

RF TEST REPORT

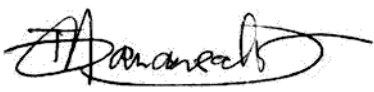


Report No.: FCC_RF_SL15072901-ZBR-024_DTS Rev. 2.0

Supersede Report No.: FCC_RF_SL15072901-ZBR-024_DTS Rev. 1.0

Applicant	:	Zebra Technologies Corporation
Product Name	:	WLAN IEEE 802.11ac/a/b/g/n 1x1 and Bluetooth 4.1 module
Model No.	:	WYSBHVXG
Test Standard	:	47 CFR 15.247 RSS 247 Iss.1 : May 2015
Test Method	:	ANSI C63.10: 2013 RSS Gen Iss 4: Nov 2014 558074 D01 DTS Meas Guidance v03r03
FCC ID	:	I28MD-FXLAN11AC
IC ID	:	3798B-FXLAN11AC
Dates of test	:	09/08/2015
Issue Date	:	11/20/2015
Test Result	:	☒ Pass ☐ Fail
Equipment complied with the specification [X]		
Equipment did not comply with the specification []		

This Test Report is Issued Under the Authority of:

	
Teody Manansala	Nima Molaei
Test Engineer	Engineer Reviewer

Issued By:
SIEMIC Laboratories
775 Montague Expressway, Milpitas, 95035 CA



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Laboratory Introduction

SIEMIC, headquartered in the heart of Silicon Valley, with superior facilities in US and Asia, is one of the leading independent testing and certification facilities providing customers with one-stop shop services for Compliance Testing and Global Certifications.



In addition to testing and certification, SIEMIC provides initial design reviews and compliance management throughout a project. Our extensive experience with China, Asia Pacific, North America, European, and International compliance requirements, assures the fastest, most cost effective way to attain regulatory compliance for the global markets.

Accreditations for Conformity Assessment

Country/Region	Accreditation Body	Scope
USA	FCC, A2LA	EMC, RF/Wireless, Telecom
Canada	IC, A2LA, NIST	EMC, RF/Wireless, Telecom
Taiwan	BSMI, NCC, NIST	EMC, RF, Telecom, Safety
Hong Kong	OFTA, NIST	RF/Wireless, Telecom
Australia	NATA, NIST	EMC, RF, Telecom, Safety
Korea	KCC/RRR, NIST	EMI, EMS, RF, Telecom, Safety
Japan	VCCI, JATE, TELEC, RFT	EMI, RF/Wireless, Telecom
Mexico	NOM, COFETEL, Caniety	Safety, EMC, RF/Wireless, Telecom
Europe	A2LA, NIST	EMC, RF, Telecom, Safety
Israel	MOC, NIST	EMC, RF, Telecom, Safety

Accreditations for Product Certifications

Country	Accreditation Body	Scope
USA	FCC TCB, NIST	EMC, RF, Telecom
Canada	IC FCB, NIST	EMC, RF, Telecom
Singapore	iDA, NIST	EMC, RF, Telecom
EU	NB	EMC & R&TTE Directive
Japan	MIC (RCB 208)	RF, Telecom
Hong Kong	OFTA (US002)	RF, Telecom

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1 Report Revision History

Report No.	Report Version	Description	Issue Date
FCC_RF_SL15072901-ZBR-024_DTS	None	Original	10/12/2015
FCC_RF_SL15072901-ZBR-024_DTS Rev. 1.0	1.0	Add Support equipmennt description to PCBA and power supply	11/10/2015
FCC_RF_SL15072901-ZBR-024_DTS Rev. 2.0	2.0	Add remarks on the radio description	11/20/2015

2 Executive Summary

The purpose of this test program was to demonstrate compliance of following product

Company: Zebra Technologies Corporation
Product: WLAN IEEE 802.11ac/a/b/g/n 1x1 and Bluetooth 4.1 module
Model: WYSBHVXGX

against the current Stipulated Standards. The specified model product stated above has demonstrated compliance with the Stipulated Standard listed on 1st page.

3 Customer information

Applicant Name	:	Zebra Technologies Corporation Error! Bookmark not defined.
Applicant Address	:	333 Corporate Woods, Vernon Hills, IL, 60061, USA
Manufacturer Name	:	Zebra Technologies Corporation
Manufacturer Address	:	333 Corporate Woods, Vernon Hills, IL, 60061, USA

4 Test site information

Lab performing tests	SIEMIC Laboratories
Lab Address	775 Montague Expressway, Milpitas, CA 95035
FCC Test Site No.	881796
IC Test Site No.	4842D-2
VCCI Test Site No.	A0133

5 Modification

Index	Item	Description	Note
-	-	-	-

6 EUT Information

6.1 EUT Description

Product Name	:	WLAN IEEE 802.11ac/a/b/g/n 1x1 and Bluetooth 4.1 module
Model No.	:	WYSBHVXGXG
Trade Name	:	Zebra Technologies Corporation
Serial No.	:	N/A
Host Model No.	:	N/A
Input Power	:	100-240VDC, 50/60Hz
Power Adapter Manu/Model	:	FSP GROPU INC./FSP025-DHAN2
Power Adapter SN	:	H00000048
Product Hardware version	:	Rev E
Product Software version	:	Ver V77.19.xx
Radio Hardware version	:	Rev D
Radio Software version	:	Ver 15.68.07.p36
Test Software version	:	Version 1.71
Date of EUT received	:	September 8, 2015
Equipment Class/ Category	:	DTS
Port/Connectors	:	USB

6.2 Spec for BT Radio

Radio Type	Bluetooth (Ver4.0+EDR)
Operating Frequency	2402MHz-2480MHz
Modulation	GFSK (LE)
Channel Spacing	2MHz (LE)
Antenna Type	Omnidirectional Antenna Patch Antenna
Antenna Gain	Omnidirectional Antenna - 3dBi (for 2.4GHz) Patch Antenna - 3.66dBi (for 2.4GHz)
Antenna Connector Type	Reverse SMA U.FL connector
Remarks	2.4GHz and 5GHz Radio does not transmit simultaneously

Type	Channel No.	Frequency (MHz)	Power Setting
Bluetooth(BLE) 2402-2480MHz	0	2402	12
	19	2440	12
	39	2480	12

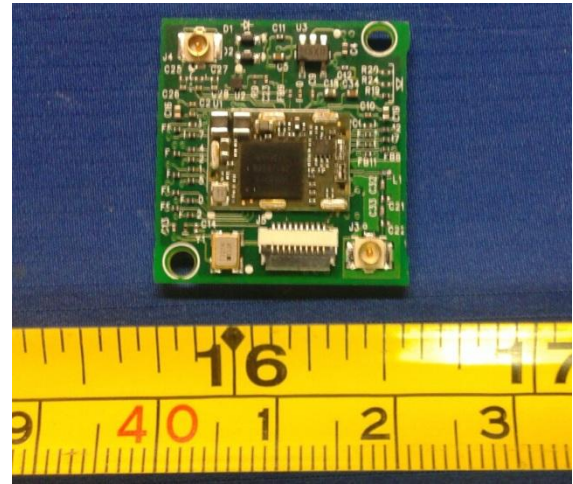
6.3 EUT test modes/configuration Description

Mode	Note
Bluetooth	BLE (GFSK)

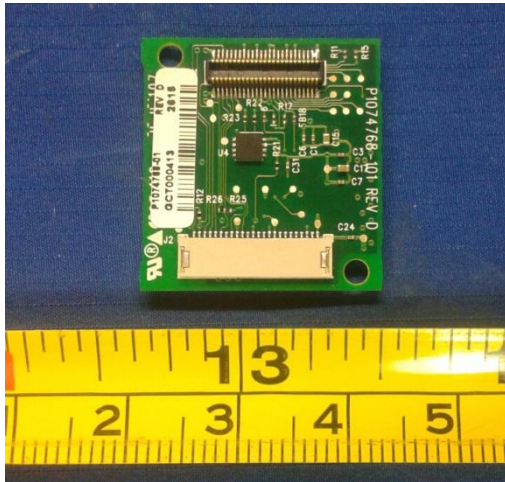
6.4 EUT Photos – Internal



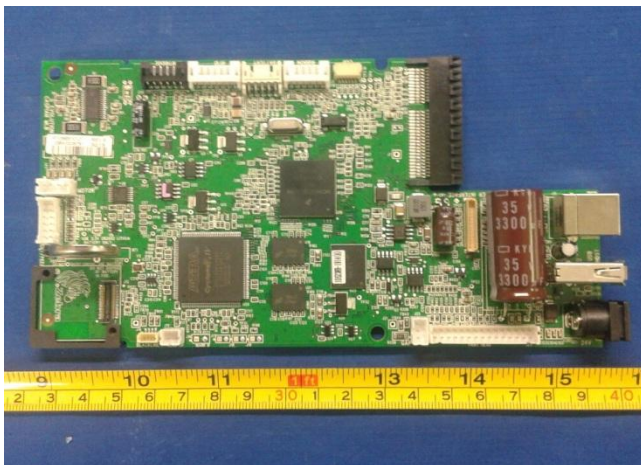
EUT Radio with Shielding Top View



EUT Radio without Shielding Top View



EUT Radio Bottom View



Support Equipment PCBA Top View



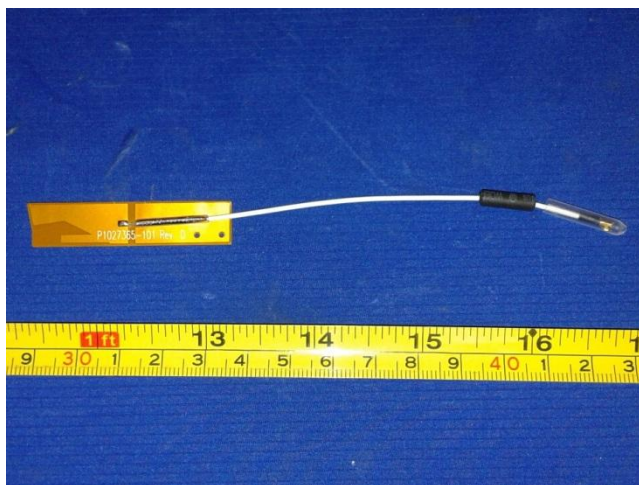
Support Equipment PCBA Bottom View



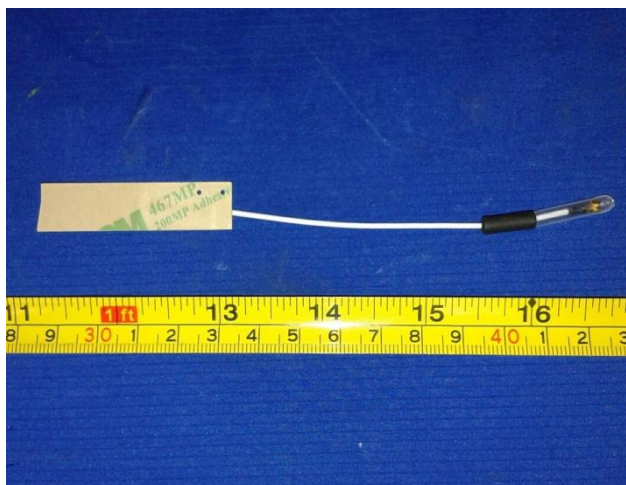
Omnidirectional Antenna



Omnidirectional Antenna



Patch Antenna Top View



Patch Antenna Bottom



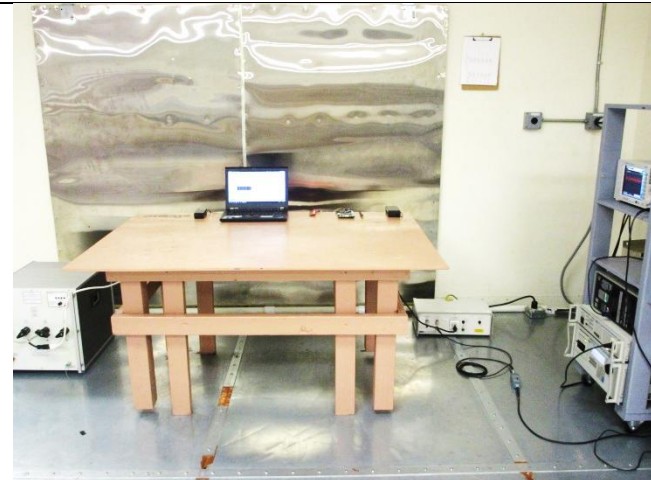
Support Equipment Power Supply Top View



Support Equipment Power Supply Bottom View

6.5 EUT Test Setup Photos

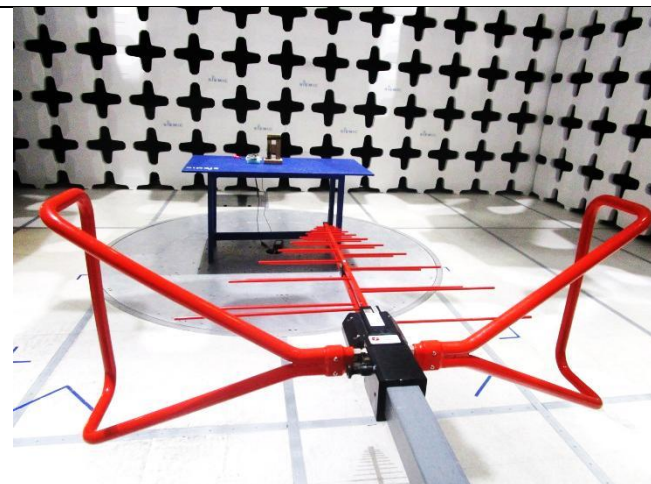
Onnidirectional Antenna



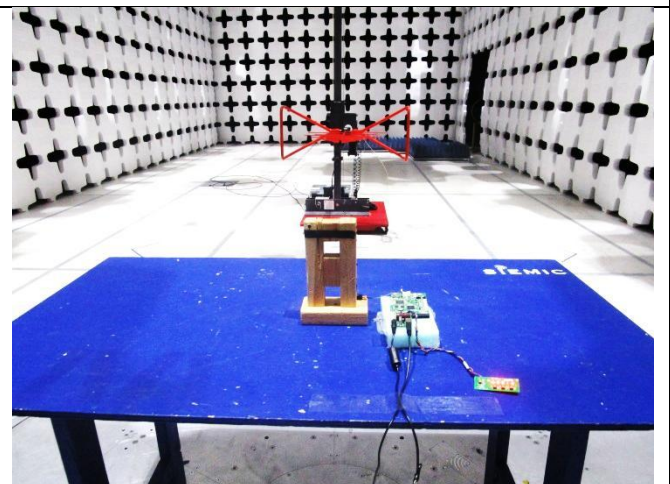
AC Line Conducted Emissions – Front View



AC Line Conducted Emissions – Rear View



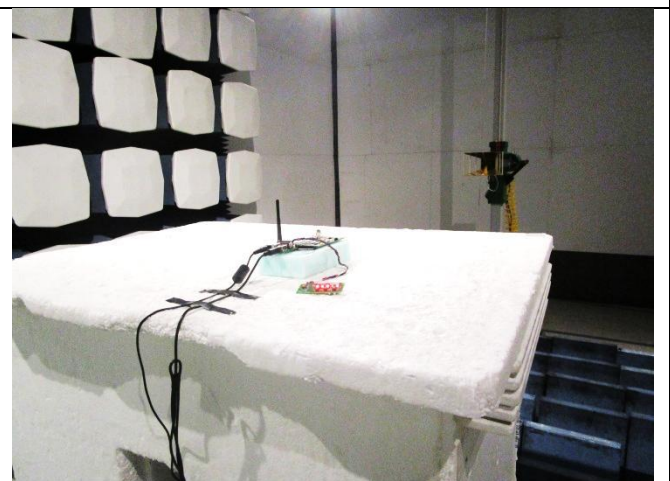
Radiated Emissions (<1GHz) – Front View



Radiated Emissions (<1GHz) – Rear View

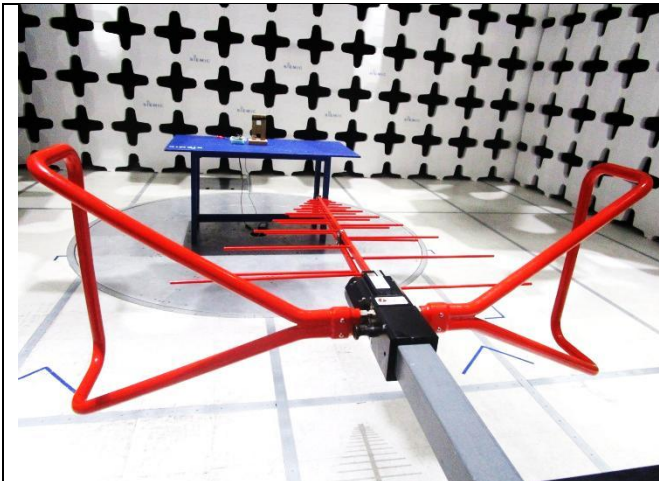


Radiated Emissions (>1GHz) – Front View

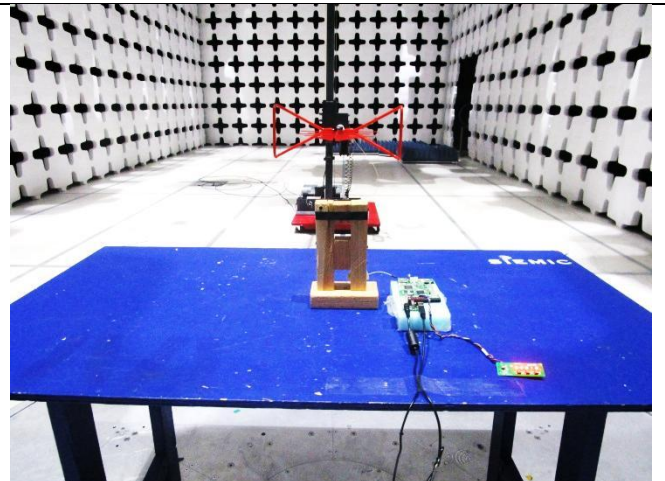


Radiated Emissions (>1GHz) – Rear View

Patch Antenna



Radiated Emissions (<1GHz) – Front View



Radiated Emissions (<1GHz) – Rear View



Radiated Emissions (>1GHz) – Front View



Radiated Emissions (>1GHz) – Rear View

7 Supporting Equipment/Software and cabling Description

7.1 Supporting Equipment

Item	Supporting Equipment Description	Model	Serial Number	Manufacturer	Note
1	Laptop	P05F Latitude E5510	N/A	Dell	-

7.2 Cabling Description

Name	Connection Start		Connection Stop		Length / shielding Info		Note
	From	I/O Port	To	I/O Port	Length (m)	Shielding	
USB	EUT	I/O Port	Laptop	USB	1	Unshielded	-

7.3 Test Software Description

Test Item	Software	Description
RF Testing	Tool Box	Set the EUT to transmit continuously in diferent test mode

8 Test Summary

Test Item	Test standard		Test Method/Procedure		Pass / Fail
Restricted Band of Operation	FCC	15.205	FCC	ANSI C63.10:2013	☒ Pass
	IC	RSS Gen 8.10	IC	558074 D01 DTS Meas Guidance v03r03	☐ N/A
AC Conducted Emissions	FCC	15.207(a)	FCC	ANSI C63.10:2013	☒ Pass
	IC	RSS Gen 8.8	IC	RSS Gen Issue 4: 2014	☐ N/A

DTS band Requirement

Test Item	Test standard		Test Method/Procedure		Pass / Fail
99% Occupied Bandwidth	-	-	-	-	☒ Pass
	IC	RSS Gen 6.6	IC	RSS Gen Issue 4: 2014 -	☐ N/A
6dB Bandwidth	FCC	15.247(a)(2)	FCC	558074 D01 DTS Meas Guidance v03r03	☒ Pass
	IC	RSS247 (5.2.1)	IC		☐ N/A
Band Edge and Radiated Spurious Emissions	FCC	15.247(d)	FCC	ANSI C63.10:2013 558074 D01 DTS Meas Guidance v03r03	☒ Pass
	IC	RSS247 (5.5)	IC		☐ N/A
Output Power	FCC	15.247(b)	FCC	558074 D01 DTS Meas Guidance v03r03	☒ Pass
	IC	RSS247 (5.4.4)	IC		☐ N/A
Receiver Spurious Emissions	IC	RSS Gen (4.8)	IC	RSS Gen Issue 4: 2014	☐ Pass ☒ N/A
Antenna Gain > 6 dBi	FCC	15.247(e)	FCC	-	☐ Pass
	IC	-	IC	-	☒ N/A
Power Spectral Density	FCC	15.247(e)	FCC	558074 D01 DTS Meas Guidance v03r03	☒ Pass
	IC	RSS247 (5.2.2)	IC		☐ N/A
RF Exposure requirement	FCC	15.247(i)	FCC	-	☐ Pass
	IC	RSS Gen(5.5)	IC	RSS Gen Issue 4: 2014	☒ N/A
Remark	- All measurement uncertainties do not take into consideration for all presented test results. - The applicant shall ensure frequency stability by showing that an emission is maintained within the band of operation under all normal operating conditions as specified in the user's manual.				

9 Measurement Uncertainty

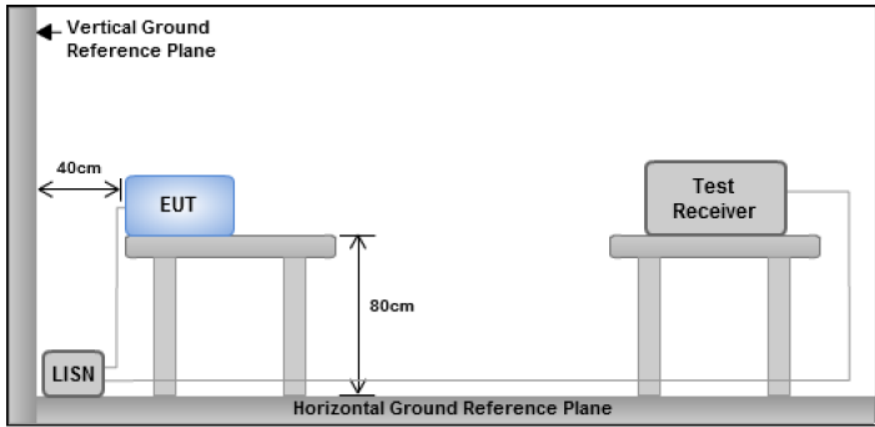
Emissions			
Test Item	Frequency Range	Description	Uncertainty
Band Edge and Radiated Spurious Emissions	30MHz – 1GHz	Confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2 (for EUTs < 0.5m X 0.5m X 0.5m)	+5.6dB/-4.5dB
Band Edge and Radiated Spurious Emissions	1GHz – 40GHz	Confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2 (for EUTs < 0.5m X 0.5m X 0.5m)	+4.3dB/-4.1dB

10 Measurements, Examination and Derived Results

10.1 Conducted Emissions

Conducted Emission Limit

Frequency ranges (MHz)	Limit (dBuV)	
	QP	Average
0.15 ~ 0.5	66 – 56	56 – 46
0.5 ~ 5	56	46
5 ~ 30	60	50

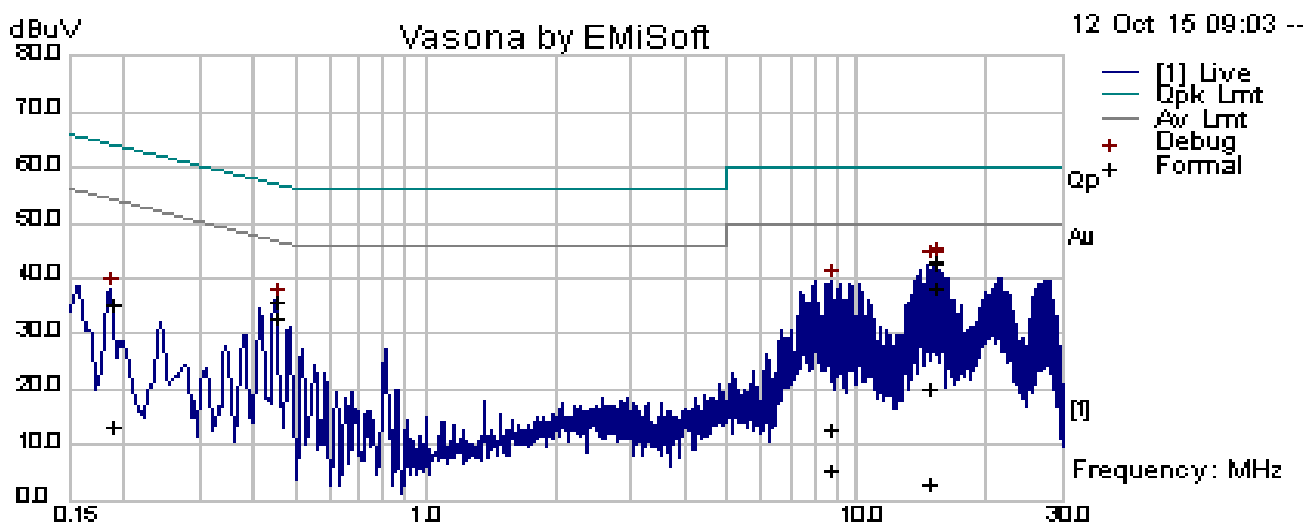
Spec	Item	Requirement	Applicable
47CFR§15.207	a)	For Low-power radio-frequency devices that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). The lower limit applies at the boundary between the frequency ranges.	☒
Test Setup	 Note: 1. Support units were connected to second LISN. 2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes		
Procedure	- The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table, as shown in Annex B. - The power supply for the EUT was fed through a 50Ω/50μH EUT LISN, connected to filtered mains. - The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss coaxial cable. - All other supporting equipment was powered separately from another main supply.		
Remark	EUT tested with AC 110V 60Hz		
Result	☒ Pass ☐ Fail		

Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

Conducted Emission Test Results

Test specification:	Conducted Emissions			
Environmental Conditions:	Temp(°C):	21	Result:	☒ Pass ☐ Fail
	Humidity (%):	42		
	Atmospheric(mbar):	1021		
Mains Power:	120Vac, 60Hz			
Tested by:	Teody Manansala			
Test Date:	10/12/2015			
Remarks	AC Line @ Line			



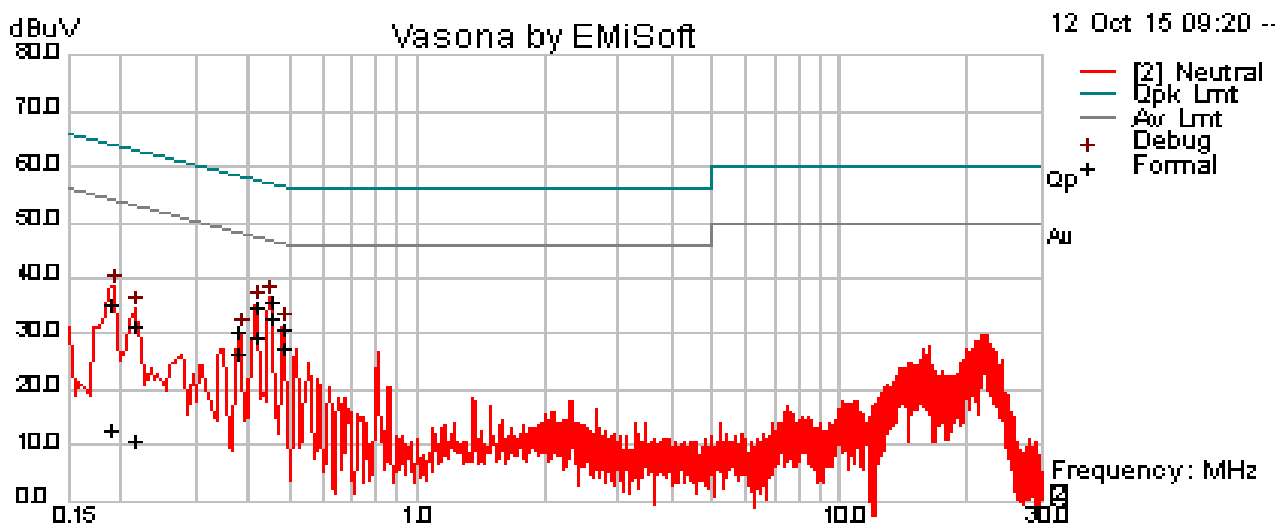
Line Plot at 120Vac, 60Hz

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Measurement Type	Line	Limit (dBuV)	Margin (dB)	Pass /Fail
15.12	31.83	10.06	0.60	42.49	Quasi Peak	Live	60.00	-17.51	Pass
15.24	32.62	10.06	0.60	43.28	Quasi Peak	Live	60.00	-16.72	Pass
14.65	9.47	10.06	0.60	20.12	Quasi Peak	Live	60.00	-39.88	Pass
8.66	2.09	10.05	0.55	12.69	Quasi Peak	Live	60.00	-47.31	Pass
0.45	25.03	10.01	0.71	35.75	Quasi Peak	Live	56.87	-21.12	Pass
0.19	24.02	10.00	1.39	35.41	Quasi Peak	Live	64.04	-28.63	Pass
15.12	27.64	10.06	0.60	38.31	Average	Live	50.00	-11.69	Pass
15.24	27.44	10.06	0.60	38.10	Average	Live	50.00	-11.90	Pass
14.65	-7.61	10.06	0.60	3.05	Average	Live	50.00	-46.95	Pass
8.66	-5.06	10.05	0.55	5.54	Average	Live	50.00	-44.46	Pass
0.45	21.90	10.01	0.71	32.62	Average	Live	46.87	-14.25	Pass
0.19	1.67	10.00	1.39	13.06	Average	Live	54.04	-40.98	Pass

Note: The results above show only the worst case.

Conducted Emission Test Results

Test specification:	Conducted Emissions			
Environmental Conditions:	Temp(°C):	21	Result:	☒ Pass ☐ Fail
	Humidity (%):	42		
	Atmospheric(mbar):	1021		
Mains Power:	120Vac, 60Hz			
Tested by:	Teody Manansala			
Test Date:	10/12/2015			
Remarks	AC Line @ Neutral			



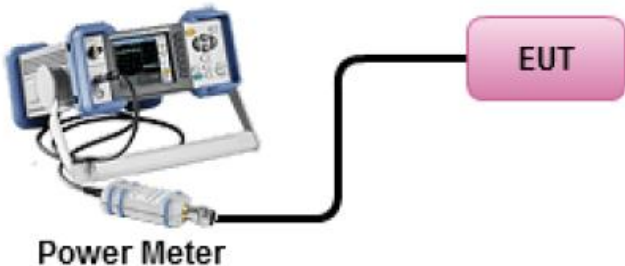
Neutral Plot at 120Vac, 60Hz

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Measurement Type	Line	Limit (dBuV)	Margin (dB)	Pass /Fail
0.45	25.23	10.01	0.71	35.95	Quasi Peak	Neutral	56.87	-20.92	Pass
0.42	24.02	10.01	0.74	34.77	Quasi Peak	Neutral	57.54	-22.77	Pass
0.48	20.45	10.01	0.69	31.15	Quasi Peak	Neutral	56.26	-25.11	Pass
0.19	24.15	10.00	1.39	35.54	Quasi Peak	Neutral	64.08	-28.54	Pass
0.38	19.74	10.01	0.77	30.52	Quasi Peak	Neutral	58.27	-27.75	Pass
0.22	20.05	10.00	1.22	31.27	Quasi Peak	Neutral	62.94	-31.67	Pass
0.45	22.05	10.01	0.71	32.77	Average	Neutral	46.87	-14.10	Pass
0.42	18.79	10.01	0.74	29.54	Average	Neutral	47.54	-18.00	Pass
0.48	16.60	10.01	0.69	27.29	Average	Neutral	46.26	-18.96	Pass
0.19	1.30	10.00	1.39	12.70	Average	Neutral	54.08	-41.38	Pass
0.38	15.92	10.01	0.77	26.70	Average	Neutral	48.27	-21.57	Pass
0.22	-0.43	10.00	1.22	10.79	Average	Neutral	52.94	-42.15	Pass

Note: The results above show only the worst case.

10.2 Output Power (Bluetooth LE)

Requirement(s):

Spec	Item	Requirement	Applicable
§ 15.247 RSS247 (5.4.2)	a)	FHSS in 2400-2483.5MHz with ≥ 75 channels: ≤ 1 Watt	☐
	b)	FHSS in 5725-5850MHz: ≤ 1 Watt	☐
	c)	For all other FHSS in the 2400-2483.5MHz band: ≤ 0.125 Watt.	☐
	d)	FHSS in 902-928MHz with ≥ 50 channels: ≤ 1 Watt	☐
	e)	FHSS in 902-928MHz with ≥ 25 & < 50 channels: ≤ 0.25 Watt	☐
	f)	DSSS in 902-928MHz, 2400-2483.5MHz, 5725-5850MHz: ≤ 1 Watt	☒
Test Setup	 Power Meter		
Test Procedure	558074 D01 DTS Meas Guidance v03r03, 9.2.3.1 Measurements may be performed using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required. - Connect EUT's RF output power to power meter - Set EUT to be continuous transmission mode - Measurement the average output power using power meter and record the result - Repeat above steps for different test channel and other modulation type.		
Test Date	09/16/2015	Environmental condition	Temperature 23°C Relative Humidity 44% Atmospheric Pressure 1021mbar
Remark	-		
Result	☒ Pass ☐ Fail		

Test Data ☒ Yes ☐ N/A

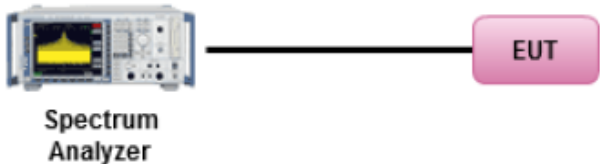
Test Plot ☐ Yes (See below) ☒ N/A

Output Power measurement result (Bluetooth)

Type	Test mode	Freq (MHz)	CH	Conducted Power (dBm)	Limit (dBm)	Result
Output power	Bluetooth LE	2402	Low	8.43	30	Pass
Output power	Bluetooth LE	2440	Mid	8.35	30	Pass
Output power	Bluetooth LE	2480	High	8.22	30	Pass

10.3 Band Edge (Bluetooth LE)

Requirement(s):

Spec	Item	Requirement	Applicable
§ 15.247 RSS247(5.5)	d)	For non-restricted band, In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB or 30dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, determined by the measurement method on output power to be used. Attenuation below the general limits specified in § 15.209 (a) is not required ☐ 20 dB down ☒ 30 dB down	☒
Test Setup			
Test Procedure	558074 D01 DTS Meas Guidance v03r03 <u>Band Edge measurement procedure</u> 1. Set the EUT to maximum power setting and enable the EUT transmit continuously. 2. Band edge emissions must be at least 30 dB down from the highest emission level within the authorized band as a measured. The attenuation shall be 30 dB instead of 20 dB when Peak conducted output power procedure is used. 3. Change modulation and channel bandwidth then repeat step 1 to 2. 4. Measured and record the results in the test report.		
Test Date	09/16/2015	Environmental condition	Temperature 22°C Relative Humidity 46% Atmospheric Pressure 1020mbar
Remark	-		
Result	☒ Pass ☐ Fail		

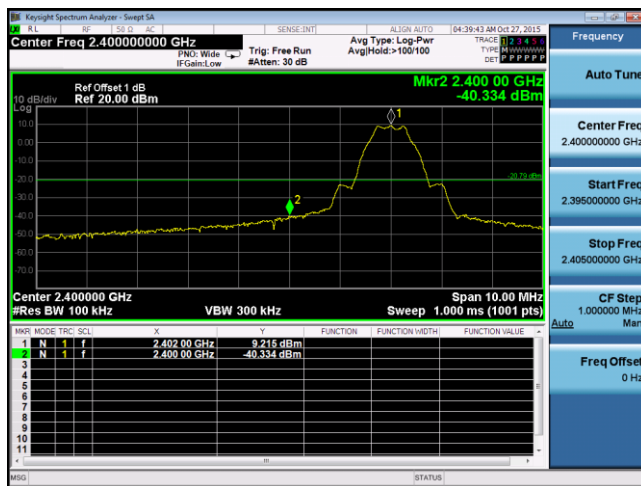
Equipment Setting

TEST	RBW	VBW	SPAN	Detector	SWEEP	Trace	NOTES
Band Edge	100KHz	≥3 x RBW	135 MHz / 55 MHz	Peak	Auto	Max Hold	-

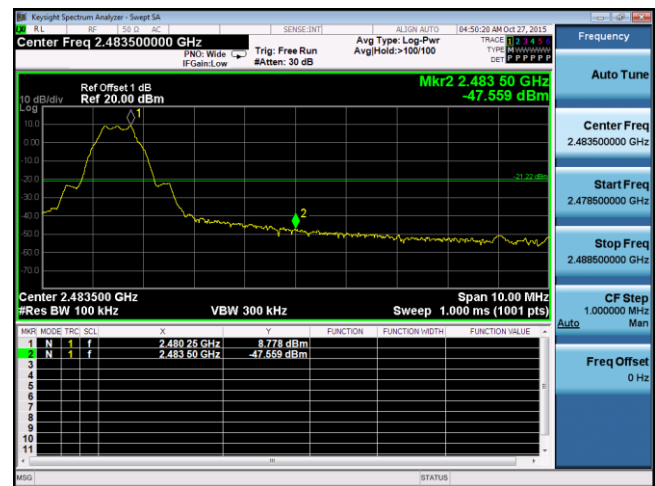
Test Data ☐ Yes ☒ N/A

Test Plot ☒ Yes (See below) ☐ N/A

Band Edge Test Plots (Bluetooth LE)



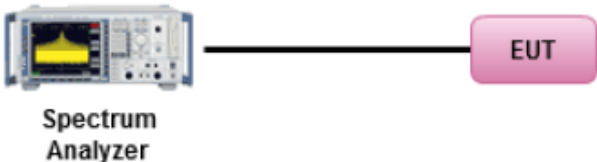
Band Edge-LE Low



Band Edge-LE High

10.4 6dB Bandwidth (Bluetooth LE)

Requirement(s):

Spec	Item	Requirement	Applicable
§ 15.247 RSS247 (5.2.1)	a)(2)	6dB BW≥500KHz;	☒
Test Setup			
Test Procedure	558074 D01 DTS Meas Guidance v03r03, 8.1 DTS bandwidth <u>6dB Emission bandwidth measurement procedure</u> - Set RBW = 100 kHz. - Set the video bandwidth (VBW) $\geq 3 \times$ RBW. - Detector = Peak. - Trace mode = max hold. - Sweep = auto couple. - Allow the trace to stabilize. - 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.		
Test Date	09/09/2015	Environmental condition	Temperature 23°C Relative Humidity 42% Atmospheric Pressure 1021mbar
Remark	N/A		
Result	☒ Pass ☐ Fail		

Equipment Setting

TEST	RBW	VBW	SPAN	Detector	SWEEP	Trace	NOTES
6 dB DTS Bandwidth	100KHz	3 x RBW	>EBW	Peak	Auto	Max hold	-

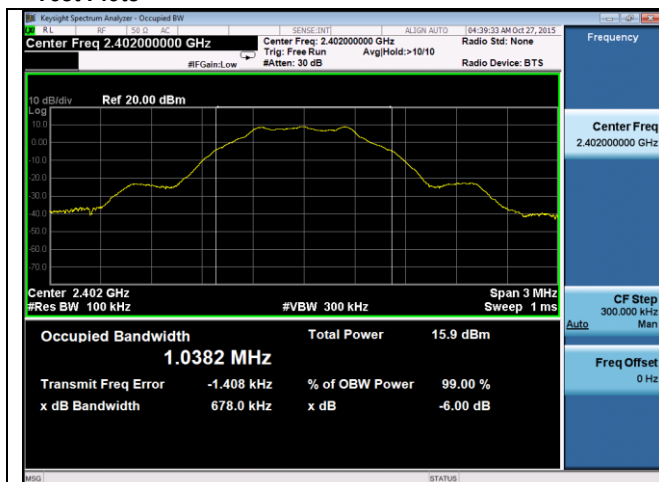
Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes ☐ N/A

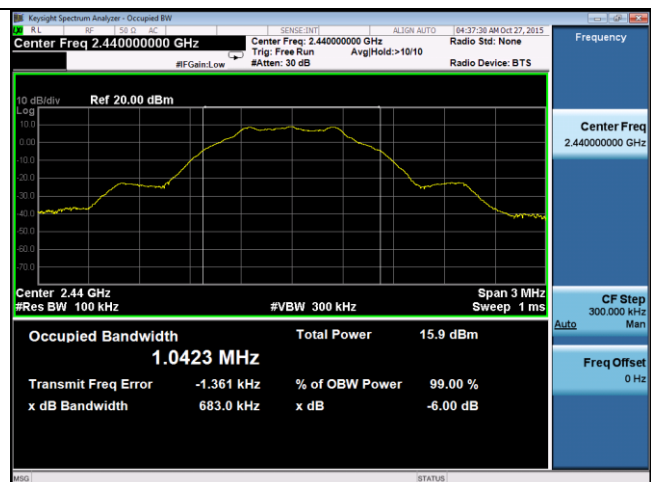
6dB Bandwidth measurement result for 2.4GHz

Type	Test mode	Freq (MHz)	CH	Result (MHz)	Limit (MHz)	Result
6dB BW	BT-LE	2402	Low	0.678	≥0.5	Pass
6dB BW	BT-LE	2440	Mid	0.683	≥0.5	Pass
6dB BW	BT-LE	2480	High	0.685	≥0.5	Pass

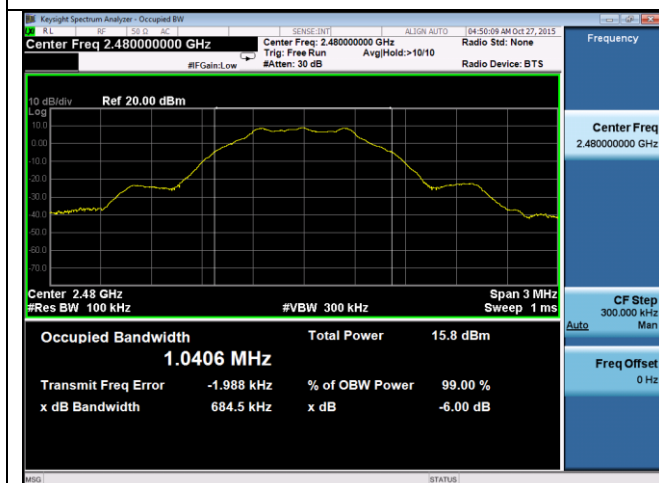
Test Plots



6dB BW –Bluetooth LE 2402MHz



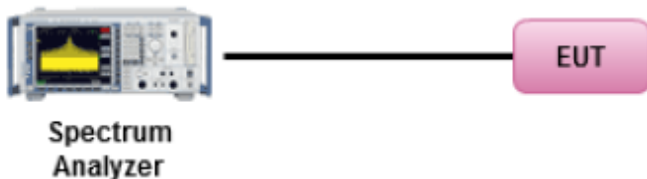
6dB BW –Bluetooth LE 2440MHz



6dB BW –Bluetooth LE 2480MHz

10.5 99% Occupied Bandwidth (Bluetooth LE)

Requirement(s):

Spec	Requirement	Applicable									
RSS Gen 4.6.1	The transmitter shall be operated at its maximum carrier power measured under normal test conditions. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used given that a peak or peak hold may produce a wider bandwidth than actual. The trace data points are recovered and directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded. The span between the two recorded frequencies is the occupied bandwidth	☒									
Test Setup											
Procedure	- EUT was set for low , mid, high channel with modulated mode and highest RF output power. - The spectrum analyzer was connected to the antenna terminal.										
Test Date	09/16/2015	<table border="1"> <tr> <td>Environmental condition</td> <td>Temperature</td> <td>23oC</td> </tr> <tr> <td></td> <td>Relative Humidity</td> <td>47%</td> </tr> <tr> <td></td> <td>Atmospheric Pressure</td> <td>1019mbar</td> </tr> </table>	Environmental condition	Temperature	23oC		Relative Humidity	47%		Atmospheric Pressure	1019mbar
Environmental condition	Temperature	23oC									
	Relative Humidity	47%									
	Atmospheric Pressure	1019mbar									
Remark	-										
Result	☒ Pass ☐ Fail										

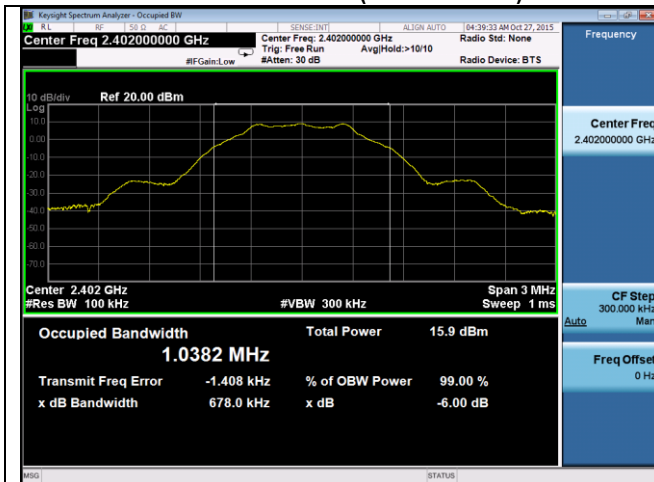
Test Data ☒ Yes (See below) ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

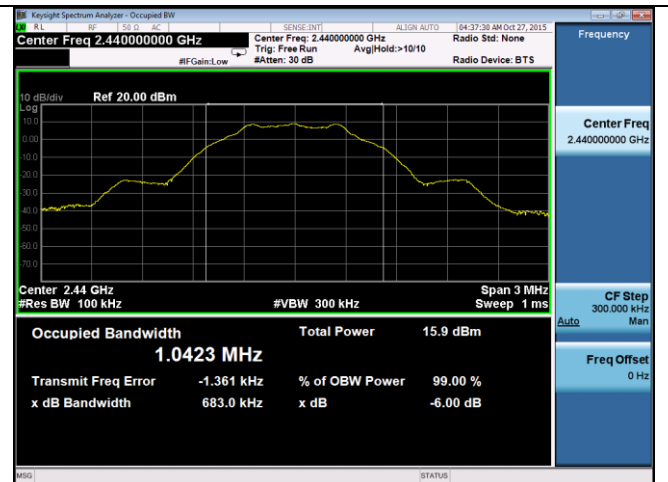
99% Bandwidth measurement result for Bluetooth LE

Type	Test mode	Freq (MHz)	CH	Result (MHz)
99% OBW	BT-LE	2402	Low	1.0382
99% OBW	BT-LE	2440	Mid	1.0423
99% OBW	BT-LE	2480	High	1.0406

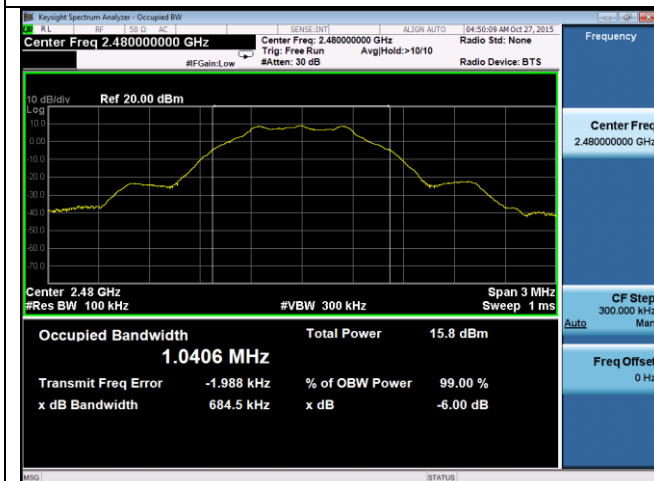
99%dB Bandwidth Test Plot (Bluetooth LE)



99% BW –Bluetooth LE 2402MHz



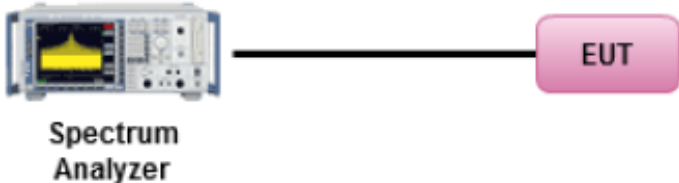
99% BW –Bluetooth LE 2440MHz



99% BW –Bluetooth LE 2480MHz

10.6 Peak Spectral Density (Bluetooth LE)

Requirement(s):

Spec	Item	Requirement	Applicable
§ 15.247(e)	e)	DSSS: $\leq 8\text{dBm}/3\text{KHz}$	☒
RSS247 (5.2.2)	f)	DSSS in hybrid sys with FH turned off: $\leq 8\text{dBm}/3\text{KHz}$	☐
Test Setup			
Test Procedure	558074 D01 DTS Meas Guidance v03r03, 10.2 Method PKPSD (peak PSD) <u>Peak spectral density measurement procedure</u> - Set analyzer center frequency to DTS channel center frequency. - Set the span to 1.5 times the DTS bandwidth. - Set the RBW to: $3\text{ kHz} \leq \text{RBW} \leq 100\text{ kHz}$. - Set the VBW $\geq 3 \times \text{RBW}$. - Detector = Peak - Sweep time = auto couple. - Trace mode = Trace Max Hold over 100 traces - Allow trace to fully stabilize. - Use the peak marker function to determine the maximum amplitude level within the RBW. - If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.		
Test Date	09/30/2015	Environmental condition	Temperature 22°C Relative Humidity 46% Atmospheric Pressure 1020mbar
Remark	-		
Result	☒ Pass ☐ Fail		

Equipment Setting

TEST	RBW	VBW	SPAN	Detector	SWEEP	Trace	NOTES
PSD	100KHz	$\geq 3 \times \text{RBW}$	1.5x DTS BW	Peak	Auto	Max Hold	-

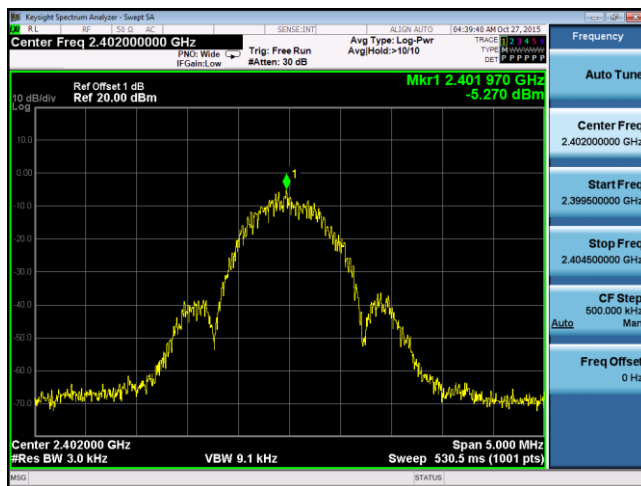
Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

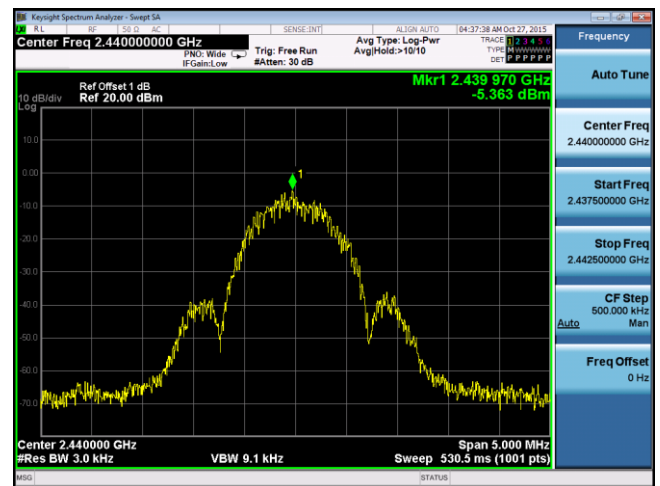
PSD measurement result (Bluetooth LE)

Type	Test mode	Freq (MHz)	CH	Conducted PSD (dBm/3KHz)	Limit (dBm/3KHz)	Result
PSD	Bluetooth LE	2402	Low	-5.270	≤8	Pass
PSD	Bluetooth LE	2440	Mid	-5.363	≤8	Pass
PSD	Bluetooth LE	2480	High	-5.464	≤8	Pass

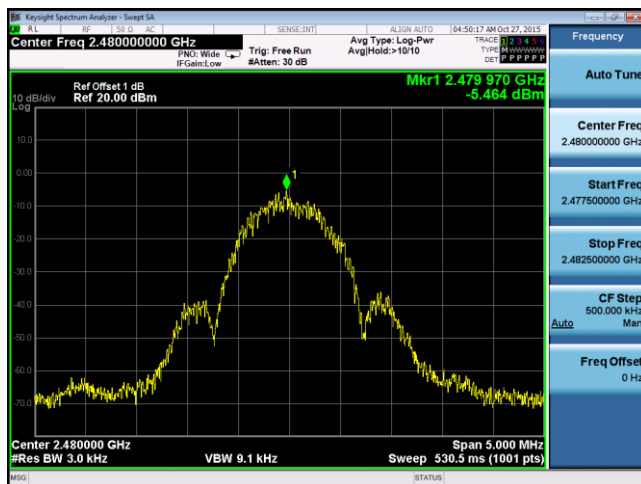
Test Plots (Bluetooth LE)



PSD -Bluetooth LE Low



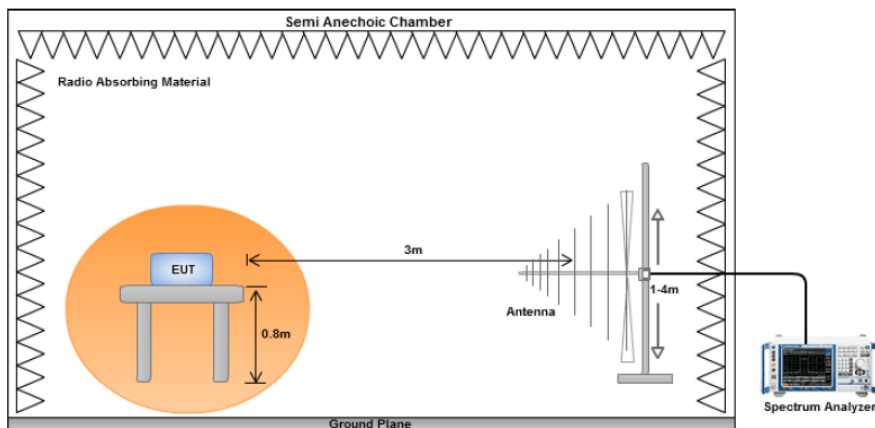
PSD -Bluetooth LE Mid



PSD -Bluetooth LE High

10.7 Transmitter Radiated Spurious Emissions Below 1GHz

Requirement(s):

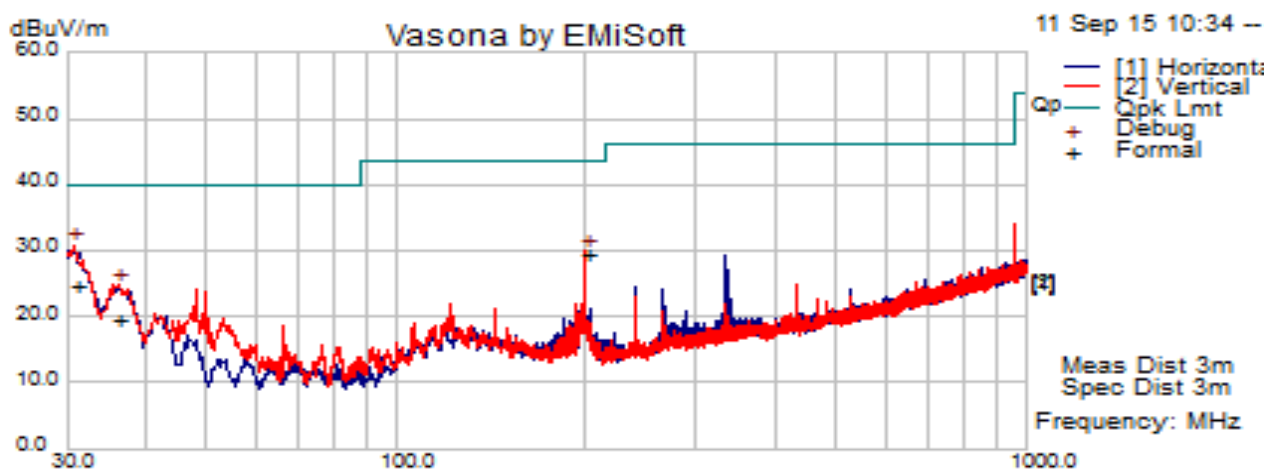
Spec	Item	Requirement	Applicable							
47CFR§15.247(d), RSS247(5.5)	a)	Except higher limit as specified elsewhere in other section, the emissions from the low-power radio-frequency devices shall not exceed the field strength levels specified in the following table and the level of any unwanted emissions shall not exceed the level of the fundamental emission. The tighter limit applies at the band edges	☒							
		<table><tr><th>Frequency range (MHz)</th><th>Field Strength (uV/m)</th></tr><tr><td>30 – 88</td><td>100</td></tr><tr><td>88 – 216</td><td>150</td></tr><tr><td>216 960</td><td>200</td></tr><tr><td>Above 960</td><td>500</td></tr></table>		Frequency range (MHz)	Field Strength (uV/m)	30 – 88	100	88 – 216	150	216 960
Frequency range (MHz)	Field Strength (uV/m)									
30 – 88	100									
88 – 216	150									
216 960	200									
Above 960	500									
Test Setup										
Procedure	1. The EUT was switched on and allowed to warm up to its normal operating condition. 2. The test was carried out at the selected frequency points obtained from the EUT characterisation. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner: a. Vertical or horizontal polarisation (whichever gave the higher emission level over a full rotation of the EUT) was chosen. b. The EUT was then rotated to the direction that gave the maximum emission. c. Finally, the antenna height was adjusted to the height that gave the maximum emission. 3. A Quasi-peak measurement was then made for that frequency point. 4. Steps 2 and 3 were repeated for the next frequency point, until all selected frequency points were measured.									
Remark	The EUT was scanned up to 1GHz. Both horizontal and vertical polarities were investigated. The results show only the worst case.									
Result	☒ Pass ☐ Fail									

Test Data ☒ Yes (See below) ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

Radiated Emission Test Results (Omnidirectional Antenna)

Test specification	Below 1GHz			
Environmental Conditions:	Temp (°C):	25.7	Result	
	Humidity (%)	29		
	Atmospheric (mPa):			
Mains Power:	110VAC, 60Hz			
Tested by:	Teody Manasala			
Test Date:	11-Sep-15			
Remarks:	Bluetooth LE 2440MHz			



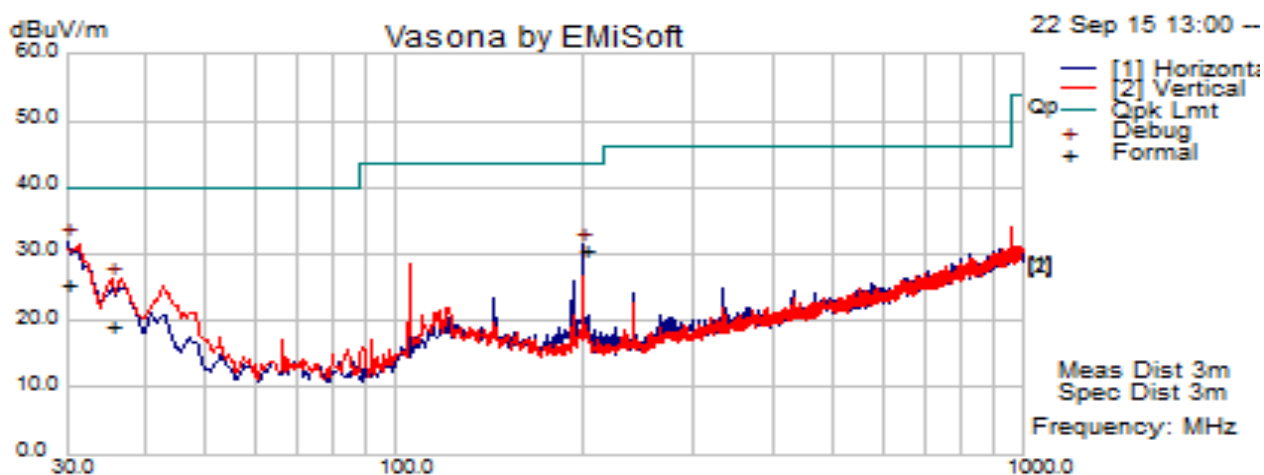
Quasi Max Measurement

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
30.97	39.29	0.81	-15.29	24.81	Quasi Max	V	107.00	110.00	40.00	-15.19	Pass
199.51	52.40	2.38	-25.52	29.25	Quasi Max	V	102.00	46.00	43.52	-14.27	Pass
36.24	38.52	0.87	-19.78	19.61	Quasi Max	V	129.00	297.00	40.00	-20.39	Pass

Note: Both horizontal and vertical polarities were investigated. The results above show only the worst case.

Radiated Emission Test Results (Patch Antenna)

Test specification	Below 1GHz			
Environmental Conditions:	Temp (°C):	25.7	Result	
	Humidity (%)	29		
	Atmospheric (mPa):			
Mains Power:	110VAC, 60Hz			
Tested by:	Teody Manasala			
Test Date:	22-Sep-15			
Remarks:	Bluetooth LE 2440MHz			



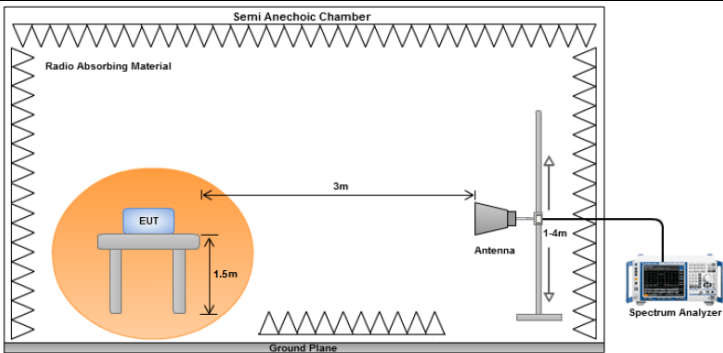
Quasi Max Measurement

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
30.00	38.98	0.81	-14.38	25.40	Quasi Max	H	323.00	225.00	40.00	-14.60	Pass
199.51	53.82	2.38	-25.52	30.68	Quasi Max	H	107.00	298.00	43.52	-12.84	Pass
35.33	37.35	0.87	-19.05	19.16	Quasi Max	V	329.00	115.00	40.00	-20.84	Pass

Note: Both horizontal and vertical polarities were investigated. The results above show only the worst case.

10.8 Transmitter Radiated Spurious Emissions > 1GHz & Restricted band

Requirement(s):

Spec	Item	Requirement	Applicable
47CFR§15.247(d), RSS247(5.5)	a)	For non-restricted band, In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB or 30dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, determined by the measurement method on output power to be used. Attenuation below the general limits specified in § 15.209(a) is not required ☐ 20 dB down ☒ 30 dB down	☒
	b)	or restricted band, emission must also comply with the radiated emission limits specified in 15.209	☒
Test Setup			
Procedure	- The EUT was switched on and allowed to warm up to its normal operating condition. - The test was carried out at the selected frequency points obtained from the EUT characterisation. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner: - Vertical or horizontal polarisation (whichever gave the higher emission level over a full rotation of the EUT) was chosen. - The EUT was then rotated to the direction that gave the maximum emission. - Finally, the antenna height was adjusted to the height that gave the maximum emission. - An average measurement was then made for that frequency point. - Steps 2 and 3 were repeated for the next frequency point, until all selected frequency points were measured.		
Remark	The EUT was scanned up to 40GHz. Both horizontal and vertical polarities were investigated. The results show only the worst case.		
Result	☒ Pass ☐ Fail		

Equipment Setting

TEST	RBW	VBW	SPAN	Detector	SWEEP	Trace	NOTES
Radiated Spurious Emission	1MHz	3MHz	1GHz - 25 GHz	Peak	Auto	Max hold	PK Measurement
Radiated Spurious Emission	1MHz	10Hz	1GHz - 25 GHz	Peak	Auto	Max hold	Ave Measurement

Test Data ☒ Yes (See below) ☐ N/A

Test Plot ☐ Yes (See below) ☒ N/A

Radiated Emission Test Results (Omnidirectional Antenna)

BLE – 2402MHz

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	AF (dB)	Level (dBuV/m)	Measurement Type	Pol (V/H)	Hgt (cm)	Azt (Deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail
1732.66	39.11	3.02	9.38	51.51	Peak Max	H	202.00	211.00	74.00	-22.49	Pass
17726.22	41.09	13.00	10.63	64.72	Peak Max	V	148.00	101.00	74.00	-9.28	Pass
14098.71	43.13	12.77	7.57	63.47	Peak Max	H	246.00	221.00	74.00	-10.53	Pass
1732.66	25.41	3.02	9.38	37.81	Average Max	H	202.00	211.00	54.00	-16.19	Pass
17726.22	27.30	13.00	10.63	50.93	Average Max	V	148.00	101.00	54.00	-3.07	Pass
14098.71	29.79	12.77	7.57	50.13	Average Max	H	246.00	221.00	54.00	-3.87	Pass

BLE – 2440MHz

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	AF (dB)	Level (dBuV/m)	Measurement Type	Pol (V/H)	Hgt (cm)	Azt (Deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail
4151.96	39.58	5.96	11.56	57.10	Peak Max	H	170.00	18.00	74.00	-16.90	Pass
17831.29	40.13	13.00	10.74	63.87	Peak Max	H	217.00	275.00	74.00	-10.13	Pass
14677.23	43.01	13.42	7.95	64.37	Peak Max	H	298.00	159.00	74.00	-9.63	Pass
4151.96	26.28	5.96	11.56	43.80	Average Max	H	170.00	18.00	54.00	-10.20	Pass
17831.29	26.85	13.00	10.74	50.59	Average Max	H	217.00	275.00	54.00	-3.41	Pass
14677.23	29.15	13.42	7.95	50.51	Average Max	H	298.00	159.00	54.00	-3.49	Pass

BLE – 2480MHz

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	AF (dB)	Level (dBuV/m)	Measurement Type	Pol (V/H)	Hgt (cm)	Azt (Deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail
17895.89	39.73	13.00	10.80	63.54	Peak Max	V	212.00	285.00	74.00	-10.46	Pass
14610.31	41.97	13.30	8.12	63.39	Peak Max	V	242.00	229.00	74.00	-10.61	Pass
4047.52	38.98	5.87	12.02	56.86	Peak Max	V	191.00	50.00	74.00	-17.14	Pass
17895.89	26.83	13.00	10.80	50.64	Average Max	V	212.00	285.00	54.00	-3.36	Pass
14610.31	29.38	13.30	8.12	50.80	Average Max	V	242.00	229.00	54.00	-3.20	Pass
4047.52	25.64	5.87	12.02	43.52	Average Max	V	191.00	50.00	54.00	-10.48	Pass

Radiated Emission Test Results (Patch Antenna)

BLE – 2402MHz

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	AF (dB)	Level (dBuV/m)	Measurement Type	Pol (V/H)	Hgt (cm)	Azt (Deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail
17998.51	36.63	13.00	10.91	60.53	Peak Max	H	224.00	196.00	74.00	-13.47	Pass
11935.60	38.09	12.20	8.49	58.79	Peak Max	H	166.00	183.00	74.00	-15.21	Pass
4098.91	35.09	5.92	11.79	52.80	Peak Max	V	151.00	187.00	74.00	-21.20	Pass
17998.51	23.99	13.00	10.91	47.90	Average Max	H	224.00	196.00	54.00	-6.10	Pass
11935.60	25.62	12.20	8.49	46.32	Average Max	H	166.00	183.00	54.00	-7.68	Pass
4098.91	22.28	5.92	11.79	39.99	Average Max	V	151.00	187.00	54.00	-14.01	Pass

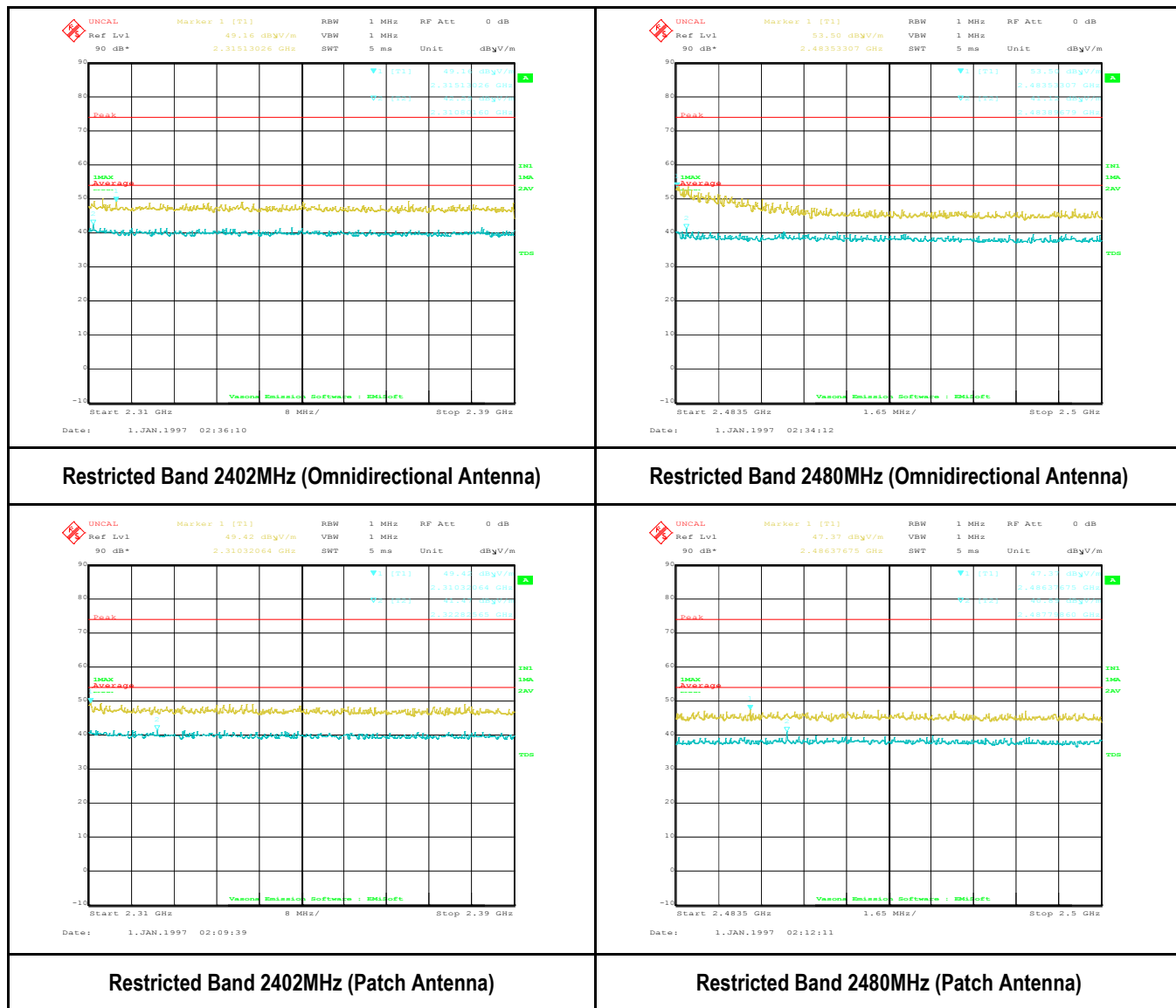
BLE – 2440MHz

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	AF (dB)	Level (dBuV/m)	Measurement Type	Pol (V/H)	Hgt (cm)	Azt (Deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail
14934.95	39.19	13.87	7.27	60.33	Peak Max	V	264.00	3.00	74.00	-13.67	Pass
17932.06	36.64	13.00	10.84	60.48	Peak Max	H	282.00	225.00	74.00	-13.52	Pass
1993.56	36.52	3.32	11.43	51.27	Peak Max	V	257.00	357.00	74.00	-22.73	Pass
14934.95	26.14	13.87	7.27	47.27	Average Max	V	264.00	3.00	54.00	-6.73	Pass
17932.06	24.06	13.00	10.84	47.90	Average Max	H	282.00	225.00	54.00	-6.10	Pass
1993.56	23.47	3.32	11.43	38.22	Average Max	V	257.00	357.00	54.00	-15.78	Pass

BLE – 2480MHz

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	AF (dB)	Level (dBuV/m)	Measurement Type	Pol (V/H)	Hgt (cm)	Azt (Deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail
14489.51	39.11	13.09	8.40	60.60	Peak Max	H	210.00	282.00	74.00	-13.40	Pass
17692.37	37.20	13.00	10.60	60.79	Peak Max	V	283.00	235.00	74.00	-13.21	Pass
4102.72	35.09	5.92	11.78	52.78	Peak Max	V	219.00	301.00	74.00	-21.22	Pass
14489.51	26.18	13.09	8.40	47.66	Average Max	H	210.00	282.00	54.00	-6.34	Pass
17692.37	24.34	13.00	10.60	47.94	Average Max	V	283.00	235.00	54.00	-6.06	Pass
4102.72	22.05	5.92	11.78	39.74	Average Max	V	219.00	301.00	54.00	-14.26	Pass

Restricted Band Test plot



Annex A. TEST INSTRUMENT

Instrument	Model	Serial #	Cal Date	Cal Cycle	Cal Due	In use
Conducted Emissions						
R & S Receiver	ESIB 40	100179	05/23/2015	1 Year	05/23/2016	☒
CHASE LISN	MN2050B	1018	08/07/2015	1 Year	08/07/2016	☒
Radiated Emissions						
R & S Receiver	ESL6	100178	05/27/2015	1 Year	05/27/2016	☒
R & S Receiver	ESIB 40	100179	05/23/2015	1 Year	05/23/2016	☒
ETS-Lingren Loop Antenna	6512	00049120	05/12/2015	1 Year	05/12/2016	☒
Bi-Log antenna (30MHz~2GHz)	JB1	A030702	08/12/2015	1 Year	08/12/2016	☒
3 Meters SAC	3M	N/A	08/08/2015	1 Year	08/08/2016	☒
10 Meters SAC	10M	N/A	09/05/2015	1 Year	09/05/2016	☒
RF Conducted Measurement						
Spectrum Analyzer	N9010A	10SL0219	08/20/2015	1 Year	08/20/2016	☒
R & S Receiver	ESIB 40	100179	05/23/2015	1 Year	05/23/2016	☒
Test Equity Environment Chamber	1007H	61201	07/31/2015	1 Year	07/31/2016	☒
USB RF Power Sensor	7002-006	10SL0190	09/03/2015	1 Year	09/03/2016	☒

Annex B. SIEMIC Accreditation

Accreditations	Document	Scope / Remark
ISO 17025 (A2LA)		Please see the documents for the detailed scope
ISO Guide 65 (A2LA)		Please see the documents for the detailed scope
TCB Designation		A1 , A2 , A3 , A4 , B1 , B2 , B3 , B4 , C
FCC DoC Accreditation		FCC Declaration of Conformity Accreditation
FCC Site Registration		3 meter site
FCC Site Registration		10 meter site
IC Site Registration		3 meter site
IC Site Registration		10 meter site
EU NB		Radio & Telecommunications Terminal Equipment: EN45001 – EN ISO/IEC 17025
		Electromagnetic Compatibility: EN45001 – EN ISO/IEC 17025
Singapore iDA CB(Certification Body)	 	Phase I , Phase II
Vietnam MIC CAB Accreditation		Please see the document for the detailed scope
Hong Kong OFCA		(Phase II) OFCA Foreign Certification Body for Radio and Telecom
		(Phase I) Conformity Assessment Body for Radio and Telecom
Industry Canada CAB		Radio: Scope A – All Radio Standard Specification in Category I
		Telecom: CS-03 Part I, II, V, VI, VII, VIII

Japan Recognized Certification Body Designation		Radio: A1. Terminal equipment for purpose of calling Telecom: B1. Specified radio equipment specified in Article 38-2, Paragraph 1, Item 1 of the Radio Law
Korea CAB Accreditation		EMI: KCC Notice 2008-39, RRL Notice 2008-3: CA Procedures for EMI KN22: Test Method for EMI EMS: KCC Notice 2008-38, RRL Notice 2008-4: CA Procedures for EMS KN24, KN61000-4-2, -4-3, -4-4, -4-5, -4-6, -4-8, -4-11: Test Method for EMS Radio: RRL Notice 2008-26, RRL Notice 2008-2, RRL Notice 2008-10, RRL Notice 2007-49, RRL Notice 2007-20, RRL Notice 2007-21, RRL Notice 2007-80, RRL Notice 2004-68 Telecom: President Notice 20664, RRL Notice 2007-30, RRL Notice 2008-7 with attachments 1, 3, 5, 6; President Notice 20664, RRL Notice 2008-7 with attachment 4
Taiwan NCC CAB Recognition		LP0002, PSTN01, ADSL01, ID0002, IS6100, CNS14336, PLMN07, PLMN01, PLMN08
Taiwan BSMI CAB Recognition		CNS 13438
Japan VCCI		R-3083: Radiation 3 meter site C-3421: Main Ports Conducted Interference Measurement T-1597: Telecommunication Ports Conducted Interference Measurement
Australia CAB Recognition		EMC: AS/NZS CISPR 11, AS/NZS CISPR 14.1, AS/NZS CISPR22, AS/NZS 61000.6.3, AS/NZS 61000.6.4 Radio communications: AS/NZS 4281, AS/NZS 4268, AS/NZS 4280.1, AS/NZS 4280.2, AS/NZS 4295, AS/NZS 4582, AS/NZS 4583, AS/NZS 4769.1, AS/NZS 4769.2, AS/NZS 4770, AS/NZS 4771 Telecommunications: AS/ACIF S002:05, AS/ACIF S003:06, AS/ACIF S004:06 AS/ACIF S006:01, AS/ACIF S016:01, AS/ACIF S031:01, AS/ACIF S038:01, AS/ACIF S040:01, AS/ACIF S041:05, AS/ACIF S043.2:06, AS/ACIF S60950.1
Australia NATA Recognition		AS/ACIF S002, AS/ACIF S003, AS/ACIF S004, AS/ACIF S006, AS/ACIF S016, AS/ACIF S031, AS/ACIF S038, AS/ACIF S040, AS/ACIF S041, AS/ACIF S043.2