



**FCC 47 CFR PART 15 SUBPART C  
ISED CANADA RSS-247 ISSUE 2**

**BLUETOOTH LOW ENERGY  
CERTIFICATION TEST REPORT**

**FOR**

**MAGIC LEAP ONE – LIGHTPACK LIGHTWEAR**

**MODEL NUMBER: M1001\M1002**

**FCC ID: 2AM5NM1000  
IC: 23045-M1000**

**REPORT NUMBER: R11694639-E9**

**ISSUE DATE: 2018-07-10**

**Prepared for  
MAGIC LEAP, INC.  
7500 WEST SUNRISE BOULEVARD  
PLANTATION, FL 33322, USA**

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



Revision History

Ver.	Issue Date	Revisions	Revised By
1	2018-06-13	Initial Issue	Brian T. Kiewra
2	2018-06-25	Updated NVLAP logo on cover page	Brian T. Kiewra
3	2018-06-27	Revised simultaneous transmission statement in Section 5.5	Brian T. Kiewra
4	2018-07-02	Added calibration interval note to Section 6.	Brian T. Kiewra
5	2018-07-10	Revised antenna gain table in Section 5.3	Brian T. Kiewra

## TABLE OF CONTENTS

<b>1. ATTESTATION OF TEST RESULTS .....</b>	<b>4</b>
<b>2. TEST METHODOLOGY .....</b>	<b>5</b>
<b>3. FACILITIES AND ACCREDITATION .....</b>	<b>5</b>
<b>4. CALIBRATION AND UNCERTAINTY .....</b>	<b>6</b>
4.1. MEASURING INSTRUMENT CALIBRATION .....	6
4.2. SAMPLE CALCULATION .....	6
4.3. MEASUREMENT UNCERTAINTY .....	6
<b>5. EQUIPMENT UNDER TEST .....</b>	<b>7</b>
5.1. DESCRIPTION OF EUT .....	7
5.2. MAXIMUM OUTPUT POWER .....	7
5.3. DESCRIPTION OF AVAILABLE ANTENNAS .....	7
5.4. SOFTWARE AND FIRMWARE .....	7
5.5. WORST-CASE CONFIGURATION AND MODE .....	8
5.6. DESCRIPTION OF TEST SETUP .....	9
<b>6. TEST AND MEASUREMENT EQUIPMENT .....</b>	<b>10</b>
<b>7. MEASUREMENT METHODS .....</b>	<b>12</b>
<b>8. ANTENNA PORT TEST RESULTS .....</b>	<b>13</b>
8.1. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS .....	13
8.2. 6 dB BANDWIDTH .....	14
8.3. 99% BANDWIDTH .....	16
8.4. OUTPUT POWER .....	18
8.5. AVERAGE POWER .....	19
8.6. POWER SPECTRAL DENSITY .....	20
8.7. CONDUCTED SPURIOUS EMISSIONS .....	22
<b>9. RADIATED TEST RESULTS .....</b>	<b>26</b>
9.1. LIMITS AND PROCEDURE .....	26
9.2. TRANSMITTER ABOVE 1 GHz .....	27
9.3. TX ABOVE 1 GHz FOR BLE MODE IN THE 2.4 GHz BAND .....	27
9.4. RADIATED WORST-CASE .....	34
<b>10. AC POWER LINE CONDUCTED EMISSIONS .....</b>	<b>37</b>
<b>11. SETUP PHOTOS .....</b>	<b>40</b>
<b>END OF REPORT .....</b>	<b>40</b>

## 1. ATTESTATION OF TEST RESULTS

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

**EUT DESCRIPTION:** Magic Leap One – Lightpack Lightwear

**MODEL:** M1001\M1002

**SERIAL NUMBER:** G321F9N03434, PB1067B00002, G321F9N03430

**DATE TESTED:** 2018-01-04 to 2018-05-15

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

## 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
<input type="checkbox"/> Chamber A
<input type="checkbox"/> Chamber C

2800 Perimeter Park Dr., Suite B, Morrisville, NC 27560
<input checked="" type="checkbox"/> Chamber NORTH
<input type="checkbox"/> Chamber SOUTH

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

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

## 4. CALIBRATION AND UNCERTAINTY

### 4.1. MEASURING INSTRUMENT CALIBRATION

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

### 4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamp Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

### 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%.

## 5. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

Magic Leap One - Lightpack Lightwear with BT/BLE/802.11a/b/g/n. This test report covers the M1001 and M1002. The only difference between the two models is the size of the headband on the Lightwear.

### 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	3.22	2.10

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes antennas with the following maximum gains:

Band Of Operation (MHz)	Ant0 gain (dBi)	Ant1 Gain (dBi)	Ant2 gain (dBi)
2401 - 2480	1.54	0.4	-0.8
5150-5250	3.3	4.6	NA
5250-5350	3.2	4.5	NA
5500-5725	2.5	3.7	NA
5745-5850	0.6	4.5	NA

BLE transmits on ANT2, therefore has a maximum gain of -0.8dB.

### 5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was PEQ5.

## 5.5. WORST-CASE CONFIGURATION AND MODE

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

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

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

BLE: 1 Mbps.

Simultaneous transmission of the following was investigated:

- Proprietary BLE and 2.4 GHz WiFi
- Proprietary BLE and BLE
- Proprietary BLE and Bluetooth
- Proprietary BLE and 5 GHz WiFi
- 2.4GHz and 5GHz (11a)
- 2.4GHz and 5GHz (11a) and Proprietary BLE
- 2.4GHz and Bluetooth and Proprietary BLE
- 5GHz and Bluetooth
- 5GHz and Bluetooth and Proprietary BLE

The following does not simultaneously transmit and thus was not considered:

- BLE and Bluetooth

Device was found to still be compliant.

Refer to UL Document R11694639-ST1 for simultaneous transmission data.



## 5.6. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Power Supply	Salcomp	M3002	Non-Serialized	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	DC/Data	<3m	None
2	Hardwired	1	Hardwired	Data	<3m	Connects Lightwear to Lightpack

### TEST SETUP

The EUT is setup as standalone equipment.

### SETUP DIAGRAM FOR TESTS

Refer to UL Document R11694639-EP9 for diagram.

## 6. TEST AND MEASUREMENT EQUIPMENT

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

Note: All equipment within calibration interval at time of use.

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

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
<b>0.009-30MHz (Loop Ant.)</b>					
AT0079	Active Loop Antenna	ETS-Lindgren	6502	2018-01-02	2019-01-02
<b>30-1000 MHz</b>					
AT0073	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2017-07-18	2018-07-31
<b>1-18 GHz</b>					
AT0072	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2018-04-30	2019-04-30
<b>18-40 GHz</b>					
AT0076	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2017-10-10	2018-10-10
<b>Gain-Loss Chains</b>					
N-SAC01	Gain-loss string: 0.009-30MHz	Various	Various	2017-09-15	2018-09-15
N-SAC02	Gain-loss string: 30-1000MHz	Various	Various	2017-06-11	2018-06-11
N-SAC03	Gain-loss string: 1-18GHz	Various	Various	2018-03-23	2019-03-23
N-SAC04	Gain-loss string: 18-40GHz	Various	Various	2018-04-03	2019-04-03
<b>Receiver &amp; Software</b>					
SA0027	Spectrum Analyzer	Agilent	N9030A	2018-04-04	2019-04-04
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
<b>Additional Equipment used</b>					
s/n 161024690	Environmental Meter	Fisher Scientific	15-077-963	2016-12-21	2018-12-21

Test Equipment Used - Wireless Conducted Measurement Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
<b>Conducted Room 2</b>					
SA0020	Spectrum Analyzer	Agilent Technologies	E4446A	2017-11-06	2018-11-06
T177	Spectrum Analyzer	Agilent Technologies	E4446A	2017-03-30	2018-03-30
SN 161024885	Environmental Meter	Fisher Scientific	15-077-963	2016-12-23	2018-12-23
<b>Additional Equipment used</b>					
PWS001	Peak and Avg Power Sensor, 50MHz to 18GHz	Keysight Technologies	N1921A	2017-05-18	2018-05-18
PWM003	RF Power Meter	Keysight Technologies	N1911A	2017-07-14	2018-07-14
MM0168	True RMS Multimeter	Agilent	U1232A	2017-10-25	2018-10-30

## 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

## 8. ANTENNA PORT TEST RESULTS

### 8.1. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS

#### LIMITS

None; for reporting purposes only.

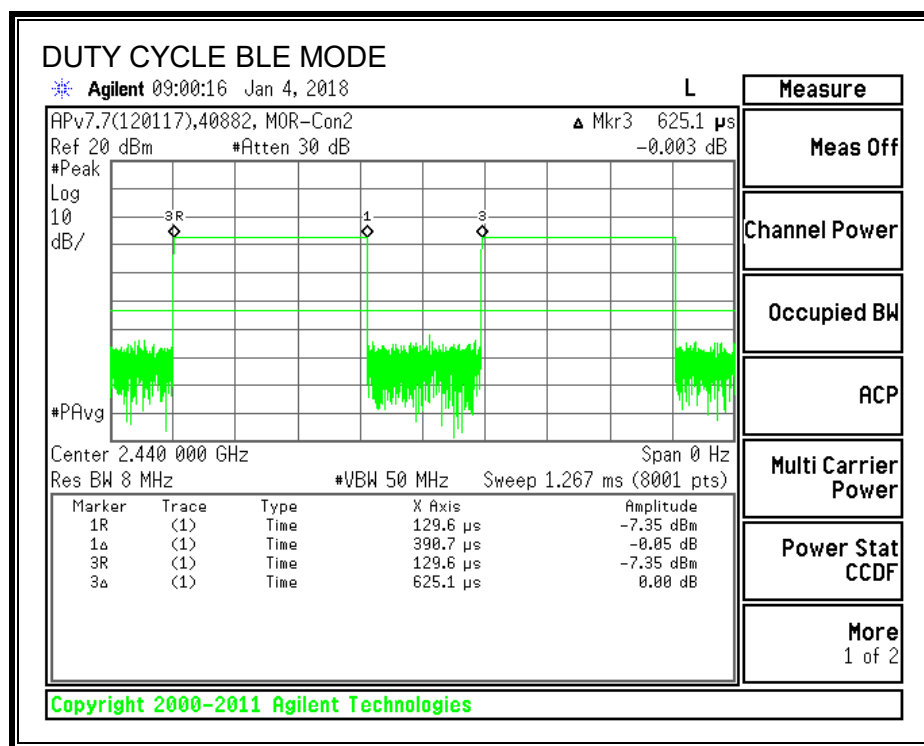
#### PROCEDURE

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	0.391	0.625	0.625	62.50%	2.04	2.560

#### DUTY CYCLE PLOTS



## 8.2.6 dB BANDWIDTH

### LIMITS

FCC §15.247 (a) (2)

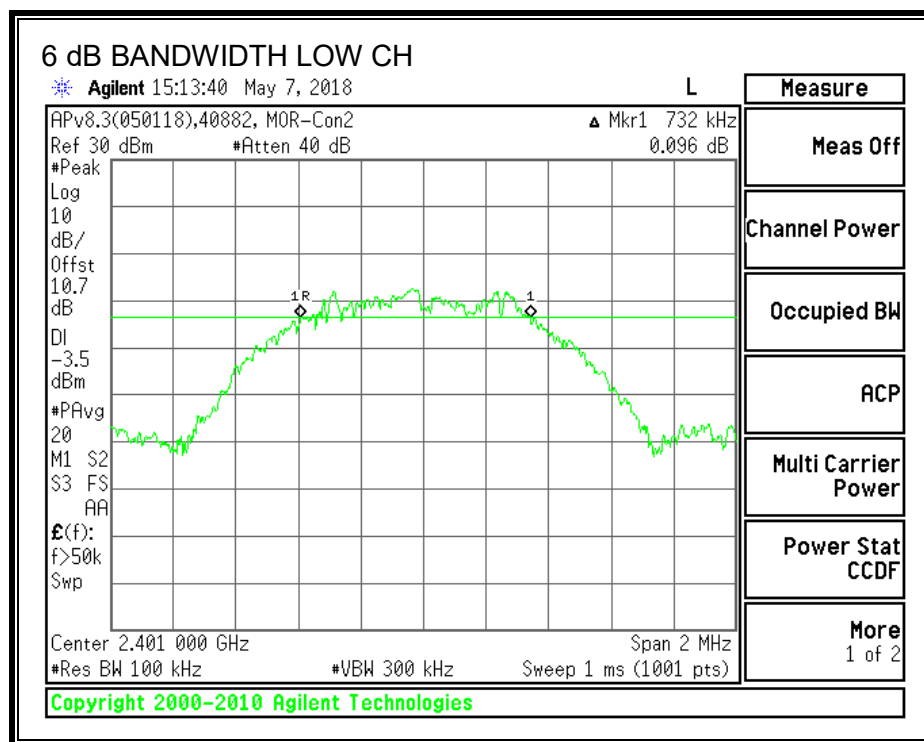
ISED RSS-247 5.2 (a)

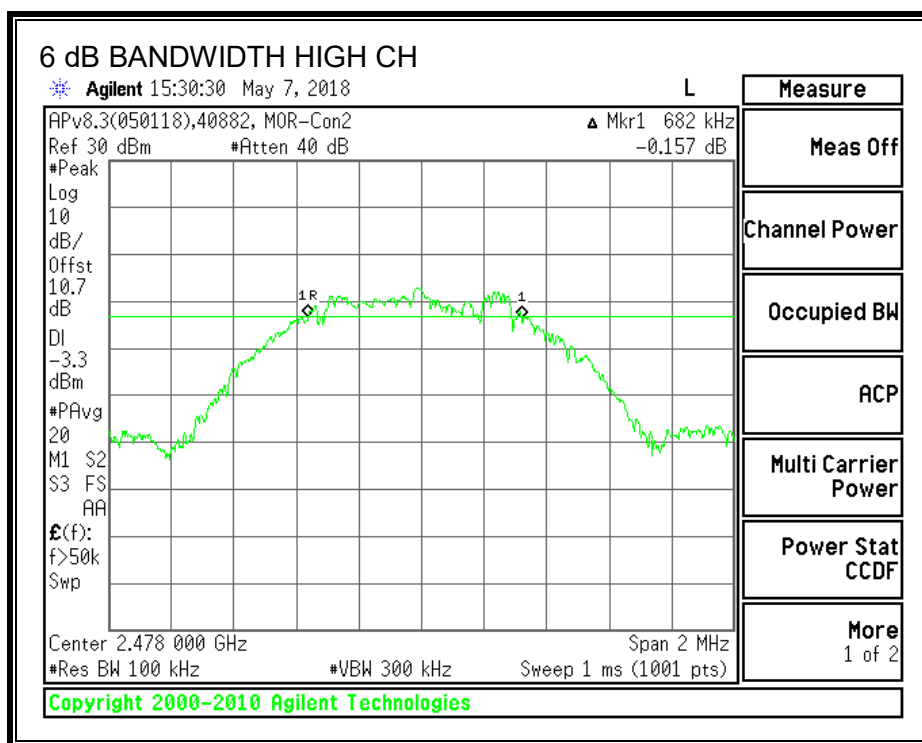
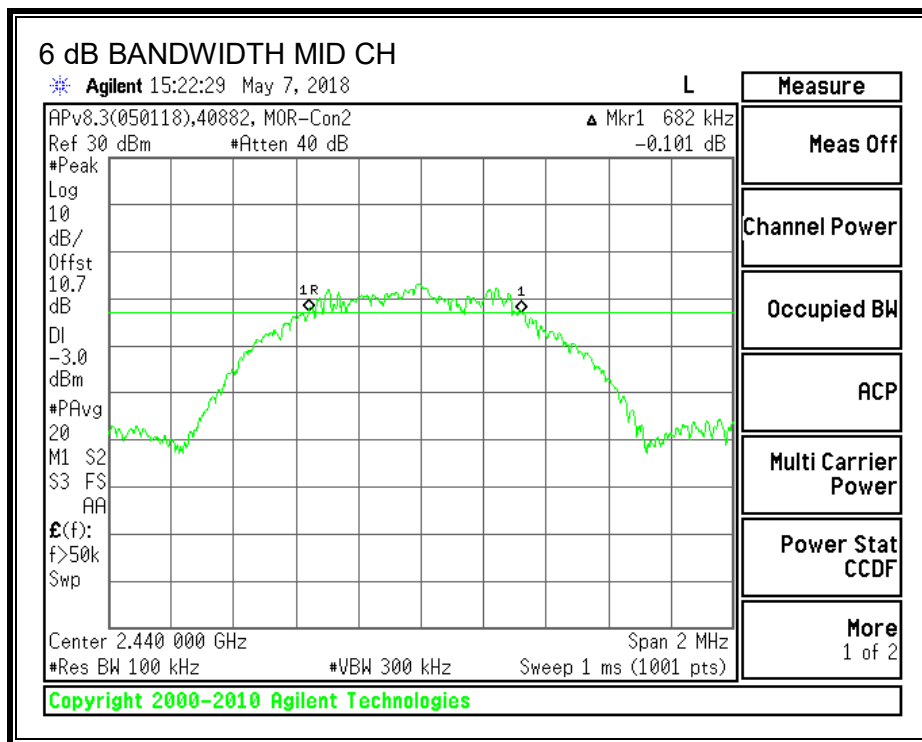
The minimum 6 dB bandwidth shall be at least 500 kHz.

### RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2401	0.7320	0.5
Middle	2440	0.6820	0.5
High	2478	0.6820	0.5

### 6 dB BANDWIDTH





### 8.3.99% BANDWIDTH

#### LIMITS

None; for reporting purposes only.

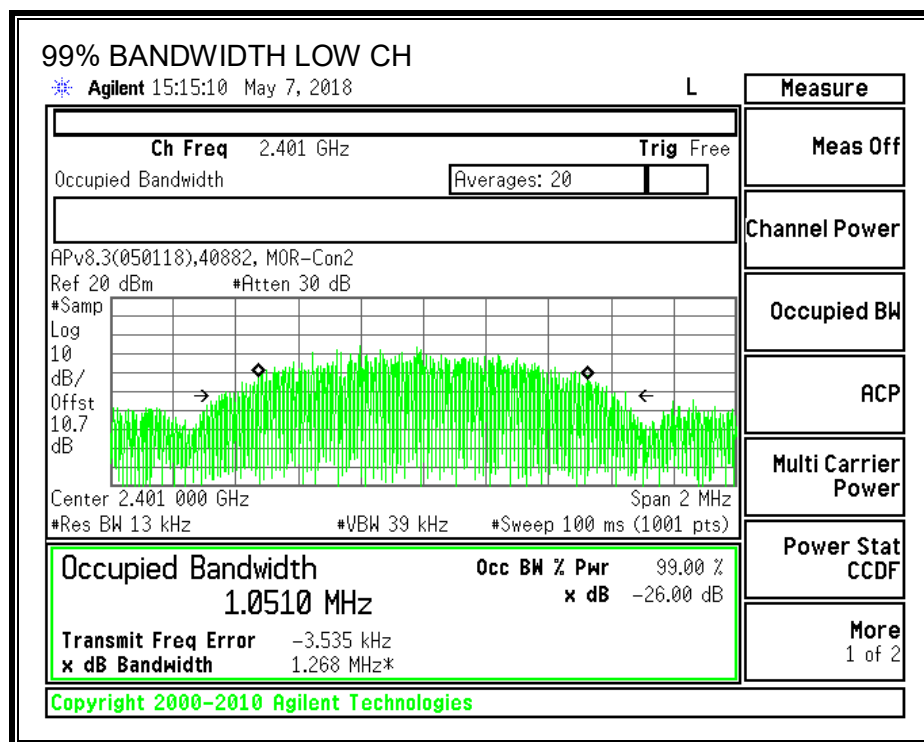
#### TEST PROCEDURE

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.

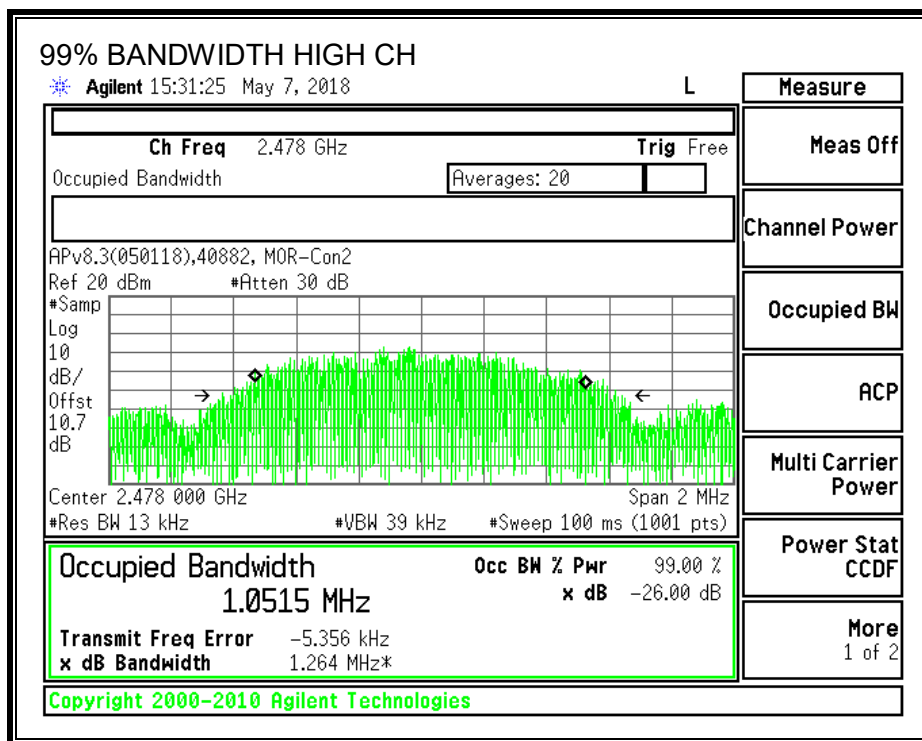
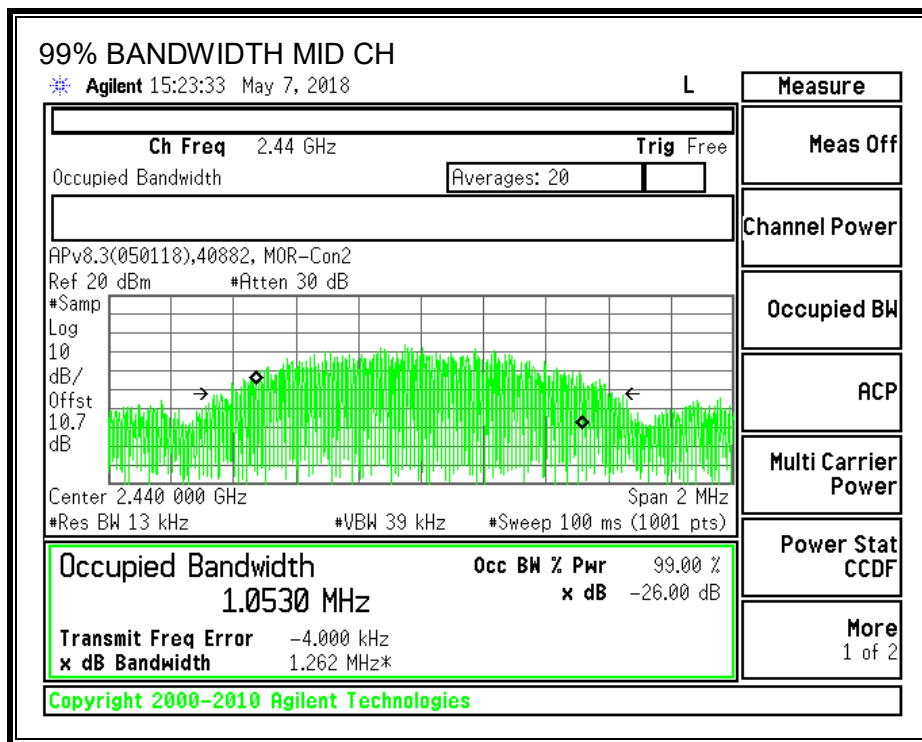
#### RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2401	1.0510
Middle	2440	1.0530
High	2478	1.0515

#### 99% BANDWIDTH PLOTS







## 8.4. OUTPUT POWER

### LIMITS

FCC §15.247 (b)

ISED RSS-247 5.4 (d)

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

### RESULTS

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2401	3.22	30	-26.78
Middle	2440	2.94	30	-27.06
High	2478	2.66	30	-27.34

## 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	3.10
Middle	2440	2.82
High	2478	2.54

## 8.6. POWER SPECTRAL DENSITY

### LIMITS

FCC §15.247 (e)

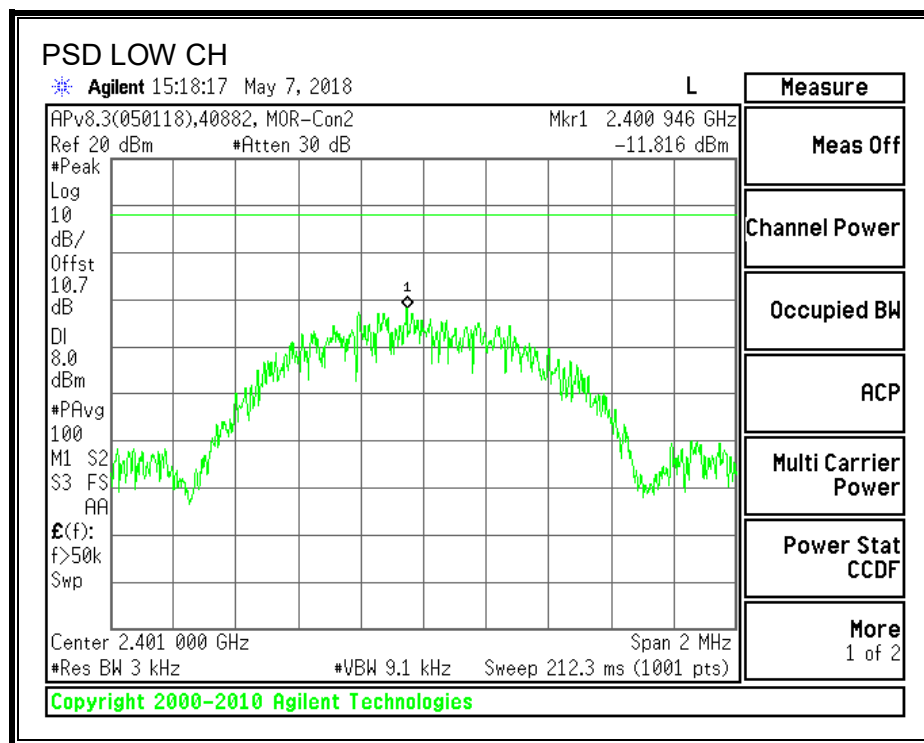
IC RSS-247 5.2 (b)

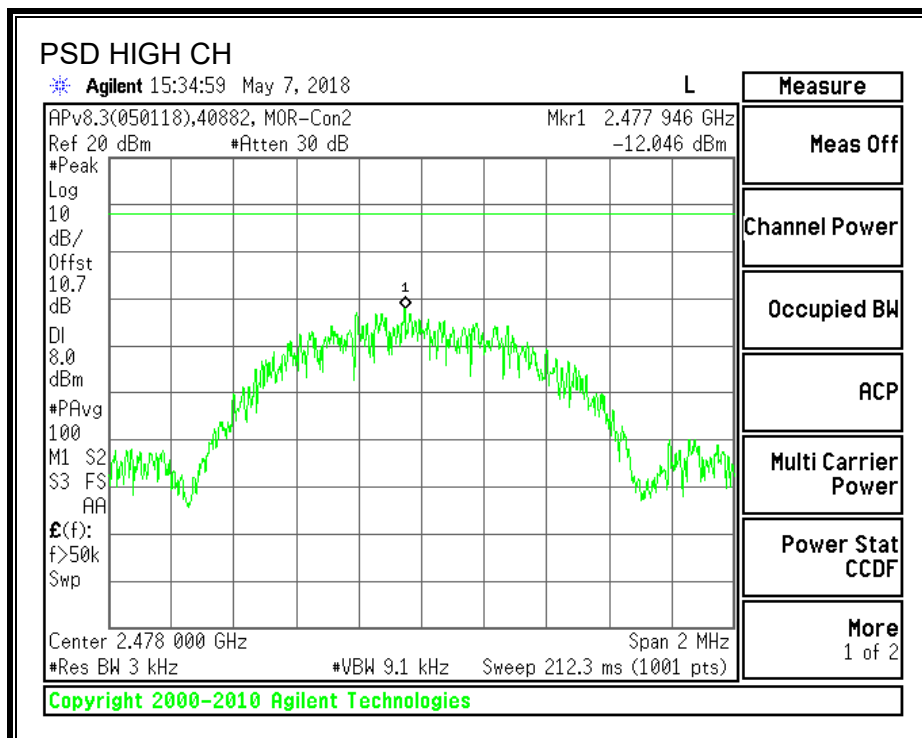
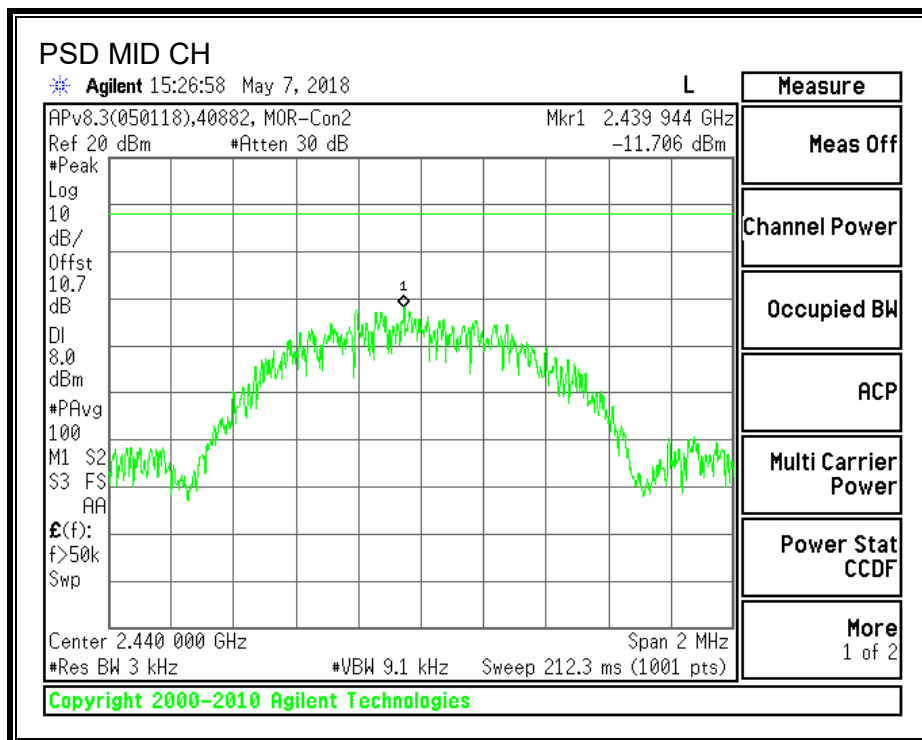
The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

### RESULTS

Channel	Frequency (MHz)	PSD (dBm)	Limit (dBm/3kHz)	Margin (dB)
Low	2401	-11.816	8	-19.82
Middle	2440	-11.706	8	-19.71
High	2478	-12.046	8	-20.05

### POWER SPECTRAL DENSITY





## 8.7. CONDUCTED SPURIOUS EMISSIONS

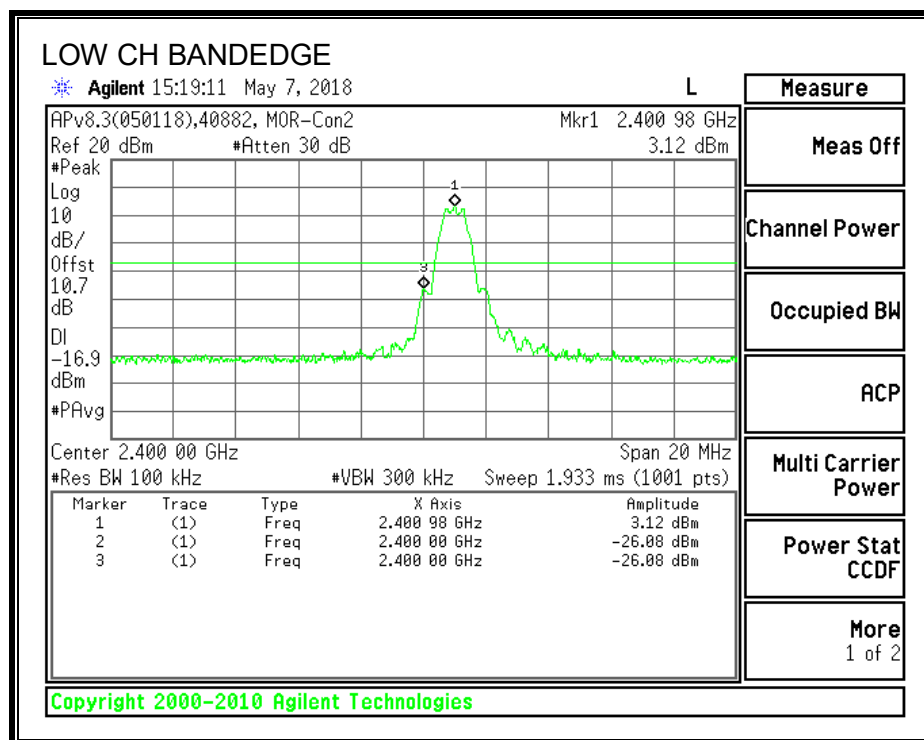
### LIMITS

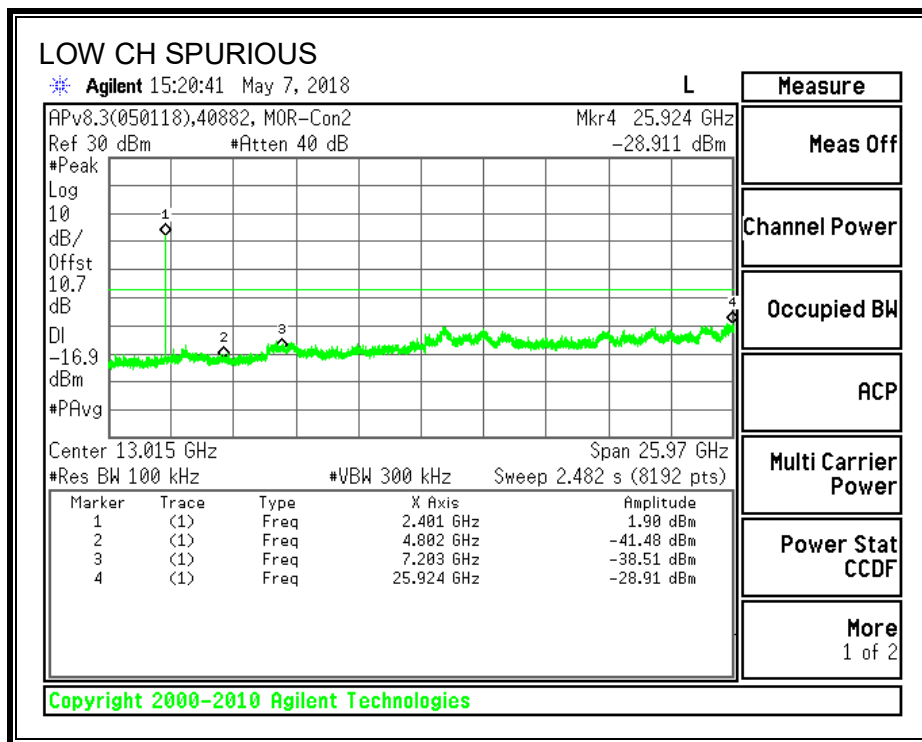
FCC §15.247 (d)

ISED RSS-247 5.5

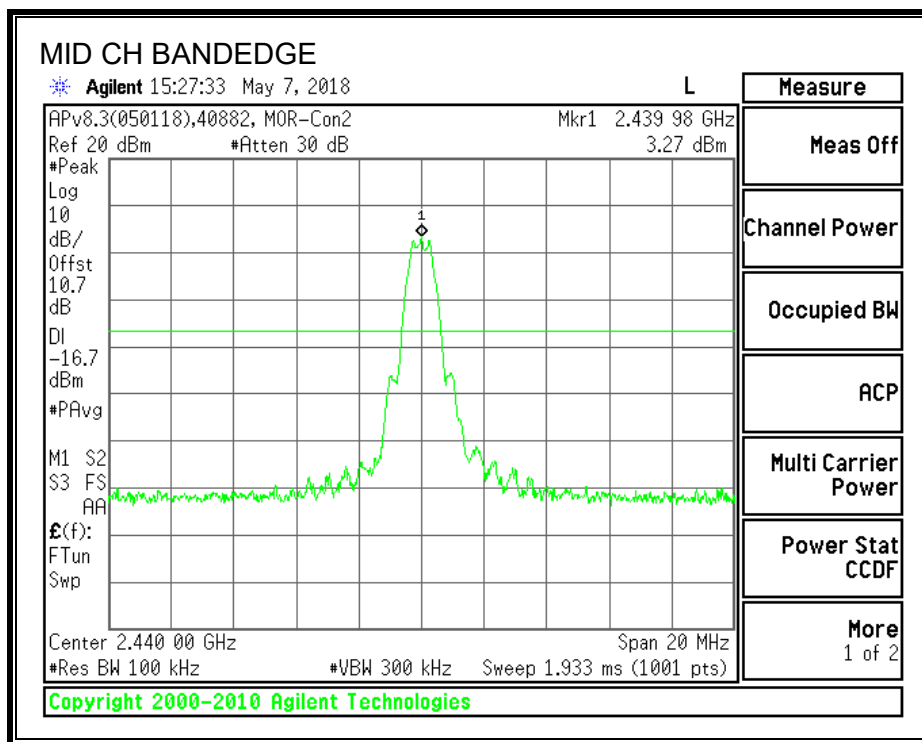
Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB.

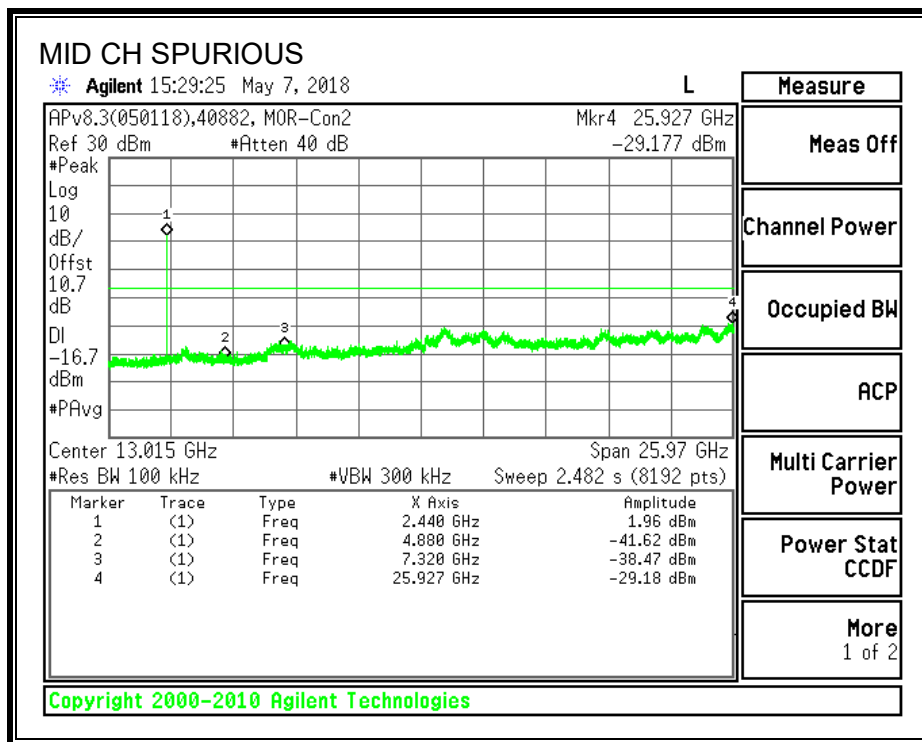
### SPURIOUS EMISSIONS, LOW CHANNEL



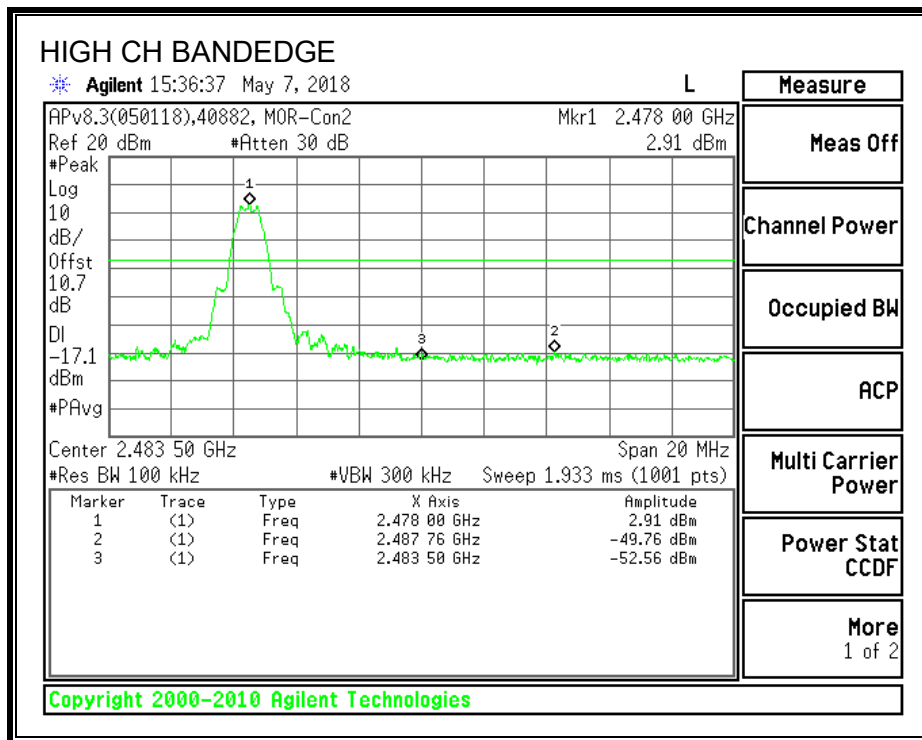


## SPURIOUS EMISSIONS, MID CHANNEL

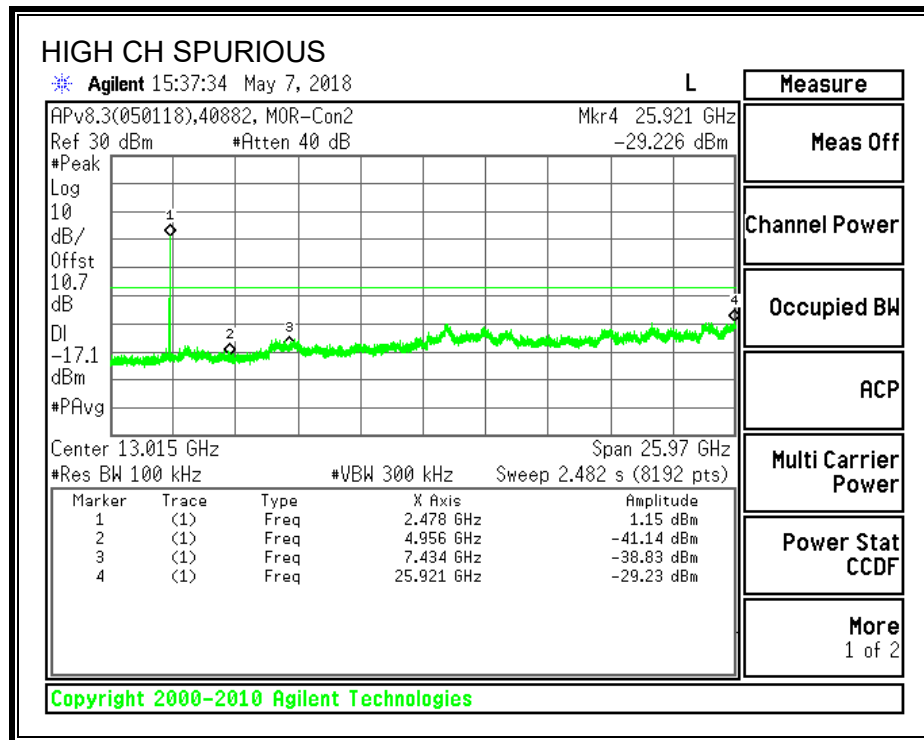




## SPURIOUS EMISSIONS, HIGH CHANNEL







## 9. RADIATED TEST RESULTS

### 9.1. LIMITS AND PROCEDURE

#### LIMITS

FCC §15.205 and §15.209  
ISED RSS-GEN Section 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.

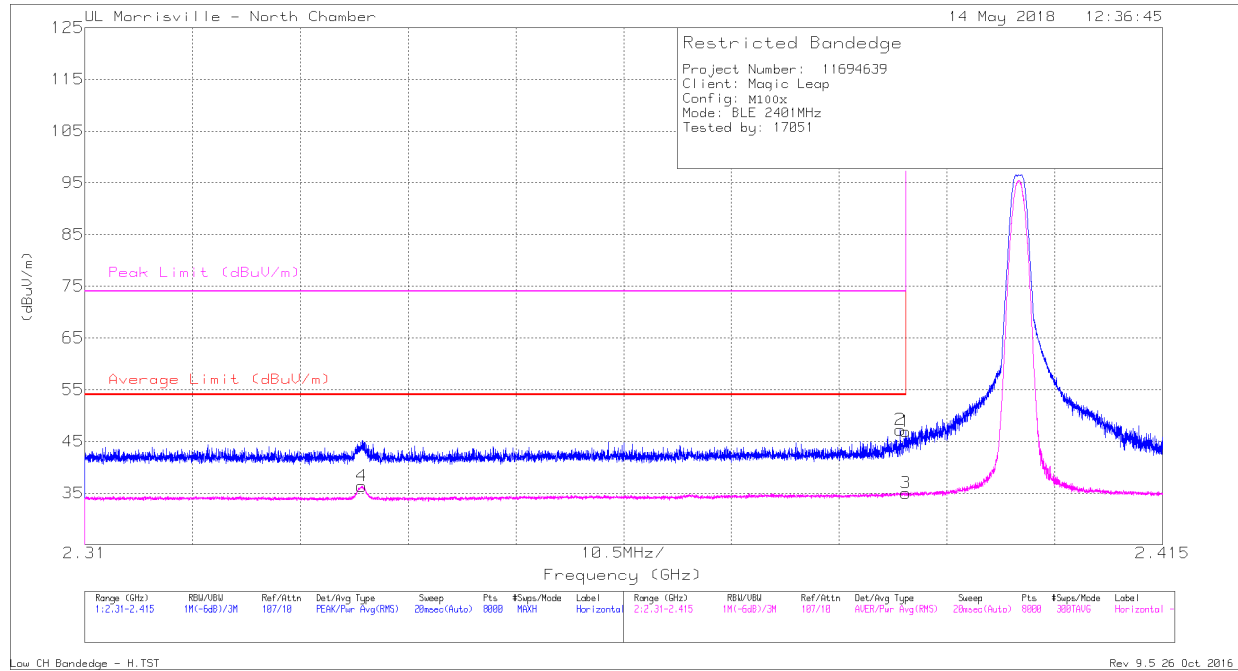
The spectrum from 1 to 18 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band. For 9kHz to 1000 MHz and 18 to 26 GHz investigation, the worst-case channel was selected.

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.

## 9.2. TRANSMITTER ABOVE 1 GHz

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

### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



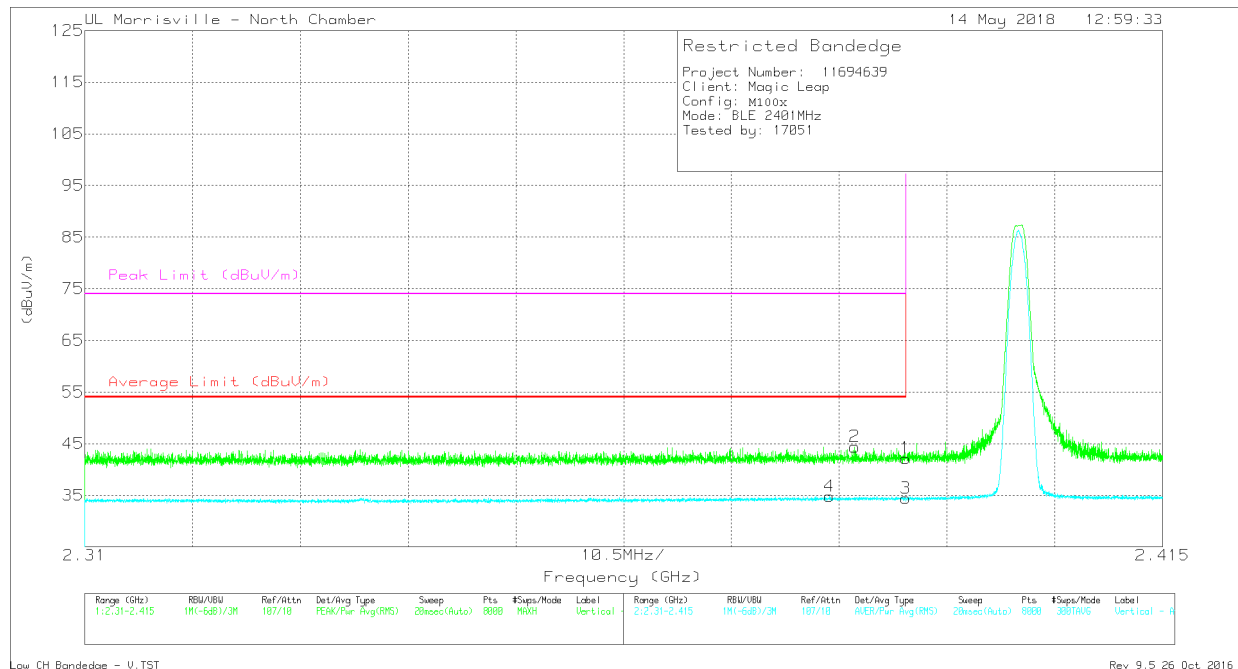
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (dB/m)	Amp/Cbl/Filtr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	39.41	Pk	32	-24.5	0	46.91	-	-	74	-27.09	292	100	H
2	* 2.389	39.73	Pk	32	-24.5	0	47.23	-	-	74	-26.77	292	100	H
3	* 2.39	25.47	RMS	32	-24.5	2.04	35.01	54	-18.99	-	-	292	100	H
4	* 2.337	27.11	RMS	31.7	-24.5	2.04	36.35	54	-17.65	-	-	292	100	H

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

Pk - Peak detector

RMS - RMS detection

# RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



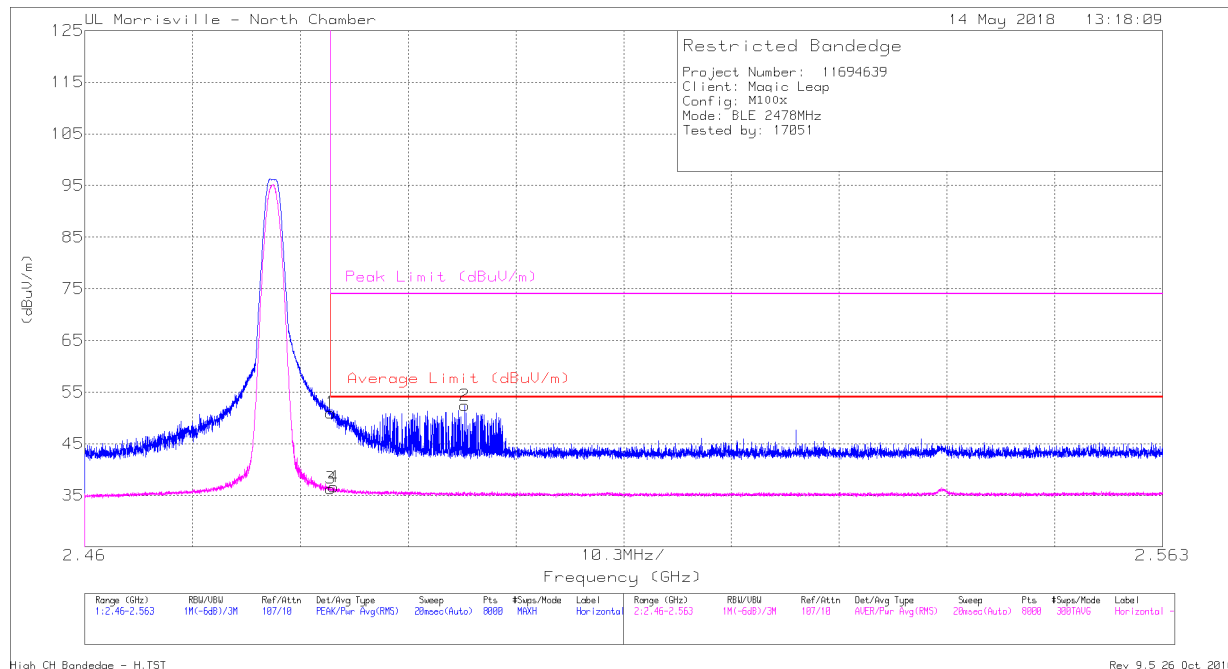
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (dB/m)	Amp/Cbl/Filtr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	34.67	Pk	32	-24.5	0	42.17	-	-	74	-31.83	106	149	V
2	* 2.385	36.91	Pk	32	-24.5	0	44.41	-	-	74	-29.59	106	149	V
3	* 2.39	24.9	RMS	32	-24.5	2.04	34.44	54	-19.56	-	-	106	149	V
4	* 2.383	25.24	RMS	32	-24.5	2.04	34.78	54	-19.22	-	-	106	149	V

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

Pk - Peak detector

RMS - RMS detection

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



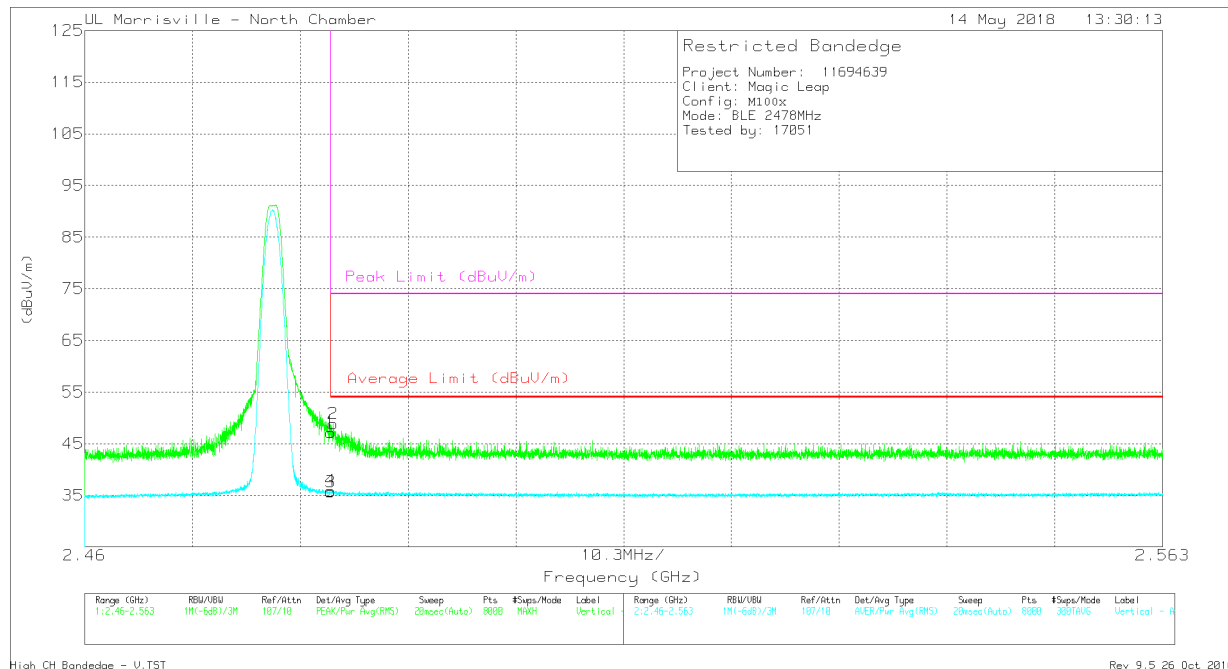
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (dB/m)	Amp/Cbl/Filtr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	42.96	Pk	32.4	-24.4	0	50.96	-	-	74	-23.04	297	182	H
2	* 2.496	44.5	Pk	32.3	-24.4	0	52.4	-	-	74	-21.6	297	182	H
3	* 2.484	26.3	RMS	32.4	-24.4	2.04	36.34	54	-17.66	-	-	297	182	H
4	* 2.484	26.58	RMS	32.4	-24.4	2.04	36.62	54	-17.38	-	-	297	182	H

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

Pk - Peak detector

RMS - RMS detection

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



Marker	Frequency (GHz)	Meter Reading (dBUV)	Det	AT0072 AF (dB/m)	Amp/Cbl/Filtr/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	39.18	Pk	32.4	-24.4	0	47.18	-	-	74	-26.82	195	363	V
2	* 2.484	40.87	Pk	32.4	-24.4	0	48.87	-	-	74	-25.13	195	363	V
3	* 2.484	25.6	RMS	32.4	-24.4	2.04	35.64	54	-18.36	-	-	195	363	V
4	* 2.484	25.83	RMS	32.4	-24.4	2.04	35.87	54	-18.13	-	-	195	363	V

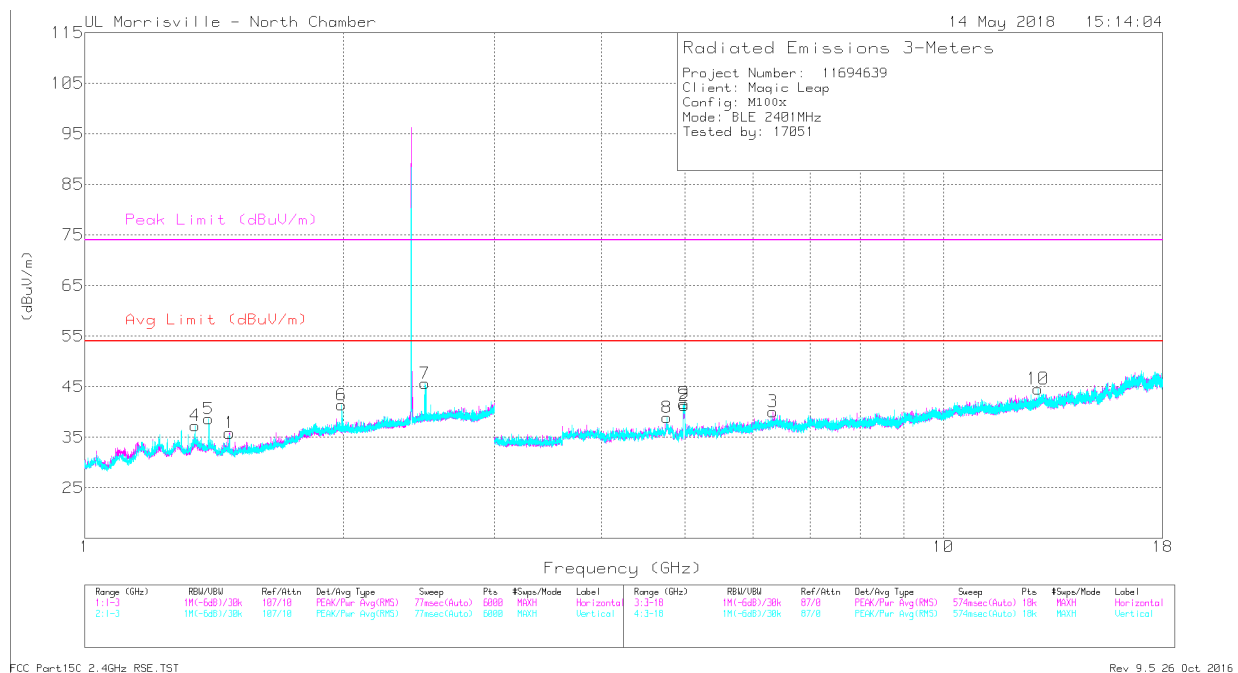
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

## HARMONICS AND SPURIOUS EMISSIONS

### LOW CHANNEL



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (dB/m)	Amp/Cbl/Filtr/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	* 1.475	40.1	PK2	28	-25.1	0	43	-	-	74	-31	19	183	H
	* 1.475	31.61	MAv1	28	-25.1	2.04	36.55	54	-17.45	-	-	19	183	H
2	* 4.994	50.06	PK2	34.1	-32.9	0	51.26	-	-	74	-22.74	22	239	H
	* 4.996	34.26	MAv1	34.1	-32.9	2.04	37.5	54	-16.5	-	-	22	239	H
4	* 1.344	40.4	PK2	29.3	-25.6	0	44.1	-	-	74	-29.9	29	173	V
	* 1.344	31.93	MAv1	29.3	-25.6	2.04	37.67	54	-16.33	-	-	29	173	V
5	* 1.395	41.88	PK2	28.8	-25.4	0	45.28	-	-	74	-28.72	68	277	V
	* 1.395	35.09	MAv1	28.8	-25.4	2.04	40.53	54	-13.47	-	-	68	277	V
7	* 2.498	48.74	PK2	32.3	-24.4	0	56.64	-	-	74	-17.36	30	144	V
	* 2.494	26.2	MAv1	32.3	-24.4	2.04	36.14	54	-17.86	-	-	30	144	V
8	* 4.802	43.35	PK2	34.1	-31.8	0	45.65	-	-	74	-28.35	13	288	V
	* 4.802	31.92	MAv1	34.1	-31.8	2.04	36.26	54	-17.74	-	-	13	288	V
9	* 4.988	50.42	PK2	34.1	-32.9	0	51.62	-	-	74	-22.38	280	100	V
	* 4.995	34.97	MAv1	34.1	-32.9	2.04	38.21	54	-15.79	-	-	280	100	V
3	6.328	34.67	Pk	35.5	-30.1	0	40.07	-	-	-	-	0-360	102	H
6	1.99	34.81	Pk	31.2	-24.6	0	41.41	-	-	-	-	0-360	102	V
10	12.882	32.75	Pk	39.2	-27.4	0	44.55	-	-	-	-	0-360	102	V

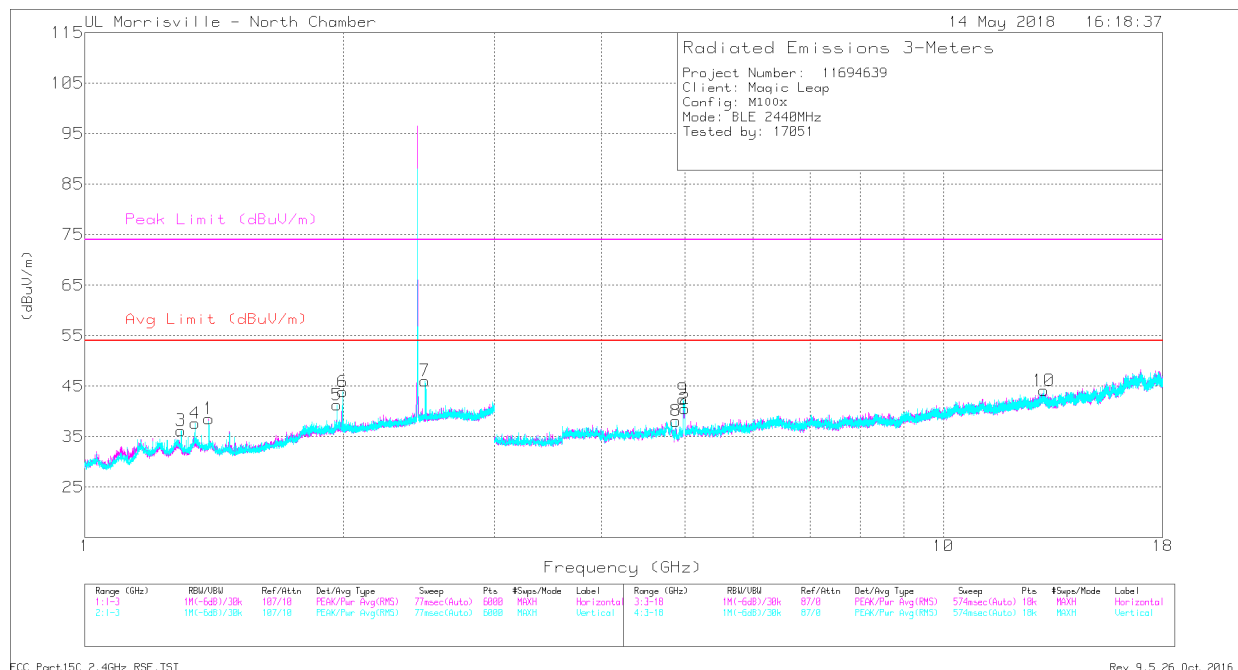
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

PK2 - Maximum Peak

MAv1 - Maximum RMS Average

## MIDDLE CHANNEL



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (dB/m)	Amp/Cbl/Filtr/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
3	* 1.296	39.79	PK2	29.1	-25.8	0	43.09	-	-	74	-30.91	77	151	V
	* 1.296	30.86	MAv1	29.1	-25.8	2.04	36.2	54	-17.8	-	-	77	151	V
4	* 1.344	40.64	PK2	29.3	-25.6	0	44.34	-	-	74	-29.66	31	173	V
	* 1.344	31.97	MAv1	29.3	-25.6	2.04	37.71	54	-16.29	-	-	31	173	V
1	* 1.395	40.03	PK2	28.8	-25.4	0	43.43	-	-	74	-30.57	80	200	H
	* 1.395	33.12	MAv1	28.8	-25.4	2.04	38.56	54	-15.44	-	-	80	200	H
7	* 2.499	49.68	PK2	32.3	-24.4	0	57.58	-	-	74	-16.42	20	145	V
	* 2.499	26.69	MAv1	32.3	-24.4	2.04	36.63	54	-17.37	-	-	20	145	V
8	* 4.879	41.78	PK2	34.1	-31.6	0	44.28	-	-	74	-29.72	257	100	V
	* 4.88	31.19	MAv1	34.1	-31.6	2.04	35.73	54	-18.27	-	-	257	100	V
9	* 5	49.14	PK2	34.1	-32.9	0	50.34	-	-	74	-23.66	276	100	V
	* 4.995	33.74	MAv1	34.1	-32.9	2.04	36.98	54	-17.02	-	-	276	100	V
2	* 5	49.27	PK2	34.1	-32.9	0	50.47	-	-	74	-23.53	24	240	H
	* 4.996	33.74	MAv1	34.1	-32.9	2.04	36.98	54	-17.02	-	-	24	240	H
5	1.968	34.55	Pk	31.2	-24.5	0	41.25	-	-	-	-	0-360	199	V
6	1.999	37.38	Pk	31.1	-24.6	0	43.88	-	-	-	-	0-360	102	V
10	13.082	30.86	Pk	39.2	-25.9	0	44.16	-	-	-	-	0-360	199	V

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

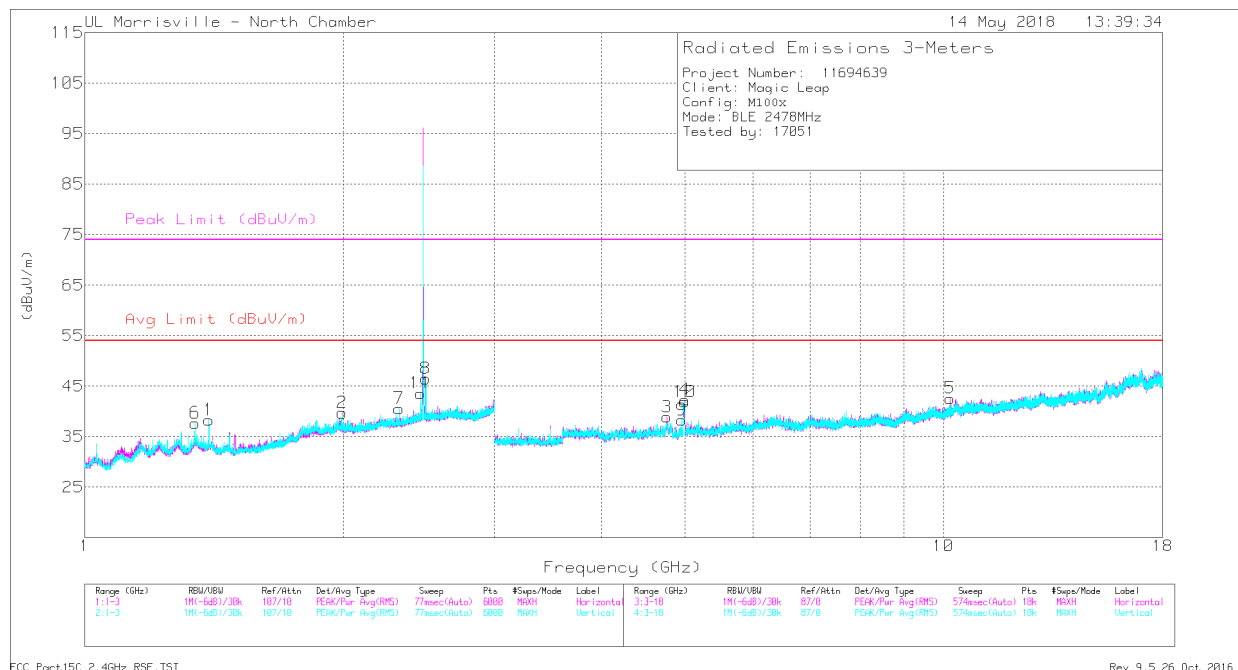
Pk - Peak detector

PK2 - Maximum Peak

MAv1 - Maximum RMS Average



## HIGH CHANNEL



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (dB/m)	Amp/Cbl/Filtr/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	* 1.395	40.67	PK2	28.8	-25.4	0	44.07	-	-	74	-29.93	79	201	H
	* 1.395	33	MAv1	28.8	-25.4	2.04	38.44	54	-15.56	-	-	79	201	H
3	* 4.768	42.2	PK2	34.1	-32.1	0	44.2	-	-	74	-29.8	354	232	H
	* 4.768	30.7	MAv1	34.1	-32.1	2.04	34.74	54	-19.26	-	-	354	232	H
4	* 4.987	49.16	PK2	34.1	-32.9	0	50.36	-	-	74	-23.64	25	239	H
	* 4.996	34.13	MAv1	34.1	-32.9	2.04	37.37	54	-16.63	-	-	25	239	H
6	* 1.344	40.77	PK2	29.3	-25.6	0	44.47	-	-	74	-29.53	28	173	V
	* 1.344	32.08	MAv1	29.3	-25.6	2.04	37.82	54	-16.18	-	-	28	173	V
7	* 2.322	37.71	PK2	31.7	-24.5	0	44.91	-	-	74	-29.09	18	142	V
	* 2.322	25.5	MAv1	31.7	-24.5	2.04	34.74	54	-19.26	-	-	18	142	V
8	* 2.493	50.14	PK2	32.3	-24.4	0	58.04	-	-	74	-15.96	22	144	V
	* 2.492	26.46	MAv1	32.3	-24.4	2.04	36.4	54	-17.6	-	-	22	144	V
9	* 4.955	42.99	PK2	34.1	-32.4	0	44.69	-	-	74	-29.31	260	117	V
	* 4.956	31.66	MAv1	34.1	-32.4	2.04	35.4	54	-18.6	-	-	260	117	V
10	* 4.984	50.32	PK2	34.1	-32.9	0	51.52	-	-	74	-22.48	278	100	V
	* 4.989	34.56	MAv1	34.1	-32.9	2.04	37.8	54	-16.2	-	-	278	100	V
2	1.994	33.13	Pk	31.2	-24.6	0	39.73	-	-	-	-	0-360	199	H
11	2.46	35.69	Pk	32.3	-24.4	0	43.59	-	-	-	-	0-360	102	V
5	10.187	32.49	Pk	37.2	-27.1	0	42.59	-	-	-	-	0-360	199	H

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

Pk - Peak detector

PK2 - Maximum Peak

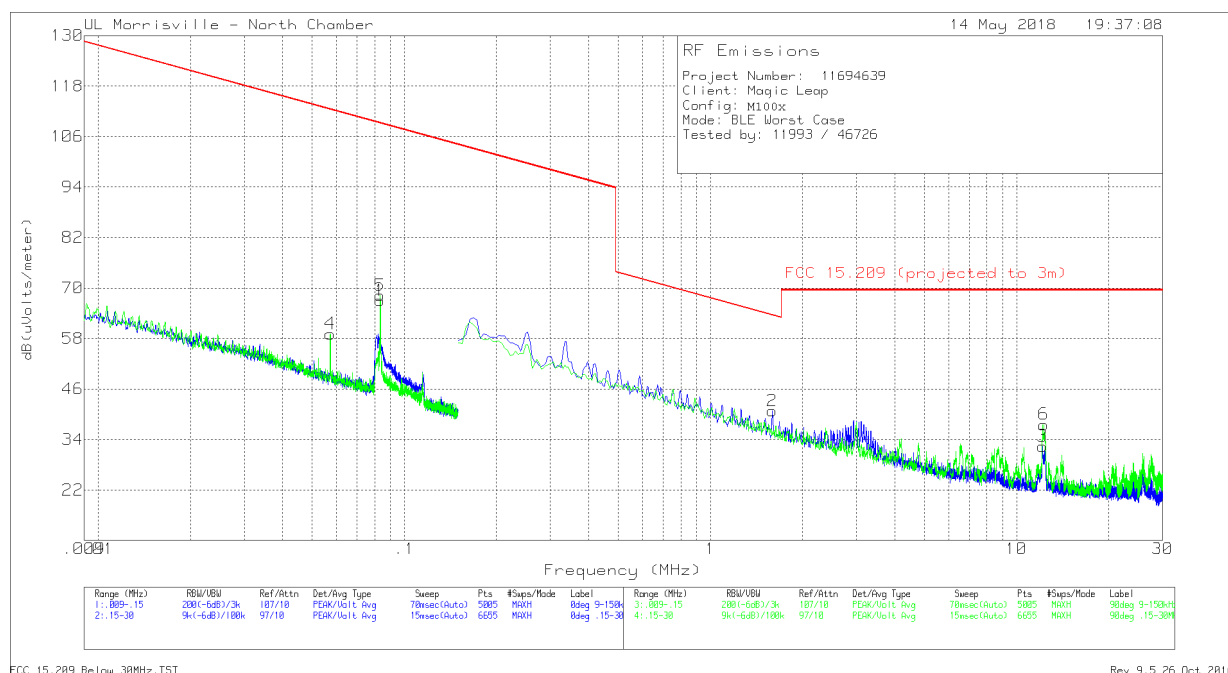
MAv1 - Maximum RMS Average

## 9.4. RADIATED WORST-CASE

### SPURIOUS EMISSIONS .009 TO 30 MHz (WORST-CASE)

**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).

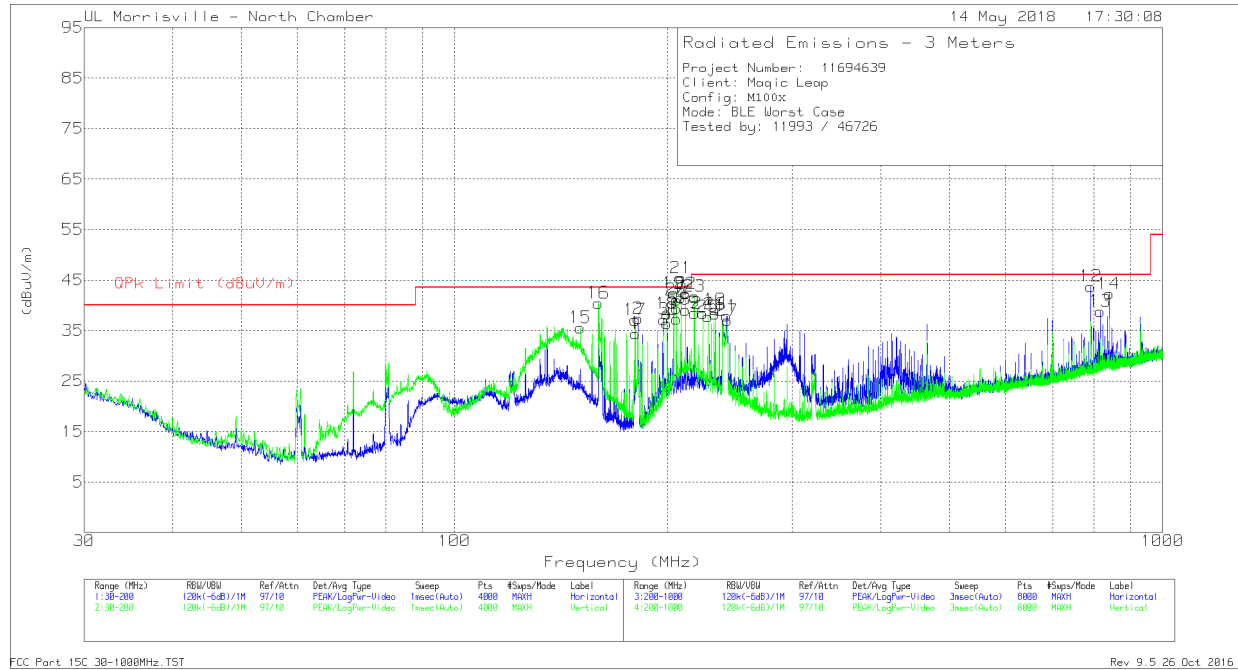
Although these tests were performed at a test site other than an open area test site, adequate comparison measurements were confirmed against an open area test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0079 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)
4	.0573	47.13	Pk	11.9	.1	59.13	-	-	112.44	-53.31	132.44	-73.31	0-360
1	.08342	55.36	Pk	11.6	.1	67.06	-	-	109.18	-42.12	129.18	-62.12	0-360
5	.08342	56.54	Pk	11.6	.1	68.24	-	-	109.18	-40.94	129.18	-60.94	0-360
2	1.59225	29.03	Pk	11.6	.2	40.83	63.56	-22.73	-	-	-	-	0-360
3	12.15005	21.24	Pk	10.6	.6	32.44	69.54	-37.1	-	-	-	-	0-360
6	12.25323	26.38	Pk	10.6	.6	37.58	69.54	-31.96	-	-	-	-	0-360

Pk - Peak detector

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

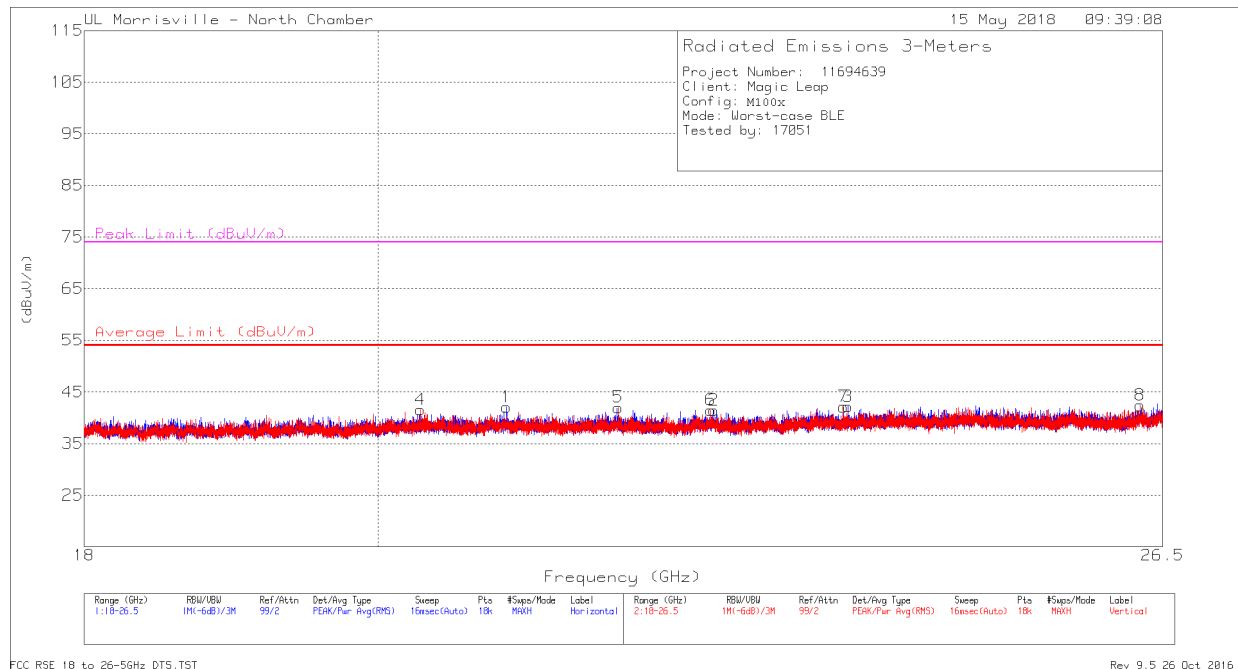


Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0073 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	180.0213	48.53	Pk	16.1	-30.2	34.43	43.52	-9.09	0-360	199	H
2	181.5942	51.49	Pk	16.1	-30.2	37.39	43.52	-6.13	0-360	199	H
3	197.3658	49.81	Pk	17.5	-30.1	37.21	43.52	-6.31	0-360	102	H
4	199.6827	48.7	Pk	17.9	-30.2	36.4	43.52	-7.12	0-360	102	H
5	203.9986	46.67	Qp	16.3	-30.1	32.87	43.52	-10.65	251	112	H
6	205.8008	51.54	Pk	15.8	-30	37.34	43.52	-6.18	0-360	198	H
7	208.8993	50.39	Qp	15.7	-30	36.09	43.52	-7.43	272	176	H
8	211.9709	47.19	Qp	15.9	-30.1	32.99	43.52	-10.53	295	157	H
9	218.1024	52.38	Pk	16.1	-30	38.48	46.02	-7.54	0-360	102	H
10	233.5044	51.93	Pk	17	-29.8	39.13	46.02	-6.89	0-360	102	H
11	242.4055	50.36	Pk	17.3	-29.8	37.86	46.02	-8.16	0-360	102	H
12	792.0029	43.72	Qp	26.5	-27.3	42.92	46.02	-3.1	176	112	H
13	815.9801	39.02	Pk	27	-27.2	38.82	46.02	-7.2	0-360	102	H
14	840.0067	41.91	Qp	27.3	-27	42.21	46.02	-3.81	183	108	H
15	150.5187	48.36	Pk	17.7	-30.5	35.56	43.52	-7.96	0-360	102	V
16	159.7662	47.13	Qp	17.5	-30.5	34.13	43.52	-9.39	152	105	V
17	179.9788	51.2	Pk	16.1	-30.2	37.1	43.52	-6.42	0-360	102	V
18	199.6864	46.97	Qp	17.9	-30.2	34.67	43.52	-8.85	50	103	V
19	203.9914	51.28	Qp	16.3	-30.1	37.48	43.52	-6.04	52	104	V
20	205.8358	50.42	Qp	15.8	-30	36.22	43.52	-7.3	32	113	V
21	208.906	55.22	Qp	15.7	-30	40.92	43.52	-2.6	44	103	V
22	211.9766	52.33	Qp	15.9	-30.1	38.13	43.52	-5.39	35	103	V
23	218.1134	52.04	Qp	16.1	-30	38.14	46.02	-7.88	39	104	V
24	224.3032	52.02	Pk	16.4	-30	38.42	46.02	-7.6	0-360	102	V
25	228.0036	50.99	Pk	16.7	-29.9	37.79	46.02	-8.23	0-360	102	V
26	233.5044	51.07	Pk	17	-29.8	38.27	46.02	-7.75	0-360	102	V
27	242.7056	49.54	Pk	17.3	-29.8	37.04	46.02	-8.98	0-360	102	V

Pk - Peak detector

Qp - Quasi-Peak detector

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



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0076 AF (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 20.944	50.09	Pk	33.2	-41.2	42.09	54	-11.91	74	-31.91	0-360	101	H
2	* 22.559	48.67	Pk	33.7	-40.9	41.47	54	-12.53	74	-32.53	0-360	101	H
3	* 23.674	48.46	Pk	34	-40.3	42.16	54	-11.84	74	-31.84	0-360	199	H
4	* 20.308	49.68	Pk	33.1	-41.2	41.58	54	-12.42	74	-32.42	0-360	102	V
6	* 22.535	48.61	Pk	33.7	-40.8	41.51	54	-12.49	74	-32.49	0-360	252	V
7	* 23.636	48.63	Pk	33.9	-40.4	42.13	54	-11.87	74	-31.87	0-360	299	V
5	21.797	49.4	Pk	33.5	-40.9	42	54	-12	74	-32	0-360	202	V
8	26.288	46.49	Pk	34.6	-38.7	42.39	54	-11.61	74	-31.61	0-360	202	V

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

Pk - Peak detector

## 10. AC POWER LINE CONDUCTED EMISSIONS

### LIMITS

FCC §15.207 (a)

ISED RSS-Gen 8.8

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 <sup>*</sup>	56 to 46 <sup>*</sup>
0.5-5	56	46
5-30	60	50

<sup>\*</sup> Decreases with the logarithm of the frequency.

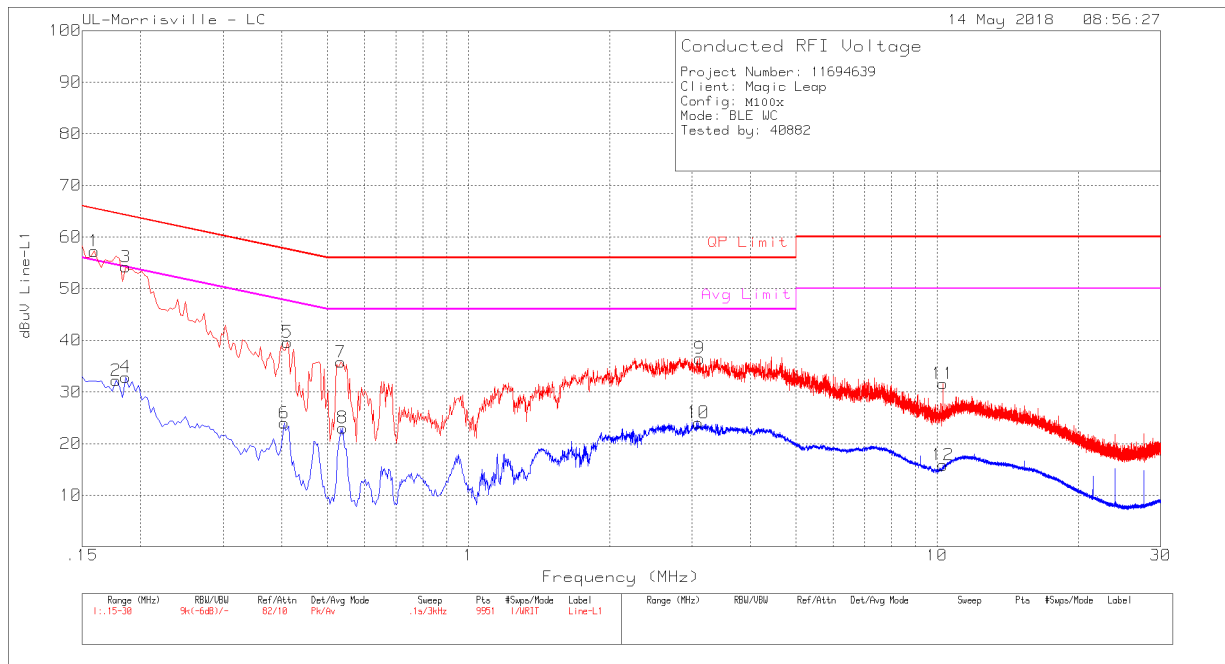
### TEST PROCEDURE

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.

## LINE 1 RESULTS

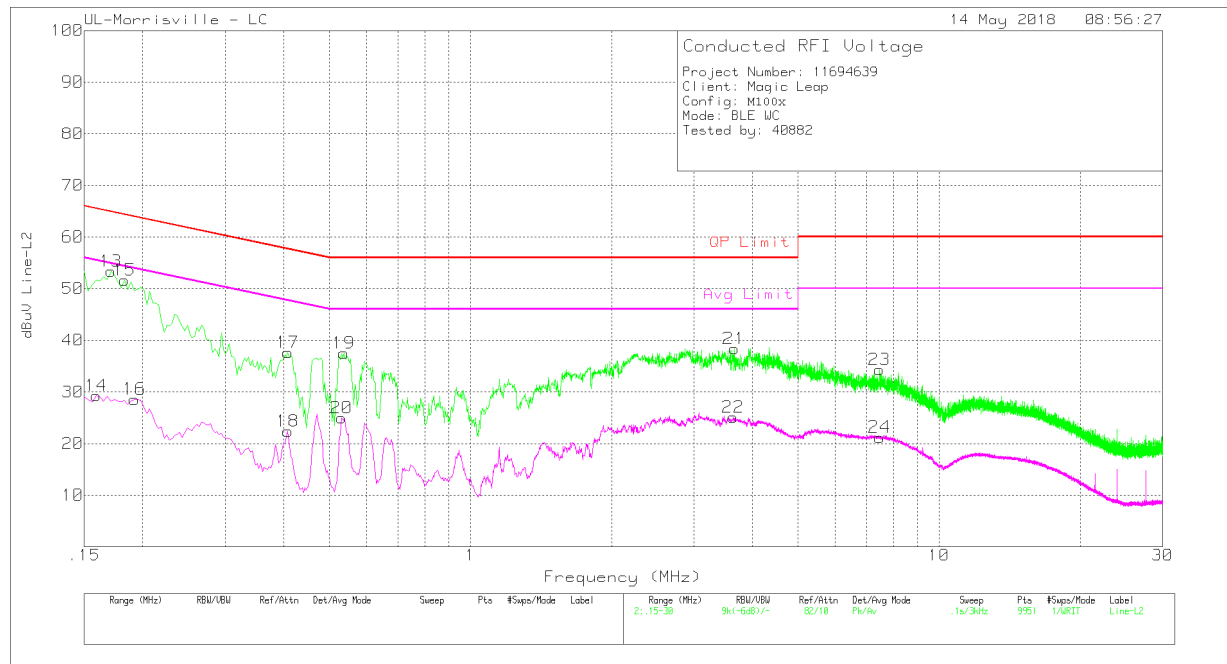


Range 1: Line-L1 .15 - 30MHz										
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN VCF (dB)	Cbl/Limiter (dB)	Corrected Reading dBuV	QP Limit	Margin (dB)	Avg Limit	Margin (dB)
1	.159	47.05	Pk	.2	10	57.25	65.52	-8.27	-	-
2	.177	22.03	Av	.2	10	32.23	-	-	54.63	-22.4
3	.186	44	Pk	.2	10	54.2	64.21	-10.01	-	-
4	.186	22.69	Av	.2	10	32.89	-	-	54.21	-21.32
5	.411	29.54	Pk	.1	10	39.64	57.63	-17.99	-	-
6	.405	13.95	Av	.1	9.9	23.95	-	-	47.75	-23.8
7	.534	25.88	Pk	0	9.9	35.78	56	-20.22	-	-
8	.54	13.16	Av	0	9.9	23.06	-	-	46	-22.94
9	3.117	26.48	Pk	0	10	36.48	56	-19.52	-	-
10	3.096	14.03	Av	0	10	24.03	-	-	46	-21.97
11	10.293	21.52	Pk	.1	10	31.62	60	-28.38	-	-
12	10.293	5.73	Av	.1	10	15.83	-	-	50	-34.17

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)
13	.171	43.18	Pk	.2	10	53.38	64.91	-11.53	-	-
14	.159	19.07	Av	.2	10	29.27	-	-	55.52	-26.25
15	.183	41.45	Pk	.2	10	51.65	64.35	-12.7	-	-
16	.192	18.39	Av	.2	10	28.59	-	-	53.95	-25.36
17	.408	27.56	Pk	.1	10	37.66	57.69	-20.03	-	-
18	.408	12.28	Av	.1	10	22.38	-	-	47.69	-25.31
19	.537	27.58	Pk	0	9.9	37.48	56	-18.52	-	-
20	.531	15.05	Av	0	9.9	24.95	-	-	46	-21.05
21	3.654	28.38	Pk	0	10	38.38	56	-17.62	-	-
22	3.633	15.07	Av	0	10	25.07	-	-	46	-20.93
23	7.467	24.21	Pk	.1	10	34.31	60	-25.69	-	-
24	7.473	11.11	Av	.1	10	21.21	-	-	50	-28.79

Pk - Peak detector

Av - Average detection

## **11. SETUP PHOTOS**

Refer to UL Document R11694639-EP9 for diagram.

**END OF REPORT**