



Measurement of RF Interference from a Model 885LM transmitter

For : The Chamberlain Group, Inc.
845 Larch Ave
Elmhurst, IL 60126

P.O. No. : 864100
Date Tested : November 15 and 24, 2009
Test Personnel : Richard King
Specification : FCC "Code of Federal Regulations" Title 47
Part 15, Subpart C
: Industry Canada RSS-210
: Industry Canada RSS-GEN

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Richard King
EMC Test Engineer

Approved By : *Raymond J. Klouda*
Raymond J. Klouda
Registered Professional
Engineer of Illinois - 44894



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REVISION HISTORY

Revision	Date	Description
—	November 25, 2009	Initial release
A	March 1, 2010	Updated model number from 378LM to 885LM

Measurement of RF Emissions from a Model 885LM transmitter

1 INTRODUCTION

1.1 Scope of Tests

This document represents the results of the series of radio interference measurements performed on a model 885LM transmitter, Serial No. N/A (hereinafter referred to as the test item). The test item was designed to transmit at approximately 315MHz using an internal antenna. The test item was manufactured and submitted for testing by The Chamberlain Group, Inc. located in Elmhurst, IL.

1.2 Purpose

The test series was performed to determine if the test item meets the conducted and radiated RF emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections 15.231 for Intentional Radiators. Testing was performed in accordance with ANSI C63.4-2003.

1.3 Deviations, Additions and Exclusions

There were no deviations, additions to, or exclusions from the test specification during this test series.

1.4 EMC Laboratory Identification

This series of tests was performed by Elite Electronic Engineering Incorporated of Downers Grove, Illinois. The laboratory is accredited by the National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP). NVLAP Lab Code: 100278-0.

1.5 Laboratory Conditions

The temperature at the time of the test was 22.1°C and the relative humidity was 34%.

2 APPLICABLE DOCUMENTS

The following documents of the exact issue designated form part of this document to the extent specified herein:

- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 15, Subpart C, dated 1 October 2008
- ANSI C63.4-2003, "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"
- Industry Canada RSS-210, Issue 7, September 2007, "Spectrum Management and Telecommunications Radio Standards Specification, Low-power License-exempt radio communication devices (All Frequency Bands): Category I Equipment"
- Industry Canada RSS-GEN, Issue 2, September 2007, "Spectrum Management and Telecommunications Radio Standards Specification, General Requirements and Information for the Certification of radio communication equipment"

3 TEST ITEM SET-UP AND OPERATION

3.1 General Description

The test item is a model 885LM transmitter. A block diagram of the test item set-up is shown as Figure 1.



3.1.1 Power Input

The test item obtained 3VDC from a 3 volt battery.

3.1.2 Peripheral Equipment

The test item does not require peripheral equipment to operate properly.

3.1.3 Interconnect Cables

The test item does not require interconnect cables to operate properly.

3.1.4 Grounding

Since the test item was powered with 3VDC from a 3 volt battery, it was ungrounded during the tests.

3.2 Operational Mode

For all tests the test item was placed on an 80cm high non-conductive stand. The test item was energized.

3.3 Test Item Modifications

The test item was not modified to meet the selected requirements.

4 TEST FACILITY AND TEST INSTRUMENTATION

4.1 Shielded Enclosure

All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. With the exception of the floor, the reflective surfaces of the shielded chamber are lined with ferrite tiles on the walls and ceiling. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4-2003 for site attenuation.

4.2 Test Instrumentation

The test instrumentation and auxiliary equipment used during the tests are listed in Table 9-1.

4.3 Calibration Traceability

Test equipment is maintained and calibrated on a regular basis. All calibrations are traceable to the National Institute of Standards and Technology (NIST).

4.4 Measurement Uncertainty

All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system.

The measurement uncertainty for these tests is presented below:

Conducted Emission Measurements		
Combined Standard Uncertainty	1.07	-1.07
Expanded Uncertainty (95% confidence)	2.1	-2.1

Radiated Emission Measurements		
Combined Standard Uncertainty	2.26	-2.18
Expanded Uncertainty (95% confidence)	4.5	-4.4



5 TEST PROCEDURES

5.1 Powerline Conducted Emissions

5.1.1 Requirements

Since the test item was powered by internal batteries, no conducted emissions tests are required.

5.2 Duty Cycle Factor Measurements

5.2.1 Procedures

The duty cycle factor is used to convert peak detected readings to average readings. This factor is computed from the time domain trace of the pulse modulation signal.

With the transmitter set up to transmit for maximum pulse density, the time domain trace is displayed on the spectrum analyzer. The markers are set at the beginning and end of a word period (start of next data pulse). If the word period exceeds 100 msec, the word period is limit to 100 msec. The pulse width and number of pulses are measured for the word period. This data is used to compute the on-time. The duty cycle is then computed as the (On-time/ word period).

5.2.2 Results

The data word consists of 86 pulses that are 250uS wide that result in a total on-time of 21mS for the data word. Since the word is greater than 100ms, the duty cycle factor is computed using the following calculation $20 \cdot \text{LOG}(21.5\text{ms}/100\text{ms}) = -13.35 \text{ dB}$.

5.3 Radiated Measurements

5.3.1 Requirements

The test item must comply with the requirements of FCC "Code of Federal Regulations Title 47", Part 15, Subpart C, Section 15.205 et seq.

Paragraph 15.231(b) has the following radiated emission limits:

Fundamental Frequency MHz	Field Intensity uV/m @ 3 meters	Field Strength Harmonics and Spurious @ 3 meters
260 to 470	3,750 to 12,500*	375 to 1,250*

* - Linear Interpolation

For 315MHz, the limit at the fundamental is 6041.7uV/m @ 3m and the limit on the harmonics is 604.2uV/m @ 3m. In addition, emissions appearing in the Restricted Bands of Operation listed in paragraph 15.205(a) shall not exceed the general requirements shown in paragraph 15.209.

5.3.2 Procedures

Radiated measurements were performed in a 32ft. x 20ft. x 14ft. high shielded enclosure. The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall. The powerline filters prevent extraneous signals from entering the enclosure on these leads.

A preliminary radiated emissions test was performed to determine the emission characteristics of the test item. For the preliminary test, a broadband measuring antenna was positioned at a 3 meter distance from the test item. The entire frequency range from 30MHz to 4.0GHz was investigated using a peak detector function. The data was then processed by the computer to calculate equivalent field intensity.

The final open field emission tests were then manually performed over the frequency range of 30MHz to 4000MHz. Between 30MHz and 1000MHz, a tuned dipole antenna was used as the pick-up device. A broadband double ridged waveguide antenna was used as the pick-up device for all frequencies above 1GHz. All significant broadband and narrowband signals were measured and recorded. The peak detected levels were converted to average levels using a duty cycle factor which was computed from the pulse train.

To ensure that maximum or worst case, emission levels were measured, the following steps were taken:

- 1) The test item was rotated so that all of its sides were exposed to the receiving antenna.
- 2) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.
- 3) The measuring antenna was raised and lowered from 1 to 4 meters for each antenna polarization to maximize the readings.
- 4) For hand-held or body-worn devices, the test item was rotated through three orthogonal axes to determine which orientation produces the highest emission relative to the limit.
- 5) In instances where it was necessary to use a shortened cable between the measuring antenna and the spectrum analyzer and the antenna cannot be raised to 4 meters. The measuring antenna is raised or lowered as much as the cable will allow and the test item is rotated through all axes to ensure the maximum readings are recorded.

5.3.3 Results

The preliminary plots, with the test item transmitting at 315MHz, are presented on data pages 15 through 18. The plots are presented for a reference only, and are not used to determine compliance.

The final open area radiated levels, with the test item transmitting at 315MHz, are presented on data page 19. As can be seen from the data, all emissions measured from the test item were within the specification limits. The emissions level closest to the limit (worst case) occurred at 315MHz. The emissions level at this frequency was 0.9 dB within the limit. See data page 19 for details. Photographs of the test configuration which yielded the highest, or worst case, radiated emission levels are shown on Figures 2 and 3.

5.4 Occupied Bandwidth Measurements

5.4.1 Requirement

In accordance with paragraph 15.231(c), all emissions within 20dB of the peak amplitude level of the center frequency are required to be within a band less than 0.25% of the center frequency wide.

5.4.2 Procedures

The test item was placed on an 80cm high non-conductive stand. The unit was set to transmit continuously. With an antenna positioned nearby, occupied bandwidth emissions were displayed on the spectrum analyzer. The resolution bandwidth was set to 30 kHz and span was set to 2 MHz. The frequency spectrum near the fundamental was plotted.

5.4.3 Results

The plot of the emissions near the fundamental frequency is presented on data page 20. As can be seen from these data pages, the transmitter met the occupied bandwidth requirements. The 99% bandwidth is 156.31kHz.



6 OTHER TEST CONDITIONS

6.1 Test Personnel and Witnesses

All tests were performed by qualified personnel from Elite Electronic Engineering Incorporated.

6.2 Disposition of the Test Item

The test item and all associated equipment were returned to The Chamberlain Group, Inc. upon completion of the tests.

7 CONCLUSIONS

It was determined that The Chamberlain Group, Inc. transmitter, Model No. 885LM, Serial No. N/A, did fully meet the radiated emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.205 et seq. for Intentional Radiators, when tested per ANSI C63.4-2003.

8 CERTIFICATION

Elite Electronic Engineering Incorporated certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the test specifications.

The data presented in this test report pertains to the test item at the test date. Any electrical or mechanical modification made to the test item subsequent to the specified test date will serve to invalidate the data and void this certification. This report must not be used to claim product endorsement by NVLAP or any agency of the US Government.



9 EQUIPMENT LIST

Table 9-1 Equipment List

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
APK0	PRE-AMPLIFIER	HEWLETT PACKARD	8449B	3008A00662	1-26.5GHZ	3/18/2009	3/18/2010
CDS2	COMPUTER	GATEWAY	MFATXPNT NMZ 500L	0028483108	1.8GHZ	N/A	
CMA1	Controllers	EMCO	2090	9701-1213	---	N/A	
NDP0	TUNED DIPOLE ANTENNA	EMCO	3121C-DB3	311	140-400MHZ	3/12/2009	3/12/2010
NTA0	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL6112	2057	0.03-2GHZ	11/14/2008	12/14/2009
NWH0	RIDGED WAVE GUIDE	TENSOR	4105	2081	1-12.4GHZ	8/11/2009	8/11/2010
PHA0	MAGNETIC FIELD PROBE	ELECTRO- METRICS	EM-6882	134	22-230MHZ	NOTE 1	
RAC1	SPECTRUM ANALYZER	HEWLETT PACKARD	85660B	3407A08369	100HZ-22GHZ	3/2/2009	3/2/2010
RACB	RF PRESELECTOR	HEWLETT PACKARD	85685A	3506A01491	20HZ-2GHZ	3/3/2009	3/3/2010
RAF3	QUASISPEAK ADAPTER	HEWLETT PACKARD	85650A	3303A01775	0.01-1000MHZ	3/3/2009	3/3/2010
RAKG	RF SECTION	HEWLETT PACKARD	85462A	3549A00284	0.009-6500MHZ	1/23/2009	1/23/2010
RAKH	RF FILTER SECTION	HEWLETT PACKARD	85460A	3448A00324	---	1/23/2009	1/23/2010
RBB0	EMI TEST RECEIVER 20HZ TO 40 GHZ	ROHDE & SCHWARZ	ESIB40	100250	20 HZ TO 40GHZ	3/11/2009	3/11/2010
XZG0	ATTENUATOR/SWITCH DRIVER	HEWLETT PACKARD	11713A	3439A02724	---	N/A	

N/A: Not Applicable

Note 1: For the purpose of this test, the equipment was calibrated over the specified frequency range, pulse rate, or modulation prior to the test or monitored by a calibrated instrument.

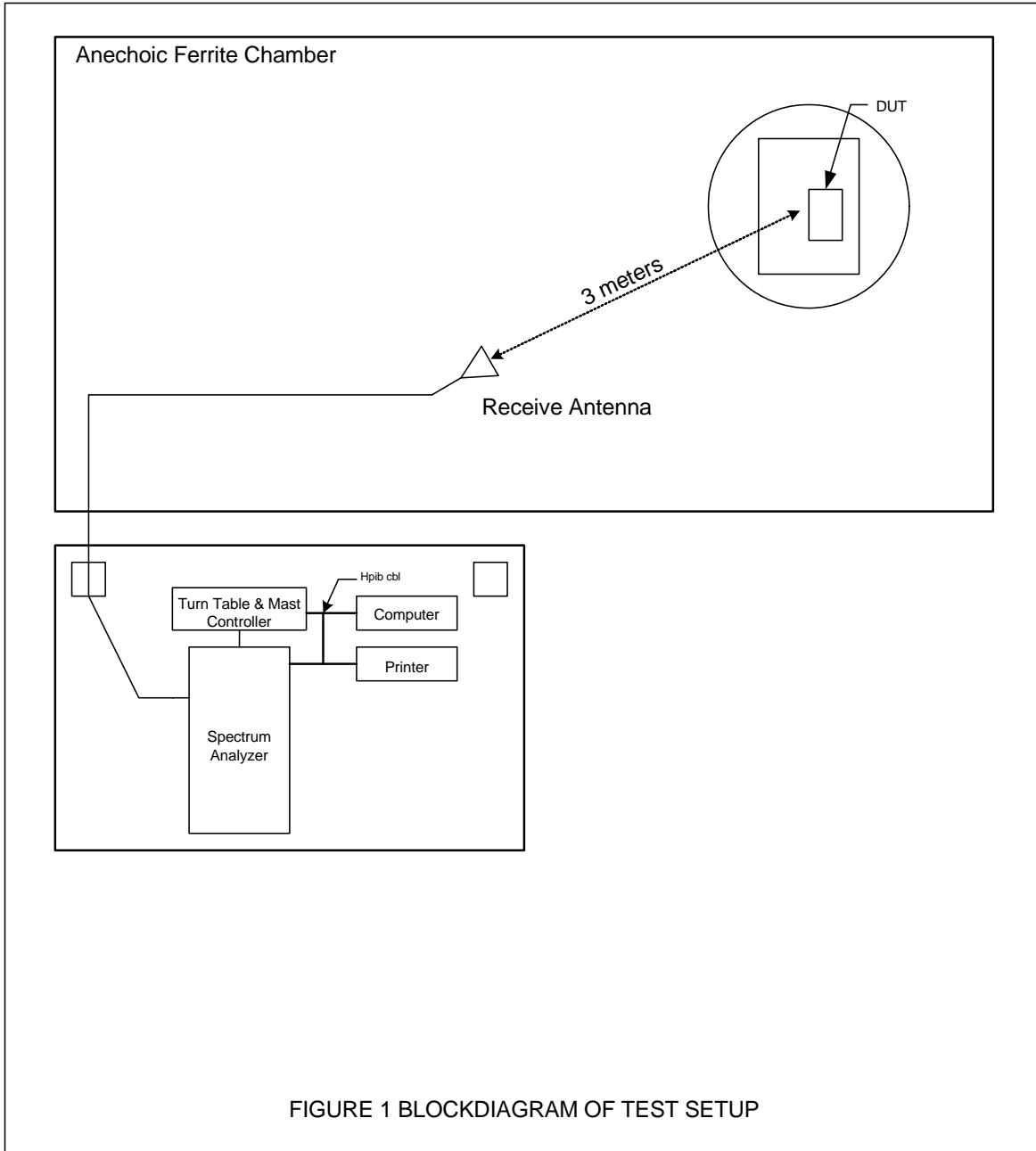
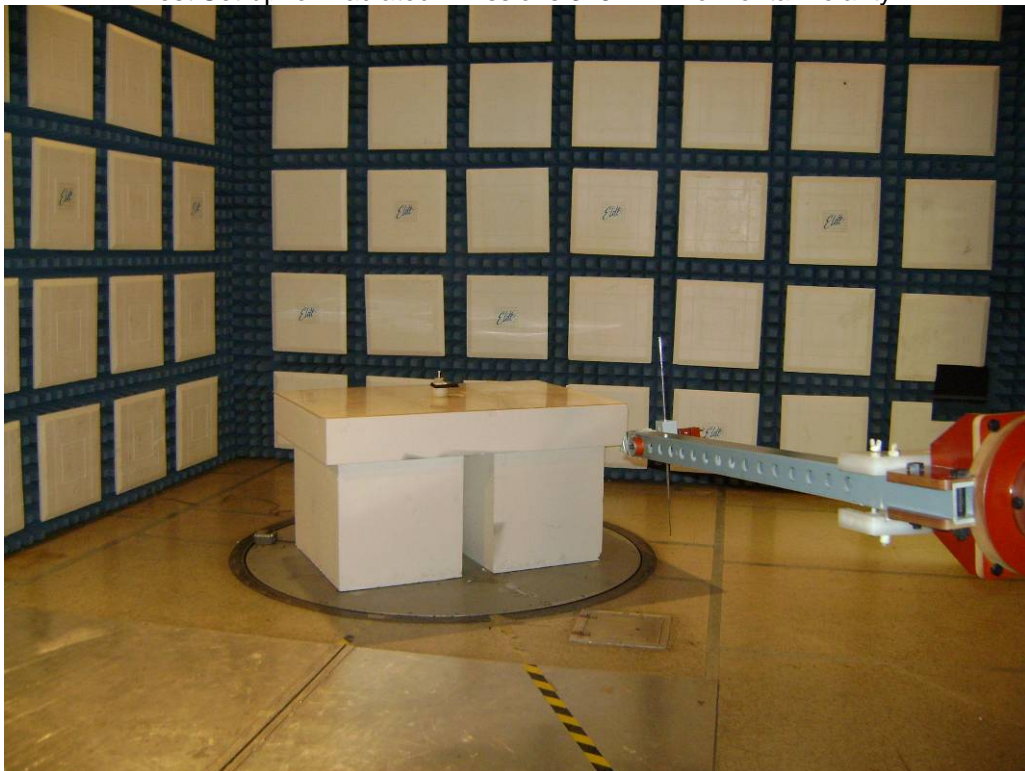


Figure 2

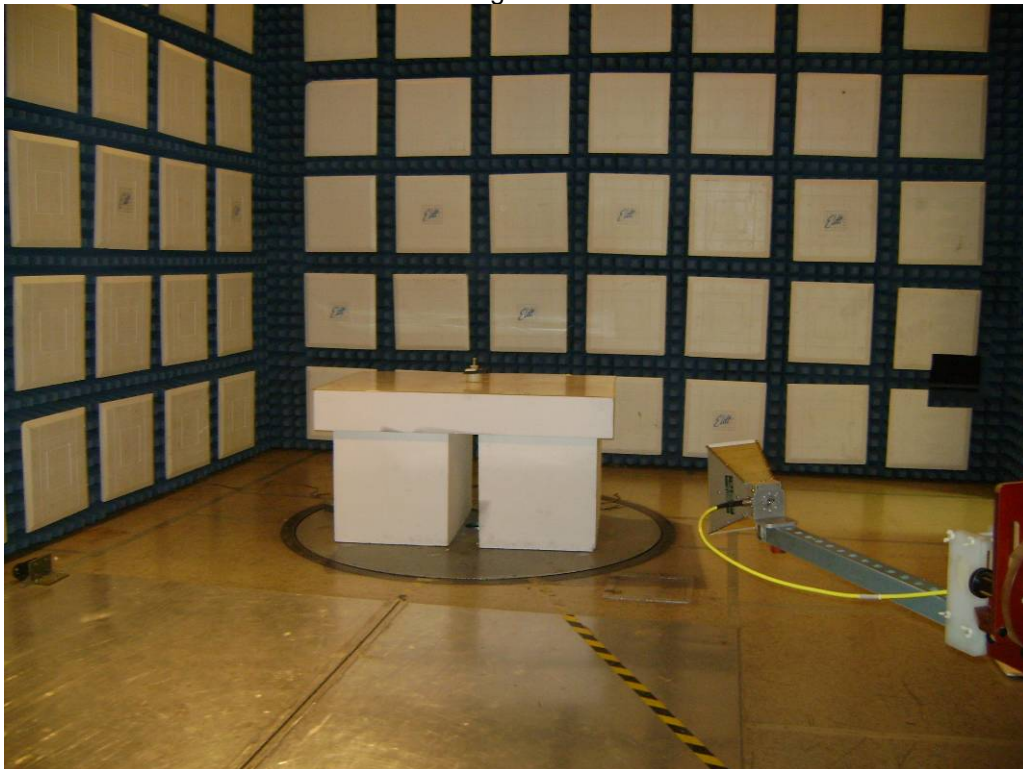


Test Set-up for Radiated Emissions 315Hz – Horizontal Polarity



Test Set-up for Radiated Emissions 315MHz – Vertical Polarity

Figure 3



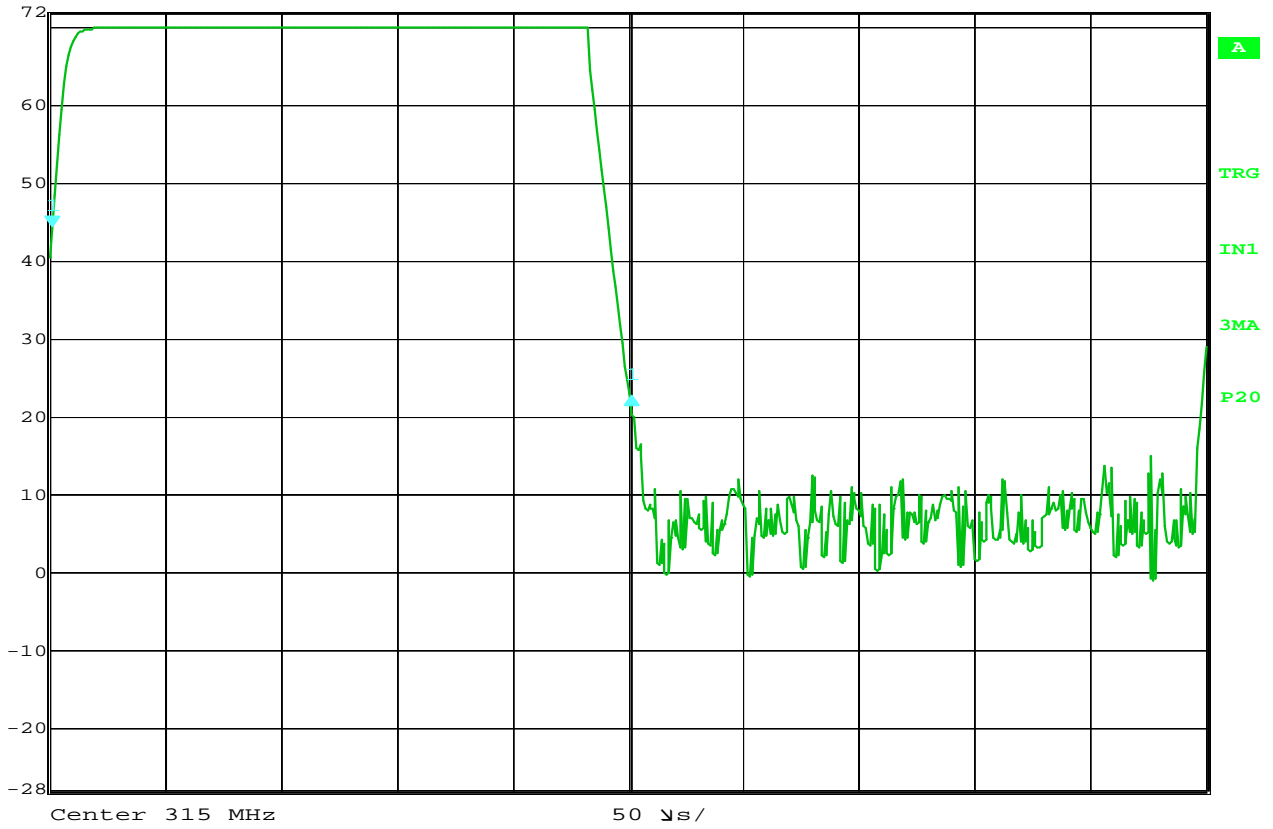
Test Set-up for Radiated Emissions 315MHz – Horizontal Polarity



Test Set-up for Radiated Emissions 315MHz – Vertical Polarity



	Delta 1 [T3]	RBW	1 MHz	RF Att	0 dB
Ref Lvl	-21.88 dB	VBW	10 MHz		
72 dBV	250.501002 μ s	SWT	500 μ s	Unit	dBV



Date: 24.NOV.2009 13:00:15

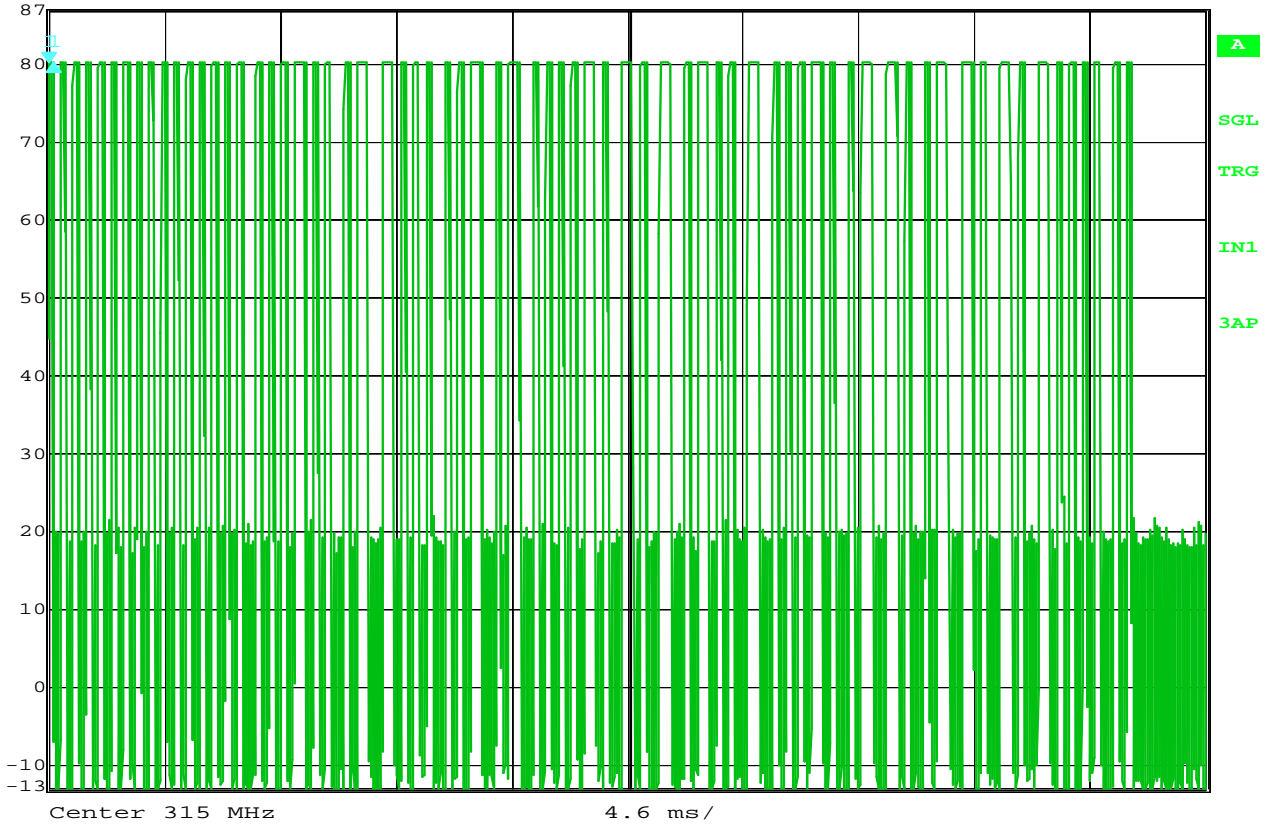
FCC Transmitter Duty Cycle

MANUFACTURER : The Chamberlain Group, Inc.
 MODEL NUMBER : 885LM
 TEST MODE : Tx at 315MHz
 NOTES : pulse width = 250uS
 EQUIPMENT USED : RBB0

NOTES



	Delta 1 [T3]	RBW	1 MHz	RF Att	0 dB
Ref Lvl	0.00 dB	VBW	10 MHz		
87 dBμV	224.448898 μs	SWT	46 ms	Unit	dBμV



Date: 17.NOV.2009 23:03:12

FCC Transmitter Duty Cycle

MANUFACTURER : The Chamberlain Group, Inc.
 MODEL NUMBER : 885LM
 TEST MODE : Tx at 315MHz
 NOTES : Number of pulses = 86
 EQUIPMENT USED : RBB0

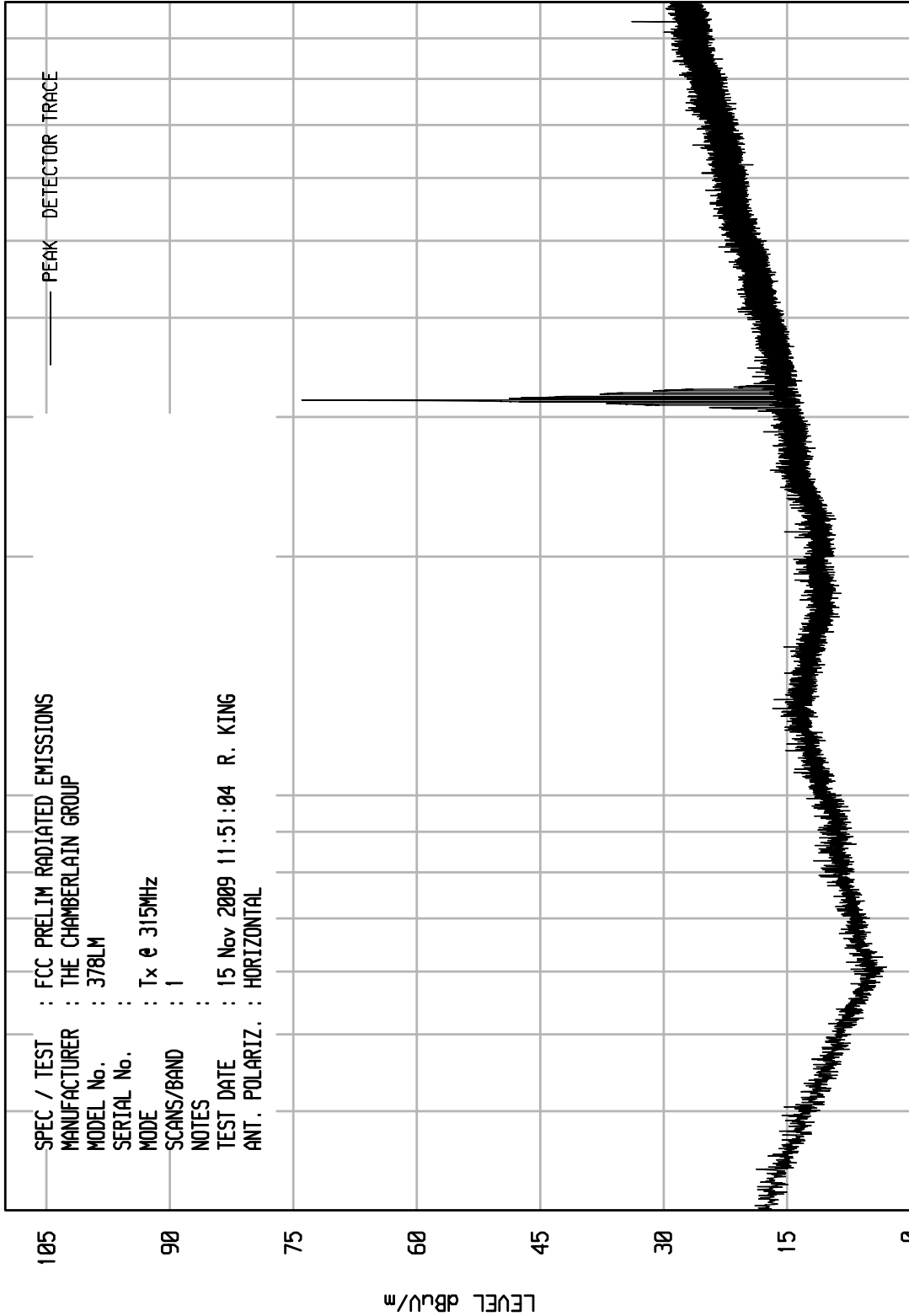
NOTES

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515

UNIU RCU EMI RUN 2

UKA1 01/30/09

SPEC / TEST : FCC PRELIM RADIATED EMISSIONS
 MANUFACTURER : THE CHAMBERLAIN GROUP
 MODEL No. : 378LM
 SERIAL No. :
 MODE : Tx @ 315MHz
 SCANS/BAND : 1
 NOTES :
 TEST DATE : 15 Nov 2009 11:51:04 R. KING
 ANT. POLARIZ. : HORIZONTAL



START = 30

100

FREQUENCY MHz

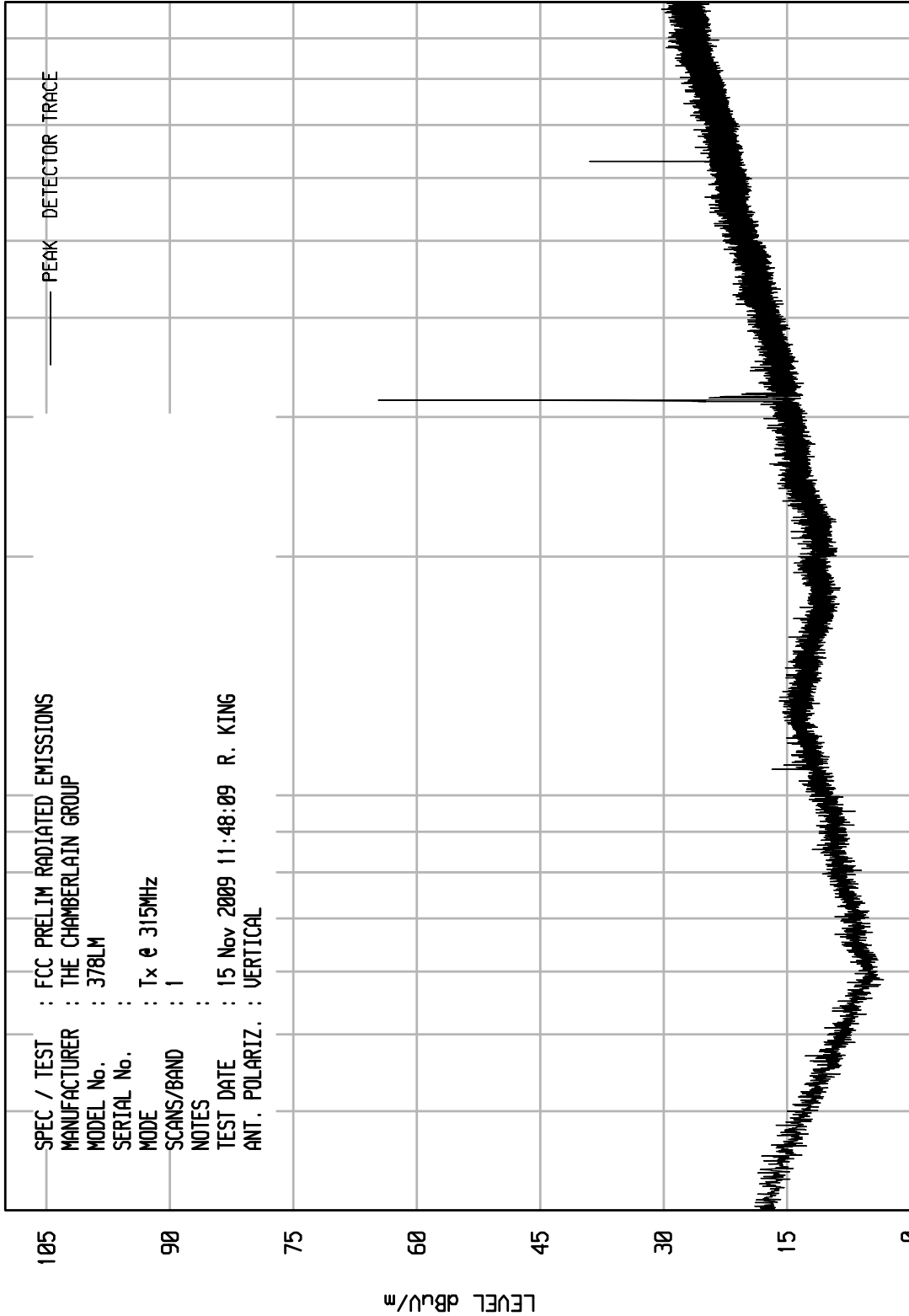
STOP = 1000

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515

UNIU RCU EMI RUN 1

UKA1 01/30/09

SPEC / TEST : FCC PRELIM RADIATED EMISSIONS
 MANUFACTURER : THE CHAMBERLAIN GROUP
 MODEL No. : 378LM
 SERIAL No. :
 MODE : Tx @ 315MHz
 SCANS/BAND : 1
 NOTES :
 TEST DATE : 15 Nov 2009 11:48:09 R. KING
 ANT. POLARIZ. : VERTICAL



START = 30

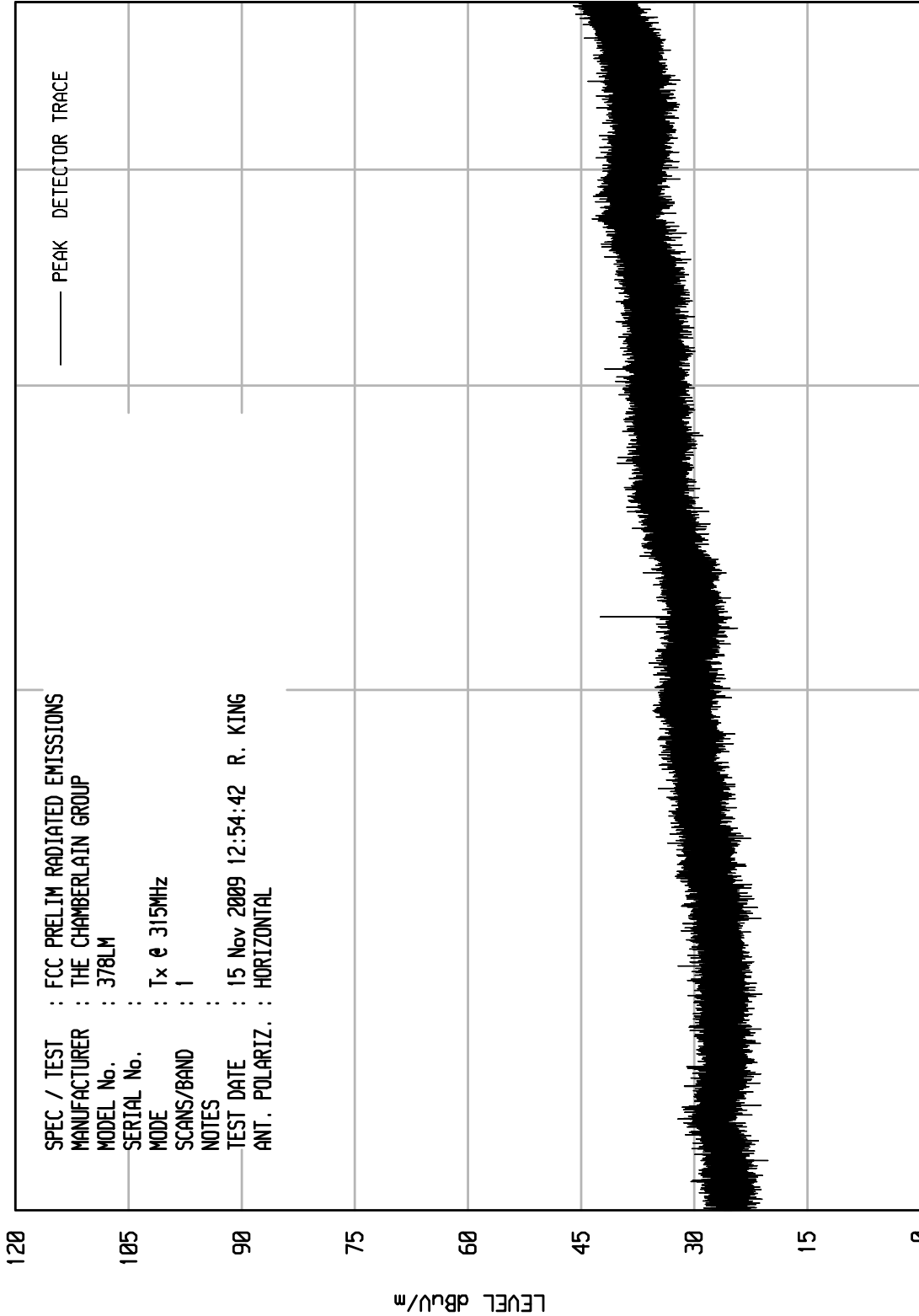
STOP = 1000

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515

UNIU RCU EMI RUN 3

UKA1 01/30/09

SPEC / TEST : FCC PRELIM RADIATED EMISSIONS
 MANUFACTURER : THE CHAMBERLAIN GROUP
 MODEL No. : 378LM
 SERIAL No. :
 MODE : Tx @ 315MHz
 SCANS/BAND : 1
 NOTES :
 TEST DATE : 15 Nov 2009 12:54:42 R. KING
 ANT. POLARIZ. : HORIZONTAL



START = 1000

FREQUENCY MHz

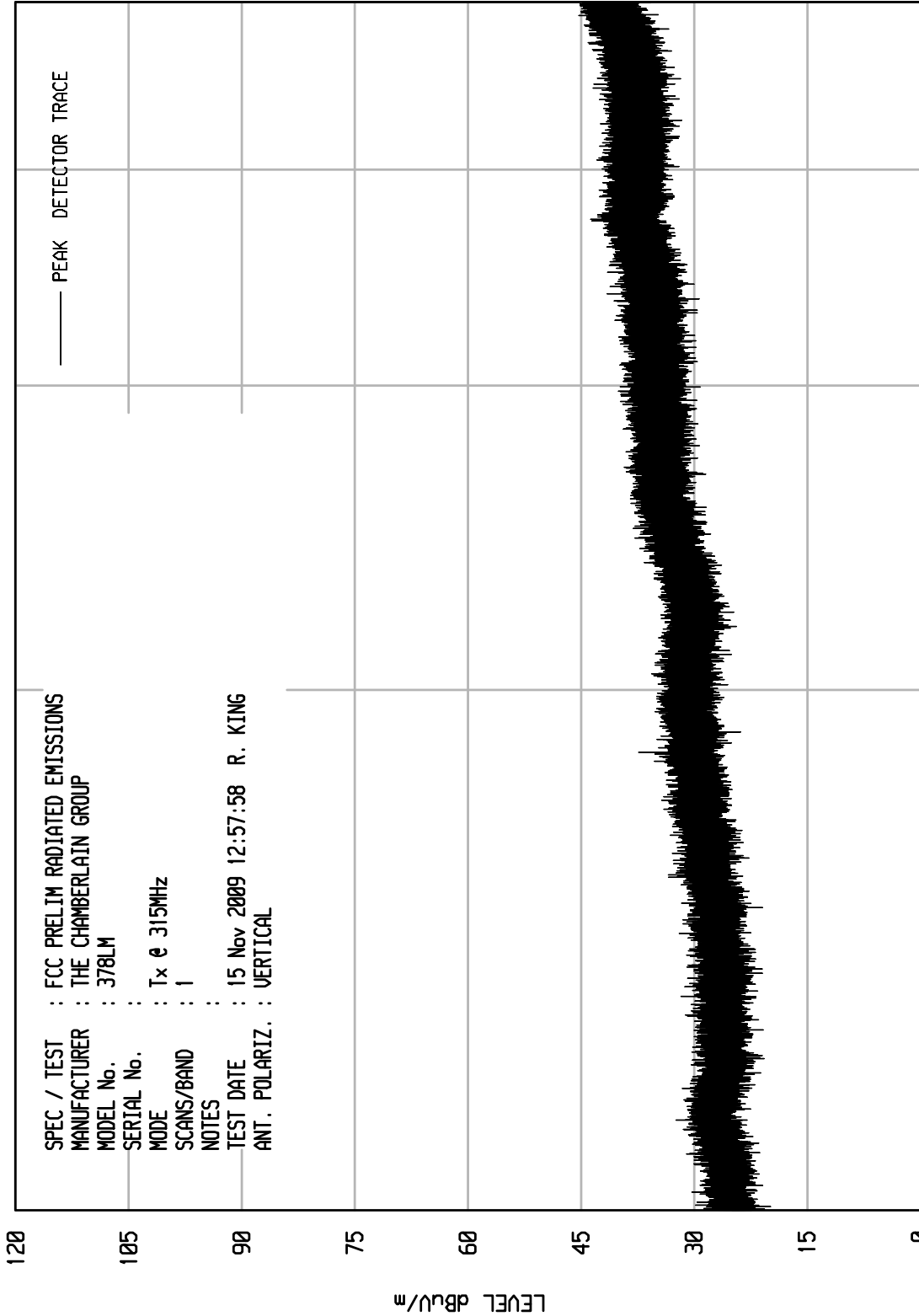
STOP = 5000

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515

UNIU RCU EMI RUN 4

UKA1 01/30/09

SPEC / TEST : FCC PRELIM RADIATED EMISSIONS
 MANUFACTURER : THE CHAMBERLAIN GROUP
 MODEL No. : 378LM
 SERIAL No. :
 MODE : Tx @ 315MHz
 SCANS/BAND : 1
 NOTES :
 TEST DATE : 15 Nov 2009 12:57:58 R. KING
 ANT. POLARIZ. : VERTICAL



START = 1000

FREQUENCY MHz

STOP = 5000



DATA PAGE

SPECIFICATION : FCC PART 15C TRANSMITTER OPEN FIELD DATA
 MANUFACTURER : The Chamberlain Group, Inc.
 TEST ITEM : transmitter
 PART NO : 885LM
 S/N : NONE ASSIGNED
 TEST DATE : November 15, 2009
 NOTES : Tx @ 315MHz

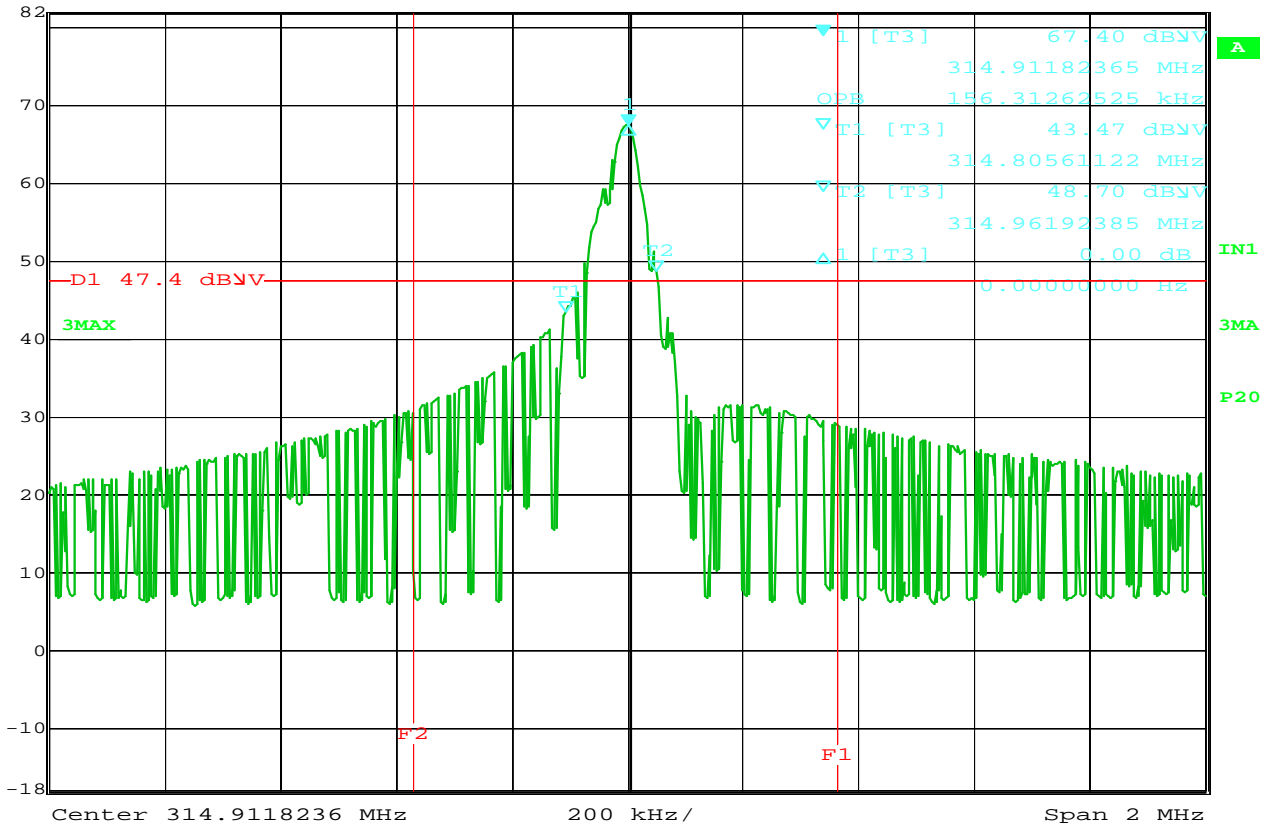
Freq (MHz)	Ant Pol	Meter Reading (dBUV)	CBL Fac (dB)	Ant Fac (dB)	Duty Cycle Factor (dB)	Total dBuV/m at 3 M	Total uV/m at 3M	Limit uV/m at 3M	Margin (dB)
315.0	H	67.9	1.4	18.8	-13.3	74.7	5443.5	6041.7	-0.9
315.0	V	49.0	1.4	18.8	-13.3	55.9	620.7	6041.7	-19.8
630.0	H	33.9	2.0	19.7	-13.3	42.3	131.0	604.2	-13.3
630.0	V	25.0	2.0	19.7	-13.3	33.4	46.6	604.2	-22.3
944.9	H	10.9	2.4	22.8	-13.3	22.8	13.8	604.2	-32.8
944.9	V	6.7	2.4	22.8	-13.3	18.6	8.5	604.2	-37.0
1259.9	H	4.8	2.9	25.6	-13.3	20.0	10.0	604.2	-35.6
1259.9	V	5.3	2.9	25.6	-13.3	20.4	10.5	604.2	-35.2
1574.9	H	26.7	3.2	26.4	-13.3	43.0	140.9	500	-11.0
1574.9	V	21.6	3.2	26.4	-13.3	37.9	78.6	500	-16.1
1889.9	H	16.7	3.5	27.8	-13.3	34.7	54.5	604.2	-20.9
1889.9	V	14.3	3.5	27.8	-13.3	32.3	41.2	604.2	-23.3
2204.9	H	16.4	3.7	28.8	-13.3	35.6	60.4	500	-18.4
2204.9	V	14.4	3.7	28.8	-13.3	33.6	48.0	500	-20.4
2519.8	H	12.9	3.9	29.6	-13.3	33.1	45.1	604.2	-22.5
2519.8	V	14.0	3.9	29.6	-13.3	34.1	51.0	604.2	-21.5
2834.8	H	15.0	4.0	30.6	-13.3	36.2	64.9	500	-17.7
2834.8	V	14.5	4.0	30.6	-13.3	35.7	61.2	500	-18.2
3149.8	H	13.6	4.2	31.9	-13.3	36.4	65.7	604.2	-19.3
3149.8	V	12.9	4.2	31.9	-13.3	35.7	60.9	604.2	-19.9

Checked BY RICHARD E. KING :

Richard E. King



Ref Lvl	Marker 1 [T3]	RBW	30 kHz	RF Att	10 dB
82 dBV	67.40 dBV	VBW	300 kHz		
	314.91182365 MHz	SWT	6 ms	Unit	dBV



Date: 15.NOV.2009 19:22:49

FCC 15.231 20dB bandwidth

MANUFACTURER : The Chamberlain Group, Inc.
 TEST ITEM : transmitter
 MODEL NUMBER : 885LM
 TEST MODE : Tx @ 315MHz
 NOTES : Display line D1 represents the 20dB down point. Display lines F1 and F2 represent the 0.25% span from the center frequency