



Report No.: FR330612A

# FCC RADIO TEST REPORT

FCC ID : 2ADZRBEACON10

Equipment : NOKIA WiFi Beacon 10

Brand Name : NOKIA

Model Name : Beacon 10

Applicant : Nokia Shanghai Bell Co., Ltd.

No.388, Ningqiao Rd, Pilot Free Trade Zone, Shanghai, 201206 P.R. China

Manufacturer : Nokia of America Corporation

2301 Sugar Bush Rd. Raleigh, NC 27612

Standard : FCC PART 15 Subpart C §15.247

The product was received on Mar. 06, 2023 and testing was performed from Mar. 15, 2023 to Apr. 29, 2023. 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.

The test results in this report apply exclusively to the tested model / sample. Without written approval from 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 333, Taiwan (R.O.C.)

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Report Template No.: BU5-FR15CWL AC MA Version 2.4

# History of this test report

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Report No.	Version	Description	Issue Date
FR330612A	01	Initial issue of report	May 11, 2023
FR330612A	02	Revise Brand Name, Section 1.1, Section 2.2, Section 3.3, Section 3.5 and Appendix A This report is an updated version, replacing the report issued on May 11, 2023.	Jun. 05, 2023

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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)	15.247(e) Power Spectral Density		-
2.4	45.047(-1)	Conducted Band Edges	Pass	-
3.4	15.247(d)	Conducted Spurious Emission	Pass	-
3.5 15.247(d) F		Radiated Band Edges and Radiated Spurious Emission	Pass	0.46 dB under the limit at 2483.620 MHz
3.6	3.6 15.207 AC Conducted Emission		Pass	12.60 dB under the limit at 0.485 MHz
3.7	15.203	Antenna Requirement	Pass	-

#### Conformity Assessment Condition:

- The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the
  regulation limits or in accordance with the requirements stipulated by the applicant/manufacturer who
  shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken
  into account.
- The measurement uncertainty please refer to each test result in the section "Measurement Uncertainty".

#### Disclaimer:

The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.

Reviewed by: Lewis Ho

**Report Producer: Michelle Chen** 

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# 1 General Description

# 1.1 Product Feature of Equipment Under Test

#### **Product Feature**

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#### **General Specs**

Wi-Fi 2.4GHz 802.11b/g/n/ac/ax, Wi-Fi 5GHz 802.11a/n/ac/ax and Wi-Fi 6GHz 802.11a/n/ac/ax.

#### **Antenna Type**

<Ant. 1>: Dipole Antenna

<Ant. 2>: Dipole Antenna

<Ant. 3>: Dipole Antenna

<Ant. 4>: Dipole Antenna

<Ant. 5>: Dipole Antenna

<Ant. 6>: Dipole Antenna

<Ant. 7>: Dipole Antenna

<Ant. 8>: Dipole Antenna

Antenna information			
2400 MHz ~ 2483.5 MHz	Peak Gain (dBi)	Ant. 1: 3.22 Ant. 2: 2.35	

Antenna information for Directional Gain / TXBF Gain				
2400 MHz ~ 2483.5 MHz	Peak Gain (dBi)	<ant. 1+2="">: 4.08</ant.>		

**Remark:** The EUT's information above is declared by manufacturer. Please refer to Disclaimer in report summary.

## 1.2 Modification of EUT

No modifications made to the EUT during the testing.

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# 1.3 Testing Location

Test Site	Sporton International Inc. EMC & Wireless Communications Laboratory
	No.52, Huaya 1st Rd., Guishan Dist.,
Toot Cita Lagation	Taoyuan City 333, Taiwan (R.O.C.)
Test Site Location	TEL: +886-3-327-3456
	FAX: +886-3-328-4978
Test Site No.	Sporton Site No.
rest Site No.	CO05-HY, 03CH07-HY

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

Test Site Sporton International Inc. Wensan Laboratory		
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855	
Test Site No.	Sporton Site No.	
rest Site No.	TH05-HY (TAF Code: 3786)	
Remark	The Conducted Test test item subcontracted to Sporton International Inc. Wensan Laboratory.	

FCC designation No.: TW1190 and TW3786

## 1.4 Applicable Standards

According to the specifications declared by 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 15.247 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 the test items were validated and recorded in accordance with the standards without any modification during the testing.
- 2. The TAF code is not including all the FCC KDB listed without accreditation.
- 3. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

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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, the measured emission level of the EUT was maximized by rotating the EUT on a turntable, adjusting the orientation of the EUT and EUT antenna in three orthogonal axis (X: flat, Y: portrait, Z: landscape), and adjusting the measurement antenna orientation, following C63.10 exploratory test procedures and only the worst case emissions were reported 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 2402 F MILE	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

This device support 26/52/106/242/484-tone RU.

The PSD of partial RU is reduced to be smaller than full RU according to TCB workshop interim guidance Oct. 2018.

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The 802.11ax mode is investigated among different tones, full resource units (RU), partial resource units. The partial RU has no higher power than full RU's, thus the full RU is chosen as main test configuration.

The 242-tone RU is covered by 20MHz channel, 484-tone RU is covered by 40MHz.

The SISO mode conducted power is covered by MIMO mode per chain, so only the MIMO mode is tested.

The power for 802.11n and 802.11ac mode is smaller than 802.11ax mode, so all other conducted and radiated test is covered by 802.11ax mode.

The final test modes include the worst data rates for each modulation shown in the table below.

#### **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

#### **TXBF Mode**

Modulation	Data Rate
802.11ax HE20	MCS0
802.11ax HE40	MCS0

Remark: The conducted power level of each chain in MIMO mode is equal or higher than SISO mode.

	Test Cases					
AC						
Conducted	Mode 1 : WLAN (2.4GHz) Link + LAN Link + AC Adapter 1					
Emission	Emission					
Remark: For Radiated Test Cases, the tests were performed with AC Adapter 1.						

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## <CDD Mode>

Ch. #	2400-2483.5 MHz			
CII. #	802.11b	802.11g	802.11ax HE20	802.11ax HE40
	01	01	01	03
Low	-	02	02	-
	-	-	-	-
Middle	06	06	06	06
wildale	-	-	09	-
Lliado	10	10	10	08
High	11	11	11	09

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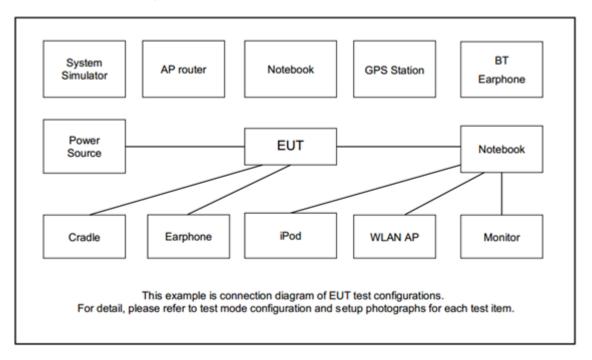
#### <TXBF Mode>

Ch. #	2400-248	33.5 MHz
CII.#	802.11ax HE20	802.11ax HE40
Low	01	03
Middle	06	06
High	11	09

**Remark:** For radiation spurious emission, the modulation and the data rate picked for testing are determined by the Max. RF conducted power.

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# 2.3 Connection Diagram of Test System



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# 2.4 Support Unit used in test configuration and system

Item	Equipment	Brand Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Notebook	Dell	Latitude 3400	FCC DoC	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
2.	Notebook	Dell	Latitude 3420	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 5.0-00202" was installed in Notebook which was programmed in

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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.

For TXBF mode, the modulation modes and data rates manipulated by the command lines in the

engineering program made the EUT link to Phone by power under the normal operation. The "Tera

Term" software tool was used to enable the EUT to transmit signals continuously.

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

Please refer to the measuring equipment list in this test report.

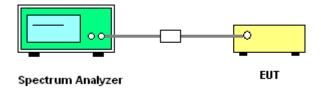
#### 3.1.3 Test Procedures

- 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 is connected to the spectrum analyzer by RF cable and attenuator. The path loss is 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



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

Please refer to Appendix A.

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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

Please refer to the measuring equipment list in this test report.

#### 3.2.3 Test Procedures

#### <CDD Modes>

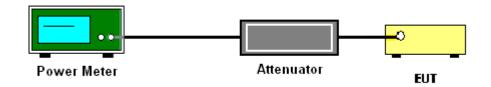
- For Average Power, the testing follows ANSI C63.10 Section 11.9.2.3.2 Method AVGPM-G
- 2. The RF output of EUT is connected to the power meter by RF cable and attenuator. The path loss is compensated to the results for each measurement.
- 3. Set the maximum power setting and enable the EUT to transmit 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.

#### <TXBF Modes>

- 1. For Average Power, the testing follows ANSI C63.10 Section 11.9.2.3.2 Method AVGPM-G
- 2. The RF output of EUT is connected to the power meter by RF cable and attenuator. The path loss is compensated to the results for each measurement.
- 3. Set the maximum power setting and enable the EUT to 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.

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# 3.2.4 Test Setup



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# 3.2.5 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

Please refer to the measuring equipment list in this test report.

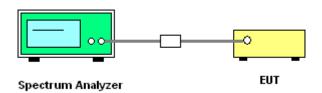
#### 3.3.3 Test Procedures

- 1. The testing follows the ANSI C63.10 Section 11.10.2 Method PKPSD.
- 2. The RF output of EUT is connected to the spectrum analyzer by RF cable and attenuator. The path loss is 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. Detector = peak, 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. Measure and record the results in the test report.
- 7. 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  $1/N_{ANT}$  <sup>th</sup> of the PSD limit .

#### 3.3.4 Test Setup



## 3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.

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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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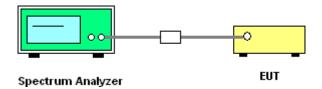
### 3.4.2 Measuring Instruments

Please refer to the measuring equipment list in 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 is connected to the spectrum analyzer by RF cable and attenuator. The path loss is 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



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

Please refer to Appendix A.

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# 3.5 Radiated Band Edges and Spurious Emission Measurement

## 3.5.1 Limit of Radiated band edge and Spurious Emission Measurement

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device is measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

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Frequency	Field Strength	Measurement Distance
(MHz)	(microvolts/meter)	(meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

## 3.5.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

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#### 3.5.3 Test Procedures

- 1. The testing follows the ANSI C63.10 Section 11.12.1 Radiated emission measurements
- 2. The EUT is arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.

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- The EUT is placed on a turntable with 0.8 meter for frequency below 1 GHz and 1.5 meter for frequency above 1 GHz respectively above ground.
- 4. The EUT is set 3 meters away from the receiving antenna, which is mounted on the top of a variable height antenna tower.
- 5. Corrected Reading: Antenna Factor + Cable Loss + Read Level Preamp Factor = Level
- 6. Radiated testing below 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading. When there is no suspected emission found and the emission level is with at least 6 dB margin against QP limit line, the position is marked as "-".
- 7. Radiated testing above 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading for scanning all frequencies. When there is no suspected emission found and the harmonic emission level is with at least 6 dB margin against average limit line, the position is marked as "-".
- 8. Use the following spectrum analyzer settings:
  - (1) Span shall wide enough to fully capture the emission being measured;
  - (2) Set RBW=100 kHz for f < 1 GHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold;
  - (3) Set RBW = 1 MHz, VBW = 3 MHz for  $f \ge 1$  GHz for peak measurement.

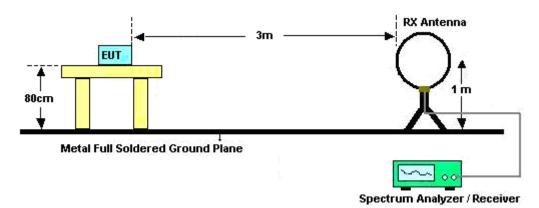
For average measurement:

- VBW = 10 Hz, when duty cycle is no less than 98 percent.
- VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

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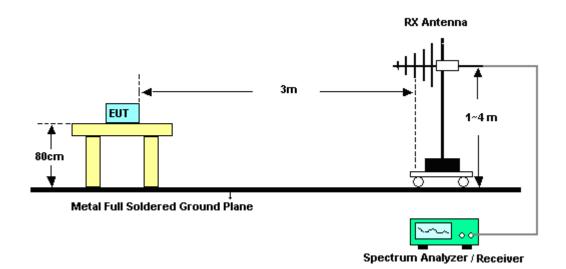
## 3.5.4 Test Setup

## For radiated emissions below 30MHz

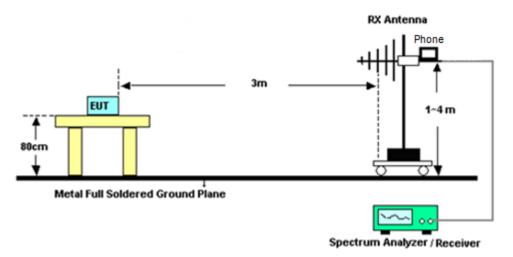


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For radiated emissions from 30MHz to 1GHz <CDD Mode>



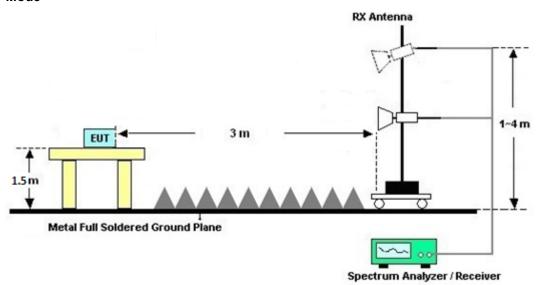
#### <TXBF Modes>



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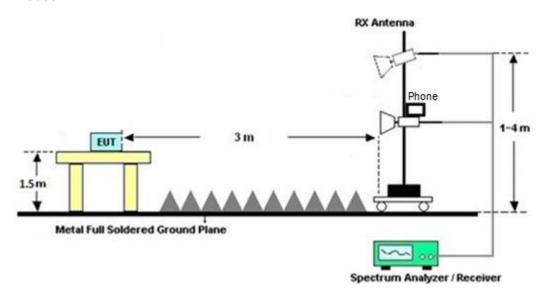
# For radiated test from 1GHz to 18GHz

#### <CDD Mode>



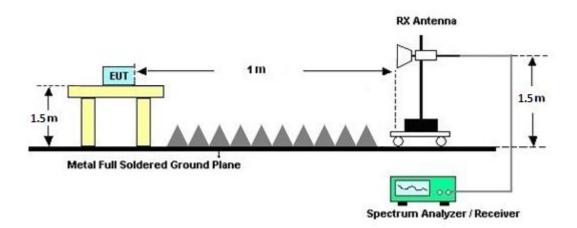
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#### <TXBF Modes>



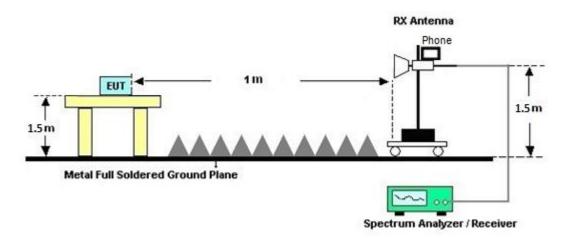
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# For radiated test above 18GHz <CDD Mode>



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#### <TXBF Modes>



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## 3.5.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which starts from 9 kHz to 30 MHz, is pre-scanned and the result which is 20 dB lower than the limit line is not reported.

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There is adequate comparison measurement of both open-field test site and alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result comes out very similar.

## 3.5.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix C and D.

## 3.5.7 Duty Cycle

Please refer to Appendix E.

## 3.5.8 Test Result of Radiated Spurious Emission (30 MHz ~ 10<sup>th</sup> Harmonic)

Please refer to Appendix C and D.

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### 3.6 AC Conducted Emission Measurement

#### 3.6.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

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Frequency of Emission	Conducted Limit (dBμV)			
(MHz)	Quasi-Peak	Average		
0.15-0.5	66 to 56*	56 to 46*		
0.5-5	56	46		
5-30	60	50		

<sup>\*</sup>Decreases with the logarithm of the frequency.

## 3.6.2 Measuring Instruments

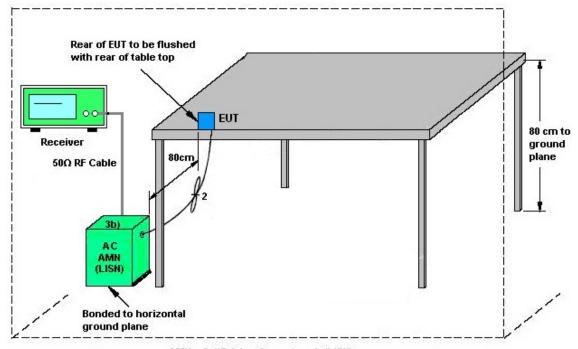
Please refer to the measuring equipment list in this test report.

## 3.6.3 Test Procedures

- 1. The EUT is placed 0.4 meter away from the conducting wall of the shielding room, and is kept at least 80 centimeters from any other grounded conducting surface.
- 2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
- 3. All the support units are connecting to the other LISN.
- 4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
- 5. The FCC states that a 50 ohm, 50 microhenry LISN shall be used.
- 6. Both Line and Neutral shall be tested in order to find out the maximum conducted emission.
- 7. The frequency range from 150 kHz to 30 MHz is scanned.
- 8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF bandwidth = 9 kHz) with Maximum Hold Mode.

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# 3.6.4 Test Setup



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AMN = Artificial mains network (LISN)

AE = Associated equipment

EUT = Equipment under test

ISN = Impedance stabilization network

## 3.6.5 Test Result of AC Conducted Emission

Please refer to Appendix B.

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# 3.7 Antenna Requirements

## 3.7.1 Standard Applicable

The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the rule.

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## 3.7.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

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# 4 List of Measuring Equipment

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	Mar. 23, 2023	N/A	Conduction (CO05-HY)
EMI Test Receiver	Rohde & Schwarz	ESR3	102388	9kHz~3.6GHz	Dec. 01, 2022	Mar. 23, 2023	Nov. 30, 2023	Conduction (CO05-HY)
Hygrometer	Testo	608-H1	34913912	N/A	Nov. 17, 2022	Mar. 23, 2023	Nov. 16, 2023	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100081	9kHz~30MHz	Nov. 17, 2022	Mar. 23, 2023	Nov. 16, 2023	Conduction (CO05-HY)
Software	Rohde & Schwarz	EMC32	N/A	N/A	N/A	Mar. 23, 2023	N/A	Conduction (CO05-HY)
Pulse Limiter	SCHWARZBE CK	VTSD 9561-F N	00691	N/A	Aug. 01, 2022	Mar. 23, 2023	Jul. 31, 2023	Conduction (CO05-HY)
LISN Cable	MVE	RG-400	260260	N/A	Dec. 29, 2022	Mar. 23, 2023	Dec. 28, 2023	Conduction (CO05-HY)
Hygrometer	TECPEL	DTM-303A	TP201996	N/A	Nov. 17, 2022	Mar. 22, 2023~ Apr. 29, 2023	Nov. 16, 2023	Conducted (TH05-HY)
Power Sensor	DARE	RPR3006W	13I00030SNO 31 (NO:182)	10MHz~6GHz	Jan. 11, 2023	Mar. 22, 2023~ Apr. 29, 2023	Jan. 10, 2024	Conducted (TH05-HY)
Power Sensor	DARE	RPR3006W	15I00041SNO 09 (NO:128)	10MHz~6GHz	Jan. 19, 2023	Mar. 22, 2023~ Apr. 29, 2023	Jan. 18, 2024	Conducted (TH05-HY)
Signal & Spectrum Analyzer	Rohde & Schwarz	FSV3044	101466	10Hz~44GHz	Feb. 01, 2023	Mar. 22, 2023~ Apr. 29, 2023	Jan. 31, 2024	Conducted (TH05-HY)
Signal & Spectrum Analyzer	Rohde & Schwarz	FSV3044	101467	10Hz~44GHz	Feb. 01, 2023	Mar. 22, 2023~ Apr. 29, 2023	Jan. 31, 2024	Conducted (TH05-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00800N1D01N-06	35419 & 03	30MHz~1GHz	Apr. 24, 2022	Mar. 15, 2023~ Apr. 13, 2023	Apr. 23, 2023	Radiation (03CH07-HY)
Double Ridge Horn Antenna	ESCO	3117	00075962	1GHz ~ 18GHz	Dec. 01, 2022	Mar. 15, 2023~ Apr. 13, 2023	Nov. 30, 2023	Radiation (03CH07-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Sep. 20, 2022	Mar. 15, 2023~ Apr. 13, 2023	Sep. 19, 2023	Radiation (03CH07-HY)
Preamplifier	MITEQ	AMF-7D-00101 800-30-10P	1590075	1GHz~18GHz	Apr. 21, 2022	Mar. 15, 2023~ Apr. 13, 2023	Apr. 20, 2023	Radiation (03CH07-HY)
Preamplifier	MITEQ	AMF-7D-00101 800-30-10P	1590075	1GHz~18GHz	Apr. 20, 2023	Apr. 26, 2023 ~ Apr. 27, 2023	Apr. 19, 2024	Radiation (03CH07-HY)
Preamplifier	COM-POWER	PA-103A	161241	10MHz~1GHz	Oct. 03, 2022	Mar. 15, 2023~ Apr. 13, 2023	Oct. 02, 2023	Radiation (03CH07-HY)
Preamplifier	Agilent	8449B	3008A02665	1GHz~26.5GHz	Dec. 28, 2022	Mar. 15, 2023~ Apr. 09, 2023	Dec. 27, 2023	Radiation (03CH07-HY)
Preamplifier	Agilent	8449B	3008A02362	1GHz~26.5GHz	Mar. 24, 2023	Apr. 10, 2023 ~ Apr. 27, 2023	Mar. 23, 2024	Radiation (03CH07-HY)
Preamplifier	EMEC	EM18G40G	0600789	18-40GHz	Jul. 21, 2022	Mar. 15, 2023~ Apr. 13, 2023	Jul. 20, 2023	Radiation (03CH07-HY)
Spectrum Analyzer	Keysight	Keysight	MY60241058	10Hz~44GHz	Jul. 07, 2022	Mar. 15, 2023~ Apr. 13, 2023	Jul. 06, 2023	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY15682/4	30MHz to 18GHz	Feb. 22, 2023	Mar. 15, 2023~ Apr. 13, 2023	Feb. 21, 2024	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY24971/4	9kHz to 18GHz	Feb. 22, 2023	Mar. 15, 2023~ Apr. 13, 2023	Feb. 21, 2024	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY28655/4	9kHz to 18GHz	Feb. 22, 2023	Mar. 15, 2023~ Apr. 13, 2023	Feb. 21, 2024	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 126	532078/126E	30MHz~18GHz	Sep. 16, 2022	Mar. 15, 2023~ Apr. 13, 2023	Sep. 15, 2023	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	MY2858/2	18GHz~40GHz	Feb. 22, 2023	Mar. 15, 2023~ Apr. 13, 2023	Feb. 21, 2024	Radiation (03CH07-HY)

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Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Controller	EMEC	EM1000	N/A	Control Ant Mast	N/A	Mar. 15, 2023~ Apr. 13, 2023	N/A	Radiation (03CH07-HY)
Controller	MF	MF-7802	N/A	Control Turn table	N/A	Mar. 15, 2023~ Apr. 13, 2023	N/A	Radiation (03CH07-HY)
Antenna Mast	EMEC	AM-BS-4500E	N/A	Boresight mast 1M~4M	N/A	Mar. 15, 2023~ Apr. 13, 2023	N/A	Radiation (03CH07-HY)
Turn Table	ChainTek	Chaintek 3000	N/A	0~360 Degree	N/A	Mar. 15, 2023~ Apr. 13, 2023	N/A	Radiation (03CH07-HY)
Software	Audix	E3	N/A	N/A	N/A	Mar. 15, 2023~ Apr. 13, 2023	N/A	Radiation (03CH07-HY)
USB Data Logger	TECPEL	TR-32	HE17XB2495	N/A	Mar. 14, 2023	Mar. 15, 2023~ Apr. 13, 2023	Mar. 13, 2024	Radiation (03CH07-HY)
EMI Test Receiver	Keysight	N9038A(MXE)	MY57290111	3Hz~26.5GHz	Dec. 15, 2022	Mar. 15, 2023~ Apr. 13, 2023	Dec. 14, 2023	Radiation (03CH07-HY)
SHF-EHF Horn Antenna	SCHWARZBE CK	BBHA 9170	BBHA9170251	18GHz~40GHz	Nov. 24, 2022	Mar. 15, 2023~ Apr. 13, 2023	Nov. 23, 2023	Radiation (03CH07-HY)

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# 5 Measurement Uncertainty

## <u>Uncertainty of Conducted Emission Measurement (150kHz ~ 30MHz)</u>

Measuring Uncertainty for a Level of Confidence	3.5 dB
of 95% (U = 2Uc(y))	3.3 ub

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#### **Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)**

-		
	Measuring Uncertainty for a Level of Confidence	6.5 dB
	of 95% (U = 2Uc(y))	0.5 UB

## <u>Uncertainty of Radiated Emission Measurement (1000 MHz ~ 6000 MHz)</u>

Measuring Uncertainty for a Level of Confidence	4.5 dB
of 95% (U = 2Uc(y))	4.5 UB

### <u>Uncertainty of Radiated Emission Measurement (6000 MHz ~ 18000 MHz)</u>

Measuring Uncertainty for a Level of Confidence	4 2 dB
of 95% (U = 2Uc(y))	4.2 dB

### <u>Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)</u>

Measuring Uncertainty for a Level of Confidence	5.3 dB
of 95% (U = 2Uc(y))	5.3 UB

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# **Appendix A. Test Result of Conducted Test Items**

Test Engineer:	Derek Hsu	Temperature:	21~25	°C
Test Date:	2023/3/22~2023/04/29	Relative Humidity:	51~54	%

# TEST RESULTS DATA 6dB and 99% Occupied Bandwidth

	2.4GHz Band MIMO														
Mod.	Data Rate	N⊤x	CH.	Freq. (MHz)	99% Occi (MI	upied BW Hz)	6dB (MI	BW Hz)	6dB BW Limit (MHz)	Pass/Fail					
					Ant1	Ant2	Ant1	Ant2							
11b	1Mbps	2	1	2412	13.64	13.68	8.08	8.10	0.50	Pass					
11b	1Mbps	2	6	2437	13.67	13.67	8.60	7.12	0.50	Pass					
11b	1Mbps	2	11	2462	13.15	13.18	7.16	7.16	0.50	Pass					
11g	6Mbps	2	1	2412	17.20	17.07	16.36	16.36	0.50	Pass					
11g	6Mbps	2	6	2437	23.79	24.60	16.34	16.36	0.50	Pass					
11g	6Mbps	2	11	2462	17.15	17.00	16.36	16.36	0.50	Pass					

# TEST RESULTS DATA Average Output Power

	2.4GHz Band MIMO															
Mod.	od. Data Rate		CH.	Freq. (MHz)		Average onducte Power (dBm)		Po Lii	lucted wer mit Bm)		DG (dBi)		RP wer Bm)	EIRP Power Limit (dBm)		Pass /Fail
					Ant1	Ant2	SUM	Ant1	Ant2	Ant1	Ant1 Ant2		Ant2	Ant1	Ant2	
11b	1Mbps	2	1	2412	26.45	26.41	29.44	30.00		3.22		32.66		36.00		Pass
11b	1Mbps	2	6	2437	26.55	26.45	29.51	30.00		3.	22	32	.73	36	.00	Pass
11b	1Mbps	2	10	2457	25.37	25.37	28.38	30	.00	3.:	22	31	.60	36	.00	Pass
11b	1Mbps	2	11	2462	22.94	22.65	25.81	30	.00	3.22		29.03		36.00		Pass
11g	6Mbps	2	1	2412	22.37	22.39	25.39	30	.00	3.22		28.61		36.00		Pass
11g	6Mbps	2	2	2417	23.62	23.30	26.47	30.00		3.	22	29.69		36.00		Pass
11g	6Mbps	2	6	2437	25.77	25.70	28.75	30.00		3.:	22	31.97		36.00		Pass
11g	6Mbps	2	10	2457	23.36	23.27	26.33	30.00		3.:	3.22		29.55		36.00	
11g	6Mbps	2	11	2462	20.02	20.12	23.08	30	.00	3.:	3.22		26.30		36.00	

Note: Measured power (dBm) has offset with cable loss.

# TEST RESULTS DATA Peak Power Spectral Density

	2.4GHz Band MIMO														
Mod.	Data Rate	NTX	CH.	Freq.		Peak PSD (dBm/3kHz)	)	DG (dBi)		Peak PSD Limit (dBm/3kHz)		Pass/Fail			
	Nate			(1011 12)	Ant1	Ant2	Worse + 3.01	Ant1	Ant2	Ant1	Ant2				
11b	1Mbps	2	1	2412	2.61	2.82	5.83	4.0	08	8.0	00	Pass			
11b	1Mbps	2	6	2437	3.95	3.91	6.96	4.0	08	8.00		Pass			
11b	1Mbps	2	11	2462	-0.15	0.00	3.01	4.0	08	8.0	00	Pass			
11g	6Mbps	2	1	2412	<b>-</b> 5.57	-5.96	-2.56	4.08		8.00		Pass			
11g	6Mbps	2	6	2437	-1.64 -1.84 1.37			4.08		8.00		Pass			
11g	6Mbps	2	11	2462	-6.51	-7.09	-3.50	4.0	08	8.00		Pass			

Measured power density (dBm) has offset with cable loss.

## TEST RESULTS DATA 6dB and 99% Occupied Bandwidth

	2.4GHz Band MIMO														
Mod.	Data Rate	INTXLCH L ' L'Contig L (MHZ) L (MHZ)			6dB BW Limit (MHz)	Pass/Fail									
						Ant1	Ant2	Ant1	Ant2						
HE20	MCS0	2	1	2412	Full	19.25	19.27	18.85	18.93	0.50	Pass				
HE20	MCS0	2	6	2437	Full	20.81	21.21	18.90	18.98	0.50	Pass				
HE20	MCS0	2	11	2462	Full	19.22	19.23	18.83	18.90	0.50	Pass				
HE40	MCS0	2	3	2422	Full	38.03	37.98	37.88	37.88	0.50	Pass				
HE40	MCS0	2	6	2437	Full	37.95	38.01	37.92	37.88	0.50	Pass				
HE40	MCS0	2	9	2452	Full	37.97	37.87	37.72	37.88	0.50	Pass				

# TEST RESULTS DATA Average Output Power

								2.4GHz	Band MIMO									
Mod.	od. Data Rate NTX		CH.	Freq. (MHz)	RU Config		Average onducte Power (dBm)		Conducted Power Limit (dBm)	D (dl		Po	RP wer Bm)	EIRP Power Limit (dBm)		Pass /Fail		
						Ant1	Ant2	SUM	Ant1 Ant2	Ant1			Ant2	Ant1	Ant2	_		
HE20	MCS0	2	1	2412	Full	21.40	21.39	24.41	30.00	3.22			.63	36.		Pass		
HE20	MCS0	2	1	2412	26/26	13.69	13.18	16.45	30.00	3.:			.67	36.		Pass		
HE20	MCS0	2	1	2412	52/52	15.59	15.90	18.76	30.00	3.	22	21	.98	36.00		Pass		
HE20	MCS0	2	1	2412	106/106	19.44	18.72	22.11	30.00	.00 3.22		25.33		36.00		Pass		
HE20	MCS0	2	2	2417	Full	23.15	22.91	26.04	30.00	3.:	3.22		29.26		36.00			
HE20	MCS0	2	3	2422	Full	24.00	23.80	26.91	30.00	3.	3.22		30.13		36.00			
HE20	MCS0	2	6	2437	Full	25.80	25.66	28.74	30.00	3.:	3.22		31.96		36.00			
HE20	MCS0	2	6	2437	26/26	18.08	17.58	20.85	30.00	3.	22	24.07		36.00		Pass		
HE20	MCS0	2	6	2437	52/52	20.52	19.97	23.26	30.00	3.	22	26.48		36.00		Pass		
HE20	MCS0	2	6	2437	106/106	24.35	23.90	27.14	30.00	3.	3.22		3.22 30.36		.36	36.00		Pass
HE20	MCS0	2	9	2452	Full	23.90	23.60	26.76	30.00	3.	22	29	.98	36.	00	Pass		
HE20	MCS0	2	10	2457	Full	22.57	22.33	25.46	30.00	3.	22	28	.68	36.	00	Pass		
HE20	MCS0	2	11	2462	Full	17.99	17.85	20.93	30.00	3.	22	24	.15	36.	00	Pass		
HE20	MCS0	2	11	2462	26/26	10.34	10.00	13.18	30.00	3.	22	16	.40	36.	00	Pass		
HE20	MCS0	2	11	2462	52/52	12.88	12.45	15.68	30.00	3.	22	18	.90	36.	00	Pass		
HE20	MCS0	2	11	2462	106/106	16.00	16.07	19.05	30.00	3.:	22	22	.27	36.	00	Pass		
HE40	MCS0	2	3	2422	Full	20.41	20.60	23.52	30.00	3.:	3.22 26.74		36.	00	Pass			
HE40	MCS0	2	6	2437	Full	21.13	21.26	24.21	30.00	3.:	3.22		3.22 27.43		36.	00	Pass	
HE40	MCS0	2	8	2447	Full	18.76	18.65	21.72	30.00	3.:	3.22		3.22 24.94		36.	00	Pass	
HE40	MCS0	2	9	2452	Full	17.35	17.44	20.41	30.00	3.:	22	23	.63	36.	36.00			

Note: Measured power (dBm) has offset with cable loss.

# TEST RESULTS DATA Peak Power Spectral Density

	2.4GHz Band MIMO														
Mod.	Data Rate	NTX	CH.	Freq.	RU Config		Peak PSD (dBm/3kHz)		D (dl	~	Peak PSD Limit (dBm/3kHz)		Pass/Fail		
	Nate			(1011 12)		Ant1	Ant2	Worse + 3.01	Ant1	Ant2	Ant1	Ant2			
HE20	MCS0	2	1	2412	Full	-5.86	-5.69	-2.68	4.0	)8	8.0	00	Pass		
HE20	MCS0	2	1	2412	26/26	-6.18	-6.45	-3.17	4.0	)8	8.00		Pass		
HE20	MCS0	2	1	2412	52/52	-6.63	-6.00	-2.99	4.08		8.00		Pass		
HE20	MCS0	2	1	2412	106/106	-6.07	-6.56	-3.06	4.08		8.00		Pass		
HE20	MCS0	2	6	2437	Full	-1.30	-1.37	1.71	4.08		8.00		Pass		
HE20	MCS0	2	6	2437	26/26	-1.62	-2.36	1.39	4.0	)8	8.00		Pass		
HE20	MCS0	2	6	2437	52/52	-1.59	-2.23	1.42	4.0	4.08 8.00		00	Pass		
HE20	MCS0	2	6	2437	106/106	-1.46	-1.32	1.69	4.0	)8	8.0	00	Pass		
HE20	MCS0	2	11	2462	Full	-9.15	-9.90	-6.14	4.0	)8	8.0	00	Pass		
HE20	MCS0	2	11	2462	26/26	-9.29	-9.71	-6.28	4.0	)8	8.0	00	Pass		
HE20	MCS0	2	11	2462	52/52	-9.43	-9.77	-6.42	4.0	)8	8.0	00	Pass		
HE20	MCS0	2	11	2462	106/106	-9.61	-9.57	-6.56	4.08		8.0	00	Pass		
HE40	MCS0	2	3	2422	Full	-8.07	-8.92	-5.06	4.08		8.0	00	Pass		
HE40	MCS0	2	6	2437	Full	-8.88	-8.42	-5.41	4.0	4.08 8.00		00	Pass		
HE40	MCS0	2	9	2452	Full	-11.74	-11.76	-8.73	4.0	)8	8.00		Pass		

Measured power density (dBm) has offset with cable loss.

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<TXBF Mode>

## TEST RESULTS DATA 6dB and 99% Occupied Bandwidth

	2.4GHz Band MIMO														
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	RU Config	99% Occ (M	upied BW Hz)	6dB (MI	BW Hz)	6dB BW Limit (MHz)	Pass/Fail				
						Ant1	Ant2	Ant1	Ant2						
HE20	MCS0	2	1	2412	Full	19.38	19.41	17.45	18.10	0.50	Pass				
HE20	MCS0	2	6	2437	Full	19.53	19.51	18.73	17.30	0.50	Pass				
HE20	MCS0	2	11	2462	Full	19.37	19.41	18.58	18.38	0.50	Pass				
HE40	MCS0	2	3	2422	Full	38.28	38.31	35.16	35.12	0.50	Pass				
HE40	MCS0	2	6	2437	Full	38.00	37.99	33.88	33.92	0.50	Pass				
HE40	MCS0	2	9	2452	Full	38.00	37.93	33.92	35.20	0.50	Pass				

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# TEST RESULTS DATA Average Output Power

	2.4GHz Band MIMO																
Mod.	Mod. Data Rate		CH.	Freq. (MHz)	RU Config	Average Conducted Power (dBm)		Conducted Power Limit (dBm)		DG (dBi)		EIRP Power (dBm)		EIRP Power Limit (dBm)		Pass /Fail	
						Ant1	Ant2	SUM	Ant1	Ant2	Ant1	Ant2	Ant1	Ant2	Ant1	Ant2	
HE20	MCS0	2	1	2412	Full	20.29	20.24	23.28	30.00		4.08		27.36		36.00		Pass
HE20	MCS0	2	6	2437	Full	23.68	23.88	26.79	30.00		4.08		30.87		36.00		Pass
HE20	MCS0	2	11	2462	Full	18.84	19.22	22.04	30.00		4.08		26.12		36.00		Pass
HE40	MCS0	2	3	2422	Full	19.14	19.00	22.08	30.00		4.08		26.16		36.00		Pass
HE40	MCS0	2	6	2437	Full	20.96	21.25	24.12	30.00		4.08		28.20		36.00		Pass
HE40	MCS0	2	9	2452	Full	17.05	16.14	19.63	30.00		4.08		23.71		36.00		Pass

Note: Measured power (dBm) has offset with cable loss.

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# TEST RESULTS DATA Peak Power Spectral Density

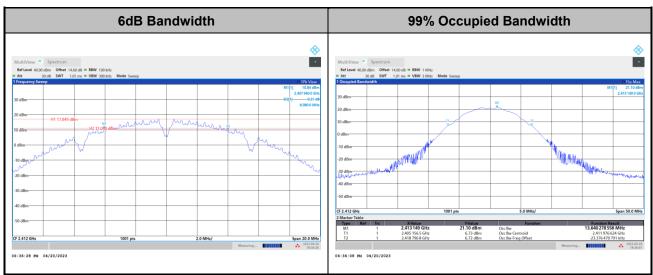
	2.4GHz Band MIMO												
Mod.	Data Rate	N⊤x	CH.	Freq. (MHz)	RU Config		Peak PSD (dBm/3kHz)		D (dl		Peak PSD Limit (dBm/3kHz)		Pass/Fail
						Ant1	Ant2	Worse + 3.01	Ant1	Ant2	Ant1	Ant2	
HE20	MCS0	2	1	2412	Full	-4.25	-3.69	-0.68	4.08		8.00		Pass
HE20	MCS0	2	6	2437	Full	-1.10	-0.55	2.46	4.08		8.00		Pass
HE20	MCS0	2	11	2462	Full	-3.88	-4.36	-0.87	4.08		8.00		Pass
HE40	MCS0	2	3	2422	Full	-5.38	-6.16	-2.37	4.08		8.00		Pass
HE40	MCS0	2	6	2437	Full	-3.44	-3.84	-0.43	4.08		8.00		Pass
HE40	MCS0	2	9	2452	Full	-7.25	-9.57	-4.24	4.08		8.00		Pass

Measured power density (dBm) has offset with cable loss.

### <CDD Modes>

### 6dB and 99% Occupied Bandwidth

### <802.11b>



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

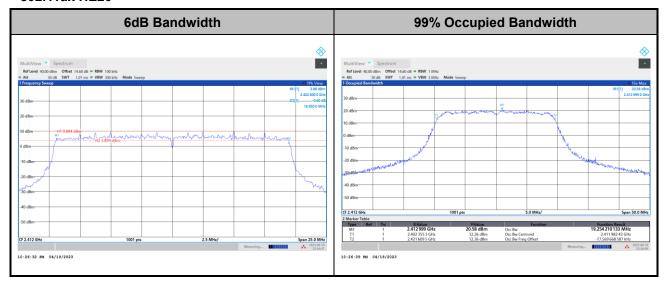
### <802.11g>



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

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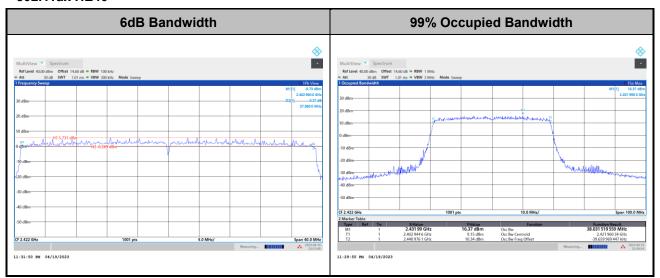
#### <802.11ax HE20>



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

#### <802.11ax HE40>

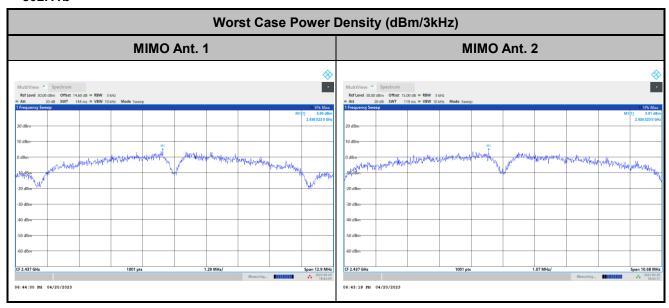


Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

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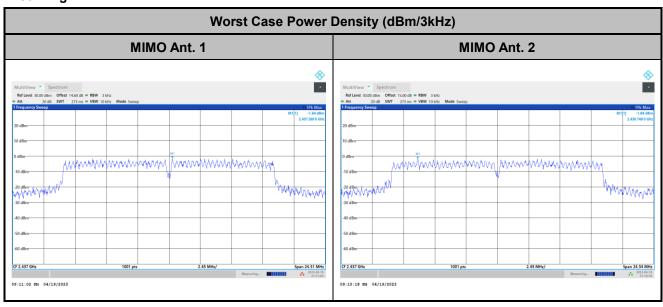
### Power Spectral Density(dBm/3kHz)

### <802.11b>



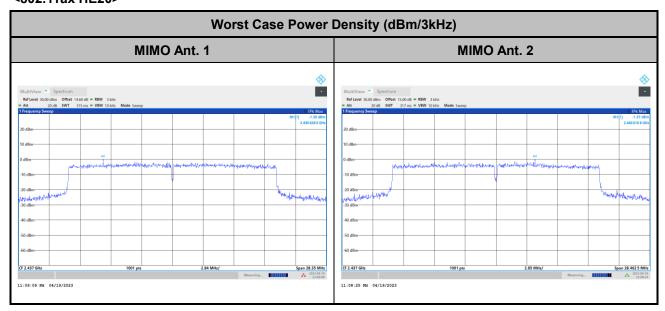
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### <802.11g>



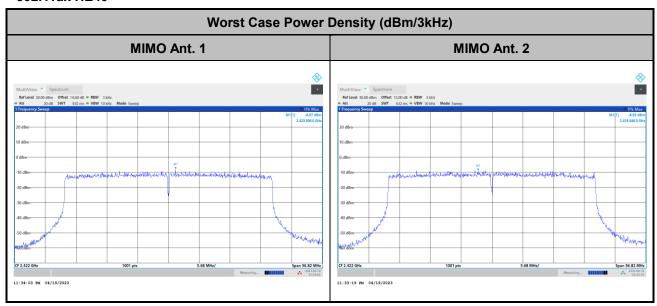
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### <802.11ax HE20>



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### <802.11ax HE40>



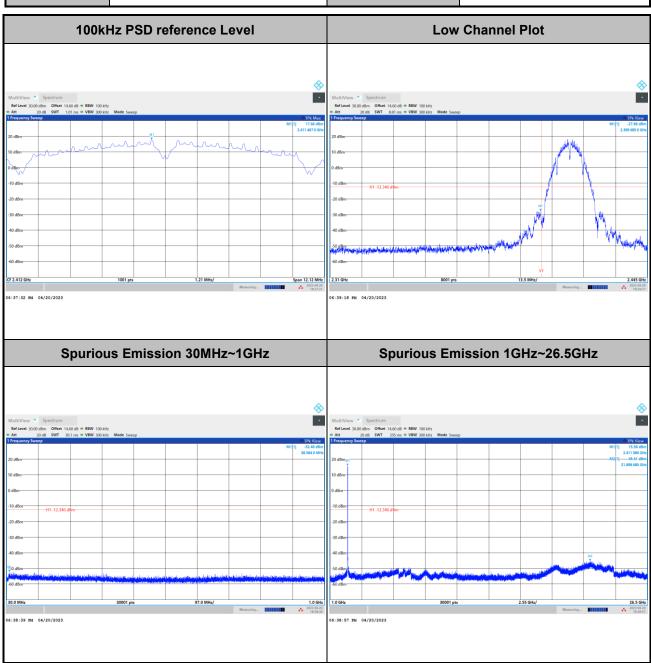
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## **Conducted Band Edges and Spurious Emission**

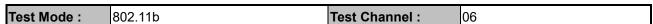
Number of TX = 2, Ant. 1 (Measured)



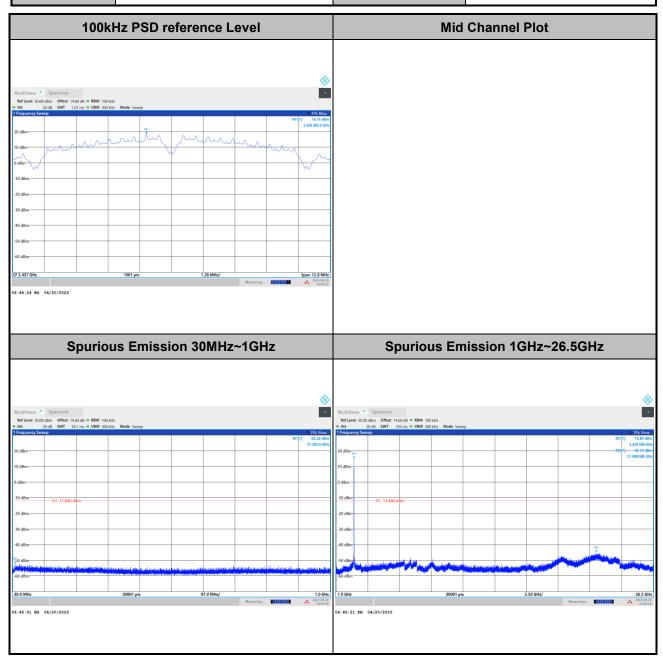
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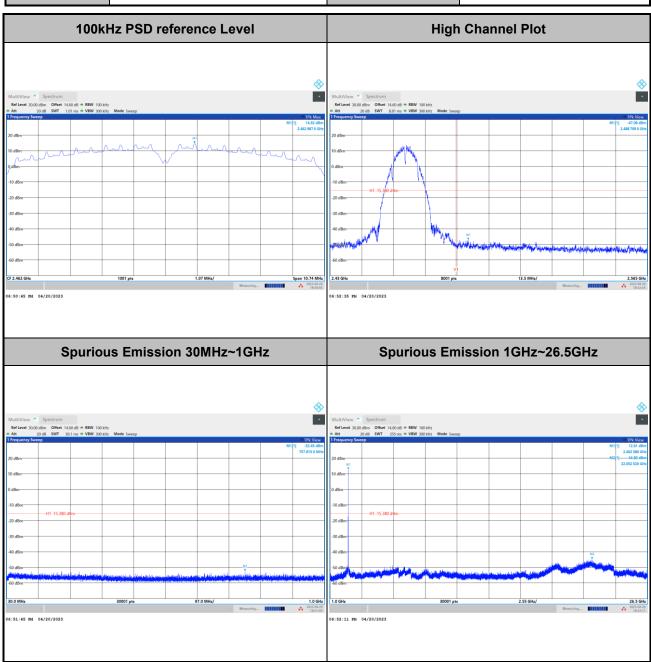


Report No.: FR330612A



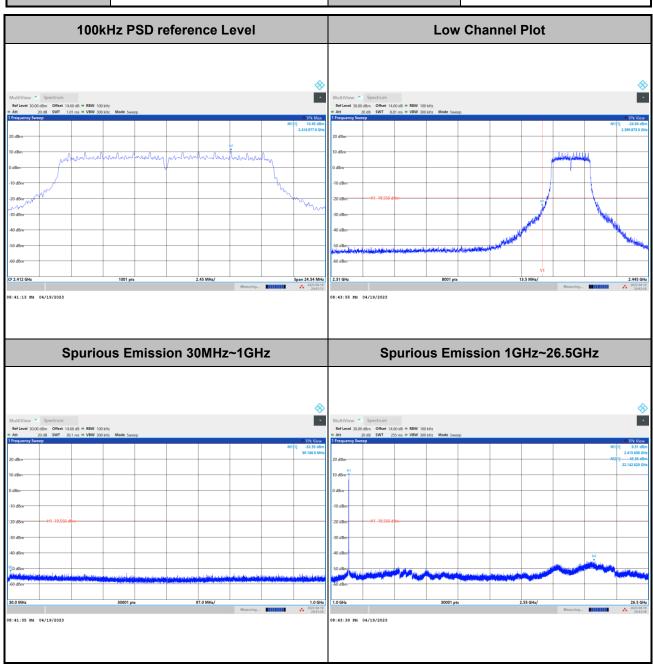
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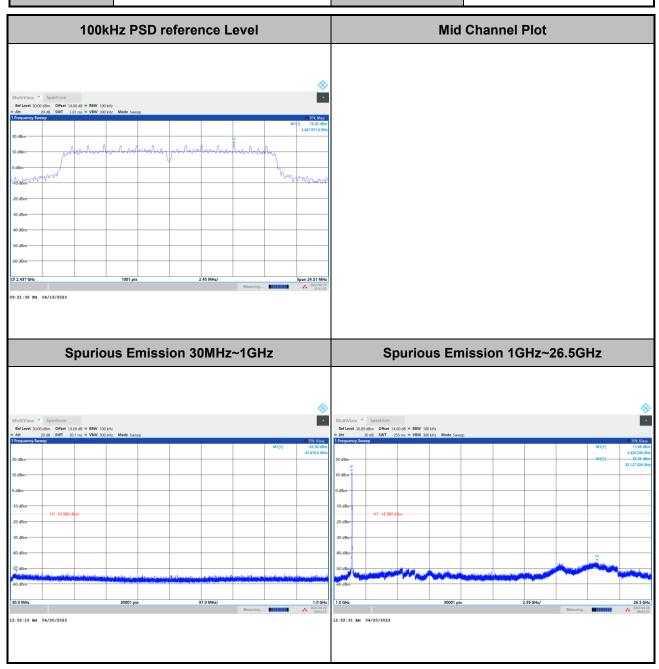
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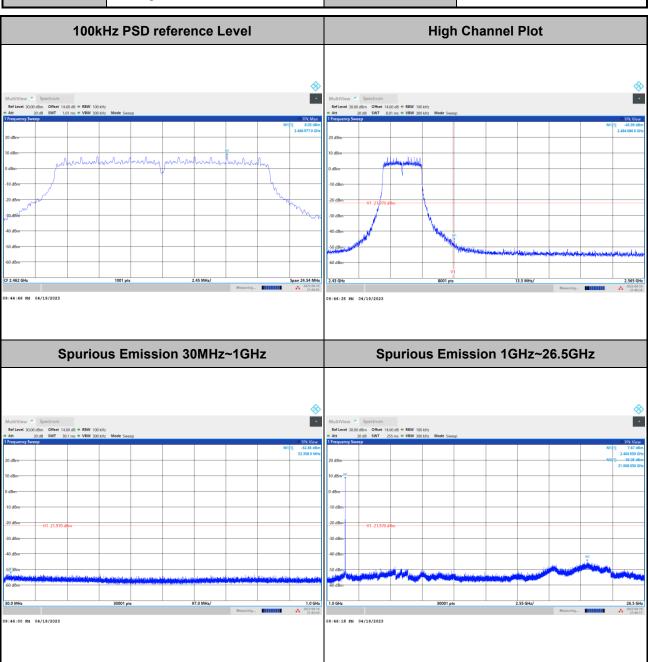
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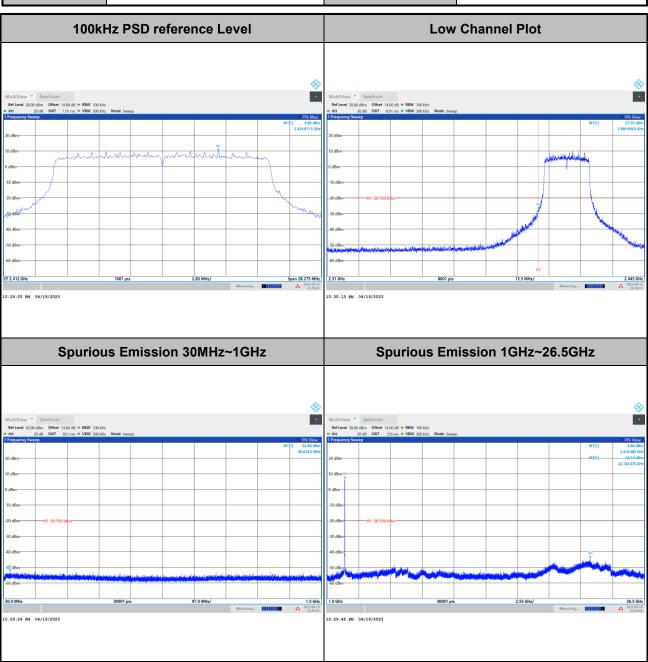
Report No.: FR330612A



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Test Mode: 802.11ax HE20 Test Channel: 01 Full RU

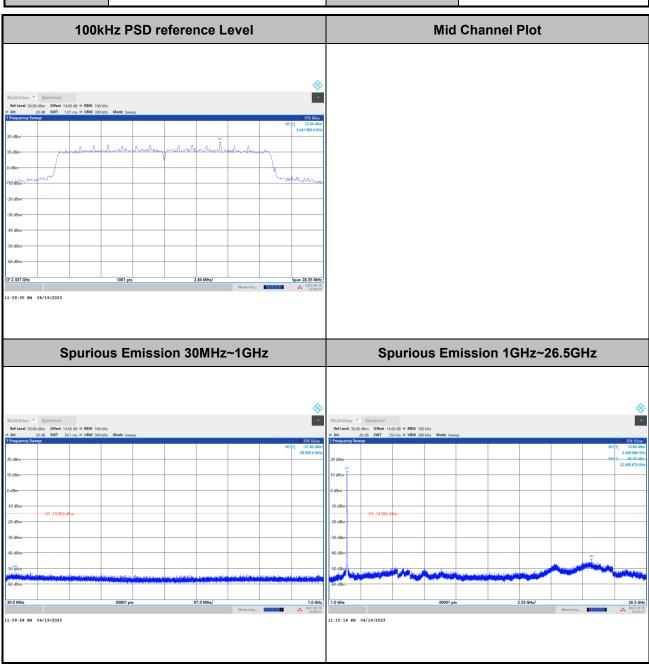
Report No.: FR330612A



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Test Mode: 802.11ax HE20 Test Channel: 06 Full RU

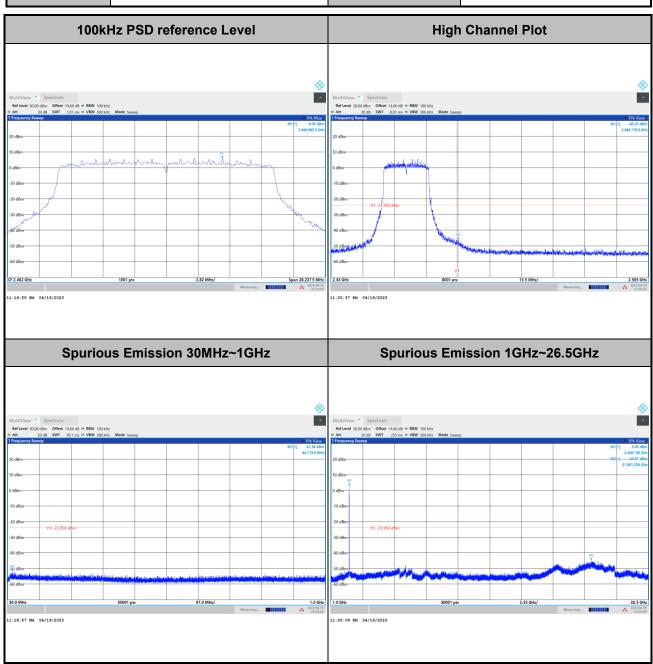
Report No. : FR330612A



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Test Mode: 802.11ax HE20 Test Channel: 11 Full RU

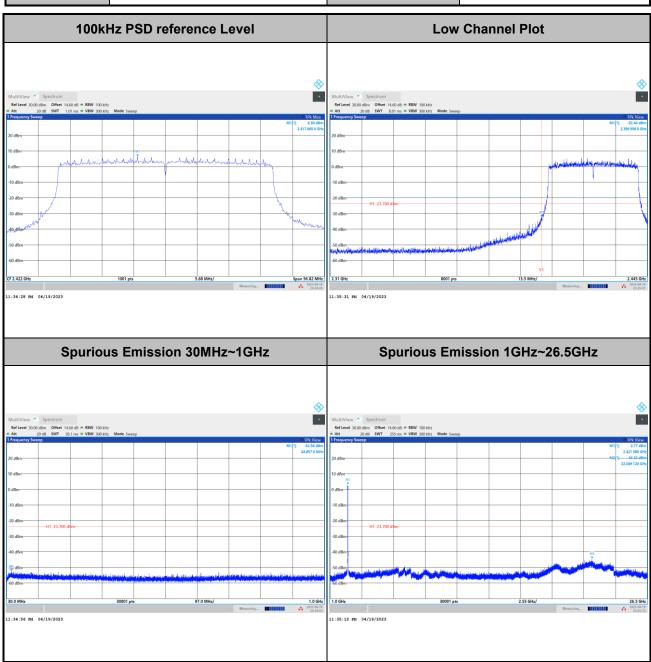
Report No.: FR330612A



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Test Mode: 802.11ax HE40 Test Channel: 03 Full RU

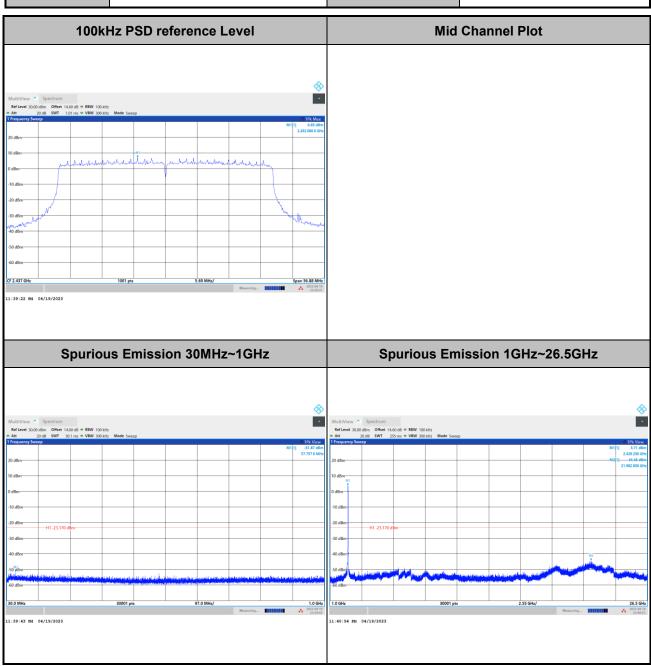
Report No.: FR330612A



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Test Mode: 802.11ax HE40 Test Channel: 06 Full RU

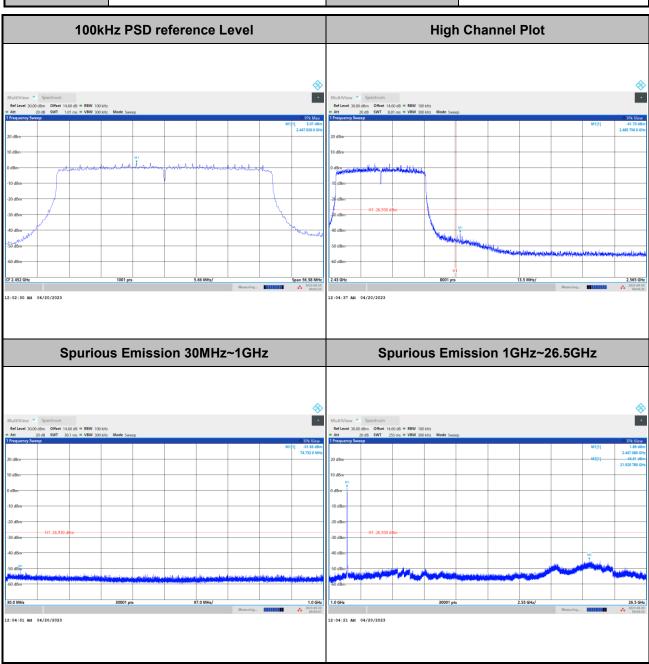
Report No.: FR330612A



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Test Mode: 802.11ax HE40 Test Channel: 09 Full RU

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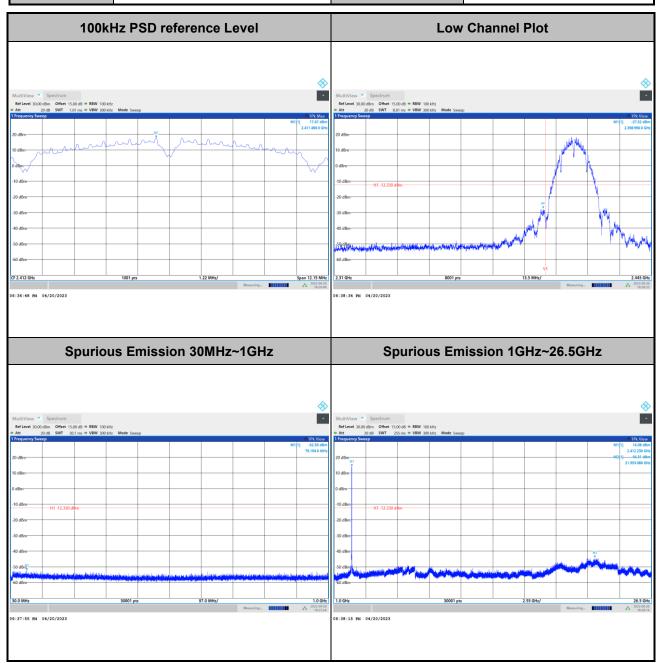


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### Number of TX = 2, Ant. 2 (Measured)

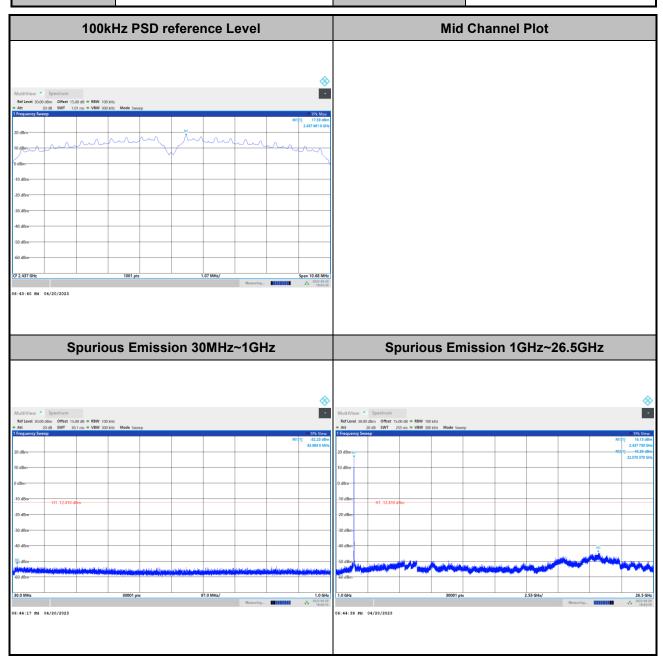
Test Mode: 802.11b Test Channel: 01

Report No.: FR330612A



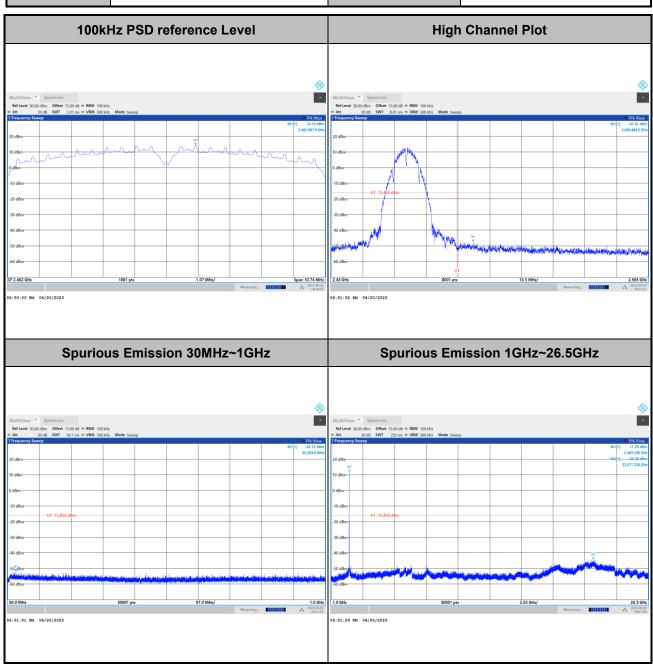
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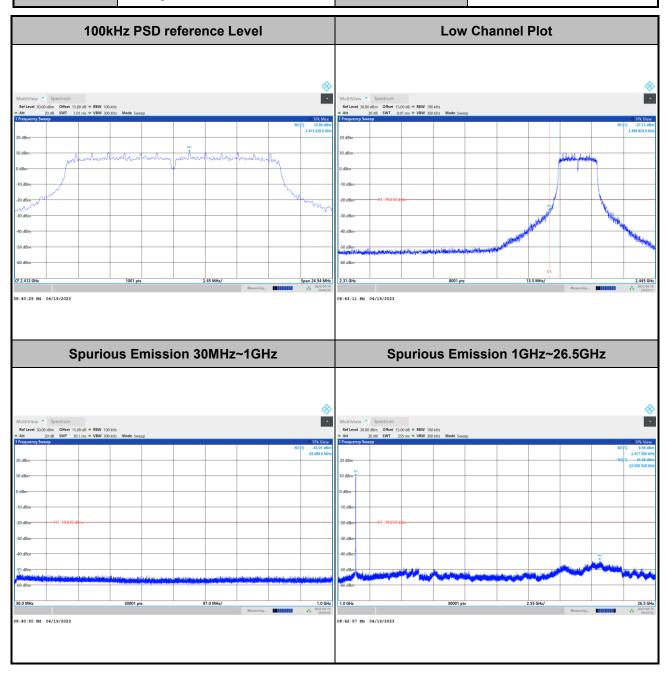
Report No.: FR330612A



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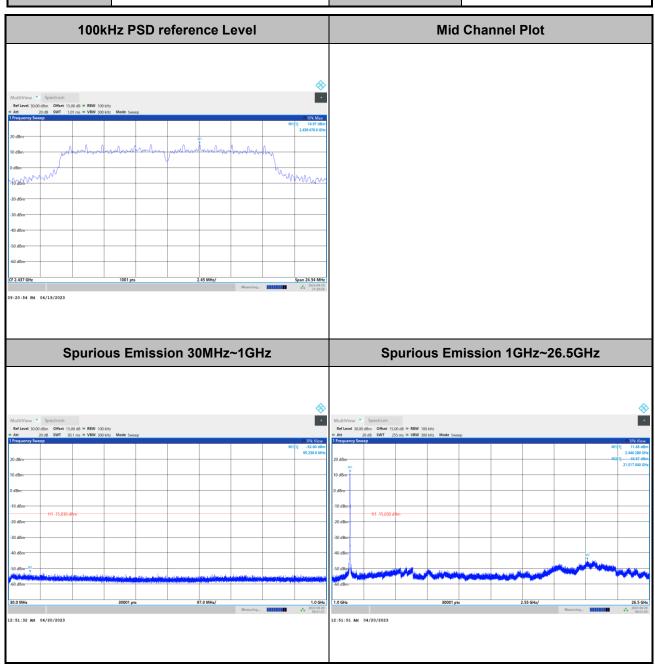


Report No.: FR330612A



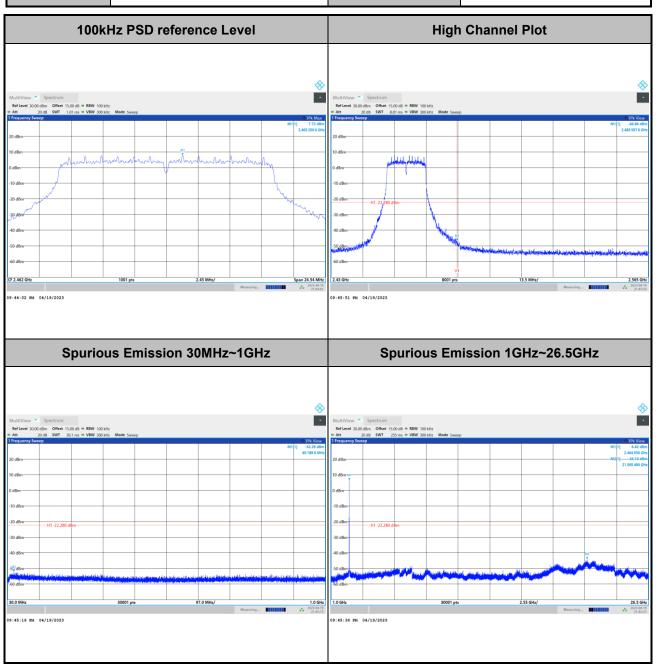
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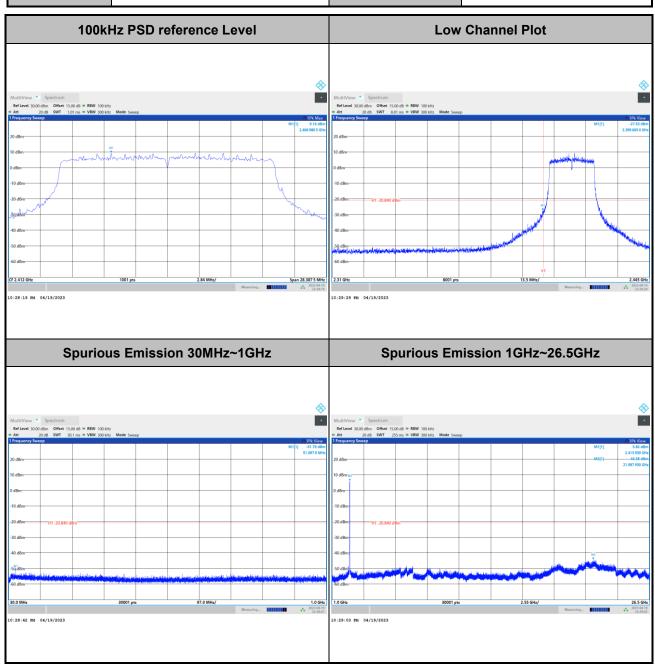
Report No.: FR330612A



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Test Mode: 802.11ax HE20 Test Channel: 01 Full RU

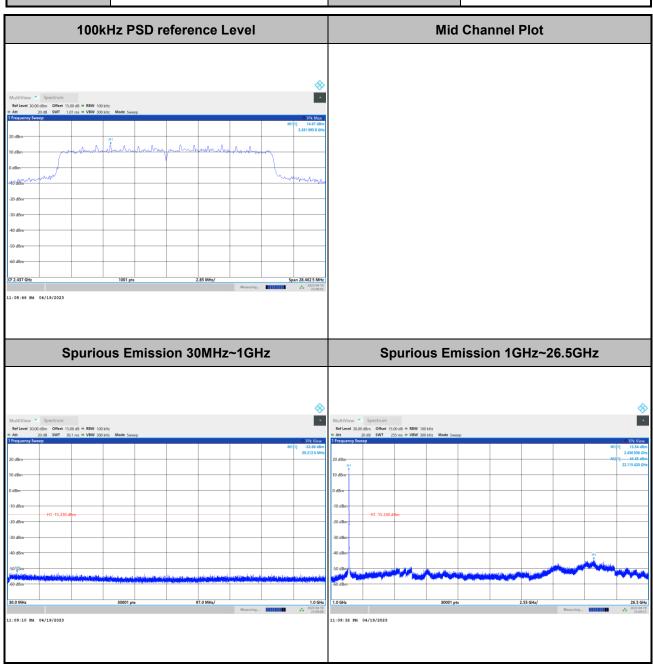
Report No.: FR330612A



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Test Mode: 802.11ax HE20 Test Channel: 06 Full RU

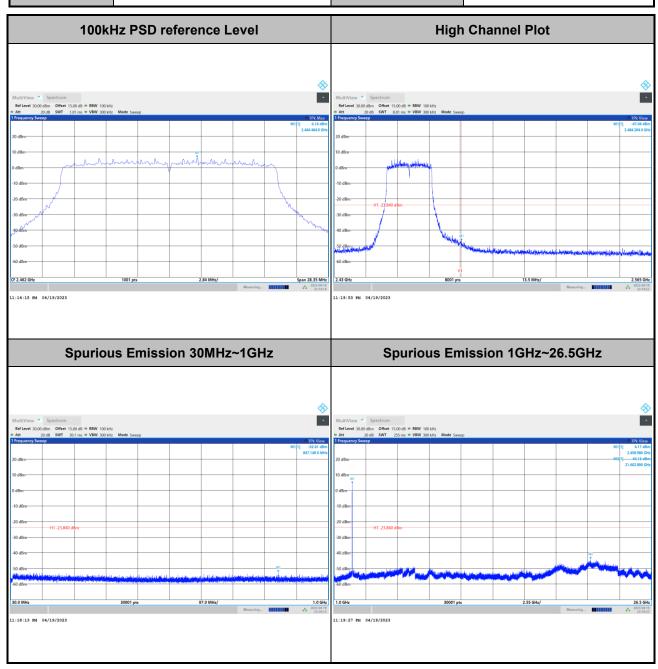
Report No. : FR330612A



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Test Mode: 802.11ax HE20 Test Channel: 11 Full RU

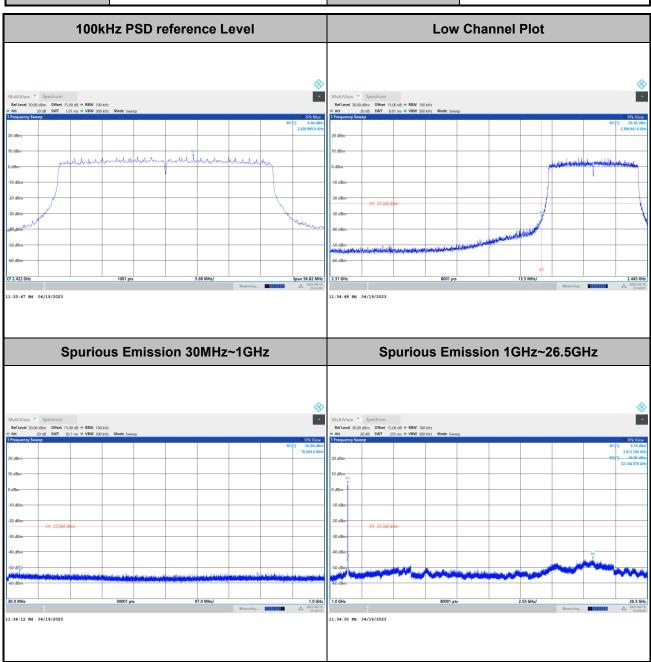
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Test Mode: 802.11ax HE40 Test Channel: 03 Full RU

Report No.: FR330612A



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