Measurement of RF Emissions from a RVIM1 Transceiver

For	CanField Connector 8510 Foxwood Court Youngstown, OH 44514
P.O. Number	1020
Date Tested	May 13th through the 16th, 2011
Test Personnel	Richard E. King
Test Specification	FCC "Code of Federal Regulations" Title 47, Part15 Industry Canada RSS-GEN Industry Canada RSS-210
Test Report By:	Richard E. King EMC Engineer
Requested By:	Mike Philips, Greg Kosec CanField Connector
Approved By:	Raymond J. Klouda Registered Professional Engineer of Illinois - 44894

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REVISION HISTORY

Revision	Date	Description
—	June 23, 2011	Initial release

Measurement of RF Emissions from a Transceiver, Model No. RVIM1

1. INTRODUCTION

1.1. Scope of Tests

This report presents the results of the RF emissions measurements performed on a transceiver, Model No. RVIM1, no serial number was assigned, (hereinafter referred to as the Equipment Under Test (EUT)). The EUT was designed to transmit at approximately 915 MHz using an antenna. The EUT was manufactured and submitted for testing by CanField Connector located in Youngstown, OH.

The receive portion of the EUT is a super-heterodyne type receiver designed to receive at 915MHz. The EUT contains a tuner which utilizes one local oscillator (LO) at 915MHz.

1.2. Purpose

The test series was performed to determine if the EUT meets the technical requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart B for receivers and Subpart C, Sections 15.249 for Intentional Radiators and Industry Canada RSS-210 and RSS-GEN. Testing was performed in accordance with ANSI C63.4-2009.

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 American Association for Laboratory Accreditation (A2LA). A2LA Certificate Number: 1786.01.

1.5. Laboratory Conditions

The temperature at the time of the test was 23^{o}C and the relative humidity was 36%.

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 C63.4-2009, "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 Radio Standards Specification, RSS-Gen, “General Requirements and Information for the Certification of Radiocommunication Equipment”, Issue 3, December 2010
- Industry Canada Radio Standards Specification, RSS-210, “Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment”, Issue 8, December 2010

3. EUT Setup and Operation

3.1. General Description

The EUT is a CanField Connector, transceiver, Model No. RVIM1. A block diagram of the EUT setup is shown as Figure 1.

3.1.1. Power Input

The EUT obtained 13.6VDC from an external power supply. The EUT typically obtains 13.6VDC from an automotive battery.

3.1.2. Peripheral Equipment

There was no peripheral equipment was submitted with the EUT.

3.1.3. Signal Input/Output Leads

There were no interconnecting cables submitted with the EUT.

3.1.4. Grounding

Since the EUT was powered with 13.6VDC through a battery, it was ungrounded during the tests.

3.2. Operational Mode

For all tests the EUT was placed on an 80cm high non-conductive stand. The EUT was set to transmit by pressing the sensetivity button on the user interface. The EUT was set to receive once power was applied.

3.3. EUT Modifications

No modifications were required for compliance.

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 C63.4-2009 for site attenuation.

4.2. Test Instrumentation

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

Conducted and radiated emission measurements were performed with a spectrum analyzer. This receiver allows measurements with the bandwidths and detector functions specified by the FCC. The receiver bandwidth was 120kHz for the 30MHz to 1000MHz radiated emissions data and 1MHz for the 1000MHz to 5000MHz 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 Emissions Measurements		
Combined Standard Uncertainty	1.07	-1.07
Expanded Uncertainty (95% confidence)	2.1	-2.1

Radiated Emissions 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 EUT is powered by batteries, no conducted emissions tests are required.

5.2. Radiated Measurements

5.2.1. Receiver

5.2.1.1 Requirements

Per CFR 47, Part 15 section 109(a) and Industry Canada RSS-Gen, all emanations from a receiver shall be below the levels shown on the following table:

Frequency MHz	Distance between Test Item And Antenna in Meters	Field Strength uV/m	Field Strength dBuV/m
30-88	3	100	40
88-216	3	150	43.5
216-960	3	200	46
Above 960	3	500	54

Note: The tighter limit shall apply at the edge between the two frequency bands.

5.2.1.2 Procedures

All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. The walls and ceiling of the shielded chamber are lined with ferrite tiles. 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.

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.

Since quasi-peak and average measurements require long integration times, it is not practical to automatically sweep through the quasi-peak or average levels. Therefore, radiated emissions from the test item were first scanned using a peak detector and automatically plotted. The frequencies where significant emission levels were noted were then remeasured using the quasi-peak or average detector.

For preliminary radiated emissions sweeps from 30MHz to 5GHz, the broadband measuring antenna was positioned at a 3 meter distance from the test item. The frequency range from 30MHz to 5GHz was investigated using a peak detector function with the bilog antenna below 1GHz and the double-ridged waveguide antenna above 1GHz. The maximum levels were plotted.

Final radiated emissions were performed on all significant broadband and narrowband emissions found in the preliminary sweeps using the following methods:

1) Measurements below 1GHz were made using a quasi-peak detector and a bilog antenna. Measurements above 1GHz were made using an average detector and a double ridged waveguide antenna.
2) To ensure that maximum or worst case, emission levels were measured, the following steps were taken:
   a. The test item was rotated so that all of its sides were exposed to the receiving antenna.
   b. Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.
   c. The measuring antenna was raised and lowered from 1 to 4 meters for each antenna polarization to maximize the readings.

5.2.1.3 Results

The preliminary plots are presented on pages 14 through 17. The plots are presented for a reference only, and are not used to determine compliance. The final radiated levels are presented on page 18. As can be seen from the data, all emissions measured from the test item were within the specification limits for receivers. Photographs of the test configuration are shown on Figure 3.

5.2.2. Transmitter

5.2.2.1 Requirements

Per CFR 47, Part 15 section 249(a) and Industry Canada RSS-210 Annex 2, section A2.9, all emanations from a transmitter shall be below the levels shown on the following table:

Fundamental Frequency MHz	Field Intensity mV/m @ 3 meter	Field Strength of Harmonics and Spurious uV/m @ 3 meter
902 to 928	50	500

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.

5.2.2.2 Procedures

All 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. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4-2003 for site attenuation.

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 10GHz was investigated using a peak detector function. The data was then processed by the computer to calculate equivalent field intensity.

The final emission tests were then manually performed over the frequency range of 30MHz to 10GHz. 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.

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.

5.2.2.3 Results

The preliminary plots are presented on data pages 19 through 22. The plots are presented for a reference only, and are not used to determine compliance. The final radiated levels are presented on data page 22. Photographs of the test configuration which yielded the highest or worst case, radiated emission levels are shown on Figure 3.

5.3. Occupied Bandwidth Measurements

5.3.1. Requirement

The radiated emissions outside of the specified frequency bands, except for harmonics, shall be attenuate by at least 50dB below the level of the fundamental or to the general radiated emissions limits in 15.209, which ever is the lesser attenuation.

5.3.2. Procedures

The EUT 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 120 kHz and span was set to 30 MHz. The frequency spectrum near the fundamental was plotted. The 99% bandwidth was measured to be 272.5kHz.

5.3.3. Results

The plot of the emissions near the fundamental frequency is presented on data page 24. As can be seen from this data page, the transmitter met the occupied bandwidth requirements.

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 CanField Connector personnel.

6.2. Disposition of the EUT

The EUT and all associated equipment were returned to CanField Connector upon completion of the tests.

7. CONCLUSIONS

It was determined that the CanField Connector transceiver, Model No. RVIM1, Serial No. S/N 1, did fully meet the technical requirements of the FCC "Code of Federal Regulations" Title 47, Part 15,. for intentional radiators and receivers, when tested per ANSI C63.4-2009. In addition, the EUT meets the technical requirements of Industry Canada RSS-210 and RSS-GEN.

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 EUT at the test date as operated by CanField Connector personnel. Any electrical or mechanical modification made to the EUT 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
CDW3	COMPUTER			004		N/A	
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
RAKG	RF SECTION	HEWLETT PACKARD	85462A	3549A00284	0.009-6500MHZ	3/28/2011	3/28/2012
RAKH	RF FILTER SECTION	HEWLETT PACKARD	85460A	3448A00324	---	3/28/2011	3/28/2012
RBB0	EMI TEST RECEIVER 20HZ TO 40 GHZ	ROHDE & SCHWARZ	ESIB40	100250	20 HZ TO 40GHZ	3/24/2011	3/24/2012
XPQ2	HIGH PASS FILTER	K&L MICROWAVE	4IH30-1804/T10000-0	3	1.8-10GHZ	10/28/2010	10/28/2011

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.

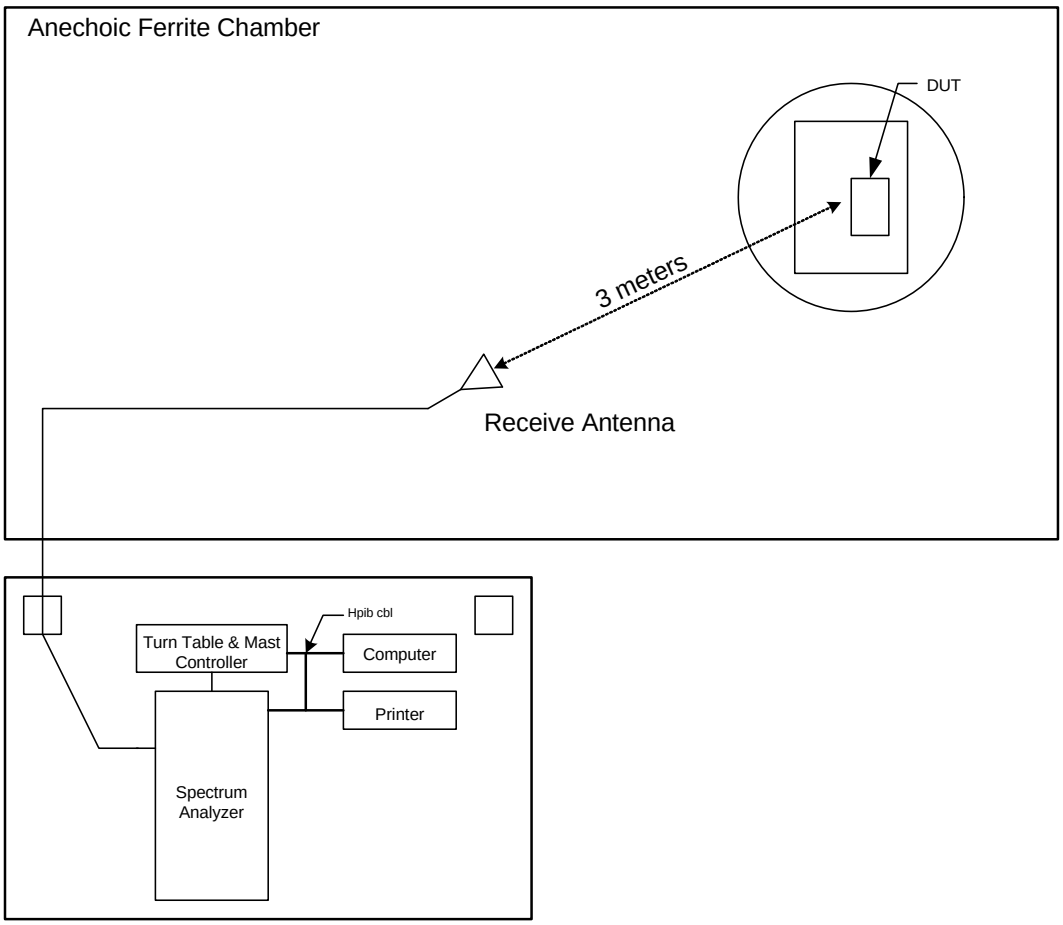


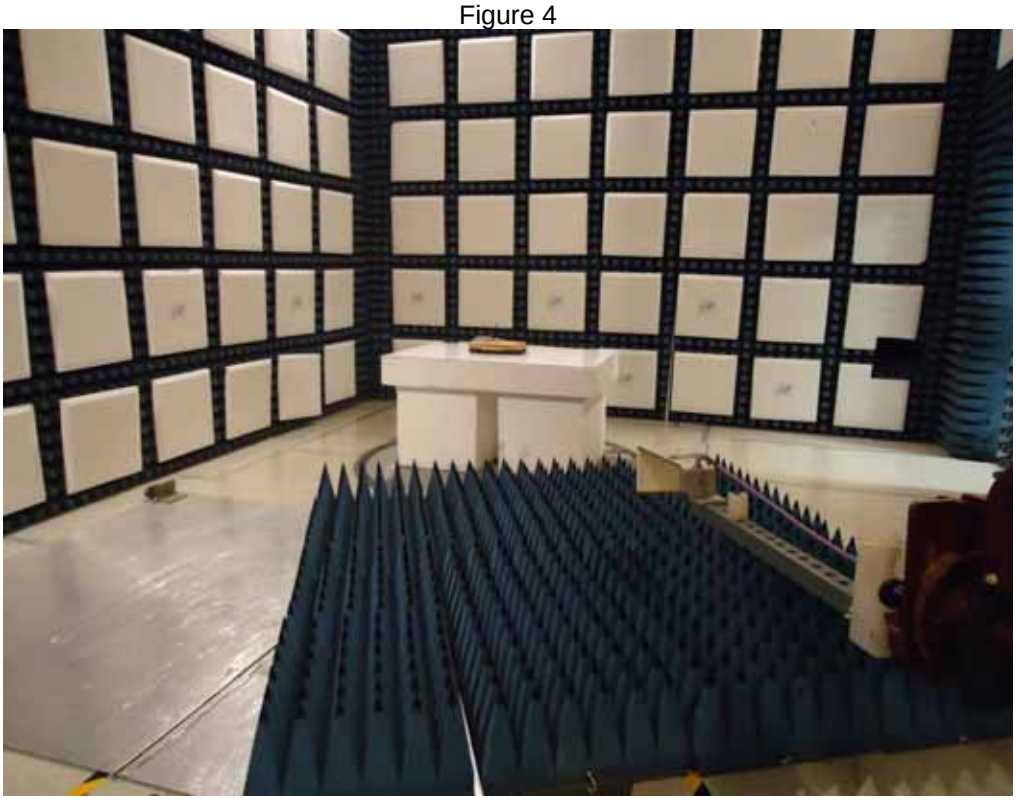
FIGURE 1 BLOCKDIAGRAM OF TEST SETUP

Figure 3

Test Setup for Radiated Emissions, 30MHz to 1GHz – Horizontal Polarization

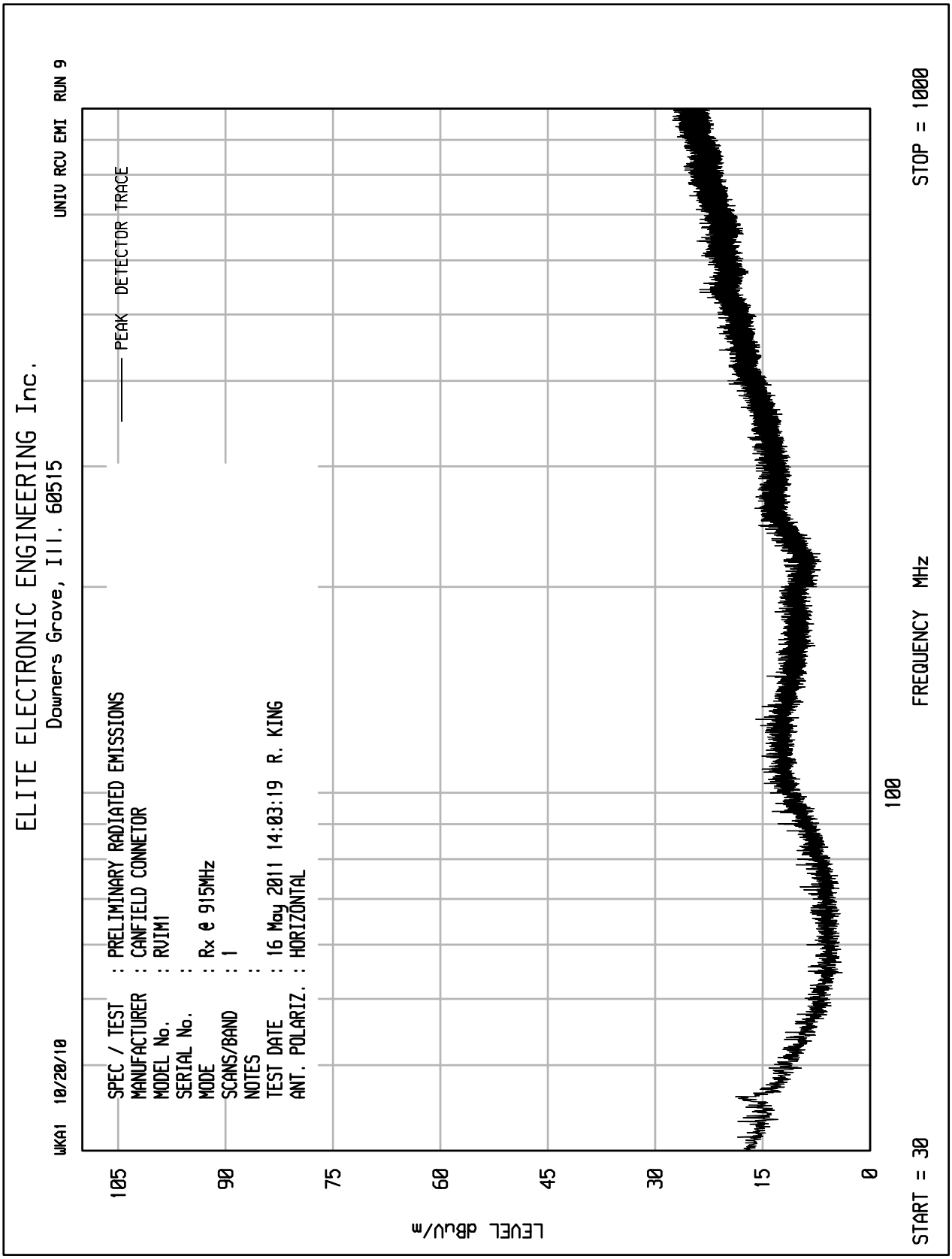
Test Setup for Radiated Emissions, 30MHz to 1GHz – Vertical Polarization

Figure 4



Test Setup for Radiated Emissions, Above 1GHz – Horizontal Polarization

Test Setup for Radiated Emissions, Above 1GHz – Vertical Polarization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Downers Grove, Ill. 60515
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WKAI 10/20/10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CANFIELD CONNETOR
MODEL No. : RVIM1
SERIAL No. :
MODE : Rx @ 915MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 16 May 2011 14:03:19 R. KING
ANT. POLARIZ. : HORIZONTAL
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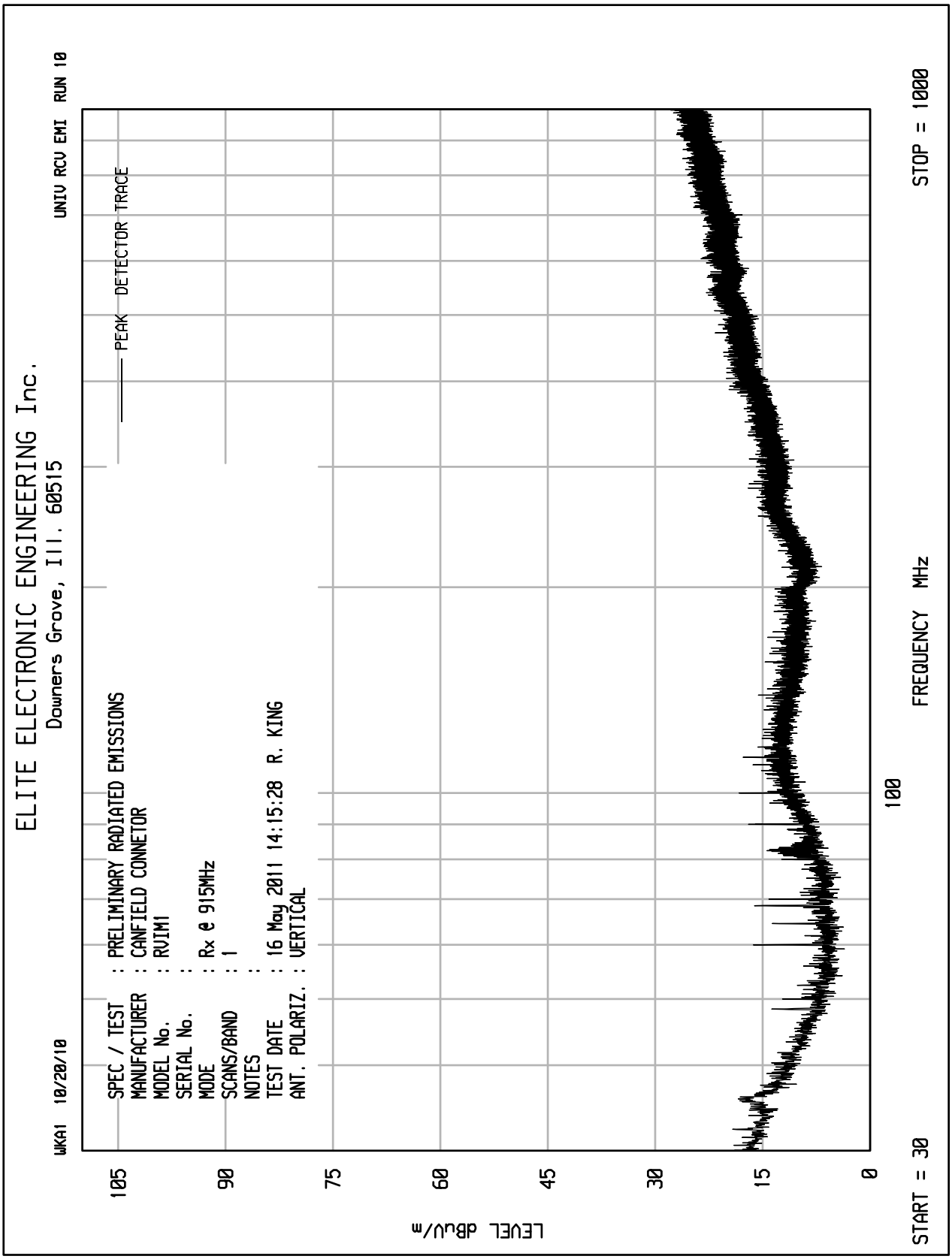
100
FREQUENCY MHz
STOP = 1000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Downers Grove, Ill. 60515
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WKA1 10/20/10
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MODEL No. : RVIMI
SERIAL No. :
MODE : Rx @ 915MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 16 May 2011 14:15:28 R. KING
ANT. POLARIZ. : VERTICAL
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45
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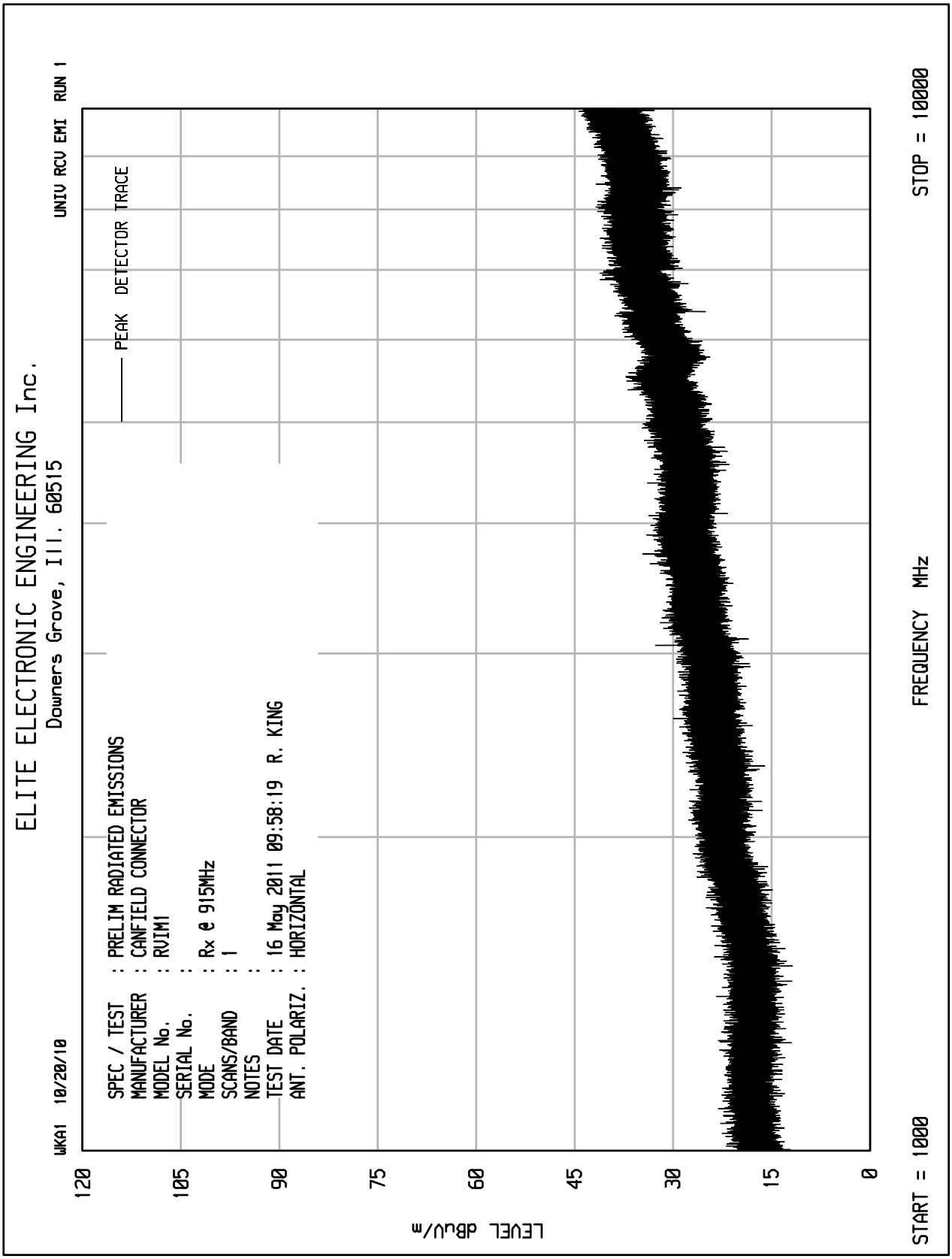
START = 30
100
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
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WKA1 10/20/10
SPEC / TEST : PRELIM RADIATED EMISSIONS
MANUFACTURER : CANFIELD CONNECTOR
MODEL No. : RVIM1
SERIAL No. :
MODE : Rx @ 915MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 16 May 2011 09:58:19 R. KING
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75
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15
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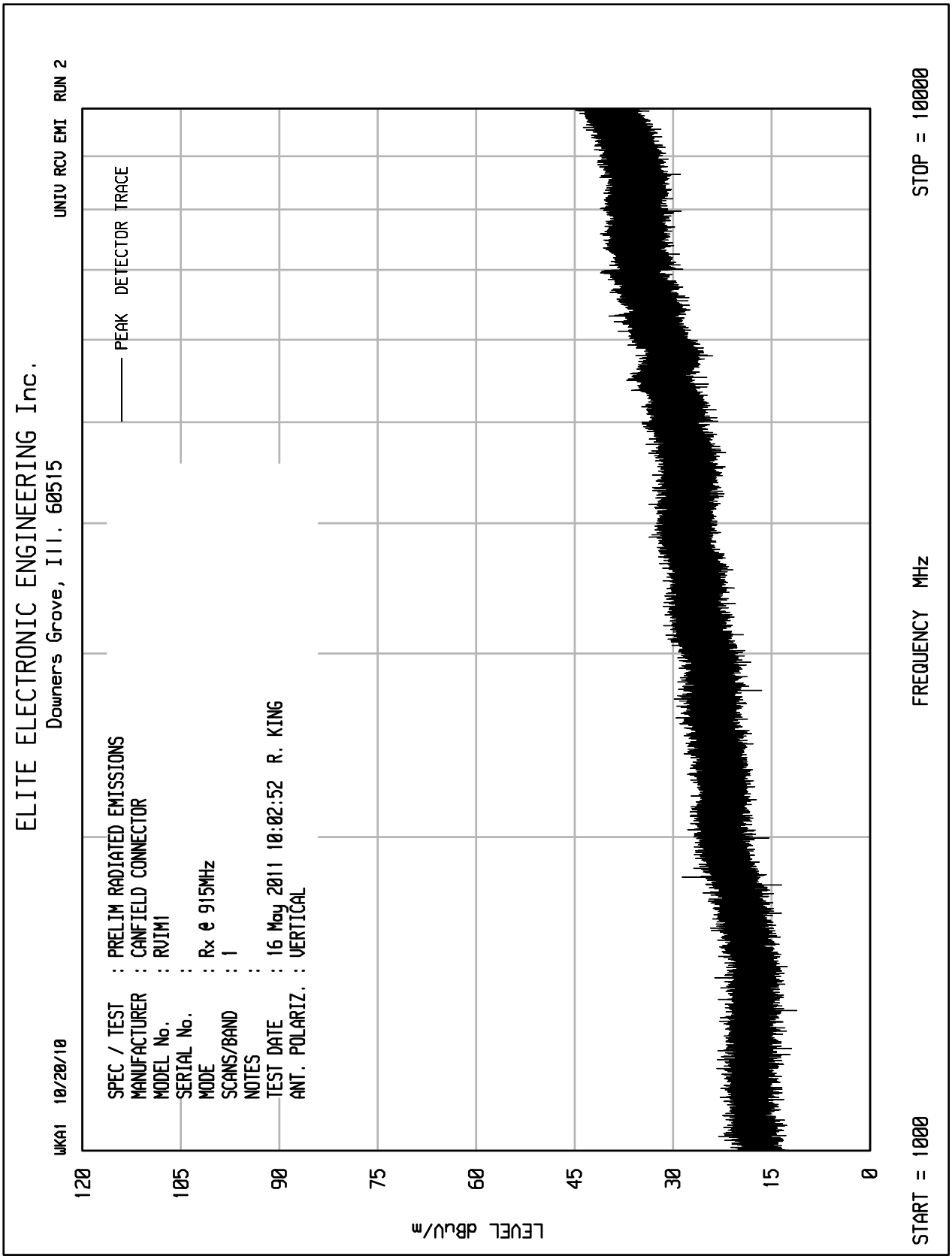
FREQUENCY MHz
STOP = 10000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Downers Grove, Ill. 60515
UNIV RCV EMI RUN 2
WKA1 10/20/10
SPEC / TEST : PRELIM RADIATED EMISSIONS
MANUFACTURER : CANFIELD CONNECTOR
MODEL No. : RVIM1
SERIAL No. :
MODE : Rx @ 915MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 16 May 2011 10:02:52 R. KING
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PEAK DETECTOR TRACE
LEVEL dBuV/m
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105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

MANUFACTURER : CanField Connector
TEST ITEM : transceiver
MODEL NO. : RVIM1
TEST SPECIFICATION : FCC 15.249, Radiated Emissions
MODE : Rx @ 915MHz
TEST DATE : May 16, 2011
TEST DISTANCE : 3 meters

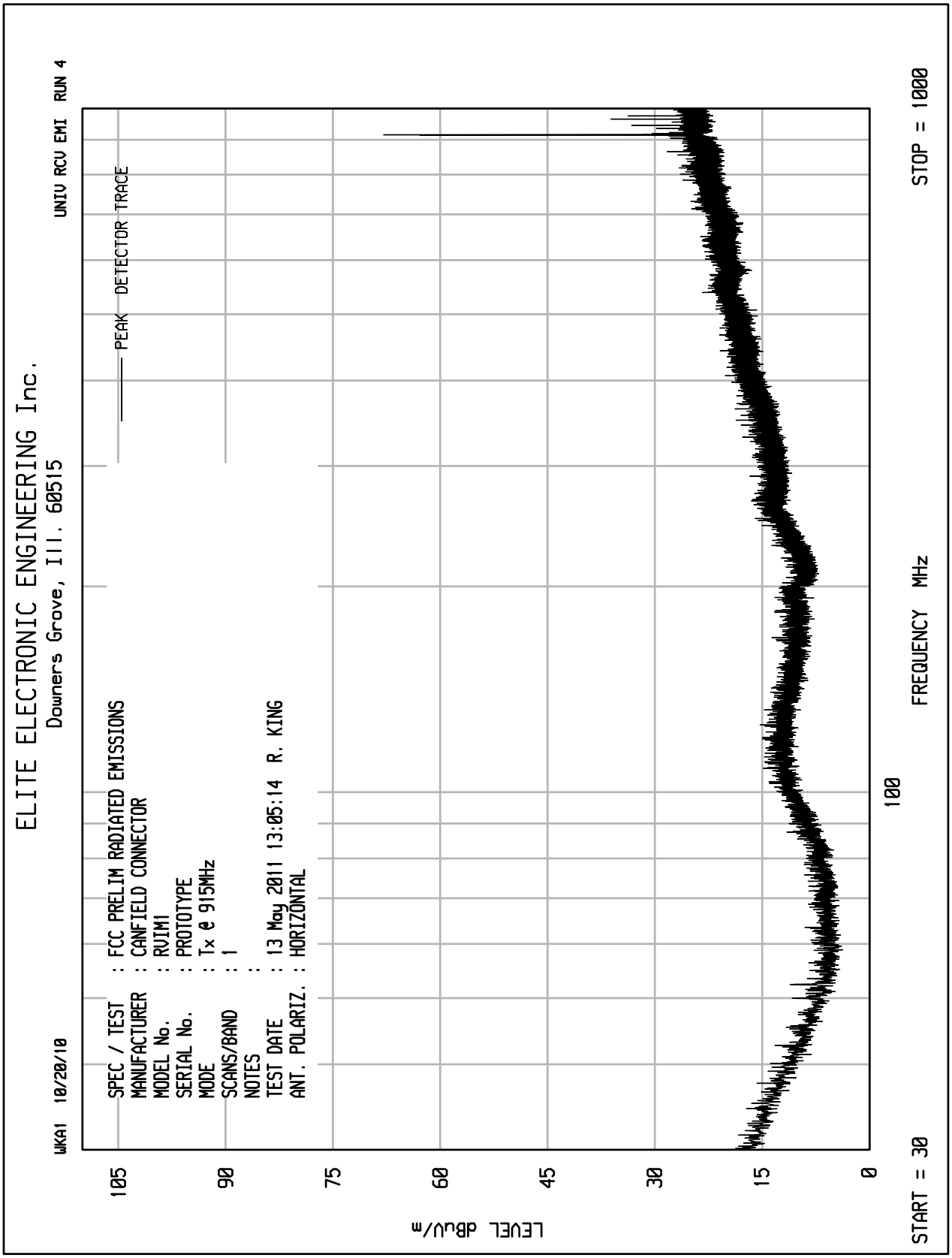
Frequency MHz	Antenna Polarity	Meter Reading dBuV	Ambient	Cable Loss dB	Antenna Factor dB	Preamp Gain dB	Total dBuV/m	Total uV/m	Limit uV/m
915.00	H	-1.2	*	2.0	21.7	0.0	22.6	13.4	200.0
915.00	V	-1.2	*	2.0	21.7	0.0	22.6	13.4	200.0
1830.00	H	34.2	*	2.9	27.5	-40.6	24.0	15.9	500.0
1830.00	V	34.3	*	2.9	27.5	-40.6	24.1	16.0	500.0
2745.00	H	32.7	*	3.7	30.3	-40.3	26.4	20.8	500.0
2745.00	V	32.6	*	3.7	30.3	-40.3	26.3	20.6	500.0
3660.00	H	32.4	*	4.3	33.2	-40.1	29.7	30.7	500.0
3660.00	V	32.3	*	4.3	33.2	-40.1	29.7	30.6	500.0
4575.00	H	31.9	*	4.8	33.7	-40.0	30.4	32.9	500.0
4575.00	V	31.9	*	4.8	33.7	-40.0	30.4	33.1	500.0

H – Horizontal
V = Vertical

Total = Meter Reading + Cable Loss + Antenna Factor + Preamp Gain

Checked BY Richard E. King :

Richard E. King


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
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WKA1 10/20/10
SPEC / TEST : FCC PRELIM RADIATED EMISSIONS
MANUFACTURER : CANFIELD CONNECTOR
MODEL No. : RVIM1
SERIAL No. : PROTOTYPE
MODE : Tx @ 915MHz
SCANS/BAND : 1
NOTES : :
TEST DATE : 13 May 2011 13:05:14 R. KING
ANT. POLARIZ. : HORIZONTAL
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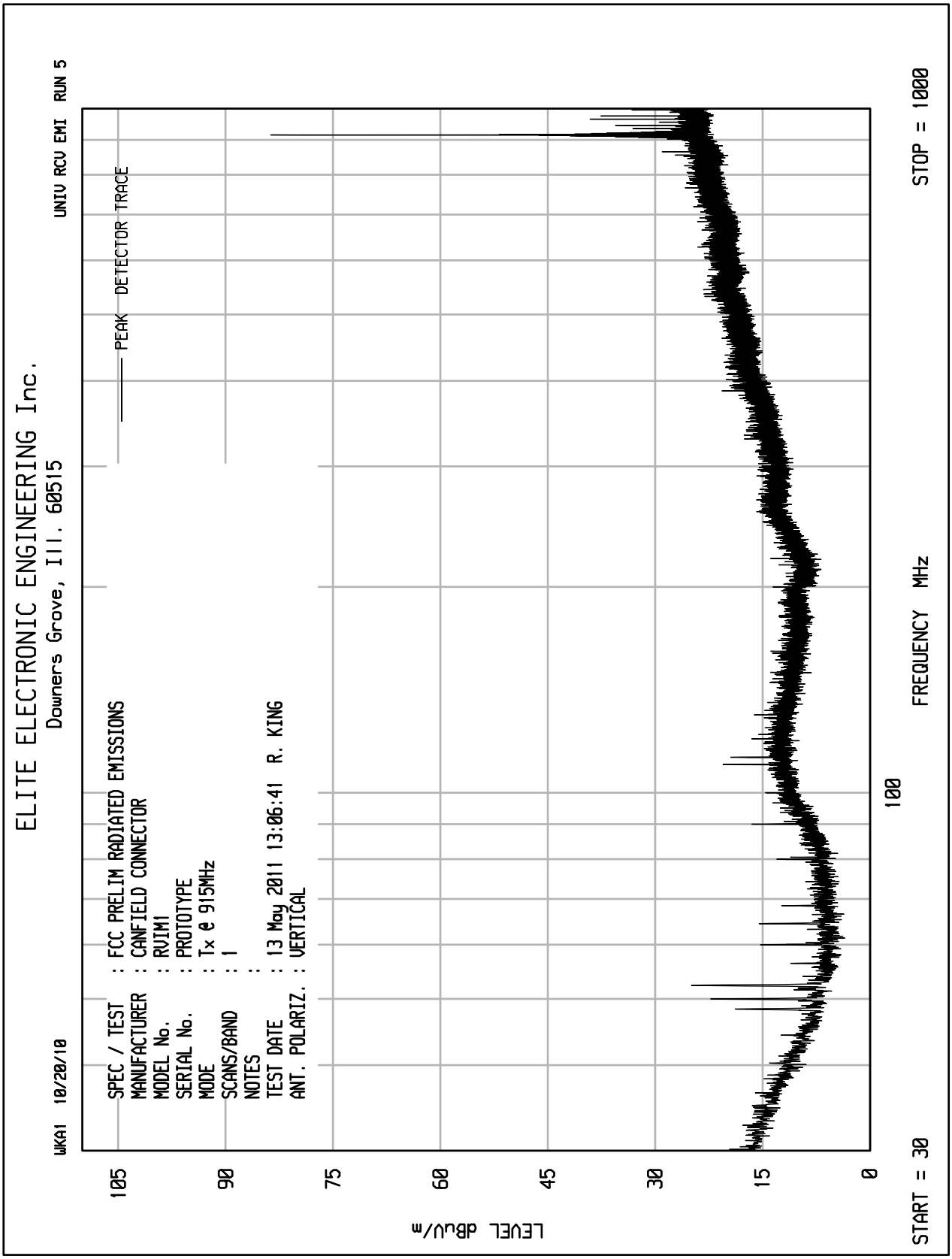
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 5
WKAI 10/20/10
SPEC / TEST : FCC PRELIM RADIATED EMISSIONS
MANUFACTURER : CANFIELD CONNECTOR
MODEL No. : RVIM1
SERIAL No. : PROTOTYPE
MODE : Tx @ 915MHz
SCANS/BAND : 1
NOTES : :
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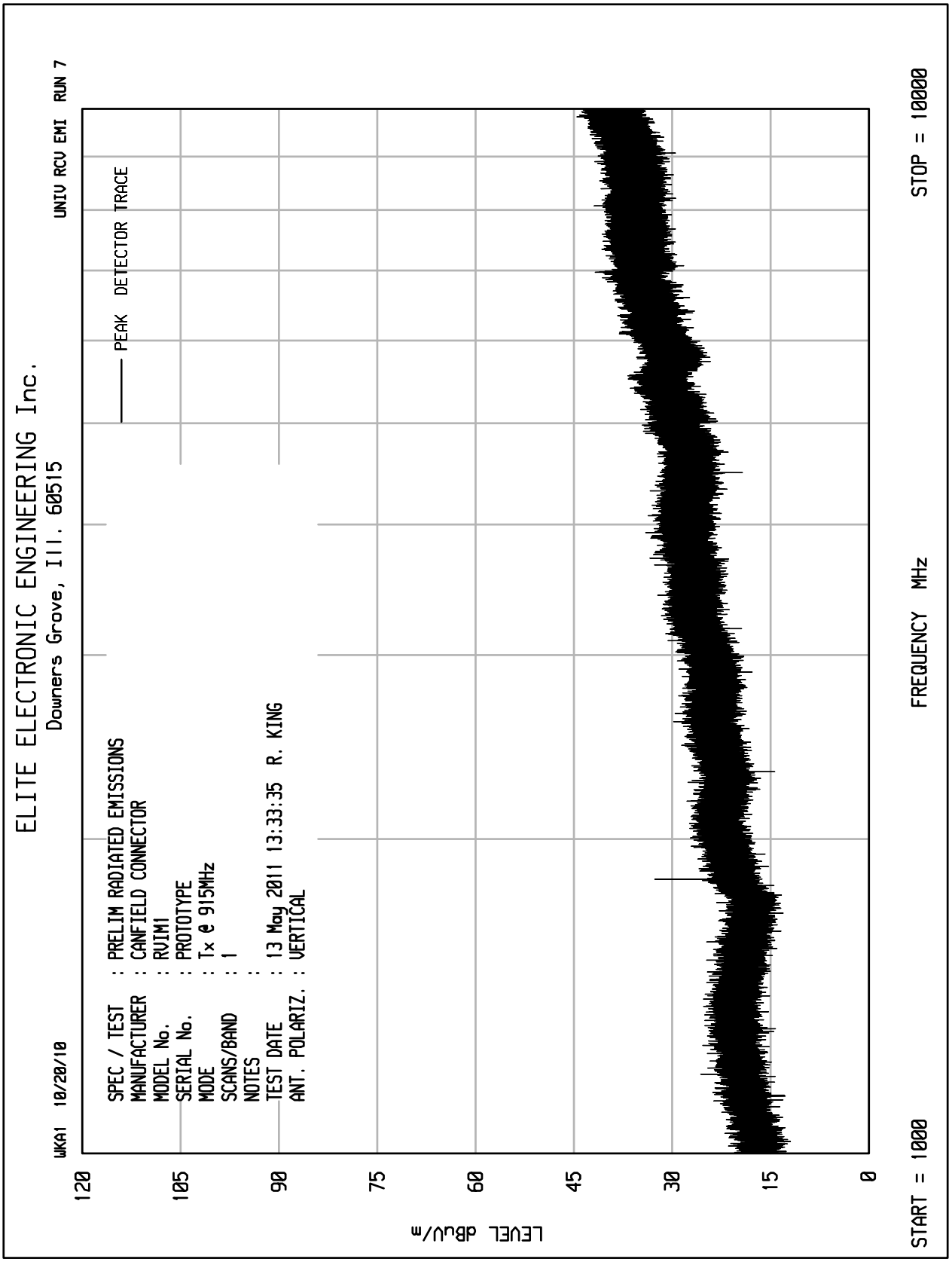
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Downers Grove, Ill. 60515
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WKAI 10/20/10
SPEC / TEST : PRELIM RADIATED EMISSIONS
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MODEL No. : RUIM1
SERIAL No. : PROTOTYPE
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SCANS/BAND : 1
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TEST DATE : 13 May 2011 13:33:35 R. KING
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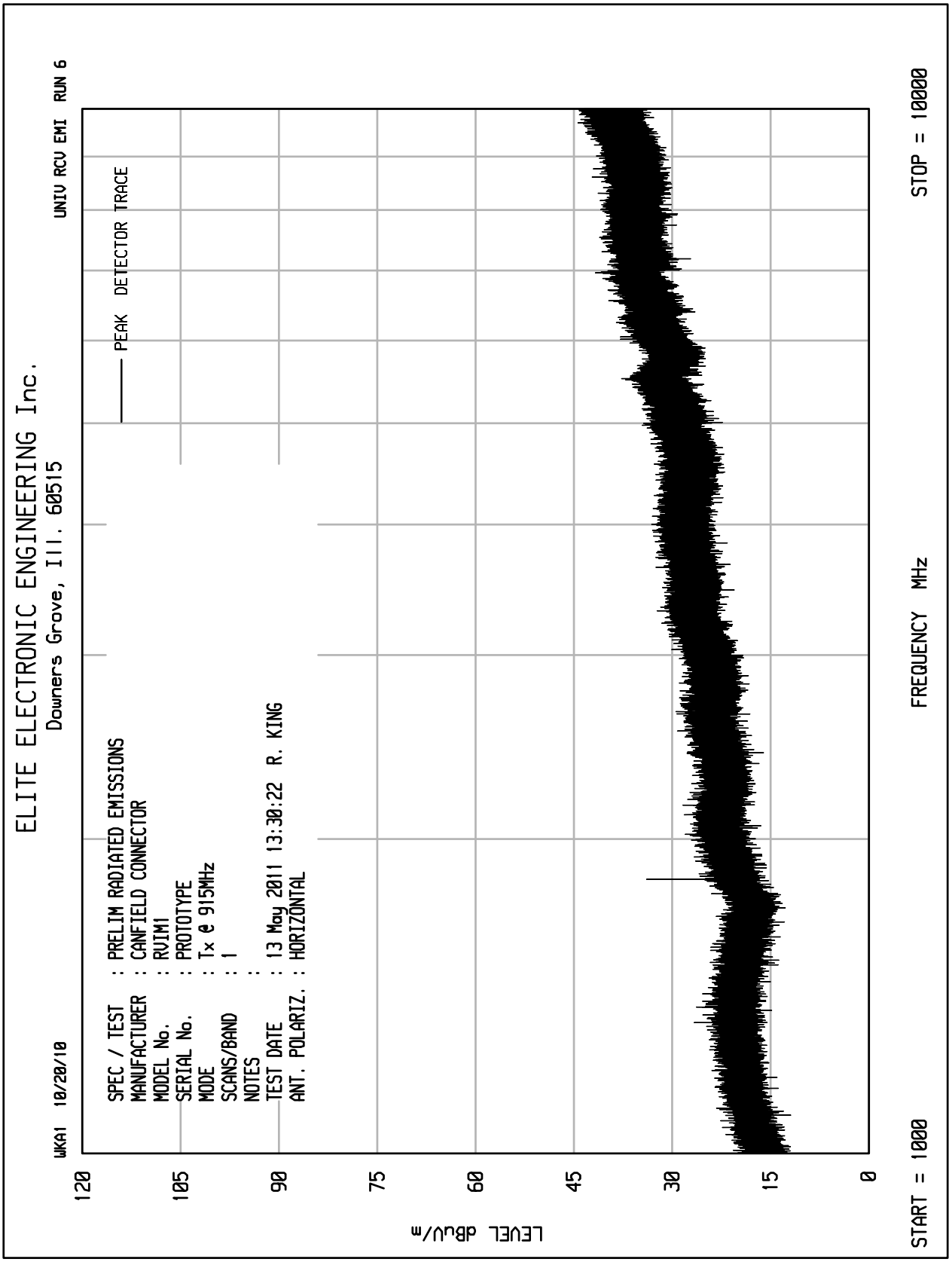
FREQUENCY MHz
STOP = 10000



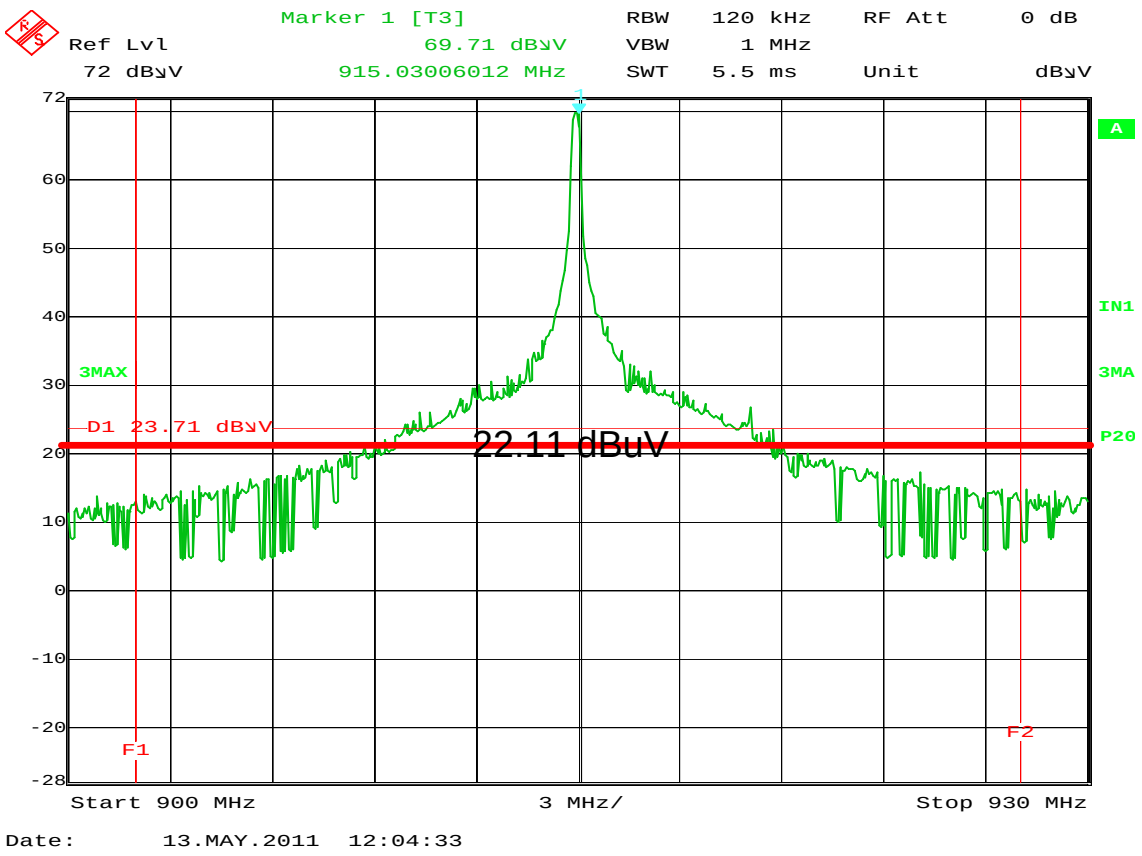
MANUFACTURER : CanField Connector
TEST ITEM : transceiver

MODEL NO. : RVIM1
TEST SPECIFICATION : FCC 15.249, Radiated Emissions
MODE : Tx @ 915MHz
TEST DATE : May 16, 2011
TEST DISTANCE : 3 meters

Frequency MHz	Antenna Polarity	Meter Reading dBuV	Cable Loss dB	Antenna Factor dB	Preamp Gain dB	Total dBuV/m	Total uV/m	Limit uV/m
915.00	H	65.8	2.0	21.7	0.0	89.5	29682.5	50000.0
915.00	V	69.9	2.0	21.7	0.0	93.6	47863.0	50000.0
1830.00	H	54.0	2.9	27.5	-40.6	43.8	155.2	500.0
1830.00	V	51.9	2.9	27.5	-40.6	41.7	121.0	500.0
2745.00	H	50.2	3.7	30.3	-40.3	43.9	156.3	500.0
2745.00	V	48.5	3.7	30.3	-40.3	42.2	128.2	500.0
3660.00	H	45.3	4.3	33.2	-40.1	42.7	136.6	500.0
3660.00	V	44.4	4.3	33.2	-40.1	41.8	123.0	500.0
4575.00	H	44.0	4.8	33.7	-40.0	42.5	133.9	500.0
4575.00	V	44.5	4.8	33.7	-40.0	43.0	142.0	500.0
5490.00	H	43.6	5.3	35.6	-40.1	44.4	166.4	500.0
5490.00	V	44.3	5.3	35.6	-40.1	45.1	179.1	500.0
6405.00	H	43.6	5.7	35.2	-39.9	44.7	171.0	500.0
6405.00	V	43.5	5.7	35.2	-39.9	44.5	168.4	500.0
7320.00	H	44.0	6.2	37.8	-39.8	48.2	257.9	500.0
7320.00	V	45.5	6.2	37.8	-39.8	49.7	304.0	500.0
8235.00	H	44.7	6.5	37.9	-39.5	49.5	299.1	500.0
8235.00	V	45.1	6.5	37.9	-39.5	49.9	312.8	500.0
9150.00	H	45.3	6.6	38.4	-39.0	51.3	365.5	500.0
9150.00	V	45.7	6.6	38.4	-39.0	51.7	382.7	500.0

Checked BY Richard E. King :

Richard E. King



FCC 15.249 Occupied Bandwidth

MANUFACTURER	: CanField Connector
PART NUMBER	: RVIM1
SERIAL NUMBER	: None Assigned
TEST MODE	: Tx @ 915MHz
TEST PARAMETER	: Emissions radiated outside of the specified frequency bands, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.
NOTE	: The peak reading of 69.71 dBuV at 915MHz represents the 93.6dBuV/m reading. In order to meet the general limits at 902MHz and 928MHz, the emissions must be down 47.6dB from the peak (93.6dBuV/m – 46dBuV/m). 47.6 dB of attenuation corresponds to a peak reading of (69.71-47.6) or 22.11dBuV. Display line at 22.1 dBuV represents the general limit. Display line F1 represents the lower band edge (902MHz). Display line F2 represents the upper band edge (928MHz).