RF TEST REPORT

SIEMIC
A Bureau Veritas Group Company

Report No.: FCC IC_RF_SL17082801-CRT-003
Supersede Report No.:

Applicant	:	CURRANT,INC. (PALO ALTO)
Product Name	:	CURRANT METER
Model No.	:	WALL01
Test Standard	:	47 CFR 15.247 RSS 247 Iss 2: Feb 2017
Test Method	:	ANSI C63.10: 2013 RSS Gen Iss 4: Nov 2014 558074 D01 DTS Meas Guidance v04
FCC ID	:	2ALKS-WALL01
IC ID	:	23170-WALL01
Dates of test	:	09/27/2017
Issue Date	:	09/28/2017
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:	
Cipher	**Chen Ge**
Test Engineer	Engineer Reviewer

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

ilac-MRA
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

CONTENTS

1 Report Revision History

Report No.	Report Version	Description	Issue Date
FCC IC_RF_SL17082801-CRT-003	None	Original	09/28/2017

2 Executive Summary

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

Company: CURRANT,INC. (PALO ALTO)
Product: CURRANT METER
Model: WALL01

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	CURRANT,INC. (PALO ALTO)
Applicant Address	195 Page Mill Road, Suite # 111, Palo Alto, CA - 94306, 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	CURRANT METER
Model No.	WALL01
Trade Name	CURRANT
Serial No.	0055349143
Host Model No.	N/A
Input Power	120V 15A 60Hz
Power Adapter Manu/Model	N/A
Power Adapter SN	N/A
Date of EUT received	09/25/2017
Equipment Class/ Category	DTS
Clock Frequencies	N/A
Port/Connectors	Serial

6.2 Radio Description

Bluetooth LE:

Radio Type	Bluetooth LE
Operating Frequency	2402MHz-2480MHz
Modulation	GFSK
Channel Spacing	2MHz
Antenna Type	Integral
Antenna Gain	1.7 dBi
Antenna Connector Type	N/A
Note	N/A

7 Supporting Equipment/Software and cabling Description

7.1 Supporting Equipment

Item	Supporting Equipment Description	Model	Serial Number	Manufacturer	Note
1	Laptop	T430	N/A	Lenovo	-
2					-

7.2 Cabling Description

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

7.3 Test Software Description

Test Item	Software	Description
RF Testing	nRFgo	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	☒ Pass ☐ N/A
	IC	RSS Gen 8.10	IC		
AC Conducted Emissions	FCC	15.207(a)	FCC	ANSI C63.10:2013	☒ Pass ☐ N/A
	IC	RSS Gen 8.8	IC	RSS Gen Issue 4: 2014	

DTS Band Requirement

Test Item	Test standard		Test Method/Procedure		Pass / Fail
99% Occupied Bandwidth	-	-	-	-	☒ Pass ☐ N/A
	IC	RSS Gen 6.6	IC	RSS Gen Issue 4: 2014 -	
6dB Bandwidth	FCC	15.247(a)(2)	FCC	558074 D01 DTS Meas Guidance v04	☒ Pass ☐ N/A
	IC	RSS247 (5.2.1)	IC		
Band Edge and Radiated Spurious Emissions	FCC	15.247(d)	FCC	ANSI C63.10:2013 558074 D01 DTS Meas Guidance v04	☒ Pass ☐ N/A
	IC	RSS247 (5.5)	IC		
Output Power	FCC	15.247(b)	FCC	558074 D01 DTS Meas Guidance v04	☒ Pass ☐ N/A
	IC	RSS247 (5.4.4)	IC		
Receiver Spurious Emissions	IC	RSS Gen (4.8)	IC	RSS Gen Issue 4: 2014	☐ Pass ☒ N/A
Antenna Gain > 6 dBi	FCC	15.247(e)	FCC	-	☐ Pass ☒ N/A
	IC	-	IC	-	
Power Spectral Density	FCC	15.247(e)	FCC	558074 D01 DTS Meas Guidance v04	☒ Pass ☐ N/A
	IC	RSS247 (5.2.2)	IC		
RF Exposure requirement	FCC	15.247(i)	FCC	-	☐ Pass ☒ N/A
	IC	RSS Gen(5.5)	IC	RSS Gen Issue 4: 2014	
Remark	1. All measurement uncertainties do not take into consideration for all presented test results.				

9 Measurement Uncertainty

9.1 Radiated Emissions (100kHz to 30MHz)

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

Source of Uncertainty	Value (dB)	Probability Distribution	Division	Sensitivity Coefficient	Expanded Uncertainty
Receiver Reading	0.10	Rectangular	1.732	1	0.069284
Cable Insertion Loss	0.21	Normal	2	1	0.105
Antenna Factor	0.65	Normal	2	1	0.325
Receiver CW accuracy	0.45	Rectangular	1.732	1	0.2598152
Mismatch	0.25	U-Shape	1.414	1	0.1768033
Combined Standard Uncertainty					0.935
Expanded Uncertainty (K=2)					**1.87**

The total derived measurement uncertainty is +/- 1.87 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

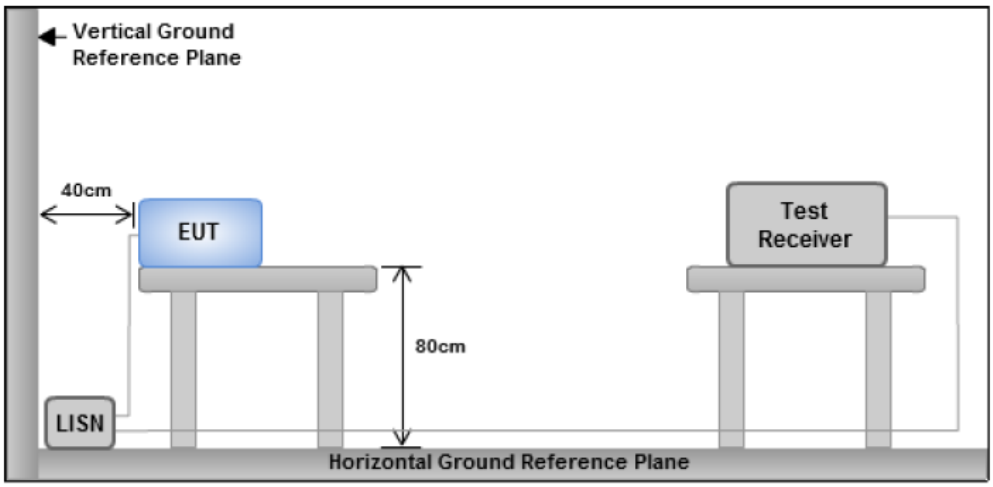
10.1 Conducted Emissions

Conducted Emission Limit

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

Spec	Item	Requirement	Applicable
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 at 120VAC, 60Hz
Result	☒ Pass ☐ Fail

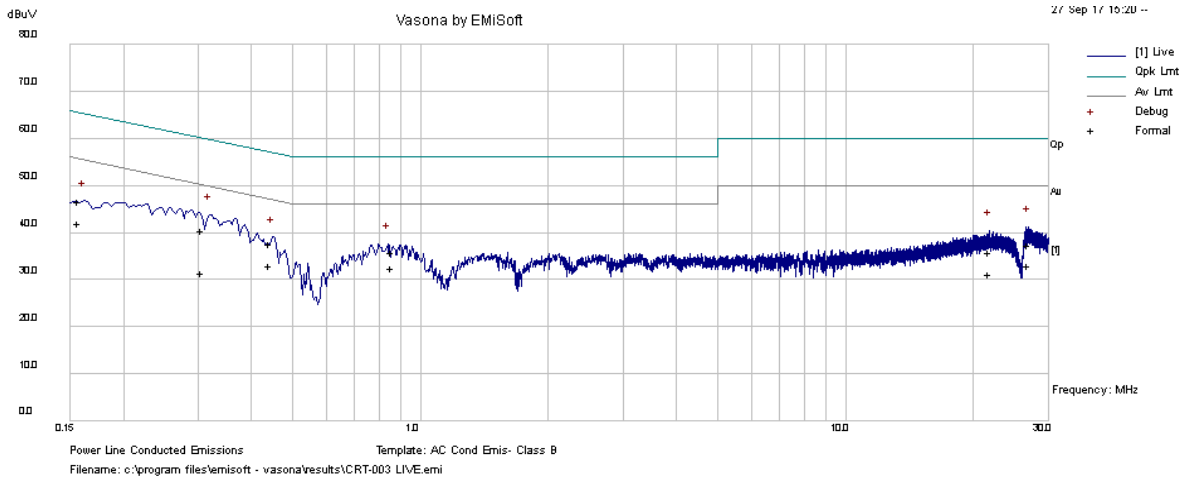
Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Cipher 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:	Rachana Khanduri			
Test Date:	09/27/2017			
Remarks	Conducted @ Live			

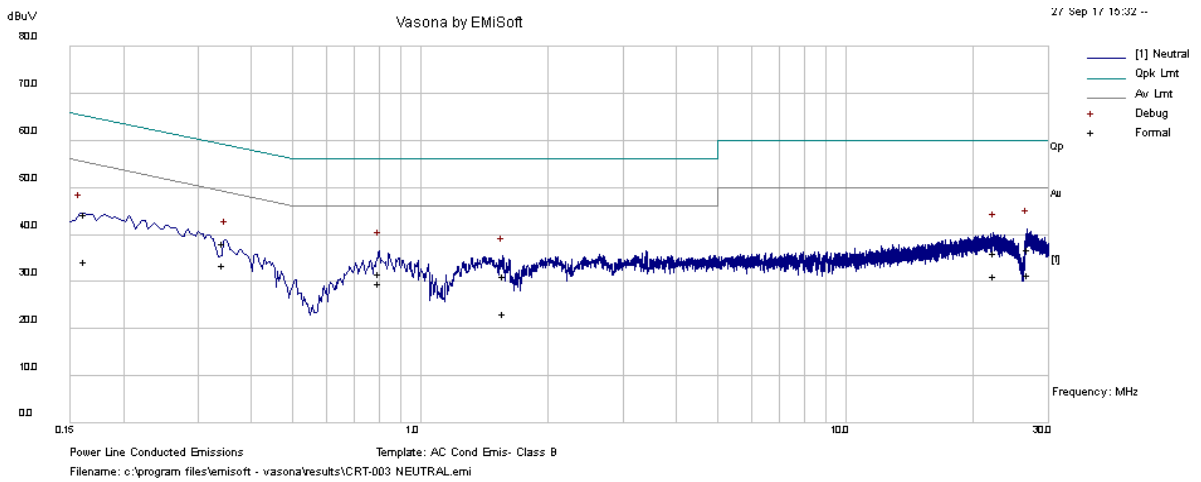


Live Plot at 120Vac, 60Hz

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Measurement Type	Line / Neutral	Limit (dBuV)	Margin (dB)	Pass /Fail
0.855054	21.92	10.01	0.54	32.47	Average	Live	46	-13.53	Pass
0.156565	30.4	10	1.66	42.06	Average	Live	55.64	-13.58	Pass
0.442701	22.33	10.01	0.67	33	Average	Live	47.01	-14.01	Pass
26.99621	22.23	10.08	0.76	33.07	Average	Live	50	-16.93	Pass
21.75178	20.52	10.07	0.69	31.28	Average	Live	50	-18.72	Pass
0.305038	20.5	10	0.84	31.35	Average	Live	50.1	-18.76	Pass
0.156565	34.91	10	1.66	46.57	Quasi Peak	Live	65.64	-19.08	Pass
0.442701	26.97	10.01	0.67	37.65	Quasi Peak	Live	57.01	-19.37	Pass
0.305038	29.52	10	0.84	40.37	Quasi Peak	Live	60.1	-19.74	Pass
0.855054	25.28	10.01	0.54	35.83	Quasi Peak	Live	56	-20.17	Pass
26.99621	26.48	10.08	0.76	37.33	Quasi Peak	Live	60	-22.67	Pass
21.75178	24.94	10.07	0.69	35.7	Quasi Peak	Live	60	-24.3	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:	Rachana Khanduri			
Test Date:	09/27/1017			
Remarks	Conducted @ Neutral			

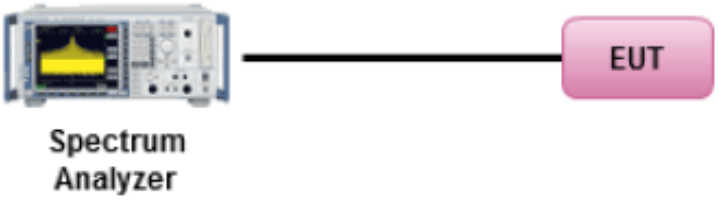


Neutral Plot at 120Vac, 60Hz

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Measurement Type	Line / Neutral	Limit (dBuV)	Margin (dB)	Pass /Fail
0.344188	22.74	10.01	0.77	33.51	Average	Neutral	49.1	-15.59	Pass
0.800345	19.03	10.01	0.55	29.59	Average	Neutral	46	-16.41	Pass
26.8538	20.63	10.08	0.76	31.47	Average	Neutral	50	-18.53	Pass
22.33524	20.31	10.07	0.7	31.08	Average	Neutral	50	-18.92	Pass
0.344188	27.34	10.01	0.77	38.12	Quasi Peak	Neutral	59.1	-20.99	Pass
0.162349	22.68	10	1.59	34.27	Average	Neutral	55.34	-21.07	Pass
0.162349	32.64	10	1.59	44.23	Quasi Peak	Neutral	65.34	-21.12	Pass
1.566397	12.79	10.02	0.51	23.32	Average	Neutral	46	-22.68	Pass
26.8538	26.06	10.08	0.76	36.9	Quasi Peak	Neutral	60	-23.1	Pass
22.33524	25.2	10.07	0.7	35.97	Quasi Peak	Neutral	60	-24.03	Pass
0.800345	21.2	10.01	0.55	31.76	Quasi Peak	Neutral	56	-24.24	Pass
1.566397	20.6	10.02	0.51	31.13	Quasi Peak	Neutral	56	-24.87	Pass

10.2 6dB & 99% Bandwidth

Requirement(s):

Spec	Requirement	Applicable
§ 15.247 RSS247 (5.2.1)	6dB BW≥500KHz;	☒
RSS Gen 4.6.1	The transmitter shall be operated at its maximum carrier power measured under normal test conditions. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used given that a peak or peak hold may produce a wider bandwidth than actual. The trace data points are recovered and directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded. The span between the two recorded frequencies is the occupied bandwidth	☒
Test Setup		
Test Procedure	558074 D01 DTS Meas Guidance v04, 8.1 DTS bandwidth 6dB Emission bandwidth measurement procedure - Set RBW = 100 kHz. - Set the video bandwidth (VBW) ⩾ 3 x RBW. - Detector = Peak. - Trace mode = max hold. - Sweep = auto couple. - Allow the trace to stabilize. - Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.	
Test Date	09/28/2017	Environmental condition: Temperature 23ºC; Relative Humidity 42%; Atmospheric Pressure 1021mbar
Remark	N/A	
Result	☒ Pass ☐ Fail	

Test Data ☒ Yes ☐ N/A
Test Plot ☒ Yes ☐ N/A

Test was done by Cipher at RF test site.

BLE:

Channel	Channel Frequency (MHz)	OBW	
		99% (MHz)	6dB(KHz)
Low	2402	1.07	686.1
Mid	2440	1.07	693.7
High	2480	1.07	696.7

6dB & 99% Bandwidth Test Plots

BLE-2402MHz

BLE-2440MHz

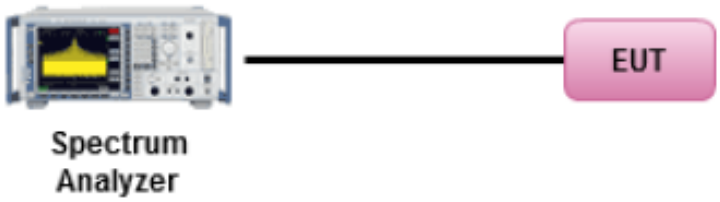

Spectrum Analyzer 1
Occupied BW
Frequency
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
Atten: 20 dB
Preamp: Off
Trig: Free Run
Gate: Off
#IF Gain: Low
Center Freq: 2.480000000 GHz
Avg|Hold:>10/10
Radio Std: None
Center Frequency
2.480000000 GHz
Settings
Span
3.0000 MHz
CF Step
300.000 kHz
Auto
Man
Freq Offset
0 Hz
1 Graph
Ref Lvl Offset 1.00 dB
Scale/Div 10.0 dB
Ref Value 20.00 dBm
Log
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Center 2.48 GHz
#Res BW 100.00 kHz
#Video BW 300.00 kHz*
Span 3 MHz
Sweep Time 1.00 ms (1001 pts)
2 Metrics
Occupied Bandwidth
1.0745 MHz
Total Power
10.9 dBm
Transmit Freq Error
599 Hz
% of OBW Power
99.00 %
x dB Bandwidth
696.7 kHz
x dB
-6.00 dB
Sep 29, 2017
3:07:53 AM

BLE-2480MHz

10.3 Output Power

Requirement(s):

Spec	Item	Requirement	Applicable
§ 15.247 RSS247 (5.4.4)	a)	FHSS in 2400-2483.5MHz with ≥ 75 channels: ≤1 Watt	☐
	b)	FHSS in 5725-5850MHz: ≤1 Watt	☐
	c)	For all other FHSS in the 2400-2483.5MHz band: ≤0.125 Watt.	☐
	d)	FHSS in 902-928MHz with ≥ 50 channels: ≤1 Watt	☐
	e)	FHSS in 902-928MHz with ≥ 25 & <50 channels: ≤0.25 Watt	☐
	f)	DSSS in 902-928MHz, 2400-2483.5MHz, 5725-5850MHz: ≤1 Watt	☒

Test Setup				
Test Procedure	558074 D01 DTS Meas Guidance v04, 9.1.1 Measurement using a Spectrum Analyzer (SA) This procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth. (a) Set the RBW ≥ DTS bandwidth. (b) Set VBW ≥ 3 RBW. (c) Set span ≥ 3 RBW (d) Sweep time = auto couple. (e) Detector = peak. (f) Trace mode = max hold. (g) Allow trace to fully stabilize (h) Use peak marker function to determine the peak amplitude level.			
Test Date	09/27/2017	Environmental condition	Temperature Relative Humidity Atmospheric Pressure	23°C 44% 1021mbar
Remark	NONE			
Result	☒ Pass ☐ Fail			

Test Data ☒ Yes ☐ N/A

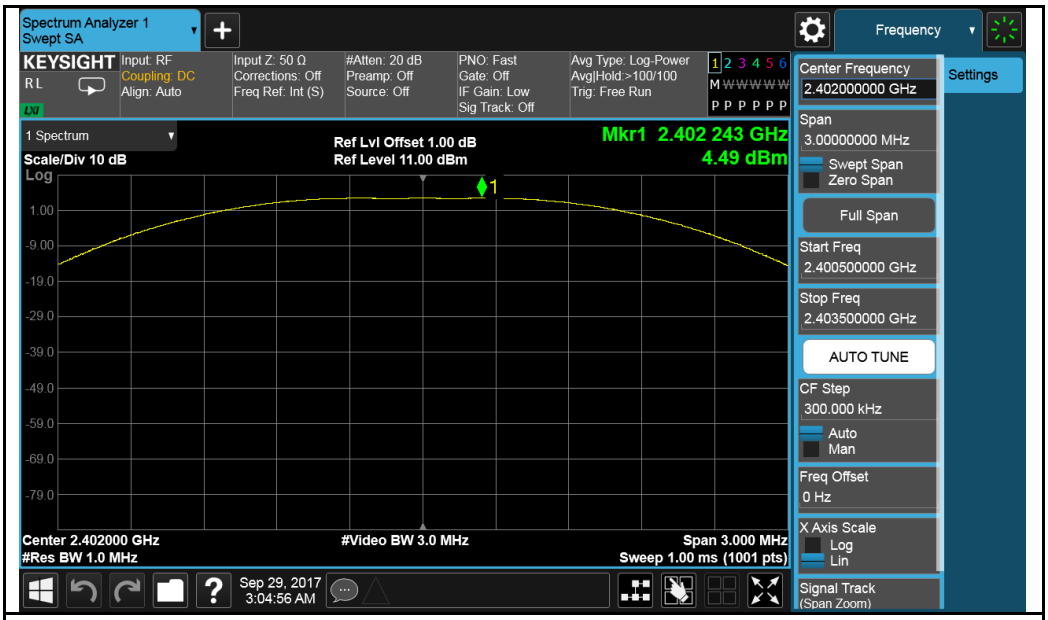
Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Cipher at RF test site.

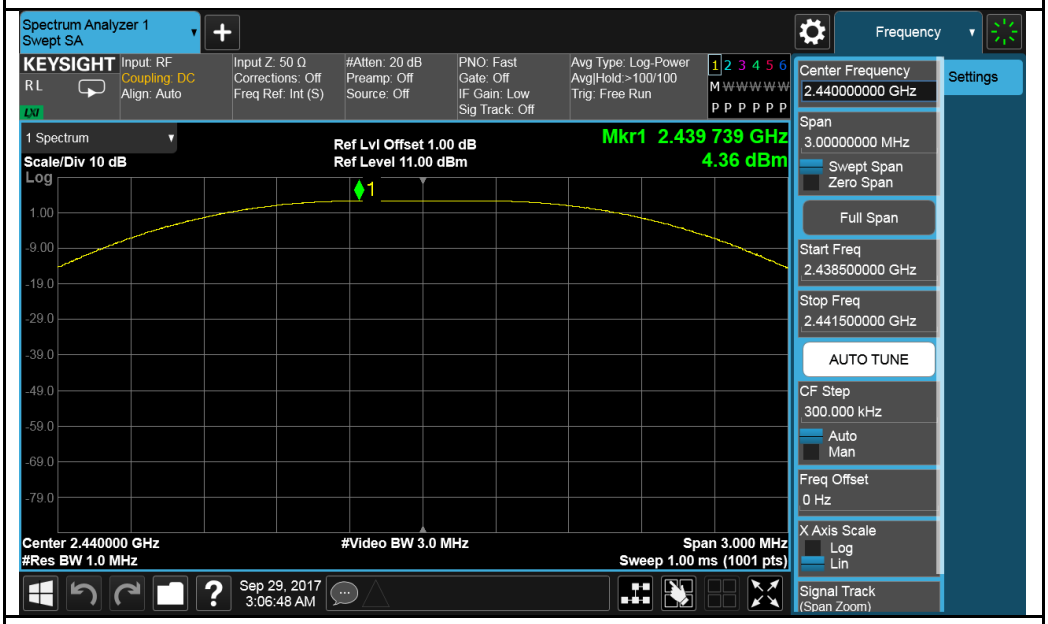
Output Power measurement results for BLE:

Type	Freq (MHz)	Test mode	CH	Conducted Power (dBm)	Limit (dBm)	Result
Output power	2402	Bluetooth LE	Low	4.49	≤30	Pass
	2440	Bluetooth LE	Mid	4.36	≤30	Pass
	2480	Bluetooth LE	High	4.30	≤30	Pass

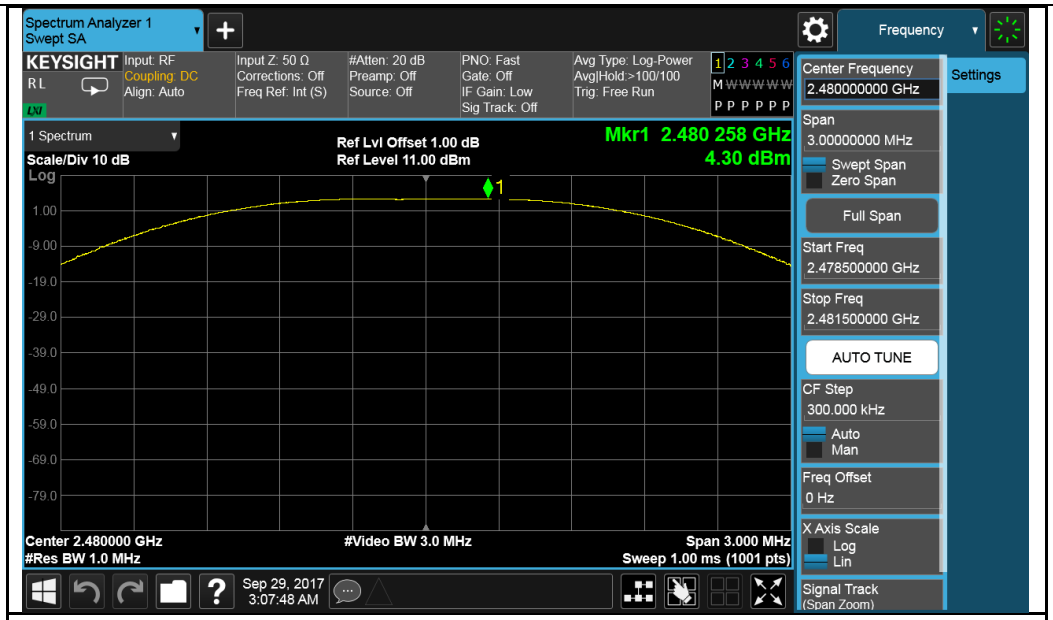
Test Plots:



BLE-2402MHz



BLE-2440MHz

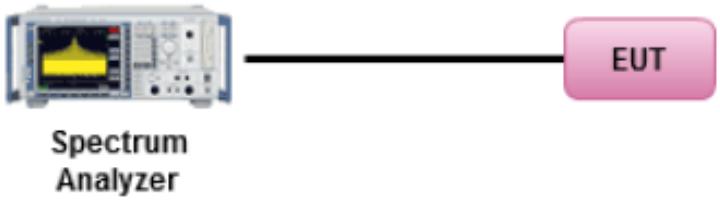

Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
#Atten: 20 dB
Preamp: Off
Source: Off
PNO: Fast
Gate: Off
IF Gain: Low
Sig Track: Off
Avg Type: Log-Power
Avg|Hold:>100/100
Trig: Free Run
1 Spectrum
Scale/Div 10 dB
Ref Lvl Offset 1.00 dB
Ref Level 11.00 dBm
Mkr1 2.480 258 GHz
4.30 dBm
Center 2.480000 GHz
#Res BW 1.0 MHz
#Video BW 3.0 MHz
Span 3.000 MHz
Sweep 1.00 ms (1001 pts)
Frequency
Center Frequency
2.480000000 GHz
Span
3.00000000 MHz
Swept Span
Zero Span
Full Span
Start Freq
2.478500000 GHz
Stop Freq
2.481500000 GHz
AUTO TUNE
CF Step
300.000 kHz
Auto
Man
Freq Offset
0 Hz
X Axis Scale
Log
Lin
Signal Track
(Span Zoom)
Settings
Sep 29, 2017
3:07:48 AM

BLE-2480MHz

10.4 Band Edge and Conducted Spurious emissions

Requirement(s):

Spec	Item	Requirement	Applicable
§ 15.247 RSS247(5.5)	d)	For non-restricted band, In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB or 30dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, determined by the measurement method on output power to be used. Attenuation below the general limits specified in § 15.209 (a) is not required ☐ 20 dB down ☒ 30 dB down	☒

Test Setup	
Test Procedure	558074 D01 DTS Meas Guidance v04 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 attunation 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.

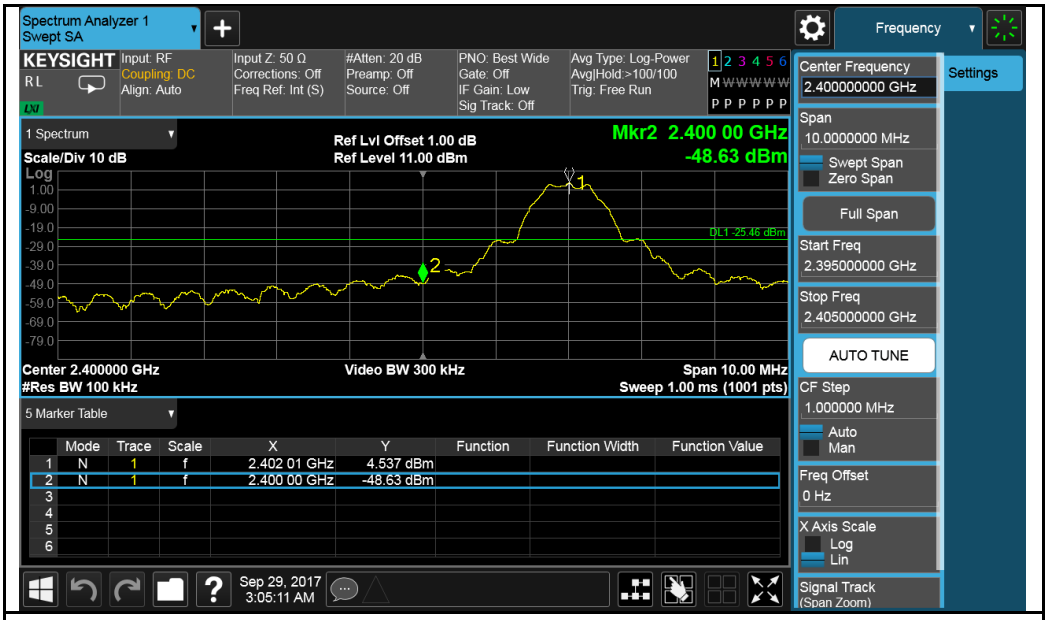
Test Date	09/27/2017	Environmental condition	Temperature Relative Humidity Atmospheric Pressure	22°C 46% 1020mbar
Remark	-			
Result	☒ Pass ☐ Fail			

Test Data ☐ Yes ☒ N/A

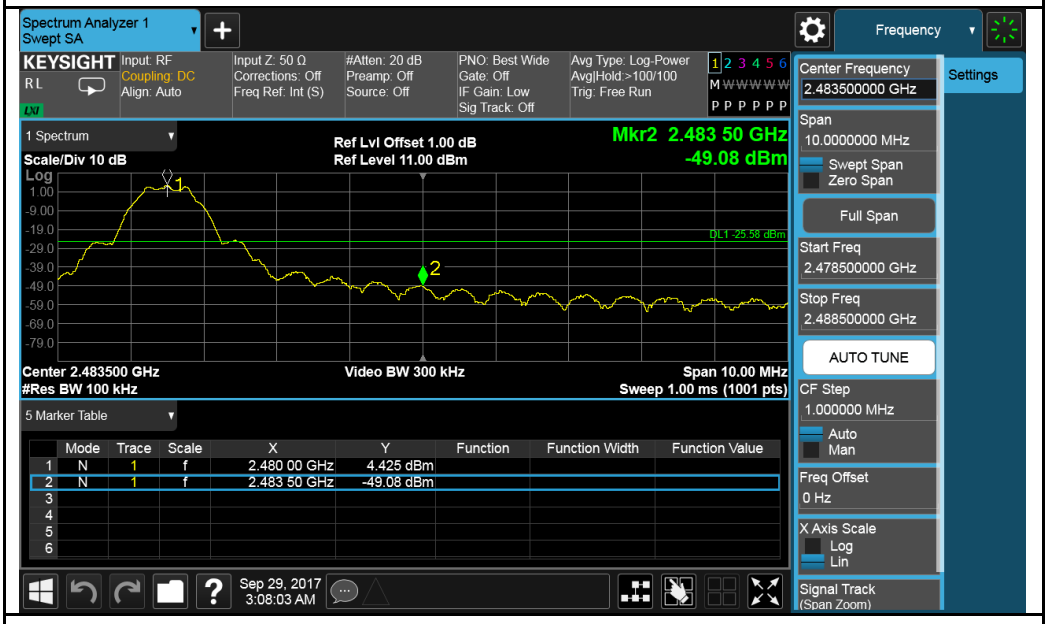
Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Cipher at RF test site.

Test Plots:

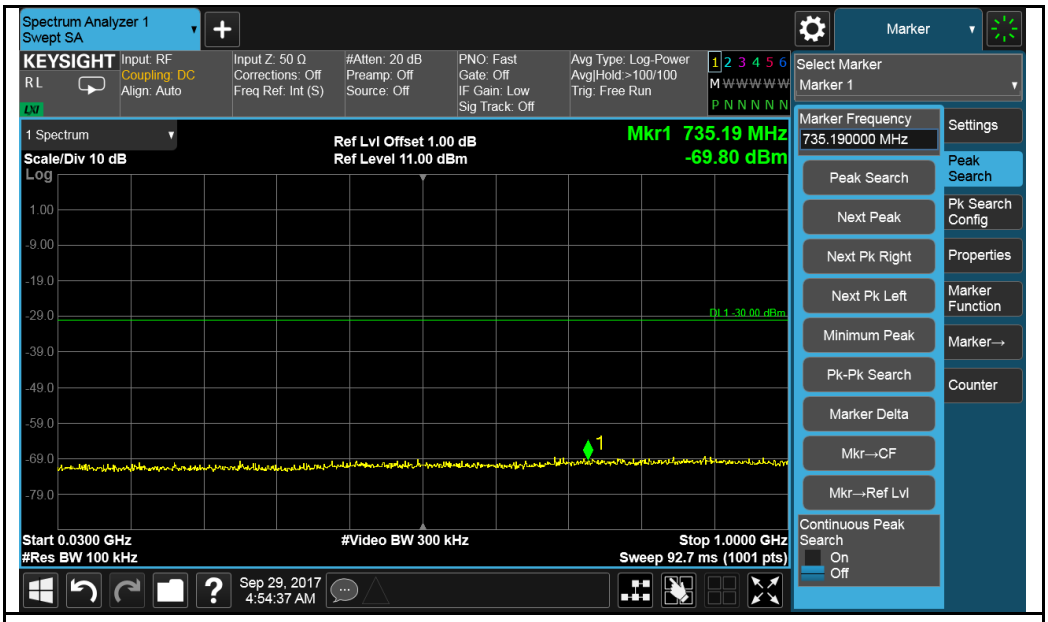


BLE-2402MHz

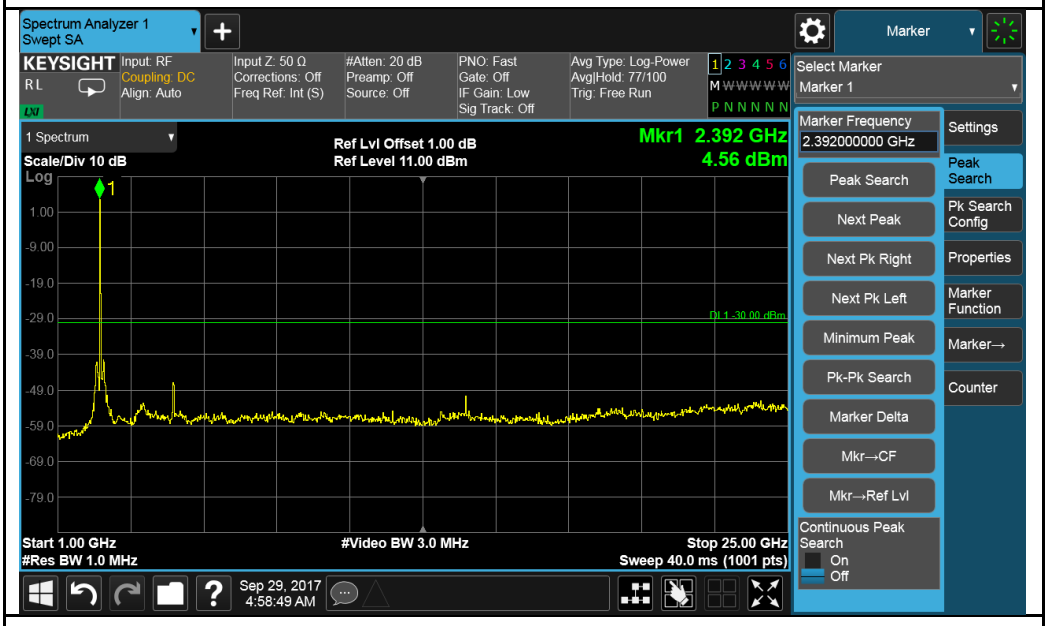


BLE-2480MHz

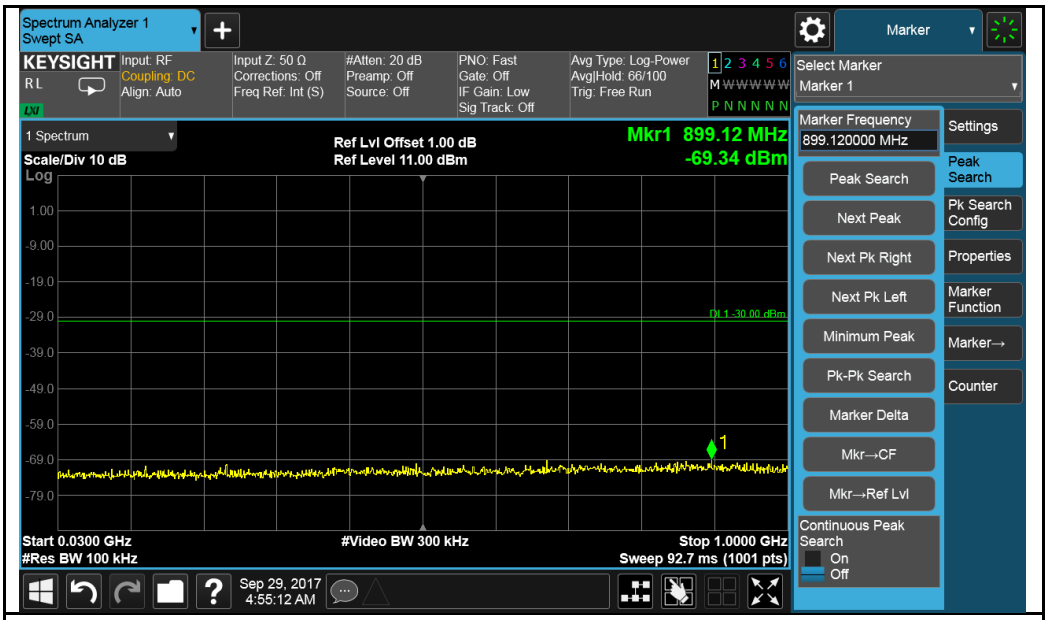
Conducted Spurious Emissions



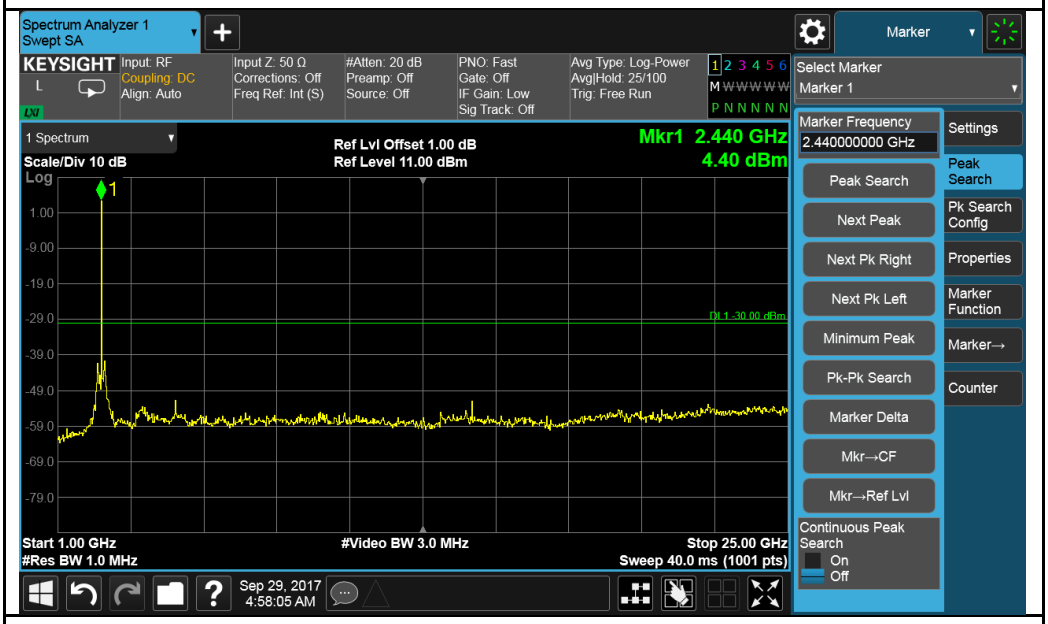
BLE-2402MHz 30MHz – 1GHz



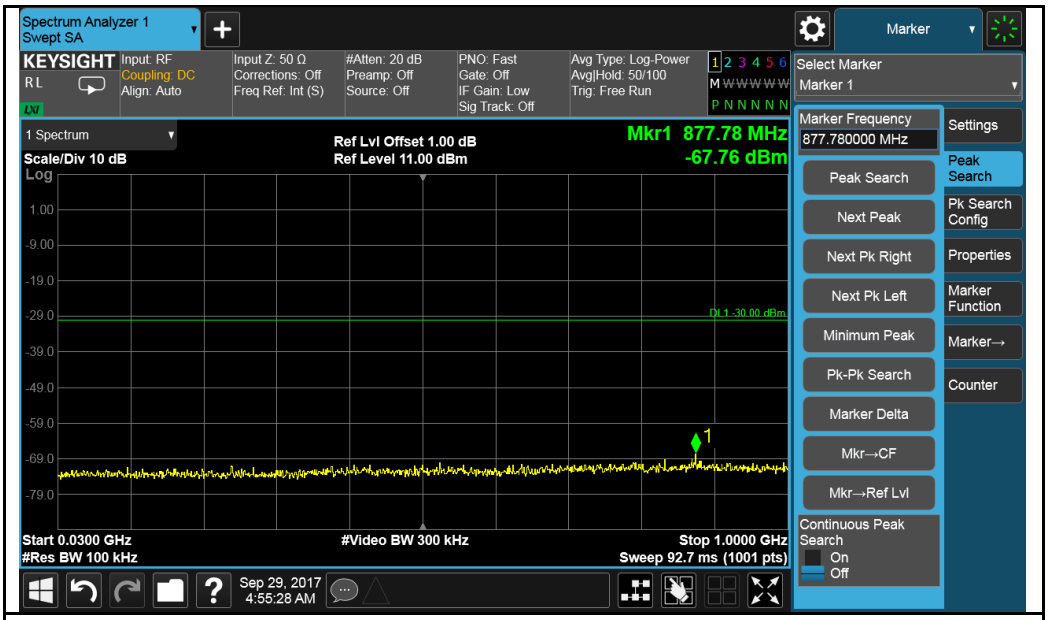
BLE-2402MHz 1GHz – 25GHz



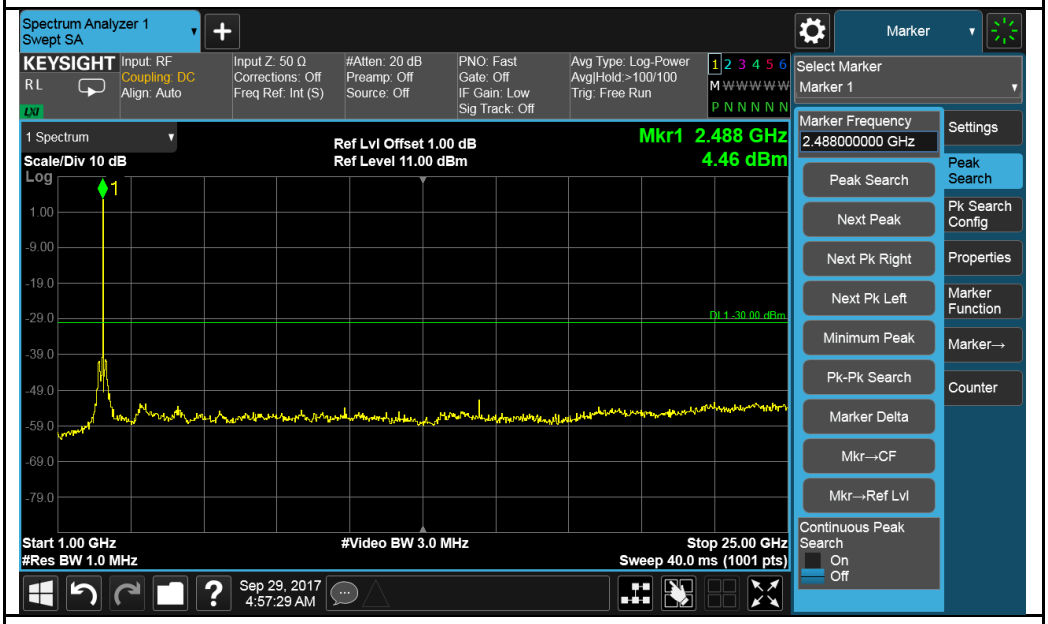
BLE-2440MHz 30MHz – 1GHz



BLE-2440MHz 1GHz – 25GHz

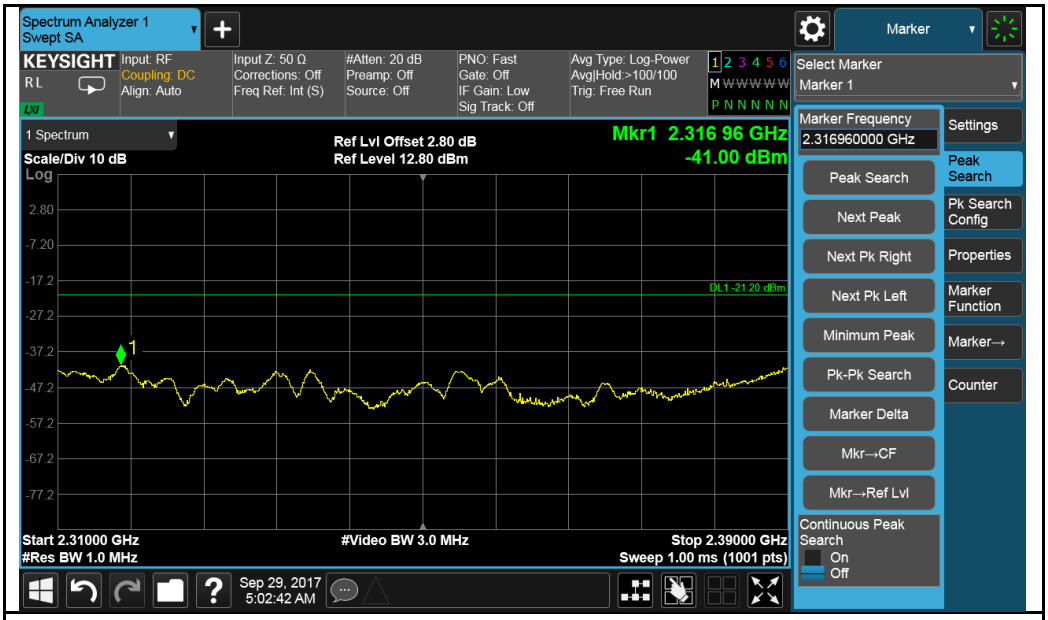


BLE-2480MHz 30MHz – 1GHz

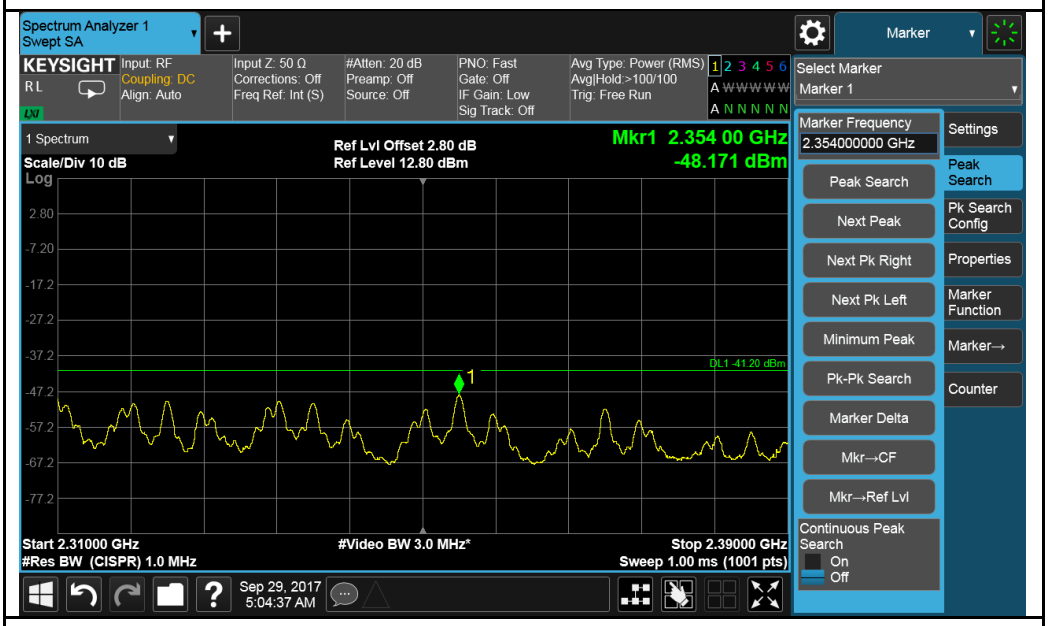


BLE-2480MHz 1GHz – 25GHz

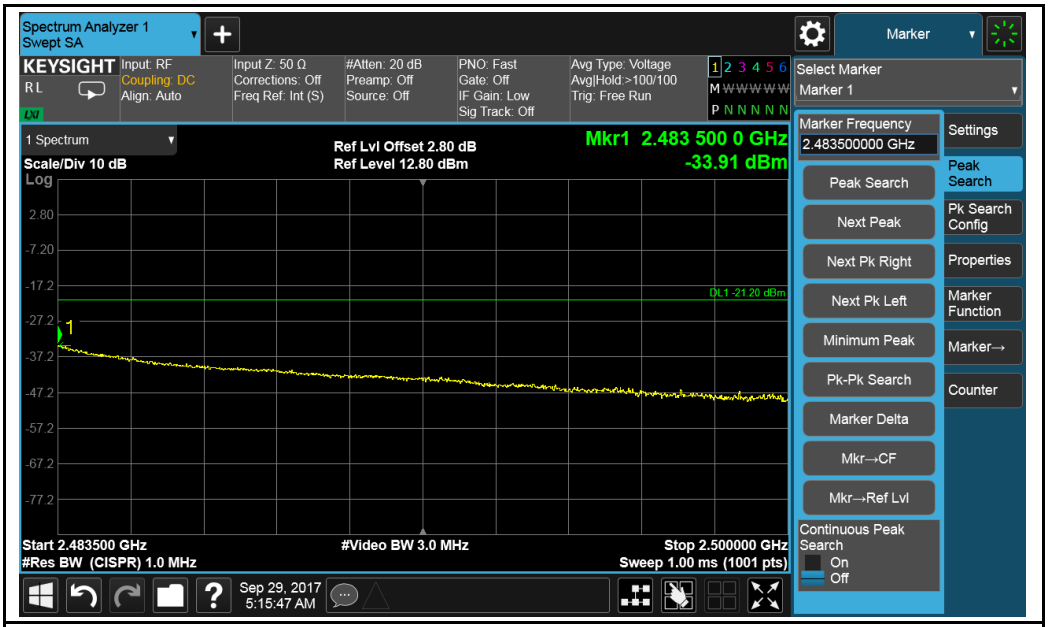
Restricted Band Measurement Plots:



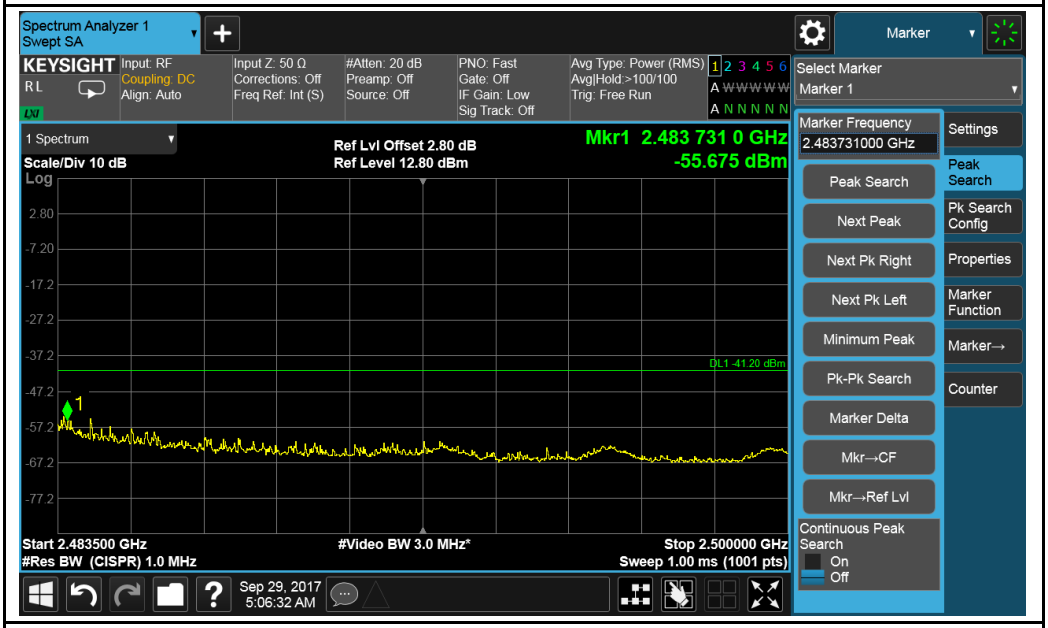
BLE-2402MHz Peak



BLE-2402MHz Average



BLE-2480MHz Peak

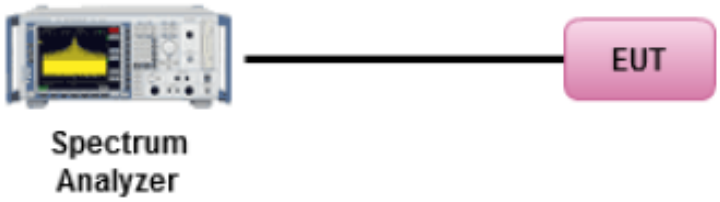


BLE-2480MHz Average

Note: Antenna gain was added to the offset.

10.5 Peak Spectral Density

Requirement(s):

Spec	Item	Requirement	Applicable
§ 15.247(e) RSS247 (5.2.2)	e)	DSSS: ≤8dBm/3KHz	☒
	f)	DSSS in hybrid sys with FH turned off: ≤8dBm/3KHz	☐
Test Setup			
Test Procedure	558074 D01 DTS Meas Guidance v04, 10.2 Method PKPSD (peak PSD) Peak spectral density measurement procedure - Set analyzer center frequency to DTS channel center frequency. - Set the span to 1.5 times the DTS bandwidth. - Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz. - Set the VBW ≥ 3 x RBW. - Detector = Peak - Sweep time = auto couple. - Trace mode = Max Hold - Allow trace to fully stabilize. - Use the peak marker function to determine the maximum amplitude level within the RBW. - If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.		
Test Date	09/27/2017	Environmental condition	Temperature 22°C Relative Humidity 46% Atmospheric Pressure 1020mbar
Remark	N/A		
Result	☒ Pass ☐ Fail		

Test Data ☒ Yes ☐ N/A

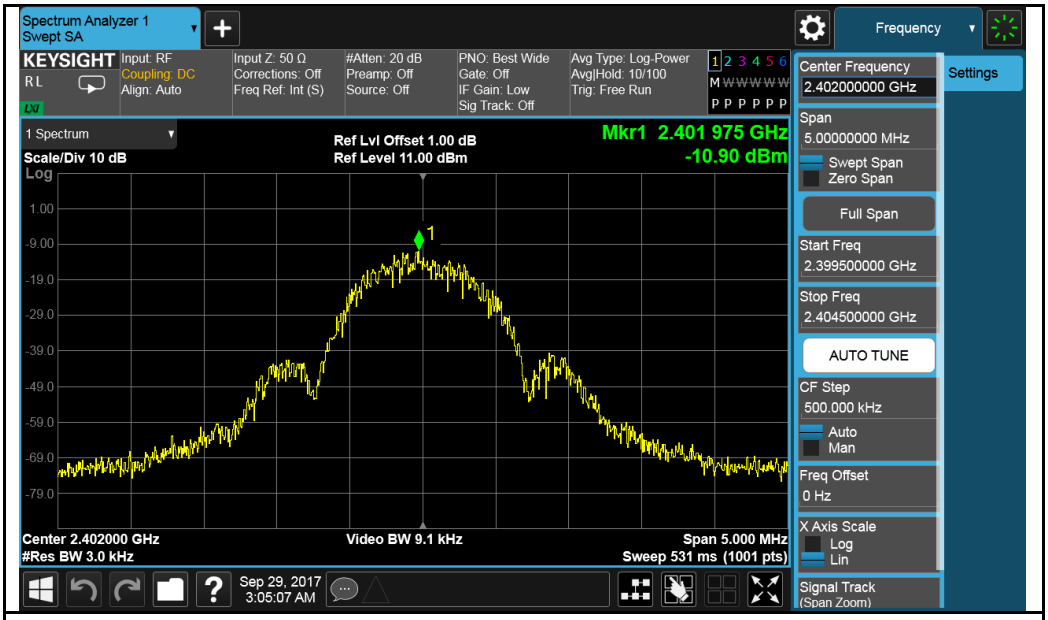
Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Cipher at RF test site.

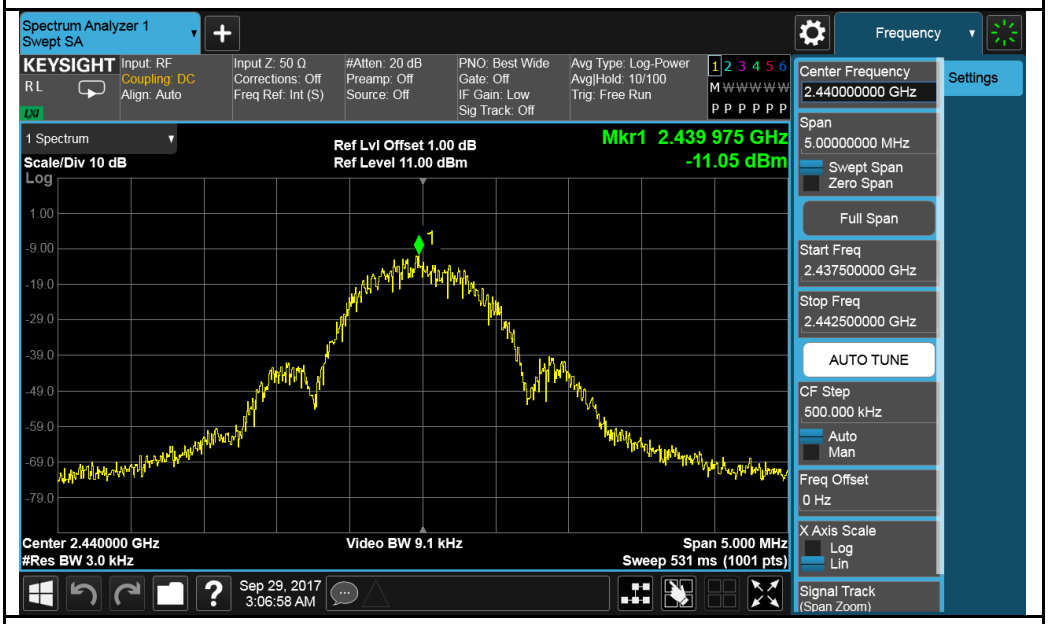
PSD measurement results for BLE:

Type	Freq (MHz)	Test mode	CH	Conducted PSD (dBm/3KHz)	Limit (dBm/3KHz)	Result
PSD	2402	Bluetooth LE	Low	-10.90	8	Pass
	2441	Bluetooth LE	Mid	-11.05	8	Pass
	2480	Bluetooth LE	High	-11.19	8	Pass

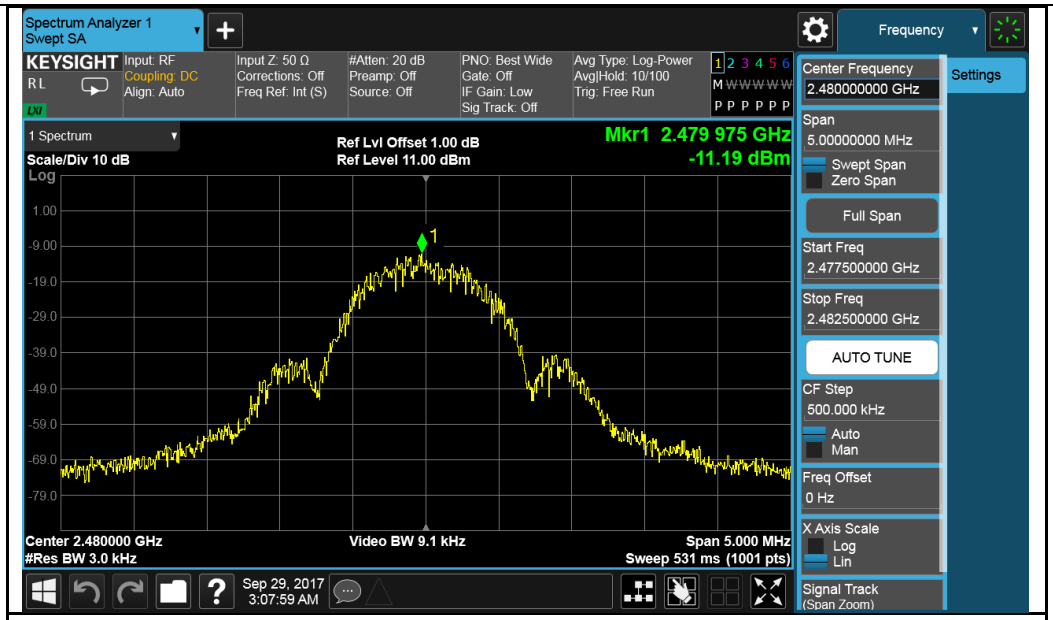
Test Plots



BLE-2402MHz



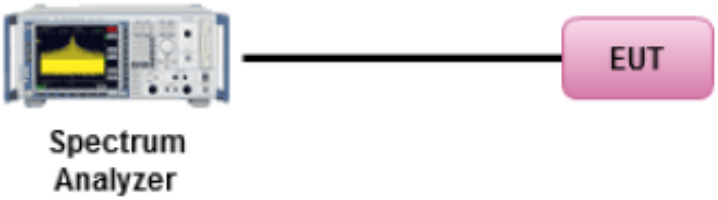
BLE-2440MHz


Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
#Atten: 20 dB
Preamp: Off
Source: Off
PNO: Best Wide
Gate: Off
IF Gain: Low
Sig Track: Off
Avg Type: Log-Power
Avg|Hold: 10/100
Trig: Free Run
1 Spectrum
Scale/Div 10 dB
Ref Lvl Offset 1.00 dB
Ref Level 11.00 dBm
Mkr1 2.479 975 GHz
-11.19 dBm
Center 2.480000 GHz
#Res BW 3.0 kHz
Video BW 9.1 kHz
Span 5.000 MHz
Sweep 531 ms (1001 pts)
Frequency
Center Frequency
2.480000000 GHz
Span
5.00000000 MHz
Swept Span
Zero Span
Full Span
Start Freq
2.477500000 GHz
Stop Freq
2.482500000 GHz
AUTO TUNE
CF Step
500.000 kHz
Auto
Man
Freq Offset
0 Hz
X Axis Scale
Log
Lin
Signal Track
(Span Zoom)
Settings
Sep 29, 2017
3:07:59 AM

BLE-2480MHz

10.6 Conducted Spurious Emissions in out of band domain

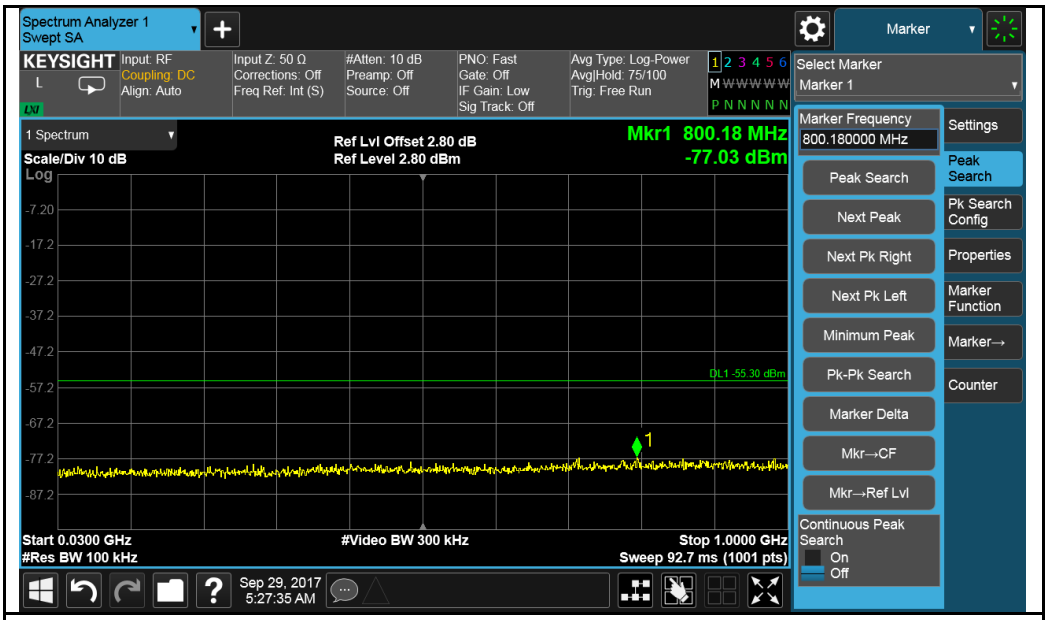
Requirement(s):

Spec	Item	Requirement	Applicable
47CFR§15.247(d) 47CFR§15.209 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. Measure the conducted output power (in dBm) using the detector specified (see 12.2.2, 12.2.3, and 12.2.4 for guidance regarding measurement procedures for determining quasi-peak, peak, and average conducted output power, respectively). 2. Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level (see 12.2.5 for guidance on determining the applicable antenna gain) 3. Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies ≤ 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000 MHz). 4. For devices with multiple antenna-ports, measure the power of each individual chain and sum the EIRP of all chains in linear terms (e.g., Watts, mW). 5. Convert the resultant EIRP level to an equivalent electric field strength using the following relationship: E = EIRP – 20log D + 104.8 where: E = electric field strength in dBμV/m, EIRP = equivalent isotropic radiated power in dBm D = specified measurement distance in meters 6. Compare the resultant electric field strength level to the applicable limit 7. Perform radiated spurious emission test	
Remark		E = EIRP – 20log D + 104.8 Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies ≤ 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000 MHz).	
Result		☒ Pass ☐ Fail	

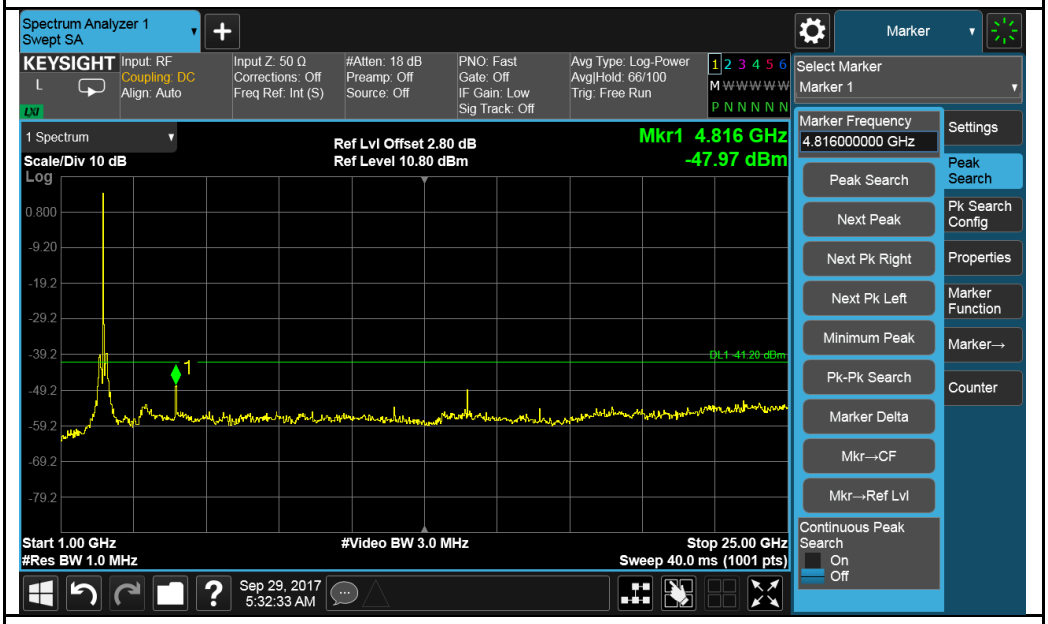
Test Data ☐ Yes (See below) ☒ N/A
Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Cipher at RF Test site.

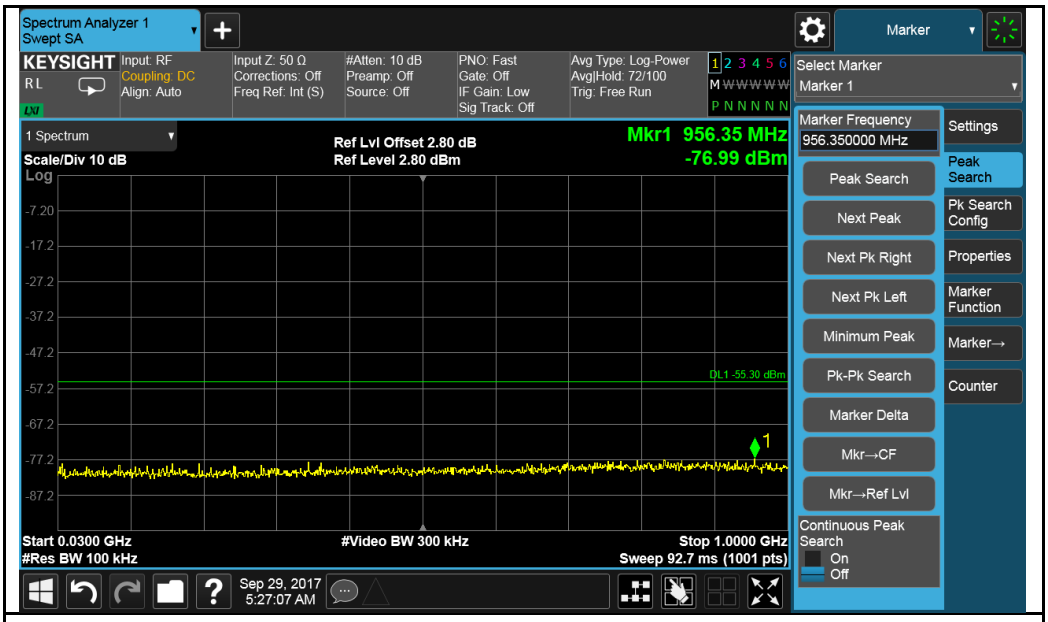
Conducted Spurious Emissions



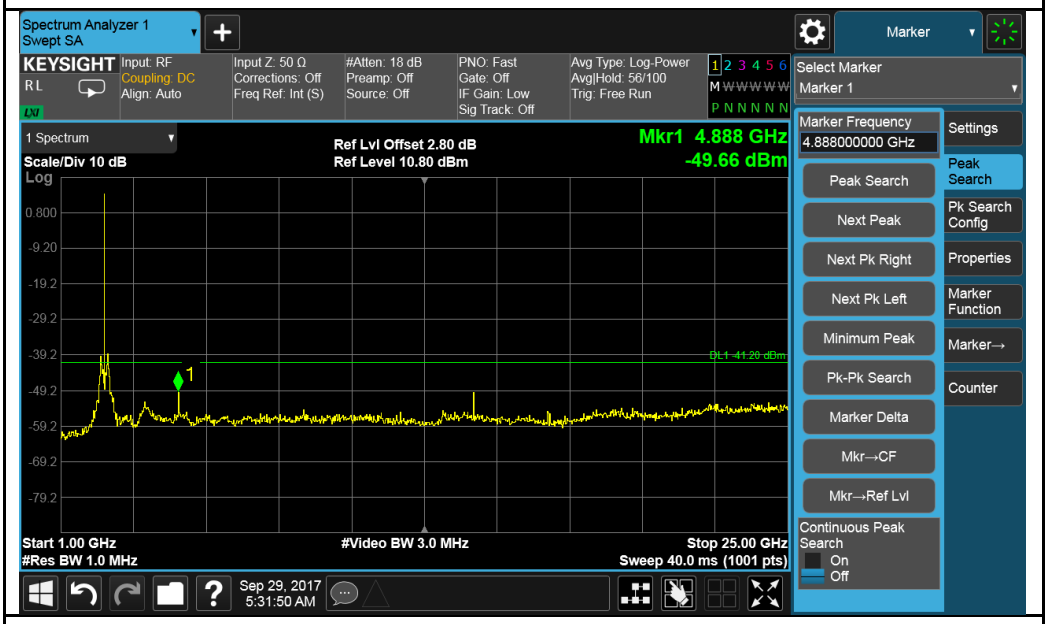
BLE-2402MHz 30MHz – 1GHz



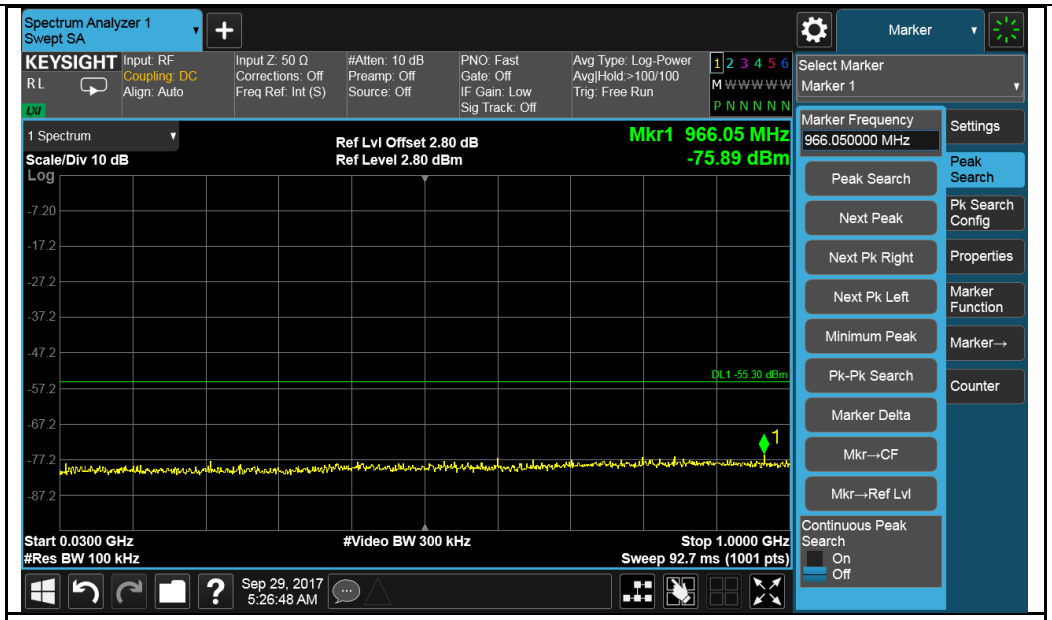
BLE-2402MHz 1GHz – 25GHz



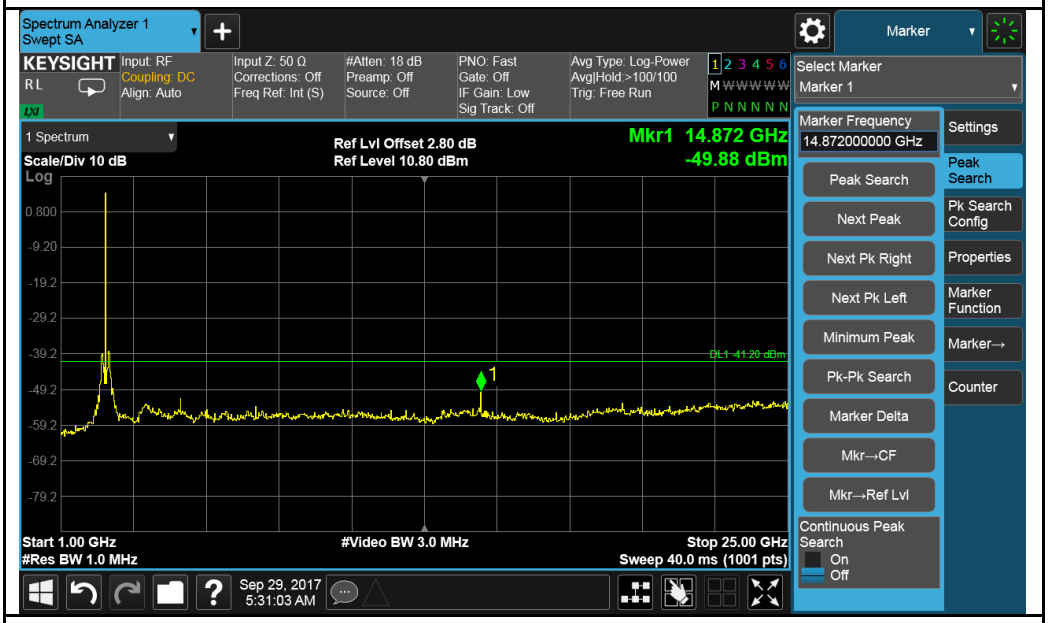
BLE-2440MHz 30MHz – 1GHz



BLE-2440MHz 1GHz – 25GHz



BLE-2480MHz 30MHz – 1GHz



BLE-2480MHz 1GHz – 25GHz

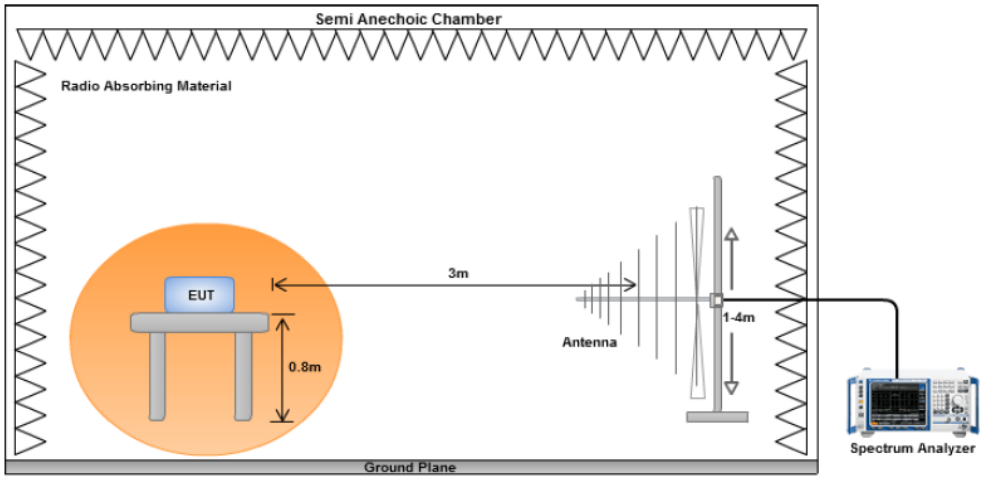
Note: Worst case limit was used for below 1GHz.

10.7 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. The EUT was evaluated in each of three orthogonal axis positions, the orientation is the worst case, please refer to setup photos.
Result	☒ Pass ☐ Fail

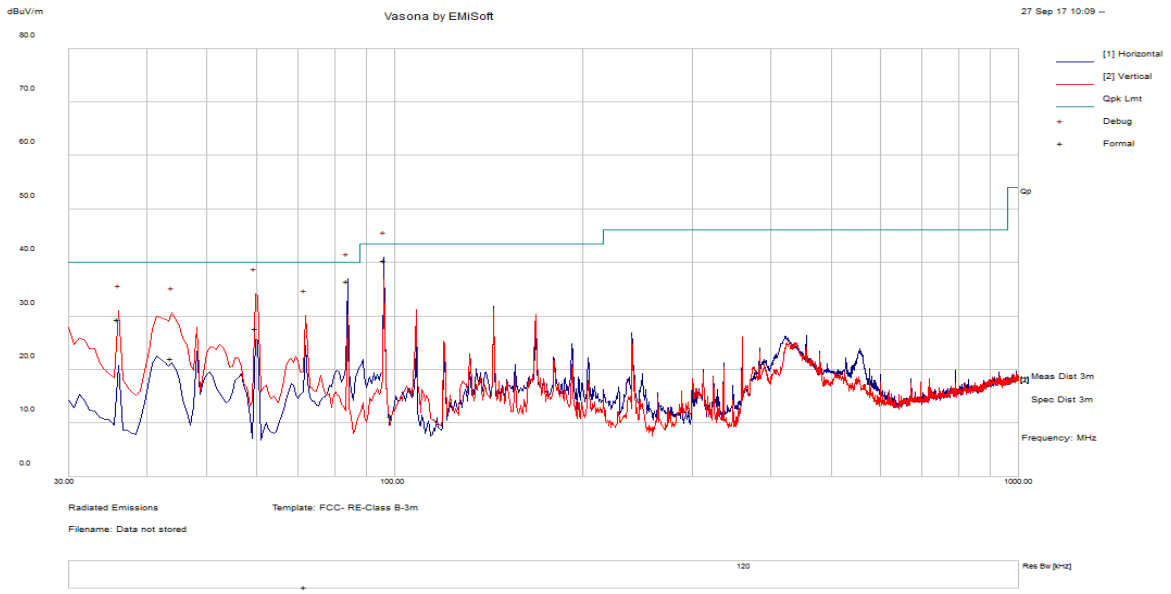
Test Data ☒ Yes (See below) ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Cipher at 10m chamber.

Radiated Emission Test Results (Below 1GHz)

Test specification	below 1GHz			
Environmental Conditions:	Temp (°C):	26.1	Result	Pass
	Humidity (%)	47.5		
	Atmospheric (mbar):	1020		
Mains Power:	3VDC			
Tested by:	Cipher			
Test Date:	09/27/2017			
Remarks:	BLE, low channel			

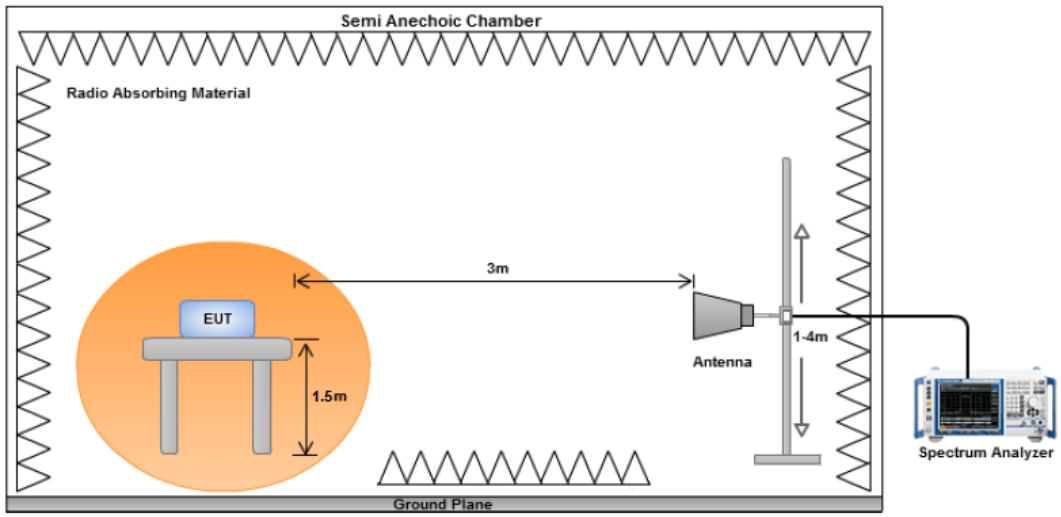


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
96.01	65.9	1.62	-27.08	40.44	Quasi Max	H	194	16	43.5	-3.06	Pass
84.02	63.51	1.55	-28.49	36.57	Quasi Max	V	217	356	40	-3.43	Pass
59.95	54.75	1.42	-28.45	27.72	Quasi Max	H	102	8	40	-12.28	Pass
36.00	47.08	1.1	-18.79	29.39	Quasi Max	H	113	295	40	-10.61	Pass
43.84	45.14	1.23	-24.25	22.12	Quasi Max	H	114	279	40	-17.89	Pass

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

10.8 Radiated Spurious Emissions between 1GHz – 25GHz

Requirement(s):

Spec	Item	Requirement	Applicable
47CFR§15.247(d), RSS210(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	☒
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 40GHz. Both horizontal and vertical polarities were investigated. The results show only the worst case. There isn't outstanding emission found at the edge of restricted frequency. The EUT was evaluated in each of three orthogonal axis positions, the orientation is the worst case, please refer to setup photos.		
Result	☒ Pass ☐ Fail		

Test Data ☒ Yes (See below) ☐ N/A

Test Plot ☐ Yes (See below) ☒ N/A

Test was done by Cipher at 10m chamber.

Radiated Emission Test Results (Above 1GHz)

Above 1GHz-25GHz- BLE - 2402MHz

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
9606.48	38.91	8.02	-0.2	44.95	Peak Max	V	147	128	74	-29.05	Pass
7202.34	39.75	6.61	-0.03	44.56	Peak Max	V	143	276	74	-29.44	Pass
4802.13	39.85	5.47	-4.97	38.57	Peak Max	H	172	78	74	-35.43	Pass
9606.48	26.95	8.02	-0.2	32.99	Average Max	H	145	190	54	-21.01	Pass
7202.34	27.9	6.61	-0.03	32.7	Average Max	V	143	276	54	-21.3	Pass
4802.13	28.21	5.47	-4.97	26.93	Average Max	H	172	78	54	-27.07	Pass

Above 1GHz-25GHz- BLE - 2440MHz

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
7318.43	39.76	6.69	0.04	44.7	Peak Max	V	124	28	74	-29.3	Pass
9762.09	39.18	7.91	-0.44	44.86	Peak Max	V	103	274	74	-29.14	Pass
4882.07	41.04	5.51	-5.11	39.67	Peak Max	H	111	159	74	-34.33	Pass
7318.43	27.71	6.69	0.04	32.65	Average Max	V	124	28	54	-21.35	Pass
9762.09	27.28	7.91	-0.44	32.96	Average Max	V	103	274	54	-21.04	Pass
4882.07	28.97	5.51	-5.11	27.6	Average Max	H	111	159	54	-26.4	Pass

Above 1GHz-25GHz- BLE - 2480MHz

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
7441.61	39.69	6.76	-0.13	44.54	Peak Max	V	138	291	74	-29.46	Pass
9921.58	39.25	7.8	-0.42	44.85	Peak Max	H	182	257	74	-29.15	Pass
4957.11	40.05	5.56	-5.13	38.7	Peak Max	V	111	211	74	-35.3	Pass
7441.61	27.4	6.76	-0.13	32.25	Average Max	V	138	291	54	-21.75	Pass
9921.58	27.63	7.8	-0.42	33.23	Average Max	V	101	46	54	-20.77	Pass
4957.11	28.24	5.56	-5.13	26.88	Average Max	V	111	211	54	-27.12	Pass

Annex A. TEST INSTRUMENT

Instrument	Model	Serial #	Cal Date	Cal Cycle	Cal Due	In use
Radiated Emissions						
Spectrum Analyzer	N9010B	10SL0219	08/20/2017	1 Year	08/20/2018	☑
RF Preamplifier	LPA-6-30	11140711	02/19/2017	1 Year	02/19/2018	☑
Bi-Log antenna (30MHz~2GHz)	JB1	A030702	08/12/2017	1 Year	08/12/2018	☑
Horn Antenna (1GHz~26GHz)	3115	100059	08/25/2017	1 Year	08/25/2018	☑
10 Meters SAC	10M	N/A	09/05/2017	1 Year	09/05/2018	☑
RF Conducted Measurement						
Spectrum Analyzer	N9010B	10SL0219	08/20/2017	1 Year	08/20/2018	☑

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