

RADIO TEST REPORT

For

MODEL NO.: 1855 FCC ID: C3K1855 IC ID: 3048A-1855

Test Report No. R-TR516-FCCISED-BT-2 Issue Date: July 15, 2019

FCC CFR47 Part 15 Subpart C Innovation, Science and Economic Development Canada RSS-247 Issue 2

> Prepared by Microsoft EMC Laboratory 17760 NE 67th Ct, Redmond WA, 98052, U.S.A. 425-421-9799 <u>dasalina@microsoft.com</u>





1 Record of Revisions

Revision	Date	Section	Page(s)	Summary of Changes	Author/Revised By:
1.0	5/24/2019	All	All	Version 1.0	Vishwas Narayan
2.0	07/15/2019	5.1	9	Included note on USB charging cable for radiated measurements	Daniel Salinas



Table of Contents

1	Rec	ord of Revisions	2
2	Dev	iations from Standards	7
3	Fac	ilities and Accreditations	7
3	.1	Test Facility	7
3	.2	Accreditations	7
3	.3	Test Equipment	7
4	Mea	asurement Uncertainty	7
5	Pro	duct Description	8
5	5.1	Test Configurations	8
5	.2	Environmental Conditions	9
5	.3	Antenna Requirements	9
5	.4	Equipment Modifications	9
5	.5	Dates of Testing	9
6	Tes	t Results Summary	10
7	Tes	t Equipment List	11
8	Tes	t Site Description	14
8	5.1	Radiated Emissions Test Site	14
	8.1.	1 Radiated Measurements in 30 MHz - 1000 MHz	14
	8.1.	2 Radiated Measurements above 1GHz	14
8	.2	Antenna port conducted measurements	14
8	.3	Test Setup Diagrams	14
9	Tes	t Results- Conducted	17
9	.1	Duty Cycle	17
	9.1.	1 Test Requirement:	17
	9.1.	2 Test Method:	17
	9.1.	3 Limits:	17
	9.1.	4 Test Results:	17
	9.1.	5 Test Data:	18
9	.2	20dB and 99% Occupied Bandwidth	20
	9.2.	1 Test Requirement:	20
	9.2.	2 Test Method:	20
	9.2.	3 Limits:	20
Rep	ort#:	R-TR516-FCCISED-BT-2 Issued: July 15, 2019	Page 3 of 81



9.2.4	Test Results:	20
9.2.5	Test Data:	21
9.3 Ou	utput Power	26
9.3.1	Test Requirement:	26
9.3.2	Test Method:	26
9.3.3	Limits:	26
9.3.4	Test Results:	27
9.3.5	Test Data:	28
9.4 Ch	nannel Spacing	33
9.4.1	Test Requirement:	33
9.4.2	Test Method:	33
9.4.3	Limits:	33
9.4.4	Test Results:	33
9.4.5	Test Data:	34
9.5 Nu	Imber of Hopping Frequencies	35
9.5.1	Test Requirement:	35
9.5.2	Test Method:	35
9.5.3	Limits:	35
9.5.4	Test Results	35
9.5.5	Test Data:	
9.6 Dv	vell Time	37
9.6.1	Test Requirement:	
9.6.2	Test Method:	37
9.6.3	Limits:	37
9.6.4	Test Results:	37
9.6.5	Test Data:	
9.7 Ba	nd Edge	41
9.7.1	Test Requirement:	41
9.7.2	Test Method:	41
9.7.3	Limits:	41
9.7.4	Test Results:	41
9.7.5	Test Data:	42
9.8 Co	onducted Spurious Emissions	48
9.8.1	Test Requirement:	48
Report#: R-T	R516-FCCISED-BT-2 Issued: July 15, 2019 Microsoft EMC Laboratory	Page 4 of 81



9.8.2	Test Method:	48
9.8.3	Limits:	48
9.8.4	Test Results:	48
9.8.5	Test Data:	49
9.9 Rad	liated Spurious and Band Edge Emissions	58
9.9.1	Test Requirement:	58
9.9.2	Test Method:	58
9.9.3	Limits:	61
9.9.4	Test Result:	61
9.9.5	Test Data:	62
9.10 AC	Line Conducted Emissions	78
9.10.1	Test Requirements	78
9.10.2	Test Method	78
9.10.3	Limit	78
9.10.4	Test Result:	78
9.10.5	Test Data:	79



Test Report Attestation

Microsoft Corporation Model: 1855 FCC ID: C3K1855 IC ID: 3048A-1855

Applicable Standards

Specification	Test Result
FCC 47CFR Rule Parts 15.207, 15.209, 15.247	Pass
Innovation, Science and Economic Development Canada RSS-247 Issue 2, RSS-GEN Issue 5	Pass

Microsoft EMC Laboratory attests that the product model identified in this report has been tested to and meets the requirements identified in the above standards. The test results in this report solely pertains to the specific sample tested, under the conditions and operating modes as provided by the customer.

This report shall not be used to claim product certification, approval, or endorsement by A2LA or any agency of any Government. Reproduction, duplication or publication of extracts from this test report is prohibited and requires prior written approval of Microsoft EMC Laboratory.

This report replaces previously issued report R-TR516-FCCISED-BT-1 issued 05/24/2019.

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Written By: Vishwas Narayan Radio Test Engineer

Reviewed/ Issued By: Daniel Salinas RF Compliance Lab Manager



2 Deviations from Standards

None.

3 Facilities and Accreditations

3.1 Test Facility

All test facilities used to collect the test data are located at Microsoft EMC Laboratory,

17760 NE 67th Ct, Redmond WA, 98052, USA

3.2 Accreditations

The lab is established and follows procedures as outlined in IEC/ISO 17025 and A2LA accreditation requirements.

A2LA Accredited Testing Certificate Number: 3472.01

FCC Registration Number: US1141

IC Site Registration Numbers: 3048A-3, 3048A-4

3.3 Test Equipment

The site and related equipment are constructed in conformance with the requirements of ANSI C63.4:2014 and other equivalent applicable standards.

Test site requirements for measurements above 1 GHz are in accordance with ANSI C63.4:2014.

ANSI C63.10:2013 and the appropriate KDB test methods were followed.

4 Measurement Uncertainty

The following measurement uncertainty levels have been estimated for tests performed on the product, as specified in ETSI TR 100 028. This represents an expanded uncertainty expressed at 95% confidence level using a coverage factor k=2. These levels are for reference only and not included to determine product compliance. Expanded uncertainty calculations are available upon request.

Test item	Uncertainty	Unit
Radiated disturbance (30 MHz to 1 GHz)	5.99	dB
Radiated disturbance (1 GHz to 18 GHz)	5.12	dB
Radiated disturbance (18 GHz to 26.5 GHz)	4.86	dB
Conducted Disturbance at Mains Port	3.31	dB
Uncertainty for Conducted Power test	1.277	dB
Uncertainty for Conducted Spurious emission test	2.742	dB
Uncertainty for Bandwidth test	4.98	kHz
Uncertainty for DC power test	0.05	%
Uncertainty for test site temperature	0.5	°C
Uncertainty for test site Humidity	3	%
Uncertainty for time	0.189	%

5 Product Description

Company Name:	Microsoft Corporation
Address:	One Microsoft Way
City, State, Zip:	Redmond, WA 98052-6399
Customer Contact:	Chaitrali Limaye
Functional Description of the EUT:	Radio transceiver device with IEEE 802.11a/b/g/n/ac MIMO radio supporting 20/40/80MHz bandwidths, Bluetooth 5.0.
Model:	1855
FCC ID:	C3K1855
IC ID:	3048A-1855
Radio under test:	BT (2402- 2480 MHz) Ch. 0-78
Modulation(s):	GFSK, π/4-DQPSK, 8PSK
Antenna Information:	Integral Antenna. Manufacturer declared max Antenna Gain in 2.4GHz band of operation: 3.90 dBi
EUT Classification:	FHSS
Equipment Design State:	Prototype/Production Equivalent – EV3
Equipment Condition:	Good
Lest Sample Details	RF Conducted Test Sample S/N: A24964030112844A, Internal ID: R-516-122718-01 RF Radiated Test Sample S/N:900054391556, Internal ID: R-516-050219-10 S/N:900218190956, Internal ID: R-516-040919-05 S/N:900128190956, Internal ID: R-516-042219-06 S/N:900216390956, Internal ID: R-516-042219-07

5.1 Test Configurations

Test software "QRCT" (V4.0.00123) provided by the customer was used to program the EUT to transmit continuously.



The device can operate in GFSK, π /4DQPSK and 8DPSK modulations and all modes were tested and included in this report. Channel numbers 0, 39 and 78 were used as Low, Mid and High Channels, respectively.

All radiated testing reported was performed with the USB charging cord connected as these results were worst case.

5.2 Environmental Conditions

Ambient air temperature of the test site was within the range of 10 °C to 40 °C (50 °F to 104 °F) unless the EUT specified testing over a different temperature range. Humidity levels were in the range of 10% to 90% relative humidity. Testing conditions were within tolerance and any deviations required from the EUT are reported.

5.3 Antenna Requirements

The antennas are permanently attached and there are no provisions for connection to an external antenna.

5.4 Equipment Modifications

No modifications were made during testing.

5.5 Dates of Testing

Testing was performed on February 15th - May 15th, 2019.

6 Test Results Summary

Test Description	FCC Rule Part ISED Rule Part	Limit	Test Result (Pass/Fail)
Duty Cycle	Reporting & Measurements	Reporting & Measurements Purposes only	N/A
20dB Bandwidth	15.247 (a)(1)(ii) RSS-247 [5.1]	For reporting purposes only.	Pass
Output Power	15.247 (a)(1)/(b)(1) RSS-247 [5.4]	< 125 mW – Conducted < 500 mW - EIRP	Pass
Channel Spacing	15.247 (a)(1) RSS-247 [5.1]	2/3 of 20dB BW or 25 kHz	Pass
Number of Hopping Frequencies	15.247 (a)(1)(iii) RSS-247 [5.1]	> 15 channels	Pass
Dwell Time	15.247 (a)(1)(iii) RSS-247 [5.1]	< 0.4 sec in 31.6 sec period	Pass
Conducted Band Edge/Spurious Emissions	15.247 (d) RSS-247 [5.5]	At least 20dBc	Pass
Radiated Spurious Emissions/ Restricted Band Emissions	15.205, 15.209 RSS-247 [5.5] RSS-Gen [8.9]	FCC CFR 47 15.209 limits RSS-Gen [8.9]	Pass
AC Powerline Conducted Emissions	15.207 RSS-Gen [8.8]	FCC CFR 47 15.207 limits RSS-Gen [8.8]	Pass

7 Test Equipment List

Equipment used for Radiated and Conducted Measurements					
Manufacturer	Description	Model #	Asset #	Calibration Due	
Rohde & Schwarz	EMI Test Receiver	ESU40	RF-192	4/10/2020	
Rohde & Schwarz	EMI Test Receiver	ESU40	RF-248	4/11/2020	
Rohde & Schwarz	EMI Test Receiver	ESU40	RF-229	4/10/2020	
Keysight	Spectrum Analyzer	N9010A	EMC-1213	11/8/2019	
Sunol Sciences	Antenna - Broadband Hybrid	JB6	EMC-639	8/17/2019	
ETS-Lindgren	Antenna	3117-PA	EMC-858	10/8/2019	
ETS-Lindgren	Antenna	3117-PA	RF-139	6/1/2019	
ETS-Lindgren	Antenna – Standard Gain	3160-09	RF-179	7/30/2019	
Rohde & Schwarz	Custom Filter Bank+PreAmp	SFUNIT RX	RF-322	12/4/2019	
Rohde & Schwarz	Custom Filter Bank+PreAmp	SFUNIT RX	RF-323	11/29/2019	
Rohde & Schwarz	Pre-Amp	TS-PR26	RF-199	11/29/2019	
Rohde & Schwarz	Switch and Control Unit	OSP130	RF-569	7/23/2019	
Rohde & Schwarz	Switch and Control Unit	OSP130	RF-018	12/4/2019	
Rohde & Schwarz	Switch and Control Unit	OSP130	RF-249	11/29/2019	
Rohde & Schwarz	Switch and Control Unit	OSP150	RF-019	12/4/2019	
Rohde & Schwarz	Switch and Control Unit	OSP150	RF-250	11/29/2019	
Murata	RF Cable	MXJA01JA1000	RF-828	N/A	
Micro-Coax	RF Cable	UTI Flex	RF-359	N/A	
Micro-Coax	RF Cable	UTI Flex	RF-354	N/A	
Huber & Suhner	RF Cable	SucoFlex 100	RF-452	N/A	
Huber & Suhner	RF Cable	SucoFlex 100	RF-350	N/A	



Manufacturer	Description	Model #	Asset #	Calibration Due
Huber & Suhner	RF Cable	SucoFlex 102A	RF-269	N/A
Huber & Suhner	RF Cable	SucoFlex 106A	RF-599	N/A
PCE	Climate Meter	PCE-THB 40	EMC-1207	9/28/2019
PCE	Climate Meter	PCE-THB 40	EMC-1206	9/28/2019
Madge Tech	THP Monitor	PRHT Temp 2000	EMC-170	10/18/2019
Micro-Coax	RF Cable	UTI Flex	RF-647	N/A
Micro-Coax	RF Cable	UTI Flex	RF-646	N/A
Micro-Coax	RF Cable	UFA210A-Q-2755- 3005GU	EMC-648	N/A
Micro-Coax	RF Cable	UFA0311-1-0787- 50U50U	EMC-351	N/A
Teledyne	RF Cable	57500	EMC-1025	N/A
Micro-Coax	RF Cable	UFC142A	RF-274	N/A
Pasternack	Attenuator	PE7004-6	EMC-950	8/17/2019
Pasternack	Attenuator	PE7087-6	RF-801	N/A
Rohde & Schwarz	Software	EMC-32 V10.01.00	RF-464	N/A



Equipment used for AC Line Conducted Emissions Measurement							
Manufacturer	Description	Model #	Asset #	Calibration Due			
Rohde & Schwarz	EMI Test Receiver	ESU	RF-604	12/26/2019			
Teseq	EUT LISN	NNB 51	EMC-057	6/7/2019			
Micro-Coax	RF Cable	UFA210A-1-1800- 50U50U	EMC-367	N/A			
ETS-Lindgren	TILE SW	Version 7.2.5.7	EMC-985	N/A			
PCE	THP Monitor	PCE THB 40	EMC-1208	9/28/2019			
Fluke	Multimeter	87V	EMC-650	7/30/2019			
Chroma	AC Power source	61602	EMC-055	N/A			

Note: Items with Calibration Due data marked as N/A are characterized before test, where applicable.

8 Test Site Description

8.1 Radiated Emissions Test Site

Radiated measurements are performed in a 3m semi-anechoic chamber, which meets NSA requirements for the frequency range of 30MHz to 1000MHz. For measurements above 1 GHz, absorbers are laid out on the ground plane between the receiving antenna and the EUT to meet Site VSWR requirements in accordance with ANSI C63.4:2014.

8.1.1 Radiated Measurements in 30 MHz - 1000 MHz

The EUT is positioned on a turntable at a height of 80cm using a non-conducting table. A linearly polarized broadband antenna is positioned at 3m from the EUT periphery. The turntable is rotated 360 degrees and the antenna height varied from 1m to 4m to determine the highest emissions. This is repeated for both horizontal and vertical polarizations of the measurement antenna. All possible orientations of the EUT were investigated for emissions and the flat orientation was identified as the worst-case configuration.

8.1.2 Radiated Measurements above 1GHz

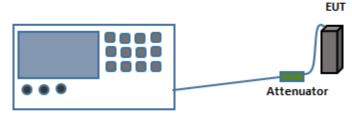
The EUT is positioned on a Turntable at a height of 1.5m. A Linearly polarized antenna is positioned at 3m from the EUT periphery. Guidelines in ANSI C63.10:2013 were followed with respect to maximizing the emissions. The measurement antenna is set at a fixed 1.5m height while the turntable is rotated 360 degrees and the EUT elevation angle is varied from 0 to 150 degrees in 30 degree increments to determine the highest emissions. This is repeated for both horizontal and vertical Polarizations of the Measurement Antenna. Measurements above 18GHz were performed at a 3m distance. Near field scanning is performed to identify frequencies above 1 GHz.

8.2 Antenna port conducted measurements

All antenna port conducted measurements were performed on a bench-top setup consisting of a spectrum analyzer, power meter (as necessary), splitters/combiners (as necessary), attenuators, and pre-characterized RF cables.

The correction factors between the EUT and the spectrum analyzer were added internally in the analyzer settings, where applicable. The plots displayed account for these correction factors.

8.3 Test Setup Diagrams



Spectrum Analyzer/ Power Meter

Fig.1. Test Setup for Antenna port conducted measurements

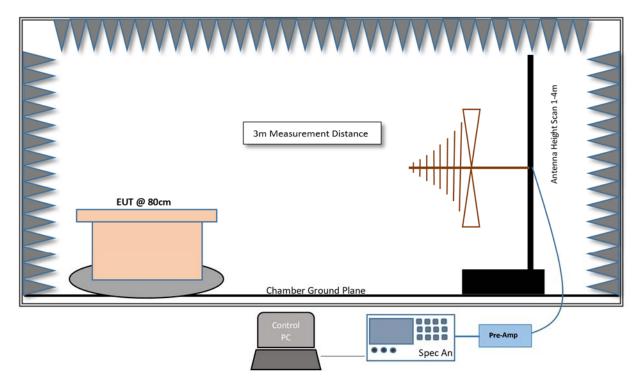


Fig.2. Test Setup for Radiated measurements in 30MHz- 1GHz Range

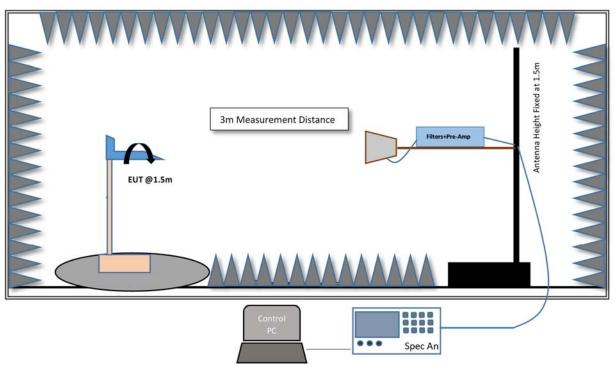


Fig.3. Test Setup for Radiated measurements in 1GHz- 18GHz Range



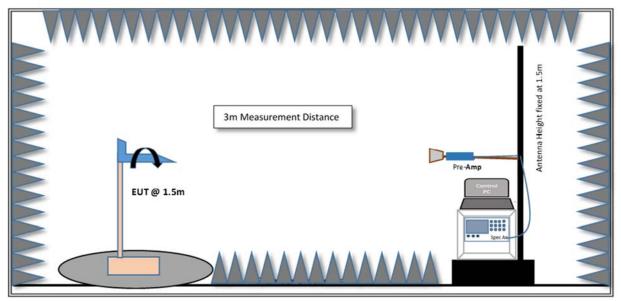


Fig.4. Test Setup for Radiated measurements >18GHz



9 Test Results- Conducted

9.1 Duty Cycle

9.1.1 **Test Requirement:**

Reporting and measurement purposes only.

9.1.2 Test Method:

Measurements were performed according to the procedure defined in ANSI C63.10:2013.

Spectrum Analyzer Settings:

 $RBW \ge Occupied Bandwidth if possible; otherwise, set RBW to the largest available value$ $VBW \ge RBW \ge Signal Period$ Detector = PeakSpan = 0 HzSweep points > 100

Sample Calculations:

Duty Cycle (%) = $[(T_{on}) / (T_{on} + T_{off})] *100$ If duty cycle >98% then the correction factor is 0, else the correction factor is calculated as follows.

Duty Cycle Correction Factor = $10 \log^{(1/DC)} = 10 \log (1/0.92) = 0.362 dB$.

9.1.3 Limits:

Reporting and measurement purposes only.

9.1.4 Test Results:

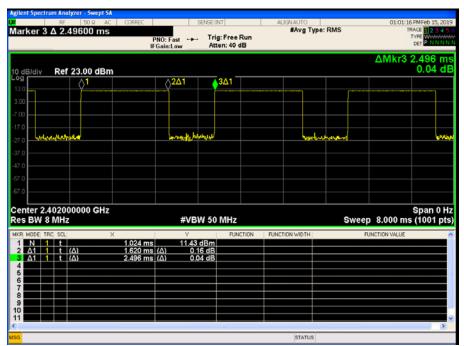
Frequency	Data Rate	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
2402	1-DH1	0.38	1.25	30.45	5.16
2402	1-DH3	1.62	2.49	64.90	1.88
2402	1-DH5	2.86	3.72	76.88	1.14



9.1.5 Test Data:

gilent Spectrum And					
arker 3 Δ 1.		PNO: Fast +++	Trig: Free Run Atten: 40 dB	ALIGNAUTO #Avg Type: R	12:59:46 PMFeb 15, 2 MS TRACE 2 3 4 TYPE WWW DET P NNN
10 dB/div Ref	23.00 dBm	IF Gain:Low			ΔMkr3 1.248 n -0.02 c
13.0			^{2∆1}	<mark>∳</mark> 3∆1	
3.00					
7.00					
17.0 27.0 🖗	handrau	support	househours	wayshow town	Uniter and the second second second
37.0					
7.0					
57.0					
enter 2.4020 tes BW 8 MH;		#VB	W 50 MHz		Span 0 Sweep 4.000 ms (1001 p
IKR MODE TRC SCL	×	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1 N 1 t 2 Δ1 1 t 3 Δ1 1 t	(Δ) 3	.328 ms 11.47 380.0 μs (Δ) -1.4 .248 ms (Δ) -0.0	dBm 2 dB 2 dB		
5 6 6					
7					
9 0 1					
			1		3
G				STATUS	





Plot 9-2. Duty Cycle (Ch. 0, 1-DH3)



Marker 1 6.04000 ms	CORREC	SEN	ISE:INT					
Marker 1 6.04000 ms			ISEUNT		ALIGNAUTO			2 PMFeb 15, 2019
		0:Fast 🔸	Trig: Free Atten: 40 d		#Avg Typ	e: RMS	Т	RACE 2345 TYPE WARANA
10 dB/div Ref 23.00 dBm							Mkr1 1	6.040 ms I.63 dBm
13.0	•	1		3∆1				
3.00								
-7.00	\rightarrow							
-17.0	\rightarrow							
-27.0	henri		لمايياتها		أخدره يسا		lowersel	
-37.0								
-47.0								
-67.0								
								On on A He
Center 2.402000000 GHz Res BW 8 MHz		#VBW	50 MHz			Sweep	20.00 ms	Span 0 Hz 5 (1001 pts
MKR MODE TRC SCL X	6.040 ms	ү 11.63 dE		CTION F	UNCTION WIDTH	FU	NCTION VALUE	
2 Δ1 1 t (Δ)	2.860 ms (/ 3.720 ms (/	A) -0.04 (dB					
4	3.720 ms (2	-0.21	aB					
6								
7								
9								
11			W					>
ISG					STATUS			

Figure 9-3 Duty Cycle (Ch. 0, 1-DH5)



9.2 20dB and 99% Occupied Bandwidth

9.2.1 Test Requirement:

FCC CFR 47 Rule Part 15.247 (a)(1)(iii)

ISED RSS-247 [5.1]

9.2.2 Test Method:

Measurements were performed according to the procedure defined in ANSI C63.10:2013 Section 7.8.

Spectrum analyzer settings:

The x dB (-20dB) function on the spectrum analyzer was used to measure 20dB BW with the settings below: Span = approximately 2 to 3 times the 20 dB or 99% Occupied bandwidth, centered on a hopping channel RBW \geq 1 to 5 % of the 20-dB bandwidth VBW \geq 3x RBW Sweep = Auto Detector function = Peak Trace = Max Hold The internal function of the spectrum analyzer is used to measure the 99% bandwidth.

Sample Calculations:

Corrected Amplitude: Amplitude (Analyzer level) + CL (Cable losses) = -25 dBm + 5 dB = - 20dBm.

9.2.3 Limits:

N/A- Reporting Purposes only.

9.2.4 Test Results:

Frequency (MHz)	Mode	Data Rate (Mbps)	Channel No.	20 dB Bandwidth (MHz)	Occupied Bandwidth (MHz)
2402	1-DH5	1	0	0.934	0.848
2441	1-DH5	1	39	0.941	0.859
2480	1-DH5	1	78	0.949	0.849
2402	2-DH5	2	0	1.278	1.174
2441	2-DH5	2	39	1.281	1.177
2480	2-DH5	2	78	1.285	1.175
2402	3-DH5	3	0	1.291	1.177
2441	3-DH5	3	39	1.289	1.174
2480	3-DH5	3	78	1.284	1.181



9.2.5 Test Data:



Figure 9-4 20dB Bandwidth (Ch. 0, 1-DH5)



Figure 9-5 20dB Bandwidth (Ch. 39, 1-DH5)





Figure 9-6 20dB Bandwidth (Ch. 78, 1-DH5)



Figure 9-7 20dB Bandwidth (Ch. 0, 2-DH5)



	RREC	SENSE:INT		ALIGN AUTO		MFeb 15, 2019	Trac	e/Detector
Center Freq 2.441000000 G	Trig:	er Freq: 2.44100 Free Run en: 40 dB	Avg Hold:	100/100	Radio Std		inac	cibeteetoi
	ounicow							
10 dB/div Ref 40.00 dBm								
30.0								Clear Write
20.0								orear o rrite
0.00	~~~~	·//	2000				_	
-10.0				~				Average
-20.0				\rightarrow			_	_
-30.0				han				
-50.0					the start	and the second		Max Hold
Center 2.441 GHz						an 3 MHz		
#Res BW 30 kHz		#VBW 91 kH	z			ep 3.2 ms		Min Hold
Occupied Bandwidth		Total P	ower	16.0	dBm			
	77 MHz							Detector
Transmit Freq Error	-8.192 kHz	OBW P	owor		0.00 %		Auto	Peak▶ Man
x dB Bandwidth	1.281 MHz	x dB	Ower		00 dB		Auto	wan
	1.201 WINZ	хuв		-20.	00 UB			
MSG				STATUS	à			

Figure 9-8 20dB Bandwidth (Ch. 39, 2-DH5)



Figure 9-9 20dB Bandwidth (Ch. 78, 2-DH5)



Agilent Spectrum Analyzer - Occupied BW	ORREC	SENSE:INT	ALIGNAUTO 01:17:56 F	MFeb 15, 2019			
Center Freq 2.402000000	Hz Cente	r Freq: 2.402000000 GHz	d: 100/100 Radio Std Radio De	l: None	Trace	Detector	
10 dB/div Ref 40.00 dBm	,						
30.0					с	lear Write	
10.0 0.00 -10.0		m	1			Average	
-20.0			homen				
-40.0			1 Junitor			Max Hold	
Center 2.402 GHz #Res BW 30 kHz	#	VBW 91 kHz		an 3 MHz p 3.2 ms		Min Hold	
Occupied Bandwidth 1.1	767 MHz	Total Power	16.2 dBm			Detector	
Transmit Freq Error	-5.854 kHz	OBW Power	99.00 %		Auto	Peak ► <u>Man</u>	
x dB Bandwidth	1.291 MHz	x dB	-20.00 dB				
MSG			STATUS				
Figure	Figure 9-10 20dB Bandwidth (Ch. 0, 3-DH5)						



Figure 9-11 20dB Bandwidth (Ch. 39, 3-DH5)



Agilent Spectrum Analyzer - Occupie							
Center Freg 2.4800000		SENSE:INT Center Freg: 2.48000	ALIGN AUTO	01:19:26 PM Radio Std:	1Feb 15, 2019 None	Trace	Detector
Center Freq 2.4800000		Trig: Free Run					
	#IFGain:Low	#Atten: 40 dB		Radio Devi	ice: BTS		
10 dB/div Ref 40.00 d	Bm						
Log							
30.0						c	lear Write
20.0						-	our mice
10.0		~					
0.00	~~~~	m	m				
-10.0	~~~~						Average
-20.0	_/						
-30.0							
40.0	J~~		Mrv,	nn			
-50.0					and the second		Max Hold
-50.0						_	_
Center 2.48 GHz				Spa	an 3 MHz		
#Res BW 30 kHz		#VBW 91 kH	Iz		3.2 ms		Min Hold
							MITTIOIG
Occupied Bandwi	dth	Total P	ower 16.4	4 dBm			
	1.1814 MF	z					Detector
							Peak►
Transmit Freq Error	-6.293 k	Hz OBW P	ower 9	9.00 %		Auto	Man
x dB Bandwidth	1.284 M	lHz xdB	-20	.00 dB			
MSG			STATU	S			

Figure 9-12 20dB Bandwidth (Ch. 78, 3-DH5)



9.3 Output Power

9.3.1 Test Requirement: FCC CFR 47 Rule Part 15.247 (b)(1)

ISED RSS-247 [5.4]

9.3.2 Test Method:

Measurements were performed according to the procedure defined in ANSI C63.10:2013 Section 7.8.

Spectrum analyzer settings:

Peak Power Measurements:

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel= 5MHz RBW > the 20 dB bandwidth of the emission being measured= 2MHz VBW \geq 3 x RBW= 6MHz Sweep = Auto Detector function = Peak Trace = Max Hold The trace was allowed to stabilize. A Marker was set to the peak of the emission. The indicated level is the peak output power.

Sample Calculations:

Effective Isotropic Radiated Power (EIRP): Amplitude (Analyzer level) + CL (Cable losses) + Antenna Gain = -25 dBm + 5 dB + 3 dBi = -17dBm.

9.3.3 Limits:

15.247/RSS-247: 1 Watt (30dBm), if \geq 75 non-overlapping channels.

Additionally, for EDR modes and devices with \leq 75 non-overlapping channels (AFH), 21dBm conducted.

RSS-247: 4 W (36dBm) EIRP.

Additionally, for EDR modes and devices with \leq 75 non-overlapping channels (AFH), 27dBm EIRP.



9.3.4 Test Results:

Frequency (MHz)	Mode	Data Rate (Mbps)	Channel No.	Cond. Peak Power (dBm)	Cond. Limit (dBm)	Margin (dB)	Results
2402	1-DH5	1	0	11.58	21	-9.42	Pass
2441	1-DH5	1	39	11.80	21	-9.20	Pass
2480	1-DH5	1	78	12.07	21	-8.93	Pass
2402	2-DH5	2	0	10.75	21	-10.25	Pass
2441	2-DH5	2	39	11.01	21	-9.99	Pass
2480	2-DH5	2	78	11.32	21	-9.68	Pass
2402	3-DH5	3	0	11.23	21	-9.77	Pass
2441	3-DH5	3	39	11.44	21	-9.56	Pass
2480	3-DH5	3	78	11.72	21	-9.28	Pass

Frequency (MHz)	Mode	Channel No.	Cond. Peak Power (dBm)	Ant. Gain (dBi)	EIRP (dBm)	ISED EIRP Limit (dBm)	Margin (dB)	Results
2402	1-DH5	0	11.58	3.900	15.48	27	-11.52	Pass
2441	1-DH5	39	11.80	3.900	15.70	27	-11.30	Pass
2480	1-DH5	78	12.07	3.900	15.97	27	-11.03	Pass
2402	2-DH5	0	10.75	3.900	14.65	27	-12.35	Pass
2441	2-DH5	39	11.01	3.900	14.91	27	-12.09	Pass
2480	2-DH5	78	11.32	3.900	15.22	27	-11.78	Pass
2402	3-DH5	0	11.23	3.900	15.13	27	-11.87	Pass
2441	3-DH5	39	11.44	3.900	15.34	27	-11.66	Pass
2480	3-DH5	78	11.72	3.900	15.62	27	-11.38	Pass



9.3.5 Test Data:

rker 1 2.401	50 R AC COF 995253000 G	lz	SENSE:INT	ALIGNAUTO #Avg Type: RMS Avg Hold: 100/100	01:37:56 PM Feb 15, 2 TRACE 1 2 3 4 TYPE MUM
		PNO: Fast	Atten: 40 dB	Avginola. Ioonioo	DET PINNS
B/div Ref 2	3.00 dBm			N	1kr1 2.401 995 G 11.577 dE
			1		
\vdash					
nter 2.402000					Span 4.747 M
s BW 3.0 MH	z	#VB	W 50 MHz	Swe	ep 1.000 ms (1001 p

Figure 9-13 Peak Power (Ch. 0, 1-DH5)



Figure 9-14 Peak Power (Ch. 39, 1-DH5)



	RREC SENSE:INT	ALIGNAUTO	01:40:01 PMFeb 15, 2019
larker 1 2.479848096000 G	HZ PNO: Fast Trig: Free Run IFGain:Low Atten: 40 dB	#Avg Type: RMS Avg Hold: 100/100	TRACE 12345 TYPE MUMMUM DET PNNNN
0 dB/div Ref 23.00 dBm		M	kr1 2.479 848 GH 12.072 dBn
13.0	↓ 1		
3.00			
7.00			
17.0			
27.0			
77.0			
7.0			
77.0			
67.0			
enter 2.480000 GHz Res BW 3.0 MHz	#VBW 50 MHz	Swee	Span 4.747 MH p 1.000 ms (1001 pt
sg		STATUS	

Figure 9-15 Peak Power (Ch. 78, 1-DH5)

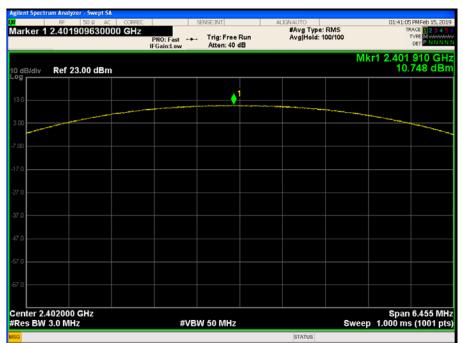


Figure 9-16 Peak Power (Ch. 0, 2-DH5)



Agilent Spectrum Analyzer - Swept SA				
Marker 1 2.440857990000 GHz	PNO: Fast +++ IFGain:Low	ISE:INT Trig: Free Run Atten: 40 dB	ALIGNAUTO #Avg Type: RMS Avg Hold: 100/100	01:41:52 PMFeb 15, 2019 TRACE 1 2 3 4 5 6 TYPE MUSANANA DET P.N.N.N.N
10 dB/div Ref 23.00 dBm			I	Mkr1 2.440 858 GHz 11.011 dBm
13.0		↓ ¹		
3.00				
-7.00				
-17.0				
-27.0				
-37.0				
47.0				
-57.0				
-67.0				
Center 2.441000 GHz #Res BW 3.0 MHz	#VBW	50 MHz	Swe	Span 6.455 MHz ep 1.000 ms (1001 pts)
453			STATUS	

Figure 9-17 Peak Power (Ch. 39, 2-DH5)



Figure 9-18 Peak Power (Ch. 78, 2-DH5)



	m Analyzer - Swept SA RF 50 Ω AC CORR		ENSE:INT	ALIGNAUTO	01:44:02 PMFeb 15, 2019
Marker 1	2.402077460000 GH	PNO: Fast	Trig: Free Run Atten: 40 dB	#Avg Type: RMS Avg Hold: 100/100	TRACE 123456 TYPE MUNICIPAL DET PNNNN
10 dB/div	Ref 23.00 dBm			N	lkr1 2.402 077 GHz 11.227 dBm
13.0			↓ 1		
3.00			an gerne	****	
7.00					
17.0					
27.0					
37.0					
47.0					
57.0					
67.0					
Center 2.4 Res BW 3	02000 GHz 3.0 MHz	#VBV	∜ 50 MHz	Swee	Span 6.455 MHz p 1.000 ms (1001 pts
ISG				STATUS	

Figure 9-19 Peak Power (Ch. 0, 3-DH5)



Figure 9-20 Peak Power (Ch. 39, 3-DH5)



Agilent Spectr	rum Analyzer - Swept SA RF 50 Q AC CORRE	c	SENSE:INT	61	IGNAUTO		01:45:36	PMFeb 15, 2019
Marker 1	2.479954815000 GHz			Run	#Avg Type: Avg Hold: 1		TF	
10 dB/div Log	Ref 23.00 dBm					MI	kr1 2.479 11.	955 GHz 724 dBm
13.0			•	1				
3.00			,			****	and and a state of the state of	
-7.00								
-17.0								
-27.0								
-37.0								
-47.0								
-57.0								
-67.0								
							0	C 455 BALL
center 2.4 #Res BW	480000 GHz 3.0 MHz	#VE	3W 50 MHz			Swee	Span 5 1.000 ms	6.455 MHz (1001 pts)
ISG					STATUS			

Figure 9-21 Peak Power (Ch. 78, 3-DH5)



9.4 Channel Spacing

9.4.1 Test Requirement: FCC CFR 47 Rule Part 15.247 (a)(1)

ISED RSS-247 [5.1]

9.4.2 Test Method:

Measurements were performed according to the procedure defined in ANSI C63.10:2013 Section 7.8. The EUT was in pseudorandom hopping mode with the separation of two peaks measured using the delta marker.

Spectrum analyzer settings:

Span = wide enough to capture the peaks of two adjacent channels Resolution (or IF) Bandwidth (RBW) = 300 kHz Video (or Average) Bandwidth (VBW) ≥ RBW= 3 MHz Sweep = Auto Detector function = Peak Trace = Max Hold The trace(s) was allowed to stabilize. The marker-delta function was used to determine the separation between the peaks of the adjacent channels.

Sample Calculations:

Channel Separation: High Channel Frequency – Low Channel Frequency = 2441 MHz – 2440 MHz = 1 MHz.

9.4.3 Limits:

The channel carrier frequencies must be separated by 25kHz or the 20dB BW of the hopping channel whichever is greater. If the output power is less than 125mW, then the channel separation can be 2/3 of the 20dB bandwidth 623.33kHz or 25kHz whichever is greater.

9.4.4 Test Results:

Pass.

Minimum channel separation= 1.0 MHz in 1-DH5 Mode.



9.4.5 Test Data:

Aglient Spectrum Analyzer - Swept SA De PF 50 2 AC CORREC Ref Level 23.00 dBm	PNO: Fast Tri IFGain:Low Att	g: Free Run ten: 40 dB	ALIGNAUTO #Avg Type: Avg Hold: 1		03:05:20 PMFeb 15, 20 TRACE 1 2 3 4 E TYPE M DET PNNNN
10 dB/div Ref 23.00 dBm				4	Mkr2 1.000 MH 0.127 di
		2Δ1	~~~~		
-7.00					
-27.0					
-47.0					
Center 2.441000 GHz #Res BW 300 kHz	#VBW 91	0 kHz		Sweep	Span 3.000 MH 1.000 ms (1001 pts
MKR MODE TRC SCL X 1 N 1 f 2.440 000 GH 2 Δ1 1 f 2.440 000 GH	v z 11.338 dBm z (Δ) 0.127 dB	FUNCTION	FUNCTION WIDTH	FUI	ICTION VALUE
3 4 5 6					
7 8 9 10					
		al and	STATUS		>

Figure 9-22 Channel Separation



9.5 Number of Hopping Frequencies

9.5.1 Test Requirement:

FCC CFR 47 Rule Part 15.247 (a)(1)(iii)

ISED RSS-247 [5.1]

9.5.2 Test Method:

Measurements were performed according to the procedure defined in ANSI C63.10:2013 Section 7.8. The EUT had its hopping function enabled.

Spectrum analyzer settings:

 $\begin{array}{l} \mbox{Span} = \mbox{the frequency band of operation} \\ \mbox{RBW} < 30\% \mbox{ of the OBW} = 300 \mbox{ kHz} \\ \mbox{VBW} \geq \mbox{RBW} = 3 \mbox{ MHz} \\ \mbox{Sweep} = \mbox{Auto} \\ \mbox{Detector function} = \mbox{Peak} \\ \mbox{Trace} = \mbox{Max Hold} \\ \mbox{The trace was allowed to stabilize, and the number of channels was counted.} \end{array}$

9.5.3 Limits:

The minimum number of hopping channels required is 15.

9.5.4 Test Results

Pass.

The EUT utilizes 79 hopping channels in BDR and EDR modes. In AFH mode, the EUT utilizes a minimum of 20 hopping channels.



9.5.5 Test Data:

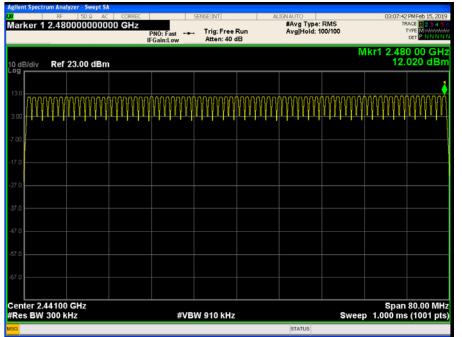


Figure 9-23 Number of Hopping Channels



9.6 Dwell Time

9.6.1 Test Requirement: FCC CFR 47 Rule Part 15.247 (a)(1)(iii)

ISED RSS-247 [5.1]

9.6.2 Test Method:

Measurements were performed according to the procedure defined in ANSI C63.10:2013 American National Standard of Procedure for Compliance Testing of Unlicensed Wireless Devices, Section 7.8. The EUT had its hopping function enabled.

Spectrum analyzer settings:

Span = zero span, centered on a hopping channel RBW = 100 kHz VBW ≥ 3 x RBW= 300 kHz Sweep = as necessary to capture the entire dwell time per hopping channel = 4ms Detector function = Peak Trace = Clear Write/ Trigger Mode

Dwell Time is measured with analyzer set to zero span at the middle channel and the trigger set to capture a burst.

Sample Calculations:

From the csv plot for 31.6s, total number of ON time is calculated. Multiplying the ON time with time resolution (microseconds) and converting this to milliseconds provides the Accumulated dwell time.

Accumulated Dwell Time = (465*0.00079)*1000 = 397.381ms

9.6.3 Limits:

400 ms within 31.6s (400 ms × 79 Channels)

9.6.4 Test Results:

Pass.

Packet Type	Accumulated Dwell Time in 31.6 s period (ms)	Limit (ms)		
1-DH1	367.381	400.000		
1-DH3	395.033	400.000		
1-DH5	364.220	400.000		



9.6.5 Test Data:

arker 2 Δ 383.000 μs	PNO: East	ISE:INT Trig Delay-1.000 m Trig: Video #Atten: 30 dB	ALIGNAUTO IS #Avg Typ Avg Hold:	e: RMS 1/1	05:38:44 PMFeb 15, 201 TRACE 2 3 4 5 TYPE MUSEUM DET P N N N
dB/div Ref 20.00 dBm					ΔMkr2 383.0 μ 0.248 dl
0.0	Q1	2∆1			
.00					
0.0					
0.0					TRIGLY
0.0 were and the second state and the second states and the second	whyme	langementer	mal the second	-unit	In smaph and see
0.0					
0.0					
0.0 0.0					
enter 2.402000000 GHz	#VBW	3.0 MHz		Sweep	Span 0 F 3.000 ms (1001 pt
enter 2.402000000 GHz es BW 1.0 MHz FI MODE TRC SCL X	Y	FUNCTION	FUNCTION WIDTH		Span 0 H 3.000 ms (1001 pt NCTION VALUE
enter 2.402000000 GHz =s BW 1.0 MHz R MODE TRC SCL X N 1 t 9900 Δ1 1 t (Δ) 3983	Y	FUNCTION	FUNCTION WIDTH		3.000 ms (1001 pt
enter 2.402000000 GHz es BW 1.0 MHz R MODE IRC SCI × N 1 t 990(Δ1 1 t Δ) 383.0	ү 0 µs 10.745 dE	FUNCTION	FUNCTION WIDTH		3.000 ms (1001 pt
enter 2.402000000 GHz es BW 1.0 MHz sr MODE I TRC SCL × 1 N 1 t 9900 2 Δ1 1 t (Δ) 383.0 4 5 5	ү 0 µs 10.745 dE	FUNCTION	FUNCTION WIDTH		Span 0 H 3.000 ms (1001 pt NCTION VALUE
anter 2.402000000 GHz set by 1.0 MHz R MODELTRC SCL × 1 N 1 t 990,1 2 Δ1 1 t (Δ) 383,0 3 Δ1 4 τ (Δ)	ү 0 µs 10.745 dE	FUNCTION	FUNCTION WIDTH		3.000 ms (1001 pt
0	ү 0 µs 10.745 dE	FUNCTION	FUNCTION WIDTH		3.000 ms (1001 pt



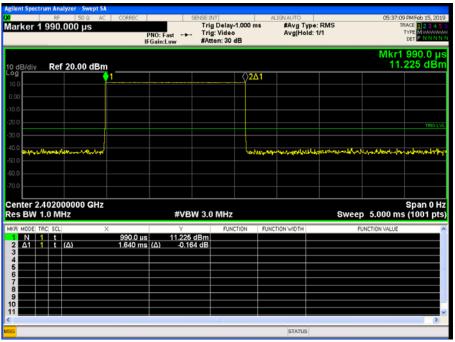


Figure 9-25 Dwell Time – DH3



0	m Analyzer - RF ≶ ∆ 2.8700	ΩΩ AC		PNO: Fast ++	SENSE:INT Trig Delay Trig: Video #Atten: 30		ALIGN AUTO #Avg Avg H	Type: RMS Iold: 1/1		TF	PMFeb 15, 201 ACE 1 2 3 4 5 FYPE MULTININ DET PINNNN
I0 dB/div	Ref 20.0	0 dBm								∆Mkr2∶	2.870 m 0.674 dl
10.0		¢1	11°		·····				<u></u> 2∆1		
10.0			l								
-30.0											TRIG LV
	Nar-Perluin	in the second							yayaa	h indepartin	en ^{ten} tent ^a ti
70.0											
Center 2.4 Res BW 1	0200000 .0 MHz	0 GHz		#VB	W 3.0 MHz			ę	Sweep		Span 0 H (1001 pts
		Х	995.0 µs 2.870 ms	2.013 (Δ) 0.6	dBm 74 dB	TION	FUNCTION WIDTH		FUN	TION VALUE	
3 4 5 6											
7 8 9											
10											>
G							STAT	US			



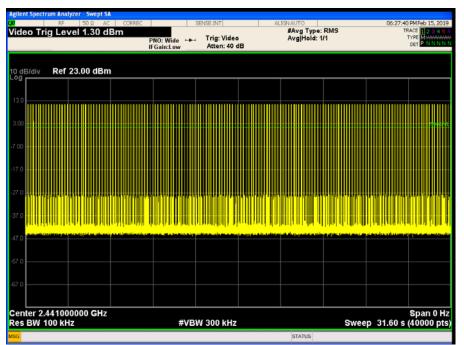


Figure 9-27 Time of Occupancy - DH1



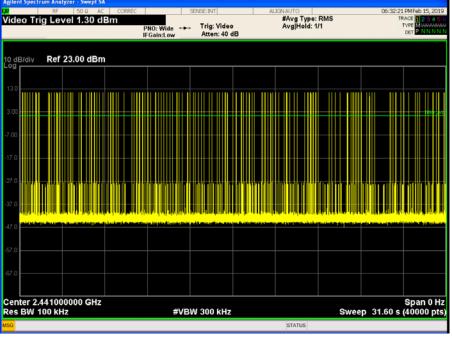


Figure 9-28 Time of Occupancy - DH3

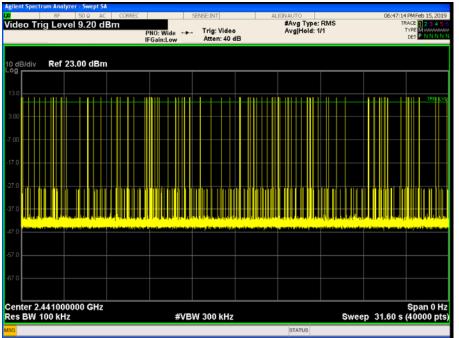


Figure 9-29 Time of Occupancy - DH5