Measurement of RF Interference from a Model 13336 KEYFOB Transmitter

For	:	Innovative Design Solutions Troy, MI 48083
P.O. No.	:	21609-01
Date Tested	:	August 5, 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

Test Report By : Richard King

Witnessed by : Matt Collin
Innovative Design Solutions

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

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Revision History

Revision	Date	Description
—	August 5, 2009	Initial release

Measurement of RF Emissions from a KEYFOB 13336 Transmitter

1 INTRODUCTION

1.1 Scope of Tests

This document represents the results of the series of radio interference measurements performed on a model KEYFOB , Part No. 13336, Serial No. #1 transmitter, (hereinafter referred to as the test item). The test item was designed to transmit at approximately 418 MHz using an internal. The test item was manufactured and submitted for testing by Innovative Design Solutions located in Troy, MI.

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 15.207 and 15.231 for Intentional Radiators and Industry Canada RSS-GEN Table 2 and RSS-210 Table 5. 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 23.1°C and the relative humidity was 41%.

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 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 KEYFOB , Part No. 13336. A block diagram of the test item setup is shown as Figure 1.

3.1.1 Power Input

The test item was powered with 3VDC from a 3VDC battery.

3.1.2 Peripheral Equipment

The following peripheral equipment was submitted with the test item:

3.1.3 Interconnect Cables

The following interconnect cables were submitted with the test item:

3.1.4 Grounding

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

3.2 Operational Mode

For all tests the test item and all peripheral equipment were placed on an 80cm high non-conductive stand. The test item and all peripheral equipment were energized.

3.3 Test Item Modifications

The test item was not modified to meet the 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. This trace is obtained by tuning center frequency to the transmitter frequency and then setting a zero span width with 10msec/div. The amplitude settings are adjusted so that the on/off transitions clear the 4th division from the bottom of the display. The markers are set at the beginning and end of a word period. If the word period exceeds 100 msec the word period is set to 100 msec. The on-time and off-time are then measured. The on-time is total time signal level exceeds the 4th division. Off-time is time under for the word period. The duty cycle is then computed as the (On-time/ word period) where the word period = (On-time + Off-time).

5.2.2 Results

The plot of the duty cycle is shown on data page 20. The duty cycle factor was computed to be -4.0 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 418MHz, the limit at the fundamental is 10333.3uV/m @ 3m. The limit for the harmonics is 1033.3uV/m @ 3m or the general limit shown in 15.209 whichever limit permits a higher field strength.

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 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 418MHz, are presented on data pages 14 through 17. 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 418MHz, 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. The emissions level closet to the limit (worst case) occurred at 836MHz. The emissions level at this frequency was 1.1 dB within the limit. See data page 18 for details. Photographs of the test configuration which yielded the highest, or worst case, radiated emission levels are shown on Figure 2.

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 plots of the emissions near the fundamental frequencies are presented on data page 19. As can be seen from these data pages, the transmitter met the occupied bandwidth requirements. The maximum 99% bandwidth was measured to be 189.2kHz.

6 OTHER TEST CONDITIONS

6.1 Test Personnel and Witnesses

All tests were performed by qualified personnel from Elite Electronic Engineering Incorporated. The test series was witnessed by Innovative Design Solutions personal.

6.2 Disposition of the Test Item

The test item and all associated equipment were returned to Innovative Design Solutions upon completion of the tests.

7 CONCLUSIONS

It was determined that the Innovative Design Solutions KEYFOB , Part No. 13336, Serial No. #1, 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 as operated by Innovative Design Solutions personnel. 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
APK1	PRE-AMPLIFIER	HEWLETT PACKARD	8449B	3008A01243	1-26.5GHZ	3/18/2009	3/18/2010
CMA1	Controllers	EMCO	2090	9701-1213	---	N/A	
NTA1	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL6112	2054	0.03-2GHZ	9/2/2008	9/2/2009
NWF0	Attenuators			2035	1-12.4GHZ	10/25/2008	10/25/2009
PHA0	MAGNETIC FIELD PROBE	ELECTRO-METRICS	EM-6882	134	22-230MHZ	NOTE 1	
RAC0	SPECTRUM ANALYZER	HEWLETT PACKARD	85660B	2449A01117	100HZ-22GHZ	7/21/2009	7/21/2010
RAE5	SPECTRUM ANALYZER	HEWLETT PACKARD	85660B	2532A02136	100HZ-22GHZ	2/23/2009	2/23/2010
XZG1	ATTENUATOR/SWITCH DRIVER	HEWLETT PACKARD	11713A	3439A02724	---	N/A	

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.

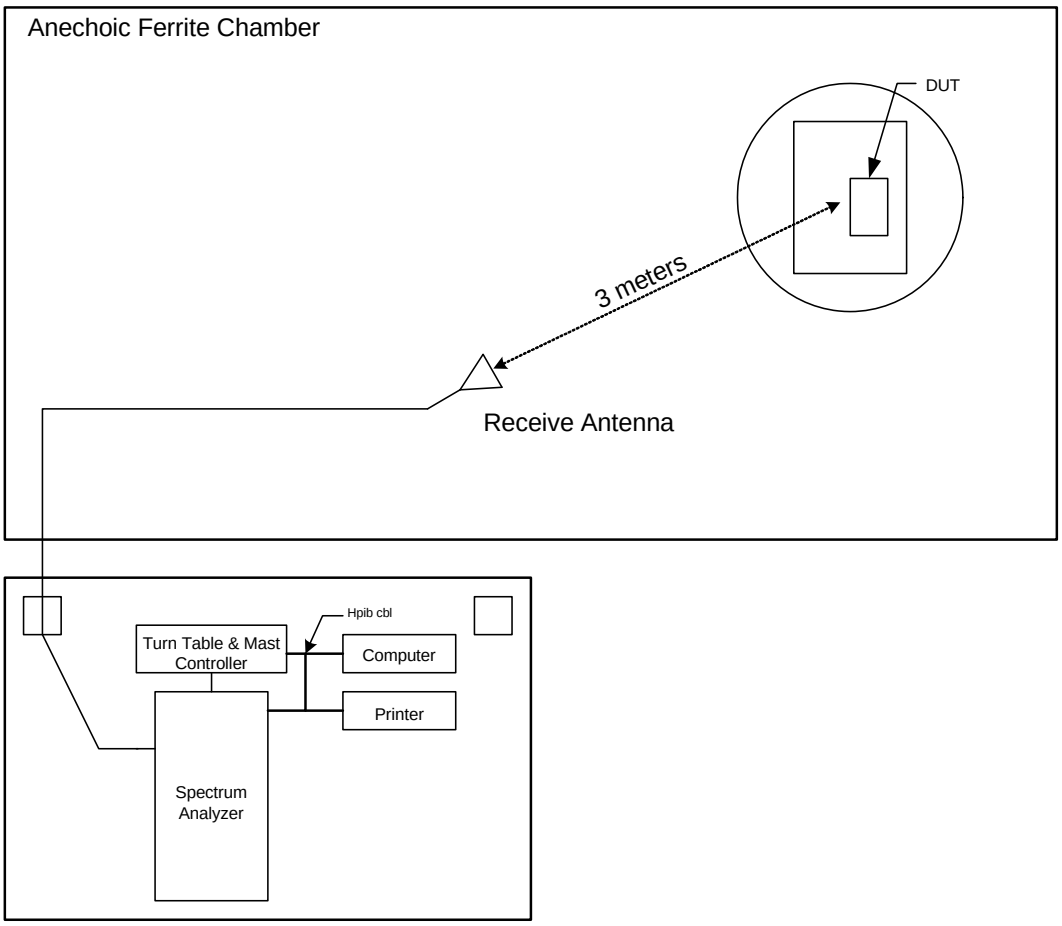
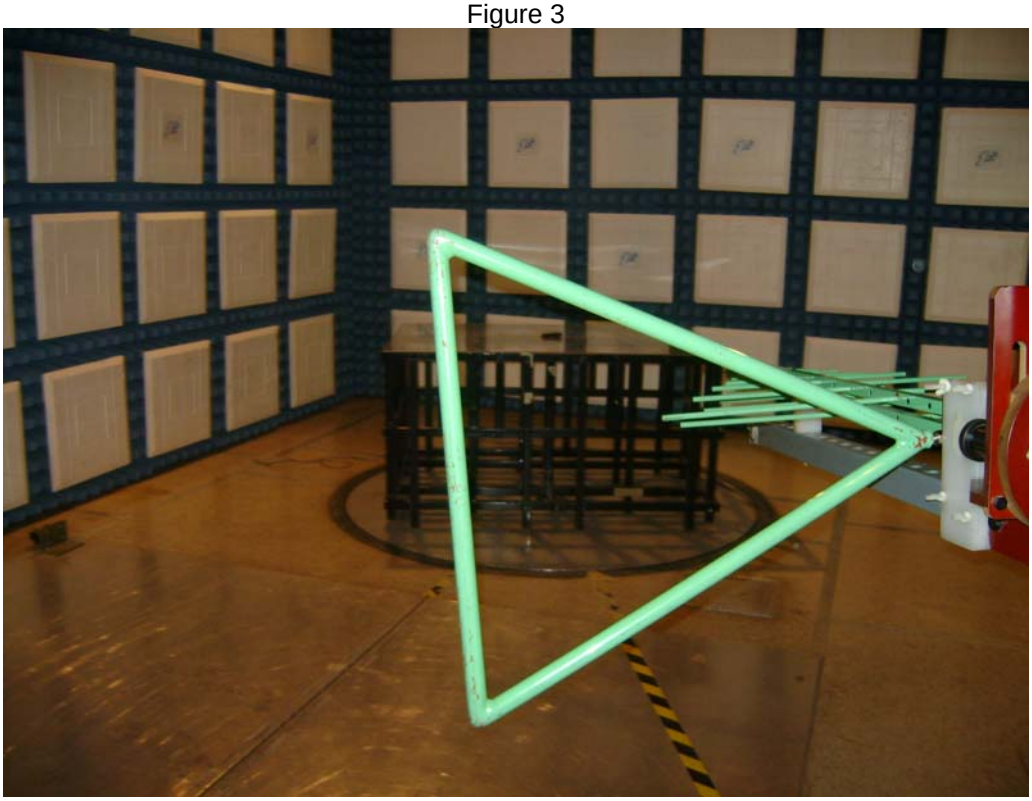


FIGURE 1 BLOCKDIAGRAM OF TEST SETUP

Figure 3

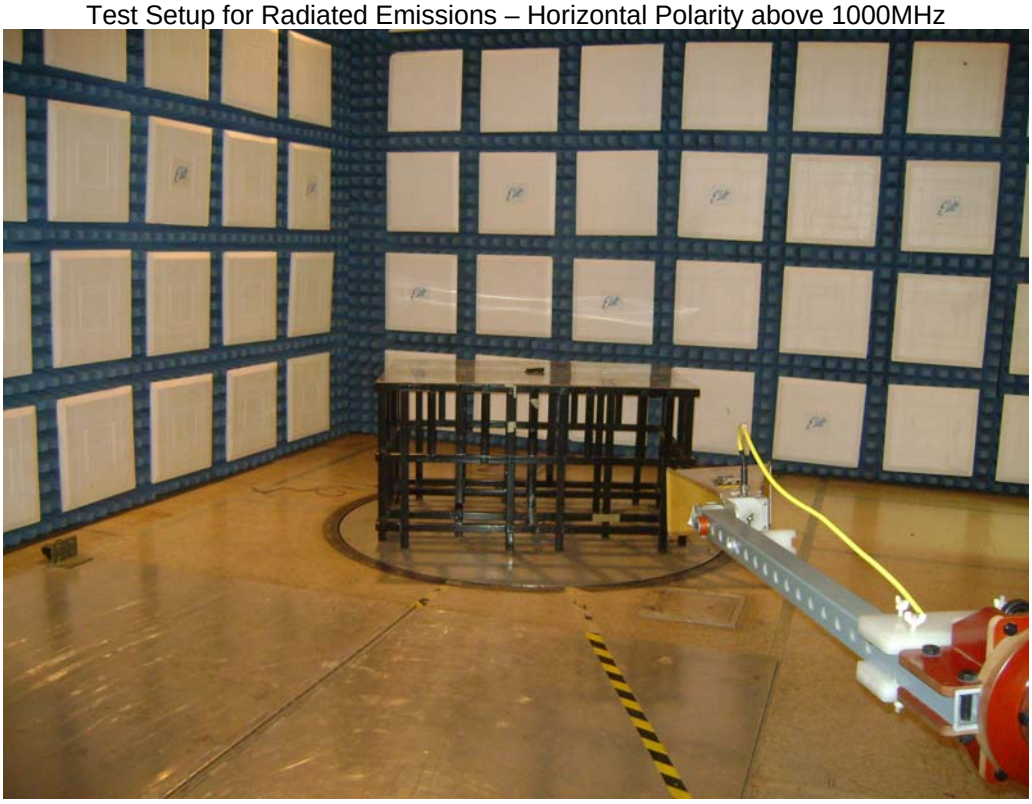


Test Setup for Radiated Emissions – Horizontal Polarity below 1000MHz

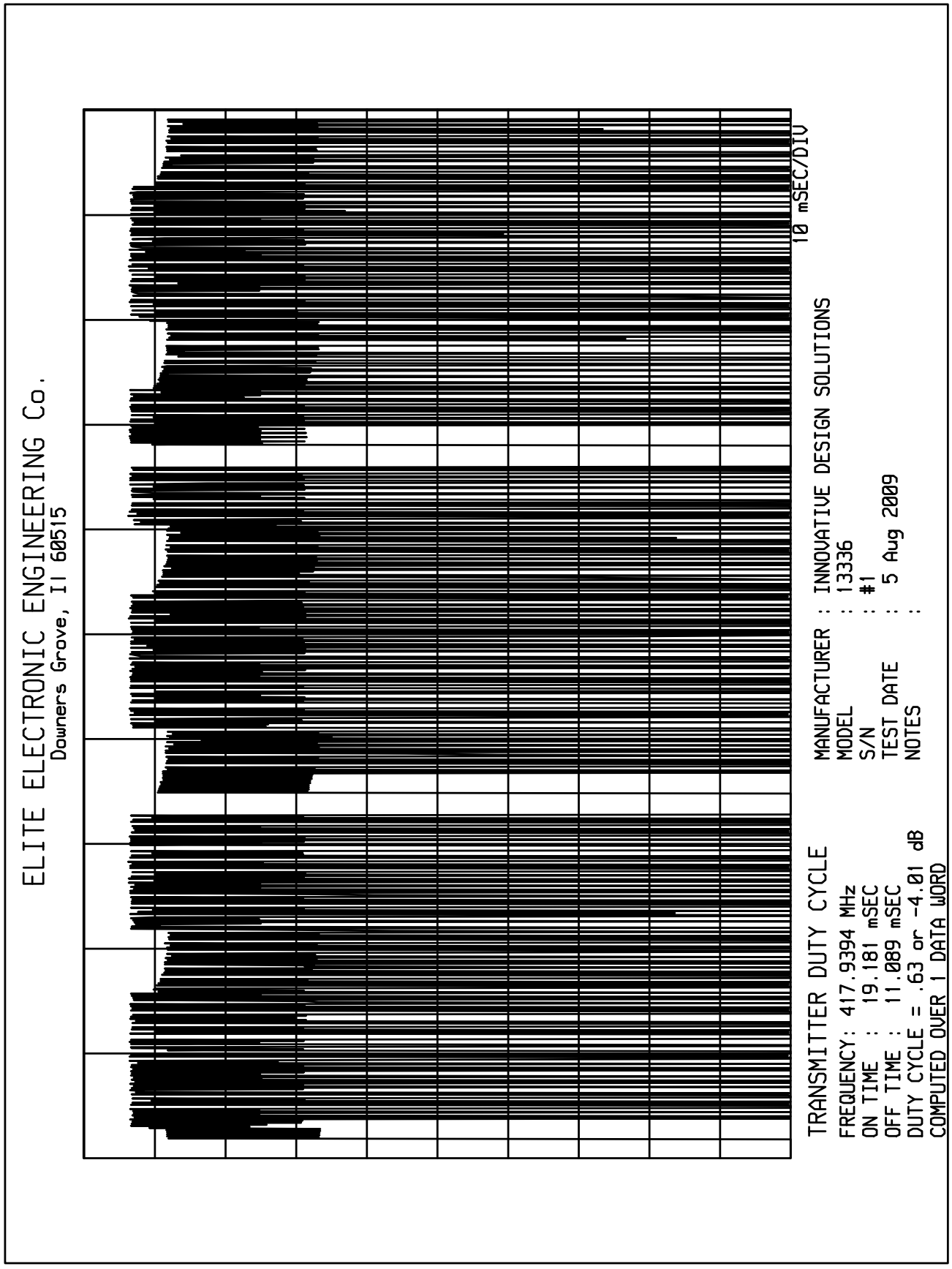
Test Setup for Radiated Emissions – Vertical Polarity below 1000MHz

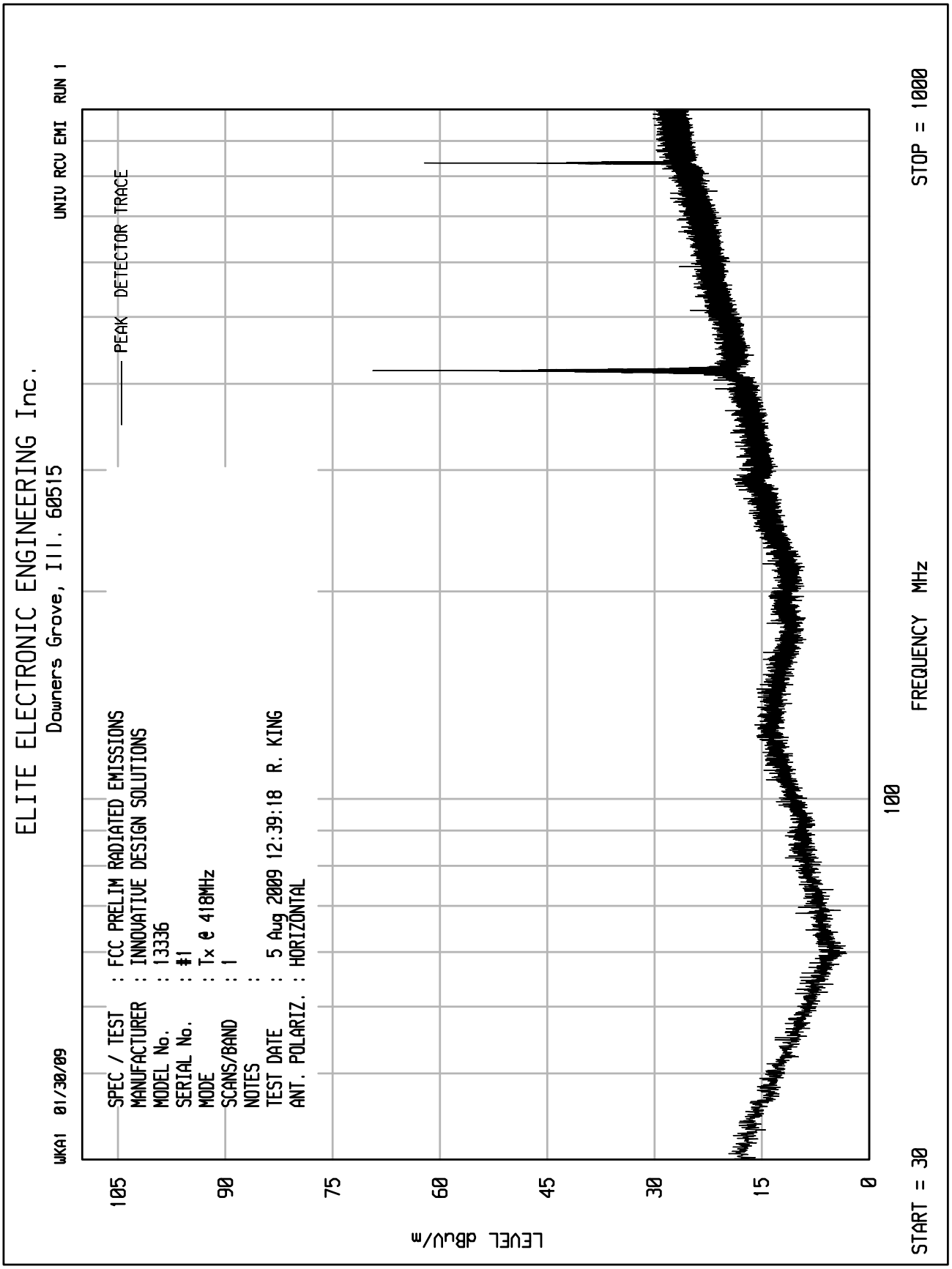
Figure 4

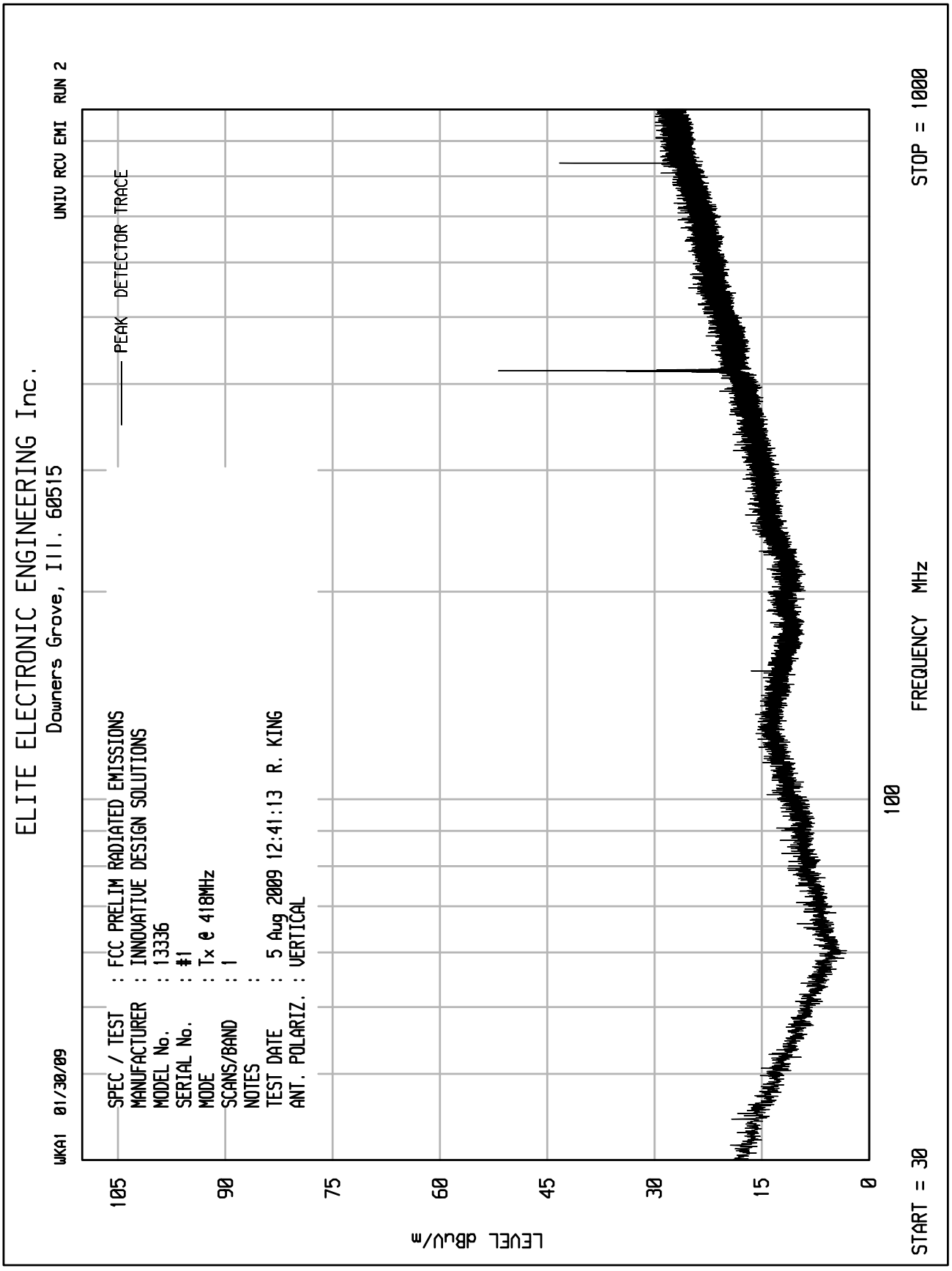
Test Setup for Radiated Emissions – Horizontal Polarity above 1000MHz

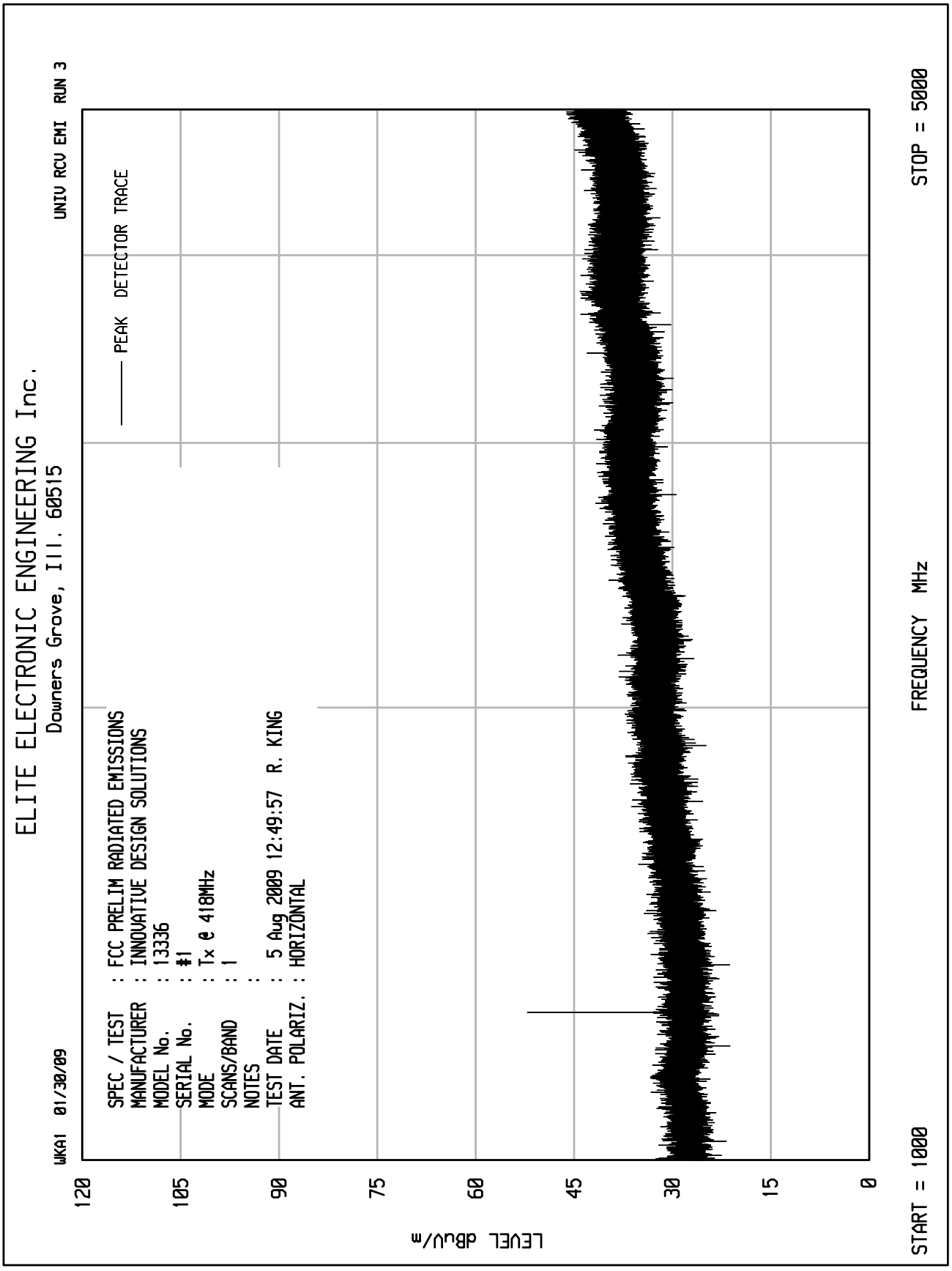


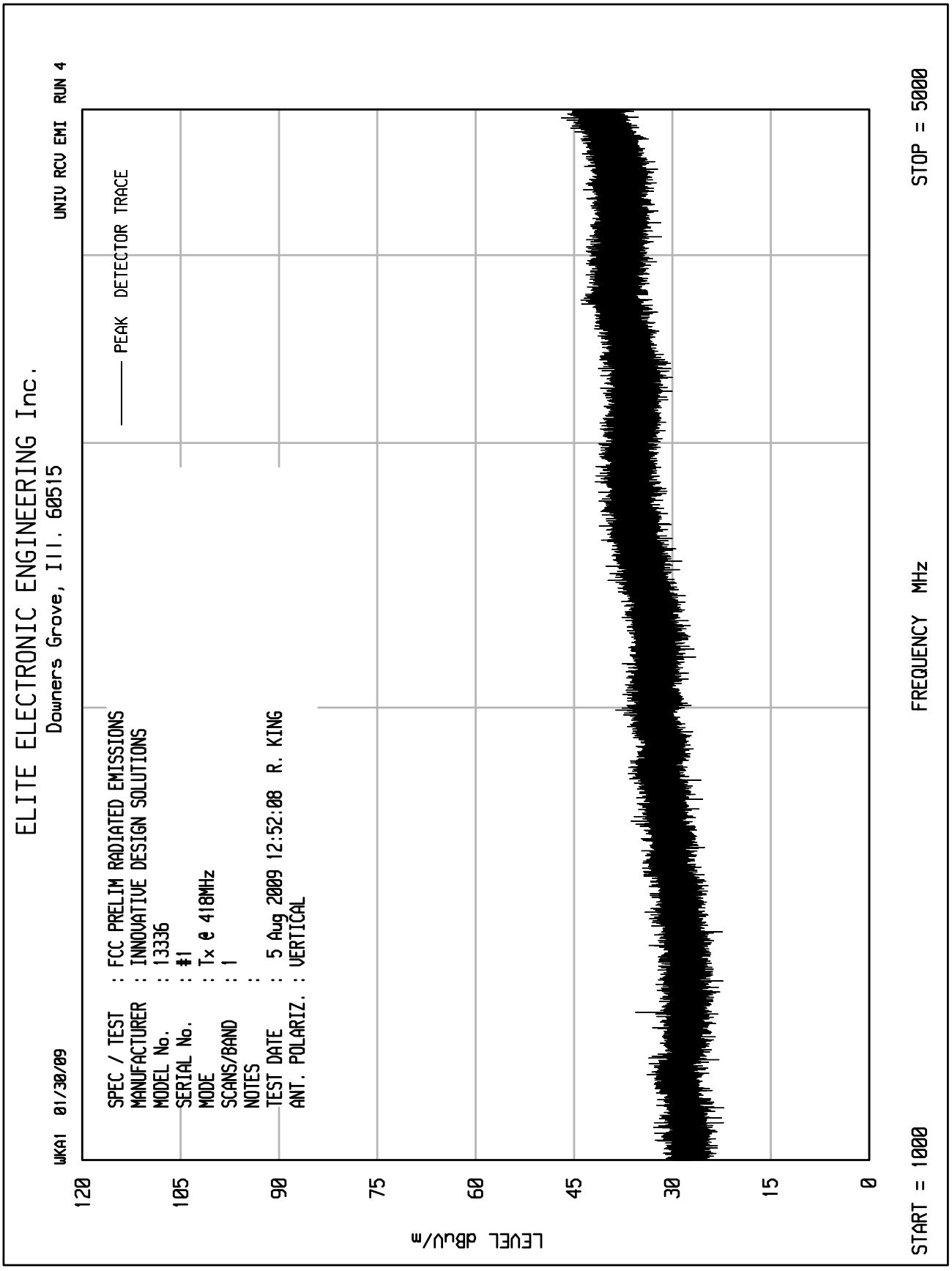
Test Setup for Radiated Emissions – Vertical Polarity above 1000MHz


ELITE ELECTRONIC ENGINEERING Co.
Downers Grove, Il 60515
10 mSEC/DIV
TRANSMITTER DUTY CYCLE
FREQUENCY: 417.9394 MHz
ON TIME : 19.181 mSEC
OFF TIME : 11.089 mSEC
DUTY CYCLE = .63 or -4.01 dB
COMPUTED OVER 1 DATA WORD
MANUFACTURER : INNOVATIVE DESIGN SOLUTIONS
MODEL : 13336
S/N : #1
TEST DATE : 5 Aug 2009
NOTES :


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 1
WKA1 01/30/09
SPEC / TEST : FCC PRELIM RADIATED EMISSIONS
MANUFACTURER : INNOVATIVE DESIGN SOLUTIONS
MODEL No. : 13336
SERIAL No. : #1
MODE : Tx @ 418MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 5 Aug 2009 12:39:18 R. KING
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
105
90
75
60
45
30
15
0
START = 30
100
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 2
WKA1 01/30/09
SPEC / TEST : FCC PRELIM RADIATED EMISSIONS
MANUFACTURER : INNOVATIVE DESIGN SOLUTIONS
MODEL No. : 13336
SERIAL No. : #1
MODE : Tx @ 418MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 5 Aug 2009 12:41:13 R. KING
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
105
90
75
60
45
30
15
0
START = 30
100
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 3
WKA1 01/30/09
SPEC / TEST : FCC PRELIM RADIATED EMISSIONS
MANUFACTURER : INNOVATIVE DESIGN SOLUTIONS
MODEL No. : 13336
SERIAL No. : #1
MODE : Tx @ 418MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 5 Aug 2009 12:49:57 R. KING
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 5000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 4
WKA1 01/30/09
SPEC / TEST : FCC PRELIM RADIATED EMISSIONS
MANUFACTURER : INNOVATIVE DESIGN SOLUTIONS
MODEL No. : 13336
SERIAL No. : #1
MODE : Tx @ 418MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 5 Aug 2009 12:52:08 R. KING
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 5000

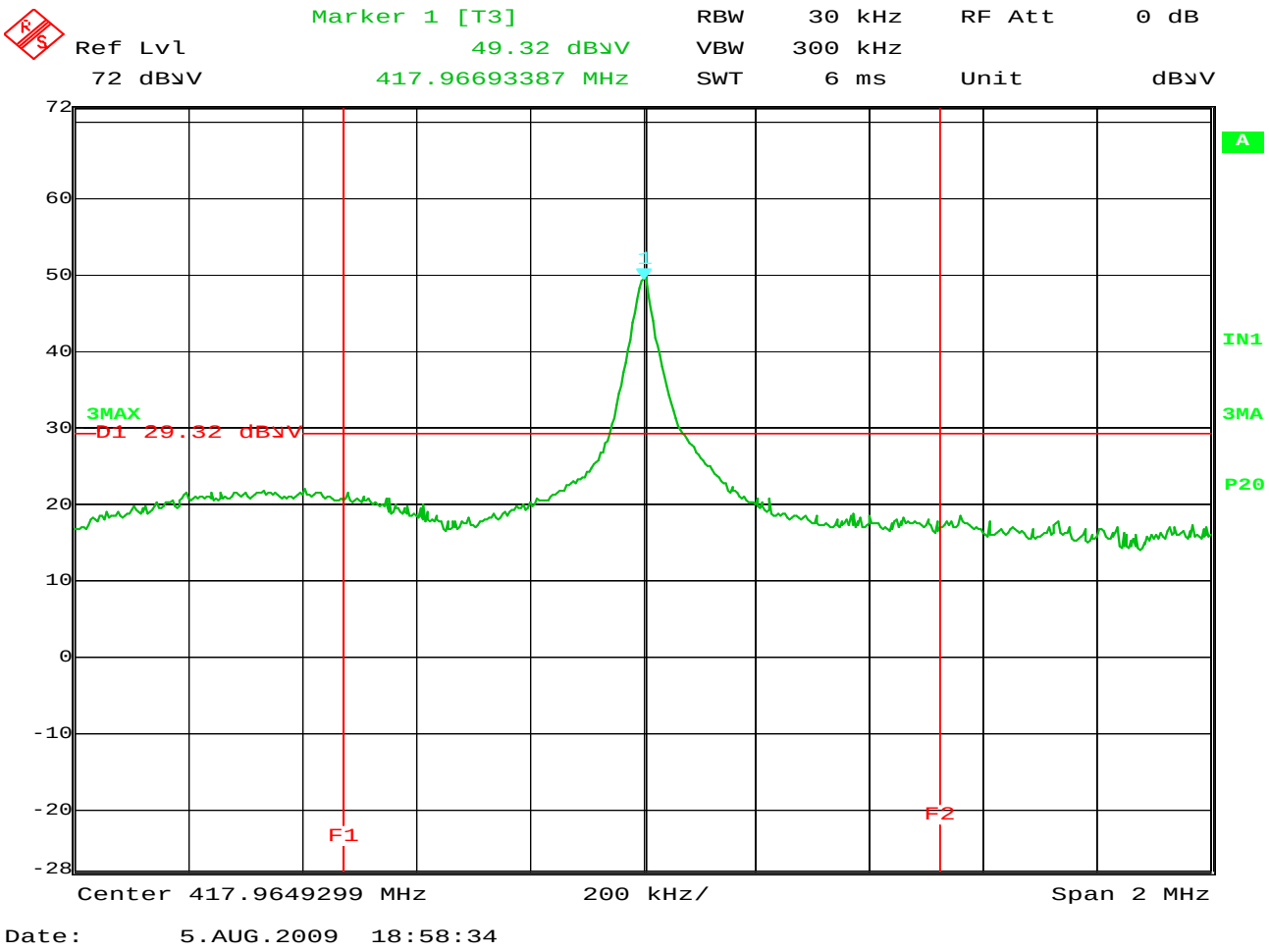
DATA PAGE

SPECIFICATION : FCC PART 15C TRANSMITTER OPEN FIELD DATA
MANUFACTURER : Innovative Design Solutions
TEST ITEM : KEYFOB
PART NO : 13336
S/N : NONE ASSIGNED
TEST DATE : August 5, 2009
NOTES : Tx @ 418MHz

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)
418.0	H	48.5	1.6	17.6	-4.0	63.8	1540.4	10333.3	-16.5
418.0	V	42.9	1.6	17.6	-4.0	58.1	804.7	10333.3	-22.2
836.0	H	38.7	2.3	22.2	-4.0	59.2	912.9	1033.3	-1.1
836.0	V	24.5	2.3	22.2	-4.0	45.0	177.4	1033.3	-15.3
1254.0	H	28.3	2.8	26.3	-4.0	53.4	470.1	1033.3	-6.8
1254.0	V	21.3	2.8	26.3	-4.0	46.4	209.5	1033.3	-13.9
1672.0	H	18.8	3.3	27.5	-4.0	45.6	190.1	500.0	-8.4
1672.0	V	15.4	3.3	27.5	-4.0	42.2	128.8	500.0	-11.8
2090.0	H	18.7	3.7	29.1	-4.0	47.5	236.3	1033.3	-12.8
2090.0	V	15.7	3.7	29.1	-4.0	44.5	167.5	1033.3	-15.8
2508.0	H	13.1	3.9	30.7	-4.0	43.6	150.5	1033.3	-16.7
2508.0	V	13.3	3.9	30.7	-4.0	43.8	155.3	1033.3	-16.5
2926.0	H	14.2	4.0	32.1	-4.0	46.3	206.3	1033.3	-14.0
2926.0	V	16.1	4.0	32.1	-4.0	48.2	256.5	1033.3	-12.1
3344.0	H	14.5	4.4	32.3	-4.0	47.2	229.8	1033.3	-13.1
3344.0	V	13.3	4.4	32.3	-4.0	46.1	200.8	1033.3	-14.2
3762.0	H	14.9	4.8	32.7	-4.0	48.4	262.7	500.0	-5.6
3762.0	V	14.2	4.8	32.7	-4.0	47.8	244.1	500.0	-6.2
4180.0	H	13.3	5.2	32.9	-4.0	47.4	235.5	500.0	-6.5
4180.0	V	13.6	5.2	32.9	-4.0	47.7	242.7	500.0	-6.3

Checked BY Richard E. King :

Richard E. King



FCC 15.231(c) 20dB Bandwidth

MANUFACTURER	: Innovative Design Solutions
MODEL NUMBER	: 13336
SERIAL NUMBER	: None Assigned
TEST MODE	: Tx @ 418MHz
TEST PARAMETER	: Display Line (D1) represents the 20dB down point : from the modulated carrier. Display Lines (F1 & F2) : represent the 0.25% bandwidth.
EQUIPMENT USED	: RBA1, NTA1