FCC / ISED Test Report

For

Lancer Controller

Report #: 57947-1

FCC ID: HS9-MRCH2
IC ID: 573R-MRCH2

Report Completion Date: 2019-03-15

Prepared by and for:
Ademco Inc.
2 Corporate Center Dr.
Suite 100 PO Box 9040
Melville, NY 11747

Testing
NVLAP Lab Code: 600110

Document Introduction

Ademco Inc. tested the above equipment in accordance with the requirements set forth in the listed standards. All indications of Pass/Fail in the report are opinions expressed by Ademco Inc. 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.

This document is a record of the FCC/ISED Test Report for Ademco Inc. products. It demonstrates the data required to be analyzed to certify a product according to the requirements of the FCC & ISED.

The results in the report reflect only the model of the items under test unless noted otherwise. This document may not be altered or revised in any way unless done so by Ademco Inc. and all revisions are duly noted in the revisions section. Any alterations of this document not carried out by Ademco Inc. 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, any agency of the Federal Government, or any agency of any government.

Ademco Inc. is the legal entity name for Honeywell Home / Resideo. All three names can be used synonymously within this test report.

Test Report Revision History

Revision	Prepared By	Reviewed By	Revision Detail	Release Date
---	M. Antola	A. Roussin	Original Release	2019-02-25
A	M. Antola	A. Roussin	Updated limit definition of 20dB bandwidth test (pg. 12); Updated Test Item Description section; Added additional RX mode data	2019-03-15
B	M. Antola	A. Roussin	Added additional RX mode data	2019-03-19

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Report Authorization

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Contents

Applicable Test Standards/Limits....5
Deviations from Test Methods....5
Facilities and Accreditation....5
Test Item Description....5
Worse-Case Configuration & Mode....6
Calibration & Measurement Uncertainty....7
Opinions / Interpretations....7
Test Summary....8
Test & Measurement Equipment....9
On Time and Duty Cycle....11
20dB Emission Bandwidth....12
99% Occupied Bandwidth....16
Maximum Conducted Output Power....20
Number of Hopping Frequencies....21
Channel Separation....23
Dwell Time....25
Out-of-Band Emissions....27
Radiated Emissions (Unintentional)....35
Radiated Emissions (Intentional)....47
END OF REPORT....60

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Applicable Test Standards/Limits

Test Standards/Limits	Result	Dates Tested
ANSI C63.4: 2014	Compliant	1/24/19 – 3/19/19
ANSI C63.10: 2013	Compliant	1/24/19 – 3/19/19
ICES-003 Issue 6: 2016	Compliant	1/24/19 – 3/19/19
RSS-247, Issue 2, Section 5	Compliant	1/24/19 – 3/19/19
RSS-GEN, Issue 4	Compliant	1/24/19 – 3/19/19
CFR 47 Pt 15 Subpart B, Section 15.109	Compliant	1/24/19 – 3/19/19
CFR 47 Pt 15 Subpart C, Section 15.209	Compliant	1/24/19 – 3/19/19
CFR 47 Pt 15 Subpart C, Section 15.247	Compliant	1/24/19 – 3/19/19

Deviations from Test Methods

#	Deviation Description
0	None

Facilities and Accreditation

The test site and measurement facility used to collect data are located at 2 Corporate Center Dr., Melville, NY 11747, USA. Ademco Inc. is accredited by NVLAP, Laboratory Code 600110-0. The full scope of accreditation can be viewed at the NVLAP website.

Test Item Description

The MRCH2 is a battery powered programmable thermostat, which contains a two-way RF device. The circuit card contains a partitioned radio block and the board also contains two microcontrollers, power supply circuitry, basic sensor conditioning circuitry, resistive-touched LCD.

The EUT contains a 902.99973-926.39401MHz frequency hopping spread spectrum (i.e. RedLINK) radio. Low/High frequencies tested are 903MHz and 926.4MHz, respectively, due to rounding. The radio utilizes two (2) antennas, which are used for diversity only. Antenna gains are listed below:

RedLINK Antenna A: -2.5 dBi
RedLINK Antenna B: 0.2 dBi

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Worse-Case Configuration & Mode
Radiated emissions was performed with the EUT set to transmit at the low/mid/high channels with the highest output power as worst-case scenario. Normal orientation of the EUT is wall-mounted (i.e. standing upright), therefore all final radiated test was performed with the EUT in the X axis (upright) orientation. See setup photos for details.

Test Sample Identification

Sample ID Number	Sample Serial Number	Date Received
MEL-661	Non-serialized production unit	2019-02-05
MEL-668	Non-serialized production unit	2019-02-05

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Calibration & Measurement Uncertainty

- Measuring Instrument Calibration – The measuring equipment utilized to perform the tests documented in this report have been calibrated in accordance with the manufacturer's recommendations and is traceable to recognized national standards.

- 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)

  [i.e.] 37 dBuV/m = 30 dBuV + 18.5 dB/m + 0.5 dB – 12 dB

- Uncertainty - Figures are valid to a confidence level of 95%.

Test	Standard Uncertainty
Radiated Emissions (30-200MHz Horizontal)	+/- 5.05 dB
Radiated Emissions (30-200MHz Vertical)	+/- 5.28 dB
Radiated Emissions (200-1000MHz Horizontal)	+/- 10.21 dB
Radiated Emissions (200-1000MHz Vertical)	+/- 10.36 dB
Radiated Emissions (Above 1GHz)	+/- 9.70 dB
Conducted Emissions (150KHz-30MHz)	+/- 4.36 dB

Opinions / Interpretations

None

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Test Summary

All tests described below are required, unless otherwise noted. Notes should be described in detail in the "Additional notes" section.

#	Test Description	Status
1	20 dB Emission Bandwidth	PASS
2	99% Occupied Bandwidth	PASS
3	Maximum Conducted Output Power	PASS
4	Number of Hopping Frequencies	PASS
5	Channel Separation	PASS
6	Dwell Time	PASS
7	Out-of-Band Emissions	PASS
8	Radiated Emissions (Intentional)	PASS

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Test & Measurement Equipment

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

Equipment List

Instrument Type	ID #	Serial #	Manufacturer	Model	Cal Date	Cal Due Date
RF Lab (RF Conducted & Power Tests)						
Spectrum Analyzer	11531	MY41000078	Agilent	E4440A	06/06/17	06/06/19
Power Sensor	11568	105317	Rohde & Schwarz	NRP-Z81	10/02/18	10/02/19
Attenuator	-	1624	Pasternack	PE7087-6	*	*
RF Chamber						
Spectrum Analyzer	11496	100303	Rohde & Schwarz	FSU26	04/11/18	04/11/19
Loop Antenna (9kHz-30MHz)	11535	121080	Com-Power	AL-130R	10/29/18	10/29/19
Bilog Antenna (30MHz-6GHz)	11534	A012816	Sunol	JB6	03/27/18	03/27/19
Horn Antenna (1-18GHz)	2319	2317	EMCO	3115	01/08/19	01/08/20
Preamp (10-4200MHz)	11537	1603006	Mini Circuits	TVA-11-422	*	*
Preamp (500MHz-18GHz)	11557	18040034	Com-Power	PAM-118A	*	*
Band Reject Filter	11553	G041	Micro-tronics	BRM50702-01	*	*
RF Cable	-	-	Mini-Circuits	RDE#2	*	*
RF Cable	-	-	Insulated Wire	SMA#8	*	*
OATS						
Spectrum Analyzer	11545	103125	Rohde & Schwarz	FSW26	02/21/18	02/21/19
Bilog Antenna (30MHz-6GHz)	11534	A012816	Sunol	JB6	03/27/18	03/27/19
Horn Antenna (1-18GHz)	2973	3127	EMCO	RGA-60	01/31/19	01/31/21
Preamp (100kHz-1.3GHz)	11540	2443AUF555	HP	8447D	*	*
Preamp (1-18GHz)	11539	160362	Amplical	AMP1G18-35	*	*
High Pass Filter	11552	G018	Micro-tronics	HPM50111-01	*	*
RF Cable	-	-	Pasternack	RDE#1	*	*
RF Cable	-	-	MegaPhase	EMC2-S1S1-360	*	*
Misc.						

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Measurement Software	11543	Version 9.5	UL	UL EMC	N/A	N/A
Environmental Meter	11533	A070144	Extech Instruments	SD700	08/21/17	08/21/20

*-Passive devices & Preamps are characterized in-house, not calibrated.

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On Time and Duty Cycle

Test Description

Refer to KDB 558074 Zero-Span Analyzer Method.

Test Criteria

Reference	Limit
KDB 558074, Section 6	None, for reporting only

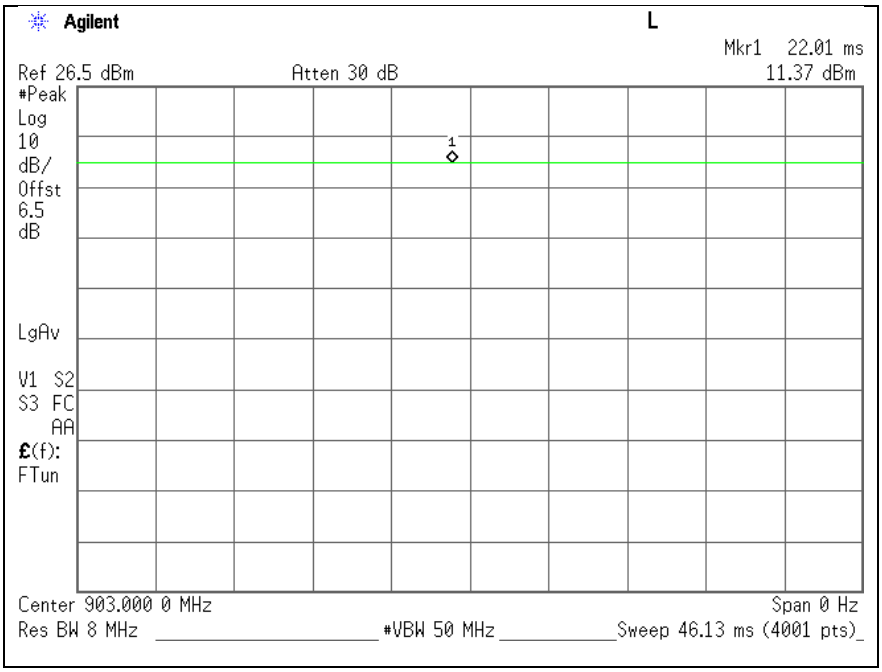
Test Information

Tester	Test Location	Date	Temperature (ºC)	Humidity (%RH)	Pressure (mbar)	Results (P/F)
MA	RF Lab	02/20/19	22.6	37.2	1014	P

Test Results

EUT Mode	ON Time (ms)	Period (ms)	Duty Cycle (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/ON Time Minimum VBW (kHz)
RedLINK	22.01	22.01	1.0	100%	0.00	0.01

Duty Cycle Plot



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20dB Emission Bandwidth

Test Description

Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

Test Limit

Reference	Limit
CFR 47 Subpart C 15.247 (a)(1)(i)	< 500kHz

Test Information

Tester	Test Location	Date	Temperature (ºC)	Humidity (%RH)	Pressure (mbar)	Results (P/F)
JB	RF Lab	01/24/19	23	41	998	P

Test Results

Channel	Frequency (MHz)	20dB Bandwidth (in kHz)	
		Antenna 1	Antenna 2
Low	903	83.856	83.419
Mid	914.6	83.328	82.821
High	926.4	84.107	84.049

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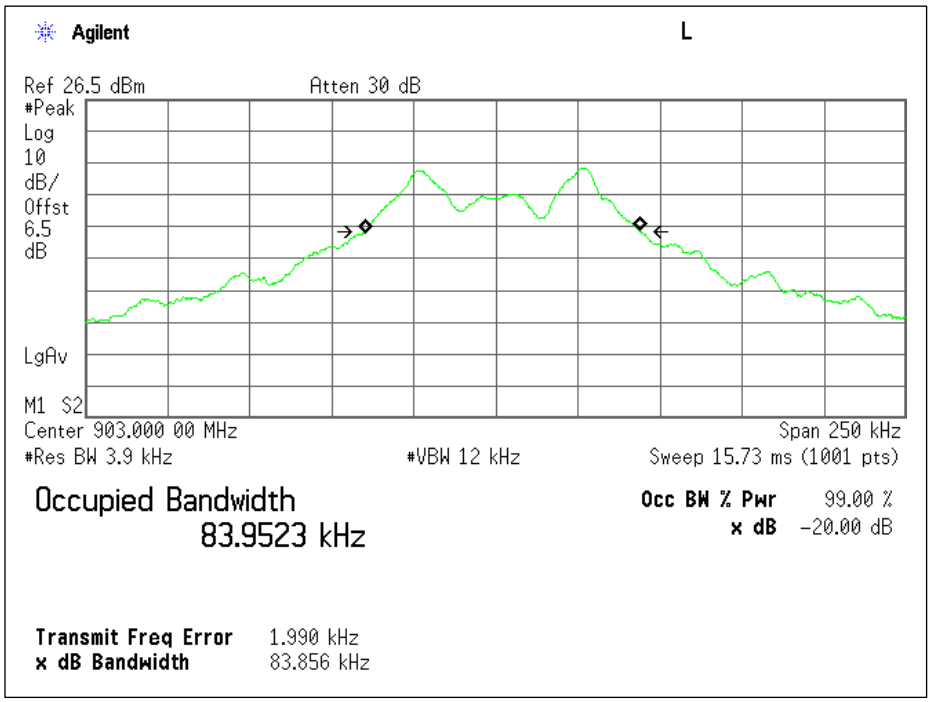
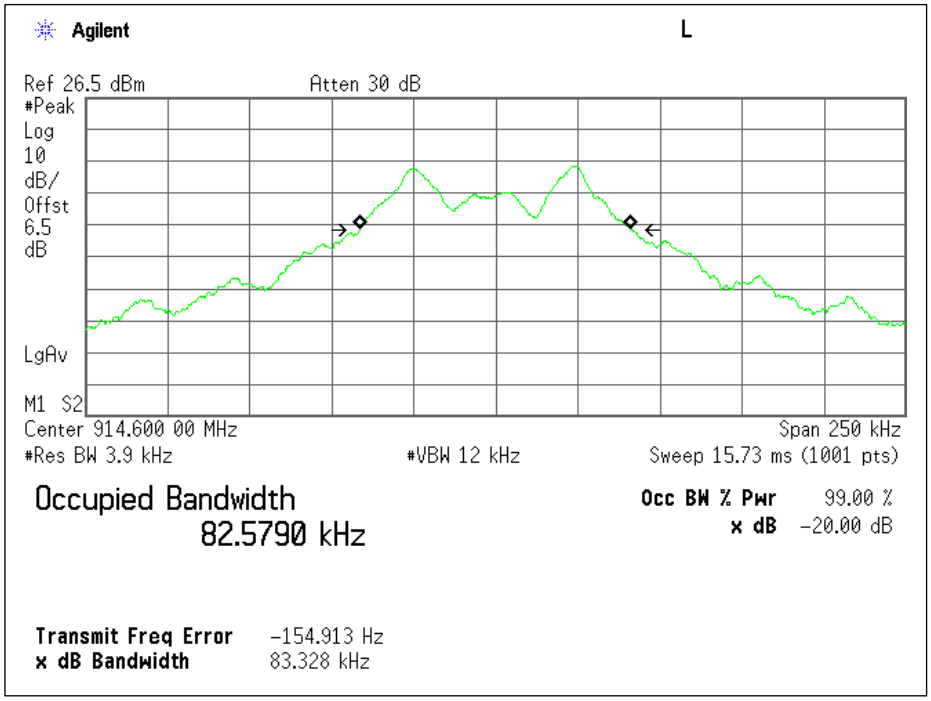
20dB Bandwidth



Antenna 1: Low Channel - Plot



Antenna 1: Mid Channel - Plot

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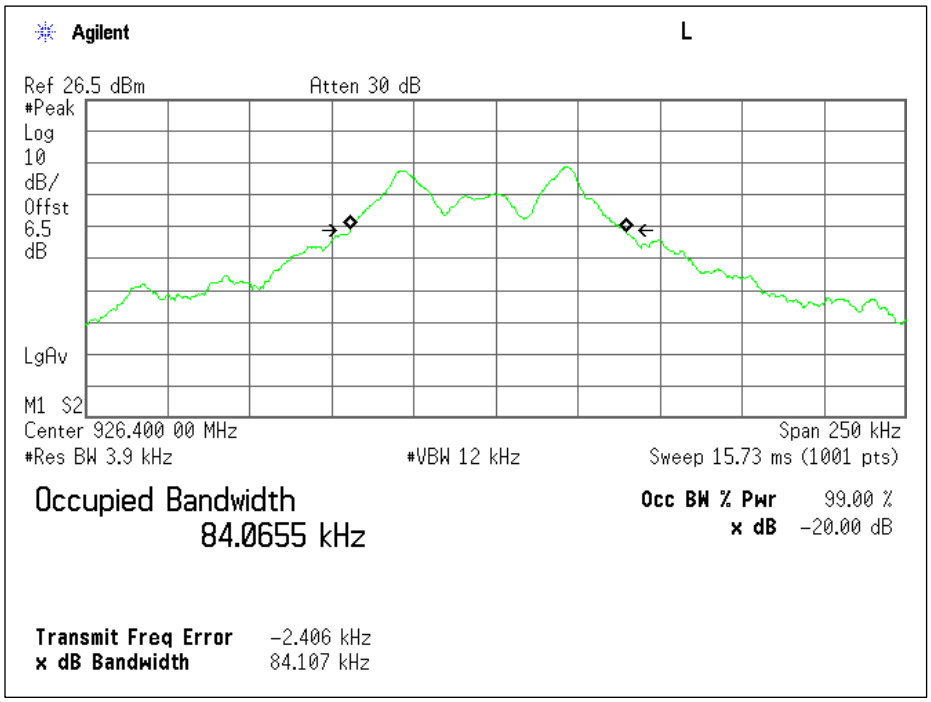
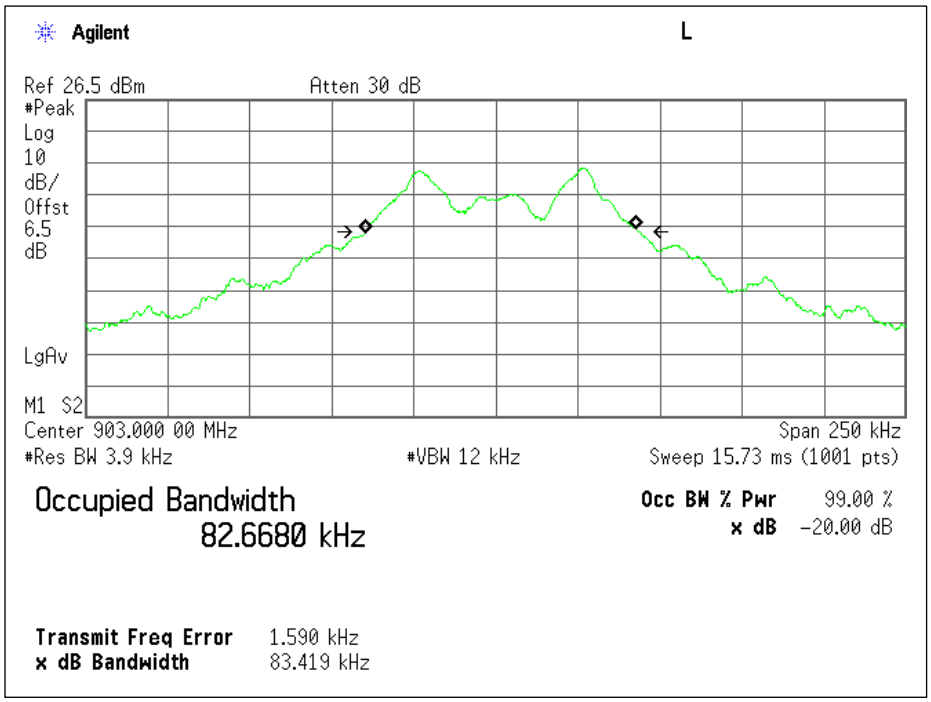


Antenna 1: High Channel – Plot



Antenna 2: Low Channel - Plot

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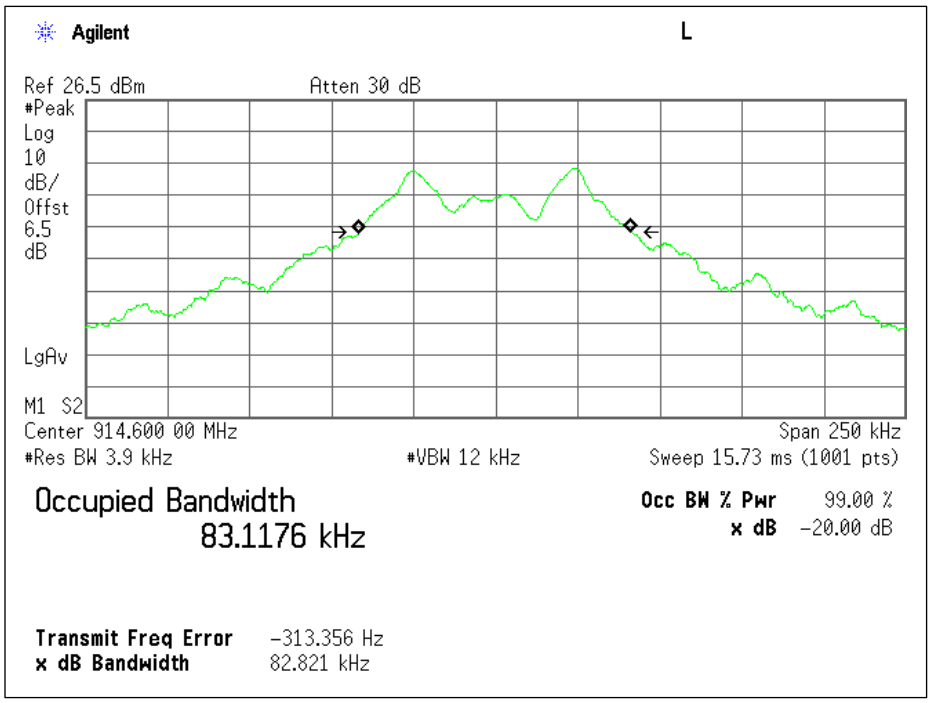
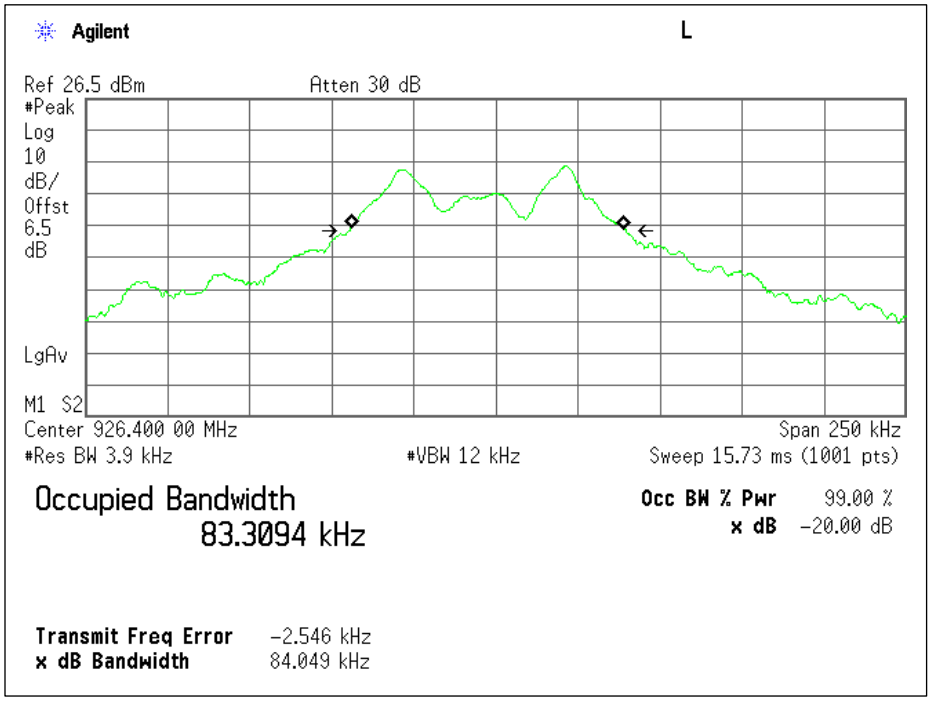


Antenna 2: Mid Channel - Plot



Antenna 2: High Channel - Plot

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99% Occupied Bandwidth

Test Description

The emission bandwidth (x dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated x dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth.
When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

Test Criteria

Reference	Limit
RSS-GEN, Section 6.6	N/A

Test Information

Tester	Test Location	Date	Temperature (ºC)	Humidity (%RH)	Pressure (mbar)	Results (P/F)
JB	RF Lab	01/24/198	23	41	998	P

Test Results

Channel	Frequency (MHz)	99% Bandwidth (in kHz)	
		Antenna 1	Antenna 2
Low	903	76.8119	76.6953
Mid	914.6	76.8575	76.3216
High	926.4	78.2782	77.4273

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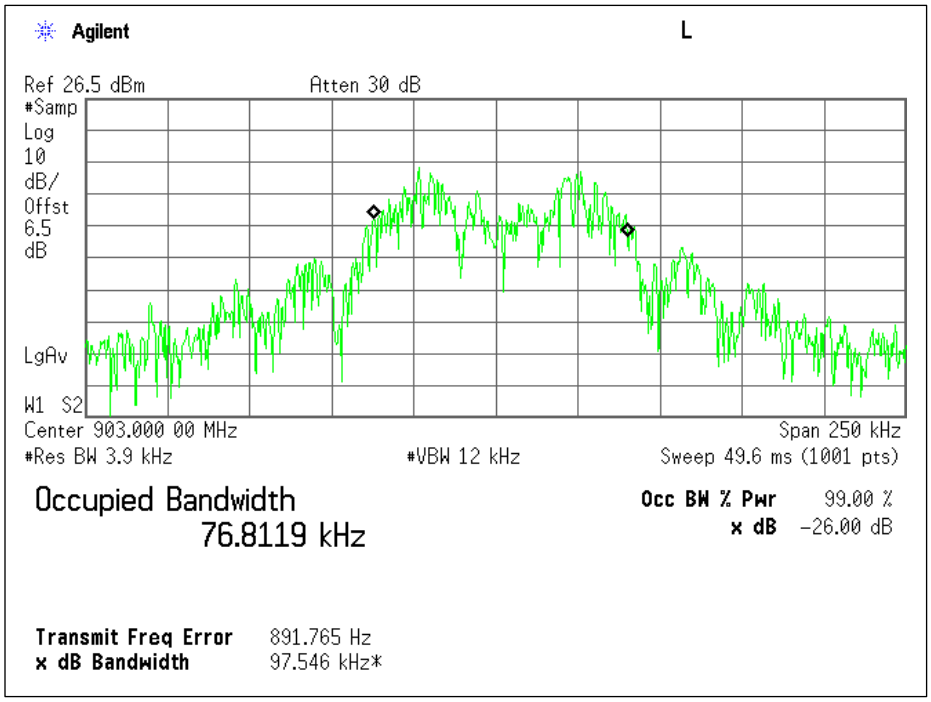
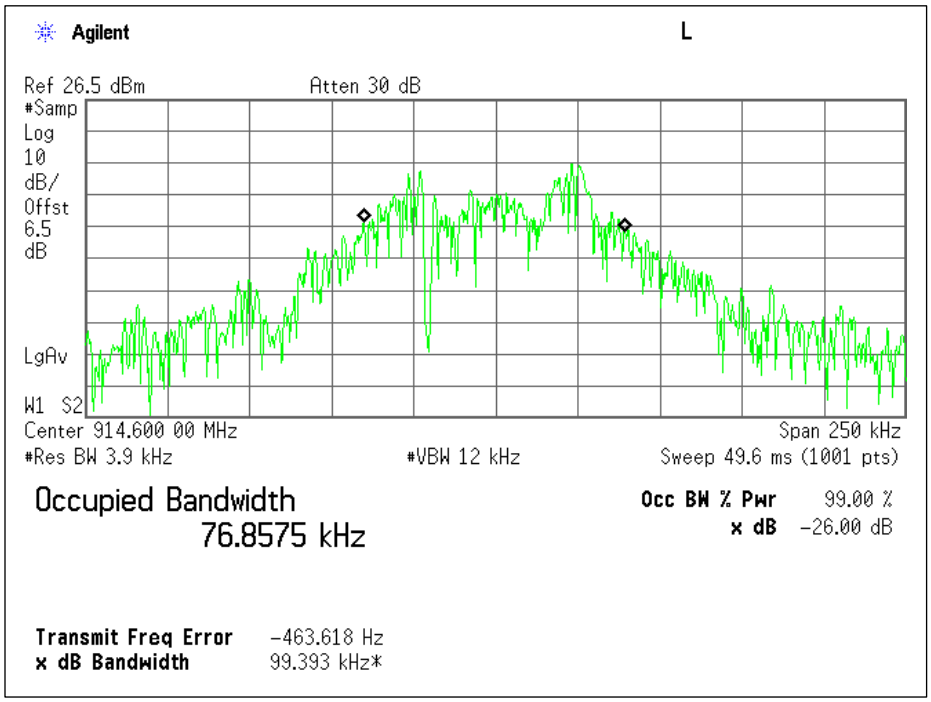
99% Occupied Bandwidth



Antenna 1: Low Channel - Plot



Antenna 1: Mid Channel - Plot

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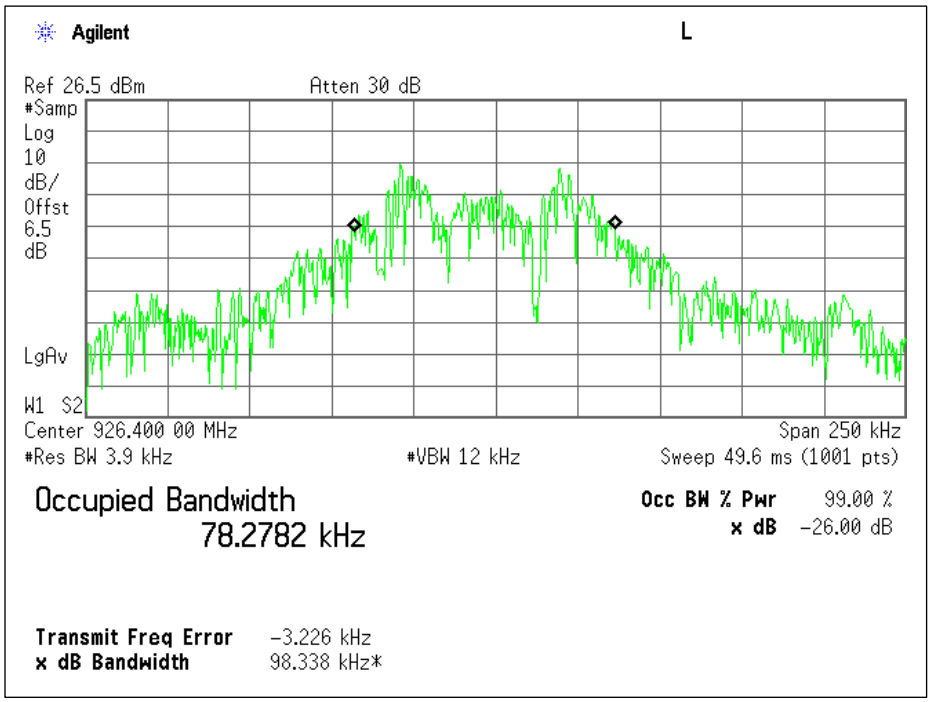
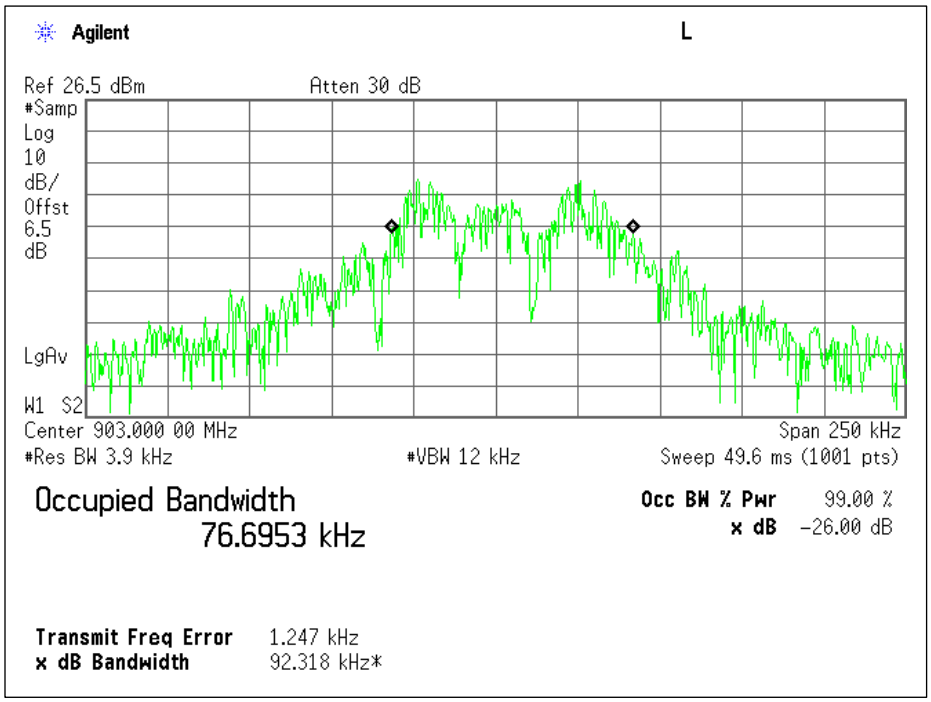


Antenna 1: High Channel – Plot



Antenna 2: Low Channel - Plot

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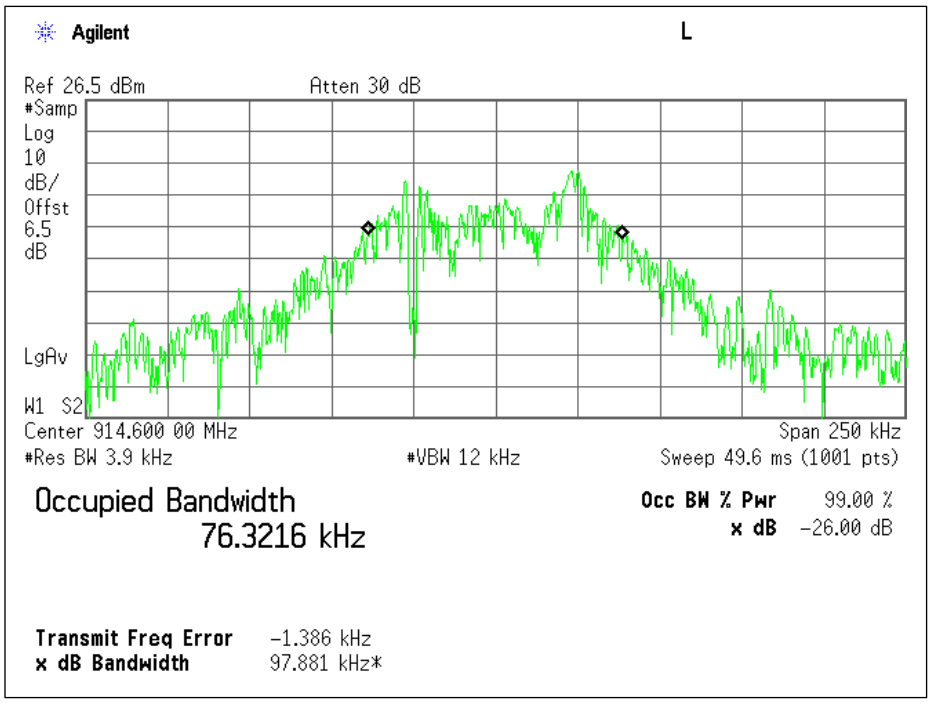
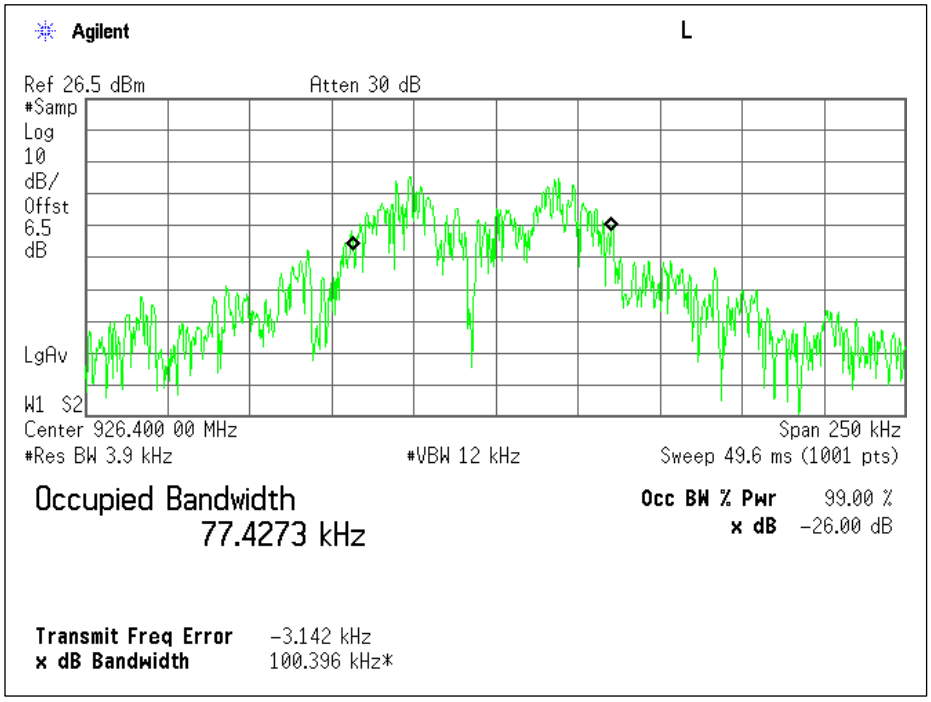


Antenna 2: Mid Channel - Plot



Antenna 2: High Channel - Plot

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Maximum Conducted Output Power

Test Description

For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels.

Maximum peak conducted output power was the method employed to determine fundamental emission output power. As allowed per Section 7.8.5 of C63.10, a peak power sensor was utilized for the measurements contained in this section.

Test Criteria

Reference	Limit
CFR 47 Subpart C 15.247 (b)(2) RSS-247 Section 5.4 (a)	1W (30dBm)

Test Information

Tester	Test Location	Date	Temperature (ºC)	Humidity (%RH)	Pressure (mbar)	Results (P/F)
JB	RF Lab	01/29/19	22.5	14.5	1012	P

Test Results

Channel	Frequency (MHz)	Tx Channel Power (dBm)	
		Antenna 1	Antenna 2
Low	903	10.52	11.79
Mid	914.6	10.51	11.70
High	926.4	10.50	11.59

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Number of Hopping Frequencies

Test Description

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.

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test Criteria

Reference	Limit
CFR 47 Subpart C 15.247 (a)(1) RSS-247 Section 5.1 (c)	≥ 50 Hopping Frequencies

Test Information

Tester	Test Location	Date	Temperature (ºC)	Humidity (%RH)	Pressure (mbar)	Results (P/F)
JB	RF Lab	01/25/19	21	14	1009	P

Test Results

Number of Channels
50

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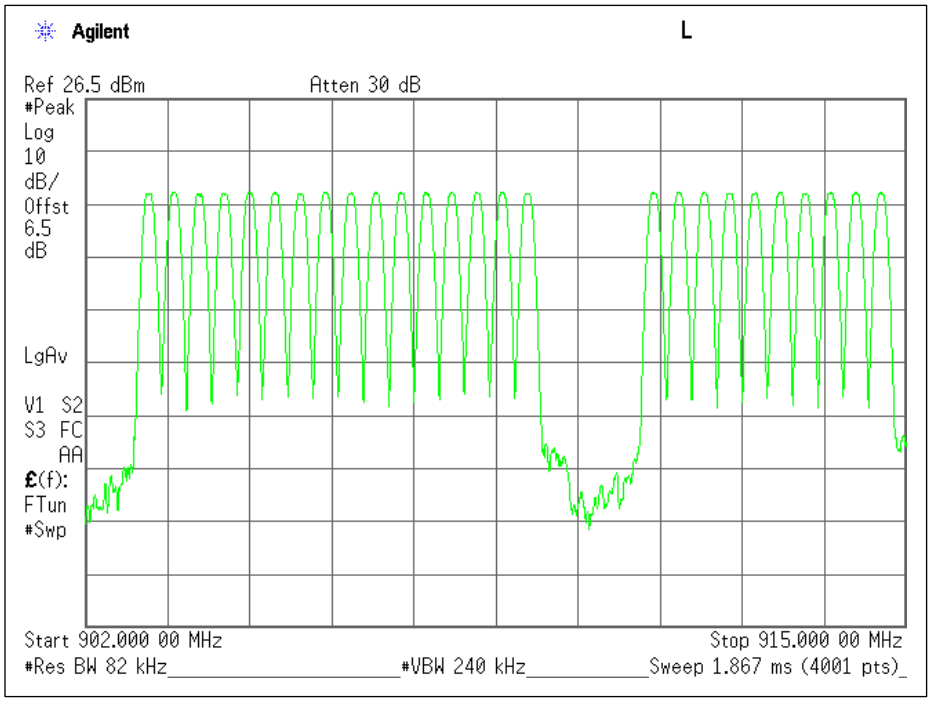
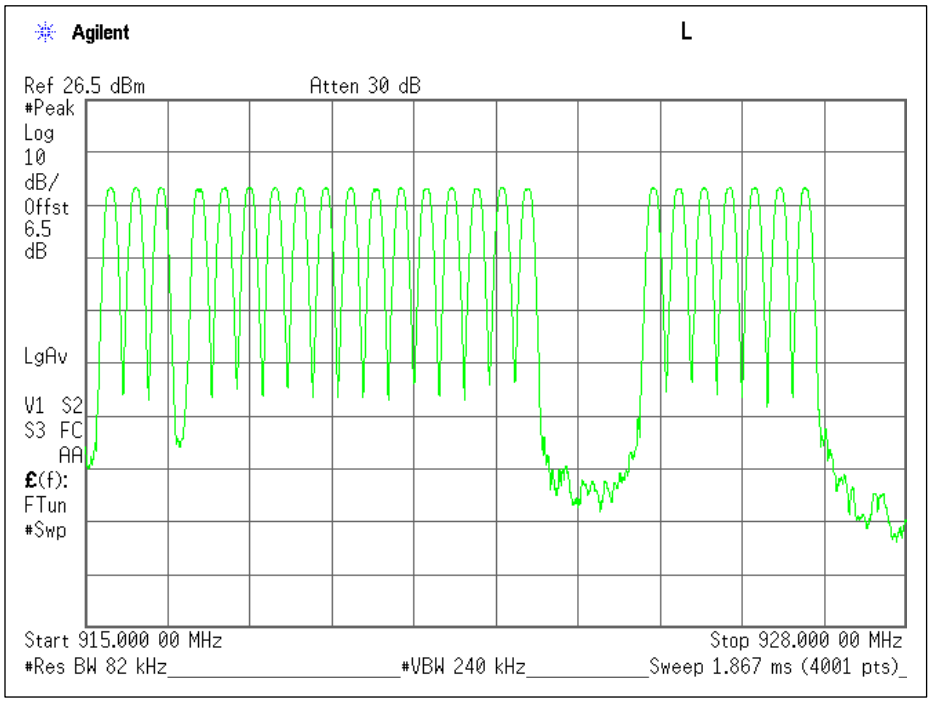
Number of Hopping Frequencies



Number of Channels - Plot 1



Number of Channels - Plot 2

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Channel Separation

Test Description

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Test Criteria

Reference	Limit
CFR 47 Subpart C 15.247 (a)(1) RSS-247 Section 5.1 (b)	25kHz or the 20dB Bandwidth, whichever is greater

Test Information

Tester	Test Location	Date	Temperature (ºC)	Humidity (%RH)	Pressure (mbar)	Results (P/F)
JB	RF Lab	01/28/19	21	9	1016	P

Test Results

Channel Separation
404kHz
752kHz
1.965MHz

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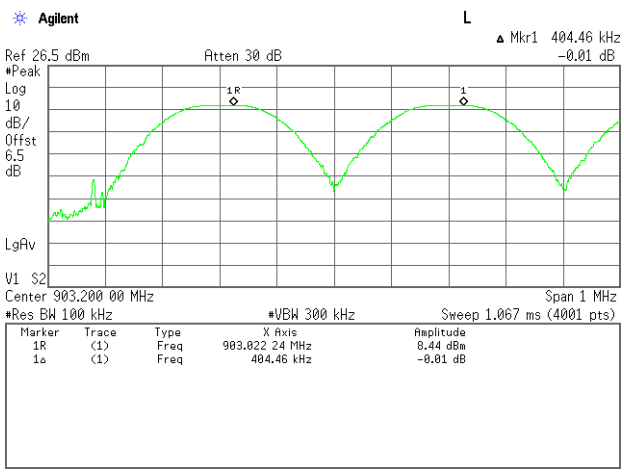
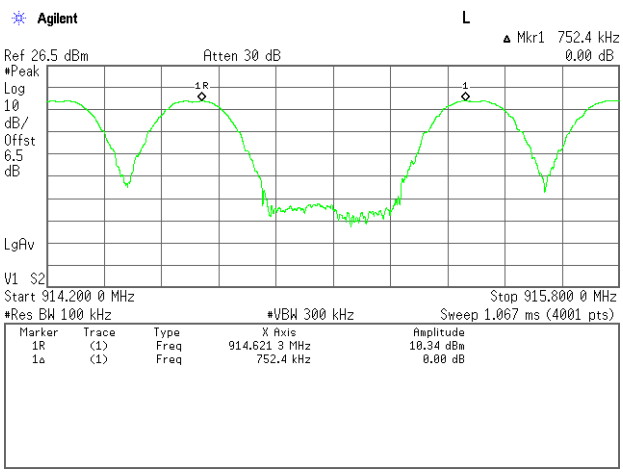
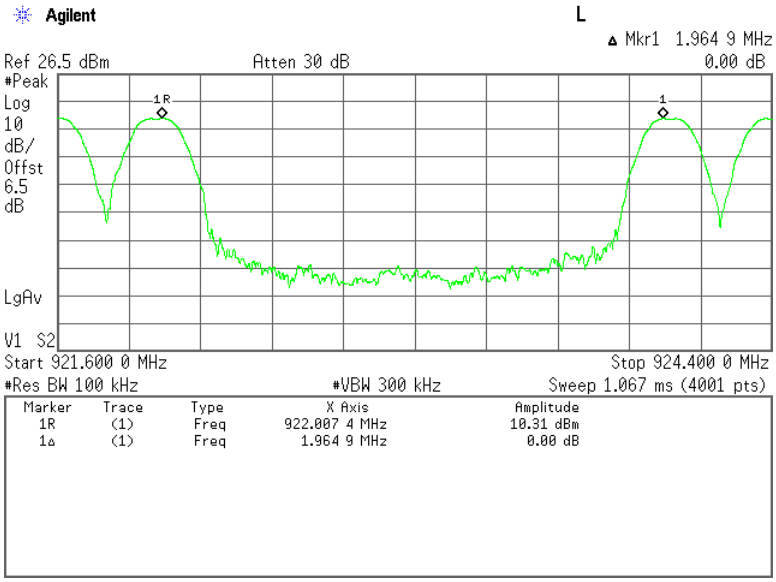
Channel Separation



Channels 0-1



Channels 25-26



Channels 42-43

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Dwell Time

Test Description

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.

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test Criteria

Reference	Limit
CFR 47 Subpart C 15.247 (a)(1) RSS-247 Section 5.1 (c/d)	< 0.4s in a 20 Second Period

Test Information

Tester	Test Location	Date	Temperature (ºC)	Humidity (%RH)	Pressure (mbar)	Results (P/F)
JB	RF Lab	01/28/19	23	7	1013	P

Test Results

Number of transmission in 20 seconds	Length of transmission time (msec)	Results (msec)	Limit (msec)	Margin (msec)
1 (time) * 2 = 2 times	179.3	2 * 179.3 = 358.6	400	-41.4

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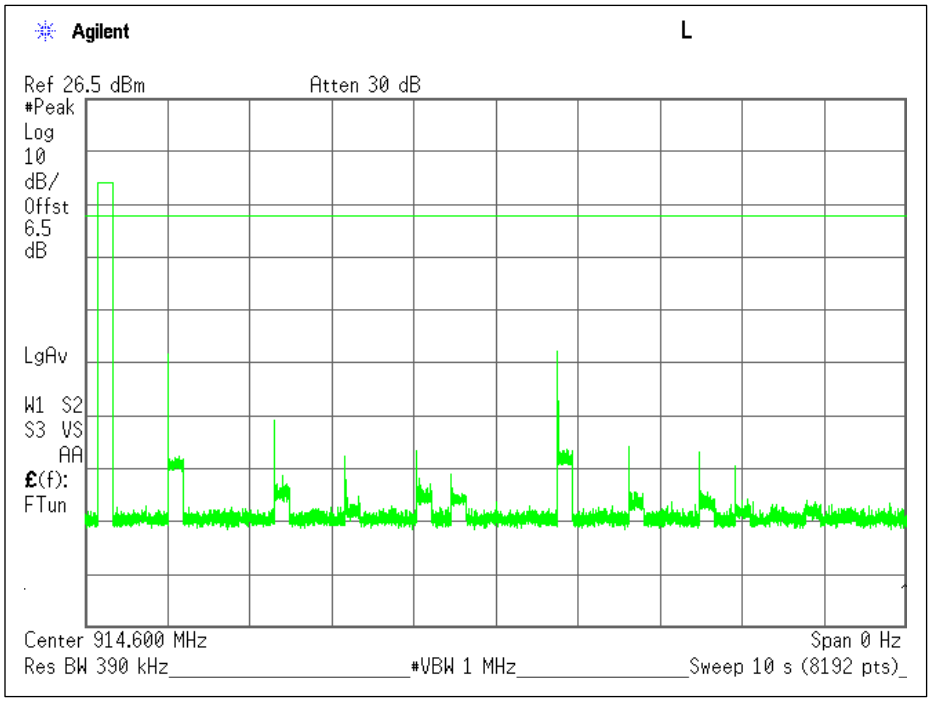
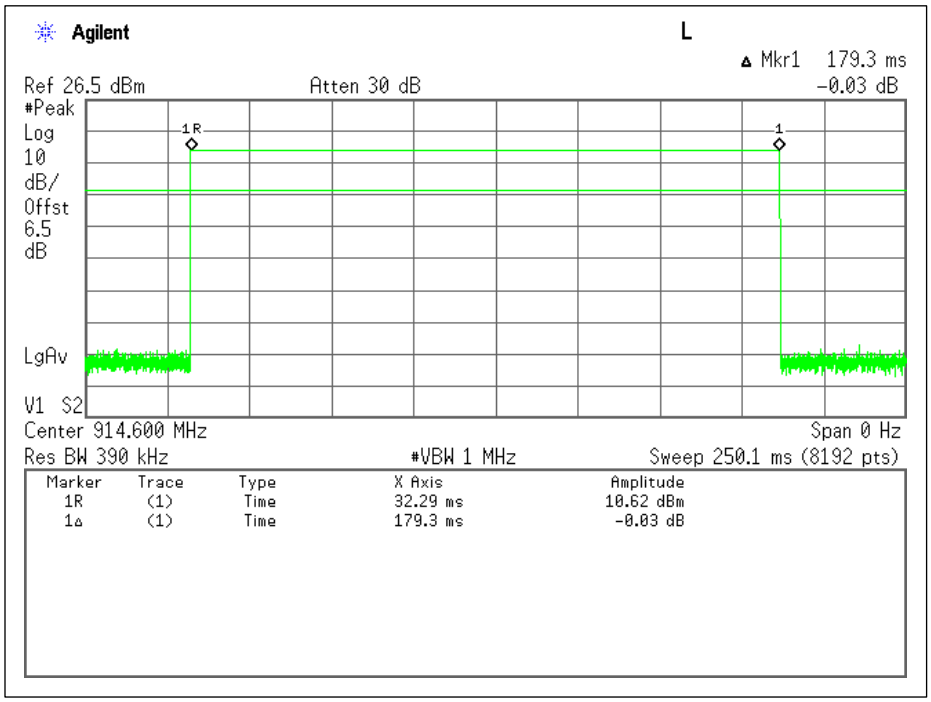
Dwell Time



Number of Transmissions in a 10 second window



Dwell Time per Channel

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Out-of-Band Emissions

Test Description

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)

Test Criteria

Reference	Limit
CFR 47 Subpart C 15.247 (d) RSS-247, Section 5.5	20dB Below the Fundamental

Test Information

Tester	Test Location	Date	Temperature (ºC)	Humidity (%RH)	Pressure (mbar)	Results (P/F)
JB	RF Lab	01/28/19	23	7	1013	P

Test Results

	Authorized Band Edge					
Mode	**Antenna**	**Channel**	**Frequency (MHz)**	**Delta from Peak to Bandedge (dB)**	**Limit (dB)**	**Margin (dB)**
Hopping Enabled	1	Low	903	60.77	20	-40.77
		High	926.4	62.48	20	-42.48
	2	Low	903	58.98	20	-38.98
		High	926.4	65.39	20	-45.39
Hopping Disabled	1	Low	903	58.68	20	-38.68
		High	926.4	63.59	20	-43.59
	2	Low	903	57.99	20	-37.99
		High	926.4	62.34	20	-42.34

Conducted Spurious			
Channel	**Frequency (MHz)**	**Highest Spurious Emission Delta from the -20dB down Limit (dB)**	
		Antenna 1	**Antenna 2**
Low	903	-37.56	-37.70
Mid	914.6	-37.39	-36.99
High	926.4	-37.45	-37.21

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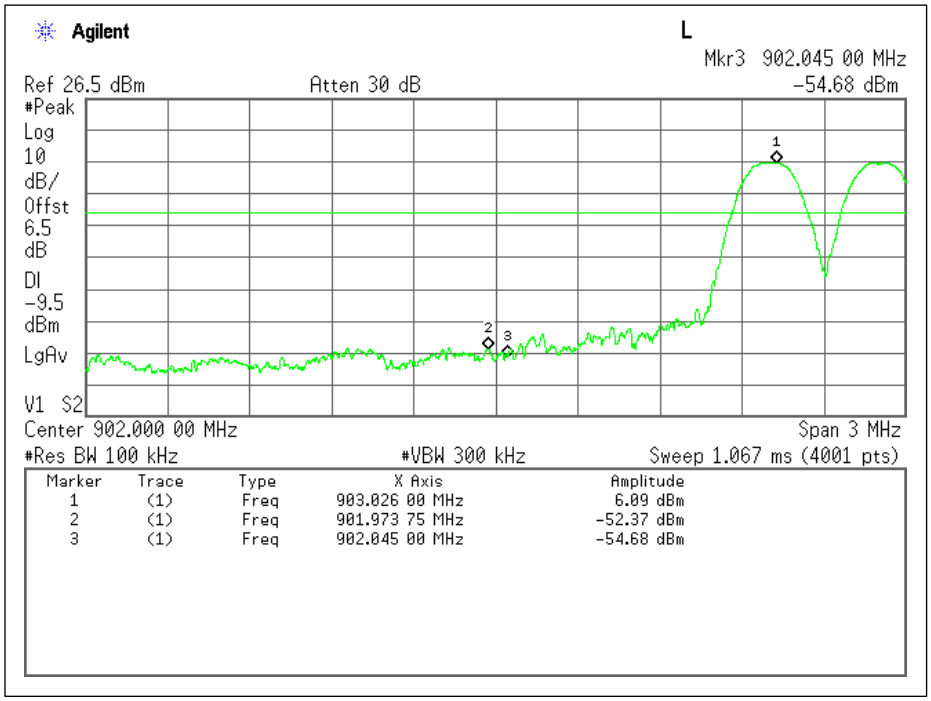
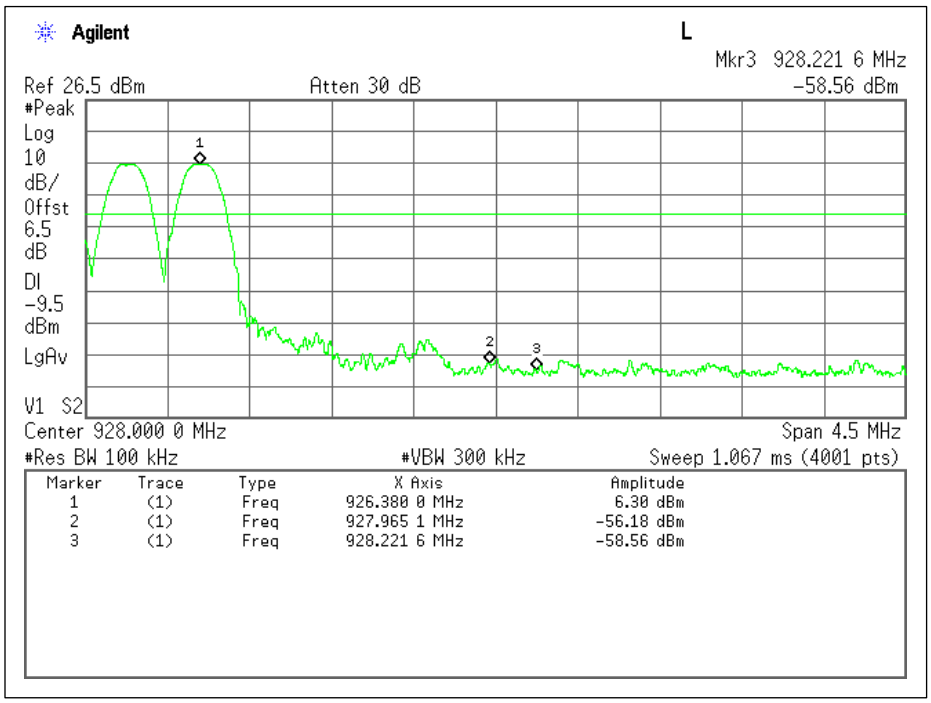
Band Edge – Hopping Enabled



Antenna 1: Low Channel - Plot



Antenna 1: High Channel – Plot

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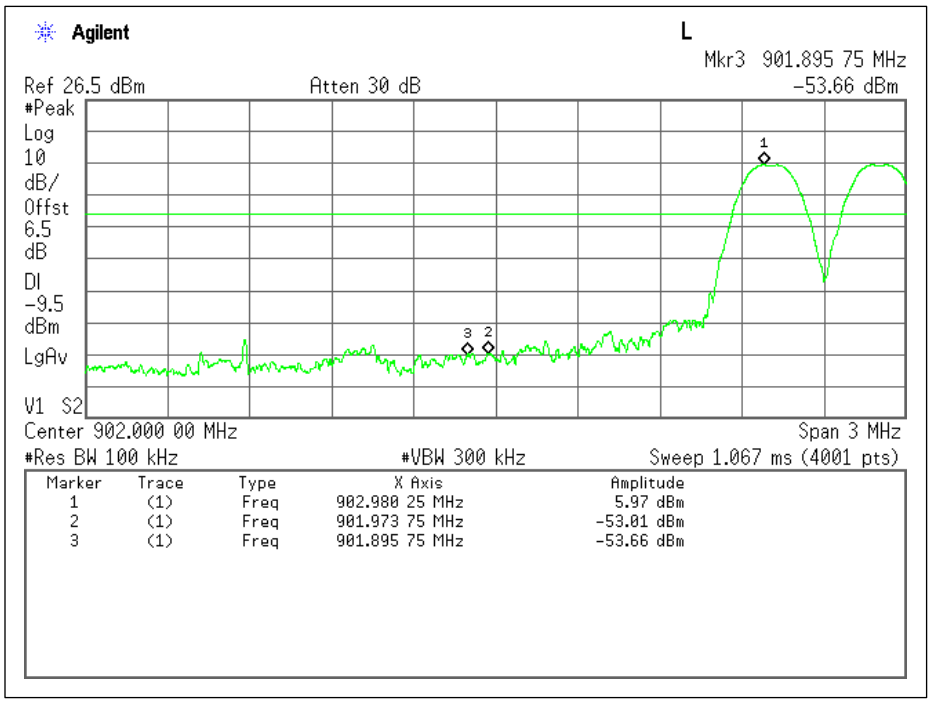
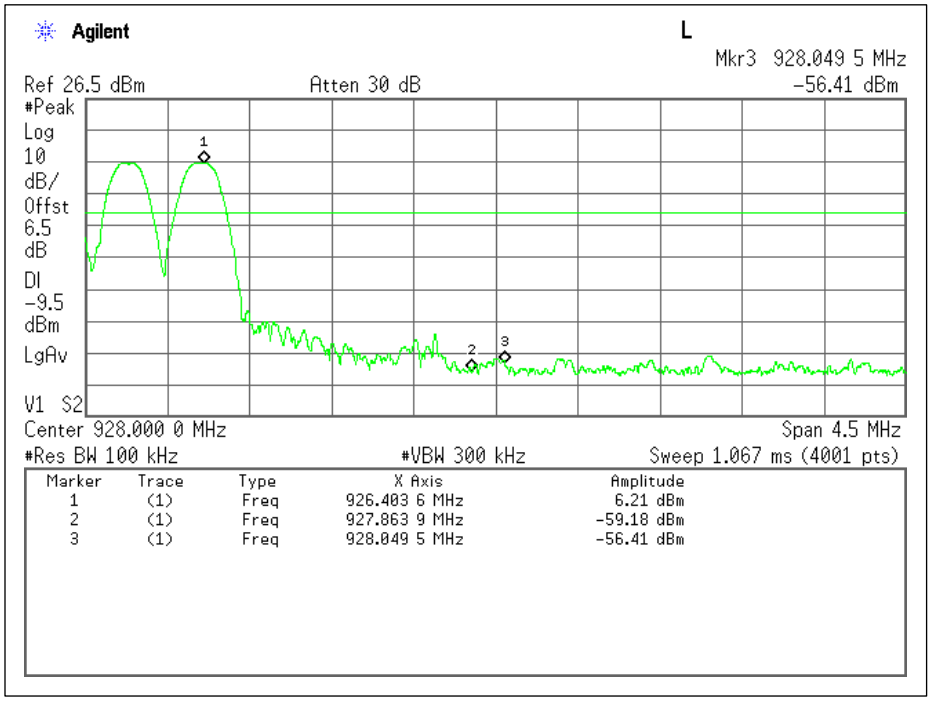


Antenna 2: Low Channel - Plot



Antenna 2: High Channel – Plot

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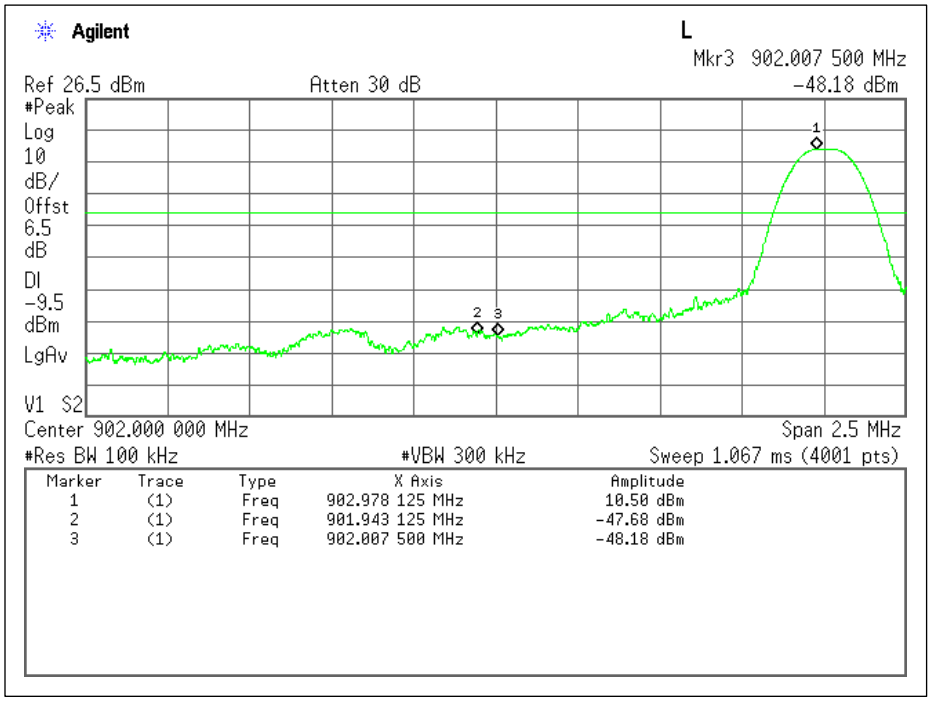
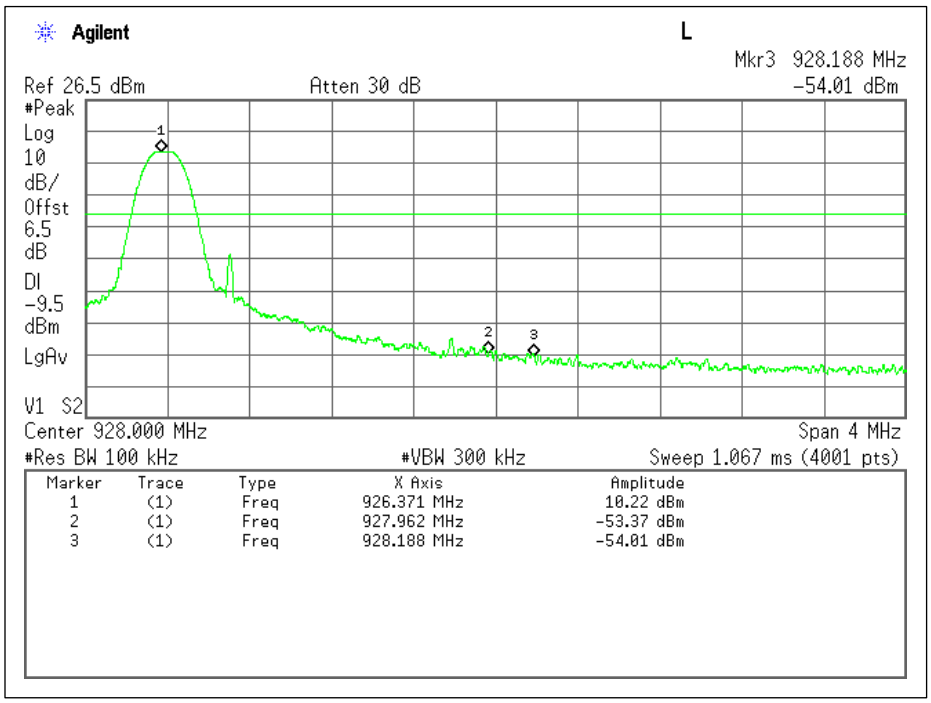
Band Edge – Hopping Disabled



Antenna 1: Low Channel - Plot



Antenna 1: High Channel – Plot

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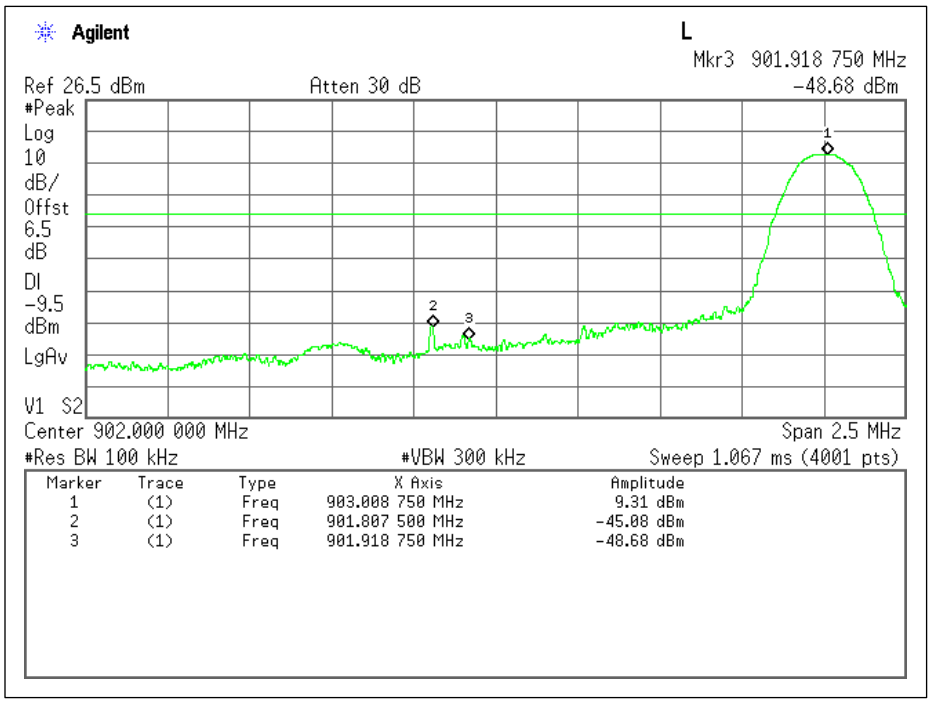
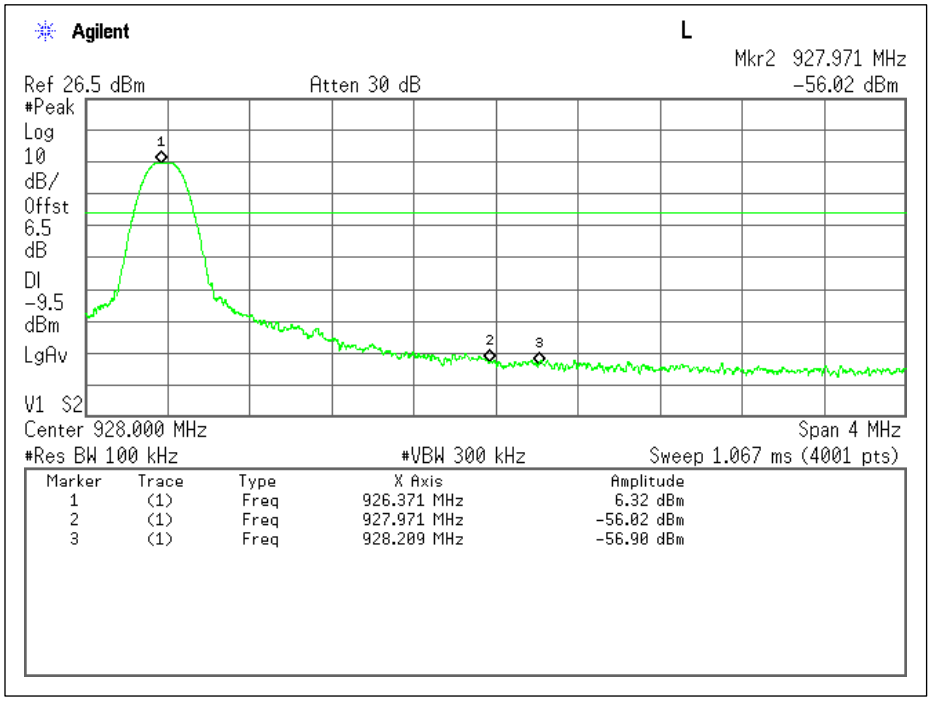


Antenna 2: Low Channel - Plot



Antenna 2: High Channel - Plot

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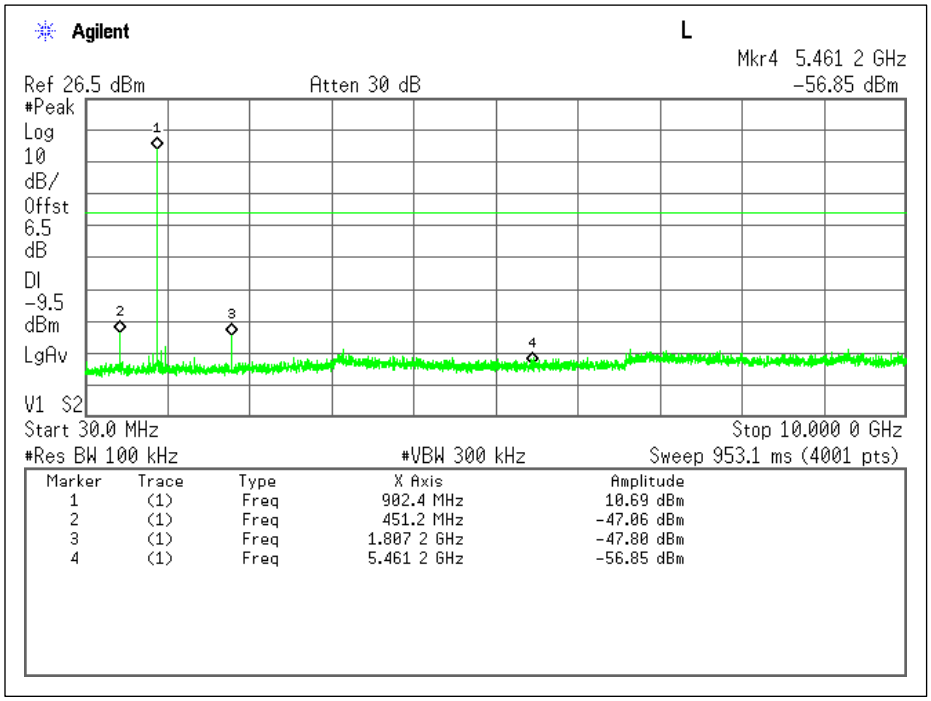
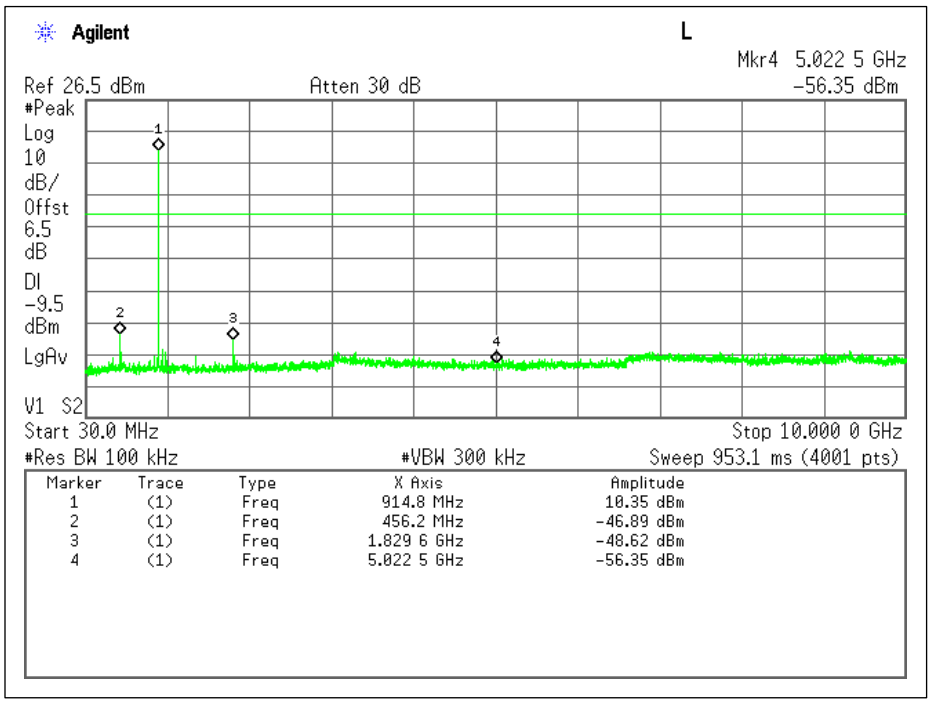
Conducted Spurious



Antenna 1: Low Channel - Plot



Antenna 1: Mid Channel - Plot

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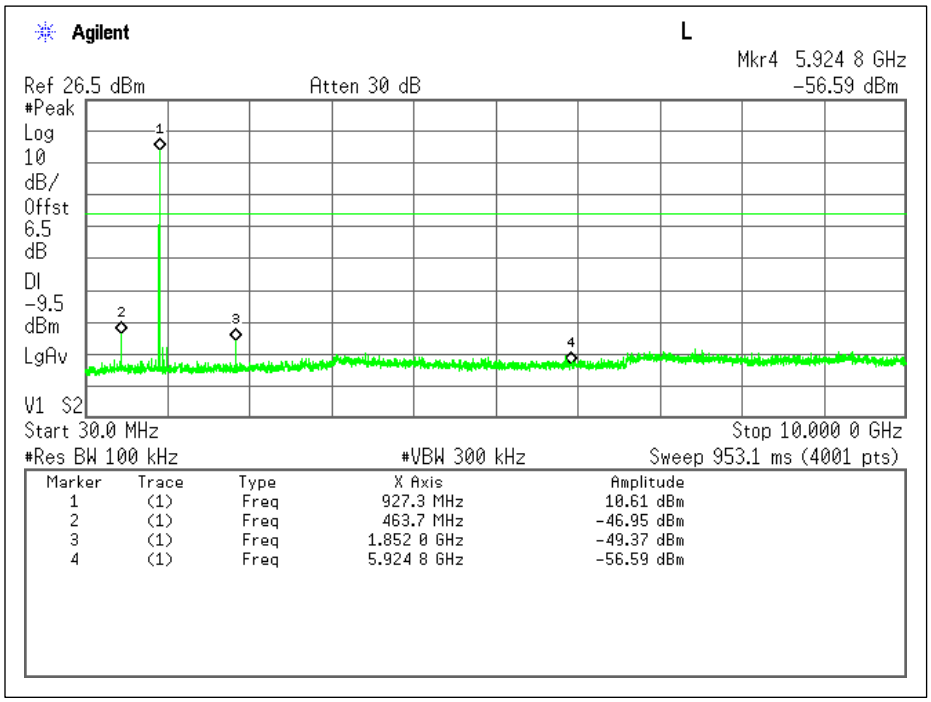
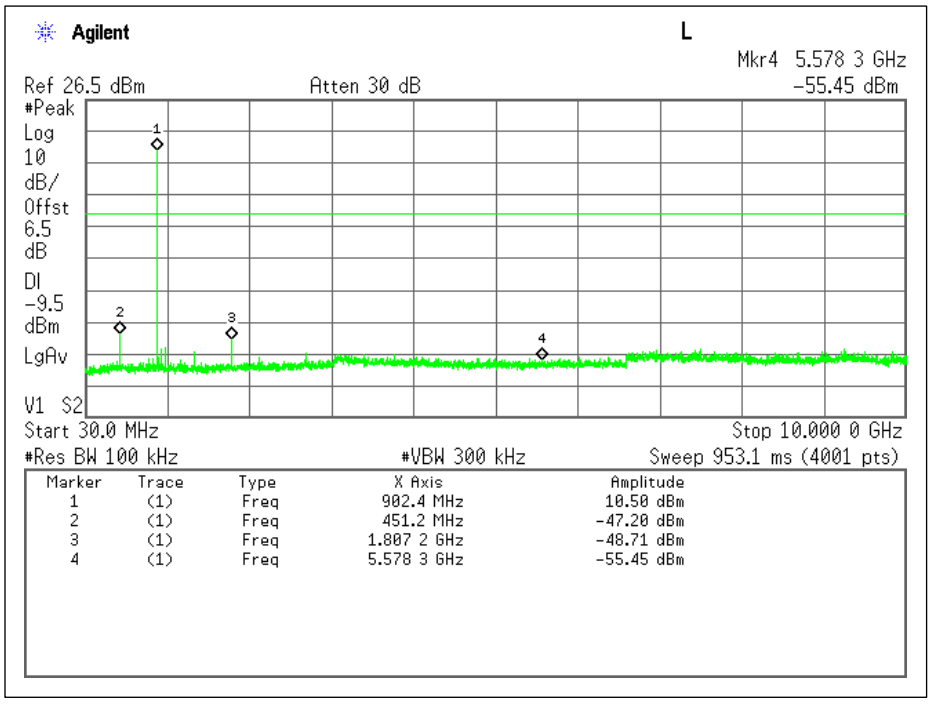


Antenna 1: High Channel – Plot



Antenna 2: Low Channel - Plot

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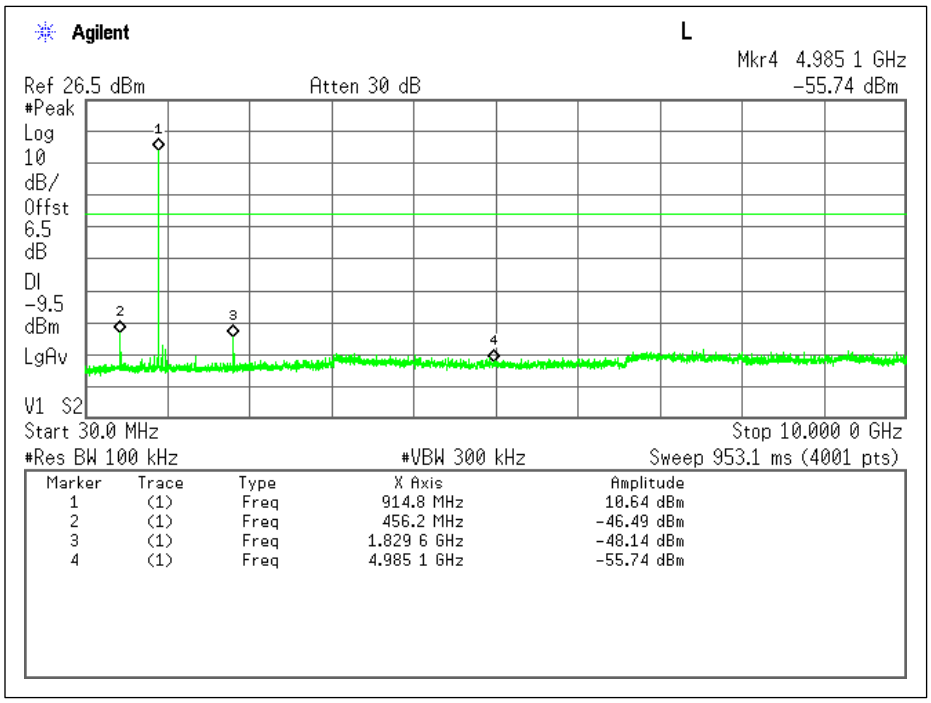
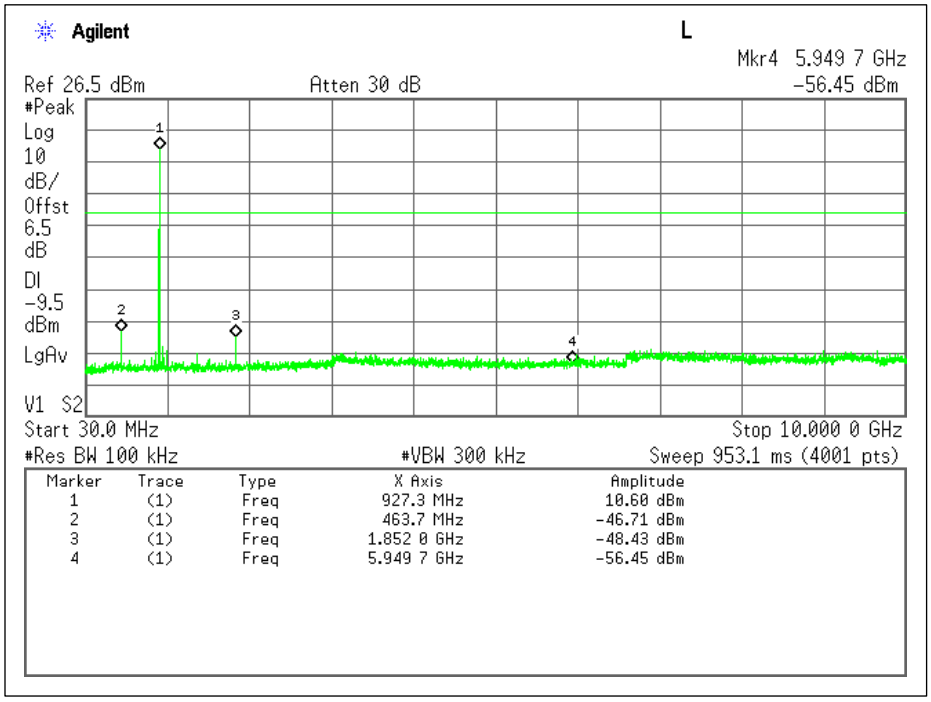


Antenna 2: Mid Channel - Plot



Antenna 2: High Channel – Plot

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Radiated Emissions (Unintentional)

Test Description

The Radiated Emissions (Unintentional) measurement is a test of the whole EUT during normal operation. It is a Radiated Emissions measurement performed from 30 MHz to 5x the highest operating frequency of the device. Prescans are done in a 3 meter anechoic chamber, while final measurements are made on the OATS. The EUT is positioned on a turntable in the manner for which the device will be normally used, with all peripherals connected in idle, with all cables typically used with the EUT dressed appropriately.

Test Criteria

Reference	Limit		
CFR 47 Subpart B, 15.109 ICES-003	Frequency Range	Field Strength Limit (uV/m) at 3M	Field Strength Limit (dBuV/m) at 3M
	30-88	100	40
	88-216	150	43.5
	216-960	200	46
	Above 960	500	54

Test Information

Tester	Test Location	Date	Temperature (ºC)	Humidity (%RH)	Pressure (mbar)	Results (P/F)
CL/JB	RF Chamber / OATS	02/07/19-03/19/19	-3.9	18	1010	P

NOTE: Prescans performed in an anechoic chamber, final measurements performed on an OATS.

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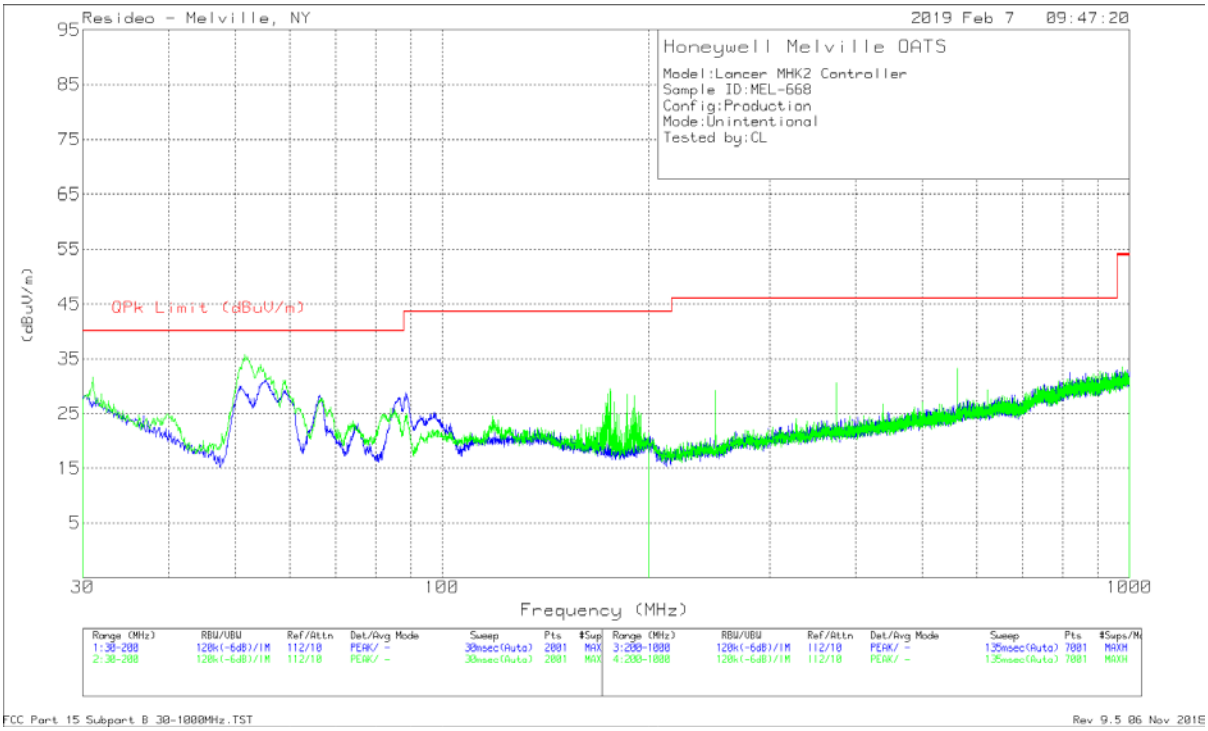
Test Results

Below 1GHz – Low Channel, Antenna 1



Frequency (MHz)	Meter Reading (dBuV)	Det	AF_JB6 [dB/m]	Gain/Loss (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
55.9078	14.58	Qp	12	1.1	27.68	40	-12.32	147	311	H
66.8053	15.49	Qp	12	1.3	28.79	40	-11.21	6	337	H
30.6277	11.42	Qp	24.4	.9	36.72	40	-3.28	257	183	V
50.9496	19.33	Qp	12.2	1	32.53	40	-7.47	64	296	V
906.292	4.43	Qp	27.2	8.3	39.93	46.02	-6.09	148	367	H
562.4818	4.47	Qp	23	5.8	33.27	46.02	-12.75	117	256	V

Qp - Quasi-Peak detector

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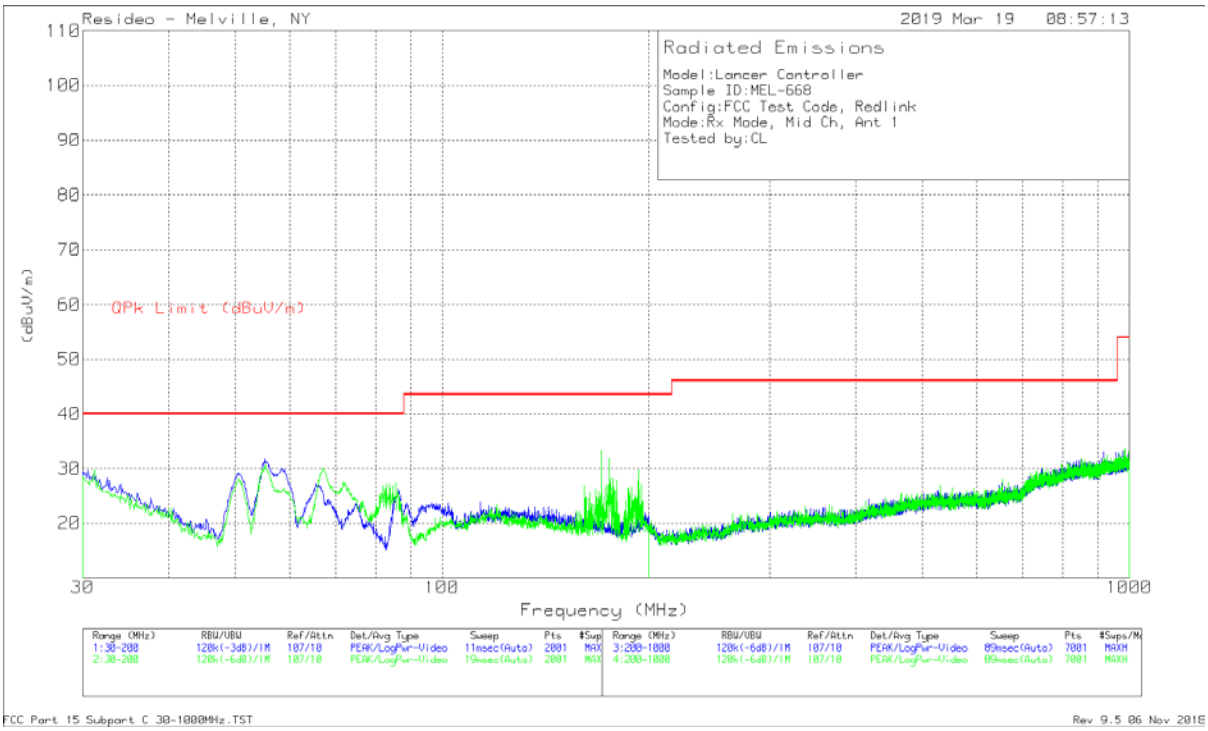
Below 1GHz – Mid Channel, Antenna 1



Frequency (MHz)	Meter Reading (dBuV)	Det	AF_JB6 [dB/m]	Gain/Loss (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
30.7591	11.06	Qp	24.3	.9	36.26	40	-3.74	172	105	H
54.5214	17.06	Qp	12.1	1.1	30.26	40	-9.74	85	394	H
66.8671	21.83	Qp	12	1.3	35.13	40	-4.87	270	163	V
55.33	19.43	Qp	12	1.1	32.53	40	-7.47	300	210	V
* 170.3374	5.74	Qp	16	2.1	23.84	43.52	-19.68	279	184	V
916.9859	5.08	Qp	27.5	8.3	40.88	46.02	-5.14	287	383	H

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

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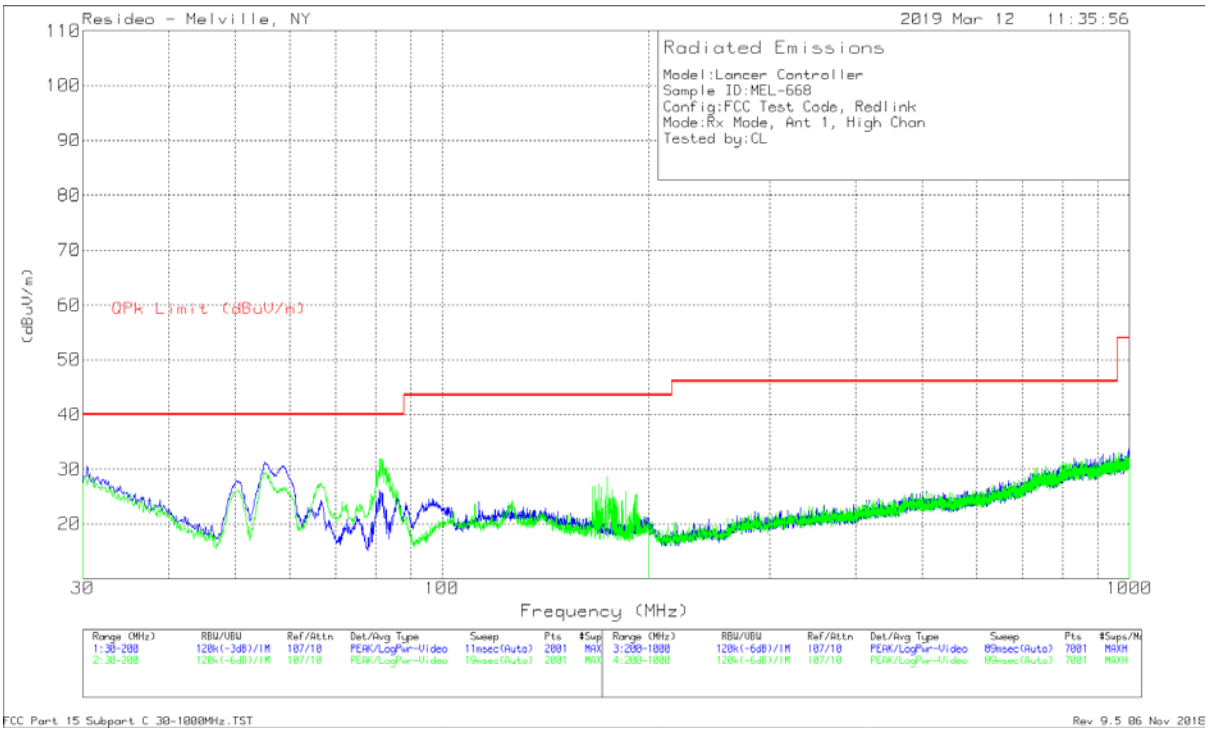
Below 1GHz – High Channel, Antenna 1



Frequency (MHz)	Meter Reading (dBuV)	Det	AF_JB6 [dB/m]	Gain/Loss (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
54.8834	15.54	Qp	12.1	1.1	28.74	40	-11.26	194	393	H
81.6493	8.42	Qp	11.7	1.4	21.52	40	-18.48	18	265	H
55.3026	17.37	Qp	12	1.1	30.47	40	-9.53	16	313	V
81.2883	13.19	Qp	11.7	1.4	26.29	40	-13.71	3	212	V
174.329	18.87	Qp	15.7	2.2	36.77	43.52	-6.75	309	139	V
958.0053	8.03	Qp	27.7	9.2	44.93	46.02	-1.09	226	150	H

Qp - Quasi-Peak detector

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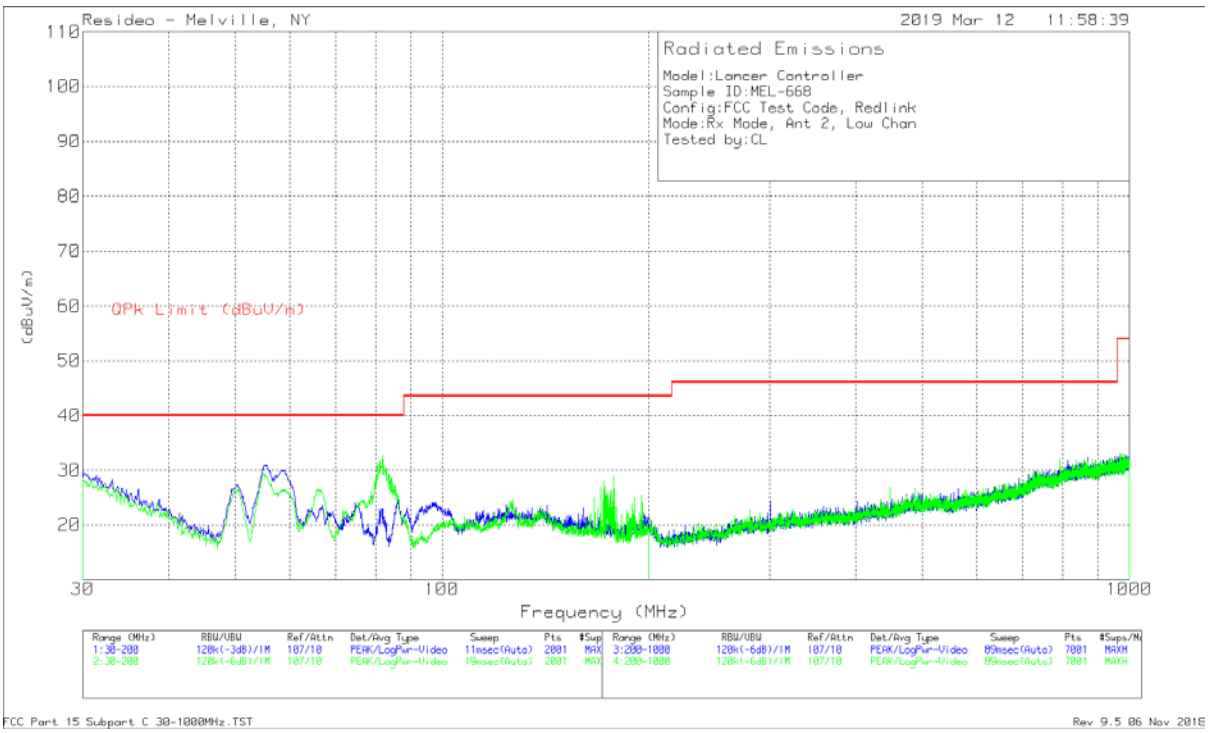
Below 1GHz – Low Channel, Antenna 2



Frequency (MHz)	Meter Reading (dBuV)	Det	AF_JB6 [dB/m]	Gain/Loss (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
30.5809	6.69	Qp	24.4	.9	31.99	40	-8.01	252	366	H
55.1326	15.18	Qp	12	1.1	28.28	40	-11.72	118	361	H
55.1012	18.39	Qp	12.1	1.1	31.59	40	-8.41	209	363	V
82.3259	14.26	Qp	11.7	1.4	27.36	40	-12.64	300	172	V
177.5174	14.36	Qp	15.5	2.1	31.96	43.52	-11.56	218	386	V
961.3222	8.08	Qp	27.7	9.2	44.98	53.97	-8.99	248	283	H

Qp - Quasi-Peak detector

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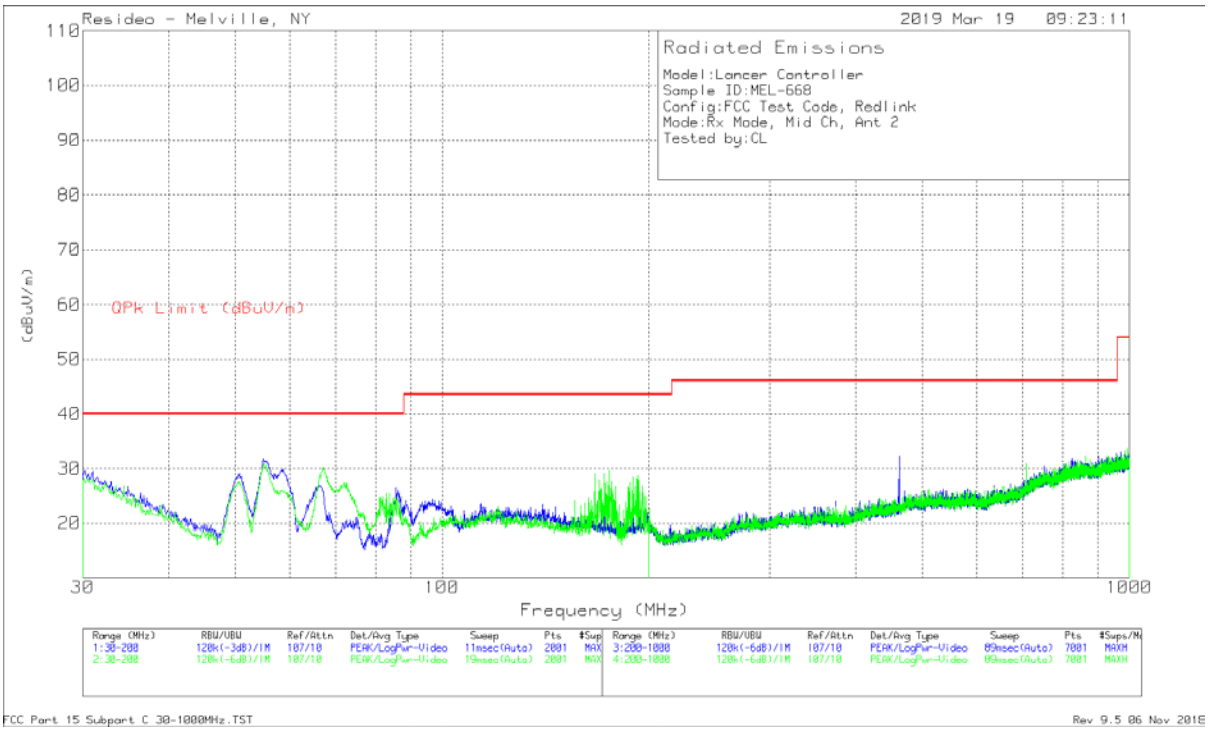
Below 1GHz – Mid Channel, Antenna 2



Frequency (MHz)	Meter Reading (dBuV)	Det	AF_JB6 [dB/m]	Gain/Loss (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
54.3134	18.51	Qp	12.1	1.1	31.71	40	-8.29	192	342	H
30.3683	11.16	Qp	24.6	.9	36.66	40	-3.34	166	282	H
55.5402	18.46	Qp	12	1.1	31.56	40	-8.44	104	308	V
67.1489	22.59	Qp	12	1.3	35.89	40	-4.11	240	124	V
175.2293	16.64	Qp	15.7	2.2	34.54	43.52	-8.98	19	103	V
462.3952	4.77	Qp	21.4	5	31.17	46.02	-14.85	154	295	H

Qp - Quasi-Peak detector

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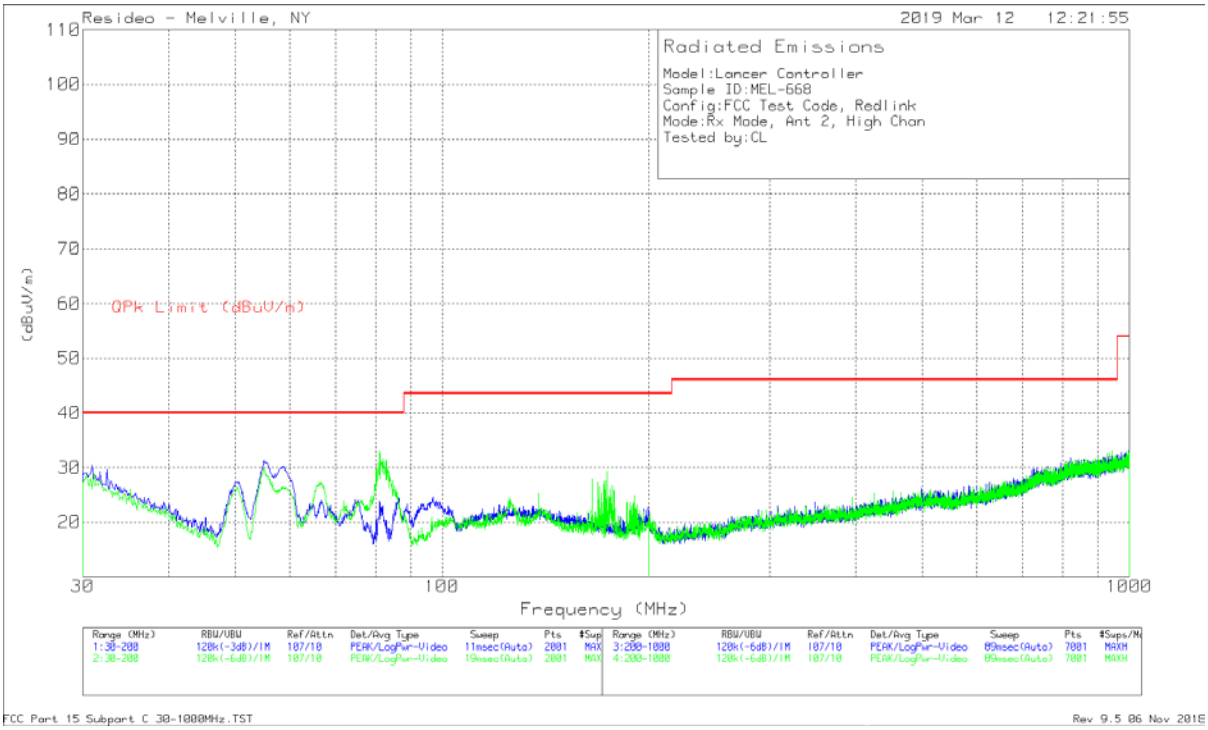
Below 1GHz – High Channel, Antenna 2



Frequency (MHz)	Meter Reading (dBuV)	Det	AF_JB6 [dB/m]	Gain/Loss (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
30.4878	6.65	Qp	24.5	.9	32.05	40	-7.95	254	226	H
54.5334	16.14	Qp	12.1	1.1	29.34	40	-10.66	84	375	H
54.8911	17.85	Qp	12.1	1.1	31.05	40	-8.95	142	110	V
81.0735	12.7	Qp	11.7	1.4	25.8	40	-14.2	196	160	V
174.3394	16.72	Qp	15.7	2.2	34.62	43.52	-8.9	232	155	V
934.1073	7.98	Qp	27.6	8.8	44.38	46.02	-1.64	202	383	H

Qp - Quasi-Peak detector

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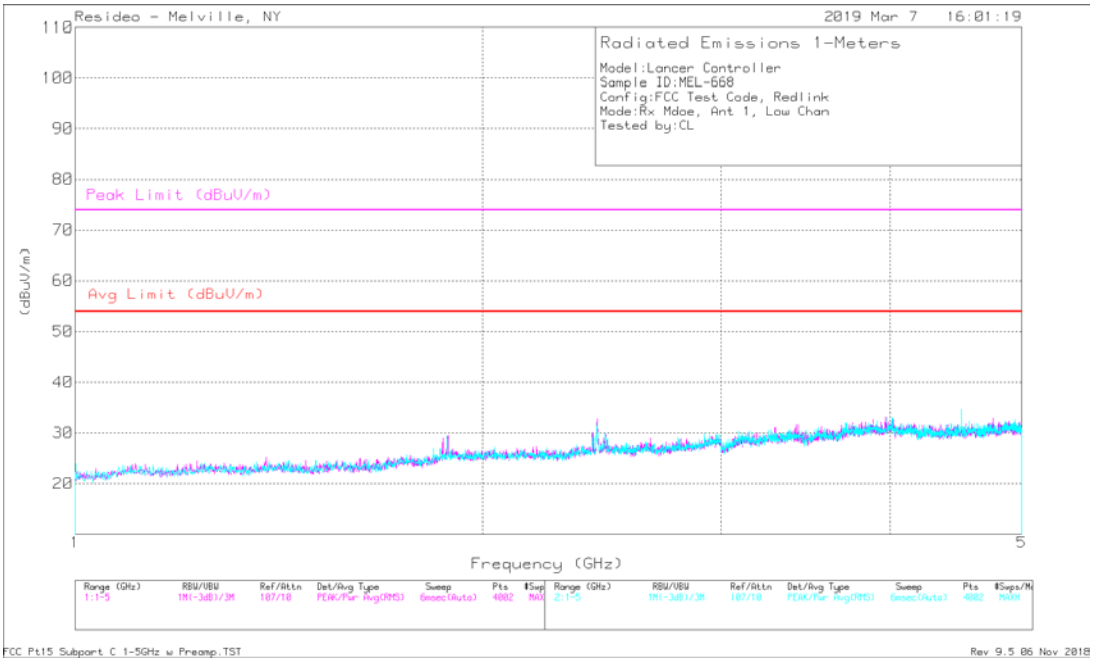
Above 1GHz – Low Channel, Antenna 1



NOTE: No emissions detected within 20dB of the average limit

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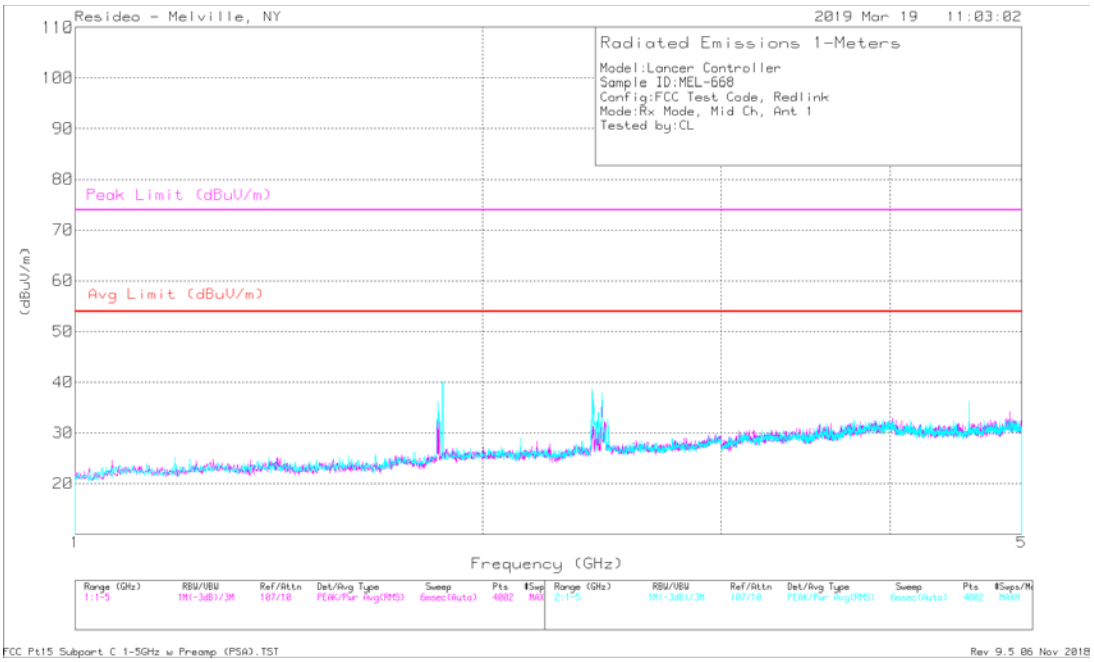
Above 1GHz – Mid Channel, Antenna 1



Frequency (GHz)	Meter Reading (dBuV)	Det	AF [dB/m]	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1.85	25.43	Av	27.4	-37.9	14.93	54	-39.07	74	-59.07	343	399	H
2.45	59.92	Av	28.7	-38.1	50.52	54	-3.48	74	-23.48	115	356	H
2.412	38.75	Av	28.6	-38.1	29.25	54	-24.75	74	-44.75	338	335	H
1.851	43.6	Av	27.4	-37.9	33.1	54	-20.9	74	-40.9	64	305	V
2.45	58.53	Av	28.7	-38.1	49.13	54	-4.87	74	-24.87	301	308	V
2.444	52.12	Av	28.7	-38.1	42.72	54	-11.28	74	-31.28	26	393	V

Av - Average detection

NOTE: Emissions detected during prescan are ambient and not a product of the EUT

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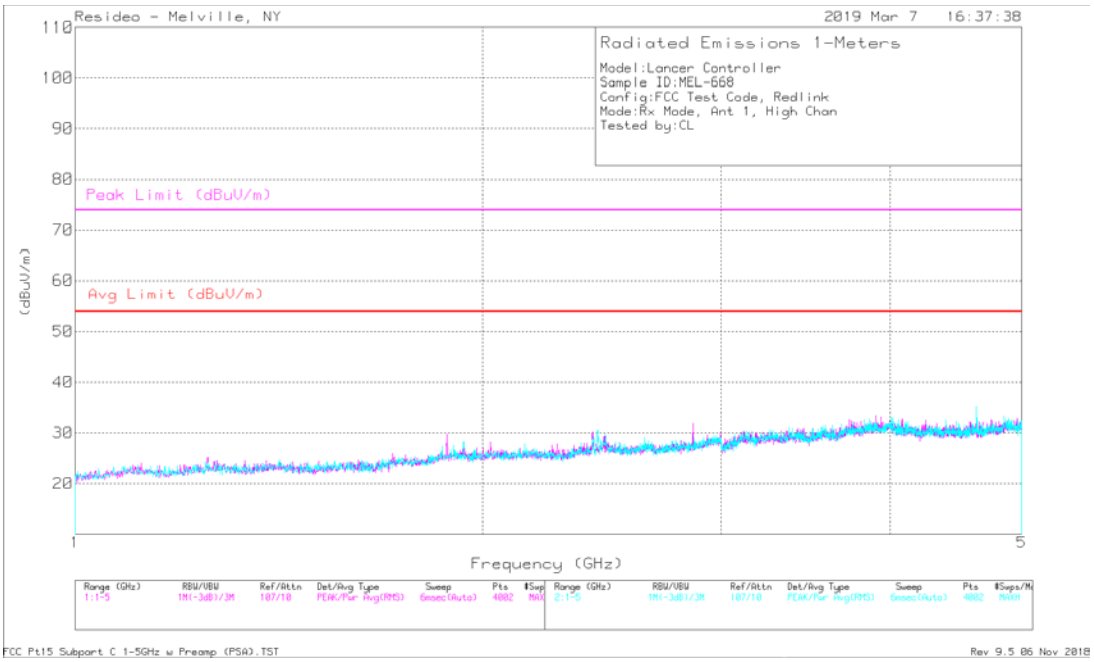
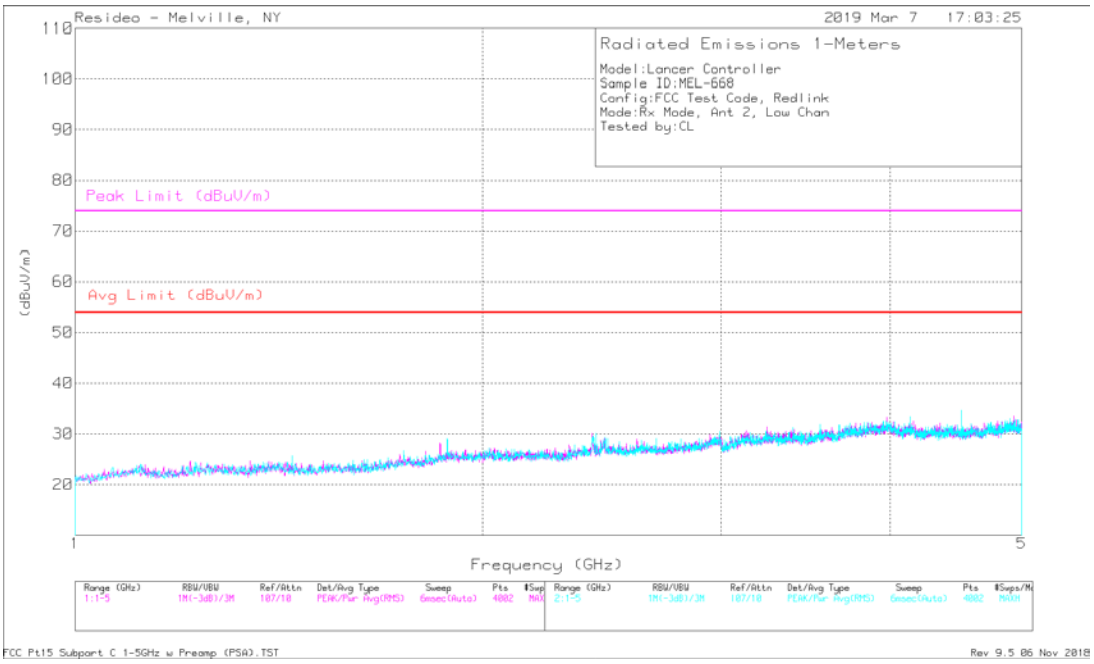
Above 1GHz – High Channel, Antenna 1



Above 1GHz – Low Channel, Antenna 2



NOTE: No emissions detected within 20dB of the average limit

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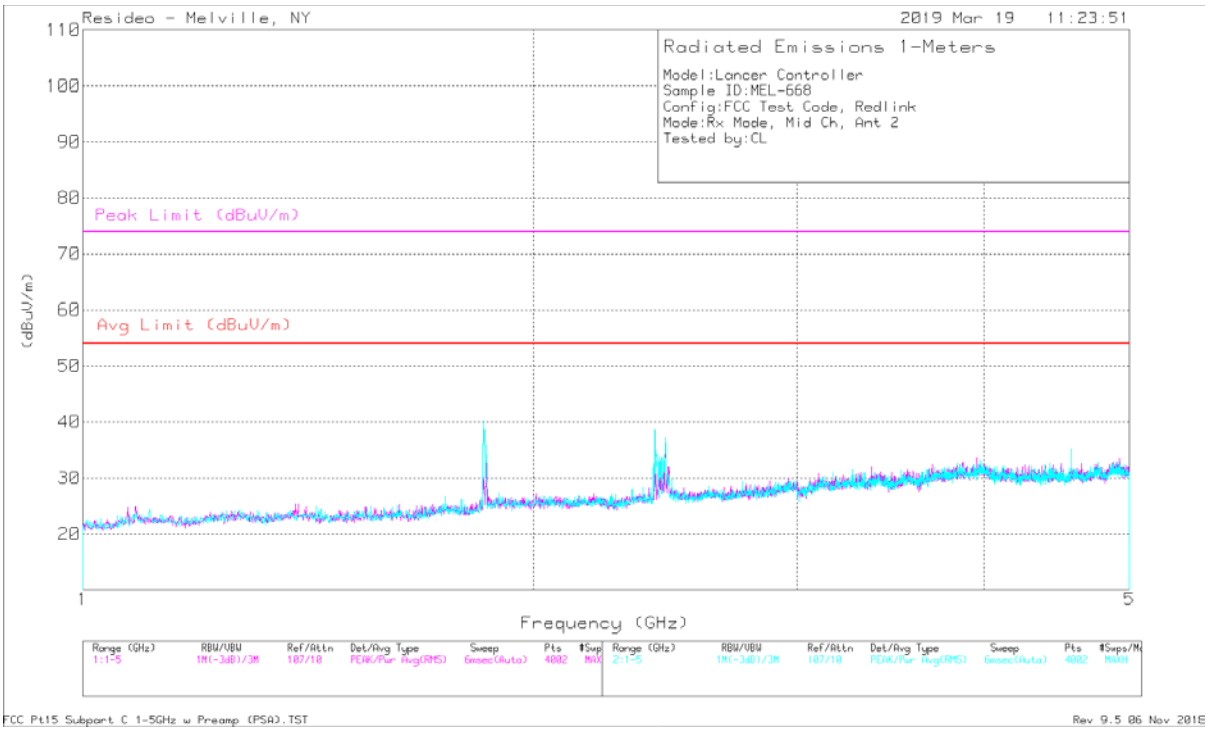
Above 1GHz – Mid Channel, Antenna 2



Frequency (GHz)	Meter Reading (dBuV)	Det	AF [dB/m]	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1.85	25.43	Av	27.4	-37.9	14.93	54	-39.07	74	-59.07	343	399	H
2.45	59.92	Av	28.7	-38.1	50.52	54	-3.48	74	-23.48	115	356	H
2.412	38.75	Av	28.6	-38.1	29.25	54	-24.75	74	-44.75	338	335	H
1.851	43.6	Av	27.4	-37.9	33.1	54	-20.9	74	-40.9	64	305	V
2.45	58.53	Av	28.7	-38.1	49.13	54	-4.87	74	-24.87	301	308	V
2.444	52.12	Av	28.7	-38.1	42.72	54	-11.28	74	-31.28	26	393	V

Av - Average detection

NOTE: Emissions detected during prescan are ambient and not a product of the EUT

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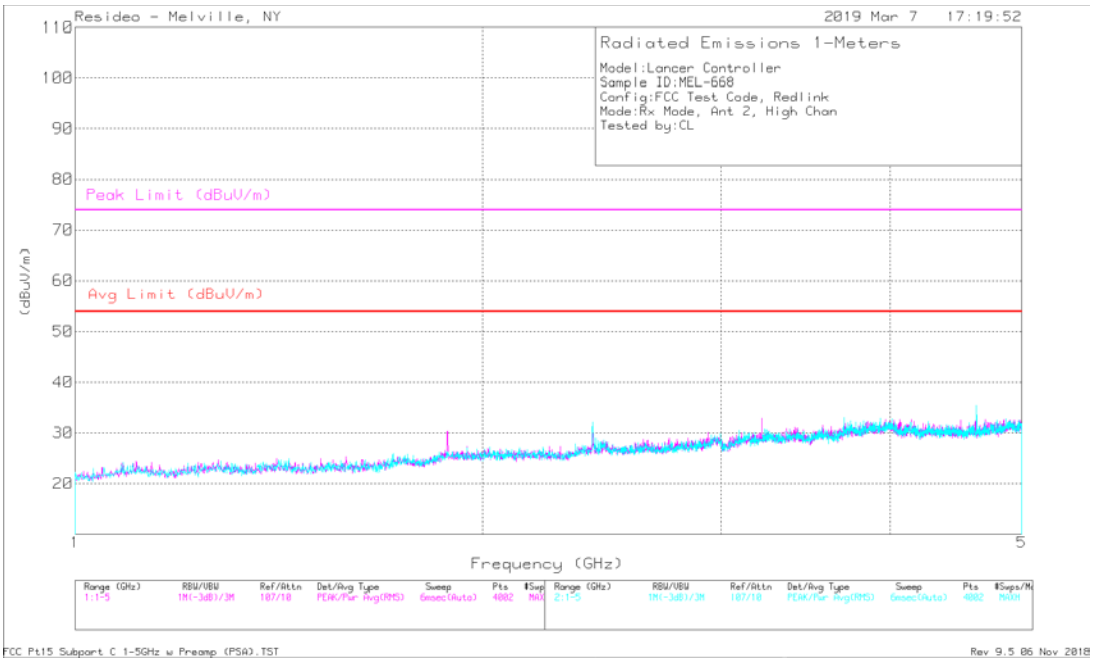
Above 1GHz – High Channel, Antenna 2



NOTE: No emissions detected within 20dB of the average limit

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Radiated Emissions (Intentional)

Test Description

Intentional Radiator Radiated Emissions are a test of the emissions, and harmonics on the EUT. The EUT is positioned to get the maximum emissions after a series of prescan measurements.
The EUT is placed on a non-conducting table 80 cm above the ground plane for below 1 GHz measurements and 1.5 m above the ground plane for above 1 GHz 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. Peak detection is used unless otherwise noted as quasi-peak.
For measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 1 MHz for peak measurements and as applicable for average measurements.
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.
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.

Test Criteria

Reference	Limit		
CFR 47 Subpart C, 15.205 CFR 47 Subpart C, 15.209 RSS-GEN	Frequency Range (MHz)	Field Strength Limit (uV/m)	Measurement distance (meters)
	0.009-0.490	2400/F(kHz)	300
	0.490-1.705	24000/F(kHz)	30
	1.705-30.0	30	30
	30-88	100**	3
	88-216	150**	3
	216-960	200**	3
	Above 960	500	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

Test Information

Tester	Test Location	Date	Temperature (ºC)	Humidity (%RH)	Pressure (mbar)	Results (P/F)
CL/JB	RF Chamber / OATS	02/07/19-02/21/19	-3.9	18	1010	P

NOTE: Below 30MHz, pretesting showed that no emissions as a product of the EUT were detected within 20dB of the regulatory limit. Prescans performed in an anechoic chamber, final measurements performed on an OATS.

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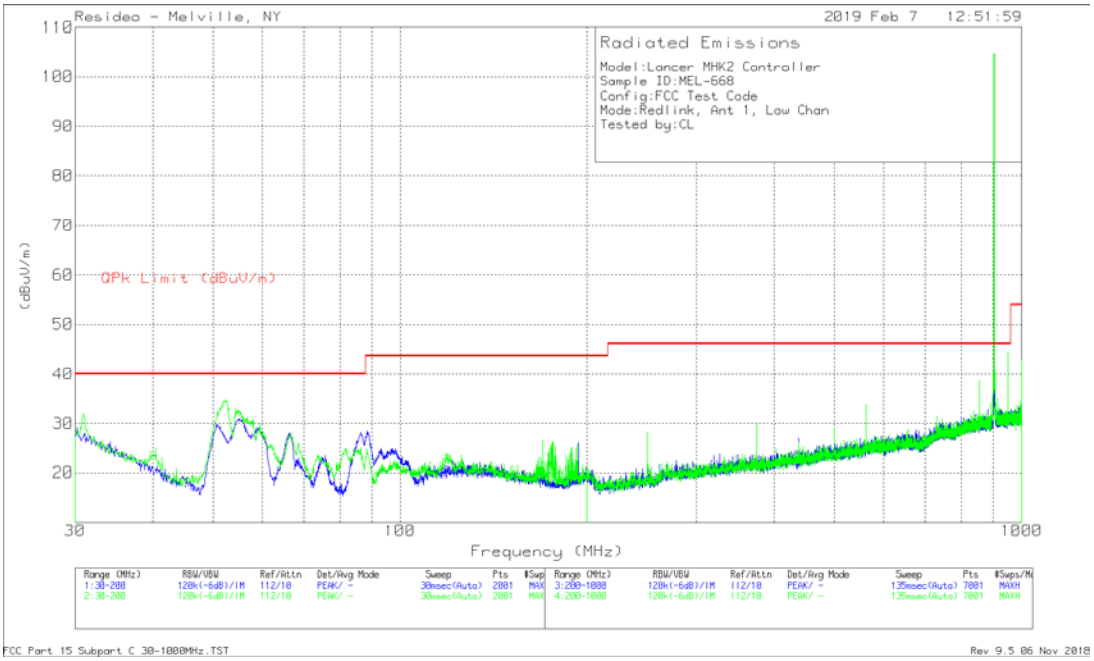
Test Results

Spurious Emissions

Below 1GHz



Antenna 1: Low Channel - Plot

Frequency (MHz)	Meter Reading (dBuV)	Det	AF_JB6 [dB/m]	Gain/Loss (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
55.5821	15.46	Qp	12	1.1	28.56	40	-11.44	100	398	H
86.7743	9.28	Qp	11.9	1.5	22.68	40	-17.32	241	356	H
* 962.6323	9.87	Qp	27.7	9.2	46.77	53.97	-7.2	108	110	H
52.6053	19.79	Qp	12.2	1.1	33.09	40	-6.91	328	121	V
855.0362	10.42	Qp	26.4	8.4	45.22	46.02	-.8	163	124	V
950.4992	4.46	Qp	27.7	9.2	41.36	46.02	-4.66	97	126	V

Qp - Quasi-Peak detector

Antenna 1: Low Channel - Data

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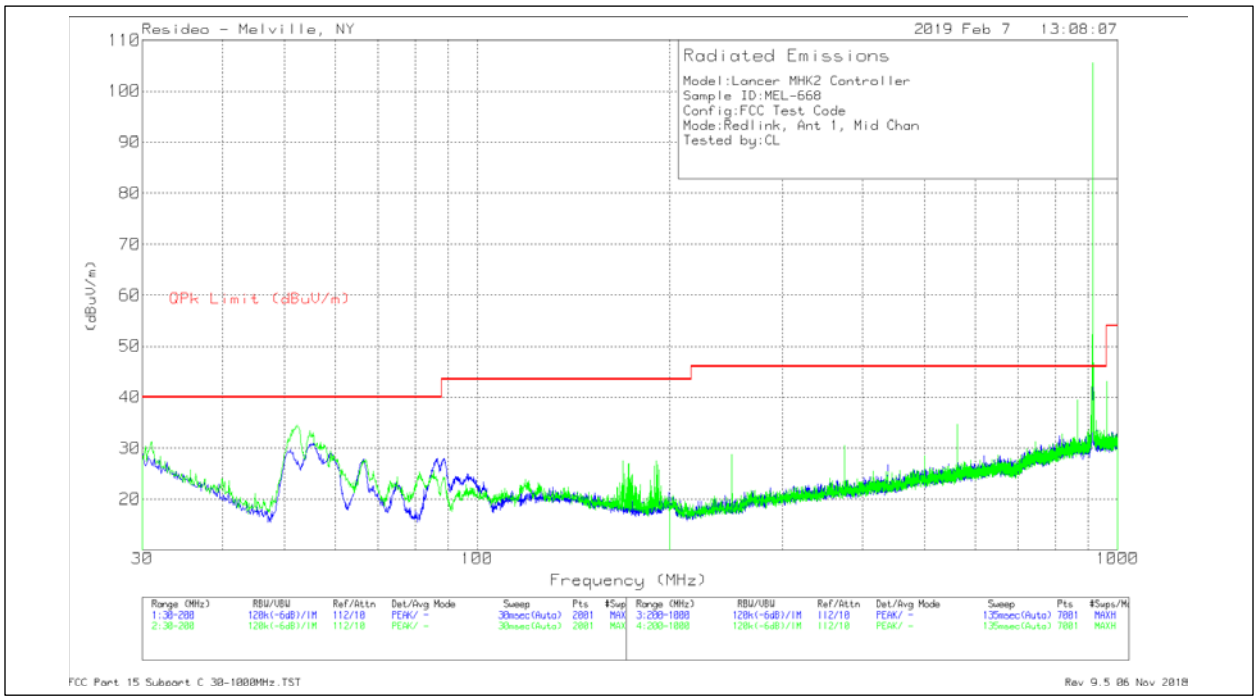

Antenna 1: Mid Channel - Plot

Frequency (MHz)	Meter Reading (dBuV)	Det	AF_JB6 [dB/m]	Gain/Loss (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
55.5604	12.24	Qp	12	1.1	25.34	40	-14.66	280	231	H
86.9301	8.87	Qp	11.9	1.5	22.27	40	-17.73	118	325	H
52.6025	20.4	Qp	12.2	1.1	33.7	40	-6.3	352	222	V
* 168.5907	6.47	Qp	16.1	2.1	24.67	43.52	-18.85	2	272	V
* 962.6328	11.72	Qp	27.7	9.2	48.62	53.97	-5.35	179	132	H
* 962.6323	9.87	Qp	27.7	9.2	46.77	53.97	-7.2	108	110	V

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

Antenna 1: Mid Channel - Data

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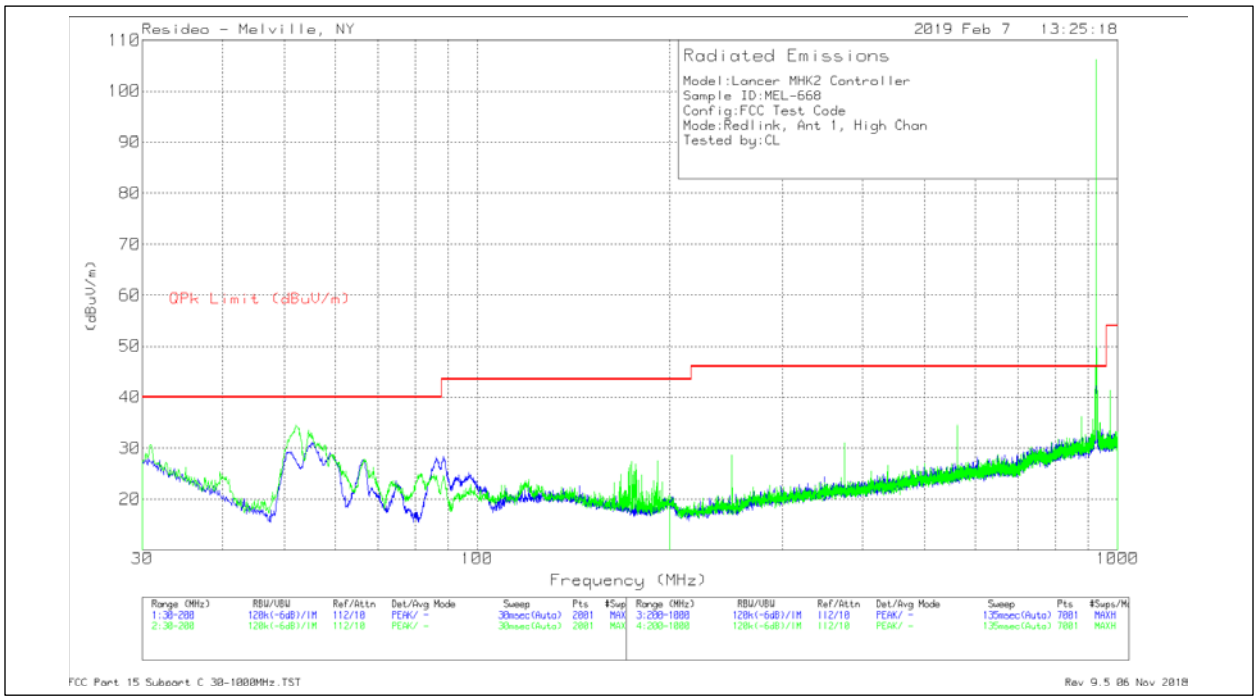

Antenna 1: High Channel - Plot

Frequency (MHz)	Meter Reading (dBuV)	Det	AF_JB6 [dB/m]	Gain/Loss (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
54.5325	16.47	Qp	12.1	1.1	29.67	40	-10.33	254	388	H
85.7932	8.92	Qp	11.8	1.5	22.22	40	-17.78	208	274	H
52.388	19.82	Qp	12.2	1.1	33.12	40	-6.88	127	318	V
* 974.5144	4.55	Qp	27.5	9.1	41.15	53.97	-12.82	247	245	H
562.9534	4.55	Qp	23	5.9	33.45	46.02	-12.57	22	177	V
* 974.9987	4.51	Qp	27.5	9.1	41.11	53.97	-12.86	178	146	V

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

Antenna 1: High Channel – Data

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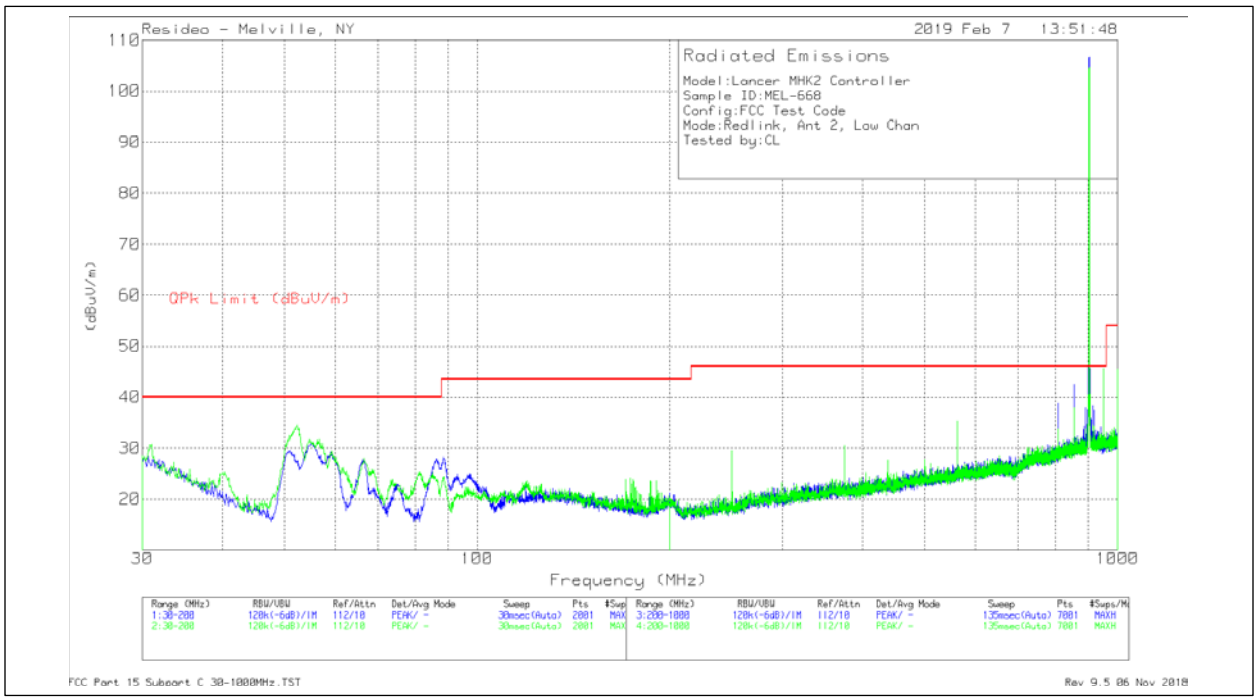

Antenna 2: Low Channel - Plot

Frequency (MHz)	Meter Reading (dBuV)	Det	AF_JB6 [dB/m]	Gain/Loss (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
54.8608	15.95	Qp	12.1	1.1	29.15	40	-10.85	291	381	H
52.8045	20.66	Qp	12.2	1.1	33.96	40	-6.04	119	319	V
855.1949	4.24	Qp	26.4	8.4	39.04	46.02	-6.98	264	208	H
951.6886	4.4	Qp	27.7	9.2	41.3	46.02	-4.72	335	266	H
563.0453	4.27	Qp	23	5.9	33.17	46.02	-12.85	339	169	V
950.4587	4.32	Qp	27.7	9.2	41.22	46.02	-4.8	359	229	V

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

Antenna 2: Low Channel - Data

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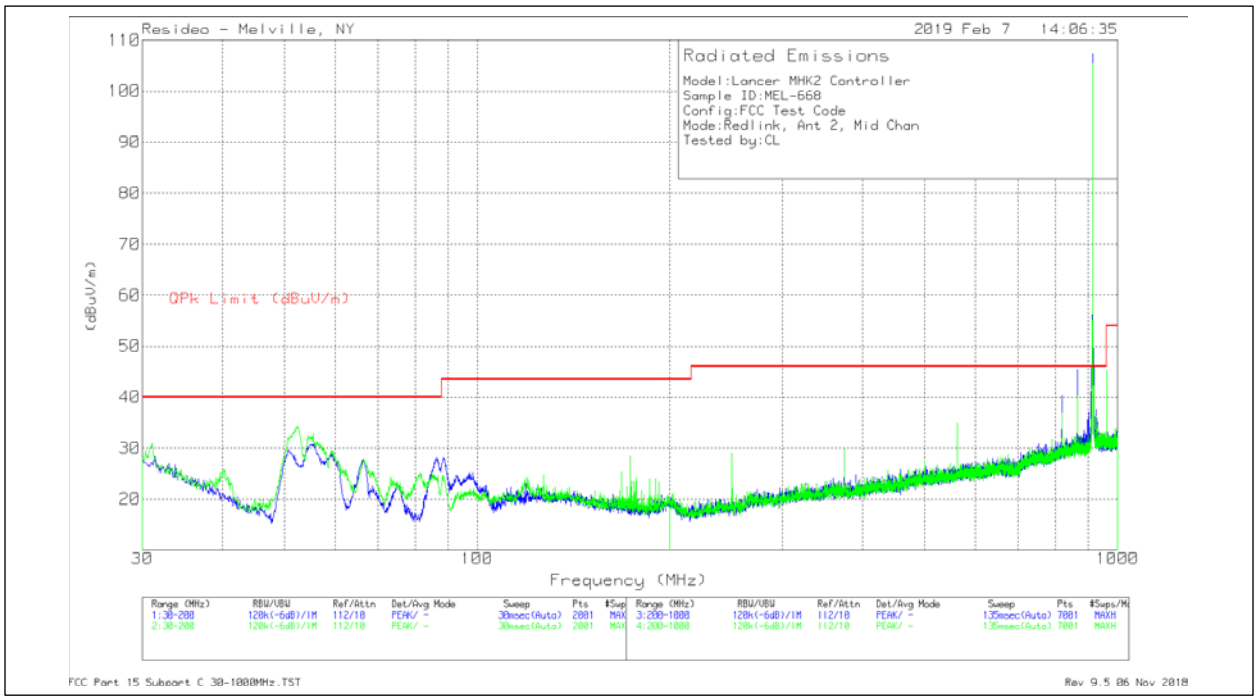

Antenna 2: Mid Channel - Plot

Frequency (MHz)	Meter Reading (dBuV)	Det	AF_JB6 [dB/m]	Gain/Loss (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
55.1264	14.94	Qp	12	1.1	28.04	40	-11.96	282	334	H
52.7961	21.23	Qp	12.2	1.1	34.53	40	-5.47	138	320	V
859.9806	4.33	Qp	26.4	8.5	39.23	46.02	-6.79	208	387	H
* 962.6306	11.23	Qp	27.7	9.2	48.13	53.97	-5.84	154	144	H
866.0057	1.08	Qp	26.4	8.7	36.18	46.02	-9.84	21	333	V
* 962.6347	12.16	Qp	27.7	9.2	49.06	53.97	-4.91	234	103	V

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

Antenna 2: Mid Channel - Data

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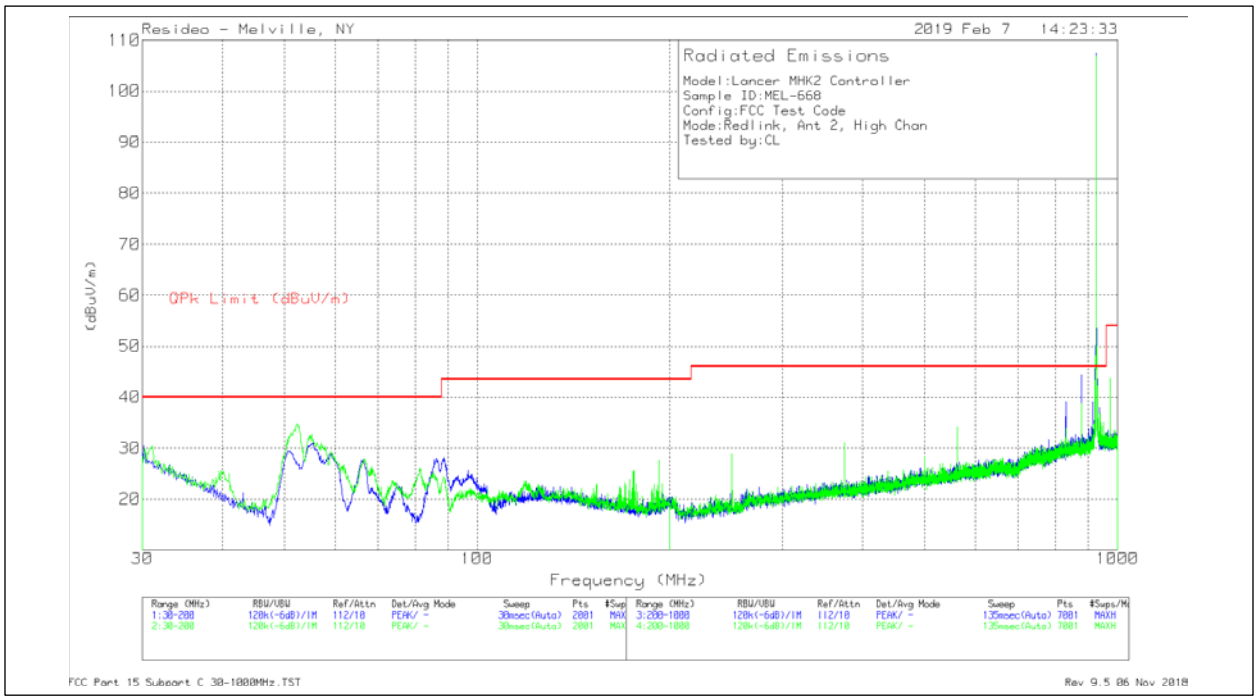

Antenna 2: High Channel - Plot

Frequency (MHz)	Meter Reading (dBuV)	Det	AF_JB6 [dB/m]	Gain/Loss (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
55.5905	11.93	Qp	12	1.1	25.03	40	-14.97	241	157	H
52.7978	21.1	Qp	12.2	1.1	34.4	40	-5.6	20	303	V
878.3142	-3.69	Qp	26.4	9	31.71	46.02	-14.31	45	395	H
* 974.5975	4.36	Qp	27.5	9.1	40.96	53.97	-13.01	352	278	H
878.4041	3.05	Qp	26.4	9	38.45	46.02	-7.57	292	272	V
* 974.3383	4.49	Qp	27.5	9.1	41.09	53.97	-12.88	294	163	V

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

Antenna 2: High Channel - Data

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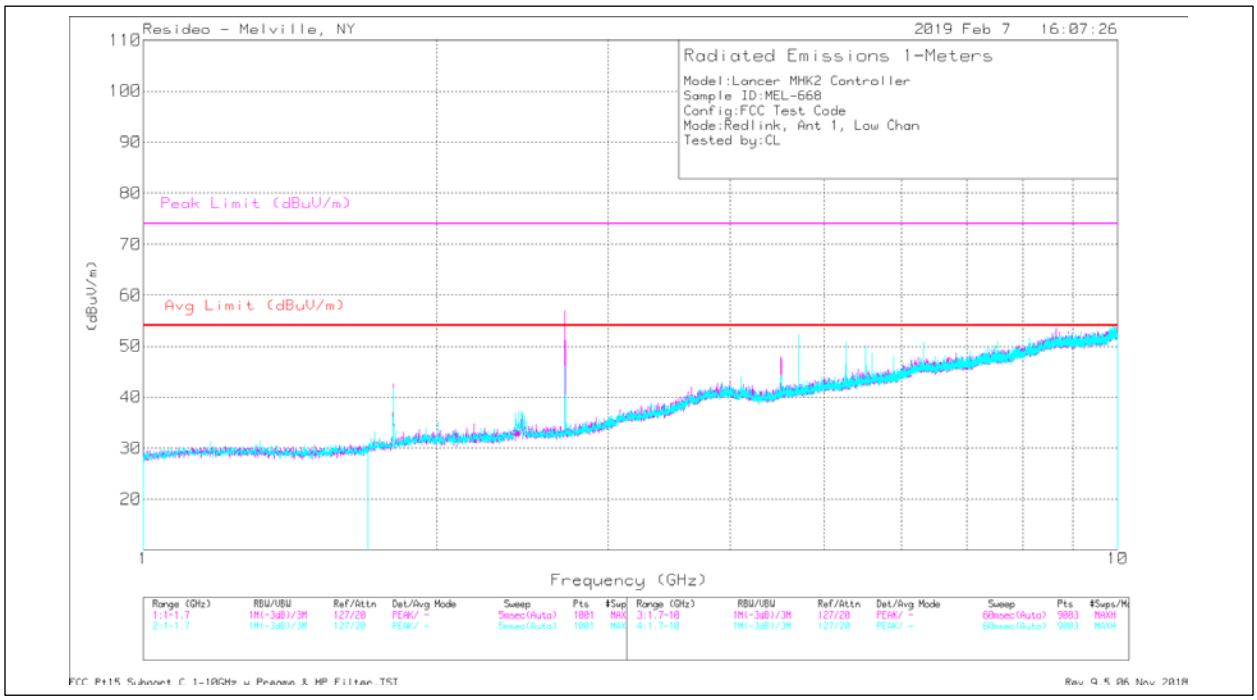
Above 1GHz



Antenna 1: Low Channel - Plot

Frequency (GHz)	Meter Reading (dBuV)	Det	AF [dB/m]	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1.806	57.78	PKFH	26.8	-37.4	47.18	-	-	74	-26.82	192	305	H
1.806	56.05	VA1T	26.8	-37.4	45.45	54	-8.55	-	-	192	305	H
* 2.706	45.01	PKFH	29	-37.9	36.11	-	-	74	-37.89	223	150	H
* 2.707	32.39	VA1T	29	-37.9	23.49	54	-30.51	-	-	223	150	H
* 4.515	48.95	PKFH	32.5	-33.9	47.55	-	-	74	-26.45	144	191	H
* 4.515	43.26	VA1T	32.5	-33.9	41.86	54	-12.14	-	-	144	191	H
1.806	52.41	PKFH	26.8	-37.4	41.81	-	-	74	-32.19	226	116	V
1.806	49.55	VA1T	26.8	-37.4	38.95	54	-15.05	-	-	226	116	V
* 2.709	55.63	PKFH	29	-37.9	46.73	-	-	74	-27.27	228	196	V
* 2.709	53.1	VA1T	29	-37.9	44.2	54	-9.8	-	-	228	196	V
* 4.708	43.81	PKFH	32.8	-33.8	42.81	-	-	74	-31.19	235	384	V
* 4.705	30.69	VA1T	32.8	-33.8	29.69	54	-24.31	-	-	235	384	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

Antenna 1: Low Channel - Data

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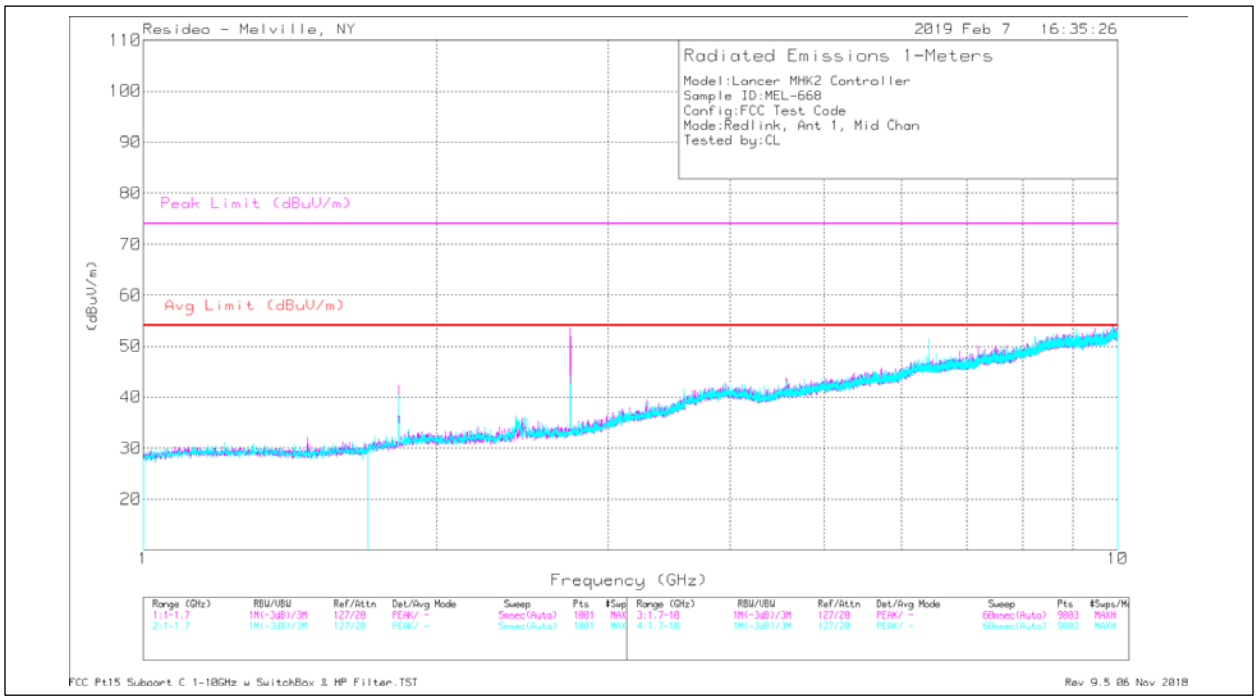

Antenna 1: Mid Channel - Plot

Frequency (GHz)	Meter Reading (dBuV)	Det	AF [dB/m]	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1.829	43.07	PKFH	27.1	-37.4	32.77	-	-	74	-41.23	317	152	H
1.829	30.37	VA1T	27.1	-37.4	20.07	54	-33.93	-	-	317	152	H
* 2.744	43.88	PKFH	29	-37.8	35.08	-	-	74	-38.92	202	363	H
* 2.744	31.59	VA1T	29	-37.8	22.79	54	-31.21	-	-	202	363	H
* 4.573	43.35	PKFH	32.6	-33.9	42.05	-	-	74	-31.95	57	372	H
* 4.573	30.56	VA1T	32.6	-33.9	29.26	54	-24.74	-	-	57	372	H
1.829	42.97	PKFH	27.1	-37.4	32.67	-	-	74	-41.33	262	371	V
1.829	30.36	VA1T	27.1	-37.4	20.06	54	-33.94	-	-	262	371	V
* 2.744	44.67	PKFH	29	-37.8	35.87	-	-	74	-38.13	193	197	V
* 2.744	31.72	VA1T	29	-37.8	22.92	54	-31.08	-	-	193	197	V
6.403	41.86	PKFH	34.7	-30.1	46.46	-	-	74	-27.54	316	235	V
6.403	29.32	VA1T	34.7	-30.1	33.92	54	-20.08	-	-	316	235	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

Antenna 1: Mid Channel - Data

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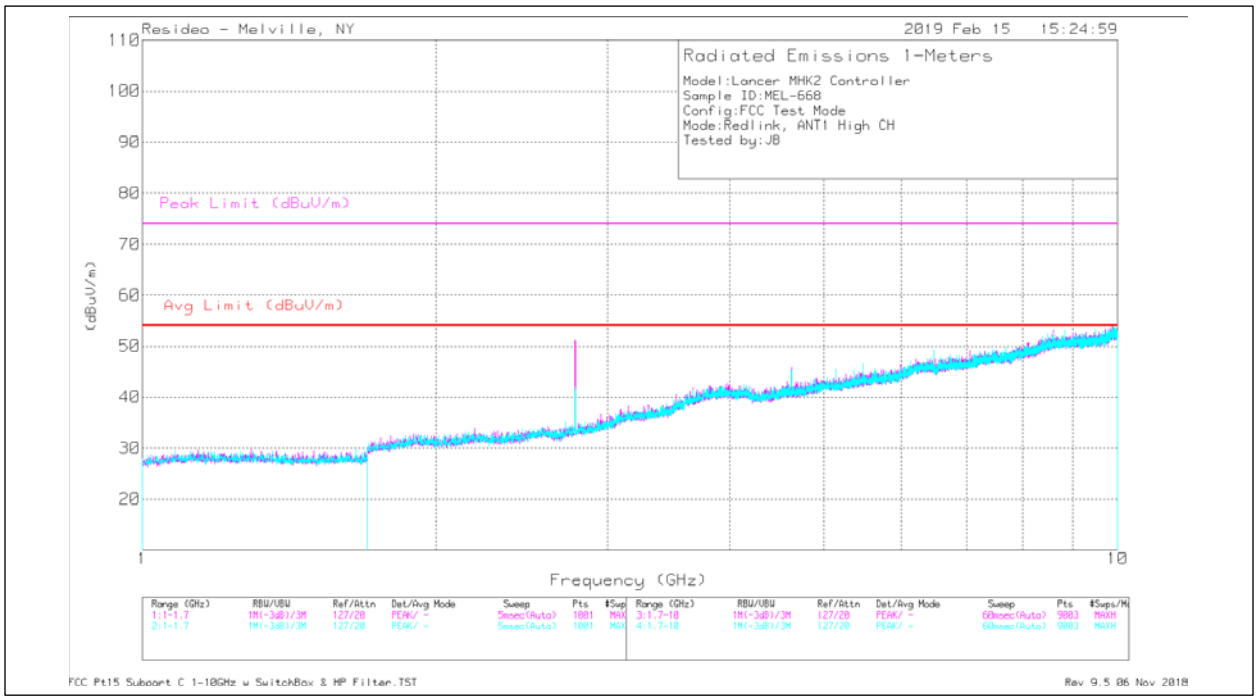

Antenna 1: High Channel - Plot

Frequency (GHz)	Meter Reading (dBuV)	Det	AF [dB/m]	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 2.779	44.32	PKFH	29.1	-37.8	35.62	-	-	74	-38.38	69	149	H
* 2.779	31.53	VA1T	29.1	-37.8	22.83	54	-31.17	-	-	69	149	H
* 4.632	43	PKFH	32.8	-33.7	42.1	-	-	74	-31.9	130	183	H
* 4.632	30.33	VA1T	32.8	-33.7	29.43	54	-24.57	-	-	130	183	H
8.622	41.8	PKFH	37.6	-28.7	50.7	-	-	74	-23.3	260	296	H
8.622	29.18	VA1T	37.6	-28.7	38.08	54	-15.92	-	-	260	296	H
* 2.779	44.66	PKFH	29.1	-37.8	35.96	-	-	74	-38.04	204	308	V
* 2.779	31.43	VA1T	29.1	-37.8	22.73	54	-31.27	-	-	204	308	V
* 5.138	42.99	PKFH	33.9	-33.6	43.29	-	-	74	-30.71	294	209	V
* 5.138	30.17	VA1T	33.9	-33.6	30.47	54	-23.53	-	-	294	209	V
9.734	42.52	PKFH	38	-28.5	52.02	-	-	74	-21.98	87	102	V
9.734	29.74	VA1T	38	-28.5	39.24	54	-14.76	-	-	87	102	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

Antenna 1: High Channel – Data

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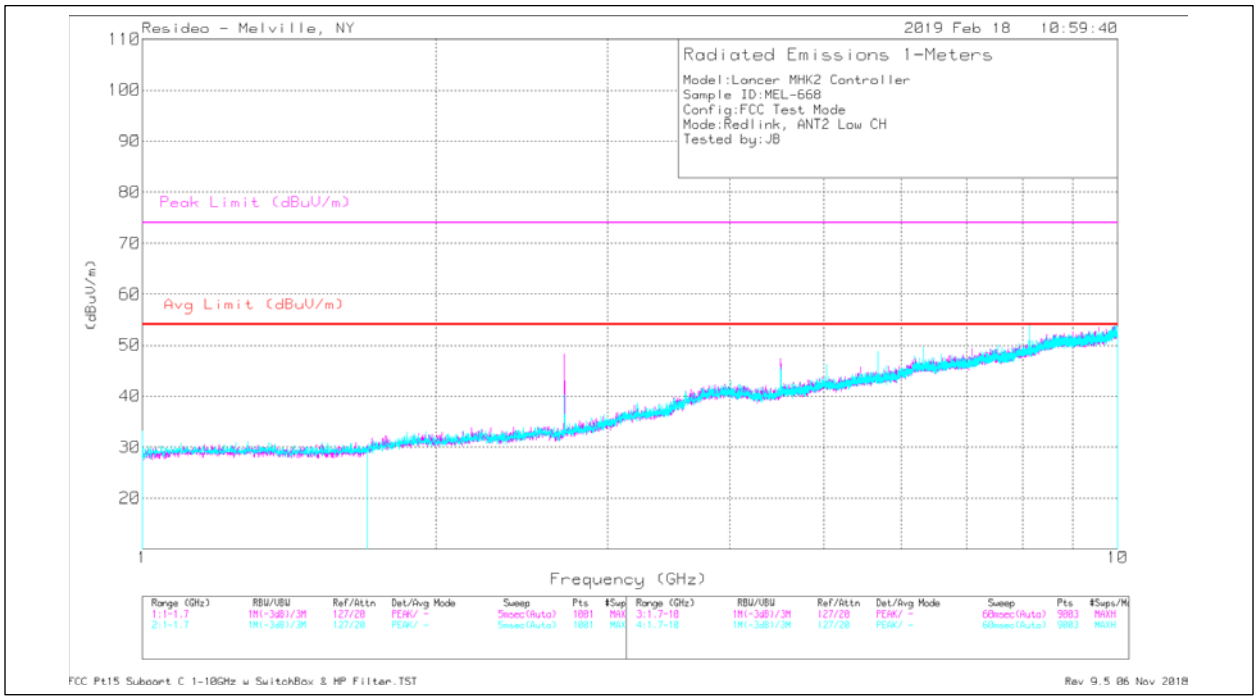

Antenna 2: Low Channel - Plot

Frequency (GHz)	Meter Reading (dBuV)	Det	AF [dB/m]	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 2.707	50.34	PKFH	29	-37.9	41.44	-	-	74	-32.56	205	153	H
* 2.708	45.05	VA1T	29	-37.9	36.15	54	-17.85	-	-	205	153	H
* 4.515	48.15	PKFH	32.5	-33.9	46.75	-	-	74	-27.25	135	203	H
* 4.515	43.29	VA1T	32.5	-33.9	41.89	54	-12.11	-	-	135	203	H
9.534	42.53	PKFH	38	-28.9	51.63	-	-	74	-22.37	166	255	H
9.534	29.57	VA1T	38	-28.9	38.67	54	-15.33	-	-	166	255	H
* 2.709	56.33	PKFH	29	-37.9	47.43	-	-	74	-26.57	270	251	V
* 2.709	54.31	VA1T	29	-37.9	45.41	54	-8.59	-	-	270	251	V
5.678	43.58	PKFH	34.3	-32.5	45.38	-	-	74	-28.62	235	192	V
5.677	30.12	VA1T	34.3	-32.5	31.92	54	-22.08	-	-	235	192	V
* 8.127	44.85	PKFH	37	-29.4	52.45	-	-	74	-21.55	226	305	V
* 8.127	36.73	VA1T	37	-29.4	44.33	54	-9.67	-	-	226	305	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

Antenna 2: Low Channel - Data

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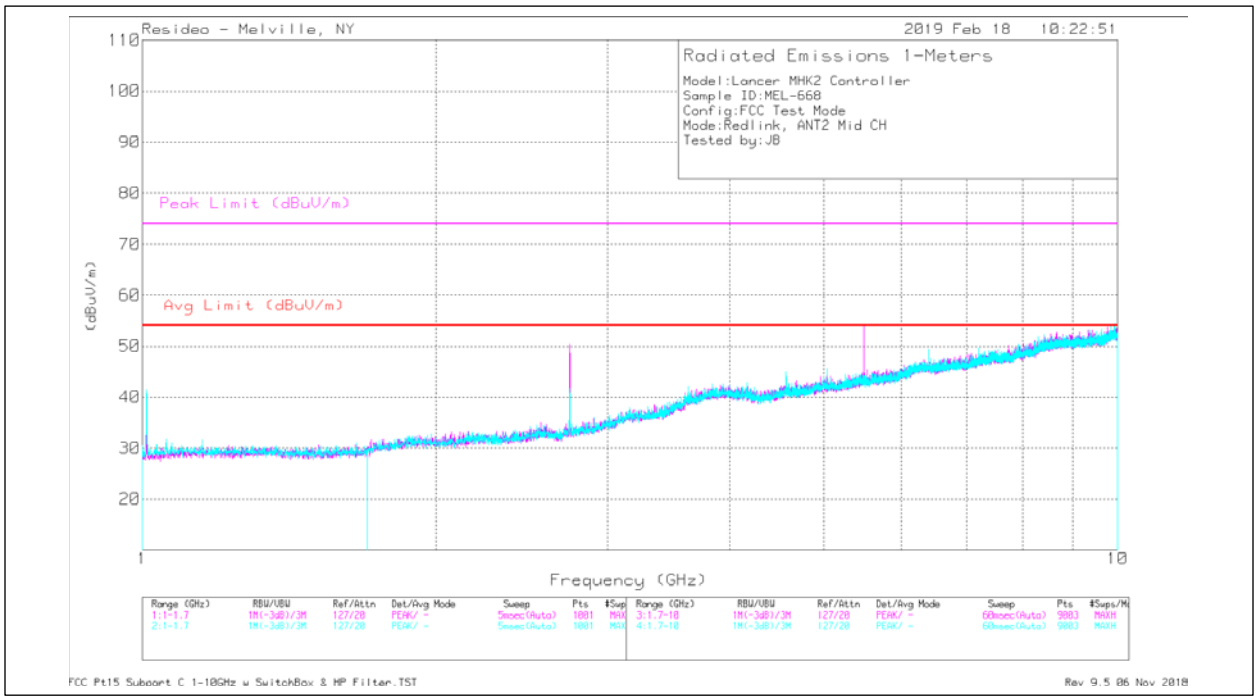

Antenna 2: Mid Channel - Plot

Frequency (GHz)	Meter Reading (dBuV)	Det	AF [dB/m]	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 2.743	44.09	PKFH	29	-37.8	35.29	-	-	74	-38.71	240	288	H
* 2.743	31.66	VA1T	29	-37.8	22.86	54	-31.14	-	-	240	288	H
5.491	42.74	PKFH	34.4	-33	44.14	-	-	74	-29.86	141	302	H
5.491	30.26	VA1T	34.4	-33	31.66	54	-22.34	-	-	141	302	H
8.639	41.99	PKFH	37.6	-28.7	50.89	-	-	74	-23.11	176	381	H
8.639	29.2	VA1T	37.6	-28.7	38.1	54	-15.9	-	-	176	381	H
* 2.744	44.41	PKFH	29	-37.8	35.61	-	-	74	-38.39	284	390	V
* 2.744	31.75	VA1T	29	-37.8	22.95	54	-31.05	-	-	284	390	V
6.402	41.7	PKFH	34.7	-30.1	46.3	-	-	74	-27.7	124	160	V
6.402	29.21	VA1T	34.7	-30.1	33.81	54	-20.19	-	-	124	160	V
9.276	41.88	PKFH	37.7	-28.9	50.68	-	-	74	-23.32	125	313	V
9.276	29.36	VA1T	37.7	-28.9	38.16	54	-15.84	-	-	125	313	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

Antenna 2: Mid Channel - Data

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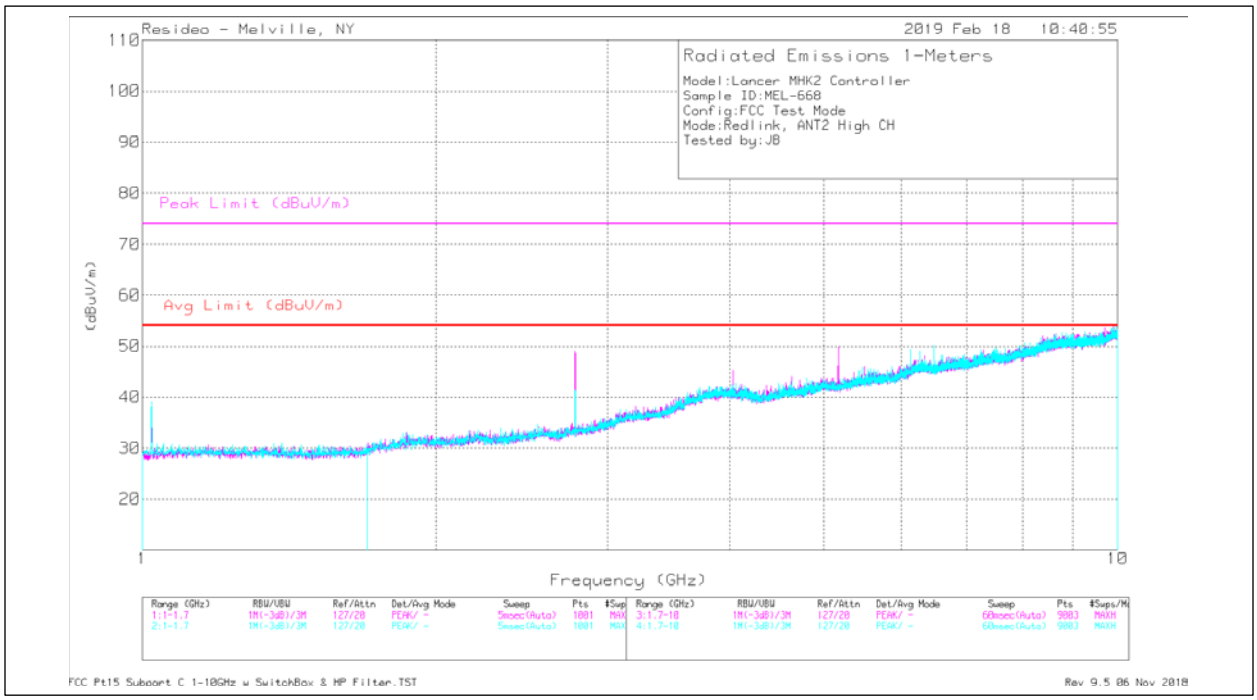

Antenna 2: High Channel - Plot

Frequency (GHz)	Meter Reading (dBuV)	Det	AF [dB/m]	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 2.779	45.45	PKFH	29.1	-37.8	36.75	-	-	74	-37.25	117	175	H
* 2.779	31.67	VA1T	29.1	-37.8	22.97	54	-31.03	-	-	117	175	H
5.171	43.22	PKFH	33.9	-33.6	43.52	-	-	74	-30.48	198	386	H
5.171	30.12	VA1T	33.9	-33.6	30.42	54	-23.58	-	-	198	386	H
9.639	42.05	PKFH	38	-28.7	51.35	-	-	74	-22.65	168	190	H
9.639	29.44	VA1T	38	-28.7	38.74	54	-15.26	-	-	168	190	H
* 2.779	43.84	PKFH	29.1	-37.8	35.14	-	-	74	-38.86	159	176	V
* 2.779	31.76	VA1T	29.1	-37.8	23.06	54	-30.94	-	-	159	176	V
6.468	41.79	PKFH	34.7	-30	46.49	-	-	74	-27.51	125	128	V
6.468	29.06	VA1T	34.7	-30	33.76	54	-20.24	-	-	125	128	V
9.824	42.53	PKFH	38.1	-28.5	52.13	-	-	74	-21.87	245	134	V
9.825	29.73	VA1T	38.1	-28.5	39.33	54	-14.67	-	-	245	134	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

Antenna 2: High Channel – Data

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END OF REPORT

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