RF TEST REPORT

Report No.: FCC IC_SL18040201-RIO-001_BT
Supersede Report No.:

Applicant	:	Resin.io
Product Name	:	Raspberry Compute Module 3 Lite
Model No.	:	Balena Fin
Test Standard	:	47 CFR 15.247 RSS247 Issue 2
Test Method	:	ANSI C63.10: 2013 FCC Public Notice DA 00-705
FCC ID	:	2APW6BLN-FN-1-00001
IC ID		24038-BLNFN100001
Dates of test	:	05/01/2018 – 06/13/2018
Issue Date	:	06/15/2018
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:	
	
Benjamin Jing	**Chen Ge**
Test Engineer	Engineer Reviewer

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

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
Hong Kong	OFTA (US002)	RF, Telecom

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1 Report Revision History

Report No.	Report Version	Description	Issue Date
FCC _IC_SL18040201_RIO-001_BT	None	Original	06/15/2018

2 Executive Summary

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

Company:	Resin.io
Product:	Raspberry Compute Module 3 Lite
Model:	Balena Fin

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	Resin.io.
Applicant Address	7 Winkley Street, London E2 6PY, UK
Manufacturer Name	Resin.io.
Manufacturer Address	7 Winkley Street, London E2 6PY, UK

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	Raspberry Compute Module 3 Lite
Model No.	Balena Fin
Trade Name	Resin.in
Serial No.	N/A
Input Power	120VAC/60Hz
Power Adapter Manu/Model	VEL36US120-US-JA
Power Adapter SN	E317867
Hardware version	N/A
Software version	N/A
Date of EUT received	04/15/2018
Equipment Class/ Category	DTS
Port/Connectors	1 X RJ45, 2 X USB, 1 X micro USB, 1 X HDMI
Remark	NONE

6.2 Spec for BT Radio

Radio Type	Bluetooth (Ver4.0+EDR)
Operating Frequency	2402MHz-2480MHz
Modulation	FHSS (BDR, EDR)
Channel Spacing	1MHz (BDR, EDR)
Antenna Type	External antenna : ¼ Dipole - Omni Embedded antenna : SMD
Antenna Gain	External antenna : 2 dBi Embedded antenna : 1 dBi
Antenna Connector Type	U.FL

6.3 EUT test modes/configuration Description

Mode	Note
Bluetooth	BDR
Bluetooth	EDR

7 Supporting Equipment/Software and cabling Description

7.1 Supporting Equipment

Item	Supporting Equipment Description	Model	Serial Number	Manufacturer	Note
1	Laptop	LATITUDE 3550	N/A	Dell	-
2	Router	WNR2000	N/A	Netgear	

7.2 Cabling Description

Name	Connection Start		Connection Stop		Length / shielding Info		Note
	From	I/O Port	To	I/O Port	Length (m)	Shielding	
Ethernet	RJ-45	EUT	RJ-45	Laptop	Ethernet 1 m	no	Unshielded

7.3 Test Software Description

Test Item	Software	Description
RF Testing	Dut Labtool	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 558074 D01 DTS Meas Guidance v04 RSS Gen Issue 4: 2014	☒ Pass ☐ N/A
	IC	RSS Gen 8.10	IC		
AC Conducted Emissions	FCC	15.207(a)	FCC	ANSI C63.10:2013 RSS Gen Issue 4: 2014	☒ Pass ☐ N/A
	IC	RSS Gen 8.10	IC		

DSS Band 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	RSS247(5.1.5)	IC	_	
20dB Occupied Bandwidth	FCC	15.247(a)(1)	FCC	Public Notice DA 00-705	☒ Pass ☐ N/A
	IC	RSS247(5.1.2)	IC	_	
99% Occupied Bandwidth	FCC	15.247(a)(2)	FCC		☒ Pass ☐ N/A
	IC	RSS Gen (6.6)	IC	RSS Gen Issue 4: 2014_	
Number of Hopping Channels	FCC	15.247(a)(1)	FCC	Public Notice DA 00-705	☒ Pass ☐ N/A
	IC	RSS247(5.1.5)	IC	_	
Band Edge and Radiated Spurious Emissions	FCC	15.247(d)	FCC	Public Notice DA 00-705	☒ Pass ☐ N/A
	IC	RSS247(5.5)	IC	_	
Time of Occupancy	FCC	15.247(a)(1)	FCC	Public Notice DA 00-705	☒ Pass ☐ N/A
	IC	RSS247(5.1.5)	IC	_	
Output Power	FCC	15.247(b)	FCC	Public Notice DA 00-705	☒ Pass ☐ N/A
	IC	RSS247(5.4.2)	IC	_	
Receiver Spurious Emissions	FCC	15.247(d)	FCC	-	☐ Pass ☒ N/A
	IC	RSS Gen (7.1)	IC	_	
Antenna Gain > 6 dBi	FCC	15.247(e)	FCC	Public Notice DA 00-705	☐ Pass ☒ N/A
	IC	RSS247(5.4.6)	IC	_	
Power Spectral Density	FCC	15.247(e)	FCC	Public Notice DA 00-705	☐ Pass ☒ N/A
	IC	RSS247(5.2.2)	IC	_	
Hybrid System Requirement	FCC	15.247(f)	FCC	Public Notice DA 00-705	☐ Pass ☒ N/A
	IC	RSS247(5.3)	IC	_	
Hopping Capability	FCC	15.247(g)	FCC	Public Notice DA 00-705	☒ Pass ☐ N/A
	IC	RSS247(5.1.5)	IC	_	
RF Exposure requirement	FCC	15.247(i)	FCC	Public Notice DA 00-705	☐ Pass ☒ N/A
	IC	RSS Gen (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

9.1 Conducted Emissions

The test is to measure the conducted emissions to the mains port of the EUT.

Some error sources that can contribute to the total uncertainty:

- Uncertainty of the receiver
- Uncertainty of the LISN
- Uncertainty of cables
- Uncertainty due to the mismatches
- Etc, see the below table for details

Source of Uncertainty	Value (dB)	Probability Distribution	Division	Sensitivity Coefficient	Expanded Uncertainty
Receiver Reading	0.12	Rectangular	1.732	1	0.069284
Cable Insertion Loss	0.21	Normal	2	1	0.105
Filter Insertion Loss	0.25	Normal	2	1	0.125
LISN Insertion Loss	0.40	Normal	2	1	0.20
Receiver CW accuracy	0.5	Rectangular	1.732	1	0.2886836
Pulse Amplitude Response	1.5	Rectangular	1.732	1	0.86605081
PRF Response	1.5	Rectangular	1.732	1	0.86605081
Mismatch LISN - Receiver	0.25	U-Shape	1.414	1	0.1768033
LISN Impedance	2.5	Triangular	2.449	1	1.0208248
Combined Standard Uncertainty					1.928133
Expanded Uncertainty (K=2)					**3.856266**

The total derived measurement uncertainty is +/- 3.86 dB.

9.2 Radiated Emissions (30MHz to 1GHz)

The test is to measure the radiated emissions of the EUT.

Some error sources that can contribute to the total uncertainty:

- Uncertainty of the receiver
- Uncertainty of the antenna
- Uncertainty of cables
- Uncertainty due to the mismatches
- NSA Calibration
- Etc., details see the below table

Source of Uncertainty	Value (dB)	Probability Distribution	Division	Sensitivity Coefficient	Expanded Uncertainty
Receiver Reading	0.12	Rectangular	1.732	1	0.069284
Cable Insertion Loss	0.21	Normal	2	1	0.105
Filter Insertion Loss	0.25	Normal	2	1	0.125
Antenna Factor	0.65	Normal	2	1	0.325
Receiver CW accuracy	0.5	Rectangular	1.732	1	0.2886836
Pulse Amplitude Response	1.5	Rectangular	1.732	1	0.86605081
PRF Response	1.5	Rectangular	1.732	1	0.86605081
Mismatch Filter - Receiver	0.25	U-Shape	1.414	1	0.1768033
NSA Calibration	4.0	U-Shape	1.414	1	2.8288543
Combined Standard Uncertainty					3.0059131
Expanded Uncertainty (K=2)					**6.0118262**

The total derived measurement uncertainty is +/- 6.00 dB.

9.3 Radiated Emissions (1GHz to 40GHz)

The test is to measure the radiated emissions of the EUT.

Some error sources that can contribute to the total uncertainty:
- Uncertainty of the receiver
- Uncertainty of the antenna
- Uncertainty of cables
- Uncertainty due to the mismatches
- VSWR Calibration
- Etc., details see the below table

Source of Uncertainty	Value (dB)	Probability Distribution	Division	Sensitivity Coefficient	Expanded Uncertainty
Receiver Reading	0.12	Rectangular	1.732	1	0.0692840
Cable Insertion Loss	0.21	Normal	2	1	0.1050000
Filter Insertion Loss	0.25	Normal	2	1	0.1250000
Antenna Factor	0.65	Normal	2	1	0.3250000
Receiver CW accuracy	0.5	Rectangular	1.732	1	0.2886836
Pulse Amplitude Response	1.5	Rectangular	1.732	1	0.8660508
PRF Response	1.5	Rectangular	1.732	1	0.8660508
Mismatch Filter - Receiver	0.25	U-Shape	1.414	1	0.1768033
VSWR Calibration	2.0	U-Shape	1.414	1	1.4144272
Combined Standard Uncertainty					4.2363
Expanded Uncertainty (K=2)					**8.4726**

The total derived measurement uncertainty is +/- 8.47 dB.

9.4 RF conducted measurement

The test is to measure the RF output power from the EUT.

Some error sources that can contribute to the total uncertainty:

- Uncertainty of the Reference Level Uncertainty
- Uncertainty of variable attenuators
- Uncertainty of cables
- Uncertainty due to the mismatches

Source of Uncertainty	Value (dB)	Probability Distribution	Division	Sensitivity Coefficient	Expanded Uncertainty
Reference Level	0.12	Rectangular	1.732	1	0.069284
Cable Insertion Loss	0.21	Normal	2	1	0.105
Attenuator	0.25	Normal	2	1	0.125
Mismatch	0.25	U-Shape	1.414	1	0.1768033
Combined Standard Uncertainty					0.476087
Expanded Uncertainty (K=2)					**0.952174**

The total derived measurement uncertainty is +/- 0.95 dB.

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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§15.211, 15.213, 15.217, 15.219, 15.221, or §15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.	☒
Remark	N/A	
Result	☒ Pass ☐ Fail	

Test Data ☐ Yes ☒ N/A
Test Plot ☐ Yes (See below) ☒ N/A

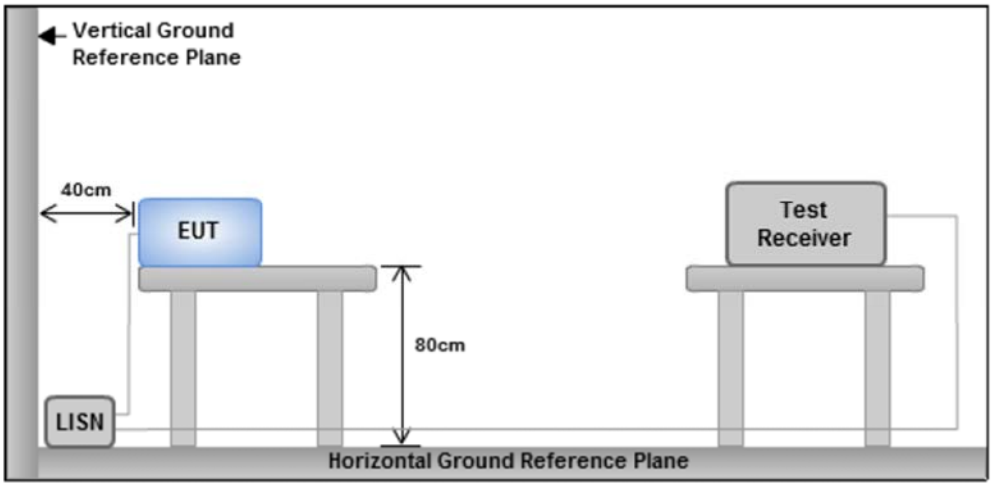
Antenna Connector Construction

Antenna Type	External antenna : ¼ Dipole - Omni Embedded antenna : SMD
Antenna Gain (Peak)	External antenna : 2 dBi Embedded antenna : 1 dBi
Antenna Connector Type	U.FL
Note	The antenna used U.FL antenna connectors which is a unique type which meet the requirement.

10.2 Conducted Emissions

Conducted Emission FCC 15.207

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
FCC 15.207 RSS247(A8.1)	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 µH/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 was tested in two modes of operations: (1) P.O.E Mode; (2) Power Supply Mode		
Result	☒ Pass ☐ Fail		

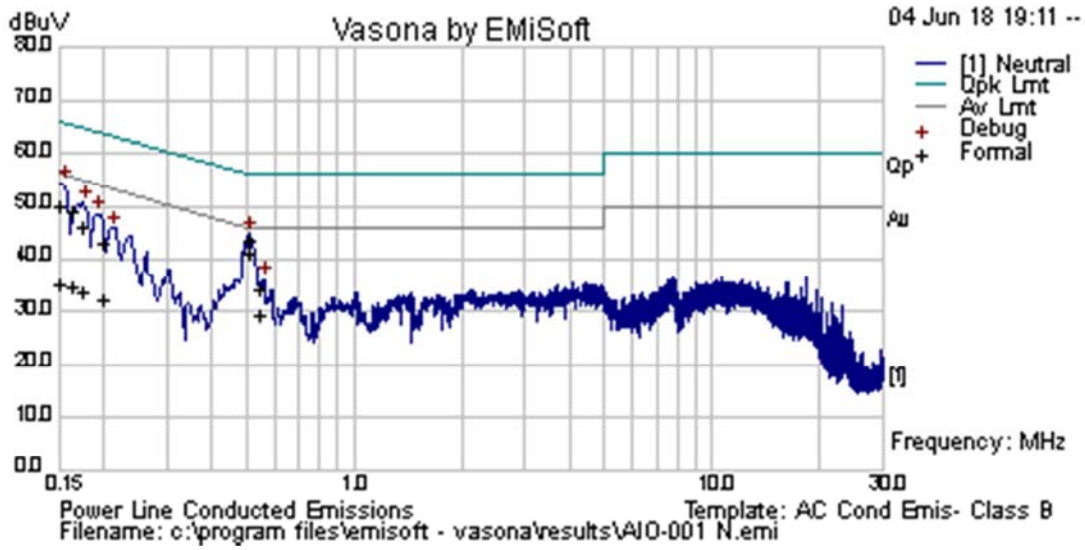
Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Benjamin Jing at Conducted Emission test site.

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:	Benjamin Jing			
Test Date:	06/04/2018			
Remarks	Conducted @ Neutral			

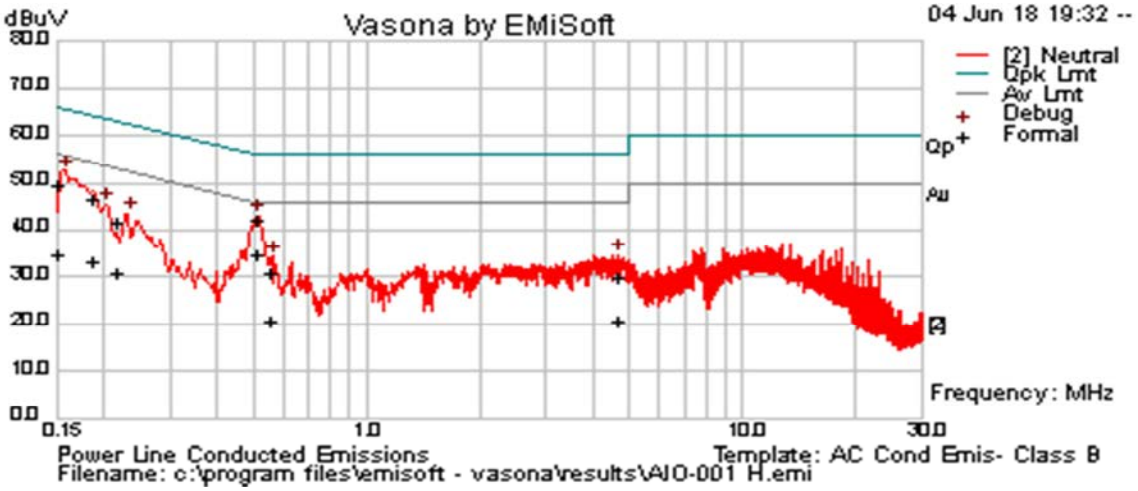


Neutral Plot at 120Vac, 60Hz

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Measurement Type	Line/ Neutral	Limit (dBuV)	Margin (dB)	Pass /Fail
0.511695	34.25	9.33	0.04	43.62	Quasi Peak	Neutral	56	-12.38	Pass
0.150002	40.61	9.33	0.05	49.99	Quasi Peak	Neutral	66	-16.01	Pass
0.161495	39.61	9.33	0.05	48.98	Quasi Peak	Neutral	65.39	-16.4	Pass
0.175154	36.87	9.33	0.05	46.25	Quasi Peak	Neutral	64.71	-18.47	Pass
0.199395	33.66	9.32	0.04	43.03	Quasi Peak	Neutral	63.64	-20.61	Pass
0.54695	24.88	9.33	0.05	34.26	Quasi Peak	Neutral	56	-21.74	Pass
0.511695	31.63	9.33	0.04	41.01	Average	Neutral	46	-4.99	Pass
0.150002	26.03	9.33	0.05	35.41	Average	Neutral	56	-20.59	Pass
0.161495	25.63	9.33	0.05	35.01	Average	Neutral	55.39	-20.38	Pass
0.175154	24.62	9.33	0.05	33.99	Average	Neutral	54.71	-20.72	Pass
0.199395	23	9.32	0.04	32.36	Average	Neutral	53.64	-21.27	Pass
0.54695	20.3	9.33	0.05	29.68	Average	Neutral	46	-16.32	Pass

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:	Benjamin Jing			
Test Date:	06/04/2018			
Remarks	Conducted @ Live			



Live Plot at 120Vac, 60Hz

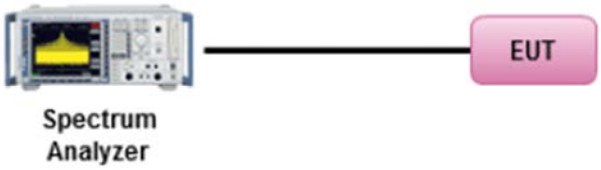
Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Measurement Type	Line/ Neutral	Limit (dBuV)	Margin (dB)	Pass /Fail
0.150002	40.1	9.33	0.05	49.48	Quasi Peak	Live	66	-16.52	Pass
0.511768	32.84	9.33	0.04	42.22	Quasi Peak	Live	56	-13.78	Pass
0.186662	37.34	9.32	0.04	46.71	Quasi Peak	Live	64.18	-17.48	Pass
0.216505	32.09	9.32	0.04	41.45	Quasi Peak	Live	62.95	-21.5	Pass
4.641004	20.58	9.35	0.08	30.01	Quasi Peak	Live	56	-25.99	Pass
0.554657	21.69	9.33	0.05	31.07	Quasi Peak	Live	56	-24.93	Pass
0.150002	25.68	9.33	0.05	35.06	Average	Live	56	-20.94	Pass
0.511768	25.64	9.33	0.04	35.01	Average	Live	46	-10.99	Pass
0.186662	24.21	9.32	0.04	33.58	Average	Live	54.18	-20.61	Pass
0.216505	21.32	9.32	0.04	30.68	Average	Live	52.95	-22.27	Pass
4.641004	11.09	9.35	0.08	20.51	Average	Live	46	-25.49	Pass
0.554657	11.36	9.33	0.05	20.74	Average	Live	46	-25.26	Pass

Note: The results above show only the worst case.

10.3 Channel Separation (Bluetooth BDR/EDR)

Requirement(s):

Spec	Item	Requirement	Applicable
47 CFR §15.247(e) RSS247(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	06/04/2018	Environmental condition	Temperature Relative Humidity Atmospheric Pressure	21°C 46% 1019mbar
Remark	NONE			
Result	☒ Pass ☐ Fail			

Test Data ☒ Yes (See below) ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Benjamin at *RF Test Site*.

Configuration : Bluetooth Mode , BDR Mode

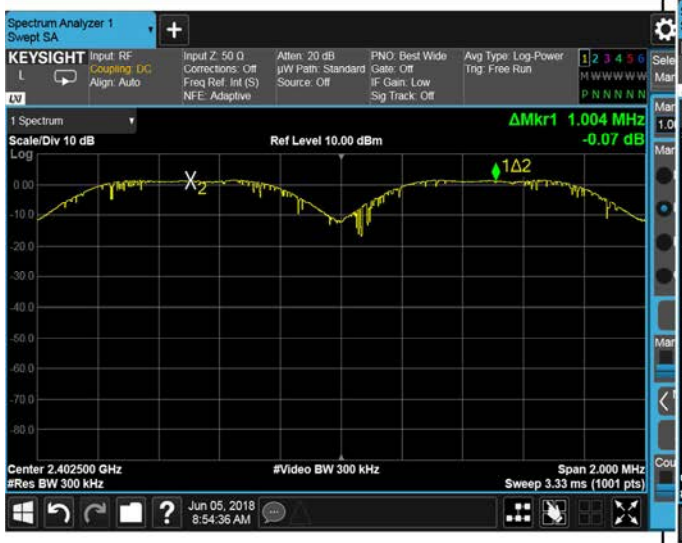
Channel	Channel Frequency (MHz)	Channel Separation (MHz)	>2/3 20dB Bandwidth (MHz)	Result
Low	2402	1.004	>585.73	Pass
Mid	2441	1.006	>591.47	Pass
High	2480	1.002	>623.53	Pass

Configuration : Bluetooth Mode , EDR Mode

Channel	Channel Frequency (MHz)	Channel Separation (MHz)	>2/3 20dB Bandwidth (MHz)	Result
Low	2402	1.018	>0.915	Pass
Mid	2441	1.002	>0.903	Pass
High	2480	1.002	>0.913	Pass

Note: The results of 20dB BW can be found in section 10.3.

Channel Separation Test Plot (Bluetooth BDR/EDR)

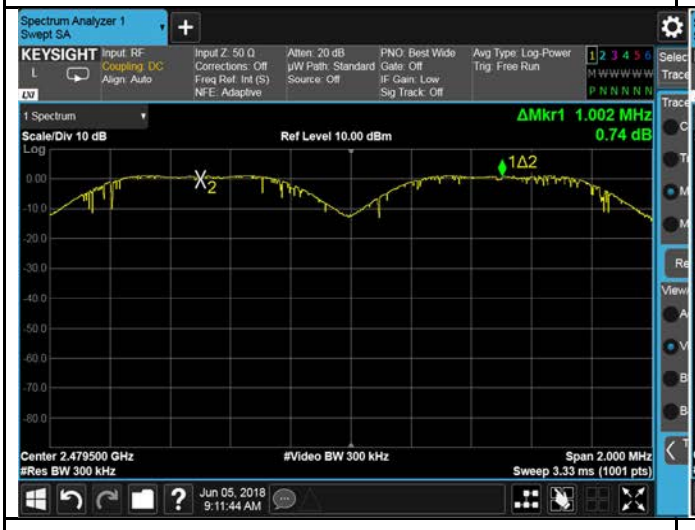


Channel Separation-BDR 2402MHz

Channel Separation-EDR 2402MHz

Channel Separation-BDR 2441MHz

Channel Separation-EDR 2441MHz

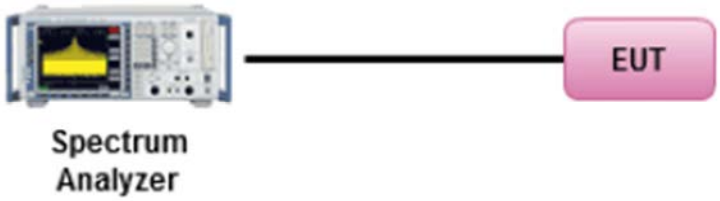


Channel Separation-BDR 2480MHz

Channel Separation-EDR 2480MHz

10.4 20dB and 99% Occupied Bandwidth (Bluetooth BDR/EDR)

Requirement(s):

Spec	Requirement	Applicable
47 CFR §15.247	Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 2/3 of 20 dB bandwidth of the hopping channel, whichever is greater.	☒
RSS Gen 4.6.1	The resolution bandwidth shall be set to as close to 1% of selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth.	☒
Test Setup		
Procedure	20dB Emission bandwidth measurement procedure - Set RBW ≥ 1% of 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. 99% bandwidth measurement procedure 1. EUT was set for low , mid, high channel with modulated mode and highest RF output power. 2. The spectrum analyzer was connected to the antenna terminal.	

Test Date	08/01/2017	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

Test was done by Benjamin Jing at *RF Test Site*.

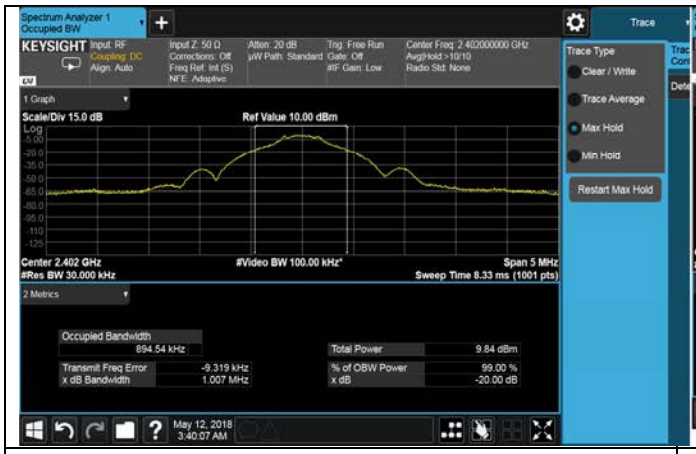
Configuration : Bluetooth mode , BDR Mode

Channel	Channel Frequency (MHz)	OBW		2/3 20dB Bandwidth (MHz)
		99% (MHz)	20dB(MHz)	
Low	2402	0.894	1.007	0.671
Mid	2441	1.185	1.329	0.886
High	2480	1.189	1.327	0.884

Configuration : Bluetooth mode , EDR mode

Channel	Channel Frequency (MHz)	OBW		2/3 20dB Bandwidth (MHz)
		99% (MHz)	20dB(MHz)	
Low	2402	1.191	1.336	0.891
Mid	2441	1.459	1.330	0.886
High	2480	1.189	1.327	0.884

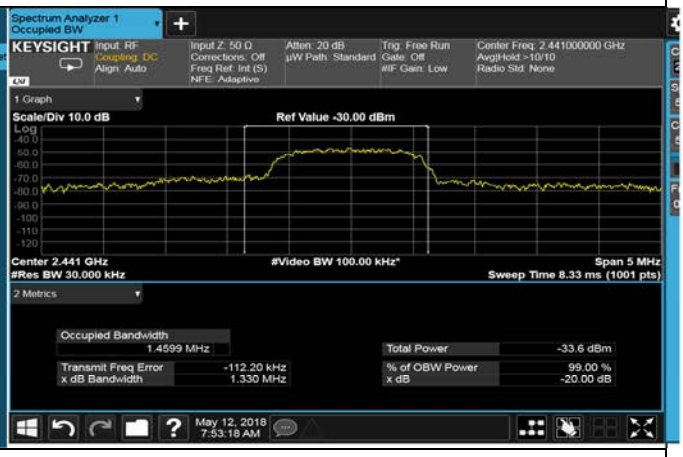
99% & 20dB Bandwidth Test Plots(Bluetooth BDR, EDR)



20dB BW –Bluetooth BDR 2402MHz

20dB BW –Bluetooth EDR 2402MHz

20dB BW –Bluetooth BDR 2441MHz



20dB BW –Bluetooth EDR 2441MHz

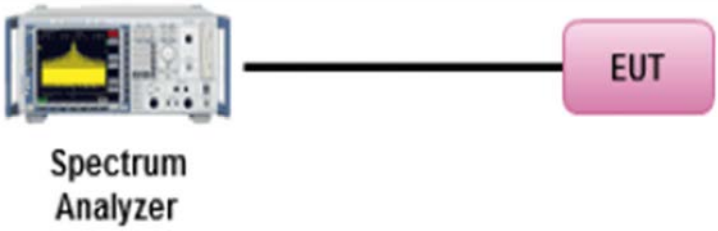
20dB BW –Bluetooth BDR 2480MHz

20dB BW –Bluetooth EDR 2480MHz

10.5 Number of Hopping Channel (Bluetooth BDR/EDR)

Requirement(s):

Spec	Requirement	Applicable
47 CFR §15.247 RSS247b(5.1.5)	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).	☒

Test Setup			
Procedure	Number of hopping frequencies procedure 1. The EUT must have its hopping function enabled 2. Span = the frequency band of operation. 3. Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span. 4. Video (or Average) Bandwidth (VBW) ≥ RBW. 5. Detector = peak. 6. Sweep time = auto couple. 7. Trace mode = max hold. 8. Allow trace to fully stabilize. 9. Save the plot		
Test Date	05/17/2018	Environmental condition	Temperature 23oC Relative Humidity 47% Atmospheric Pressure 1019mbar
Remark	-		
Result	☒ Pass ☐ Fail		

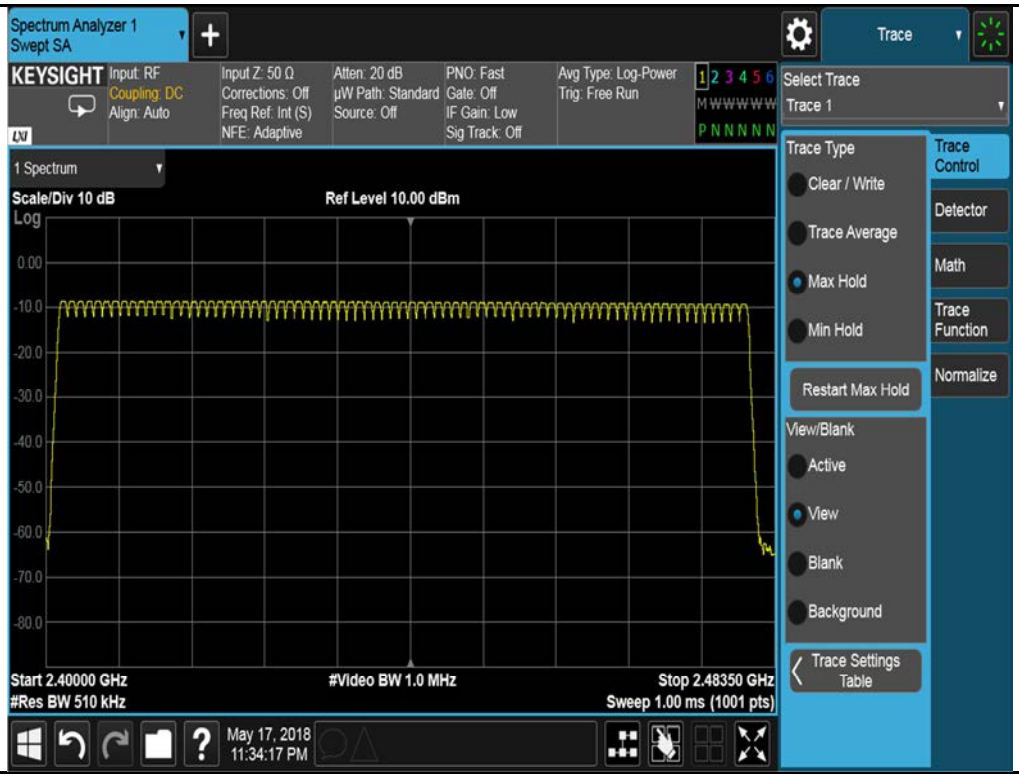
Test Data ☒ Yes (See below) ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Benjamin Jing at *RF Test Site*.

Channel Number	Limit	Result
79	>15	Pass

Hopping Channel Test Plots(Bluetooth BDR, EDR)



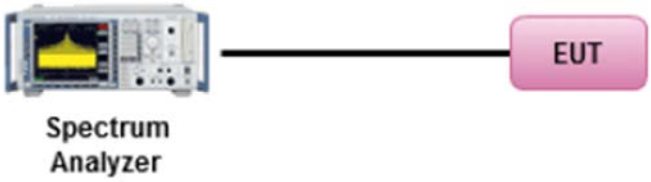
BDR – 79 Channels

EDR – 79 Channels

10.6 Time of Occupancy (Bluetooth BDR/EDR)

Requirement(s):

Spec	Requirement	Applicable
47 CFR §15.247 RSS247 (5.1.5)	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 Time of Occupancy 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	06/13/2018	Environmental condition	Temperature Relative Humidity Atmospheric Pressure	21ºC 46% 1019mbar
Remark	Dwell Time=Pulse time*(1600/6/79)*31.6s DH5 is the worst case.			
Result	☒ Pass ☐ Fail			

Test Data ☒ Yes (See below) ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Benjamin at *RF Test Site*.

Bluetooth BDR Test Mode

Channel	Channel Frequency (MHz)	On Time (mSec)	Dwell Time (Sec)	Limit (Sec)
Low	2402	2.893	0.31	0.4
Mid	2441	2.893	0.31	0.4
High	2480	2.904	0.31	0.4

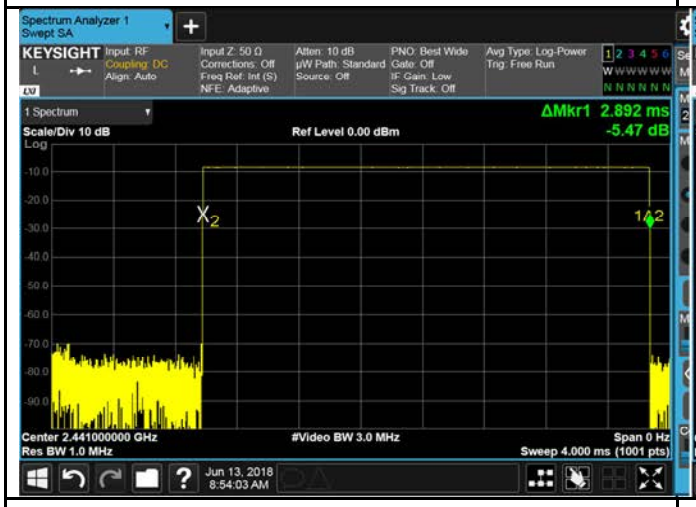
Bluetooth EDR Test Mode

Channel	Channel Frequency (MHz)	On Time (mSec)	Dwell Time (Sec)	Limit (Sec)
Low	2402	2.896	0.31	0.4
Mid	2441	2.900	0.31	0.4
High	2480	2.896	0.31	0.4

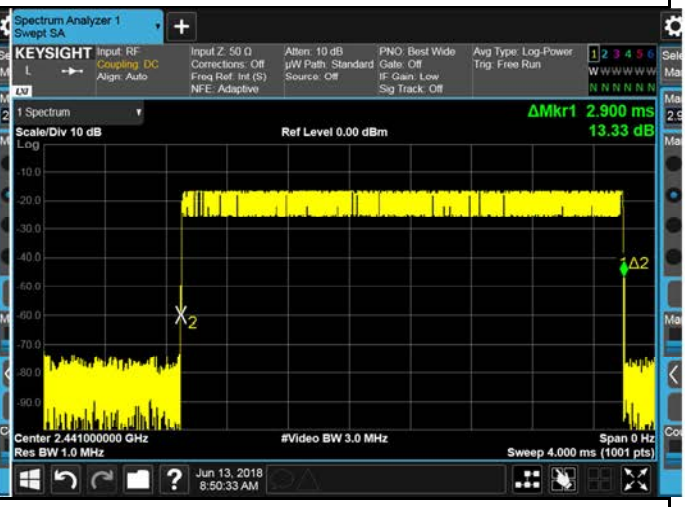
Time of Occupancy Test Plot (Bluetooth BDR/EDR)

BDR Low Channel (On-Time)

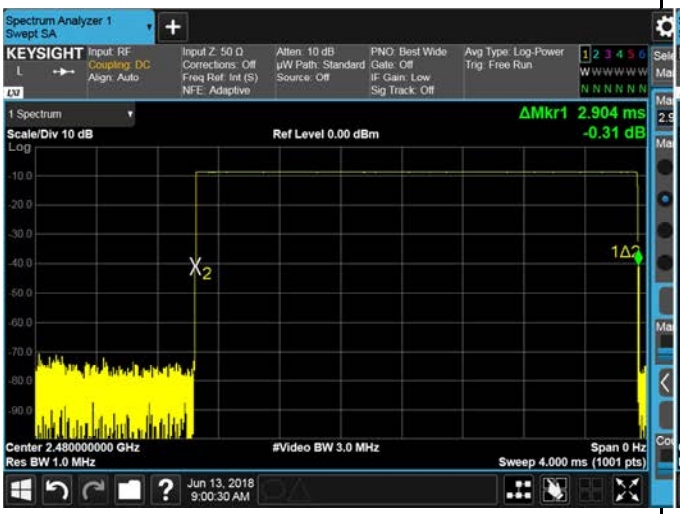
EDR Low Channel (On-Time)



BDR Middle Channel (On-Time)



EDR Middle Channel (On-Time)



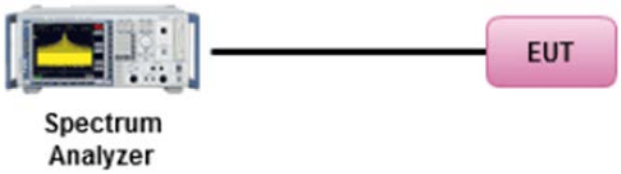
BDR High Channel (On-Time)

EDR High Channel (On-Time)

10.7 Peak Output Power (Bluetooth BDR/EDR)

Requirement(s):

Spec	Item	Requirement	Applicable
§ 15.247	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)	☐
§ 15.247		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 > 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	05/12/2018	Environmental condition	Temperature Relative Humidity Atmospheric Pressure	21°C 46% 1019mbar
Remark	NONE			
Result	☒ Pass ☐ Fail			

Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes ☐ N/A

Test was done by Benjamin Jing at *RF Test Site*.

Output Power measurement results

Type	Freq (MHz)	Test mode	CH	Conducted Power (dBm)	Limit (dBm)	Result
Output power	2402	Bluetooth BDR	Low	0.30	≤30	Pass
	2441	Bluetooth BDR	Mid	0.01	≤30	Pass
	2480	Bluetooth BDR	High	-0.43	≤30	Pass
	2402	Bluetooth EDR	Low	0.31	≤30	Pass
	2441	Bluetooth EDR	Mid	0.01	≤30	Pass
	2480	Bluetooth EDR	High	-0.47	≤30	Pass

Peak Output Power Test Plot (Bluetooth BDR/EDR)

Output power - BDR 2402MHz

Output power - EDR 2402MHz

Output power - BDR 244MHz

Output power - EDR 2441MHz

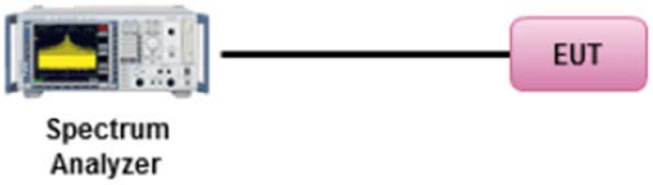
Output power - BDR 2480MHz

Output power - EDR 2480MHz

10.8 Band Edge (Bluetooth BDR/EDR)

Requirement(s):

Spec	Item	Requirement	Applicable
§ 15.247	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	☒

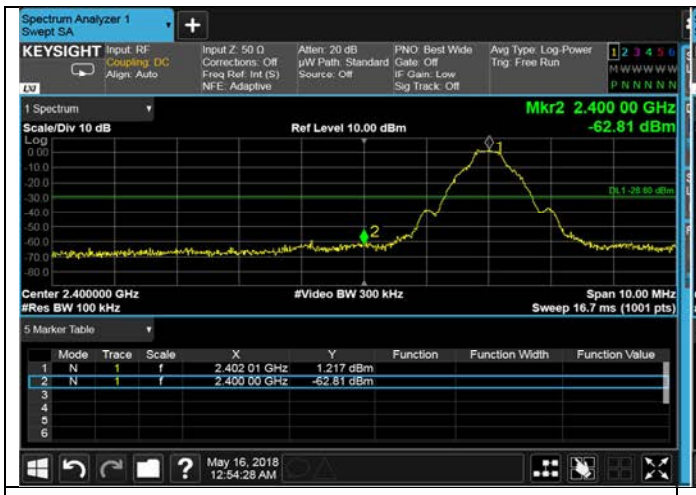
Test Setup			
Test Procedure	Band Edge measurement procedure 1. Set the EUT to maximum power setting and enable the EUT transmit continuously. 2. Band edge emissions must be at least 30 dB down from the highest emission level within the authorized band as a measured. The attenuation shall be be 30 dB instead of 20 dB when 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	05/16/2018 & 5-18-2018	Environmental condition	Temperature 22ºC Relative Humidity 46% Atmospheric Pressure 1020mbar
Remark	N/A		
Result	☒ Pass ☐ Fail		

Test Data ☐ Yes ☒ N/A

Test Plot ☒ Yes (See below) ☐ N/A

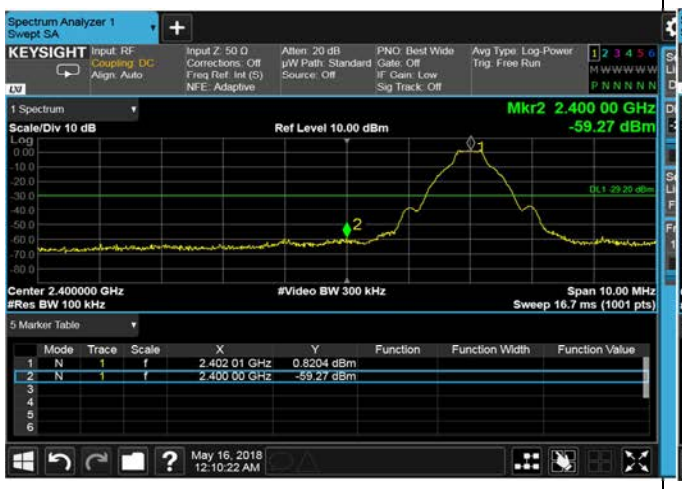
Test was done by Benjamin Jing at *RF Test Site*.

Band Edge Test Plots (Bluetooth)

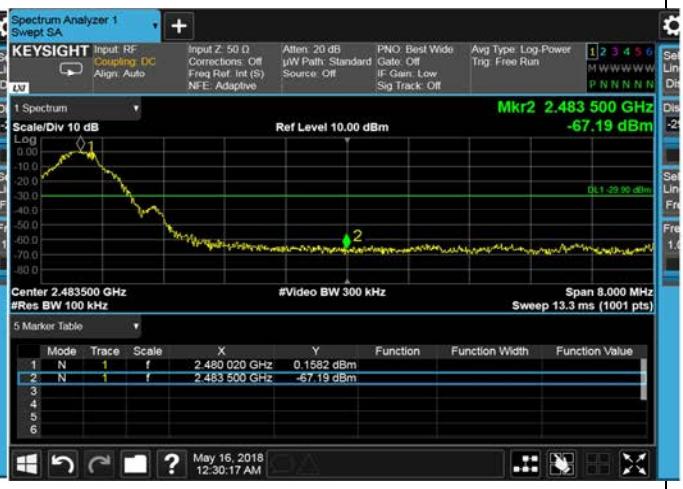


Band Edge -BDR 2402MHz

Band Edge -BDR 2480MHz



Band Edge -EDR 2402MHz



Band Edge -EDR 2480MHz

Band Edge Hopping Test Plots (Bluetooth)

Band Edge-Hopping-BDR 2402MHz

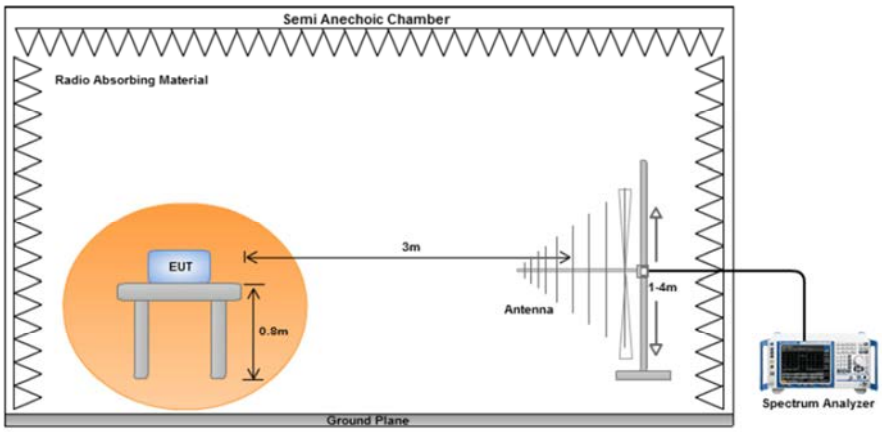
Band Edge- Hopping-BDR 2480MHz

Band Edge- Hopping-EDR 2402MHz

Band Edge- Hopping-EDR 2480MHz

10.9 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 **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

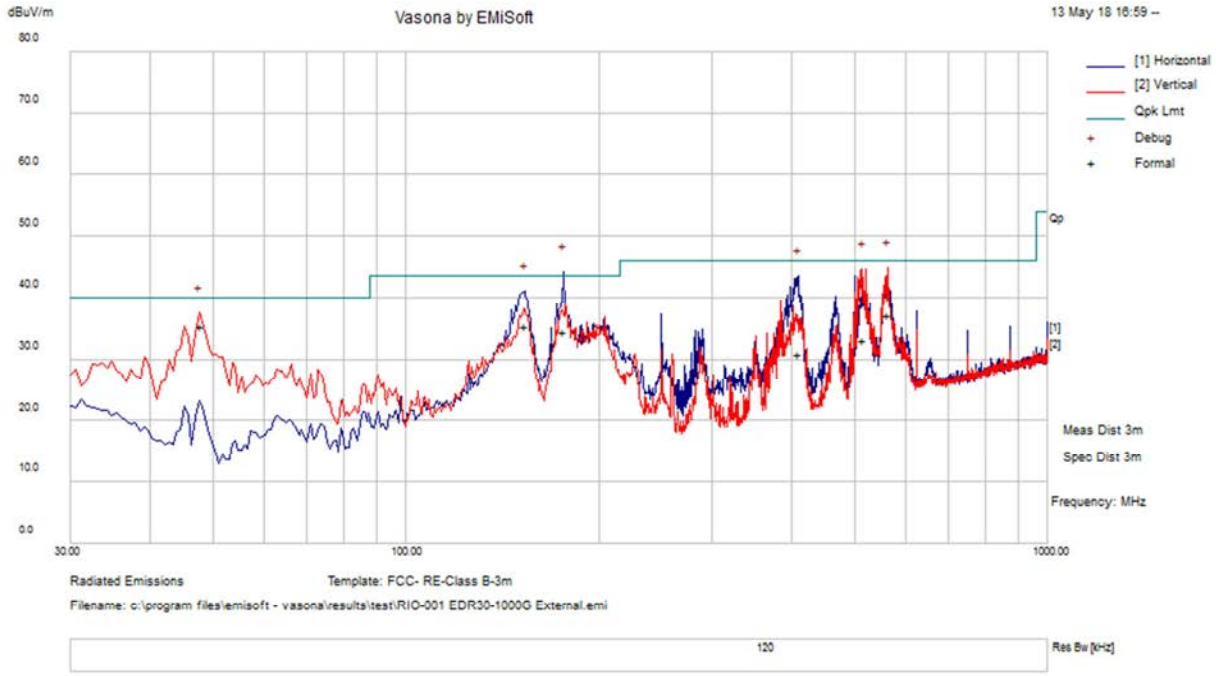
Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Benjamin at *10m Chamber.*

Radiated Emission Test Results (Below 1GHz)

External antenna

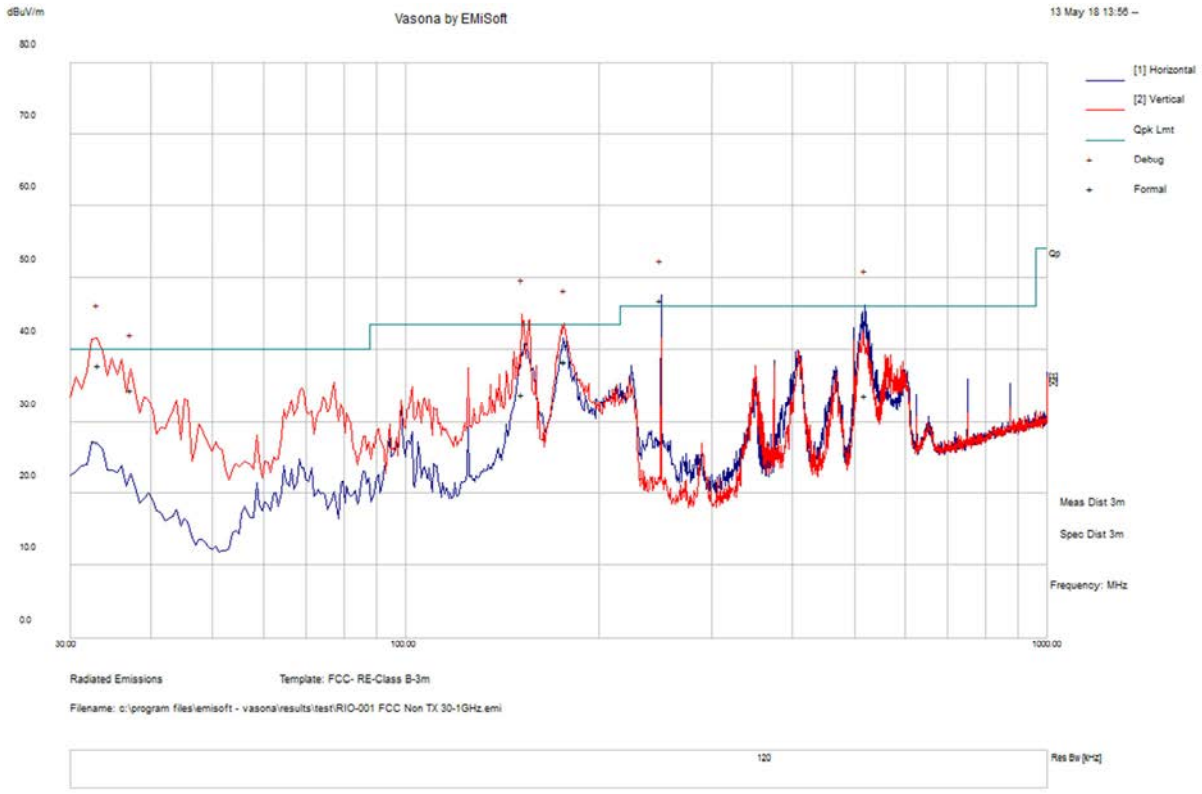
Test specification:	Radiated Spurious Emissions (30MHz – 1000MHz)			
Environmental Conditions:	Temp(°C):	22	Result :	☒ Pass ☐ Fail
	Humidity (%):	37		
	Atmospheric(mbar):	1021		
Mains Power:	120VAC, 60Hz			
Tested by:	Benjamin			
Test Date:	05/13/2018			
Remarks:	BDR 2441MHz			



Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	AF (dB)	Level (dBuV/m)	Measurement Type	Pol	Hgt (cm)	Azt (Deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail
175.9288	46.91	12.4	-24.83	34.48	Quasi Max	H	197	106	43.5	-9.02	Pass
563.1391	40.37	14.49	-17.55	37.3	Quasi Max	V	109	196	46	-8.7	Pass
514.5013	37.15	14.33	-18.32	33.16	Quasi Max	V	157	158	46	-12.84	Pass
153.0638	46.78	12.21	-23.62	35.37	Quasi Max	H	173	60	43.5	-8.13	Pass
408.5075	37.88	13.85	-20.84	30.89	Quasi Max	H	102	236	46	-15.11	Pass
47.78531	50.11	11.43	-26.04	35.5	Quasi Max	V	104	192	40	-4.5	Pass

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

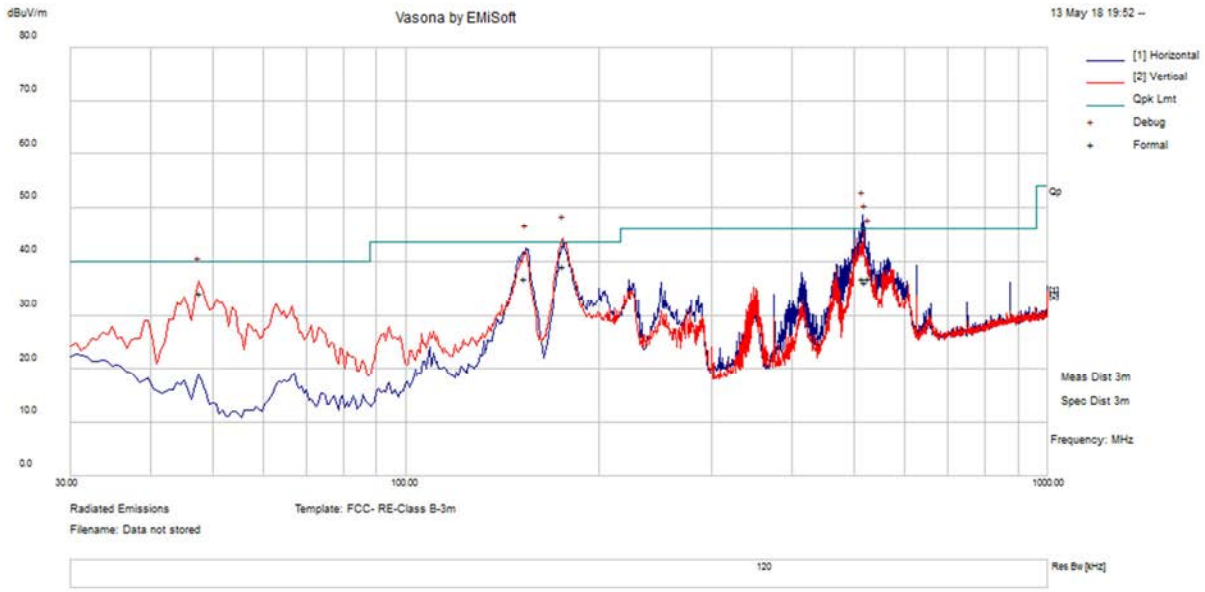
Test specification:	Radiated Spurious Emissions (30MHz – 1000MHz)			
Environmental Conditions:	Temp(°C):	22	Result :	☒ Pass ☐ Fail
	Humidity (%):	37		
	Atmospheric(mbar):	1021		
Mains Power:	120VAC, 60Hz			
Tested by:	Benjamin			
Test Date:	05/13/2018			
Remarks:	EDR 2441MHz			



Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	AF (dB)	Level (dBuV/m)	Measurement Type	Pol	Hgt (cm)	Azt (Deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail
511.9788	40.18	14.3	-18.4	36.08	Quasi Max	H	177	356	46	-9.92	Pass
33.17156	42.59	11.16	-15.83	37.92	Quasi Max	V	123	254	40	-2.08	Pass
152.0084	45.37	12.21	-23.64	33.94	Quasi Max	V	108	331	43.5	-9.56	Pass
519.8013	37.57	14.38	-18.21	33.73	Quasi Max	H	144	253	46	-12.27	Pass
176.6131	50.99	12.4	-24.9	38.49	Quasi Max	V	111	335	43.5	-5.01	Pass
37.37313	42.54	11.25	-19.26	34.52	Quasi Max	V	101	134	40	-5.48	Pass

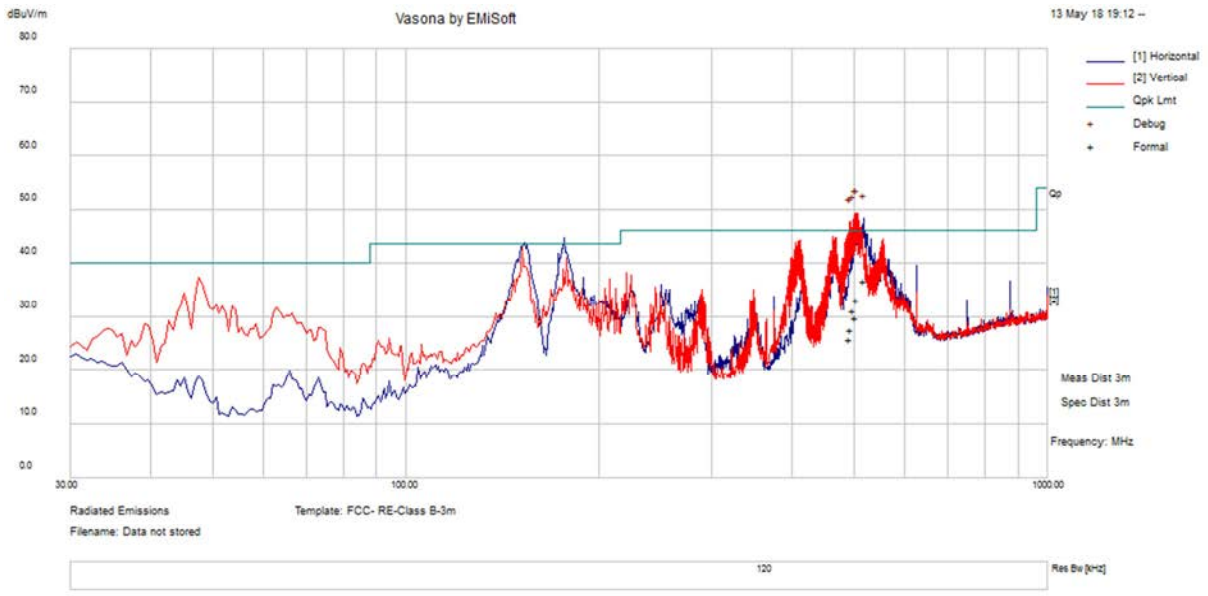
Test specification:	Radiated Spurious Emissions (30MHz – 1000MHz)			
Environmental Conditions:	Temp(°C):	22	Result :	☒ Pass ☐ Fail
	Humidity (%):	37		
	Atmospheric(mbar):	1021		
Mains Power:	120VAC, 60Hz			
Tested by:	Benjamin			
Test Date:	05/13/2018			
Remarks:	BDR 2441MHz			

Embedded Antenna



Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	AF (dB)	Level (dBuV/m)	Measurement Type	Pol	Hgt (cm)	Azt (Deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail
516.1216	40.98	14.34	-18.29	37.04	Quasi Max	H	198	156	46	-8.96	Pass
175.6222	51.55	12.4	-24.79	39.16	Quasi Max	V	143	29	43.5	-4.34	Pass
519.0197	40.1	14.37	-18.23	36.25	Quasi Max	H	182	112	46	-9.75	Pass
153.4781	48.33	12.21	-23.62	36.93	Quasi Max	H	133	85	43.5	-6.58	Pass
525.7934	40.61	14.44	-18.1	36.95	Quasi Max	H	192	141	46	-9.05	Pass
47.79344	49.01	11.43	-26.04	34.4	Quasi Max	V	112	261	40	-5.6	Pass

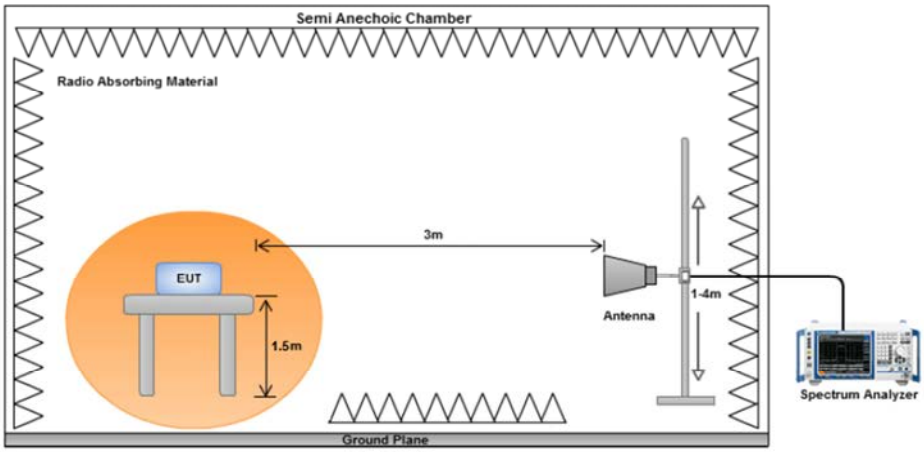
Test specification:	Radiated Spurious Emissions (30MHz – 1000MHz)			
Environmental Conditions:	Temp(°C):	22	Result :	☒ Pass ☐ Fail
	Humidity (%):	37		
	Atmospheric(mbar):	1021		
Mains Power:	120VAC, 60Hz			
Tested by:	Benjamin			
Test Date:	05/13/2018			
Remarks:	EDR 2441MHz			



Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	AF (dB)	Level (dBuV/m)	Measurement Type	Pol	Hgt (cm)	Azt (Deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail
503.9069	37.41	14.18	-18.51	33.08	Quasi Max	V	204	356	46	-12.92	Pass
502.0913	34.2	14.16	-18.52	29.84	Quasi Max	V	190	164	46	-16.16	Pass
516.8588	40.6	14.35	-18.27	36.67	Quasi Max	H	163	139	46	-9.33	Pass
497.8763	35.62	14.18	-18.52	31.28	Quasi Max	V	155	357	46	-14.72	Pass
493.8894	31.93	14.2	-18.45	27.67	Quasi Max	V	195	291	46	-18.33	Pass
492.0053	30.08	14.21	-18.42	25.86	Quasi Max	V	127	339	46	-20.14	Pass

10.10 Transmitter Radiated Spurious Emissions > 1GHz & Restricted band & non-restricted band emission

Requirement(s):

Spec	Item	Requirement	Applicable
47CFR§15.247(d), RSS247n(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		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		The EUT was scanned up to 26GHz. 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

Test was done by Benjamin at *3m Chamber.*

Radiated Emission Test Results

External Antenna

Bluetooth BDR – 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
17787.63	38.86	8.1	8.28	55.24	Peak Max	V	159	48	74	-18.76	Pass
13211.2	37.35	6.98	4.73	49.06	Peak Max	V	130	142	74	-24.95	Pass
6140.579	38.6	4.74	-0.31	43.03	Peak Max	V	133	222	74	-30.97	Pass
17787.63	26.55	8.1	8.28	42.94	Average Max	V	159	48	54	-11.06	Pass
13211.2	24.95	6.98	4.73	36.66	Average Max	V	130	142	54	-17.34	Pass
6140.579	26.28	4.74	-0.31	30.71	Average Max	V	133	222	54	-23.29	Pass

Bluetooth BDR – 2441MHz

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
17966.68	38.33	7.9	8.72	54.94	Peak Max	V	175	4	74	-19.06	Pass
12487.7	38.36	6.54	4.15	49.05	Peak Max	V	105	278	74	-24.96	Pass
2560.119	42.3	3.04	-3.31	42.03	Peak Max	V	193	91	74	-31.97	Pass
17966.68	26.63	7.9	8.72	43.25	Average Max	V	175	4	54	-10.75	Pass
12487.7	26.01	6.54	4.15	36.7	Average Max	V	105	278	54	-17.3	Pass
2560.119	29.23	3.04	-3.31	28.96	Average Max	V	193	91	54	-25.04	Pass

Bluetooth BDR – 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
17913.3	38.68	7.96	8.66	55.3	Peak Max	V	122	118	74	-18.7	Pass
11838.07	38.26	6.31	3.08	47.66	Peak Max	V	216	86	74	-26.34	Pass
10171.72	38.94	5.93	1.4	46.28	Peak Max	V	278	356	74	-27.72	Pass
17913.3	26.66	7.96	8.66	43.28	Average Max	V	122	118	54	-10.72	Pass
11838.07	25.82	6.31	3.08	35.22	Average Max	V	216	86	54	-18.78	Pass
10171.72	26.7	5.93	1.4	34.04	Average Max	V	278	356	54	-19.97	Pass

Bluetooth EDR – 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
17766.68	38.4	8.13	8.22	54.75	Peak Max	H	107	288	74	-19.25	Pass
3091.642	39.65	3.34	-1.42	41.58	Peak Max	V	196	292	74	-32.43	Pass
2548.968	41.14	3.03	-3.33	40.84	Peak Max	V	348	32	74	-33.16	Pass
17766.68	26.55	8.13	8.22	42.89	Average Max	H	107	288	54	-11.11	Pass
3091.642	27.43	3.34	-1.42	29.35	Average Max	V	196	292	54	-24.65	Pass
2548.968	29.2	3.03	-3.33	28.9	Average Max	V	348	32	54	-25.1	Pass

Bluetooth EDR – 2441MHz

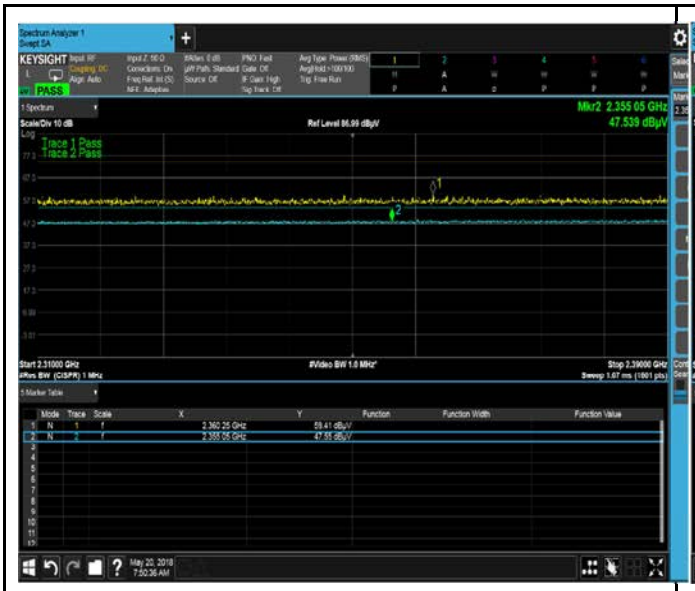
Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	AF (dB)	Level (dBuV/m)	Measurement Type	Pol (V/H)	Hgt (cm)	Azt (Deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail
17774.91	38.83	8.12	8.24	55.19	Peak Max	H	214	340	74	-18.81	Pass
2577.14	41.76	3.05	-3.28	41.52	Peak Max	V	101	349	74	-32.48	Pass
1009.933	48	1.89	-7.86	42.03	Peak Max	V	103	228	74	-31.97	Pass
17774.91	26.53	8.12	8.24	42.89	Average Max	H	214	340	54	-11.11	Pass
2577.14	29.11	3.05	-3.28	28.88	Average Max	V	101	349	54	-25.12	Pass
1009.933	40.99	1.89	-7.86	35.03	Average Max	V	103	228	54	-18.97	Pass

Bluetooth EDR – 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
17817.82	39.66	8.07	8.38	56.11	Peak Max	H	121	146	74	-17.89	Pass
3583.082	39.8	3.57	-1.57	41.8	Peak Max	V	343	29	74	-32.2	Pass
2353.138	41.64	2.94	-3.6	40.99	Peak Max	V	274	182	74	-33.01	Pass
17817.82	26.51	8.07	8.38	42.96	Average Max	H	121	146	54	-11.04	Pass
3583.082	26.92	3.57	-1.57	28.92	Average Max	V	343	29	54	-25.08	Pass
2353.138	28.83	2.94	-3.6	28.17	Average Max	V	274	182	54	-25.83	Pass

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

Restricted Band Test plot (Bluetooth BDR/EDR)



Restricted Band BDR 2402MHz

Restricted Band BDR 2480MHz

Restricted Band EDR 2402MHz

Restricted Band EDR 2480MHz

Embedded Antenna

Bluetooth BDR – 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
17915.26	38.7	7.96	8.66	55.31	Peak Max	H	263	20	74	-18.69	Pass
9614.385	38.82	5.59	0.53	44.94	Peak Max	V	167	49	74	-29.06	Pass
2626.039	40.35	3.08	-3.05	40.38	Peak Max	V	274	257	74	-33.62	Pass
17915.26	26.61	7.96	8.66	43.23	Average Max	H	263	20	54	-10.77	Pass
9614.385	26.44	5.59	0.53	32.56	Average Max	V	167	49	54	-21.44	Pass
2626.039	27.9	3.08	-3.05	27.93	Average Max	V	274	257	54	-26.07	Pass

Bluetooth BDR – 2441MHz

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
17913.3	38.68	7.96	8.66	55.3	Peak Max	V	122	118	74	-18.7	Pass
2008.797	40.93	2.74	-2.46	41.21	Peak Max	V	100	272	74	-32.79	Pass
2378.494	40.05	2.95	-3.64	39.37	Peak Max	V	161	217	74	-34.63	Pass
17913.3	26.66	7.96	8.66	43.28	Average Max	V	122	118	54	-10.72	Pass
2008.797	28.11	2.74	-2.46	28.4	Average Max	V	100	272	54	-25.6	Pass
2378.494	27.62	2.95	-3.64	26.93	Average Max	V	161	217	54	-27.07	Pass

Bluetooth BDR – 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
3200.974	39.79	3.43	-1.51	41.71	Peak Max	V	100	340	74	-32.29	Pass
11838.07	38.26	6.31	3.08	47.66	Peak Max	V	216	86	74	-26.34	Pass
10171.72	38.94	5.93	1.4	46.28	Peak Max	V	278	356	74	-27.72	Pass
3200.974	27.32	3.43	-1.51	29.25	Average Max	V	100	340	54	-24.75	Pass
11838.07	25.82	6.31	3.08	35.22	Average Max	V	216	86	54	-18.78	Pass
10171.72	26.7	5.93	1.4	34.04	Average Max	V	278	356	54	-19.97	Pass

Bluetooth EDR – 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
17817.82	39.66	8.07	8.38	56.11	Peak Max	H	121	146	74	-17.89	Pass
3091.642	39.65	3.34	-1.42	41.58	Peak Max	V	196	292	74	-32.43	Pass
2548.968	41.14	3.03	-3.33	40.84	Peak Max	V	348	32	74	-33.16	Pass
17766.68	26.55	8.13	8.22	42.89	Average Max	H	107	288	54	-11.11	Pass
3091.642	27.43	3.34	-1.42	29.35	Average Max	V	196	292	54	-24.65	Pass
2548.968	29.2	3.03	-3.33	28.9	Average Max	V	348	32	54	-25.1	Pass

Bluetooth EDR – 2441MHz

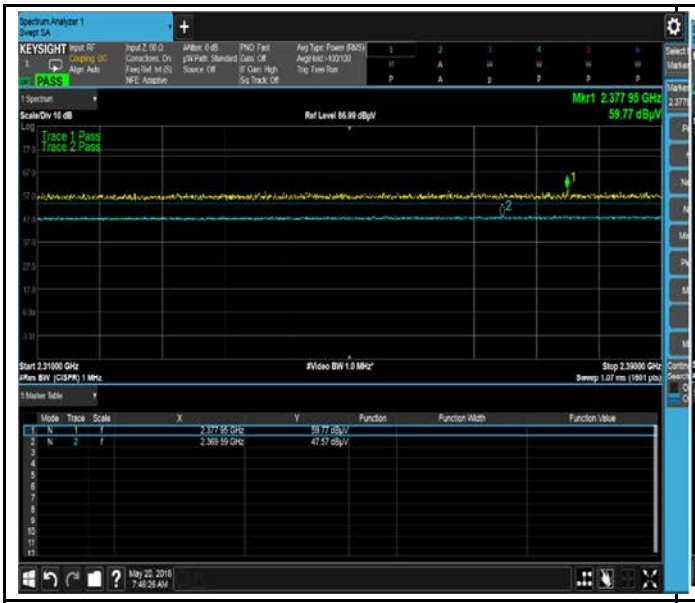
Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	AF (dB)	Level (dBuV/m)	Measurement Type	Pol (V/H)	Hgt (cm)	Azt (Deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail
17787.63	38.86	8.1	8.28	55.24	Peak Max	V	159	48	74	-18.76	Pass
2577.14	41.76	3.05	-3.28	41.52	Peak Max	V	101	349	74	-32.48	Pass
1009.933	48	1.89	-7.86	42.03	Peak Max	V	103	228	74	-31.97	Pass
17774.91	26.53	8.12	8.24	42.89	Average Max	H	214	340	54	-11.11	Pass
2577.14	29.11	3.05	-3.28	28.88	Average Max	V	101	349	54	-25.12	Pass
1009.933	40.99	1.89	-7.86	35.03	Average Max	V	103	228	54	-18.97	Pass

Bluetooth EDR – 2480MHz

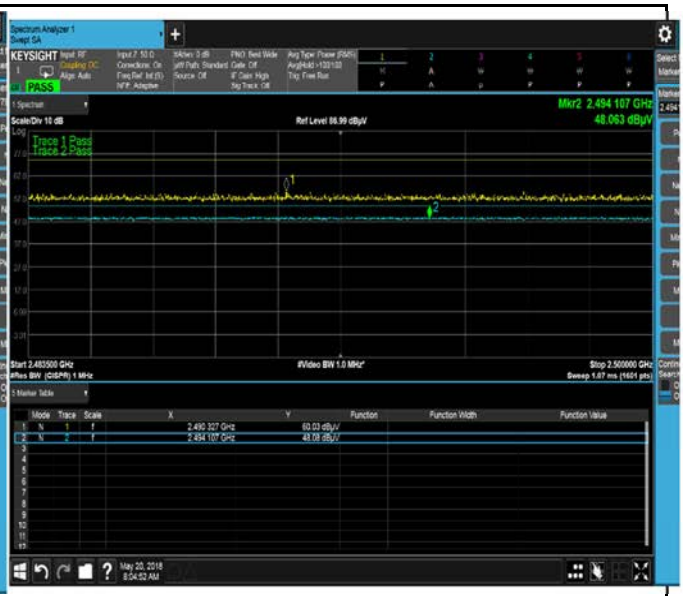
Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	AF (dB)	Level (dBuV/m)	Measurement Type	Pol (V/H)	Hgt (cm)	Azt (Deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail
17774.91	38.83	8.12	8.24	55.19	Peak Max	H	214	340	74	-18.81	Pass
3583.082	39.8	3.57	-1.57	41.8	Peak Max	V	343	29	74	-32.2	Pass
2353.138	41.64	2.94	-3.6	40.99	Peak Max	V	274	182	74	-33.01	Pass
17817.82	26.51	8.07	8.38	42.96	Average Max	H	121	146	54	-11.04	Pass
3583.082	26.92	3.57	-1.57	28.92	Average Max	V	343	29	54	-25.08	Pass
2353.138	28.83	2.94	-3.6	28.17	Average Max	V	274	182	54	-25.83	Pass

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

Restricted Band Test plot (Bluetooth BDR/EDR)



Restricted Band BDR 2402MHz



Restricted Band BDR 2480MHz

Restricted Band EDR 2402MHz

Restricted Band EDR 2480MHz

Annex A. TEST INSTRUMENT

Instrument	Model	Serial #	Cal Date	Cal Cycle	Cal Due	In use
Conducted Emissions						
R & S Receiver	ESIB 40	100179	04/21/2018	1 Year	04/21/2019	☑
CHASE LISN	MN2050B	1018	08/16/2017	1 Year	08/16/2018	☑
Radiated Emissions						
Keysight EXA 44GHz Spectrum Analyzer	N9010A	MY51440112	11/02/2017	1 Year	11/02/2018	☑
Bi-Log antenna (30MHz~2GHz)	JB1	A030702	01/13/2018	1 Year	01/13/2019	☑
Horn Antenna (1GHz~26GHz)	3115	100059	08/11/2017	1 Year	08/11/2018	☑
Pre-Amplifier (1-40GHz)	SAS-474	579	05/04/2018	1 Year	05/04/2019	☑
Preamplifier (100KHz-7GHz)	LPA-6-30	11140711	02/09/2018	1 Year	02/09/2019	☑
3 Meters SAC	3M	N/A	09/09/2017	1 Year	09/09/2018	☑
10 Meters SAC	10M	N/A	10/06/2017	1 Year	10/06/2018	☑
RF Conducted Measurement						
Spectrum Analyzer	N9010A	10SL0219	11/16/2017	1 Year	11/16/2018	☑

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