

# MAY 2017

# FCC & ISED CANADA CERTIFICATION TEST REPORT

for the

SOLOSHOT3 Base with Bluetooth operation FCC ID: 2ALGWRJSS3B IC ID: 22498-RJSS3B

# SOLOSHOT3 BASE WITH BLUETOOTH OPERATION

**REPORT# 14971-02 REV 2** 

Prepared for:

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Prepared By:

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Testing Certificate AT-1448

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# FCC & ISED Canada Certification Test Report

for the

# SOLOSHOT, Inc.

# SOLOSHOT3 Base with Bluetooth operation

FCC ID: 2ALGWRJSS3B ISED ID: 22498-RJSS3B

# May 2017 Re-issued May 25, 2017 WLL REPORT# 14971-01 REV 2

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<b>Revision History</b>	Description of Change	Date
Rev 0	Initial Release	May 2017



# TABLE OF CONTENTS

Table of Contents iv
List of Tables
List of Figures v
1 Introduction
1.1 Compliance Statement 1
1.2 Contract Information 1
1.3 Test Dates 1
1.4 Test and Support Personnel
1.5 Abbreviations
2 Equipment Under Test
2.1 EUT Identification & Description
2.2 Test Configuration
2.3 Testing Algorithm
2.4 Test Location
2.5 Measurements
2.5.1 References
2.6 Measurement Uncertainty
3 Test Equipment
4 Test Results10
4.1 Conducted Emissions
4.1.1 AC Conducted Emissions 10
4.1.2 Test Procedure Summary10
4.1.3 Measurement Method 10
4.1.4 Conducted Data Reduction and Reporting11
4.1.5 Results Summary
4.1.6 Areas of Concern
4.1.7 Test Data
4.2 Conducted Emissions at Antenna Terminals
4.3 Bluetooth Hopping Channels
4.4 Output Power (FCC Part §2.1046)
4.5 Occupied Bandwidth: (FCC Part §2.1049)
4.6 Spurious Emissions at Antenna Terminals (FCC Part §2.1051) and Band Edge
Compliance
4.7 Radiated Emissions: (FCC Part §2.1053)
4.7.1 Test Procedure

SOLOSHOT, Inc. SOLOSHOT3 Base with Bluetooth operation



# LIST OF TABLES

Table 1: Device Summary Bluetooth Operation	5
Table 3: Expanded Uncertainty List	
Table 4: Test Equipment List	9
Table 5: Conducted Emissions Limits	
Table 6. BT Output Power	
Table 10: Occupied Bandwidth Results: Bluetooth Modes	
Table 11: Occupied Bandwidth Results: B Mode	
Table 14: Radiated Emission Test Data. BT Mode Low Channel	
Table 15: Radiated Emission Test Data. BT Mode Middle Channel	
Table 16: Radiated Emission Test Data. BT Mode High Channel	
Table 23: Digital Emissions to FCC 15.209	

SOLOSHOT, Inc. SOLOSHOT3 Base with Bluetooth operation



# LIST OF FIGURES

Figure 1: Hopping Channel Separation	
Figure 2: Hopping Channels BT Mode = 78	. 15
Figure 3: Hopping On Time in 1 ms	. 16
Figure 4: Hopping over 5 minutes	. 17
Figure 5: Output Power Lower Channel BT Mode	. 19
Figure 6: Output Power Middle Channel BT Mode	. 20
Figure 7: Output Power Upper Channel BT Mode	. 21
Figure 17: Occupied Bandwidth Lower Channel Bluetooth Mode	. 23
Figure 18: Occupied Bandwidth Middle Channel Bluetooth Mode	. 24
Figure 19: Occupied Bandwidth Upper Channel Bluetooth Mode	. 25
Figure 29: Spurious Emissions BT Mode	. 27
Figure 30: Spurious Emissions BT Mode	. 28
Figure 31: Spurious Emissions BT Mode	. 29
Figure 32: Spurious Emissions BT Mode	. 30
Figure 33: Spurious Emissions BT Mode	. 31
Figure 34: Spurious Emissions BT Mode	. 32
Figure 35: Spurious Emissions BT Mode `	. 33
Figure 36: Band Edge BT Mode (Hopping)	. 34
Figure 37: Band Edge BT Mode (Hopping and non-Hopping Modes)	. 35
Figure 38: Band Edge BT Mode (Hopping Modes)	. 36
Figure 39: Band Edge BT Mode (Hopping and non-Hopping Modes)	. 37
Figure 40: Band Edge BT Mode (non-Hopping Modes)	. 38
Figure 41: Band Edge BT Mode (non-Hopping Modes)	. 39



# **1 INTRODUCTION**

# **1.1 COMPLIANCE STATEMENT**

This report has been prepared on behalf of SOLOSHOT, Inc. to support the attached Application for Equipment Authorization. The test report and application are submitted for an Intentional Radiator under Part 15.247 (10/2014) of the FCC Rules and Regulations and Spectrum Management and Telecommunications Policy and under RSS-247 issue 2 of Innovation, Science and Economic Development Canada (ISED). This Certification Test Report documents the test configuration and test results for the SOLOSHOT, Inc. SOLOSHOT3 **Base with Bluetooth Operation**.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. The ISED OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ANAB under Certificate AT-1448 as an independent FCC test laboratory.

The SOLOSHOT, Inc. SOLOSHOT3 Base with Bluetooth operation complies with the limits for a Digital Transmission System (DTS) Transmitter and Frequency Hopping Spread Spectrum (FHSS) device under FCC Part 15.247 and Innovation, Science and Economic Development Canada (ISED) RSS-247.

# **1.2 CONTRACT INFORMATION**

Customer:	SOLOSHOT, Inc.	
Address	520 S El Camino Real, Suite 816	

San Mateo, CA 94402

Purchase Order Number:	Per MV
Quotation Number:	69996

# **1.3 TEST DATES**

Testing was performed on the following date(s): 3/10/2017-3/16/2017

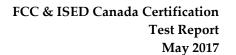


# 1.4 TEST AND SUPPORT PERSONNEL

Washington Laboratories, LTD

Customer Representative

Mike Violette Alex Sammons



## **1.5 Abbreviations**

А	Ampere
ас	alternating current
AM	Amplitude Modulation
Amps	Amperes
b/s	<b>b</b> its per <b>s</b> econd
BW	BandWidth
CE	Conducted Emission
cm	Centimeter
CW	Continuous Wave
dB	<b>d</b> eci <b>B</b> el
dc	<b>d</b> irect <b>c</b> urrent
EMI	Electromagnetic Interference
EUT	Equipment Under Test
FM	Frequency Modulation
G	<b>g</b> iga – prefix for 10 <sup>9</sup> multiplier
Hz	Hertz
IF	Intermediate Frequency
k	kilo – prefix for 10 <sup>3</sup> multiplier
LISN	Line Impedance Stabilization Network
M	Mega – prefix for 10 <sup>6</sup> multiplier
m	Meter
μ	<b>m</b> icro – prefix for 10 <sup>-6</sup> multiplier
NB	Narrowband
QP	Quasi-Peak
RE	Radiated Emissions
RF	Radio Frequency
rms	<b>r</b> oot- <b>m</b> ean- <b>s</b> quare
SN	Serial Number
S/A	Spectrum Analyzer
V	Volt



# 2 EQUIPMENT UNDER TEST

# 2.1 EUT IDENTIFICATION & DESCRIPTION

The SOLOSHOT, Inc. SOLOSHOT3 Base with Bluetooth operation is used in conjunction with a transmit beacon **Tag** (FCC ID: 2ALGWRJSS3T, ISED ID: 22498-RJSS3T). The SOLOSHOT3 Base is fitted with a HD camera that is controlled and streams HDMI to the screen on the unit as well as to an internal mini-SD card. The SOLOSHOT3 Base tracks the position of the Tag, which provides an 802.15 modulated signal that is received by the SOLOSHOT3 base. The SOLOSHOT3 Base continuously tracks the position of the Tag and allows the camera to follow a moving subject.

The Bluetooth and WiFi radios share the same antenna, however, they do not operate simultaneously.



## **Table 1: Device Summary Bluetooth Operation**

Item	SOLOSHOT3 Base used with Soloshot Camera	
Manufacturer:	SOLOSHOT, Inc.	
FCC ID:		
ISED ID:	22498-RJSS3B	
Model:	SOLOSHOT3 Base with Bluetooth operation	
Serial Number of Unit Tested	N/A	
FCC Rule Parts:	§15.247	
Innovation, Science and	DSS 247	
Economic Development Canada:	RSS-247	
Frequency Range:	2402-2480MHz	
Maximum Output Power:	8.9 dBm (7.7mW) at 2442 MHz	
Modulation:	Bluetooth	
Occupied Bandwidth:	1.96 MHz	
Keying:	Automatic	
Type of Information:	Data	
Number of Channels:	78	
Power Output Level	Fixed	
Antenna Connector	Internal, not accessible to user	
Antenna Type & Maximum Gain	hin Whip 3.15 dBi	
Manufacturer & Model	Molex GPS/WiFi (2.4/5GHz) Combo Balance Flex Antenna 1461860100	
Maximum Data Rate	25 Mbps	
Power Source & Voltage:	Internal battery charged with USB charger	



# **2.2 TEST CONFIGURATION**

The SOLOSHOT3 Base with Bluetooth operation was configured with a detachable camera and set to transmit using the Qualcomm Radio Test Communications (QRTC) software, which allowed the selection of different modulations, frequencies and modes of operation.

# **2.3 TESTING ALGORITHM**

The SOLOSHOT3 Base with Bluetooth operation was tested by configuring the various channels for measurement of the RF parameters.

Once connected to the SOLOSHOT3 Base, commands were sent over the USB connection from a PC. The following modes were tested:

1. BT Hopping and Non-Hopping (carrier and modulated with PS data stream). Power was also measured at the lowest, middle and high channel.

# 2.4 TEST LOCATION

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. The ISED Canada OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ANAB under Certificate AT-1448 as an independent FCC test laboratory.



## 2.5 MEASUREMENTS

## 2.5.1 References

ANSI C63.2-2016 Specifications for Electromagnetic Noise and Field Strength Instrumentation in the Frequency Range 9 kHz to 40 GHz

ANSI C63.10-2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

ANSI C63.4-2014 American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

# 2.6 MEASUREMENT UNCERTAINTY

All results reported herein relate only to the equipment tested. The basis for uncertainty calculation uses ANSI/NCSL Z540-2-1997 (R2002) with a type B evaluation of the standard uncertainty. Elements contributing to the standard uncertainty are combined using the method described in Equation 1 to arrive at the total standard uncertainty. The standard uncertainty is multiplied by the coverage factor to determine the expanded uncertainty which is generally accepted for use in commercial, industrial, and regulatory applications and when health and safety are concerned (see Equation 2). A coverage factor was selected to yield a 95% confidence in the uncertainty estimation.

## **Equation 1: Standard Uncertainty**

$$u_{c} = \pm \sqrt{\frac{a^{2}}{div_{a}^{2}} + \frac{b^{2}}{div_{b}^{2}} + \frac{c^{2}}{div_{c}^{2}} + \dots}$$

Where  $u_c = standard$  uncertainty

a, b, c,.. = individual uncertainty elements

Div<sub>a</sub>, <sub>b</sub>, <sub>c</sub> = the individual uncertainty element divisor based on the probability distribution

Divisor = 1.732 for rectangular distribution

Divisor = 2 for normal distribution

Divisor = 1.414 for trapezoid distribution



## **Equation 2: Expanded Uncertainty**

$$U = ku_c$$

Where U	= expanded uncertainty
k	= coverage factor
	$k{\leq}2$ for 95% coverage (ANSI/NCSL Z540-2 Annex G)
uc	= standard uncertainty

The measurement uncertainty complies with the maximum allowed uncertainty from CISPR 16-4-2. Measurement uncertainty is <u>not</u> used to adjust the measurements to determine compliance. The expanded uncertainty values for the various scopes in the WLL accreditation are provided in Table 2 below.

#### Table 2: Expanded Uncertainty List

Scope	Standard(s)	Expanded Uncertainty
Conducted Emissions	CISPR11, CISPR22, CISPR14, FCC Part 15	<u>+</u> 2.63 dB
Radiated Emissions	CISPR11, CISPR22, CISPR14, FCC Part 15	<u>+</u> 4.55 dB



#### **TEST EQUIPMENT** 3

Table 3 shows a list of the test equipment used for measurements along with the calibration information.

# **Table 3: Test Equipment List**

Test Name:	Conducted Emissions Voltage	Test Date:	March 6, 2017
Asset #	Manufacturer/Model	Description	Cal. Due
125	SOLAR - 8028-50-TS-24-BNC	LISN	2/16/2018
126	SOLAR - 8028-50-TS-24-BNC	LISN	2/16/2018
823	AGILENT - N9010A	EXA SPECTRUM ANALYZER	12/21/2017
Test Name:	Radiated Emissions	Test Date:	March 6 2017
Asset #	Manufacturer/Model	Description	Cal. Due
4	ARA - DRG-118/A	ANTENNA DRG 1-18GHZ	12/14/2018
66	B&Z (HP) - BZ-01002650-401545-282525	HF PRE-AMPLIFIER 1-26.5GHZ (MODIFIED)	2/14/2018
823	AGILENT - N9010A	EXA SPECTRUM ANALYZER	12/21/2017
382	SUNOL SCIENCES CORPORATION - JB1	ANTENNA BICONLOG	8/31/2017
626	ARA - DRG-118/A	ANTENNA HORN	4/7/2018
210	NARDA - V638	HORN STANDARD GAIN	CNR
453	AH SYSTEMS - PAM1840	PRE-AMPLIFIER 18GHZ-40 GHZ	5/11//2019
280	ITC - 21C-3A1	WAVEGUIDE 3.45-11.0GHZ	8/1/2017
281	ITC - 21A-3A1	WAVEGUIDE 4.51-10.0GHZ	8/1/2017
282	ITC - 21X-3A1	WAVEGUIDE 6.8-15GHZ	10/22/2017



# 4 Test Results

## 4.1 Conducted Emissions

4.1.1 AC Conducted Emissions

Test Arrangement: Table-top/tripod mount

#### Compliance Standard: FCC Part 15 (10/2014), Class B

FCC Compliance Limits		
Frequency	Quasi-peak	Average
0.15-0.5MHz	66 to 56dBµV	56 to 46dBµV
0.5 to 5MHz	56dBµV	46dBµV
0.5-30MHz	60dBµV	50dBµV

#### 4.1.2 Test Procedure Summary

The requirements of FCC Part 15B and ICES-003 call for the EUT to be placed on an 80 cm high 1 X 1.5 m non-conductive table above a ground plane. Power to the EUT was provided through a Solar Corporation 50  $\Omega$ /50 uH Line Impedance Stabilization Network bonded to a 3 X 2 meter ground plane. The LISN has its AC input supplied from a filtered AC power source. Power was supplied to the peripherals through a second LISN. The peripherals were placed on the table in accordance with ANSI C63.4-2014. Power and data cables were moved about to obtain maximum emissions.

The 50  $\Omega$  output of the LISN was connected to the input of the spectrum analyzer and the emissions in the frequency range of 150 kHz to 30 MHz were measured. The detector function was set to quasi-peak, peak, or average as appropriate, and the resolution bandwidth during testing was at least 9 kHz, with all post-detector filtering no less than 10 times the resolution bandwidth. For average measurements the post-detector filter was set to 10 Hz.

At frequencies where quasi-peak or peak measurements comply with the average limit, no average measurements need be performed.

#### 4.1.3 Measurement Method

All emission measurements herein were performed according to the referenced standard. Calibration checks are made periodically to verify proper performance of the measuring instrumentation.



#### 4.1.4 Conducted Data Reduction and Reporting

To convert the raw spectrum analyzer conducted data into a form that can be compared with the limits, it is necessary to account for various calibration factors that are supplied with the LISNs and other measurement accessories. These factors are included into the LISN correction factor (LISN corr.) column of the table and in the cable factor (Cable Loss) column of the table. The LISN correction (in dB) and the Cable Loss (in dB) is algebraically added to the raw Spectrum Analyzer Voltage in dB $\mu$ V to obtain the Conducted RF Electric Voltage in dB $\mu$ V. This level is then compared to the limit.

#### Example:

Spectrum Analyzer Voltage:	VdBµV
LISN Correction Factor:	LISN Correction dB
Cable Correction Factor:	Cable Loss dB
RF Electric Voltage Level:	$EdBuV = V dB\mu V + LISN Correction dB + Cable Loss dB$

#### 4.1.5 Results Summary

The system complied with the emission requirements throughout the test.

Testing was performed by powering the unit on and set the transmitter to enabled.

Test Date(s): March 13, 2017

Test Engineer/Technician: Mike Violette

#### 4.1.6 Areas of Concern

None

#### 4.1.7 Test Data

Table 5 provides the test results for phase and neutral line power line conducted emissions. Charging power the unit is provided by the Base.



NEUTRAL												
Frequency (MHz)	Level QP (dBµV)	Level AVG (dBµV)	Cable Loss (dB)	LISN Corr (dB)	Level QP Corr (dBµV)	Level Corr Avg (dBµV)	Limit QP (dBµV)	Limit AVG (dBµV)	Margin QP (dB)	Margin AVG (dB)		
0.180	44.0	31.0	10.2	0.3	54.4	41.4	64.5	54.5	-10.1	-13.1		
0.326	31.4	12.5	10.2	0.3	41.8	22.9	59.6	49.6	-17.7	-26.6		
1.000	35.0	12.8	10.3	0.3	45.6	23.4	56.0	46.0	-10.4	-22.6		
1.600	34.8	17.2	10.2	0.3	45.3	27.7	56.0	46.0	-10.7	-18.3		
5.000	33.3	19.9	10.7	0.2	44.2	30.8	60.0	50.0	-15.8	-19.2		
10.000	33.3	19.5	11.1	0.1	44.5	30.7	60.0	50.0	-15.5	-19.3		
29.900	25.5	16.0	12.0	1.3	38.8	29.3	60.0	50.0	-21.2	-20.7		

#### Table 4: Conducted Emissions Limits

#### PHASE

Frequency (MHz)	Level QP (dBµV)	Level AVG (dBµV)	Cable Loss (dB)	LISN Corr (dB)	Level QP Corr (dBµV)	Level Corr Avg (dBµV)	Limit QP (dBµV)	Limit AVG (dBµV)	Margin QP (dB)	Margin AVG (dB)
0.180	42.4	28.3	10.2	0.1	52.7	38.6	64.5	54.5	-11.8	-15.9
0.326	33.9	15.3	10.2	0.2	44.3	25.7	59.6	49.6	-15.3	-23.9
1.000	38.8	24.5	10.3	0.2	49.3	35.0	56.0	46.0	-6.7	-11.0
1.600	35.1	19.9	10.2	0.3	45.6	30.4	56.0	46.0	-10.4	-15.6
5.000	34.1	20.2	10.7	0.2	45.0	31.1	60.0	50.0	-15.0	-18.9
10.000	33.7	19.2	11.1	0.2	45.0	30.5	60.0	50.0	-15.0	-19.5
29.900	29.4	15.7	12.0	1.5	42.9	29.2	60.0	50.0	-17.1	-20.8



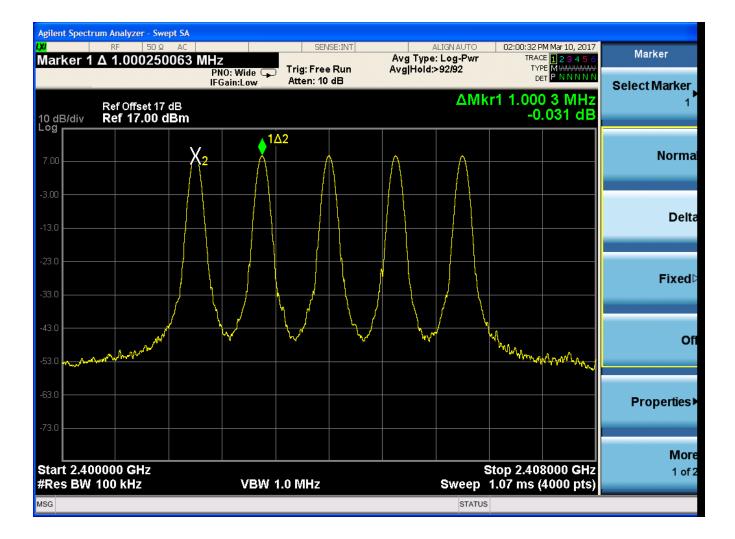
# 4.2 Conducted Emissions at Antenna Terminals

The general procedure for measuring the conducted energy at the antenna terminals of the device consisted of connecting the output of the EUT to the input of a spectrum analyzer via attenuator pads and bandpass filters, as appropriate for the measurement.

## 4.3 Bluetooth Hopping Channels

Per §2.1046 and 5.1(d) of RSS 247 require a minimum of 15 hopping channels and a minimum channel spacing of 25 kHz or the 20dB bandwidth of the hopping channel, whichever is greater. The following figure shows that more than 15 channels are employed in the device (78 total channels). In addition, the average time of occupancy shall not be greater than 0.4seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.







## Figure 2: Hopping Channels BT Mode = 78





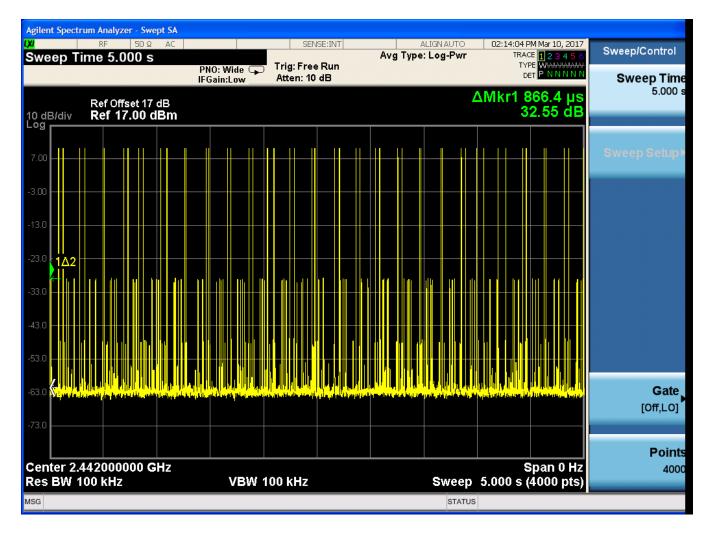
Dwell time is calculated by measuring the occupancy time of a single burst and extrapolating out to the period of 0.4 seconds X # of hopping channels employed.



#### Figure 3: Hopping On Time in 1 ms



## Figure 4: Hopping over 5 minutes



An observation time of 5 seconds was selected to make the determination of the number of hops over the averaging time. In this case, 79 hops were counted in a span of 5 seconds. The averaging time is equal to 0.4Xnumber of channels.

Pulse on-time: 0.386ms Hops in 5s: 79 Averaging time: 0.4s X number of channels: 0.4X78 = 31.2s 436.8 Hops per 31.2 s

#### Total On-time: 0.386 msX436.8 Hops = 0.168s

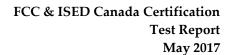


# 4.4 Output Power (FCC Part §2.1046)

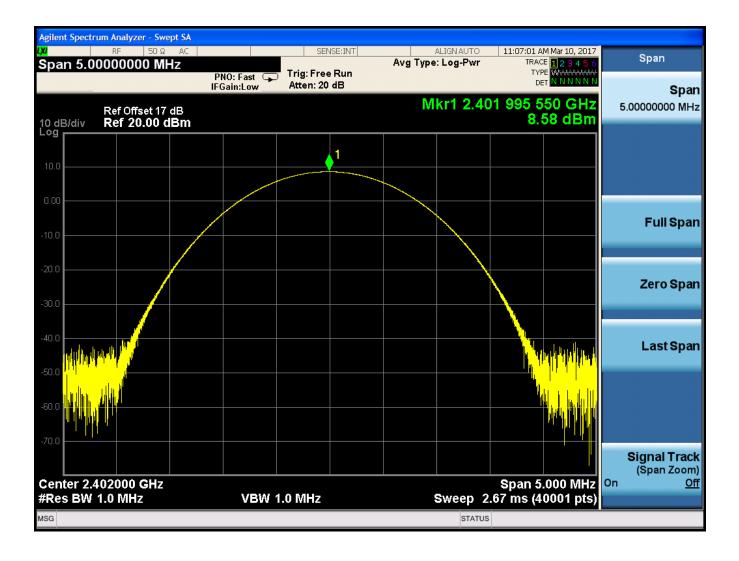
Output power was measured by coupling the output of the EUT to the input of a spectrum analyzer. The spectrum analyzer was set with the RBW=1MHz and the VBW> RBW.

#### Table 5. BT Output Power

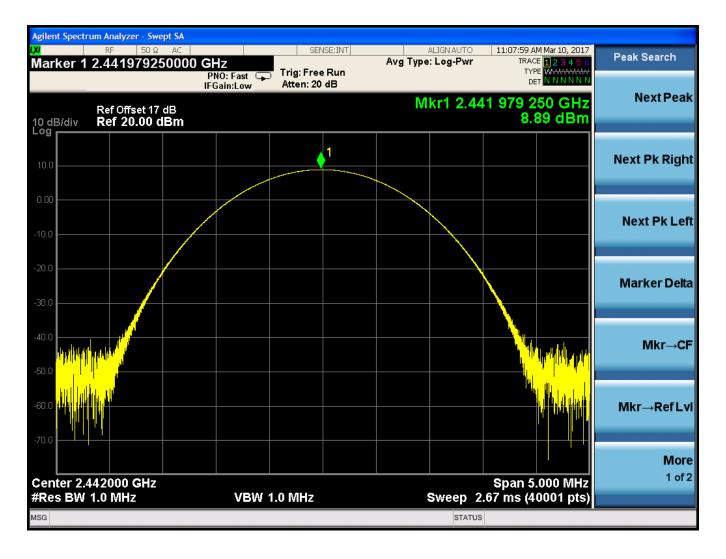
BT Mode			
Frequency MHz	Output Power dBm	Limit dBm	Pass/Fail
2402	8.6	30	Pass
2442	8.9	30	Pass
2480	8.9	30	Pass

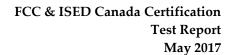


#### Figure 5: Output Power Lower Channel BT Mode

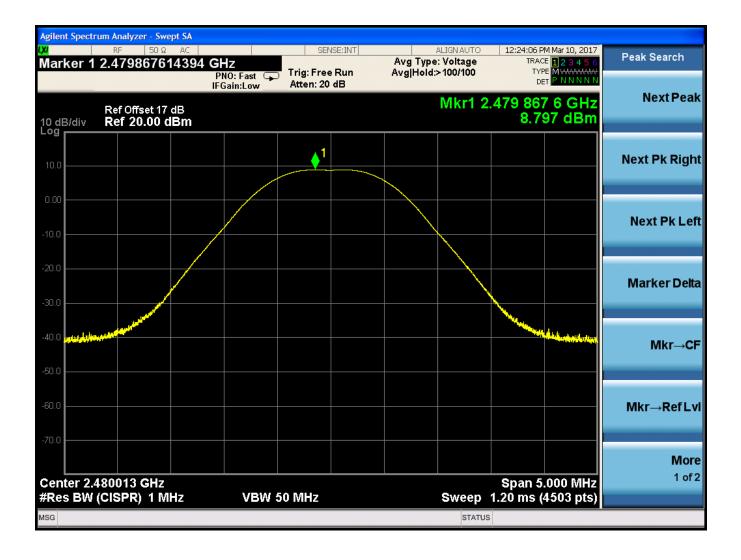


#### Figure 6: Output Power Middle Channel BT Mode





#### Figure 7: Output Power Upper Channel BT Mode





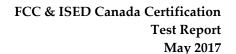
# 4.5 Occupied Bandwidth: (FCC Part §2.1049)

Occupied bandwidth was performed by coupling the output of the EUT to the input of a spectrum analyzer. Table 6 and Table 7 provide summaries of the Occupied Bandwidth Results.

Frequency MHz	Bandwidth MHz	Limit	Pass/Fail
2402	1.95	N/A	Pass
2442	1.96	N/A	Pass
2480	1.96	N/A	Pass

#### Table 6: Occupied Bandwidth Results: Bluetooth Modes

At full modulation, the occupied bandwidth was measured as shown:

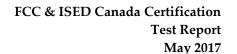


#### Figure 8: Occupied Bandwidth Lower Channel Bluetooth Mode

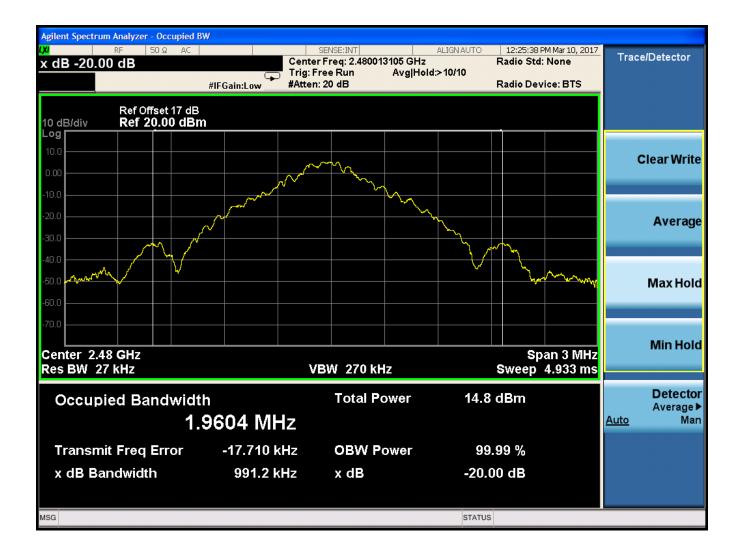


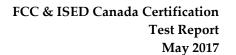
#### Figure 9: Occupied Bandwidth Middle Channel Bluetooth Mode





#### Figure 10: Occupied Bandwidth Upper Channel Bluetooth Mode

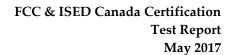




#### Table 7: Occupied Bandwidth Results: B Mode

B Mode			
Frequency MHz	Bandwidth MHz	Bit Rate Mbps	Pass/Fail
2412	9.2	11	Pass
2437	8.4	1	Pass
2462	9.7	2	Pass

At full modulation, the occupied bandwidth was measured as shown:



# 4.6 Spurious Emissions at Antenna Terminals (FCC Part §2.1051) and Band Edge Compliance

Spurious emissions at the antenna terminals were collected over the frequency range of 30MHz to 24.835GHz.

In addition, it is necessary for all emissions at the band edges be 20dB below the peak energy measured in a 100 kHz bandwidth. These data are shown in the following collection of plots.

Agilent Spectr	r <mark>um Analyzer - Swept SA</mark> RF 50 Ω AC		CENCE THE		10/50/10 PM Mar 10, 2017	
Display L	Line -9.40 dBm		SENSE:INT	ALIGN AUTO	12:58:12 PM Mar 10, 2017 TRACE 123456 TYPE MWWWWW	Recall
		PNO: Fast 🖵 IFGain:Low	Trig: Free Run Atten: 20 dB	Avg Hold:>100/100	DET PNNNN	
10 dB/div Log	Ref Offset 17 dB Ref 20.00 dBm			Mkr	1 2.465 04 GHz 10.435 dBm	State►
10.0					1	Trace (+ State)
0.00						( cuity
-10.0					-9.40 <mark>.dBm</mark>	
-20.0						Data
-30.0						(Import) ► Trace 1
-40.0						
-50.0	n - Lasta I marten Ala la <mark>sta ba</mark> ta ya		والفاقي والمعاقبة والمعادية والمعادية والمعادية ومتعادية	n a hydroddiad fry ddiad yn y chwad Daile llifeth		
-60.0		a an	Nik, ang pang pang ang ing biga bagi ng Pangang ang pang pang pang pang pang pang	n a bry pring interning (reference an any application in the second second second second second second second s		
-70.0						
Start 30 M #Res BW		VBW	1.0 MHz	Sween	Stop 2.484 GHz 227 ms (40001 pts)	
MSG				STATUS		

#### Figure 11: Spurious Emissions BT Mode



#### Figure 12: Spurious Emissions BT Mode

	t Spectru	m Analyzer - Sw	/ept SA								
l <mark>XI</mark> Stati					SEN	NSE:INT		ALIGN AUTO : Log-Pwr		M Mar 10, 2017 E <mark>1 2 3 4 5 6</mark>	Trace/Det
Stop	o Frec	6.400000		NO: Fast 🗔	Trig: Free		Avg Hold:	25/100	TY	PE M WWWWWW	
				Gain:Low	Atten: 20	dB			DI		Select Trace
		Ref Offset 17	7 dB					M	kr1 2.46	5 0 GHz	1
10 dE Log r	3/div	Ref 20.00	dBm						-52.2	64 dBm	
Log											
											Clear Write
10.0	hl										Cicui Milic
0.00											
										-9.40 dBm	Trace Average
-10.0										-0.40 0.01	
-20.0											
											Max Hold
-30.0											
-40.0											Min Hold
						h .	ul., rais à ultra la serie		alar hair rin airde	the state of the second	IVIIN HOID
-50.0	V-N-	and the second	Al Marine Interference	a sint all all and a second				والمعالية وأندار والدوس	مينين الراقية معادية محديقة إلى مع	alas satu and a state of a state	
	National States of the state	Mada Para and an addition of	in the lease of the second	a de la competencia d	) na patapanta na kata	and a second	a and a second				
-60.0					·						View/Blank ⊾
											Trace On
-70.0											
											More
											1 of 3
	t 2.400							_	Stop 6	.400 GHz	1013
	SBW 1	00 kHz		VBW	1.0 MHz			Sweep	371 ms (4	0001 pts)	
MSG								STATU	S		



Agiler	nt Spectr	um Analyzer -									
()// Stol	n Erec		00000 GI	-17	SEN	NSE:INT		ALIGNAUTO : Log-Pwr	TRAC	PM Mar 10, 2017 CE <mark>1 2 3 4 5 6</mark>	Frequency
ete	5 1 1 0 1	1 101-1000		PNO: Fast 🖵 FGain:Low	Trig: Free Atten: 20		Avg Hold:		TYI Di	PE M <del>WWWWW</del> ET P. N.N.N.N.N	
				rGam.cow	rateri. 20			M	(r1 2 46	5 0 GHz	Auto Tune
10 di Log	B/div	Ref Offset Ref 20.0								dBm	
9											Center Freq
10.0											8.40000000 GHz
0.00											Start Freq
-10.0										-9.40 dBm	6.400000000 GHz
-20.0	<u> </u>										Stop Freq
-30.0	1										10.40000000 GHz
-30.0	, ⊬										
-40.0	<u> </u>										CF Step 400.000000 MHz
	նումուներ	hand the base of the second	e e	ulli a co			. 11	www.al.i.a.	o	han al both an a table in	Auto Man
-50.0	Antibute de la filia		agus ann an suisean an ann an suisean		di deterre de la dage		and the second second				
-60.0	. It out		line harrie al arrad	lin hallstop, so stand fight		ale of the second s	Her age of the second of the				Freq Offset
											0 Hz
-70.0	<u> </u>										
	t 6.40							_	Stop 10	.400 GHz	
	s BW	100 kHz		VBW	1.0 MHz					0001 pts)	
MSG								STATUS	5		



#### Figure 14: Spurious Emissions BT Mode

	t Spectru	n Analyzer - S	wept SA								
<mark>IXI</mark> Stor	- Erog	RF 50	Ω AC	11-7	SEN	NSE:INT		ALIGNAUTO : Log-Pwr		PM Mar 10, 2017 CE <mark>1 2 3 4 5 6</mark>	Frequency
SIO	JFreq	14.4000	00000 G	PNO: Fast G IFGain:Low	Trig: Free Atten: 20		Avg Hold:	19/100	TY	PE MWWWWW ET P N N N N N	
10 dE Log		Ref Offset 1 Ref 20.00						М	kr1 2.46	5 0 GHz dBm	Auto Tune
10.0											<b>Center Freq</b> 12.400000000 GHz
0.00 -10.0										-9.40 dBm	<b>Start Freq</b> 10.400000000 GHz
-20.0 -30.0	1										<b>Stop Freq</b> 14.400000000 GHz
-40.0 -50.0	<u>(</u>			L <sub>es</sub> en latura d'avantica <sup>l</sup> avita <sup>s</sup> urda						and a second second	<b>CF Step</b> 400.000000 MHz <u>Auto</u> Man
-60.0	natoletsijtig	lagan dan saka ti dan kasalan dikenti.	<mark>nu di sena na padala di Kh</mark>	<mark>, an para para bana di kun di kun di kun da kun da para para pana pana bana bana bana bana bana ban</mark>	a bir yan da milan da	ام الفائل الفائل العالم (بالا الي الم الم الفائل الفائل المالية (بالا المالية المالية المالية المالية المالية ا	l lê fêrêy have ye ke weke koveke	<mark>, k, m∫ulipis, and</mark>	Mark and a second s	renzen er en	<b>Freq Offset</b> 0 Hz
-70.0	40.40								0407 14		
	t 10.40 s BW 1	U GHZ 00 kHz		VBW	1.0 MHz			Sweep	371 ms (4	.400 GHz 0001 pts)	
MSG								STAT			



### Figure 15: Spurious Emissions BT Mode

	t Spectru	ım Analyzer - Sv									
<mark>IXI</mark> Stor	n Erec	RF 50 S 18.40000		7	SEI	NSE:INT		ALIGNAUTO		M Mar 10, 2017	Frequency
erer	51100	10.40000	I	PNO: Fast 🕞 Gain:Low	Trig: Free Atten: 20		Avg Hold:		TY		
10 dE Log i	3/div	Ref Offset 1 Ref 20.00						Μ	kr1 2.46	5 0 GHz dBm	Auto Tune
10.0											<b>Center Freq</b> 16.40000000 GHz
0.00											10.40000000 GHZ
-10.0										-9.40 dBm	<b>Start Freq</b> 14.40000000 GHz
-20.0											Oton From
-30.0	1										<b>Stop Freq</b> 18.40000000 GHz
-40.0	←										CF Step
	natal da	alban (pagtap) kasan timb		eterlekan) burkeler		an a sent has to not	inde a posible identitation 	ladarijani <mark>jan</mark> i		e ditte meter på den flet	400.000000 MHz <u>Auto</u> Man
-50.0	t plat point	nalayin too a salatilati							1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	i i in hai hai an hai	
-60.0											Freq Offset 0 Hz
-70.0											
		00 GHz 100 kHz		VBW	1.0 MHz			Sweep	Stop 18 371 ms (4	.400 GHz 0001 pts)	
MSG								STATU	US		



Figure 16: Spurious	s Emissions BT Mode
---------------------	---------------------

Agiler	nt Spectr	um Analyzer									
IXI Stol	n Ere		50Ω AC	GHz	SEN	NSE:INT		ALIGNAUTO	TRAC	M Mar 10, 2017 E <mark>1 2 3 4 5 6</mark>	Frequency
e.e	p n o	1 22.400	000000	PNO: Fast G	Trig: Free Atten: 20		Avg Hold:	9/100	TYI Di		
				IFGam.LOW	rateri. 20			MI	(r1 2 46	5 0 GHz	Auto Tune
10 dl Log	B/div	Ref Offse Ref 20.0								dBm	
											Center Freq
10.0											20.40000000 GHz
0.00											Start Freq
-10.0										-9.40 dBm	18.40000000 GHz
-20.0											Stop Freq
-30.0	1										22.400000000 GHz
-30.0	Ĺ										
-40.0				ha ayan da baran dari		lite a line of a stand of a stand of	a dan da	a and a faile of the second	li de la centra de	a a fatta a fat	CF Step
	and and a		nen engine orden en e	<mark>I Nord Tray (1997) I Tray</mark>		والمراجع والمتقلقان والمرود ودرا	an dan kanalara ka	linetre sint fedication	<mark>Chairman Providing and an </mark>		400.000000 MHz <u>Auto</u> Man
-50.0	allow and the		a kalina ina ma								
-60.0											Freq Offset
00.0											0 Hz
-70.0											
		00 GHz							Stop 22	.400 GHz	
#Re	s BW	100 kHz		VBW	1.0 MHz			Sweep	371 ms (4	0001 pts)	
MSG								STATU	5		



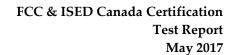
Agilent Sp		nalyzer - Swe									
<mark>IXI</mark> Stop	R Freg 2		AC 2000 GH2	7	SEN	NSE:INT		ALIGNAUTO	TRAC	M Mar 10, 2017 E <mark>1 2 3 4 5 6</mark>	Frequency
			PI	NO:Fast 🖵 Gain:Low	Trig: Free Atten: 20		Avg Hold:	5/100	TYP		
	_			5411.20				Mk	1 2.465	04 GHz	Auto Tune
10 dB/d Log		f Offset 17 e <b>f 20.00 d</b>								dBm	
											Center Freq
10.0											24.700000000 GHz
0.00											Start Freq
-10.0										-9.40 dBm	22.400000000 GHz
-20.0											Stop Freq
-30.0 1 -											27.00000000 GHz
- k				1400	والمحافظينان التربي ال	, and the second sector of the second sector of the second second second second second second second second se	le de la contration	and reduced and	in a thing this think in the same	the work of the second	
-40.0 🔒	lite and a state of the state of	and plates with the			and the second second	ويتر التوارية والمتراجع والمتراجع	فأشفانا أرفاق والمتناط	والمتلكة والملحور والمتركبة	likin alama da mandari di atao, na d	nt destaten stiller so	CF Step 460.000000 MHz
	وأعراضهم والمعادران	أحادين والعروم مرجى	tale hours part parts				non ab.		<sup>th</sup> ypological participation of the	al contractor	<u>Auto</u> Man
-30.0											
-60.0											Freq Offset 0 Hz
											UHZ
-70.0											
	22.400 ( BW 100			VBW	1.0 MHz			Sweep	27 Stop 427 ms (4	.000 GHz 0001 pts)	
MSG								STATU	-		



## Figure 18: Band Edge BT Mode (Hopping)

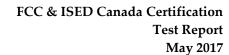
•

	t Spectro	um Analyzer									
<mark>IXI</mark> Marl	cor 3	RF 2.40000	50 Ω AC	GH7	SEN	NSE:INT	Avg Type	ALIGN AUTO		M Mar 10, 2017 E <mark>1 2 3 4 5 6</mark>	Marker
Meth	Nel J	2.40000	0000000	PNO: Fast IFGain:Low	Trig: Free Atten: 20		Avg Hold:	>100/100	TYI Di	PE MWWWWW ET P NNNNN	Select Marker
10 dE Log r	3/div	Ref Offse <b>Ref 20.0</b>	t 17 dB I <b>0 dBm</b>					Mkra	3 2.400 0 -48.0	00 GHz 87 dBm	3
10.0										n m X21	Normal
0.00 - 10.0 -											Delta
-20.0											Fixed⊳
-30.0											Off
-50.0	ut han ha	<b>Mundatiper</b> Matri	thijathijuurist.thij	ndethers) belgetatherennes	pathoning and a state of the second state of the second state of the second state of the second state of the se	an manager and the	utanoninati quphit	dyhtergerfolgerand			
-60.0 ·											Properties►
Stari #Res	t 2.37	500 GHz (CISPR)	120 kHz	#VBM	8.0 MHz			Sweep	Stop 2.40 3.60 ms (	0500 GHz 4503 pts)	More 1 of 2
MSG								STATU			



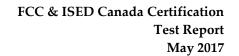
## Figure 19: Band Edge BT Mode (Hopping and non-Hopping Modes)

Marker 3 2.40000000000 GHz PN0: Wide PN0:	Agilent Spectr	um Analyzer - Swe									
PN0: Wide     Irrg: Free Run Healint.ow     AvgRHold>100/00     Irrel Without     Select Marker 3       10 dB/div     Ref Offset 17 dB Ref 20.00 dBm     Mkr3 2.400 000 000 GHz -49.575 dBm     Normal       10 dB/div     Ref offset 17 dB Ref 20.00 dBm     Delta     Normal       10 dB/div     Mkr3 2.400 000 000 GHz     Delta       10 dB/div     Mkr3 2.400 000 000 GHz     More       10 dB/div     Mkr3 2.400 000 GHz     Span 5.000 MHz       10 dB/div     VBW 1.0 MHz     Sweep 2.67 ms (40001 pts)	Marker 3			∣ Iz			Avg Type	: Log-Pwr	TRAC	E 123456	Marker
Ref Offset 17 dB         Mkr3 2.400 000 000 GHz         3           10 dB/div         Ref 20.00 dBm         49.575 dBm         3           10 dB/div         49.575 dBm         0         0           10 dB/div         10 d         10 d         10 d         0 <th></th> <th></th> <th>PN</th> <th>IO: Wide 🖕</th> <th></th> <th></th> <th>Avg Hold:</th> <th>&gt;100/100</th> <th>TYI Di</th> <th></th> <th>Select Marker</th>			PN	IO: Wide 🖕			Avg Hold:	>100/100	TYI Di		Select Marker
Normal   Normal   Normal   Normal   Normal   Normal   Delta   D		Ref Offset 17 Ref 20.00 d	dB Bm				М	kr3 2.4(	00 000 0 -49.5	00 GHz 75 dBm	•
100     102     Delta       200     100     100       300     100     100       400     3     100       400     3     100       400     3     100       400     100     100       400     100     100       400     100     100       400     100     100						( <sub>2</sub> )					Normal
-30.0       -30.0       -30.0       -40.0       -50.0 <td< td=""><td></td><td></td><td></td><td></td><td>162</td><td></td><td>\</td><td></td><td></td><td></td><td>Delta</td></td<>					162		\				Delta
40.0       3       3       60.0       6											Fixed⊳
-50.0 -70.0 -70.0 Center 2.402000 GHz #Res BW 100 kHz VBW 1.0 MHz Sweep 2.67 ms (40001 pts) -70 VBW 1.0 MHz Sweep 2.67 ms (40001 pts)	-40.0	3	-					human	Multine and		Off
Center 2.402000 GHz         Span 5.000 MHz         1 of 2           #Res BW 100 kHz         VBW 1.0 MHz         Sweep 2.67 ms (40001 pts)										**************	Properties►
	-70.0	402000 GHz							Span 5	.000 MHz	
	#Res BW	100 KHZ		VBW	T.U IVIHZ					ooon pts)	



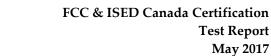
### Figure 20: Band Edge BT Mode (Hopping Modes)





# Figure 21: Band Edge BT Mode (Hopping and non-Hopping Modes)

Agilent Spectr	um Analyzer - Swept SA						
I <mark>XI</mark> Spap 10			SENSE:INT	ALIGN Avg Type: Volt		M Mar 10, 2017 E <mark>1 2 3 4 5 6</mark>	Span
Span 10.	0000000 MHz	PNO: Wide 😱	Trig: Free Run	Avg Hold:>100/	100 TYP	E M <del>WWWWW</del>	
		IFGain:Low	Atten: 20 dB				Span
	Ref Offset 17 dB			Mk	r3 2.483 500	0 GHz	10.000000 MHz
10 dB/div Log	Ref 20.00 dBm				-51.30	00 dBm	
-09							
10.0							
10.0			<u>/X2</u>				
0.00							
0.00							
-10.0			1∆	2			Full Span
-10.0							
-20.0							
-20.0							Zero Span
			/ \				2010 3041
-30.0		/\v	/V	<u></u>			
				\ <u>\</u>			
-40.0		کس کر		Wy -			Last Span
					3		· · · · ·
-50.0	Water and when the water the			. Annadal (A	M.M.M.M.M.M.M.M.M.M.M.M.M.M.M.M.M.M.M.	mann	
-60.0							
-70.0							
							Signal Track (Span Zoom)
Center 2.4	480013 GHz				Span 1	0.00 MHz	
	(-6dB) 120 kHz	<b>VBW 9</b> 1	10 kHz	Sw	eep 1.20 ms (	4503 pt <u>s)</u>	
MSG					STATUS		

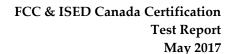


Agilent Spectr	um Analyzer - Swept S					
Marker 3	RF 50 Ω A		SENSE:INT	ALIGNAUTO Avg Type: Log-Pwr	02:38:46 PM Mar 10, 2017 TRACE 1 2 3 4 5 6	Trace/Det
		PNO: Fast 🖵 IFGain:Low	Trig: Free Run Atten: 20 dB	Avg Hold:>100/100		Select Trace
10 dB/div Log	Ref Offset 17 dB Ref 20.00 dBr			Mkr3	2.392 223 7 GHz -51.778 dBm	1
10.0				,		Clear Write
0.00						
-10.0						Trace Average
-20.0						Max Hold
-40.0						Min Hold
-50.0	alise in the state of the state	hi hatalah da karatiki da karati	3		. <u></u>	MITHOIC
-60.0						View/Blank Trace On
-70.0						
Start 2.37 #Res BW		VBW	1.0 MHz	Sweep	Stop 2.40945 GHz 5.33 ms (40001 pts)	More 1 of 3
MSG				STAT		



Figure 23: Band Edge BT Mode	(non-Hopping Modes)
------------------------------	---------------------

Agilent Spectr	rum Analyzer - Swept SA						
Marker 3	RF 50 Ω AC 2.48350000000		SENSE:INT	Avg Type	LIGNAUTO	02:41:25 PM Mar 10, 2017 TRACE 1 2 3 4 5 6	Marker
		PNO: Fast 😱 IFGain:Low	Trig: Free Run Atten: 20 dB	Avg Hold:	>100/100	TYPE MWWWW DET PNNNN	Select Marker
10 dB/div Log	Ref Offset 17 dB <b>Ref 20.00 dBm</b>			I	Mkr3 2.	483 500 00 GHz -51.731 dBm	3
	1 1 X2						Norma
-10.0	142					-4.20 dBm	Delta
-20.0							Fixed▷
-40.0		3					Off
-50.0		rindi yang mengangkan kang berpangkan kang berpangkan kang berpangkan kang berpangkan kang berpangkan kang ber Kang berpangkan kang berpangkan kang berpangkan kang berpangkan kang berpangkan kang berpangkan kang berpangkan Kang berpangkan kang berpangkan kang berpangkan kang berpangkan kang berpangkan kang berpangkan kang berpangkan	Line and a set of a set of the se	niyati eshi yelan bayaa aad		ifete alle alexandra para transferencia de la contra a	Properties▶
-70.0							More
Start 2.47 #Res BW		VBW	I.0 MHz		Sweep :	Stop 2.50500 GHz 5.33 ms (40001 pts)	1 of 2
MSG					STATUS	3	



## 4.7 Radiated Emissions: (FCC Part §2.1053)

The EUT must comply with the radiated emission limits of 15.209. The limits are as shown in the following table.

#### 4.7.1 Test Procedure

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured. Readings under 1000MHz were performed using a Quasi-Peak Detector function. Average readings were calculated based on the peak reading minus the Duty Cycle correction.

The emissions were measured using the following resolution bandwidths:

Frequency Range	Resolution Bandwidth	Video Bandwidth
30MHz-1000 MHz	120kHz	>100 kHz
>1000 MHz	1 MHz	1MHz (Peak)

Emissions were measured to the 10th harmonic of the transmit frequency. Worst-case emission levels are reported.

Emissions were also scanned from 30 MHz to 10X fundamental and compared with the 15.209 limits. No detectable emissions were found aside from harmonics of the transmit frequency shown in the following table.

The following is a sample calculation used in the data tables for calculating the final field strength of spurious emissions and comparing these levels to the specified limits.

Sample Calculation:

Spectrum Analyzer Voltage (SA Level):	V dBµV
Antenna Factor (Ant Corr):	AFdB/m
Cable Loss Correction (Cable Corr):	CCdB
Duty Cycle Correction (Average)	DCCdB
Amplifier Gain:	GdB
Electric Field (Corr Level): $EdB\mu V/m = VdB\mu$	V + AFdB/m + CCdB + DCCdB - GdB



Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)
2400.00	V	180.00	1.64	60.61	-15.2	187.2	500.0	-8.5
2483.50	V	135.00	1.64	52.81	-16.0	69.6	500.0	-17.1
4804.00	V	180.00	1.64	52.85	-8.5	165.9	500.0	-9.6
7206.00	V	90.00	1.64	47.67	-0.2	236.5	500.0	-6.5
2400.00	Н	270.00	1.64	61.93	-15.2	218.0	500.0	-7.2
2483.50	Н	270.00	1.64	52.70	-16.0	68.8	500.0	-17.2
4804.00	Н	0.00	1.65	52.14	-8.5	152.9	500.0	-10.3
7206.00	Н	90.00	1.65	48.81	-0.2	269.5	500.0	-5.4

## Table 8: Radiated Emission Test Data. BT Mode Low Channel

## Table 9: Radiated Emission Test Data. BT Mode Middle Channel

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)
2400.00	V	135.00	1.64	63.21	-15.2	252.4	500.0	-5.9
2483.50	V	270.00	1.64	61.02	-16.0	179.2	500.0	-8.9
4884.00	V	90.00	1.00	46.60	-8.1	84.3	500.0	-15.5
7326.00	V	90.00	1.00	41.30	-0.5	109.9	500.0	-13.2
2400.00	Н	45.00	1.64	66.91	-15.2	386.7	500.0	-2.2
2483.50	Н	315.00	1.64	60.79	-16.0	174.5	500.0	-9.1
4884.00	Н	0.00	1.00	45.00	-8.1	70.1	500.0	-17.1
7326.00	Н	0.00	1.00	48.00	-0.5	237.8	500.0	-6.5



Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)
2400.00	V	0.00	0.00	58.60	-15.2	148.5	500.0	-10.5
2483.50	V	0.00	0.00	59.70	-16.0	153.9	500.0	-10.2
4960.00	V	90.00	1.00	47.70	-7.8	99.0	500.0	-14.1
7440.00	V	90.00	1.00	46.30	-0.6	193.4	500.0	-8.3
2400.00	Н	270.00	1.00	58.40	-15.2	145.1	500.0	-10.7
2483.00	Н	180.00	1.00	58.70	-16.0	137.2	500.0	-11.2
4960.00	Н	0.00	0.00	49.90	-7.8	127.5	500.0	-11.9
7440.00	Н	0.00	0.00	45.50	-0.6	176.4	500.0	-9.1

## Table 10: Radiated Emission Test Data. BT Mode High Channel



Frequency (MHz)	Polarity (H/V)	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Peak or Average	Note
50.20	V	0.0	1.0	39.3	-18.9	20.4	30.0	-9.6	Peak	BB
54.80	V	0.0	1.0	40.8	-19.6	21.3	30.0	-8.7	QP	BB
63.60	V	0.0	1.0	42.7	-18.9	23.8	30.0	-6.2	QP	BB
288.00	V	0.0	3.0	39.1	-11.0	28.1	37.0	-8.9	QP	
336.00	V	0.0	2.0	26.4	-10.1	16.3	37.0	-20.7	QP	
360.00	V	90.0	1.0	39.0	-9.2	29.8	37.0	-7.2	QP	
384.00	V	0.0	1.0	33.3	-8.9	24.4	37.0	-12.6	QP	
504.00	V	270.0	1.0	27.0	-5.3	21.7	37.0	-15.3	QP	
576.00	V	0.0	1.0	29.3	-3.5	25.8	37.0	-11.2	QP	
371.00	V	0.0	2.0	33.2	-8.8	24.4	37.0	-12.6	QP	
50.20	V	0.0	2.0	37.6	-18.9	18.7	30.0	-11.3	QP	QP
54.80	V	90.0	2.0	37.6	-19.6	18.0	30.0	-12.0	QP	BB
63.60	V	90.0	2.0	40.4	-18.9	21.5	30.0	-8.5	QP	BB
68.80	V	0.0	2.0	37.6	-18.4	19.2	30.0	-10.8	QP	BB
124.80	V	0.0	2.0	34.4	-11.9	22.5	30.0	-7.5	QP	BB
129.60	V	0.0	2.0	33.8	-12.2	21.6	30.0	-8.4	QP	BB
138.80	V	180.0	2.0	31.5	-12.9	18.6	30.0	-11.4	QP	BB
352.90	V	270.0	1.0	31.6	-9.6	22.0	37.0	-15.0	QP	
432.00	V	0.0	1.0	31.5	-7.1	24.4	37.0	-12.6	QP	
50.20	Н	0.0	1.0	31.7	-18.9	12.8	30.0	-17.2	Peak	BB
54.80	Н	0.0	1.0	34.2	-19.6	14.6	30.0	-15.4	Peak	BB
63.60	Н	180.0	1.0	38.2	-18.9	19.2	30.0	-10.8	Peak	BB
68.80	Н	90.0	1.5	38.2	-18.4	19.8	30.0	-10.2	Peak	BB
288.00	Н	0.0	2.0	38.2	-11.0	27.1	37.0	-9.9	Peak	
336.00	Н	0.0	1.0	25.0	-10.1	14.9	37.0	-22.1	Peak	
360.00	Н	90.0	2.5	40.8	-9.2	31.6	37.0	-5.4	Peak	
384.00	Н	90.0	1.0	31.9	-8.9	23.0	37.0	-14.0	Peak	
504.00	Н	45.0	1.0	27.5	-5.3	22.2	37.0	-14.8	Peak	
576.00	Н	180.0	1.0	35.0	-3.5	31.5	37.0	-5.5	Peak	
114.70	Н	90.0	2.0	33.5	-12.6	20.9	30.0	-9.1	Peak	BB
118.70	Н	270.0	1.0	28.1	-12.0	16.1	30.0	-13.9	Peak	BB
138.80	Н	0.0	2.0	31.6	-12.9	18.7	30.0	-11.3	Peak	BB

## Table 11: Digital Emissions to FCC 15.209