3.3 Conducted Emission Measurement

3.3.1 Limits of Conducted Emission Measurement

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

Note: 1. The lower limit shall apply at the transition frequencies.
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

3.3.2 Test Instruments

Test Name: CE Voltage – AC Power Port			**Test Date(s):** N/A		
MET Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1U0337	LISN	Com-Power	LI-215A	10/12/2022	10/12/2023
1S2003	EMI Test Receiver	Keysight	N9030B	11/01/2022	11/01/2023
Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.					

NOTE:

3.3.3 Test Procedure

a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.

b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

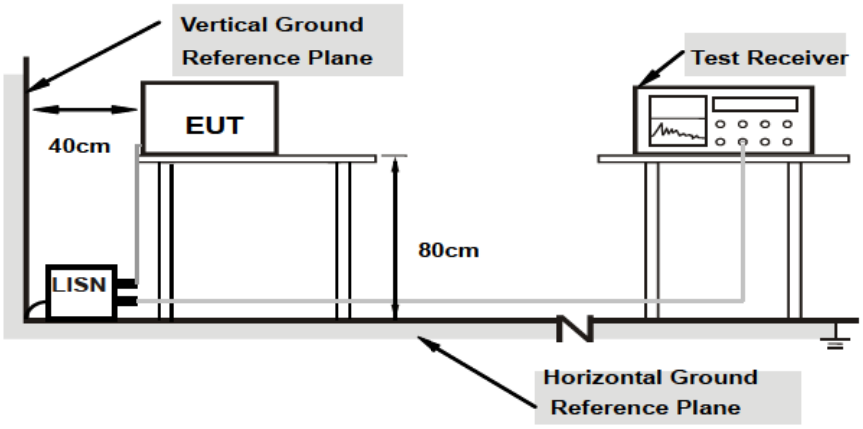
c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

NOTE: All modes of operation were investigated and the worst-case emissions are reported.

3.3.4 Deviation from Test Standard

No deviation.

3.3.5 Test Setup



Note: 1.Support units were connected to second LISN.
2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes

For the actual test configuration, please refer to the attached file (Test Setup Photo).

3.3.6 EUT Operating Condition

Same as 4.1.6.

3.3.7 Test Results
N/A

3.4 Transmit Power Measurement

3.4.1 Limits of Transmit Power Measurement

Operation Band	EUT Category		Limit
U-NII-1		Outdoor Access Point	1 Watt (30 dBm) (Max. e.i.r.p ≦ 125mW(21 dBm) at any elevation angle above 30 degrees as measured from the horizon)
		Fixed point-to-point Access Point	1 Watt (30 dBm)
		Indoor Access Point	1 Watt (30 dBm)
		Client device	250mW (24 dBm)
U-NII-2A	√		250mW (24 dBm) or 11 dBm+10 log B*
U-NII-2C	√		250mW (24 dBm) or 11 dBm+10 log B*
U-NII-3			1 Watt (30 dBm)

*B is the 26 dB emission bandwidth in megahertz

Per KDB 662911 Method of conducted output power measurement on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$;
Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any N_{ANT};
Array Gain = 5 log(N_{ANT}/N_{SS}) dB or 3 dB, whichever is less for 20-MHz channel widths with $N_{ANT} \geq 5$.

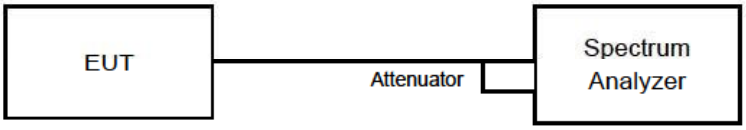
For power measurements on all other devices: Array Gain = 10 log(N_{ANT}/N_{SS}) dB.

3.4.2 Test Setup

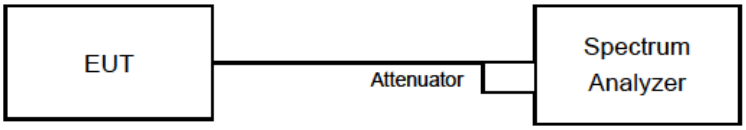
FOR POWER OUTPUT MEASUREMENT

◆ **Power Meter Measurement**

◆ **Spectrum Measurement**



FOR 26dB OCCUPIED BANDWIDTH



3.4.3 Test Instruments

Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1S4775	Power Meter	ROHDE & SCHWARZ	NRQ6	06/23/2022	06/23/2023

3.4.4 Test Procedure

For Average Power Measurement

For 802.11a, 802.11n (HT20), 802.11n (HT40), 802.11ac (VHT20, 802.11ac (VHT40)

Method PM is used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of TX on burst and set the detector to AVERAGE. Duty factor is not added to measured value.

For 802.11ac (VHT80)

1) Set span to encompass the entire 26 dB EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal.
2) Set sweep trigger to “free run”.
3) Set RBW = 1 MHz.
4) Set VBW ≥ 3 MHz
5) Number of points in sweep ≥ 2 Span / RBW.
6) Sweep time ≤ (number of points in sweep) * T
7) Using emission bandwidth to determine the frequency span for integration the channel bandwidth.
8) Detector = RMS.
9) Trace mode = max hold.
10) Allow max hold to run for at least 60 seconds, or longer as needed to allow the trace to stabilize.

◆ **Power Meter Measurement**

Method PM is used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of TX on burst. Duty factor is not added to measured value.

◆ **Spectrum Measurement**

Follow FCC KDB 789033 UNII test procedure:
Method SA-1

1. Set span to encompass the entire emission bandwidth (EBW) of the signal.
2. Set RBW =1MHz.
3. Set the VBW ≥ 3 x RBW.
4. Number of points in sweep ≥ 2 Span / RBW.
5. Sweep time = auto.
6. Set trigger to free run (duty cycle ≥ 98 percent)
7. Detector = RMS.
8. Trace average at least 100 traces in power averaging mode
9. Compute power by integrating the spectrum across the 26 dB EBW of the signal.

Follow FCC KDB 789033 UNII test procedure:
Method SA-2

1. Set span to encompass the emission bandwidth (EBW) of the signal.
2. Set RBW =1MHz.
3. Set the VBW ≥ 3 x RBW.
4. Number of points in sweep ≥ 2 Span / RBW.
5. Sweep time = auto.
6. Detector = RMS.
7. Trace average at least 100 traces in power averaging mode
8. Compute power by integrating the spectrum across the 26 dB EBW of the signal.
9. Duty factor need added to measured value (duty cycle < 98 percent).

FOR 26dB OCCUPIED BANDWIDTH

1. Set RBW = approximately 1% of the emission bandwidth.
2. Set the VBW > RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

3.4.5 Deviation from Test Standard

No deviation.

3.4.6 EUT Operating Condition

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

3.4.7 Test Results

Output Power measurement result for UNII-2 Band

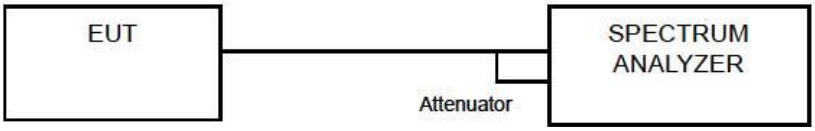
Type	Test mode	Freq (MHz)	CH	Conducted Power (dBm)	Limit (dBm)	Result
Output Power	802.11a	5260	Low	6.554	24	Pass
		5280	Mid	6.713	24	Pass
		5320	High	6.453	24	Pass
		5500	Low	6.499	24	Pass
		5580	Mid	6.667	24	Pass
		5700	High	6.313	24	Pass
	802.11n-HT20	5260	Low	6.934	24	Pass
		5280	Mid	6.822	24	Pass
		5320	High	6.279	24	Pass
		5500	Low	6.724	24	Pass
		5580	Mid	6.747	24	Pass
		5700	High	6.456	24	Pass

3.5 26dB Bandwidth & 6dB Bandwidth Measurement

3.5.1 Limits of 6 dB Bandwidth Measurement

The minimum of 6 dB Bandwidth Measurement is 0.5 MHz.

3.5.2 Test Setup



3.5.3 Test Instruments

MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1S2003	EMI Test Receiver	Keysight	N9030B	11/01/2022	11/01/2023

3.5.4 Test Procedure

26dB Emission bandwidth measurement procedure (Other than 5.725-5.85 GHz)

- Allow the trace to stabilize.
- Use the spectrum analyzer built-in measurement function to determine the 26dB BW.
  Set RBW = around 1% of emission bandwidth
  Set VBW > RBW
  Detector = Peak
  Trace mode = max hold
- Capture the plot.
- Repeat above steps for different test channel and other modulation type.

6 dB Minimum emission bandwidth measurement procedure

- Allow the trace to stabilize.
- Use the spectrum analyzer built-in measurement function to determine the 6dB BW.
  Set RBW = 100 KHz
  Set VBW ≥ 3 x RBW
  Detector = Peak
  Trace mode = max hold
  Sweep = auto couple
- Capture the plot.
- Repeat above steps for different test channel and other modulation type.

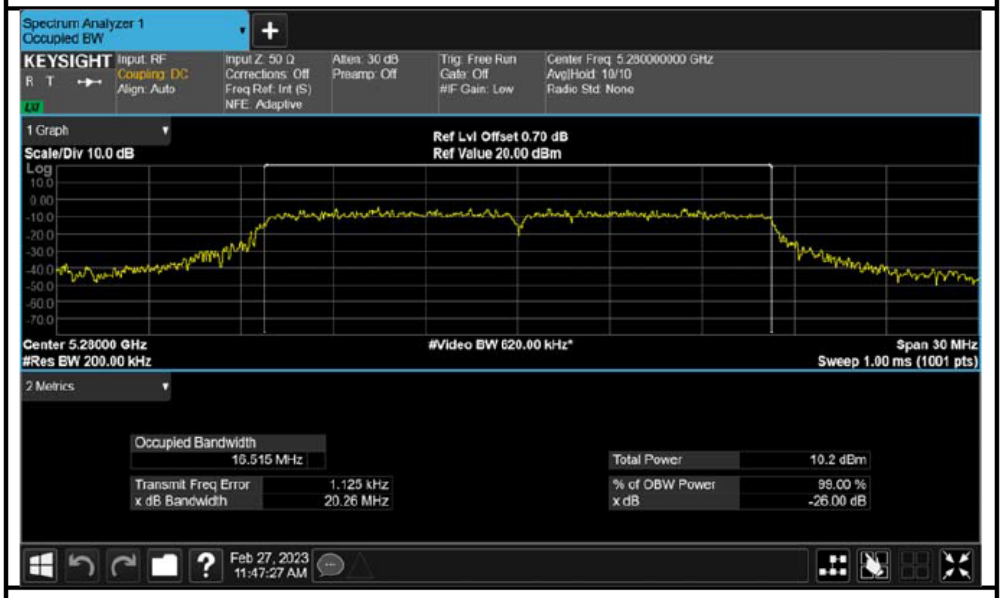
3.5.5 Test Results

26dB Bandwidth measurement result for UNII-2 Band

Type	Test mode	Freq (MHz)	CH	99% OBW(MHz)	26 dB OBW(MHz)
26dB BW	802.11a	5260	Low	16.461	19.951
		5280	Mid	16.515	20.260
		5320	High	16.437	20.314
		5500	Low	16.459	19.759
		5580	Mid	16.462	19.827
		5700	High	16.469	19.789
	802.11n-HT20	5260	Low	17.617	20.803
		5280	Mid	17.600	20.181
		5320	High	17.638	20.709
		5500	Low	17.606	21.029
		5580	Mid	17.582	21.282
		5700	High	17.637	21.129

Occupied Bandwidth Test Plots
UNII-2 Band

802.11a-5260MHz



802.11a-5280MHz

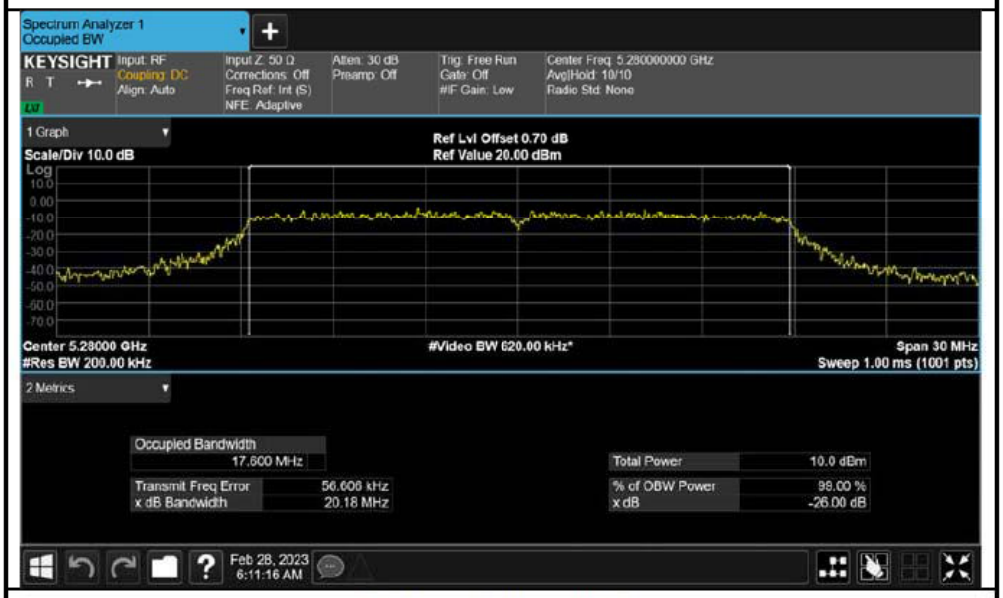
802.11a-5320MHz

802.11a-5500MHz

802.11a-5580MHz

802.11a-5700MHz

802.11n HT20-5260MHz



802.11n HT20-5280MHz

802.11n HT20-5320MHz

802.11n HT20-5500MHz

802.11n HT20-5580MHz

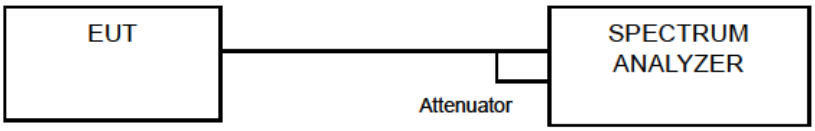
802.11n HT20-5700MHz

3.6 Peak Power Spectral Density Measurement

3.6.1 Limits of Peak Power Spectral Density Measurement

Operation Band	EUT Category		Limit
U-NII-1		Outdoor Access Point	17dBm/ MHz
		Fixed point-to-point Access Point	
		Indoor Access Point	
	√	Client device	11dBm/ MHz
U-NII-2A	√		11dBm/ MHz
U-NII-2C	√		11dBm/ MHz
U-NII-3	√		30dBm/ 500kHz

3.6.2 Test Setup



3.6.3 Test Instruments

MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1S2003	EMI Test Receiver	Keysight	N9030B	11/01/2022	11/01/2023

3.6.4 Test Procedure

For U-NII-1, U-NII-2A, U-NII-2C band:

Using method SA-1

1. Set span to encompass the entire emission bandwidth (EBW) of the signal.
2. Set RBW = 1 MHz, Set VBW ≥ 3 MHz, Detector = RMS
3. Sweep time = auto, trigger set to “free run”.
4. Trace average at least 100 traces in power averaging mode.
5. Record the max value

For U-NII-3:

1. Set span to encompass the entire emission bandwidth (EBW) of the signal.
2. Set RBW = 300 kHz, Set VBW ≥ 1 MHz, Detector = RMS
3. Use the peak marker function to determine the maximum power level in any 300 kHz band segment within the fundamental EBW.
4. Scale the observed power level to an equivalent value in 500 kHz by adjusting (reducing) the measured power by a bandwidth correction factor (BWCF) where BWCF = 10log(500 kHz/300kHz)
5. Sweep time = auto, trigger set to “free run”.
6. Trace average at least 100 traces in power averaging mode.
7. Record the max value

3.6.5 Deviation from Test Standard

No deviation.

3.6.6 EUT Operating Condition

Same as Item 4.3.6.

3.6.7 Test Results

PSD measurement result for UNII-2 Band

Type	Test mode	Freq (MHz)	CH	Conducted PSD (dBm/MHz)	Limit (dBm/MHz)	Result
Output Power	802.11a	5260	Low	0.102	11	Pass
		5280	Mid	0.356	11	Pass
		5320	High	0.034	11	Pass
		5500	Low	0.413	11	Pass
		5580	Mid	0.363	11	Pass
		5700	High	-0.183	11	Pass
	802.11n-HT20	5260	Low	-0.092	11	Pass
		5280	Mid	-0.009	11	Pass
		5320	High	-0.168	11	Pass
		5500	Low	0.053	11	Pass
		5800	Mid	-0.011	11	Pass
		5700	High	-0.233	11	Pass

Test Plot for:

UNII-2 Band

802.11a-5260MHz

802.11a-5280MHz

802.11a-5320MHz

802.11a-5500MHz

802.11a-5580MHz

802.11a-5700MHz

802.11n HT20-5260MHz

802.11n HT20-5280MHz

802.11n HT20-5320MHz

802.11n HT20-5500MHz

802.11n HT20-5580MHz

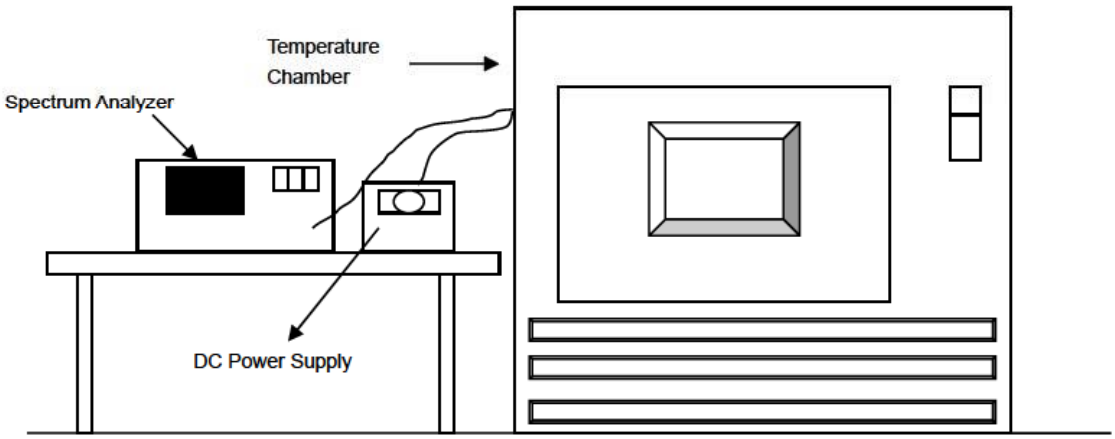
802.11n HT20-5700MHz

3.7 Frequency Stability Measurement

3.7.1 Limits of Frequency Stability Measurement

The frequency of the carrier signal shall be maintained within band of operation.

3.7.2 Test Setup



3.7.3 Test Instruments

MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1S2003	EMI Test Receiver	Keysight	N9030B	11/01/2022	11/01/2023
1S2776	Temperature Chambers	Lunaire	BTC	Note 1	Note 1
Note 1: Verified by calibrated instrumentation at the time of testing					

3.7.4 Test Procedure

a. The EUT was placed inside the environmental test chamber and powered by nominal DC voltage.
b. Turn the EUT on and couple its output to a spectrum analyzer.
c. Turn the EUT off and set the chamber to the highest temperature specified.
d. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize, turn the EUT on and measure the operating frequency after 2, 5, and 10 Minutes.
e. Repeat step (d) with the temperature chamber set to the next desired temperature until measurements down to the lowest specified temperature have been completed..
f. The test chamber was allowed to stabilize at +20 degree C for a minimum of 30 Minutes. The supply voltage was then adjusted on the EUT from 85% to 115% and the frequency record.

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3.7.5 Deviation from Test Standard

No deviation.

3.7.6 EUT Operating Condition

Set the EUT transmit at un-modulation mode to test frequency stability.

3.7.7 Test Results

Frequency Stability Versus Temp.									
Operating Frequency: 5260 MHz									
TEMP. (℃)	Power Supply (Vdc)	0 Minute		2 Minute		5 Minute		10 Minute	
		Measured Frequency (MHz)	Pass/Fail	Measured Frequency (MHz)	Pass/Fail	Measured Frequency (MHz)	Pass/Fail	Measured Frequency (MHz)	Pass/Fail
50	3.0	5259.984	Pass	5260.073	Pass	5259.993	Pass	5260.014	Pass
40	3.0	5260.061	Pass	5260.006	Pass	5260.012	Pass	5260.013	Pass
30	3.0	5260.002	Pass	5260.013	Pass	5260.003	Pass	5260.002	Pass
20	3.0	5260.005	Pass	5260.013	Pass	5260.005	Pass	5260.02	Pass
10	3.0	5259.987	Pass	5259.983	Pass	5260.009	Pass	5260.019	Pass
0	3.0	5260.014	Pass	5260.015	Pass	5259.982	Pass	5260.995	Pass
-10	3.0	5259.985	Pass	5259.993	Pass	5259.985	Pass	5260.007	Pass
-20	3.0	5259.916	Pass	5260.002	Pass	5260.014	Pass	5260.02	Pass
-30	3.0	5260.015	Pass	5259.999	Pass	5260.002	Pass	5260.003	Pass

Frequency Stability Versus Voltage									
Operating Frequency: 5260 MHz									
TEMP. (℃)	Power Supply (Vdc)	0 Minute		2 Minute		5 Minute		10 Minute	
		Measured Frequency (MHz)	Pass/Fail	Measured Frequency (MHz)	Pass/Fail	Measured Frequency (MHz)	Pass/Fail	Measured Frequency (MHz)	Pass/Fail
20	3.45	5260.021	Pass	5259.991	Pass	5260.02	Pass	5260.013	Pass
	3.0	5259.997	Pass	5259.927	Pass	5260.034	Pass	5260.013	Pass
	2.55	5260.131	Pass	5260.023	Pass	5259.9	Pass	5259.992	Pass

4 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

--- END ---