

### FCC 47 CFR PART 15 SUBPART C INDUSTRY CANADA RSS-247 ISSUE 1

**CERTIFICATION TEST REPORT** 

FOR

### WIRELESS INPUT DEVICE

**MODEL NUMBER: 1708** 

FCC ID: C3K1708 IC: 3048A-1708

### REPORT NUMBER: R11040094-E3

**ISSUE DATE: 2016-06-09** 

Prepared for MICROSOFT CORPORATION ONE MICROSOFT WAY REDMOND, WA, 98052, USA

Prepared by UL LLC 12 LABORATORY DR. RESEARCH TRIANGLE PARK, NC 27709 USA TEL: (919) 549-1400

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NVLAP Lab code: 200246-0

### **Revision History**

Ver.	Issue Date	Revisions	Revised By
1	2016-03-23	Initial Issue	Ron Reichard
2	2016-05-10	Revised equipment list, added below 30 MHz data and added Line Conducted data.	Jeff Moser
3	2016-05-13	Revised/clarified measurement equipment list.	Jeff Moser
4	2016-06-06	Added below 30 MHz limits on page 101.	Jeff Moser
5	2016-06-9	Updated sections 5.1, 5.4 and Attestation page	Grace Rincand

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## **1. ATTESTATION OF TEST RESULTS**

**INDUSTRY CANADA RSS-GEN Issue 4** 

COMPANY NAME:	MICROSOFT CORPORATION ONE MICROSOFT WAY REDMOND, WA, 98052, USA		
EUT DESCRIPTION:	WIRELESS INPUT DEVICE		
MODEL:	1708		
SERIAL NUMBER:	Radiated: EV3-A21-977 (02980009626543) Conducted: A2- 977 (902980009626543)		
DATE TESTED:	2016-02-11 to 2016-03-11, 2016-05-05 to 2016-05-10		
	APPLICABLE STANDARDS	3	
STA	NDARD	TEST RESULTS	
CFR 47 Pa	art 15 Subpart C	Pass	
INDUSTRY CAN	ADA RSS-247 Issue 1	Pass	

UL LLC tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL LLC based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For UL LLC By:

Jeff Moser **EMC Program Manager** UL – Consumer Technology Division

Prepared By:

Ron Reichard **EMC** Project Lead UL – Consumer Technology Division

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Pass

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# 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2013, RSS-GEN Issue 4, RSS-247 Issue 1.

# 3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 12 Laboratory Dr., Research Triangle Park, NC 27709, USA and 2800 Suite B. Perimeter Park Drive, Morrisville, NC 27560.

12 Laboratory Dr., RTP, NC 27709
Chamber A
🛛 Chamber C

2800 Suite B Perimeter Park Dr.,				
Morrisville, NC 27560				
Chamber NORTH				
🛛 Chamber SOUTH				

The onsite chambers are covered under Industry Canada company address code 2180C with site numbers 2180C -1 through 2180C-4, respectively.

UL LLC (RTP) is accredited by NVLAP, Laboratory Code 200246-0. The full scope of accreditation can be viewed at http://www.nist.gov/nvlap/

# 4. CALIBRATION AND UNCERTAINTY

#### 4.1. **MEASURING INSTRUMENT CALIBRATION**

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

#### 4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided: Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) - Preamp Gain (dB) 36.5 dBuV + 18.7 dB/m + 0.6 dB - 26.9 dB = 28.9 dBuV/m

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## 4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Total RF power, conducted	+/- 0.45
RF power density, conducted	+/- 1.50
Spurious emissions, conducted	+/- 2.94
All emissions, radiated up to 18 GHz	+/- 5.36
Temperature	+/- 0.07
Humidity	+/- 2.26
DC and low frequency voltages	+/- 1.27

Uncertainty figures are valid to a confidence level of 95%.

# 5. EQUIPMENT UNDER TEST

#### 5.1. **DESCRIPTION OF EUT**

Model 1708 is a wireless input device that contains an 802.11a/g/n and Bluetooth transceiver. The EUT can be powered by battery or USB.

#### 5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

Frequency Range	Mode	Output Power	Output Power
(MHz)		(dBm)	(mW)
2402 - 2480	Basic GFSK	9.17	8.26
2402 - 2480	DQPSK	8.84	7.66
2402 - 2480	Enhanced 8PSK	9.10	8.13

#### 5.3. **DESCRIPTION OF AVAILABLE ANTENNAS**

The radio utilizes an integral antenna, with a maximum gain of 0.0 dBi.

#### SOFTWARE AND FIRMWARE 5.4.

The HQA UART Tool version used was: Ind SW v.1.22

The EUT firmware used with the EUT during testing was 3.1.703.0 and Radio Firmware was 1.0.107.0.

Additionally, a Rohde and Schwarz Bluetooth Call Box was used (CBT).

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## 5.5. WORST-CASE CONFIGURATION AND MODE

Radiated emissions testing were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

The fundamental of the EUT was investigated in three orthogonal orientations X,Y,Z, it was determined that X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X orientation.

For Enhanced Data rate modes, 8DPSK is considered worst-case and only select tests were performed for the DQPSK mode. Additionally, unless noted in the test report, all tests were performed with the DH5 packet size as this was considered worst-case.

## 5.6. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

Support Equipment List						
Description Manufacturer Model Serial Number FCC ID						
External DC Source	Circuit Specialist	CS13005X5	Not available	N/A		
Bluetooth Tester	Rohde & Schwartz	CBT (1153.9000K35)	100901	N/A		

### I/O CABLES

I/O Cable List							
Cable Port # of identical			Connector	Cable Type	Cable	Remarks	
No		ports	Туре		Length		
1	Antenna	1	SMA	Un-Shielded	0.5	SMA To SMA cable from	
						Analyzer to Directional	
						Coupler, Directional	
					Coupler to EUT and		
						Directional Coupler to	
						Bluetooth Call Box.	

### TEST SETUP

The EUT was configured as table top equipment during the tests. During Conducted Emissions testing, the EUT was connected to a Bluetooth Call Box (CBT) to change modes/channels and the EUT was powered via an external DC power source or battery. During Radiated testing, the EUT was tested as a stand-alone device and controlled over the air via the Bluetooth Call Box.

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### SETUP DIAGRAM



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# 6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment Used	d - Radiated Disturbance	Emissions Test E	Equipment (Mo	orrisville - North	n Chambe	r)
E an sine						

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	30-1000 MHz Range				
AT0073	Hybrid Broadband Antenna, 30-1000MHz	Sunol Sciences Corp.	JB3	2015-06-10	2016-06-30
	Gain-Loss Chains				
N-SAC02	Gain-loss string: 30- 1000MHz	Various	Various	2015-06-04	2016-06-30
	Receiver & Software				
SA0026	Spectrum Analyzer	Agilent	N9030A	2015-03-27	2016-03-31
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
HI0079	Temp/Humid/Pressure Meter	Springfield Precision	PreciseTemp	2015-07-01	2016-07-31
77491	CBT Blue Tooth Tester	Rohde & Schwarz	1153.9000.35	NA	NA

Note 1 – CBT was used to assist in controlling the EUT and not to measure emissions. Note 2 – This chamber was used prior to 2016-03-31.

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Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville - South Chamber)

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	0.009-30MHz	(Loop Ant.)			
AT0079	Active Loop Antenna	ETS-Lindgren	6502	2015-12-08	2016-12-31
	1-18 GHz				
AT0069 (Prior to 2/28/2016)	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2015-02-17	2016-02-29
AT0067 (02/28-03/17/2016)				2015-03-12	2016-03-31
AT0069 (As of 03/18/2016)				2016-03-07	2017-03-31
	Gain-Loss Chains				
S-SAC01	Gain-loss string: 0.009- 30MHz	Various	Various	2015-10-07	2016-10-31
S-SAC03	Gain-loss string: 1-18GHz	Various	Various	2015-08-22	2016-08-31
	Receiver & Software				
SA0025	Spectrum Analyzer	Keysight	N9030A	2015-03-27, 2016-03-17	2016-03-31, 2017-03-31
SA0018	Spectrum Analyzer	Agilent	N9030A	2015-11-07	2016-11-30
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
HI0050	Temp/Humid/Pressure Meter	Cole-Parmer	99760-00	2015-07-01	2016-07-31
77491	CBT Blue Tooth Tester	Rohde & Schwarz	1153.9000.35	NA	NA

Note 1 - South Chamber testing performed between 2016-02-11 and 2016-02-12 and on 2016-05-05

Note 2 - CBT was used to assist in controlling the EUT and not to measure emissions.

Test Equipment Used - Radiated Disturbance Emissions Test Equipment (RTP – C Chamber)

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	18-26GHz				
AT0063	Horn Antenna, 18- 26.5GHz	ARA	MWH-1826/B	2015-08-27	2016-08-31
	Gain-Loss Chains				
C-SAC03	Gain-loss string: 18- 40GHz	Various	Various	2015-09-27	2016-09-30
	Receiver & Software				
SA0016	Spectrum Analyzer	Agilent	PXA N9030A	2015-08-26	2016-08-31
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
	Additional Equipment used				
HI0034	Temp/Humid/Pressure Meter	Cole-Parmer	99760-00	2015-03-23	2016-03-31
77491	CBT Blue Tooth Tester	Rohde & Schwarz	1153.9000.35	NA	NA

Note 1 – CBT was used to assist in controlling the EUT and not to measure emissions.

Note 2 – This chamber was used prior to 2016-03-31.

Test Equipment Used - Wireless Conducted Measurement Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	Conducted Room 1				
SA0019	Spectrum Analyzer	Agilent Technologies	E4446A	2015-09-02	2016-09-30
PWM004	RF Power Meter	Keysight Technologies	N1911A	2015-06-08	2017-06-08
PWS004	Peak and Avg Power Sensor, 50MHz to 6GHz	Keysight Technologies	E9323A	2015-06-05	2016-06-05
HI0079	Temp/Humid/Pressure Meter	Springfield	PreciseTemp	2015-07-1	2016-07-31
MM0167	True RMS Multimeter	Agilent	U1232A	2015-08-17	2016-08-31
76022	DC Regulated Power Supply	CircuitSpecialist s.Com	CSI3005X5	N/A	N/A
77491	CBT Blue Tooth Tester	Rohde & Schwarz	1153.9000.35	NA	NA
	Conducted Room 2				
SA0020	Spectrum Analyzer	Agilent Technologies	E4446A	2015-02-26	2016-02-29
T146	Spectrum Analyzer	Agilent Technologies	E4446A	2015-06-17	2016-06-17
PWM003	RF Power Meter	Keysight Technologies	N1911A	2015-06-08	2017-06-08
PWS003	Peak and Avg Power Sensor, 50MHz to 6GHz	Keysight Technologies	E9323A	2015-06-05	2016-06-05
1100502	Temp/Humid Chamber	Cincinnati Sub- Zero	ZPH-8-3.5-SCT/AC	2015-05-13	2016-05-31
43733	Temp/Humid/Pressure Meter	Cole-Parmer	99760-00	2014-03-24	2016-03-24
MM0168	True RMS Multimeter	Agilent	U1232A	2015-08-17	2016-08-31
76021	DC Regulated Power Supply	CircuitSpecialist s.Com	CSI3005X5	N/A	N/A
77491	CBT Blue Tooth Tester	Rohde & Schwarz	1153.9000.35	NA	NA

Note 1 – CBT was used to assist in controlling the EUT and not to measure emissions.

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Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
CBL077	Coax cable, RG223, N-male to BNC-male, 20-ft.	Pasternack	PE3476-240	2015-10-29	2016-10-31
HI0079	Temp/Humid/Pressure Meter	Springfield Precision	PreciseTemp	2015-07-01	2016-07-31
LISN003	LISN, 50-ohm/50-uH, 2- conductor, 25A	Fischer Custom Com.	FCC-LISN-50-25-2- 01-550V	2015-08-24	2016-08-31
LISN008	LISN, 50-ohm/50-uH, 2- conductor, 25A (For support gear only.)	Solar Electronics	8012-50-R-24-BNC	2015-09-03	2016-09-30
MM0167	Multi-meter	Agilent	U1232A	2015-08-17	2016-08-31
PRE0101521 (75141)	EMI Test Receiver 9kHz-7GHz	Rohde & Schwarz	ESCI 7	2015-08-26	2016-08-31
TL001	Transient Limiter, 0.009-30MHz	Com-Power	LIT-930A	2015-05-22	2016-05-31
PS214	AC Power Source	Elgar	CW2501M (s/n 1523A02396)	NA	NA
PS215	AC Power Source	Elgar	CW2501M (s/n 1523A02397)	NA	NA
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
77491	CBT Blue Tooth Tester	Rohde & Schwarz	1153.9000.35	NA	NA

Note 1 – CBT was used to assist in controlling the EUT and not to measure emissions.

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# 7. ANTENNA PORT TEST RESULTS

## 7.1. ON TIME AND DUTY CYCLE

### <u>LIMITS</u>

None; for reporting purposes only.

### PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

### 7.1.1. ON TIME AND DUTY CYCLE RESULTS

Mode	Mode ON Time		<b>Duty Cycle</b>	Duty	Duty Cycle	1/B	
	В		x	Cycle	<b>Correction Factor</b>	Minimum VBW	
	(msec)	(msec)	(linear)	(%)	(dB)	(kHz)	
2.4 GHz band (Hopping	OFF)						
Bluetooth GFSK	2.877	3.753	0.767	76.66%	1.15	0.348	
Bluetooth 8PSK	2.877	3.753	0.767	76.66%	1.15	0.348	

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### 7.1.2. DUTY CYCLE PLOTS

### **HOPPING OFF**



DUTY MODE	CYCLE	8PSK				
🔆 Agiler	nt 16:18:22	Feb 18,20	16		L	Measure
APv4.2(0) Ref 20 df #Peak [	20216),467 Bm	22, Morrisvill #Atten 40 d	e Conducted B	▲ M	kr2 3.753 ms -0.038 dB	Meas Off
Log			<u>, , , , , , , , , , , , , , , , , , , </u>			Channel Power
12.7 dB		haymuland		hardenedyd		Occupied BW
#PAvg						ACP
Center 2. Res BW 8 Marker	.441 000 G MHz Trace	Hz Type	+VBW 50 MHz X Axis	Sweep 8.267 r	Span 0 Hz ns (1001 pts) Amplitude	Multi Carrier Power
1R 1۵ 2R 2۵	(1) (1) (1) (1)	Time Time Time Time	2.629 mg 2.877 mg 2.629 mg 3.753 mg	3 3 3 3	7.56 dBm 0.62 dB 7.56 dBm -0.04 dB	Power Stat CCDF
						More 1 of 2
Copyrigh	nt 2000-2	010 Agilent	Technologies			

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## 7.2. BASIC DATA RATE GFSK MODULATION

### 7.2.1. 20 dB AND 99% BANDWIDTH

### <u>LIMIT</u>

None; for reporting purposes only.

### TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 1-5% of the 20 dB bandwidth. The VBW is set to 3x or more of the RBW. The sweep time is coupled.

The transmitter output is connected to a spectrum analyzer. The RBW is set to 1-5% of the 99% OBW. The VBW is set to 3x or more of the RBW. The sweep time is coupled.

### **RESULTS**

Channel	Frequency	20 dB Bandwidth	99% Bandwidth
	(MHz)	(kHz)	(kHz)
Low	2402	938	897.4430
Middle	2441	936	891.9203
High	2480	950	894.9131

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#### 20 dB BANDWIDTH



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BANDWIDTH H	IIGH CH					
🔆 Agilent 15:57:57	Feb 18, 2016			L	-	Measure
APv4.2(020216),4672 Ref 10 dBm #Peak	2, Morrisville Con Atten 10 dB	ducted	ا <u>م</u>	Mkr1 950 0.132	0 kHz 2 dB	Meas Off
Log 10 dB/		Mr.	h.			Channel Power
12.7 dB DI				ny -		Occupied BW
-14.3 dBm #PAvg 20				4	$\bigtriangleup$	ACP
V1 S2 S3 FS AA						Multi Carrier Power
€(f): f>50k Swp						Power Stat CCDF
Center 2.480 000 GH: #Res BW 22 kHz	z #VBW (	68 kHz	Sweep 4 m	Span 2 s (1001	MHz pts)	More 1 of 2
Copyright 2000-20	10 Agilent Tech	nologies				

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#### 99% BANDWIDTH



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### 7.2.2. HOPPING FREQUENCY SEPARATION

LIMIT

FCC §15.247 (a) (1)

IC RSS-247 5.1 (2)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hoping 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.

#### TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to  $\geq$  RBW. The sweep time is coupled.

#### **RESULTS**

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#### **HOPPING FREQUENCY SEPARATION**



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### 7.2.3. NUMBER OF HOPPING CHANNELS

### LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-247 5.1 (4)

Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping channels.

### TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps for visibility of the entire span. Then, smaller spans are set to more clearly identify the channels. The RBW is set to 30% of the channel spacing (approx. 300 kHz). The analyzer is set to Max Hold.

#### RESULTS

Normal Mode: 79 Channels observed. AFH Mode: 20 Channels declared.

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### NUMBER OF HOPPING CHANNELS



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NUM SEGN	ЗER ЛEN	OF T)	Η	OF	PF	PIN	IG	С	H	٩N	N	EI	LS	6 (	30	) N	/⊢	ΙZ	S	SP	AN	١,	FIRST
🔆 Agi	lent 17	:11:0	3	Feb	18	3, 20	016	ì												L		_[	Measure
APv4.2 Ref 20	(02021 dBm	6),46	i722 F	2, Mo Attei	orr n 2	isvil 20 c	lle 1B	Cor	Iduc	ted							_					ľ	Meas Off
Log 10 dB/ 0ffst	Ĥ	Ŵ	$\mathbb{A}$	A	¥	$\overline{\mathbb{A}}$	¥	¥	Ŵ	¥	A		A	¥	¥	A	Ĥ	Ŷ	¥	¥	¥¥		hannel Power
12.7 dB DI 3.1			' '	<u> </u>	`		·			·				'	-			<u> </u>	<u> </u>				Occupied BW
dBm #PAvg	+		_									+		_			+						ACP
M1 S2 S3 FC AA	/																						Multi Carrier Power
<b>£</b> (f): FTun Swp														_									Power Stat CCDF
Center #Res Bl	2.415 \ 300	00 G kHz	 Hz			+	ŧVB	 3W 3	300	kHz	2		S	wee	ep (	20	S ms	òpa (1	in 3 .00	30 1 p	MHz ots)		<b>More</b> 1 of 2
Copyri	ght 20	100-1	201	LU A	gi	lent	tT	eci	nol	ogi	es												

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Ag	j <b>ilent</b> 17	7:11:52	2 F€	əb 18	8,201	ô						L	Measure
2v4.2 f 20	2(02021 dBm	.6),46	722, At	Mori ten	risville 20 dB	Cond	uct	ed:					Meas Of
eak g													
1 37 5-1	M		Æ	₩	MA	₩	A	MA		MA	MA	M	Channel Power
rst 1.7 }			• • 	<u>' '</u>			'						Occupied Bk
2 3m 'Ava													ACF
S2 FC													Multi Carriei Powei
(f): un p													Power Sta CCDF
enter es B	2.445 W 300	 00 GH kHz	 Iz		#VF	 3W 30	10	kHz	Swe	en 20	 	30 MHz 11 pts)	More 1 of 3

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### 7.2.4. AVERAGE TIME OF OCCUPANCY

### LIMIT

FCC §15.247 (a) (1) (iii)

IC 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.

### **TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

The average time of occupancy in the specified 31.6 second period (79 channels \* 0.4 s) is equal to 10 \* (# of pulses in 3.16 s) \* pulse width.

For AFH mode, the average time of occupancy in the specified 8 second period (20 channels \* 0.4 seconds) is equal to 10 \* (# of pulses in 0.8 s) \* pulse width.

DH Packet	Pulse Width	Number of Pulses in	Average Time of Occupancy	Limit	Margin
	(msec)	3.16	(sec)	(sec)	(sec)
		seconds			
GFSK Norma	I Mode				
DH1	0.367	32	0.117	0.4	-0.283
DH3	1.616	19	0.307	0.4	-0.093
DH5	2.856	12	0.343	0.4	-0.057
		-			
DH Packet	Pulse	Number of	Average Time	Limit	Margin
	Width	Pulses in	of Occupancy		
	(msec)	0.8	(sec)	(sec)	(sec)
		seconds			
GFSK AFH M	lode				
DH1	0.367	8	0.029	0.4	-0.371
DH3	1.616	4.75	0.077	0.4	-0.323
DH5	2.856	3	0.086	0.4	-0.314

### RESULTS

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### PULSE WIDTH - DH1



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### NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH1



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### PULSE WIDTH - DH3



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### NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3



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## PULSE WIDTH – DH5

PULSE WIDTH — D ∰ Agilent 17:27:17 Feb 1	<b>H5</b> 8, 2016	L	Measure
APv4.2(020216),46722, Mor Ref 20 dBm Atten #Peak	risville Conducted 20 dB	▲ Mkr1 2.856 ms 0.03 dB	Meas Off
Log 1R 10 0 dB/ 0/for		1	Channel Power
dB			Occupied BW
#PAvg			ACP
W1 S2 S3 VC AA 4,444		Alikiana di Aliyakana	Multi Carrier Power
£(f): FTun			Power Stat CCDF
Center 2.441 000 GHz Res BW 1 MHz	#VBW 1 MHz	Span 0 Hz Sweep 4 ms (1001 pts)	More 1 of 2

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### NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH5



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## 7.2.5. OUTPUT POWER

### <u>LIMIT</u>

§15.247 (b) (1)

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 watts.

RSS-247 Clause 5.4 (2)

For frequency hopping systems operating in the band 2400-2483.5 MHz and employing at least 75 hopping channels, the maximum peak conducted output power shall not exceed 1 W; for all other frequency hopping systems in the band, the maximum peak conducted output power shall not exceed 0.125 W.

### TEST PROCEDURE

The transmitter output was connected to a power meter equipped with a power sensor capable of measuring peak power. The cable assembly insertion loss of 12.7 dB (including 12.464 dB directional coupler and 0.24 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

### **RESULTS**

For 75 or more hopping channels

Channel	Frequency (MHz)	Output Power (dBm)	Directional Gain (dBi)	Limit (dBm)	Margin (dB)
Low	2402	8.22	0.00	30	-21.78
Middle	2441	8.70	0.00	30	-21.30
High	2480	9.17	0.00	30	-20.83

# 7.2.6. AVERAGE POWER

## <u>LIMIT</u>

None; for reporting purposes only.

## TEST PROCEDURE

The transmitter output is connected to a power meter.

### **RESULTS**

The cable assembly insertion loss of 12.7 dB (including 12.464 dB directional coupler and 0.24 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency	Average Power
	(MHz)	(dBm)
Low	2402	8.06
Middle	2441	8.14
High	2480	8.63

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# 7.2.7. CONDUCTED SPURIOUS EMISSIONS

### <u>LIMITS</u>

FCC §15.247 (d)

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 §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

IC RSS-247 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4 (4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

## TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

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### **RESULTS**

#### SPURIOUS EMISSIONS, LOW CHANNEL



- Adiient	15.42.18	Feb 18 201	6				1	Moscuro
APv4.2(020 Ref 10 dBn #Peak	n #	2, Morrisville Atten 20 dE	Conducted		Mkr4	4 25.8 -47.16	03 GHz 2 dBm	Meas Off
Log 10 dB/ 0ffst								Channel Power
12.7 dB DI	2	3				نية ال <sub>الم</sub> ينداني		Occupied BW
dBm								ACP
Center 13. #Res BW 10 Marker	015 GHz 00 kHz Trace	#\ Type	/BW 300 kHz X Axis	Sweep	Sp 2.482	an 25.9 s (819 Amplit	97 GHz 2 pts) ude	Multi Carrier Power
1 2 3 4	(1) (1) (1) (1)	Freq Freq Freq Freq	2.402 GHz 4.804 GHz 7.206 GHz 25.803 GHz			7.34 -54.76 -55.89 -47.16	dBm dBm dBm dBm	Power Stat CCDF
								More 1 of 2

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### SPURIOUS EMISSIONS, MID CHANNEL



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Agilent 1	5:36:20	SF UNI Feb 18, 20	16				L	Measure
APv4.2(0202 Ref 10 dBm ≇Peak [	16),4672;	2, Morrisvill Atten 20 d	e Conducted B		Mkr	4 24.7 -46.84	54 GHz 5 dBm	Meas Off
og Ø  B/								Channel Power
2.7 B	2 \$	3		-			4	Occupied BW
-11.2 IBm PAvg								ACP
Center 13.01 Res BW 100 Marker	l5 GHz   kHz Trace	# Type	VBW 300 kHz X Axis	Sweep	Sp 2.482	an 25.9 s (819 Amplit	97 GHz 2 pts) ude	Multi Carrier Power
1 2 3 4	(1) (1) (1) (1)	Freq Freq Freq Freq	2.441 GH: 4.882 GH: 7.323 GH: 24.754 GH:	2 2 2 2		8.57 -55.23 -57.27 -46.85	dBm dBm dBm dBm	Power Stat CCDF
								More 1 of 2

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### SPURIOUS EMISSIONS, HIGH CHANNEL



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🔆 Agilent 15	:59:58 Feb 1	18,2016						L	Measure
APv4.2(02021 Ref 10 dBm #Peak	6),46722, Mo #Atten	rrisville ( 20 dB	Conduct	ed		Mkr	4 24.8 -47.08	46 GHz 6 dBm	Meas Off
Log 10 dB/									Channel Power
12.7 dB		3		<b></b>		and the state of the			Occupied BW
-11.2 dBm #PAvg									ACP
Center 13.019 #Res BW 100 Marker T	5 GHz kHz race Typ	#VBI	W 300 K	(Hz Axis	Sweep	Sp 2.482	an 25.9 s (819 Amplit	97 GHz 2 pts) ude	Multi Carrier Power
1 2 3 4	(1) Fre (1) Fre (1) Fre (1) Fre		2.4 4.9 7.4 24.8	80 GHz 60 GHz 40 GHz 46 GHz			8.22 -56.85 -56.91 -47.09	dBm dBm dBm dBm	Power Stat CCDF
									<b>More</b> 1 of 2

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### SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



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# 7.3. ENHANCED DATA RATE QPSK MODULATION

## 7.3.1. 20 dB AND 99% BANDWIDTH

### <u>LIMIT</u>

None; for reporting purposes only.

### TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 1-5% of the 20 dB bandwidth. The VBW is set to  $\geq$  RBW. The sweep time is coupled.

The transmitter output is connected to a spectrum analyzer. The RBW is set to 1-5% of the 99% Occupied Bandwidth. The VBW is set to  $\geq$  RBW. The sweep time is coupled

### **RESULTS**

Channel	Frequency	20 dB Bandwidth	99% Bandwidth
	(MHz)	(kHz)	(kHz)
Low	2402	1.26	1.1788
Middle	2441	1.26	1.1803
High	2480	1.26	1.1794

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### 20 dB BANDWIDTH



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Measure	L				i	GH CH	<b>)TH HIG</b> 31:22 Feb	DWIE ilent 16	
Z Meas Off	L 1.260 MHz -0.054 dB	<b>∆</b> Mkr		ted	Conduc	1orrisville en 10 dB	6),46722, Ma Atter	(02021 dBm	APv4.2 Ref 10 #Peak
Channel Power			Mr My	malin	North	18			Log 10 dB/ Offst
Occupied BW			1			<b>9</b>			12.7 dB DI
ACP	humber	har				/	www.hopen	W W	-16.0 dBm #PAvg 20
Multi Carrier Power									V1 S2 S3 FS AA
Power Stat CCDF									€(f): f>50k Swp
More 1 of 2	Span 3 MHz (1001 pts)	.933 m	Sweep	 <hz< td=""><td>  3W 68  </td><td></td><td>000 GHz Iz</td><td>2.480 W 22 ki</td><td>Center #Res B</td></hz<>	 3W 68		000 GHz Iz	2.480 W 22 ki	Center #Res B
				ogies	echnol	Agilent T	00-2010 A	ght 20	Copyri

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### 99% BANDWIDTH



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# 7.3.2. AVERAGE TIME OF OCCUPANCY

### <u>LIMIT</u>

FCC §15.247 (a) (1) (iii)

IC 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.

## TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

The average time of occupancy in the specified 31.6 second period (79 channels \* 0.4 s) is equal to 10 \* (# of pulses in 3.16 s) \* pulse width.

### **RESULTS**

Time Of Occupancy = 10 \* xx pulses \* yy msec = zz msec

DQPSK	Mode
-------	------

DH Packet	Pulse	Number of	Average	Limit	Margin
	Width	Pulses in	Time of		-
	(msec)	3.16	(sec)	(sec)	(sec)
		seconds			
DH1	0.372	32	0.119	0.4	-0.281
DH3	1.622	13	0.211	0.4	-0.189
DH5	2.860	12	0.343	0.4	-0.057

**Note:** for AFH (DQPSK) mode, please refer to the results of AFH (GFSK) mode; the channel selection and hopping rate are the same for both EDR and Basic Rate operation, data for Basic Rate on page 35 demonstrates compliance with channel occupancy when AFH is employed.

### PULSE WIDTH - DH1



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### NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH1



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## PULSE WIDTH – DH3

Agilent	08:39:35	Feb 1	9,2016						L	Measure
v4.2(020 f 20 dBr eak E	0216),467 n	722, Morı Atten	risville ( 20 dB	Conduct	ted	1	▲ Mk	r1 1. -3.	.622 ms .24 dB	Meas O
/	1R	1 Martin Prop	n in politika	y-u-anal/h	t an state of the st	ntation and	nd/ling.the hairs are	(philosofery)	1 •	Channel Powe
fst .7	+									Occupied B
Avg										AC
S2 VC									Marah d	Multi Carrie Powe
f):										Power Sta CCD
nter 2.4 « RW 1 M	41 000 G	iHz			<u> </u>	 Sui	een 2 m	Spa	n 0 Hz 1 pts)	Mor 1 of

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### NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3



## PULSE WIDTH – DH5

🔆 Agilent 🤅	08:45:15	Feb 19	9,2016						L	Measure
APv4.2(0202 ?ef 20 dBm ⊧Peak ⊑	216),467	22, Morr Atten	risville 20 dB	Conduct	ted		▲ MI	kr1 : -0	2.86 ms .70 dB	Meas Off
.og .0 HB/	1 R 9-14-14-14-14-14-14-14-14-14-14-14-14-14-	uning paralitati	l <sub>e</sub> (triathathini	hin a lither to	utoren argene	anan mitti ana kati a	han na han sa han s In the sa han s	1		Channel Power
.2.7 IB										Occupied BW
PAvg										ACP
I1 S2 3 VC AA	N							adai dala	Manalandaria	Multi Carrier Power
(f): 1997 Tun								19 100 19 10		Power Stat CCDF
enter 2.44 es BW 1 MH	 1 000 G  z	Hz	#V	BW 1 M	Hz	Swe	ep4m	Spa s (100	n 0 Hz 1 pts)	More 1 of 2

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### NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH5



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# 7.3.3. OUTPUT POWER

## <u>LIMIT</u>

§15.247 (b) (1)

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 watts.

RSS-247 Clause 5.4 (2)

For frequency hopping systems operating in the band 2400-2483.5 MHz and employing at least 75 hopping channels, the maximum peak conducted output power shall not exceed 1 W; for all other frequency hopping systems in the band, the maximum peak conducted output power shall not exceed 0.125 W.

### TEST PROCEDURE

The transmitter output was connected to a power meter equipped with a power sensor capable of measuring peak power. The cable assembly insertion loss of 12.7 dB (including 12.464 dB directional coupler and 0.24 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

### **RESULTS**

For DQPSK mode, the channel separation was limited to 2/3 the 20 dB bandwidth. Therefore, the output power was limited to 125 mW. This was based on the channel separation measurements for the 8PSK mode.

Channel	Frequency	Output Power	Directional	Limit	Margin
	(MHz)	(dBm)	Gain (dBi)	(dBm)	(dB)
Low	2402	7.90	0.00	21	-13.10
Middle	2441	8.42	0.00	21	-12.58
High	2480	8.84	0.00	21	-12.16

# 7.3.4. AVERAGE POWER

## <u>LIMIT</u>

None; for reporting purposes only.

## TEST PROCEDURE

The transmitter output is connected to a power meter.

### RESULTS

The cable assembly insertion loss of 12.7 dB (including 12.464 dB directional coupler and 0.45 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency	Average Power	
	(MHz)	(dBm)	
Low	2402	4.83	
Middle	2441	4.99	
High	2480	5.46	

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# 7.4. ENHANCED DATA RATE 8PSK MODULATION

## 7.4.1. 20 dB AND 99% BANDWIDTH

### <u>LIMIT</u>

None; for reporting purposes only.

### TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 1-5% of the 20 dB bandwidth. The VBW is set to 3x or more of the RBW. The sweep time is coupled.

The transmitter output is connected to a spectrum analyzer. The RBW is set to 1-5% of the 99% OBW. The VBW is set to 3x or more of the RBW. The sweep time is coupled.

### **RESULTS**

Channel	Frequency	20 dB Bandwidth	99% Bandwidth
	(MHz)	(kHz)	(kHz)
Low	2402	1.290	1.1873
Middle	2441	1.260	1.1905
High	2480	1.260	1.1870

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### 20 dB BANDWIDTH



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BANDWIDTH H	HIGH CH		L	Measure	
APv4.2(020216),4672 Ref 10 dBm	22, Morrisville Conduc Atten 10 dB	ted <b>∆</b> MI	kr1 1.260 MHz -0.276 dB	Meas Off	
Log 10 dB/	1.Rr Market	Multin Ma		Channel Power	
12.7 dB DI				Occupied BW	
-16.2 dBm #PAvg		- h.	Marymon	ACP	
V1 S2 S3 FS AA				Multi Carrier Power	
£(f): f>50k Swp				Power Stat CCDF	
Center 2.480 000 GH #Res BW 22 kHz	Center 2.480 000 GHz Span 3 MHz More   #Res BW 22 kHz #VBW 68 kHz Sweep 5.933 ms (1001 pts) 1 of 2				
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#### 99% BANDWIDTH



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# 7.4.2. HOPPING FREQUENCY SEPARATION

LIMIT

FCC §15.247 (a) (1)

IC RSS-247 5.1 (2)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hoping 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.

### TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to  $\geq$  RBW. The sweep time is coupled.

### **RESULTS**

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### HOPPING FREQUENCY SEPARATION



Note – The channel hopping separation of 1MHz is less than the 20 dB bandwidth (approx. 1.3 MHz). However, the output power is less than 125 mW and the channel separation is greater than 2/3 the 20 dB bandwidth (approx. 860 kHz).

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# 7.4.3. NUMBER OF HOPPING CHANNELS

### <u>LIMIT</u>

FCC §15.247 (a) (1) (iii)

IC RSS-247 5.1 (4)

Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping channels.

### TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps for visibility of the entire span. Then, smaller spans are set to more clearly identify the channels. The RBW is set to 30% of the channel spacing (approx. 300 kHz). The analyzer is set to Max Hold.

# **RESULTS**

Normal Mode: 79 Channels observed. AFH Mode: 20 Channels declared.

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### NUMBER OF HOPPING CHANNELS



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Agi	lent 03	9:10:40	Feb 1	9,2010	)					L	Measure
4.2) 20	(02021 dBm	16),467	22, Mor Atten	risville 20 dB	Conduc <sup>.</sup>	ted					Meas Of
ак /	~	N. W.	ww	~~~	ww	γwγ	~~~~	<b>W</b>	Ŵ	VVV	Channel Powe
7											Occupied Bl
n Ivg	<u> </u>										ACI
S2 FC AA											Multi Carrie Powe
): in											Power Sta CCDI
lter s Bl	2.415 J 300	00 GH: kHz	z	#\/F	 2W 200	 kHz	مسک	en 20 m	Span (	30 MHz 1 nts)	More 1 of 3

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Ag	ilent 09	1:00:56	Feb 1	9,2016	ì					L	Measure
°v4.2 f 20	(02021 dBm	.6),4672	22, Mori Atten	risville 20 dB	Conduc	ted					Meas Of
eak a											
9   8/	VVV	vvv	$\sqrt{\gamma}$	$\sim$	$\sqrt{2}$	w	Ŵ	<b>^</b>	$\mathcal{M}$	Ŵ	Channel Powe
fst 1.7											Occupied B
											occupied b
∂ Smr											AC
Avg											
S2 FC											Multi Carrie Powe
f): un											Power Sta
p											
nter	2.445	   00 GHz	2		200		Suc		Span 3	30 MHz	Mor 1 of

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NUMBER OF HOP SEGMENT)	PING CHANNEL	_S (30 MHZ SPAN	I, THIRD
🔆 Agilent 09:01:49 Feb	19,2016	L	Measure
APv4.2(020216),46722, Mo Ref 20 dBm Atter #Peak	rrisville Conducted 20 dB		Meas Off
Log 10 dB/ 0ffst	AMAAMAA	M/1	Channel Power
12.7 dB DI 3.7			Occupied BW
dBm #PAvg			ACP
M1 S2 S3 FC AA		Mar water water water water	Multi Carrier Power
£(f): FTun Swp			Power Stat CCDF
Center 2.475 00 GHz #Res BW 300 kHz	#VBW 300 kHz	Span 30 MHz Sweep 20 ms (1001 pts)	More 1 of 2
Copyright 2000-2010 A	gilent Technologies		

# 7.4.4. AVERAGE TIME OF OCCUPANCY

# <u>LIMIT</u>

FCC §15.247 (a) (1) (iii)

IC 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.

# TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

The average time of occupancy in the specified 31.6 second period (79 channels \* 0.4 s) is equal to 10 \* (# of pulses in 3.16 s) \* pulse width.

# **RESULTS**

Time Of Occupancy = 10 \* xx pulses \* yy msec = zz msec

8PSK (	(EDR)	) Mode
--------	-------	--------

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
DH1	0.375	32	0.120	0.4	-0.280
DH3	1.624	16	0.260	0.4	-0.140
DH5	2.864	10	0.286	0.4	-0.114

**Note:** for AFH (8PSK) mode, please refer to the results of AFH (GFSK) mode; the channel selection and hopping rate are the same for both EDR and Basic Rate operation, data for Basic Rate on page 35 demonstrates compliance with channel occupancy when AFH is employed.

# PULSE WIDTH - DH1



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### NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH1



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# PULSE WIDTH – DH3

PULSE	WIDTH	H – Dł	-13							
🔆 Agilent	<b>t</b> 07:51:37	Mar 11	,2016						L	Measure
APv4.2(02 Ref 20 dB #Peak	0216),467 m	22, Morr Atten 2	isville ( 20 dB	Conduct	ted		<b>∆</b> Mk	r1 1 _1	624 ms 47 dB	Meas Off
Log 10 dB/	1R ••••••••••••••••••••••••••••••••••••	www.	adaga	rnnikhuvish	rintentent	Maray Hilliam	nt	hinterio	1	Channel Power
12.7 dB										Occupied BW
#PAvg										ACP
W1 S2 S3 VS AA	witte									Multi Carrier Power
<b>£</b> (f):									- Window W	Power Stat CCDF
Center 2.4 Res BW 1	 441 000 GI MHz	l l	#VE	3W 1 M	Hz	Swe	eep 2 m	Sp is (10	an 0 Hz 01 pts)	More 1 of 2
Copyright	t 2000-20	011 Agi	lent Te	echnol	ogies					

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### NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3



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# PULSE WIDTH – DH5

K Agilent 07:54	1:58 Mar 11, 201	6	L	Measure
Pv4.2(020216) ef 20 dBm Peak	46722, Morrisville Atten 20 dE	Conducted	▲ Mkr1 2.864 -1.49	dB Meas Off
0g 1R 0 <b>S</b> B/			1	Channel Power
2.7 B				Occupied BW
PAvg				
11 S2 3 VS AA <i>V</i> (,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			Understandigenerated	Multi Carrier Power
(f): [ <sup>[1]</sup> ] <sup>#</sup>				Power Stat CCDF
Center 2.441 00 des BW 1 MHz	0 GHz	VBW 1 MHz	Span 0 Sweep 4 ms (1001 p	Hz More ts) 1 of 2

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### NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH5



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# 7.4.5. OUTPUT POWER

### <u>LIMIT</u>

§15.247 (b) (1)

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 watts.

RSS-247 Clause 5.4 (2)

For frequency hopping systems operating in the band 2400-2483.5 MHz and employing at least 75 hopping channels, the maximum peak conducted output power shall not exceed 1 W; for all other frequency hopping systems in the band, the maximum peak conducted output power shall not exceed 0.125 W.

# TEST PROCEDURE

The transmitter output was connected to a power meter equipped with a power sensor capable of measuring peak power. The cable assembly insertion loss of 12.7 dB (including 12.464 dB directional coupler and 0.24 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

### **RESULTS**

For 8PSK mode, the channel separation was limited to 2/3 the 20 dB bandwidth. Therefore, the output power was limited to 125 mW.

Channel	Frequency (MHz)	Output Power (dBm)	Directional Gain (dBi)	Limit (dBm)	Margin (dB)
Low	2402	8.18	0.00	21	-12.82
Middle	2441	8.68	0.00	21	-12.32
High	2480	9.10	0.00	21	-11.90

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# 7.4.6. AVERAGE POWER

# <u>LIMIT</u>

None; for reporting purposes only.

# TEST PROCEDURE

The transmitter output is connected to a power meter.

# **RESULTS**

The cable assembly insertion loss of 12.7 dB (including 12.464 dB directional coupler and 0.45 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency	Average Power
	(MHz)	(dBm)
Low	2402	4.61
Middle	2441	4.69
High	2480	5.23

# 7.4.7. CONDUCTED SPURIOUS EMISSIONS

# LIMITS

FCC §15.247 (d)

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 §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

IC RSS-247 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4 (4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

# **TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

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### **RESULTS**

#### SPURIOUS EMISSIONS, LOW CHANNEL



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🔆 Agilent 16:	10:05 Feb 18	, 2016			L	Measure
APv4.2(020216 Ref10 dBm ⊭Peak ∽	),46722, Morri #Atten 2	sville Conducte 0 dB	d	Mkr4 2 -46	5.984 GHz .607 dBm	Meas Off
Log 1- 10 dB/ Offst						Channel Power
12.7 dB DI 13.7			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		~~~	Occupied BW
dBm ≢PAvg						ACP
Center 13.015 #Res BW 100 k Marker Tr	GHz Hz ace Type	#VBW 300 ki	Hz Swee Txis	Span 2 p 2.482 s (8 Am	25.97 GHz 3192 pts) plitude	Multi Carrier Power
	1) Freq 1) Freq 1) Freq 1) Freq 1) Freq	2.40 4.80 7.20 25.98	12 GHz 14 GHz 16 GHz 14 GHz	3. -59. -57. -46.	80 dBm 26 dBm 53 dBm 61 dBm	Power Stat CCDF
						<b>More</b> 1 of 2

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### SPURIOUS EMISSIONS, MID CHANNEL



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🔆 Agilent 16:	06:24 Feb 18	,2016				L	Measure
PPv4.2(020210 Ref10 dBm ≇Peak	),46722, Morri #Atten 2	isville Conduct 20 dB	ed	Mkr4	24.92 47.264	8 GHz dBm	Meas Off
LOG LO dB/							Channel Power
12.7 dB DI						4	Occupied BW
dBm #PAvg							ACP
Center 13.015 #Res BW 100 k Marker Tr	GHz Hz ace Type	#VBW 300 k	(Hz Swe Axis	Spa ep 2.482 s	n 25.97 : (8192 Amplitud	'GHz pts) Ie	Multi Carrier Power
1 ( 2 ( 3 ( 4 (	1) Freq 1) Freq 1) Freq 1) Freq 1) Freq	2.4 4.8 7.3 24.9	41 GHz 82 GHz 23 GHz 28 GHz	-! -! 	3.02 dB 59.22 dB 55.93 dB 47.26 dB	im im im im	Power Stat CCDF
							<b>More</b> 1 of 2

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### SPURIOUS EMISSIONS, HIGH CHANNEL



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🔆 Agilent 16:	13:53 Feb 18,	, 2016		L	Measure
APv4.2(02021) Ref10 dBm ≇Peak <b>γ</b>	ð),46722, Morri #Atten 2	sville Conducted 0 dB	Mkr	4 25.940 GHz -46.939 dBm	Meas Off
.og L0 dB/ Dffst					Channel Power
12.7 dB DI -13.7 decembra					Occupied BW
dBm					ACP
Center 13.015 #Res BW 100 k Marker Tr	GHz Hz ace Type	#VBW 300 kHz X Axis	Sp Sweep 2.482	an 25.97 GHz s (8192 pts) Amplitude	Multi Carrier Power
1 ( 2 ( 3 ( 4 (	1)         Freq           1)         Freq           1)         Freq           1)         Freq           1)         Freq           1)         Freq	2.480 GHz 4.960 GHz 7.440 GHz 25.940 GHz		5.00 dBm -59.17 dBm -55.88 dBm -46.94 dBm	Power Stat CCDF
					<b>More</b> 1 of 2

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### SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



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🔆 Agi	ilent 10	:19:22	Feb 19	9,2016	ì					L	Measure
APv4.20 Ref 20 Peak	(02021 dBm	6),4672	22, Morr Atten 2	isville 20 dB	Conduc	ted		Mkr2 ;	2.483 5 -54.1	00 GHz 0 dBm	Meas Off
Log 10 dB/ Offst	s. Ma	<u>∧</u> ∕	un Mun								Channel Power
12.7 dB DI				Low J		2					Occupied BW
dBm #PAvg					- Contraction	· · · · ·	Angertan.	·····	mar		ACP
Center #Res Bl Marke	2.483 W 100 ∍r T	500 GH kHz race	IZ Type	#VB	W 300 >	kHz Axis	Sweep	1.467 n	Span 1 ns (100 Amplit	l5 MHz 1 pts) ude	Multi Carrier Power
1 2		(1) (1)	Freq Freq		2.483 2.483	500 GH2 500 GH2	2		-54.10 -54.10	dBm dBm	Power Stat CCDF
											More 1 of 2

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# 8. RADIATED TEST RESULTS

# 8.1. LIMITS AND PROCEDURE

# **LIMITS**

FCC §15.205 and §15.209

IC RSS-GEN Clause 8.9 (Transmitter)

IC RSS-GEN Clause 7.1.2 (Receiver)

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
0.009-0.490	2400/F(kHz) @ 300 m	-
0.490-1.705	24000/F(kHz) @ 30 m	-
1.705 - 30	30 @ 30m	-
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

# TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for below 1GHz measurements and 1.5 m above the ground plane for above 1GHz measurements. The antenna to EUT distance is 3 meters.

For measurements below 1 GHz the resolution bandwidth is set to 120 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements for the 30-1000 MHz range, 9 kHz for peak detection measurements or 9 kHz for quasi-peak detection measurements for the 0.15-30 MHz range and 200 Hz for peak detection measurements or 200 Hz for quasi-peak detection measurements for the 9 to 150 kHz range. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 1 MHz for peak measurements and as applicable for average measurements. For this investigation, the averaging method was by using a Peak detector with the resolution bandwidth set to 1MHz and a reduced video bandwidth, based on  $1/T_{on}$  where  $T_{on}$  is the transmit on time.

The spectrum from 9 kHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band, except where noted.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

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#### 8.2. **TRANSMITTER 1-18 GHz**

# 8.2.1. BASIC DATA RATE GFSK MODULATION



# **RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)**

**Trace Markers** 

Marker	Frequency	Meter	Det	AF AT0069	Amp/Cbl/	Corrected	Average	Margin	Peak Limit	РК	Azimuth	Height	Polarity
	(GHz)	Reading		(dB/m)	Fltr/Pad	Reading	Limit	(dB)	(dBuV/m)	Margin	(Degs)	(cm)	
		(dBuV)			(dB)	(dBuV/m)	(dBuV/m)			(dB)			
1	* 2.39	40.6	Pk	32	-24.8	47.8	-	-	74	-26.2	120	205	Н
2	* 2.362	43.45	Pk	31.9	-24.9	50.45	-	-	74	-23.55	120	205	Н
3	* 2.39	31.13	V1TR	32	-24.8	38.33	54	-15.67	-	-	120	205	н
4	* 2.384	31.29	V1TR	32	-24.7	38.59	54	-15.41	-	-	120	205	Н

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

V1TR - VB=1/Ton, where: Ton is packet duration

# **RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**



Marker	Frequency	Meter	Det	AF AT0069	Amp/Cbl/	Corrected	Average	Margin	Peak Limit	PK Margin	Azimuth	Height	Polarity
	(GHz)	Reading		(dB/m)	Fltr/Pad	Reading	Limit	(dB)	(dBuV/m)	(dB)	(Degs)	(cm)	
		(dBuV)			(dB)	(dBuV/m)	(dBuV/m)						
1	* 2.39	40.93	Pk	32	-24.8	48.13	-	-	74	-25.87	316	290	V
2	* 2.333	43.15	Pk	31.9	-24.8	50.25	-	-	74	-23.75	316	290	V
3	* 2.39	30.94	V1TR	32	-24.8	38.14	54	-15.86	-	-	316	290	V
4	* 2.385	31.12	V1TR	32	-24.7	38.42	54	-15.58	-	-	316	290	V

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

V1TR - VB=1/Ton, where: Ton is packet duration

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# RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



Marker	Frequency	Meter	Det	AF AT0069	Amp/Cbl/	Corrected	Average	Margin	Peak Limit	РК	Azimuth	Height	Polarity
	(GHz)	Reading		(dB/m)	Fltr/Pad	Reading	Limit	(dB)	(dBuV/m)	Margin	(Degs)	(cm)	
		(dBuV)			(dB)	(dBuV/m)	(dBuV/m)			(dB)			
1	* 2.484	43.71	Pk	32.1	-24.7	51.11	-	-	74	-22.89	117	100	Н
2	* 2.486	44.69	Pk	32.1	-24.7	52.09	-	-	74	-21.91	117	100	Н
3	* 2.484	33.96	V1TR	32.1	-24.7	41.36	54	-12.64	-	-	117	100	Н
4	* 2.484	33.96	V1TR	32.1	-24.7	41.36	54	-12.64	-	-	117	100	Н

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band Pk - Peak detector V1TR: VB=1/Ton, where: Ton is packet duration

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# **RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)**



Marker	Frequency	Meter	Det	AF	Amp/Cbl/	Corrected	Average	Margin	Peak Limit	PK Margin	Azimuth	Height	Polarity
	(GHz)	Reading		AT0069	Fltr/Pad	Reading	Limit	(dB)	(dBuV/m)	(dB)	(Degs)	(cm)	
		(dBuV)		(dB/m)	(dB)	(dBuV/m)	(dBuV/m)						
1	* 2.484	41.65	Pk	32.1	-24.7	49.05	-	-	74	-24.95	68	115	V
2	* 2.493	44.57	Pk	32.1	-24.7	51.97	-	-	74	-22.03	68	115	V
3	* 2.484	32.41	V1TR	32.1	-24.7	39.81	54	-14.19	-	-	68	115	V
4	* 2.484	32.45	V1TR	32.1	-24.7	39.85	54	-14.15	-	-	68	115	V

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band Pk - Peak detector V1TR: VB=1/Ton, where: Ton is packet duration

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### HARMONICS AND SPURIOUS EMISSIONS



### Low Channel

Marker	Frequency	Meter	Det	AF AT0069	Amp/Cbl	Corrected	Avg Limit	Margin	Peak Limit	PK	Azimuth	Height	Polarity
	(GHz)	Reading		(dB/m)	/fltr/Pad	Reading	(dBuV/m)	(dB)	(dBuV/m)	Margin	(Degs)	(cm)	
		(dBuV)			(dB)	(dBuV/m)				(dB)			
2	* 4.804	46.14	PK-U	34	-31.7	48.44	-	-	74	-25.56	300	107	Н
	* 4.804	40.52	V1TR	34	-31.7	42.82	54	-11.18	-	-	300	107	Н
5	* 4.804	45.36	PK-U	34	-31.7	47.66	-	-	74	-26.34	323	109	V
	* 4.804	39.47	V1TR	34	-31.7	41.77	54	-12.23	-	-	323	109	V
6	* 13.317	37.35	PK-U	39.1	-26	50.45	-	-	74	-23.55	346	182	V
	* 13.315	25.39	V1TR	39.1	-26	38.49	54	-15.51	-	-	346	182	V
1	3.256	39.56	Pk	32.8	-33.7	38.66	-	-	-	-	0-360	102	Н
4	3.256	40.77	Pk	32.8	-33.7	39.87	-	-	-	-	0-360	101	V
3	15.26	33.39	Pk	40	-25.6	47.79	-	-	-	-	0-360	102	Н

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

PK-U: Maximum Peak

V1TR: VB=1/Ton, where: Ton is packet duration

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### REPORT NO: R11040094-E3 FCC ID: C3K1708

# Mid Channel



Marker	Frequency	Meter	Det	AF AT0069	Amp/Cbl/	Corrected	Avg Limit	Margin	Peak Limit	РК	Azimuth	Height	Polarity
	(GHz)	Reading		(dB/m)	fltr/Pad	Reading	(dBuV/m)	(dB)	(dBuV/m)	Margin	(Degs)	(cm)	
		(dBuV)			(dB)	(dBuV/m)				(dB)			
2	* 4.882	45.25	PK-U	33.9	-31.5	47.65	-	-	74	-26.35	294	106	Н
	* 4.882	39.75	V1TR	33.9	-31.5	42.15	54	-11.85	-	-	294	106	Н
5	* 4.882	46.78	PK-U	33.9	-31.5	49.18	-	-	74	-24.82	202	117	V
	* 4.882	41.79	V1TR	33.9	-31.5	44.19	54	-9.81	-	-	202	117	V
1	3.256	39.02	Pk	32.8	-33.7	38.12	-	-	-	-	0-360	102	Н
3	6.345	31.69	Pk	35.4	-28.5	38.59	-	-	-	-	0-360	102	Н
4	3.256	40.1	Pk	32.8	-33.7	39.2	-	-	-	-	0-360	102	V
6	13	31.88	Pk	39.2	-24.9	46.18	-	-	-	-	0-360	102	V

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

PK-U: Maximum Peak

V1TR: VB=1/Ton, where: Ton is packet duration

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### REPORT NO: R11040094-E3 FCC ID: C3K1708

# **High Channel**



Marker	Frequency	Meter	Det	AF AT0069	Amp/Cbl	Corrected	Avg Limit	Margin	Peak Limit	РК	Azimuth	Height	Polarity
	(GHz)	Reading		(dB/m)	/fltr/Pad	Reading	(dBuV/m)	(dB)	(dBuV/m)	Margin	(Degs)	(cm)	
		(dBuV)			(dB)	(dBuV/m)				(dB)			
2	* 4.96	46.31	PK-U	33.9	-31.6	48.61	-	-	74	-25.39	292	121	н
	* 4.96	40.99	V1TR	33.9	-31.6	43.29	54	-10.71	-	-	292	121	н
4	* 12.292	36.42	PK-U	39	-24.8	50.62	-	-	74	-23.38	344	164	н
	* 12.292	24.74	V1TR	39	-24.8	38.94	54	-15.06	-	-	344	164	н
6	* 4.96	46.39	PK-U	33.9	-31.6	48.69	-	-	74	-25.31	329	102	V
	* 4.96	40.97	V1TR	33.9	-31.6	43.27	54	-10.73	-	-	329	102	V
1	3.256	38.89	Pk	32.8	-33.7	37.99	-	-	-	-	0-360	102	Н
5	3.256	40.46	Pk	32.8	-33.7	39.56	-	-	-	-	0-360	102	V
3	6.2	34.06	Pk	35.3	-30	39.36	-	-	-	-	0-360	102	н
7	14.104	32.72	Pk	39.2	-25.3	46.62	-	-	-	-	0-360	199	V

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

PK-U: Maximum Peak

V1TR: VB=1/Ton, where: Ton is packet duration

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UL LLC
# 8.2.2. ENHANCED DATA RATE 8PSK MODULATION



# RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)

Marker	Frequency	Meter	Det	AF AT0069	Amp/Cbl/	Corrected	Average	Margin	Peak Limit	PK Margin	Azimuth	Height	Polarity
	(GHz)	Reading		(dB/m)	Fltr/Pad	Reading	Limit	(dB)	(dBuV/m)	(dB)	(Degs)	(cm)	
		(dBuV)			(dB)	(dBuV/m)	(dBuV/m)						
2	*2.381	44.13	Pk	32	-24.7	51.43	-	-	74	-22.57	124	115	Н
4	*2.382	31.42	V1TR	32	-24.7	38.72	54	-15.28	-	-	124	115	Н
1	*2.39	40.36	Pk	32	-24.8	47.56	-	-	74	-26.44	124	115	Н
3	*2.39	31.12	V1TR	32	-24.8	38.32	54	-15.68	-	-	124	115	Н

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band Pk - Peak detector

V1TR: VB=1/Ton, where: Ton is packet duration

# **RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**



Marker	Frequency	Meter	Det	AF AT0069	Amp/Cbl/	Corrected	Average	Margin	Peak Limit	РК	Azimuth	Height	Polarity
	(GHz)	Reading		(dB/m)	Fltr/Pad	Reading	Limit	(dB)	(dBuV/m)	Margin	(Degs)	(cm)	
		(dBuV)			(dB)	(dBuV/m)	(dBuV/m)			(dB)			
1	* 2.39	41.78	Pk	32	-24.8	48.98	-	-	74	-25.02	75	101	V
2	* 2.374	43.23	Pk	31.9	-24.8	50.33	-	-	74	-23.67	75	101	V
3	* 2.39	31.18	V1TR	32	-24.8	38.38	54	-15.62	-	-	75	101	V
4	* 2.383	31.27	V1TR	32	-24.7	38.57	54	-15.43	-	-	75	101	V

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band Pk - Peak detector V1TR: VB=1/Ton, where: Ton is packet duration

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# **RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**



Marker	Frequency	Meter	Det	AF	Amp/Cbl/	Corrected	Average	Margin	Peak Limit	РК	Azimuth	Height	Polarity
	(GHz)	Reading		AT0069	Fltr/Pad	Reading	Limit	(dB)	(dBuV/m)	Margin	(Degs)	(cm)	
		(dBuV)		(dB/m)	(dB)	(dBuV/m)	(dBuV/m)			(dB)			
1	*2.484	44.17	Pk	32.1	-24.7	51.57	-	-	74	-22.43	114	110	Н
2	*2.484	46.14	Pk	32.1	-24.7	53.54	-	-	74	-20.46	114	110	Н
3	*2.484	33.21	V1TR	32.1	-24.7	40.61	54	-13.39	-	-	114	110	Н
4	*2.484	33.24	V1TR	32.1	-24.7	40.64	54	-13.36	-	-	114	110	Н

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band Pk - Peak detector V1TR: VB=1/Ton, where: Ton is packet duration

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# **RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)**



Marker	Frequency	Meter	Det	AF	Amp/Cbl/	Corrected	Average	Margin	Peak Limit	PK Margin	Azimuth	Height	Polarity
	(GHz)	Reading		AT0069	Fltr/Pad	Reading	Limit	(dB)	(dBuV/m)	(dB)	(Degs)	(cm)	
		(dBuV)		(dB/m)	(dB)	(dBuV/m)	(dBuV/m)						
1	* 2.484	40.72	Pk	32.1	-24.7	48.12	-	-	74	-25.88	74	114	V
3	* 2.484	31.67	V1TR	32.1	-24.7	39.07	54	-14.93	-	-	74	114	V
4	* 2.484	31.81	V1TR	32.1	-24.7	39.21	54	-14.79	-	-	74	114	V
2	2.55	43.4	Pk	32.1	-24.7	50.8	-	-	74	-23.2	74	114	V

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

V1TR: VB=1/Ton, where: Ton is packet duration

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### HARMONICS AND SPURIOUS EMISSIONS

# Low Channel



Marker	Frequency	Meter	Det	AF	Amp/Cbl/	Corrected	Avg Limit	Margin	Peak Limit	РК	Azimuth	Height	Polarity
	(GHz)	Reading		AT0069	fltr/Pad	Reading	(dBuV/m)	(dB)	(dBuV/m)	Margin	(Degs)	(cm)	
		(dBuV)		(dB/m)	(dB)	(dBuV/m)				(dB)			
2	* 4.804	43.77	PK-U	34	-31.7	46.07	-	-	74	-27.93	265	102	н
	* 4.804	34.2	V1TR	34	-31.7	36.5	54	-17.5	-	-	265	102	Н
5	* 4.804	45.03	PK-U	34	-31.7	47.33	-	-	74	-26.67	335	115	V
	* 4.804	34.62	V1TR	34	-31.7	36.92	54	-17.08	-	-	335	115	V
1	3.256	39.61	Pk	32.8	-33.7	38.71	-	-	-	-	0-360	102	Н
3	16.558	31.87	Pk	41.7	-24	49.57	-	-	-	-	0-360	102	Н
4	3.256	40.64	Pk	32.8	-33.7	39.74	-	-	-	-	0-360	102	V
6	16.576	30.95	Pk	41.8	-23.5	49.25	-	-	-	-	0-360	199	V

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

PK-U: Maximum Peak

V1TR: VB=1/Ton, where: Ton is packet duration

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# Mid Channel



Marker	Frequency	Meter	Det	AF	Amp/Cbl/	Corrected	Avg Limit	Margin	Peak Limit	РК	Azimuth	Height	Polarity
	(GHz)	Reading		AT0069	fltr/Pad	Reading	(dBuV/m)	(dB)	(dBuV/m)	Margin	(Degs)	(cm)	
		(dBuV)		(dB/m)	(dB)	(dBuV/m)				(dB)			
2	* 4.882	42.02	PK-U	33.9	-31.5	44.42	-	-	74	-29.58	177	214	Н
	* 4.882	31.89	V1TR	33.9	-31.5	34.29	54	-19.71	-	-	177	214	Н
5	* 4.882	43.24	PK-U	33.9	-31.5	45.64	-	-	74	-28.36	190	158	V
	* 4.882	33.52	V1TR	33.9	-31.5	35.92	54	-18.08	-	-	190	158	V
1	3.256	38.69	Pk	32.8	-33.7	37.79	-	-	-	-	0-360	102	Н
3	16.975	31.95	Pk	42	-24.8	49.15	-	-	-	-	0-360	102	Н
4	3.256	40.47	Pk	32.8	-33.7	39.57	-	-	-	-	0-360	102	V
6	17.023	31.14	Pk	42	-24.5	48.64	-	-	-	-	0-360	102	V

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

PK-U: Maximum Peak

V1TR: VB=1/Ton, where: Ton is packet duration

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# **High Channel**



Marker	Frequency	Meter	Det	AF AT0069	Amp/Cbl/	Corrected	Avg Limit	Margin	Peak Limit	PK	Azimuth	Height	Polarity
	(GHz)	Reading		(dB/m)	fltr/Pad	Reading	(dBuV/m)	(dB)	(dBuV/m)	Margin	(Degs)	(cm)	
		(dBuV)			(dB)	(dBuV/m)				(dB)			
2	* 4.96	44.63	PK-U	33.9	-31.6	46.93	-	-	74	-27.07	303	138	Н
	* 4.96	35.34	V1TR	33.9	-31.6	37.64	54	-16.36	-	-	303	138	Н
5	* 4.96	45.67	PK-U	33.9	-31.6	47.97	-	-	74	-26.03	199	131	V
	* 4.96	36.33	V1TR	33.9	-31.6	38.63	54	-15.37	-	-	199	131	V
1	3.256	39.15	Pk	32.8	-33.7	38.25	-	-	-	-	0-360	102	Н
3	6.2	34.9	Pk	35.3	-30	40.2	-	-	-	-	0-360	102	Н
4	3.256	40.66	Pk	32.8	-33.7	39.76	-	-	-	-	0-360	102	V
6	9.684	31.29	Pk	36.8	-26.5	41.59	-	-	-	-	0-360	102	V

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

PK-U: Maximum Peak

V1TR: VB=1/Ton, where: Ton is packet duration

#### 8.3. WORST-CASE 18-26GHz

### SPURIOUS EMISSIONS 18 TO 26GHz (WORST-CASE CONFIGURATION)



Marker	Frequency	Meter	Det	AF (dB/m)	Amp/Cbl	Corrected	Average	Margin	Peak Limit	Margin	Azimuth	Height	Polarity
	(GHz)	Reading			(dB)	Reading	Limit	(dB)	(dBuV/m)	(dB)	(Degs)	(cm)	
		(dBuV)				(dBuV/m)	(dBuV/m)						
1	* 19.473	48.95	PK-U	32.5	-40.7	40.75	-	-	74	-33.25	144	138	Н
	* 19.475	37.56	V1TR	32.5	-40.7	29.36	54	-24.64	-	-	144	138	Н
3	* 22.414	48.38	PK-U	35.5	-40.5	43.38	-	-	74	-30.62	47	105	Н
	* 22.415	37.1	V1TR	35.5	-40.5	32.1	54	-21.9	-	-	47	105	Н
8	* 22.327	48.97	PK-U	36.1	-40.5	44.57	-	-	74	-29.43	138	104	V
	* 22.327	37.21	V1TR	36.1	-40.5	32.81	54	-21.19	-	-	138	104	V
2	21.569	48.93	Pk	34.5	-40.4	43.03	-	-	-	-	0-360	101	Н
4	23.392	48.69	Pk	33.9	-40.2	42.39	-	-	-	-	0-360	101	Н
5	24.76	47.46	Pk	33.7	-38.8	42.36	-	-	-	-	0-360	125	Н
6	25.297	46.43	Pk	34.1	-38.4	42.13	-	-	-	-	0-360	175	Н
7	21.416	49.28	Pk	33.7	-40.8	42.18	-	-	-	-	0-360	125	V
9	24.492	47.52	Pk	33.6	-38.8	42.32	-	-	-	-	0-360	101	V
10	25.654	46.86	Pk	33.9	-37.7	43.06	-	-	-	-	0-360	200	V

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

PK-U: Maximum Peak

V1TR: VB=1/Ton, where: Ton is packet duration

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# 8.4. WORST-CASE BELOW 1 GHz

# SPURIOUS EMISSIONS 9kHz-30 MHz (WORST-CASE CONFIGURATION)

**Note**: All measurements were made at a test distance of 3 m. The limits in the plots and tabular data are the FCC/IC limits extrapolated from the specification distance (300 m from 9-490 kHz and 30 m from 490 kHz – 30 MHz) to the measurement distance to clearly show the relative levels of fundamental and spurious emissions and demonstrate compliance with the requirement that the level of any spurious emissions be below the level of the intentionally transmitted signal. The extrapolation factor for the limits were 40\*Log (specification distance / test distance).

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# Ambient Scan



#### EUT Plot



The above plots demonstrate there were no EUT-related emissions of interest relative to the FCC 15.209 limit below 30MHz.

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# SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION)



Marker	Frequency	Meter	Det	AF AT0074	Port 0 Factors	Corrected	QPk Limit	Margin	Azimuth	Height	Polarity
	(MHz)	Reading		(dB/m)		Reading	(dBuV/m)	(dB)	(Degs)	(cm)	
		(dBuV)				(dBuV/m)					
1	338	38.29	Pk	18.8	-29.5	27.59	46.02	-18.43	0-360	102	Н
2	364	41.16	Pk	19.7	-29.4	31.46	46.02	-14.56	0-360	102	Н
3	494	39.49	Pk	22.1	-28.9	32.69	46.02	-13.33	0-360	199	Н
4	676	35.56	Pk	24.3	-28.4	31.46	46.02	-14.56	0-360	102	Н
5	728	40.5	Pk	25	-28.2	37.3	46.02	-8.72	0-360	102	Н
6	780	32.37	Qp	25.5	-28	29.87	46.02	-16.15	206	106	Н

Pk - Peak detector

**Qp** - Quasi-Peak detector

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# 9. AC POWER LINE CONDUCTED EMISSIONS

# <u>LIMITS</u>

FCC §15.207 (a)

RSS-GEN 8.8

Frequency of Emission (MHz)	Conducted L	.imit (dBuV)
	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.

# TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.10.

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

Line conducted data is recorded for both NEUTRAL and HOT lines.

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# **RESULTS**

#### LINE 1 and 2 RESULTS



# **<u>6 WORST EMISSIONS</u>**

#### **Trace Markers**

Marker	Frequency	Meter	Det	LISN VCF [dB]	Cbl/Limiter	Corrected	Class-B QP	Margin	Class-B Avg	Margin
	(MHz)	Reading			(dB)	Reading	Limit	(dB)	Limit	(dB)
		(dBuV)				dBuV				
1	.486	33.04	Pk	.1	10	43.14	56.24	-13.1	-	-
2	.486	17.22	Av	.1	10	27.32	-	-	46.24	-18.92
3	.486	32.91	Pk	.1	10	43.01	56.24	-13.23	-	-
4	.486	11.38	Av	.1	10	21.48	-	-	46.24	-24.76
5	4.926	32.48	Pk	.1	10.2	42.78	56	-13.22	-	-
6	4.926	6.9	Av	.1	10.2	17.2	-	-	46	-28.8

Pk - Peak detector

Av - Average detection

CE 150K-30MHz Class B Step Rcvr.TST Rev 9.5 20 Aug 2015

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