





## Measurement of RF Interference from a Model D6000223 Cadillac RFA Transmitter

For : Omron Electronics  
3709 Ohio Avenue  
St. Charles, IL 60174

P.O. Number : 64220N  
Date Tested : December 9 and 10, 2010  
Test Personnel : Daniel Crowder  
Specification : FCC "Code of Federal Regulations" Title 47  
Part 15, Subpart C  
: Industry Canada RSS-210  
: Industry Canada RSS-GEN

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Daniel Crowder

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Registered Professional  
Engineer of Illinois - 44894



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**REVISION HISTORY**

Revision	Date	Description
—	10 Dec 2010	Initial release

## Measurement of RF Emissions from a Cadillac RFA D6000223 Transmitter

### 1 INTRODUCTION

#### 1.1 Scope of Tests

This document represents the results of the series of radio interference measurements performed on a model Cadillac RFA, Part No. D6000223 transmitter, (hereinafter referred to as the test item). No serial number was assigned to 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 Omron Electronics located in St. Charles, 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. The test series was also performed to determine if the test item meets the conducted and radiated RF emission requirements of the Industry Canada Radio Standards Specification 210. 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 21°C and the relative humidity was 19%.

### 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 2010
- 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, June 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, June 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 Cadillac RFA remote control transmitter, Part No. D6000223. A block diagram of the test item set-up is shown as Figure 1.

##### 3.1.1 Power Input

The test item received 3VDC from a 3VDC battery.

##### 3.1.2 Peripheral Equipment

The test item does not utilize peripheral equipment.

##### 3.1.3 Interconnect Cables

The test item does not utilize interconnect cables or ports.

##### 3.1.4 Grounding

Since the test item was powered from a 3VDC internal 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 transmit button of the test item was held down during testing thereby setting the unit to transmit continuously. The transmitting mechanism automatically deactivated when the transmit button was released. The battery voltage was periodically checked to ensure proper operation. The test was performed with the test item transmitting at 315.0MHz.

#### 3.3 Test Item Modifications

No modifications were required for compliance to the FCC 15.231 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.

Radiated emissions were performed with a spectrum analyzer. This receiver allows measurements with the bandwidths and detectors specified by the FCC.

#### 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.

## 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 Periodic Operation Measurements

#### 5.2.1 Requirements

A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released. Also, a transmitter activated automatically shall cease transmission within 5 seconds after activation.

#### 5.2.2 Procedures

The spectrum analyzer was setup to display the time domain trace. The EUT was set to transmit normally. The spectrum analyzer was used to record the amount of time that the EUT remained active following activation.

#### 5.2.3 Results

The plot of the periodic timing is shown on data page 13. The data shows that the EUT ceases operation within the allotted time.

### 5.3 Duty Cycle Factor Measurements

#### 5.3.1 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.

The following procedure was used to determine the duty cycle factor:

- a) With the transmitter set up to transmit for maximum pulse density, the time domain trace is displayed on the spectrum analyzer.
- b) The pulse width is measured and a plot of this measurement is recorded.
- c) The off time between pulses is measured and a plot is recorded.
- d) Finally the length of the word period is measured and a third plot is recorded. If the word period exceeds 100 msec, the word period is limited to 100 msec.
- e) The pulse width and number of pulses for the word period are used to compute the on-time. The duty cycle is then computed as the (on-time/ word period).

The duty cycle factor is computed from the duty cycle.

#### 5.3.2 Results

The plots of the duty cycle are shown on data pages 14 and 15. The duty cycle factor was computed to be -15.9 dB.

### 5.4 Radiated Measurements

#### 5.4.1 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

Example For 315MHz, the limit at the fundamental is 6041.7 uV/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.

#### 5.4.2 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 3150GHz 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 3150MHz. Between 30MHz and 1000MHz, a bilog 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.

#### 5.4.3 Results

The preliminary plots, with the test item transmitting at 315MHz, are presented on data pages 16 and 17. The plots are presented for a reference only, and are not used to determine compliance.

The final radiated levels, with the test item transmitting at 315MHz, are presented on data page 18. As can be seen from the data, all emissions measured from the test item were within the specification limits. Photographs

of the test set-up are shown on Figures 2 and 3.

## 5.5 Occupied Bandwidth Measurements

### 5.5.1 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.

### 5.5.2 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.

### 5.5.3 Results

The plot of the emissions near the fundamental frequency is presented on data page 19. As can be seen from this data page, the transmitter met the occupied bandwidth requirements. The 99% bandwidth was measured to be 617kHz.

## 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 Omron Electronics upon completion of the tests.

## 7 CONCLUSIONS

It was determined that the Omron Electronics Cadillac RFA, Part No. D6000223, did fully meet the conducted and radiated emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.205 et seq. for Intentional Radiators and Industry Canada RSS-210, 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
CMA1	Controllers	EMCO	2090	9701-1213	---	N/A	
NTA2	BILOG ANTENNA	TESEQ	6112D	28040	25-1000MHz	6/7/2010	6/7/2011
NWH0	RIDGED WAVE GUIDE	TENSOR	4105	2081	1-12.4GHZ	8/31/2010	8/31/2011
PHA0	MAGNETIC FIELD PROBE	ELECTRO-METRICS	EM-6882	134	22-230MHZ	NOTE 1	
RBA0	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB26	100145	20HZ-26.5GHZ	3/12/2010	3/12/2011
RBB0	EMI TEST RECEIVER 20HZ TO 40 GHZ.	ROHDE & SCHWARZ	ESIB40	100250	20 HZ TO 40GHZ	3/16/2010	3/16/2011

I/O: Initial Only

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.

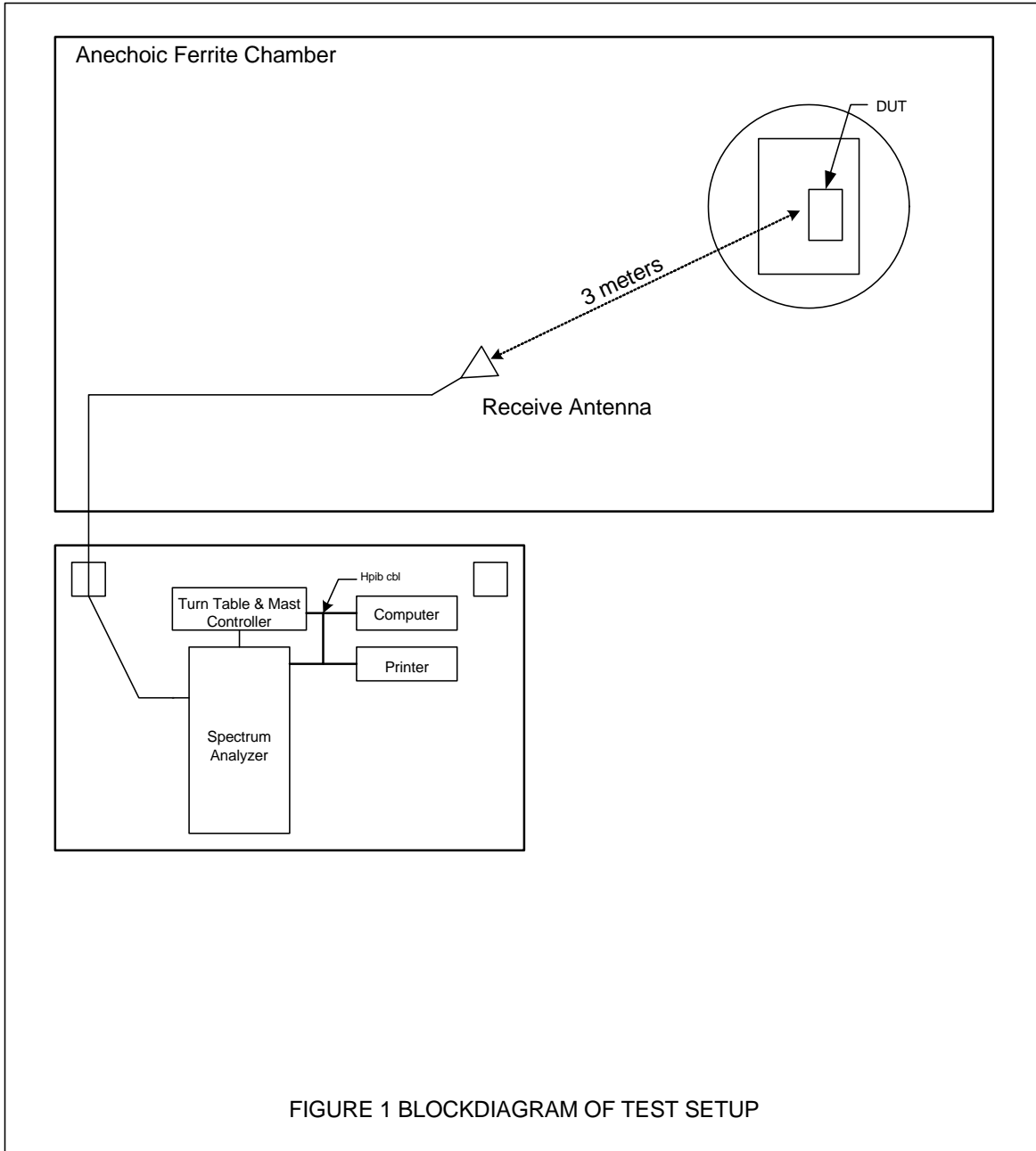
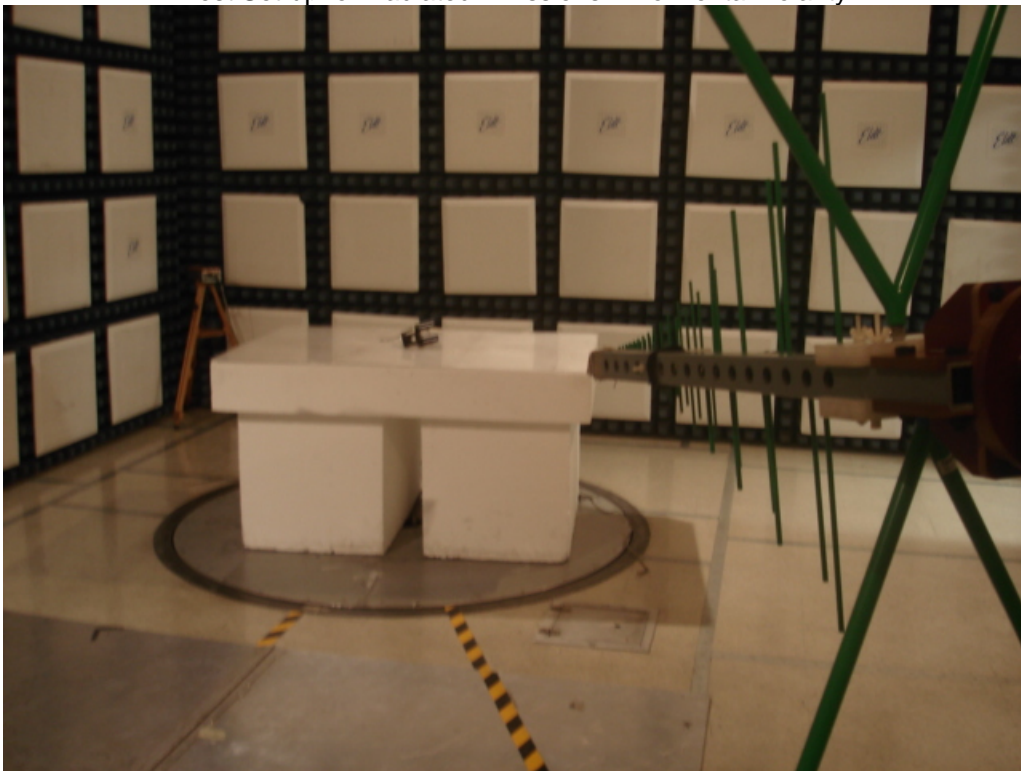


Figure 2

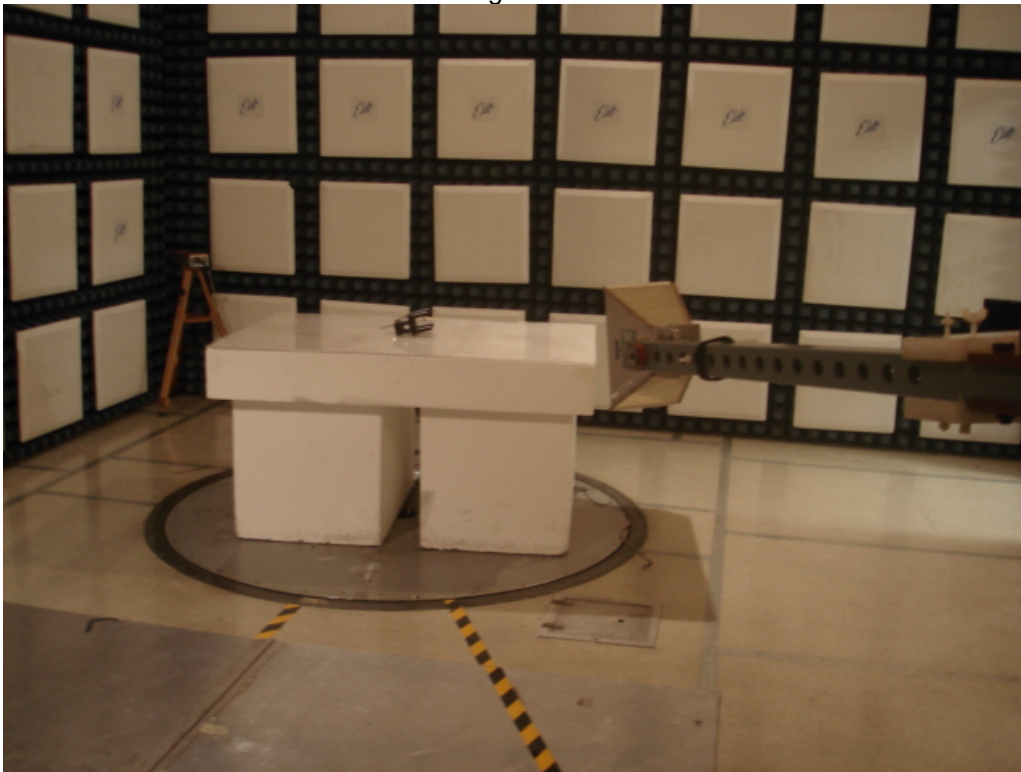


Test Set-up for Radiated Emissions – Horizontal Polarity

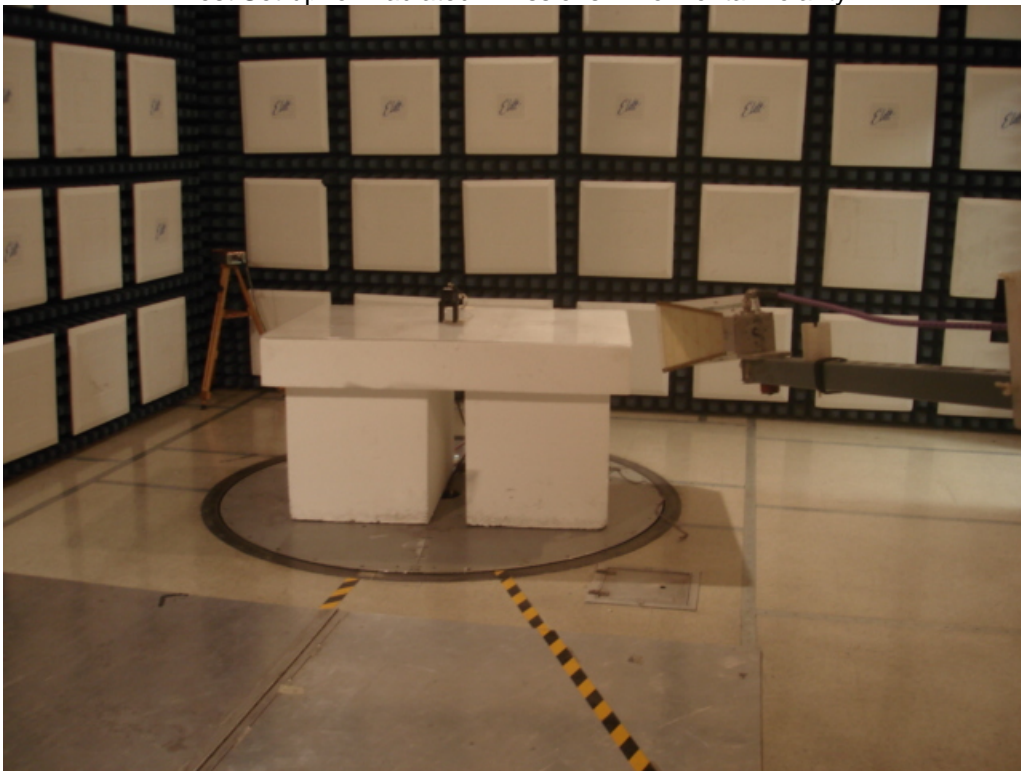


Test Set-up for Radiated Emissions – Vertical Polarity

Figure 3



Test Set-up for Radiated Emissions – Horizontal Polarity

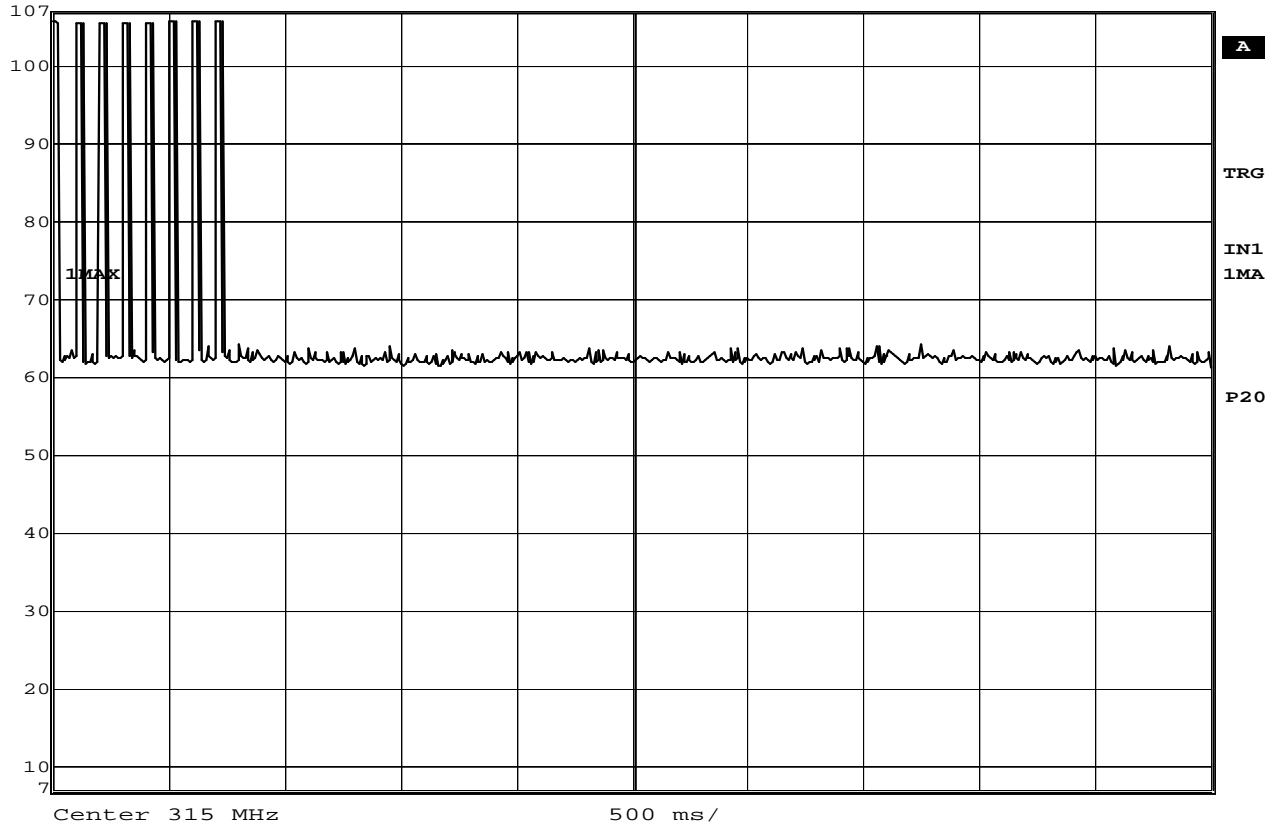


Test Set-up for Radiated Emissions – Vertical Polarity



Ref Lvl  
107 dBµV

RBW 1 MHz RF Att 50 dB  
VBW 1 MHz  
SWT 5 s Unit dBµV



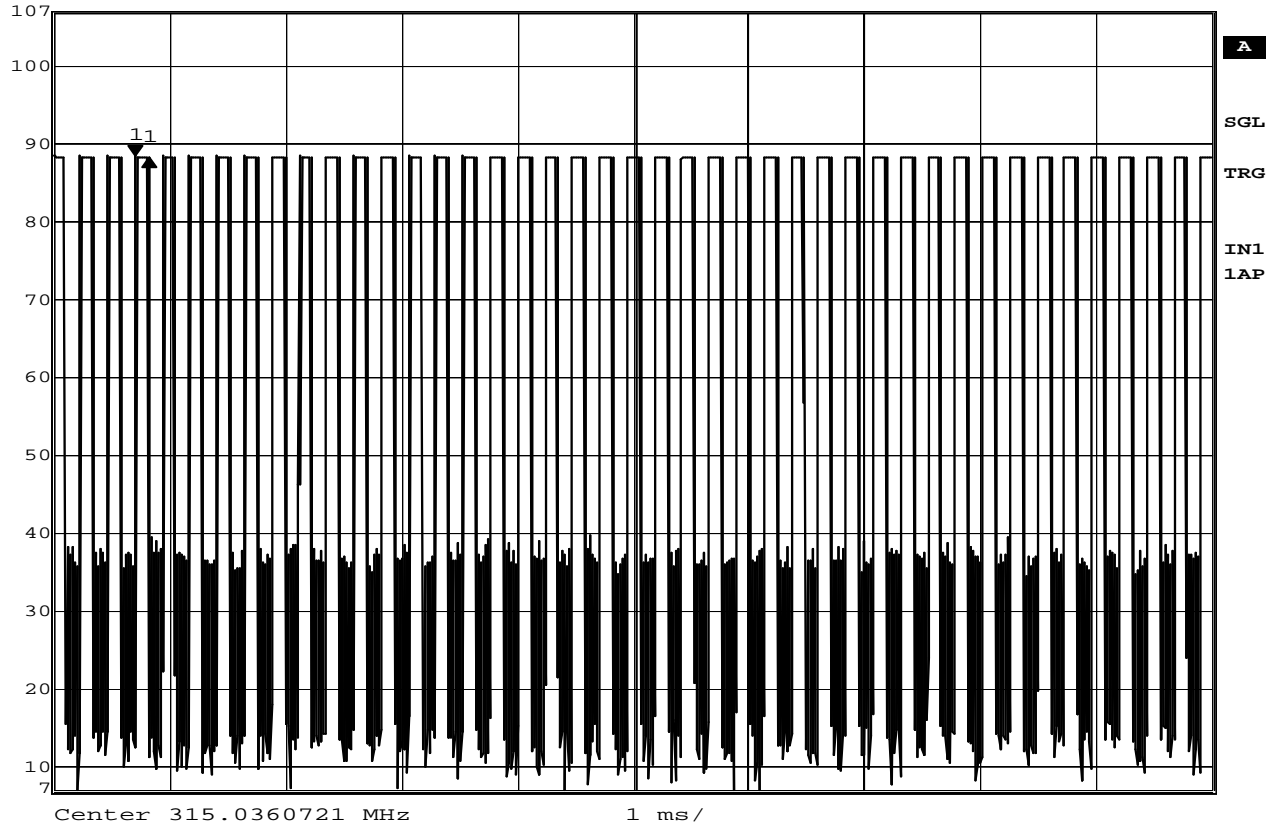
Date: 10.DEC.2010 11:14:39

### 15.231(c) Periodic Operation

MANUFACTURER : Omron  
 MODEL NUMBER : Cadillac RFA Remote Keyless Transmitter (P/N: D6000223)  
 SERIAL NUMBER : None Assigned  
 TEST MODE : Tx @ 315MHz  
 NOTES :  
 TEST DATE : December 10, 2010  
 TEST PARAMETERS : A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.  
 NOTES :  
 EQUIPMENT USED : RBA0, PHA0



Delta 1 [T1]	RBW	5 MHz	RF Att	10 dB
Ref Lvl	-0.12 dB	VBW	5 MHz	
107 dB $\mu$ V	120.240481 $\mu$ s	SWT	10 ms	Unit dB $\mu$ V



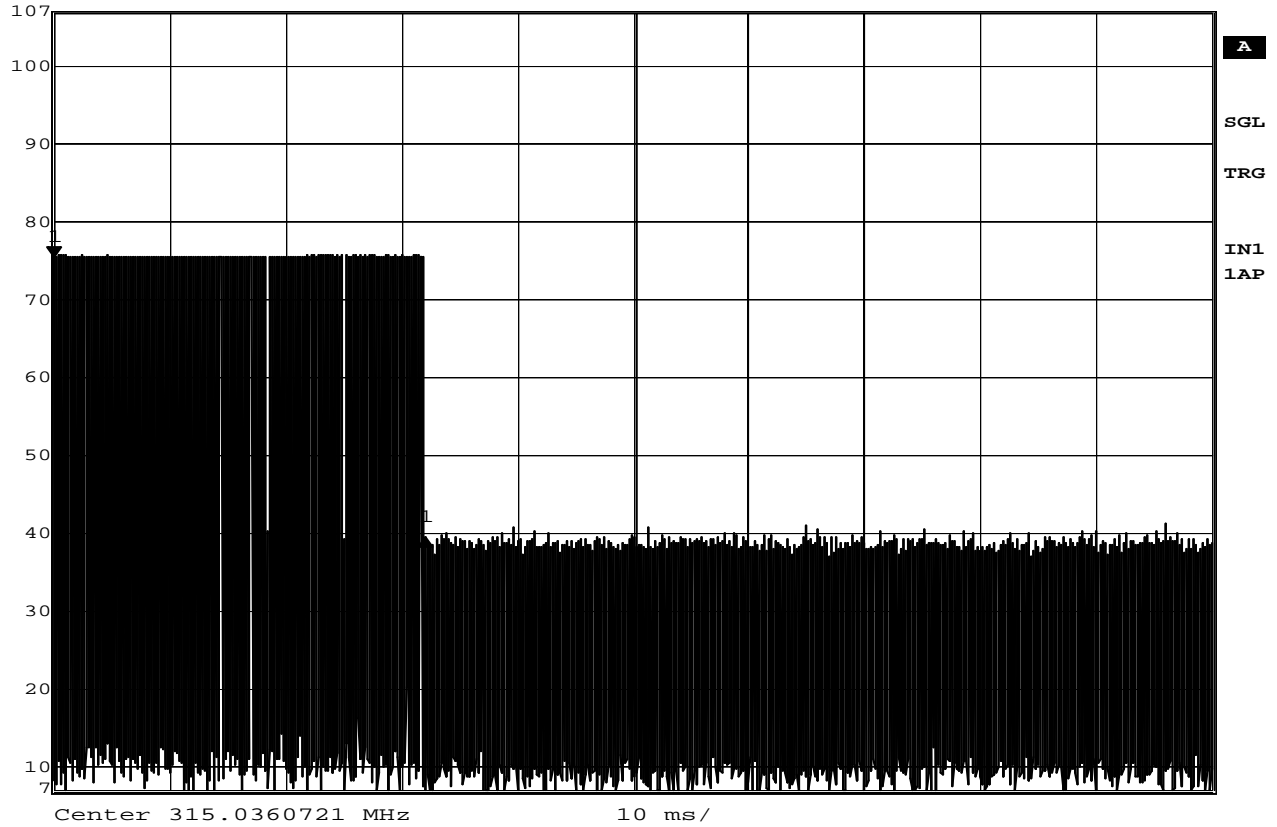
Date: 9.DEC.2010 13:43:26

### 15.35 Duty Cycle Correction Factor

MANUFACTURER	:	Omron
MODEL NUMBER	:	Cadillac RFA Remote Keyless Transmitter (P/N: D6000223)
SERIAL NUMBER	:	None Assigned
TEST MODE	:	Tx @ 315MHz
NOTES	:	
TEST DATE	:	December 9, 2010
TEST PARAMETERS	:	Duty Cycle Correction Factor
NOTES	:	The EUT utilized "On-Off" keying. "On-Off" keying has a 50% duty cycle.
EQUIPMENT USED	:	RBA0, PHA0



Delta 1 [T1]	RBW	5 MHz	RF Att	10 dB
Ref Lvl	-35.96 dB	VBW	5 MHz	
107 dBμV	32.064128 ms	SWT	100 ms	Unit dBμV



Date: 9.DEC.2010 13:26:12

### 15.35 Duty Cycle Correction Factor

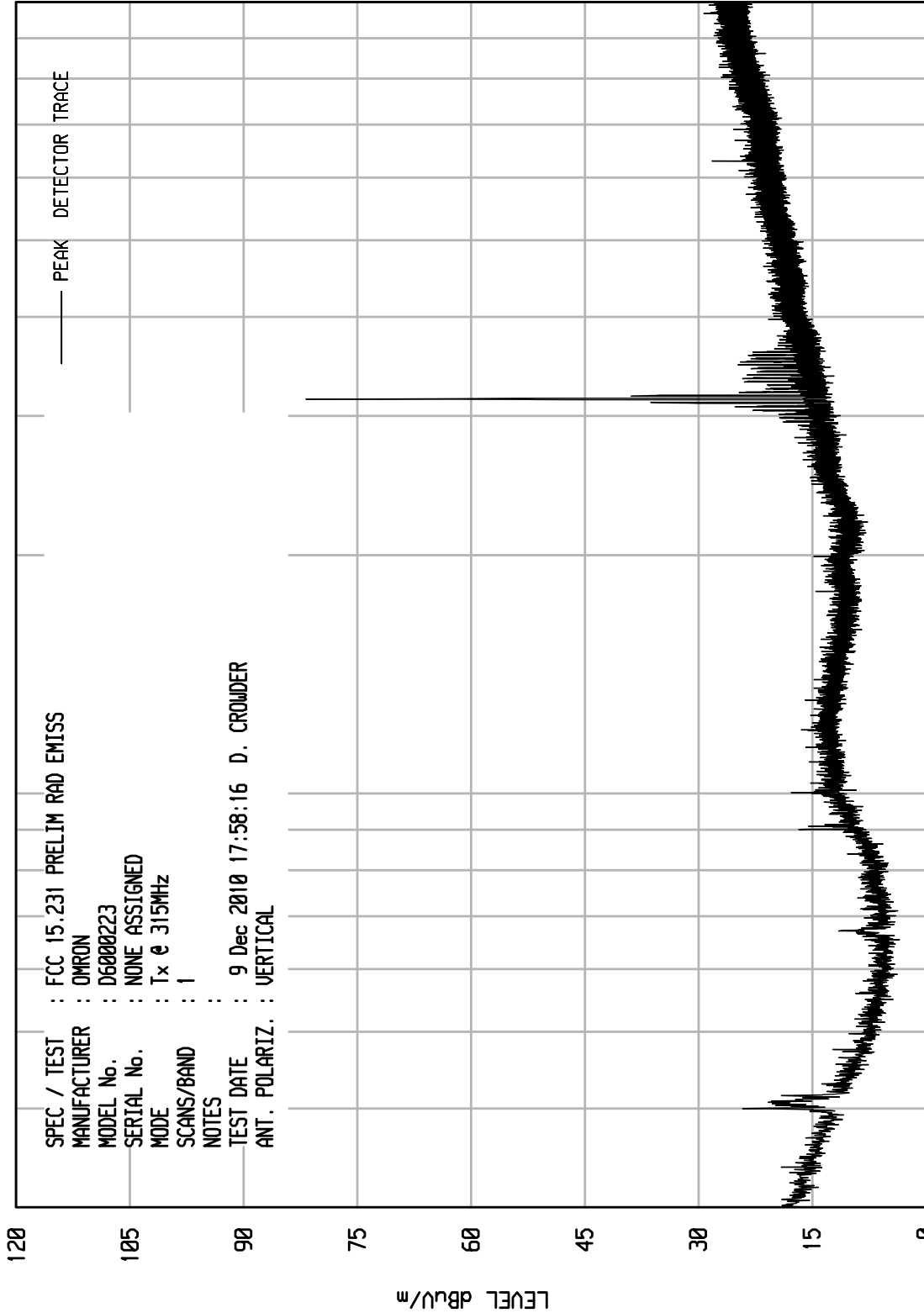
MANUFACTURER : Omron  
 MODEL NUMBER : Cadillac RFA Remote Keyless Transmitter (P/N: D6000223)  
 SERIAL NUMBER : None Assigned  
 TEST MODE : Tx @ 315MHz  
 NOTES :  
 TEST DATE : December 9, 2010  
 TEST PARAMETERS : Duty Cycle Correction Factor  
 NOTES : The EUT has an on time of 32msec. In the 32msec on time, the EUT utilizes "On-Off" keying or 50% duty cycle. Therefore the total on time in a 100msec period is 32msec x 50% = 16msec. Therefore the duty cycle correction factor =  $20 \cdot \log(16\text{msec}/100\text{msec}) = -15.9\text{dB}$ .  
 EQUIPMENT USED : RBA0, PHA0

ELITE ELECTRONIC ENGINEERING Inc.  
Downers Grove, Ill. 60515

UNIU RCU EMI RUN 1

UKAI 01/25/10

SPEC / TEST : FCC 15.231 PRELIM RAD EMISS  
 MANUFACTURER : OMRON  
 MODEL No. : D6000223  
 SERIAL No. : NONE ASSIGNED  
 MODE : Tx @ 315MHz  
 SCANS/BAND : 1  
 NOTES :  
 TEST DATE : 9 Dec 2010 17:58:16 D. CROWDER  
 ANT. POLARIZ. : VERTICAL



— PEAK DETECTOR TRACE

STOP = 1000

FREQUENCY MHz

100

START = 30

LEVEL dBu/m

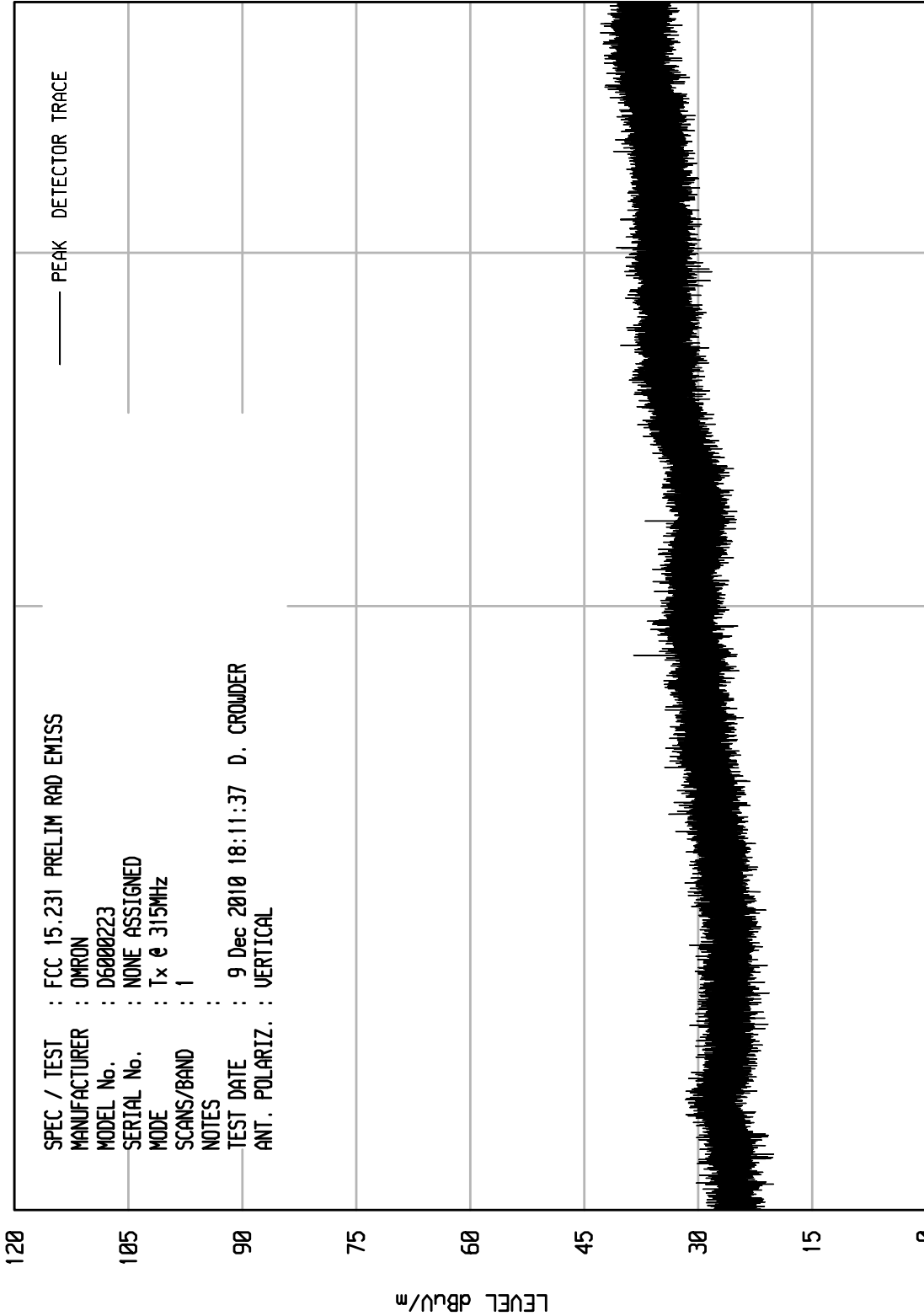


ELITE ELECTRONIC ENGINEERING Inc.  
Downers Grove, Ill. 60515

UNIU RCU EMI RUN 2

UKAI 01/25/10

SPEC / TEST : FCC 15.231 PRELIM RAD EMISS  
 MANUFACTURER : OMRON  
 MODEL No. : D6000223  
 SERIAL No. : NONE ASSIGNED  
 MODE : Tx @ 315MHz  
 SCANS/BAND : 1  
 NOTES :  
 TEST DATE : 9 Dec 2010 18:11:37 D. CROWDER  
 ANT. POLARIZ. : VERTICAL



START = 1000

FREQUENCY MHz

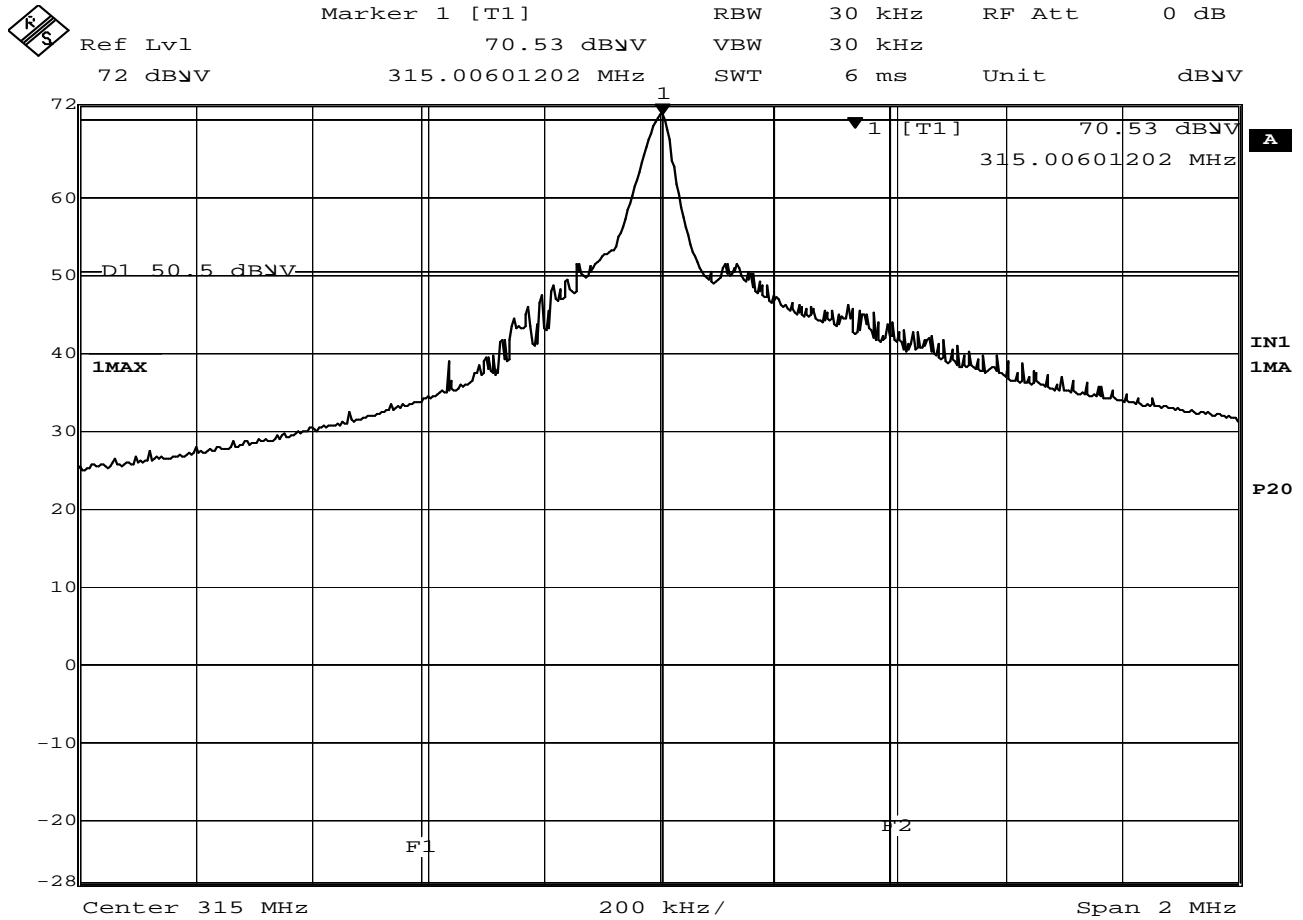
STOP = 4000



**MANUFACTURER** : Omron Electronics  
**TEST ITEM** : Cadillac RFA  
**MODEL NO.** : D6000223  
**SERIAL NO.** :  
**SPECIFICATION** : FCC- 15C Transmitter Open Field Data  
**DATE** : December 9, 2010  
**NOTES** : Test Distance is 3 Meters

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)
315.000	H	74.4	1.1	14.5	-15.9	74.0	5032.7	6041.7	-1.6
315.000	V	69.8	1.1	14.5	-15.9	69.4	2963.5	6041.7	-6.2
630.000	H	44.8	1.6	19.7	-15.9	50.1	321.2	604.2	-5.5
630.000	V	41.8	1.6	19.7	-15.9	47.1	227.4	604.2	-8.5
945.000	H	22.3	2.0	22.1	-15.9	30.5	33.3	604.2	-25.2
945.000	V	17.2	2.0	22.1	-15.9	25.4	18.5	604.2	-30.3
1260.000	H	25.0	2.3	25.6	-15.9	37.0	70.8	604.2	-18.6
1260.000	V	21.7	2.3	25.6	-15.9	33.7	48.4	604.2	-21.9
1575.000	H	12.5	2.7	26.4	-15.9	25.6	19.1	500.0	-28.3
1575.000	V	24.8	2.7	26.4	-15.9	37.9	78.8	500.0	-16.0
1890.000	H	22.8	2.9	27.7	-15.9	37.6	75.6	604.2	-18.1
1890.000	V	22.8	2.9	27.7	-15.9	37.6	75.6	604.2	-18.1
2205.000	H	19.9	3.2	28.7	-15.9	35.9	62.5	500.0	-18.1
2205.000	V	21.0	3.2	28.7	-15.9	37.0	70.9	500.0	-17.0
2520.000	H	21.7	3.5	29.5	-15.9	38.8	86.7	604.2	-16.9
2520.000	V	20.2	3.5	29.5	-15.9	37.3	72.9	604.2	-18.4
2835.000	H	24.5	3.8	30.6	-15.9	43.0	140.8	500.0	-11.0
2835.000	V	22.2	3.8	30.6	-15.9	40.7	108.0	500.0	-13.3
3150.000	H	12.8	4.0	31.7	-15.9	32.6	42.5	604.2	-23.1
3150.000	V	12.8	4.0	31.7	-15.9	32.6	42.5	604.2	-23.1





Date: 9.DEC.2010 17:32:47

### 15.231(c) 20dB Bandwidth

MANUFACTURER : Omron  
 MODEL NUMBER : Cadillac RFA Remote Keyless Transmitter (P/N: D6000223)  
 SERIAL NUMBER : None Assigned  
 TEST MODE : Tx @ 315MHz  
 NOTES :  
 TEST DATE : December 9, 2010  
 TEST PARAMETERS : The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.

NOTES : Display line D1 represents the 20dB down point. Display lines F1 and F2 represent the 0.25% of the center frequency.

EQUIPMENT USED : RBA0, PHA0