



Measurement of RF Interference from a Model D0000221 RKE FOB Transmitter

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

Date Tested : February 17, 24 and 25, 2010
Test Personnel : Richard King
Specification : FCC "Code of Federal Regulations" Title 47
Part 15, Subpart C
: Industry Canada RSS-210
: Industry Canada RSS-GEN

Test Report By : *RICHARD E. KING*
Richard King

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



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REVISION HISTORY

Revision	Date	Description
—	March 17, 2010	Initial release

Measurement of RF Emissions from a RKE FOB D0000221 Transmitter

1 INTRODUCTION

1.1 Scope of Tests

This document represents the results of the series of radio interference measurements performed on a model RKE FOB, Part No. D0000221, Serial No. 11470 transmitter, (hereinafter referred to as the test item). The test item was designed to transmit at approximately 315MHz using an 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. 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 23.8°C and the relative humidity was 38%.

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 2009
- 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 6, September 2005, "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 1, September 2005, "Spectrum Management and Telecommunications Radio Standards Specification, General Requirements and Information for the Certification of radio communication equipment"

3 TEST ITEM SETUP AND OPERATION

3.1 General Description

The test item is a RKE FOB, Part No. D0000221. A block diagram of the test item setup 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 need peripheral equipment.

3.1.3 Interconnect Cables

The test item does not need interconnect cables or ports.

3.1.4 Grounding

Since the test item was powered with 3VDC 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. All equipment was calibrated per the instruction manuals supplied by the manufacturer.

Conducted emission tests were performed with a spectrum analyzer in conjunction with a quasi-peak adapter.

Radiated emissions were performed with a spectrum analyzer. This receiver allows measurements with the bandwidths specified by the FCC and with the quasi-peak detector function. The receiver bandwidth was 120kHz for the 30MHz to 1000MHz radiated emissions data.

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.

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.

5.2.2 Results

The plots of the duty cycle are shown on data pages 13 through 15. The duty cycle factor was computed to be -15.9 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

Field Strength



Frequency MHz	Field Intensity uV/m @ 3 meters	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.

5.3.2 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 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.

5.3.3 Results

The preliminary plots, with the test item transmitting at 315MHz, are presented on data pages 16 through 19. 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 20. As can be seen from the data, all emissions measured from the test item were within the specification limits. Photographs of the test setup 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 21. As can be seen from this data page, the transmitter met the occupied bandwidth requirements. The 99% bandwidth was 685kHz.

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 RKE FOB, Part No. D0000221, Serial No. 11470, 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, 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	
HRE1	LASER JET 5P	HEWLETT PACKARD	C3150A	USHB061052	---	N/A	
NTA1	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL6112	2054	0.03-2GHZ	9/10/2009	9/10/2010
NWH0	RIDGED WAVE GUIDE	TENSOR	4105	2081	1-12.4GHZ	8/11/2009	8/11/2010
RAKG	RF SECTION	HEWLETT PACKARD	85462A	3549A00284	0.009-6500MHZ	2/16/2010	2/16/2011
RAKH	RF FILTER SECTION	HEWLETT PACKARD	85460A	3448A00324	---	2/16/2010	2/16/2011
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.

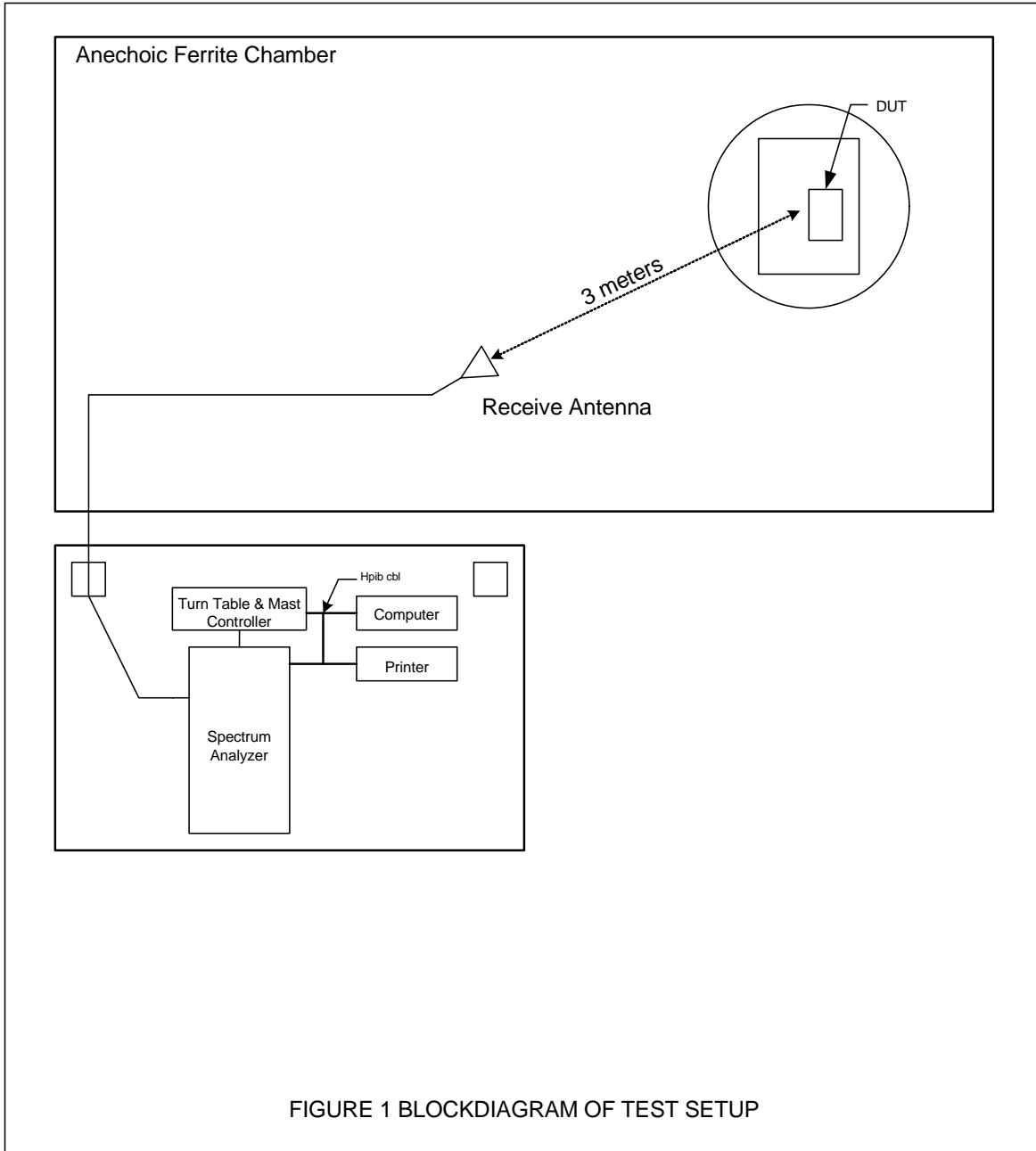
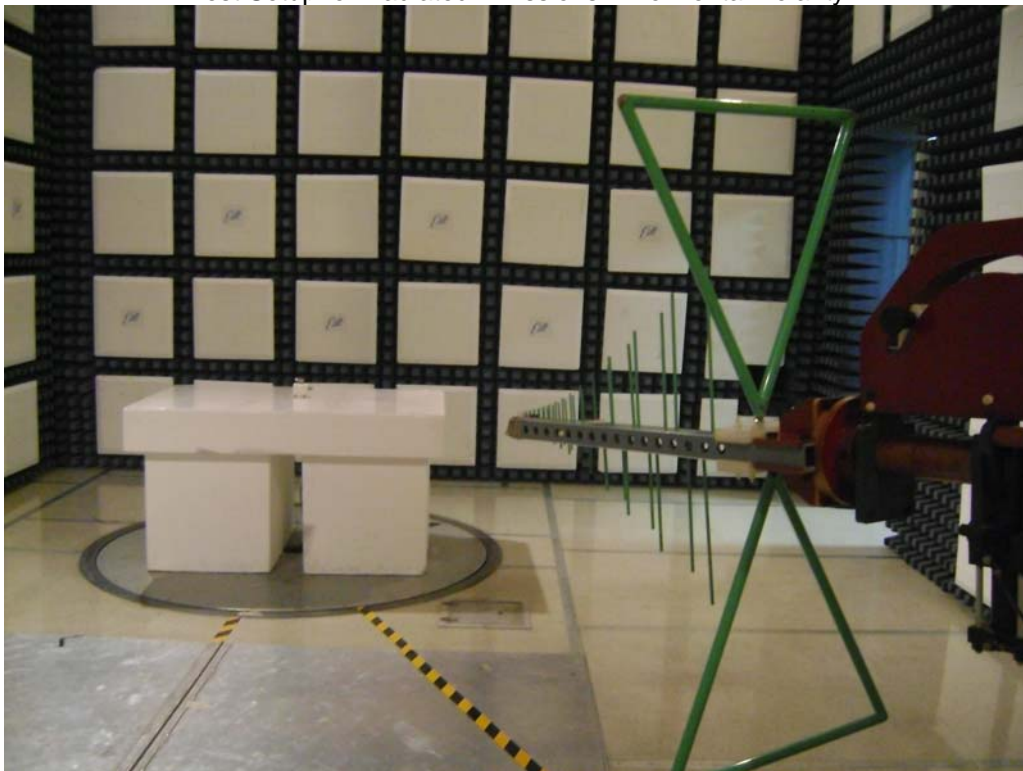


Figure 2



Test Setup for Radiated Emissions – Horizontal Polarity



Test Setup for Radiated Emissions – Vertical Polarity

Figure 3



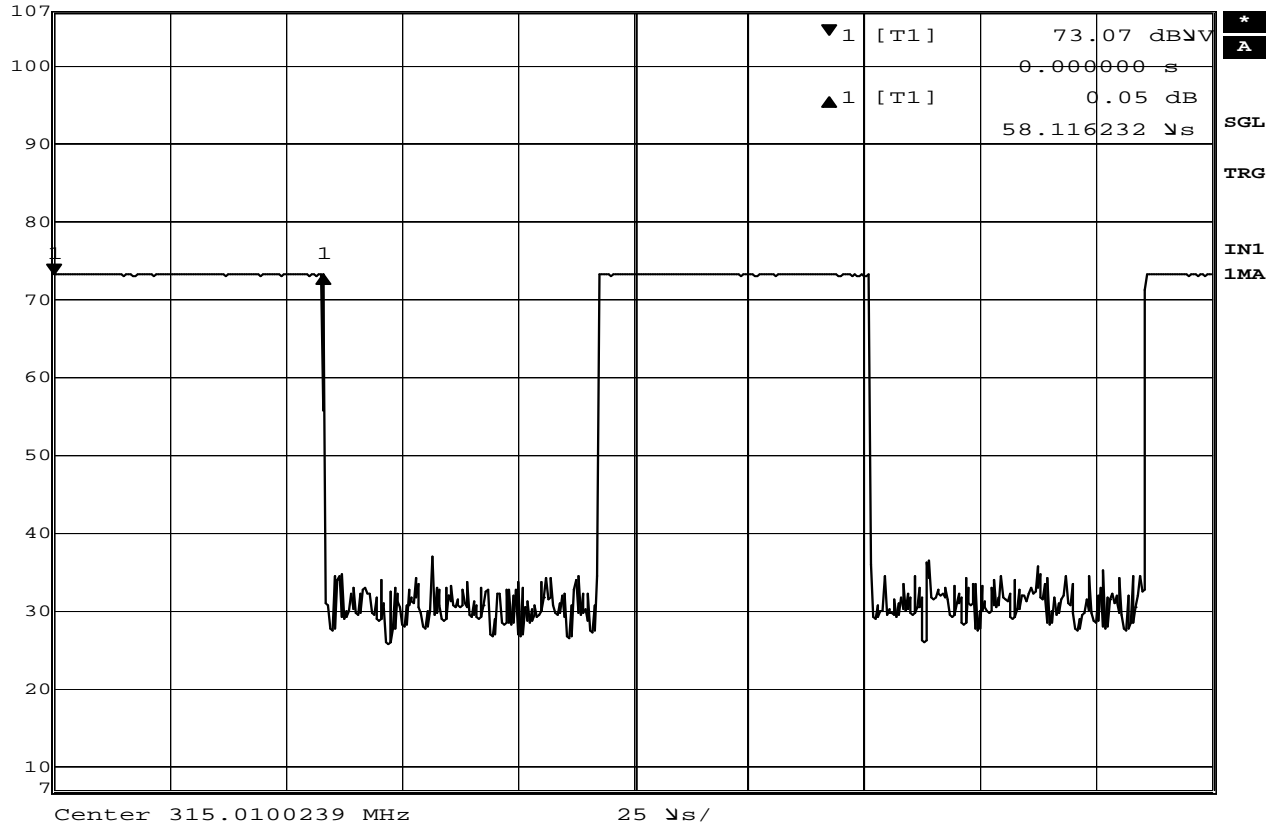
Test Setup for Radiated Emissions – Horizontal Polarity



Test Setup for Radiated Emissions – Vertical Polarity



Delta 1 [T1]	RBW	3 MHz	RF Att	10 dB
Ref Lvl	0.05 dB	VBW	3 MHz	
107 dB μ V	58.116232 μ s	SWT	250 μ s	Unit dB μ V

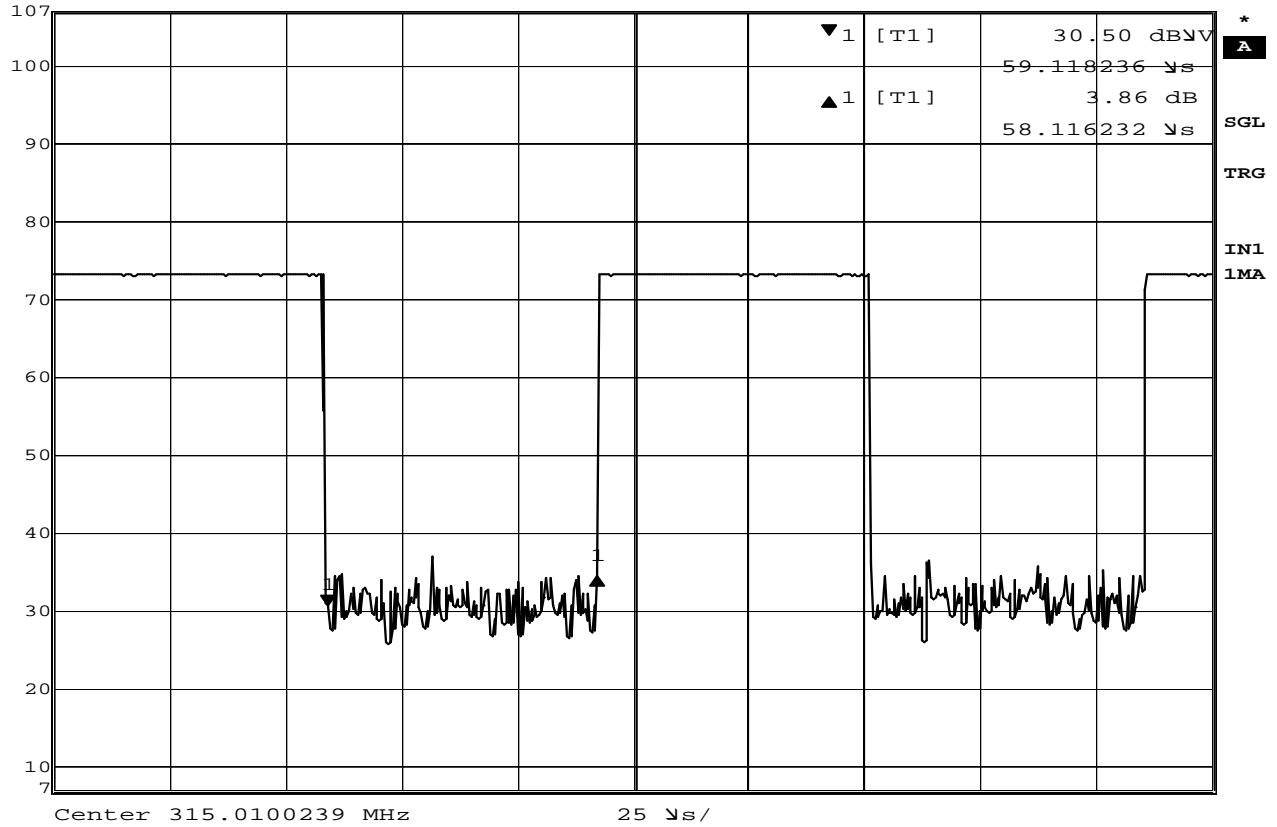


Date: 17.FEB.2010 21:38:40

SPECIFICATION : FCC PART 15C TRANSMITTER DUTY CYCLE
 MANUFACTURER : Omron Electronics
 TEST ITEM : RKE FOB
 MODEL NUMBER : D0000221
 SERIAL NUMBER : 11470
 TEST MODE : Tx @ 315MHz



	Delta 1 [T1]	RBW	3 MHz	RF Att	10 dB
Ref Lvl	3.86 dB	VBW	3 MHz		
107 dB μ V	58.116232 μ s	SWT	250 μ s	Unit	dB μ V



Date: 17.FEB.2010 21:40:07

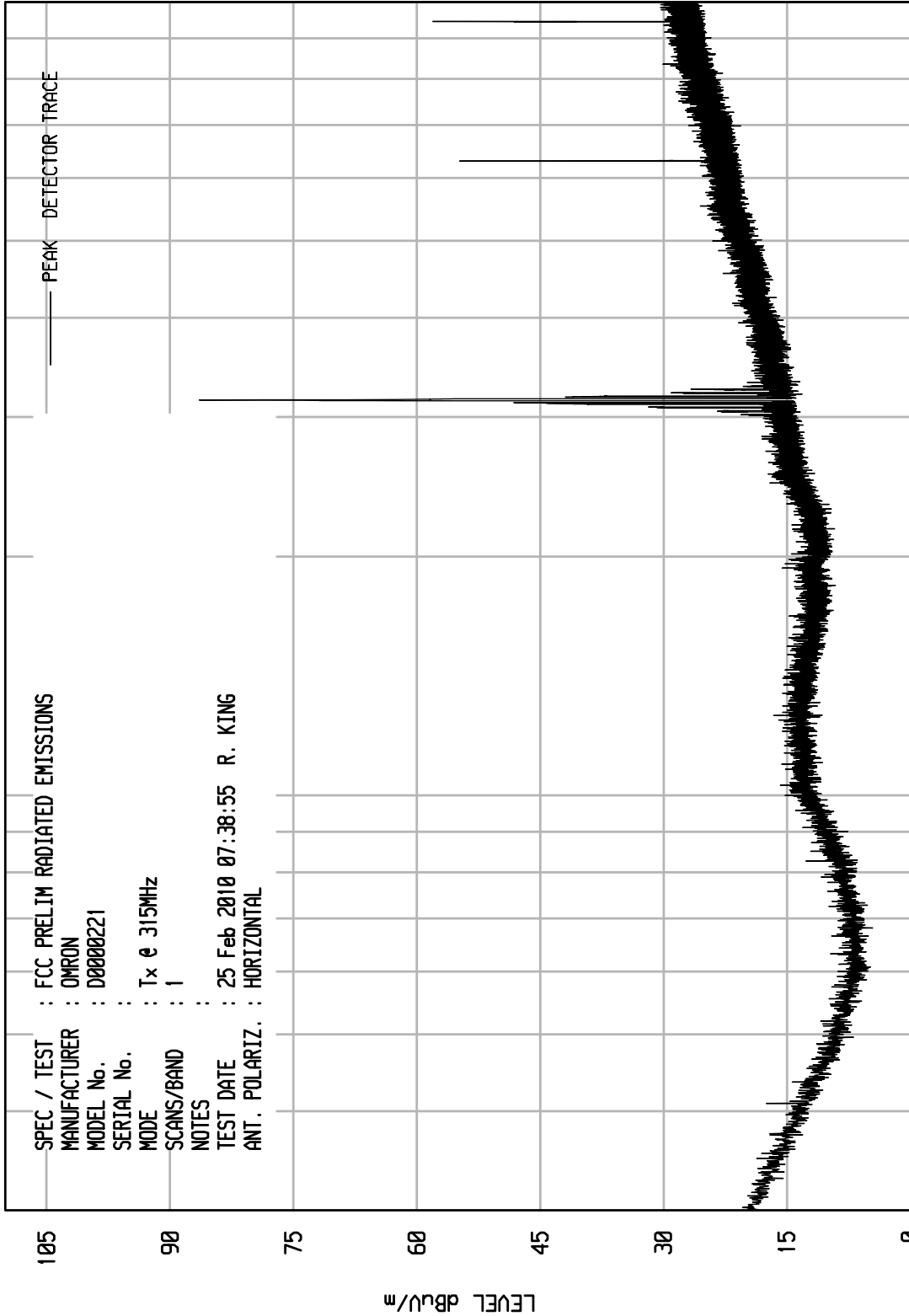
SPECIFICATION : FCC PART 15C TRANSMITTER DUTY CYCLE
 MANUFACTURER : Omron Electronics
 TEST ITEM : RKE FOB
 MODEL NUMBER : D0000221
 SERIAL NUMBER : 11470
 TEST MODE : Tx @ 315MHz

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515

UNIU RCU EMI RUN 4

UKA1 01/25/10

SPEC / TEST : FCC PRELIM RADIATED EMISSIONS
 MANUFACTURER : OMRON
 MODEL No. : D0000221
 SERIAL No. :
 MODE : Tx @ 315MHz
 SCANS/BAND : 1
 NOTES :
 TEST DATE : 25 Feb 2010 07:38:55 R. KING
 ANT. POLARIZ. : HORIZONTAL



START = 30

100

FREQUENCY MHz

STOP = 1000

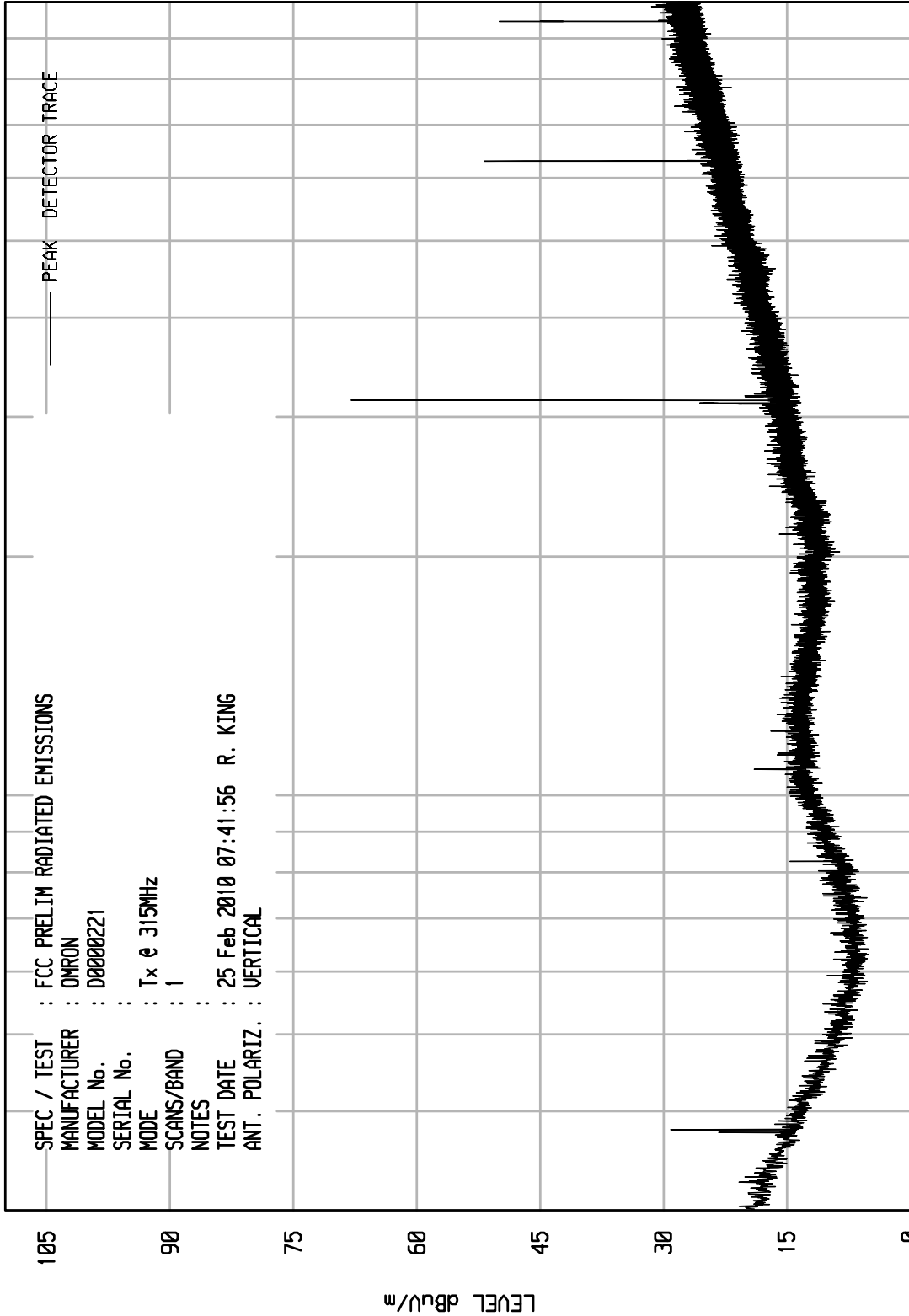
LEVEL dBuV/m

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515

UNIU RCU EMI RUN 5

UKA1 01/25/10

SPEC / TEST : FCC PRELIM RADIATED EMISSIONS
 MANUFACTURER : OMRON
 MODEL No. : D0000221
 SERIAL No. :
 MODE : Tx @ 315MHz
 SCANS/BAND : 1
 NOTES :
 TEST DATE : 25 Feb 2010 07:41:56 R. KING
 ANT. POLARIZ. : VERTICAL



START = 30

100

FREQUENCY MHz

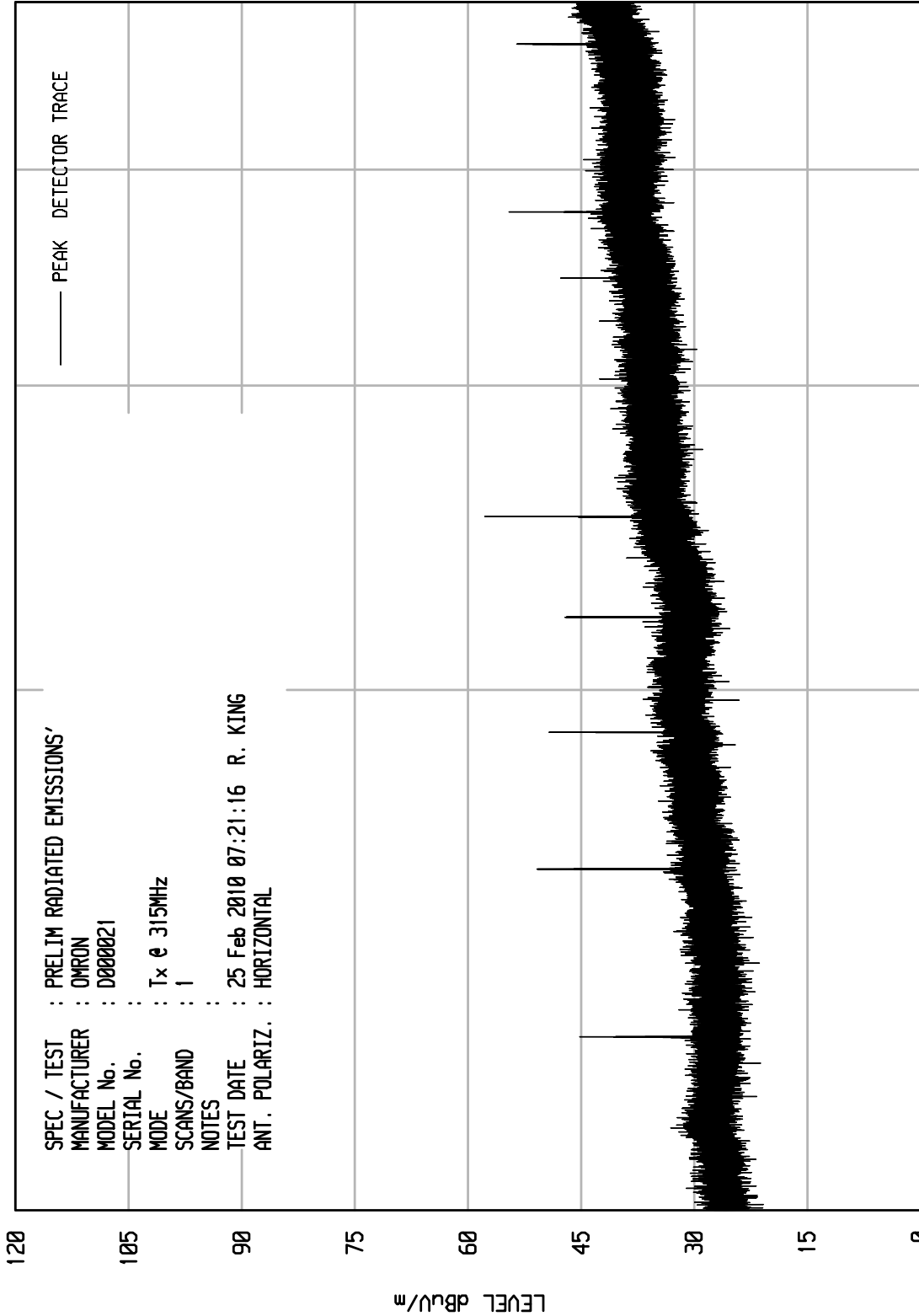
STOP = 1000

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515

UNIU RCU EMI RUN 1

UKA1 01/25/10

SPEC / TEST : PRELIM RADIATED EMISSIONS'
 MANUFACTURER : OMRON
 MODEL No. : D000021
 SERIAL No. :
 MODE : Tx @ 315MHz
 SCANS/BAND : 1
 NOTES :
 TEST DATE : 25 Feb 2010 07:21:16 R. KING
 ANT. POLARIZ. : HORIZONTAL



START = 1000

FREQUENCY MHz

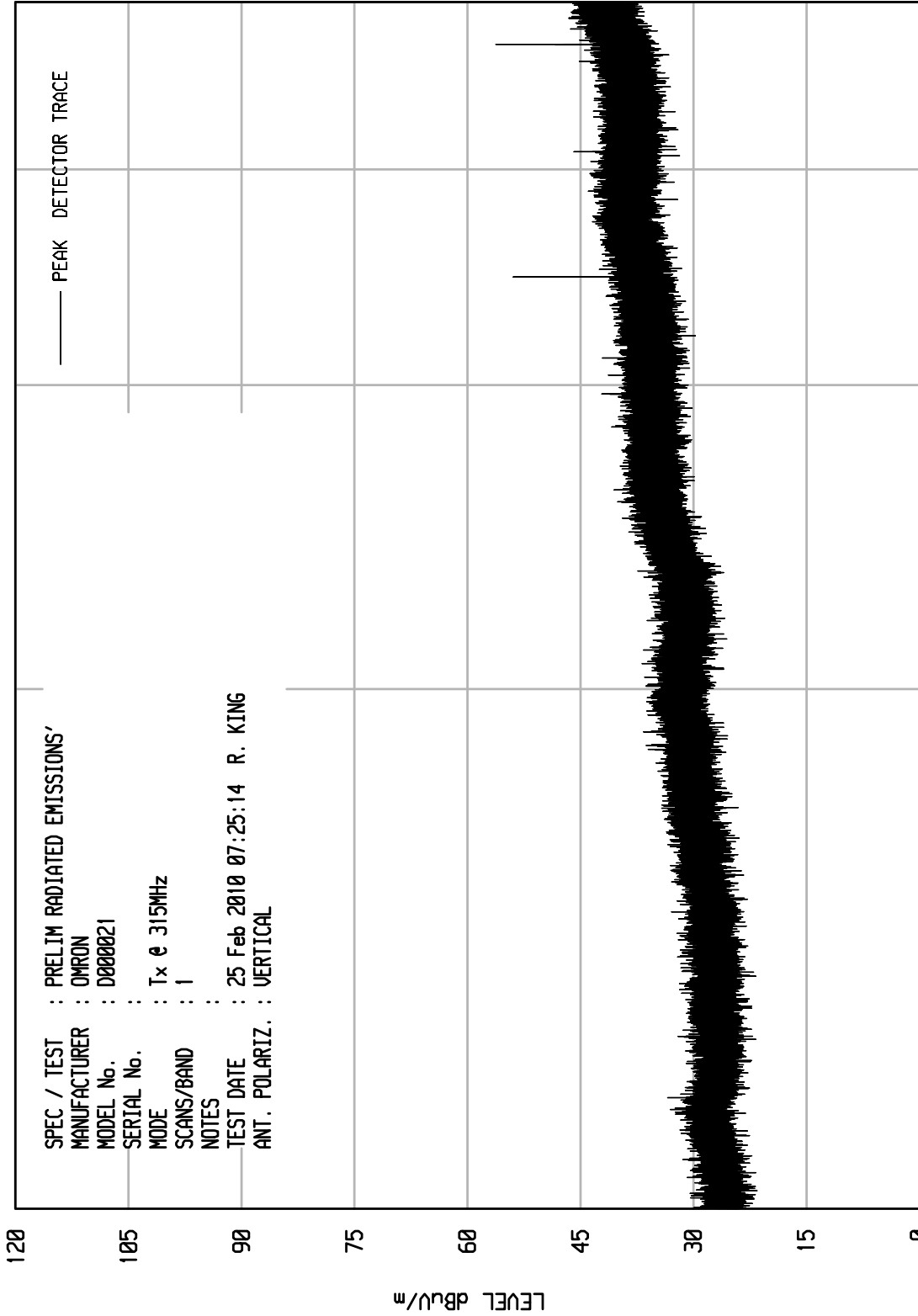
STOP = 5000

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515

UNIU RCU EMI RUN 2

UKA1 01/25/10

SPEC / TEST : PRELIM RADIATED EMISSIONS'
 MANUFACTURER : OMRON
 MODEL No. : D000021
 SERIAL No. :
 MODE : Tx @ 315MHz
 SCANS/BAND : 1
 NOTES :
 TEST DATE : 25 Feb 2010 07:25:14 R. KING
 ANT. POLARIZ. : VERTICAL



START = 1000

FREQUENCY MHz

STOP = 5000



MANUFACTURER : Omron Electronics
TEST ITEM : RKE FOB
MODEL NO. : D0000221
SERIAL NO. : 11470
SPECIFICATION : FCC- 15C Transmitter Open Field Data
DATE : February 25, 2010
NOTES : Test Distance is 3 Meters

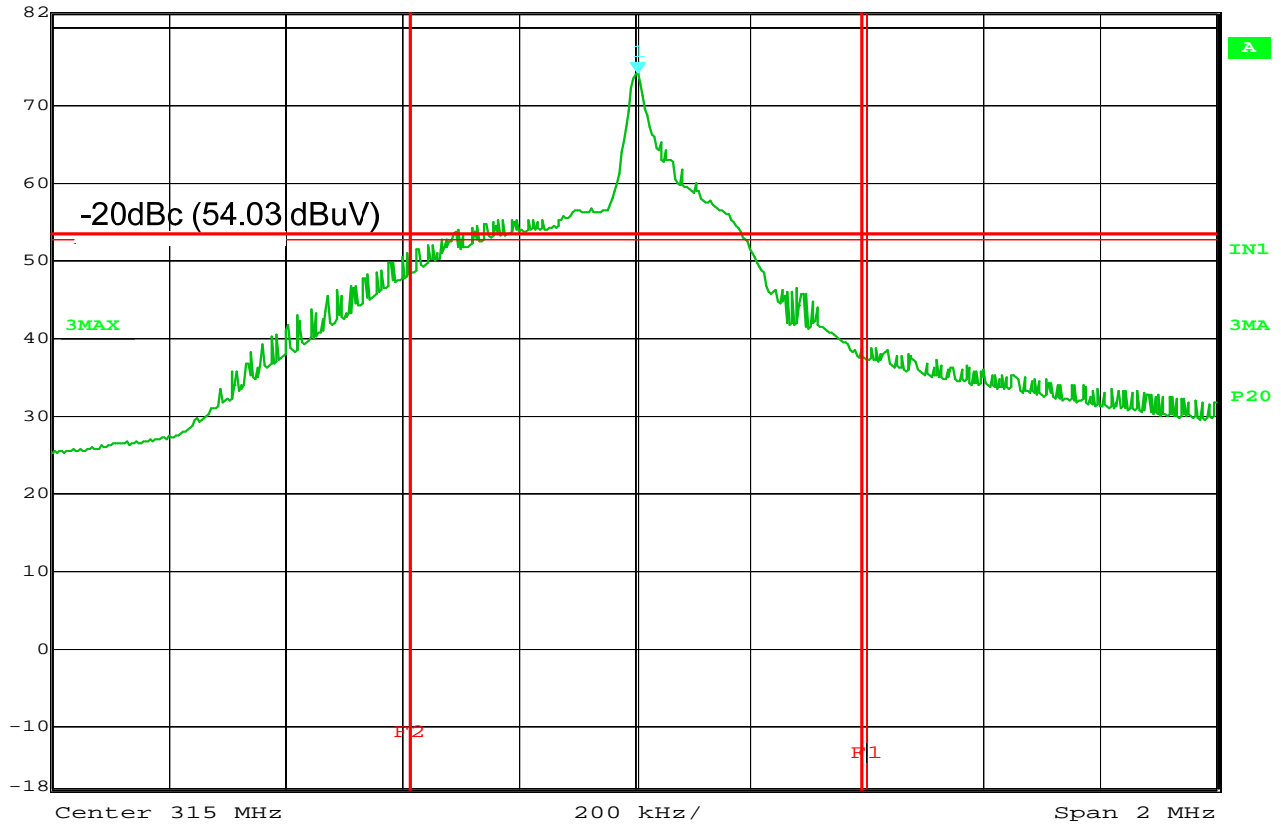
Freq (MHz)	Ant Pol	Meter Reading (dBUV)	CBL Fac (dB)	Ant Fac (dB)	Duty Cycle Factor (dB)	Total dBuV/m at 3 M	Total uV/m at 3M	Limit uV/m at 3M	Margin (dB)
315.0	H	73.4	1.4	15.3	-15.9	74.2	5109.2	6041.7	-1.5
315.0	V	54.2	1.4	15.3	-15.9	54.9	558.9	6041.7	-20.7
630.0	H	42.9	2.0	20.1	-15.9	49.1	283.7	604.2	-6.6
630.0	V	31.6	2.0	20.1	-15.9	37.8	77.5	604.2	-17.8
945.0	H	39.4	2.4	22.8	-15.9	48.7	271.5	604.2	-6.9
945.0	V	27.8	2.4	22.8	-15.9	37.1	71.3	604.2	-18.6
1260.0	H	27.3	2.9	25.6	-15.9	39.8	97.5	604.2	-15.8
1260.0	V	20.3	2.9	25.6	-15.9	32.8	43.4	604.2	-22.9
1575.0	H	32.4	3.2	26.4	-15.9	46.1	201.6	500.0	-7.9
1575.0	V	24.1	3.2	26.4	-15.9	37.7	76.8	500.0	-16.3
1890.0	H	27.0	3.5	27.7	-15.9	42.4	131.4	604.2	-13.3
1890.0	V	25.4	3.5	27.7	-15.9	40.7	108.5	604.2	-14.9
2205.0	H	36.8	3.7	28.7	-15.9	53.3	461.1	500.0	-0.7
2205.0	V	32.5	3.7	28.7	-15.9	49.0	281.1	500.0	-5.0
2520.0	H	36.0	3.9	29.5	-15.9	53.4	466.2	604.2	-2.3
2520.0	V	29.9	3.9	29.5	-15.9	47.2	229.7	604.2	-8.4
2835.0	H	32.6	4.0	30.6	-15.9	51.2	365.1	500.0	-2.7
2835.0	V	22.9	4.0	30.6	-15.9	41.5	119.0	500.0	-12.5
3150.0	H	35.2	4.2	31.7	-15.9	55.1	571.3	604.2	-0.5
3150.0	V	29.7	4.2	31.7	-15.9	49.6	303.3	604.2	-6.0

Checked BY Richard E. King :

Richard E. King



Marker 1 [T3] RBW 30 kHz RF Att 10 dB
 Ref Lvl 74.03 dBuV VBW 300 kHz
 82 dBuV 315.00601202 MHz SWT 6 ms Unit dBuV



Date: 24.FEB.2010 20:49:29

FCC 15.231 20dB bandwidth

MANUFACTURER : Omron Electronics
 TEST ITEM : RKE FOB
 MODEL NUMBER : D0000221
 SERIAL NUMBER : 11470
 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