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Project #:	SR9617362
Order Number:	10004849
File Number:	MC15343
Date:	March 04, 2013
Model:	1D7966

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** **Elmhurst, IL 60126**
Applicant Contact: Phone: E-mail:	**Hank Sieradzki** **(630) 993-6564** **Hank.Sieradzki@chamberlaingroup.com**
Test Report Date:	**March 04, 2013**
Product Type:	**Universal Periodic Transmitter (Bling)**
Product standards	**FCC Part 15, Subpart C, 15.231 & RSS-210**
Model Number:	1D7966
EUT Category:	**Wireless Device**
Testing Start Date:	**February 20, 2013**
Date Testing Complete:	**March 03, 2013**
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
none			

1.0 G E N E R A L - Product Description

1.1 Equipment Description

The equipment under test is a universal 1D7966 (Bling) portable push button transmitter used with various brand garage door operators. The transmitter uses 310MHz, 315MHz, and 390MHz. It is user programmable for use with specific garage door operators.

1.2 Device Configuration During Test

1.2.1 Equipment Used During Test:

Use	Product Type	Manufacturer	Model	Comments
EUT	Periodic Transmitter	Chamberlain Group Inc.	1D7966	The model number 1D7966 is a part number. The device can be also referenced by 895MAX and 895RGD

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

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	6	-	-	dc	-	2 x CR2016 Battery

1.3 EUT Configurations

Mode #	Description
1	EUT with fresh batteries set to transmit.

1.4 EUT Operation Modes

Mode #	Description
1	EUT transmitting per specific configuration with specific X, Y, Z orientation.

1.5 Rational for EUT Configuration

Mode #	Description
1	Below is a list of possible configurations. Configurations that were not tested (configuration 1) had same power amplifier setting, same frequency and same duty cycle number as configuration 2. Worst case was determined by first setting the device to configuration 2. The fundamental frequencies were measured with the EUT in X-Axis, Y-Axis and Z-Axis and with the receiving antenna set to horizontal and vertical polarization. Once the worst case axis per frequency was determined the mounting clip was added and the fundamental was re-measured with the worst case axis obtained from initial measurements. It was assumed that the worst case axis will remain unchanged for all other configurations. The worst case configurations are as follow: For 310MHz and 315MHz it was found that the X-Axis, no clip is the worst. For 390MHz it was found that the Y-Axis, with clip is the worst. See Appendix B for test setup photos and axis information.

Configuration #	Frequency
1*	310MHz, 315MHz, 390MHz (E-Code)
2	310MHz, 315MHz, 390MHz (F-Code)
3	315MHz (D-Code)
4	390MHz (D-Code)
5	390MHz (A-Code)

* Configuration 1 has the same power setting and duty cycle as configuration 2. Only configuration 2 was tested.

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
FCC Part 15, Subpart C, 15.231	Code of Federal Regulations, Part 15, Radio Frequency Devices	2012
RSS-210	License - exempt Radio Apparatus (All Frequency Bands): Category I Equipment	Issue 8

2.4 Results Summary

Requirement – Test	Result (Compliant / Non-Compliant)*
Line Conducted Emissions	N/A – EUT is battery operated only
Occupied Bandwidth	Compliant
Cease Operation	Compliant
Pulse Train and Duty Cycle	Compliant
Fundamental Frequency & Spurious Radiated Emissions*	Compliant
* Peak limit and margin to peak limit is not shown in the data. In all cases the duty cycle correction factor is less than 20dB thus no emission will be more then 20dB above the average level.	

Test Engineer:

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UL Verification Services - EMC

Reviewer:

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WiSE Senior Project Engineer
UL Verification Services - EMC

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:

FCC	47 CFR Part 15 – Intentional Radiators
IC	RSS-210 and RSS-Gen License - exempt Radio Apparatus

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 Configuration 2 Test Data

4.1.1 Test Conditions and Results – Occupied 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(c)
Occupied Bandwidth Limits	
0.25% of Center Frequency (310MHz: 775.00kHz) 0.25% of Center Frequency (315MHz: 787.50kHz) 0.25% of Center Frequency (390MHz: 975.00kHz)	

Table 1 Occupied Bandwidth Configuration Settings

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

Table 2 Occupied Bandwidth Spectrum Analyzer Settings

Resolution Bandwidth	Occupied Bandwidth Requirements	
	dBc	% PWR
10kHz	-20	99
Supplementary information: None		

Table 3 Occupied Bandwidth Test Result Summary

Center Frequency	20dB BW Measured (kHz)	99% BW Measured (kHz)
310MHz	56.43	100.62
315MHz	52.83	110.77
390MHz	52.71	106.23

Figure 1 – Bandwidth Graph 310MHz - FCC

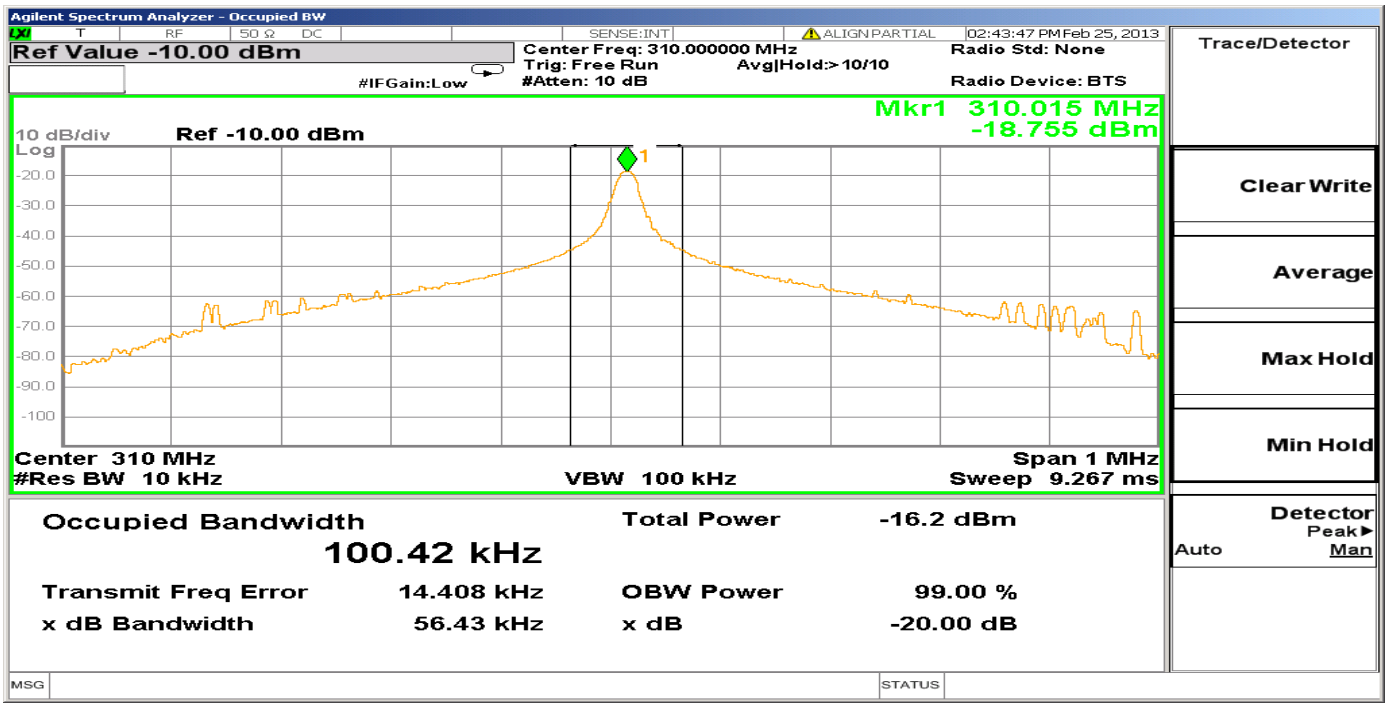


Figure 2 – Bandwidth Graph 310MHz – IC

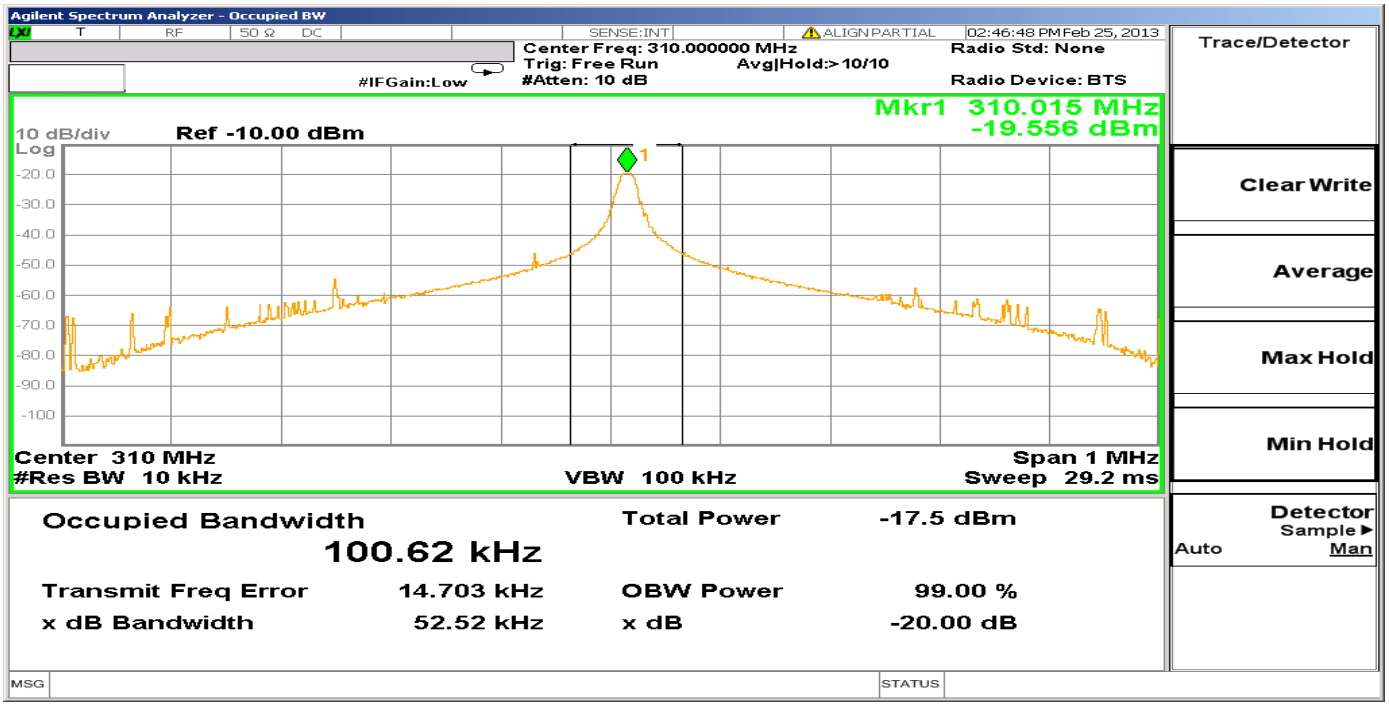


Figure 3 – Bandwidth Graph 315MHz – FCC

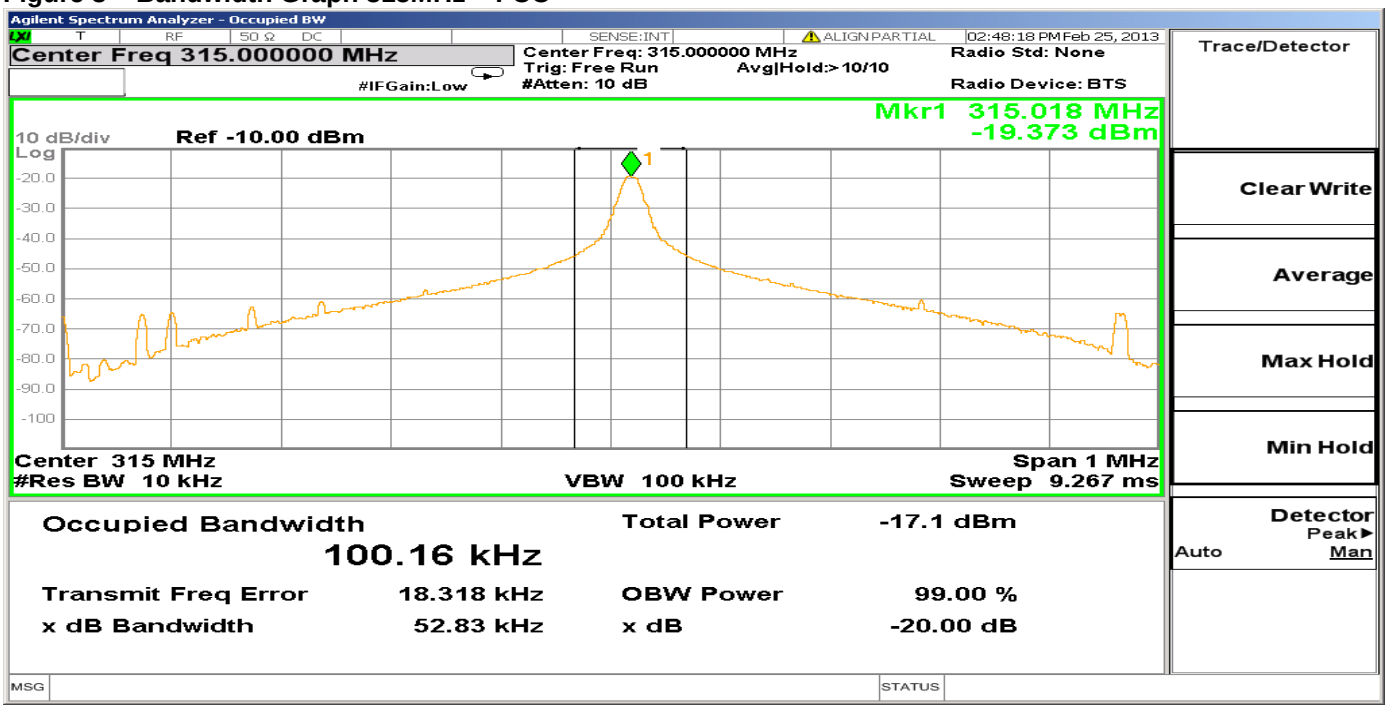


Figure 4 – Bandwidth Graph 315MHz - IC

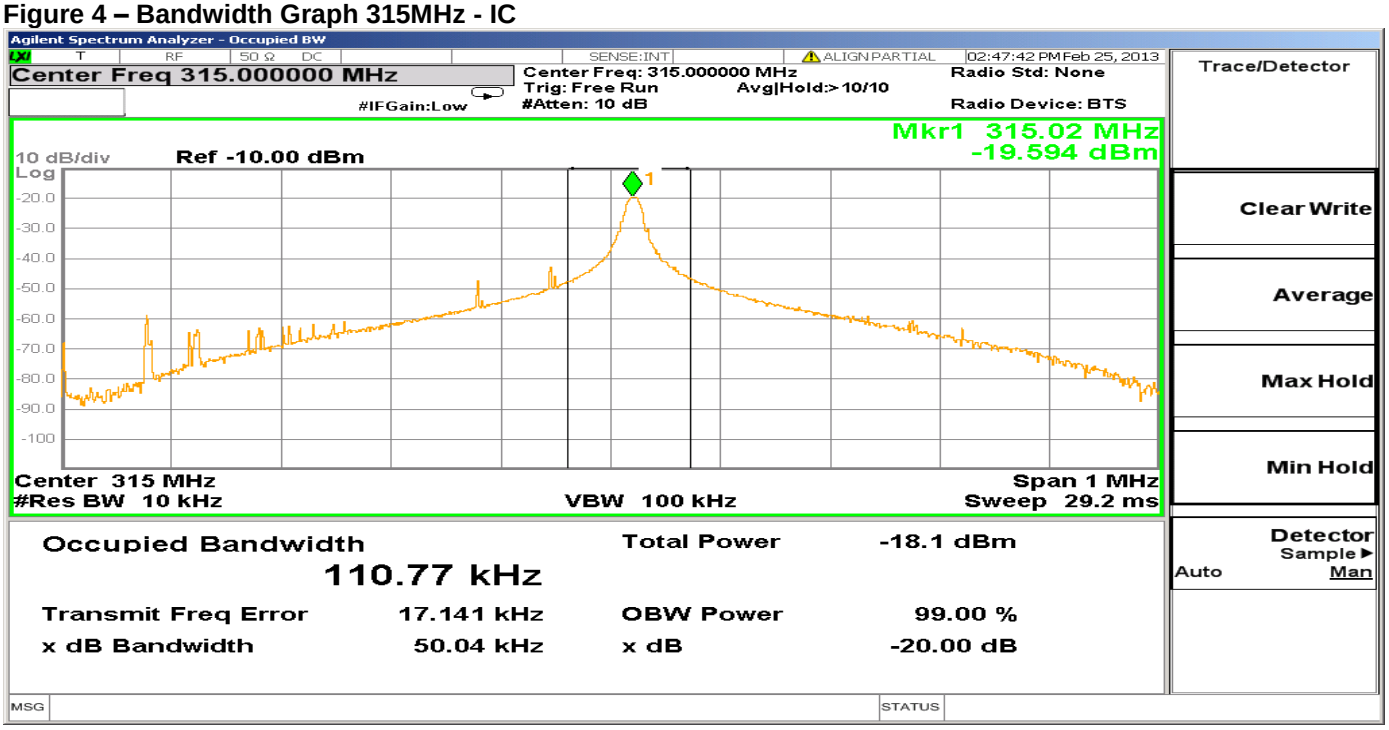


Figure 5 – Bandwidth Graph 390MHz – FCC

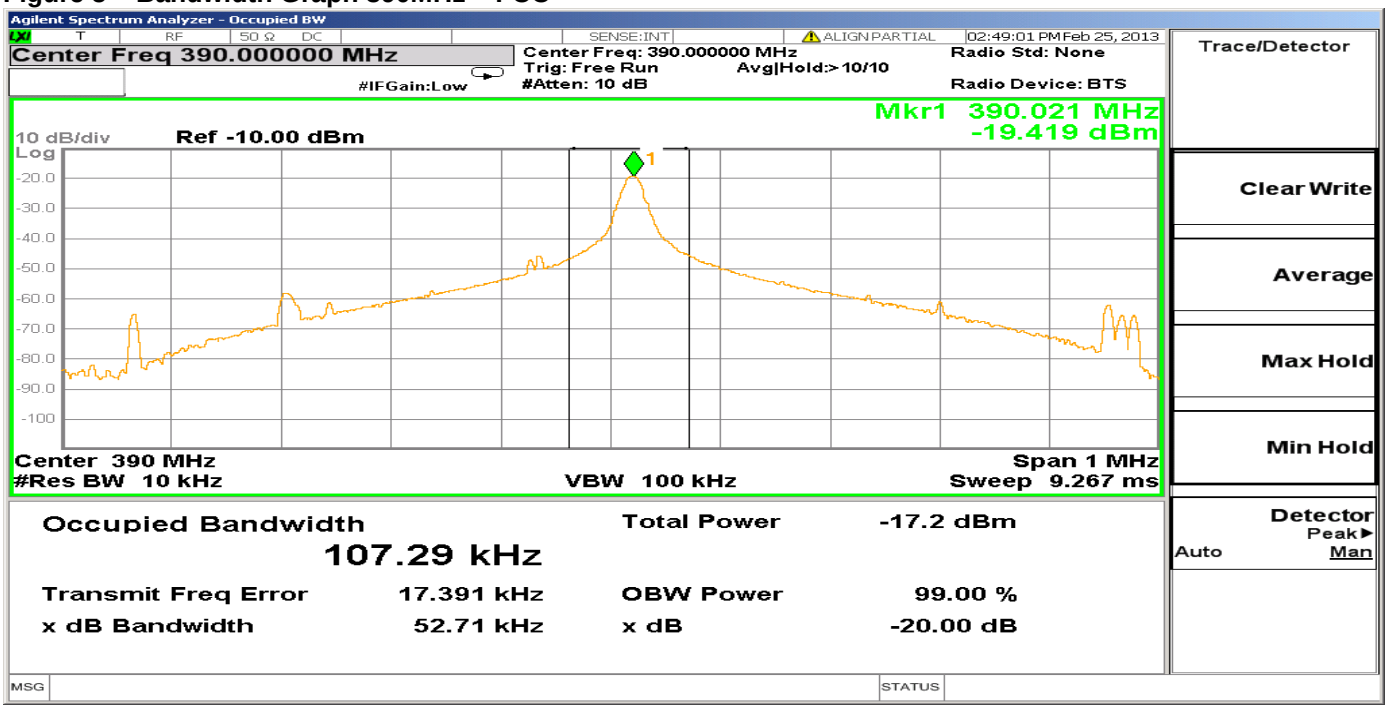
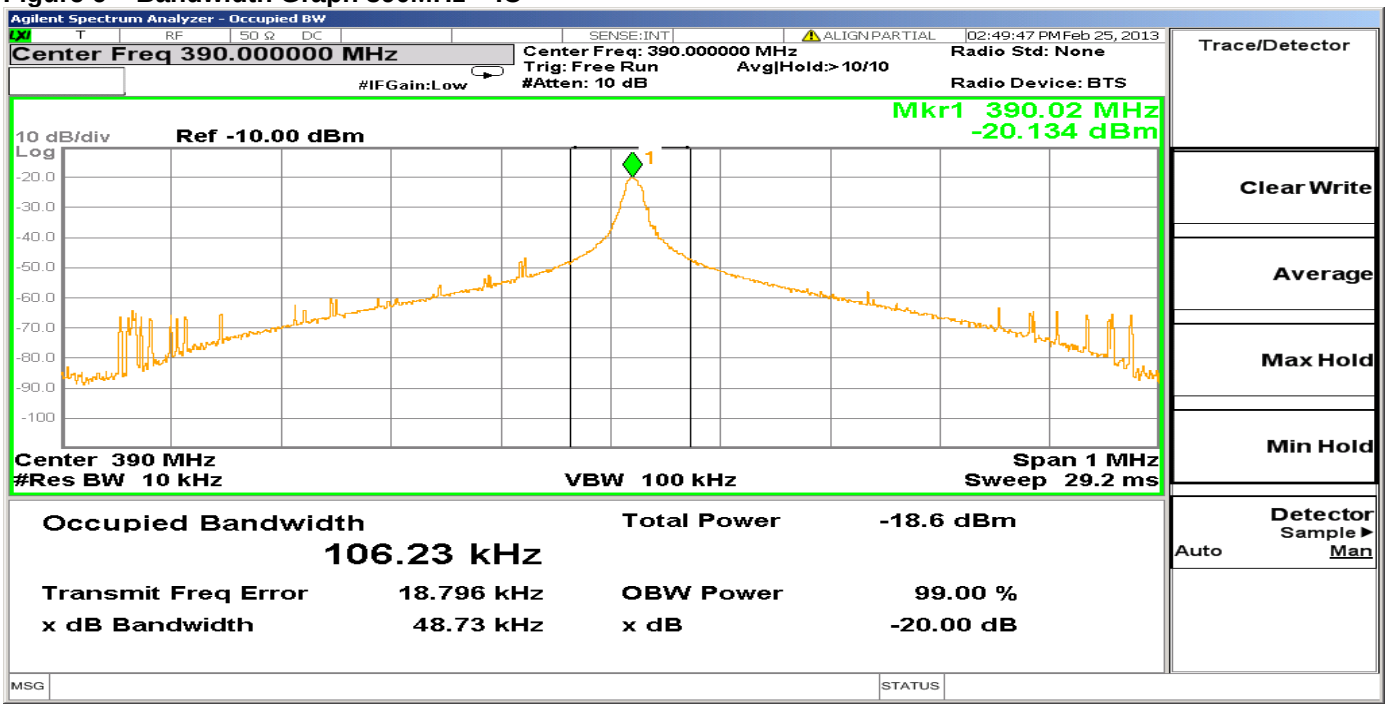


Figure 6 – Bandwidth Graph 390MHz – IC



4.1.2 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(a)
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 4 Cease Operation Configuration Settings

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

Figure 7 Cease Operation Graph 310MHz

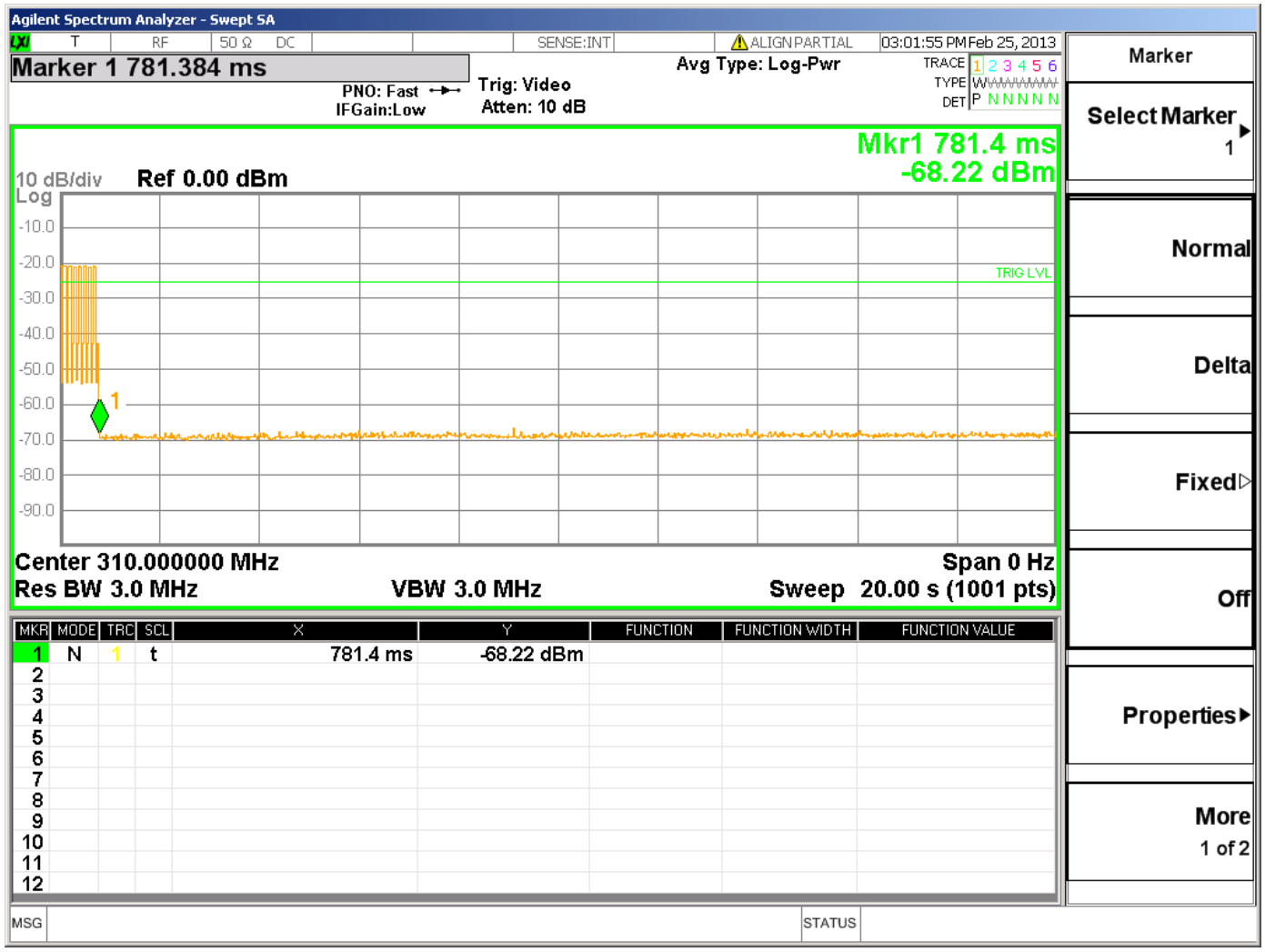


Figure 8 Cease Operation Graph 315MHz

Figure 9 Cease Operation Graph 390MHz

4.1.3 Test Conditions and Results – Pulse Train

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 5 Pulse Train Configuration Settings

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

Table 6 Pulse Train Calculation

TX Frequency	Total TX time	Total Transmission period or 100ms whichever is lesser	DC Correction Factor (dB) $20\log\left(\frac{PulseWidth}{Period}\right)$
310MHz	(9x0.515)+(45x0.265)	99.6	-15.58
315MHz	0.129+(0.265x52)+(0.510x5)	100.0	-15.67
390MHz	(0.260x38)+(0.510x12)	99.9	-15.91
Worst Case Duty Cycle: The manufacturer declared duty cycle as -16.19dB, worst case measured duty cycle is used for all radiated emissions data.			

Figure 10 Pulse Train Graphs for 310MHz

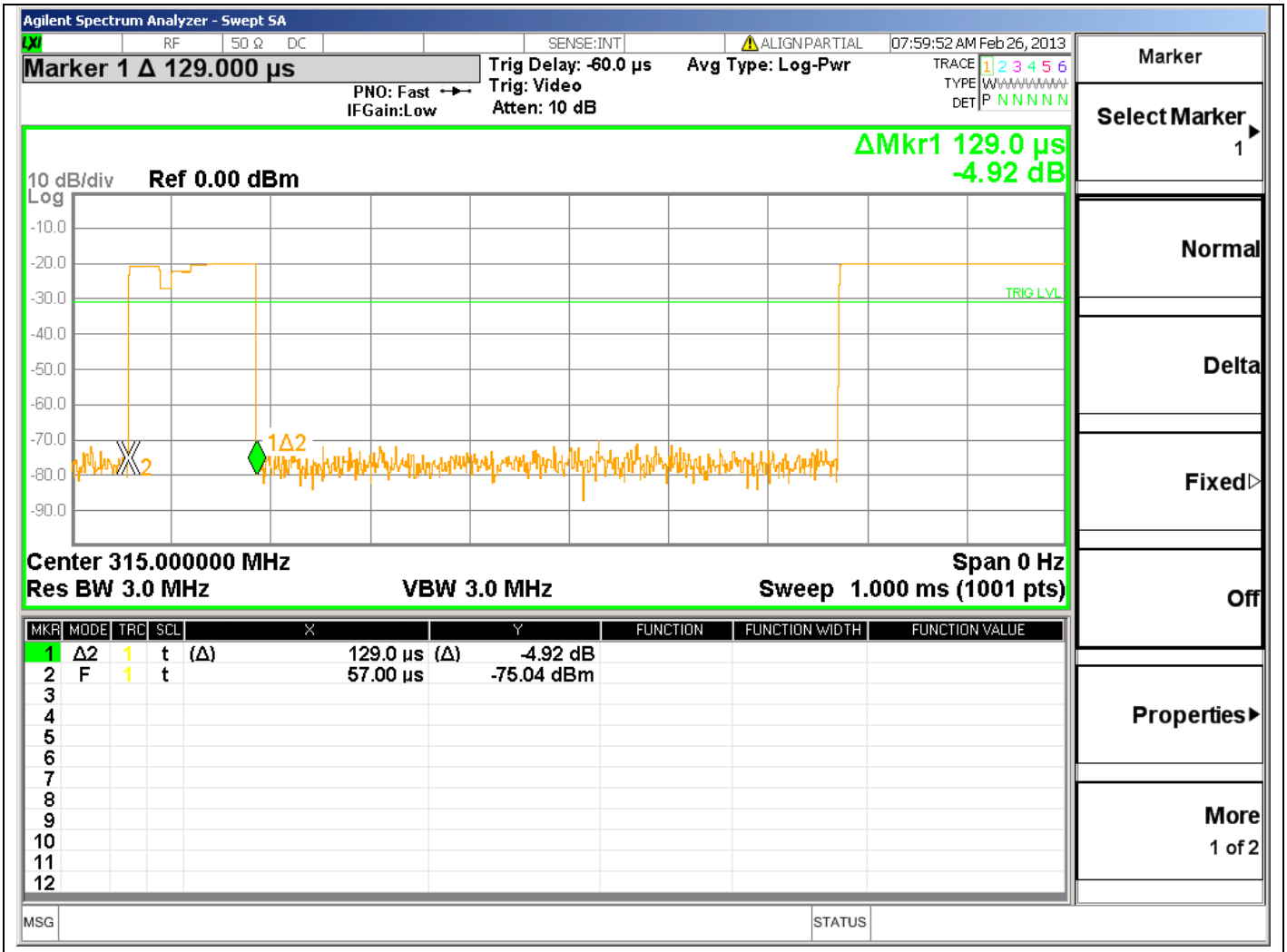
Tuning pulse duration: 0.135mS

Pulse Duration: Short Pulse 0.265mS, Long Pulse 0.515mS

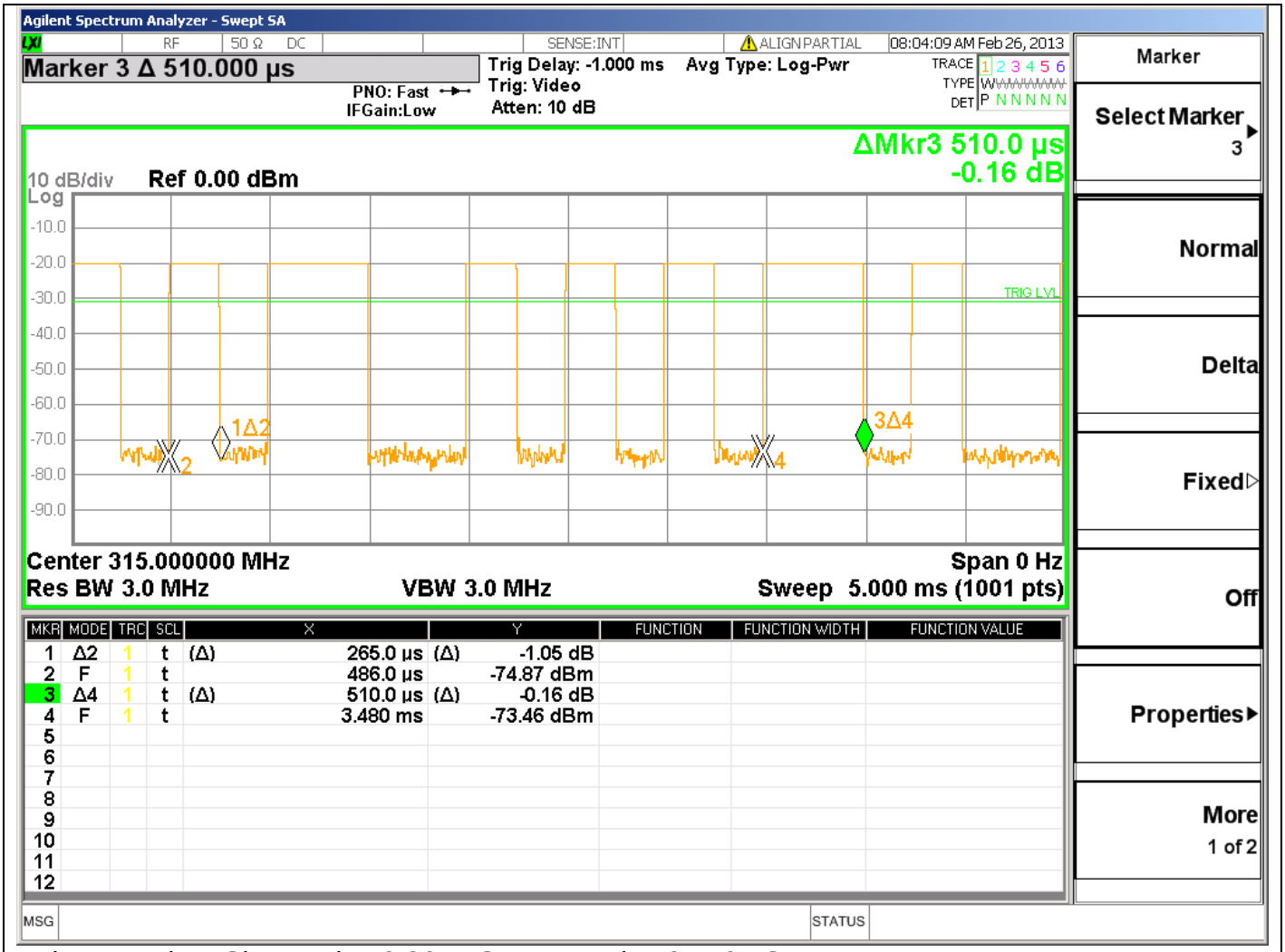
Number of Pulses: 45 Short, 9 Long

Period scan 99.6mS

Figure 11 Pulse Train Graphs for 315MHz



Tuning pulse duration: 0.129mS

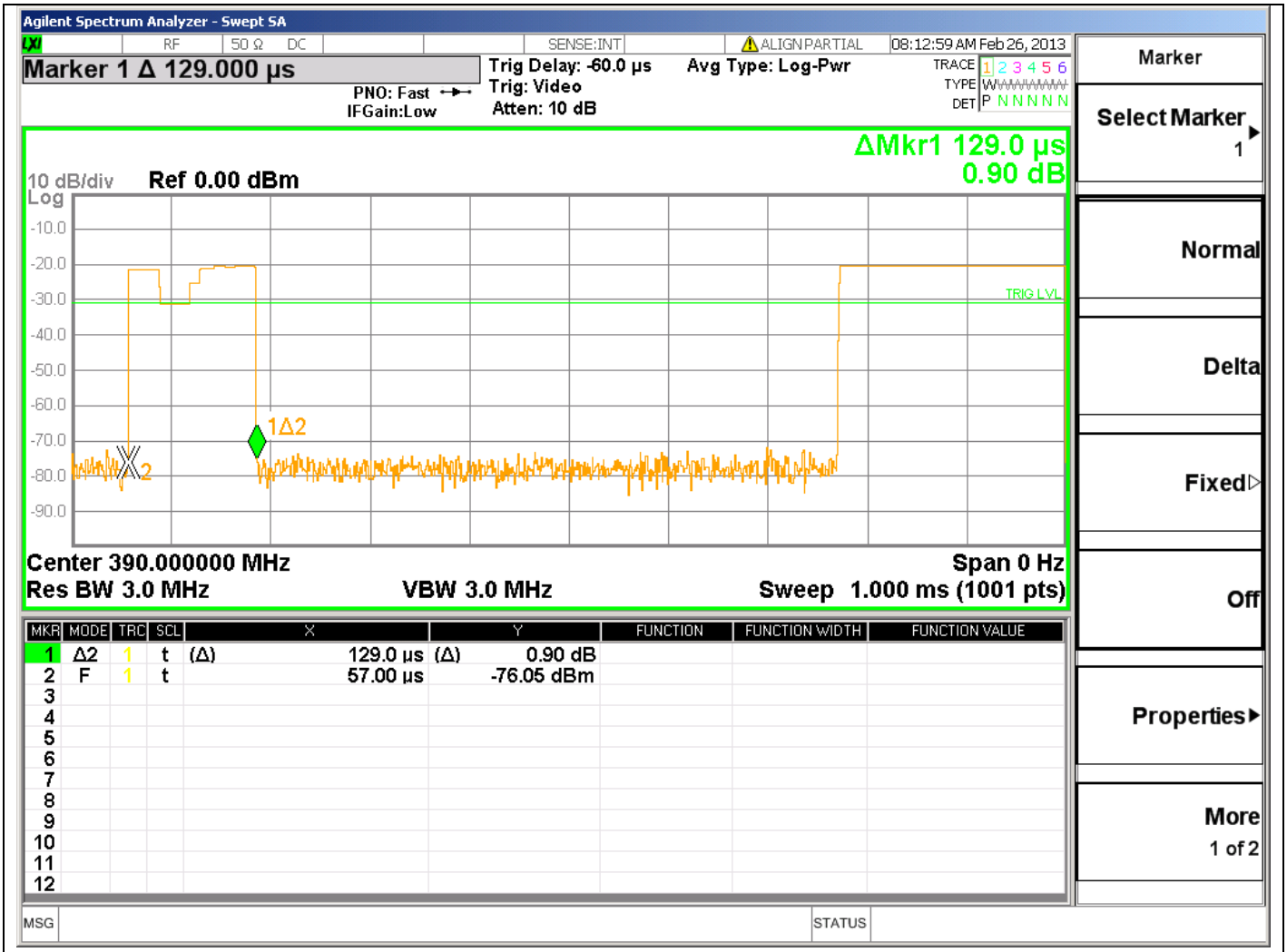


Pulse Duration: Short Pulse 0.265mS, Long Pulse 0.510mS

Number of Pulses: 52 Short, 5 Long

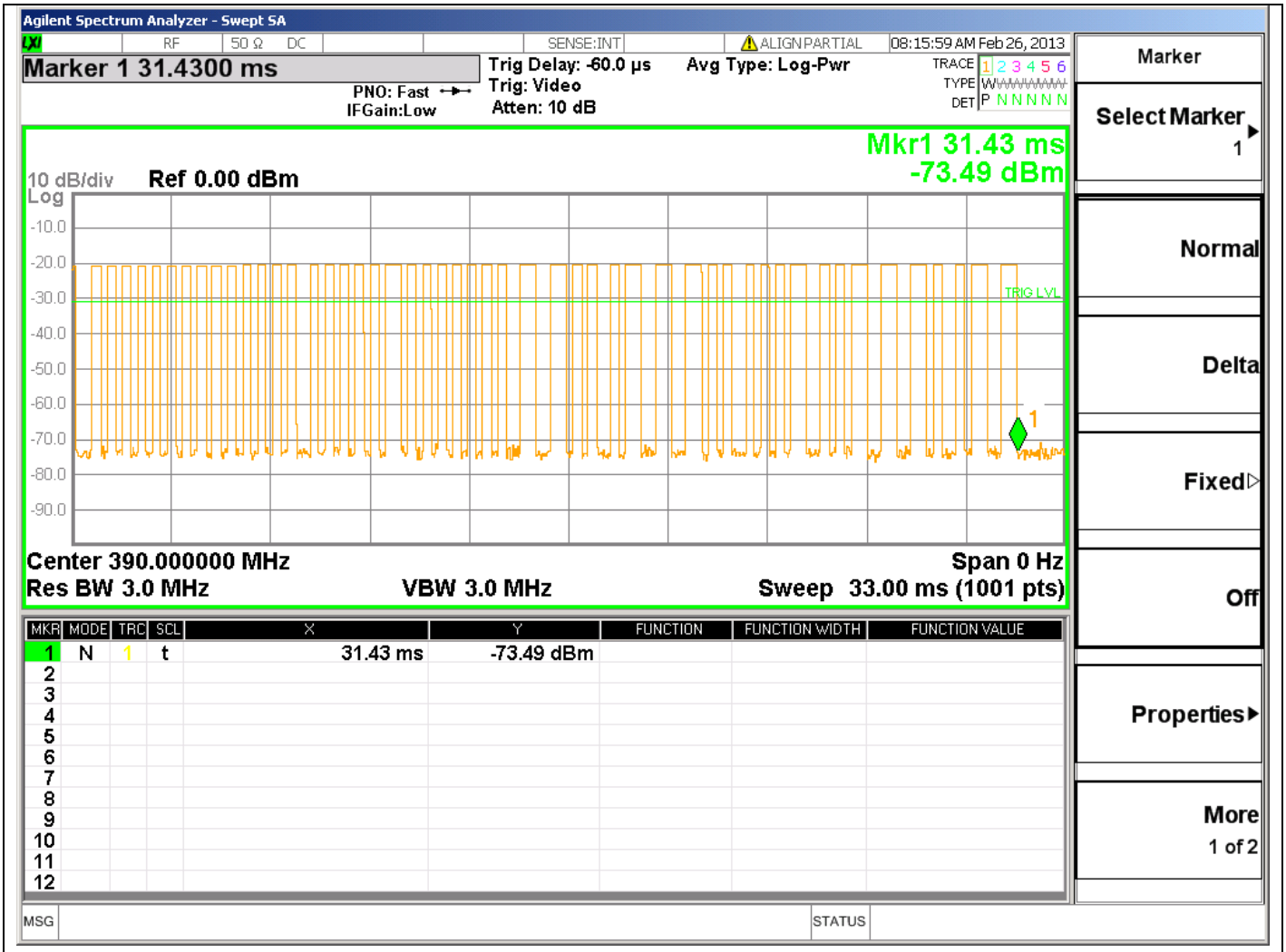
Period scan: 100.2

Figure 12 Pulse Train Graphs for 390MHz



First tuning pulse duration: 0.129mS

Pulse Duration: Short Pulse 0.260mS, Long Pulse 0.510mS



Number of Pulses: 38 Short, 12 Long

Period scan: 99.9mS

4.1.4 Test Conditions and Results – RADIATED EMISSIONS Fundamental and Spurious

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 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 subpart C, and RSS-210		
UL LPG	80-EM-S0029		
	Frequency range	Measurement Point	
Fully configured sample scanned over the following frequency range	30MHz – 1GHz	3 meter distance	
	1GHz – 4GHz	3 meter distance	

Out of band spurious emissions limit

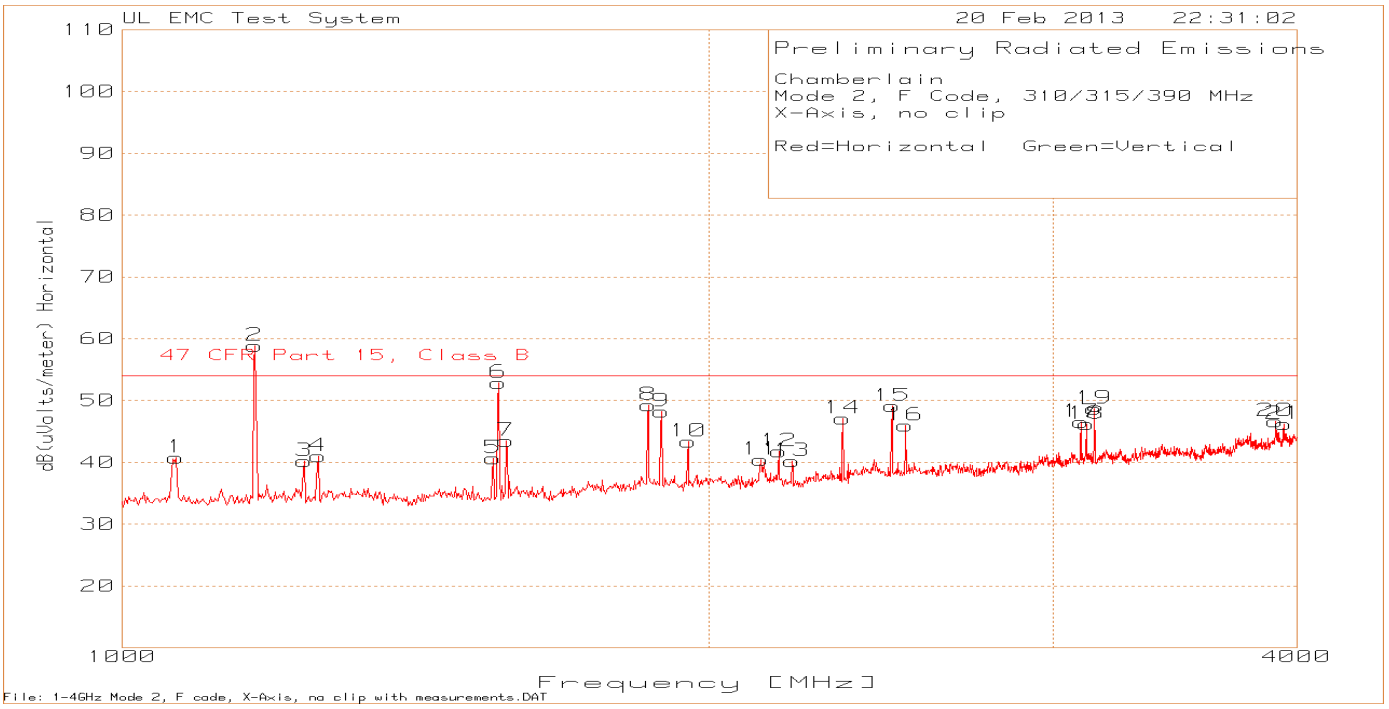
Frequency (MHz)	Limit (dBµV/m)	
	Quasi-Peak	Peak
30 - 88	40.00	NA
88 - 216	43.52	NA
216 - 960	46.02	NA
960 - 1000	54	NA
Above 1000 (FCC)	NA	54 (at 3-meter)

Fundamental Frequency Limits and Non-restricted band Harmonic Limits

Frequency (MHz)	Limit (dBµV/m) @ 3m distance All harmonics except those in restricted bands must be attenuated by 20dB or more	
	Average - Fundamental	Peak - Fundamental
310	75.32	95.32
315	75.62	95.62
390	79.24	99.24

Supplementary information: See section 4.1.3 for duty cycle information. Below 1GHz only emissions visible above the noise floor were the fundamental and the harmonics of the fundamental.

Figure 13 Radiated Emissions Graph (Above 1GHz X-Axis)



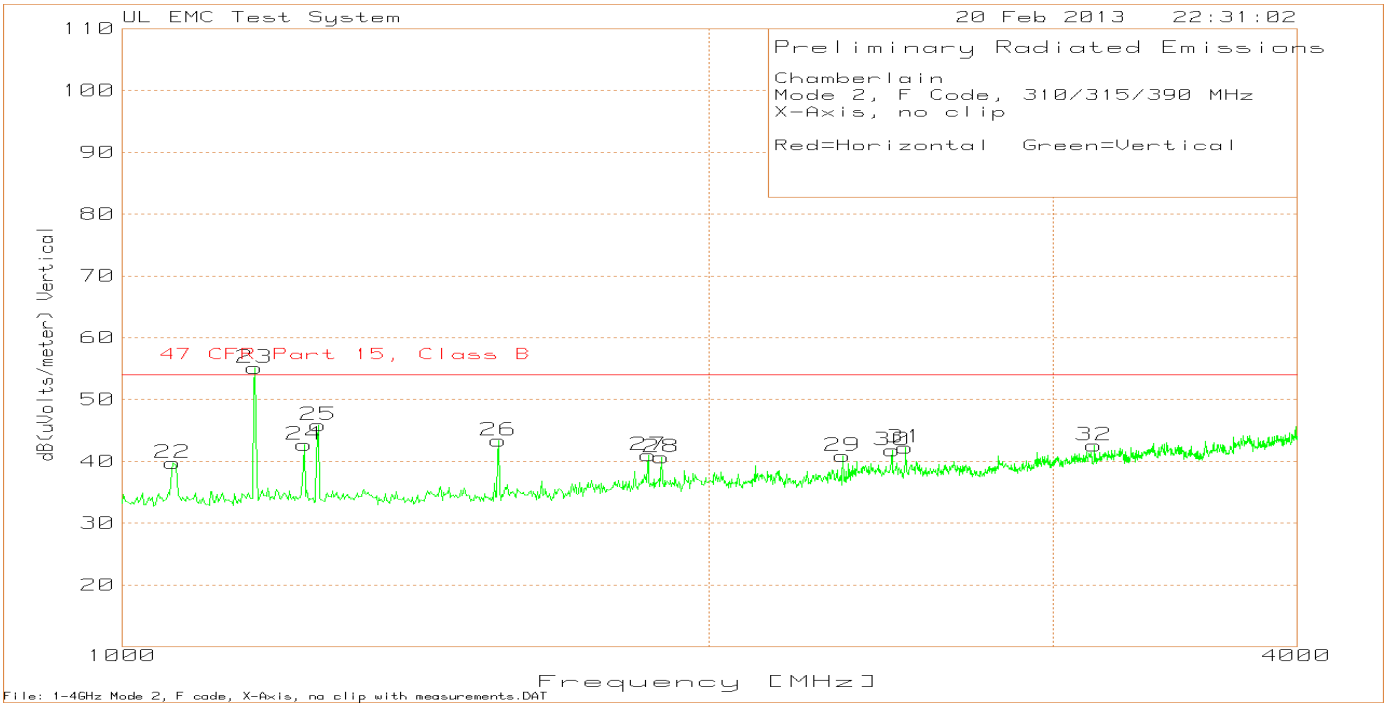
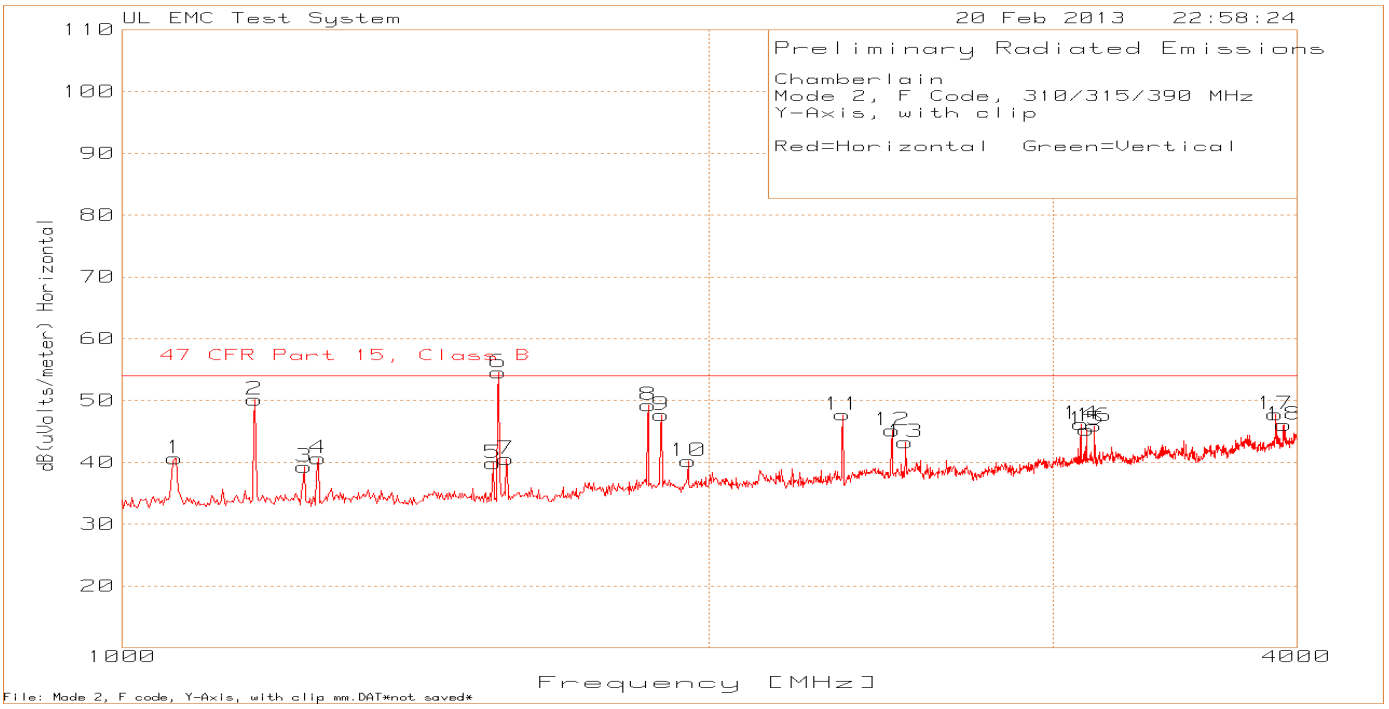


Figure 14 Radiated Emissions Graph (Above 1GHz Y-Axis)



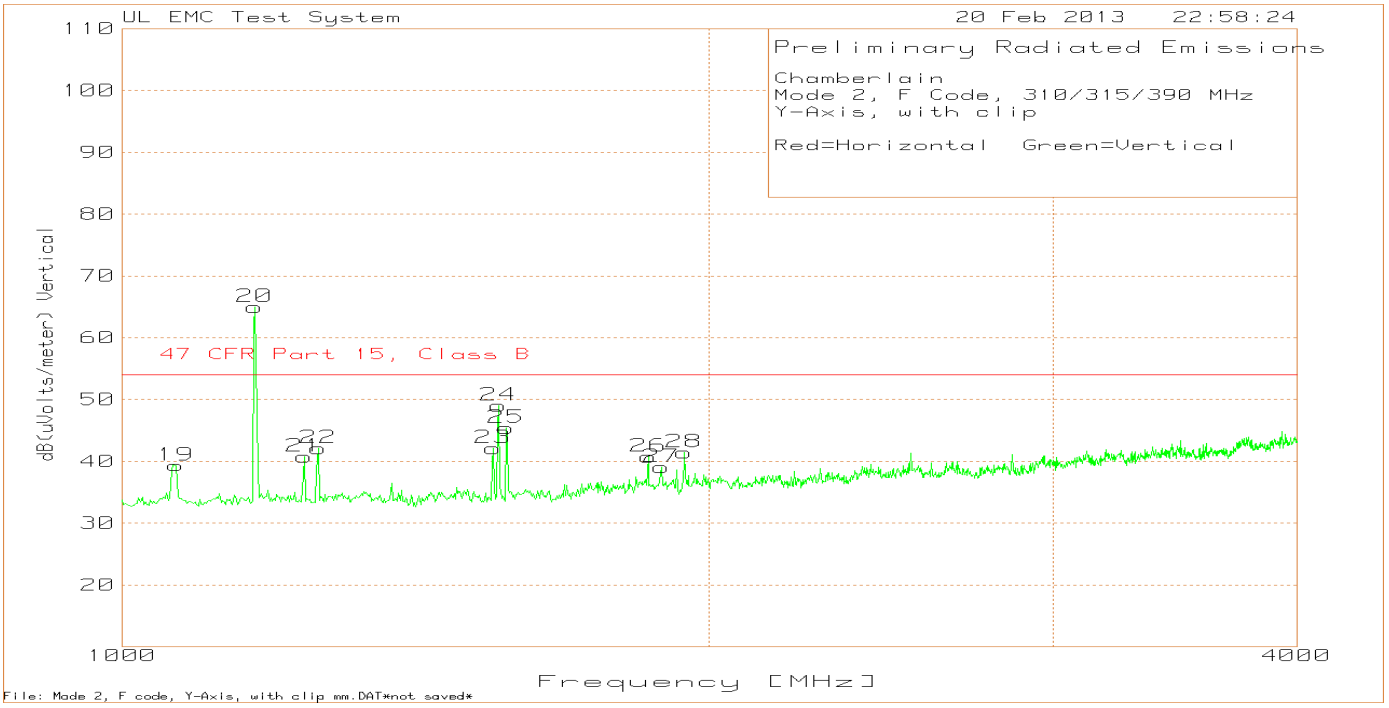


Table 7 - Radiated Emissions Data Points

Test Frequency MHz	Meter Reading	Detector	AF dB	Path L/G dB	Level dBuV/m	Duty Cycle dB	Level with DC dBuV/m	Limit dBuV/m	Margin dB	Azimuth [Degs]	Height [cm]	Polarity	Notes
310.0185	74.01	PK	14.1	2.1	90.21	-15.58	74.63	75.32	-0.69	97	102	Horz	1
310.0175	58.13	PK	14.1	2.1	74.33	-15.58	58.75	75.32	-16.57	195	108	Vert	1
620.037	28.93	PK	20.4	3	52.33	-15.58	36.75	55.32	-18.57	198	125	Horz	1
620.0435	22.18	PK	20.4	3	45.58	-15.58	30	55.32	-25.32	262	100	Vert	1
930.0535	35.11	PK	23.8	3.8	62.71	-15.58	47.13	55.32	-8.19	19	154	Horz	1
930.075	24.95	PK	23.8	3.8	52.55	-15.58	36.97	55.32	-18.35	310	241	Vert	1
315.0165	74.5	PK	14.3	2.1	90.9	-15.58	75.32	75.62	-0.3	96	100	Horz	2
315.0165	58.46	PK	14.3	2.1	74.86	-15.58	59.28	75.62	-16.34	205	101	Vert	2
630.053	27.26	PK	20.7	3	50.96	-15.58	35.38	55.32	-19.94	196	117	Horz	2
630.038	20.99	PK	20.7	3	44.69	-15.58	29.11	55.32	-26.21	301	100	Vert	2
945.071	31.36	PK	23.9	3.8	59.06	-15.58	43.48	55.32	-11.84	7	147	Horz	2
945.0415	17.69	PK	23.9	3.8	45.39	-15.58	29.81	55.32	-25.51	92	156	Vert	2
390.0235	65.22	PK	16.1	2.3	83.62	-15.58	68.04	79.24	-11.2	360	166	Horz	3
390.022	72.04	PK	16.1	2.3	90.44	-15.58	74.86	79.24	-4.38	266	145	Vert	3
780.045	26.83	PK	22	3.4	52.23	-15.58	36.65	59.24	-22.59	156	100	Horz	3
780.044	15.31	PK	22	3.4	40.71	-15.58	25.13	59.24	-34.11	217	203	Vert	3
1170.1413	92.93	PK	25	-57.24	60.69	-15.58	45.11	54	-8.89	360	128	Horz	3
1240.16	72.07	PK	25.1	-56.96	40.21	-15.58	24.63	54	-29.37	*	150	Horz	1
1260.173	72.8	PK	25.1	-56.92	40.98	-15.58	25.4	54	-28.6	*	100	Horz	2
1550.367	71.48	PK	25.2	-56.02	40.66	-15.58	25.08	54	-28.92	*	100	Horz	1
1560.0661	83.17	PK	25.2	-55.66	52.71	-15.58	37.13	54	-16.87	360	100	Horz	3
1574.383	73.58	PK	25.2	-55.3	43.48	-15.58	27.9	54	-26.1	*	100	Horz	2
1860.574	76.58	PK	27.1	-54.44	49.24	-15.58	33.66	54	-20.34	*	150	Horz	1
1890.594	75.38	PK	27.2	-54.32	48.26	-15.58	32.68	54	-21.32	*	150	Horz	2
1950.634	67.26	PK	27.3	-54.39	40.17	-15.58	24.59	54	-29.41	*	150	Horz	3
2170.781	67.35	PK	27.4	-52.92	41.83	-15.58	26.25	54	-27.75	*	100	Horz	1
2204.803	66.05	PK	27.4	-53.2	40.25	-15.58	24.67	54	-29.33	*	100	Horz	2
2340.894	72.53	PK	28.1	-52.9	47.73	-15.58	32.15	54	-21.85	*	100	Horz	3
2480.987	72.86	PK	28.8	-52.57	49.09	-15.58	33.51	54	-20.49	*	100	Horz	1
2521.014	69.32	PK	28.9	-52.19	46.03	-15.58	30.45	54	-23.55	*	100	Horz	2
3101.401	67.31	PK	30.5	-51.31	46.5	-15.58	30.92	54	-23.08	*	150	Horz	1
3121.414	66.11	PK	30.6	-51.41	45.3	-15.58	29.72	54	-24.28	*	150	Horz	3
3151.434	69.84	PK	30.6	-51.71	48.73	-15.58	33.15	54	-20.85	*	150	Horz	2
3901.935	67.14	PK	32.6	-51.99	47.75	-15.58	32.17	54	-21.83	*	150	Horz	3

Test Frequency MHz	Meter Reading	Detector	AF dB	Path L/G dB	Level dBuV/m	Duty Cycle dB	Level with DC dBuV/m	Limit dBuV/m	Margin dB	Azimuth [Degs]	Height [cm]	Polarity	Notes
1170.0451	90.7	PK	25	-57.24	58.46	-15.58	42.88	54	-11.12	0	247	Vert	3
1240.16	74.56	PK	25.1	-56.96	42.7	-15.58	27.12	54	-26.88	*	150	Vert	1
1260.173	77.73	PK	25.1	-56.92	45.91	-15.58	30.33	54	-23.67	*	150	Vert	2
1560.374	79.44	PK	25.2	-55.65	48.99	-15.58	33.41	54	-20.59	*	100	Vert	3
1860.574	68.38	PK	27.1	-54.44	41.04	-15.58	25.46	54	-28.54	*	100	Vert	1
1890.594	67.83	PK	27.2	-54.32	40.71	-15.58	25.13	54	-28.87	*	100	Vert	2
2340.894	65.73	PK	28.1	-52.9	40.93	-15.58	25.35	54	-28.65	*	100	Vert	3
2480.987	65.55	PK	28.8	-52.57	41.78	-15.58	26.2	54	-27.8	*	150	Vert	1
2521.014	65.49	PK	28.9	-52.19	42.2	-15.58	26.62	54	-27.38	*	100	Vert	2
3151.434	63.68	PK	30.6	-51.71	42.57	-15.58	26.99	54	-27.01	*	150	Vert	2
Notes:													

1 - Mode 2, Code F, 310MHz, X-Axis, No Clip
2 - Mode 2, Code F, 315MHz, X-Axis, No Clip
3 - Mode 2, Code F, 390MHz, Y-Axis, With Clip
* Prescan Data, not maximized
PK - Peak detector

4.2 Configuration 3 Test Data

4.2.1 Test Conditions and Results – Occupied 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(c)
Occupied Bandwidth Limits	
0.25% of Center Frequency (315MHz: 787.5kHz)	

Table 8 Occupied Bandwidth Configuration Settings

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

Table 9 Occupied Bandwidth Spectrum Analyzer Settings

Resolution Bandwidth	Occupied Bandwidth Requirements	
	dBc	% PWR
10kHz	-20	99
Supplementary information: None		

Table 10 Occupied Bandwidth Test Result Summary

Center Frequency	20dB BW Measured (kHz)	99% BW Measured (kHz)
315MHz	52.93	102.27

Figure 15 – Bandwidth Graph – FCC

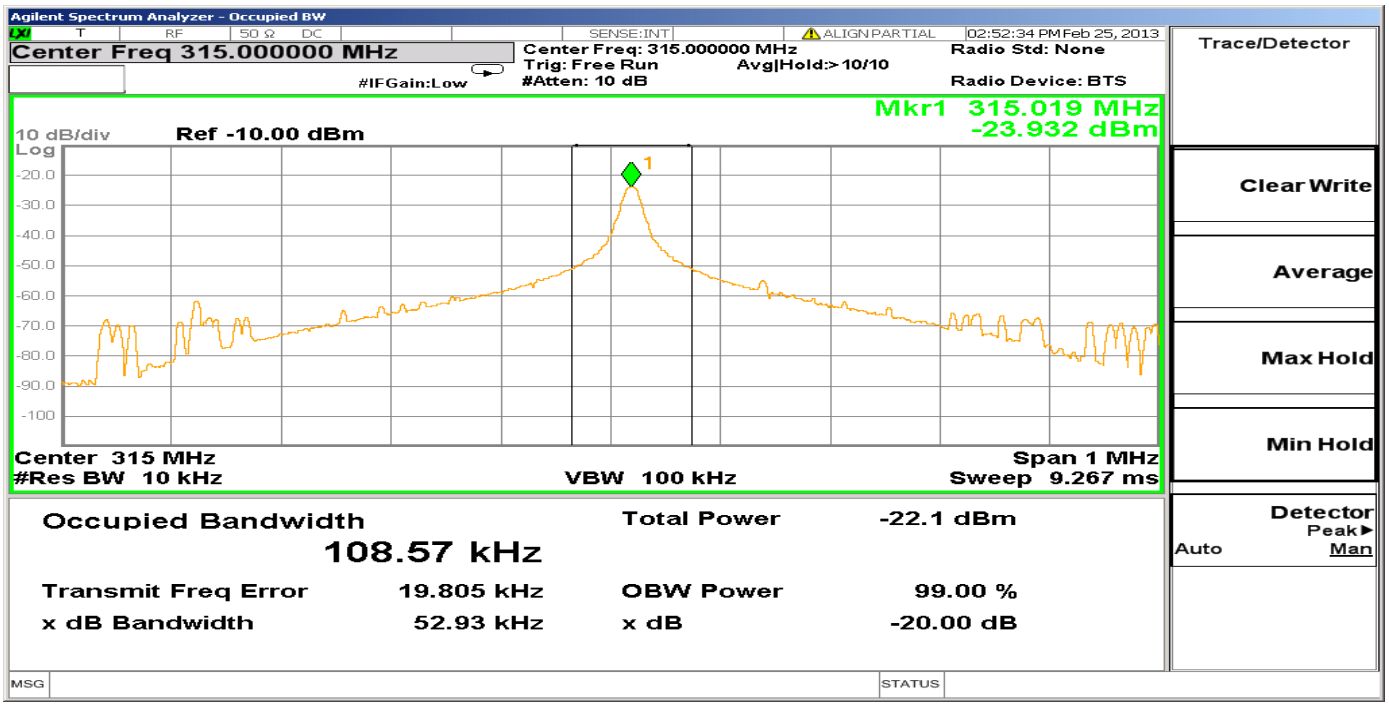
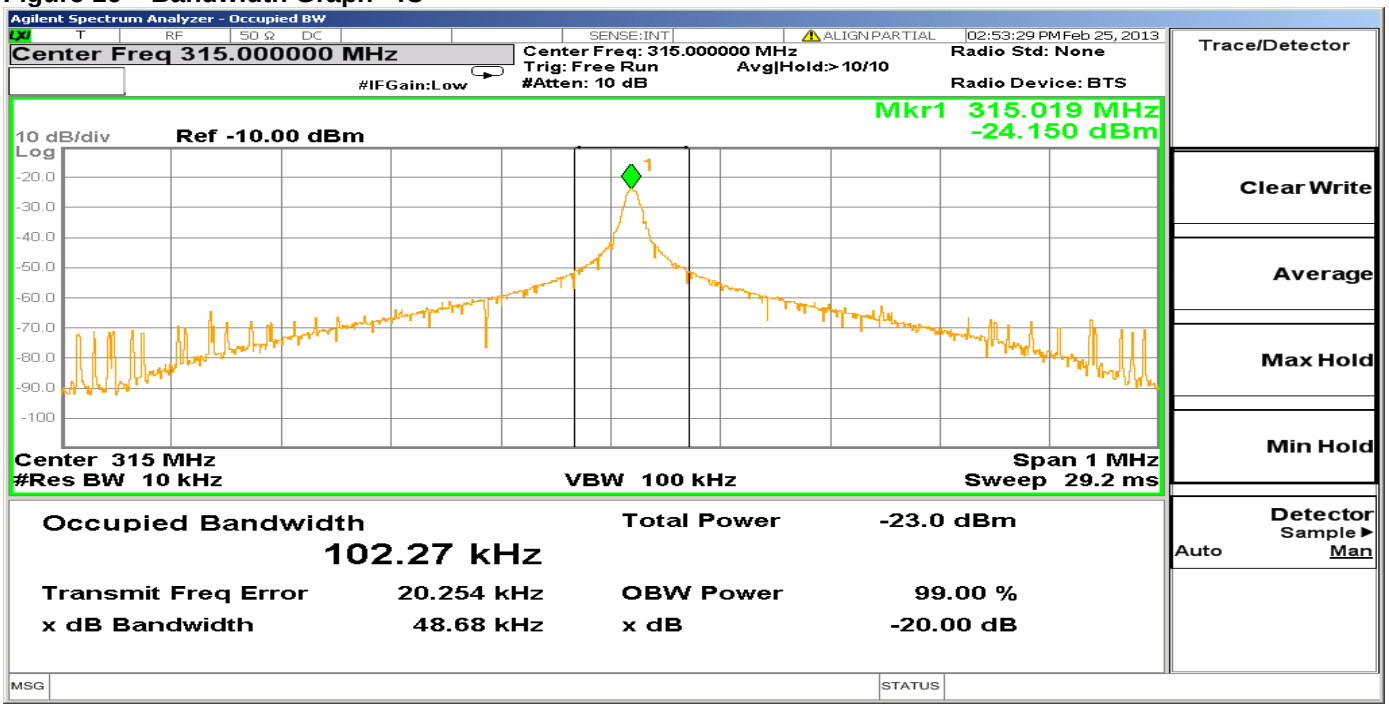


Figure 16 – Bandwidth Graph - IC



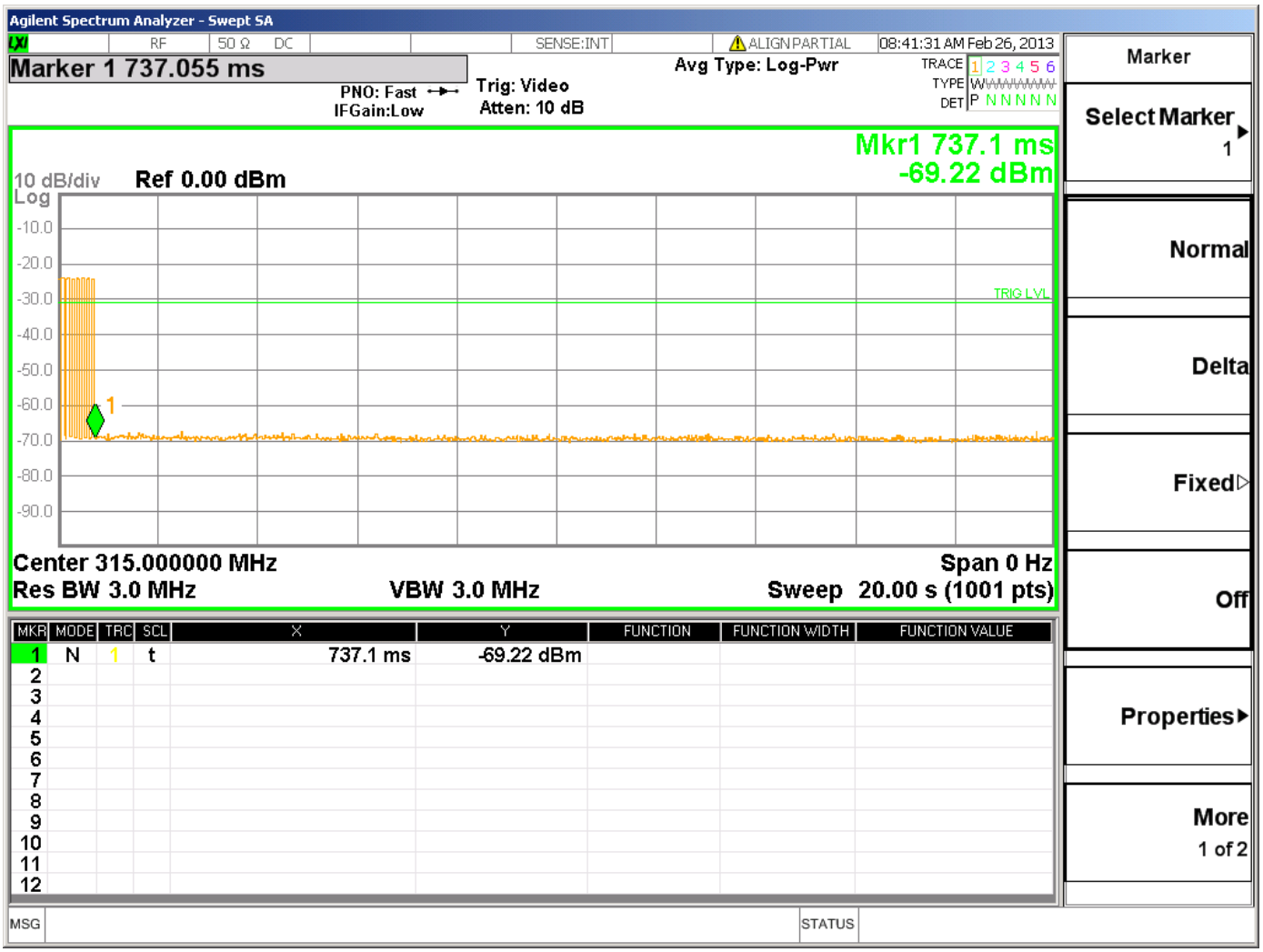
4.2.2 Test Conditions and Results – Cease Operation

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(a)
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 11 Cease Operation Configuration Settings

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

Figure 17 Cease Operation Graph



4.2.3 Test Conditions and Results – Pulse Train

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.	

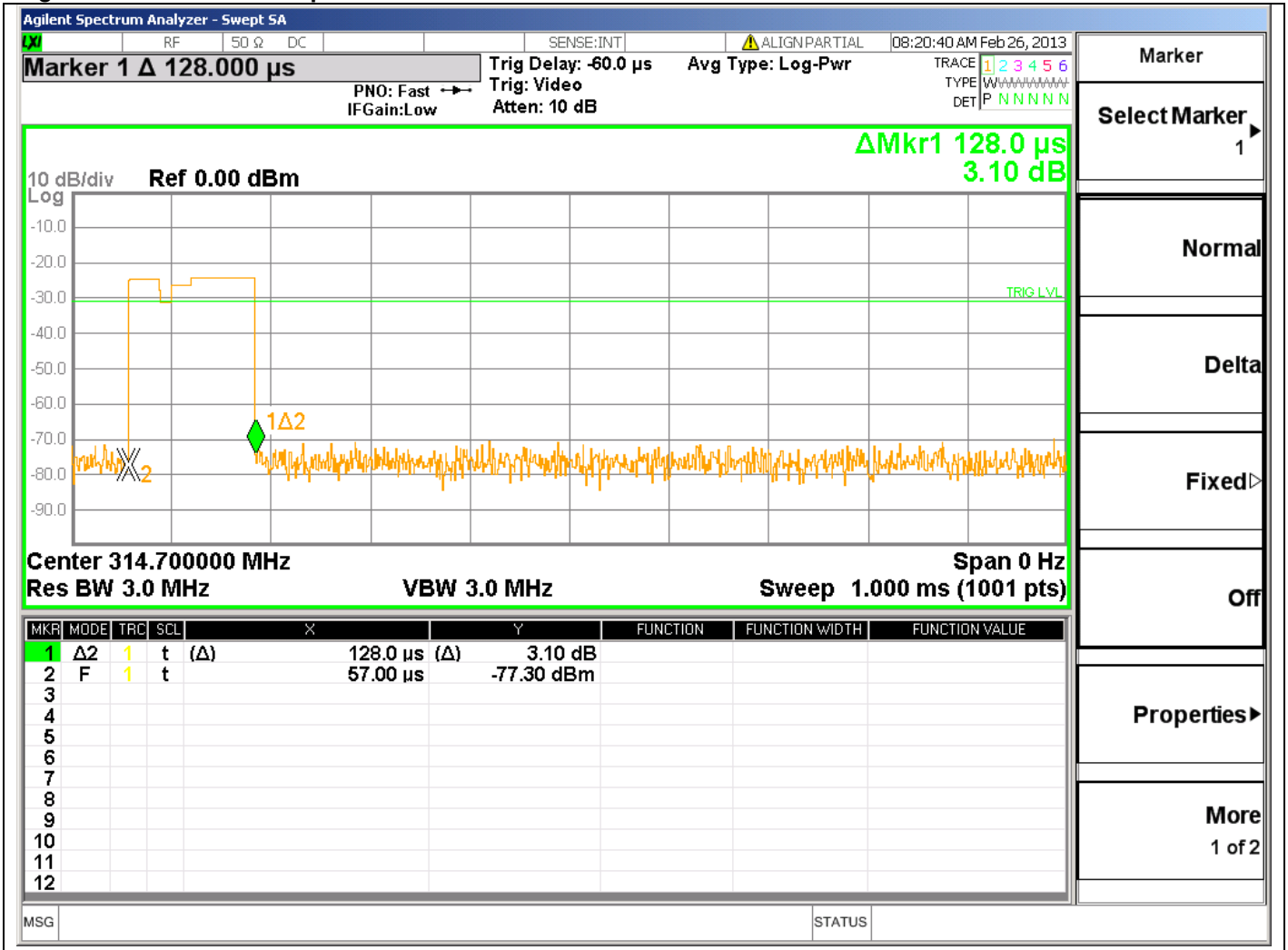
Table 12 Pulse Train Configuration Settings

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

Table 13 Pulse Train Calculation

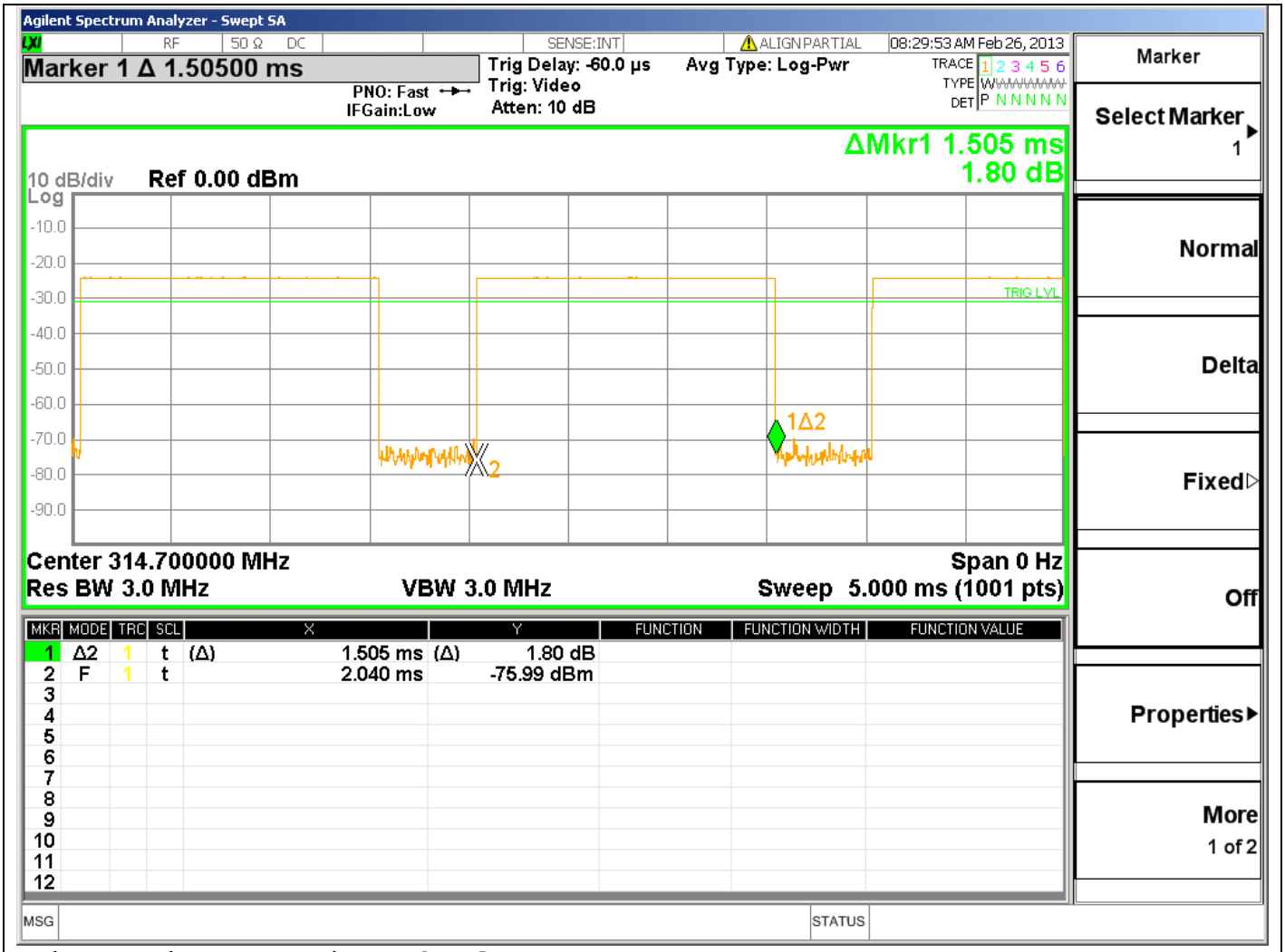
TX Frequency	Total TX time	Total Transmission period or 100ms whichever is lesser	DC Correction Factor (dB) $20\log\left(\frac{PulseWidth}{Period}\right)$
315MHz	0.128+(8x0.510)+(11x1.010)+(2x1.505)	100	-14.73
Worst Case Duty Cycle: Worst case duty cycle was calculated over 100mS including the tuning pulse. The manufacturer declared duty cycle as -10.17dB and it is used for all radiated emissions data.			

Figure 18 Pulse Train Graphs for 315MHz



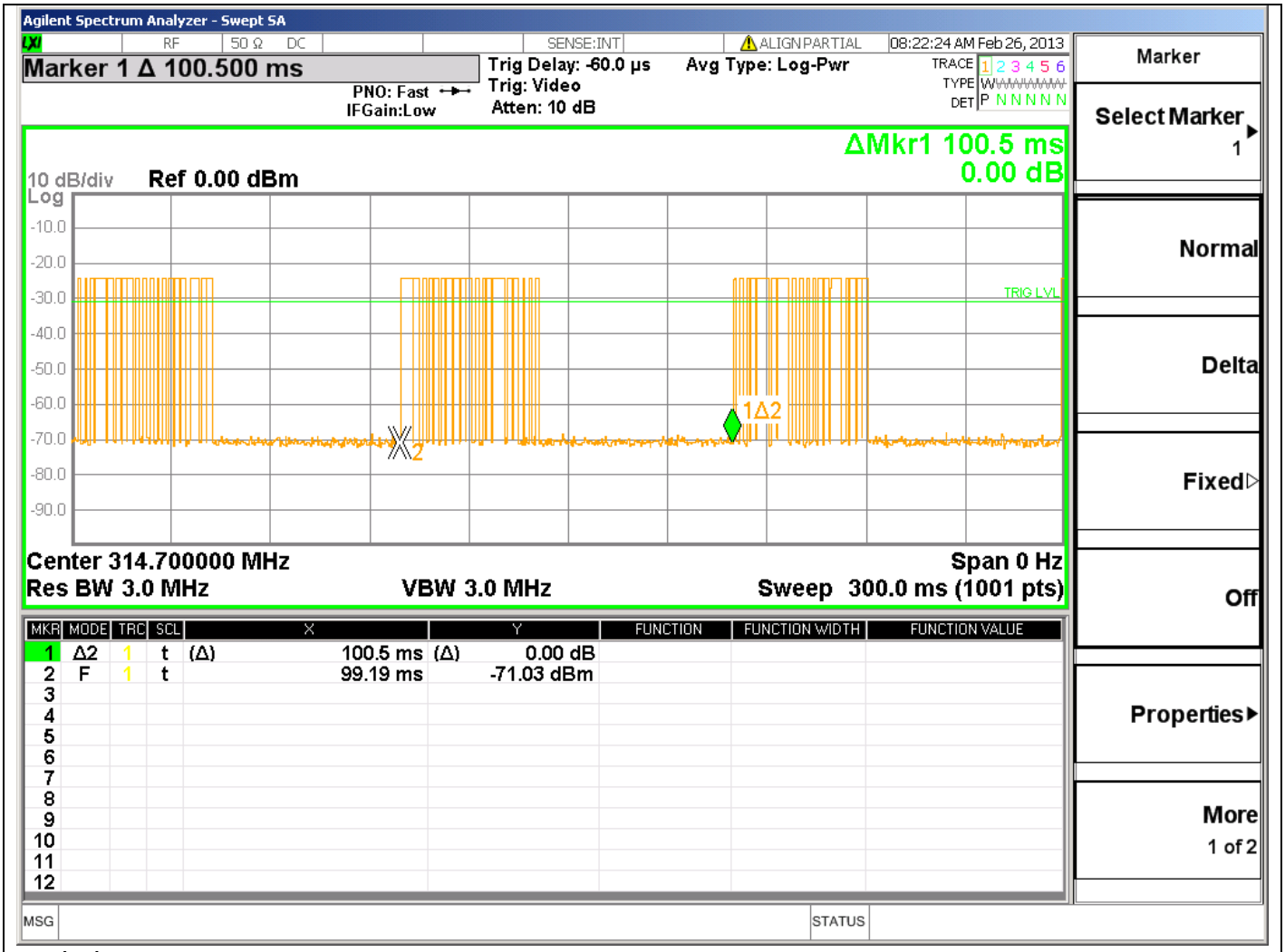
First tuning pulse duration: 0.128mS

Pulse Duration: Short Pulse 0.510mS, Medium Pulse 1.010mS,



Pulse Duration: Long Pulse 1.505mS

Number of Pulses: 8 Short, 11 Medium, 2 Long


Agilent Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN PARTIAL
08:22:24 AM Feb 26, 2013
Marker 1 Δ 100.500 ms
PNO: Fast
IFGain:Low
Trig Delay: -60.0 µs
Trig: Video
Atten: 10 dB
Avg Type: Log-Pwr
TRACE 1 2 3 4 5 6
TYPE W
DET P N N N N N
ΔMkr1 100.5 ms
0.00 dB
10 dB/div
Log
Ref 0.00 dBm
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
-90.0
TRIG LVL
1Δ2
Center 314.700000 MHz
Res BW 3.0 MHz
VBW 3.0 MHz
Span 0 Hz
Sweep 300.0 ms (1001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 Δ2 1 t (Δ) 100.5 ms (Δ) 0.00 dB
2 F 1 t 99.19 ms -71.03 dBm
Marker
Select Marker 1
Normal
Delta
Fixed
Off
Properties
More 1 of 2
MSG
STATUS

Period scan

4.2.4 Test Conditions and Results – RADIATED EMISSIONS Fundamental and Spurious

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 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 subpart C, and RSS-210		
UL LPG	80-EM-S0029		
	Frequency range	Measurement Point	
Fully configured sample scanned over the following frequency range	30MHz – 1GHz	3 meter distance	
	1GHz – 4GHz	3 meter distance	

Out of band spurious emissions limits

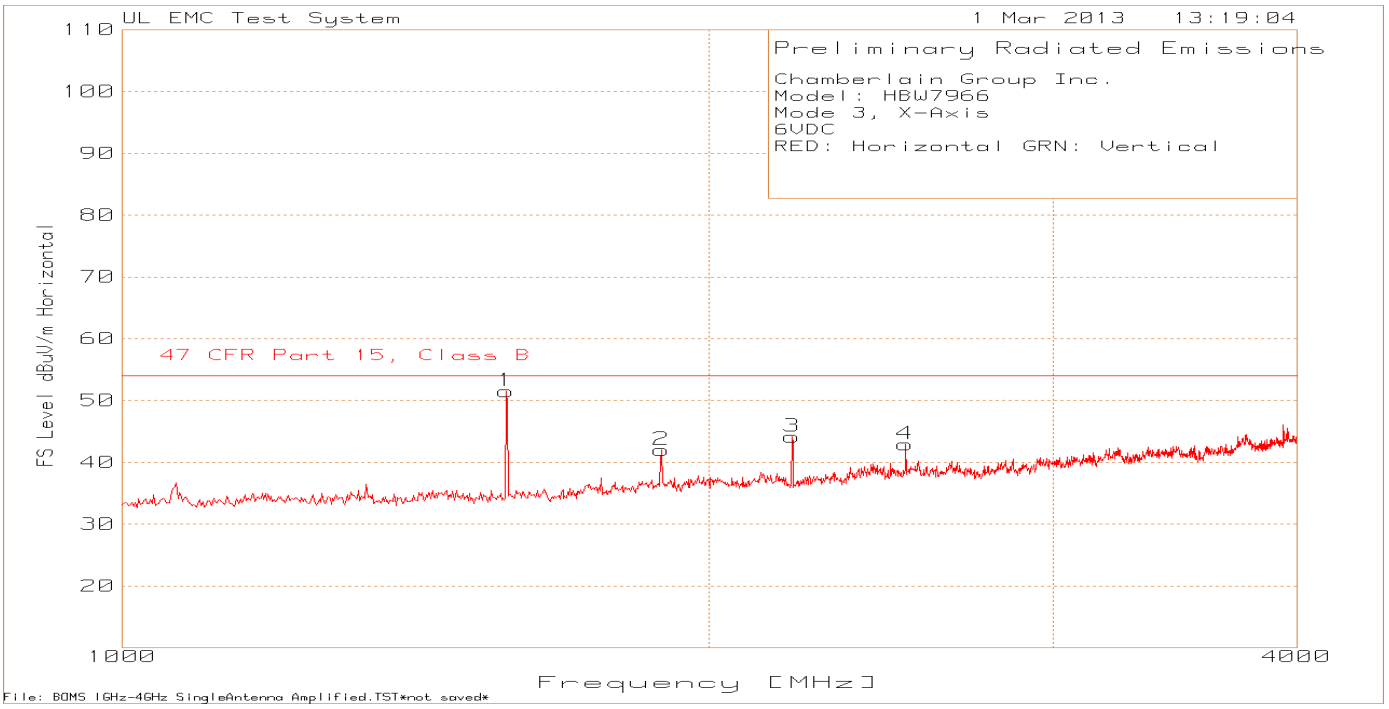
Frequency (MHz)	Limit (dBµV/m)	
	Quasi-Peak	Peak
30 - 88	40.00	NA
88 - 216	43.52	NA
216 - 960	46.02	NA
960 - 1000	54	NA
Above 1000 (FCC)	NA	54 (at 3-meter)

Fundamental Frequency Limits and Non-restricted band Harmonic Limits

Frequency (MHz)	Limit (dBµV/m) @ 3m distance All harmonics except those in restricted bands must be attenuated by 20dB or more	
	Average - Fundamental	Peak - Fundamental
315	75.62	95.62

Supplementary information: See section 4.2.3 for duty cycle information. Below 1GHz only emissions visible above the noise floor were the fundamental and the harmonics of the fundamental.

Figure 19 Radiated Emissions Graph (Above 1GHz)



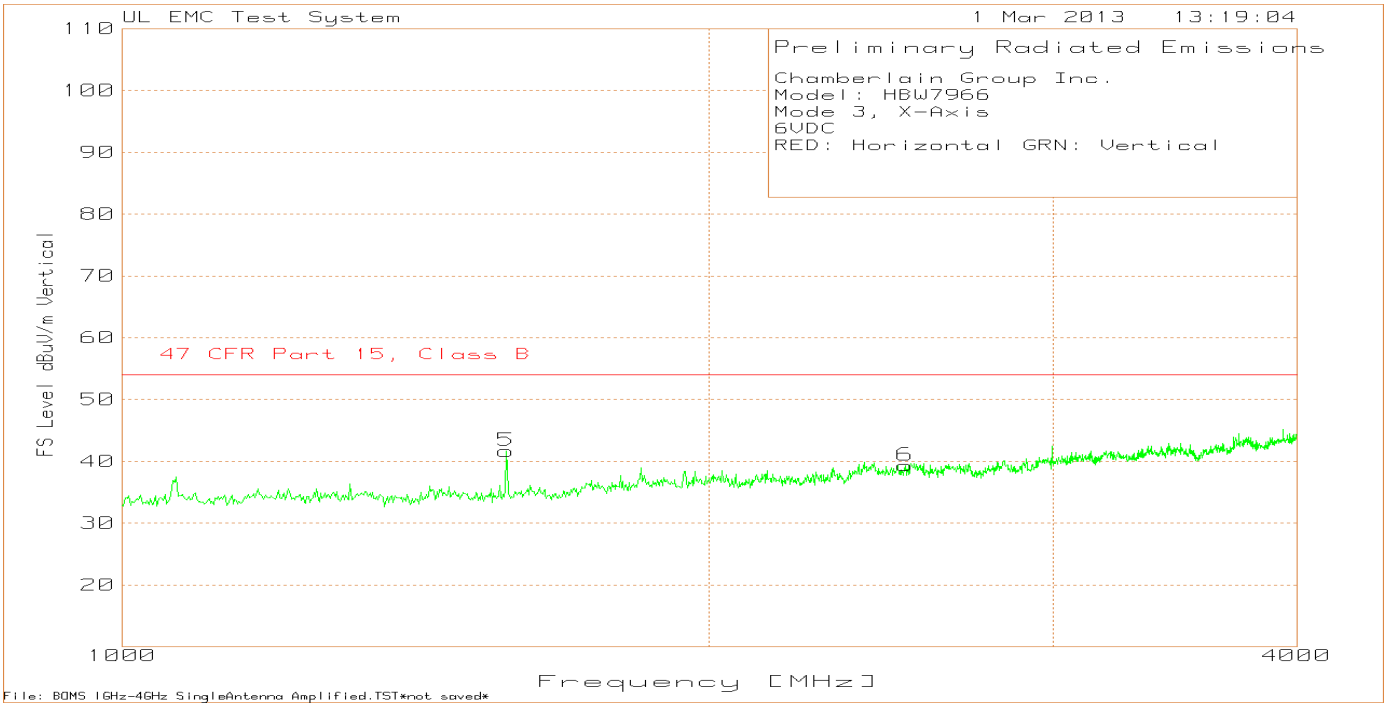


Table 14 - Radiated Emissions Data Points 315MHz

Test Frequency MHz	Meter Reading	Detector	AF dB	Path L/G dB	Level dBuV/m	Duty Cycle dB	Level with DB dBuV/m	Limit dBuV/m	Margin dB	Azimuth [Degs]	Height [cm]	Polarity	Notes
315.0192	65.23	PK	14.3	2.1	81.63	-10.17	71.46	75.62	-4.16	92	101	Horz	1
315.0202	48.61	PK	14.3	2.1	65.01	-10.17	54.84	75.62	-20.78	183	101	Vert	1
630.0324	15.64	PK	20.7	3	39.34	-10.17	29.17	55.62	-26.45	360	272	Horz	1
630.056	8.64	PK	20.7	3	32.34	-10.17	22.17	55.62	-33.45	266	101	Vert	1
945.082	20.86	PK	23.9	3.8	48.56	-10.17	38.39	55.62	-17.23	0	148	Horz	1
945.0984	11.08	PK	23.9	3.8	38.78	-10.17	28.61	55.62	-27.01	146	159	Vert	1
1575.0902	82.51	PK	25.2	-55.29	52.42	-10.17	42.25	54	-11.75	340	105	Horz	1
1890.594	69.11	PK	27.2	-54.32	41.99	-10.17	31.82	54	-22.18	*	150	Horz	1
2204.803	69.98	PK	27.4	-53.2	44.18	-10.17	34.01	54	-19.99	*	100	Horz	1
2521.014	66.22	PK	28.9	-52.19	42.93	-10.17	32.76	54	-21.24	*	100	Horz	1
1574.383	71.73	PK	25.2	-55.3	41.63	-10.17	31.46	54	-22.54	*	100	Vert	1
2521.014	62.65	PK	28.9	-52.19	39.36	-10.17	29.19	54	-24.81	*	200	Vert	1

Notes:
1 - Mode 3, Code D, 315MHz, X-Axis, No Clip
PK - Peak detector
* Prescan Data, not maximized

4.3 Configuration 4 Test Data

4.3.1 Test Conditions and Results – Occupied 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(c)
Occupied Bandwidth Limits	
0.25% of Center Frequency (390MHz: 975.0kHz)	

Table 15 Occupied Bandwidth Configuration Settings

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

Table 16 Occupied Bandwidth Spectrum Analyzer Settings

Resolution Bandwidth	Occupied Bandwidth Requirements	
	dBc	% PWR
10kHz	-20	99
Supplementary information: None		

Table 17 Occupied Bandwidth Test Result Summary

Center Frequency	20dB BW Measured (kHz)	99% BW Measured (kHz)
390MHz	49.53	102.25

Figure 20 – Bandwidth Graph – FCC

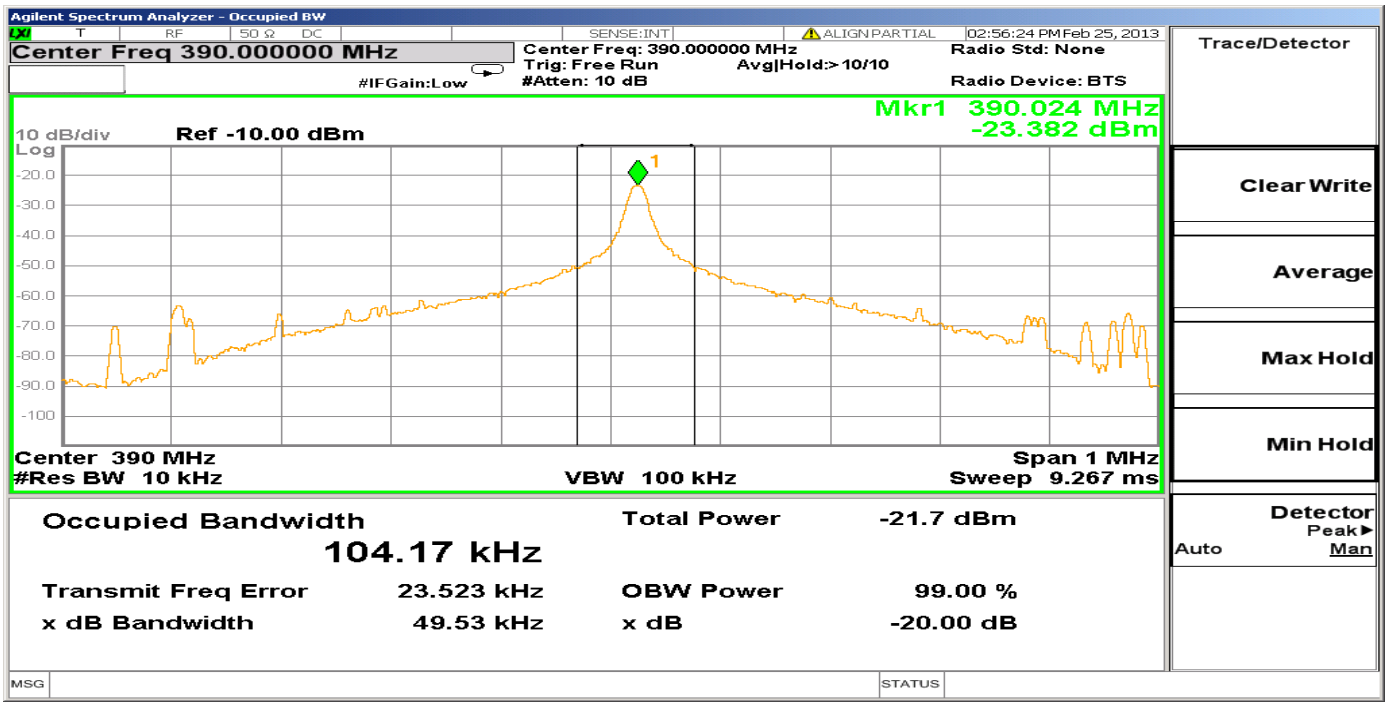
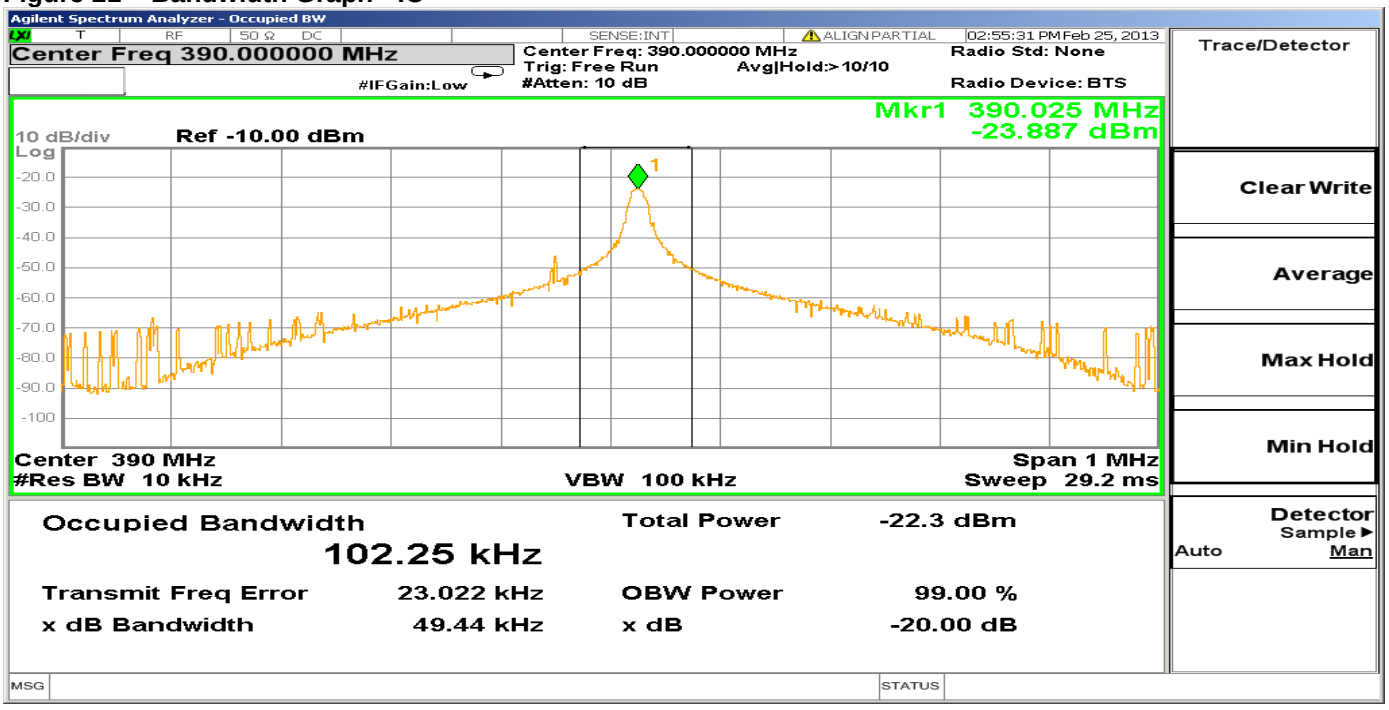


Figure 21 – Bandwidth Graph - IC



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(a)
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 18 Cease Operation Configuration Settings

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

Figure 22 Cease Operation Graph

4.3.3 Test Conditions and Results – Pulse Train

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.	

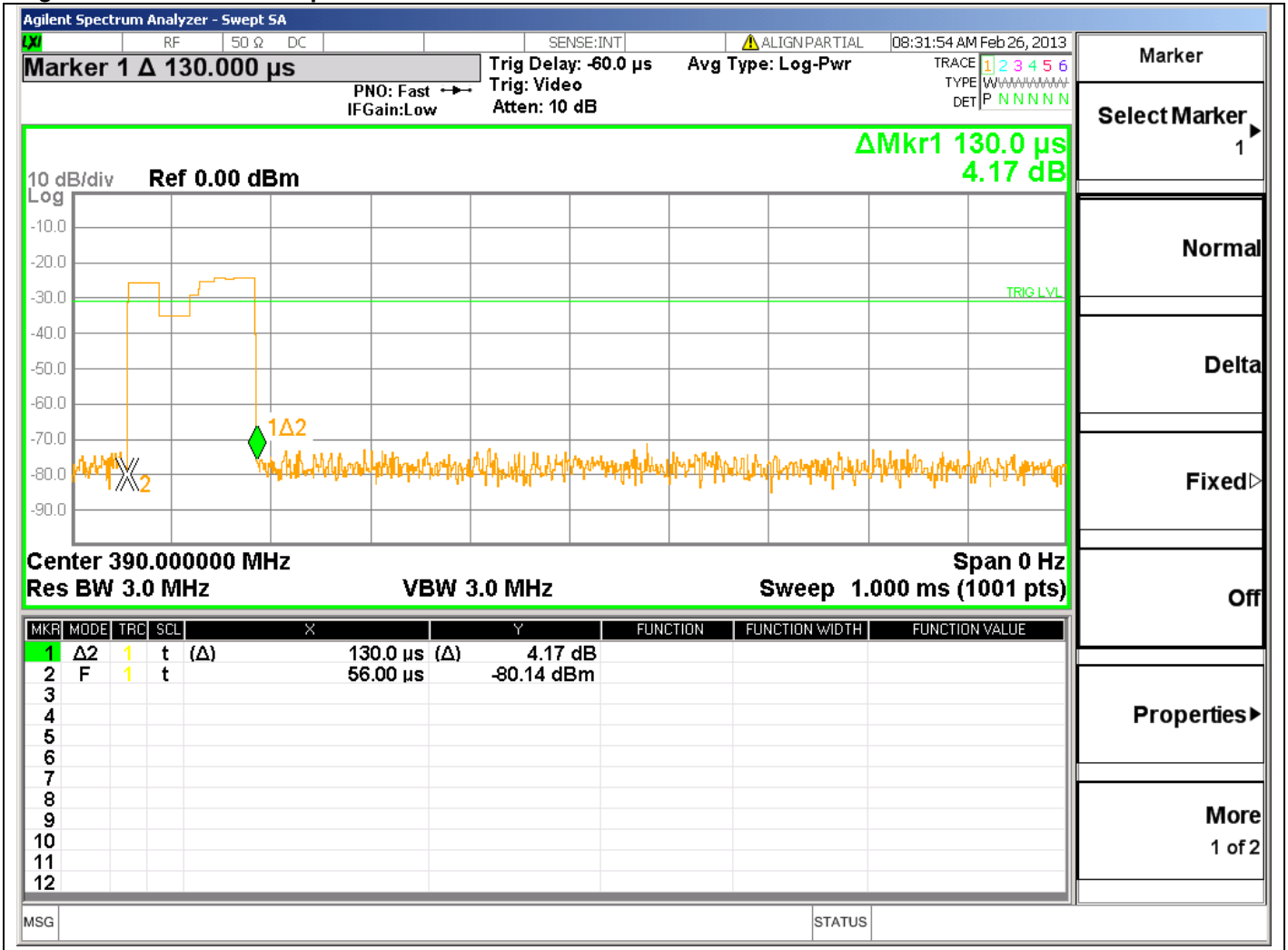
Table 19 Pulse Train Configuration Settings

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

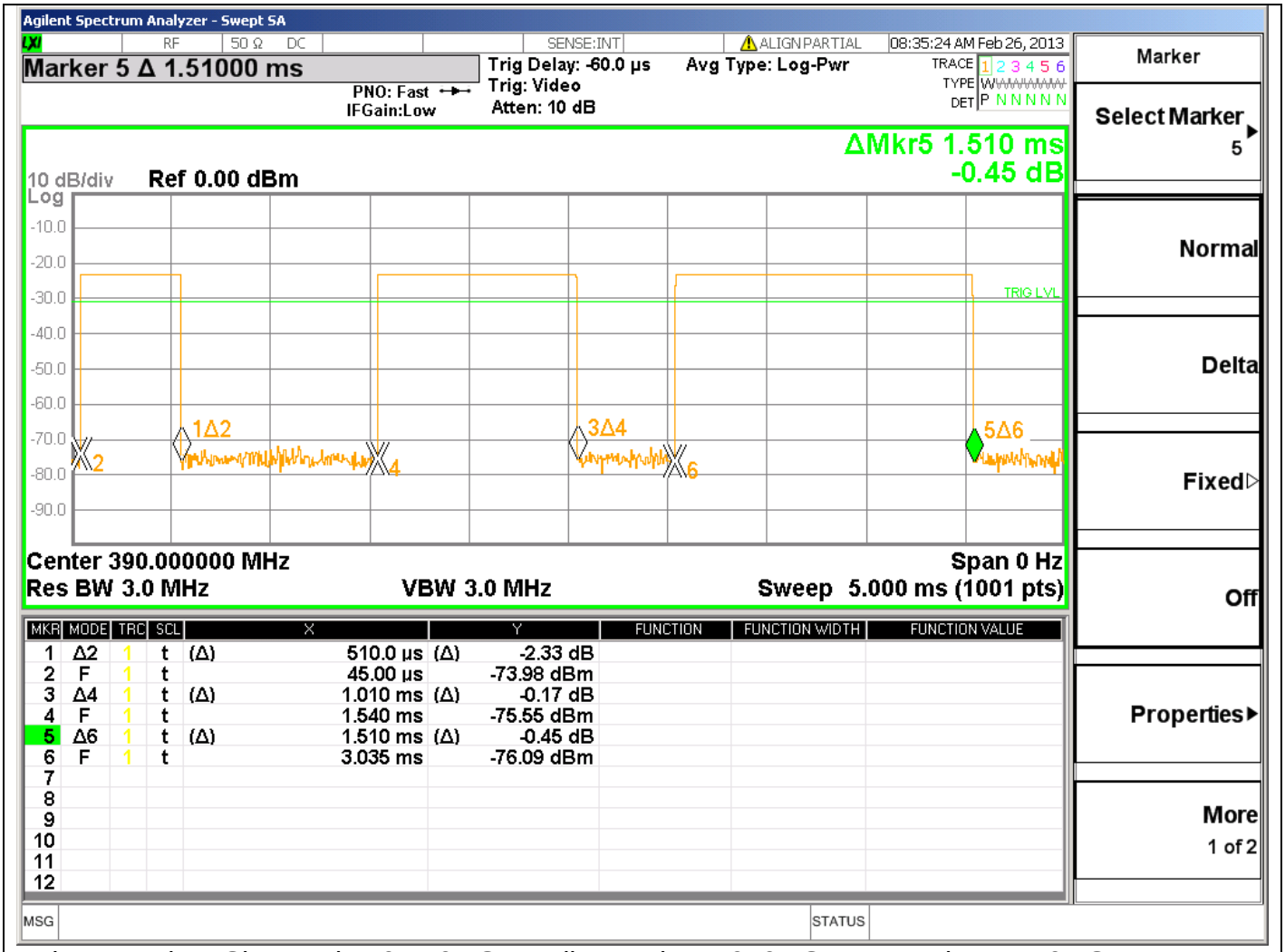
Table 20 Pulse Train Calculation

TX Frequency	Total TX time	Total Transmission period or 100ms whichever is lesser	DC Correction Factor (dB) $20\log\left(\frac{PulseWidth}{Period}\right)$
390MHz	0.130+(6x0.510)+(7x1.010)+(8x1.510)	100	-13.02
Worst Case Duty Cycle: Worst case duty cycle was calculated over 100ms including the tuning pulses. The manufacturer declared duty cycle as -10.17dB and it is used for all radiated emissions data.			

Figure 23 Pulse Train Graphs for 390MHz



First tuning pulse duration: 0.130mS



Pulse Duration: Short Pulse 0.510mS, Medium Pulse 1.010mS, Long Pulse 1.510mS

Number of Pulses: 6 Short, 7 Medium, 8 Long

Period scan: 100.8mS

4.3.4 Test Conditions and Results – RADIATED EMISSIONS Fundamental and Spurious

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 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 subpart C, and RSS-210		
UL LPG	80-EM-S0029		
	Frequency range	Measurement Point	
Fully configured sample scanned over the following frequency range	30MHz – 1GHz	3 meter distance	
	1GHz – 4GHz	3 meter distance	

Out of band spurious emissions

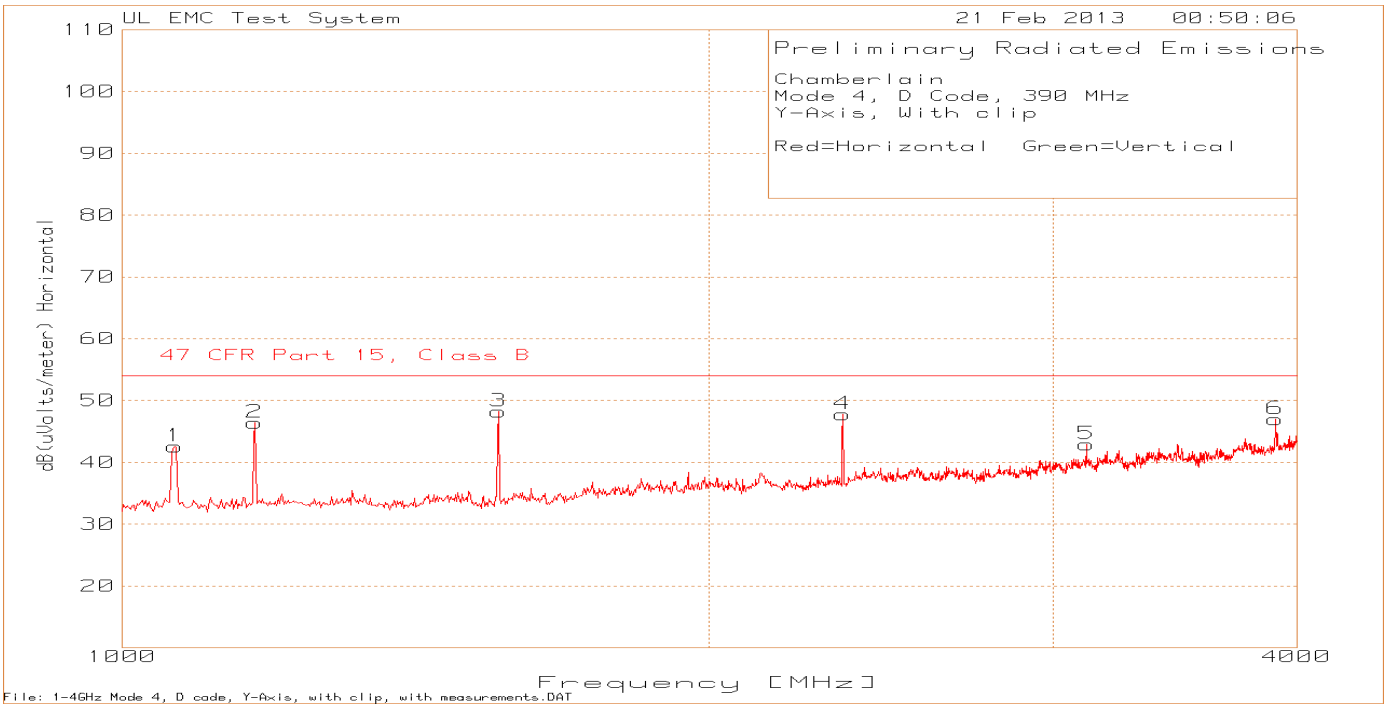
Frequency (MHz)	Limit (dBµV/m)	
	Quasi-Peak	Peak
30 - 88	40.00	NA
88 - 216	43.52	NA
216 - 960	46.02	NA
960 - 1000	54	NA
Above 1000 (FCC)	NA	54 (at 3-meter)

Fundamental Frequency Limits and Non-restricted band Harmonic Limits

Frequency (MHz)	Limit (dBµV/m) @ 3m distance All harmonics except those in restricted bands must be attenuated by 20dB or more	
	Average - Fundamental	Peak - Fundamental
390	79.24	99.24

Supplementary information: See section 4.3.3 for duty cycle information. Below 1GHz only emissions visible above the noise floor were the fundamental and the harmonics of the fundamental.

Figure 24 Radiated Emissions Graph (Above 1GHz)



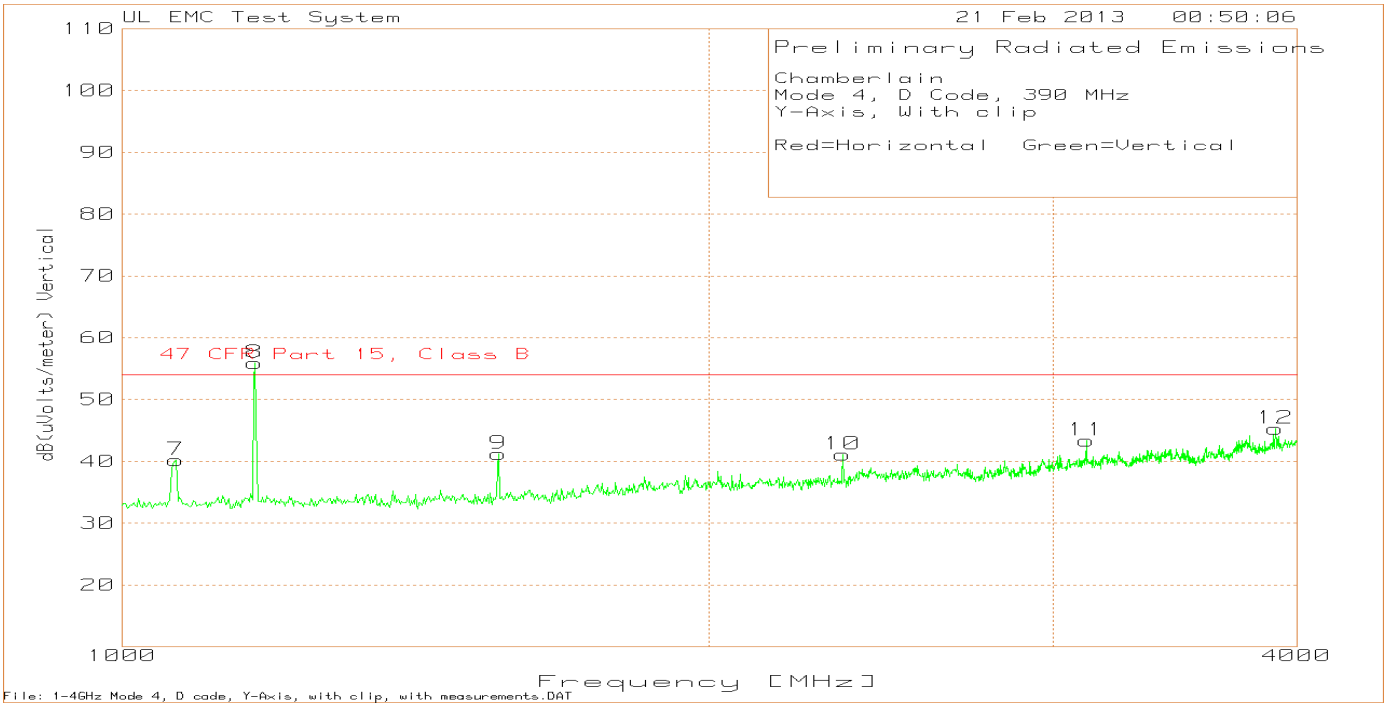


Table 21 - Radiated Emissions Data Points

Test Frequency MHz	Meter Reading	Detector	AF dB	Path L/G dB	Level dBuV/m	Duty Cycle dB	Level with DB dBuV/m	Limit dBuV/m	Margin dB	Azimuth [Degs]	Height [cm]	Polarity	Notes
390.028	62.34	PK	16.1	2.3	80.74	-10.17	70.57	79.24	-8.67	171	387	Horz	1
390.027	69.4	PK	16.1	2.3	87.8	-10.17	77.63	79.24	-1.61	274	143	Vert	1
780.053	21.35	PK	22	3.4	46.75	-10.17	36.58	59.24	-22.66	5	101	Horz	1
780.049	11.98	PK	22	3.4	37.38	-10.17	27.21	59.24	-32.03	212	181	Vert	1
1064.043	74.72	PK	24.5	-56.63	42.59	-10.17	32.42	54	-21.58	*	100	Horz	1
1170.113	78.63	PK	25	-57.24	46.39	-10.17	36.22	54	-17.78	*	149	Horz	1
1560.1273	79.29	PK	25.2	-55.66	48.83	-10.17	38.66	54	-15.34	166	100	Horz	1
2340.894	72.63	PK	28.1	-52.9	47.83	-10.17	37.66	54	-16.34	*	100	Horz	1
3121.414	63.75	PK	30.6	-51.41	42.94	-10.17	32.77	54	-21.23	*	149	Horz	1
3901.935	66.38	PK	32.6	-51.99	46.99	-10.17	36.82	54	-17.18	*	149	Horz	1
1170.3667	91.92	PK	25	-57.23	59.69	-10.17	49.52	54	-4.48	360	133	Vert	1
1560.374	71.64	PK	25.2	-55.65	41.19	-10.17	31.02	54	-22.98	*	149	Vert	1
2340.894	65.87	PK	28.1	-52.9	41.07	-10.17	30.9	54	-23.1	*	149	Vert	1
3121.414	64.2	PK	30.6	-51.41	43.39	-10.17	33.22	54	-20.78	*	149	Vert	1
3901.935	64.72	PK	32.6	-51.99	45.33	-10.17	35.16	54	-18.84	*	149	Vert	1

Notes:
1 - Mode 4, Code D, 390MHz, Y-Axis, With Clip
* Prescan data, not maximized

4.4 Configuration 5 Test Data

4.4.1 Test Conditions and Results – Occupied 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(c)
Occupied Bandwidth Limits	
0.25% of Center Frequency (390MHz: 975.0kHz)	

Table 22 Occupied Bandwidth Configuration Settings

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

Table 23 Occupied Bandwidth Spectrum Analyzer Settings

Resolution Bandwidth	Occupied Bandwidth Requirements	
	dBc	% PWR
10kHz	-20	99
Supplementary information: None		

Table 24 Occupied Bandwidth Test Result Summary

Center Frequency	20dB BW Measured (kHz)	99% BW Measured (kHz)
390MHz	54.66	98.813

Figure 25 – Bandwidth Graph – FCC

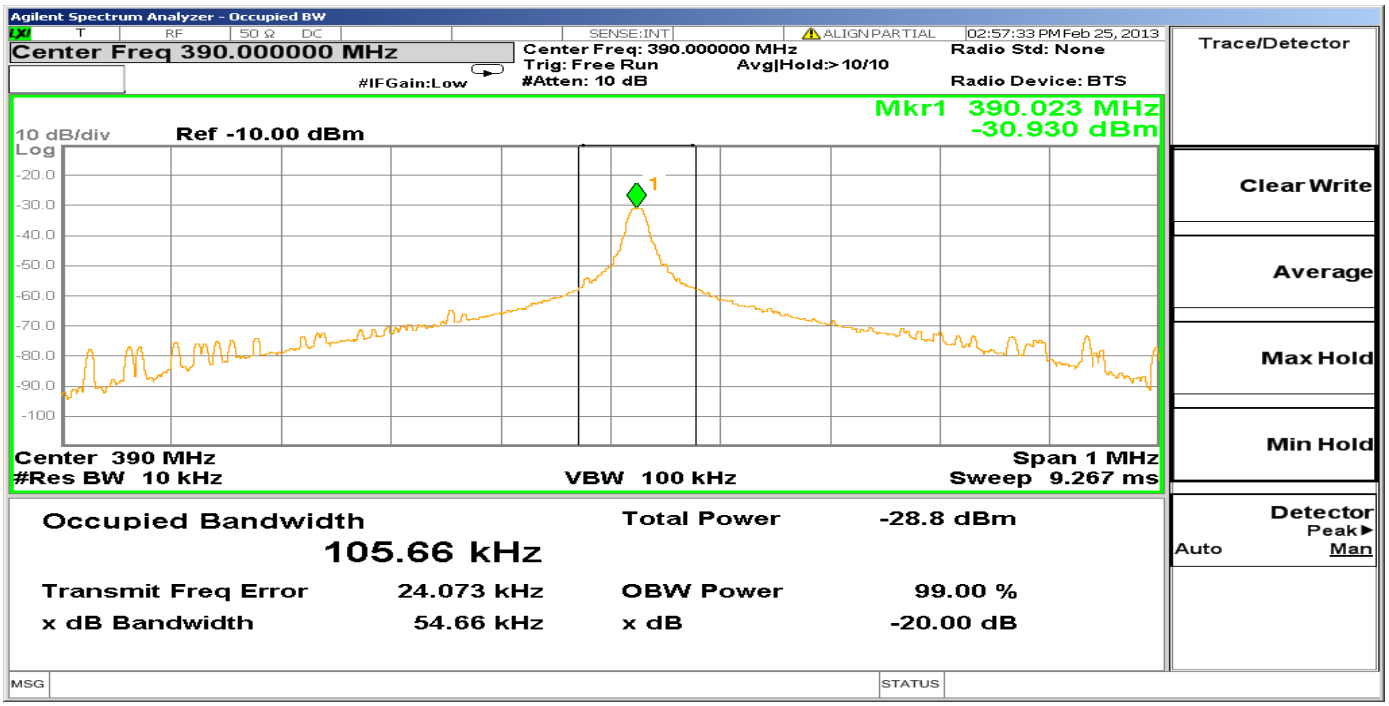
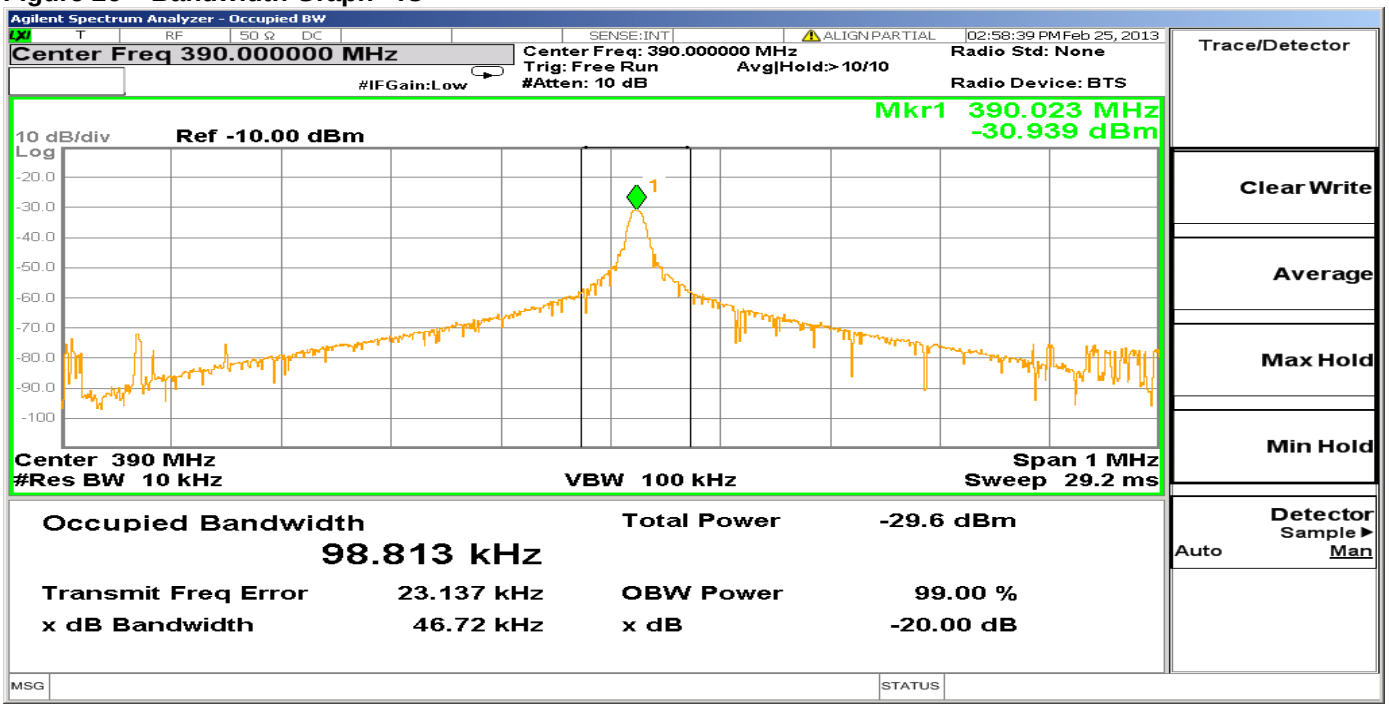


Figure 26 – Bandwidth Graph - IC



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(a)
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 25 Cease Operation Configuration Settings

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

Figure 27 Cease Operation Graph

4.4.3 Test Conditions and Results – Pulse Train

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.	

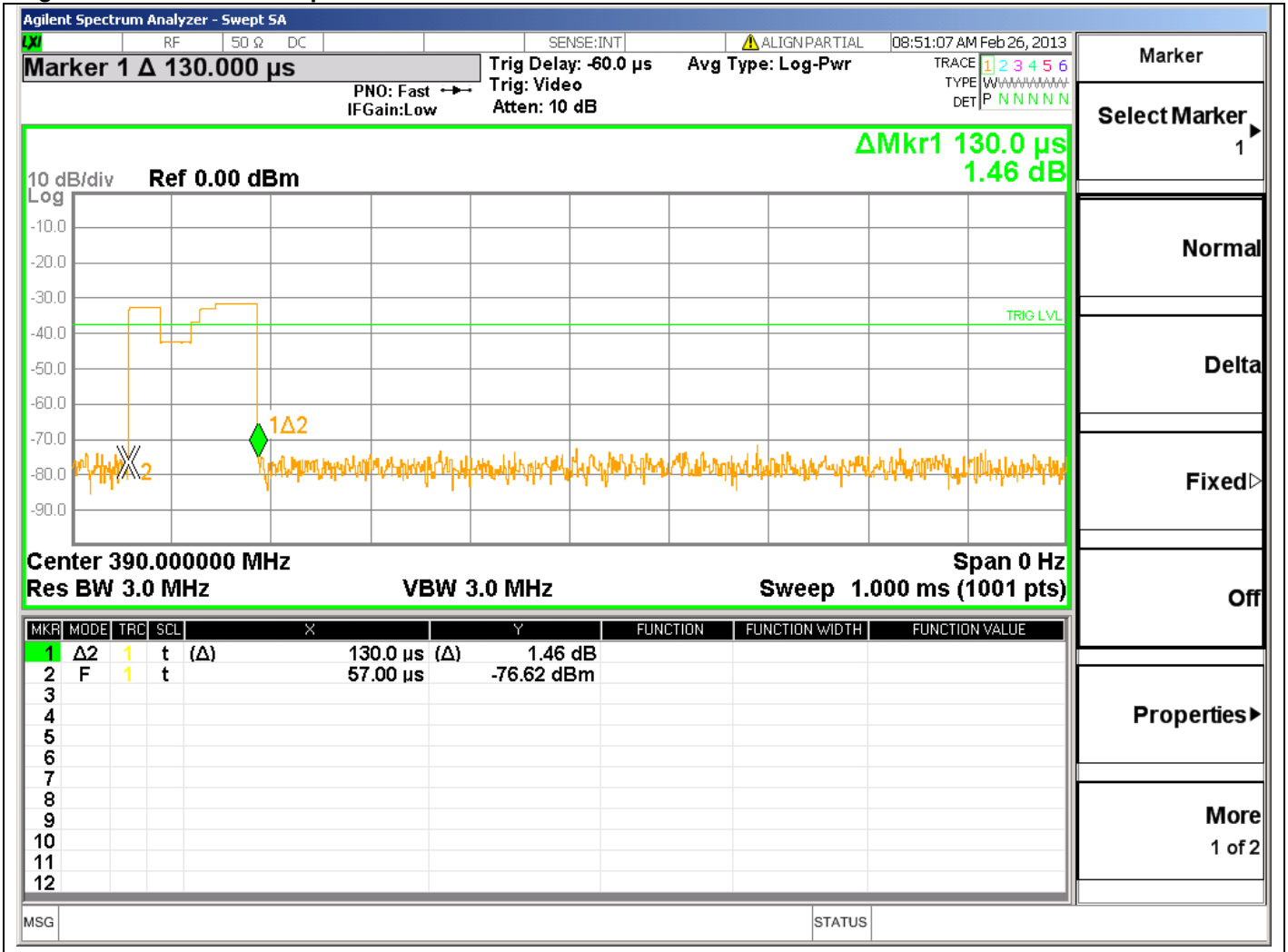
Table 26 Pulse Train Configuration Settings

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

Table 27 Pulse Train Calculation

TX Frequency	Total TX time	Total Transmission period or 100ms whichever is lesser	DC Correction Factor (dB) $20\log\left(\frac{PulseWidth}{Period}\right)$
390MHz	(6x1.02)+(3x2.04)+(2x3.04)	76.4	-12.3
Worst Case Duty Cycle: Worst case duty cycle was calculated over normal period of 76.4mS not including the tuning pulses. The manufacturer declared duty cycle as -6.74dB and it is used for all radiated emissions data.			

Figure 28 Pulse Train Graphs for 390MHz



First tuning pulse duration: 0.130mS

Pulse Duration: Short Pulse 1.020mS, Medium Pulse 2.040mS

Pulse Duration: Medium Pulse 2.040 Long Pulse 3.040mS

Number of Pulses – first count: 10 Short, 1 Medium, 0 Long
Number of Pulses – second count: 6 Short, 3 Medium, 2 Long

Period scan: 76.4mS

4.4.4 Test Conditions and Results – RADIATED EMISSIONS Fundamental and Spurious

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 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 subpart C, and RSS-210		
UL LPG	80-EM-S0029		
	Frequency range	Measurement Point	
Fully configured sample scanned over the following frequency range	30MHz – 1GHz	3 meter distance	
	1GHz – 4GHz	3 meter distance	

Restricted Band Limits

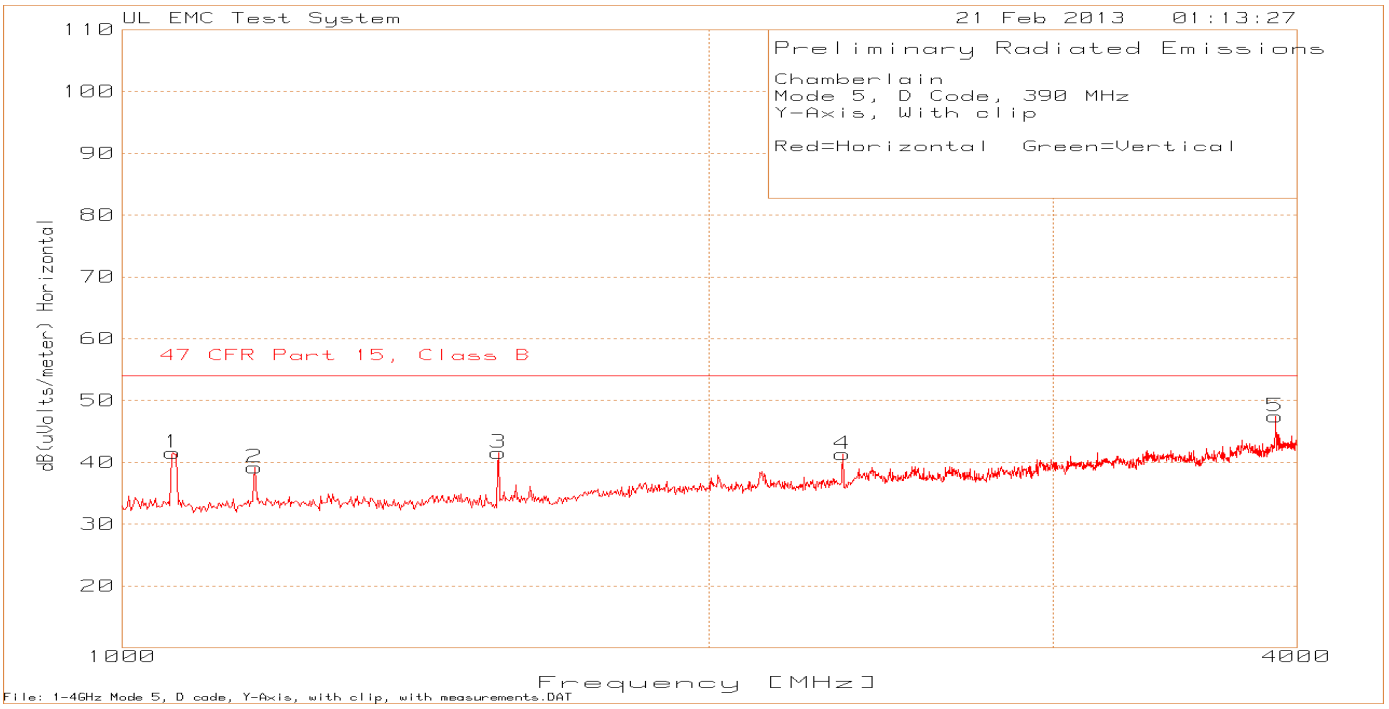
Frequency (MHz)	Limit (dBµV/m)	
	Quasi-Peak	Peak
30 - 88	40.00	NA
88 - 216	43.52	NA
216 - 960	46.02	NA
960 - 1000	54	NA
Above 1000 (FCC)	NA	54 (at 3-meter)

Fundamental Frequency Limits and Non-restricted band Harmonic Limits

Frequency (MHz)	Limit (dBµV/m) @ 3m distance All harmonics except those in restricted bands must be attenuated by 20dB or more	
	Average - Fundamental	Peak - Fundamental
390	79.24	99.24

Supplementary information: See section 4.4.3 for duty cycle information. Below 1GHz only emissions visible above the noise floor were the fundamental and the harmonics of the fundamental.

Figure 29 Radiated Emissions Graph (Above 1GHz)



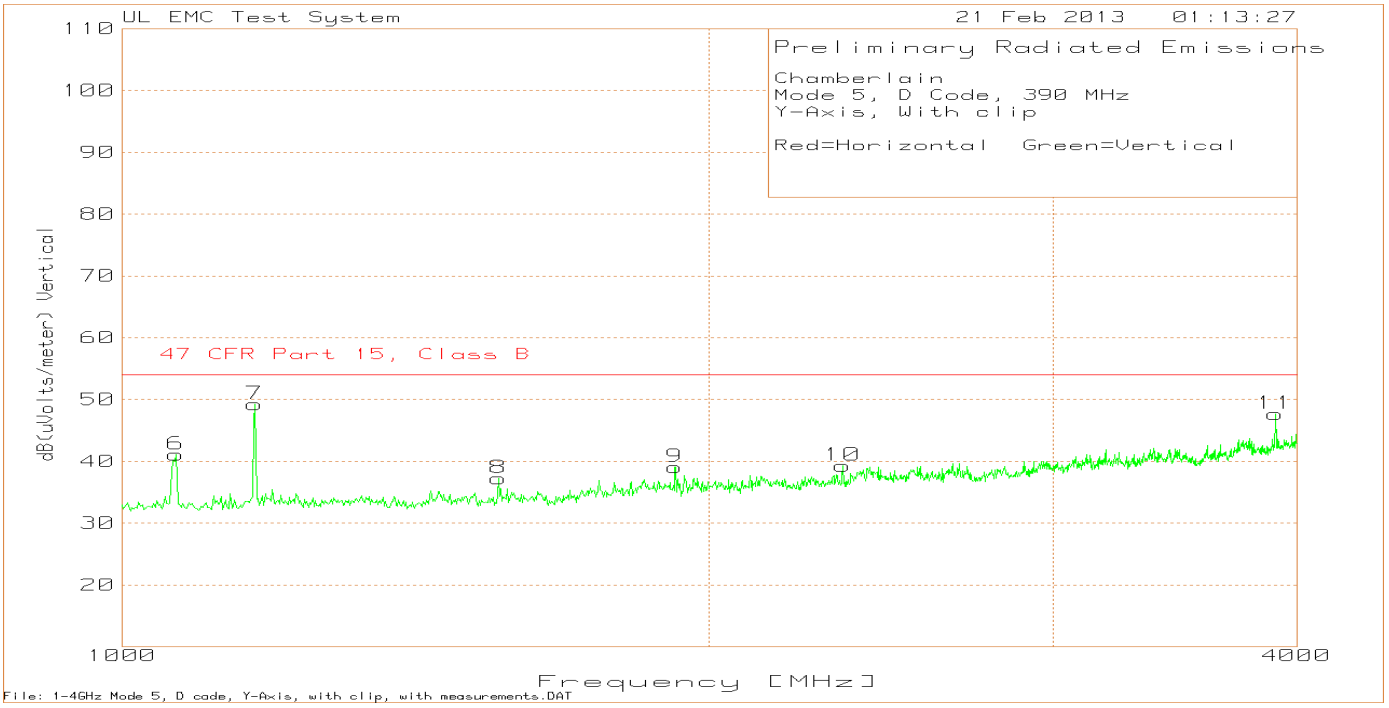


Table 28 - Radiated Emissions Data Points

Test Frequency MHz	Meter Reading	Detector	AF dB	Path L/G dB	Level dBuV/m	Duty Cycle dB	Level with DB dBuV/m	Limit dBuV/m	Margin dB		Azimuth [Degs]	Height [cm]	Polarity	Notes
390.0214	62.27	PK	16.1	2.3	80.67	-6.74	73.93	79.24	-5.31		280	136	Vert	1
390.0214	55.08	PK	16.1	2.3	73.48	-6.74	66.74	79.24	-12.5		168	390	Horz	1
780.039	13.97	PK	22	3.4	39.37	-6.74	32.63	59.24	-26.61		360	102	Horz	1
780.049	7.99	PK	22	3.4	33.39	-6.74	26.65	59.24	-32.59		210	183	Vert	1
1062.041	73.69	PK	24.5	-56.64	41.55	-6.74	34.81	54	-19.19	*		100	Horz	1
1170.113	71.47	PK	25	-57.24	39.23	-6.74	32.49	54	-21.51	*		150	Horz	1
1560.374	71.99	PK	25.2	-55.65	41.54	-6.74	34.8	54	-19.2	*		100	Horz	1
2340.894	66.16	PK	28.1	-52.9	41.36	-6.74	34.62	54	-19.38	*		100	Horz	1
3901.935	66.84	PK	32.6	-51.99	47.45	-6.74	40.71	54	-13.29	*		150	Horz	1
1066.044	73.27	PK	24.5	-56.71	41.06	-6.74	34.32	54	-19.68	*		150	Vert	1
1170.0671	82.99	PK	25	-57.24	50.75	-6.74	44.01	54	-9.99		0	134	Vert	1
1560.374	67.75	PK	25.2	-55.65	37.3	-6.74	30.56	54	-23.44	*		100	Vert	1
1920.614	66.22	PK	27.3	-54.41	39.11	-6.74	32.37	54	-21.63	*		100	Vert	1
2340.894	64.11	PK	28.1	-52.9	39.31	-6.74	32.57	54	-21.43	*		150	Vert	1
3901.935	67.04	PK	32.6	-51.99	47.65	-6.74	40.91	54	-13.09	*		100	Vert	1

Notes:

1 - Mode 5, Code D, 390MHz, Y-Axis, With Clip

* Prescan Data, not maximized

Appendix A

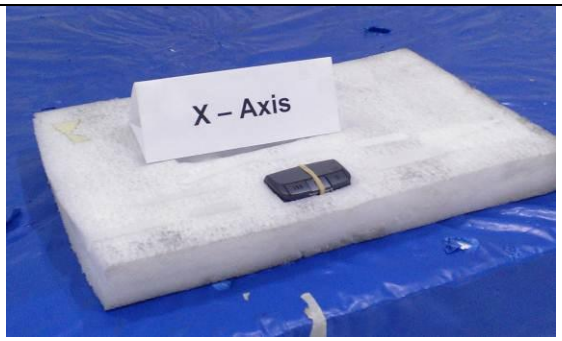
Test Equipment Used

Test Equipment Used for Near Field Measurements					
Description	Manufacturer	Model	Identifier	Cal Date	Cal Due Date
Spectrum analyzer	Agilent	PXA	EMC4360	20121226	20131226
Generic Di-pole Antenna	-	-	-	-	-

Test Equipment Used for Radiated Emissions					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due Date
EMI Test Receiver	Rohde & Schwarz	ESU	EMC4323	20121227	20131231
Bicon Antenna	Electro-Metircs	EM-6912A	EMC4070	20120806	20130831
Log-P Antenna	Chase	UPA6109	EMC4313	20120807	20130831
Spectrum Analyzer	Rhode & Schwarz	FSEK	EMC4182	20121226	20131231
Antenna Array	UL	BOMS	EMC4276	20111227	20131231

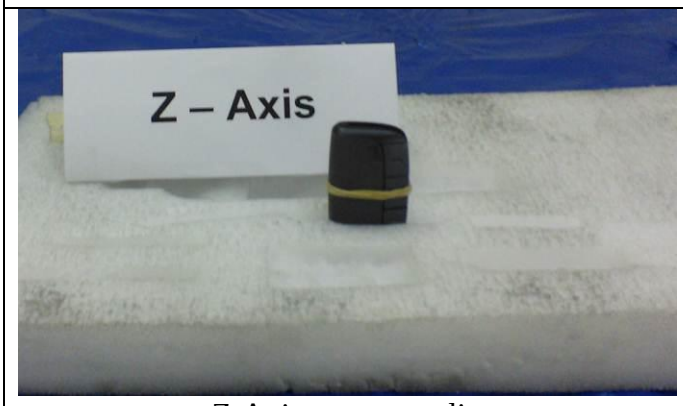
Appendix B

Test Setup Photos

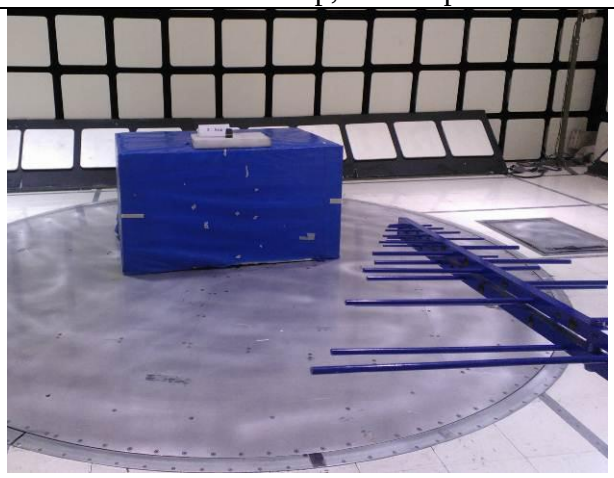


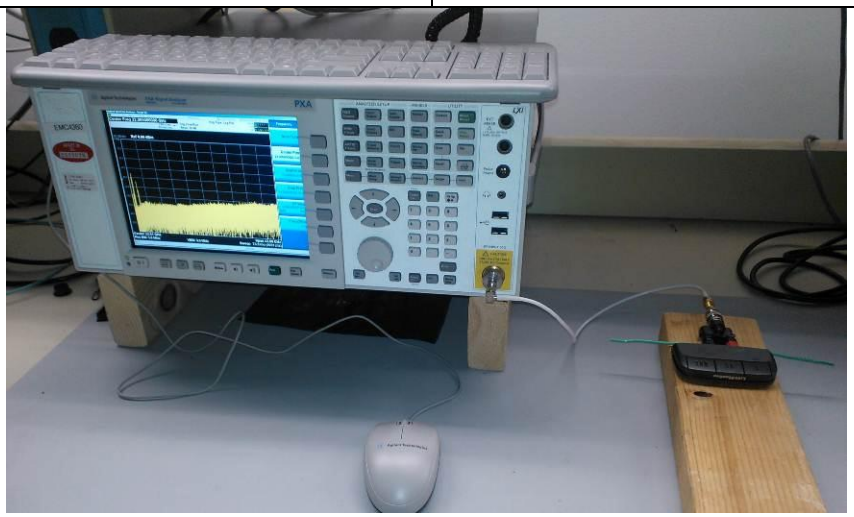
X-Axis Setup, no clip

Y-Axis Setup, with clip



Z-Axis setup, no clip


Radiated Emissions Setup


Near Field Measurements

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 2180

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.: Radiated Emissions R-621, Conducted Emissions C-642.

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

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