FCC Test Report

Product Name	ICEBOX THERMOSTAT
Model No	NORM
FCC ID.	2AAAH-NORM001
IC ID.	11309A-NORM001

Applicant	Quirky, Inc.
Address	606 W. 28th St. Floor 7 New York United States

Date of Receipt	Oct. 08, 2014
Issue Date	Nov. 06, 2014
Report No.	14A0217R-RFUSP42V01
Report Version	V1.0

Testing Laboratory
3023

Test Report

Issue Date: Nov. 06, 2014
Report No.: 14A0217R-RFUSP42V01

Product Name	ICEBOX THERMOSTAT
Applicant	Quirky, Inc.
Address	606 W. 28th St. Floor 7 New York United States
Manufacturer	Flex Computing
Address	No.1 Guanpu Road, Wuzhong District Suzhou China
Model No.	NORM
FCC ID.	2AAAH-NORM001
IC ID.	11309A-NORM001
EUT Rated Voltage	AC 24V
EUT Test Voltage	AC 24V
Trade Name	Quirky
Applicable Standard	FCC CFR Title 47 Part 15 Subpart C: 2014 ANSI C63.4:2009, KDB 558074 D01 DTS Meas Guidance v03r02 Industry Canada RSS-Gen Issue 3/RSS-210 Issue 8
Test Result	Complied

Documented By : Rita Huang

(Senior Adm. Specialist / Rita Huang)

Tested By : Henk Huang

(Engineer / Henk Huang)

Approved By :

(Manager / Vincent Lin)

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1. GENERAL INFORMATION

1.1. EUT Description

Product Name	ICEBOX THERMOSTAT
Trade Name	Quirky
Model No.	NORM
FCC ID.	2AAAH-NORM001
IC ID.	11309A-NORM001
Frequency Range	2405MHz-2475MHz
Number of Channels	15
Data Speed	250kbps
Type of Modulation	DSSS / O-QPSK
Maximum Power	20.46dBm
Antenna Type	Dipole Antenna
Antenna Gain	Peak 0dBi
Channel Control	Auto
Power Adapter	N/A

Antenna List

No.	Manufacturer	Antenna Type	Peak Gain
1	Flextronics	Dipole	0 dBi for 2.4 GHz

Note:

1. The antenna of EUT is soldered on the PCB, conform to FCC 15.203 Antenna requirement.

Center Frequency of Each Channel:

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
Channel 00:	2405 MHz	Channel 01:	2410 MHz	Channel 02:	2415 MHz	Channel 03:	2420 MHz
Channel 04:	2425 MHz	Channel 05:	2430 MHz	Channel 06:	2435 MHz	Channel 07:	2440 MHz
Channel 08:	2445 MHz	Channel 09:	2450 MHz	Channel 10:	2455 MHz	Channel 11:	2460 MHz
Channel 12:	2465 MHz	Channel 13:	2470 MHz	Channel 14:	2475 MHz		

Note:

1. Regarding to the operation frequency, the lowest, middle and highest frequency are selected to perform the test.

2. The radiation measurements are performed in X, Y, Z axis positioning. Only the worst case is shown in the report.

Test Mode:	Mode 1: Transmit with maximum duty cycle (>98%)

1.2. Operational Description

The EUT is an ICEBOX THERMOSTAT, using zigbee technology but only use 15channels.

This is thermostats used in the air conditioner for North America smart home. The user can control remotely residential HVAC via mobile or cloud APPs through ZigBee.

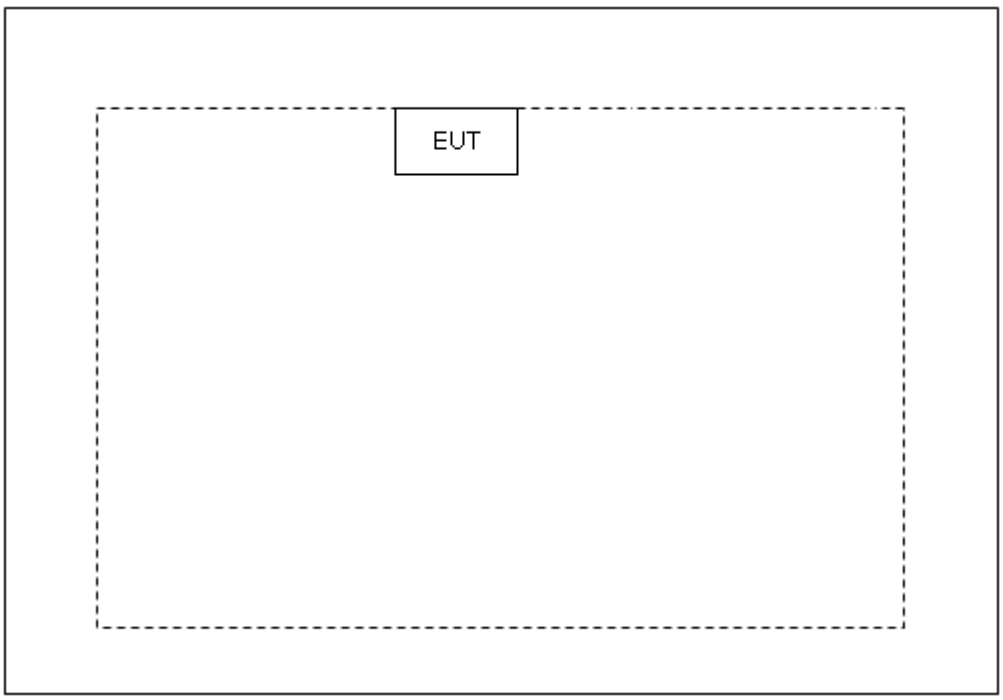
HVAC supply power to this board. Sensor seek room temperature and humidity, then through Zigbee Antenna transmit this signal to gateway, if the user want to adjust current temperature and humidity, then he/she may send change information to gateway when he/she receive this varies. Then through Zigbee Antenna receive this command to inform this board to control air conditioner heating or cooling. Button is for Zigbee network pairing in this board, RGB LED indicates this network signal strength status. Relay is used to switch DC voltage to control AC voltage, then control air conditioner heating or cooling function.

1.3. Tested System Details

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

	Product	Manufacturer	Model No.	Serial No.	Power Cord
1	N/A	N/A	N/A	N/A	N/A

Configuration of Tested System



1.4. EUT Exercise Software

Setup the EUT and simulators as shown on above.
Turn on the power of equipment.
Run the RF test software, and set the test mode and channel, then press OK to start continue transmit or receive.

1.5. Test Facility

Ambient conditions in the laboratory:

Items	Required (IEC 68-1)	Actual
Temperature (°C)	15-35	20-35
Humidity (%RH)	25-75	50-65
Barometric pressure (mbar)	860-1060	950-1000

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/

Site Description: File on
Federal Communications Commission
FCC Engineering Laboratory
7435 Oakland Mills Road
Columbia, MD 21046
Registration Number: 92195

Site Name: Quietek Corporation
Site Address: 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

FCC Accreditation Number: TW1014

2. Conducted Emission

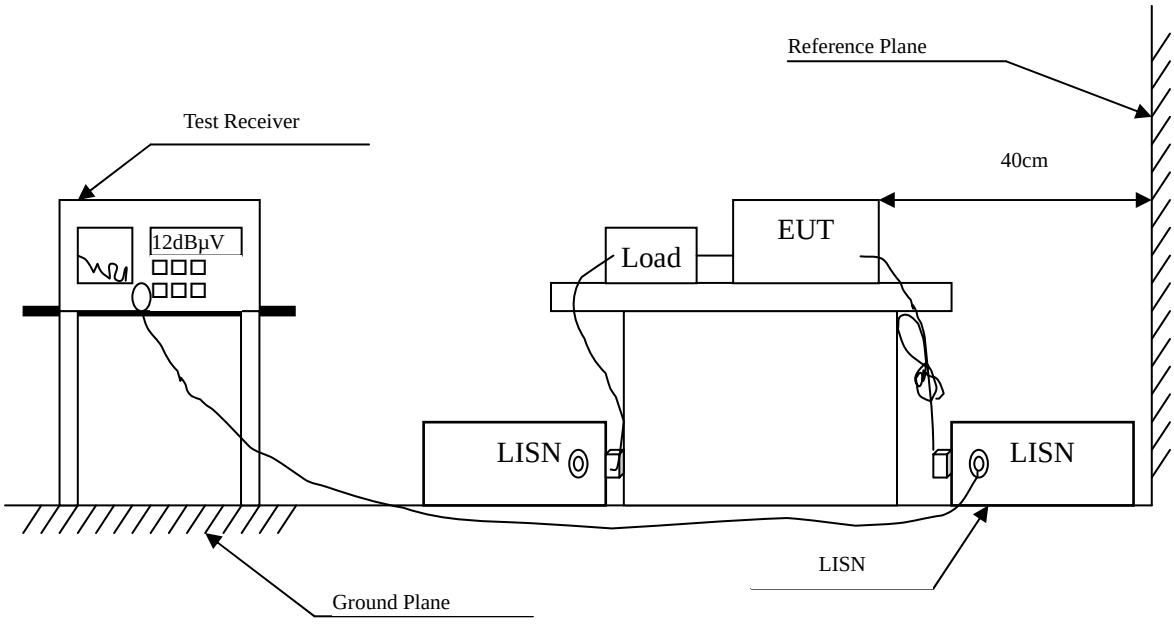
2.1. Test Equipment

	Equipment	Manufacturer	Model No. / Serial No.	Last Cal.	Remark
X	Test Receiver	R & S	ESCS 30 / 825442/018	Sep., 2014	
X	Artificial Mains Network	R & S	ENV4200 / 848411/10	Feb., 2014	Peripherals
X	LISN	R & S	ESH3-Z5 / 825562/002	Feb., 2014	EUT
	DC LISN	Schwarzbeck	8226 / 176	Mar, 2014	EUT
X	Pulse Limiter	R & S	ESH3-Z2 / 357.8810.52	Feb., 2014	
	No.1 Shielded Room				

Note:

1. All equipments are calibrated every one year.
2. The test instruments marked by “X” are used to measure the final test results.

2.2. Test Setup



2.3. Limits

FCC Part 15 Subpart C Paragraph 15.207 (dBµV) Limit		
Frequency MHz	Limits	
	QP	AVG
0.15 - 0.50	66-56	56-46
0.50-5.0	56	46
5.0 - 30	60	50

2.4. Test Procedure

The EUT and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm /50uH coupling impedance with 50ohm termination. (Please refers to the block diagram of the test setup and photographs.)

Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4: 2009 on conducted measurement.

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

2.5. Uncertainty

± 2.26 dB

2.6. Test Result of Conducted Emission

EUT is 24V AC powered it’s connected to the power system. It will not connect the public low voltage power supply system directly, test is not applicable.

3. Peak Power Output

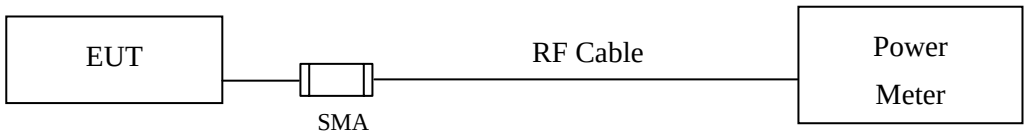
3.1. Test Equipment

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
X	Power Meter	Anritsu	ML2495A/6K00003357	May, 2014
X	Power Sensor	Anritsu	MA2411B/0738448	Jun, 2014

Note:

1. All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.
2. The test instruments marked with "X" are used to measure the final test results.

3.2. Test Setup



3.3. Limits

The maximum peak power shall be less 1 Watt.

3.4. Test Procedure

The EUT was tested according to DTS test procedure of KDB 558074 for compliance to FCC 47CFR 15.247 requirements. The maximum peak conducted output power using KDB 558074 D01 DTS Meas Guidance v03r02 section 9.1.2 PKPM1 Peak power meter method.

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

3.5. Uncertainty

± 1.27 dB

3.6. Test Result of Peak Power Output

Product : ICEBOX THERMOSTAT
Test Item : Peak Power Output Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit with maximum duty cycle

Channel No	Frequency (MHz)	Peak Power Measurement Level (dBm)	Required Limit	Result
0	2405	20.11	<30dBm	Pass
7	2440	20.46	<30dBm	Pass
14	2475	19.56	<30dBm	Pass

Note: Peak Power Output Value =Reading value on power meter + cable loss

4. Radiated Emission

4.1. Test Equipment

The following test equipment are used during the radiated emission test:

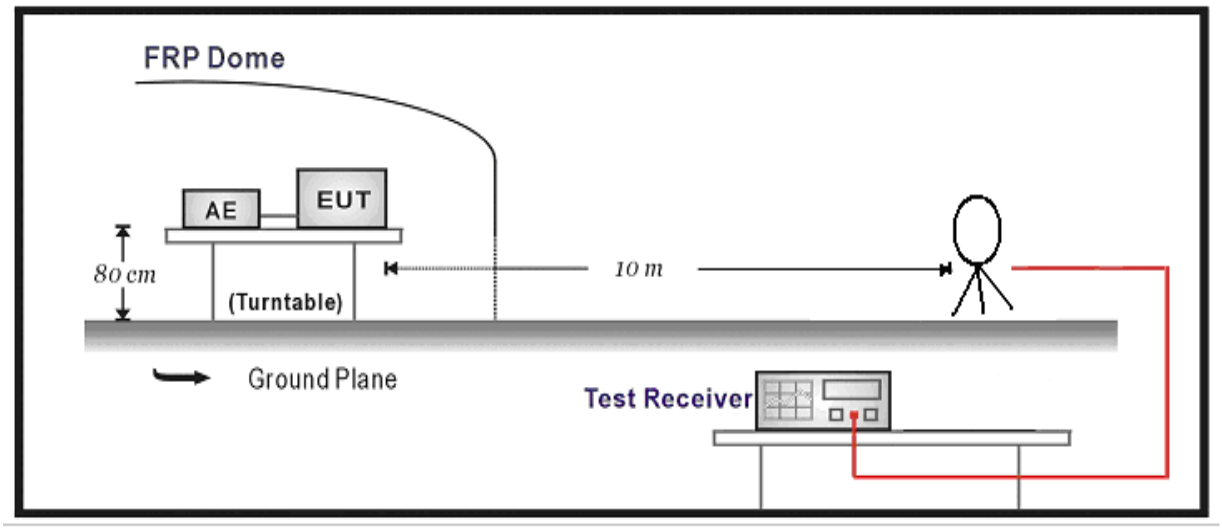
Test Site	Equipment		Manufacturer	Model No./Serial No.	Last Cal.
☒Site # 3	X	Loop Antenna	Teseq	HLA6120 / 26739	Jul., 2014
	X	Bilog Antenna	Schaffner Chase	CBL6112B/2673	Sep., 2014
	X	Horn Antenna	Schwarzbeck	BBHA9120D/D305	Sep., 2014
	X	Horn Antenna	Schwarzbeck	BBHA9170/208	Jul., 2014
	X	Pre-Amplifier	Agilent	8447D/2944A09549	Sep., 2014
	X	Spectrum Analyzer	Agilent	E4407B / US39440758	May, 2014
	X	Test Receiver	R & S	ESCS 30/ 825442/018	Sep., 2014
	X	Coaxial Cable	QuieTek	QTK-CABLE/ CAB5	Feb., 2014
	X	Controller	QuieTek	QTK-CONTROLLER/ CTRL3	N/A
	X	Coaxial Switch	Anritsu	MP59B/6200265729	N/A

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

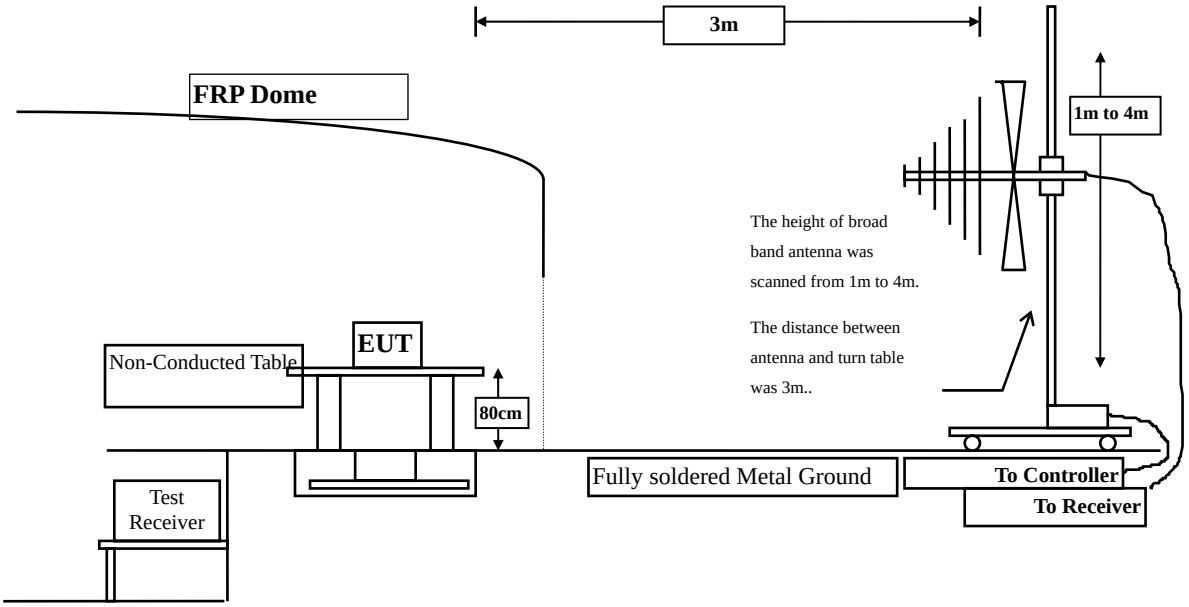
2. The test instruments marked with “X” are used to measure the final test results.

4.2. Test Setup

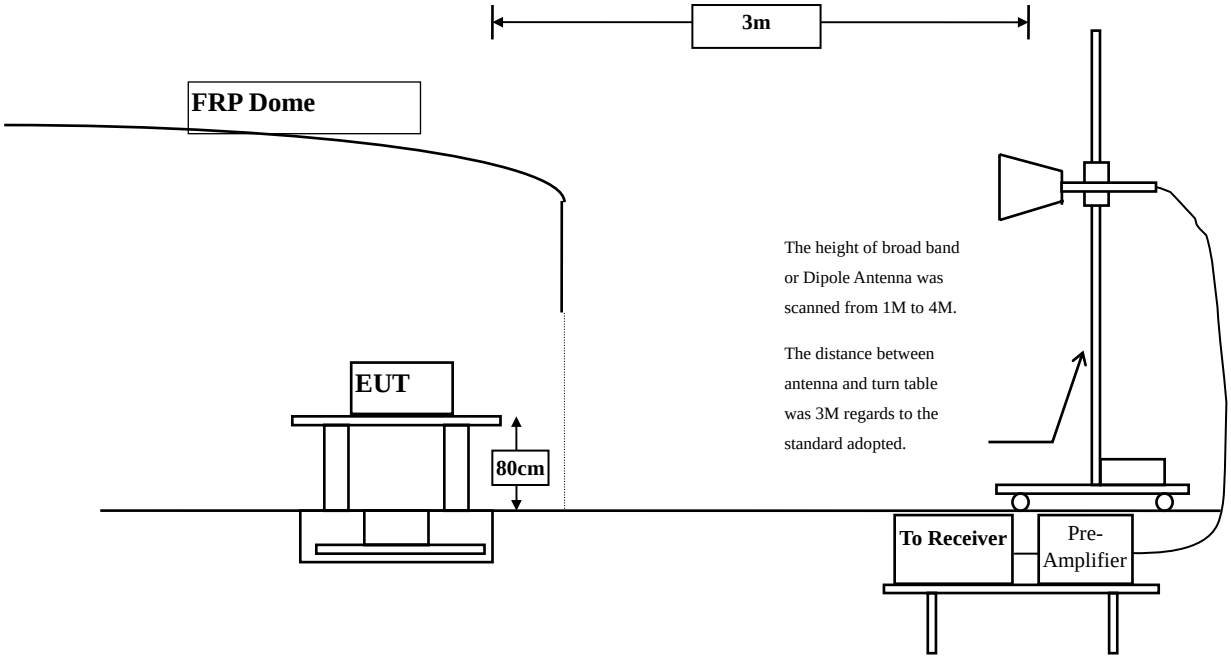
Radiated Emission Below 30MHz



Radiated Emission Below 1GHz



Radiated Emission Above 1GHz



4.3. Limits

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

FCC Part 15 Subpart C Paragraph 15.209(a) Limits		
Frequency MHz	Field strength (microvolts/meter)	Measurement distance (meter)
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
88-216	150	3
216-960	200	3
Above 960	500	3

Remarks: E field strength (dBμV/m) = 20 log E field strength (uV/m)

4.4. Test Procedure

The EUT was setup according to ANSI C63.4: 2009 and tested according to DTS test procedure of KDB558074 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 between 1 meter and 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: 2009 on radiated measurement.
The resolution bandwidth below 30MHz setting on the field strength meter is 9kHz and 30MHz~1GHz is 120kHz and above 1GHz is 1MHz.
Radiated emission measurements below 30MHz are made using Loop Antenna and 30MHz~1GHz are made using broadband Bilog antenna and above 1GHz are made using Horn Antennas.
The measurement is divided into the Preliminary Measurement and the Final Measurement.
The suspected frequencies are searched for in Preliminary Measurement with the measurement antenna kept pointed at the source of the emission both in azimuth and elevation, with the polarization of the antenna oriented for maximum response. The antenna is pointed at an angle towards the source of the emission, and the EUT is rotated in both height and polarization to maximize the measured emission. The emission is kept within the illumination area of the 3 dB bandwidth of the antenna.
The worst radiated emission is measured in the Open Area Test Site on the Final Measurement.
The frequency range from 9kHz to 10th harmonics 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

± 3.9 dB above 1GHz
± 3.8 dB below 1GHz

4.6. Test Result of Radiated Emission

Product : ICEBOX THERMOSTAT
Test Item : Harmonic Radiated Emission Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit with maximum duty cycle

CH	Antenna	Frequency (MHz)	Reading Level (dBuV/m)	Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
0	H	4952.5	34.6	10.5	45.1	54(note6)	-8.9	PK
	H	4952.5	34.6	10.5	45.1	54(note6)	-8.9	PK
	V	7425.0	28.1	12.1	40.2	54(note6)	-13.8	PK
	V	7425.0	26.8	12.1	38.9	54(note6)	-15.1	PK
7	H	4876.0	32.7	10.2	42.9	54(note6)	-11.1	PK
	H	4876.0	33.9	10.2	44.1	54(note6)	-9.9	PK
	V	7320.0	26.7	12.0	38.7	54(note6)	-15.3	PK
	V	7320.0	26.2	12.0	38.2	54(note6)	-15.8	PK
14	H	4810.0	29.9	9.7	39.6	54(note6)	-14.4	PK
	H	4808.0	34.1	9.7	43.8	54(note6)	-10.2	PK
	V	7215.0	24.8	11.9	36.7	54(note6)	-17.3	PK
	V	7215.0	25.3	11.9	37.2	54(note6)	-16.8	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

The worst case of Radiated Emission below 1GHz: (Mode: Transmit @2405MHz)

From 9kHz~30MHz

Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Remark
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Note: The amplitude of emissions are more than 20dB attenuation below the limit. So no reading is reported.

From 30MHz~1GHz

Horizontal:

Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
133.790	24.719	1.058	-18.781	43.500	23.661	QP
255.525	27.060	0.419	-18.940	46.000	26.641	QP

Vertical:

Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
129.425	24.190	1.567	-19.310	43.500	22.623	QP
255.525	25.943	1.408	-20.057	46.000	24.535	QP

Note:

1. Measurement Level = Reading Level + Correct Factor.
2. Correct Factor = Antenna factor + Cable loss –Amplifier gain.

5. RF antenna conducted test

5.1. Test Equipment

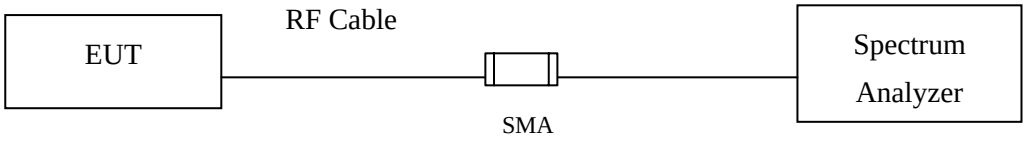
	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
	Spectrum Analyzer	R&S	FSP40 / 100170	Jun, 2014
	Spectrum Analyzer	Agilent	E4407B / US39440758	Jun, 2014
X	Spectrum Analyzer	Agilent	N9010A / MY48030495	Apr., 2014

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

2. The test instruments marked with "X" are used to measure the final test results.

5.2. Test Setup

RF antenna Conducted Measurement:



5.3. Limits

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. Attenuation below the general limits specified in Section 15.209(a) is not required. 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)).

5.4. Test Procedure

The EUT was tested according to DTS test procedure of Jan. 2012 KDB558074 for compliance to FCC 47CFR 15.247 requirements.

Set RBW = 100 kHz, Set VBW> RBW, scan up through 10th harmonic.

5.5. Uncertainty

The measurement uncertainty
Conducted is defined as ± 1.27dB

5.6. Test Result of RF antenna conducted test

Product : ICEBOX THERMOSTAT
Test Item : RF antenna conducted test
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit with maximum duty cycle

Channel 0 (2405MHz)

Channel 7 (2440MHz)

Channel 14 (2475MHz)

6. Band Edge

6.1. Test Equipment

RF Conducted Measurement

The following test equipments are used during the band edge tests:

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
	Spectrum Analyzer	R&S	FSP40 / 100170	Jun, 2014
	Spectrum Analyzer	Agilent	E4407B / US39440758	Jun, 2014
X	Spectrum Analyzer	Agilent	N9010A / MY48030495	Apr., 2014

Note:

1. All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.
2. The test instruments marked with "X" are used to measure the final test results.

RF Radiated Measurement:

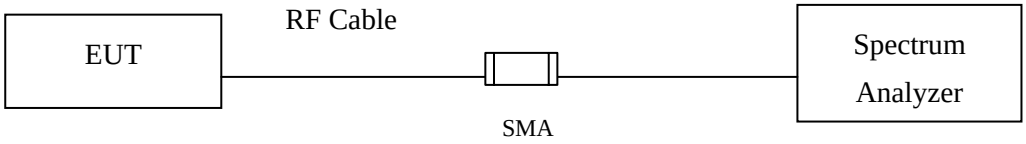
The following test equipments are used during the band edge tests:

Test Site		Equipment	Manufacturer	Model No./Serial No.	Last Cal.
☒Site # 3		Bilog Antenna	Schaffner Chase	CBL6112B/2673	Sep., 2014
	X	Horn Antenna	Schwarzbeck	BBHA9120D/D305	Sep., 2014
		Horn Antenna	Schwarzbeck	BBHA9170/208	Jul., 2014
	X	Pre-Amplifier	Agilent	8447D/2944A09549	Sep., 2014
	X	Spectrum Analyzer	Agilent	E4407B / US39440758	May, 2014
		Test Receiver	R & S	ESCS 30/ 825442/018	Sep., 2014
	X	Coaxial Cable	QuieTek	QTK-CABLE/ CAB5	Feb., 2014
	X	Controller	QuieTek	QTK-CONTROLLER/ CTRL3	N/A
	X	Coaxial Switch	Anritsu	MP59B/6200265729	N/A

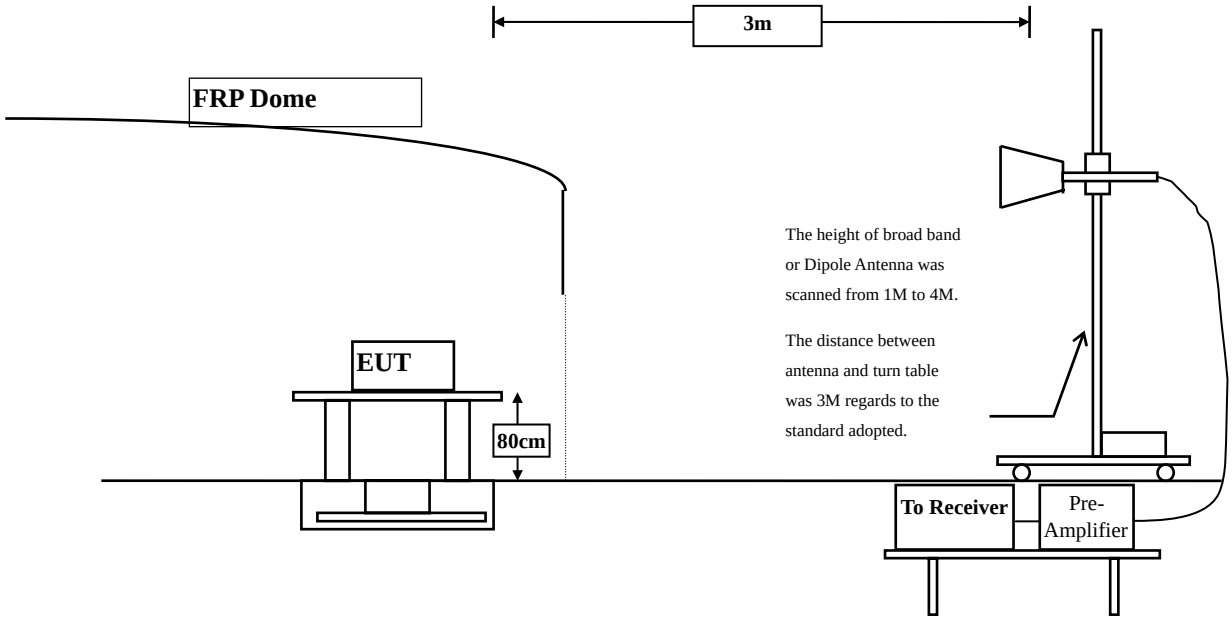
Note: 1. All instruments are calibrated every one year.
2. The test instruments marked by "X" are used to measure the final test results.

6.2. Test Setup

RF Conducted Measurement



RF Radiated Measurement:



6.3. Limits

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

6.4. Test Procedure

The EUT was setup according to ANSI C63.4: 2009 and tested according to DTS test procedure of KDB558074 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: 2009 on radiated measurement.

Since the EUT can be set to transmit continuouly (Duty cycle >98%), use KDB 558074 Section 11.13.3.3 to perform band edge test for average value.

If the EUT can be configured or modified to transmit continuously (D ≥ 98%), then the average emission levels within 2 MHz of the authorized band edge may be measured using the following method (with EUT transmitting continuously):

a) Set instrument center frequency to the frequency of the emission to be measured (must be within 2 MHz of the authorized band edge).

b) Set span to 2 MHz.

c) RBW = 100 kHz.

d) VBW ≥ [3 × RBW].

e) Detector = RMS (power averaging), if [span / (# of points in sweep)] ≤ (RBW / 2).

f) Averaging type = power (i.e., rms).

1) As an alternative, the detector and averaging type may be set for linear voltage averaging.

2) Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.

g) Sweep time = auto.

h) Perform a trace average of at least 100 traces.

i) Compute the power by integrating the spectrum over 1 MHz using the analyzer's band power measurement function with band limits set equal to the emission frequency (femission) ± 0.5 MHz. If the instrument does not have a band power function, then sum the amplitude levels (in power units) at 100 kHz intervals extending across the 1 MHz spectrum defined by femission ± 0.5 MHz.

6.5. Uncertainty

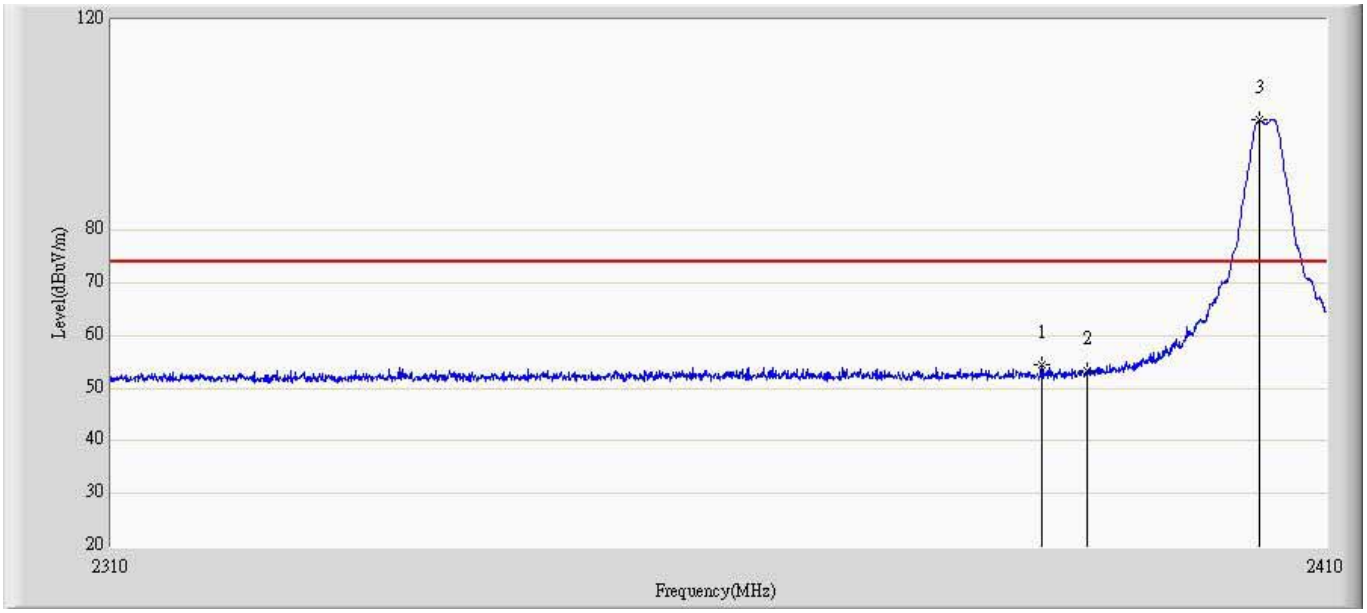
± 3.9 dB above 1GHz

± 3.8 dB below 1GHz

6.6. Test Result of Band Edge

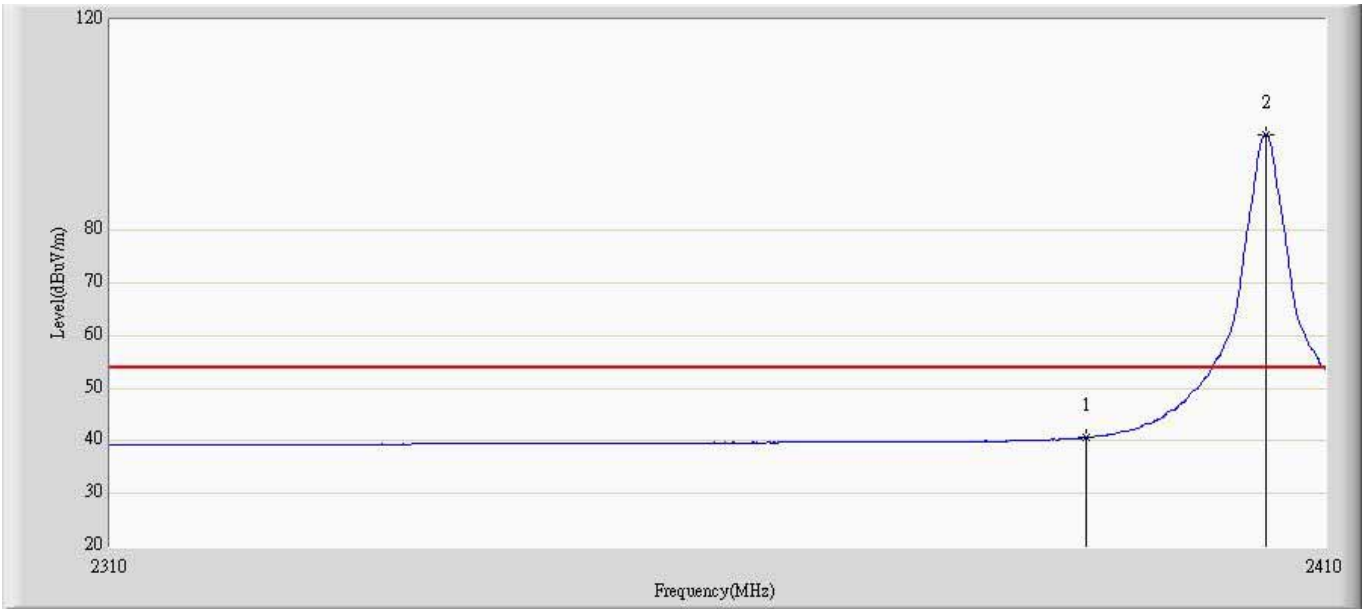
Product : ICEBOX THERMOSTAT
Test Item : Band Edge Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit with maximum duty cycle (2405MHz)

Site: No.3	Time: 2014/10/28 - 14:41
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: BBHA9120D _00167055(1-18GHz)	Polarity: Horizontal
EUT: ICEBOX THERMOSTAT	Power: AC 24V/60Hz
Note: Mode 1 transmit at 2405MHz	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor	Type
1			2386.200	54.379	16.705	-19.621	74.000	37.674	PK
2			2390.000	53.359	15.666	-20.641	74.000	37.693	PK
3		*	2404.400	100.905	63.141	N/A	N/A	37.764	PK

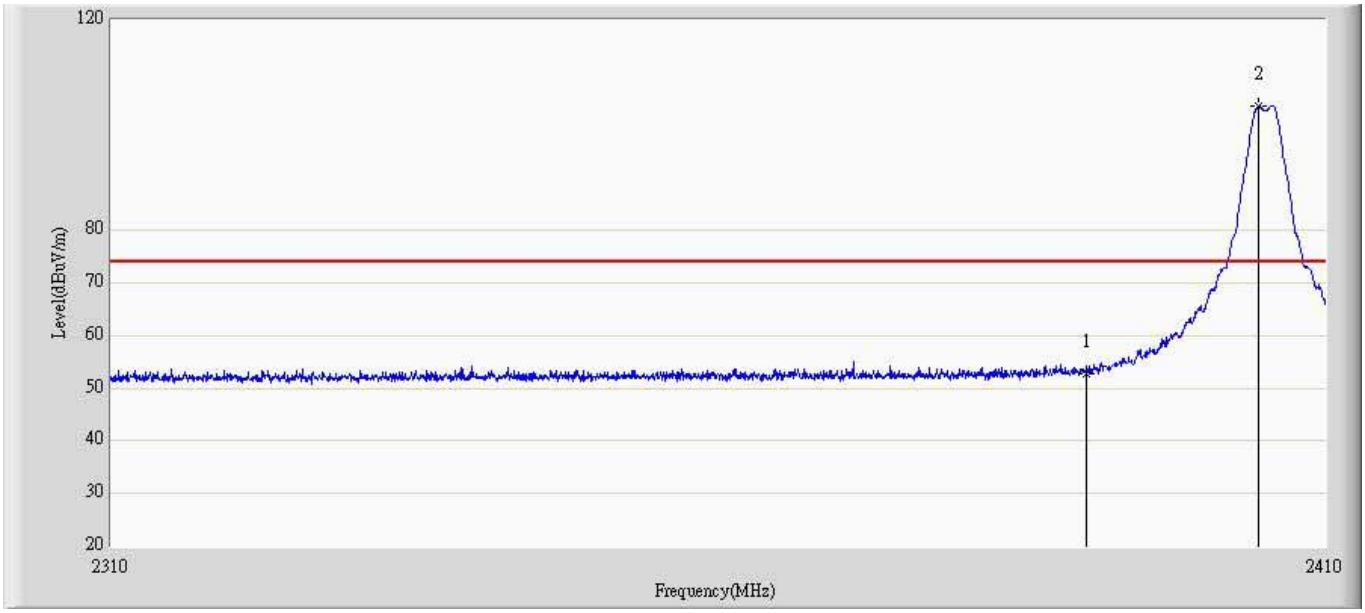
Site: No.3	Time: 2014/10/28 - 14:46
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: BBHA9120D _00167055(1-18GHz)	Polarity: Horizontal
EUT: ICEBOX THERMOSTAT	Power: AC 24V/60Hz
Note: Mode 1 transmit at 2405MHz	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor	Type
1			2390.000	40.607	2.914	-13.393	54.000	37.693	AV
2		*	2405.050	98.301	60.534	N/A	N/A	37.767	AV

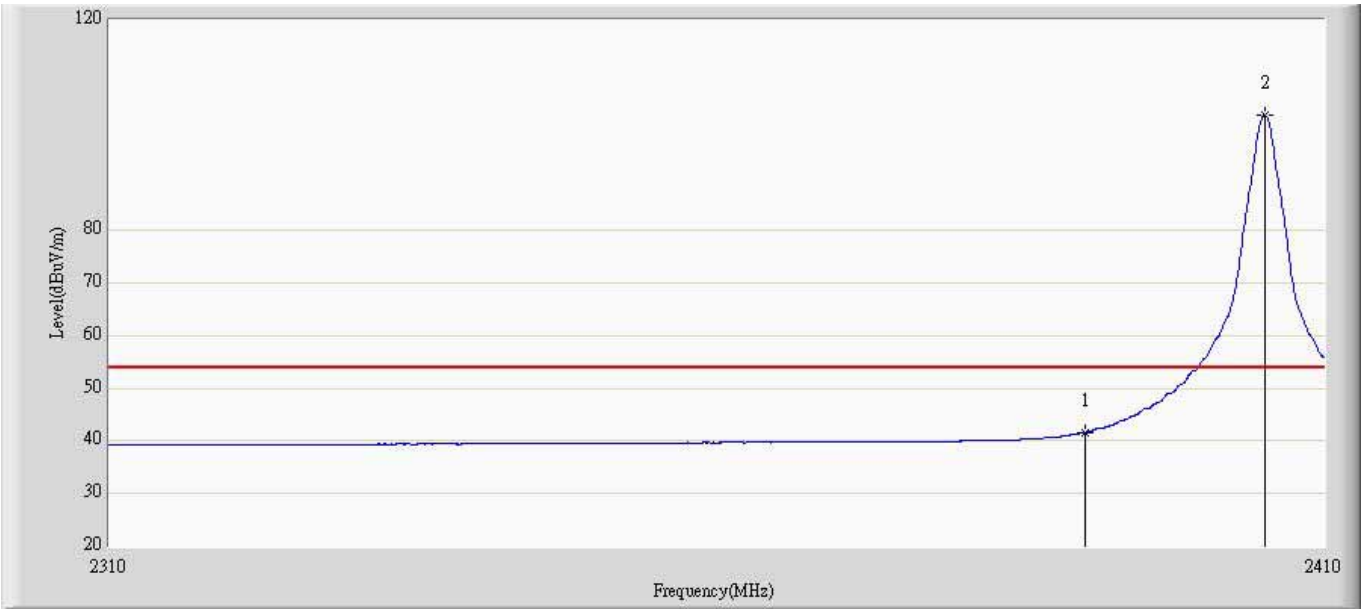
Note: For the 2390MHz point, it’s integrate within 1MHz channel power and with trace average.

Site: AC5	Time: 2014/10/28 - 14:54
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: BBHA9120D _00167055(1-18GHz)	Polarity: Vertical
EUT: ICEBOX THERMOSTAT	Power: AC 24V/60Hz
Note: Mode 1 transmit at 2405MHz	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor	Type
1			2390.000	52.708	15.015	-21.292	74.000	37.693	PK
2		*	2404.400	103.495	65.731	N/A	N/A	37.764	PK

Site: AC5	Time: 2014/10/28 - 14:54
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: BBHA9120D _00167055(1-18GHz)	Polarity: Vertical
EUT: ICEBOX THERMOSTAT	Power: AC 24V/60Hz
Note: Mode 1 transmit at 2405MHz	

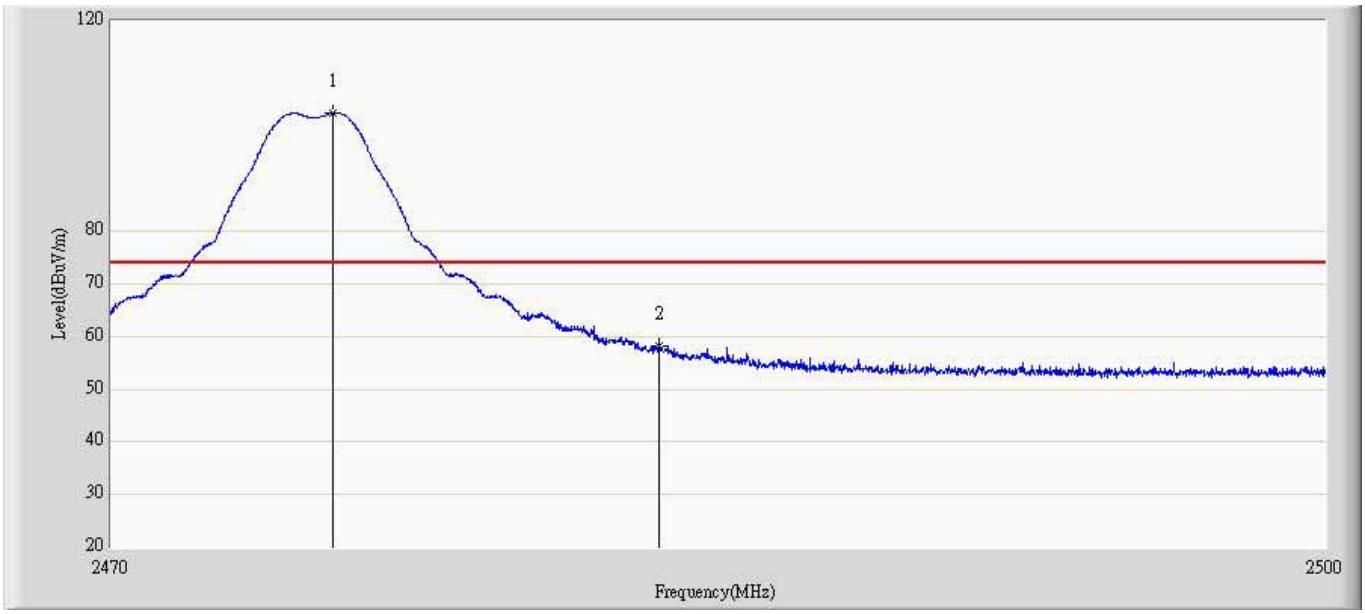


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor	Type
1			2390.000	41.601	3.908	-12.399	54.000	37.693	AV
2		*	2405.050	101.814	64.047	N/A	N/A	37.767	AV

Note: For the 2390MHz point, it’s integrate within 1MHz channel power and with trace average.

Product : ICEBOX THERMOSTAT
Test Item : Band Edge Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit with maximum duty cycle

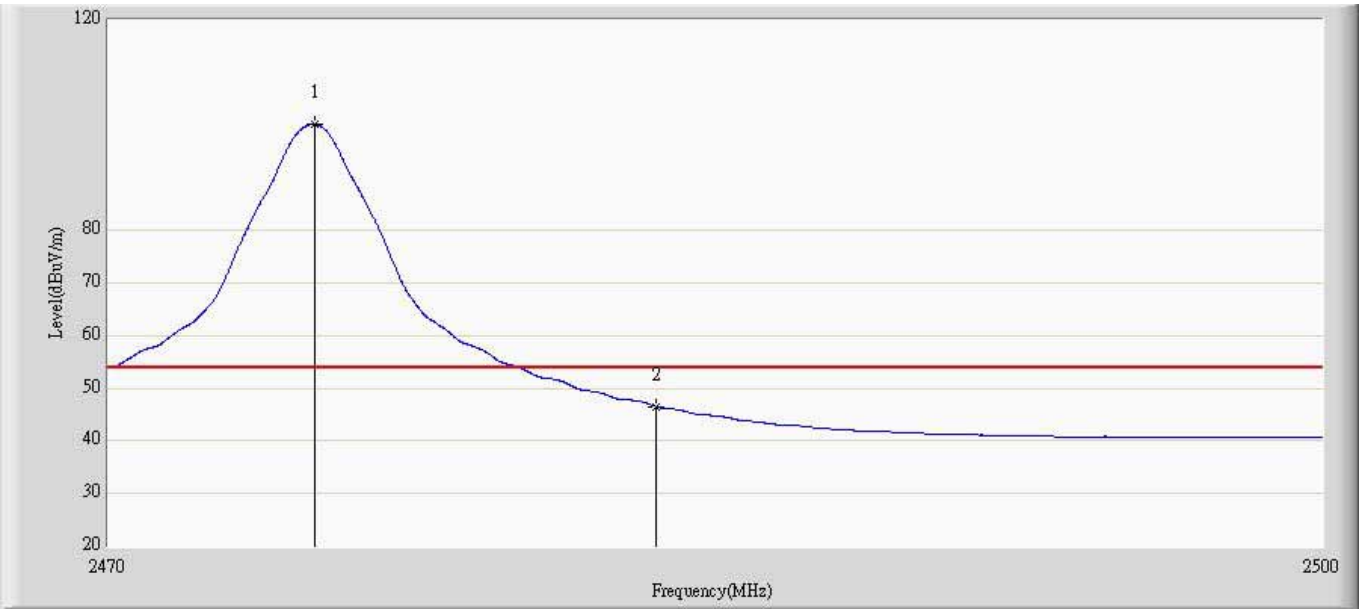
Site: AC5	Time: 2014/10/28 - 14:59
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: BBHA9120D _00167055(1-18GHz)	Polarity: Horizontal
EUT: ICEBOX THERMOSTAT	Power: AC 24V/60Hz
Note: Mode 1 transmit at 2475MHz	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor	Type
1		*	2475.460	102.455	64.343	N/A	N/A	38.111	PK
2			2483.500	58.078	19.927	-15.922	74.000	38.150	PK

Note: For the 2483.5MHz point, it's integrate within 1MHz channel power and with trace average.

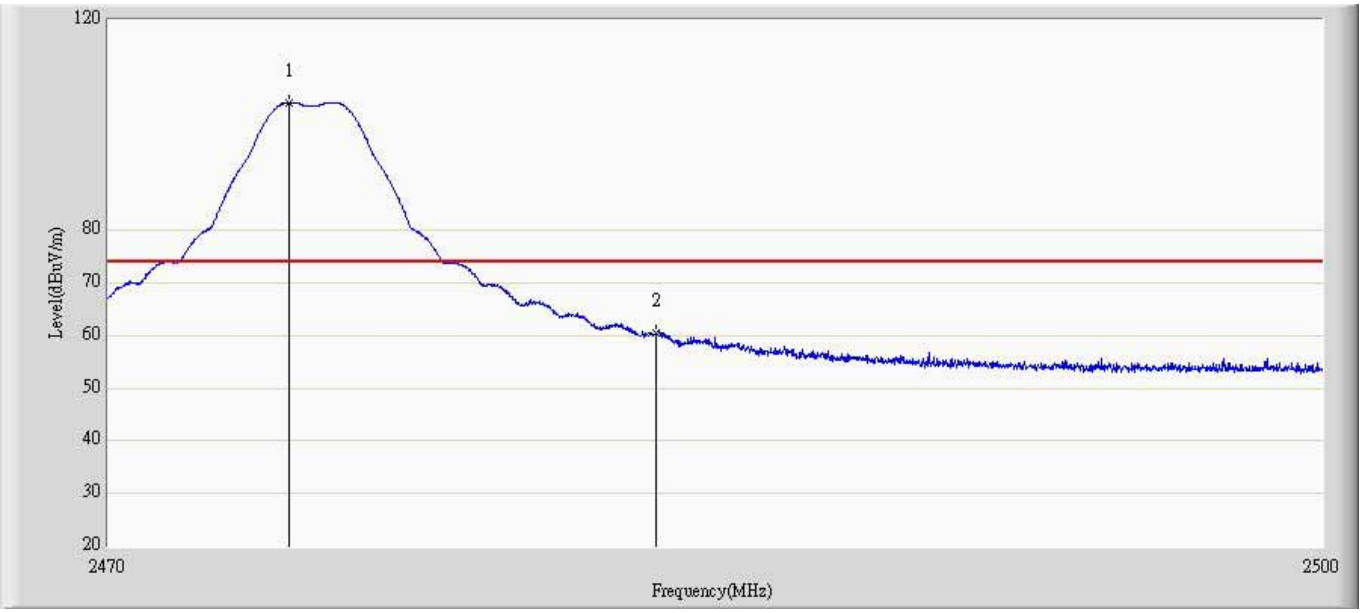
Site: AC5	Time: 2014/10/28 - 15:00
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: BBHA9120D _00167055(1-18GHz)	Polarity: Horizontal
EUT: ICEBOX THERMOSTAT	Power: AC 24V/60Hz
Note: Mode 1 transmit at 2475MHz	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor	Type
1		*	2475.085	100.155	62.045	N/A	N/A	38.110	AV
2			2483.500	46.511	8.360	-7.489	54.000	38.150	AV

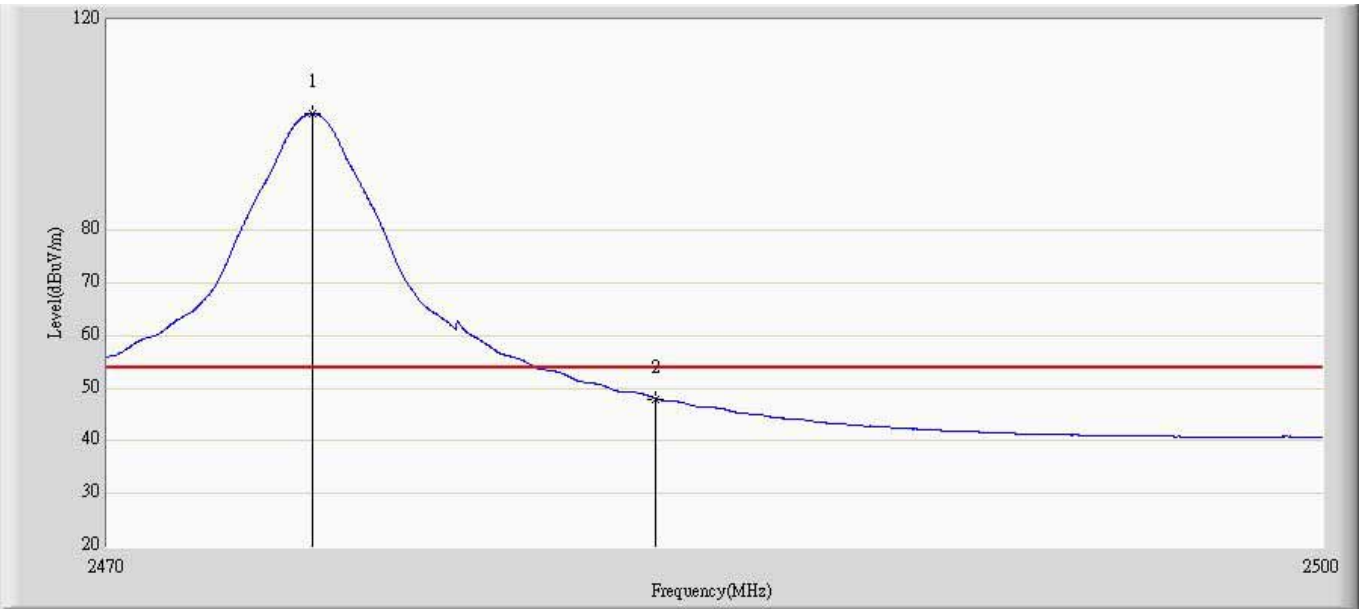
Note: For the 2483.5MHz point, it’s integrate within 1MHz channel power and with trace average.

Site: AC5	Time: 2014/10/28 - 15:03
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: BBHA9120D _00167055(1-18GHz)	Polarity: Vertical
EUT: ICEBOX THERMOSTAT	Power: AC 24V/60Hz
Note: Mode 1 transmit at 2475MHz	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor	Type
1		*	2474.455	104.319	66.212	N/A	N/A	38.107	PK
2			2483.500	60.398	22.247	-13.602	74.000	38.150	PK

Site: AC5	Time: 2014/10/28 - 15:05
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: BBHA9120D _00167055(1-18GHz)	Polarity: Vertical
EUT: ICEBOX THERMOSTAT	Power: AC 24V/60Hz
Note: Mode 1 transmit at 2475MHz	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor	Type
1		*	2475.040	102.146	64.036	N/A	N/A	38.110	AV
2			2483.500	48.017	9.866	-5.983	54.000	38.150	AV

Note: For the 2483.5MHz point, it’s integrate within 1MHz channel power and with trace average.

7. Occupied Bandwidth

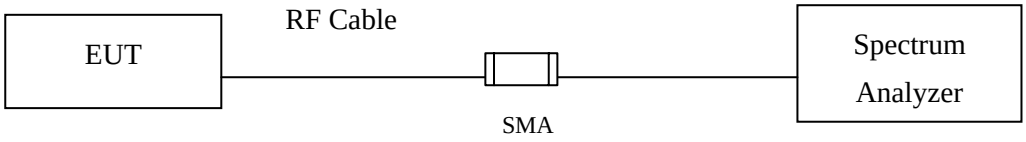
7.1. Test Equipment

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
	Spectrum Analyzer	R&S	FSP40 / 100170	Jun, 2014
	Spectrum Analyzer	Agilent	E4407B / US39440758	Jun, 2014
X	Spectrum Analyzer	Agilent	N9010A / MY48030495	Apr., 2014

Note:

1. All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.
2. The test instruments marked with "X" are used to measure the final test results.

7.2. Test Setup



7.3. Limits

The minimum bandwidth shall be at least 500 kHz.

7.4. Test Procedure

The EUT was setup according to ANSI C63.4: 2009; tested according to DTS test procedure of KDB558074 for compliance to FCC 47CFR 15.247 requirements.

The 6dB bandwidth test is using KDB 558074 Section 8.1 option 1 method.

a) Set RBW = 100 kHz.

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) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

7.5. Uncertainty

± 150Hz

7.6. Test Result of Occupied Bandwidth

Product : ICEBOX THERMOSTAT
Test Item : Occupied Bandwidth Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit with maximum duty cycle (2405MHz)

Channel No.	Frequency (MHz)	6dB BW (kHz)	99% BW (kHz)	Required Limit (kHz)	Result
1	2405	1603	2453.6	>500	Pass

Figure Channel 0 (2405MHz):

Product : ICEBOX THERMOSTAT
Test Item : Occupied Bandwidth Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit with maximum duty cycle (2440MHz)

Channel No.	Frequency (MHz)	6dB BW (kHz)	99% BW (kHz)	Required Limit (kHz)	Result
7	2440	1620	2476.8	>500	Pass

Figure Channel 7 (2440MHz):

Product : ICEBOX THERMOSTAT
Test Item : Occupied Bandwidth Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit with maximum duty cycle (2475MHz)

Channel No.	Frequency (MHz)	6dB BW (kHz)	99% BW (kHz)	Required Limit (kHz)	Result
14	2475	1623	2483.8	>500	Pass

Figure Channel 14 (2475MHz):

8. Operation Frequency Range of 20dB Bandwidth

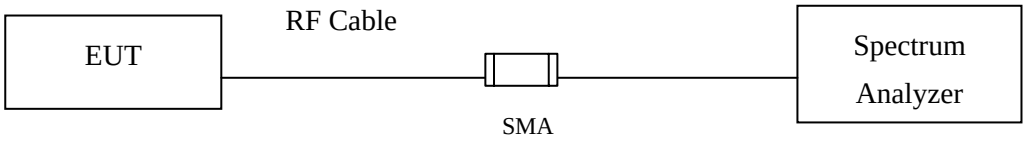
8.1. Test Equipment

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
	Spectrum Analyzer	R&S	FSP40 / 100170	Jun, 2014
	Spectrum Analyzer	Agilent	E4407B / US39440758	Jun, 2014
X	Spectrum Analyzer	Agilent	N9010A / MY48030495	Apr., 2014

Note:

3. All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.
4. The test instruments marked with "X" are used to measure the final test results.

8.2. Test Setup



8.3. Limits

The 20 dB bandwidth of the emission is contained within the operation frequency band.

8.4. Test Procedure

The EUT was setup according to ANSI C63.4: 2009; tested according to DTS test procedure of KDB558074 for compliance to FCC 47CFR 15.247 requirements.

The 20dB bandwidth test is using KDB 558074 Section 8.1 option 1 method.

a) Set RBW = 100 kHz.

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) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 20dB relative to the maximum level measured in the fundamental emission.

h) Remark the 20dB down frequency point and make sure this is within the operating frequency band.

8.5. Uncertainty

± 150Hz

8.6. Test Result of Occupied Bandwidth

Product : ICEBOX THERMOSTAT
Test Item : Occupied Bandwidth Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit with maximum duty cycle (2405MHz)

Channel No.	Center Frequency (MHz)	Measurement Frequency (MHz)	Required Limit (MHz)	Result
1	2405	2403.66	>2400	Pass

Figure Channel 0 (2405MHz):

Product : ICEBOX THERMOSTAT
Test Item : Occupied Bandwidth Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit with maximum duty cycle (2475MHz)

Channel No.	Center Frequency (MHz)	Measurement Frequency (MHz)	Required Limit (MHz)	Result
7	2475	2476.345	<2483.5	Pass

Figure Channel 7 (2475MHz):

9. Power Density

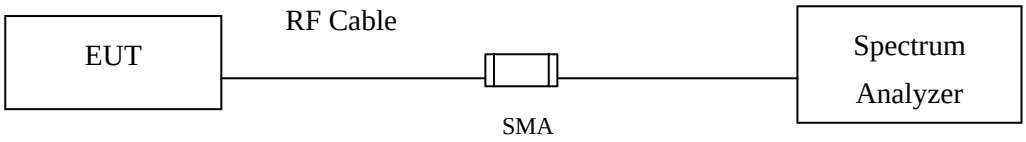
9.1. Test Equipment

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
	Spectrum Analyzer	R&S	FSP40 / 100170	Jun, 2014
X	Spectrum Analyzer	Agilent	E4407B / US39440758	Jun, 2014
	Spectrum Analyzer	Agilent	N9010A / MY48030495	Apr., 2014

Note:

1. All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.
2. The test instruments marked with "X" are used to measure the final test results.

9.2. Test Setup



9.3. Limits

The transmitted power density averaged over any time interval of continuous transmission shall not be greater +8dBm in any 3kHz bandwidth.

9.4. Test Procedure

The EUT was setup according to ANSI C63.10, 2009; 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 $\leqslant$ RBW $\leqslant$ 100 kHz. (Actually we use 3kHz RBW)

d) Set the VBW $\geqslant$ 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 withi

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

9.5. Uncertainty

± 1.27 dB

9.6. Test Result of Power Density

Product : ICEBOX THERMOSTAT
Test Item : Power Density Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit with maximum duty cycle (2405MHz)

Channel No.	Frequency (MHz)	Measure Level (dBm)	Limit (dBm)	Result
1	2405	5.779	< 8dBm	Pass

Figure Channel 0 (2405MHz):

Product : ICEBOX THERMOSTAT
Test Item : Power Density Data
Test Site : No.3OATS
Test Mode : Mode 1: Transmit with maximum duty cycle (2440MHz)

Channel No.	Frequency (MHz)	Measurement Level (dBm)	Required Limit (dBm)	Result
7	2440	5.941	< 8dBm	Pass

Figure Channel 7 (2440MHz):

Product : ICEBOX THERMOSTAT
Test Item : Power Density Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit with maximum duty cycle (2475MHz)

Channel No.	Frequency (MHz)	Measurement Level (dBm)	Required Limit (dBm)	Result
14	2475	5.278	< 8dBm	Pass

Figure Channel 14 (2475MHz):

10. Receiver Spurious Emission for Industry Canada RSS-Gen Requirement

10.1. Test Equipment

The following test equipment are used during the radiated emission test:

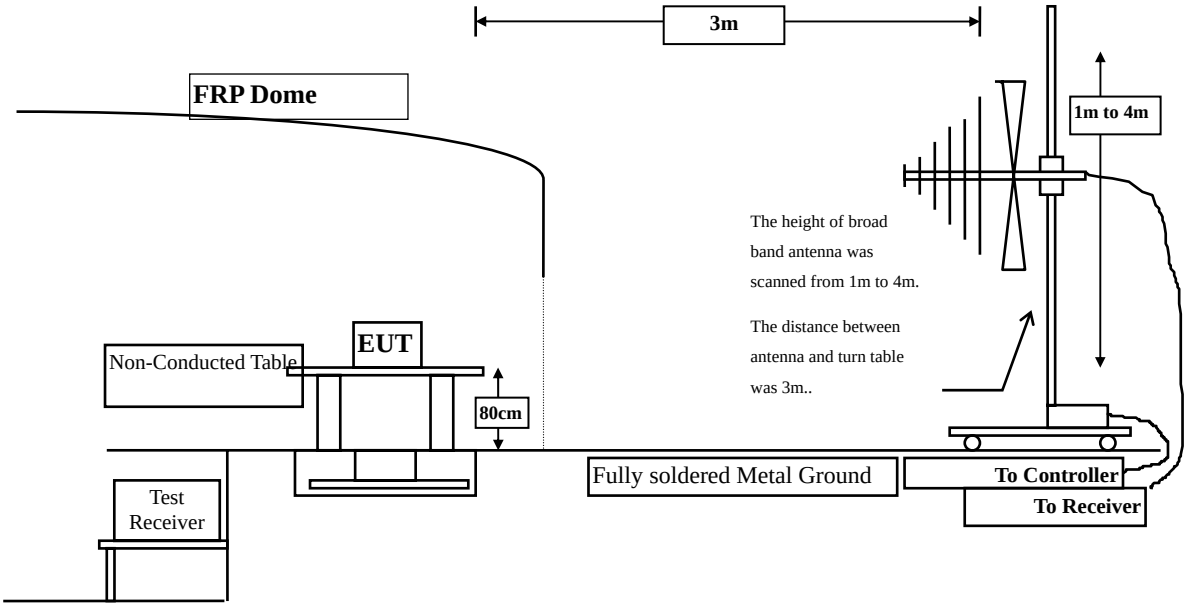
Test Site	Equipment		Manufacturer	Model No./Serial No.	Last Cal.
☒Site # 3	X	Loop Antenna	Teseq	HLA6120 / 26739	Jul., 2014
	X	Bilog Antenna	Schaffner Chase	CBL6112B/2673	Sep., 2014
	X	Horn Antenna	Schwarzbeck	BBHA9120D/D305	Sep., 2014
	X	Horn Antenna	Schwarzbeck	BBHA9170/208	Jul., 2014
	X	Pre-Amplifier	Agilent	8447D/2944A09549	Sep., 2014
	X	Spectrum Analyzer	Agilent	E4407B / US39440758	May, 2014
	X	Test Receiver	R & S	ESCS 30/ 825442/018	Sep., 2014
	X	Coaxial Cable	QuieTek	QTK-CABLE/ CAB5	Feb., 2014
	X	Controller	QuieTek	QTK-CONTROLLER/ CTRL3	N/A
	X	Coaxial Switch	Anritsu	MP59B/6200265729	N/A

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

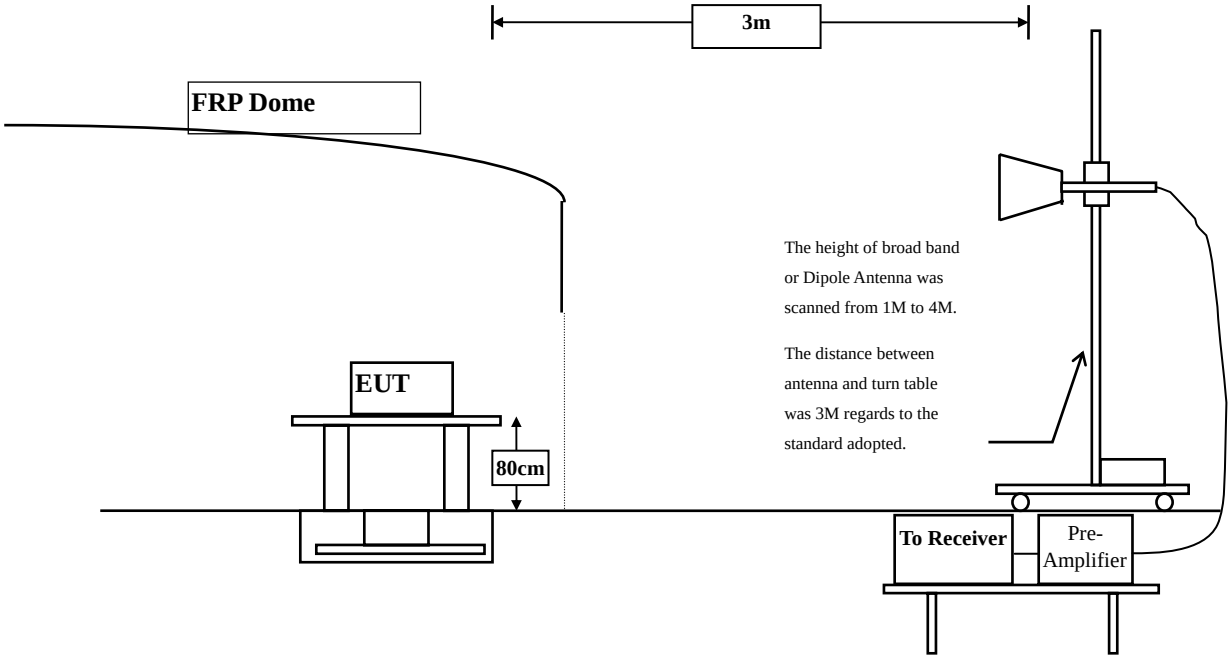
2. The test instruments marked with “X” are used to measure the final test results.

10.2. Test Setup

Radiated Emission Below 1GHz



Radiated Emission Above 1GHz



10.3. Limits

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

FCC Part 15 Subpart C Paragraph 15.209(a) Limits		
Frequency MHz	Field strength (microvolts/meter)	Measurement distance (meter)
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
88-216	150	3
216-960	200	3
Above 960	500	3

Remarks: E field strength (dBμV/m) = 20 log E field strength (uV/m)

10.4. Test Procedure

The EUT was setup according to ANSI C63.4: 2009 and tested according to DTS test procedure of KDB558074 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 between 1 meter and 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: 2009 on radiated measurement.

The resolution bandwidth below 30MHz setting on the field strength meter is 9kHz and 30MHz~1GHz is 120kHz and above 1GHz is 1MHz.

Radiated emission measurements below 30MHz are made using Loop Antenna and 30MHz~1GHz are made using broadband Bilog antenna and above 1GHz are made using Horn Antennas.

The measurement is divided into the Preliminary Measurement and the Final Measurement.

The suspected frequencies are searched for in Preliminary Measurement with the measurement antenna kept pointed at the source of the emission both in azimuth and elevation, with the polarization of the antenna oriented for maximum response. The antenna is pointed at an angle towards the source of the emission, and the EUT is rotated in both height and polarization to maximize the measured emission. The emission is kept within the illumination area of the 3 dB bandwidth of the antenna.

The worst radiated emission is measured in the Open Area Test Site on the Final Measurement.

The frequency range from 9kHz to 10th harmonics is checked.

10.5. Uncertainty

± 3.9 dB above 1GHz

± 3.8 dB below 1GHz

10.6. Test Result of Radiated Emission

Product : ICEBOX THERMOSTAT
Test Item : Harmonic Radiated Emission Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit with maximum duty cycle
(Channel 0, 2405MHz; Channel 7, 2440MHz; Channel 14, 2475MHz)

CH	Antenna	Frequency (MHz)	Reading Level (dBuV/m)	Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
0	H	3507.0	50.5	-15.4	35.1	54(Note)	-18.9	PK
	H	3507.5	50.9	-15.4	35.5	54(Note)	-18.5	PK
	V	5887.5	49.9	-10.0	39.9	54(Note)	-14.1	PK
	V	5887.5	50.9	-10.0	40.9	54(Note)	-13.1	PK
7	H	3269.5	52.2	-16.1	36.1	54(Note)	-17.9	PK
	H	3269.0	50.9	-16.1	34.8	54(Note)	-19.2	PK
	V	5811.0	50.7	-10.2	40.5	54(Note)	-13.5	PK
	V	5811.0	49.7	-10.2	39.5	54(Note)	-14.5	PK
14	H	3558.0	50.7	-15.2	35.5	54(Note)	-18.5	PK
	H	3558.5	52.7	-15.2	37.5	54(Note)	-16.5	PK
	V	6253.0	49.6	-8.6	41.0	54(Note)	-13.0	PK
	V	6253.0	50.5	-8.6	41.9	54(Note)	-12.1	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

The worst case of Radiated Emission below 1GHz (Mode: Receive @ 2405MHz)

For Horizontal

Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
119.846	24.446	5.707	-19.054	43.500	18.738	QP
608.605	33.572	6.452	-12.428	46.000	27.120	QP

For Vertical

Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
586.174	33.749	6.895	-12.251	46.000	26.854	QP
736.524	35.625	7.141	-10.375	46.000	28.484	QP

Note:
1. Measurement Level = Reading Level + Correct Factor.
2. Correct Factor = Antenna factor + Cable loss –Amplifier gain.

11. EMI Reduction Method During Compliance Testing

No modification was made during testing.