

**UL LLC** 333 Pfingsten Rd. Northbrook, IL 60062

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10011450B 13N15104 2013 July 17 2013 August 02 Model: 821LM

# **Electromagnetic Compatibility Test Report**

For

# Chamberlain Group Inc.

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Order Number: Model Number:	10011450B 821LM	Project Number:	13N15104	Page Rev1	2 of 69
Client Name:	Chamberlain	Group Inc.			
		Test Report	Details		
Tests Performed By:		UL LLC 333 Pfingsten Rd. Northbrook, IL 60	062		
Tests Performed For:		Chamberlain Grou 845 Larch Av	ıp Inc.		
Applicant Contact: Phone: E-mail:		Hank Sieradzki (630) 993-6564 Hank.Sieradzki@d	chamberlaingroup.c	om	
Test Report Date: Rev1 Report Date		2013 July 17 2013 August 02			
Product Type:		Multi Mode Multi F Transmitter	Frequency Garage [	Door Ope	rator
Product standards		47 CFR Part 15, S	ubpart C, RSS-210,	RSS-Gen	1
Model Number:		821LM			
EUT Category:		Wireless Device			
Testing Start Date:		2013 May 30			
Date Testing Complet	e:	2013 July 02			
Overall Results:		Compliant			

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Client Name:	Chamberlain (	Group Inc.			

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#### **Report Revision History**

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

## 1.0 GENERAL - 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:       DC = DC Power Port       N/E = Non-Electrical         I/O       = Signal Input or Output Port (Not Involved in Process Control)       TP         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

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## 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.

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## 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

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#### 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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Reviewer:

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

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## 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	225,25	Relative	45 . 15	Barometric	050 + 150
Temperature, °C	$22.5 \pm 2.5$	Humidity, %	45 ± 15	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)

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#### 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 Stand	ard		47 CFR	Part 15.207,	RSS-Gen 7.2.4
UL LPG				80-EM-S0	0026
Frequency range on each side of Measureme line				Measurement Point	
Fully configured sample scanned over the following frequency range		150kHz to 30MHz		Mains	
			Limits - Class B		
			Limit (	dBµV)	
Frequency (	MHZ)	Qua	asi-Peak		Average
0.15-0.	.5	66 to 56 56 to 46			56 to 46
0.5-5	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		

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#### Figure 1 Conducted Emissions Graph





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

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#### **Table 2 Conducted Emissions Data Points**

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

Trace Marker Test No. Frequen [MHz]	rs Meter cy Reading (dBuV)	Transduo Factor [dB]	cer Gain/Los r Factor [dB]	s Level (dB(uVo	Limit:1 lts))	2	3	4	5	6
Line - L1 . 1 .31265 2 .39918 3 .79913	15 - 1MHz 26.98 H 29.12 H 24.58 H	РК .1 РК .1 РК .1	10.8 Margin 10.7 Margin 10.6	37. [dB] 39. [dB] 35.	88 79 -41. 92 79 -39. 28 73	66 12 -28 66 08 -26 60	59.9 .12 -22. 57.9 .08 -17. 56	49.9 02 -12.02 47.9 98 -7.98 46	- - - -	- - - -
Line - L2 . 4 .31159	15 - 1MHz 27.04 E	?к .1	Margin 10.8	[dB] 	-37. 94 79	72 –24  66 06 –28	.72 -20. 59.9	72 -10.72 49.9	-	-
5 .39547 6 .7539	30.64 e 23.54 e	РК .1 РК .1	Margin 10.8 Margin 10.6 Margin	[dB] [dB] 34. [dB]	54 79 -37. 24 73 -38.	66 46 -24 60 76 -25	.46 -16. 56 .76 -21.	47.9 36 -6.36 46 76 -11.76		- - -
Quasi Peak Test Frequency [MHz]	Data Meter Tra Reading E (dBuV)	ansducer Factor [dB]	Gain/Loss Factor (dE [dB]	Level (uVolts)	Limit:1 )	2	3	4	5	6
Line - L1 . .31356	15 - 1MHz 21.02 QP	.1	10.8 Margin [dB]:	31.92	79 -47.08	66 -34.08	59.88 -27.96	49.88 -17.96	-	
.3975 .79952	25.83 QP 18.76 QP	.1 .1	10.7 Margin [dB]: 10.6 Margin [dB]:	36.63 29.46	79 -42.37 73 -43.54	66 -29.37 60 -30.54	57.91 -21.28 56 -26.54	47.91 -11.28 46 -16.54	- - -	- - -
Line - L2 . .31198	15 - 1MHz 21.1 QP	.1	10.8 Margin [dB]:	32	79 -47	66 -34	59.92 -27.92	49.92 -17.92	-	-
.75265	25.93 QP 14.5 QP	•1 •1	Margin [dB]: 10.6 Margin [dB]:	25.2	-42.27 73 -47.8	-29.27 60 -34.8	-21.18 56 -30.8	-11.18 46 -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

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Average Data

Test Frequency [MHz]	Meter Reading (dBuV)	Transducer Factor [dB]	Gain/Loss Factor (dB [dB]	Level (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

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#### 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			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			
_		Limit (dBµV/m)			
Frequ	uency (MHz)	Quasi-Peak		Average	
:	30 – 88	40		NA	
8	38 – 216	43.52		NA	
2	16 – 960	46.02		NA	
960	and above	54		NA	
Supplementa	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		

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#### 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 1 Reading (dBuV)	Fransducer Factor [dB]	Gain/Loss 1 Factor dBu [dB]	Level I ıV/m	Limit:1	2	3	4	5	6	
1	34.5027	37.18 PK	16.2	-19	34.38	40	-	-	-	-	-	
2	EE 4070	Height:2	249 Horz	Margin [dB.		-5.62	-	-	-	-	-	
2	55.48/5	J4.00 PK	/.4	=19 Margin [dP]	23.00	40	_	_	_	_	_	
٦	34 9275	38 47 PK	16 1	–19	35 57	40	_	_	_	_	_	
5	51.5275	Height:	10.1 99 Vert	Margin [dB]	1	-4.43	_	_	_	_	_	
4	55.997	44.73 PK	7.2	-19	32.93	40	-	-	_	-	_	
		Height:2	249 Vert	Margin [dB	]	-7.07	-	-	-	-	-	
5	64.068	38.34 PK	6.2	-18.9	25.64	40	-	-	-	-	-	
		Height:4	100 Vert	Margin [dB]	]	-14.36	-	-	-	-	-	
6	256.2292	39.05 PK	12.4	-21.3	30.15	46	-	-	-	-	-	
		Height:3	399 Horz	Margin [dB]	]	-15.85	-	-	-	-	-	
7	288.4744	37.24 PK	13.2	-21.1	29.34	46	-	-	-	-	-	
		Height:3	399 Horz	Margin [dB]	]	-16.66	-	-	-	-	-	
8	256.2292	38.24 PK	12.4	-21.3	29.34	46	-	-	-	-	-	
~	000 4744	Height:	199 Vert	Margin [dB.	20.01	-16.66	-	-	-	-	-	
9	288.4/44	38.11 PK	13.2	-21.1 Managin [dD]	30.21	46	-	-	-	-	-	
I Fre	'est Met equency Rea Hzl (dB	er Trans ding Fac	sducer Gai stor Fa	n/Loss Lev ctor dBuV/m	vel Lir	nit:1	2	3	4	5	6	
===		===========		, ====================================								
34.	6314 25.	49 PK	16.2	-19 22	.69 40	C	-	-	-	-	-	
Azi	muth: 348	Height:178	Horz	Margin [d]	3]: -1	17.31	-	-	-	-	-	
35.	0635 33.	07 PK	16.1	-18.9 30	.27 40	C	-	-	-	-	-	
Azi	muth: 327	Height:101	Vert	Margin [d]	3]: -9	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

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#### 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	30 MHz – 1GHz	(3m distance)			
over the following frequency range	1GHz – 4GHz	(3m distance)			

#### Limits Limit (dBµV/m) Frequency (MHz) Fundamental AV Limit Non-Restricted Spurious Harmonics AV 75 32 55.32 310 315 75.62 55.62 79.24 59.24 390 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	Supplementary information: None						

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Figure 3 Radiated Emissions Graph 30MHz – 1GHz

File: 20130530 Chamberlain 10m with 3m limits.TST



File: 20130530 Chamberlain 10m with 3m limits.TST

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#### Figure 4 Radiated Emissions Graph 1Hz – 4GHz

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## Table 6 Radiated Emissions Data Points

Fundamental	Test	Meter				Peak	DC	Average	Peak	Peak	Average				
Frequency	Frequency	Reading		AF		Level	Factor	Level	Limit	Margin	Limit	Margin	Azimuth	Height	
MHz	MHz	dBuV	Detector	dB/m	PF dB	dBuV/m	dB	dBuV/m	dBuV/m	dB	dBuV/m	dB	[Degs]	[cm]	Polarity
<mark>310</mark>	<mark>310.005</mark>	<mark>65.74</mark>	PK	<mark>14.1</mark>	<mark>2.1</mark>	<mark>81.94</mark>	<mark>-12.36</mark>	<mark>69.58</mark>	<mark>95.32</mark>	<mark>-13.38</mark>	<mark>75.32</mark>	<mark>-5.74</mark>	<mark>174</mark>	<mark>101</mark>	Horz
<mark>310</mark>	<mark>310.0048</mark>	<mark>59.46</mark>	<b>PK</b>	<mark>14.1</mark>	<mark>2.1</mark>	<mark>75.66</mark>	<mark>-12.36</mark>	<mark>63.3</mark>	<mark>95.32</mark>	<mark>-19.66</mark>	<mark>75.32</mark>	<mark>-12.02</mark>	<mark>190</mark>	<mark>101</mark>	Vert
310	619 993	20.62	PK	20.4	3	44 02	-12 36	31.66	66	-21.98	46	<mark>-14 34</mark>	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	020.0100 030.025	10.00		20.7 23.8	28	47.54	12.00	25.00 35.18	00 33	-18/16	10 /6	-10.82	360	1/5	Horz
210 210	930.023	19.94 20.40		20.0 00.0	2.0 2.0	47.04 FC 00	10.00	42 72	00 60	-10.40	40	-10.02	<u>300</u>	14J 140	11012
<u>310</u>	929.994	20.49		23.0	<b>0.0</b>	00.00	-12.30	43.73	00	-9.91	40 75 00	-2.21	104		
315	315.0098	63.9	PK	14.3	2.1	80.3	-10.17	70.13	95.62	-15.32	/5.62	-5.49	1/8	101	Horz
<u>315</u>	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	<mark>20.7</mark>	3	<mark>45.81</mark>	-10.17	<mark>35.64</mark>	<mark>66</mark>	-20.19	<mark>46</mark>	<mark>-10.36</mark>	<mark>38</mark>	<mark>129</mark>	Horz
<mark>315</mark>	629.982	<mark>18.61</mark>	PK	20.7	<mark>3</mark>	<mark>42.31</mark>	-10.17	<mark>32.14</mark>	<mark>66</mark>	<mark>-23.69</mark>	<mark>46</mark>	<mark>-13.86</mark>	<mark>14</mark>	<mark>101</mark>	Vert
<mark>315</mark>	<mark>945.0213</mark>	<mark>28.08</mark>	<mark>PK</mark>	<mark>23.9</mark>	<mark>3.8</mark>	<mark>55.78</mark>	<mark>-10.17</mark>	<mark>45.61</mark>	<mark>66</mark>	<mark>-10.22</mark>	<mark>46</mark>	<mark>-0.39</mark>	<mark>153</mark>	<mark>110</mark>	<mark>Vert</mark>
<mark>315</mark>	945.0065	<mark>23.06</mark>	<mark>PK</mark>	<mark>23.9</mark>	<mark>3.8</mark>	<mark>50.76</mark>	<mark>-10.17</mark>	<mark>40.59</mark>	<mark>66</mark>	<mark>-15.24</mark>	<mark>46</mark>	<mark>-5.41</mark>	<mark>219</mark>	<mark>141</mark>	Horz
390	389.9998	<b>56.59</b>	<b>PK</b>	<mark>16.1</mark>	2.3	74.99	<u>-6.75</u>	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	34	49 09	-6 75	42 34	66	-16.91	46	-3 66	0	101	Horz
390	779 9965	26.00	PK	22	3.4	51.63	-6.75	44.88	66	-14 37	46	-1 12	222	145	Vert
210	1550 267	75.01		25.0	56.02	44.40	10.75	21.00	74	20.01	<del>40</del>	20.17	000	140	
<u>310</u>	1000.007	70.01		23.2	-00.02	44.19	-12.30	<u>00.07</u>	74	-29.01	04 54	-22.17		100	
310	1550.367	72.55	PK	25.2	-56.02	41.73	-12.36	29.37	<mark>/4</mark>	-32.27	<u>54</u>	-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	<mark>167</mark>	100	Horz
<mark>390</mark>	1560.374	<mark>76.78</mark>	<mark>PK</mark>	<mark>25.2</mark>	-55.65	<mark>46.33</mark>	<mark>-6.75</mark>	<mark>39.58</mark>	<mark>74</mark>	-27.67	<mark>54</mark>	<mark>-14.42</mark>	-	<mark>100</mark>	Vert
<mark>315</mark>	<mark>1574.383</mark>	<mark>76.21</mark>	<mark>PK</mark>	<mark>25.2</mark>	<mark>-55.3</mark>	<mark>46.11</mark>	<mark>-10.17</mark>	<mark>35.94</mark>	<mark>74</mark>	<mark>-27.89</mark>	<mark>54</mark>	<mark>-18.06</mark>		<mark>100</mark>	Horz
<mark>315</mark>	1574.383	<mark>73.71</mark>	<mark>PK</mark>	<mark>25.2</mark>	<mark>-55.3</mark>	<mark>43.61</mark>	-10.17	<mark>33.44</mark>	<mark>74</mark>	-30.39	<mark>54</mark>	-20.56		<mark>100</mark>	Vert
<mark>310</mark>	1859.991	<mark>84.16</mark>	<b>PK</b>	<mark>27.1</mark>	<mark>-54.43</mark>	<mark>56.83</mark>	<mark>-12.36</mark>	<mark>44.47</mark>	<mark>74</mark>	<mark>-17.17</mark>	<mark>54</mark>	<mark>-9.53</mark>	<mark>199</mark>	<mark>115</mark>	Horz
310	1860 0391	78 52	PK	27 1	-54 43	51 19	-12 36	<mark>38 83</mark>	74	-22.81	54	- <u>15 17</u>	244	109	Vert
315	1890.0691	84.32	PK	27.2	-54 31	57 21	-10 17	47 04	74	-16 79	<u>54</u>	-6.96	222	116	Horz
315	1890.0571	80.66		27.2	-5/ 31	53.55	10.17	12.28	7/	20.45	54	10.62	282	107	Vort
200	1050.001	00.00		07.2	-J4.J1	55.55 EC 10	6 75	40.44	74	17.01		4.50	202	111	
<u>390</u>	1950.012	70.00		27.5	-54.59	50.19	-0.75	49.44	74	-17.01	54	-4.50	213	114	
<u>390</u>	1950.634	79.88	PK	27.3	-54.39	52.79	-b./5	46.04	<mark>/4</mark>	-21.21	<mark>54</mark>	-7.96		100	vert
X	2132.755	69.91	PK	27.5	-53.18	44.23	0	44.23	/4	-29.77	54	-9.77	-	100	Vert
<mark>310</mark>	<u>2170.781</u>	<mark>71.94</mark>	PK	<mark>27.4</mark>	<mark>-52.92</mark>	<mark>46.42</mark>	<mark>-12.36</mark>	<mark>34.06</mark>	<mark>74</mark>	<mark>-27.58</mark>	<mark>54</mark>	<mark>-19.94</mark>	-	<mark>100</mark>	Horz
<mark>310</mark>	<mark>2170.781</mark>	<mark>66.29</mark>	PK	<mark>27.4</mark>	<mark>-52.92</mark>	<mark>40.77</mark>	<mark>-12.36</mark>	<mark>28.41</mark>	<mark>74</mark>	<mark>-33.23</mark>	<mark>54</mark>	<mark>-25.59</mark>	-	<mark>100</mark>	<mark>Vert</mark>
<mark>315</mark>	2204.803	<mark>71.92</mark>	<mark>PK</mark>	<mark>27.4</mark>	<mark>-53.2</mark>	<mark>46.12</mark>	<mark>-10.17</mark>	<mark>35.95</mark>	<mark>74</mark>	<mark>-27.88</mark>	<mark>54</mark>	<mark>-18.05</mark>		<mark>100</mark>	Horz
<mark>315</mark>	2204.803	<mark>65.11</mark>	<mark>PK</mark>	<mark>27.4</mark>	<mark>-53.2</mark>	<mark>39.31</mark>	<mark>-10.17</mark>	<mark>29.14</mark>	<mark>74</mark>	- <u>34.69</u>	<mark>54</mark>	<mark>-24.86</mark>	-	<mark>100</mark>	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	- <u>12.36</u>	33.70	74	-27.85	<u>54</u>	-20.21		100	Vert
215	2521.01/	68.46		28.0	-52 10	45.17	-10.17		7/	-28.82	<b>5</b> 1	10		150	Horz
215	2521.014	00.40		20.9	-52.15	40.17	-10.17	201	74	-20.00	54	-13		100	
010 040	2521.014	09.00		20.9	-52.19	40.27	-10.17	07.04	74	-21.13	04 54	-17.9		100	
310	<u>3101.401</u>	70.51	PK	30.5	-51.31	<u>49.7</u>	-12.36	37.34	<mark>/4</mark>	-24.3	<u>54</u>	-16.66	-	150 150	Horz
310	<mark>3101.401</mark>	<mark>67.61</mark>	PK	<mark>30.5</mark>	<mark>-51.31</mark>	<mark>46.8</mark>	<mark>-12.36</mark>	<mark>34.44</mark>	<mark>74</mark>	<mark>-27.2</mark>	<mark>54</mark>	<mark>-19.56</mark>	-	<mark>100</mark>	Vert
<mark>390</mark>	3120.015	<mark>71.74</mark>	<mark>PK</mark>	<mark>30.6</mark>	-51.39	<mark>50.95</mark>	<mark>-6.75</mark>	<mark>44.2</mark>	<mark>74</mark>	-23.05	<mark>54</mark>	<mark>-9.8</mark>	<mark>17</mark>	<mark>100</mark>	Horz
<mark>390</mark>	3119.9609	<mark>70.64</mark>	<mark>PK</mark>	<mark>30.6</mark>	<mark>-51.39</mark>	<mark>49.85</mark>	<mark>-6.75</mark>	<mark>43.1</mark>	<mark>74</mark>	<mark>-24.15</mark>	<mark>54</mark>	<mark>-10.9</mark>	<mark>108</mark>	<mark>100</mark>	Vert
<mark>315</mark>	3151.434	<mark>68.22</mark>	<mark>PK</mark>	<mark>30.6</mark>	-51.71	<mark>47.11</mark>	-10.17	<mark>36.94</mark>	<mark>74</mark>	-26.89	<mark>54</mark>	-17.06		<mark>150</mark>	Horz
315	3151.434	67.75	PK	30.6	-51.71	46.64	-10.17	36.47	<mark>74</mark>	-27.36	<mark>54</mark>	-17.53		200	Vert
<mark>310</mark>	3719 8257	<mark>69 31</mark>	PK	32	- <u>51 49</u>	49.82	-12 36	<mark>37 46</mark>	74	-24 18	<mark>54</mark>	- <u>16 54</u>	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
215	3781.955	67.00		32 4	<u>51 6</u>	47.80	10.17	37 72	7/	26.11		16.09		100	Horz
010 04E	2704.000	01.09		20.4	-51.0	47.03	10.17	07.1Z	74	-20.11		10.20		100	Vort
315	3701.005	00./		32.4	-01.0	47.5	-10.17	37.33	74	-20.5	54	-10.07		100	ven
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	<u>3901.935</u>	<u>65.56</u>	PK	<mark>32.6</mark>	<mark>-51.99</mark>	<mark>46.17</mark>	<mark>-6.75</mark>	<u>39.42</u>	<mark>74</mark>	-27.83	<mark>54</mark>	<mark>-14.58</mark>		<mark>150</mark>	Vert
AF _ Antenna I	Factor PF - P	ath Loss/Ga	in DC – Dut	v Cvcla											

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#### 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					

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## Figure 5 Cease Operation Graph for 310MHz

					- Swept SA	Spectrum Analyzer - Swept S	Agilent
Marker	11:29:44 AM Jul 01, 2013	ALIGN AUTO		SENSE:INT	50 Ω DC	RF 50 Ω	l XI
Marker	TRACE 1 2 3 4 5 6	e: Log-Pwr	Avg Typ		)1 ms	ker 1 839.501 ms	Mar
Select Marker	/kr1 839.5 ms -75.62 dBm			Atten: 10 dB	PNO: Wide +++ IFGain:Low 00 dBm	Bidiv Ref 0.00 dE	10 dE
Normal							-10.0
Delta							-20.0
Fixed⊳	TRIG LVL						-40.0
Off						x1	-60.0
Properties▶	NORM	d and stand a stand		nyetynyed i detai <mark>on den staarden a</mark>	ne veten andere en et el el ne et en rent en		-80.0
More 1 of 2	Span 0 Hz 0.00 s (1001 pts)	Sweep		1.0 MHz	00 MHz #VBW	ter 310.000000 MH BW 1.0 MHz	Cen Res
	,	STATUS					MSG

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## 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.						

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#### Figure 6 Pulse Train Graphs for 310MHz



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## 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 wid	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					

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## Figure 7 20dB Bandwidth Graphs

Agilent	Spectrum Ar	nalyzer - Occupi	ied BW											
LXI	T	RF 50 Ω	DC			SEN	VSE:			ALIGN AUTO	10:25:02/	AM Jun 03, 2013	Trac	e/Detector
Cen	ter Fred	<u>q 310.00(</u>	0000 MHz	2	Cent	er Fr	eq:	310.000	000 MHz	J. 10/10	Radio Std	: None	mac	cibereeroi
			#160	-++ Cain:Low	. Trig. #Atte	n: 10	d B		Avginoid	a. 10/10	Radio Dev	vice: BTS		
			#IFV	34111.LUW	HT ICCC		WE				Tiudio Dei	Noc. Bilo		
10 dE	3/div	Ref -20.0	00 dBm											
Log														
-30.0							_							
							\							Clear Write
-4U.U						$\square$	t							
-50.0						$\boldsymbol{\mathcal{A}}$	_\							
					ر ا	4								
-60.0					مر مر			- North						Average
-70.0					م م			- Why						-
				mor				۲ .	mylyn -					
-80.0				and a start					· without					
-90 N		- martha	your have a for the second							a way burly way	m Pho Anna			
00.0	᠂᠃ᠰᠬᡃᡗ᠄ᠺ᠕᠃	mar												
-100													_	
-110														
110														
Com	ton 040													Min Hold
Cen #Do	ter 310				,			100 14	-		Sp	an 1 MHz		
#Re	S BW 1	J KHZ				VBV	V Č	100 KI	1Z		sweep	9.267 ms		
														Detector
0	ccupie	ed Band	width					otal P	ower	-28.4	aBm			Peak▶
			64 3	265 VI	- 7								Auto	Man
			04.											
Т	ansmit	Fred En	or	-1 477	kHz_		0	RW P	ower	q	0.00 %			
	anomit								04401		/////			
x	dB Ban	idwidth		51.30 I	kHz		х	dB		-20.	00 dB			
MSG										STATUS				
						_	-							

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#### Figure 8 99% Power Bandwidth Graphs



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#### 4.4 Mode 2 315MHz

## 4.4.1 Test Conditions and Results – Fundamental and Harmonics Radiated Emissions

Test Description	est vescription 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 Standa	ard	47 CFF	R Part 15.231, RS	S-210 A1.1		
		Frequency r	ange	Measurement Point		
Fully configu	red sample scanned	30 MHz – 1	GHz	(3m distance)		
over the follo	wing frequency range	1GHz – 40	GHz	(3m distance)		
Limits						
E		Limit (dBµV/m)				
Freq	uency (MHZ)	Fundamental AV Limit	Non-Restricte	d Spurious Harmonics AV		
	310	75.32		55.32		
	315	75.62		55.62		
	390	79.24		59.24		
		All Other Emissions	including Harmon	ics in restricted bands		
30M	Hz – 88MHz		40.00			
88MF	Hz – 216MHz	43.52				
216M	Hz – 960MHz	46.02				
960MH	lz – 4,000MHz	54.00				
Supplementa	ry information: Please	refer to Section 4.3, Mode	I for Radiated Spu	urious Emission Data		

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#### 4.4.2 Test Conditions and Results – Cease Operation

Test Description	Measurements were made tuned to the transmit freque was operated and the trans span at the fundamental free	in the laboratory environment. A Dipole (or equivalent) antenna ency was attached to the input of a spectrum analyzer. The device smission time measured with the spectrum analyzer set to zero equency.	
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		

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## Figure 9 Cease Operation Graph

Agilent Sp	pectrum Analyzer - Swept SA								
LXI	RF 50Ω DC		SENS	EINT	ALIG		11:05:27 /	M Jul 01, 2013	Marker
Marke	er 1 763.501 ms		Tria: Video	AV:	g Type: Lo	g-Pwr	TYP	= <mark>1 2 3 4 5 6</mark> E WIMMANANA	
		PNU: Wide ++++	Atten: 10 dl	в			DE	NNNNN	Soloct Marker
							Mbed 70	2.5 mc	Select Marker
							74	o d D m	1
10 dB/	div Ref 0.00 dBm						-74.3		
- vg									
									Normal
-10.0									Norma
-20.0									
									Dalta
20.0									Deita
-30.0									
-40.0								TRIG LVL	
									Fixed⊳
-50.0									
60.0									
-00.0									Off
-70.0								NORM	
	Versentlerentisterentist	the last standard states and the	an the state of the second	halos et tande hos ha	In the last	al denses	and participants	allocation.	
-80.0									Properties ►
00.0									
-90.0									
									More
Cente	or 315 000000 MHz						e	nan () Hz	1 of 2
Res R		#\/R\/(	1 0 MHz		21	ween	3000 e /	1001 nte)	
	· · · · · · · · · · · · · · · · · · ·	#*DV4	1.7 191112			ncch	20.00 3 (	1001 pt3)	
MSG						STATUS			

Order Number:	10011450B	Project Number:	13N15104	Page	31 of 69
Model Number:	821LM			Rev1	
Client Name:	Chamberlain (	Group Inc.			

## 4.4.3 Test Conditions and Results – Pulse Train / Duty Cycle

Test Description	Measurements were made tuned to the transmit freque train was measured with th	in the laboratory environment. A Dipole (or equivalent) antenna ency was attached to the input of a spectrum analyzer. The pulse e 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.					

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Client Name:	Chamberlain (	Group Inc.			

#### Figure 10 Pulse Train Graphs



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Model Number:	821LM			Rev1	
Client Name:	Chamberlain (	Group Inc.			

## 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						

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Model Number:	821LM			Rev1	
Client Name:	Chamberlain (	Group Inc.			

## Figure 11 20dB Bandwidth Graphs

Agilent	Spectrum Ar	nalyzer - Occupi	ied BW											
LXI	T	RF 50 Ω	DC			SEN	VSE:I			ALIGN AUTO	10:53:24/	M Jun 03, 2013	Trac	e/Detector
Cen	ter Fred	<u>q 315.00(</u>	0000 MH2	z	Cen	ter Fr	eq:	315.000		. 10/10	Radio Std	: None		
			#160	-+- Cain:Low	. Ing. #Attr	en: 10	i dB	r1	Avginoid	1. 10/10	Radio Dev	vice: BTS		
			#160	Jam.Luw	HT ICC		40				Ttaalo Bei	Nec. Bito		
10 dE	3/div	Ref -20.0	00 dBm											
Log						Ĩ.								
-30.0														<b>0</b>     <b>1</b>   - : 4 -
10.0						1	١.							Clear write
-40.0							1							
-50.0							4							
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-6U.U					ď			Mr V						Average
-70.0								<u> </u>						
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-100													_	
-110														
110														
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tern #Day		NELS				VOV			1-		Swaan	0 267 mg		
#Rea						VDV	V		12		Sweep	9.207 1115		
			! . 141.						ouver	22-3	/ dDm			Detector
0	ccupie	ed Band	wiath						ower	-33.1	aem			Peak▶
			67 9	954 kl	47								Auto	Man
			07.0		14									
Tr	ansmit	Frea Err	ror	-1.224	kHz_		0	BW P	ower	99	9.00 %			
X	dB Ban	idwidth		53.34 I	кНz		X	dB		-20.	00 dB			
MSG										STATUS				

Order Number:	10011450B	Project Number:	13N15104	Page	35 of 69
Model Number:	821LM			Rev1	
Client Name:	Chamberlain (	Group Inc.			

#### Figure 12 99% Power Bandwidth Graphs



Order Number:	10011450B	Project Number:	13N15104	Page	36 of 69
Model Number:	821LM			Rev1	
Client Name:	Chamberlain	Group Inc.			

#### 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 Standa	ard	47 CFF	R Part 15.231, RS	S-210 A1.1		
		Frequency r	ange	Measurement Point		
Fully configu	red sample scanned	30 MHz – 1	GHz	(3m distance)		
over the follo	wing frequency range	1GHz – 40	GHz	(3m distance)		
	Limits					
_			Limit (dBµV/m)			
Freq	uency (MHz)	Fundamental AV Limit	Non-Restricted Spurious Harmonics A			
	318	75.80	55.80			
		All Other Emissions	All Other Emissions including Harmonics in restricted bands			
30M	Hz – 88MHz		40.00			
88MH	Hz – 216MHz		43.52			
216M	Hz – 960MHz		46.02			
960MF	lz – 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			

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Model Number:	821LM			Rev1	
Client Name:	Chamberlain (	Group Inc.			



## Figure 13 Radiated Emissions Graph 30MHz – 1GHz

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Model Number:	821LM			Rev1	
Client Name:	Chamberlain (	Group Inc.			



#### Figure 14 Radiated Emissions Graph 1GHz – 4GHz

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Model Number:	821LM			Rev1	
Client Name:	Chamberlain	Group Inc.			

## **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	РК	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	РК	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	РК	20.7	3.1	46.62	-15.11	31.51	66	-19.38	46	-14.49	201	139	Horz
635.993	18.62	РК	20.7	3.1	42.42	-15.11	27.31	66	-23.58	46	-18.69	13	101	Vert
954.0125	22.5	РК	24	3.9	50.4	-15.11	35.29	66	-15.6	46	-10.71	218	234	Horz
954.0015	27.75	РК	24	3.9	55.65	-15.11	40.54	66	-10.35	46	-5.46	152	112	Vert
1590.394	75.31	РК	25.3	-54.9	45.71	-15.11	30.6	74	-28.29	54	-23.4	-	100	Horz
1908.0451	83.24	РК	27.3	-54.46	56.08	-15.11	40.97	74	-17.92	54	-13.03	179	146	Horz
2226.818	70.55	РК	27.5	-52.96	45.09	-15.11	29.98	74	-28.91	54	-24.02	-	100	Horz
2545.03	69.11	РК	28.9	-52.04	45.97	-15.11	30.86	74	-28.03	54	-23.14	-	150	Horz
3181.454	68.61	РК	30.7	-51.64	47.67	-15.11	32.56	74	-26.33	54	-21.44	-	200	Horz
3499.666	66.91	РК	31.2	-51.05	47.06	-15.11	31.95	74	-26.94	54	-22.05	-	100	Horz
3815.8166	69.92	РК	32.5	-52.62	49.8	-15.11	34.69	74	-24.2	54	-19.31	2	100	Horz
1590.394	72.41	РК	25.3	-54.9	42.81	-15.11	27.7	74	-31.19	54	-26.3	-	100	Vert
1908.0451	82.34	РК	27.3	-54.46	55.18	-15.11	40.07	74	-18.82	54	-13.93	279	104	Vert
2545.03	69.28	РК	28.9	-52.04	46.14	-15.11	31.03	74	-27.86	54	-22.97	-	100	Vert
3181.454	67.36	РК	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 dete	ector, DC-D	uty cycle								

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Client Name:	Chamberlain (	Group Inc.			

## 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				

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Model Number:	821LM			Rev1	
Client Name:	Chamberlain (	Group Inc.			

## Figure 15 Cease Operation Graph

Agilent S	Spectrum Analyzer - Swept SA								
<mark>(X)</mark> Mark	RF 50Ω DC		SEN	SE:INT	Avg Type	ALIGNAUTO : Log-Pwr	11:24:38 . TRAC	AM Jul 01, 2013 E 1 2 3 4 5 6	Marker
10 dB/	div Ref 0.00 dBm	PNO: Wide ↔ IFGain:Low	Trig: Video Atten: 10	o dB		-	۳۷۴ De -74.1	1.040 s 24 dBm	Select Marker
-10.0 -									Normal
-20.0 -									Delta
-40.0								TRIG LVL	Fixed⊳
-60.0	1								Off
-80.0		lan bah ilu terseben du	Ha herri, stadica	talan keyen	land, day diga dan s	ر میں انہ انہ انہ میں ا	ddaedmith as	NORM	Properties►
-90.0 Cente Res E	er 318.000000 MHz 3W 1.0 MHz	#VBW <sup>/</sup>	1.0 MHz			Sweep	S 20.00 s (	pan 0 Hz 1001 pts)	More 1 of 2
MSG						STATUS			

Order Number:	10011450B	Project Number:	13N15104	Page	42 of 69
Model Number:	821LM			Rev1	
Client Name:	Chamberlain (	Group Inc.			

## 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 Stand	ard	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.						

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Model Number:	821LM			Rev1	
Client Name:	Chamberlain (	Group Inc.			

#### Figure 16 Pulse Train Graphs



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Model Number:	821LM			Rev1	
Client Name:	Chamberlain (	Group Inc.			

## 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							

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Model Number:	821LM			Rev1	
Client Name:	Chamberlain (	Group Inc.			

## Figure 17 20dB Bandwidth Graphs

Agilent	Spectrum A	nalyzer - Occup	ied BW											
LXI	T	RF 50 Ω	DC			SEN	VSE:I	NT		ALIGN AUTO	01:35:27	PM Jun 03, 2013	Trac	e/Detector
Cent	ter Fre	q 318.000	0000 MHz	2	Cent	Eroo	eq: D	318.000 n		d- 10/10	Radio Std	: None		
			#160	⊶+• Cain:Low	. Ing. #Atta	n: 10	dB	ſ	Avgino	a. 10/10	Radio Dev	vice: BTS		
			#IFC	Jamilow	HT ICC						Hadro De	Nee. B To		
10 dB	3/div	Ref -20.0	00 dBm											
Log							_							
-30.0														
						ΙΛ	\							Clear Write
-40.0							Ĭ							
-50.0							X							
						1	``							
-60.0					_			$\lambda$						Average
-70.0					J.			\_						
					4									
-80.0				Provent and a state					- June					
-90.0	᠋ᡁᡗᡐᡗᢏ᠇ᡳᢘᢩᠰᢑᢦ	www.r.m.Aw	$\sim \sim $	<i>(</i>						The Carlow Marine	mar march			Max Hold
00.0														Max Holu
-100		_								_			_	
-110														
110														
Cont	or 240										<u> </u>			Min Hold
Gent #Door		NILL-				1010		00 14	1-		Shoon			
#Res	S BW 1	U KHZ				VBV		UU KI	1Z		Sweep	9.267 ms		
								tel D		20.0	) al Dana			Detector
	ccupie	ed Band	Iwidth				IC	ital P	ower	-30.3	a a B m			Peak▶
	71.326 kHz						Auto	<u>Man</u>						
Tr	ansmit	Freq Eri	ror	-629	Hz		0	BW P	ower	9	9.00 %			
<u> </u>	dD Dar	dwidth		55 75 1				AD		20	00 48			
		rawiatri		33.731	ΔΠΖ		X	uD		-20.	UU UB			
MSG							_			STATUS				

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Client Name:	Chamberlain (	Group Inc.			

#### Figure 18 99% Power Bandwidth Graphs



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Model Number:	821LM			Rev1	
Client Name:	Chamberlain	Group Inc.			

#### 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 Standa	ard	47 CFF	R Part 15.231, RS	S-210 A1.1			
		Frequency r	ange	Measurement Point			
Fully configu	red sample scanned	30 MHz – 1	GHz	(3m distance)			
over the follo	wing frequency range	1GHz – 40	GHz	(3m distance)			
Limits							
_			Limit (dBµV/m)				
Freq	uency (MHz)	Fundamental AV Limit	Non-Restricted Spurious Harmonics A				
	372.5	78.52	78.52 58.52				
		All Other Emissions	All Other Emissions including Harmonics in restricted bands				
30M	Hz – 88MHz		40.00				
88MI	Hz – 216MHz	43.52					
216M	Hz – 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				

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Client Name:	Chamberlain	Group Inc.			



#### Figure 19 Radiated Emissions Graph 30MHz – 1GHz



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Model Number:	821LM			Rev1	
Client Name:	Chamberlain	Group Inc.			



#### Figure 20 Radiated Emissions Graph 1GHz – 4GHz

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Model Number:	821LM			Rev1	
Client Name:	Chamberlain	Group Inc.			

## **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 De	PK – Peak Detector, AF – Antenna Factor, PF – Path Loss/Gain, DC-Duty cycle													

Order Number:	10011450B	Project Number:	13N15104	Page	51 of 69
Model Number:	821LM			Rev1	
Client Name:	Chamberlain (	Group Inc.			

#### 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		

Order Number:	10011450B	Project Number:	13N15104	Page	52 of 69
Model Number:	821LM			Rev1	
Client Name:	Chamberlain (	Group Inc.			

## Figure 21 Cease Operation Graph

Agilent Spectru	m Analyzer - Swept SA								
LXI	RF 50Ω DC		SENS	E:INT	/	ALIGN AUTO	11:39:54 /	M Jul 01, 2013	Marker
Marker 1	793.501 ms	PNO: Wide ↔	Trig: Video	_ A\	/g lype:	Log-Pwr	TYP	= <u>1</u> 2 3 4 5 6 E WWWWWW T N N N N N N	
		IFGain:Low	Atten: 10 d	В					Select Marker
							Mkr1 79	3.5 ms	1
10 dB/div	Ref 0.00 dBm						-75.0		
-10.0									Normal
-20.0									
									Dalta
-30.0									Deita
-40.0									
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-90.0								Ĩ	
									More
Center 37	2 500000 MHz						6	nan 0 Hz	1 of 2
Res BW 1	1.0 MHz	#VBW	1.0 MHz			Sweep	20.00 s (*	1001 pts)	
MSG (i) Alian	ment Completed					STATUS	·		
	intent oonplotod								

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Model Number:	821LM			Rev1	
Client Name:	Chamberlain (	Group Inc.			

## 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 Stand	ard	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.						

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Client Name:	Chamberlain (	Group Inc.			

## Figure 22 Pulse Train Graphs



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Client Name:	Chamberlain (	Group Inc.			

## 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						

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Client Name:	Chamberlain (	Group Inc.			

## Figure 23 20dB Bandwidth Graphs

Agilent 9	Spectrum A	nalyzer - Occupi	ied BW											
LXI	Т	RF 50 Ω	DC			SEN	VSE:			ALIGN AUTO	02:00:51	PM Jun 03, 2013	Trac	e/Detector
Cent	ter Free	q 372.500	0000 MHz	z	Cent	ter Fr	eq:	372.500	000 MHz	14. 40/40	Radio Std	: None	mac	cibereerei
			<b>ж</b> іг <i>с</i>	→ Colori our	. Irig: #∆#4	nree	i de		Avgino	51d: 10/10	Radio Des	vice: BTS		
			#IFU	Jain:Low	#Aut	-II. IV	uL.				Radio De	nce. BTS		
10 dB	Vdiv	Ref -20.0	)0 dBm											
Log														
-30.0														
30.0							γ							Clear Write
-40.0						++	$\left\{ - \right\}$							
50.0														
-50.0 -														
-60.0						1		<u> </u>						Average
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-70.0					م م			- <sup>1</sup> ~	<b></b>					
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-100  -														
-110														
Cent	er 372	5 MHz									Sn	an 1 MHz		Min Hold
#Dac	BM 1	0 kH7				VRV	v ,	100 ki	7		Sween	0 267 me		
#Res						V DV	Υ		12		aweep	9.207 1115		
		a al Dana al	! .141.				Ξ.	stal B	owor	24 (	) dDm			Detector
	ccupi	ed Band	wiath					JLAIF	Ower	-51.0	UDIII			Peak▶
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MSG										STATUS	;			
							_							

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Client Name:	Chamberlain (	Group Inc.			

#### Figure 24 99% Power Bandwidth Graphs



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Client Name:	Chamberlain	Group Inc.			

#### 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 Standa	ard	47 CFF	R Part 15.231, RS	S-210 A1.1			
		Frequency ra	ange	Measurement Point			
Fully configu	red sample scanned	30 MHz – 1	GHz	(3m distance)			
over the follo	wing frequency range	1GHz – 4G	1GHz – 4GHz				
		Limits					
_		Limit (dBµV/m)					
Freq	uency (MHz)	Fundamental AV Limit	Fundamental AV Limit Non-Restricted Spurious Harmo				
	390	79.24		59.24			
		All Other Emissions	All Other Emissions including Harmonics in restricted bands				
30M	Hz – 88MHz		40.00				
88MHz – 216MHz			43.52				
216MHz – 960MHz			46.02				
960MHz – 4,000MHz		54.00					
Supplementa	ry information: Please	refer to Section 4.3, Mode 8	for Radiated Spu	urious Emission Data			

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## 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		

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## Figure 25 Cease Operation Graph for 390MHz

Agilent Spectru	um Analyzer - Swept SA							
LXI	RF 50 Ω DC		SENSE	HINT	ALIGN AUTO	11:10:30	AM Jul 01, 2013	Maukan
Marker 1	l 643.501 ms			Avg	Type: Log-Pwr	TRAC	Е <mark>123456</mark>	Marker
40 40/40	Pof 0 00 dPm	PNO: Wide ↔ IFGain:Low	Trig: Video Atten: 10 dE	3		Mkr1 64	43.5 ms	Select Marker 1 ▶
	Rei 0.00 übili							
-10.0								Normal
-20.0								
-30.0								Delta
-40.0								
-40.0							TRIG LVL	
-50.0								
60.0								
-70.0								Off
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-90.0								
	00.00000 MILL					_		More
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RCS DW		#VDVV			aweeh	20.00 \$ (	ivoi pisj	
MSG					STATUS	5		

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## 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 Stand	Jard FCC Part 15 Subpart A, 15.35				
	Pulse Train Limits				
There are no to the meas	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.				

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#### Figure 26 Pulse Train Graphs for 390MHz



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## 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 Stand	asic Standard 47 CFR Part 15.231, RSS-210 A1.1.3			
	Occupied Bandwidth Limits			
No wid	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					

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## Figure 27 20dB Bandwidth Graphs

Agilent	Spectrum A	nalyzer - Occupi	ied BW											
LXI	Т	RF 50 Ω	DC			SEN	ISE:	INT		ALIGN AUTO	11:25:31/	AM Jun 03, 2013	Trac	e/Detector
Cent	ter Fre	q 390.000	0000 MH2	2	Cent	Eroo	eq:	390.000	000 MHz	d: 10/10	Radio Std	: None		
			#160	⊶+• Cain:Low	. Ing. #Atte	n: 10	dE	171 3	Avginor	a. 10/10	Radio Dev	vice: BTS		
			#IFV	Jamilow	W/ ICCC		WL				Huuro Dei	100.010		
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Log														
-30.0														
10.0														Clear Write
-40.0 -														
-50.0							Į.							
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#RGA						VDV	Y		12		Sweep	9.207 1115		
		ad Danad						atal P	owor	26 1	) dDm			Detector
	ccupie	ea Bana	wiath					υιαι Γ	Owei	-30.2	2 UDIII			Peak▶
			61.2	256 kl	Ηz								Auto	<u>Man</u>
Tr	ansmit	Freq Err	or	-2.354	kHz		0	BW P	ower	99	9.00 %			
~	dB Bar	dwidth		10 79 1			v	AB		_20	00 48			
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MSG							_			STATUS	;			
							-							

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#### Figure 28 99% Power Bandwidth Graphs



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## Appendix A

## **Test Setup Photos**



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## 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
		BOMS 1GHz-			
Antenna Array	UL	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

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## 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 complian

nce 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 gualified 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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