

### FCC 47 CFR PART 15 SUBPART C

### **CERTIFICATION TEST REPORT** FOR

### GSM/WCDMA/CDMA/LTE + BLUETOOTH, DTS/UNII a/b/g/n/ac, ANT+ & NFC

### FCC ID: PY7-PM0841

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Prepared for SONY MOBILE COMMUNICATIONS, INC. 1-8-15 KONAN, MINATO-KU **TOKYO, 108-0075 JAPAN** 

Prepared by **UL VERIFICATION SERVICES INC. 47173 BENICIA STREET** FREMONT, CA 94538, U.S.A. TEL: (510) 771-1000 FAX: (510) 661-0888



NVLAP LAB CODE 200065-0

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## 1. ATTESTATION OF TEST RESULTS

COMPANY NAME:	SONY MOBILE COMMUNICATIONS, INC.
EUT DESCRIPTION:	GSM/WCDMA/CDMA/LTE + BLUETOOTH, DTS/UNII a/b/g/n/ac, ANT+ &
	NFC
SERIAL NUMBER:	CB5A24QGLY (Conducted), CB5A24QGLV (Radiated)
DATE TESTED:	APRIL 1 – 7, 2015

AI	PPLICABLE STANDARDS
STANDARD	
CFR 47 Part 15 Subpa	rt C

TEST RESULTS Pass

UL Verification Services Inc. 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 Verification Services Inc. 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 Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. 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 Verification Services Inc. By:

CHOON OOI CONSUMER TECHNOLOGY DIVISION PROJECT LEAD UL Verification Services Inc.

Tested By:

CHARLES VERGONIO CONSUMER TECHNOLOGY DIVISION WISE LAB ENGINEER UL Verification Services Inc.

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## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2009, FCC CFR 47 Part 2, FCC CFR 47 Part 15.

## 3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street
Chamber A(IC: 2324B-1)	Chamber D(IC: 2324B-4)
Chamber B(IC: 2324B-2)	Chamber E(IC: 2324B-5)
Chamber C(IC: 2324B-3)	Chamber F(IC: 2324B-6)
	Chamber G(IC: 2324B-7)
	Chamber H(IC: 2324B-8)

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <u>http://ts.nist.gov/standards/scopes/2000650.htm</u>.

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## 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

## 4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	3.52 dB
Radiated Disturbance, 30 to 18000 MHz	4.94 dB

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

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## 5. EQUIPMENT UNDER TEST

## 5.1. DESCRIPTION OF EUT

The EUT is a GSM/WCDMA/CDMA/LTE + BLUETOOTH, DTS/UNII a/b/g/n/ac & NFC

## 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	9.37	8.65
2402 - 2480	Enhanced 8PSK	9.27	8.45

Note: GFSK, Pi/4-DQPSK, 8PSK average Power are all investigated, The GFSK & 8PSK Power are the worst case. Testing is based on this mode to showing compliance. For average power data please refer to section 8.6.

## 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an FPCB antenna, with a maximum gain of -1.4dBi.

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## 5.4. WORST-CASE CONFIGURATION AND MODE

Radiated emission and power line conducted emission 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.

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## 5.5. DESCRIPTION OF TEST SETUP

#### SUPPORT EQUIPMENT

Support Equipment List							
Description Manufacturer Model Serial Number FCC ID							
AC Adapter	SONY	EP880	3514W 01 S08328	N/A			
Earphone	Sony	N/A	N/A	N/A			
USB cable	Sony	N/A	N/A	N/A			

### I/O CABLES

I/O Cable List						
Cable	Cable Port # of identical Connector Cable Type Cable Remarks					
No		ports	Туре		Length (m)	
1	DC Power	1	Mini-USB	Shielded	1.2m	N/A
2	Audio	1	Mini-Jack	Unshielded	1m	N/A

#### TEST SETUP

The EUT is continuously communicating to the Bluetooth tester during the tests.

EUT was set in the Hidden menu mode to enable BT communications.

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### SETUP DIAGRAM FOR TESTS



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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 List						
Description	Manufacturer	Model	Asset	Cal Due		
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01069	12/20/15		
Spectrum Analyzer,9KHz-40GHz	HP	8564E	106	08/06/15		
EMI Test Receiver, 9 kHz-7 GHz	R & S	ESCI 7	100773	08/15/15		
Peak Power Meter	Agilent / HP	E4416A	C00963	12/13/15		
Peak / Average Power Sensor	Agilent / HP	E9327A	C00964	12/13/15		
Antenna, Horn, 18GHz	EMCO	3115	C00783	10/25/15		
Antenna, Horn,18- 26 GHz	ARA	MWH-1826/B	C00946	11/12/15		
Antenna, Horn, 26-40 GHz	ARA	MWH-2640	C00891	06/28/15		
Antenna, Bilog, 30MHz-1 GHz	Sunol Sciences	JB1	T243	12/08/15		
RF Preamplifier, 100KHz -> 1300MHz	HP	TBD	C00825	06/01/15		
RF Preamplifier, 26GHz - 40GHz	Miteq	NSP4000-SP2	86	04/07/16		
RF Preamplifier, 1GHz - 26.5GHz	HP	8449B	F00351	06/27/15		
AC Power Supply, 2,500VA 45-500Hz	Elgar-Ametek	CW2501M	F00013	CNR		
RF Preamplifier, 1GHz - 18GHz	Miteq	AFS42-00101800-25-S-42	1818466	05/09/15		
Attenuator / Switch driver	HP	11713A	F00204	CNR		
Low Pass Filter 3GHz	Micro-Tronics	LPS17541	F00219	05/23/15		
High Pass Filter 5GHz	Micro-Tronics	HPS17542	F00222	05/22/15		
High Pass Filter 6GHz	Micro-Tronics	HPM17543	F00224	05/22/15		

Test Software List					
Description Manufacturer Model Version					
Radiated Software	UL	UL EMC	Version 9.5, 07/22/14		
Conducted Software	UL	UL EMC	Version 9.5, 05/17/14		
CLT Software	UL	UL RF	Version 1.0, 02/02/15		
Antenna Port Software	UL	UL RF	Version 2.1.1.1, 1/20/15		

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# 7. SUMMARY TABLE

FCC Part Section	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Worst Case
2.1049	RSS-GEN 4.6	Occupied Band width (99%)	N/A		Pass	1.254 MHz
2.1051, 15.247 (d)	RSS-210 A8.5	Band Edge / Conducted Spurious Emission	-20dBc		Pass	-45.98 dBm
15.247 (b)(1)	RSS-210 A8.4	TX conducted output power	<21dBm		Pass	9.37 dBm
15.247 (a)(1)	RSS-210 A8.1(b)	Hopping frequency separation	> 25KHz	Conducted	Pass	1 MHz
15.247 (a)(1)(iii)	RSS-210 A8.1(d)	Number of Hopping channels	More than 15 non- overlapping channels		Pass	79 ch
15.247 (a)(1)(iii)	RSS-210 A8.1(d)	Avg Time of Occupancy	< 0.4sec		Pass	0.26 s
15.207 (a)	RSS-GEN 7.2.2	AC Power Line conducted emissions	Section 10		Pass	41.7 dBuV (AV)
15.205, 15.209	RSS-210 Clause 2.6, RSS-210 Clause 6	Radiated Spurious Emission	< 54dBuV/m	Radiated	Pass	39.51 dBuV/m

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## 8. ANTENNA PORT TEST RESULTS

### 8.1. 20 dB AND 99% BANDWIDTH

#### <u>LIMIT</u>

None; for reporting purposes only.

#### TEST PROCEDURE

DA 00-705: The transmitter output is connected to a spectrum analyzer. The RBW is set to  $\geq$  1% of the 20 dB bandwidth. The VBW is set to  $\geq$  RBW. The sweep time is coupled.

### **RESULTS**

### 8.1.1. BASIC DATA RATE GFSK MODULATION

Channel	Frequency	20 dB Bandwidth	99% Bandwidth
	(MHz)	(MHz)	(MHz)
Low	2402	0.921	0.585
Middle	2441	0.918	0.605
High	2480	0.923	0.567
Worst		0.923	0.605

### 8.1.2. ENHANCED DATA RATE 8PSK MODULATION

Channel	Frequency	20 dB Bandwidth	99% Bandwidth
	(MHz)	(MHz)	(MHz)
Low	2402	1.095	1.253
Middle	2441	1.094	1.254
High	2480	1.094	1.197
Worst		1.095	1.254

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### 8.1.3. 20 dB AND 99% BANDWIDTH PLOTS

#### GFSK 20 dB BANDWIDTH

LOW CHANNEL								
※ Agilent 10:23:57 Apr 7, 2015         R T	Freq/Channel							
Ch Freq 2.402 GHz Trig Free Occupied Bandwidth	Certer Freq 2.40200000 GHz							
	Start Freq 2.40050000 GHz							
Ref 20 dBm Atten 20 dB #Peak	Stop Freq 2.40350000 GHz							
10 dB/ Offst 10.4	CF Step 300.000000 kHz <u>Auto Man</u>							
dB Center 2.402 000 GHz Span 3 MHz	Freq Ctfset 0.00000000 Hz							
#Res BW 30 kHz VBW 91 kHz #Sweep 100 ms (601 pts)	Signal Track							
Occupied Bandwidth         Occ BW % Pwr         99.00 %           889.7921 kHz         × dB         -20.00 dB	On <u>Qif</u>							
Transmit Freq Error-2.009 kHzx dB Bandwidth921.425 kHz								
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MIDCHANNEL		
🔆 Agilent 10:21:55 Apr 7, 2015	RT	Freq/Channel
Ch Freq 2.441 GHz Occupied Bandwidth	Trig Free	Center Freq 2.44100000 GHz
		Start Freq 2.43950000 GHz
Ref 20 dBm Atten 20 dB #Peak Log		Stop Freq 2.44250000 GHz
10 dB/ Offst 10.4		CF Step 300.000000 kHz Auto Man
dB	Span 3 MHz	Freq Clfset 0.00000000 Hz
#Res BW 30 kHz         VBW 91 kHz         #Sweep 100 m           Occupied Bandwidth         Occ BW % Pwr           890 0531 kHz         × dB	99.00 % -20.00 dB	Signal Track <sup>On <u>Cif</u></sup>
Transmit Freq Error -8.039 kHz x dB Bandwidth 918.091 kHz		
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	поп	CHANNEL		
🔆 Agilent 10:21:11 Apr 7, 201	15		RΤ	Freq/Channel
Ch Freq 2.48 G	GHz		Trig Free	Certer Freq 2.48000000 GHz
				Start Freq 2.47850000 GHz
Ref 20 dBm Atten 20 #Peak	) dB			Stop Freq 2.48150000 GHz
10 dB/ Offst 10.4		- Vee	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	CF Step 300.000000 kHz <u>Auto Mar</u>
dB			Span 3 MHz	Freq Clfset 0.00000000 Hz
#Res BW 30 kHz	Circul Transla			
Occupied Bandwidt 888.38	On <u>Cif</u>			
Transmit Freq Error -1 x dB Bandwidth 92	7.857 kHz 23.371 kHz			
Copyright 2000-2010 Agilent Tec	hnologies			

### HIGH CHANNEL

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#### GFSK 99% BANDWIDTH



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MID CHANNEL

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**HIGH CHANNEL** 

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#### 8PSK 20 dB BANDWIDTH



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MID CHANNEL	
🔆 Agilent 10:22:44 Apr 7, 2015 🛛 🛛 🛛 🕂 R 🗋	Freq/Channel
Ch Freq 2.441 GHz Trig Fre	Certer Freq 2.44100000 GHz
	Start Freq 2.43950000 GHz
Ref 20 dBm Atten 20 dB #Peak Log	Stop Freq 2.44250000 GHz
10 dB/ Offst 10.4	CF Step 300.000000 kHz Auto Man
dB Center 2.441 000 GHz Span 3 M	Freq Clfset 0.00000000 Hz
#Res BW 30 kHz         VBW 91 kHz         #Sweep 100 ms (601 pts)           Occupied Bandwidth         Occ BW % Pwr         99.00 %           1 0935 MHz         × dB         -20.00 dB	Signal Track <sup>%</sup> On <u>Cif</u>
Transmit Freq Error 6.549 kHz x dB Bandwidth 1.210 MHz	
Copyright 2000-2010 Agilent Technologies	

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	пюг			
🔆 Agilent 10:20:23 Apr 7, 201	15		RΤ	Freq/Channel
Ch Freq 2.48 G	эНz		Trig Free	Certer Freq 2.48000000 GHz
				Start Freq 2.47850000 GHz
Ref 20 dBm Atten 20 #Peak	dB ◆			Stop Freq 2.48150000 GHz
dB/ Offst 10.4		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~	$\sim$	CF Step 300.000000 kHz <u>Auto Man</u>
dB Center 2.480 000 GHz			Span 3 MHz	Freq Clfset 0.00000000 Hz
#Res BW 30 kHz	Cignal Track			
Occupied Bandwid 1.0941	th MHz	Occ BW % Pwr x dB	99.00 % -20.00 dB	On <u>Cif</u>
Transmit Freq Error80x dB Bandwidth1.	10.022 Hz 211 MHz			
Copyright 2000-2010 Agilent Tec	hnologies			

### HIGH CHANNEL

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#### 8PSK 99% BANDWIDTH



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### MID CHANNEL

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### **HIGH CHANNEL**

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## 8.2. HOPPING FREQUENCY SEPARATION

### LIMIT

FCC §15.247 (a) (1)

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

DA 00-705: The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

#### **RESULTS**

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### HOPPING FREQUENCY SEPARATION PLOT



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## 8.3. NUMBER OF HOPPING CHANNELS

### <u>LIMIT</u>

FCC §15.247 (a) (1) (iii)

IC RSS-210 A8.1 (d)

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

### TEST PROCEDURE

DA 00-705: 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. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

#### RESULTS

Normal Mode: 79 Channels observed.

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#### NUMBER OF HOPPING CHANNELS PLOTS

Agilent 14:11:22       Apr 3, 2015       R L       Freq/Channe         Ref 20 dBm       Atten 20 dB       1.58 dB       1.58 dB       2.44000000 GH         #Peak       1.58 dB       1.58 dB       2.44000000 GH       3.3000000 GH         10       dB/       1.58 dB       3.30000000 GH       3.3000000 GH       3.3000000 GH         10.5       1.8       1.8       1.58 dB       3.3000000 GH       3.3000000 GH       3.30000000 GH         LgAv       1.8       1.9       1.9       1.9       1.9       1.9       3.0000000 GH         V1 S2       S3 FC       1.9       1.9       1.9       1.9       1.9       1.9         Swp       1.9					UFFIN	G CHA		-3 (100		L SPAN	
▲ Mkr1         80.6 MHz         Center Fre           *Peak         1.58 dB         2.44000000 GH           Log         10         5         3           10         10         10         10         10           dB/         10         10         10         10         10           dB/         10	🔆 Agilent 14	:11:22	Apr 3,	2015						RL	Freq/Channel
Log         Start Fre           10         IR	Ref 20 dBm #Peak		Atten	20 dB				<b>∆</b> Mk	r1 8	30.6 MHz 1.58 dB	Center Freq 2.44000000 GHz
10.5       1R       Stop Fre         dB       Image: state s	Log 10 dB/ Offst		*******		مسمعين		*******	and the second	******	m	<b>Start Freq</b> 2.39000000 GHz
LgAv         CF Ste           V1 S2         Image: S3 FC Arrow of the second secon	10.5 dB	R Ø								*	<b>Stop Freq</b> 2.49000000 GHz
V1 S2         Freq Offse           S3 FC         0.0000000 H           AA         0.0000000 H           £(f):         Swp	LgAv										<b>CF Step</b> 10.000000 MHz <u>Auto</u> Man
£(f):     Signal Trac       Swp     Image: Signal Trac	V1 S2 S3 FC AA									Undo	FreqOffset 0.00000000 Hz
	<b>£</b> (f): FTun Swp										<b>Signal Track</b> <sup>On <u>Off</u></sup>
Start 2.390 0 GHz         Stop 2.490 0 GHz           #Res BW 1 MHz         #VBW 1 MHz         Sweep 20 ms (1001 pts)           Copyright 2000-2010 Agilent Technologies	Start 2.390 0 #Res BW 1 MH	GHz z	)10 Aqi	#V	BW 1 M echnol	Hz Ogies	Swee	Stop ep 20 ms	2.49 3 (10	0 0 GHz 01 pts)	

#### 

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NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, FIRST SEGMENT)

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f 20 dBm Atten 20 dB eak g fst .5 Av	Center Freq 2.44500000 GHz
9 // //////////////////////////////////	Start Freq
4 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	2.43000000 GHZ
Av Av	- Stop Freq 2.46000000 GHz
	<b>CF Step</b> 3.00000000 MHz <u>Auto</u> Man
S2 FC AA	Freq Offset 0.00000000 Hz
f): un p	Signal Track
art 2.430 00 GHz Stop 2.460 00 GH es BW 300 kHz #VBW 300 kHz Sweep 20 ms (1001 pts	

### NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, SECOND SEGMENT)

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## 8.4. AVERAGE TIME OF OCCUPANCY

### <u>LIMIT</u>

FCC §15.247 (a) (1) (iii)

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.

#### **RESULTS**

DH Packet Pulse		Number of	Average Time	Limit	Margin		
	Width	Pulses in	of Occupancy				
	(msec)	3.16	(sec)	(sec)	(sec)		
		seconds					
GFSK Normal Mode							
DH1	0.404	29	0.11716	0.4	-0.28284		
DH3	1.642	14	0.22988	0.4	-0.17012		
DH5	2.896	9	0.26064	0.4	-0.13936		
DH Packet	Pulse	Number of	Average Time	Limit	Margin		
	Width	Pulses in	of Occupancy				
	(msec)	0.8 seconds	(sec)	(sec)	(sec)		
GFSK AFH	Mode						
DH1	0.404	7.25	0.02929	0.4	-0.37071		
DH3	1.642	3.5	0.05747	0.4	-0.34253		
DH5	2.896	2.25	0.06516	0.4	-0.33484		

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🔆 Ag	<b>ilent</b> 15	:41:41	Apr 3,	2015					F	۲L	Freq/Channel
Ref 20 #Peak	dBm		Atten	20 dB				▲ Mk	(r1 25	404 µs .70 dB	Center Freq 2.44100000 GHz
Log 10 dB/ Offst		<u>. Mutu</u> t	<u> </u>								Start Freq 2.44100000 GHz
16.5 dB	1# \$										<b>Stop Freq</b> 2.44100000 GHz
LgAv	MM-YAM					yanaliya	<b>WYWW</b>	un an		ndipetition perf	<b>CF Step</b> 1.0000000 MHz <u>Auto</u> Man
Center Res Bk Mark	2.441   1 MHz er Ti	000 GH race	łz Type	#V	BW 1 M	Hz Axis	Swe	eep 1 m	Spa ns (100 Amplit	in 0 Hz 11 pts) ude	FreqOffset 0.00000000 Hz
1R 14	1	(1) (1)	Time Time			83 μs 404 μs			-45.97 25.70	dBm IdB	<b>Signal Track</b> On <u>Off</u>
Copyri	ight 20	00-20	10 Ag	ilent T	echnol	ogies					

### PULSE WIDTH - DH1

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# NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH1

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🔆 Agilent 🕻	15:40:45	Apr 3,	2015						RL		Freq/Channel
Ref 20 dBm #Peak		Atten	20 dB					Mkr1	1.642 15.86	ms dB	Center Freq 2.44100000 GHz
Log 10 dB/ 0ffst		₩ ₩	Aliantalia	<u>n Hir P</u> TT			AL.	ra ra			<b>Start Freq</b> 2.44100000 GHz
16.5 dB											<b>Stop Freq</b> 2.44100000 GHz
LgAv	<mark>4</mark> 1										<b>CF Step</b> 1.00000000 MHz <u>Auto</u> Man
Center 2.44 Res BW 1 M Marker	1 000 GH Hz Trace		#V	BW 1 M	Hz Axis	Swe	eep 2	:  Am	Span 0 1001 pt plitude	Hz ts)	FreqOffset 0.00000000 Hz
1R 1۵	(1) (1)	Time Time		1	194 µs .642 ms			-20. 19	19 dBm 5.86 dB		<b>Signal Track</b> On <u>Off</u>
Copyright	2000-20	)10 Agi	ilent T	echnol	ogies						

## PULSE WIDTH - DH3

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# NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH3

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🔆 Ag	j <b>ilent</b> 15	:40:05	Apr 3,	2015					F	۲ L	Freq/Chann	el
Ref 20 #Peak	dBm		Atten	20 dB				▲ Mk	r1 2. -28.	.896 ms .12 dB	<b>Center Fre</b> 2.44100000 G	eq iHz
Log 10 dB/ Offst		R >									<b>Start Fre</b> 2.44100000 G	eq Hz
16.5 dB									•		<b>Stop Fre</b> 2.44100000 G	eq Hz
LgAv	₩ <b>₩</b> ₩ <b>₩</b> ₩								₩ <b>₩</b> ₩	n Alexandrian 	<b>CF Ste</b> 1.00000000 M <u>Auto</u> M	<b>ep</b> IHz 1an
Center Res Bh Mark	2.441 1 MHz er Ti	000 GH race	lz Type	#V	BW 1 M x	Hz Axis	Swe	ep4m	Spa s (100 Amplit	n 0 Hz 1 pts) <sup>ude</sup>	Freq Offs 0.00000000	et Hz
1R 1۵		(1) (1)	Time Time		2	392 µs .896 ms			-3.62 -28.12	dBm dB	Signal Trac <sup>On <u>(</u></sup>	<b>ck</b> Off
Copyr	ight 20	100-20	)10 Agi	lent T	echnol	ogies						

## PULSE WIDTH - DH5

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# NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH5

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# 8.5. OUTPUT POWER

#### <u>LIMIT</u>

§15.247 (b) (1)

The maximum antenna gain is less than 6 dBi, therefore the limit is 21 dBm.

#### TEST PROCEDURE

DA 00-705: The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

#### **RESULTS**

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Channel	Frequency	Output Power	Limit	Margin
	(MHz)	(dBm)	(dBm)	(dB)
Low	2402	8.74	21	-12.26
Middle	2441	9.37	21	-11.63
High	2480	8.86	21	-12.14
Worst		9.37		-11.63

# 8.5.1. BASIC DATA RATE GFSK MODULATION

# 8.5.2. ENHANCED DATA RATE 8PSK MODULATION

Channel	Frequency	Output Power	Limit	Margin
	(MHz)	(dBm)	(dBm)	(dB)
Low	2402	8.76	21	-12.24
Middle	2441	9.27	21	-11.73
High	2480	8.57	21	-12.43
Worst		9.27		-11.73

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# 8.5.3. OUTPUT POWER PLOTS

#### **GFSK OUTPUT POWER**

🔆 Agilent	10:09:48	Apr 7, 2015			RT	Freq/Channel
Ref 20 dBm #Peak		Atten 20 dB		Mkr1 2.	401 760 GHz 8.74 dBm	Certer Freq 2.40200000 GHz
Log 10 dB/ Offst			1 •			Start Freq 2.40050000 GHz
10.4 dB						Stop Freq 2.40350000 GHz
#PAvg						CF Step 300.000000 kHz <u>Auto Mar</u>
M1 S2 S3 FC AA						Freq Clfset 0.00000000 Hz
¤(f): FTun Swp						Signal Track On <u>Cif</u>
Center 2.40 #Res BW 3	2 000 GHz MHz		#VBW 3 MHz	Sweep 1 m	Span 3 MHz ns (1001 pts)	
Copyright 20	00-2010 A	gilent Technol	ogies			

# LOW CHANNEL

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🔆 Agilent 10:11	:12 Apr 7, 2015			RΤ	Freq/Channel
Ref 20 dBm #Peak	Atten 20 dB		Mkr1 2.441	087 GHz 9.37 dBm	Certer Freq 2.44100000 GHz
Log 10 dB/					Start Freq 2.43950000 GHz
10.4 dB					Stop Freq 2.44250000 GHz
#PAvg					CF Step 300.000000 kHz <u>Auto Ma</u>
M1 S2 S3 FC AA					Freq Clifset 0.00000000 Hz
¤(f): FTun Swp					Signal Track <sup>On <u>C</u>‼</sup>
Center 2.441 000 #Res BW 3 MHz	GHz #V	/BW 3 MHz	Sl Sweep 1 ms (1	pan 3 MHz 001 pts)	

## MID CHANNEL

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🔆 Agiler	nt 10:12:20	Apr 7, 2015			RΤ	Freq/Channel
Ref 20 dB #Peak	m	Atten 20 d	B	Mkr1 2	.479 748 GHz 8.86 dBm	Certer Freq 2.48000000 GHz
Log 10 dB/ Offst			¢			Start Freq 2.47850000 GHz
10.4 dB						Stop Freq 2.48150000 GHz
#PAvg						CF Step 300.000000 kHz <u>Auto Ma</u>
M1 S2 S3 FC AA						Freq Olfset 0.00000000 Hz
¤(1): FTun Swp						Signal Track <sup>On <u>C</u>:</sup>
Center 2.4 #Res BW	480 000 GH 3 MHz	z	#VBW 3 MHz	Sweep 1 n	Span 3 MHz ns (1001 pts)	
Copyright :	2000-2010	Agilent Techn	ologies			

#### HIGH CHANNEL

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#### 8PSK OUTPUT POWER

🔆 Agilent	10:10:38	Apr 7, 201	15				F	R T	Freq/Channel
Ref 20 dBm #Peak		Atten 20	dB			Mkr1 2.	401 93 <sup>-</sup> 8.7(	1 GHz 5 dBm	Certer Freq 2.40200000 GHz
Log 10 dB/ Offst				1 •					Start Freq 2.40050000 GHz
10.4 dB									Stop Freq 2.40350000 GHz
#PAvg									CF Step 300.000000 kHz <u>Auto Mar</u>
M1 S2 S3 FC AA									Freq Clfset 0.00000000 Hz
¤(1): FTun Swp									Signal Track <sup>On <u>C</u>:f</sup>
Center 2.40 #Res BW 3	2 000 GHz MHz	<u> </u>	#VBV	V 3 MHz	Swe	eep 1 m	Spar is (1001	n 3 MHz pts)	
Copyright 20	00-2010 A	gilent Tecl	hnologies						

LOW CHANNEL

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					i req/chann	ei
Ref 20 dBm #Peak	Atten 20 dB		Mkr1 3	2.440 862 GH 9.27 dBr	m Center Fr 2.44100000 G	eq SHz
Log 10 dB/ Offst		1 <b>0</b>			Start Fre	eq ƏHz
dB					Stop Fr 2.44250000 G	req SHz
#PAvg					CF S 300.000000 k <u>Auto</u>	Step (Hz <u>Ma</u>
M1 S2 S3 FC AA					Freq Clfs	set Hz
¤(f): FTun Swp					Signal Tra	ack <u>Oif</u>
Center 2.441 000 #Res BW 3 MHz	GHz #	VBW 3 MHz	Sweep 1	Span 3 M ms (1001 pts)	IHz )	

## MID CHANNEL

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🔆 Agi	lent <mark>10:1</mark>	3:02 Apr	7, 2015					F	τ	Freq/Channel
Ref 20 o #Peak	lBm	At	ten 20 d	B			Mkr1 2	.479 955 8.57	5 GHz 7 dBm	Certer Freq 2.48000000 GHz
Log 10 dB/ Offst					•					Start Freq 2.47850000 GHz
10.4 dB										Stop Freq 2.48150000 GHz
#PAvg										CF Step 300.000000 kHz <u>Auto Ma</u>
M1 S2 S3 FC AA										Freq Clfset 0.00000000 Hz
¤(f): FTun Swp										Signal Track <sup>On <u>C</u>!</sup>
Center∶ #Res B\	2.480 000 N 3 MHz	) GHz		#VBW 3	B MHz	Swe	eep 1 n	Spar ns (1001	n 3 MHz I pts)	
Copyrigh	nt 2000-2	010 Agile	nt Techn	ologies						

## HIGH CHANNEL

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# 8.6. AVERAGE POWER

#### <u>LIMIT</u>

None; for reporting purposes only.

#### TEST PROCEDURE

DA 00-705: The transmitter output is connected to a power meter.

#### **RESULTS**

The cable assembly insertion loss of 10.7 dB (including 10 dB pad and 0.7 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

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# 8.6.1. BASIC DATA RATE GFSK MODULATION

Channel	Frequency	Average Power
	(MHz)	(dBm)
Low	2402	9
Middle	2441	9.3
High	2480	8.7
Worst		9.3

# 8.6.2. DATA RATE PI/4-DQPSK MODULATION

Channel	Frequency	Average Power
	(MHz)	(dBm)
Low	2402	7.20
Middle	2441	7.60
High	2480	7.00
Worst		7.60

# 8.6.3. ENHANCED DATA RATE 8PSK MODULATION

Channel	Frequency	Average Power
	(MHz)	(dBm)
Low	2402	7.1
Middle	2441	7.6
High	2480	7
Worst		7.6

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# 8.7. CONDUCTED SPURIOUS EMISSIONS

## LIMITS

FCC §15.247 (d)

Limit = -20 dBc

#### 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.

#### **RESULTS**

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# 8.7.1. BASIC DATA RATE GFSK MODULATION

#### SPURIOUS EMISSIONS, LOW CHANNEL



## LOW CHANNEL BANDEDGE

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🔆 Agi	ilent 13:39	9:12 Apr 3, 20	15				F	R T	Freq/Channel
Ref 20 #Peak	dBm	Atten 2	0 dB			Mk	ar1 2.40 -0.61	02 GHz dBm	Certer Freq 13.0150000 GHz
Log 10 dB/ Offst									Start Freq 30.0000000 MHz
10.5 dB DI									Stop Freq 26.000000 GHz
-16.1 dBm #PAvg									CF Step 2.59700000 GHz <u>Auto Mar</u>
Start 30 #Res B	0 MHz W 100 kHz	2	#VBW 30	0 kHz	Swee	Sto p 2.482 s	p 26.00 s (8192	0 GHz pts)	Freq Olfset 0.00000000 Hz
1	(1)	e Type Fieq Fieq		2.402 GHz 7.448 GHz			-0.61 dB -59.18 dB	m Im	Signal Track <sup>On <u>C</u>:f</sup>
Copyrig	ht 2000-20	10 Agilent Teo	hnologies						

## LOW CHANNEL SPURIOUS

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#### SPURIOUS EMISSIONS, MID CHANNEL



MID CHANNEL BANDEDGE

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🔆 Ag	ilent 13	:38:11 /	Apr 3, 20	15					F	RΤ	Freq/Channel
Ref 20 #Peak	dBm		Atten 2	0 dB				Mk	.58.22	9 GHz dBm	Certer Freq 13.0150000 GHz
Log 10 dB/ Offst		\$									Start Freq 30.0000000 MHz
10.5 dB DI											Stop Freq 26.000000 GHz
-16.1 dBm #PAvg			2 <b>(</b>			, sété mentes		a pitan fita pita ita			CF Step 2.59700000 GHz <u>Auto Ma</u>
Start 30 #Res B	) MHz W 100 I	(Hz Iace	Туре	#VE	3W 300	kHz Axis	Swee	Sto p 2.482	p 26.00 s (8192 Amplitu	0 GHz pts)	Freq Olfset 0.00000000 Hz
1 2		(1) (1)	Fieq Fieq		2.4 6.7	40 GHz 39 GHz			-0.03 dB -58.22 dB	m im	Signal Track <sup>On <u>C</u>if</sup>
Copyrig	ht 2000	-2010 Aç	gilent Teo	chnologi	es						

## MID CHANNEL SPURIOUS

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#### SPURIOUS EMISSIONS, HIGH CHANNEL

🔆 Ag	<b>ilent</b> 13	:34:47	Apr 3,	2015					I	۲L	Freq/Channel
Ref 20 #Peak	dBm		Atten	20 dB				Mkr2 ;	2.485 3 -61.8	330 GHz 36 dBm	Center Freq 2.48350000 GHz
Log 10 dB/ Offst			$\bigwedge$								<b>Start Freq</b> 2.47600000 GHz
10.5 dB DI				h.							<b>Stop Freq</b> 2.49100000 GHz
-16.1 dBm #PAvg	low for the	and the second		۳. الر	Hornors	1 Rayaliyan	2	*~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		- Carlow Mr	<b>CF Step</b> 1.50000000 MHz <u>Auto</u> Man
Center #Res B Mark	2.483 W 100 er T	500 GH kHz race	Z Type	#VB	W 300 X	kHz Axis	Sweep	1.467 r	Span ns (100 Amplit	15 MHz )1 pts) ude	FreqOffset 0.00000000 Hz
1 2		(1) (1)	Freq Freq		2.483 ! 2.485 :	500 GHz 330 GHz			-63.47 -61.86	dBm dBm	<b>Signal Track</b> <sup>On <u>Off</u></sup>
Copyri	ght 20	00-20	10 Agi	lent T	echnol	ogies					

## **HIGH CHANNEL BANDEDGE**

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🔆 Agi	ilent 13:3	7:27 Apr 3, 2	2015					F	RΤ	Freq/Channel
Ref 20 ( #Peak	dBm	Atten	20 dB				Mk	ar1 2.48 3.35	81 GHz 5 dBm	Certer Freq 13.0150000 GHz
Log 10 dB/ Offst	\$									Start Freq 30.0000000 MHz
10.5 dB DI	2									Stop Freq 26.0000000 GHz
.16.1 dBm #PAvg					in fabring p					CF Step 2.59700000 GHz <u>Auto Ma</u> r
Start 30 #Res BV	) MHz W 100 kH	I <b>z</b> ce Type	#VB	3W 300 k	Hz Axis	Swee	Sto p 2.482	p 26.00 s (8192 Amplitu	0 GHz pts)	Freq Olfset 0.00000000 Hz
1 2	(1) (1)	) Freq ) Freq		2.48 70	31 GHz 05 MHz			3.35 dE -45.98 dB	im Im	Signal Track <sup>On <u>C</u>if</sup>
Copyrig	ht 2000-2	010 Agilent T	echnologi	es						

## HIGH CHANNEL SPURIOUS

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#### SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



#### LOW BANDEDGE WITH HOPPING ON

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🔆 Ag	ilent 14:	13:23	Apr 3,	2015						RL	Freq/C	nannel
Ref 20 #Peak	dBm		Atten	20 dB				Mkr2	2.489 -61.	065 GHz .25 dBm	2 Cente 2.483500	<b>r Freq</b> )00 GHz
Log 10 dB/ Offst	$\bigvee$	$\bigwedge$	$\nabla$								<b>Star</b> 2.476000	<b>t Freq</b> )00 GHz
10.5 dB DI				<u>h</u>							<b>Sto</b> 2.491000	<b>p Freq</b> )00 GHz
-16.1 dBm #PAvg				-h <sub>r</sub>	hn	1	Angana angana ang		2		<b>C</b> 1.500000 <u>Auto</u>	<b>F Step</b> 100 MHz Man
Center #Res B Mark	2.483 W 110 k er Tr	500 GH (Hz ace	łz Type	#VB	3W 330 x	kHz ( Axis	Swee	p 1.2	Span ms (10 Ampli	15 MHz 01 pts) itude	<b>Freq</b> 0.00000	Offset 000 Hz
1 2	(	(1) (1)	Freq Freq		2.483 ! 2.489	500 GHz 065 GHz			-64.12 -61.25	2 dBm 5 dBm	Signal	Track Off
Copyri	ght 20	00-20	10 Agi	lent T	echnol	ogies						

# HIGH BANDEDGE WITH HOPPING ON

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# 8.7.2. ENHANCED DATA RATE 8PSK MODULATION

#### SPURIOUS EMISSIONS, LOW CHANNEL

	LO	N CHANNEL BAND	EDGE	
🔆 Agilent 13:48:05	Apr 3,2015		RL	Freq/Channel
Ref 20 dBm #Peak	Atten 20 dB	M	lkr2 2.399 415 GHz -53.31 dBm	Center Freq 2.40000000 GHz
Log 10 dB/ Offst				Start Freq 2.39250000 GHz
10.5 dB			ή	<b>Stop Freq</b> 2.40750000 GHz
HPAvg	malinman	AW AN	W work was	<b>CF Step</b> 1.5000000 MHz <u>Auto</u> Man
Center 2.400 000 G #Res BW 100 kHz Marker Trace	Hz #VB Type	W 300 kHz – Sweep 1. X Axis	Span 15 MHz .467 ms (1001 pts) Amplitude	FreqOffset 0.00000000 Hz
1 (1) 2 (1)	Freq Freq	2.400 000 GHz 2.399 415 GHz	–55.78 dBm –53.31 dBm	Signal Track <sup>On <u>Off</u></sup>
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🔆 Ag	ilent 13	:53:12 /	Apr 3, 20	)15					F	RТ	Freq/Channel
Ref 20 #Peak	dBm		Atten 2	0 dB				Mk	ar1 2.40 -1.74	02 GHz dBm	Certer Freq 13.0150000 GHz
Log 10 dB/ Offst											Start Freq 30.0000000 MHz
10.5 dB DI											Stop Freq 26.000000 GHz
.17.2 dBm #PAvg			2 <b>(</b>						i i i i i i i i i i i i i i i i i i i		CF Step 2.59700000 GHz <u>Auto Ma</u>
Start 30 #Res B	0 MHz W 100 I	Hz	Type	#VE	3W 300	kHz Axis	Swee	Sto p 2.482 s	p 26.00 s (8192	0 GHz pts)	Freq Olfset 0.00000000 Hz
1		(1) (1)	Freq		2.4 6.6	02 GHz 88 GHz			-1.74 dB -59.01 dB	m Im	Signal Track <sup>On <u>C</u>if</sup>
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## LOW CHANNEL SPURIOUS

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#### SPURIOUS EMISSIONS, MID CHANNEL



#### **MID CHANNEL BANDEDGE**

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🔆 Ag	ilent 13	:52:05 /	Apr 3, 20	15					F	R T	Freq/Channel
Ref 20 ( #Peak	dBm		Atten 2	0 dB				Mkr	2 13.77 -56.47	8 GHz dBm	Center Freq 13.0150000 GHz
Log 10 dB/ Offst											Start Freq 30.0000000 MHz
10.5 dB DI						2					Stop Freq 26.0000000 GHz
-17.2 dBm #PAvg						8					CF Step 2.59700000 GHz <u>Auto Mar</u>
Start 30 #Res Bl	) MHz W 100 I	(Hz	Type	#VE	3W 300   ×	kHz Axis	Swee	Sto p 2.482 s	p 26.00 s (8192	0 GHz pts)	Freq Clfset 0.00000000 Hz
1 2		(1) (1)	Freq		2.4 13.7	40 GHz 78 GHz		,	-1.82 dB -56.47 dB	m m	Signal Track <sup>On <u>Cif</u></sup>
	L. 0000	0040 4		<b>.</b>							
Copyrig	nt 2000	2010 Aç	glient Leo	cnnologi	es						

## MID CHANNEL SPURIOUS

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#### SPURIOUS EMISSIONS, HIGH CHANNEL

🔆 Agilen	<b>t</b> 13:49:31	Apr 3,	2015					F	? L	Freq/Channel
Ref 20 dB #Peak	3m	Atten 2	20 dB				Mkr2 :	2.483 7 -61.1	70 GHz 2 dBm	Center Freq 2.48350000 GHz
Log 10 dB/ Offst		M								Start Freq 2.47600000 GHz
10.5 dB DI	- A		M							<b>Stop Freq</b> 2.49100000 GHz
-17.2 dBm #PAvg	and for the second			why the f	2	allen and a start a	alara Ma	homen		<b>CF Step</b> 1.50000000 MHz <u>Auto</u> Man
Center 2.4 #Res BW 1 Marker	483 500 GH .00 kHz Trace	Z Type	#VB	W 300 X	kHz Axis	Sweep	1.467 n	Span 1 ns (100 Amplite	5 MHz 1 pts) ude	FreqOffset 0.00000000 Hz
1 2	(1) (1)	Freq Freq		2.483 5 2.483 7	500 GHz 770 GHz			-63.68 -61.12	dBm dBm	<b>Signal Track</b> <sup>On <u>Off</u></sup>
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## **HIGH CHANNEL BANDEDGE**

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🔆 Ag	ilent 13	:51:15 /	Apr 3, 20	)15					F	R T	Freq/Channel
Ref 20 #Peak	dBm		Atten 2	0 dB				Mk	(r1 2.48 -1.61	dBm	Center Freq 13.0150000 GHz
Log 10 dB/ Offst											Start Freq 30.0000000 MHz
10.5 dB DI											Stop Freq 26.0000000 GHz
-17.2 dBm #PAvg		( <sup>2</sup>									CF Step 2.59700000 GHz Auto Mar
Start 30 #Res B	) MHz W 100 k	Hz		#VE	3W 300	kHz	Swee	Sto p 2.482	p 26.00 s (8192	0 GHz Î pts)	Freq Clfset 0.00000000 Hz
Marker 1 2	r Ti	(1) (1)	Type Freq Freq		X 2.4 6.6	Axis 181 GHz 189 GHz			Ampliti -1.61 dB -59.19 dB	ude m im	Signal Track <sup>On <u>C</u>:f</sup>
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## HIGH CHANNEL SPURIOUS

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#### SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



#### LOW BANDEDGE WITH HOPPING ON

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* Agilent 14:17:27 A	Apr 3,2015	RI	Eron /Channal
			rreq/channel
Ref 20 dBm At #Peak	Atten 20 dB	Mkr2 2.487 490 GH -61.58 dBm	Z Center Freq 2.48350000 GHz
Log 10 hhave have by dB/ 0ffst	wmhy		Start Freq 2.47600000 GHz
10.5 dB DI	- Vering -		<b>Stop Freq</b> 2.49100000 GHz
-17.2 dBm #PAvg	1 Maria		<b>CF Step</b> 1.50000000 MHz <u>Auto</u> Man
Center 2.483 500 GHz #Res BW 110 kHz Marker Trace	#VBW 330 kHz Type X Axis	Span 15 MHz Sweep 1.2 ms (1001 pts) Amplitude	FreqOffset 0.00000000 Hz
1 (1) 2 (1)	Freq 2.483 500 GHz Freq 2.487 490 GHz	-63.38 dBm -61.58 dBm	Signal Track <sup>On <u>Off</u></sup>
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## HIGH BANDEDGE WITH HOPPING ON

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# 9. RADIATED TEST RESULTS

# 9.1. LIMITS AND PROCEDURE

FCC §15.205 and §15.209

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m			
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. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.4. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For band edge measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and 1/T (on time) for average measurement. GFSK = 1/T = 1 / 0.0028S = 360Hz.

The spectrum from 1GHzHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

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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# 9.2. TRANSMITTER ABOVE 1 GHz

# 9.2.1. BASIC DATA RATE GFSK MODULATION

# **RESTRICTED BANDEDGE (LOW CHANNEL)**

## HORIZONTAL PEAK AND AVERAGE PLOT



# HORIZONTAL DATA

Marker	Frequency	Meter	Det	AF T119	Amp/Cbl/	Corrected	Average	Margin	Peak Limit	PK Margin	Azimuth	Height	Polarity
	(GHZ)	(dBuV)		(dB/m)	(dB)	(dBuV/m)	(dBuV/m)	(ab)	(dBuV/m)	(ab)	(Degs)	(cm)	
1	* 2.39	39.34	РК	32	-23.1	48.24	-	-	74	-25.76	276	108	н
2	* 2.357	42.65	PK	31.9	-23.1	51.45	-	-	74	-22.55	276	108	н
3	* 2.39	29.68	VB1T	32	-23.1	38.58	54	-15.42	-	-	276	108	Н
4	* 2.39	29.82	VB1T	32	-23.1	38.72	54	-15.28	-	-	276	108	Н

\* - indicates frequency in CFR 47, Part 15 and Industry Canada RSS-Restricted Band.

PK - Peak detector

VB1T - FHSS Method: VB=1/Ton, Voltage Averaging Max Hold where: Ton is the duration of the packet

 UL VERIFICATION SERVICES INC.
 FORM NO: CCSUP47011

 47173 BENICIA STREET, FREMONT, CA 94538, USA
 TEL: (510) 771-1000
 FAX: (510) 661-0888

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#### VERTICAL PEAK AND AVERAGE PLOT

#### **VERTICAL DATA**

Marker	Frequency	Meter	Det	AF T119	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	* 2.336	43.44	PK	31.8	-23.1	52.14	-	-	74	-21.86	124	309	V
4	* 2.384	29.67	VB1T	32	-23.1	38.57	54	-15.43	-	-	124	309	V
1	* 2.39	39.03	PK	32	-23.1	47.93	-	-	74	-26.07	124	309	V
3	* 2.39	29.56	VB1T	32	-23.1	38.46	54	-15.54	-	-	124	309	V

\* - indicates frequency in CFR 47, Part 15 and Industry Canada RSS-Restricted Band.

#### PK - Peak detector

VB1T - FHSS Method: VB=1/Ton, Voltage Averaging Max Hold where: Ton is the duration of the packet

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# AUTHORIZED BANDEDGE (HIGH CHANNEL)



#### HORIZONTAL PEAK AND AVERAGE PLOT

#### HORIZONTAL DATA

Marker	Frequency	Meter	Det	AF T119	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	* 2.484	41.76	РК	32.3	-22.8	51.26	-	-	74	-22.74	111	238	н
2	* 2.499	42.7	РК	32.3	-22.7	52.3	-	-	74	-21.7	111	238	н
3	* 2.484	29.86	VB1T	32.3	-22.8	39.36	54	-14.64	-	-	111	238	н
4	* 2.484	30.01	VB1T	32.3	-22.8	39.51	54	-14.49	-	-	111	238	н

\* - indicates frequency in CFR 47, Part 15 and Industry Canada RSS-Restricted Band.

#### PK - Peak detector

VB1T - FHSS Method: VB=1/Ton, Voltage Averaging Max Hold where: Ton is the duration of the packet

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### VERTICAL PEAK AND AVERAGE PLOT

#### VERTICAL DATA

Marker	Frequency	Meter	Det	AF T119	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	* 2.484	39.82	РК	32.3	-22.8	49.32	-	-	74	-24.68	177	247	V
3	* 2.484	29.71	VB1T	32.3	-22.8	39.21	54	-14.79	-	-	177	247	V
4	* 2.484	29.76	VB1T	32.3	-22.8	39.26	54	-14.74	-	-	177	247	V
2	2.535	42.7	РК	32.4	-22.8	52.3	-	-	74	-21.7	177	247	V

\* - indicates frequency in CFR 47, Part 15 and Industry Canada RSS-Restricted Band.

PK - Peak detector

VB1T - FHSS Method: VB=1/Ton, Voltage Averaging Max Hold where: Ton is the duration of the packet

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## HARMONICS AND SPURIOUS EMISSIONS



#### LOW CHANNEL HORIZONTAL

Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

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#### LOW CHANNEL VERTICAL

Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

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## LOW CHANNEL DATA

#### TRACE MARKERS

Marker	Frequency	Meter	Det	AF T119	Amp/Cbl/F	Corrected	Avg Limit	Margin	Peak Limit	PK Margin	Azimuth	Height	Polarity
	(GHz)	Reading		(dB/m)	ltr/Pad	Reading	(dBuV/m)	(dB)	(dBuV/m)	(dB)	(Degs)	(cm)	
		(dBuV)			(dB)	(dBuV/m)							
2	* 1.364	34.28	PK	29.1	-23.8	39.58	-	-	74	-34.42	0-360	200	н
1	* 1.324	34.47	PK	29.6	-23.8	40.27	-	-	74	-33.73	0-360	100	V
3	* 2.25	33.75	PK	31.5	-23	42.25	-	-	74	-31.75	0-360	100	V
5	* 4.276	31.9	PK	33.5	-31.2	34.2	-	-	74	-39.8	0-360	100	н
6	* 4.673	31.54	PK	34	-30.7	34.84	-	-	74	-39.16	0-360	200	н
4	* 4.094	32.39	РК	33.3	-31.5	34.19	-	-	74	-39.81	0-360	200	V

\* - indicates frequency in CFR 47, Part 15 and Industry Canada RSS-Restricted Band.

PK - Peak detector

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#### MID CHANNEL HORIZONTAL

Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

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#### MID CHANNEL VERTICAL

Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

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#### MID CHANNEL DATA

#### TRACE MARKERS

Marker	Frequency	Meter	Det	AF T119	Amp/Cbl/F	Corrected	Avg Limit	Margin	Peak Limit	PK Margin	Azimuth	Height	Polarity
	(GHz)	Reading		(dB/m)	ltr/Pad	Reading	(dBuV/m)	(dB)	(dBuV/m)	(dB)	(Degs)	(cm)	
		(dBuV)			(dB)	(dBuV/m)							
1	* 1.299	33.65	PK	29.9	-23.8	39.75	-	-	74	-34.25	0-360	200	н
2	* 1.305	33.68	PK	29.8	-23.8	39.68	-	-	74	-34.32	0-360	200	V
3	* 2.242	33.68	PK	31.5	-23	42.18	-	-	74	-31.82	0-360	200	V
4	* 3.693	31.7	PK	33	-30.8	33.9	-	-	74	-40.1	0-360	200	н
5	* 3.703	31.57	PK	33	-30.8	33.77	-	-	74	-40.23	0-360	200	V
6	* 7.297	31.35	PK	35.6	-28.8	38.15	-	-	74	-35.85	0-360	100	V

\* - indicates frequency in CFR 47, Part 15 and Industry Canada RSS-Restricted Band.

PK - Peak detector

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## HIGH CHANNEL HORIZONTAL

Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

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**HIGH CHANNEL VERTICAL** 

Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

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## HIGH CHANNEL DATA

#### TRACE MARKERS

Marker	Frequency	Meter	Det	AF T119	Amp/Cbl/F	Corrected	Avg Limit	Margin	Peak Limit	PK Margin	Azimuth	Height	Polarity
	(GHz)	Reading		(dB/m)	ltr/Pad	Reading	(dBuV/m)	(dB)	(dBuV/m)	(dB)	(Degs)	(cm)	
		(dBuV)			(dB)	(dBuV/m)							
1	* 1.34	34.7	PK	29.4	-23.8	40.3	-	-	74	-33.7	0-360	200	Н
2	* 1.315	34.42	PK	29.7	-23.8	40.32	-	-	74	-33.68	0-360	200	V
3	* 2.263	34.05	PK	31.5	-23	42.55	-	-	74	-31.45	0-360	100	V
6	* 4.143	31.33	PK	33.3	-31	33.63	-	-	74	-40.37	0-360	100	н
4	* 4.805	31.68	PK	34	-30.3	35.38	-	-	74	-38.62	0-360	100	V
5	* 12.446	30.49	РК	39	-26.7	42.79	-	-	74	-31.21	0-360	200	V

\* - indicates frequency in CFR 47, Part 15 and Industry Canada RSS-Restricted Band.

PK - Peak detector

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# 9.2.2. ENHANCED DATA RATE 8PSK MODULATION RESTRICTED BANDEDGE (LOW CHANNEL)



### HORIZONTAL PEAK AND AVERAGE PLOT

#### HORIZONTAL DATA

Marker	Frequency	Meter	Det	AF T119	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	2.37	42.63	РК	31.9	-23	51.53	-	-	74	-22.47	213	387	Н
4	2.388	29.74	VB1T	32	-23.1	38.64	54	-15.36	-	-	213	387	н
1	2.39	40.15	PK	32	-23.1	49.05	-	-	74	-24.95	213	387	Н
3	2.39	29.7	VB1T	32	-23.1	38.6	54	-15.4	-	-	213	387	н

PK - Peak detector

VB1T - FHSS Method: VB=1/Ton, Voltage Averaging Max Hold where: Ton is the duration of the packet

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#### VERTICAL PEAK AND AVERAGE PLOT

#### VERTICAL DATA

Marker	Frequency (GHz)	Meter Reading	Det	AF T119 (dB/m)	Amp/Cbl/ Fltr/Pad	Corrected Reading	Average Limit	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
		(dBuV)			(dB)	(dBuV/m)	(dBuV/m)						
1	* 2.39	41.39	РК	32	-23.1	50.29	-	-	74	-23.71	183	396	V
2	* 2.327	42.73	PK	31.7	-23.1	51.33	-	-	74	-22.67	183	396	V
3	* 2.39	29.62	VB1T	32	-23.1	38.52	54	-15.48	-	-	183	396	V
4	* 2.389	29.69	VB1T	32	-23.1	38.59	54	-15.41	-	-	183	396	V

\* - indicates frequency in CFR 47, Part 15 and Industry Canada RSS-Restricted Band.

#### PK - Peak detector

VB1T - FHSS Method: VB=1/Ton, Voltage Averaging Max Hold where: Ton is the duration of the packet

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# AUTHORIZED BANDEDGE (HIGH CHANNEL)



#### HORIZONTAL PEAK AND AVERAGE PLOT

#### HORIZONTAL DATA

Marker	Frequency	Meter	Det	AF T119	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	* 2.484	40.46	РК	32.3	-22.8	49.96	-	-	74	-24.04	111	238	н
3	* 2.484	29.77	VB1T	32.3	-22.8	39.27	54	-14.73	-	-	111	238	н
4	* 2.484	29.85	VB1T	32.3	-22.8	39.35	54	-14.65	-	-	111	238	н
2	2.562	42.86	РК	32.4	-22.7	52.56	-	-	74	-21.44	111	238	н

\* - indicates frequency in CFR 47, Part 15 and Industry Canada RSS-Restricted Band.

PK - Peak detector

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### VERTICAL PEAK AND AVERAGE PLOT

#### VERTICAL DATA

Marker	Frequency	Meter	Det	AF T119	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	* 2.484	39.92	РК	32.3	-22.8	49.42	-	-	74	-24.58	185	362	V
2	* 2.498	43.09	РК	32.3	-22.7	52.69	-	-	74	-21.31	185	362	V
3	* 2.484	29.67	VB1T	32.3	-22.8	39.17	54	-14.83	-	-	185	362	V
4	2.524	29.57	VB1T	32.4	-22.7	39.27	54	-14.73	-	-	185	362	V

\* - indicates frequency in CFR 47, Part 15 and Industry Canada RSS-Restricted Band.

PK - Peak detector

VB1T - FHSS Method: VB=1/Ton, Voltage Averaging Max Hold where: Ton is the duration of the packet

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## HARMONICS AND SPURIOUS EMISSIONS



#### LOW CHANNEL HORIZONTAL

Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

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#### LOW CHANNEL VERTICAL

Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

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#### LOW CHANNEL DATA

#### TRACE MARKERS

Marker	Frequency	Meter	Det	AF T119	Amp/Cbl/F	Corrected	Avg Limit	Margin	Peak Limit	PK Margin	Azimuth	Height	Polarity
	(GHz)	Reading		(dB/m)	ltr/Pad	Reading	(dBuV/m)	(dB)	(dBuV/m)	(dB)	(Degs)	(cm)	
		(dBuV)			(dB)	(dBuV/m)							
1	* 1.303	33.78	PK	29.8	-23.8	39.78	-	-	74	-34.22	0-360	100	Н
3	* 2.279	33.7	PK	31.6	-23.1	42.2	-	-	74	-31.8	0-360	100	Н
2	* 1.295	33.65	РК	29.8	-23.8	39.65	-	-	74	-34.35	0-360	100	V
4	* 3.662	31.74	PK	32.9	-31	33.64	-	-	74	-40.36	0-360	100	V
5	* 4.24	31.38	РК	33.4	-30.8	33.98	-	-	74	-40.02	0-360	200	V
6	* 4.813	31.12	PK	34	-30.3	34.82	-	-	74	-39.18	0-360	100	V

\* - indicates frequency in CFR 47, Part 15 and Industry Canada RSS-Restricted Band.

PK - Peak detector

#### **Radiated Emissions**

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 4.811	40.02	PK3	34	-30.4	43.62	-	-	74	-30.38	360	100	V
* 4.811	27.4	VB1T	34	-30.4	31	54	-23	-	-	360	100	V

\* - indicates frequency in CFR 47, Part 15 and Industry Canada RSS-Restricted Band.

PK3 - FHSS Method: Maximum Peak

VB1T - FHSS Method: VB=1/Ton, Voltage Averaging Max Hold where: Ton is the duration of the packet

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#### MID CHANNEL HORIZONTAL

Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

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#### **MID CHANNEL VERTICAL**

Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

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#### MID CHANNEL DATA

TRACE MARKERS

Marker	Frequency	Meter	Det	AF T119	Amp/Cbl/F	Corrected	Avg Limit	Margin	Peak Limit	PK Margin	Azimuth	Height	Polarity
	(GHz)	Reading		(dB/m)	ltr/Pad	Reading	(dBuV/m)	(dB)	(dBuV/m)	(dB)	(Degs)	(cm)	
		(dBuV)			(dB)	(dBuV/m)							
2	* 1.247	33.85	PK	29.4	-23.8	39.45	-	-	74	-34.55	0-360	100	Н
1	* 1.265	34.07	PK	29.6	-23.8	39.87	-	-	74	-34.13	0-360	100	V
3	* 2.328	33.79	РК	31.7	-23.1	42.39	-	-	74	-31.61	0-360	200	V
5	* 3.87	31.69	PK	33.1	-31.4	33.39	-	-	74	-40.61	0-360	200	н
4	* 3.682	31.26	РК	33	-30.7	33.56	-	-	74	-40.44	0-360	100	V
6	4.46	31.32	PK	33.7	-30.9	34.12	-	-	-	-	0-360	200	V

\* - indicates frequency in CFR 47, Part 15 and Industry Canada RSS-Restricted Band.

PK - Peak detector

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## HIGH CHANNEL HORIZONTAL

Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

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#### HIGH CHANNEL VERTICAL

Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

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## HIGH CHANNEL DATA

TRACE MARKERS

Marker	Frequency	Meter	Det	AF T119	Amp/Cbl/F	Corrected	Avg Limit	Margin	Peak Limit	PK Margin	Azimuth	Height	Polarity
	(GHz)	Reading		(dB/m)	ltr/Pad	Reading	(dBuV/m)	(dB)	(dBuV/m)	(dB)	(Degs)	(cm)	
		(dBuV)			(dB)	(dBuV/m)							
1	* 1.284	33.95	PK	29.7	-23.8	39.85	-	-	74	-34.15	0-360	100	Н
2	* 1.292	33.69	PK	29.8	-23.8	39.69	-	-	74	-34.31	0-360	100	V
3	* 2.353	34.35	PK	31.8	-23.1	43.05	-	-	74	-30.95	0-360	100	V
4	* 3.691	31.48	PK	33	-30.8	33.68	-	-	74	-40.32	0-360	200	н
5	* 4.81	31.38	РК	34	-30.5	34.88	-	-	74	-39.12	0-360	100	Н
6	4.407	30.72	PK	33.7	-30.2	34.22	-	-	-	-	0-360	200	V

\* - indicates frequency in CFR 47, Part 15 and Industry Canada RSS-Restricted Band.

PK - Peak detector

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# 9.3. WORST-CASE BELOW 1 GHz

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



## HORIZONTAL PLOT

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## **VERTICAL PLOT**

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## **BELOW 1 GHz TABLE**

### **Trace Markers**

Marker	Frequency	Meter	Det	AF T243	Amp/Cbl (dB)	Corrected	QPk Limit	Margin	Azimuth	Height	Polarity
	(MHz)	Reading		(dB/m)		Reading	(dBuV/m)	(dB)	(Degs)	(cm)	
		(dBuV)				(dBuV/m)					
2	* 110.495	31.8	РК	12.7	-28	16.5	43.52	-27.02	0-360	300	Н
4	47.6375	47.63	РК	9.2	-28.7	28.13	40	-11.87	0-360	101	V
1	48.02	40.11	РК	9	-28.6	20.51	40	-19.49	0-360	300	Н
5	57.2	48.06	РК	7.4	-28.5	26.96	40	-13.04	0-360	101	V
3	157.9675	38.72	РК	12.3	-27.4	23.62	43.52	-19.9	0-360	300	Н
6	158.86	43.11	PK	12.3	-27.4	28.01	43.52	-15.51	0-360	101	V

\* - indicates frequency in CFR 47, Part 15 and Industry Canada RSS-Restricted Band.

PK - Peak detector

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# **10. AC POWER LINE CONDUCTED EMISSIONS**

#### **LIMITS**

FCC §15.207 (a)

Frequency of Emission (MHz)	Conducted Limit (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 C63.4.

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.

#### **RESULTS**

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



LINE 1 PLOT

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Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency	Meter	Det	T24 IL L1	LC Cables	Corrected	CISPR 22	Margin	CISPR 22	Margin	
	(MHz)	Reading			1&3	Reading	Class B QP	(dB)	Class B	(dB)	
		(dBuV)				dBuV			Avg		
1	1.2795	41.39	Pk	.2	.1	41.69	56	-14.31			
2	1.275	25.51	Av	.2	.1	25.81			46	-20.19	

## **LINE 1 RESULTS**

Pk - Peak detector

Av - Average detection

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LINE 2 PLOT



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Range 2: Line-L2 .15 - 30MHz										
Marker	Frequency	Meter	Det	T24 IL L2	LC Cables	Corrected	CISPR 22	Margin	CISPR 22	Margin
	(MHz)	Reading			2&3	Reading	Class B QP	(dB)	Class B	(dB)
		(dBuV)				dBuV			Avg	
3	1.347	40.93	Pk	.2	.1	41.23	56	-14.77		
4	1.3425	22.97	Av	.2	0	23.17			46	-22.83
5	17.907	37.58	Pk	.3	.2	38.08	60	-21.92		
6	17.9205	23.27	Av	.3	.2	23.77			50	-26.23
7	23.5095	40.99	Pk	.3	.2	41.49	60	-18.51		
8	23.505	21.22	Av	.3	.2	21.72			50	-28.28

## LINE 2 RESULTS

#### Pk - Peak detector

Av - Average detection

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