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

CERTIFICATION TEST REPORT

FOR

BLUETOOTH AND LORA CELLPHONE CONNECTION ASSISTANT

MODEL NUMBER: BT 007

FCC ID: 2AJY7007
IC: 22043-007

REPORT NUMBER: R11576797-E2

ISSUE DATE: 2017-04-12

Prepared for
BEARTOOTH RADIO, INC.
45 DISCOVERY DRIVE
BOZEMAN, MT 59718 USA

Prepared by
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NVLAP LAB CODE 200246-0

Revision History

Ver.	Issue Date	Revisions	Revised By
1	2017-04-12	Initial Issue	Brian Kiewra

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ATTESTATION OF TEST RESULTS

COMPANY NAME: Beartooth Radio, Inc.
45 Discovery Drive
Bozeman, MT, 59718 USA

EUT DESCRIPTION: Bluetooth and LoRa Cellphone Connection Assistant

MODEL: BT 007

SERIAL NUMBER: BT007170400006, BT007170400004, and BT007170900063

DATE TESTED: 2017-02-21 to 2017-04-12

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

UL LLC tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL LLC based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

Approved & Released
For UL LLC By:

Jeffrey Moser
EMC Program Manager
UL – Consumer Technology Division

Prepared By:

Brian T. Kiewra
EMC Engineer
UL – Consumer Technology Division

1. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2013, RSS-GEN Issue 4, RSS-247 Issue 2.

2. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 12 Laboratory Dr., Research Triangle Park, NC 27709, USA and 2800 Suite B, Perimeter Park Drive, Morrisville, NC 27560.

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

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

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

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

3. CALIBRATION AND UNCERTAINTY

3.1. 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.

3.2. 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

3.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
RF output power, conducted	±0.45 dB
Power Spectral Density, conducted	±1.50 dB
Unwanted Emissions, conducted	±2.94 dB
All emissions, radiated	±5.36 dB
Conducted Emissions (0.150 – 30MHz)	±3.65 dB
Temperature	±0.07 °C
Humidity	±2.26 %
DC and Low Frequency Voltages	±1.27 %

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

4. EQUIPMENT UNDER TEST

4.1. DESCRIPTION OF EUT

The EUT is a Bluetooth and LoRa cellphone connection assistant.

4.2. MAXIMUM OUTPUT POWER

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

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
902 - 928	LoRa	25.99	397.19

4.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an antenna with a maximum gain of +4dBi.

4.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was mk1_fcc_test, rev. 1.0.1.

4.5. WORST-CASE CONFIGURATION AND MODE

Radiated emission (0.009-30MHz) and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

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

4.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Power Supply	Motorola	SSW-2680US SPN5864A	15005-CD-0817337	NA

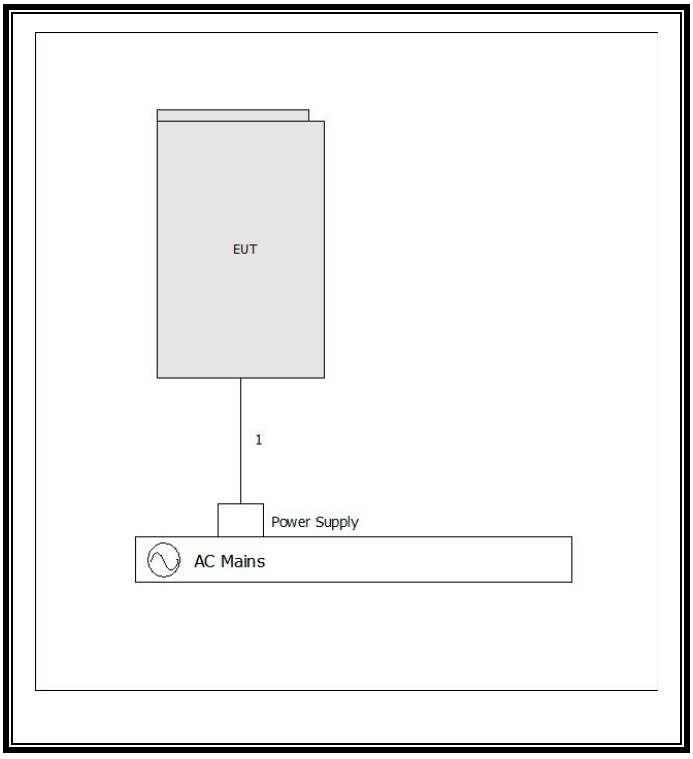
I/O CABLES

I/O Cable List						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	USB	1	µUSB	USB	<3m	NA

TEST SETUP

The EUT is installed in as a standalone device.

SETUP DIAGRAM FOR TESTS



5. TEST AND MEASUREMENT EQUIPMENT

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

Radiated Equipment Used For Testing

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
0.009-30MHz (Loop Ant.)					
AT0079	Active Loop Antenna	ETS-Lindgren	6502	2016-12-28	2017-12-31
30-1000 MHz					
AT0073	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2016-06-27	2017-06-30
1-18 GHz					
AT0067	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2017-03-23	2018-03-23
AT0072	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2016-03-07	2017-03-31
18-40 GHz					
AT0076	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2016-09-06	2017-09-06
Gain-Loss Chains					
N-SAC01	Gain-loss string: 0.009-30MHz	Various	Various	2016-10-04	2017-10-04
N-SAC02	Gain-loss string: 30-1000MHz	Various	Various	2016-06-26	2017-06-30
N-SAC03	Gain-loss string: 1-18GHz	Various	Various	2016-08-28	2017-08-28
Receiver & Software					
SA0026	Spectrum Analyzer	Agilent	N9030A	2017-02-17	2018-02-28
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
BRF007	900MHz Band Reject Filter	Micro-Tronics	BRC17691	2017-03-03	2018-03-03

Antenna Port Conducted Equipment Used For Testing

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
Conducted Room 1					
72822 (SA0019)	Spectrum Analyzer	Agilent Technologies	E4446A	2016-08-25	2017-08-25
PWM003	RF Power Meter	Keysight Technologies	N1911A	2016-06-21	2017-06-21
PWS003	Peak and Avg Power Sensor, 50MHz to 6GHz	Keysight Technologies	E9323A	2016-06-21	2017-06-21
MM0168	True RMS Multimeter	Agilent	U1232A	2016-10-07	2017-10-31

Line Conducted Equipment Used For Testing

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
CBL077	Coax cable, RG223, N-male to BNC-male, 20-ft.	Pasternack	PE3476-240	2016-06-15	2017-06-30
LISN003	LISN, 50-ohm/50-uH, 2-conductor, 25A	Fischer Custom Com.	FCC-LISN-50-25-2-01-550V	2016-08-24	2017-08-24
PRE0101521 (75141)	EMI Test Receiver 9kHz-7GHz	Rohde & Schwarz	ESCI 7	2016-08-23	2017-08-23
TL001	Transient Limiter, 0.009-30MHz	Com-Power	LIT-930A	2016-06-09	2017-06-30
PS215	AC Power Source	Elgar	CW2501M (s/n 1523A02397)	NA	NA
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
Additional Equipment Used					
MM0168	True RMS Multimeter	Agilent	U1232A	2016-10-07	2017-10-31
CDECABLE001	ANSI C63.4 1m extension cable.	UL	Per Annex B of ANSI C63.4	2016-06-04	2017-06-30

6. ANTENNA PORT TEST RESULTS

6.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

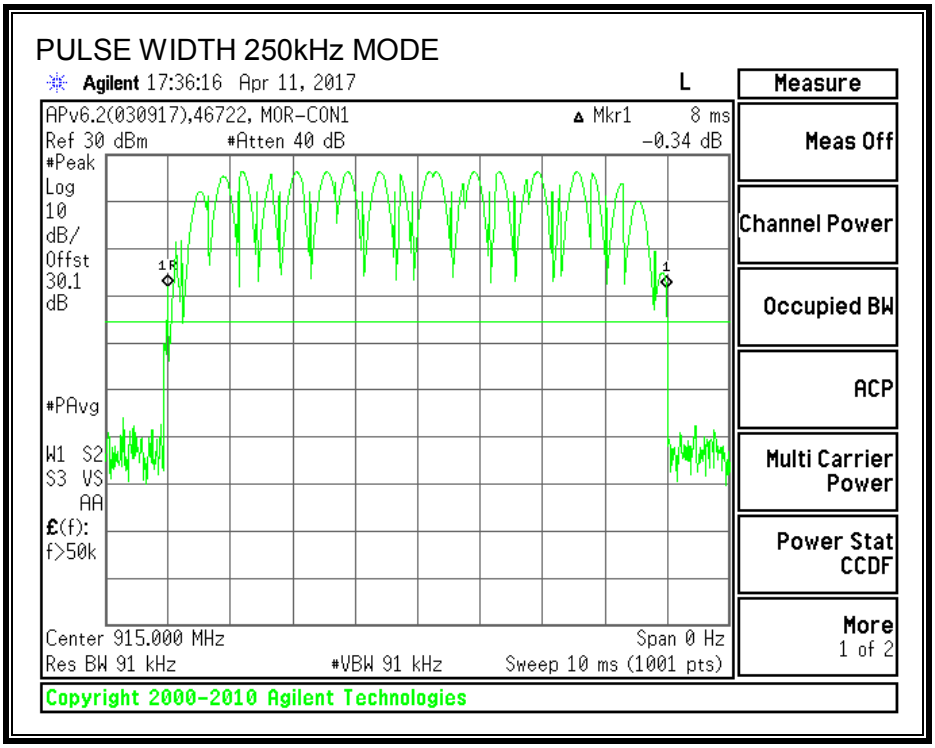
PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 400ms scan, to enable resolution of each occurrence. The duty cycle was then calculated based on a 100 ms period as described in FCC 15.35.

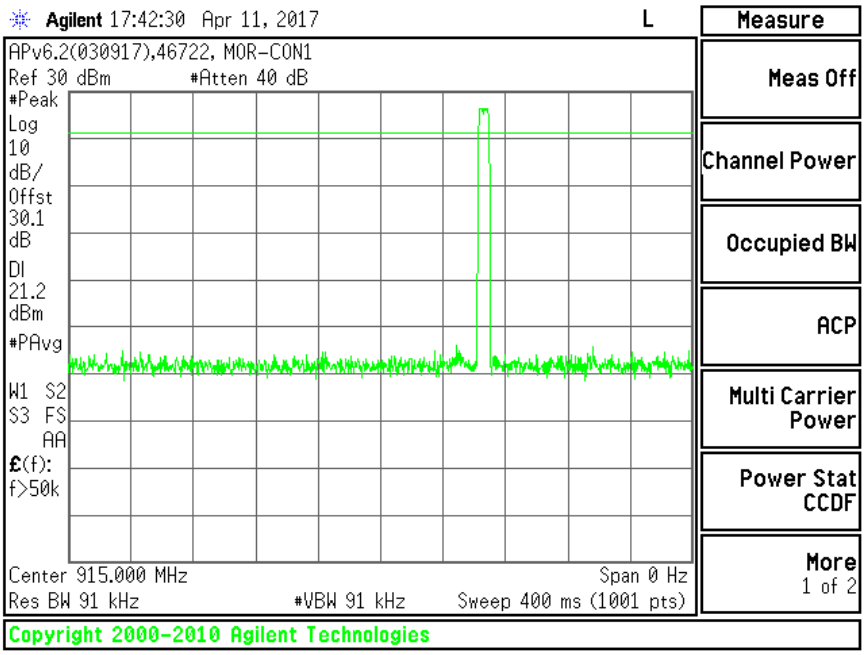
ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
900MHz band					
LoRa 250kHz	8.000	100.000	0.080	8.00%	-21.94

DUTY CYCLE PLOTS



PULSE PER PERIOD 250kHz MODE



TEST INFORMATION
Date: 2017-04-11
Project No: 11576797
Tester: John Manser

6.2. 20 dB AND 99% BANDWIDTH

LIMIT

The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Test per FCC §15.247(a)(1); IC RSS-247 5.1 (1), RSS-Gen 6.6.

TEST PROCEDURE

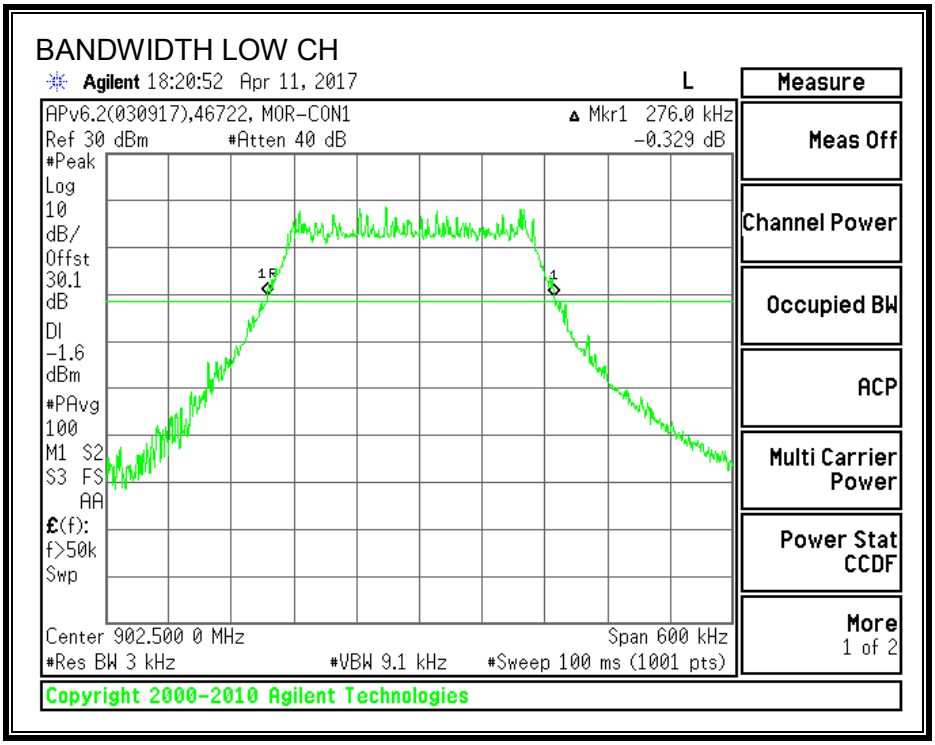
The transmitter output is connected to a spectrum analyzer. The RBW is set to 1-5% of the 20 dB bandwidth and 99% Occupied Bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

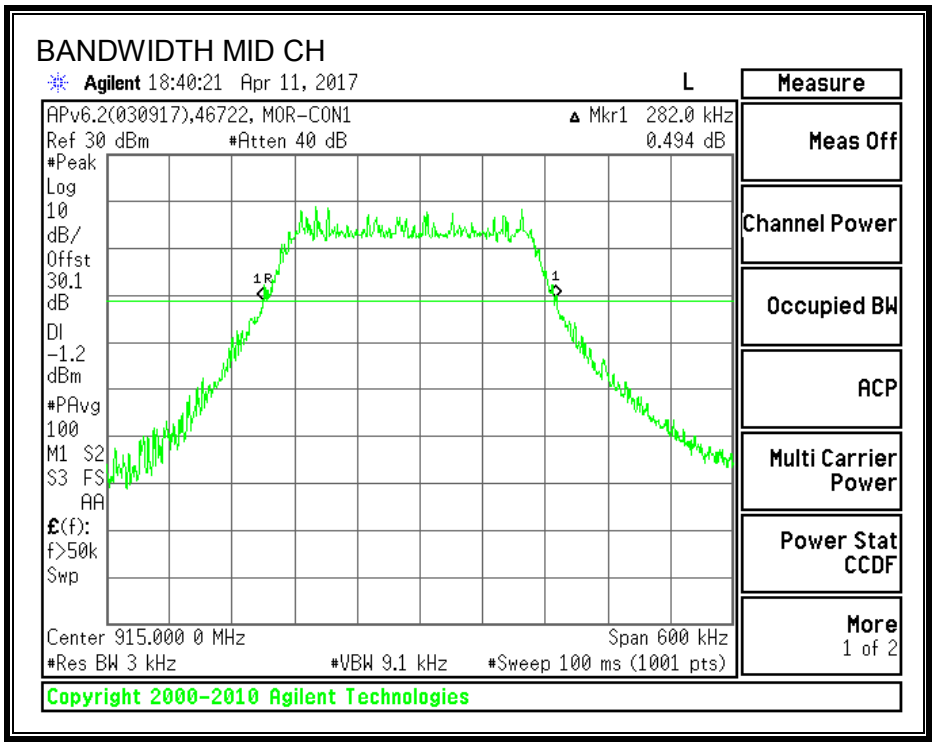
RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	902.5	276	252.6652
Middle	915	282	255.7668
High	927.5	290.4	258.1347

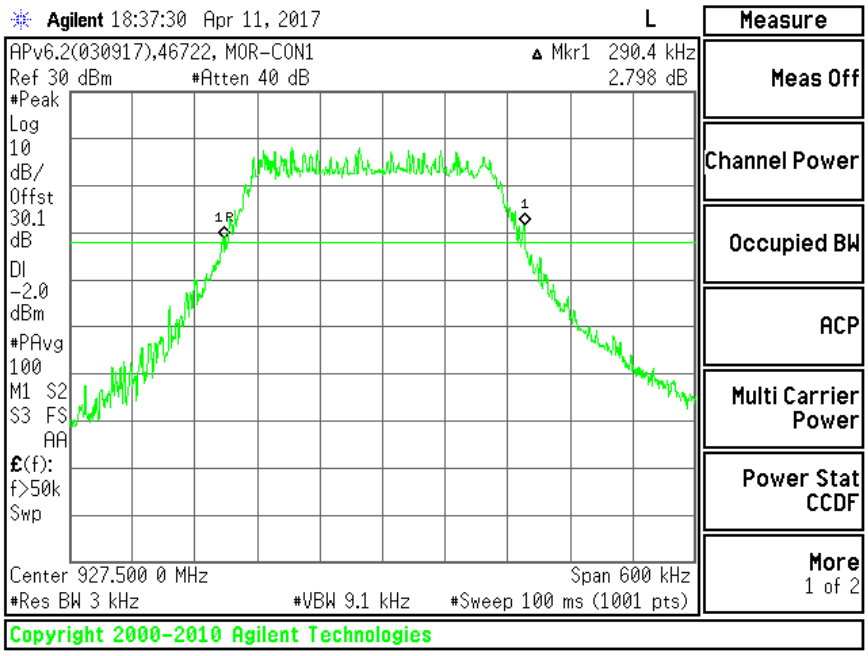
TEST INFORMATION
Date: 2017-04-11
Project No: 11576797
Tester: John Manser

20 dB AND 99% BANDWIDTH

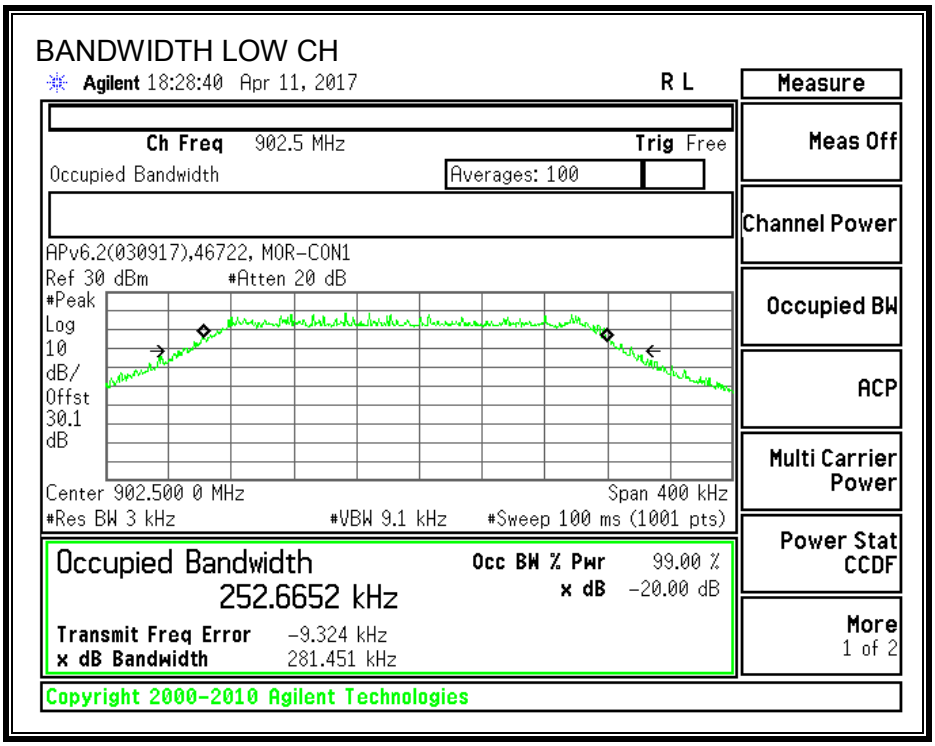


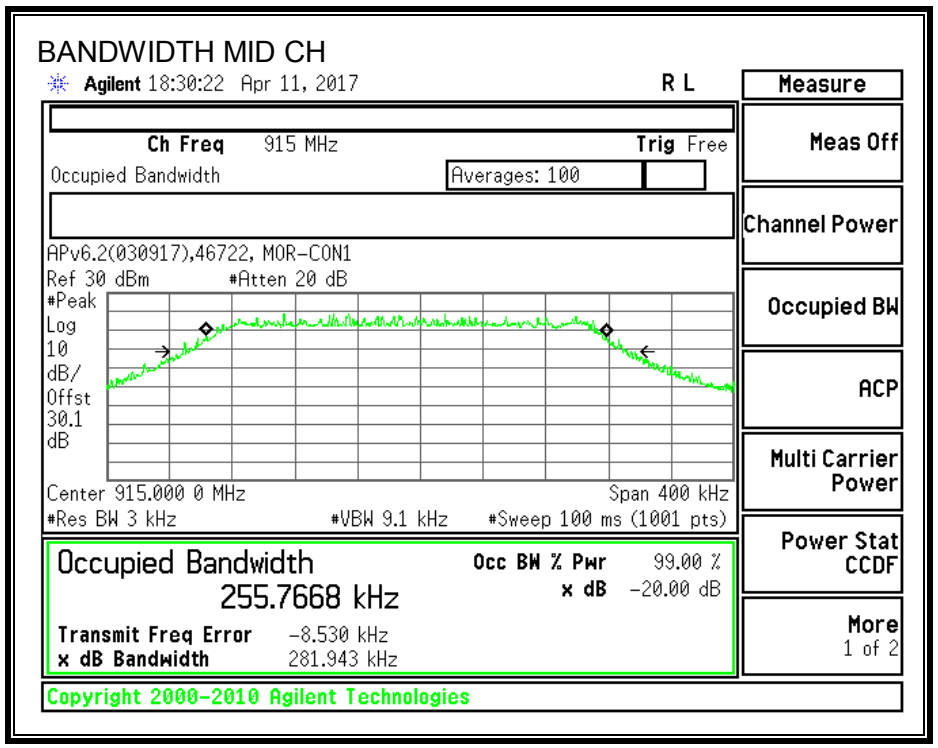


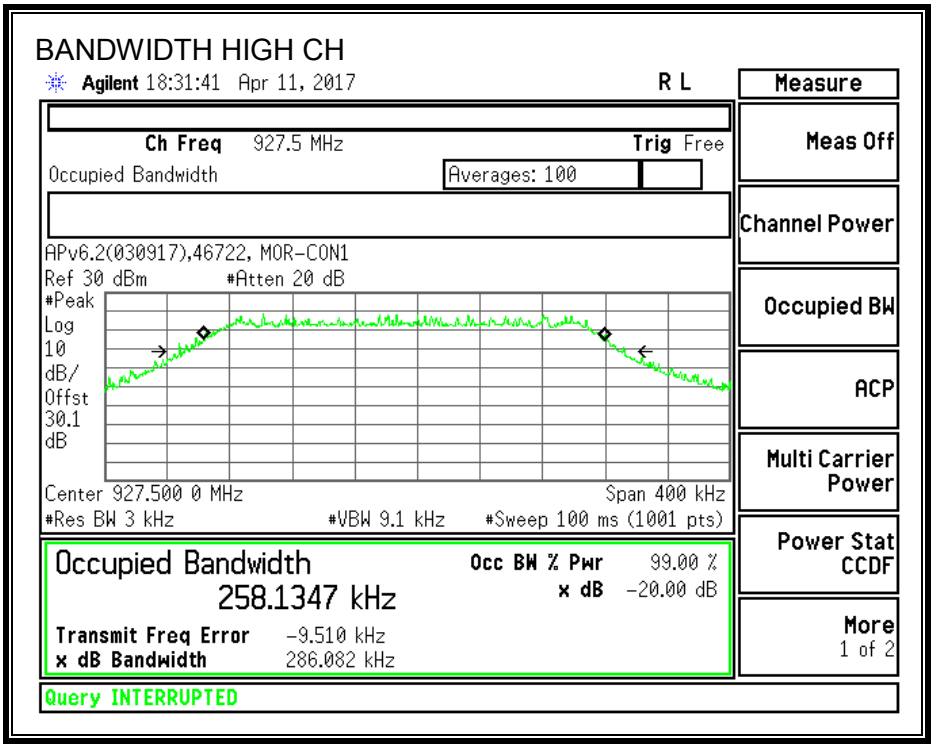
BANDWIDTH HIGH CH



99% BANDWIDTH







6.3. HOPPING FREQUENCY SEPARATION

LIMIT

FCC §15.247 (a) (1)

IC RSS-247 5.1 (2)

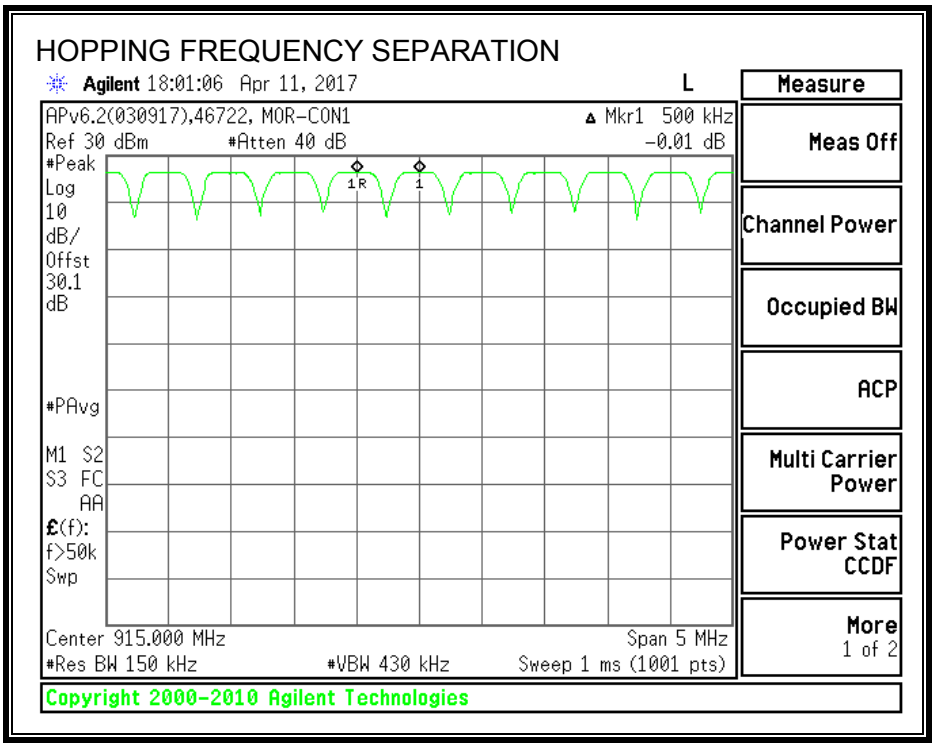
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hoping channel, whichever is greater.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 30% of channel spacing and the VBW is set such that VBW ≥ RBW. The sweep time is auto.

RESULTS

HOPPING FREQUENCY SEPARATION



TEST INFORMATION
Date: 2017-04-11
Project No: 11576797
Tester: John Manser

6.4. NUMBER OF HOPPING CHANNELS

LIMIT

FCC §15.247 (a) (1) (i)

IC RSS-247 5.1 (c)

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies. If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies.

TEST PROCEDURE

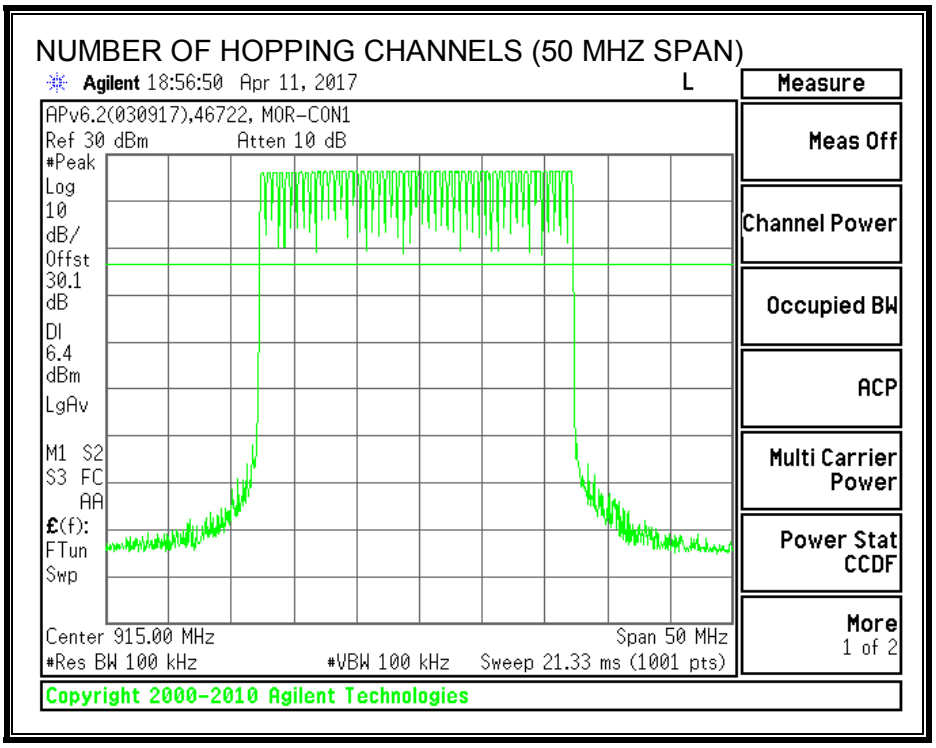
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps for visibility of the entire span. Then, smaller spans are set to more clearly identify the channels. The RBW is set to less than 30% of the channel spacing (approx. 100 kHz). The analyzer is set to Max Hold.

RESULTS

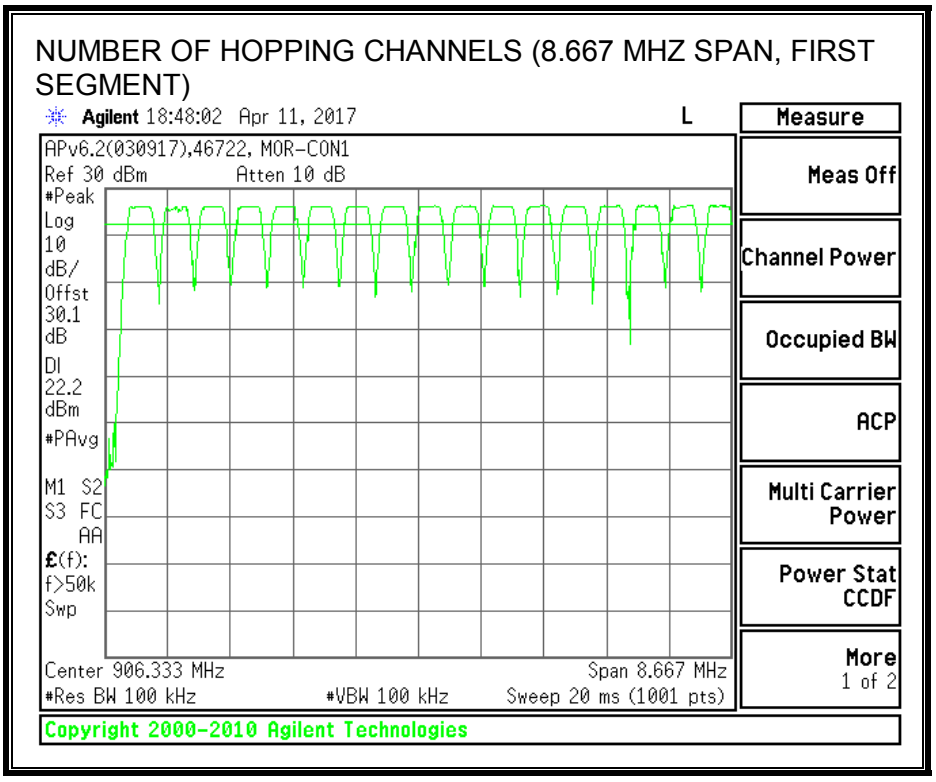
Normal Mode: 50 Channels observed.

NUMBER OF HOPPING CHANNELS

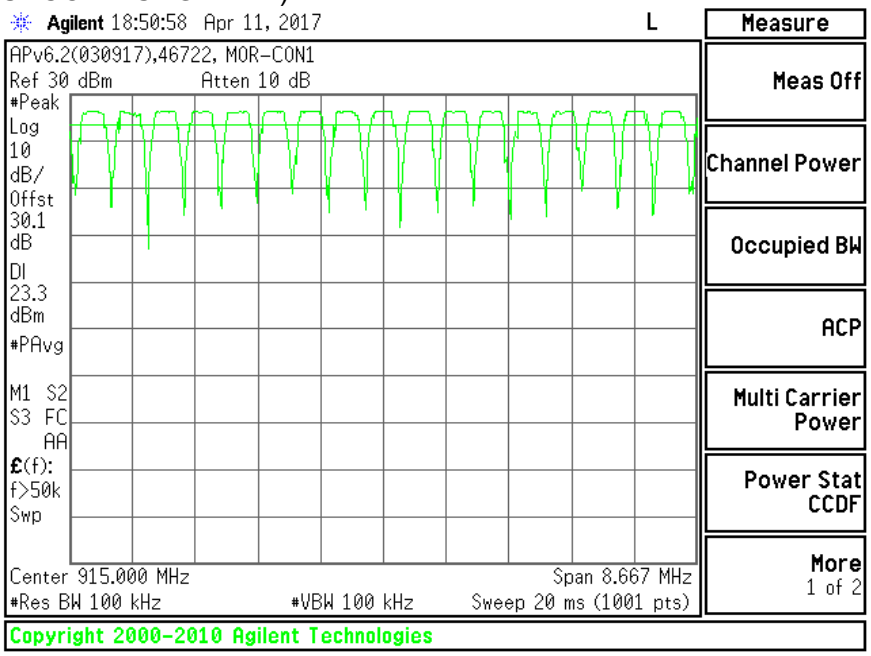
NUMBER OF HOPPING CHANNELS (50 MHZ SPAN)



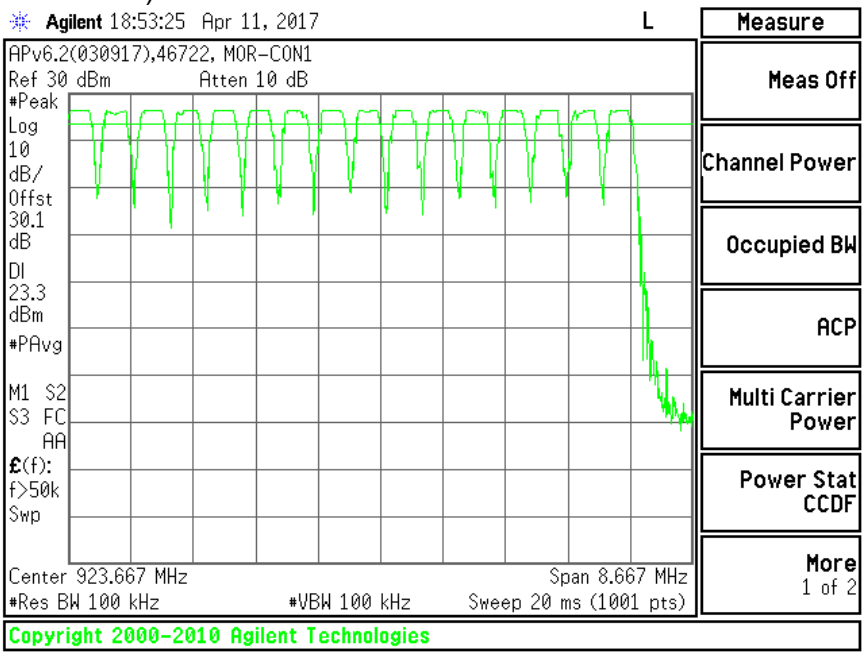
NUMBER OF HOPPING CHANNELS (8.667 MHZ SPAN, FIRST SEGMENT)



NUMBER OF HOPPING CHANNELS (8.667 MHZ SPAN, SECOND SEGMENT)



NUMBER OF HOPPING CHANNELS (8.667 MHZ SPAN, THIRD SEGMENT)



TEST INFORMATION
Date: 2017-04-11
Project No: 11576797
Tester: John Manser

6.5. AVERAGE TIME OF OCCUPANCY

LIMIT

FCC §15.247 (a) (1) (i)

IC RSS-247 5.1 (c)

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 2 second scan, to enable resolution of each occurrence.

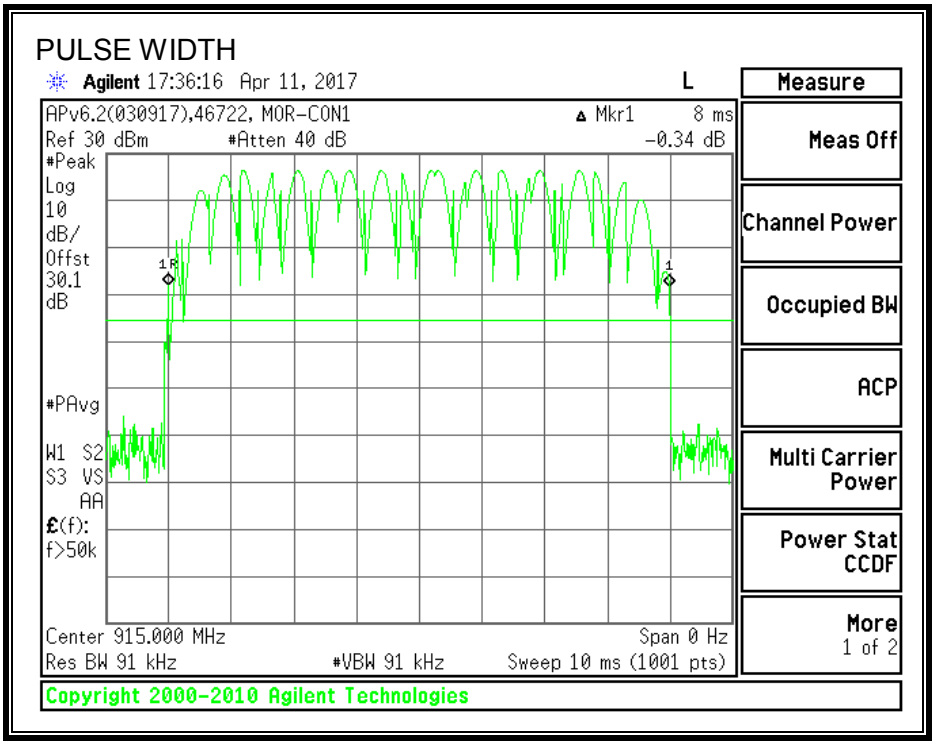
The average time of occupancy in the specified 10 second period is equal to 5 * (# of pulses in 2 s) * pulse width.

RESULTS

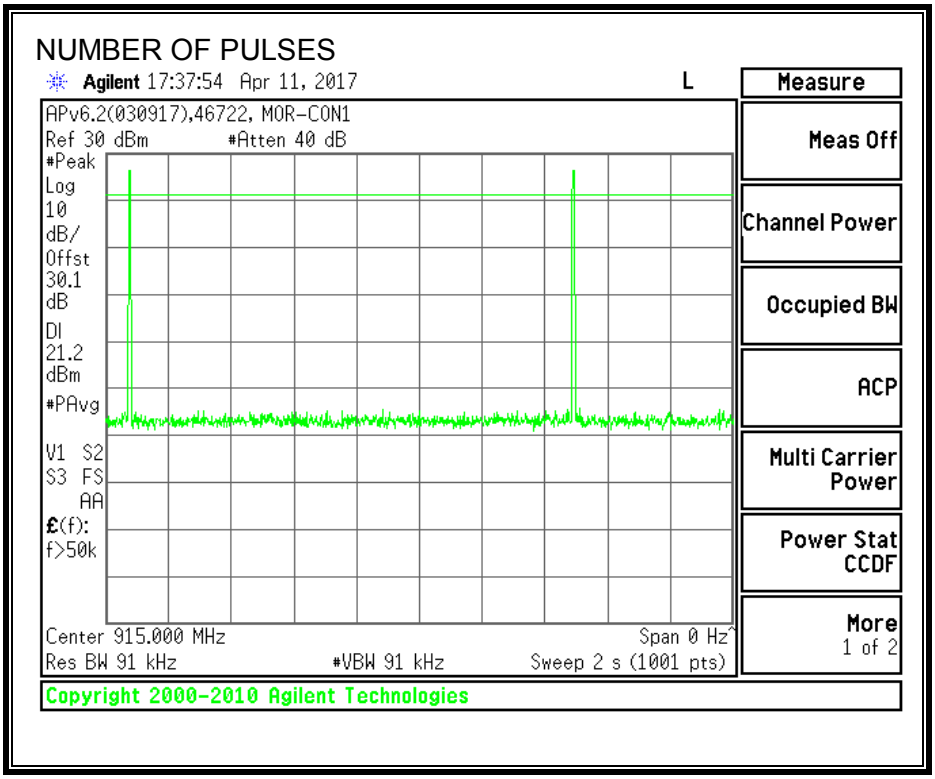
250kHz Mode

	Pulse Width (msec)	Number of Pulses in 2 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
250kHz	8	2	0.080	0.4	-0.320

PULSE WIDTH



NUMBER OF PULSES IN 2 SECOND OBSERVATION PERIOD



TEST INFORMATION
Date: 2017-04-10
Project No: 11576797
Tester: Jeff Cabrera

6.6. OUTPUT POWER

LIMIT

§15.247 (b) (2)

For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels

RSS-247 5.4 (a)

For FHSs operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1.0 W, and the e.i.r.p. shall not exceed 4 W if the hopset uses 50 or more hopping channels; the maximum peak conducted output power shall not exceed 0.25 W and the e.i.r.p. shall not exceed 1 W if the hopset uses less than 50 hopping channels.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 30.3 dB (including 30 dB pad and 0.3 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Output Power (dBm)	Directional Gain (dBi)	Limit (dBm)	Margin (dB)
Low	902.5	25.44	4.00	30	-4.56
Middle	915	25.79	4.00	30	-4.21
High	927.5	25.99	4.00	30	-4.01

TEST INFORMATION
Date: 2017-04-10
Project No: 11576797
Tester: Jeff Cabrera

6.7. AVERAGE POWER

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter and a gated measurement was taken.

RESULTS

The cable assembly insertion loss of 30.3 dB (including 30 dB pad and 0.3 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Frequency (MHz)	Average Power (dBm)
902.5	24.48
915	24.88
927.5	25.03

TEST INFORMATION
Date: 2017-04-10
Project No: 11576797
Tester: Jeff Cabrera

6.8. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

IC RSS-247 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section A8.4 (4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

TEST PROCEDURE

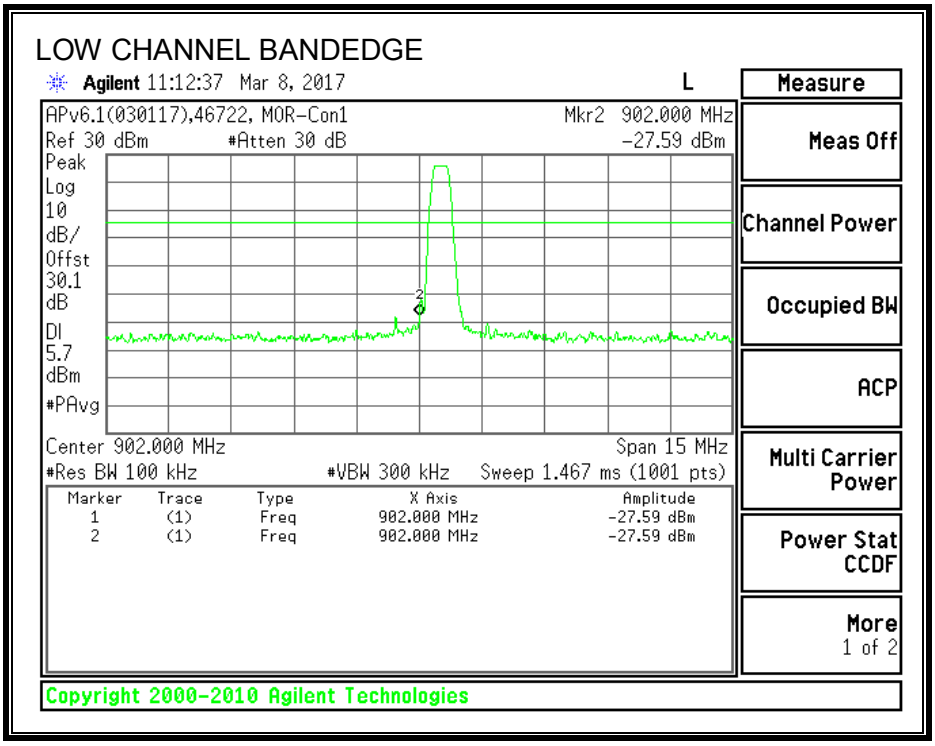
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

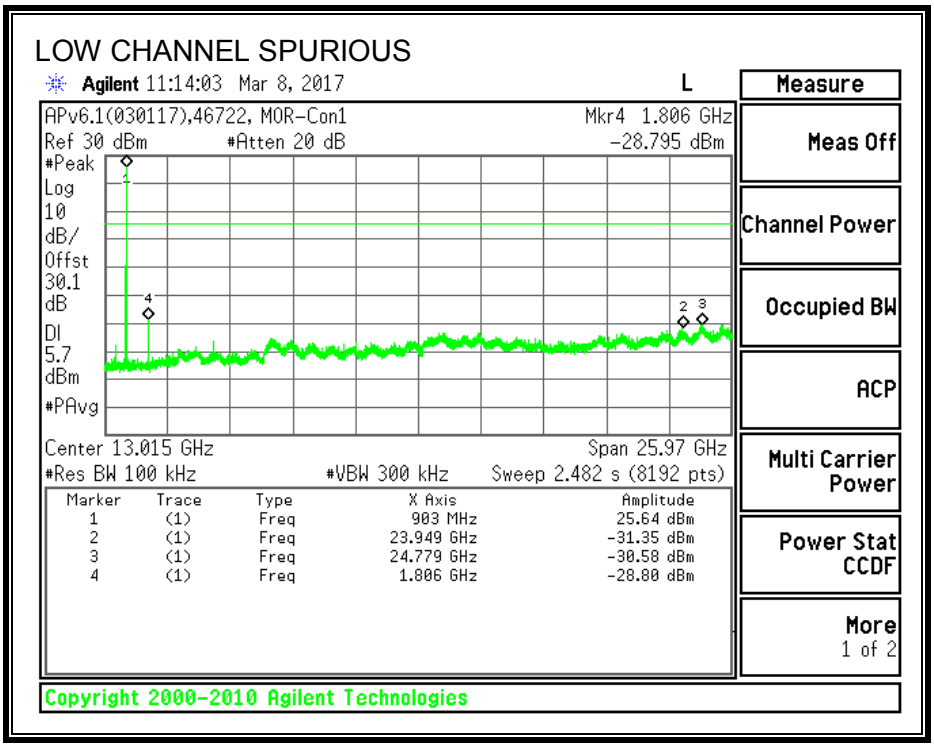
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

The authorized bandedges at 902 MHz and 928 MHz are investigated with the transmitter set to the non-hopping and normal hopping mode.

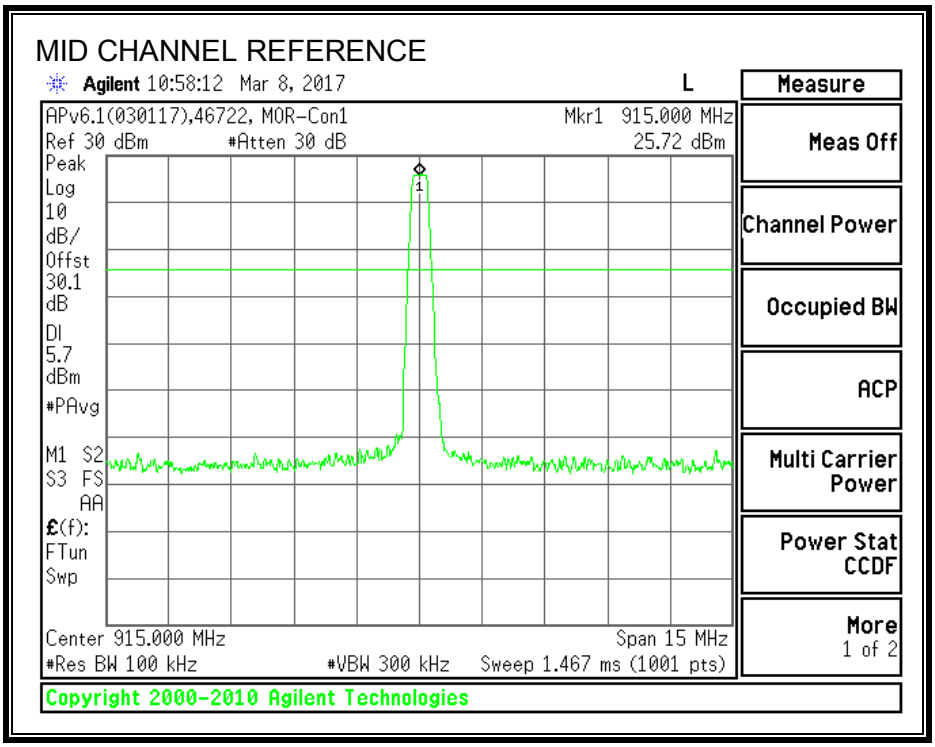
RESULTS

SPURIOUS EMISSIONS, LOW CHANNEL

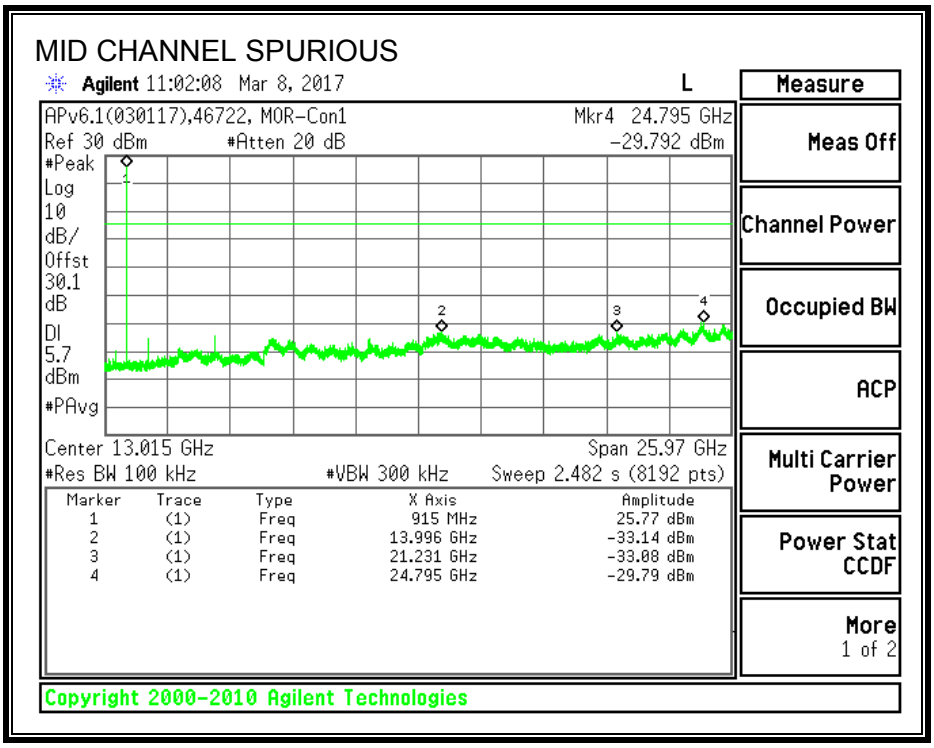




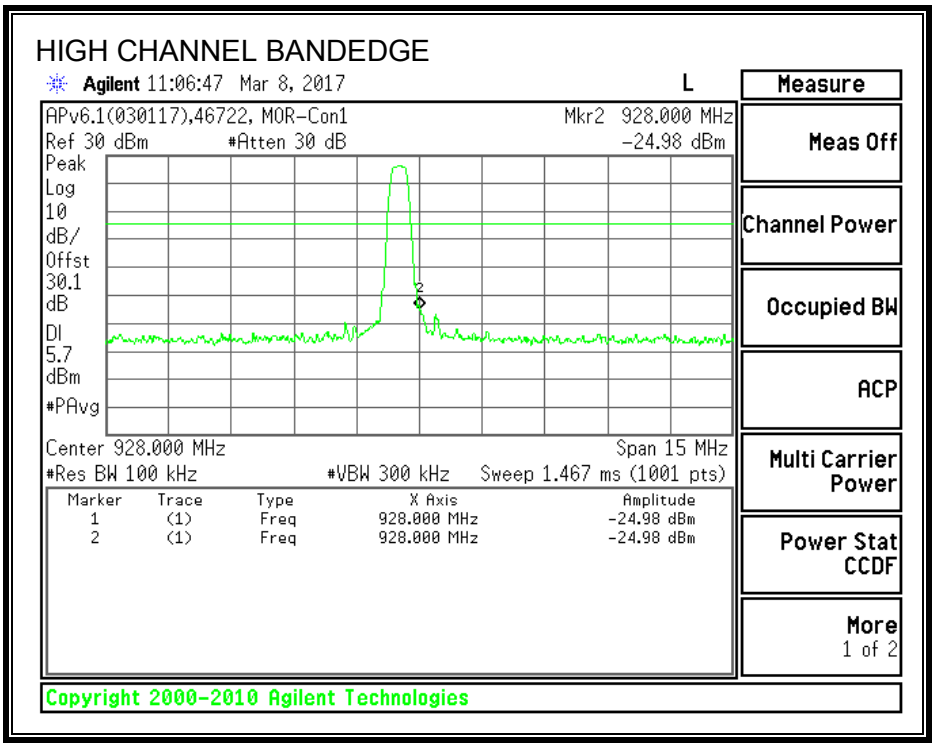
SPURIOUS EMISSIONS, MID CHANNEL

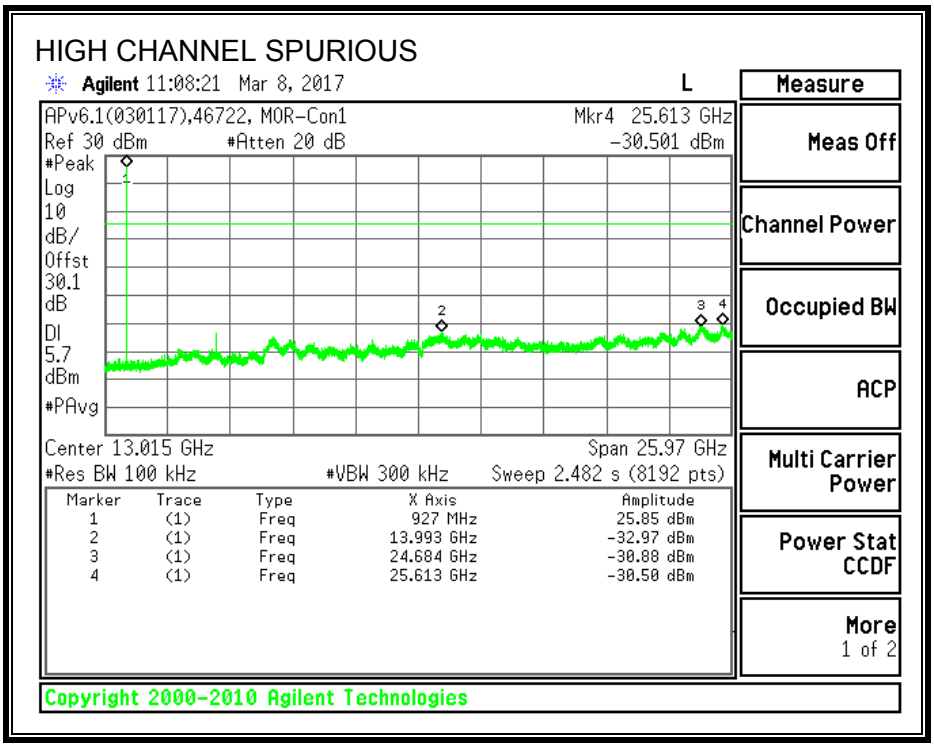


MID CHANNEL SPURIOUS

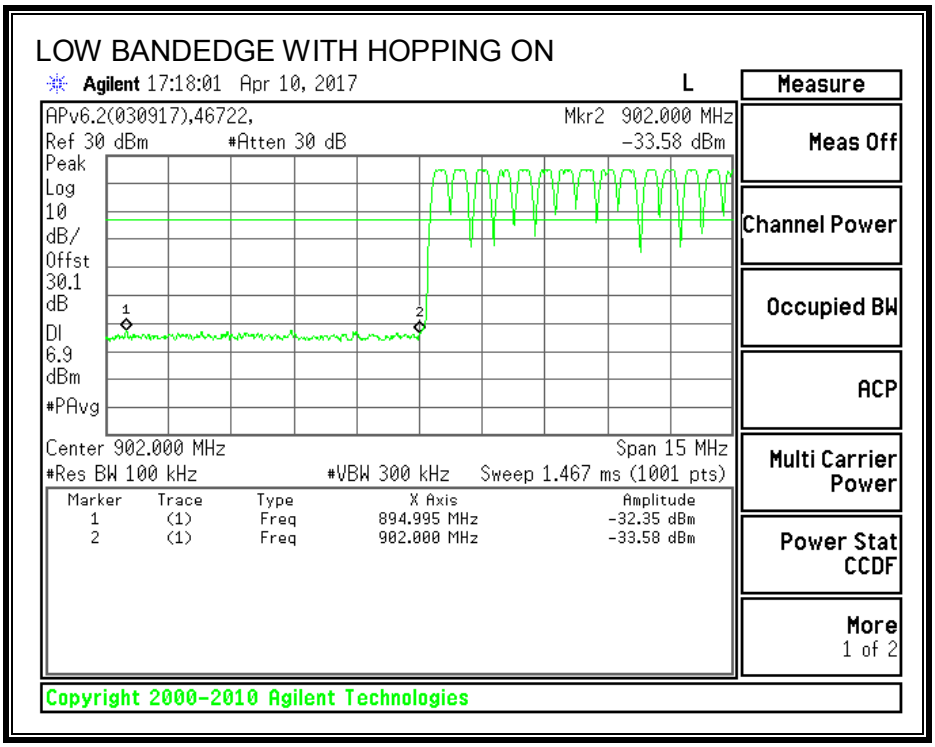


SPURIOUS EMISSIONS, HIGH CHANNEL

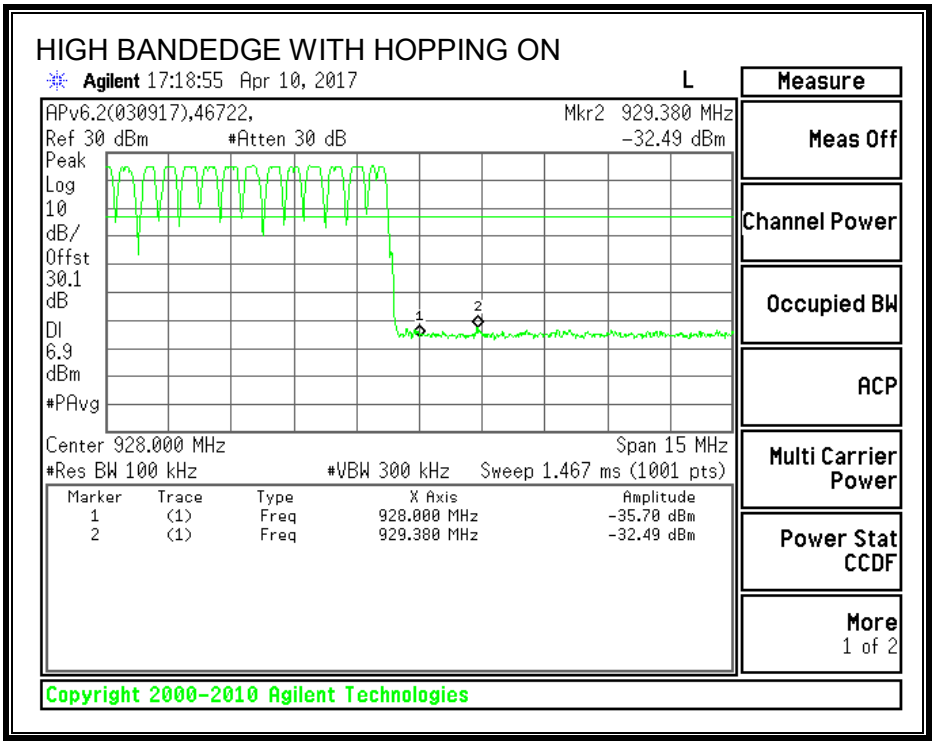




SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



Note – The limit line should be 5.7 dBm. However, the above plot shows enough margin to meet the 5.7 dBm limit line.



Note – The limit line should be 5.7 dBm. However, the above plot shows enough margin to meet the 5.7 dBm limit line.

7. RADIATED TEST RESULTS

7.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209
IC RSS-GEN Clause 8.9 (Transmitter)
IC RSS-GEN Clause 7.1.2 (Receiver)

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
0.009-0.490	2400/F(kHz) @ 300 m	-
0.490-1.705	24000/F(kHz) @ 30 m	-
1.705 - 30	30 @ 30m	-
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for below 1GHz measurements and 1.5 m above the ground plane for above 1GHz measurements. The antenna to EUT distance is 3 meters.

For measurements below 1 GHz the resolution bandwidth is set to 120 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements for the 30-1000 MHz range, 9 kHz for peak detection measurements or 9 kHz for quasi-peak detection measurements for the 0.15-30 MHz range and 200 Hz for peak detection measurements or 200 Hz for quasi-peak detection measurements for the 9 to 150 kHz range. Peak detection is used unless otherwise noted as quasi-peak.

For peak measurements above 1 GHz, the resolution bandwidth is set to 1 MHz and the video bandwidth is set to 3 MHz. For average measurements above 1GHz a duty cycle correction factor (based on on-time in a 100ms sweep) was subtracted from the PK measurements, AV = PK – DCCF. The calculated duty cycle correction is 20log(8ms/100ms) = -21.94 dB.

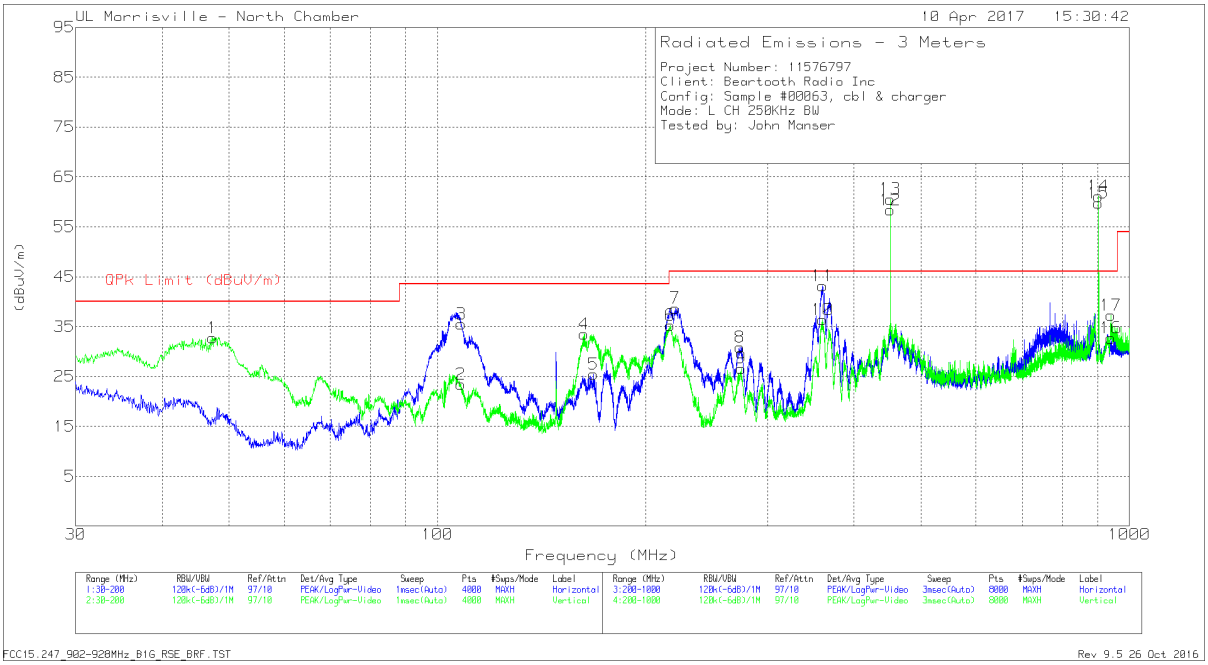
The spectrum from 9 kHz to 26 GHz is investigated. From 1-18GHz and from 30-1000MHz the transmitter set to the lowest, middle, and highest channels in each applicable band. For below 30MHz the worst-case channel was selected.

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.

7.2. 250kHz BW TRANSMITTER BELOW 1 GHz

SPURIOUS EMISSIONS 30 TO 1000 MHz

LOW CHANNEL

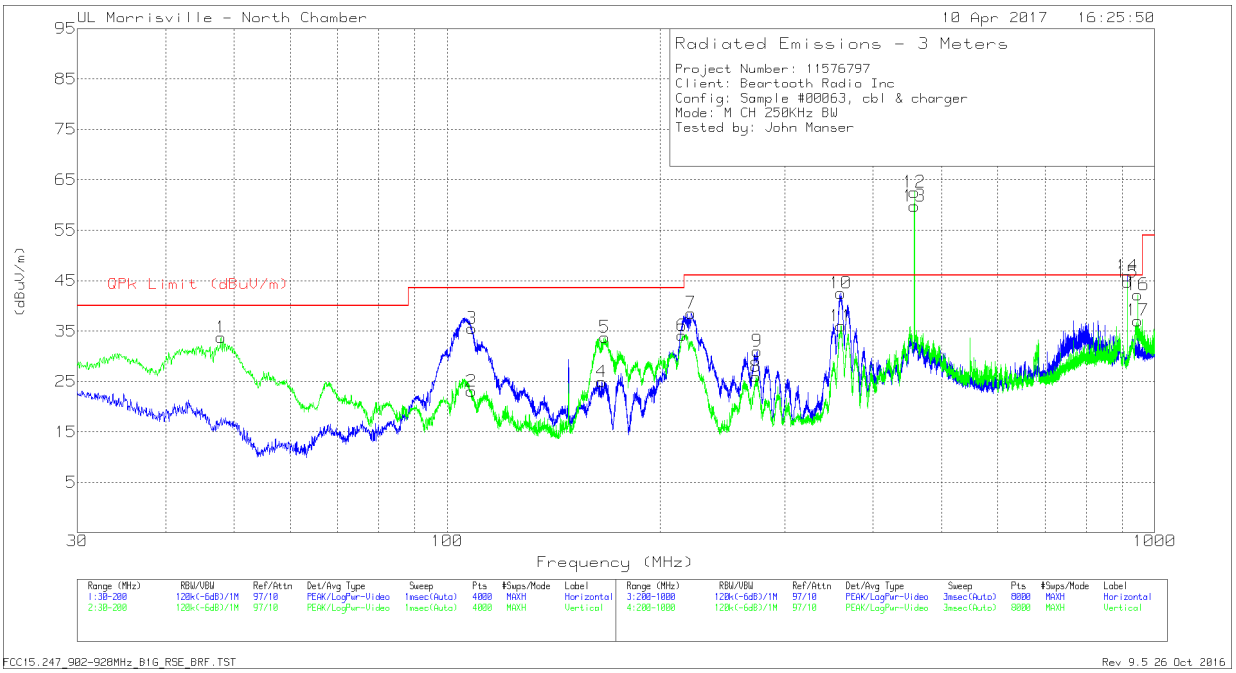


Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0073 AF (dB/m)	Amp/Cbl (dB)	BRF (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	* 108.3226	46.23	Qp	16.7	-30.9	.3	32.33	43.52	-11.19	114	290	H
5	* 167.979	34.13	Qp	16.5	-30.3	.3	20.63	43.52	-22.89	262	201	H
2	* 108.111	39.85	Qp	16.6	-30.9	.3	25.85	43.52	-17.67	195	237	V
4	* 162.8248	41.29	Qp	16.8	-30.4	.3	27.99	43.52	-15.53	292	111	V
8	* 273.9173	38.29	Qp	17.9	-29.5	.3	26.99	46.02	-19.03	8	117	H
9	* 274.667	33.51	Qp	17.9	-29.6	.3	22.11	46.02	-23.91	316	194	V
1	47.302	50.46	Pk	13.7	-31.5	.1	32.76	-	-	0-360	102	V
6	217.1022	49.6	Pk	15.4	-30	.3	35.3	-	-	0-360	102	V
7	220.5027	52.8	Pk	15.5	-29.9	.3	38.7	-	-	0-360	102	H
11	360.3208	52.3	Pk	19.6	-29.1	.4	43.2	-	-	0-360	102	H
10	360.3208	45.52	Pk	19.6	-29.1	.4	36.42	-	-	0-360	299	V
13	451.2327	67.57	Pk	21.2	-28.7	.5	60.57	-	-	0-360	102	V
12	451.3327	65.37	Pk	21.2	-28.7	.5	58.37	-	-	0-360	199	H
15	902.3913	56.76	Pk	26.8	-26.3	2.5	59.76	-	-	0-360	102	H
14	902.3913	58.1	Pk	26.8	-26.3	2.5	61.1	-	-	0-360	102	V
17	940.8963	34.2	Pk	27.4	-25.9	1.6	37.3	-	-	0-360	102	V
16	941.1963	29.7	Pk	27.4	-25.9	1.5	32.7	-	-	0-360	199	H

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

Note: Notch filter in the range of 902-928 was used.

MID CHANNEL

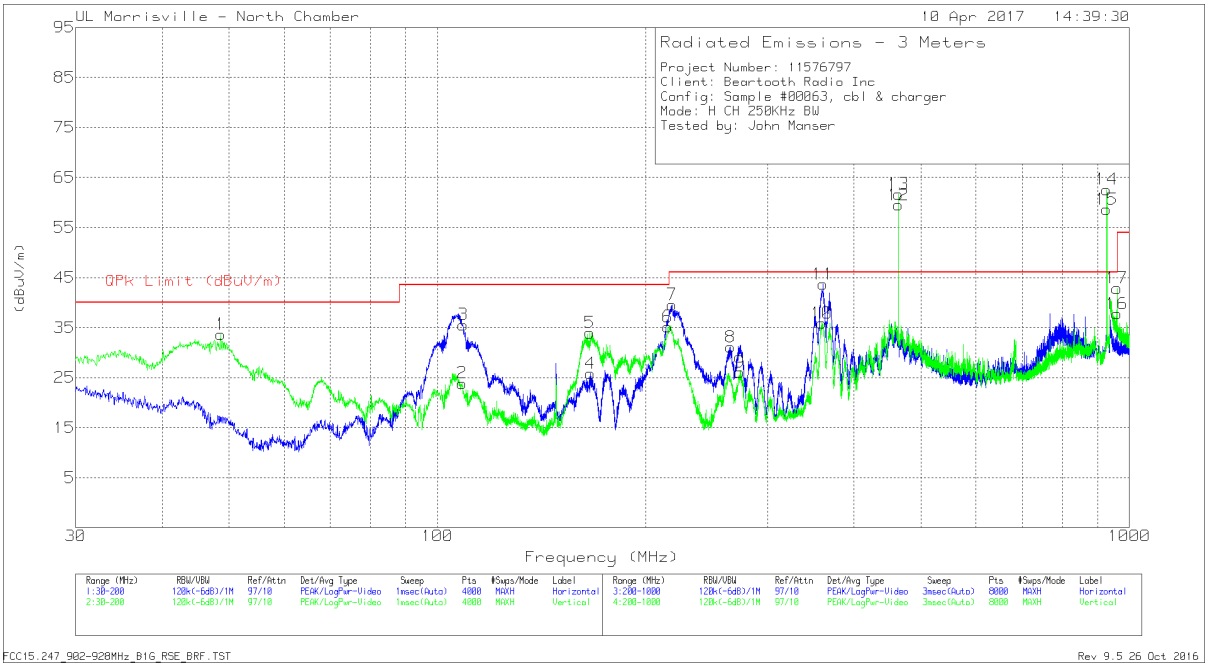


Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0073 AF (dB/m)	Amp/Cbl (dB)	BRF (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	* 108.0838	46.47	Qp	16.6	-30.9	.3	32.47	43.52	-11.05	272	299	H
4	* 165.2959	32.25	Qp	16.7	-30.4	.3	18.85	43.52	-24.67	84	189	H
2	* 108.0433	40.43	Qp	16.6	-30.9	.3	26.43	43.52	-17.09	188	252	V
5	* 167.026	42.9	Qp	16.6	-30.4	.3	29.4	43.52	-14.12	304	105	V
9	* 274.5228	36.6	Qp	17.9	-29.5	.3	25.3	46.02	-20.72	354	129	H
8	* 272.8333	32.88	Qp	17.9	-29.6	.3	21.48	46.02	-24.54	308	186	V
1	47.8971	51.73	Pk	13.4	-31.5	.1	33.73	-	-	0-360	102	V
6	214.6019	48.56	Pk	15.3	-30	.3	34.16	-	-	0-360	102	V
7	221.3028	52.66	Pk	15.5	-29.9	.3	38.56	-	-	0-360	102	H
10	360.0208	51.6	Pk	19.6	-29.1	.4	42.5	-	-	0-360	102	H
11	360.4209	45.14	Pk	19.6	-29.1	.4	36.04	-	-	0-360	299	V
13	457.4335	66.5	Pk	21.4	-28.6	.5	59.8	-	-	0-360	199	H
12	457.4335	69.26	Pk	21.4	-28.6	.5	62.56	-	-	0-360	102	V
14	914.8929	42.87	Pk	26.9	-26.2	2.4	45.97	-	-	0-360	399	H
15	914.9929	41.61	Pk	26.9	-26.2	2.4	44.71	-	-	0-360	102	V
16	946.9971	39.42	Pk	27.4	-25.8	1.2	42.22	-	-	0-360	102	V
17	947.0971	34.28	Pk	27.4	-25.8	1.2	37.08	-	-	0-360	199	H

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

Note: Notch filter in the range of 902-928 was used.

HIGH CHANNEL



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0073 AF (dB/m)	Amp/Cbl (dB)	BRF (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	* 108.1187	46.68	Qp	16.6	-30.9	.3	32.68	43.52	-10.84	290	286	H
4	* 166.242	34.5	Qp	16.6	-30.4	.3	21	43.52	-22.52	269	179	H
8	* 265.2568	38.46	Qp	17.5	-29.7	.3	26.56	46.02	-19.46	14	116	H
2	* 108.5667	37.7	Qp	16.7	-30.9	.3	23.8	43.52	-19.72	6	391	V
5	* 166.2189	39.85	Qp	16.6	-30.4	.3	26.35	43.52	-17.17	6	104	V
9	* 273.4839	33.97	Qp	17.9	-29.6	.3	22.57	46.02	-23.45	319	195	V
1	48.6198	51.86	Pk	13.2	-31.5	.1	33.66	-	-	0-360	102	V
6	215.102	49.57	Pk	15.3	-30	.3	35.17	-	-	0-360	102	V
10	359.2207	45	Pk	19.6	-29.1	.4	35.9	-	-	0-360	102	V
11	360.6209	52.74	Pk	19.6	-29.1	.4	43.64	-	-	0-360	103	H
12	463.7343	66.04	Pk	21.6	-28.6	.5	59.54	-	-	0-360	199	H
15	927.3945	55.12	Pk	27.1	-26	2.4	58.62	-	-	0-360	103	H
16	959.3987	34.94	Pk	27.6	-25.6	.8	37.74	-	-	0-360	103	H
13	463.7343	68.18	Pk	21.6	-28.6	.5	61.68	-	-	0-360	102	V
14	927.3945	59.09	Pk	27.1	-26	2.4	62.59	-	-	0-360	102	V
17	959.3987	40.07	Pk	27.6	-25.6	.8	42.87	-	-	0-360	102	V

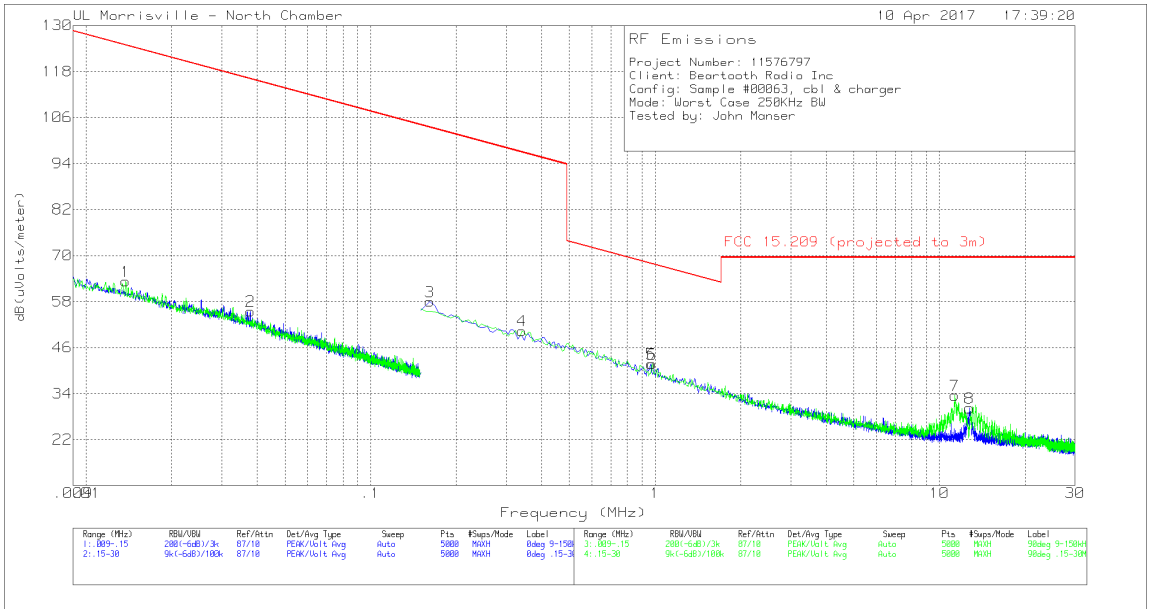
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
Qp - Quasi-Peak detector

Note: Notch filter in the range of 902-928 was used.

SPURIOUS EMISSIONS 0.009 TO 30 MHz (Worse-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 937606.



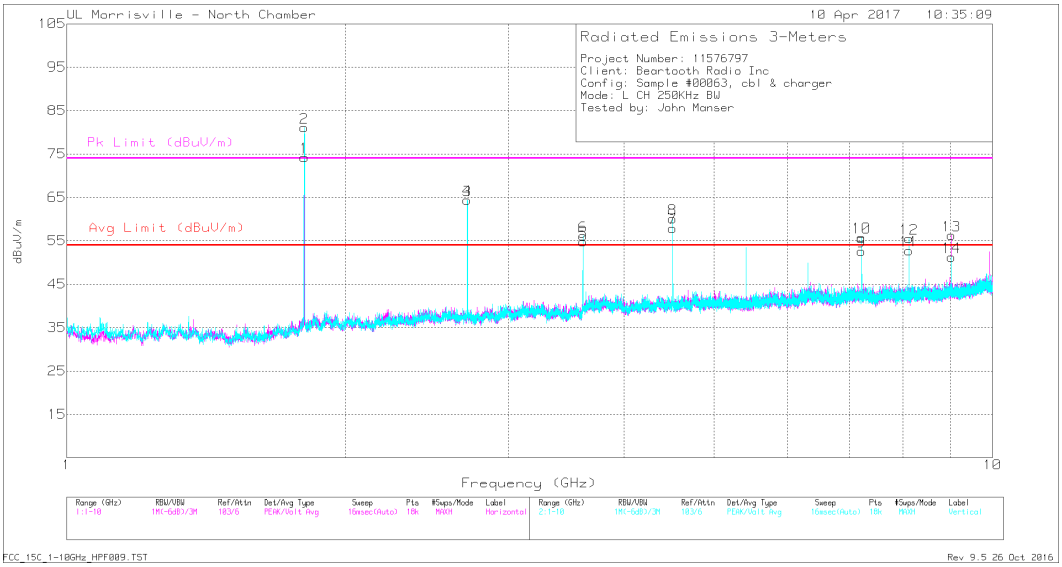
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0079 AF (dB/m)	Cbl (dB)	Corrected Reading dB(uVolts/meter)	FCC 15.209 (projected to 3m)	Margin (dB)	Azimuth (Degs)
1	.01379	46.44	Pk	16.7	.1	63.24	124.81	-61.57	0-360
2	.03778	42.79	Pk	12.6	.1	55.49	116.06	-60.57	0-360
3	.16194	47.18	Pk	10.7	.1	57.98	103.42	-45.44	0-360
4	.34107	39.7	Pk	10.6	.1	50.4	96.95	-46.55	0-360
5	.96803	30.69	Pk	10.9	.2	41.79	67.89	-26.1	0-360
6	.97997	30.51	Pk	11	.2	41.71	67.78	-26.07	0-360
7	11.33965	22.43	Pk	10.5	.6	33.53	69.54	-36.01	0-360
8	12.74881	19.2	Pk	10.4	.6	30.2	69.54	-39.34	0-360

Pk - Peak detector

7.3. 250kHz BW TRANSMITTER ABOVE 1 GHz

HARMONICS AND SPURIOUS EMISSIONS

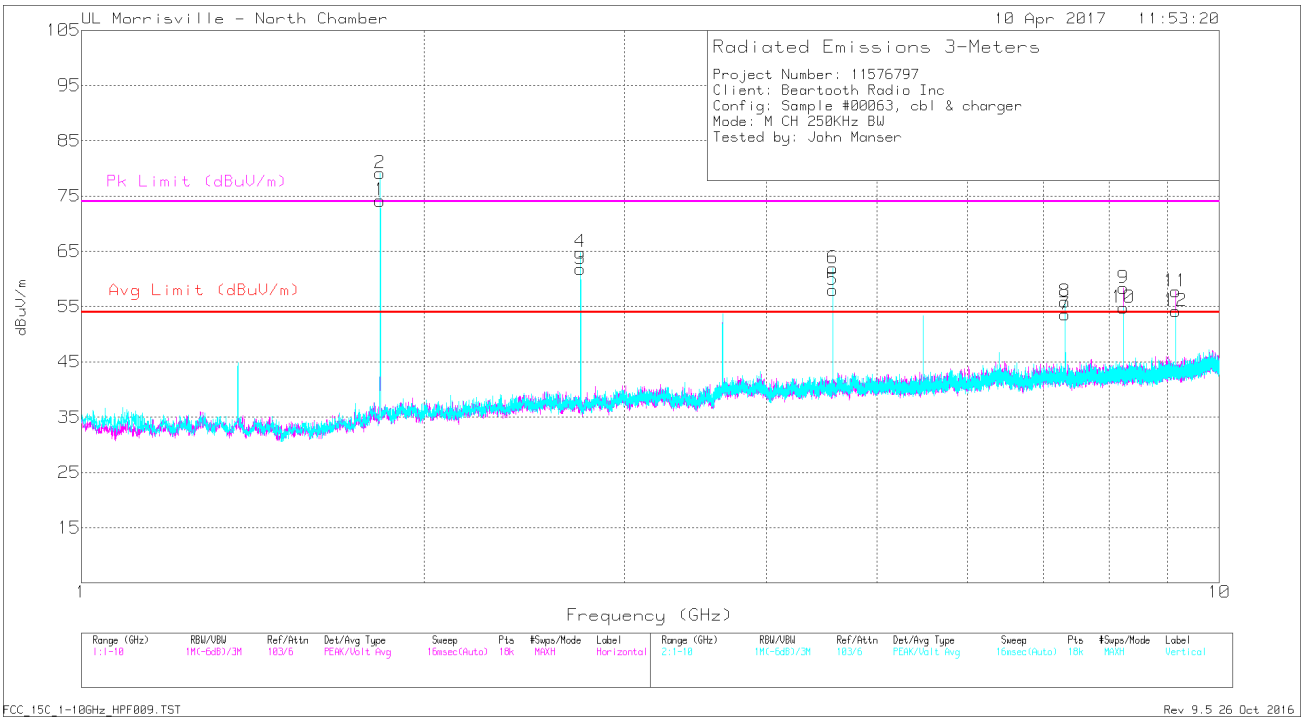
LOW CHANNEL



Marker	Freq (GHz)	Meter Reading (dBuV)	Det	AT0067 AF (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	HPF009 (dB)	DCCF (dB)	Corrected Reading dBuV/m	Avg Limit (dBuV/m)	Margin (dB)	Pk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	* 2.707	67.49	Pk	32	-34.2	0.4	-	65.69	-	-	74	-8.31	163	248	H
			Av				-21.94	43.75	54	-10.25	-	-	163	248	H
5	* 3.61	53.75	Pk	33.1	-33.3	0.5	-	54.05	-	-	74	-19.95	125	300	H
			Av				-21.94	32.11	54	-21.89	-	-	125	300	H
7	* 4.512	57.69	Pk	33.9	-33	0.3	-	58.89	-	-	74	-15.11	125	204	H
			Av				-21.94	36.95	54	-17.05	-	-	125	204	H
11	* 8.122	49.09	Pk	35.8	-29.8	0.3	-	55.39	-	-	74	-18.61	72	267	H
			Av				-21.94	33.45	54	-20.55	-	-	72	267	H
13	* 9.025	51.49	Pk	36	-29.6	0.5	-	58.39	-	-	74	-15.61	83	291	H
			Av				-21.94	36.45	54	-17.55	-	-	83	291	H
4	* 2.707	67.78	Pk	32	-34.2	0.4	-	65.98	-	-	74	-8.02	239	337	V
			Av				-21.94	44.04	54	-9.96	-	-	239	337	V
6	* 3.61	57.65	Pk	33.1	-33.3	0.5	-	57.95	-	-	74	-16.05	121	204	V
			Av				-21.94	36.01	54	-17.99	-	-	121	204	V
8	* 4.512	60	Pk	33.9	-33	0.3	-	61.2	-	-	74	-12.8	191	204	V
			Av				-21.94	39.26	54	-14.74	-	-	191	204	V
12	* 8.122	51.45	Pk	35.8	-29.8	0.3	-	57.75	-	-	74	-16.25	269	217	V
			Av				-21.94	35.81	54	-18.19	-	-	269	217	V
14	* 9.026	47.97	Pk	36	-29.6	0.5	-	54.87	-	-	74	-19.13	278	103	V
			Av				-21.94	32.93	54	-21.07	-	-	278	103	V
2	1.805	85.68	Pk	30.5	-35.6	.5	-	81.08	-	-	-	-	0-360	102	V
1	1.806	78.77	Pk	30.6	-35.6	.5	-	74.27	-	-	-	-	0-360	202	H
10	7.22	50.54	Pk	35.6	-30.6	.3	-	55.84	-	-	-	-	0-360	102	V
9	7.221	47.3	Pk	35.6	-30.6	.3	-	52.6	-	-	-	-	0-360	399	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
AV – Average Detector where AV= PK – DCCF (20log(8ms/100ms) = 21.94 dB

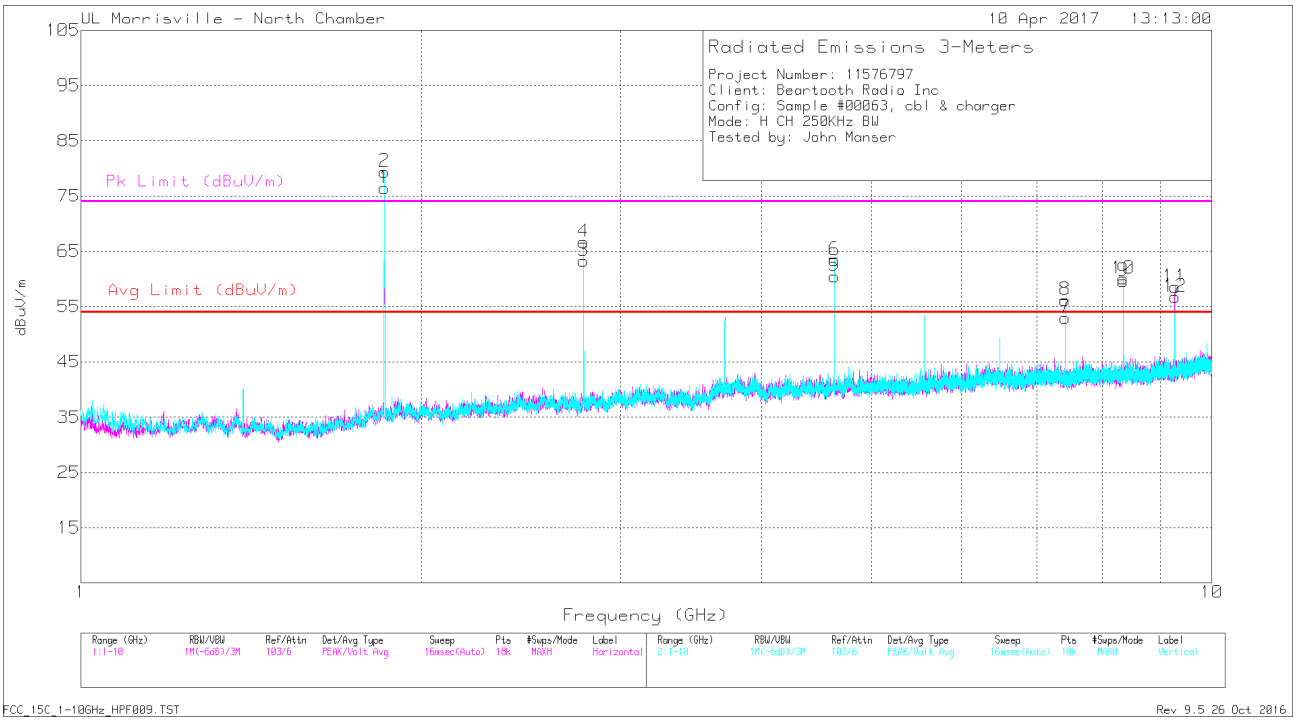
MID CHANNEL



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 AF (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	HPF009 (dB)	DCCF (dB)	Corrected Reading dBuV/m	Avg Limit (dBuV/m)	Margin (dB)	Pk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	* 2.745	63.82	Pk	32.1	-34.1	0.4	-	62.22	-	-	74	-11.78	313	201	H
			Av				-21.94	40.28	54	-13.72	-	-	313	201	H
5	* 4.575	57.76	Pk	34	-33.1	0.3	-	58.96	-	-	74	-15.04	186	311	H
			Av				-21.94	37.02	54	-16.98	-	-	186	311	H
7	* 7.319	50.67	Pk	35.7	-30.3	0.3	-	56.37	-	-	74	-17.63	88	387	H
			Av				-21.94	34.43	54	-19.57	-	-	88	387	H
9	* 8.235	53.54	Pk	35.7	-29.6	0.3	-	59.94	-	-	74	-14.06	77	248	H
			Av				-21.94	38	54	-16	-	-	77	248	H
11	* 9.15	50.99	Pk	36.1	-29.1	0.4	-	58.39	-	-	74	-15.61	207	292	H
			Av				-21.94	36.45	54	-17.55	-	-	207	292	H
4	* 2.745	67.35	Pk	32.1	-34.1	0.4	-	65.75	-	-	74	-8.25	236	362	V
			Av				-21.94	43.81	54	-10.19	-	-	236	362	V
6	* 4.575	61.18	Pk	34	-33.1	0.3	-	62.38	-	-	74	-11.62	288	167	V
			Av				-21.94	40.44	54	-13.56	-	-	288	167	V
10	* 8.348	54.24	Pk	35.7	-29.8	0.4	-	60.54	-	-	74	-13.46	164	205	V
			Av				-21.94	38.6	54	-15.4	-	-	164	205	V
8	* 7.32	51.78	Pk	35.7	-30.3	0.3	-	57.48	-	-	74	-16.52	237	186	V
			Av				-21.94	35.54	54	-18.46	-	-	237	186	V
10	* 8.235	51.61	Pk	35.7	-29.6	0.3	-	58.01	-	-	74	-15.99	106	178	V
			Av				-21.94	36.07	54	-17.93	-	-	106	178	V
12	* 9.15	49.03	Pk	36.1	-29.1	0.4	-	56.43	-	-	74	-17.57	324	234	V
			Av				-21.94	34.49	54	-19.51	-	-	324	234	V
1	1.83	78.27	Pk	31	-35.6	.5	-	74.17	-	-	-	-	0-360	299	H
2	1.83	83.22	Pk	31	-35.6	.5	-	79.12	-	-	-	-	0-360	102	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
AV – Average Detector where AV= PK – DCCF (20log(8ms/100ms) = 21.94 dB

HIGH CHANNEL



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 AF (dB/m)	Amp/Cbl /Fltr/Pad (dB)	HPF009 (dB)	DCCF (dB)	Corrected Reading dBuV/m	Avg Limit (dBuV/m)	Margin (dB)	Pk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	* 2.783	64.8	Pk	32.3	-34.1	0.4	-	63.40	-	-	74	-10.6	135	105	H
			Av				21.94	41.46	54	-12.54	-	-	135	105	H
5	* 4.637	60.94	Pk	34.1	-32.9	0.3	-	62.44	-	-	74	-11.56	319	215	H
			Av				21.94	40.50	54	-13.50	-	-	319	215	H
7	* 7.421	49.93	Pk	35.6	-30.2	0.3	-	55.63	-	-	74	-18.37	96	389	H
			Av				21.94	33.69	54	-20.31	-	-	96	389	H
9	* 8.348	54.52	Pk	35.7	-29.7	0.4	-	60.92	-	-	74	-13.08	78	192	H
			Av				21.94	38.98	54	-15.02	-	-	78	192	H
4	* 2.783	69.27	Pk	32.3	-34.1	0.4	-	67.87	-	-	74	-6.13	243	330	V
			Av				21.94	45.93	54	-8.07	-	-	243	330	V
6	* 4.638	62.27	Pk	34.1	-32.9	0.3	-	63.77	-	-	74	-10.23	306	175	V
			Av				21.94	41.83	54	-12.17	-	-	306	175	V
8	* 7.42	51.88	Pk	35.6	-30.2	0.3	-	57.58	-	-	74	-16.42	251	174	V
			Av				21.94	35.64	54	-18.36	-	-	251	174	V
10	* 8.348	54.24	Pk	35.7	-29.8	0.4	-	60.54	-	-	74	-13.46	164	205	V
			Av				21.94	38.60	54	-15.40	-	-	164	205	V
2	1.854	83.23	Pk	31.3	-35.5	.4	-	79.43	-	-	-	-	0-360	102	V
1	1.855	80.21	Pk	31.3	-35.5	.4	-	76.41	-	-	-	-	0-360	300	H
11	9.275	51.07	Pk	36.2	-29.2	.5	-	58.57	-	-	-	-	0-360	300	H
12	9.276	49.3	Pk	36.2	-29.2	.5	-	56.8	-	-	-	-	0-360	102	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
AV – Average Detector where AV= PK – DCCF (20log(8ms/100ms) = 21.94 dB

8. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

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

* Decreases with the logarithm of the frequency.

TEST PROCEDURE

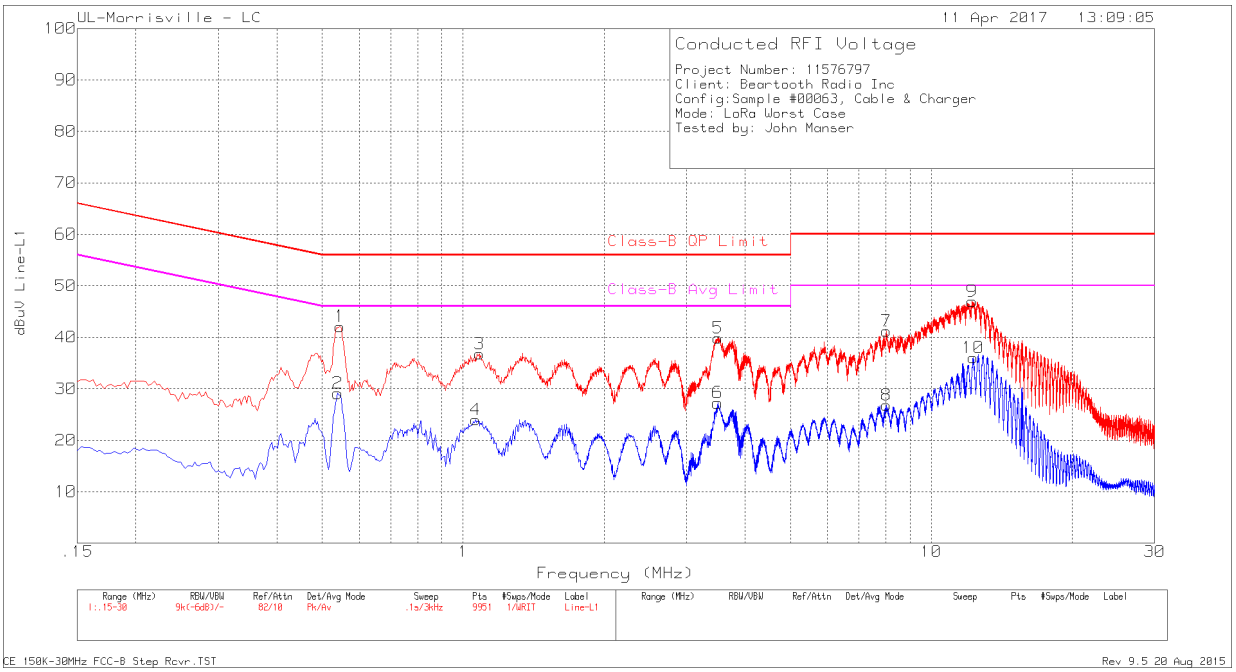
The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.10.

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS

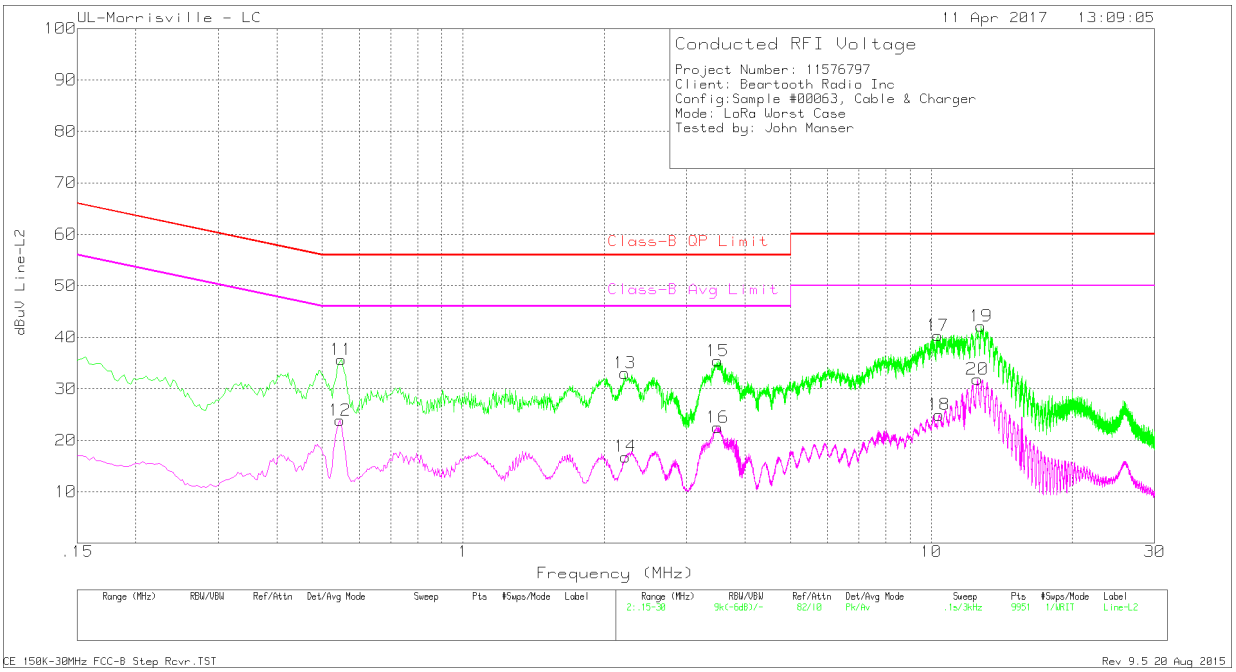
LINE 1 RESULTS



Range 1: Line-L1 .15 - 30MHz										
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN VCF (dB)	Cbl/Limiter (dB)	Corrected Reading dBuV	Class-B QP Limit	Margin (dB)	Class-B Avg Limit	Margin (dB)
1	.546	32.11	Pk	0	10	42.11	56	-13.89	-	-
2	.54	19.11	Av	0	10	29.11	-	-	46	-16.89
3	1.083	26.74	Pk	0	10	36.74	56	-19.26	-	-
4	1.065	14	Av	0	10	24	-	-	46	-22
5	3.504	29.76	Pk	0	10.1	39.86	56	-16.14	-	-
6	3.498	17.16	Av	0	10.1	27.26	-	-	46	-18.74
7	8.013	30.92	Pk	.1	10.2	41.22	60	-18.78	-	-
8	8.028	16.52	Av	.1	10.2	26.82	-	-	50	-23.18
9	12.228	36.56	Pk	.1	10.3	46.96	60	-13.04	-	-
10	12.288	25.62	Av	.1	10.3	36.02	-	-	50	-13.98

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**	**Class-B QP Limit**	**Margin (dB)**	**Class-B Avg Limit**	**Margin (dB)**
11	.549	25.65	Pk	0	10	35.65	56	-20.35	-	-
12	.546	13.87	Av	0	10	23.87	-	-	46	-22.13
13	2.217	22.93	Pk	0	10.1	33.03	56	-22.97	-	-
14	2.223	6.7	Av	0	10.1	16.8	-	-	46	-29.2
15	3.498	25.35	Pk	0	10.1	35.45	56	-20.55	-	-
16	3.498	12.42	Av	0	10.1	22.52	-	-	46	-23.48
17	10.317	29.95	Pk	.1	10.3	40.35	60	-19.65	-	-
18	10.389	14.52	Av	.1	10.3	24.92	-	-	50	-25.08
19	12.78	31.71	Pk	.1	10.4	42.21	60	-17.79	-	-
20	12.546	21.35	Av	.1	10.4	31.85	-	-	50	-18.15

Pk - Peak detector
Av - Average detection