Test Report

FCC Part15 Subpart C

Product Name	:	IP-STB
Model No.	:	4400X
FCC ID	:	TC2-R1010
IC	:	5959A-R1010

Applicant : Roku Inc.

Address : 12980 Saratoga Ave, Suite D Saratoga, CA 95070

Date of Receipt	:	Aug.31, 2015
Test Date	:	Sept.03, 2015~Sept.17, 2015
Issued Date	:	Sept.22, 2015
Report No.	:	1590118R-RF-US-P06V01
Report Version	:	V1.0

The test results relate only to the samples tested.

The test results shown in the test report are traceable to the national/international standard through the calibration of the equipment and evaluated measurement uncertainty herein.

This report must not be used to claim product endorsement by TAF any agency of the government.

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Test Report Certification

Issued Date : Sept. 22, 2015
Report No. : 1590118R-RF-US-P06V01

Product Name	:	IP-STB
Applicant	:	Roku Inc.
Address	:	12980 Saratoga Ave, Suite D Saratoga, CA 95070
Manufacturer	:	Ambit Mircosystems (Shanghai) LTD.
Address	:	1925, Nanle Road, Songjiang Export Processing Zone, Shanghai, China 201613
Model No.	:	4400X
FCC ID	:	TC2-R1010
IC	:	5959A-R1010
EUT Voltage	:	DC 12V
Brand Name	:	Roku
Applicable Standard	:	FCC CFR Title 47 Part 15 Subpart C: 2014 ANSI C63.4: 2014; ANSI C63.10: 2013 Industry Canada RSS-Gen Issue 4 / RSS-247 Issue 1
Test Result	:	Complied
Performed Location	:	Suzhou EMC Laboratory No.99 Hongye Rd., Suzhou Industrial Park, Suzhou, 215006, Jiangsu, China TEL: +86-512-6251-5088 / FAX: +86-512-6251-5098
Documented By	:	Elaine Wang
Reviewed By	:	Harry Zhao
Approved By	:	Dream Cao

Laboratory Information

We, **QuieTek Corporation**, are an independent EMC and safety consultancy that was established the whole facility in our laboratories. The test facility has been accredited/accepted(audited or listed) by the following related bodies in compliance with ISO 17025, EN 45001 and specified testing scope:

Taiwan R.O.C.	**:**	**BSMI, NCC,TAF**
USA	**:**	**FCC**
Japan	**:**	**VCCI**
China	**:**	**CNAS**

The related certificate for our laboratories about the test site and management system can be downloaded from QuieTek Corporation's Web Site :http://www.quietek.com/tw/ctg/cts/accreditations.htm
The address and introduction of QuieTek Corporation's laboratories can be founded in our Web site : http://www.quietek.com/
If you have any comments, Please don't hesitate to contact us. Our contact information is as below:

HsinChu Testing Laboratory :
No.75-2, 3rd Lin, Wangye Keng, Yonghxing Tsuen, Qionglin Shiang, Hsinchu County 307, Taiwan, R.O.C.
TEL:+886-3-592-8858 / FAX:+886-3-592-8859 E-Mail : service@quietek.com

LinKou Testing Laboratory :
No.5-22, Ruishukeng, Linkou Dist., New Taipei City 24451, Taiwan, R.O.C.
TEL : 886-2-8601-3788 / FAX : 886-2-8601-3789 E-Mail : service@quietek.com

Suzhou Testing Laboratory :
No.99 Hongye Rd., Suzhou Industrial Park, Suzhou, 215006, Jiangsu,China
TEL : +86-512-6251-5088 / FAX : 86-512-6251-5098 E-Mail : service@quietek.com

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History of This Test Report

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
1590118R-RF-US-P06V01	V1.0	Initial Issued Report	Sept. 22, 2015

1. General Information

1.1. EUT Description

Product Name	IP-STB
Brand Name	Roku
Model No.	4400X
EUT Voltage	DC 12V
WIFI	
Frequency Range	For 2.4GHz Band 802.11b/g/n(20MHz): 2412~2462MHz 802.11n(40MHz): 2422~2452MHz For 5.0GHz Band 802.11a/n/ac(20MHz): 5180~5240MHz, 5745~5825MHz 802.11n/ac(40MHz): 5190~5230MHz, 5755~5795MHz 802.11ac(80MHz): 5210MHz,5775MHz
Channel Number	For 2.4GHz Band 802.11b/g/n(20MHz): 11 802.11n(40MHz): 7 For 5GHz Band 802.11a/n(20MHz)/ac(20MHz): 9 802.11n(40MHz)/ac(40MHz): 4 802.11ac(80MHz): 2
Type of Modulation	802.11b: DSSS
	802.11a/g/n: OFDM
Data Rate	802.11a/g: 6/9/12/18/24/36/48/54 Mbps
	802.11b: 1/2/5.5/11 Mbps
	802.11n: up to 300 Mbps
	802.11ac: up to 866.6 Mbps
Channel Control	Auto
Antenna Delivery	2*Tx + 2*Rx
Bluetooth	
Bluetooth Specification	V3.0+V4.0
Frequency Range	2402- 2480 MHz
Channel Number	V3.0: 79 V4.0: 40
Channel Separation	V3.0: 1MHz V4.0: 2MHz
Type of Modulation	V3.0: GFSK, Pi/4 DQPSK, 8DPSK V4.0: GFSK

Data Rate	V3.0: 1Mbps(GFSK), 2Mbps(Pi/4 DQPSK), 3Mbps (8DPSK) V4.0: 1Mbps(GFSK)
Antenna Type	Reference to Antenna List
Peak Antenna Gain	Reference to Antenna List
Power Adapter	MFR: Roku M/N:W15-024N2A Input: AC 100-120V,0.8A 50-60Hz Output: DC 12V, 2.0A

Bluetooth Working Frequency of Each Channel: (For V4.0)							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
00	2402 MHz	01	2404 MHz	02	2406 MHz	03	2408 MHz
04	2410 MHz	05	2412 MHz	06	2414 MHz	07	2416 MHz
08	2418 MHz	09	2420 MHz	10	2422 MHz	11	2424 MHz
12	2426 MHz	13	2428 MHz	14	2430 MHz	15	2432 MHz
16	2434 MHz	17	2436 MHz	18	2438 MHz	19	2440 MHz
20	2442 MHz	21	2444 MHz	22	2446 MHz	23	2448 MHz
24	2450 MHz	25	2452 MHz	26	2454 MHz	27	2456 MHz
28	2458 MHz	29	2460 MHz	30	2462 MHz	31	2464 MHz
32	2466 MHz	33	2468 MHz	34	2470 MHz	35	2472 MHz
36	2474 MHz	37	2476 MHz	38	2478 MHz	39	2480 MHz

Bluetooth Antenna List

Antenna No.	Manufacturer	Model No.	Peak Gain
Antenna	Airgain	N2410CM3	0.7dBi

1.2. Mode of Operation

QuieTek has verified the construction and function in typical operation. All the test modes were carried out with the EUT in normal operation, which was shown in this test report and defined as:

Test Mode
Mode 1: Transmit-1Mbps(GFSK_BLE)

Note:

1. Regards to the frequency band operation: the lowest、middle and highest frequency of channel were selected to perform the test, then shown on this report.
2. For portable device, radiated spurious emission was verified over X, Y, Z Axis, and shown the worst case on this report.

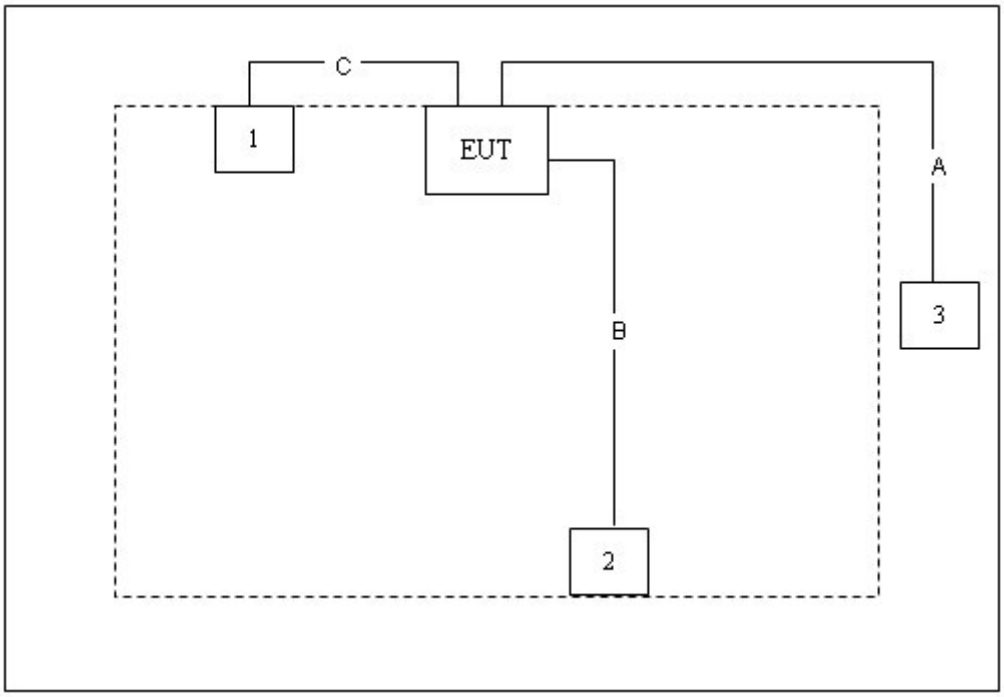
1.3. Tested System Details

The types for all equipments, plus descriptions of all cables used in the tested system (including inserted cards) are:

Product		Manufacturer	Model No.	Serial No.	Power Cord
1	LCD Monitor	DELL	ST2420LB	CN-OXOK27-74261-189-OA4U	Non-Shielded, 1.8m
2	iPod	Apple	A1199	7J71085BVQ5E	Power by PC
3	Laptop PC	Asus	N80V	8BN0AS226971468	N/A

1.4. Configuration of Tested System

Connection Diagram



Signal Cable Type		Signal cable Description
A	LAN Cable	Shielded, >10m
B	USB Cable	Shielded, 0.5m
C	HDMI Cable	Shielded, 0.8m

1.5. EUT Exercise Software

1	Setup the EUT and simulators as shown on above.
2	Turn on the power of all equipment.
3	Run the RF test software, and set the test mode and channel, then press OK to start continue Transmit.

2. Technical Test

2.1. Summary of Test Result

☒ No deviations from the test standards
☐ Deviations from the test standards as below description:

For FCC

Performed Test Item	Normative References	Test Performed	Deviation
Conducted Emission	FCC CFR Title 47 Part 15 Subpart C: 2014 Section 15.207	Yes	No
Radiated Emission	FCC CFR Title 47 Part 15 Subpart C: 2014 Section 15.209	Yes	No
RF Antenna Conducted Spurious	FCC CFR Title 47 Part 15 Subpart C: 2014 Section 15.247(d)	Yes	No
Radiated Emission Band Edge	FCC CFR Title 47 Part 15 Subpart C: 2014 15.247(d)	Yes	No
Operation Frequency Range of 20dB Bandwidth	FCC CFR Title 47 Part 15 Subpart C: 2014 15.215(c)	Yes	No
6dB Bandwidth	FCC CFR Title 47 Part 15 Subpart C: 2014 Section 15.247(a)(2)	Yes	No
Power Output	FCC CFR Title 47 Part 15 Subpart C: 2014 Section 15.247(b)(3)	Yes	No
Power Spectral Density	FCC CFR Title 47 Part 15 Subpart C: 2014 Section 15.247(e)	Yes	No

For IC

Performed Test Item	Normative References	Test Performed	Deviation
Conducted Emission	RSS-Gen Issue 4 November 2014 Section 8.8	Yes	No
Radiated Emission	RSS-247 Issue 1 May 2015 Section 5.5	Yes	No
RF Antenna Conducted Spurious	RSS-247 Issue 1 May 2015 Section 5.5	Yes	No
Radiated Emission Band Edge	RSS-Gen Issue 4 November 2014 Section 8.10	Yes	No
Occupied Bandwidth	RSS-Gen Issue 4 November 2014 Section 6.6 RSS-247 Issue 1 May 2015 Section 5.2	Yes	No
Power Output	RSS-247 Issue 1 May 2015 Section 5.4	Yes	No
Power Spectral Density	RSS-247 Issue 1 May 2015 Section 5.2	Yes	No

2.2. Test Environment

Items	Required (IEC 68-1)	Actual
Temperature (°C)	15-35	21
Humidity (%RH)	25-75	50
Barometric pressure (mbar)	860-1060	950-1000

3. Conducted Emission

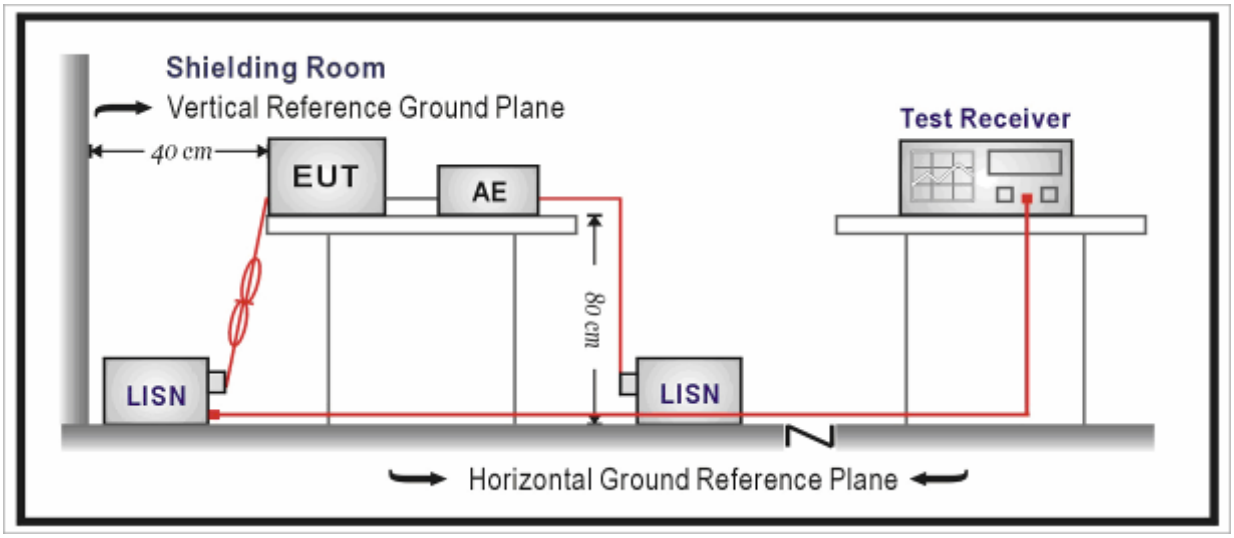
3.1. Test Equipment

Conducted Emission / TR-1

Instrument	Manufacturer	Type No.	Serial No.	Cal. Due Date
EMI Test Receiver	R&S	ESCI	100726	2016.03.30
Two-Line V-Network	R&S	ENV216	100043	2016.03.30
Two-Line V-Network	R&S	ENV216	100044	2016.09.16
50ohm Coaxial Switch	Anritsu	MP59B	6200464462	2016.03.01
50ohm Termination	SHX	TF2	07081401	2016.09.16
Temperature/Humidity Meter	zhicheng	ZC1-2	TR1-TH	2016.01.08

Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

3.2. Test Setup



3.3. Limit

FCC Part 15 Subpart C Paragraph 15.207 Limits		
Frequency (MHz)	QP (dBuV)	AV (dBuV)
0.15 - 0.50	66 - 56	56 – 46
0.50 - 5.0	56	46
5.0 - 30	60	50

Note 1: The lower limit shall apply at the transition frequencies.

Note 2: The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz.

3.4. Test Procedure

The EUT was setup according to ANSI C63.4, 2014 and tested according to KDB 558074 for compliance to FCC 47CFR 15.247 requirements. The EUT was placed on a platform of nominal size, 1 m by 1.5 m, raised 80 cm above the conducting ground plane. The vertical conducting plane was located 40 cm to the rear of the EUT. All other surfaces of EUT were at least 80 cm from any other grounded conducting surface. The EUT and simulators are connected to the main power through a line impedance stabilization network (LISN). The LISN provides a 50 ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN. (Please refer to the block diagram of the test setup and photographs) Each current-carrying conductor of the EUT power cord, except the ground (safety) conductor, was individually connected through a LISN to the input power source.

The excess length of the power cord between the EUT and the LISN receptacle were folded back and forth at the center of the lead to form a bundle not exceeding 40 cm in length.

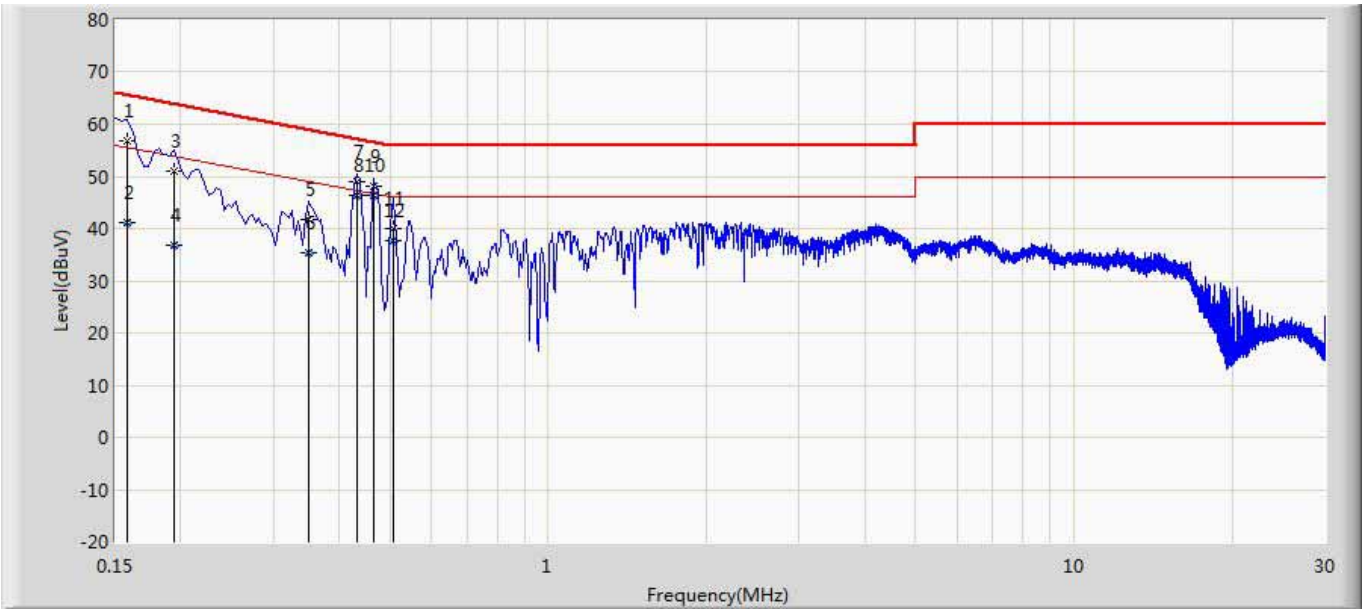
Conducted emissions were investigated over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9 kHz.

3.5. Uncertainty

The measurement uncertainty is defined as ± 2.02 dB

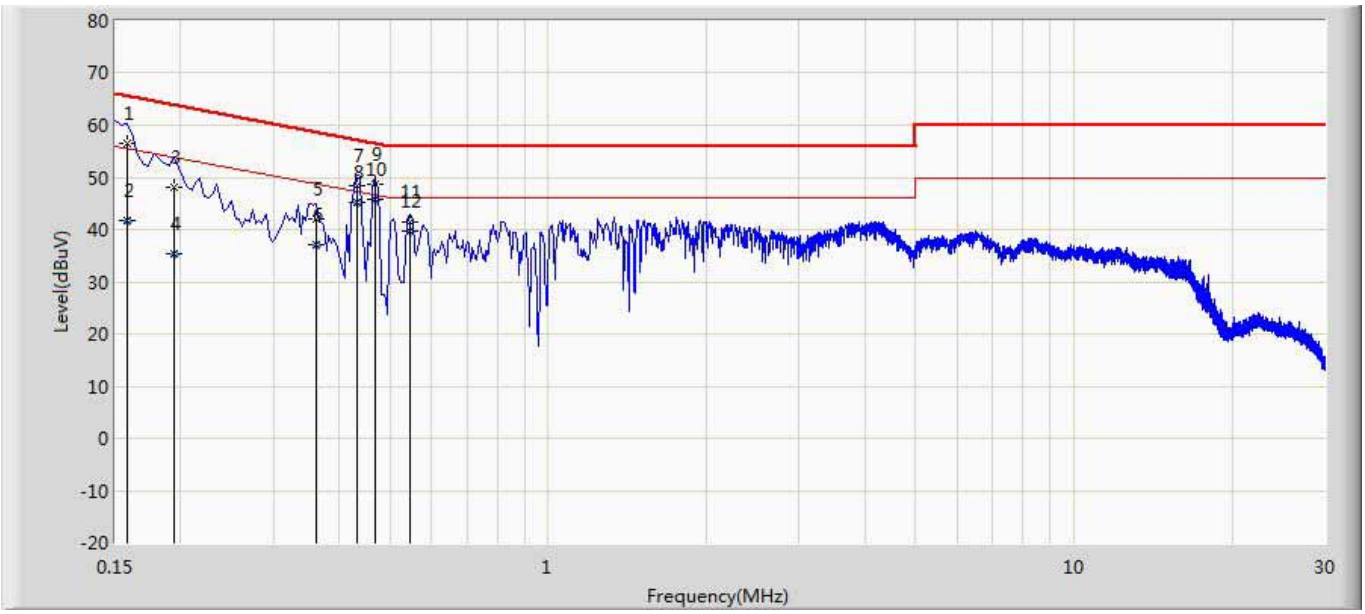
3.6. Test Result

Engineer: Scott	
Site: TR1	Time: 2015/09/06 - 08:55
Limit: FCC_Part15.107_CE_AC Power_ClassB	Margin: 0
Probe: ENV216_101044(0.009-30MHz)	Polarity: Line
EUT: IP-STB	Power: AC 120V/60Hz
Note: Mode 1	



No	Mark	Frequency (MHz)	Measure Level (dBuV)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV)	Factor (dB)	Type
1		0.158	56.680	46.865	-8.889	65.568	9.815	QP
2		0.158	41.040	31.225	-14.529	55.568	9.815	AV
3		0.194	51.012	41.184	-12.852	63.864	9.828	QP
4		0.194	36.908	27.080	-16.956	53.864	9.828	AV
5		0.350	41.734	31.878	-17.228	58.962	9.855	QP
6		0.350	35.446	25.590	-13.516	48.962	9.855	AV
7		0.434	48.850	38.977	-8.326	57.176	9.874	QP
8		0.434	46.447	36.573	-0.729	47.176	9.874	AV
9		0.466	48.106	38.228	-8.479	56.585	9.879	QP
10	*	0.466	46.275	36.396	-0.310	46.585	9.879	AV
11		0.506	39.911	30.032	-16.089	56.000	9.880	QP
12		0.506	37.782	27.903	-8.218	46.000	9.880	AV

Engineer: Scott	
Site: TR1	Time: 2015/09/06 - 09:18
Limit: FCC_Part15.107_CE_AC Power_ClassB	Margin: 0
Probe: ENV216_101044(0.009-30MHz)	Polarity: Neutral
EUT: IP-STB	Power: AC 120V/60Hz
Note: Mode 1	



No	Mark	Frequency (MHz)	Measure Level (dBuV)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV)	Factor (dB)	Type
1		0.158	56.595	46.635	-8.974	65.568	9.960	QP
2		0.158	41.633	31.673	-13.936	55.568	9.960	AV
3		0.194	48.112	38.219	-15.752	63.864	9.893	QP
4		0.194	35.304	25.412	-18.559	53.864	9.893	AV
5		0.362	42.001	32.044	-16.682	58.682	9.957	QP
6		0.362	37.128	27.171	-11.555	48.682	9.957	AV
7		0.434	48.437	38.439	-8.739	57.176	9.999	QP
8		0.434	45.099	35.101	-2.077	47.176	9.999	AV
9		0.470	48.617	38.600	-7.897	56.514	10.018	QP
10	*	0.470	45.717	35.700	-0.797	46.514	10.018	AV
11		0.546	41.569	31.572	-14.431	56.000	9.997	QP
12		0.546	39.771	29.774	-6.229	46.000	9.997	AV

4. Radiated Emission

4.1. Test Equipment

Radiated Emission / AC-2

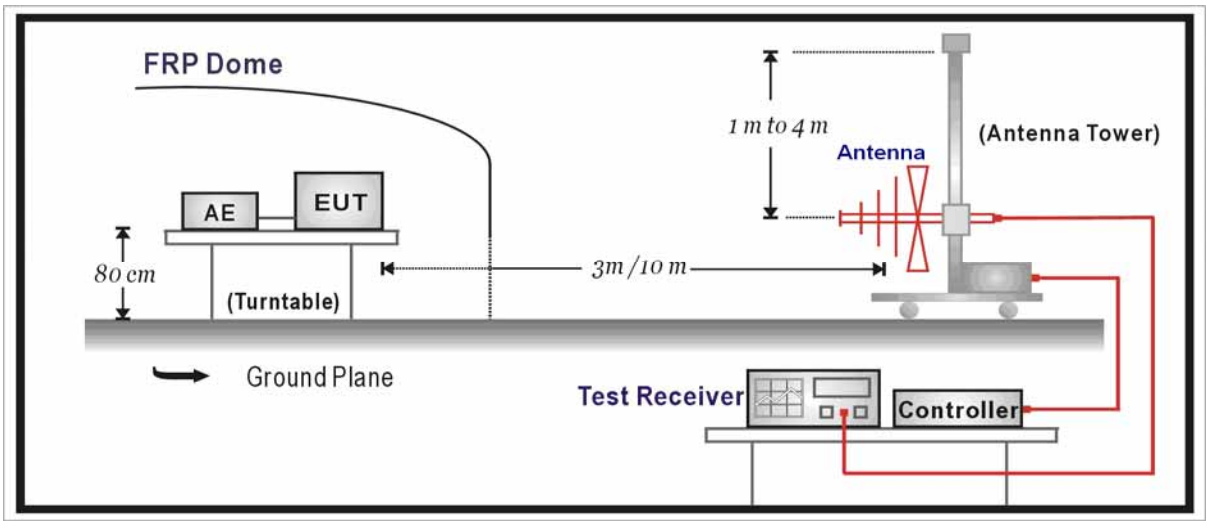
Instrument	Manufacturer	Type No.	Serial No.	Cal. Due Date
EMI Test Receiver	R&S	ESCI	100573	2016.03.28
Loop Antenna	R&S	HFH2-Z2	833799/003	2015.11.25
Bilog Antenna	Teseq GmbH	CBL6112D	27611	2015.10.10
Coaxial Cable	Huber+Suhner	SUCOFLEX 106	AC2-C	2016.03.01
Temperature/Humidity Meter	Zhicheng	ZC1-2	AC2-TH	2016.01.08

Radiated Emission / AC-5

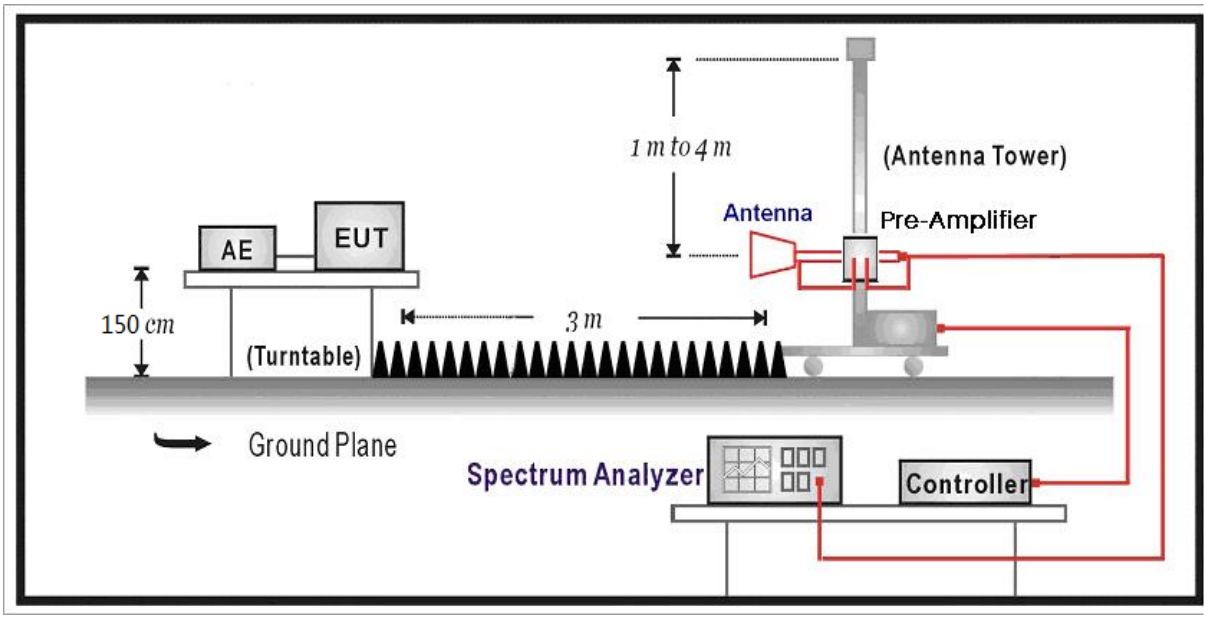
Instrument	Manufacturer	Type No.	Serial No.	Cal. Due Date
Spectrum Analyzer	Agilent	N9010A	MY48030494	2016.05.12
Preamplifier	Miteq	NSP1800-25	1364185	2016.05.03
Preamplifier	QuieTek	AP-040G	CHM-0906001	2016.05.03
Bilog Antenna	Teseq GmbH	CBL6112D	27612	2015.10.15
Broad-Band Horn Antenna	Schwarzbeck	BBHA9120D	499	2016.06.08
Broad-Band Horn Antenna	Schwarzbeck	BBHA9170	294	2016.04.10
Coaxial Cable	Huber+Suhner	SUCOFLEX 106	AC5-C1	2016.03.01
Coaxial Cable	Huber+Suhner	SUCOFLEX 106	AC5-C2	2016.03.01
Coaxial Cable	Huber+Suhner	SUCOFLEX 102	AC5-C3	2016.03.01
Temperature/Humidity Meter	Zhicheng	ZC1-2	AC5-TH	2016.01.08

4.2. Test Setup

Below 1GHz Test Setup:



Above 1GHz Test Setup:



4.3. Limit

FCC Part 15 Subpart C Paragraph 15.209		
Frequency (MHz)	Distance (m)	Level (dBuV/m)
30 - 88	3	40
88 - 216	3	43.5
216 - 960	3	46
Above 960	3	54

Note 1: The lower limit shall apply at the transition frequency.
Note 2: Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.
Note 3: E field strength (dBuV/m) = 20 log E field strength (uV/m)

4.4. Test Procedure

The EUT was setup according to ANSI C63.4, 2014 and tested according to KDB 558074 for compliance to FCC 47CFR 15.247 requirements.

The EUT is placed on a turn table which is 0.8 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.4:2014 on radiated measurement.

The resolution bandwidth below 1GHz setting on the field strength meter is 120 kHz and above 1GHz is 1MHz.

The frequency range from 30MHz to 10th harmonic is checked.

Note: When doing emission measurement above 1GHz, the horn antenna will be bended down a little (as horn antenna has the narrow beamwidth) in order to keeping the antenna in the “cone of radiation” of EUT. The 3dB beamwidth is 10~60 degrees for H-plane and 10~90 degrees for E-plane.

4.5. Uncertainty

The measurement uncertainty above 1GHz is defined as ± 3.9 dB
below 1GHz is defined as ± 3.8 dB

4.6. Test Result

All of the test result shown indicates the worst case, and spectrum analyzer parameters setting as shown below:

Peak detector: RBW = 1MHz, VBW = 3MHz, sweep time = 200ms;

Average detector: RBW = 1MHz, VBW = 10Hz, sweep time = auto.

Measure Level = Reading Level + Cable Loss + Antenna Factor - Preamplifier Gain

Mode 1: Transmitter-1Mbps(GFSK_BLE)

CH	Antenna	Frequency (MHz)	Reading Level (dBuV/m)	Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
0	H	4804.0	50.4	-6.2	44.2	54(Note2)	-9.8	PK
	V	4804.0	51.0	-6.2	44.8	54(Note2)	-9.2	PK
	H	7206.0	44.6	-1.7	42.9	54(Note2)	-11.1	PK
	V	7206.0	44.8	-1.7	43.1	54(Note2)	-10.9	PK
	H	9608.0	37.7	4.9	42.6	54(Note2)	-11.4	PK
	V	9608.0	37.5	4.9	42.4	54(Note2)	-11.6	PK
19	H	4880.0	50.6	-6.2	44.4	54(Note2)	-9.6	PK
	V	4880.0	50.0	-6.2	43.8	54(Note2)	-10.2	PK
	H	7320.0	43.8	-1.4	42.4	54(Note2)	-11.6	PK
	V	7320.0	42.8	-1.4	41.4	54(Note2)	-12.6	PK
	H	9760.0	36.7	5.2	41.9	54(Note2)	-12.1	PK
	V	9760.0	36.5	5.2	41.7	54(Note2)	-12.3	PK
39	H	4960.0	50.4	-6.3	44.1	54(Note2)	-9.9	PK
	V	4960.0	51.0	-6.3	44.7	54(Note2)	-9.3	PK
	H	7440.0	44.5	-0.8	43.7	54(Note2)	-10.3	PK
	V	7440.0	44.5	-0.8	43.7	54(Note2)	-10.3	PK
	H	9920.0	37.2	5.5	42.7	54(Note2)	-11.3	PK
	V	9920.0	36.7	5.5	42.2	54(Note2)	-11.8	PK

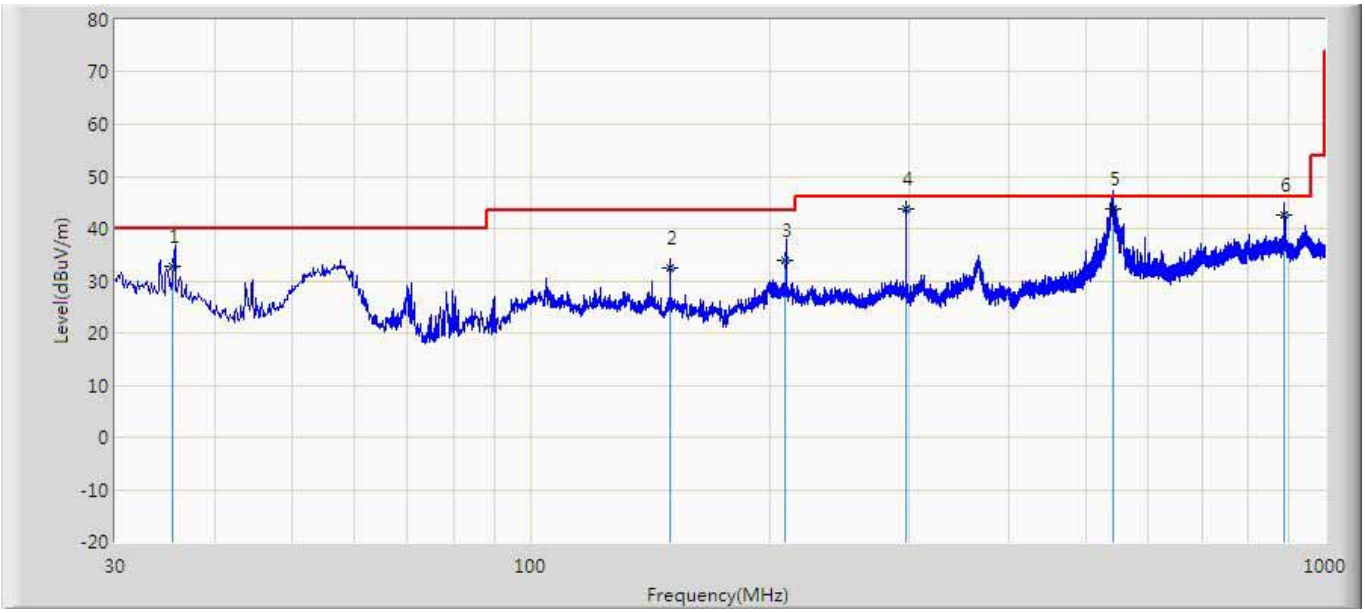
Note: 1. Measure Level = Reading Level + Factor.

2. The test frequency range, 9kHz~30MHz, 18GHz~25GHz, both of the worst case are at least 6dB below the limits, therefore no data appear in the report.

3. This limit applies for using average detector, if the test result on peak is lower than average limit, then average measurement needn't be performed.

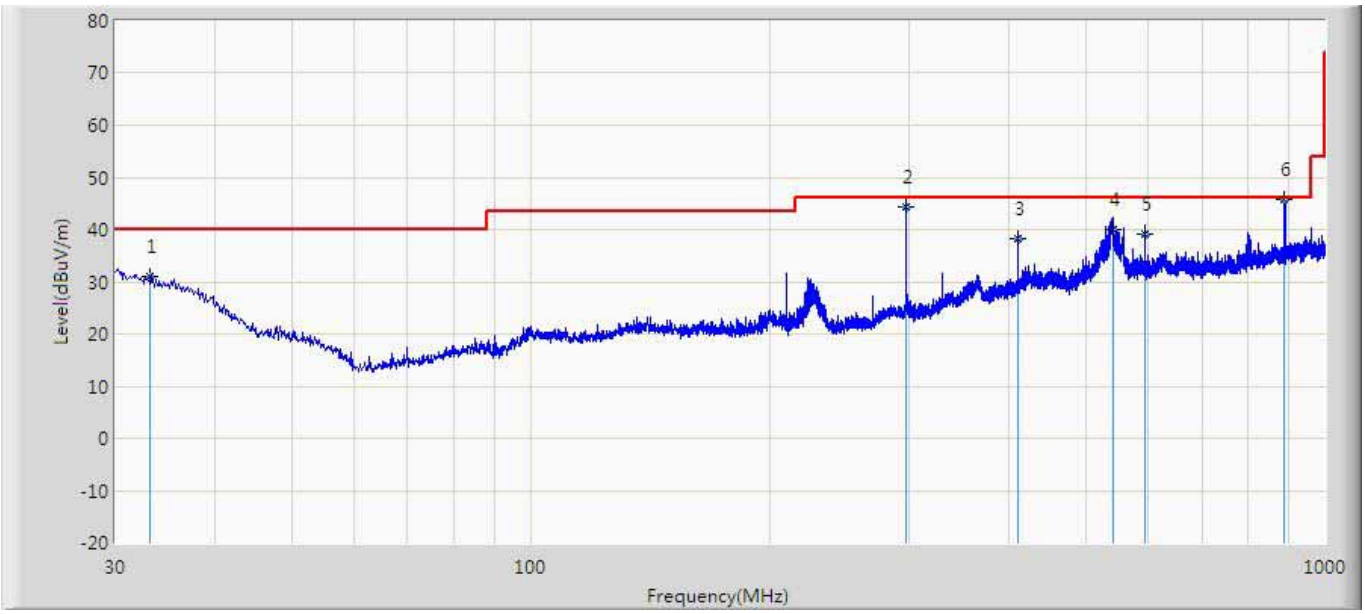
The worst case of Radiated Emission below 1GHz:

Engineer: Scott	
Site: AC3	Time: 2015/08/28 - 20:44
Limit: FCC_Part15.109_RE(3m)_ClassB	Margin: 0
Probe: AC3_10m (30-1000MHz)	Polarity: Vertical
EUT: IP-STB	Power: AC 120V/60Hz
Note: Mode 1: Transmit at channel 2402MHz by BLE	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		35.482	32.649	10.400	-7.351	40.000	22.249	QP
2		149.695	32.394	13.700	-11.106	43.500	18.695	QP
3		209.415	33.851	10.500	-9.649	43.500	23.351	QP
4		296.729	43.679	20.200	-2.321	46.000	23.479	QP
5	*	540.754	43.890	17.800	-2.110	46.000	26.091	QP
6		890.202	42.752	9.400	-3.248	46.000	33.352	QP

Engineer: Scott	
Site: AC3	Time: 2015/08/28 - 21:15
Limit: FCC_Part15.109_RE(3m)_ClassB	Margin: 0
Probe: AC3_10m (30-1000MHz)	Polarity: Horizontal
EUT: IP-STB	Power: AC 120V/60Hz
Note: Mode 1: Transmit at channel 2402MHz by BLE	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		33.152	31.078	4.800	-8.922	40.000	26.278	QP
2		296.728	44.474	24.200	-1.526	46.000	20.274	QP
3		410.844	38.194	12.400	-7.806	46.000	25.794	QP
4		540.824	40.015	13.700	-5.985	46.000	26.315	QP
5		593.462	39.182	10.900	-6.818	46.000	28.282	QP
6	*	890.241	45.936	14.600	-0.064	46.000	31.336	QP

5. RF Antenna Conducted Spurious

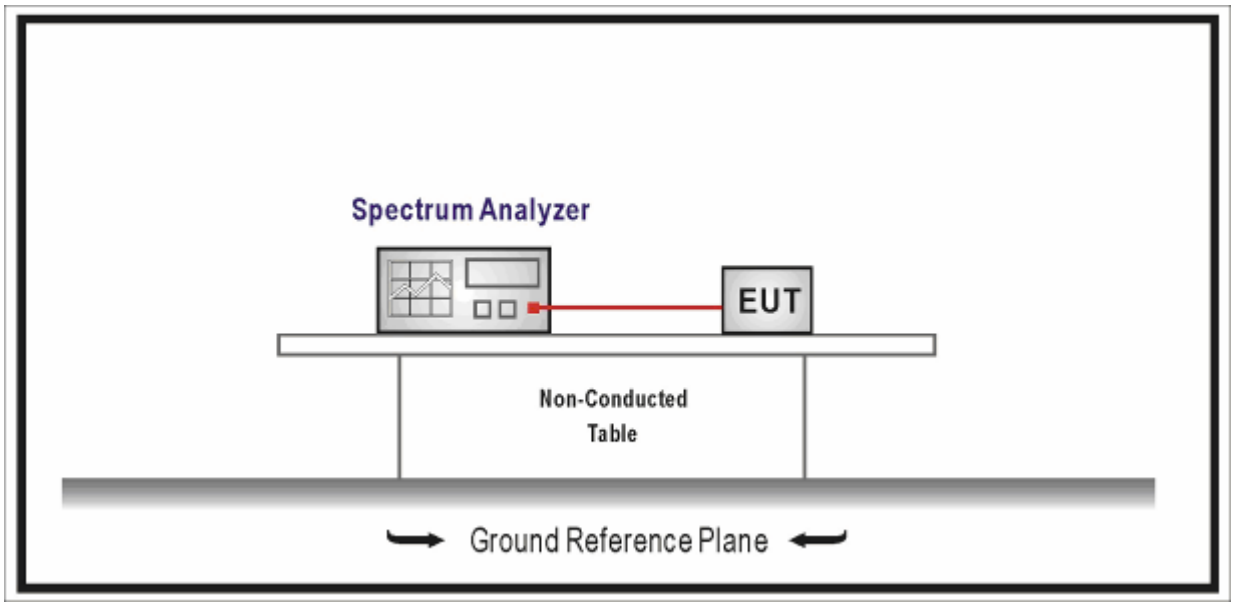
5.1. Test Equipment

RF Antenna Conducted Spurious / TR-8

Instrument	Manufacturer	Type No.	Serial No.	Cal. Due Date
Spectrum Analyzer	Agilent	E4446A	MY45300103	2016.01.05
Temperature/Humidity Meter	zhicheng	ZC1-2	TR8-TH	2016.04.09

Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

5.2. Test Setup



5.3. Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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.

5.4. Test Procedure

According to ANSI C63.10: 2013& ANSI C63.4: 2014

Use the following spectrum analyzer settings:
Span = approximately 2 to 3 times the 20dB bandwidth
RBW ≧ 1% of the 20dB bandwidth
VBW ≧ RBW
Sweep = auto
Detector function = peak
Trace = max hold
The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize.
Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-IP-STB function to measure 20 dB down one side of the emission. Reset the marker-IP-STB function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-IP-STB reading at this point is the 20 dB bandwidth of the emission. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation.

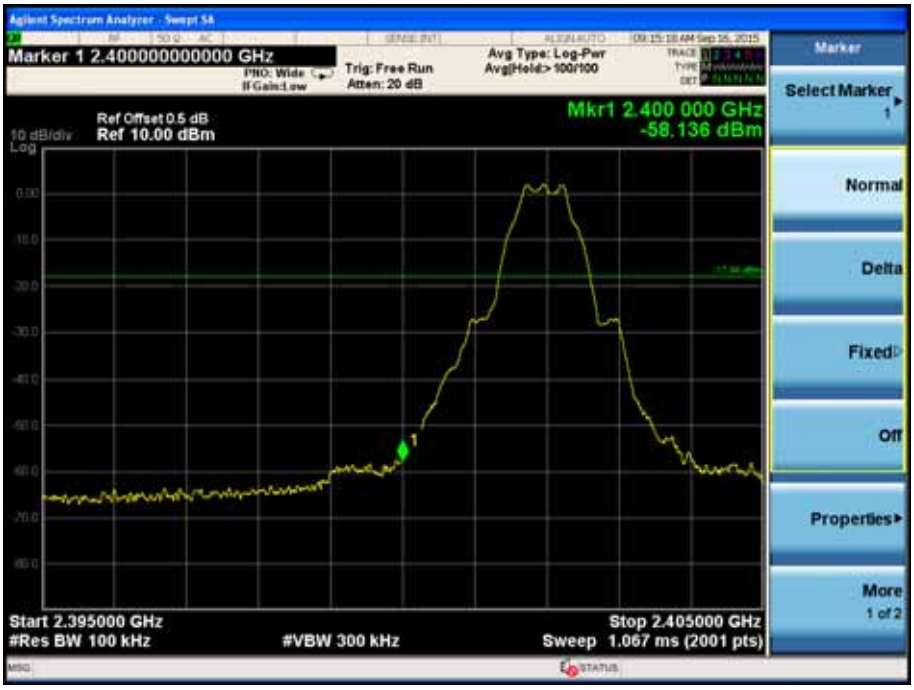
5.5. Uncertainty

The measurement uncertainty is defined as ± 1.27 dB

5.6. Test Result

Product	:	IP-STB
Test Item	:	RF Antenna Conducted Spurious
Test Site	:	TR-8
Test Mode	:	Mode 1: Transmit-1Mbps(GFSK_BLE)

Channel 00 (2402MHz)



Channel 19 (2440MHz)

Channel 39 (2480MHz)

Agilent Spectrum Analyzer - Swept SA
Marker 1 2.483500000000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>1/1
Ref Offset 0.5 dB
10 dB/div
Ref 10.00 dBm
Log
Mkr1 2.483 500 GHz
-65.068 dBm
Start 2.478500 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.488500 GHz
Sweep 1.067 ms (2001 pts)
Marker
Select Marker
1
Normal
Delta
Fixed
Off
Properties
More
1 of 2

Agilent Spectrum Analyzer - Swept SA
Marker 1 24.720960250000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>1/1
Ref Offset 0.5 dB
10 dB/div
Ref 10.00 dBm
Log
Mkr1 24.721 0 GHz
-51.939 dBm
Start 30 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.00 GHz
Sweep 2.387 s (40001 pts)
No Peak Found
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

6. Radiated Emission Band Edge

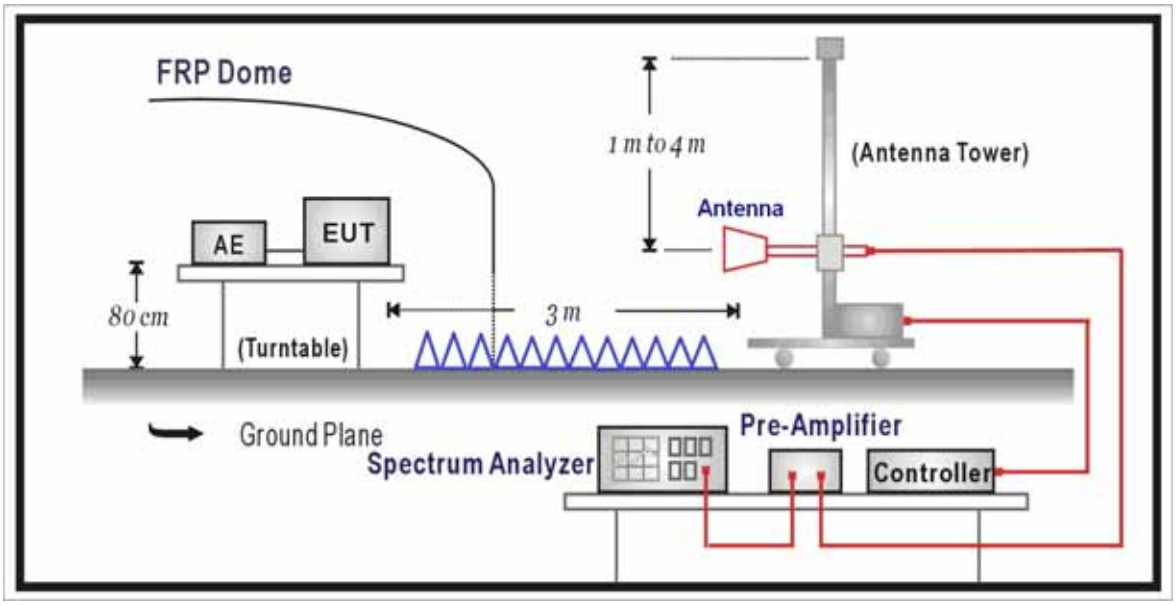
6.1. Test Equipment

☒Radiated Emission Band Edge / AC-5

Instrument	Manufacturer	Type No.	Serial No.	Cal. Due Date
Spectrum Analyzer	Agilent	N9020A	MY49100159	2016.03.30
Preamplifier	Miteq	NSP1800-25	1364185	2016.05.03
Preamplifier	QuieTek	AP-040G	CHM-0906001	2016.05.03
Bilog Antenna	Teseq GmbH	CBL6112D	27612	2015.10.15
DRG Horn	ETS-Lindgren	3117	00123988	2016.01.05
Coaxial Cable	Huber+Suhner	SUCOFLEX 106	AC5-C1	2016.03.01
Coaxial Cable	Huber+Suhner	SUCOFLEX 106	AC5-C2	2016.03.01
Coaxial Cable	Huber+Suhner	SUCOFLEX 102	AC5-C3	2016.03.01
EMI Receiver	Agilent	N9038A	MY51210196	2016.08.07
Temperature/Humidity Meter	Zhicheng	ZC1-2	AC5-TH	2016.01.08

Note 1: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

6.2. Test Setup



6.3. Limit

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a) of FCC part 15, must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

6.4. Test Procedure

According to ANSI C63.10: 2013.
This test is required for any spurious emission or modulation product that falls in a Restricted Band, as defined in Section 15.205 of FCC part 15. It must be performed with the highest gain of each type of antenna proposed for use with the EUT. Use the following spectrum analyzer settings:
Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≧ 1 GHz, 100 kHz for f < 1GHz
VBW ≧ RBW
Sweep = auto
Detector function = peak
Trace = max hold
Follow the guidelines in ANSI C63.4 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization, etc. A pre-amp and a high pass filter are required for this test, in order to provide the measuring system with

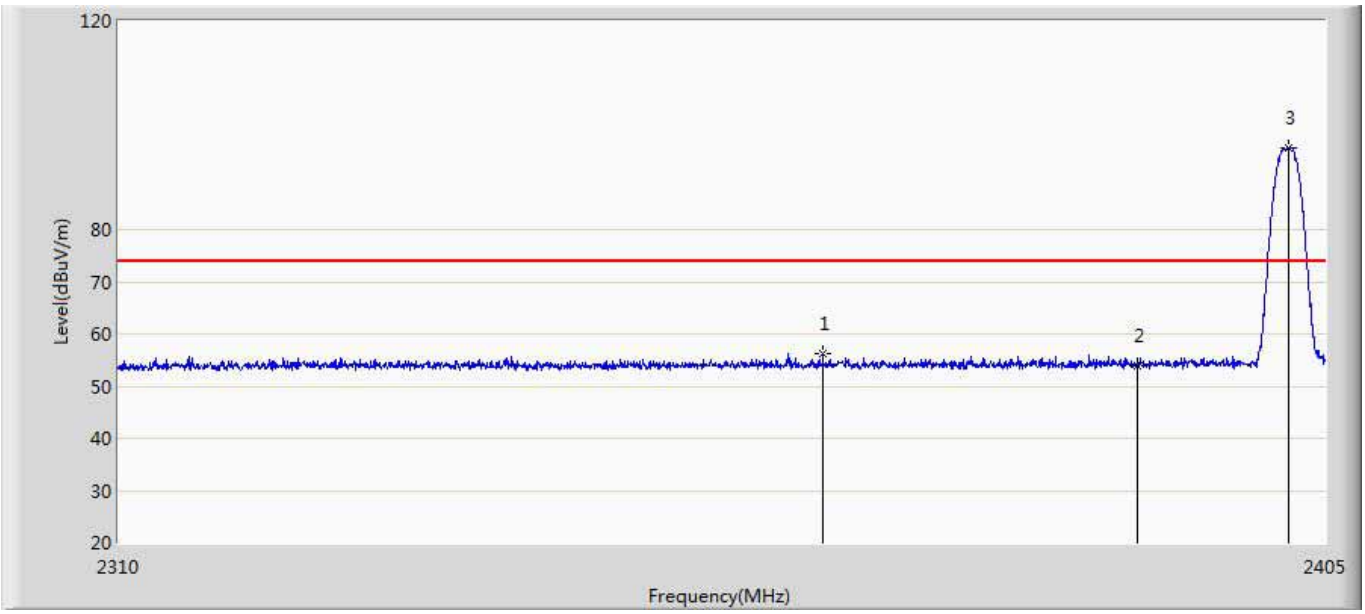
sufficient sensitivity. Allow the trace to stabilize. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, which must comply with the limit specified in Section 15.35(b) of FCC part 15.
Now set the VBW ≥ 1 / T (the minimum transmission duration), while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209 of FCC Part 15.
If the emission on which a radiated measurement must be made is located at the edge of the authorized band of operation, then the alternative “marker-IP-STB” method may be employed.

6.5. Uncertainty

The measurement uncertainty above 1G is defined as ± 3.9 dB

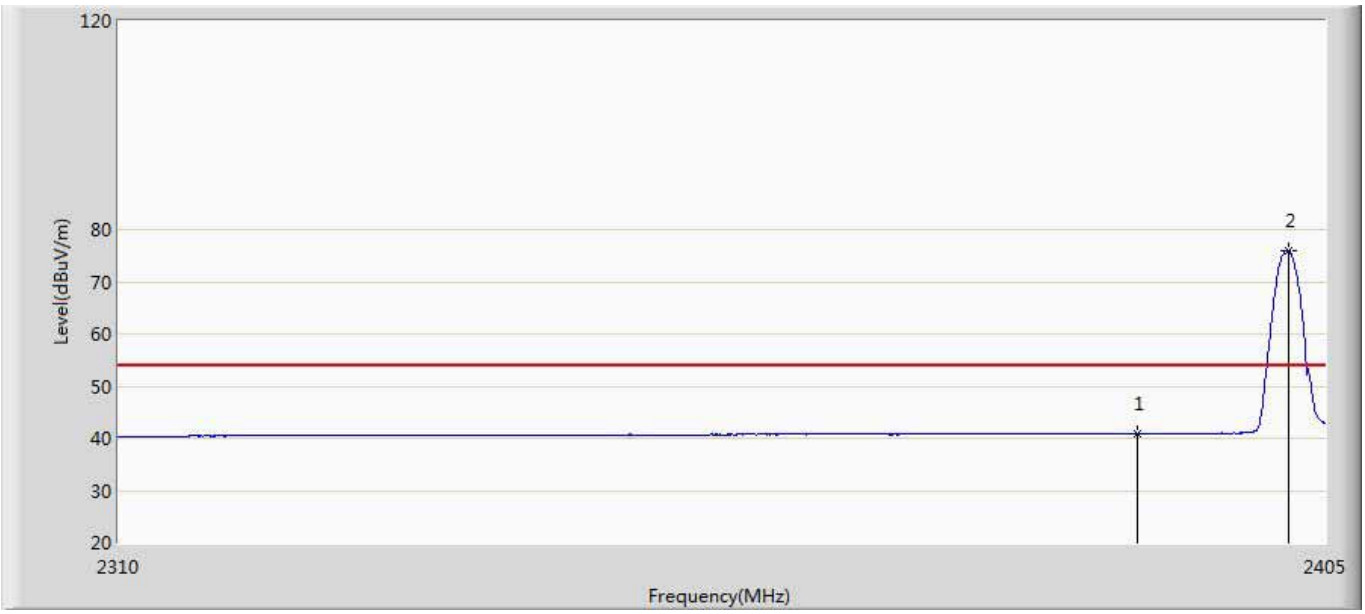
6.6. Test Result

Engineer: Scott	
Site: AC5	Time: 2015/09/20 - 12:01
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)	Polarity: Vertical
EUT: IP-STB	Power: AC 120V/60Hz
Note: Mode 1: Transmit at CH2402MHz by BLE	



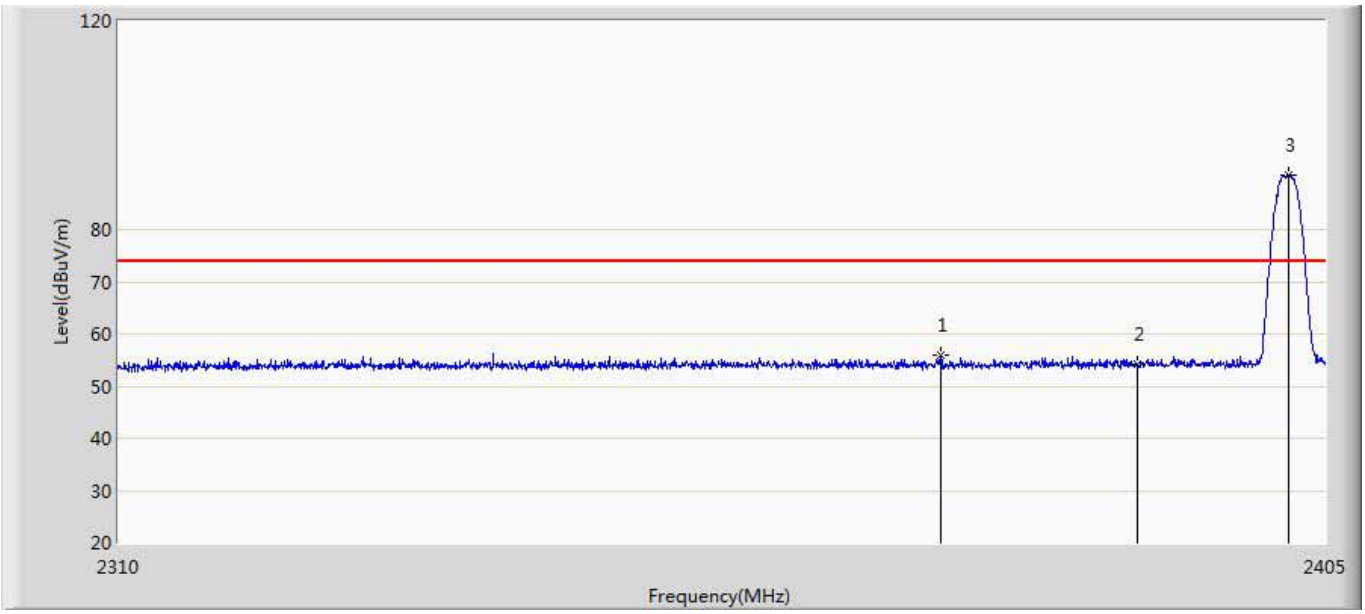
No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		2365.005	56.222	19.346	-17.778	74.000	36.876	PK
2		2390.000	53.883	16.892	-20.117	74.000	36.991	PK
3	*	2402.103	95.674	58.667	N/A	N/A	37.007	PK

Engineer: Scott	
Site: AC5	Time: 2015/09/20 - 12:02
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)	Polarity: Vertical
EUT: IP-STB	Power: AC 120V/60Hz
Note: Mode 1: Transmit at CH2402MHz by BLE	



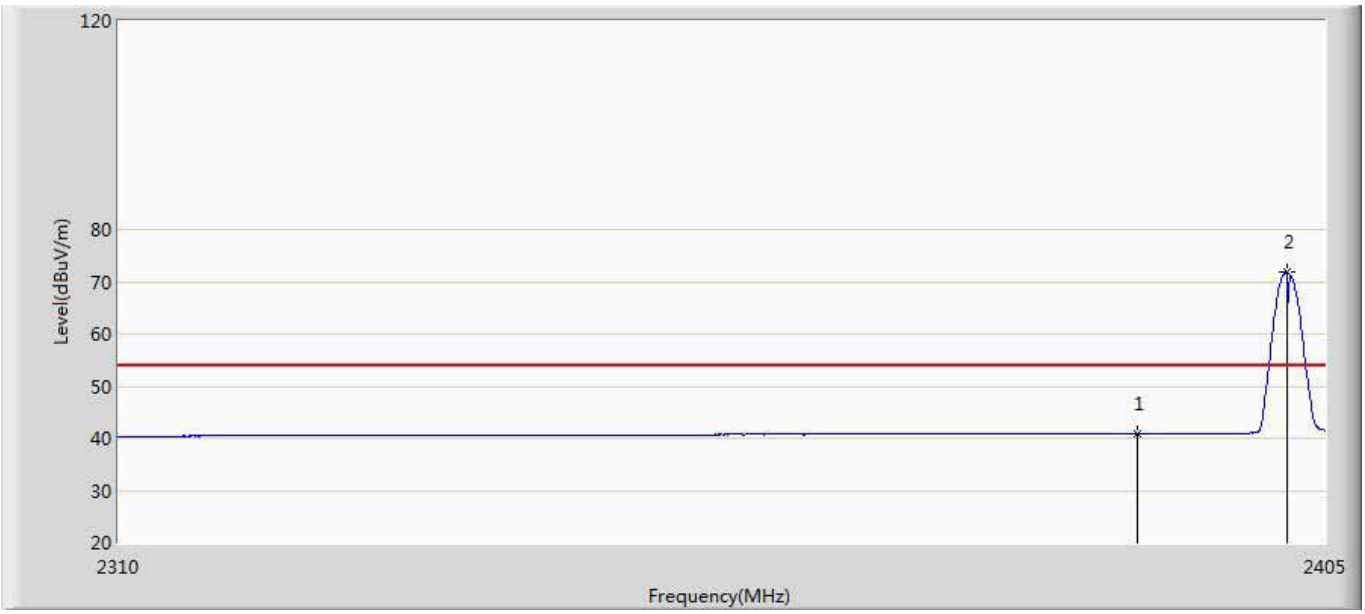
No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		2390.000	40.896	3.905	-13.104	54.000	36.991	AV
2	*	2402.055	76.014	39.007	N/A	N/A	37.006	AV

Engineer: Scott	
Site: AC5	Time: 2015/09/20 - 13:01
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)	Polarity: Horizontal
EUT: IP-STB	Power: AC 120V/60Hz
Note: Mode 1: Transmit at CH2402MHz by BLE	



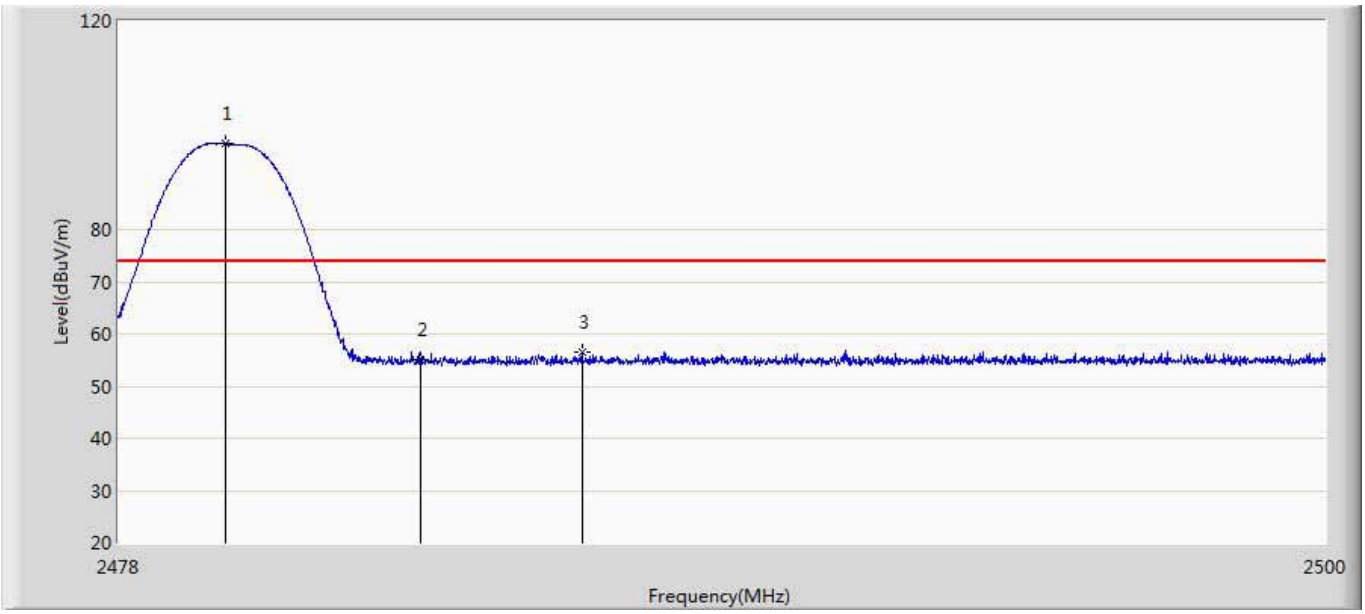
No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		2374.315	55.982	19.038	-18.018	74.000	36.944	PK
2		2390.000	54.227	17.236	-19.773	74.000	36.991	PK
3	*	2402.103	90.419	53.412	N/A	N/A	37.007	PK

Engineer: Scott	
Site: AC5	Time: 2015/09/20 - 13:02
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)	Polarity: Horizontal
EUT: IP-STB	Power: AC 120V/60Hz
Note: Mode 1: Transmit at CH2402MHz by BLE	



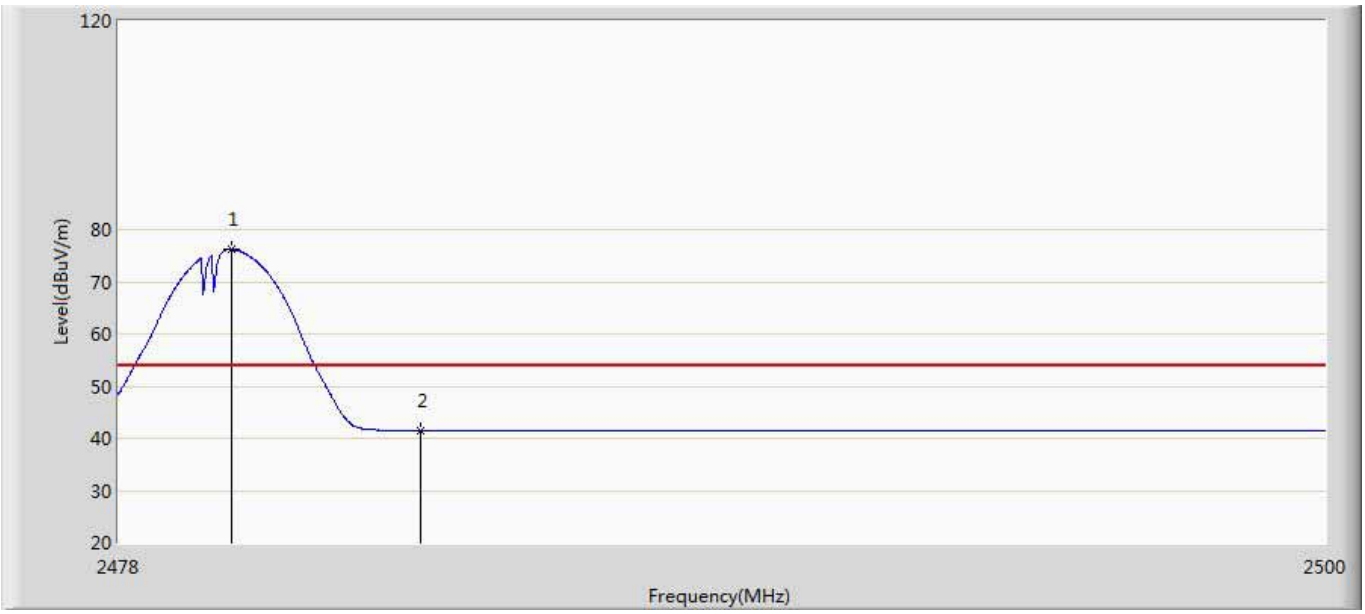
No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		2390.000	40.890	3.899	-13.110	54.000	36.991	AV
2	*	2401.960	72.024	35.017	N/A	N/A	37.006	AV

Engineer: Scott	
Site: AC5	Time: 2015/09/20 - 13:06
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)	Polarity: Vertical
EUT: IP-STB	Power: AC 120V/60Hz
Note: Mode 1: Transmit at CH2480MHz by BLE	



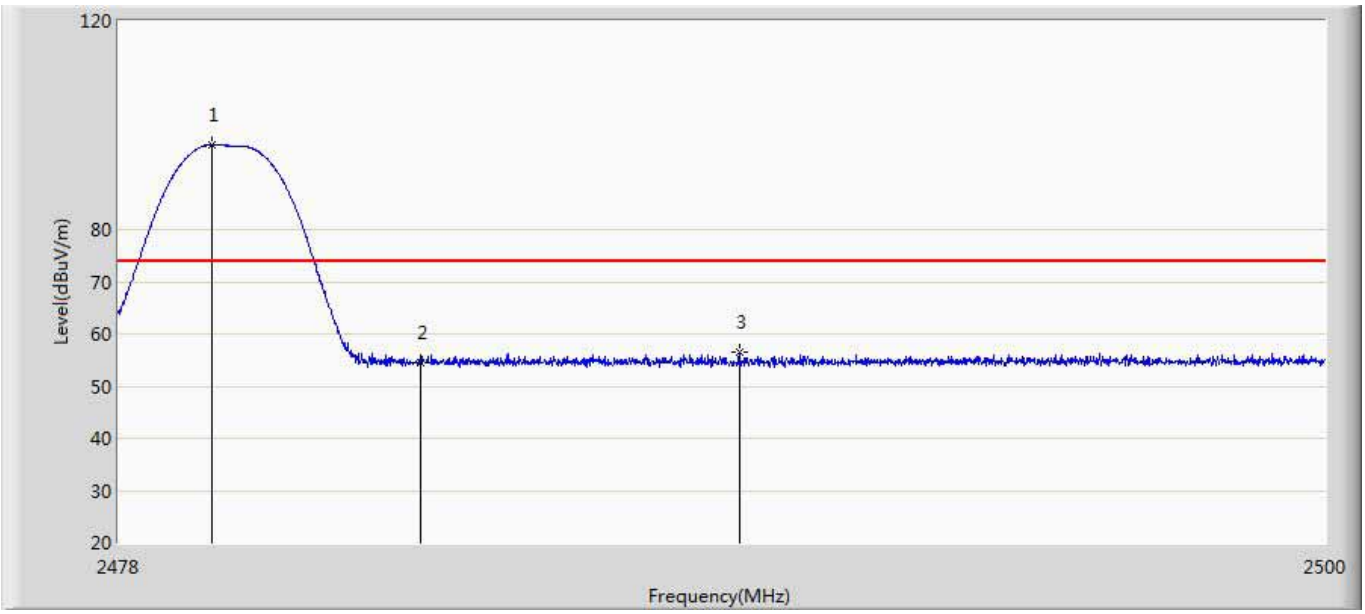
No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2479.947	96.391	59.054	N/A	N/A	37.337	PK
2		2483.500	54.960	17.589	-19.040	74.000	37.371	PK
3		2486.437	56.561	19.161	-17.439	74.000	37.400	PK

Engineer: Scott	
Site: AC5	Time: 2015/09/20 - 13:07
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)	Polarity: Vertical
EUT: IP-STB	Power: AC 120V/60Hz
Note: Mode 1: Transmit at CH2480MHz by BLE	



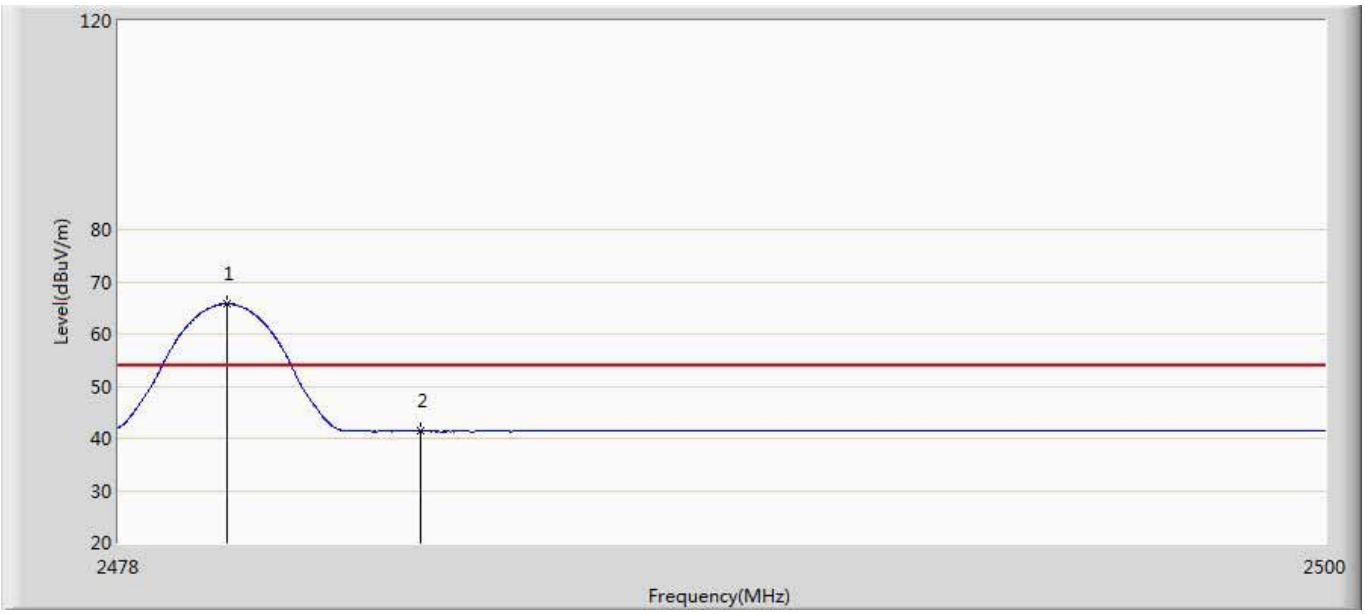
No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2480.046	76.170	38.832	N/A	N/A	37.338	AV
2		2483.500	41.461	4.090	-12.539	54.000	37.371	AV

Engineer: Scott	
Site: AC5	Time: 2015/09/20 - 13:09
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)	Polarity: Horizontal
EUT: IP-STB	Power: AC 120V/60Hz
Note: Mode 1: Transmit at CH2480MHz by BLE	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2479.705	96.249	58.914	N/A	N/A	37.335	PK
2		2483.500	54.350	16.979	-19.650	74.000	37.371	PK
3		2489.297	56.629	19.201	-17.371	74.000	37.428	PK

Engineer: Scott	
Site: AC5	Time: 2015/09/20 - 13:12
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)	Polarity: Horizontal
EUT: IP-STB	Power: AC 120V/60Hz
Note: Mode 1: Transmit at CH2480MHz by BLE	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2479.980	65.712	28.375	N/A	N/A	37.338	AV
2		2483.500	41.344	3.973	-12.656	54.000	37.371	AV

7. 6dB Bandwidth and Occupied Bandwidth

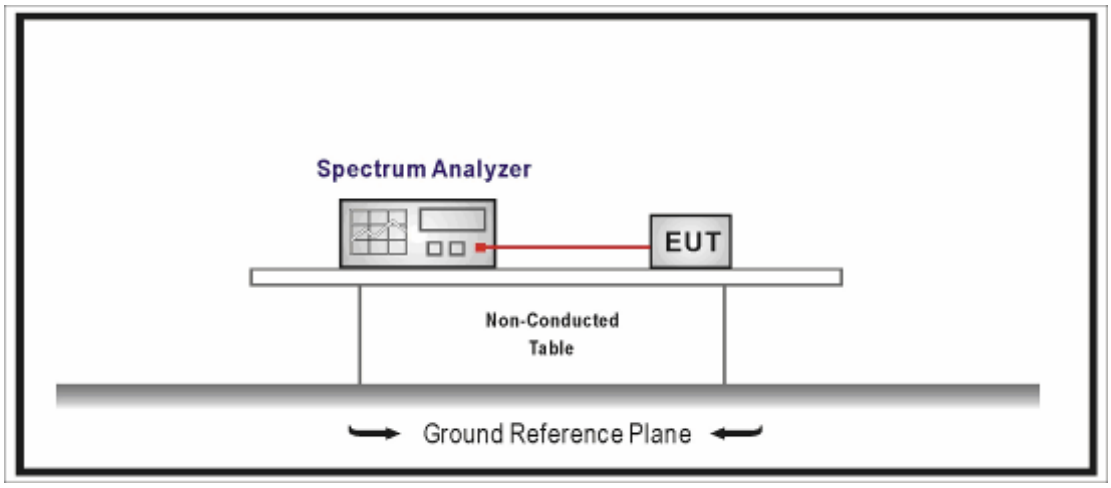
7.1. Test Equipment

Occupied Bandwidth / TR-8

Instrument	Manufacturer	Type No.	Serial No.	Cal. Due Date
Spectrum Analyzer	Agilent	E4446A	MY45300103	2016.01.05
Temperature/Humidity Meter	zhicheng	ZC1-2	TR8-TH	2016.04.09

Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

7.2. Test Setup



7.3. Limit

The minimum 6dB bandwidth shall be at least 500 kHz.

7.4. Test Procedure

The EUT was setup according to ANSI C63.4: 2014; tested according to DTS test procedure of ANSI C63.10 requirements.

When the average power is exercised, the measured power is to be referenced to the OBW (99% occupied bandwidth) rather than to the DTS bandwidth according to Clause 11.9.2.1 of ANSI C63.10.

The 99% bandwidth test is using ANSI C63.10 Section 6.9.3 method.

a) Set RBW = in the range of 1% to 5% of the OBW.
b) Set the video bandwidth (VBW) ≥ 3 × RBW.
c) Detector = Peak.
d) Trace mode = max hold.

e) Sweep = auto couple.

f) Allow the trace to stabilize.

g) Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.

7.5. Uncertainty

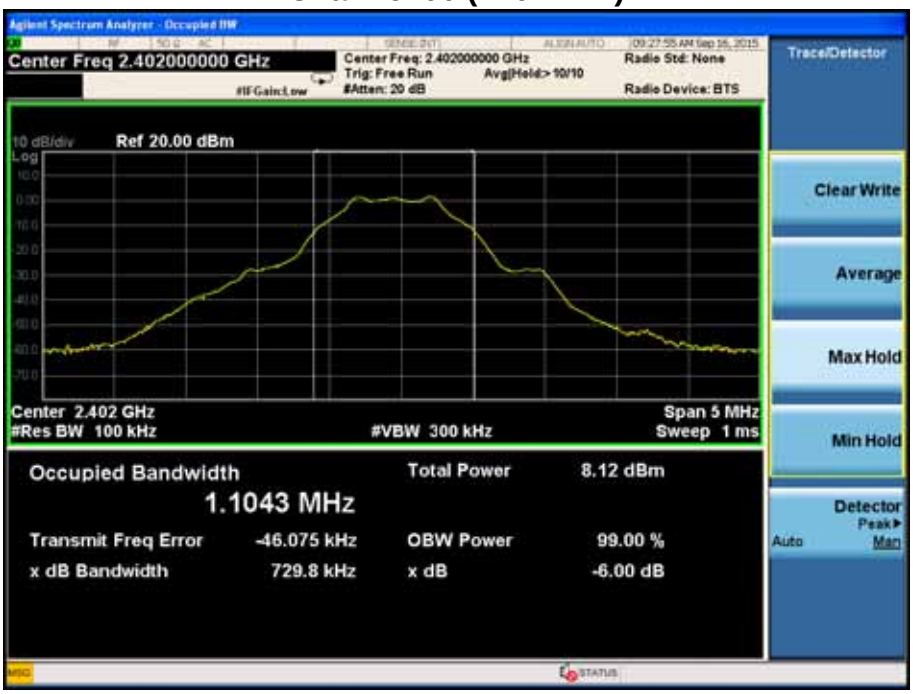
The measurement uncertainty is defined as ± 1 kHz

7.6. Test Result

Product	:	IP-STB
Test Item	:	6dB Bandwidth & 99% Occupied Bandwidth
Test Site	:	TR-8
Test Mode	:	Mode 1: Transmit-1Mbps(GFSK_BLE)

Channel No.	Frequency (MHz)	6dB Bandwidth (kHz)	Occupied Bandwidth (kHz)	Limit (kHz)	Result
00	2402	729.8	1104.3	>500	Pass
19	2440	720.3	1105.0	>500	Pass
39	2480	723.5	1106.1	>500	Pass

Channel 00 (2402MHz)



Channel 19 (2440MHz)

Channel 39 (2480MHz)

8. Power Output

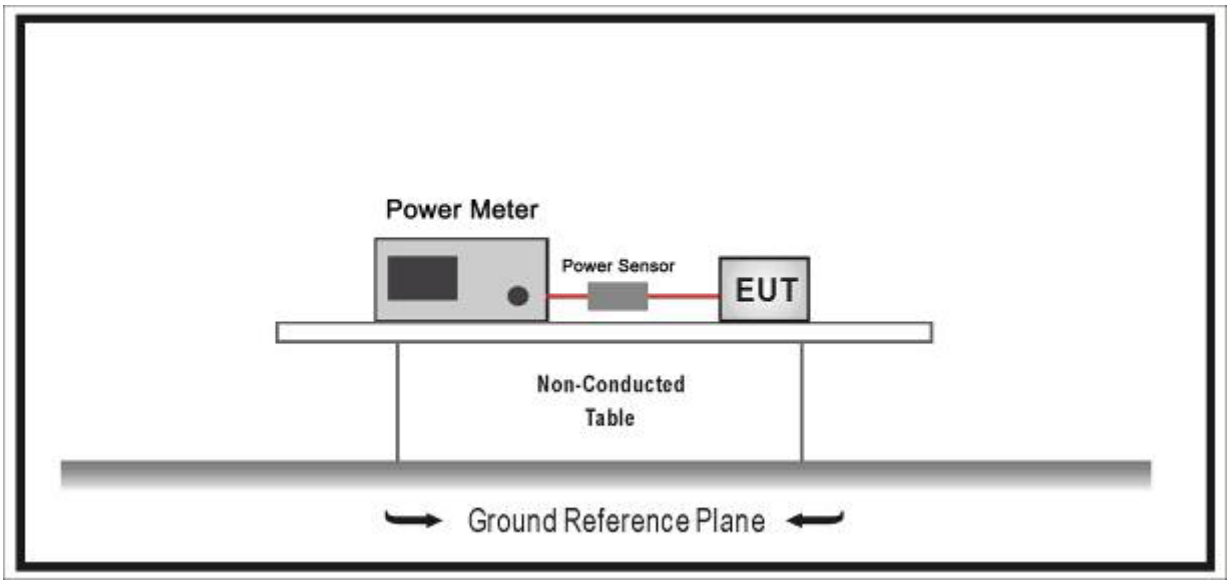
8.1. Test Equipment

Power Output / TR-8

Instrument	Manufacturer	Type No.	Serial No.	Cal. Due Date
Wideband Peak Power Meter	Anritsu	ML2495A	0905006	2015.11.10
Power Sensor	Anritsu	MA2411B	0846014	2015.11.10
Temperature/Humidity Meter	zhicheng	ZC1-2	TR8-TH	2016.04.09

Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

8.2. Test Setup



8.3. Limit

The maximum peak power shall be less 1 Watt (30dBm).

Note: the conducted output power limit specified above is based on the use the antennas with directional gains that do not exceed 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values above, as appropriate, by the amount in dB that the directional gain of antenna exceeds 6 dBi.

For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. Except as provided in Section 5.4(5), the e.i.r.p. shall not exceed 4 W.

8.4. Test Procedure

The EUT was tested according to DTS test procedure of ANSI C63.10 for compliance to FCC 47CFR 15.247 requirements. The maximum conducted output power using ANSI C63.10 section 11.9.1.1 peak power meter method.

1. Power meter and sensor's minimum video bandwidth is 50MHz, larger than occupied bandwidth;
2. Fast responding diode sensors respond immediately to changes in power level to reduce total test time.
3. Use peak detector to test.

8.5. Uncertainty

The measurement uncertainty is defined as ± 1.27 dB

8.6. Test Result

Product	:	IP-STB
Test Item	:	Power Output
Test Site	:	TR8
Test Mode	:	Mode 1: Transmit-1Mbps(GFSK_BLE)

Channel No.	Frequency (MHz)	Power Output (dBm)	Output Power Limit (dBm)	Result
00	2402	4.32	30.00	Pass
19	2440	4.11	30.00	Pass
39	2480	3.87	30.00	Pass

9. Power Spectral Density

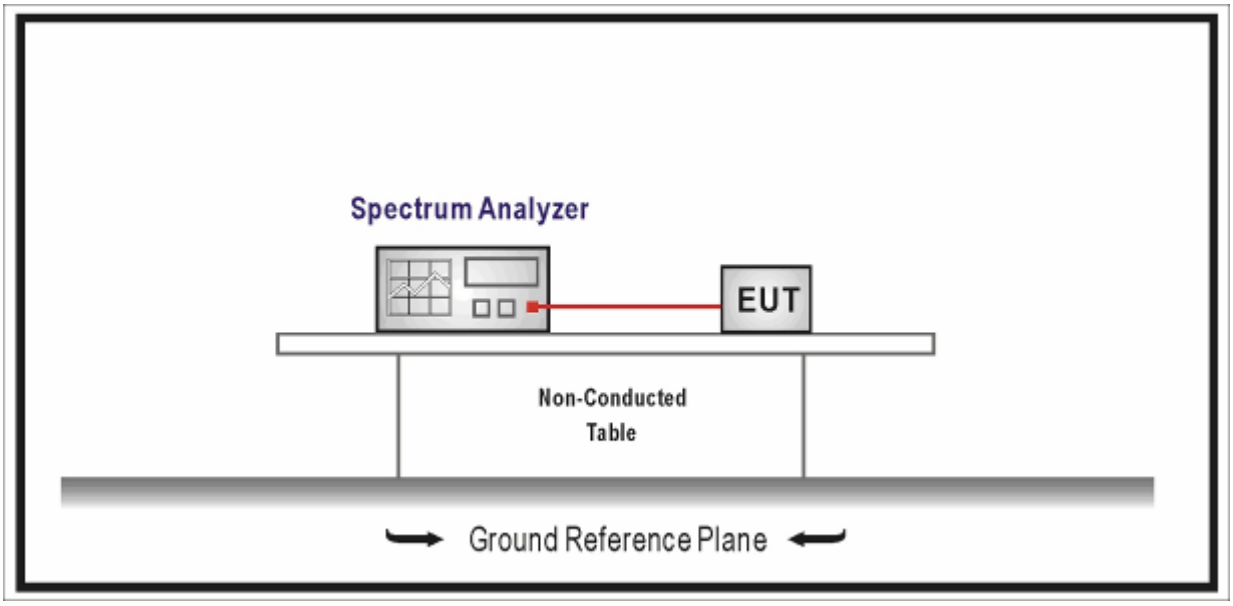
9.1. Test Equipment

Power Spectral Density / TR-8

Instrument	Manufacturer	Type No.	Serial No.	Cali. Due Date
Spectrum Analyzer	Agilent	E4446A	MY45300103	2016.01.05
Temperature/Humidity Meter	zhicheng	ZC1-2	TR8-TH	2016.04.09

Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

9.2. Test Setup



9.3. Limit

For digitally modulated systems, the power spectral density conducted from the intentional radiated to the Antenna shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission.

9.4. Test Procedure

The EUT was setup according to ANSI C63.4, 2014; tested according to DTS test procedure of KDB 558074 for compliance to FCC 47CFR 15.247 requirements.
The maximum power spectral density using KDB 558074 section 10.2 PKPSD (peak PSD) method.

a) Set analyzer center frequency to DTS channel center frequency.
b) Set the span to 1.5 times the DTS bandwidth.

c) Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz. (Actually we use 3kHz RBW)

d) Set the VBW ≥ 3 × RBW.

e) Detector = peak.

f) Sweep time = auto couple.

g) Trace mode = max hold.

h) Allow trace to fully stabilize.

i) Use the peak marker function to determine the maximum amplitude level within the band.

j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

9.5. Uncertainty

The measurement uncertainty is defined as ± 1.27 dB

9.6. Test Result

Product	:	IP-STB
Test Item	:	Power Spectral Density
Test Site	:	TR-8
Test Mode	:	Mode 1: Transmit-1Mbps(GFSK_BLE)

Channel No.	Frequency (MHz)	Measurement PPSD (dBm)	Limit (dBm)	Result
00	2402	-12.033	8	Pass
19	2440	-11.541	8	Pass
39	2480	-11.979	8	Pass

Channel 00 (2402MHz)

Channel 19 (2440MHz)

Channel 39 (2480MHz)

The End