5.11 Radiated Spurious Emission & Restricted bands

Test Requirement:	47 CFR Part 15C Section 15.209 and 15.205
Test Method:	ANSI C63.10: 2013
Test Site:	Measurement Distance: 3m (Semi-Anechoic Chamber)

Receiver Setup:

Frequency	Detector	RBW	VBW	Remark
0.009MHz-0.090MHz	Peak	10kHz	30kHz	Peak
0.009MHz-0.090MHz	Average	10kHz	30kHz	Average
0.090MHz-0.110MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
0.110MHz-0.490MHz	Peak	10kHz	30kHz	Peak
0.110MHz-0.490MHz	Average	10kHz	30kHz	Average
0.490MHz -30MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
30MHz-1GHz	Peak	100 kHz	300kHz	Peak
Above 1GHz	Peak	1MHz	3MHz	Peak
	Peak	1MHz	10Hz	Average

Limit:

Frequency	Field strength (microvolt/meter)	Limit (dBuV/m)	Remark	Measurement distance (m)
0.009MHz-0.490MHz	2400/F(kHz)	-	-	300
0.490MHz-1.705MHz	24000/F(kHz)	-	-	30
1.705MHz-30MHz	30	-	-	30
30MHz-88MHz	100	40.0	Quasi-peak	3
88MHz-216MHz	150	43.5	Quasi-peak	3
216MHz-960MHz	200	46.0	Quasi-peak	3
960MHz-1GHz	500	54.0	Quasi-peak	3
Above 1GHz	500	54.0	Average	3

Note: 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.

Test Setup:	

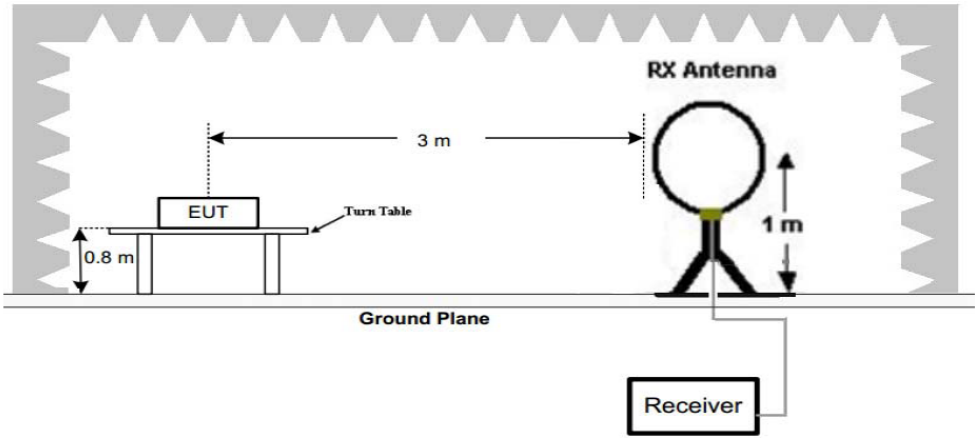


Figure 1. Below 30MHz

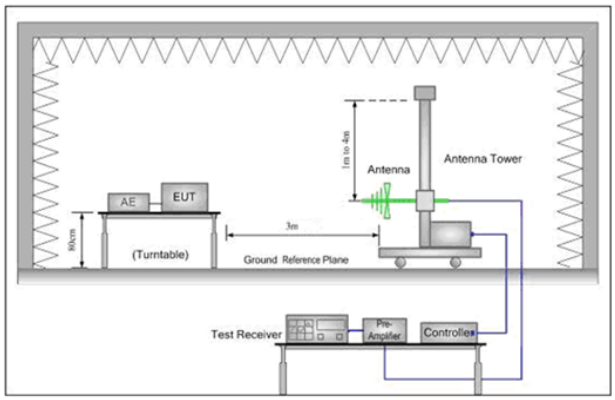


Figure 2. 30MHz to 1GHz

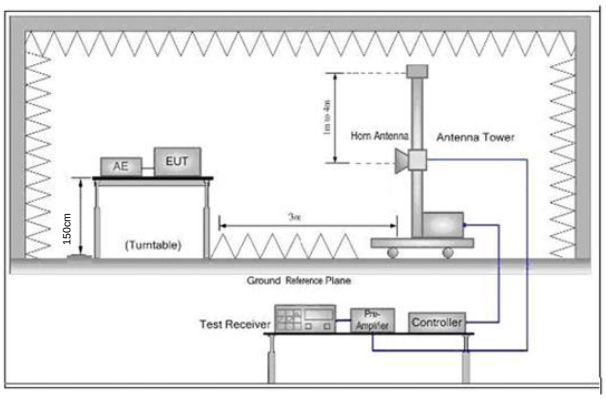


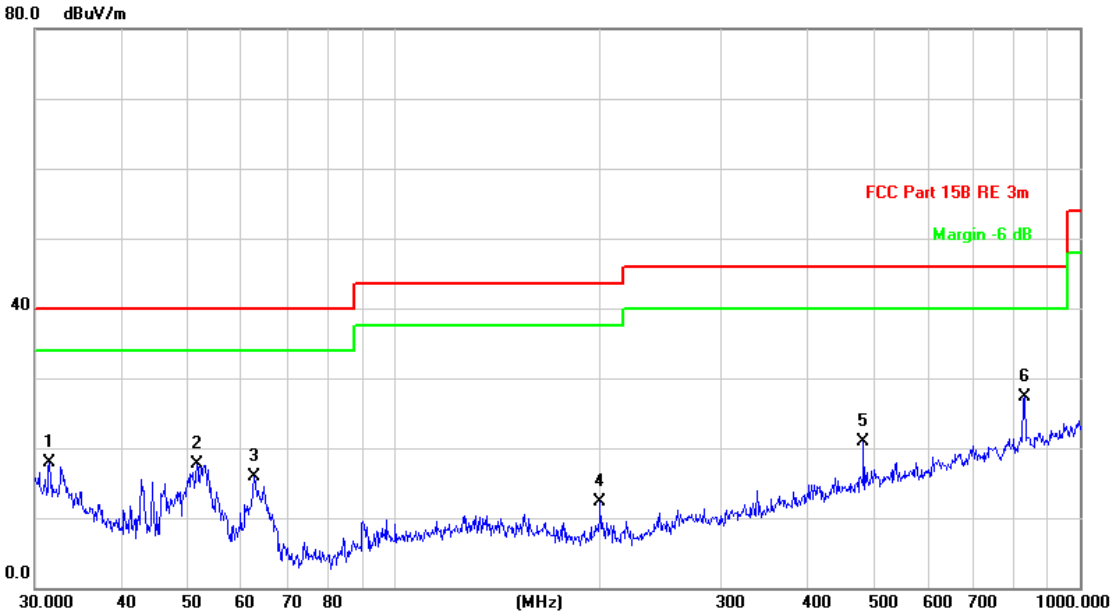
Figure 3. Above 1 GHz

Test Procedure:	a. 1) Below 1G: The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation. 2) Above 1G: The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation. Note: For the radiated emission test above 1GHz: Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane. b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

	d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading. e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet. g. Test the EUT in the lowest channel (2402MHz),the middle channel (2441MHz),the Highest channel (2480MHz) h. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case. i. Repeat above procedures until all frequencies measured was complete.
Exploratory Test Mode:	Non-hopping transmitting mode with all kind of modulation and all kind of data type Transmitting mode, Charging mode.
Final Test Mode:	Pretest the EUT at Charging mode, found the Charging mode which it is worse case For below 1GHz part, through pre-scan, the worst case is the lowest channel. Only the worst case is recorded in the report.
Test Results:	Pass

5.11.1 Radiated Emission below 1GHz

30MHz~1GHz		
Test mode:	Transmitting	Vertical



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		31.5095	24.15	-6.16	17.99	40.00	-22.01	QP			
2		51.6616	36.35	-18.73	17.62	40.00	-22.38	QP			
3		62.6507	34.90	-18.95	15.95	40.00	-24.05	QP			
4		199.9856	25.18	-12.83	12.35	43.50	-31.15	QP			
5		483.9094	27.66	-6.81	20.85	46.00	-25.15	QP			
6	*	830.4002	28.41	-1.13	27.28	46.00	-18.72	QP			

Remark:

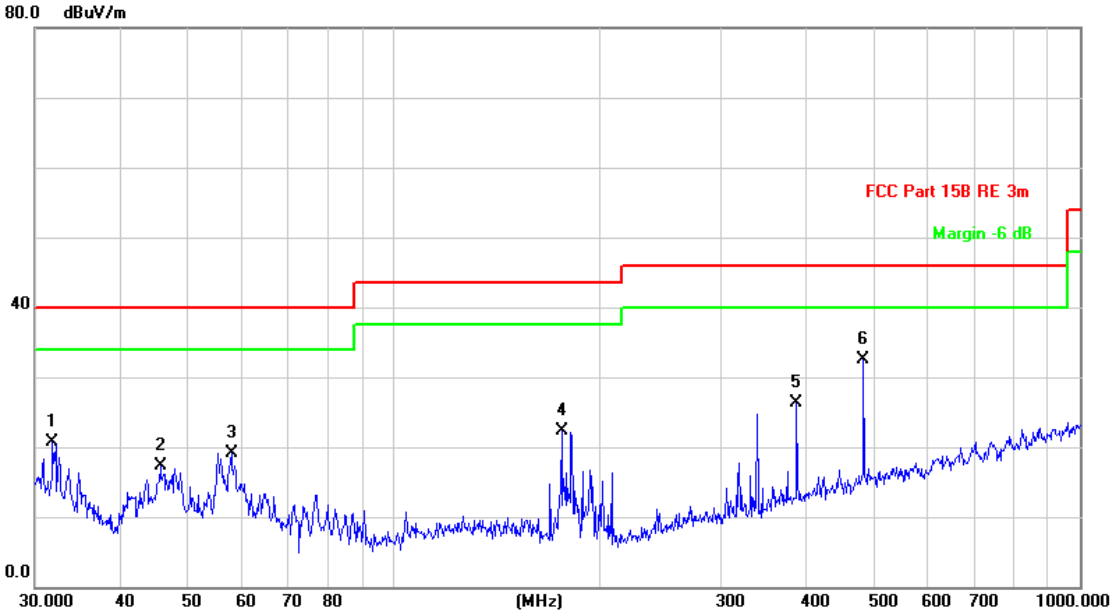
The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

Factor= Antenna Factor + Cable Factor – Preamplifier Factor,

Level = Read Level + Factor,

Over Limit=Level-Limit Line.

Test mode:	Transmitting	Horizontal



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		31.8427	25.68	-5.07	20.61	40.00	-19.39	QP			
2		45.6948	32.91	-15.68	17.23	40.00	-22.77	QP			
3		57.9993	37.92	-18.88	19.04	40.00	-20.96	QP			
4		175.6516	36.53	-14.27	22.26	43.50	-21.24	QP			
5		386.6338	35.37	-8.98	26.39	46.00	-19.61	QP			
6	*	483.9094	39.00	-6.49	32.51	46.00	-13.49	QP			

Remark:

The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

Factor= Antenna Factor + Cable Factor – Preamplifier Factor,

Level = Read Level + Factor,

Over Limit=Level-Limit Line.

5.11.2 Transmitter Emission above 1GHz

mode:		GFSK(DH5)		Test channel:		Lowest	
Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Over (dB)	Detector Type	Ant. Pol. H/V
2390	57.62	-9.2	48.42	74	-25.58	**Peak**	**H**
2400	59.08	-9.39	49.69	74	-24.31	Peak	H
4804	56.44	-4.33	52.11	74	-21.89	Peak	H
7206	52.40	1.01	53.41	74	-20.59	Peak	H
2390	58.32	-9.2	49.12	74	-24.88	**Peak**	**V**
2400	59.08	-9.39	49.69	74	-24.31	Peak	V
4804	55.25	-4.33	50.92	74	-23.08	Peak	V
7206	52.29	1.01	53.30	74	-20.70	Peak	V

mode:		GFSK(DH5)		Test channel:		Middle	
Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Over (dB)	Detector Type	Ant. Pol. H/V
4882	55.07	-4.11	50.96	74	-23.04	**Peak**	H
7323	48.17	1.51	49.68	74	-24.32	Peak	H
4882	54.80	-4.11	50.69	74	-23.31	**Peak**	V
7323	48.69	1.51	50.20	74	-23.80	Peak	V

mode:		GFSK(DH5)		Test channel:		Highest	
Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Over (dB)	Detector Type	Ant. Pol. H/V
2483.5	55.35	-9.29	46.06	74	-27.94	**Peak**	**H**
4960	53.08	-4.04	49.04	74	-24.96	Peak	H
7440	50.03	1.57	51.60	74	-22.40	Peak	H
2483.5	55.73	-9.29	46.44	74	-27.56	**Peak**	**V**
4960	53.67	-4.04	49.63	74	-24.37	Peak	V
7440	50.72	1.57	52.29	74	-21.71	Peak	V

mode:		π/4DQPSK (2DH5)		Test channel:		Lowest	
Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Over (dB)	Detector Type	Ant. Pol. H/V
2390	57.84	-9.2	48.64	74	-25.36	**Peak**	**H**
2400	59.43	-9.39	50.04	74	-23.96	Peak	H
4804	56.24	-4.33	51.91	74	-22.09	Peak	H
7206	53.23	1.01	54.24	74	-19.76	Peak	H
2390	56.94	-9.2	47.74	74	-26.26	**Peak**	**V**
2400	59.40	-9.39	50.01	74	-23.99	Peak	V
4804	55.83	-4.33	51.50	74	-22.50	Peak	V
7206	51.75	1.01	52.76	74	-21.24	Peak	V

mode:		π/4DQPSK (2DH5)		Test channel:		Middle	
Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Over (dB)	Detector Type	Ant. Pol. H/V
4882	55.37	-4.11	51.26	74	-22.74	peak	H
7323	48.18	1.51	49.69	74	-24.31	peak	H
4882	54.94	-4.11	50.83	74	-23.17	peak	V
7323	49.58	1.51	51.09	74	-22.91	peak	V

mode:		π/4DQPSK (2DH5)		Test channel:		Highest	
Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Over (dB)	Detector Type	Ant. Pol. H/V
2483.5	55.18	-9.29	45.89	74	-28.11	**Peak**	**H**
4960	53.17	-4.04	49.13	74	-24.87	Peak	H
7440	48.80	1.57	50.37	74	-23.63	Peak	H
2483.5	54.51	-9.29	45.22	74	-28.78	**Peak**	**V**
4960	53.62	-4.04	49.58	74	-24.42	Peak	V
7440	48.93	1.57	50.50	74	-23.50	Peak	V

mode:		8DPSK (3DH5)		Test channel:		Lowest	
Frequency	Meter Reading	Factor	Emission Level	Limits	Over	Detector Type	Ant. Pol.
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)		H/V
2390	57.56	-9.2	48.36	74	-25.64	**Peak**	**H**
2400	57.94	-9.39	48.55	74	-25.45	Peak	H
4804	55.36	-4.33	51.03	74	-22.97	Peak	H
7206	53.64	1.01	54.65	74	-19.35	Peak	H
2390	57.96	-9.2	48.76	74	-25.24	**Peak**	**V**
2400	59.11	-9.39	49.72	74	-24.28	Peak	V
4804	55.52	-4.33	51.19	74	-22.81	Peak	V
7206	51.86	1.01	52.87	74	-21.13	Peak	V

mode:		8DPSK (3DH5)		Test channel:		Middle	
Frequency	Meter Reading	Factor	Emission Level	Limits	Over	Detector Type	Ant. Pol.
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)		H/V
4882	55.56	-4.11	51.45	74	-22.55	peak	H
7323	48.00	1.51	49.51	74	-24.49	peak	H
4882	56.43	-4.11	52.32	74	-21.68	peak	V
7323	49.66	1.51	51.17	74	-22.83	peak	V

mode:		8DPSK (3DH5)		Test channel:		Highest	
Frequency	Meter Reading	Factor	Emission Level	Limits	Over	Detector Type	Ant. Pol.
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)		H/V
2483.5	55.33	-9.29	46.04	74	-27.96	**Peak**	**H**
4960	54.26	-4.04	50.22	74	-23.78	Peak	H
7440	50.24	1.57	51.81	74	-22.19	Peak	H
2483.5	55.28	-9.29	45.99	74	-28.01	**Peak**	**V**
4960	53.08	-4.04	49.04	74	-24.96	Peak	V
7440	50.60	1.57	52.17	74	-21.83	Peak	V

Remark:

1) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

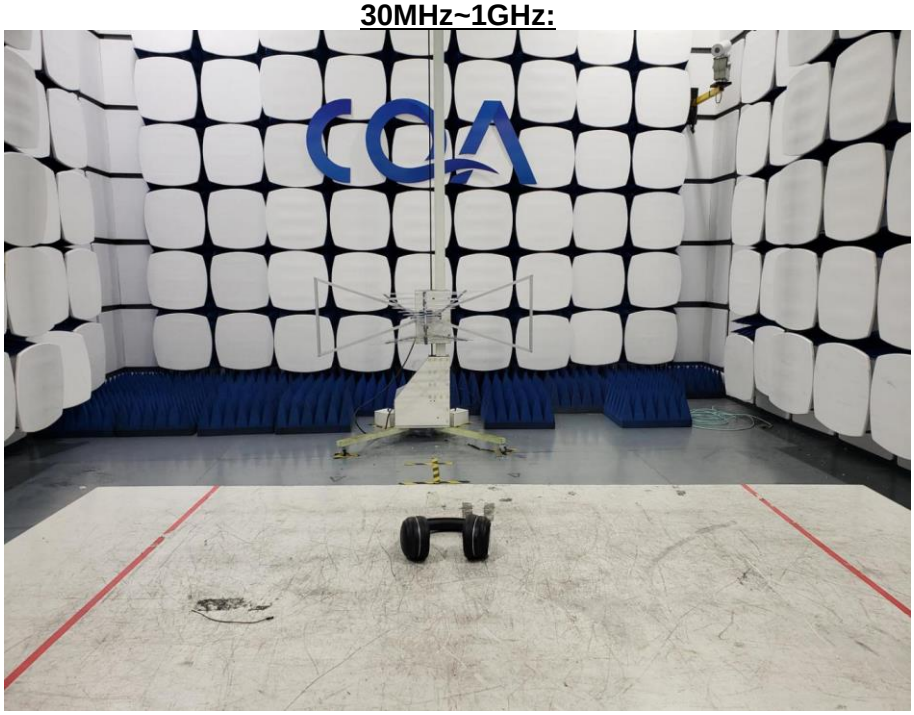
   Final Test Level =Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor

2) Scan from 9kHz to 25GHz, the disturbance above 10GHz and below 30MHz was very low. As shown in this section, for frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. So, only the peak measurements were shown in the report.

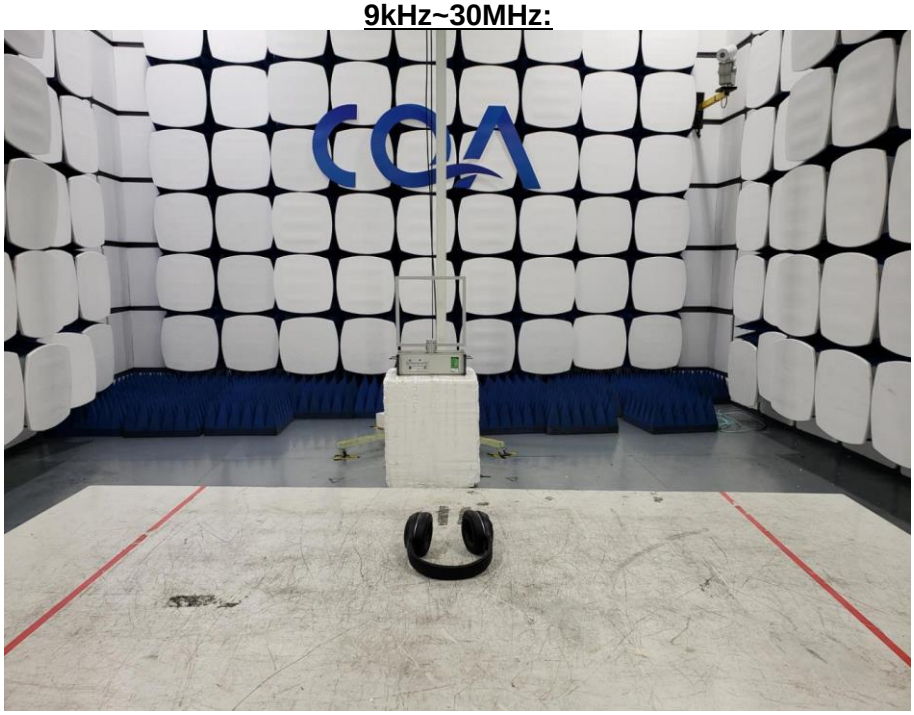
6 Photographs - EUT Test Setup

Please see test setup file

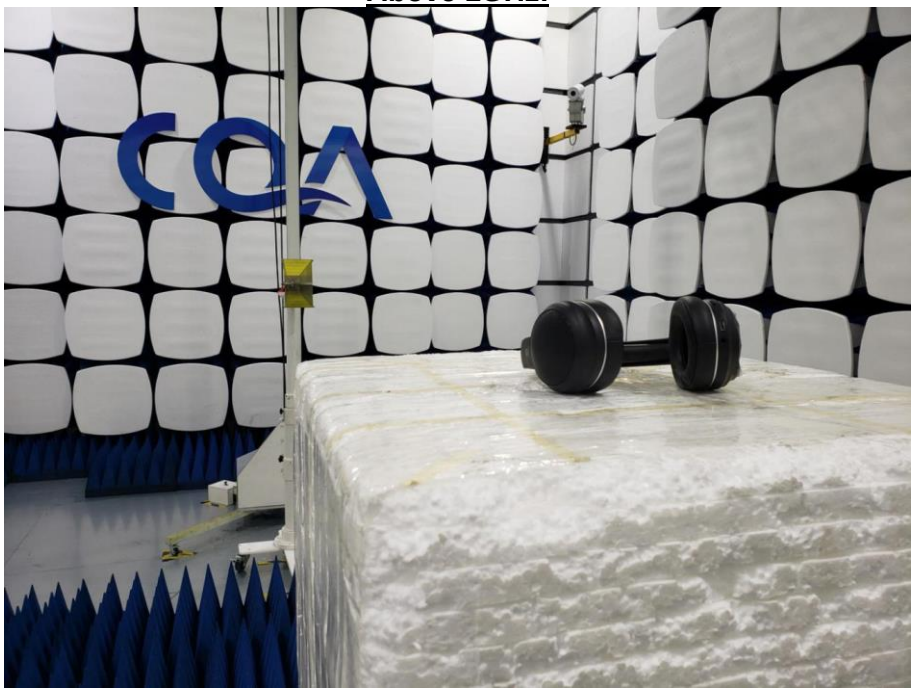
30MHz~1GHz:



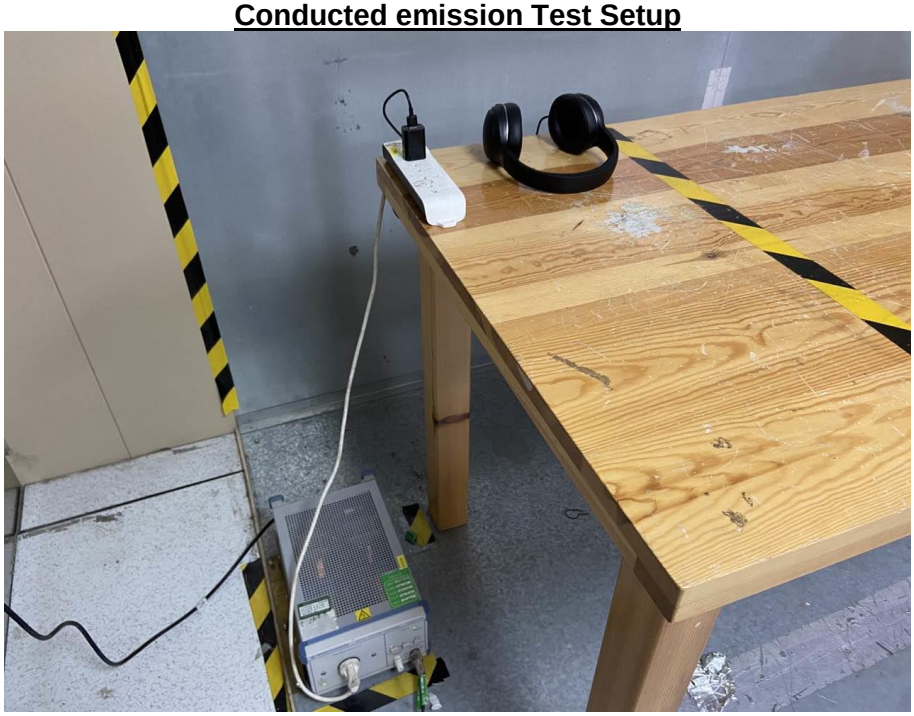
9kHz~30MHz:



Above 1GHz:



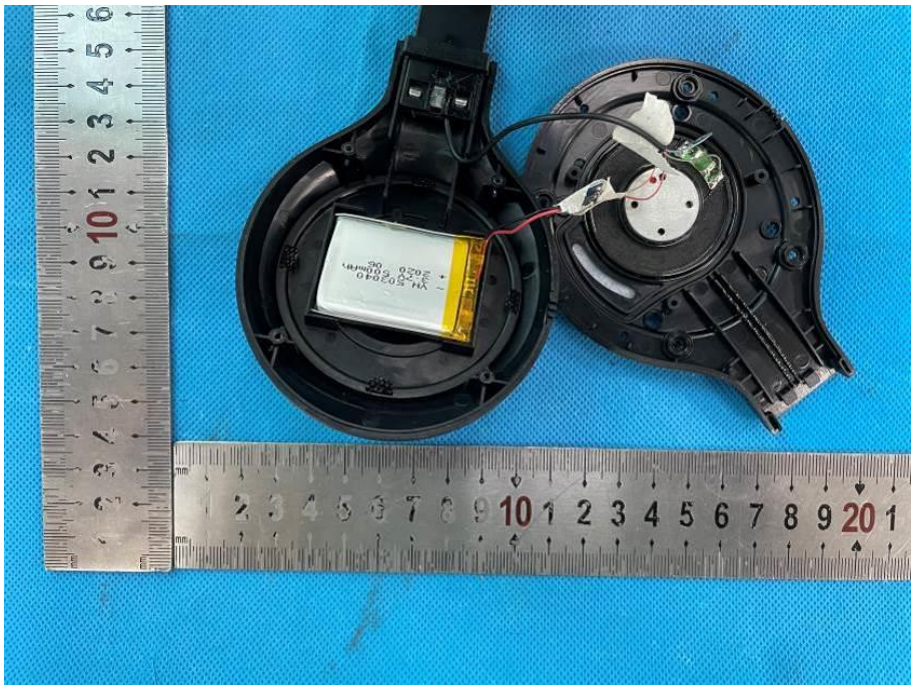
Conducted emission Test Setup

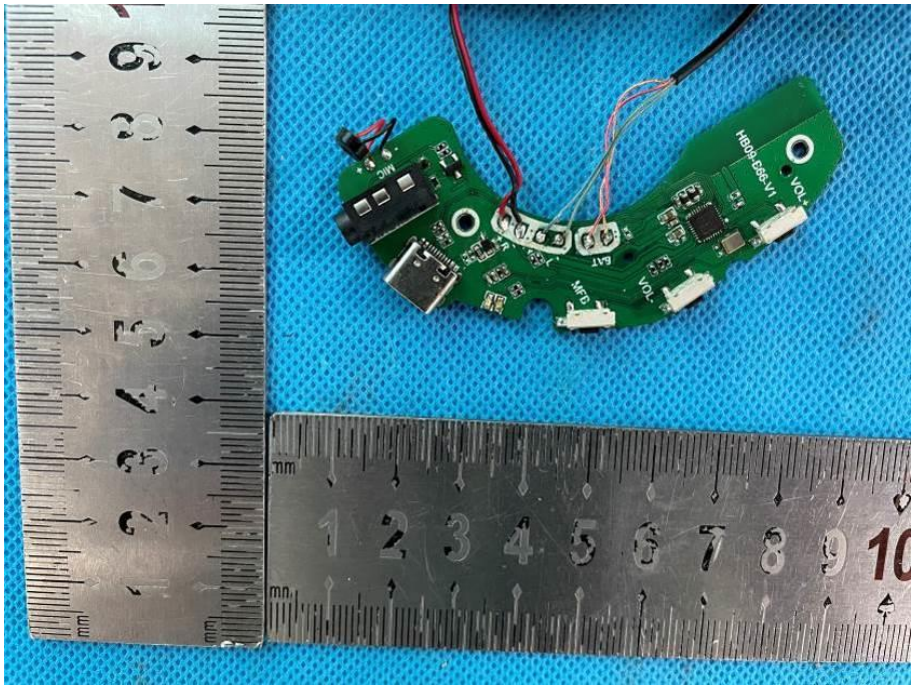


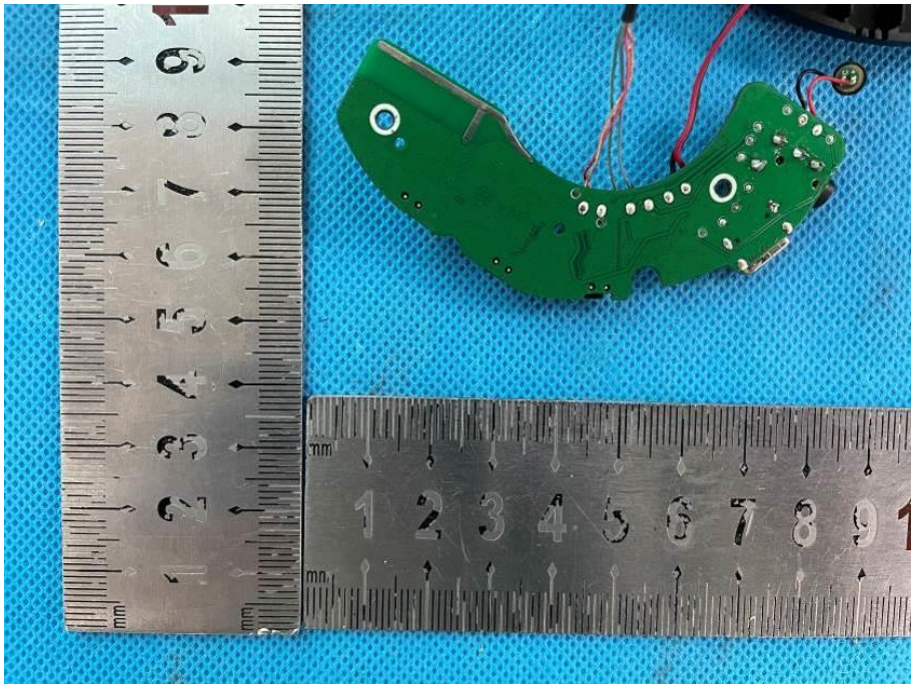
7 Photographs - EUT Constructional Details

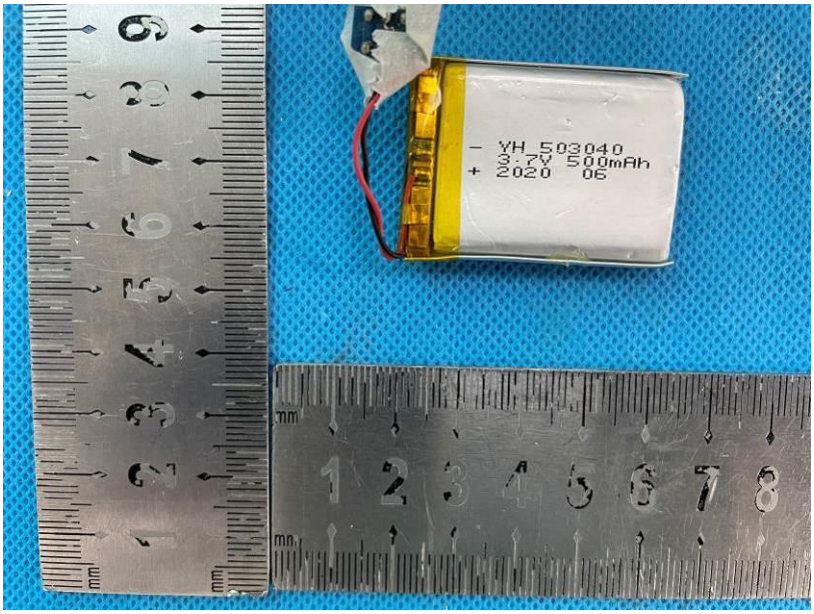
External photos

Internal photos




MIC
BAT
MFD
VOL+
VOL-





The End