

Report No.: FR111826B

# FCC RADIO TEST REPORT

FCC ID : TVE-3417T0695A

Equipment : Network Security Gateway

Brand Name : FORTINET F RTINET

Model Name : FWF-80F-2Rxxxxxx, FortiWiFi 80F-2Rxxxxxx,

FORTIWIFI-80F-2Rxxxxxx

FWF-81F-2Rxxxxxx, FortiWiFi 81F-2Rxxxxxx,

**FORTIWIFI-81F-2Rxxxxxx** 

FWF-80F-2R-3G4G-DSLxxxxxx, FortiWiFi

80F-2R-3G4G-DSLxxxxxx,

FORTIWIFI-80F-2R-3G4G-DSLxxxxxx FWF-81F-2R-3G4G-DSLxxxxxx, FortiWiFi

81F-2R-3G4G-DSLxxxxxx,

FORTIWIFI-81F-2R-3G4G-DSLxxxxxx

(where "x" can be used as "A-Z", or "0-9", or

"-", or blank for software changes or

marketing purposes only)

Marketing Name: FortiWiFi 80F-2R, FortiWiFi 81F-2R, FortiWiFi

80F-2R-3G4G-DSL, FortiWiFi

81F-2R-3G4G-DSL

Applicant : Fortinet Inc.

899 KIFER RD

**SUNNYVALE CA 94086** 

**UNITED STATES** 

Manufacturer : Fortinet Inc.

899 KIFER RD

**SUNNYVALE CA 94086** 

**UNITED STATES** 

Standard : FCC PART 15 Subpart C §15.247

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The product was received on Jan. 19, 2021 and testing was started from Jan. 28, 2021 and completed on Feb. 28, 2021. We, SPORTON INTERNATIONAL INC., EMC & Wireless Communications Laboratory, 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.

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The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

Louis Wu

Approved by: Louis Wu

SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory

No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)

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# History of this test report

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Report No.	Version	Description	Issued Date
FR111826B	01	Initial issue of report	Feb. 28, 2021

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## **Summary of Test Result**

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Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark	
3.1	15.247(a)(2)	6dB Bandwidth	Pass	-	
3.1	2.1049	99% Occupied Bandwidth	Reporting only	-	
3.2	15.247(b)	Power Output Measurement	Pass	-	
3.3	15.247(e)	Power Spectral Density	Pass	-	
0.4	45.047(1)	0.4	Conducted Band Edges	Pass	-
3.4	15.247(d)	Conducted Spurious Emission	Pass	-	
3.5 15.247(d)		Radiated Band Edges and Radiated Spurious Emission	Pass	Under limit 0.24 dB at 2487.080 MHz	
3.6 15.207 AC Conducted Emission		AC Conducted Emission	Pass	Under limit 11.14 dB at 0.416 MHz	
3.7	15.203 & 15.247(b)	Antenna Requirement	Pass	-	

### Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

### **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.

Reviewed by: Wii Chang Report Producer: Yimin Ho

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## 1 General Description

## 1.1 Product Feature of Equipment Under Test

WCDMA/LTE, Bluetooth - LE, Wi-Fi 2.4GHz 802.11b/g/n/ac/ax and Wi-Fi 5GHz 802.11a/n/ac/ax and GNSS.

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Product Specification subjective to this standard			
	WWAN: Dipole Antenna WLAN:		
_	<ant. 1=""> Dipole Antenna <ant. 2=""> Dipole Antenna</ant.></ant.>		
Antenna Type	<ant. 3=""> Dipole Antenna</ant.>		
	Bluetooth - LE:		
	<ant. 4=""> PIFA Antenna</ant.>		
	GPS/Glonass/BDS/Galileo: Dipole Antenna		

Antenna information			
2400 MHz ~ 2483.5 MHz	Peak Gain (dBi)	Ant. 1: 3.24 Ant. 2: 3.24 Ant. 3: 3.24	

**Remark:** The above EUT's information was declared by manufacturer. Please refer to Comments and Explanations in report summary.

## 1.2 Modification of EUT

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

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## 1.3 Testing Location

Test Site SPORTON INTERNATIONAL INC. EMC & Wireless Communication Laboratory	
Test Site Location	No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-3456 FAX: +886-3-328-4978
Test Site No.	Sporton Site No. TH05-HY, CO05-HY

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Note: The test site complies with ANSI C63.4 2014 requirement.

Test Site	SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory	
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855	
Test Site No.	Sporton Site No. 03CH16-HY	

Note: The test site complies with ANSI C63.4 2014 requirement.

FCC designation No.: TW1190 and TW0007

## 1.4 Applicable Standards

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

- FCC Part 15 Subpart C §15.247
- FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02
- FCC KDB 414788 D01 Radiated Test Site v01r01.
- 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. The TAF code is not including all the FCC KDB listed without accreditation.

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## 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). For radiated measurement, pre-scanned in two degrees (Ant. Horizontal and Ant. Vertical). The worst cases (Ant. Vertical) were recorded in this report.

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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)
	1	2412	7	2442
	2	2417	8	2447
2400 2492 E MH=	3	2422	9	2452
2400-2483.5 MHz	4	2427	10	2457
	5	2432	11	2462
	6	2437		

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## 2.2 Test Mode

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

### **Single Mode**

Modulation	Data Rate
802.11b	1 Mbps
802.11g	6 Mbps
802.11n HT20	MCS0
802.11n HT40	MCS0

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#### **MIMO Mode**

Modulation	Data Rate
802.11b	1 Mbps
802.11g	6 Mbps
802.11n HT20 (Covered by HE20)	MCS0
802.11n HT40 (Covered by HE40)	MCS0
802.11ac VHT20 (Covered by HE20)	MCS0
802.11ac VHT40 (Covered by HE40)	MCS0
802.11ax HE20	MCS0
802.11ax HE40	MCS0

**Remark:** The device have support beamforming function in 802.11 ac/ax mode, the manufacturer defines worst case were Non Beamforming, other test items only test worst case and documented.

Test Cases				
AC Conducted	Mode 1 :LTE Band 41 Link + WLAN (2.4GHz) Link + Bluetooth Link + Adapter*2			
Emission	Mode 2 LTE Band 41 Idle + WLAN (2.4GHz) Idle + Bluetooth Idle + Adapter*2			
Remark: The worst case of conducted emission is mode 2; only the test data of it was reported.				

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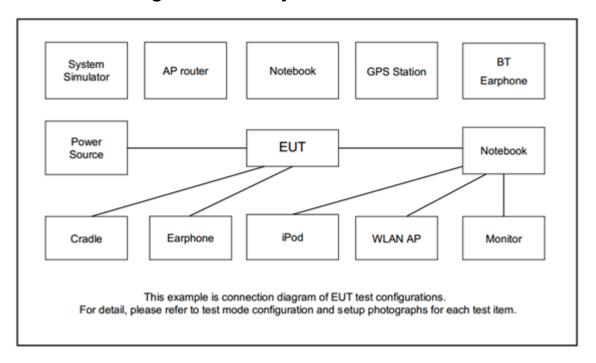
Ch. #	2400-2483.5 MHz			
CII. #	802.11b	802.11g	802.11n HT20	802.11n HT40
Low	01	01	01	03
Middle	06	06	06	06
High	11	11	11	09

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Ch #	2400-2483.5 MHz			
Ch. #	802.11ax HE20	802.11ax HE40		
Low	01	03		
Middle	06	06		
High	11	09		

**Remark:** For radiation spurious emission, the final modulation and the worst data rate was reference the max RF conducted power.

## 2.3 Connection Diagram of Test System



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## 2.4 Support Unit used in test configuration and system

Item	Equipment	<b>Brand Name</b>	Model Name	FCC ID	Data Cable	Power Cord
1.	System Simulator	Anritsu	MT8820C	N/A	N/A	Unshielded, 1.8 m
2.	Phone	SAMSUNG	SM-A730F/DS	A3LSMA730F	N/A	N/A
3.	Notebook	DELL	Latitude 3400	FCC DoC	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m

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## 2.5 EUT Operation Test Setup

The RF test items, utility "QSPR Version5.0-00196" was installed in Notebook which was programmed in order to make the EUT get into the engineering modes to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.

## 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 and attenuator factor 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 and attenuator factor.

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 4.2 dB and 10 dB attenuator.

 $Offset(dB) = RF \ cable \ loss(dB) + attenuator \ factor(dB).$ 

= 4.2 + 10 = 14.2 (dB)

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### 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

See list of measuring equipment of this test report.

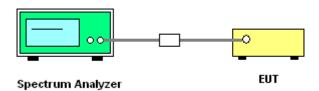
### 3.1.3 Test Procedures

- 1. The testing follows the ANSI C63.10 Section 6.9.3 (OBW) and 11.8.1 (6dB BW).
- 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.

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- 3. Set the maximum power setting and enable the EUT to 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.
- For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set
   1-5% of the emission bandwidth and set the Video bandwidth (VBW) ≥ 3 \* RBW.
- 6. Measure and record the results in the test report.

### 3.1.4 Test Setup

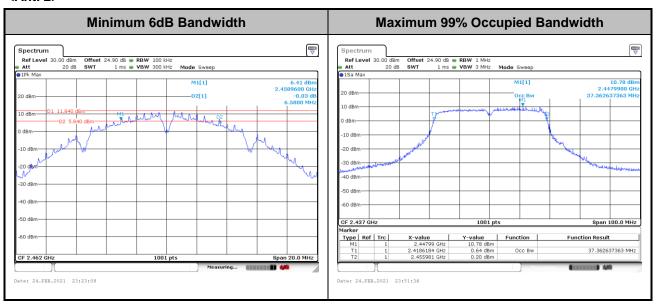


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## 3.1.5 Test Result of 6dB and 99% Occupied Bandwidth

Please refer to Appendix A.

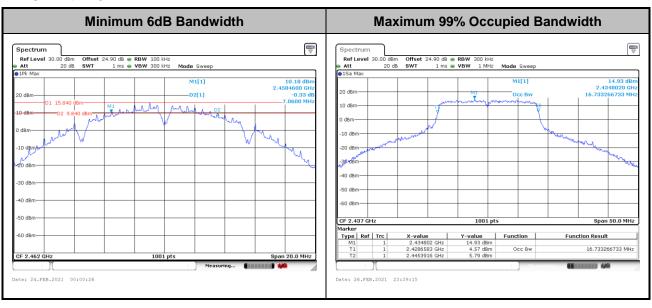
#### <Ant. 2>



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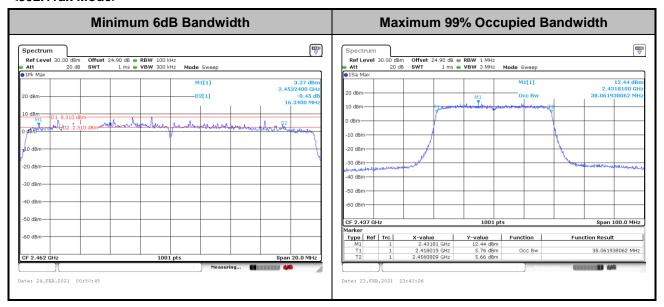
Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

#### MIMO < Ant. 1+3>



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#### <802.11ax Mode>



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

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## 3.2 Output Power Measurement

## 3.2.1 Limit of Output Power

For systems using digital modulation in the 2400-2483.5 MHz, the limit for output power is 30 dBm. If transmitting antenna with directional gain greater than 6 dBi 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 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

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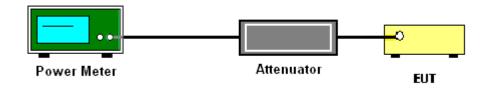
### 3.2.2 Measuring Instruments

See list of measuring equipment of this test report.

#### 3.2.3 Test Procedures

- 1. For Peak Power, the testing follows ANSI C63.10 Section 11.9.1.3 PKPM1
- 2. For Average Power, the testing follows ANSI C63.10 Section 11.9.2.3.2 Method AVGPM-G
- 3. 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.
- 4. Set the maximum power setting and enable the EUT to transmit continuously.
- 5. Measure the conducted output power and record the results in the test report.
- 6. 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 Peak Output Power (Reporting Only)

Please refer to Appendix A.

### 3.2.6 Test Result of Average Output Power

Please refer to Appendix A.

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## 3.3 Power Spectral Density Measurement

### 3.3.1 Limit of Power Spectral Density

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

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### 3.3.2 Measuring Instruments

See list of measuring equipment of this test report.

#### 3.3.3 Test Procedures

#### Method AVGPSD-3

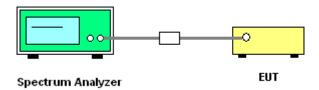
- 1. The testing follows the ANSI C63.10 Section 11.10.7 Method AVGPSD-3.
- 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 3. Set the maximum power setting and enable the EUT to transmit continuously.
- 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. Number of points in sweep ≥ 2 Span / RBW. (This ensures that bin-to-bin spacing is ≤ RBW/2, so that narrowband signals are not lost between frequency bins).
- 6. Detector = RMS, Sweep time = auto couple.
- 7. Trace mode = max hold.
- 8. Allow max hold to run for at least 60 seconds, or longer as needed to allow the trace to stabilize.
- 9. Measure and record the results in the test report.
- For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

Method (c): Measure and add 10 log(N<sub>ANT</sub>) dB.

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.

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## 3.3.4 Test Setup

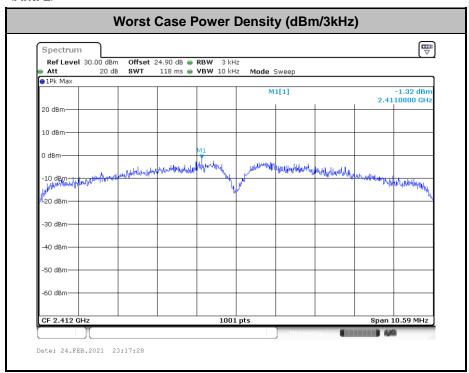


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## 3.3.5 Test Result of Power Spectral Density

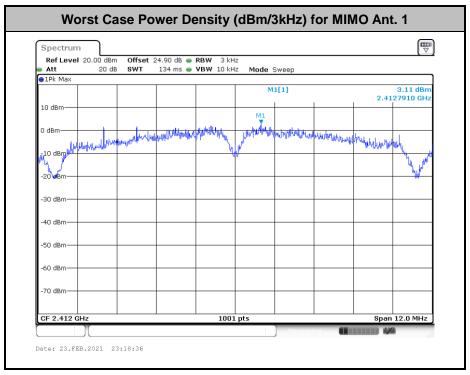
Please refer to Appendix A.

#### <Ant. 2>

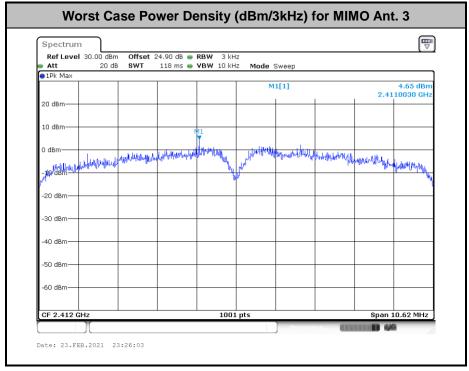


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MIMO < Ant. 1+3>

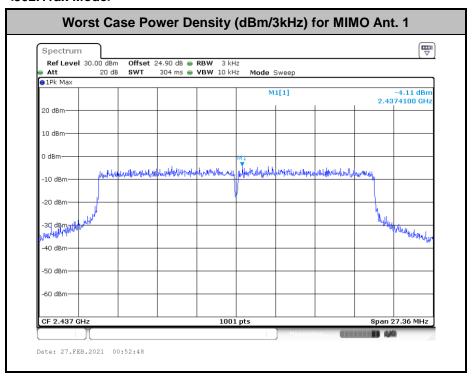


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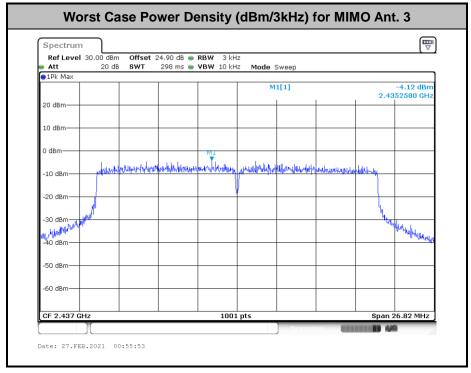


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#### <802.11ax Mode>



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## 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 20 dB / 30dB relative to the maximum PSD level in 100 kHz by RF conducted measurement.

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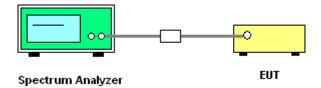
### 3.4.2 Measuring Instruments

See list of measuring equipment of this test report.

#### 3.4.3 Test Procedures

- 1. The testing follows the ANSI C63.10 Section 11.11.3 Emission level measurement
- 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 the maximum power setting and enable the EUT to 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.
- The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

### 3.4.4 Test Setup



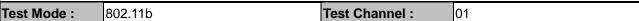
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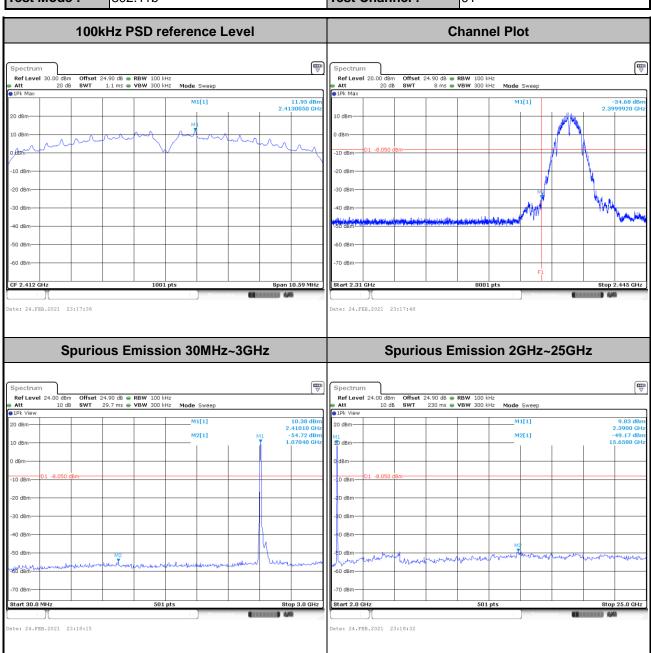
## 3.4.5 Test Result of Conducted Band Edges and Spurious Emission

Tost Engineer :	Hank Hsu	Temperature :	21~25℃
rest Engineer.		Relative Humidity :	51~54%

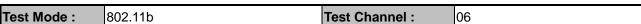
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## Number of TX = 1, Ant. 2 (Measured)

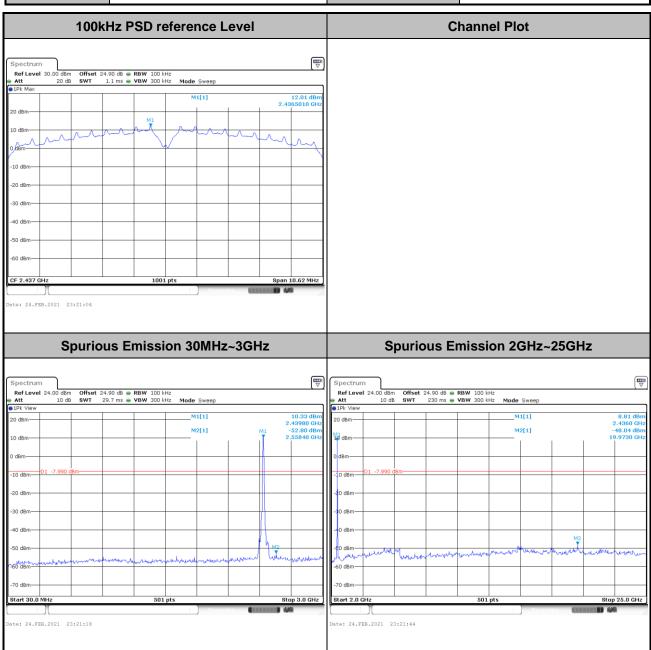




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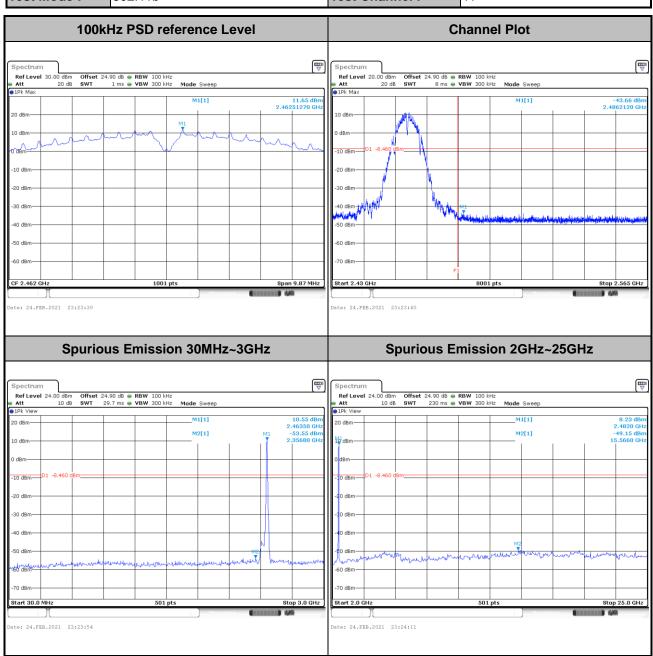


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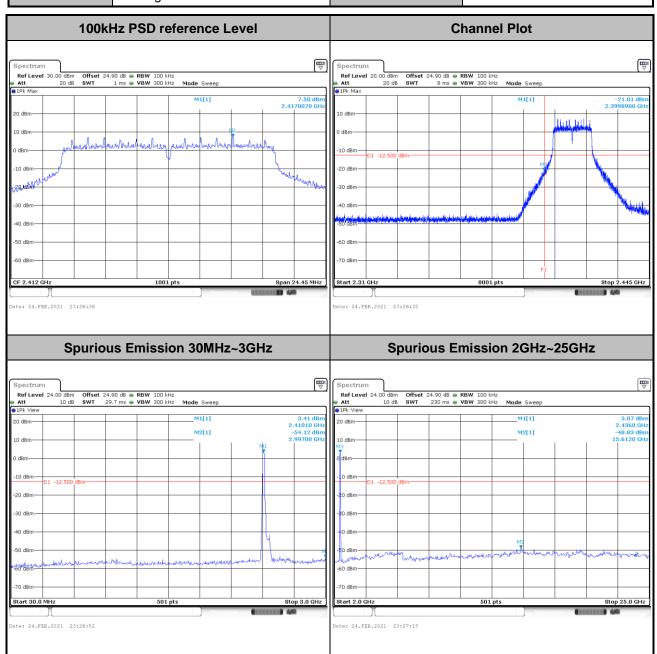
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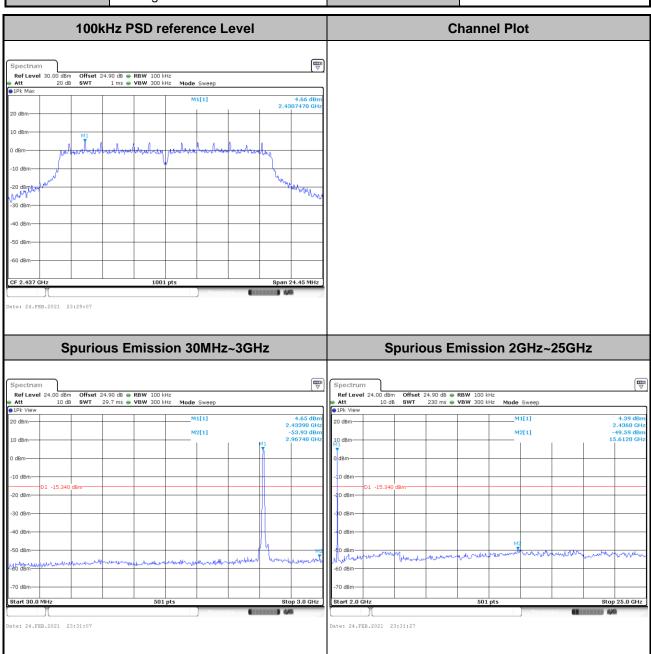
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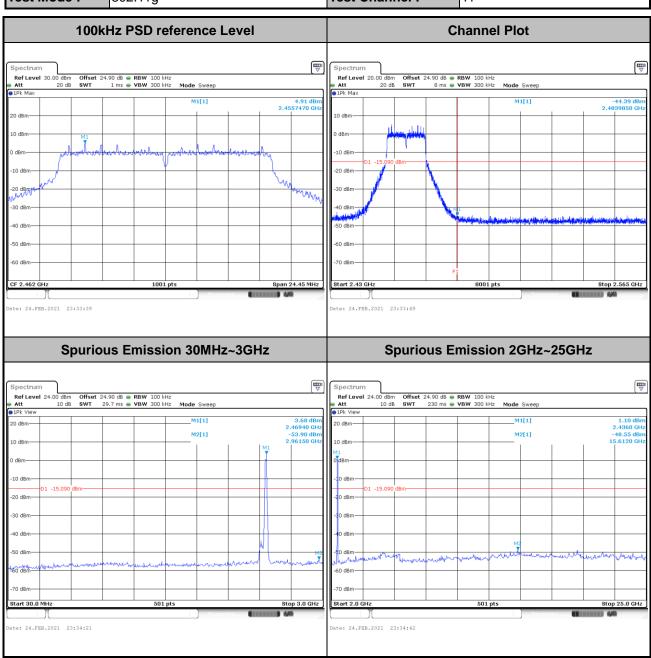
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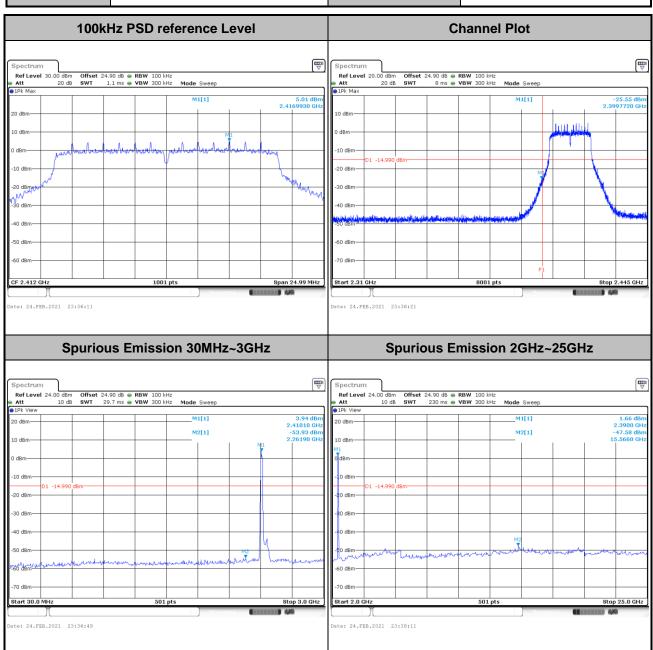
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Test Mode: 802.11n HT20 Test Channel: 01

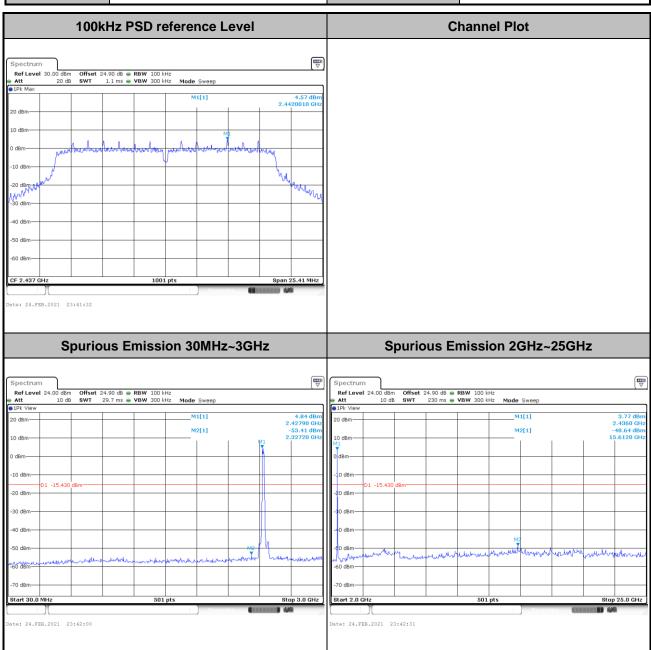
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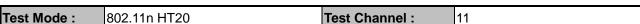
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Test Mode: 802.11n HT20 Test Channel: 06

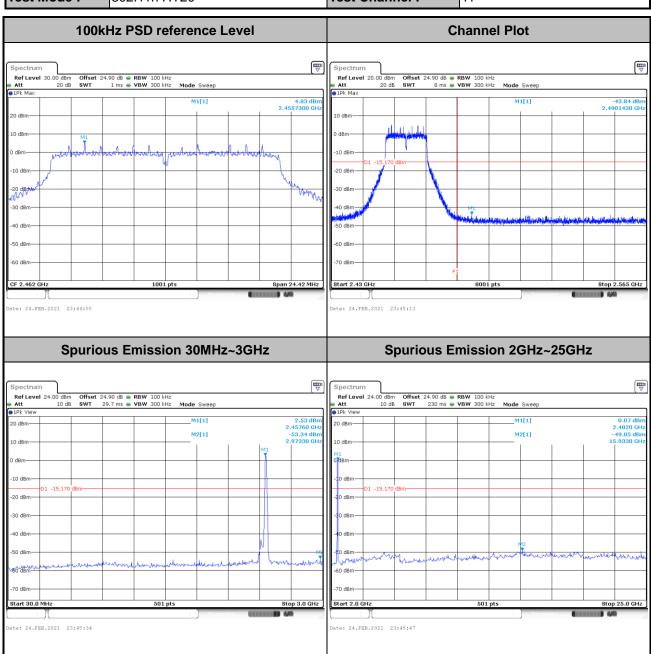
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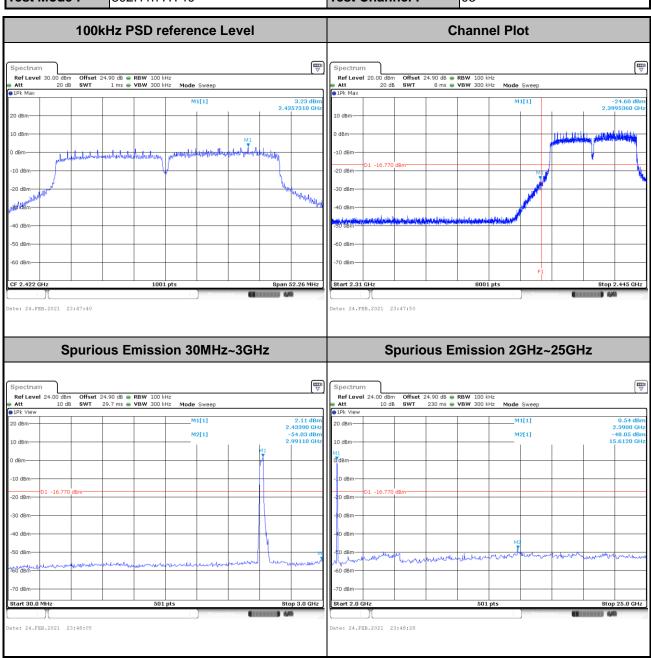
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Test Mode: 802.11n HT40 Test Channel: 03

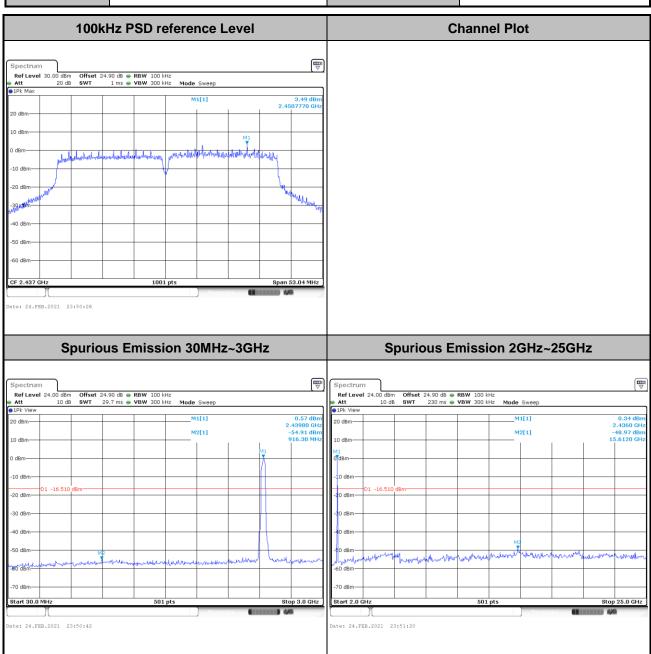
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 Test Mode :
 802.11n HT40
 Test Channel :
 06

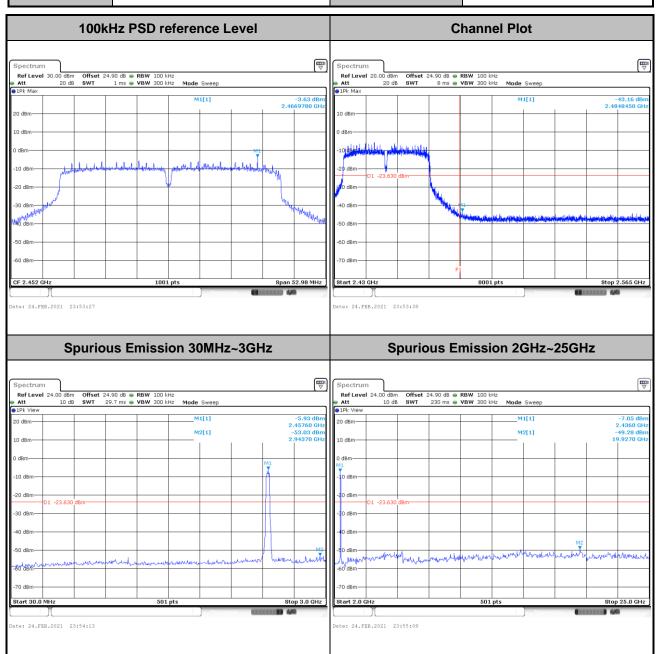
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Test Mode: 802.11n HT40 Test Channel: 09

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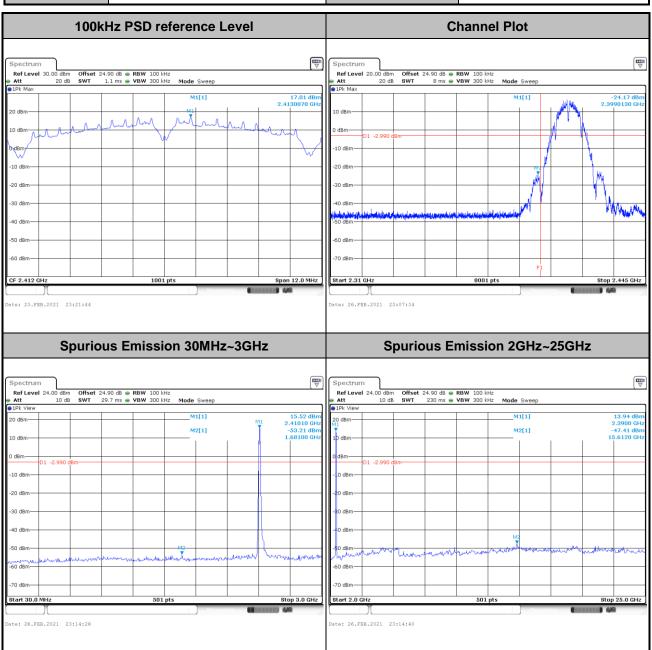
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#### <CDD Modes>

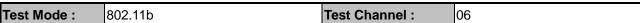
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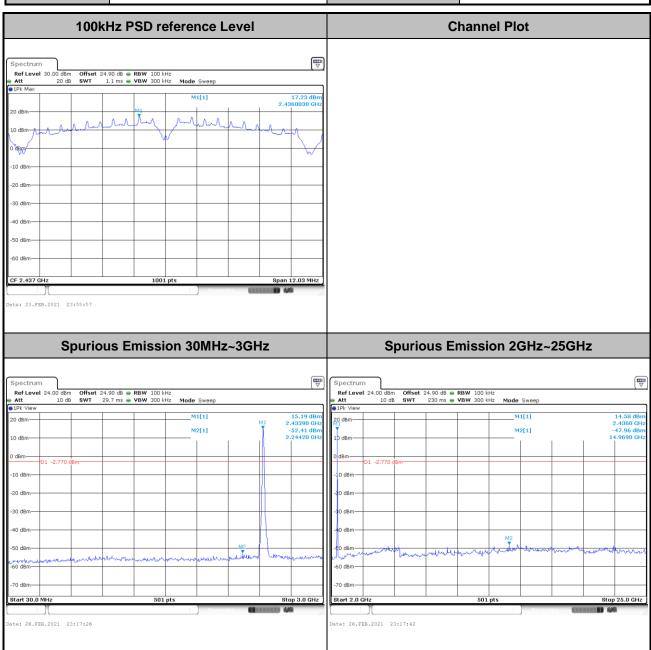
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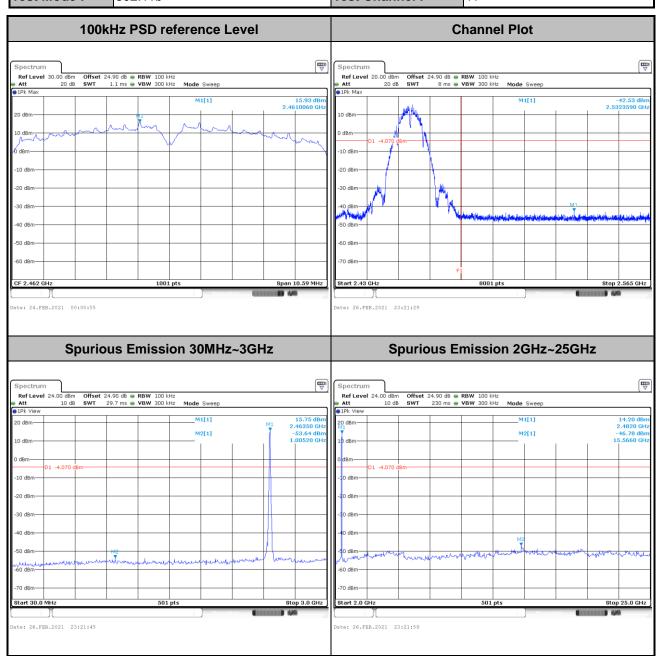


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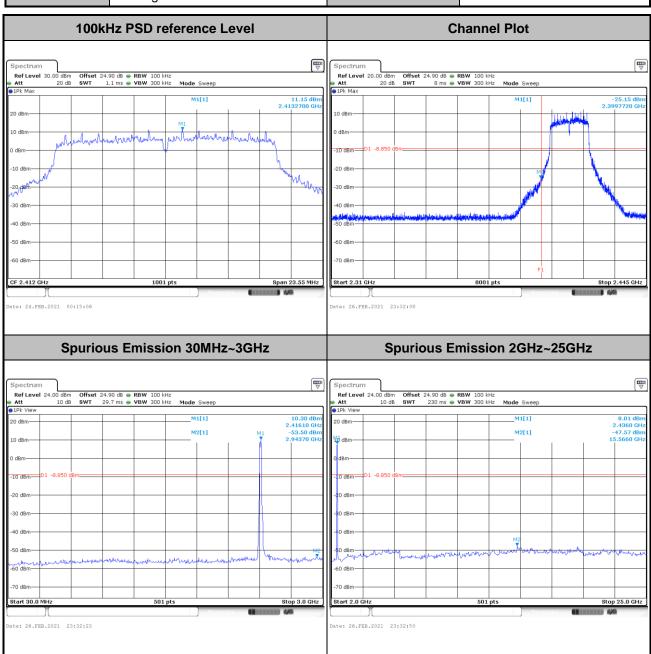
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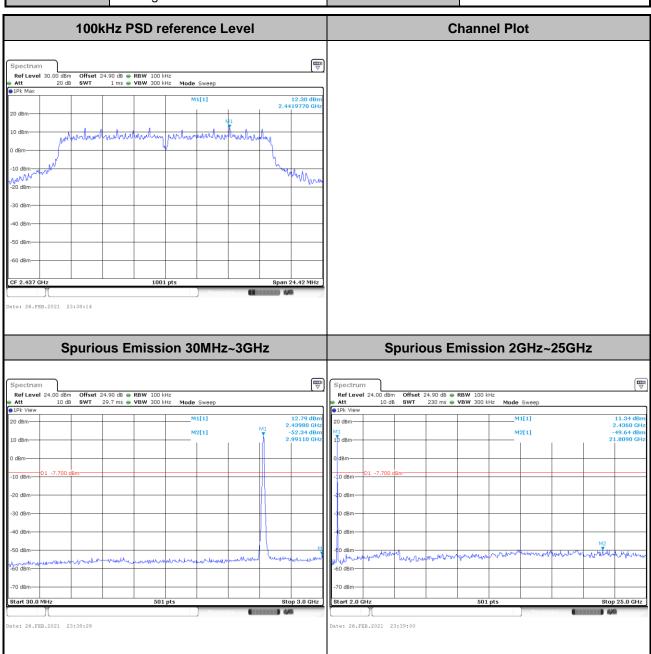
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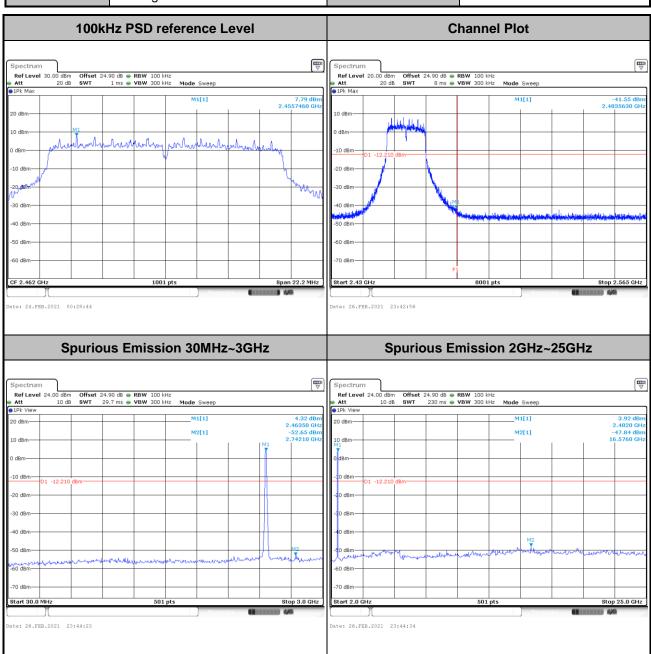
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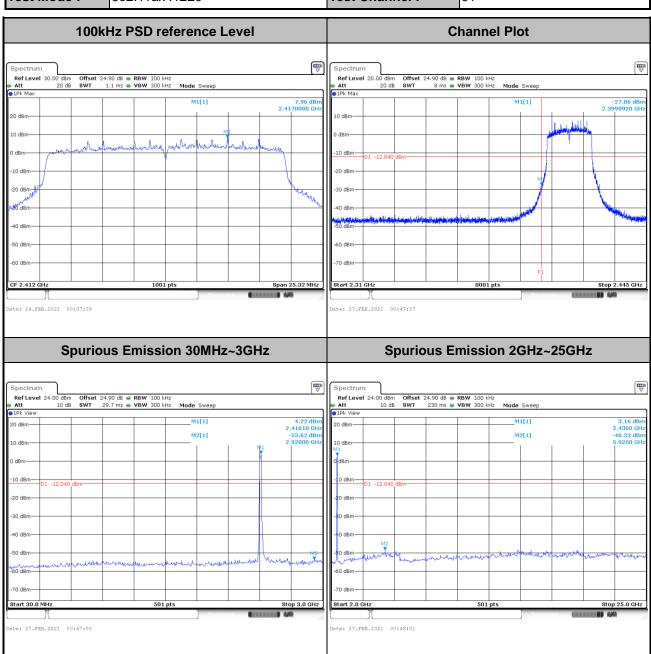
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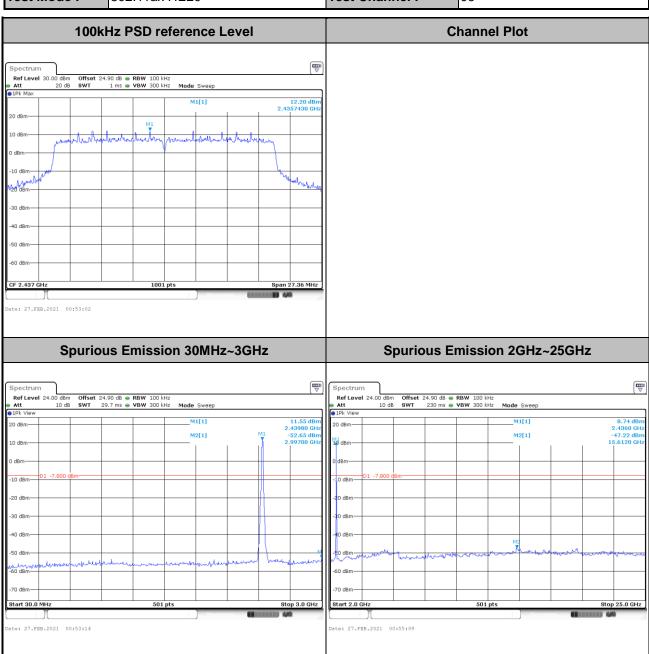
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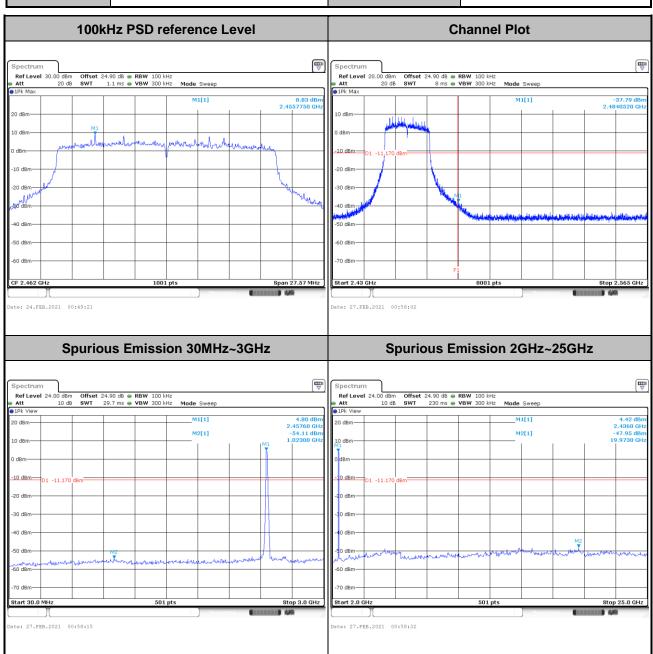
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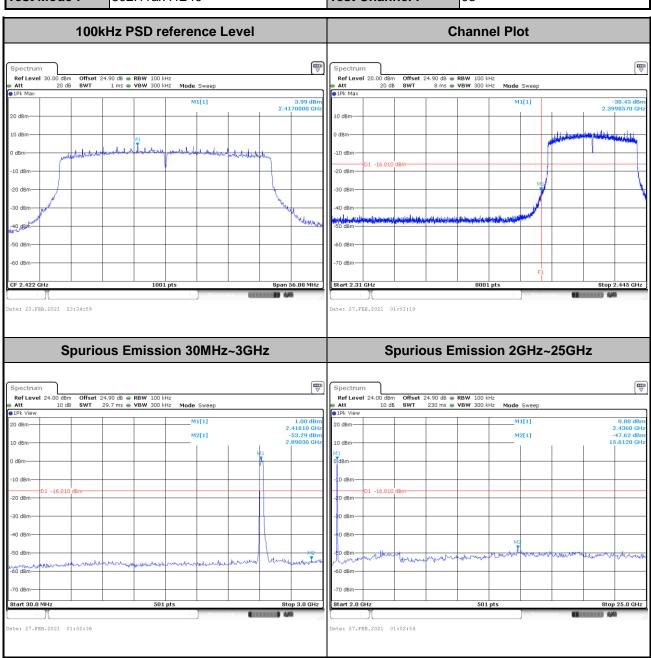
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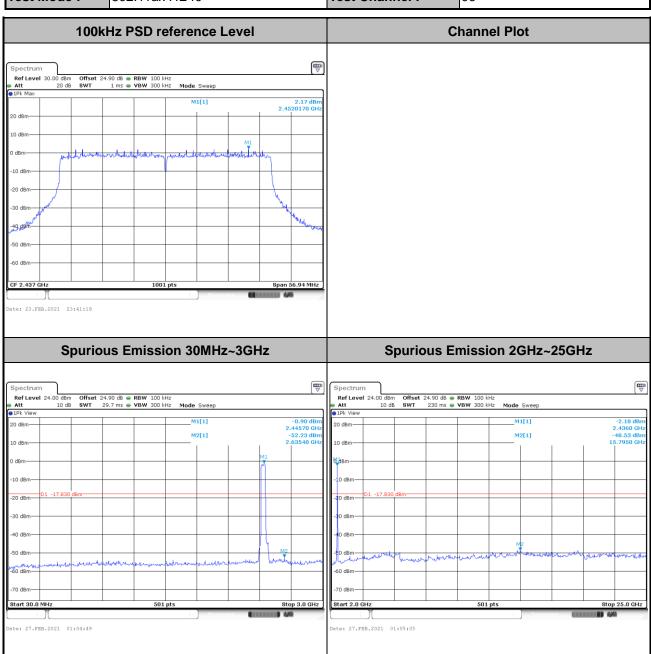
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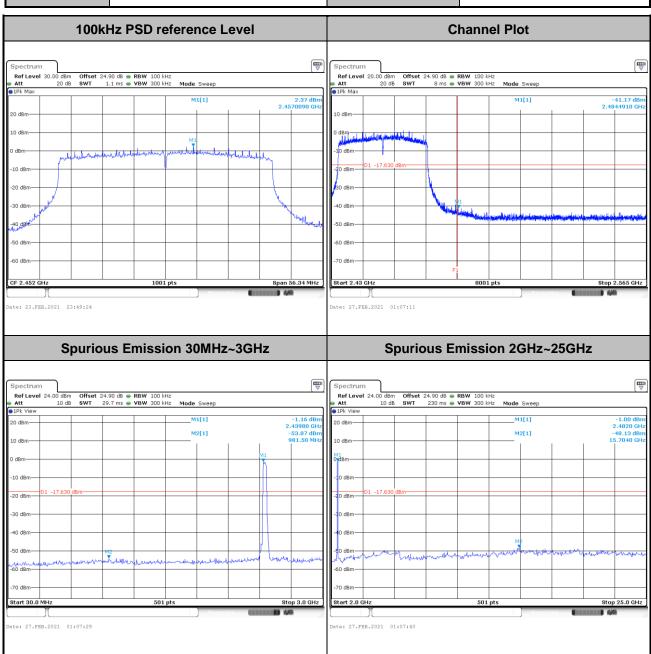
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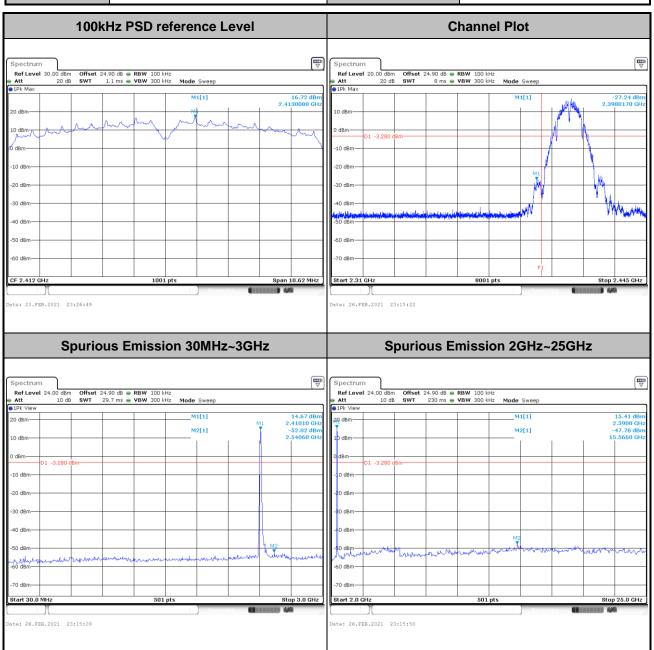


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## Number of TX = 2, Ant. 3 (Measured)

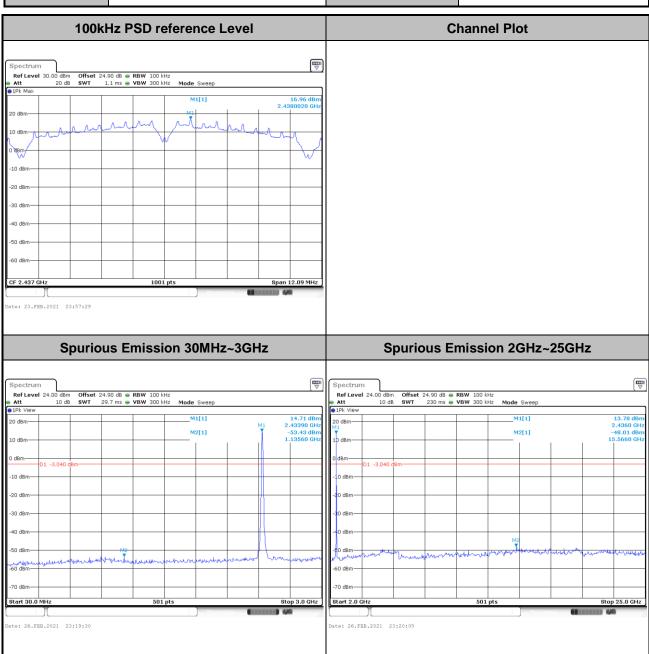


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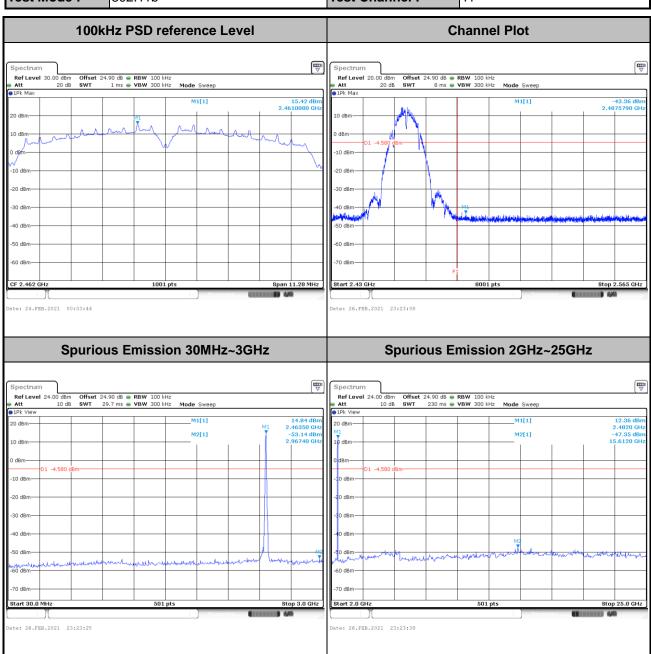
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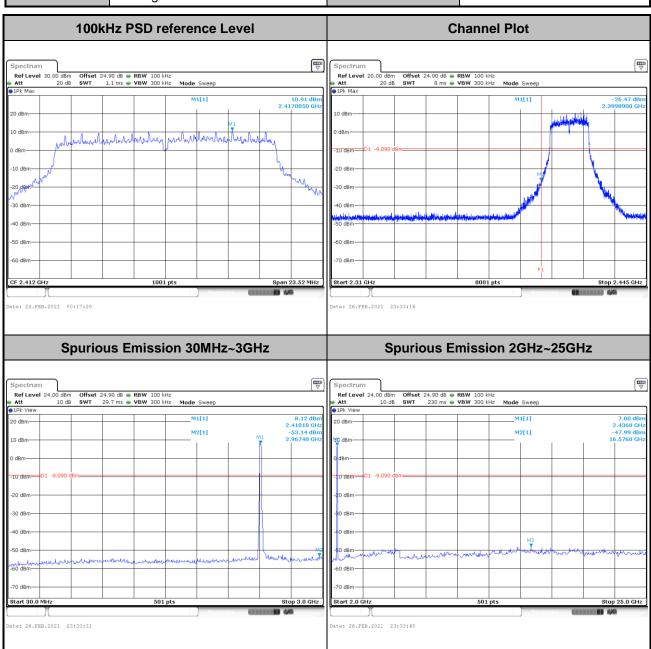
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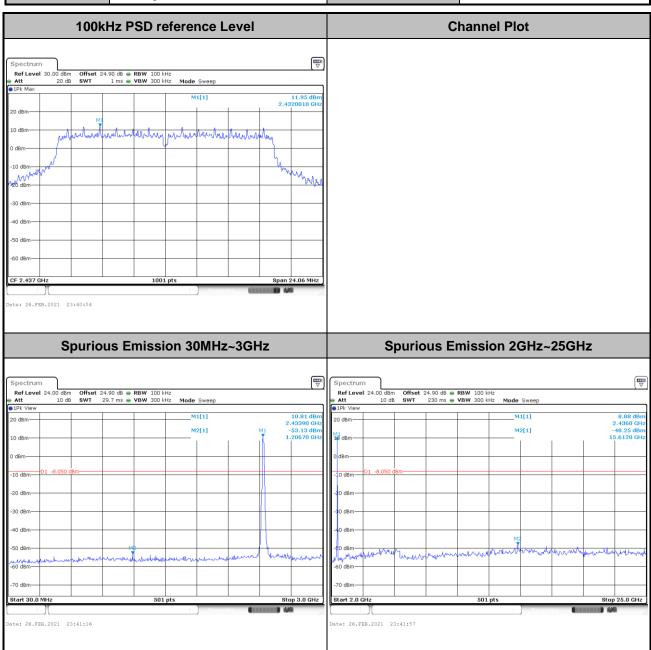
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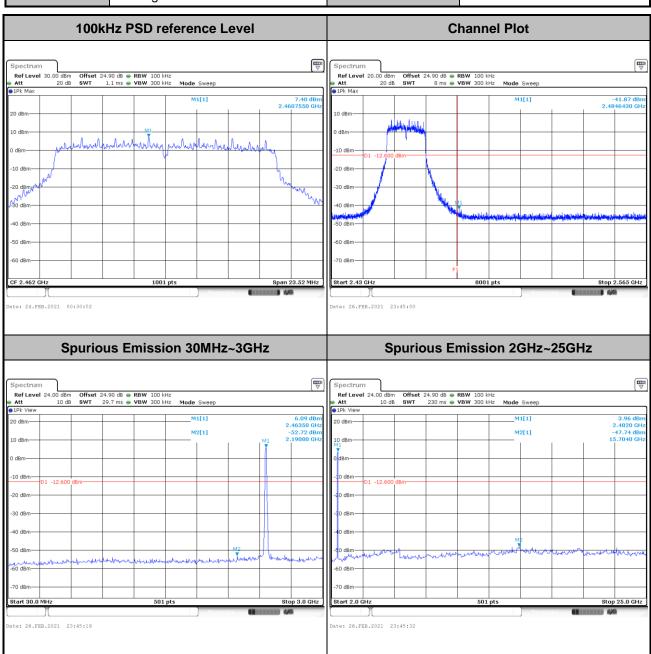
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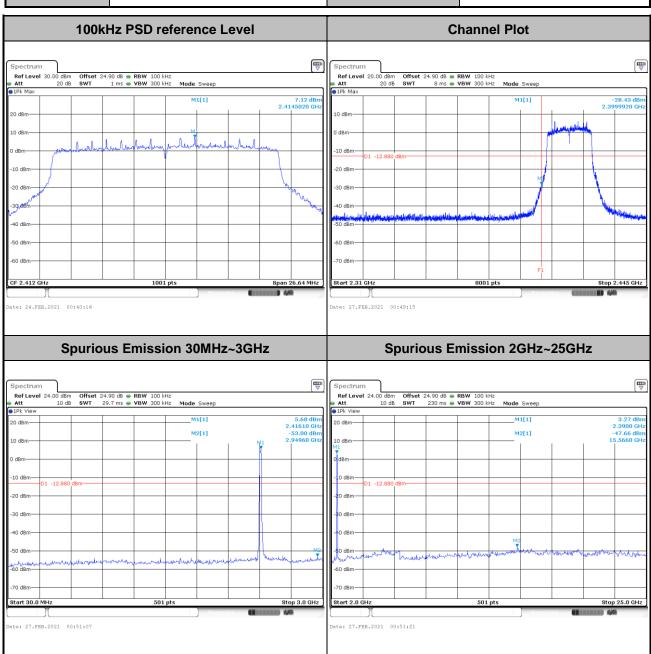
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