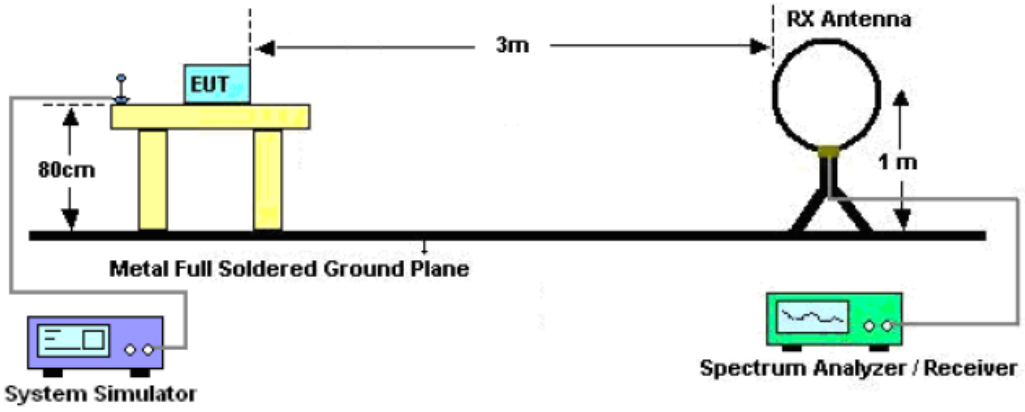
11. RADIATED EMISSION

11.1. MEASUREMENT PROCEDURE

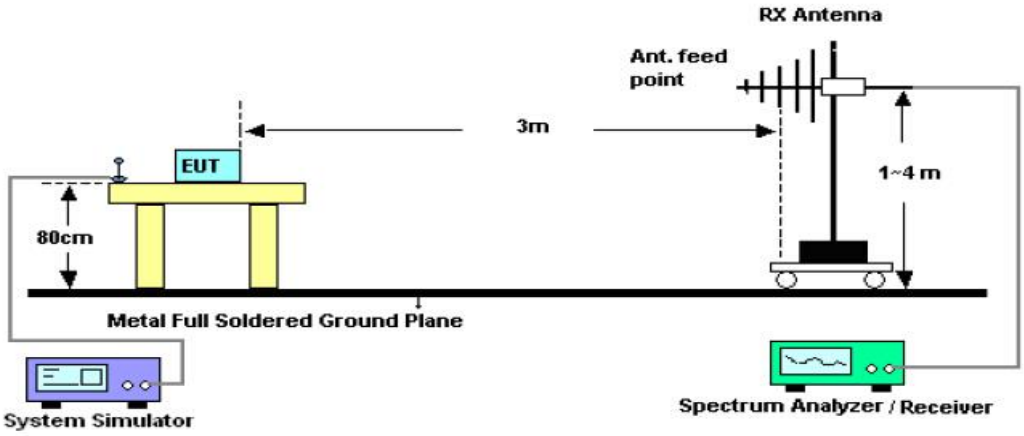
1. The EUT was placed on the top of the turntable 0.8 or 1.5 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz VBW and RBW for peak reading. Then 1MHz RBW and 10Hz VBW for average reading in spectrum analyzer. 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.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum values.
8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High - Low scan is not required in this case.

11.2. TEST SETUP

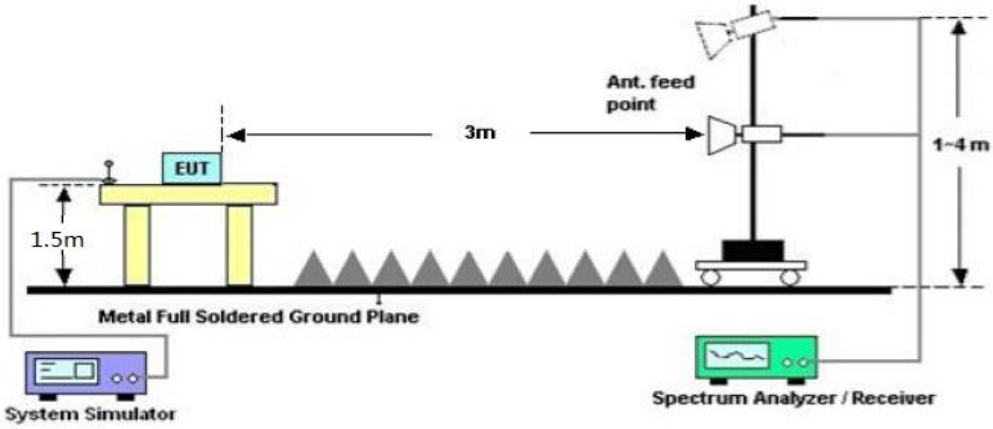
Radiated Emission Test-Setup Frequency Below 30MHz



RADIATED EMISSION TEST SETUP 30MHz-1000MHz



RADIATED EMISSION TEST SETUP ABOVE 1000MHz



11.3. LIMITS AND MEASUREMENT RESULT

15.209(a) Limit in the below table has to be followed

Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (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

Note: All modes were tested For restricted band radiated emission,
the test records reported below are the worst result compared to other modes.

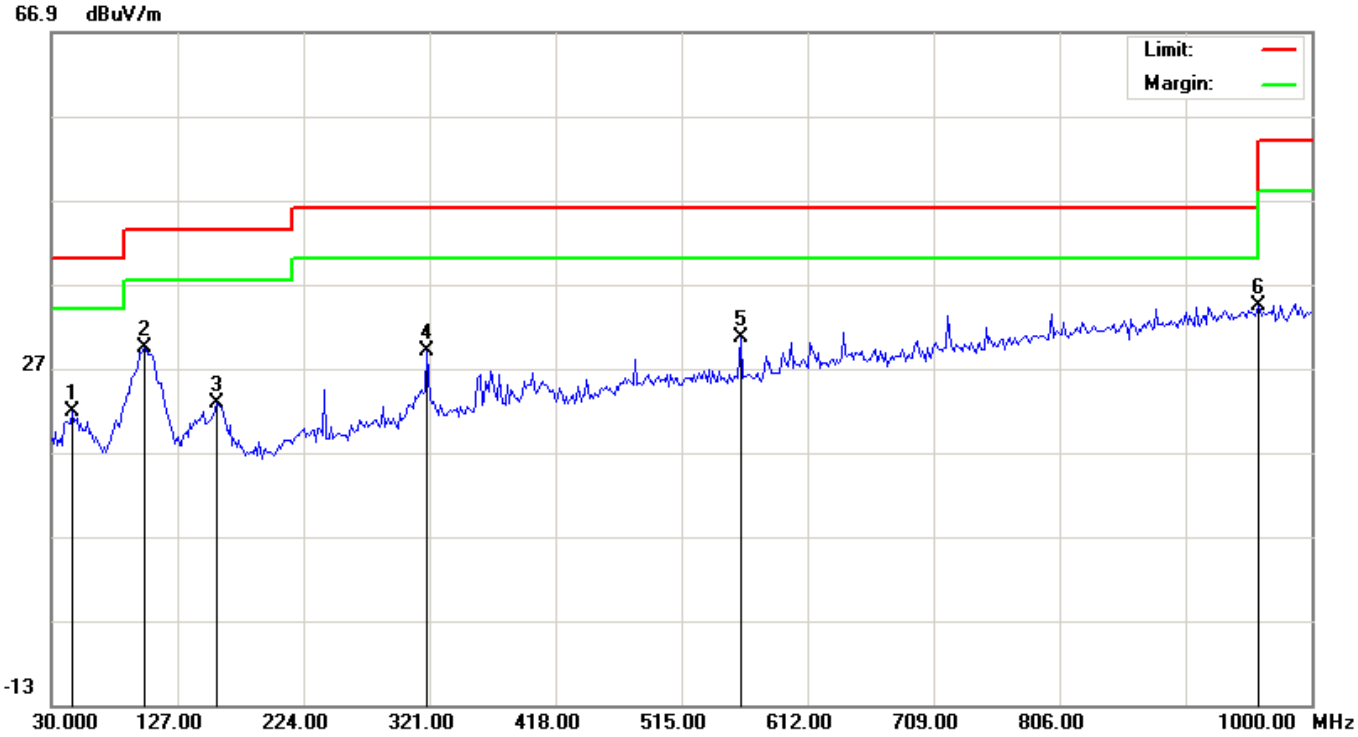
11.4. TEST RESULT

RADIATED EMISSION BELOW 30MHZ

No emission found between lowest internal used/generated frequencies to 30MHz.

RADIATED EMISSION BELOW 1GHZ

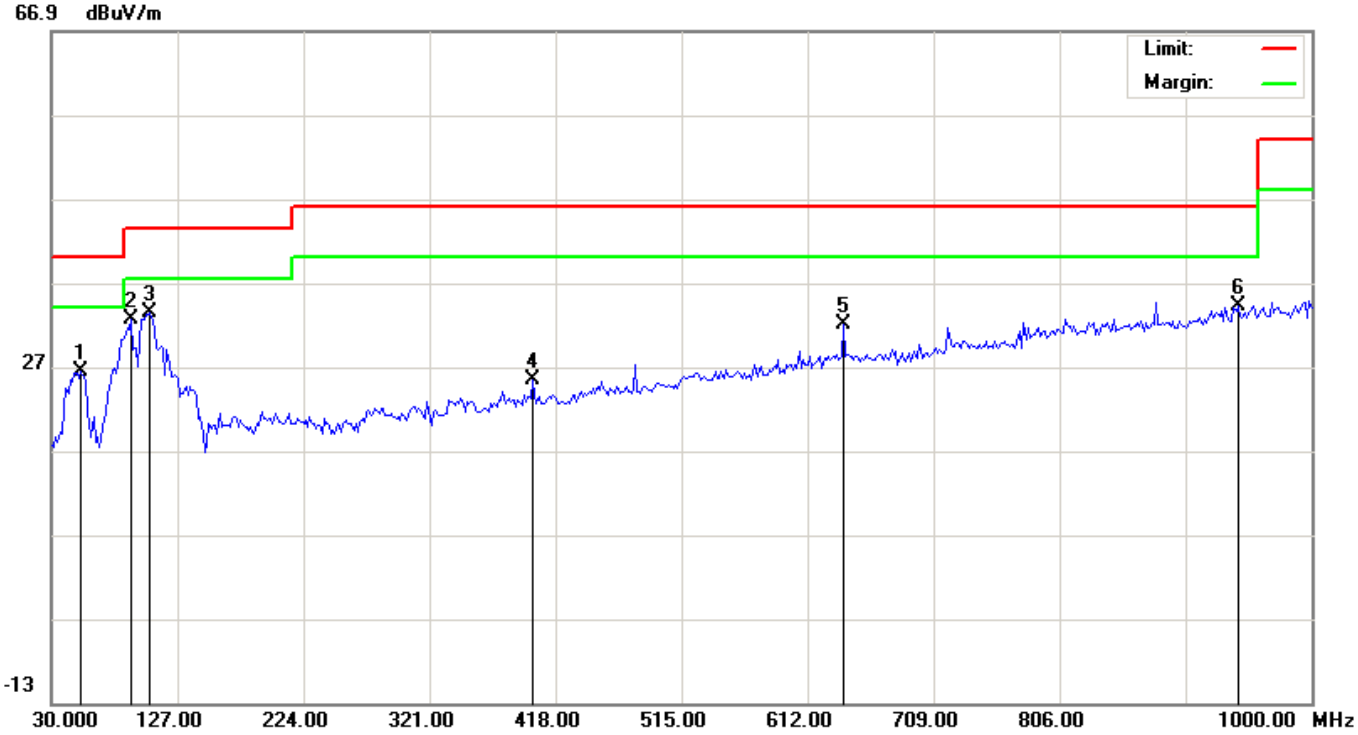
RADIATED EMISSION TEST- (30MHZ-1GHZ) -HORIZONTAL



No.	Mk	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
	-	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1		46.1667	1.87	19.87	21.74	40.00	-18.26	peak			
2		101.1333	13.27	16.12	29.39	43.50	-14.11	peak			
3		157.7167	3.67	19.19	22.86	43.50	-20.64	peak			
4		319.3833	8.94	20.15	29.09	46.00	-16.91	peak			
5		560.2667	4.52	26.17	30.69	46.00	-15.31	peak			
6	*	959.5833	2.21	32.21	34.42	46.00	-11.58	peak			

RESULT: PASS

RADIATED EMISSION TEST- (30MHZ-1GHZ) -VERTICAL



No.	Mk.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1		52.6333	6.82	19.50	26.32	40.00	-13.68	peak			
2		91.4333	17.50	15.13	32.63	43.50	-10.87	peak			
3	*	105.9833	16.81	16.60	33.41	43.50	-10.09	peak			
4		400.2167	2.36	22.98	25.34	46.00	-20.66	peak			
5		639.4833	4.60	27.42	32.02	46.00	-13.98	peak			
6		943.4167	2.17	32.07	34.24	46.00	-11.76	peak			

RESULT: PASS

Note: 1. Factor=Antenna Factor + Cable loss, Margin= Result -Limit.

2. The “Factor” value can be calculated automatically by software of measurement system.

3. All test modes had been pre-tested. The 802.11b at low channel is the worst case and recorded in the report.

RADIATED EMISSION ABOVE 1GHZ

Frequency (MHz)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type	Comment
TX 11b 2412MHz					
4824	49.02	74	-24.98	Pk	Horizontal
4824	35.62	54	-18.38	AV	Horizontal
7236	50.13	74	-23.87	pk	Horizontal
7236	34.62	54	-19.38	AV	Horizontal
4824	50.62	74	-23.38	Pk	Vertical
4824	34.42	54	-19.58	AV	Vertical
7236	50.64	74	-23.36	Pk	Vertical
7236	39.09	54	-14.91	AV	Vertical
TX 11b 2437MHz					
4874	49.85	74	-24.15	Pk	Horizontal
4874	32.06	54	-21.94	AV	Horizontal
7311	46.23	74	-27.77	Pk	Horizontal
7311	34.89	54	-19.11	AV	Horizontal
4874	49.60	74	-24.40	Pk	Vertical
4874	40.34	54	-13.66	AV	Vertical
7311	47.99	74	-26.01	Pk	Vertical
7311	37.95	54	-16.05	AV	Vertical
TX 11b 2462MHz					
4924	50.04	74	-23.96	Pk	Horizontal
4924	34.13	54	-19.87	AV	Horizontal
7386	48.62	74	-25.38	Pk	Horizontal
7386	39.21	54	-14.79	AV	Horizontal
4924	50.27	74	-23.73	Pk	Vertical
4924	38.19	54	-15.81	AV	Vertical
7386	49.00	74	-25.00	Pk	Vertical
7386	36.94	54	-17.06	AV	Vertical

RESULT: PASS

Note:

1. Margin = Emission Level - Limit

2.1GHz-25GHz(All test modes had been pre-tested. The 802.11b mode is the worst case and recorded in the report. No recording in the test report at least have 20dB margin).

12. BAND EDGE EMISSION

12.1. MEASUREMENT PROCEDURE

1)Radiated restricted band edge measurements

The radiated restricted band edge measurements are measured with an EMI test receiver connected to the receive antenna while the EUT is transmitting

2)Conducted Emissions at the bang edge

a)The transmitter output was connected to the spectrum analyzer

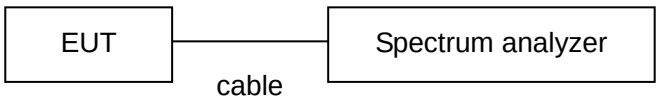
b)Set RBW=100kHz,VBW=300kHz

c)Suitable frequency span including 100kHz bandwidth from band edge

12.2. TEST SET-UP

Radiated same as 11.2

Conducted set up



12.3. RADIATED TEST RESULT

Frequency	Emission Level	Limits	Margin	Detector	Comment
(MHz)	(dBμV/m)	(dBμV/m)	(dB)	Type	
TX 11b 2412MHz					
2399.9	47.31	74	-26.69	pk	Horizontal
2399.9	41.05	54	-12.95	AV	Horizontal
2400	50.39	74	-23.61	pk	Horizontal
2400	35.43	54	-18.57	AV	Horizontal
2399.9	53.57	74	-20.43	pk	Vertical
2399.9	38.13	54	-15.87	AV	Vertical
2400	48.88	74	-25.12	pk	Vertical
2400	38.22	54	-15.78	AV	Vertical
TX 11b 2462MHz					
2483.5	47.48	74	-26.52	pk	Horizontal
2483.5	38.09	54	-15.91	AV	Horizontal
2483.6	48.92	74	-25.08	pk	Horizontal
2483.6	39.08	54	-14.92	AV	Horizontal
2483.5	48.42	74	-25.58	pk	Vertical
2483.5	34.20	54	-19.80	AV	Vertical
2483.6	52.87	74	-21.13	pk	Vertical
2483.6	39.27	54	-14.73	AV	Vertical

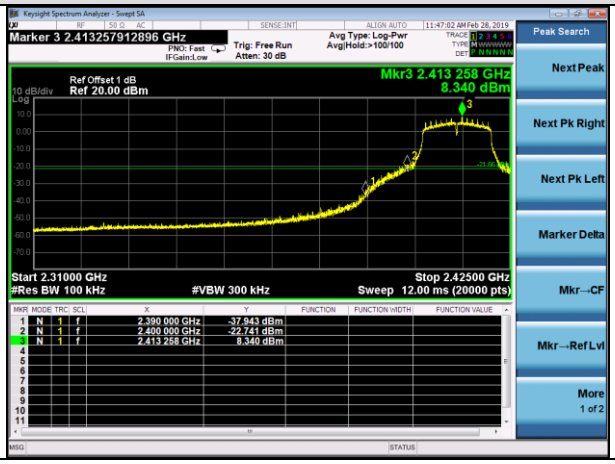
RESULT: PASS

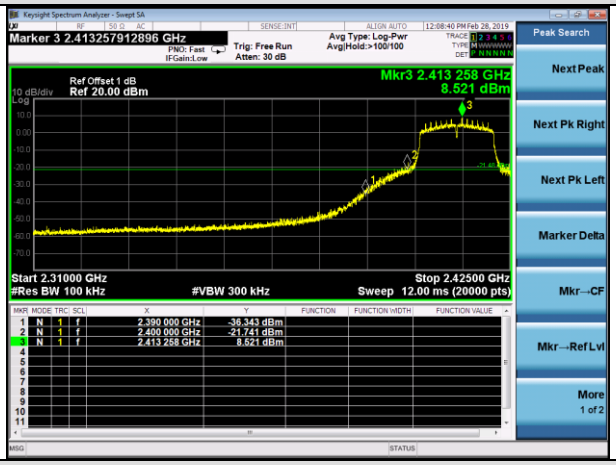
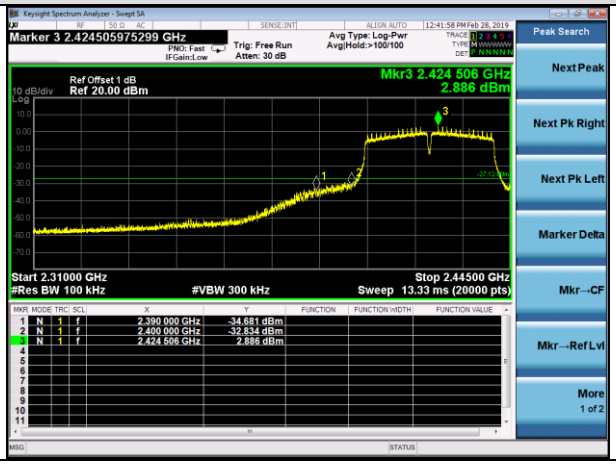
Note: Scan with 11b,11g,11n, the worst case is 11b Mode
Margin= Emission Level -Limit.

12.4. CONDUCTED TEST RESULT

Test Graph

11b-LCH	11b-HCH

11g-LCH	11g-HCH
	

11nHT20-LCH	11nHT20-HCH
	
11nHT40-LCH	**11nHT40-HCH**
	

13. FCC LINE CONDUCTED EMISSION TEST

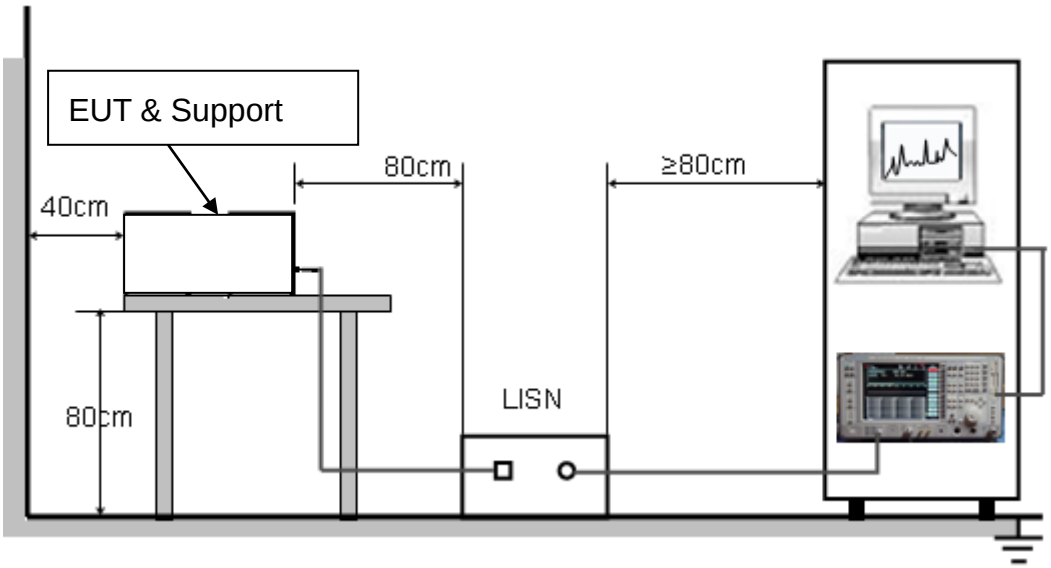
13.1. LIMITS OF LINE CONDUCTED EMISSION TEST

Frequency	Maximum RF Line Voltage	
	Q.P.(dBuV)	Average(dBuV)
150kHz~500kHz	66-56	56-46
500kHz~5MHz	56	46
5MHz~30MHz	60	50

Note:

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

13.2. BLOCK DIAGRAM OF LINE CONDUCTED EMISSION TEST



13.3. PRELIMINARY PROCEDURE OF LINE CONDUCTED EMISSION TEST

1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. When the EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10 (see Test Facility for the dimensions of the ground plane used). When the EUT is a floor-standing equipment, it is placed on the ground plane which has a 3-12 mm non-conductive covering to insulate the EUT from the ground plane.
2. Support equipment, if needed, was placed as per ANSI C63.10.
3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10.
4. All support equipments received AC120V/60Hz power from a LISN, if any.
5. The EUT received charging voltage by adapter which received 120V/60Hzpower by a LISN..
6. The test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7. Analyzer / Receiver scanned from 150 kHz to 30MHz for emissions in each of the test modes.
8. During the above scans, the emissions were maximized by cable manipulation.
9. The test mode(s) were scanned during the preliminary test.

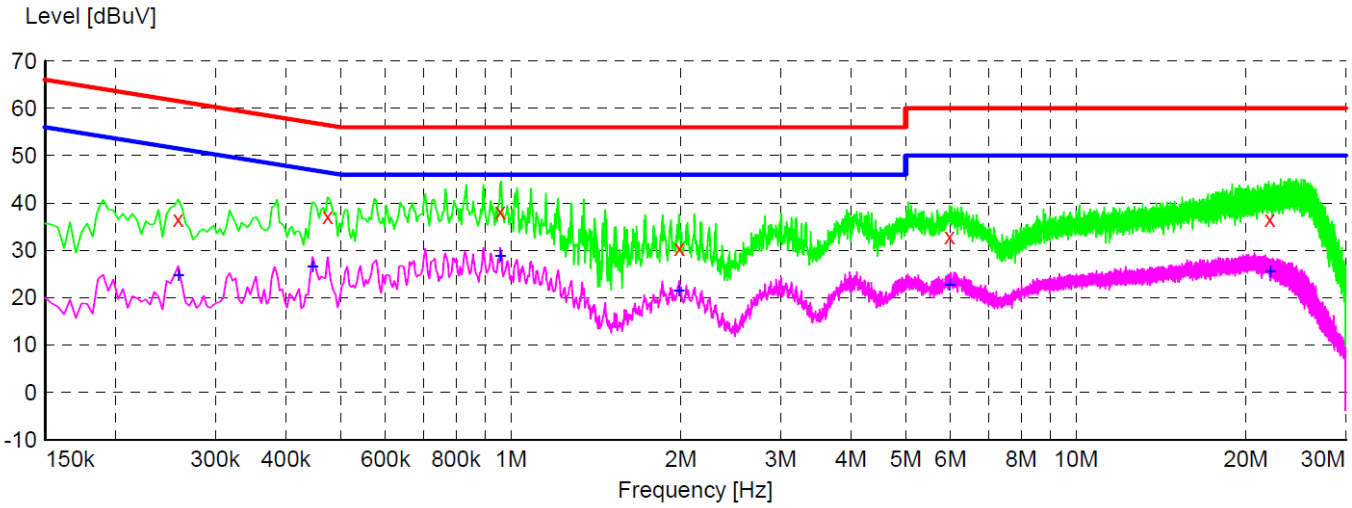
Then, the EUT configuration and cable configuration of the above highest emission level were recorded for reference of final testing.

13.4. FINAL PROCEDURE OF LINE CONDUCTED EMISSION TEST

1. EUT and support equipment was set up on the test bench as per step 2 of the preliminary test.
2. A scan was taken on both power lines, Line 1 and Line 2, recording at least the six highest emissions. Emission frequency and amplitude were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit. If EUT emission level was less –2dB to the A.V. limit in Peak mode, then the emission signal was re-checked using Q.P and Average detector.
3. The test data of the worst case condition(s) was reported on the Summary Data page.

13.5. TEST RESULT OF LINE CONDUCTED EMISSION TEST

LINE CONDUCTED EMISSION TEST LINE 1-L



MEASUREMENT RESULT: "TEST_fin"

2019/2/28 11:05

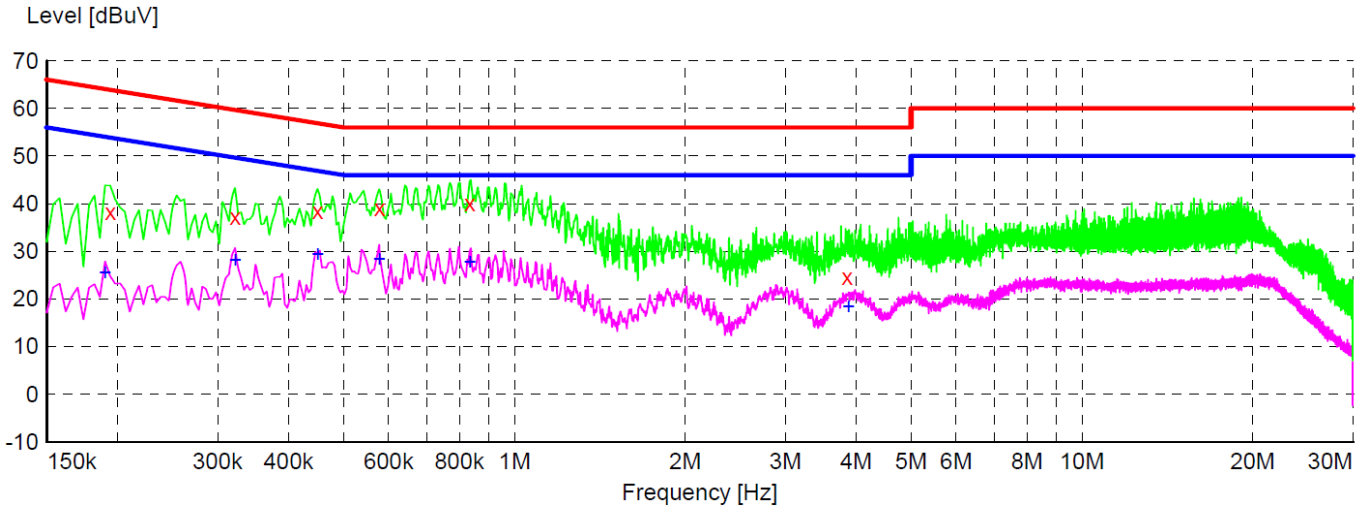
Frequency MHz	Level dBuV	Transd dB	Limit dBuV	Margin dB	Detector	Line	PE
0.258000	36.50	10.2	62	25.0	QP	L1	FLO
0.474000	37.20	10.3	56	19.2	QP	L1	FLO
0.958000	38.20	10.4	56	17.8	QP	L1	FLO
1.986000	30.40	10.4	56	25.6	QP	L1	FLO
5.978000	32.80	10.5	60	27.2	QP	L1	FLO
22.030000	36.60	11.1	60	23.4	QP	L1	FLO

MEASUREMENT RESULT: "TEST_fin2"

2019/2/28 11:05

Frequency MHz	Level dBuV	Transd dB	Limit dBuV	Margin dB	Detector	Line	PE
0.258000	24.80	10.2	52	26.7	AV	L1	FLO
0.446000	26.60	10.3	47	20.3	AV	L1	FLO
0.958000	28.80	10.4	46	17.2	AV	L1	FLO
1.986000	21.50	10.4	46	24.5	AV	L1	FLO
5.978000	22.80	10.5	50	27.2	AV	L1	FLO
22.062000	25.60	11.1	50	24.4	AV	L1	FLO

Line Conducted Emission Test Line 2-N



MEASUREMENT RESULT: "TEST_fin"

2019/2/28 10:55

Frequency MHz	Level dBuV	Transd dB	Limit dBuV	Margin dB	Detector	Line	PE
0.194000	38.20	10.3	64	25.7	QP	N	FLO
0.322000	37.20	10.2	60	22.5	QP	N	FLO
0.450000	38.40	10.3	57	18.5	QP	N	FLO
0.578000	38.90	10.3	56	17.1	QP	N	FLO
0.834000	39.90	10.4	56	16.1	QP	N	FLO
3.858000	24.60	10.4	56	31.4	QP	N	FLO

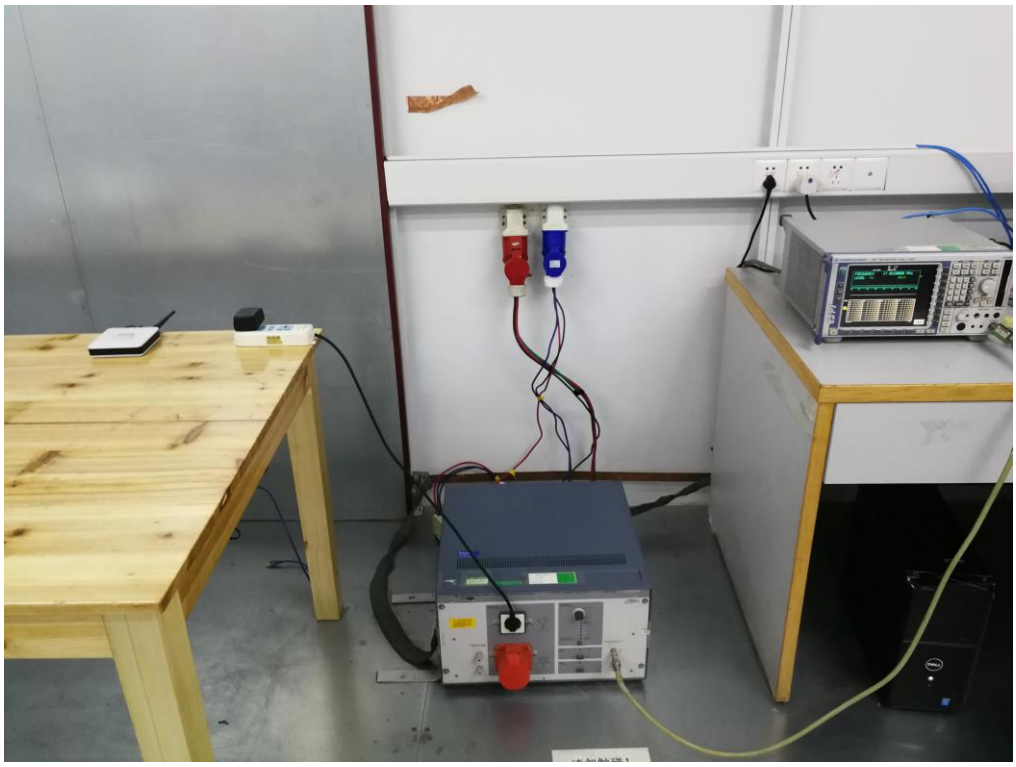
MEASUREMENT RESULT: "TEST_fin2"

2019/2/28 10:55

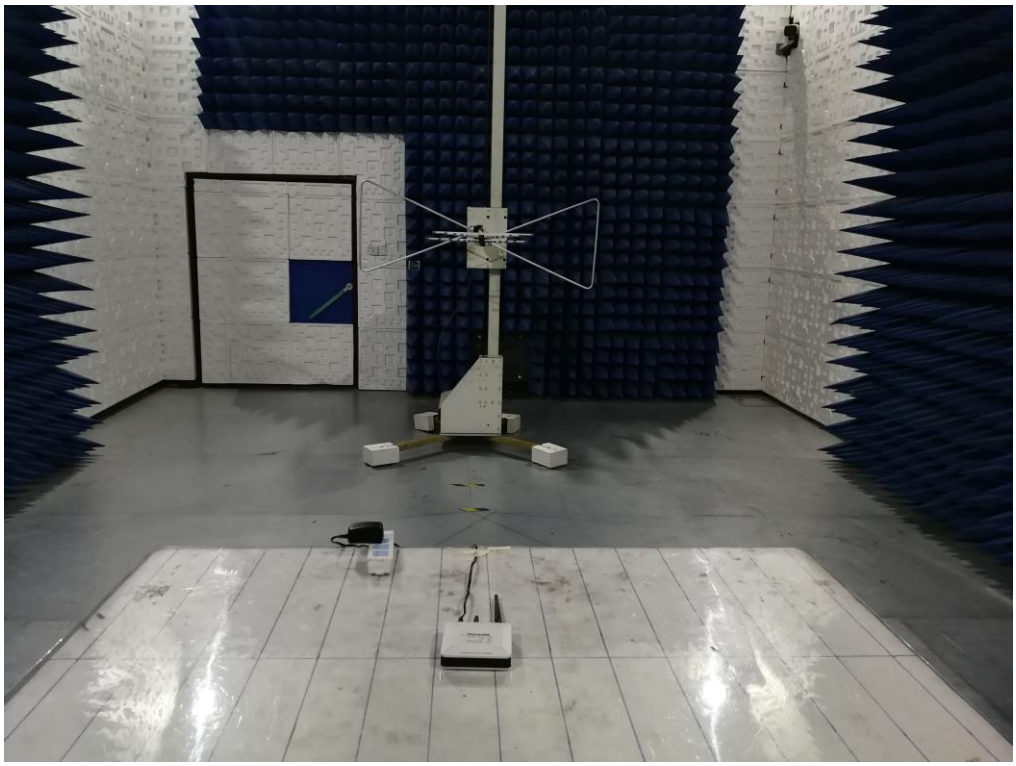
Frequency MHz	Level dBuV	Transd dB	Limit dBuV	Margin dB	Detector	Line	PE
0.190000	25.50	10.3	54	28.5	AV	N	FLO
0.322000	28.10	10.2	50	21.6	AV	N	FLO
0.450000	29.40	10.3	47	17.5	AV	N	FLO
0.578000	28.50	10.3	46	17.5	AV	N	FLO
0.834000	27.80	10.4	46	18.2	AV	N	FLO
3.878000	18.50	10.4	46	27.5	AV	N	FLO

APPENDIX A: PHOTOGRAPHS OF TEST SETUP

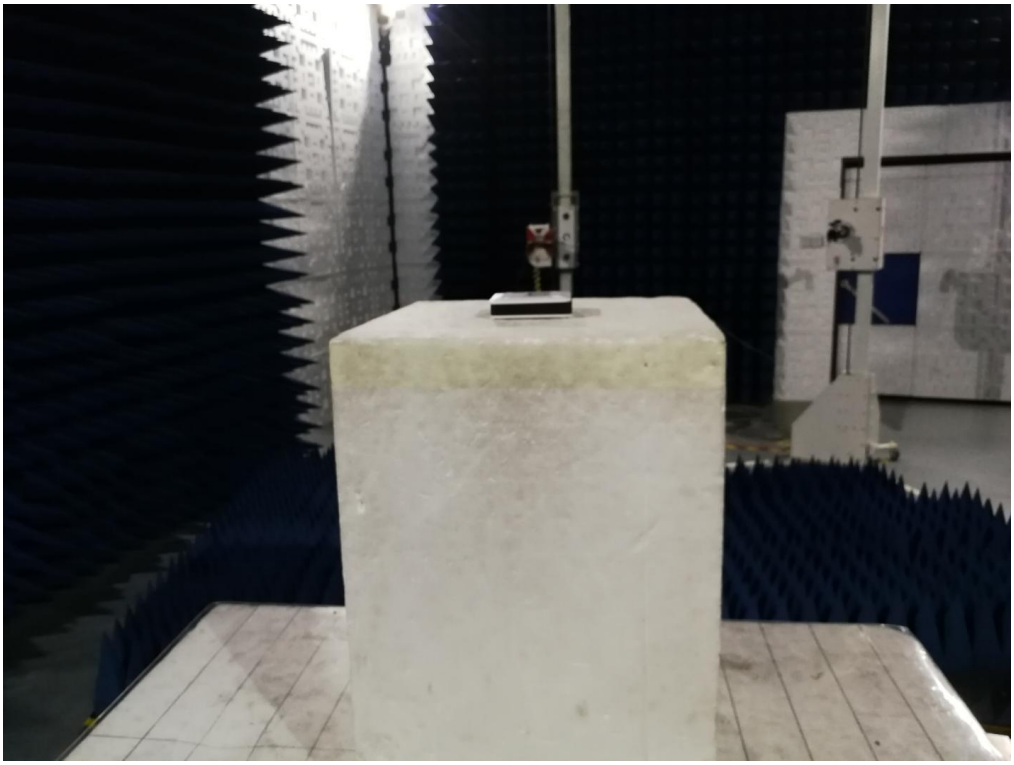
LINE CONDUCTED EMISSION TEST SETUP



RADIATED EMISSION TEST SETUP



RADIATED EMISSION ABOVE 1G TEST SETUP



----END OF REPORT----