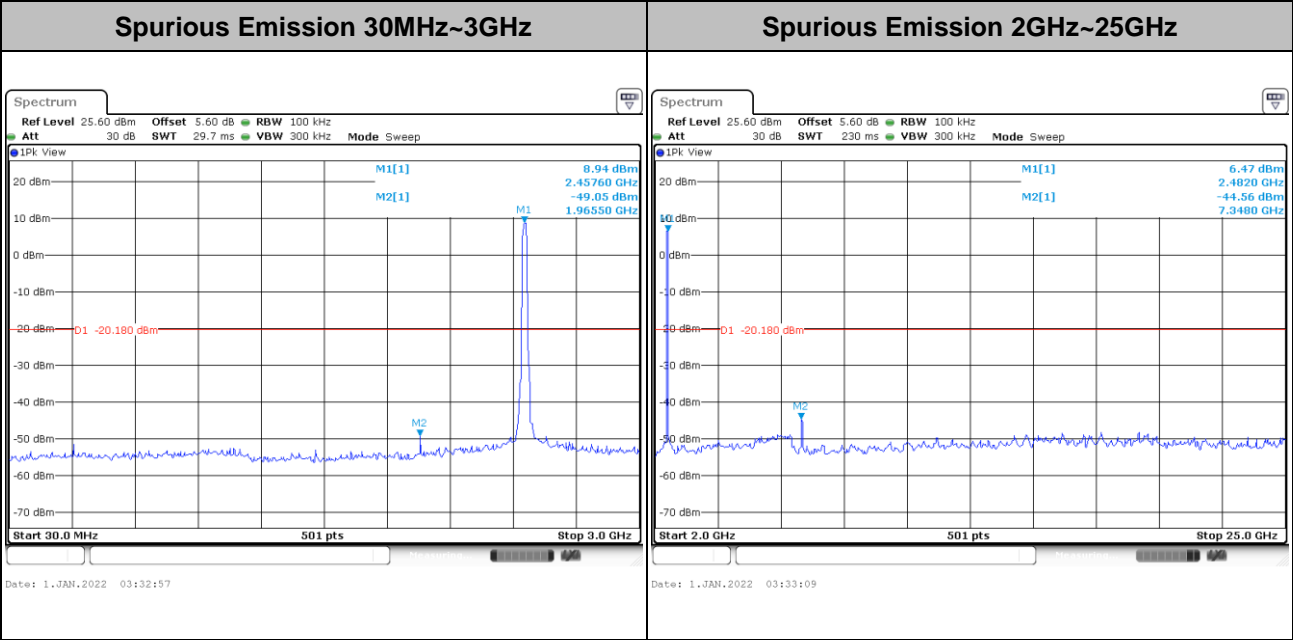
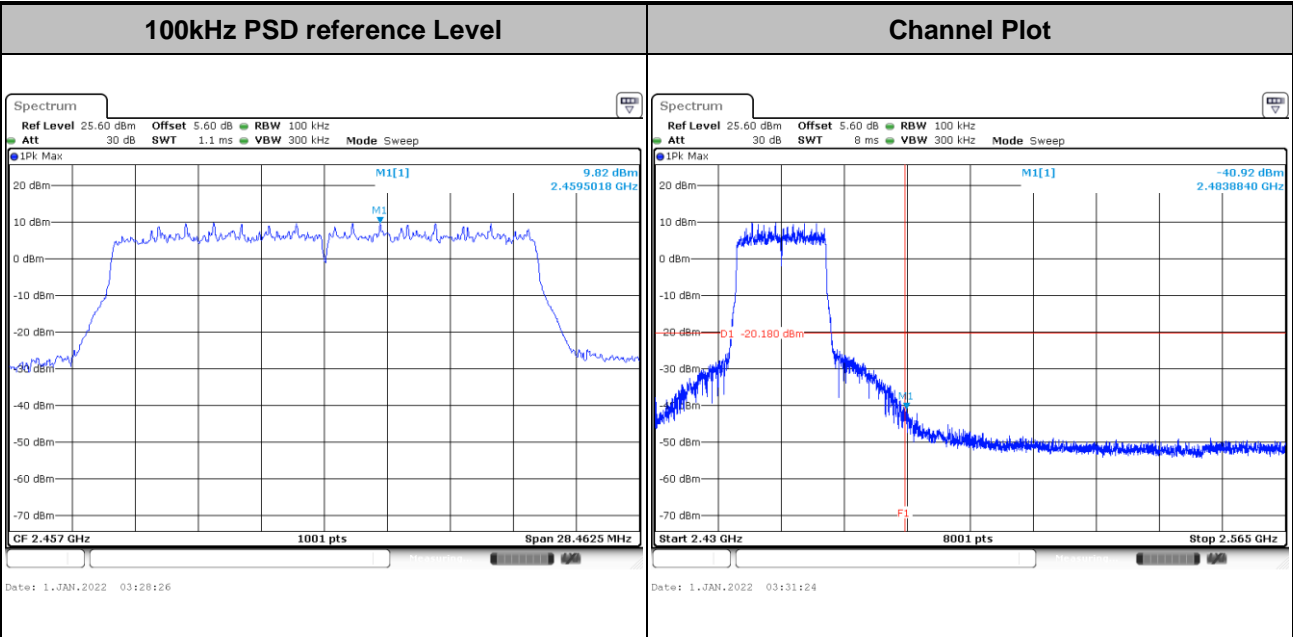


Test Mode : 802.11ax HE20 Test Channel : 09



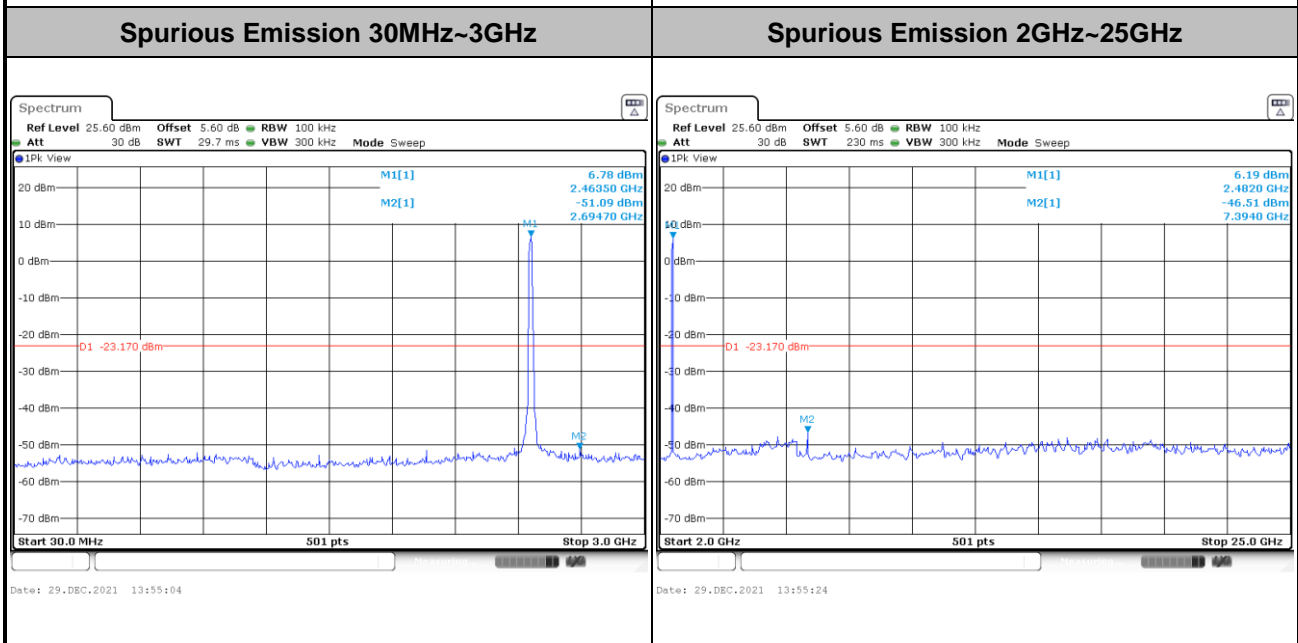
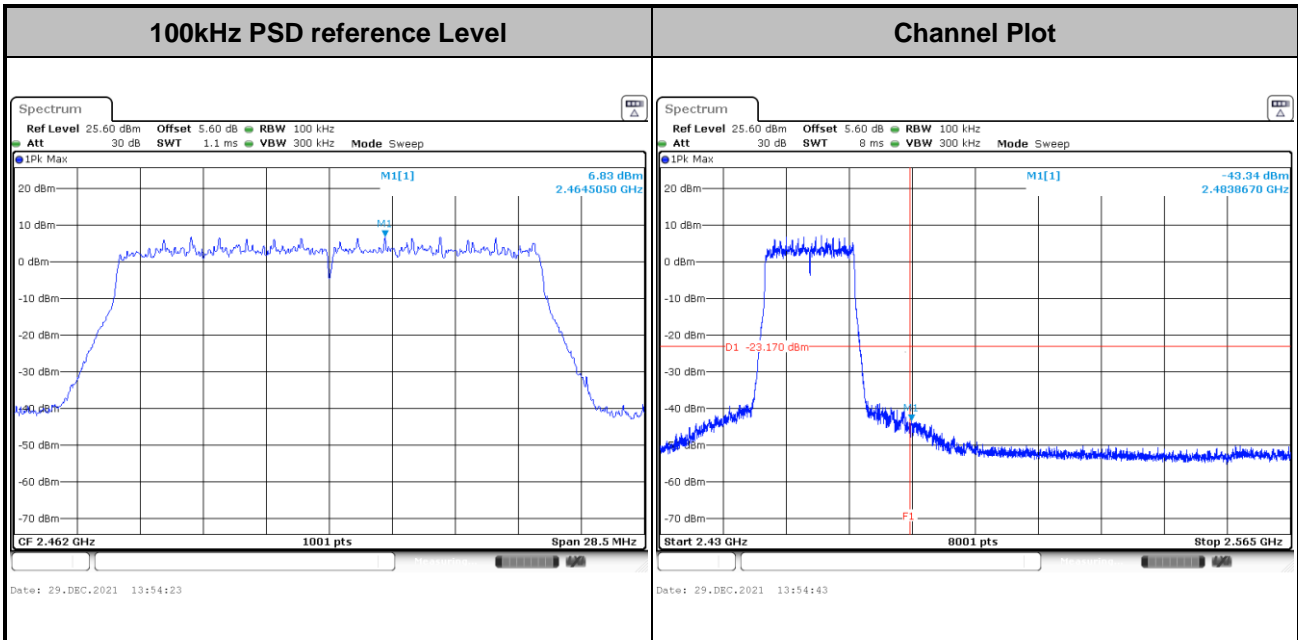


Test Mode :	802.11ax HE20	Test Channel :	10
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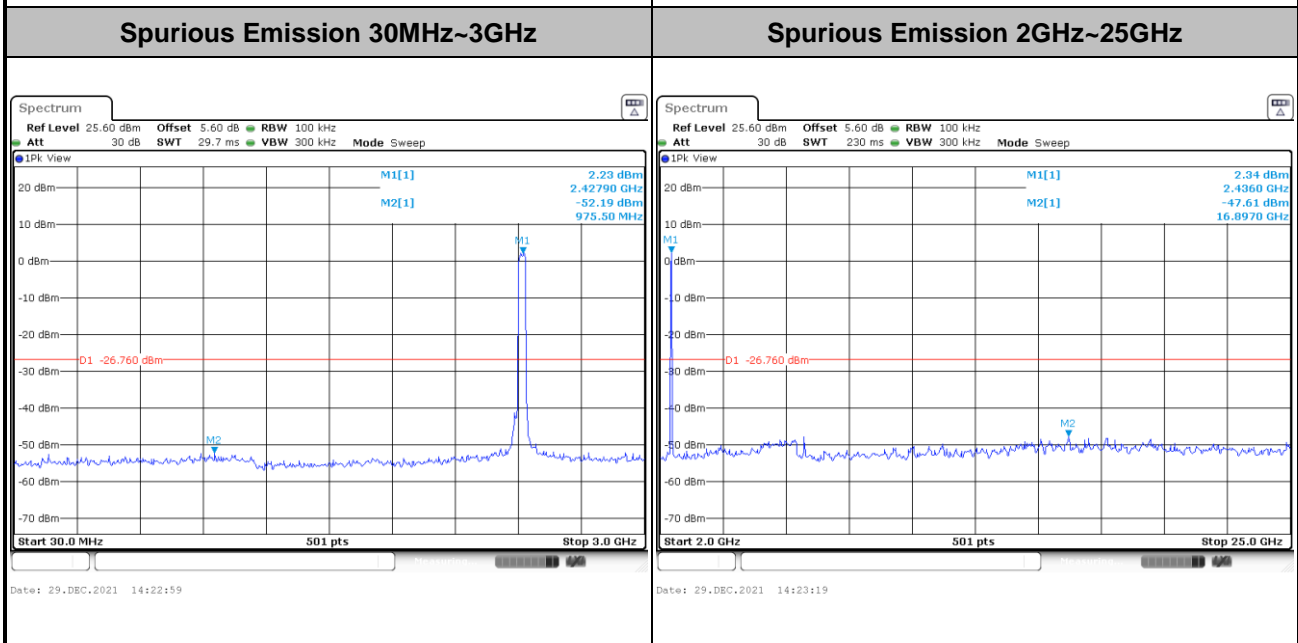
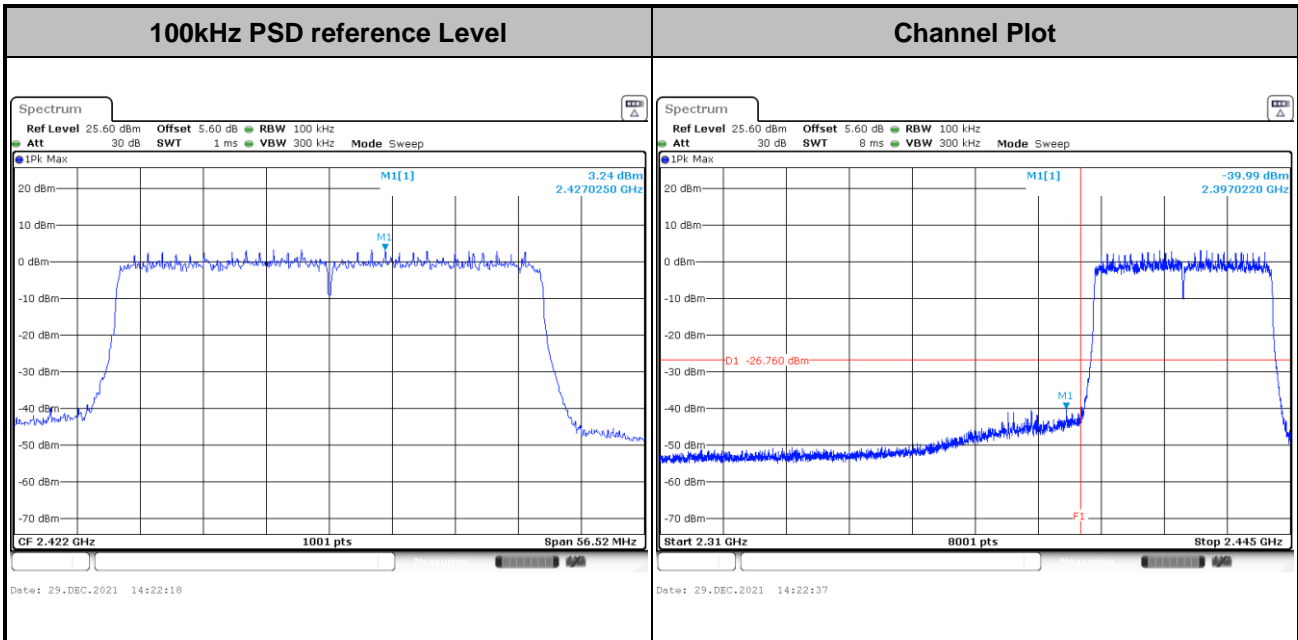


Test Mode :	802.11ax HE20	Test Channel :	11
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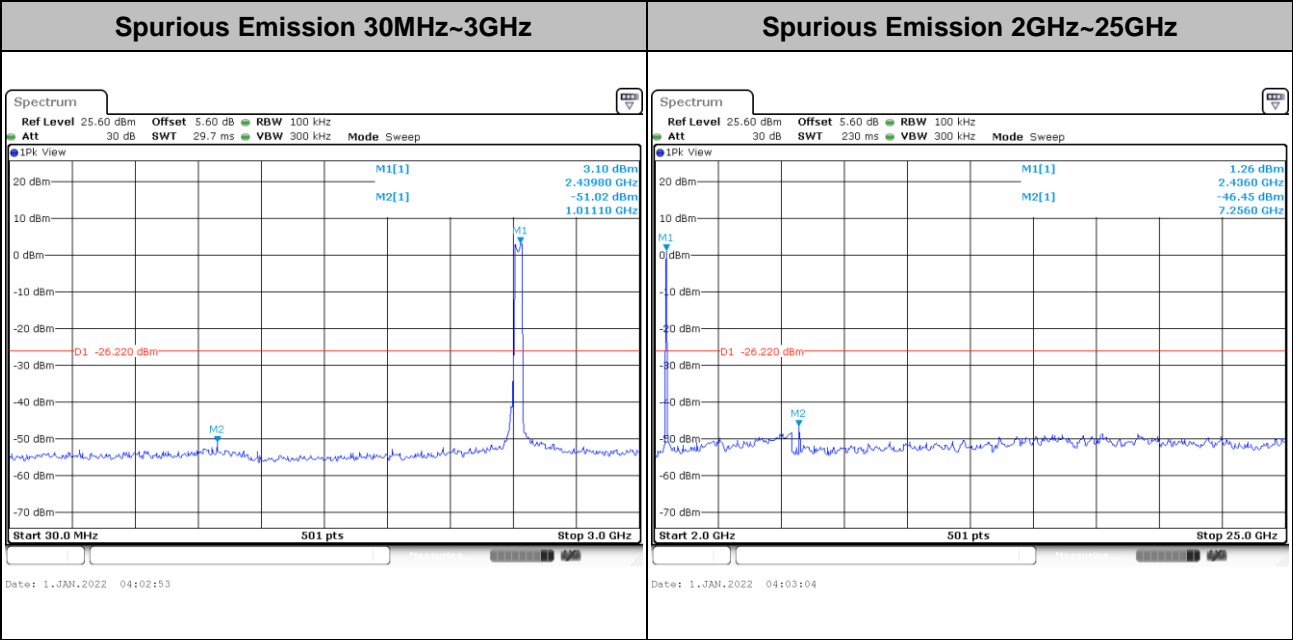
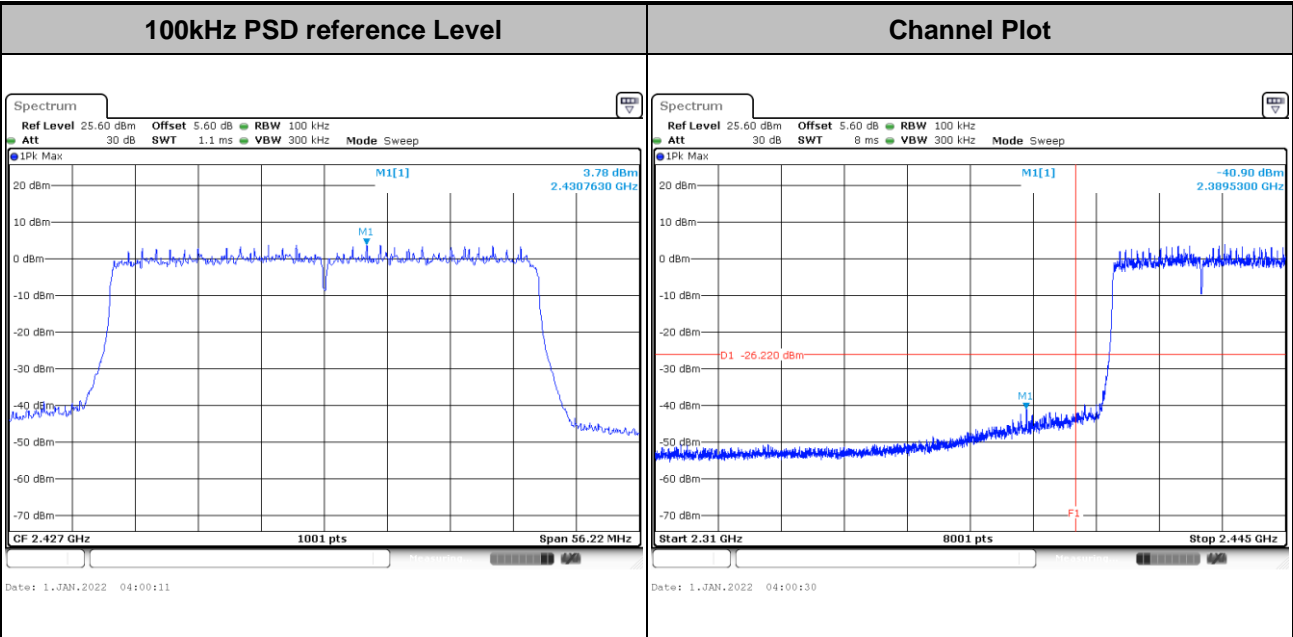


Test Mode :	802.11ax HE40	Test Channel :	03
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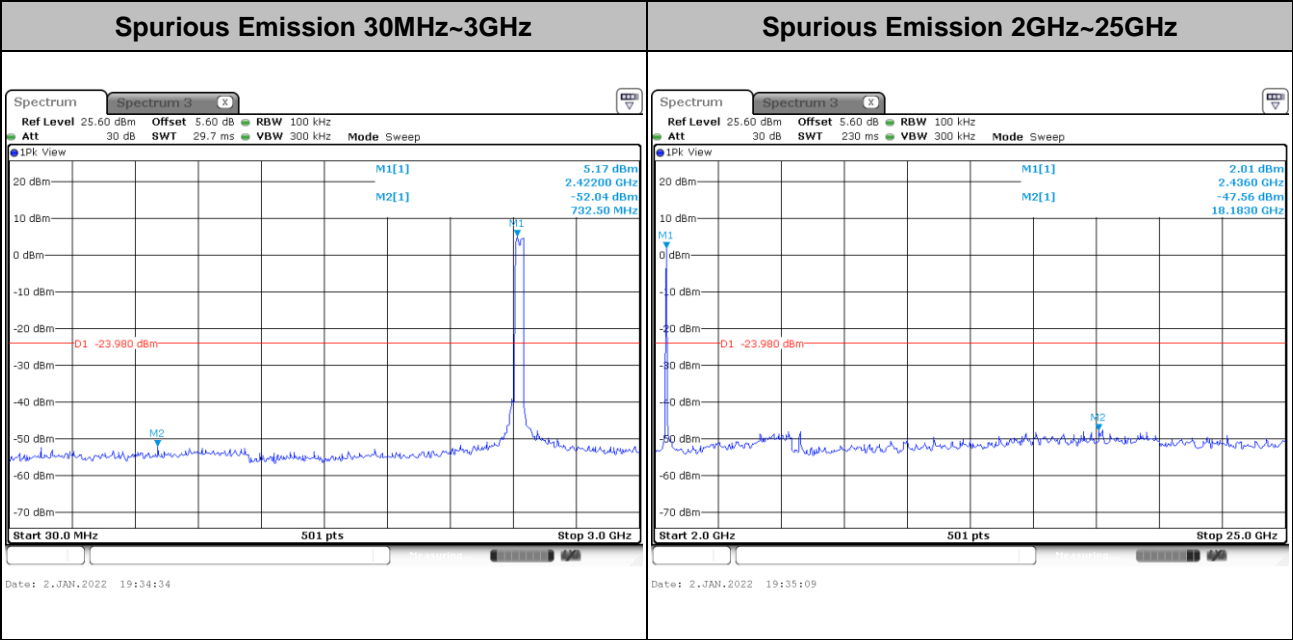
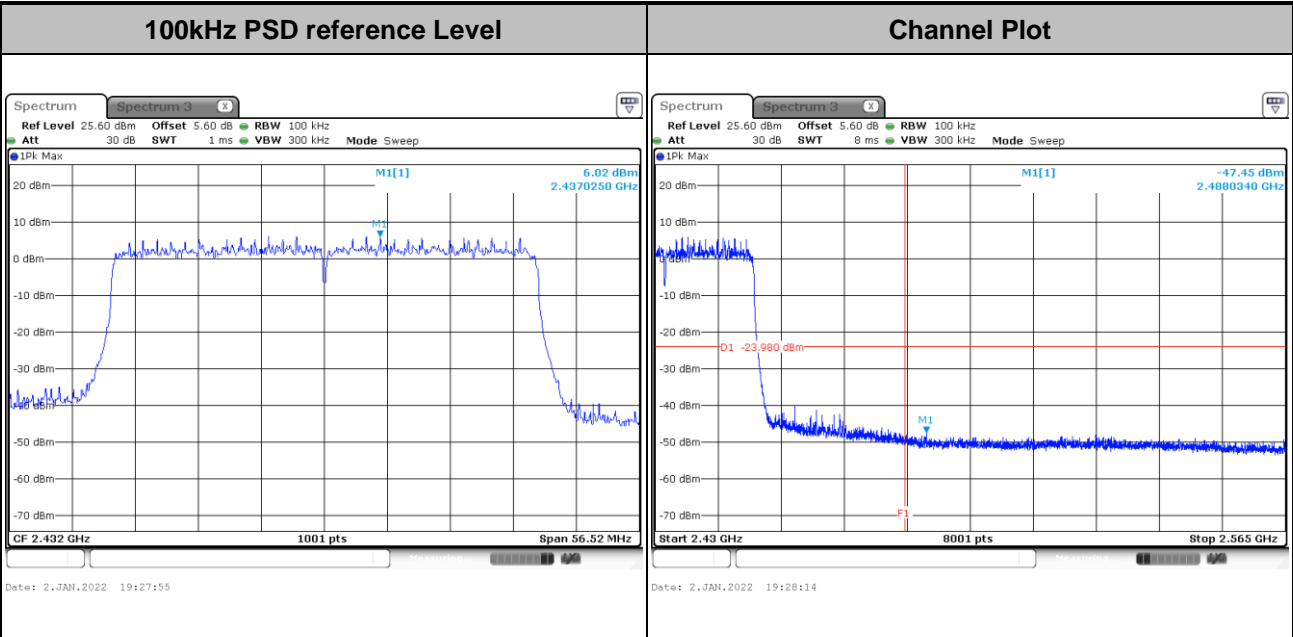


Test Mode :	802.11ax HE40	Test Channel :	04
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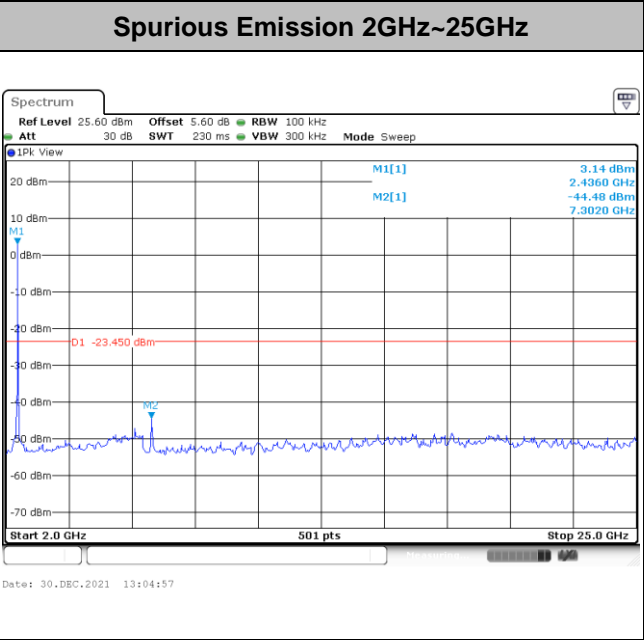
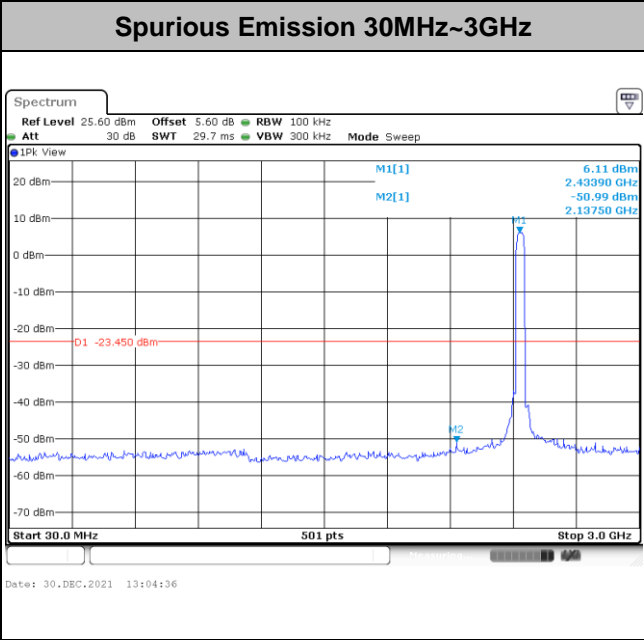
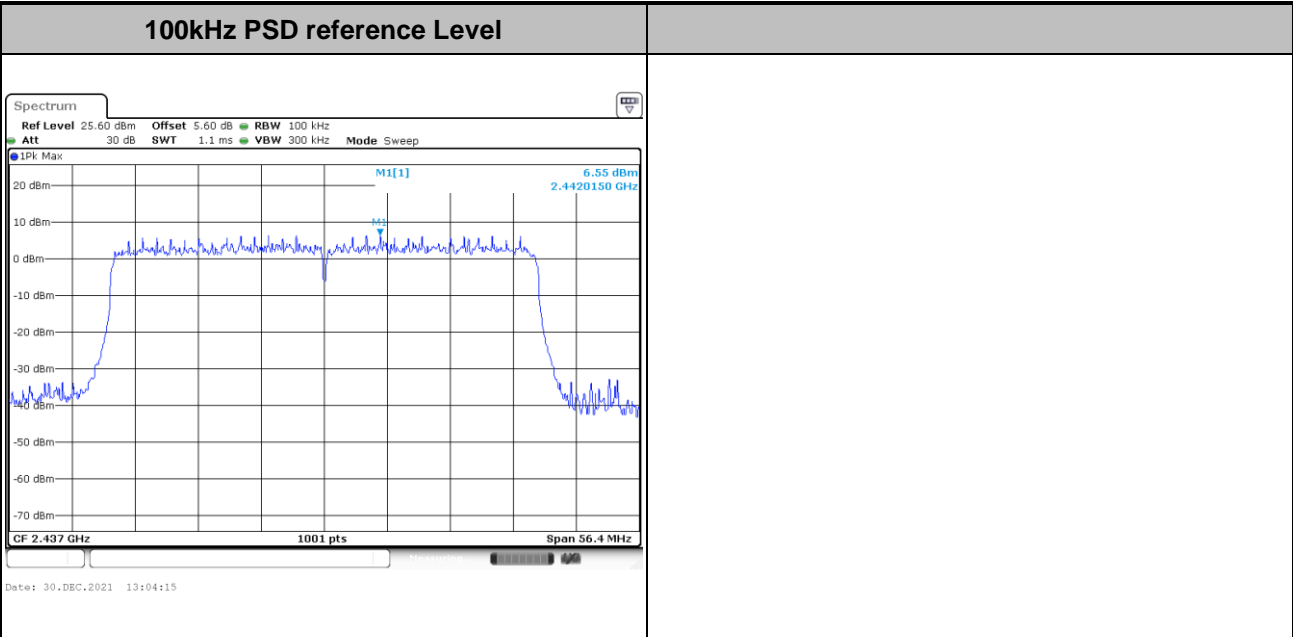


Test Mode :	802.11ax HE40	Test Channel :	05
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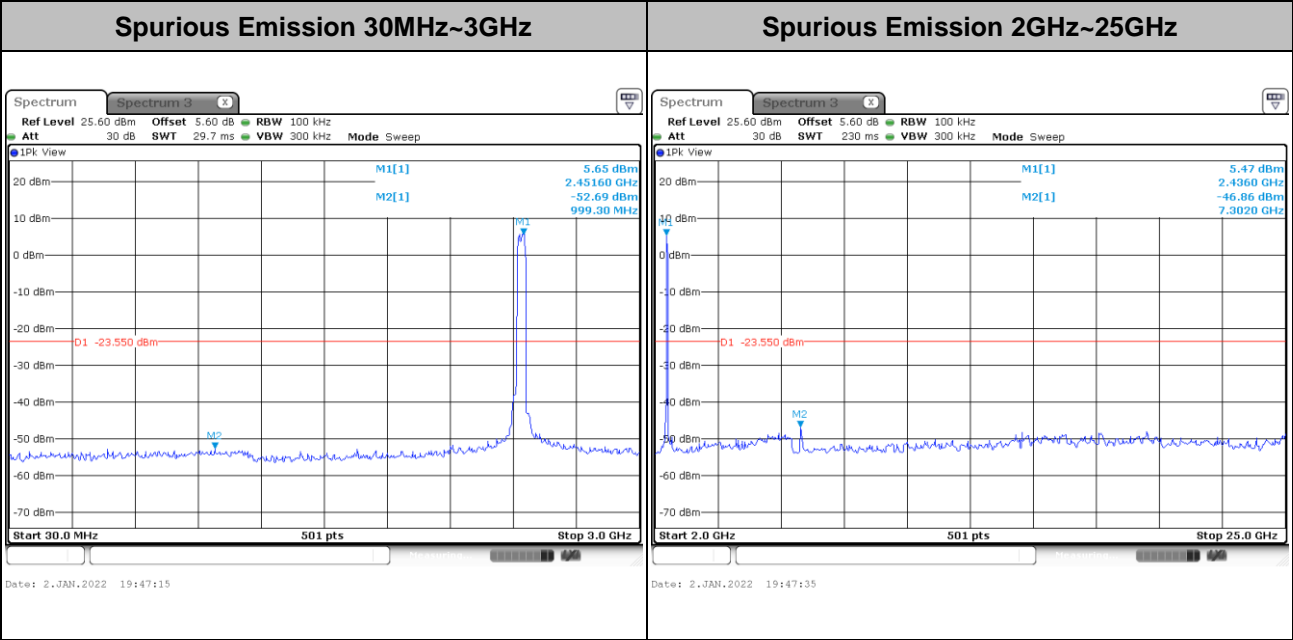
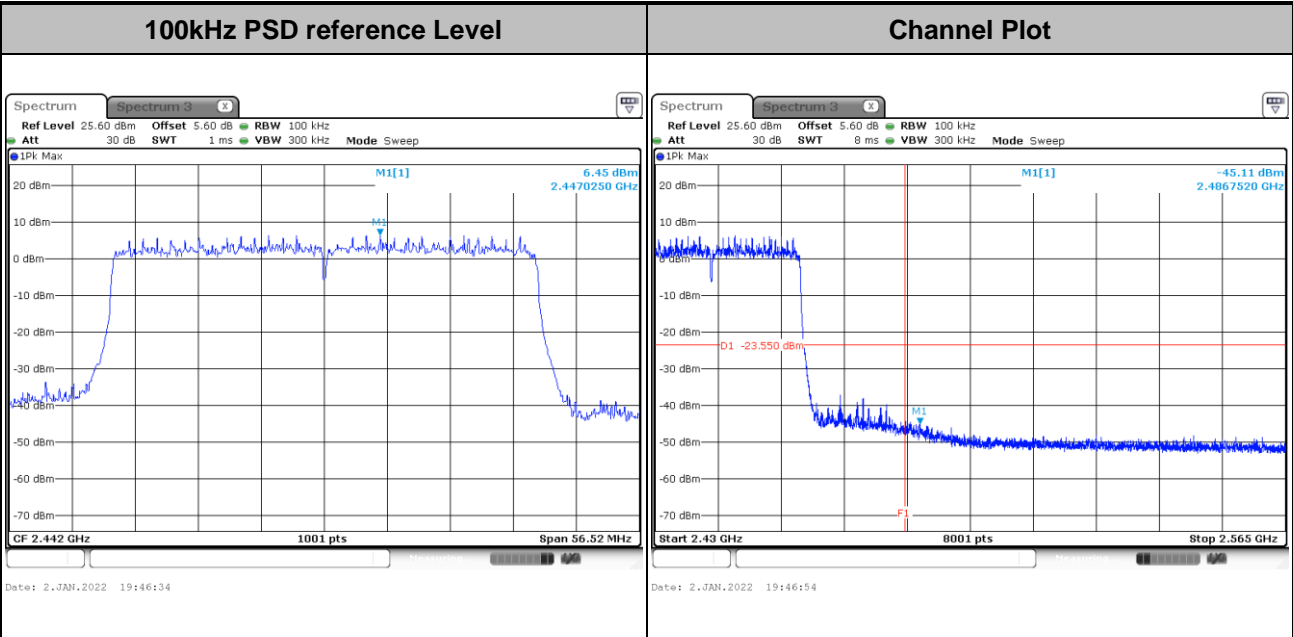


Test Mode :	802.11ax HE40	Test Channel :	06
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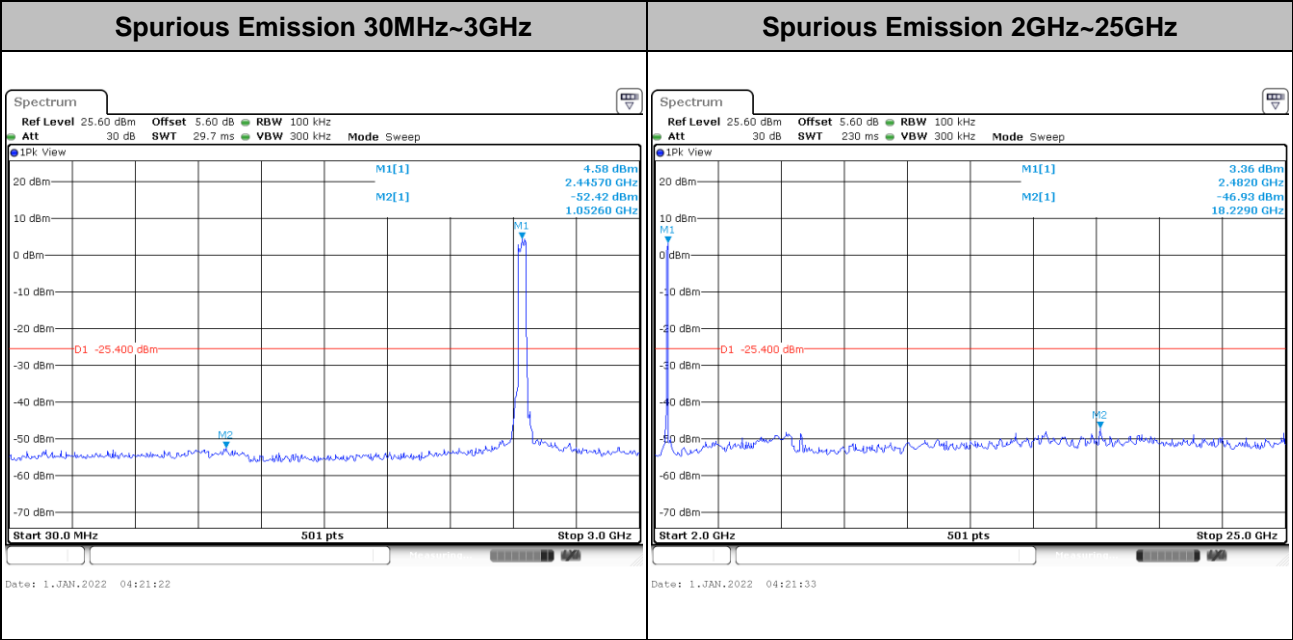
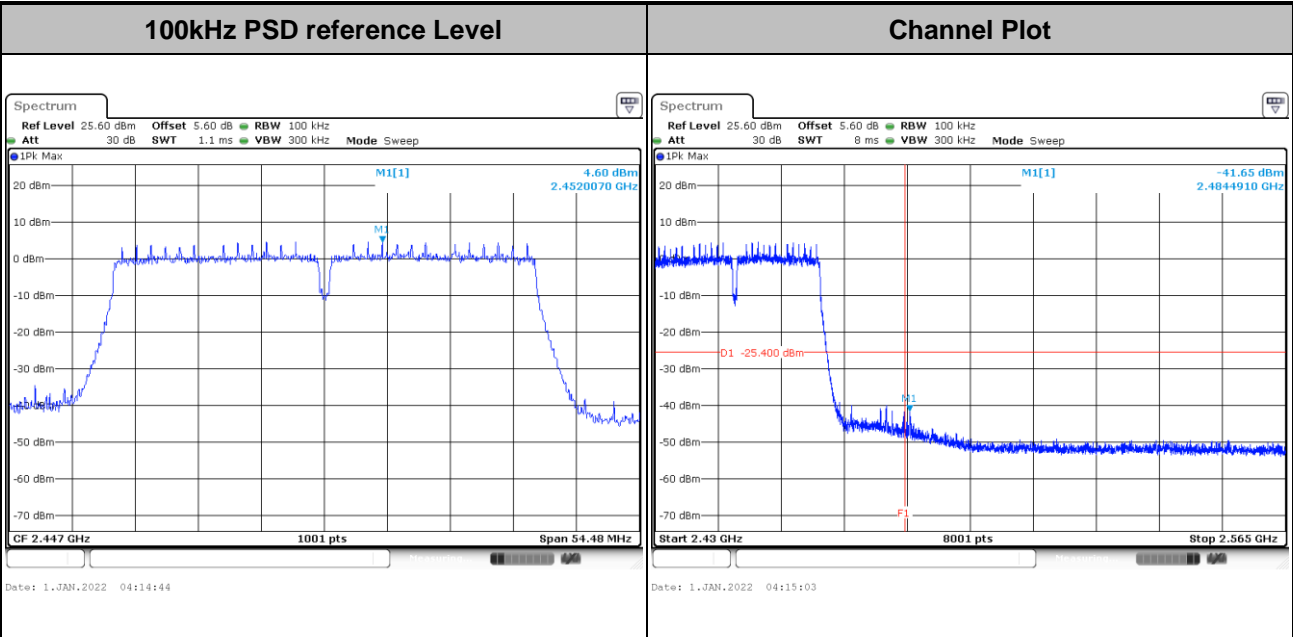


Test Mode : 802.11ax HE40	Test Channel : 07
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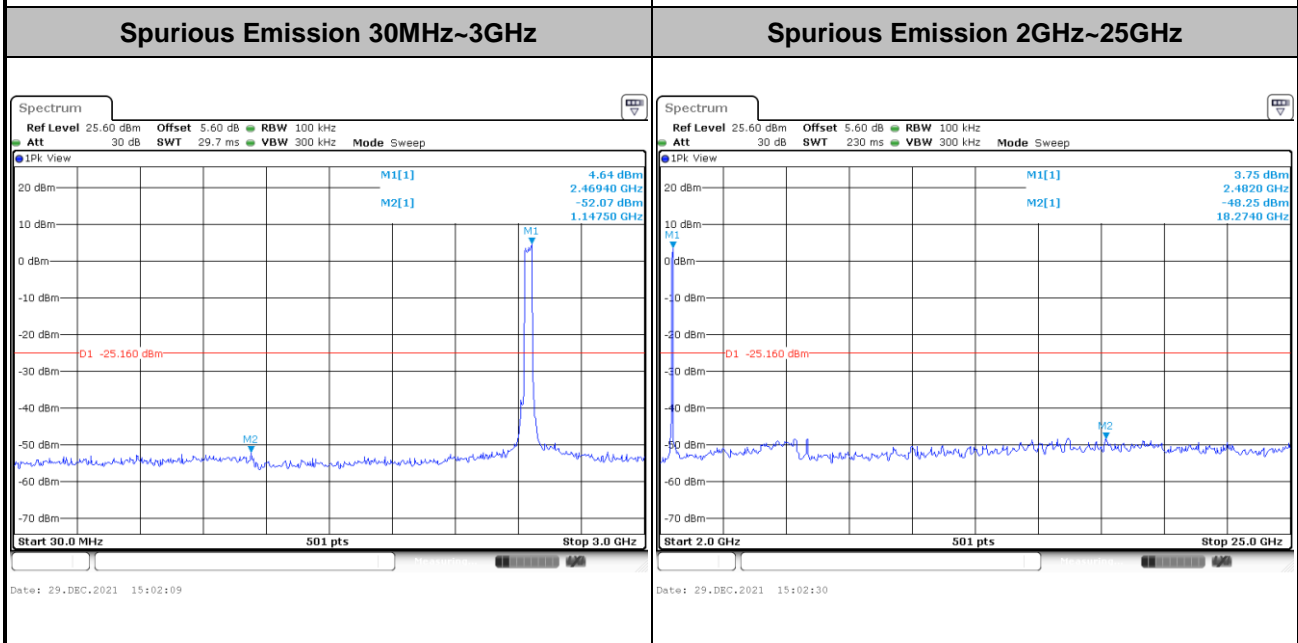
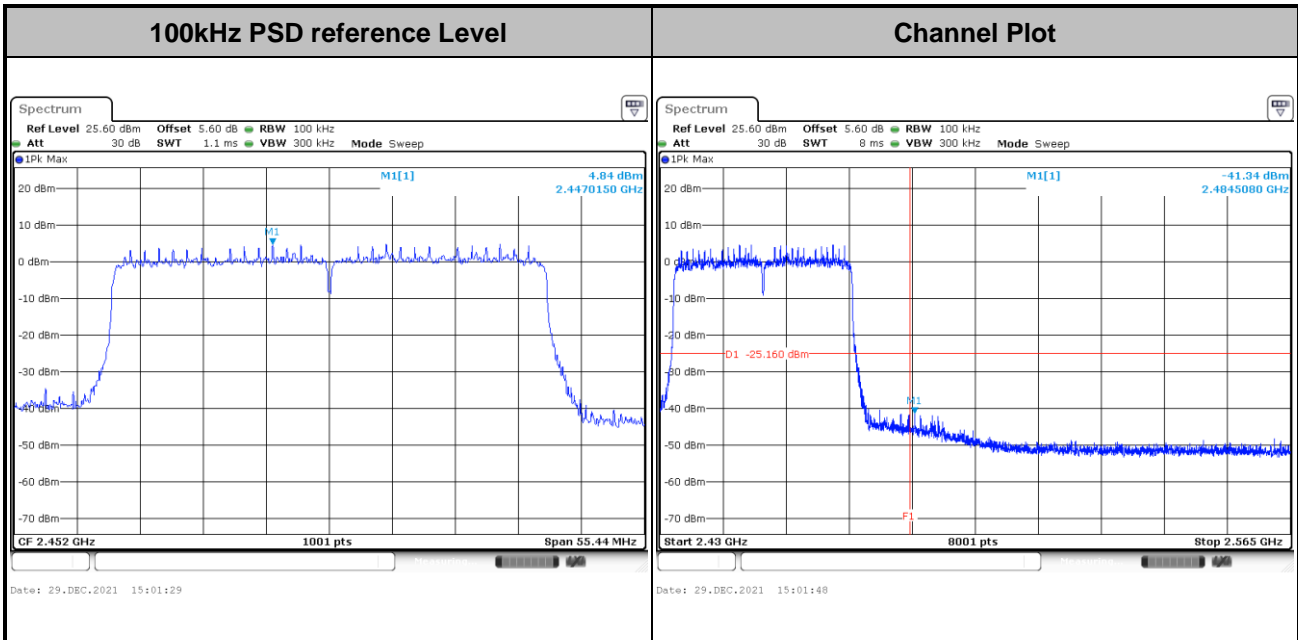


Test Mode :	802.11ax HE40	Test Channel :	08
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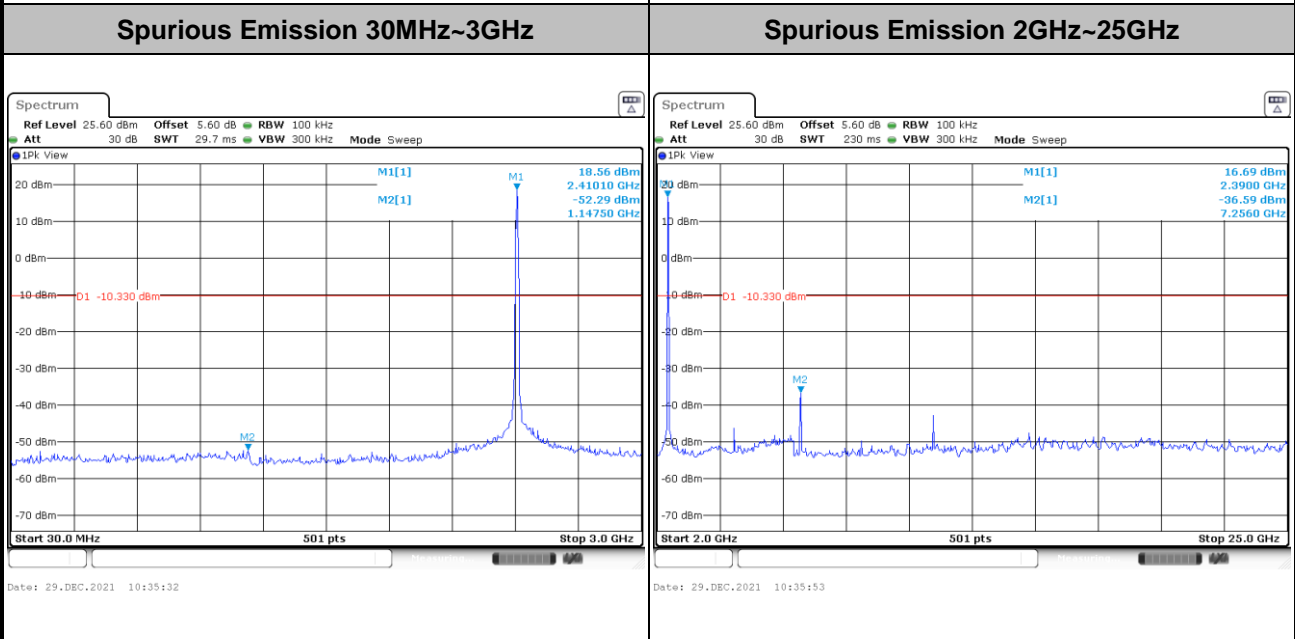
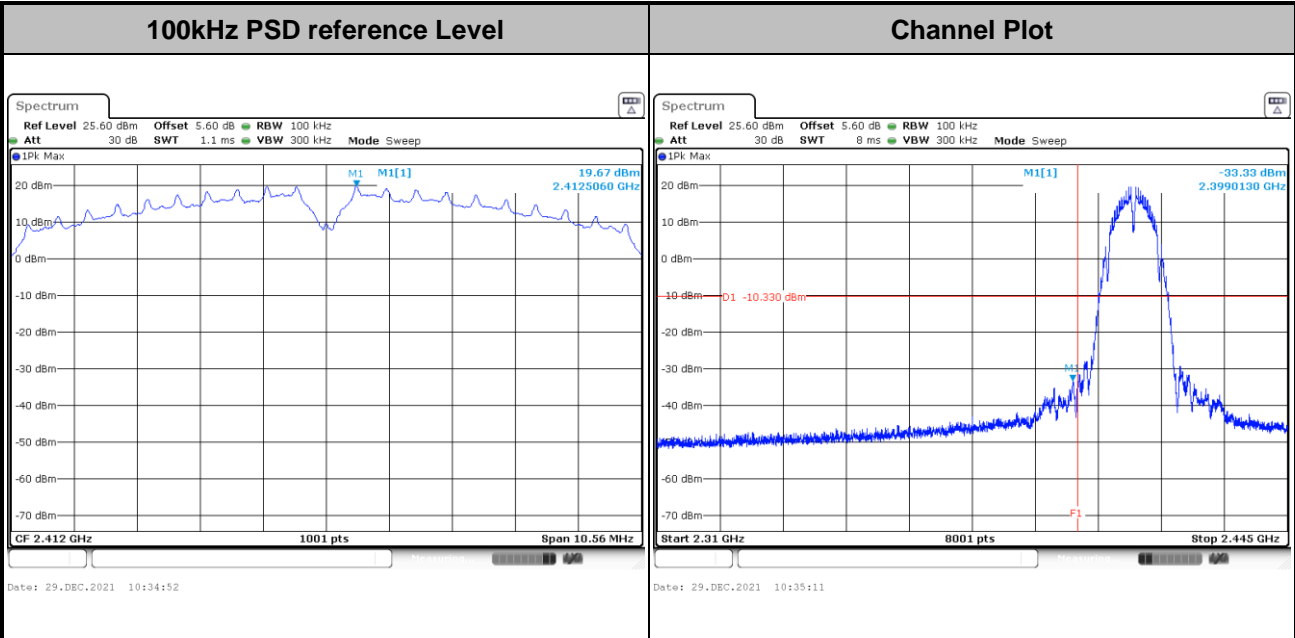
Test Mode :	802.11ax HE40	Test Channel :	09
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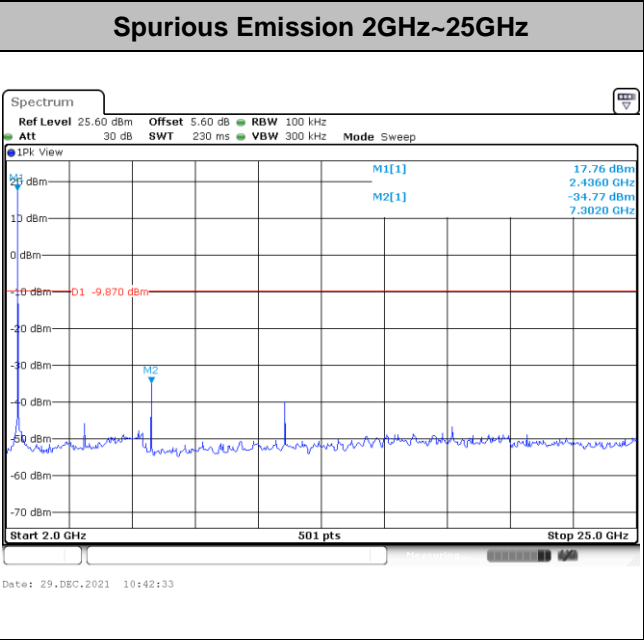
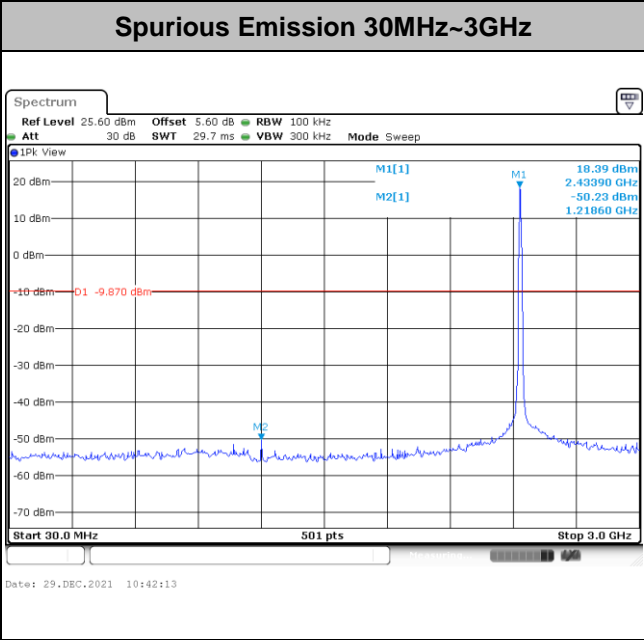
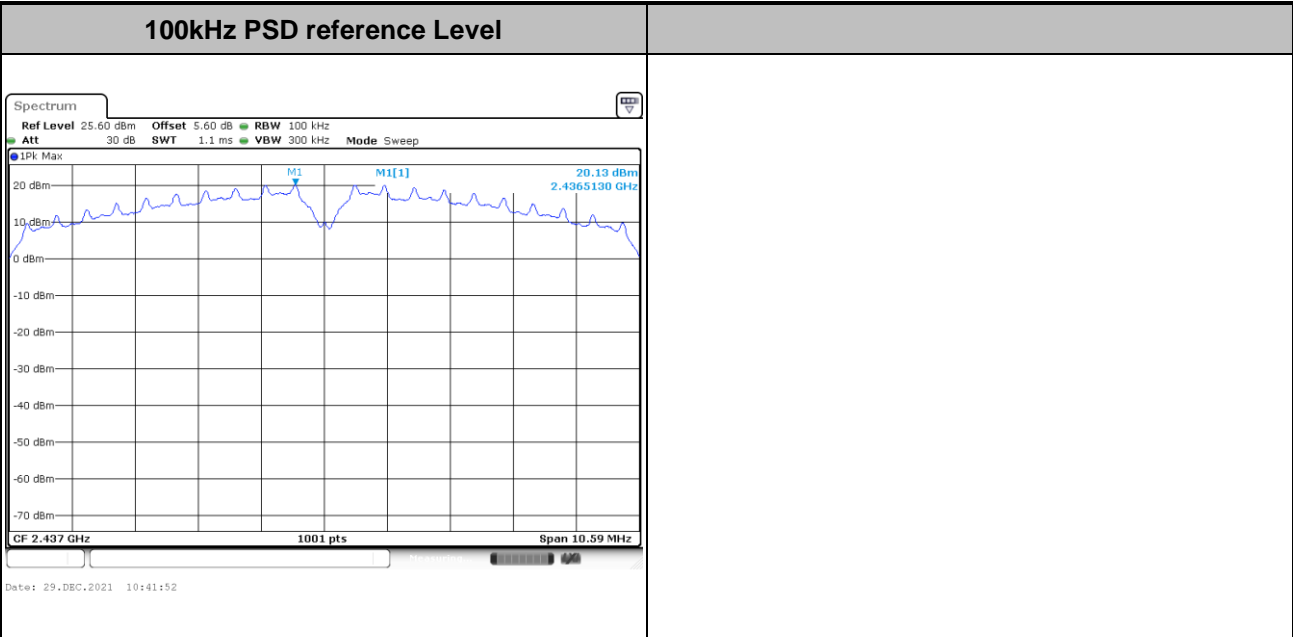
Number of TX = 2, Ant. 2 (Measured)

Test Mode :	802.11b	Test Channel :	01
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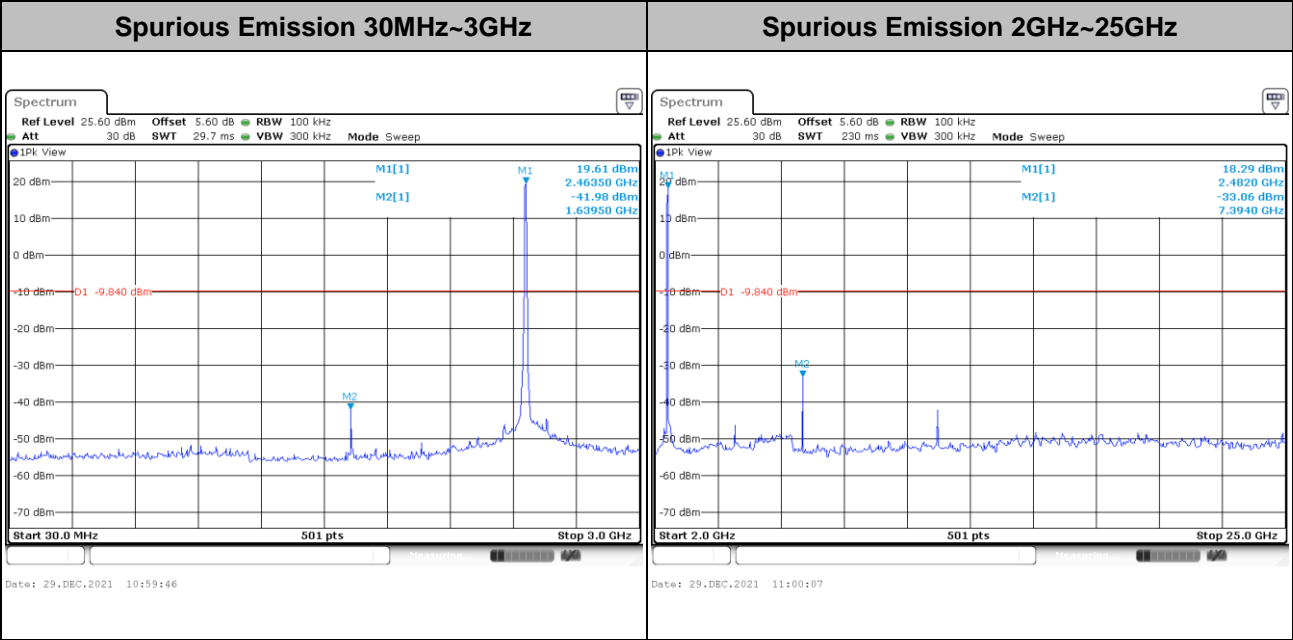
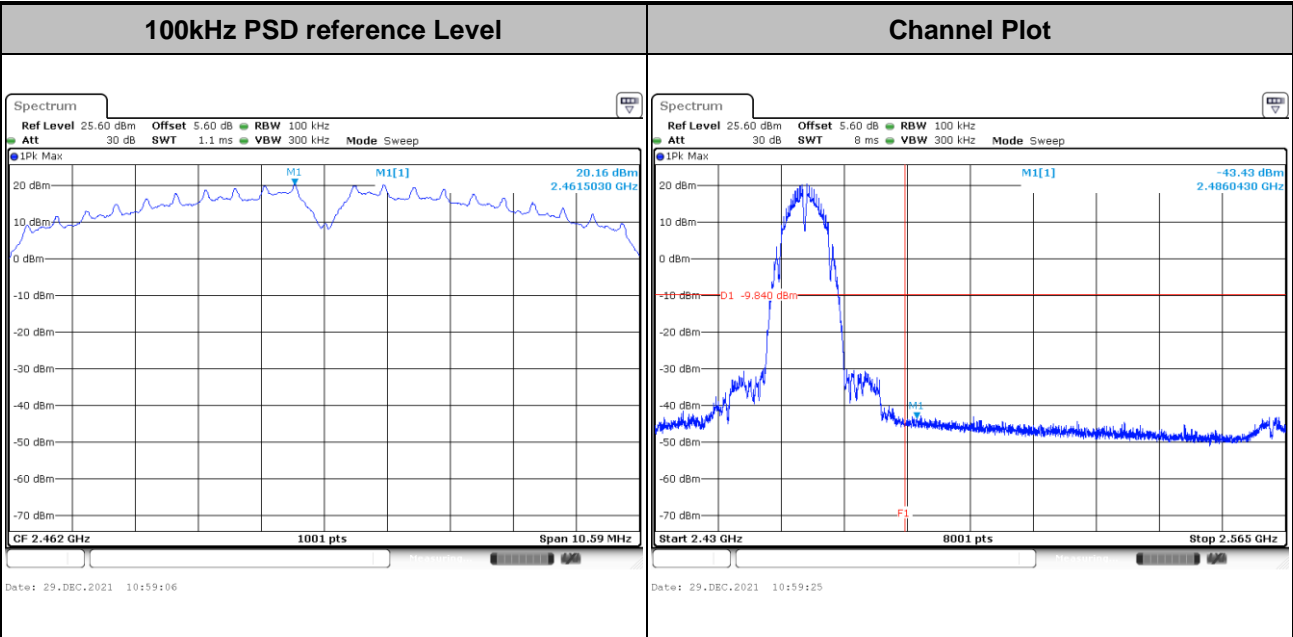


Test Mode :	802.11b	Test Channel :	06
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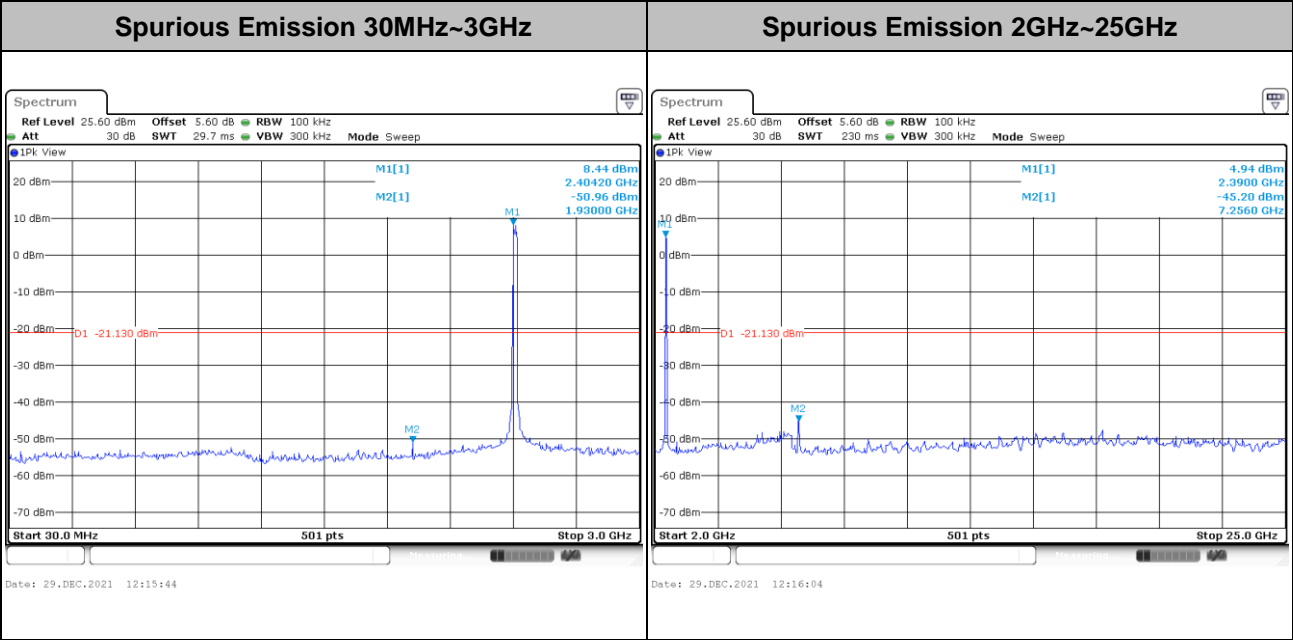
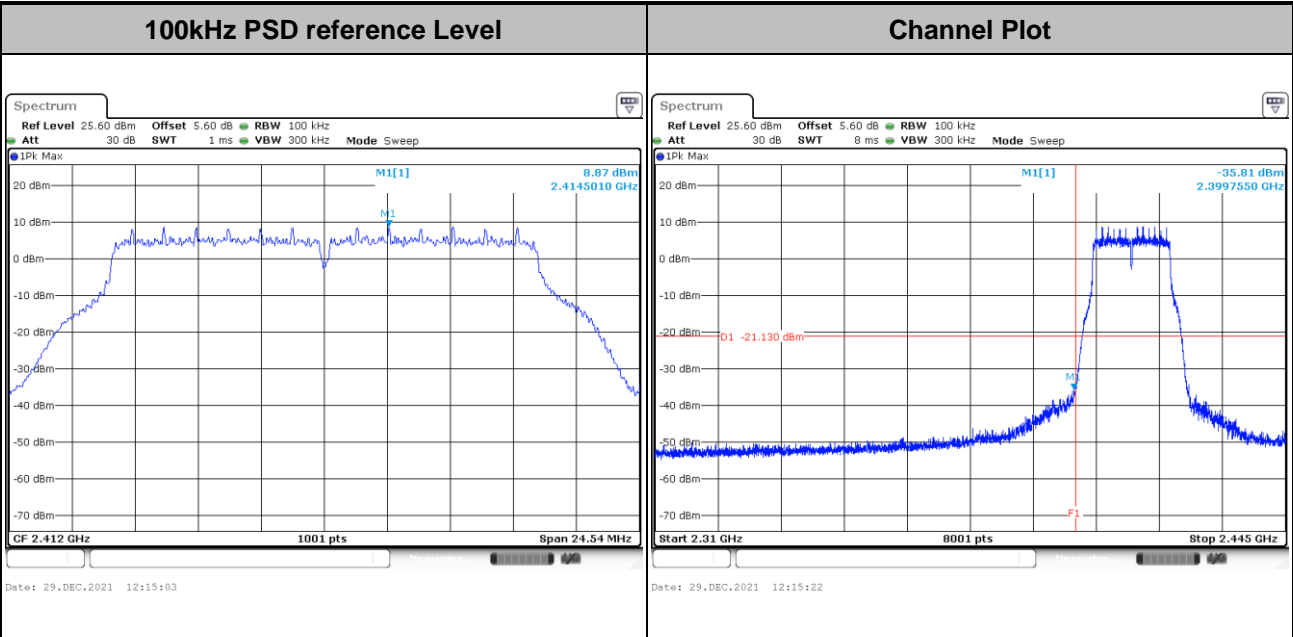


Test Mode :	802.11b	Test Channel :	11
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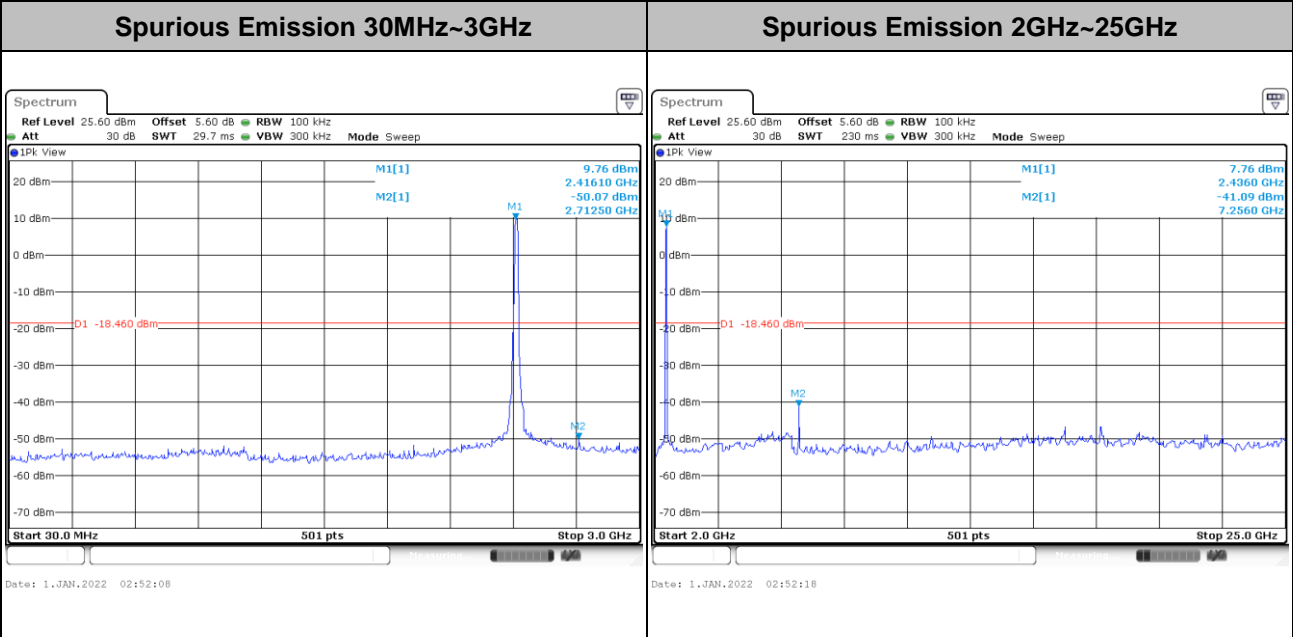
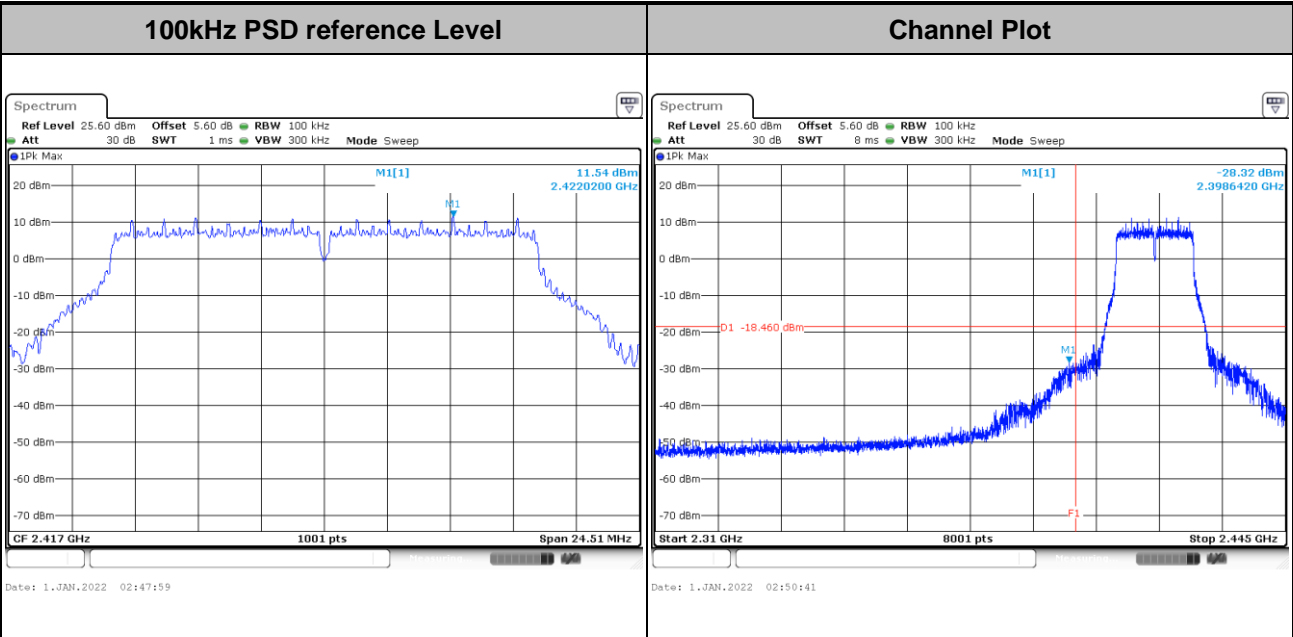


Test Mode : 802.11g Test Channel : 01



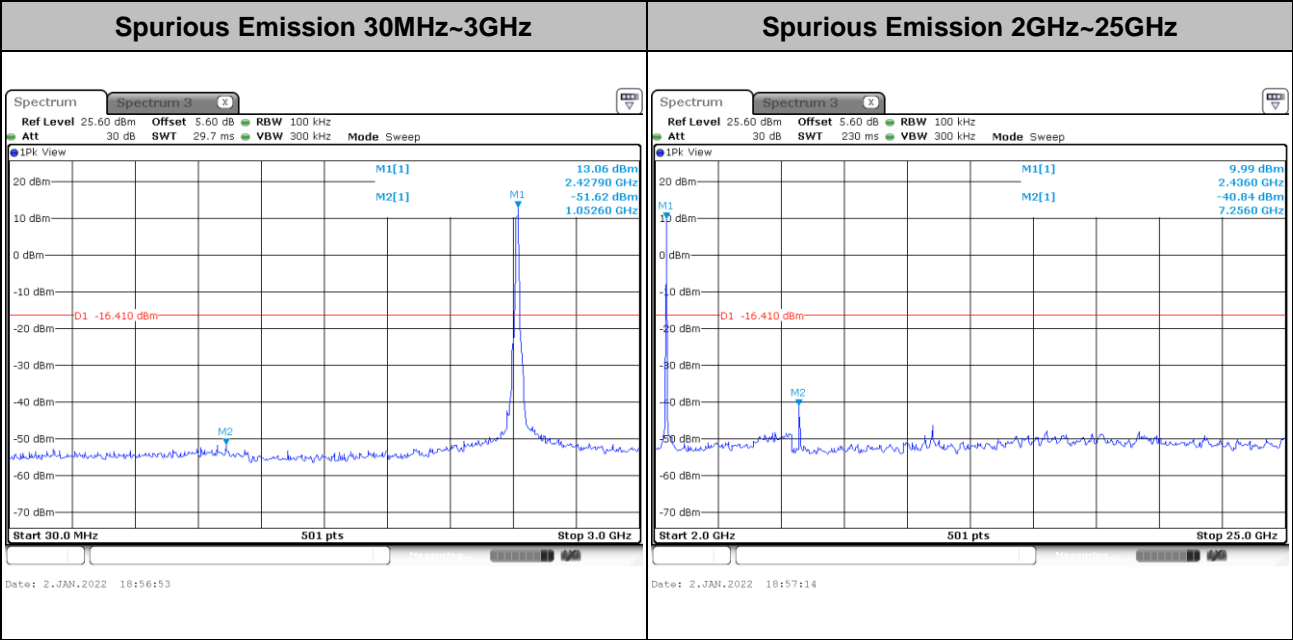
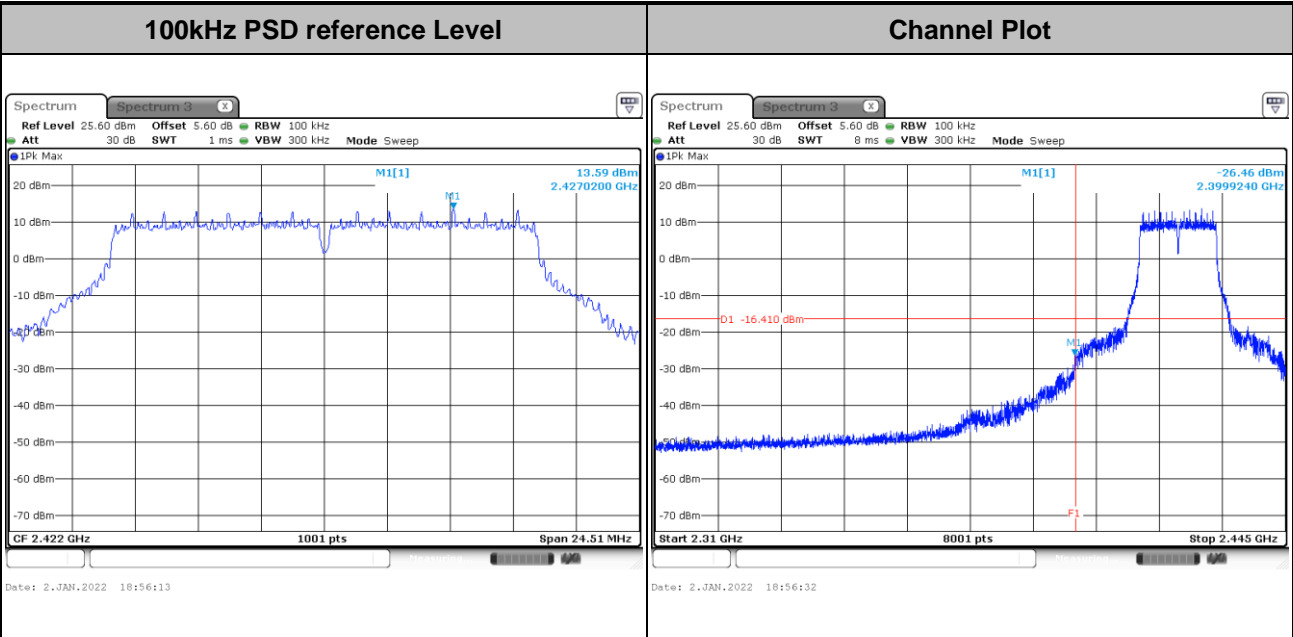


Test Mode : 802.11g Test Channel : 02



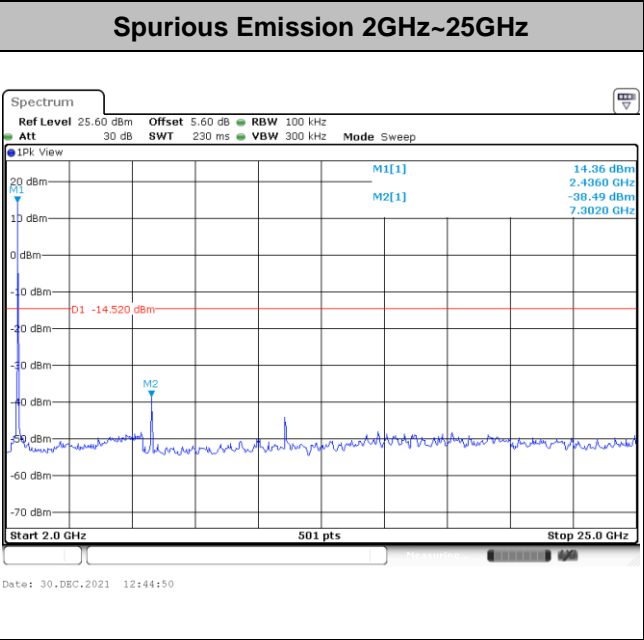
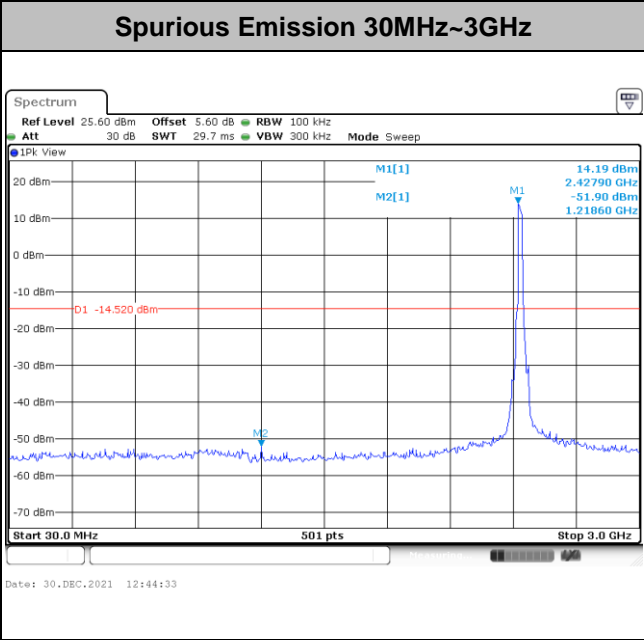
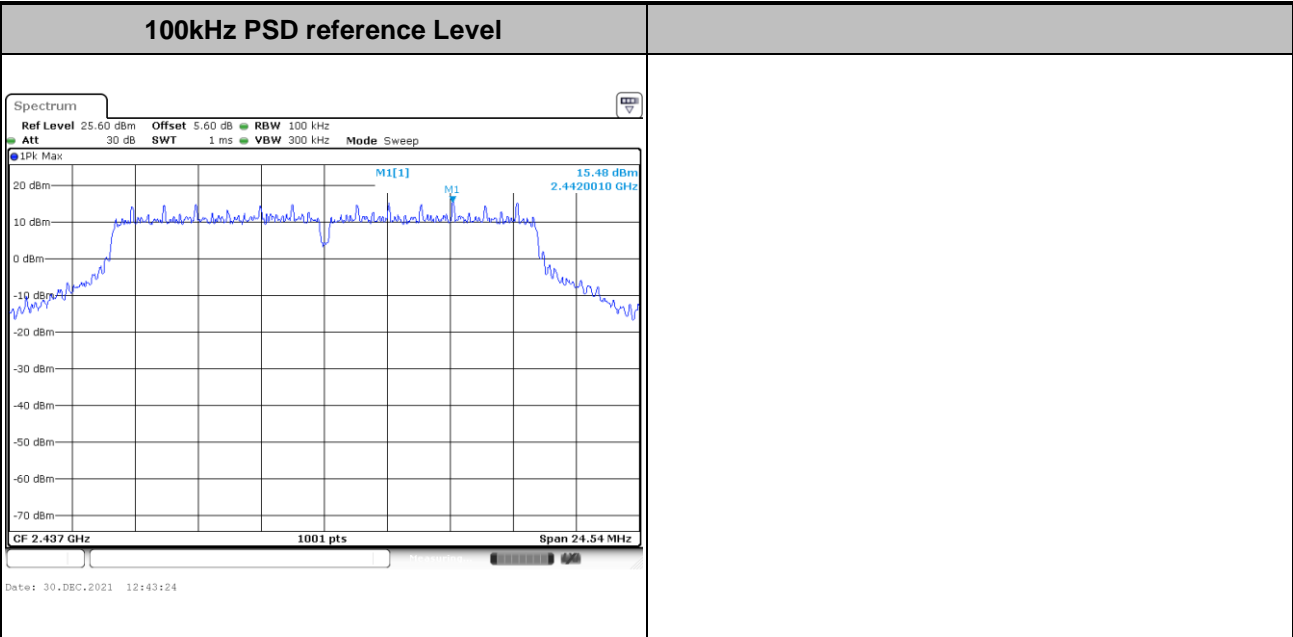


Test Mode : 802.11g Test Channel : 03





Test Mode :	802.11g	Test Channel :	06
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Test Mode : 802.11g	Test Channel : 09
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