RF TEST REPORT

SIEMIC
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Report No.: FCC_RF_SL14091201-ZBR-031_BT_DSS Rev1.0
Supersede Report No.: FCC_RF_SL14091201-ZBR-031_BT_DSS

Applicant	**Zebra Technologies Corporation**
Product Name	**Bluetooth 4.0 LE Module**
Model No.	**BT40LE-ZQ500**
Test Standard	**47CFR15.247** **RSS 210 ISSUE 8, Dec 2010, RSS Gen Issue 4, Nov 2014**
Test Method	**ANSI C63.4: 2014** **DA 00-705**
FCC ID	**I28MD-ZBR7BTLE**
IC ID	**3798B-ZBR7BTLE**
Date of test	**12/01/2014 - 12/09/2014**
Issue Date	**01/19/2015**
Test Result	**Pass** **Fail**

Equipment complied with the specification	**[x]**
Equipment did not comply with the specification	**[ ]**

	
Ricky Wang	David Zhang
Test Engineer	**Engineer Reviewer**

This test report may be reproduced in full only
Test result presented in this test report is applicable to the tested sample only

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

ilac-MRA
A2LA ACCREDITED
TESTING CERT # 2742-01

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/RRA, 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
HongKong	OFTA (US002)	RF , Telecom

CONTENTS

1 Report Revision History

Report No.	Report Version	Description	Issue Date
FCC_RF_SL14091201-ZBR-031_BT_FHSS	Original	NONE	01/05/2015
FCC_RF_SL14091201-ZBR-031_BT_DSS	N/A	Update EUT and standard information	01/13/2015
FCC_RF_SL14091201-ZBR-031_BT_DSS Rev1.0	Rev1.0	Update RSS standard Version	01/19/2015

2 Executive Summary

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

Company: Zebra Technologies Corporation
Product: Bluetooth 4.0 LE Module
Model: BT40LE-ZQ500

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 Corp.
Applicant Address	:	333 Corporate Woods Pkwy. Vernon Hills,IL 60061, USA
Manufacturer Name	:	Zebra Technologies Corp.
Manufacturer Address	:	333 Corporate Woods Pkwy. 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	:	Bluetooth 4.0 LE Module
Model No.	:	BT40LE-ZQ500
Trade Name	:	ZEBRA
Serial No.	:	GAN000244
Input Power	:	3.3VDC
Power Adapter Manu/Model	:	N/A
Power Adapter SN	:	N/A
Hardware version	:	N/A
Software version	:	N/A
Date of EUT received	:	11/20/2014
Equipment Class/ Category	:	DSS, DTS
Clock Frequencies	:	N/A
Port/Connectors	:	N/A

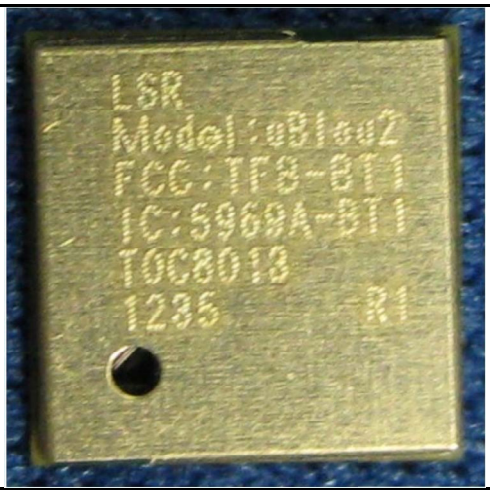
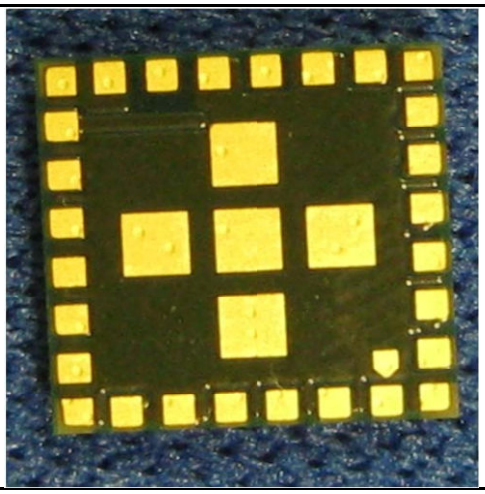
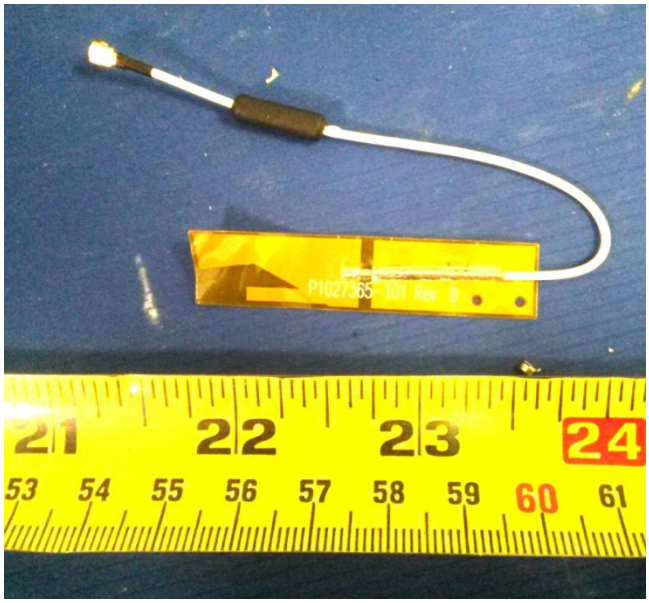
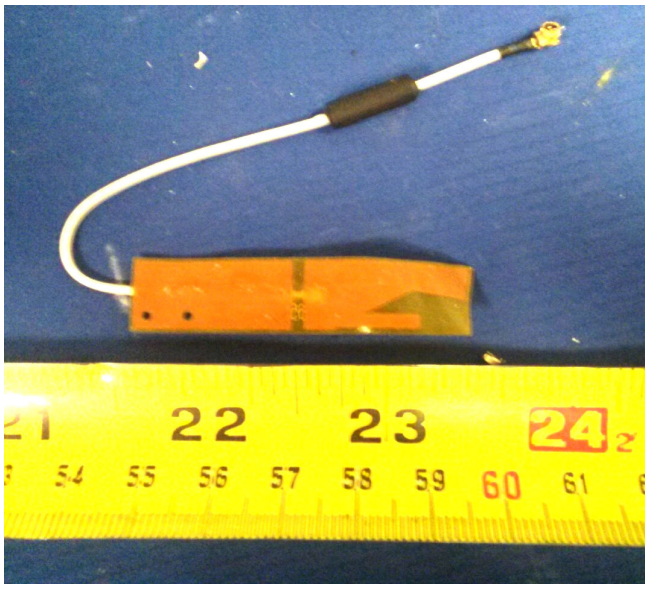
6.2 Radio Description

Radio Type	Bluetooth (Ver4.0+EDR)
Operating Frequency	2402MHz-2480MHz
Modulation	FHSS (BDR, EDR), DSSS (LE)
Channel Spacing	1MHz (BDR, EDR), 2MHz (LE)
Antenna Type	Dipole
Antenna Gain	2.8 dBi (2.4GHz)
Antenna Connector Type	U.FL connector

6.3 EUT test modes/configuration Description

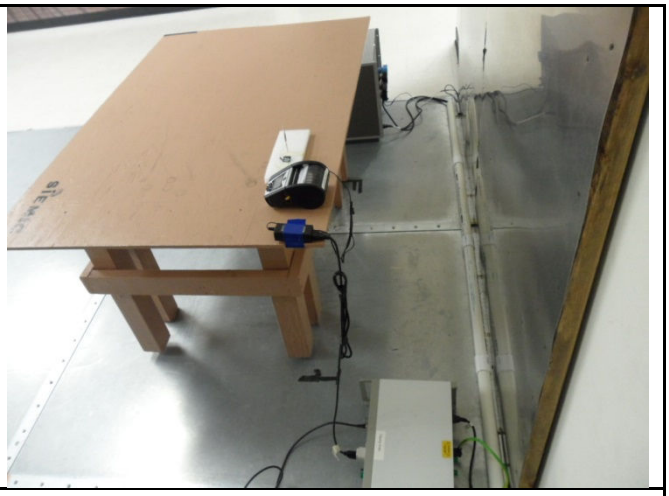
Mode	Note
Bluetooth	BDR (GFSK), EDR (8-DPSK), LE (GFSK)

6.4 EUT Photos

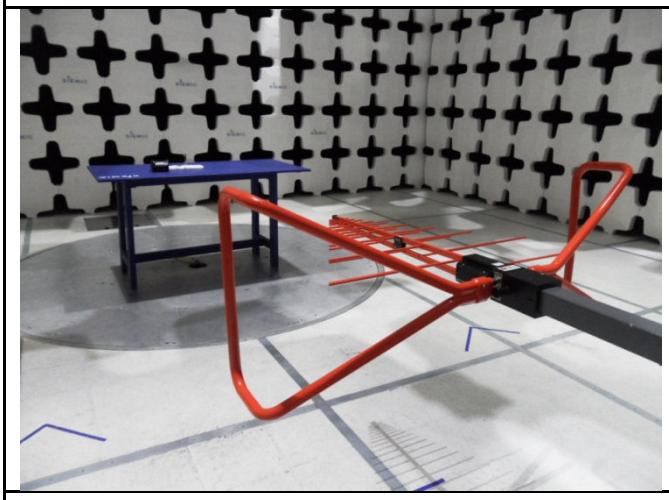
<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>EUT - Top</td><td>EUT – Bottom</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Antenna Top View</td><td>Antenna Bottom View</td></tr>
</table>

6.5 EUT Test Setup Photos

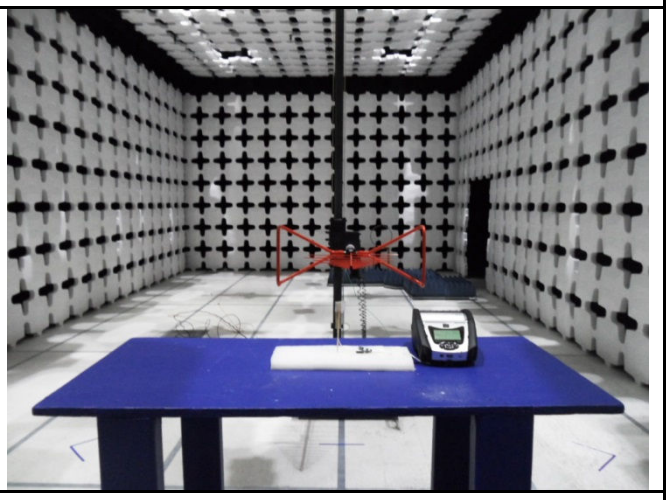
Conducted Emission Test setup - Front



Conducted Emission Test setup - Rear

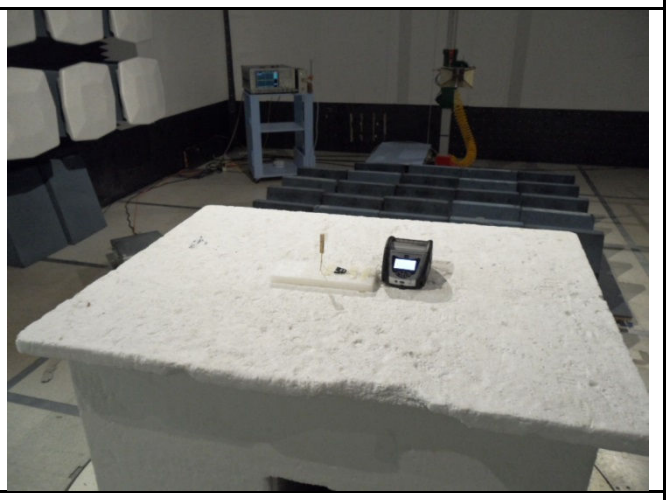


Radiated Emission Test Setup (30MHz-1GHz) - Front



Radiated Emission Test Setup (30MHz-1GHz) – Rear

Radiated Emission Test Setup (>1GHz) - Front



Radiated Emission Test Setup (>1GHz) – Rear

7 Supporting Equipment/Software and cabling Description

7.1 Supporting Equipment

Index	Supporting Equipment Description	Model	Serial No.	Manu	Note
1	Zebra Mobile Printer	QLn420	N/A	Zebra	-

7.2 Cabling Description

Name	Connection Start		Connection Stop		Length / shielding Info		Note
	From	I/O Port	To	I/O Port	Length (m)	Shielding	
Flat cable	Host	-	EUT	-	0.1	NO	-
RF Cable	EUT	PLUG	Antenna	PLUG	0.1	NO	

7.3 Test Software Description

Test Item	Software	Description
RF Testing	Toolbox 1.71	Set the EUT to different modulation and channel

8 Test Summary

General Technical Requirement

Test Item	Test standard		Test Method/Procedure		Pass / Fail
Restricted Band of Operation	FCC	15.205	FCC	ANSI C63.4 – 2014 Public Notice DA 00-705	☒ Pass ☐ N/A
	IC	RSS 210 ISSUE 8, Dec 2010 (2.2)	IC	-	
AC Conducted Emissions Voltage	FCC	15.207(a)	FCC	ANSI C63.4 – 2014	☒ Pass ☐ N/A
	IC	RSS Gen Issue 4, Nov 2014 (8.8)	IC	-	

FHSS requirement

Test Item	Test standard		Test Method/Procedure		Pass / Fail
Channel Separation	FCC	15.247 (a)(1)	FCC	Public Notice DA 00-705	☒ Pass ☐ N/A
	IC	RSS 210 ISSUE 8, Dec 2010 (A8.1)	IC	-	
Occupied Bandwidth	FCC	15.247(a)(1)	FCC	-	☐ Pass ☒ N/A
	IC	RSS Gen Issue 4, Nov 2014 (4.6.1)	IC	-	
20 dB Bandwidth	FCC	15.247(a)(2)	FCC	Public Notice DA 00-705	☒ Pass ☐ N/A
	IC	RSS 210 ISSUE 8, Dec 2010 (A8.2)	IC	-	
Number of Hopping Channels	FCC	15.247(a)(1)	FCC	Public Notice DA 00-705	☒ Pass ☐ N/A
	IC	RSS 210 ISSUE 8, Dec 2010(A8.1)	IC	-	
Band Edge and Radiated Spurious Emissions	FCC	15.247(d)	FCC	Public Notice DA 00-705	☒ Pass ☐ N/A
	IC	RSS 210 ISSUE 8, Dec 2010(A8.5)	IC	-	
Time of Occupancy	FCC	15.247(a)(1)	FCC	Public Notice DA 00-705	☒ Pass ☐ N/A
	IC	RSS 210 ISSUE 8, Dec 2010(A8.1)	IC	-	
Output Power	FCC	15.247(b)	FCC	Public Notice DA 00-705	☒ Pass ☐ N/A
	IC	RSS 210 ISSUE 8, Dec 2010 (A8.4)	IC	-	
Receiver Spurious Emissions	FCC	15.247(d)		Public Notice DA 00-705	☒ Pass ☐ N/A
	IC	RSS Gen Issue 4, Nov 2014 (7.1)		-	
Antenna Gain > 6 dBi	FCC	15.247(e)	FCC	Public Notice DA 00-705	☐ Pass ☒ N/A
	IC	RSS 210 ISSUE 8, Dec 2010(A8.4)	IC	-	
Power Spectral Density	FCC	15.247(e)	FCC	Public Notice DA 00-705	☐ Pass ☒ N/A
	IC	RSS 210 ISSUE 8, Dec 2010(A8.3)	IC	-	
Hybrid System Requirement	FCC	15.247(f)	FCC	Public Notice DA 00-705	☐ Pass ☒ N/A
	IC	RSS 210 ISSUE 8, Dec 2010(A8.3)	IC	-	
Hopping Capability	FCC	15.247(g)	FCC	Public Notice DA 00-705	☒ Pass ☐ N/A
	IC	RSS 210 ISSUE 8, Dec 2010(A8.1)	IC	-	
Hopping Coordination Requirement	FCC	15.247(h)	FCC	Public Notice DA 00-705	☐ Pass ☒ N/A
	IC	RSS 210 ISSUE 8, Dec 2010(A8.1)	IC	-	

RF Exposure requirement	FCC	15.247(i)	FCC	Public Notice DA 00-705	☒ Pass ☐ N/A
	IC	RSS Gen Issue 4, Nov 2014 (3.2)	IC	-	
Remark	1. All measurement uncertainties are not taken into consideration for all presented test result. 2. 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

Test Item	Frequency Range	Description	Uncertainty
AC Conducted Emissions Voltage	150KHz – 30MHz	Confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2	±3.5dB
6 dB & 26 dB & 99% Bandwidth	30MHz – 40GHz		±1.5dB
Maximum conducted output power	30MHz – 40GHz		±1.5dB
Maximum peak spectral density	30MHz – 40GHz		±1.5dB
Peak Excursion Ratio	30MHz – 40GHz		
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

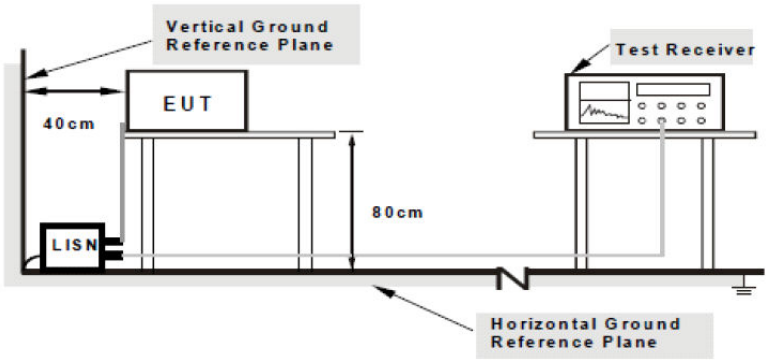
10.1 Antenna Requirement

Spec	Requirement	Applicable
§15.203	An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. Antenna requirement must meet at least one of the following: a) Antenna must be permanently attached to the device. b) Antenna must use a unique type of connector to attach to the device. c) Device must be professionally installed. Installer shall be responsible for ensuring that the correct antenna is employed with the device.	☒
Remark	The BT antenna is integral to the PCB board permanently to the device which meets the requirement (See Internal Photographs submitted as another Exhibit).	
Result	☒ PASS ☐ FAIL	

10.2 Conducted Emission Test Result

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

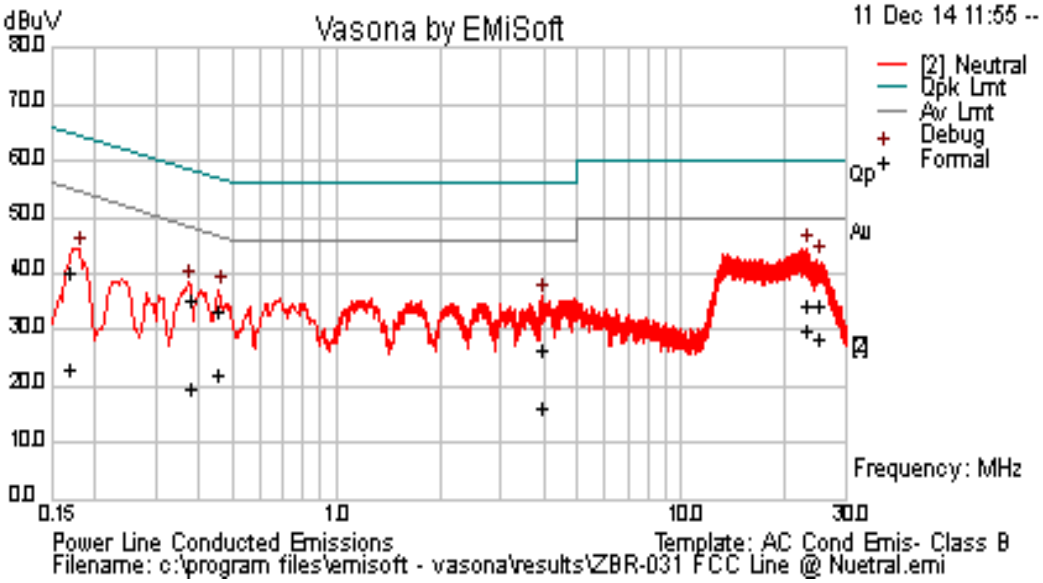
Spec	Item	Requirement	Applicable
§ 15.207, RSS 210 ISSUE 8, Dec 2010(A8.1)	a)	For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits set in § 15.207, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). AC Line conducted emission within the band 150KHz to 30MHz	☒
Test Setup	 Note: 1.Support units were connected to second LISN. 2.Both of LISNs (AMN) are 80cm from EUT and at least 80cm from other units and other metal planes support units.		
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 were powered separately from another main supply.		
Remark	N/A		
Result	☒ Pass ☐ Fail		

Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

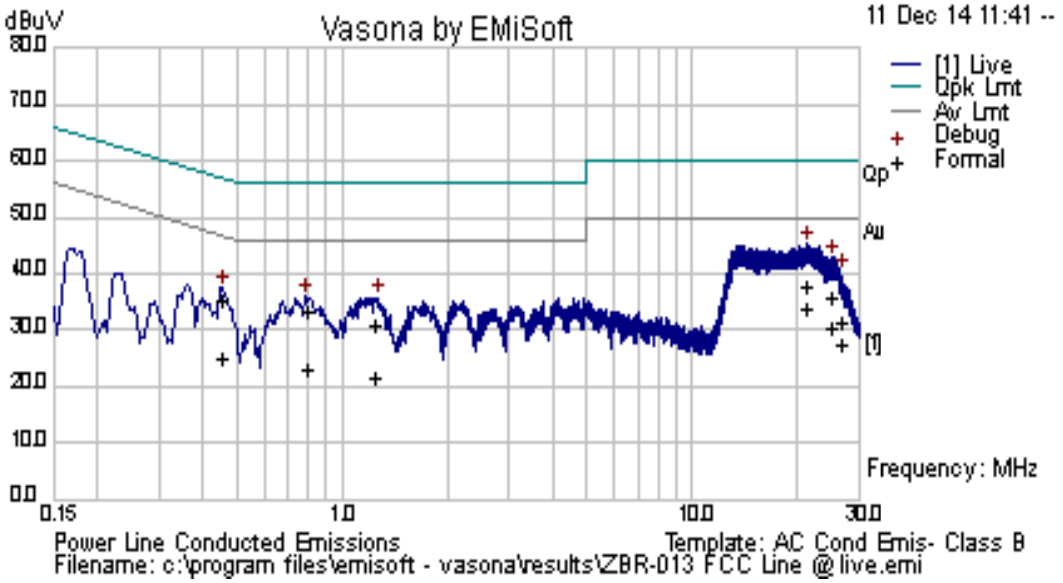
Test Result

Test specification:	47CFR15.247			
Environ Conditions:	Temp(°C):	22	Result:	Pass
	Humidity (%):	45		
	Atmospheric(mPa):	1021		
Voltage/Line & Phase	110VAC, 60Hz/Neutral			
Test Date:	12/11/2014			
Tested by:	Teody Mnansala			
Remarks:	None			



Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB	Pass /Fail
0.45	22.77	10.01	0.73	33.51	Quasi Peak	Neutral	56.80	-23.29	Pass
0.37	24.35	10.01	0.72	35.08	Quasi Peak	Neutral	58.39	-23.32	Pass
0.17	29.40	10.00	0.75	40.15	Quasi Peak	Neutral	65.00	-24.85	Pass
24.76	21.94	10.08	2.27	34.28	Quasi Peak	Neutral	60.00	-25.72	Pass
23.09	21.78	10.07	2.27	34.12	Quasi Peak	Neutral	60.00	-25.88	Pass
3.96	15.46	10.03	1.08	26.57	Quasi Peak	Neutral	56.00	-29.43	Pass
23.09	17.72	10.07	2.27	30.06	Average	Neutral	50.00	-19.94	Pass
24.76	16.16	10.08	2.27	28.51	Average	Neutral	50.00	-21.49	Pass
0.45	11.47	10.01	0.73	22.21	Average	Neutral	46.80	-24.59	Pass
0.37	9.08	10.01	0.72	19.81	Average	Neutral	48.39	-28.59	Pass
3.96	5.31	10.03	1.08	16.42	Average	Neutral	46.00	-29.58	Pass
0.17	12.41	10.00	0.75	23.16	Average	Neutral	55.00	-31.84	Pass

Test specification:	ANSI C63.10			
Environ Conditions:	Temp(°C):	22	Result:	Pass
	Humidity (%):	45		
	Atmospheric(mPa):	1021		
Voltage/Line & Phase	110VAC, 60Hz/Line			
Test Date:	12/11/2014			
Tested by:	Teody Mnansala			
Remarks:	None			



Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB	Pass /Fail
0.45	24.53	10.01	0.73	35.27	Quasi Peak	Line	56.84	-21.57	Pass
21.34	25.26	10.07	2.27	37.60	Quasi Peak	Line	60.00	-22.40	Pass
0.80	22.42	10.01	0.76	33.19	Quasi Peak	Line	56.00	-22.81	Pass
25.06	23.45	10.08	2.27	35.80	Quasi Peak	Line	60.00	-24.20	Pass
1.24	19.85	10.02	0.82	30.69	Quasi Peak	Line	56.00	-25.31	Pass
26.61	18.84	10.08	2.27	31.20	Quasi Peak	Line	60.00	-28.80	Pass
21.34	21.70	10.07	2.27	34.04	Average	Line	50.00	-15.96	Pass
25.06	18.00	10.08	2.27	30.35	Average	Line	50.00	-19.65	Pass
0.45	14.38	10.01	0.73	25.12	Average	Line	46.84	-21.73	Pass
26.61	14.91	10.08	2.27	27.26	Average	Line	50.00	-22.74	Pass
0.80	12.07	10.01	0.76	22.84	Average	Line	46.00	-23.16	Pass
1.24	10.73	10.02	0.82	21.57	Average	Line	46.00	-24.43	Pass

10.3 RF Conducted Measurement

10.3.1 20dB Bandwidth – FHSS (Bluetooth BDR&EDR)

Requirement(s):

Spec	Item	Requirement	Applicable
47 CFR §15.247 RSS-210 (A2.6)	a)	Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater. However, frequency hopping systems operated in 2400-2483.5MHz with output power not greater than 125mW, the intervals of hopping channel carrier frequencies shall not be less than 25kHz or two thirds of the 20dB bandwidth of the hopping channel, whichever is greater.	☒
47 CFR §15.247 RSS-210 (A2.6)	b)	Frequency hopping systems operating in the 5725-5850MHz band shall use at least 75 hopping frequencies. The maximum 20dB bandwidth of the hopping channel is 1MHz.	☐
Test Setup			
Test Procedure		20dB Emission bandwidth measurement procedure - Set RBW ≥ 1% 20dB Bandwidth - Set the video bandwidth (VBW) ≥ 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	12/01/2014	Environmental condition	Temperature 21°C Relative Humidity 46% Atmospheric Pressure 1019mbar
Remark	The 20 dB test result and the 2/3 of 20 dB data calculation are for channel separation measurement reference only. There isn't limit for 20 dB bandwidth for this product.		
Result	☒ Pass ☐ Fail		

Equipment Setting

TEST	RBW	VBW	SPAN	Detector	SWEEP	Trace	NOTES
20dB Bandwidth	≥1% 20dB bandwidth	≥ RBW	~2 – 3 times 20dBbandwidth	Peak	Auto	Maxhold	-

Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes ☐ N/A

20dB Bandwidth Test Result

Type	Freq (MHz)	Test mode	CH	20dB Bandwidth (MHz)	2/3 20dB Bandwidth (MHz)
20dB OBW	2402	BDR	Low	0.930	0.620
20dB OBW	2441	BDR	Mid	0.927	0.618
20dB OBW	2480	BDR	High	0.924	0.616
20dB OBW	2402	EDR	Low	1.336	0.891
20dB OBW	2441	EDR	Mid	1.330	0.887
20dB OBW	2480	EDR	High	1.329	0.886

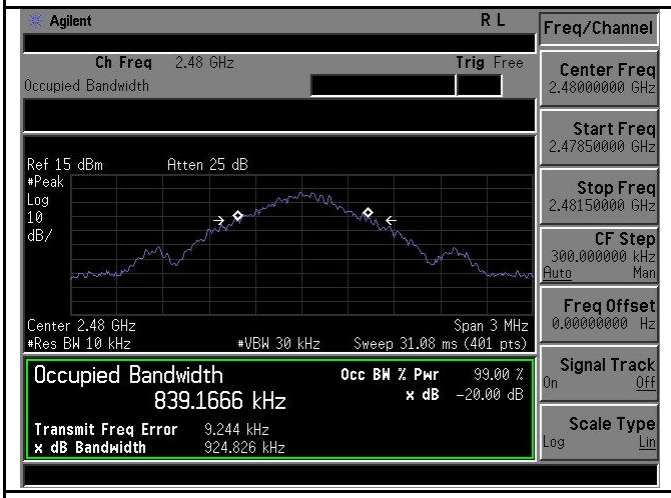
99% Bandwidth Test Result

Type	Freq (MHz)	Test mode	CH	99% Bandwidth (MHz)
99% OBW	2402	BDR	Low	0.834
99% OBW	2441	BDR	Mid	0.841
99% OBW	2480	BDR	High	0.842
99% OBW	2402	EDR	Low	1.190
99% OBW	2441	EDR	Mid	1.199
99% OBW	2480	EDR	High	1.200

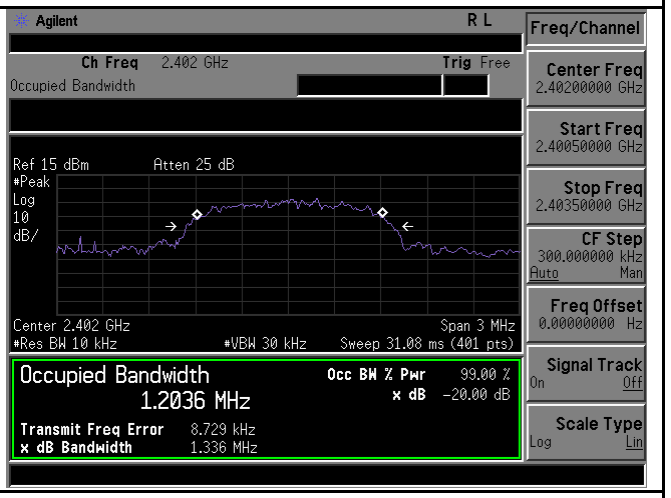
20dB OBW Test Plots

20dB Low CH 2402 - BDR

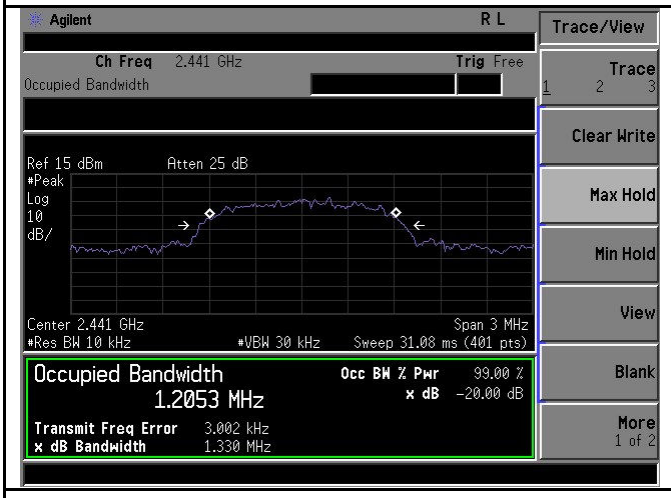
20dB Mid CH 2441 - BDR



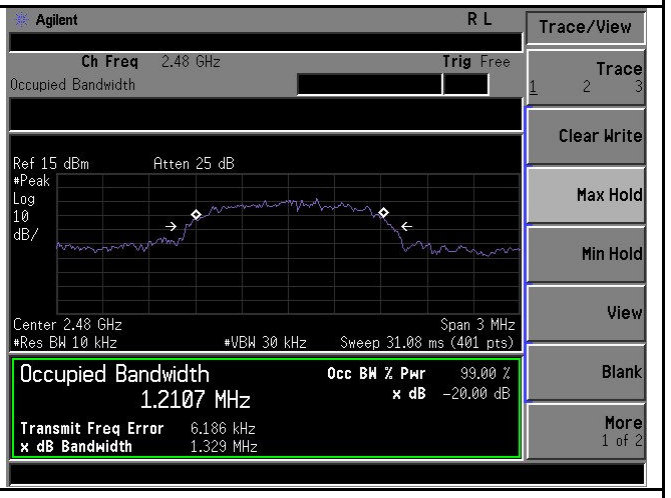
20dB High CH 2480 - BDR



20dB Low CH 2402 - EDR

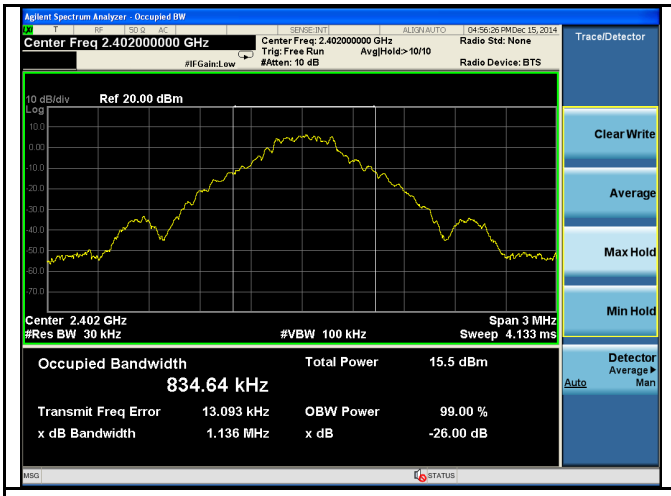


20dB Mid CH 2441 - EDR

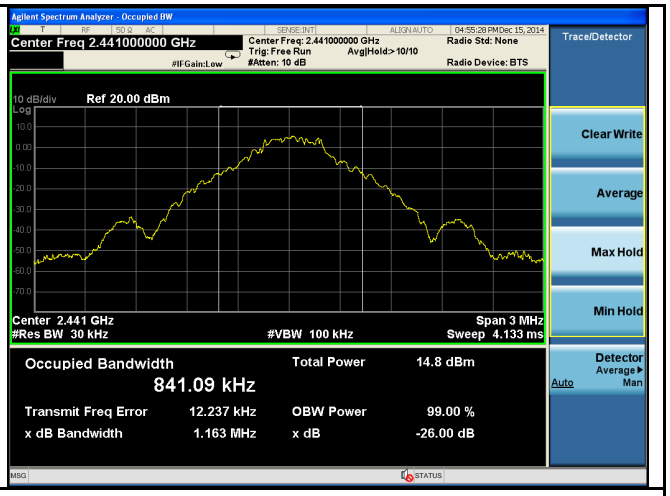


20dB High CH 2480 - EDR

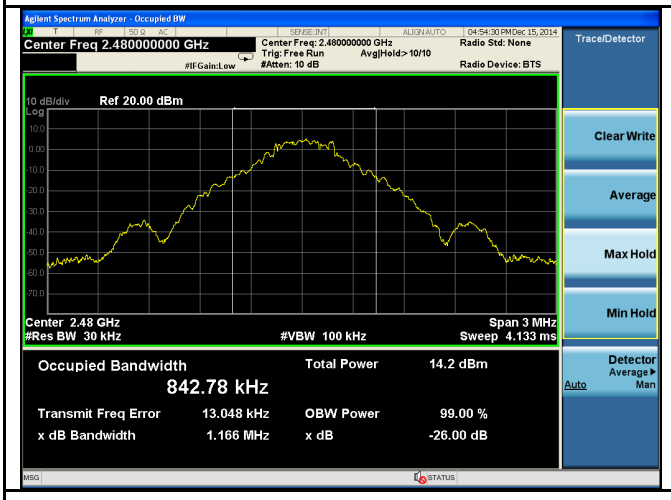
99% OBW Test Plots



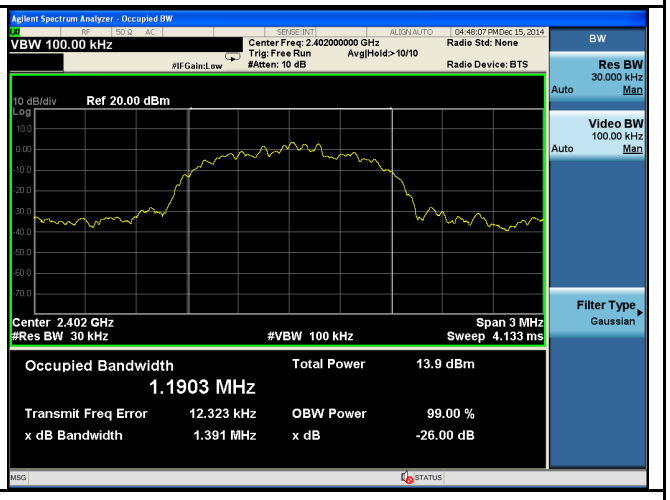
20dB Low CH 2402 - BDR



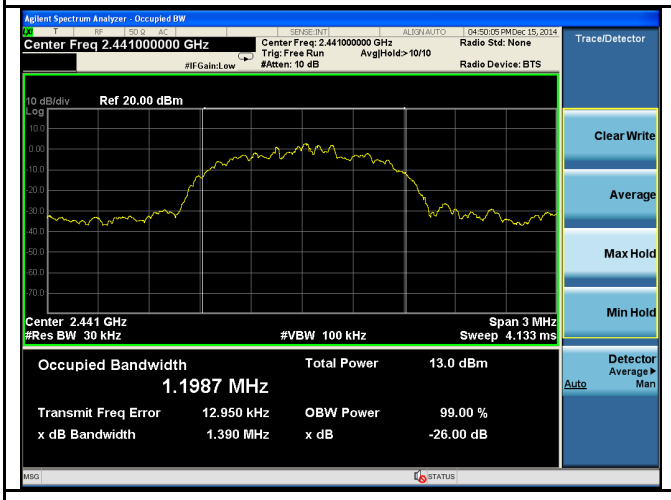
20dB Mid CH 2441 - BDR



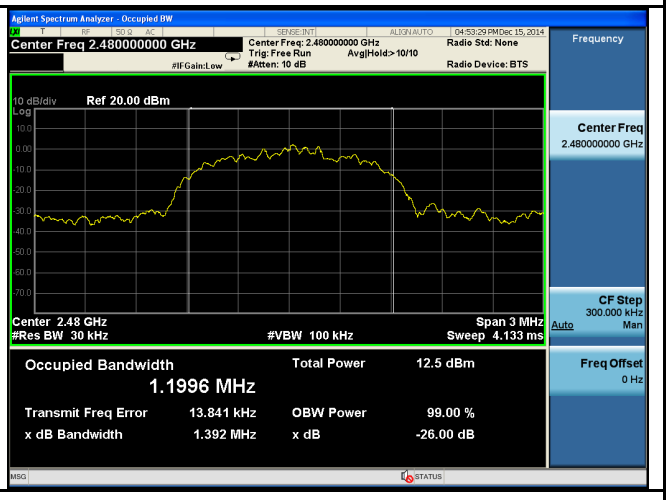
20dB High CH 2480 - BDR



20dB Low CH 2402 - EDR



20dB Mid CH 2441 - EDR



20dB High CH 2480 - EDR

10.3.2 Number of Hopping Channel – FHSS (Bluetooth BDR&EDR)

Requirement(s):

Spec	Item	Requirement	Applicable
47 CFR §15.247 RSS-210 (A2.6)	a)	For frequency hopping systems in the 2400-2483.5MHz band employing at least 15 hopping channels.	☒

Test Setup				
Test Procedure	Number of hopping frequencies procedure - The EUT must have its hopping function enabled - Span = the frequency band of operation. - Resolution (or IF) Bandwidth (RBW) >= 1% of the span. - Video (or Average) Bandwidth (VBW) >= RBW. - Detector = peak. - Sweep time = auto couple. - Trace mode = max hold. - Allow trace to fully stabilize. - Save the plot			
Test Date	12/01/2014	Environmental condition	Temperature Relative Humidity Atmospheric Pressure	21°C 46% 1019mbar
Remark	NONE			
Result	☒ Pass ☐ Fail			

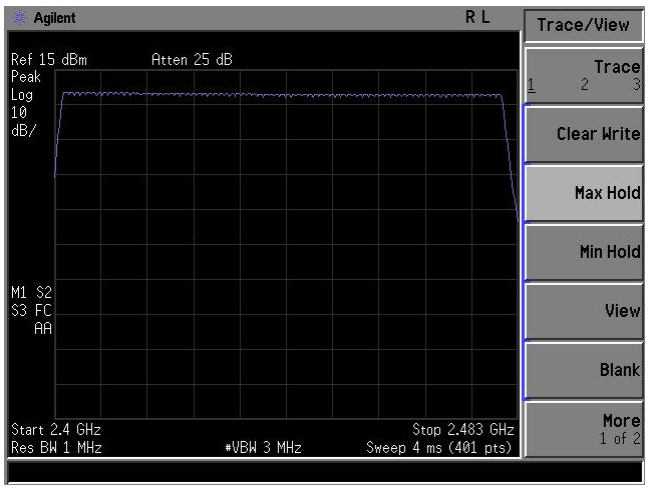
Equipment Setting

TEST	RBW	VBW	SPAN	Detector	SWEEP	Trace	NOTES
Hopping Channel Number	≥1% Span	≥ RBW	-	PK	Auto	Maxhold	-

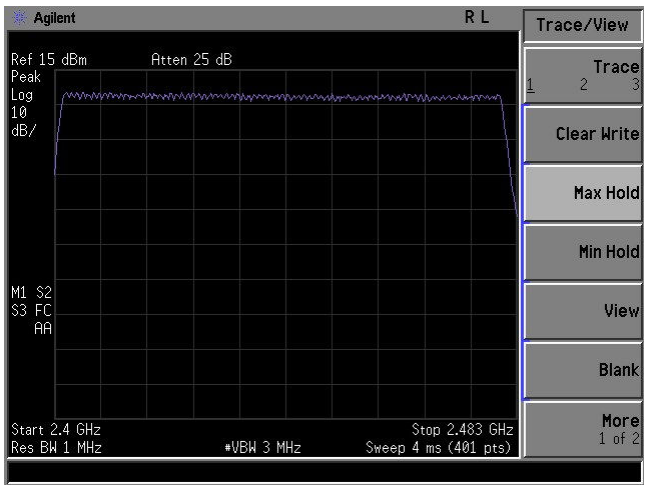
Test Data ☐ Yes ☒ N/A

Test Plot ☒ Yes ☐ N/A

Test Plots



79 CH – BDR



79 CH - EDR

10.3.3 Peak Output Power – FHSS (Bluetooth BDR&EDR)

Requirement(s):

Spec	Item	Requirement	Applicable
47 CFR §15.247 (b) RSS-210 (A2.6)	a)	For frequency hopping systems in the 2400-2483.5MHz band employing at least 75 hopping channels, and all frequency hopping systems in the 5725-5850MHz band: below 1 Watt (inclusive).	☐
	b)	Power reduction (antenna gain > 6dBi)	☐
47 CFR §15.247 (b) RSS-210 (A2.6)		frequency hopping systems operated in 2400-2483.5MHz with output power not greater than 125mW, the intervals of hopping channel carrier frequencies shall not be less than 25kHz or two thirds of the 20dB bandwidth of the hopping channel, whichever is greater.	☒

Test Setup			
Test Procedure	Maximum output power measurement procedure - Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel. - RBW > the 20 dB bandwidth of the emission being measured; - VBW >= RBW. - Detector = peak. - Sweep time = auto couple. - Trace mode = max hold. - Allow trace to fully stabilize. - Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power.		
Test Date	12/01/2014	Environmental condition	Temperature 21ºC Relative Humidity 46% Atmospheric Pressure 1019mbar
Remark	None		
Result	☒ Pass ☐ Fail		

Equipment Setting

TEST	RBW	VBW	SPAN	Detector	SWEEP	Trace	NOTES
PK output power	≥ 20dB bandwidth	≥ RBW	~ 5 times 20dB bandwidth	Peak	Auto	Maxhold	Including Cable loss and Attenuation

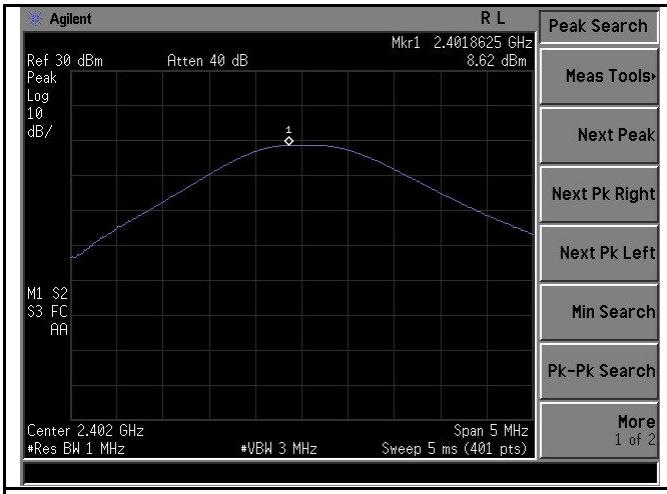
Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes ☐ N/A

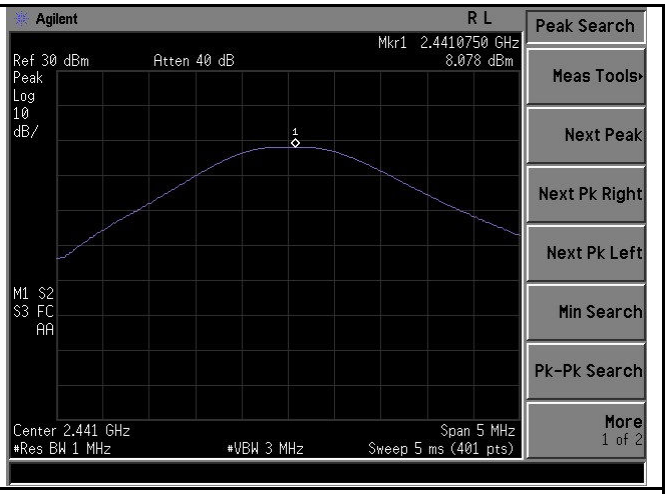
Output Power Test Result

Type	Freq (MHz)	Test mode	CH	Conducted Power (dBm)	Limit (dBm)	Result
Output power	2402	BDR	Low	8.620	21	Pass
Output power	2441	BDR	Mid	8.078	21	Pass
Output power	2480	BDR	High	7.899	21	Pass
Output power	2402	EDR	Low	9.092	21	Pass
Output power	2441	EDR	Mid	8.506	21	Pass
Output power	2480	EDR	High	8.242	21	Pass

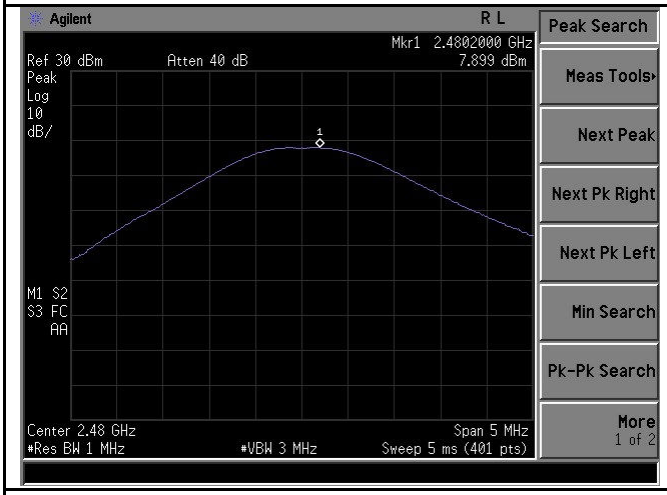
Test Plots



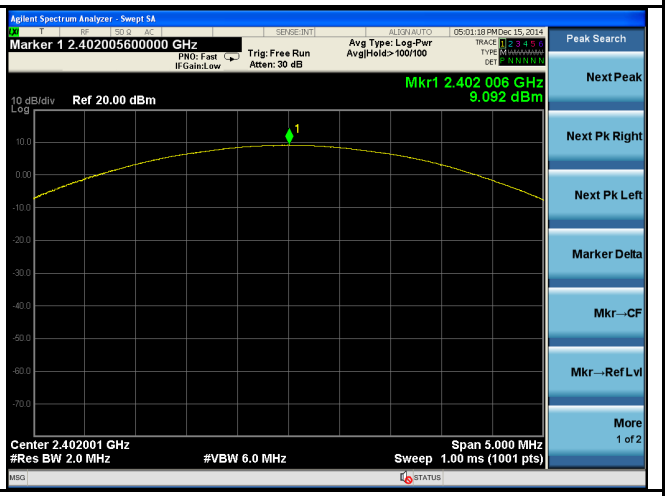
Output power - Low CH 2402 - BDR



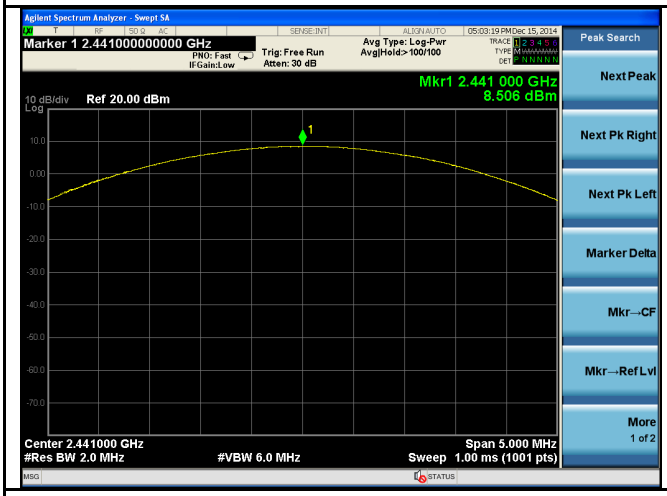
Output power - Mid CH 2441 - BDR



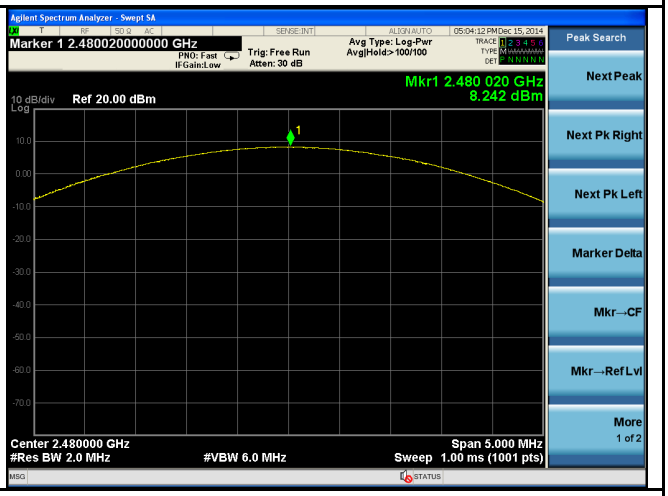
Output power - High CH 2480 – BDR



Output power - Low CH 2402 - EDR



Output power - Mid CH 2441 - EDR



Output power - High CH 2480 - EDR

10.3.4 Channel Separation – FHSS (Bluetooth BDR&EDR)

Requirement(s):

Spec	Item	Requirement	Applicable
47 CFR §15.247 (e) RSS-210 (A2.6)	a)	Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater.	☒

Test Setup				
Test Procedure	DA 00-705 Measurement Guidelines for Frequency Hopping Spread Spectrum Systems Channel Separation procedure - The EUT must have its hopping function enabled. - Span = wide enough to capture the peaks of two adjacent channels - Resolution (or IF) Bandwidth (RBW) >= 1% of the span - Video (or Average) Bandwidth (VBW) >= RBW. - Detector = Peak. - Trace mode = max hold. - Use the marker-delta function to determine the separation between the peaks of the adjacent channels.			
Test Date	12/01/2014	Environmental condition	Temperature Relative Humidity Atmospheric Pressure	21°C 46% 1019mbar
Remark	NONE			
Result	☒ Pass ☐ Fail			

Equipment Setting

TEST	RBW	VBW	SPAN	Detector	SWEEP	Trace	NOTES
Channel Separation	≥1% Span	≥ RBW	-	Peak	Auto	Maxhold	-

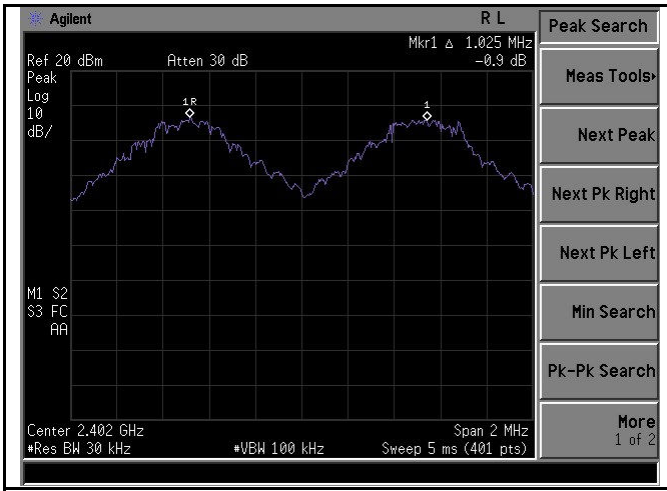
Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes ☐ N/A

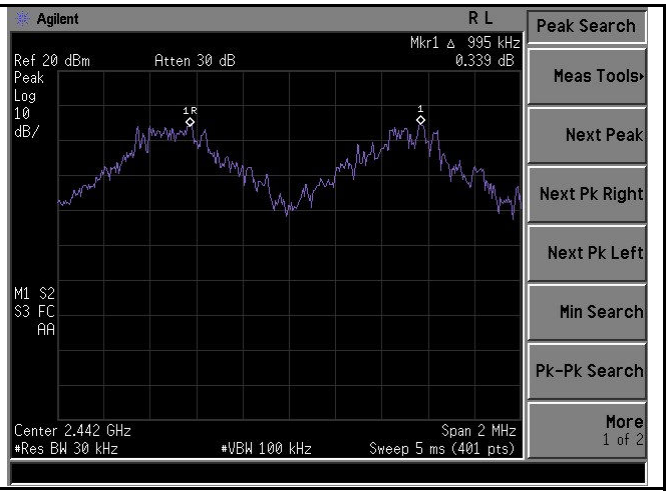
Channel Separation Test Result

Type	Freq (MHz)	Test mode	CH	Result (MHz)	2/3 20dB Bandwidth (MHz)	Result
Channel Sep	2402	BDR	Low	1.025	0.620	Pass
Channel Sep	2441	BDR	Mid	0.995	0.618	Pass
Channel Sep	2480	BDR	High	0.895	0.616	Pass
Channel Sep	2402	EDR	Low	1.000	0.891	Pass
Channel Sep	2441	EDR	Mid	0.990	0.887	Pass
Channel Sep	2480	EDR	High	1.026	0.886	Pass

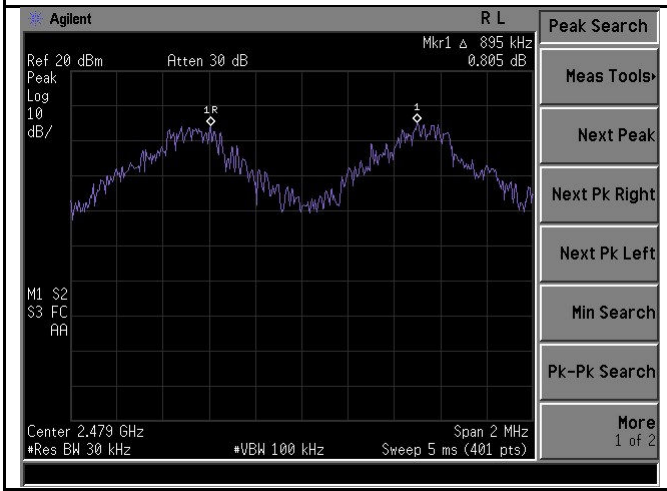
Test Plots



Low CH 2402 - BDR

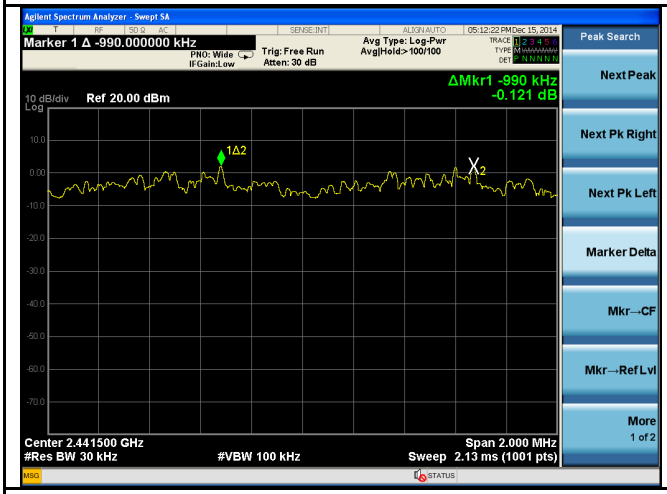


Mid CH 2441 - BDR

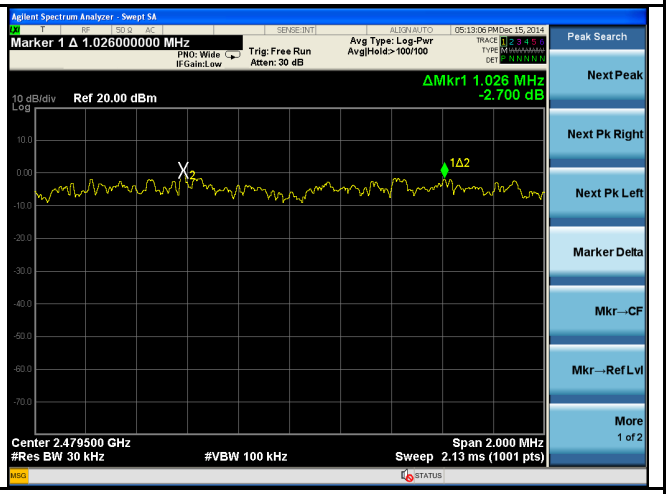


High CH 2480 - BDR

Low CH 2402 - EDR



Mid CH 2441 - EDR



High CH 2480 - EDR

10.3.5 Time of Occupancy – FHSS (Bluetooth BDR&EDR)

Requirement(s):

Spec	Item	Requirement	Applicable
47 CFR §15.247 RSS-210 (A2.6)	a)	Frequency hopping systems in the 2400-2483.5MHz band shall use at least 15 non-overlapping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems which use fewer than 75 hopping frequencies may employ intelligent hopping techniques to avoid interference to other transmissions.	☒
Test Setup			
Test Procedure	DA 00-705 Measurement Guidelines for Frequency Hopping Spread Spectrum Systems Channel Separation procedure - The EUT must have its hopping function enabled. - Span = zero span - centered on a hopping channel - RBW = 1 MHz; VBW >= RBW - Sweep = as necessary to capture the entire dwell time per hopping channel. - Detector = Peak. - Trace mode = max hold. - If possible, use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation.		
Test Date	12/01/2014	Environmental condition	Temperature 21°C Relative Humidity 46% Atmospheric Pressure 1019mbar
Remark	NONE		
Result	☒ Pass ☐ Fail		

Equipment Setting

TEST	RBW	VBW	SPAN	Detector	SWEEP	Trace	NOTES
Occupied Time	1MHz	≥ RBW	0Hz	Peak	-	Maxhold	-

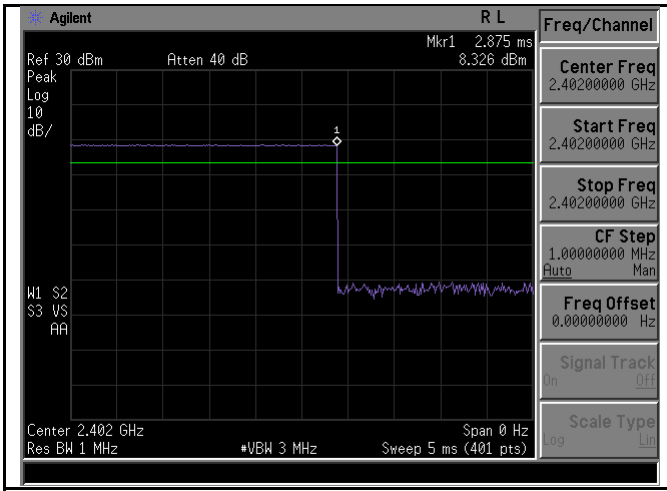
Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes ☐ N/A

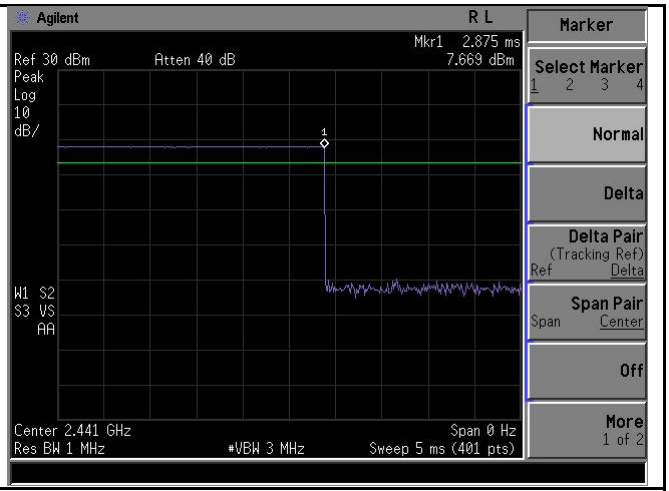
Dwell Time Test Result

Type	Freq (MHz)	Test mode	CH	Pulse time (msec)	Dwell Time (sec)	Limit (Sec)	Result
Dwell time	2402	BDR	Low	2.875	0.306	0.4	Pass
Dwell time	2441	BDR	Mid	2.875	0.306	0.4	Pass
Dwell time	2480	BDR	High	2.875	0.306	0.4	Pass
Dwell time	2402	EDR	Low	2.875	0.306	0.4	Pass
Dwell time	2441	EDR	Mid	2.862	0.305	0.4	Pass
Dwell time	2480	EDR	High	2.850	0.304	0.4	Pass
Dwell Time= Pulse time (s) x (1600 ÷6÷79) x 31.6 seconds							

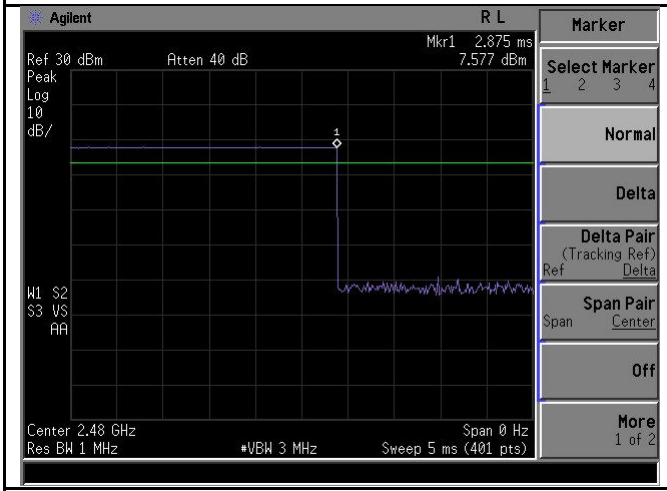
Test Plots



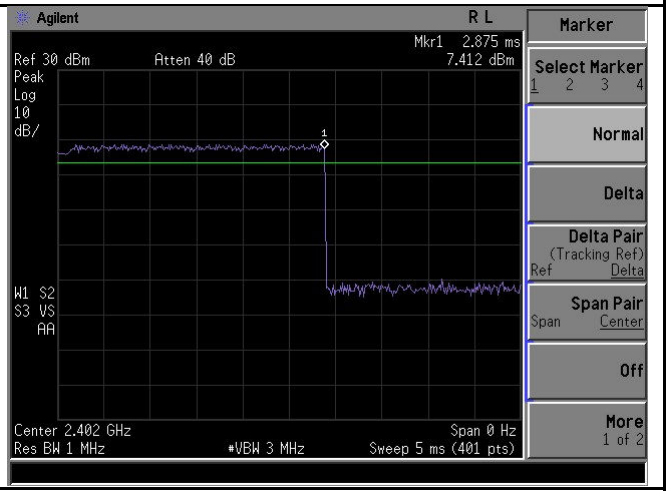
BDR-Dwell Time-2402M



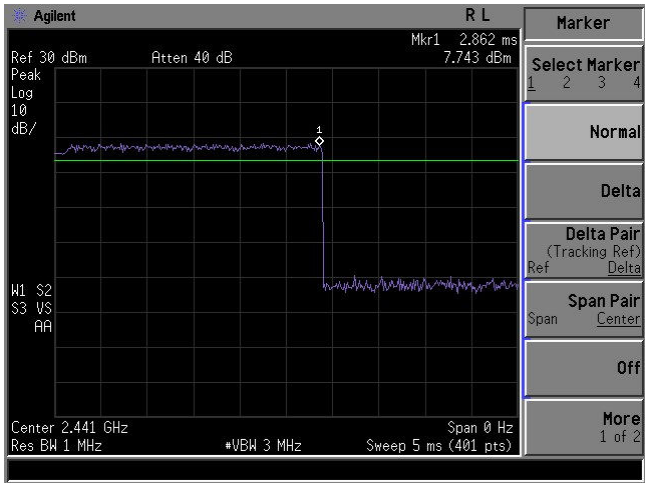
BDR-Dwell Time -2441M



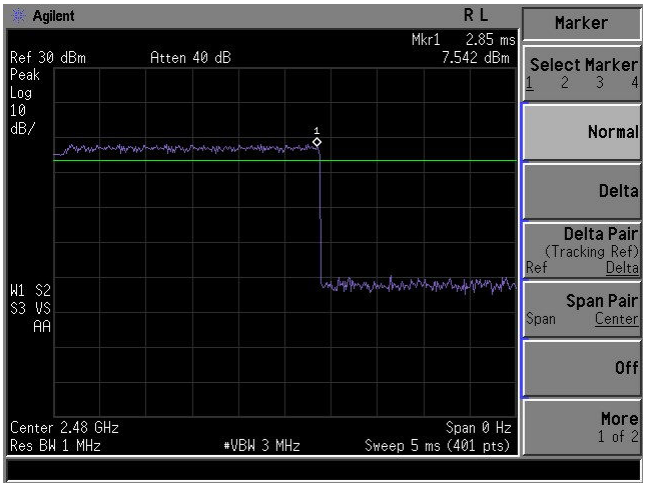
BDR-Dwell Time -2480M



EDR-Dwell Time -2402M



EDR-Dwell Time -2441M



EDR-Dwell Time -2480M

10.3.6 Band Edge – FHSS (Bluetooth BDR&EDR)

Requirement(s):

Spec	Item	Requirement	Applicable
§ 15.247(d), RSS 210 ISSUE 8, Dec 2010(A8.5)	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 v03r02 Band Edge measurement procedure 1. Set the EUT to maximum power setting and enable the EUT transmit continuously. 2. Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as a measured. The attenuation shall be be 30 dB instead of 20 dB when RMS 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	12/05/2014	Environmental condition	Temperature Relative Humidity Atmospheric Pressure	22°C 46% 1020mbar
Remark	None			
Result	☒ Pass ☐ Fail			

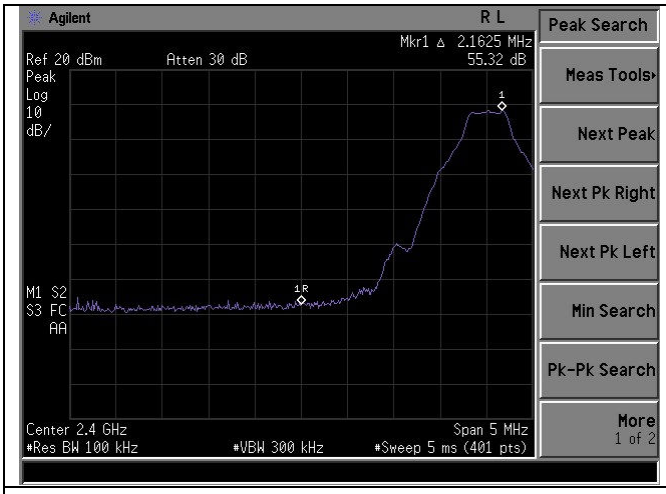
Equipment Setting

TEST	RBW	VBW	Detector	SWEEP	Trace	NOTES
Band Edge	100KHz	≥3 x RBW	Peak	Auto	Maxhold	-

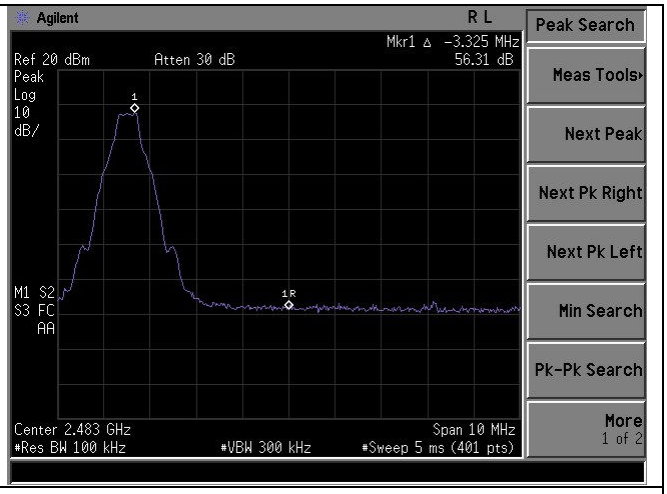
Test Data ☐ Yes ☒ N/A

Test Plot ☒ Yes ☐ N/A

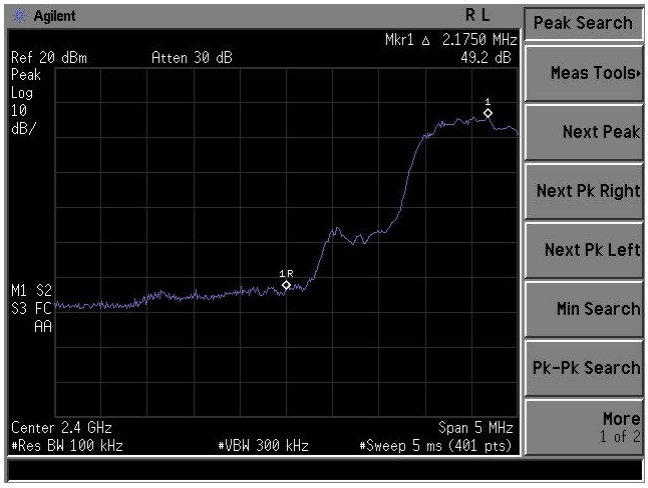
Test Plots



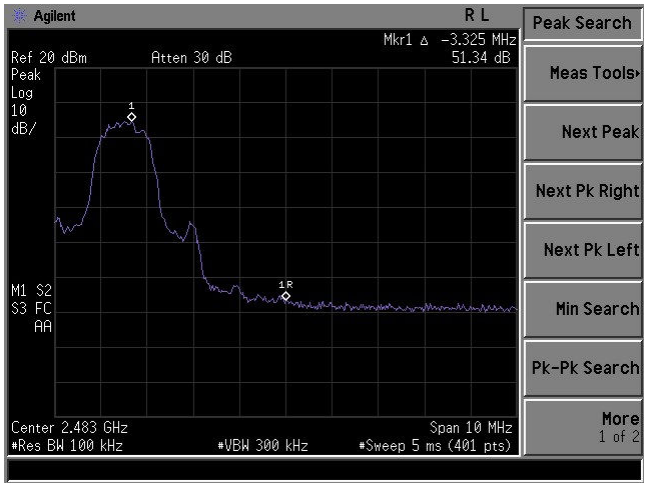
Band Edge-BDR-Low



Band Edge-BDR-High



Band Edge-EDR-Low



Band Edge-EDR-High

Radiated Restricted Band

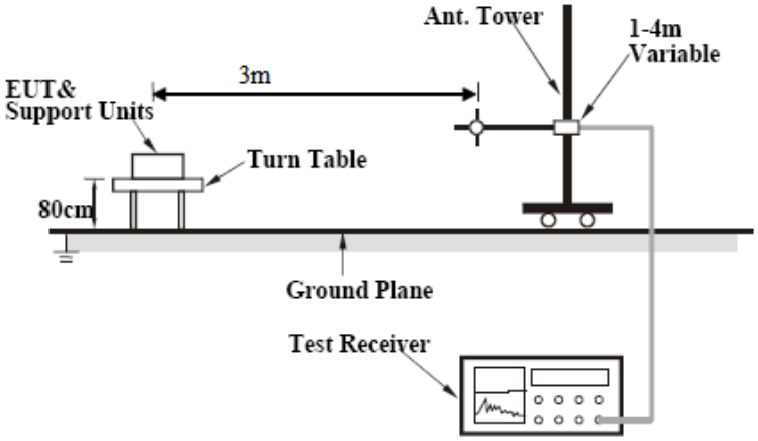
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
2483.50	13.74	2.15	28.75	44.64	Peak Max	V	122.00	210.00	54.00	-9.36	Pass

Note: Only the worst case result under EDR mode operating at 2480MHz is presented here. Both horizontal and vertical polarities have been verified.

10.4 Radiated Measurement

10.4.1 Radiated Measurement below 1GHz

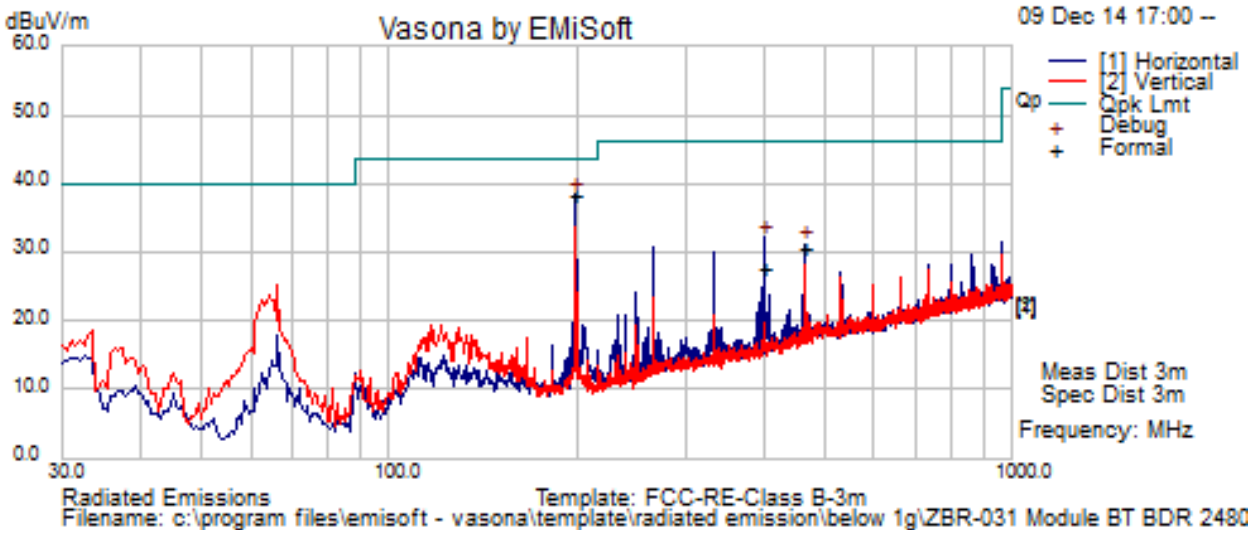
Requirement(s):

Spec	Item	Requirement	Applicable
47CFR§15.247(d), RSS 210 ISSUE 8, Dec 2010(A8.5)	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 **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		N/A	
Result		☒ Pass ☐ Fail	

Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes ☐ N/A

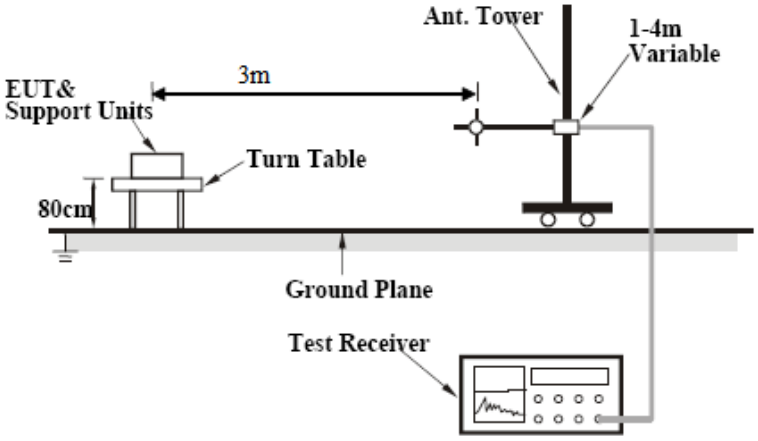
Test specification:	ANSI C63.10			
Environ Conditions:	Temp(°C):	22	Result:	Pass
	Humidity (%):	45		
	Atmospheric(mPa):	1021		
Mains Power:	110VAC, 60Hz			
Test Date:	12/14/2014			
Tested by:	Teody Mnansala			
Remarks:	None			
Frequency Range:	30 MHz – 1000 MHz			



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB
199.50	62.73	2.50	-26.94	38.29	Quasi Max	H	145.00	106.00	43.50	-5.21
399.00	48.45	3.33	-24.11	27.67	Quasi Max	H	102.00	30.00	46.00	-18.33
465.50	49.28	3.89	-22.63	30.54	Quasi Max	H	180.00	165.00	46.00	-15.46

10.4.2 Radiated Spurious Emissions > 1GHz

Requirement(s):

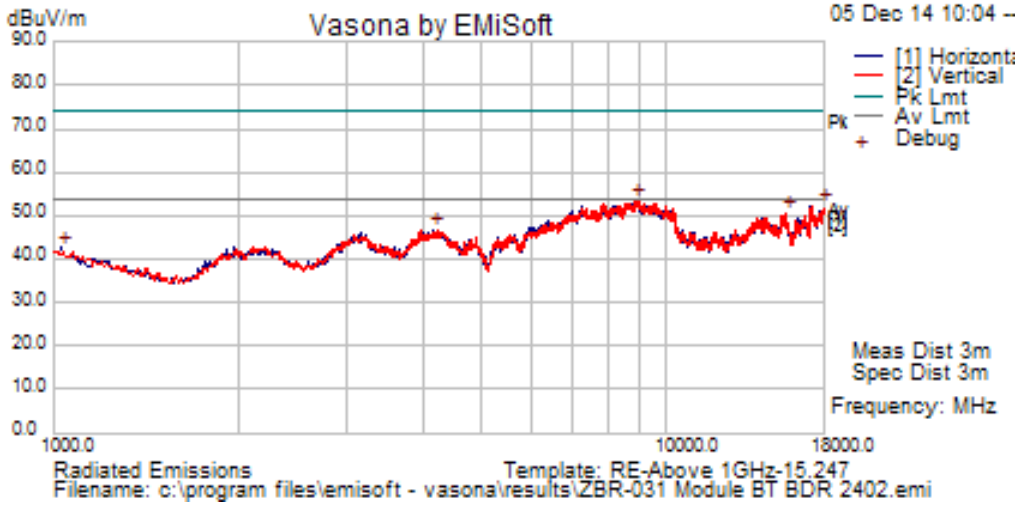
Spec	Item	Requirement	Applicable
47CFR§15.247(d), RSS 210 ISSUE 8, Dec 2010(A8.5)	a)	For non-restricted band, In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional 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		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. An average 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		All peak detection results are under average limits. So formal scans are unnecessary.	
Result		☒ Pass ☐ Fail	

Test Data ☐ Yes ☒ N/A

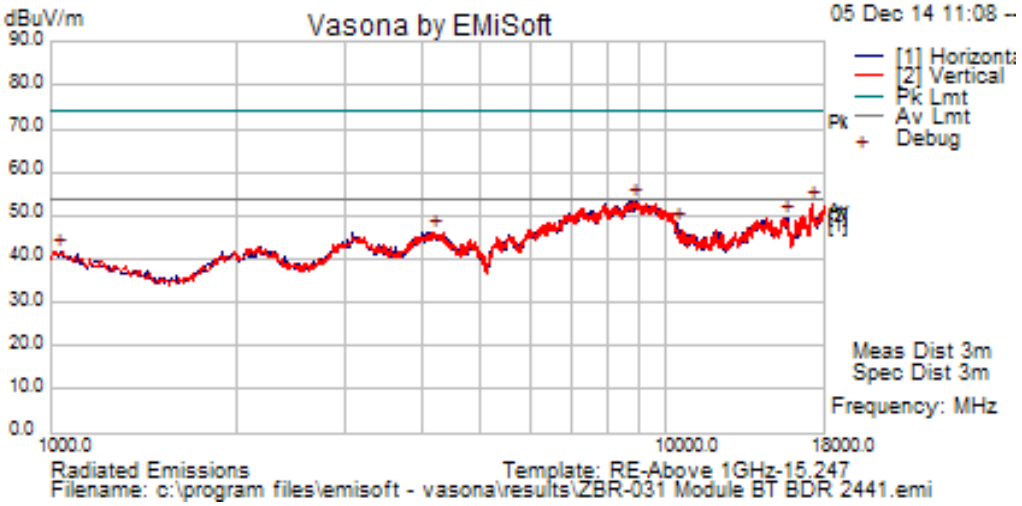
Test Plot ☒ Yes ☐ N/A

Test Result for Bluetooth-BDR

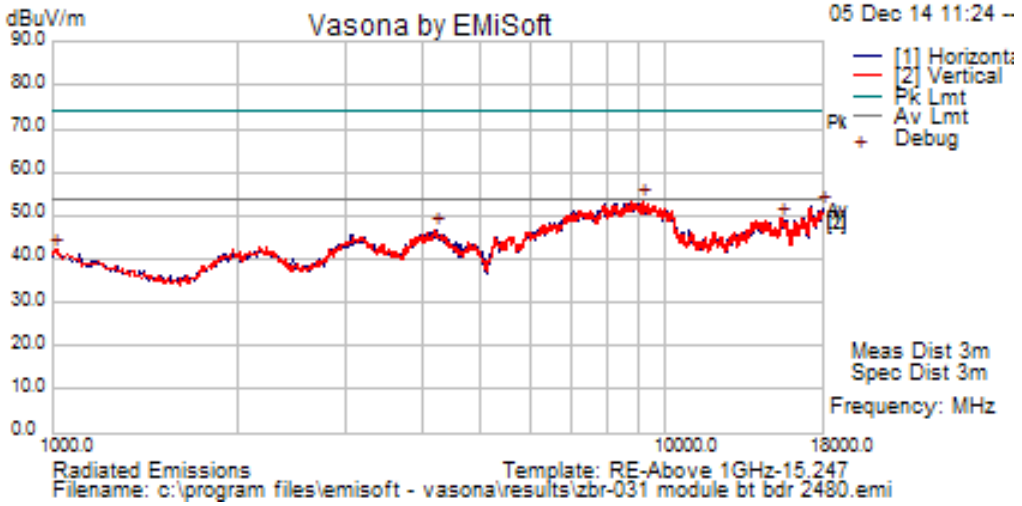
Low Channel @ 2402MHz @ 3 Meter



Mid Channel @ 2442MHz @ 3 Meter

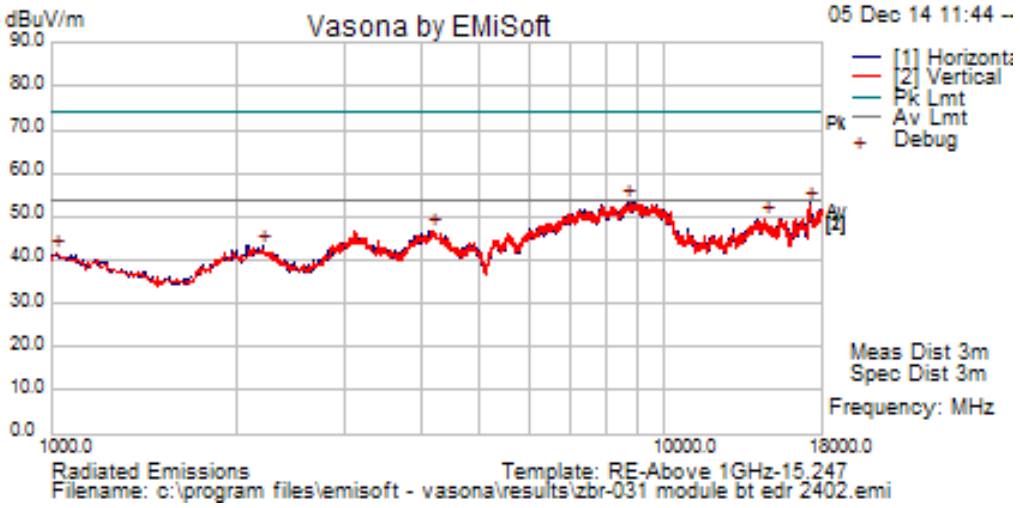


High Channel @ 2480MHz @ 3 Meter

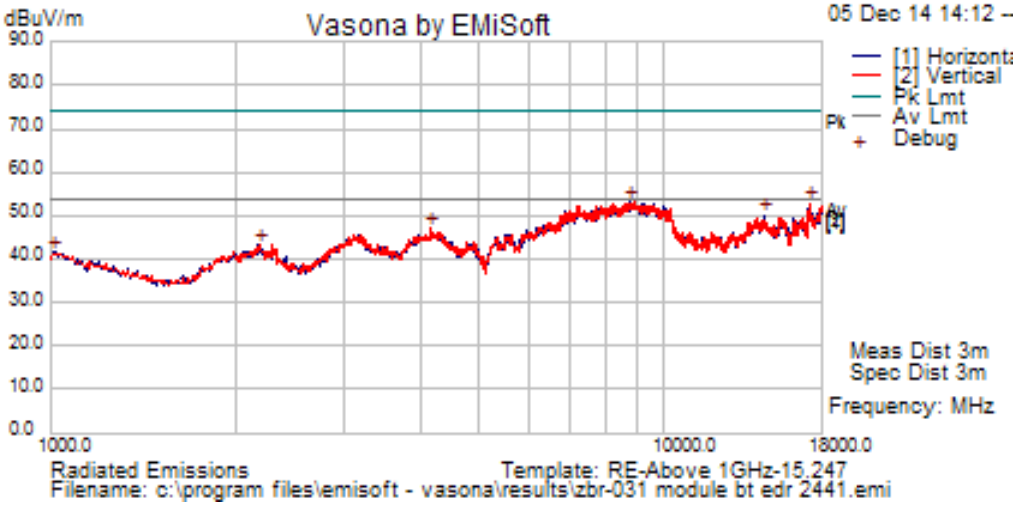


Test Result for Bluetooth-EDR

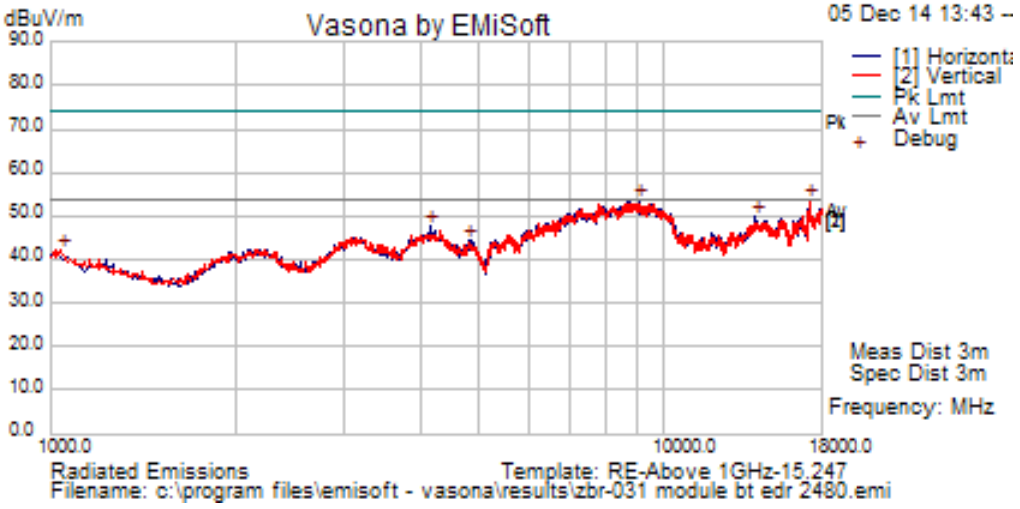
Low Channel @ 2402MHz @ 3 Meter



Mid Channel @ 2442MHz @ 3 Meter



High Channel @ 2480MHz @ 3 Meter



Annex A. TEST INSTRUMENT

Instrument	Model	Serial #	Cal Date	Cal Cycle	Cal Due	In use
Conducted Emissions						
R & S Receiver	ESIB 40	100179	04/20/2014	1 Year	04/20/2015	☑
LISN	Schwarzbeck	NNLK 8129	08/11/2014	1 Year	08/11/2015	☑
CHASE LISN	MN2050B	1018	07/31/2014	1 Year	07/31/2015	☑
Sekonic Hygro Hermograph	ST-50	HE01-000092	05/25/2014	1 Year	05/25/2015	☑
Radiated Emissions						
R & S Receiver	ESL6	100178	03/01/2014	1 Year	03/01/2015	☑
R & S Receiver	ESIB 40	100179	04/20/2014	1 Year	04/20/2015	☑
ETS-Lingren Loop Antenna	6512	00049120	05/13/2014	1 Year	05/13/2015	☐
Bi-Log antenna (30MHz~2GHz)	JB1	A030702	07/03/2014	1 Year	07/03/2015	☑
Horn Antenna (1-26.5GHz)	3115	10SL0059	04/26/2014	1 Year	04/26/2015	☑
Horn Antenna (18-40 GHz)	AH-840	101013	04/23/2014	1 Year	04/23/2015	☑
Pre-Amplifier (1-26.5GHz)	8449B	3008A00715	05/30/2014	1 Year	05/30/2015	☑
Microwave Preamplifier (18-40 GHz)	PA-840	181251	05/30/2014	1 Year	05/30/2015	☑
3 Meters SAC	3M	N/A	10/13/2014	1 Year	10/13/2015	☑
10 Meters SAC	10M	N/A	06/05/2014	1 Year	06/05/2015	☑
Sekonic Hygro Hermograph	ST-50	HE01-000092	05/25/2014	1 Year	05/25/2015	☑
RF Conducted Measurement						
Spectrum Analyzer	N9010A	MY50210206	05/30/2014	1 Year	05/30/2015	☑
Spectrum Analyzer	E4407B	US88441016	05/31/2014	1 Year	05/31/2015	☐
R & S Receiver	ESIB 40	100179	04/20/2014	1 Year	04/20/2015	☑

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
HongKong 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 FCC 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 Measuremet
Australia CAB Regocnition		**EMC:** AS/NZS CISPR 11, AS/NZS CISPR 14.1, AS/NZS CISPR22, AS/NZS 61000.6.3, AS/NZS 61000.6.4
		Radiocommunications: 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