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Order Number:	10011450B
Project Number:	13N15104
Date:	2013 July 17
Rev1 Date	2013 August 02
Model:	821LM

Electromagnetic Compatibility Test Report

For

Chamberlain Group Inc.

Test Report Details

Tests Performed By:	**UL LLC** **333 Pfingsten Rd.** **Northbrook, IL 60062**
Tests Performed For:	**Chamberlain Group Inc.** **845 Larch Av**
Applicant Contact: Phone: E-mail:	**Hank Sieradzki** **(630) 993-6564** **Hank.Sieradzki@chamberlaingroup.com**
Test Report Date: Rev1 Report Date	**2013 July 17** **2013 August 02**
Product Type:	**Multi Mode Multi Frequency Garage Door Operator Transmitter**
Product standards	**47 CFR Part 15, Subpart C, RSS-210, RSS-Gen**
Model Number:	**821LM**
EUT Category:	**Wireless Device**
Testing Start Date:	**2013 May 30**
Date Testing Complete:	**2013 July 02**
Overall Results:	**Compliant**

UL LLC reports apply only to the specific samples tested under stated test conditions. All samples tested were in good operating condition throughout the entire test program. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. UL LLC shall have no liability for any deductions, inferences or generalizations drawn by the client or others from UL LLC issued reports. 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.

This report may contain test results that are not covered by the NVLAP or A2LA accreditation. The scope of accreditation is limited to the specific tests that are listed on the NVLAP and/or A2LA websites referenced at the end of this report.

Report Directory

Report Revision History

Revision Date	Description	Revised By	Revision Reviewed By
20130802 Rev1	Editorial Corrections	BM	MF

1.0 G E N E R A L - Product Description

1.1 Equipment Description

The Equipment Under Test was a garage door gateway capable of controlling various garage door openers via multi frequency periodic transmitters and via Chamberlain FHSS 900MHz radio. In addition is equipped with WiFi and BT LE module allowing connection to mobile devices and control via internet.

1.2 Device Configuration During Test

1.2.1 Equipment Used During Test:

Use	Product Type	Manufacturer	Model	Comments
EUT	Garage Door Controller	Chamberlain Group Inc.	821LM	None
AE	Power Supply	Generic	GEO101a-075100W	none

Note: **EUT** - Equipment Under Test, **AE** - Auxiliary/Associated Equipment, or **SIM** - Simulator (Not Subjected to Test)

1.2.2 Input/Output Ports:

Port #	Name	Type*	Cable Max. >3m (Y/N)	Cable Shielded (Y/N)	Comments
0	Enclosure	N/E	—	—	None
1	Mains	AC	N	N	AC-DC adapter

Note:
AC = AC Power Port DC = DC Power Port N/E = Non-Electrical
I/O = Signal Input or Output Port (Not Involved in Process Control)
TP = Telecommunication Ports

1.2.3 Power Interface:

Mode # /Rated	Voltage (V)	Current (A)	Power (W)	Frequency (DC/AC-Hz)	Phases (#)	Comments
1	120	-	-	AC - 60Hz	1	AC to DC adapter

1.3 EUT Configurations

Config #	Description
1	EUT was setup on 80 cm support, connected to power source and set to transmit in specific mode.
2	EUT was placed on bench top, connected to power. Near field antenna was used to conduct measurements.

1.4 EUT Operation Modes

Mode #	Description
1	EUT was set to transmit on three frequencies in sequence. First 310MHz, followed by 315MHz, followed by 390MHz and over again.
2	EUT set to transmit continuously on 315MHz
3	Possible but not used for testing
4	EUT set to transmit continuously on 390MHz
5 & 6	Possible but not used for testing
7	EUT set to transmit continuously on 318MHz
8	EUT set to transmit continuously on 310MHz
9	EUT set to transmit continuously on 372.5MHz
10	EUT set to RX mode (scanning all frequencies)

1.5 Rational for EUT Configuration

Rationale #	Description
1	It is possible to mount the EUT either in ceiling mount configuration or wall mount configuration. During preliminary testing it was determined that the worst case emissions were observed when EUT is installed in wall mount configuration. All radiated emissions testing was conducted in wall mount orientation.
2	The periodic transmitter is designed to operate on various programed frequencies in the 300MHz-400MHz frequency band. All various modes of operation use the same power settings for all available frequencies. All testing per frequency was conducted in a mode which the manufacturer stated has the lowest duty cycle correction with the exception of Radiated Spurious Emissions on 310MHz, 315MHz and 390MHz. Spurious emissions on those three frequencies were measured with transmitter set to mode 1. Because of type of detector used the peak level of the emission will not change with the various duty cycles possible. The Duty cycle correction factor for those frequencies was measured with the mode which according to the manufacturer will have the lowest duty cycle correction.

2.0 Summary

The tests listed in the Summary of Testing section of this report have been performed and the results recorded by UL LLC in accordance with the procedures stated in each test requirement and specification. The applicant determined the list of tests performed were applicable to the Equipment Under Test. As a result, the subject product has been verified to comply or not comply as noted in the Summary of Testing with each test specification. The test results relate only to the items tested.

2.1 Deviations from standard test methods

None

2.2 Device Modifications Necessary for Compliance

None

2.3 Reference Standards

Standard Number	Standard Name	Standard Date
RSS-210	Spectrum Management and Telecommunications Radio Standards Specification License-exempt Radio Apparatus (All Frequency Bands): Category I Equipment	Issue 8
RSS-Gen	Spectrum Management and Telecommunications Radio Standards Specification General Requirements and Information for the Certification of Radio Apparatus	Issue 3
47 CFR Part 15, Subpart C	Radio Frequency Devices	2012

2.4 Results Summary

Requirement – Test	Results
Mains Terminal – Conducted Emissions	Compliant
Digital Radiated Emissions	Compliant
Radiated Spurious Emissions	Compliant
Cease Operation	Compliant
Pulse Train / Duty Cycle	Reported Only
20dB Bandwidth	Compliant
99% Power Bandwidth	Compliant

Test Engineer:

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WiSE Staff Engineer
Wireless, Interoperability, payment Security, & EMC
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Reviewer:

Michael Ferrer(Ext.41312)
WiSE Project Lead
Wireless, Interoperability, payment Security, & EMC
Verification Services

Any information and documentation involving UL Mark services are provided on behalf of UL LLC (UL) or any authorized licensee of UL.

3.0 Calibration of Equipment Used for Measurement

All test equipment and test accessories are calibrated on a regular basis. The maximum time between calibrations is one year or the manufacturers' recommendation, whichever is less.

All test equipment calibrations are traceable to the National Institute of Standards and Technology (NIST); therefore, all test data recorded in this report is traceable to NIST.

4.0 EMISSIONS TEST RESULTS

The emissions tests were performed according to following regulations:

---------- US ----------
47 CFR Part 15

---------- Canada ----------
RSS-210 and RSS-Gen

Unless specified otherwise in the individual Methods, the tests shall be conducted under the following ambient conditions. Confirmation of these conditions shall be verified at the time the test is conducted.

Ambient Temperature, °C	22.5 ± 2.5	Relative Humidity, %	45 ± 15	Barometric Pressure, mBar	950 ± 150

Sample Calculations
Radiated Field Strength and Conducted Emissions data contained within this report is calculated on the following basis:

Field Strength (dBuV/m) = Meter Reading (dBuV) + AF (dB/m) - Gain (dB) + Cable Loss (dB)
Conducted Voltage (dBuV) = Meter Reading (dBuV) + Cable Loss (dB) + LISN IL (dB)
Conducted Current (dBuA) = Meter Reading (dBuV) + Cable Loss (dB) - Transducer Factor (dBohms)

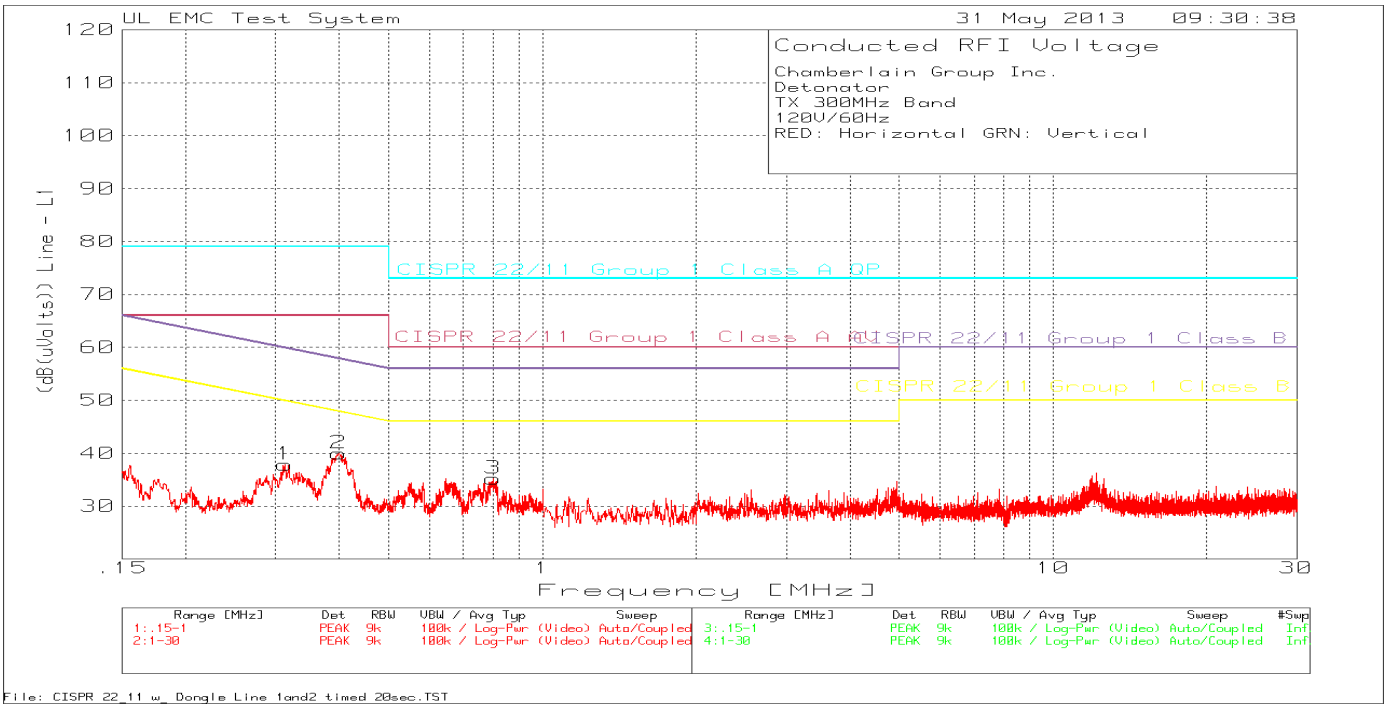
4.1 Test Conditions and Results – MAINS TERMINAL – CONDUCTED EMISSIONS

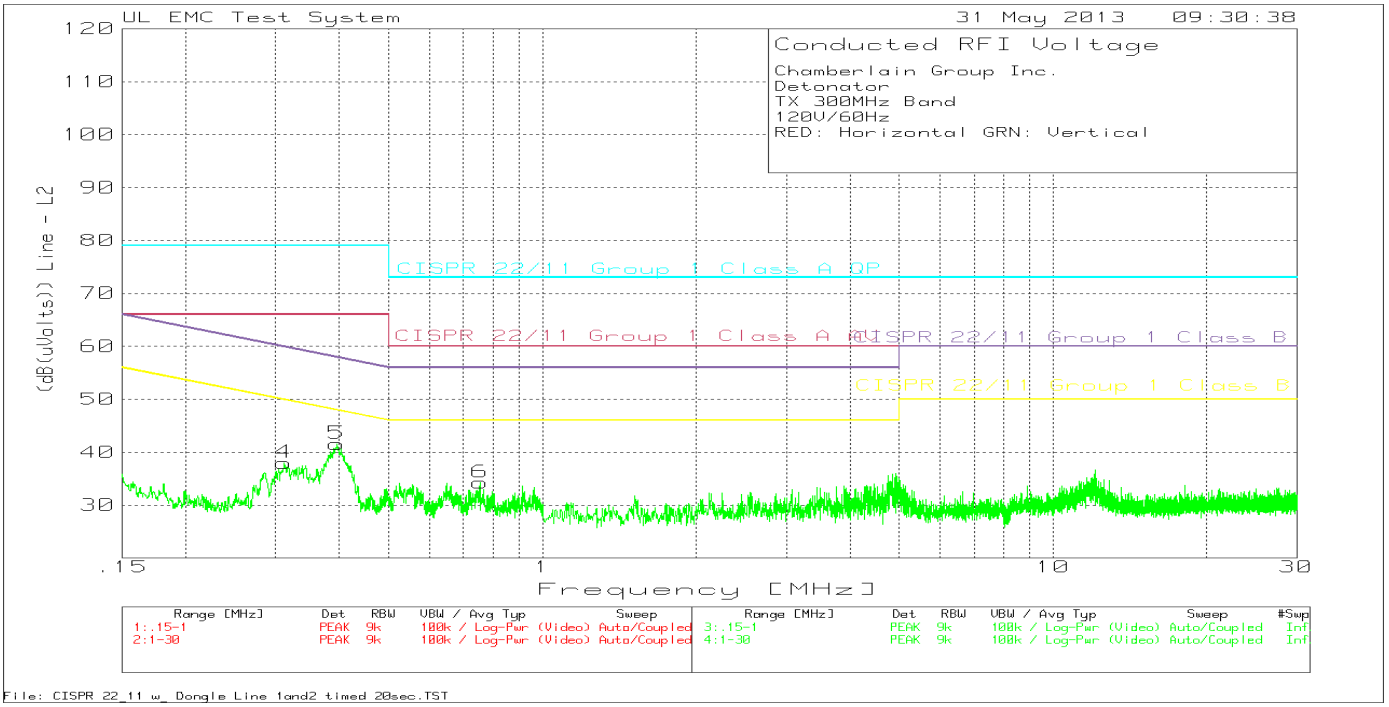
Test Description	Measurements were made on a ground plane. All power was connected to the system through Artificial Mains Network (AMN). Conducted voltage measurements on mains lines were made at the output of the AMN.		
Basic Standard		47 CFR Part 15.207, RSS-Gen 7.2.4	
UL LPG		80-EM-S0026	
		Frequency range on each side of line	Measurement Point
Fully configured sample scanned over the following frequency range		150kHz to 30MHz	Mains
Limits - Class B			
Frequency (MHz)	Limit (dBµV)		
	Quasi-Peak	Average	
0.15-0.5	66 to 56	56 to 46	
0.5-5	56	46	
5-30	60	50	
Supplementary information: None			

Table 1 Conducted Emissions EUT Configuration Settings

Power Interface Mode #	EUT Configurations Mode #	EUT Operation Mode #
1	1	1
Supplementary information: None		

Figure 1 Conducted Emissions Graph





* The above plots have incorrect title block. The last line should say RED: L1, GRN: N.

Table 2 Conducted Emissions Data Points

Chamberlain Group Inc.
Detonator
TX 300MHz Band
120V/60Hz

Trace Markers

Test No.	Frequency [MHz]	Meter Reading (dBuV)	Transducer Factor [dB]	Gain/Loss Factor [dB]	Level (dB(uVolts))	Limit:1	2	3	4	5	6
Line - L1 .15 - 1MHz											
1	.31265	26.98 PK	.1	10.8	37.88	79	66	59.9	49.9	-	-
				Margin [dB]		-41.12	-28.12	-22.02	-12.02	-	-
2	.39918	29.12 PK	.1	10.7	39.92	79	66	57.9	47.9	-	-
				Margin [dB]		-39.08	-26.08	-17.98	-7.98	-	-
3	.79913	24.58 PK	.1	10.6	35.28	73	60	56	46	-	-
				Margin [dB]		-37.72	-24.72	-20.72	-10.72	-	-
Line - L2 .15 - 1MHz											
4	.31159	27.04 PK	.1	10.8	37.94	79	66	59.9	49.9	-	-
				Margin [dB]		-41.06	-28.06	-21.96	-11.96	-	-
5	.39547	30.64 PK	.1	10.8	41.54	79	66	57.9	47.9	-	-
				Margin [dB]		-37.46	-24.46	-16.36	-6.36	-	-
6	.7539	23.54 PK	.1	10.6	34.24	73	60	56	46	-	-
				Margin [dB]		-38.76	-25.76	-21.76	-11.76	-	-

Quasi Peak Data

Frequency [MHz]	Test	Meter Reading (dBuV)	Transducer Factor [dB]	Gain/Loss Factor [dB]	Level (dB(uVolts))	Limit:1	2	3	4	5	6
Line - L1 .15 - 1MHz											
.31356		21.02 QP	.1	10.8	31.92	79	66	59.88	49.88	-	-
				Margin [dB]:		-47.08	-34.08	-27.96	-17.96	-	-
.3975		25.83 QP	.1	10.7	36.63	79	66	57.91	47.91	-	-
				Margin [dB]:		-42.37	-29.37	-21.28	-11.28	-	-
.79952		18.76 QP	.1	10.6	29.46	73	60	56	46	-	-
				Margin [dB]:		-43.54	-30.54	-26.54	-16.54	-	-
Line - L2 .15 - 1MHz											
.31198		21.1 QP	.1	10.8	32	79	66	59.92	49.92	-	-
				Margin [dB]:		-47	-34	-27.92	-17.92	-	-
.39707		25.93 QP	.1	10.7	36.73	79	66	57.91	47.91	-	-
				Margin [dB]:		-42.27	-29.27	-21.18	-11.18	-	-
.75265		14.5 QP	.1	10.6	25.2	73	60	56	46	-	-
				Margin [dB]:		-47.8	-34.8	-30.8	-20.8	-	-

NOTE: "+" - Indicates an emission level in excess of the
applicable limit (s).

PK - Peak detector
QP - Quasi-Peak detector

LIMIT 1: CISPR 22/11 Group 1 Class A QP
LIMIT 2: CISPR 22/11 Group 1 Class A AV
LIMIT 3: CISPR 22/11 Group 1 Class B QP
LIMIT 4: CISPR 22/11 Group 1 Class B AV

Average Data

Test Frequency [MHz]	Meter Reading (dBuV)	Transducer Factor [dB]	Gain/Loss Factor [dB]	Level (dB(uVolts))	Limit:1	2	3	4	5	6
Line - L1 .15 - 1MHz										
.31356	9.92 Av	.1	10.8	20.82	79	66	59.88	49.88	-	-
			Margin [dB]:		-58.18	-45.18	-39.06	-29.06	-	-
.3975	15.78 Av	.1	10.7	26.58	79	66	57.91	47.91	-	-
			Margin [dB]:		-52.42	-39.42	-31.33	-21.33	-	-
.79952	4.6 Av	.1	10.6	15.3	73	60	56	46	-	-
			Margin [dB]:		-57.7	-44.7	-40.7	-30.7	-	-
Line - L2 .15 - 1MHz										
.31198	6.22 Av	.1	10.8	17.12	79	66	59.92	49.92	-	-
			Margin [dB]:		-61.88	-48.88	-42.8	-32.8	-	-
.39707	12.11 Av	.1	10.7	22.91	79	66	57.91	47.91	-	-
			Margin [dB]:		-56.09	-43.09	-35	-25	-	-
.75265	.13 Av	.1	10.6	10.83	73	60	56	46	-	-
			Margin [dB]:		-62.17	-49.17	-45.17	-35.17	-	-

NOTE: "+" - Indicates an emission level in excess of the applicable limit (s).

Av - average detection

LIMIT 1: CISPR 22/11 Group 1 Class A QP
LIMIT 2: CISPR 22/11 Group 1 Class A AV
LIMIT 3: CISPR 22/11 Group 1 Class B QP
LIMIT 4: CISPR 22/11 Group 1 Class B AV

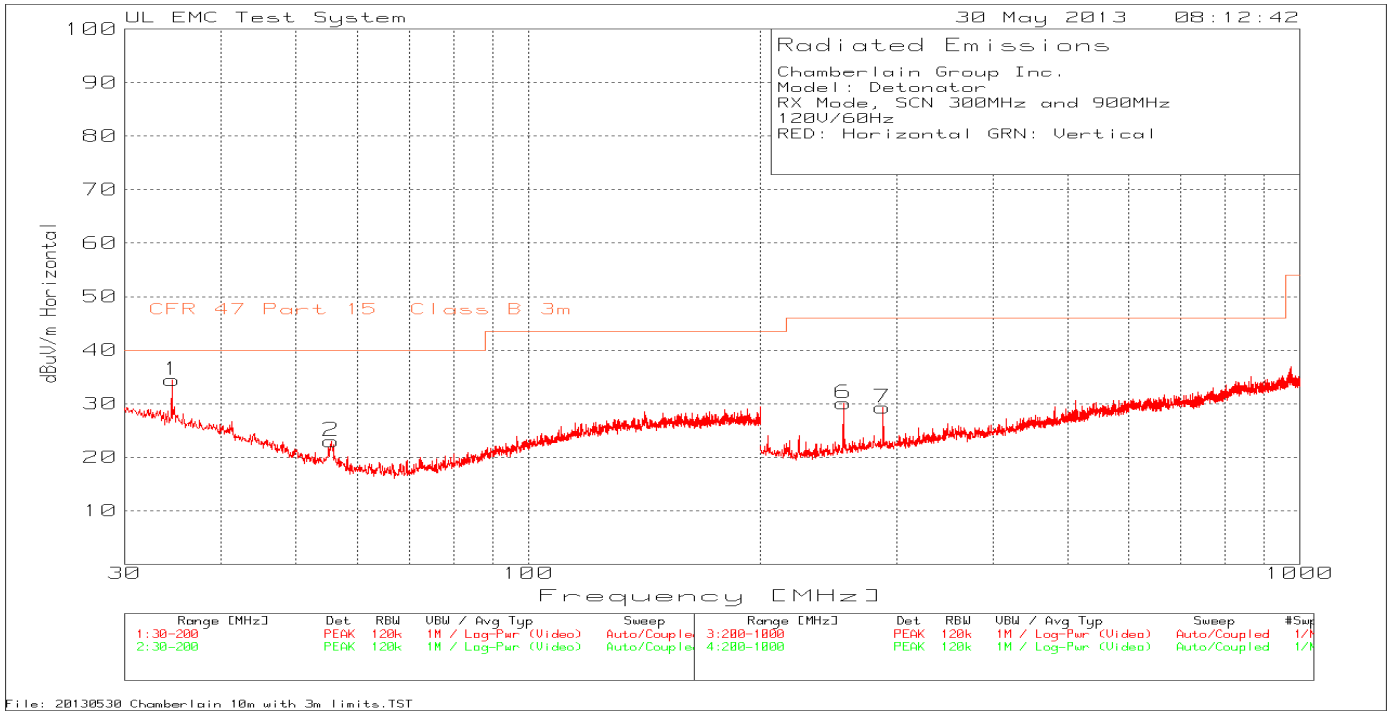
4.2 Test Conditions and Results – DIGITAL RADIATED EMISSIONS

Test Description	Measurements were made in a 10-meter semi-anechoic chamber that complies to CISPR 16/ANSI C63.4. Preliminary (peak) measurements were performed at an antenna to EUT separation distance of 3-meter. The EUT was rotated 360° about its azimuth with the receive antenna located at various heights in both horizontal and vertical polarities. Final measurements (quasi-peak or average as noted) were then performed by rotating the EUT 360° and adjusting the receive antenna height from 1 to 4-meters. All frequencies were investigated in both horizontal and vertical antenna polarity, where applicable.		
Basic Standard	47 CFR Part 15.109 / ICES-003		
UL LPG	80-EM-S0029		
	Frequency range	Measurement Point	
Fully configured sample scanned over the following frequency range	30MHz – 4GHz	3m distance	
Limits - Class B			
Frequency (MHz)	Limit (dBµV/m)		
	Quasi-Peak	Average	
30 – 88	40	NA	
88 – 216	43.52	NA	
216 – 960	46.02	NA	
960 and above	54	NA	
Supplementary information: None			

Table 3 Radiated Emissions EUT Configuration Settings

Power Interface Mode #	EUT Configurations Mode #	EUT Operation Mode #
1	1	10
Supplementary information: None		

Figure 2 Receive Mode 30MHz-1GHz Radiated Emissions Graph



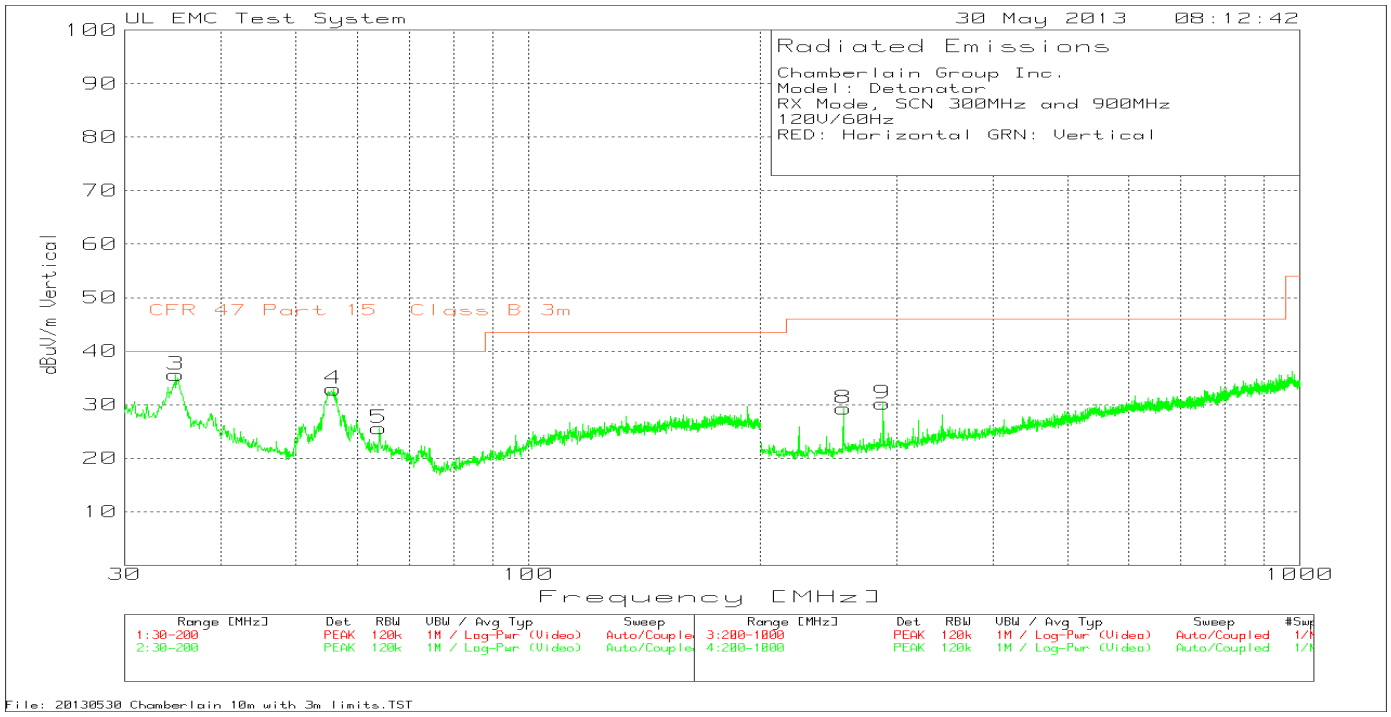


Table 4 Receive Mode 30MHz-1GHz Radiated Emissions Data Points

Chamberlain Group Inc.
Model: Detonator
RX Mode, SCN 300MHz and 900MHz
120V/60Hz
RED: Horizontal GRN: Vertical

No.	Test Frequency [MHz]	Meter Reading (dBuV)	Transducer Factor [dB]	Gain/Loss Factor [dB]	Level dBuV/m	Limit:1	2	3	4	5	6
1	34.5027	37.18 PK	16.2	-19	34.38	40	-	-	-	-	-
		Height:249 Horz		Margin [dB]		-5.62	-	-	-	-	-
2	55.4873	34.66 PK	7.4	-19	23.06	40	-	-	-	-	-
		Height:400 Horz		Margin [dB]		-16.94	-	-	-	-	-
3	34.9275	38.47 PK	16.1	-19	35.57	40	-	-	-	-	-
		Height:99 Vert		Margin [dB]		-4.43	-	-	-	-	-
4	55.997	44.73 PK	7.2	-19	32.93	40	-	-	-	-	-
		Height:249 Vert		Margin [dB]		-7.07	-	-	-	-	-
5	64.068	38.34 PK	6.2	-18.9	25.64	40	-	-	-	-	-
		Height:400 Vert		Margin [dB]		-14.36	-	-	-	-	-
6	256.2292	39.05 PK	12.4	-21.3	30.15	46	-	-	-	-	-
		Height:399 Horz		Margin [dB]		-15.85	-	-	-	-	-
7	288.4744	37.24 PK	13.2	-21.1	29.34	46	-	-	-	-	-
		Height:399 Horz		Margin [dB]		-16.66	-	-	-	-	-
8	256.2292	38.24 PK	12.4	-21.3	29.34	46	-	-	-	-	-
		Height:199 Vert		Margin [dB]		-16.66	-	-	-	-	-
9	288.4744	38.11 PK	13.2	-21.1	30.21	46	-	-	-	-	-
		Height:99 Vert		Margin [dB]		-15.79	-	-	-	-	-

Frequency [MHz]	Meter Reading (dBuV)	Transducer Factor [dB]	Gain/Loss Factor [dB]	Level dBuV/m	Limit:1	2	3	4	5	6
34.6314	25.49 PK	16.2	-19	22.69	40	-	-	-	-	-
Azimuth: 348	Height:178 Horz		Margin [dB]:		-17.31	-	-	-	-	-
35.0635	33.07 PK	16.1	-18.9	30.27	40	-	-	-	-	-
Azimuth: 327	Height:101 Vert		Margin [dB]:		-9.73	-	-	-	-	-

LIMIT 1: CFR 47 Part 15 Class B 3m

PK - Peak detector
QP - Quasi-Peak detector

***There were no emissions recorded above noise floor above 1GHz**

4.3 Mode 8 310MHz (Includes Radiated Spurious Emissions for Mode 2 and Mode 4)

4.3.1 Test Conditions and Results – Fundamental and Harmonics Radiated Emissions

Test Description	Measurements were made in a 10-meter semi-anechoic chamber that complies to CISPR 16/ANSI C63.4:2003. Preliminary (peak) measurements were performed at an antenna to EUT separation distance of 10-meter or 3-meter as noted. The EUT was rotated 360° about its azimuth with the receive antenna located at various heights in both horizontal and vertical polarities. Final measurements (quasi-peak or average as noted) were then performed by rotating the EUT 360° and adjusting the receive antenna height from 1 to 4-meters. All frequencies were investigated in both horizontal and vertical antenna polarity, where applicable.

Basic Standard	47 CFR Part 15.231, RSS-210 A1.1	
	Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range	30 MHz – 1GHz	(3m distance)
	1GHz – 4GHz	(3m distance)

Limits

Frequency (MHz)	Limit (dBµV/m)	
	Fundamental AV Limit	Non-Restricted Spurious Harmonics AV
310	75.32	55.32
315	75.62	55.62
390	79.24	59.24
	All Other Emissions including Harmonics in restricted bands	
30MHz – 88MHz	40.00	
88MHz – 216MHz	43.52	
216MHz – 960MHz	46.02	
960MHz – 4,000MHz	54.00	

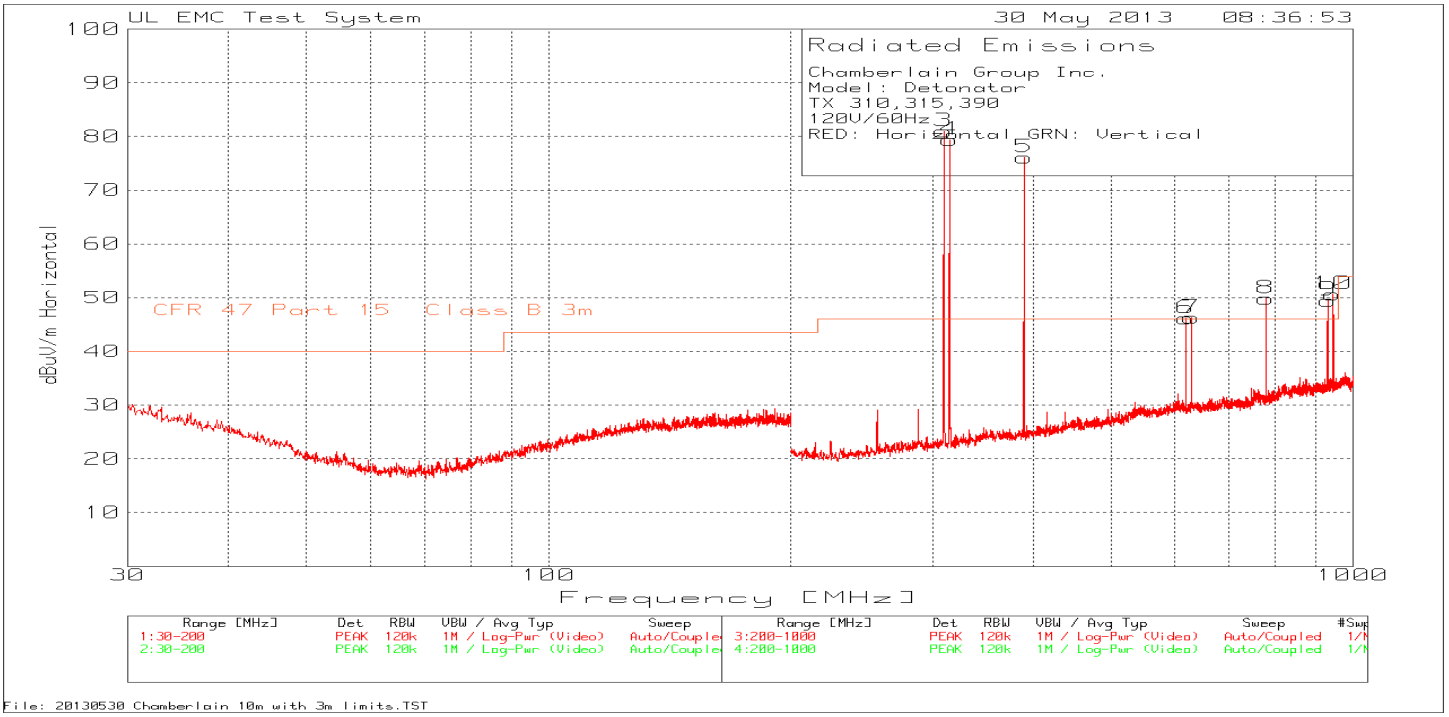
Supplementary information: Spurious limits are only applied against products of the transmitter. All other emissions must meet the general limits. All emissions below 1GHz were maximized. Above 1GHz only emissions within 6dB of the limit were maximized. Emissions that do not contain azimuth data, their level is based on pre-scan data.

Included data in this section is also for 315MHz and 390MHz. The used duty cycle correction factors are the worst case factors for the frequency in question.

Table 5 Radiated Emissions EUT Configuration Settings

Power Interface Mode	EUT Configurations Mode	EUT Operation Mode
1	1	1
Supplementary information: None		

Figure 3 Radiated Emissions Graph 30MHz – 1GHz



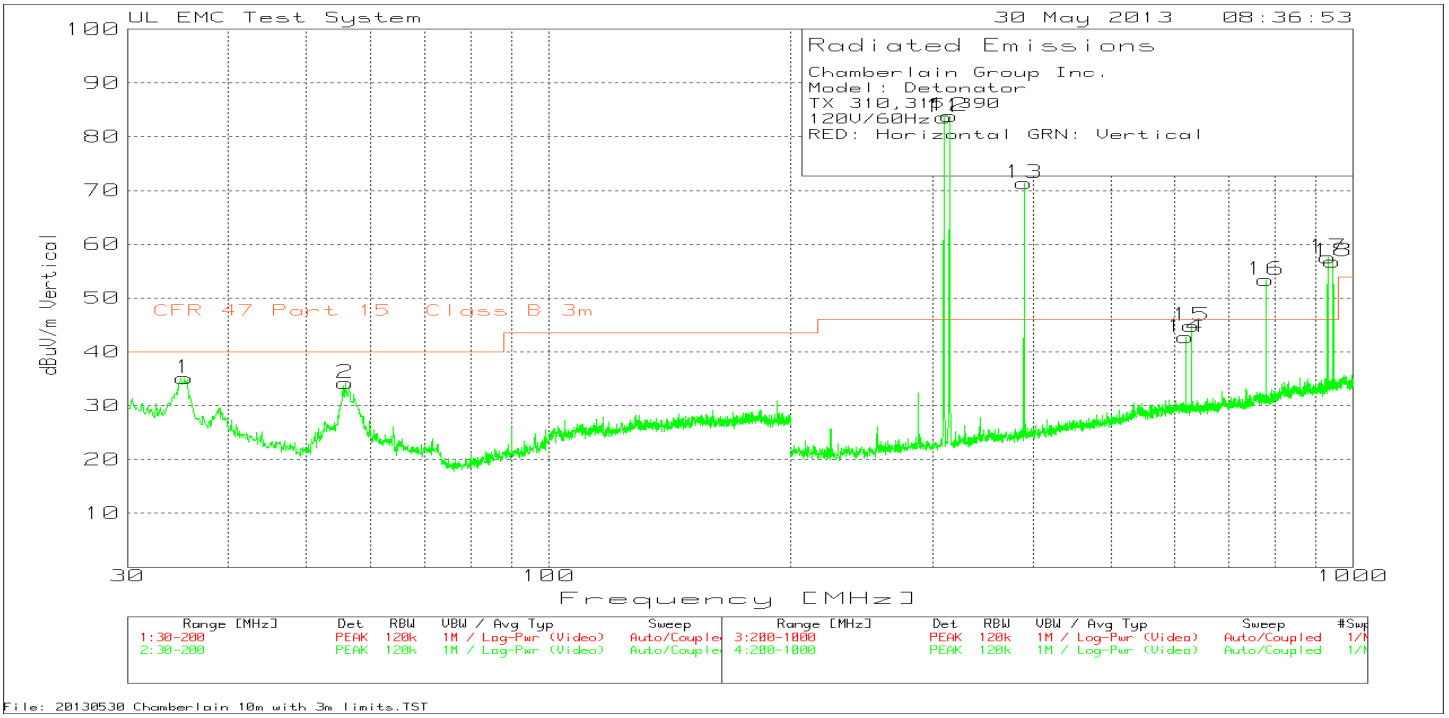
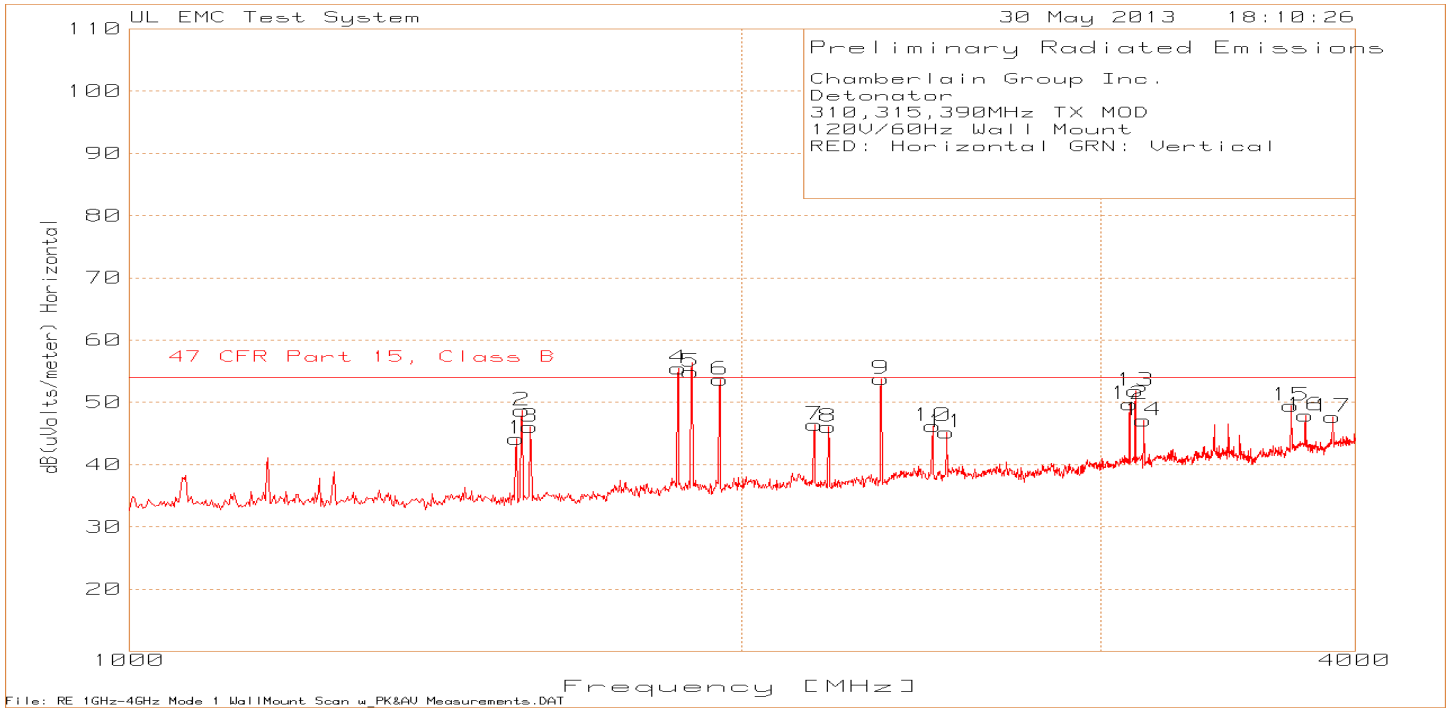


Figure 4 Radiated Emissions Graph 1Hz – 4GHz



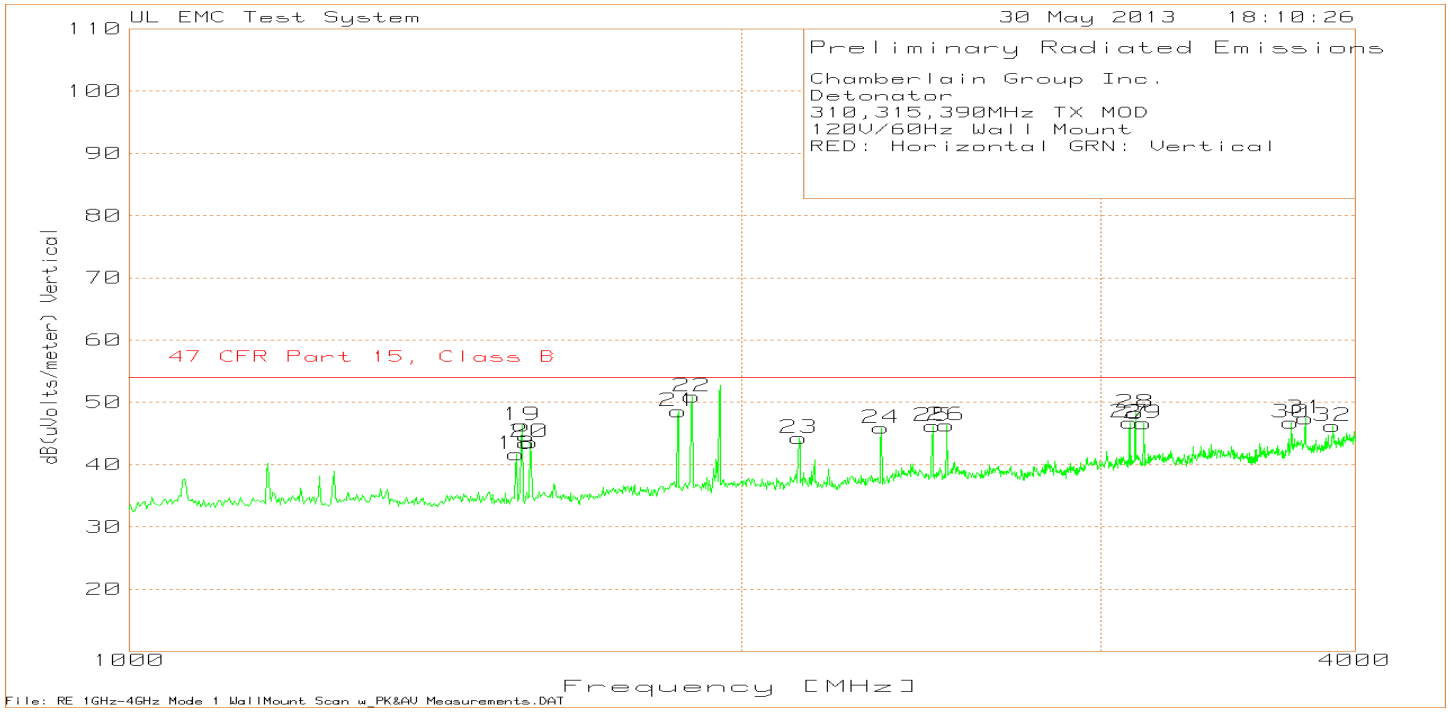


Table 6 Radiated Emissions Data Points

Fundamental Frequency MHz	Test Frequency MHz	Meter Reading dBuV	Detector	AF dB/m	PF dB	Peak Level dBuV/m	DC Factor dB	Average Level dBuV/m	Peak Limit dBuV/m	Peak Margin dB	Average Limit dBuV/m	Margin dB	Azimuth [Degs]	Height [cm]	Polarity
310	310.005	65.74	PK	14.1	2.1	81.94	-12.36	69.58	95.32	-13.38	75.32	-5.74	174	101	Horz
310	310.0048	59.46	PK	14.1	2.1	75.66	-12.36	63.3	95.32	-19.66	75.32	-12.02	190	101	Vert
310	619.993	20.62	PK	20.4	3	44.02	-12.36	31.66	66	-21.98	46	-14.34	53	129	Horz
310	620.0135	18.05	PK	20.4	3	41.45	-12.36	29.09	66	-24.55	46	-16.91	16	100	Vert
310	930.025	19.94	PK	23.8	3.8	47.54	-12.36	35.18	66	-18.46	46	-10.82	360	145	Horz
310	929.994	28.49	PK	23.8	3.8	56.09	-12.36	43.73	66	-9.91	46	-2.27	154	110	Vert
315	315.0098	63.9	PK	14.3	2.1	80.3	-10.17	70.13	95.62	-15.32	75.62	-5.49	178	101	Horz
315	315.0083	59.44	PK	14.3	2.1	75.84	-10.17	65.67	95.62	-19.78	75.62	-9.95	190	101	Vert
315	630.0095	22.11	PK	20.7	3	45.81	-10.17	35.64	66	-20.19	46	-10.36	38	129	Horz
315	629.982	18.61	PK	20.7	3	42.31	-10.17	32.14	66	-23.69	46	-13.86	14	101	Vert
315	945.0213	28.08	PK	23.9	3.8	55.78	-10.17	45.61	66	-10.22	46	-0.39	153	110	Vert
315	945.0065	23.06	PK	23.9	3.8	50.76	-10.17	40.59	66	-15.24	46	-5.41	219	141	Horz
390	389.9998	56.59	PK	16.1	2.3	74.99	-6.75	68.24	99.24	-24.25	79.24	-11	189	101	Horz
390	389.9995	47.68	PK	16.1	2.3	66.08	-6.75	59.33	99.24	-33.16	79.24	-19.91	124	101	Vert
390	779.9898	23.69	PK	22	3.4	49.09	-6.75	42.34	66	-16.91	46	-3.66	0	101	Horz
390	779.9965	26.23	PK	22	3.4	51.63	-6.75	44.88	66	-14.37	46	-1.12	333	145	Vert
310	1550.367	75.01	PK	25.2	-56.02	44.19	-12.36	31.83	74	-29.81	54	-22.17	-	100	Horz
310	1550.367	72.55	PK	25.2	-56.02	41.73	-12.36	29.37	74	-32.27	54	-24.63	-	100	Vert
390	1560.0671	80.43	PK	25.2	-55.66	49.97	-6.75	43.22	74	-24.03	54	-10.78	167	100	Horz
390	1560.374	76.78	PK	25.2	-55.65	46.33	-6.75	39.58	74	-27.67	54	-14.42	-	100	Vert
315	1574.383	76.21	PK	25.2	-55.3	46.11	-10.17	35.94	74	-27.89	54	-18.06	-	100	Horz
315	1574.383	73.71	PK	25.2	-55.3	43.61	-10.17	33.44	74	-30.39	54	-20.56	-	100	Vert
310	1859.991	84.16	PK	27.1	-54.43	56.83	-12.36	44.47	74	-17.17	54	-9.53	199	115	Horz
310	1860.0391	78.52	PK	27.1	-54.43	51.19	-12.36	38.83	74	-22.81	54	-15.17	244	109	Vert
315	1890.0691	84.32	PK	27.2	-54.31	57.21	-10.17	47.04	74	-16.79	54	-6.96	222	116	Horz
315	1890.0571	80.66	PK	27.2	-54.31	53.55	-10.17	43.38	74	-20.45	54	-10.62	282	107	Vert
390	1950.012	83.28	PK	27.3	-54.39	56.19	-6.75	49.44	74	-17.81	54	-4.56	215	114	Horz
390	1950.634	79.88	PK	27.3	-54.39	52.79	-6.75	46.04	74	-21.21	54	-7.96	-	100	Vert
x	2132.755	69.91	PK	27.5	-53.18	44.23	0	44.23	74	-29.77	54	-9.77	-	100	Vert
310	2170.781	71.94	PK	27.4	-52.92	46.42	-12.36	34.06	74	-27.58	54	-19.94	-	100	Horz
310	2170.781	66.29	PK	27.4	-52.92	40.77	-12.36	28.41	74	-33.23	54	-25.59	-	100	Vert
315	2204.803	71.92	PK	27.4	-53.2	46.12	-10.17	35.95	74	-27.88	54	-18.05	-	100	Horz
315	2204.803	65.11	PK	27.4	-53.2	39.31	-10.17	29.14	74	-34.69	54	-24.86	-	100	Vert
390	2339.9609	79.49	PK	28.1	-52.91	54.68	-6.75	47.93	74	-19.32	54	-6.07	202	100	Horz
390	2340.894	70.72	PK	28.1	-52.9	45.92	-6.75	39.17	74	-28.08	54	-14.83	-	150	Vert
310	2480.987	70.01	PK	28.8	-52.57	46.24	-12.36	33.88	74	-27.76	54	-20.12	-	200	Horz
310	2480.987	69.92	PK	28.8	-52.57	46.15	-12.36	33.79	74	-27.85	54	-20.21	-	100	Vert
315	2521.014	68.46	PK	28.9	-52.19	45.17	-10.17	35	74	-28.83	54	-19	-	150	Horz
315	2521.014	69.56	PK	28.9	-52.19	46.27	-10.17	36.1	74	-27.73	54	-17.9	-	100	Vert
310	3101.401	70.51	PK	30.5	-51.31	49.7	-12.36	37.34	74	-24.3	54	-16.66	-	150	Horz
310	3101.401	67.61	PK	30.5	-51.31	46.8	-12.36	34.44	74	-27.2	54	-19.56	-	100	Vert
390	3120.015	71.74	PK	30.6	-51.39	50.95	-6.75	44.2	74	-23.05	54	-9.8	17	100	Horz
390	3119.9609	70.64	PK	30.6	-51.39	49.85	-6.75	43.1	74	-24.15	54	-10.9	108	100	Vert
315	3151.434	68.22	PK	30.6	-51.71	47.11	-10.17	36.94	74	-26.89	54	-17.06	-	150	Horz
315	3151.434	67.75	PK	30.6	-51.71	46.64	-10.17	36.47	74	-27.36	54	-17.53	-	200	Vert
310	3719.8257	69.31	PK	32	-51.49	49.82	-12.36	37.46	74	-24.18	54	-16.54	0	100	Horz
310	3721.815	66.21	PK	32	-51.39	46.82	-12.36	34.46	74	-27.18	54	-19.54	-	100	Vert
315	3781.855	67.09	PK	32.4	-51.6	47.89	-10.17	37.72	74	-26.11	54	-16.28	-	100	Horz
315	3781.855	66.7	PK	32.4	-51.6	47.5	-10.17	37.33	74	-26.5	54	-16.67	-	100	Vert
390	3901.935	67.08	PK	32.6	-51.99	47.69	-6.75	40.94	74	-26.31	54	-13.06	-	200	Horz
390	3901.935	65.56	PK	32.6	-51.99	46.17	-6.75	39.42	74	-27.83	54	-14.58	-	150	Vert

AF – Antenna Factor, PF – Path Loss/Gain, DC – Duty Cycle

4.3.2 Test Conditions and Results – Cease Operation

Test Description	Measurements were made in the laboratory environment. A Dipole (or equivalent) antenna tuned to the transmit frequency was attached to the input of a spectrum analyzer. The device was operated and the transmission time measured with the spectrum analyzer set to zero span at the fundamental frequency.
Basic Standard	47 CFR Part 15.231, RSS-210 A1.1
Cease Operation Limits	
The transmissions shall stop within 5 seconds of either a button being released or if automatically controlled transmissions shall be stopped 5 seconds after transmissions begin.	

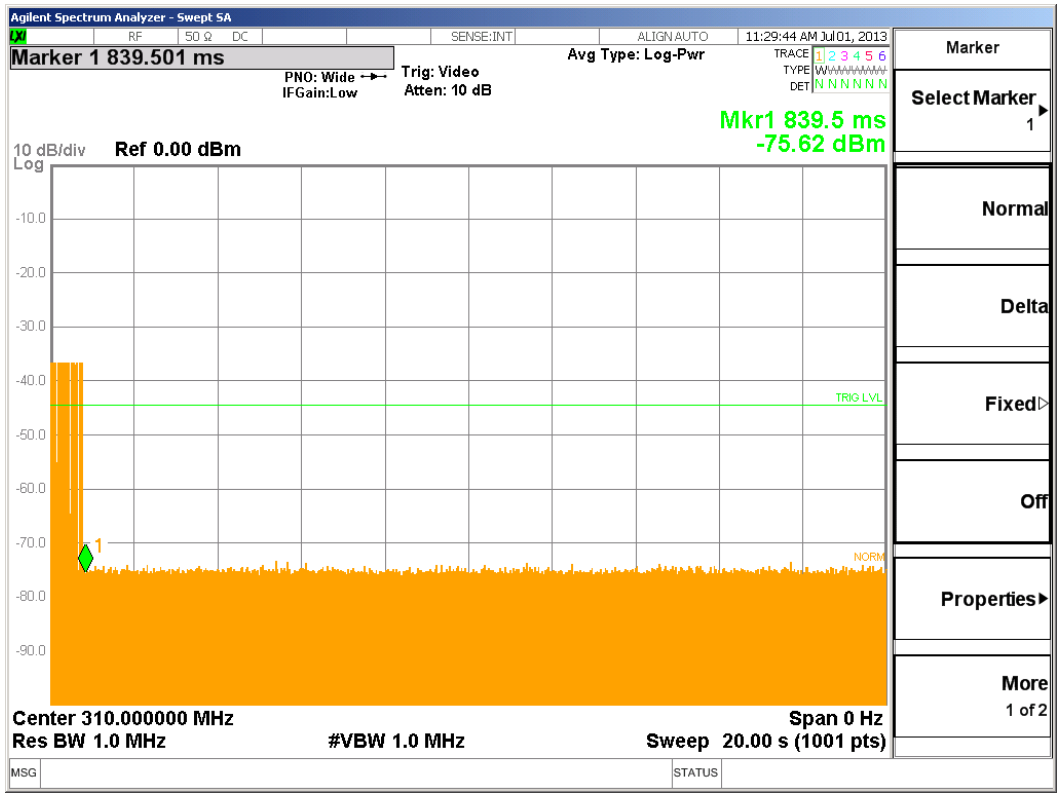
Table 7 Cease Operation Configuration Settings

Power Interface Mode	EUT Configurations Mode	EUT Operation Mode
1	2	8
Supplementary information: None		

Table 8 Cease Operation Test Results

Frequency	Requirement	Cease Operation Time
310MHz	5 seconds or less	839.5mS
Supplementary information: None		

Figure 5 Cease Operation Graph for 310MHz



4.3.3 Test Conditions and Results – Pulse Train / Duty Cycle

Test Description	Measurements were made in the laboratory environment. A Dipole (or equivalent) antenna tuned to the transmit frequency was attached to the input of a spectrum analyzer. The pulse train was measured with the spectrum analyzer set to zero span at the fundamental frequency.
Basic Standard	FCC Part 15 Subpart A, 15.35
Pulse Train Limits	
There are no limits for this test. This data is used to calculate the averaging correction factor that is applied to the measured peak radiated emissions results.	

Table 9 Pulse Train Configuration Settings

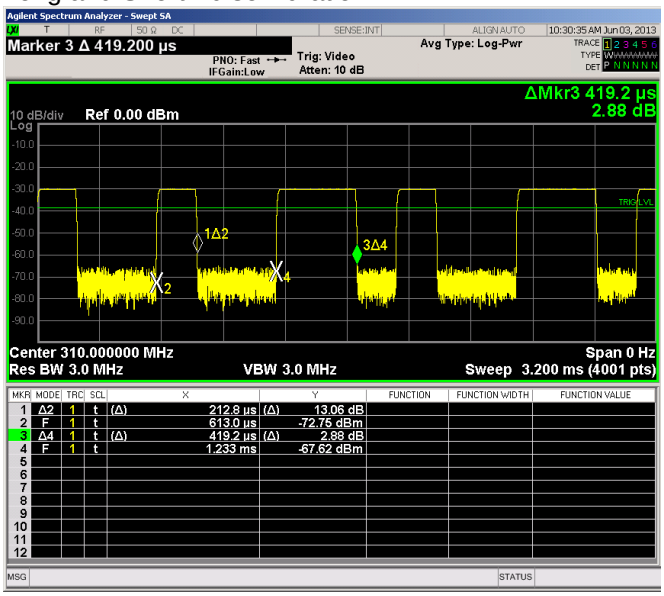
Power Interface Mode	EUT Configurations Mode	EUT Operation Mode
1	2	8
Supplementary information: None		

Table 10 Pulse Train Calculation

Frequency	Pulse Width (mS)	Period or 100ms whichever is lesser	Average Correction Factor (dB) $20\log\left(\frac{PulseWidth}{TotalTransmissionTime}\right)$
310MHz	23.6928	100mS	-12.51
Manufacturer declares the worst case duty cycle at -12.36dB. Declared duty cycle is used for all data.			

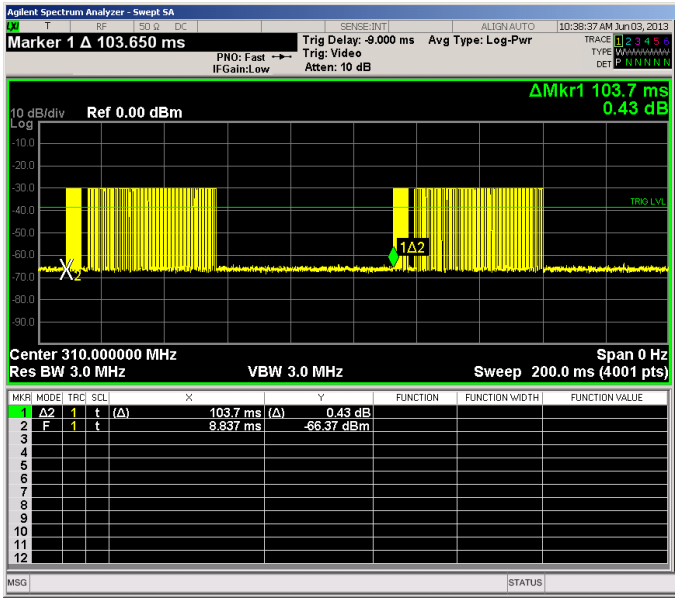
Figure 6 Pulse Train Graphs for 310MHz

Long and Short Pulse Duration



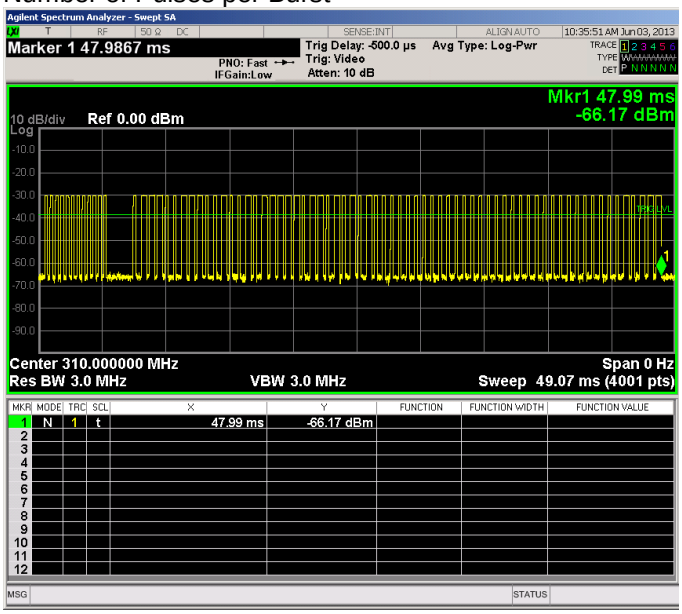
Short Pulse: 212.8uS Long Pulse:419.2uS

Period



Duration: 103.7mS

Number of Pulses per Burst



Short: 56, Long 22

4.3.4 Test Conditions and Results – 20dB / 99% Bandwidth

Test Description	Measurements were made in the laboratory environment. A Dipole (or equivalent) antenna tuned to the transmit frequency was attached to the input of a spectrum analyzer. The device was operated and the spectrum analyzer resolution bandwidth set per the appropriate standard.
Basic Standard	47 CFR Part 15.231, RSS-210 A1.1.3
Occupied Bandwidth Limits	
No wider than 0.25% of the center frequency for devices operating between 70MHz and 900MHz.	
310MHz – 0.7750MHz, 315MHz – 0.7875MHz, 390MHz – 0.9750MHz	

Table 11 Occupied Bandwidth Configuration Settings

Power Interface Mode #	EUT Configurations Mode	EUT Operation Mode
1	2	8
Supplementary information: None		

Table 12 Occupied Bandwidth Spectrum Analyzer Settings

Occupied Bandwidth Requirements		
RBW / VBW Setting – 10kHz/ 30kHz or larger	dBc	%
Requirement	**-20**	**99**
Results for 310MHz	51.300kHz	66.082kHz
Supplementary information: None		

Figure 7 20dB Bandwidth Graphs

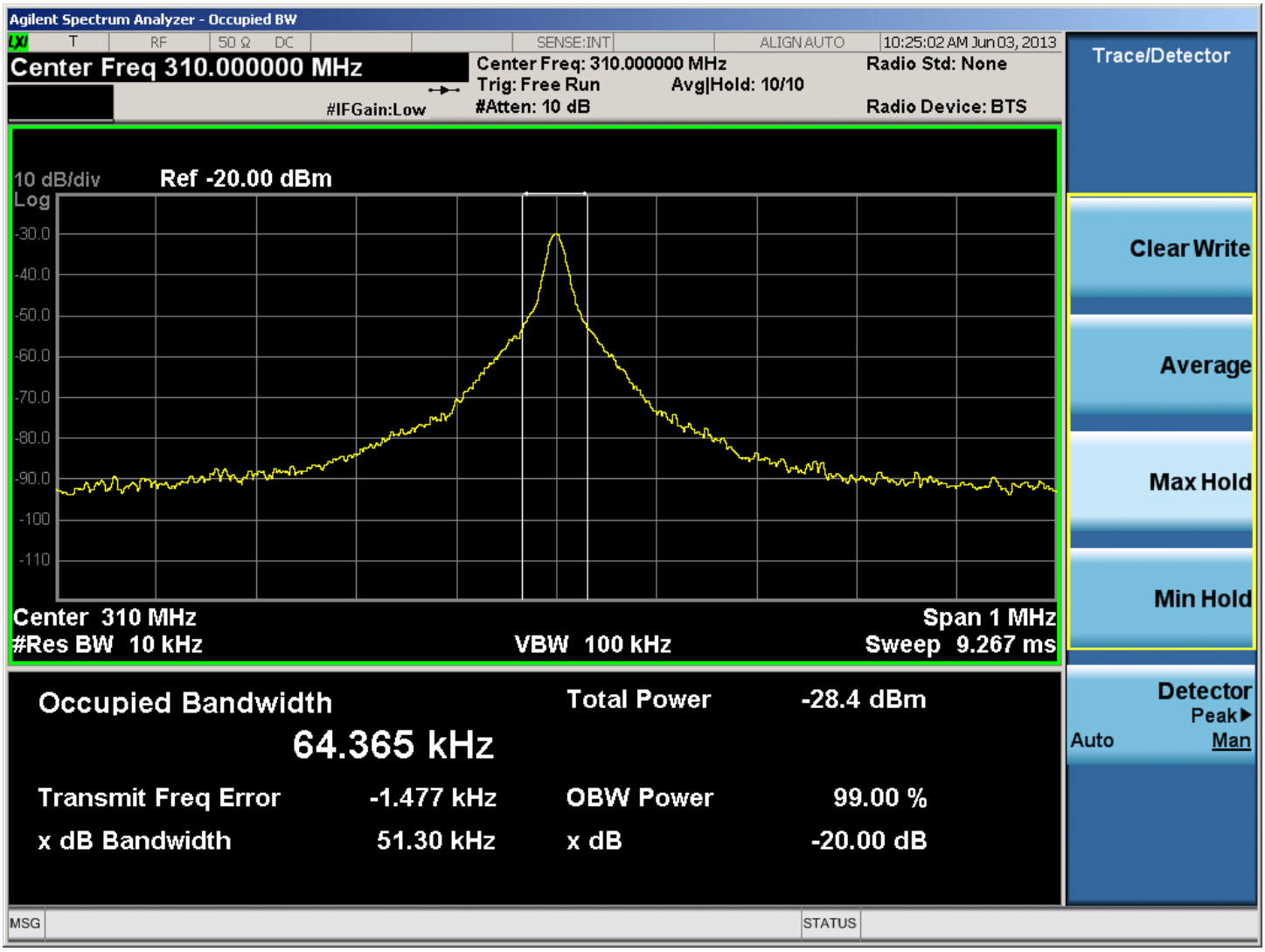
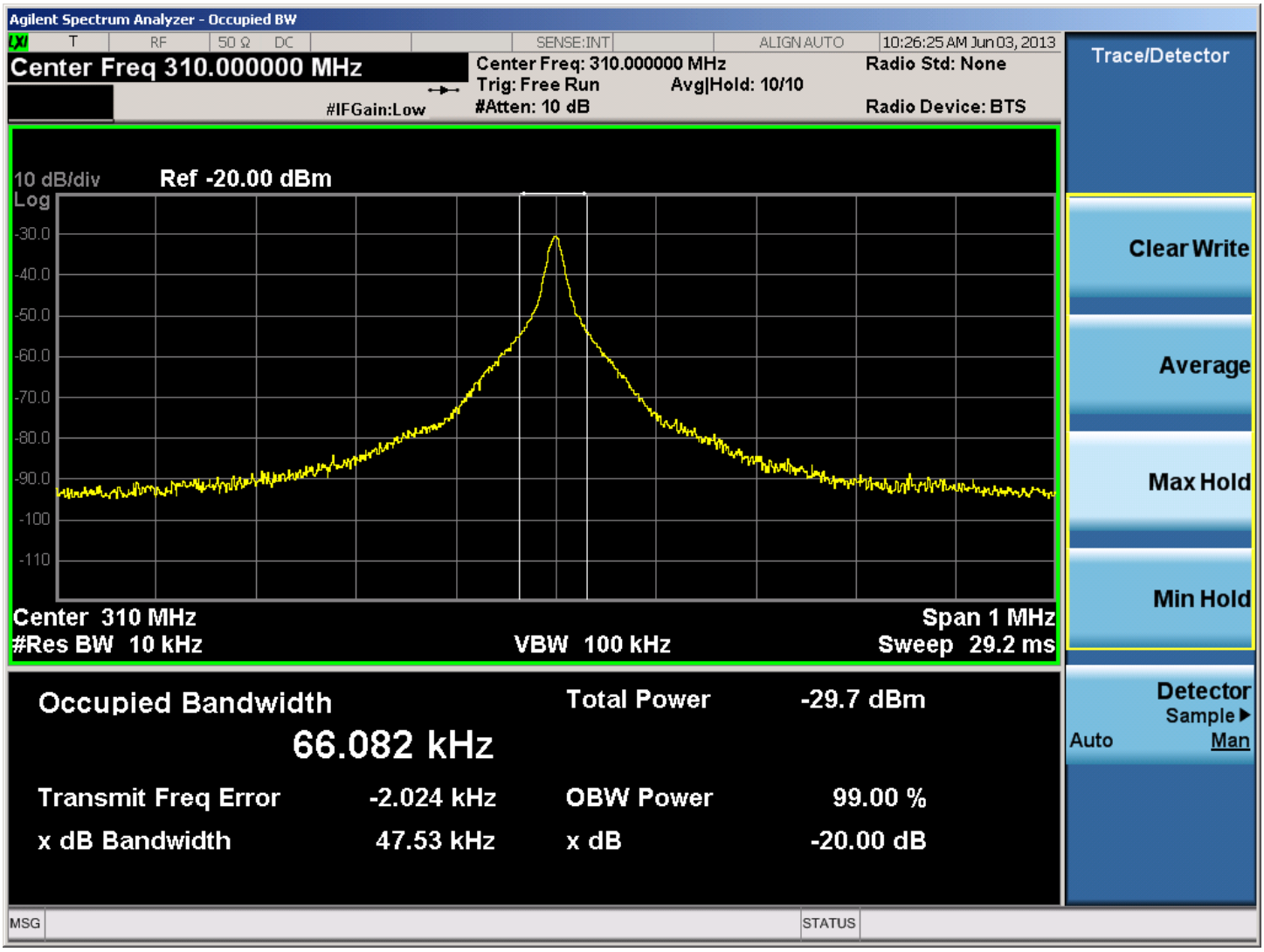


Figure 8 99% Power Bandwidth Graphs



4.4 Mode 2 315MHz

4.4.1 Test Conditions and Results – Fundamental and Harmonics Radiated Emissions

Test Description	Measurements were made in a 10-meter semi-anechoic chamber that complies to CISPR 16/ANSI C63.4:2003. Preliminary (peak) measurements were performed at an antenna to EUT separation distance of 10-meter or 3-meter as noted. The EUT was rotated 360° about its azimuth with the receive antenna located at various heights in both horizontal and vertical polarities. Final measurements (quasi-peak or average as noted) were then performed by rotating the EUT 360° and adjusting the receive antenna height from 1 to 4-meters. All frequencies were investigated in both horizontal and vertical antenna polarity, where applicable.		
Basic Standard	47 CFR Part 15.231, RSS-210 A1.1		
	Frequency range	Measurement Point	
Fully configured sample scanned over the following frequency range	30 MHz – 1GHz	(3m distance)	
	1GHz – 4GHz	(3m distance)	

Limits

Frequency (MHz)	Limit (dBµV/m)	
	Fundamental AV Limit	Non-Restricted Spurious Harmonics AV
310	75.32	55.32
315	75.62	55.62
390	79.24	59.24
	All Other Emissions including Harmonics in restricted bands	
30MHz – 88MHz	40.00	
88MHz – 216MHz	43.52	
216MHz – 960MHz	46.02	
960MHz – 4,000MHz	54.00	

Supplementary information: Please refer to Section 4.3, Mode 1 for Radiated Spurious Emission Data

4.4.2 Test Conditions and Results – Cease Operation

Test Description	Measurements were made in the laboratory environment. A Dipole (or equivalent) antenna tuned to the transmit frequency was attached to the input of a spectrum analyzer. The device was operated and the transmission time measured with the spectrum analyzer set to zero span at the fundamental frequency.
Basic Standard	47 CFR Part 15.231, RSS-210 A1.1
Cease Operation Limits	
The transmissions shall stop within 5 seconds of either a button being released or if automatically controlled transmissions shall be stopped 5 seconds after transmissions begin.	

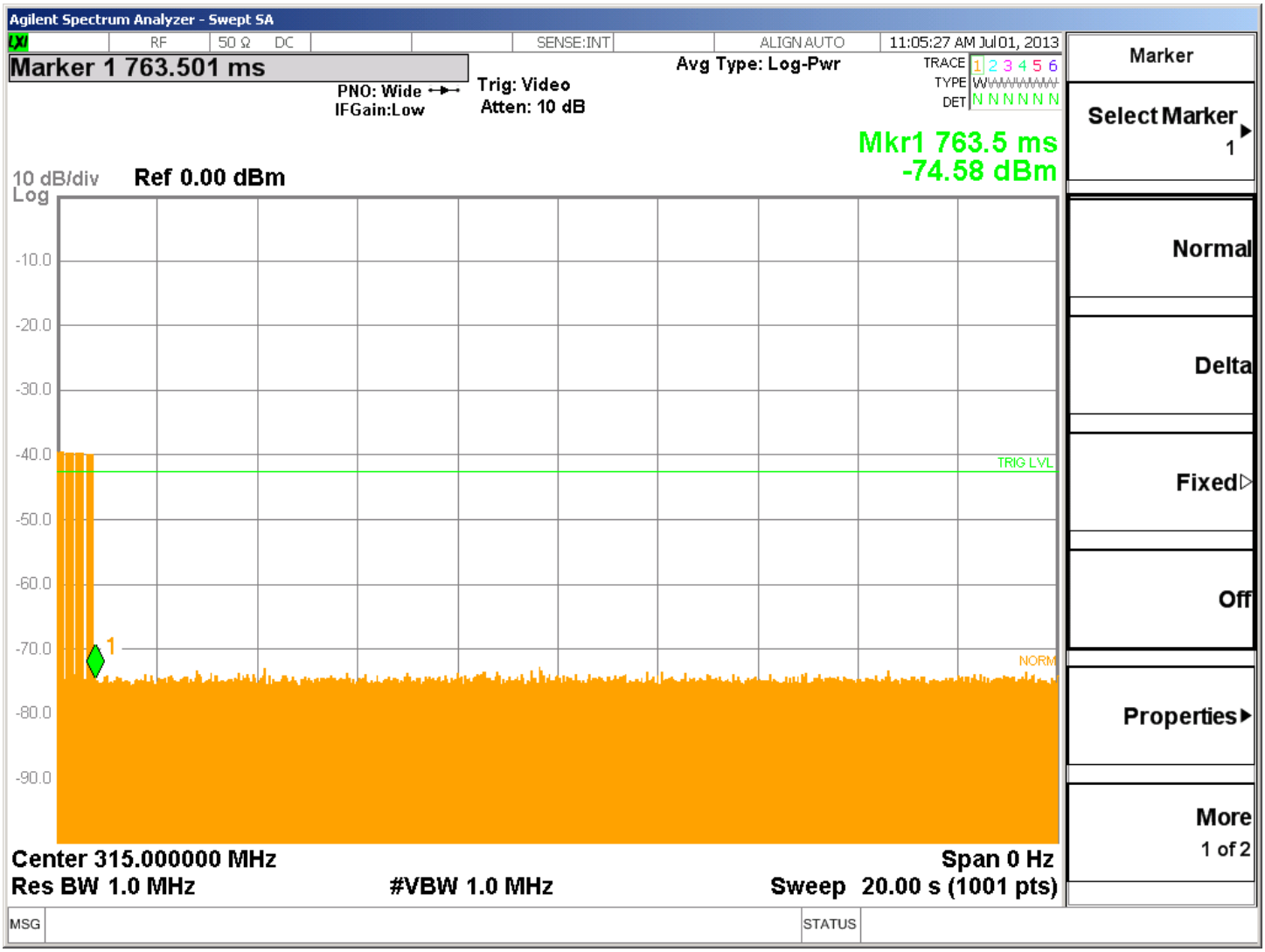
Table 13 Cease Operation Configuration Settings

Power Interface Mode	EUT Configurations Mode	EUT Operation Mode
1	2	2
Supplementary information: None		

Table 14 Cease Operation Test Results

Frequency	Requirement	Cease Operation Time
315MHz	5 seconds or less	763.5mS
Supplementary information: None		

Figure 9 Cease Operation Graph



4.4.3 Test Conditions and Results – Pulse Train / Duty Cycle

Test Description	Measurements were made in the laboratory environment. A Dipole (or equivalent) antenna tuned to the transmit frequency was attached to the input of a spectrum analyzer. The pulse train was measured with the spectrum analyzer set to zero span at the fundamental frequency.
Basic Standard	FCC Part 15 Subpart A, 15.35
Pulse Train Limits	
There are no limits for this test. This data is used to calculate the averaging correction factor that is applied to the measured peak radiated emissions results.	

Table 15 Pulse Train Configuration Settings

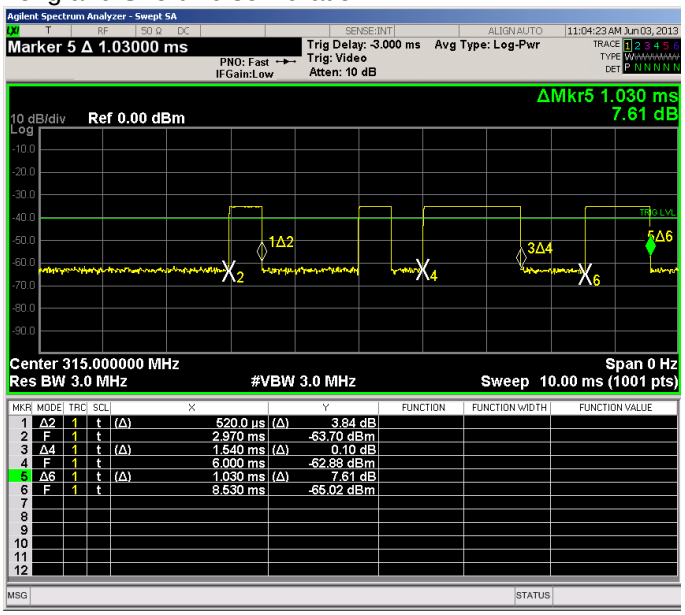
Power Interface Mode	EUT Configurations Mode	EUT Operation Mode
1	2	2
Supplementary information: None		

Table 16 Pulse Train Calculation

Frequency	Pulse Width (mS)	Period or 100ms whichever is lesser	Average Correction Factor (dB) $20\log\left(\frac{PulseWidth}{TotalTransmissionTime}\right)$
315MHz	23.6928	99.35mS	-14.81
Manufacturer declares the worst case duty cycle at -10.17dB. Declared duty cycle is used for all data.			

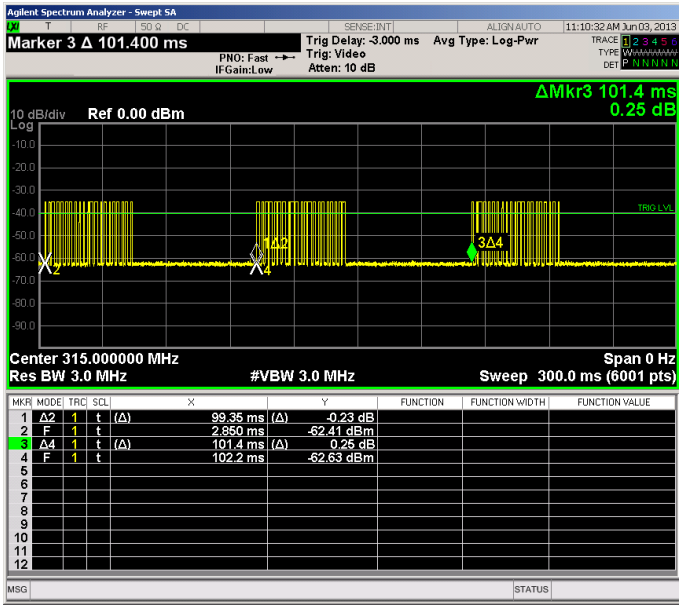
Figure 10 Pulse Train Graphs

Long and Short Pulse Duration



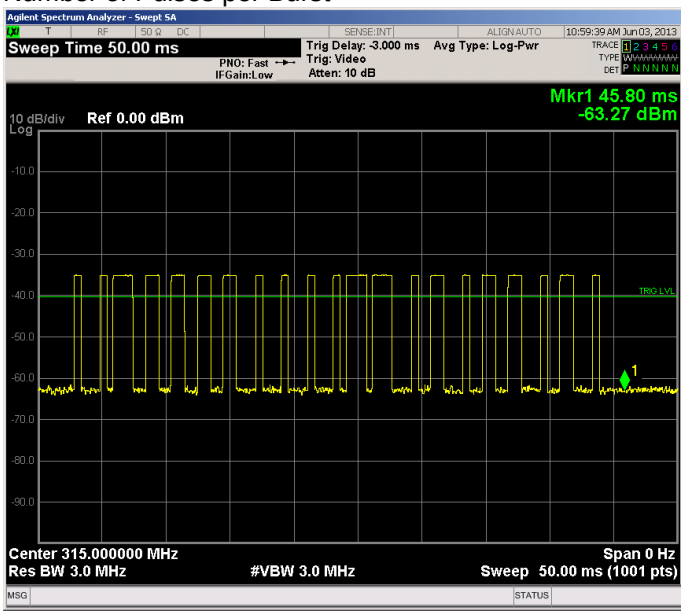
Short: 520.0uS Medium: 1030uS Long 1540uS

Period



Duration: 99.35mS

Number of Pulses per Burst



Short: 10 Medium: 8 Long: 3

4.4.4 Test Conditions and Results – 20dB / 99% Bandwidth

Test Description	Measurements were made in the laboratory environment. A Dipole (or equivalent) antenna tuned to the transmit frequency was attached to the input of a spectrum analyzer. The device was operated and the spectrum analyzer resolution bandwidth set per the appropriate standard.
Basic Standard	47 CFR Part 15.231, RSS-210 A1.1.3
Occupied Bandwidth Limits	
No wider than 0.25% of the center frequency for devices operating between 70MHz and 900MHz.	
310MHz – 0.7750MHz, 315MHz – 0.7875MHz, 390MHz – 0.9750MHz	

Table 17 Occupied Bandwidth Configuration Settings

Power Interface Mode #	EUT Configurations Mode	EUT Operation Mode
1	2	2
Supplementary information: None		

Table 18 Occupied Bandwidth Spectrum Analyzer Settings

Occupied Bandwidth Requirements		
RBW / VBW Setting – 10kHz/30kHz or larger	dBc	%
Requirement	**-20**	**99**
Results for 315MHz	53.340kHz	65.433kHz
Supplementary information: None		

Figure 11 20dB Bandwidth Graphs

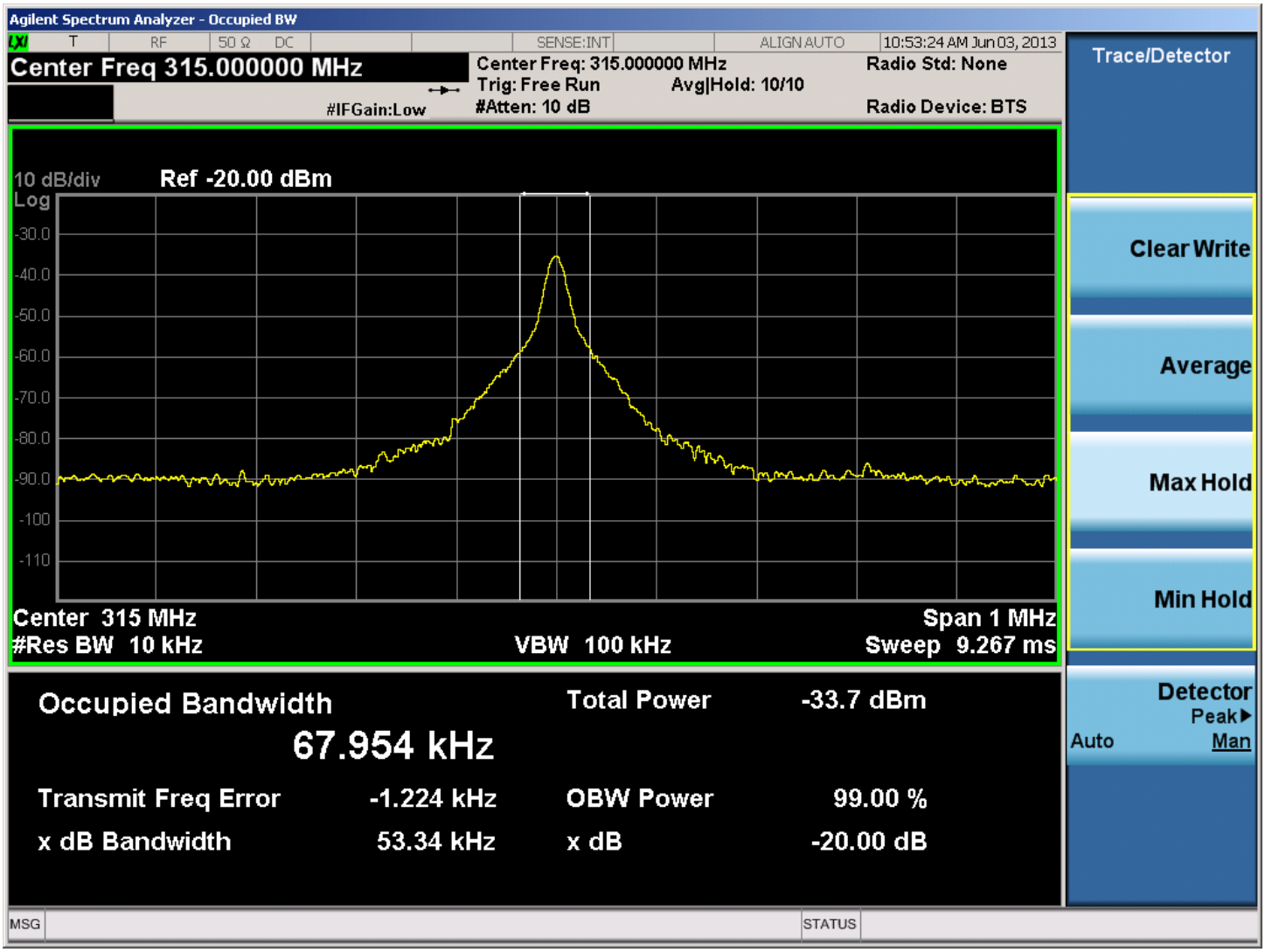
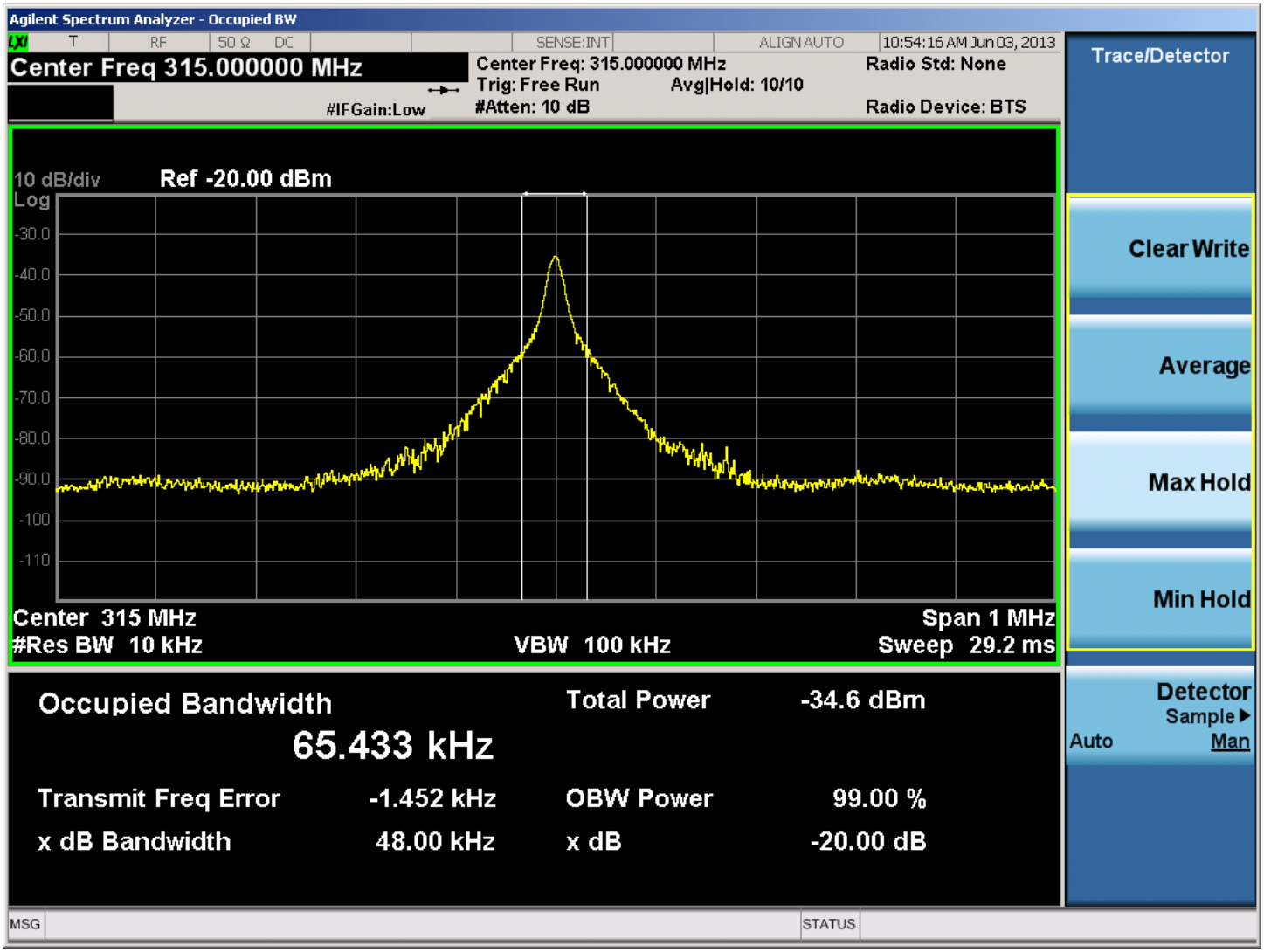


Figure 12 99% Power Bandwidth Graphs



4.5 Mode 7 318MHz

4.5.1 Test Conditions and Results – Fundamental and Harmonics Radiated Emissions

Test Description	Measurements were made in a 10-meter semi-anechoic chamber that complies to CISPR 16/ANSI C63.4:2003. Preliminary (peak) measurements were performed at an antenna to EUT separation distance of 10-meter or 3-meter as noted. The EUT was rotated 360° about its azimuth with the receive antenna located at various heights in both horizontal and vertical polarities. Final measurements (quasi-peak or average as noted) were then performed by rotating the EUT 360° and adjusting the receive antenna height from 1 to 4-meters. All frequencies were investigated in both horizontal and vertical antenna polarity, where applicable.		
Basic Standard	47 CFR Part 15.231, RSS-210 A1.1		
	Frequency range	Measurement Point	
Fully configured sample scanned over the following frequency range	30 MHz – 1GHz	(3m distance)	
	1GHz – 4GHz	(3m distance)	

Limits

Frequency (MHz)	Limit (dBµV/m)	
	Fundamental AV Limit	Non-Restricted Spurious Harmonics AV
318	75.80	55.80
	All Other Emissions including Harmonics in restricted bands	
30MHz – 88MHz	40.00	
88MHz – 216MHz	43.52	
216MHz – 960MHz	46.02	
960MHz – 4,000MHz	54.00	

Supplementary information: Spurious limits are only applied against products of the transmitter. All other emissions must meet the general limits. All emissions below 1GHz were maximized. Above 1GHz only emissions within 6dB of the limit were maximized. Emissions that do not contain azimuth data, their level is based on pre-scan data.

Table 19 Radiated Emissions EUT Configuration Settings

Power Interface Mode	EUT Configurations Mode	EUT Operation Mode
1	1	7
Supplementary information: None		

Figure 13 Radiated Emissions Graph 30MHz – 1GHz

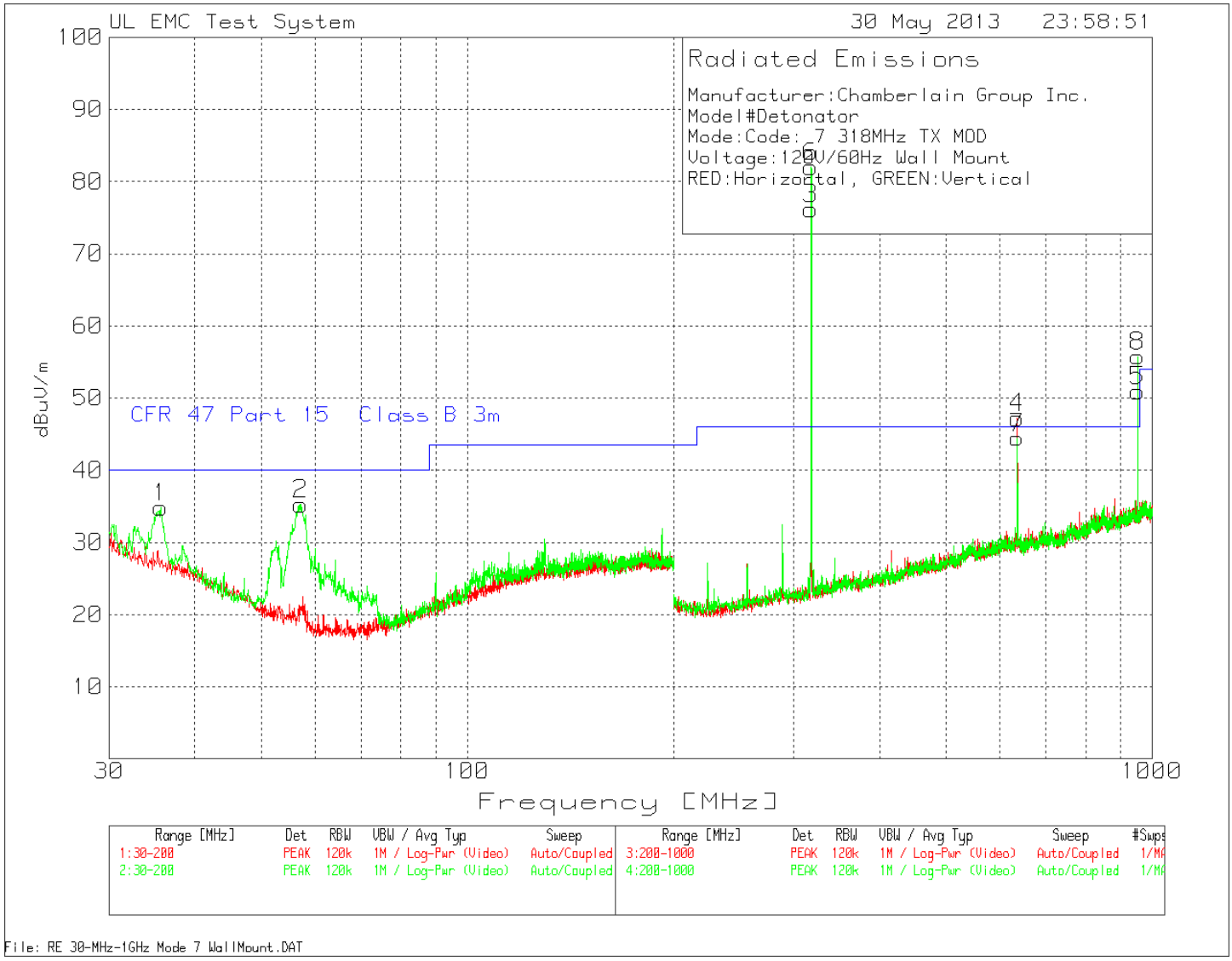
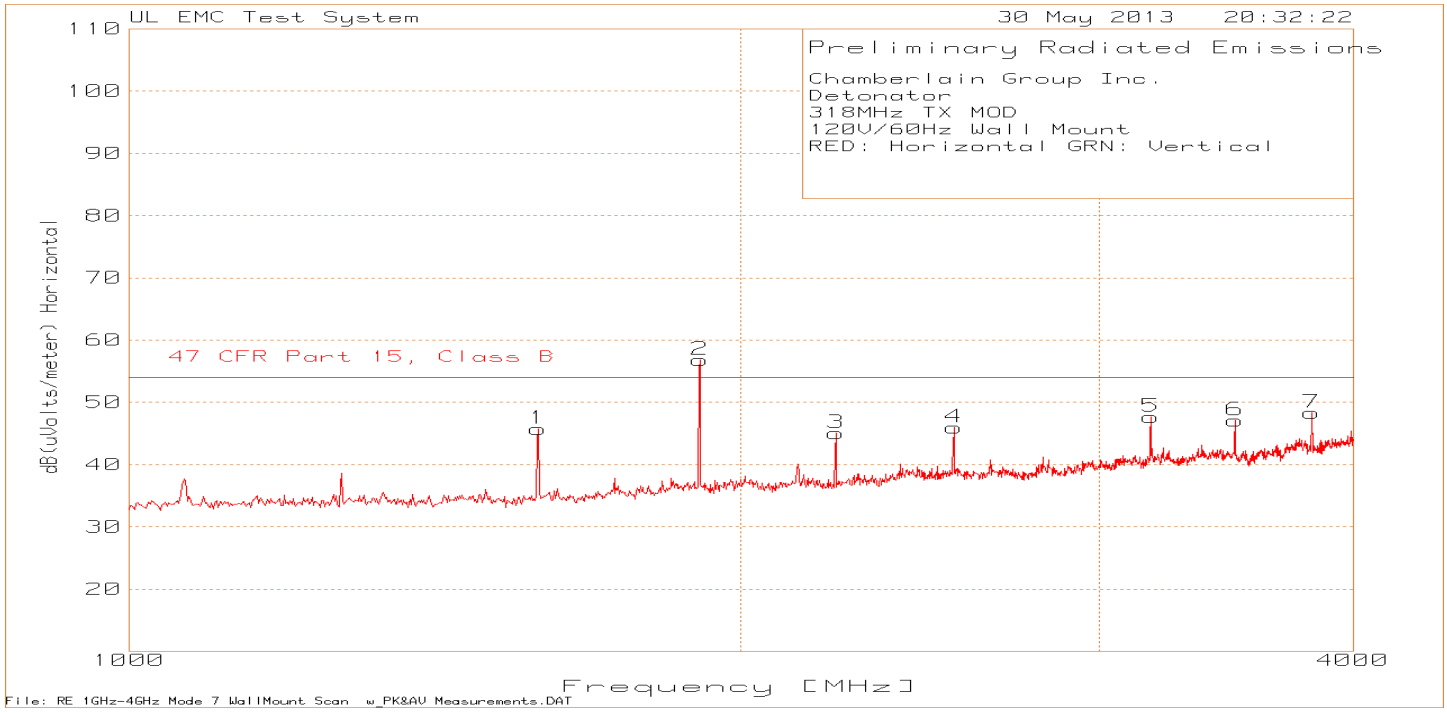


Figure 14 Radiated Emissions Graph 1GHz – 4GHz



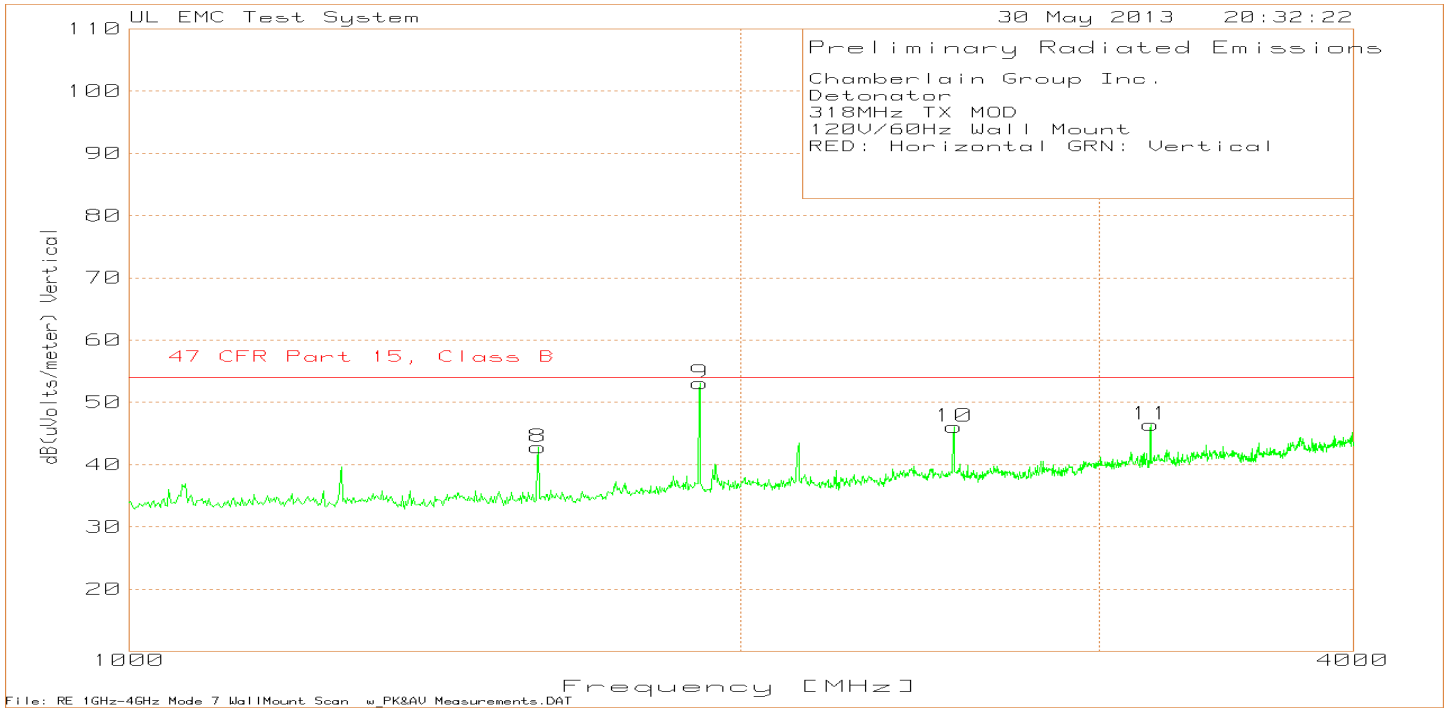


Table 20 Radiated Emissions Data Points

Test Frequency MHz	Meter Reading dBuV	Detector	AF dB/m	PF dB	Peak Level dBuV/m	DC Factor dB	Average Level dBuV/m	Peak Limit dBuV/m	Peak Margin dB	Average Limit dBuV/m	Margin dB	Azimuth [Degs]	Height [cm]	Polarity
318.0098	61.58	PK	14.4	2.1	78.08	-15.11	62.97	95.8	-17.72	75.8	-12.83	188	102	Horz
318.0123	57.99	PK	14.4	2.1	74.49	-15.11	59.38	95.8	-21.31	75.8	-16.42	204	102	Vert
636.0065	22.82	PK	20.7	3.1	46.62	-15.11	31.51	66	-19.38	46	-14.49	201	139	Horz
635.993	18.62	PK	20.7	3.1	42.42	-15.11	27.31	66	-23.58	46	-18.69	13	101	Vert
954.0125	22.5	PK	24	3.9	50.4	-15.11	35.29	66	-15.6	46	-10.71	218	234	Horz
954.0015	27.75	PK	24	3.9	55.65	-15.11	40.54	66	-10.35	46	-5.46	152	112	Vert
1590.394	75.31	PK	25.3	-54.9	45.71	-15.11	30.6	74	-28.29	54	-23.4	-	100	Horz
1908.0451	83.24	PK	27.3	-54.46	56.08	-15.11	40.97	74	-17.92	54	-13.03	179	146	Horz
2226.818	70.55	PK	27.5	-52.96	45.09	-15.11	29.98	74	-28.91	54	-24.02	-	100	Horz
2545.03	69.11	PK	28.9	-52.04	45.97	-15.11	30.86	74	-28.03	54	-23.14	-	150	Horz
3181.454	68.61	PK	30.7	-51.64	47.67	-15.11	32.56	74	-26.33	54	-21.44	-	200	Horz
3499.666	66.91	PK	31.2	-51.05	47.06	-15.11	31.95	74	-26.94	54	-22.05	-	100	Horz
3815.8166	69.92	PK	32.5	-52.62	49.8	-15.11	34.69	74	-24.2	54	-19.31	2	100	Horz
1590.394	72.41	PK	25.3	-54.9	42.81	-15.11	27.7	74	-31.19	54	-26.3	-	100	Vert
1908.0451	82.34	PK	27.3	-54.46	55.18	-15.11	40.07	74	-18.82	54	-13.93	279	104	Vert
2545.03	69.28	PK	28.9	-52.04	46.14	-15.11	31.03	74	-27.86	54	-22.97	-	100	Vert
3181.454	67.36	PK	30.7	-51.64	46.42	-15.11	31.31	74	-27.58	54	-22.69	-	150	Vert

AF – Antenna Factor, PF-Path Loss/Gain, PK-peak detector, DC-Duty cycle

4.5.2 Test Conditions and Results – Cease Operation

Test Description	Measurements were made in the laboratory environment. A Dipole (or equivalent) antenna tuned to the transmit frequency was attached to the input of a spectrum analyzer. The device was operated and the transmission time measured with the spectrum analyzer set to zero span at the fundamental frequency.
Basic Standard	47 CFR Part 15.231, RSS-210 A1.1
Cease Operation Limits	
The transmissions shall stop within 5 seconds of either a button being released or if automatically controlled transmissions shall be stopped 5 seconds after transmissions begin.	

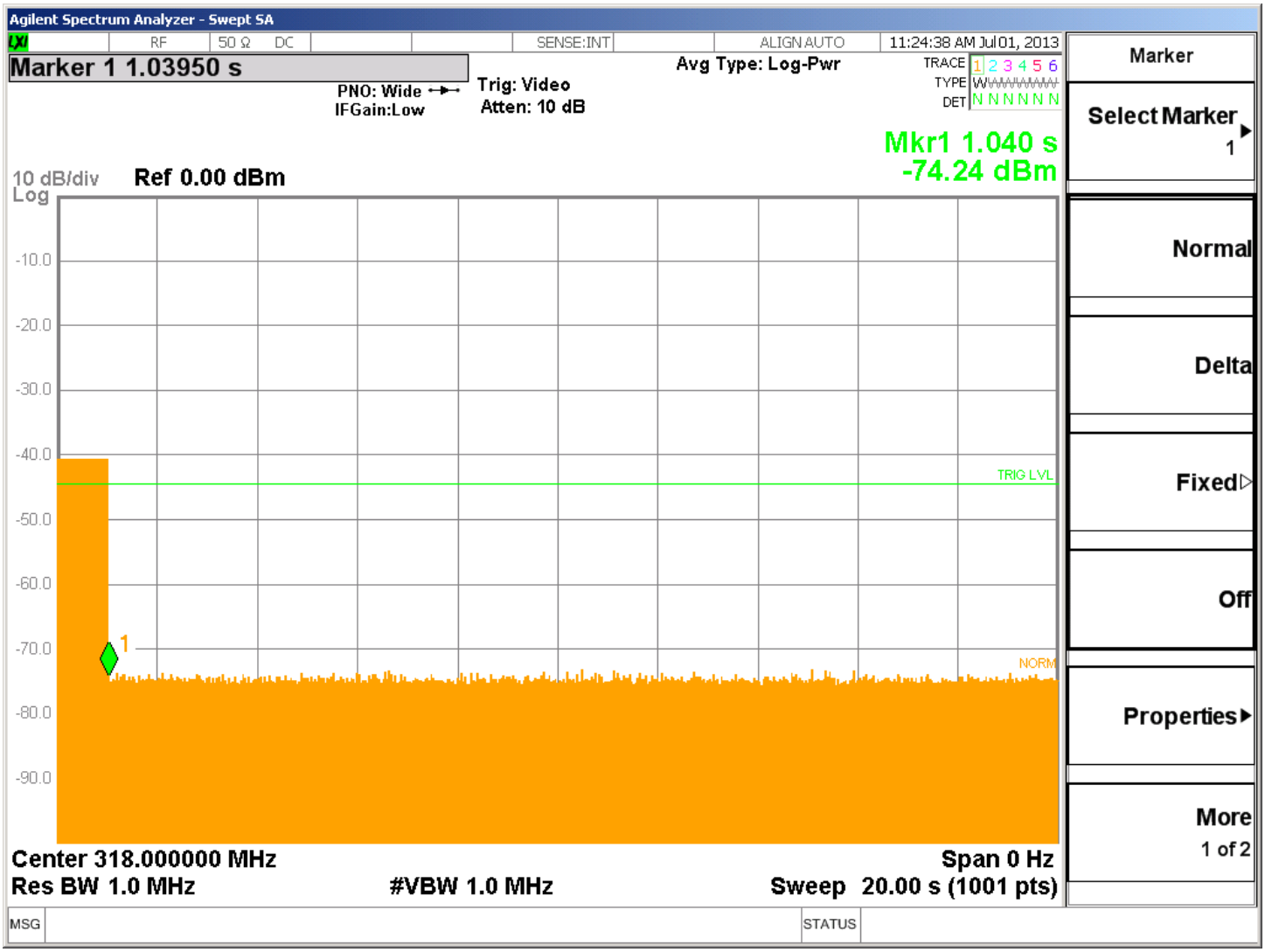
Table 21 Cease Operation Configuration Settings

Power Interface Mode	EUT Configurations Mode	EUT Operation Mode
1	2	7
Supplementary information: None		

Table 22 Cease Operation Test Results

Frequency	Requirement	Cease Operation Time
318MHz	5 seconds or less	1.040s
Supplementary information: None		

Figure 15 Cease Operation Graph



4.5.3 Test Conditions and Results – Pulse Train / Duty Cycle

Test Description	Measurements were made in the laboratory environment. A Dipole (or equivalent) antenna tuned to the transmit frequency was attached to the input of a spectrum analyzer. The pulse train was measured with the spectrum analyzer set to zero span at the fundamental frequency.
Basic Standard	FCC Part 15 Subpart A, 15.35
Pulse Train Limits	
There are no limits for this test. This data is used to calculate the averaging correction factor that is applied to the measured peak radiated emissions results.	

Table 23 Pulse Train Configuration Settings

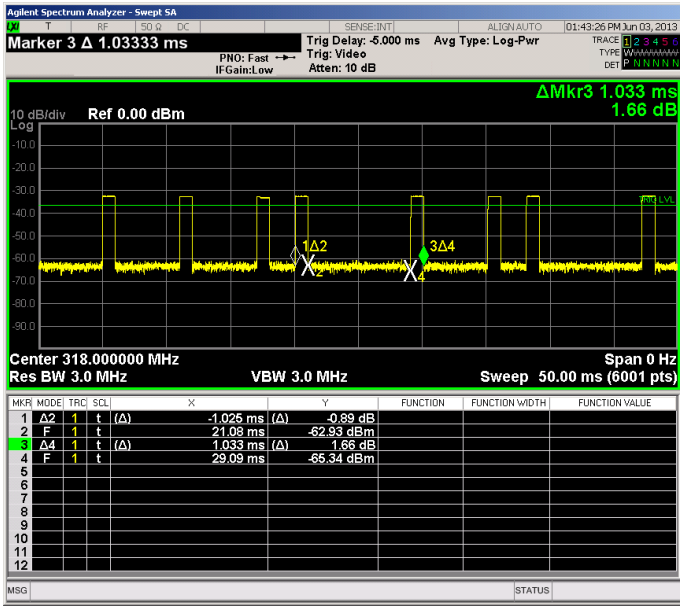
Power Interface Mode	EUT Configurations Mode	EUT Operation Mode
1	2	7
Supplementary information: None		

Table 24 Pulse Train Calculation

Frequency	Pulse Width (mS)	Period or 100ms whichever is lesser	Average Correction Factor (dB) $20\log\left(\frac{PulseWidth}{TotalTransmissionTime}\right)$
318MHz	17.561	100mS	-15.11
Manufacturer declares the worst case duty cycle at -15.39dB. Measured Duty cycle used for all data.			

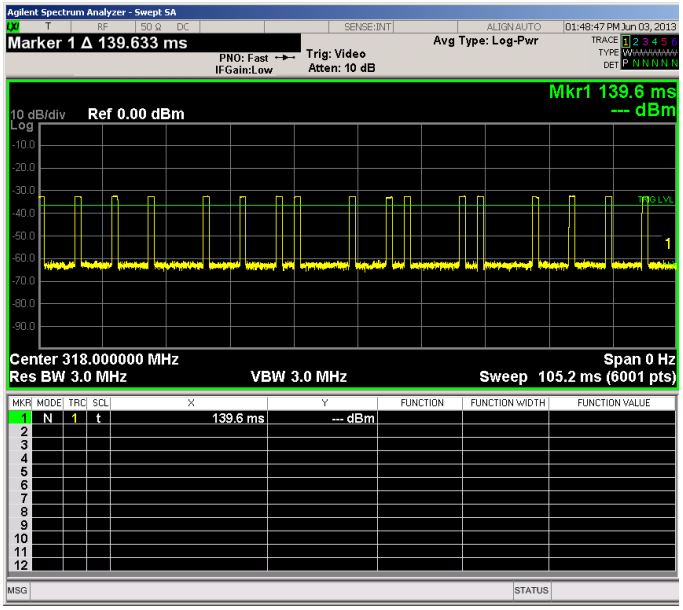
Figure 16 Pulse Train Graphs

Pulse Duration



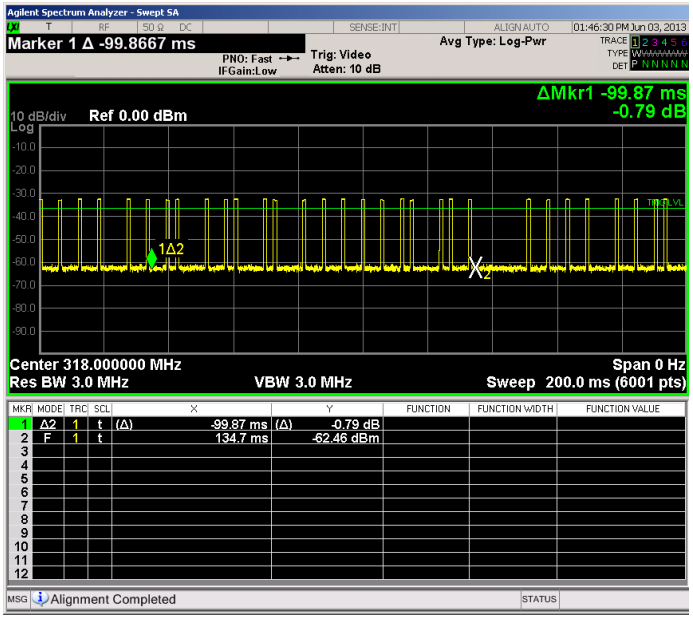
Duration: 1.033mS

Number of Pulses in 100mS – count 1



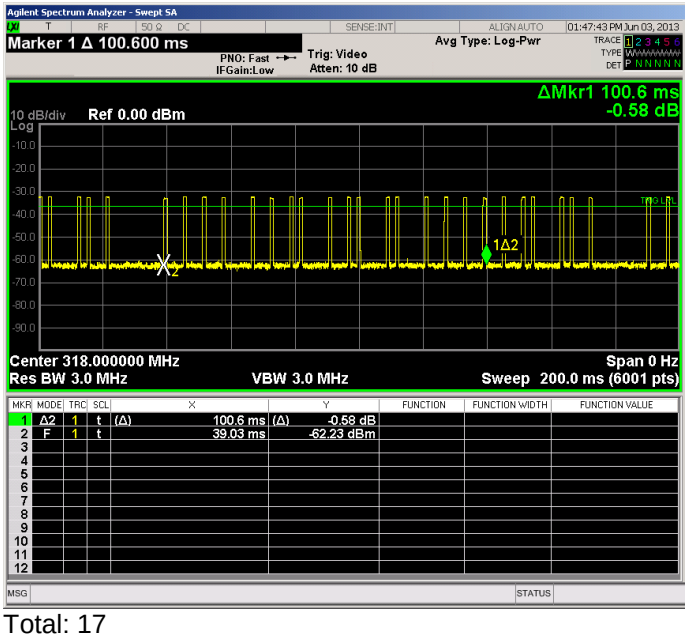
Total: 17

Number of Pulses in 100mS – count 2



Total: 17

Number of Pulses in 100mS – count 3



Total: 17

4.5.4 Test Conditions and Results – 20dB / 99% Bandwidth

Test Description	Measurements were made in the laboratory environment. A Dipole (or equivalent) antenna tuned to the transmit frequency was attached to the input of a spectrum analyzer. The device was operated and the spectrum analyzer resolution bandwidth set per the appropriate standard.
Basic Standard	47 CFR Part 15.231, RSS-210 A1.1.3
Occupied Bandwidth Limits	
No wider than 0.25% of the center frequency for devices operating between 70MHz and 900MHz.	
For 318MHz: 0.795MHz Allowed Bandwidth	

Table 25 Occupied Bandwidth Configuration Settings

Power Interface Mode #	EUT Configurations Mode	EUT Operation Mode
1	2	7
Supplementary information: None		

Table 26 Occupied Bandwidth Spectrum Analyzer Settings

Occupied Bandwidth Requirements		
Minimum RBW / VBW Setting – 10kHz/30kHz or larger	dBc	%
Requirement	**-20**	**99**
Results for 318MHz	55.750kHz	70.792kHz
Supplementary information: None		

Figure 17 20dB Bandwidth Graphs

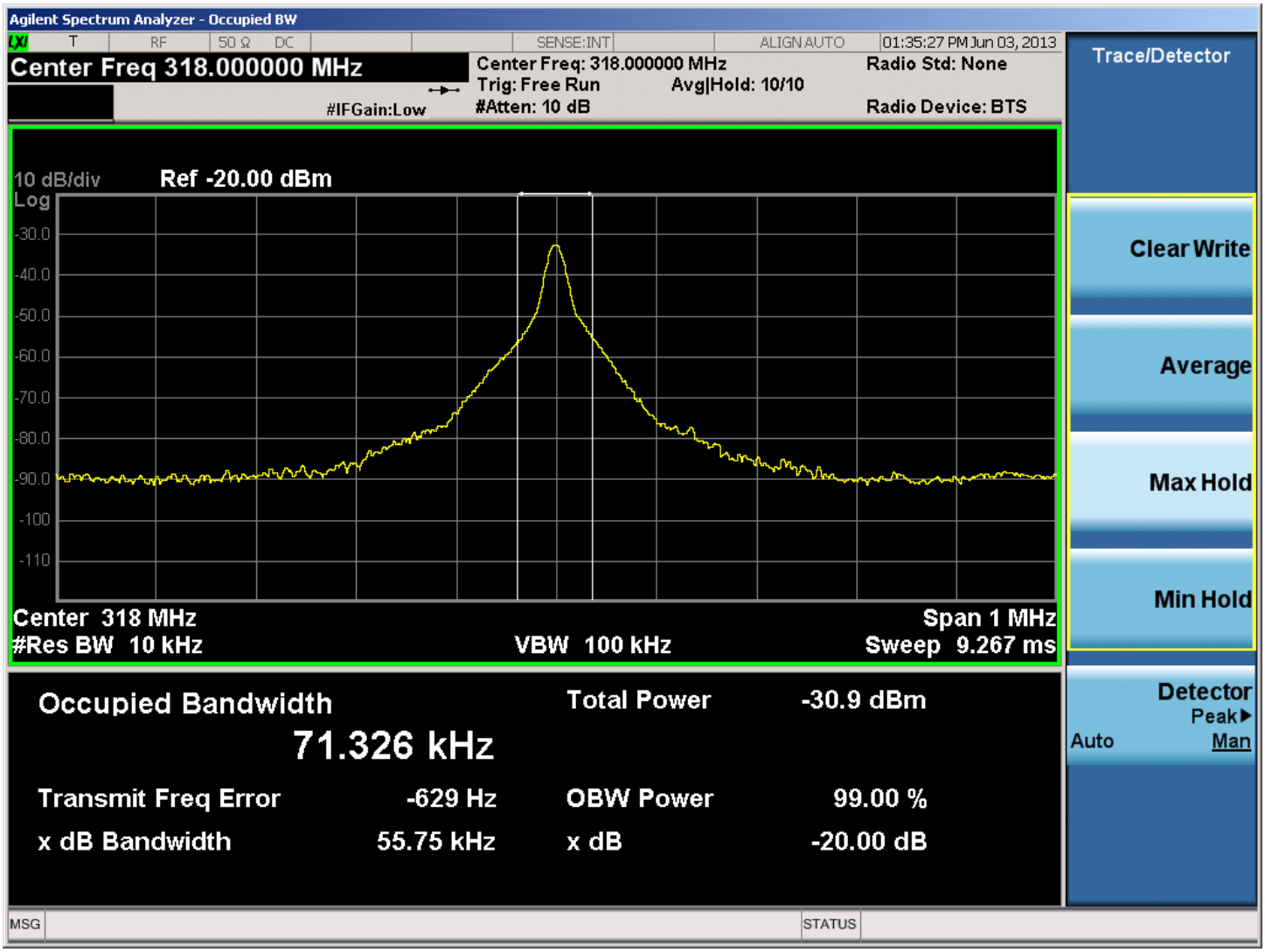
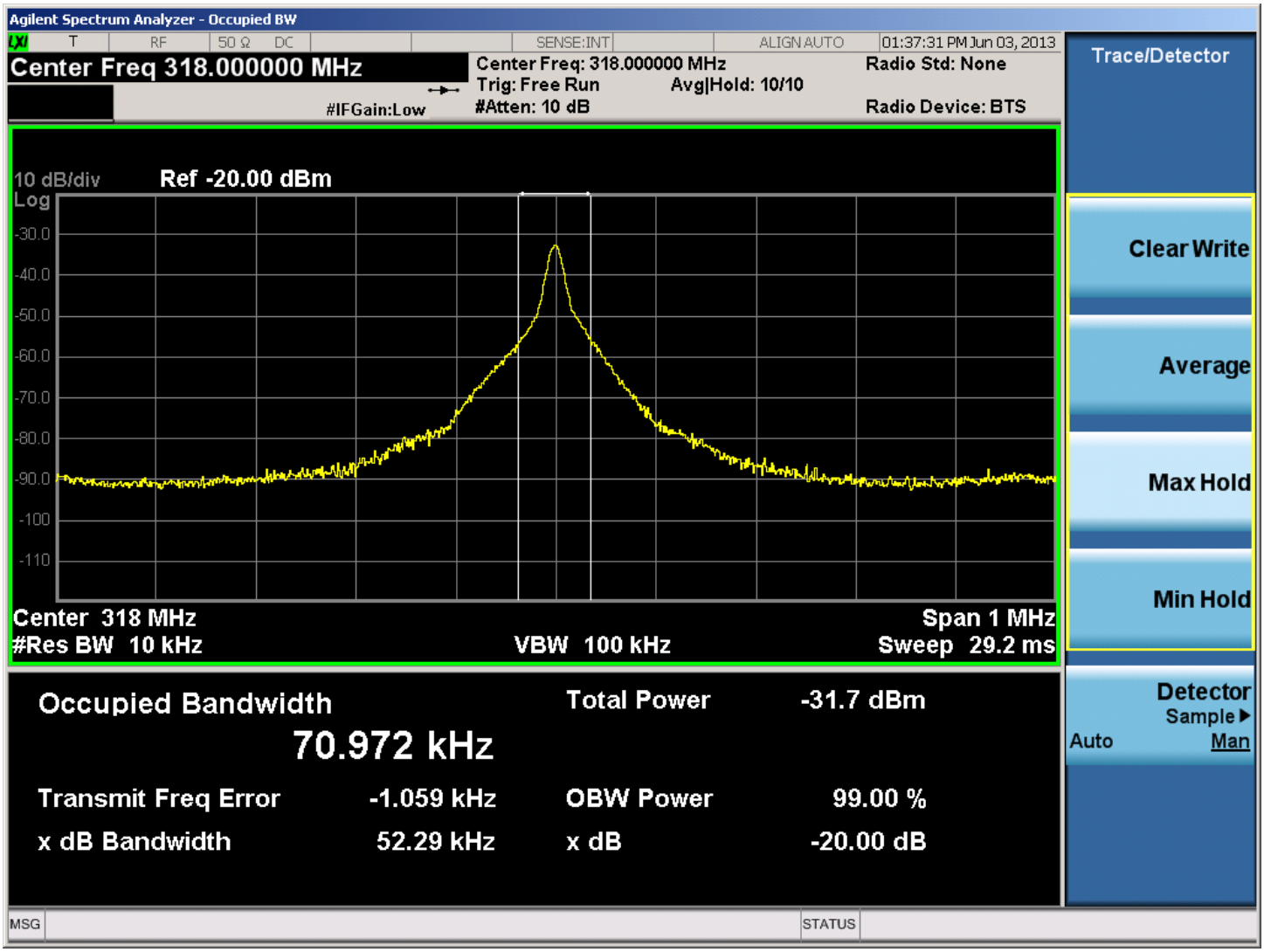


Figure 18 99% Power Bandwidth Graphs



4.6 Mode 9 372.5MHz

4.6.1 Test Conditions and Results – Fundamental and Harmonics Radiated Emissions

Test Description	Measurements were made in a 10-meter semi-anechoic chamber that complies to CISPR 16/ANSI C63.4:2003. Preliminary (peak) measurements were performed at an antenna to EUT separation distance of 10-meter or 3-meter as noted. The EUT was rotated 360° about its azimuth with the receive antenna located at various heights in both horizontal and vertical polarities. Final measurements (quasi-peak or average as noted) were then performed by rotating the EUT 360° and adjusting the receive antenna height from 1 to 4-meters. All frequencies were investigated in both horizontal and vertical antenna polarity, where applicable.		
Basic Standard	47 CFR Part 15.231, RSS-210 A1.1		
	Frequency range	Measurement Point	
Fully configured sample scanned over the following frequency range	30 MHz – 1GHz	(3m distance)	
	1GHz – 4GHz	(3m distance)	

Limits

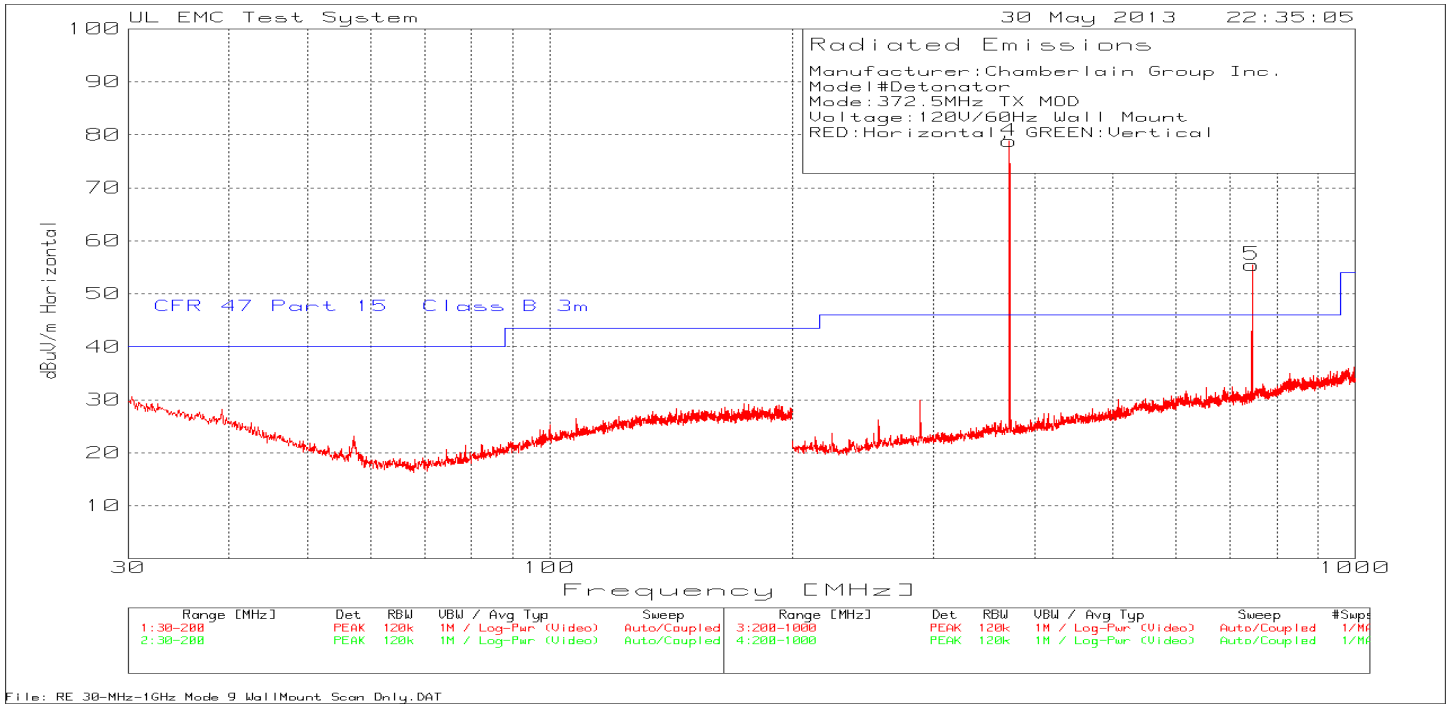
Frequency (MHz)	Limit (dBµV/m)	
	Fundamental AV Limit	Non-Restricted Spurious Harmonics AV
372.5	78.52	58.52
	All Other Emissions including Harmonics in restricted bands	
30MHz – 88MHz	40.00	
88MHz – 216MHz	43.52	
216MHz – 960MHz	46.02	
960MHz – 4,000MHz	54.00	

Supplementary information: Spurious limits are only applied against products of the transmitter. All other emissions must meet the general limits. All emissions below 1GHz were maximized. Above 1GHz only emissions within 6dB of the limit were maximized. Emissions that do not contain azimuth data, their level is based on pre-scan data.

Table 27 Radiated Emissions EUT Configuration Settings

Power Interface Mode	EUT Configurations Mode	EUT Operation Mode
1	1	9
Supplementary information: None		

Figure 19 Radiated Emissions Graph 30MHz – 1GHz



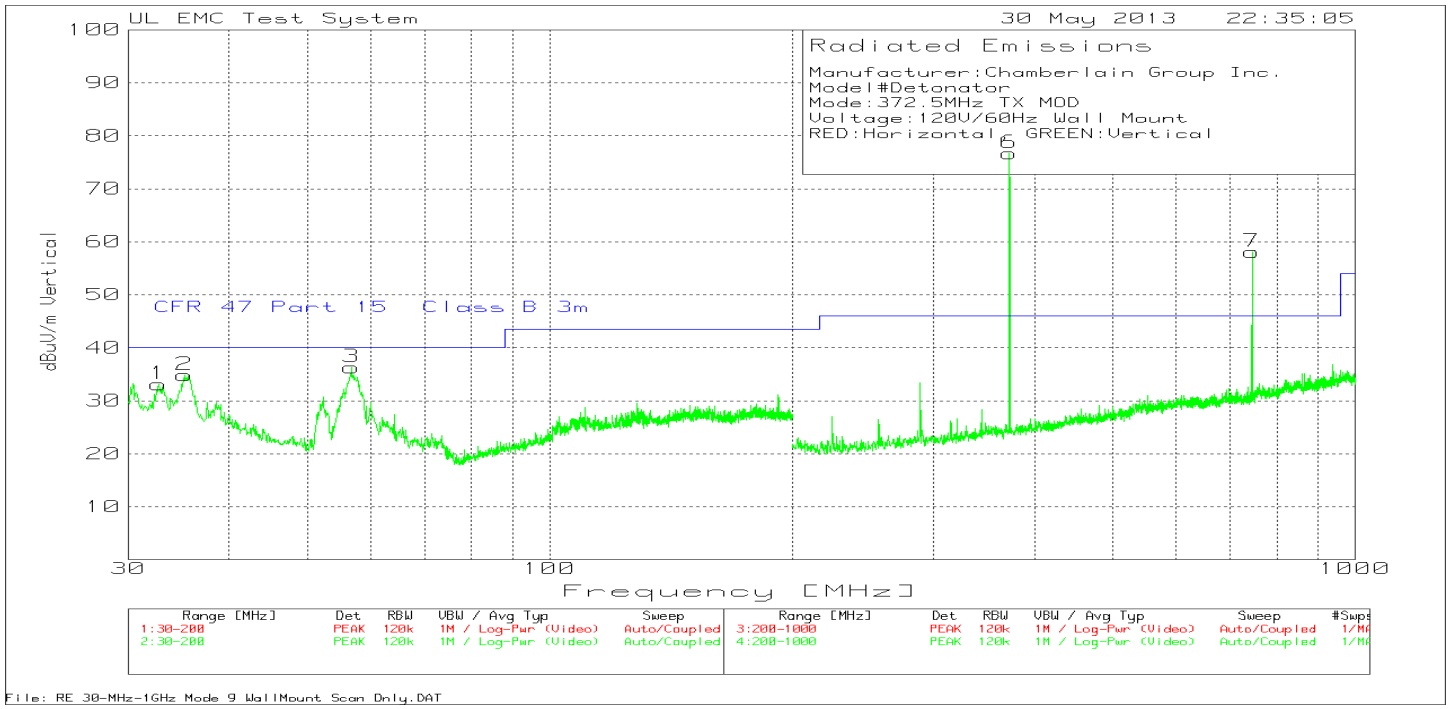


Figure 20 Radiated Emissions Graph 1GHz – 4GHz

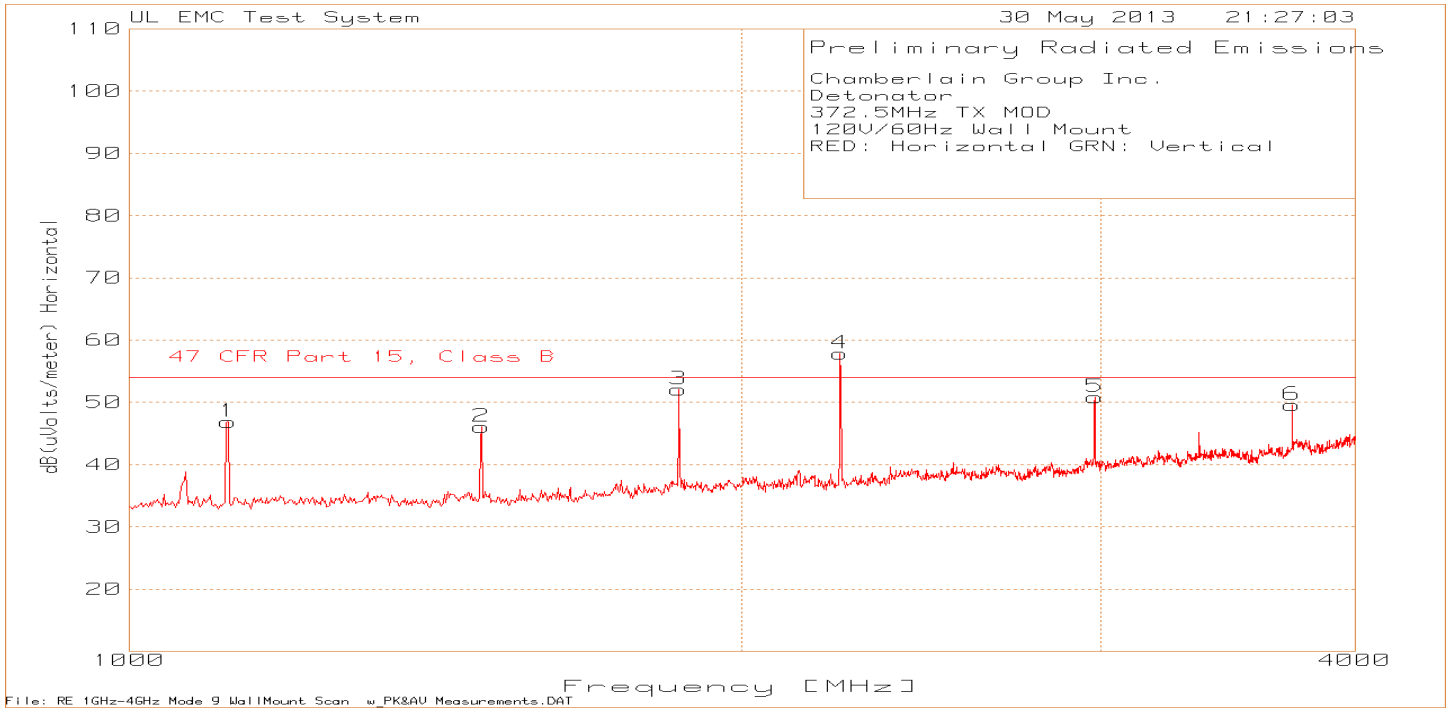


Table 28 Radiated Emissions Data Points

Test Frequency MHz	Meter Reading dBuV	Detector	AF dB/m	PF dB	Peak Level dBuV/m	DC Factor dB	Average Level dBuV/m	Peak Limit dBuV/m	Peak Margin dB	Average Limit dBuV/m	Margin dB	Azimuth [Degs]	Height [cm]	Polarity
372.5055	59.39	PK	15.7	2.3	77.39	-12.36	65.03	98.52	-21.13	78.52	-13.49	191	101	Horz
372.512	52	PK	15.7	2.3	70	-12.36	57.64	98.52	-28.52	78.52	-20.88	134	127	Vert
745.0123	30.24	PK	21.7	3.4	55.34	-12.36	42.98	66	-10.66	46	-3.02	18	110	Horz
745.0038	31.99	PK	21.7	3.4	57.09	-12.36	44.73	66	-8.91	46	-1.27	338	150	Vert
1118.079	79.42	PK	24.9	-57.49	46.83	-12.36	34.47	74	-27.17	54	-19.53	-	150	Horz
1490.327	76.54	PK	25.2	-55.64	46.1	-12.36	33.74	74	-27.9	54	-20.26	-	100	Horz
1862.4248	81.04	PK	27.1	-54.43	53.71	-12.36	41.35	74	-20.29	54	-12.65	195	116	Horz
2235.0872	83.24	PK	27.5	-52.81	57.93	-12.36	45.57	74	-16.07	54	-8.43	221	100	Horz
2980.0752	72.35	PK	29.8	-50.9	51.25	-12.36	38.89	74	-22.75	54	-15.11	216	100	Horz
3724.6844	70.56	PK	32	-51.24	51.32	-12.36	38.96	74	-22.68	54	-15.04	353	100	Horz
1118.079	78.89	PK	24.9	-57.49	46.3	-12.36	33.94	74	-27.7	54	-20.06	-	100	Vert
1490.327	75.21	PK	25.2	-55.64	44.77	-12.36	32.41	74	-29.23	54	-21.59	-	100	Vert
1862.575	71.76	PK	27.1	-54.43	44.43	-12.36	32.07	74	-29.57	54	-21.93	-	150	Vert
2235.0271	75.82	PK	27.5	-52.81	50.51	-12.36	38.15	74	-23.49	54	-15.85	216	100	Vert
2981.321	67.15	PK	29.8	-50.9	46.05	-12.36	33.69	74	-27.95	54	-20.31	-	100	Vert
3724.8948	70.25	PK	32	-51.22	51.03	-12.36	38.67	74	-22.97	54	-15.33	177	100	Vert
PK – Peak Detector, AF – Antenna Factor, PF – Path Loss/Gain, DC-Duty cycle														

4.6.2 Test Conditions and Results – Cease Operation

Test Description	Measurements were made in the laboratory environment. A Dipole (or equivalent) antenna tuned to the transmit frequency was attached to the input of a spectrum analyzer. The device was operated and the transmission time measured with the spectrum analyzer set to zero span at the fundamental frequency.
Basic Standard	47 CFR Part 15.231, RSS-210 A1.1
Cease Operation Limits	
The transmissions shall stop within 5 seconds of either a button being released or if automatically controlled transmissions shall be stopped 5 seconds after transmissions begin.	

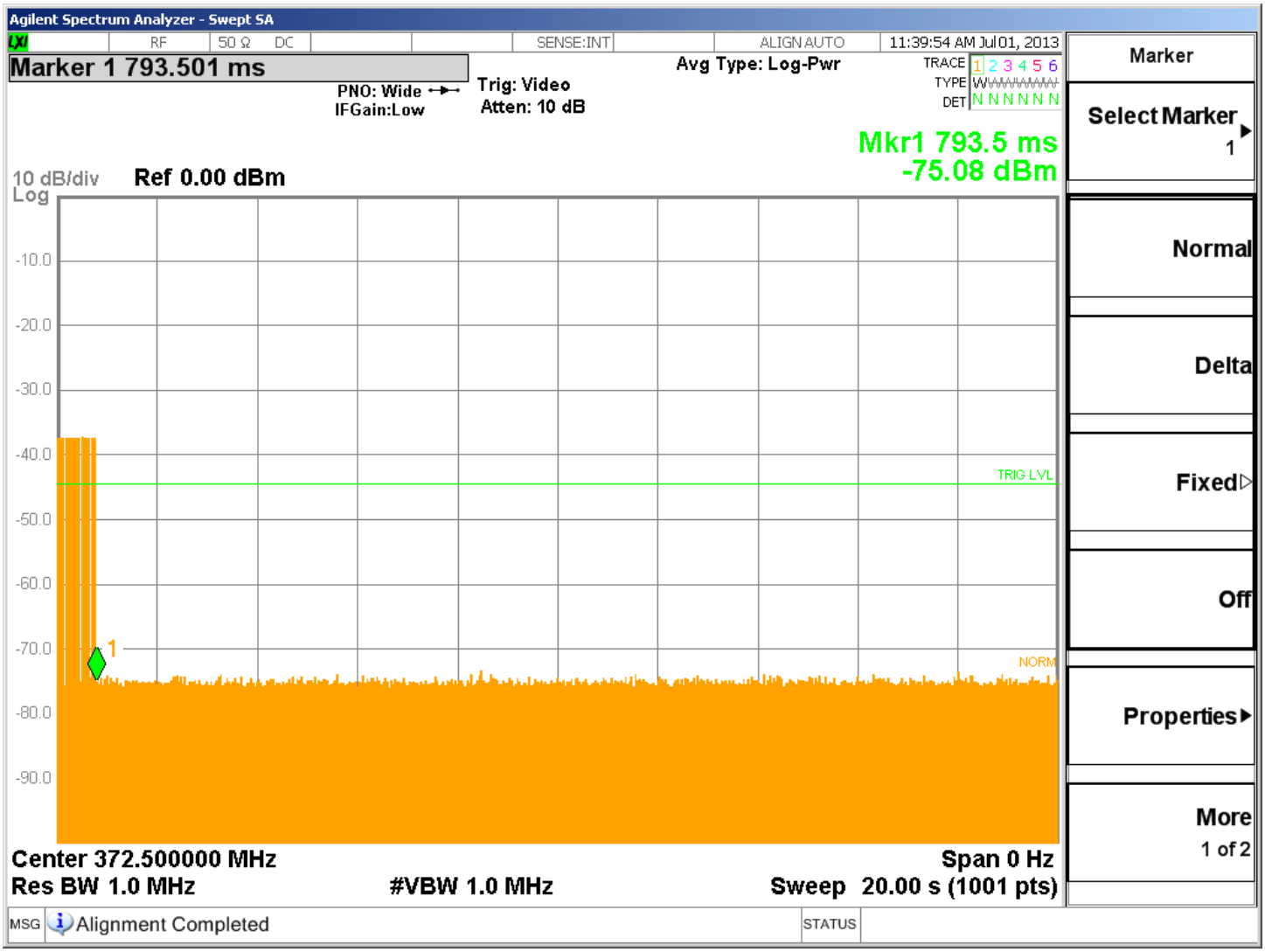
Table 29 Cease Operation Configuration Settings

Power Interface Mode	EUT Configurations Mode	EUT Operation Mode
1	2	9
Supplementary information: None		

Table 30 Cease Operation Test Results

Frequency	Requirement	Cease Operation Time
372.5MHz	5 seconds or less	793.5mS
Supplementary information: None		

Figure 21 Cease Operation Graph



4.6.3 Test Conditions and Results – Pulse Train / Duty Cycle

Test Description	Measurements were made in the laboratory environment. A Dipole (or equivalent) antenna tuned to the transmit frequency was attached to the input of a spectrum analyzer. The pulse train was measured with the spectrum analyzer set to zero span at the fundamental frequency.
Basic Standard	FCC Part 15 Subpart A, 15.35
Pulse Train Limits	
There are no limits for this test. This data is used to calculate the averaging correction factor that is applied to the measured peak radiated emissions results.	

Table 31 Pulse Train Configuration Settings

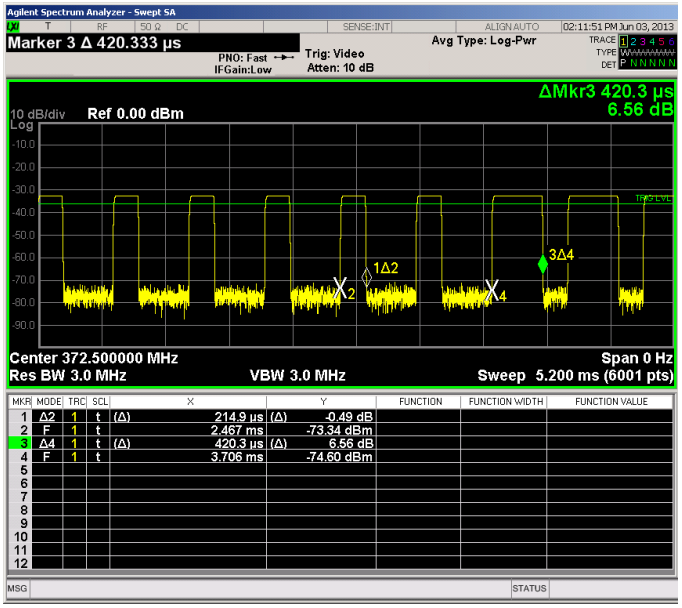
Power Interface Mode	EUT Configurations Mode	EUT Operation Mode
1	2	9
Supplementary information: None		

Table 32 Pulse Train Calculation

Frequency	Pulse Width (mS)	Period or 100ms whichever is lesser	Average Correction Factor (dB) $20\log\left(\frac{PulseWidth}{TotalTransmissionTime}\right)$
372.5MHz	18.28	100mS	-14.76
Manufacturer declares the worst case duty cycle at -12.36. Declared duty cycle is used for all measurements.			

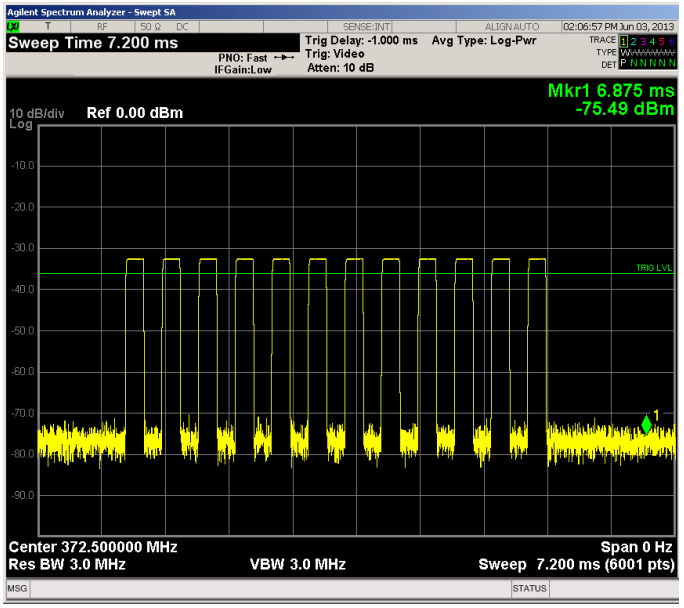
Figure 22 Pulse Train Graphs

Pulse Duration



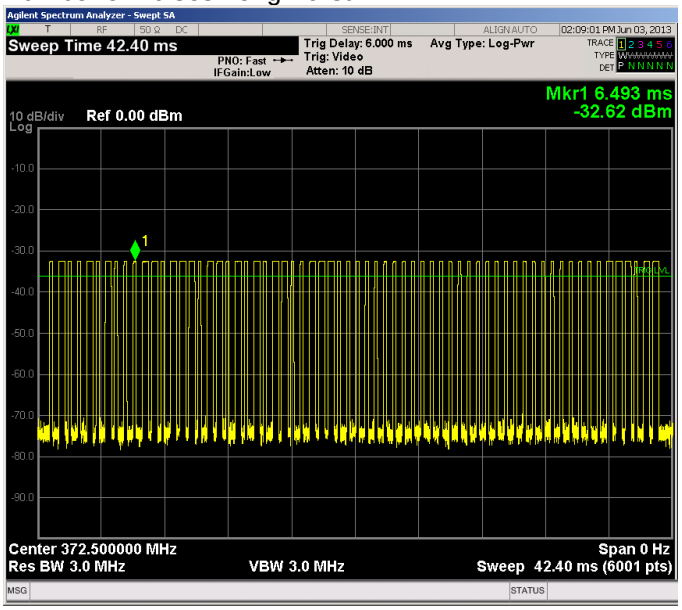
Short: 0.2149mS, Long: 0.4203mS

Number of Pulses initial burst



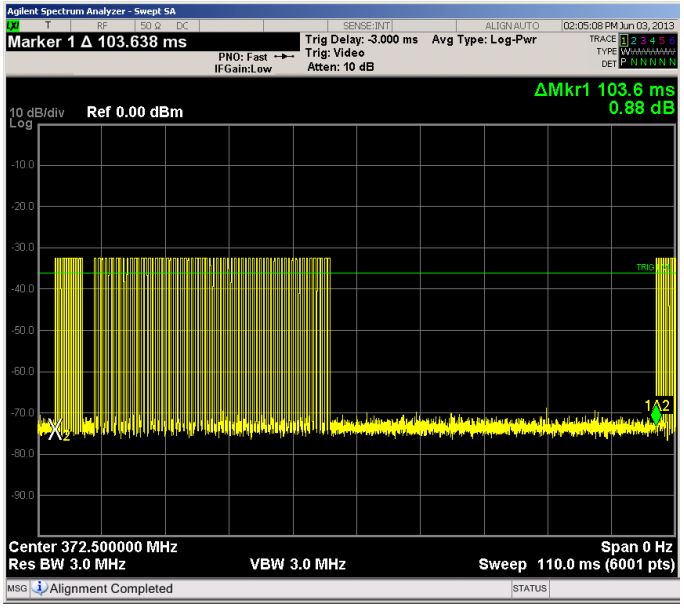
Short pulses: 12

Number of Pulses Long Burst



Short: 44, Long: 21

Period



100mS

4.6.4 Test Conditions and Results – 20dB / 99% Bandwidth

Test Description	Measurements were made in the laboratory environment. A Dipole (or equivalent) antenna tuned to the transmit frequency was attached to the input of a spectrum analyzer. The device was operated and the spectrum analyzer resolution bandwidth set per the appropriate standard.
Basic Standard	47 CFR Part 15.231, RSS-210 A1.1.3
Occupied Bandwidth Limits	
No wider than 0.25% of the center frequency for devices operating between 70MHz and 900MHz.	
For 372.5MHz: 0.93125MHz Allowed Bandwidth	

Table 33 Occupied Bandwidth Configuration Settings

Power Interface Mode #	EUT Configurations Mode	EUT Operation Mode
1	2	9
Supplementary information: None		

Table 34 Occupied Bandwidth Spectrum Analyzer Settings

Occupied Bandwidth Requirements		
Minimum RBW / VBW Setting – 10kHz/30kHz or larger	dBc	%
Requirement	**-20**	**99**
Results for 372.5MHz	50.070kHz	63.089kHz
Supplementary information: None		

Figure 23 20dB Bandwidth Graphs

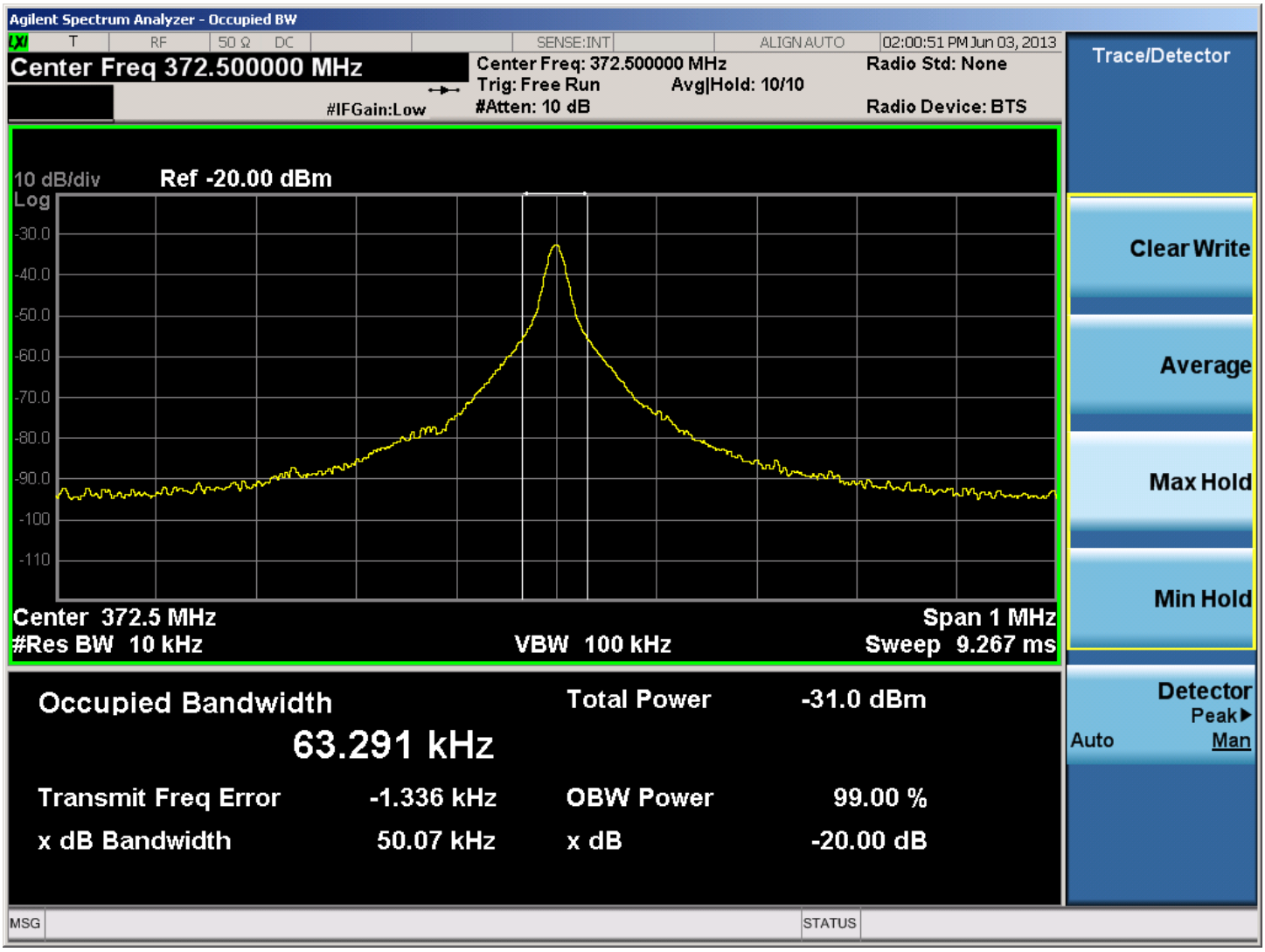
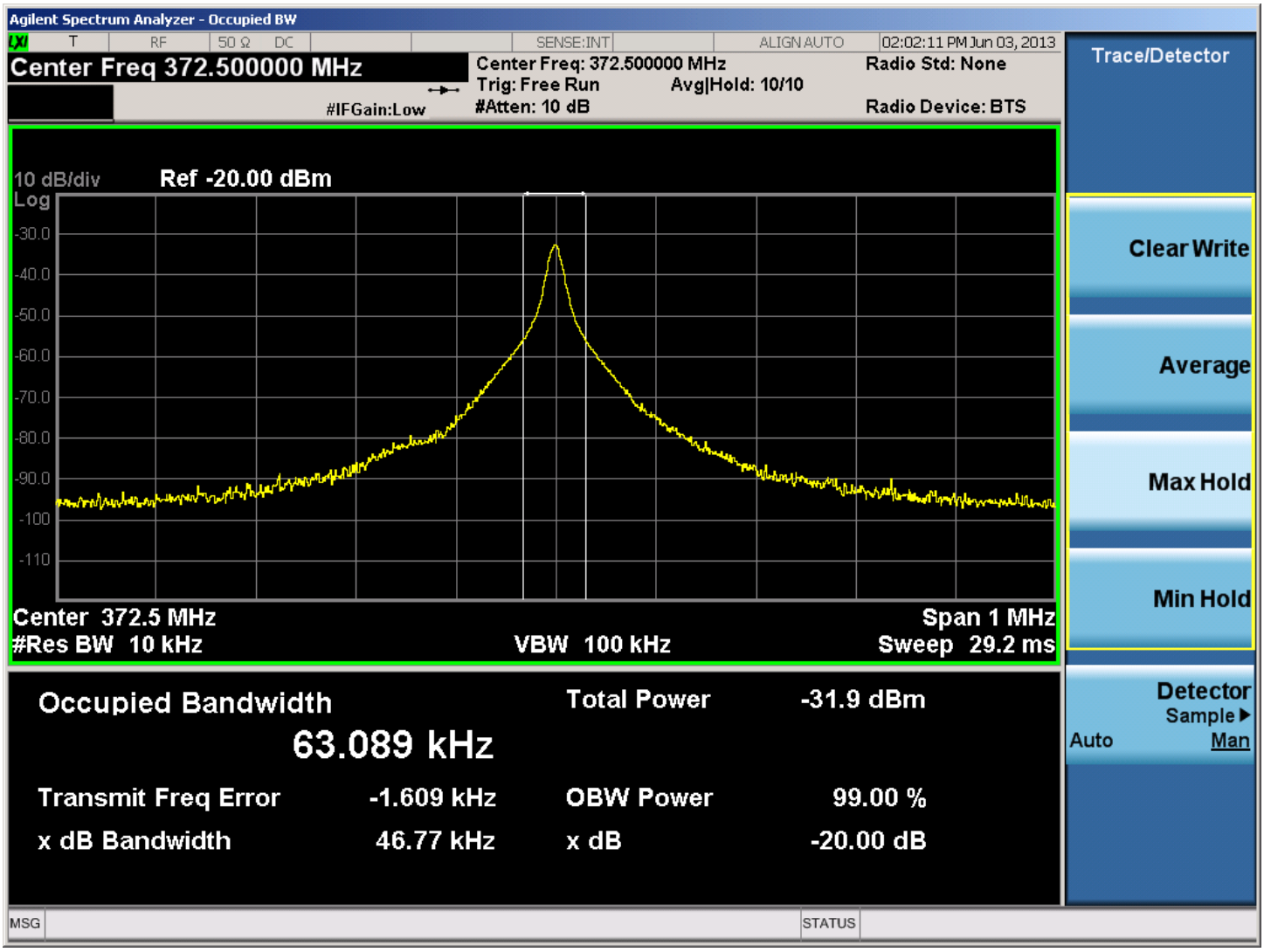


Figure 24 99% Power Bandwidth Graphs



4.7 Mode 4 390MHz

4.7.1 Test Conditions and Results – Fundamental and Harmonics Radiated Emissions

Test Description	Measurements were made in a 10-meter semi-anechoic chamber that complies to CISPR 16/ANSI C63.4:2003. Preliminary (peak) measurements were performed at an antenna to EUT separation distance of 10-meter or 3-meter as noted. The EUT was rotated 360° about its azimuth with the receive antenna located at various heights in both horizontal and vertical polarities. Final measurements (quasi-peak or average as noted) were then performed by rotating the EUT 360° and adjusting the receive antenna height from 1 to 4-meters. All frequencies were investigated in both horizontal and vertical antenna polarity, where applicable.		
Basic Standard	47 CFR Part 15.231, RSS-210 A1.1		
	Frequency range	Measurement Point	
Fully configured sample scanned over the following frequency range	30 MHz – 1GHz	(3m distance)	
	1GHz – 4GHz	(3m distance)	

Limits

Frequency (MHz)	Limit (dBµV/m)	
	Fundamental AV Limit	Non-Restricted Spurious Harmonics AV
390	79.24	59.24
	All Other Emissions including Harmonics in restricted bands	
30MHz – 88MHz	40.00	
88MHz – 216MHz	43.52	
216MHz – 960MHz	46.02	
960MHz – 4,000MHz	54.00	

Supplementary information: Please refer to Section 4.3, Mode 8 for Radiated Spurious Emission Data

4.7.2 Test Conditions and Results – Cease Operation

Test Description	Measurements were made in the laboratory environment. A Dipole (or equivalent) antenna tuned to the transmit frequency was attached to the input of a spectrum analyzer. The device was operated and the transmission time measured with the spectrum analyzer set to zero span at the fundamental frequency.
Basic Standard	47 CFR Part 15.231, RSS-210 A1.1
Cease Operation Limits	
The transmissions shall stop within 5 seconds of either a button being released or if automatically controlled transmissions shall be stopped 5 seconds after transmissions begin.	

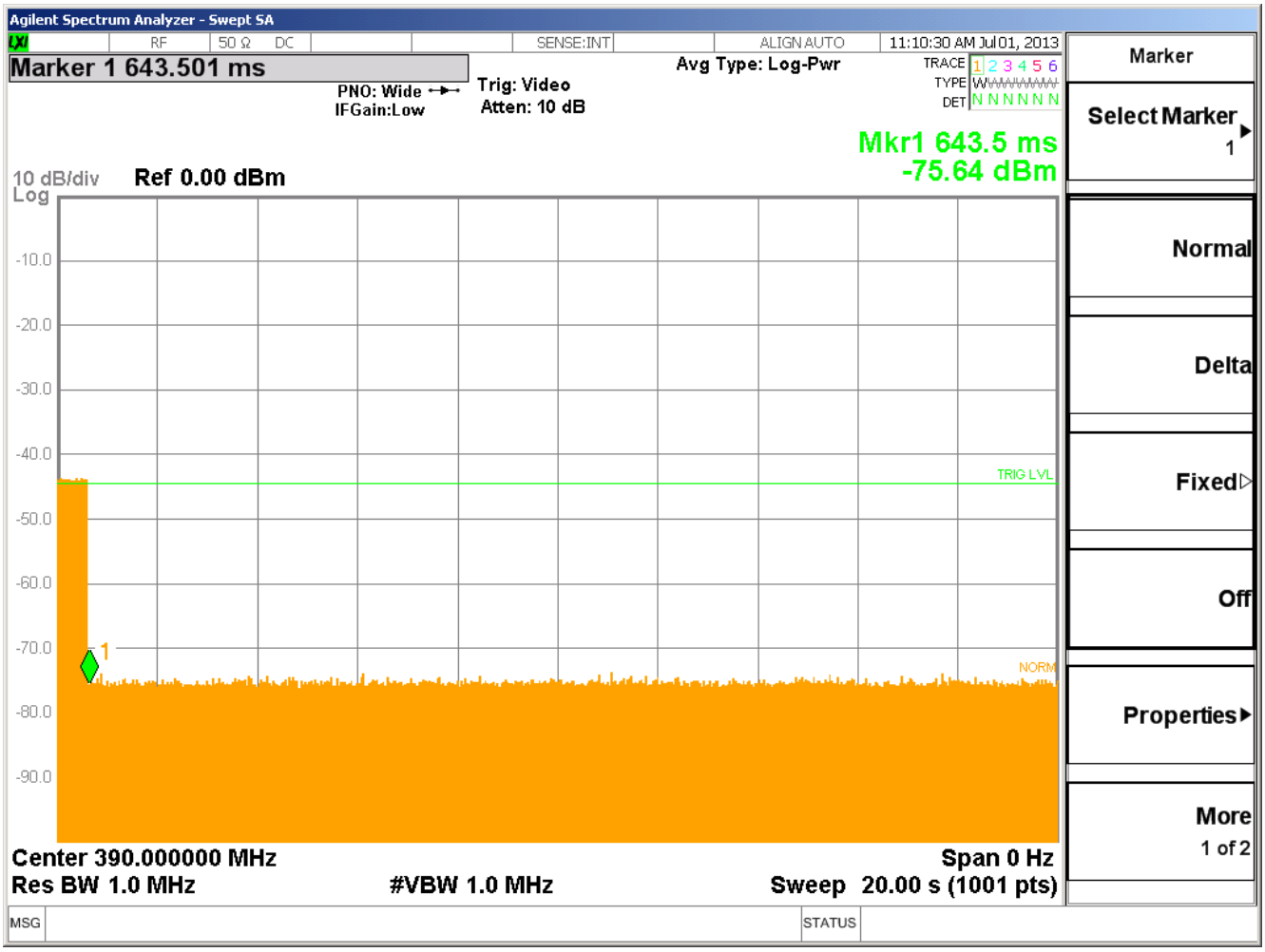
Table 35 Cease Operation Configuration Settings

Power Interface Mode	EUT Configurations Mode	EUT Operation Mode
1	2	4
Supplementary information: None		

Table 36 Cease Operation Test Results

Frequency	Requirement	Cease Operation Time
390MHz	5 seconds or less	643.5mS
Supplementary information: None		

Figure 25 Cease Operation Graph for 390MHz



4.7.3 Test Conditions and Results – Pulse Train / Duty Cycle

Test Description	Measurements were made in the laboratory environment. A Dipole (or equivalent) antenna tuned to the transmit frequency was attached to the input of a spectrum analyzer. The pulse train was measured with the spectrum analyzer set to zero span at the fundamental frequency.
Basic Standard	FCC Part 15 Subpart A, 15.35
Pulse Train Limits	
There are no limits for this test. This data is used to calculate the averaging correction factor that is applied to the measured peak radiated emissions results.	

Table 37 Pulse Train Configuration Settings

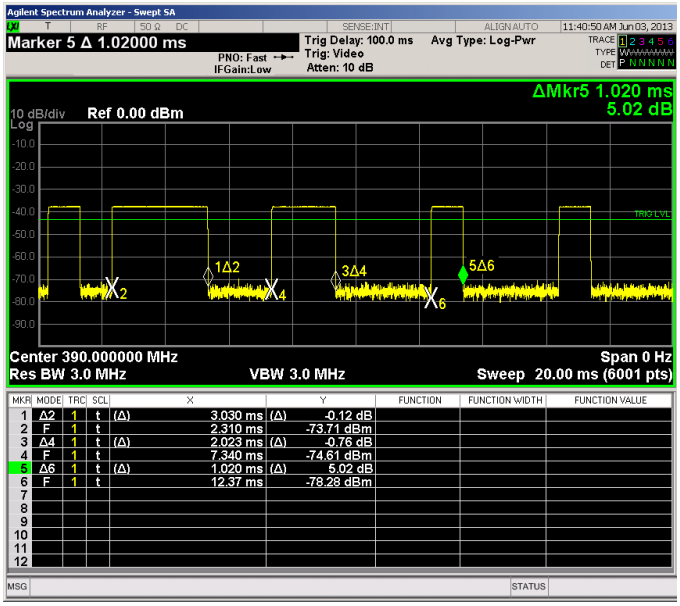
Power Interface Mode	EUT Configurations Mode	EUT Operation Mode
1	2	4
Supplementary information: None		

Table 38 Pulse Train Calculation

Frequency	Pulse Width (mS)	Period or 100ms whichever is lesser	Average Correction Factor (dB) $20\log\left(\frac{PulseWidth}{TotalTransmissionTime}\right)$
390MHz	16.243	100mS	-14.09
Manufacturer declares the worst case duty cycle at -6.75dB. Declared duty cycle is used for all data.			

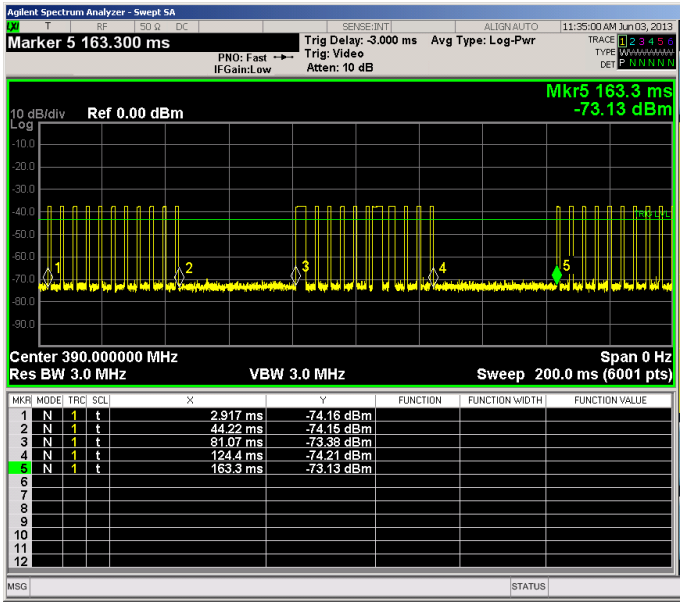
Figure 26 Pulse Train Graphs for 390MHz

Pulse Duration



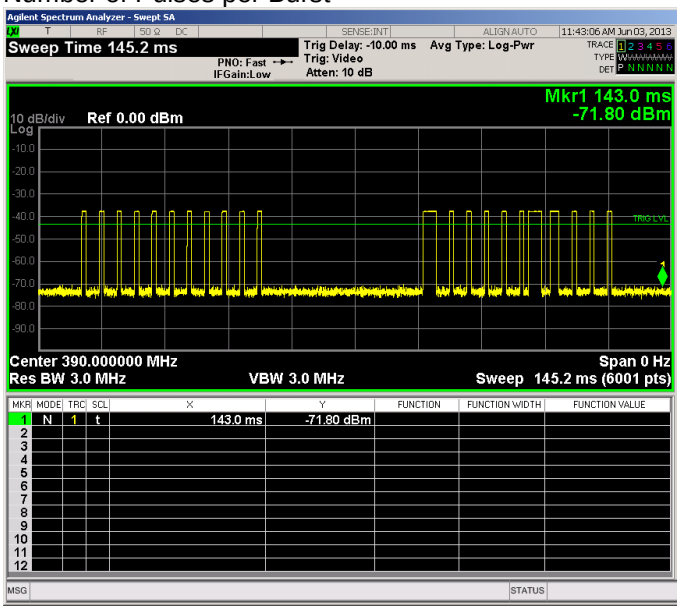
Short: 1.020mS, Medium: 2.023mS, Long: 3.030mS

Period



Duration: 82.23mS

Number of Pulses per Burst



First Burst: 11 short (11.22mS Total)
Second Burst: 2 Long, 1 Medium, 8 Short (16.243mS)

4.7.4 Test Conditions and Results – 20dB / 99% Bandwidth

Test Description	Measurements were made in the laboratory environment. A Dipole (or equivalent) antenna tuned to the transmit frequency was attached to the input of a spectrum analyzer. The device was operated and the spectrum analyzer resolution bandwidth set per the appropriate standard.
Basic Standard	47 CFR Part 15.231, RSS-210 A1.1.3
Occupied Bandwidth Limits	
No wider than 0.25% of the center frequency for devices operating between 70MHz and 900MHz.	
390MHz – 0.7750MHz, 315MHz – 0.7875MHz, 390MHz – 0.9750MHz	

Table 39 Occupied Bandwidth Configuration Settings

Power Interface Mode #	EUT Configurations Mode	EUT Operation Mode
1	2	4
Supplementary information: None		

Table 40 Occupied Bandwidth Spectrum Analyzer Settings

Occupied Bandwidth Requirements		
RBW / VBW Setting – 10kHz/30kHz or larger	dBc	%
Requirement	**-20**	**99**
Results for 390MHz	49.780kHz	60.246kHz
Supplementary information: None		

Figure 27 20dB Bandwidth Graphs

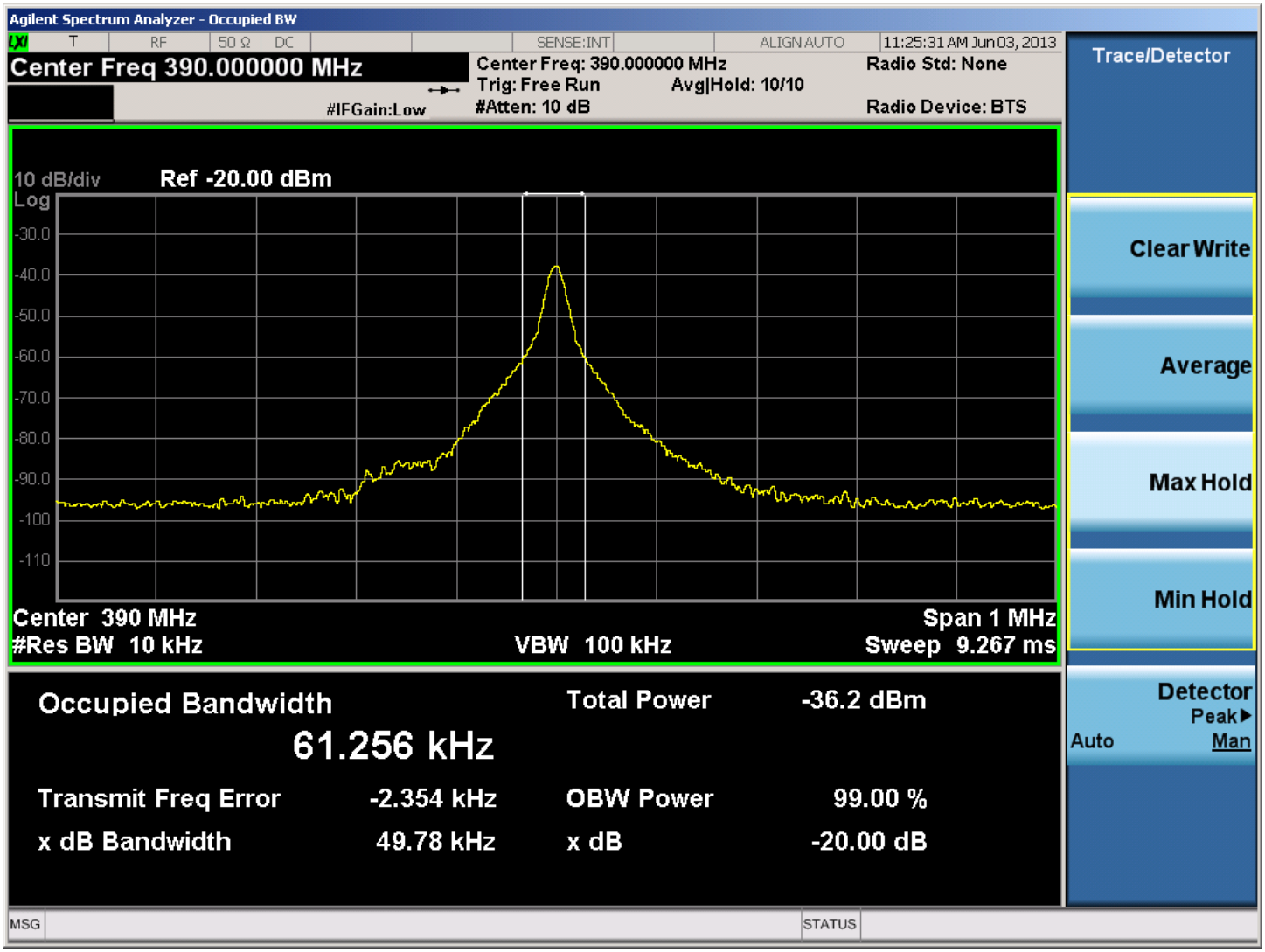
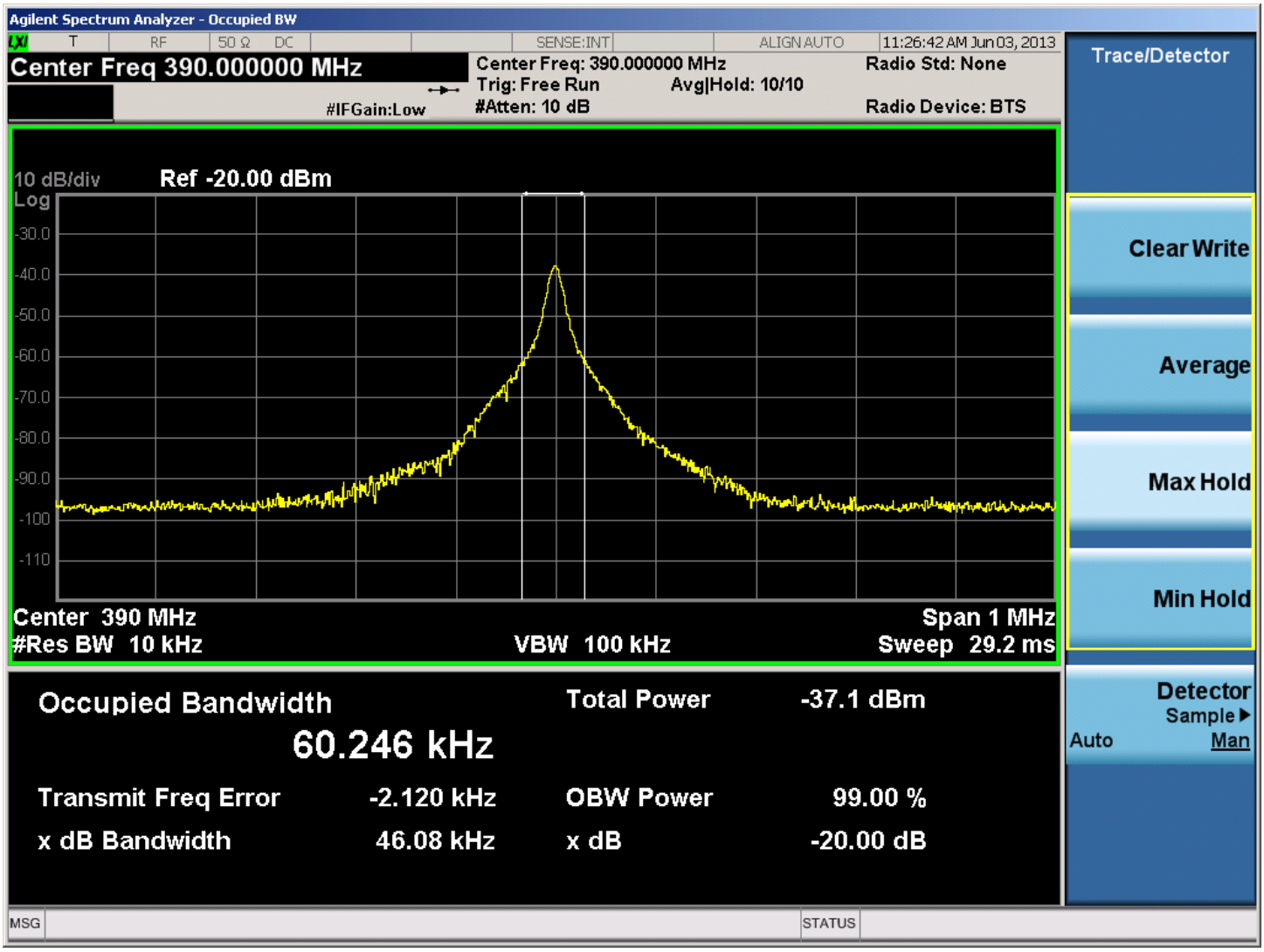


Figure 28 99% Power Bandwidth Graphs

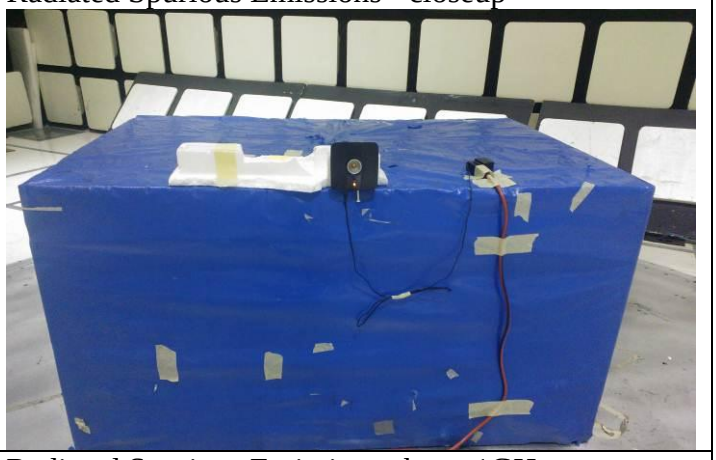


Appendix A

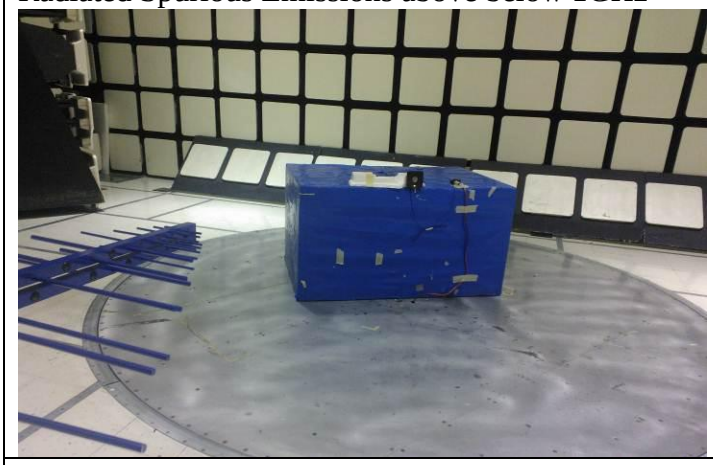
Test Setup Photos

Line Conducted Emissions

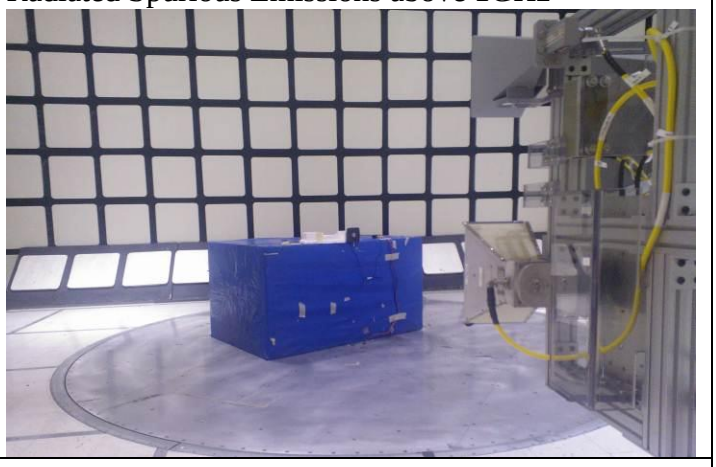
Radiated Spurious Emissions - closeup



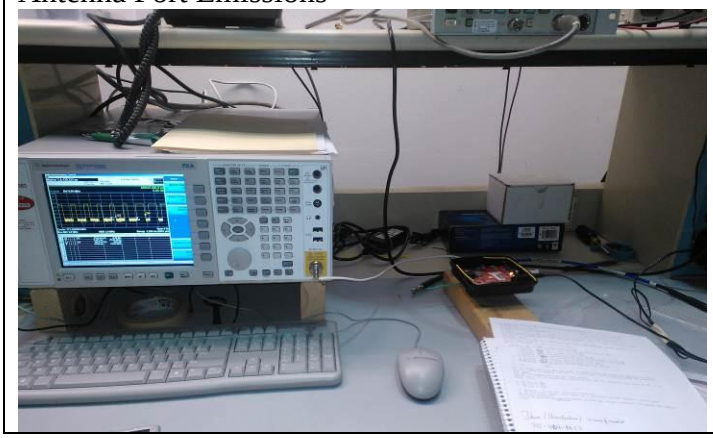
Radiated Spurious Emissions above below 1GHz



Radiated Spurious Emissions above 1GHz



Antenna Port Emissions



Appendix B

Test Equipment

Conducted Emissions

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due Date
EMI Test Receiver	Rohde & Schwarz	ESCI	EMC4328	Dec 30, 2012	Dec 30, 2013
Transient Limiter	Electro-Metrics	EM7600-2	EMC4224	N/A	N/A
HighPass Filter	Solar Electronics	2803-150	885551	N/A	N/A
Attenuator	HP	8494B	2831A00838	N/A	N/A
LISN - L1	Solar	8602-50-TS-50-N	EMC4052	Jan 15, 2013	Jan 16, 2014
LISN - L2	Solar	8602-50-TS-50-N	EMC4064	Jan 15, 2013	Jan 16, 2014

Radiated Emissions – 10-Meter Chamber

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due Date
EMI Test Receiver	Rohde & Schwarz	ESU	EMC4323	20121227	20131231
Bicon Antenna	Electro-Metrics	EM6912A	EMC4070	20120806	20130830
Log-P Antenna	Chase	UPA6109	EMC4313	20120807	20130831
Spectrum Analyzer	Rhode & Schwarz	FSEK	EMC4182	20121226	20131231
Antenna Array	UL	BOMS 1GHz-40GHz	EMC4276	20111227	20131231

Antenna Port Conducted Emissions

Description	Manufacturer	Model	Identifier	Cal Date	Cal Due Date
Spectrum analyzer	Agilent	PXA	EMC4360	20121226	20131226
Generic Near Field Antenna	-	-	-	N/A	N/A

Appendix C

Accreditations and Authorizations

NVLAP Lab code: 100414-0

NVLAP: The National Institute of Standards and Technology (NIST) administers the National Voluntary Laboratory Accreditation Program (NVLAP). NVLAP is comprised of laboratory accreditation programs (LAPs) which are established on the basis of requests and demonstrated need. Each LAP includes specific calibration and/or test standards and related methods and protocols assembled to satisfy the unique needs for accreditation in a field of testing or calibration. NVLAP accredits public and private laboratories based on evaluation of their technical qualifications and competence to carry out specific calibrations or tests. Accreditation criteria are established in accordance with the U.S. Code of Federal Regulations (CFR, Title 15, Part 285), NVLAP Procedures and General Requirements, and encompass the requirements of ISO/IEC 17025. For a full scope listing see http://ts.nist.gov/standards/scopes/1004140.htm

FCC: Details of the measurement facilities used for these tests have been filed with the Federal Communications Commission's Laboratory in Columbia, Maryland (Ref. No. 91044).

Industry Canada Industrie Canada

Industry of Canada: Accredited by Industry Canada for performance of radiated measurements. Our test site complies with RSP 100, Issue 7, Section 3.3. File #: IC 2180A

VCCI: Accepted as an Associate Member to the VCCI. The measurement facilities detailed in this test report have been registered in accordance with Regulations for Voluntary Control Measures, Article 8. Registration Nos.: A0140.

ICASA: ICASA (Independent Communications Authority of South Africa) has appointed UL as a Designated Test Laboratory to test Telecommunications equipment for type approval in compliance with CISPR 22 to assist in fulfilling its mandate under section 54(1) of the Telecommunications Act, 1996 (Act 103 of 1996).

NIST/CAB: Validated by the European Commission as a U.S. Conformity Assessment Body (CAB) of the U.S.-EU Mutual Recognition Agreement (MRA) for the Electromagnetic Compatibility - Council Directive 2004/108/EC, Annex III (2-3). Also validated for the Telecommunication Equipment-Council Directive 99/5/EC, Annex III and IV, Identification Number: 0983.
NIST/CAB: Provisioned to act as a U.S. Conformity Assessment Body (CAB) under Appendix B, Phase I Procedures, of the Asia Pacific Economic Cooperation (APEC) MRA between the American Institute in Taiwan (AIT) and the United States. Our laboratory is considered qualified to test equipment subject to the applicable EMC regulations of the Chinese Taipei Bureau of Standards, Metrology and Inspection (BSMI) which require testing to CNS 13438 (CISPR 22).
NIST/CAB: Recognized by the Infocomm Development Authority of Singapore (IDA) under the Asia Pacific Economic Cooperation Mutual Recognition Agreement (APEC MRA). Our laboratory is provisionally designated to act as a Conformity Assessment Body (CAB) under Appendix B, Phase I Procedures, of the APEC MRA. Our scope of designation includes IDA TS EMC (CISPR 22), IEC 61000-4-2, -4-3, -4-4, -4-5, and -4-6