2.4 GHz Bluetooth Radio Test Report
(FHSS)
For
SPK-SHARE

supports

2.4 GHz/5.0 GHz Wi-Fi Radio 802.11a/ac/b/g/n+ Bluetooth v2.1+EDR, BTLE v4.0

FCC ID: LDKSPKSH1576
ISED ID: 2461L-SPKSH1576

Against the following Specifications :

47 CFR 15.247
47 CFR 15.209
47 CFR 15.205
RSS-Gen issue 4
RSS-247 Issue 2

ACCREDITED

Cisco Systems
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This report replaces any previously entered test report under EDCS – This test report has been electronically authorized and archived using the CISCO Engineering Document Control system. Test Report Template EDCS# 703456

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Section 1: Overview

1.1 Test Summary

The samples were assessed against the tests detailed in section 3 under the requirements of the following specifications:

Specifications
47 CFR Part 15.247 47 CFR Part 15.209 47 CFR Part 15.205 RSS-247 Issue 2 RSS-Gen Issue 4

Measurements were made in accordance with

- ANSI C63.10:2013 Procedure for Compliance Testing of Unlicensed Wireless Devices
- Public Notice. DA 00-0705

Section 2: Assessment Information

2.1 General

This report contains an assessment of an apparatus against Radio Standards based upon tests carried out on the samples submitted. The testing was performed by and for the use of Cisco systems Inc:

With regard to this assessment, the following points should be noted:

a) The results contained in this report relate only to the items tested and were obtained in the period between the date of the initial assessment and the date of issue of the report. Manufactured products will not necessarily give identical results due to production and measurement tolerances.

b) The apparatus was set up and exercised using the configuration and modes of operation defined in this report only.

c) Where relevant, the apparatus was only assessed using the susceptibility criteria defined in this report and the Test Assessment Plan (TAP).

d) All testing was performed under the following environmental conditions:

Temperature	15°C to 35°C (54°F to 95°F)
Atmospheric Pressure	860mbar to 1060mbar (25.4" to 31.3")
Humidity	10% to 75*%

e) All AC testing was performed at one or more of the following supply voltages:
110V 60 Hz (+/-20%)

2.2 Units of Measurement

The units of measurements defined in the appendices are reported in specific terms, which are test dependent. Where radiated measurements are concerned these are defined at a particular distance. Basic voltage measurements are defined in units of [dBuV]

As an example, the basic calculation for all measurements is as follows:

Emission level [dBuV] = Indicated voltage level [dBuV] + Cable Loss [dB] + Other correction factors [dB]

The combinations of correction factors are dependent upon the exact test configurations [see test equipment lists for further details] and may include:-

Antenna Factors, Pre Amplifier Gain, LISN Loss, Pulse Limiter Loss and Filter Insertion Loss..

Note: to convert the results from dBuV/m to uV/m use the following formula:-

Level in uV/m = Common Antilogarithm [(X dBuV/m)/20] = Y uV/m

Measurement Uncertainty Values

voltage and power measurements	± 2 dB
conducted emissions measurements	± 1.4 dB
radiated emissions measurements	± 3.2 dB
frequency measurements	± 2.4 10-7
temperature measurements	± 0.54º.
humidity measurements	± 2.3%
DC and low frequency measurements	± 2.5%.

Where relevant measurement uncertainty levels have been estimated for tests performed on the apparatus. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Radiated emissions (expanded uncertainty, confidence interval 95%)

30 MHz – 300 MHz	± 3.8 dB
300 MHz – 1000 MHz	± 4.3 dB
1.0 GHz – 10.0 GHz	± 4.0 dB
10.0 GHz – 18.0 GHz	± 8.2 dB
18.0 GHz – 26.5 GHz	± 4.1 dB
26.5 GHz – 40.0 GHz	± 3.9 dB

Conducted emissions (expanded uncertainty, confidence interval 95%)

30 MHz – 40.0 GHz	± 0.38 dB

A product is considered to comply with a requirement if the nominal measured value is below the limit line. The product is considered to not be in compliance in case the nominal measured value is above the limit line.

2.3 Date of testing **(Initial sample receipt date to last date of testing)**

16-Oct-2017 – 11-Jan-2018

2.4 Report Issue Date

Cisco uses an electronic system to issue, store and control the revision of test reports. This system is called the Engineering Document Control System (EDCS). The actual report issue date is embedded into the original file on EDCS. Any copies of this report, either electronic or paper, that are not on EDCS must be considered uncontrolled

2.5 Testing facilities

This assessment was performed by:

Testing Laboratories

Cisco Systems, Inc.
125 West Tasman Drive (Building P)
San Jose, CA 95134
USA

Headquarters

Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134
USA

Registration Numbers for Industry Canada

Cisco System Site	Address	Site Identifier
Building P, 10m Chamber	125 West Tasman Dr San Jose, CA 95134	Company #: 2461N-2
Building P, 5m Chamber	125 West Tasman Dr San Jose, CA 95134	Company #: 2461N-1
Building I, 5m Chamber	285 W. Tasman Drive San Jose, California 95134	Company #: 2461M-1
Building 7, 5m Chamber	425 E. Tasman Drive San Jose, California 95134 United States	Company #: 2461N-3

Test Engineer(s)

Danh Le
Zain Ali
Farida Rahmanzai

2.6 Equipment Assessed (EUT)
SPK-SHARE

2.7 EUT Description

Cisco SPK-SHARE dongle is the next generation cloud collaboration platform that unifies messaging, meeting and calling and content-sharing. Cisco SPK-Share provides HDMI support for connection to a display and USB Type-C interface to receive 5V power. Cisco SPK-Share offers both wired and wireless solution with Ethernet via USB 2.0 external adapter and 802.11a/b/g/n/ac, Bluetooth classic and Bluetooth LE radios.

Below are brief summary of the SPK-SHARE hardware specifications:

Wired Protocol support

- USB C main interface (Power, Ethernet via USB2)
- External POE Ethernet adapter (Ethernet Injector accessory connected via USB type C)
  - Ethernet: 10/100/1000BASE-T Ethernet network (IEEE 802.3i/802.3u/802.3ab/802.3az)
- External18W power supply (Direct connected via USB)

Wireless Protocols support

- Wi-Fi: IEEE 802.11a, 802.11b, 802.11g, 802.11n, 802.11ac
- Bluetooth: IEEE 802.15 Basic Rate v2.1+ EDR, Low Energy v4.0

2.4GHz FHSS Radio Supported Modes:

- 802.15 BlueTooth ver 2.1+EDR (1Mbps – 3Mbps, Single stream)

2.4GHz BTLE Radio Supported Modes:

- 802.15 BlueTooth ver 4.0 (1Mbps, Single stream)

- **2.4GHz WLAN Radio Supported Modes:**
- 802.11b (1Mbps – 11Mbps)
- 802.11g (6Mbps - 54Mbps)
- 802.11n (HT20, M0 – M15)
- 802.11n (HT40, M0 – M15)

5GHz WLAN Radio Supported Modes:

- 802.11a (6Mbps – 54Mbps,)
- 802.11n (HT20, M0 – M15)
- 802.11n (HT40, M0 – M15)
- 802.11ac (VHT20, M0 – M8)
- 802.11ac (VHT40, M0 – M9)
- 802.11ac (VHT80, M0 – M9)

Model Differences

SPK-SHARE
SPK-SHARE-K9

Both have identical components, PCB layout, electronics circuitries and enclosure. The only difference is the encryption software being offered for SPK_SHARE-K9

Section 3: Result Summary

RF Conducted Emissions		
Basic Standard	**Technical Requirements / Details**	**Result**
FCC 15.247 **RSS-247**	**20 dB Bandwidth**: The 20 dB emission bandwidth is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated 20 dB below the maximum in-band spectral density of the modulated signal. There is no limit for 20 dB bandwidth.	**Pass**
FCC 15.247 (b) (3) **RSS-247** 5.4 (2)	**Maximum Peak Conducted Output Power**: For frequency hopping systems operating in the 2400-2483.5 MHz Band employing at least 75 non-overlapping hopping channels, and all Frequency Hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency Hopping systems in the 2400-2483.5 MHz band: 0.125 Watt.	**Pass**
FCC 15.247 (a) (1) **RSS-247** 5.1 (2)	**Carrier Frequency Separation**: For frequency hopping systems according to a hopping channel carrier Frequencies that are separated by 25 kHz or the 20 dB Bandwidth of the Hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.	**Pass**
FCC15.247(a) (1) (iii) **RSS-247** (5.1) (4)	**No. of Hopping Frequencies / Time Occupancy**: Frequency hopping systems in the 2400-2483.5 MHz band shall use at Least 15 Channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of Hopping channels employed.	**Pass**
FCC 15.247 (d) **RSS-247** (5.5)	**Conducted Band-Edge**: **FCC/RSS:** 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 below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in FCC§15.209(a) & RSS-Gen is not required.	**Pass**

RF Conducted Emissions (continue)		
Basic Standard	**Technical Requirements / Details**	**Result**
FCC15.247 (d) **FCC 15.205** **RSS-Gen** 8.10	**Restricted band**: **FCC:** In addition, radiated emissions which fall in the restricted bands, as defined in FCC §15.205(a), must also comply with the radiated emission limits specified in Sec. 15.209(a). **FCC:** (b) Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. **RSS-Gen:** Unwanted emissions falling into restricted bands of Table 6 shall comply with the limits of Table 4 specified in RSS-Gen 8.9.	**Pass**

Radiated Emissions		
Basic Standard	**Technical Requirements / Details**	**Result**
FCC 15.209/205 **RSS-Gen** 6.13(a)/8.10	**TX Spurious Emissions & Restricted Bands** **FCC:** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the field strength limits table in this section. In addition, radiated emissions which fall in the restricted bands as defined in FCC §15.205(a), must also comply with the radiated emission limits specified in Sec. 15.209(a). **RSS**: In measuring unwanted emissions, the spectrum shall be investigated from 30 MHz or the lowest radio frequency signal generated in the equipment, whichever is lower, without going below 9 kHz, up to at least the frequency given below: a) If the equipment operates below 10 GHz; to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower. **RSS:** Unwanted emissions falling into restricted bands of Table 6 shall comply with the limits of Table 4 specified in RSS-Gen 8.9.	

AC Conducted Emissions		
Basic Standard	**Technical Requirements / Details**	**Result**
FCC15.207 **RSS-Gen 8.8**	**AC Power Line Conducted Emissions:** **FCC**: (a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator 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). **RSS**: A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 0.15 MHz to 30 MHz shall not exceed the limits in Table 3 shown in this section.	**Pass**

Section 4: Sample Details

Note: Each sample was evaluated to ensure that its condition was suitable to be used as a test sample prior to the commencement of testing. Please also refer to the "Justification for worst Case test Configuration" section of this report for further details on the selection of EUT samples.

4.1 Sample Details

Sample Number	Equipment Description	Manufacturer / Model#	Hardware Rev.	Firmware Rev.	Serial Number
S01	Wireless dongle (radiated sample)	Cisco / SPK-SHARE	P3	novum1.1.0 PreAlpha1 2017-10-03	FCH2138EAMB
S02	Wireless dongle (conducted sample)	Cisco / SPK-SHARE	P3	novum1.1.0 PreAlpha1 2017-10-03	FCH2135DG58
S03	Switching Power Supply	Cisco / AQ18A-59CFA	Production	----------	PH1212400BC

4.2 System Details

System #	Description	Samples
1	Radiated Radio Test Sample and Power Supply	S01 & S03
2	RF Conducted Radio Test Sample and Power Supply	S02 & S03

4.3 Mode of Operation Details

Mode#	Description	Comments
1	Bluetooth hopping disabled	System shall be set in Transmitter Mode and hopping on single channel at various combination of modulation and packet type.
2	Bluetooth hopping enabled	System shall be set in Transmitter Mode and hopping on all 79 channels at various combination of modulation and packet type.

4.4 Test Mode, Modulation and Data Rate Description

Setting#	Modulation	Packet Type	Data Rate
1*	GFSK	DH1	1 Mbps
2	GFSK	DH3	1 Mbps
3	GFSK	DH5	1 Mbps
4	π/4 DQPSK	2-DH1	2 Mbps
5	π/4 DQPSK	2-DH3	2 Mbps
6	π/4 DQPSK	2-DH5	2 Mbps
7	8-DPSK	3-DH1	3 Mbps
8	8-DPSK	3-DH3	3 Mbps
9	8-DPSK	3-DH5	3 Mbps
***: Setting**#1 was determined to be the worst case emissions of all modulation and data packet type combinations and selected for RSE testing.			

4.5 Software Used for Testing

Tool#	Description	Comments
1	EMIsoft Vasona, version 6.0	Vasona is Windows based automated software PC controlled tool kit designed to run radiated emissions.
2	HCI command test set	Hci command set was used to set BT radio in hopping mode, standby mode, changing channels, modulations, packet types, etc… according to the standard requirements.

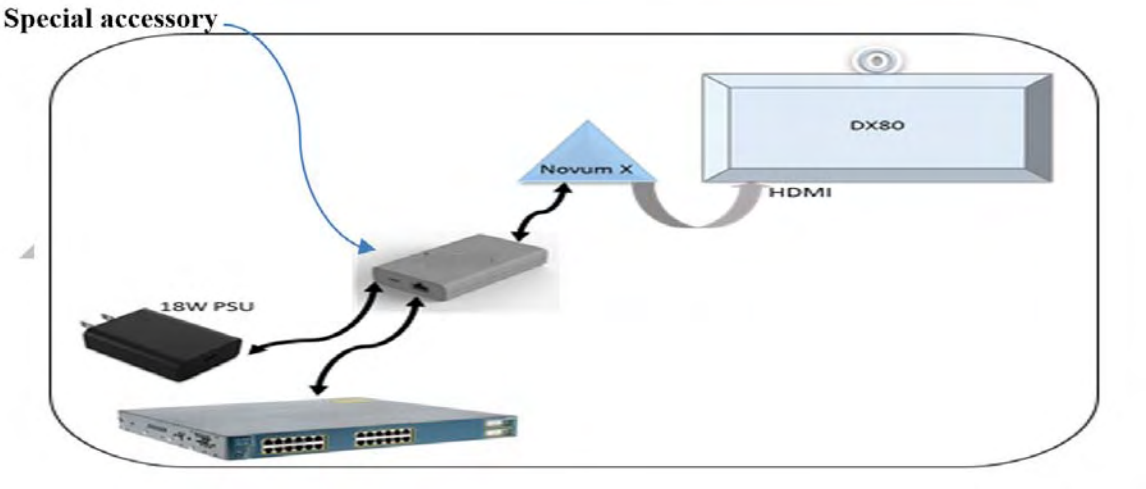
4.6 Antenna Information

The following antennas are supported by this product series.
The data included in this report represent the worst case data for all antennas.

Frequency (MHz)	Part Number	Antenna Type	Antenna Gain Peak (dBi)
2400 – 2500	CI8847-11-000-R-FA	PIFA	1.24
5150 – 5250	CI8847-11-000-R-FA	PIFA	4.26
5250 – 5350	CI8847-11-000-R-FA	PIFA	4.26
5470 – 5725	CI8847-11-000-R-FA	PIFA	3.77
5725 – 5850	CI8847-11-000-R-FA	PIFA	2.85

4.7 Special Accessories included in the test setup

Due to hardware design limitation, an **external Ethernet adapter** was used as a special accessory to access into the EUT in order to execute all required radio test command scripts.



Section 5: Modifications

5.1 Sample Modifications Performed During Assessment

No modifications were performed during assessment.

Appendix A: Conducted Test Results

Target Maximum Channel Power

Note: Each sample was evaluated to ensure that its condition was suitable to be used as a test sample prior to the commencement of testing. During preliminary testing, slowest data rate setting was evaluated to determine the "Worst Case" mode.

The following table details the maximum supported Total Channel Power for all operating modes.

Operating Mode	Maximum Channel Power (dBm) (Conducted)		
	Frequency (MHz)		
	2402	2441	2480
Bluetooth Basic Rate 1 Mbps	----	----	7.0

A.1 20dB Bandwidth

The 20 dB emission bandwidth is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated 20 dB below the maximum in-band spectral density of the modulated signal

A.1.1 Limits

FCC 15.247 (a) (1), RSS- 247 5.1

There is no limit for 20 dB bandwidth.

A.1.2 Test Procedure

Step 1:

- Edit the spectrum analyzer settings according to the parameters below.
  -Center Frequency: frequency under test
  -Span: approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
  -RBW: ≥ 1% of the 20 dB bandwidth
  -VBW: ≥ RBW
  - Sweep: Auto Couple
  -Ref Level: 10dB (or higher if required)
  -Attenuation: 20dB (if required)
  -Detector: Peak
  - Trace Mode: Max Hold

Step 2:

- The EUT is set in a transmitter mode at its maximum data rate. Allow the trace to stabilize, use the marker-to-peak function to set the marker to the peak of the emission. Then use the marker-normal function to place at the 20 dB down on one side of the emission. Reset with the marker-delta function and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. Record data.

Tested By: Farida Rahmanzai	**Date of testing:** 11-Jan-2018
Test Result : PASS	

A.1.3 20dB Bandwidth Data Table

20dB Bandwidth		
Packet Type	**Frequency (MHz)**	**20dB BW (KHz)**
Modulation type : GFSK		
DH5	2402	930 KHz
	2441	927 KHz
	2480	924 KHz
DH3	2402	924 KHz
	2441	924 KHz
	2480	927 KHz
DH1	2402	981 KHz
	2441	984 KHz
	2480	984 KHz
Modulation type : π/4-DQPSK		
2-DH5	2402	1353 KHz
	2441	1311 KHz
	2480	1311 KHz
2-DH3	2402	1311 KHz
	2441	1311 KHz
	2480	1311 KHz
2-DH1	2402	1284 KHz
	2441	1281 KHz
	2480	1272 KHz
Modulation type : 8-DPSK		
3-DH5	2402	1266 KHz
	2441	1266 KHz
	2480	1266 KHz
3-DH3	2402	1275 KHz
	2441	1275 KHz
	2480	1308 KHz
3-DH1	2402	1209 KHz
	2441	1209 KHz
	2480	1233 KHz

A.1.4 20dB Bandwidth Graphical Test Results

20dB Bandwidth Graphical Test Results
Modulation : GFSK / Packet Type: DH5 / Frequency: 2402 MHz

Modulation: GFSK / Packet Type: DH5 / Frequency: 2441 MHz

Modulation: GFSK / Packet Type: DH5 / Frequency: 2480 MHz


20dB Bandwidth Graphical Test Results
Modulation : GFSK / Packet Type: DH3 / Frequency: 2402 MHz

Modulation : GFSK / Packet Type: DH3 / Frequency: 2441 MHz

Modulation : GFSK / Packet Type: DH3 / Frequency: 2480 MHz


20dB Bandwidth Graphical Test Results
Modulation : GFSK / Packet Type: DH1 / Frequency: 2402 MHz

Modulation : GFSK / Packet Type: DH1 / Frequency: 2441 MHz

Modulation : GFSK / Packet Type: DH1 / Frequency: 2480 MHz

20dB Bandwidth Graphical Test Results
Modulation : π/4 DQPSK / Packet Type: 2-DH5 / Frequency: 2402 MHz

Modulation : π/4 DQPSK / Packet Type: 2-DH5 / Frequency: 2441 MHz

Modulation : π/4 DQPSK / Packet Type: 2-DH5 / Frequency: 2480 MHz


20dB Bandwidth Graphical Test Results
Modulation : π/4 DQPSK / Packet Type: 2-DH3 / Frequency: 2402 MHz

Modulation : π/4 DQPSK / Packet Type: 2-DH3 / Frequency: 2441 MHz

Modulation : π/4 DQPSK / Packet Type: 2-DH3 / Frequency: 2480 MHz


20dB Bandwidth Graphical Test Results
Modulation : π/4 DQPSK / Packet Type: 2-DH1 / Frequency: 2402 MHz

Modulation : π/4 DQPSK / Packet Type: 2-DH1 / Frequency: 2441 MHz

Modulation : π/4 DQPSK / Packet Type: 2-DH1 / Frequency: 2480 MHz

20dB Bandwidth Graphical Test Results

Modulation : 8DPSK / Packet Type: 3-DH5 / Frequency: 2402 MHz

Modulation : 8DPSK / Packet Type: 3-DH5 / Frequency: 2441 MHz

Modulation : 8DPSK / Packet Type: 3-DH5 / Frequency: 2480 MHz

20dB Bandwidth Graphical Test Results
Modulation : 8DPSK / Packet Type: 3-DH3 / Frequency: 2402 MHz

Modulation : 8DPSK / Packet Type: 3-DH3 / Frequency: 2441 MHz

Modulation : 8DPSK / Packet Type: 3-DH3 / Frequency: 2480 MHz

20dB Bandwidth Graphical Test Results
Modulation : 8DPSK / Packet Type: 3-DH1 / Frequency: 2402 MHz

Modulation : 8DPSK / Packet Type: 3-DH1 / Frequency: 2441 MHz

Modulation : 8DPSK / Packet Type: 3-DH1 / Frequency: 2480 MHz


A.2 Maximum Peak Conducted Output Power

The maximum peak conducted output power is defined as the maximum power level measured with a peak detector using a filter with width and shape of which is sufficient to accept the signal bandwidth. However, when a filter with adequate width is not available, an integrated method utilizing a peak detector is acceptable.

A.2.1 Limits

FCC 15.247 (b) (3)
The maximum conducted output power of the intentional radiator for systems using frequency hopping systems in the 2400-2483.5MHz band shall not exceed 1 Watt (30dBm). If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

RSS 247 5.4 (2)
For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W and the e.i.r.p. shall not exceed 4 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W and the e.i.r.p. shall not exceed 0.5 W if the hopset uses less than 75 hopping channels

A.2.3 Test Procedure

Refer to Public Notice DA 00-705

- Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
- RBW > the 20 dB bandwidth of the emission being measured
- VBW ≥ RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission.

Tested By: Danh Le	**Date of testing:** 29-Aug-2017 – 21-Oct-2017
Test Result : PASS	

A.2.4 Maximum Peak Conducted Output Power Data Table

Maximum Peak Conducted Output Power & E.I.R.P						
Frequency (MHz)	**Peak Conducted Output Power (dBm)**	**Peak Conducted Power Limit (dBm)**	**Antenna Gain (dBi)**	**E.I.R.P (dBm)**	**E.I.R.P Limit (dBm)**	**Result**
Basic Rate: 1 Mbps		**Modulation**: GFSK			**Packet Type**: DH5	
2402	3.80	30	1.24	5.04	36	Pass
2441	5.22	30	1.24	6.46	36	Pass
2480	5.78	30	1.24	7.02	36	Pass
Basic Rate: 1 Mbps		**Modulation**: GFSK			**Packet Type**: DH3	
2402	3.82	30	1.24	5.06	36	Pass
2441	5.24	30	1.24	6.48	36	Pass
2480	5.74	30	1.24	6.98	36	Pass
Basic Rate: 1 Mbps		**Modulation**: GFSK			**Packet Type**: DH1	
2402	3.86	30	1.24	5.10	36	Pass
2441	5.27	30	1.24	6.51	36	Pass
2480	**5.78**	30	1.24	**7.02**	36	Pass

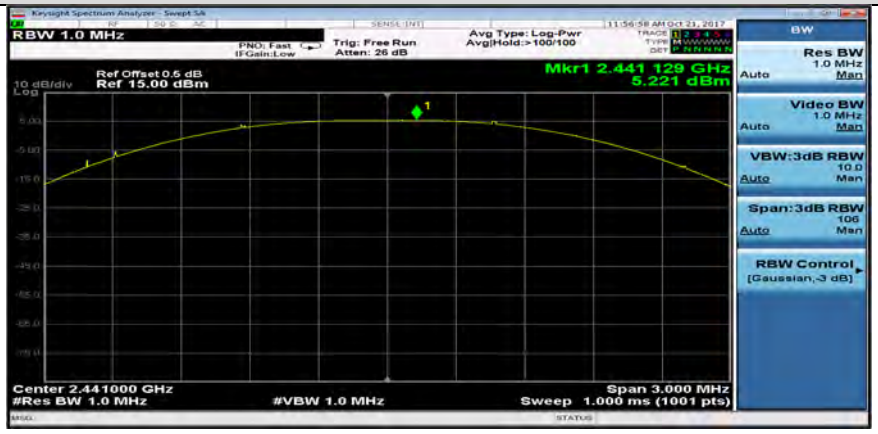
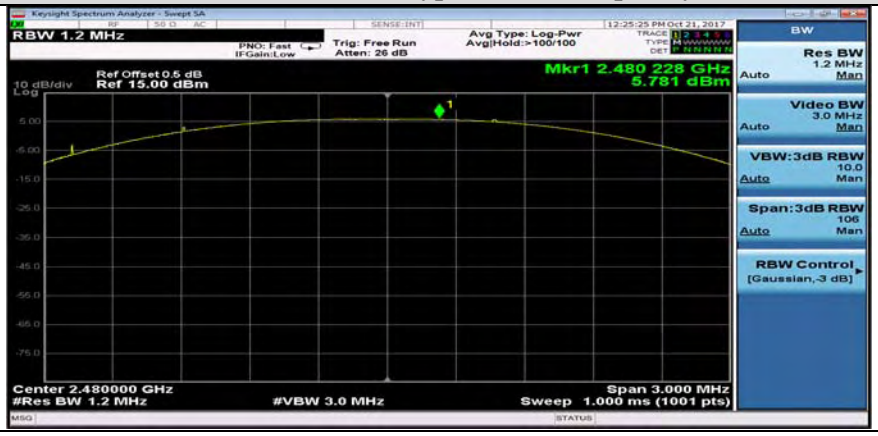
Maximum Peak Conducted Output Power & E.I.R.P						
Frequency (MHz)	**Peak Conducted Output Power (dBm)**	**Peak Conducted Power Limit (dBm)**	**Antenna Gain (dBi)**	**E.I.R.P (dBm)**	**E.I.R.P Limit (dBm)**	**Result**
Enhanced Data Rate: 2Mbps		**Modulation**: π/4 DQPSK			**Packet Type**: DH5	
2402	3.79	30	1.24	5.03	36	Pass
2441	4.67	30	1.24	5.91	36	Pass
2480	5.03	30	1.24	6.27	36	Pass
Enhance Data Rate: 2Mbps		**Modulation**: π/4 DQPSK			**Packet Type**: DH3	
2402	3.72	30	1.24	4.96	36	Pass
2441	4.56	30	1.24	5.80	36	Pass
2480	4.97	30	1.24	6.21	36	Pass
Enhance Data Rate: 2Mbps		**Modulation**: π/4 DQPSK			**Packet Type**: DH1	
2402	3.85	30	1.24	5.09	36	Pass
2441	4.82	30	1.24	6.06	36	Pass
2480	5.11	30	1.24	6.35	36	Pass

Maximum Peak Conducted Output Power & E.I.R.P						
Frequency (MHz)	**Peak Conducted Output Power (dBm)**	**Peak Conducted Power Limit (dBm)**	**Antenna Gain (dBi)**	**E.I.R.P (dBm)**	**E.I.R.P Limit (dBm)**	**Result**
Enhanced Data Rate: 3Mbps		**Modulation**: 8-DPSK			**Packet Type**: DH5	
2402	4.17	30	1.24	5.41	36	Pass
2441	5.04	30	1.24	6.28	36	Pass
2480	5.33	30	1.24	6.57	36	Pass
Enhanced Data Rate: 3Mbps		**Modulation**: 8-DPSK			**Packet Type**: DH3	
2402	4.20	30	1.24	5.44	36	Pass
2441	5.10	30	1.24	6.34	36	Pass
2480	5.41	30	1.24	6.65	36	Pass
Enhanced Data Rate: 3Mbps		**Modulation**: 8-DPSK			**Packet Type**: DH1	
2402	4.20	30	1.24	5.44	36	Pass
2441	5.03	30	1.24	6.27	36	Pass
2480	5.36	30	1.24	6.60	36	Pass

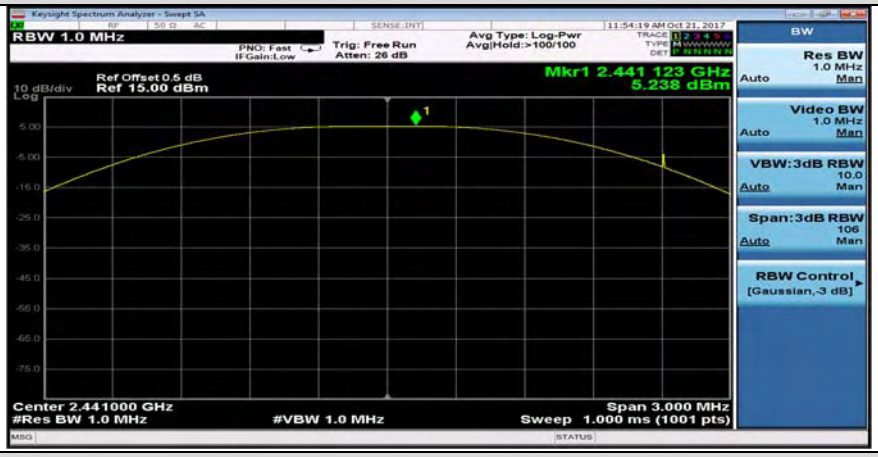
Note: Worst case is determined as the modulation with Highest Output Power.
Worst cases emissions to be determined as GFSK / DH-1

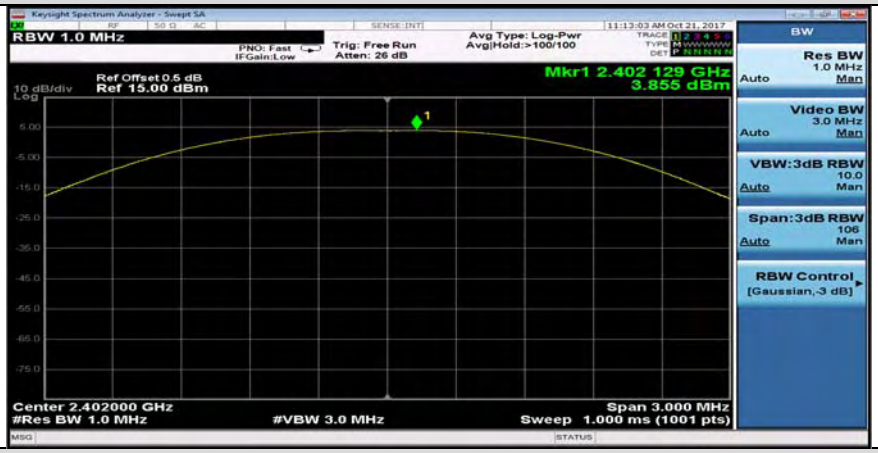
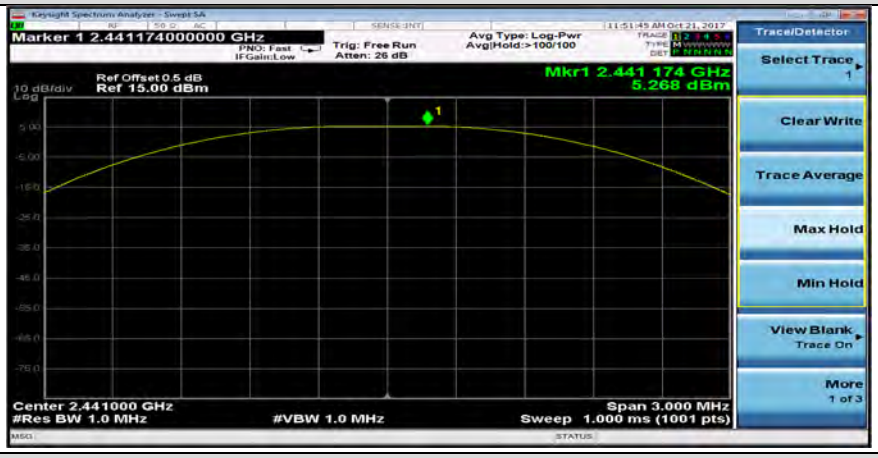
A.2.5 Maximum Peak Conducted Output Power Graphical Test Results

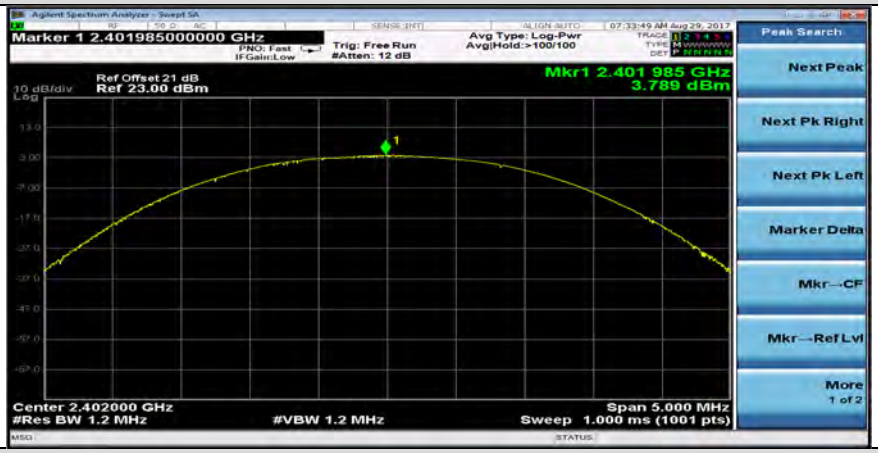
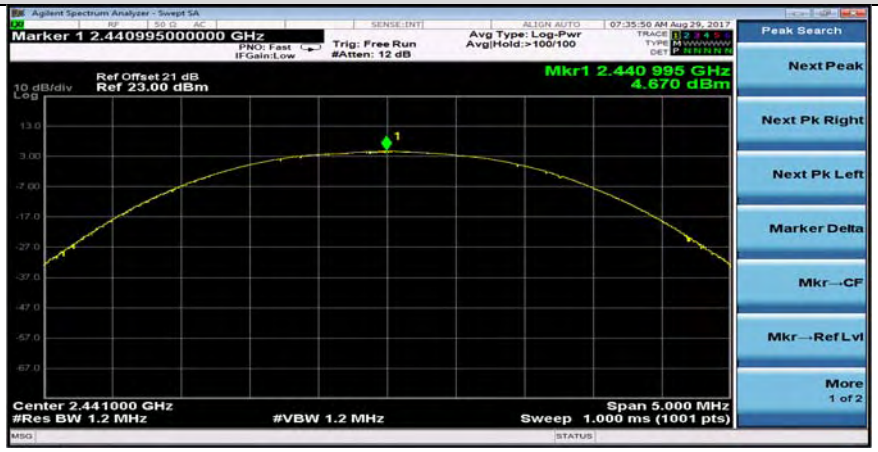
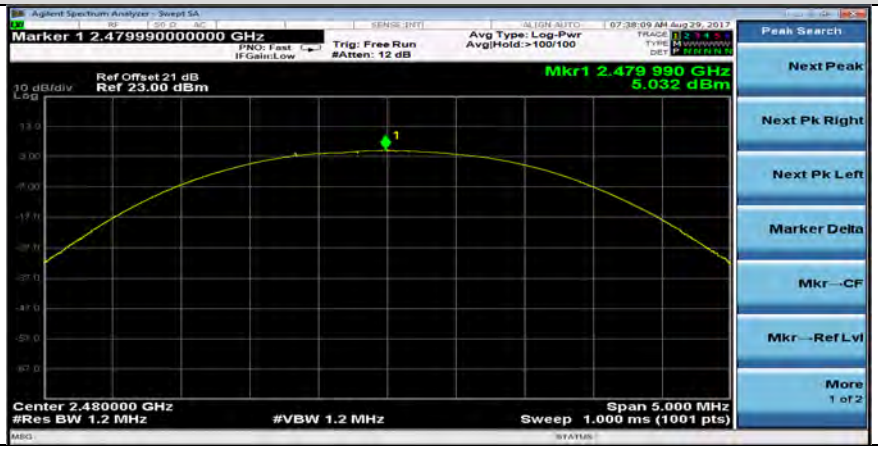
Maximum Peak Conducted Output Power
Modulation : GFSK / Packet Type: DH5 / Frequency: 2402 MHz

Modulation : GFSK / Packet Type: DH5 / Frequency: 2441 MHz

Modulation : GFSK / Packet Type: DH5 / Frequency: 2480 MHz


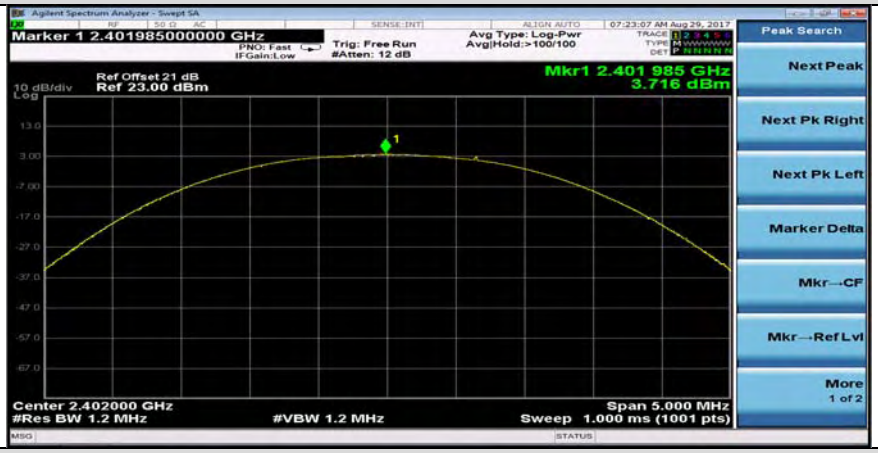
Maximum Peak Conducted Output Power
Modulation : GFSK / Packet Type: DH3 / Frequency: 2402 MHz

Modulation : GFSK / Packet Type: DH3 / Frequency: 2441 MHz

Modulation : GFSK / Packet Type: DH3 / Frequency: 2480 MHz

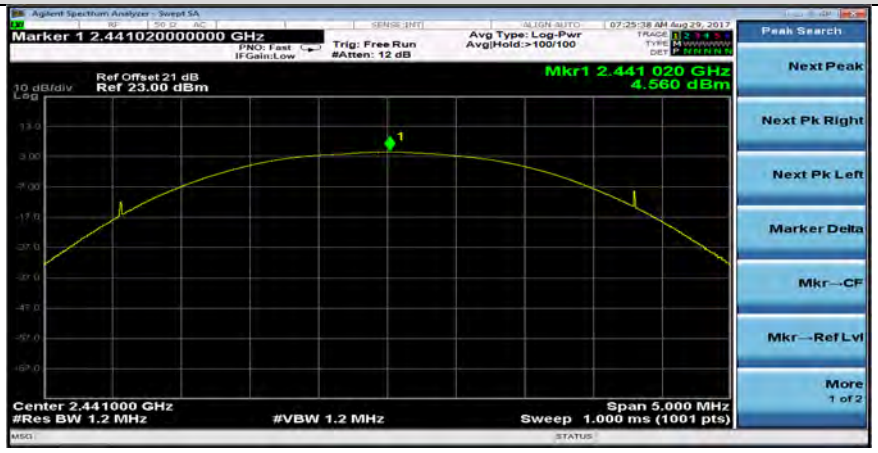

Maximum Peak Conducted Output Power
Modulation : GFSK / Packet Type: DH1 / Frequency: 2402 MHz

Modulation : GFSK / Packet Type: DH1 / Frequency: 2441 MHz

Modulation : GFSK / Packet Type: DH1 / Frequency: 2480 MHz


Maximum Peak Conducted Output Power
Modulation : π/4 DQPSK / Packet Type: 2-DH5 / Frequency: 2402 MHz

Modulation : π/4 DQPSK / Packet Type: 2-DH5 / Frequency: 2441 MHz

Modulation : π/4 DQPSK / Packet Type: 2-DH5 / Frequency: 2480 MHz


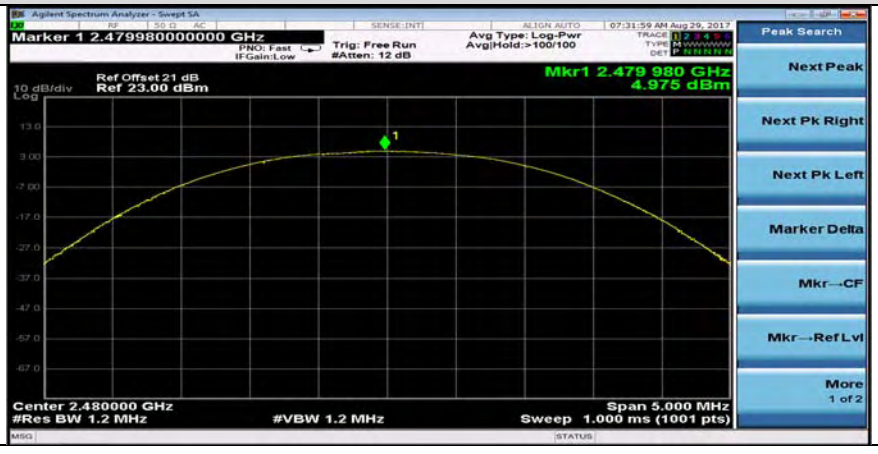
Maximum Peak Conducted Output Power
Modulation : π/4 DQPSK / Packet Type: 2-DH3 / Frequency: 2402 MHz



Modulation : π/4 DQPSK / Packet Type: 2-DH3 / Frequency: 2441 MHz

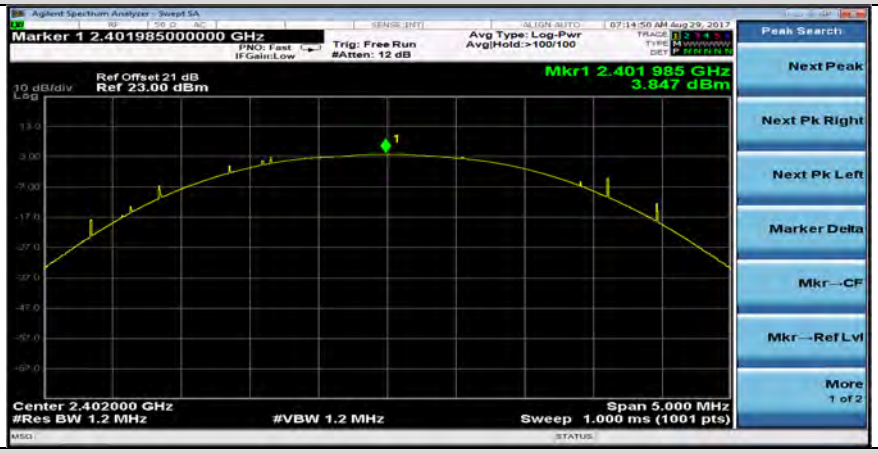


Modulation : π/4 DQPSK / Packet Type: 2-DH3 / Frequency: 2480 MHz



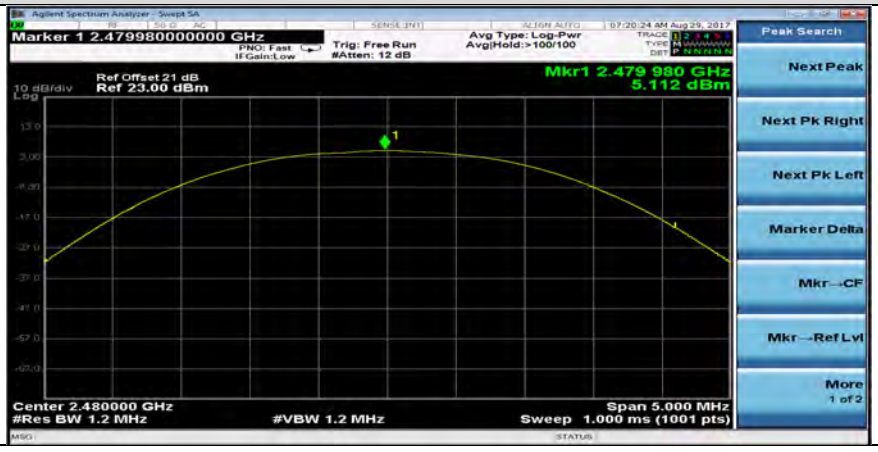
Maximum Peak Conducted Output Power

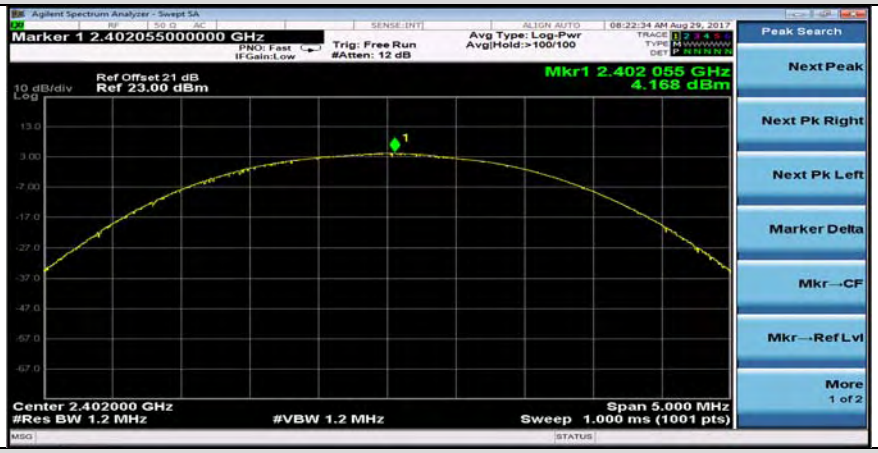
Modulation : π/4 DQPSK / Packet Type: 2-DH1 / Frequency: 2402 MHz



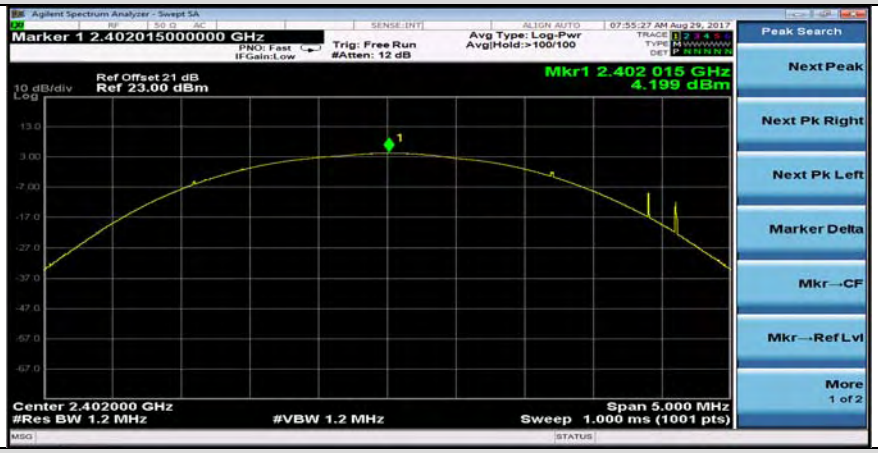
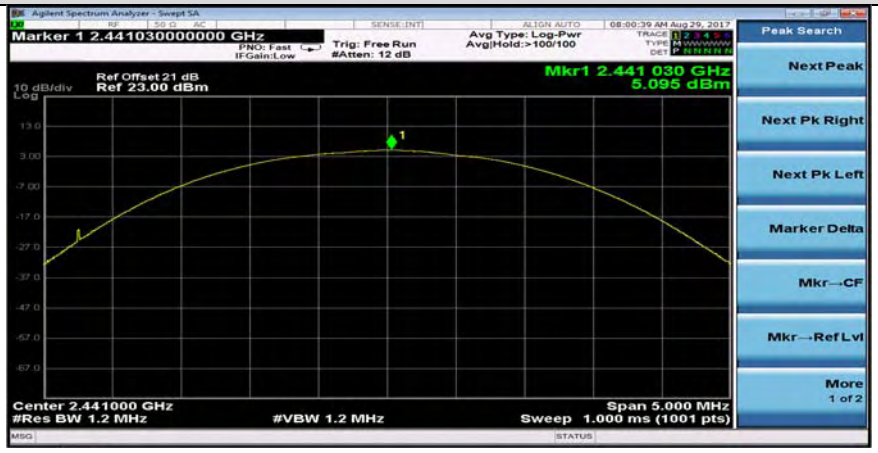
Modulation : π/4 DQPSK / Packet Type: 2-DH1 / Frequency: 2441 MHz

Modulation : π/4 DQPSK / Packet Type: 2-DH1 / Frequency: 2480 MHz

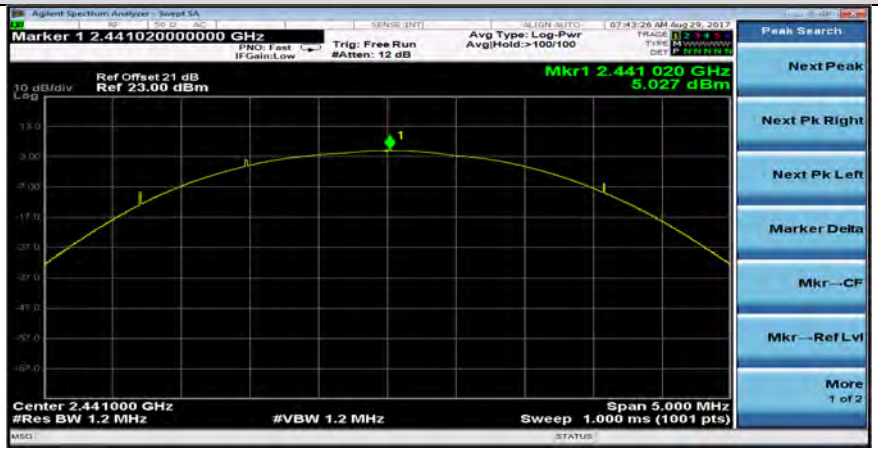
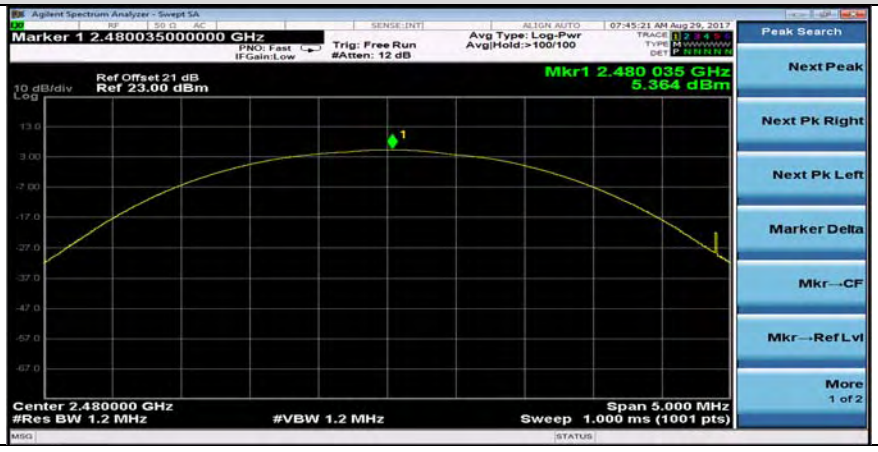


Maximum Peak Conducted Output Power
Modulation : 8DPSK / Packet Type: 3-DH5 / Frequency: 2402 MHz

Modulation : 8DPSK / Packet Type: 3-DH5 / Frequency: 2441 MHz

Modulation : 8DPSK / Packet Type: 3-DH5 / Frequency: 2480 MHz


Maximum Peak Conducted Output Power
Modulation : 8DPSK / Packet Type: 3-DH3 / Frequency: 2402 MHz

Modulation : 8DPSK / Packet Type: 3-DH3 / Frequency: 2441 MHz

Modulation : 8DPSK / Packet Type: 3-DH3 / Frequency: 2480 MHz


Maximum Peak Conducted Output Power
Modulation : 8DPSK / Packet Type: 3-DH1 / Frequency: 2402 MHz

Modulation : 8DPSK / Packet Type: 3-DH1 / Frequency: 2441 MHz

Modulation : 8DPSK / Packet Type: 3-DH1 / Frequency: 2480 MHz


A.3 Carrier Frequency Separation

A.3.1 Limits

FCC 15.247(a) (1) & RSS-247 5.1(2)
For frequency hopping systems operating in the 2400-2483.5MHz band may have hopping channel frequencies that are separated by 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternately, frequency hopping systems operating in the 2400-2483.5MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater, provided the system operates with an output power no greater than 125 mW.

A.3.2 Test Procedure

Refer Public Notice DA 00-705
The EUT must have its hopping function enabled. Use the following spectrum analyzer Settings:

- 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
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

A.3.3 Carrier Frequency Separation Data Table

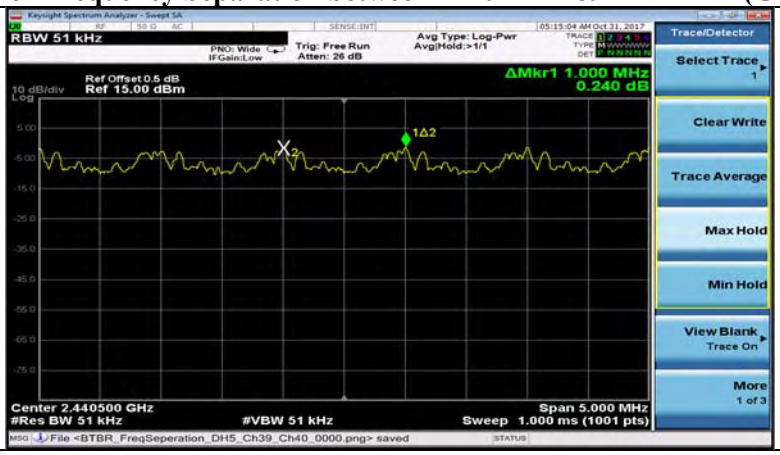
Frequency (MHz)	Modulation Systems	Carrier Frequency Separation (KHz)	Limits (KHz)	Results
2441 & 2442	GFSK	1000.00	≥ 984	Pass
2441 & 2442	π/4 DQPSK	1000.00	≥ 901	Pass
2441 & 2442	8- DPSK	1000.00	≥ 871	Pass

Note: For GFSK the limit is 20 dB bandwidth.
For π/4 DQPSK and 8DPSK, the limit is 2/3 of 20 dB bandwidth.

Tested By: Danh Le	**Date of testing:** 31-Oct-2017
Test Result : PASS	

A.3.4 Carrier Frequency Separation Graphical Results

Title: **Carrier Frequency Separation between 2440 MHz & 2441 MHz (GFSK-DH1)**



Title: **Carrier Frequency Separation between 2440 MHz & 2441 MHz (π/4 DQPSK-2DH1)**

Title: **Carrier Frequency Separation between 2440 MHz & 2441 MHz (8-DPSK-3DH1)**

A.4 Number of Hopping Frequencies

A.4.1 Limits

FCC 15.247(a) (iii) & RSS-247 (5.1) (4)
Frequency hopping systems operating in the band 2400-2483.5MHz shall use at least 15 hopping channels.

A.4.2 Test Procedures

Refer to Public Notice DA 00-705
The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

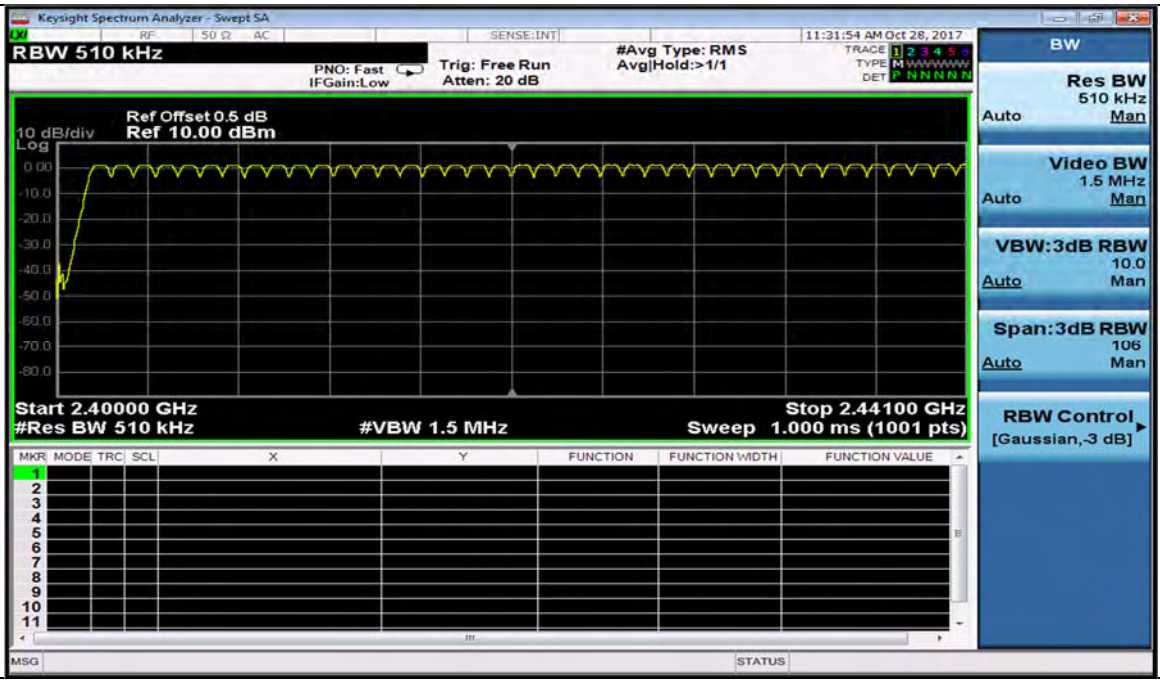
- Span = the frequency band of operation
- RBW > 1% of the span
- VBW > RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Allow the trace to stabilize
- It may prove necessary to break the span up to sections, in order to clearly show all of the hopping frequencies.

A.4.3 Number of Hopping Frequencies Data Table

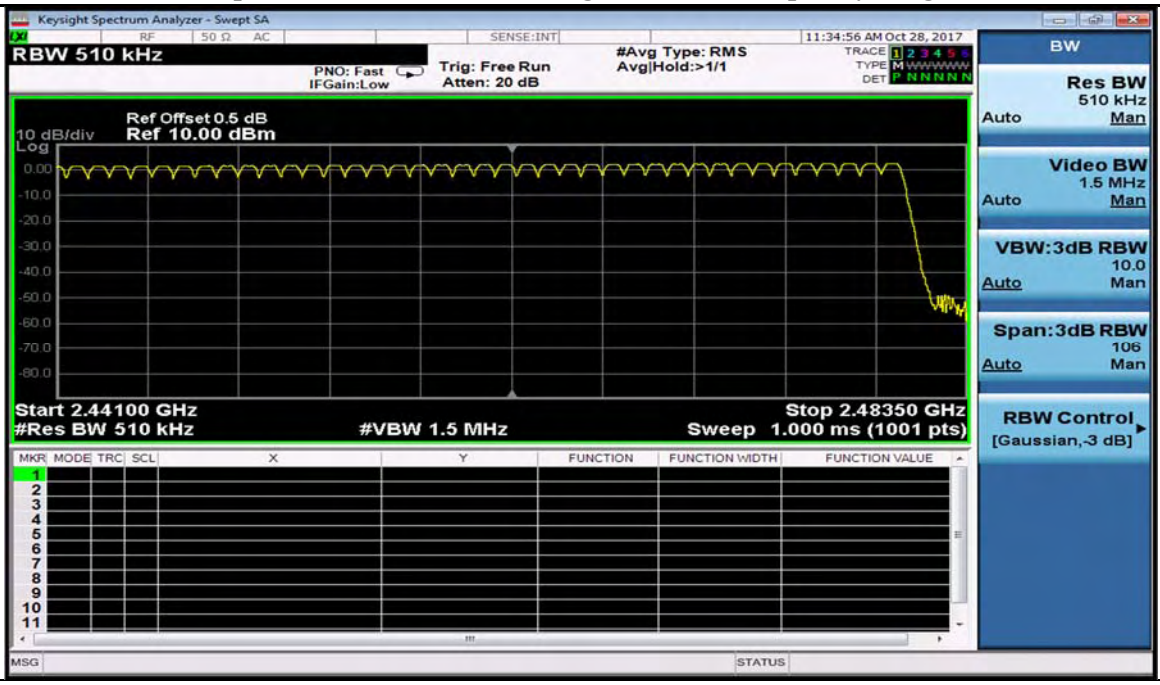
Frequency (MHz)	Total No. of Channels	Limits	Results
2400 – 2483.5	79	≥ 15	Pass
Total number of hopping frequencies in the 2400-2483.5MHz Band = 79 Channels			

Tested By: Danh Le	**Date of testing:** 28-Oct-2017
Test Result : PASS	

A.4.4 Number of Hopping Frequencies Graphical Test Results



Title: **Total No. of Hops Channels = 39.5 for 1st segment in the frequency range 2400-2440MHz**



Title: **Total No. of Hops Channels = 39.5 for 2nd segment in the frequency range 2441-2483.5MHz**

A.5 Average Time of Occupancy

A.5.1 Limits

FCC 15.247 (a) (iii) & RSS-247 (5.1) (4)
The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

A.5.2 Test Procedure

Refer to Public Notice DA 00 705
The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

- 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 function = peak
- Trace = 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

The total sweep time is 0.4(79) = 31.6 seconds.
Due to too many number of hops in the 31.6s sweep, we determined to reduce the sweep time to 15.80, count the number of hops and multiply by 2. The total number of hops will be multiplied by the measured time of one pulse (dwell-time).

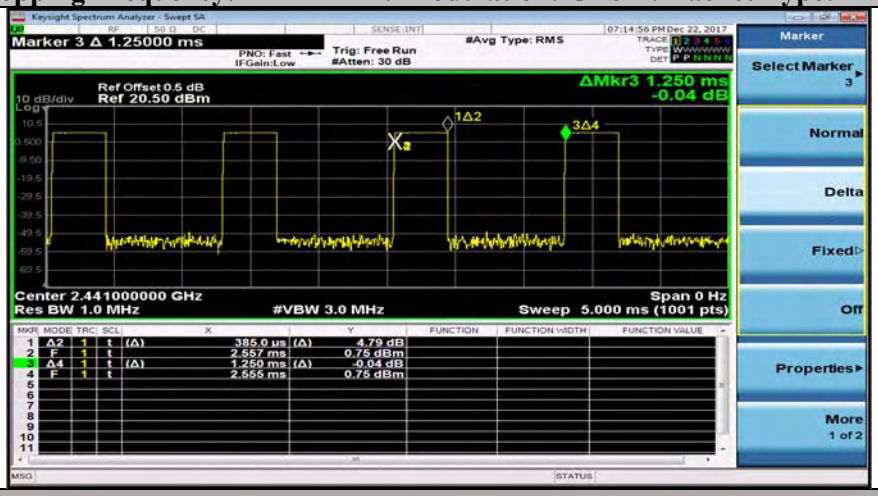
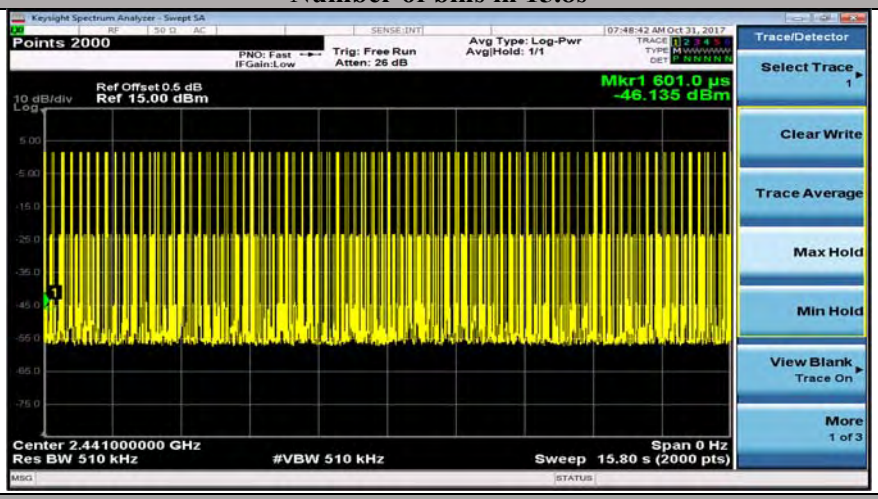
Example: Number of Hops in 15.80s = 80. Total Number of Hops in 31.6s = 80 (2) = 160
Single Pulse Width = 0.001s. Time of Occupancy = 160 (0.001) = 0.160s

Tested By: Danh Le	**Date of testing:** 31-Oct-2017 – 10-Jan-2018
Test Result : PASS	

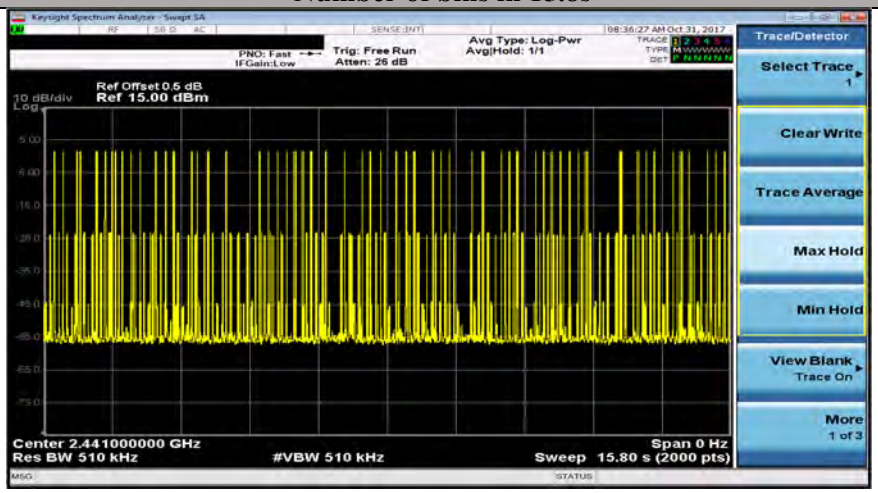
A.5.3 Average Time of Occupancy and Dwell Time Data table

Frequency (MHz)	Packet Type	Dwell Time (ms)	Time Occupancy (ms)	Limits (ms)	Results
2441	DH1	0.385	116.3	400	Pass
2441	DH3	1.63	238.0	400	Pass
2441	DH5	2.87	333.0	400	Pass
2441	2-DH1	0.385	111.6	400	Pass
2441	2-DH3	1.64	275.5	400	Pass
2441	2-DH5	2.885	271.2	400	Pass
2441	3-DH1	0.385	116.3	400	Pass
2441	3-DH3	1.64	257.5	400	Pass
2441	3-DH5	2.89	277.4	400	Pass

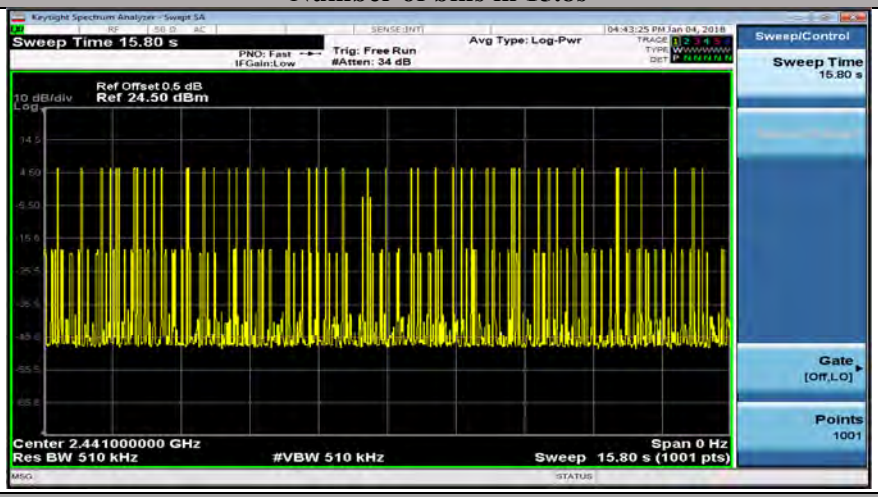
A.5.4 Average Time of Occupancy, Dwell Time Graphical Test Results & Calculation

Dwell Time
Hopping Frequency: 2441 MHz / Modulation: GFSK / Packet Type: DH1

Number of bins in 15.8s


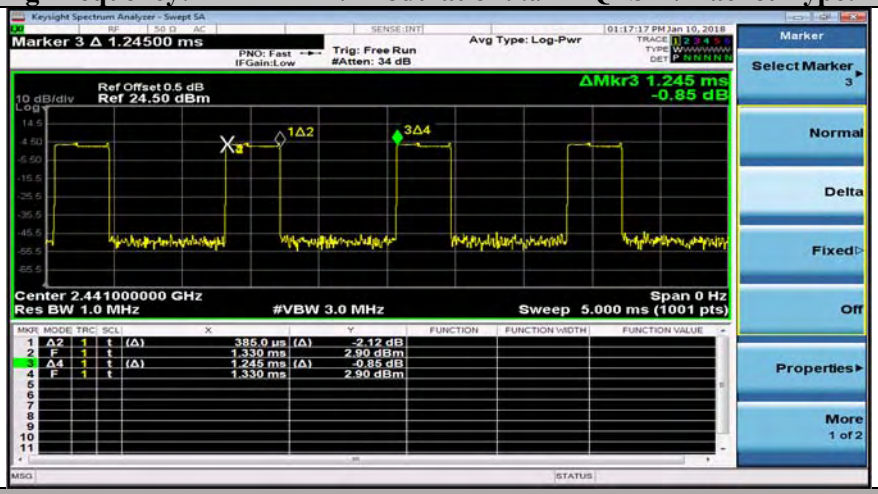
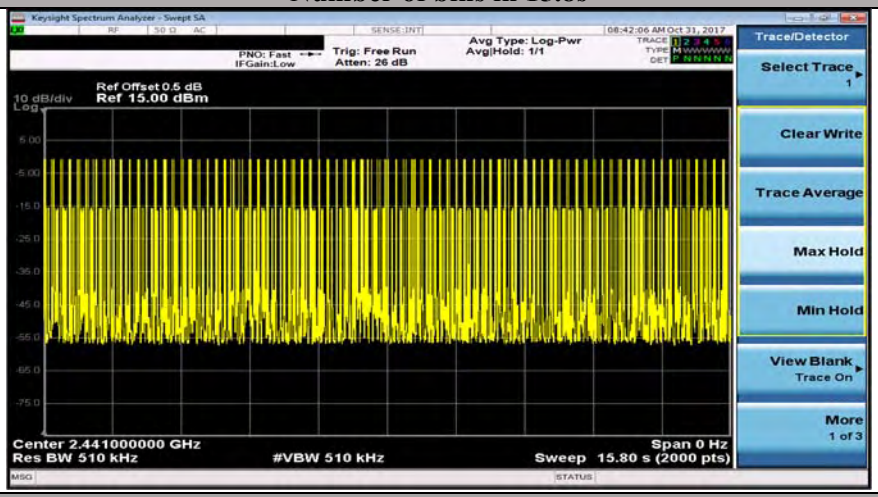
Average Time of Occupancy Calculation	
Mode/Packet Type: GFSK/ DH1	Dwell Time = **0.385ms** Total bins in 15.8 s =151 Max. Allowed time window = 0.4s x No. of available channels = 0.4s x 79 = 31.6s Max. Allowed time = 0.4s Total bins in 31.6s = 151 (in 15.8s) x 2 = 302 bins Total time occupancy (in 31.6s) = 302 x 0.385ms = 116.3ms or **0.116s**

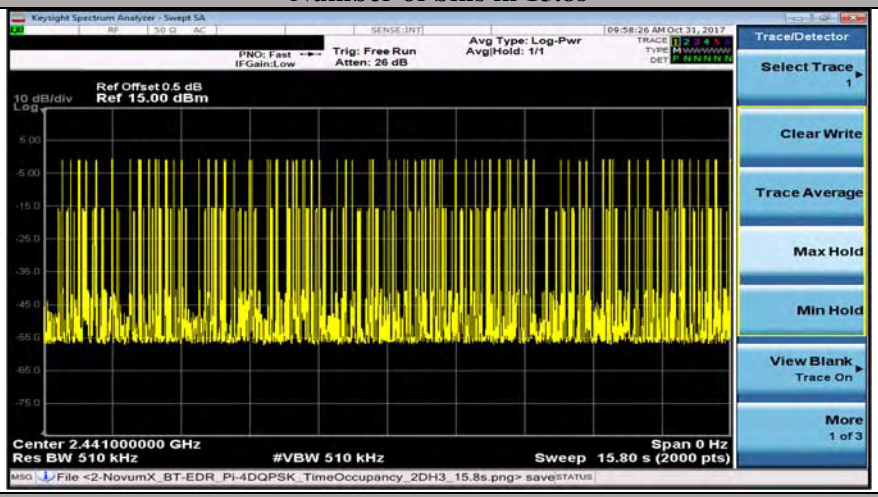
Dwell Time	
Hopping Frequency: 2441 MHz / Modulation: GFSK / Packet Type: DH3	
	
Number of bins in 15.8s	
	
Mode/Packet Type: GFSK/ DH3	Dwell Time = **1.63ms** Total bins in 15.8 s = 73 Max. Allowed time window = 0.4s x No. of available channels = 0.4s x 79 = 31.6s Max. Allowed time = 0.4s Total bins in 31.6s = 73 (in 15.8s) x 2 = 146 bins Total time occupancy (in 31.6s) = 146 x 1.63ms = 238.0ms or **0.238s**

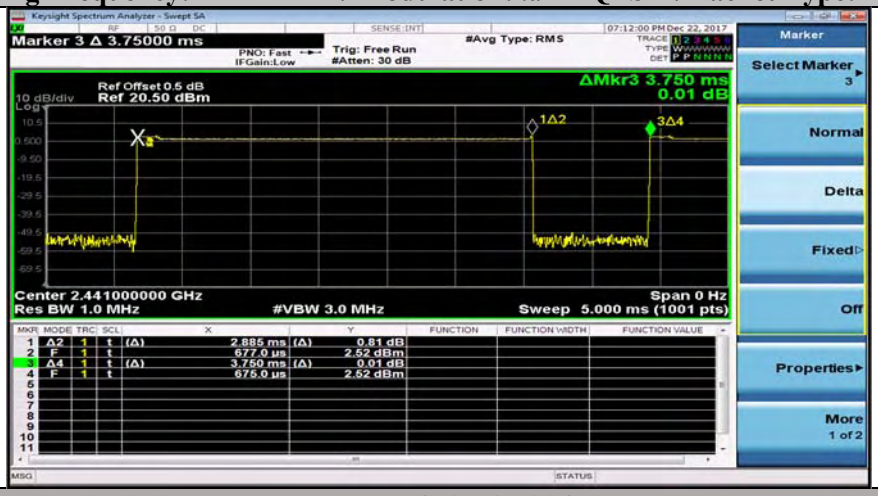
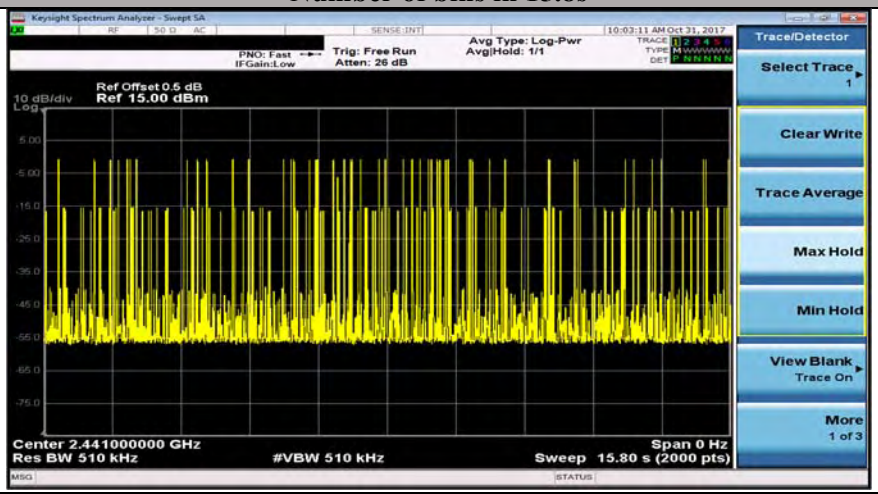
Dwell Time
Hopping Frequency: 2441 MHz / Modulation: GFSK / Packet Type: DH5

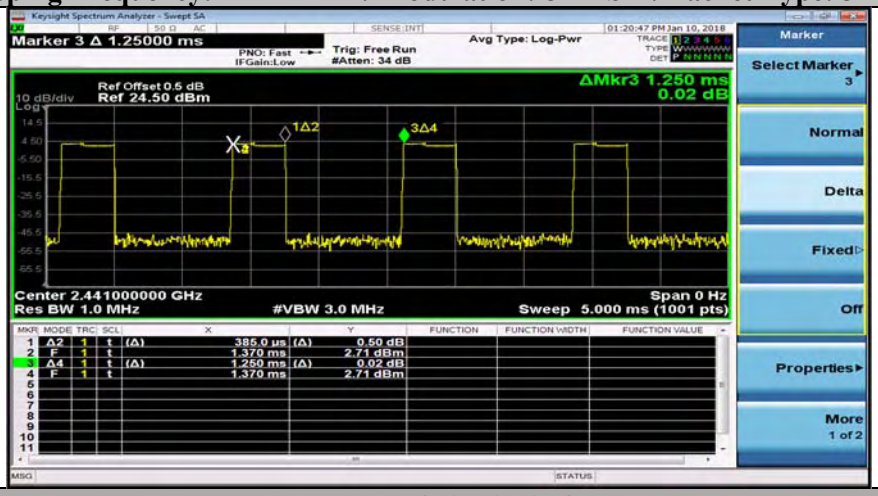
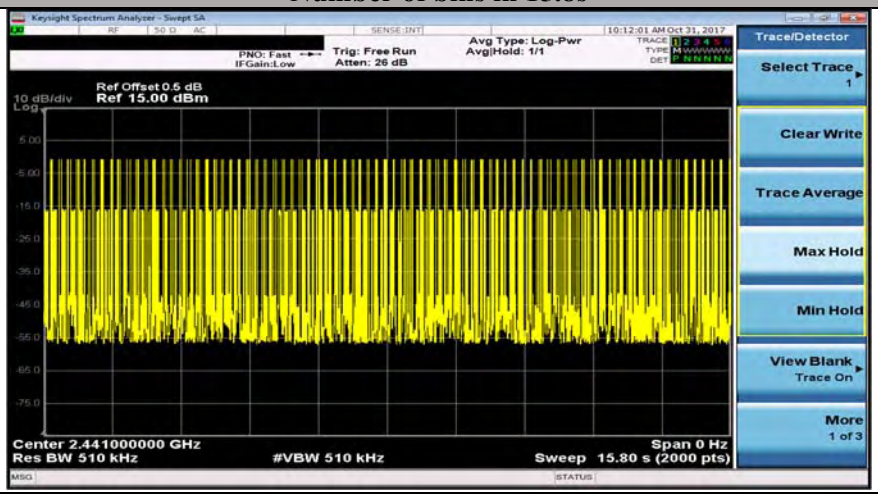
Number of bins in 15.8s

Average Time of Occupancy Calculation

Mode/Packet Type: GFSK/ DH5	Dwell Time = **2.87ms** Total bins in 15.8s = 58 Max. Allowed time window = 0.4s x No. of available channels = 0.4s x 79 = 31.6s Max. Allowed time = 0.4s Total bins in 31.6s = 58 (in 15.8s) x 2 = 166 bins Total time occupancy (in 31.6s window) = 166 x 2.87ms = 332.9ms or **0.333s**

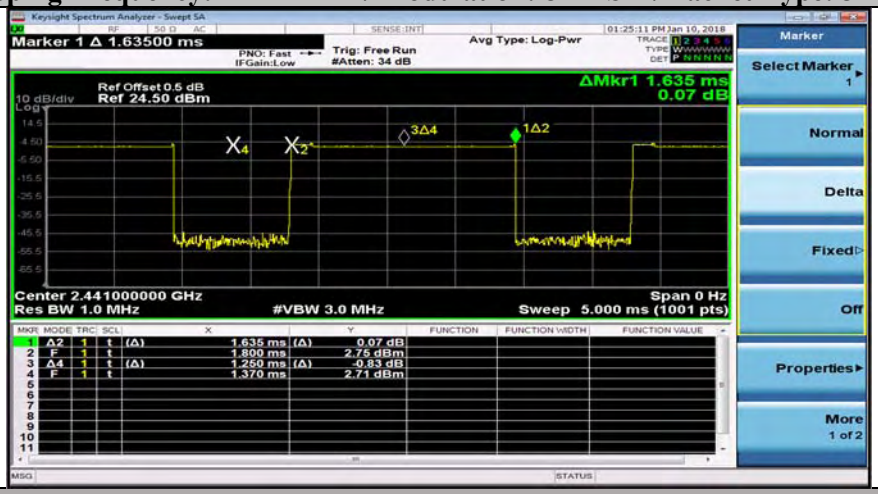
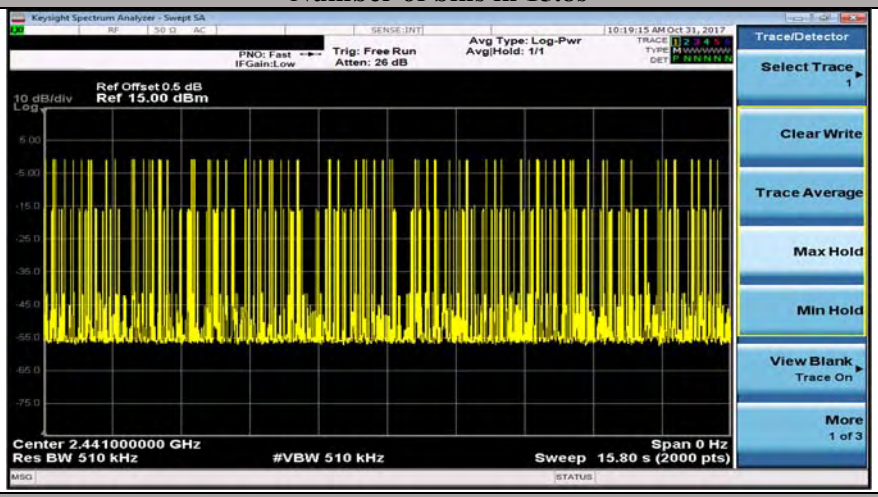
Dwell Time	
Hopping Frequency: 2441 MHz / Modulation: π/4 DQPSK / Packet Type: 2-DH1	
	
Number of bins in 15.8s	
	
Average Time of Occupancy Calculation	
Mode/Packet Type: π/4DQPSK/ 2-DH1	Dwell Time = **0.385** Total bins in 15.8 s = 145 Max. Allowed time window = 0.4s x No. of available channels = 0.4s x 79 = 31.6s Max. Allowed time = 0.4s Total bins in 31.6s = 145 (in 15.8s) x 2 = 290 bins Total time occupancy (in 31.6s) = 290 x 0.385ms = 111.6ms or **0.112s**

Dwell Time	
Hopping Frequency: 2441 MHz / Modulation: π/4 DQPSK / Packet Type: 2-DH3	
	
Number of bins in 15.8s	
	
Average Time of Occupancy Calculation	
Mode/Packet Type: π/4 DQPSK/ 2-DH3	Dwell Time = **1.64ms** Total bins in 15.8 s = 84 Max. Allowed time window = 0.4s x No. of available channels = 0.4s x 79 = 31.6s Max. Allowed time = 0.4s Total bins in 31.6s = 84 (in 15.8s) x 2 = 168 bins Total time occupancy (in 31.6s) = 168 x 1.64ms = 275.5ms or 0.**276s**

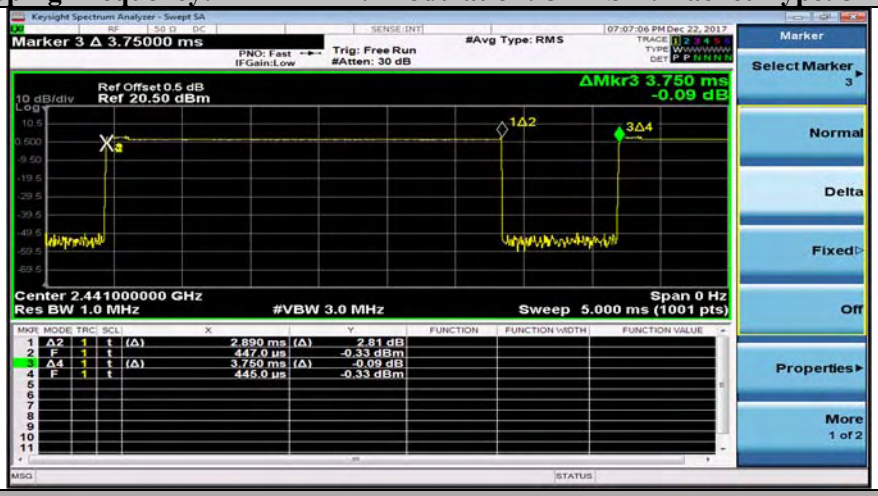
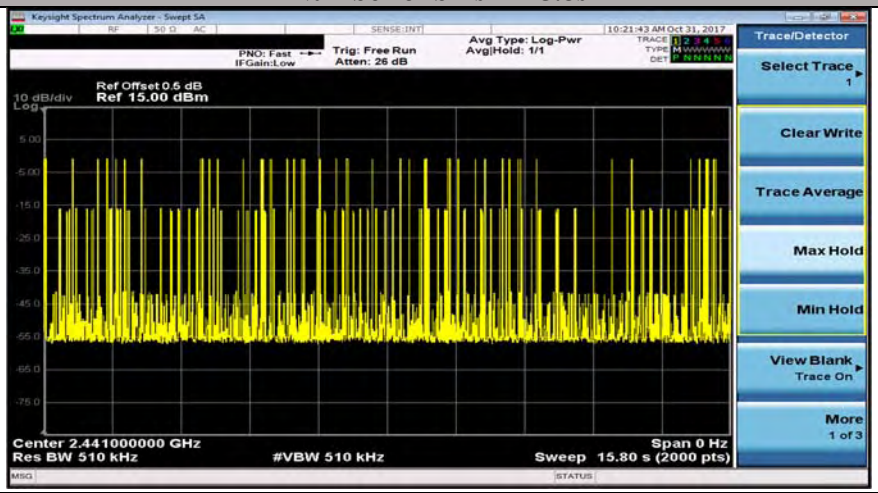
Dwell Time	
Hopping Frequency: 2441 MHz / Modulation: π/4 DQPSK / Packet Type: 2-DH5	
	
Number of bins in 15.8s	
	
Average Time of Occupancy Calculation	
Mode/Packet Type: π/4DQPSK/ 2-DH5	Dwell Time = **2.885 ms** Total bins in 15.8s = 47 Max. Allowed time window = 0.4 s x No. of available channels = 0.4s x 79 = 31.6s Max. Allowed time = 0.4s Total bins in 31.6s = 47 (in 15.8s) x 2 = 94 bins Total time occupancy (in 31.6s) = 94 x 2.885ms = 271.2ms or **0.271s**

Dwell Time
Hopping Frequency: 2441 MHz / Modulation: 8-DPSK / Packet Type: 3-DH1

Number of bins in 15.8s


Mode/Packet Type: 8DPSK / 3-DH1	Dwell Time = **0.385** Total bins in 15.8 s = 151 Max. Allowed time window = 0.4 s x No. of available channels = 0.4s x 79 = 31.6s Max. Allowed time = 0.4s Total bins in 31.6s = 151 (in 15.8s) x 2 = 302 bins Total time occupancy (in 31.6s) = 302 x 0.385ms = 116.3ms or **0.116s**

Dwell Time
Hopping Frequency: 2441 MHz / Modulation: 8-DPSK / Packet Type: 3-DH3

Number of bins in 15.8s


Mode/Packet Type: 8DPSK / 3-DH3	Dwell Time = **1.63ms** Total bins in 15.8 s = 79 Max. Allowed time window = 0.4 s x No. of available channels = 0.4s x 79 = 31.6s Max. Allowed time = 0.4s Total bins in 31.6s = 79 (in 15.8s) x 2 = 158 bins Total time occupancy (in 31.6s) = 158 x 1.63ms = 257.5ms or **0.257s**

Dwell Time
Hopping Frequency: 2441 MHz / Modulation: 8-DPSK / Packet Type: 3-DH5

Number of bins in 15.8s


Mode/Packet Type: 8DPSK / 3-DH5	Dwell Time = **2.89ms** Total bins in 15.8s = 48 Max. Allowed time window = 0.4 s x No. of available channels = 0.4s x 79 = 31.6s Max. Allowed time = 0.4s Total bins in 31.6s = 48 (in 15.8s) x 2 = 96 bins Total time occupancy (in 31.6s) = 96 x 2.89ms = 277.4ms or **0.277s**

A.6 Conducted Band Edge

A.6.1 Limits

15.247 (d) & RSS-247 (5.5)

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 below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in FCC §15.209(a) & RSS-Gen is not required.

A.6.2 Test Procedure

Refer to Public notice DA-00 705

- Use the following spectrum analyzer settings:
- Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation
- RBW ≥ 1% of the span
- VBW ≥ RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Allow the trace to stabilize.
- Set the Bluetooth in hopping disabled mode. Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. The marker-delta value now displayed must comply with the limit specified in this Section. Submit this plot.
- Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit. Submit this plot.

Tested By: Danh Le	**Date of testing:** 31-Aug-2017
Test Result : PASS	

A.6.3 Conducted Band Edge Graphical Test Results

Conducted Band Edge (Hoping Disable)			
Hopping on Channel: 0 (2402MHz)	**Lower BE**	**Hopping on Channel: 78 (2480MHz)**	**Higher BE**
Basic Rate (1Mbps) Modulation/Packet Type: GFSK/DH1			
			
Enhance Data Rate (2Mbps) Modulation/Packet Type: π/4 DQPSK / 2-DH1			
			
Enhance Data Rate (3Mbps) Modulation/Packet Type: 8DPSK/3-DH1			
			

Conducted Band Edge (Hopping Enable)

Hopping on all channels	Lower BE	Hopping on all channels	Higher BE

Basic Rate (1Mbps) Modulation/Packet Type: GFSK/DH1

Enhance Data Rate (2Mbps) Modulation/Packet Type: π/4 DQPSK / 2-DH1

Enhance Data Rate (3Mbps) Modulation/Packet Type: 8DPSK/3-DH1

A.7 Restricted Bands

A.7.1 Limits

FCC 15.247(e); RSS-Gen 8.10

FCC: Radiated emissions which fall in the restricted bands, as defined in FCC §15.205(a), must also comply with the radiated emission limits specified in Sec. 15.209(a).

RSS: Unwanted emissions falling into restricted bands of Table 6 shall comply with the limits specified in RSS-Gen

A.7.2 Test Procedure

Refer to Public notice DA-00 705

- Set the Bluetooth in the transmitter mode at the maximum level.
- Use the following spectrum analyzer settings:

For peak measurement:

- Span = wide enough to fully capture the emission being measured.
- RBW = 1 MHz for above 1 GHz
- VBW ≥ RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Allow the trace to stabilize.
- Set the marker on the peak of any spurious emission using peak search function. The level displayed must comply with the limit specified in this Section
- Submit this plot.

For average measurement:

- Span = wide enough to fully capture the emission being measured.
- RBW = 1 MHz for above 1 GHz
- VBW =10 Hz
- Sweep = auto
- Detector function = peak
- Allow the trace to stabilize.
- Set the marker on the peak of any spurious emission using peak search function. The level displayed must comply with the limit specified in this Section
- Submit this plot.

RSS: Unwanted emissions falling into restricted bands of Table 3 shall comply with the limits specified in RSS-Gen 7.2.5.

Tested By: Danh Le	**Date of testing:** 05-Jan-2018
Test Result : PASS	

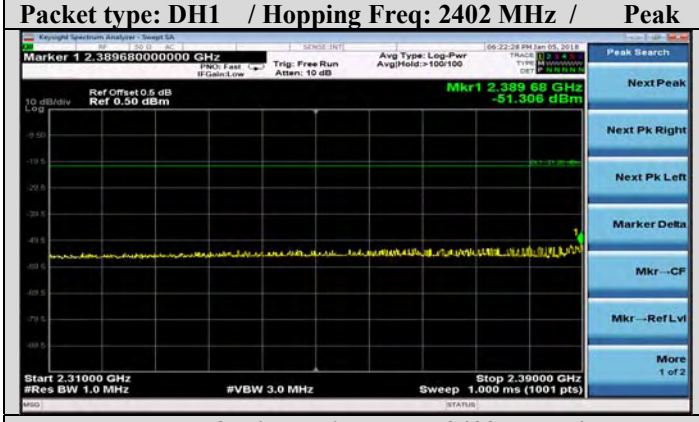
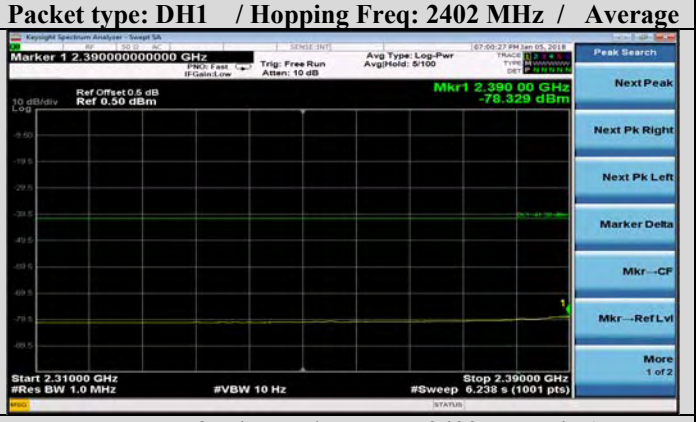
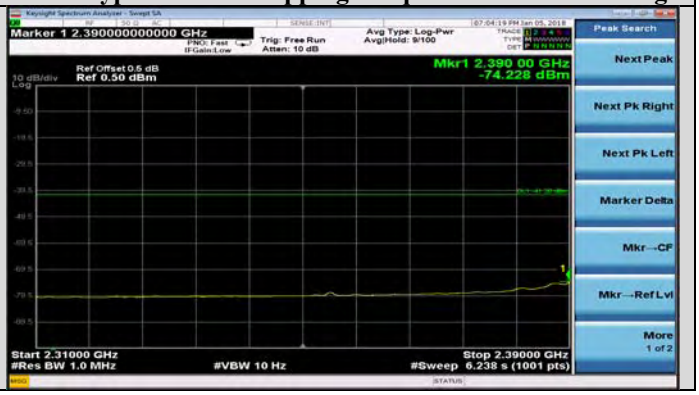
A.7.3 Restricted Bands Test Data

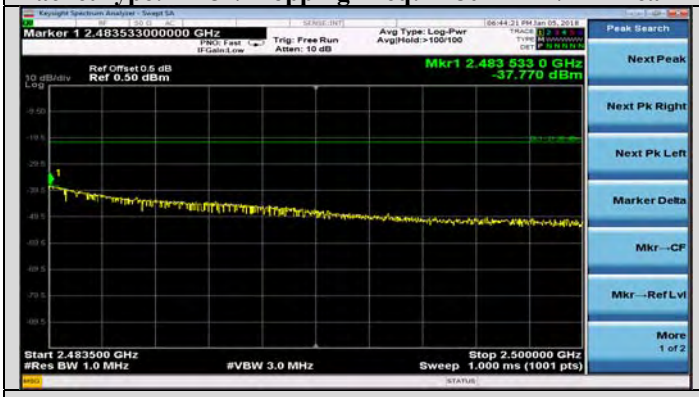
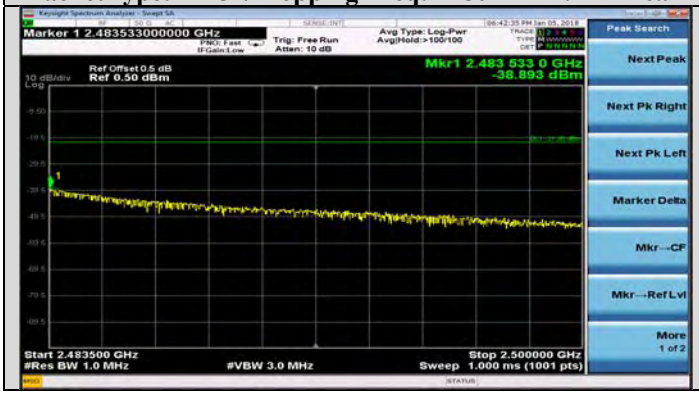
Operating Frequency (MHz)	Data Rate (Mbps)	DCCF (dB)	A.G (dBi)	Restricted Bands (MHz)	Max. Power Level (dBm)	E.I.R.P (dBm)	Limit (dBm)	Result
GFSK/DH1								
2402	1	N/A	1.24	2310–2390	-51.31	-52.55	-21.2	Pass
2402	1	N/A	1.24	2310–2390	-78.33*	-79.57*	-41.2*	Pass
2480	1	N/A	1.24	2483.5-2500	-40.52	-41.76	-21.2	Pass
2480	1	N/A	1.24	2483.5-2500	-68.30*	-69.54*	-41.2*	Pass
GFSK/DH3								
2402	1	N/A	1.24	2310–2390	-48.44	-49.68	-21.2	Pass
2402	1	N/A	1.24	2310–2390	-75.23*	-76.47*	-41.2*	Pass
2480	1	N/A	1.24	2483.5-2500	-37.77	-39.01	-21.2	Pass
2480	1	N/A	1.24	2483.5-2500	-65.50*	-66.74*	-41.2*	Pass
GFSK/DH5								
2402	1	N/A	1.24	2310–2390	-48.36	-49.60	-21.2	Pass
2402	1	N/A	1.24	2310–2390	-75.23*	-76.47*	-41.2*	Pass
2480	1	N/A	1.24	2483.5-2500	-38.89	-40.13	-21.2	Pass
2480	1	N/A	1.24	2483.5-2500	-64.64*	-65.88*	-41.2*	Pass

Note1: *Correction factors (ext. attenuation + cable loss) are compensated in the offset function of the measuring instrument. The readings with * at the end represent measurements in average.*

Note2: *GFSK modulation produces the highest output power which represents the worst case.*

A.7.4 Restricted Bands Graphical Test Results

Lower Restricted Bands (2310-2390MHz)	
Modulation: GFSK	
Packet type: DH1 / Hopping Freq: 2402 MHz / Peak	Packet type: DH1 / Hopping Freq: 2402 MHz / Average
	
Packet type: DH3 / Hopping Freq: 2402 MHz / Peak	Packet type: DH3 / Hopping Freq: 2402 MHz / Average
	
Packet type: DH5 / Hopping Freq: 2402 MHz / Peak	Packet type: DH5 / Hopping Freq: 2402 MHz / Average
	

Upper Restricted Bands (2483.5-2500MHz)	
Operating Frequency: 2480 MHz / Modulation: GFSK	
Packet type: DH1 / Hopping Freq: 2480 MHz / Peak	**Packet type: DH1 / Hopping Freq: 2480 MHz / Average**
	
PacketType: DH3 / Hopping Freq: 2480 MHz / Peak	**PacketType: DH3 / Hopping Freq: 2480 MHz / Average**
	
PacketType: DH5 / Hopping Freq: 2480 MHz / Peak	**PacketType: DH5 / Hopping Freq: 2480 MHz / Average**
	

Appendix B: Radiated Test Results

B.1 Transmitter Spurious Emissions & Restricted Bands

Emissions on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

RSS-Gen 6.13: In measuring unwanted emissions, the spectrum shall be investigated from 30 MHz or the lowest radio frequency signal generated in the equipment, whichever is lower, without going below 9 kHz, up to at least the frequency given below:

(a) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

(b) If the equipment operates at or above 10 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.

Restricted Bands

RSS-Gen 8.10 (**b**) Unwanted emissions that fall into restricted bands of Table 6 shall comply with the limits specified in RSS-Gen; and (**c**) Unwanted emissions that do not fall within the restricted frequency bands of Table 6 shall comply either with the limits specified in the applicable RSS or with those specified in this RSS-Gen.

Table 6 Restricted Bands

MHz	MHz	GHz
0.090-0.110	74.8-75.2	9.0-9.2
2.1735-2.1905	108-138	9.3-9.5
3.020-3.026	156.52475-156.52525	10.6-12.7
4.125-4.128	156.7-156.9	13.25-13.4
4.17725-4.17775	240-285	14.47-14.5
4.20725-4.20775	322-335.4	15.35-16.2
5.677-5.683	399.9-410	17.7-21.4
6.215-6.218	608-614	22.01-23.12
6.26775-6.26825	960-1427	23.6-24.0
6.31175-6.31225	1435-1626.5	31.2-31.8
8.291-8.294	1645.5-1646.5	36.43-36.5
8.362-8.366	1660-1710	Above 38.6
8.37625-8.38675	1718.8-1722.2	*
8.41425-8.41475	2200-2300	
12.29-12.293	2310-2390	
12.51975-12.52025	2655-2900	
12.57675-12.57725	3260-3267	
13.36-13.41	3332-3339	
16.42-16.423	3345.8-3358	
16.69475-16.69525	3500-4400	
16.80425-16.80475	4500-5150	
25.5-25.67	5350-5460	
37.5-38.25	7250-7750	
73-74.6	8025-8500	

B.1.1 Limits

FCC 15.209; RSS-Gen 8.10 Issue 4

The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the table specified in the table in FCC§15.209(a) and in RSS-Gen 8.9 table 4.

15.209 (a) except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (uV/meter)	Field strength (dBuV/meter)	Measurement distance (meters)
30-88	100**	40 Qp	3
88-216	150**	43.5 Qp	3
216-960	200**	46 Qp	3
Above 960	500	54 Av / 74 Pk	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz However, operation within These frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz Radiated emission limits in these three bands are based on measurements employing an average detector

B.1.2 Test Procedure

Ref. C63.10-2013 section 6.5 & 6.6

Test Procedure
1. Using Vasona software, configure the spectrum analyzer as below (be sure to enter all losses between the transmitter output and the spectrum analyzer). 2. Place the radio in hopping on single channel transmit mode. Maximize Turntable (find worst case table angle) and maximize Antenna (find worst case height). 3. Use the peak marker function to determine the maximum amplitude level. 4. Center marker frequency and perform final measurement in Quasi-peak (≤ 1Ghz) and Average (above 1 GHz) 4. Record at least 6 highest readings for the worst case operating mode.

Ref. C63.10-2013 section 4 / CISPR16-1-1

Test Parameters
Span = Entire frequency range or segment if necessary. Reference Level = 80 dBuV RBW = 100 kHz (less than or equal to 1 GHz); 1 MHz (above 1 GHz) VBW ≥ 3 x RBW Detector = Peak & Quasi-Peak (frequency range 30 MHz to 1 GHz); Peak & Average (frequency range above 1 GHz); Changing VBW to 10 Hz for average measurement Sweep Time = Couple

. The system was evaluated up to 26 GHz but there were no measurable emissions above 18 GHz.
. These data represent the worst case mode data for all supported operating modes and antennas.

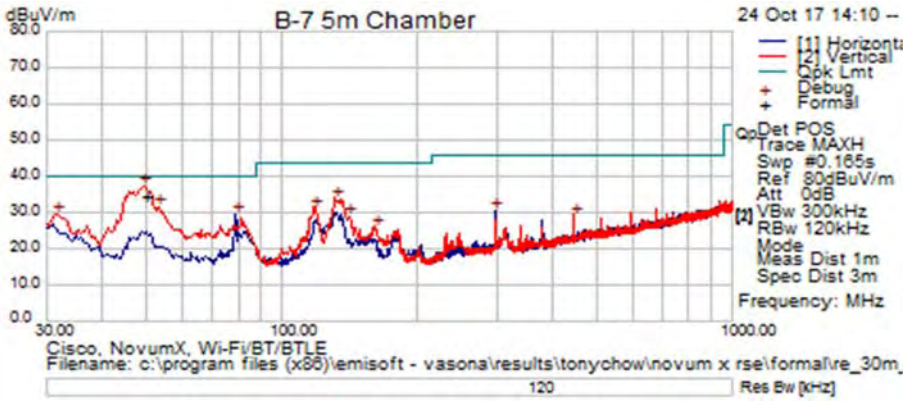
- For emissions below 1000 MHz, measurements shall be performed using a CISPR quasi-peak detector and the related measurement bandwidth. As an alternative to CISPR quasi-peak measurement, compliance with the emission limit can be demonstrated using measuring equipment employing a peak detector function properly adjusted for factors such as pulse desensitization as required, with an equal or greater measurement bandwidth relative to the applicable CISPR quasi-peak bandwidth.
- Above 1000 MHz, measurements shall be performed using an average detector with a minimum Resolution bandwidth of 1 MHz

Note1: A Notch Filter was used during formal testing from 1 – 18GHz to help prevent the front end of the analyzer from over loading. The Notch filters used are designed to suppress TX fundamental frequency but do not effect harmonics of the fundamental frequency from being measured

Note2: The data displayed on the plots detailed in this appendix were measured using a 'Peak Detector'. Please refer to the results table for the detectors used during formal measurements

B.1.3 Transmitter Radiated Spurious Emissions Graphical Data Results

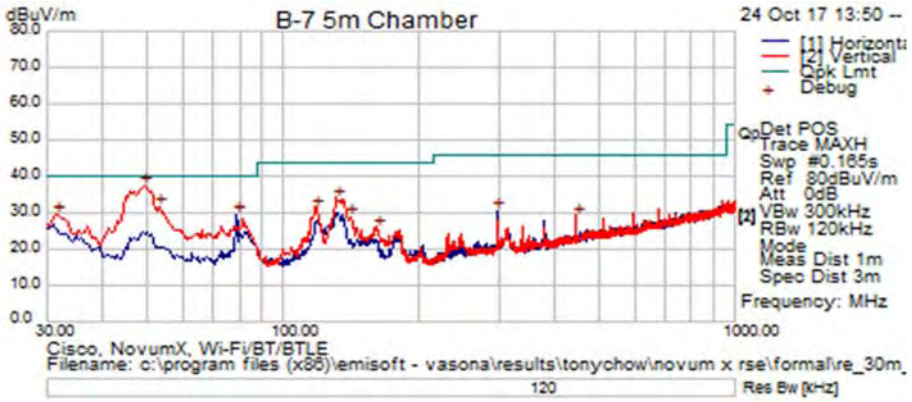
Subtest Date:	24-Oct-2017
Engineer	Danh Le, Zain Ali
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	30MHz-1GHz
Comments on the above Test Results	GFSK/DH1; Tx Channel 0 (2402 MHz)



Title: **TX Spurious Emissions from 30MHz-1GHz – Ch0 (2402 MHz)**

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
48.915	38.23	0.77	-1.21	37.8	Peak	V	100	0	40	-2.2	Pass	Tx/Ch0
48.958	34.75	0.77	-1.23	34.3	Quasi Max	V	101	329	40	-5.7	Pass	Tx/Ch0
53.28	32.87	0.83	-2.27	31.43	Peak	V	100	0	40	-8.57	Pass	Tx/Ch0
78.5	31.68	1	-1.69	30.99	Peak	V	100	0	40	-9.01	Pass	Tx/Ch0
135.245	28.49	1.3	4.03	33.82	Peak	V	100	0	43.5	-9.68	Pass	Tx/Ch0
31.455	18.04	0.62	10.89	29.54	Peak	V	200	0	40	-10.46	Pass	Tx/Ch0
118.755	27.32	1.23	4.33	32.88	Peak	V	100	0	43.5	-10.62	Pass	Tx/Ch0
141.55	24.14	1.33	3.4	28.87	Peak	V	100	0	43.5	-14.63	Pass	Tx/Ch0
594.055	19.38	2.76	8.96	31.1	Peak	H	100	0	46	-14.9	Pass	Tx/Ch0
297.235	23.96	1.94	3.78	29.68	Peak	H	100	0	46	-16.32	Pass	Tx/Ch0
445.645	19.53	2.38	7.26	29.17	Peak	V	100	0	46	-16.83	Pass	Tx/Ch0

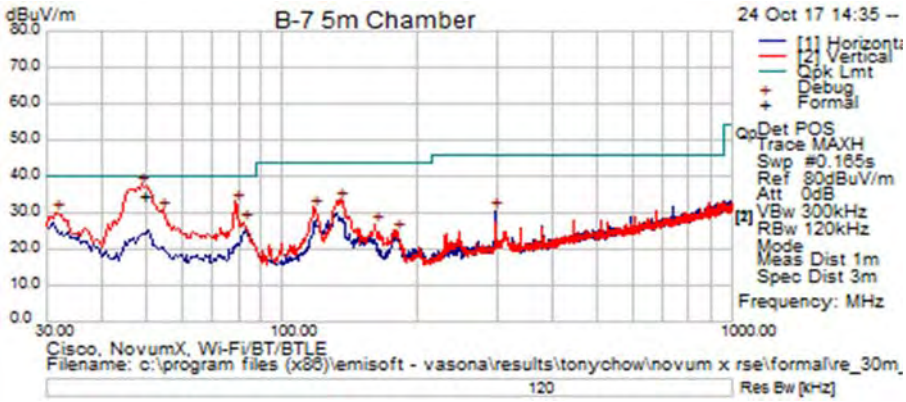
Subtest Date:	24-Oct-2017
Engineer	Danh Le, Zain Ali
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	30MHz-1GHz
Comments on the above Test Results	GFSK/DH1; Tx Channel 39 (2441 MHz)



Title: **TX Spurious Emissions from 30MHz-1GHz – Ch39 (2441 MHz)**

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
49.4	37.85	0.78	-1.36	37.27	Peak	V	100	0	40	-2.73	Pass	Tx/Ch39
49.53325	35.43	0.78	-1.4	34.8	Quasi Max	V	108	47	40	-5.2	Pass	Tx/Ch39
53.28	33.06	0.83	-2.27	31.62	Peak	V	100	0	40	-8.38	Pass	Tx/Ch39
131.365	28.25	1.28	4.32	33.86	Peak	V	100	0	43.5	-9.64	Pass	Tx/Ch39
31.455	18.04	0.62	10.89	29.54	Peak	V	100	0	40	-10.46	Pass	Tx/Ch39
78.985	30.1	1.01	-1.74	29.36	Peak	H	200	0	40	-10.64	Pass	Tx/Ch39
118.27	25.9	1.23	4.28	31.41	Peak	V	100	0	43.5	-12.09	Pass	Tx/Ch39
141.065	24.3	1.32	3.45	29.08	Peak	V	100	0	43.5	-14.42	Pass	Tx/Ch39
297.235	24.66	1.94	3.78	30.39	Peak	H	100	0	46	-15.61	Pass	Tx/Ch39
445.645	19.59	2.38	7.26	29.23	Peak	V	100	0	46	-16.77	Pass	Tx/Ch39
160.95	22.08	1.41	2.56	26.06	Peak	V	100	0	43.5	-17.44	Pass	Tx/Ch39

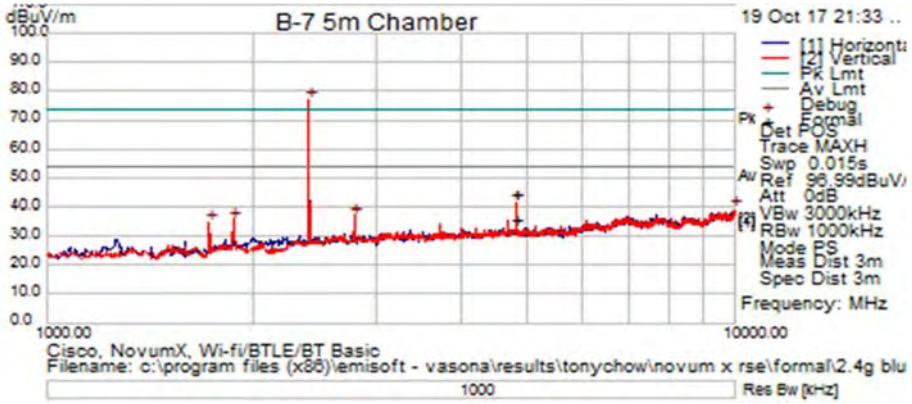
Subtest Date:	24-Oct-2017
Engineer	Danh Le, Zain Ali
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	30MHz-1GHz
Comments on the above Test Results	GFSK/DH1; Tx Channel 78 (2480 MHz)



Title: **TX Spurious Emissions from 30MHz-1GHz – Ch78 (2480 MHz)**

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
48.915	38.08	0.77	-1.21	37.65	Peak	V	100	0	40	-2.35	Pass	Tx/Ch78
48.960	35.27	0.77	-1.23	34.82	Quasi Max	V	118	49	40	-5.18	Pass	Tx/Ch78
78.985	33.72	1.01	-1.74	32.98	Peak	V	100	0	40	-7.02	Pass	Tx/Ch78
54.25	32.22	0.84	-2.34	30.72	Peak	V	100	0	40	-9.28	Pass	Tx/Ch78
31.455	18.63	0.62	10.89	30.14	Peak	V	100	0	40	-9.86	Pass	Tx/Ch78
135.245	28.12	1.3	4.03	33.46	Peak	V	100	0	43.5	-10.04	Pass	Tx/Ch78
117.785	25.85	1.22	4.24	31.31	Peak	V	100	0	43.5	-12.19	Pass	Tx/Ch78
82.38	28.4	1.03	-1.98	27.44	Peak	V	100	0	40	-12.56	Pass	Tx/Ch78
297.235	24.92	1.94	3.78	30.65	Peak	H	100	0	46	-15.35	Pass	Tx/Ch78
160.95	22.88	1.41	2.56	26.85	Peak	V	100	0	43.5	-16.65	Pass	Tx/Ch78
179.865	22.11	1.51	1.47	25.09	Peak	V	100	0	43.5	-18.41	Pass	Tx/Ch78

Subtest Date:	19-Oct-2017
Engineer	Danh Le, Zain Ali
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	1GHz-10GHz
Comments on the above Test Results	GFSK/DH1; Tx Channel 0 (2402 MHz)



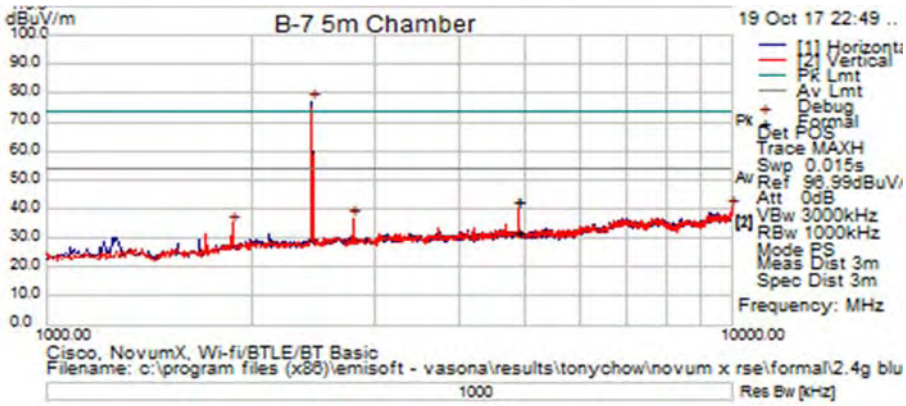
Title: **TX Spurious Emissions from 1-10GHz – Ch0 (2402 MHz)**

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Corrected Level +10dB (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
2400.625	82.73	5.8	-11.39	77.14	87.14	Peak	H	200	199	N/A	N/A	Ignored	Fundamental
4804.298	44.84	8.53	-8.96	44.41	54.41	Peak	H	194	146	74	-19.59	Pass	2nd harmonic
4804.298	35.96	8.53	-8.96	35.53	45.53	Average	V	194	146	54	-8.47	Pass	2nd harmonic
9994.375	30.24	13.13	-3.96	39.41	49.41	Peak	V	200	304	74	-24.59	Pass	Tx/Ch0
2800	41.63	6.33	-10.78	37.18	47.18	Peak	V	200	186	74	-26.82	Pass	Tx/Ch0
1866.25	43.26	5.05	-12.4	35.91	45.91	Peak	V	200	181	74	-28.1	Pass	Tx/Ch0
1720	43.88	4.83	-13.96	34.75	44.75	Peak	V	150	328	74	-29.25	Pass	Tx/Ch0
1680.738	34.04	4.78	-14.35	24.46	34.46	Peak	H	98	0	74	-39.54	Pass	Tx/Ch0

Note1: *10 dB external attenuator was added at the input port of the spectrum Analyzer to maintain at least 10 dB of headroom and prevent overloading. The corrected levels were compensated by adding 10 dB in the corrected level column above from the raw data.*

Note2: *Where limits are specified by regulations for both average and peak detection, if the maximized peak measured value complies with the average limit, then it is unnecessary to perform an average measurement*

Subtest Date:	19-Oct-2017
Engineer	Danh Le, Zain Ali
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	1GHz-10GHz
Comments on the above Test Results	GFSK/DH1; Tx Channel 39 (2441 MHz)



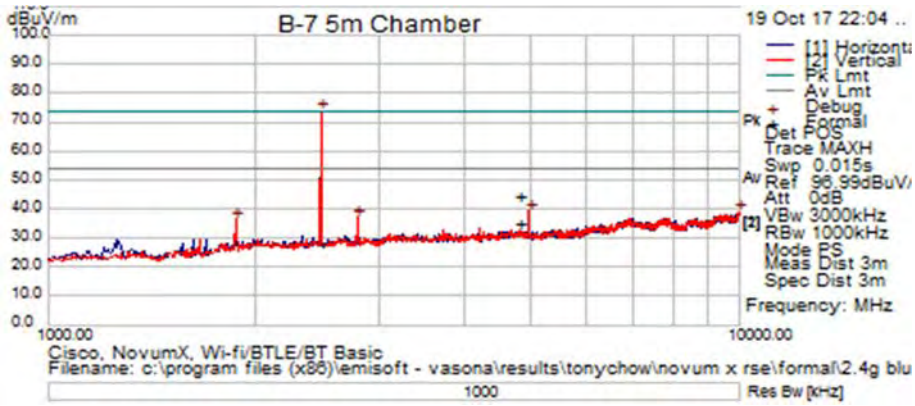
Title: **TX Spurious Emissions from 1-10GHz – Ch39 (2441 MHz)**

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Corrected Level +10dB (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
2440	82.14	5.85	-10.98	77.0	87.0	Peak	H	200	122	N/A	N/A	Ignored	Fundamental
4882.258	42.89	8.62	-9.13	42.38	52.38	Peak	H	194	146	74	-21.62	Pass	2nd harmonic
4882.258	32.37	8.62	-9.13	31.86	41.86	Average	V	194	146	54	-12.14	Pass	2nd harmonic
2800	41.38	6.33	-10.78	36.94	46.94	Peak	V	200	200	74	-27.06	Pass	Tx/Ch39
1866.25	42.53	5.05	-12.4	35.18	45.18	Peak	V	200	192	74	-28.82	Pass	Tx/Ch39
9994.375	31.27	13.13	-3.96	40.45	50.45	Peak	V	100	228	74	-23.55	Pass	Tx/Ch39

Note1: *10 dB external attenuator was added at the input port of the spectrum Analyzer to maintain at least 10 dB of headroom and prevent overloading. The corrected levels were compensated by adding 10 dB in the corrected level column above from the raw data.*

Note2: *Where limits are specified by regulations for both average and peak detection, if the maximized peak measured value complies with the average limit, then it is unnecessary to perform an average measurement*

Subtest Date:	19-Oct-2017
Engineer	Danh Le, Zain Ali
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	1GHz-10GHz
Comments on the above Test Results	GFSK/DH1; Tx Channel 78 (2480 MHz)



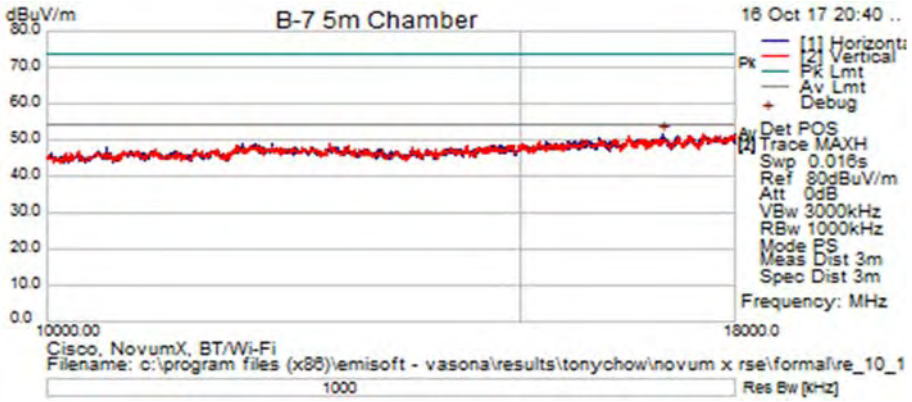
Title: **TX Spurious Emissions from 1-10GHz – Ch78 (2480 MHz)**

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Corrected Level +10dB (dBuV)	Detector (Pk/Av)	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
2479.375	78.68	5.92	-10.82	73.79	83.79	Peak	H	100	154	N/A	N/A	Ignored	Fundamental
4960	39.34	8.72	-8.91	39.16	49.16	Peak	V	200	124	54	-4.84	Pass	2nd harmonic
2800	41.72	6.33	-10.78	37.28	47.28	Peak	V	200	182	54	-6.72	Pass	Tx/Ch78
1866.25	43.77	5.05	-12.4	36.42	46.42	Peak	V	200	170	54	-7.58	Pass	Tx/Ch78
9988.75	29.7	13.12	-3.94	38.88	48.88	Peak	V	100	324	54	-5.12	Pass	Tx/Ch78

Note1: *10 dB external attenuator was added at the input port of the spectrum Analyzer to maintain at least 10 dB of headroom and prevent overloading. The corrected levels were compensated by adding 10 dB in the corrected level column above from the raw data.*

Note2: *Where limits are specified by regulations for both average and peak detection, if the maximized peak measured value complies with the average limit, then it is unnecessary to perform an average measurement*

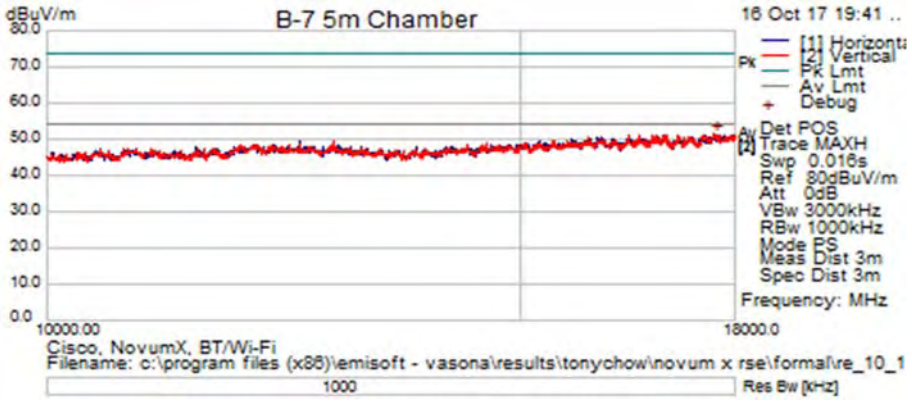
Subtest Date:	16-Oct-2017
Engineer	Danh Le, Zain Ali
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	10-18GHz
Comments on the above Test Results	GFSK/DH1; Tx Channel 0 (2402 MHz)



Title: **TX Spurious Emissions from 10-18GHz – Ch0 (2402 MHz)**

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
16910	46.07	18.73	-13.05	51.74	Peak	H	125	80	54	-2.26	Pass	Tx/Ch0

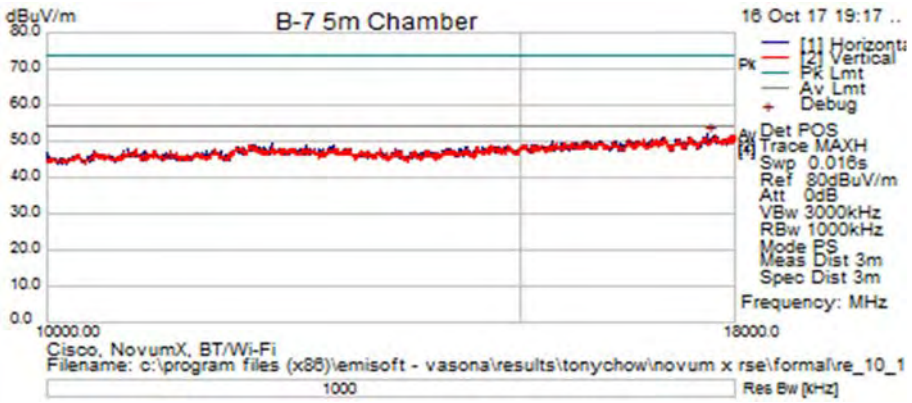
Subtest Date:	16-Oct-2017
Engineer	Danh Le, Zain Ali
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	10-18GHz
Comments on the above Test Results	GFSK/DH1, Tx Channel 39 (2441 MHz)



Title: **TX Spurious Emissions from 10-18GHz – Ch39 (2441 MHz)**

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
17685	44.9	19.49	-12.86	51.52	Peak	V	250	40	54	-2.48	Pass	Tx/Ch39

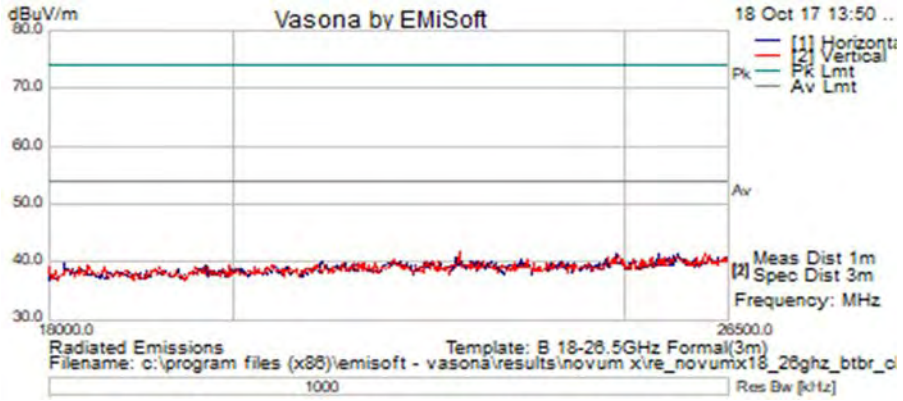
Subtest Date:	16-Oct-2017
Engineer	Danh Le, Zain Ali
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	10-18GHz
Comments on the above Test Results	GFSK/DH1, Tx Channel 78 (2480 MHz)



Title: **TX Spurious Emissions from 10-18GHz – Ch78 (2480 MHz)**

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
17595	45.58	19.3	-12.96	51.91	Peak	H	125	217	54	-2.09	Pass	Tx/Ch78

Subtest Date:	18-Oct-2017
Engineer	Danh Le, Zain Ali
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	18-26GHz
Comments on the above Test Results	GFSK/DH1, Tx Channel 39 (2441 MHz)



Title: **TX Spurious Emissions from 18-26GHz – Ch39 (24412 MHz)**

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
17595	45.58	19.3	-12.96	51.91	Peak	H	125	217	54	-2.09	Pass	Tx/Ch39

B.2 AC Power Line Conducted Emissions

B.2.1 Limits.

FCC 15.207 / RSS-Gen 8.8 issue4

FCC 15.207

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator 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). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

RSS-Gen 8.8

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 0.15 MHz to 30 MHz shall not exceed the limits in Table 3 shown in this section.

	Conducted Limits	
Frequency of Emission (MHz)	Quasi-Peak	Average
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30	60	50

*Decreases with the logarithm of the frequency

B.2.2 Test Procedure

Ref: C63.10:2013

Section 6.2.2 Measurement requirements

Measured levels of ac power-line conducted emission shall be the emission voltages from the voltage probe or across the 50 Ω LISN port (to which the EUT is connected), where permitted, terminated into a 50 Ω measuring instrument, or where permitted or required, the emission currents on the power line sensed by a current probe. All emission voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord by the use of mating plugs and receptacles on the LISN, if used. Equipment shall be tested with power cords that are normally supplied or recommended by the manufacturer, and that have electrical and shielding characteristics that are the same as those cords normally supplied or recommended by the manufacturer. For those measurements, using a LISN, the 50 Ω measuring port is terminated by a measuring instrument having a 50 Ω input impedance. All other ports are terminated in 50 Ω loads. Figure 5, Figure 6, and Figure 7 show typical test setups for ac power-line conducted emissions testing (see 6.13). For information about the use of a RF-shielded (screen) room, vertical conducting plane and voltage probe, see ANSI C63.4.

Tabletop devices shall be placed on a platform of nominal size, 1 m by 1.5 m, raised 80 cm above the reference ground plane. The vertical conducting plane or wall of an RF-shielded (screen) room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on the reference ground-plane or on insulating material as described in ANSI C63.4. All other surfaces of tabletop or floor standing EUTs shall be at least 80 cm from any other grounded conducting surface, including the case or cases of one or more LISNs.

Section 6.2.5 Final ac power-line conducted emission measurements

Based on the exploratory tests of the EUT performed in 6.2.4, the one EUT cable configuration and arrangement and mode of operation that produced the emission with the highest amplitude relative to the limit is selected for the final measurement, while applying the appropriate modulating signal to the EUT. If the EUT is relocated from an exploratory test site to a final test site, the highest emissions shall be remaximized at the final test location before final ac power-line conducted emission measurements are performed. The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment in the system) is then performed for the full frequency range for which the EUT is being tested for compliance without further variation of the EUT arrangement, cable positions, or EUT mode of operation. If the EUT is comprised of equipment units that have their own separate ac power connections, e.g., floor-standing equipment with independent power cords for each shelf that are able to connect directly to the ac power network, each current-carrying conductor of one unit is measured while the other units are connected to a second (or more) LISN(s). All units shall be separately measured. If a power strip is provided by the manufacturer, to supply all of the units making up the EUT, only the conductors in the power cord of the power strip shall be measured.

Record the six highest EUT emissions relative to the limit of each of the current-carrying conductors of the power cords of the equipment that comprises the EUT over the frequency range specified by the procuring or regulatory agency. Diagram or photograph the test setup that was used. See Clause 8 for full reporting requirements.

Ref. C63.10:2013, section 6.2

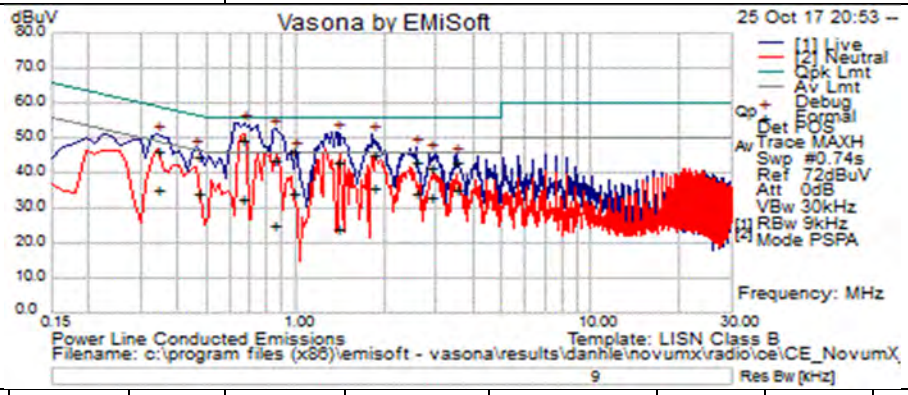
Test Procedure
1. Using Vasona software, configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer). 2. Set the radio in a hopping on single channel transmit mode. 3. Connect cable end to LISN Hot port and other cable end to the spectrum Analyzer/EMC receiver RF input port. Terminate the LISN neutral port with a 50 Ω impedance terminator. 4. Sweep the frequency range from 150 kHz to 30 MHz (segment if necessary) 5. Use the peak marker function to determine the maximum amplitude level. 6. Center marker frequency and perform final measurement using applicable detector (Quasi-Pk/Average). 7. Record at least 6 highest reading for the worst case operating modes in Quasi-peak/Average. 8. Repeat the test on Neutral lead. 9. Repeat step 3 – 7 with the radio sets in the Receiver mode. 10. Record at least 6 highest reading in Quasi-peak/Average

Ref. C63.10:2013, section 4 / CISPR16-1-1

Test Parameters
Span = Entire frequency range or segment if necessary. Reference Level = 70 dBuV RBW = 9 kHz VBW ≥ 3 x RBW Sweep Time = Couple Detector = Quasi-Peak & Average

B.2.3 AC Conducted Emissions Test Data and Graphical Test Results

Subtest Date:	25-Oct-2017
Engineer	Danh Le
Lab Information	Building 7, formal immunity room
Subtest Title	Conducted Emissions
Frequency Range	150 kHz - 30 MHz
Comments on the above Test Results	Hopping on Ch39 (2441 MHz) / Modulation: GFSK / Packet type: DH1– 1 Mbps



Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	Factors (dB)	Level (dBuV)	Detector	Lines (Live/Neutral)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
1.85	25.1	20	0.1	45.1	Quasi Peak	Live	56	-10.9	Pass	TX / Ch39
0.34	25.7	20.3	0.1	46.1	Quasi Peak	Live	59.2	-13.1	Pass	TX / Ch39
2.571	23	20	0.1	43.1	Quasi Peak	Live	56	-12.9	Pass	TX / Ch39
0.989	26.4	20	0.1	46.4	Quasi Peak	Live	56	-9.6	Pass	TX / Ch39
0.465	24.7	20	0.1	44.8	Quasi Peak	Live	56.6	-11.8	Pass	TX / Ch39
2.866	21.3	20	0.1	41.4	Quasi Peak	Live	56	-14.6	Pass	TX / Ch39
3.507	23.1	20	0.1	43.2	Quasi Peak	Live	56	-12.8	Pass	TX / Ch39
0.667	29.5	20	0.1	49.6	Quasi Peak	Neutral	56	-6.4	Pass	TX / Ch39
0.847	23.7	20	0.1	43.8	Quasi Peak	Neutral	56	-12.2	Pass	TX / Ch39
1.383	22.8	20	0	42.8	Quasi Peak	Neutral	56	-13.2	Pass	TX / Ch39
1.85	15.8	20	0.1	35.9	Average	Live	46	-10.1	Pass	TX / Ch39
0.34	14.7	20.3	0.1	35.1	Average	Live	49.2	-14.1	Pass	TX / Ch39
2.571	14	20	0.1	34.1	Average	Live	46	-11.9	Pass	TX / Ch39
0.989	13.9	20	0.1	34	Average	Live	46	-12.0	Pass	TX / Ch39
0.465	13.8	20	0.1	33.9	Average	Live	46.6	-12.7	Pass	TX / Ch39
2.866	12.8	20	0.1	32.9	Average	Live	46	-13.1	Pass	TX / Ch39
3.507	14.8	20	0.1	34.9	Average	Live	46	-11.1	Pass	TX / Ch39
0.667	12.5	20	0.1	32.6	Average	Neutral	46	-13.4	Pass	TX / Ch39
0.847	4.9	20	0.1	24.9	Average	Neutral	46	-21.1	Pass	TX / Ch39
1.383	4.1	20	0	24.2	Average	Neutral	46	-21.8	Pass	TX / Ch39

Appendix C: List of Test Equipment Used to perform the test

Equip#	Manufacturer/ Model	Description	Last Cal	Next Due	Test Item
Radiated Emissions					
CIS008113	Cisco/NSA 5m Chamber	NSA 5m Chamber	06-Sep-17	06-Sep-18	B1
CIS034741	ETS Lindgren / 3117	Double Ridged Guide Horn Antenna	09-Aug-17	09-Aug-18	B1
CIS045723	Cisco / TH0118	Mast Mount Preamplifier Array, 1-18GHz	27-Feb-17	27-Feb-17	B1
CIS033670	Sunol Sciences / JB1	Combination Bi-Log Antenna, 30MHz-2GHz	09-Mar-17	09-Mar-18	B1
CIS036710	Cisco/1840	18-40GHz EMI Test Head/Verification Fixture	14-Dec-17	14-Dec-18	BI
CIS018231	Rohde & Schwarz /ESI 40(ESIB 40)	EMI RECEIVER TEST 20Hz-40GHz	03-Feb-17	03-Feb-18	BI
CIS041955	Rohde & Schwarz / ESCI	EMI Test Receiver	07-Mar-17	07-Mar-18	B1
CIS040604	Agilent / E4440A	Precision Spectrum Analyzer	20-Oct-17	20-Oct-18	B1
CIS055178	Huber+Suhner /Sucoflex 106PA	RF Coaxial Cable, to 18GHz, 8.5 m	30-Nov-17	30-Nov-18	B1
CIS025660	Huber+Suhner /Sucoflex 106PA	RF Coaxial Cable, to 18GHz, 8.5 m	30-Nov-17	30-Nov-18	B1
CIS025640	Micro-Coax / UFB311A-0-2720-520520	Coaxial Cable, 272.0 in. to 18GHz	30-Nov-17	30-Nov-18	B1
CIS037557	JFW/50HF-010N	10dB Attenuator	02-Feb-17	02-Feb-18	B1
AC Conducted Emissions					
CIS42014	Rohde & Schwarz / ESCI	EMI Test Receiver	21-Apr-17	21-Apr-18	B2
CIS019210	TTE / H785-150K-50-21378	High Pass Filter 150KHz	28-Feb-17	28-Feb-18	B2
CIS05039	Fisher Custom Com / 50/250-50-2-02	LISN (9kHz-30MHz)	21-Feb-17	21-Feb-18	B2
CIS034158	Fisher Custom Com / 50-2-RA-NEMA-5-20R	LISN Receptacle Adaptor	21-Feb-17	21-Feb-18	B2
CIS040532	Huber + Suhner / RG-223	25 ft RG-223 Cable	04-Dec-16	04-Dec-17	B2
RF Conducted Emissions					
Equip#	**Manufacturer/ Model**	**Description**	**Last Cal**	**Next Due**	**Test Item**
CIS042660	Gore/ EJR01R01036.0	SMA RF Cable 26.5GHz	18-Oct-17	18-Oct-18	A1, A2, A3, A4, A5, A6
CIS056098	Keysight (Agilent/HP) / N9020A-526	MXA Spectrum Analyzer, 10Hz-26.5GHz	20-Sep-17	20-Sep-18	A1, A2, A3, A4, A5, A6
CIS055609	Mini-Circuits/BW-S20W2	20dB Attenuator	31-Aug-17	31-Aug-18	A2, A3, A6

Appendix D: Abbreviation Key and Definitions

The following table defines abbreviations used within this test report.

Abbreviation	Description	Abbreviation	Description
EMC	Electro Magnetic Compatibility	°F	Degrees Fahrenheit
EMI	Electro Magnetic Interference	°C	Degrees Celsius
EUT	Equipment Under Test	Temp	Temperature
ITE	Information Technology Equipment	S/N	Serial Number
TAP	Test Assessment Schedule	Qty	Quantity
ESD	Electro Static Discharge	Emf	Electromotive force
EFT	Electric Fast Transient	RMS	Root mean square
EDCS	Engineering Document Control System	Qp	Quasi Peak
Config	Configuration	Av	Average
CIS#	Cisco Number (unique identification number for Cisco test equipment)	Pk	Peak
Cal	Calibration	kHz	Kilohertz ($1x10^3$)
EN	European Norm	MHz	MegaHertz ($1x10^6$)
IEC	International Electro technical Commission	GHz	Gigahertz ($1x10^9$)
CISPR	International Special Committee on Radio Interference	H	Horizontal
CDN	Coupling/Decoupling Network	V	Vertical
LISN	Line Impedance Stabilization Network	dB	decibel
PE	Protective Earth	V	Volt
GND	Ground	kV	Kilovolt ($1x10^3$)
L1	Line 1	µV	Microvolt ($1x10^{-6}$)
L2	Line2	A	Amp
L3	Line 3	µA	Micro Amp ($1x10^{-6}$)
DC	Direct Current	mS	Milli Second ($1x10^{-3}$)
RAW	Uncorrected measurement value, as indicated by the measuring device	µS	Micro Second ($1x10^{-6}$)
RF	Radio Frequency	µS	Micro Second ($1x10^{-6}$)
SLCE	Signal Line Conducted Emissions	M	Meter
Meas dist	Measurement distance	Spec dist	Specification distance
N/A or NA	Not Applicable	SL	Signal Line (or Telecom Line)
P	Power Line	L	Live Line
N	Neutral Line	R	Return
S	Supply	AC	Alternating Current

Appendix E: Software Used to Perform Testing

EMIsoft Vasona, version 6.024

QRCT Radio Control Software version 3.0.242.0

HCI command set

Appendix F: Test Procedures

Measurements were made in accordance with

- ANSI C63.10:2013 Procedure for Compliance Testing of Unlicensed Wireless Devices
- RSS Gen Issue 4 General requirements for Compliance of Radio Apparatus
- Public Notice DA Public notice DA-00 705

Appendix G: Scope of Accreditation (A2LA certificate number 1178-01)

The scope of accreditation of Cisco Systems, Inc. can be found on the A2LA web page at:

http://www.a2la.org/scopepdf/1178-01.pdf

Note: FCC 15.205, FCC 15.207 and FCC 15.209 are additional requirement not covered under the scope of accreditation

Appendix H: Test Assessment Plan

Compliance Test Plan (Excel) EDCS- 11790857
Target Power Tables EDCS-12164400

Appendix I: Worst Case Justification

Worst case modes were selected by ANSI C63.10 2013 Section **5.6.2.2**

For devices with multiple operating modes, measurements on the middle channel can be used to determine the worst-case mode(s). The worst-case modes are as follows:

a) Band edge requirements—Measurements on the mode with the widest bandwidth can be used to cover the same channel (center frequency) on modes with narrower bandwidth that have the same or lower output power for each modulation family (e.g., OFDM and direct sequence spread spectrum).

b) Spurious emissions—Measure the mode with the highest output power and the mode with the highest output power spectral density for each modulation family (e.g., OFDM and direct sequence spread spectrum).

c) In-band PSD—Measurements on the mode with the narrowest bandwidth can be used to cover all modes within the same modulation family of an equal or lower output power provided the result is less than 50% of the limit.