FCC IC Test Report

Report No.:	FCC_IC_RF_SL20110901-JAD-004 Rev_1.0
FCC ID:	QV5MERCURY6E-M
IC:	5407A-MERCURY6EM
Test Model:	M6e-Micro
Variant Model:	M6e-M
Received Date:	12/02/2020
Test Date:	12/12/2020
Issued Date:	12/29/2020
Applicant:	JADAK, a business unit of Novanta Corporation
Address:	125 Middlesex Turnpike, Bedford, MA 01730
Manufacturer:	JADAK, a business unit of Novanta Corporation
Address:	125 Middlesex Turnpike, Bedford, MA 01730
Issued By:	Bureau Veritas Consumer Products Services, Inc.
Lab Address:	775 Montague Expressway, Milpitas, CA 95035
Test Location (1):	775 Montague Expressway, Milpitas, CA 95035
FCC Registration / Designation Number:	540430
ISED# / CAB identifier:	4842D

ACCREDITED
TESTING CERT # 2742-01

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Release Control Record

Issue No.	Description	Date Issued
FCC_IC_RF_SL20110901-JAD-004	Orignal Release	12/14/2020
FCC_IC_RF_SL20110901-JAD-004 Rev_1.0	Add channel list description	12/29/2020

1 Certificate of Conformity

Product:	RFID module
Brand:	JADAK, a business unit of Novanta Corporation
Test Model:	M6e-Micro, M6e-M
Sample Status:	Engineering sample
Applicant:	JADAK, a business unit of Novanta Corporation
Test Date:	12/11/2020
Standards:	47 CFR FCC Part 15, Subpart C (Section 15.247) RSS-247 Issue 2, February 2017 ANSI C63.10: 2013 RSS-Gen Issue 5, March 2019 DA 00-705, 2000

The above equipment has been tested by **Bureau Veritas Consumer Products Services, Inc., Milpitas Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : _____ , **Date:** 12/29/2020

Deon Dai / Compliance Engineer

Approved by : _____ , **Date:** 12/29/2020

Gary Chou / Engineer Reviewer

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (SECTION 15.247)			
FCC Clause	Test Item	Result	Remarks
15.207	AC Power Conducted Emission	N/A	Device is DC powered.
15.247(a)(1)(iii)	Number of Hopping Frequency Used	PASS	Meet the requirement of limit.
15.247(a)(1)(iii)	Dwell Time on Each Channel	PASS	Meet the requirement of limit.
15.247(a)(1)	1. Hopping Channel Separation 2. Spectrum Bandwidth of a Frequency Hopping Sequence Spread Spectrum System	PASS	Meet the requirement of limit.
15.247(b)	Maximum Peak Output Power	PASS	Meet the requirement of limit.
15.247(d)	Band Edge Measurement	PASS	Meet the requirement of limit.
15.205 & 209 & 15.247(d)	Radiated Emissions	PASS	Meet the requirement of limit.
15.203	Antenna Requirement	PASS	Antenna connector is RP-TNC not a standard connector. Professional installation is required.

Refer to Original Report No.:
EM2037-1 Issue 1, 11/10/2012 tested by Curtis-Straus LLC, a wholly owned subsidiary of BV CPS

This report details the partial testing for FCC ID: QV5MERCURY6E-M and IC: 5407A-MERCURY6EM) with the following modifications:

The channel plan was added via Firmware with a narrower spacing of 375 kHz instead of the original 500kHz.

Channel list

902.625, 903, 903.375, 903.75, 904.125, 904.5, 904.875, 905.25, 905.625, 906, 906.375, 906.750, 907.125, 907.5, 907.875, 908.25, 908.625, 909, 909.375, 909.75, 910.125, 910.5, 910.875, 911.25, 912, 912.375, 912.75, 913.125, 913.5, 913.875, 914.25, 914.625, 915, 915.375, 915.75, 916.125, 916.5, 916.875, 917.25, 917.625, 918, 918.375, 918.75, 919.125, 919.5, 919.875, 920.25, 920.625, 921

2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150kHz ~ 30MHz	3.51dB
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	3.73dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	4.64dB
	6GHz ~ 18GHz	4.82dB
	18GHz ~ 40GHz	4.91dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	RFID module
Brand	JADAK, a business unit of Novanta Corporation
Test Model	M6e-Micro, M6e-M
Variant Model	M6e-M
Identification No. of EUT	262034801007
Status of EUT	Engineering sample
Power Supply Rating	5Vdc
Modulation Type	ASK
Modulation Technology	FHSS
Transfer Rate	160kHz
Operating Frequency	902.675-921.00MHz
Number of Channel	50
Output Power	Power at the output of module: 29.88 dBm Output Power at the end of the cable: 28.38 dBm.
Antenna Info	ANT 1: Antenna Type: RHCP Patch Antenna Gain: 9.5 dBiC(6.5 dbi) Typical Brand: MTI Wireless Edge Ltd. Model No: MT-242043/TRH/A/K ANT2: Antenna Type: Dipole Gain: 4 dBd (6.15 dBi) Brand: Laird Technologies Model No: S8964B
Antenna Connector	RP-TNC

3.2 Description of Test Modes

50 channels are provided to this EUT:

Mode 1(NA4)

Channel	Frequency (MHz)
Low	902.625
Mid	911.625
High	921.000

3.3 Description of Support Units

The RFID module (which is the EUT) is soldered to the CARRIER BOARD.

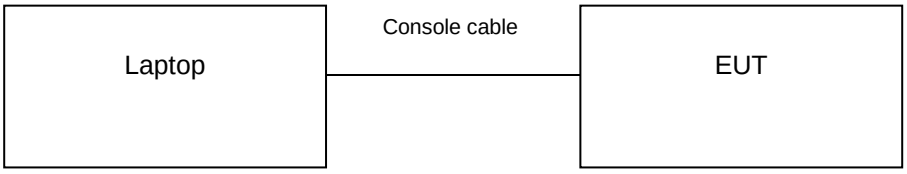
The M6E-DEVKIT provides power to the module and has Serial and USB interfaces to support both board-to-board and board-to-host connectivity.

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	DC power supply	RIGOL	DP712	SED234155	N/A	N/A
B.	Laptop	Dell	XPS	C1MR31G5G944	N/A	N/A
C.	M6E-DEVKIT	JADAK, a business unit of Novanta Corporation	540-0061-01	N/A	N/A	N/A
D.	12 ft. cable	ThingMagic	CBL-P12	N/A	N/A	N/A

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	USB console cable	1	0.8	N	0	Provided by Customer

Note: The core(s) is(are) originally attached to the cable(s).

3.3.1 Configuration of System under Test



3.4 General Description of Applied Standards

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

47 CFR FCC Part 15, Subpart C (Section 15.247)
RSS 247 Issue2, February 2017
ANSI C63.10: 2013
RSS Gen Issue5, March 2019
DA 00-705, 2000

All test items have been performed and recorded as per the above standards.

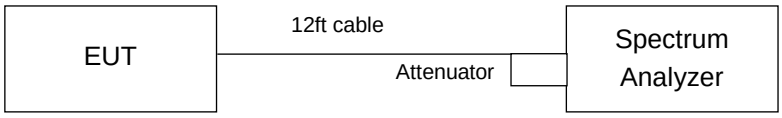
4 Test Types and Results

4.1 Channel Bandwidth

4.1.1 Limits of Channel Bandwidth Measurement

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.

4.1.2 Test Setup



4.1.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.1.4 Test Procedure

a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
c. Measure the frequency difference of two frequencies that were attenuated 20dB from the reference level. Record the frequency difference as the emission bandwidth.
d. Repeat above procedures until all frequencies measured were complete.

4.1.5 Deviation from Test Standard

No deviation.

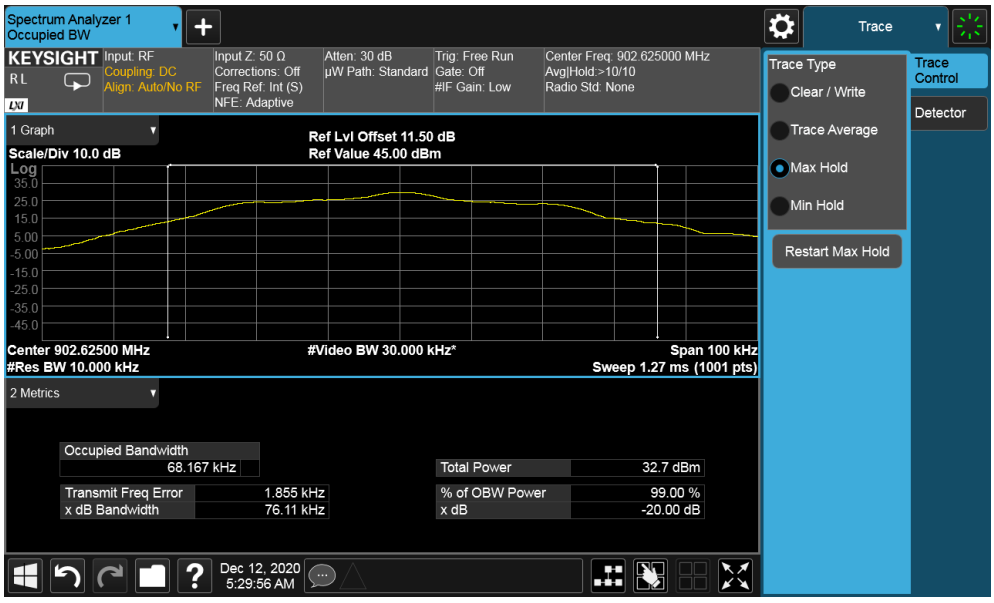
4.1.6 EUT Operating Condition

The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

4.1.7 Test Results

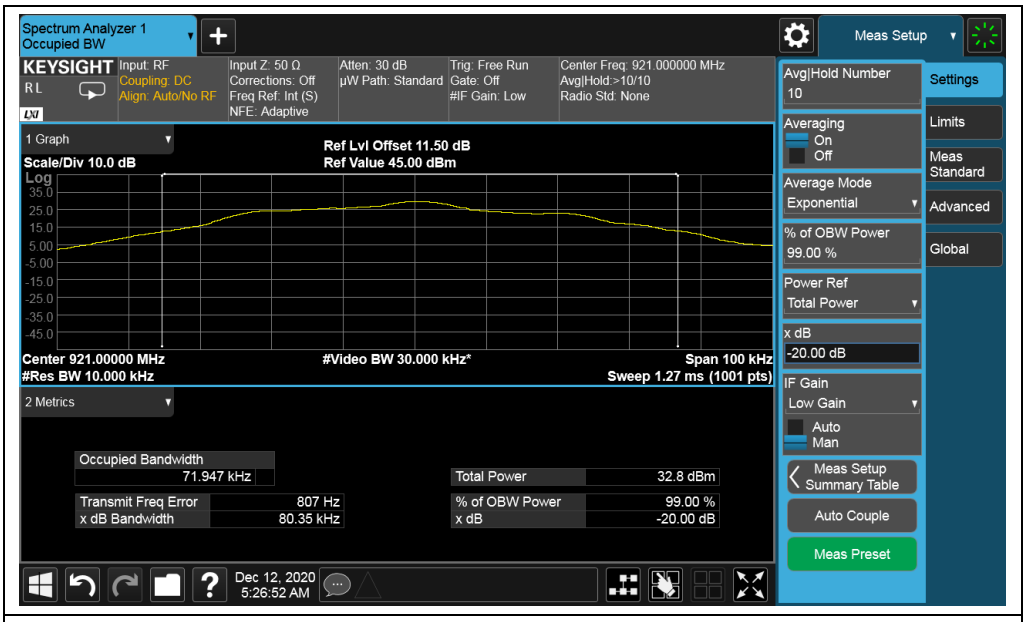
Channel	Frequency (MHz)	20dB Bandwidth (kHz)
Low	902.625	76.11
Mid	911.625	75.97
High	921.000	80.35

Test Plots:



Low Channel

Middle Channel



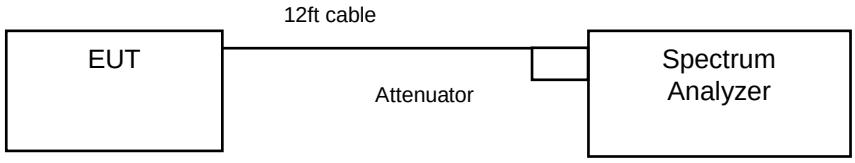
High Channel

4.2 Hopping Channel Separation

4.2.1 Limits of Hopping Channel Separation Measurement

At least 25kHz or 20dB hopping channel bandwidth (whichever is greater).

4.2.2 Test Setup



4.2.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.2.4 Test Procedure

Measurement Procedure REF

a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.

b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range.

c. By using the MaxHold function record the separation of two adjacent channels.

d. Measure the frequency difference of these two adjacent channels by SA MARK function. And then plot the result on SA screen.

e. Repeat above procedures until all frequencies measured were complete.

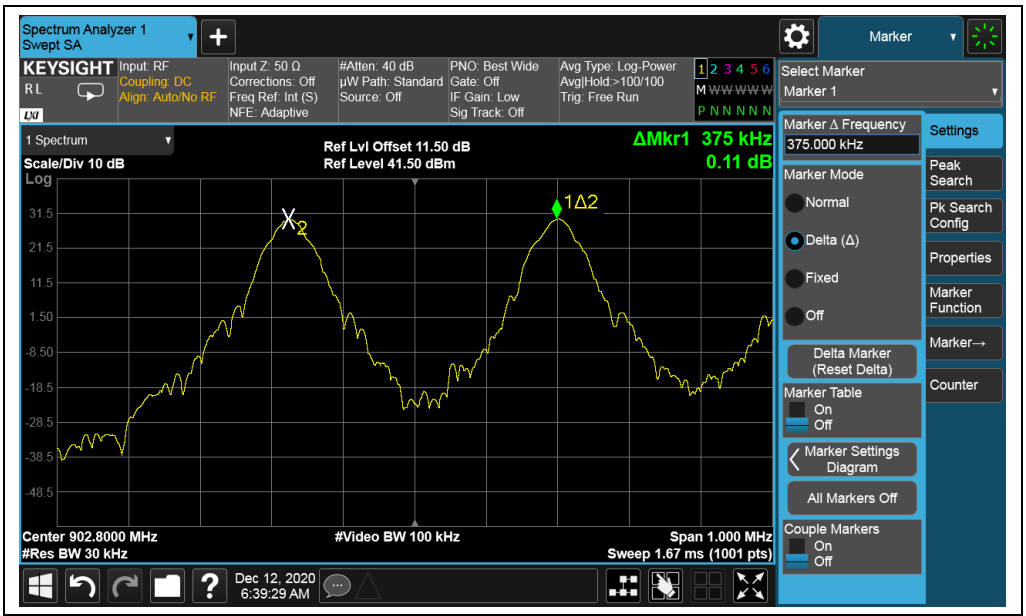
4.2.5 Deviation from Test Standard
No deviation.

4.2.6 Test Results

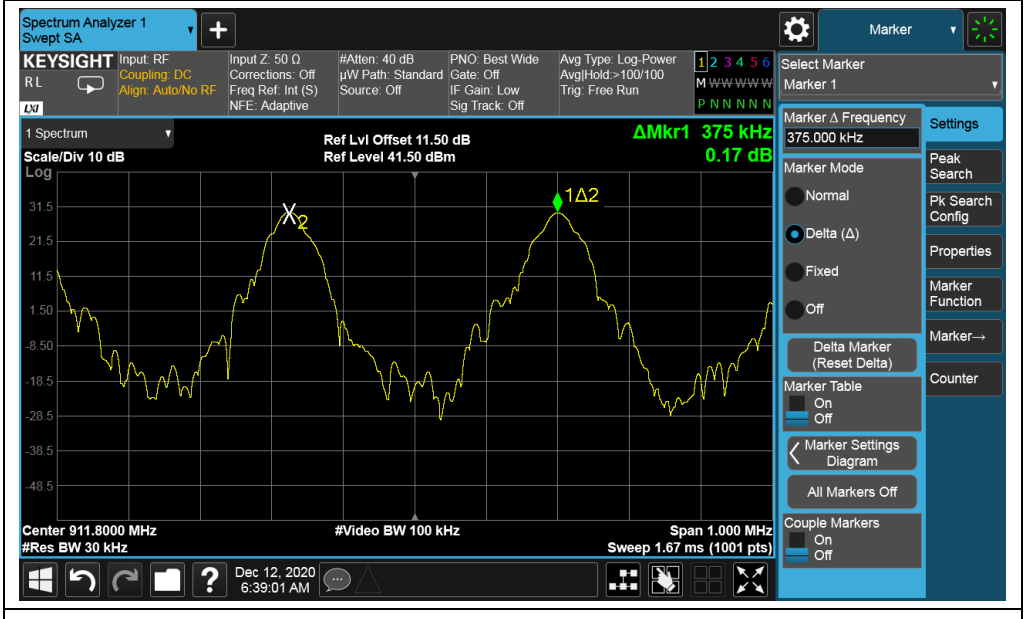
Channel	Frequency (MHz)	Adjacent Channel Separation (kHz)	20dB Bandwidth (kHz)	Minimum Limit (kHz)	Pass / Fail
Low	902.625	375	76.11	50.74	Pass
Mid	911.625	375	75.97	50.65	Pass
High	921.000	375	80.35	53.57	Pass

NOTE: The minimum limit is two-third 20dB bandwidth.

Test Plots:



Low Channel



Middle Channel

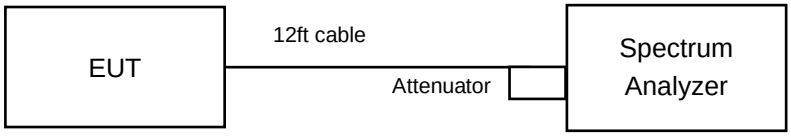
High Channel

4.3 Conducted Output Power Measurement

4.3.1 Limits of Conducted Output Power Measurement

For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels.

4.3.2 Test Setup



4.3.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.3.4 Test Procedures

a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.

b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.

c. The center frequency of the spectrum analyzer is set to the fundamental frequency and using 1MHz RBW and 3 MHz VBW.

d. Measure the captured power within the band and recording the plot.

e. Repeat above procedures until all frequencies required were complete.

4.3.5 Deviation from Test Standard

No deviation.

4.3.6 Test Results

ANT1 Port:

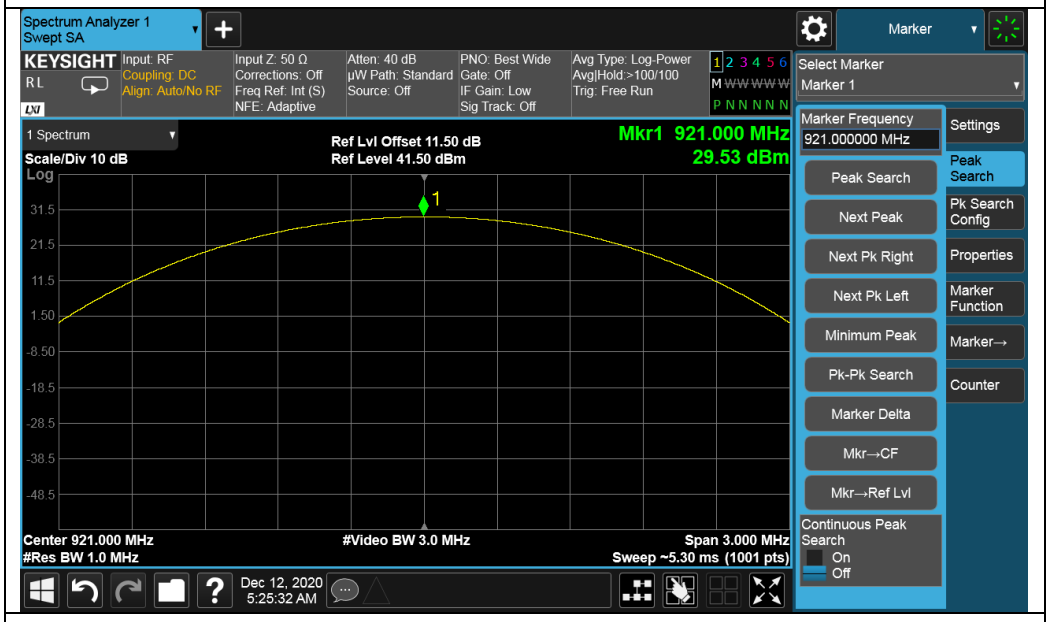
Channel	Frequency (MHz)	Conducted Power at the end of the cable (dBm)	Limit (dBm)	Pass/Fail
Low	902.625	29.88	30	Pass
Mid	911.625	29.69	30	Pass
High	921.000	29.53	30	Pass

Note: The power result is measured at antenna port, the actual power from module is 1.5dB higher, a cable with adapters with total loss of 1.5 dB is connected between the module and the antenna.

Test Plots:

Low Channel

Middle Channel



High Channel

ANT2 Port:

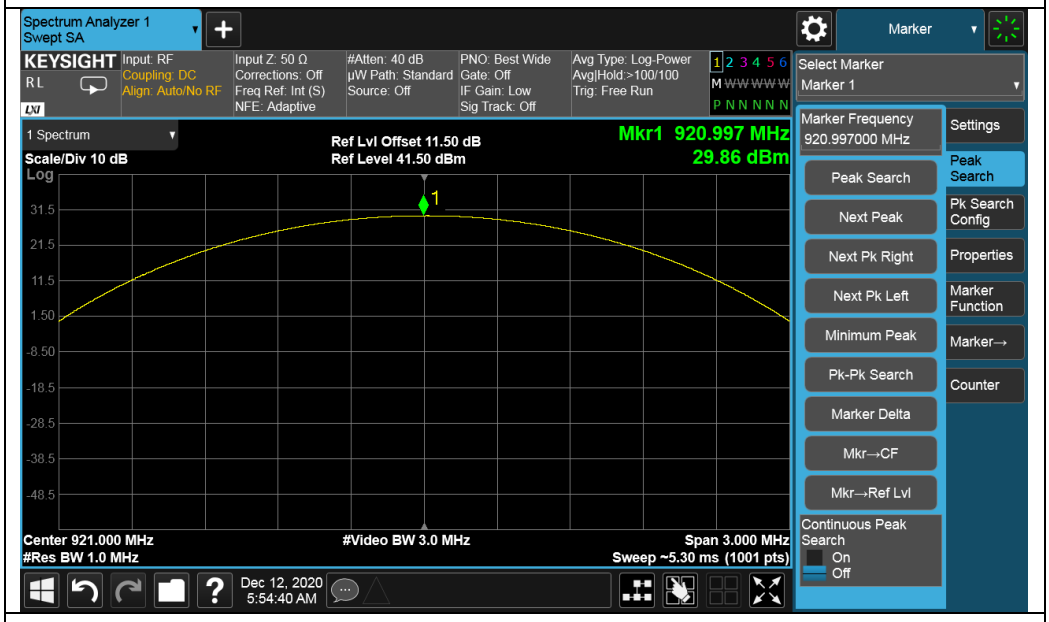
Channel	Frequency (MHz)	Conducted Power at the end of the cable (dBm)	Limit (dBm)	Pass/Fail
Low	902.625	29.51	30	Pass
Mid	911.625	29.59	30	Pass
High	921.000	29.86	30	Pass

Note: The power result is measured at antenna port, the actual power from module is 1.5dB higher, a cable with adapters with total loss of 1.5 dB is connected between the module and the antenna.

Test Plots:

Low Channel

Middle Channel



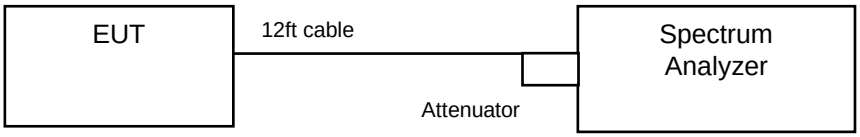
High Channel

4.4 Number of Hopping Frequency Used

4.4.1 Limits of Hopping Frequency Used Measurement

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

4.4.2 Test Setup



4.4.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.4.4 Test Procedure

a. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.

b. Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.

c. Set the SA on MaxHold Mode, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been recorded.

d. Set the SA on View mode and then plot the result on SA screen.

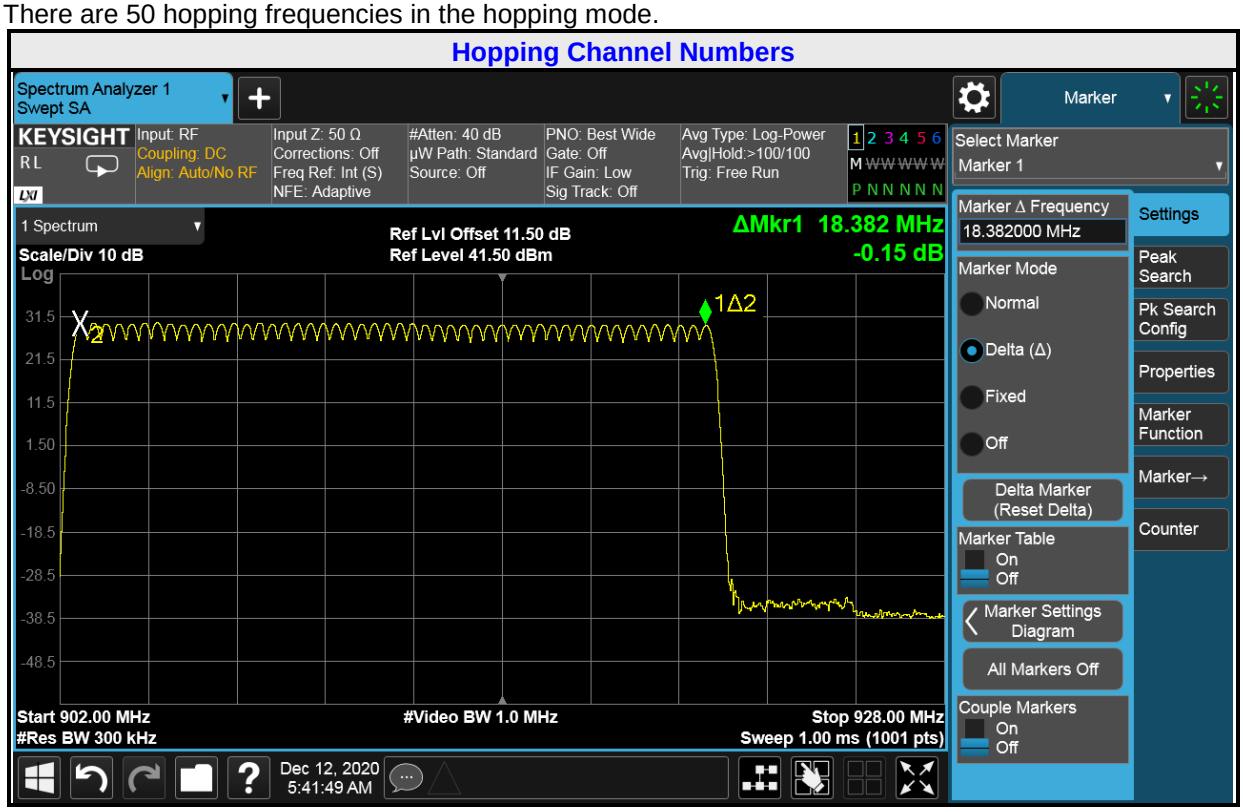
e. Repeat above procedures until all frequencies measured were complete.

4.4.5 Deviation from Test Standard

No deviation.

4.4.6 Test Results

There are 50 hopping frequencies in the hopping mode.



Appendix – Information on the Testing Laboratories

Bureau Veritas is a global leader in testing, inspection and certification (TIC) services. We help businesses improve safety, sustainability and productivity; and our clients include the majority of leading brands in retail, manufacturing and other industries. With a presence in every major country around the world, our quality assurance and compliance solutions are vital in helping our customers enhance product quality and concept-to-consumer journeys. We also assist with increasing speed to market, profitability and brand equity throughout the supply chain. Bureau Veritas is a leading wireless/IoT testing, inspection, audit and certification provider, with a global network of test laboratories to support the IoT industry in areas of connectivity, security, interoperability as well as quality, health & safety, and environmental/chemical requirements.

If you have any comments, please feel free to contact us at the following:

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The address and road map of all our labs can be found in our web site also.

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