BLE CERTIFICATION TEST REPORT

Report Number. : R11694639-E2

Applicant	:	MAGIC LEAP, INC. 7500 WEST SUNRISE BOULEVARD PLANTATION, FL 33322, USA
Model	:	M2001
FCC ID	:	2AM5NM2000
IC	:	23045-M2000
EUT Description	:	MAGIC LEAP ONE - CONTROL WITH 2.4G PROPRIETARY RADIO (BLE) AND EM TRANSMITTER
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C ISED RSS-247 ISSUE 2 ISED RSS-GEN ISSUE 4

Date Of Issue:
June 15, 2018

Prepared by:
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NVLAP TESTING
ilac-MRA
NVLAP Lab code: 200246-0

Revision History

Ver.	Issue Date	Revisions	Revised By
1	2018-05-15	Initial Issue	Brian T. Kiewra
2	2018-06-04	Revised model to M2001	Brian T. Kiewra
3	2018-06-15	Revised antenna gain in Section 5.3. Revised worst-case statement to include testing of 1-18GHz in Section 5.5. Corrected limit units in Section 8.6.	Brian T. Kiewra

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Magic Leap, Inc.
7500 West Sunrise Boulevard
Plantation, FL 33322, USA

EUT DESCRIPTION: Magic Leap One - Control with 2.4G Proprietary Radio (BLE) and EM transmitter

MODEL: M2001

SERIAL NUMBER: Radiated: GA10E4J00964
Conducted: GA10E4J00983

DATE TESTED: 2018-01-23 to 2018-02-21

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Compliant
ISED CANADA RSS-247 Issue 2	Compliant
ISED CANADA RSS-GEN Issue 4	Compliant

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
Operations Leader
UL – Consumer Technology Division

Prepared By:

Brian T. Kiewra
Project Engineer
UL – Consumer Technology Division

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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, KDB 558074 D01 v04, ANSI C63.10-2013, RSS-GEN Issue 4, RSS-247 Issue 2.

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 Perimeter Park Dr., Suite B, Morrisville, NC 27560, USA.

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

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

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

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

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4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

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

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

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

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

4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY	Required by standard
Occupied Channel Bandwidth	2.00%	±5 %
RF output power, conducted	1.3 dB	±1,5 dB
Power Spectral Density, conducted	2.47 dB	±3 dB
Unwanted Emissions, conducted	2.94 dB	±3 dB
All emissions, radiated	5.36 dB	±6 dB
Temperature	2.26 °C	±3 °C
Supply voltages	2.40%	±3 %
Time	3.39%	±5 %

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

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5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a handheld controller with EM and BLE transmitters. Operates from 2401—2478 MHz.

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)
2401 - 2478	BLE	19.92	98.17

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a printed PCB antenna, with a maximum gain of +2.2 dBi.

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was v0.12_0.

5.5. WORST-CASE CONFIGURATION AND MODE

Radiated emissions 1-18GHz were performed with the EUT set to low, mid, and high channels. Radiated emission (<1GHz and >18GHz) and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power and PSD as worst-case scenario.

The EUT models was investigated in three orthogonal orientations, X,Y, and Z-axes. It was determined that Y was worst-case orientation. Therefore all radiated testing was performed in the Y orientation.

Worst-case data rates as provided by the client were:

BLE: 1 Mbps.

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5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Power Supply	Magic Leap	M3001	173700055201	NA

I/O CABLES

I/O Cable List						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	USB-C	1	USB-C	USB	<3m	None

TEST SETUP

The EUT is setup as standalone equipment.

SETUP DIAGRAM FOR TESTS

Refer to UL Report R11694639-EP2.

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6. TEST AND MEASUREMENT EQUIPMENT

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

Test Equipment Used - Wireless Conducted Measurement Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
SA0020	Spectrum Analyzer	Agilent Technologies	E4446A	2017-04-25	2018-04-25
SN 161024885	Environmental Meter	Fisher Scientific	15-077-963	2016-12-23	2018-12-23
72822 (SA0019)	Spectrum Analyzer	Agilent Technologies	E4446A	2017-08-21	2018-09-21
SN 161024885	Environmental Meter	Fisher Scientific	15-077-963	2016-12-23	2018-12-23
PWM001	RF Power Meter	Keysight Technologies	N1912A	2017-05-23	2018-05-23
PWS006	Peak and Avg Power Sensor, 50MHz to 6GHz	Keysight Technologies	E9323A	2017-05-18	2018-05-18
MM0168	True RMS Multimeter	Agilent	U1232A	2017-10-25	2018-10-30

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

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
0.009-30MHz (Loop Ant.)					
AT0059	Active Loop Antenna	EMCO	6502	2017-06-05	2018-06-30
30-1000 MHz					
AT0074	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2017-06-15	2018-06-15
1-18 GHz					
AT0069	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2017-04-05	2018-04-05
18-40 GHz					
AT0076	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2017-10-10	2018-10-10
Gain-Loss Chains					
S-SAC01	Gain-loss string: 0.009-30MHz	Various	Various	2017-09-15	2018-09-15
S-SAC02	Gain-loss string: 30-1000MHz	Various	Various	2017-06-11	2018-06-11
S-SAC03	Gain-loss string: 1-18GHz	Various	Various	2017-12-31	2018-12-31
S-SAC04	Gain-loss string: 18-40GHz	Various	Various	2017-03-03	2018-03-03
Receiver & Software					
SA0025	Spectrum Analyzer	Agilent	N9030A	2017-04-10	2018-04-10
SA0026 (18-40GHz RSE)	Spectrum Analyzer	Agilent	N9030A	2017-02-17	2018-02-28
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
Additional Equipment used					
s/n 161024887	Environmental Meter	Fisher Scientific	15-077-963	2016-12-23	2018-12-23

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7. MEASUREMENT METHODS

On Time and Duty Cycle: KDB 558074 D01 v04, Section 6.0

6 dB BW: KDB 558074 D01 v04 Section 8.1

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

Output Power: KDB 558074 D01 v04 Section 9.1.3

Power Spectral Density: KDB 558074 D01 v04 Section 10.2

Out-of-band emissions in non-restricted bands: KDB 558074 D01 v04 Section 11.0

Out-of-band emissions in restricted bands: KDB 558074 D01 v04 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

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8. ANTENNA PORT TEST RESULTS

8.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

PROCEDURE

KDB 558074 D01 v04 Zero-Span Spectrum Analyzer Method.

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 (1MBps)	0.310	0.625	0.497	49.66%	3.04	3.225

TEST INFORMATION

Test Date: 2018-02-21
Project: 11694639
Tested By: Jeffrey Cabrera

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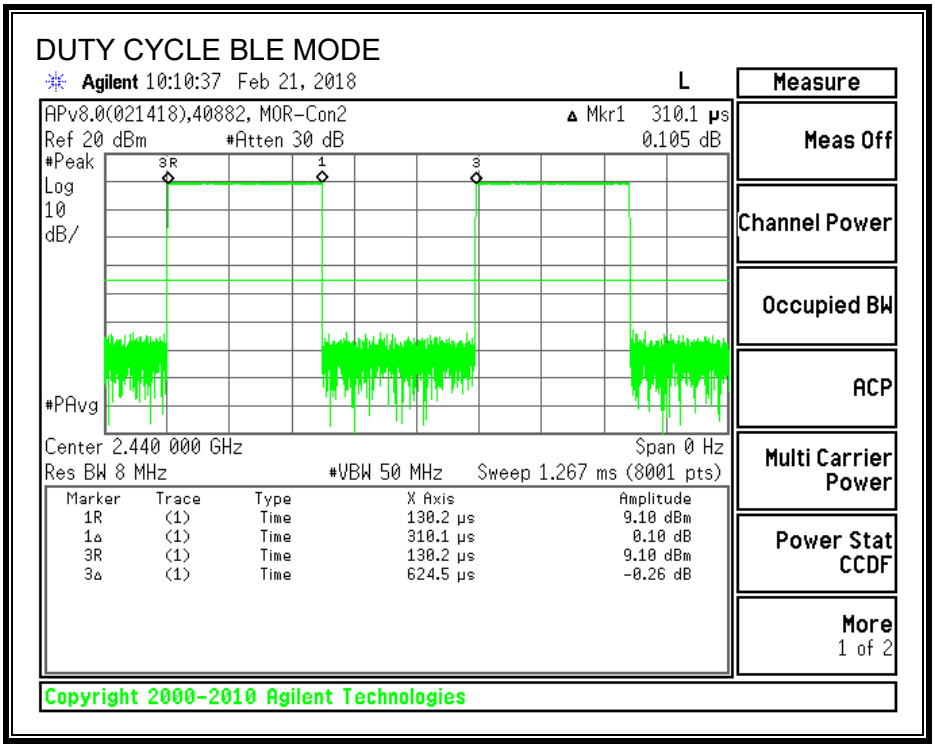
DUTY CYCLE PLOTS



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8.2.6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

ISED RSS-247 5.2 (a)

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

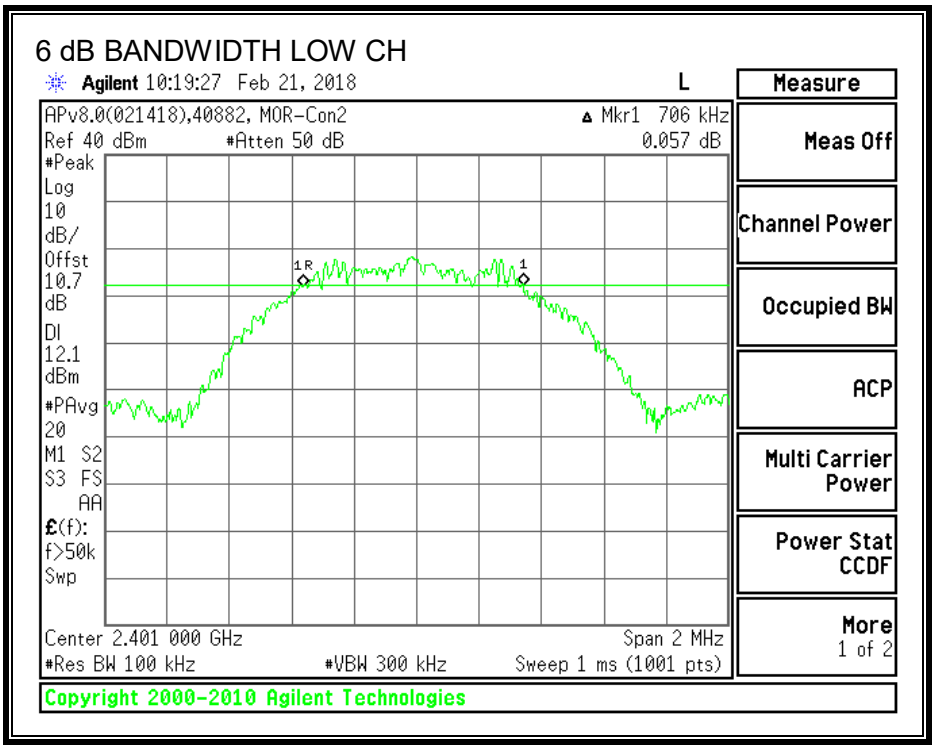
RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2401	0.706	0.5
Middle	2440	0.686	0.5
High	2478	0.700	0.5

TEST INFORMATION

Test Date: 2018-02-21
Project: 11694639
Tested By: Jeffrey Cabrera

6 dB BANDWIDTH PLOTS



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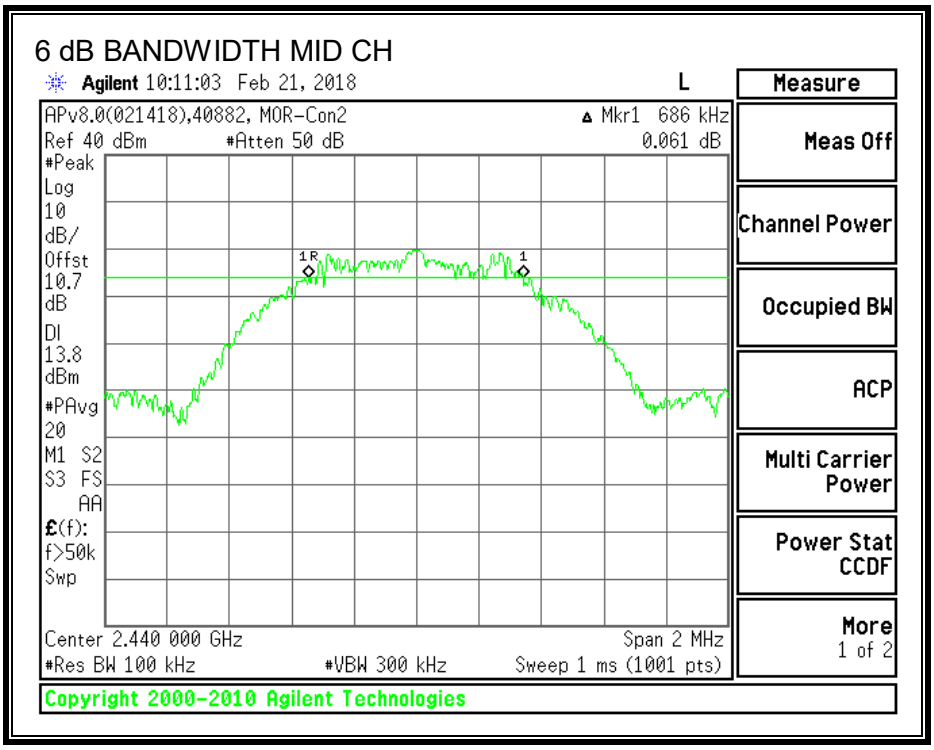
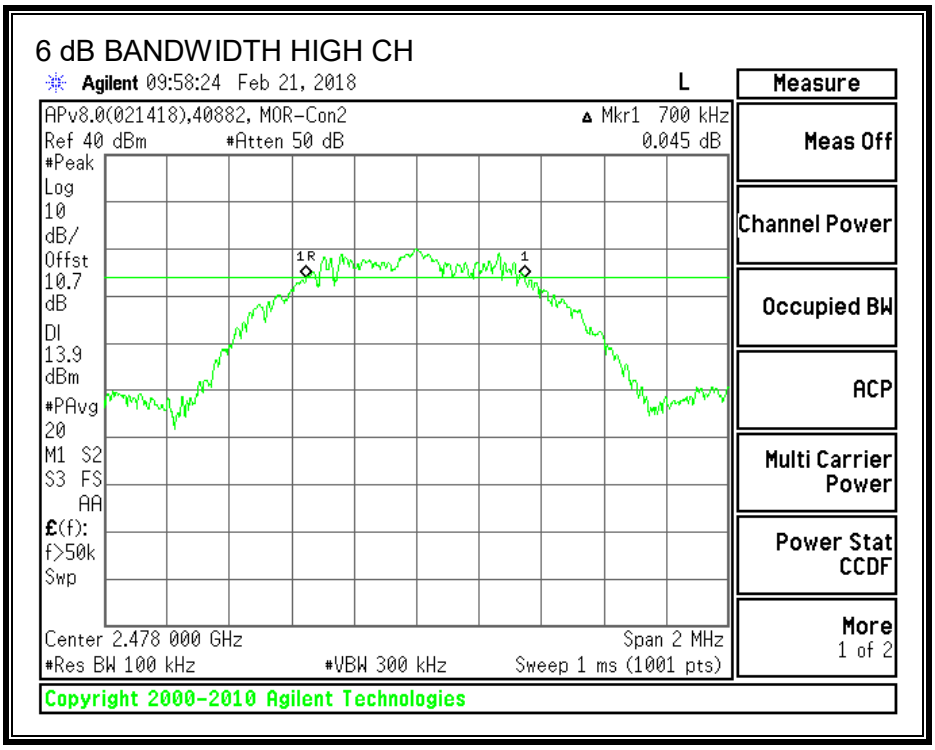
6 dB BANDWIDTH MID CH



6 dB BANDWIDTH HIGH CH



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8.3. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.
Tested per RSS-GEN.

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.

TEST INFORMATION

Test Date: 2018-02-21
Project: 11694639
Tested By: Jeffrey Cabrera

RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2401	1.0490
Middle	2440	1.0564
High	2478	1.0549

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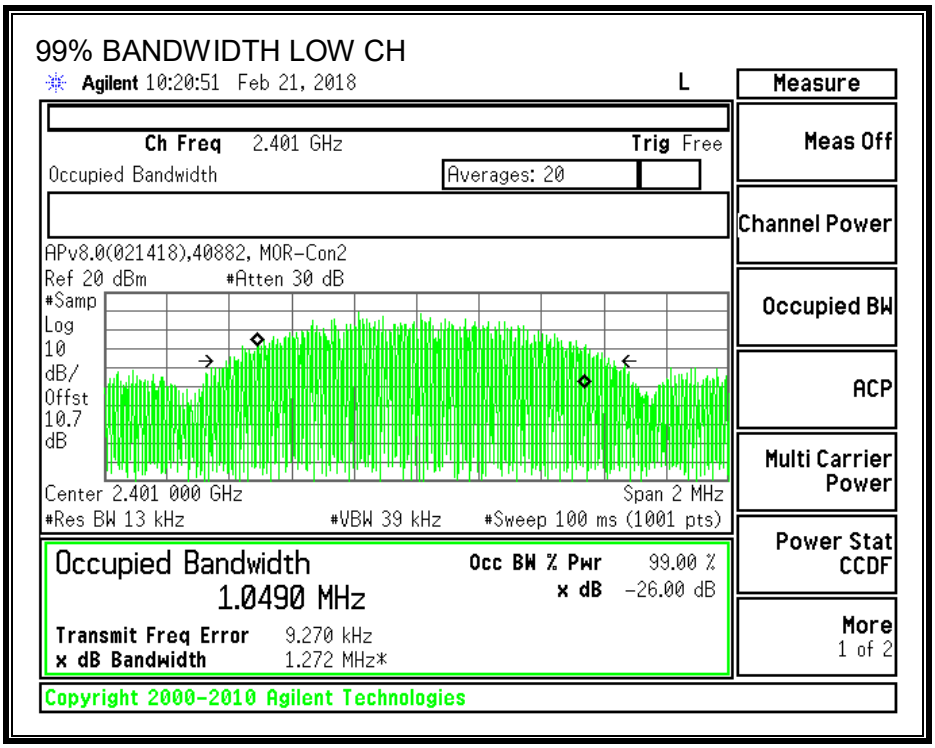
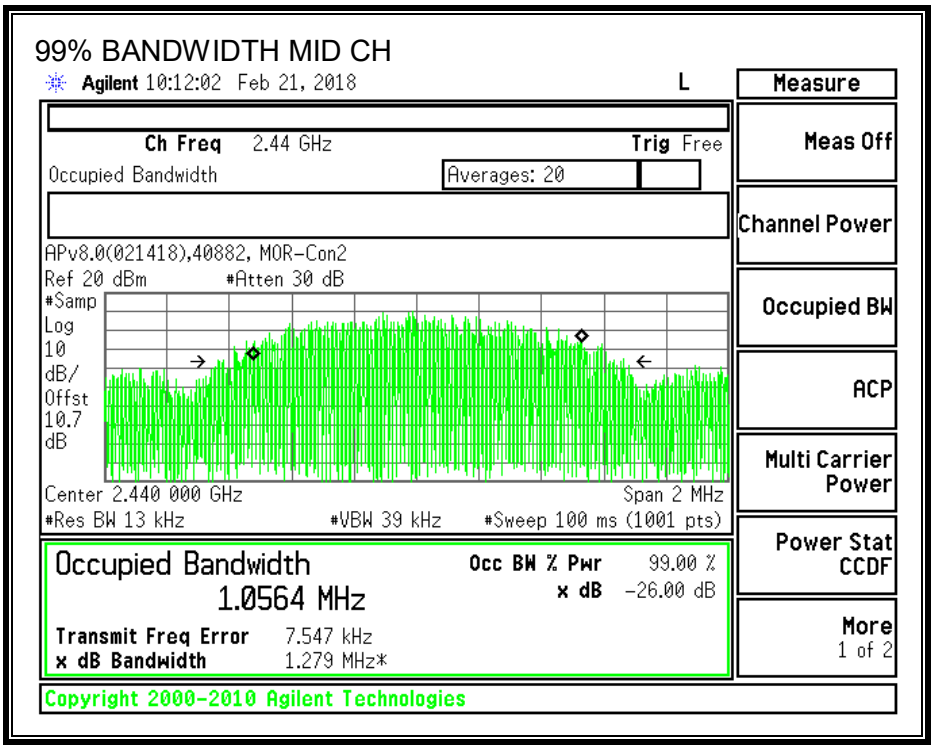
99% BANDWIDTH PLOTS





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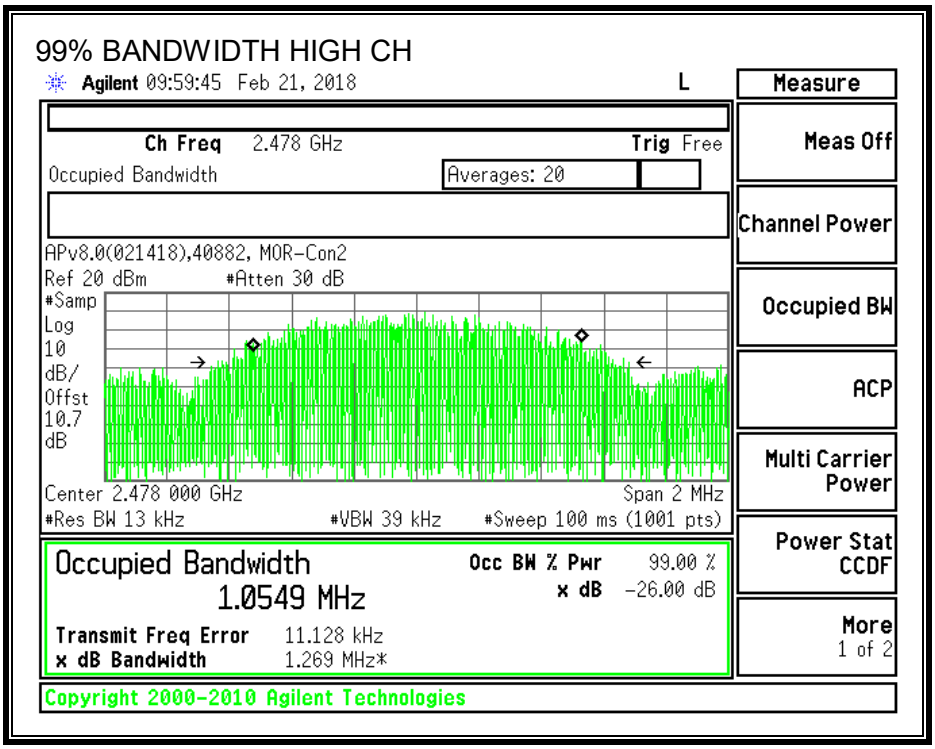

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8.4. OUTPUT POWER

LIMITS

FCC §15.247 (b)(3)

ISED RSS-247 5.4 (d)

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 30 dBm.

TEST INFORMATION

Test Date: 2018-02-21
Project: 11694639
Tested By: Jeffrey Cabrera

RESULTS

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2401	18.91	30	-11.090
Middle	2440	19.79	30	-10.210
High	2478	19.92	30	-10.080

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8.5. AVERAGE POWER

LIMITS

None; for reporting purposes only.

RESULTS

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

Channel	Frequency (MHz)	AV power (dBm)
Low	2401	18.80
Middle	2440	19.70
High	2478	19.83

TEST INFORMATION

Test Date: 2018-02-21
Project: 11694639
Tested By: Jeffrey Cabrera

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8.6. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247 (e)

ISED RSS-247 5.2 (b)

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.

TEST INFORMATION

Test Date: 2018-02-21
Project: 11694639
Tested By: Jeffrey Cabrera

RESULTS

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2401	3.614	8	-4.39
Middle	2440	5.023	8	-2.98
High	2478	5.004	8	-3.00

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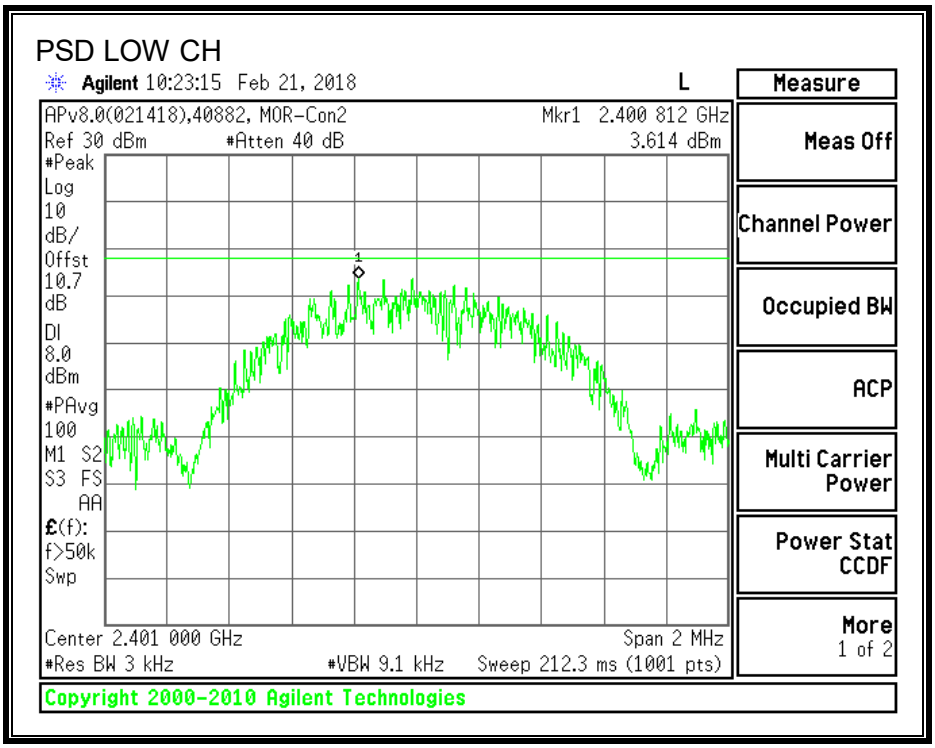
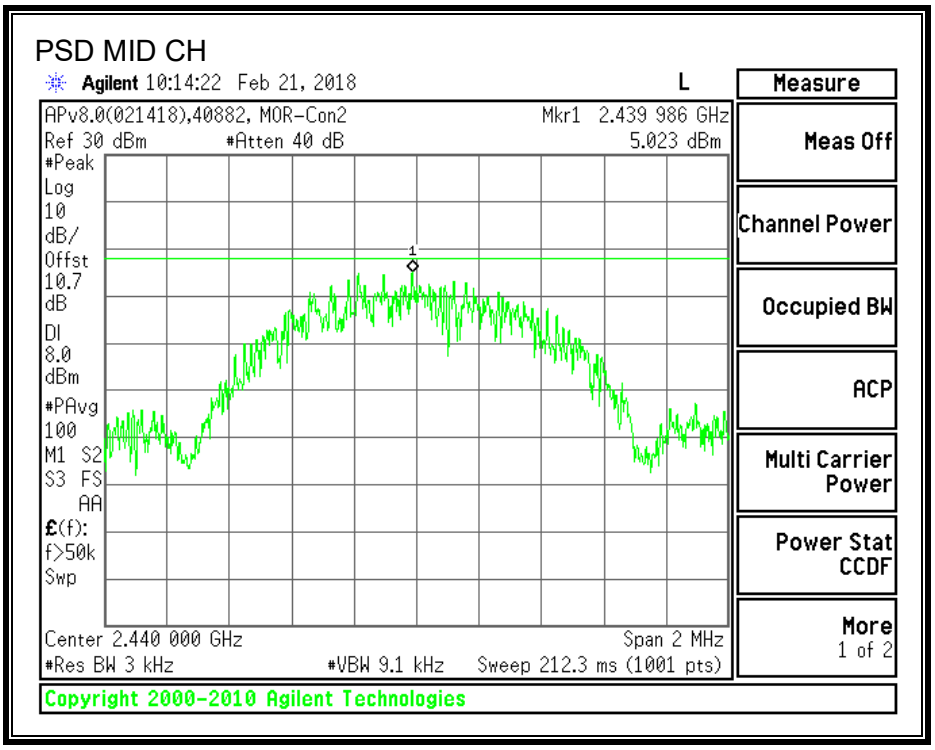
POWER SPECTRAL DENSITY PLOTS





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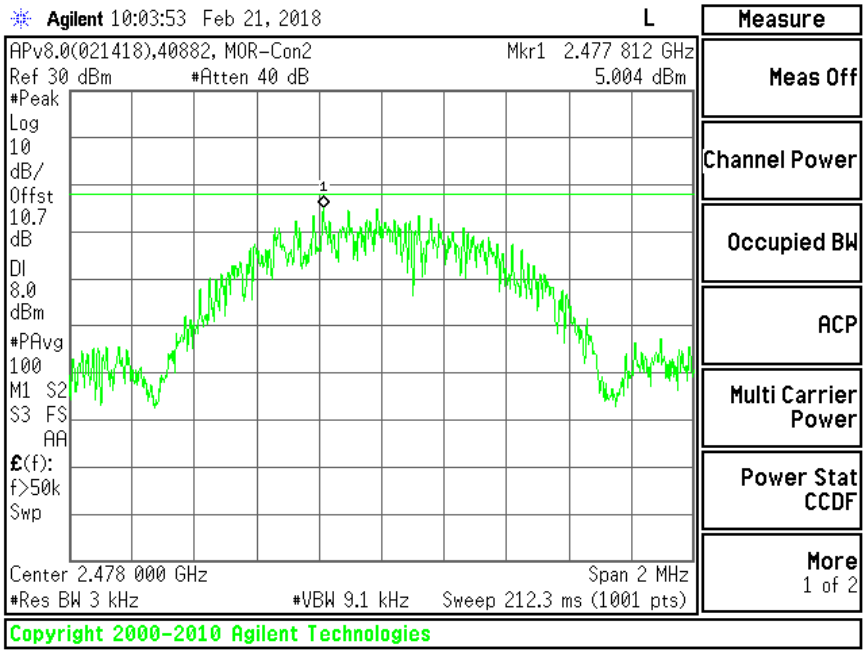
PSD HIGH CH



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8.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

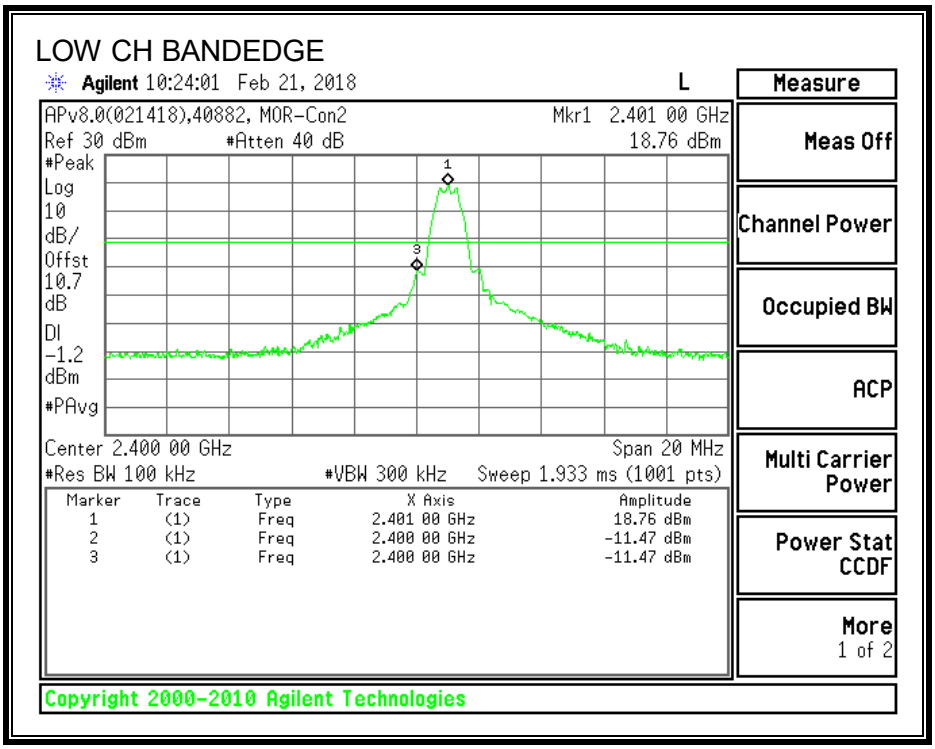
FCC §15.247 (d)

ISED RSS-247 5.5

TEST INFORMATION

Test Date: 2018-02-21
Project: 11694639
Tested By: Jeffrey Cabrera

SPURIOUS EMISSIONS, LOW CHANNEL



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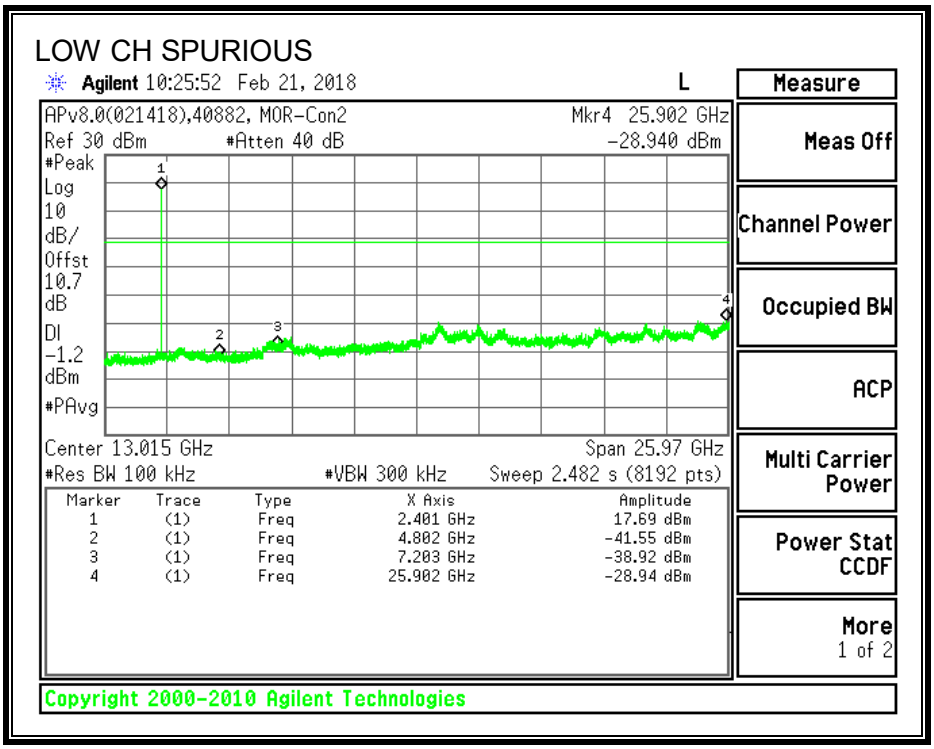
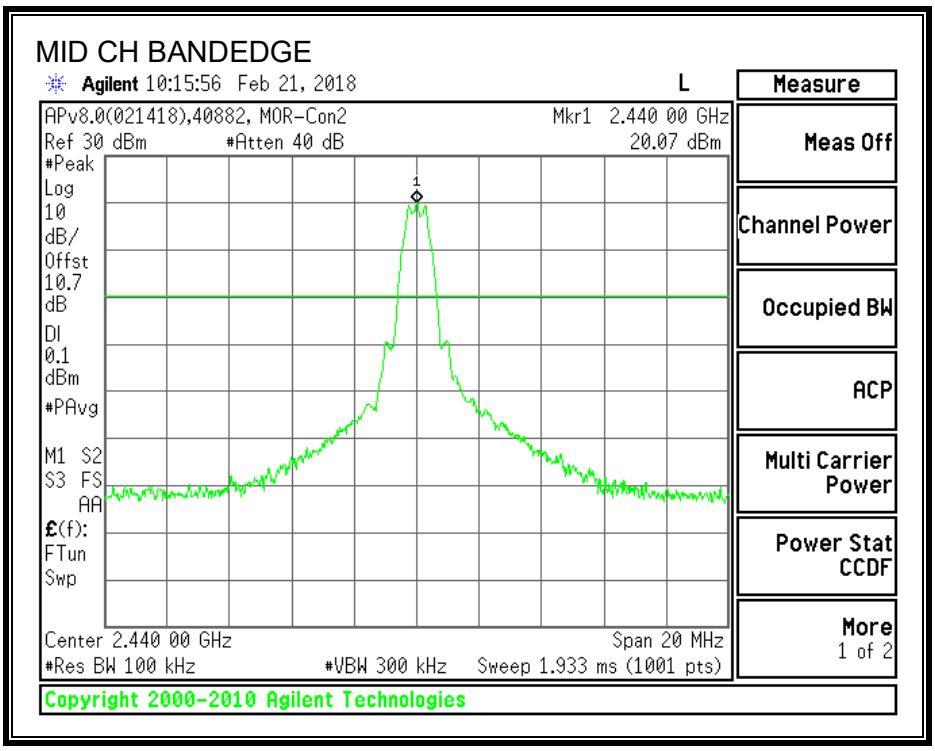


SPURIOUS EMISSIONS, MID CHANNEL



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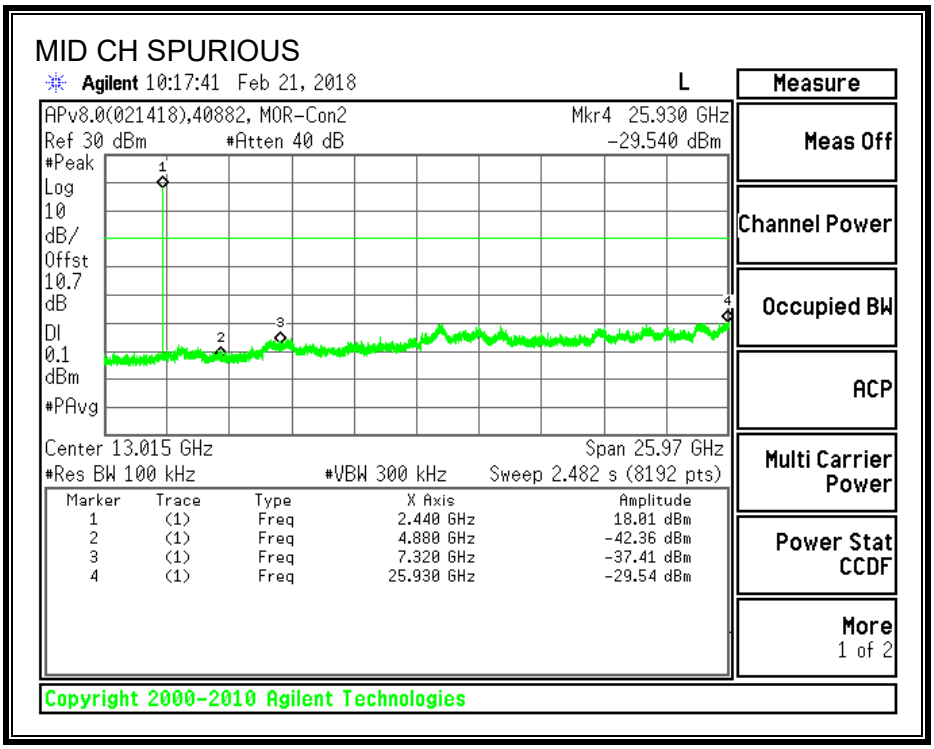
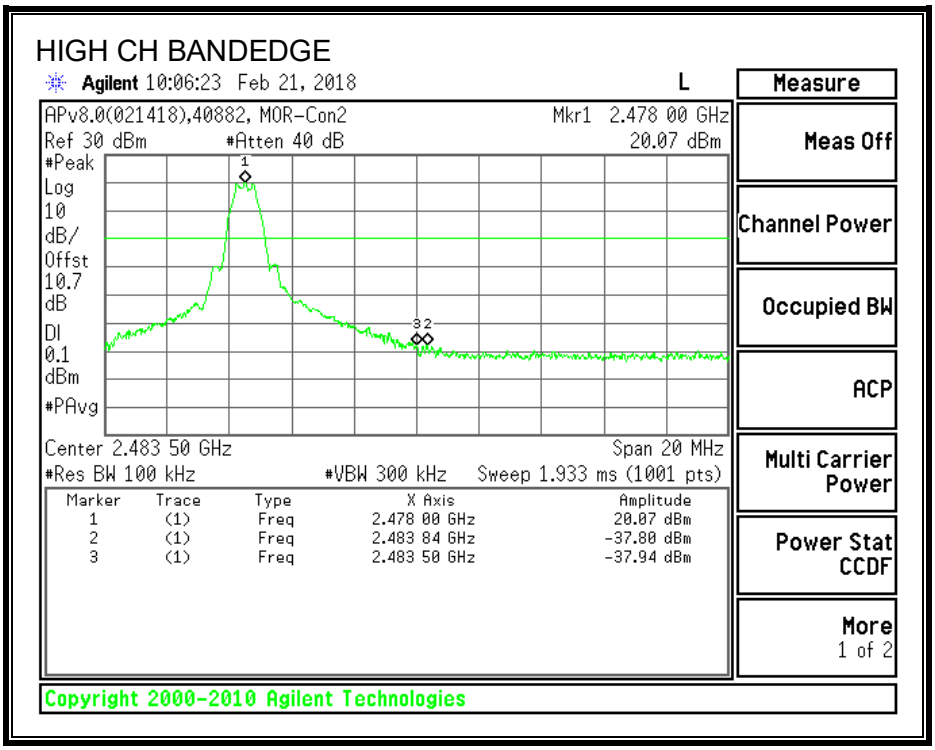


SPURIOUS EMISSIONS, HIGH CHANNEL



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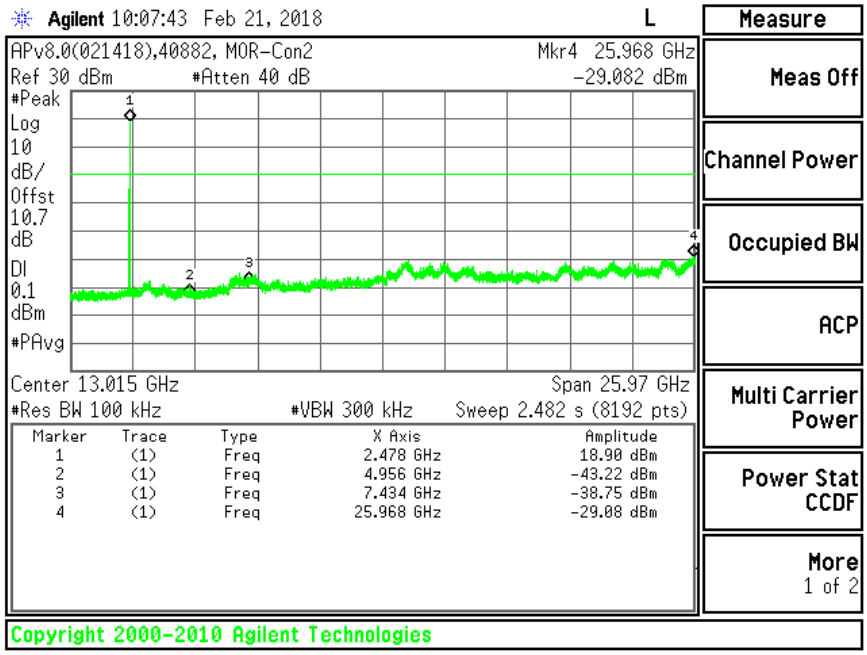
HIGH CH SPURIOUS



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9. RADIATED TEST RESULTS

9.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209
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. The particular averaging method used for this test program was RMS averaging.

The spectrum from 1 to 18 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band. For 9kHz to 1000 MHz and 18 to 26 GHz investigation, the worst-case channel was selected.

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

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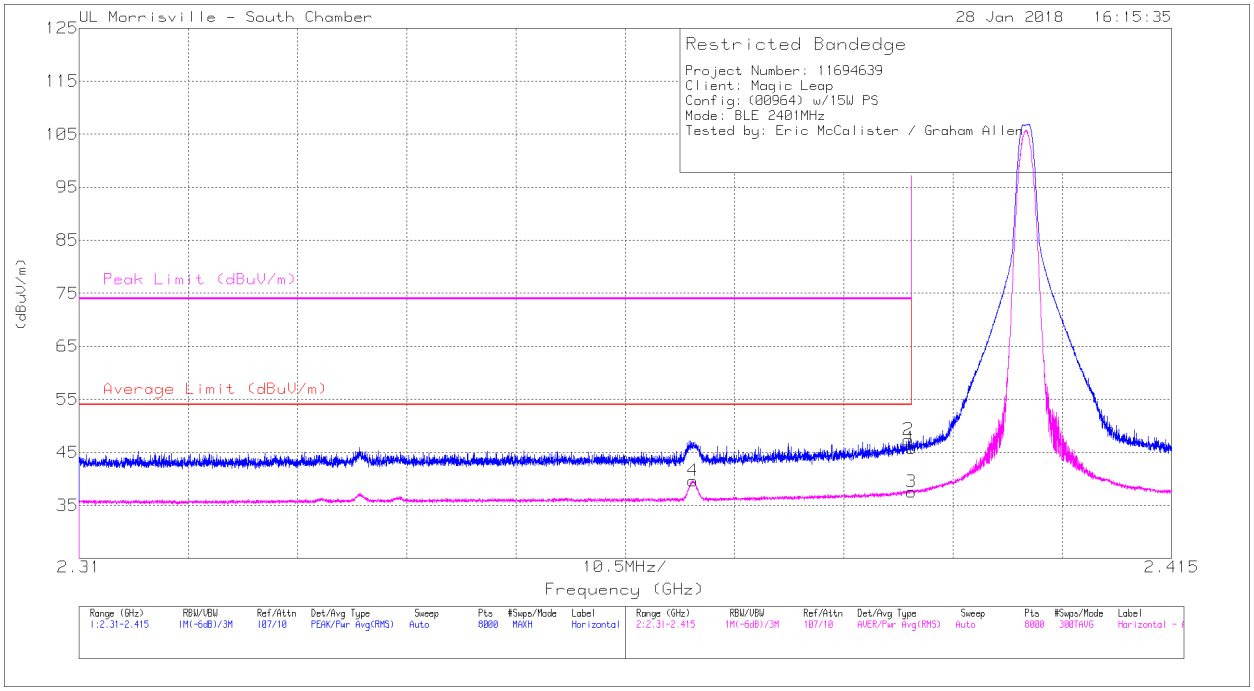
9.2. TX ABOVE 1 GHz FOR BLE MODE IN THE 2.4 GHz BAND

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0069 AF (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	37.98	Pk	31.9	-24.1	0	45.78	-	-	74	-28.22	307	241	H
2	* 2.39	39.6	Pk	31.9	-24.1	0	47.4	-	-	74	-26.6	307	241	H
3	* 2.39	26.75	RMS	31.9	-24.1	3.04	37.59	54	-16.41	-	-	307	241	H
4	* 2.369	28.79	RMS	31.8	-24	3.04	39.63	54	-14.37	-	-	307	241	H

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

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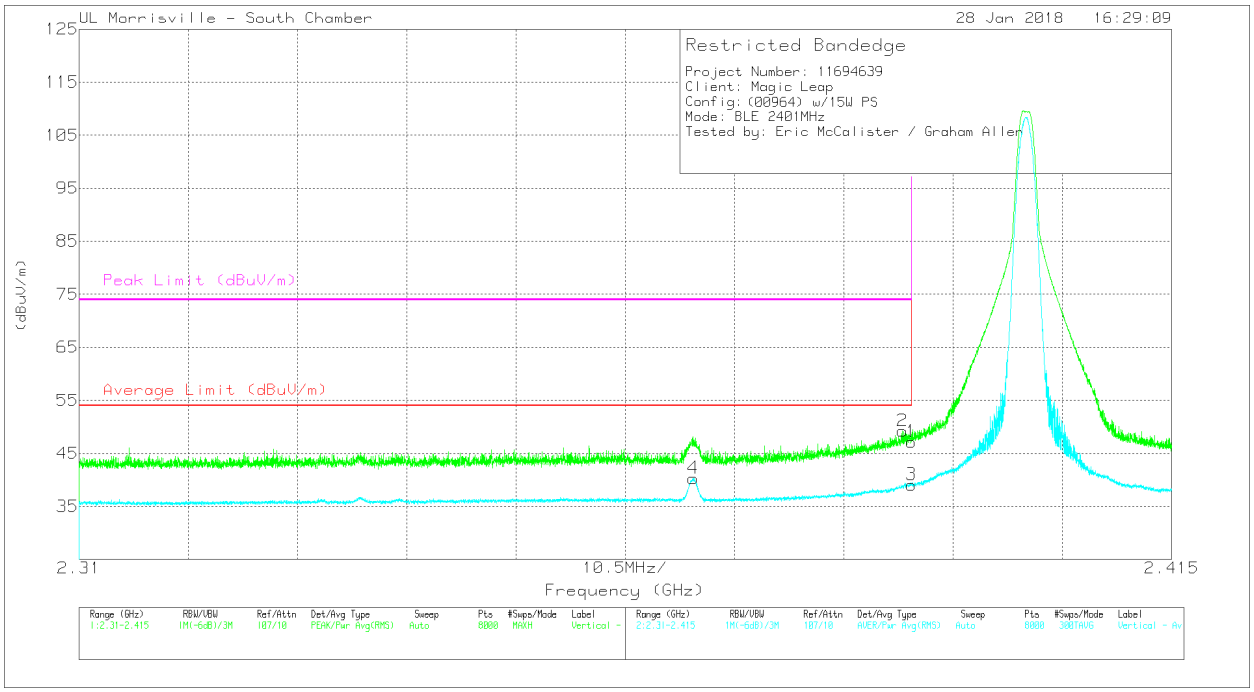
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0069 AF (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	39.38	Pk	31.9	-24.1	0	47.18	-	-	74	-26.82	44	243	V
2	* 2.389	41.46	Pk	31.9	-24.1	0	49.26	-	-	74	-24.74	44	243	V
3	* 2.39	28.26	RMS	31.9	-24.1	3.04	39.10	54	-14.90	-	-	44	243	V
4	* 2.369	29.47	RMS	31.8	-24	3.04	40.31	54	-13.69	-	-	44	243	V

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

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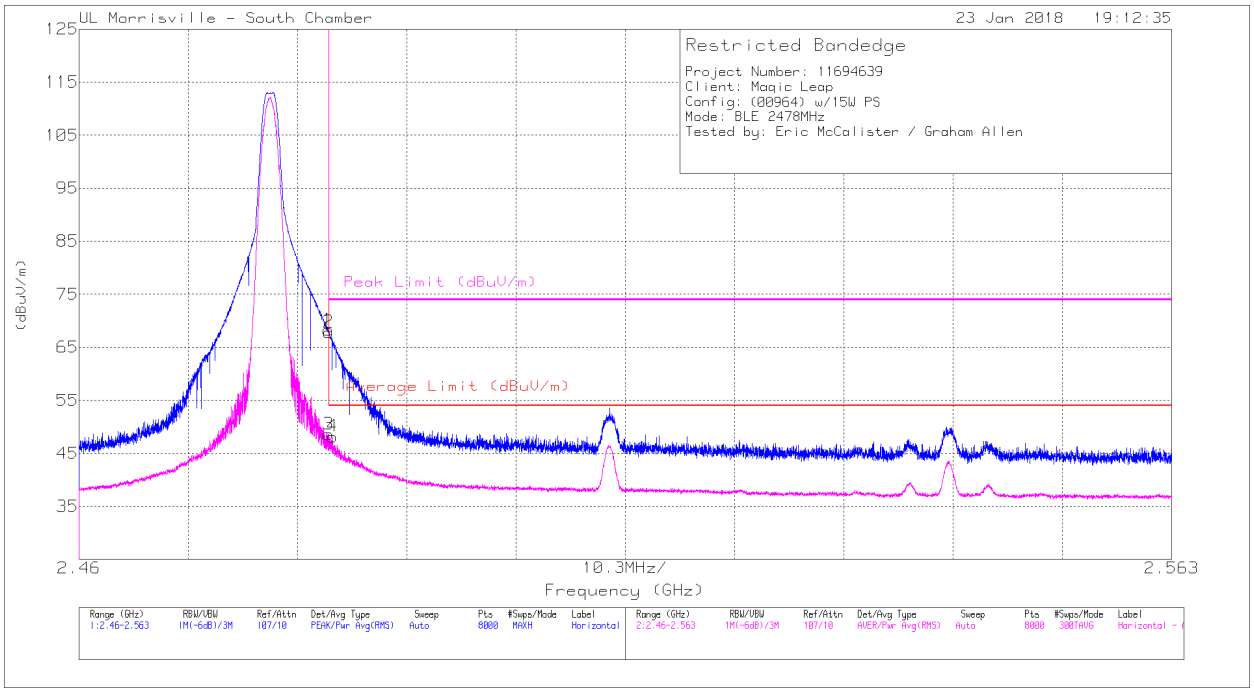
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0069 AF (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	* 2.484	60.46	Pk	32.4	-24.6	0	68.26	-	-	74	-5.74	327	142	H
2	* 2.484	60.05	Pk	32.4	-24.6	0	67.85	-	-	74	-6.15	327	142	H
3	* 2.484	37.82	RMS	32.4	-24.6	3.04	48.66	54	-5.34	-	-	327	142	H
4	* 2.484	37.36	RMS	32.4	-24.6	3.04	48.20	54	-5.80	-	-	327	142	H

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

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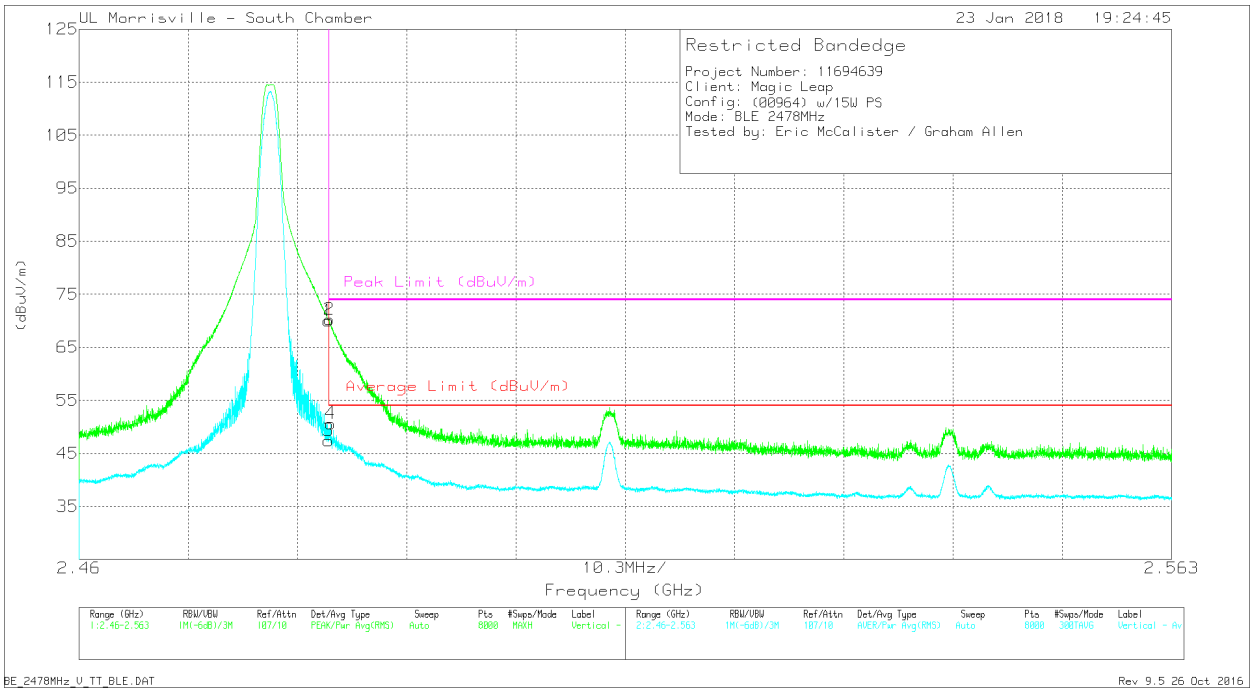
RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0069 AF (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	* 2.484	62.17	Pk	32.4	-24.6	0	69.97	-	-	74	-4.03	240	283	V
2	* 2.484	62.42	Pk	32.4	-24.6	0	70.22	-	-	74	-3.78	240	283	V
3	* 2.484	36.6	RMS	32.4	-24.6	3.04	47.44	54	-6.56	-	-	240	283	V
4	* 2.484	39.8	RMS	32.4	-24.6	3.04	50.64	54	-3.36	-	-	240	283	V

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

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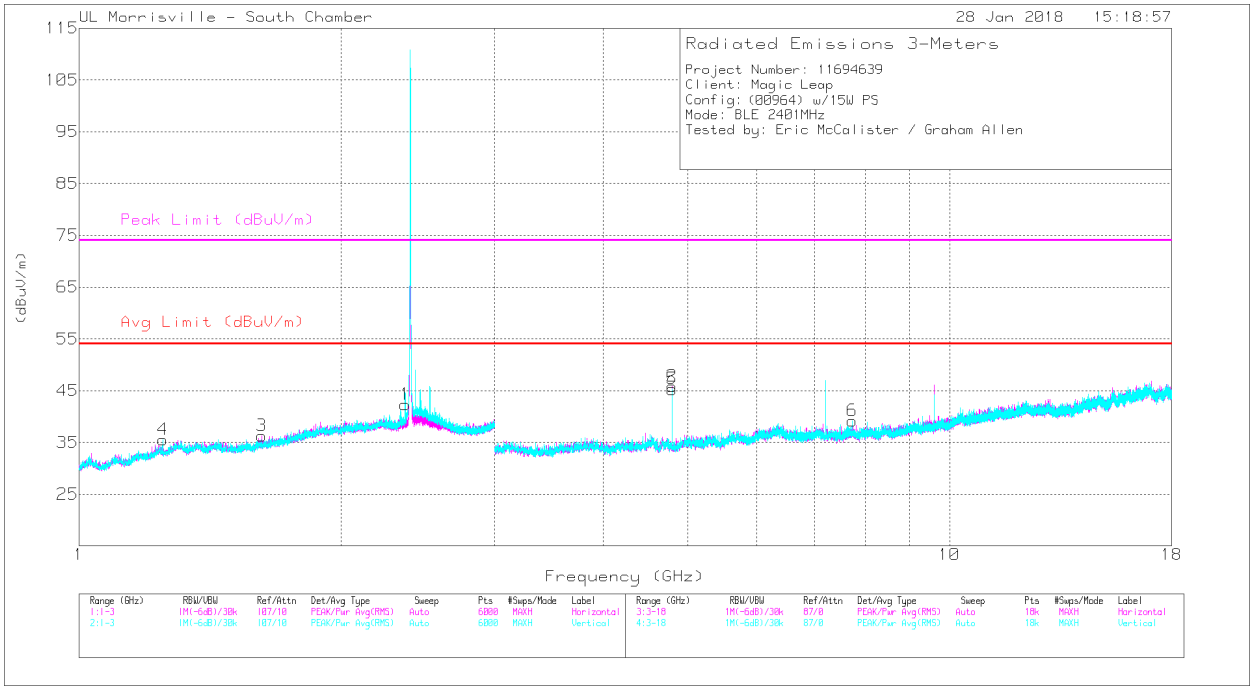
HARMONICS AND SPURIOUS EMISSIONS

Low Channel



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0069 AF (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	* 2.369	40.28	PK2	31.8	-24	0	48.08	-	-	74	-25.92	228	343	H
	* 2.369	31.96	MAv1	31.8	-24	3.04	42.80	54	-11.20	-	-	228	343	H
3	* 1.622	35.96	PK2	28.4	-22.2	0	42.16	-	-	74	-31.84	67	193	H
	* 1.619	23.66	MAv1	28.4	-22.3	3.04	32.80	54	-21.20	-	-	67	193	H
2	* 4.803	47.96	PK2	34	-31.3	0	50.66	-	-	74	-23.34	20	211	H
	* 4.802	38.9	MAv1	34	-31.3	3.04	44.64	54	-9.36	-	-	20	211	H
4	* 1.249	35.45	PK2	28.6	-23.5	0	40.55	-	-	74	-33.45	198	117	V
	* 1.247	23.56	MAv1	28.6	-23.5	3.04	31.70	54	-22.30	-	-	198	117	V
6	* 4.802	45.74	PK2	34	-31.3	0	48.44	-	-	74	-25.56	224	104	V
	* 4.802	37.12	MAv1	34	-31.3	3.04	42.86	54	-11.14	-	-	224	104	V
7	* 7.728	36.57	PK2	35.8	-27.9	0	44.47	-	-	74	-29.53	113	259	V
	* 7.726	24.71	MAv1	35.8	-27.9	3.04	35.65	54	-18.35	-	-	113	259	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK2 - Maximum Peak
MAv1 - Maximum RMS Average

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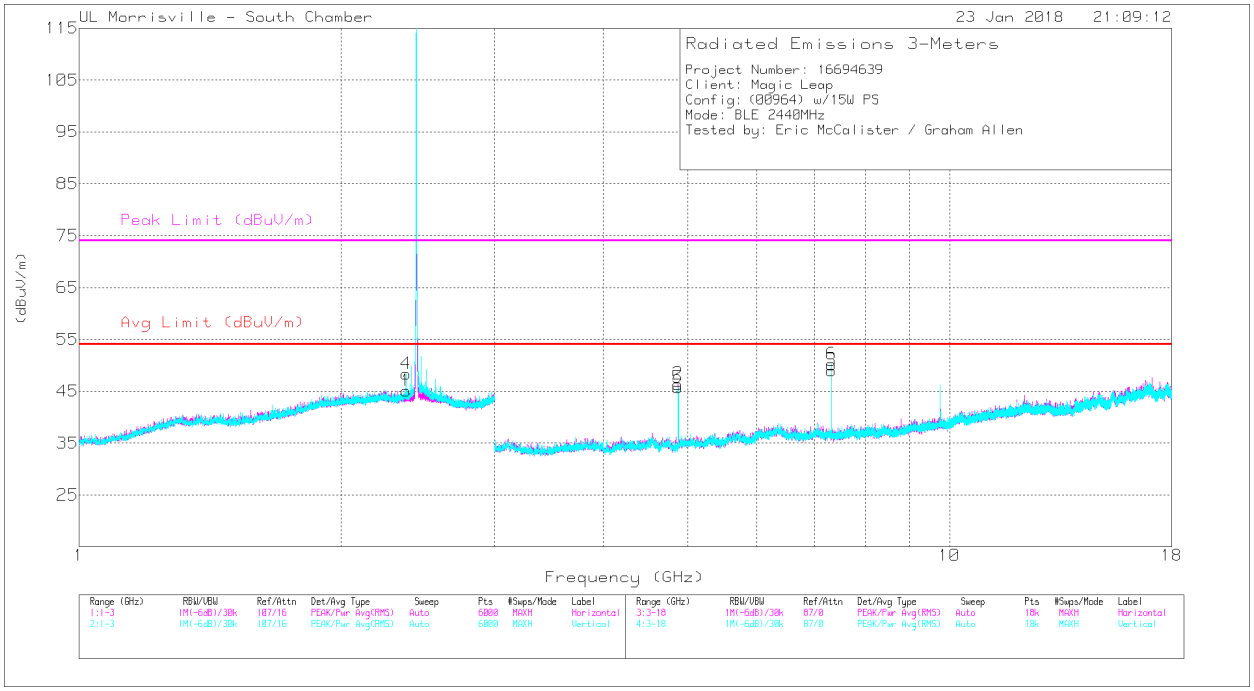
Mid Channel



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0069 AF (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	* 2.376	43.51	PK2	31.8	-24	0	51.31	-	-	74	-22.69	313	240	H
	* 2.376	32.66	MAv1	31.8	-24	3.04	43.50	54	-10.50	-	-	313	240	H
2	* 4.88	45.98	PK2	34	-30.8	0	49.18	-	-	74	-24.82	334	111	H
	* 4.88	37.75	MAv1	34	-30.8	3.04	43.99	54	-10.01	-	-	334	111	H
3	* 7.319	46.18	PK2	35.5	-27.8	0	53.88	-	-	74	-20.12	52	106	H
	* 7.319	37.89	MAv1	35.5	-27.8	3.04	48.63	54	-5.37	-	-	52	106	H
4	* 2.376	45.81	PK2	31.8	-24	0	53.61	-	-	74	-20.39	354	103	V
	* 2.376	35.53	MAv1	31.8	-24	3.04	46.37	54	-7.63	-	-	354	103	V
5	* 4.88	46.84	PK2	34	-30.8	0	50.04	-	-	74	-23.96	221	102	V
	* 4.88	38.82	MAv1	34	-30.8	3.04	45.06	54	-8.94	-	-	221	102	V
6	* 7.321	45.41	PK2	35.5	-27.8	0	53.11	-	-	74	-20.89	213	118	V
	* 7.319	36.59	MAv1	35.5	-27.8	3.04	47.33	54	-6.67	-	-	213	118	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK2 - Maximum Peak
MAv1 - Maximum RMS Average

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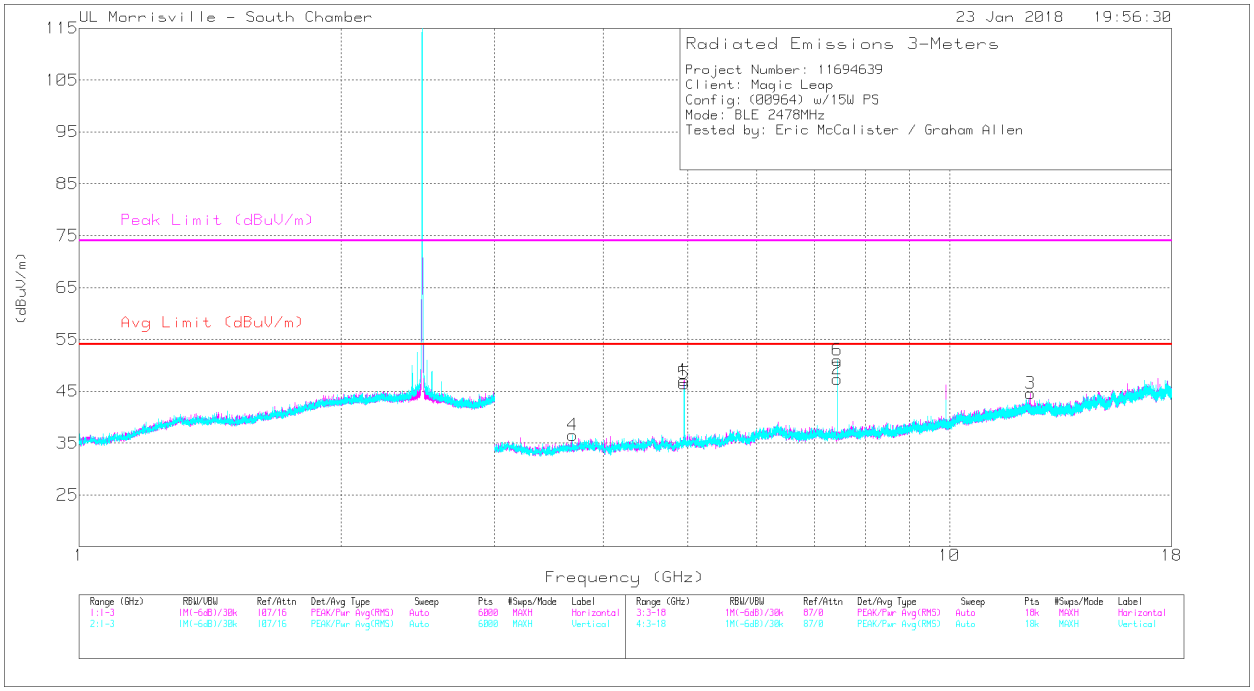
High Channel



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0069 AF (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	* 4.955	48.04	PK2	34	-31.3	0	50.74	-	-	74	-23.26	359	101	H
	* 4.956	40.01	MAv1	34	-31.3	3.04	45.75	54	-8.25	-	-	359	101	H
2	* 7.435	45.88	PK2	35.5	-28.1	0	53.28	-	-	74	-20.72	46	115	H
	* 7.433	38.51	MAv1	35.5	-28.1	3.04	48.95	54	-5.05	-	-	46	115	H
3	* 12.389	36.35	PK2	38.9	-24.7	0	50.55	-	-	74	-23.45	209	295	H
	* 12.389	24.67	MAv1	38.9	-24.7	3.04	41.91	54	-12.09	-	-	209	295	H
4	* 3.691	41.16	PK2	33.1	-32.5	0	41.76	-	-	74	-32.24	19	184	V
	* 3.693	28.98	MAv1	33.2	-32.6	3.04	32.62	54	-21.38	-	-	19	184	V
5	* 4.956	47.6	PK2	34	-31.3	0	50.3	-	-	74	-23.7	262	212	V
	* 4.956	39.24	MAv1	34	-31.3	3.04	44.98	54	-9.02	-	-	262	212	V
6	* 7.433	46.5	PK2	35.5	-28.1	0	53.9	-	-	74	-20.1	224	126	V
	* 7.433	39.29	MAv1	35.5	-28.1	3.04	49.73	54	-4.27	-	-	224	126	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK2 - Maximum Peak
MAv1 - Maximum RMS Average

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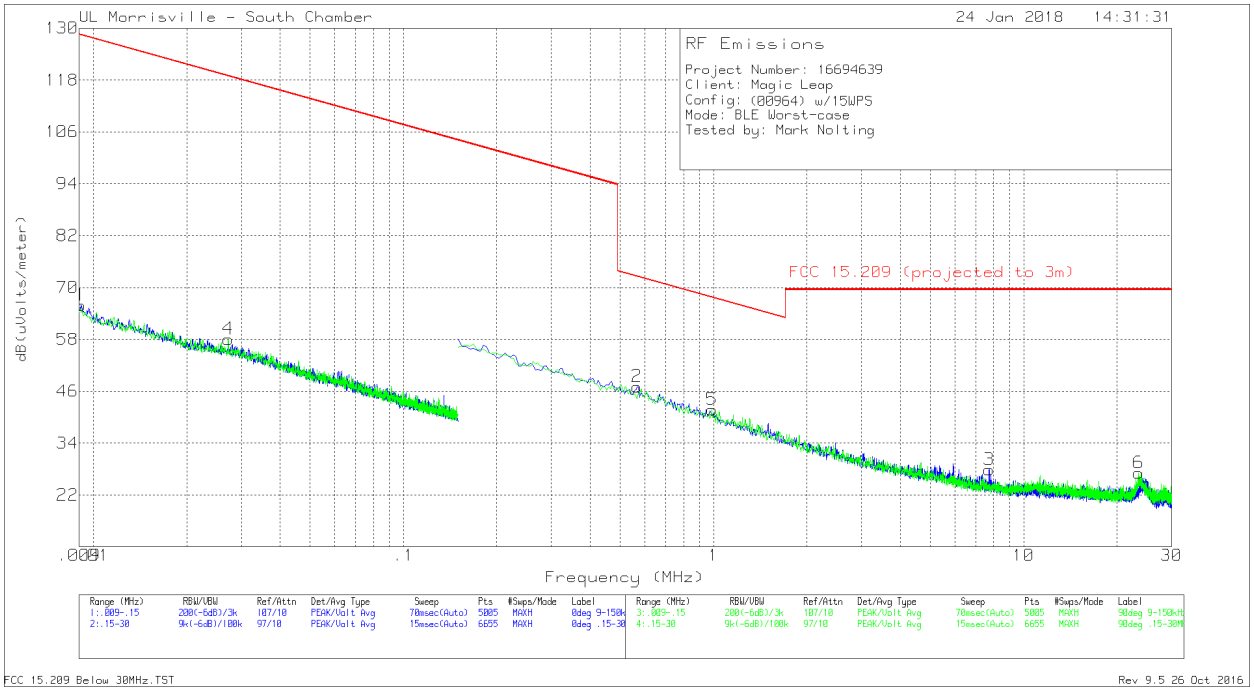
9.3. RADIATED WORST-CASE

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*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 414788.



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF (dB/m)	Cbl (dB)	Corrected Reading dB(uV/m)	FCC 15.209 QP (projected to 3m)	QP Margin (dB)	FCC 15.209 AV (projected to 3m)	AV Margin (dB)	FCC 15.209 PK (projected to 3m)	PK Margin (dB)	Azimuth (Degs)
The following is for the loop antenna @ 0-degrees.													
1	.00914	45.42	Pk	20.3	.1	65.82	-	-	128.39	-62.57	148.39	-82.57	0-360
2	.5672	36.57	Pk	10.4	.1	47.07	72.53	-25.46	-	-	-	-	0-360
3	7.73807	16.64	Pk	10.7	.5	27.84	69.54	-41.7	-	-	-	-	0-360
The following is for the loop antenna @ 90-degrees.													
4	.02723	44.07	Pk	13.9	.1	58.07	-	-	118.9	-60.83	138.9	-80.83	0-360
5	.98888	31.02	Pk	10.6	.1	41.72	67.7	-25.98	-	-	-	-	0-360
6	23.48617	16.52	Pk	9.8	.8	27.12	69.54	-42.42	-	-	-	-	0-360

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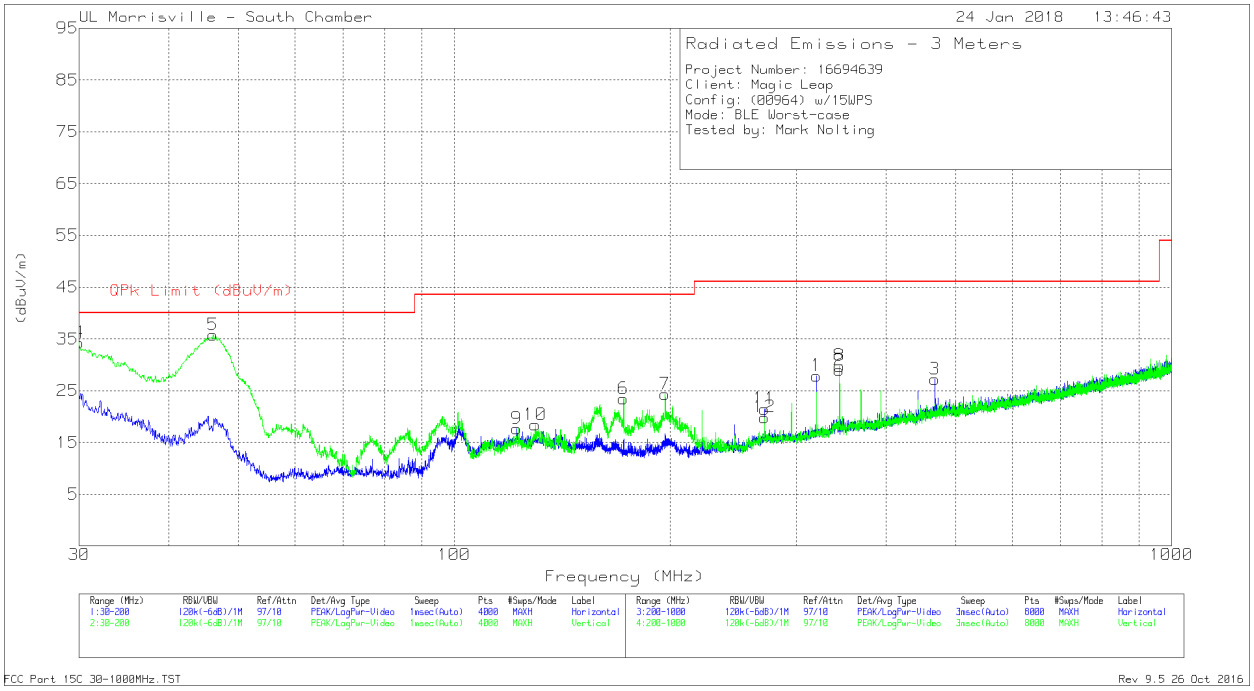
Pk - Peak detector

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



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0074 AF (dB/m)	Cbl/Amp (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
9	* 122.1213	30.25	Pk	18.2	-30.8	17.65	43.52	-25.87	0-360	102	H
11	* 270.6092	33.28	Pk	17.9	-29.7	21.48	46.02	-24.54	0-360	102	H
10	* 129.6883	31.02	Pk	18.2	-30.8	18.42	43.52	-25.1	0-360	102	V
6	* 172.1993	37.87	Pk	16.1	-30.5	23.47	43.52	-20.05	0-360	102	V
12	* 270.7092	31.67	Pk	17.9	-29.7	19.87	46.02	-26.15	0-360	299	V
1	319.8156	38.79	Pk	18.7	-29.6	27.89	46.02	-18.13	0-360	102	H
2	344.3188	39.27	Pk	19.1	-29.4	28.97	46.02	-17.05	0-360	102	H
3	467.2347	34.39	Pk	21.7	-28.9	27.19	46.02	-18.83	0-360	102	H
4	30	35.53	Qp	26.3	-31.8	30.03	40	-9.97	1	102	V
5	45.9917	49.47	Qp	14.4	-31.6	32.27	40	-7.73	165	100	V
7	196.8132	37.39	Pk	17.1	-30.2	24.29	43.52	-19.23	0-360	102	V
8	344.4188	40.09	Pk	19.1	-29.4	29.79	46.02	-16.23	0-360	199	V

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

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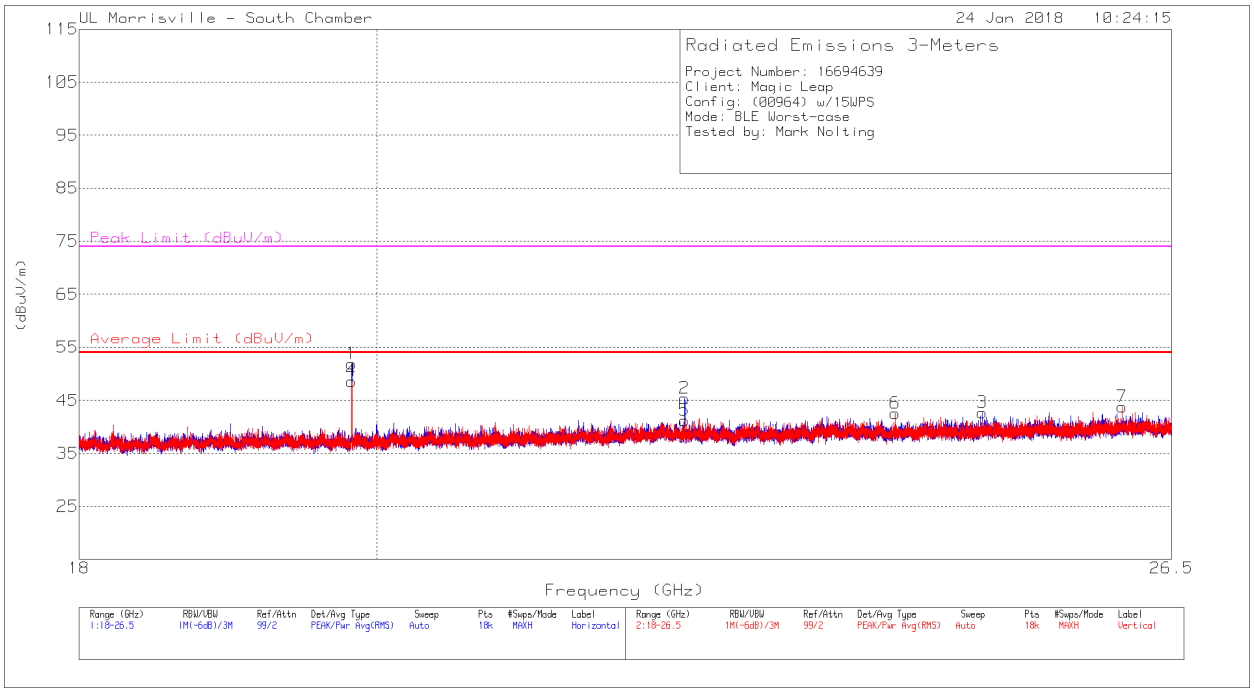
SPURIOUS EMISSIONS 18 TO 26.5 GHz (WORST-CASE CONFIGURATION)



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0076 AF (dB/m)	Amp/Cbl (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 19.824	62.06	PK2	32.7	-40	0	54.76	-	-	74	-19.24	169	180	H
	* 19.822	53.67	MAv1	32.7	-40.1	3.04	49.31	54	-4.69	-	-	169	180	H
2	* 22.3	51.05	Pk	33.7	-39.4	0	45.35	54	-8.65	74	-28.65	0-360	249	H
4	* 19.824	58.61	PK2	32.7	-40	0	51.31	-	-	74	-22.69	277	101	V
	* 19.822	49.74	MAv1	32.7	-40.1	3.04	45.38	54	-8.62	-	-	277	101	V
5	* 22.3	46.93	Pk	33.7	-39.4	0	41.23	54	-12.77	74	-32.77	0-360	151	V
6	24.029	47.03	Pk	34	-38.5	0	42.53	54	-11.47	74	-31.47	0-360	251	V
3	24.782	46.47	Pk	34.4	-38.2	0	42.67	54	-11.33	74	-31.33	0-360	149	H
7	26.038	46.5	Pk	34.5	-37.2	0	43.8	54	-10.2	74	-30.2	0-360	151	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
PK2 - Maximum Peak
MAv1 - Maximum RMS Average

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10. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

ISED RSS-GEN, Section 8.8

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 lines.

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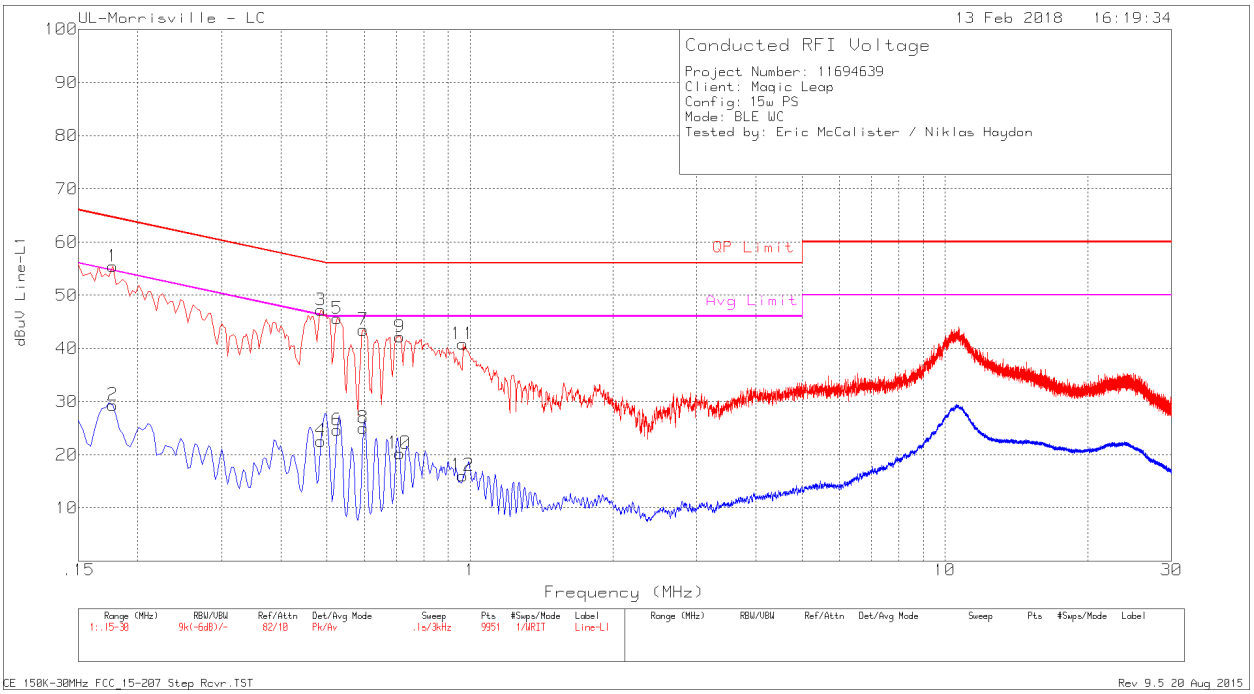
LINE 1 RESULTS



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	.177	45.22	Pk	.2	10	55.42	64.63	-9.21	-	-
2	.177	19.15	Av	.2	10	29.35	-	-	54.63	-25.28
3	.486	37.32	Pk	0	9.9	47.22	56.24	-9.02	-	-
4	.486	12.71	Av	0	9.9	22.61	-	-	46.24	-23.63
5	.525	35.74	Pk	0	9.9	45.64	56	-10.36	-	-
6	.525	14.75	Av	0	9.9	24.65	-	-	46	-21.35
7	.597	33.58	Pk	0	9.9	43.48	56	-12.52	-	-
8	.597	15.15	Av	0	9.9	25.05	-	-	46	-20.95
9	.711	32.3	Pk	0	9.9	42.2	56	-13.8	-	-
10	.711	10.36	Av	0	9.9	20.26	-	-	46	-25.74
11	.966	30.9	Pk	0	9.9	40.8	56	-15.2	-	-
12	.966	6.19	Av	0	9.9	16.09	-	-	46	-29.91

Pk - Peak detector
Av - Average detection

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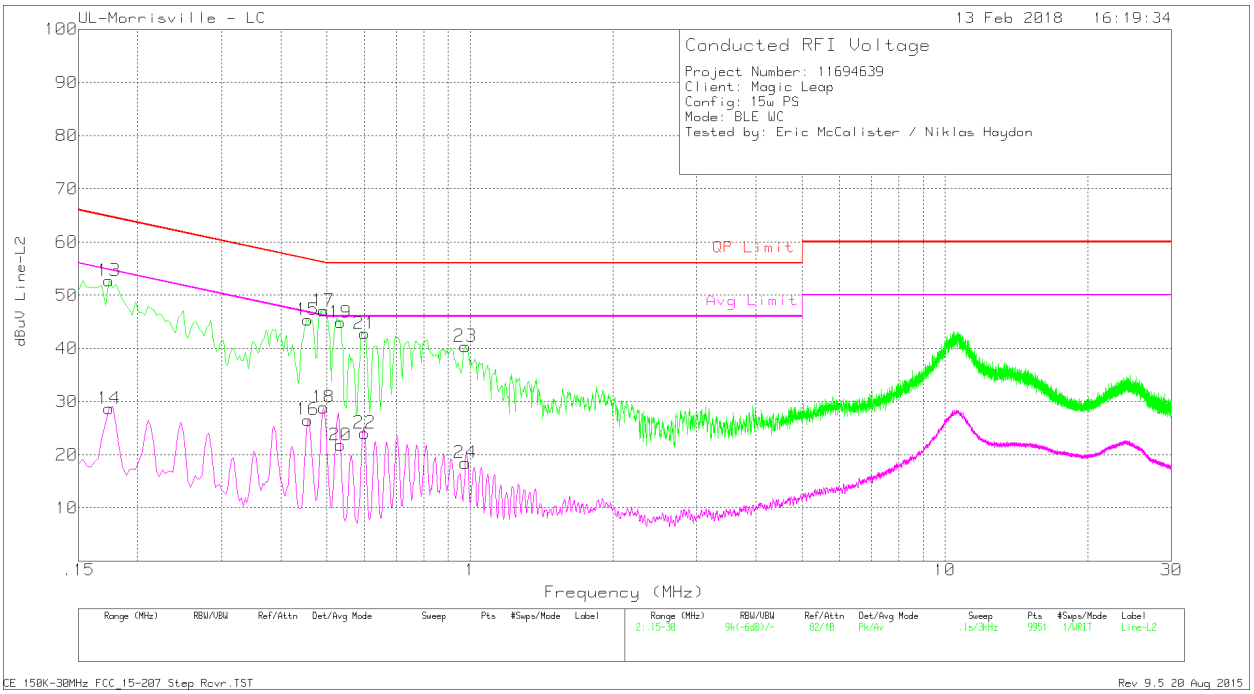
LINE 2 RESULTS



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)
13	.174	42.5	Pk	.2	10	52.7	64.77	-12.07	-	-
14	.174	18.49	Av	.2	10	28.69	-	-	54.77	-26.08
15	.456	35.38	Pk	.1	9.9	45.38	56.77	-11.39	-	-
16	.456	16.54	Av	.1	9.9	26.54	-	-	46.77	-20.23
17	.492	37.06	Pk	.1	9.9	47.06	56.13	-9.07	-	-
18	.492	18.88	Av	.1	9.9	28.88	-	-	46.13	-17.25
19	.534	34.98	Pk	0	9.9	44.88	56	-11.12	-	-
20	.534	11.94	Av	0	9.9	21.84	-	-	46	-24.16
21	.6	32.91	Pk	0	9.9	42.81	56	-13.19	-	-
22	.6	14.17	Av	0	9.9	24.07	-	-	46	-21.93
23	.978	30.47	Pk	0	9.9	40.37	56	-15.63	-	-
24	.978	8.56	Av	0	9.9	18.46	-	-	46	-27.54

Pk - Peak detector
Av - Average detection

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11. SETUP PHOTOS

Refer to UL Report R11694639-EP2.

END OF REPORT

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