

4.4 Maximum Conducted Average Output Power

TEST CONFIGURATION



TEST PROCEDURE

According to KDB789033 D02 General UNII Test Procedures New Rules v01 Section E3 Measurement using a Power Meter (PM):

- a. Measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the conditions listed below are satisfied
 1. The EUT is configured to transmit continuously or to transmit with a constant duty cycle
 2. At all times when the EUT is transmitting, it must be transmitting at its maximum power control level.
 3. The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.
- b. If the transmitter does not transmit continuously, measure the duty cycle, x , of the transmitter output signal as described in section II.B
- c. Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.

Adjust the measurement in dBm by adding $10 \log(1/x)$ where x is the duty cycle (e.g., $10 \log(1/0.25)$ if the duty cycle is 25 percent).

LIMIT

According to §15.407(a): The maximum output power should be not exceed follow:

Frequency Range (MHz)	Limit
5150-5250	Fixed: 1 Watt (30dBm) Mobile and portable: 250mW (23.98dBm)
5250-5350	250mW (23.98dBm)
5470-5725	250mW (23.98dBm)
5725-5850	1 Watt (30dBm)

Note: The maximum e.i.r.p at any elevation angle above 30 degrees as measured from the horizon must not exceed 125mW(21dBm)

Test Results

Test Mode	Frequency[M Hz]	Channel Power [dBm]	Duty Cycle [%]	DC Factor [dBm]	Result [dBm]	Limit [dBm]	Verdict
11A	5180	12.04	94.50	0.25	12.29	≤23.98	PASS
11A	5200	13.16	92.79	0.32	13.48	≤23.98	PASS
11A	5240	11.83	91.96	0.36	12.19	≤23.98	PASS
11N20SISO	5180	11.92	91.87	0.37	12.29	≤23.98	PASS
11N20SISO	5200	13.12	92.31	0.35	13.47	≤23.98	PASS
11N20SISO	5240	11.64	95.05	0.22	11.86	≤23.98	PASS
11N40SISO	5190	12.57	84.68	0.72	13.29	≤23.98	PASS
11N40SISO	5230	9.29	84.68	0.72	10.01	≤23.98	PASS
11AC20SISO	5180	11.93	92.79	0.32	12.25	≤23.98	PASS
11AC20SISO	5200	13.02	93.69	0.28	13.30	≤23.98	PASS
11AC20SISO	5240	11.60	92.79	0.32	11.92	≤23.98	PASS
11AC40SISO	5190	12.51	84.82	0.72	13.23	≤23.98	PASS
11AC40SISO	5230	9.25	85.71	0.67	9.92	≤23.98	PASS
11AC80SISO	5210	9.34	75.41	1.23	10.57	≤23.98	PASS

4.5 Power Spectral Density

TEST CONFIGURATION



TEST PROCEDURE

According to KDB 789033 D02 General UNII Test Procedures New Rules v01 F: The rules requires “maximum power spectral density” measurements where the intent is to measure the maximum value of the time average of the power spectral density measured during a period of continuous transmission

- a. Create an average power spectrum for the EUT operating mode being tested by following the instructions in section II.E.2. for measuring maximum conducted output power using a spectrum analyzer or EMI receiver: select the appropriate test method (SA-1, SA-2, SA-3, or alternatives to each) and apply it up to, but not including, the step labeled, “Compute power...”. (This procedure is required even if the maximum conducted output power measurement was performed using a power meter, method PM.)
- b. Use the peak search function on the instrument to find the peak of the spectrum and record its value.
- c. Make the following adjustments to the peak value of the spectrum, if applicable:
 1. If Method SA-2 or SA-2 Alternative was used, add $10 \log(1/x)$, where x is the duty cycle, to the peak of the spectrum.
 2.) If Method SA-3 Alternative was used and the linear mode was used in step II.E.2.g)(viii), add 1 dB to the final result to compensate for the difference between linear averaging and power averaging.
- d. The result is the Maximum PSD over 1 MHz reference bandwidth.
- e. For devices operating in the bands 5.15-5.25 GHz, 5.25-5.35 GHz, and 5.47-5.725 GHz, the above procedures make use of 1 MHz RBW to satisfy directly the 1 MHz reference bandwidth specified in § 15.407(a)(5). For devices operating in the band 5.725-5.85 GHz, the rules specify a measurement bandwidth of 500 kHz. Many spectrum analyzers do not have 500 kHz RBW, thus a narrower RBW may need to be used. The rules permit the use of a RBWs less than 1 MHz, or 500 kHz, “provided that the measured power is integrated over the full reference bandwidth” to show the total power over the specified measurement bandwidth (i.e., 1 MHz, or 500 kHz). If measurements are performed using a reduced resolution bandwidth (< 1 MHz, or < 500 kHz) and integrated over 1 MHz, or 500 KHz bandwidth, the following adjustments to the procedures apply:
 1. Set $RBW \geq 1/T$, where T is defined in section II.B.I.a).
 2. Set $VBW \geq 3$ RBW.
 3. If measurement bandwidth of Maximum PSD is specified in 500 kHz, add $10\log(500\text{kHz}/RBW)$ to the measured result, whereas $RBW (< 500 \text{ KHz})$ is the reduced resolution bandwidth of the spectrum analyzer set during measurement.
 4. If measurement bandwidth of Maximum PSD is specified in 1 MHz, add $10\log(1\text{MHz}/RBW)$ to the measured result, whereas $RBW (< 1 \text{ MHz})$ is the reduced resolution bandwidth of spectrum analyzer set during measurement.
 5. Care must be taken to ensure that the measurements are performed during a period of continuous transmission or are corrected upward for duty cycle.

Note: As a practical matter, it is recommended to use reduced RBW of 100 KHz for the sections 5.c) and 5.d) above, since $RBW=100 \text{ KHz}$ is available on nearly all spectrum analyzers.

- f. Adjust the measurement in dBm by adding $10 \log(1/x)$ where x is the duty cycle (e.g., $10 \log(1/0.25)$ if the duty cycle is 25 percent).

LIMIT

According to §15.407(a): The maximum output power should be not exceed follow:

Frequency Range (MHz)	Limit
5150-5250	Other then Mobile and portable:17dBm/MHz Mobile and portable:11dBm/MHz
5250-5350	11dBm/MHz
5470-5725	11dBm/MHz
5725-5850	30dBm/500kHz

Test Results

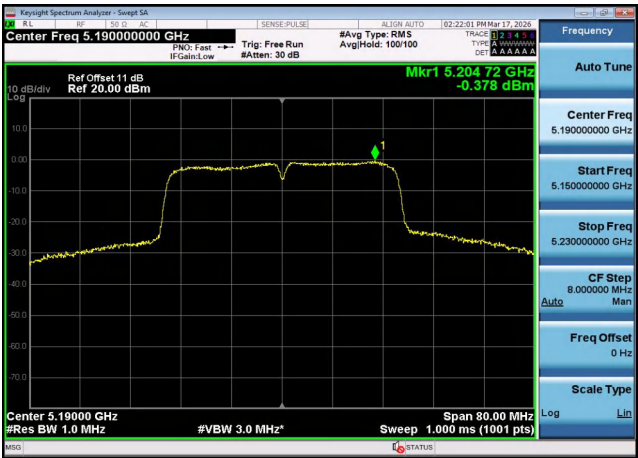
Type	Bands	Channel	Power Spectral Density (dBm/MHz)	Limit (dBm/MHz)	Result
802.11a	U-NII 1	36	1.76	11	Pass
		40	2.66		
		48	1.44		
802.11n (HT20)	U-NII 1	36	1.52		
		40	2.36		
		48	0.86		
802.11n (HT40)	U-NII 1	38	-0.38		
		46	-3.78		
802.11ac (VHT20)	U-NII 1	36	1.49		
		40	2.39		
		48	1.03		
802.11ac (VHT40)	U-NII 1	38	-0.42		
		46	-4.06		
802.11ac (VHT80)	U-NII 1	42	-5.18		

Test plot as follows



802.11n(HT40)

U-NII 1



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802.11ac(VHT20)

U-NII 1



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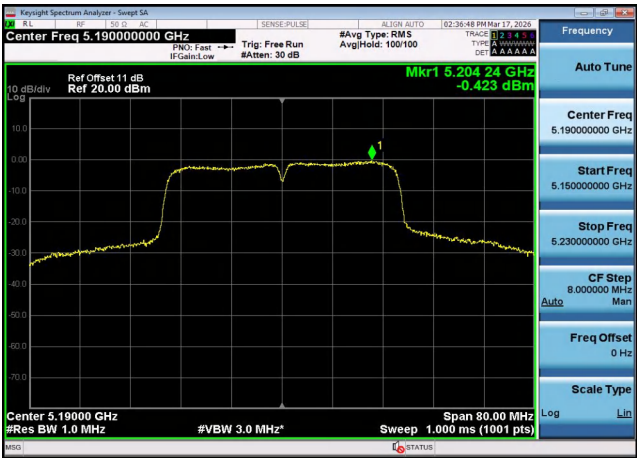
CH40



CH48

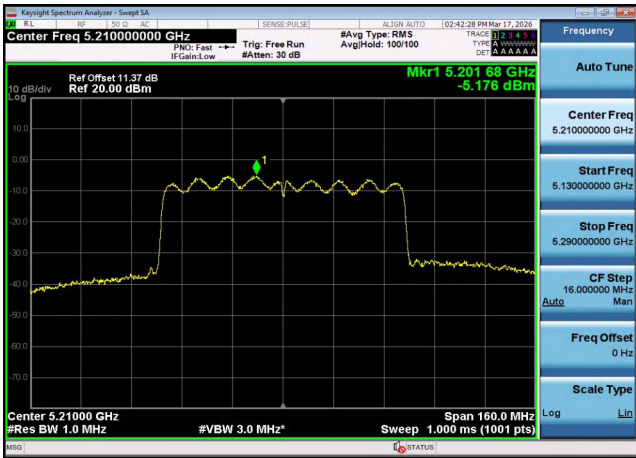
802.11ac(VHT40)

U-NII 1



802.11ac(VHT80)

U-NII 1



CH38



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4.6 Emission Bandwidth (26dB Bandwidth)

TEST CONFIGURATION



TEST PROCEDURE

According to KDB789033 D02 General UNII Test Procedures New Rules v01 for one of the following procedures may be used for Emission Bandwidth (EBW) measurement:

- Set RBW: 1%-5% of the EBW.
- Set VBW = $> 3 \times \text{RBW}$
- Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Allow the trace to stabilize
- Measure the maximum width of the emission that is 26 dB down from the maximum 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%.

Note: The automatic bandwidth measurement capability of a spectrum analyzer or EMI receiver may be employed if it implements the functionality described above.

LIMIT

No Limits for 26dBc Bandwidth

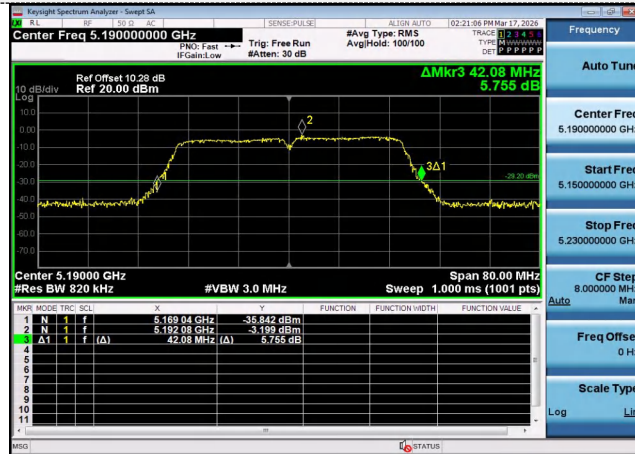
Test Results

Type	Bands	Channel	26dB Bandwidth (MHz)	Limit (MHz)	Result
802.11a	U-NII 1	36	21.440	N/A	Pass
		40	22.040		
		48	21.760		
802.11n(HT20)	U-NII 1	36	22.400		
		40	21.840		
		48	21.760		
802.11n(HT40)	U-NII 1	38	42.080		
		46	42.880		
802.11ac(VHT20)	U-NII 1	36	21.840		
		40	21.760		
		48	21.840		
802.11ac(VHT40)	U-NII 1	38	41.600		
		46	43.200		
802.11ac(VHT40)	U-NII 1	42	81.920		

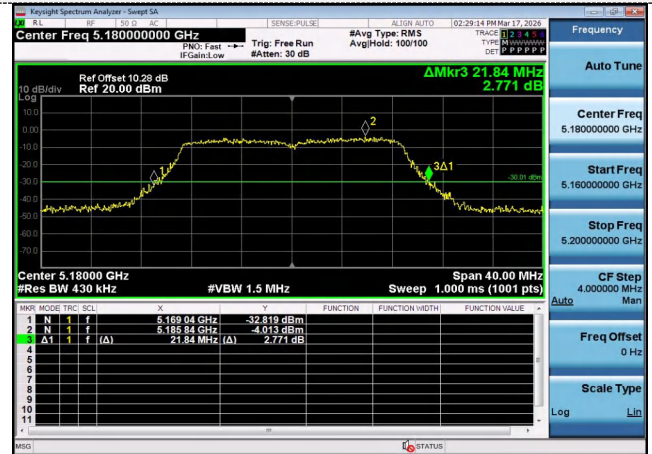
Test plot as follows:



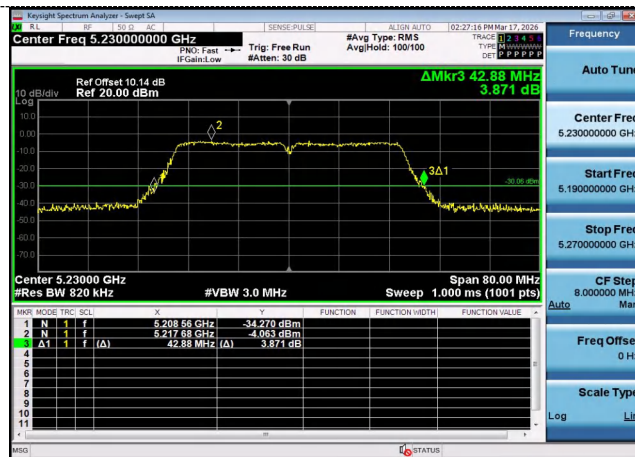
802.11n(HT40)



802.11ac(VHT20)



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CH36



CH46

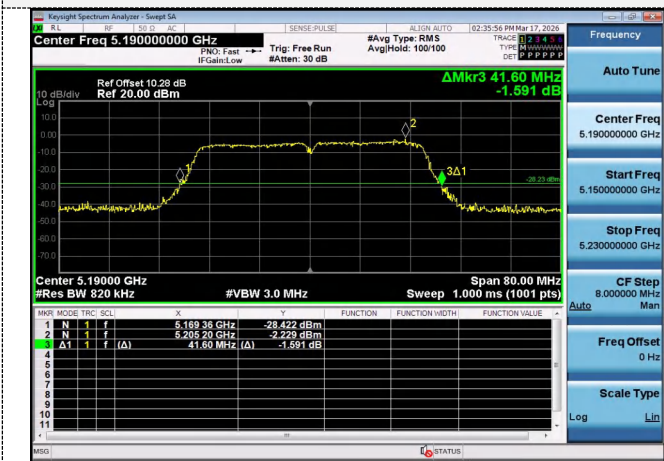


CH40

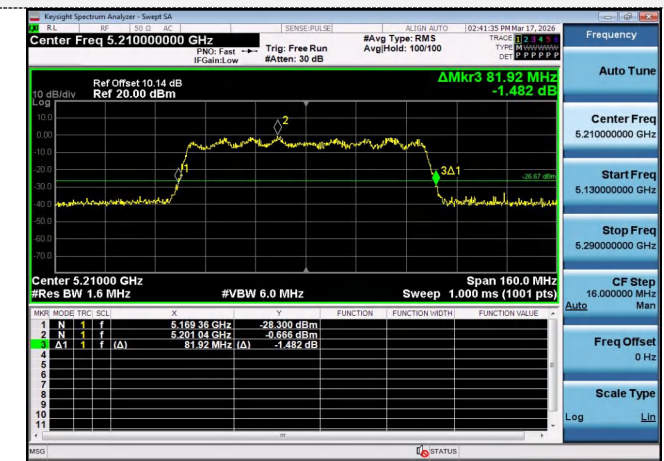


CH48

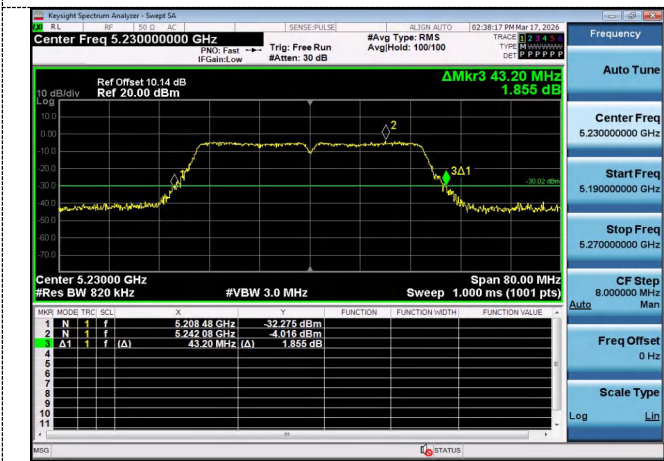
802.11ac(VHT40)



802.11ac(VHT80)



CH38



CH42



CH46



4.7 Minimum Emission Bandwidth (6dB Bandwidth)

TEST CONFIGURATION



TEST PROCEDURE

According to KDB789033 D02 General UNII Test Procedures New Rules v01 for one of the following procedures may be used for section 15.407(e) specifies the minimum 6 dB emission bandwidth of at least 500 KHz for the band 5.715-5.85 GHz. The following procedure shall be used for measuring this bandwidth:

- a. Set RBW = 100 kHz.
- b. Set the video bandwidth (VBW) $\geq 3 \times$ RBW
- c. Detector = Peak.
- d. Trace mode = max hold.
- e. Sweep = auto couple.
- f. Allow the trace to stabilize
- g. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Note: The automatic bandwidth measurement capability of a spectrum analyzer or EMI receiver may be employed if it implements the functionality described above.

LIMIT

For Section 15.407(e) specifies the minimum 6 dB emission bandwidth of at least 500 KHz for the band 5.715-5.85 GHz

Test Results

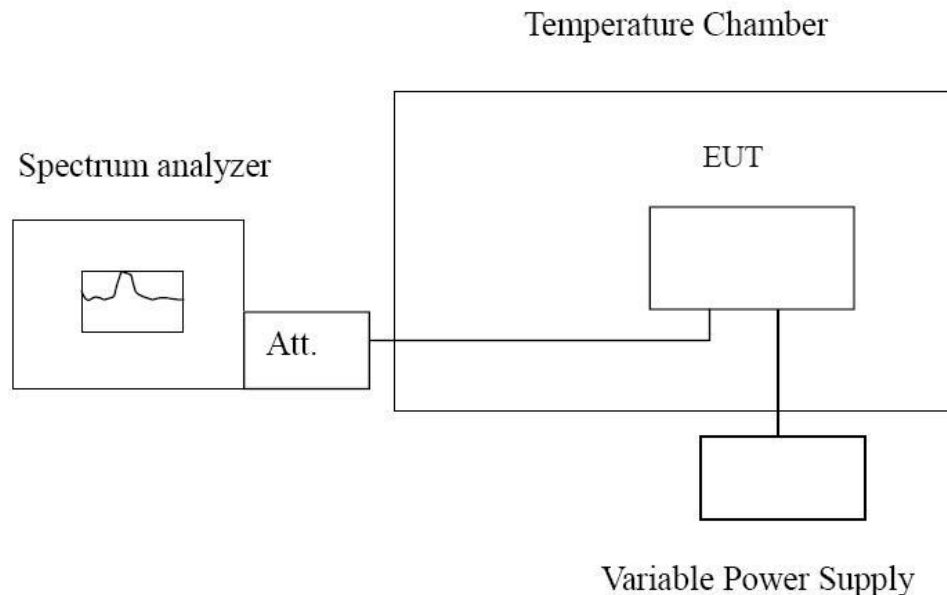
The EUT doesn't have the 5.745-5.825 GHz band, So this test item is not applicable for the EUT.

4.8 Frequency Stability

LIMIT

Manufacturers 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 users manual.

TEST CONFIGURATION



TEST PROCEDURE

Frequency Stability under Temperature Variations:

The equipment under test was connected to an external AC or DC power supply and input rated voltage. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators. The EUT was placed inside the temperature chamber. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 20°C operating frequency as reference frequency. Turn EUT off and set the chamber temperature to -30°C. After the temperature stabilized for approximately 30 minutes recorded the frequency. Repeat step measure with 10°C increased per stage until the highest temperature of +50°C reached.

Frequency Stability under Voltage Variations:

Set chamber temperature to 20°C. Use a variable AC power supply / DC power source to power the EUT and set the voltage to rated voltage. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and recorded the frequency.

Reduce the input voltage to specify extreme voltage variation ($\pm 15\%$) and endpoint, record the maximum frequency change.

TEST RESULTS

Record worst case as below:

Reference Frequency: 802.11ac channel=36 frequency=5180MHz					
Voltage (V)	Temperature (°C)	Frequency error		Limit (ppm)	Result
		Hz	ppm		
5.0	-30	122.168	0.02358	Within the band of operation	Pass
	-20	164.191	0.03170		
	-10	123.822	0.02390		
	0	119.671	0.02310		
	10	147.586	0.02849		
	20	113.740	0.02196		
	30	122.863	0.02372		
	40	134.377	0.02594		
	50	132.264	0.02553		
5.5	20	117.705	0.02272		
4.5	20	175.043	0.03379		

4.9 Automatically Discontinue Transmission

Standard Applicable

FCC CFR Title 47 Part 15 Subpart C Section 15.407(c):

The device shall automatically discontinue transmission in case of either absence of information to transmit or operational failure. These provisions are not intended to preclude the transmission of control or signalling information or the use of repetitive codes used by certain digital technologies to complete frame or burst intervals. Applicants shall include in their application for equipment authorization a description of how this requirement is met.

Test Result:

Declared by applicants that the device will automatically discontinue transmission in case of either absence of information to transmit or operational failure.

4.10 Band edge for RF Conducted Emissions

Limit

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.

2) For transmitters operating solely in the 5.725 – 5.850 GHz band.

All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

Test Procedure

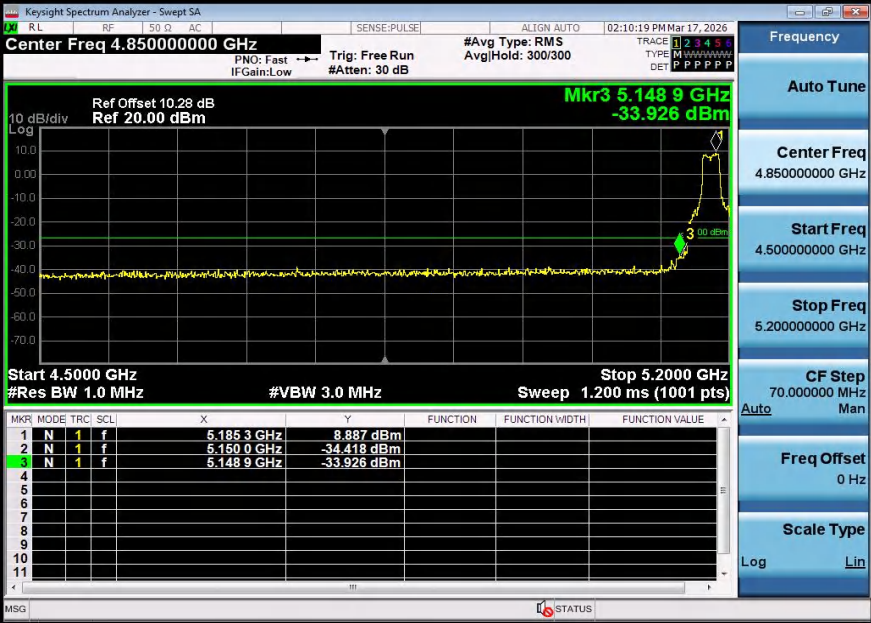
Connect the transmitter output to spectrum analyzer using a low loss RF cable, and set the spectrum analyzer to RBW=1MHz, VBW= 1MHz, peak detector , and max hold.

Test Configuration



Test Results

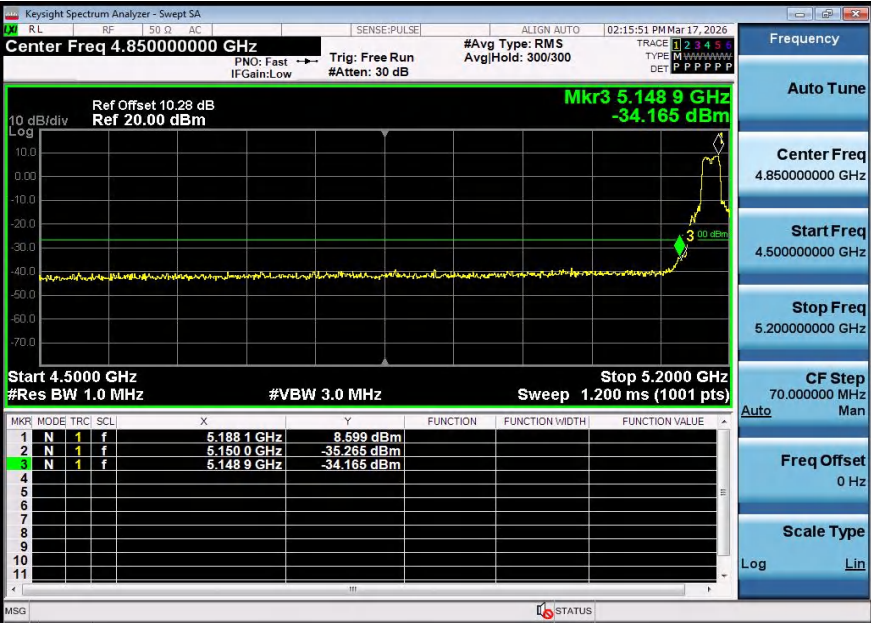
Test plot as follows:



11A-5180-PASS



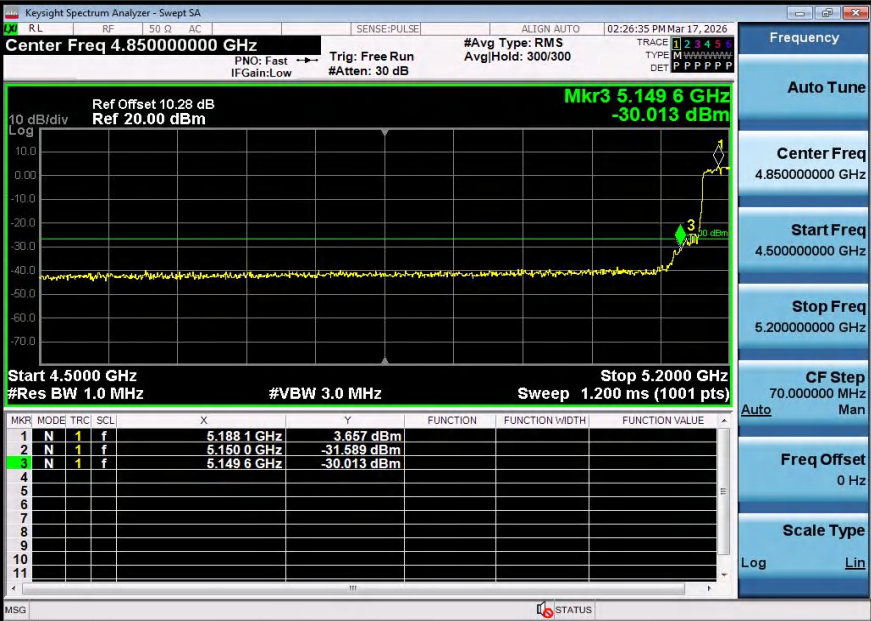
11A-5240-PASS



11N20SISO-5180-PASS



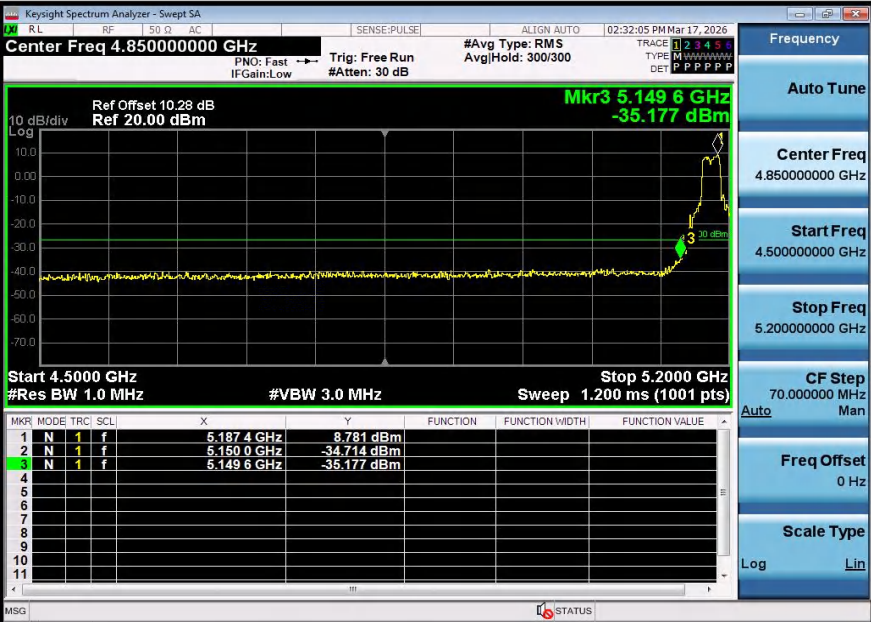
11N20SISO-5240-PASS



11N40SISO-5190-PASS



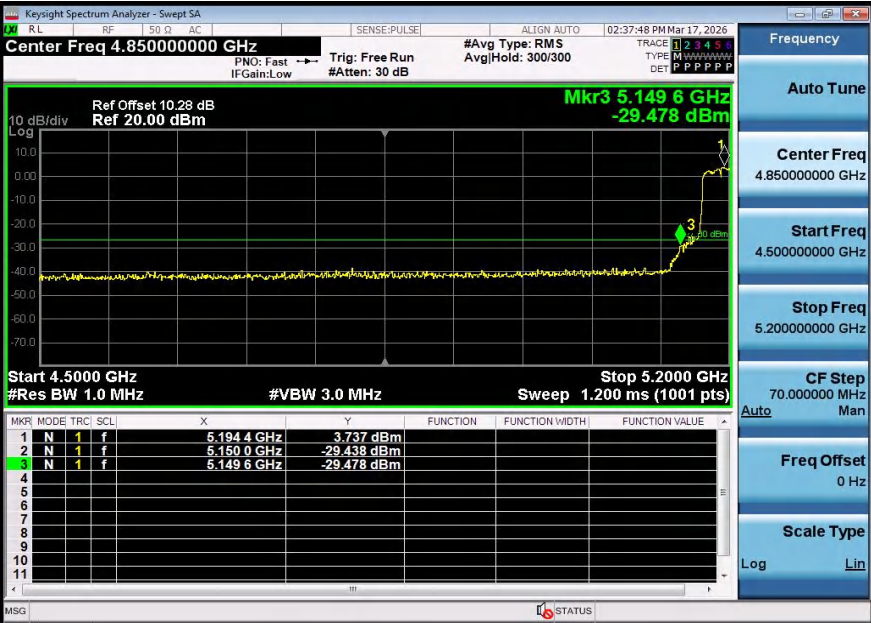
11N40SISO-5230-PASS



11AC20SISO-5180-PASS



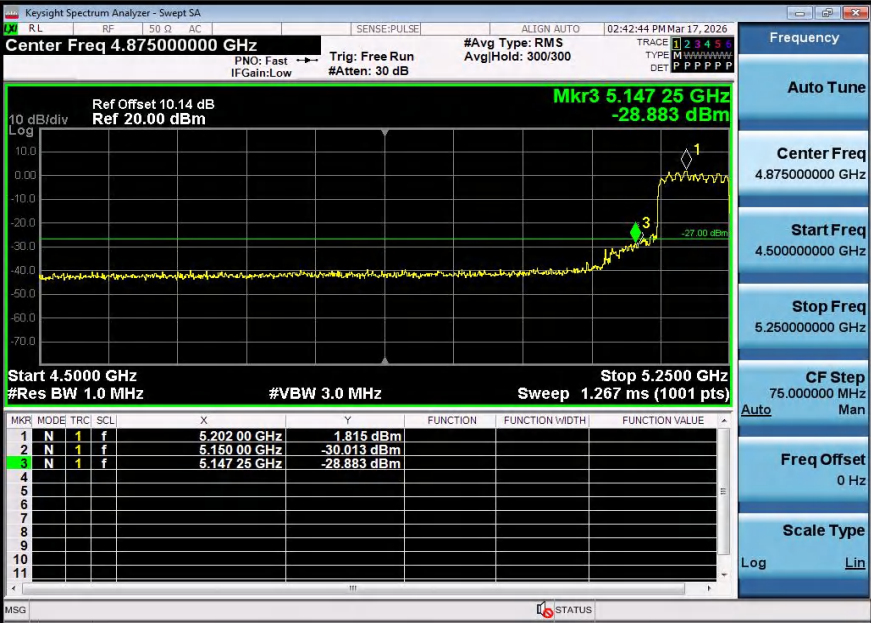
11AC20SISO-5240-PASS



11AC40SISO-5190-PASS



11AC40SISO-5230-PASS



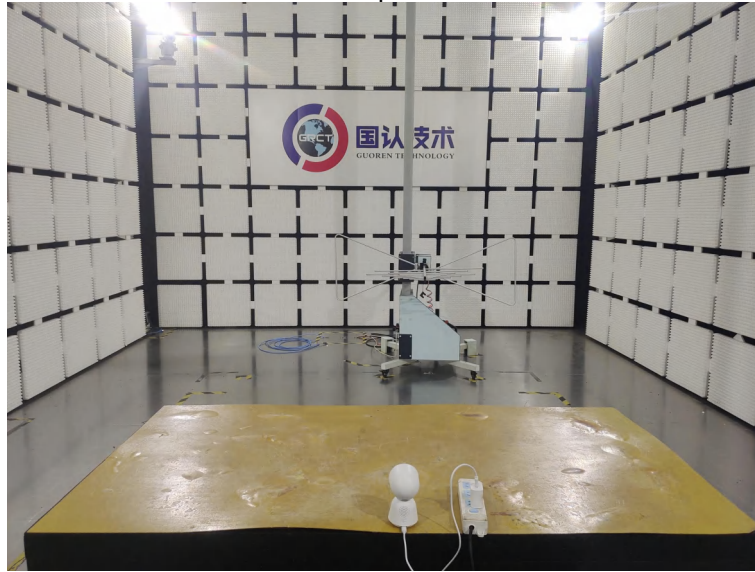
11AC80SISO-5210-PASS



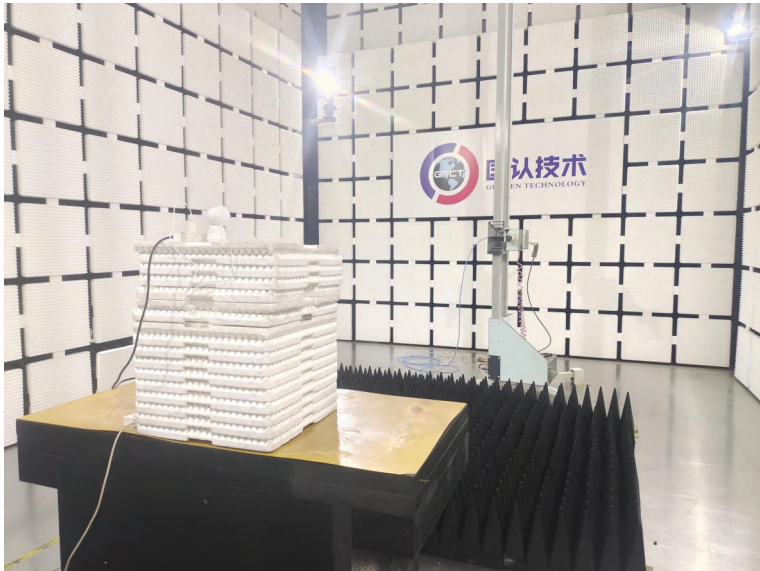
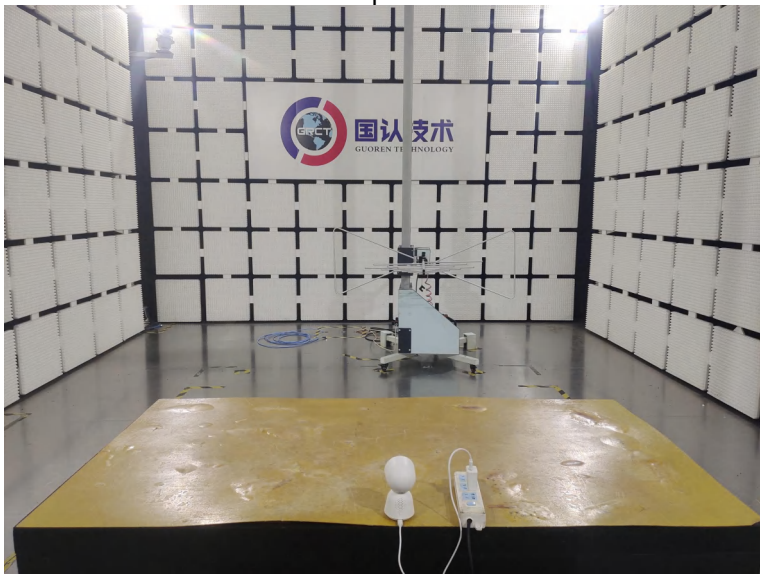
11AC80SISO-5210-PASS

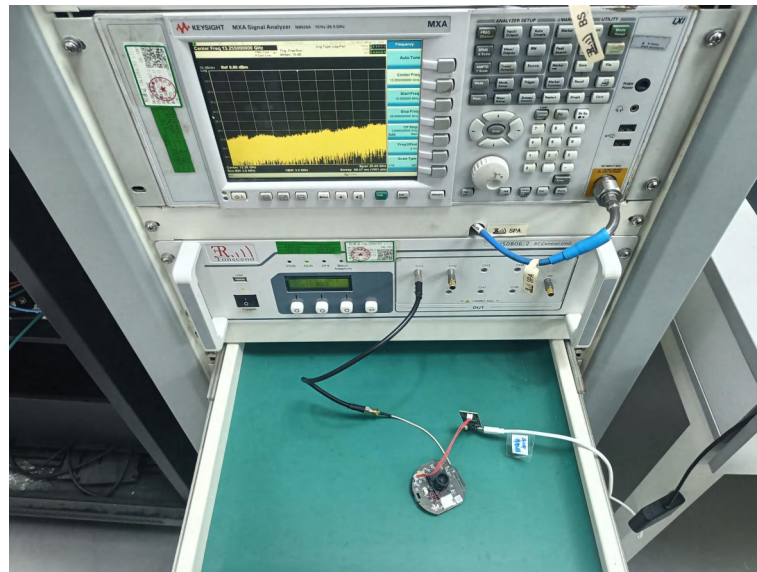
5 Test Setup Photos of the EUT

Adapter 1



Adapter 2





6 Photos of the EUT

Reference to the test report No. GRCTR260302005-01.

***** End of Report *****