RF TEST REPORT

SIEMIC
A Bureau Veritas Group Company

Report No.: FCC_IC_RF_SL18100302-ZBR-057_UHF RFID_Rev1.0
Supersede Report No.: FCC_IC_RF_SL18100302-ZBR-057

Applicant	Zebra Technologies Corporation
Product Name	UHF RFID module
Module Model No.	M6E-NANO
Test Standard	47CFR15.247 RSS-247 Issue 2 February 2017
Test Method	ANCI C63.10: 2013 558074 D01 DTS Meas Guidance v05 RSS-Gen Issue 5 April 2018
FCC ID	I28-M6ENANO
IC	3798B-M6ENANO
Date of test	11/28/2018 – 11/30/2018
Issue Date	02/06/2019
Test Result	☒ Pass ☐ Fail
Equipment complied with the specification	[x]
Equipment did not comply with the specification	[ ]

Rachana Khanduri	Chen Ge
Test Engineer	Engineer Reviewer

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Test result presented in this test report is applicable to the tested sample only

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

ilac-MRA

A2LA ACCREDITED
TESTING CERT # 2742-01

Laboratory Introduction

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

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

Accreditations for Conformity Assessment

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

Accreditations for Product Certifications

Country	Accreditation Body	Scope
USA	FCC TCB, NIST	EMC, RF, Telecom
Canada	IC FCB, NIST	EMC, RF, Telecom
Singapore	iDA, NIST	EMC, RF, Telecom
EU	NB	EMC & RED
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_RF_SL18100302-ZBR-057	None	Original	01/24/2019
FCC_IC_RF_SL18100302-ZBR-057_Rev1.0	Rev1.0	Updated as per reviewer's comments	02/06/2019

2 Executive Summary

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

Company: Zebra Technologies Corporation
Product: UHF RFID module
Module Model No.: M6E-NANO

3 Customer information

Applicant Name	Zebra Technologies Corp.
Applicant Address	3 Overlook Point, Lincolnshire, IL 60069
Manufacturer Name	Zebra Technologies Corp.
Manufacturer Address	3 Overlook Point, Lincolnshire, IL 60069

4 Test site information

Lab performing tests	SIEMIC Laboratories
Lab Address	775 Montague Expressway, Milpitas, CA 95035
FCC Test Site No.	540430
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	UHF RFID module
Module Model No.	M6E-NANO
Trade Name	Zebra
Serial No.	XXZJJ183501302
Input Power	100-240VAC,50/60Hz
Power Adapter Manu/Model	FSP025-DYAA3
Power Adapter SN	N/A
Product Hardware version	N/A
Product Software version	N/A
Radio Hardware version	N/A
Radio Software version	N/A
Date of EUT received	11/28/2018
Equipment Class/ Category	RFID
Port/Connectors	USB
Remark	NONE

6.2 Radio Description

Radio Type	UHF RFID
Radio Module	M6E-NANO
Operating Frequency	902-928 MHz
Modulation	ASK
Radio type	RFID
Number of Channels	50
Antenna Type	Loop
Antenna Gain	-28 dBi
Maximum conducted power	21.68 dBm See pg21
Maximum EIRP	-8.32 dBm

7 Supporting Equipment/Software and cabling Description

7.1 Supporting Equipment

Supporting Equipment Description	Model	Serial No.	Manu	Note
Laptop	LATITUDE E5410	N/A	Dell	-
Printer	ZQ630	N/A	Zebra	-

7.2 Cabling Description

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

7.3 Test Software Description

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

8 Test Summary

Test Item	Test standard		Test Method/Procedure	Pass / Fail
Antenna Requirement	FCC	15.203	ANSI C63.10 – 2013 558074 D01 DTS Meas. Guidance v05	☒ Pass ☐ N/A
	IC	-		
AC Conducted Emissions Voltage	FCC	15.207	ANSI C63.10 2013 RSS Gen	☒ Pass ☐ N/A
	IC	RSS Gen		

Test Item	Test standard		Test Method/Procedure		Pass / Fail
Channel Separation	FCC	15.247	FCC	558074 D01 DTS Meas Guidance v05	☒ Pass ☐ N/A
	IC	RSS-247	IC	ANSI C63.10:2013	
Time of Occupancy	FCC	15.247	FCC	558074 D01 DTS Meas Guidance v05	☒ Pass ☐ N/A
	IC	RSS-247	IC	ANSI C63.10:2013	
Occupied Bandwidth	FCC	15.247	FCC	558074 D01 DTS Meas Guidance v05	☒ Pass ☐ N/A
	IC	RSS-247	IC	ANSI C63.10:2013	
Bandwidth	FCC	15.247	FCC	558074 D01 DTS Meas Guidance v05	☒ Pass ☐ N/A
	IC	RSS-247	IC	ANSI C63.10:2013	
Band Edge and Radiated Spurious Emissions	FCC	15.247	FCC	558074 D01 DTS Meas Guidance v05	☒ Pass ☐ N/A
	IC	RSS-247	IC	ANSI C63.10:2013	
Time of Occupancy	FCC	15.247	FCC	558074 D01 DTS Meas Guidance v05	☒ Pass ☐ N/A
	IC	RSS-247	IC	ANSI C63.10:2013	
Output Power	FCC	15.247	FCC	558074 D01 DTS Meas Guidance v05	☒ Pass ☐ N/A
	IC	RSS-247	IC	ANSI C63.10:2013	
Number of Hopping Channels	FCC	15.247	FCC	558074 D01 DTS Meas Guidance v05	☒ Pass ☐ N/A
	IC	RSS-247	IC	ANSI C63.10:2013	
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 Radiated Emissions (9 kHz 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

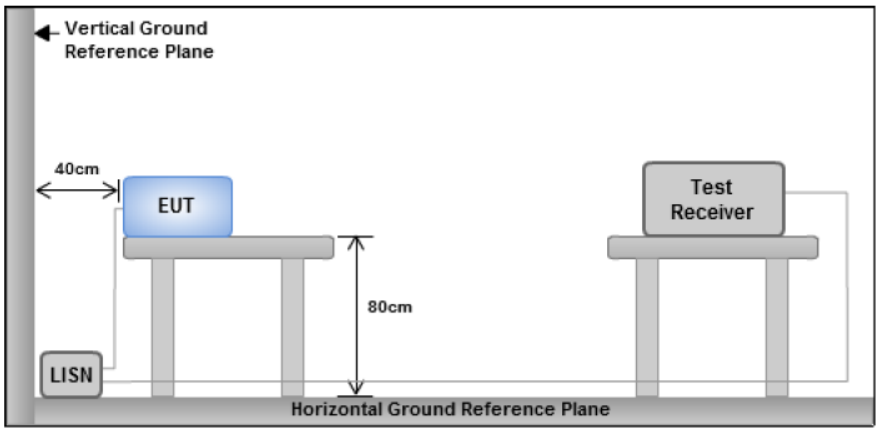
10.1 Antenna Requirement

Spec	Requirement	Applicable
§15.203	An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. Antenna requirement must meet at least one of the following: a) Antenna must be permanently attached to the device. b) Antenna must use a unique type of connector to attach to the device. c) Device must be professionally installed. Installer shall be responsible for ensuring that the correct antenna is employed with the device.	☒
Remark	The device has a unique coupling connector attached to the device, RP-SMA	
Result	☒ PASS ☐ FAIL	

10.2 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	Requirement	Applicable
47CFR§15.207 RSS-Gen	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 frequencies 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	-	
Result	☒ Pass ☐ Fail	

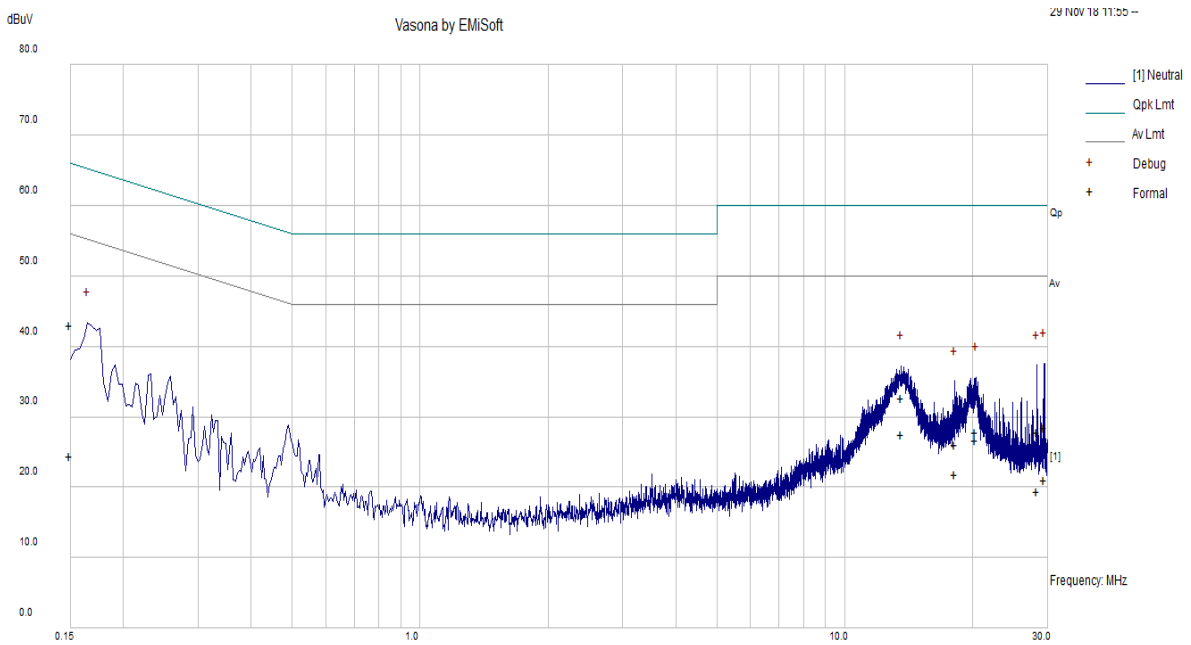
Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

Test was done by *George Hsu* at *Conducted Emission Test Site*.

Conducted Emission Test Results

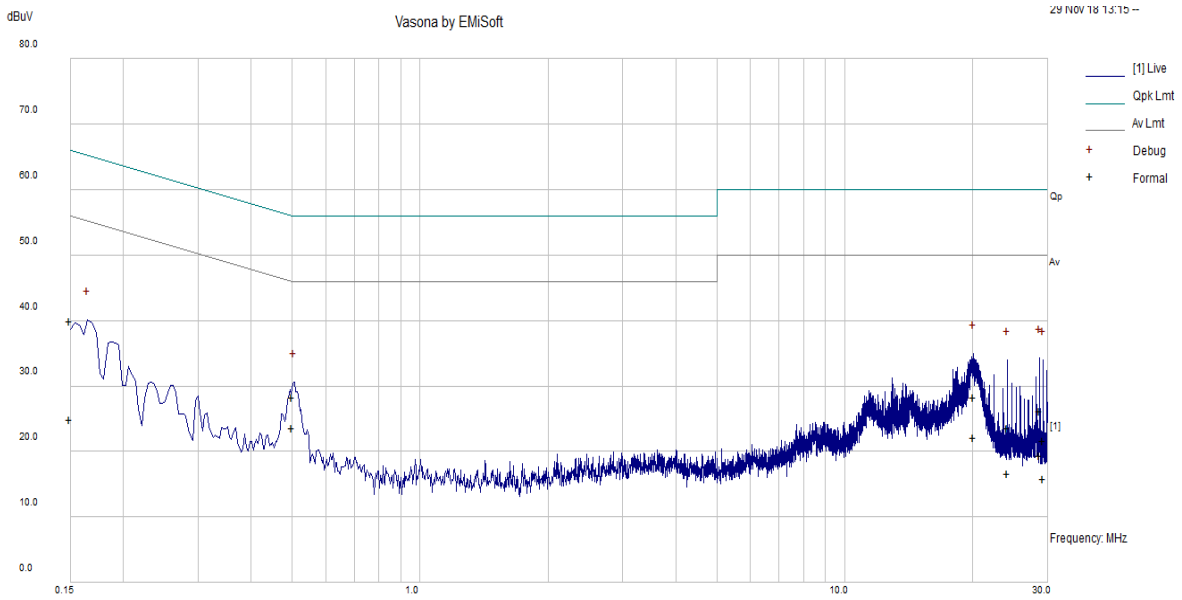
Test specification:	Conducted Emissions			
Environmental Conditions:	Temp(°C):	25.7	Result:	☒ Pass ☐ Fail
	Humidity (%):	43.3		
	Atmospheric(mbar):	1014.9		
Mains Power:	120VAC, 60Hz			
Tested by:	George Hsu			
Test Date:	11/29/2018			
Remarks	Conducted @ Neutral			



Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Measurement Type	Line / Neutral	Limit (dBuV)	Margin (dB)	Pass /Fail
0.15	14.97	9.33	0.04	24.34	Average	Neutral	56	-31.66	Pass
13.58	17.86	9.38	0.33	27.56	Average	Neutral	50	-22.44	Pass
18.18	11.94	9.44	0.41	21.78	Average	Neutral	50	-28.22	Pass
20.40	16.73	9.46	0.45	26.64	Average	Neutral	50	-23.36	Pass
28.41	9.24	9.43	0.81	19.47	Average	Neutral	50	-30.53	Pass
29.55	10.68	9.44	0.85	20.97	Average	Neutral	50	-29.03	Pass
0.15	33.72	9.33	0.04	43.09	Quasi Peak	Neutral	66	-22.91	Pass
13.58	23.02	9.38	0.33	32.72	Quasi Peak	Neutral	60	-27.28	Pass
18.18	16.24	9.44	0.41	26.08	Quasi Peak	Neutral	60	-33.92	Pass
20.39	17.97	9.46	0.45	27.88	Quasi Peak	Neutral	60	-32.12	Pass
28.41	17.54	9.43	0.81	27.77	Quasi Peak	Neutral	60	-32.23	Pass
29.55	18.12	9.44	0.85	28.41	Quasi Peak	Neutral	60	-31.59	Pass

Conducted Emission Test Results

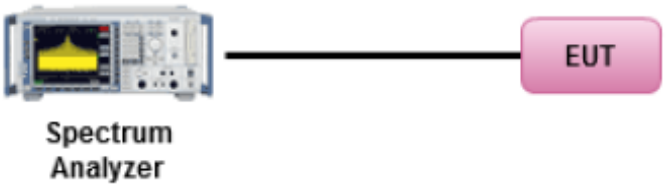
Test specification:	Conducted Emissions			
Environmental Conditions:	Temp(°C):	25.7	Result:	☒ Pass ☐ Fail
	Humidity (%):	43.3		
	Atmospheric(mbar):	1014.9		
Mains Power:	120VAC, 60Hz			
Tested by:	George Hsu			
Test Date:	11/29/2018			
Remarks	Conducted @ Live			



Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Measurement Type	Line / Neutral	Limit (dBuV)	Margin (dB)	Pass /Fail
0.15	15.44	9.33	0.05	24.82	Average	Live	56.00	-31.18	Pass
0.50	14.29	9.33	0.04	23.66	Average	Live	46.01	-22.35	Pass
20.14	12.27	9.46	0.46	22.19	Average	Live	50.00	-27.81	Pass
24.20	6.66	9.42	0.53	16.61	Average	Live	50.00	-33.39	Pass
28.80	9.42	9.43	0.59	19.45	Average	Live	50.00	-30.55	Pass
29.39	5.84	9.43	0.60	15.87	Average	Live	50.00	-34.13	Pass
0.15	30.53	9.33	0.05	39.90	Quasi Peak	Live	66.00	-26.10	Pass
0.50	18.87	9.33	0.04	28.24	Quasi Peak	Live	56.01	-27.77	Pass
20.14	18.45	9.46	0.46	28.37	Quasi Peak	Live	60.00	-31.63	Pass
24.20	13.58	9.42	0.53	23.53	Quasi Peak	Live	60.00	-36.47	Pass
28.80	16.12	9.43	0.59	26.14	Quasi Peak	Live	60.00	-33.86	Pass
29.39	11.62	9.43	0.60	21.66	Quasi Peak	Live	60.00	-38.34	Pass

10.3 99% OBW and 20dB Bandwidth

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 20 dB bandwidth of the hopping channel, whichever is greater.	☒
RSS Gen	99% BW: For FCC reference only; required by IC.	☒
Test Setup		
Procedure	20dB Emission bandwidth measurement procedure 1. Set RBW ⩾ 1% of 20dB Bandwidth 2. Set the video bandwidth (VBW) ⩾ RBW. 3. Detector = Peak. 4. Trace mode = max hold. 5. Sweep = auto couple. 6. Allow the trace to stabilize. 7. 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	11/29/2018	Environmental condition	Temperature 24°C Relative Humidity 46.3% Atmospheric Pressure 1019mbar
Remark	-		
Result	☒ Pass ☐ Fail		

Test Data ☒ Yes ☐ N/A

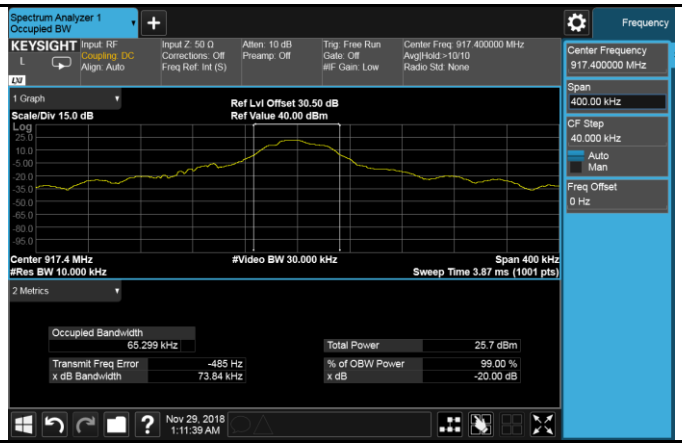
Test Plot ☒ Yes ☐ N/A

Test was done by Rachana Khanduri at RF Test Site.

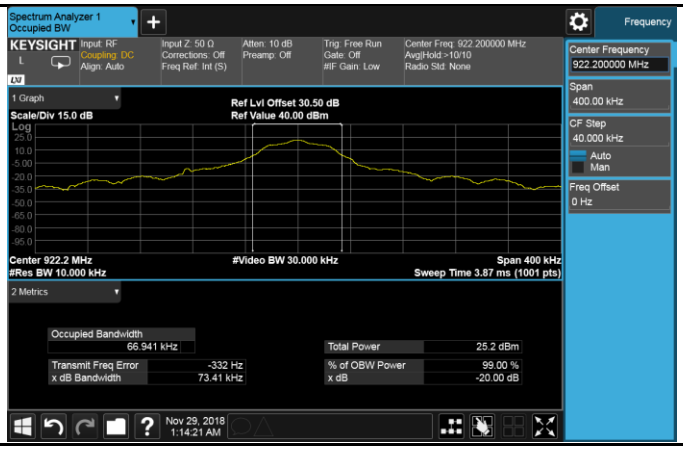
99% OBW and 20dB Bandwidth Test Result

Type	Freq (MHz)	Test mode	CH	20dB Bandwidth (KHz)	99% OBW (KHz)
20dB OBW	917.4	Con-TX	Low	73.84	65.299
	922.2	Con-TX	Mid	73.41	66.941
	927.2	Con-TX	High	74.60	69.932

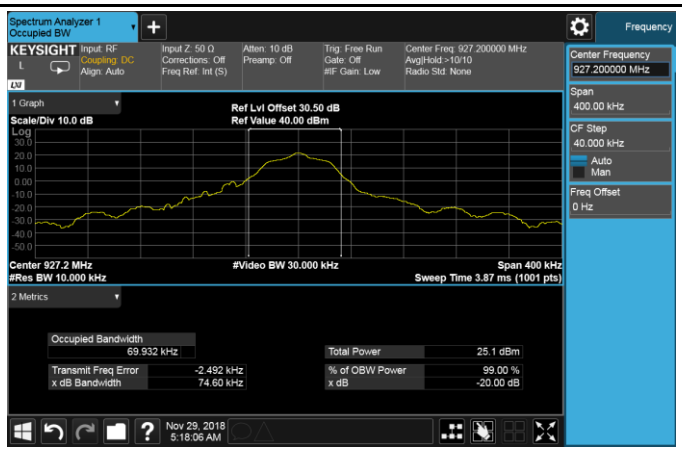
Test Plots:



Low Channel



Mid Channel



High Channel

10.4 Number of Hopping Channel

Requirement(s):

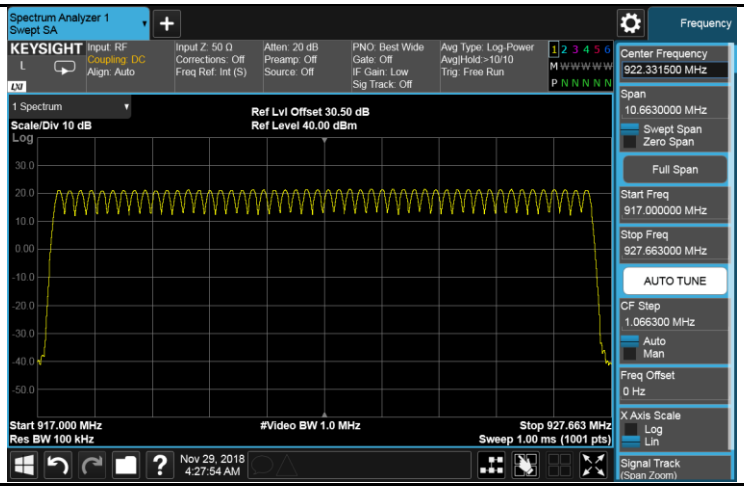
Spec	Requirement	Applicable
47 CFR §15.247 RSS-247	For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz	☒
Test Setup		
Test Procedure	Number of hopping frequencies procedure - The EUT must have its hopping function enabled - Span = the frequency band of operation. - Resolution (or IF) Bandwidth (RBW) >= 1% of the span. - Video (or Average) Bandwidth (VBW) >= RBW. - Detector = peak. - Sweep time = auto couple. - Trace mode = max hold. - Allow trace to fully stabilize. - Save the plot	
Remark	NONE	
Result	☒ Pass ☐ Fail	

Test Data ☐ Yes ☒ N/A

Test Plot ☒ Yes (See below) ☒ N/A

Test was done by Rachana Khanduri at RF Test Site.

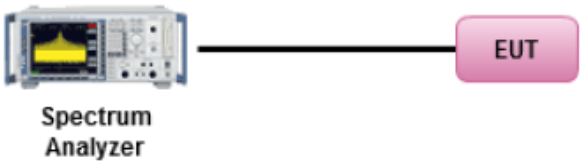
Test Plots



Hopping Channel Number

10.5 Peak Output Power

Requirement(s):

Spec	Requirement	Applicable
47 CFR §15.247 RSS-247	For all other frequency hopping systems in the 902-928 MHz band: 1 Watt. The power is converted from watt to dBm, therefore, 1 watt = 30dBm.	☒
Test Setup		
Procedure	Maximum output power measurement procedure - Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel. - RBW > 1% of the 20 dB bandwidth of the emission being measured; - VBW >= RBW. - Detector = peak. - Sweep time = auto couple. - Trace mode = max hold. - Allow trace to fully stabilize. - Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power.	
Test Date	11/29/2018	Environmental condition: Temperature 22.1°C; Relative Humidity 45.5%; Atmospheric Pressure 1019mbar
Remark	-	
Result	☒ Pass ☐ Fail	

Test Data ☒ Yes ☐ N/A

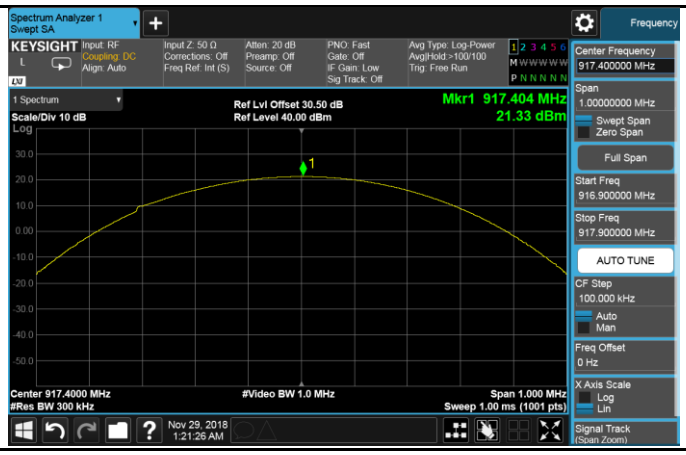
Test Plot ☒ Yes ☐ N/A

Test was done by Rachana Khanduri at RF Test Site.

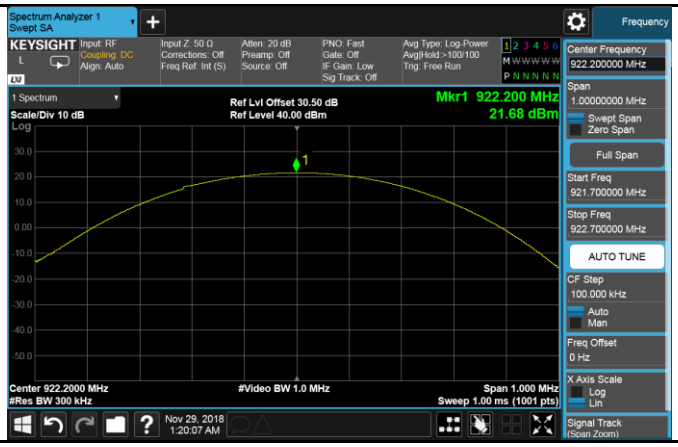
Output Power Test Result

Type	Freq (MHz)	Test mode	CH	Conducted Power (dBm)	Limit (dBm)	Result
Output power	917.4	Cont-TX	Low	21.33	30	Pass
Output power	922.2	Cont-TX	Mid	21.68	30	Pass
Output power	927.2	Cont-TX	High	21.59	30	Pass

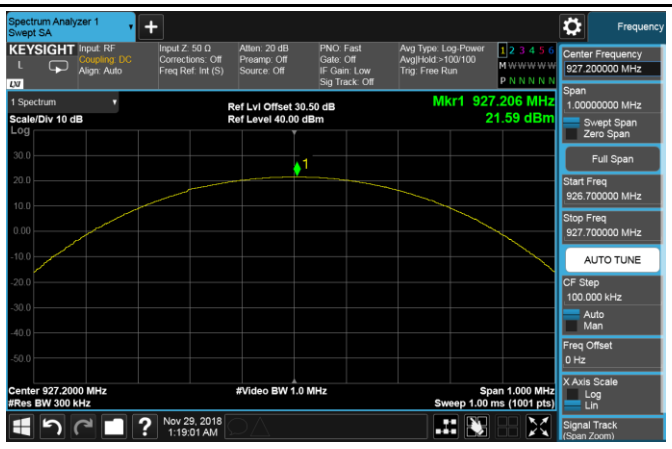
Test Plots:



Low Channel



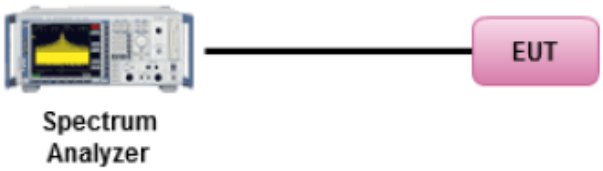
Mid Channel



High Channel

10.6 Channel Separation

Requirement(s):

Spec	Requirement	Applicable
47 CFR §15.247 RSS-247	Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.	☒
Test Setup		
Procedure	Channel Separation procedure 1. The EUT must have its hopping function enabled. 2. Span = wide enough to capture the peaks of two adjacent channels 3. Resolution (or IF) Bandwidth (RBW) >= 1% of the span 4. Video (or Average) Bandwidth (VBW) >= RBW. 5. Detector = Peak. 6. Trace mode = max hold. 7. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.	

Test Date	11/29/2018	Environmental condition	Temperature 22.1°C Relative Humidity 45.5% Atmospheric Pressure 1019mbar
Remark	-		
Result	☐ Pass ☐ Fail ☒ N/A		

Test Data ☒ Yes ☐ N/A

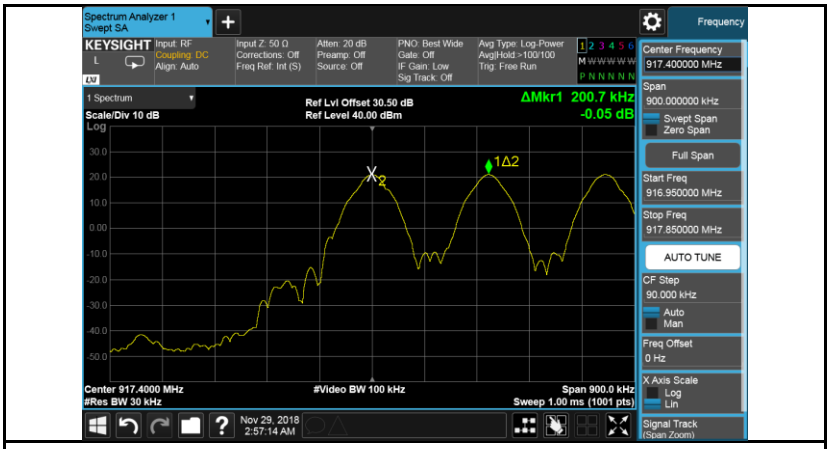
Test Plot ☒ Yes ☐ N/A

Test was done by Rachana Khanduri at RF Test Site.

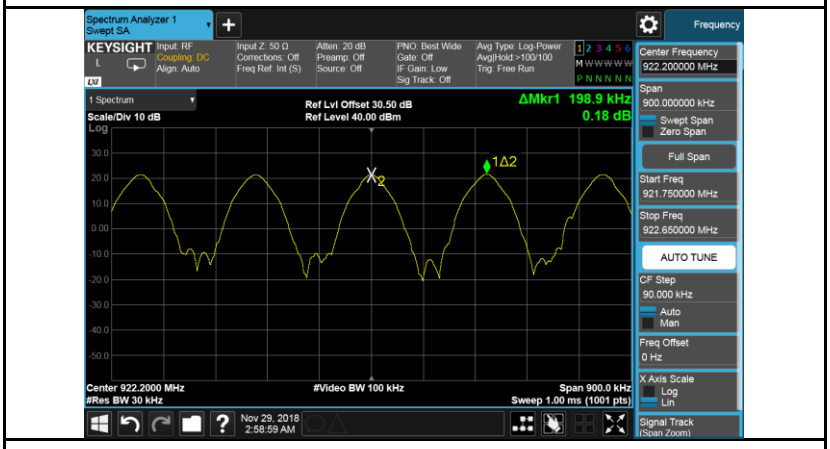
Channel Separation Test Result

Type	Freq (MHz)	Test mode	CH	Result (KHz)	20dB Bandwidth (KHz)	Result
Channel Sep	917.4	Con-TX	Low	200.7	73.84	Pass
Channel Sep	922.2	Con-TX	Mid	198.9	73.41	Pass
Channel Sep	927.2	Con-TX	High	200.7	74.60	Pass

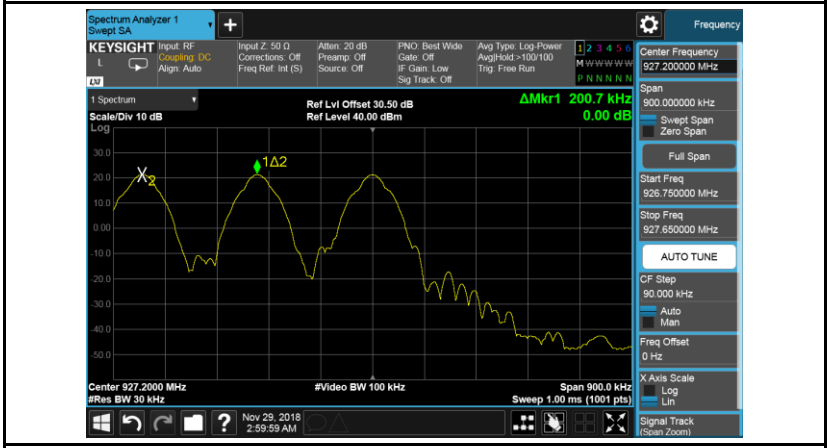
Channel Separation Test Plots



Low Channel



Mid Channel

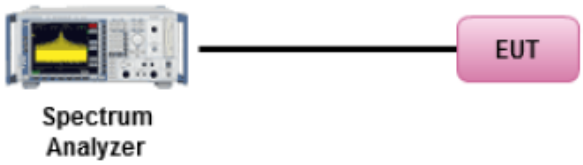


High Channel

10.7 Time of Occupancy

Requirement(s):

Spec	Requirement	Applicable
47 CFR §15.247 RSS-247	For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.	☒

Test Setup			
Procedure	Channel Separation procedure 1. The EUT must have its hopping function enabled. 2. Span = zero span 3. centered on a hopping channel 4. RBW = 1 MHz; VBW >= RBW 5. Sweep = as necessary to capture the entire dwell time per hopping channel. 6. Detector = Peak. 7. Trace mode = max hold. 8. 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	11/29/2018	Environmental condition	Temperature 22.1°C Relative Humidity 45.5% Atmospheric Pressure 1019mbar
Remark	The dwell time was calculated from pulse width multiplied by the number of hops in 20 seconds.		
Result	☒ Pass ☐ Fail		

Test Data ☒ Yes ☐ N/A

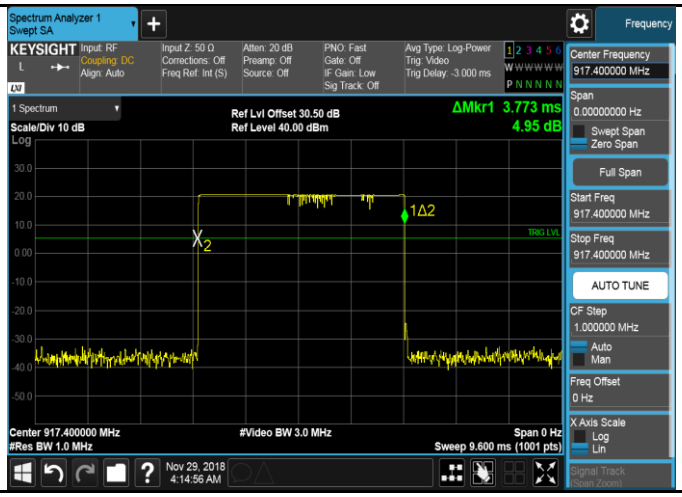
Test Plot ☒ Yes ☐ N/A

Test was done by Rachana Khanduri at RF Test Site.

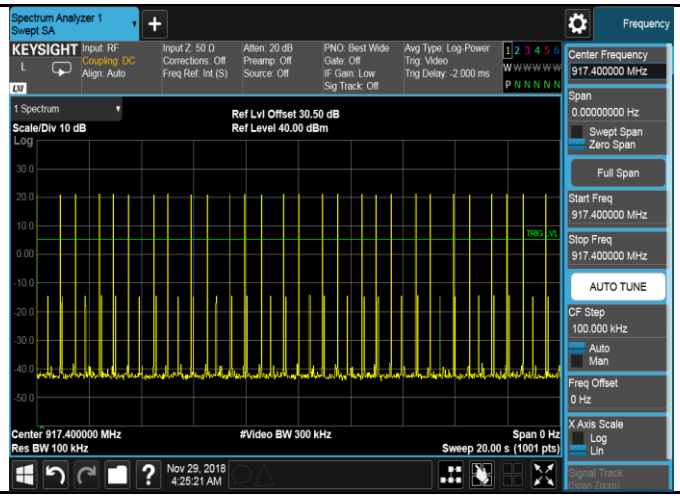
Dwell Time Test Result

Type	Freq (MHz)	CH	Pulse time (msec)	Repetition Cycle Number in 20s	Dwell Time (sec)	Limit (Sec)
Dwell time	917.4	Low	3.773	27	0.1019	0.4
Dwell time	922.2	Mid	3.773	27	0.1019	0.4
Dwell time	927.2	High	3.773	27	0.1019	0.4

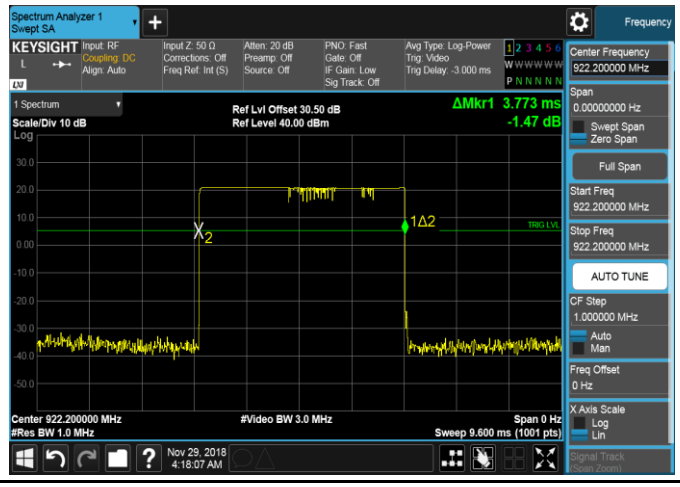
Test Plots



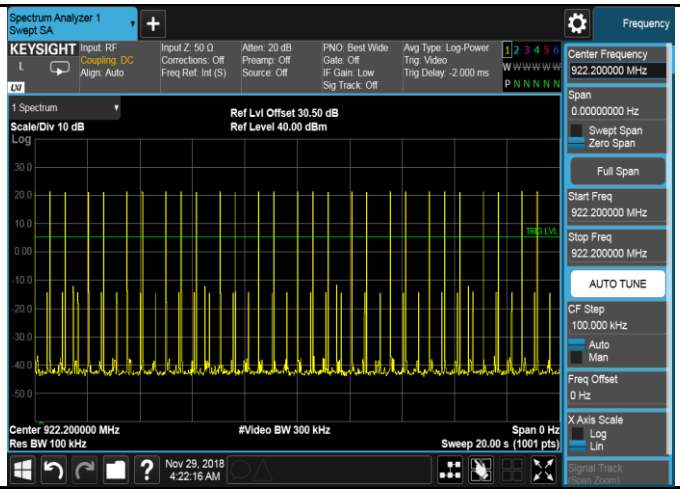
Low Channel



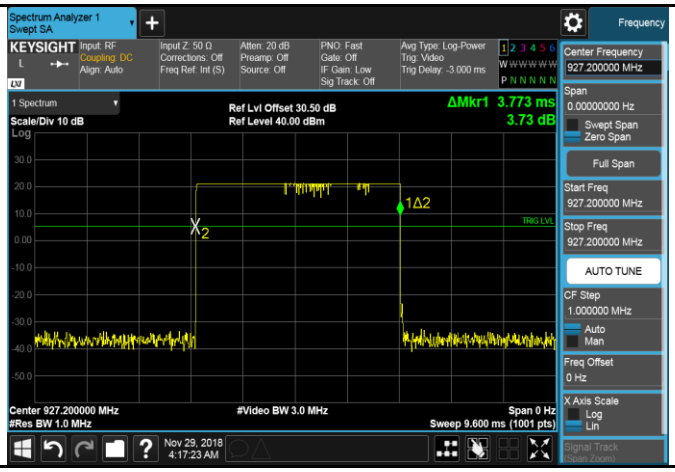
Low Channel- Number of Hopping (20S)



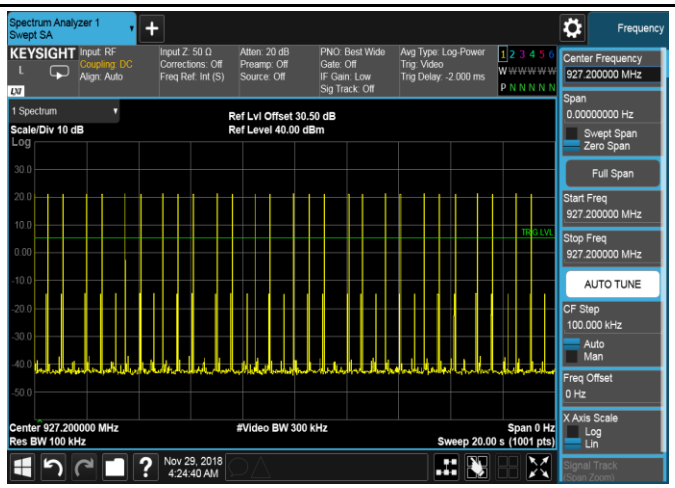
Mid Channel



Mid Channel-Number of Hopping (20S)



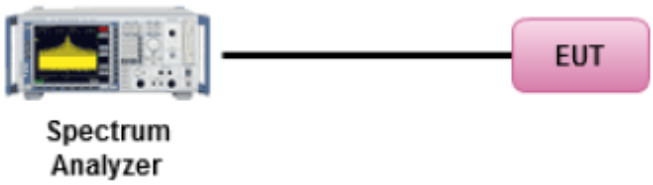
High Channel



High Channel (20S)

10.8 Band Edge

Requirement(s):

Spec	Requirement	Applicable
§ 15.247 RSS-247	The emissions at the band-edges must be at least 20dB below the highest level measured within the band. 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. Span = Wide enough to capture the peak level of the emission operating on the channel closest to the band edge. 3. RBW = 1% of the span,VBW >= RBW 4. Sweep=auto 5. Detector function = peak 6. Trace = Max hold 7. Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as a measured. The attenuation shall be 30 dB instead of 20 dB when RMS conducted output power procedure is used. 8. Change modulation and channel bandwidth then repeat step 1 to 2. 9. Measured and record the results in the test report.	

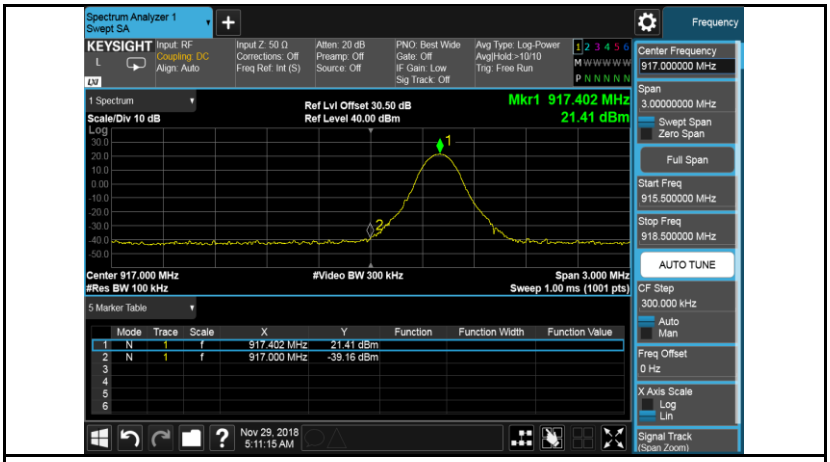
Test Date	11/29/2018	Environmental condition	Temperature 22.1°C Relative Humidity 45.5% Atmospheric Pressure 1019mbar
Remark	None		
Result	☒ Pass ☐ Fail		

Test Data ☐ Yes ☒ N/A

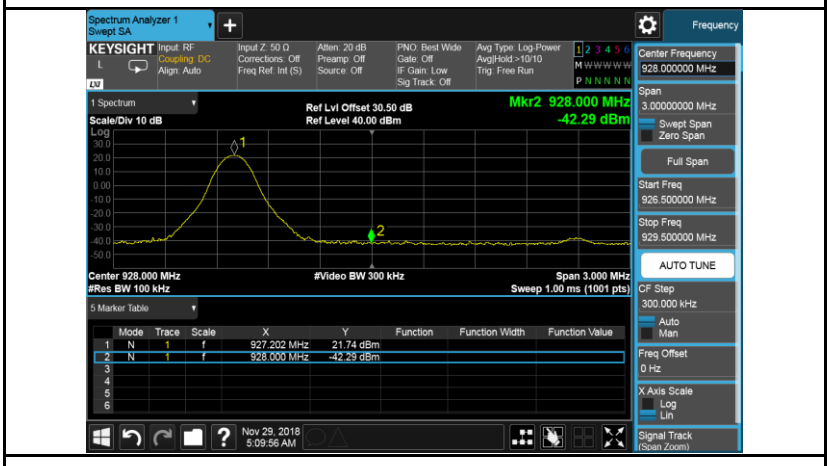
Test Plot ☒ Yes ☐ N/A

Test was done by Rachana Khanduri at RF Test Site.

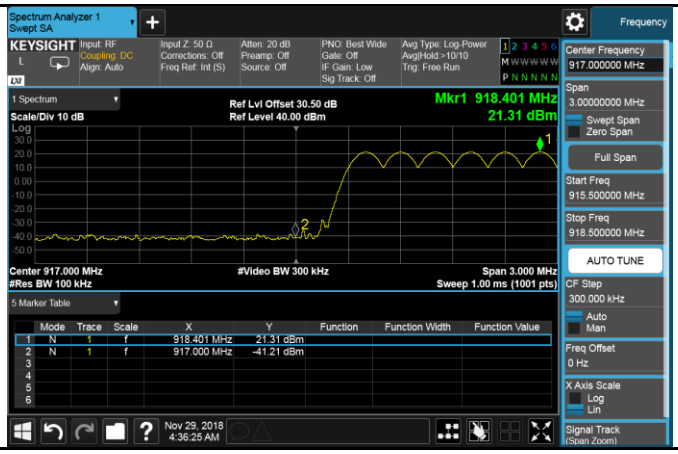
Test Plots



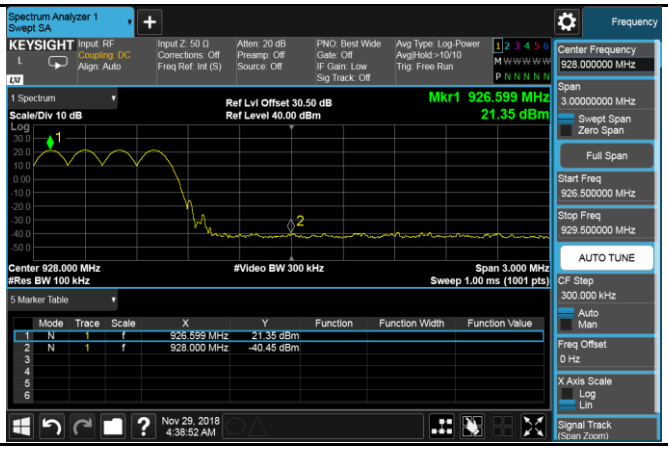
Low Channel



High Channel



Low Channel-Hopping



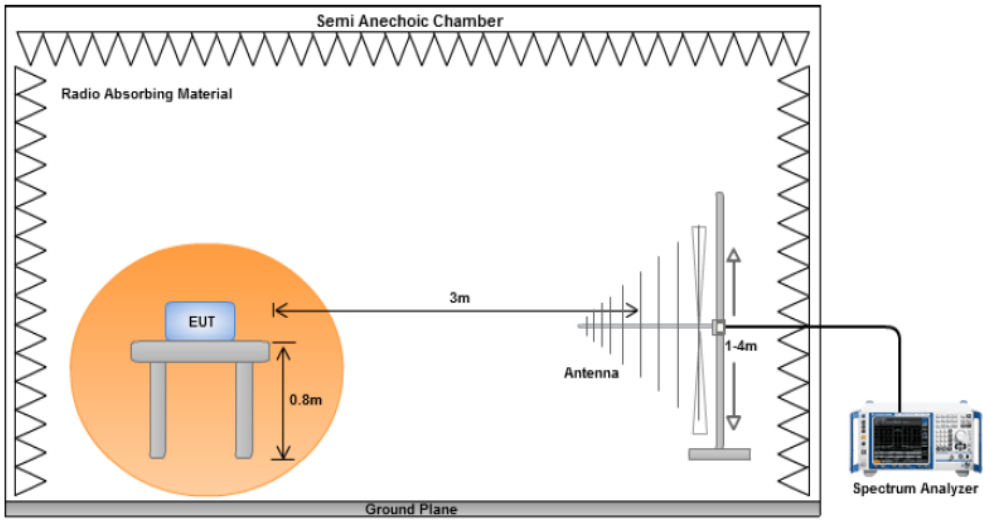
High Channel-Hopping

10.9 Radiated Emissions below 1GHz

Requirement(s):

Spec	Requirement	Applicable
47CFR§15.247 RSS-247	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

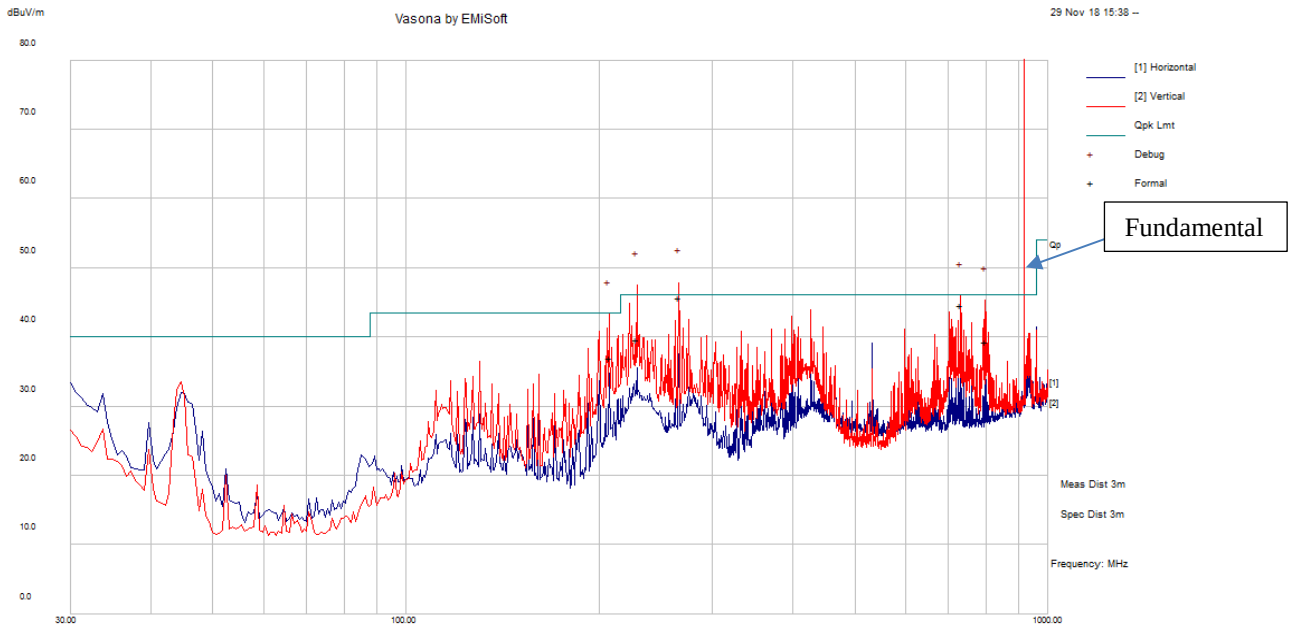
Test Setup	
Procedure	1. The EUT was switched on and allowed to warm up to its normal operating condition. 2. The test was carried out at the selected frequency points obtained from the EUT characterisation. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, 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	Different EUT orientations were evaluated. Only the worst case is presented in this report.
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)

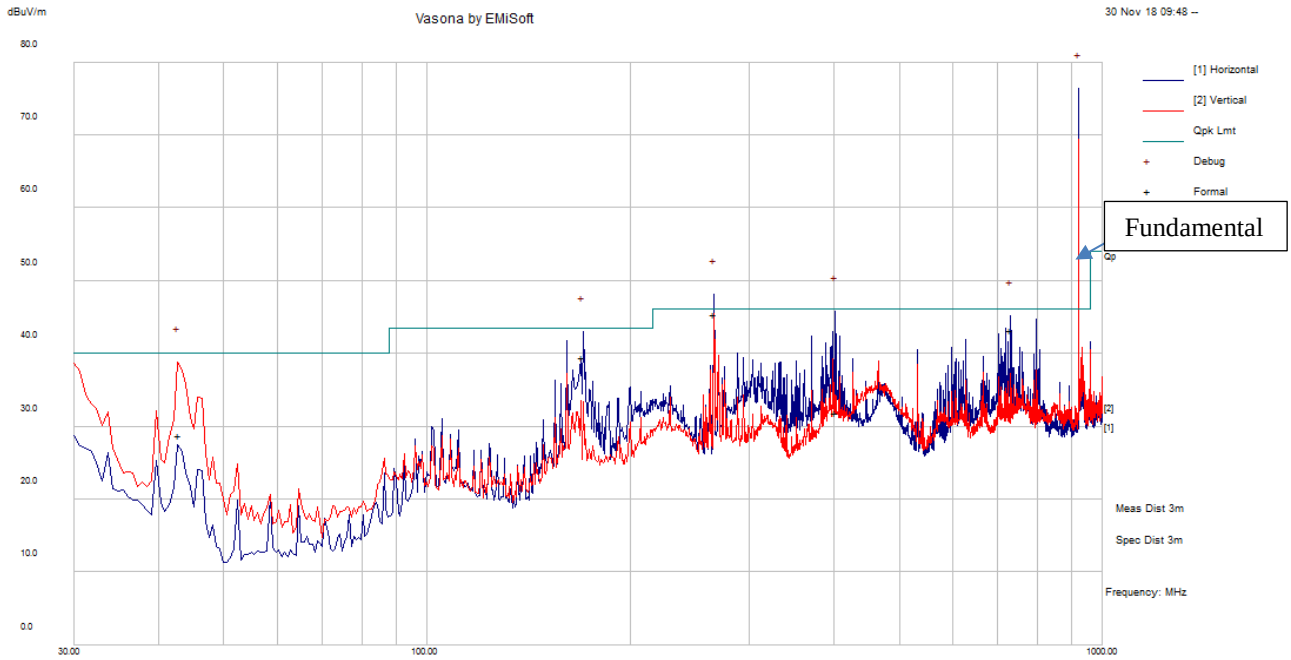
Test specification	Below 1GHz		Result	Pass
Environmental Conditions:	Temp (°C):	20		
	Humidity (%)	38		
	Atmospheric (mbar):	1019		
Mains Power:	120VAC,60Hz			
Tested by:	Cipher			
Test Date:	11/29/2018			
Remarks:	Continuous TX at Low Channel			



30MHz – 1000MHz at 3 meters

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
265.99	56.06	13.06	-23.41	45.71	Quasi Max	V	115	134	46	-0.30	Pass
228.9	51.42	12.85	-24.64	39.63	Quasi Max	V	170	287	46	-6.37	Pass
731.54	44.65	15.17	-15.10	44.72	Quasi Max	V	101	28	46	-1.28	Pass
207.26	49.09	12.69	-24.74	37.03	Quasi Max	V	198	246	43.5	-6.47	Pass
798.01	38.15	15.47	-14.28	39.35	Quasi Max	V	173	80	46	-6.65	Pass

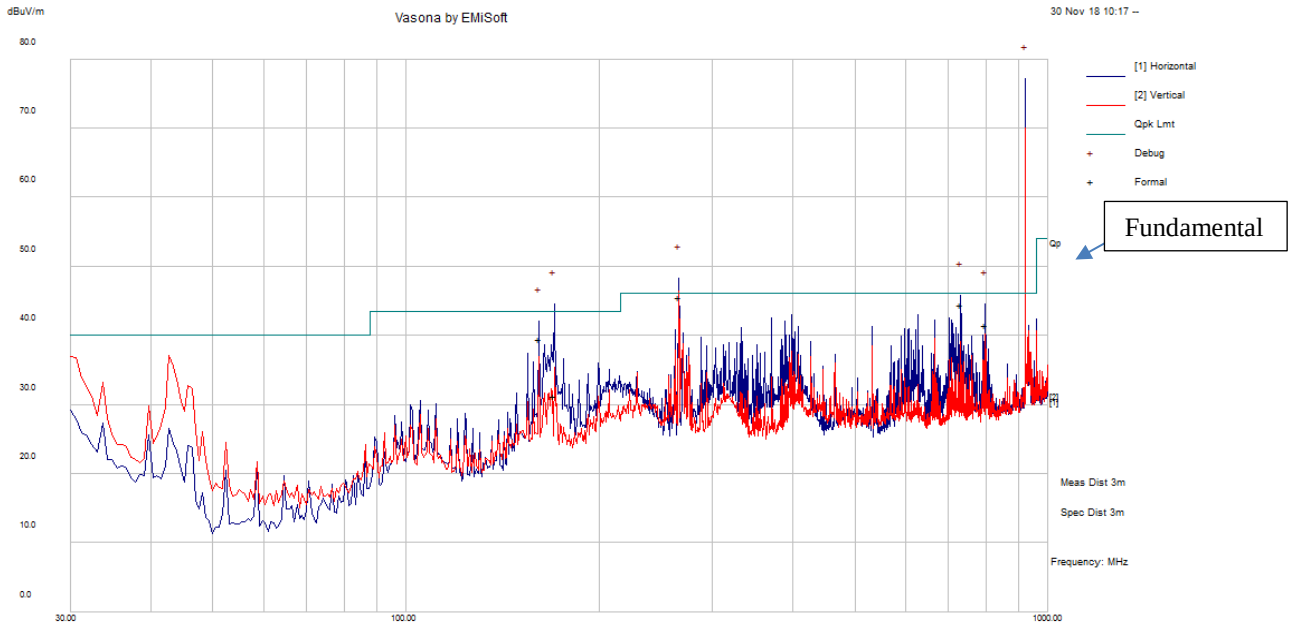
Test specification	Below 1GHz		Result	Pass
Environmental Conditions:	Temp (°C):	20		
	Humidity (%)	38		
	Atmospheric (mbar):	1019		
Mains Power:	120VAC,60Hz			
Tested by:	Cipher			
Test Date:	11/30/2018			
Remarks:	Continuous TX at Mid Channel			



30MHz – 1000MHz at 3 meters

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
266.02	55.76	13.06	-23.41	45.41	Quasi Max	H	103	102	46	-0.59	Pass
402.12	38.42	13.78	-20.20	32.00	Quasi Max	H	101	138	46	-14.00	Pass
170.12	51.04	12.35	-23.88	39.51	Quasi Max	H	198	356	43.5	-3.99	Pass
731.50	43.13	15.17	-15.10	43.20	Quasi Max	H	105	58	46	-2.80	Pass
42.97	39.73	11.36	-22.33	28.76	Quasi Max	V	114	316	40	-11.24	Pass

Test specification	Below 1GHz		Result	Pass
Environmental Conditions:	Temp (°C):	20		
	Humidity (%)	38		
	Atmospheric (mbar):	1019		
Mains Power:	120VAC,60Hz			
Tested by:	Cipher			
Test Date:	11/30/2018			
Remarks:	Continuous TX at High Channel			



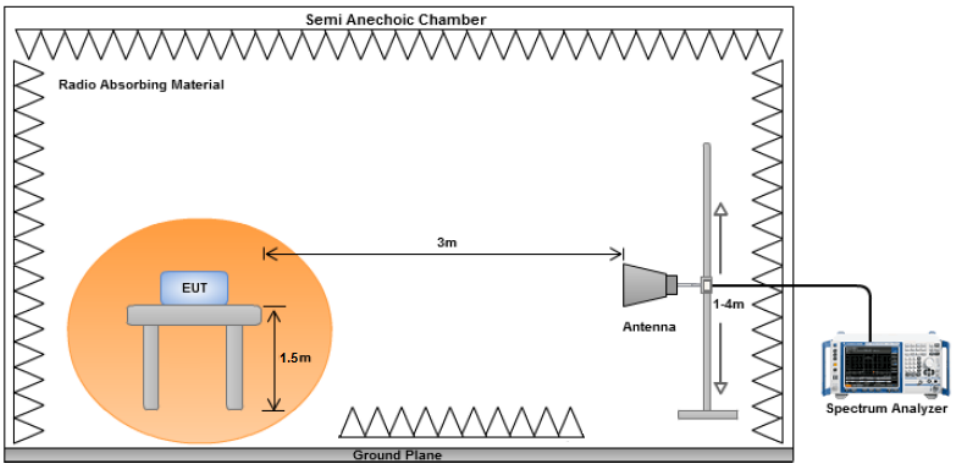
30MHz – 1000MHz at 3 meters

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
266.01	55.88	13.06	-23.41	45.53	Quasi Max	H	108	75	46	-0.47	Pass
170.13	42.76	12.35	-23.88	31.23	Quasi Max	H	152	66	43.5	-12.27	Pass
731.51	44.46	15.17	-15.10	44.53	Quasi Max	H	100	53	46	-1.47	Pass
161.06	50.55	12.28	-23.33	39.50	Quasi Max	H	172	342	43.5	-4.01	Pass
798.01	40.30	15.47	-14.28	41.50	Quasi Max	H	112	106	46	-4.50	Pass

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

10.10 Radiated Spurious Emissions above 1GHz

Requirement(s):

Spec	Requirement	Applicable
47CFR§15.247 RSS-247	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.	

Test Date	11/29/2018	Environmental condition	Temperature 23°C Relative Humidity 53% Atmospheric Pressure 1009mbar
Remark	-		
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.

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
1726.14	52.72	6.76	-10.67	48.81	Peak Max	H	100	136	74	-25.19	Pass
2127.42	48.07	7.55	-7.88	47.74	Peak Max	V	189	321	74	-26.26	Pass
1599.84	60.06	6.48	-12.09	54.45	Peak Max	V	136	17	74	-19.55	Pass
1726.14	35.71	6.76	-10.67	31.80	Average Max	H	100	136	54	-22.20	Pass
2127.42	33.90	7.55	-7.88	33.57	Average Max	V	189	321	54	-20.43	Pass
1599.84	39.39	6.48	-12.09	33.78	Average Max	V	136	17	54	-20.22	Pass

Mid 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
1726.07	59.28	6.76	-10.67	55.37	Peak Max	H	125	357	74	-18.63	Pass
1599.78	61.04	6.48	-12.09	55.43	Peak Max	V	162	26	74	-18.57	Pass
1995.71	54.81	7.30	-8.08	54.03	Peak Max	V	126	356	74	-19.97	Pass
1726.07	35.71	6.76	-10.67	31.80	Average Max	H	125	357	54	-22.20	Pass
1599.78	41.50	6.48	-12.09	35.89	Average Max	V	162	26	54	-18.11	Pass
1995.71	34.19	7.30	-8.08	33.41	Average Max	V	126	356	54	-20.59	Pass

High 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
1727.31	60.73	6.76	-10.67	56.82	Peak Max	H	160	13	74	-17.18	Pass
1595.47	59.92	6.47	-12.17	54.22	Peak Max	H	141	350	74	-19.78	Pass
2127.65	47.81	7.55	-7.88	47.48	Peak Max	V	145	272	74	-26.52	Pass
1727.31	35.60	6.76	-10.67	31.69	Average Max	H	160	13	54	-22.31	Pass
1595.47	40.74	6.47	-12.17	35.04	Average Max	H	141	350	54	-18.96	Pass
2127.65	33.75	7.55	-7.88	33.42	Average Max	V	145	272	54	-20.58	Pass

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

Annex A. TEST INSTRUMENT

Instrument	Model	Serial #	Cal Date	Cal Cycle	Cal Due	In use
Radiated Emissions						
EMI Test Receiver	ESIB 40	100179	08/28/2018	1 Year	08/28/2019	☑
Pre-Amplifier	LPA-6-30	11170601	07/23/2018	1 Year	07/23/2019	☑
Pre-Amplifier (1-26.5GHz)	8449B	3008A00715	05/06/2018	1 Year	05/06/2019	☑
Bi-Log antenna (30MHz~2GHz)	JB1	A030702	03/09/2018	2 Year	03/09/2020	☑
Horn Antenna (1-18GHz)	3115	10SL0059	01/26/2018	2 Year	01/26/2020	☑
RF Conducted Measurement						
Spectrum Analyzer	N9010A	MY50210206	01/18/2018	2 Year	01/18/2020	☑
Conducted Emissions						
EMI Test Receiver	ESIB 40	100179	08/28/2018	1 Year	08/28/2019	☑
LISN (150 kHz - 30 MHz)	3816/2NM	214372	01/10/2018	1 Year	01/10/2019	☑

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