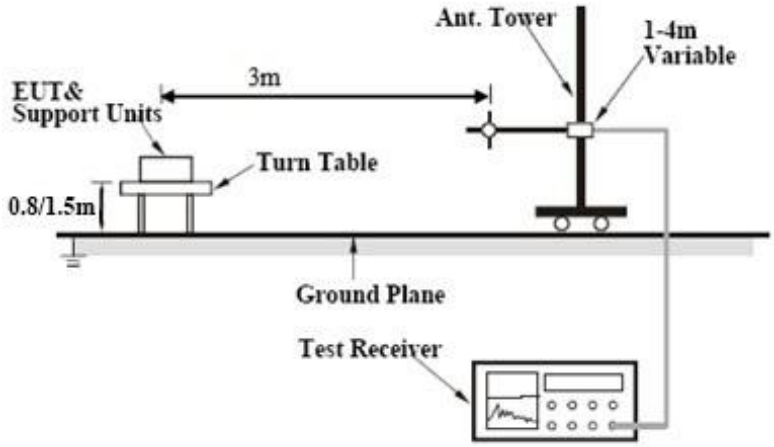
6.5 Band-Edge & Unwanted Emissions into Non-Restricted Frequency Bands

Temperature	20°C
Relative Humidity	50%
Atmospheric Pressure	1019mbar
Test date :	June 02, 2017
Tested By :	Amos Xia

Requirement(s):

Spec	Item	Requirement	Applicable
§15.247(d)	a)	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.	☑

Test Setup



Test Procedure

Radiated Method Only

- 1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 2. Position the EUT without connection to measurement instrument. Put it on the Rotated table and turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
- 3. First, set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100kHz bandwidth from band edge, check the emission of EUT, if pass then set Spectrum Analyzer as below:
  a. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasiy Peak detection at frequency below 1GHz.
  b. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz with Peak detection for Peak measurement at frequency above 1GHz.
  c. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz with Peak detection for Average Measurement as below at frequency above 1GHz.
- 4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
- 5. Repeat above procedures until all measured frequencies were complete.

Remark

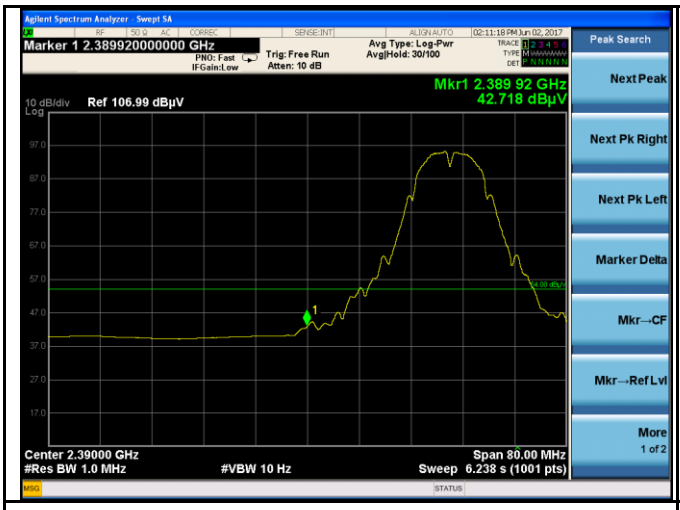
Result

☑ Pass ☐ Fail

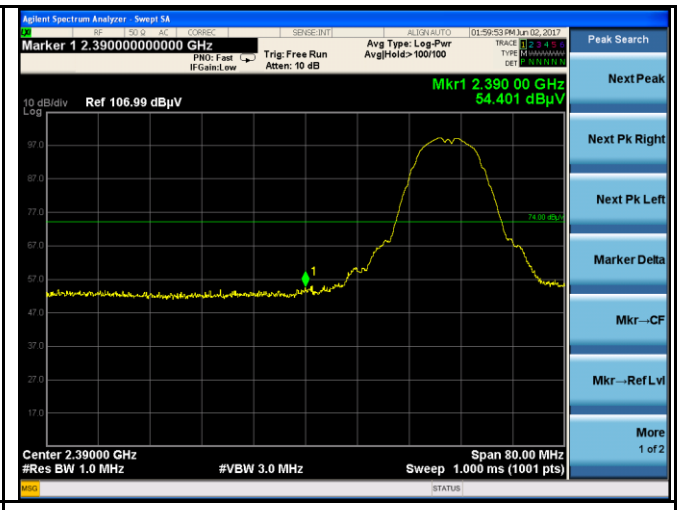
Test Data ☑ Yes ☐ N/A

Test Plot ☑ Yes (See below) ☐ N/A

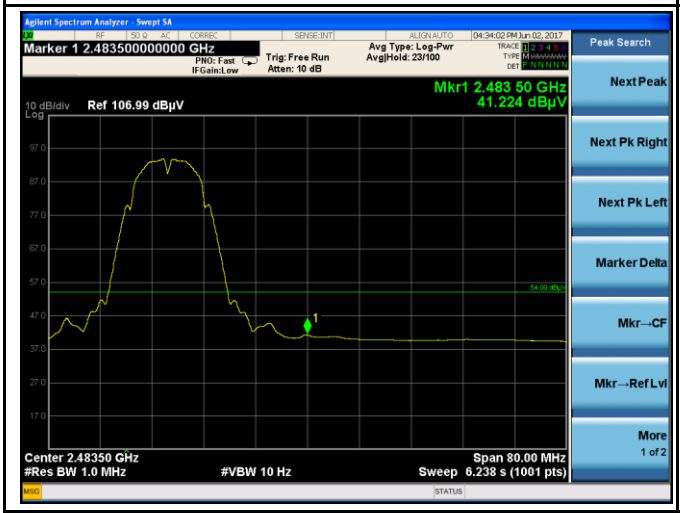
Test Plots
Band Edge measurement result



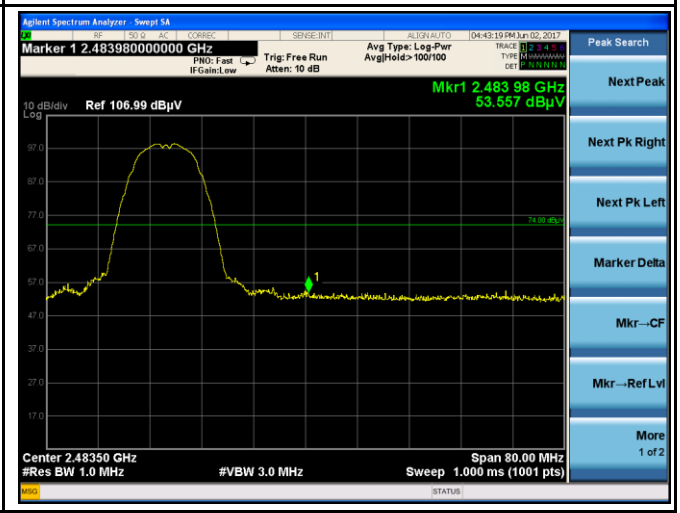
Band Edge, Left Side (Average) - 802.11b – CH 1



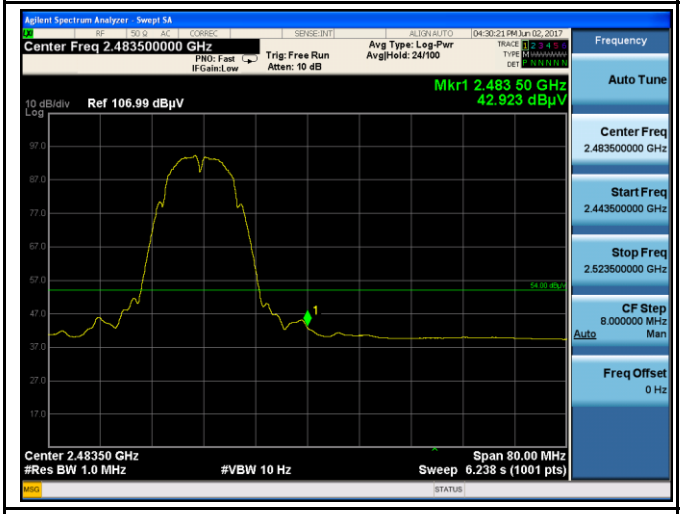
Band Edge, Left Side (Peak) - 802.11b – CH 1



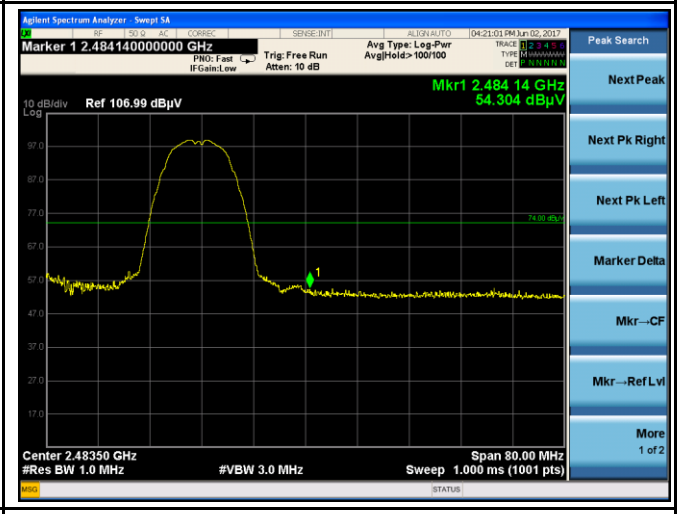
Band Edge, Right Side (Average) – 802.11b - CH 11



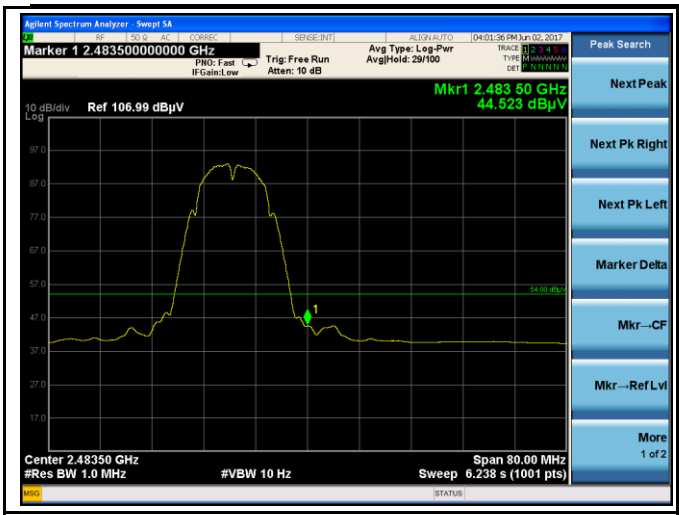
Band Edge, Right Side (Peak) – 802.11b - CH 11



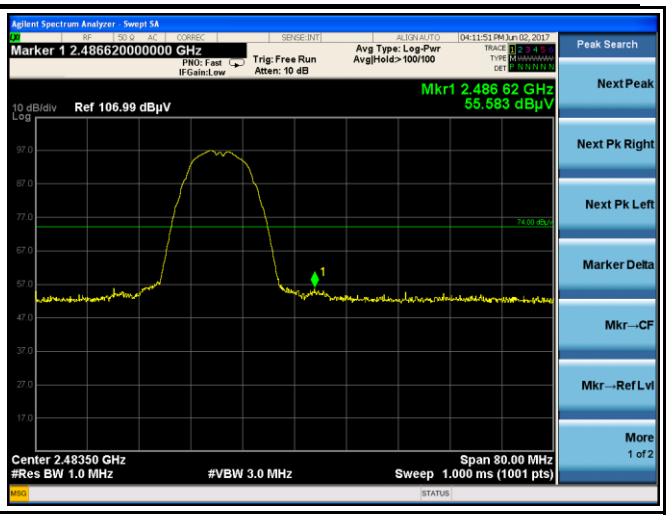
Band Edge, Right Side (Average) – 802.11b - CH 12



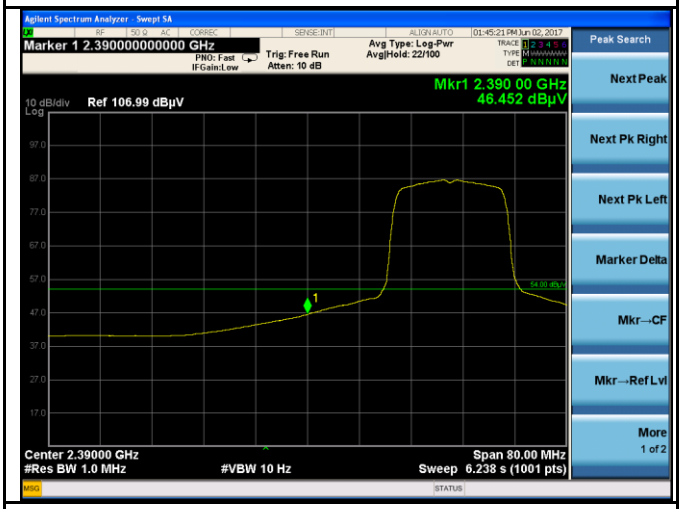
Band Edge, Right Side (Peak) – 802.11b - CH 12



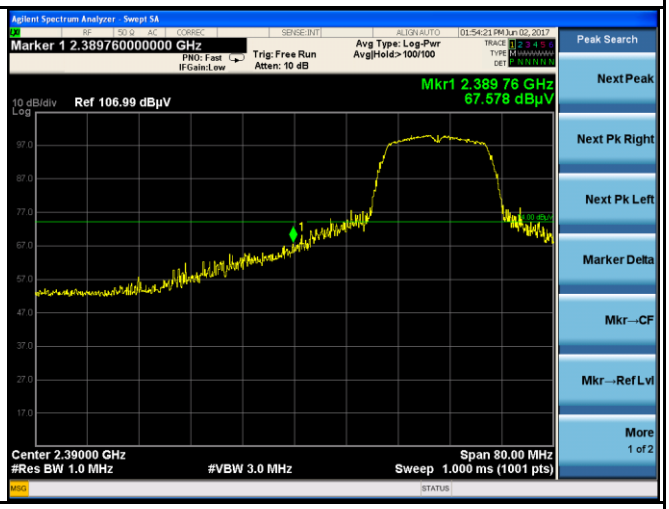
Band Edge, Right Side (Average) – 802.11b - CH 13



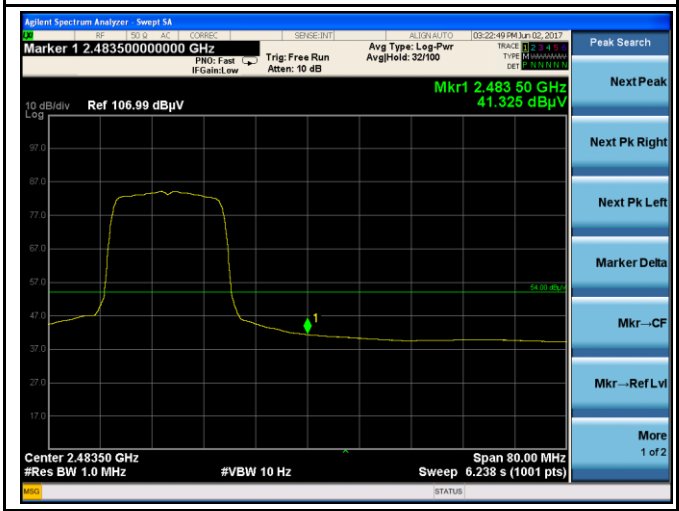
Band Edge, Right Side (Peak) – 802.11b - CH 13



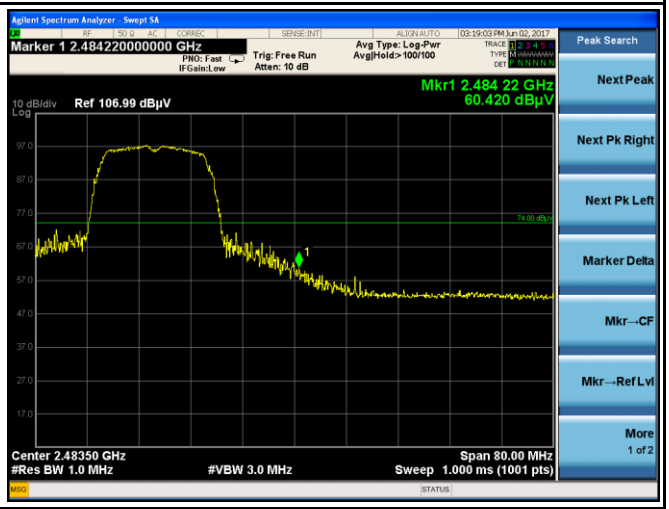
Band Edge, Left Side (Average) - 802.11g – CH 1



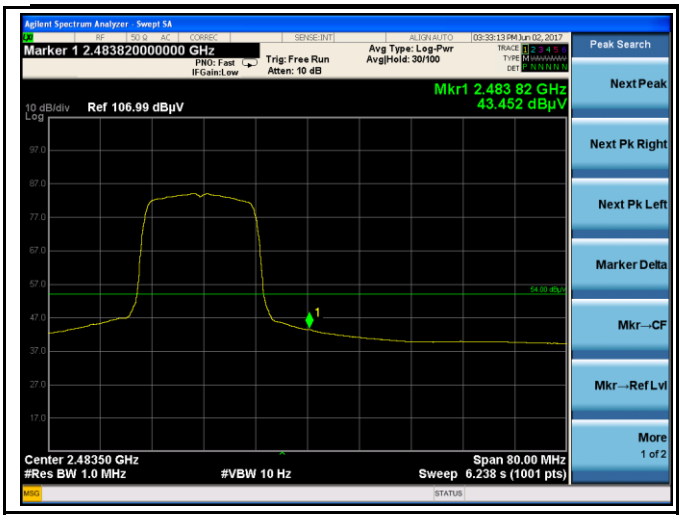
Band Edge, Left Side (Peak) - 802.11g – CH 1



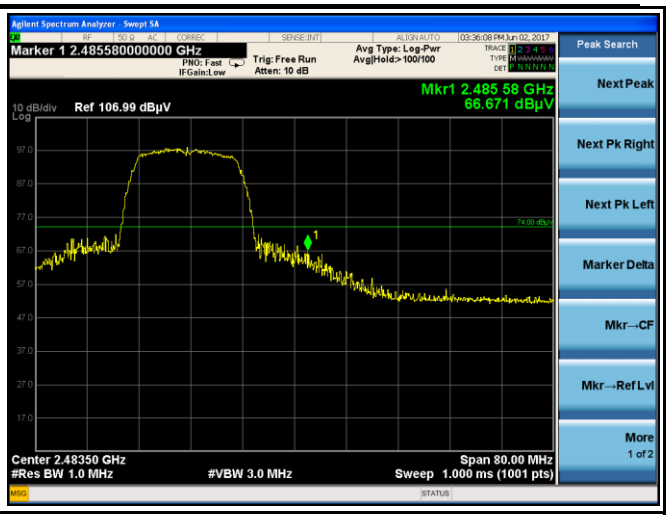
Band Edge, Left Side (Average) - 802.11g – CH 11



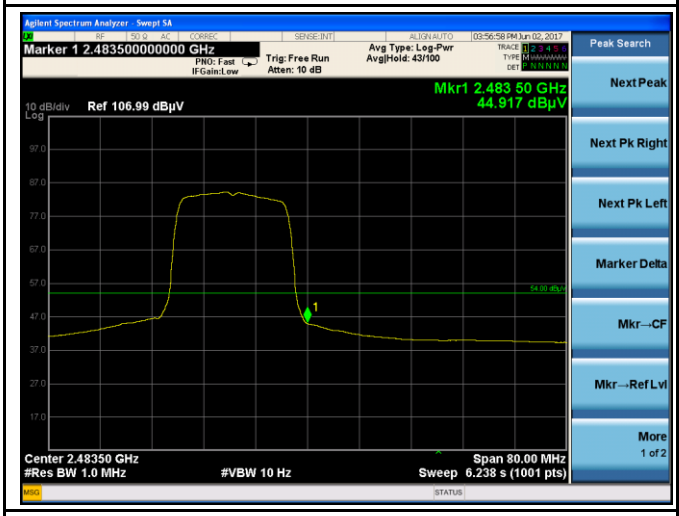
Band Edge, Left Side (Peak) - 802.11g – CH 11



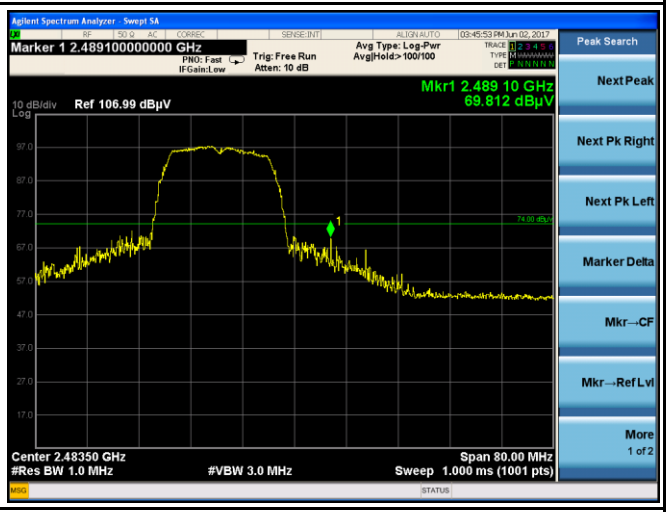
Band Edge, Left Side (Average) - 802.11g – CH 12



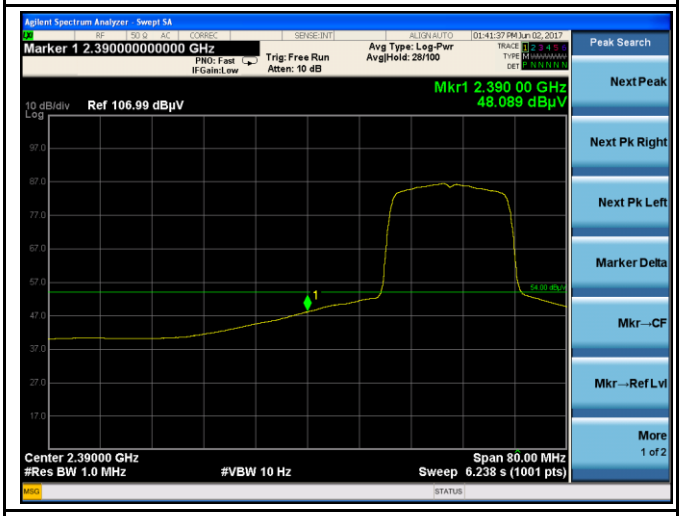
Band Edge, Left Side (Peak) - 802.11g – CH 12



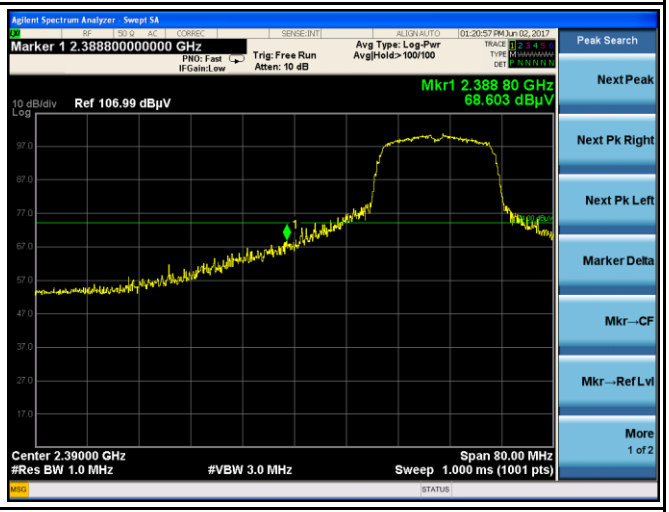
Band Edge, Left Side (Average) - 802.11g – CH 13



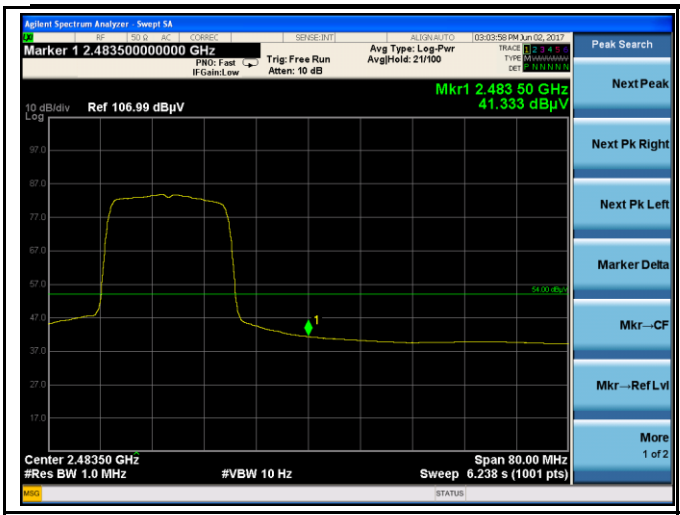
Band Edge, Left Side (Peak) - 802.11g – CH 13



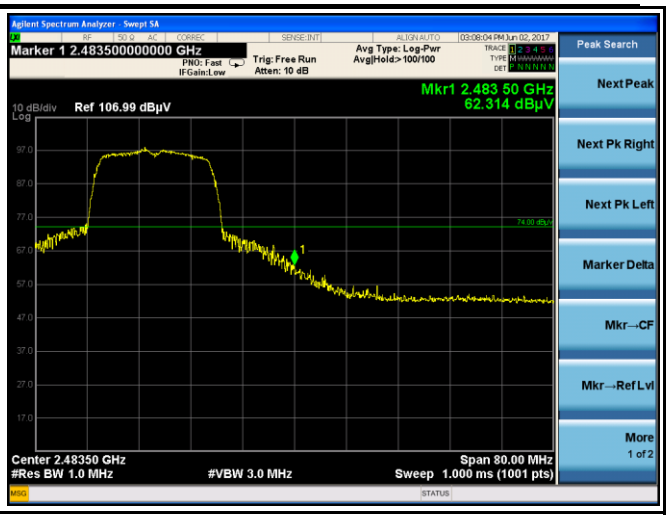
Band Edge, Left Side (Average) - 802.11 n(20M) – CH 1



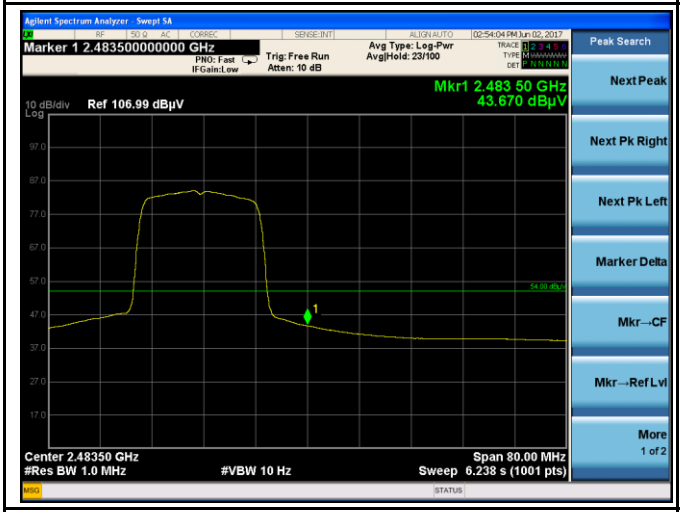
Band Edge, Left Side (Peak) - 802.11 n(20M) – CH 1



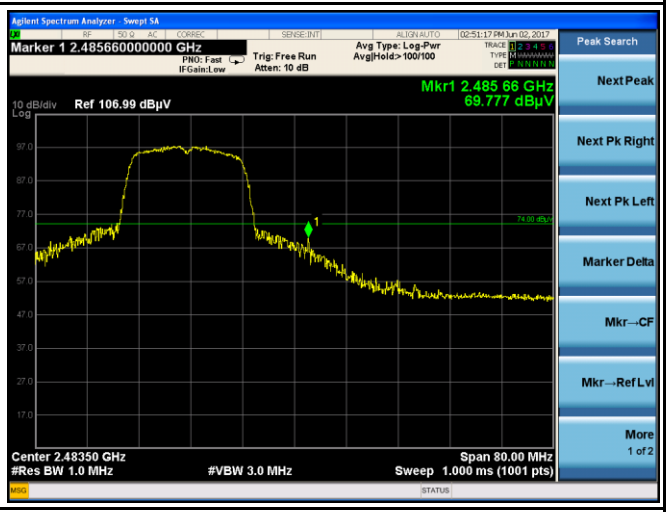
Band Edge, Left Side (Average) - 802.11 n(20M) – CH 11



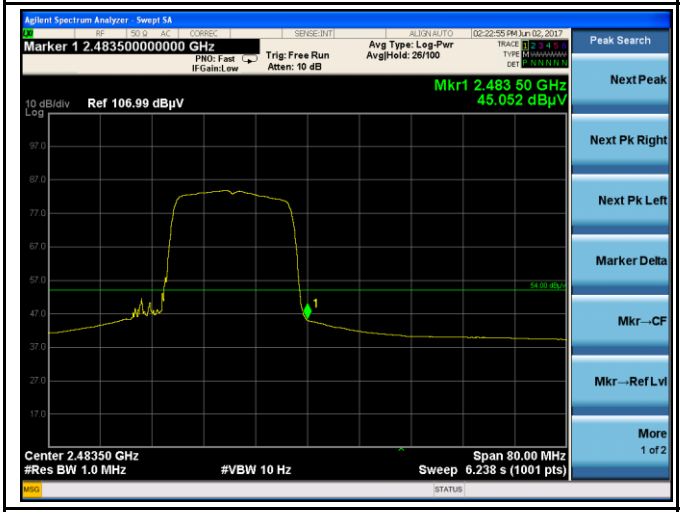
Band Edge, Left Side (Peak) - 802.11 n(20M) – CH 11



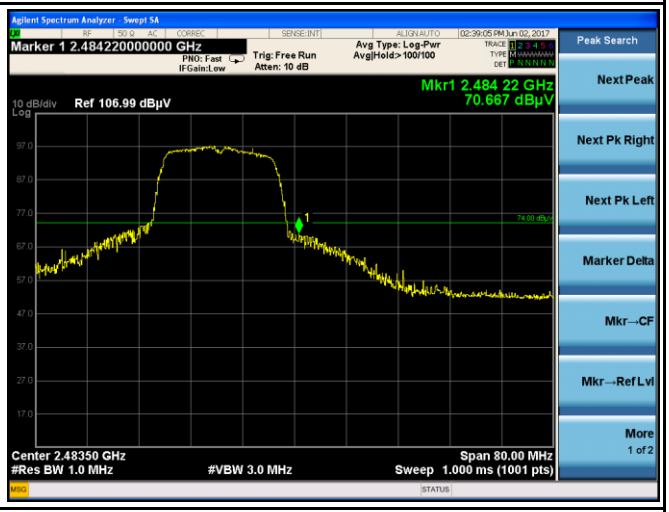
Band Edge, Left Side (Average) - 802.11 n(20M) – CH 12



Band Edge, Left Side (Peak) - 802.11 n(20M) – CH 12



Band Edge, Left Side (Average) - 802.11 n(20M) – CH 13

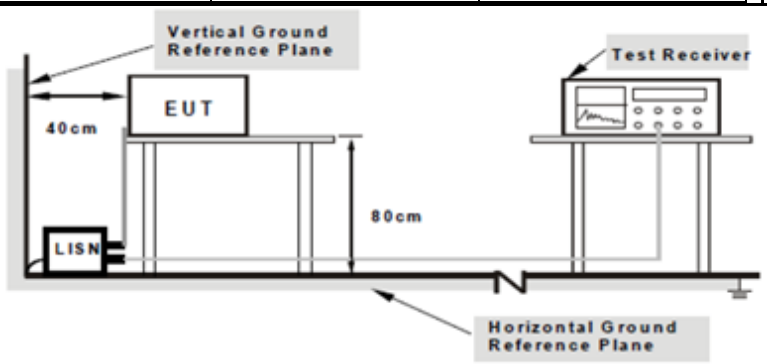


Band Edge, Left Side (Peak) - 802.11 n(20M) – CH 13

6.6 AC Power Line Conducted Emissions

Temperature	27.9°C
Relative Humidity	61%
Atmospheric Pressure	1019mbar
Test date :	June 05, 2017
Tested By :	Amos Xia

Requirement(s):

<table>
<tr><th>Spec</th><th>Item</th><th>Requirement</th><th>Applicable</th></tr>
<tr><td>47CFR§15.207, RSS210 (A8.1)</td><td>a)</td><td>For Low-power radio-frequency devices that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 [mu] H/50 ohms line impedance stabilization network (LISN). The lower limit applies at the boundary between the frequencies ranges.
<table>
<tr><th rowspan="2">Frequency ranges (MHz)</th><th colspan="2">Limit (dBμV)</th></tr>
<tr><th>QP</th><th>Average</th></tr>
<tr><td>0.15 ~ 0.5</td><td>66 – 56</td><td>56 – 46</td></tr>
<tr><td>0.5 ~ 5</td><td>56</td><td>46</td></tr>
<tr><td>5 ~ 30</td><td>60</td><td>50</td></tr>
</table>
</td><td>☑</td></tr>
<tr><td>Test Setup</td><td colspan="3"> 

Note: 1.Support units were connected to second LISN.
2.Both of LISNs (AMN) are 80cm from EUT and at least 80cm from other units and other metal planes support units.</td></tr>
<tr><td>Procedure</td><td colspan="3">1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table.
2. The power supply for the EUT was fed through a 50W/50mH EUT LISN, connected to filtered mains.
3. The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss coaxial cable.
4. All other supporting equipment were powered separately from another main supply.
5. The EUT was switched on and allowed to warm up to its normal operating condition.
6. A scan was made on the NEUTRAL line (for AC mains) or Earth line (for DC power) over the required frequency range using an EMI test receiver.
7. High peaks, relative to the limit line, The EMI test receiver was then tuned to the selected frequencies and the necessary measurements made with a receiver bandwidth setting of 10 kHz.
8. Step 7 was then repeated for the LIVE line (for AC mains) or DC line (for DC power).</td></tr>
<tr><td>Remark</td><td colspan="3"></td></tr>
<tr><td>Result</td><td colspan="3">☑ Pass ☐ Fail</td></tr>
</table>

Test Data ☑ Yes ☐ N/A

Test Plot ☑ Yes (See below) ☐ N/A

Data sample

No.	Frequency	Reading	Detector	Lisn/Isn	Ps_Lmt	Cab_L	Result	Limit	Margin
	(MHz)	(dBμV)		(dB}	(dB)	(dB)	(dBμV)	(dBμV)	(dB)

Frequency (MHz) = Emission frequency in MHz

Reading (dBμV) = Receiver Reading Value

Detector=Quasi Peak Detector or Average Detector

Lisn/ISN= Insertion loss of LISN

Ps_Lmt= Insertion loss of transient limiter (The transient limiter included 10dB attenuation)

Cab_L= cable loss

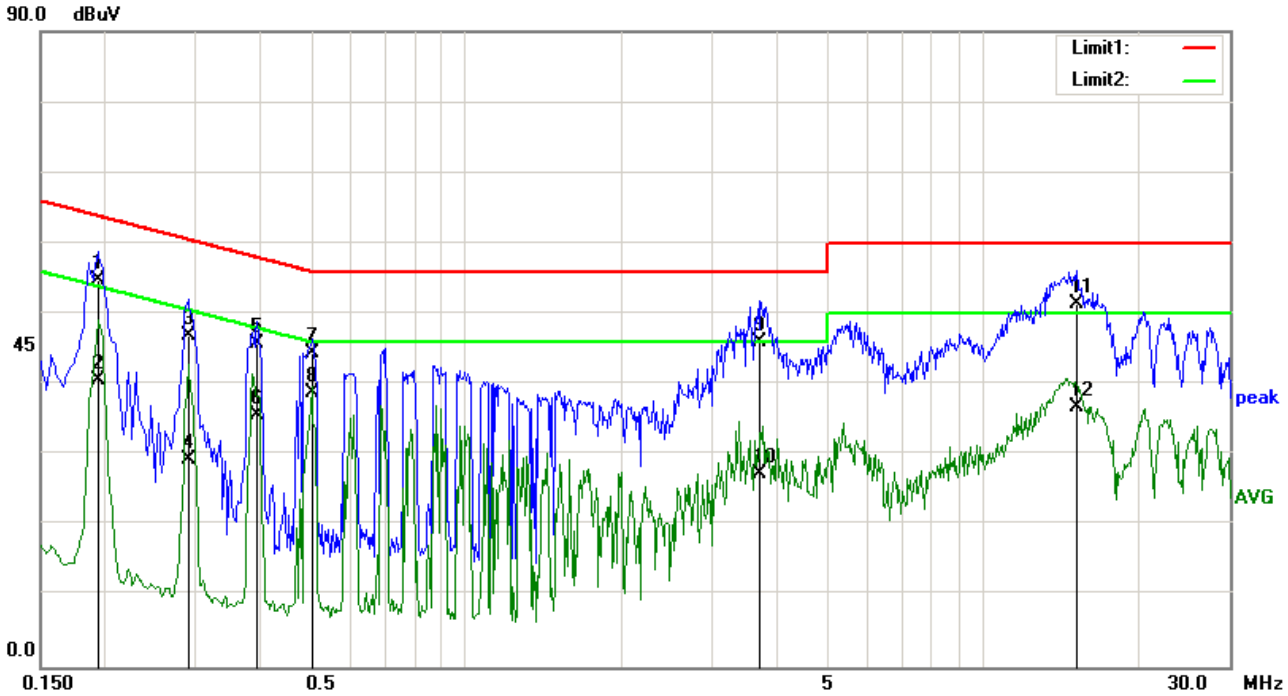
Result (dBμV) = Reading Value + Corrected Value

Limit (dBμV) = Limit stated in standard

Calculation Formula:

Margin (dB) = Result (dBμV) – limit (dBμV)

Test Mode:	Transmitting Mode （ Low Channel ）



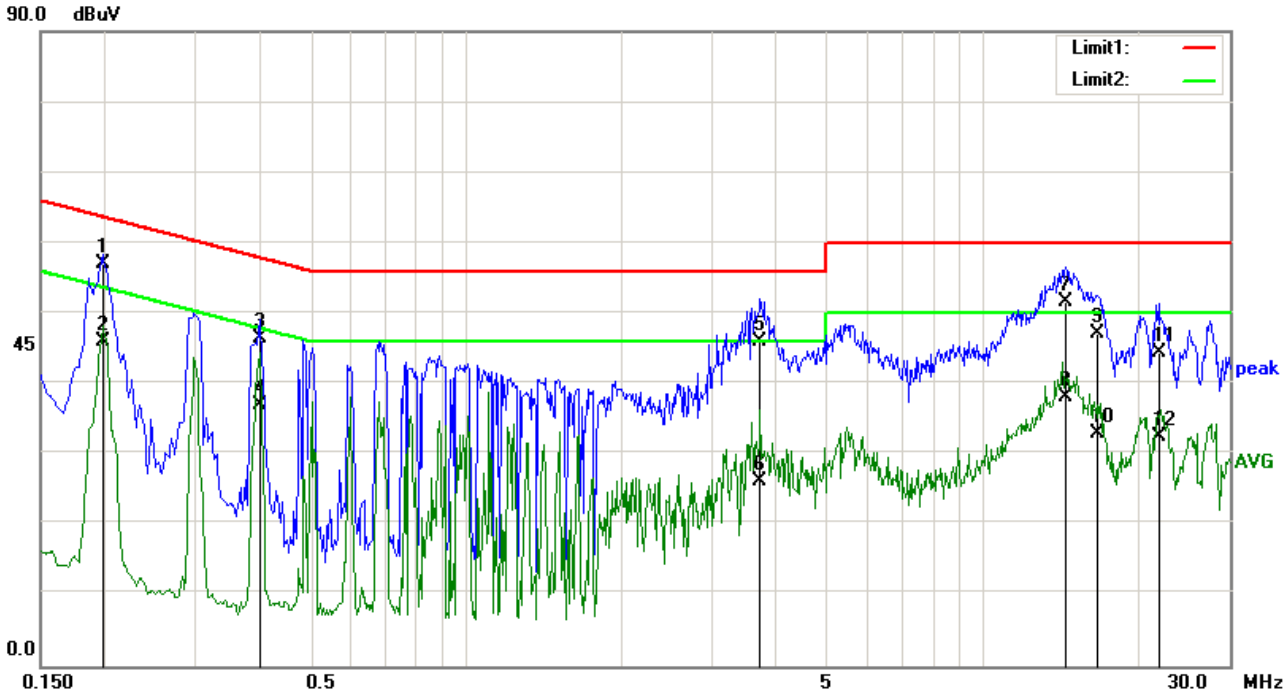
Test Data

Phase Line Plot at 240Vac, 50Hz

No.	Frequency (MHz)	Reading (dBuV)	Detector	Lisn/lsn (dB}	Ps_Lmt (dB)	Cab_L (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)
1	0.1940	44.43	QP	0.10	-10.00	0.29	54.82	63.86	-9.04
2	0.1940	30.30	AVG	0.10	-10.00	0.29	40.69	53.86	-13.17
3	0.2900	36.71	QP	0.11	-10.00	0.20	47.02	60.52	-13.50
4	0.2900	19.15	AVG	0.11	-10.00	0.20	29.46	50.52	-21.06
5	0.3940	35.54	QP	0.11	-10.00	0.21	45.86	57.98	-12.12
6	0.3940	25.29	AVG	0.11	-10.00	0.21	35.61	47.98	-12.37
7	0.5060	34.19	QP	0.12	-10.00	0.21	44.52	56.00	-11.48
8	0.5060	28.46	AVG	0.12	-10.00	0.21	38.79	46.00	-7.21
9	3.7180	35.51	QP	0.22	-10.00	0.25	45.98	56.00	-10.02
10	3.7180	16.95	AVG	0.22	-10.00	0.25	27.42	46.00	-18.58
11	15.1500	39.99	QP	0.87	-10.00	0.47	51.33	60.00	-8.67
12	15.1500	25.54	AVG	0.87	-10.00	0.47	36.88	50.00	-13.12

Note: We had tested different mode Low/Mid/High channel,and only show worse case (802.11b Low channel) in the report.

Test Mode:	Transmitting Mode (Low Channel)



Test Data

Phase Neutral Plot at 240Vac, 50Hz

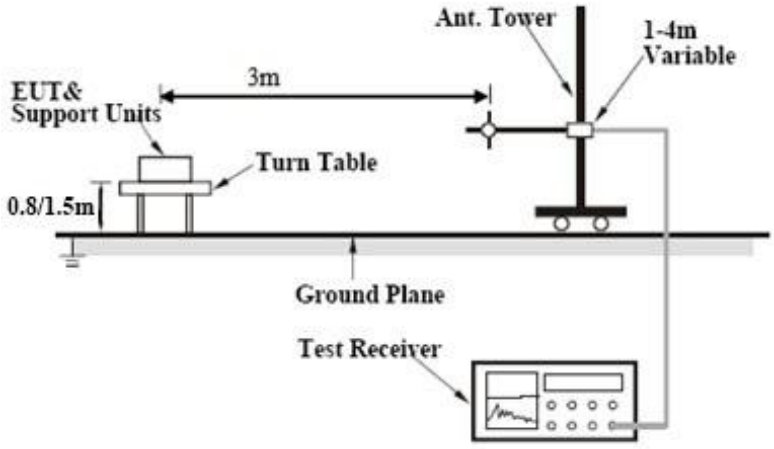
No.	Frequency (MHz)	Reading (dBuV)	Detector	Lisn/lsn (dB}	Ps_Lmt (dB)	Cab_L (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)
1	0.1980	46.72	QP	0.10	-10.00	0.28	57.10	63.69	-6.59
2	0.1980	35.59	AVG	0.10	-10.00	0.28	45.97	53.69	-7.72
3	0.3980	36.24	QP	0.11	-10.00	0.21	46.56	57.90	-11.34
4	0.3980	26.78	AVG	0.11	-10.00	0.21	37.10	47.90	-10.80
5	3.7100	35.60	QP	0.23	-10.00	0.25	46.08	56.00	-9.92
6	3.7100	15.74	AVG	0.23	-10.00	0.25	26.22	46.00	-19.78
7	14.5020	40.37	QP	0.91	-10.00	0.47	51.75	60.00	-8.25
8	14.5020	26.73	AVG	0.91	-10.00	0.47	38.11	50.00	-11.89
9	16.6540	35.60	QP	1.03	-10.00	0.49	47.12	60.00	-12.88
10	16.6540	21.51	AVG	1.03	-10.00	0.49	33.03	50.00	-16.97
11	21.8620	32.46	QP	1.28	-10.00	0.65	44.39	60.00	-15.61
12	21.8620	20.49	AVG	1.28	-10.00	0.65	32.42	50.00	-17.58

Note: We had tested different mode Low/Mid/High channel,and only show worse case (802.11b Low channel) in the report.

6.7 Radiated Emissions

Temperature	26°C
Relative Humidity	60%
Atmospheric Pressure	1019mbar
Test date :	May 31, 2017
Tested By :	Amos Xia

Requirement(s):

<table>
<tr><th>Spec</th><th>Item</th><th>Requirement</th><th>Applicable</th></tr>
<tr><td rowspan="3">47CFR§15.247(d), RSS210 (A8.5)</td><td>a)</td><td>Except higher limit as specified elsewhere in other section, the emissions from the low-power radio-frequency devices shall not exceed the field strength levels specified in the following table and the level of any unwanted emissions shall not exceed the level of the fundamental emission. The tighter limit applies at the band edges
<table>
<tr><th>Frequency range (MHz)</th><th>Field Strength (μV/m)</th></tr>
<tr><td>30 – 88</td><td>100</td></tr>
<tr><td>88 – 216</td><td>150</td></tr>
<tr><td>216 960</td><td>200</td></tr>
<tr><td>Above 960</td><td>500</td></tr>
</table></td><td>☒</td></tr>
<tr><td>b)</td><td>For non-restricted band, In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB or 30dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, determined by the measurement method on output power to be used. Attenuation below the general limits specified in § 15.209(a) is not required
☒ 20 dB down ☐ 30 dB down</td><td>☒</td></tr>
<tr><td>c)</td><td>or restricted band, emission must also comply with the radiated emission limits specified in 15.209</td><td>☒</td></tr>
<tr><td>Test Setup</td><td colspan="3"> 
</td></tr>
<tr><td>Procedure</td><td colspan="3">1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. The test was carried out at the selected frequency points obtained from the EUT characterization. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
a. Vertical or horizontal polarization (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
b. The EUT was then rotated to the direction that gave the maximum emission.
c. Finally, the antenna height was adjusted to the height that gave the maximum emission.
3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasiy Peak detection at frequency below 1GHz.</td></tr>
</table>

	4. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz with Peak detection for Peak measurement at frequency above 1GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz with Peak detection for Average Measurement as below at frequency above 1GHz. 5. Steps 2 and 3 were repeated for the next frequency point, until all selected frequency points were measured.
Remark	
Result	☒Pass ☐ Fail

Test Data ☑Yes ☐N/A

Test Plot ☑Yes (See below) ☐N/A

Data sample

No.	Frequency	Reading	Detector	Lisn/Isn	Ps_Lmt	Cab_L	Result	Limit	Margin
	(MHz)	(dBμV)		(dB}	(dB)	(dB)	(dBμV)	(dBμV)	(dB)

Frequency (MHz) = Emission frequency in MHz

Reading (dBμV) = Receiver Reading Value

Detector=Quasi Peak Detector or Average Detector

Lisn/ISN= Insertion loss of LISN

Ps_Lmt= Insertion loss of transient limiter (The transient limiter included 10dB attenuation)

Cab_L= cable loss

Result (dBμV) = Reading Value + Corrected Value

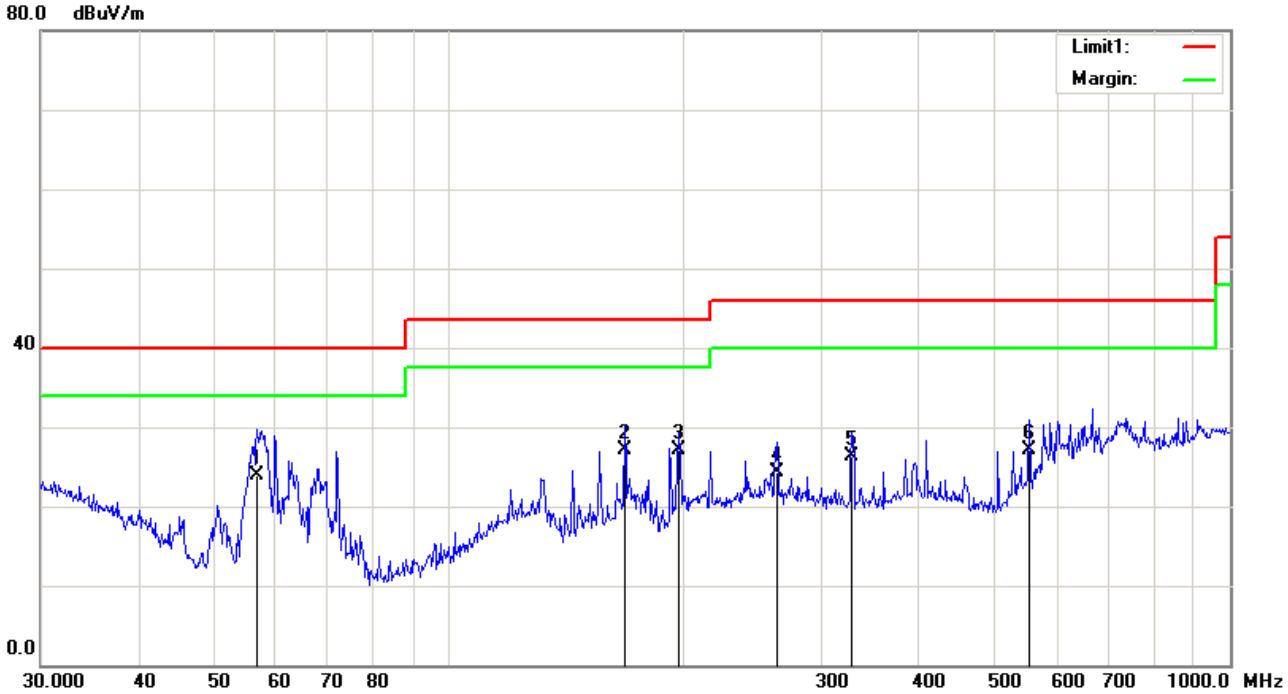
Limit (dBμV) = Limit stated in standard

Calculation Formula:

Margin (dB) = Result (dBμV) – limit (dBμV)

Test Mode:	Transmitting Mode (Low Channel)

(Below 1GHz)



Test Data

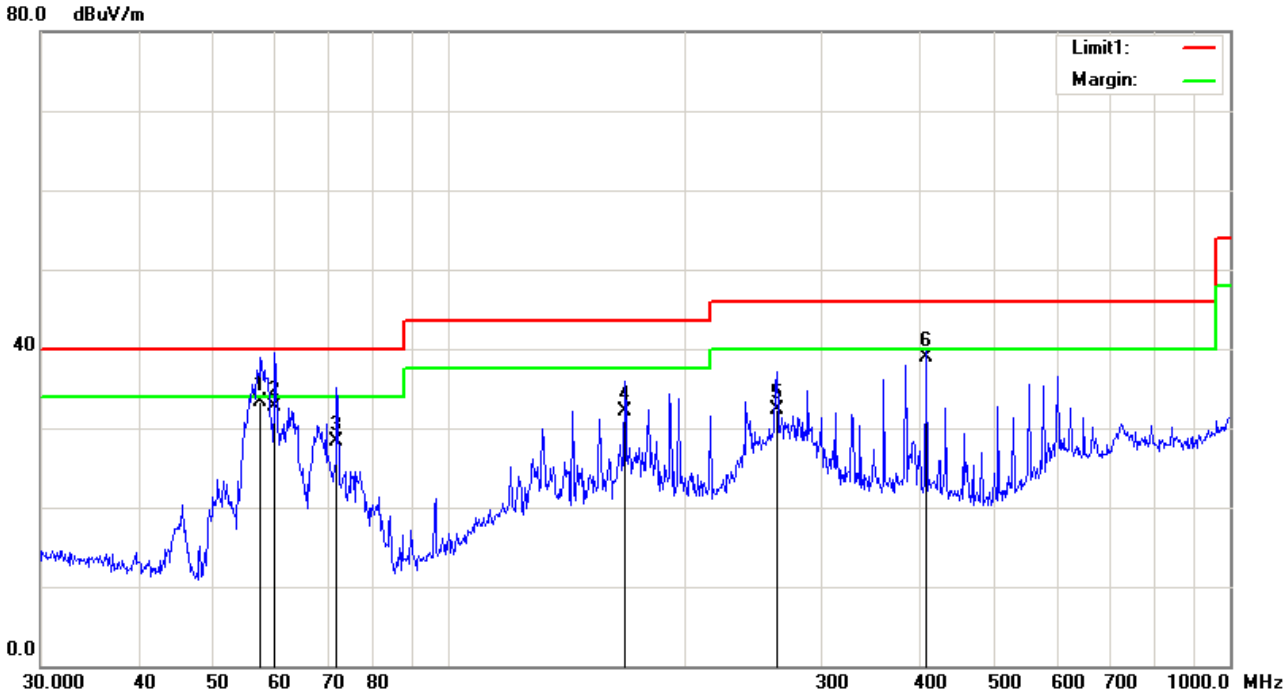
Vertical Polarity Plot @3m

No.	Frequency	Reading	Detector	Ant_F	PA_G	Cab_L	Result	Limit	Margin	Height	Degree
	(MHz)	(dBuV/m)		(dB/m)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	(cm)	(°)
1	56.7917	61.40	QP	8.23	46.91	1.28	24.00	40.00	-16.00	100	255
2	167.8243	57.60	QP	14.17	46.66	2.09	27.20	43.50	-16.30	200	279
3	197.2001	57.93	QP	14.18	47.16	2.25	27.20	43.50	-16.30	100	327
4	262.8955	54.99	QP	14.91	48.18	2.58	24.30	46.00	-21.70	100	109
5	327.8873	56.75	QP	15.52	48.77	2.90	26.40	46.00	-19.60	200	34
6	552.8833	53.80	QP	17.93	48.39	3.76	27.10	46.00	-18.90	200	95

Note: We had tested different mode Low/Mid/High channel,and only show worse case (802.11b Low channel) in the report.

Test Mode:	Transmitting Mode (Low Channel)

(Below 1GHz)



Test Data

Horizontal Polarity Plot @3m

No.	Frequency (MHz)	Reading (dBuV/m)	Detector	Ant_F (dB/m)	PA_G (dB)	Cab_L (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)
1	57.3923	69.51	QP	9.59	46.98	1.28	33.40	40.00	-6.60	200	160
2	59.8588	69.17	QP	9.49	47.26	1.30	32.70	40.00	-7.30	200	338
3	71.8320	64.27	QP	10.50	47.91	1.44	28.30	40.00	-11.70	200	330
4	167.8243	64.50	QP	12.27	46.66	2.09	32.20	43.50	-11.30	200	60
5	262.8955	62.30	QP	15.60	48.18	2.58	32.30	46.00	-13.70	100	150
6	408.9460	68.73	QP	16.00	48.99	3.26	39.00	46.00	-7.00	100	138

Note: We had tested different mode Low/Mid/High channel,and only show worse case (802.11b Low channel) in the report.

Test Mode:	Transmitting Mode (Low Channel)

(Above 1GHz)

Test Data

Vertical Polarity Plot @3m

No.	Frequency	Reading	Detector	Ant_F	PA_G	Cab_L	Result	Limit	Margin	Height	Degree
	(MHz)	(dBuV/m)		(dB/m)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	(cm)	(°)
1	1595.000	64.40	peak	28.95	50.31	3.91	46.95	74.00	-27.05	100	185
2	1901.000	67.97	peak	30.73	51.77	3.98	50.91	74.00	-23.09	200	184
3	4824.000	66.58	peak	32.65	52.29	6.06	53.00	74.00	-21.00	100	83
4	6355.000	56.00	peak	33.97	52.38	5.84	43.43	74.00	-30.57	100	164
5	8038.000	55.57	peak	36.41	54.66	7.89	45.21	74.00	-28.79	100	80
6	11047.000	55.19	peak	38.42	53.22	9.56	49.95	74.00	-24.05	100	74

Horizontal Polarity Plot @3m

No.	Frequency	Reading	Detector	Ant_F	PA_G	Cab_L	Result	Limit	Margin	Height	Degree
	(MHz)	(dBuV/m)		(dB/m)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	(cm)	(°)
1	1595.000	66.91	peak	28.95	50.31	3.91	49.46	74.00	-24.54	100	196
2	3006.000	59.43	peak	31.55	52.81	4.45	42.62	74.00	-31.38	200	9
3	4824.000	67.66	peak	32.65	52.29	6.06	54.08	74.00	-19.92	100	82
4	6338.000	55.13	peak	33.94	52.33	5.84	42.58	74.00	-31.42	200	359
5	7647.000	55.74	peak	35.54	54.78	7.55	44.05	74.00	-29.95	200	48
6	11489.000	53.40	peak	38.60	53.14	10.09	48.95	74.00	-25.05	200	63

Note: We had tested different mode Low/Mid/High channel,and only show worse case (802.11b Low channel) in the report.

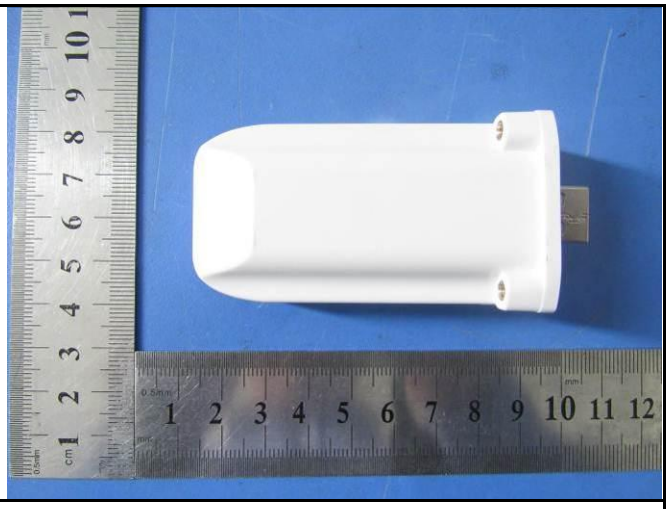
Annex A. TEST INSTRUMENT

Instrument	Model	Serial #	Cal Date	Cal Due	In use
AC Line Conducted Emissions					
R&S EMI Test Receiver	ESPI3	101216	05/03/2017	05/02/2018	☒
V-LISN	ESH3-Z5	838979/005	03/31/2017	03/30/2018	☒
SIEMIC EZ_EMC Conducted Emissions software	Ver.ICP-03A1	N/A	N/A	N/A	☒
RF conducted test					
R&S EMI Receiver	ESPI3	101216	05/03/2017	05/02/2018	☒
Power Splitter	1#	1#	02/02/2017	02/01/2018	☒
Spectrum Analyzer	N9010A	MY47191130	05/03/2017	05/02/2018	☒
Radiated Emissions					
Spectrum Analyzer	N9010A	MY47191130	05/03/2017	05/02/2018	☐
R&S EMI Receiver	ESPI3	101216	05/03/2017	05/02/2018	☒
Antenna (30MHz~6GHz)	JB6	A121411	10/31/2016	10/31/2017	☒
EMCO Horn Antenna (1 ~18GHz)	3115	N/A	11/15/2016	11/14/2017	☒
INFOMW Antenna (1 ~18GHz)	JXTXLB-10180	J2031081120092	10/31/2016	10/30/2017	☒
Horn Antenna (18~40GHz)	AH-840	101013	04/22/2017	04/21/2018	☐
Microwave Pre-Amp (18~40GHz)	PA-840	181250	05/29/2017	05/28/2017	☐
Hp Agilent Pre-Amplifier	8447F	1937A01160	10/30/2016	10/29/2017	☒
Agilent Technologies Pre-Amplifier (1-6G)	8449B	3008A02224	10/30/2016	10/29/2017	☒
SIEMIC EZ_EMC Radiated Emissions software	Ver.ICP-03A1	N/A	N/A	N/A	☒

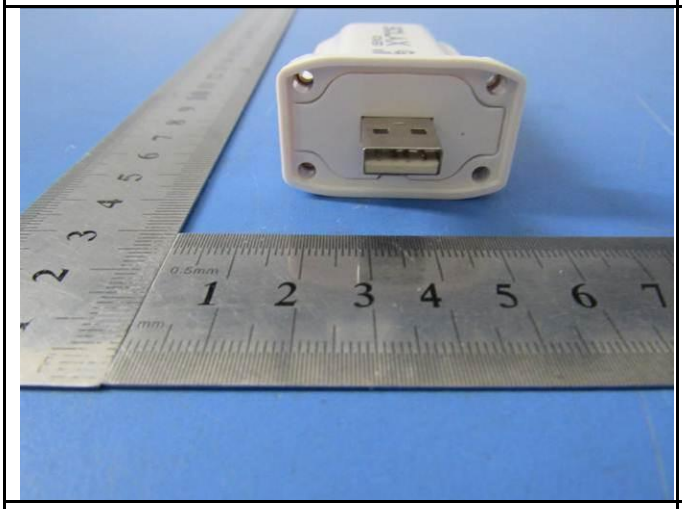
Annex B. EUT and Test Setup Photographs

Annex B.i. Photograph: EUT External Photo

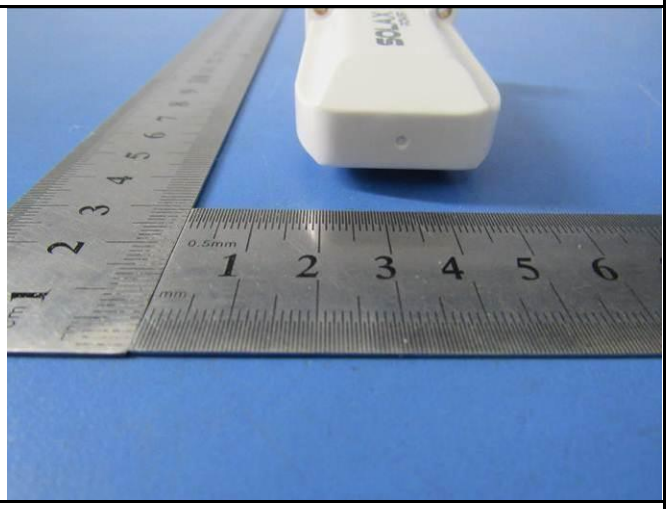
EUT – Top View



EUT – Bottom View

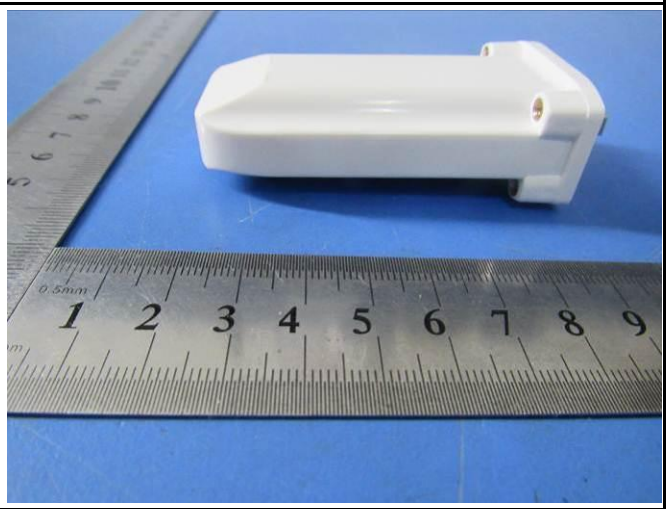


EUT – Left View



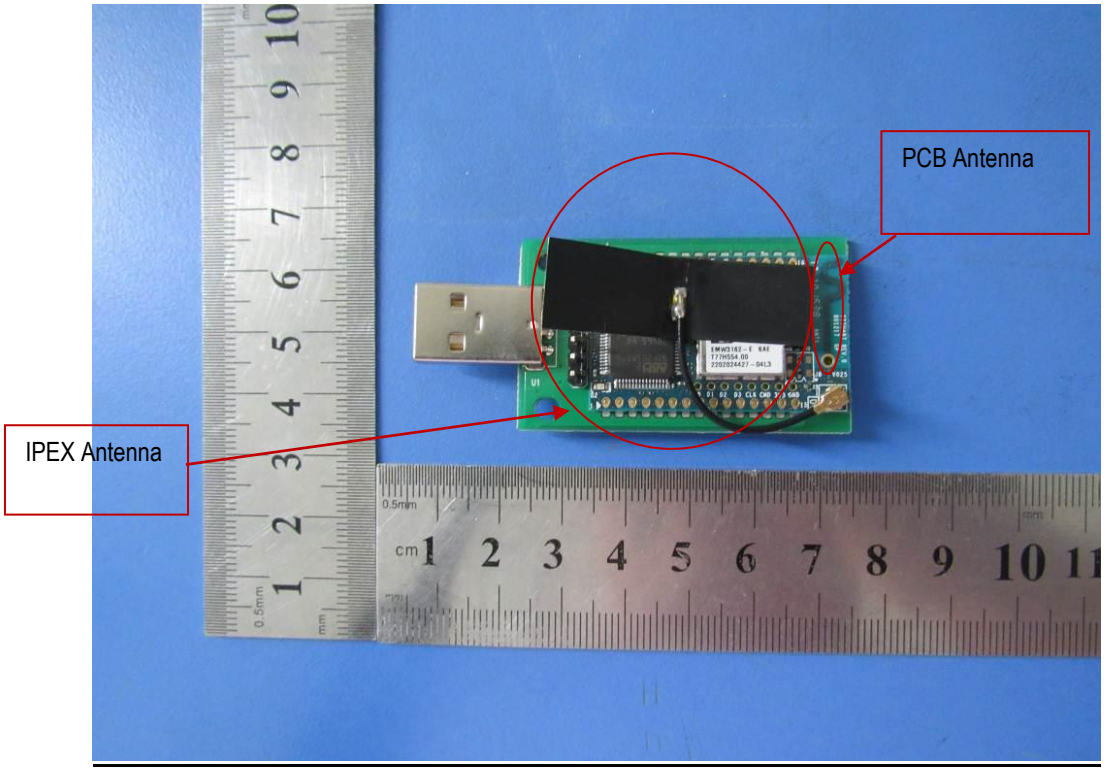
EUT – Right View

EUT - Front View

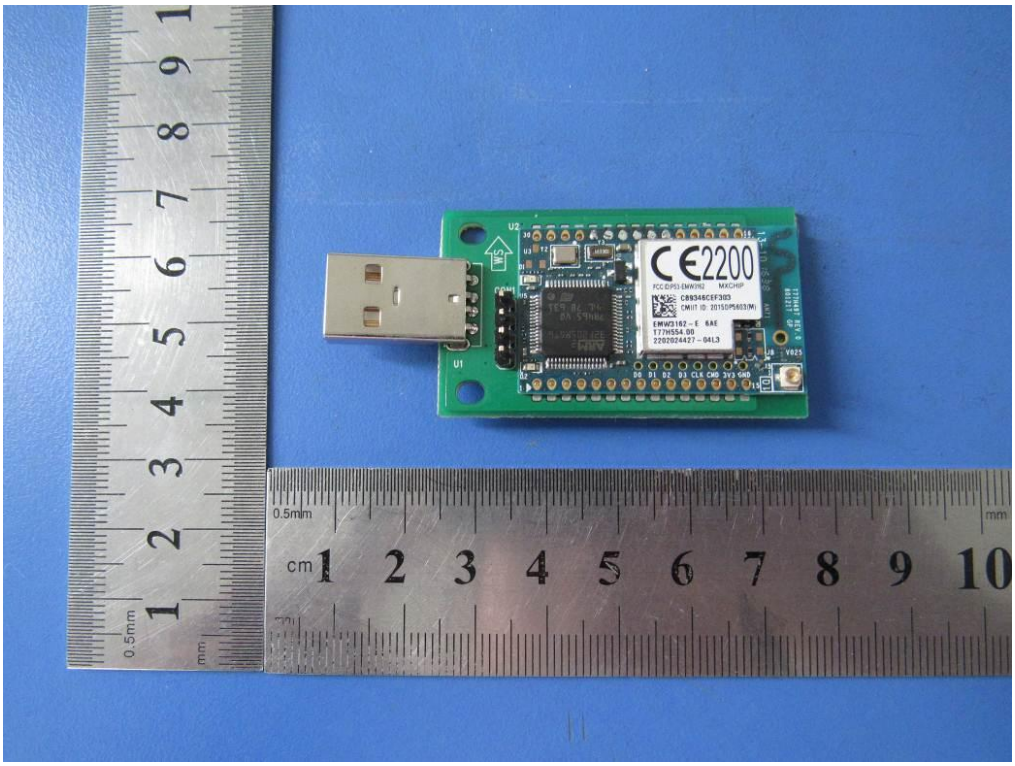


EUT - Rear View

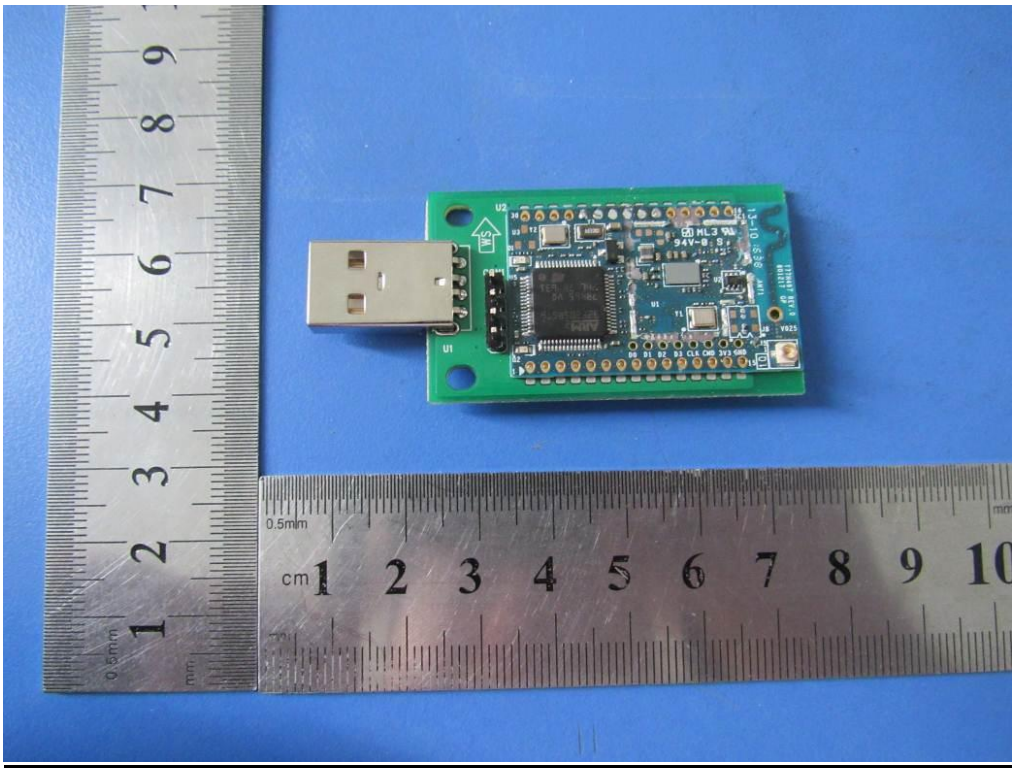
Annex B.ii. Photograph: EUT Internal Photo



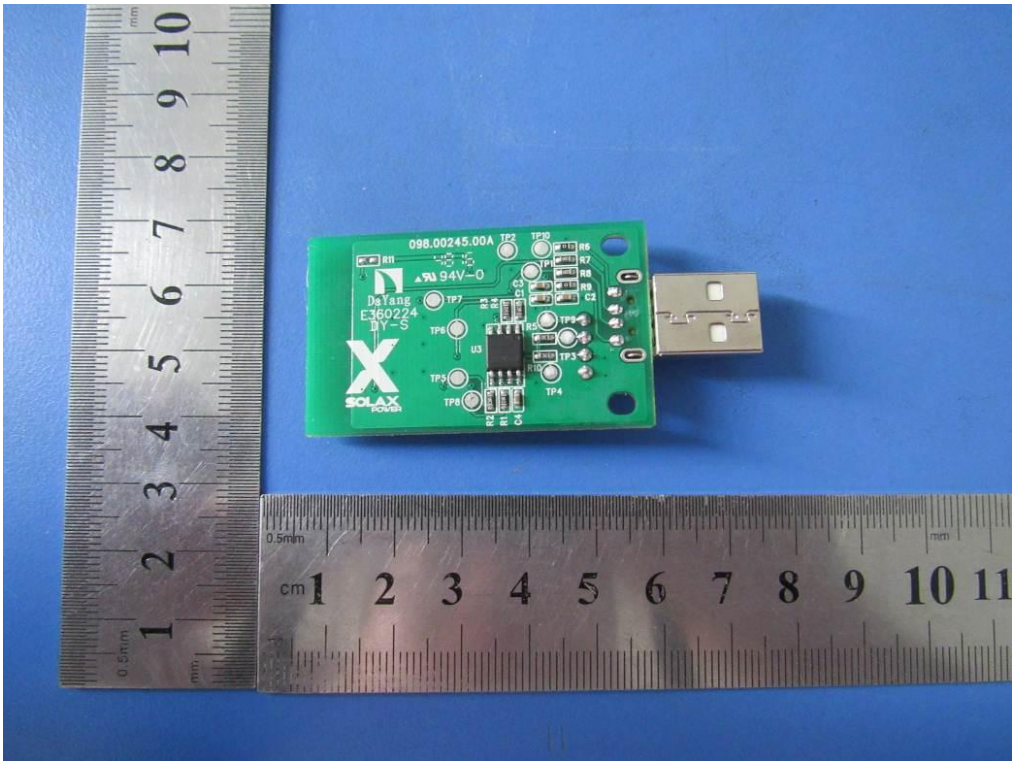
EUT – Uncover Front View-1



EUT – Uncover Front View - 2



EUT – Uncover Front View - 3

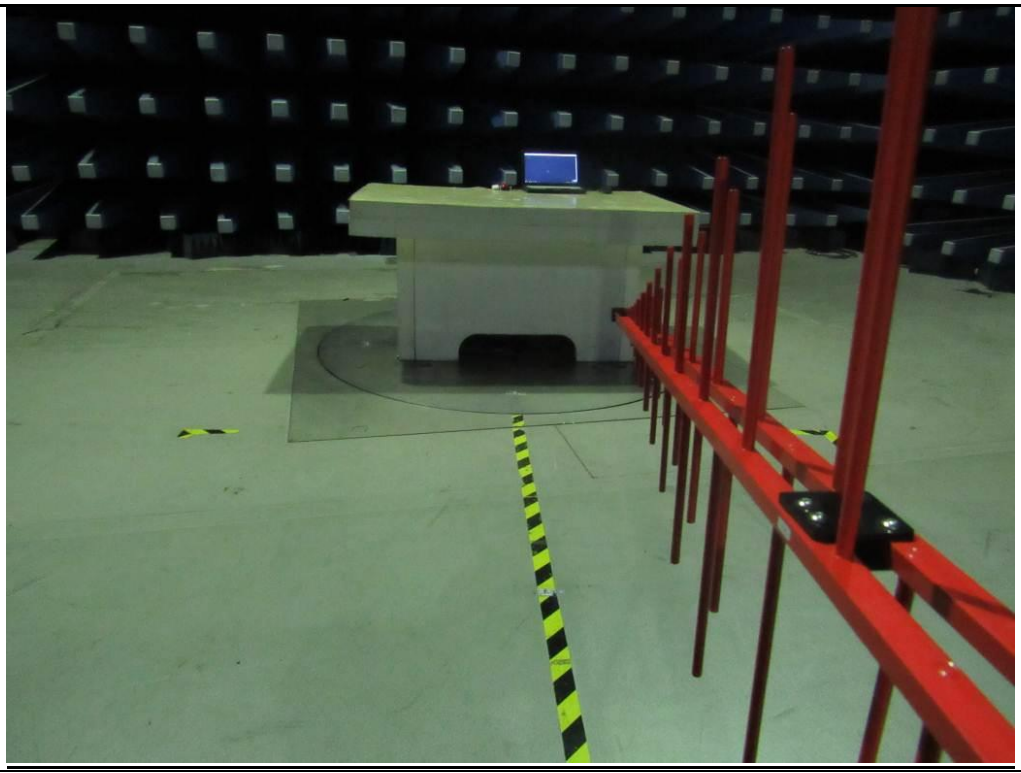


EUT – Uncover Rear View

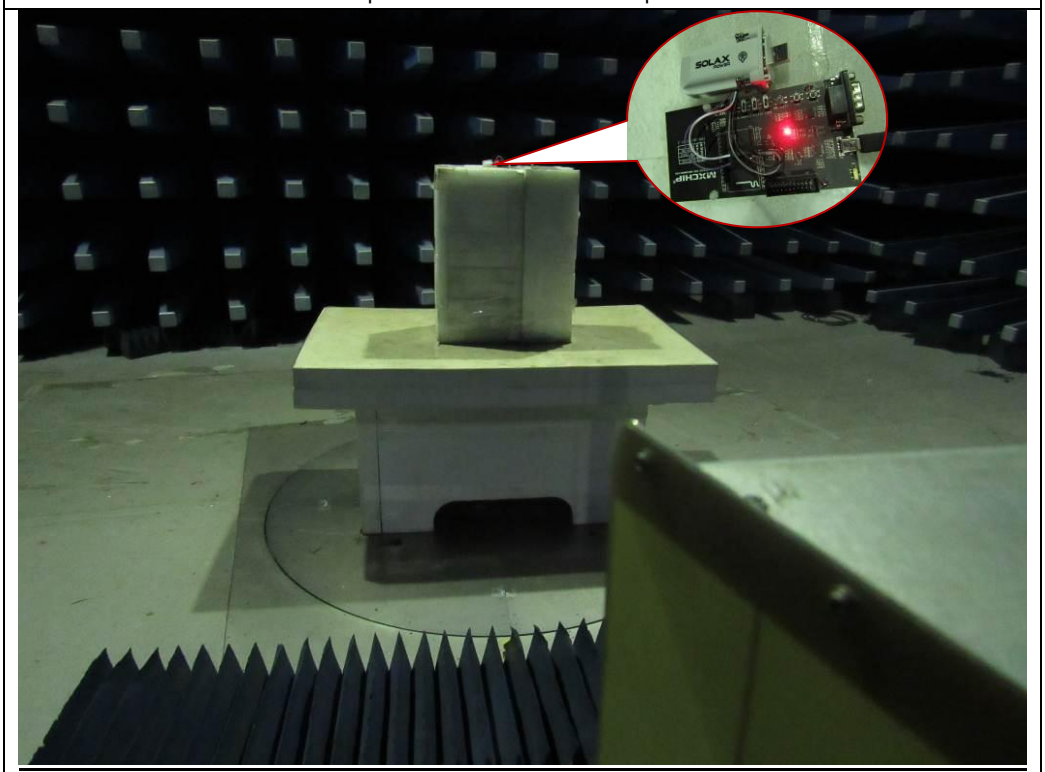
Annex B.iii. Photograph: Test Setup Photo

Conducted Emissions Test Setup – Front View

Conducted Emissions Test Setup – Rear View



Radiated Spurious Emissions Test Setup Below 1GHz

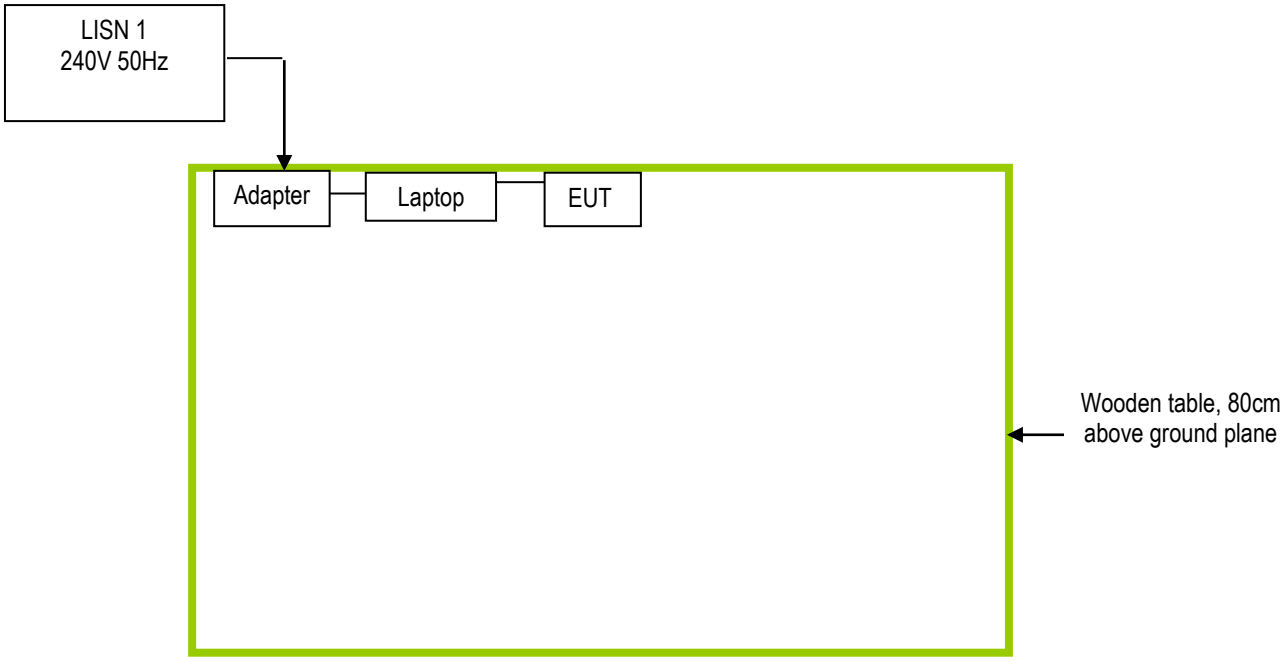


Radiated Spurious Emissions Test Setup Above 1GHz

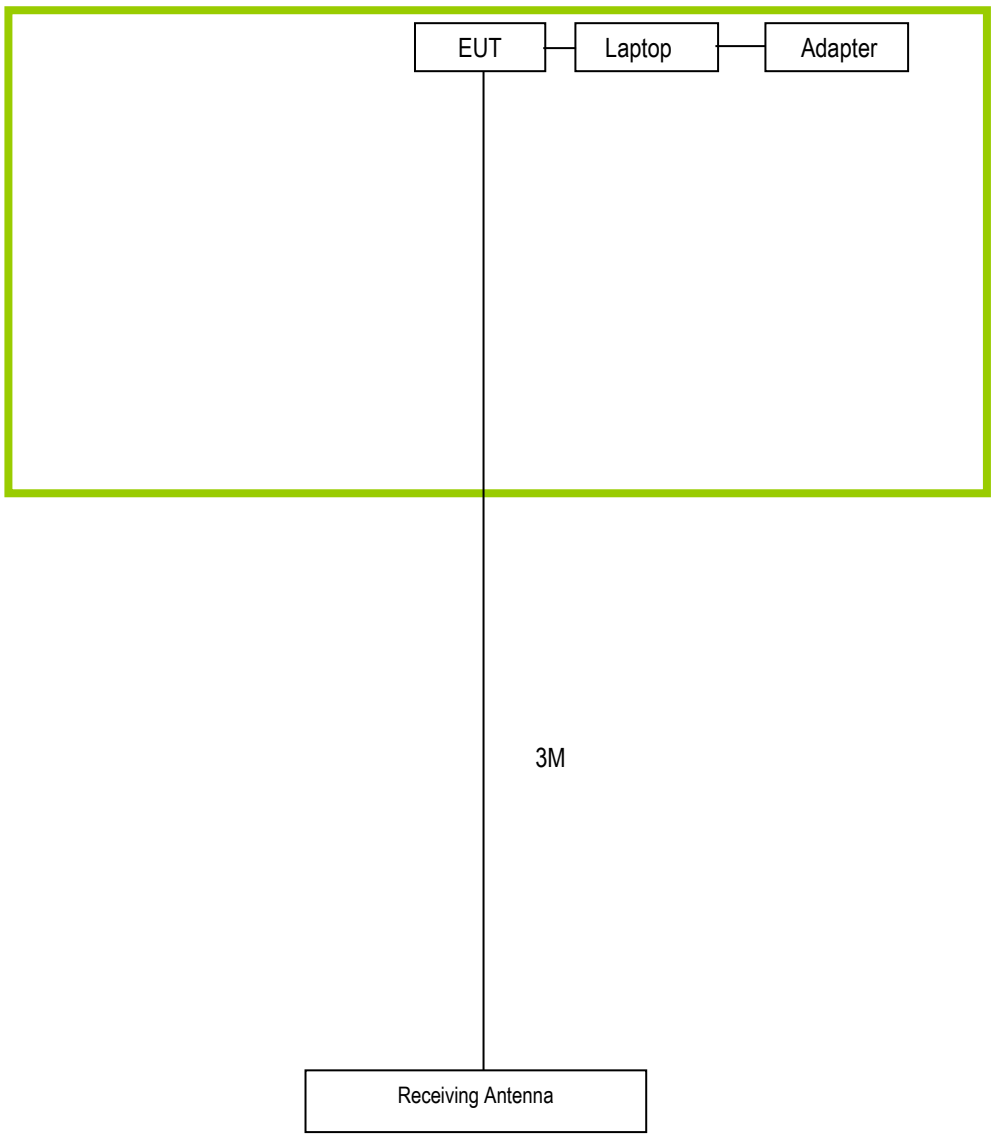
Annex C. TEST SETUP AND SUPPORTING EQUIPMENT

Annex C.ii. TEST SET UP BLOCK

Block Configuration Diagram for Conducted Emissions



Block Configuration Diagram for Radiated Emissions



Annex C. il. SUPPORTING EQUIPMENT DESCRIPTION

The following is a description of supporting equipment and details of cables used with the EUT.

Manufacturer	Equipment Description	Model	Calibration Date	Calibration Due Date
Lenovo	Lenovo Laptop	E40& 0579A52	N/A	N/A
Mi	Adapter	DX-13250	N/A	N/A

Annex D. User Manual / Block Diagram / Schematics / Partlist

Please see attachment

Annex E. DECLARATION OF SIMILARITY

N/A