Report No.SH16030055W36

FCC RF TEST REPORT

Issued to

TRIMBLE EUROPE B.V.

For

Rugged Smart Phone

Model Name	:	TDC100_4G
Trade Name	:	Trimble
Brand Name	:	Trimble
Standard	:	47 CFR Part 15,Subpart C ANSI C63.10-2013 RSS 247 Issue 1 RSS GEN Issue 4
FCC ID	:	NZI-10900320
IC ID	:	9288A-10900320
Test date	:	Apr.7,2016 to Apr.8,2016
Issue date	:	Jul.12,2016

by

Shanghai Skylabs Co., Ltd.

Tested by Wu Hongfei ***Approved by*** Gu Yongjiang ***Review by*** Leonard Bao

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Change History

Issue	Date	Reason for change
1.0	Apr.9,2016	First edition
2.0	Jul.12,2016	Second edition

1. General Information

1.1 Applicant

TRIMBLE EUROPE B.V.
European Regional Fulfilment Centre
Meerheide, 45
5521DZ Eersel
THE NETHERLANDS

1.2 Manufacturer

TRIMBLE EUROPE B.V.
European Regional Fulfilment Centre
Meerheide, 45
5521DZ Eersel
THE NETHERLANDS

1.3 Description of EUT

EUT Name..... :	Rugged Smart Phone
Model Name..... :	TDC100_4G
Brand Name..... :	Trimble
Trade Name ..... :	Trimble
Hardware Version ..... :	TDC100.4G_V1.0
Software Version ..... :	TDC100.4G.16.22.08
Modulation Type ..... :	Bluetooth V4.0:1Mbps(GFSK), FHSS
Frequency Range..... :	2.402GHz - 2.480GHz (at interval of 2MHz)
Channel Number..... :	40
EUT Stage ..... :	Production Unit
Antenna Type..... :	ABS Frame and FPC antenna
Antenna Gain..... :	0.44 dBi

NOTE 1:
*The EUT is a Smart Phone. The EUT contains Bluetooth Module operating at 2.4GHz ISM band; the frequencies allocated for the Bluetooth Module is F(MHz)=2402+2*n (0<=n<=39). The lowest, middle, highest channel numbers of the Bluetooth Module used and tested in this report are separately 0 (2402MHz), 19 (2440MHz) and 39 (2480MHz).*
NOTE 2:
For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacture.

2. Facilities and Accreditations

2.1 Test Facility

Shanghai Skylabs Co., Ltd. Skylabs is a third party testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L6644. A 9*6*6(m) full/semi-anechoic chamber was used for the radiated emissions test.

2.2 Environmental Conditions

Ambient temperature: 15~35°C
Relative humidity: 30~60%
Atmosphere pressure: 86-106kPa

2.3 Measurement Uncertainty

The uncertainty is calculated using the methods suggested in the "Guide to the Expression of Uncertainty in Measurement" (GUM) published by ISO.
Uncertainty of Conducted Emission: ±1.76dB
Uncertainty of Radiated Emission:±3.16dB

2.4 List of Equipments Used

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Service Simulator	Anritsu	MT8852A	6K00002788	2015.9.22	1year
Spectrum Analyzer	R&S	FSU26	200880	2016.2.25	1year
Power Splitter	Weinschel	1506A	NW521	(n.a.)	(n.a.)
Power Splitter	Mini-Circuits	ZFRSC-183-S+	765001016	(n.a.)	(n.a.)
Attenuator 1	Resnet	10dB	(n.a.)	(n.a.)	(n.a.)
Attenuator 2	Resnet	3dB	(n.a.)	(n.a.)	(n.a.)
Full/Semi-Anechoic Chamber	CHENGYU	9.2×6.25×6.15m	SAR	2015.9.14	3year
EMI Test Receiver	R&S	ESCI7	100787	2016.2.55	1year
Antenna	R&S	HL562	100385	2015.6.17	1year
Antenna	R&S	HF906	100565	2015.6.17	1year
LISN	TESEQ	NNB 51	33285	2016.2.25	1year
Personal Computer	HP	(n.a.)	(n.a.)	(n.a.)	(n.a.)
Test Antenna-Horn	Schwarzbeck	BBHA9170	BBHA91970171	2015.9.22	1year
Test Antenna-Horn	Schwarzbeck	BBHA 9120D	9120D-1033	2015.7.25	1year
Test Antenna-Log	Schwarzbeck	VULB 9163	9163-561	2015.9.25	1year
Test Antenna-Loop	Rohde&Schwarz	HFH2-Z2	860004/001	2015.9.22	1year
Temporary Antenna Connector	Farpu	SMA-K	(n.a.)	(n.a.)	(n.a.)
RF Cable	(n.a.)	(n.a.)	(n.a.)	(n.a.)	(n.a.)

NOTE:
Equipments listed above have been calibrated and are in the period of validation.

3. Test Standards and Results

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

FCC Part 15 Subpart C §15.247
ANSI C63.10-2013
June 2015 KDB558074
INDUSTRY CANADA RSS 247 Issue 1
INDUSTRY CANADA RSS GEN Issue 4

NOTE:
(1)All test items were verified and recorded according to the standards and without any deviation during the test.
(2)This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart C (Bluetooth,2.4GHz ISM band radiators),recorded in a separate test report.

Test items and the results are as bellow:

No.	FCC Rules	IC Rules	Description	Result
1	15.203	RSS-GEN 7.1.2	Antenna Requirement	Pass
2	15.247(b)	RSS-247 5.4(4)	Peak Output power	Pass
3	15.247(b)	RSS-247 5.4(4)	Average Power	Pass
4	15.247(a)	RSS-247 5.2(1)	6dB & 20dB Bandwidth	Pass
5	15.247(d)	RSS-247 5.5 RSS-GEN 8.10	Conducted Spurious Emission and Band Edge	Pass
6	15.247(d)	RSS-247 5.5 RSS-GEN 8.10	Restricted Frequency Bands	Pass
7	15.207	RSS-GEN 8.8	Conducted Emission	Pass
8	15.247(d) 15.209	RSS-247 5.5 RSS-GEN 8.9	Radiated Emission	Pass
9	15.247(e)	RSS-247 5.2(2)	Power Spectral Density (PSD)	Pass

4. 47 CFR Part 15C

4.1 Antenna requirement

4.1.1 Applicable standard

According to FCC 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by 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.

4.1.2 Result: Compliant

The EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.

5. Test Result

5.1 Peak Output Power

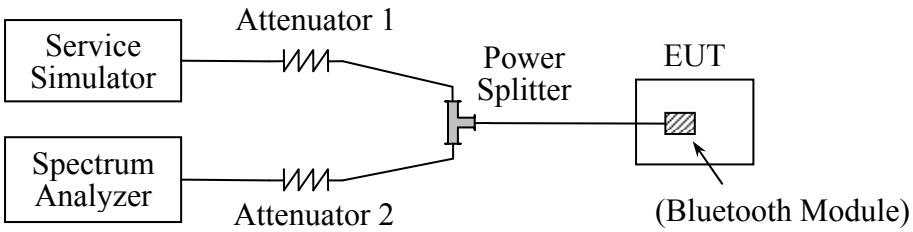
5.1.1 Requirement

According to FCC section 15.247(b)(3), For systems using digital modulation in the 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz bands: The maximum peak conducted output power of the intentional radiator shall not exceed 1 Watt.

5.1.2 Test Description

The measured output power was calculated by the reading of the spectrum analyzer and calibration.

A. Test Setup:



The Bluetooth Module of the EUT, which is powered by the Battery, is coupled to the Spectrum Analyzer (SA) and the Bluetooth Service Simulator (SS) withAttenuators through the Power Splitter; the RF load attached to the EUT antenna terminal is 50Ohm;the path loss as the factoris calibrated to correct the reading.During the measurement, the Bluetooth Module of the EUT is activated and controlled by theSS, and is set to operate under test mode transmitting at maximum power.

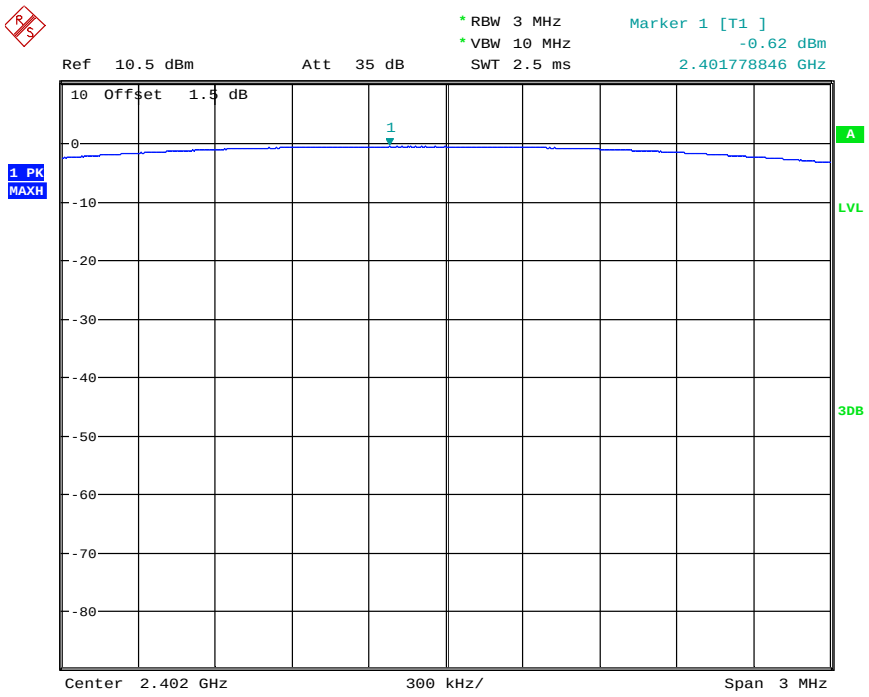
5.1.3 Test Result

The lowest, middle and highest channels are selected to perform testing to verify the conducted RF output peak power of the Module.(Duty cycle > 98%)

A. Test Verdict:

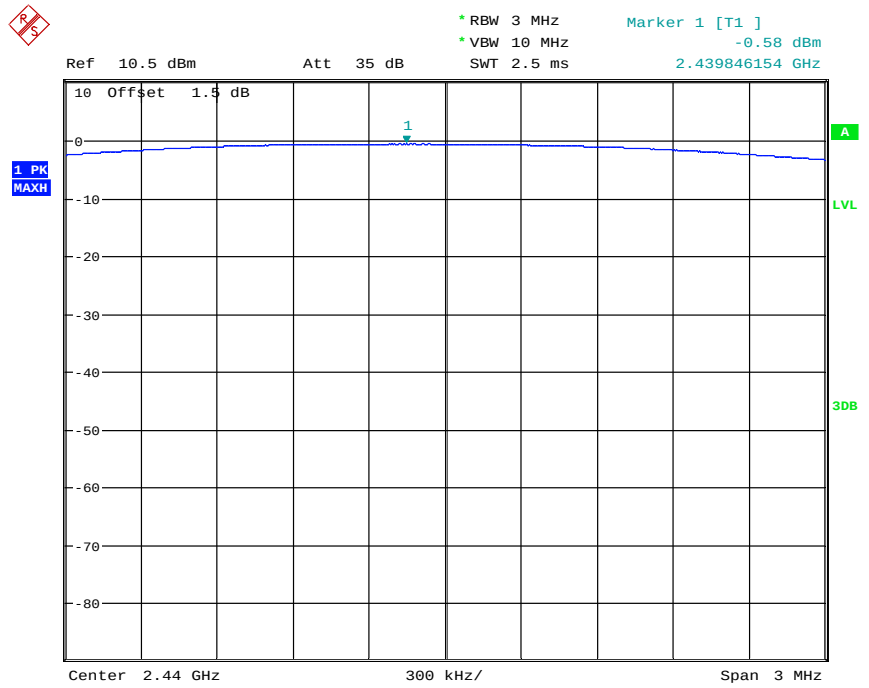
Channel	Frequency (MHz)	Measured Output Peak Power		Refer to plot	Limit		Verdict
		dBm	W		dBm	W	
0	2402	-0.62	0.00087	Plot A	30	1	Pass
19	2440	-0.58	0.00087	Plot B			Pass
39	2480	-3.55	0.00044	Plot C			Pass

B. Test Plots:



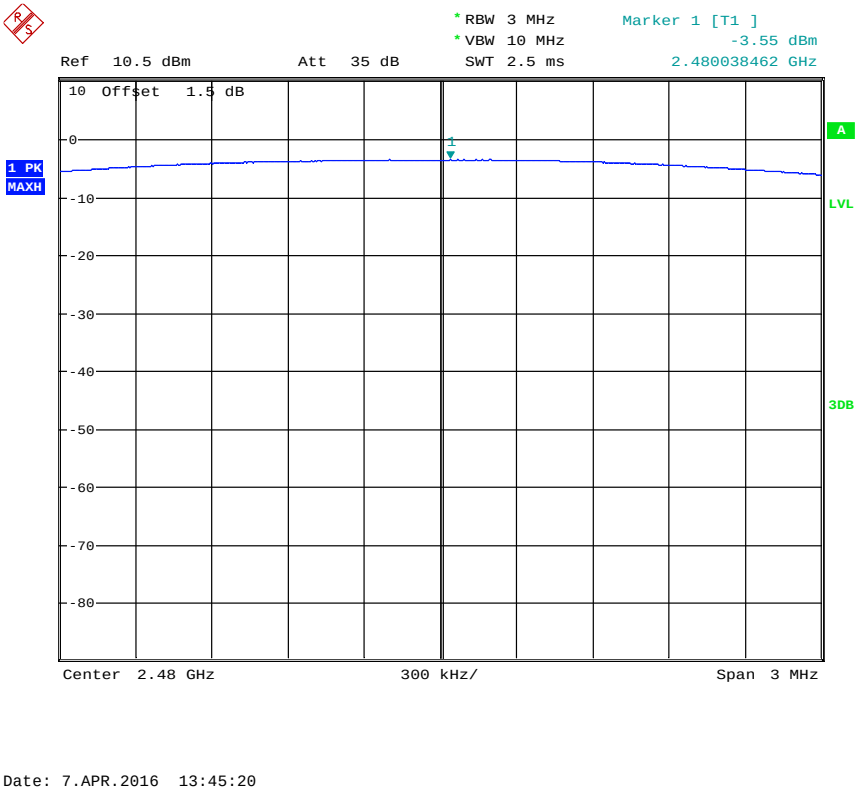
Date: 7.APR.2016 13:44:11

(Plot A: Channel 0:2402MHz)



Date: 7.APR.2016 13:44:43

(Plot B:Channel 19: 2440MHz)



(Plot C: Channel 39:2480MHz)

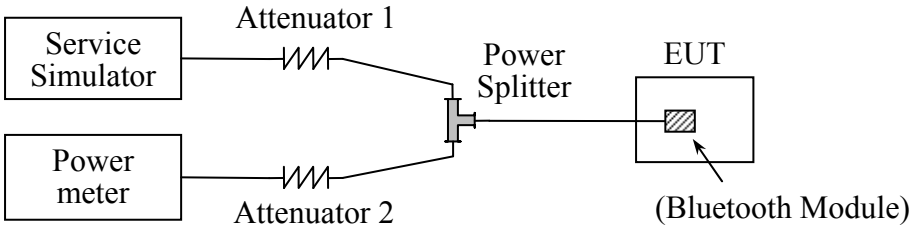
5.2 Average Power

5.2.1 Requirement

None; for reporting purposes only.

5.2.2 Test Description

The transmitter output was split to 2 ways, the one was connected to Service Simulator as monitor, the other one was connected to Power Meter. (Duty cycle > 98%)



5.2.3 Results

Channel	Frequency (MHz)	Measured Output Peak Power	
		dBm	W
0	2402	-0.74	0.00084
19	2440	-0.71	0.00085
39	2480	-3.72	0.00042

5.3 6dB & 20dB Bandwidth

5.3.1 Requirement

According to FCC section 15.247(a) (2), Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

5.3.2 Test Description

See section 5.1.2 of this report.

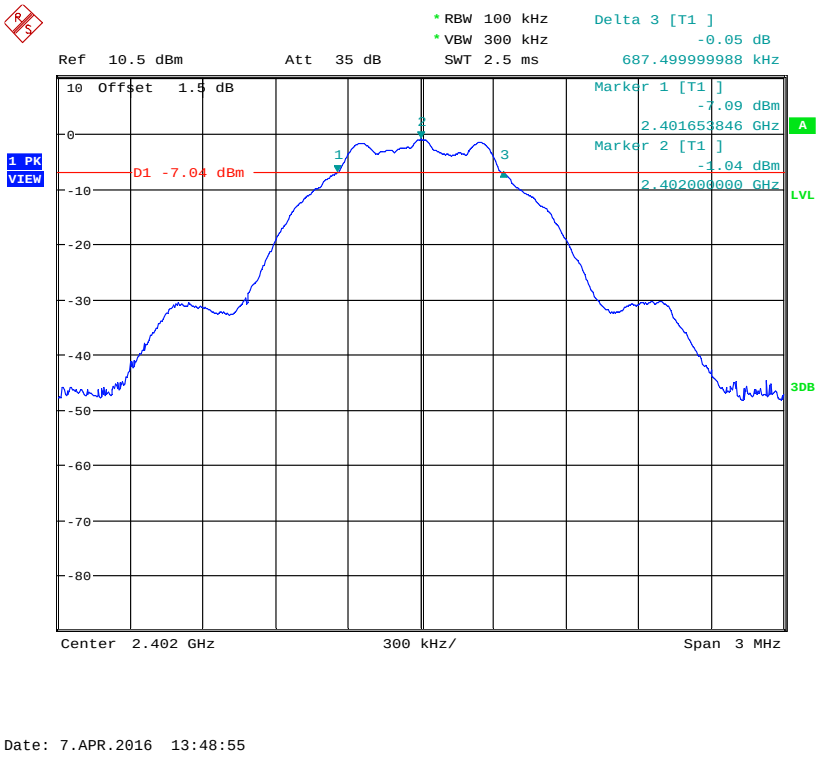
5.3.3 Test Result

The lowest, middle and highest channels are selected to perform testing to record the 6 dB bandwidth of the Module.

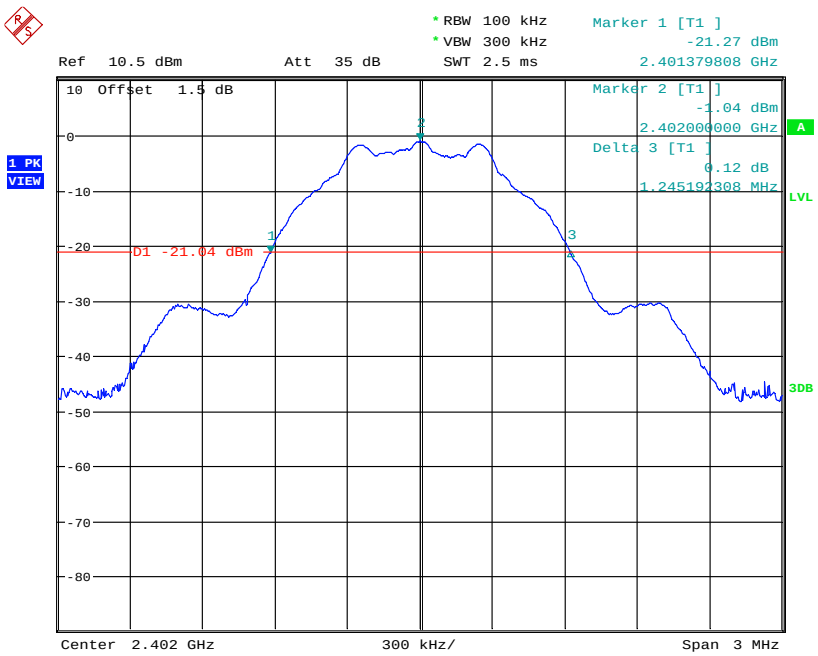
A. Test Verdict:

Channel	Frequency (MHz)	6dB Bandwidth (KHz)	Refer to plot	20dB Bandwidth (MHz)	Refer to plot	Limit (KHz)	Result
0	2402	687.499	Plot A1	1.245	Plot A2	⩾500	Pass
19	2440	701.923	Plot B1	1.240	Plot B2	⩾500	Pass
39	2480	667.884	Plot C1	1.153	Plot C2	⩾500	Pass

B. Test Plots:

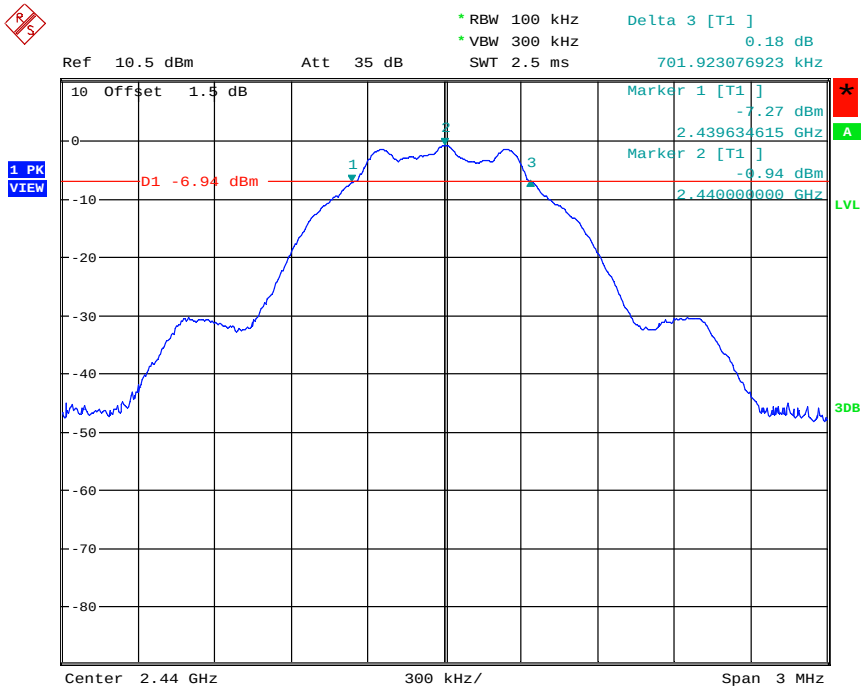


(Plot A1:Channel 0:2402MHz)



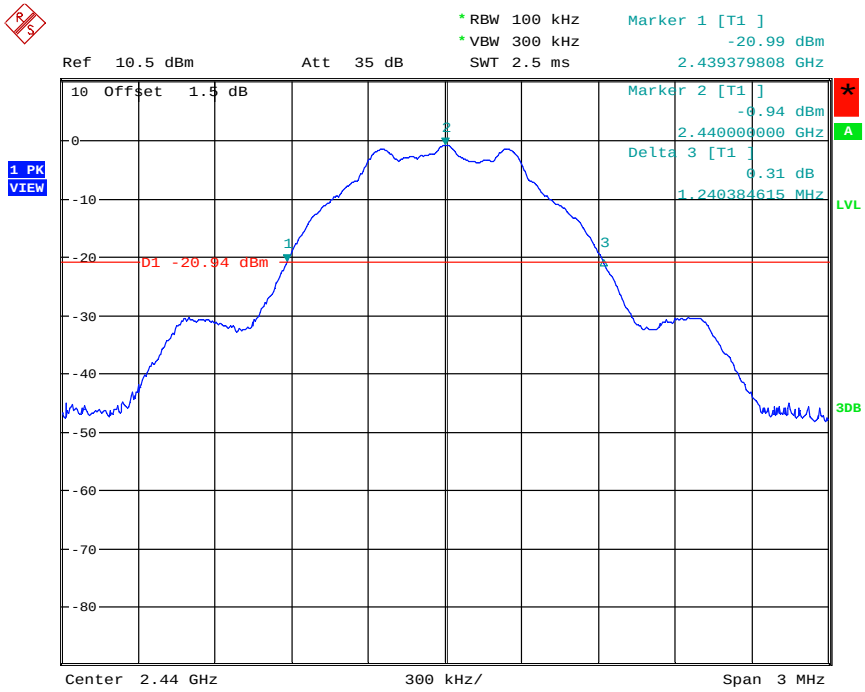
Date: 7.APR.2016 13:49:46

(Plot A2:Channel 0:2402MHz)



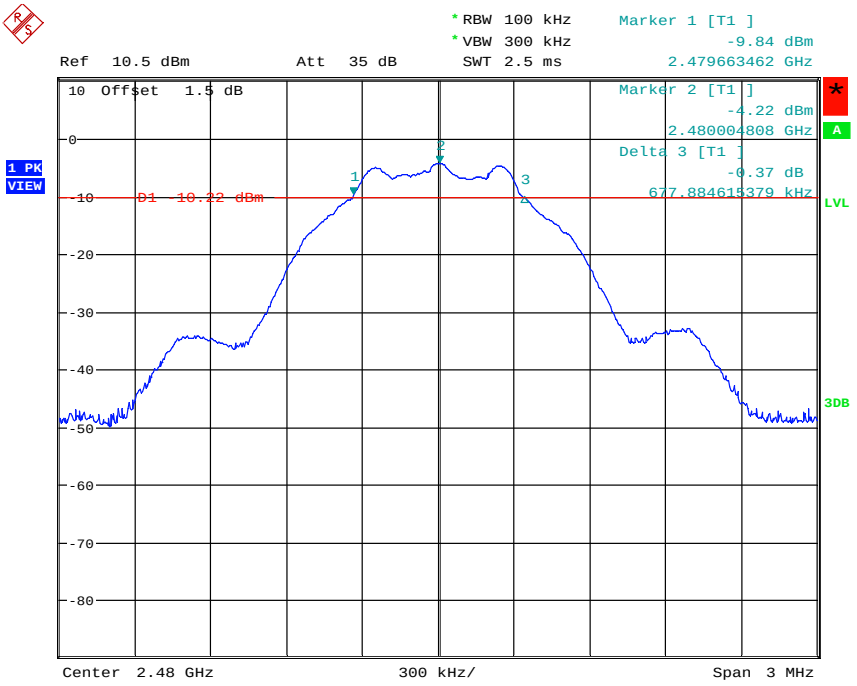
Date: 7.APR.2016 13:50:53

(Plot B1:Channel 19:2440MHz)



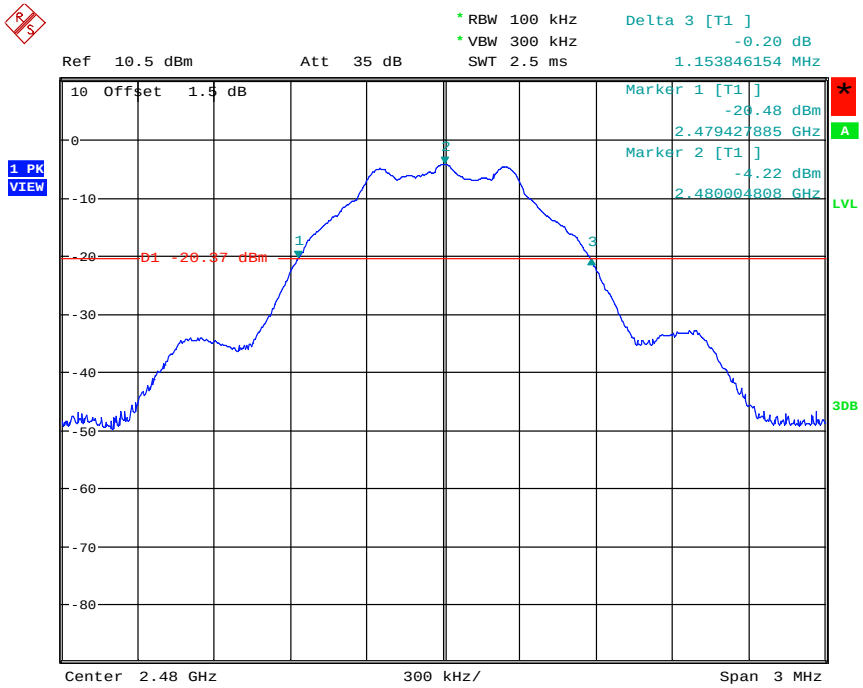
Date: 7.APR.2016 13:51:31

(Plot B2:Channel 19:2440MHz)



Date: 7.APR.2016 13:52:44

(Plot C1:Channel 39:2480MHz)



Date: 7.APR.2016 13:53:21

(Plot C2:Channel 39:2480MHz)

5.4 Conducted Spurious Emissions and Band Edge

5.4.1 Requirement

According to FCC section 15.247(d), in any 100kHz 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

5.4.2 Test Description

See section 5.1.2 of this report.

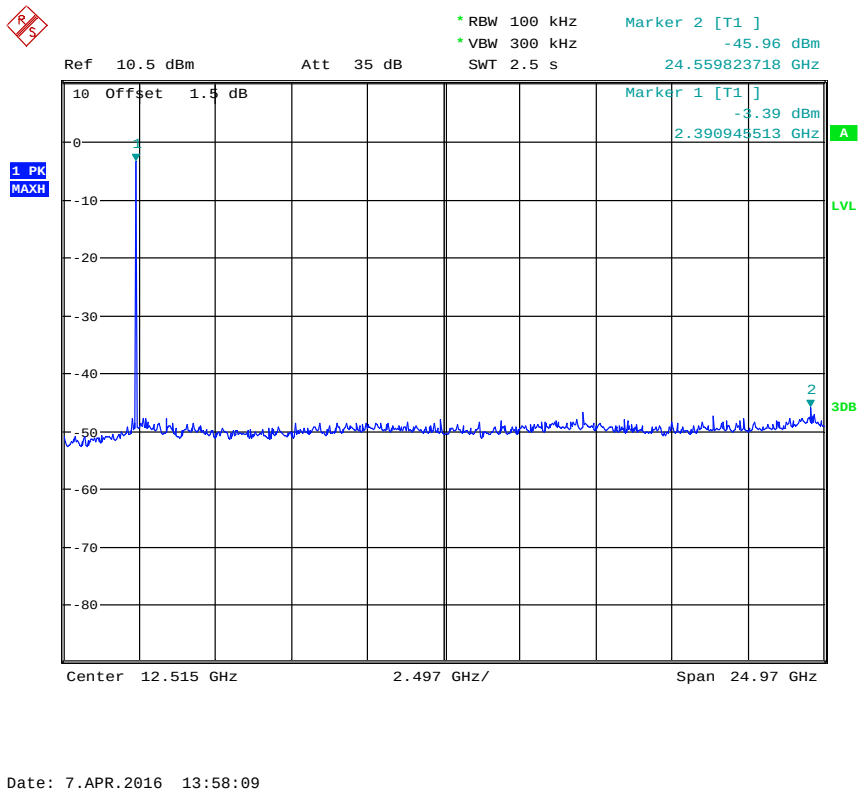
5.4.3 Test Result

The Bluetooth Module operates at hopping-off test mode. The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions.

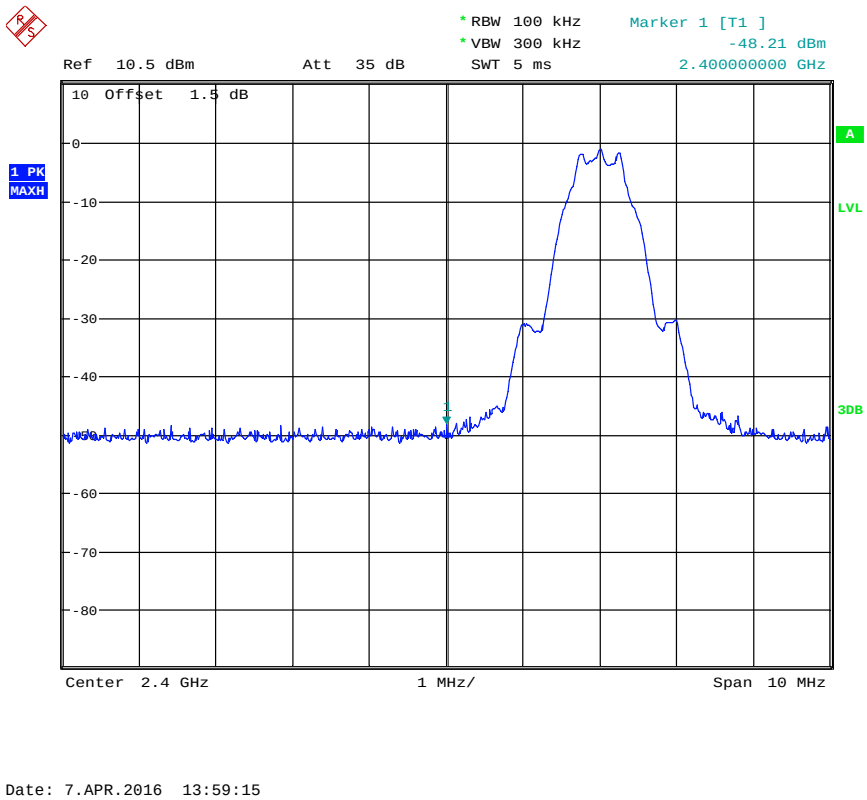
A. Test Verict:

Channel	Frequency (MHz)	Measured max out of band emission(dBm)	Refer to plot	Limit(dBm)		Result
				Carrier level	Calculated 20dBc limit	
0	2402	-45.96	Plot A1/A2	-3.39	-23.39	Pass
19	2440	-46.30	Plot B	-1.29	-21.29	Pass
39	2480	-47.75	Plot C1/C2	-5.46	-25.46	Pass

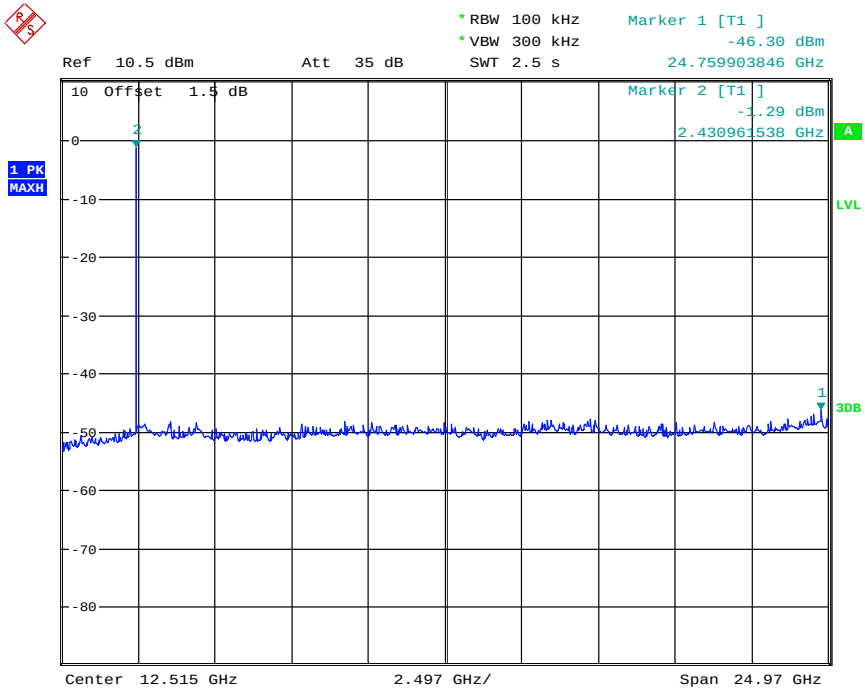
B. Test Plot:



(Plot A1:Channel0:2402MHz 30MHz~25GHz)

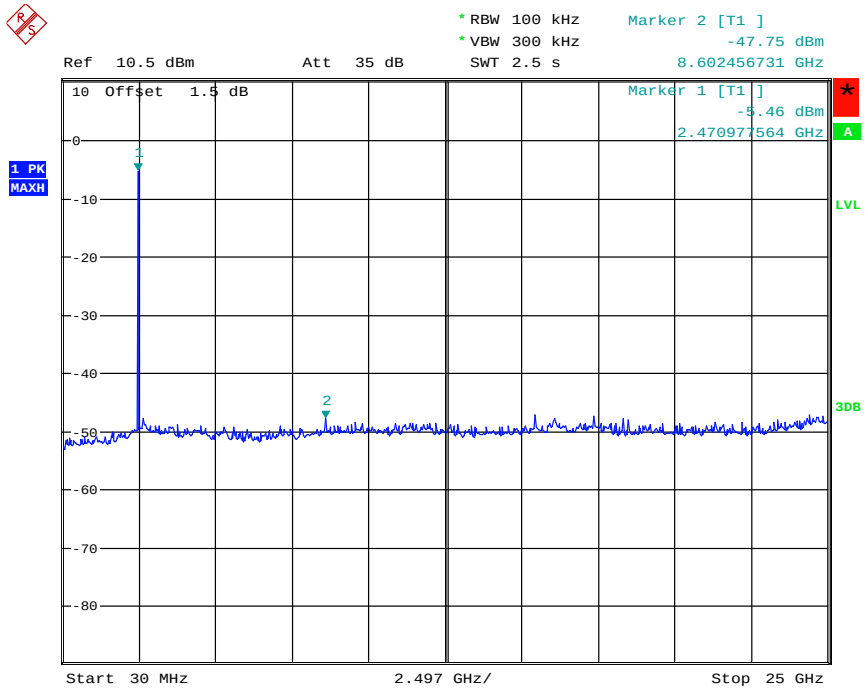


(Plot A2: Channel 0: 2402MHz Band Edge)



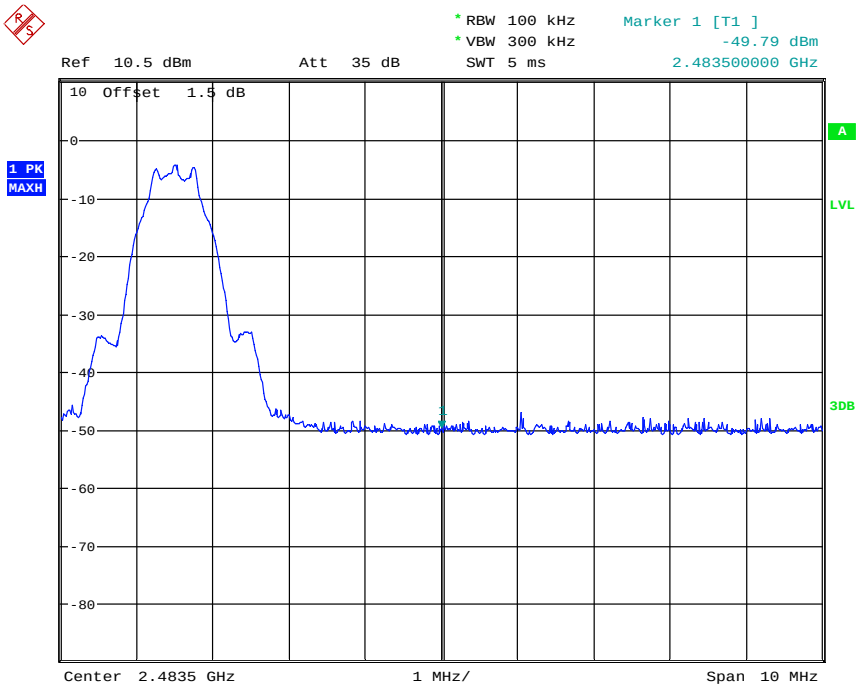
Date: 7.APR.2016 13:56:56

(Plot B: Channel 19:2440MHz 30MHz~25GHz)



Date: 7.APR.2016 13:55:54

(PlotC1:Channel39:2480MHz 30MHz~25GHz)



Date: 7.APR.2016 14:00:03

(PlotC2:Channel 39:2480MHz Band Edge)

5.5 Power Spectral Density(PSD)

5.5.1 Requirement

According to FCC section 15.247(e), the same method of determining the conducted output power shall be used to determine the power spectral density. If a peak output power is measured, then a peak power spectral density measurement is required. If an average output power is measured, then an average power spectral density measurement should be used

5.5.2 Test Description

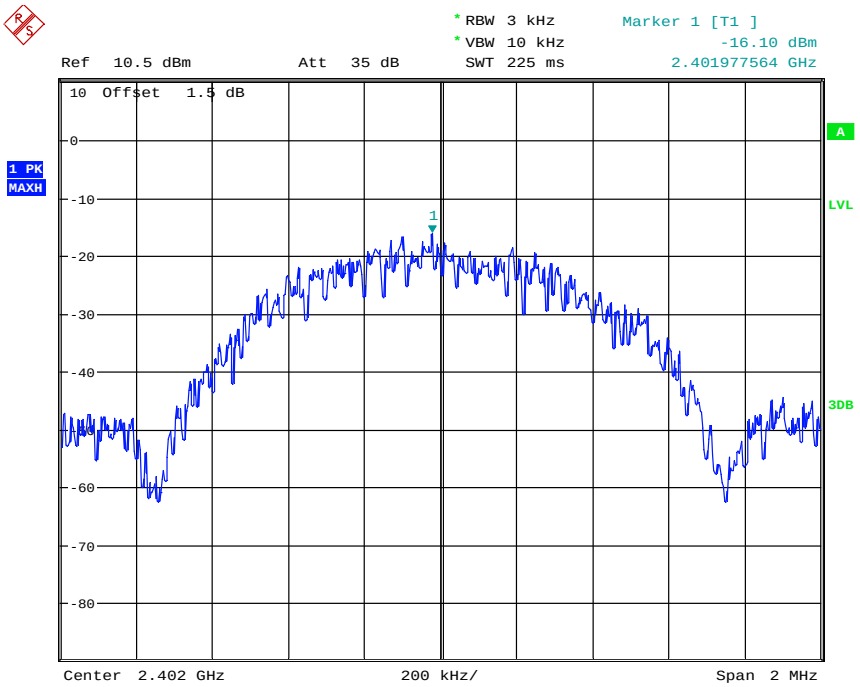
See section 5.1.2 of this report.

5.5.3 Test Result

A. Test Verdict

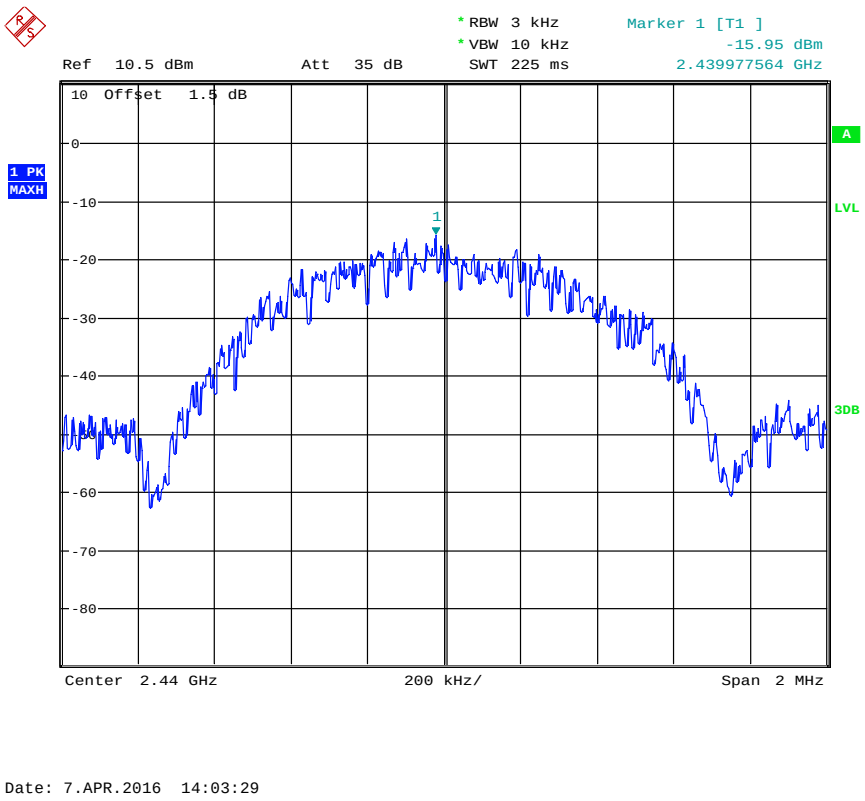
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Refer to plot	Limit (dBm/3kHz)	Result
0	2402	-16.10	Plot A	8	Pass
19	2440	-15.95	Plot B	8	Pass
39	2480	-19.18	Plot C	8	Pass

B. Test Plot

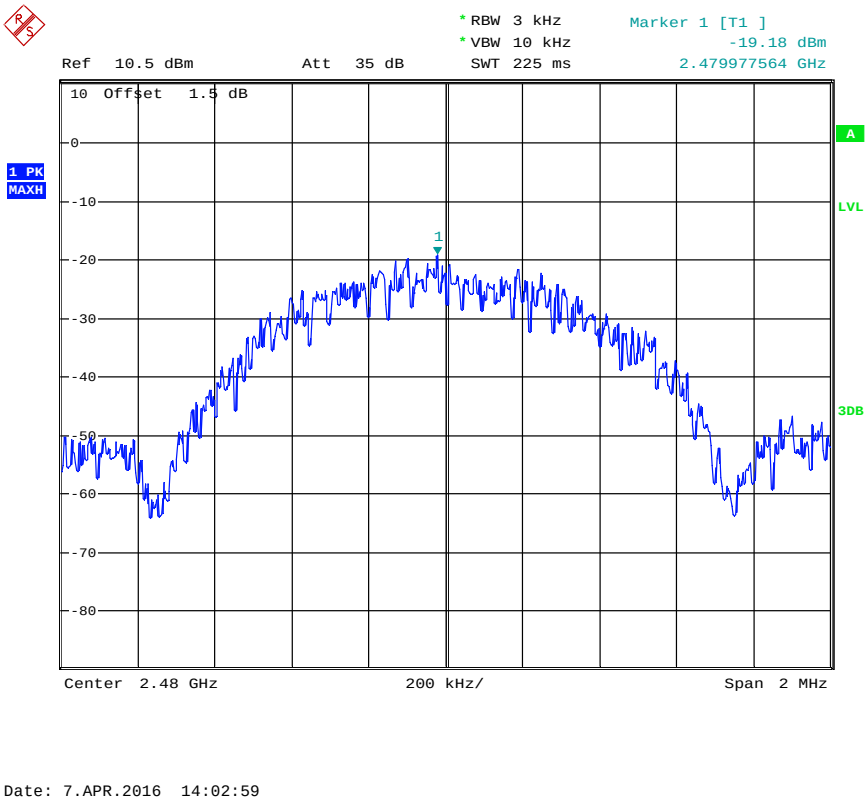


Date: 7.APR.2016 14:03:56

(Plot A: Channel = 0, 2402MHz)



(Plot B: Channel = 19, 2440MHz)



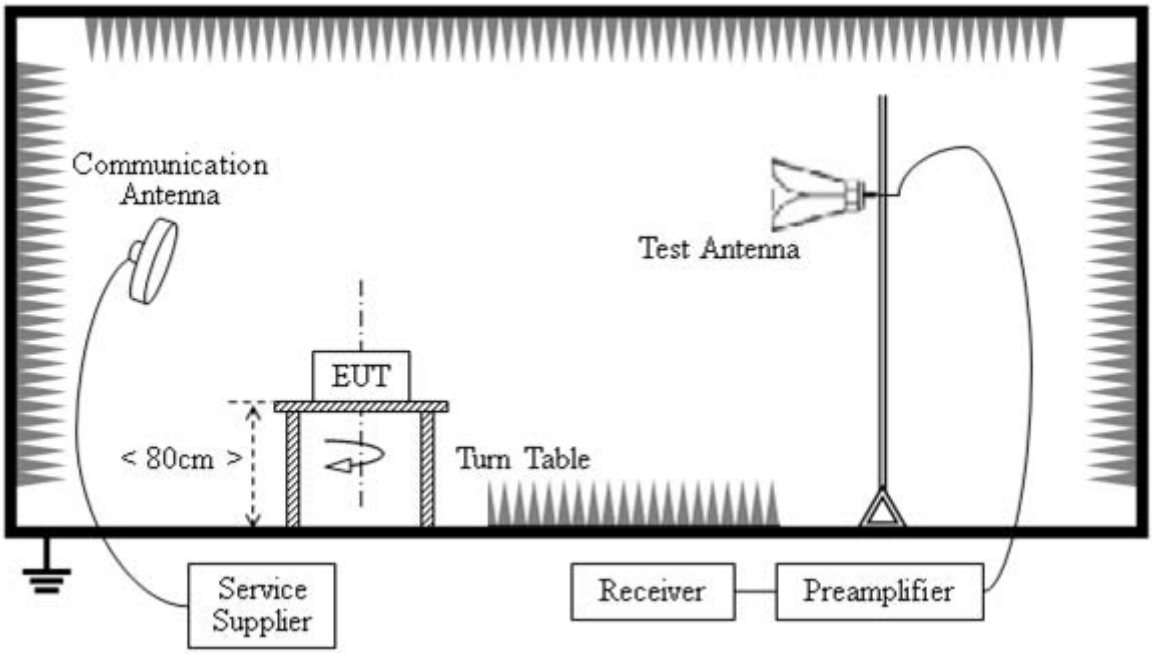
(Plot C: Channel = 39, 2480MHz)

5.6 Restricted Frequency Bands

5.6.1 Requirement

According to FCC section 15.247(d), in any 100kHz 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, , In addition, radiated emissions which fall in the restricted bands, as defined in 15.205(a), must also comply with the radiated emission limits specified in 15.209(a).

5.6.2 Test Description



The Module is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of the site as factors are calculated to correct the reading.

For the Test Antenna:

Test Antenna is 3m away from the EUT. Test Antenna height is varied from 1m to 4m above the ground to determine the maximum value of the field strength.

5.6.3 Test Result

The lowest and highest channels are tested to verify the Restricted Frequency Bands.

The measurement results are obtained as below:

E [dBV/m] =UR + AT + AFactor [dB]; AT =LCable loss [dB]-Gpreamp [dB]

AT: Total correction Factor except Antenna

UR: Receiver Reading

Gpreamp: Preamplifier Gain

AFactor: Antenna Factor at 3m

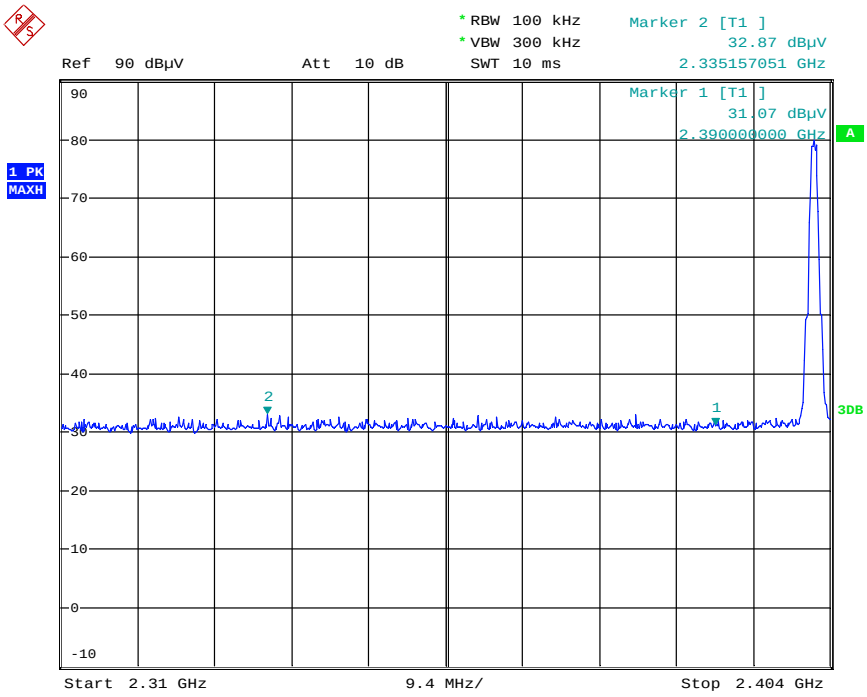
Note: Restricted Frequency Bands were performed when antenna was at vertical and horizontal polarity, and only the worse test condition (vertical) was recorded in this test report.

The lowest and highest channels are tested to verify the Restricted Frequency Bands

A. Test Verdict

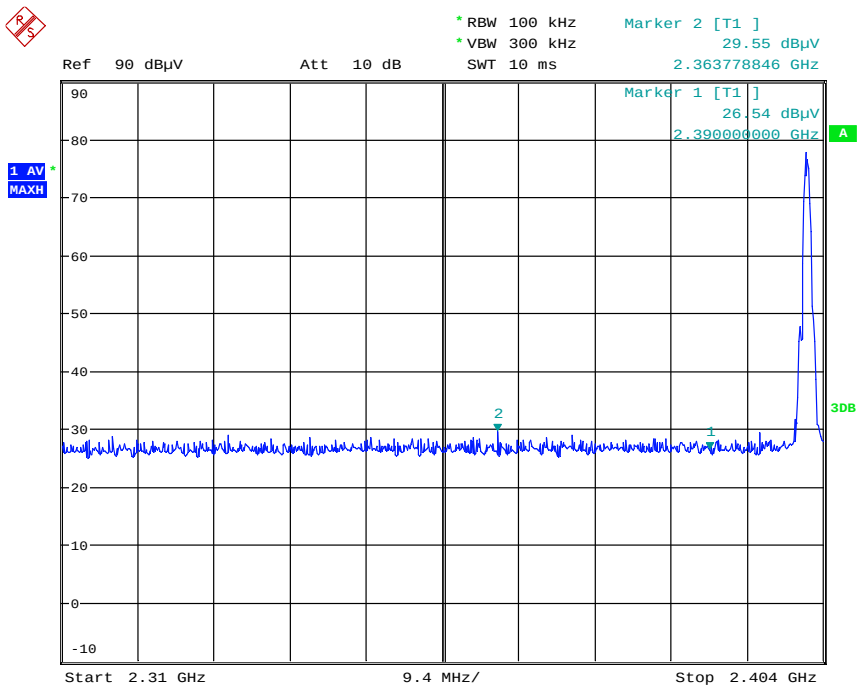
Ch	Frequency (MHz)	Detector PK/AV	Receiver Reading UR (dBuV/m)	AT (dB)	Afactor (dB@3m)	Max. Emission (dBuV/m)	Limit (dBuV/m)	Result
0	2335.15	PK	32.87	-32.2	32.56	33.23	74	Pass
0	2363.77	AV	29.55	-32.2	32.56	29.91	54	Pass
39	2485.05	PK	31.86	-30.7	32.50	33.66	74	Pass
39	2492.56	AV	29.45	-30.7	32.50	31.25	54	Pass

B. Test Plot



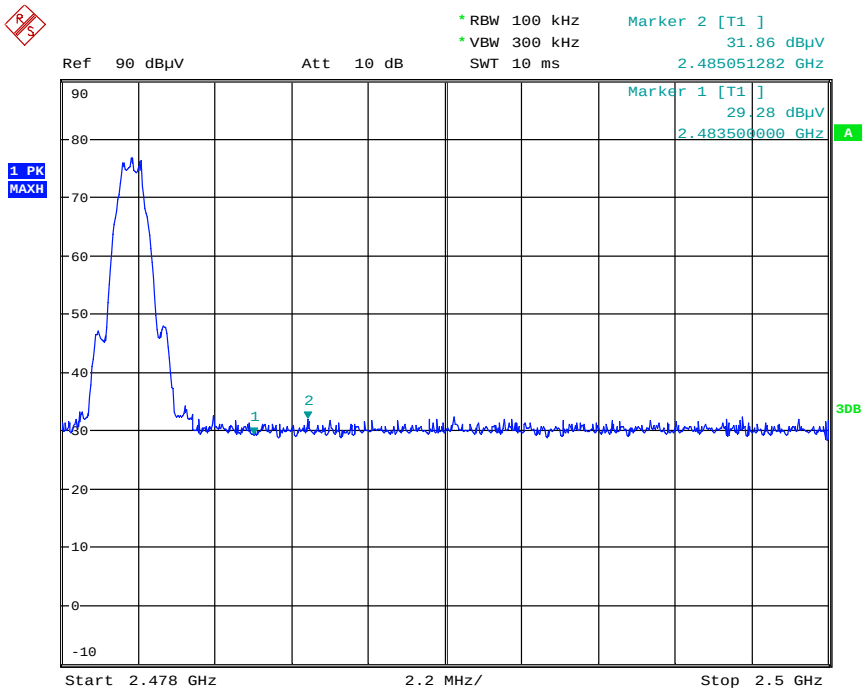
Date: 7.APR.2016 14:32:07

(Channel = 0 PK)



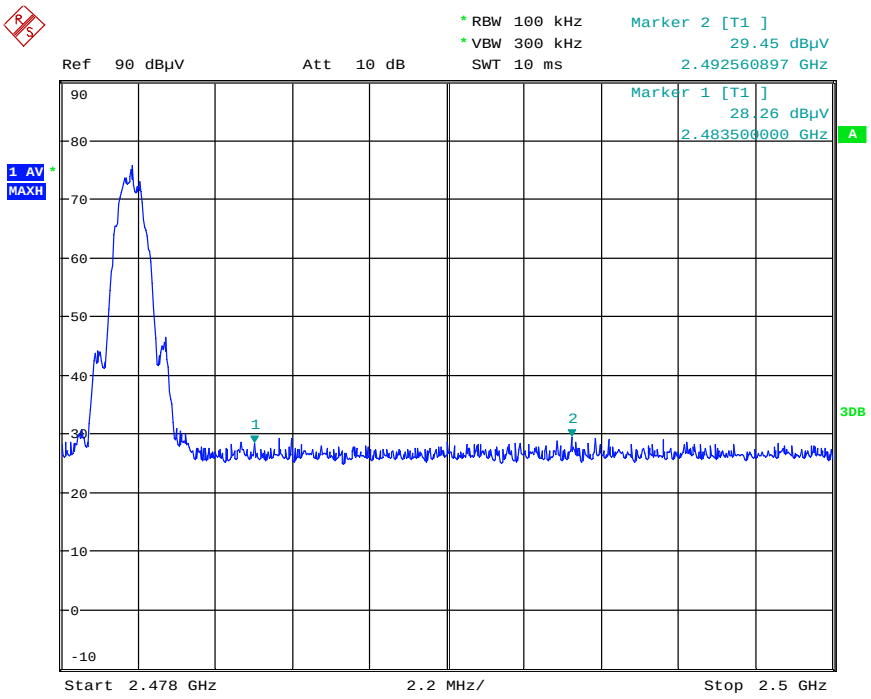
Date: 7.APR.2016 14:32:40

(Channel = 0 AV)



Date: 7.APR.2016 14:35:07

(Channel = 39 PK)



Date: 7.APR.2016 14:34:11

(Channel = 39 AV)

5.7 Conducted Emission

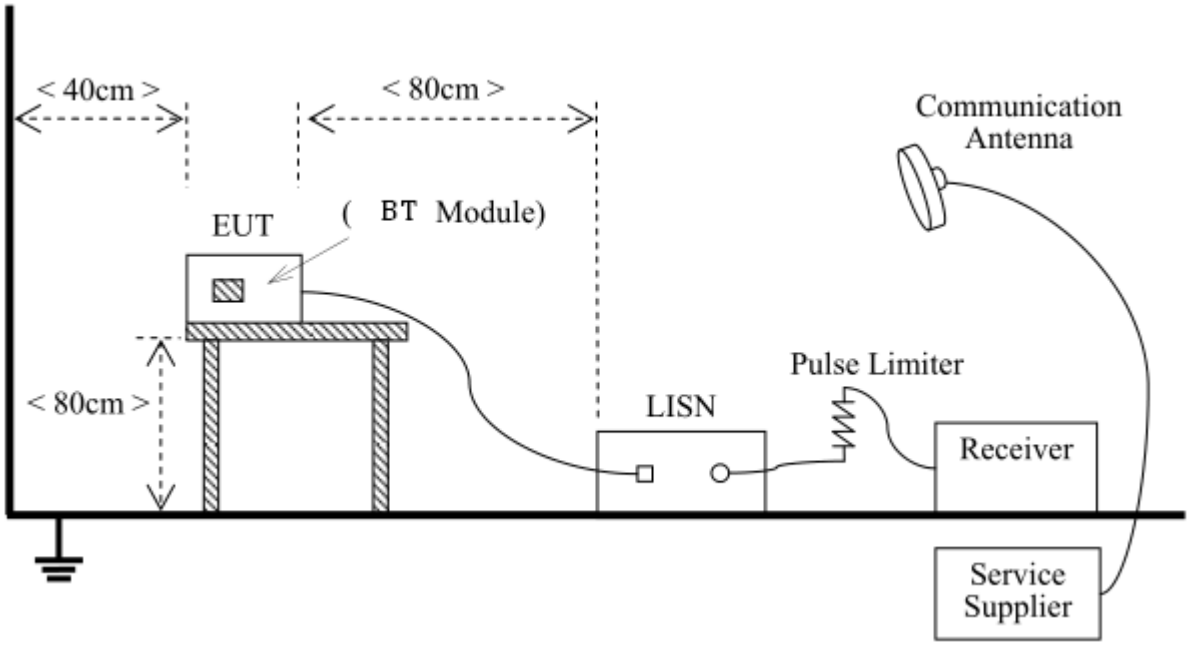
5.7.1 Requirement

According to FCC section 15.207, for an intentional radiator 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 within the band 150kHz to 30MHz shall not exceed the limits in the following table, as measured using a 50μH/50Ω line impedance stabilization network(LISN).

Frequency range (MHz)	Conducted Limit (dBμV)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
5 - 30	60	50

NOTE:
(a) The lower limit shall apply at the band edges.
(b) The limit decreases linearly with the logarithm of the frequency in the range 0.15 - 0.50MHz.

5.7.2 Test Description

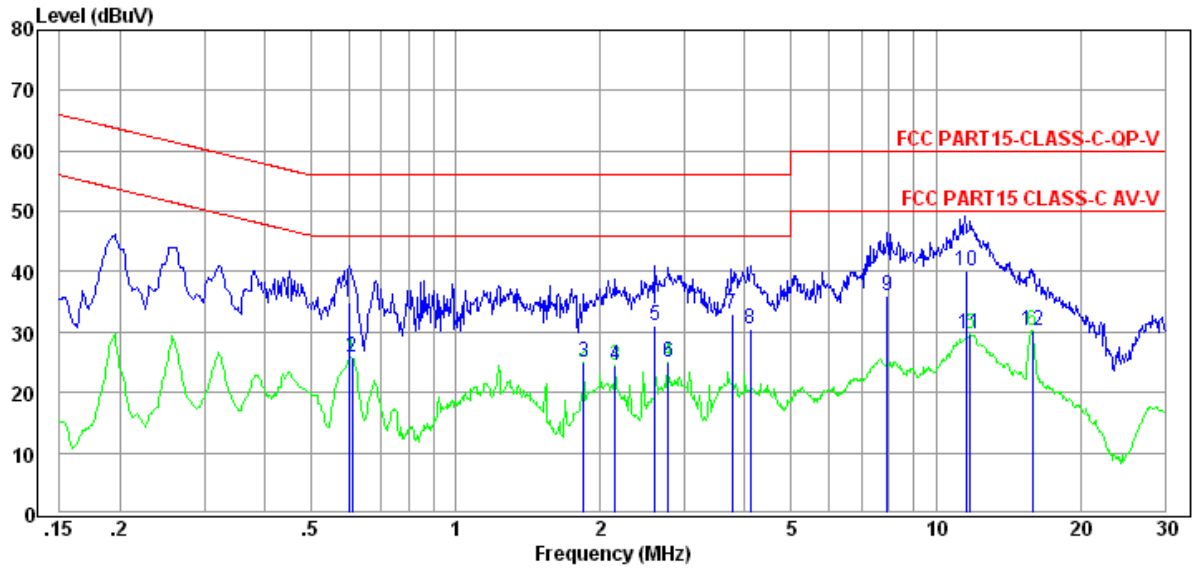


The Table-top EUT was placed upon a non-metallic table 0.8m above the horizontal metal reference ground plane. EUT was connected to LISN and LISN was connected to reference Ground Plane. EUT was 80cm from LISN. The set-up and test methods were according to ANSI C63.10-2013

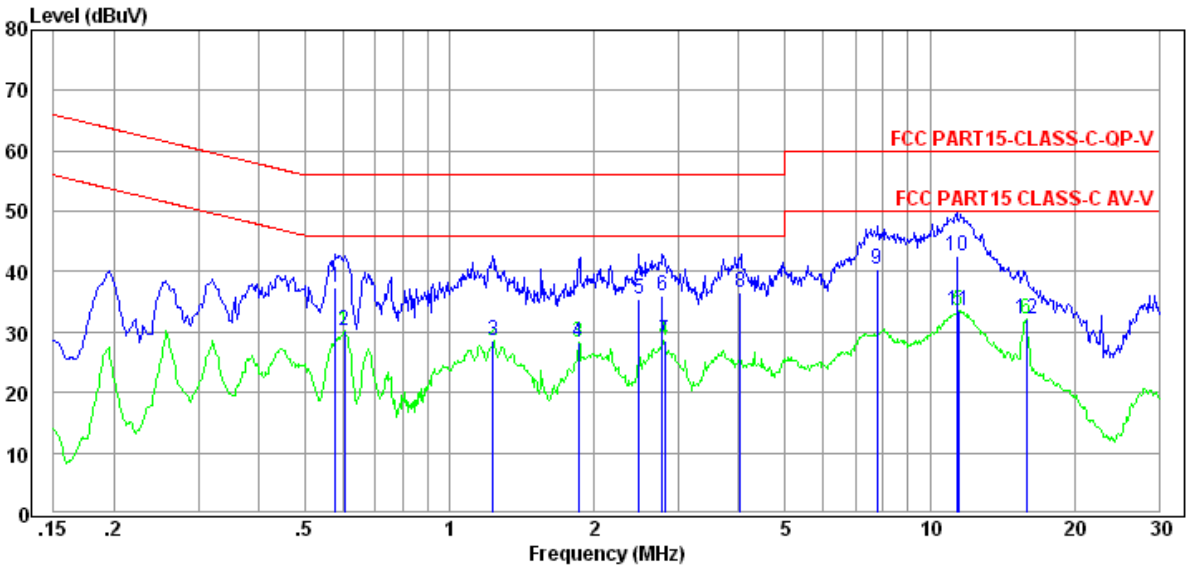
5.7.3 Test result

Frequency (MHz)	Level (dBuV)	Limit Line (dBuV)	Margin (dB)	Phase line	Detector
0.60	34.84	56.00	21.16	L	QP
0.61	25.83	56.00	30.17	L	Average
1.85	24.93	56.00	31.07	L	Average
2.15	24.47	56.00	31.53	L	Average
2.61	31.06	56.00	24.94	L	QP
2.77	25.10	56.00	30.90	L	Average
3.76	32.89	56.00	23.11	L	QP
4.12	30.46	56.00	25.54	L	QP
7.92	36.03	60.00	23.97	L	QP
11.54	40.23	60.00	19.77	L	QP
0.58	37.34	56.00	18.66	N	QP
0.61	30.12	46.00	15.88	N	Average
1.23	28.53	46.00	17.47	N	Average
1.86	28.24	46.00	17.76	N	Average
2.49	35.50	56.00	20.50	N	QP
2.78	36.05	56.00	19.95	N	QP
2.81	28.65	46.00	17.35	N	Average
4.04	36.56	56.00	19.44	N	QP
7.77	40.28	60.00	19.72	N	QP
11.42	42.55	60.00	17.45	N	QP
11.45	33.54	50.00	16.46	N	Average
15.92	32.28	50.00	17.72	N	Average

5.7.4 Test Plot



L Line


Level (dBuV)
80
70
60
50
40
30
20
10
0
.15
.2
.5
1
2
5
10
20
30
Frequency (MHz)
FCC PART15-CLASS-C-QP-V
FCC PART15 CLASS-C AV-V
1
2
3
4
5
6
7
8
9
10
11
12

N Line

5.8 Radiated Emission

5.8.1 Requirement

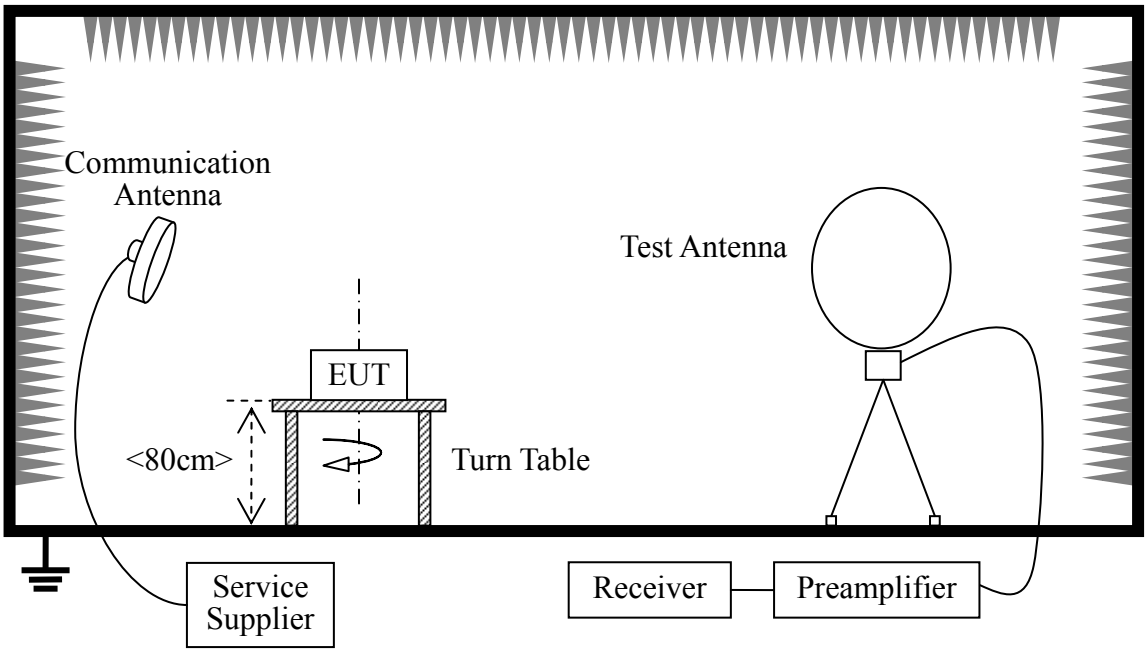
According to FCC section 15.247(c), radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table

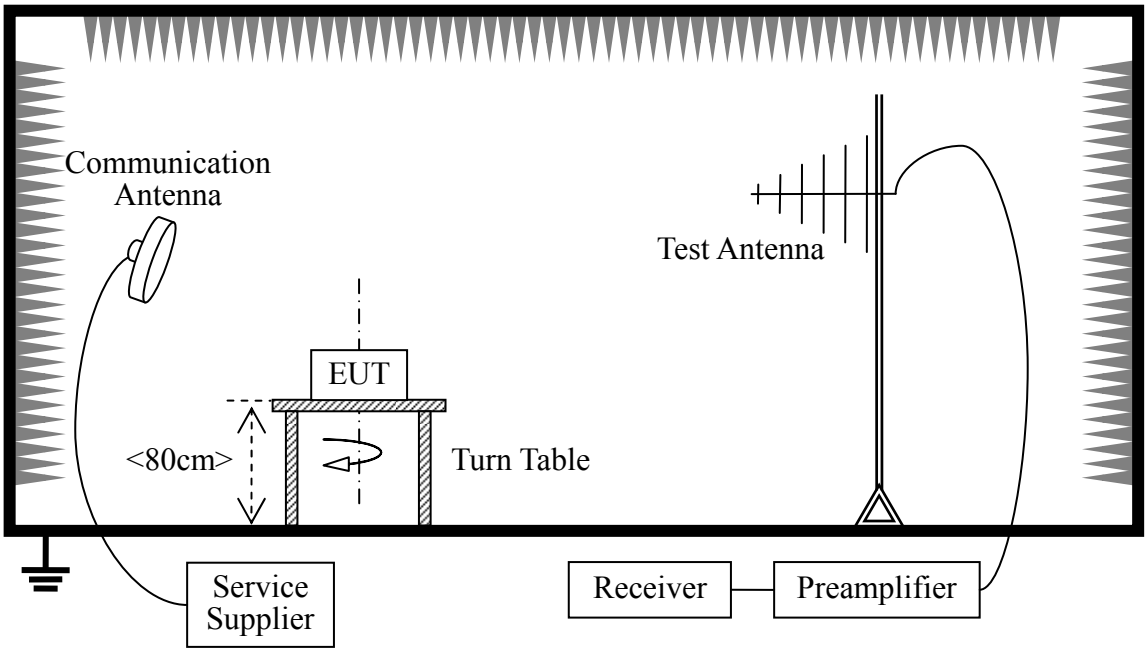
Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)	Limit(dBμV/m)	Detector
0.009-0.490	2400/F(kHz)	300	/	/
0.490-1.705	24000/F(kHz)	30	/	/
1.705-30	30	30	/	/
30 - 88	100	3	40	QP
88 - 216	150	3	43.5	QP
216 - 960	200	3	46	QP
960 - 1000	500	3	54	QP
Above 1000	500	3	54	AV

In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), also should comply with the radiated emission limits specified in Section 15.209(a)(above table)

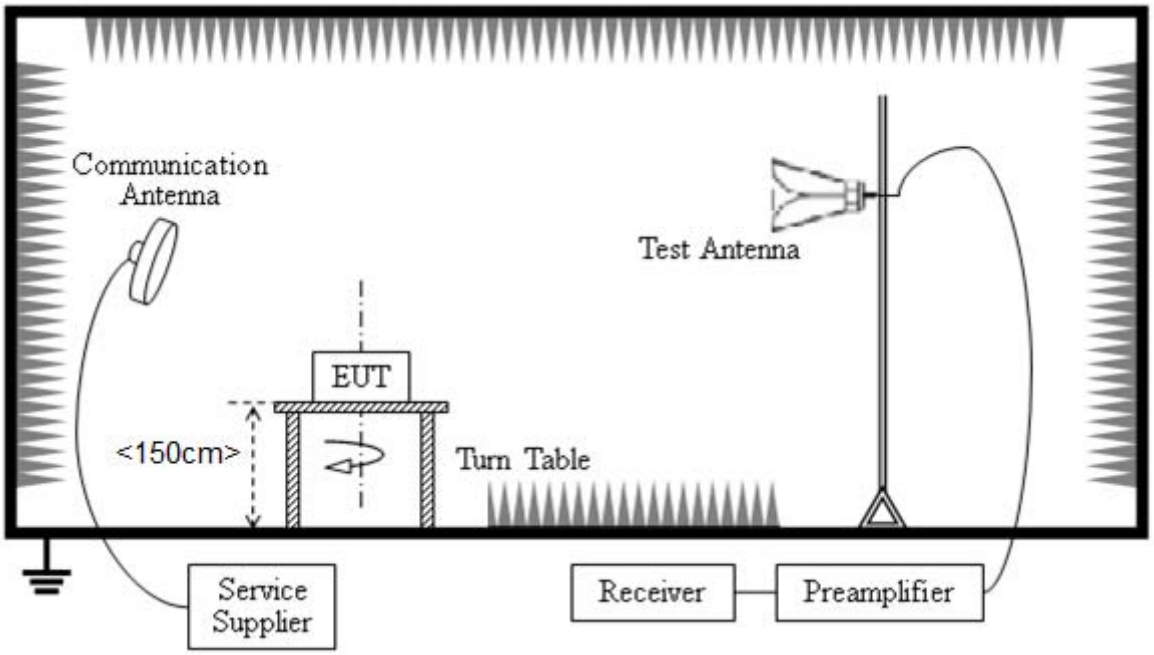
5.8.2 Test setup



Radiated Emissions Below 30MHz



Radiated Emissions 30-1000MHz



Radiated Emissions above 1000MHz

The test site semi-anechoic chamber has met the requirement of NSA tolerance 4dB according to the standards: ANSI C63.10-2013. Below 1GHz, the EUT was set-up on insulator 80cm above the Ground Plane. Above 1GHz, the EUT was set-up on insulator 150cm above the Ground Plane. The set-up and test methods were according to ANSI C63.10

The Module is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of the site as factors are calculated to correct the reading. During the measurement, the Bluetooth Module is activated and controlled by the Bluetooth Service Supplier (SS) via a Common Antenna, and is set to

operate under hopping-on test mode transmitting at maximum power.

For the Test Antenna: In the frequency range above 30MHz, Bi-Log Test Antenna (30MHz to 1GHz) and Horn Test Antenna (above 1GHz) are used. Test Antenna is 3m away from the EUT. Test Antenna height is varied from 1m to 4m above the ground to determine the maximum value of the field strength, the azimuth range of turntable was 0o to 360o, the receive antenna has two polarizations horizontal and vertical. When doing measurements above 1GHz, the EUT was placed within the 3dB beam width range of the horn antenna, and the EUT was tested in 3 orthogonal positions as recommended in ANSI C63.10 for Radiated Emissions and the worst-case data was presented.

5.8.3 Test Result

A. Test Result for 9kHz~30MHz

Frequency (MHz)	Level (dBuV)	Over Limit (dB)	Limit Line (dBuV)	Remark
--	--	20	--	See Note

Note:

a) The amplitude of spurious emissions that are attenuated by more than 20dB below the permissible value has no need to be reported.

b) Distance extrapolation factor = 40 log (specific distance / test distance) (dB);

c) Limit line = specific limits (dBuV) + distance extrapolation factor.

B. Test Result for above 30MHz ~ 10th Harmonic

Frequency (MHz)	Level (dBuV)	Limit Line (dBuV)	Margin (dB)	Antenna Polarization	Result
104.90	19.96	43.50	23.54	Horizontal	PASS
223.73	19.47	46.00	26.53	Horizontal	PASS
348.03	23.67	46.00	22.33	Horizontal	PASS
1271.37	35.51	54.00	18.49	Horizontal	PASS
1989.80	35.88	54.00	18.12	Horizontal	PASS
4804.64	38.02	54.00	15.98	Horizontal	PASS
56.79	19.71	40.00	20.29	Vertical	PASS
100.23	19.78	43.50	23.72	Vertical	PASS
203.52	18.48	43.50	25.02	Vertical	PASS
1327.24	39.88	54.00	54.00	Vertical	PASS
1443.85	40.44	54.00	54.00	Vertical	PASS
1607.72	37.42	54.00	54.00	Vertical	PASS
1996.95	42.58	54.00	54.00	Vertical	PASS
4804.64	45.46	54.00	54.00	Vertical	PASS

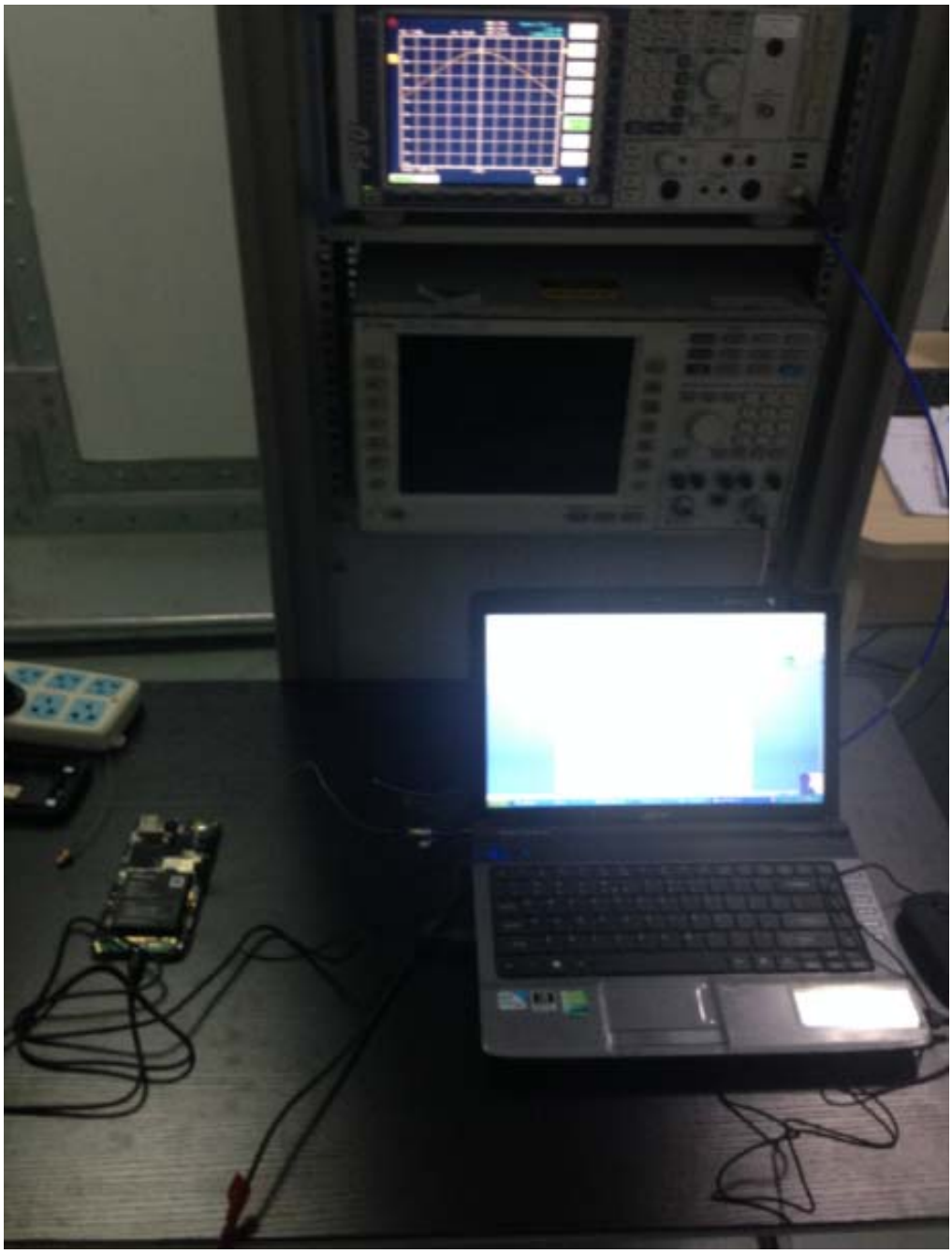
Note:

The worst case (Channel 0:2402MHz) is recorded in the report.

Annex A Photos of the EUT

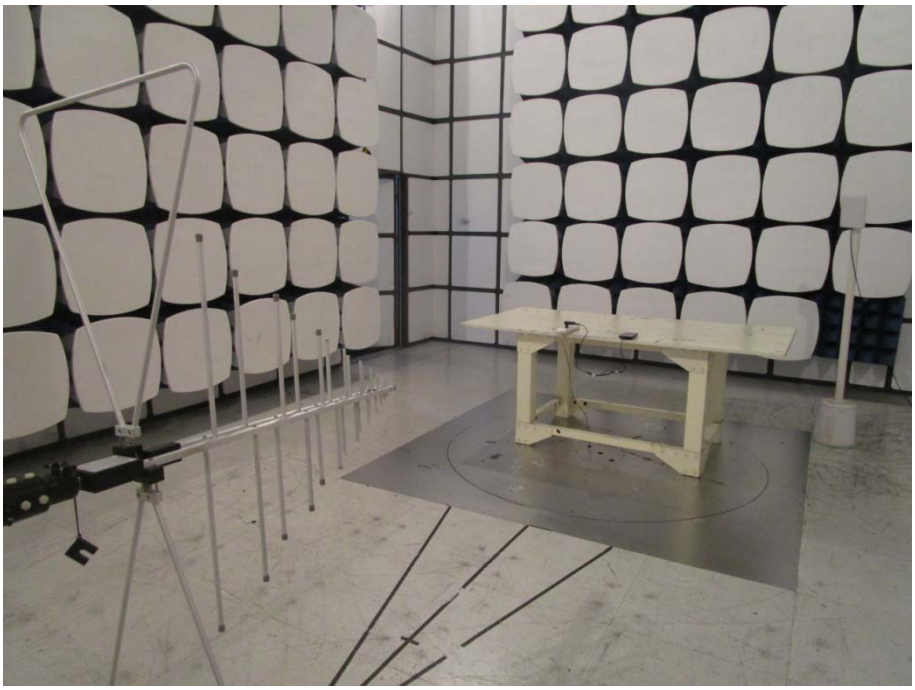
Annex B Photos of Setup

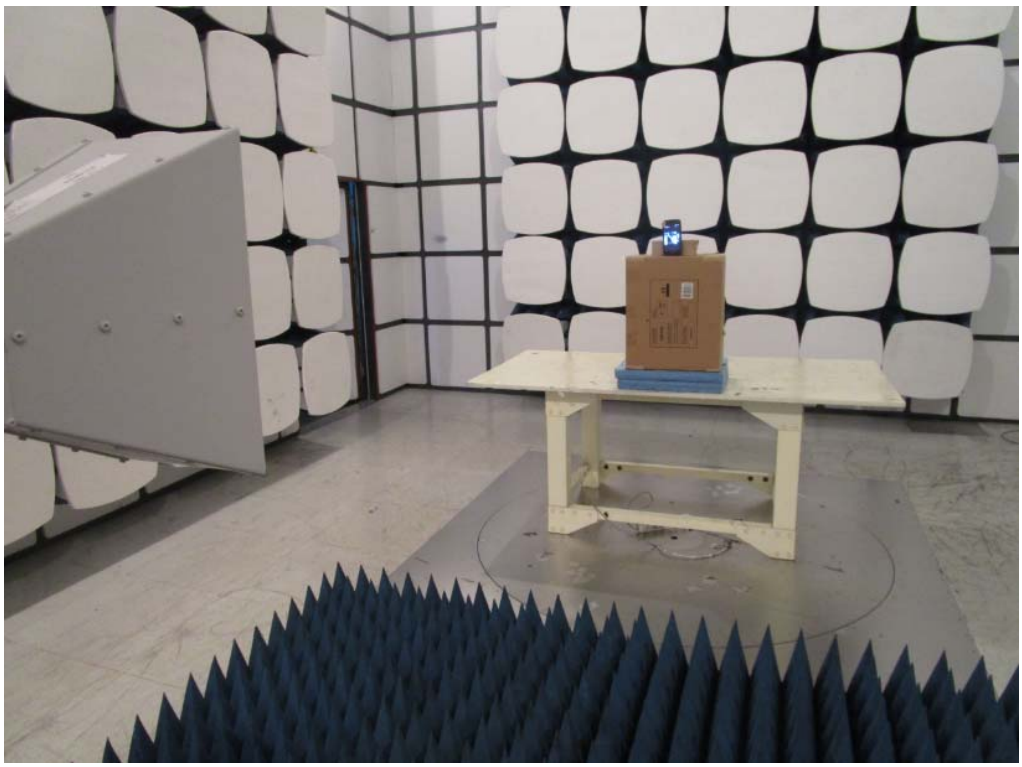
1. RF



2. Conducted Emission

3. Radiated Emission





** END OF REPORT **