

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

CERTIFICATION TEST REPORT

FOR

WIRELESS HEADSET

MODEL NUMBER: AI1

FCC ID: A94AI1 IC: 3232A-AI1

REPORT NUMBER: R11043795-E1

ISSUE DATE: 2016-06-09

Prepared for BOSE CORP. 100 THE MOUNTAIN RD, FRAMINGHAM MASSACHUSETTS, 01701, USA

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

NVLAP Lab code: 200246-0

Revision History

Version	lssue Date	Revisions	Revised By
1	2016-04-19	Initial Issue	Ron Reichard
2	2016-05-12	Added below 30 MHz data.	Jeff Moser
3	2016-05-17	Clarified Radiated measurement mode 'V1TR', added statement regarding chamber characterizartion for below 30 MHz on page 113.	Jeff Moser
4	2016-05-20	Included below 30 MHz limits on page 97.	Jeff Moser
5	2016-06-09	Revised informative average power measurements (DQPSK and 8PSK).	Jeff Moser

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Page 2 of 124

TABLE OF CONTENTS

1.	ATTESTATION OF TEST RESULTS	5
2.	TEST METHODOLOGY	6
3.	FACILITIES AND ACCREDITATION	6
4.	CALIBRATION AND UNCERTAINTY	6
4	1. MEASURING INSTRUMENT CALIBRATION	6
4	2. SAMPLE CALCULATION	6
4	3. MEASUREMENT UNCERTAINTY	7
5.	EQUIPMENT UNDER TEST	8
5	1. DESCRIPTION OF EUT	8
5	2. MAXIMUM OUTPUT POWER	8
5	3. DESCRIPTION OF AVAILABLE ANTENNAS	8
5	4. SOFTWARE AND FIRMWARE	8
5	5. WORST-CASE CONFIGURATION AND MODE	9
5	6. DESCRIPTION OF TEST SETUP	10
6.	TEST AND MEASUREMENT EQUIPMENT	13
7.	ANTENNA PORT TEST RESULTS	15
7	1. ON TIME AND DUTY CYCLE	
7		
	2. BASIC DATA RATE GFSK MODULATION	
	7.2.1. 20 dB AND 99% BANDWIDTH	17 17
	7.2.1. 20 dB AND 99% BANDWIDTH7.2.2. HOPPING FREQUENCY SEPARATION	17 17 24
	 7.2.1. 20 dB AND 99% BANDWIDTH 7.2.2. HOPPING FREQUENCY SEPARATION 7.2.3. NUMBER OF HOPPING CHANNELS 	17 17 24 26
	7.2.1. 20 dB AND 99% BANDWIDTH7.2.2. HOPPING FREQUENCY SEPARATION	17 17 24 26 31
	 7.2.1. 20 dB AND 99% BANDWIDTH	17 24 26 31 38 39
	 7.2.1. 20 dB AND 99% BANDWIDTH	17 24 26 31 38 39 40
7	 7.2.1. 20 dB AND 99% BANDWIDTH	17 17 24 26 31 38 39 40 49
7	 7.2.1. 20 dB AND 99% BANDWIDTH	17 24 26 31 38 39 40 49 49
7	 7.2.1. 20 dB AND 99% BANDWIDTH	17 24 26 31 38 39 40 49 49 49 56
7	 7.2.1. 20 dB AND 99% BANDWIDTH	17 24 26 31 38 39 40 49 49 56 63
	 7.2.1. 20 dB AND 99% BANDWIDTH. 7.2.2. HOPPING FREQUENCY SEPARATION	17 24 26 31 38 39 40 49 49 56 63 64 65
	 7.2.1. 20 dB AND 99% BANDWIDTH. 7.2.2. HOPPING FREQUENCY SEPARATION. 7.2.3. NUMBER OF HOPPING CHANNELS	17 24 26 31 38 39 40 49 49 56 63 65 65
	 7.2.1. 20 dB AND 99% BANDWIDTH	17 24 26 31 39 40 49 49 65 63 65 65 72
	 7.2.1. 20 dB AND 99% BANDWIDTH. 7.2.2. HOPPING FREQUENCY SEPARATION. 7.2.3. NUMBER OF HOPPING CHANNELS	17 24 26 31 39 40 49 49 63 63 63 65 65 72 74
	 7.2.1. 20 dB AND 99% BANDWIDTH	17 24 26 31 38 39 40 49 49 56 63 63 64 65 72 74 79 86
	 7.2.1. 20 dB AND 99% BANDWIDTH	17 24 26 31 38 39 40 49 49 65 65 65 65 72 74 79 86 87

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8.	RAD	DIATED	TEST R	ESULTS			 	97
8.	1.	LIMITS	AND PF	ROCEDURE			 	97
8.	2.			ABOVE 1 GHz				
	8.2.1	1. BA	SIC DAT	A RATE GFSK	MODULAT	TON	 	
	8.2.2			D DATA RATE 8				
8.	3.	WORS	T-CASE	18-26GHz			 	
8.	4.	WORS	T-CASE	BELOW 1 GHz.			 	113
9.	AC I	POWER			IISSIONS.		 	115
10.	SE	ETUP P	HOTOS				 	116

PASS

PASS

1. ATTESTATION OF TEST RESULTS

INDUSTRY CANADA RSS-247 Issue 1

INDUSTRY CANADA RSS-GEN Issue 4

COMPANY NAME:	Bose Corp. 100 The Mountain Rd. Framingham, Massachusetts, 01701, USA
EUT DESCRIPTION:	Wireless Headset
MODEL:	Al1
SERIAL NUMBER:	ID 2305610-EMC (Radiated sample); ID EB77B5 (Conducted sample)
DATE TESTED:	2016-02-22 to 2016-03-31, 2016-05-05, 2016-06-08
	APPLICABLE STANDARDS
STA	ANDARD TEST RESULTS
CFR 47 Pa	art 15 Subpart C 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

Page 5 of 124

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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 <u>http://www.nist.gov/nvlap/.</u>

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

Page 6 of 124

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 26 GHz	+/-	5.36
Temperature	+/-	0.07
Humidity	+/-	2.26
DC and low frequency voltages	+/-	1.27
Conducted Emissions (0.150-30MHz)	+/-	2.37

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

Page 7 of 124

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a Wireless Headset that contains a Bluetooth transceiver.

The radio module is manufactured by Cambridge Silicon Radio, CSR8670.

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	9.21	8.34
2402 - 2480	DQPSK	8.10	6.46
2402 - 2480	Enhanced 8PSK	8.30	6.76

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a meander printed etch antenna, with a maximum gain of +0.6 dBi.

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was version 0.2.0.84.

The test utility and driver software used during testing was Polycomm, ver. 0.1.5.0 and CSR BlueSuite ver 2.5.8

Page 8 of 124

5.5. WORST-CASE CONFIGURATION AND MODE

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

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

Page 9 of 124

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List							
Description Manufacturer Model Serial Number FCC ID							
Laptop PC (for	Lenovo	20BU-S04K00	PC-0A2UQS	N/A			
commissioning the EUT)	commissioning the EUT)						
AC Adapter (for laptop PC)							

I/O CABLES

	I/O Cable List							
Cable No	CablePort# of identicalConnectorCable TypeCableRemarksNoportsTypeLength (m)Image: Cable Cabl							
1	USB	1	Micro USB	Unshielded	0.33	For USB charging cable.		

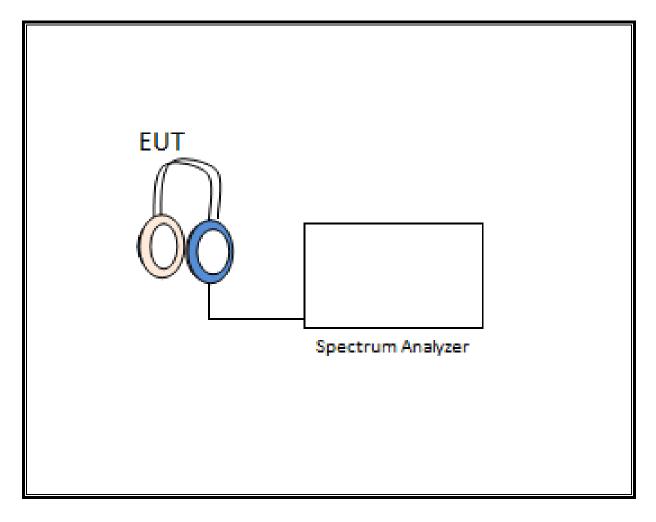
TEST SETUP

The EUT is set up as a stand-alone device during radiated-emissions testing. For convenience, the device is connected to a laptop PC via a USB cable to configure the device for test during antenna-port measurements. Test software exercised the radio portion of the device.

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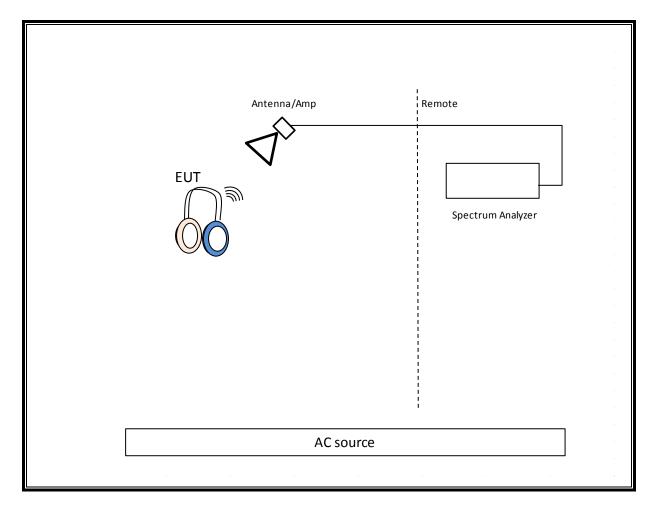
Page 10 of 124

SETUP DIAGRAM FOR CONDUCTED TESTS



Page 11 of 124

SETUP DIAGRAM FOR RADIATED TESTS



Page 12 of 124

6. TEST AND MEASUREMENT EQUIPMENT

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

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	2016-06-30
PWS004	Peak and Avg Power Sensor, 50MHz to 6GHz	Keysight Technologies	E9323A	2015-06-05	2016-06-30
PRE0128068	RF Power Meter	Anritsu	ML2495A	2015-12-16	2016-12-16
PRE0128067	Pulse Power Sensor, 300MHz to 40GHz	Anritsu	MA2411B	2015-12-16	2016-12-16
HI0079	Temp/Humid/Pressure Meter	Springfield	PreciseTemp	2015-07-01	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
	Conducted Room 2				
SA0020	Spectrum Analyzer	Agilent Technologies	E4446A	2015-02-26	2016-02-29
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

Test Equipment Used - Wireless Conducted Measurement Equipment

Note – All testing in Conducted Room 2 was performed prior to 2016-02-29.

Equip.					
ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
AT0073	Hybrid Broadband Antenna, 30-1000MHz	Sunol Sciences Corp.	JB3	2015-06-10	2016-06-30
AT0072	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz		3117	2015-02-17	2016-02-29
N-SAC02	Gain-loss string: 30- 1000MHz	Various	Various	2015-06-04	2016-06-30
N-SAC03	Gain-loss string: 1-18GHz	Various	Various	2015-09-29	2016-09-30
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

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

Note – All testing in this chamber was performed prior to 2016-02-29

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

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
AT0079	Active Loop Antenna	ETS-Lindgren	6502	2015-12-08	2016-12-31
AT0076	Horn Antenna, 18- 26.5GHz	ARA	MWH-1826/B	2015-08-27	2016-08-31
S-SAC01	Gain-loss string: 0.009- 30MHz	Various	Various	2015-10-07	2016-10-31
S-SAC04	Gain-loss string: 18- 40GHz	Various	Various	2016-02-29	2017-02-28
SA0018	Spectrum Analyzer	Agilent	N9030A	2015-11-07	2016-11-30
SA0025	Spectrum Analyzer	Agilent	N9030A	2016-03-17	2017-03-31
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
HI0050	Temp/Humid/Pressure Meter	Cole-Parmer	99760-00	2015-07-01	2016-07-31

7. ANTENNA PORT TEST RESULTS

7.1. **ON TIME AND DUTY CYCLE**

LIMITS

None; for reporting purposes only.

PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

ON TIME AND DUTY CYCLE RESULTS

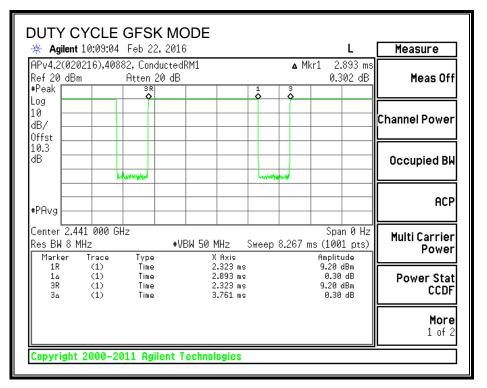
Mode	ON Time	Period	Duty Cycle	Duty	Duty Cycle	1/B
	В		x	Cycle	Correction Factor	Minimum VBW
	(msec)	(msec)	(linear)	(%)	(dB)	(kHz)
2.4 GHz band (Hopping	OFF)					
Bluetooth GFSK	2.893	3.761	0.769	76.92%	1.14	0.346
Bluetooth 8PSK	2.902	3.753	0.773	77.32%	1.12	0.345

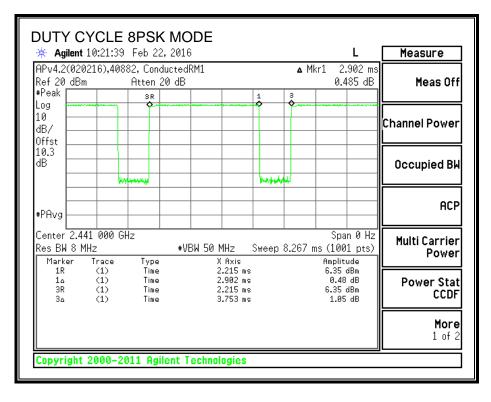
Page 15 of 124

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DUTY CYCLE PLOTS

HOPPING OFF





Page 16 of 124

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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 and 99% Occupied Bandwidth. The VBW is set to \geq RBW. The sweep time is coupled.

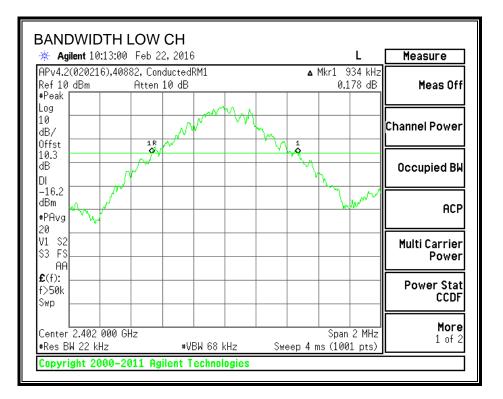
RESULTS

Channel	Frequency	20 dB Bandwidth	99% Bandwidth
	(MHz)	(kHz)	(kHz)
Low	2402	934	883.3763
Middle	2441	948	879.7397
High	2480	936	871.9877

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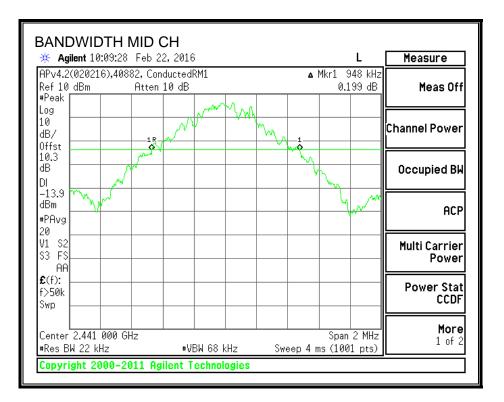
Page 17 of 124

20 dB BANDWIDTH



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Page 18 of 124

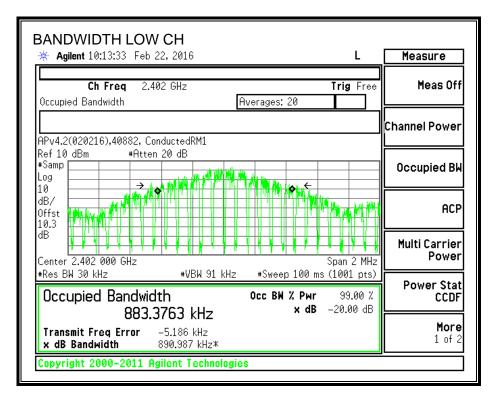


Page 19 of 124

🔆 Agilent 10:1	.7 : 06 Feb 22	2,2016				L	Measure
APv4.2(020216) Ref 10 dBm #Peak),40882, Cond Atten 1				Mkr1 93 0.02	36 kHz 25 dB	Meas Off
Log 10 dB/ Offst	1R 01	and the second s	MA ho	1			Channel Power
10.3 dB DI	N			12 m	h		Occupied BW
-15.6 dBm #PAvg 20						₽M	ACP
V1 S2 S3 FS AA							Multi Carrier Power
£(f): f>50k Swp							Power Stat CCDF
Center 2.480 0 #Res BW 22 kHz		#VBW 68	Hz Sw	/eep 4 m	Span 2 Is (1001		More 1 of 2

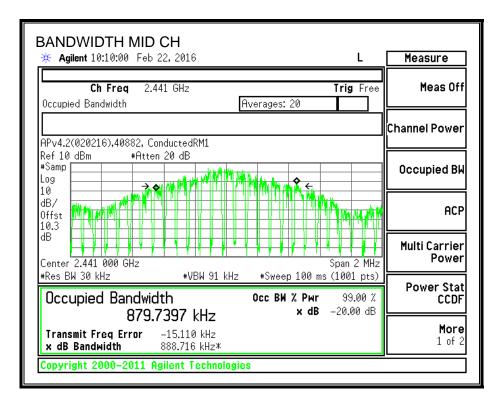
Page 20 of 124

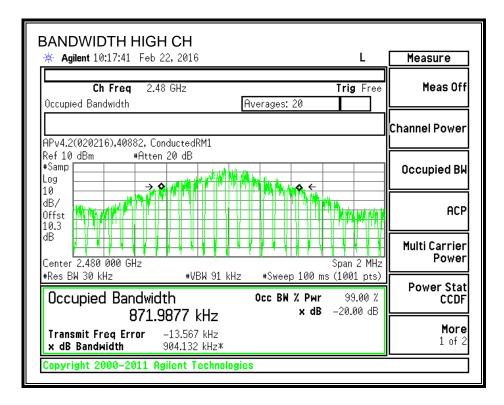
99% BANDWIDTH



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Page 21 of 124





Page 23 of 124

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.

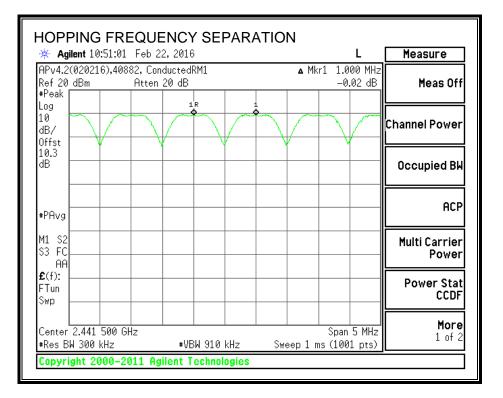
TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to 3x RBW. The sweep time is coupled.

RESULTS

Page 24 of 124

HOPPING FREQUENCY SEPARATION



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Page 25 of 124

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 nonoverlapping 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.

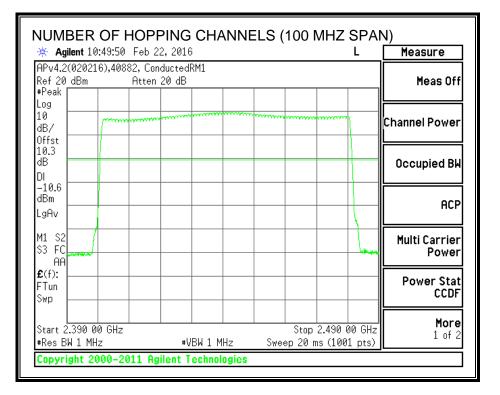
RESULTS

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

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Page 26 of 124

NUMBER OF HOPPING CHANNELS



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Page 27 of 124

			Feb 2							L	Measure
	(02021 dBm	.6),408	82, Cor Atten	iducted 20 dB	RM1	1		1			Meas Of
g) }/ fst		M		M	W	M	M	M	W	Ψ¥	Channel Powe
).3 }						• • •					Occupied B
4 3m 'Avg											AC
S2 S FC AA	/										Multi Carrie Powe
(f): Tun /p											Power Sta CCD
enter	2.415	00 GH	z						Span 3	0 MHz	Mor 1 of

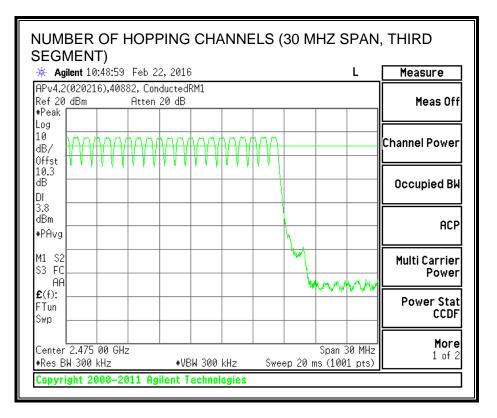
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Page 28 of 124

			Feb 2							L	Measure
Pv4.2 ≷ef20 Peak∣		16),408	82, Cor Atten	ducted 20 dB	RM1						Meas Off
.og .0 HB/)ffst	W	W		W	W	W	YYY	W	ŴŶ	Ŵ	Channel Power
.0.3 IB)											Occupied BW
i.3 ¦Bm ⊧PAvg											ACP
11 S2 3 FC AA											Multi Carrier Power
C(f): Tun Swp											Power Stat CCDF
	2.445 W 300	00 GH:	 z	#UF	 3W 300	 	Sula.	ep 20 m		30 MHz	More 1 of 2

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Page 29 of 124



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Page 30 of 124

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	Number of	Average Time	Limit	Margin							
	Width	Pulses in	of Occupancy									
	(msec)	3.16	(sec)	(sec)	(sec)							
		seconds										
GFSK Norma	al Mode											
DH1	0.385	33	0.127	0.4	-0.273							
DH3	1.64	16	0.262	0.4	-0.138							
DH5	2.892	11	0.318	0.4	-0.082							
DH Packet	Pulse	Number of	Average Time	Limit	Margin							
	Width	Pulses in	of Occupancy		Ē							
	(msec)	0.8	(sec)	(sec)	(sec)							
		seconds										
GFSK AFH N	GFSK AFH Mode											
DH1	0.385	8.25	0.032	0.4	-0.368							
DH3	1.64	4	0.066	0.4	-0.334							
DH5	2.892	2.75	0.080	0.4	-0.320							

RESULTS

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Page 31 of 124

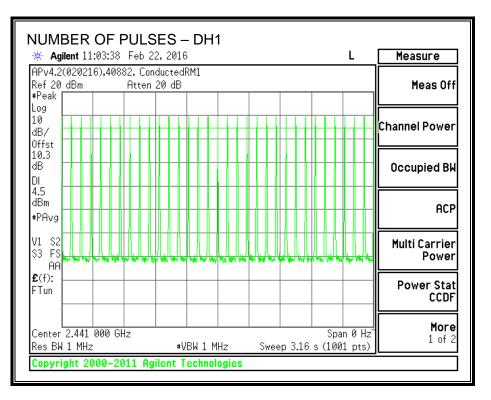
PULSE WIDTH - DH1

PULS	ΕW	IDTH	I – D	H1																						
🔆 🔆 Agilo	ent 10	:57:25	Feb 2	2,2016	i					L		Measure														
Ref 20 d #Peak	2(020216),40882, ConductedRM1 ▲ Mkr1 0 dBm Atten 20 dB · · ·																									Meas Off
Log 10 dB/ Offst	1R	TA WANT'N				TANK TITLE	MÛMÎN	aa aalafa a				Channel Power														
10.3 dB		Alhadda fa	NV PP UL	<u></u>	איין יע	ALAALA Alaa	MALIN N	N. ANAT	ali della	Muli	NIX	Occupied BW														
#PAvg										_	_	ACP														
W1 S2 S3 VC AA												Multi Carrier Power														
£ (f): - FTun -												Power Stat CCDF														
Center 2 Res BW Copyrig	1 MHz						Sweer	о 410 н		oan 0 001 p		More 1 of 2														
copyrig	jnt 20	100-20	JII Hg	nent I	echnol	ugies																				

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Page 32 of 124

NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH1



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Page 33 of 124

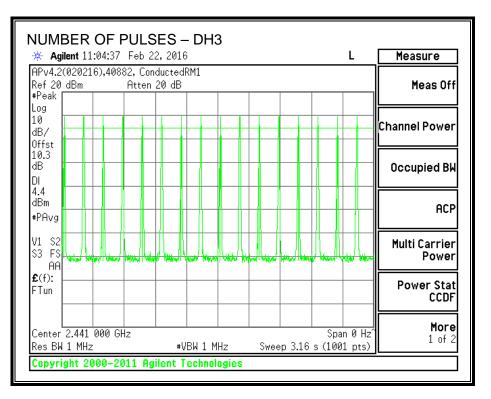
PULSE WIDTH – DH3

🔆 Agi	ilent 11	:00:30	Feb 2	2,2016	ì					L	Measure
Ref 20 #Peak		6),4088	32, Con Atten	ducted 20 dB	RM1			▲ MI	kr1	1.64 ms 1.99 dB	Meas Off
Log 10 dB/ Offst	1.B.									1	Channel Power
dB	7111	111, 4 41		1171°N	(14 T M)	1 4 . M		Y I PPY T	¶"¶		Occupied BW
#PAvg											ACP
W1 S2 S3 VC AA											Multi Carrier Power
£ (f): FTun											Power Stat CCDF
 Center Res BW		000 GH	łz	 #V	 BW 1 M	Hz	 Sweep	1.733 m		pan 0 Hz 001 pts)	More 1 of 2

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Page 34 of 124

NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH3



 Page 35 of 124

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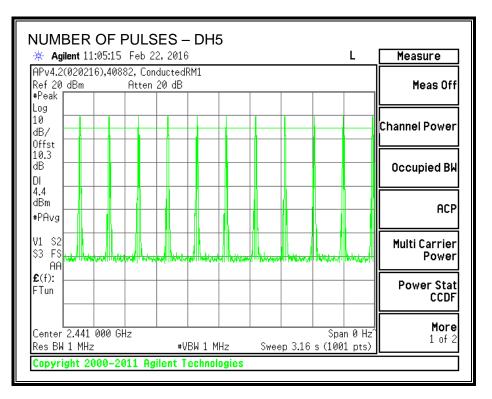
PULSE WIDTH - DH5

PULSE WIDTH – D	-		L	Measure
APv4.2(020216),40882, Con		▲ Mkr1	2.892 ms 0.81 dB	Meas Off
Log 1R 10 dB/ 0ffst				Channel Power
dB				Occupied BW
#PAvg				ACP
W1 S2 S3 VC AAU				Multi Carrier Power
£(f): ⁴⁴ FTun				Power Stat CCDF
Center 2.441 000 GHz Res BW 1 MHz	+VBW 1 MHz	Sweep 3.133 ms (Span 0 Hz 1001 pts)	More 1 of 2
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Page 36 of 124

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Page 37 of 124

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 5.1 (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 10.294 dB (including 10 dB pad and 0.294 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	6.62	0.60	30	-23.38
Middle	2441	9.21	0.60	30	-20.79
High	2480	7.70	0.60	30	-22.30

7.2.6. AVERAGE POWER

<u>LIMIT</u>

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter and a gated average power measurement was performed. The cable assembly insertion loss of 10.294 dB (including 10 dB pad and 0.294 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

RESULTS

Channel	Frequency	Average Power
	(MHz)	(dBm)
Low	2402	6.33
Middle	2441	9.02
High	2480	7.47

Page 39 of 124

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 A8.4 (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.

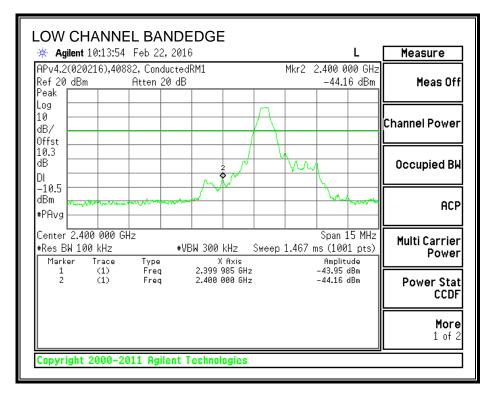
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

RESULTS

UL LLC

SPURIOUS EMISSIONS, LOW CHANNEL

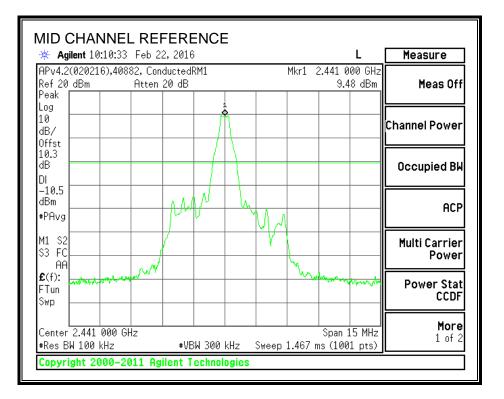


Page 41 of 124 FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 This report shall not be reproduced except in full, without the written approval of UL LLC.

LOW CHANNEL S		_	
🔆 🔆 Agilent 10:16:08 Feb	22,2016	L	Measure
#Peak 9	onductedRM1 m 20 dB	Mkr4 24.976 GHz -50.954 dBm	Meas Off
Log 10 dB/ Offst			Channel Power
10.3 dB DI -10.5	3 3	4	Occupied BW
dBm #PAvg			ACP
Start 30 MHz #Res BW 100 kHz Marker Trace Tyj	pe X Axis	Stop 26.000 GHz ep 2.482 s (8192 pts) Amplitude	Multi Carrier Power
2 (1) Fr 3 (1) Fr	req 2.402 GHz req 4.804 GHz req 7.206 GHz req 24.976 GHz	5.73 dBm -60.93 dBm -59.49 dBm -50.95 dBm	Power Stat CCDF
			More 1 of 2
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SPURIOUS EMISSIONS, MID CHANNEL



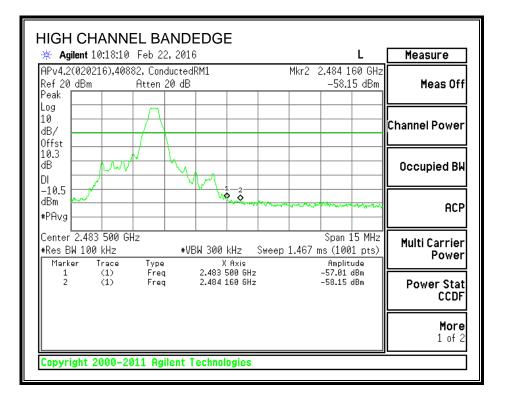
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Page 43 of 124

Measure	L			HANNE ent 10:11:52	-
Meas Off	Mkr4 25.027 GHz -50.162 dBm		882, Cond #Atten 2	020216),40 dBm <u>o</u> f	Ref 10 #Peak
Channel Power					Log 10 dB/ Offst
Occupied BW			2 3		10.3 dB DI -10.5
ACP					dBm #PAvg
Multi Carrier Power	Stop 26.000 GHz Sweep 2.482 s (8192 pts) Amplitude	#VBW 300 kHz X Axis	Туре	l 100 kHz r Trace	Marke
Power Stat CCDF	8.83 dBm -61.90 dBm -59.23 dBm -50.16 dBm	2.441 GHz 4.882 GHz 7.323 GHz 25.027 GHz	Freq Freq Freq Freq	(1) (1) (1) (1)	1 2 3 4
More 1 of 2					
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Page 44 of 124

SPURIOUS EMISSIONS, HIGH CHANNEL

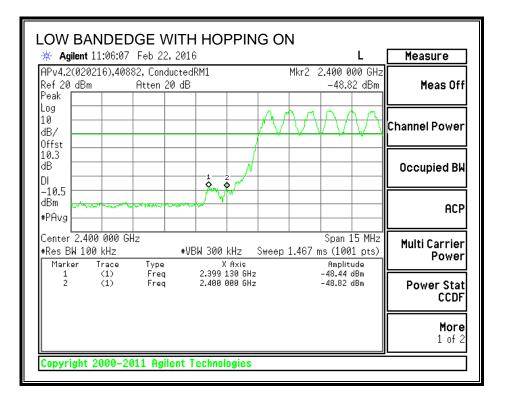


Page 45 of 124

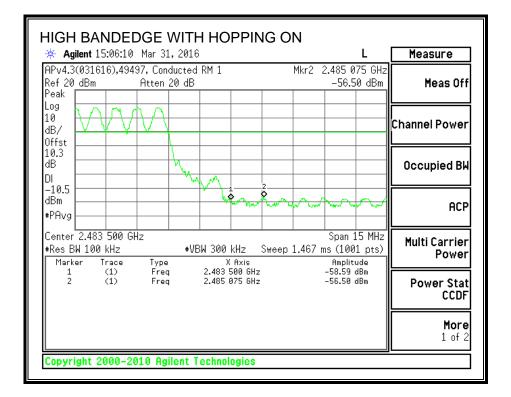
HIGH CHANNEL SPURIOU	S		
🔆 Agilent 10:19:09 Feb 22, 2016		L	Measure
APv4.2(020216),40882, ConductedRM1 Ref 10 dBm #Atten 20 dB #Peak 4	Mkr4 25 	.042 GHz 366 dBm	Meas Off
Log 10 dB/ Offst			Channel Power
10.3 dB DI -10.5		4	Occupied BW
dBm #PAvg			ACP
Start 30 MHz #Res BW 100 kHz #VBW 30 Marker Trace Type	X Axis Ampl	.92 pts) itude	Multi Carrier Power
2 (1) Freq 3 (1) Freq	2.480 GHz 7.01 4.960 GHz -62.5 7.440 GHz -60.21 5.042 GHz -50.31	5 dBm	Power Stat CCDF
			More 1 of 2
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Page 46 of 124

SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



Page 47 of 124



Page 48 of 124

7.3. ENHANCED DATA RATE QPSK MODULATION

7.3.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

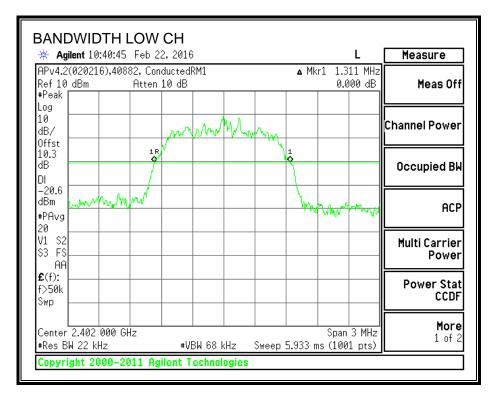
The transmitter output is connected to a spectrum analyzer. The RBW is set to 1-5% of the 20 dB bandwidth and 99% Occupied Bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

RESULTS

Channel	Frequency	20 dB Bandwidth	99% Bandwidth
	(MHz)	(kHz)	(kHz)
Low	2402	1311	1199.9
Middle	2441	1233	1213.1
High	2480	1353	1212.7

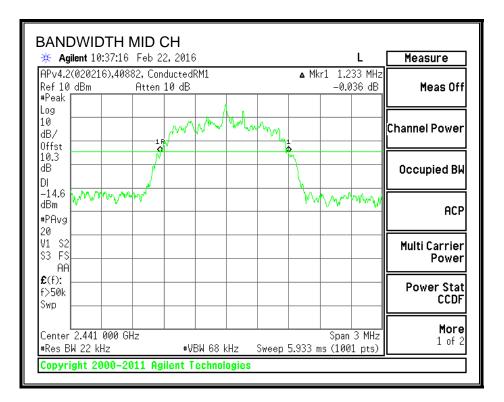
Page 49 of 124

20 dB BANDWIDTH



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Page 50 of 124



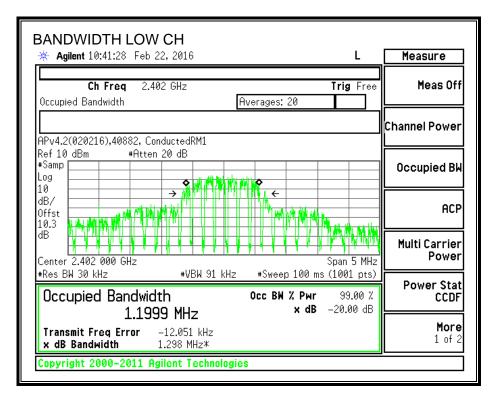
Page 51 of 124

🔆 Agilent 10:43	3:53 Feb 22, 2010)		L	Measure
Ref 10 dBm #Peak	40882, Conducted, Atten 10 dB	RM1	▲ Mk	r1 1.353 MHz 0.601 dB	Meas Off
Log 10 dB/ 0ffst	m	Man	mm		Channel Power
10.3 dB					Occupied BW
-21.2 dBm #PAvg	www		h,	mon	ACP
20 V1 S2 S3 FS					Multi Carrier Power
£(f): f>50k Swp					Power Stat CCDF
Center 2.480 00 #Res BW 22 kHz		 BW 68 kHz	Sweep 5.933 n	Span 3 MHz ns (1001 pts)	More 1 of 2

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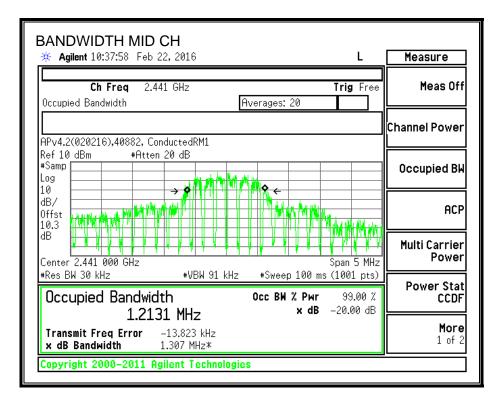
Page 52 of 124

99% BANDWIDTH

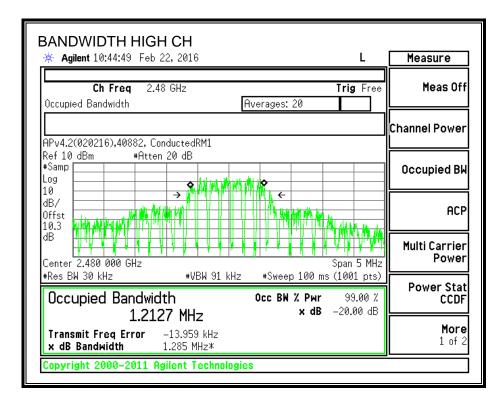


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Page 53 of 124



Page 54 of 124



Page 55 of 124

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.

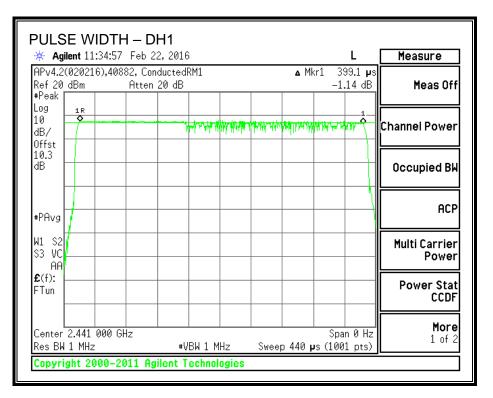
<u>RESULTS</u>

DQPSK Mode

DH Packet	Pulse	Number of	Average	Limit	Margin
	Width (msec)	Pulses in 3.16	Time of (sec)	(sec)	(sec)
		seconds			
DH1	0.399	32	0.128	0.4	-0.272
DH3	1.651	16	0.264	0.4	-0.136
DH5	2.886	11	0.317	0.4	-0.083

<u>Note:</u> 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 31 demonstrates compliance with channel occupancy when AFH is employed.

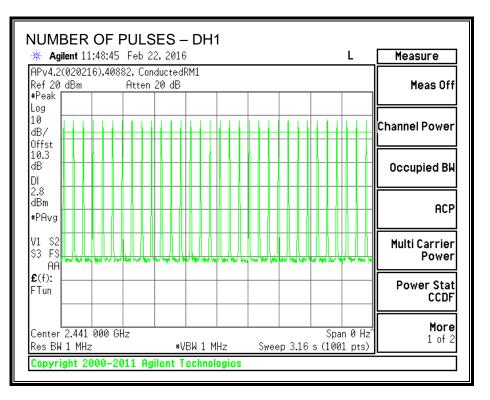
PULSE WIDTH - DH1



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Page 57 of 124

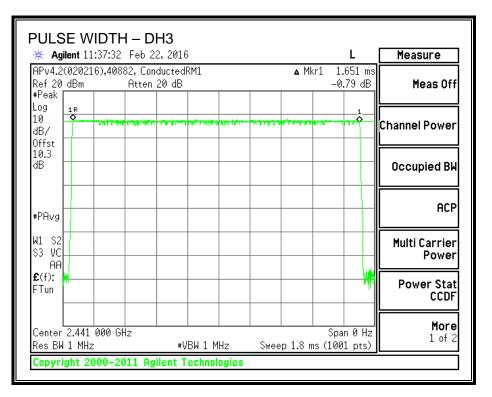
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH1



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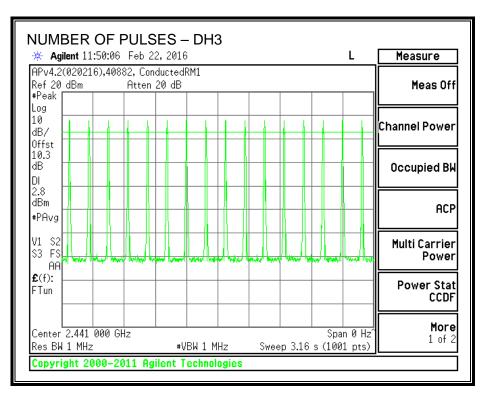
Page 58 of 124

PULSE WIDTH - DH3



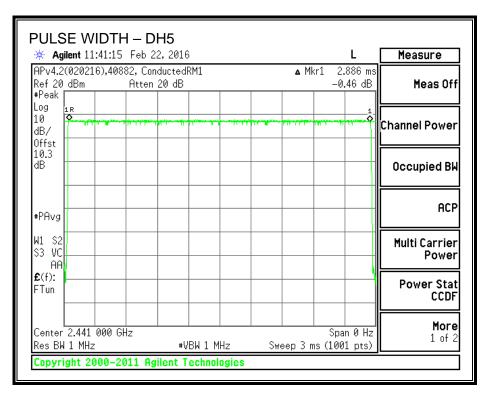
Page 59 of 124 UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 This report shall not be reproduced except in full, without the written approval of UL LLC.

NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH3



Page 60 of 124 UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 This report shall not be reproduced except in full, without the written approval of UL LLC.

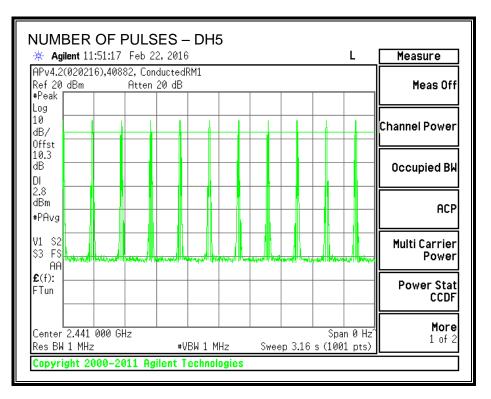
PULSE WIDTH - DH5



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Page 61 of 124

NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH5



 Page 62 of 124

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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 5.1 (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 10.294 dB (including 10 dB pad and 0.294 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 (MHz)	Output Power (dBm)	Directional Gain	Limit (dBm)	Margin (dB)
Low	2402	4.92	(dBi) 0.60	21	-16.08
Middle	2441	8.10	0.60	21	-12.90
High	2480	6.22	0.60	21	-14.78

7.3.4. AVERAGE POWER

<u>LIMIT</u>

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter and a gated average power measurement was performed. The cable assembly insertion loss of 10.294 dB (including 10 dB pad and 0.294 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

RESULTS

Channel	Frequency	Average Power
	(MHz)	(dBm)
Low	2402	2.56
Middle	2441	5.92
High	2480	4.10

Page 64 of 124

7.4. **ENHANCED DATA RATE 8PSK MODULATION**

7.4.1. 20 dB AND 99% BANDWIDTH

LIMIT

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 and 99% Occupied Bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

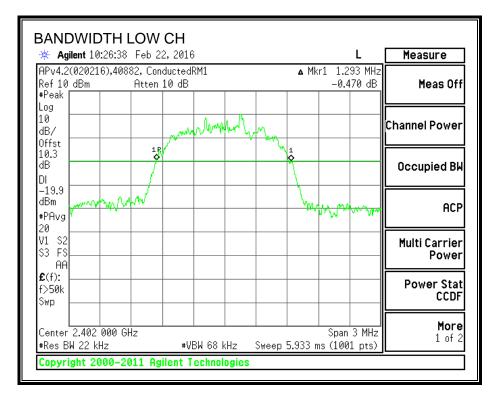
RESULTS

Channel	Frequency	20 dB Bandwidth	99% Bandwidth
	(MHz)	(kHz)	(kHz)
Low	2402	1293	1211.1
Middle	2441	1266	1214.5
High	2480	1311	1216

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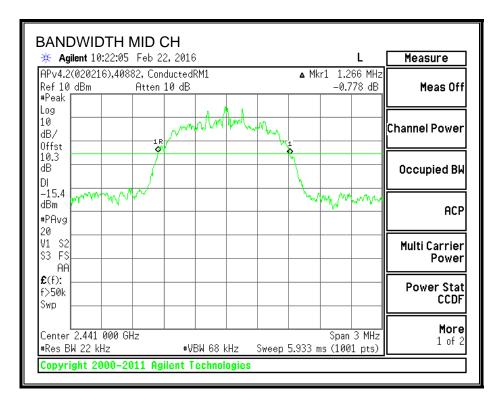
Page 65 of 124

20 dB BANDWIDTH



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Page 66 of 124

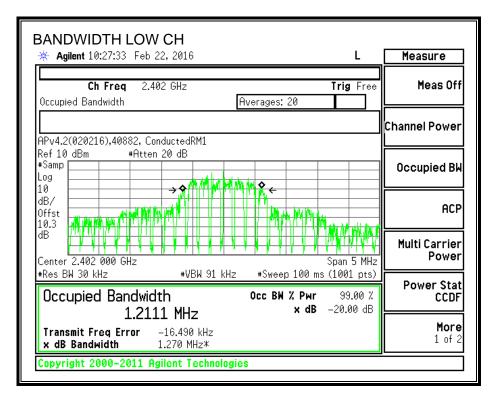


Page 67 of 124

-	0:14 Feb 22,20			L	Measure
Ref 10 dBm #Peak	40882, Conduct Atten 10 d		▲ MI	kr1 1.311 MHz -0.299 dB	Meas Off
Log 10 dB/ Offst		mhim	mm		Channel Power
dB					Occupied BW
-19.4 dBm #PAvg	mm		h	Man	ACP
20 V1 S2 S3 FS AA					Multi Carrier Power
£(f): f>50k Swp					Power Stat CCDF
Center 2.480 00 #Res BW 22 kHz		 ≢VBW 68 kHz	Sweep 5.933	Span 3 MHz ms (1001 nts)	More 1 of 2

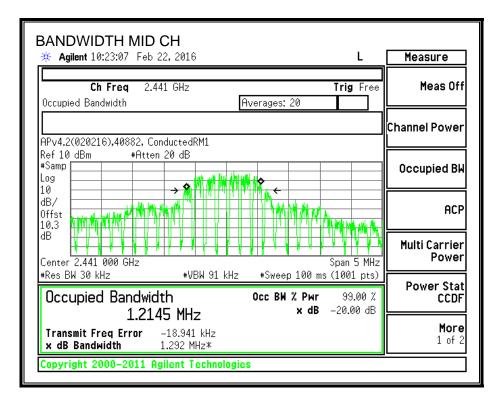
Page 68 of 124 UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 This report shall not be reproduced except in full, without the written approval of UL LLC.

99% BANDWIDTH



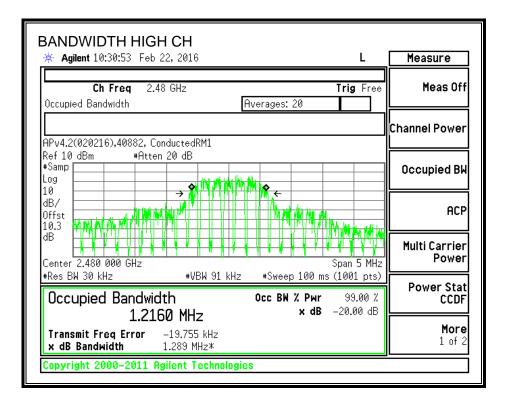
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Page 69 of 124



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Page 70 of 124



Page 71 of 124

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.

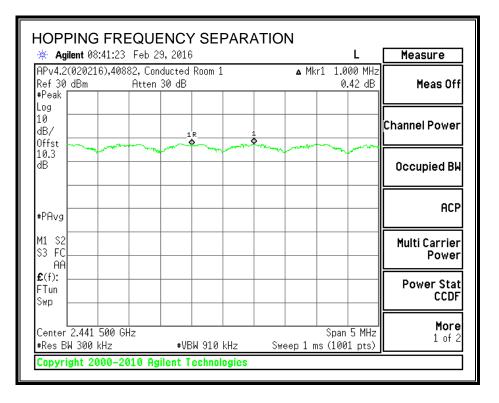
TEST PROCEDURE

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.

Page 72 of 124

RESULTS

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. 875 kHz).

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Page 73 of 124

7.4.3. 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 nonoverlapping 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

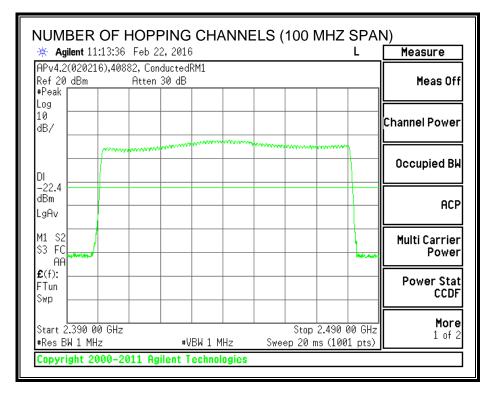
Normal Mode: 79 Channels observed. AFH Mode: min of 20 Channels declared.

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Page 74 of 124

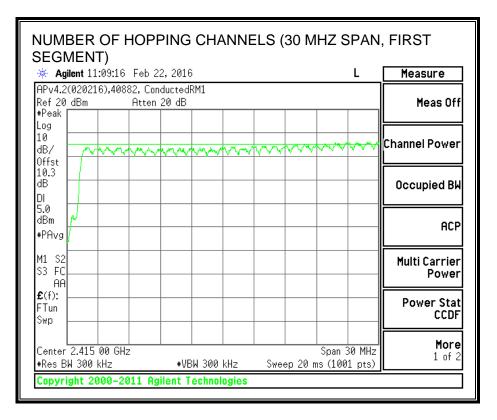
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NUMBER OF HOPPING CHANNELS



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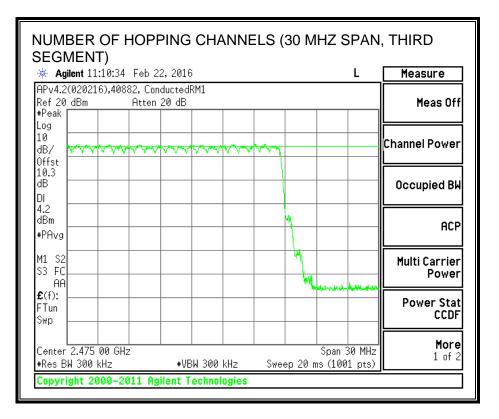
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Page 76 of 124

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NUMI SEGN			HOPF	PING	CHA	NNE	ELS (30 M	HZ S	PAN	, SECOND
		'	Feb 2	2,2016	i					L	Measure
APv4.2 Ref 20 #Peak			82, Con Atten		RM1						Meas Off
Log 10 dB/ Offst	V ~V	~~~	᠂ᠬ	৵৵৵	ᠬᢦᡃᢆᡟᡟ᠊ᢦ	M M	rw vrv	VwV	and and a start of the	vvv	Channel Power
10.3 dB DI											Occupied BW
6.2 dBm #PAvg											ACP
M1 S2 S3 FC AA											Multi Carrier Power
£ (f): FTun Swp											Power Stat CCDF
Center #Res B		00 GHz kHz	2	#VB	W 300	kHz	Swe	ep 20 m	Span 3 1s (1001		More 1 of 2
Copyri	ight 20	000-20)11 Ag	ilent T	echnol	ogies					

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Page 78 of 124

7.4.4. 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.

<u>RESULTS</u>

8PSK (EDR) Mode

DH Packet	OH Packet Pulse		Average	Limit	Margin	
	Width (msec)	Pulses in 3.16	Time of (sec)	(sec)	(sec)	
		seconds				
DH1	0.399	32	0.128	0.4	-0.272	
DH3	1.641	16	0.263	0.4	-0.137	
DH5	2.898	11	0.319	0.4	-0.081	

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 31 demonstrates compliance with channel occupancy when AFH is employed.

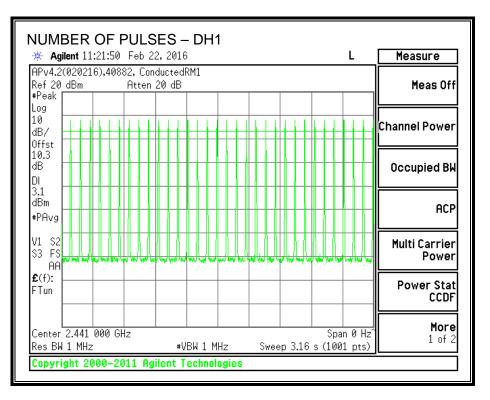
PULSE WIDTH - DH1

PULSE WIDTH -	– DH1		
🔆 🔆 Agilent 11:17:08 F	eb 22, 2016	L	Measure
APv4.2(020216),40882, Ref 20 dBm A #Peak	, ConductedRM1 Itten 20 dB	▲ Mkr1 399 -0.69 d	
Log <u>1R</u> 10 9 dB/ Offst			Channel Power
10.3 dB			Occupied BW
#PAvg			- ACP
W1 S2 S3 VC AA			Multi Carrier Power
£(f): FTun			Power Stat CCDF
Center 2.441 000 GHz Res BW 1 MHz Copyright 2000-201	#VBW 1 MHz 1 Agilent Technologies	Span 0 H Sweep 420 µs (1001 pt;	Hz 1 of 2

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Page 80 of 124

NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH1



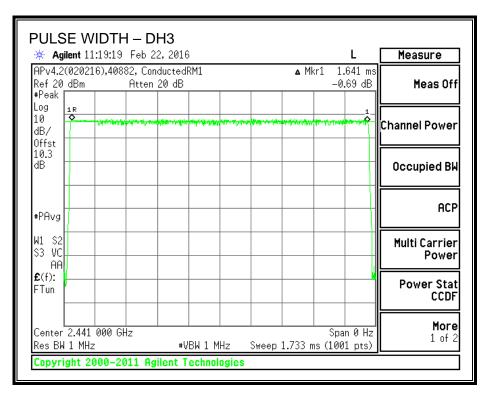
 Page 81 of 124

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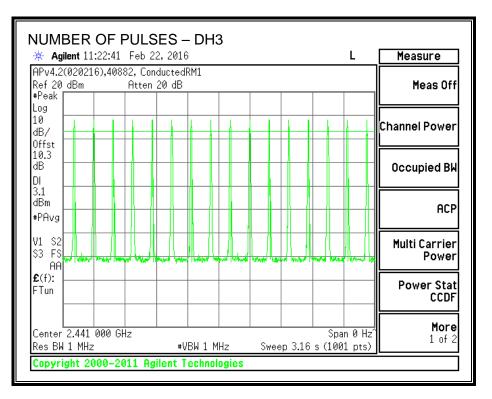
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PULSE WIDTH - DH3



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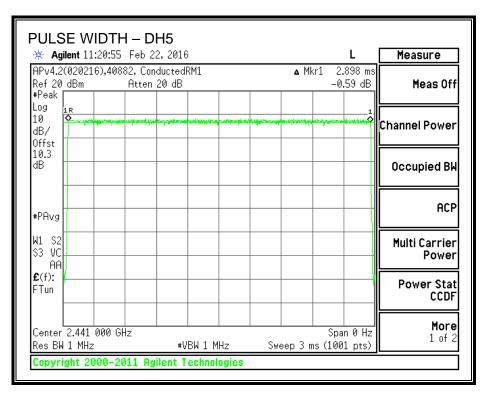
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH3



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Page 83 of 124

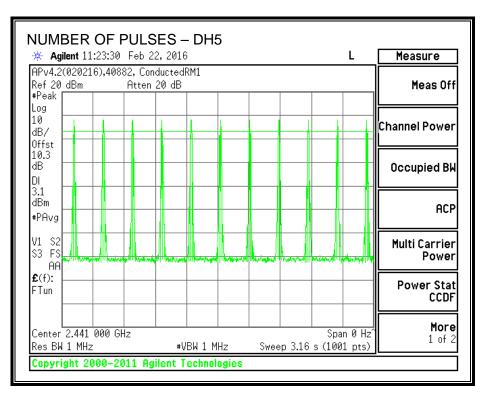
PULSE WIDTH - DH5



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Page 84 of 124

NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH5



 Page 85 of 124

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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 5.1 (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 10.294 dB (including 10 dB pad and 0.294 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	5.20	0.60	21	-15.80	
Middle	2441	8.30	0.60	21	-12.70	
High	2480	6.56	0.60	21	-14.44	

7.4.6. AVERAGE POWER

<u>LIMIT</u>

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter and a gated average power measurement was performed. The cable assembly insertion loss of 10.294 dB (including 10 dB pad and 0.294 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

RESULTS

Channel	Frequency	Average Power
	(MHz)	(dBm)
Low	2402	2.46
Middle	2441	5.86
High	2480	4.06

Page 87 of 124

7.4.7. 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 A8.4 (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

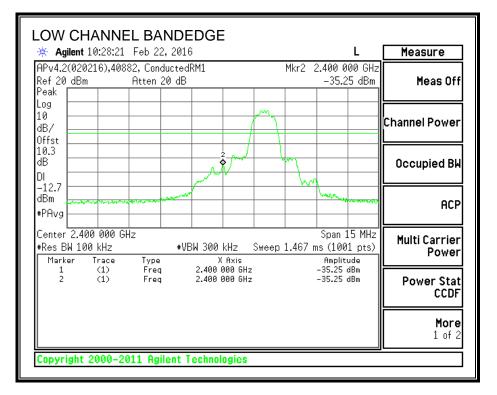
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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.

RESULTS

SPURIOUS EMISSIONS, LOW CHANNEL

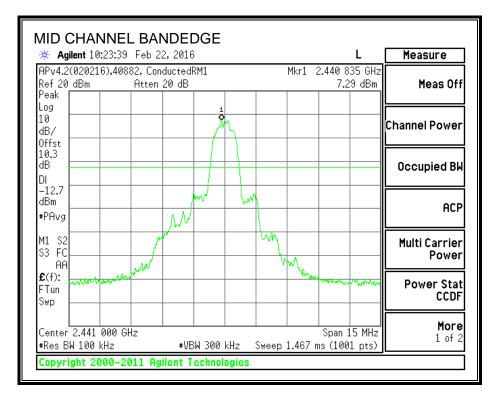


Page 89 of 124

LOW CHANNEL			
🔆 🔆 Agilent 10:29:26 🛛	Feb 22, 2016	L	Measure
#Peak	2, ConductedRM1 Atten 20 dB	Mkr4 25.052 GHz -50.976 dBm	Meas Off
Log 10 dB/ Offst			Channel Power
10.3 dB DI -12.7	3 3	4	Occupied BW
dBm #PAvg			ACP
Start 30 MHz #Res BW 100 kHz Marker Trace	#VBW 300 kHz Type X Axis	Stop 26.000 GHz Sweep 2.482 s (8192 pts) Amplitude	Multi Carrier Power
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	Freq 2.402 GHz Freq 4.804 GHz Freq 7.206 GHz Freq 25.052 GHz	0.02 dBm -61.83 dBm -58.23 dBm -50.98 dBm	Power Stat CCDF
			More 1 of 2
Copyright 2000-201	1 Agilent Technologies		

Page 90 of 124

SPURIOUS EMISSIONS, MID CHANNEL



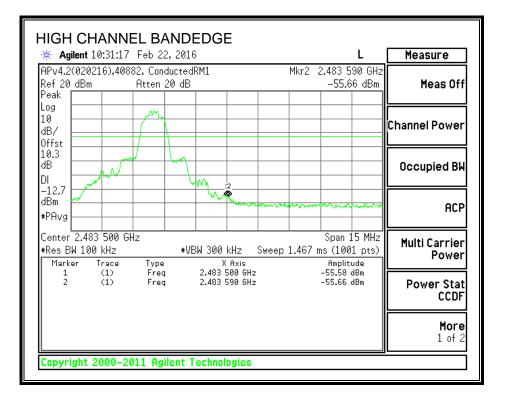
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Page 91 of 124

🔆 Agilent	10:24:32	Feb 22, 201	16		L	Measure
Ref 10 dBr #Peak		82, Conducte #Atten 20 dE			25.008 GHz 0.649 dBm	Meas Off
Log 10 dB/ Offst						Channel Power
10.3 dB DI -12.7	2	3				Occupied BW
dBm						ACP
Start 30 M #Res BW 10 Marker	00 kHz Trace	Туре	X Axis	weep 2.482 s (Am	plitude	Multi Carrier Power
1 2 3 4	(1) (1) (1) (1)	Freq Freq Freq Freq	2.441 GHz 4.882 GHz 7.323 GHz 25.008 GHz	-62. -59.	31 dBm 37 dBm 78 dBm 65 dBm	Power Stat CCDF
						More 1 of 2

Page 92 of 124 UL LLC FORM NO: 03-EM-F00858 12 Laboratory Dr., RTP, NC 27709 TEL: (919) 549-1400 This report shall not be reproduced except in full, without the written approval of UL LLC.

SPURIOUS EMISSIONS, HIGH CHANNEL



 Page 93 of 124

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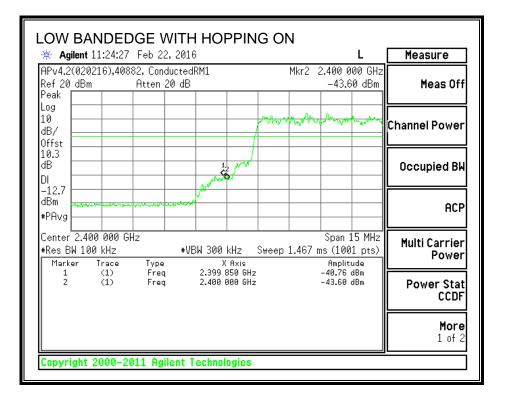
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HIGH CHANN		US							
🔆 🔆 Agilent 10:32:10	Feb 22, 2016			L		Measure			
Ref 10 dBm #Peak 💊									
Log 2 10 dB/ Offst					Cha	nnel Power			
10.3 dB DI -12.7			منوريان المرازيان			ccupied BW			
dBm #PAvg						ACP			
Start 30 MHz #Res BW 100 kHz Marker Trace	Туре	X Axis	Sto Sweep 2.482	Amplitude		lulti Carrier Power			
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	Freq Freq Freq Freq	2.480 GHz 4.960 GHz 7.440 GHz 24.827 GHz		2.23 dBm -63.39 dBm -60.30 dBm -49.92 dBm		Power Stat CCDF			
						More 1 of 2			
Copyright 2000-20	011 Agilent Tech	nologies							

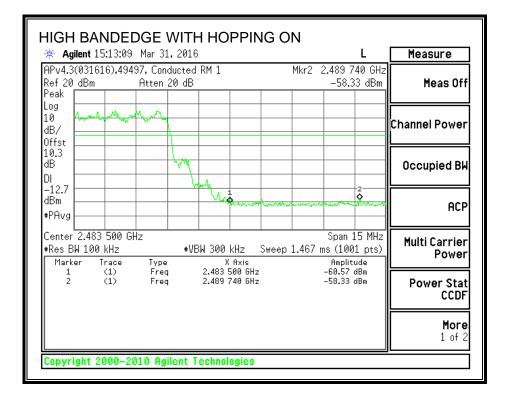
Page 94 of 124

SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



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Page 95 of 124



Page 96 of 124

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 peak measurements above 1 GHz, the resolution bandwidth is set to 1 MHz and the video bandwidth is set to 3 MHz. For average measurements above 1GHz, the resolution bandwidth and video bandwidth are set as described in ANSI C63.10:2013 for the applicable measurement. The particular averaging method used for this test program was by measuring 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.

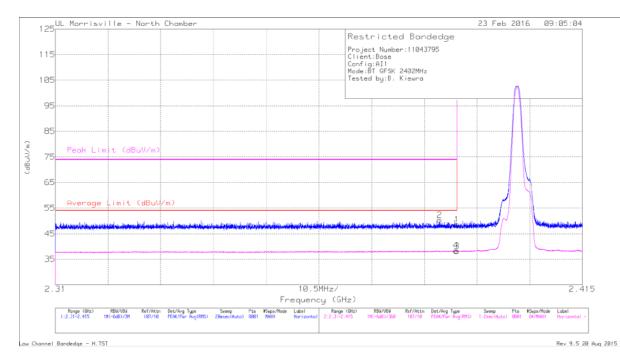
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

Page 97 of 124

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8.2. TRANSMITTER ABOVE 1 GHz

8.2.1. BASIC DATA RATE GFSK MODULATION



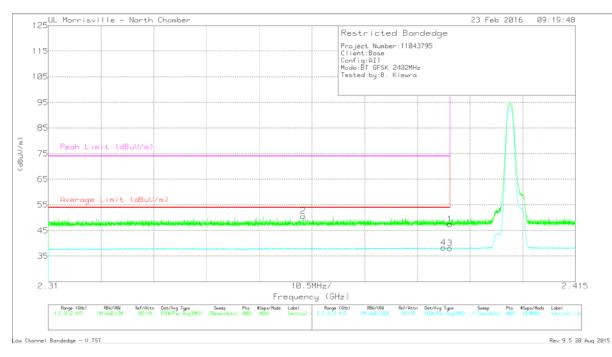
RESTRICTED BANDEDGE (LOW CHANNEL)

Marker	Frequency	Meter	Det	AF	Amp/Cbl	Corrected	Average	Margin	Peak Limit	РК	Azimuth	Height	Polarity
	(GHz)	Reading		AT0072	/Fltr/Pad	Reading	Limit	(dB)	(dBuV/m)	Margin	(Degs)	(cm)	
		(dBuV)		(dB/m)	(dB)	(dBuV/m)	(dBuV/m)			(dB)			
1	* 2.39	41.78	Pk	31.9	-25.1	48.58	-	-	74	-25.42	334	215	Н
2	* 2.387	43.51	Pk	31.9	-25.1	50.31	-	-	74	-23.69	334	215	Н
3	* 2.39	31.4	V1TR	31.9	-25.1	38.2	54	-15.8	-	-	334	215	Н
4	* 2.39	31.65	V1TR	31.9	-25.1	38.45	54	-15.55	-	-	334	215	Н

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

Pk - Peak detector

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



Marker	Frequency	Meter	Det	AF	Amp/Cbl/	Corrected	Average	Margin	Peak	РК	Azimuth	Height	Polarity
	(GHz)	Reading		AT0072	Fltr/Pad	Reading	Limit	(dB)	Limit	Margin	(Degs)	(cm)	
		(dBuV)		(dB/m)	(dB)	(dBuV/m)	(dBuV/m)		(dBuV/m)	(dB)			
1	* 2.39	40.6	Pk	31.9	-25.1	47.4	-	-	74	-26.6	354	353	V
2	* 2.361	43.98	Pk	31.8	-25.1	50.68	-	-	74	-23.32	354	353	V
3	* 2.39	31.32	V1TR	31.9	-25.1	38.12	54	-15.88	-	-	354	353	V
4	* 2.389	31.51	V1TR	31.9	-25.1	38.31	54	-15.69	-	-	354	353	V

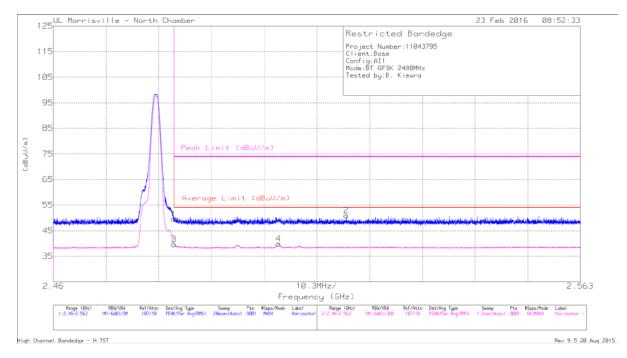
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

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

Page 99 of 124

RESTRICTED BANDEDGE (HIGH CHANNEL)



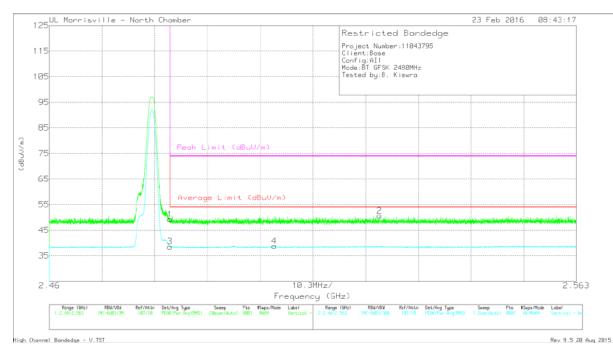
Marker	Frequency	Meter	Det	AF	Amp/Cbl	Corrected	Average	Margin	Peak	РК	Azimuth	Height	Polarity
	(GHz)	Reading		AT0072	/Fltr/Pad	Reading	Limit	(dB)	Limit	Margin	(Degs)	(cm)	
		(dBuV)		(dB/m)	(dB)	(dBuV/m)	(dBuV/m)		(dBuV/m)	(dB)			
1	* 2.484	42.26	Pk	32.1	-24.9	49.46	-	-	74	-24.54	78	194	Н
2	2.517	43.65	Pk	32.1	-24.8	50.95	-	-	74	-23.05	78	194	Н
3	* 2.484	32.44	V1TR	32.1	-24.9	39.64	54	-14.36	-	-	78	194	Н
4	2.504	32.65	V1TR	32.1	-24.9	39.85	54	-14.15	-	-	78	194	Н

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

Pk - Peak detector

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

Page 100 of 124



Marker	Frequency	Meter	Det	AF	Amp/Cbl	Corrected	Average	Margin	Peak Limit	РК	Azimuth	Height	Polarity
	(GHz)	Reading		AT0072	/Fltr/Pad	Reading	Limit	(dB)	(dBuV/m)	Margin	(Degs)	(cm)	
		(dBuV)		(dB/m)	(dB)	(dBuV/m)	(dBuV/m)			(dB)			
1	* 2.484	42.07	Pk	32.1	-24.9	49.27	-	-	74	-24.73	61	244	V
2	2.525	43.42	Pk	32.1	-24.9	50.62	-	-	74	-23.38	61	244	V
3	* 2.484	31.41	V1TR	32.1	-24.9	38.61	54	-15.39	-	-	61	244	V
4	2.504	31.62	V1TR	32.1	-24.9	38.82	54	-15.18	-	-	61	244	V

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

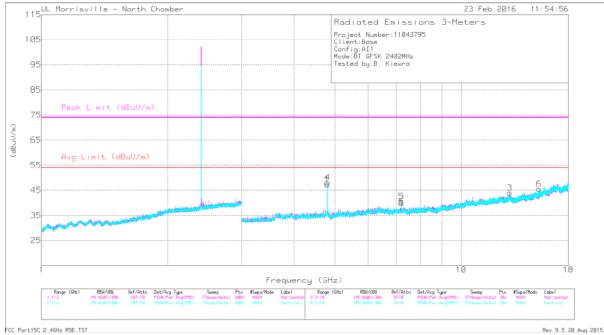
Pk - Peak detector

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

Page 101 of 124

HARMONICS AND SPURIOUS EMISSIONS

1-18 GHz Low Channel



Marker	Frequency	Meter	Det	AF AT0072	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)			
1	* 4.804	48.13	PK-U	34.1	-32.3	49.93	-	-	74	-24.07	245	106	Н
	* 4.804	43.56	V1TR	34.1	-32.3	45.36	54	-8.64	-	-	245	106	Н
4	* 4.804	48.88	PK-U	34.1	-32.3	50.68	-	-	74	-23.32	345	101	V
	* 4.804	44.27	V1TR	34.1	-32.3	46.07	54	-7.93	-	-	345	101	V
2	7.206	35.01	Pk	35.7	-30.9	39.81	-	-	74	-34.19	0-360	101	Н
3	13.058	30.95	Pk	39.3	-26.3	43.95	-	-	74	-30.05	0-360	101	Н
5	7.206	35.71	Pk	35.7	-30.9	40.51	-	-	74	-33.49	0-360	101	V
6	15.327	33.04	Pk	40.2	-27.7	45.54	-	-	74	-28.46	0-360	101	V

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

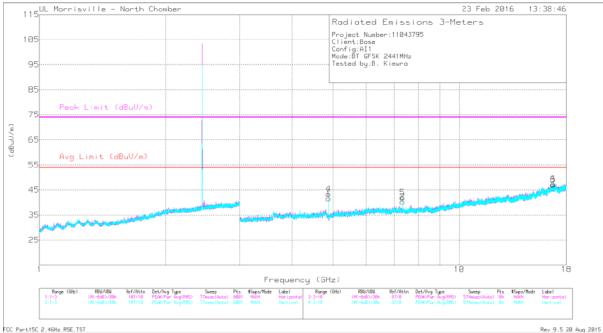
Pk - Peak detector

PK-U: Maximum Peak

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

Page 102 of 124

1-18 GHz Mid Channel



Marker	Frequency	Meter	Det	AF AT0072	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)			
1	* 4.88	36.46	PK-U	34.1	-32.4	38.16	-	-	74	-35.84	339	118	Н
	* 4.881	25.37	V1TR	34.1	-32.4	27.07	54	-26.93	-	-	339	118	Н
2	* 7.323	40.73	PK-U	35.7	-30	46.43	-	-	74	-27.57	220	109	Н
	* 7.323	31.66	V1TR	35.7	-30	37.36	54	-16.64	-	-	220	109	Н
4	* 4.882	45.04	PK-U	34.1	-32.4	46.74	-	-	74	-27.26	349	133	V
	* 4.882	39.12	V1TR	34.1	-32.3	40.92	54	-13.08	-	-	349	133	V
5	* 7.322	40.66	PK-U	35.7	-30	46.36	-	-	74	-27.64	349	102	V
	* 7.323	31.64	V1TR	35.7	-30	37.34	54	-16.66	-	-	349	102	V
3	16.705	29.13	Pk	42.2	-24.3	47.03	-	-	74	-26.97	0-360	200	Н
6	16.748	30.88	Pk	42.3	-25.8	47.38	-	-	74	-26.62	0-360	200	V

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

Pk - Peak detector

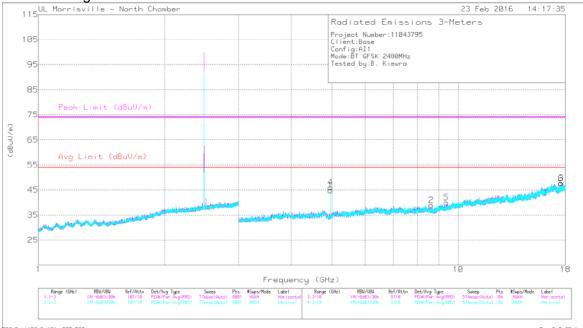
PK-U: Maximum Peak

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

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Page 103 of 124

1-18 GHz High Channel



FCC Port15C 2.4GHz RSE.TST

Rev 9.5 28 Aug 2815

Marker	Frequency	Meter	Det	AF	Amp/Cbl/	Corrected	Avg Limit	Margin	Peak Limit	РК	Azimuth	Height	Polarity
	(GHz)	Reading		AT0072	Fltr/Pad	Reading	(dBuV/m)	(dB)	(dBuV/m)	Margin	(Degs)	(cm)	
		(dBuV)		(dB/m)	(dB)	(dBuV/m)				(dB)			
1	* 4.96	46.92	PK-U	34.1	-33.2	47.82	-	-	74	-26.18	251	113	Н
	* 4.96	42.29	V1TR	34.1	-33.2	43.19	54	-10.81	-	-	251	113	н
4	* 4.961	46.87	PK-U	34.1	-33.2	47.77	-	-	74	-26.23	331	105	V
	* 4.96	42.11	V1TR	34.1	-33.2	43.01	54	-10.99	-	-	331	105	V
5	* 9.38	36.83	PK-U	36.6	-29.1	44.33	-	-	74	-29.67	330	140	V
	* 9.38	25.88	V1TR	36.6	-29.1	33.38	54	-20.62	-	-	330	140	V
2	8.633	32.5	Pk	36	-29.6	38.9	-	-	74	-35.1	0-360	200	Н
3	17.591	31.16	Pk	41.8	-25.2	47.76	-	-	74	-26.24	0-360	101	Н
6	17.568	30.98	Pk	41.8	-25.2	47.58	-	-	74	-26.42	0-360	101	V

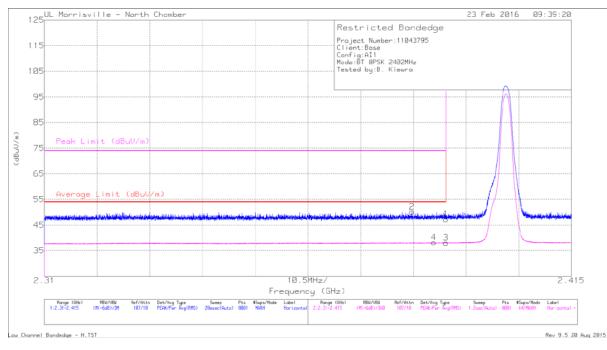
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

PK-U: Maximum Peak

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

8.2.2. ENHANCED DATA RATE 8PSK MODULATION



RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)

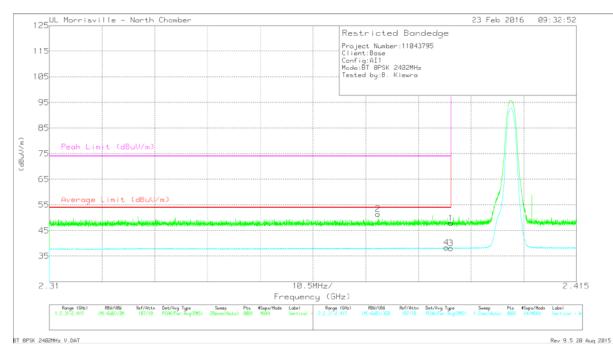
Marker	Frequency	Meter	Det	AF AT0072	Amp/Cbl	Corrected	Average	Margin	Peak Limit	РК	Azimuth	Height	Polarity
	(GHz)	Reading		(dB/m)	/Fltr/Pad	Reading	Limit	(dB)	(dBuV/m)	Margin	(Degs)	(cm)	
		(dBuV)			(dB)	(dBuV/m)	(dBuV/m)			(dB)			
1	* 2.39	40.44	Pk	31.9	-25.1	47.24	-	-	74	-26.76	309	137	Н
2	* 2.383	43.38	Pk	31.9	-25.1	50.18	-	-	74	-23.82	309	137	Н
3	* 2.39	31.27	V1TR	31.9	-25.1	38.07	54	-15.93	-	-	309	137	Н
4	* 2.388	31.44	V1TR	31.9	-25.1	38.24	54	-15.76	-	-	309	137	Н

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

Pk - Peak detector

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

Page 105 of 124



Marker	Frequency	Meter	Det	AF	Amp/Cbl	Corrected	Average	Margin	Peak Limit	РК	Azimuth	Height	Polarity
	(GHz)	Reading		AT0072	/Fltr/Pad	Reading	Limit	(dB)	(dBuV/m)	Margin	(Degs)	(cm)	
		(dBuV)		(dB/m)	(dB)	(dBuV/m)	(dBuV/m)			(dB)			
1	* 2.39	41.09	Pk	31.9	-25.1	47.89	-	-	74	-26.11	9	396	V
2	* 2.375	44.64	Pk	31.9	-25.1	51.44	-	-	74	-22.56	9	396	V
3	* 2.39	31.3	V1TR	31.9	-25.1	38.1	54	-15.9	-	-	9	396	V
4	* 2.389	31.55	V1TR	31.9	-25.1	38.35	54	-15.65	-	-	9	396	V

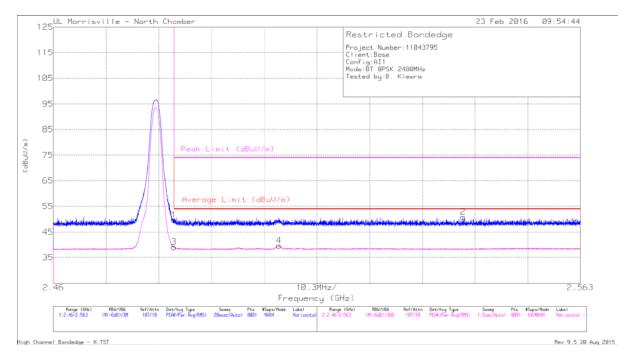
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

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

Page 106 of 124

RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



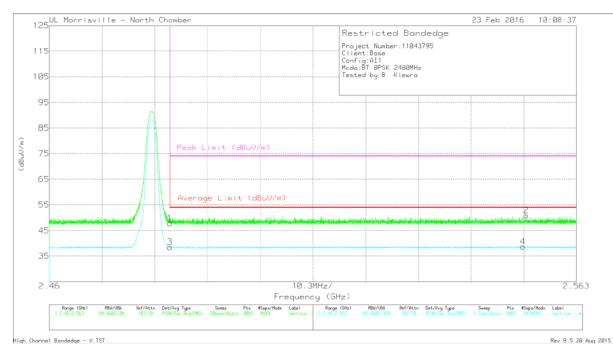
Marker	Frequency	Meter	Det	AF	Amp/Cbl/	Corrected	Average	Margin	Peak Limit	РК	Azimuth	Height	Polarity
	(GHz)	Reading		AT0072	Fltr/Pad	Reading	Limit	(dB)	(dBuV/m)	Margin	(Degs)	(cm)	
		(dBuV)		(dB/m)	(dB)	(dBuV/m)	(dBuV/m)			(dB)			
1	* 2.484	42.54	Pk	32.1	-24.9	49.74	-	-	74	-24.26	343	164	Н
3	* 2.484	31.94	V1TR	32.1	-24.9	39.14	54	-14.86	-	-	343	164	Н
4	2.504	32.46	V1TR	32.1	-24.9	39.66	54	-14.34	-	-	343	164	Н
2	2.54	43.83	Pk	32.1	-25	50.93	-	-	74	-23.07	343	164	Н

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

Pk - Peak detector

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

Page 107 of 124



Marker	Frequency	Meter	Det	AF	Amp/Cbl	Corrected	Average	Margin	Peak Limit	РК	Azimuth	Height	Polarity
	(GHz)	Reading		AT0072	/Fltr/Pad	Reading	Limit	(dB)	(dBuV/m)	Margin	(Degs)	(cm)	
		(dBuV)		(dB/m)	(dB)	(dBuV/m)	(dBuV/m)			(dB)			
1	* 2.484	40.68	Pk	32.1	-24.9	47.88	-	-	74	-26.12	359	370	V
3	* 2.484	31.32	V1TR	32.1	-24.9	38.52	54	-15.48	-	-	359	370	V
2	2.553	43.54	Pk	32.2	-24.9	50.84	-	-	74	-23.16	359	370	V
4	2.553	31.45	V1TR	32.2	-24.9	38.75	54	-15.25	-	-	359	370	V

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

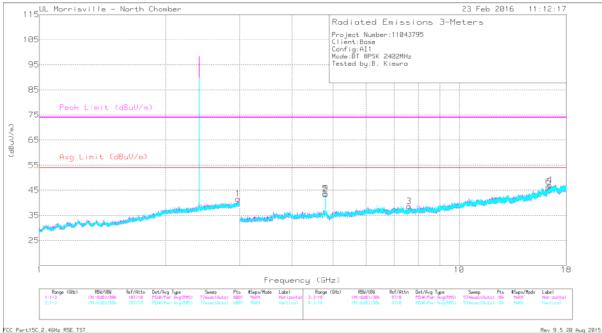
Pk - Peak detector

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

Page 108 of 124

HARMONICS AND SPURIOUS EMISSIONS

1-18 GHz Low Channel



Marker	Frequency	Meter	Det	AF	Amp/Cbl/	Corrected	Avg Limit	Margin	Peak Limit	РК	Azimuth	Height	Polarity
	(GHz)	Reading		AT0072	Fltr/Pad	Reading	(dBuV/m)	(dB)	(dBuV/m)	Margin	(Degs)	(cm)	
		(dBuV)		(dB/m)	(dB)	(dBuV/m)				(dB)			
2	* 4.804	44.97	PK-U	34.1	-32.3	46.77	-	-	74	-27.23	244	364	Н
	* 4.804	35.86	V1TR	34.1	-32.3	37.66	54	-16.34	-	-	244	364	Н
3	* 7.597	38.03	PK-U	35.8	-30.3	43.53	-	-	74	-30.47	32	192	Н
	* 7.596	26.84	V1TR	35.8	-30.3	32.34	54	-21.66	-	-	32	192	Н
5	* 4.804	46.26	PK-U	34.1	-32.3	48.06	-	-	74	-25.94	1	114	V
	* 4.804	38.43	V1TR	34.1	-32.3	40.23	54	-13.77	-	-	1	114	V
1	2.973	32.82	Pk	32.4	-23.6	41.62	-	-	74	-32.38	0-360	199	Н
6	16.318	30.15	Pk	41.4	-25.1	46.45	-	-	74	-27.55	0-360	101	V
4	16.45	32.73	Pk	41.7	-27.4	47.03	-	-	74	-26.97	0-360	101	Н

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

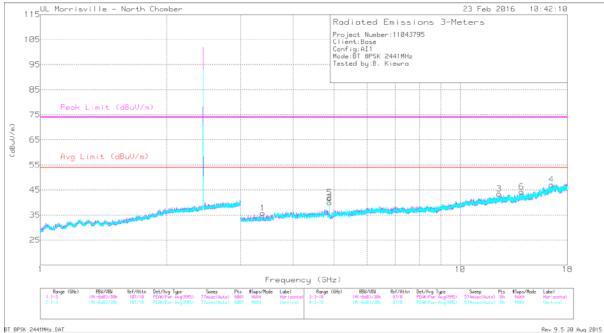
Pk - Peak detector

PK-U: Maximum Peak

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

Page 109 of 124

1-18 GHz Mid Channel



Marker	Frequency	Meter	Det	AF	Amp/Cbl	Corrected	Avg Limit	Margin	Peak Limit	РК	Azimuth	Height	Polarity
	(GHz)	Reading		AT0072	/Fltr/Pad	Reading	(dBuV/m)	(dB)	(dBuV/m)	Margin	(Degs)	(cm)	
		(dBuV)		(dB/m)	(dB)	(dBuV/m)				(dB)			
2	* 4.882	44.75	PK-U	34.1	-32.4	46.45	-	-	74	-27.55	247	108	Н
	* 4.882	35.77	V1TR	34.1	-32.4	37.47	54	-16.53	-	-	247	108	Н
3	* 12.382	36.12	PK-U	39.1	-27.2	48.02	-	-	74	-25.98	359	226	Н
	* 12.384	24.9	V1TR	39.1	-27.2	36.8	54	-17.2	-	-	359	226	Н
5	* 4.882	44.6	PK-U	34.1	-32.4	46.3	-	-	74	-27.7	351	104	V
	* 4.882	36.56	V1TR	34.1	-32.3	38.36	54	-15.64	-	-	351	104	V
1	3.384	35.82	Pk	33	-33.1	35.72	-	-	74	-38.28	0-360	199	Н
6	14.002	32.56	Pk	39.2	-27.5	44.26	-	-	74	-29.74	0-360	199	V
4	16.504	32.07	Pk	41.8	-26.7	47.17	-	-	74	-26.83	0-360	101	Н

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

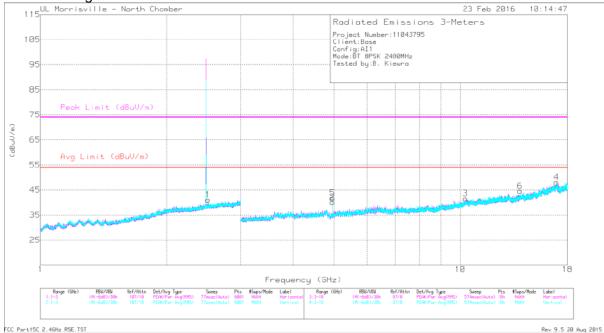
Pk - Peak detector

PK-U: Maximum Peak

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

Page 110 of 124

1-18 GHz High Channel



Marker	Frequency	Meter	Det	AF	Amp/Cbl	Corrected	Avg Limit	Margin	Peak Limit	РК	Azimuth	Height	Polarity
	(GHz)	Reading		AT0072	/Fltr/Pad	Reading	(dBuV/m)	(dB)	(dBuV/m)	Margin	(Degs)	(cm)	
		(dBuV)		(dB/m)	(dB)	(dBuV/m)				(dB)			
2	* 4.96	44.44	PK-U	34.1	-33.2	45.34	-	-	74	-28.66	257	115	Н
	* 4.96	35.91	V1TR	34.1	-33.2	36.81	54	-17.19	-	-	257	115	Н
5	* 4.96	45.4	PK-U	34.1	-33.2	46.3	-	-	74	-27.7	330	109	V
	* 4.96	36.96	V1TR	34.1	-33.2	37.86	54	-16.14	-	-	330	109	V
1	2.504	33.72	Pk	32.1	-24.7	41.12	-	-	74	-32.88	0-360	200	Н
3	10.29	31.13	Pk	37.5	-27	41.63	-	-	74	-32.37	0-360	101	Н
6	13.89	33.38	Pk	39.2	-28	44.58	-	-	74	-29.42	0-360	101	V
4	16.967	31.17	Pk	42.2	-25.3	48.07	-	-	74	-25.93	0-360	101	Н

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

Pk - Peak detector

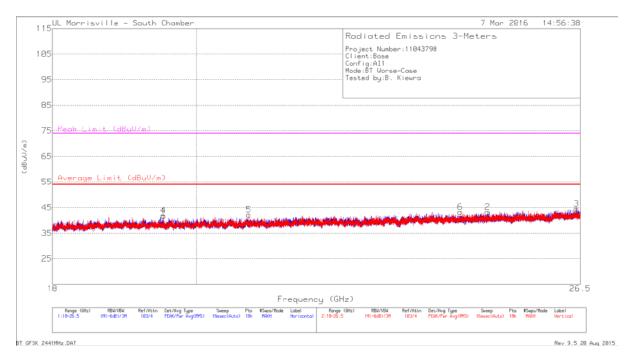
PK-U: Maximum Peak

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

Page 111 of 124

8.3. WORST-CASE 18-26GHz

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



Marker	Frequency	Meter	Det	AF AT0076	Amp/Cbl	Corrected	Average	Margin	Peak Limit	РК	Azimuth	Height	Polarity
	(GHz)	Reading		(dB/m)	(dB)	Reading	Limit	(dB)	(dBuV/m)	Margin	(Degs)	(cm)	
		(dBuV)				(dBuV/m)	(dBuV/m)			(dB)			
1	* 19.524	51.89	PK-U	32.9	-40.4	44.39	54	-9.61	74	-29.61	337	123	Н
4	* 19.524	52.98	PK-U	32.9	-40.4	45.48	54	-8.52	74	-28.52	62	110	V
5	* 20.785	48.32	PK-U	33.5	-40.3	41.52	54	-12.48	74	-32.48	201	291	V
2	24.762	47.05	Pk	34.6	-38.4	43.25	-	-	74	-30.75	0-360	199	Н
3	26.428	46.79	Pk	35.1	-37.4	44.49	-	-	74	-29.51	0-360	102	Н
6	24.267	47.58	Pk	34.4	-38.7	43.28	-	-	74	-30.72	0-360	299	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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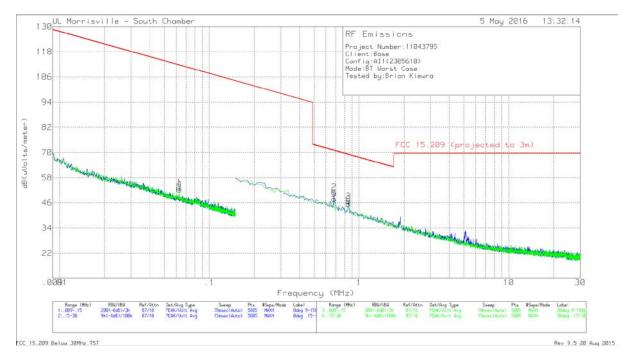
Page 112 of 124

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).

The anechoic chamber has been properly calibrated so that the measurement results correspond to what would be obtained from an open field sites.



Marker	Frequency	Meter	Det	AT0079 AF (dB/m)	Cbl (dB)	Corrected	FCC 15.209	Margin	Azimuth
	(MHz) Reading					Reading	(projected to 3m)	(dB)	(Degs)
		(dBuV)				dB(uVolts/meter)			
1	.06293	41.02	Pk	12.2	.1	53.32	111.63	-58.31	0-360
4	.06293	40.06	Pk	12.2	.1	52.36	111.63	-59.27	0-360
2	.68089	39.04	Pk	11.9	.1	51.04	70.94	-19.9	0-360
5	.68089	35.79	Pk	11.9	.1	47.79	70.94	-23.15	0-360
3	.84791	34.76	Pk	11.9	.1	46.76	69.04	-22.28	0-360
6	.84791	33.44	Pk	11.9	.1	45.44	69.04	-23.6	0-360

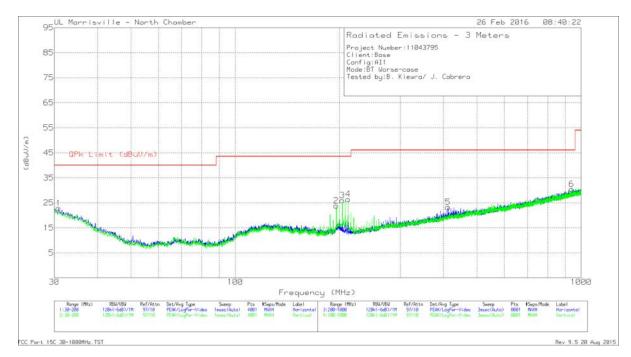
Pk - Peak detector FCC 15.209 Below 30MHz.TST Rev 9.5 20 Aug 2015

Page 113 of 124

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



Marker	Frequency	Meter	Det	AT0073 AF	Amp/Cbl (dB)	Corrected	QPk Limit	Margin	Azimuth	Height	Polarity
	(MHz)	Reading		(dB/m)		Reading	(dBuV/m)	(dB)	(Degs)	(cm)	
		(dBuV)				(dBuV/m)					
1	30.85	28.91	Pk	25.5	-31.6	22.81	40	-17.19	0-360	399	н
5	412	31.57	Pk	20.7	-29	23.27	46.02	-22.75	0-360	199	н
2	196.005	37.05	Pk	16.9	-30.1	23.85	43.52	-19.67	0-360	102	V
3	204	40.04	Pk	16	-30.1	25.94	43.52	-17.58	0-360	102	V
4	212	41.31	Pk	15.2	-30	26.51	43.52	-17.01	0-360	199	V
6	938.2	29.4	Pk	27.3	-26.2	30.5	46.02	-15.52	0-360	199	V

Pk - Peak detector

Page 114 of 124

9. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

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 C63.10.

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.

<u>RESULTS</u>

Line conducted testing was considered but deemed not applicable because the EUT does not transmit or receive when the EUT is plugged in for charging. The Bluetooth radio is disabled when the USB is connected to a laptop or charger.

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Page 115 of 124