FCC TEST REPORT

FCC ID	: Z23TE2A1
Applicant	: Teenage Engineering AB
Address	: Katarina bangata 71 garage, Stockholm, Sweden

Equipment Under Test (EUT) :

Product Name	: OP-1
Model No.	: TE002AS001A

Standards	: FCC CFR47 Part 15 Section 15.247:2009
Date of Test	: September 9 ~ September 15, 2011
Date of Issue	: September 24, 2011
Test Engineer	: Hunk yan / Engineer
Reviewed By	: Philo zhong / Manager

Test Result	**: PASS**

Prepared By:
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✧ The sample detailed above has been tested to the requirements of Council Directives ANSI C63.4:2003. The test results have been reviewed against the Directives above and found to meet their essential requirements.

2 Test Summary

Test Items	Test Requirement	Result
Radiated Spurious Emissions (9kHz to 25GHz)	15.205(a) 15.209 15.247(d)	PASS
Conduct Emission	15.207	PASS
20dB Bandwidth	15.247(a)(1)	PASS
Maximum Peak Output Power	15.247(b)(1)	PASS
Frequency Separation	15.247(a)(1)	PASS
Number of Hopping Frequency	15.247(a)(1)(iii)	PASS
Dwell time	15.247(a)(1)(iii)	PASS
Maximum Permissible Exposure (Exposure of Humans to RF Fields)	1.1307(b)(1)	PASS

3 Contents

4 General Information

4.1 Client Information

Applicant : Teenage Engineering AB

Address of Applicant : Katarina bangata 71 garage, Stockholm, Sweden

Manufacturer : Teenage Engineering AB

Address of Manufacturer : Katarina bangata 71 garage, Stockholm, Sweden

4.2 General Description of E.U.T.

Product Name : OP-1

Model No. : TE002AS001A

4.3 Details of E.U.T.

Technical Data : Input: 5.0VDC (Charging mode)
Internal Li-ion Battery: 3.7V

Operation Frequency : 2402MHz ~ 2480MHz

Antenna Gain : -1.9 dBi

4.4 Description of Support Units

The EUT has been tested as an independent unit.

4.5 Standards Applicable for Testing

The customer requested FCC tests for a OP-1. The standards used were FCC CFR47 Part 15 Section 15.203, Section 15.207, Section 15.209 and Section 15.247.

4.6 Test Facility

The test facility has a test site registered with the following organizations:

- **IC – Registration No.: IC7760A**

  Waltek Services(Shenzhen) Co., Ltd. has been registered and fully described in a report filed with the Industry Canada. The acceptance letter from the Industry Canada is maintained in our files. Registration 7760A, August 3, 2010.

- **FCC – Registration No.: 880581**

  Waltek Services(Shenzhen) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 880581, May 26, 2011.

4.7 Test Location

All the tests were performed at:
Waltek Services(Shenzhen) Co., Ltd. at 1/F, Fukangtai Building, West Baima Rd.,Songgang Street, Baoan District, Shenzhen, China

5 Equipment Used during Test

Equipment Name	Manufacturer Model	Equipment No	Internal No	Specification	Cal. Date	Due Date	Uncertainty
EMC Analyzer	Agilent/ E7405A	MY45114943	W2008001	9k-26.5GHz	Aug. 2, 2011	Aug. 1, 2012	±1dB
Trilog Broadband Antenne	SCHWARZBECK MESS-ELEKTROM / VULB9163	336	W2008002	30-3000 MHz	Aug. 2, 2011	Aug. 1, 2012	±1dB
Broad-band Horn Antenna	SCHWARZBECK MESS-ELEKTROM / BBHA 9120D(1201)	667	W2008003	1-18GHz	Aug. 2, 2011	Aug. 1, 2012	f < 10 GHz : ±1dB 10GHz < f < 18 GHz : ±1.5dB
Broadband Preamplifier	SCHWARZBECK MESS-ELEKTROM / BBV 9718	9718-148	W2008004	0.5-18GHz	Aug. 2, 2011	Aug. 1, 2012	±1.2dB
10m Coaxial Cable with N-male Connectors	SCHWARZBECK MESS-ELEKTROM / AK 9515 H	-	-	-	Aug. 2, 2011	Aug. 1, 2012	-
10m 50 Ohm Coaxial Cable	SCHWARZBECK MESS-ELEKTROM / AK 9513	-	-	-	Aug. 2, 2011	Aug. 1, 2012	-
Positioning Controller	C&C LAB/ CC-C-IF	-	-	-	Aug. 2, 2011	Aug. 1, 2012	-
Color Monitor	SUNSPO/ SP-14C	-	-	-	Aug. 2, 2011	Aug. 1, 2012	-
Test Receiver	ROHDE&SCHWARZ/ ESPI	101155	W2005001	9k-3GHz	Aug. 2, 2011	Aug. 1, 2012	±1dB
Two-Line V-Network	ROHDE&SCHWARZ/ ENV216	100115	W2005002	50Ω/50μH	Aug. 2, 2011	Aug. 1, 2012	±10%
Digital Power Analyzer	Em Test AG/Switzerland/ DPA 500	V0745103095	W2008012	Power : 2000VA Vol-range : 0-300V Freq_range : 10-80Hz	Aug. 2, 2011	Aug. 1, 2012	Voltage distinguish: 0.025% Power_freq distinguish: 0.02Hz
Power Source	Em Test AG/Switzerland/ ACS 500	V0745103096	W2008013	Vol-range : 0-300V Power_freq : 10-80Hz			
RF Generator	TESEQ GmbH/ NSG4070	25781	W2008008	Fraq-range : 9K-1GHz RF voltage : -60 dBm-+10dBm	Aug. 2, 2011	Aug. 1, 2012	Power_freq distinguish0.1Hz RFeletricity distinguish 0.1B
CDN M-	TESEQ	25112	W2008009	Voltage	Aug. 2,	Aug. 1,	150K-

Equipment Name	Manufacturer Model	Equipment No	Internal No	Specification	Cal. Date	Due Date	Uncertainty
Type	GmbH/ CDN M016			correct factor 9.5 dB	2011	2012	80MHz : ±1dB 80-230MHz:-2-+3dB
EM-Clamp	TESEQ GmbH/ KEMZ 801	25453	W2008010	Freq_range : 0.15-1000 MHz	Aug. 2, 2011	Aug. 1, 2012	0.3-400 MHz : ±4dB Other freq : ±5dB
Attenuator 6dB	TESEQ GmbH/ ATN6050	25365	-	-	Aug. 2, 2011	Aug. 1, 2012	-
All Modules Generator	SCHAFFNER/6150	34579	W2008006	voltage:200V -4.4KV Pulse current : 100A-2.2KA	Aug. 2, 2011	Aug. 1, 2012	voltage: ±10% Pulse current : ±10%
Active Loop Antenna 9kHz-30MHz	Beijing Dazhi / ZN30900A	-	-	9kHz-30MHz	Aug. 2, 2011	Aug. 1, 2012	±1dB
Capacitive Coupling Clamp	SCHAFFNER/ CDN 8014	25311	-	-	Aug. 2, 2011	Aug. 1, 2012	-
Signal and Data Line Coupling Network	SCHAFFNER/ CDN 117	25627	W2008011	1.2/50μS	Aug. 2, 2011	Aug. 1, 2012	-
AC Power Supply	TONGYUN/ DTDGC-4	-	-	-	Aug. 2, 2011	Aug. 1, 2012	-
PC	Lenovo	T2900D	-	-	Aug.2, 2011	Aug.1, 2012	±1dB
Display	ViewSonic	S27996-1W	-	-	Aug.2, 2011	Aug.1, 2012	±0.5dB
K/B	Dell	L100	-	-	Aug.2, 2011	Aug.1, 2012	±0.5dB
Mouse	Acer	M-UVACR1	-	-	Aug.2, 2011	Aug.1, 2012	±0.5dB

6 Conducted Emission

Test Requirement:	FCC CFR 47 Part 15 Section 15.207
Test Method:	ANSI C63.4:2003
Test Result:	PASS
Frequency Range:	150kHz to 30MHz
Class:	Class B
Limit:	66-56 dBμV between 0.15MHz & 0.5MHz 56 dBμV between 0.5MHz & 5MHz 60 dBμV between 5MHz & 30MHz
Detector:	Peak for pre-scan (9kHz Resolution Bandwidth) Quasi-Peak & Average if maximised peak within 6dB of Average Limit

E.U.T. Operation

Operating Environment:

Temperature: 25.5 °C

Humidity: 51 % RH

Atmospheric Pressure: 1012 mbar

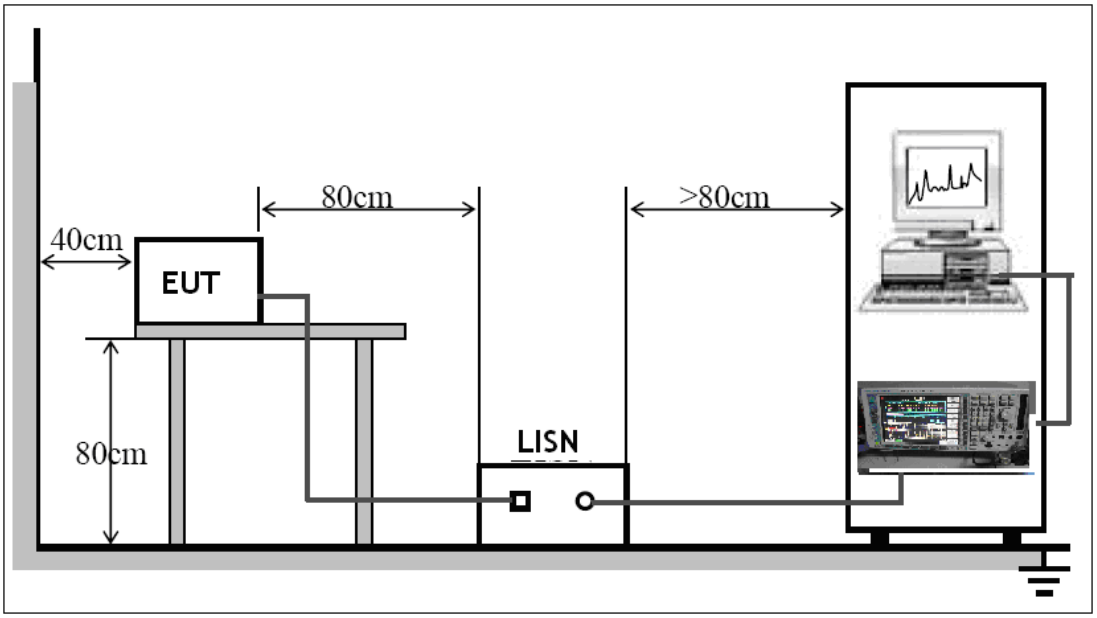
EUT Operation:

The EUT was tested according to ANSI C63.4:2003. The frequency spectrum from 150kHz to 30MHz was investigated.

The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.4:2003, The specification used in this report was the FCC Part15 B 15.207 limits.



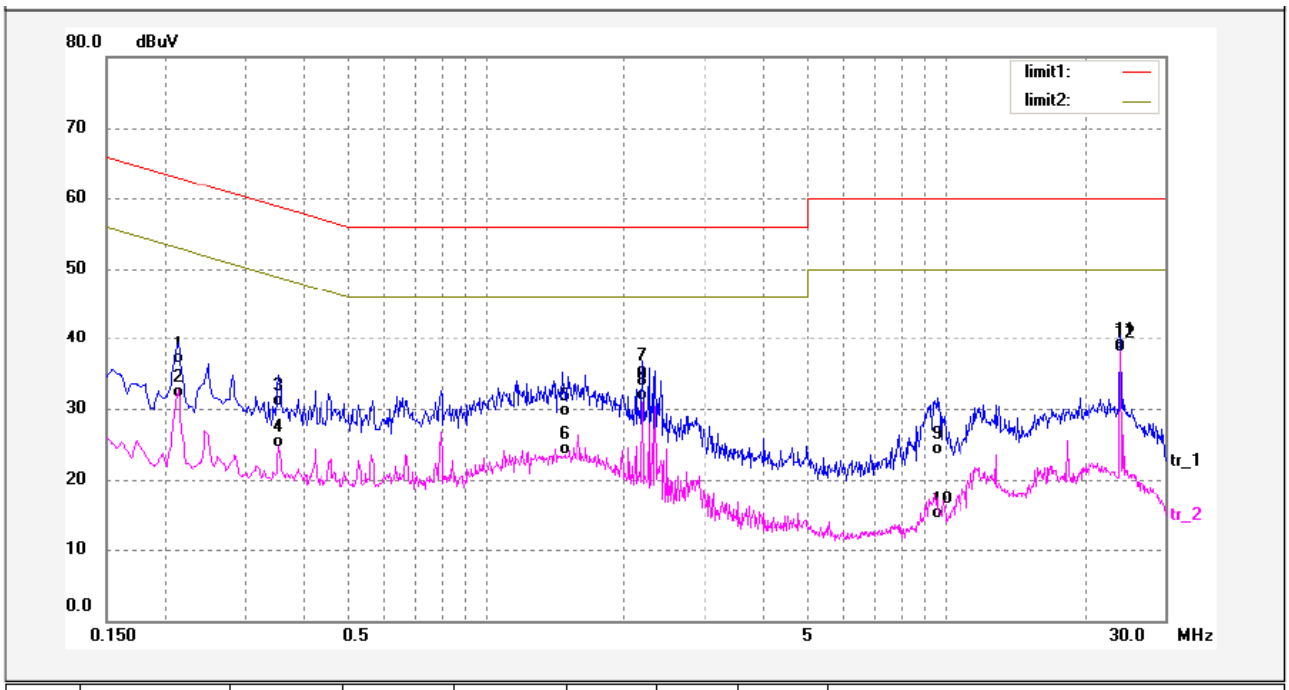
The EUT was placed on the test table in shielding room

Conducted Emission Test Result

An initial pre-scan was performed on the live and neutral lines.

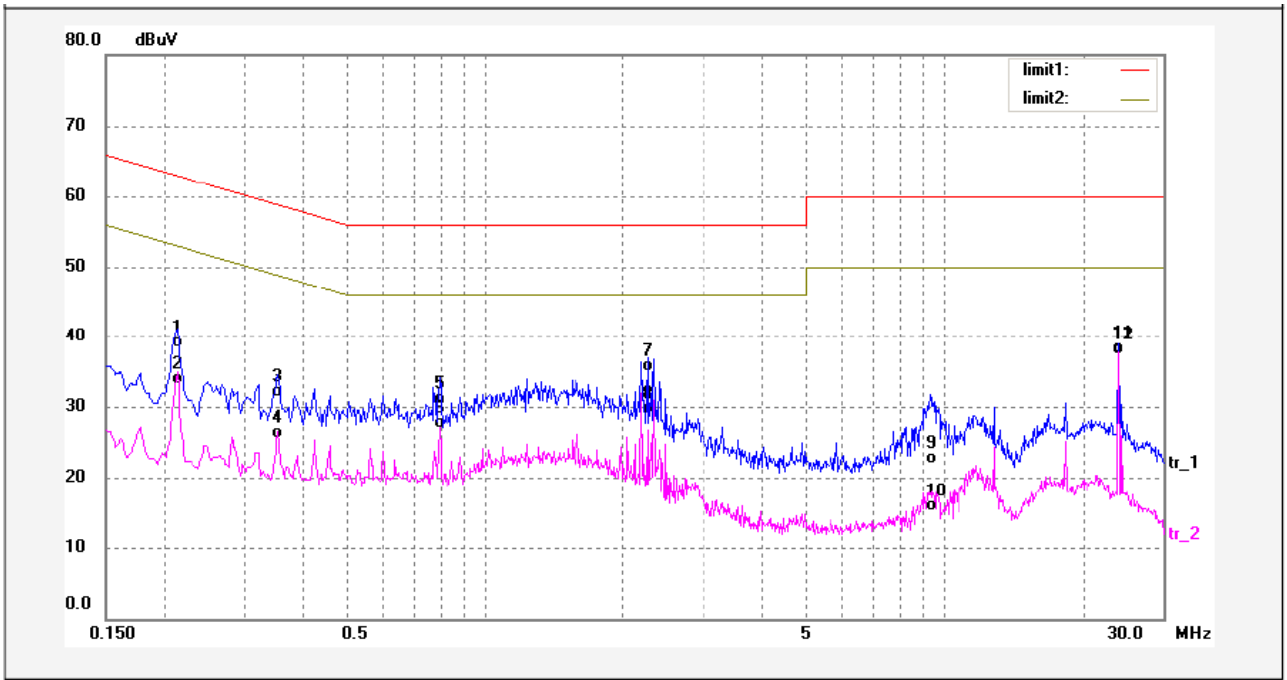
The EUT was tested in charging mode.

Live line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.2140	25.67	10.66	36.33	63.04	-26.71	QP	
2	0.2140	20.82	10.66	31.48	53.04	-21.56	AVG	
3	0.3540	19.57	10.74	30.31	58.87	-28.56	QP	
4	0.3540	13.67	10.74	24.41	48.87	-24.46	AVG	
5	1.4700	16.77	12.19	28.96	56.00	-27.04	QP	
6	1.4700	11.39	12.19	23.58	46.00	-22.42	AVG	
7	2.1940	22.19	12.25	34.44	56.00	-21.56	QP	
8	2.1940	18.94	12.25	31.19	46.00	-14.81	AVG	
9	9.5540	11.60	11.91	23.51	60.00	-36.49	QP	
10	9.5540	2.33	11.91	14.24	50.00	-35.76	AVG	
11	24.0780	25.78	12.48	38.26	60.00	-21.74	QP	
12	24.0780	25.40	12.48	37.88	50.00	-12.12	AVG	

Neutral line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.2140	27.72	10.66	38.38	63.04	-24.66	QP	
2	0.2140	22.54	10.66	33.20	53.04	-19.84	AVG	
3	0.3540	20.63	10.74	31.37	58.87	-27.50	QP	
4	0.3540	14.75	10.74	25.49	48.87	-23.38	AVG	
5	0.7980	18.05	12.17	30.22	56.00	-25.78	QP	
6	0.7980	14.69	12.17	26.86	46.00	-19.14	AVG	
7	2.2659	22.64	12.26	34.90	56.00	-21.10	QP	
8	2.2659	16.61	12.26	28.87	46.00	-17.13	AVG	
9	9.3500	10.02	11.89	21.91	60.00	-38.09	QP	
10	9.3500	3.17	11.89	15.06	50.00	-34.94	AVG	
11	24.0780	25.01	12.48	37.49	60.00	-22.51	QP	
12	24.0780	24.85	12.48	37.33	50.00	-12.67	AVG	

Photograph – Conducted Emission Test Setup

7 Radiated Spurious Emissions

Test Requirement:	FCC CFR47 Part 15 Section 15.209 & 15.247
Test Method:	Base on ANSI C63.4:2003
Test Result:	PASS
Frequency Range:	9kHz to 25GHz
Measurement Distance:	3m
15.209 Limit:	40.0 dBuV/m between 30MHz & 88MHz 43.5 dBuV/m between 88MHz & 216MHz 46.0 dBuV/m between 216MHz & 960MHz 54.0 dBuV/m above 960MHz
15.247 (d) Limit:	(d) 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 mode:	The EUT was tested in continuously Transmit mode.

EUT Operation :

Operating Environment:

Temperature: 25.5 °C
Humidity: 51 % RH
Atmospheric Pressure: 1012 mbar

Measurement Uncertainty

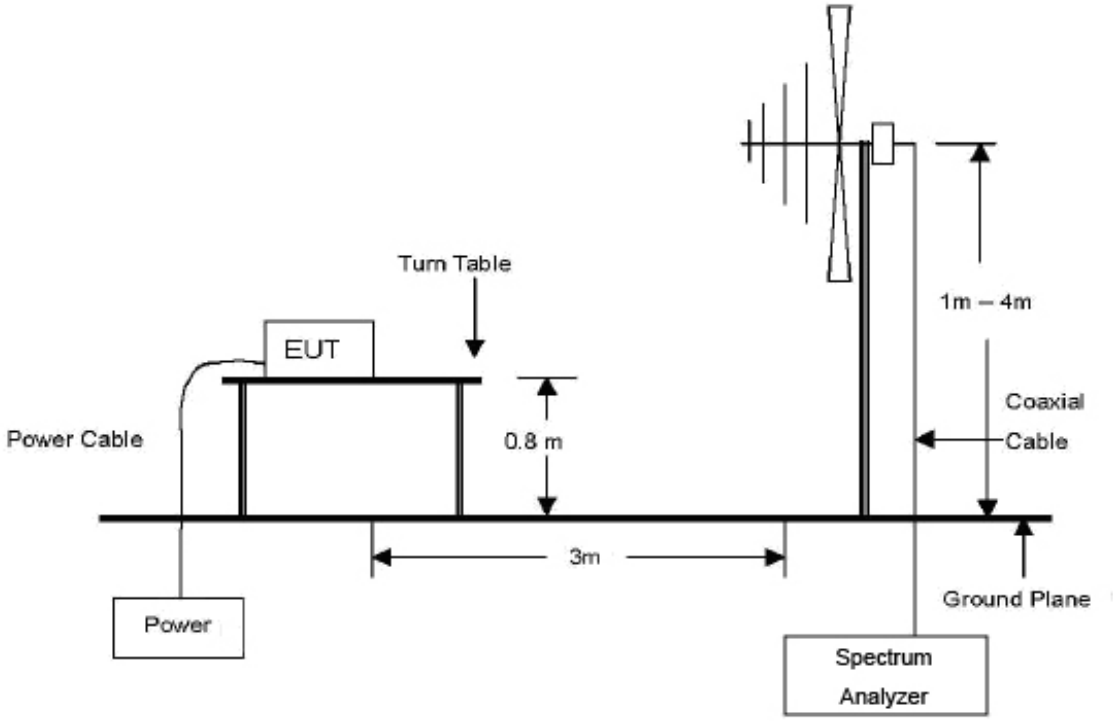
All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of a radiation emissions measurement at Waltek EMC Lab is ±5.03dB.

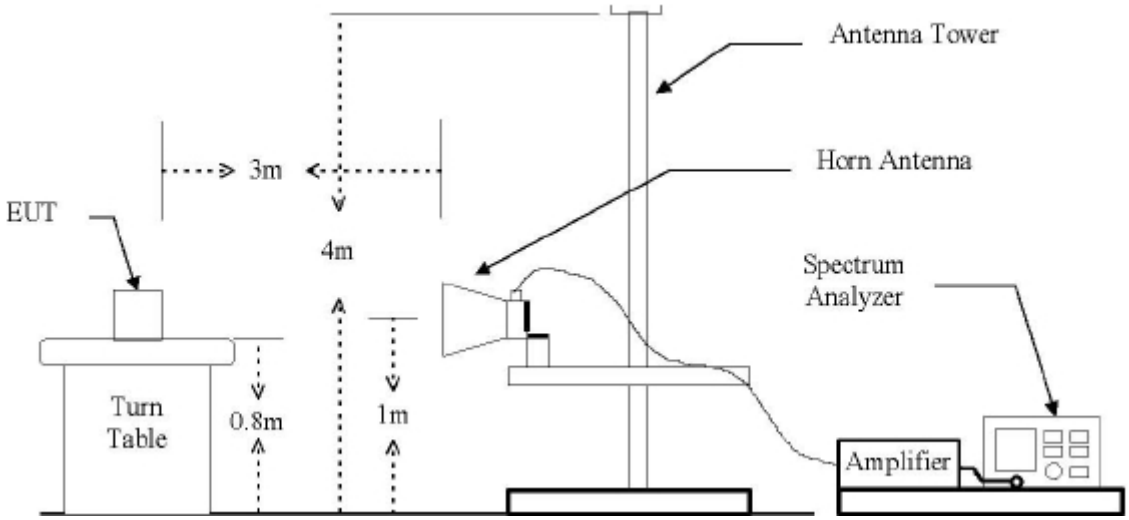
Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.4:2003.

The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 GHz to 25 GHz Emissions.



Spectrum Analyzer Setup

According to FCC Part15 Rules, the system was tested 9kHz to 25000MHz.

9kHz ~ 30MHz

Start Frequency	9kHz
Stop Frequency	30MHz
Sweep Speed	Auto
IF Bandwidth	10KHz
Video Bandwidth	10KHz
Resolution Bandwidth	10KHz

30MHz ~ 1GHz

Start Frequency	30 MHz
Stop Frequency	1000MHz
Sweep Speed	Auto
IF Bandwidth	120 KHz
Video Bandwidth	100KHz
Quasi-Peak Adapter Bandwidth	120 KHz
Quasi-Peak Adapter Mode	Normal
Resolution Bandwidth	100KHz

Above 1GHz

Start Frequency	1000 MHz
Stop Frequency	25000MHz
Sweep Speed	Auto
IF Bandwidth	120 KHz
Video Bandwidth	1MHz
Quasi-Peak Adapter Bandwidth	120 KHz
Quasi-Peak Adapter Mode	Normal
Resolution Bandwidth	1MHz

Test Procedure

1. The EUT is placed on a turntable, which is 0.8m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. The radiation measurements are performed in X(normal uses) axis positioning. And all the modes was tested in the report.Only the worst case is shown in the report.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corr. Ampl. = Indicated Reading + Antenna Factor + Cable Factor - Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dBμV means the emission is 7dBμV below the maximum limit for Class B. The equation for margin calculation is as follows:

Margin = Corr. Ampl. – Limit

Summary of Test Results

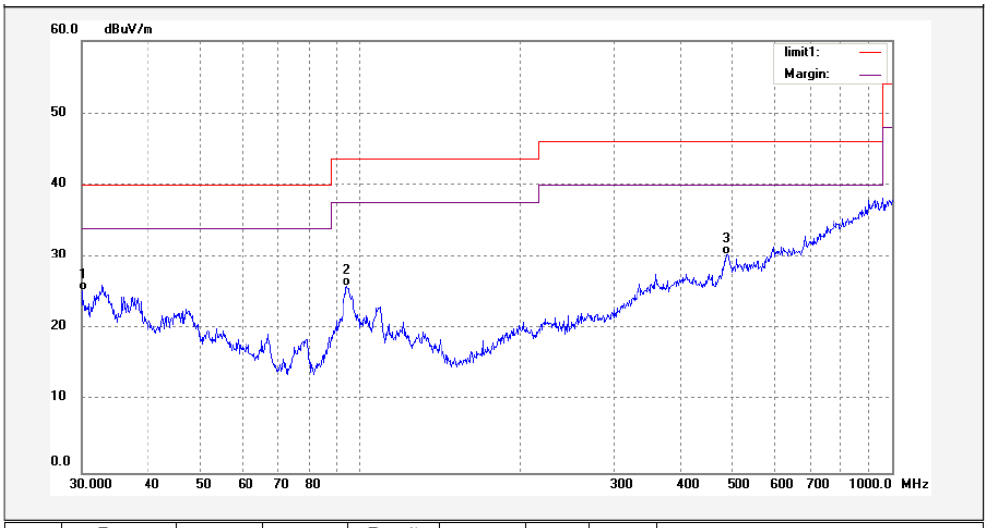
According to the data in this section, the EUT complied with the FCC CFR47 Part 15 Section 15.209 & 15.247 standards.

Test mode: continuously recevie mode

Remark: the EUT was pretested at the high, middle and low channel, and the worse case was the low Channel, so the data show was the low channel only. Because the emissions below 30MHz are more than 20dB below the limit, the data is not show in the report.

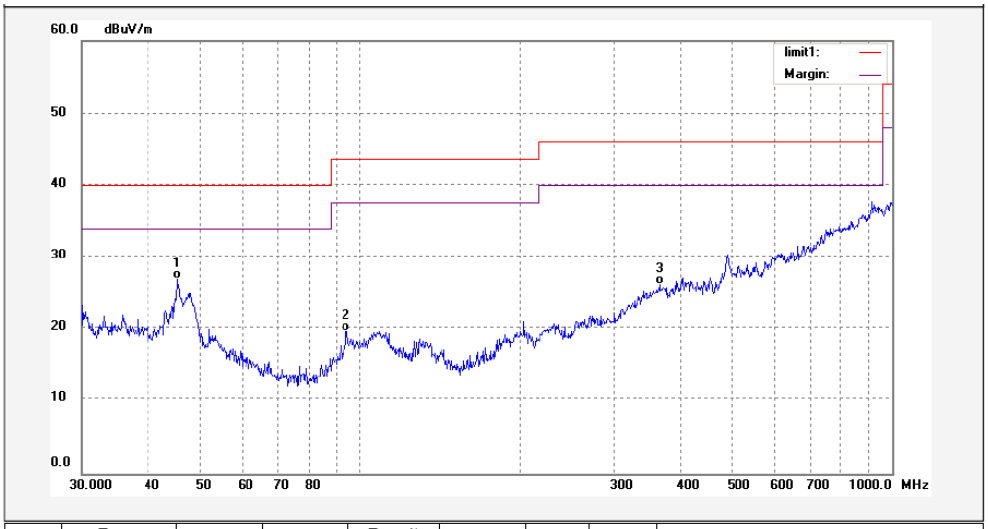
Test Frequency : 30MHz ~ 1000MHz

Antenna polarization: Vertical



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	30.0000	9.16	16.15	25.31	40.00	-14.69	QP	
2	94.6456	12.85	13.05	25.90	43.50	-17.60	QP	
3	488.3263	5.18	25.25	30.43	46.00	-15.57	QP	

Antenna polarization: Horizontal

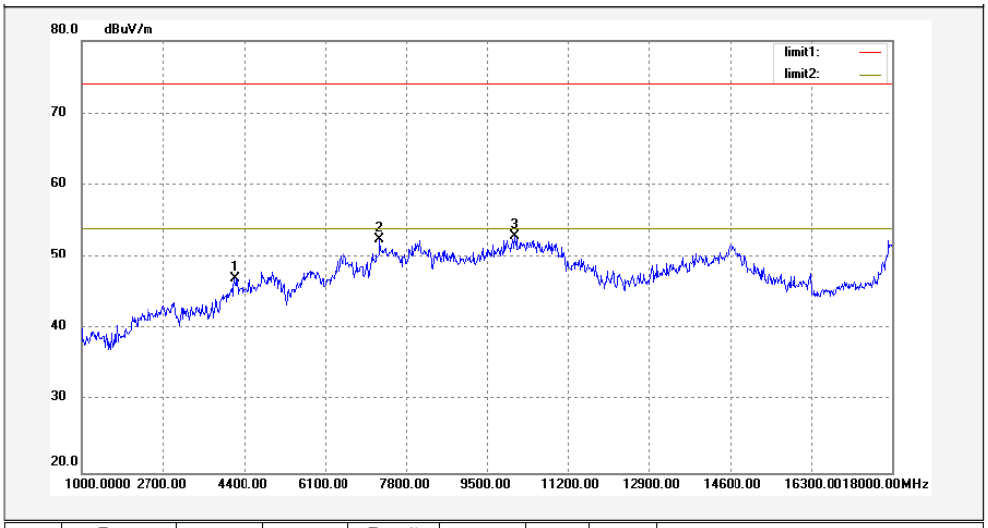


No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	45.4130	12.24	14.66	26.90	40.00	-13.10	QP	
2	94.3137	6.83	12.96	19.79	43.50	-23.71	QP	
3	366.0866	5.60	20.64	26.24	46.00	-19.76	QP	

Test Frequency: Above 1GHz radiation test data:

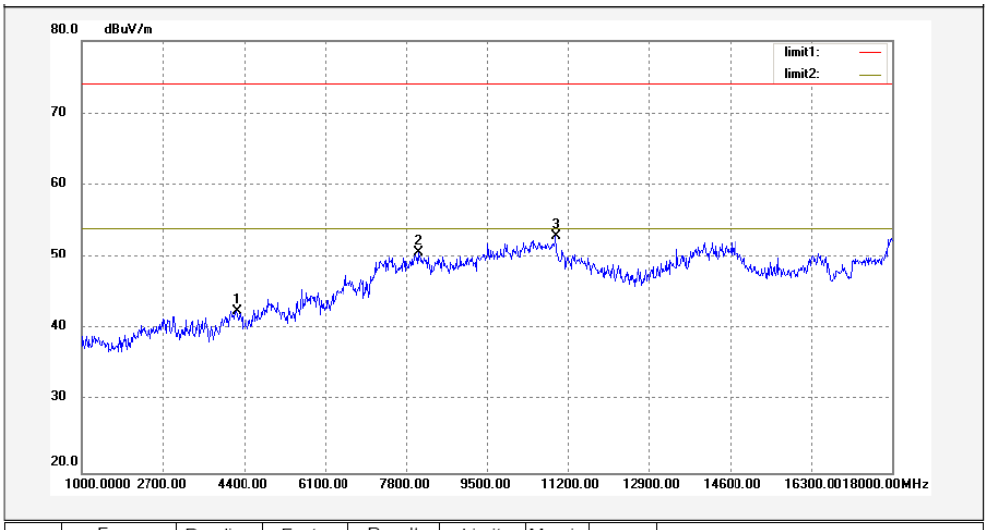
Remark: above 18GHz, the test signal below the noise level, so the data was not perfromed.

Antenna polarization: Vertical



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	4185.371	40.52	6.46	46.98	74.00	-27.02	peak	
2	7251.503	36.63	15.85	52.48	74.00	-21.52	peak	
3	10079.158	32.27	20.58	52.85	74.00	-21.15	peak	

Antenna polarization: Horizontal



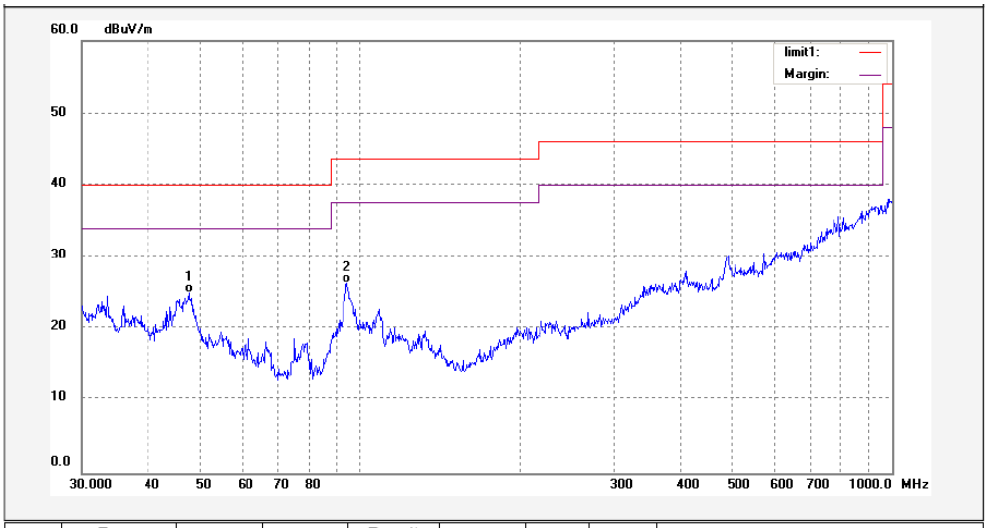
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	4236.473	39.30	3.10	42.40	74.00	-31.60	peak	
2	8052.104	35.75	14.91	50.66	74.00	-23.34	peak	
3	10947.896	33.63	19.31	52.94	74.00	-21.06	peak	

Test mode: continuously transmit mode

Remark: the EUT was pretested at the high, middle and low channel, and the worse case was the low Channel, so the data show was the low channel only. Because the emissions below 30MHz are more than 20dB below the limit, the data is not show in the report.

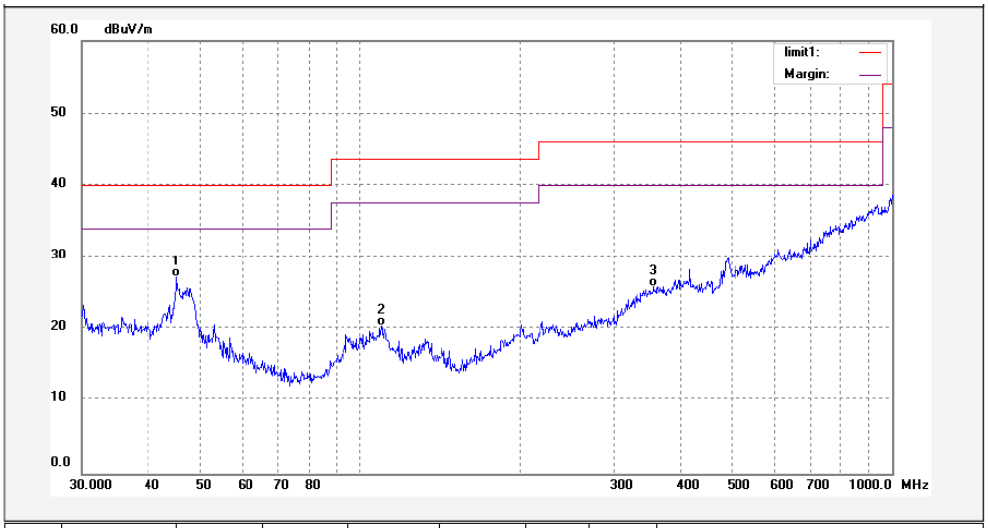
Test Frequency : 30MHz ~ 1000MHz

Antenna polarization: Vertical



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	47.7028	10.28	14.63	24.91	40.00	-15.09	QP	
2	94.6456	13.25	13.05	26.30	43.50	-17.20	QP	

Antenna polarization: Horizontal



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	45.2538	12.47	14.69	27.16	40.00	-12.84	QP	
2	109.6957	6.70	13.78	20.48	43.50	-23.02	QP	
3	357.1925	5.33	20.59	25.92	46.00	-20.08	QP	

Test Frequency: 1GHz ~ 25GHz

And the below is the Fundamental and Harmonic

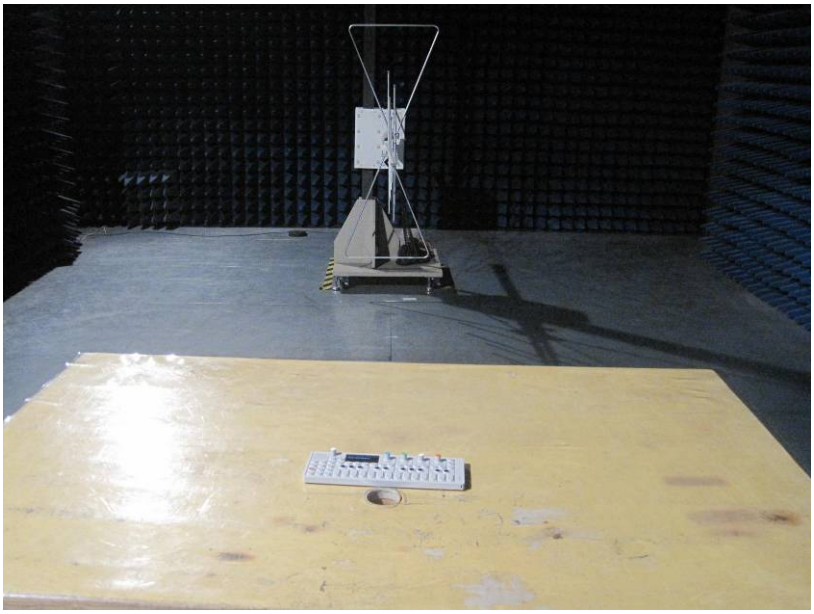
Frequency (MHz)	Detector	Antenna Polarization	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Turntable Angle (°)
Low frequency							
2402.00	AV	Vertical	83.96		(Fund.)	1.2	10
4804.00	AV	Vertical	44.20	54.00	-9.80	1.2	55
7206.00	AV	Vertical	45.14	54.00	-8.86	1.5	130
9608.00	AV	Vertical	41.87	54.00	-12.13	1.8	70
12010.00	AV	Vertical	38.23	54.00	-15.77	1.6	145
14412.00	AV	Vertical	39.52	54.00	-14.48	1.4	130
16814.00	AV	Vertical	36.33	54.00	-17.67	1.7	110
19216.00	AV	Vertical	34.61	54.00	-19.39	1.5	70
21618.00	AV	Vertical	32.39	54.00	-21.61	1.6	10
24020.00	AV	Vertical	33.54	54.00	-20.46	1.2	70
2402.00	AV	Horizontal	77.69		(Fund.)	1.2	10
4804.00	AV	Horizontal	43.51	54.00	-10.49	1.2	130
7206.00	AV	Horizontal	41.26	54.00	-12.74	1.5	70
9608.00	AV	Horizontal	38.37	54.00	-15.63	1.2	110
12010.00	AV	Horizontal	40.35	54.00	-13.65	1.5	70
14412.00	AV	Horizonta	35.26	54.00	-18.74	1.2	130
16814.00	AV	Horizontal	41.36	54.00	-12.64	1.5	110
19216.00	AV	Horizontal	33.21	54.00	-20.79	1.8	110
21618.00	AV	Horizontal	34.54	54.00	-19.46	1.2	110
24020.00	AV	Horizontal	36.31	54.00	-17.69	1.5	20
2402.00	PK	Vertical	95.84		(Fund.)	1.5	10
4804.00	PK	Vertical	57.20	74.00	-16.80	1.8	70
7206.00	PK	Vertical	58.14	74.00	-15.86	1.6	100
9608.00	PK	Vertical	54.87	74.00	-19.13	1.4	190
12010.00	PK	Vertical	51.23	74.00	-22.77	1.2	70
14412.00	PK	Vertical	52.52	74.00	-21.48	1.2	70
16814.00	PK	Vertical	49.33	74.00	-24.67	1.4	145
19216.00	PK	Vertical	47.61	74.00	-26.39	1.2	130
21618.00	PK	Vertical	45.39	74.00	-28.61	1.7	70
24020.00	PK	Vertical	46.54	74.00	-27.46	1.4	100
2402.00	PK	Horizontal	89.19		(Fund.)	1.8	70
4804.00	PK	Horizontal	43.51	74.00	-30.49	1.8	100
7206.00	PK	Horizontal	41.26	74.00	-32.74	1.8	70
9608.00	PK	Horizontal	38.37	74.00	-35.63	1.2	10
12010.00	PK	Horizontal	40.35	74.00	-33.65	1.2	145
14412.00	PK	Horizontal	35.26	74.00	-38.74	1.5	10
16814.00	PK	Horizontal	41.36	74.00	-32.64	1.8	190
19216.00	PK	Horizontal	33.21	74.00	-40.79	1.5	70
21618.00	PK	Horizontal	34.54	74.00	-39.46	1.2	130

24020.00	PK	Horizontal	36.31	74.00	-37.69	1.2	70
Middle frequency							
2441.00	AV	Vertical	84.12		(Fund.)	1.5	10
4882.00	AV	Vertical	46.26	54.00	-7.74	1.2	100
7323.00	AV	Vertical	44.37	54.00	-9.63	1.0	100
9764.00	AV	Vertical	40.23	54.00	-13.77	1.2	10
12205.00	AV	Vertical	43.47	54.00	-10.53	1.2	10
14646.00	AV	Vertical	36.14	54.00	-17.86	1.2	160
17087.00	AV	Vertical	39.39	54.00	-14.61	1.5	10
19528.00	AV	Vertical	34.20	54.00	-19.80	1.5	10
21969.00	AV	Vertical	38.19	54.00	-15.81	1.8	190
24410.00	AV	Vertical	31.25	54.00	-22.75	1.2	100
2441.00	AV	Horizontal	78.35		(Fund.)	1.0	130
4882.00	AV	Horizontal	41.33	54.00	-12.67	1.0	100
7323.00	AV	Horizontal	43.06	54.00	-10.94	1.5	280
9764.00	AV	Horizontal	37.17	54.00	-16.83	1.2	130
12205.00	AV	Horizontal	39.92	54.00	-14.08	1.2	160
14646.00	AV	Horizontal	35.32	54.00	-18.68	1.4	190
17087.00	AV	Horizontal	32.51	54.00	-21.49	1.6	145
19528.00	AV	Horizontal	35.20	54.00	-18.80	1.4	100
21969.00	AV	Horizontal	36.43	54.00	-17.57	1.2	160
24410.00	AV	Horizontal	31.11	54.00	-22.89	1.7	130
2441.00	PK	Vertical	96.14		(Fund.)	1.0	10
4882.00	PK	Vertical	59.26	74.00	-14.74	1.1	100
7323.00	PK	Vertical	57.37	74.00	-16.63	1.4	110
9764.00	PK	Vertical	53.23	74.00	-20.77	1.3	130
12205.00	PK	Vertical	56.47	74.00	-17.53	1.7	190
14646.00	PK	Vertical	49.14	74.00	-24.86	1.2	10
17087.00	PK	Vertical	52.39	74.00	-21.61	1.4	10
19528.00	PK	Vertical	47.20	74.00	-26.80	1.5	130
21969.00	PK	Vertical	51.19	74.00	-22.81	1.5	145
24410.00	PK	Vertical	44.25	74.00	-29.75	1.2	130
2441.00	PK	Horizontal	89.25		(Fund.)	1.0	10
4882.00	PK	Horizontal	54.33	74.00	-19.67	1.7	55
7323.00	PK	Horizontal	56.06	74.00	-17.94	1.6	100
9764.00	PK	Horizontal	50.17	74.00	-23.83	1.5	70
12205.00	PK	Horizontal	52.92	74.00	-21.08	1.4	160
14646.00	PK	Horizontal	48.32	74.00	-25.68	1.2	160
17087.00	PK	Horizontal	45.51	74.00	-28.49	1.1	130
19528.00	PK	Horizontal	48.20	74.00	-25.80	1.5	160
21969.00	PK	Horizontal	49.43	74.00	-24.57	1.1	10
24410.00	PK	Horizontal	44.11	74.00	-29.89	1.6	145
High frequency							
2480.00	AV	Vertical	84.37		(Fund.)	1.0	160
4960.00	AV	Vertical	44.74	54.00	-9.26	1.2	10

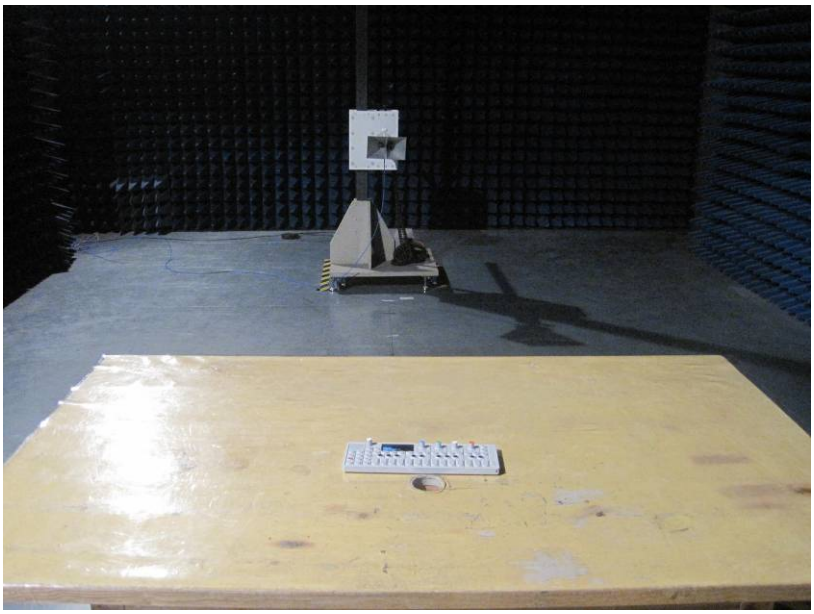
7440.00	AV	Vertical	41.17	54.00	-12.83	1.2	130
9920.00	AV	Vertical	43.63	54.00	-10.37	1.4	70
12400.00	AV	Vertical	38.73	54.00	-15.27	1.5	100
14880.00	AV	Vertical	45.28	54.00	-8.72	1.8	130
17360.00	AV	Vertical	39.31	54.00	-14.69	1.1	110
19840.00	AV	Vertical	40.18	54.00	-13.82	1.1	190
22320.00	AV	Vertical	38.50	54.00	-15.50	1.4	130
24800.00	AV	Vertical	32.12	54.00	-21.88	1.5	145
2480.00	AV	Horizontal	78.52		(Fund.)	1.0	130
4960.00	AV	Horizontal	41.13	54.00	-12.87	1.8	160
7440.00	AV	Horizontal	39.44	54.00	-14.56	1.2	130
9920.00	AV	Horizontal	40.26	54.00	-13.74	1.5	190
12400.00	AV	Horizontal	38.12	54.00	-15.88	1.2	145
14880.00	AV	Horizontal	32.31	54.00	-21.69	1.2	130
17360.00	AV	Horizontal	36.52	54.00	-17.48	1.4	190
19840.00	AV	Horizontal	31.19	54.00	-22.81	1.8	70
22320.00	AV	Horizontal	34.02	54.00	-19.98	1.3	100
24800.00	AV	Horizontal	29.40	54.00	-24.60	1.6	100
2480.00	PK	Vertical	96.34		(Fund.)	1.0	190
4960.00	PK	Vertical	57.74	74.00	-16.26	1.2	40
7440.00	PK	Vertical	54.17	74.00	-19.83	1.8	120
9920.00	PK	Vertical	56.63	74.00	-17.37	1.5	110
12400.00	PK	Vertical	51.73	74.00	-22.27	1.4	100
14880.00	PK	Vertical	58.28	74.00	-15.72	1.2	70
17360.00	PK	Vertical	52.31	74.00	-21.69	1.2	100
19840.00	PK	Vertical	53.18	74.00	-20.82	1.2	130
22320.00	PK	Vertical	51.50	74.00	-22.50	1.6	130
24800.00	PK	Vertical	45.12	74.00	-28.88	1.4	145
2480.00	PK	Horizontal	88.54		(Fund.)	1.1	190
4960.00	PK	Horizontal	54.13	74.00	-19.87	1.4	70
7440.00	PK	Horizontal	52.44	74.00	-21.56	1.5	130
9920.00	PK	Horizontal	53.26	74.00	-20.74	1.3	190
12400.00	PK	Horizontal	51.12	74.00	-22.88	1.2	100
14880.00	PK	Horizontal	45.31	74.00	-28.69	1.7	100
17360.00	PK	Horizontal	49.52	74.00	-24.48	1.8	160
19840.00	PK	Horizontal	44.19	74.00	-29.81	1.5	160
22320.00	PK	Horizontal	47.02	74.00	-26.98	1.8	130
24800.00	PK	Horizontal	42.40	74.00	-31.60	1.0	190

Photograph – Radiation Spurious Emission Test Setup

Below 1GHz



Above 1GHz

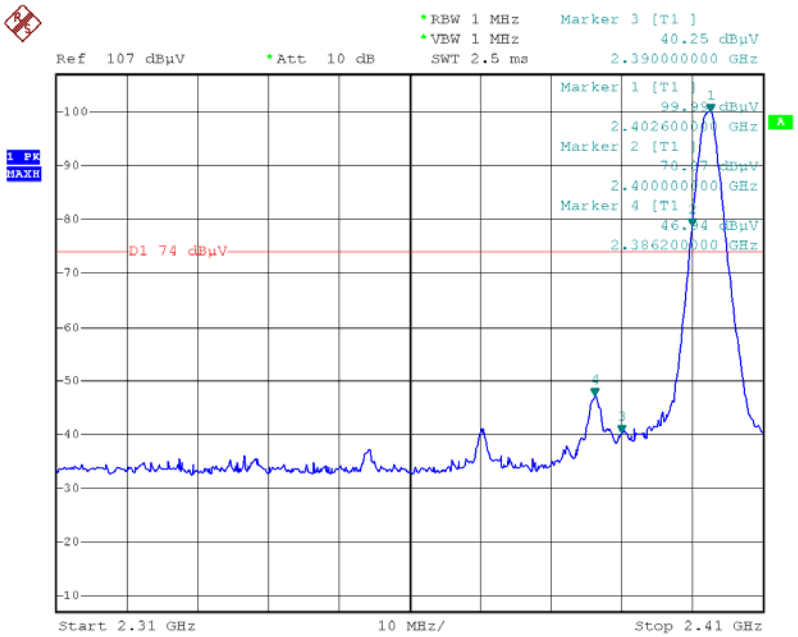


8 Band Edge Measurement

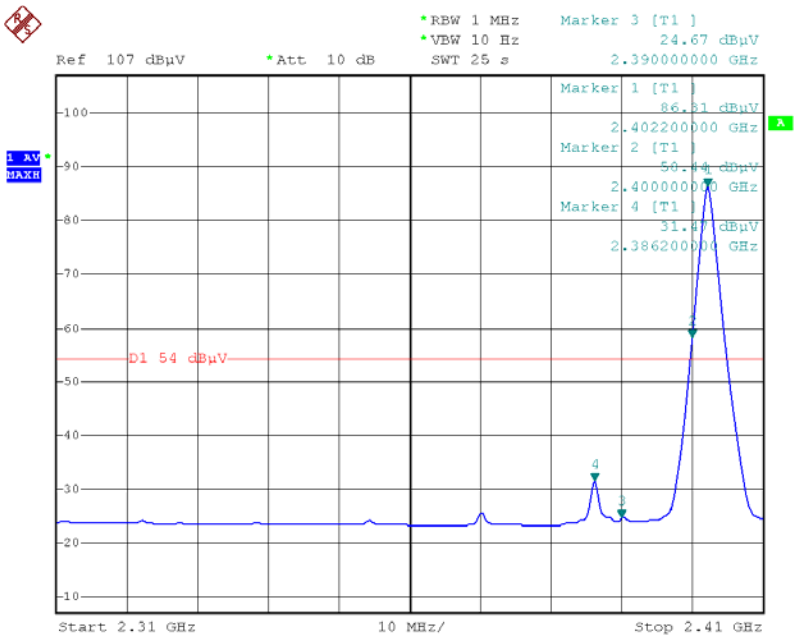
Test Requirement:	Section 15.247(d) In addition, radiated emissions which fall in the restricted bands. as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).
Test Method:	Base on ANSI C63.4:2003
Measurement Distance:	3m
Limit:	40.0 dBuV/m between 30MHz & 88MHz; 43.5 dBuV/m between 88MHz & 216MHz; 46.0 dBuV/m between 216MHz & 960MHz; 54.0 dBuV/m above 960MHz. 74.0 dBuV/m for peak above 1GHz 54.0 dBuV/m for AVG above 1GHz
Detector:	For Peak value: RBW = 1 MHz for f ≥ 1 GHz VBW ≥ RBW; Sweep = auto Detector function = peak Trace = max hold For AVG value: RBW = 1 MHz for f ≥ 1 GHz VBW = 10Hz; Sweep = auto Detector function = AVG Trace = max hold

Test Result:

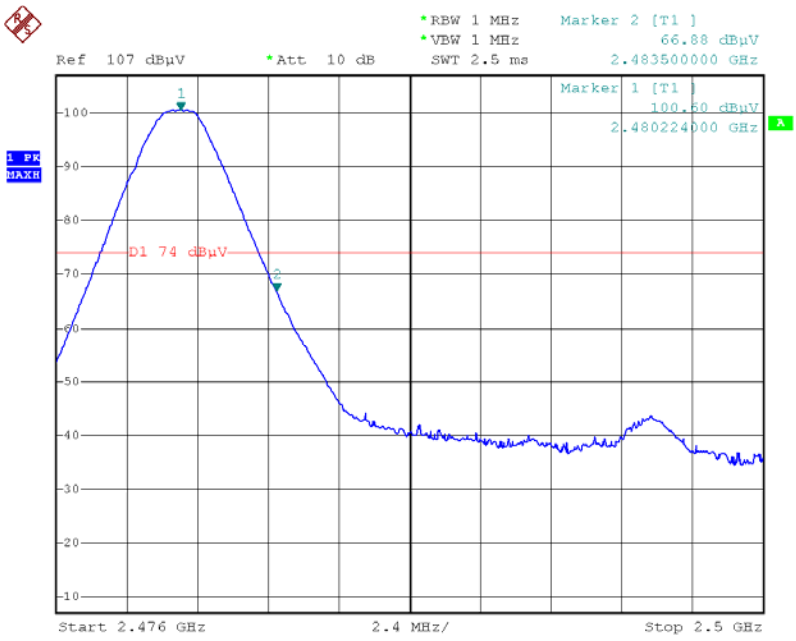
Low Channel – Peak



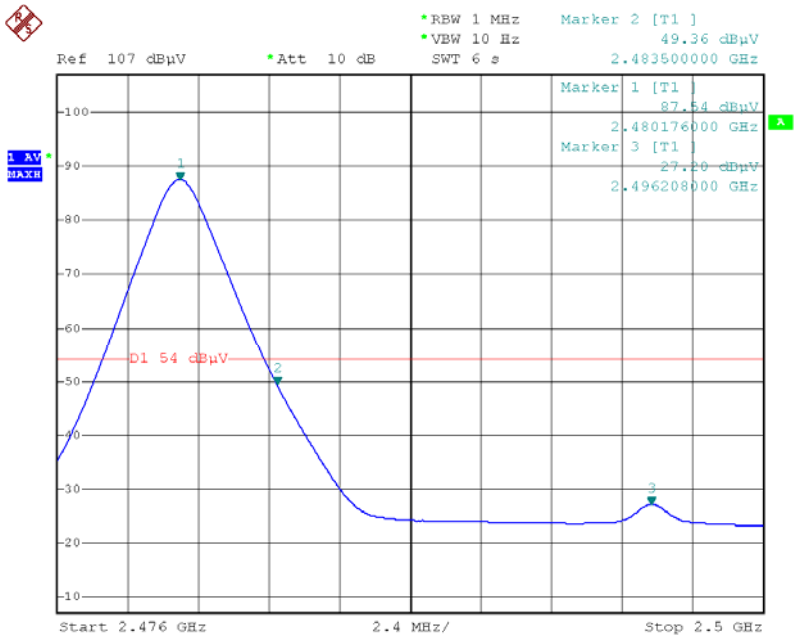
Low Channel – AV



High Channel – Peak



High Channel – AV



9 20 dB Bandwidth Measurement

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: Based on FCC Part 15.247

Test Mode: Test in fixing operating frequency at low, Middle, high channel.

Test Procedure:

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;

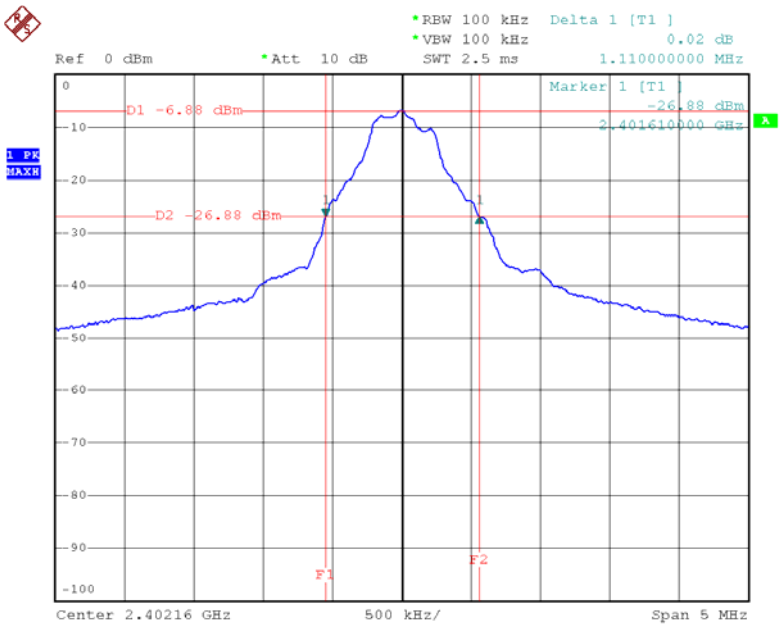
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 100kHz

Test Result:

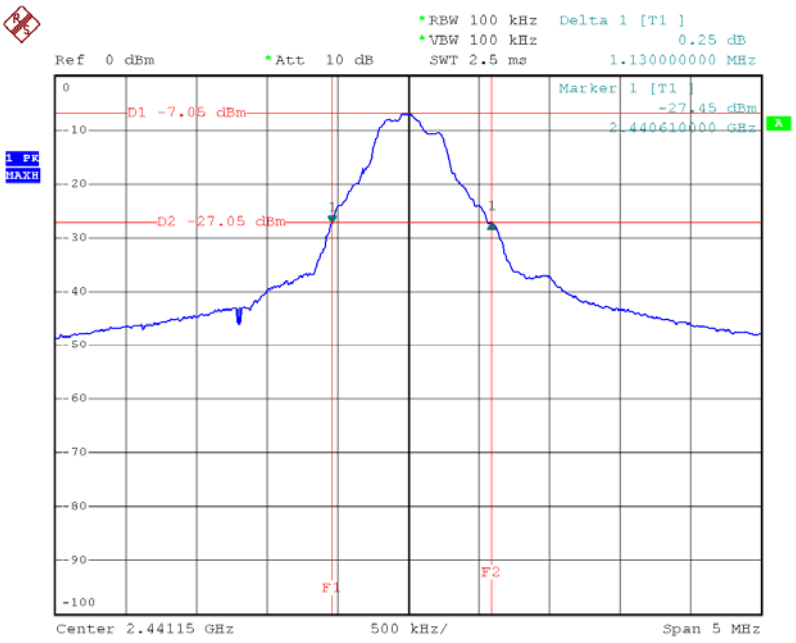
Test Channel	Bandwidth
Low	1.11MHz
Middle	1.13 MHz
High	1.14 MHz

Test result plot as follows:

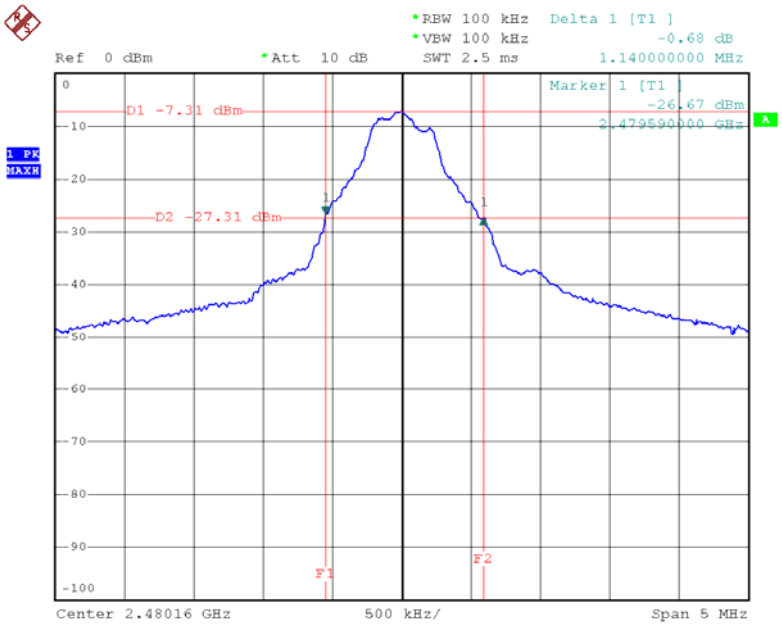
Low Channel



Middle Channel



High Channel



10 Maximum Peak Output Power

Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	Based on ANSI C63.4:2003
Test Limit:	Regulation 15.247 (b)(1)For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts. Refer to the result "Number of Hopping Frequency" of this document. The 1watts (30 dBm) limit applies.
Test mode:	Test in fixing frequency transmitting mode.

Test Procedure:

1． Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

2． Set the spectrum analyzer: RBW = 1 MHz. VBW = 1 MHz. Sweep = auto; Detector Function = Peak.

3． Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

Test Result:

Test Channel	Output Power (dBm)	Limit (dBm)
Low	-4.75	30
Middle	-5.07	30
High	-4.68	30

11 Hopping Channel Separation

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: Based on FCC Part 15.247

Test Limit: Regulation 15.247(a)(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 1W.

Test Mode: Test in hopping transmitting operating mode.

Test Procedure:

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

2. Set the spectrum analyzer: RBW = 30kHz. VBW = 100kHz , Span = 3MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.

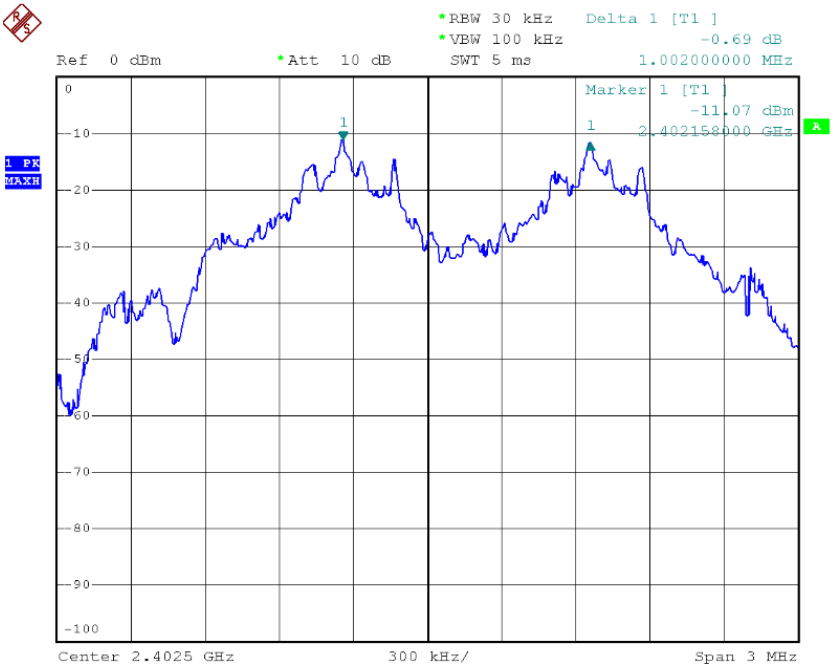
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.

Test Result:

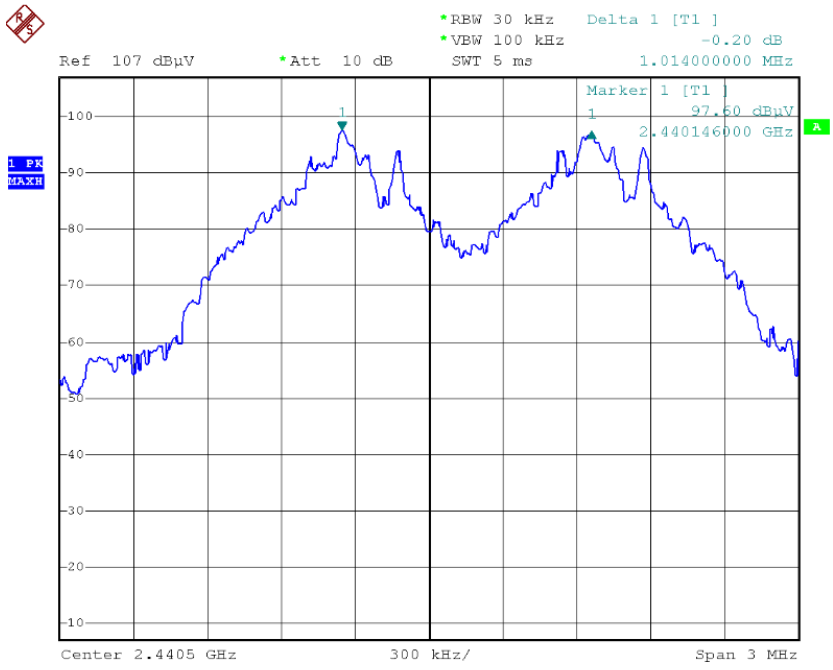
Test Channel	Separation (MHz)	Result
Low	1.002	PASS
Middle	1.014	PASS
High	1.000	PASS

Test result plot as follows:

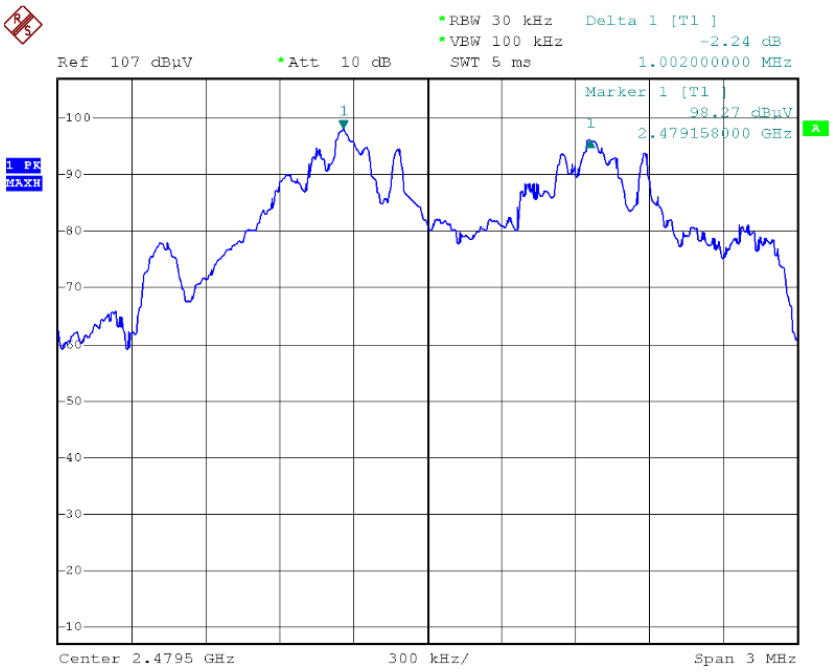
Low Channel:



Middle Channel



High Channel


*RBW 30 kHz
*VBW 100 kHz
SWT 5 ms
Delta 1 [T1]
-2.24 dB
1.002000000 MHz
Ref 107 dBµV
*Att 10 dB
Marker 1 [T1]
98.27 dBµV
2.479158000 GHz
1 PK
MAXH
A
100
90
80
70
60
50
40
30
20
10
Center 2.4795 GHz
300 kHz/
Span 3 MHz

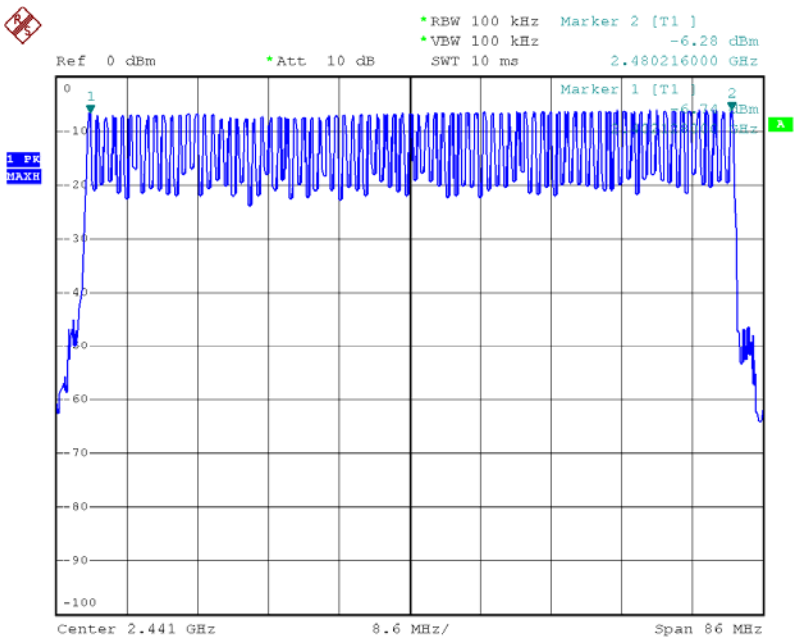
12 Number of Hopping Frequency

Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	Based on FCC Part 15.247
Test Limit:	Regulation 15.247 (a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.
Test Mode:	Test in hopping transmitting operating mode.

Test Procedure:

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 100 kHz. VBW = 100 kHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.
4. Set the spectrum analyzer: Start Frequency = 2398MHz, Stop Frequency = 2483MHz. Submit the test result graph.

Test Result: Total Channels are 79 Channels.



13 Dwell Time

Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	Based on FCC Part 15.247
Test Limit:	Regulation 15.247(a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.
Test Mode:	Test in hopping transmitting operating mode.

Test Procedure:

1.Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

2.Set spectrum analyzer span = 0. centered on a hopping channel;

3.Set RBW = 1MHz and VBW = 1MHz.Sweep = as necessary to capture the entire dwell time per hopping channel.

4.Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g.. data rate. modulation format. etc.). repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

Test Result:

Dwell time = Pulse wide x (Hopping rate / Number of channels) x Period

The test period: T= 0.4(s) * 79 = 31.6 (s)

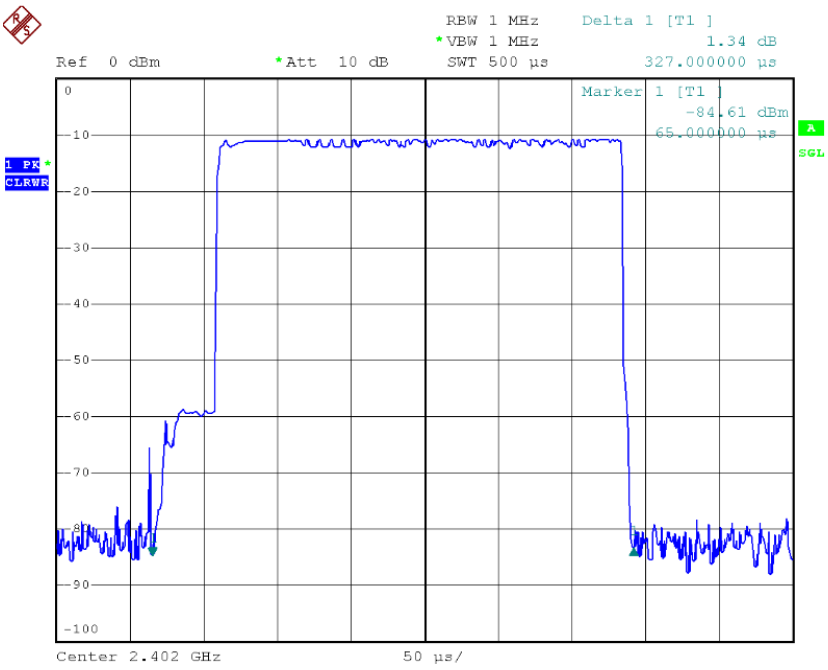
So, the Dwell Time can be calculated as follows:

Dwell time = 28 * 31.6 * (MkrDelta) / 1000

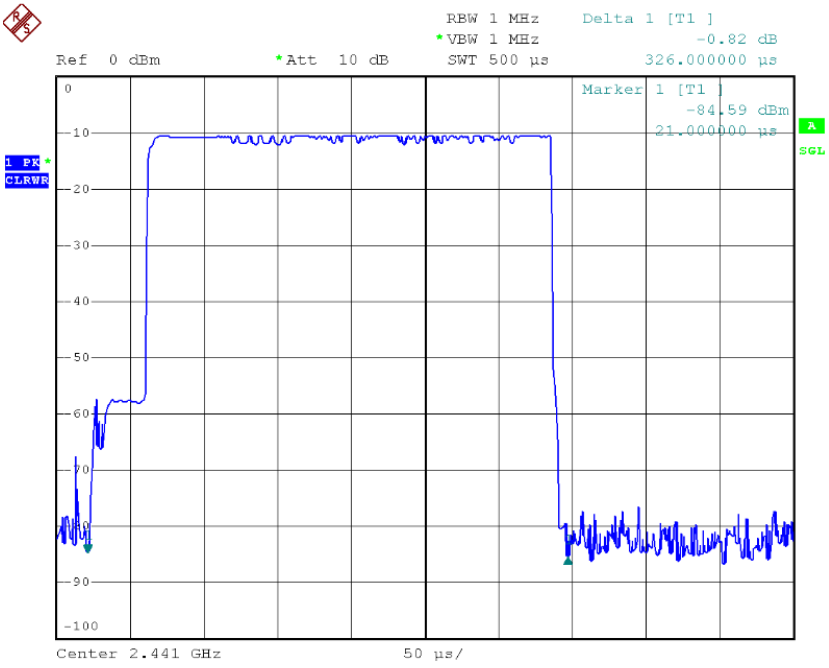
Note : Mkr Delta is once pulse time.

Frequency	Mkr Delta(ms)	Dwell Time(s)	Limits(s)	Result
2402 MHz	0.327	0.289	0.400	Pass
2441 MHz	0.326	0.288	0.400	Pass
2480 MHz	0.322	0.284	0.400	Pass

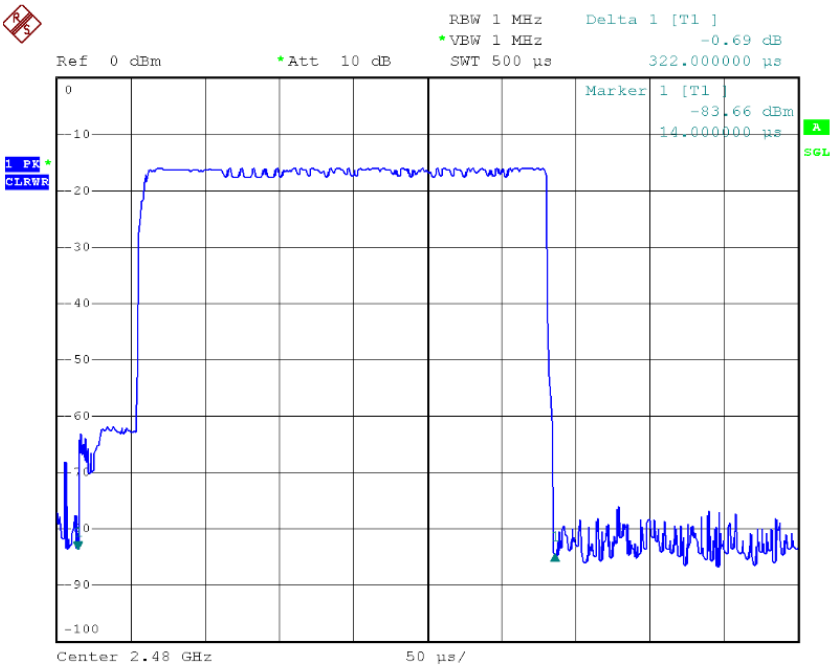
Low Channel: 2402MHz



Middle Channel: 2441MHz



High Channel: 2480MHz



14 Antenna Requirement

According to the FCC Part 15 Paragraph 15.203, 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 shall be considered sufficient to comply with the provisions of this section. This product has a permanent antenna, fulfill the requirement of this section.

15 RF Exposure

Requiments:

According to §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

This is a portable device.

Measurement Result:

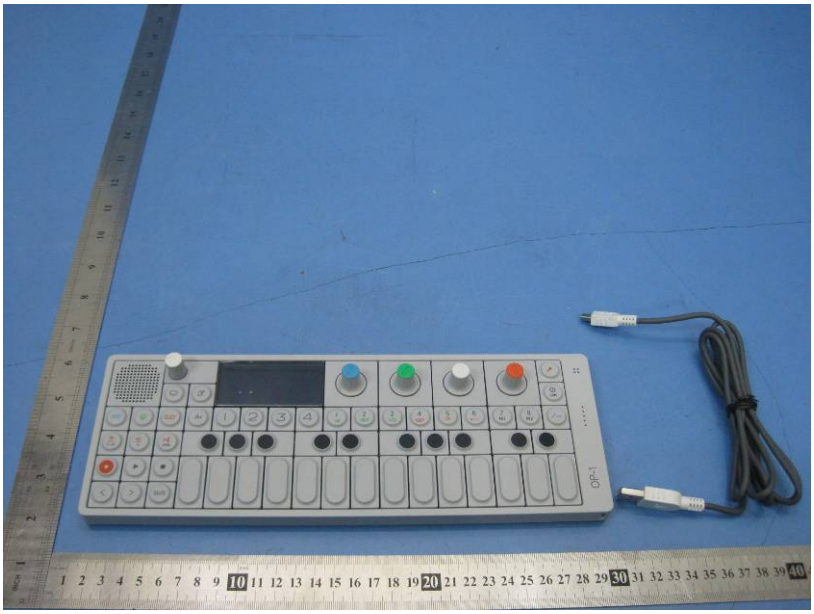
Antenna Gain (dBi)	Antenna Gain (numeric)	Conducted Power (dBm)	Conducted Power (mW)	Radiated Power (e.i.r.p) (mW)
-1.9	0.646	-4.75	0.335	0.216
-1.9	0.646	-5.07	0.311	0.201
-1.9	0.646	-4.68	0.340	0.220

The EUT works on the 2.4G ISM band, and the max output power (conducted) of which is 0.340 mW lower than low threshold 60/f (GHz) mW (24.48mW), d < 2.5cm in general population category.

The SAR evaluation is not required.

16 Photographs - Constructional Details

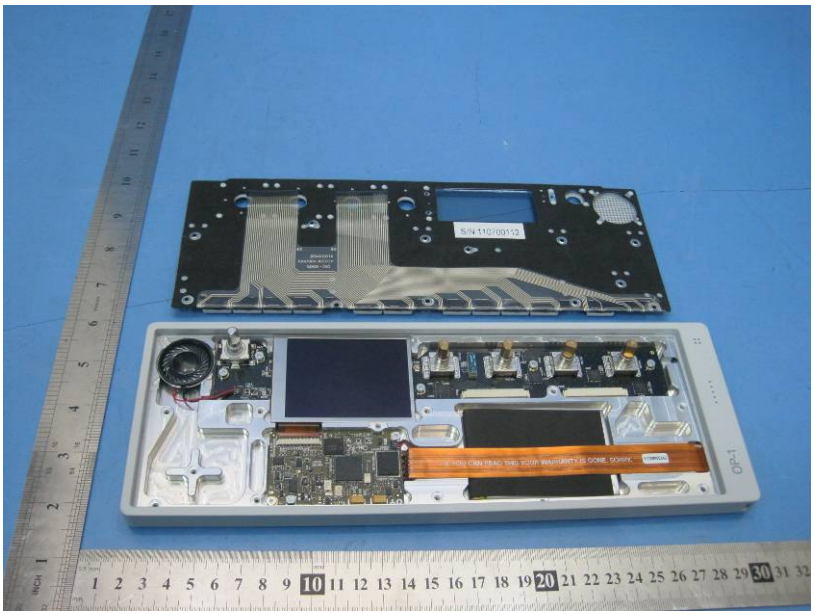
16.1 Product View



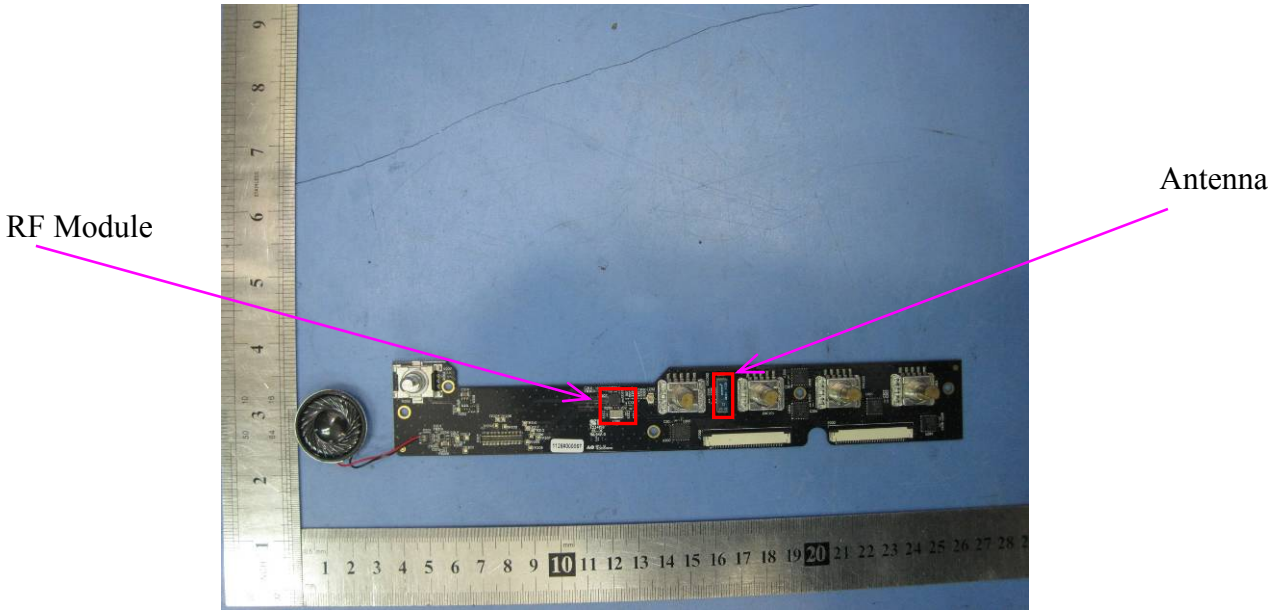
16.2 EUT – Front View

16.3 EUT – Back View

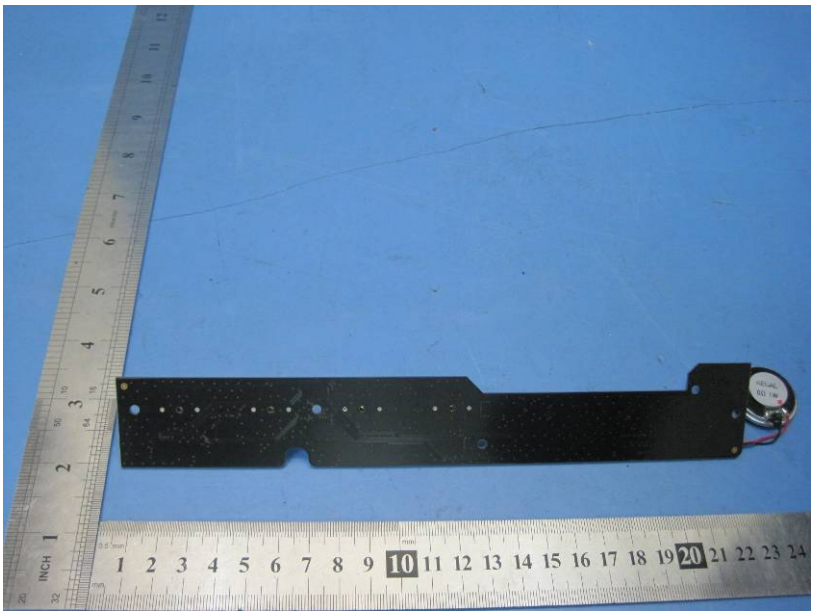
16.4 EUT – Open View



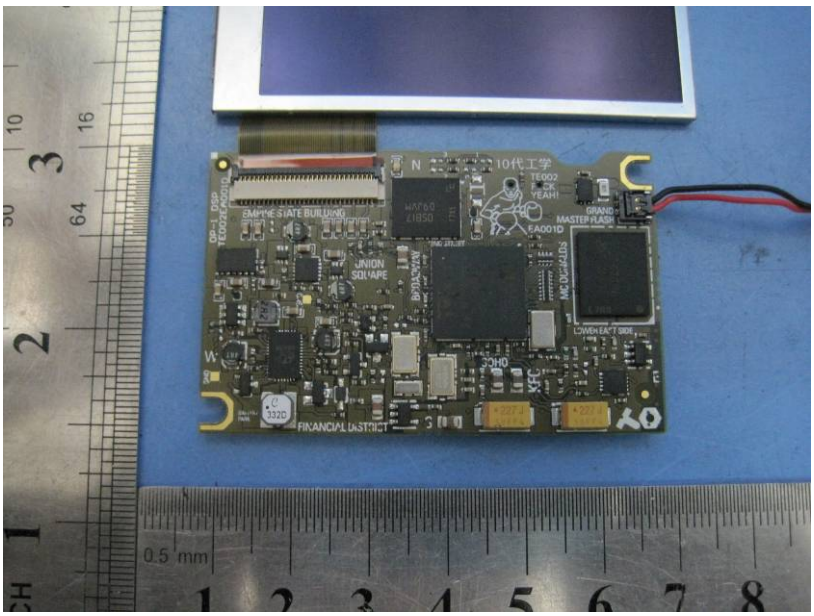
16.5 PCB 1 – Front View



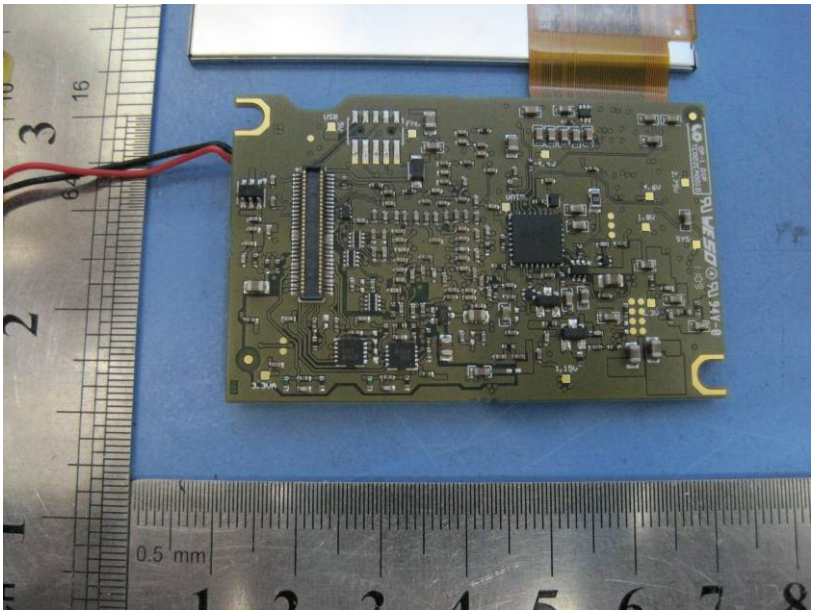
16.6 PCB 1 – Back View



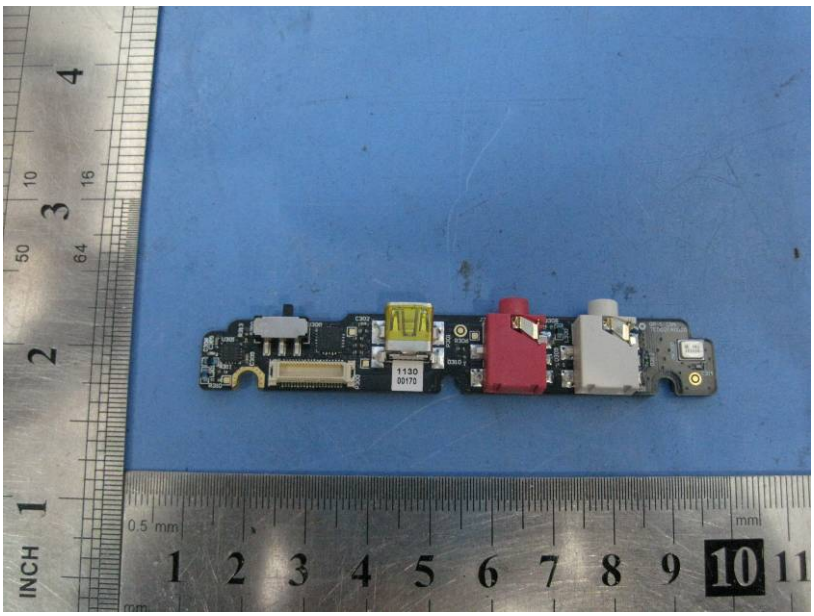
16.7 PCB 2 – Front View



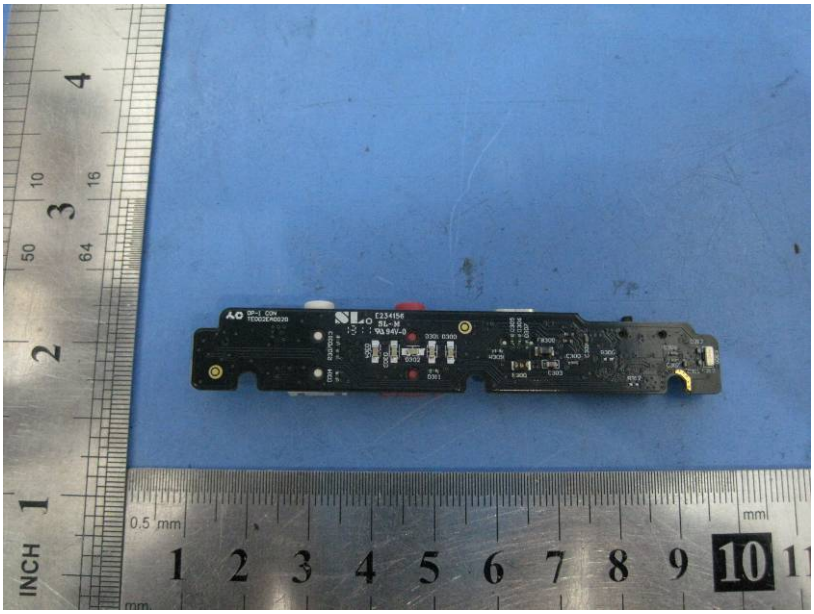
16.8 PCB 2 – Back View



16.9 PCB 3 – Front View



16.10 PCB 3 – Back View



17 FCC Label

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

The Label must not be a stick-on paper. The Label on these products must be permanently affixed to the product and readily visible at the time of purchase and must last the expected lifetime of the equipment not be readily detachable.

Proposed Label Location on EUT

EUT Back View/ proposed FCC Label Location