



**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-E3

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

<u>Ver.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
1	2018-06-13	Initial Issue	Brian T. Kiewra
2	2018-06-25	Revised to cover module 1 only	Brian T. Kiewra
3	2018-06-27	Revised simultaneous transmission in Section 5.5.	Brian T. Kiewra
4	2018-06-29	Revised serial numbers in Section 1.	Brian T. Kiewra
5	2018-07-02	Added calibration interval note in Section 6.	Brian T. Kiewra
6	2018-07-10	Revised antenna gain table in Section 5.3.	Brian T. Kiewra

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS	4
2. TEST METHODOLOGY	5
3. FACILITIES AND ACCREDITATION	5
4. CALIBRATION AND UNCERTAINTY	6
4.1. <i>MEASURING INSTRUMENT CALIBRATION</i>	<i>6</i>
4.2. <i>SAMPLE CALCULATION</i>	<i>6</i>
4.3. <i>MEASUREMENT UNCERTAINTY</i>	<i>6</i>
5. EQUIPMENT UNDER TEST	7
5.1. <i>DESCRIPTION OF EUT</i>	<i>7</i>
5.2. <i>MAXIMUM OUTPUT POWER.....</i>	<i>7</i>
5.3. <i>DESCRIPTION OF AVAILABLE ANTENNAS</i>	<i>7</i>
5.4. <i>SOFTWARE AND FIRMWARE.....</i>	<i>7</i>
5.5. <i>WORST-CASE CONFIGURATION AND MODE.....</i>	<i>8</i>
5.6. <i>DESCRIPTION OF TEST SETUP.....</i>	<i>9</i>
6. TEST AND MEASUREMENT EQUIPMENT	10
7. MEASUREMENT METHODS	12
8. ANTENNA PORT TEST RESULTS.....	13
8.1. <i>ON TIME AND DUTY CYCLE LIMITS.....</i>	<i>13</i>
8.2. <i>6 dB BANDWIDTH.....</i>	<i>14</i>
8.3. <i>99% BANDWIDTH.....</i>	<i>16</i>
8.4. <i>OUTPUT POWER.....</i>	<i>19</i>
8.5. <i>AVERAGE POWER.....</i>	<i>20</i>
8.6. <i>POWER SPECTRAL DENSITY</i>	<i>21</i>
8.7. <i>CONDUCTED SPURIOUS EMISSIONS.....</i>	<i>24</i>
9. RADIATED TEST RESULTS.....	28
9.1. <i>LIMITS AND PROCEDURE.....</i>	<i>28</i>
9.2. <i>TX ABOVE 1 GHz FOR BLE MODE IN THE 2.4 GHz BAND</i>	<i>29</i>
9.3. <i>WORST-CASE RADIATED.....</i>	<i>36</i>
10. AC POWER LINE CONDUCTED EMISSIONS	39
11. SETUP PHOTOS	42
END OF REPORT	42

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: PB1067B00000, PB1067B00001, PB1067B00002

DATE TESTED: 2017-11-13 to 2018-04-27

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 checked="" 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:

Mode	Frequency Range (MHz)	Output Power (dBm)	Output Power (mW)
BLE - Module 1	2402 - 2480	6.29	4.26

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 Ant1, therefore has a maximum gain of +0.4dB.

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was PEQ5.

5.5. WORST-CASE CONFIGURATION AND MODE

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 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 X axis was worst-case orientation. Therefore all radiated testing was performed in the X-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-EP3

6. TEST AND MEASUREMENT EQUIPMENT

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

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

Test Equipment Used - Wireless Conducted Measurement Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
Conducted Room 1					
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
Conducted Room 2					
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
Additional Equipment used					
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
PWM003	RF Power Meter	Keysight Technologies	N1911A	2017-07-14	2018-07-14
PWS001	Peak and Avg Power Sensor, 50MHz to 18GHz	Keysight Technologies	N1921A	2017-05-18	2018-05-18
MM0168	True RMS Multimeter	Agilent	U1232A	2017-10-25	2018-10-30

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

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
1-18 GHz					
AT0069	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2017-04-05	2018-04-05
Gain-Loss Chains					
S-SAC03	Gain-loss string: 1-18GHz	Various	Various	2017-08-18	2018-08-18
Receiver & Software					
SA0025	Spectrum Analyzer	Agilent	N9030A	2017-04-10	2018-04-10
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA

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

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
0.009-30MHz (Loop Ant.)					
AT0059	Active Loop Antenna	ETS-Lindgren	6502	2017-06-05	2018-06-05
30-1000 MHz					
AT0073	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2017-07-18	2018-07-31
1-18 GHz					
AT0072	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					
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	2017-08-18	2018-08-18
N-SAC04	Gain-loss string: 18-40GHz	Various	Various	2017-03-03	2018-03-03
Receiver & Software					
SA0027	Spectrum Analyzer	Agilent	N9030A	2017-03-16	2018-03-16
SA0026 (18-40GHz RSE)	Spectrum Analyzer	Agilent	N9030A	2017-02-17	2018-02-28
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA

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

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
CBL076	Coax cable, RG223, N-male to BNC-male, 20-ft.	Pasternack	PE3476-240	2017-06-12	2018-06-12
LISN003	LISN, 50-ohm/50-uH, 2-conductor, 25A	Fischer Custom Com.	FCC-LISN-50-25-2-01-550V	2017-08-22	2018-08-22
PRE0101521 (75141)	EMI Test Receiver 9kHz-7GHz	Rohde & Schwarz	ESCI 7	2017-08-23	2018-08-23
TL001	Transient Limiter, 0.009-30MHz	Com-Power	LIT-930A	2017-06-12	2018-06-12
PS215	AC Power Source	Elgar	CW2501M (s/n 1523A02397)	NA	NA
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
CDECABLE001	ANSI C63.4 1m extension cable.	UL	Per Annex B of ANSI C63.4	2017-07-03	2018-07-03

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 AND DUTY CYCLE LIMITS

None; for reporting purposes only.

PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

TEST INFORMATION

Test Date: 2017-11-13 and 2017-11-30

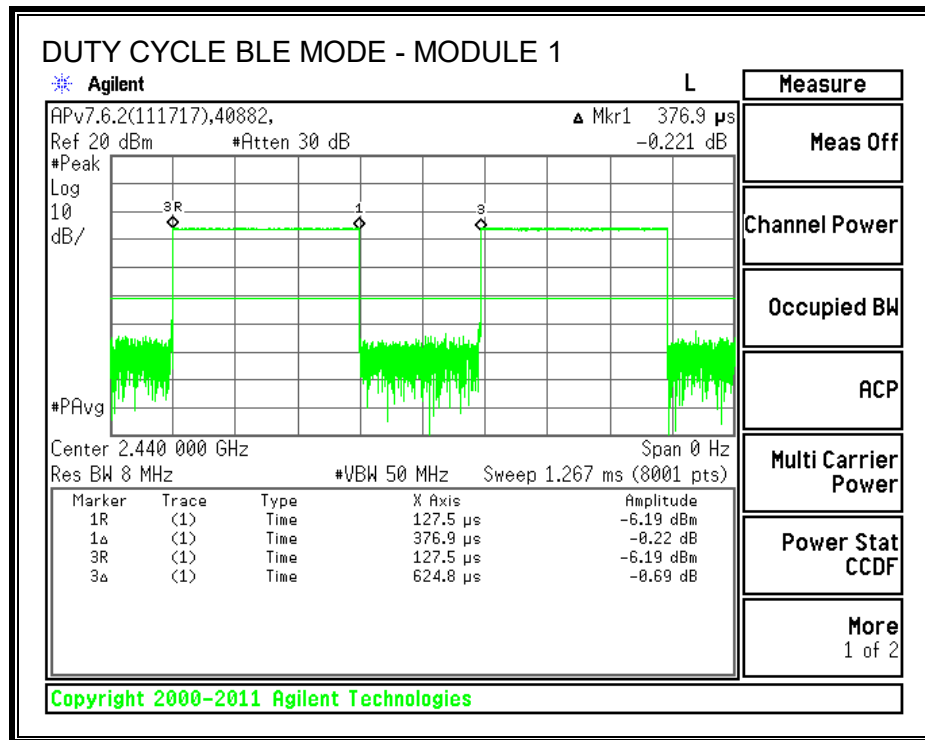
Project: 11694639

Tested By: Jeffrey Cabrera

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 - Module 1	0.3769	0.6248	0.603	60.32%	2.20	2.653

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

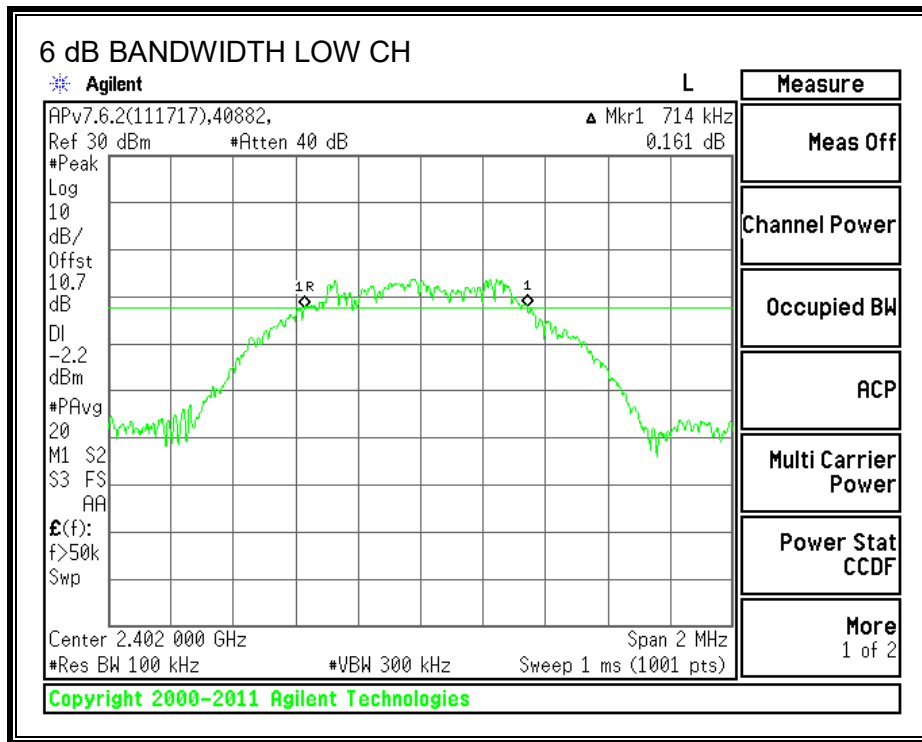
Module 1

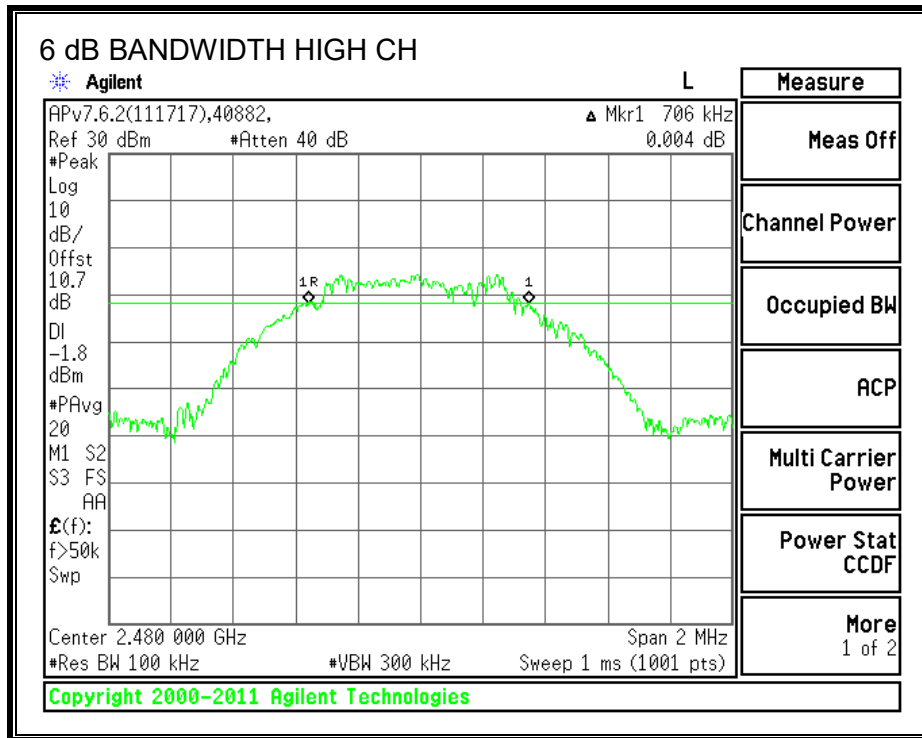
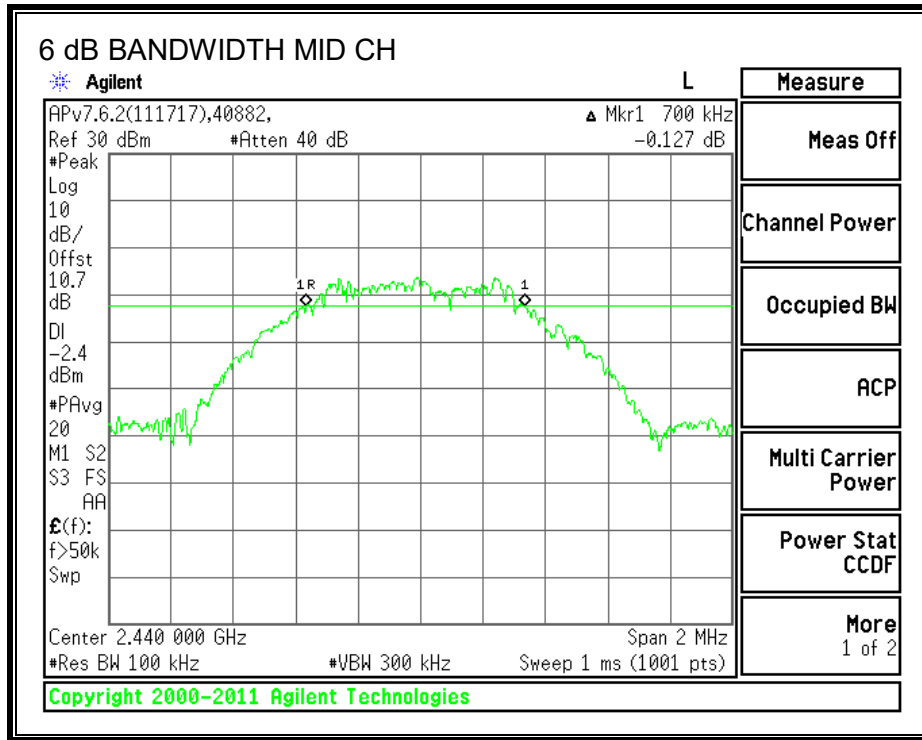
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.714	0.5
Middle	2440	0.700	0.5
High	2480	0.706	0.5

TEST INFORMATION

Test Date: 2017-11-13 and 2017-11-30
 Project: 11694639
 Tested By: Jeffrey Cabrera

6 dB BANDWIDTH PLOTS - MODULE 1





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.

TEST INFORMATION

Test Date: 2017-11-13 and 2017-11-30

Project: 11694639

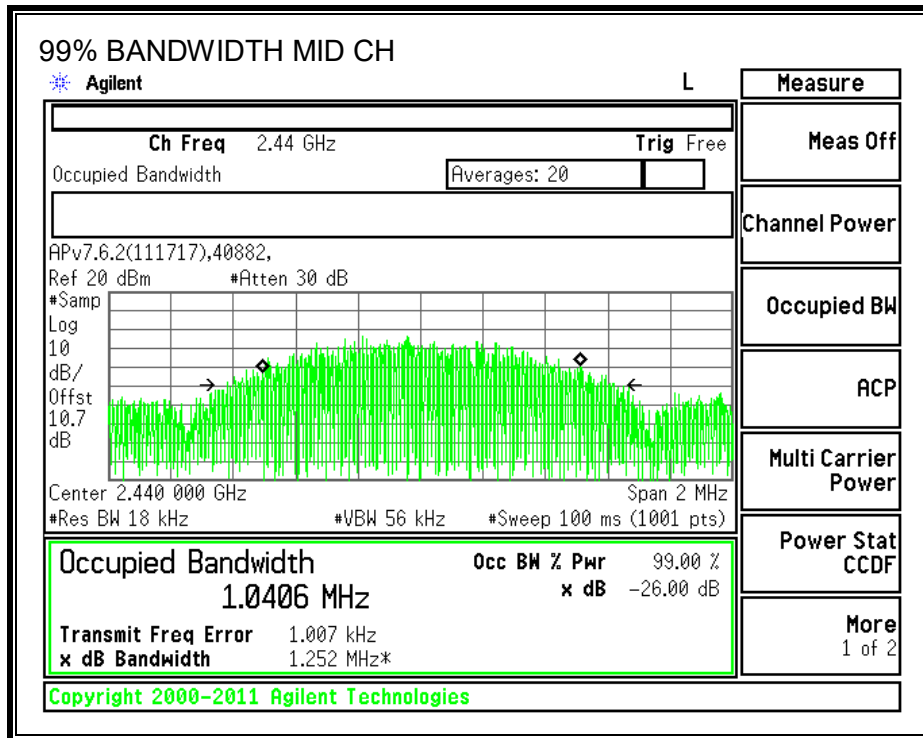
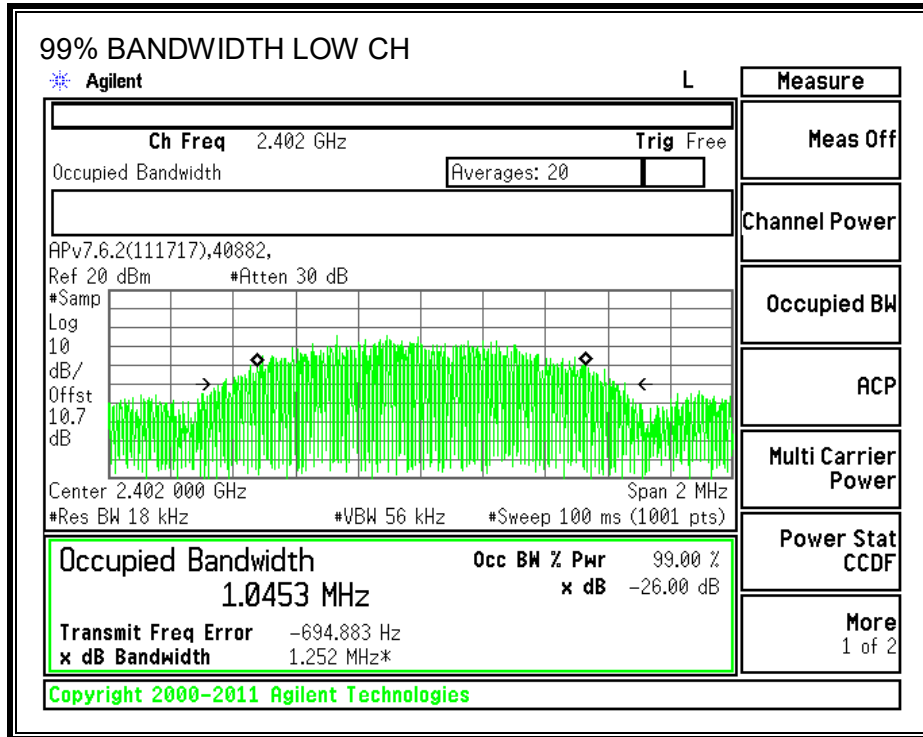
Tested By: Jeffrey Cabrera

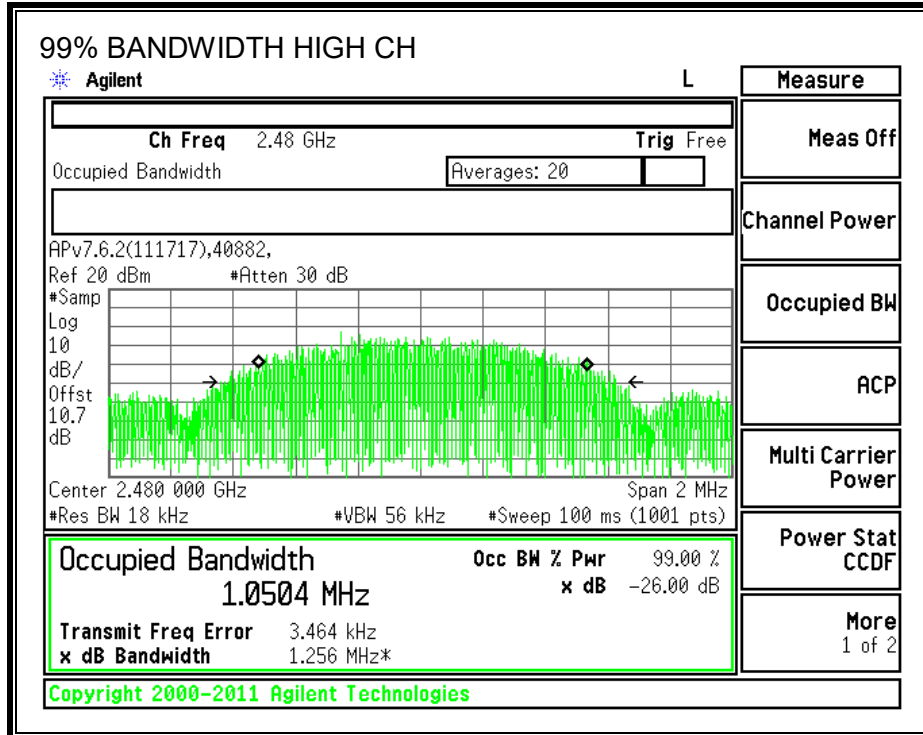
RESULTS

Module 1

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0453
Middle	2440	1.0406
High	2480	1.0504

99% BANDWIDTH PLOTS - MODULE 1





8.4. OUTPUT POWER

LIMITS

FCC §15.247 (b)

ISED RSS-247 5.4

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

RESULTS

Module 1

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	6.16	30	-23.840
Middle	2440	5.46	30	-24.540
High	2480	6.29	30	-23.710

TEST INFORMATION

Test Date: 2017-11-13 and 2017-11-30

Project: 11694639

Tested By: Jeffrey Cabrera

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.

Module 1

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	5.85
Middle	2440	5.07
High	2480	5.97

TEST INFORMATION

Test Date: 2017-11-13 and 2017-11-30

Project: 11694639

Tested By: Jeffrey Cabrera

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.

RESULTS

Module 1

Channel	Frequency (MHz)	PSD (dBm)	Limit (dBm)	Margin (dB)
Low	2402	-10.530	8	-18.53
Middle	2440	-10.879	8	-18.88
High	2480	-10.102	8	-18.10

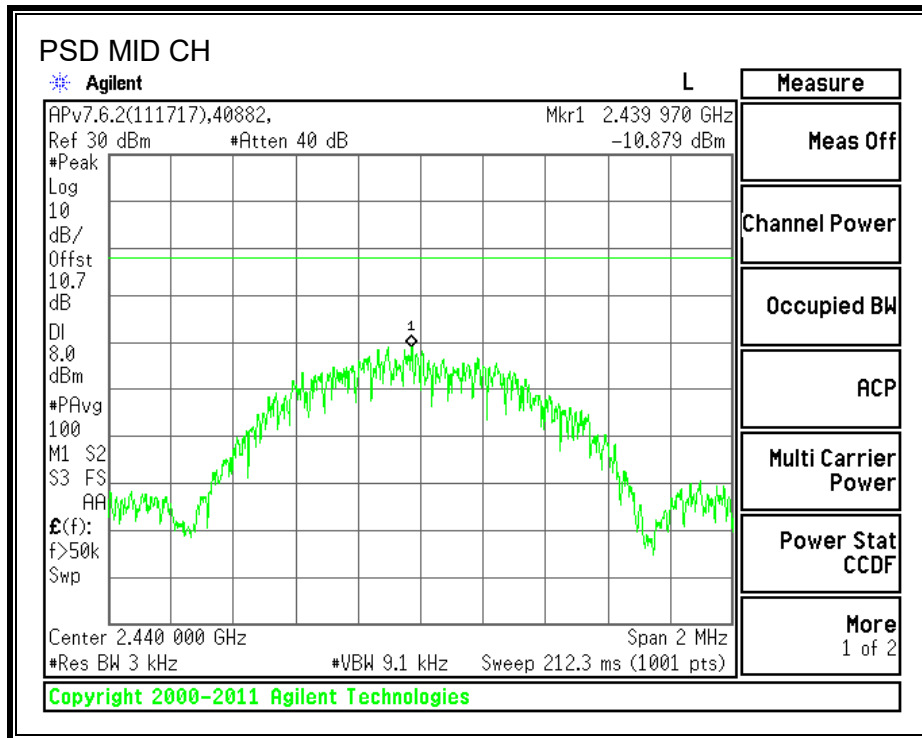
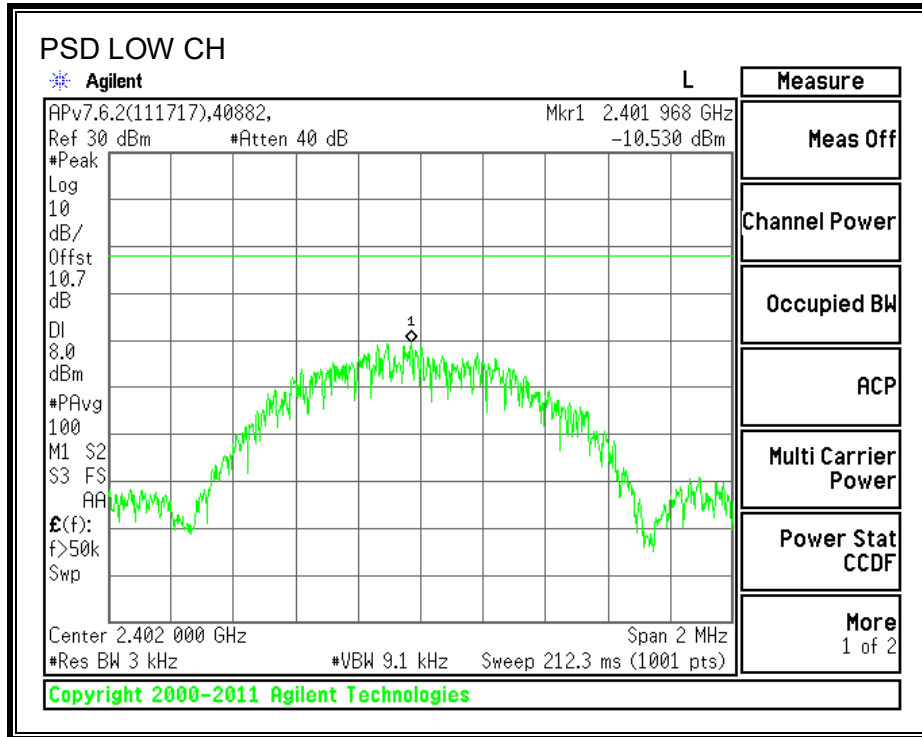
TEST INFORMATION

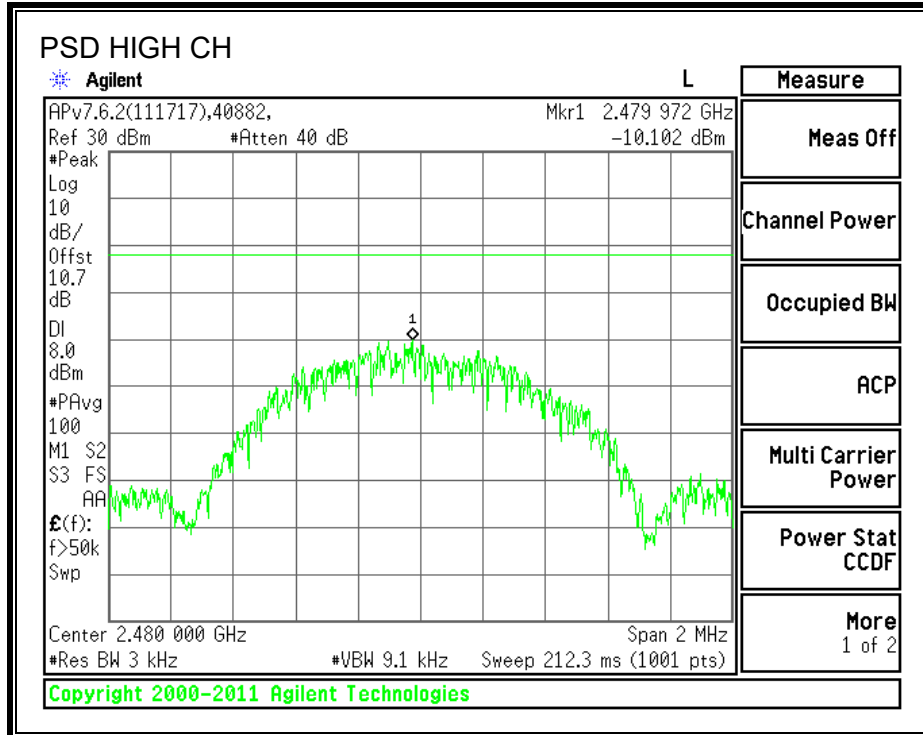
Test Date: 2017-11-13 and 2017-11-30

Project: 11694639

Tested By: Jeffrey Cabrera

POWER SPECTRAL DENSITY PLOTS - MODULE 1





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.

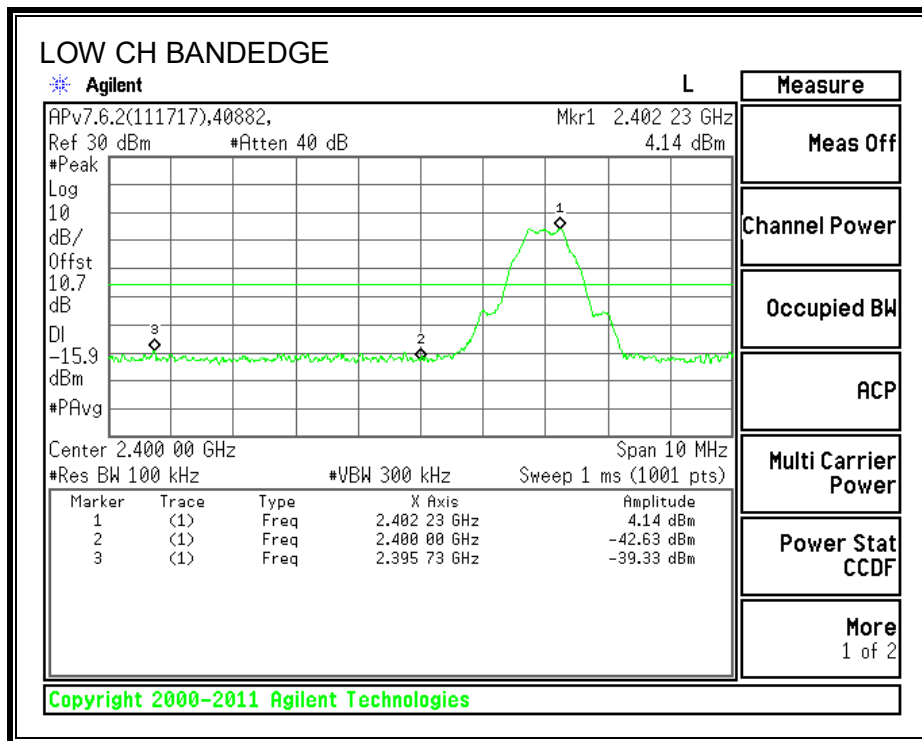
TEST INFORMATION

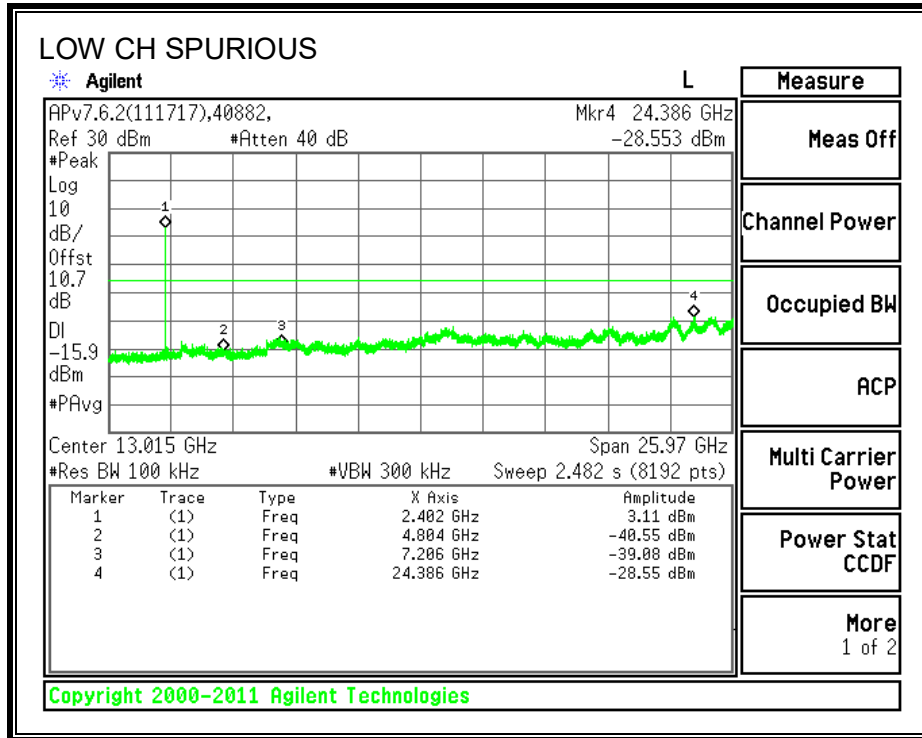
Test Date: 2017-11-13 and 2017-11-30

Project: 11694639

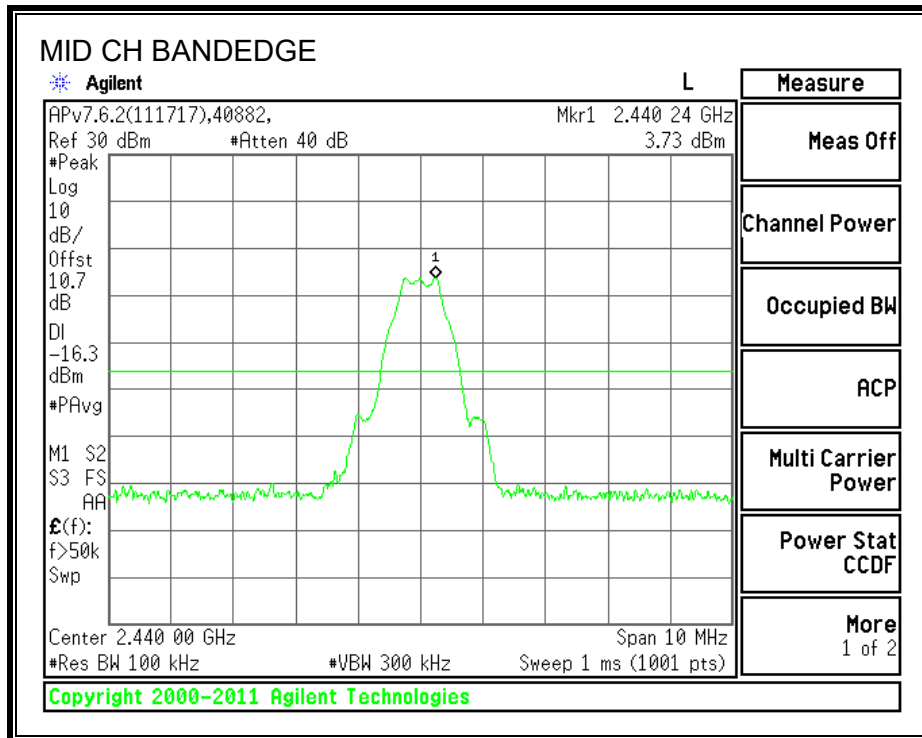
Tested By: Jeffrey Cabrera

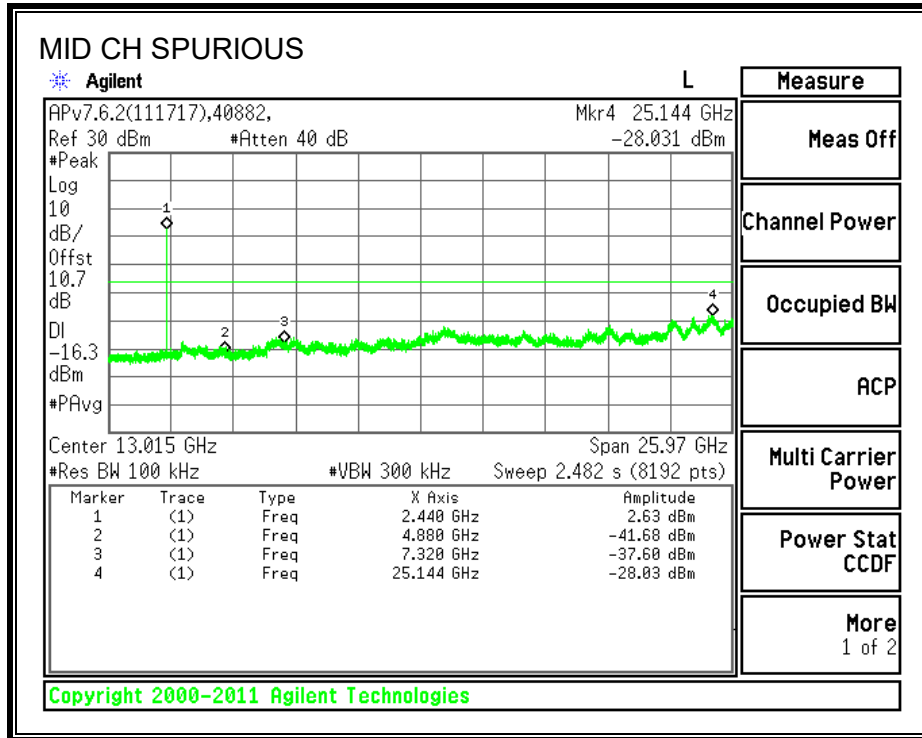
SPURIOUS EMISSIONS, LOW CHANNEL - MODULE 1



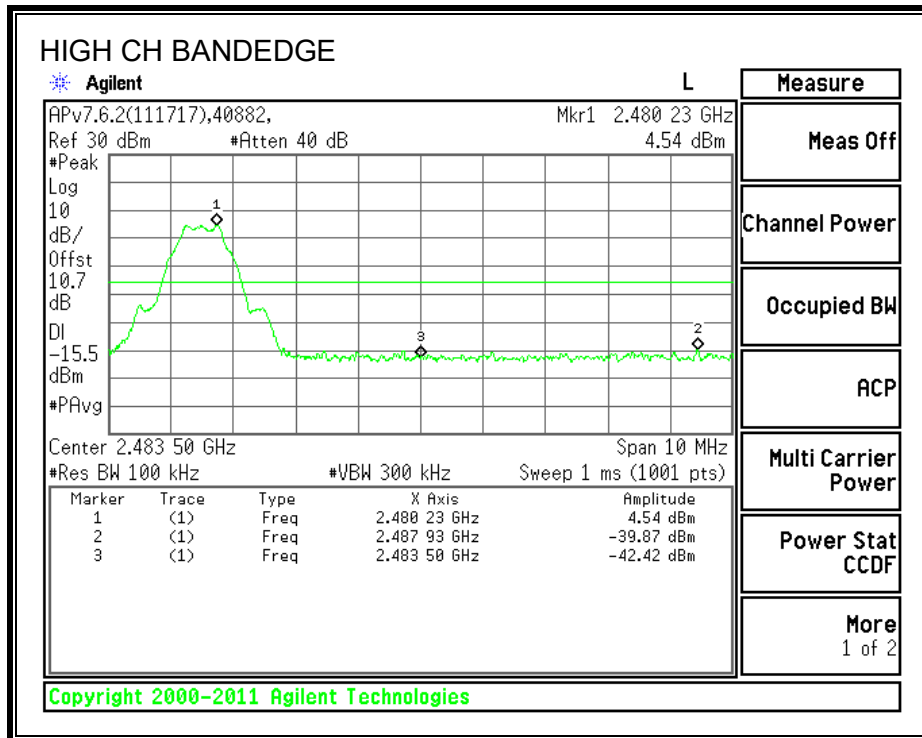


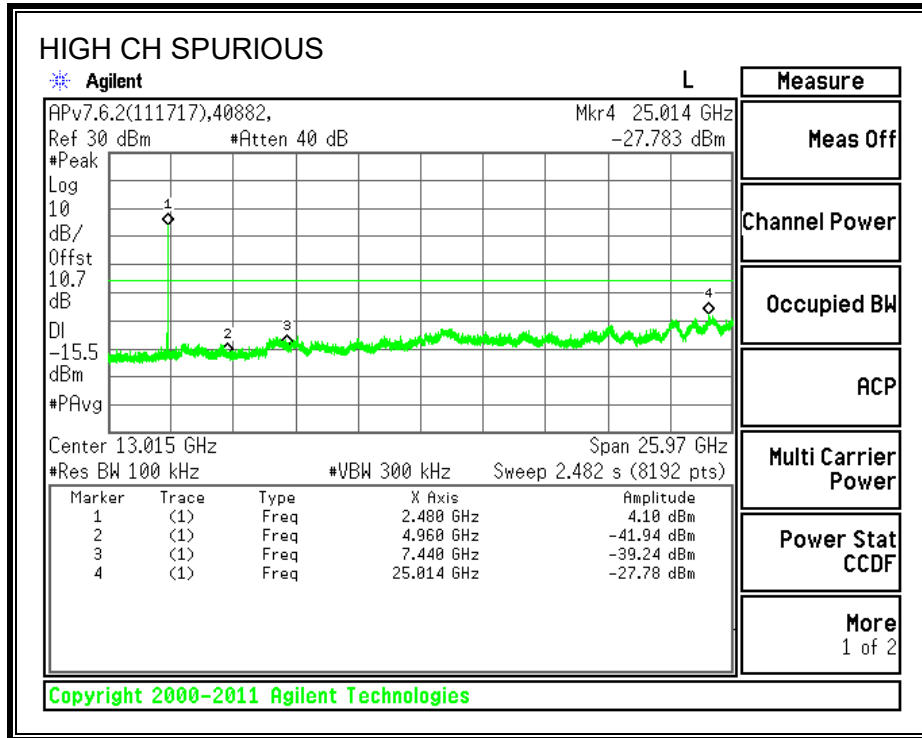
SPURIOUS EMISSIONS, MID CHANNEL - MODULE 1





SPURIOUS EMISSIONS, HIGH CHANNEL - MODULE 1





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.

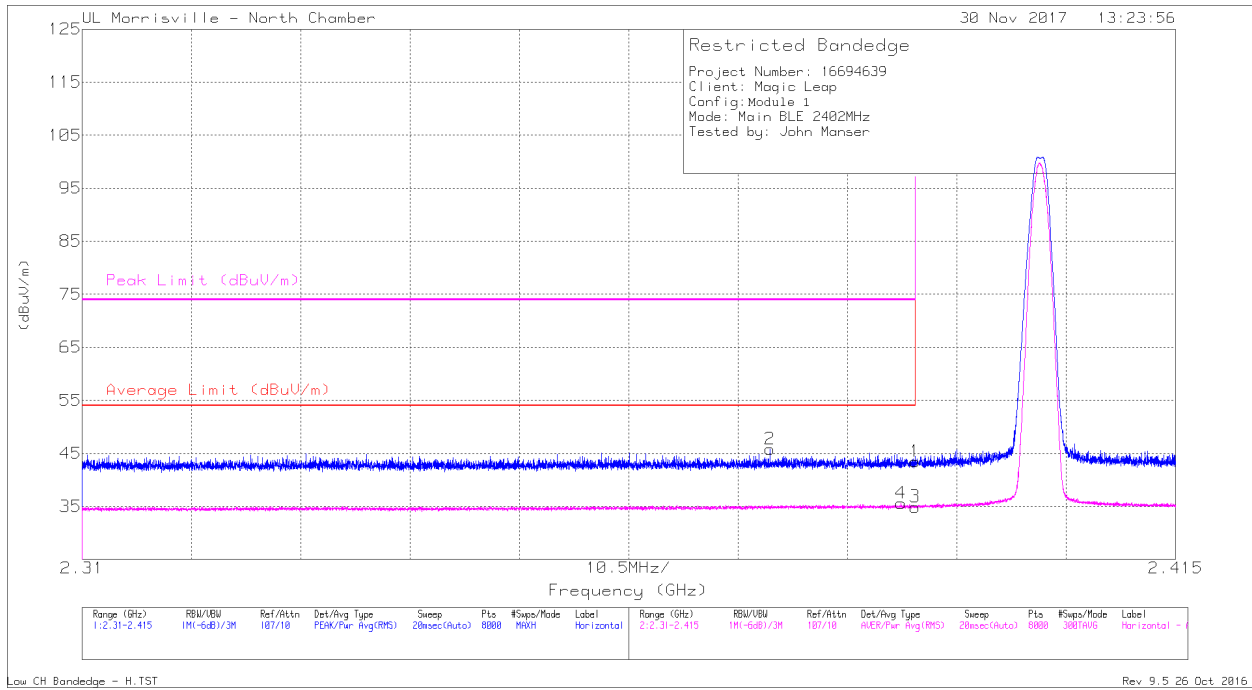
For peak measurements above 1 GHz, the resolution bandwidth is set to 1 MHz and the video bandwidth is set to 3 MHz. For average measurements above 1GHz, the resolution bandwidth and video bandwidth are set as described in ANSI C63.10:2013 for the applicable measurement. The particular averaging method 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. TX ABOVE 1 GHz FOR BLE MODE IN THE 2.4 GHz BAND

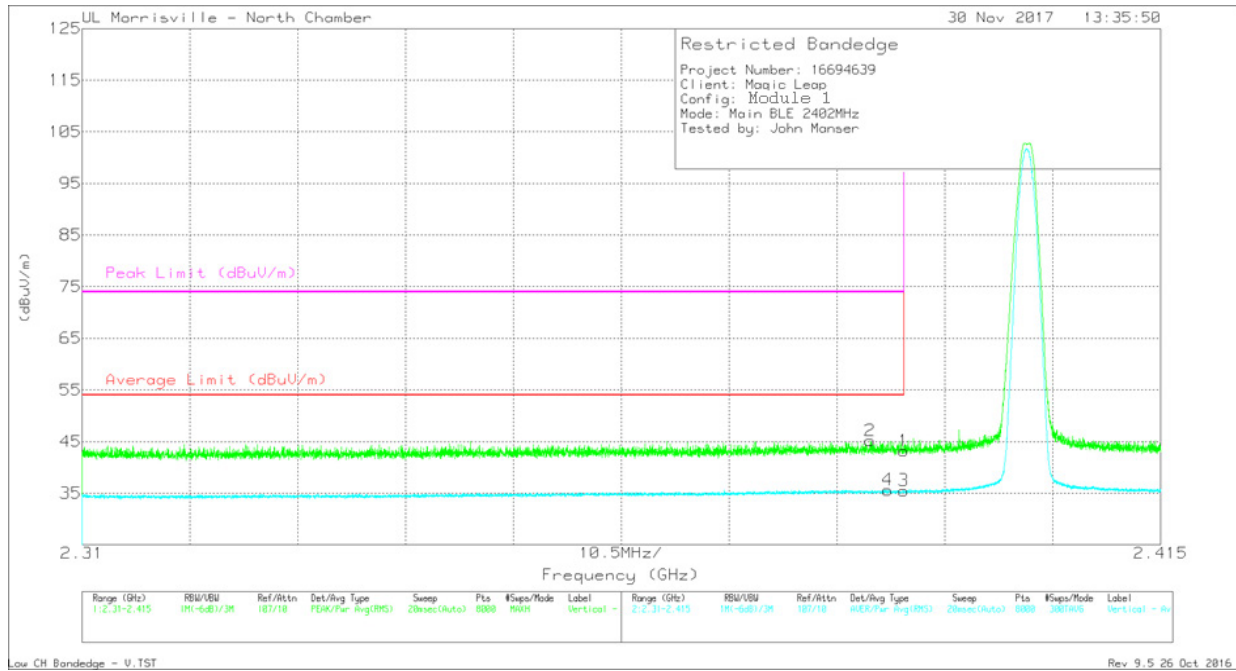
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL) - MODULE 1



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	35.57	Pk	31.8	-23.9	0	43.47	-	-	74	-30.53	253	283	H
2	* 2.376	37.89	Pk	31.8	-23.9	0	45.79	-	-	74	-28.21	253	283	H
3	* 2.39	24.81	RMS	31.8	-23.9	2.2	34.91	54	-19.09	-	-	253	283	H
4	* 2.389	25.46	RMS	31.8	-23.9	2.2	35.56	54	-18.44	-	-	253	283	H

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

RESTRICTED BANDEGE (LOW CHANNEL, VERTICAL) - MODULE 1



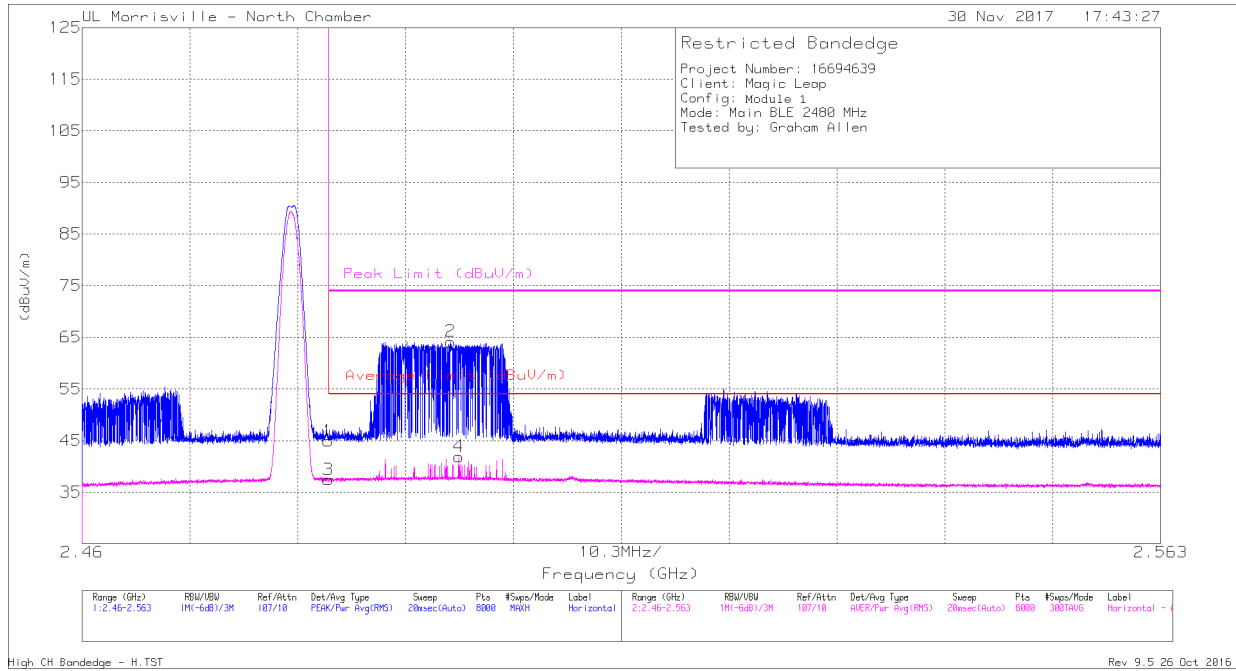
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (dB/m)	Amp/Cbl/Filtr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	35.32	Pk	31.8	-23.9	0	43.22	-	-	74	-30.78	202	258	V
2	* 2.387	37.24	Pk	31.8	-23.9	0	45.14	-	-	74	-28.86	202	258	V
3	* 2.39	25.41	RMS	31.8	-23.9	2.2	35.51	54	-18.49	-	-	202	258	V
4	* 2.388	25.54	RMS	31.8	-23.9	2.2	35.64	54	-18.36	-	-	202	258	V

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

Pk - Peak detector

RMS - RMS detection

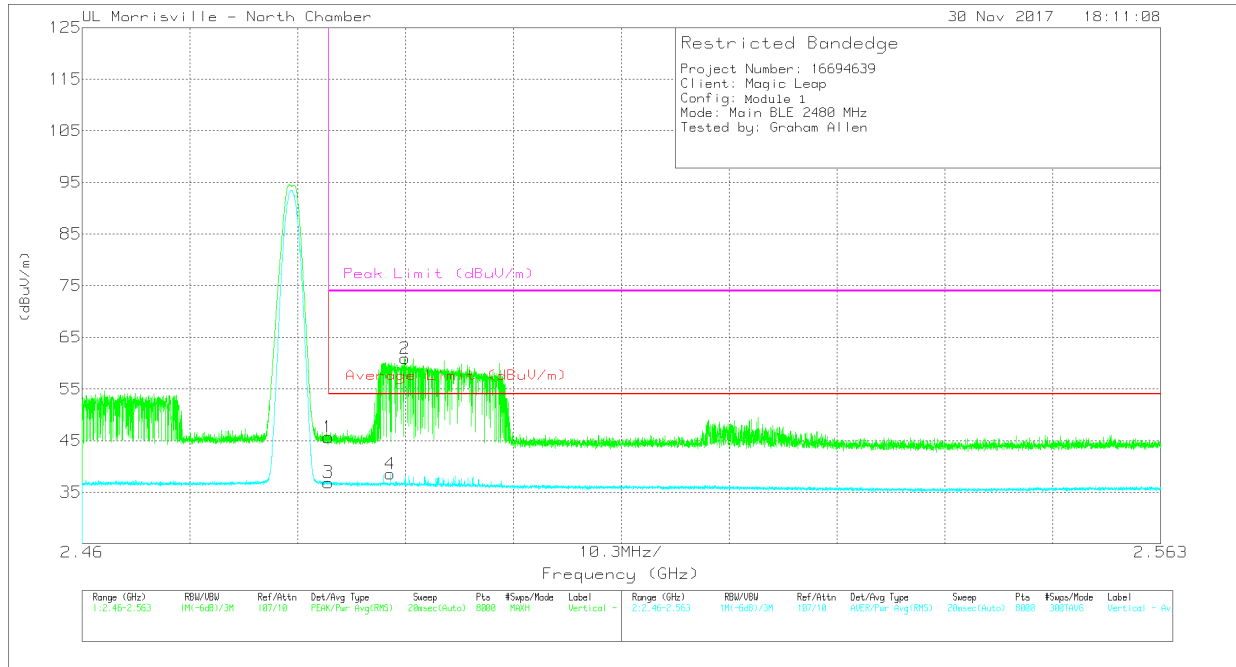
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL) - MODULE 1



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	36.44	Pk	32.3	-23.8	0	44.94	-	-	74	-29.06	130	276	H
2	* 2.495	55.67	Pk	32.3	-23.8	0	64.17	-	-	74	-9.83	130	276	H
3	* 2.484	26.7	RMS	32.3	-23.8	2.2	37.4	54	-16.6	-	-	130	276	H
4	* 2.496	31.21	RMS	32.3	-23.8	2.2	41.91	54	-12.09	-	-	130	276	H

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

RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL) - MODULE 1

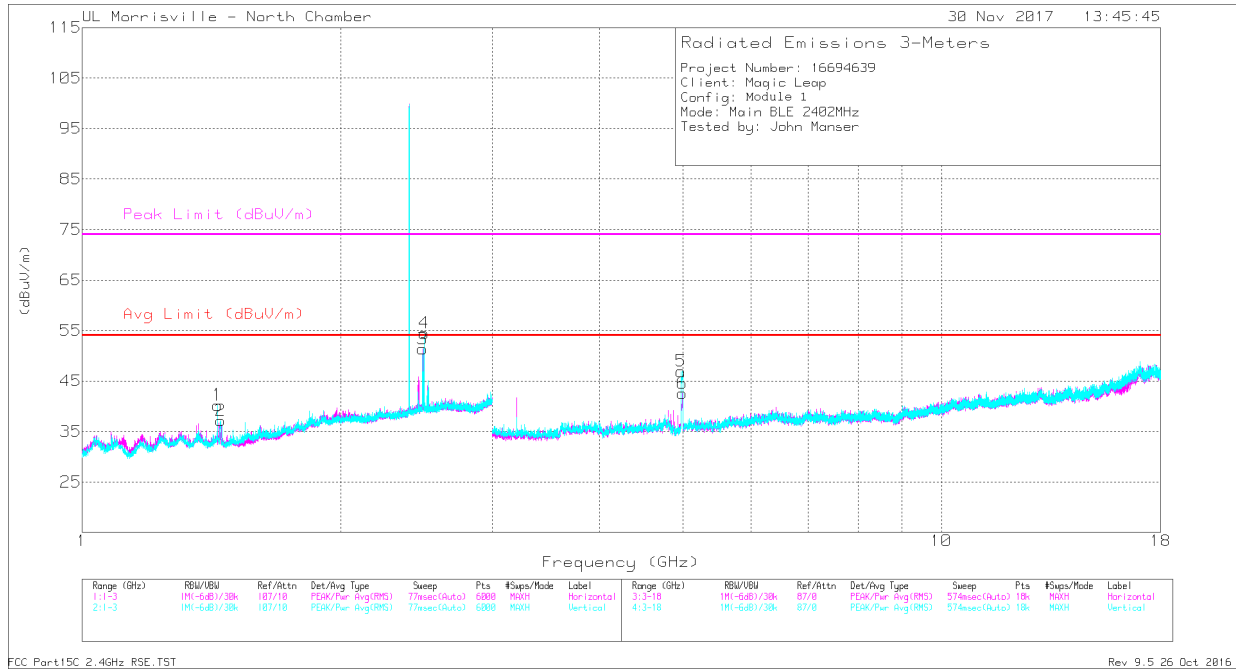


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (dB/m)	Amp/Cbl/Filtr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	37.13	Pk	32.3	-23.8	0	45.63	-	-	74	-28.37	260	155	V
2	* 2.491	52.39	Pk	32.3	-23.8	0	60.89	-	-	74	-13.11	260	155	V
3	* 2.484	26.18	RMS	32.3	-23.8	2.2	36.88	54	-17.12	-	-	260	155	V
4	* 2.489	27.86	RMS	32.3	-23.8	2.2	38.56	54	-15.44	-	-	260	155	V

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

HARMONICS AND SPURIOUS EMISSIONS - MODULE 1

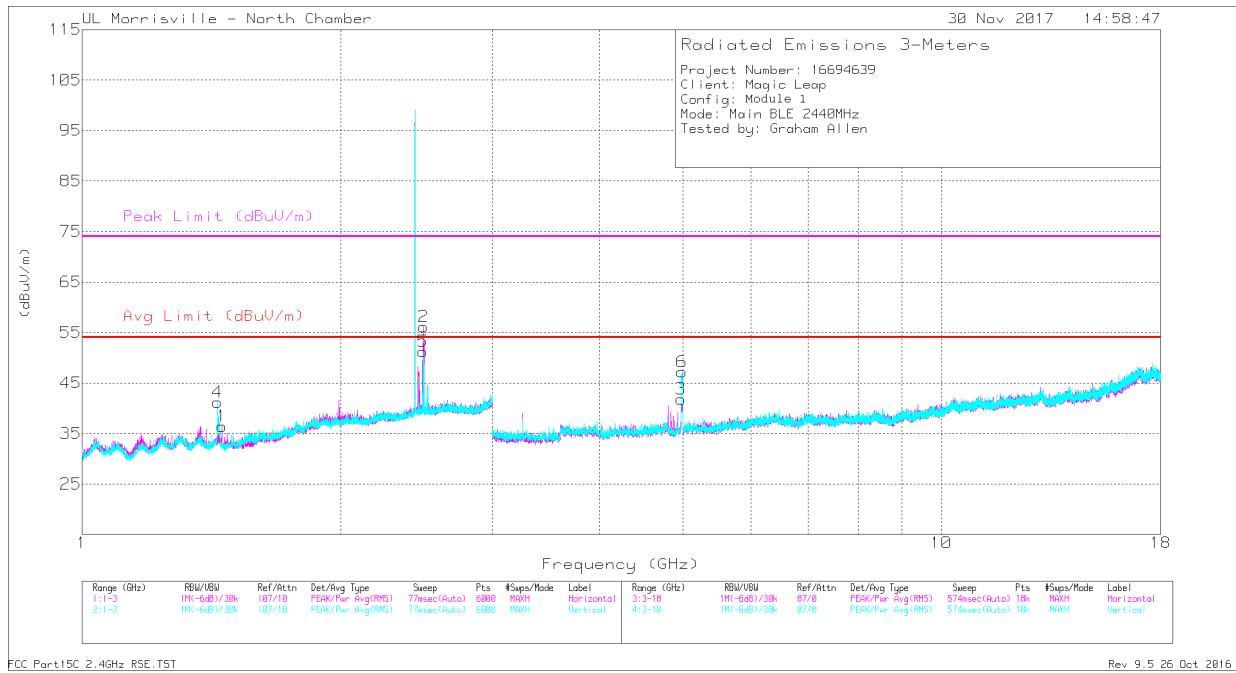
LOW CHANNEL



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
2	* 1.455	38.36	PK2	28.5	-24.6	0	42.26	-	-	74	-31.74	263	152	H
	* 1.442	24.16	MAv1	28.7	-24.6	2.2	30.46	54	-23.54	-	-	263	152	H
3	* 2.489	53.12	PK2	32.3	-23.8	0	61.62	-	-	74	-12.38	272	152	H
	* 2.489	27.95	MAv1	32.3	-23.8	2.2	38.65	54	-15.35	-	-	272	152	H
1	* 1.437	43.72	PK2	28.7	-24.6	0	47.82	-	-	74	-26.18	323	188	V
	* 1.437	24.18	MAv1	28.7	-24.6	2.2	30.48	54	-23.52	-	-	323	188	V
4	* 2.498	52.26	PK2	32.3	-23.8	0	60.76	-	-	74	-13.24	260	197	V
	* 2.498	27.67	MAv1	32.3	-23.8	2.2	38.37	54	-15.63	-	-	260	197	V
6	* 4.996	49.3	PK2	34.1	-32.2	0	51.2	-	-	74	-22.8	240	292	H
	* 4.992	34.26	MAv1	34.1	-32.2	2.2	38.36	54	-15.64	-	-	240	292	H
5	* 4.978	54.56	PK2	34.1	-32.1	0	56.56	-	-	74	-17.44	142	123	V
	* 4.978	38.45	MAv1	34.1	-32.1	2.2	42.65	54	-11.35	-	-	142	123	V

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

MID CHANNEL



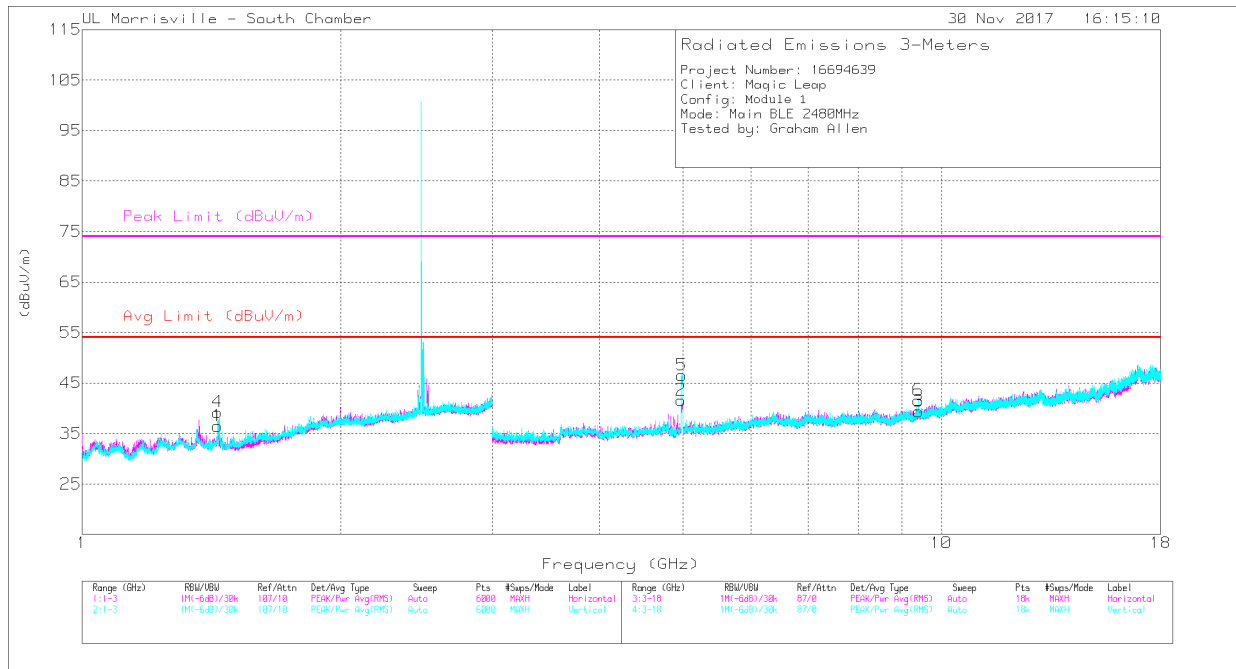
Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (dB/m)	Amp/Cbl/Filtr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.454	42.56	PK2	28.5	-24.6	0	46.46	-	-	74	-27.54	32	289	H
	* 1.454	23.87	MAV1	28.5	-24.6	2.2	29.97	54	-24.03	-	-	32	289	H
2	* 2.498	52.1	PK2	32.3	-23.8	0	60.6	-	-	74	-13.4	289	110	H
	* 2.498	27.83	MAV1	32.3	-23.8	2.2	38.53	54	-15.47	-	-	289	110	H
5	* 4.978	50	PK2	34.1	-32.1	0	52	-	-	74	-22	185	309	H
	* 4.978	33.96	MAV1	34.1	-32.1	2.2	38.16	54	-15.84	-	-	185	309	H
4	* 1.437	43.11	PK2	28.7	-24.6	0	47.21	-	-	74	-26.79	296	137	V
	* 1.437	24.49	MAV1	28.7	-24.6	2.2	30.79	54	-23.21	-	-	296	137	V
3	* 2.492	51.08	PK2	32.3	-23.8	0	59.58	-	-	74	-14.42	198	193	V
	* 2.492	26.95	MAV1	32.3	-23.8	2.2	37.65	54	-16.35	-	-	198	193	V
6	* 4.992	53.03	PK2	34.1	-32.2	0	54.93	-	-	74	-19.07	131	248	V
	* 4.992	36.83	MAV1	34.1	-32.2	2.2	40.93	54	-13.07	-	-	131	248	V

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

PK2 - Maximum Peak

MAV1 - Maximum RMS Average

HIGH CHANNEL



Markers	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	* 1.437	43.71	PK2	28.7	-24.6	0	47.81	-	-	74	-26.19	23	136	H
	* 1.437	24.23	MAV1	28.7	-24.6	2.2	30.53	54	-23.47	-	-	23	136	H
2	* 4.977	49.16	PK2	34.1	-32.1	0	51.16	-	-	74	-22.84	185	196	H
	* 4.977	33.4	MAV1	34.1	-32.1	2.2	37.6	54	-16.4	-	-	185	196	H
3	* 9.402	37.39	PK2	36.6	-27.6	0	46.39	-	-	74	-27.61	70	187	H
	* 9.403	25.32	MAV1	36.6	-27.6	2.2	36.52	54	-17.48	-	-	70	187	H
4	* 1.437	43.45	PK2	28.7	-24.6	0	47.55	-	-	74	-26.45	306	148	V
	* 1.437	24.1	MAV1	28.7	-24.6	2.2	30.4	54	-23.6	-	-	306	148	V
5	* 4.989	55.62	PK2	34.1	-32.2	0	57.52	-	-	74	-16.48	146	137	V
	* 4.989	38.45	MAV1	34.1	-32.2	2.2	42.55	54	-11.45	-	-	146	137	V
6	* 9.399	37.66	PK2	36.6	-27.7	0	46.56	-	-	74	-27.44	186	143	V
	* 9.399	25.43	MAV1	36.6	-27.7	2.2	36.53	54	-17.47	-	-	186	143	V

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

PK2 - Maximum Peak

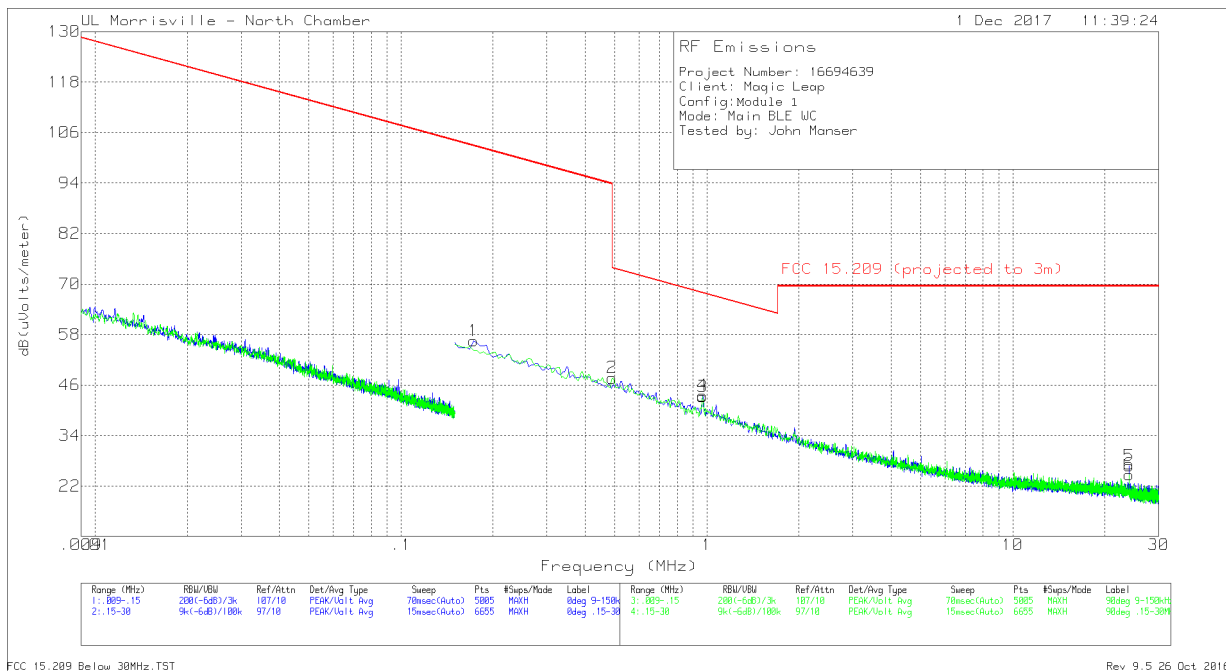
MAV1 - Maximum RMS Average

9.3. WORST-CASE RADIATED

SPURIOUS EMISSIONS 9 kHz TO 30 MHz (WORST-CASE CONFIGURATION) - MODULE 1

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).

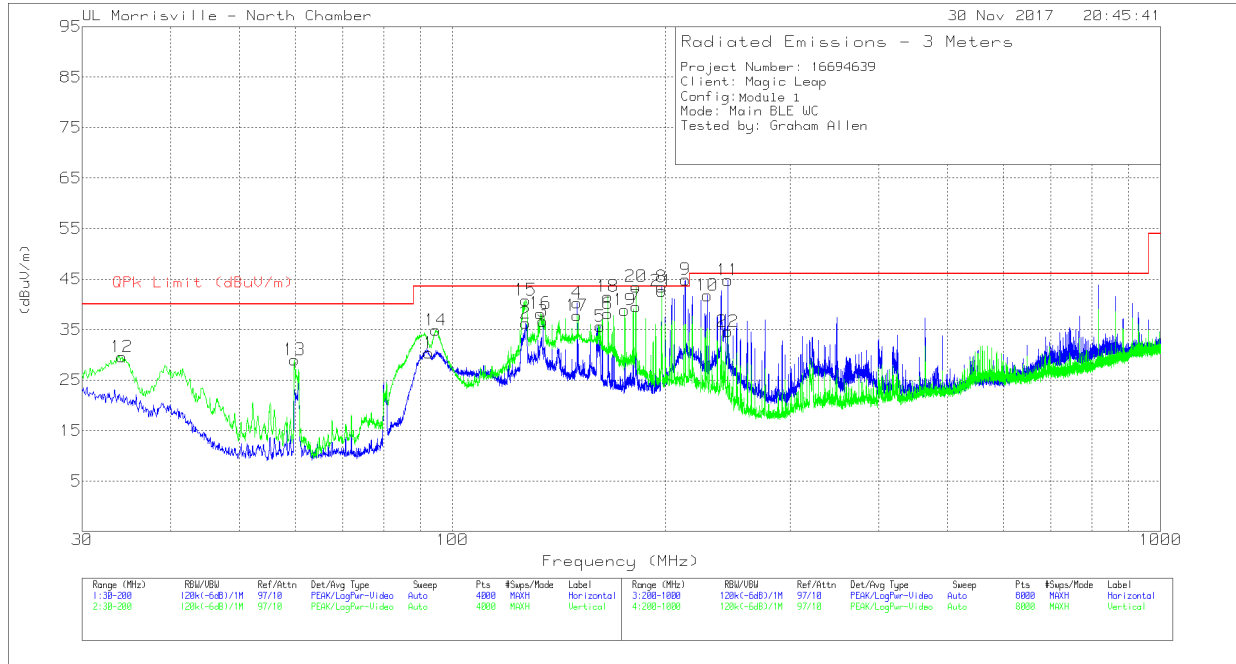
Although these tests were performed at a test site other than an open area test site, adequate comparison measurements were confirmed against an open area test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made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



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	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)
1	.17243	45.67	Pk	10.7	.1	56.47	-	-	102.87	-46.4	122.87	-66.4	0-360
2	.49094	36.79	Pk	10.8	.1	47.69	73.78	-26.09	-	-	-	-	0-360
4	.96645	32.48	Pk	10.9	.1	43.48	67.9	-24.42	-	-	-	-	0-360
3	.96645	32.19	Pk	10.9	.1	43.19	67.9	-24.71	-	-	-	-	0-360
5	23.99758	16.76	Pk	9.2	.8	26.76	69.54	-42.78	-	-	-	-	0-360
6	23.99758	14.76	Pk	9.2	.8	24.76	69.54	-44.78	-	-	-	-	0-360

Pk - Peak detector

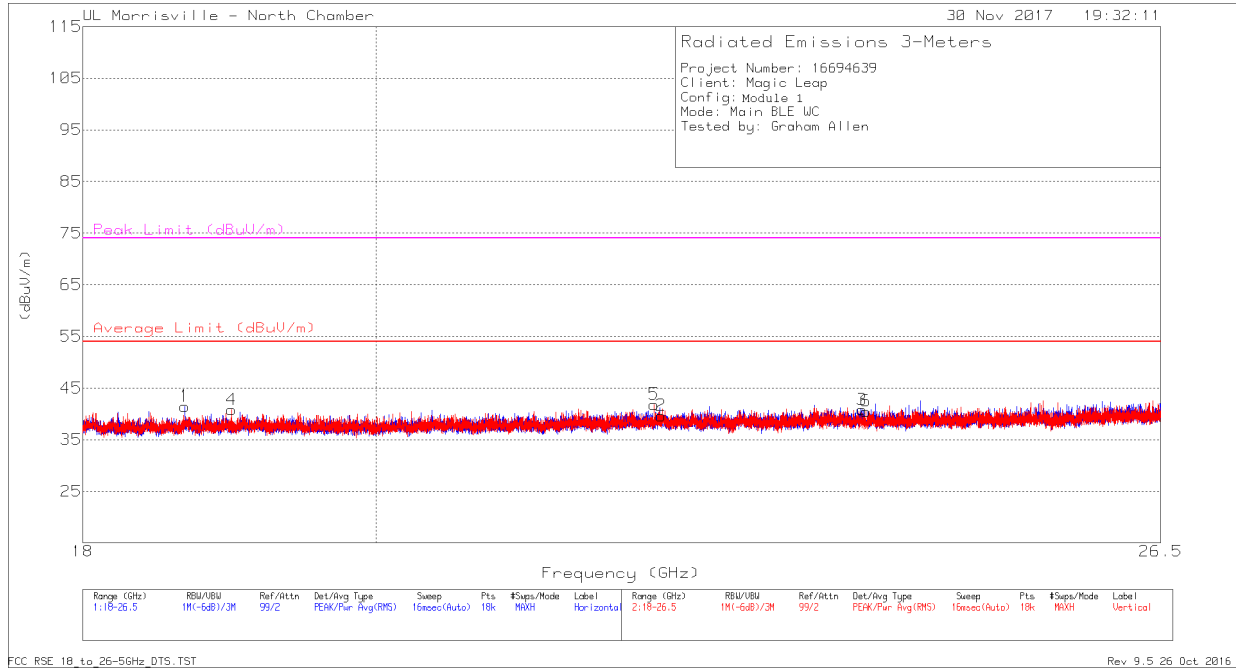
SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION) - MODULE 1



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
2	* 126.9251	47.76	Pk	19.1	-30.6	36.26	43.52	-7.26	0-360	199	H
3	* 134.1945	48.41	Pk	18.8	-30.6	36.61	43.52	-6.91	0-360	199	H
4	* 150.0052	49	Qp	17.7	-30.5	36.2	43.52	-7.32	30	207	H
6	* 165.7964	48.06	Qp	17.3	-30.3	35.06	43.52	-8.46	141	178	H
15	* 126.8627	48.53	Qp	19.1	-30.6	37.03	43.52	-6.49	312	108	V
16	* 132.968	45.86	Qp	18.9	-30.7	34.06	43.52	-9.46	149	120	V
17	* 150.0052	46.5	Qp	17.7	-30.5	33.7	43.52	-9.82	166	109	V
18	* 165.7863	50.19	Qp	17.3	-30.3	37.19	43.52	-6.33	47	102	V
11	* 244.7591	52.77	Qp	17.3	-29.8	40.27	46.02	-5.75	66	120	H
22	* 244.7058	47.13	Pk	17.3	-29.8	34.63	46.02	-11.39	0-360	199	V
12	34.1236	37.48	Pk	23.8	-31.7	29.58	40	-10.42	0-360	101	V
13	59.8002	47.61	Pk	12.7	-31.3	29.01	40	-10.99	0-360	101	V
1	92.5337	48.25	Pk	13.2	-31.1	30.35	43.52	-13.17	0-360	199	H
14	94.6592	52.05	Pk	13.8	-31	34.85	43.52	-8.67	0-360	101	V
5	161.4865	48.55	Pk	17.5	-30.4	35.65	43.52	-7.87	0-360	199	H
19	175.0986	52.02	Qp	16.4	-30.3	38.12	43.52	-5.4	67	105	V
7	181.5925	49.97	Qp	16.1	-30.2	35.87	43.52	-7.65	13	137	H
20	181.5908	51.91	Qp	16.1	-30.2	37.81	43.52	-5.71	94	102	V
8	197.3821	52.22	Qp	17.5	-30.1	39.62	43.52	-3.9	170	154	H
21	197.3682	49.24	Qp	17.5	-30.1	36.64	43.52	-6.88	118	112	V
9	213.1609	56.07	Qp	15.9	-30.1	41.87	43.52	-1.65	356	147	H
10	228.9592	50.11	Qp	16.8	-29.9	37.01	46.02	-9.01	97	114	H

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

SPURIOUS EMISSIONS 18 TO 26.5 GHz (WORST-CASE CONFIGURATION) - MODULE 1



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	* 18.673	49.47	Pk	32.5	-40.5	0	41.47	54	-12.53	74	-32.53	0-360	249	H
2	* 22.151	46.85	Pk	33.7	-40.9	0	39.65	54	-14.35	74	-34.35	0-360	299	H
3	* 23.807	47.29	Pk	34	-40.5	0	40.79	54	-13.21	74	-33.21	0-360	249	H
4	* 18.987	49.29	Pk	32.6	-41.1	0	40.79	54	-13.21	74	-33.21	0-360	299	V
5	* 22.094	48.94	Pk	33.8	-40.9	0	41.84	54	-12.16	74	-32.16	0-360	299	V
6	* 23.842	47.11	Pk	34	-40.6	0	40.51	54	-13.49	74	-33.49	0-360	252	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 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.

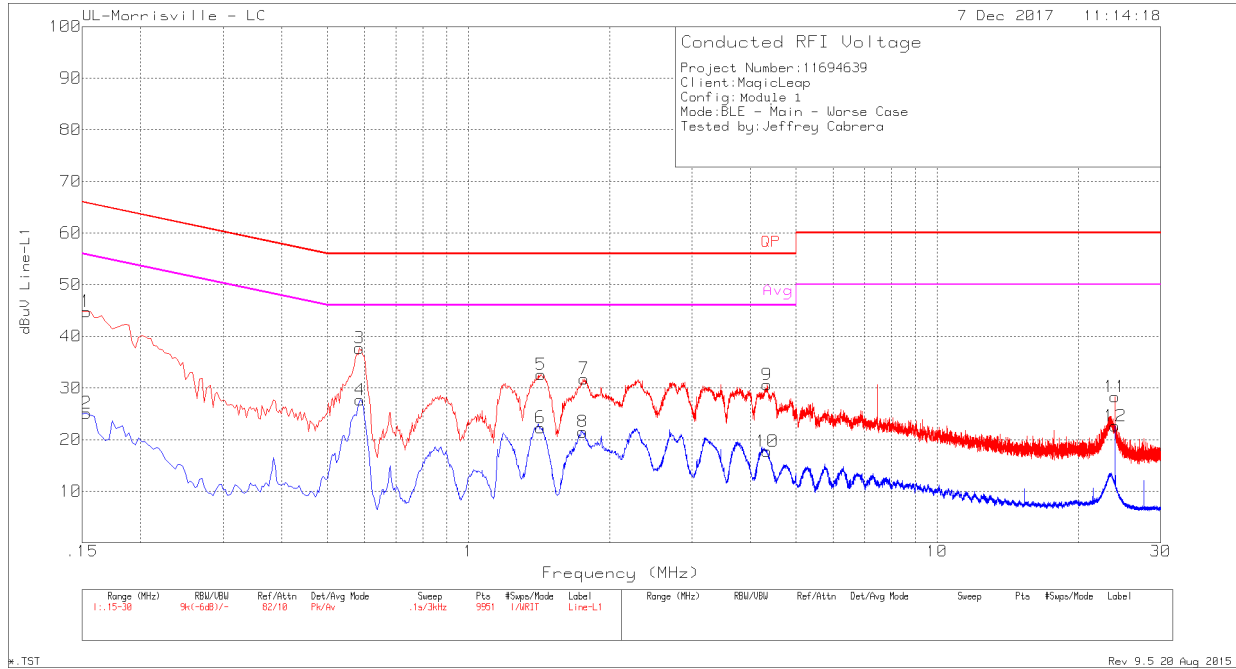
TEST PROCEDURE

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.

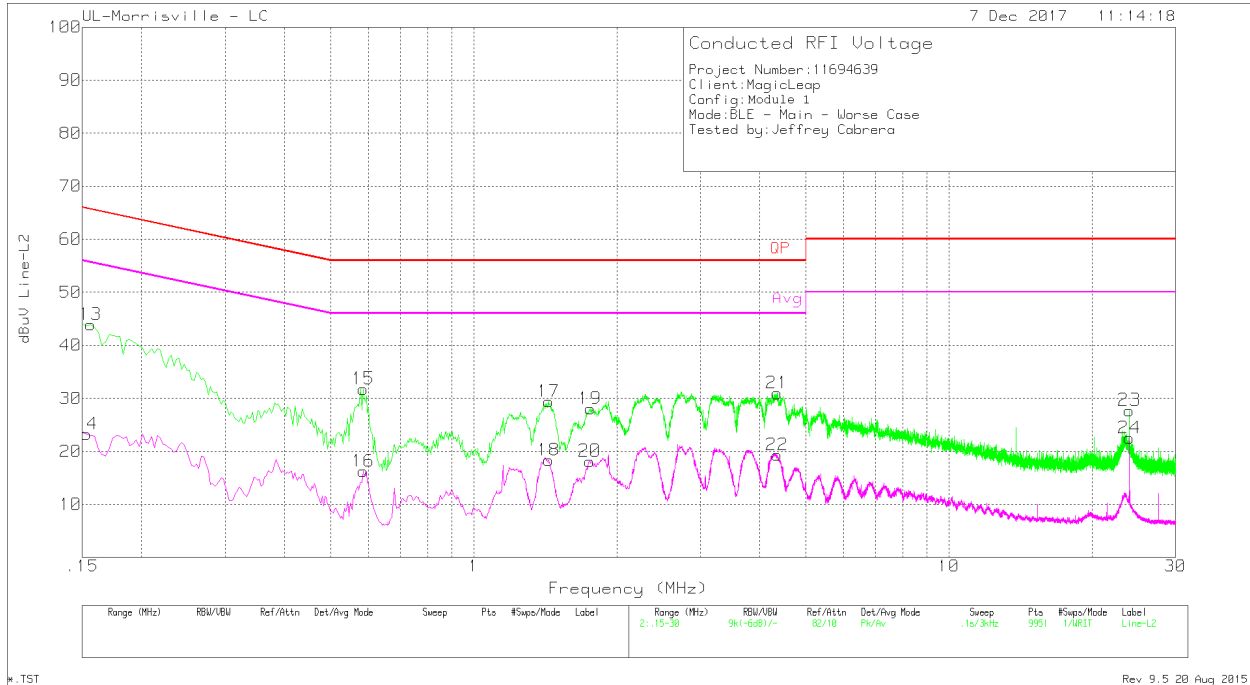
LINE 1 RESULTS – MODULE 1



Range 1: Line-L1 .15 - 30MHz										
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN VCF (dB)	Cbl/Limiter (dB)	Corrected Reading dBuV	QP Limit (dBuV)	QP Margin (dB)	Avg Limit (dBuV)	Margin (dB)
1	.153	34.6	Pk	.2	10	44.8	65.84	-21.04	-	-
2	.153	14.93	Av	.2	10	25.13	-	-	55.84	-30.71
3	.585	27.81	Pk	0	9.9	37.71	56	-18.29	-	-
4	.588	17.77	Av	0	9.9	27.67	-	-	46	-18.33
5	1.431	22.62	Pk	0	10	32.62	56	-23.38	-	-
6	1.425	12.31	Av	0	10	22.31	-	-	46	-23.69
7	1.767	21.78	Pk	0	10	31.78	56	-24.22	-	-
8	1.755	11.49	Av	0	10	21.49	-	-	46	-24.51
9	4.341	20.63	Pk	0	10	30.63	56	-25.37	-	-
10	4.344	7.75	Av	0	10	17.75	-	-	46	-28.25
11	24	17.91	Pk	.2	10.2	28.31	60	-31.69	-	-
12	24	12.25	Av	.2	10.2	22.65	-	-	50	-27.35

Pk - Peak detector
 Av - Average detection

LINE 2 RESULTS- MODULE 1



Range 2: Line-L2 .15 - 30MHz										
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN VCF (dB)	Cbl/Limiter (dB)	Corrected Reading dBuV	QP Limit (dBuV)	Margin (dB)	Avg Limit (dBuV)	Margin (dB)
13	.156	33.72	Pk	.2	10	43.92	65.67	-21.75	-	-
14	.153	13.04	Av	.2	10	23.24	-	-	55.84	-32.6
15	.585	21.87	Pk	0	9.9	31.77	56	-24.23	-	-
16	.585	6.35	Av	0	9.9	16.25	-	-	46	-29.75
17	1.437	19.37	Pk	0	10	29.37	56	-26.63	-	-
18	1.437	8.31	Av	0	10	18.31	-	-	46	-27.69
19	1.758	18.04	Pk	0	10	28.04	56	-27.96	-	-
20	1.755	8.13	Av	0	10	18.13	-	-	46	-27.87
21	4.353	20.95	Pk	0	10	30.95	56	-25.05	-	-
22	4.35	9.28	Av	0	10	19.28	-	-	46	-26.72
23	24.003	17.33	Pk	.2	10.2	27.73	60	-32.27	-	-
24	24	12.09	Av	.2	10.2	22.49	-	-	50	-27.51

Pk - Peak detector
 Av - Average detection

11. SETUP PHOTOS

Refer to UL Document R11694639-EP3

END OF REPORT