



**FCC 47 CFR PART 15 SUBPART C
INDUSTRY (ISED) CANADA RSS-247 ISSUE 1**

**BLUETOOTH LOW ENERGY
CERTIFICATION TEST REPORT**

FOR

WIRELESS SPEAKER

MODEL NUMBER: 419356

FCC ID: A94419356

IC: 3232A-419356

REPORT NUMBER: R11223338-E2

ISSUE DATE: 2017-04-04

**Prepared for
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NVLAP LAB CODE 200246-0

Revision History

Ver	Issue Date	Revisions	Revised By
1	2016-09-14	Initial Issue	Brian Kiewra
2	2016-12-16	Revised Note on page 5.	Jeff Moser
3	2017-04-04	Revised Section 5.5 to be more specific and modified the test procedure in Section 9.1.	Jeff Moser

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Bose Corporation
100 The Mountain Rd.
Framingham, MA, 01701 USA

EUT DESCRIPTION: Wireless Speaker

MODEL: 419356

SERIAL NUMBER: Conducted: 00-0031
Radiated: 00-0023

DATE TESTED: 2016-08-05 to 2016-08-26, 2016-09-13

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Pass
INDUSTRY (ISED) CANADA RSS-247 Issue 1	Pass
INDUSTRY (ISED) CANADA RSS-GEN Issue 4	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 or any agency of the U.S. Government.

Approved & Released
For UL LLC By:



Jeffrey Moser
EMC Program Manager
UL – Consumer Technology Division

Prepared By:



Brian Kiewra
EMC Engineer
UL – Consumer Technology Division

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 (ISED) Canada company address code 2180C with site numbers 2180C -1 through 2180C-4, respectively.

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

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

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

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

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)	± 3.65

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a wireless speaker that contains Bluetooth/BLE transceivers, manufactured by Cambridge Silicon Radio, CSR8675.

The EUT is provided with a Bose model S008AHU0500160 power supply.

5.2. MAXIMUM OUTPUT POWER

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

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2402 - 2480	BLE	5.11	3.24

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an inverted F antenna formed by printed circuit board etch internal to the product, with a maximum gain of 4.9 dBi.

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was version 0.6.1.4215

The test utility software used during testing was Polycomm, ver 0.1.9.0 and CSR BlueSuite ver 2.5.8.

5.5. WORST-CASE CONFIGURATION AND MODE

For all Radiated Emissions, the EUT is only intended to operate in a fixed orientation. The fundamental of the EUT was investigated in various configurations:

- Stand alone with music player
- Connected to power charger
- Connected to laptop
- Connected to power charger and music player via 3.5 mm cable

It was determined that connected to the power charger configuration was the worst-case configuration. Therefore, all final radiated testing was performed with the EUT in 'connected to power charger' configuration.

Radiated emission below 1 GHz and power line conducted emissions were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial or Part Number	FCC ID
Laptop PC	Lenovo	20BUS04K00	PC0A2UQS	N/A
AC Adapter	Lenovo	ADLX65NLC2A	54DE1T	N/A
AC Adapter	Bose	AFD5V-1C-1U-US	724081-0010	N/A
AC Adapter	Bose	S008AHU0500160	745559-0030	N/A

I/O CABLES

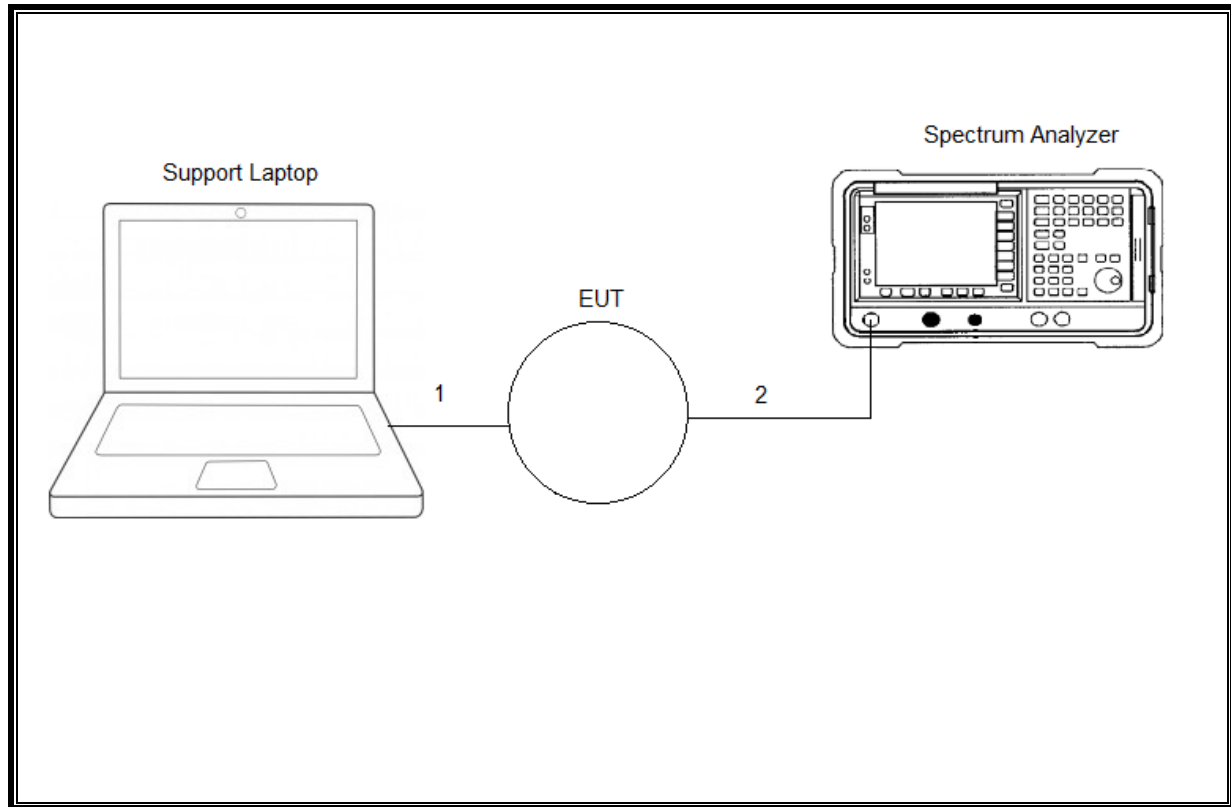
I/O Cable List						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	USB	1	Micro USB	Unshielded	<1m	N/A
2	Antenna	1	RF	RF	<1m	N/A
3	DC Mains	1	DC	DC Mains	>1m	N/A

TEST SETUP

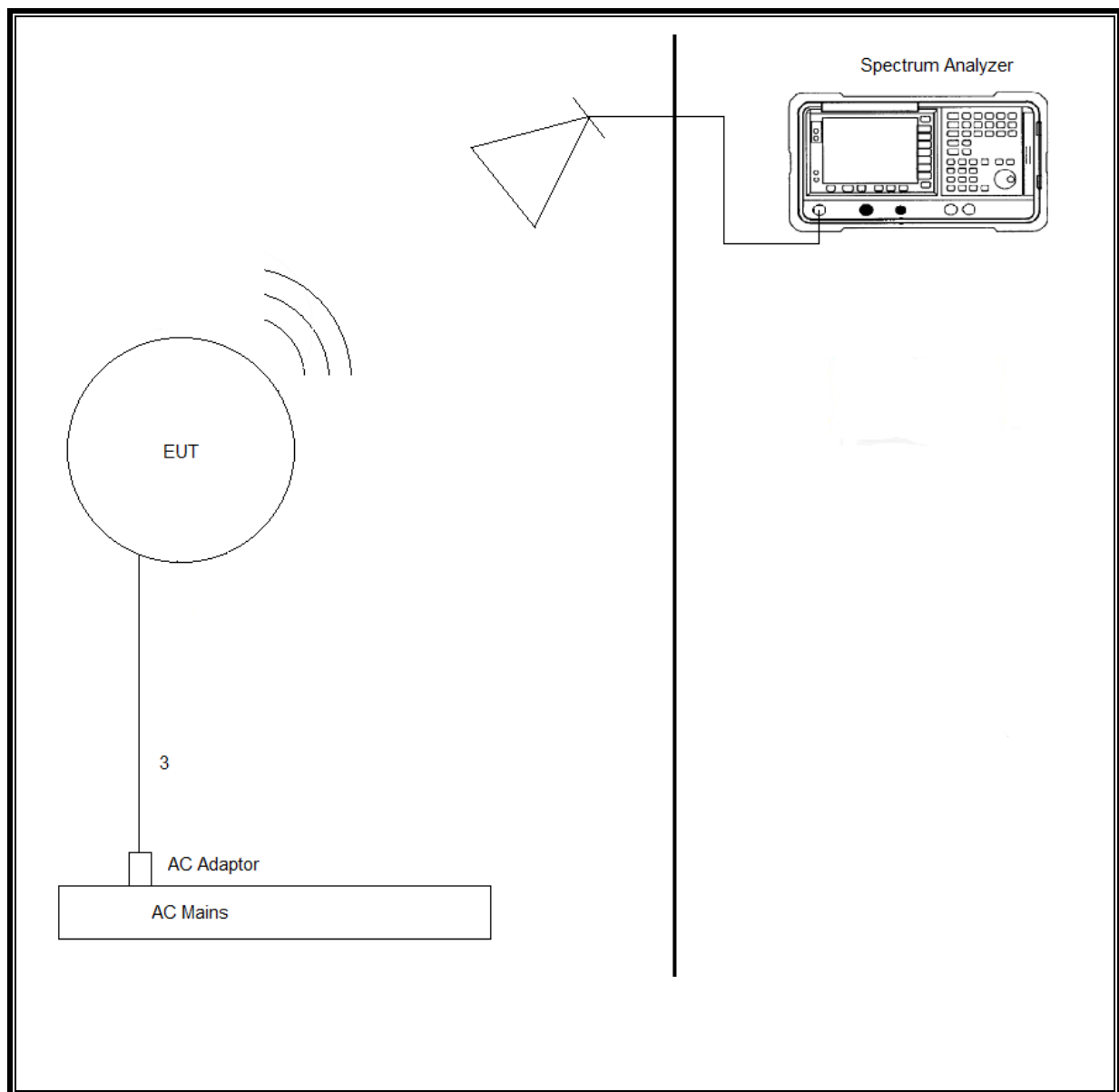
The EUT is set up with its associated AC/DC adapter during radiated-emissions testing. For convenience, the device is connected to a laptop PC via a USB cable to configure the device for test during antenna-port measurements. Test software exercised the radio portion of the device.

SETUP DIAGRAM FOR TESTS

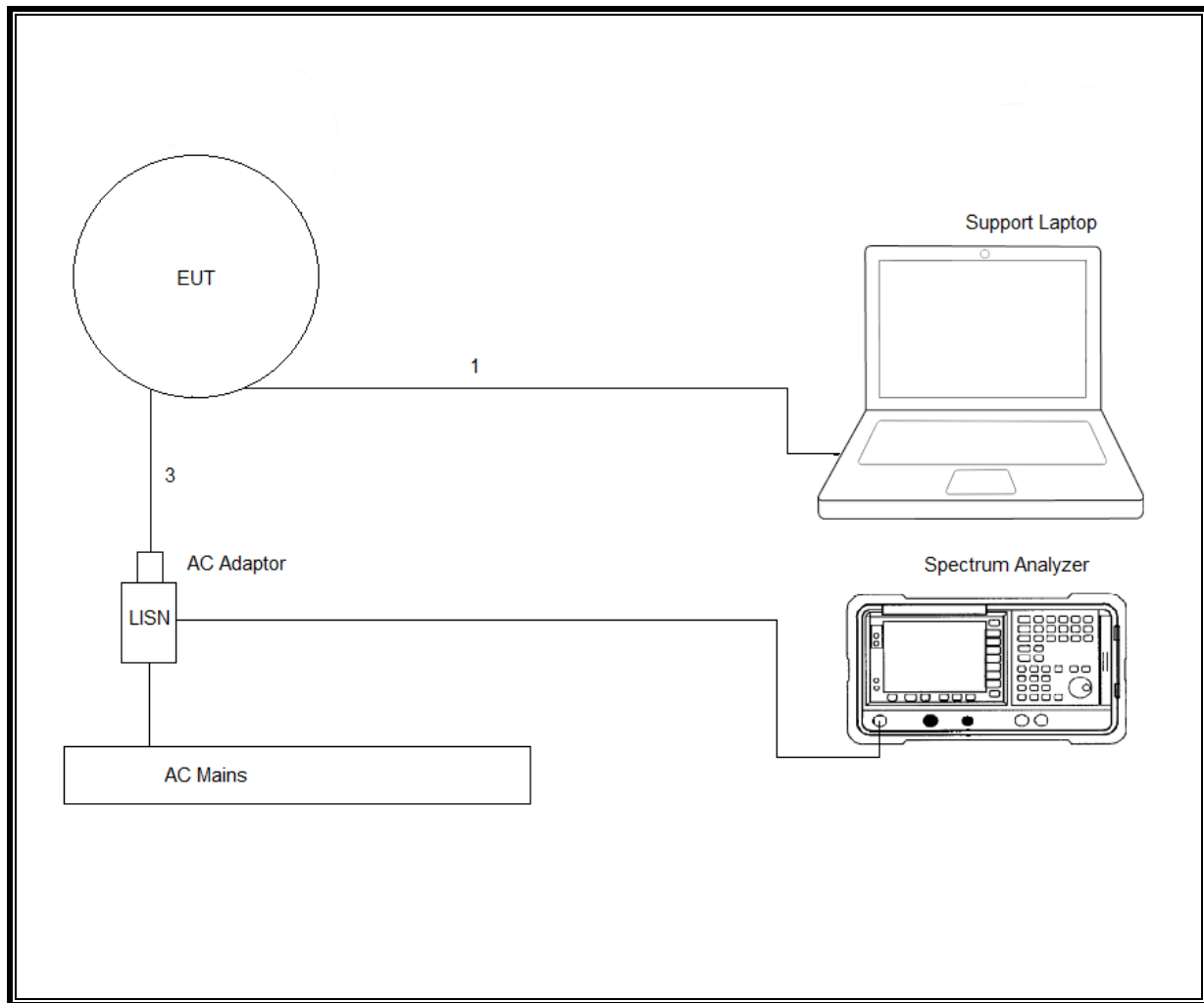
Conducted Setup



Radiated Setup



Line Conducted Setup



6. TEST AND MEASUREMENT EQUIPMENT

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

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

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	0.009-30MHz	(Loop Ant.)			
AT0079	Active Loop Antenna	ETS-Lindgren	6502	2015-12-08	2016-12-31
	30-1000 MHz				
AT0074	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2016-06-07	2017-06-30
	1-18 GHz				
AT0069	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2016-03-07	2017-03-31
	18-40 GHz				
AT0076	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2015-08-27	2016-08-31
AT0077	Horn Antenna, 26-40GHz	ARA	MWH-2640/B	2015-08-27	2016-08-31
	Gain-Loss Chains				
S-SAC01	Gain-loss string: 0.009-30MHz	Various	Various	2015-10-07	2016-10-31
S-SAC02	Gain-loss string: 30-1000MHz	Various	Various	2016-06-26	2017-06-30
S-SAC03	Gain-loss string: 1-18GHz	Various	Various	2015-08-22	2016-08-31
S-SAC04	Gain-loss string: 18-40GHz	Various	Various	2016-02-29	2017-02-28
	Receiver & Software				
SA0025	Spectrum Analyzer	Agilent	N9030A	2016-03-17	2017-03-31
SA0026 (18-40GHz RSE)	Spectrum Analyzer	Agilent	N9030A	2016-02-24	2017-02-28
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
	Additional Equipment used				
HI0050	Temp/Humid/Pressure Meter	Cole-Parmer	99760-00	2015-07-01	2016-08-31

Note – This test area was used prior to 2016-08-31.

Test Equipment Used - Wireless Conducted Measurement Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
Conducted Room 1					
72822 (SA0019)	Spectrum Analyzer	Agilent Technologies	E4446A	2015-09-02	2016-09-30
PWM004	RF Power Meter	Keysight Technologies	N1911A	2016-06-22	2017-06-22
PWS004	Peak and Avg Power Sensor, 50MHz to 6GHz	Keysight Technologies	E9323A	2016-06-22	2017-06-22
HI0078	Temp/Humid/Pressure Meter	Springfield	PreciseTemp	2016-06-13	2017-06-13
MM0167	True RMS Multimeter	Agilent	U1232A	2015-08-17	2016-08-31
76022	DC Regulated Power Supply	CircuitSpecialists.Com	CSI3005X5	N/A	N/A
Conducted Room 2					
SA0020	Spectrum Analyzer	Agilent Technologies	E4446A	2016-03-22	2017-03-31
PWM003	RF Power Meter	Keysight Technologies	N1911A	2016-06-21	2017-06-21
PWS003	Peak and Avg Power Sensor, 50MHz to 6GHz	Keysight Technologies	E9323A	2016-06-21	2017-06-21
1100502	Temp/Humid Chamber	Cincinnati Sub-Zero	ZPH-8-3.5-SCT/AC	2016-06-06	2017-06-06
HI0078	Temp/Humid/Pressure Meter	Springfield	PreciseTemp	2016-06-13	2017-06-13
MM0168	True RMS Multimeter	Agilent	U1232A	2015-08-17	2016-08-31
76021	DC Regulated Power Supply	CircuitSpecialists.Com	CSI3005X5	N/A	N/A

Note – This test area was used prior to 2016-08-31.

Test Equipment Used - Line-Conducted Emissions – Voltage (Morrisville – Conducted 1)

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
CBL077	Coax cable, RG223, N-male to BNC-male, 20-ft.	Pasternack	PE3476-240	2016-06-15	2017-06-30
HI0078	Temp/Humid/Pressure Meter	Springfield	PreciseTemp	2016-06-13	2017-06-30
LISN003	LISN, 50-ohm/50-uH, 2-conductor, 25A	Fischer Custom Com.	FCC-LISN-50-25-2-01-550V	2016-08-24	2017-08-24
LISN008	LISN, 50-ohm/50-uH, 2-conductor, 25A (For support gear only.)	Solar Electronics	8012-50-R-24-BNC	2015-09-03	2016-09-30
PRE0101521 (75141)	EMI Test Receiver 9kHz-7GHz	Rohde & Schwarz	ESCI 7	2016-08-23	2017-08-23
TL001	Transient Limiter, 0.009-30MHz	Com-Power	LIT-930A	2016-06-09	2017-06-30
PS214	AC Power Source	Elgar	CW2501M (s/n 1523A02396)	NA	NA
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
	Miscellaneous				
CDECABLE001	ANSI C63.4 1m extension cable.	UL	Per Annex B of ANSI C63.4	2016-06-04	2017-06-30

7. MEASUREMENT METHODS

Duty Cycle: KDB 558074 D01 v03r05 Section 6.0

6 dB BW: KDB 558074 D01 v03r05, Section 8.1.

99% Occupied Bandwidth: ANSI C63.10:2013, Section 6.9.3

Output Power: KDB 558074 D01 v03r05, Section 9.1.2

Power Spectral Density: KDB 558074 D01 v03r05, Section 10.2.

Out-of-band emissions in non-restricted bands: KDB 558074 D01 v03r05, Section 11.0.

Out-of-band emissions in restricted bands: KDB 558074 D01 v03r05, Section 12.1.

General Radiated Emissions: ANSI C63.10:2013 Sections 6.3-6.6

Line Conducted Emissions: ANSI C63.10:2013 Sections 6.2

8. ANTENNA PORT TEST RESULTS

8.1. ON TIME, DUTY CYCLE

LIMITS

None; for reporting purposes only.

PROCEDURE

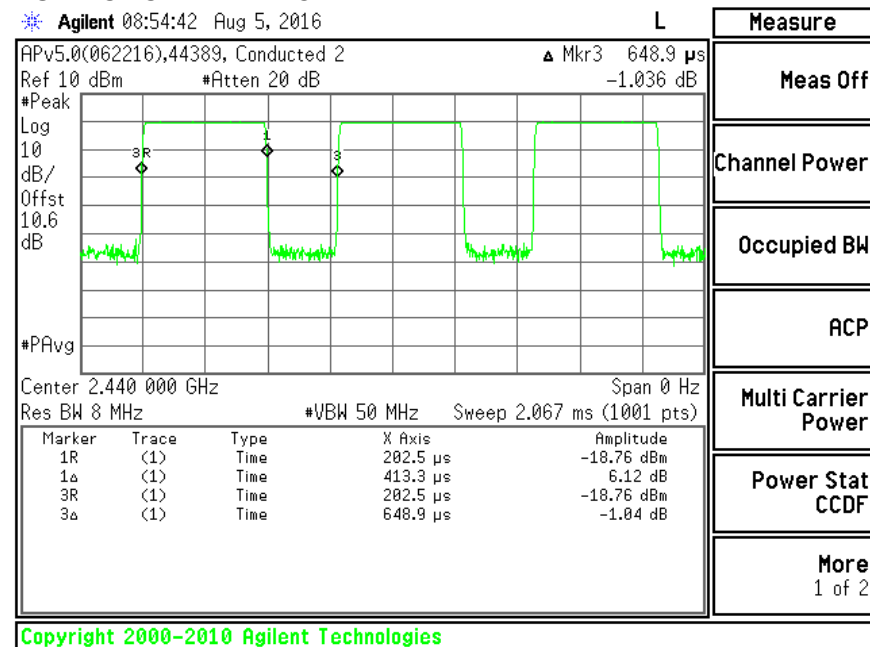
KDB 558074 D01 v03r05 Section 6.0

ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
BLE	0.413	0.649	0.637	63.69%	1.96	2.420

DUTY CYCLE PLOTS

DUTY CYCLE BLE MODE



Test Information

Tester: Niklas Haydon/Jeff Cabrera

Date: 2016-08-05

8.2. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

IC RSS-247 5.2 (1)

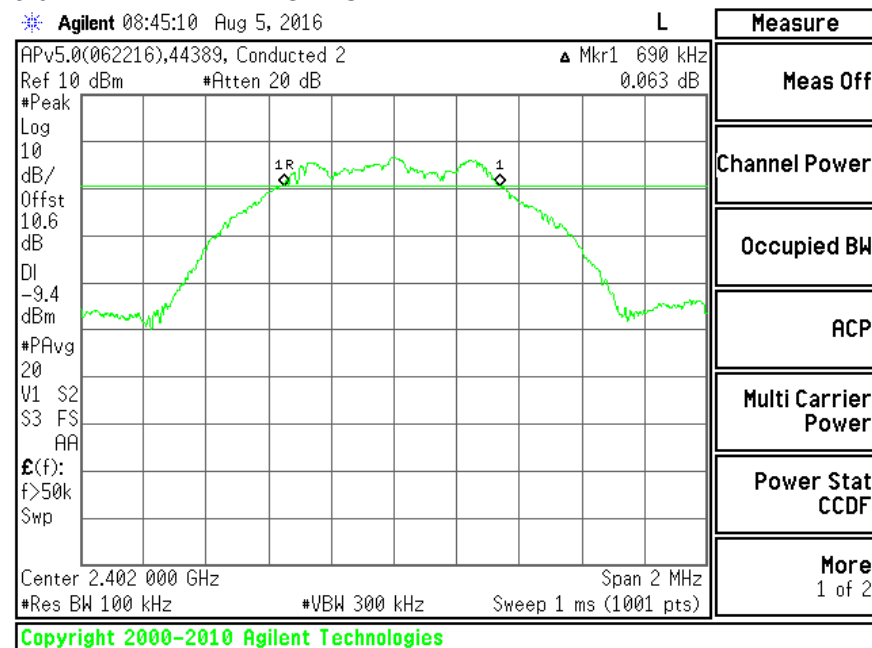
The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS

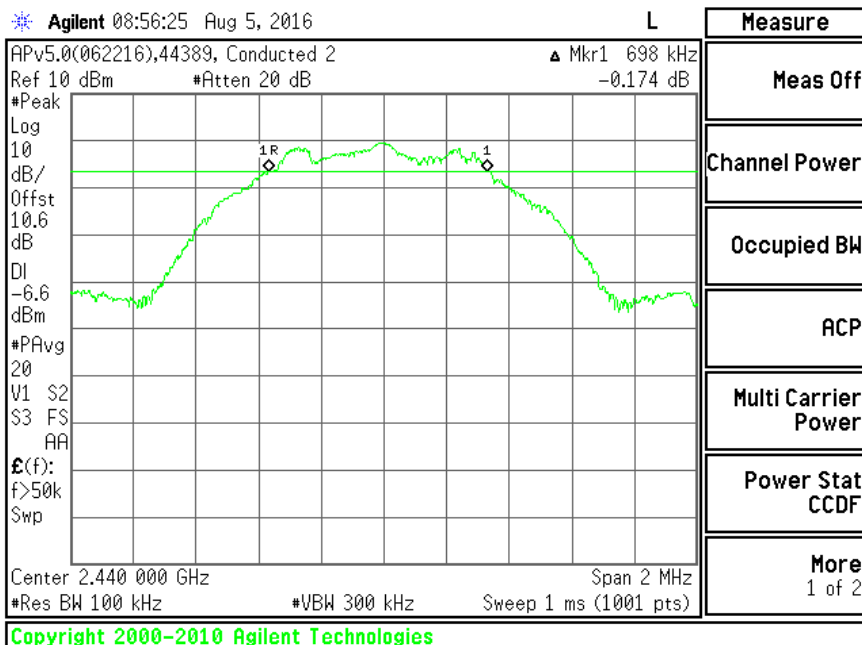
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.6900	0.5
Middle	2440	0.6980	0.5
High	2480	0.6980	0.5

6 dB BANDWIDTH

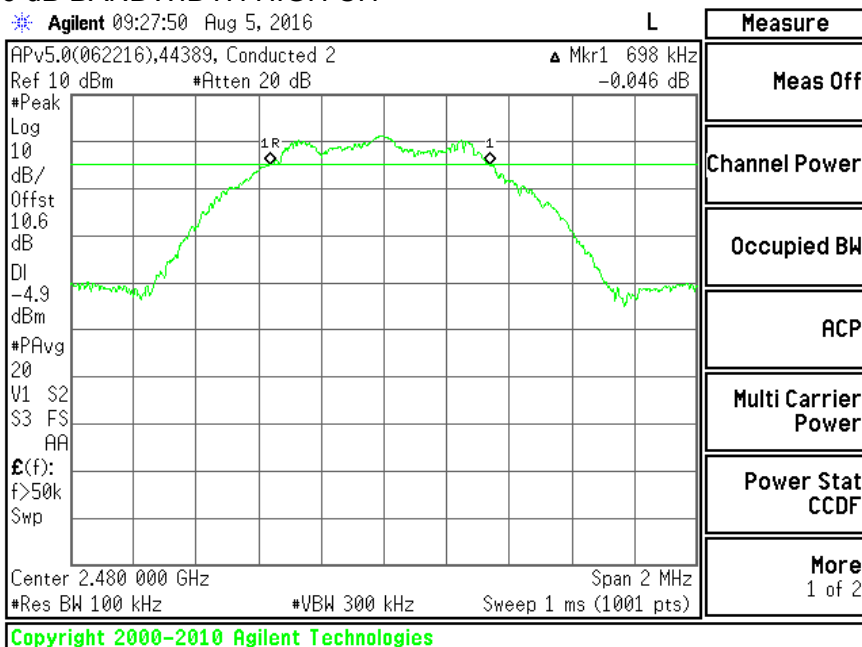
6 dB BANDWIDTH LOW CH



6 dB BANDWIDTH MID CH



6 dB BANDWIDTH HIGH CH



Test Information

Tester: Niklas Haydon/Jeff Cabrera
Date: 2016-08-05

8.3. 99% BANDWIDTH

LIMITS

None; for reporting purposes only. Testing per RSS-Gen Clause 6.6.

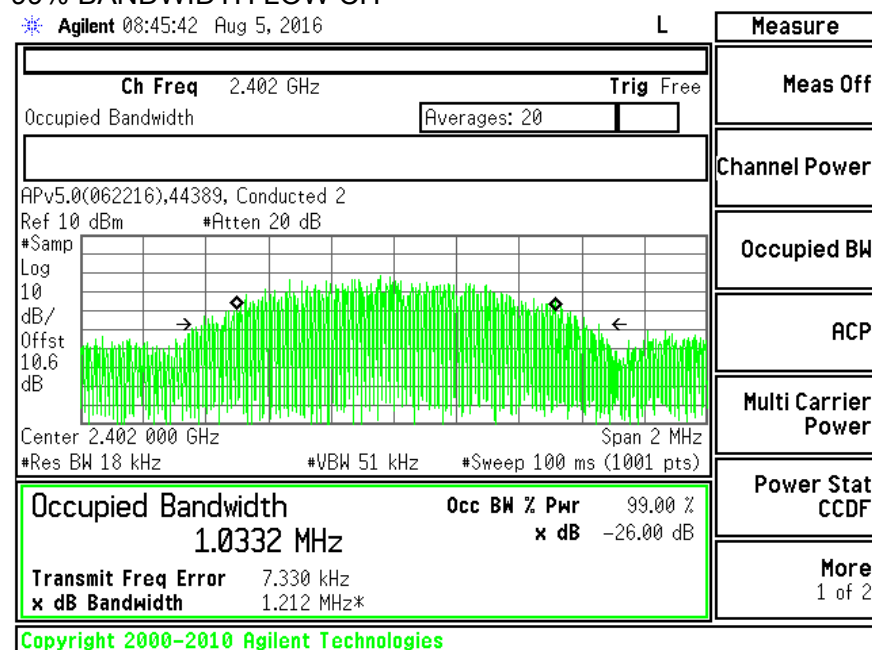
TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 5% of the 99 % bandwidth and to 1% of the span. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

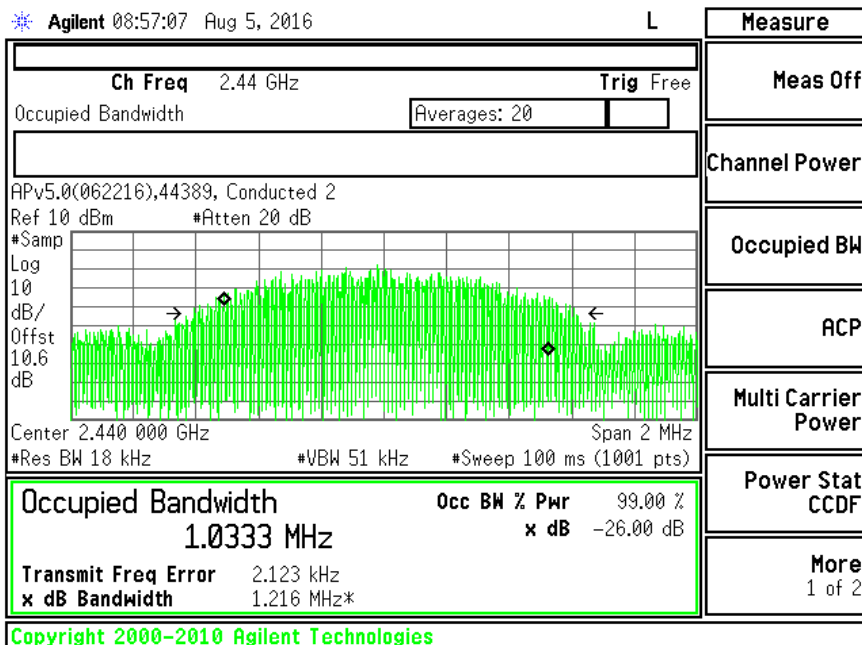
RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0332
Middle	2440	1.0333
High	2480	1.0302

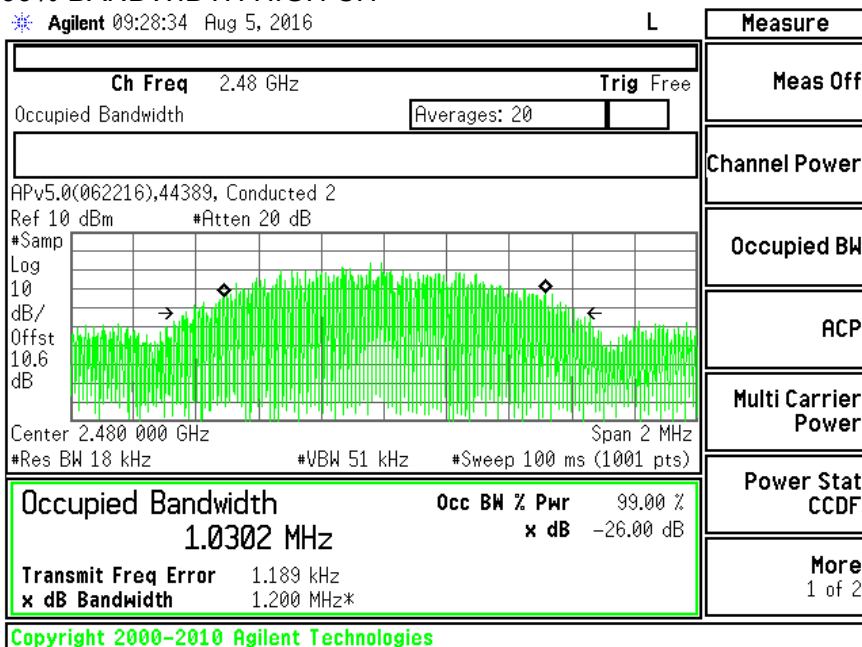
99% BANDWIDTH LOW CH



99% BANDWIDTH MID CH



99% BANDWIDTH HIGH CH



Test Information

Tester: Niklas Haydon/Jeff Cabrera
Date: 2016-08-05

8.4. OUTPUT POWER

LIMITS

FCC §15.247 (b) (3)

IC RSS-247 5.4 (4)

FCC - For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt, based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

RSS - For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. Except as provided in Section 5.4(5), the e.i.r.p. shall not exceed 4 W.

RESULTS

The cable assembly insertion loss of 10.98 dB (including 10 dB pad and 0.98 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	1.290	30	-28.710
Middle	2440	3.730	30	-26.270
High	2480	5.110	30	-24.890

Test Information

Tester: Niklas Haydon/Jeff Cabrera.

Date: 2016-08-05

8.5. AVERAGE POWER

LIMITS

None; for reporting purposes only.

RESULTS

The cable assembly insertion loss of 10.98 dB (including 10 dB pad and 0.98 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	0.93
Middle	2440	3.48
High	2480	4.89

Test Information

Tester: Niklas Haydon/Jeff Cabrera

Date: 2016-08-05

8.6. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247 (e)

IC RSS-247 5.2 (2)

The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

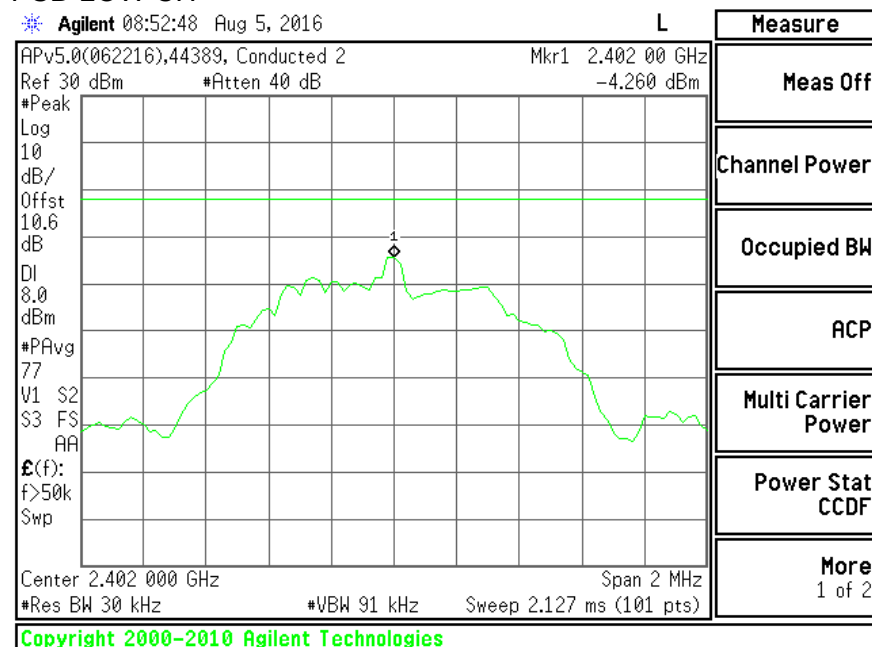
RESULTS

Channel	Frequency (MHz)	PSD (dBm/30kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-4.26	8	-12.26
Middle	2440	-1.32	8	-9.32
High	2480	-0.30	8	-8.30

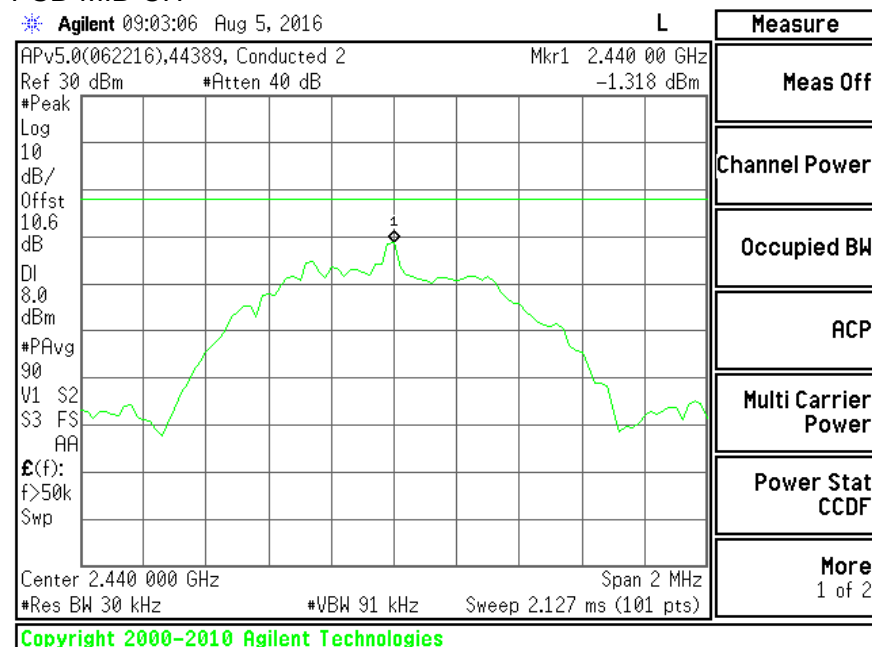
Note – A 30 kHz measurement is considered a worst-case measure vs. 3 kHz.

POWER SPECTRAL DENSITY

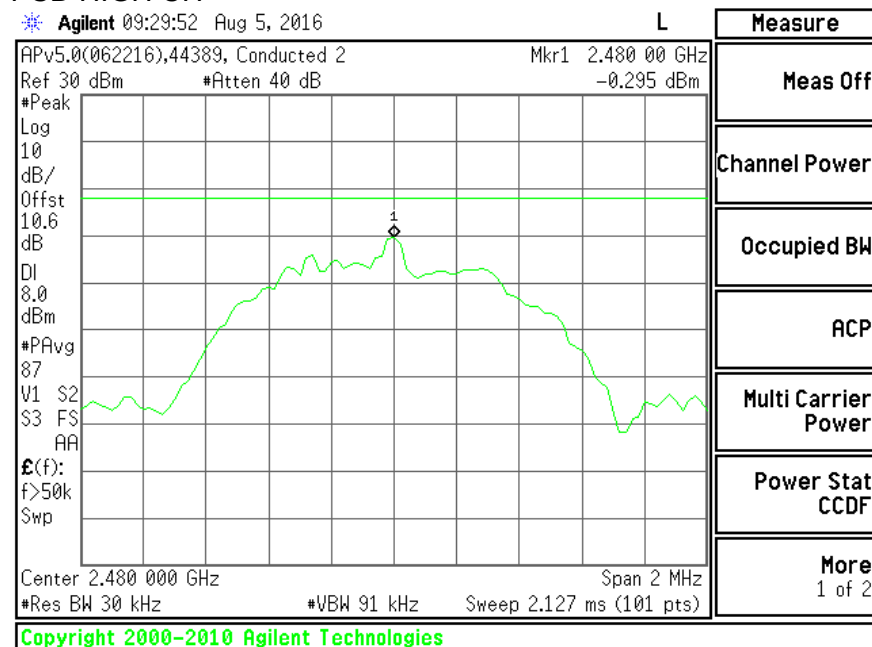
PSD LOW CH



PSD MID CH



PSD HIGH CH



Test Information

Tester: Niklas Haydon/Jeff Cabrera
Date: 2016-08-05

8.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-247 5.5

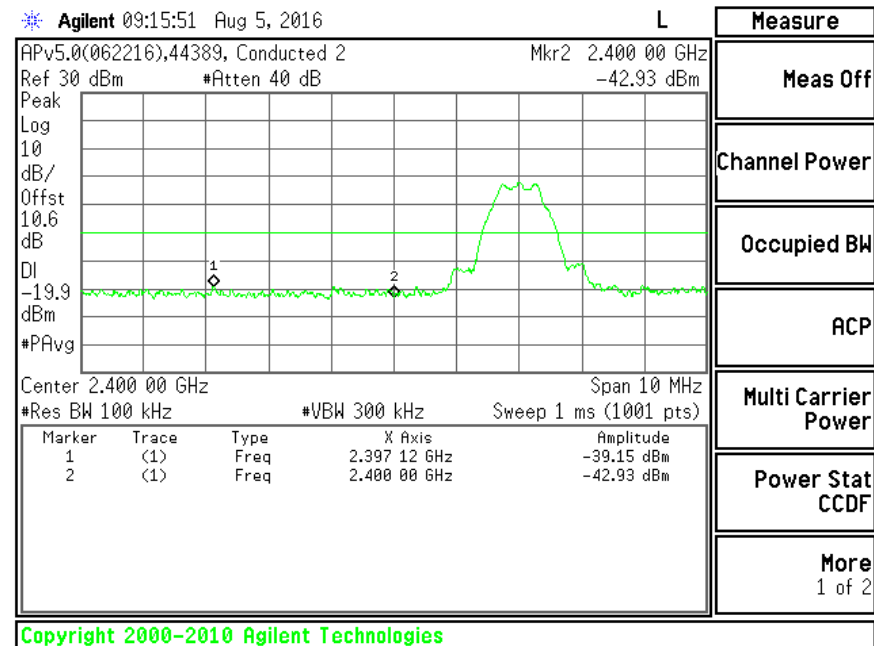
FCC - In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains 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.

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

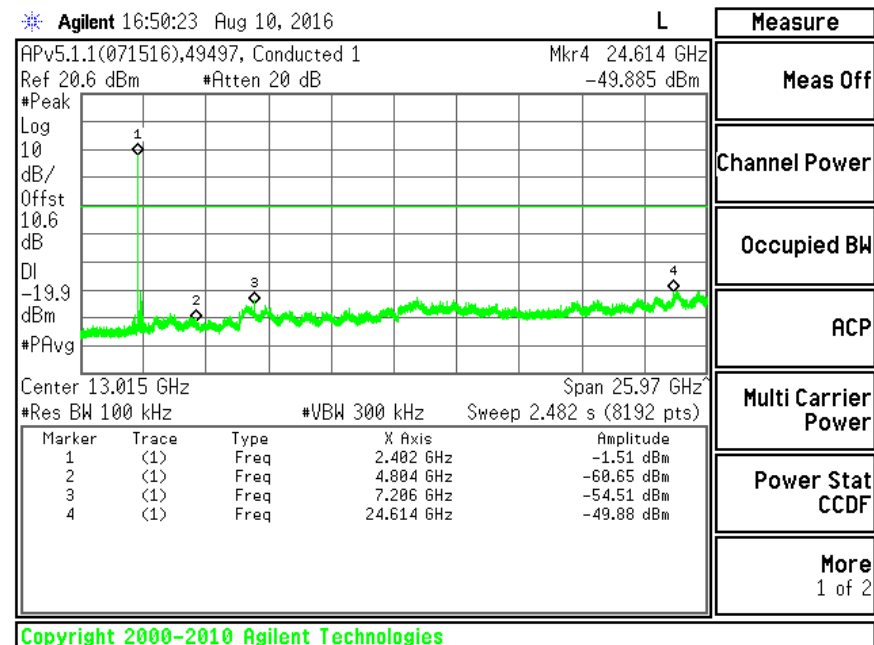
RESULTS

SPURIOUS EMISSIONS, LOW CHANNEL

LOW CH BANDEDGE

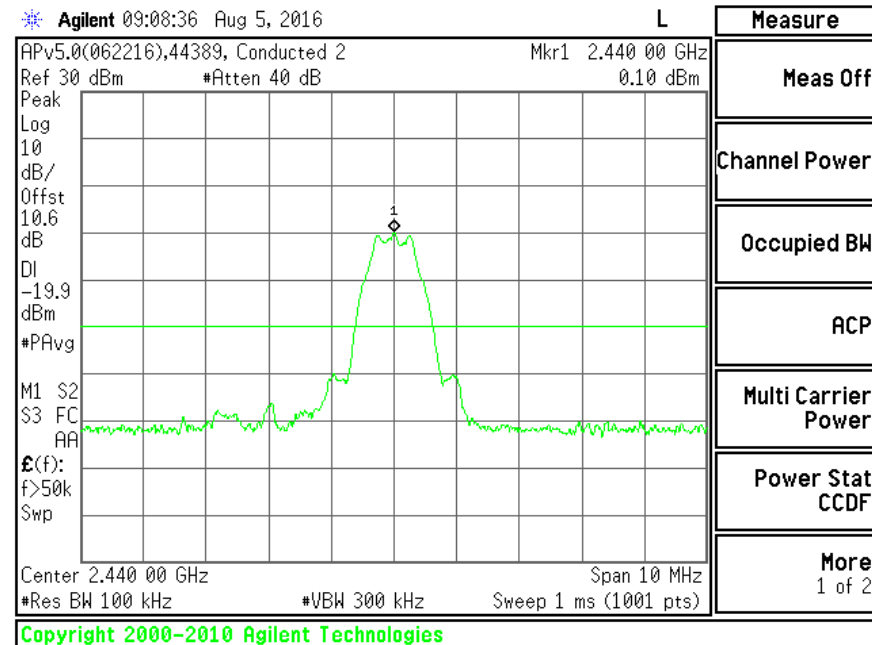


LOW CH SPURIOUS

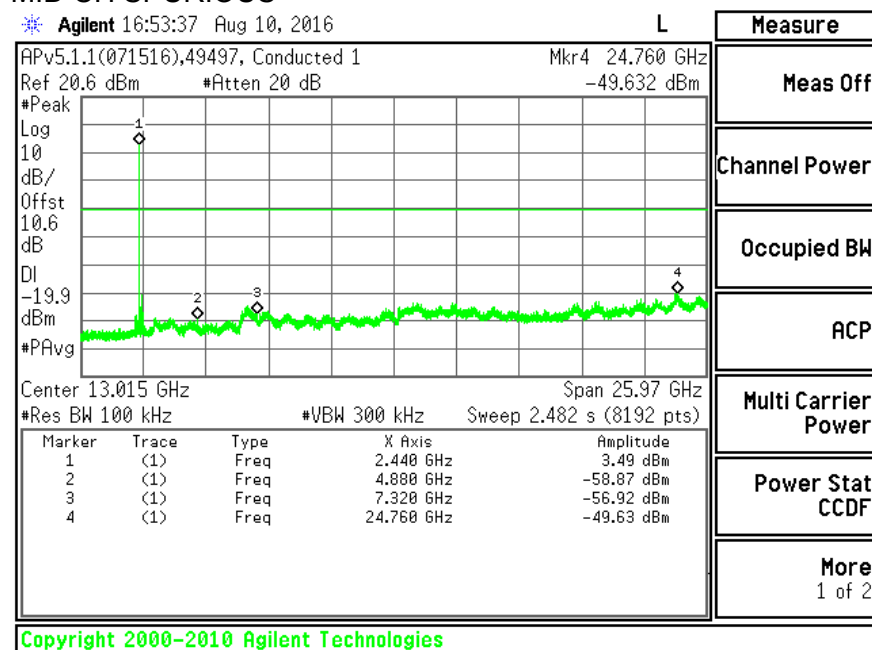


SPURIOUS EMISSIONS, MID CHANNEL

MID CH BANDEDGE

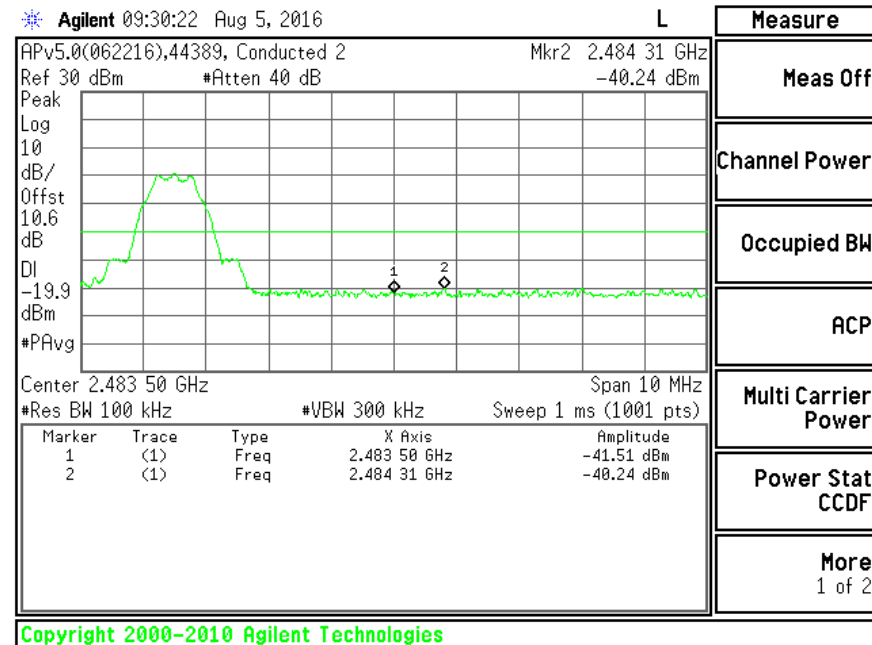


MID CH SPURIOUS

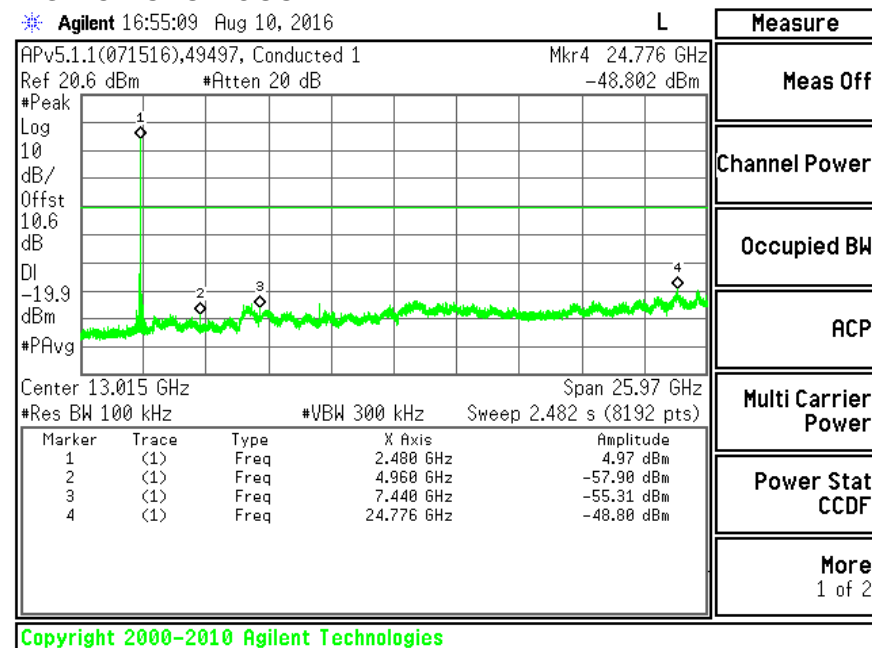


SPURIOUS EMISSIONS, HIGH CHANNEL

HIGH CH BANDEDGE



HIGH CH SPURIOUS



Test Information

Tester: Niklas Haydon/Jeff Cabrera and Mark Learner
Date: 2016-08-05, 2016-08-10

9. RADIATED TEST RESULTS

9.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205, §15.209, §15.247 (d)

IC RSS-GEN Clause 8.9 (Transmitter)

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. For this evaluation, RMS Power Averaging was used and the resolution/video bandwidth settings were 1MHz/3MHz.

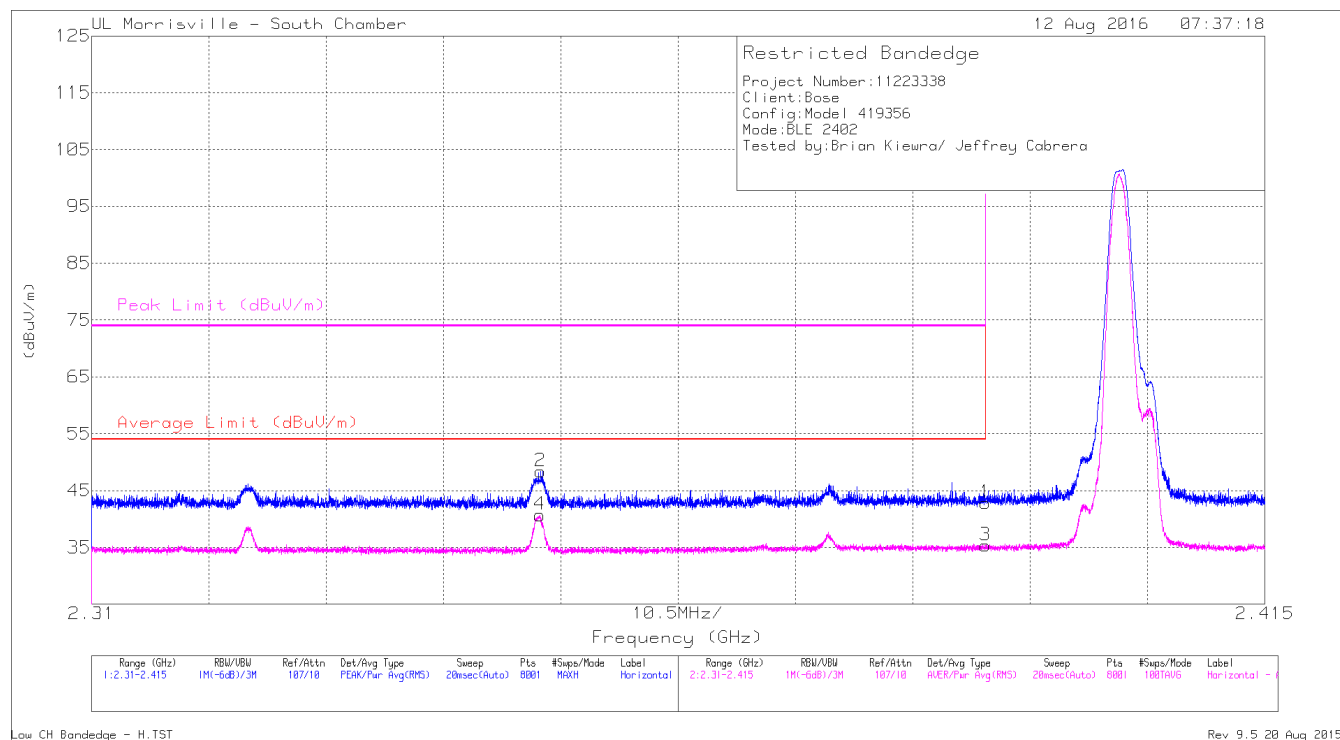
The spectrum from 9 kHz to 26 GHz was investigated. From 1-18 GHz, the transmitter was set to the lowest, middle, and highest channels. For above 18 GHz and below 1GHz, the worst-case channel was set as described in Section 5.5.

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.

9.2. TRANSMITTER ABOVE 1 GHz

9.2.1. TX 1-18 GHz FOR BLE MODE IN THE 2.4 GHz BAND

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF AT0069 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	34.86	Pk	32.2	-24.2	0	42.86	-	-	74	-31.14	80	350	H
2	* 2.35	40.58	Pk	31.8	-24	0	48.38	-	-	74	-25.62	80	350	H
3	* 2.39	25.35	RMS	32.2	-24.2	1.96	35.31	54	-18.69	-	-	80	350	H
4	* 2.35	30.94	RMS	31.8	-24	1.96	40.7	54	-13.3	-	-	80	350	H

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

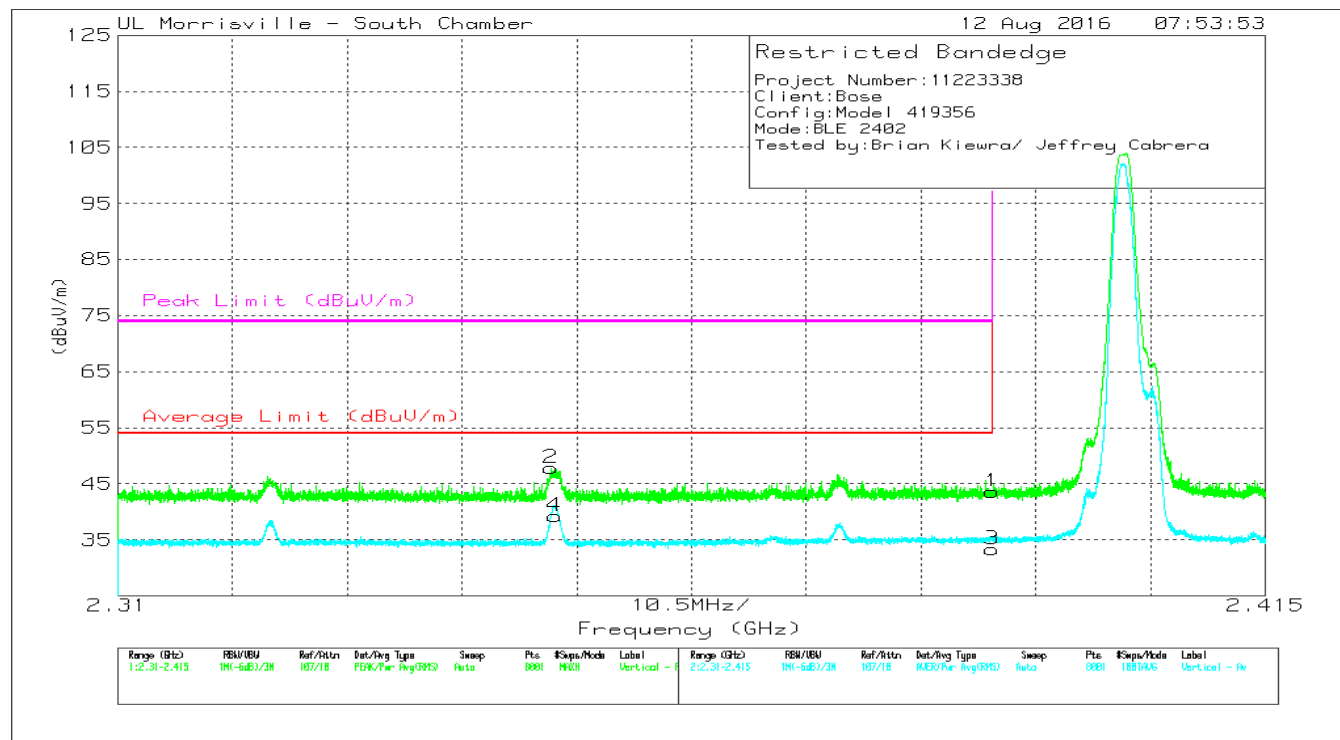
Pk - Peak detector

RMS - RMS detection

Low CH Bandedge - H.TST

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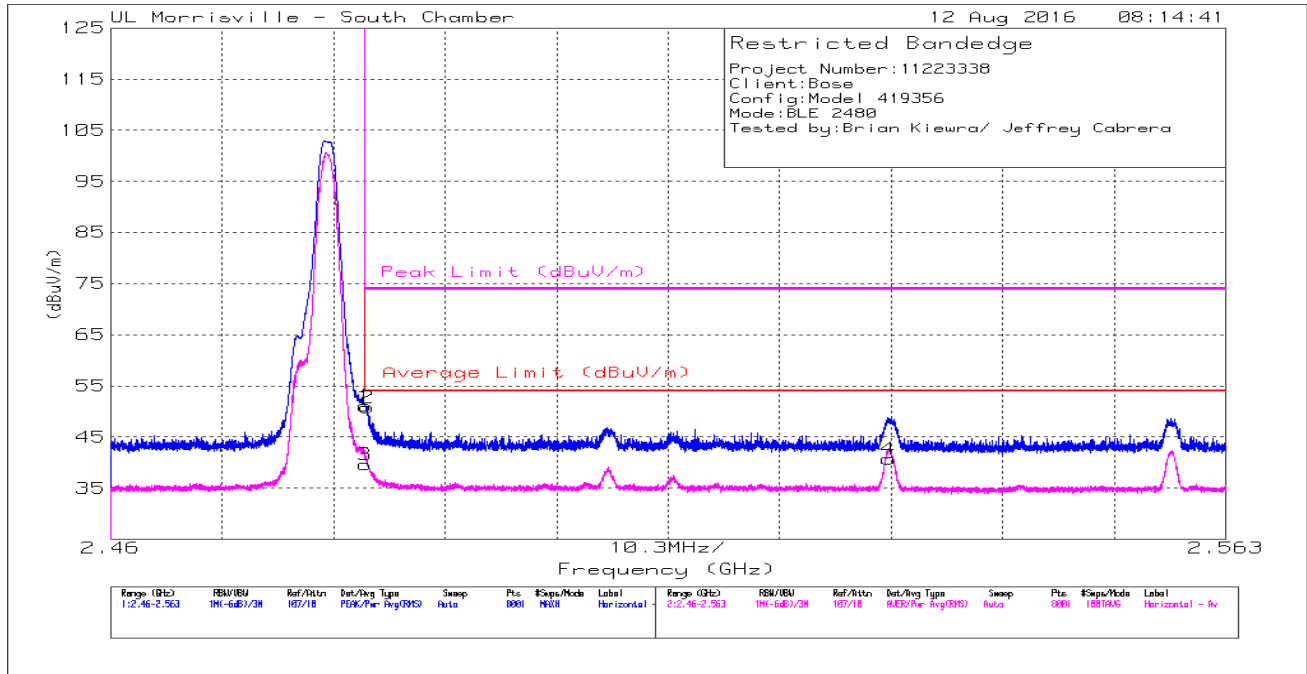
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF AT0069 (dB/m)	Amp/Cbl/FI tr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	35.62	Pk	32.2	-24.2	0	43.62	-	-	74	-30.38	34	327	V
2	* 2.35	40.01	Pk	31.8	-24	0	47.81	-	-	74	-26.19	34	327	V
3	* 2.39	25.3	RMS	32.2	-24.2	1.96	35.26	54	-18.74	-	-	34	327	V
4	* 2.35	31.44	RMS	31.8	-24	1.96	41.2	54	-12.8	-	-	34	327	V

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

RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



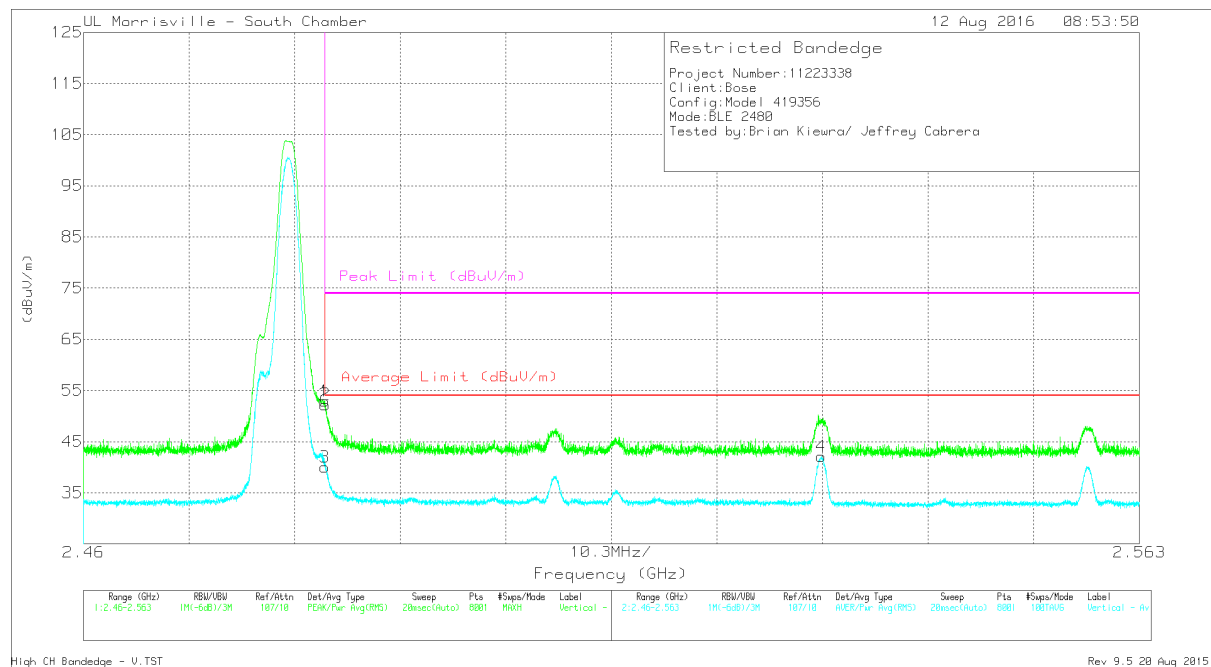
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF AT0069 (dB/m)	Amp/Cbl/FI tr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	43.42	Pk	32.4	-24.7	0	51.12	-	-	74	-22.88	350	375	H
2	* 2.484	43.07	Pk	32.4	-24.7	0	50.77	-	-	74	-23.23	350	375	H
3	* 2.484	31.89	RMS	32.4	-24.7	1.96	41.55	54	-12.45	-	-	350	375	H
4	2.532	33.24	RMS	32.4	-24.9	1.96	42.7	54	-11.3	-	-	350	375	H

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

Pk - Peak detector

RMS - RMS detection

RESTRICTED BANDEGE (HIGH CHANNEL, VERTICAL)



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF AT0069 (dB/m)	Amp/Cbl/FI tr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	45.21	Pk	32.4	-24.7	0	52.91	-	-	74	-21.09	31	335	V
2	* 2.484	44.54	Pk	32.4	-24.7	0	52.24	-	-	74	-21.76	31	335	V
3	* 2.484	32.3	RMS	32.4	-24.7	1.96	41.96	54	-12.04	-	-	31	335	V
4	2.532	34.61	RMS	32.4	-24.9	1.96	44.07	54	-9.93	-	-	31	335	V

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

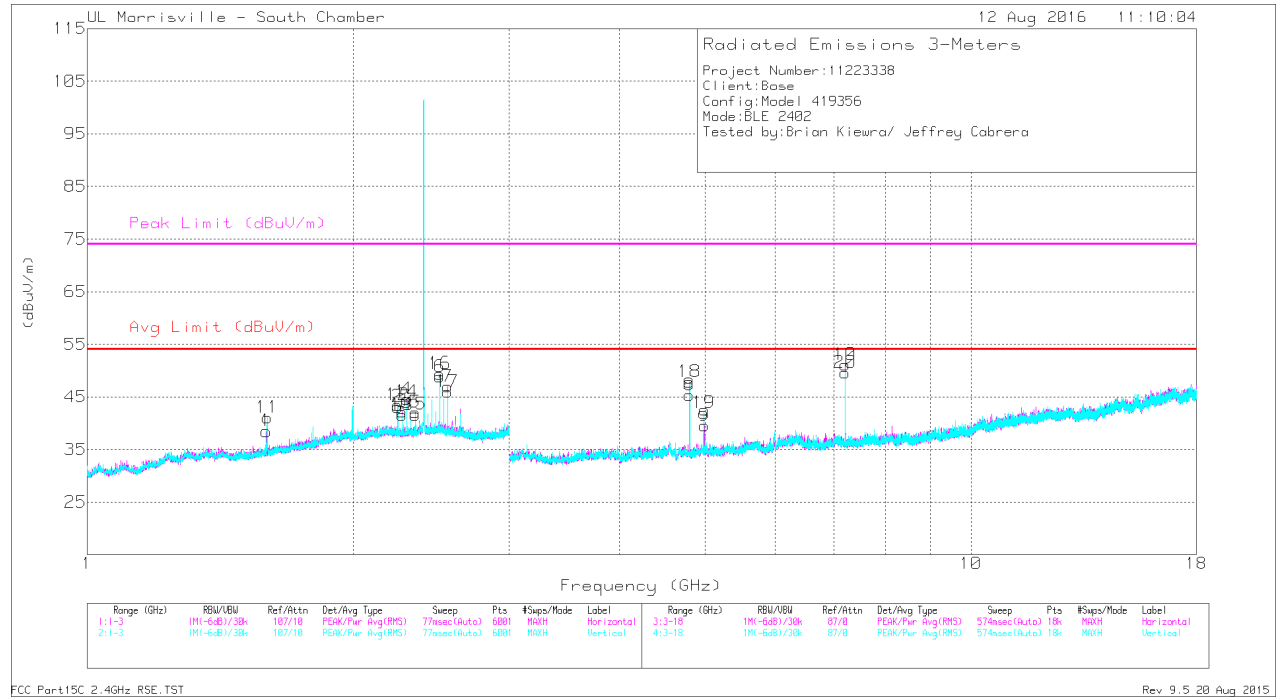
Pk - Peak detector

RMS - RMS detection

High CH Bandedge - V.TST

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HARMONICS AND SPURIOUS EMISSIONS



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF AT0069 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.595	41.55	PK2	28.3	-22.5	0	47.35	-	-	74	-26.65	175	198	H
	* 1.593	23.74	MAv1	28.3	-22.5	1.96	31.5	54	-22.5	-	-	175	198	H
2	* 2.246	40.38	PK2	31.7	-23.6	0	48.48	-	-	74	-25.52	78	198	H
	* 2.246	31.37	MAv1	31.7	-23.6	1.96	41.43	54	-12.57	-	-	78	198	H
3	* 2.272	39.5	PK2	31.7	-23.7	0	47.5	-	-	74	-26.5	111	198	H
	* 2.272	29.98	MAv1	31.7	-23.7	1.96	39.94	54	-14.06	-	-	111	198	H
4	* 2.298	41.08	PK2	31.7	-23.8	0	48.98	-	-	74	-25.02	89	198	H
	* 2.298	33.11	MAv1	31.7	-23.8	1.96	42.97	54	-11.03	-	-	89	198	H
5	* 2.35	39.51	PK2	31.8	-24	0	47.31	-	-	74	-26.69	84	198	H
	* 2.35	30.04	MAv1	31.8	-24	1.96	39.8	54	-14.2	-	-	84	198	H
8	* 4.804	46.99	PK2	34	-31.7	0	49.29	-	-	74	-24.71	213	198	H
	* 4.804	39.33	MAv1	34	-31.7	1.96	43.59	54	-10.41	-	-	213	198	H
9	* 4.999	39.88	PK2	34.1	-32	0	41.98	-	-	74	-32.02	163	198	H
	* 4.998	28.06	MAv1	34.1	-32	1.96	32.12	54	-21.88	-	-	163	198	H
11	* 1.599	35.77	PK2	28.4	-22.5	0	41.67	-	-	74	-32.33	61	198	V
	* 1.597	23.59	MAv1	28.3	-22.5	1.96	31.35	54	-22.65	-	-	61	198	V
12	* 2.246	40.27	PK2	31.7	-23.6	0	48.37	-	-	74	-25.63	56	198	V
	* 2.246	31.15	MAv1	31.7	-23.6	1.96	41.21	54	-12.79	-	-	56	198	V
13	* 2.272	39.21	PK2	31.7	-23.7	0	47.21	-	-	74	-26.79	47	198	V
	* 2.272	29.56	MAv1	31.7	-23.7	1.96	39.52	54	-14.48	-	-	47	198	V
14	* 2.298	41.09	PK2	31.7	-23.8	0	48.99	-	-	74	-25.01	41	198	V
	* 2.298	33.24	MAv1	31.7	-23.8	1.96	43.1	54	-10.9	-	-	41	198	V
15	* 2.35	39.53	PK2	31.8	-24	0	47.33	-	-	74	-26.67	35	198	V
	* 2.35	29.82	MAv1	31.8	-24	1.96	39.58	54	-14.42	-	-	35	198	V
18	* 4.804	48.95	PK2	34	-31.7	0	51.25	-	-	74	-22.75	154	198	V
	* 4.804	42.06	MAv1	34	-31.7	1.96	46.32	54	-7.68	-	-	154	198	V
19	* 4.986	39.25	PK2	34.1	-32	0	41.35	-	-	74	-32.65	17	198	V
	* 4.986	27.95	MAv1	34.1	-32	1.96	32.01	54	-21.99	-	-	17	198	V

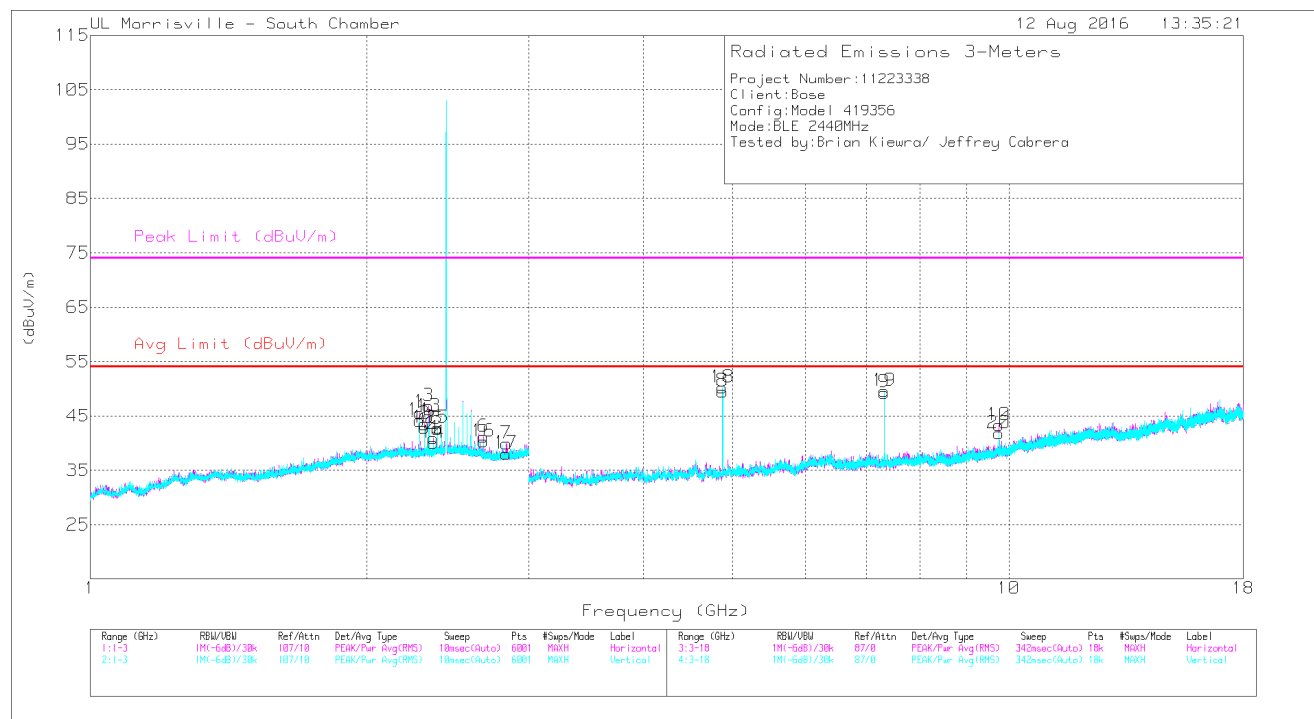
Marker	Frequency (GHz)	Meter Reading (dBUV)	Det	AF AT0069 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBUV/m)	Avg Limit (dBUV/m)	Margin (dB)	Peak Limit (dBUV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
6	2.506	41.16	Pk	32.5	-24.8	0	48.86	-	-	-	-	0-360	199	H
7	2.558	39.69	Pk	32.4	-25.1	0	46.99	-	-	-	-	0-360	199	H
10	7.205	44.19	Pk	35.6	-28.7	0	51.09	-	-	-	-	0-360	199	H
16	2.506	41.69	Pk	32.5	-24.8	0	49.39	-	-	-	-	0-360	199	V
17	2.558	38.66	Pk	32.4	-25.1	0	45.96	-	-	-	-	0-360	199	V
20	7.206	42.67	Pk	35.6	-28.7	0	49.57	-	-	-	-	0-360	199	V

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

Pk - Peak detector

PK2 - Maximum Peak

MAv1 - Maximum RMS Average



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF AT0069 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.284	41.65	PK2	31.7	-23.8	0	49.55	-	-	74	-24.45	89	198	H
	* 2.284	33.72	MAv1	31.7	-23.8	1.96	43.58	54	-10.42	-	-	89	198	H
3	* 2.336	42.02	PK2	31.8	-24	0	49.82	-	-	74	-24.18	340	198	H
	* 2.336	33.6	MAv1	31.8	-24	1.96	43.36	54	-10.64	-	-	340	198	H
4	* 2.362	38.19	PK2	31.9	-24.2	0	45.89	-	-	74	-28.11	70	198	H
	* 2.362	28.58	MAv1	31.9	-24.2	1.96	38.24	54	-15.76	-	-	70	198	H
5	* 2.388	39.8	PK2	32.2	-24.1	0	47.9	-	-	74	-26.1	73	198	H
	* 2.388	29.82	MAv1	32.2	-24.1	1.96	39.88	54	-14.12	-	-	73	198	H
6	* 2.68	40.06	PK2	32.4	-25.9	0	46.56	-	-	74	-27.44	125	198	H
	* 2.68	30.38	MAv1	32.4	-25.9	1.96	38.84	54	-15.16	-	-	125	198	H
7	* 2.838	37.58	PK2	32.8	-26.2	0	44.18	-	-	74	-29.82	306	104	H
	* 2.84	25.87	MAv1	32.8	-26.2	1.96	34.43	54	-19.57	-	-	306	104	H
11	* 2.284	41	PK2	31.7	-23.8	0	48.9	-	-	74	-25.1	33	198	V
	* 2.284	32.6	MAv1	31.7	-23.8	1.96	42.46	54	-11.54	-	-	33	198	V
13	* 2.336	41.46	PK2	31.8	-24	0	49.26	-	-	74	-24.74	40	198	V
	* 2.336	33.5	MAv1	31.8	-24	1.96	43.26	54	-10.74	-	-	40	198	V
14	* 2.362	38.36	PK2	31.9	-24.2	0	46.06	-	-	74	-27.94	27	103	V
	* 2.362	27.98	MAv1	31.9	-24.2	1.96	37.64	54	-16.36	-	-	27	103	V
15	* 2.388	40.18	PK2	32.2	-24.1	0	48.28	-	-	74	-25.72	43	198	V
	* 2.388	31.06	MAv1	32.2	-24.1	1.96	41.12	54	-12.88	-	-	43	198	V
16	* 2.68	39.76	PK2	32.4	-25.9	0	46.26	-	-	74	-27.74	34	104	V
	* 2.68	29.8	MAv1	32.4	-25.9	1.96	38.26	54	-15.74	-	-	34	104	V
17	* 2.836	37.52	PK2	32.7	-26.2	0	44.02	-	-	74	-29.98	312	198	V
	* 2.837	25.87	MAv1	32.7	-26.2	1.96	34.33	54	-19.67	-	-	312	198	V
8	* 4.88	48.99	PK2	34.1	-31.6	0	51.49	-	-	74	-22.51	232	198	H
	* 4.88	42.31	MAv1	34.1	-31.6	1.96	46.77	54	-7.23	-	-	232	198	H
9	* 7.319	45.04	PK2	35.5	-28.4	0	52.14	-	-	74	-21.86	283	198	H
	* 7.319	37	MAv1	35.5	-28.4	1.96	46.06	54	-7.94	-	-	283	198	H
18	* 4.88	50.14	PK2	34.1	-31.6	0	52.64	-	-	74	-21.36	12	198	V
	* 4.88	43.39	MAv1	34.1	-31.6	1.96	47.85	54	-6.15	-	-	12	198	V
19	* 7.319	46.01	PK2	35.5	-28.4	0	53.11	-	-	74	-20.89	269	198	V

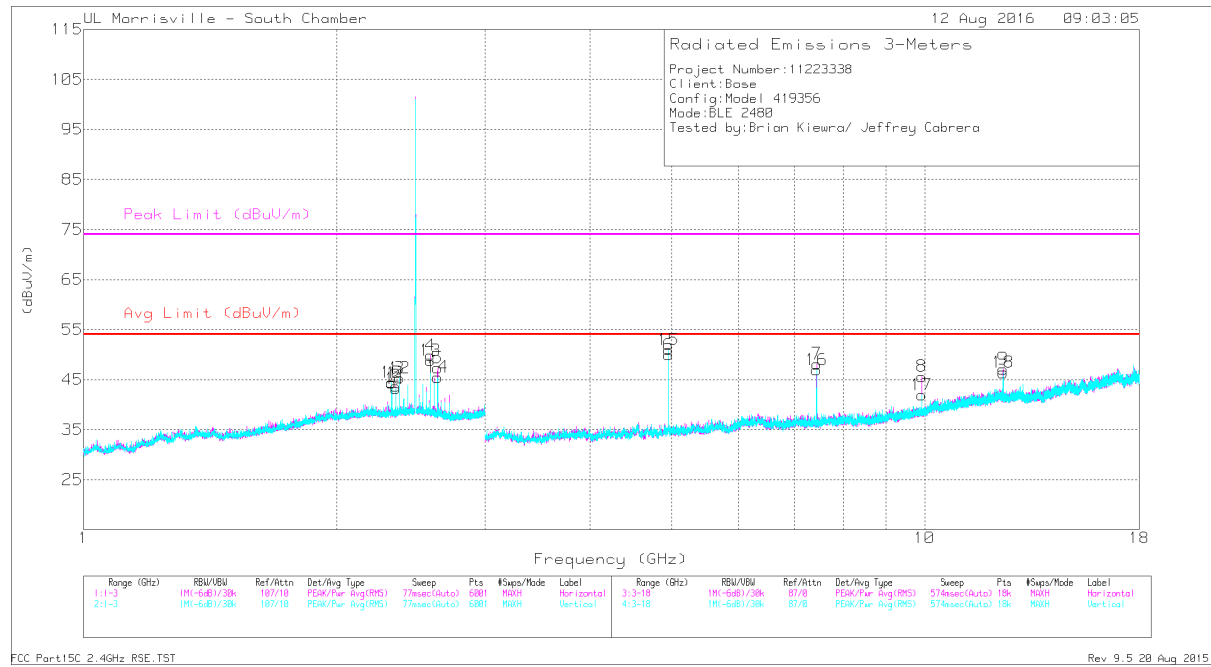
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF AT0069 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
	* 7.319	38.37	MAv1	35.5	-28.4	1.96	47.43	54	-6.57	-	-	269	198	V
2	2.31	35.63	Pk	31.7	-23.8	0	43.53	-	-	-	-	0-360	199	H
12	2.31	34.93	Pk	31.7	-23.8	0	42.83	-	-	-	-	0-360	199	V
20	9.758	31.54	Pk	36.8	-26.5	0	41.84	-	-	-	-	0-360	102	V
10	9.759	32.98	Pk	36.8	-26.5	0	43.28	-	-	-	-	0-360	199	H

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

Pk - Peak detector

PK2 - Maximum Peak

MAv1 - Maximum RMS Average



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF AT0069 (dB/m)	Amp/Cbl/Fitr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.324	40.98	PK2	31.7	-23.9	0	48.78	-	-	74	-25.22	88	199	H
	* 2.324	33.17	MAv1	31.7	-23.9	1.96	42.93	54	-11.07	-	-	88	199	H
2	* 2.35	40.56	PK2	31.8	-24	0	48.36	-	-	74	-25.64	86	199	H
	* 2.35	31.69	MAv1	31.8	-24	1.96	41.45	54	-12.55	-	-	86	199	H
3	* 2.376	41.89	PK2	32.1	-24.1	0	49.89	-	-	74	-24.11	86	199	H
	* 2.376	33.98	MAv1	32.1	-24.1	1.96	43.94	54	-10.06	-	-	86	199	H
10	* 2.324	40.92	PK2	31.7	-23.9	0	48.72	-	-	74	-25.28	39	199	V
	* 2.324	33.16	MAv1	31.7	-23.9	1.96	42.92	54	-11.08	-	-	39	199	V
11	* 2.35	40.44	PK2	31.8	-24	0	48.24	-	-	74	-25.76	40	199	V
	* 2.35	31.66	MAv1	31.8	-24	1.96	41.42	54	-12.58	-	-	40	199	V
12	* 2.376	42.03	PK2	32.1	-24.1	0	50.03	-	-	74	-23.97	45	199	V
	* 2.376	34.17	MAv1	32.1	-24.1	1.96	44.13	54	-9.87	-	-	45	199	V
6	* 4.96	49.2	PK2	34.1	-31.6	0	51.7	-	-	74	-22.3	30	104	H
	* 4.96	42.35	MAv1	34.1	-31.6	1.96	46.81	54	-7.19	-	-	30	104	H
7	* 7.439	44.95	PK2	35.5	-28.6	0	51.85	-	-	74	-22.15	316	199	H
	* 7.439	37.1	MAv1	35.5	-28.6	1.96	45.96	54	-8.04	-	-	316	199	H
9	* 12.399	37.8	PK2	39	-25	0	51.8	-	-	74	-22.2	47	104	H
	* 12.399	27.78	MAv1	39	-25	1.96	43.74	54	-10.26	-	-	47	104	H
15	* 4.959	51.48	PK2	34.1	-31.6	0	53.98	-	-	74	-20.02	23	214	V
	* 4.96	45	MAv1	34.1	-31.6	1.96	49.46	54	-4.54	-	-	23	214	V
16	* 7.439	45.05	PK2	35.5	-28.6	0	51.95	-	-	74	-22.05	22	201	V
	* 7.439	36.68	MAv1	35.5	-28.6	1.96	45.54	54	-8.46	-	-	22	201	V
18	* 12.4	38.41	PK2	39	-25	0	52.41	-	-	74	-21.59	50	201	V
	* 12.399	27.75	MAv1	39	-25	1.96	43.71	54	-10.29	-	-	50	201	V
4	2.584	42.78	Pk	32.4	-25.3	0	49.88	-	-	-	-	0-360	200	H
13	2.584	41.78	Pk	32.4	-25.3	0	48.88	-	-	-	-	0-360	102	V
5	2.636	40.55	Pk	32.5	-25.7	0	47.35	-	-	-	-	0-360	200	H
14	2.636	38.71	Pk	32.5	-25.7	0	45.51	-	-	-	-	0-360	200	V
8	9.92	35.04	Pk	37.1	-26.5	0	45.64	-	-	-	-	0-360	102	H
17	9.92	31.31	Pk	37.1	-26.5	0	41.91	-	-	-	-	0-360	102	V

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

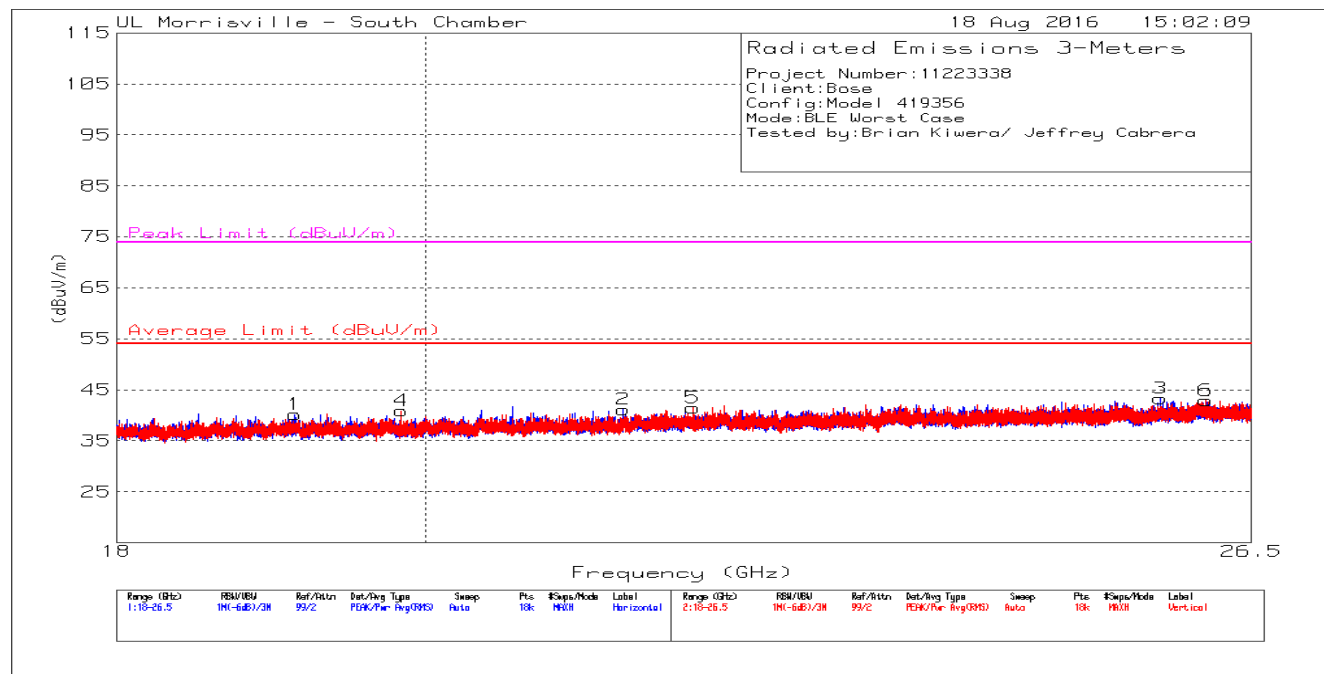
Pk - Peak detector

PK2 - Maximum Peak

MAv1 - Maximum RMS Average

9.2.2. WORST-CASE ABOVE 18GHz

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



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF AT0076 (dB/m)	Amp/Cbl (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuths (Degs)	Height (cm)	Polarity
1	* 19.127	48.12	PK2	32.9	-40.8	0	40.22	54	-13.78	74	-33.78	313	149	H
2	* 21.391	46.96	PK2	33.4	-40	0	40.36	54	-13.64	74	-33.64	268	248	H
4	* 19.836	49.07	PK2	33	-40.4	0	41.67	54	-12.33	74	-32.33	246	203	V
3	25.689	46.31	Pk	34.9	-37.9	0	43.31	54	-10.69	74	-30.69	0-360	199	H
5	21.909	47.94	Pk	33.6	-40.1	0	41.44	54	-12.56	74	-32.56	0-360	101	V
6	26.092	45.52	Pk	35	-37.6	0	42.92	54	-11.08	74	-31.08	0-360	151	V

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

Pk - Peak detector

PK2 - Maximum Peak

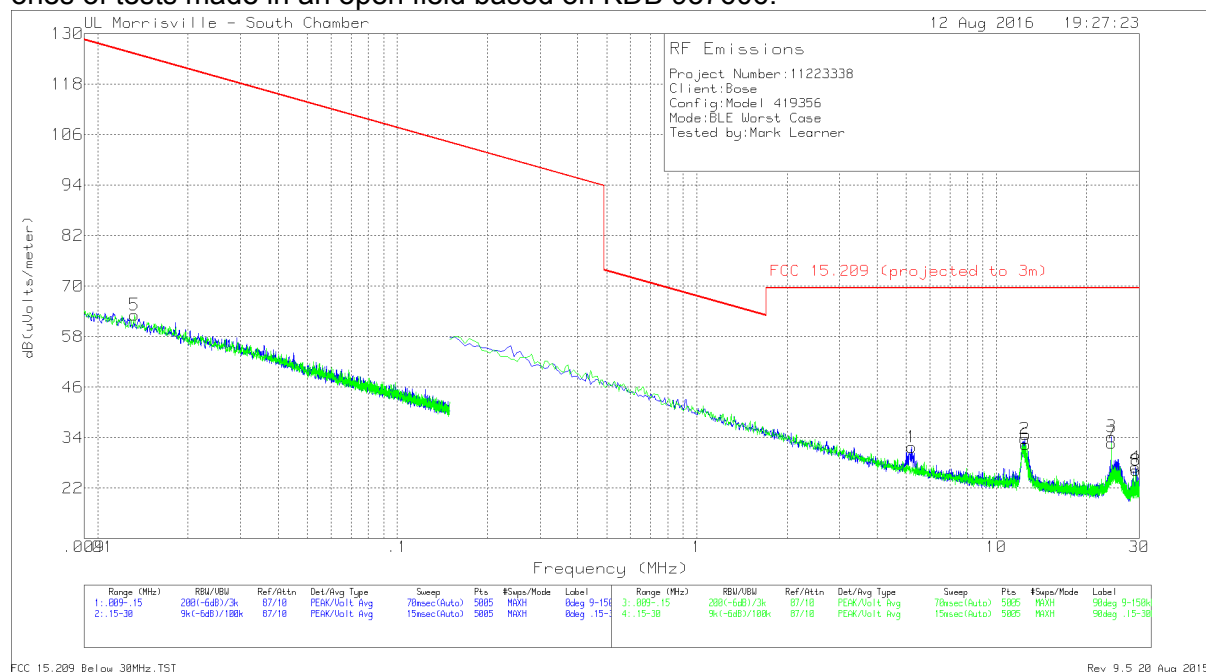
MAV1 - Maximum RMS Average

9.3. WORST-CASE BELOW 1 GHz

SPURIOUS EMISSIONS 9kHz to 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 $40 \cdot \log$ (specification distance / test distance).

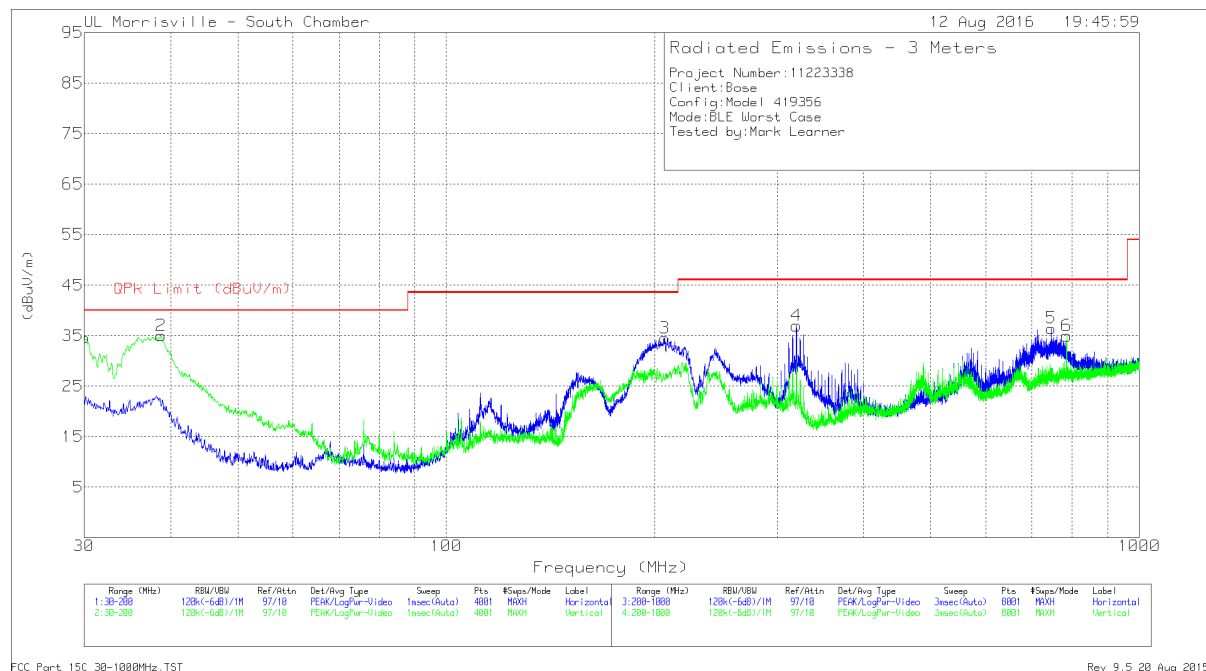
Although these tests were performed at a test site other than an open area test site, adequate comparison measurements were confirmed against an open area test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 937606.



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0079 AF (dB/m)	Cbl (dB)	Corrected Reading dB(uV/m)	FCC 15.209 (projected to 3m)	Margin (dB)	Azimuth (Degs)	Polarity
1	5.20832	20.05	Pk	11.3	.4	31.75	69.54	-37.79	0-360	On
2	12.43194	22.21	Pk	10.9	.6	33.71	69.54	-35.83	0-360	On
3	24.25457	24.15	Pk	9.3	.8	34.25	69.54	-35.29	0-360	On
4	29.11604	17.57	Pk	8.5	.9	26.97	69.54	-42.57	0-360	On
5	.01326	45.34	Pk	17.7	.1	63.14	125.16	-62.02	0-360	Off
6	12.53334	21	Pk	10.8	.6	32.4	69.54	-37.14	0-360	Off
7	24.25457	22.63	Pk	9.3	.8	32.73	69.54	-36.81	0-360	Off
8	29.23534	16.81	Pk	8.5	.9	26.21	69.54	-43.33	0-360	Off

Pk - Peak detector

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



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0074 AF (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	206.5	49.01	Pk	15.6	-30.1	34.51	43.52	-9.01	0-360	102	H
4	320	47.98	Pk	18.5	-29.5	36.98	46.02	-9.04	0-360	102	H
5	746.1	39.46	Pk	25.2	-28.2	36.46	46.02	-9.56	0-360	102	H
1	30.0329	35.73	Qp	26	-31.8	29.93	40	-10.07	261	105	V
2	38.9024	43.05	Qp	19.2	-31.7	30.55	40	-9.45	123	105	V
6	785.6	37.07	Pk	25.9	-28	34.97	46.02	-11.05	0-360	299	V

Pk - Peak detector

Qp - Quasi-Peak detector

10. 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

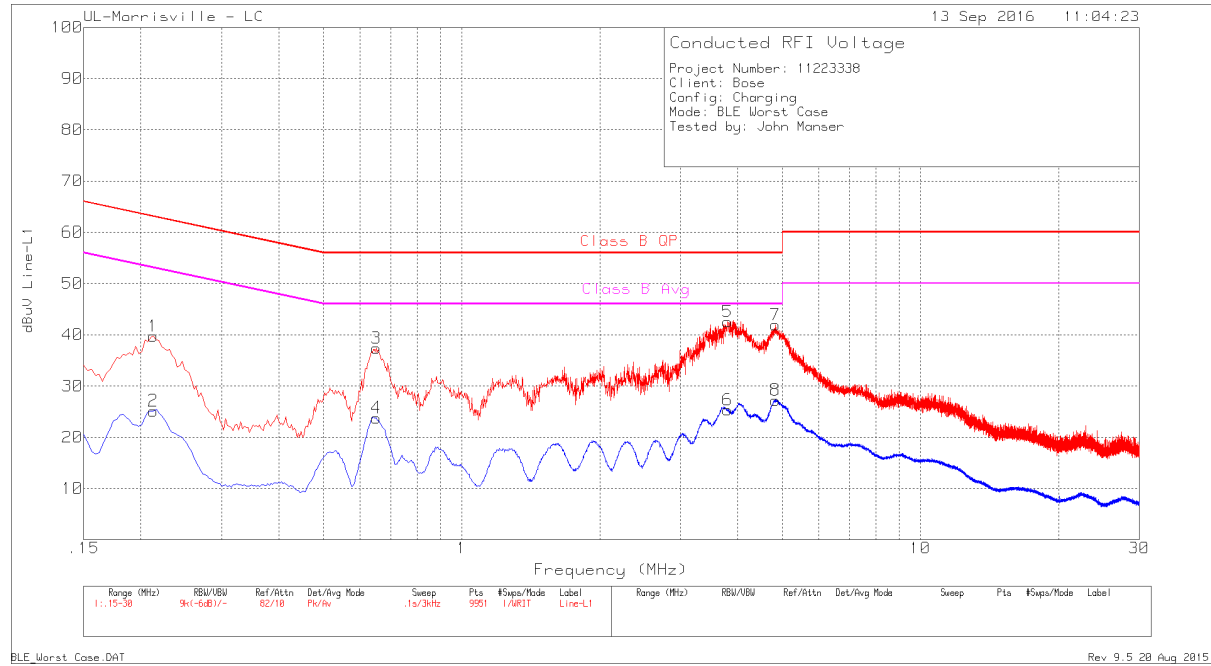
The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.10.

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.

RESULTS

LINE 1 RESULTS

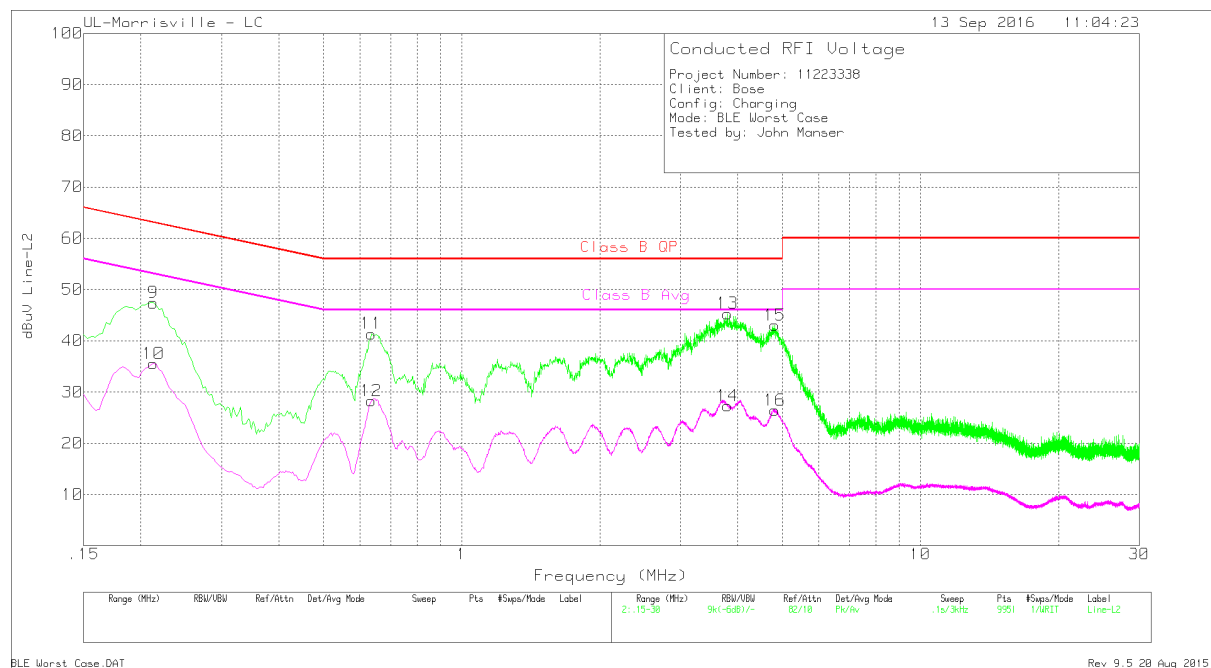


Range 1: Line-L1 .15 - 30MHz										
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN VCF (dB)	Cbl/Limiter (dB)	Corrected Reading dBuV	QP Limit	Margin (dB)	AVG Limit	Margin (dB)
1	.213	29.59	Pk	.1	10	39.69	63.09	-23.4	-	-
2	.213	15.05	Av	.1	10	25.15	-	-	53.09	-27.94
3	.651	27.4	Pk	0	10	37.4	56	-18.6	-	-
4	.651	13.78	Av	0	10	23.78	-	-	46	-22.22
5	3.804	32.45	Pk	0	10.1	42.55	56	-13.45	-	-
6	3.804	15.22	Av	0	10.1	25.32	-	-	46	-20.68
7	4.827	31.74	Pk	0	10.2	41.94	56	-14.06	-	-
8	4.827	17.04	Av	0	10.2	27.24	-	-	46	-18.76

Pk - Peak detector

Av - Average detection

LINE 2 RESULTS



Range 2: Line-L2 .15 - 30MHz										
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN VCF (dB)	Cbl/Limiter (dB)	Corrected Reading dBuV	QP Limit	Margin (dB)	AVG Limit	Margin (dB)
9	.213	37.32	Pk	.1	10	47.42	63.09	-15.67	-	-
10	.213	25.42	Av	.1	10	35.52	-	-	53.09	-17.57
11	.636	31.38	Pk	0	10	41.38	56	-14.62	-	-
12	.636	18.29	Av	0	10	28.29	-	-	46	-17.71
13	3.798	35.22	Pk	0	10.1	45.32	56	-10.68	-	-
14	3.798	17.19	Av	0	10.1	27.29	-	-	46	-18.71
15	4.809	32.86	Pk	0	10.2	43.06	56	-12.94	-	-
16	4.809	16.22	Av	0	10.2	26.42	-	-	46	-19.58

Pk - Peak detector

Av - Average detection

BLE_Worst Case.DAT

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