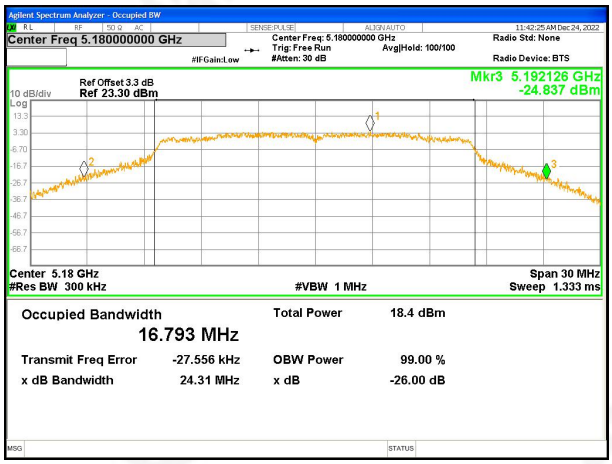
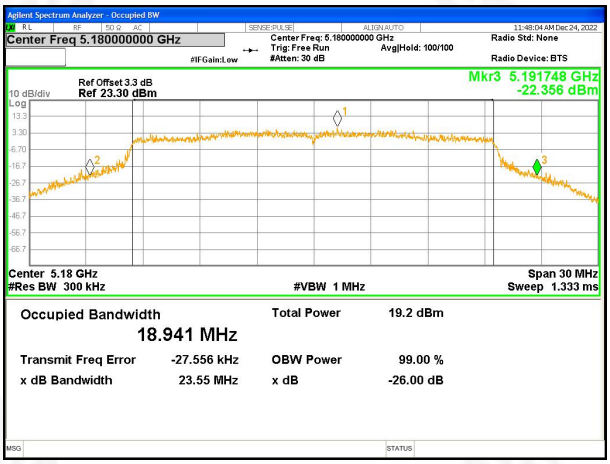
Test plot Antenna 1

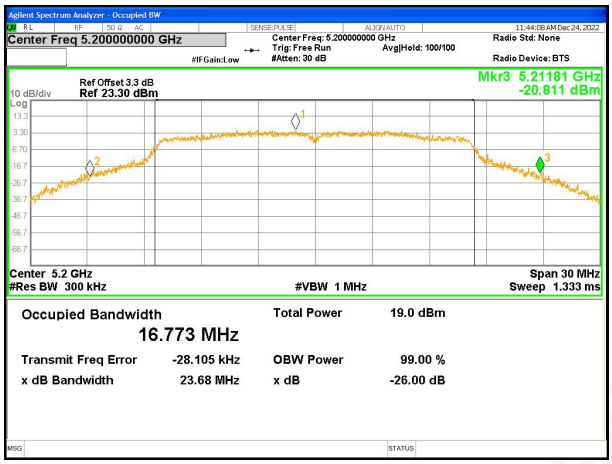
(802.11 a20) 26dB Bandwidth plot on channel 36



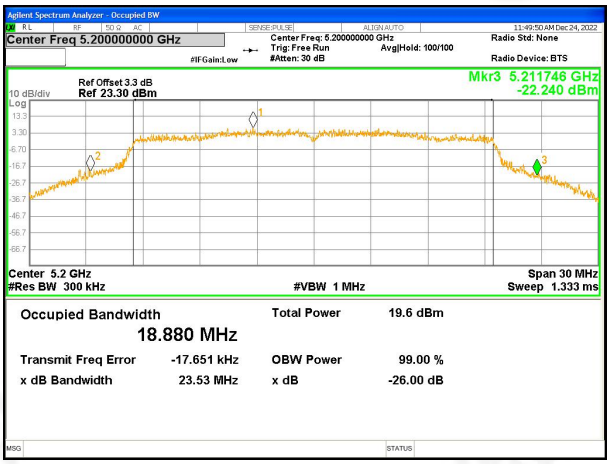
(802.11 n20) 26dB Bandwidth plot on channel 36



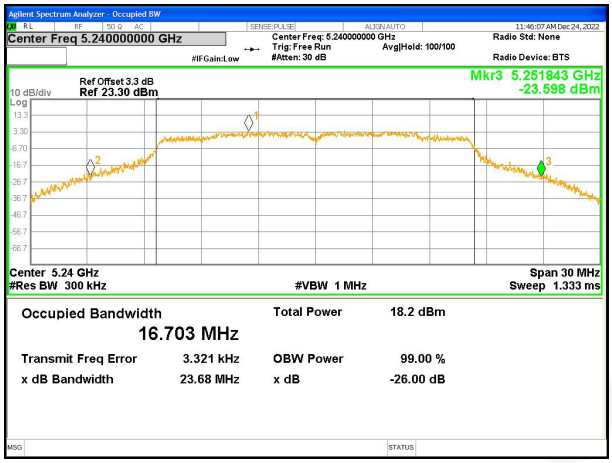
(802.11 a20) 26dB Bandwidth plot on channel 40



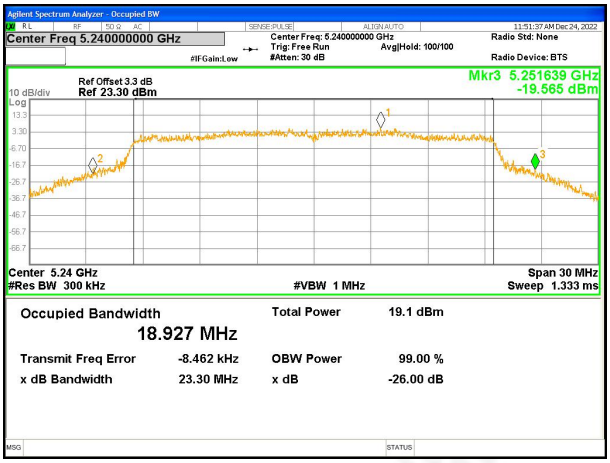
(802.11 n20) 26dB Bandwidth plot on channel 40



(802.11 a20) 26dB Bandwidth plot on channel 48

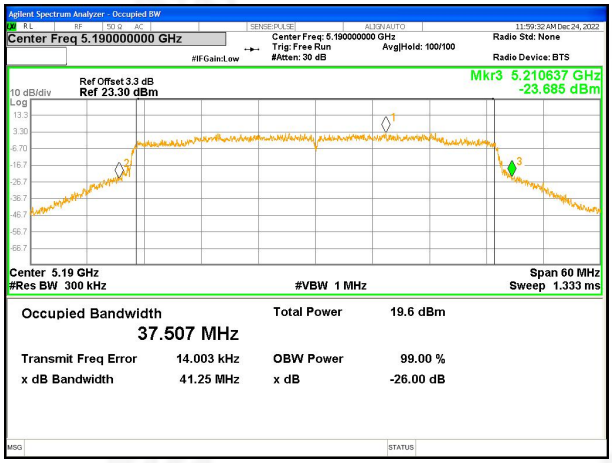


(802.11 n20) 26dB Bandwidth plot on channel 48

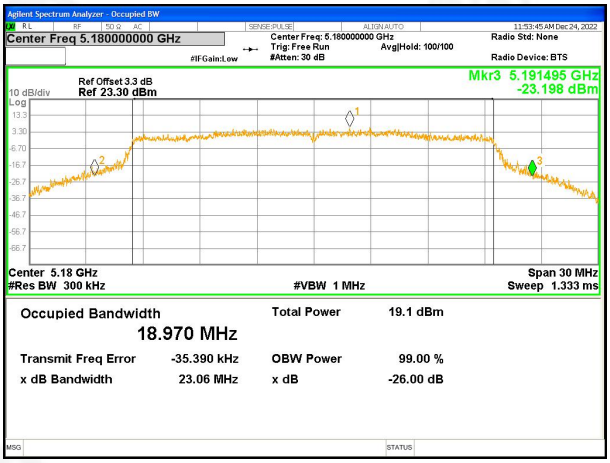


Test plot Antenna 1

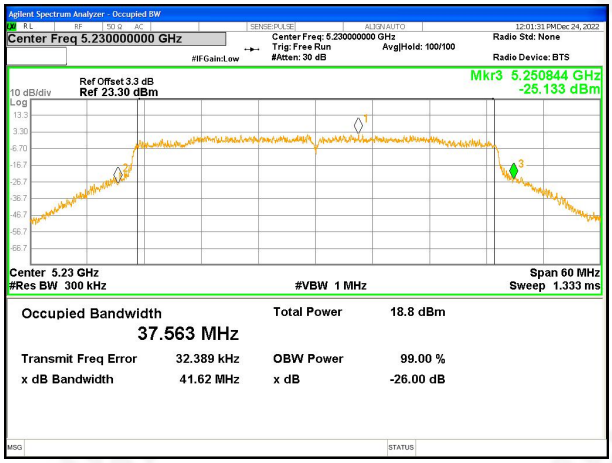
(802.11 n40) 26dB Bandwidth plot on channel 38



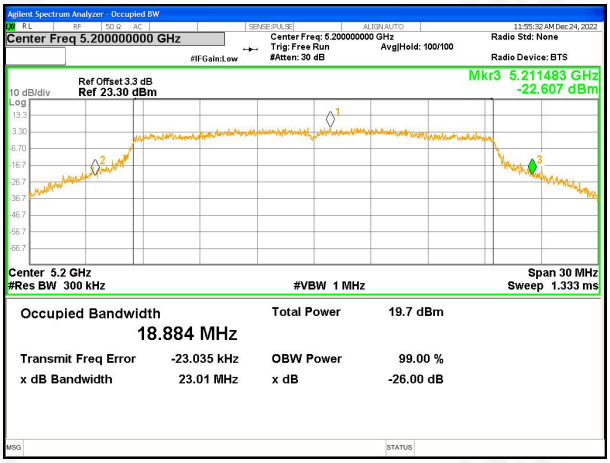
(802.11ac20) 26dB Bandwidth plot on channel 36



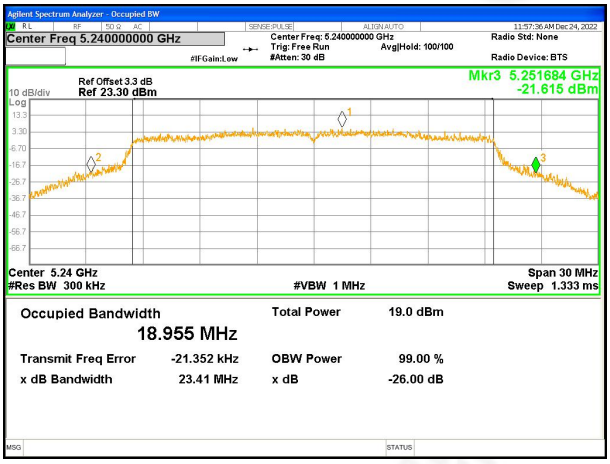
(802.11 n40) 26dB Bandwidth plot on channel 46



(802.11ac20) 26dB Bandwidth plot on channel 40

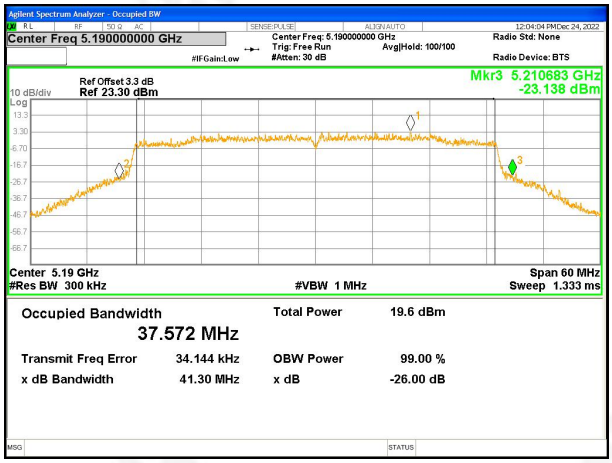


(802.11ac20) 26dB Bandwidth plot on channel 48

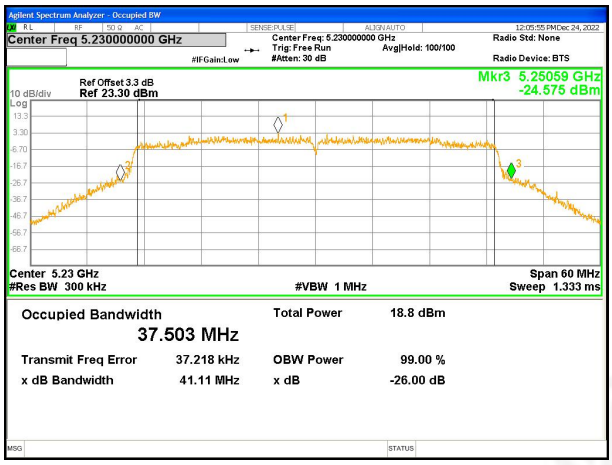


Test plot Antenna 1

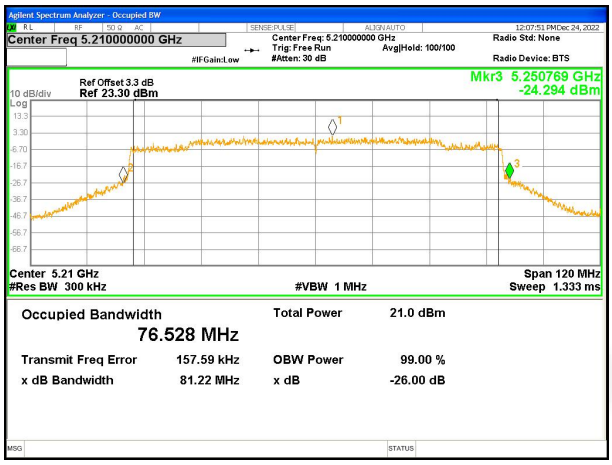
(802.11 ac40) 26dB Bandwidth plot on channel 42



(802.11 ac40) 26dB Bandwidth plot on channel 42



(802.11 ac80) 26dB Bandwidth plot on channel 42



7.MAXIMUM CONDUCTED OUTPUT POWER

7.1 PPLIED PROCEDURES / LIMIT

According to FCC §15.407
The maximum conduced output power should not exceed:

Frequency Band(MHz)	Limit
5150~5250	250mW

If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

7.2 TEST PROCEDURE

The EUT was directly connected to the Power meter

1. Device Configuration
If possible, configure or modify the operation of the EUT so that it transmits continuously at its maximum power control level (see section II.B.).
a) The intent is to test at 100 percent duty cycle; however a small reduction in duty cycle (to no lower than 98 percent) is permitted if required by the EUT for amplitude control purposes. Manufacturers are expected to provide software to the test lab to permit such continuous operation.
b) If continuous transmission (or at least 98 percent duty cycle) cannot be achieved due to hardware limitations (e.g., overheating), the EUT shall be operated at its maximum power control level with the transmit duration as long as possible and the duty cycle as high as possible.

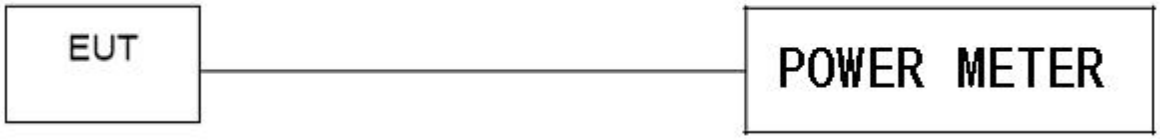
2. Measurement using a Spectrum Analyzer or EMI Receiver (SA)
Measurement of maximum conducted output power using a spectrum analyzer requires integrating the spectrum across a frequency span that encompasses, at a minimum, either the EBW or the 99-percent occupied bandwidth of the signal.1 However, the EBW must be used to determine bandwidth dependent limits on maximum conducted output power in accordance with § 15.407(a).
a) The test method shall be selected as follows: (i) Method SA-1 or SA-1 Alternative (averaging with the EUT transmitting at full power throughout each sweep) shall be applied if either of the following conditions can be satisfied:
• The EUT transmits continuously (or with a duty cycle ≥ 98 percent).
• Sweep triggering or gating can be implemented in a way that the device transmits at the maximum power control level throughout the duration of each of the instrument sweeps to be averaged. This condition can generally be achieved by triggering the instrument's sweep if the duration of the sweep (with the analyzer configured as in Method SA-1, below) is equal to or shorter than the duration T of each transmission from the EUT and if those transmissions exhibit full power throughout their durations.
(ii) Method SA-2 or SA-2 Alternative (averaging across on and off times of the EUT transmissions, followed by duty cycle correction) shall be applied if the conditions of (i) cannot be achieved and the transmissions exhibit a constant duty cycle during the measurement duration. Duty cycle will be considered to be constant if variations are less than ± 2 percent.
(iii) Method SA-3 (RMS detection with max hold) or SA-3 Alternative (reduced VBW with max hold) shall be applied if the conditions of (i) and (ii) cannot be achieved.
b) Method SA-1 (trace averaging with the EUT transmitting at full power throughout each sweep): (i) Set span to encompass the entire emission bandwidth (EBW) (or, alternatively, the entire 99% occupied bandwidth) of the signal.
(ii) Set RBW = 1 MHz.
(iii) Set VBW ≥ 3 MHz.
(iv) 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.)
(v) Sweep time = auto.
(vi) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.
(vii) If transmit duty cycle < 98 percent, use a video trigger with the trigger level set to enable triggering only on full power pulses. Transmitter must operate at maximum power control level for the entire duration of every sweep. If the EUT transmits continuously (i.e., with no off intervals) or at duty cycle ≥ 98 percent, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to "free run".

(viii) Trace average at least 100 traces in power averaging (i.e., RMS) mode.
(ix) Compute power by integrating the spectrum across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal using the instrument's band power measurement function with band limits set equal to the EBW (or occupied bandwidth) band edges. If the instrument does not have a band power function, sum the spectrum

7.3 DEVIATION FROM STANDARD

No deviation.

7.4 TEST SETUP



7.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

7.6 TEST RESULTS

Temperature:	26 ℃	Relative Humidity:	54%
Pressure:	1012 hPa	Test Voltage :	DC 11.4V
Test Mode :	TX		

Test Channel	Frequency (MHz)	Maximum output power (dBm)			LIMIT dBm	Result
		ANT0	ANT1	Total		
TX 802.11 a20M Mode						
CH36	5180	11.79	12.52	/	23.98	Pass
CH40	5200	12.18	13.11	/	23.98	Pass
CH48	5240	11.77	12.43	/	23.98	Pass
TX 802.11 n20M Mode						
CH36	5180	12.2	12.59	15.41	21.98	Pass
CH40	5200	12.69	13.12	15.92	21.98	Pass
CH48	5240	11.84	12.52	15.20	21.98	Pass
TX 802.11 n40M Mode						
CH38	5190	12.52	12.99	15.77	21.98	Pass
CH46	5230	11.55	12.12	14.85	21.98	Pass
TX 802.11 ac20M Mode						
CH36	5180	12.21	12.55	15.39	21.98	Pass
CH40	5200	12.64	13.06	15.87	21.98	Pass
CH48	5240	11.84	12.53	15.21	21.98	Pass
TX 802.11 ac40M Mode						
CH38	5190	12.51	13	15.77	21.98	Pass
CH46	5230	11.47	12.14	14.83	21.98	Pass
TX 802.11 ac80M Mode						
CH42	5210	13.78	14.03	16.92	21.98	Pass

Directional Gain Calculations for In-Band Measurements
a) Basic methodology with N_{ANT} transmit antennas, each with the same directional gain G_{ANT} dBi, being driven by N_{ANT} transmitter outputs of equal power. Directional gain is to be computed as follows:
(i) If any transmit signals are correlated with each other,
Directional gain = G_{ANT} + 10 log(N_{ANT}) dBi
(ii) If all transmit signals are completely uncorrelated with each other,
Directional gain = G_{ANT}

802.11b/g is SISO(transmit signals are completely uncorrelated), 802.11n is MIMO(transmit signals are correlated)

Note: EIRP=Peak Output Power+Directional gain，Peak Output Power=conduced output power+duty cycle factor(802.11a duty cycle factor is 0.09, 802.11n/ac duty cycle factor is 0)

8.OUT OF BAND EMISSIONS

8.1 APPLICABLE STANDARD

According to FCC §15.407(b)

Undesirable emission limits. Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

(1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

Frequency Band (MHz)	Function	Resolution bandwidth	Video Bandwidth
30 to 1000	QP	120 kHz	300 kHz
Above 1000	Peak	1 MHz	1 MHz
	Average	1 MHz	10 Hz

8.2 TEST PROCEDURE

a. The measuring distance of at 3 m shall be used for measurements at frequency up to 1GHz. For frequencies above 1GHz, any suitable measuring distance may be used.
b. The EUT was placed on the top of a rotating table 0.8 m for below 1GHz and 1.5m for above 1GHz the ground at a 3 meter. The table was rotated 360 degrees to determine the position of the highest radiation.
c. The height of the equipment or of the substitution antenna shall be 0.8 m for below 1GHz and 1.5m for above 1GHz; the height of the test antenna shall vary between 1 m to 4 m. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d. The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
e. If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed.
f. For the actual test configuration, please refer to the related Item –EUT Test Photos.

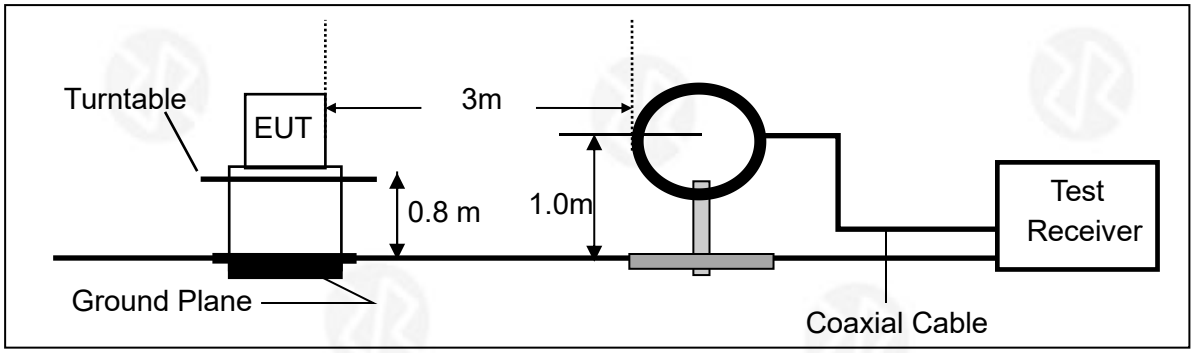
Note:

Both horizontal and vertical antenna polarities were tested
and performed pretest to three orthogonal axis. The worst case emissions were reported

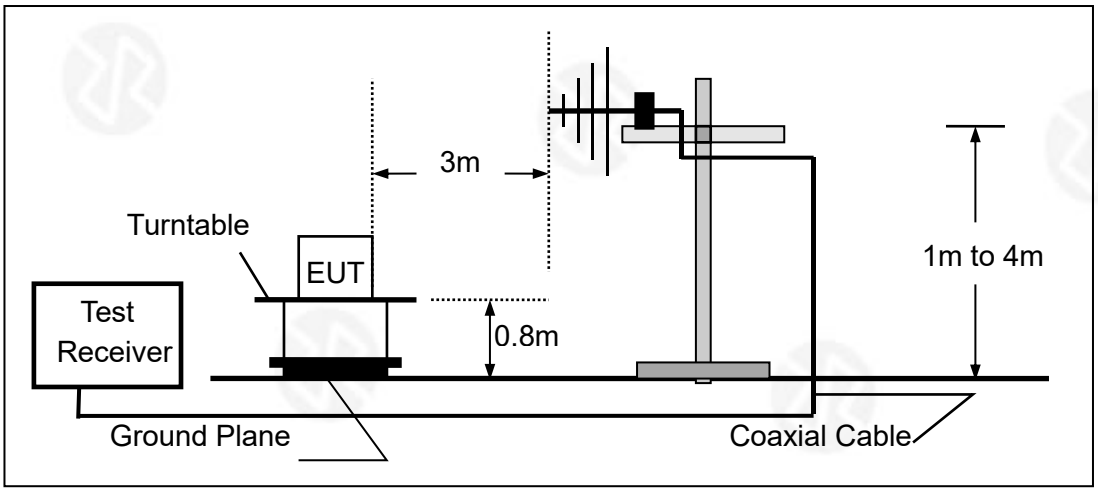
8.3 DEVIATION FROM STANDARD

No deviation.

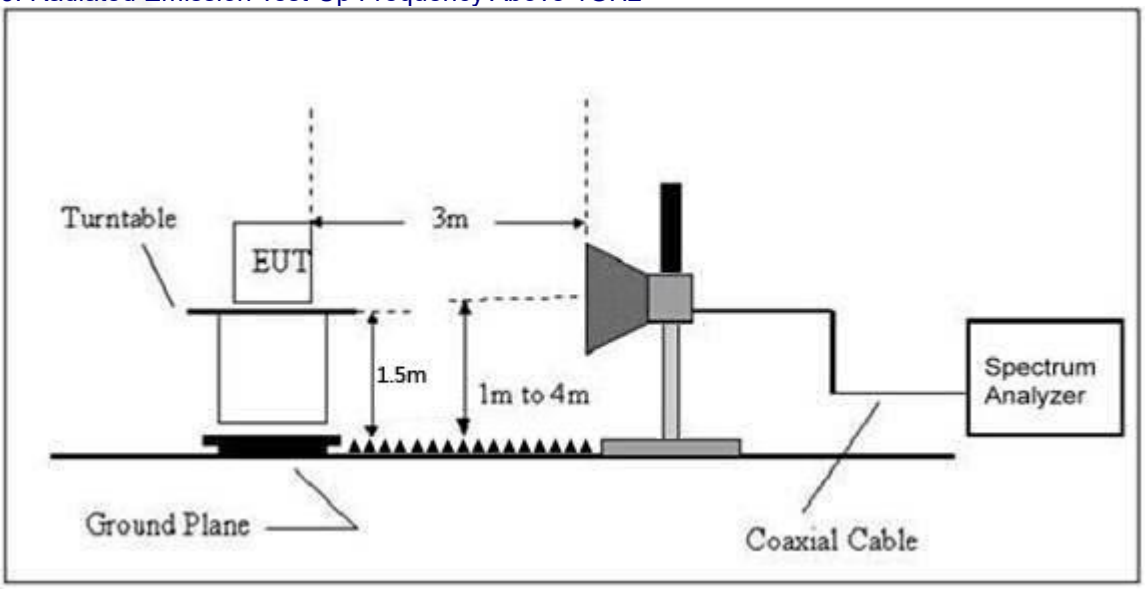
8.4 TEST SETUP



2.For radiated emissions from 30MHz to 1000MHz



3. Radiated Emission Test-Up Frequency Above 1GHz



8.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

8.6 TEST RESULTS

Mode	Frequency (MHz)	Antenna/MIMO	Test Frequency (MHz) Worst Data	Max Value (dBuV/m) Peak	Limit (dBuV/m)	Verdict
a	5180	Ant0	5110.9	47.45	74	Pass
a	5240	Ant0	5389.3	48.45	74	Pass
a	5180	Ant1	5110.9	47.45	74	Pass
a	5240	Ant1	5389.3	48.45	74	Pass
n20	5180	MIMO	5110.8	39.81	74	Pass
n20	5240	MIMO	5389.1	48.27	74	Pass
n40	5190	MIMO	5111.1	38.1	74	Pass
n40	5230	MIMO	5379.4	48.13	74	Pass
ac20	5180	MIMO	5110.7	42.7	74	Pass
ac20	5240	MIMO	5359.0	47.73	74	Pass
ac40	5190	MIMO	5051.3	41.6	74	Pass
ac40	5230	MIMO	5369.3	47.04	74	Pass
ac80	5210	MIMO	5398.9	36.76	74	Pass

Note:-27dBm(EIRP)=68.3dBuV/m(Field strength at 3m), According to the test results of the above table, while fulfill the requirements of out-of-band spurious
AV Value＜Max Value Peak，So the AV value is not record in the report

10.Frequency Stability Measurement

10.1 LIMIT

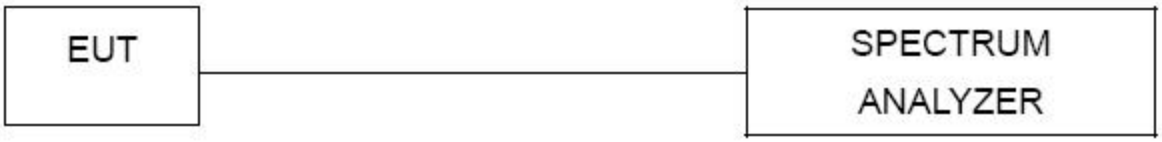
Manufactures of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

The transmitter center frequency tolerance shall be ± 20 ppm maximum for the 5 GHz band (IEEE 802.11n specification).

10.2 TEST PROCEDURES

1. The transmitter output (antenna port) was connected to the spectrum analyzer.
2. EUT have transmitted absence of modulation signal and fixed channelize.
3. Set the spectrum analyzer span to view the entire absence of modulation emissions bandwidth.
4. Set RBW = 10 kHz, VBW = 10 kHz with peak detector and max hold settings.
5. fc is declaring of channel frequency. Then the frequency error formula is (fc-f)/fc × 106 ppm and the limit is less than ±20ppm (IEEE 802.11nspecification).
6. The test extreme voltage is to change the primary supply voltage from 85 to 115 percent of the nominal value
7. Extreme temperature is -20°C~70°C.

10.3 TEST SETUP LAYOUT



10.4 EUT OPERATION DURING TEST

The EUT was programmed to be in continuously un-modulation transmitting mode.

10.5 TEST RESULTS

Temperature:	26 ℃	Relative Humidity:	54%
Pressure:	1012 hPa	Test Voltage :	DC 3.8V
Test Mode :	TX		

5.2G

802.11a20

Reference Frequency(Middle Channel): 5200MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		MCF	Error (ppm)
50	11.4	21	0.00363
40	11.4	24	0.00415
30	11.4	32	0.00553
20	11.4	22	0.0038
10	11.4	12	0.00207
0	11.4	32	0.00553
-10	11.4	24	0.00415
-20	11.4	22	0.0038
-30	11.4	12	0.00207

802.11n_HT20

Reference Frequency(Middle Channel): 5200MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		MCF	Error (ppm)
50	11.4	13	0.00225
40	11.4	21	0.00363
30	11.4	32	0.00553
20	11.4	55	0.00951
10	11.4	42	0.00726
0	11.4	32	0.00553
-10	11.4	24	0.00415
-20	11.4	22	0.0038
-30	11.4	12	0.00207

802.11n_HT40

Reference Frequency(Middle Channel): 5190MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		MCF	Error (ppm)
50	11.4	44	0.00759
40	11.4	34	0.00587
30	11.4	32	0.00552
20	11.4	61	0.01053
10	11.4	54	0.00932
0	11.4	42	0.00725
-10	11.4	51	0.0088
-20	11.4	34	0.00587
-30	11.4	42	0.00725

802.11 ac20

Reference Frequency(Middle Channel): 5200 MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		MCF	Error (ppm)
50	11.4	32	0.00553
40	11.4	23	0.00398
30	11.4	26	0.00449
20	11.4	63	0.01089
10	11.4	51	0.00882
0	11.4	43	0.00743
-10	11.4	43	0.00743
-20	11.4	22	0.0038
-30	11.4	36	0.00622

802.11ac40

Reference Frequency(Middle Channel): 5190MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		MCF	Error (ppm)
50	11.4	44	0.00759
40	11.4	34	0.00587
30	11.4	22	0.0038
20	11.4	61	0.01053
10	11.4	52	0.009
0	11.4	43	0.00745
-10	11.4	51	0.0088
-20	11.4	36	0.00622
-30	11.4	43	0.00743

802.11ac80

Reference Frequency(Middle Channel): 5210MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		MCF	Error (ppm)
50	11.4	41	0.0071
40	11.4	36	0.00623
30	11.4	32	0.00554
20	11.4	63	0.01091
10	11.4	52	0.009
0	11.4	43	0.00745
-10	11.4	52	0.009
-20	11.4	34	0.00589
-30	11.4	43	0.00745

So, Frequency Stability Versus Input Voltage is:

802.11a20

Reference Frequency(Middle Channel): 5200 MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		Frequency	Error (ppm)
20	11.4	44	0.00759
	9.69	43	0.00743
	13.11	42	0.00725

802.11n_HT20

Reference Frequency(Middle Channel): 5200 MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		Frequency	Error (ppm)
20	11.4	21	0.00363
	9.69	43	0.00743
	13.11	55	0.00951

802.11n_HT40

Reference Frequency(Middle Channel): 5190 MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		Frequency	Error (ppm)
20	11.4	44	0.00759
	9.69	42	0.00725
	13.11	42	0.00725

802.11ac20

Reference Frequency(Middle Channel): 5200 MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		Frequency	Error (ppm)
20	11.4	32	0.00553
	9.69	33	0.0057
	13.11	34	0.00588

802.11ac40

Reference Frequency(Middle Channel): 5190 MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		Frequency	Error (ppm)
20	11.4	32	0.00553
	9.69	42	0.00725
	13.11	42	0.00725

802.11ac80

Reference Frequency(Middle Channel): 5210 MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		Frequency	Error (ppm)
20	11.4	44	0.00762
	9.69	42	0.00727
	13.11	33	0.0057

11.ANTENNA REQUIREMENT

Standard requirement:	FCC Part15 C Section 15.203
15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.	
EUT Antenna:	
The two WIFI 5G antennas are PCB Antenna, the best case gain for two antennas are 5dBi, reference to the appendix II for details	

12.DUTY CYCLE

Standard requirement:	KDB 789033 D02
Test Method:	ANSI C63.10: 2013

Test Procedures：

1. The transmitter output (antenna port) was connected to the spectrum analyzer.
2. EUT have transmitted absence of modulation signal and fixed channelize.
3. Set the spectrum analyzer span to view the entire absence of modulation emissions bandwidth.
4. Set RBW = 1MHz, VBW = 3MHz, SPAN=0MHz with peak detector and max hold settings.

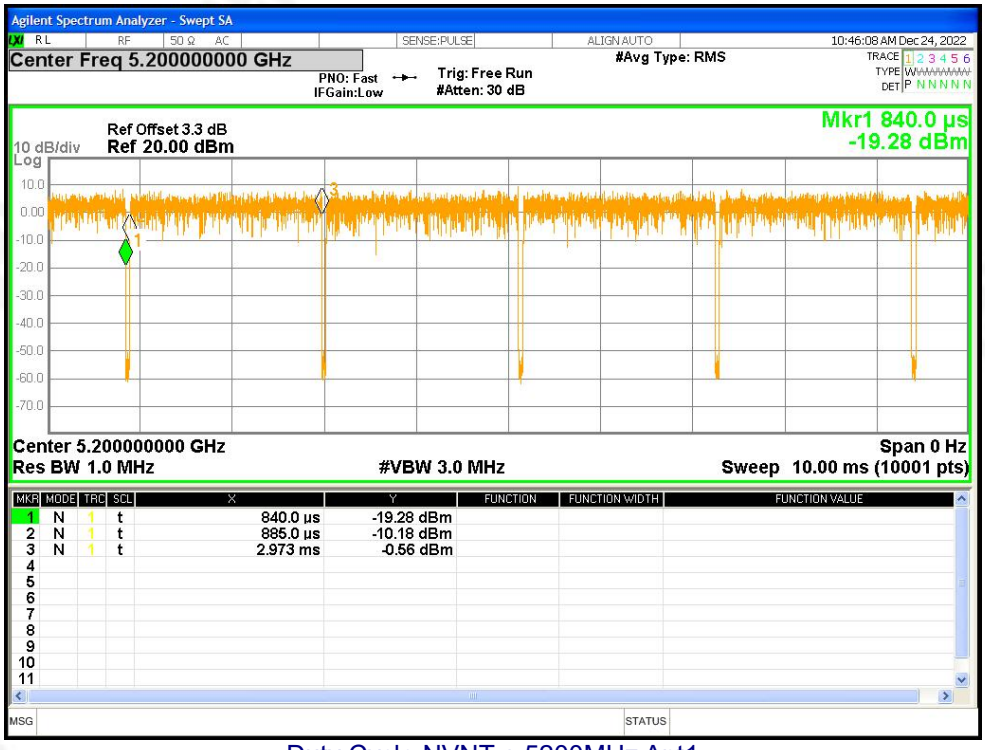
Remark:

Through Pre-scan, The duty cycle set for channel low, middle and high are same, and the duty cycle test is performed at channel low only, The report only records the test data of antenna 1

12.1 TEST RESULTS

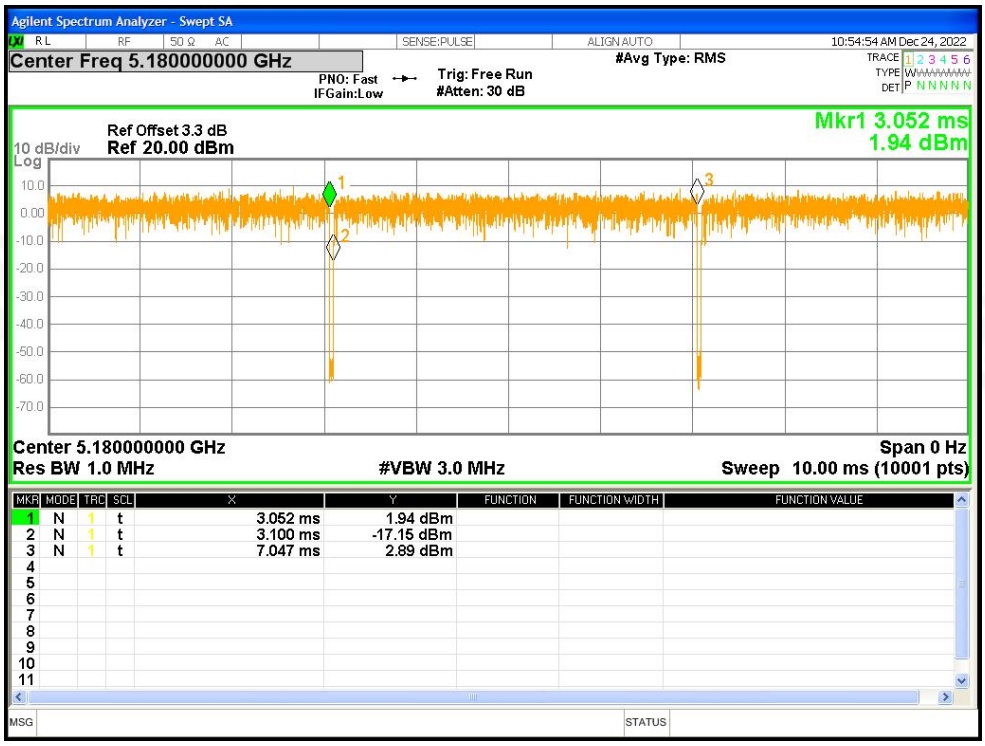
Mode	Frequency (MHz)	Antenna	Duty Cycle (%)	Correction Factor (dB)
a	5180	Ant1	97.89	0.09
a	5200	Ant1	97.89	0.09
a	5240	Ant1	97.89	0.09
n20	5180	Ant1	98.8	0
n20	5200	Ant1	98.85	0
n20	5240	Ant1	98.82	0
n40	5190	Ant1	98.83	0
n40	5230	Ant1	98.83	0
ac20	5180	Ant1	98.82	0
ac20	5200	Ant1	98.82	0
ac20	5240	Ant1	98.82	0
ac40	5190	Ant1	98.83	0
ac40	5230	Ant1	98.86	0
ac80	5210	Ant1	98.83	0

Duty Cycle NVNT a 5180MHz Ant1

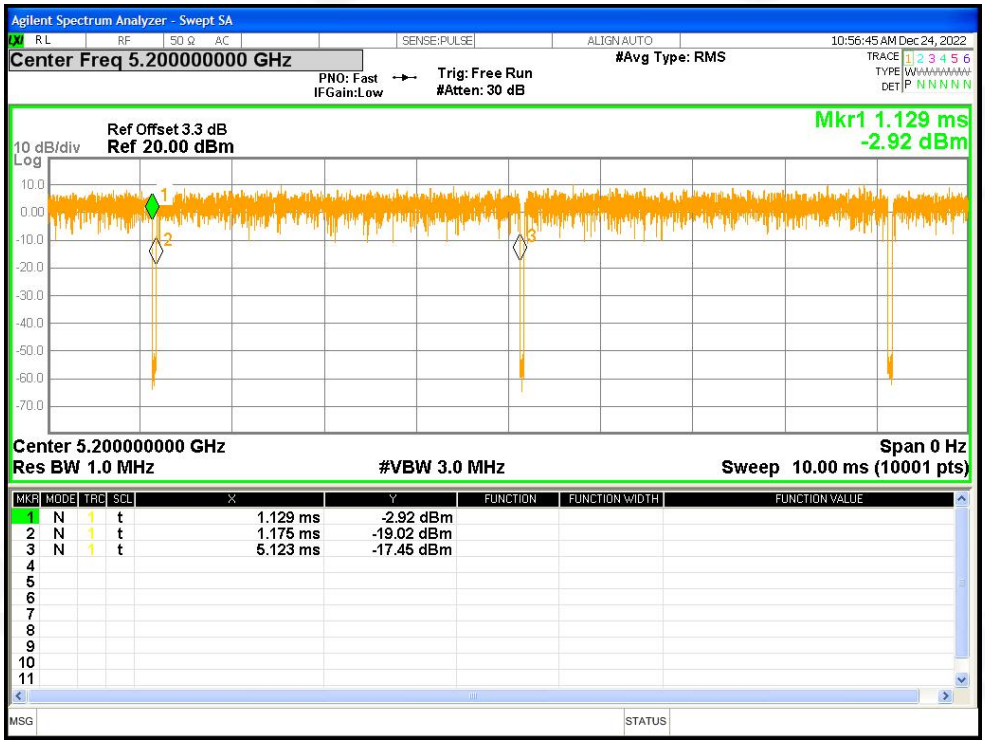


Duty Cycle NVNT a 5200MHz Ant1

Duty Cycle NVNT a 5240MHz Ant1

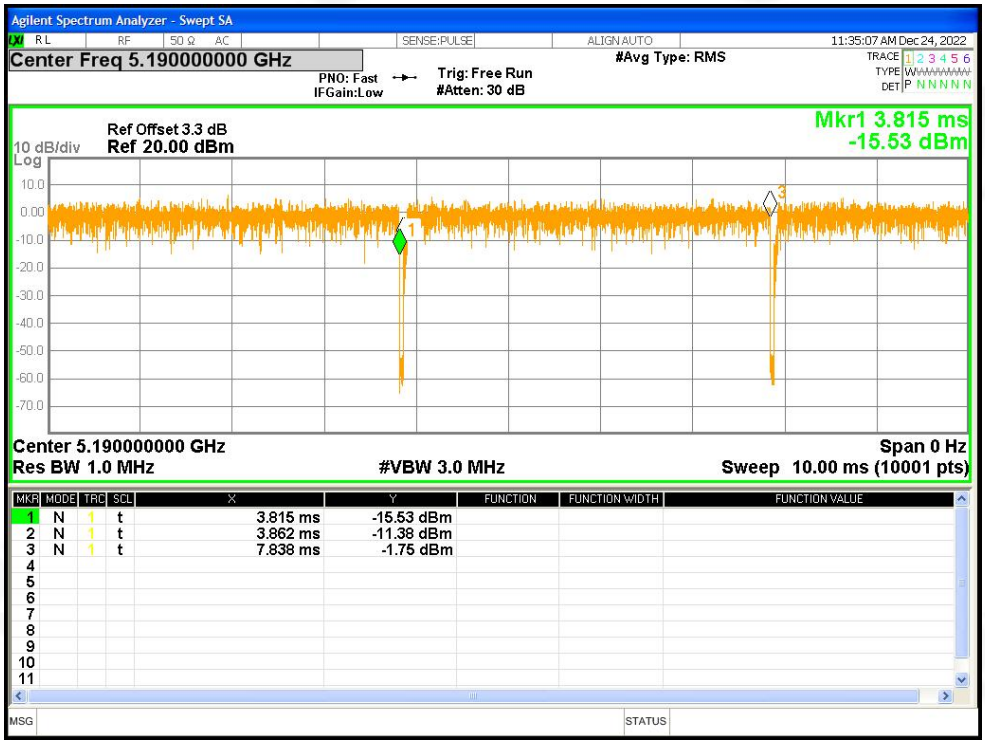


Duty Cycle NVNT n20 5180MHz Ant1



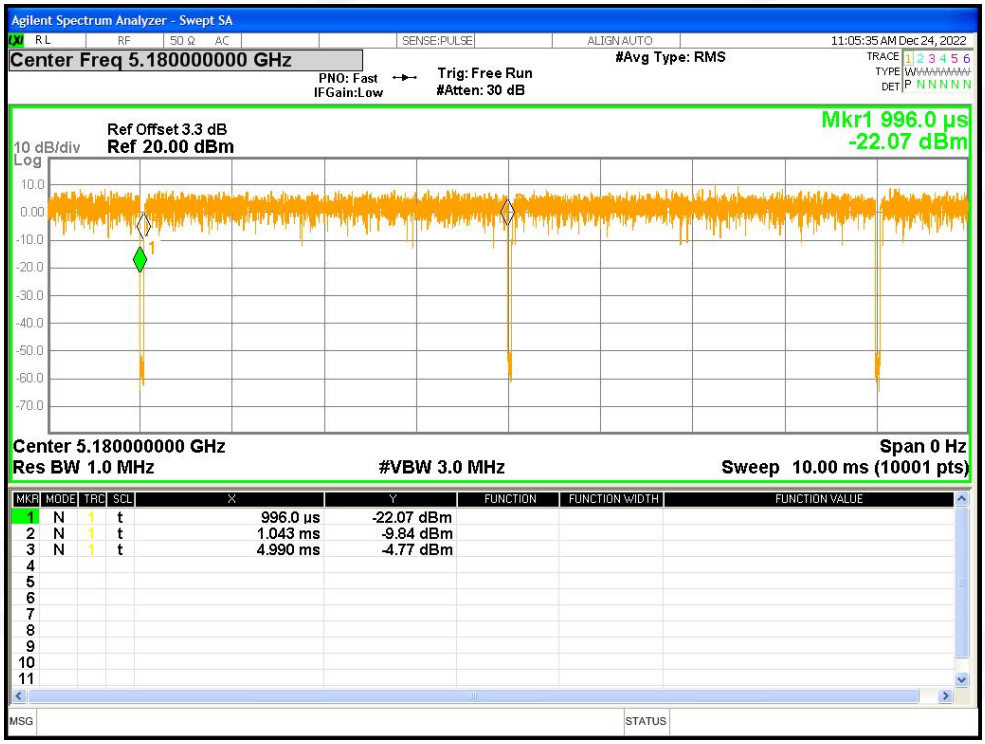
Duty Cycle NVNT n20 5200MHz Ant1

Duty Cycle NVNT n20 5240MHz Ant1



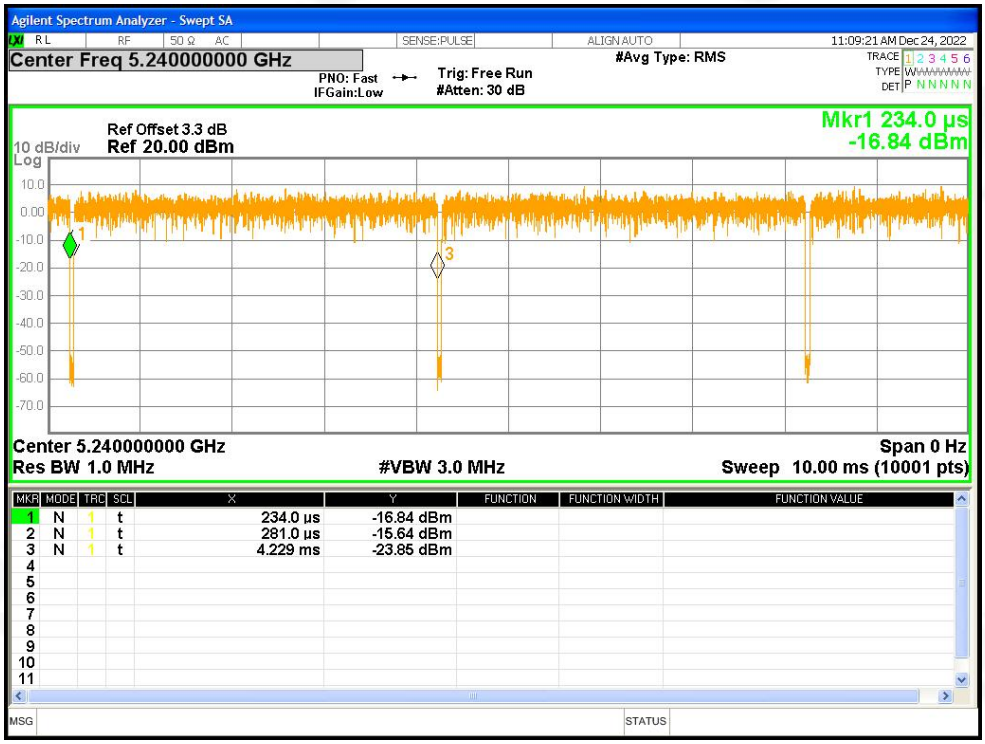
Duty Cycle NVNT n40 5190MHz Ant1

Duty Cycle NVNT n40 5230MHz Ant1

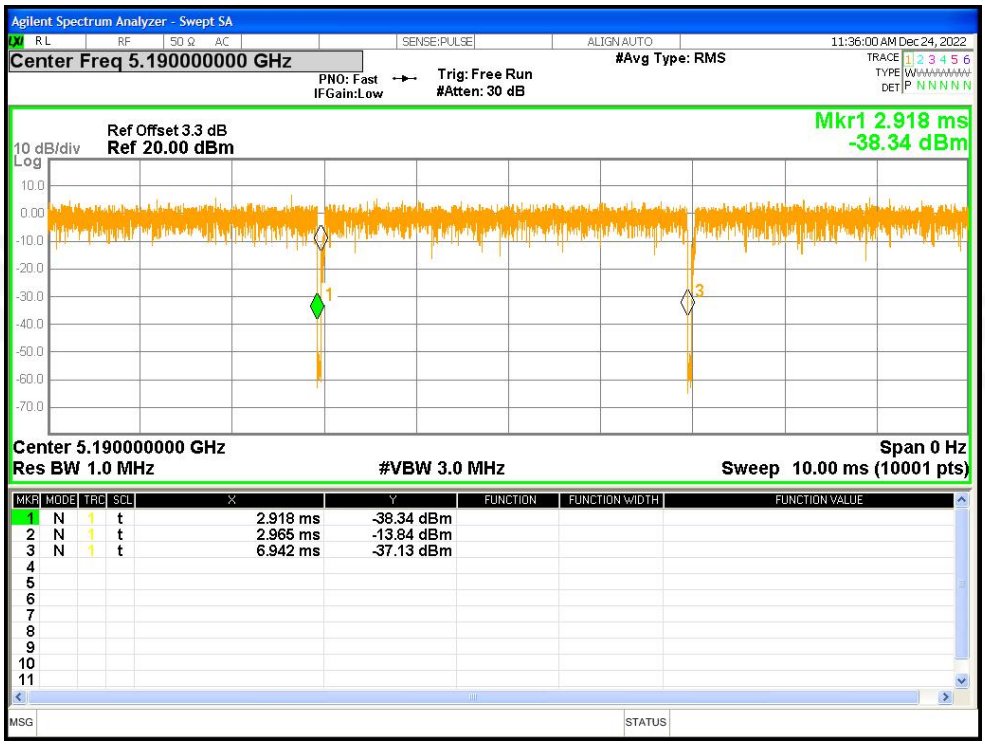


Duty Cycle NVNT ac20 5180MHz Ant1

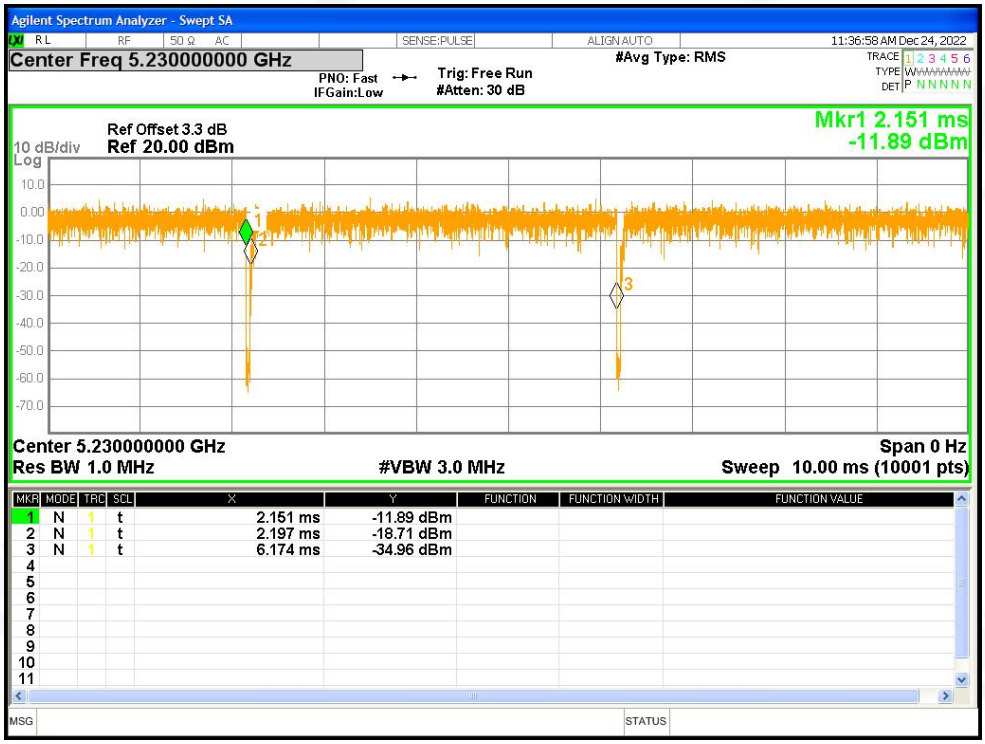
Duty Cycle NVNT ac20 5200MHz Ant1



Duty Cycle NVNT ac20 5240MHz Ant1



Duty Cycle NVNT ac40 5190MHz Ant1



Duty Cycle NVNT ac40 5230MHz Ant1

Duty Cycle NVNT ac80 5210MHz Ant1

13. TEST SETUP PHOTO

Reference to the appendix I for details.

14. EUT CONSTRUCTIONAL DETAILS

Reference to the appendix II for details.

※※※※※ END OF REPORT ※※※※※