RF TEST REPORT

SIEMIC
A Bureau Veritas Group Company

Report No.: FCC-RF-SL17120401-FLU-001_Bridge
Supersede Report No.:None

Applicant	:	Flume Inc
Product Name	:	Flume Bridge
Model No.	:	F1200
Test Standard	:	47 CFR 15.247
Test Method	:	ANSI C63.10: 2013 FCC Public Notice DA 00-705
FCC ID	:	2A0X8-F1200
Dates of test	:	01/08/2018-01/29/2018
Issue Date	:	02/08/2018
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:	
Vijay Chaudhary	**Chen Ge**
RF 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

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1 Report Revision History

Report No.	Report Version	Description	Issue Date
FCC_RF_SL17120401-FLU-001_Bridge	Original	None	02/08/2018

2 Executive Summary

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

Company: Flume Inc
Product Name: Flume Bridge
Model No.: F1200

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	Flume Inc
Applicant Address	872 Higuera St, San Luis Obispo, CA-93405
Manufacturer Name	Green Circuits
Manufacturer Address	1130 Ringwood Court,San Jose,CA-95131

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	Flume Bridge
Model No.	F1200
Trade Name	Flume
Serial No.	N/A
Input Power	120V
Power Adapter Manu/Model	Switching
Power Adapter SN	GEO151UB-6025
Hardware version	R6
Software version	1.0
Date of EUT received	01/08/2018
Equipment Class/ Category	FHSS
Clock Freq	160MHz
Remark	NONE

6.2 Spec for RFID Radio

Radio Type	UHF-RFID (915 MHz)
Operating Frequency	902MHz-928MHz
Modulation	ASK
Channel Spacing	500 KHz
Antenna Type	Dipole Antenna
Antenna Gain	3 dBi
Antenna Connector Type	u.FL

7 Supporting Equipment/Software and Cabling Description

7.1 Supporting Equipment

Item	Supporting Equipment Description	Model	Serial Number	Manufacturer	Note
1	Laptop	ThinkPad T420s	N/A	Lenovo	-

7.2 Cabling Description

Name	Connection Start		Connection Stop		Length / shielding Info		Note
	From	I/O Port	To	I/O Port	Length (m)	Shielding	
USB	EUT	I/O Port	Laptop	USB	2	Unshielded	-

7.3 Test Software Description

Test Item	Software	Description
-	-	-

8 Test Summary

Test Item	Test standard		Test Method/Procedure		Pass / Fail
Antenna Requirement	FCC	15.203	FCC	ANSI C63.10-2013 558074 D01 DTS Meas. Guidance v03r02	☐ Pass ☒ N/A
AC Conducted Emissions Voltage	FCC	15.207(a)	FCC	ANSI C63.10: 2013	☒ Pass ☐ N/A

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
20dB Occupied Bandwidth	FCC	15.247(a)(1)	FCC	Public Notice DA 00-705	☒ Pass ☐ N/A
99% Occupied Bandwidth	FCC	15.247(a)(2)	FCC	Public Notice DA 00-705	☒ Pass ☐ N/A
Number of Hopping Channels	FCC	15.247(a)(1)	FCC	Public Notice DA 00-705	☒ Pass ☐ N/A
Band Edge and Radiated Spurious Emissions	FCC	15.247(d)	FCC	Public Notice DA 00-705	☒ Pass ☐ N/A
Time of Occupancy	FCC	15.247(a)(1)	FCC	Public Notice DA 00-705	☒ Pass ☐ N/A
Output Power	FCC	15.247(b)	FCC	Public Notice DA 00-705	☒ Pass ☐ N/A
Antenna Gain > 6 dBi	FCC	15.247(e)	FCC	Public Notice DA 00-705	☐ Pass ☒ N/A
Power Spectral Density	FCC	15.247(e)	FCC	Public Notice DA 00-705	☐ Pass ☒ N/A
Hybrid System Requirement	FCC	15.247(f)	FCC	Public Notice DA 00-705	☐ Pass ☒ N/A
Hopping Capability	FCC	15.247(g)	FCC	Public Notice DA 00-705	☒ Pass ☐ N/A
RF Exposure requirement	FCC	15.247(i)	FCC	Public Notice DA 00-705	☐ Pass ☒ N/A
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

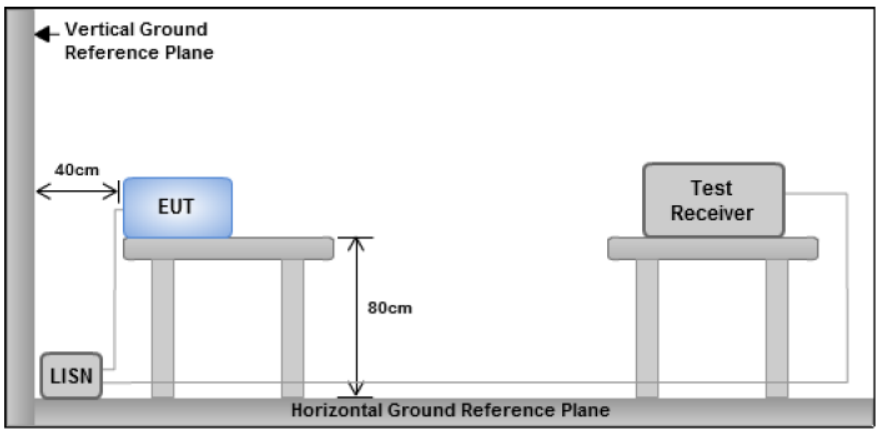
10.1 Antenna Requirement

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. Antenna requirement must meet at least one of the following: a) Antenna must be permanently attached to the device. b) The antenna must use a unique type of connector to attach to the device. c) Device must be professionally installed. The installer shall be responsible for ensuring that the correct antenna is employed by the device.	☒
Remark	All Radio use special uFl connector for antenna connection which meets the requirement.	
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	Item	Requirement	Applicable
47CFR§15.207	a)	For Low-power radio-frequency devices that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 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 tested with AC 120V 60Hz	
Result	☒ Pass ☐ Fail	

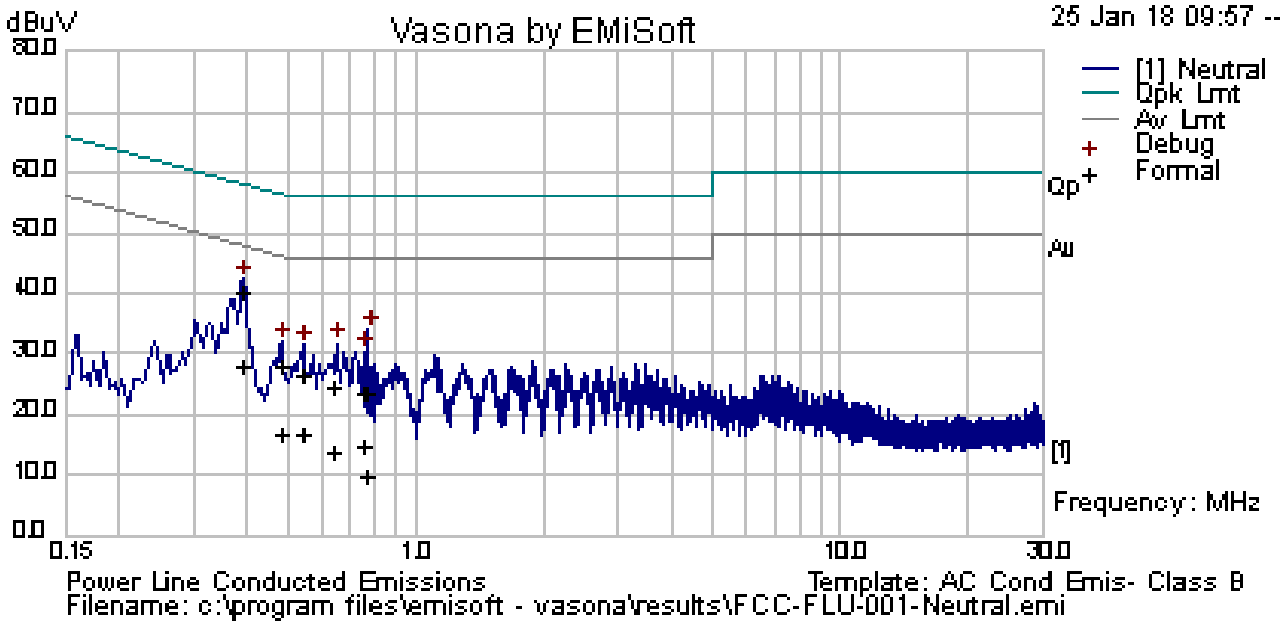
Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

Test was done by *Vijay Chaudhary* at *Conducted Emission Test Site*.

Conducted Emission Test Results

Test specification:	Conducted Emissions			
Environmental Conditions:	Temp(°C):	21	Result:	☒ Pass ☐ Fail
	Humidity (%):	45		
	Atmospheric(mbar):	1021		
Mains Power:	120VAC, 60Hz			
Tested by:	Vijay Chaudhary			
Test Date:	01/25/2018			
Remarks	Conducted @ Neutral			

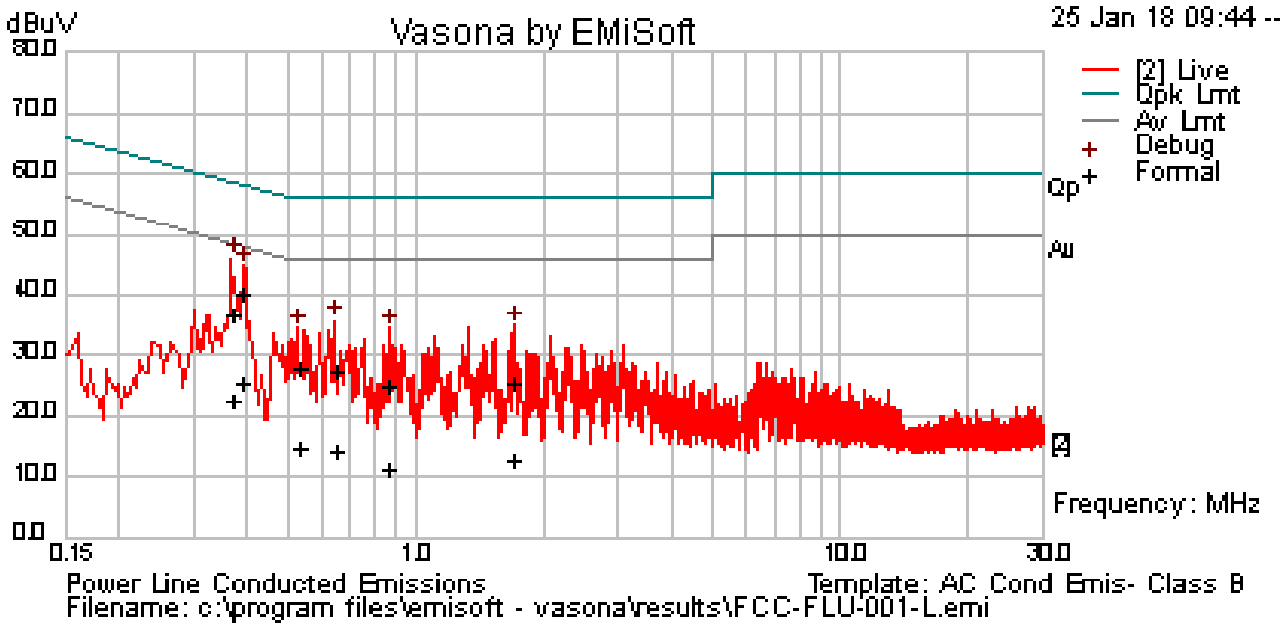


Neutral Plot at 120Vac, 60Hz

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Measurement Type	Line / Neutral	Limit (dBuV)	Margin (dB)	Pass /Fail
0.391948	31.05	9.33	0.04	40.42	Quasi Peak	Neutral	58.02	-17.6	Pass
0.769551	14.02	9.32	0.04	23.39	Quasi Peak	Neutral	56	-32.61	Pass
0.64485	15.36	9.33	0.05	24.74	Quasi Peak	Neutral	56	-31.26	Pass
0.481768	18.76	9.33	0.04	28.13	Quasi Peak	Neutral	56.31	-28.18	Pass
0.544701	17.13	9.33	0.05	26.51	Quasi Peak	Neutral	56	-29.49	Pass
0.75814	14.12	9.32	0.04	23.48	Quasi Peak	Neutral	56	-32.52	Pass
0.391948	18.55	9.33	0.04	27.92	Average	Neutral	48.02	-20.11	Pass
0.769551	0.49	9.32	0.04	9.86	Average	Neutral	46	-36.14	Pass
0.64485	4.56	9.33	0.05	13.94	Average	Neutral	46	-32.06	Pass
0.481768	7.53	9.33	0.04	16.9	Average	Neutral	46.31	-29.41	Pass
0.544701	7.32	9.33	0.05	16.7	Average	Neutral	46	-29.3	Pass
0.75814	5.60	9.32	0.04	14.96	Average	Neutral	46	-31.04	Pass

Conducted Emission Test Results

Test specification:	Conducted Emissions			
Environmental Conditions:	Temp(°C):	22	Result:	☒ Pass ☐ Fail
	Humidity (%):	45		
	Atmospheric(mbar):	1021		
Mains Power:	120Vac, 60Hz			
Tested by:	Vijay Chaudhary			
Test Date:	01/25/2018			
Remarks	Conducted @ Live			



Live Plot at 120Vac, 60Hz

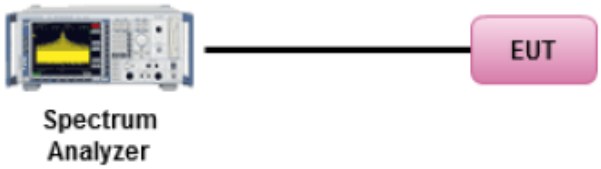
Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Measurement Type	Line / Neutral	Limit (dBuV)	Margin (dB)	Pass /Fail
0.370737	27.53	9.33	0.04	36.9	Quasi Peak	Live	58.48	-21.59	Pass
0.392597	30.79	9.33	0.04	40.16	Quasi Peak	Live	58.01	-17.85	Pass
0.647327	17.98	9.33	0.05	27.36	Quasi Peak	Live	56	-28.64	Pass
1.681527	15.87	9.34	0.06	25.27	Quasi Peak	Live	56	-30.73	Pass
0.863988	15.68	9.33	0.04	25.05	Quasi Peak	Live	56	-30.95	Pass
0.536886	18.59	9.33	0.05	27.97	Quasi Peak	Live	56	-28.03	Pass
0.370737	13.06	9.33	0.04	22.42	Average	Live	48.48	-26.06	Pass
0.392597	16.12	9.33	0.04	25.49	Average	Live	48.01	-22.52	Pass
0.647327	4.83	9.33	0.05	14.2	Average	Live	46	-31.8	Pass
1.681527	3.37	9.34	0.06	12.78	Average	Live	46	-33.22	Pass
0.863988	1.70	9.33	0.04	11.07	Average	Live	46	-34.93	Pass
21.09	8.03	10.07	0.68	18.78	Average	Live	50.00	-31.22	Pass

Note: The results above show only the worst case.

10.3 Channel Separation

Requirement(s):

Spec	Item	Requirement	Applicable
47 CFR §15.247 (e)	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	01/08/2018-01/29/2018	Environmental condition	Temperature Relative Humidity Atmospheric Pressure	21°C 46% 1019mbar
Remark	NONE			
Result	☒ Pass ☐ Fail			

Test Data ☒ Yes (See below) ☐ N/A

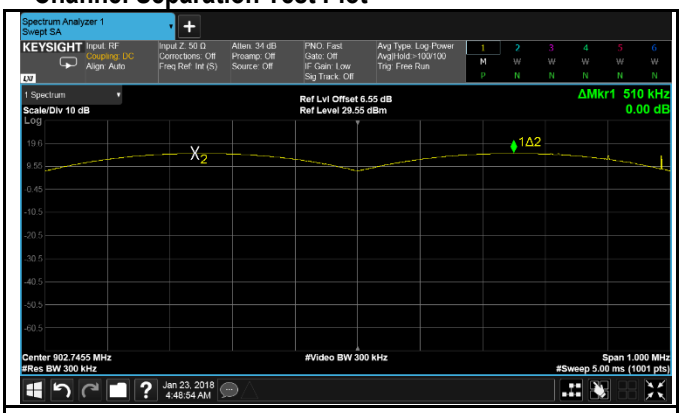
Test Plot ☒ Yes (See below) ☐ N/A

Test was done by *Vijay Chaudhary* at *RF Test Site*.

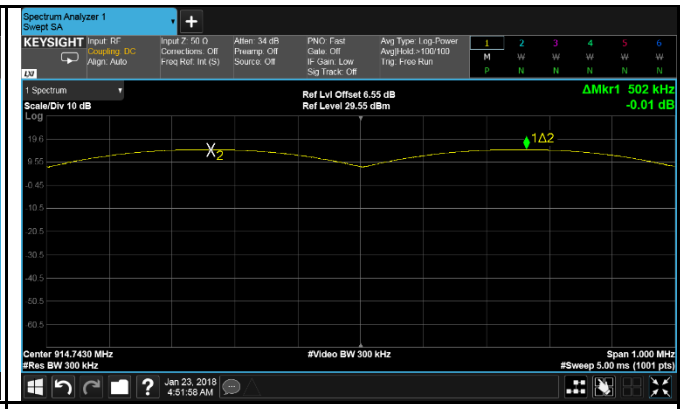
Test Mode:

Channel	Channel Frequency (MHz)	Channel Separation (KHz)	20dB Bandwidth (KHz)	Pass/Fail
Low	902.5	510	112.2	Pass
Mid	914.5	502	115.6	Pass
High	927	505	115.6	Pass

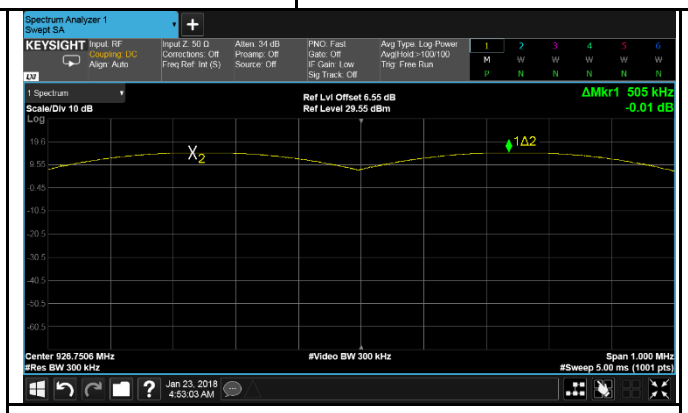
Channel Separation Test Plot



Channel Separation-902.5MHz



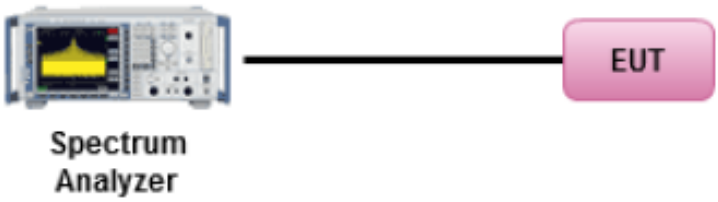
Channel Separation-914.5MHz



Channel Separation-927MHz

10.4 20dB and 99% Occupied 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 the 2/3 of 20 dB bandwidth of the hopping channel, whichever is greater.	☒
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	01/08/2018-01/29/2018	Environmental condition	Temperature 23oC Relative Humidity 47% Atmospheric Pressure 1019mbar
Remark	-		
Result	☐ Pass ☐ Fail		

Test Data ☒ Yes (See below) ☐ N/A

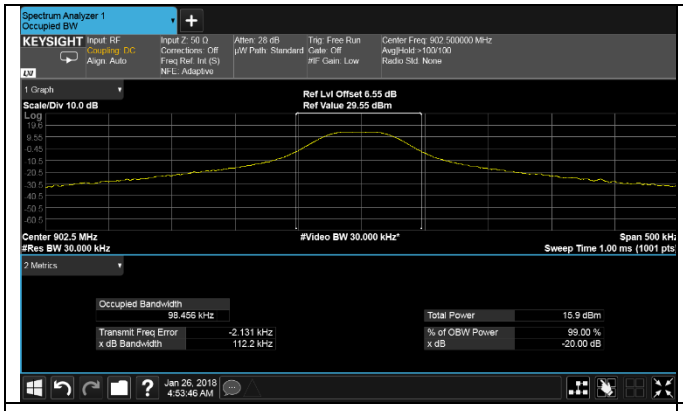
Test Plot ☒ Yes (See below) ☐ N/A

Test was done by *Vijay Chaudhary* at *RF Test Site*.

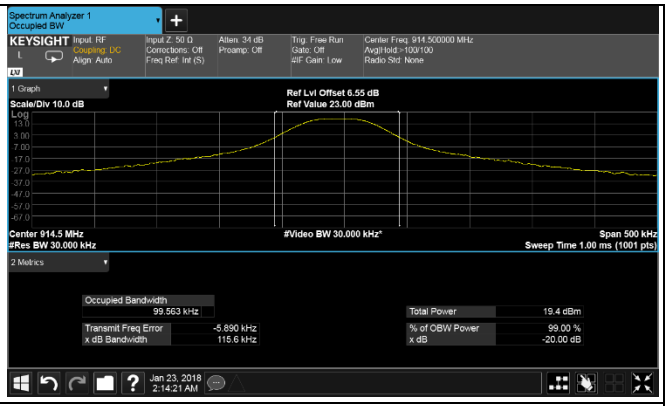
Test Mode:

Channel	Channel Frequency (MHz)	OBW	
		99% (KHz)	20dB(KHz)
Low	902.5	98.45	112.2
Mid	914.5	99.56	115.6
High	927.0	100.71	115.6

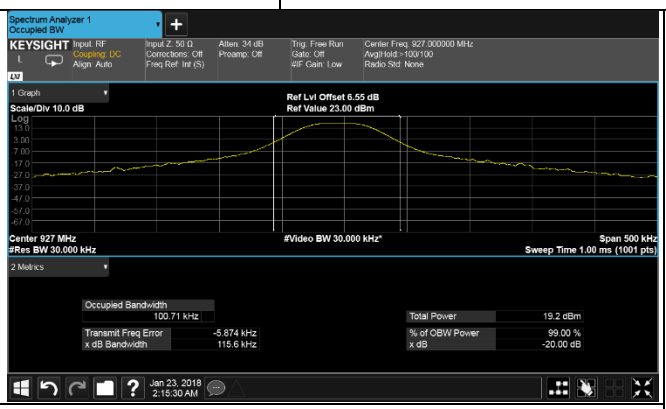
99% & 20dB Bandwidth Test Plots



99% and 20dB BW – 902.5MHz



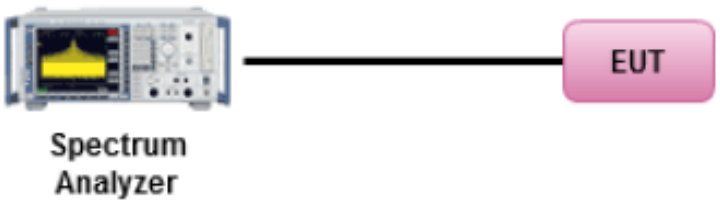
99% and 20dB BW – 914.5MHz



99% and 20dB BW – 927MHz

10.5 Number of Hopping Channel

Requirement(s):

Spec	Requirement	Applicable
47 CFR §15.247	For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250KHz, the system shall use at least 50 hopping frequiencies.	☒
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	01/08/2018-01/29/2018	Environmental condition: Temperature 23oC; Relative Humidity 47%; Atmospheric Pressure 1019mbar
Remark	-	
Result	☒ Pass ☐ Fail	

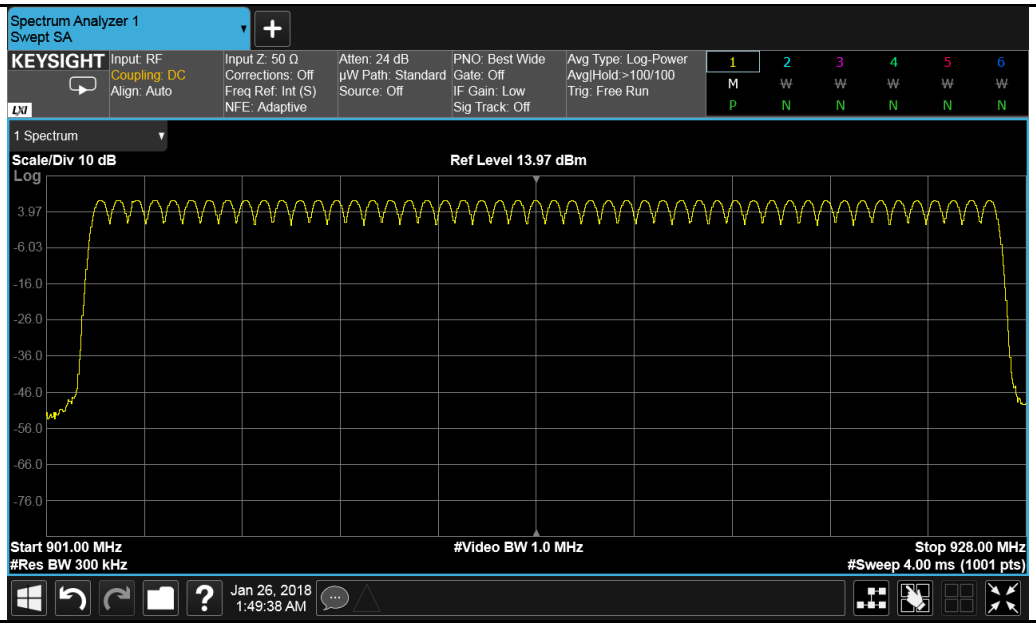
Test Data ☒ Yes (See below) ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

Test was done by *Vijay Chaudhary* at *RF Test Site*.

Channel Number	Limit	Pass/Fail
50	≥50	Pass

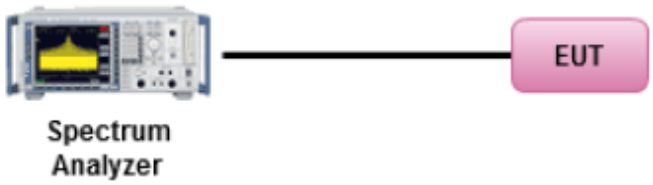
Hopping Channel Test Plots



Hopping Channels

10.6 Time of Occupancy

Requirement(s):

Spec	Requirement	Applicable
47 CFR §15.247	For Frequency hopping systems in the 902.928 MHz band: If the 20 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 greated than 0.4 seconds within a 20 second period: if the 20 dB bandwidth of hopping channel is 250 KHz or greated, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greated 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	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	01/08/2018-01/29/2018	Environmental condition	Temperature 21°C Relative Humidity 46% Atmospheric Pressure 1019mbar
Remark	Dwell Time=Pulse time*Repetition times in period		
Result	☒ Pass ☐ Fail		

Test Data ☒ Yes (See below) ☐ N/A

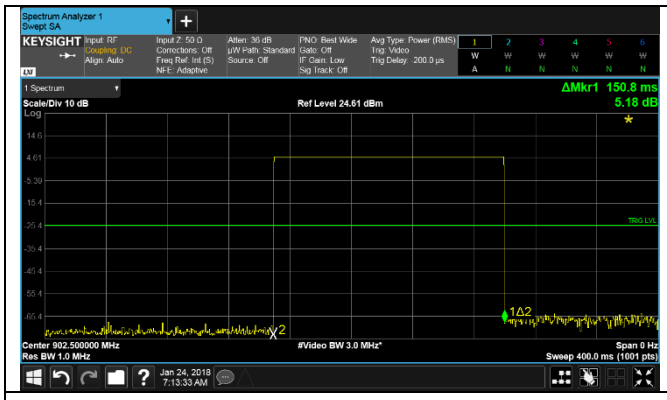
Test Plot ☒ Yes (See below) ☐ N/A

Test was done by *Vijay Chaudhary* at *RF Test Site*.

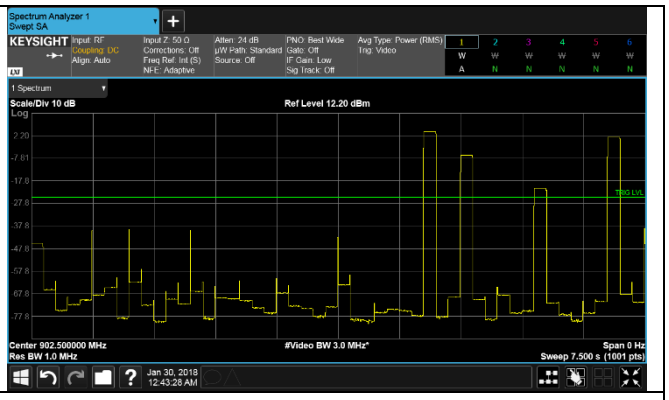
Test Mode:

Type	Channel Frequency (MHz)	Number of Hopping	Number of Transmission in a period (Channel Number X 0.4 Sec)				Length of transmission on- time (Sec)	Dwell Time (Sec)	Limit (Sec)	Result
			Period (Sec)	Sweep Time (Sec)	Times in a sweep	Times in a period				
915	902.5 MHz	50	20	7.5	1	2.66	0.150	0.39	≤0.4	Pass
915	914.5 MHz	50	20	7.5	1	2.66	0.151	0.40	≤0.4	Pass
915	927 MHz	50	20	7.5	1	2.66	0.150	0.39	≤0.4	Pass

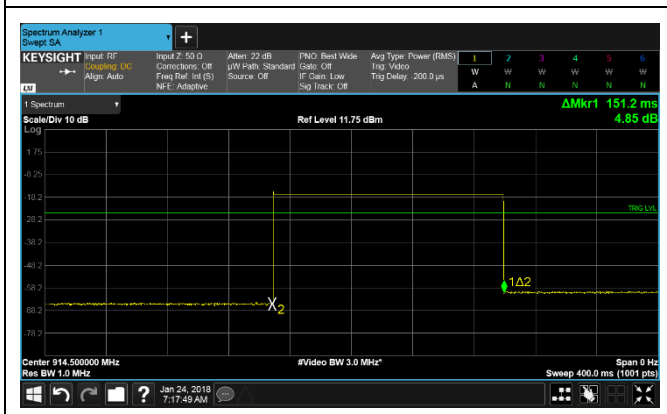
Time of Occupancy Test Plot



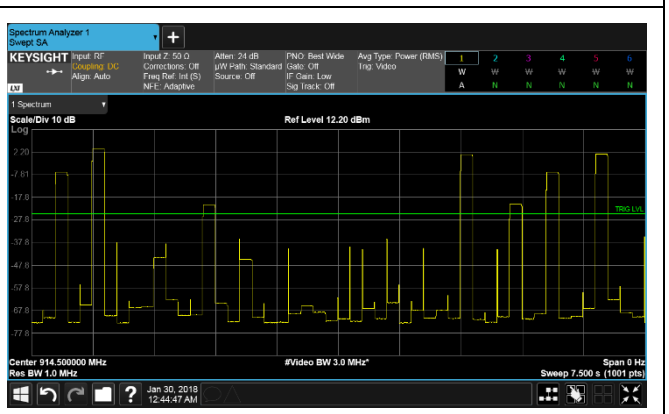
902.5 MHz On Time



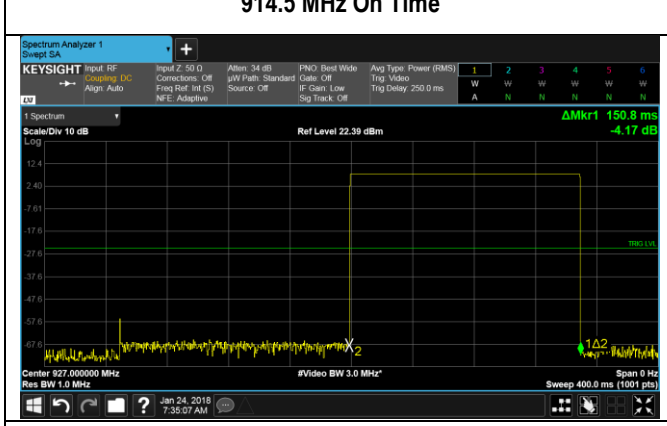
Hopping-902.5 MHz



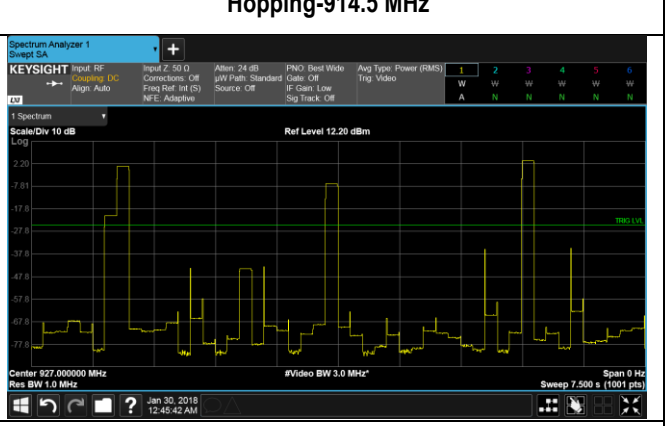
914.5 MHz On Time



Hopping-914.5 MHz



927 MHz On Time

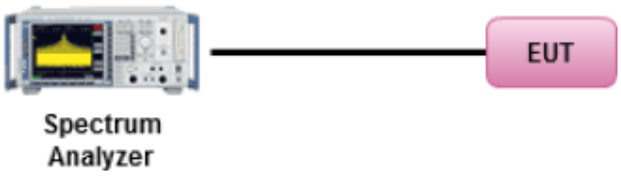


Hopping- 927MHz

10.7 Peak Output Power

Requirement(s):

Spec	Item	Requirement	Applicable
§ 15.247	a)	For frequency hopping systems operating in the 902-928 MHz band : 1 watt for systems employing at least 50 hopping channels.	☒
	b)	Power reduction (antenna gain > 6dBi)	☐
§ 15.247		Frequency hopping systems operating in 902-928 MHz band : 0.25 watt for systems employing less than 50 hopping channels but at least 25 hopping channels.	☐

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	01/08/2018-01/29/2018	Environmental condition	Temperature 21ºC Relative Humidity 46% Atmospheric Pressure 1019mbar
Remark	NONE		
Result	☒ Pass ☐ Fail		

Test Data ☒ Yes ☐ N/A

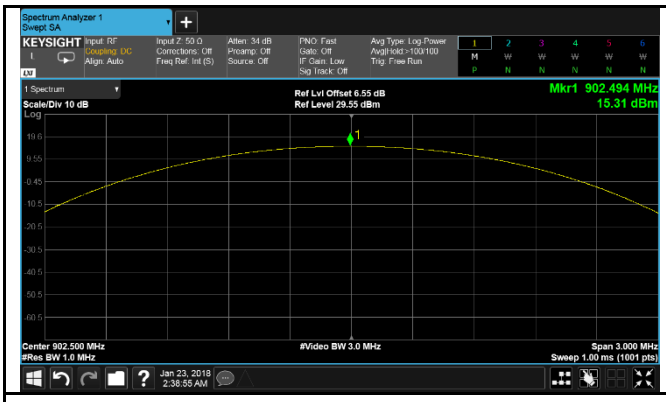
Test Plot ☒ Yes ☐ N/A

Test was done by *Vijay Chaudhary* at *RF Test Site*.

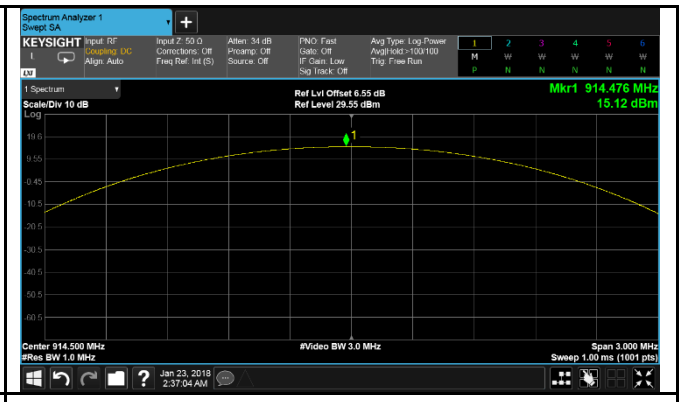
Output Power measurement results

Type	Freq (MHz)	CH	Conducted Power (dBm)	Limit (dBm)	Result
Output power	902.5	Low	15.31	≤30	Pass
	914.5	Mid	15.12	≤30	Pass
	927.0	High	14.95	≤30	Pass

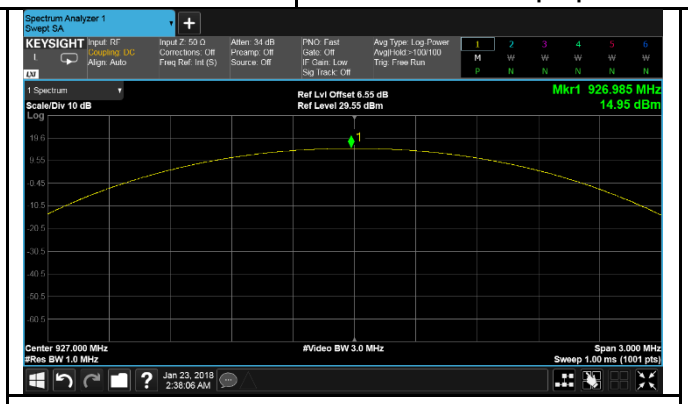
Peak Output Power Test Plot



Output power – 902.5 MHz



Output power - 914.5MHz

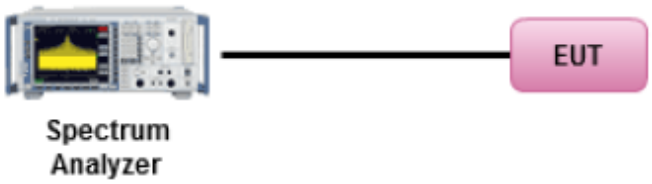


Output power - 927MHz

10.8 Band Edge

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	01/08/2018-01/29/2018	Environmental condition	Temperature 22ºC Relative Humidity 46% Atmospheric Pressure 1020mbar
Remark	N/A		
Result	☒ Pass ☐ Fail		

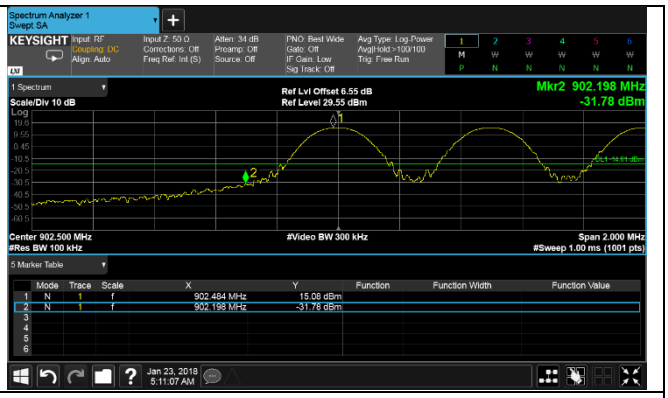
Test Data ☐ Yes ☒ N/A

Test Plot ☒ Yes (See below) ☐ N/A

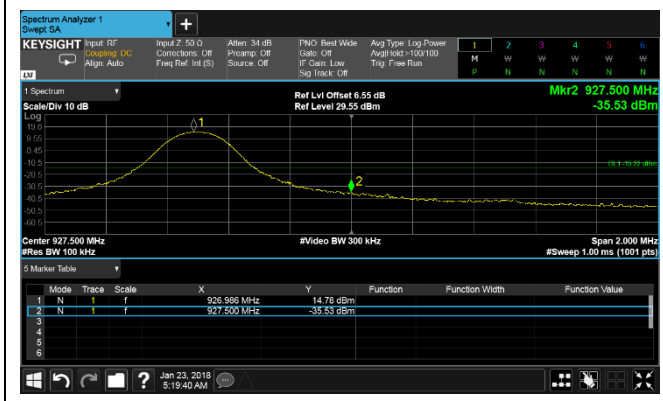
Test was done by *Vijay Chaudhary* at *RF Test Site*.

Band Edge Test Plots

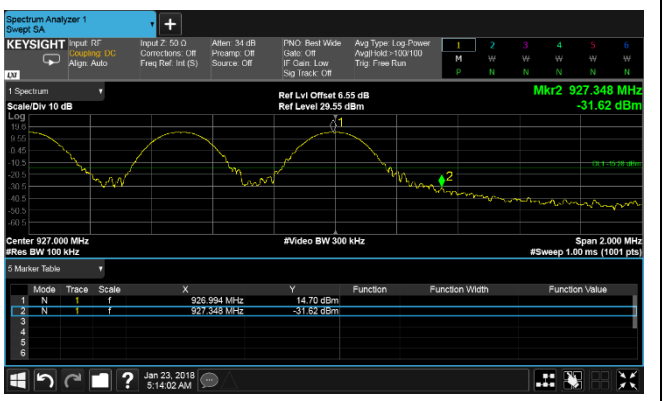
Band Edge -902.5 MHz



Band Edge -Hopping-902.5 MHz



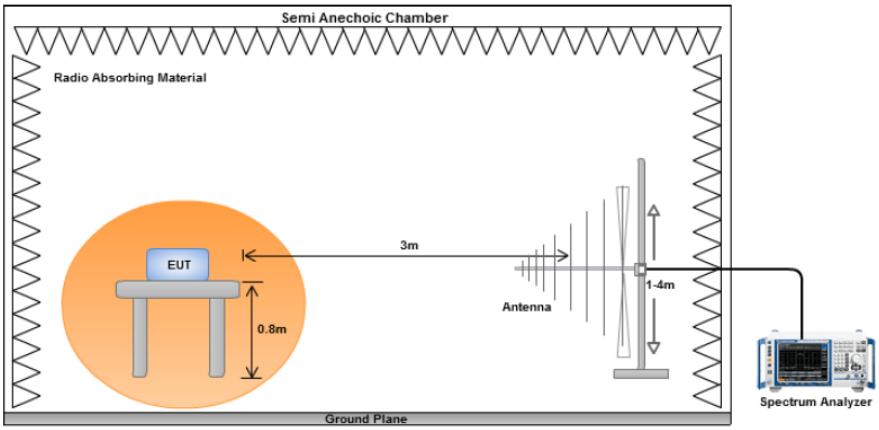
Band Edge -927 MHz



Band Edge -Hopping-927 MHz

10.9 Transmitter Radiated Spurious Emissions Below 1GHz

Requirement(s):

Spec	Item	Requirement	Applicable
47CFR§15.247(d),	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		

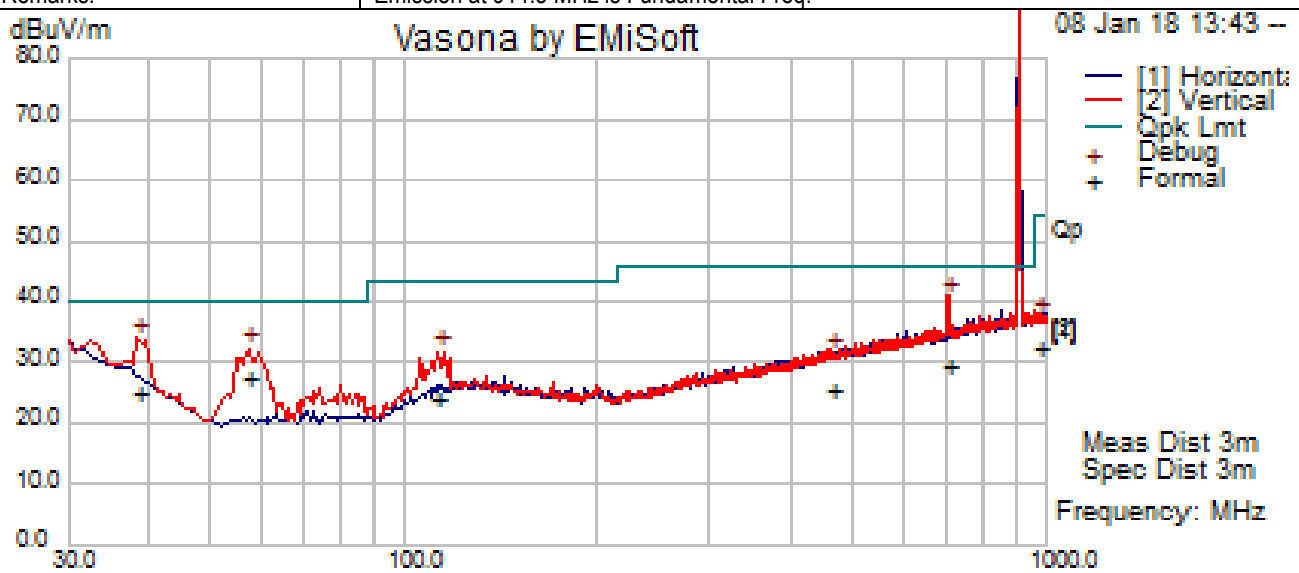
Test Data ☒ Yes (See below) ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

Test was done by *Vijay Chaudhary* at *10m Chamber.*

Radiated Emission Test Results (Below 1GHz)

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:	Vijay Chaudhary			
Test Date:	1/8/2018			
Remarks:	Emission at 914.5 MHz is Fundamental Freq.			

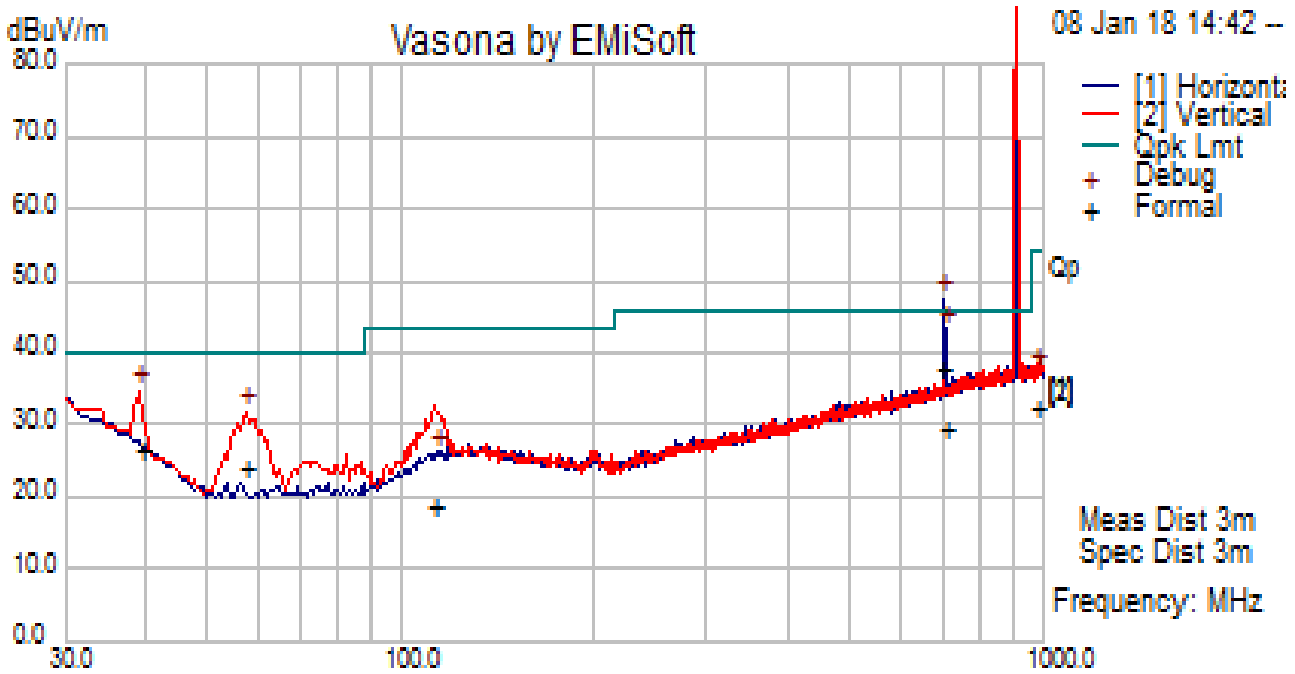


Quasi Max Measurement

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
700.38	19.15	25.67	-15.54	29.27	Quasi Max	V	280	151	46	-16.73	Pass
38.58	23.98	21.43	-20.18	25.23	Quasi Max	V	131	87	40	-14.77	Pass
57.06	33.20	21.64	-27.59	27.25	Quasi Max	V	105	343	40	-12.75	Pass
112.81	25.45	22.17	-23.43	24.20	Quasi Max	V	148	35	43.5	-19.30	Pass
463.92	20.07	24.45	-19.20	25.32	Quasi Max	V	374	110	46	-20.68	Pass
979.05	18.29	26.85	-12.75	32.38	Quasi Max	V	315	141	54	-21.62	Pass

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

Environmental Conditions:	Temp(°C):	22	Result :	☒ Pass ☐ Fail
	Humidity (%):	37		
	Atmospheric(mbar):	1021		
Mains Power:	120VAC, 60Hz			
Tested by:	Vijay Chaudhary			
Test Date:	1/8/2018			
Remarks:	Co-Location (915 MHz & 2.4GHz) Emission at 914.5 MHz is Fundamental Freq.			



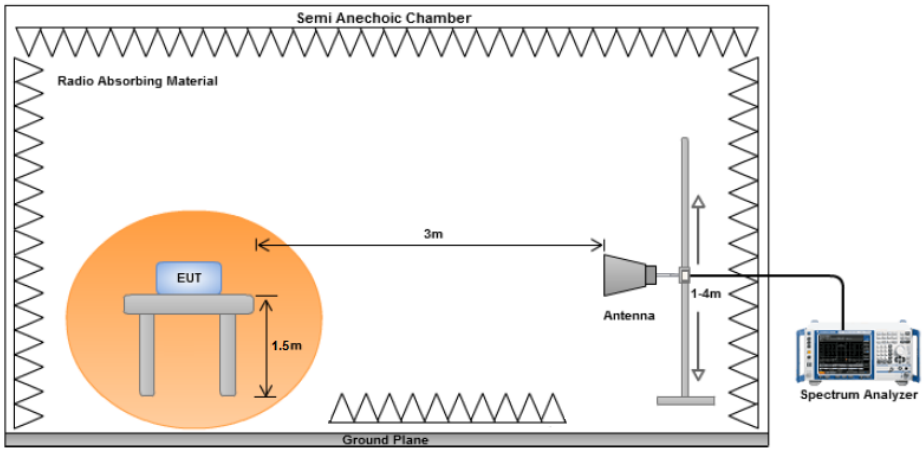
Quasi Max Measurement

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
700.09	27.53	25.66	-15.55	37.64	Quasi Max	H	175	75	46	-8.36	Pass
703.43	19.13	25.71	-15.43	29.42	Quasi Max	H	400	39	46	-16.58	Pass
39.19	25.63	21.44	-20.62	26.45	Quasi Max	V	139	157	40	-13.55	Pass
57.15	30.10	21.64	-27.59	24.15	Quasi Max	V	140	357	40	-15.85	Pass
974.22	18.49	26.88	-12.98	32.40	Quasi Max	V	350	44	54	-21.60	Pass
112.91	19.89	22.17	-23.42	18.65	Quasi Max	H	216	33	43.5	-24.86	Pass

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

10.10 Transmitter Radiated Spurious Emissions Above 1GHz

Requirement(s):

Spec	Item	Requirement	Applicable
47CFR§15.247(d),	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 *Vijay Chaudhary* at *3m Chamber.*

Radiated Emission Test Results

RFID- 902.5 MHz

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
1804.99	54.70	2.62	-3.52	53.80	Peak Max	V	107	216	74	-20.20	Pass
4509.75	39.43	4.23	-1.01	42.65	Peak Max	V	231	56	74	-31.35	Pass
2707.51	43.19	3.13	-2.26	44.06	Peak Max	V	112	188	74	-29.95	Pass
1804.99	52.95	2.62	-3.52	52.05	Average Max	V	107	216	54	-1.95	Pass
4509.75	26.75	4.23	-1.01	29.98	Average Max	V	231	56	54	-24.02	Pass
2707.51	33.44	3.13	-2.26	34.31	Average Max	V	112	188	54	-19.69	Pass

RFID- 914.5 MHz

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
1829.35	57.76	2.63	-3.41	56.98	Peak Max	V	104	191	74	-17.02	Pass
2745.04	39.78	3.15	-2.2	40.73	Peak Max	V	252	189	74	-33.28	Pass
4573.38	46.90	4.18	-0.83	50.25	Peak Max	V	135	89	74	-23.75	Pass
1829.35	52.38	2.63	-3.41	51.60	Average Max	V	104	191	54	-2.40	Pass
2745.04	27.27	3.15	-2.2	28.21	Average Max	V	252	189	54	-25.79	Pass
4573.38	36.76	4.18	-0.83	40.11	Average Max	V	135	89	54	-13.89	Pass

RFID- 927 MHz

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
1854.36	57.41	2.65	-3.27	56.79	Peak Max	V	100	184	74	-17.21	Pass
2781.35	42.06	3.17	-2.34	42.88	Peak Max	V	99	184	74	-31.12	Pass
4633.65	44.55	4.14	-0.74	47.94	Peak Max	V	107	75	74	-26.06	Pass
1854.36	51.53	2.65	-3.27	50.91	Average Max	V	100	184	54	-3.09	Pass
2781.35	30.41	3.17	-2.34	31.24	Average Max	V	99	184	54	-22.76	Pass
4633.65	33.25	4.14	-0.74	36.64	Average Max	V	107	75	54	-17.36	Pass

Co-Location(914.5MHz & 2.4GHz-11b-2412)

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
1829.40	57.73	2.63	-3.41	56.95	Peak Max	V	109	186	74	-17.05	Pass
2747.47	39.94	3.15	-2.2	40.89	Peak Max	V	206	145	74	-33.11	Pass
4823.90	38.93	4.12	-0.8	42.25	Peak Max	V	278	137	74	-31.75	Pass
1829.40	51.87	2.63	-3.41	51.09	Average Max	V	109	186	54	-2.91	Pass
2747.47	27.30	3.15	-2.2	28.25	Average Max	V	206	145	54	-25.76	Pass
4823.90	26.45	4.12	-0.8	29.77	Average Max	V	278	137	54	-24.23	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
Conducted Emissions						
R & S Receiver	ESIB 40	100179	04/21/2017	1 Year	04/21/2018	☑
CHASE LISN	3816/2NM	214372	09/27/2017	1 Year	09/27/2018	☑
Radiated Emissions						
Keysight PXA 50GHz Spectrum Analyzer	N9030B	MY57140584	10/02/2017	1 Year	10/02/2018	☑
Bi-Log antenna (30MHz~2GHz)	JB1	A030702	01/13/2017	1 Year	01/13/2018	☑
Horn Antenna (1GHz~26GHz)	3115	100059	11/09/2017	1 Year	11/09/2018	☑
Pre-Amplifier (1-26GHz)	8449B	3008A00715	08/16/2017	1 Year	08/16/2018	☑
Preamplifier (100KHz-7GHz)	LPA-6-30	11140711	02/09/2017	1 Year	02/09/2018	☑
RF Conducted Measurement						
Keysight PXA 50GHz Spectrum Analyzer	N9030B	My57140597	10/02/2017	1 Year	10/02/2018	☑

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 Equipment: EN45011:** EN ISO/IEC 17065
		Electromagnetic Compatibility: EN45011 – EN ISO/IEC 17065
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 Measuremet
Australia CAB Regocnition		**EMC:** AS/NZS CISPR 11, AS/NZS CISPR 14.1, AS/NZS CISPR22, AS/NZS 61000.6.3, AS/NZS 61000.6.4
		Radiocommunications: AS/NZS 4281, AS/NZS 4268, AS/NZS 4280.1, AS/NZS 4280.2, AS/NZS 4295, AS/NZS 4582, AS/NZS 4583, AS/NZS 4769.1, AS/NZS 4769.2, AS/NZS 4770, AS/NZS 4771
		Telecommunications: AS/ACIF S002:05, AS/ACIF S003:06, AS/ACIF S004:06 AS/ACIF S006:01, AS/ACIF S016:01, AS/ACIF S031:01, AS/ACIF S038:01, AS/ACIF S040:01, AS/ACIF S041:05, AS/ACIF S043.2:06, AS/ACIF S60950.1
Australia NATA Recognition		AS/ACIF S002, AS/ACIF S003, AS/ACIF S004, AS/ACIF S006, AS/ACIF S016,AS/ACIF S031, AS/ACIF S038, AS/ACIF S040, AS/ACIF S041, AS/ACIF S043.2