



## Measurement of RF Emissions from the Pulsar R96 with HART Tank Level Probing Radar Transmitter

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For	Magnetrol International 705 Enterprise Street Aurora, IL 60504
P.O. Number	212734
Date Tested	April 27 through May 1, 2015
Test Personnel	Richard King
Test Specification	FCC "Code of Federal Regulations" Title 47 Part15, Subpart C

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THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE  
WRITTEN APPROVAL OF ELITE ELECTRONIC ENGINEERING INCORPORATED.

### REVISION HISTORY

Revision	Date	Description
—	8 June 2015	Initial release

## Measurement of RF Emissions from a Tank Level Probing Radar, Model No. Pulsar R96 with HART Transmitter

### 1. INTRODUCTION

#### 1.1. Scope of Tests

This report presents the results of the RF emissions measurements performed on a Tank Level Probing Radar, Model No. Pulsar R96 with HART, Serial No. 001, (hereinafter referred to as the Equipment Under Test (EUT)). The EUT was designed to transmit at approximately 6.2GHz using a dielectric rod antenna identified as ANT 1 or a 4" horn antenna identified as ANT 2. The EUT was manufactured and submitted for testing by Magnetrol International located in Aurora, IL.

#### 1.2. Purpose

The test series was performed to determine if the EUT meets the radiated RF emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections 15.209 for Intentional Radiators. Testing was performed in accordance with ANSI C63.4-2014.

#### 1.3. Deviations, Additions and Exclusions

These tests were performed at the Magnetrol International facility in an open area inside the facility and at the Downers Grove Waste Water Treatment facility. The measurement distances for the radiated emission tests were adjusted according to the space constraints at the facilities. The site attenuation was not verified.

#### 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. Temperature and Humidity Conditions

The temperature and humidity were not controlled and varied over the course of the testing; however they remained within tolerance.

### 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 2014
- ANSI C63.4-2014, "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"
- ANSI C63.10-2013, " American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices"
- Federal Communications Commission Office of Engineering and Technology Laboratory Division 890966 D01 Meas level Probing Radars v01r01 - 2014, "MEASUREMENT PROCEDURE FOR LEVEL PROBING RADARS"

### 3. EUT SETUP AND OPERATION

#### 3.1. General Description

The EUT is a Magnetrol International, Tank Level Probing Radar, Model No. Pulsar R96 with HART. A block diagram of the EUT setup is shown as Figure 1.

##### 3.1.1. Power Input

The EUT obtained 24VDC from a 24V DC power supply.

##### 3.1.2. Peripheral Equipment

No peripheral equipment was required for the EUT to operate therefore none was used.

##### 3.1.3. Signal Input/Output Leads

No signal leads were required for the EUT to operate therefore none were used.

##### 3.1.4. Grounding

The EUT was ungrounded during the tests.

#### 3.2. Software

For all tests the EUT had Firmware Version 0.02b0 loaded onto the device to provide correct load characteristics.

#### 3.3. Operational Mode

For all tests the EUT was either mounted to the metallic tank at the Magnetrol International facility or to the concrete tank at the Downers Grove Waste Water Treatment facility.

Once powered, the EUT was transmitting at 6.2GHz.

#### 3.4. EUT Modifications

No modifications were required for compliance to the Title 47, Part 15, Subpart C, Sections 15.209 requirements.

### 4. TEST INSTRUMENTATION

#### 4.1. Test Instrumentation

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

#### 4.2. 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).

#### 4.3. Measurement Uncertainty

The measurement uncertainty was not characterized since the site was not verified.

### 5. TEST PROCEDURES

#### 5.1. Radiated Measurements

##### 5.1.1. Requirements

The EUT must comply with the requirements of FCC "Code of Federal Regulations Title 47", Part 15, Subpart C, Section 15.209 et seq.

The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

\*\*Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

### 5.1.2. Procedures

All tests were performed in an open area at either the Magnetrol International Facility or at the Downers Grove Waste Water treatment Facility. The site attenuation was not verified.

A preliminary radiated emissions test was performed to determine the emission characteristics of the EUT. For the preliminary test, a broadband measuring antenna was positioned at a 3 meter distance from the EUT. The entire frequency range from 30MHz to 40GHz 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 40GHz. 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 from the EUT were measured and recorded.

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

- 1) The measurement antenna was rotated so that as much as possible of the EUT sides were exposed to the receiving antenna depending
- 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) 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 EUT is rotated through all axes to ensure the maximum readings are recorded.

### 5.1.3. Results

The preliminary plots of the ambient environment at both the Magnetrol International facility and at the Downers Waste Water Treatment facility are presented on data pages 10 through 49 and 130 through 161. The plots are presented for a reference only, and the ambient environment with the EUT unpowered.

The preliminary plots, with the EUT transmitting at 6.2GHz for both ANT 1 and ANT 2 at the Magnetrol International facility, are presented on data pages 50 through 129. The plots are presented for a reference only, and are not used to determine compliance.

The preliminary plots, with the EUT transmitting at 6.2GHz for both ANT 1 and ANT 2 at the Downers Grove Waste Water Treatment facility, are presented on data pages 162 through 224. The plots are presented for a reference only, and are not used to determine compliance.

The final open area radiated levels, with the EUT transmitting at 6.2GHz with both ANT 1 and ANT 2 at both the Magnetrol International facility and the Downers Grove Waste Water Treatment facility, are presented on data page 225 through 228. As can be seen from the data, all emissions measured from the EUT were within the specification limits.

## 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 Magnetrol International personnel.

### 6.2. Disposition of the EUT

The EUT and all associated equipment were returned to Magnetrol International upon completion of the tests.

## 7. CONCLUSIONS

It was determined that the Magnetrol International Tank Level Probing Radar, Model No. Pulsar R96 with HART, Serial No. 001, 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 C63.4-2014.

## 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 Magnetrol International 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 certification, approval, or endorsement by NVLAP, NIST or any agency of the Federal Government.

## 9. EQUIPMENT LIST

**Table 9-1 Equipment List**

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
APW0	PREAMPLIFIER	PLANAR ELECTRONICS	PE2-30-20G20R6G	PL2926/0646	20GHZ-26.5GHZ	2/17/2015	2/17/2016
APW11	PREAMPLIFIER	PMI	PE2-35-120-5R0-10-12-SFF	PL11685/1241	1GHZ-20GHZ	3/5/2015	3/5/2016
APW4	PREAMPLIFIER	PLANAR	PE2-36-2D540G-5R0-10	PL3043/0651	26.5GHZ-40GHZ	2/17/2015	2/17/2016
CDU3	LAPTOP COMPUTER						
NHG1	STANDARD GAIN HORN ANTENNA	NARDA	638	---	18-26.5GHZ	NOTE 1	
NHH1	STANDARD GAIN HORN ANTENNA	NARDA	V637	---	26.5-40GHZ	NOTE 1	
NTA1	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL6112	2054	0.03-2GHZ	2/18/2015	2/18/2016
NWQ0	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS LINDGREN	3117	66657	1GHZ-18GHZ	3/11/2014	3/11/2016
RBB0	EMI TEST RECEIVER 20HZ TO 40 GHZ.	ROHDE & SCHWARZ	ESIB40	100250	20 HZ TO 40GHZ	2/13/2015	2/13/2016
XLTE	5W, 50 OHM TERMINATION	JFW INDUSTRIES	50T-052	---	DC-2GHZ	2/3/2015	2/3/2016
XPQ5	FILTER	K&L MICROWAVE	11SH10-9000/U2000-O/O	1	5000-5800 MHZ	12/1/2014	12/1/2015
XPRO	HIGH PASS FILTER	K&L MICROWAVE	11SH10-4800/X20000	001	4.8-20GHZ	9/19/2014	9/19/2015

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.

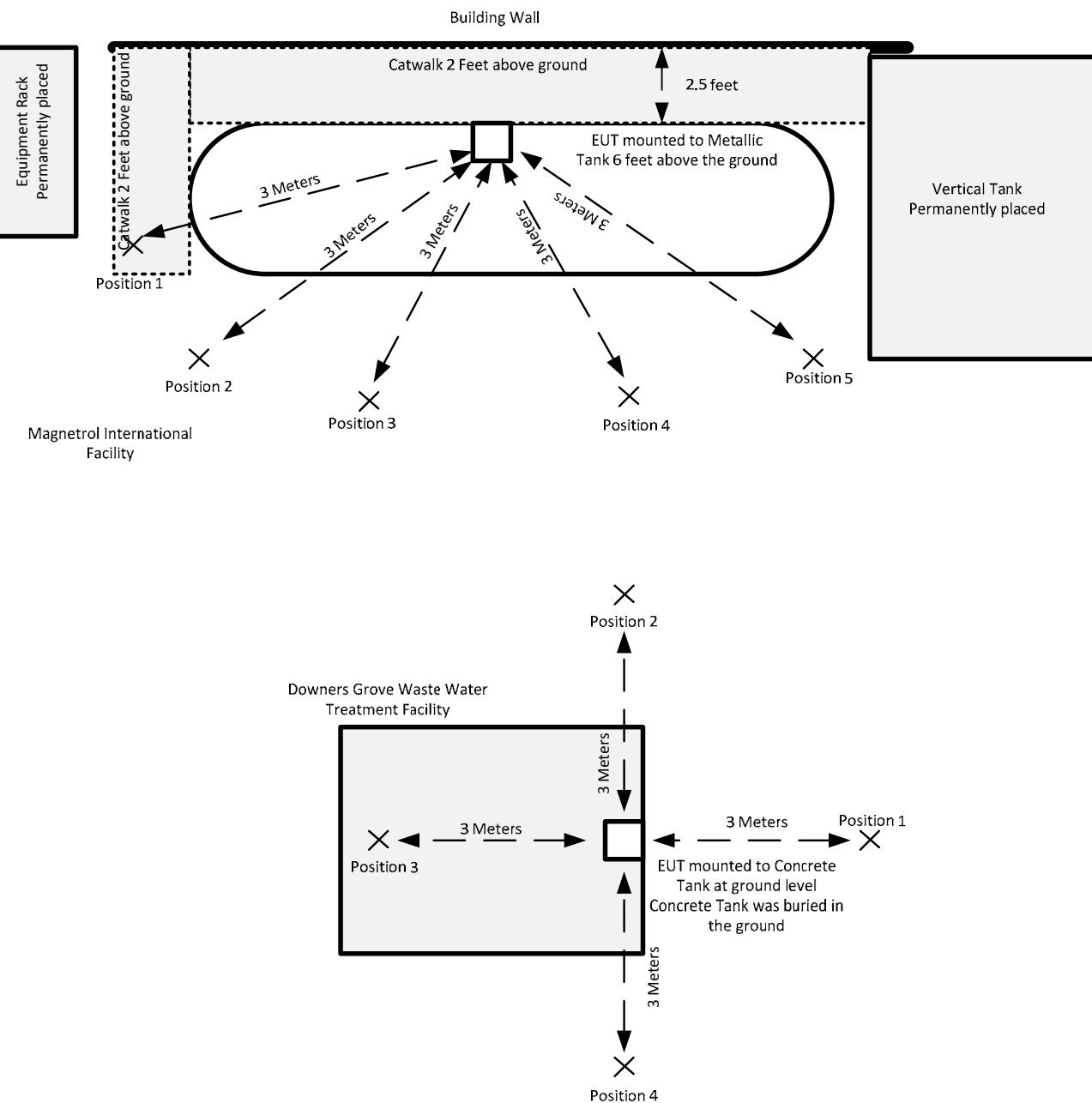
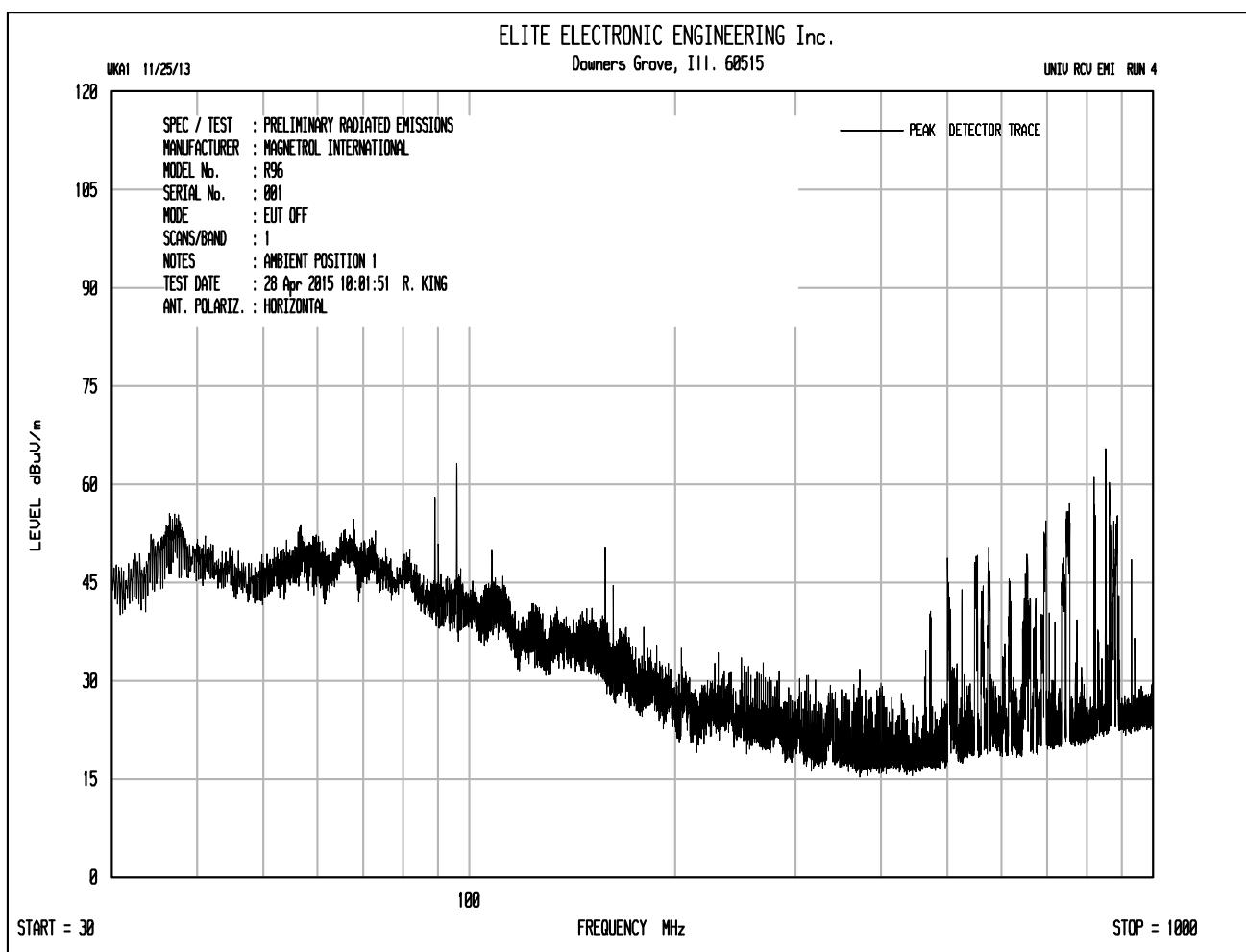
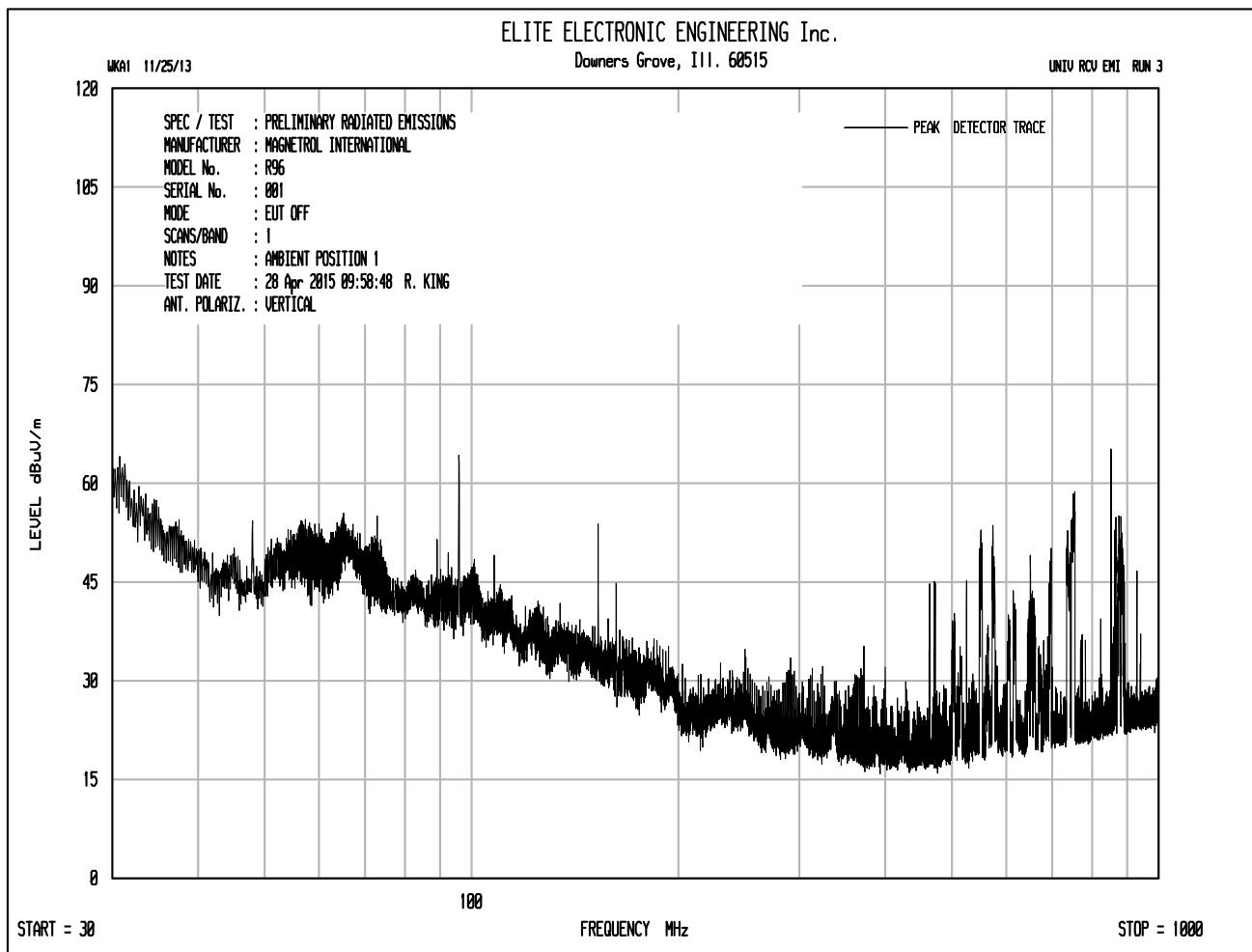
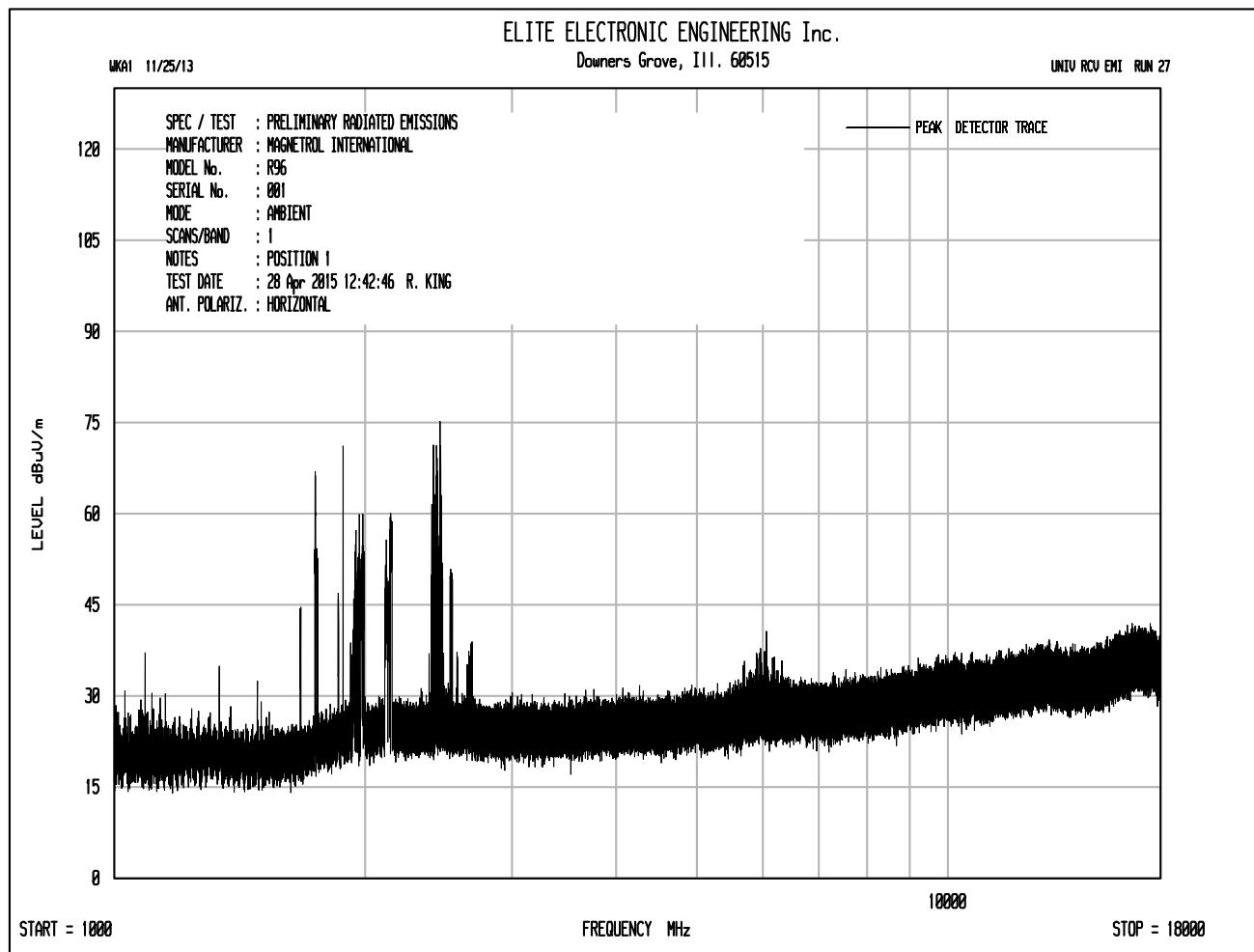


Figure 1 Test Sites





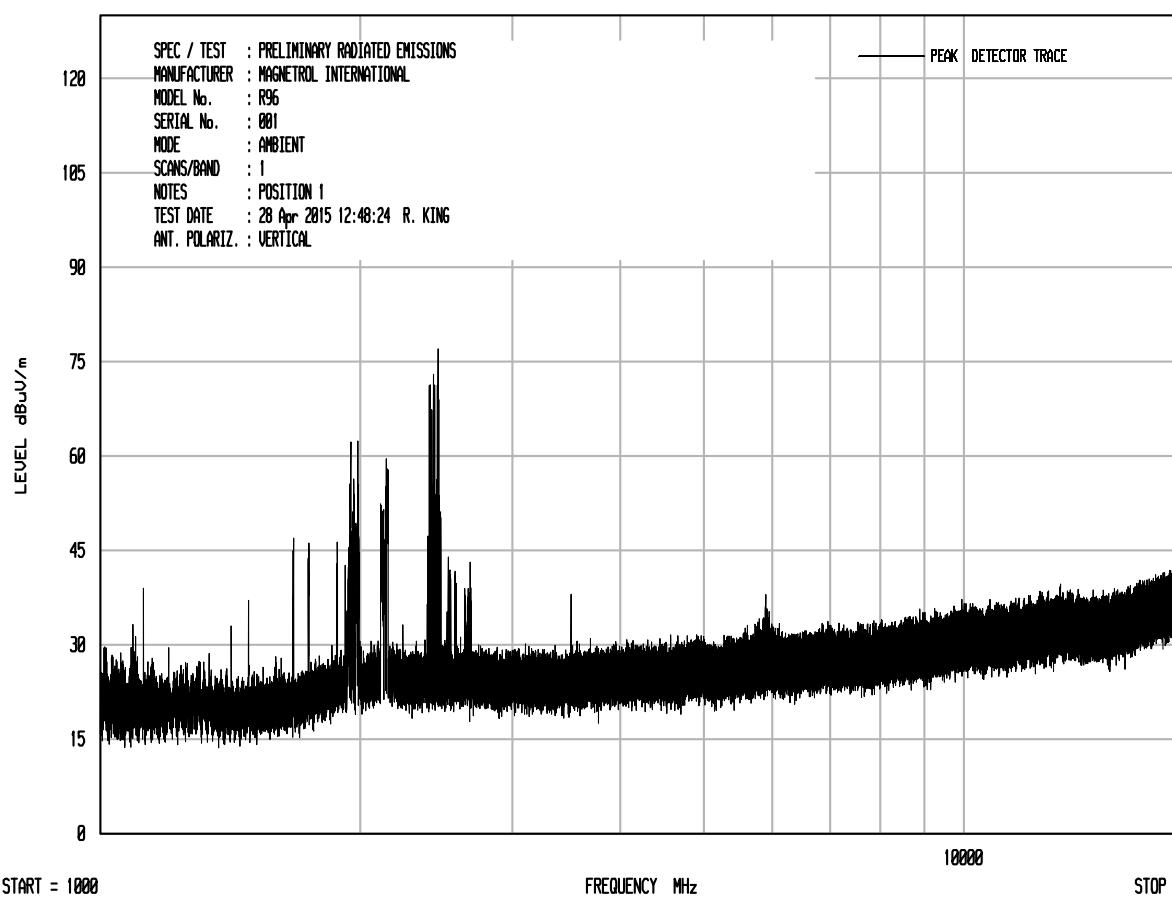


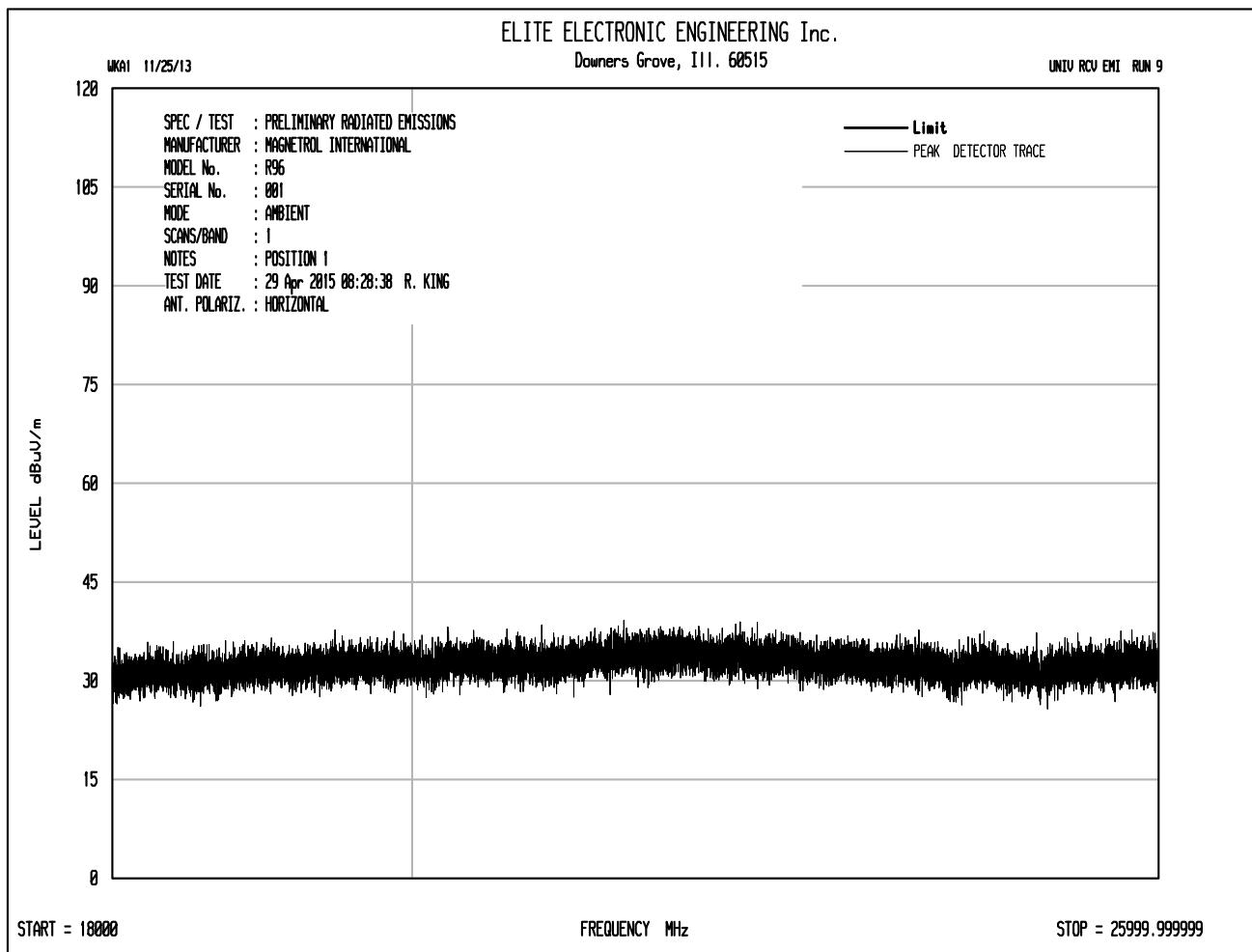
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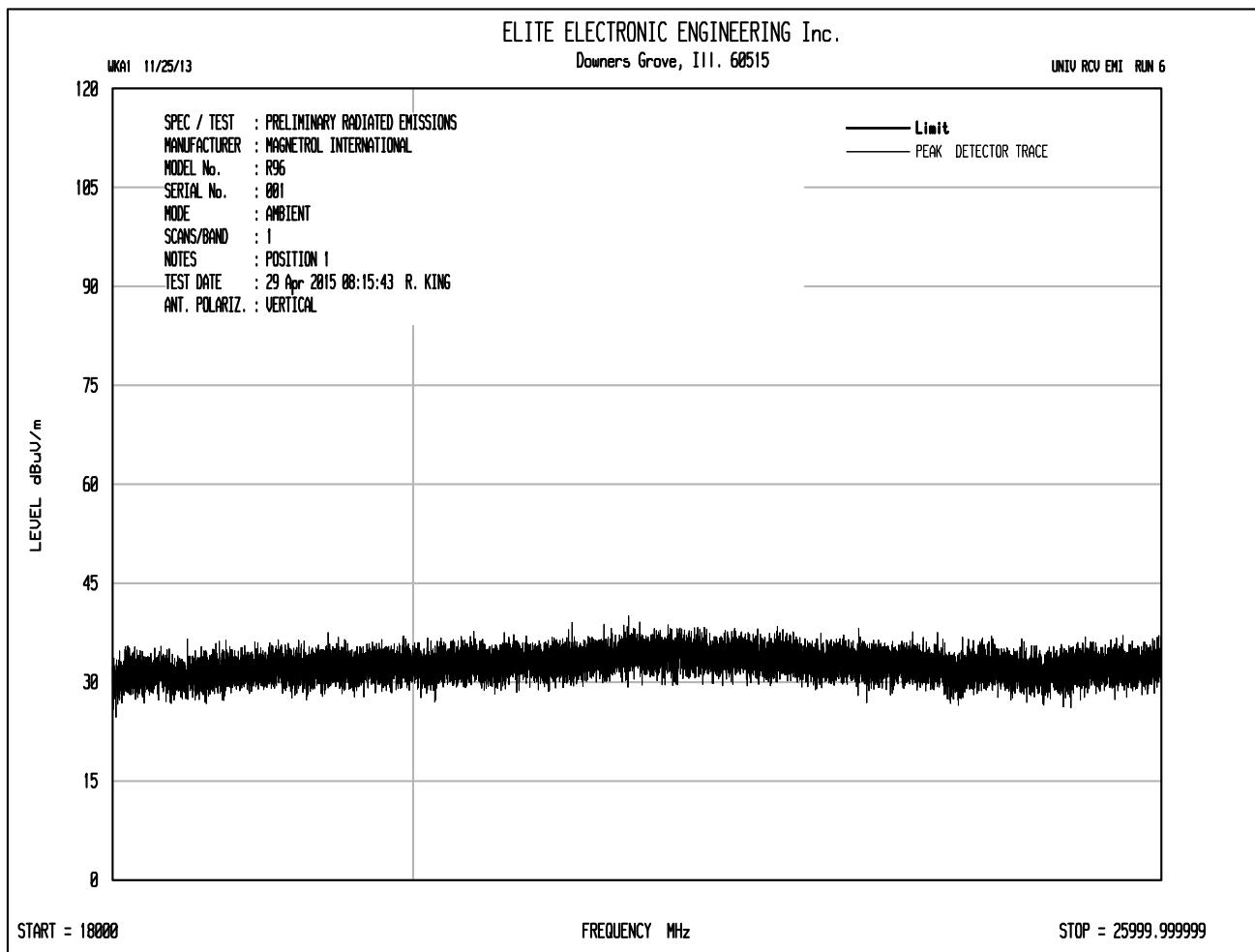
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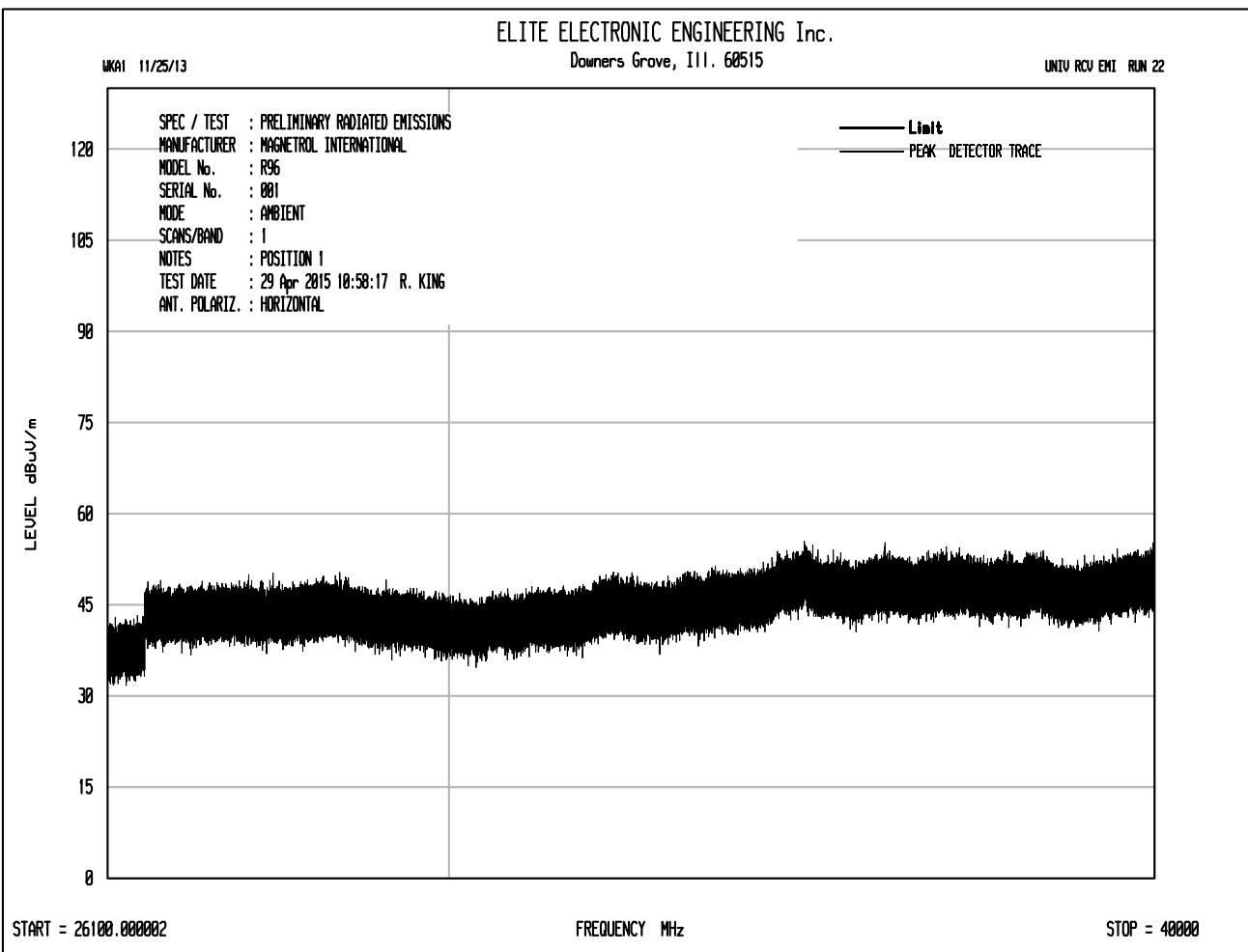
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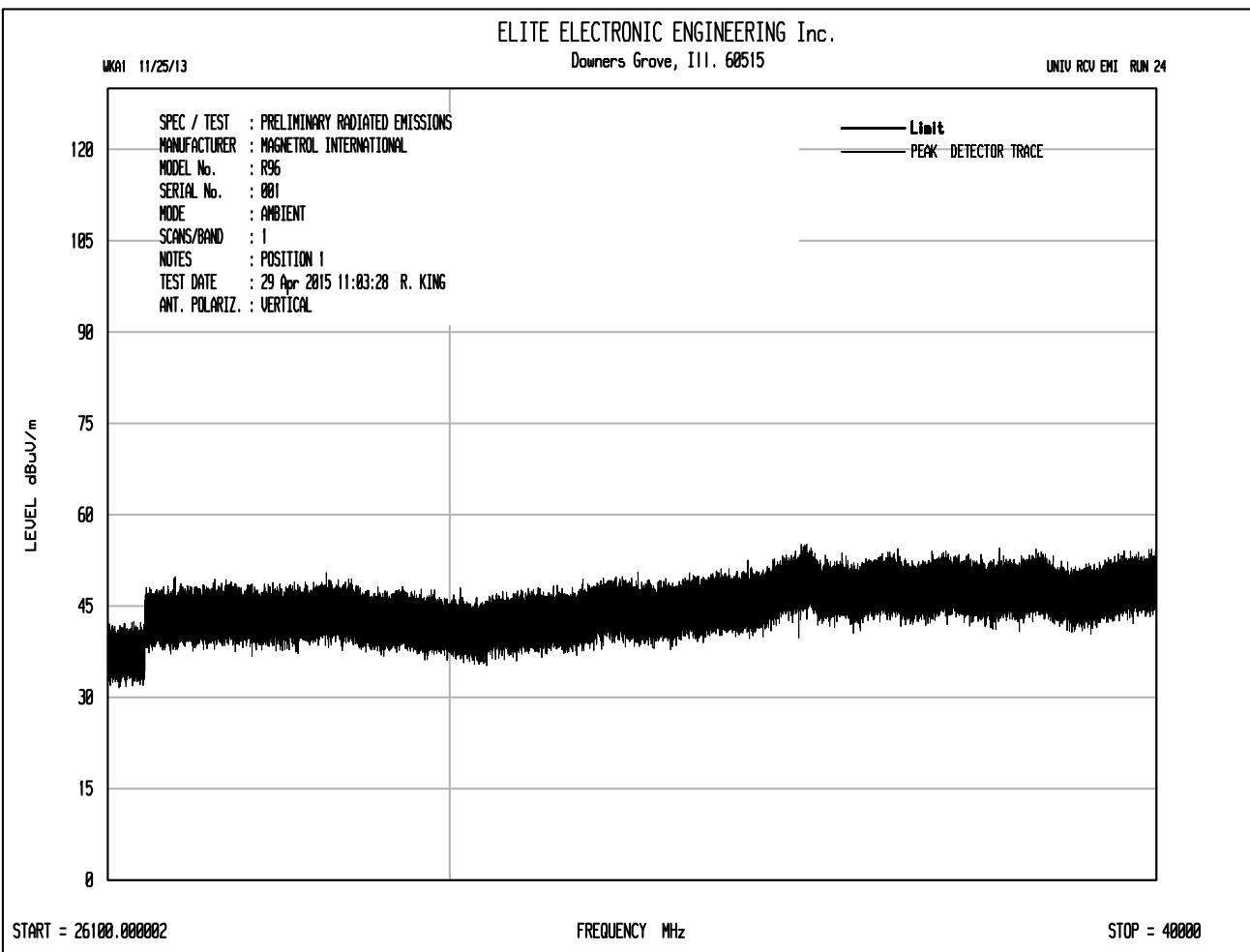
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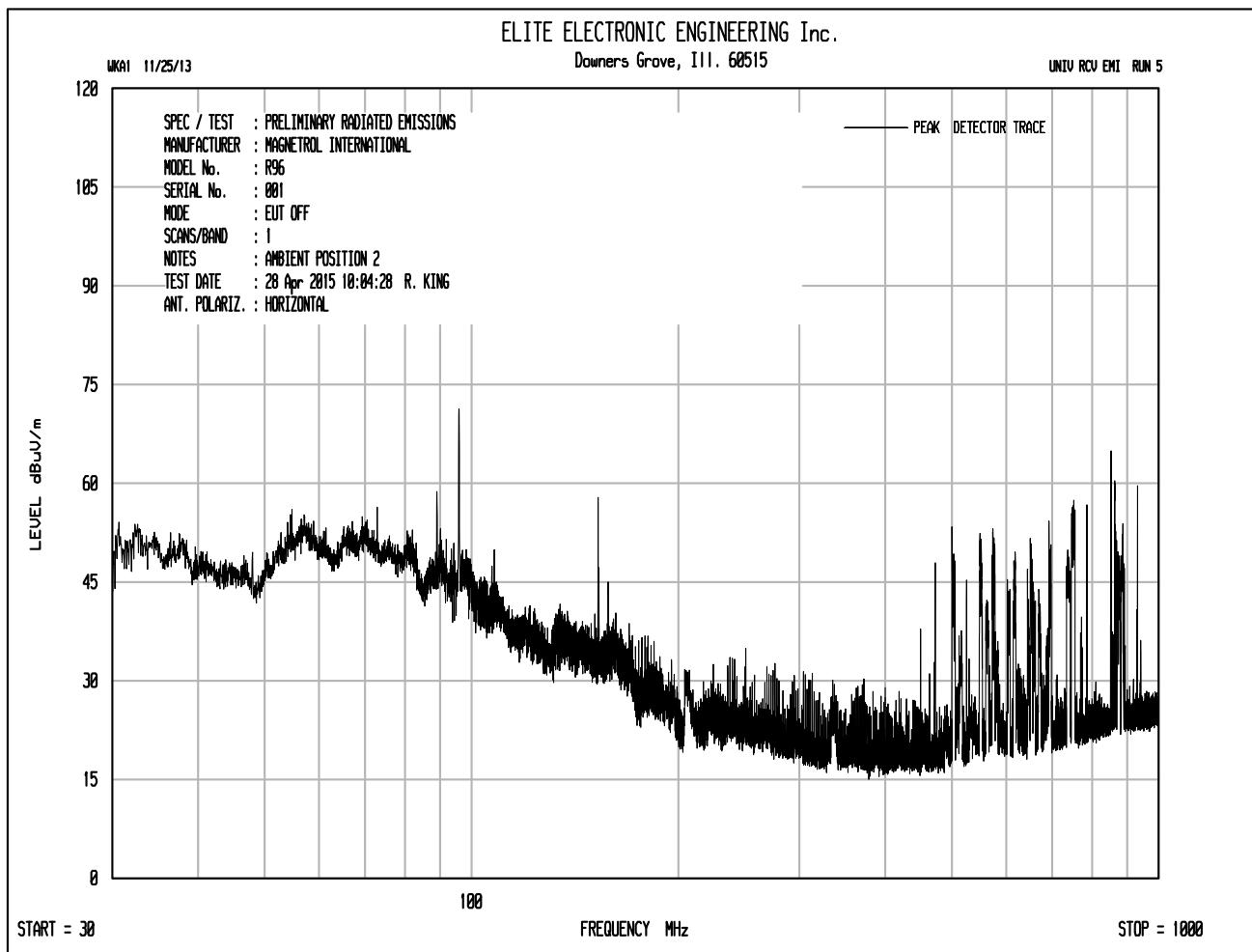


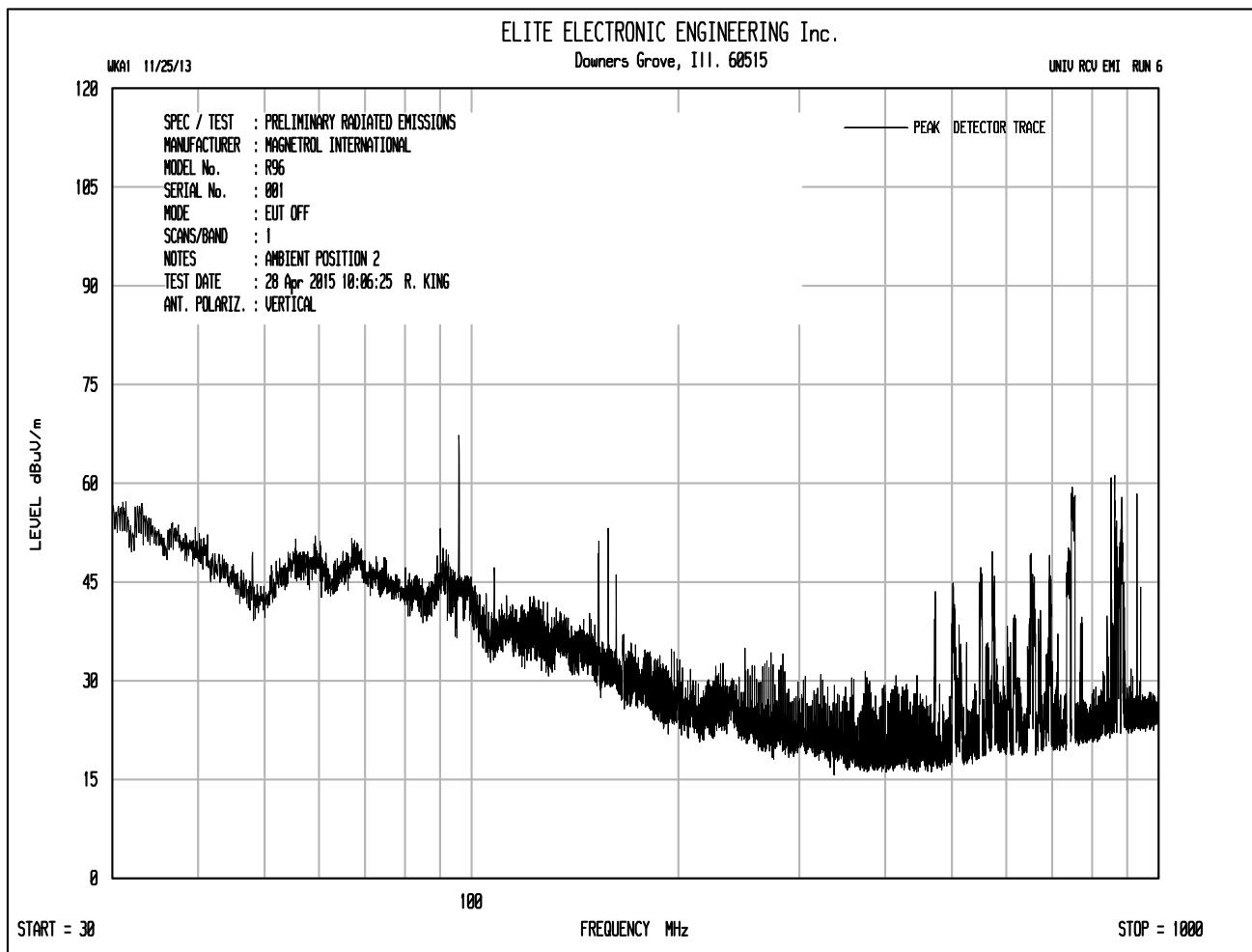










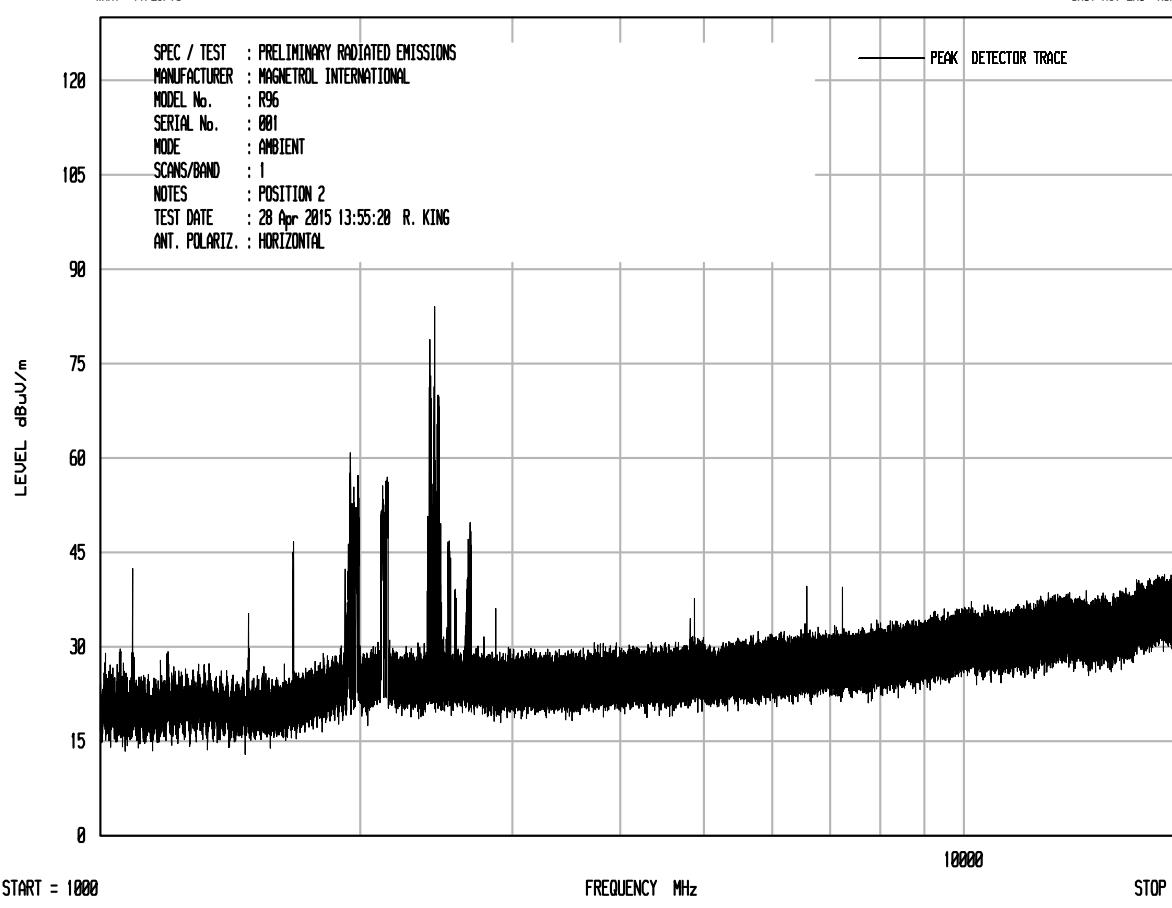


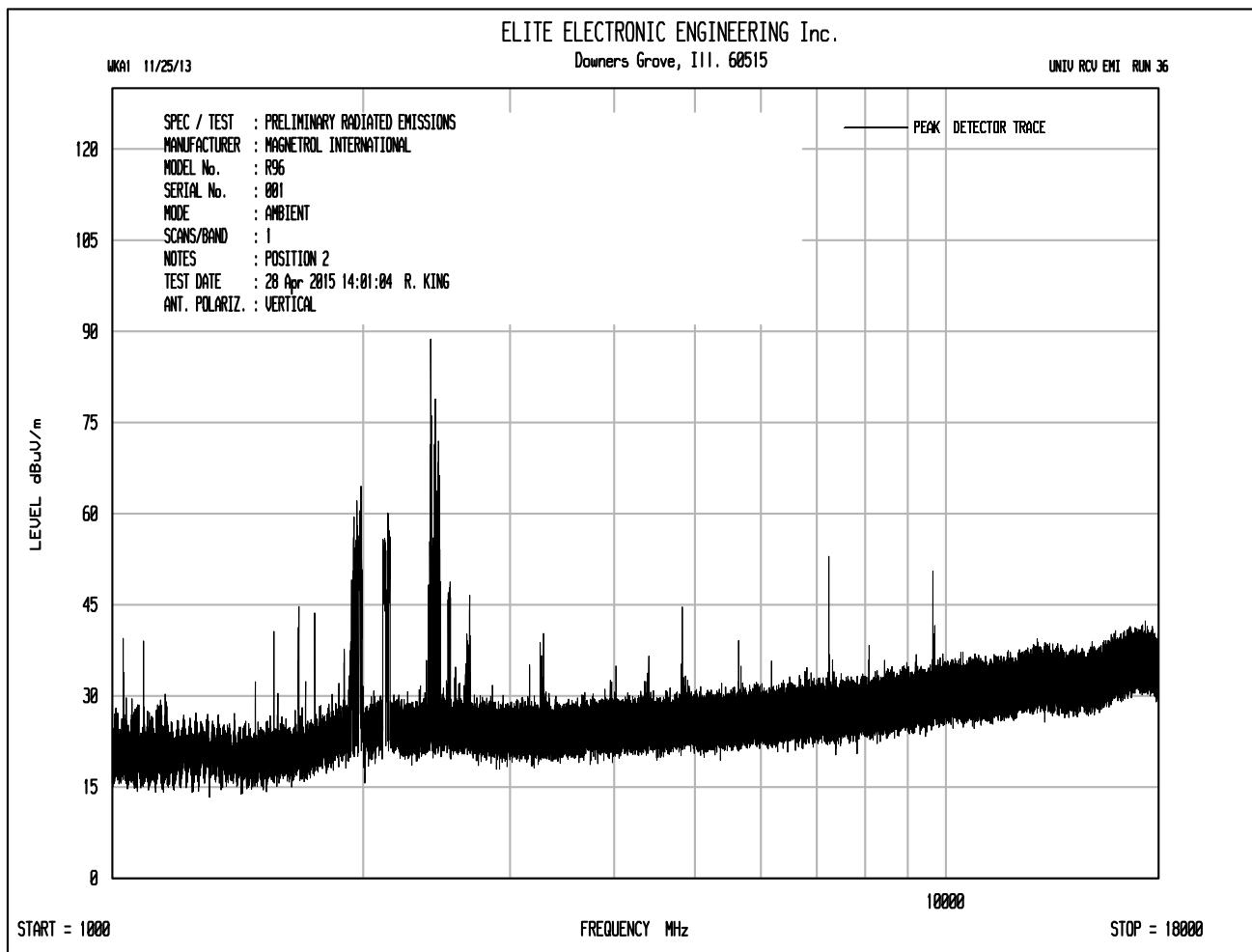
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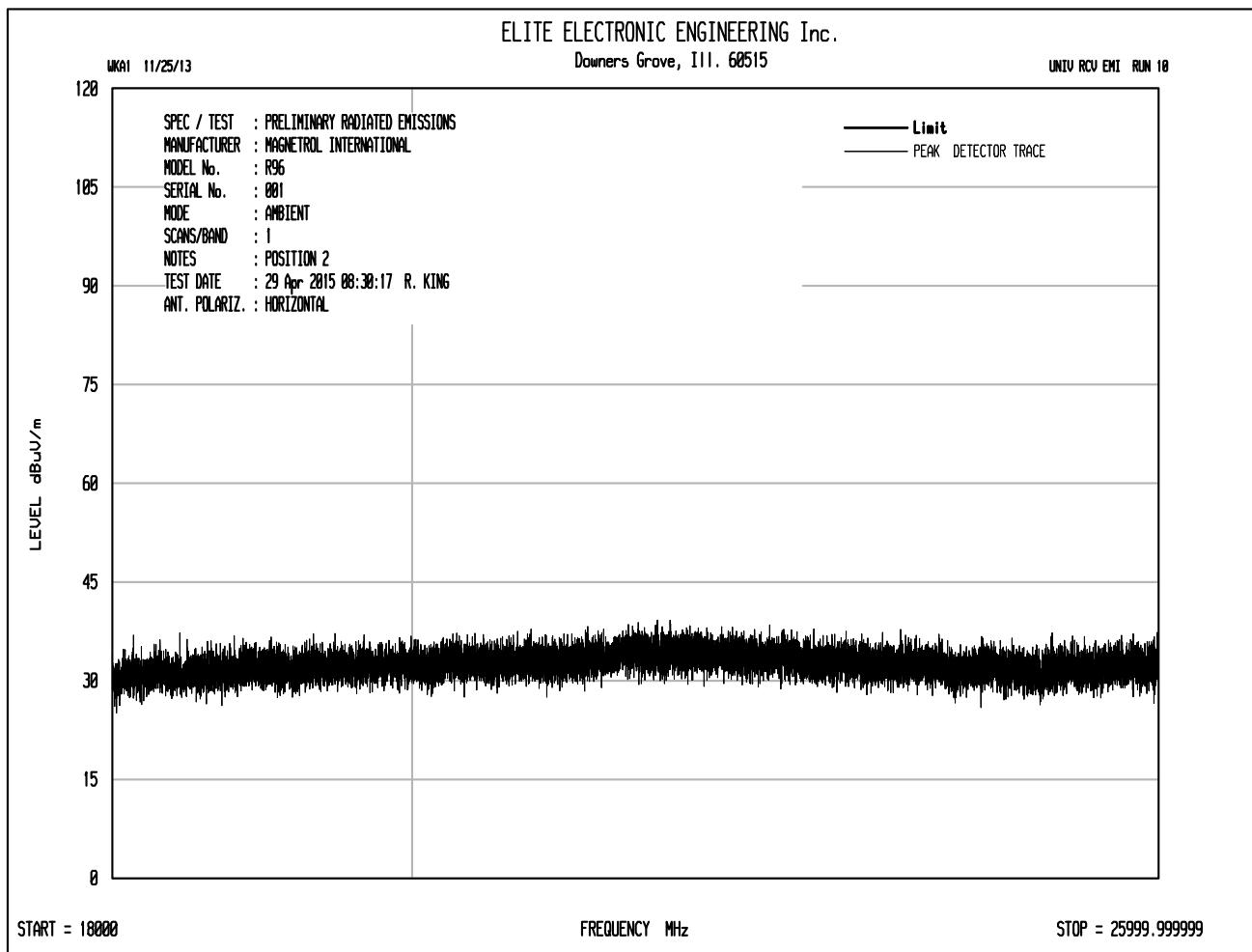
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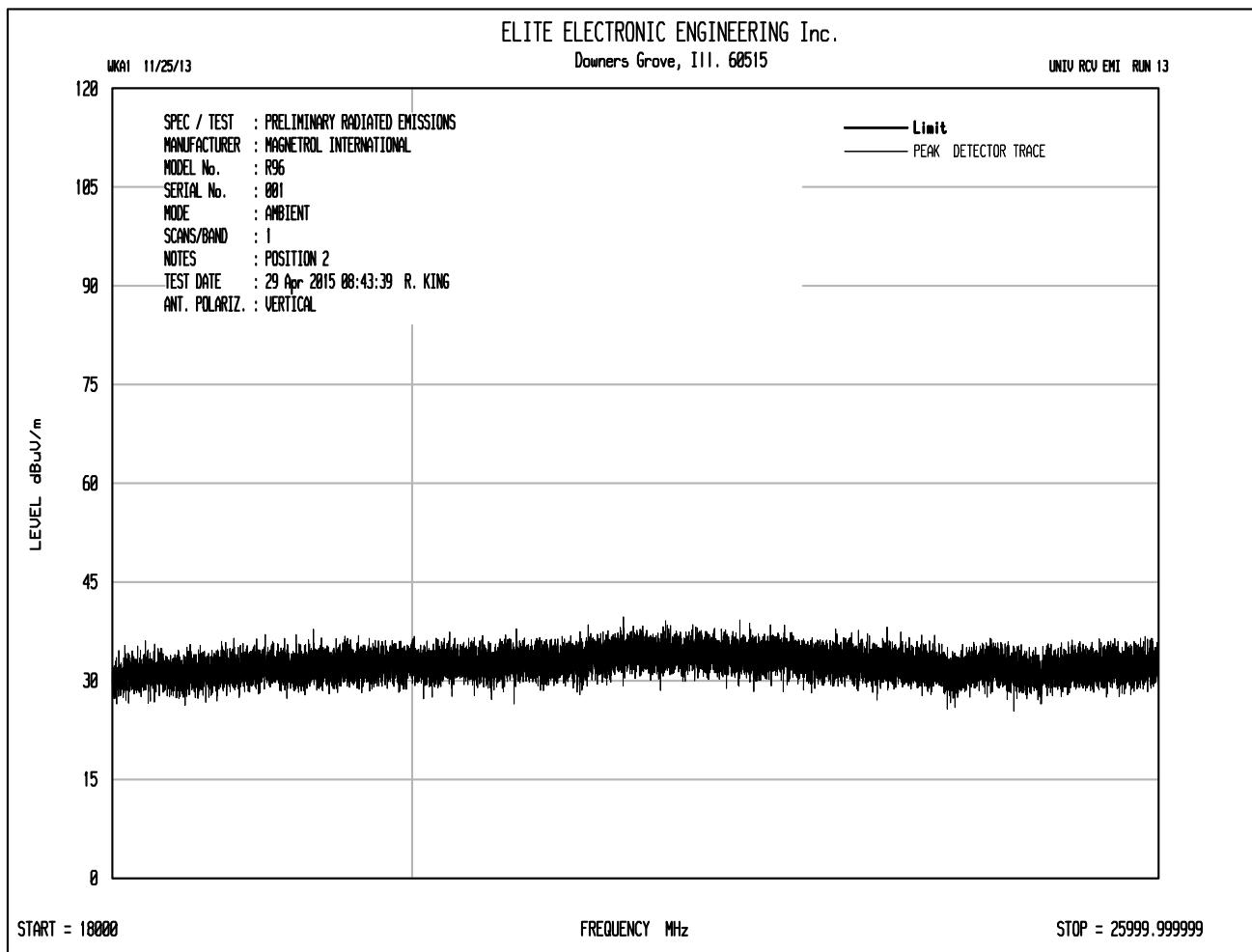
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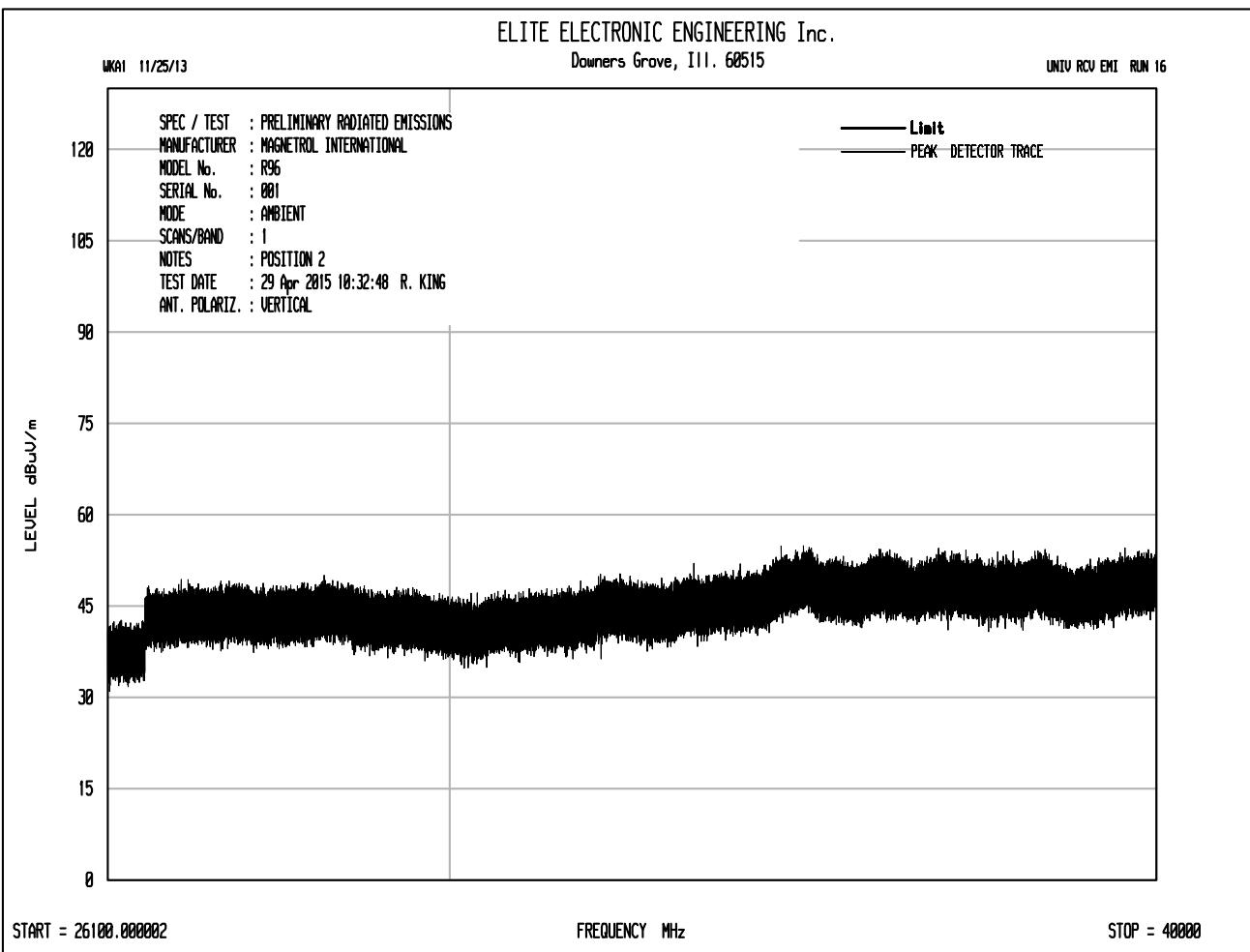
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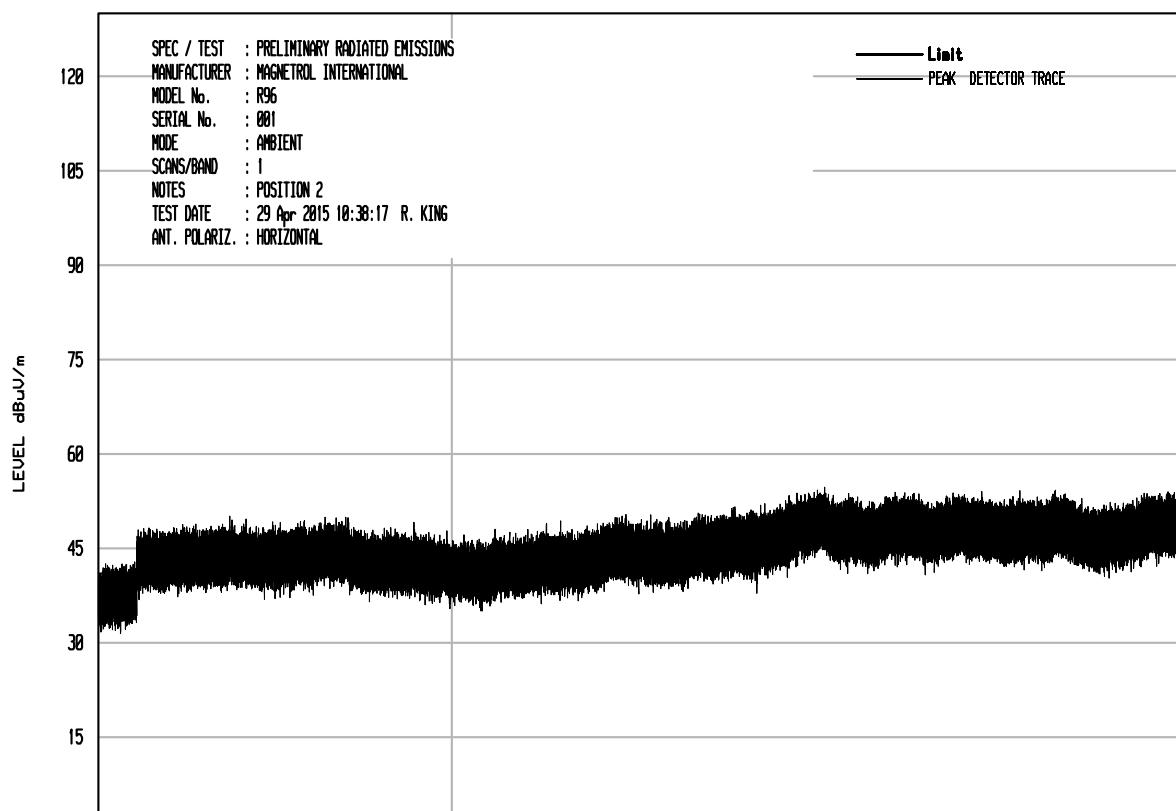


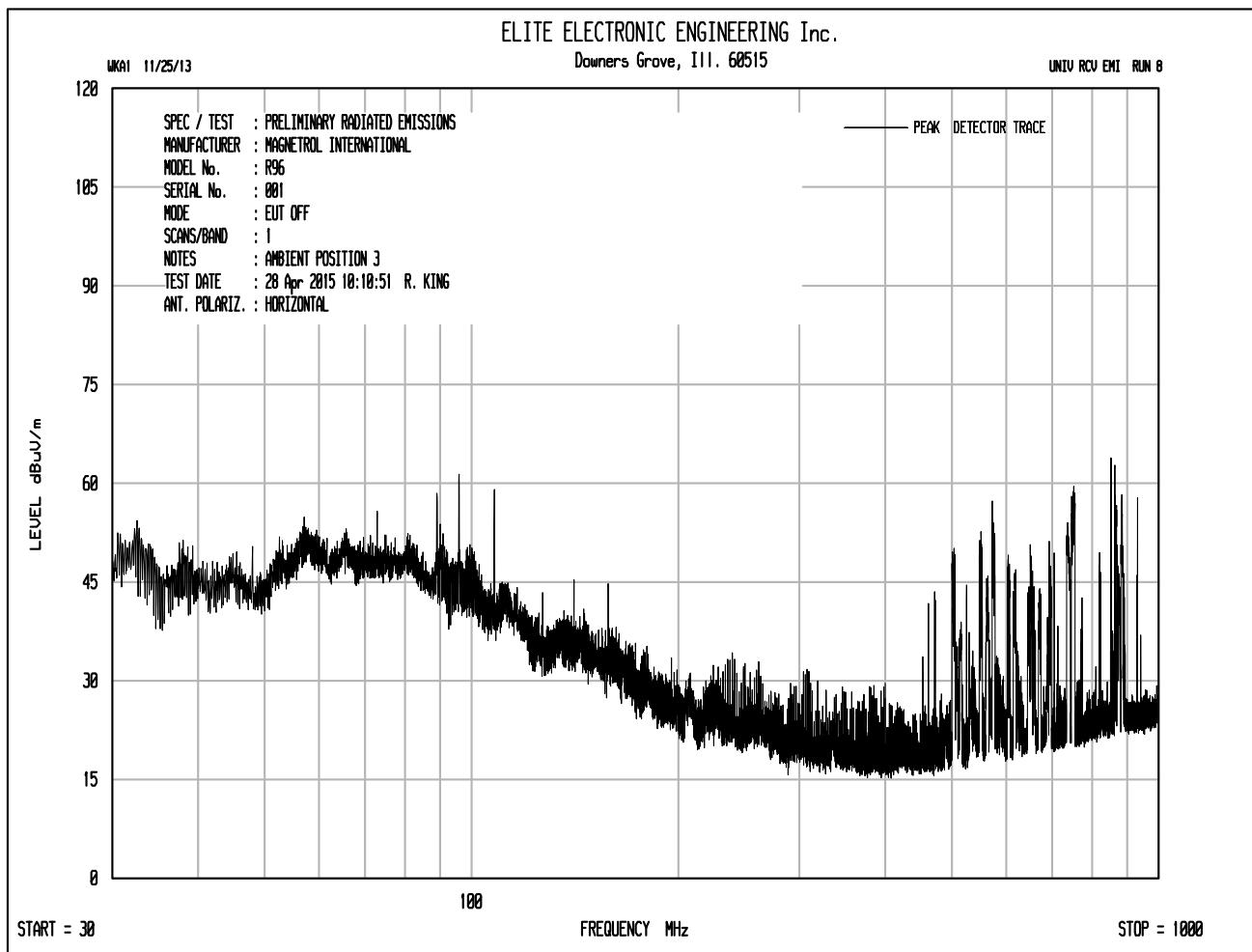
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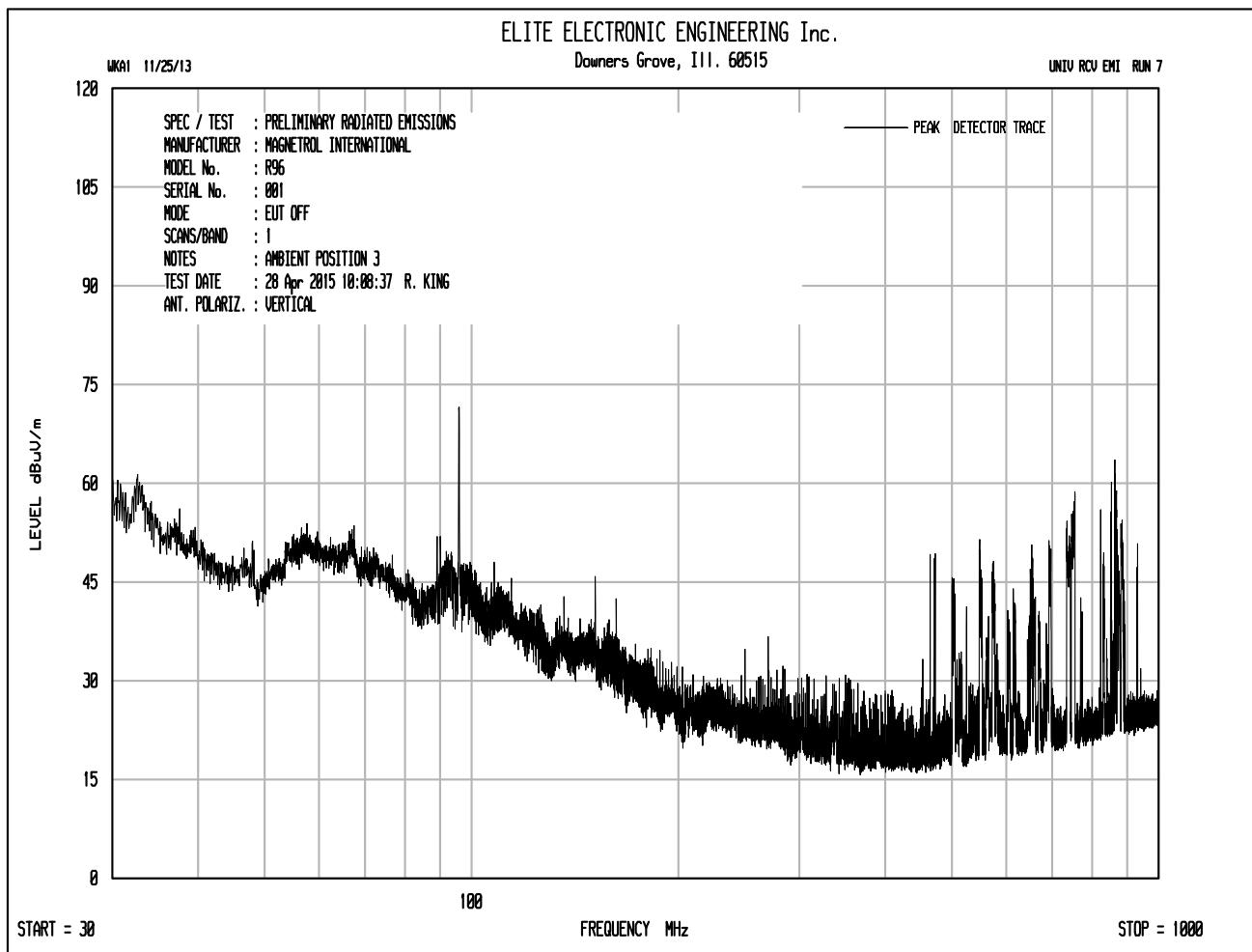
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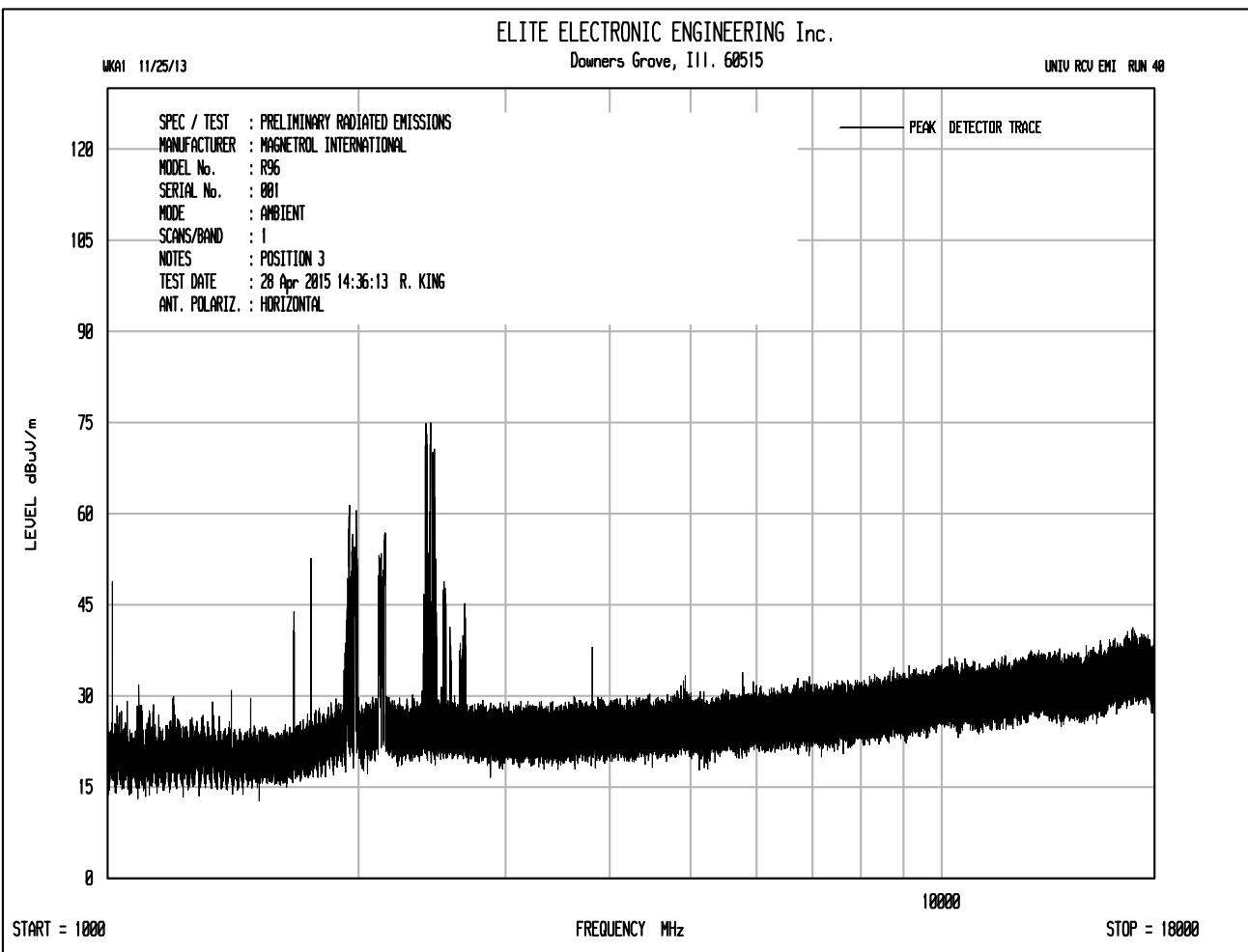
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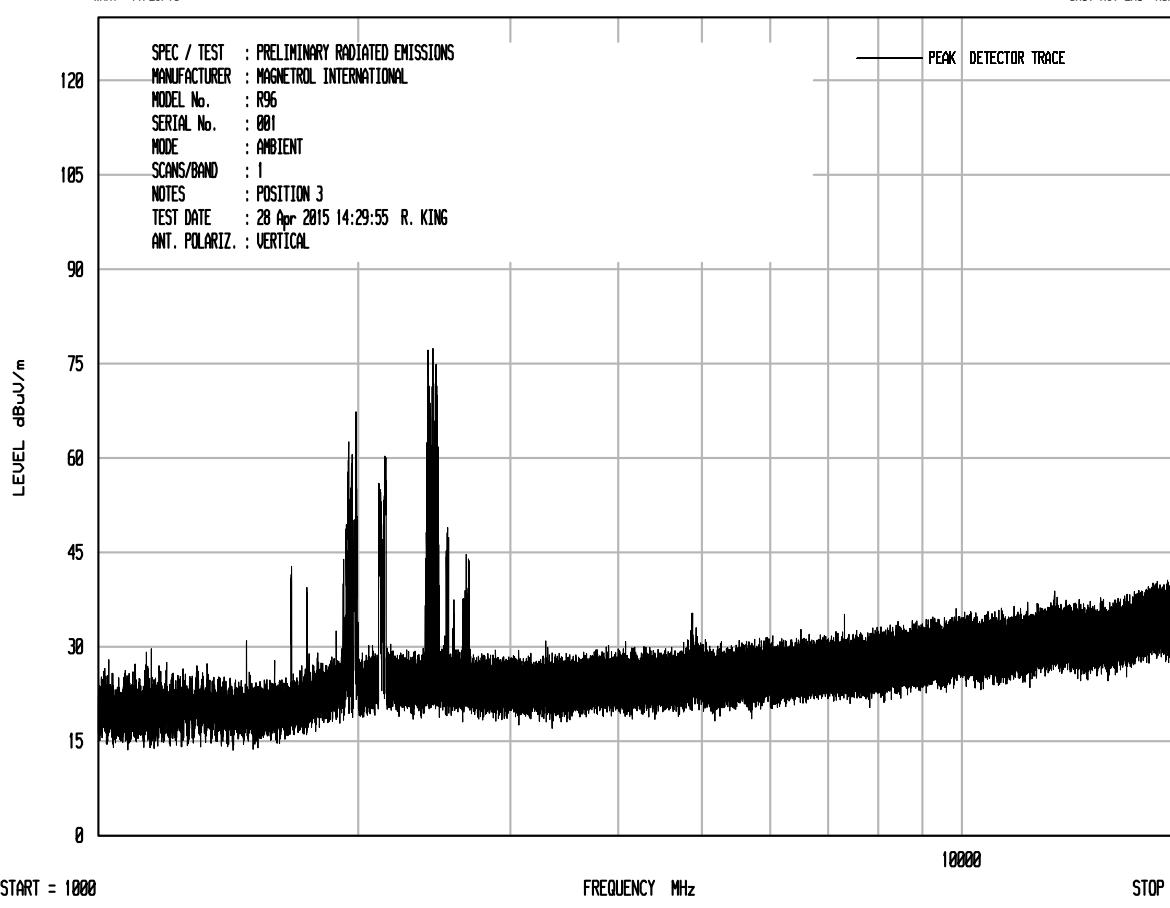


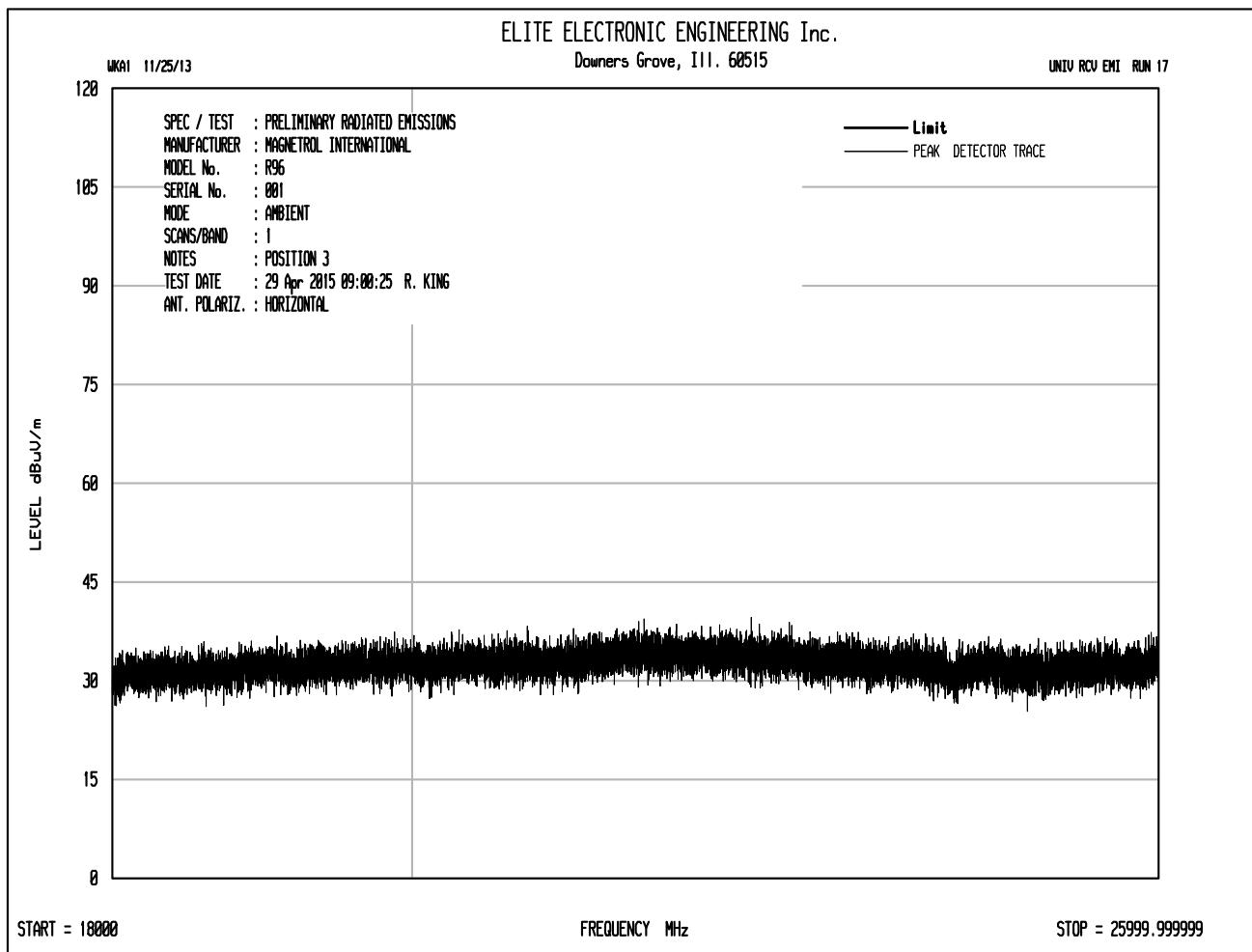
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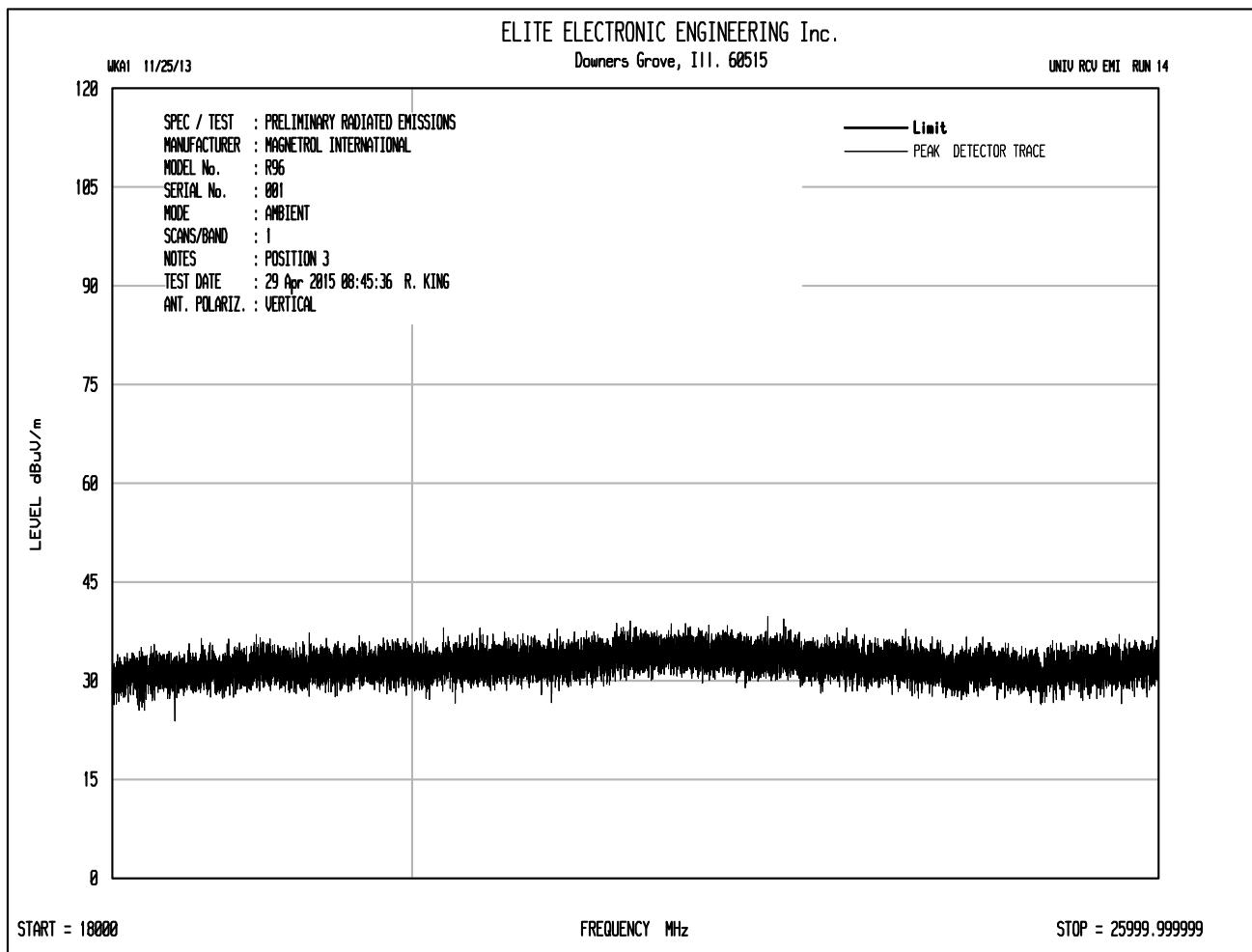
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Downers Grove, Ill. 60515

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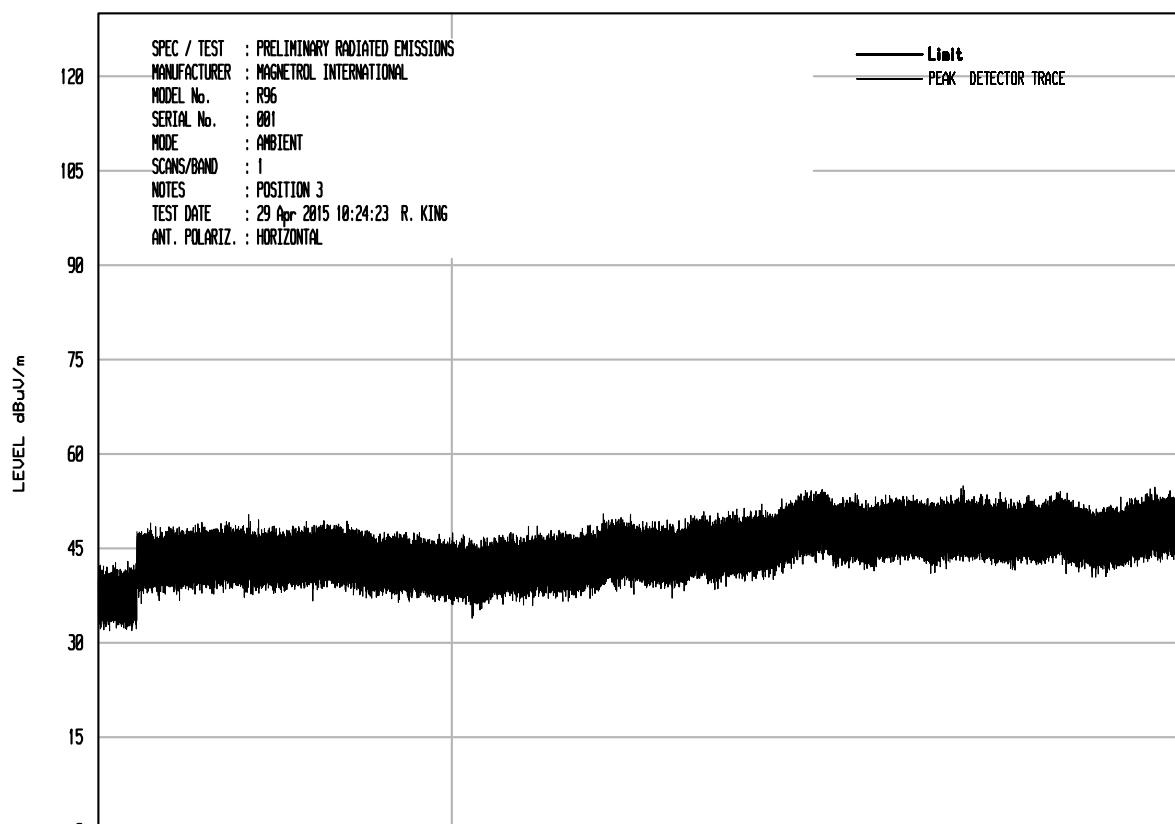


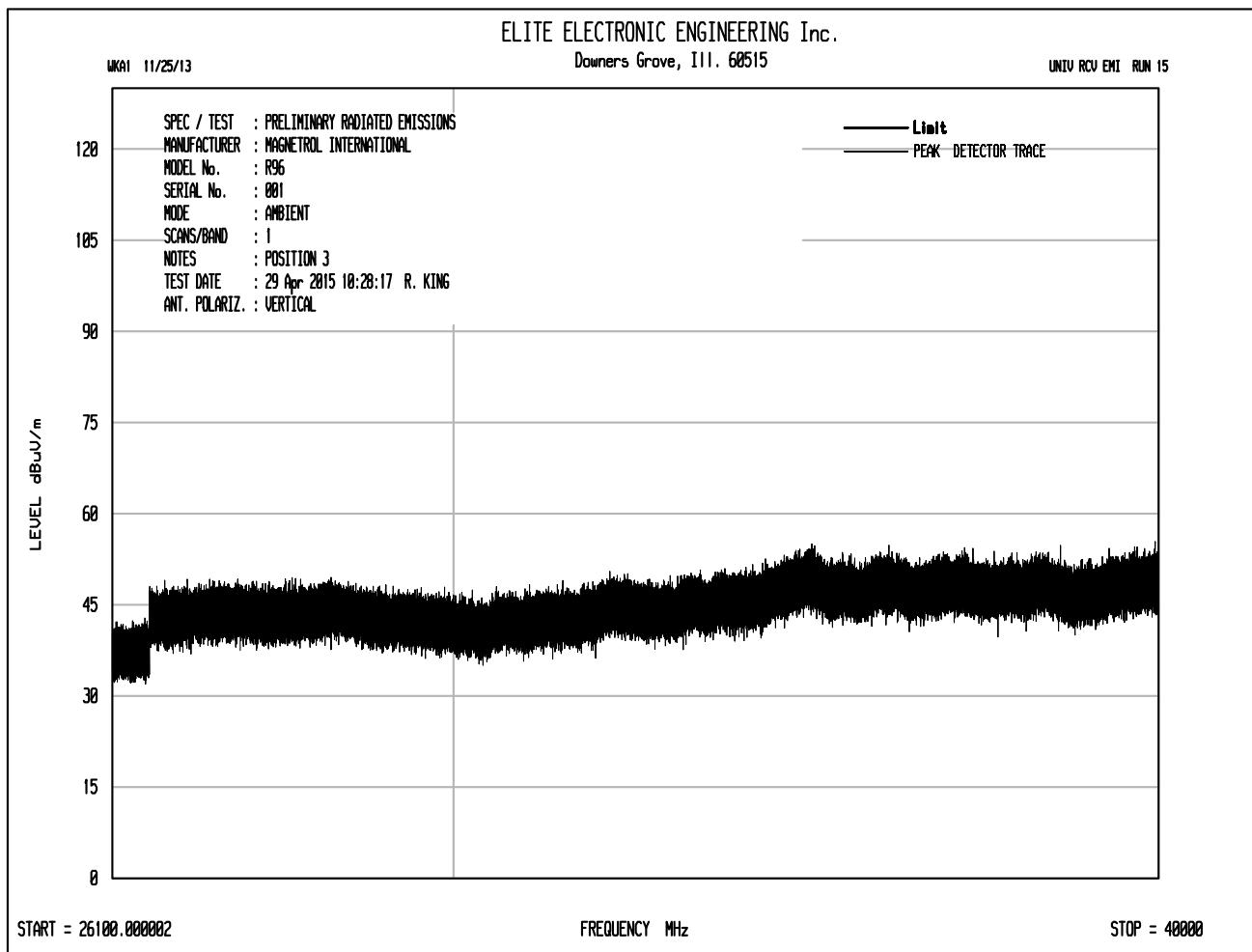
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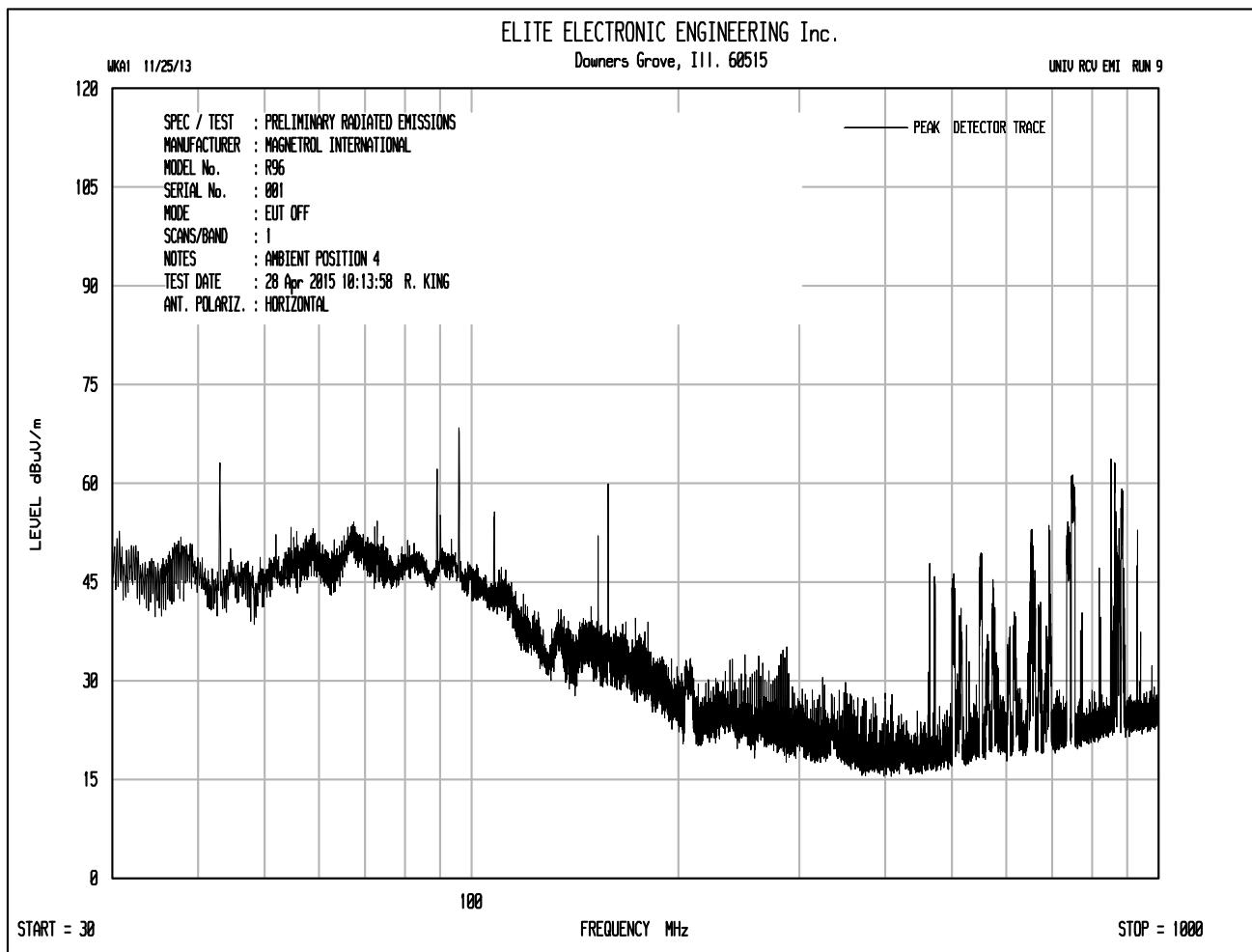
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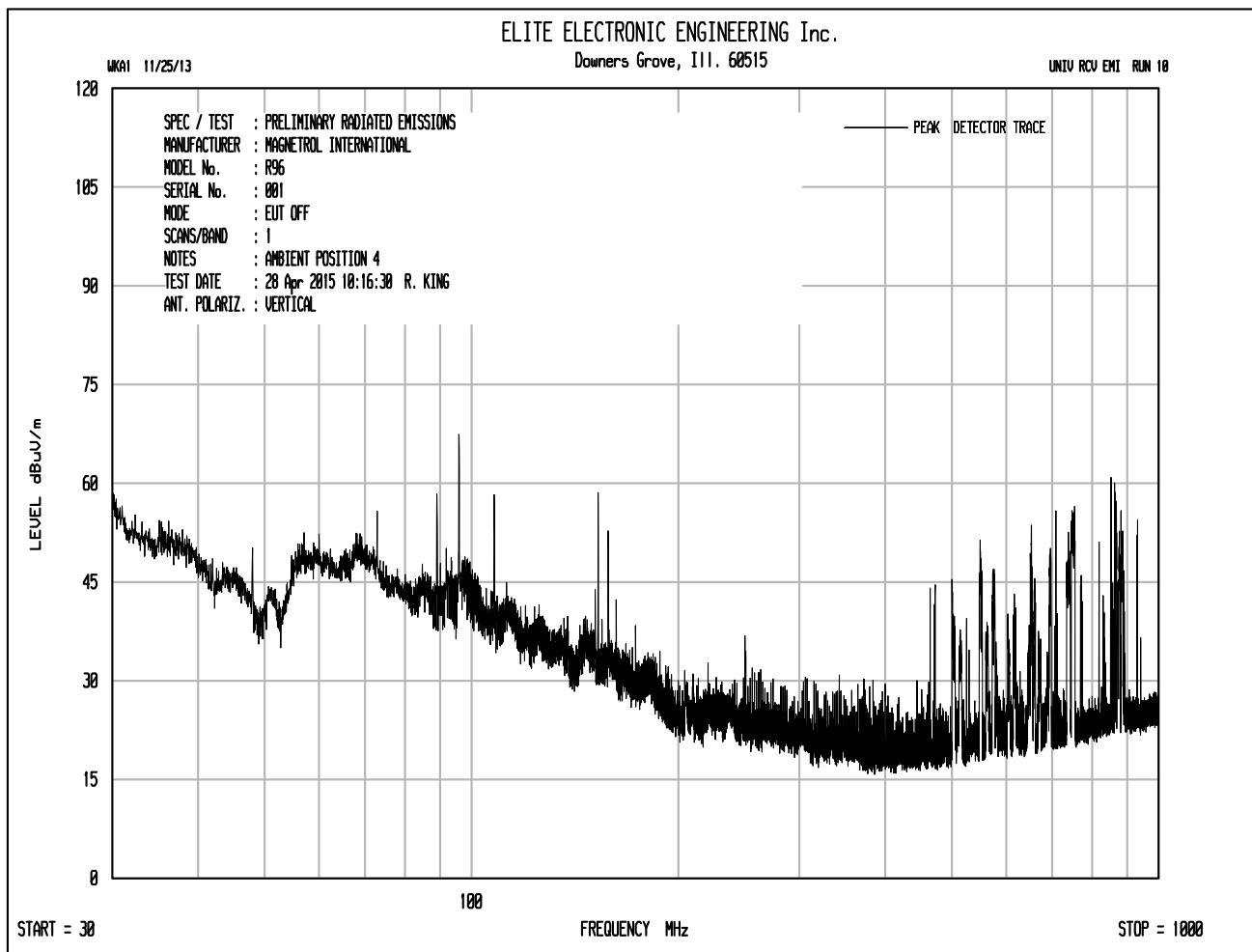
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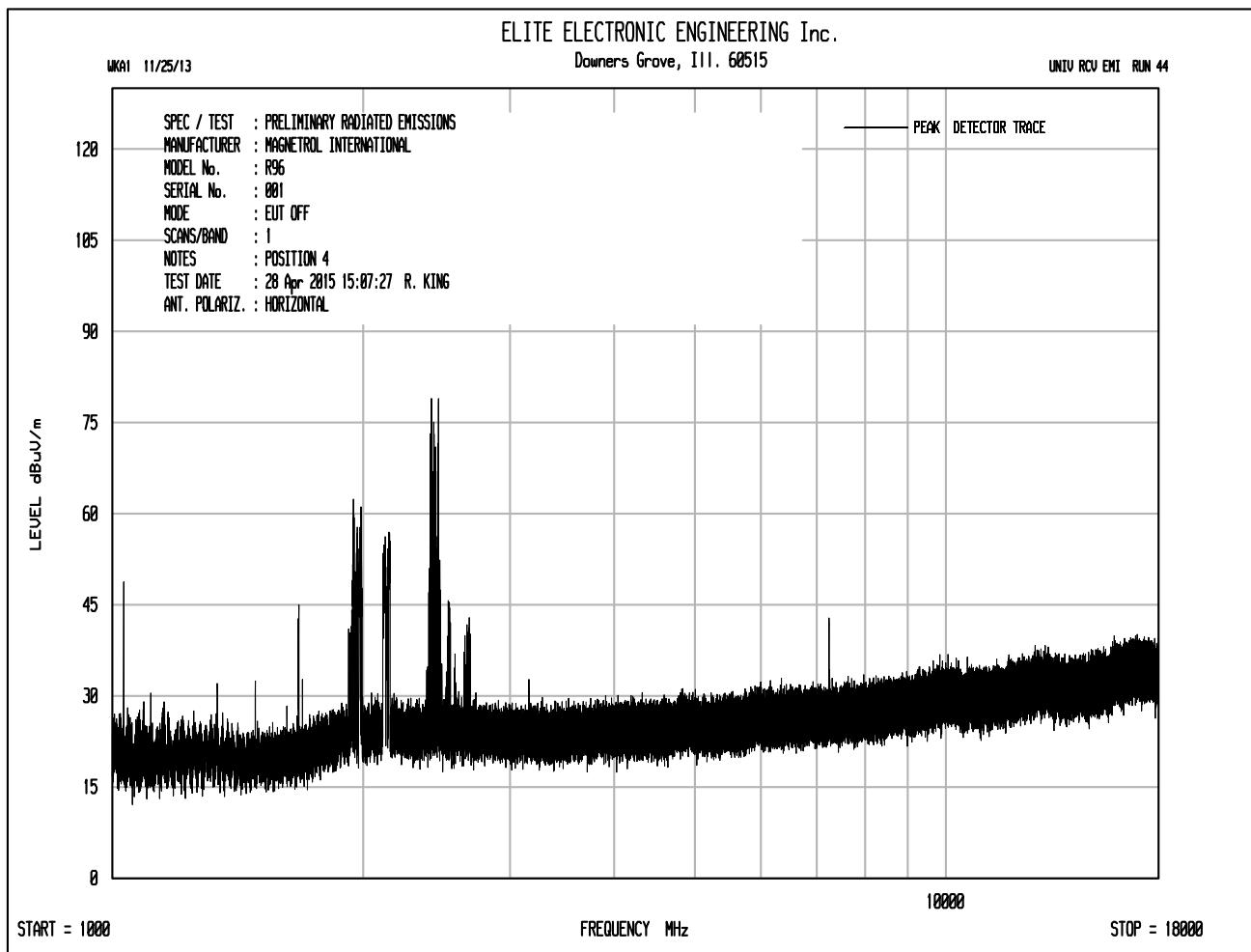
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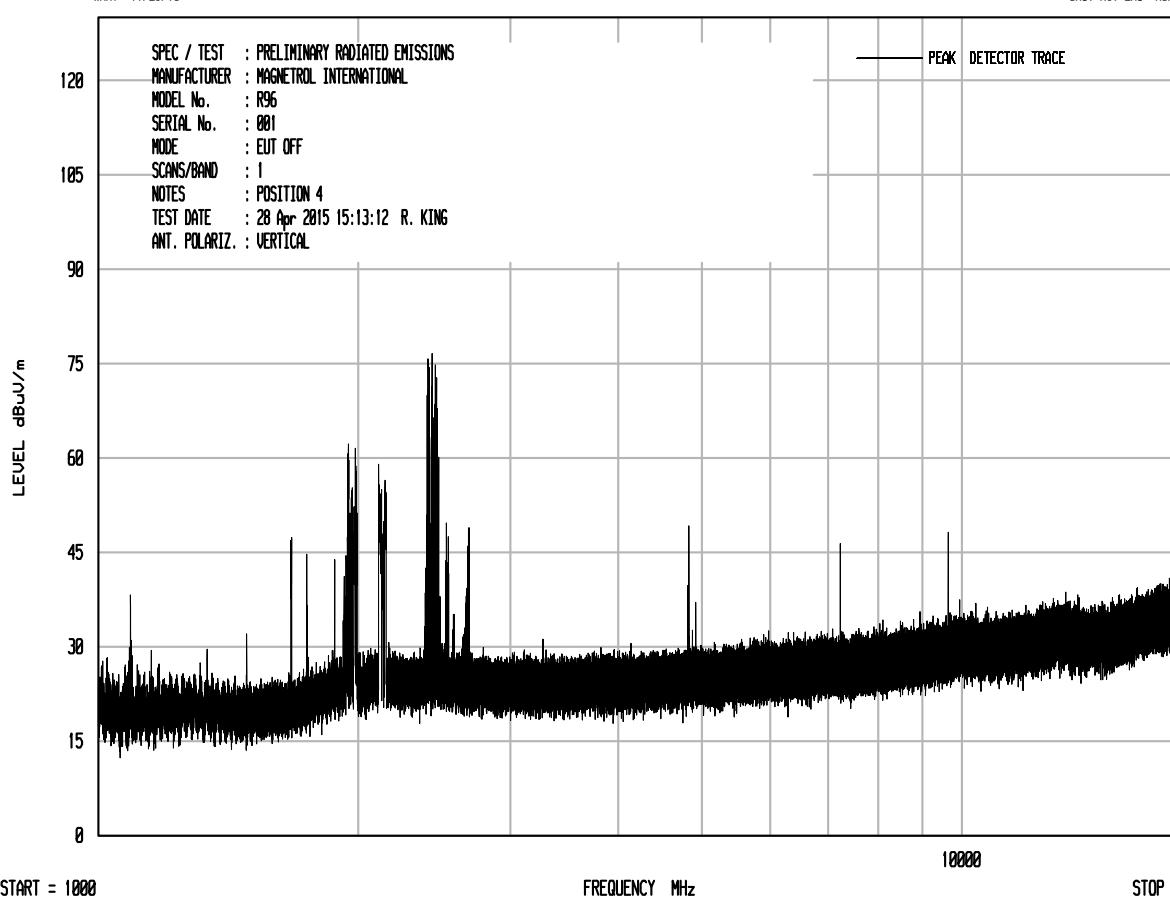


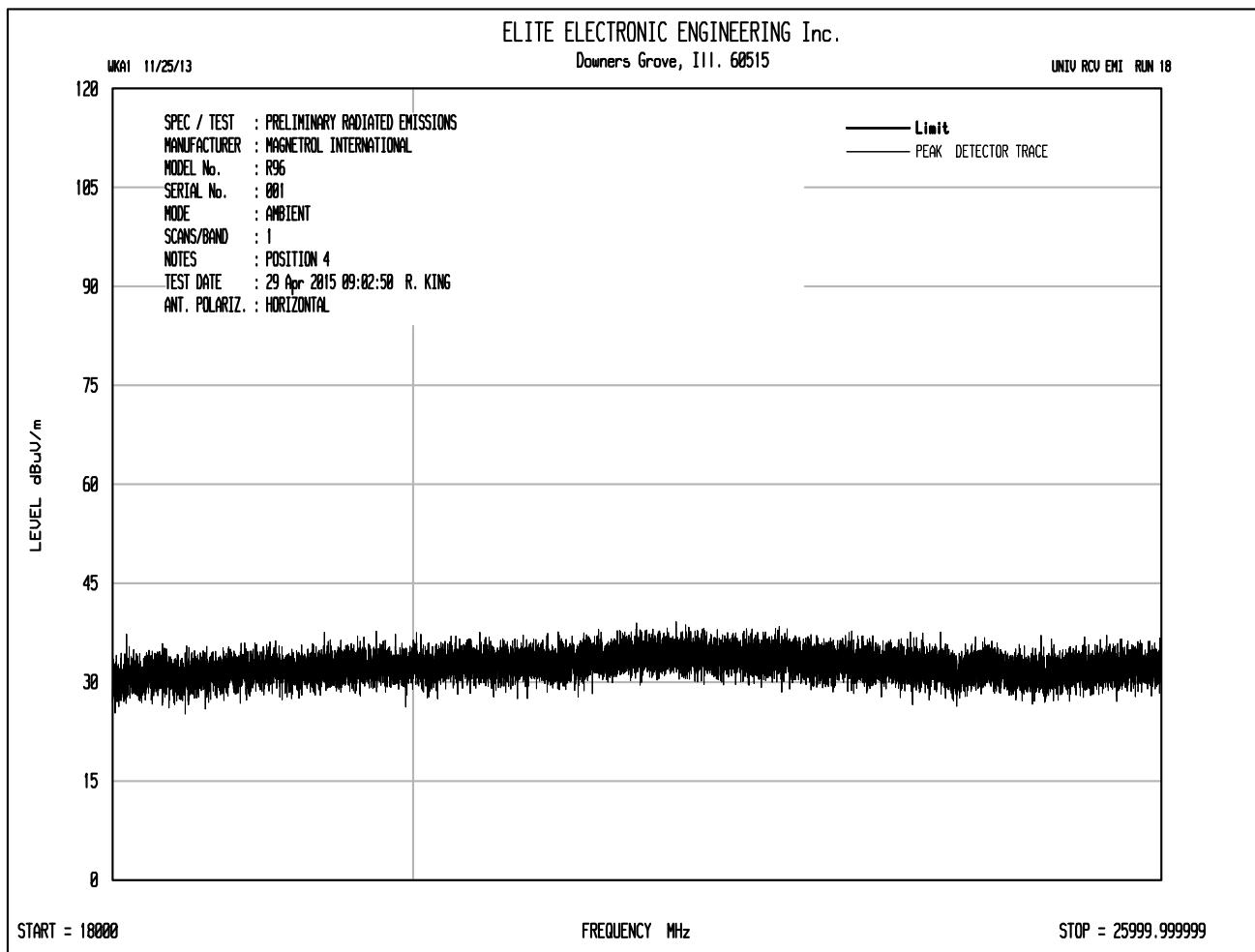
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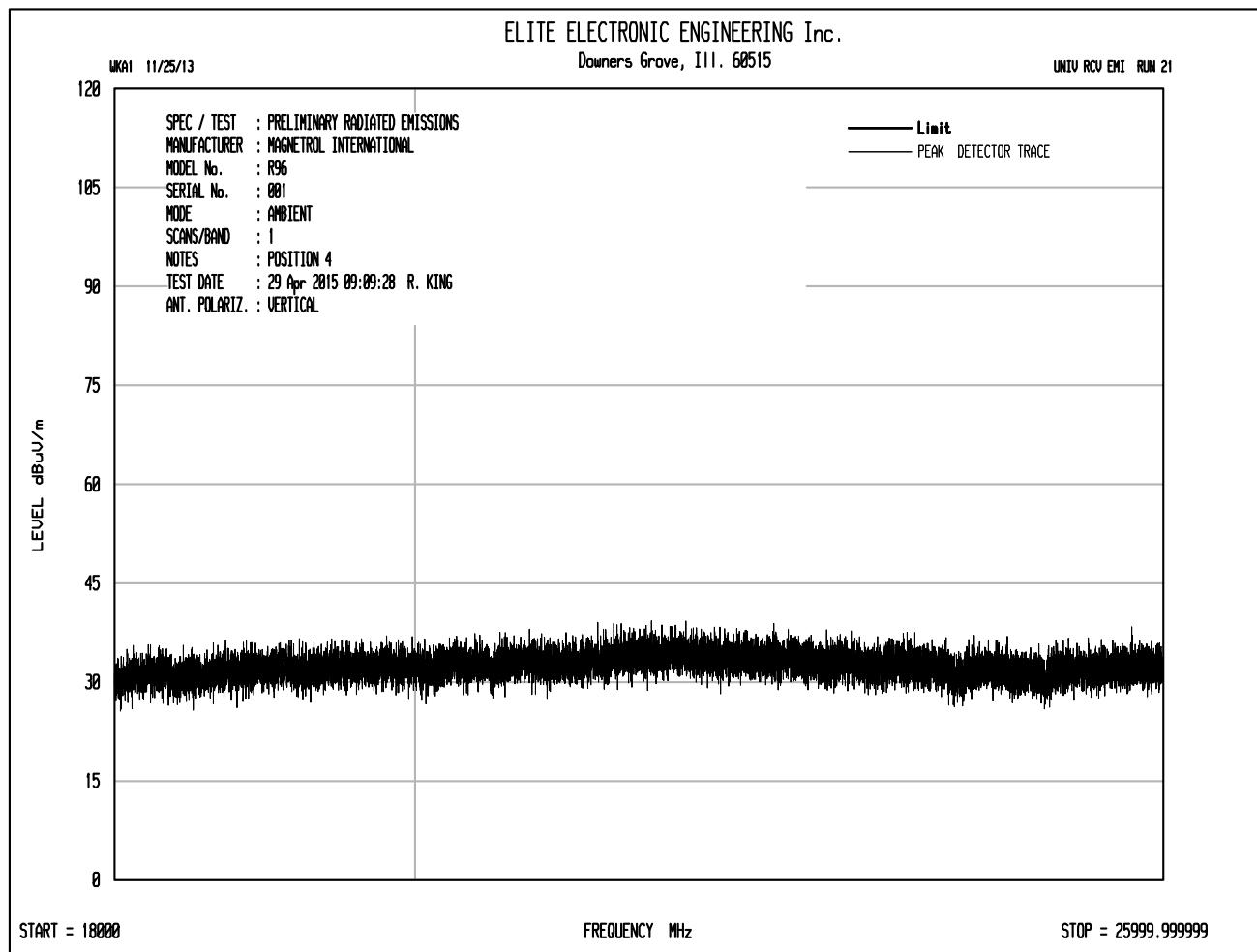
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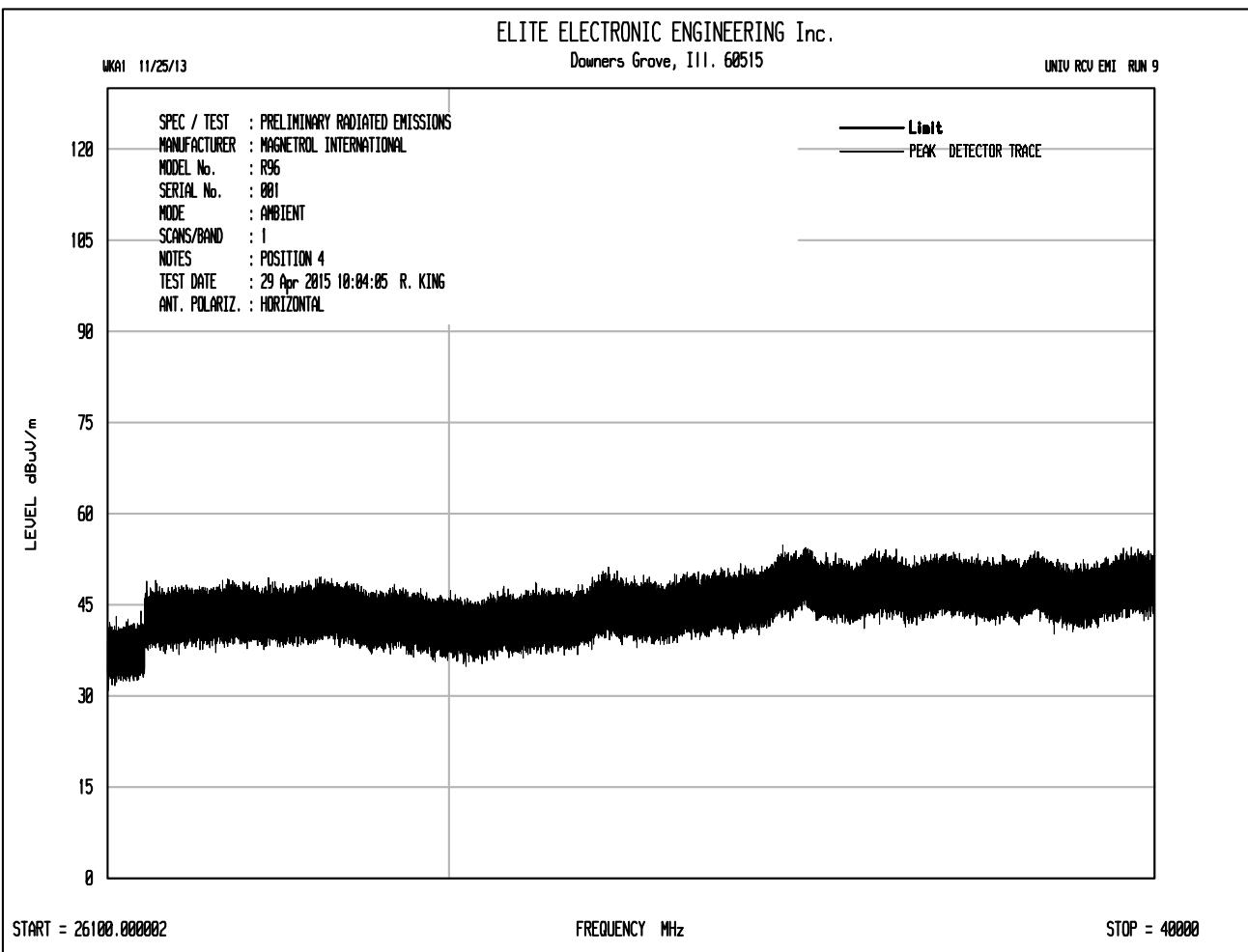
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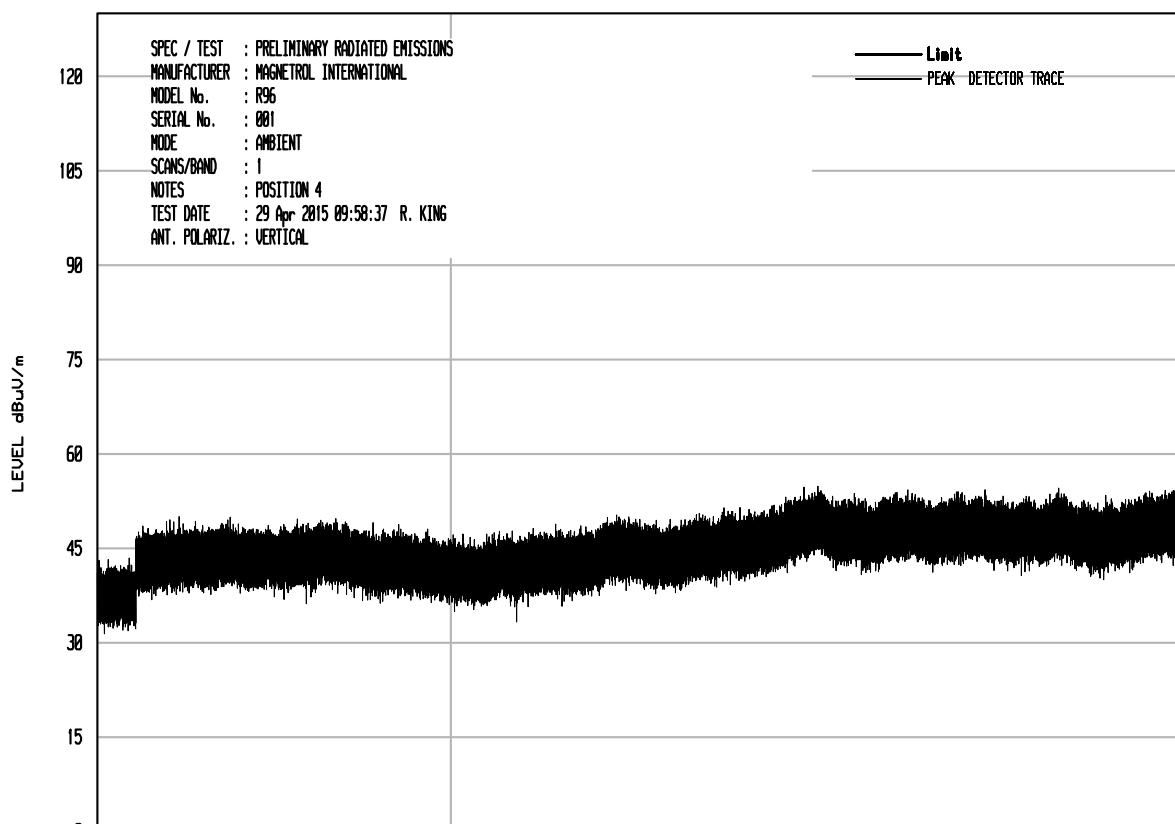
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WKA1 11/25/13

SPEC / TEST : PRELIMINARY RADIATED EMISSIONS  
MANUFACTURER : MAGNETROL INTERNATIONAL  
MODEL No. : R96  
SERIAL No. : 081  
MODE : AMBIENT  
SCANS/BAND : 1  
NOTES : POSITION 4  
TEST DATE : 29 Apr 2015 09:58:37 R. KING  
ANT. POLARIZ. : VERTICAL

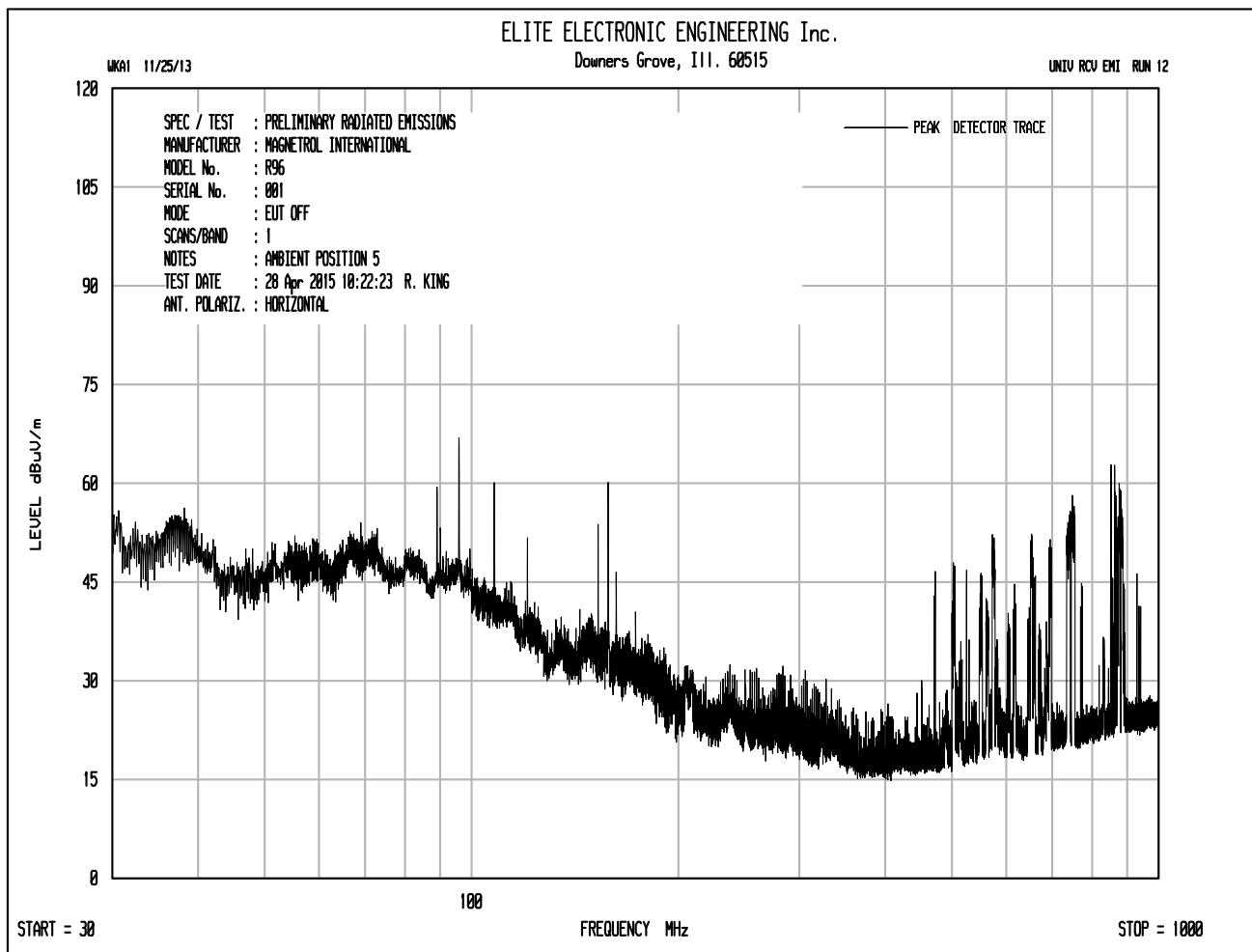
**Limit**  
PEAK DETECTOR TRACE

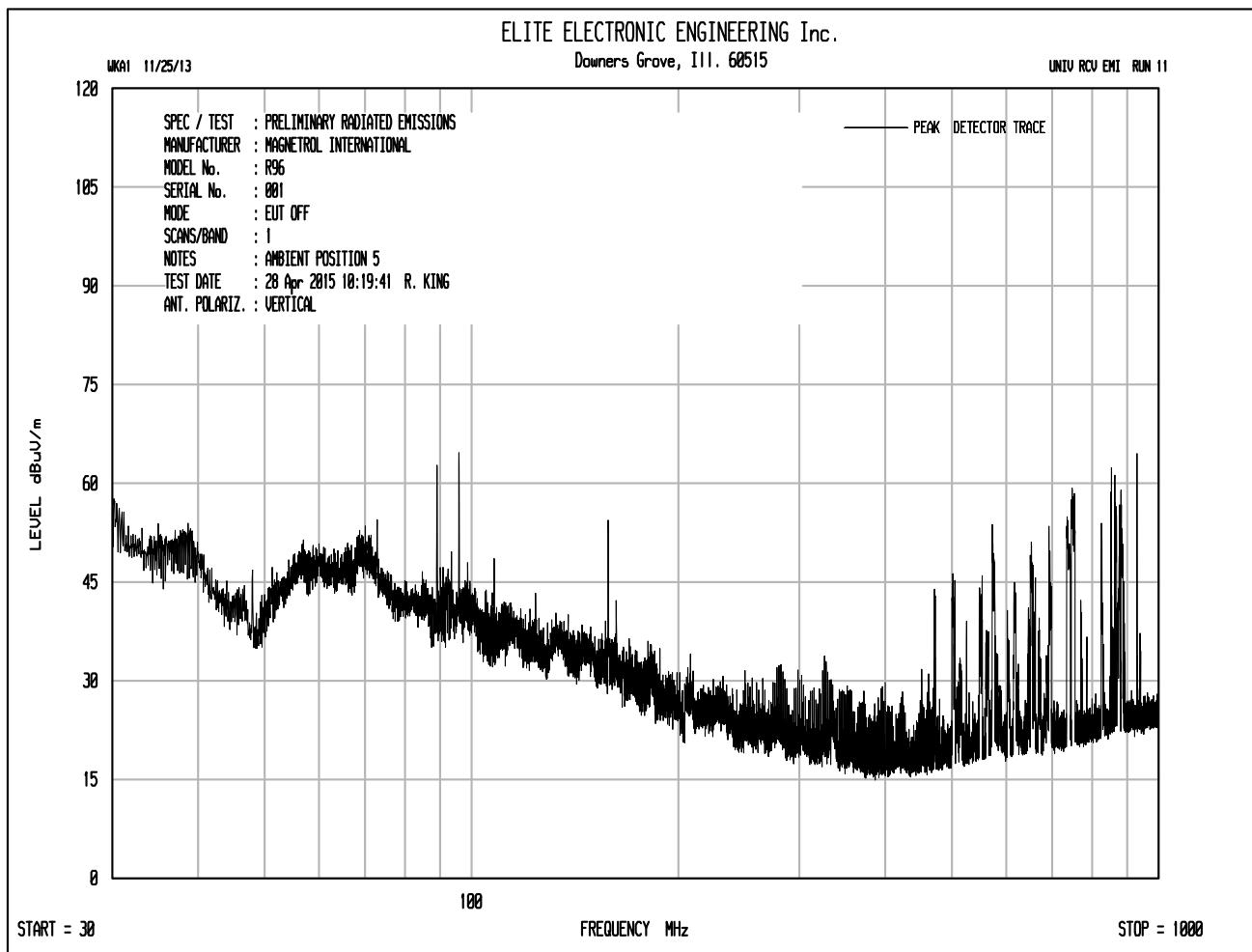


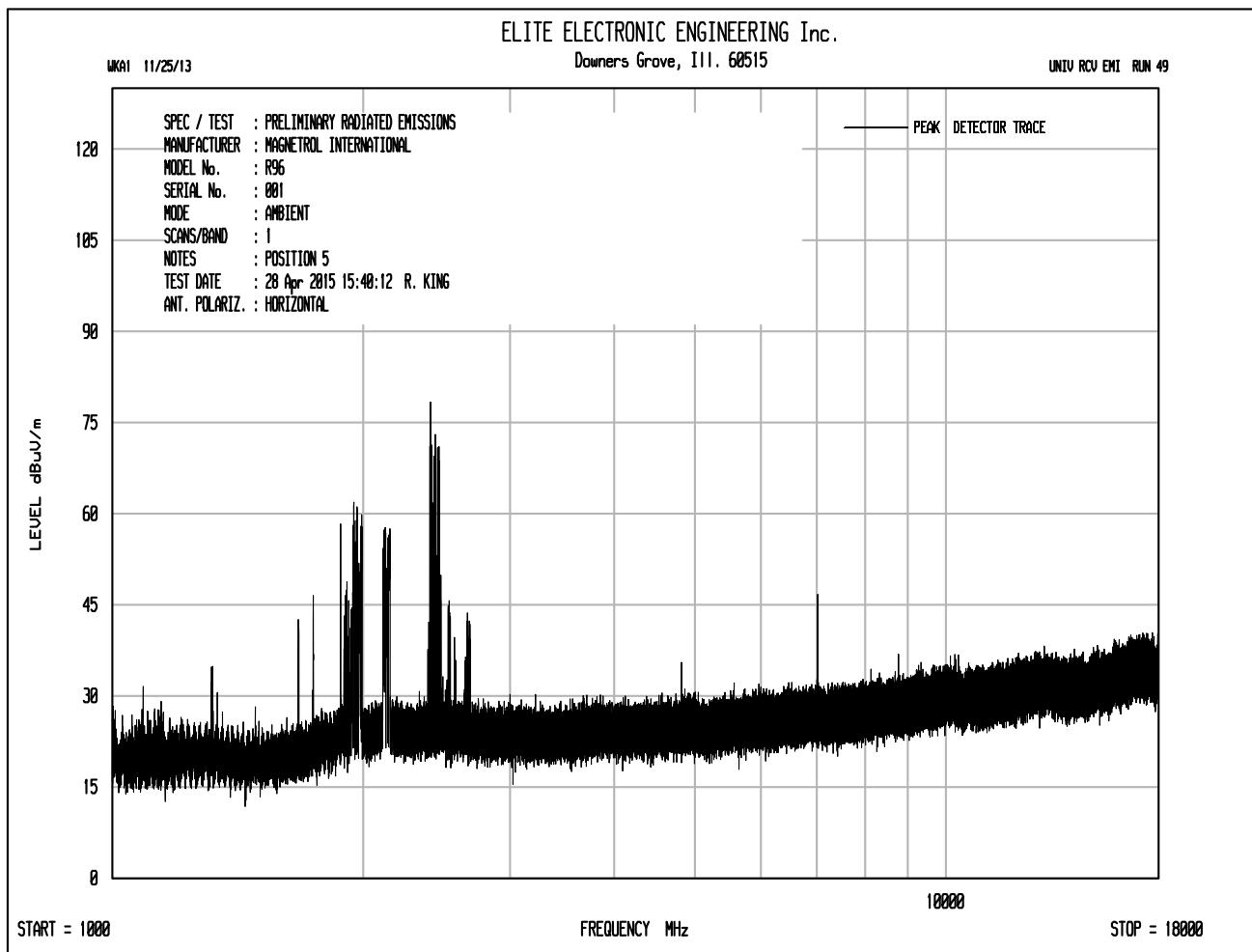
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**FREQUENCY MHz**

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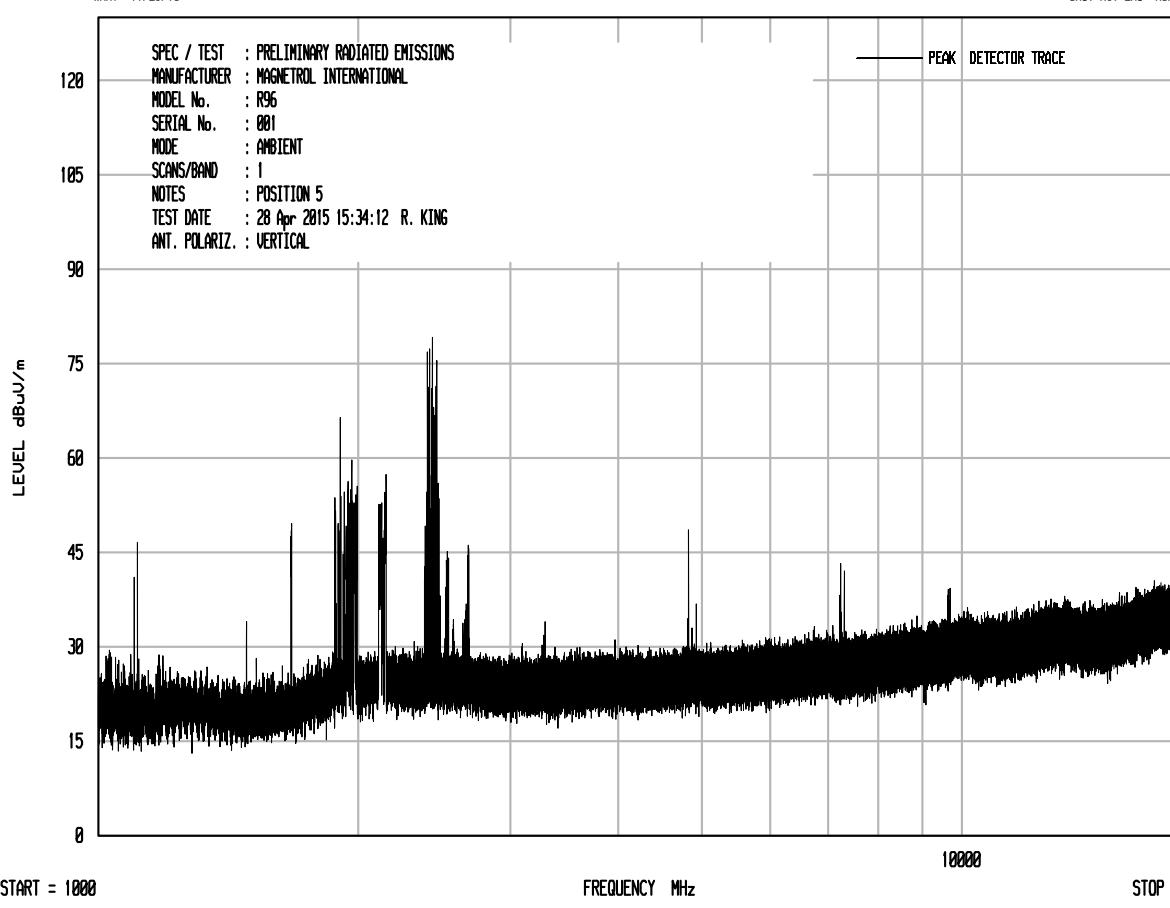


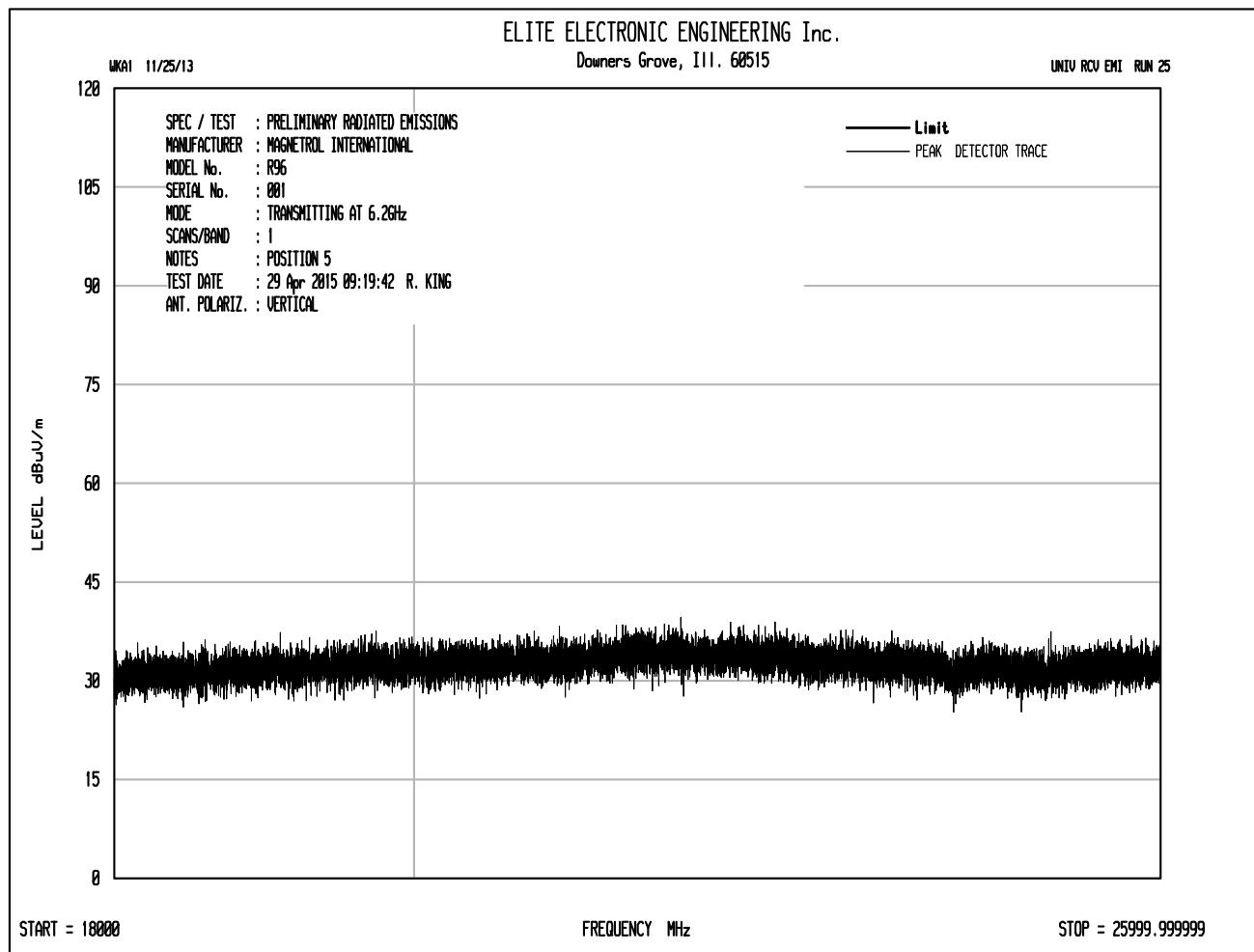
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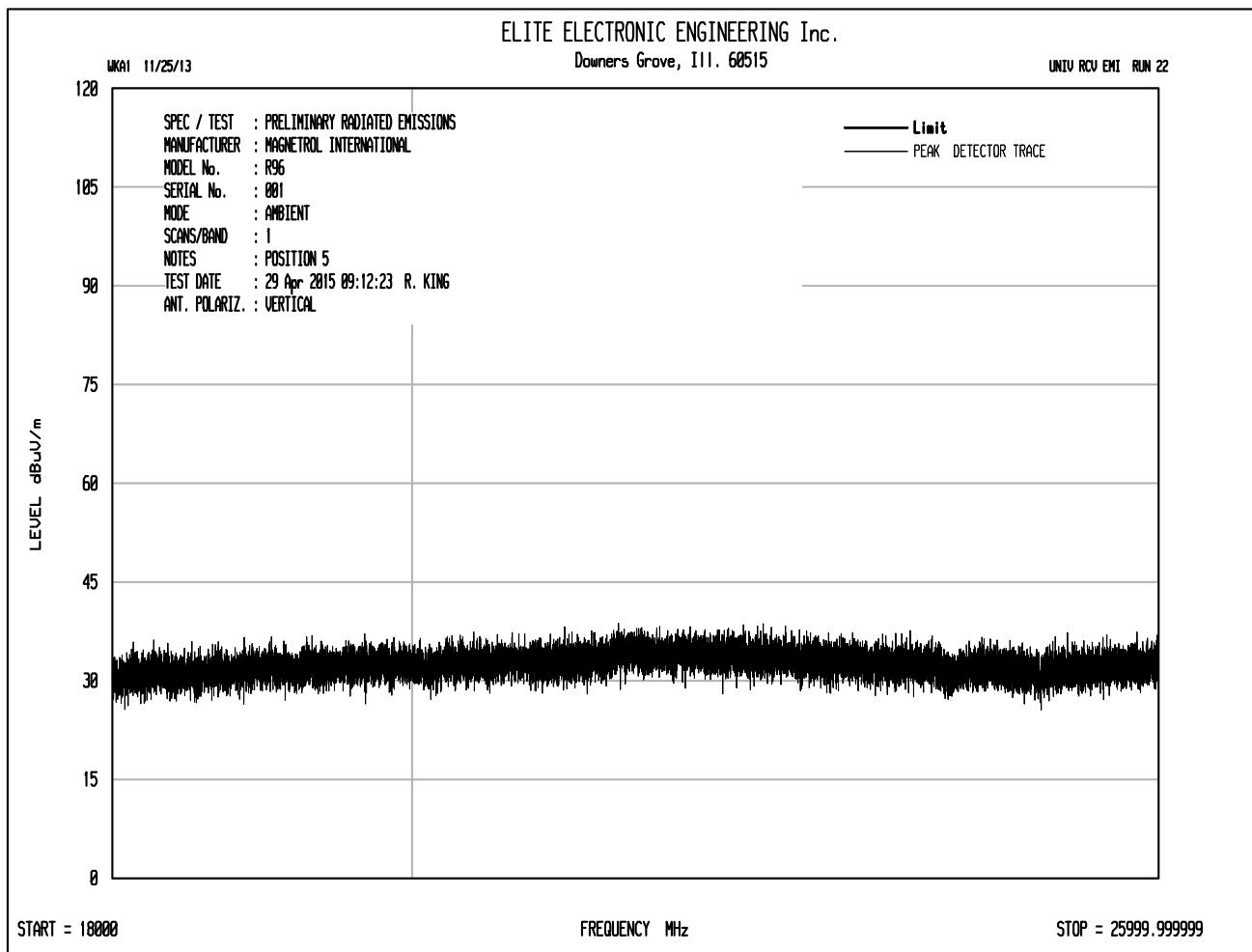
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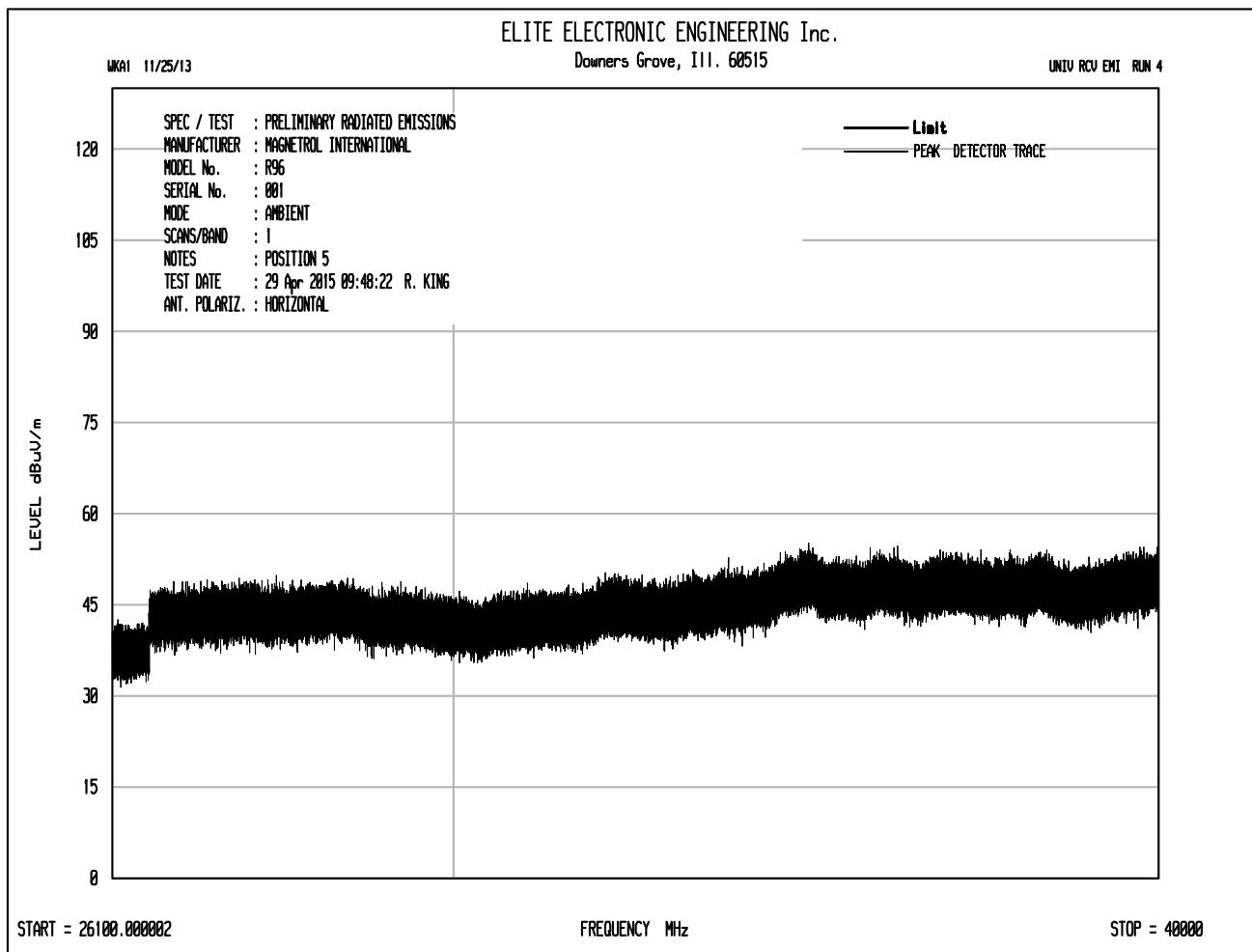
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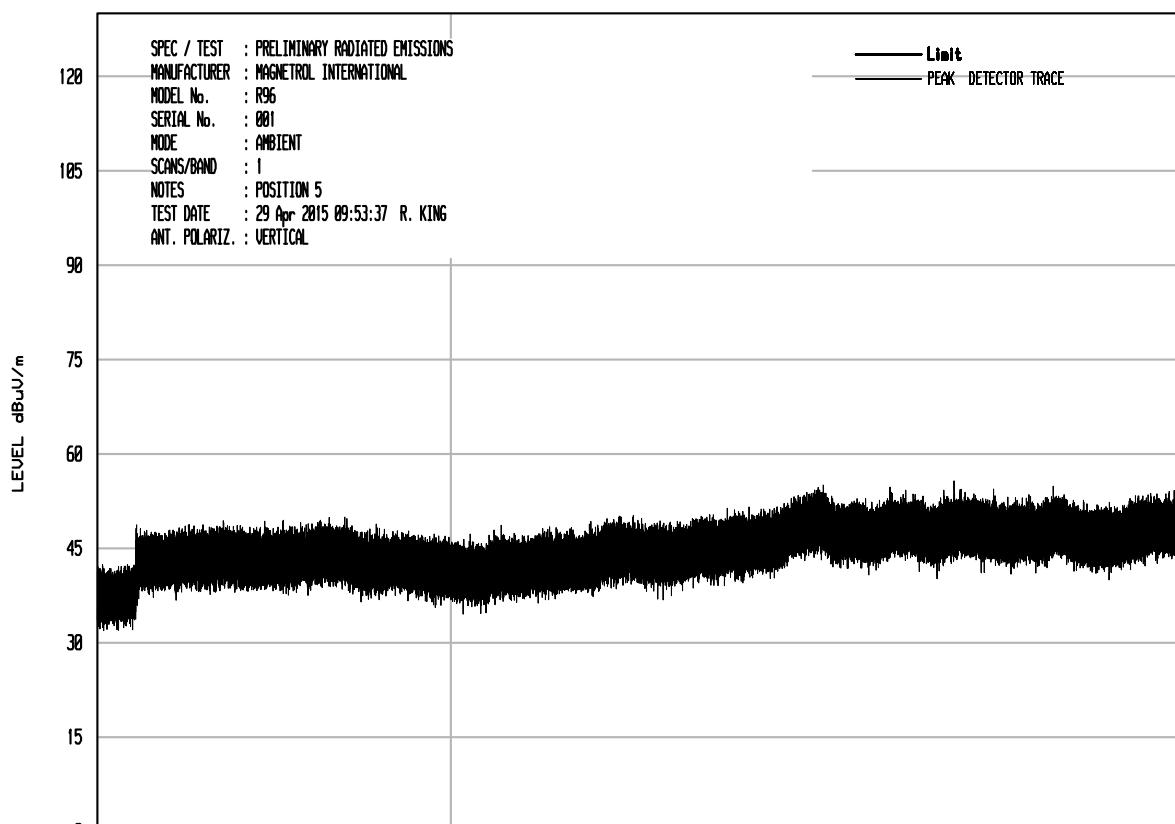
ELITE ELECTRONIC ENGINEERING Inc.

Downers Grove, Ill. 60515

UNIV RCU EMI RUN 6

SPEC / TEST : PRELIMINARY RADIATED EMISSIONS  
MANUFACTURER : MAGNETROL INTERNATIONAL  
MODEL No. : R96  
SERIAL No. : 001  
MODE : AMBIENT  
SCANS/BAND : 1  
NOTES : POSITION 5  
TEST DATE : 29 Apr 2015 09:53:37 R. KING  
ANT. POLARIZ. : VERTICAL

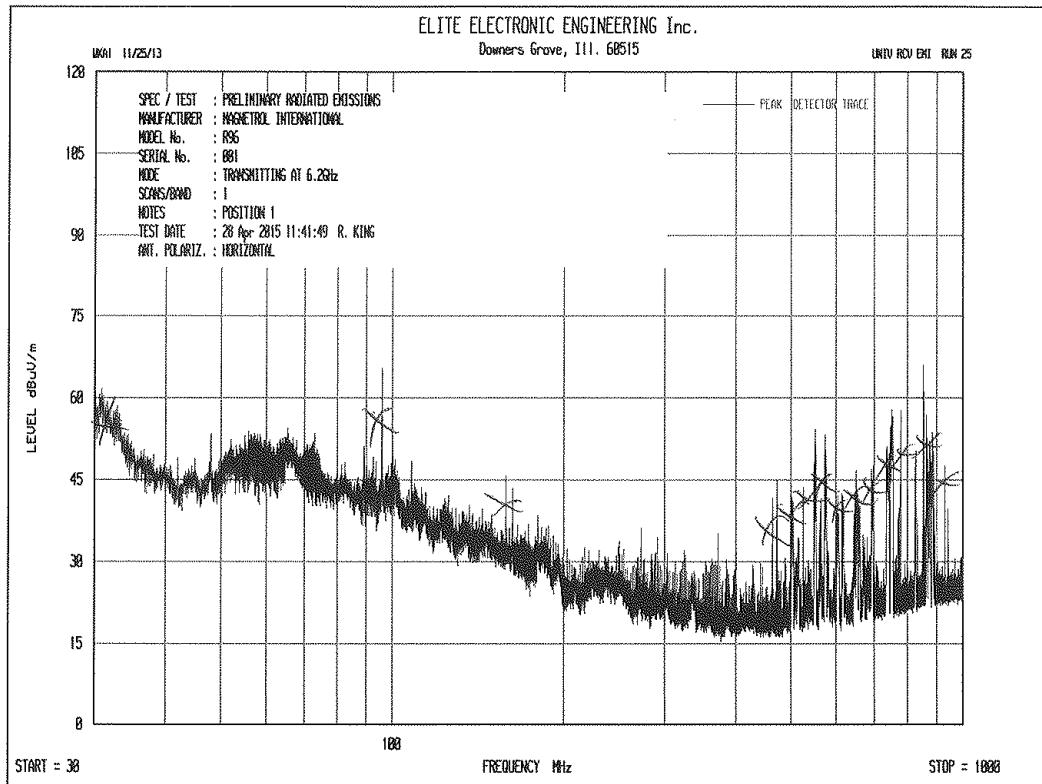
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— PEAK DETECTOR TRACE



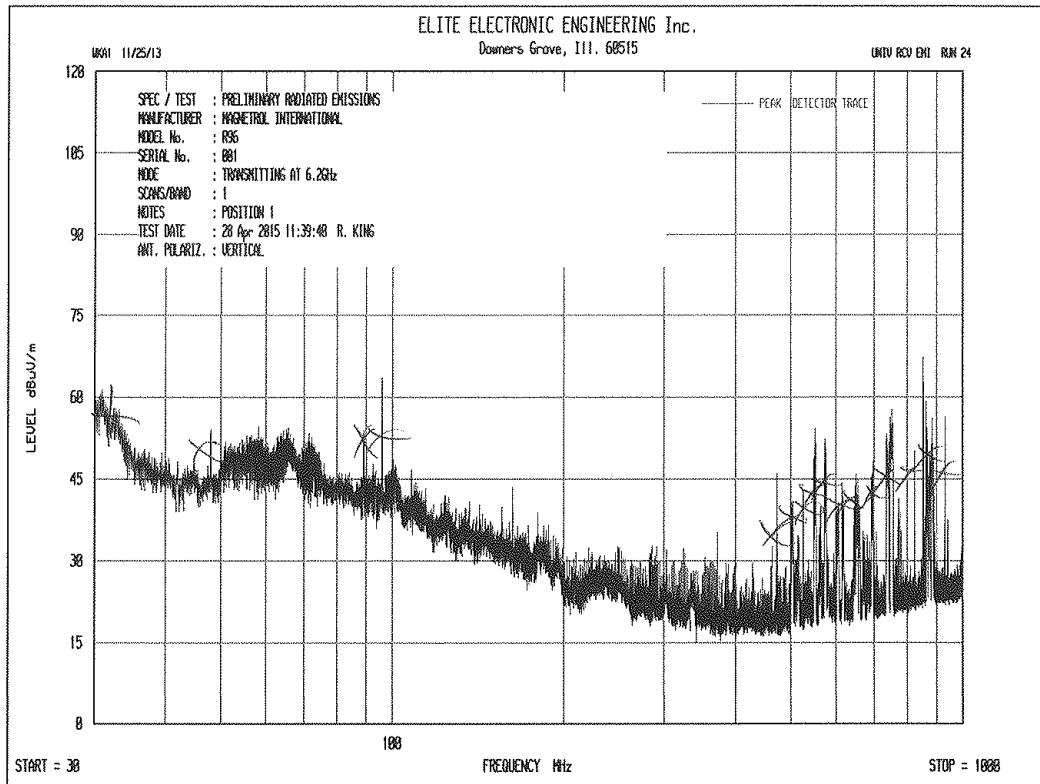
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**FREQUENCY MHz**

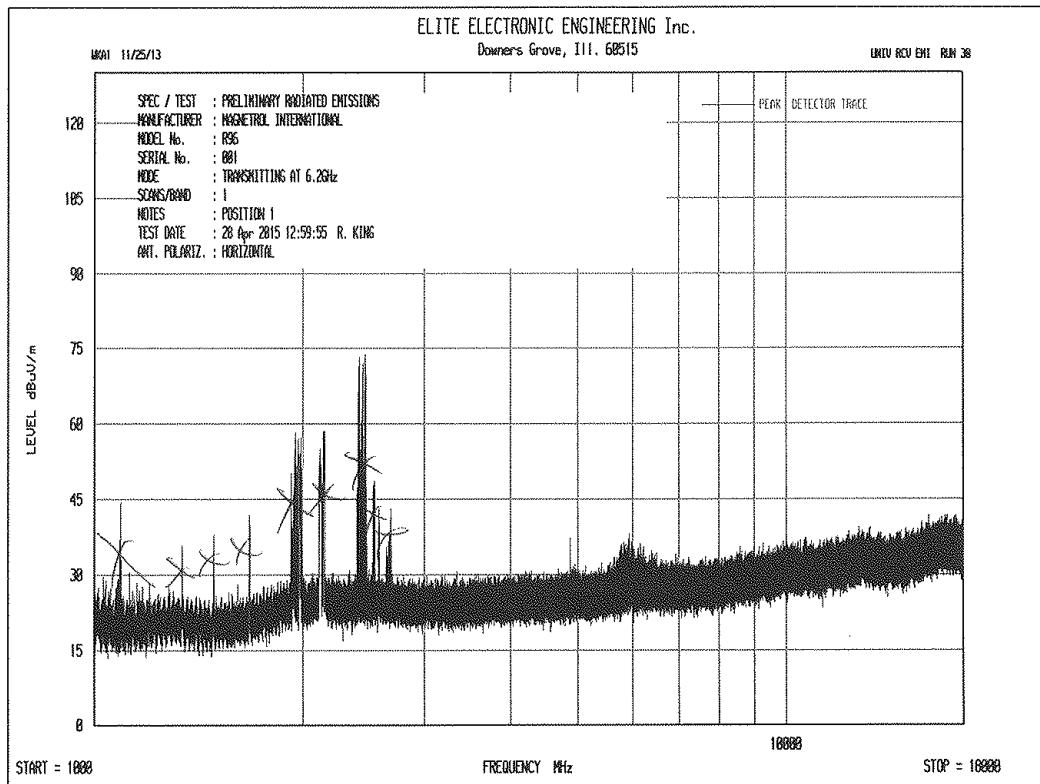
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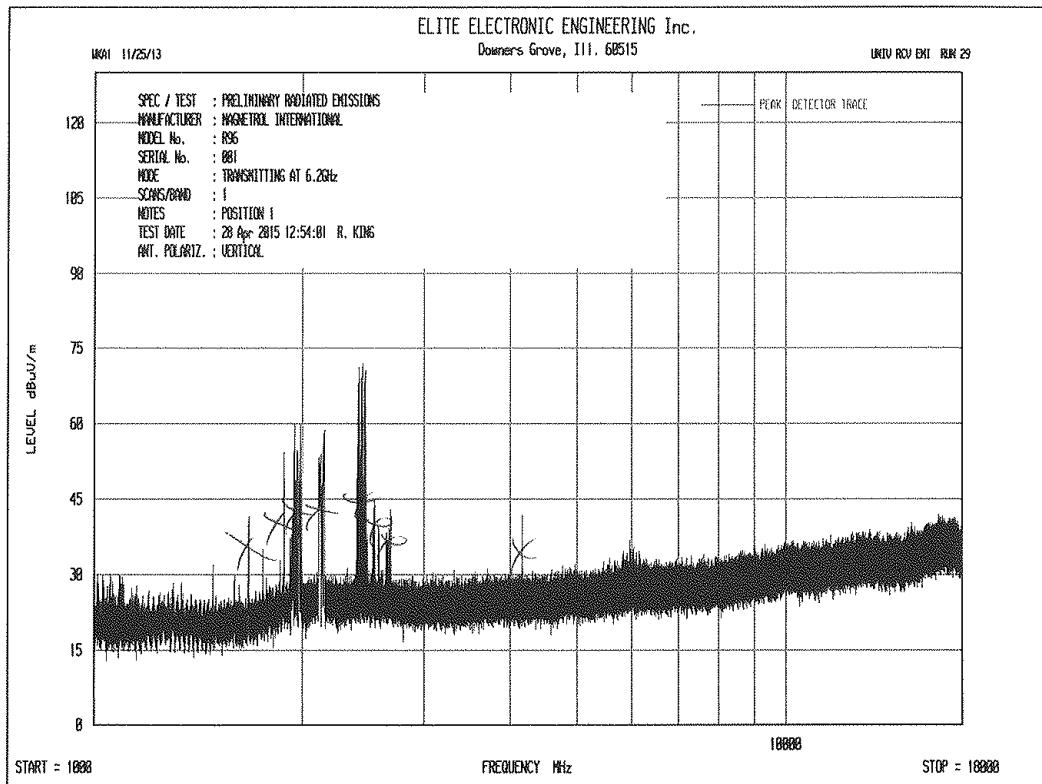
All emissions measured were attributed to the ambient environment.



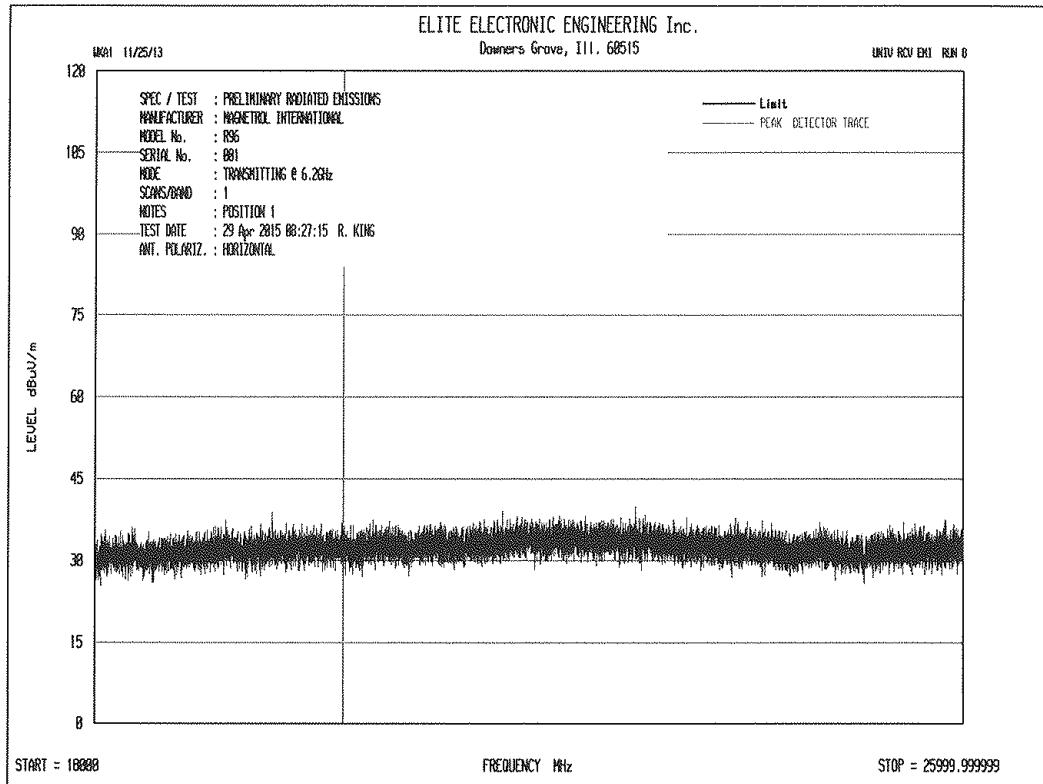
All emissions measured were attributed to the ambient environment.

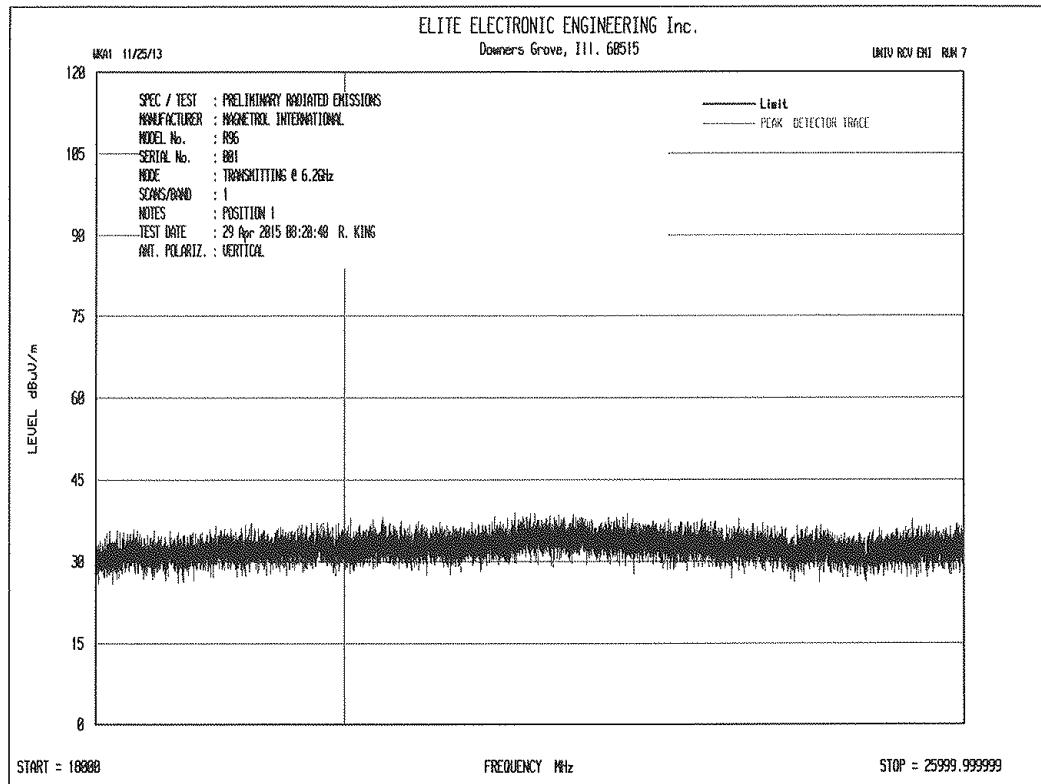


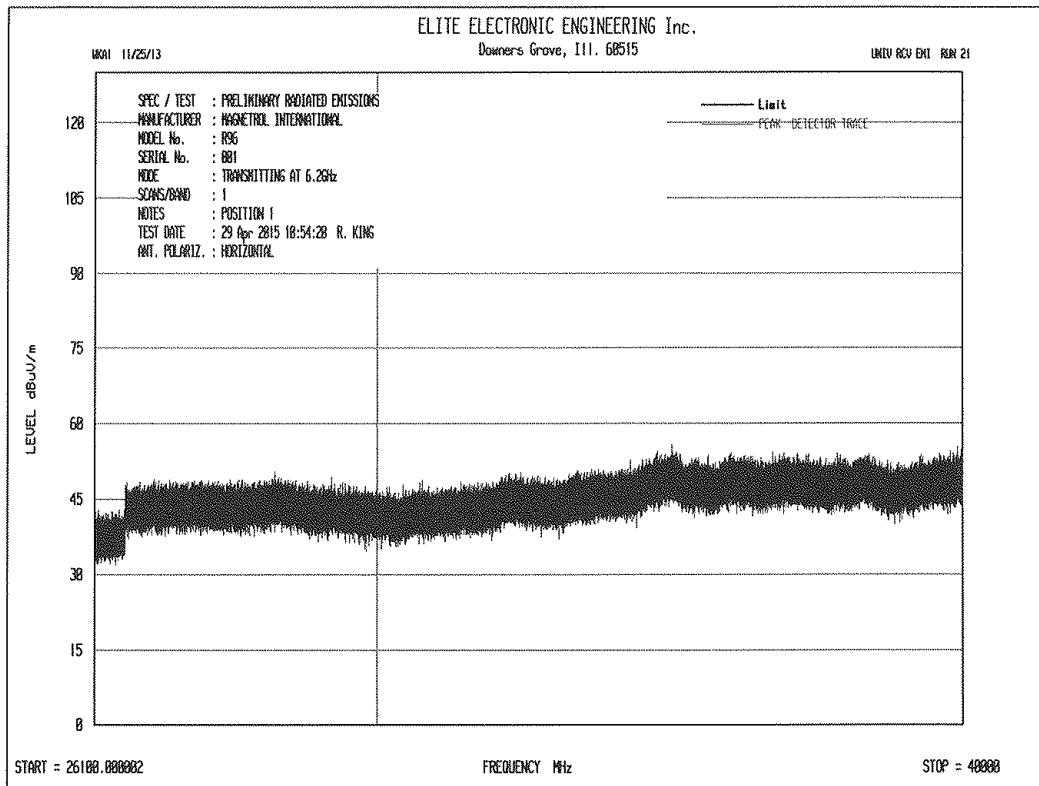
All emissions measured were attributed to the ambient environment.

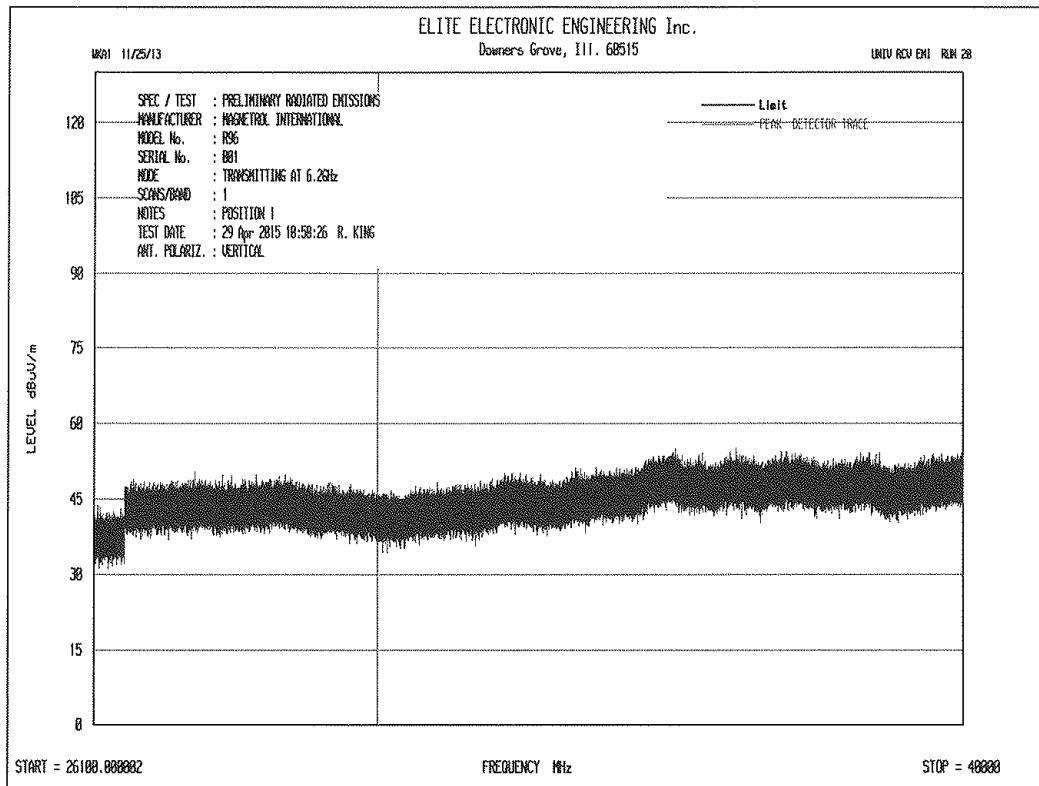


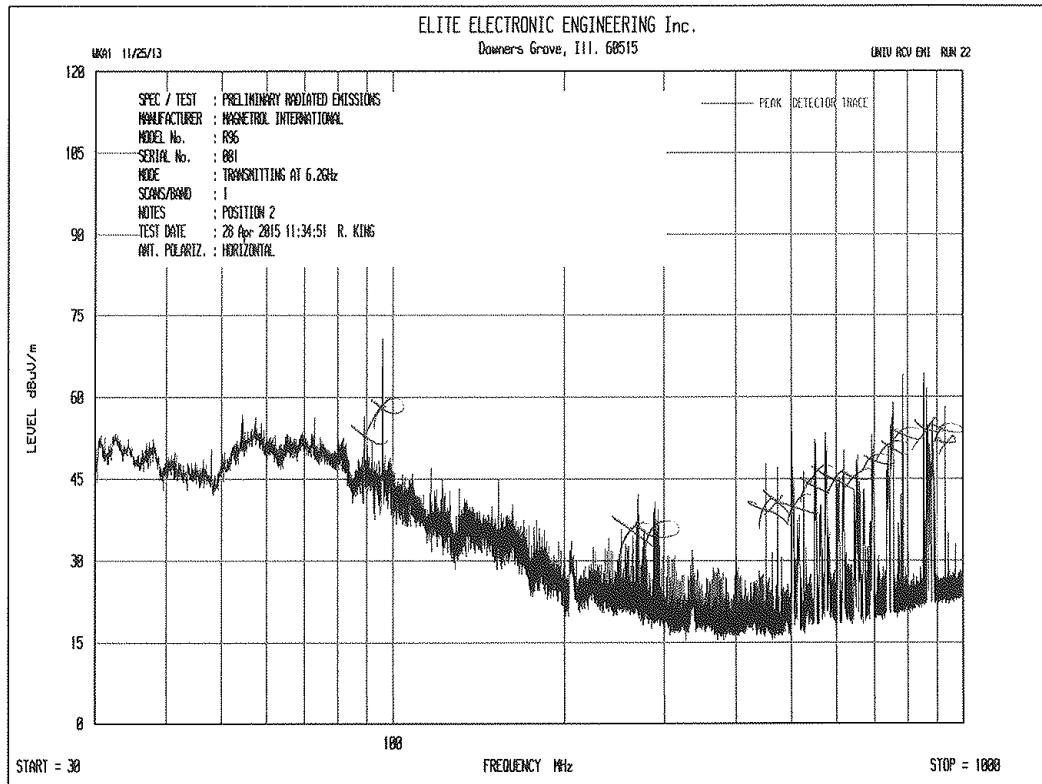
all emissions measured were attributed to the ambient environment.



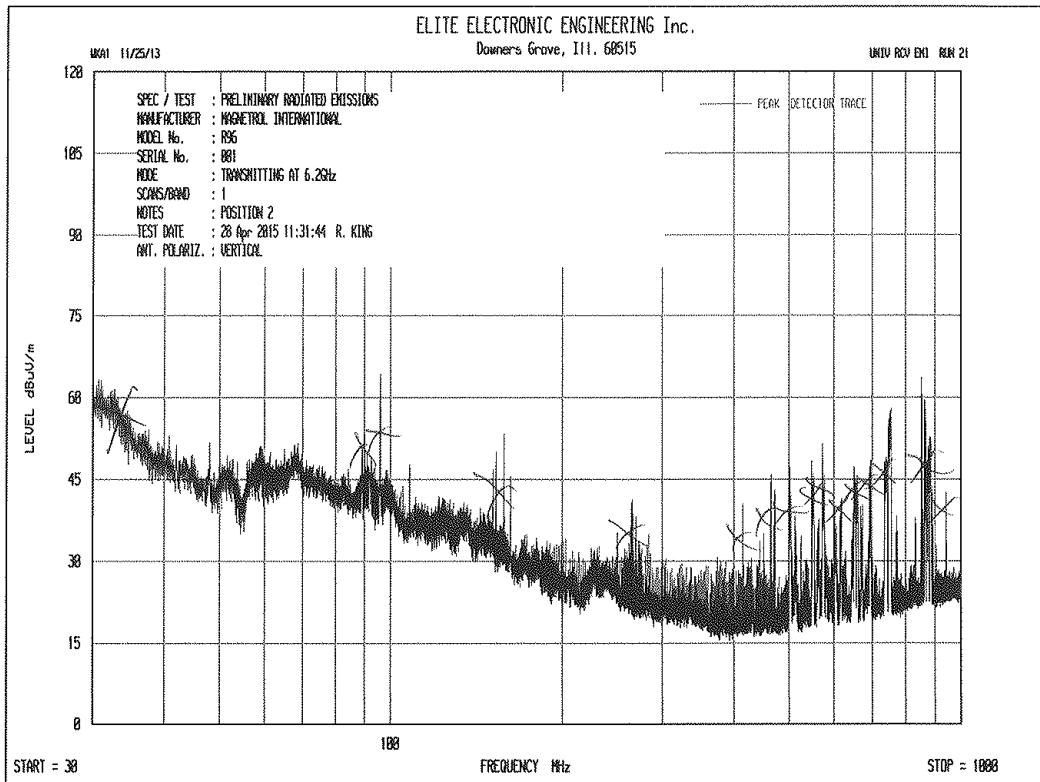




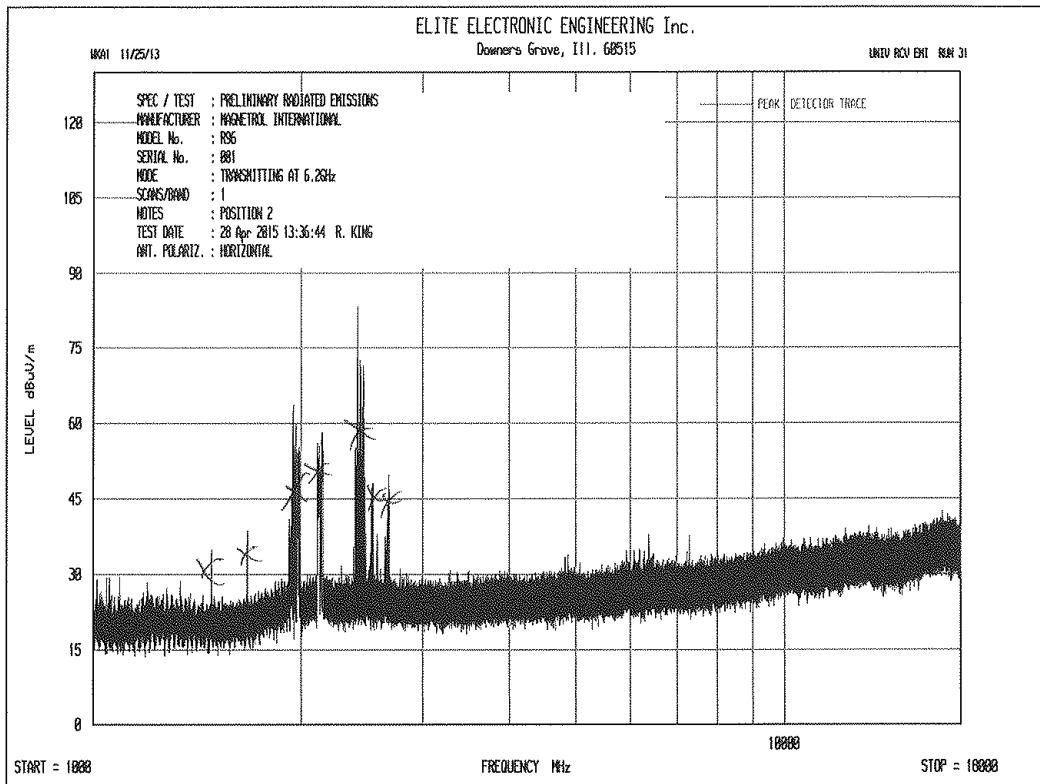




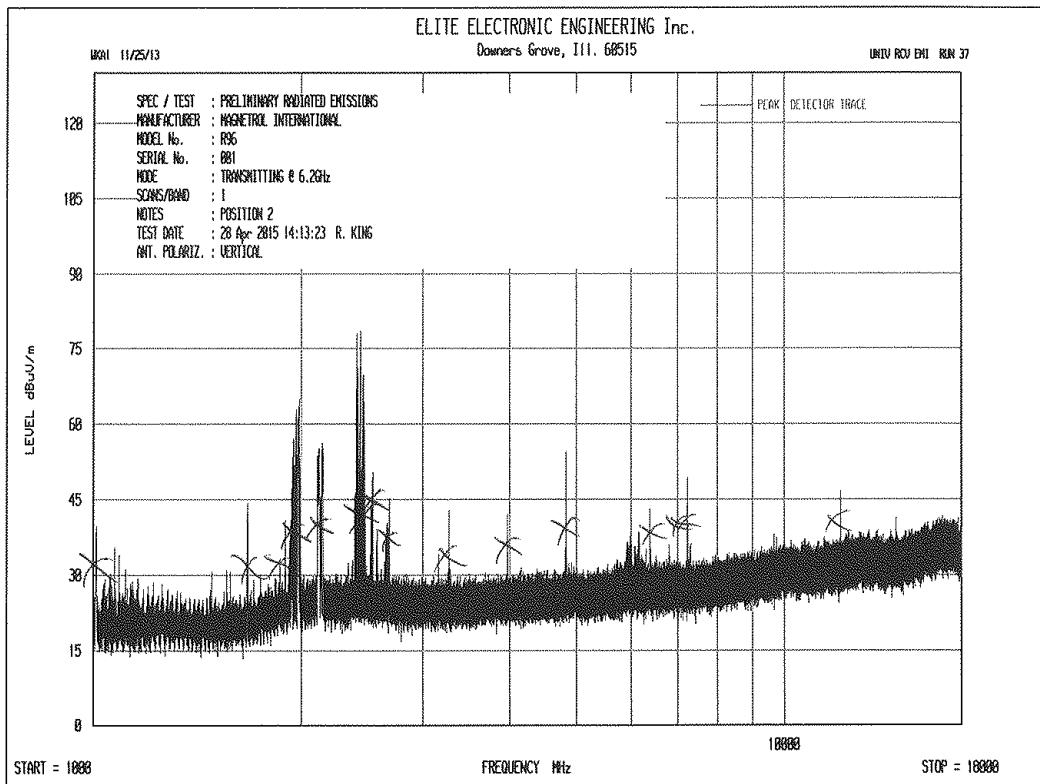
All emissions measured are attributed to the ambient environment.



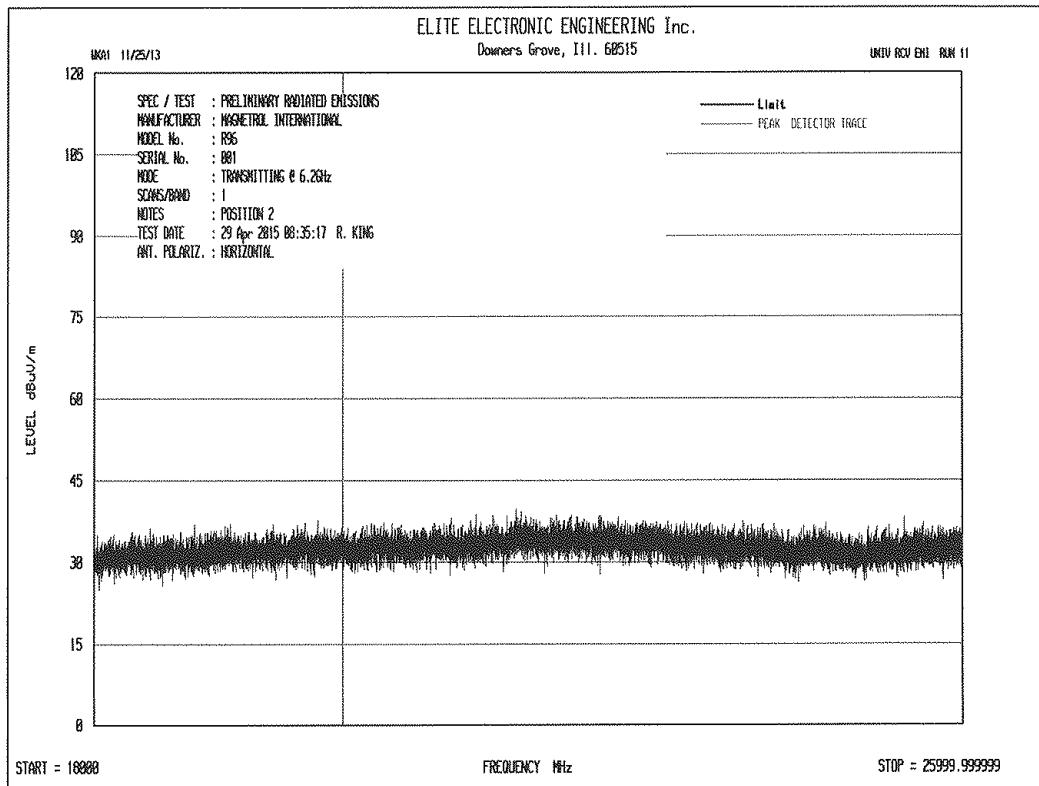
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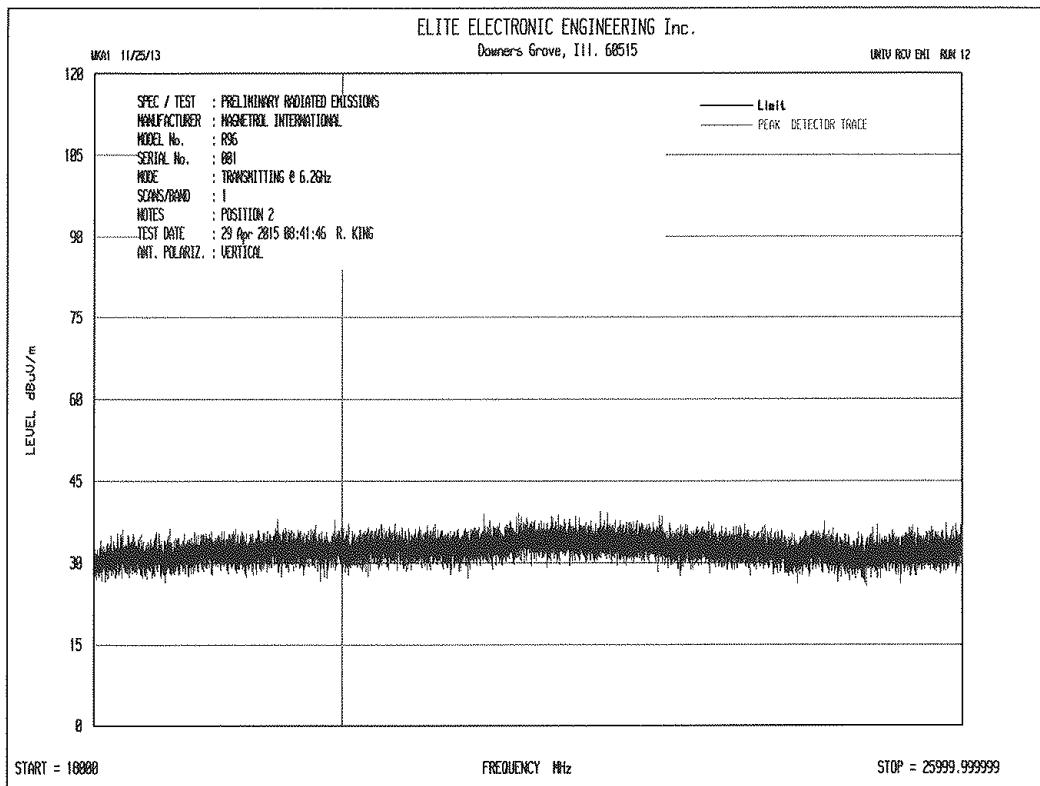


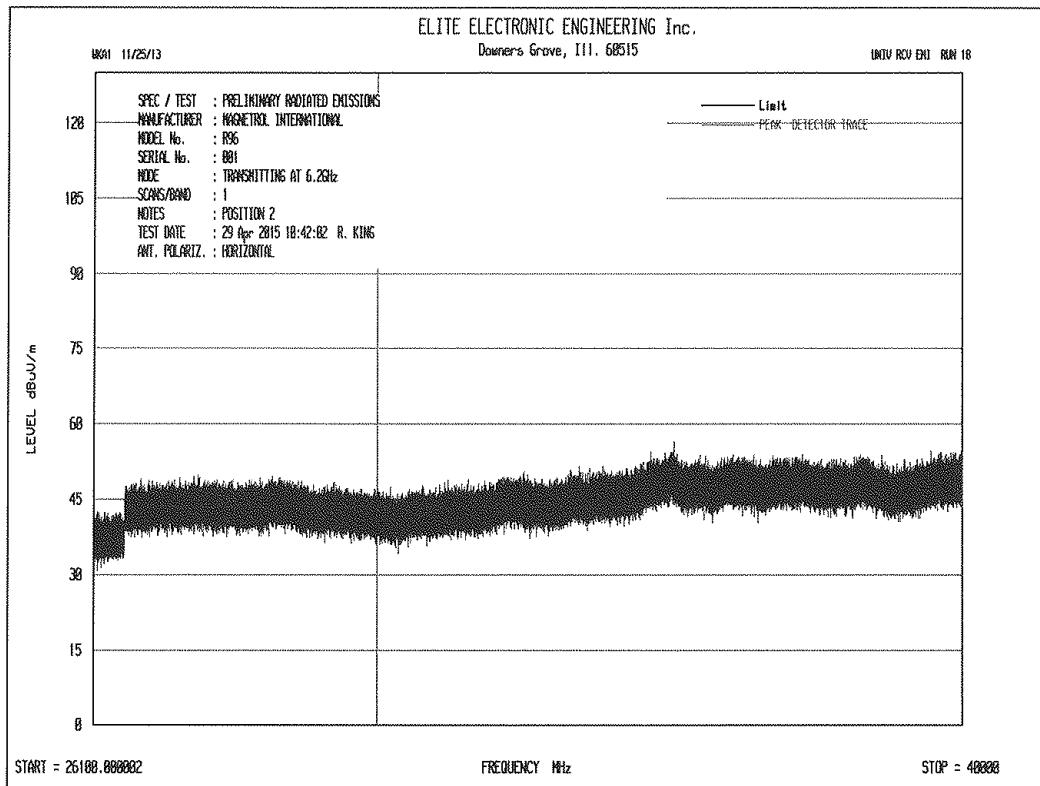
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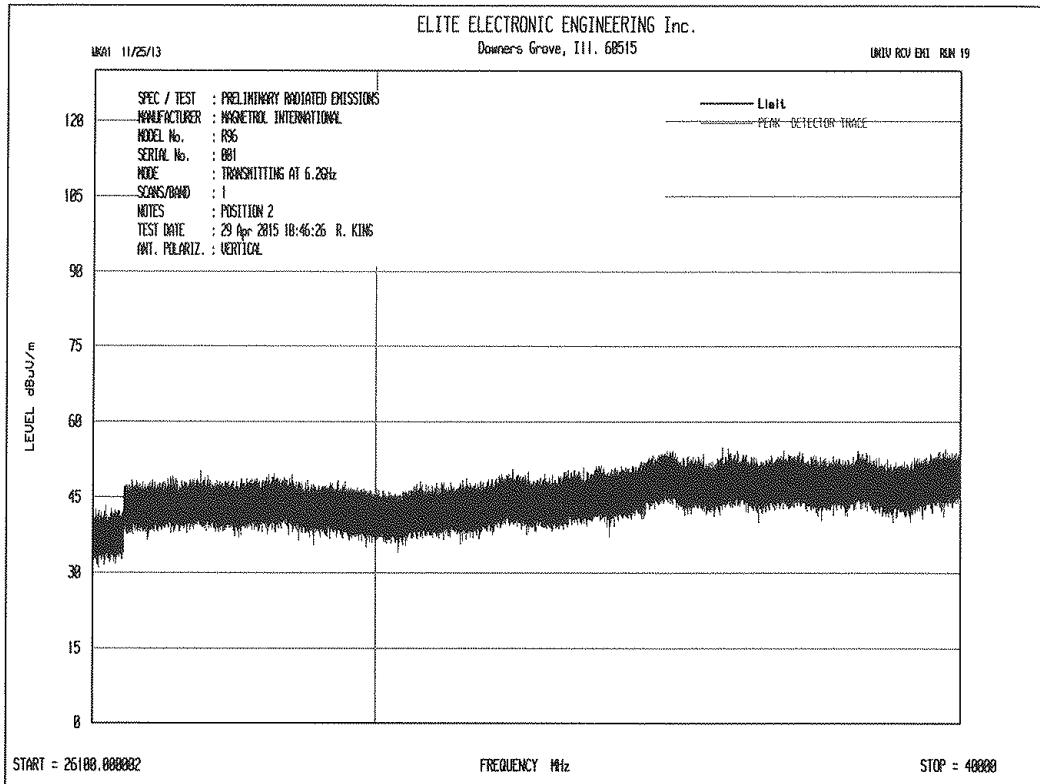


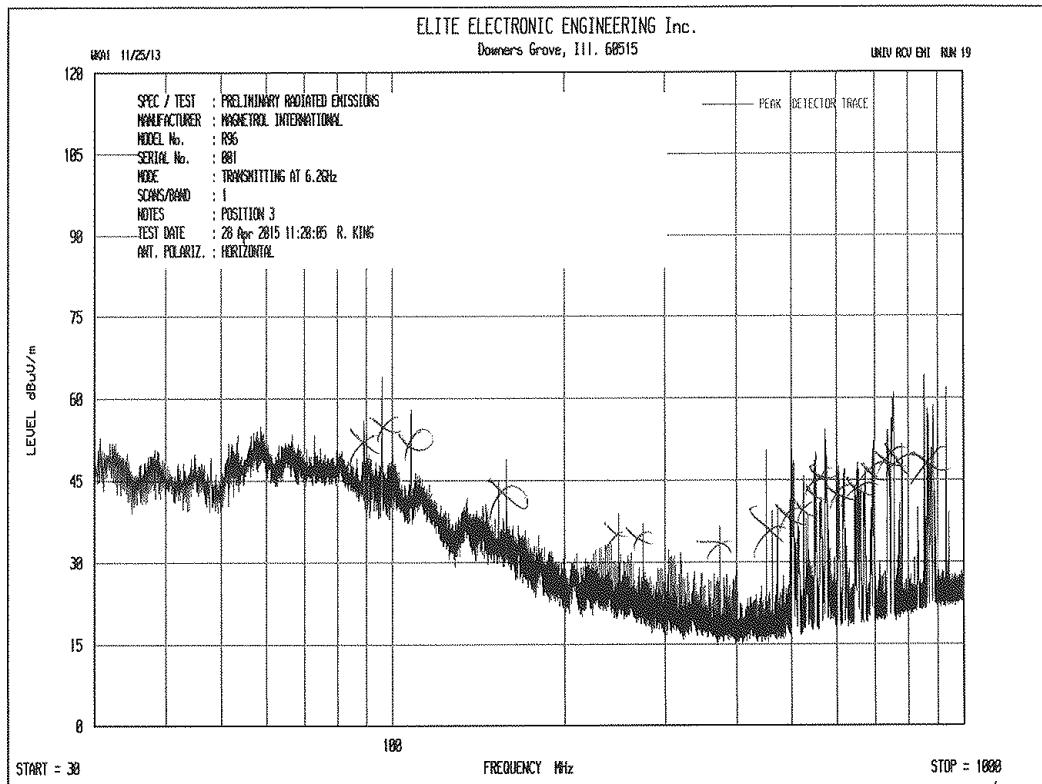
All measured emissions were attributed to the ambient environment.



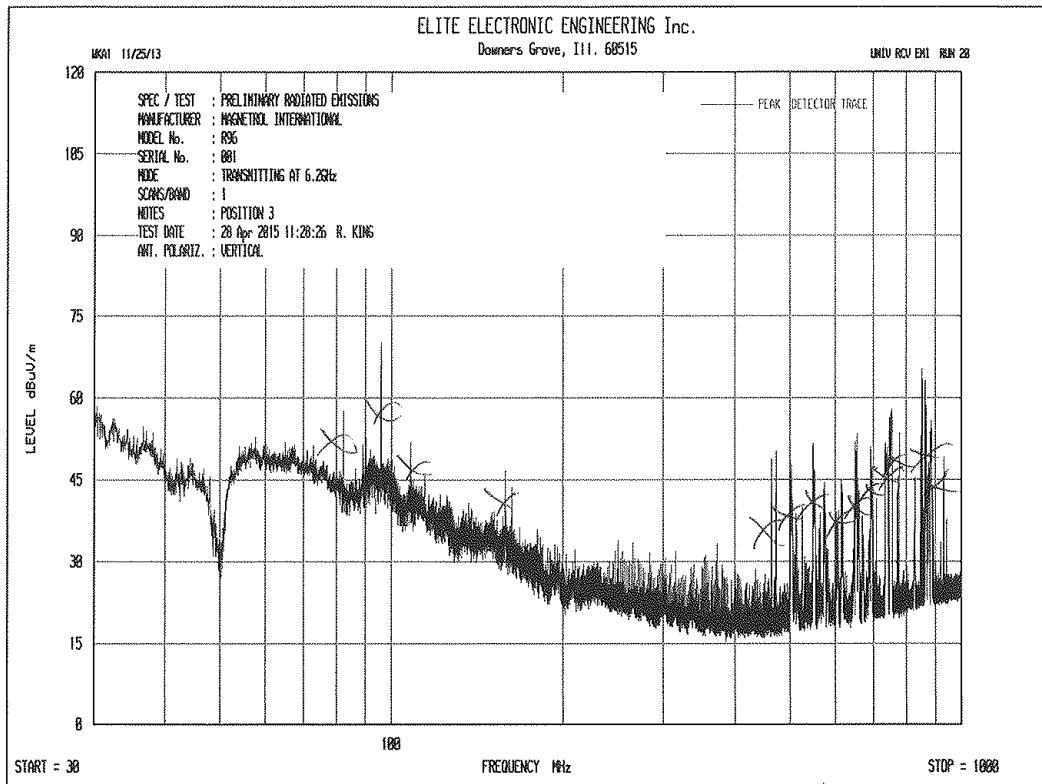




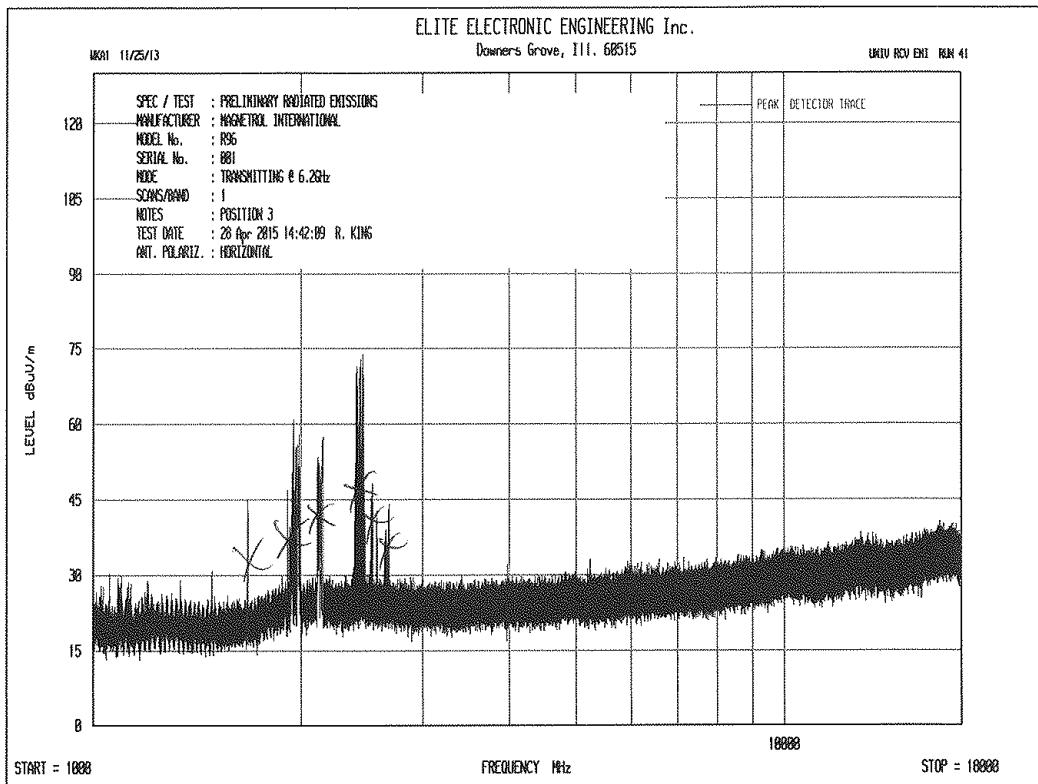




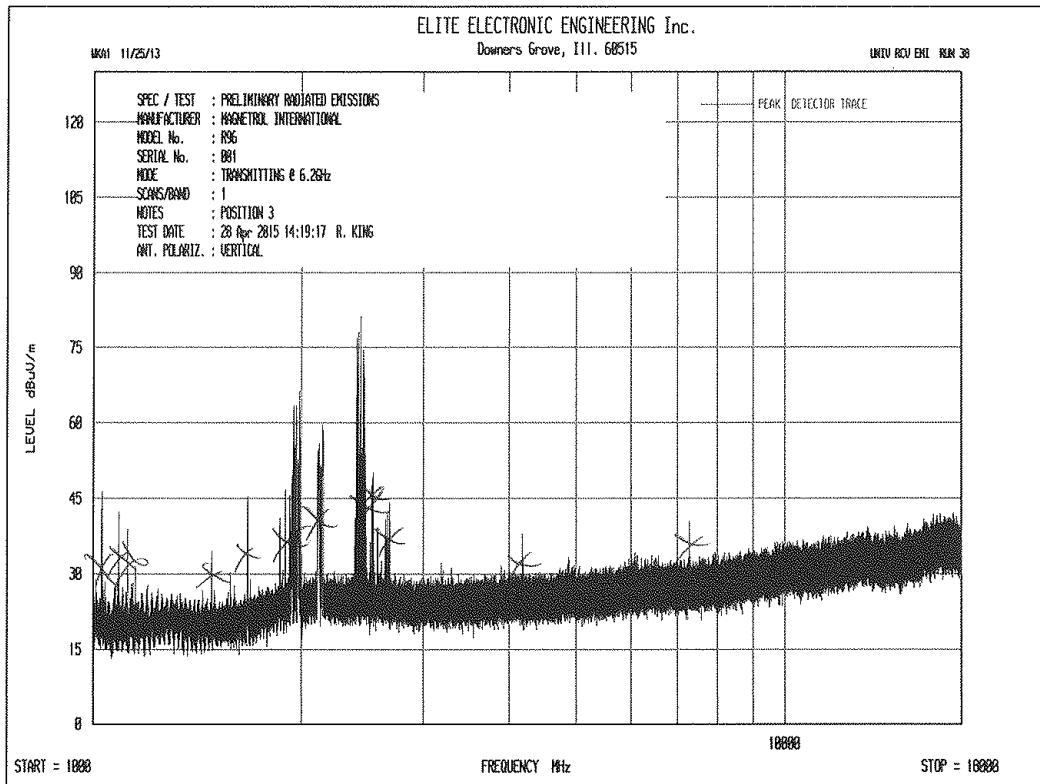
all measured emissions were attributed to the ambient environment.



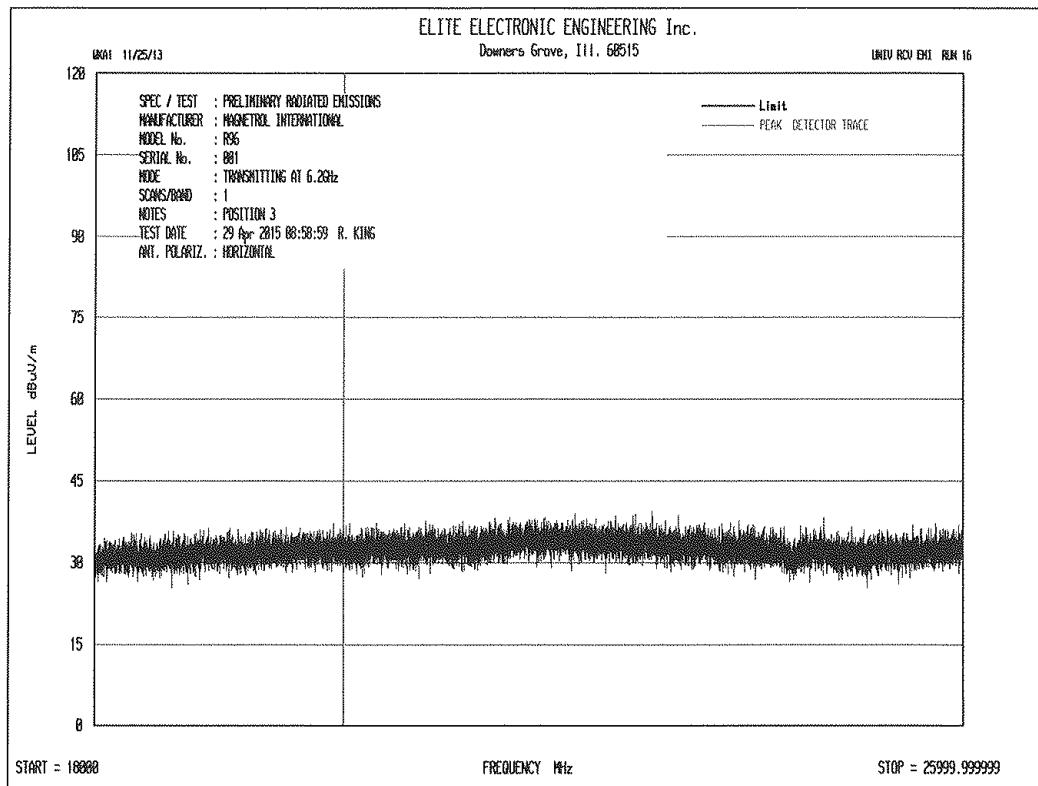
All emissions measured were attributed to the ambient environment.

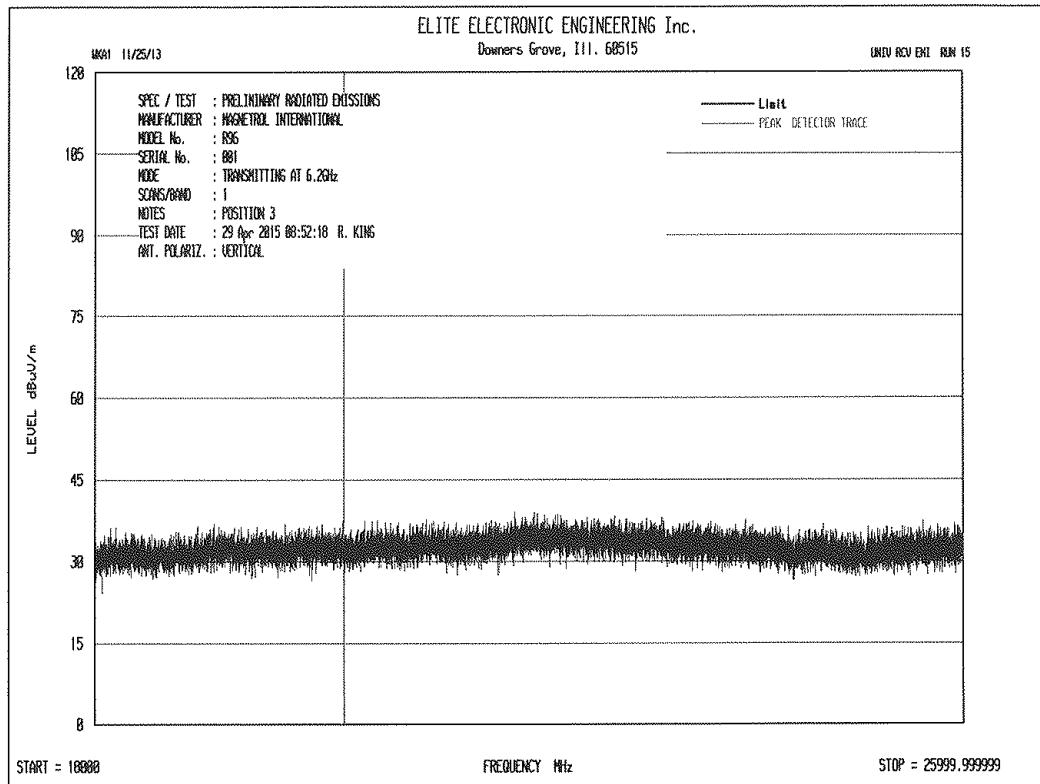


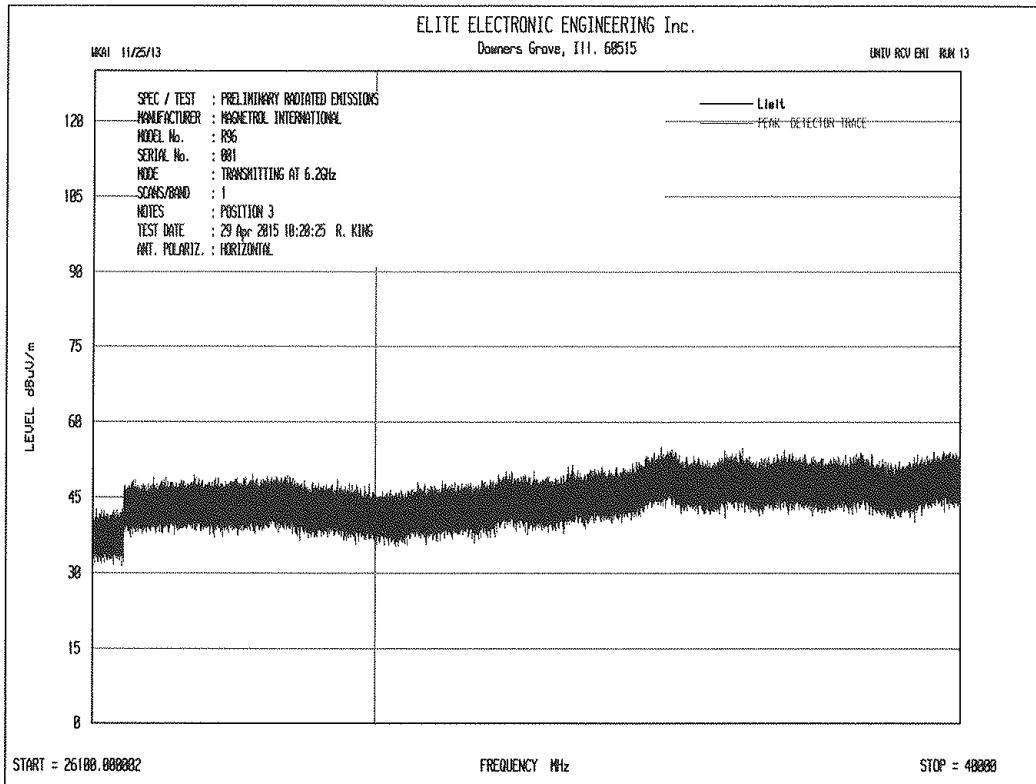
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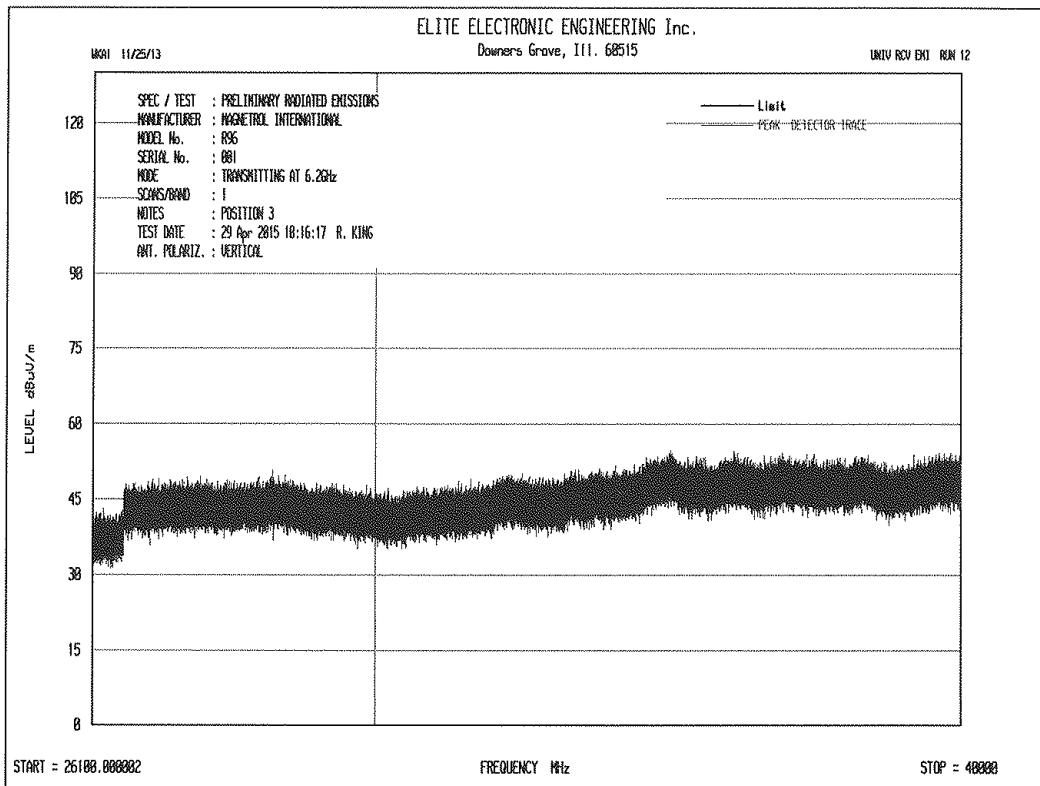


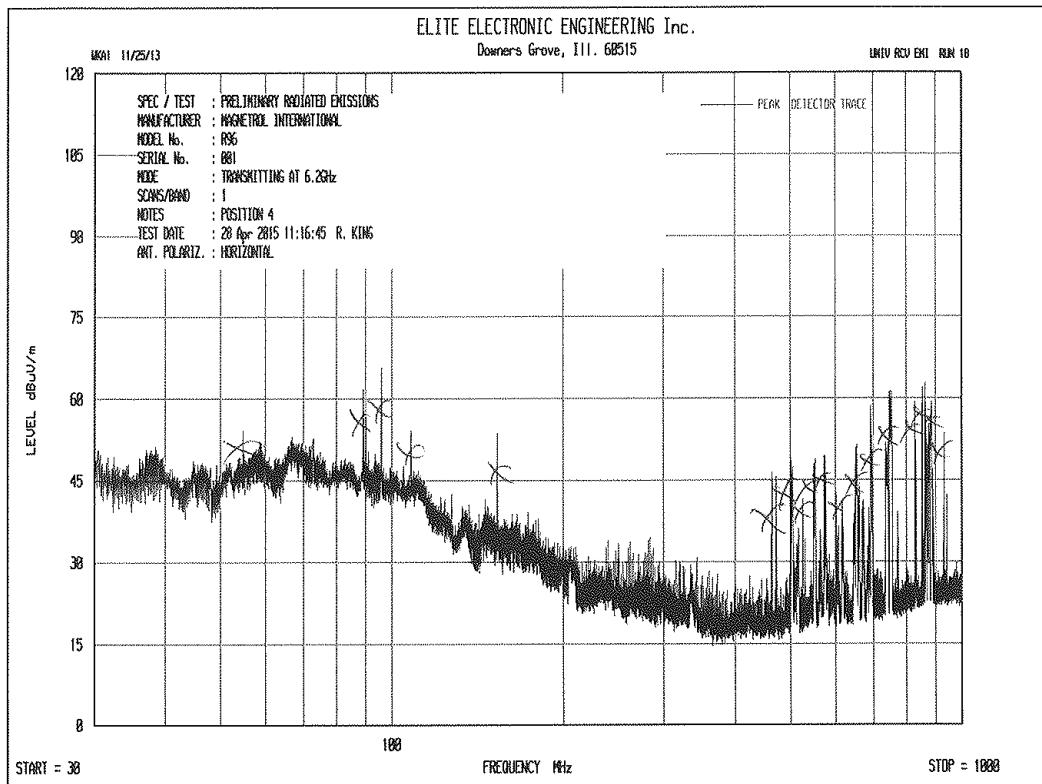
All emissions measured were attributed to the ambient environment.



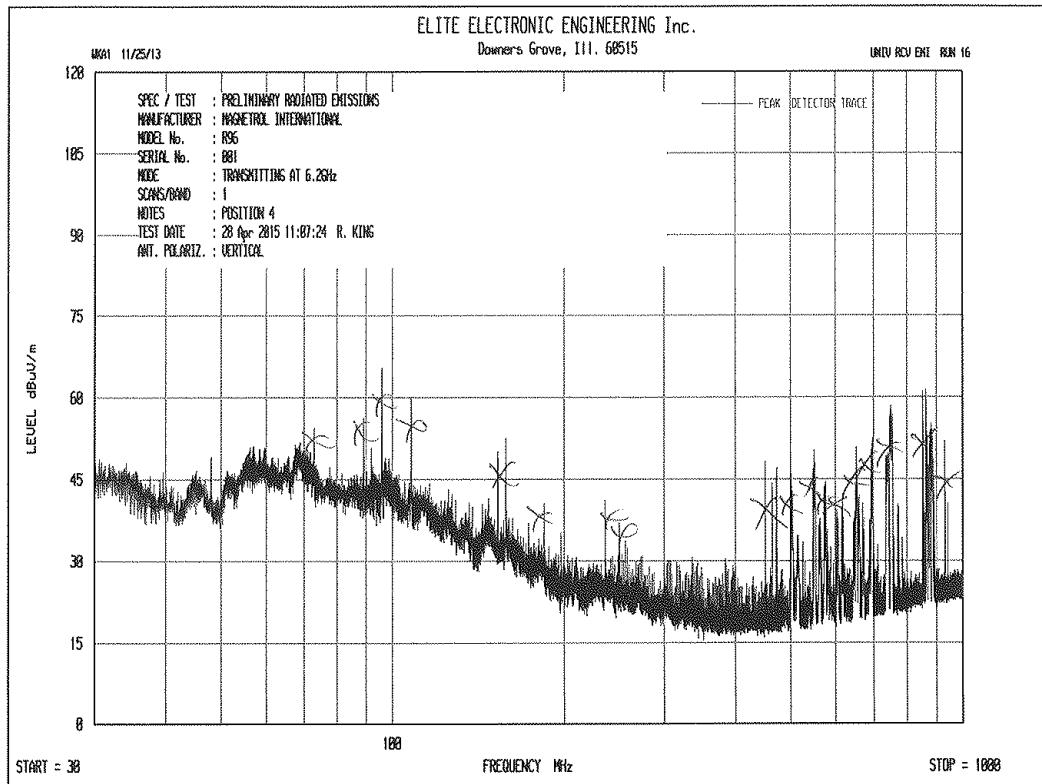




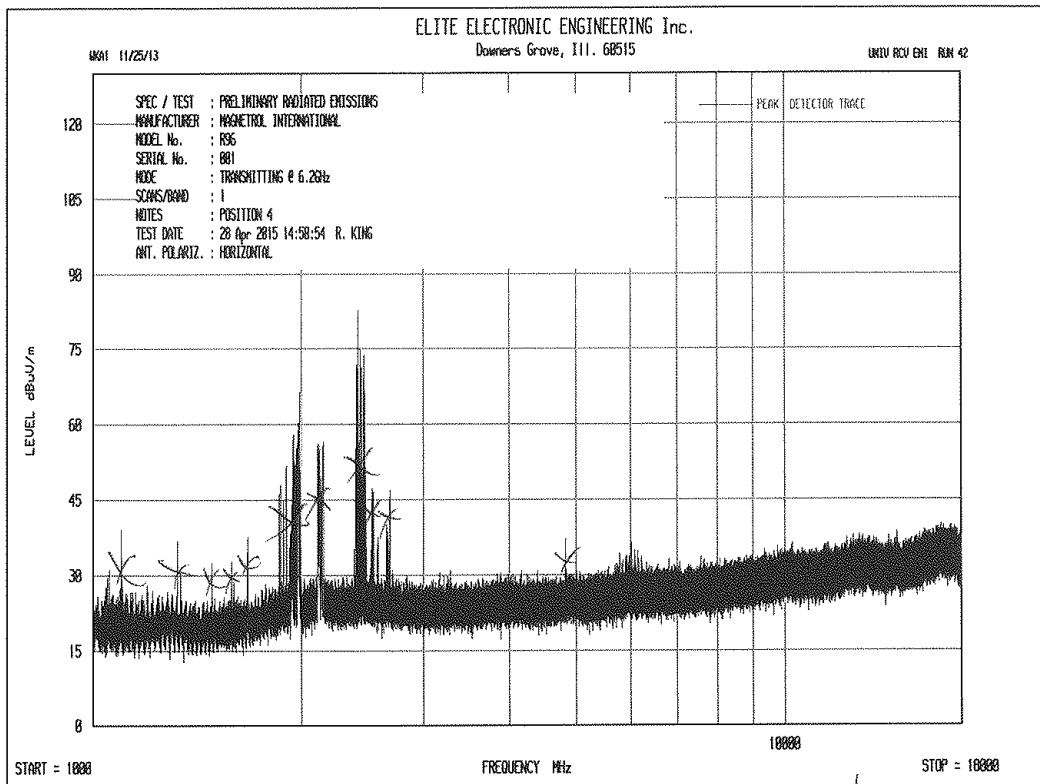




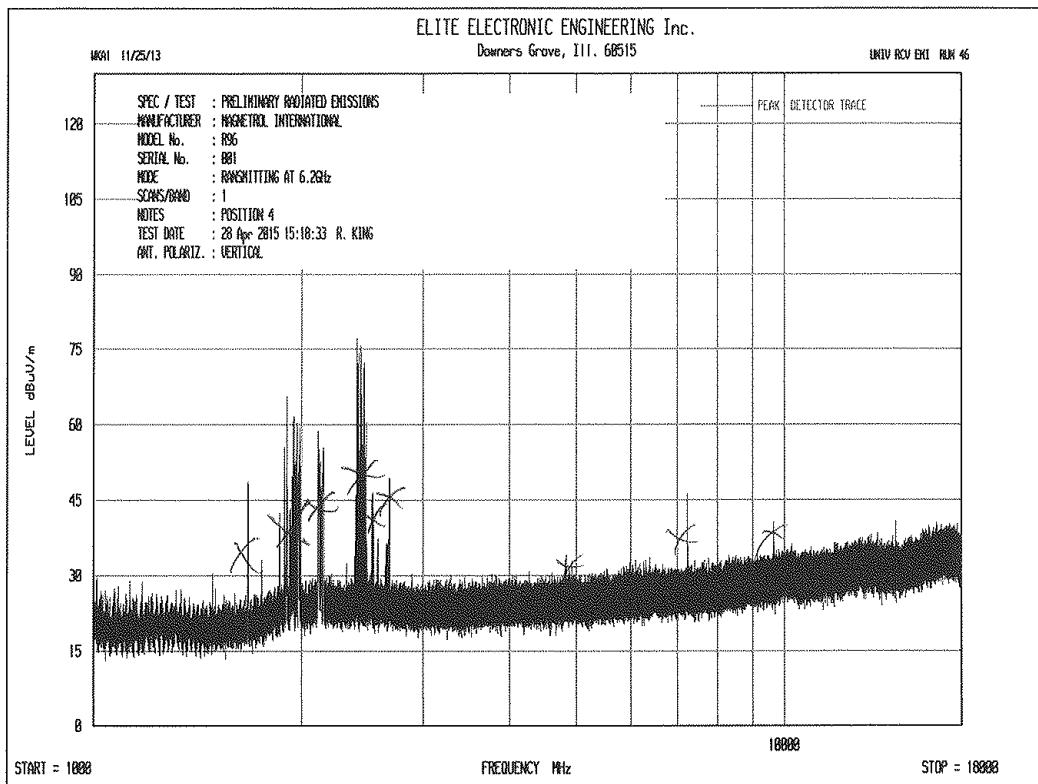
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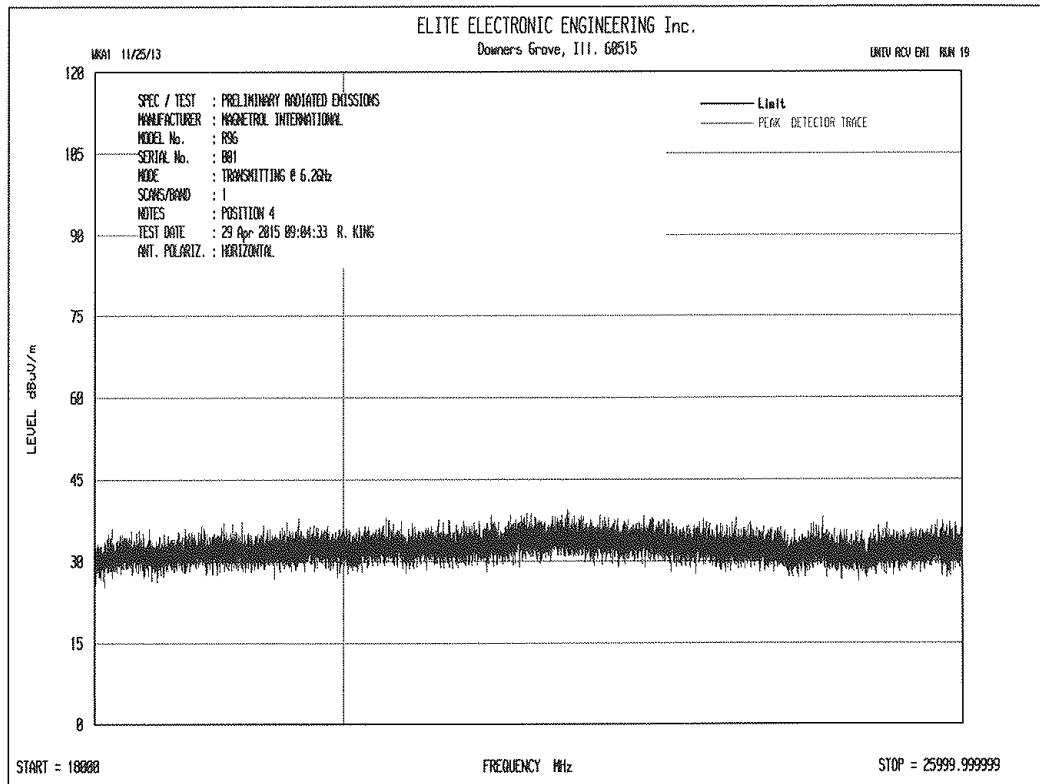
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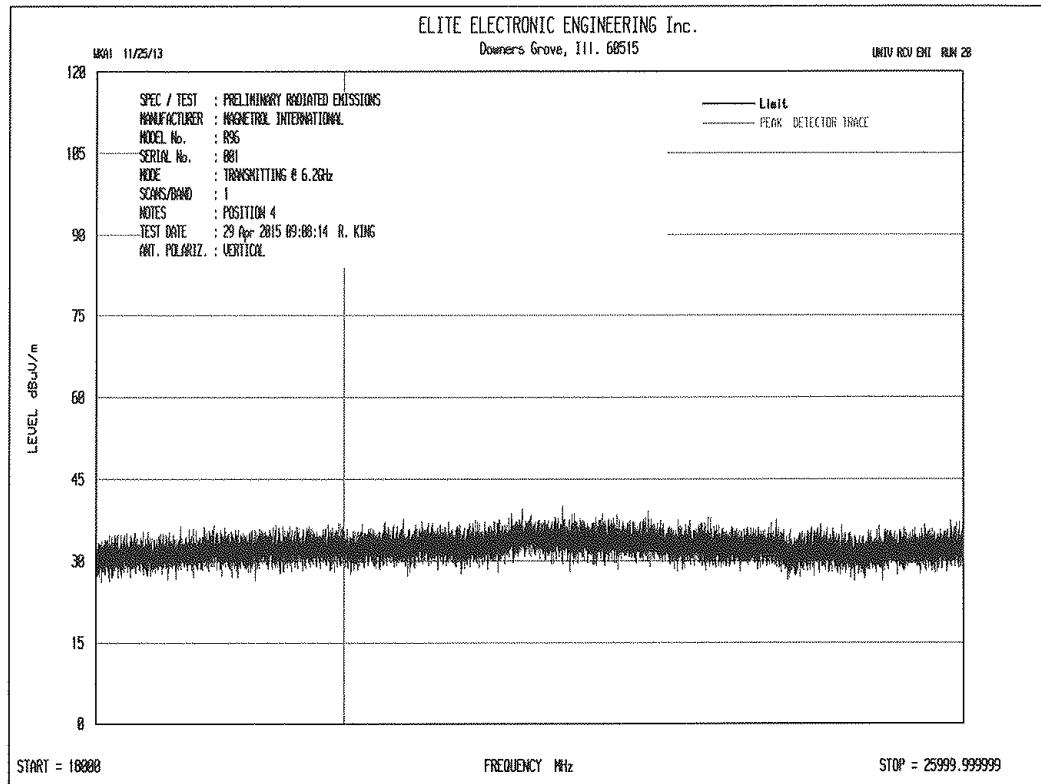


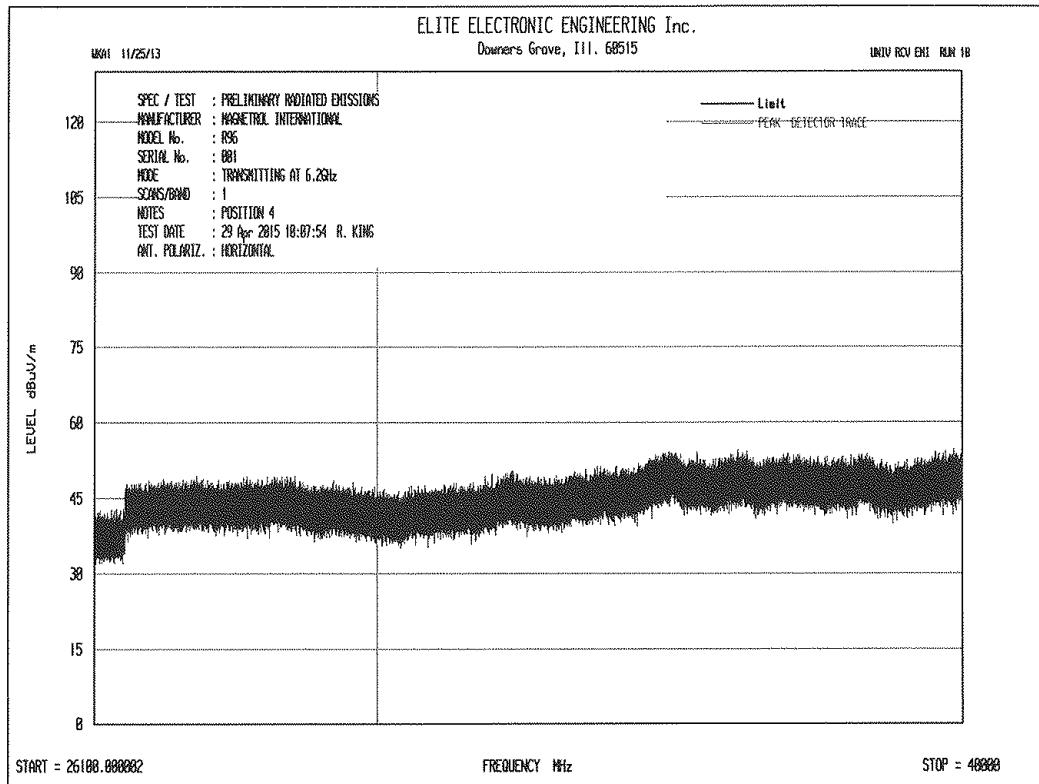
All emissions measured were attributed to the ambient environment.

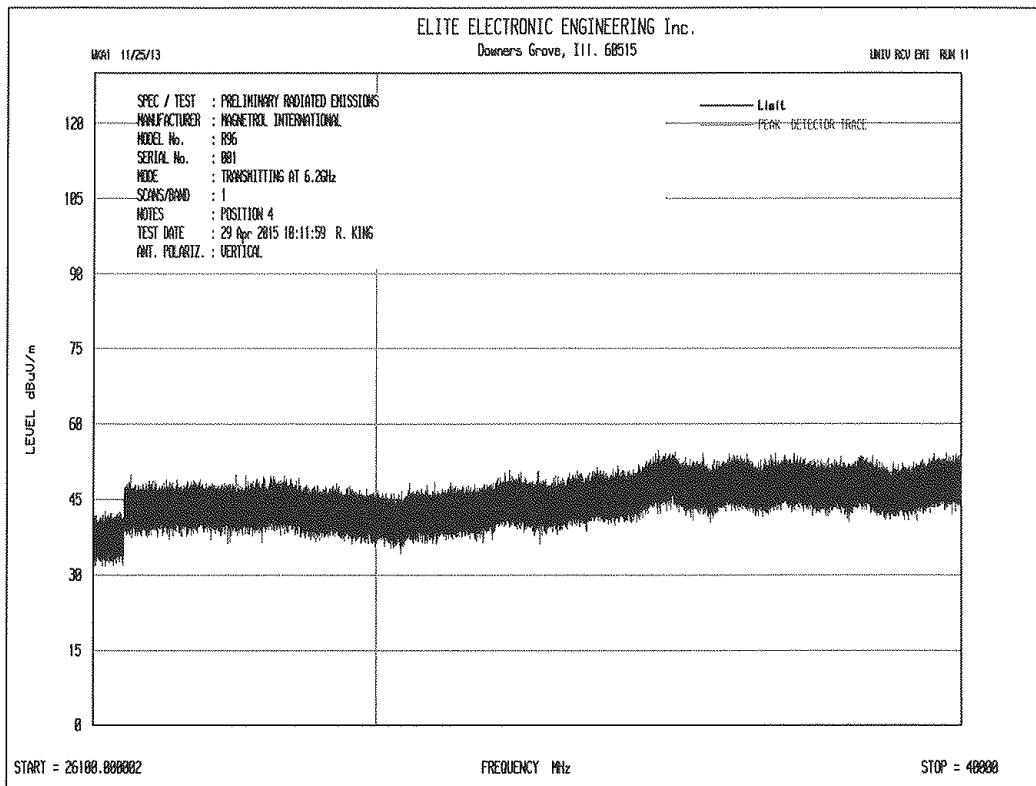


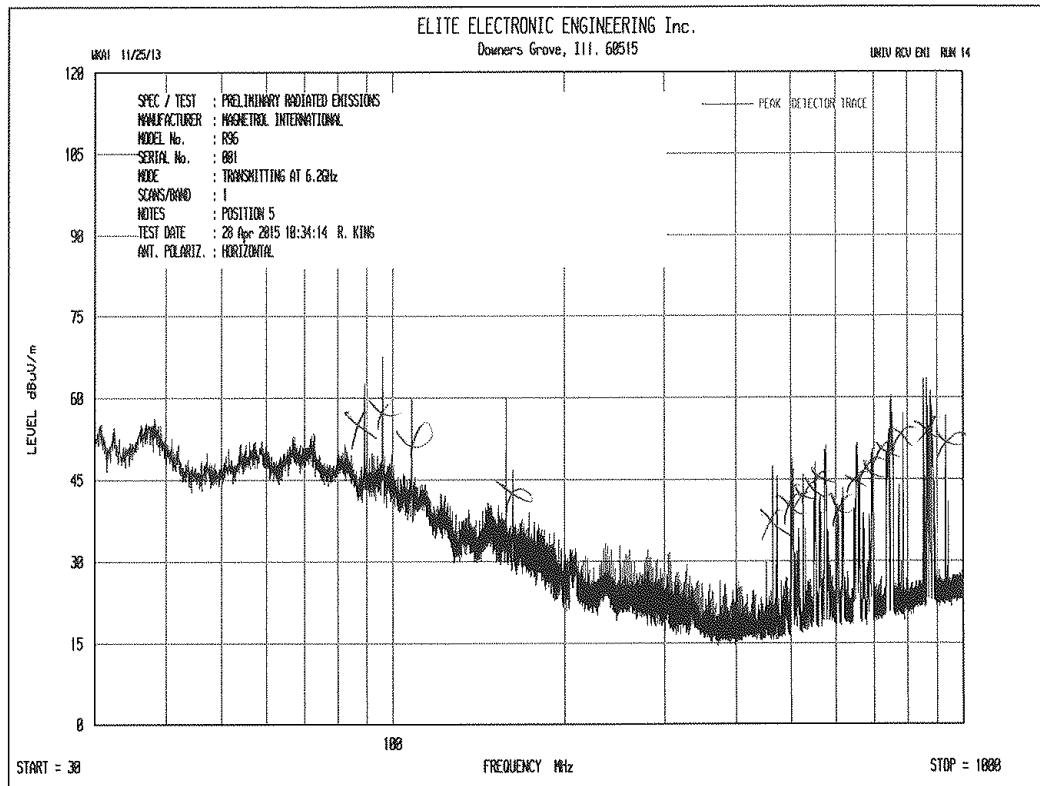
*All emissions measured were attributed to the ambient environment.*



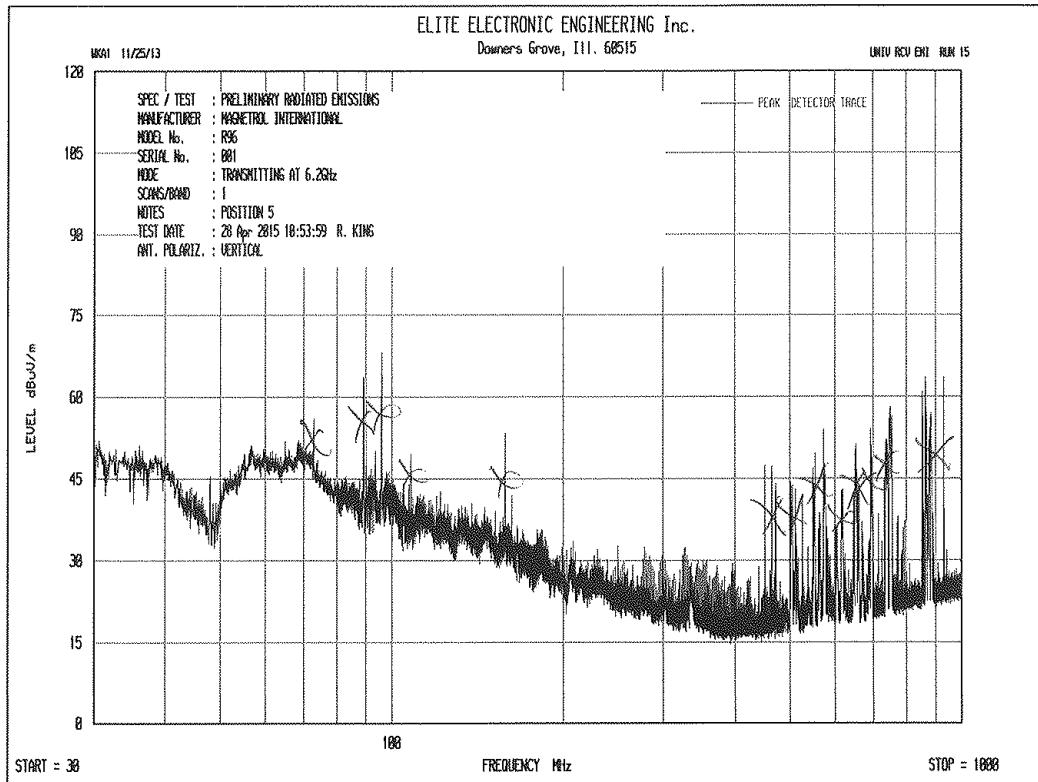


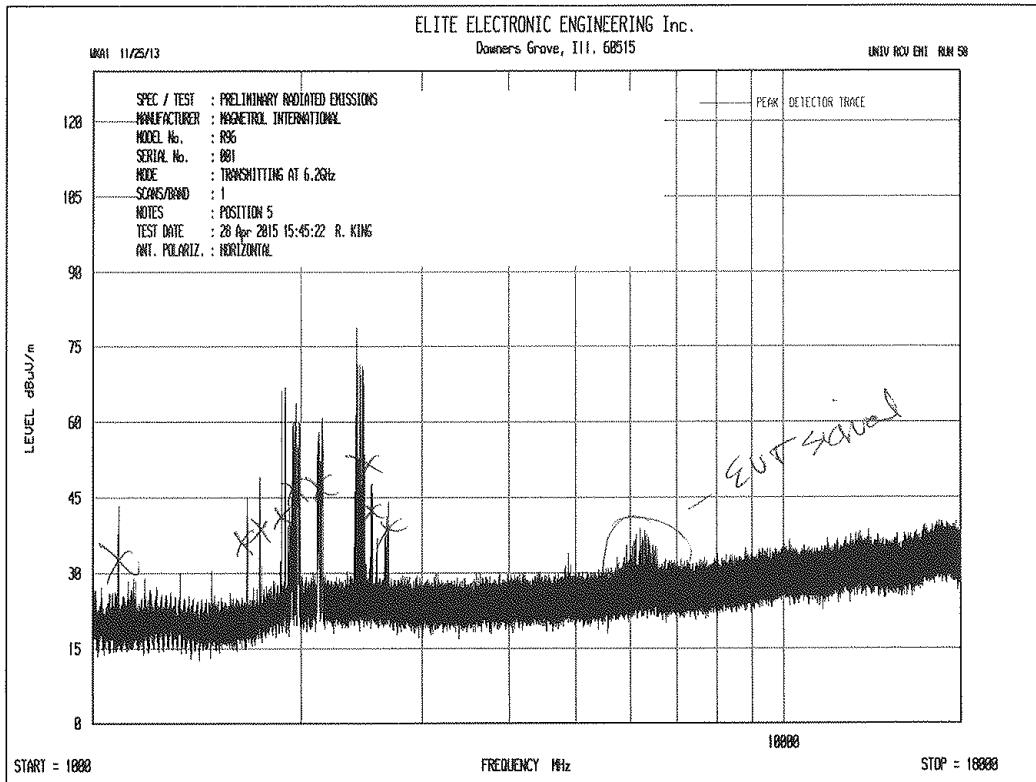




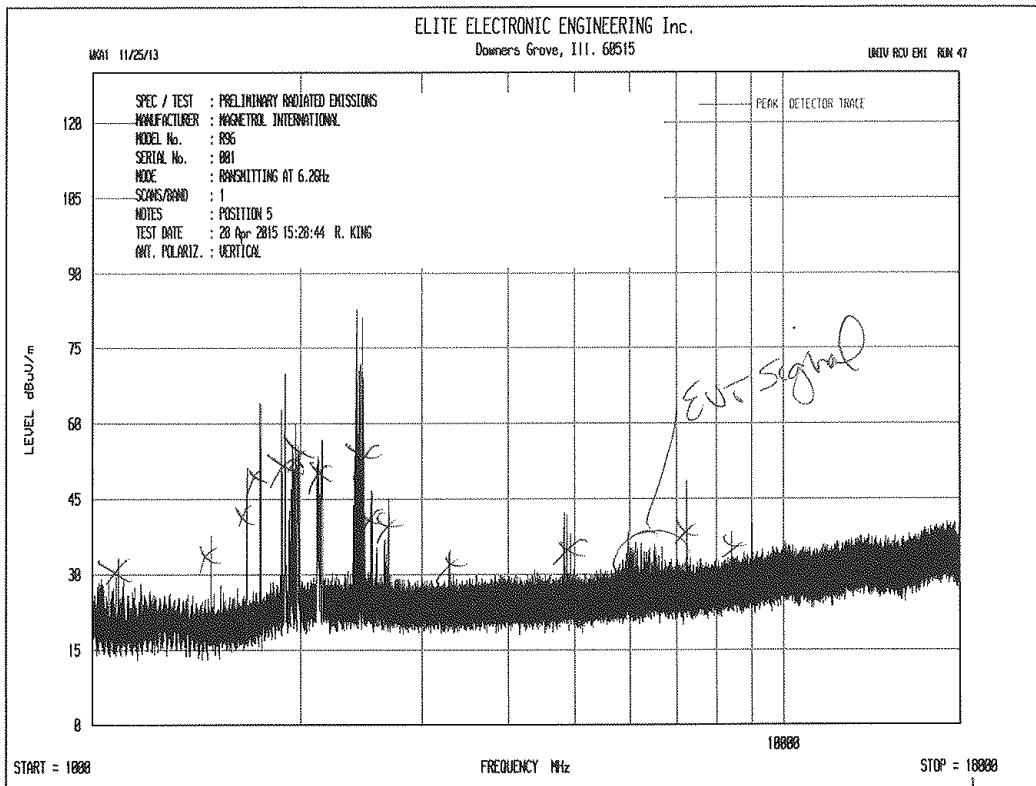


All emissions measured were attributed to the ambient environment.

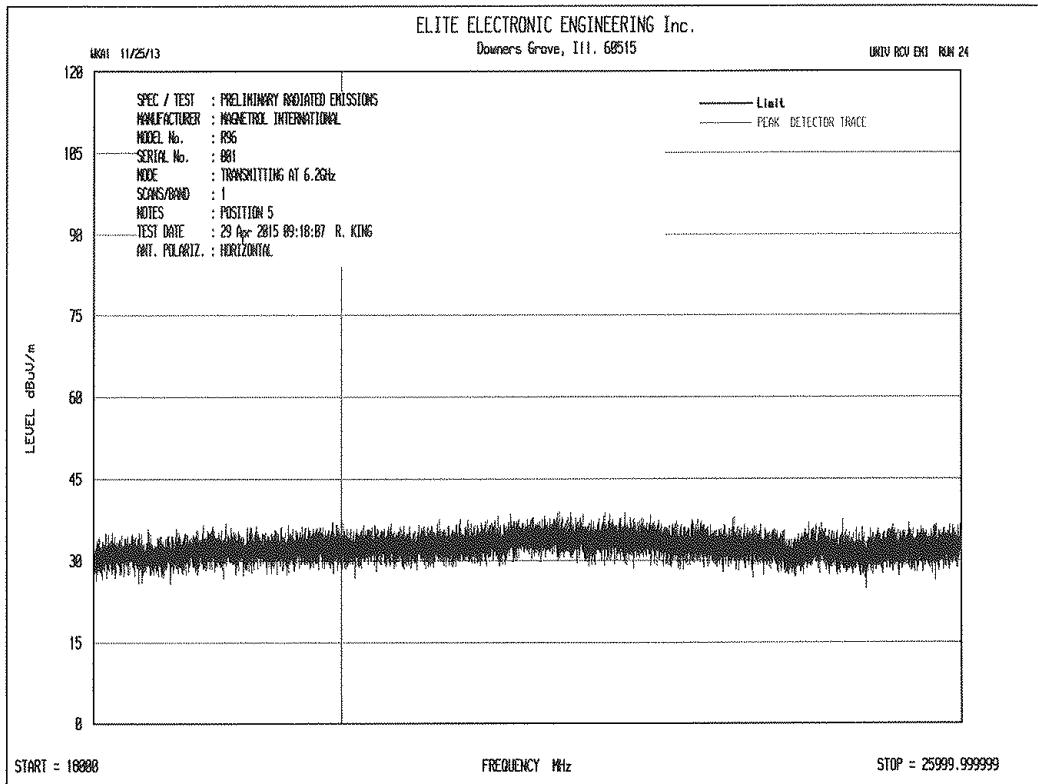


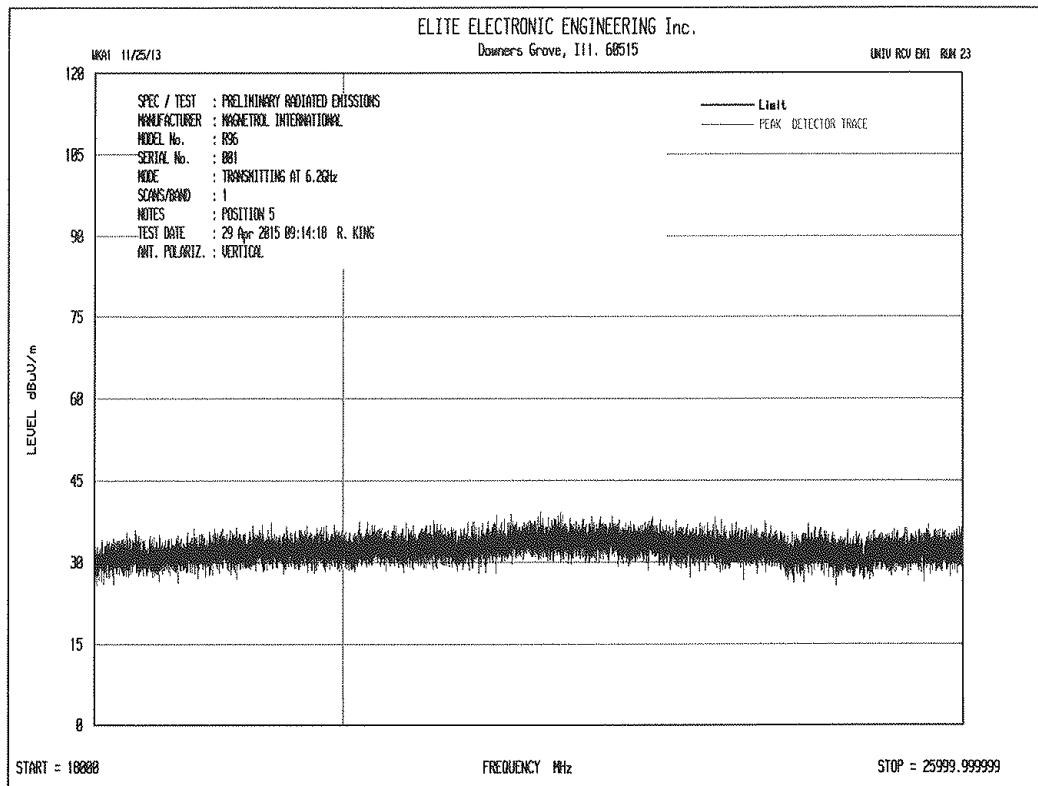


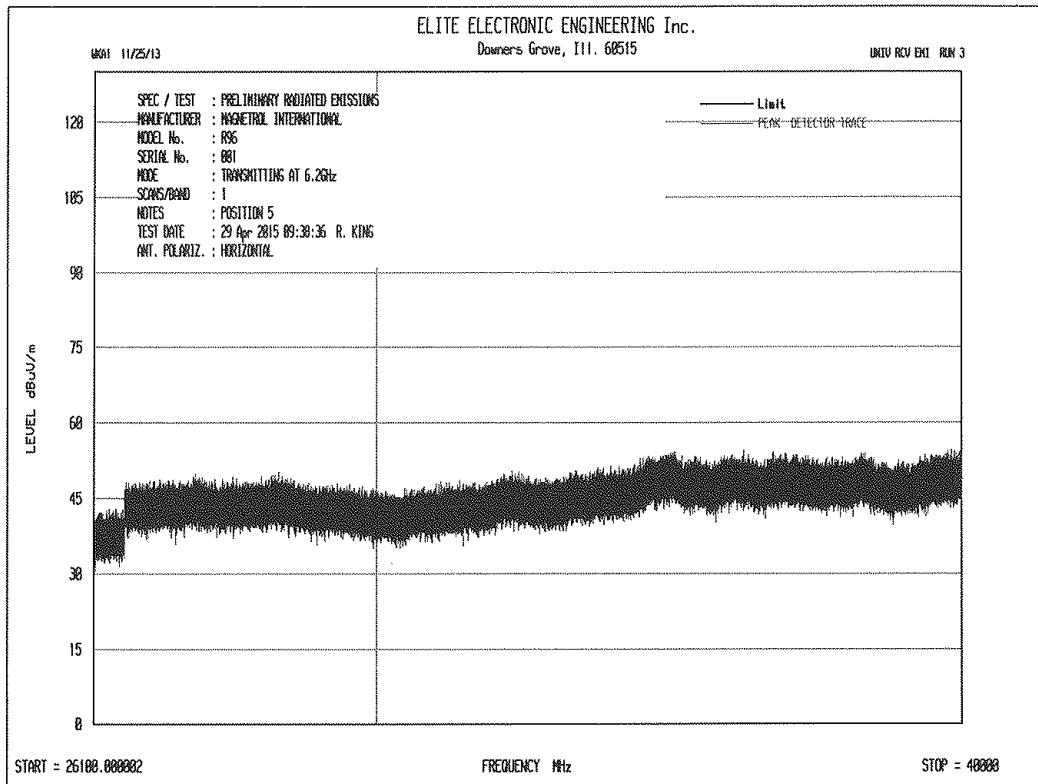
All emissions measured except the fundamental were attributed to the <sup>ambient</sup> environment.

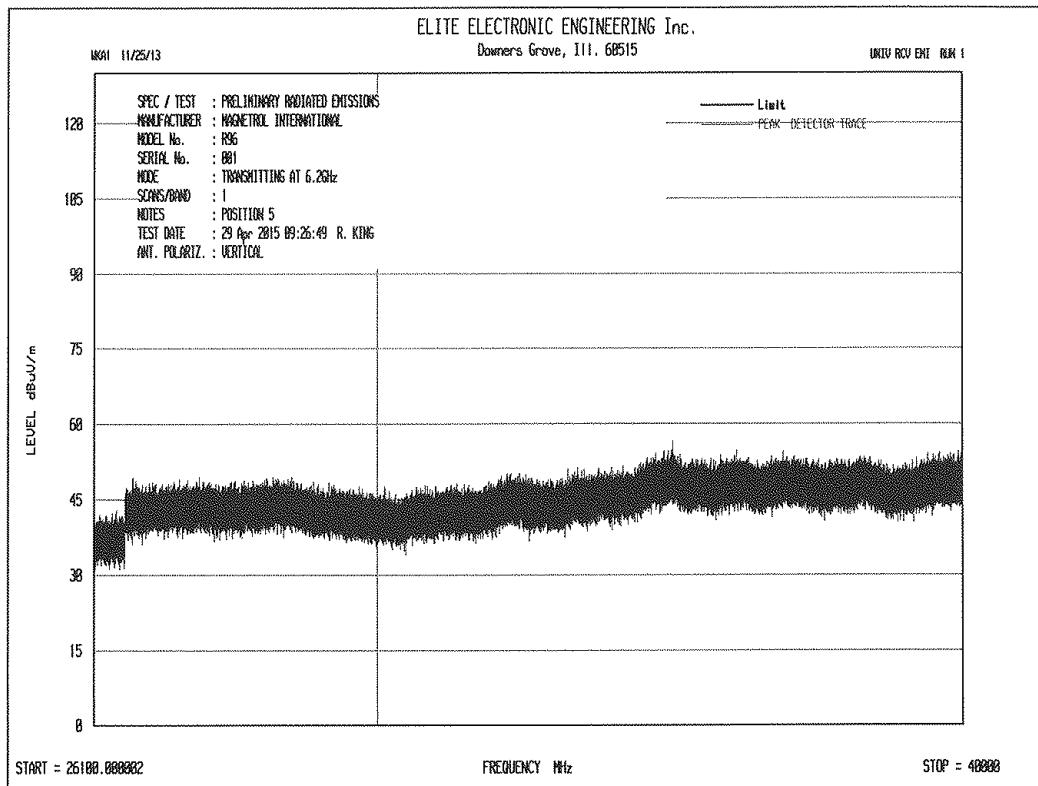


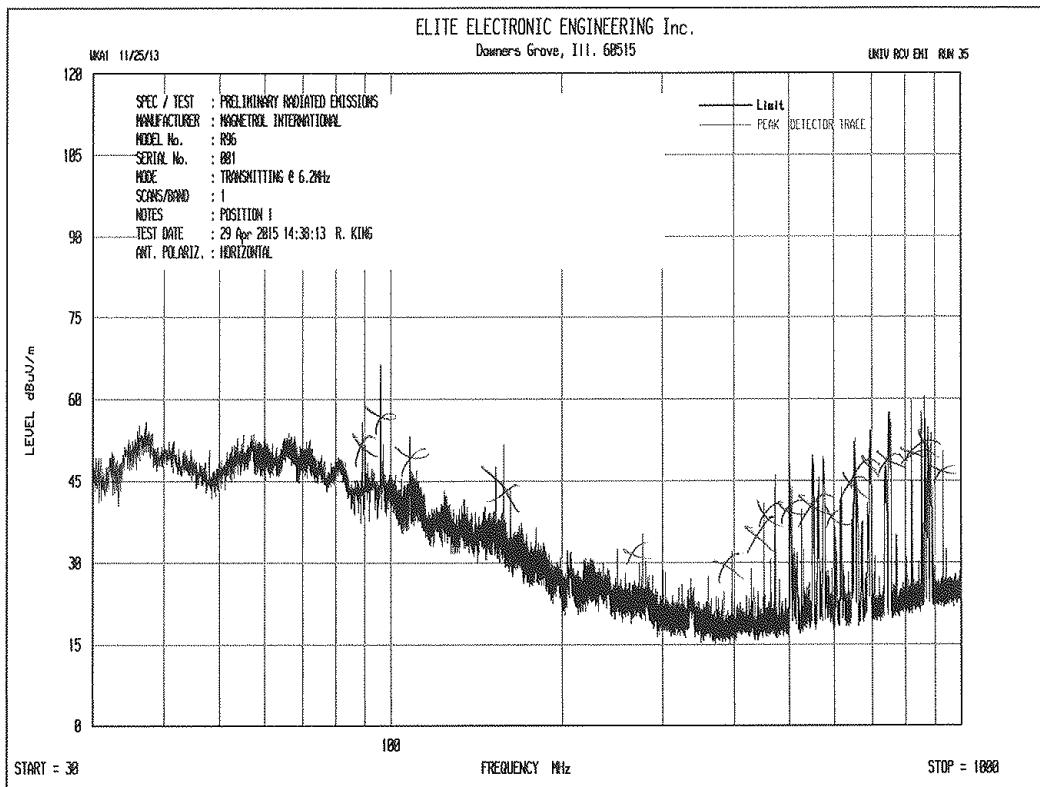
All emissions measured were attributed to the ambient environment.



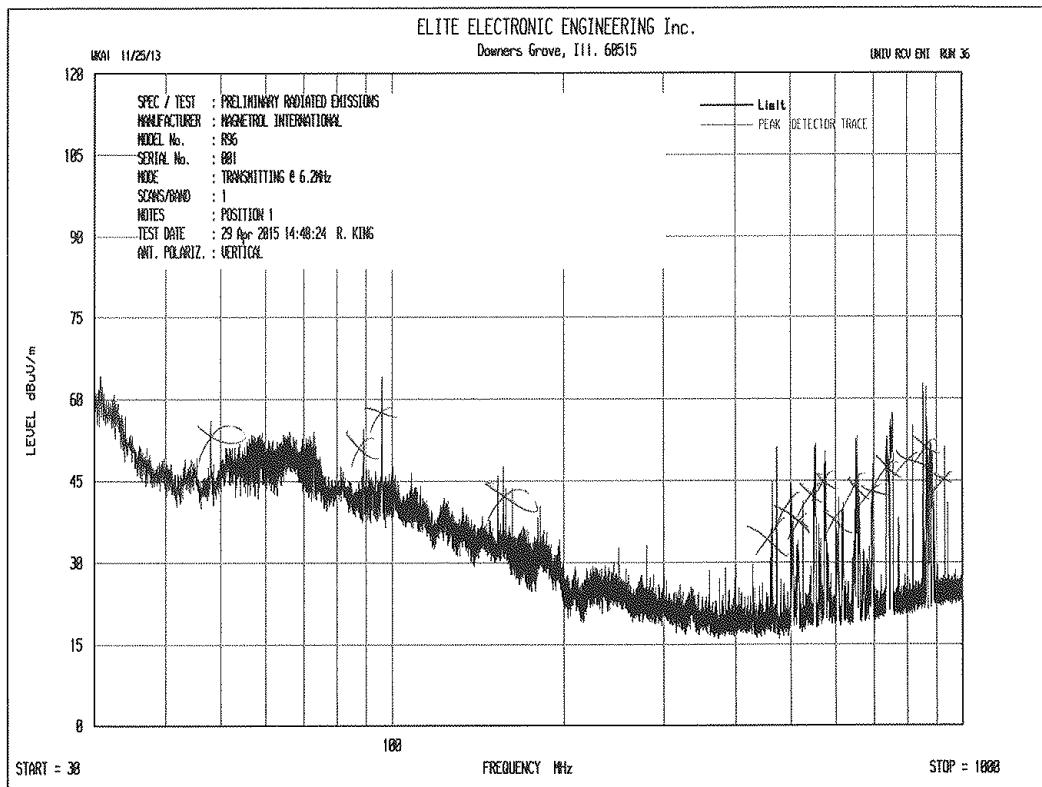




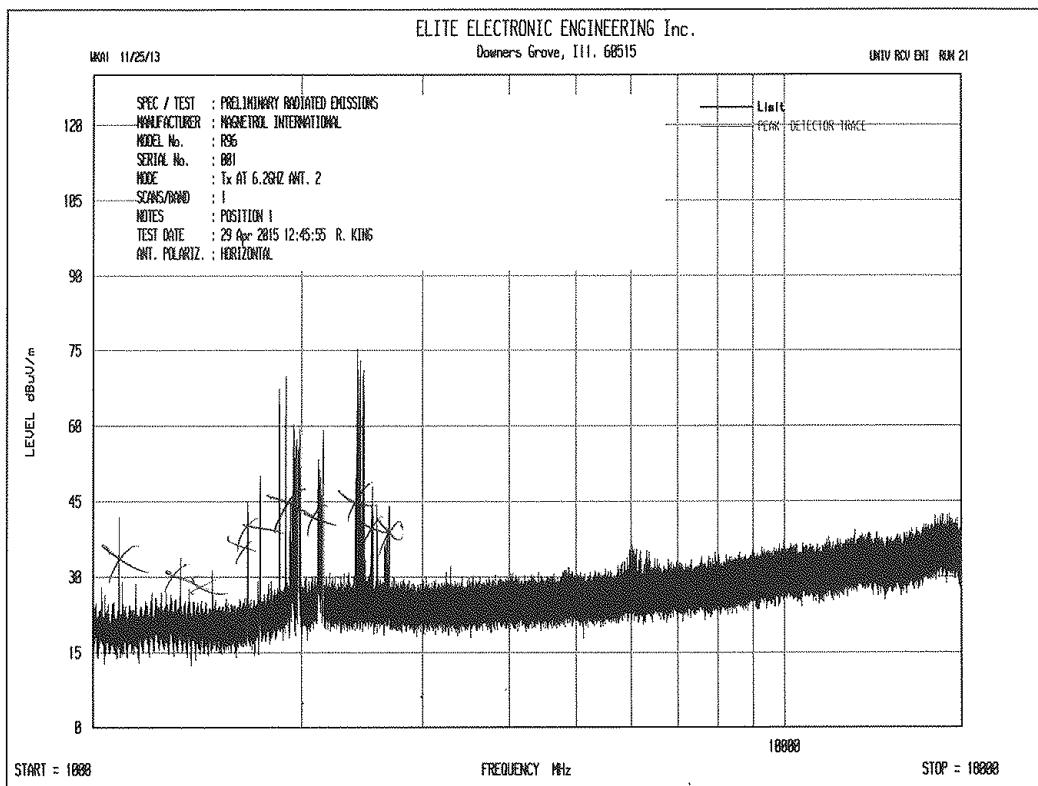




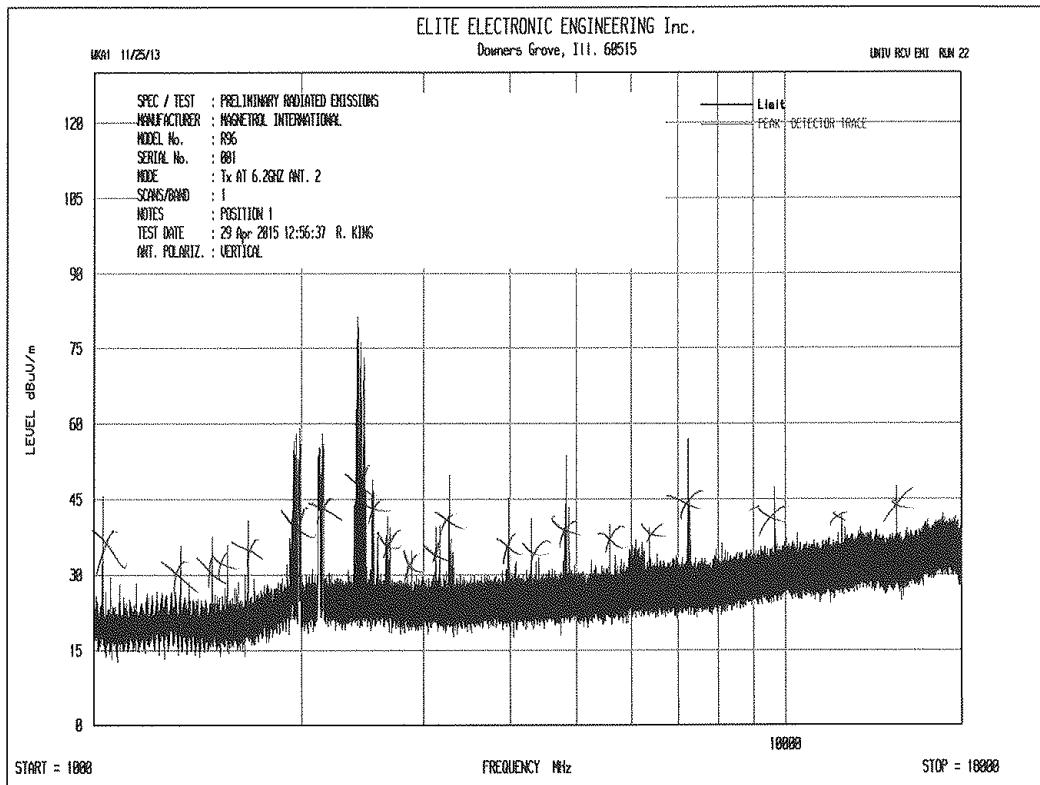
All emissions measured are attributed to the ambient environment.



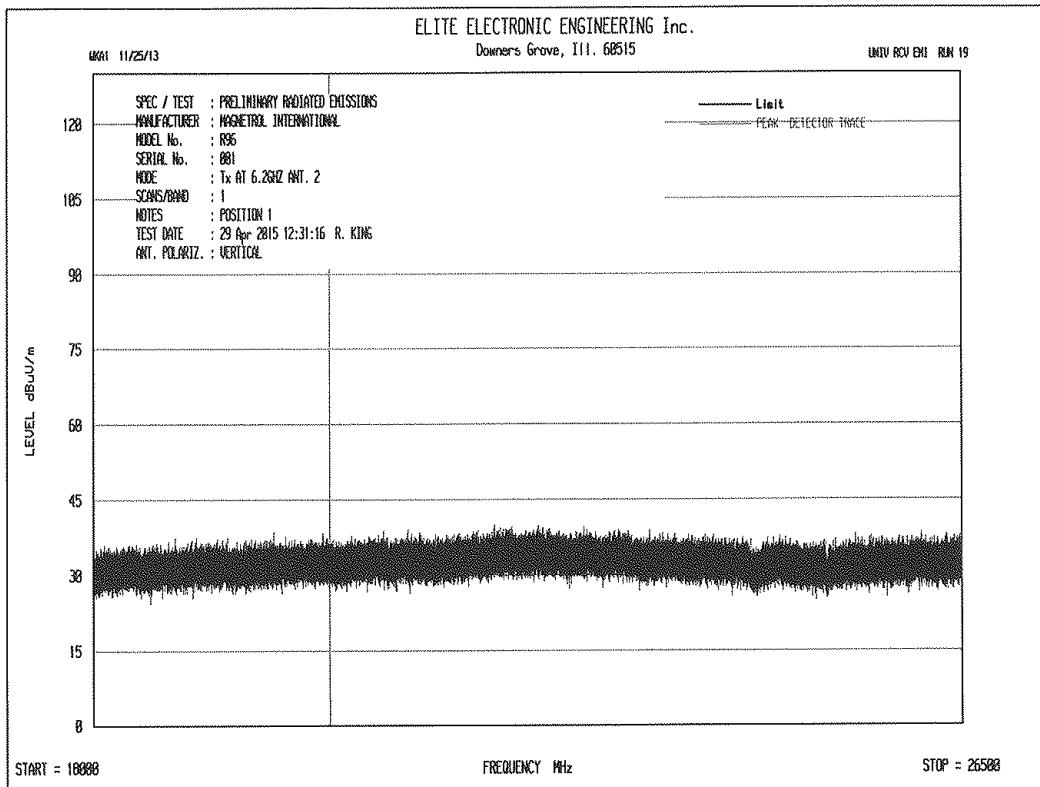
All emissions measured were attributed to the ambient environment.

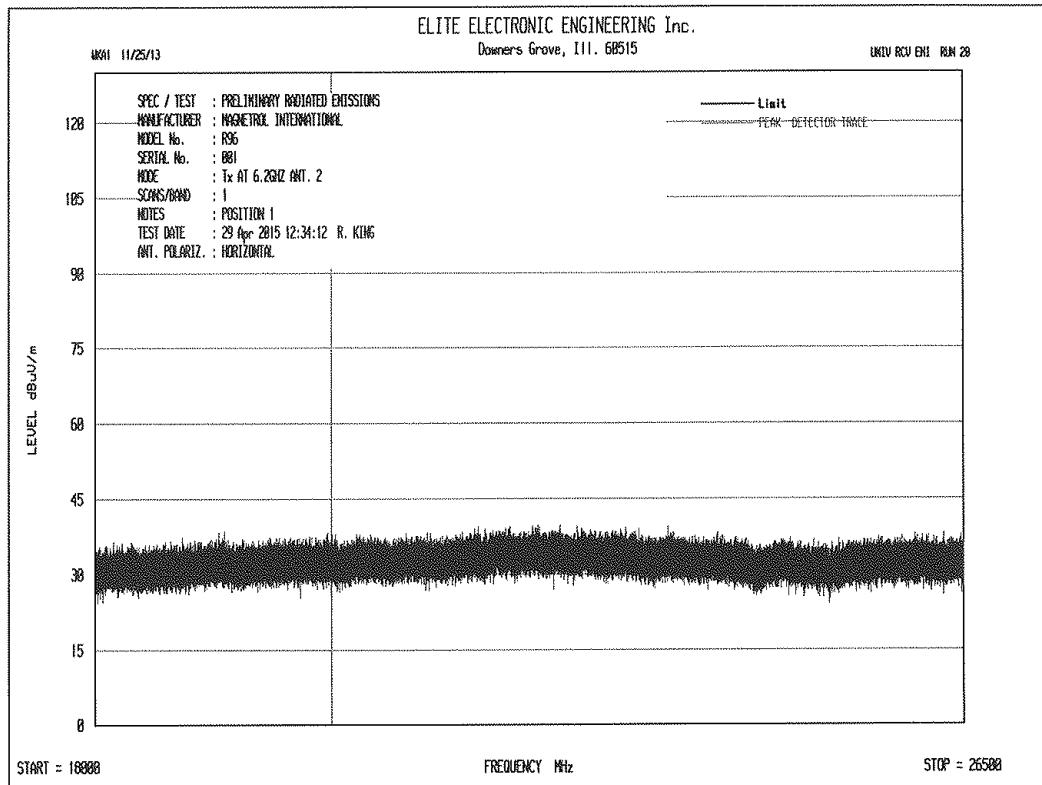


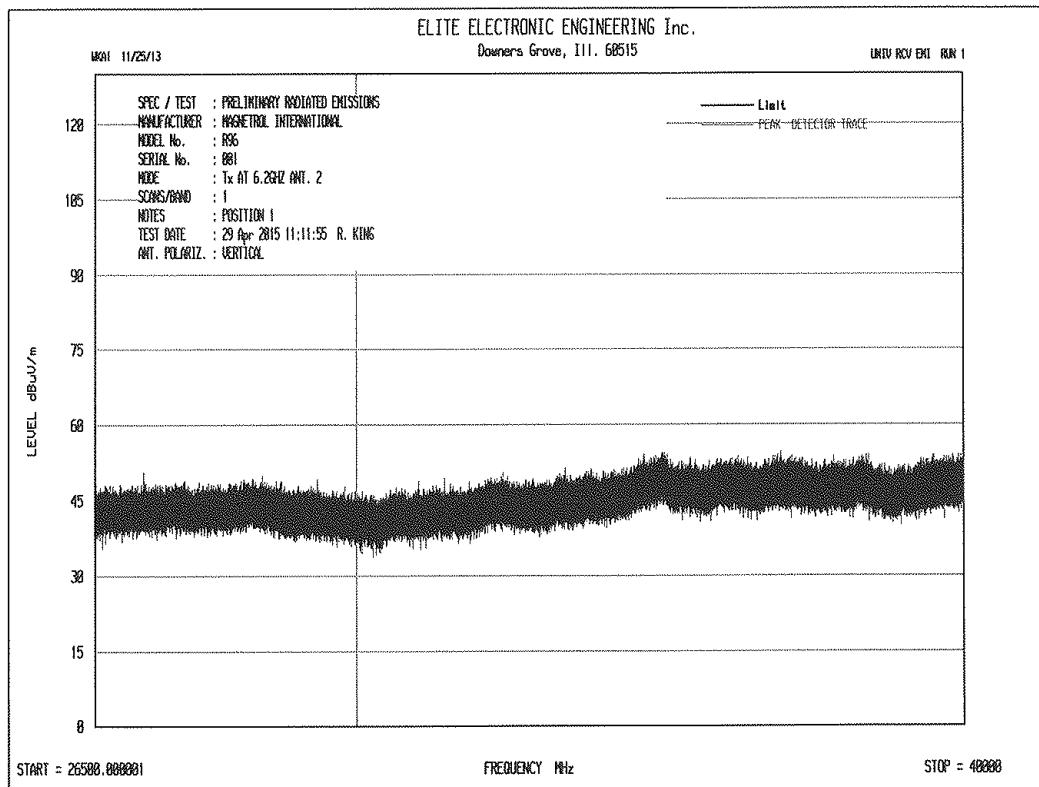
All measured emissions were attributed to the ambient environment.

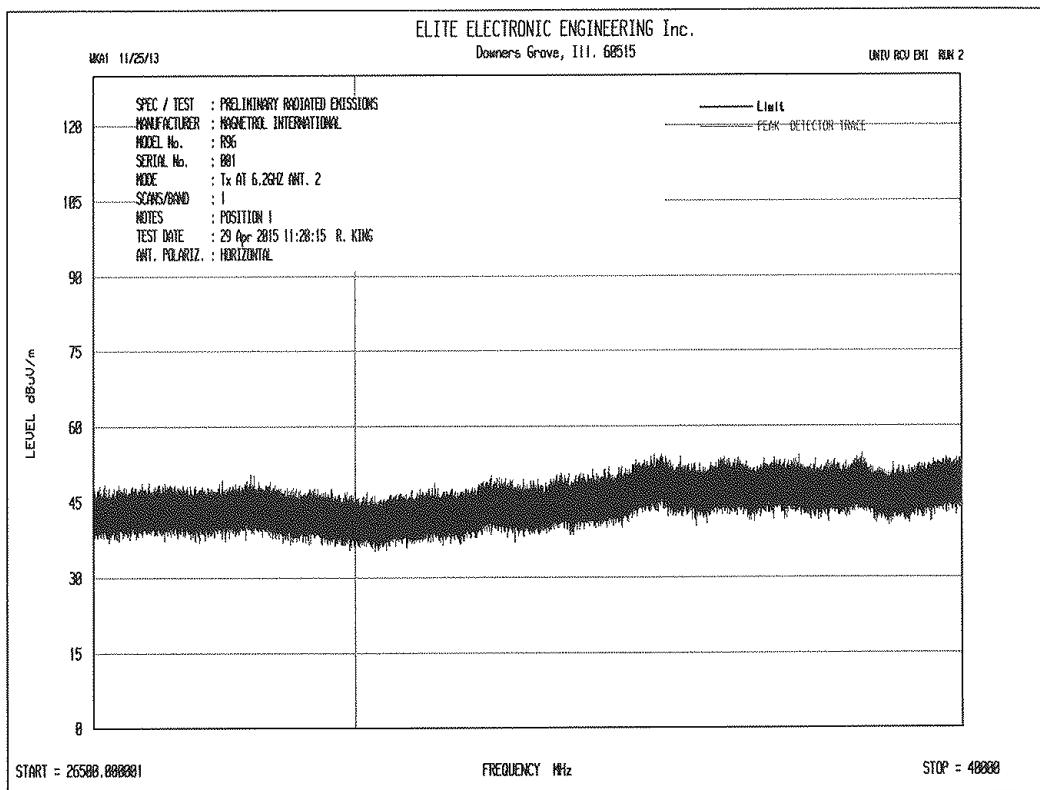


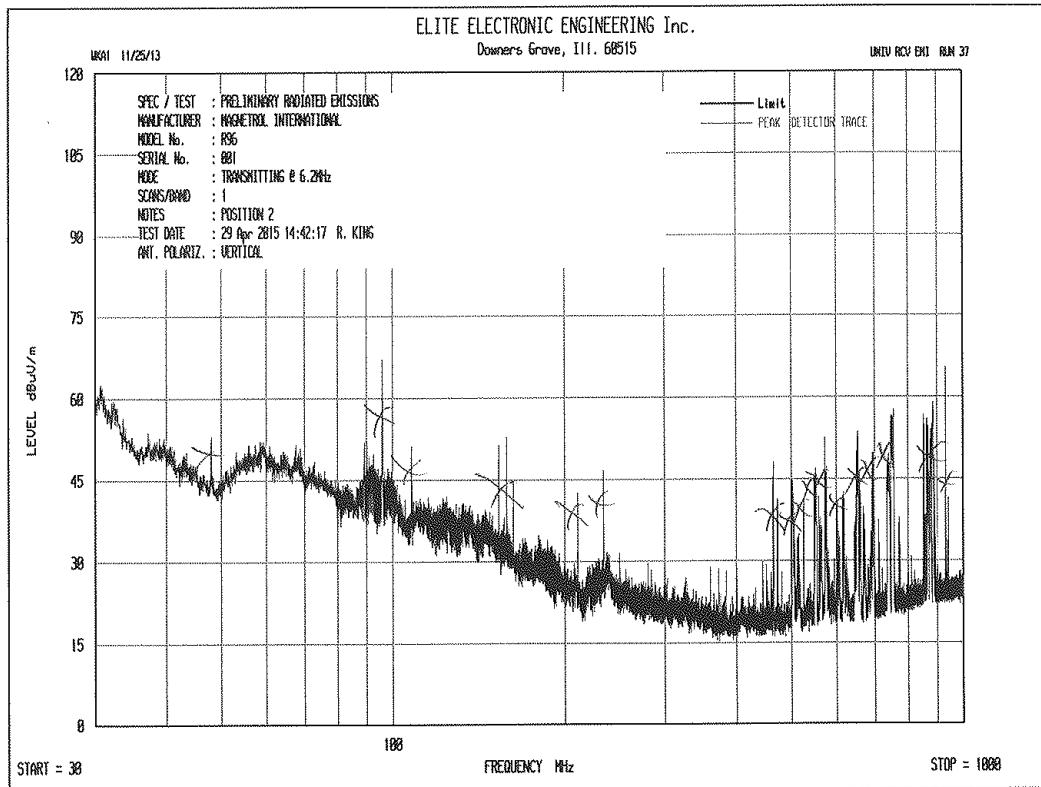
All emissions measured were within the ambient domain.



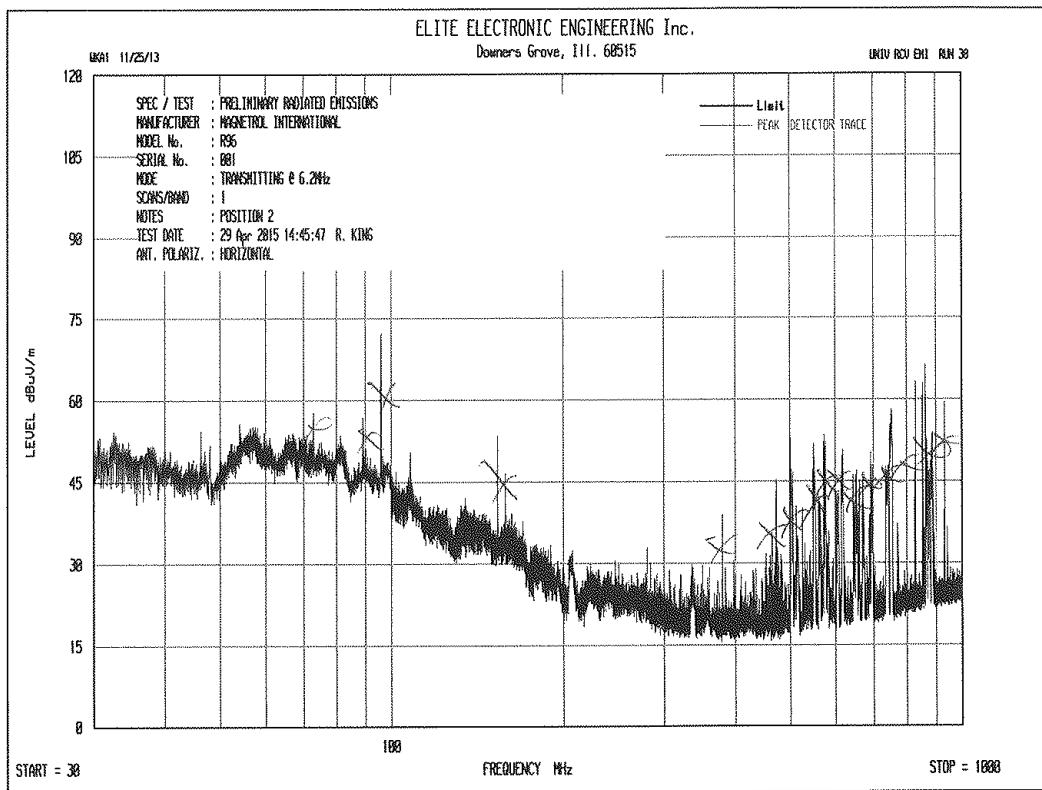




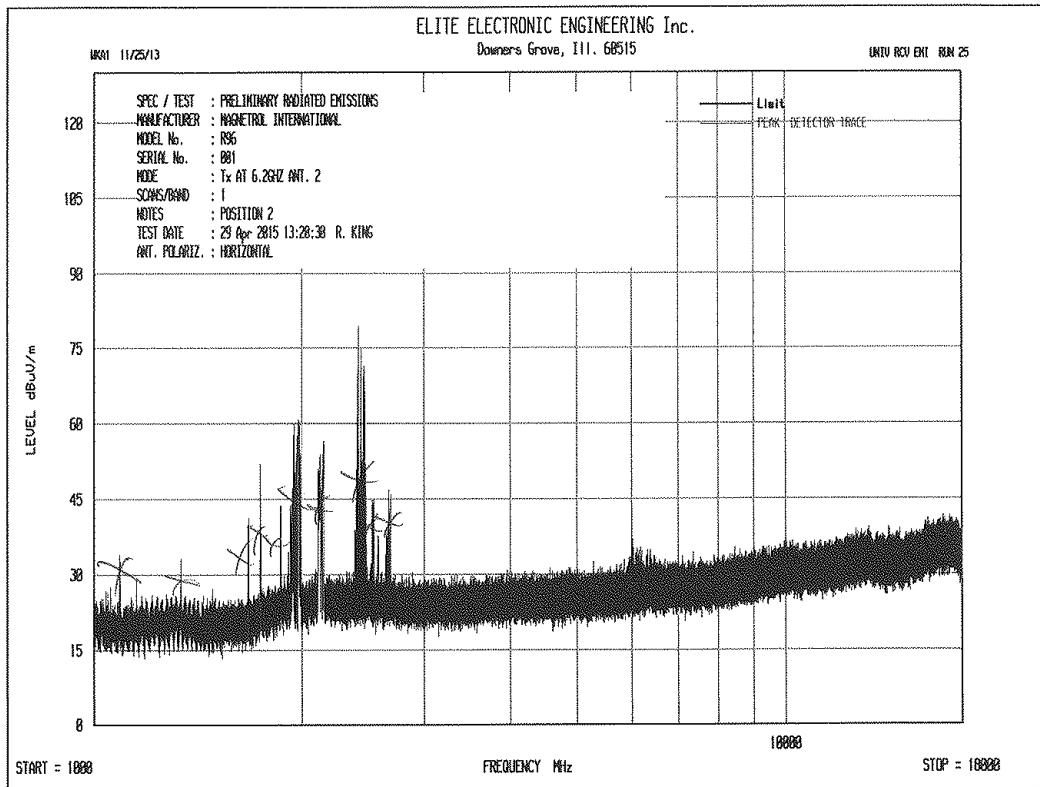




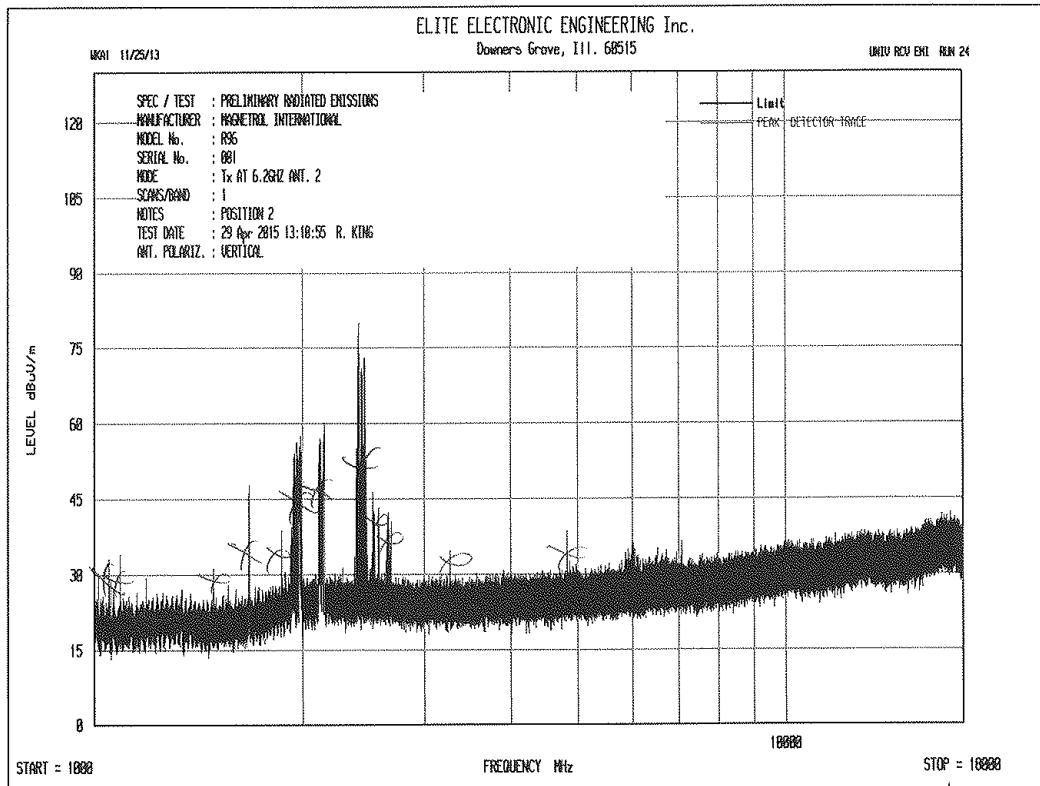
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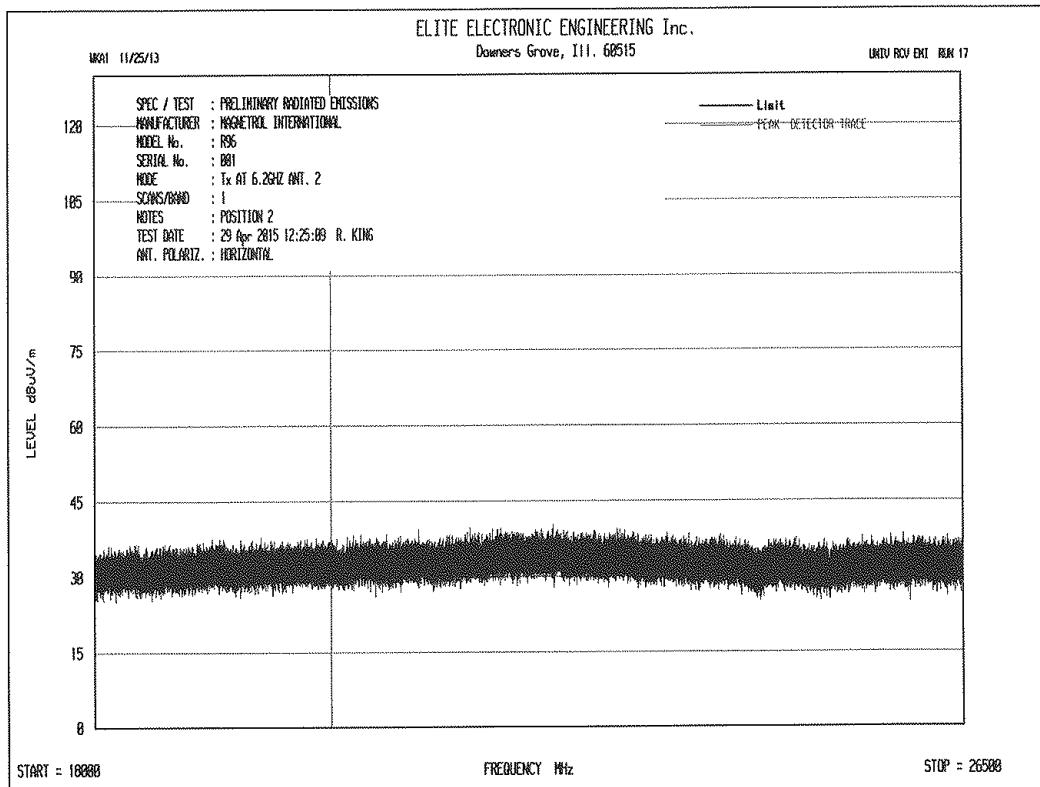
All emissions measured were attributed to the ambient environment.

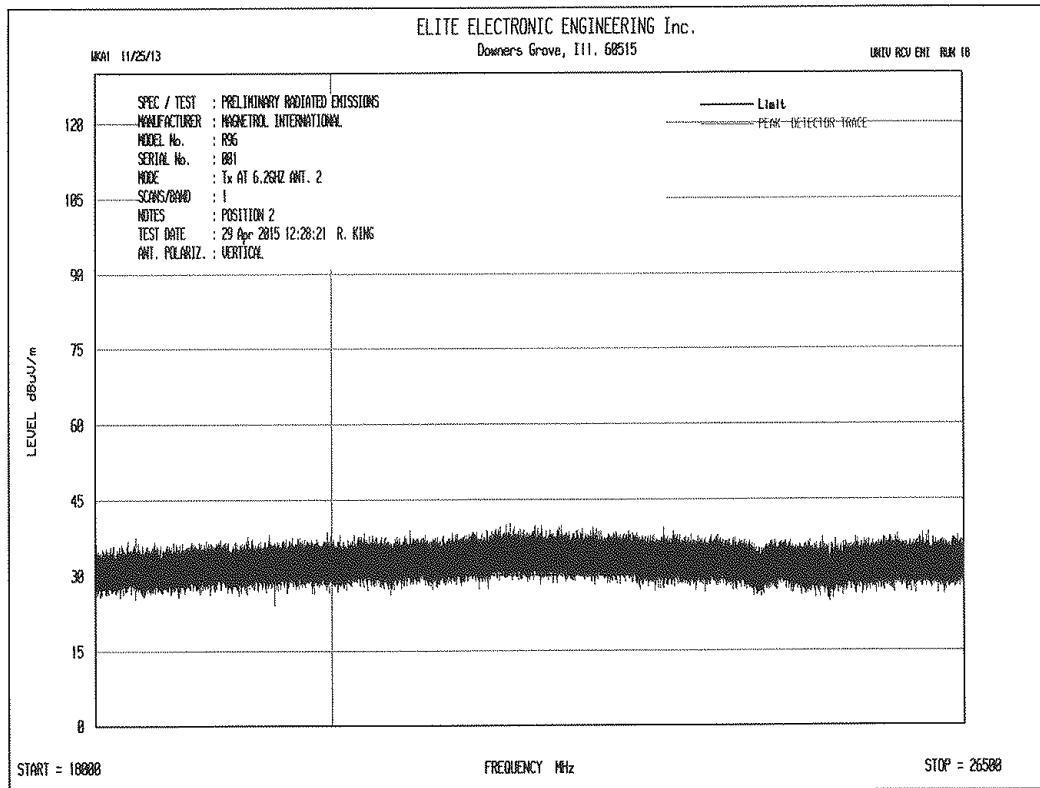


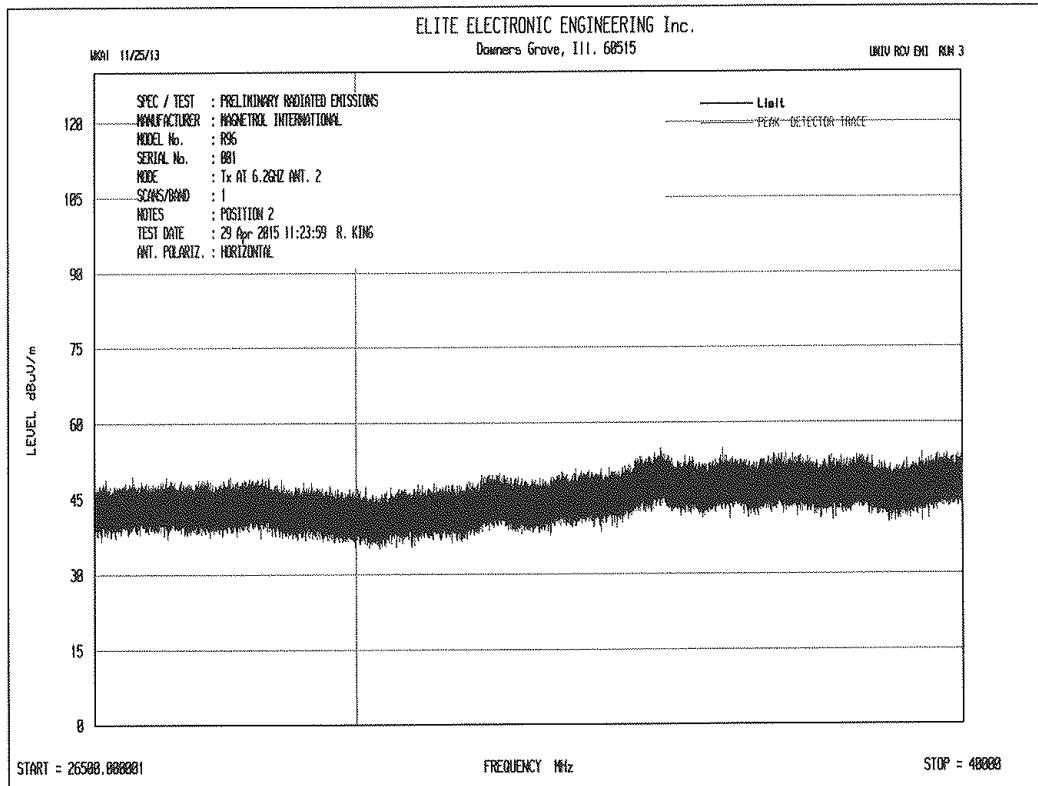
All emissions measured were attributed to the ambient environment.

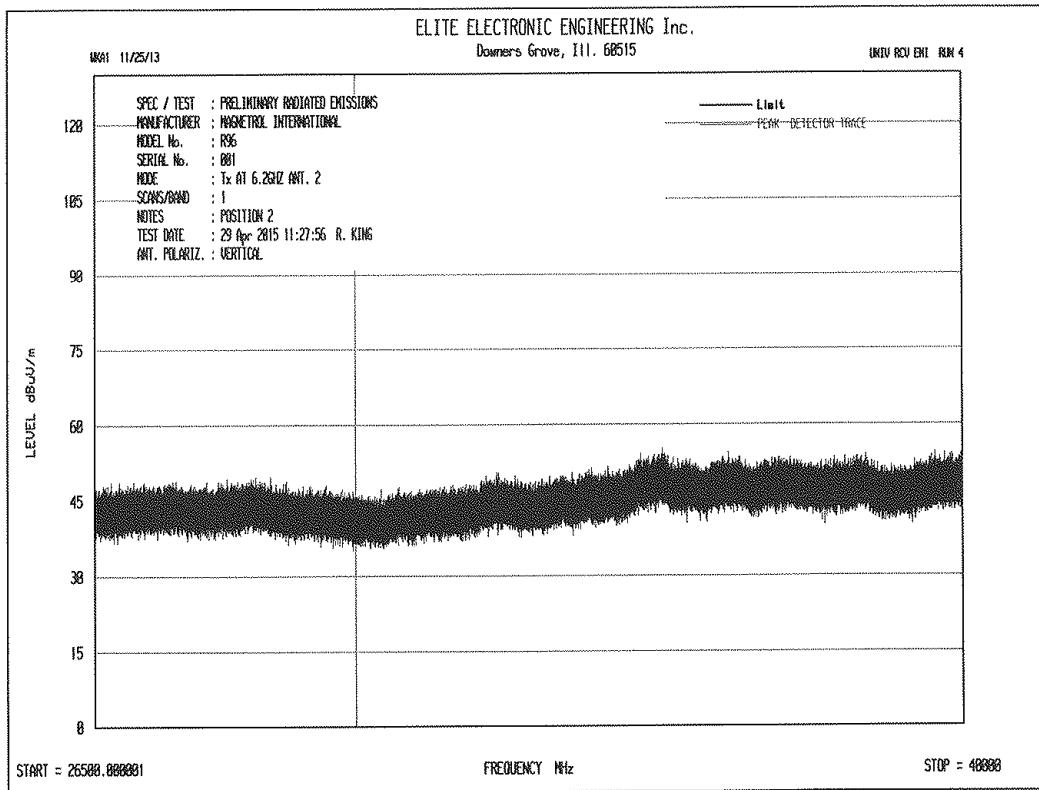


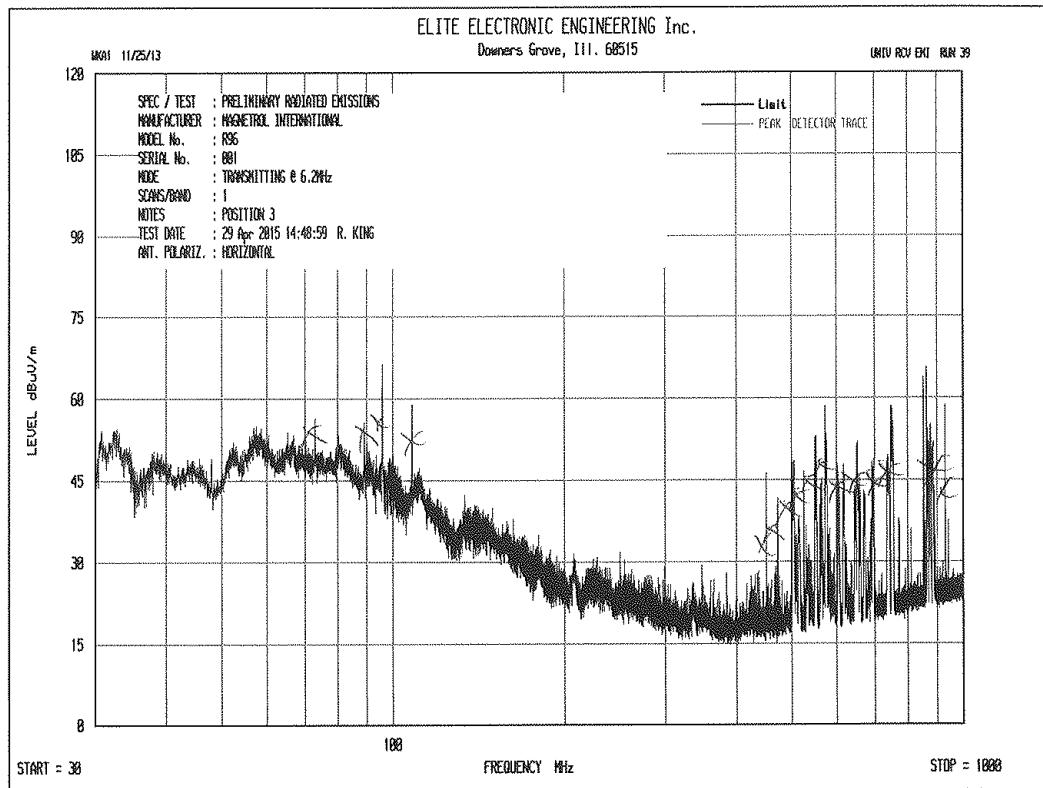
all emissions measured were attributed to the ambient environment.



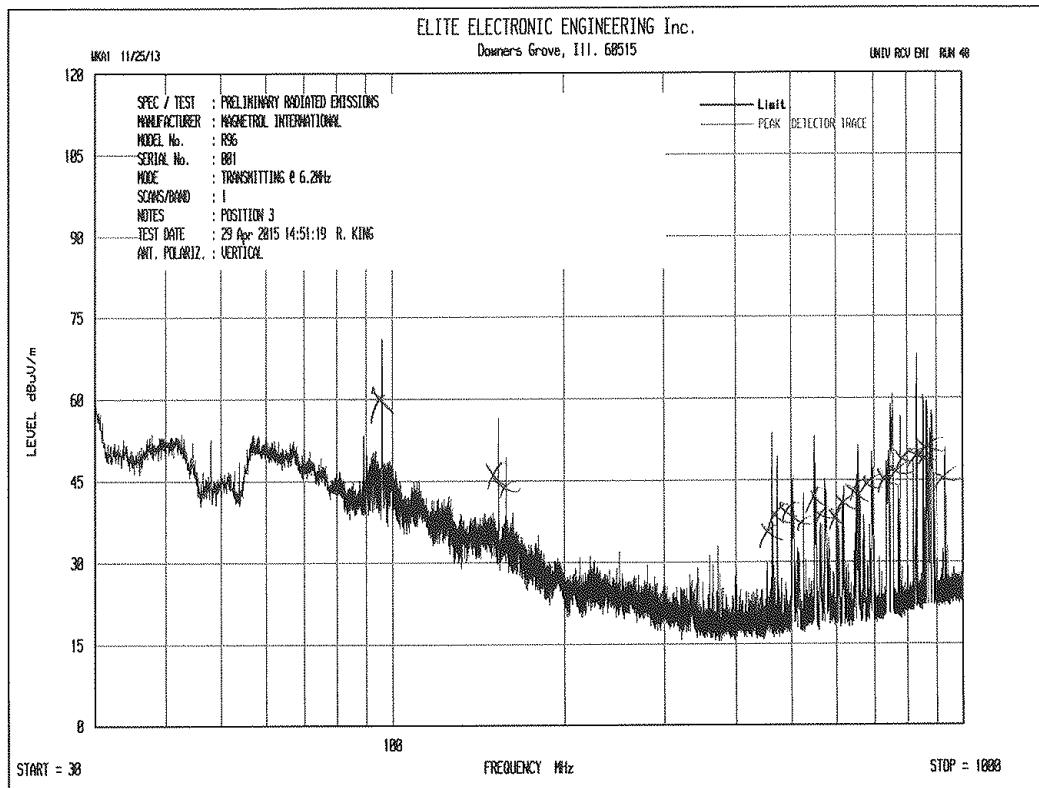




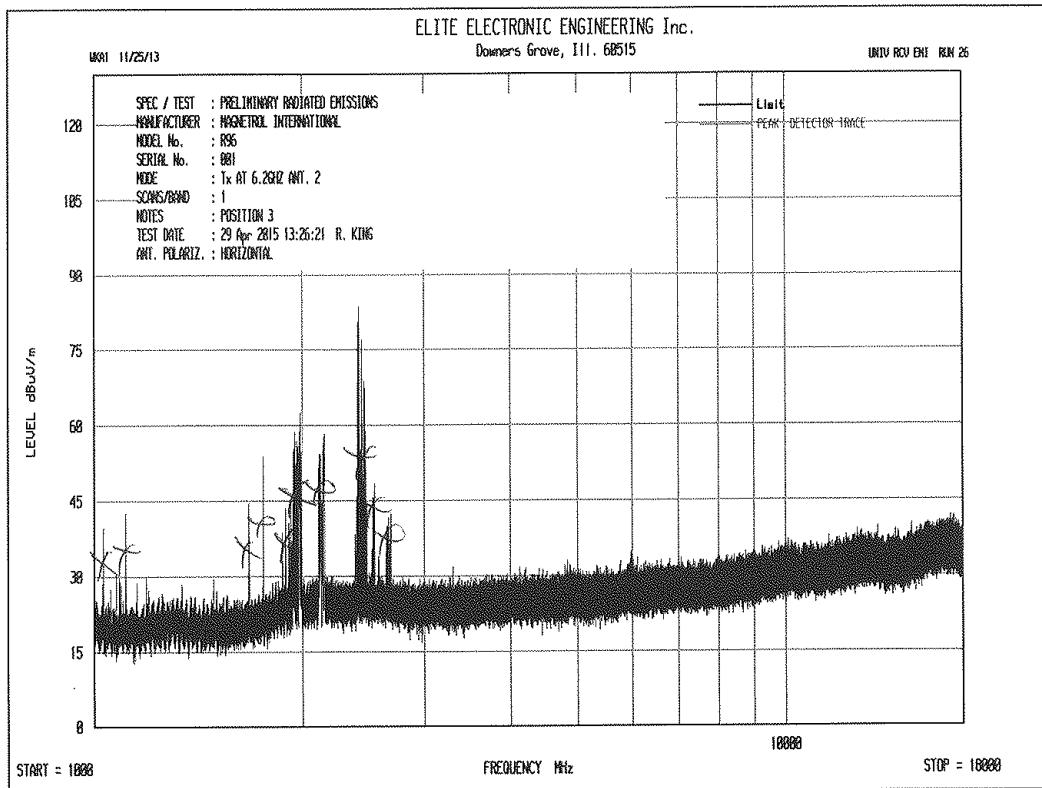




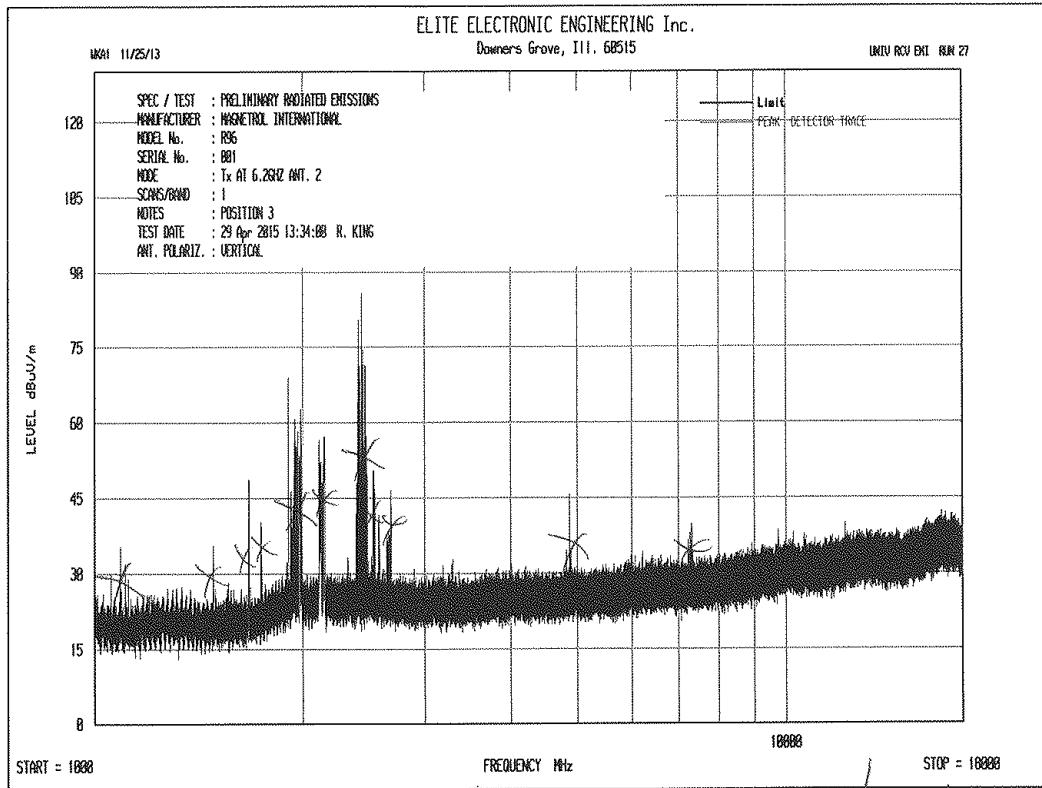
All emissions measured were attributed to the ambient environment.



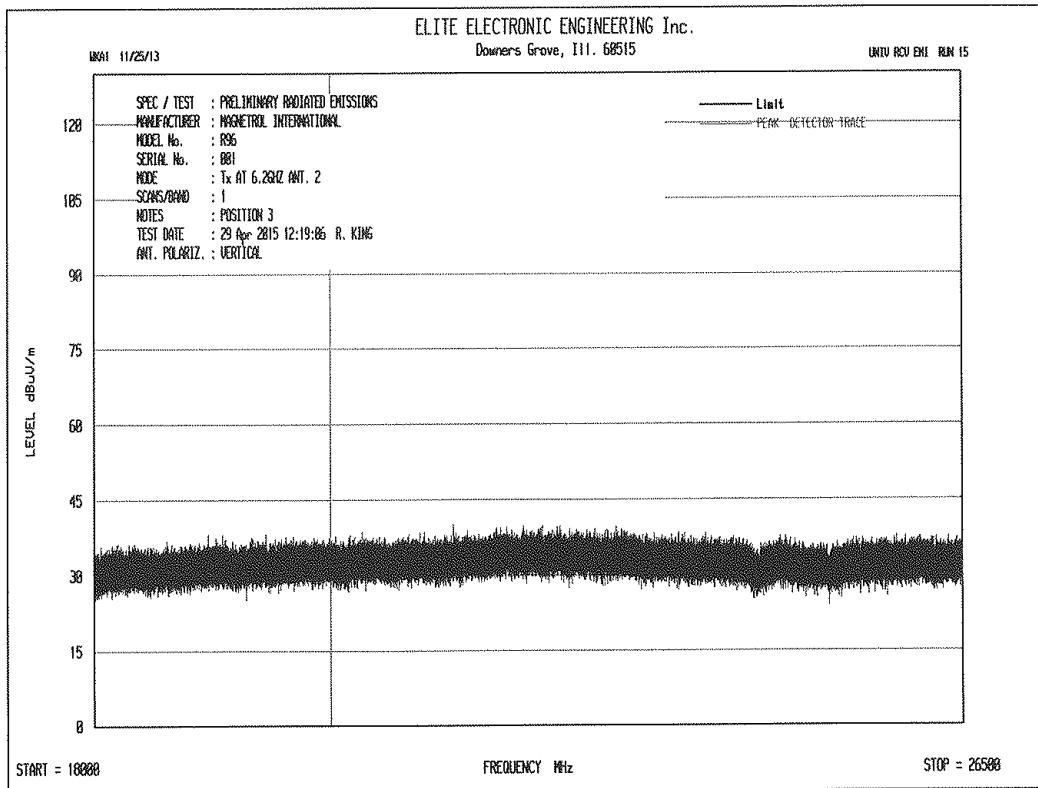
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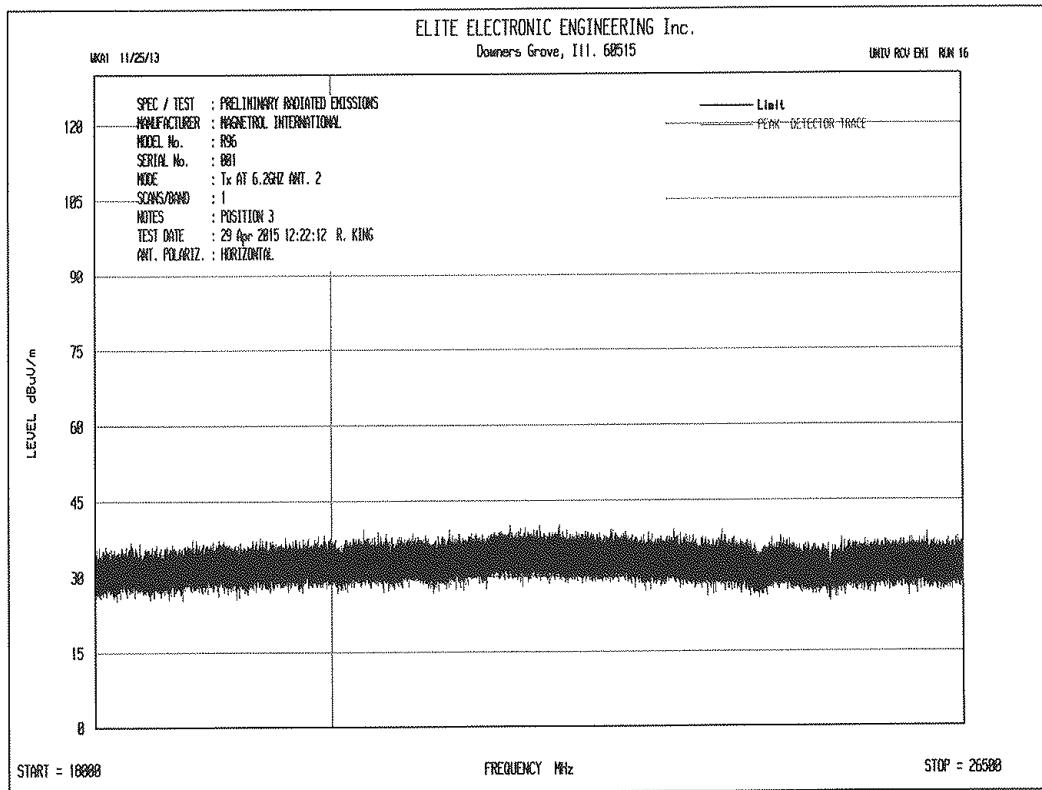


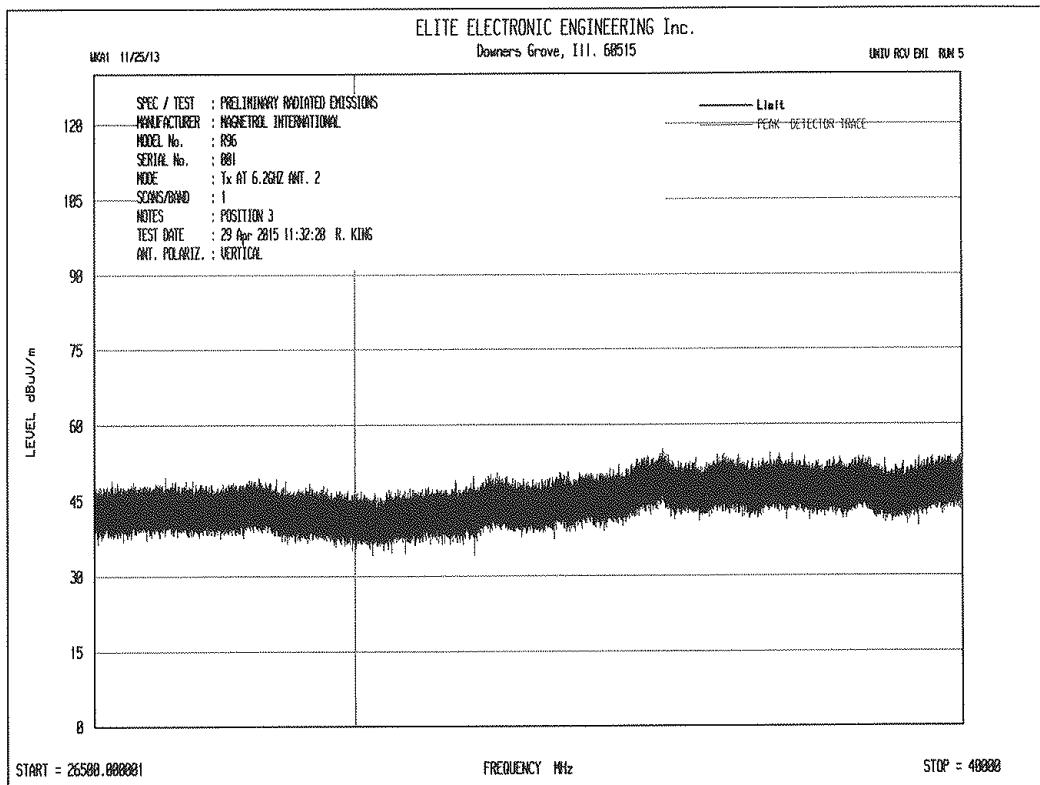
all emissions measured were attributed to the ambient environment.

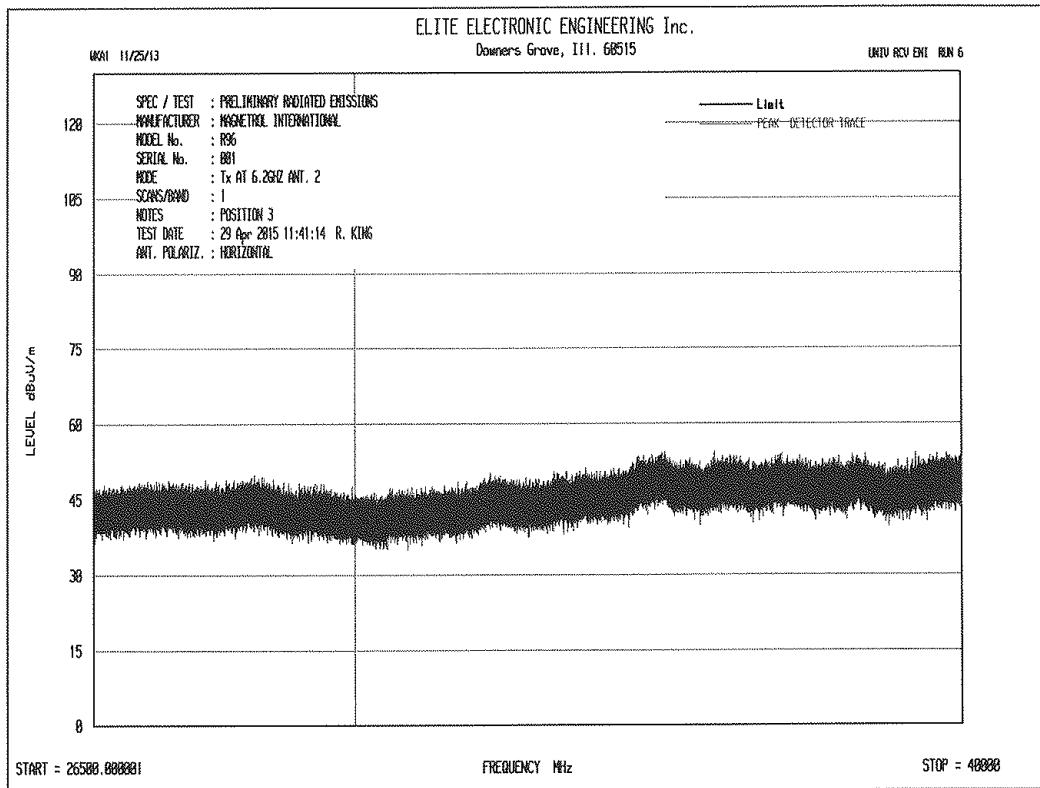


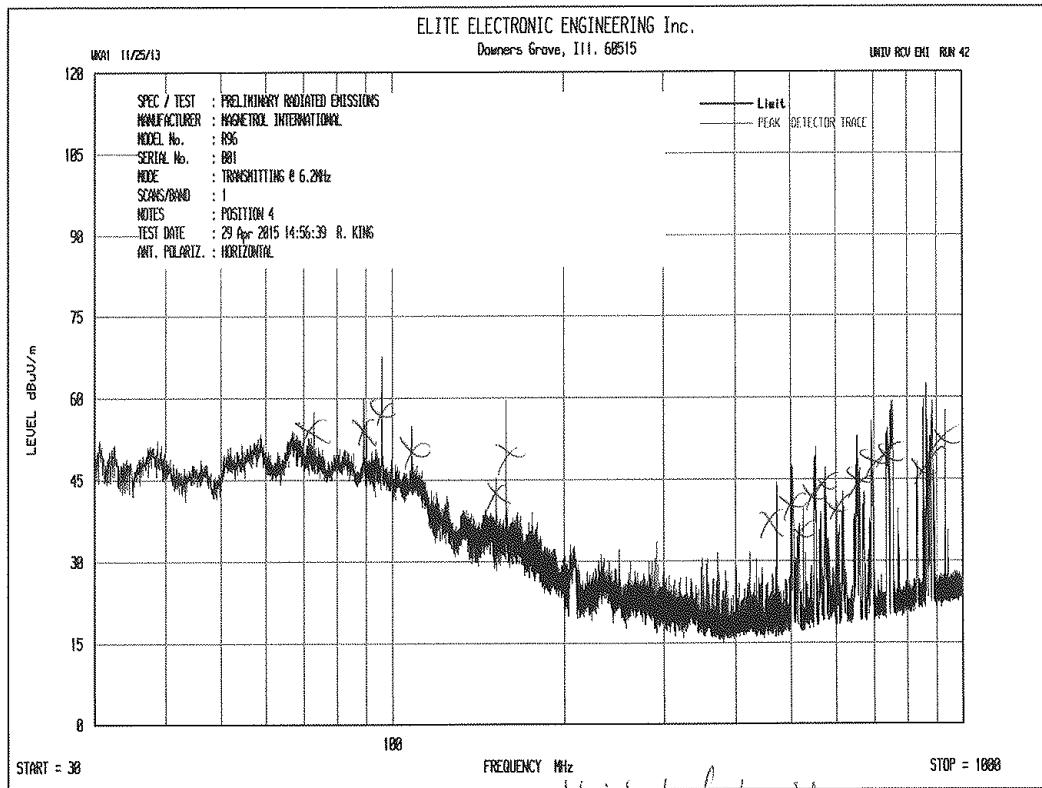
all emissions measured were within the analytical domain.





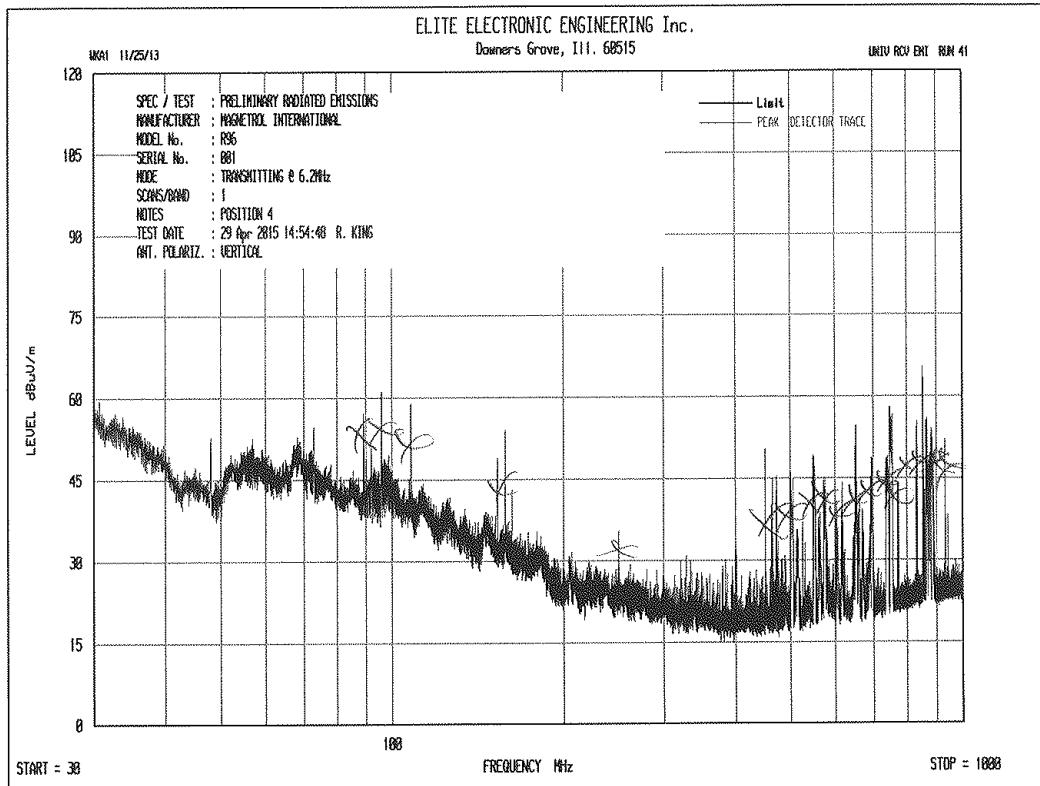




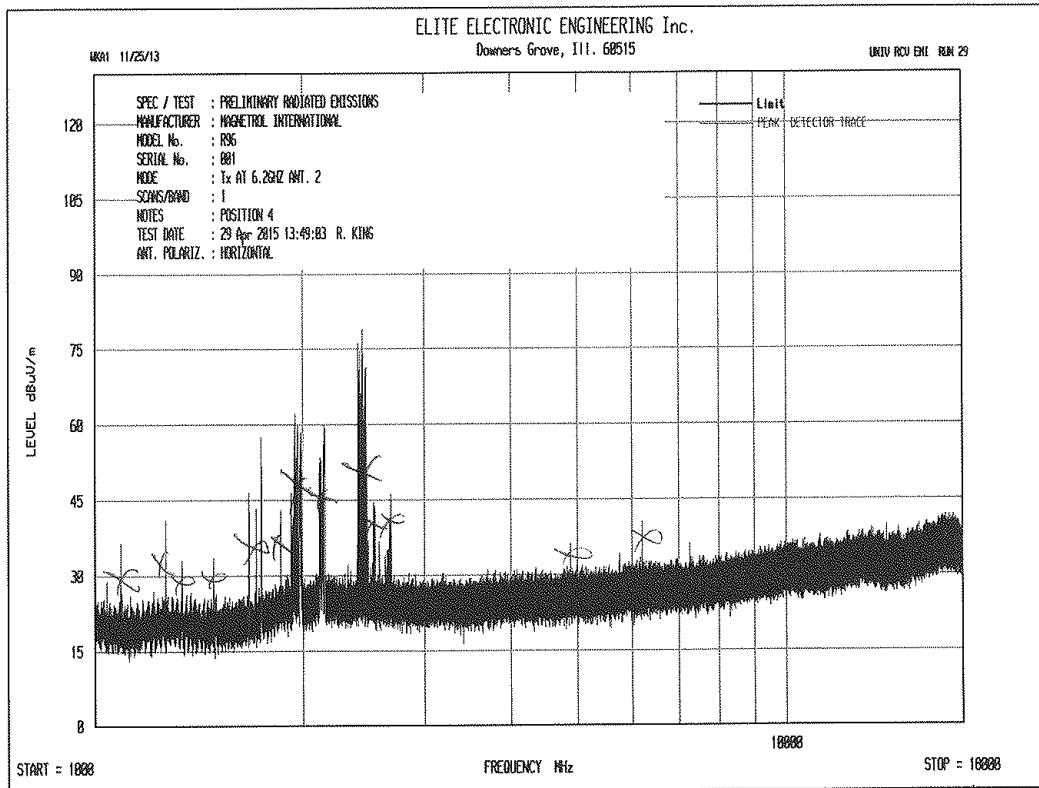


START = 30 FREQUENCY MHz STOP = 1000

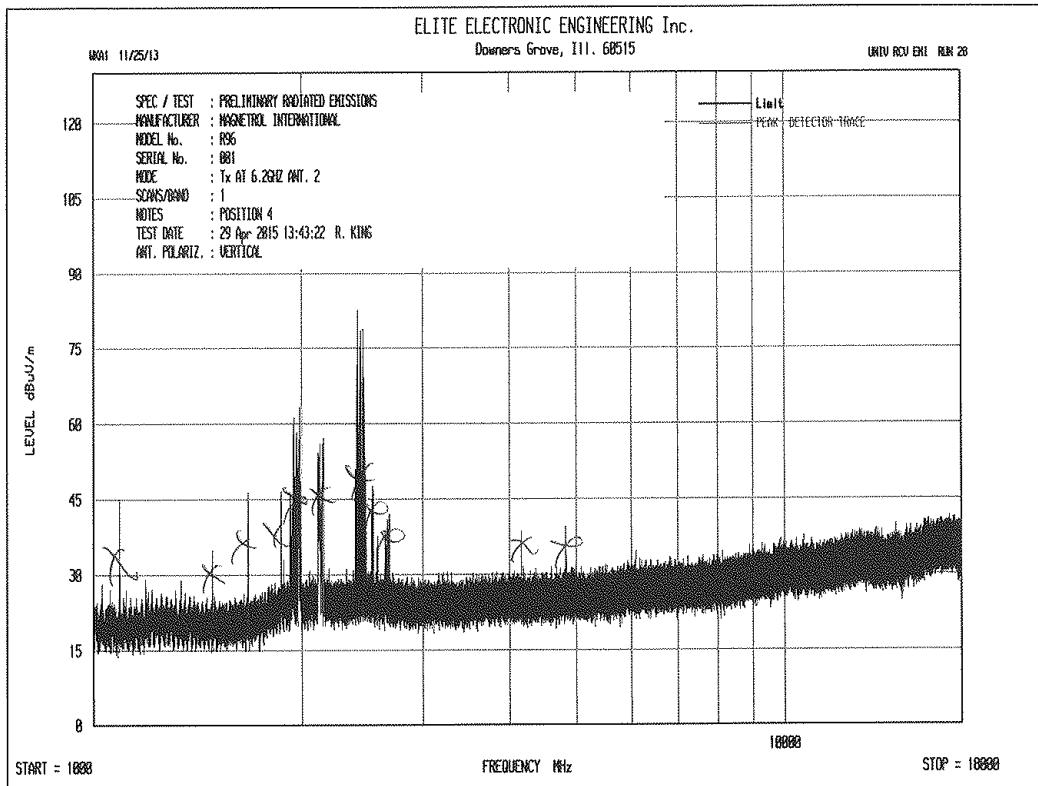
All emissions measured were attributed to the ambient environment.



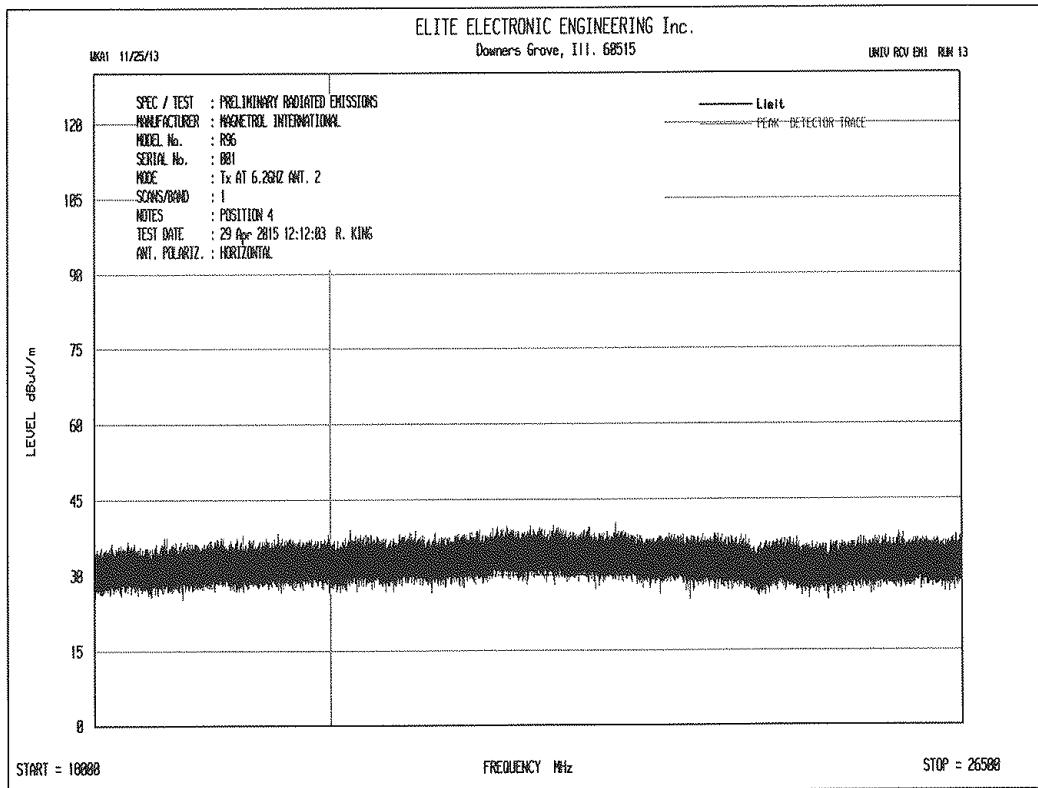
All emissions measured were attributed to the ambient environment.

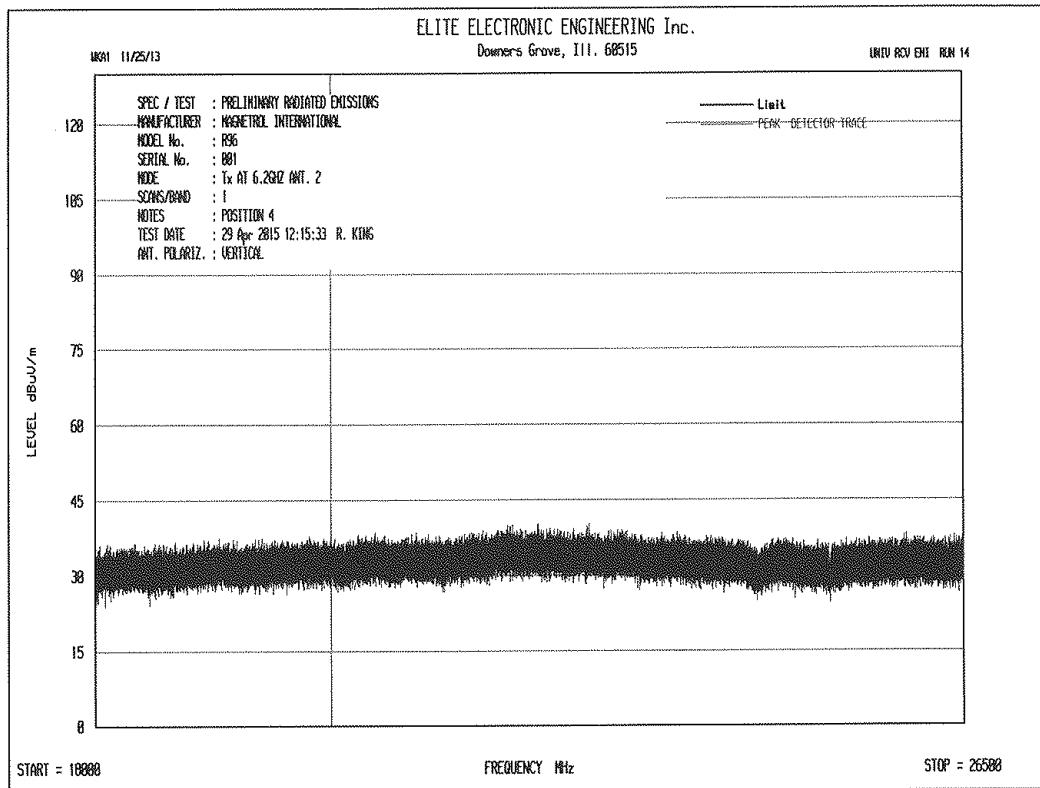


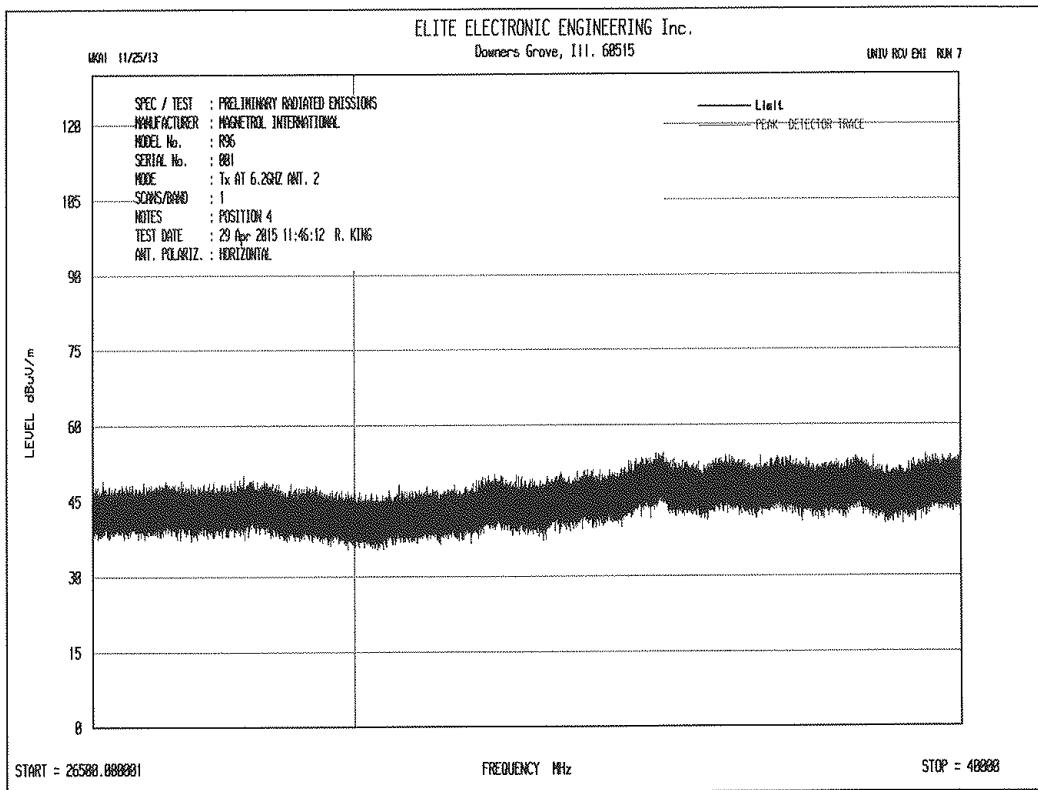
all emissions measured were attributed to the ambient environment.

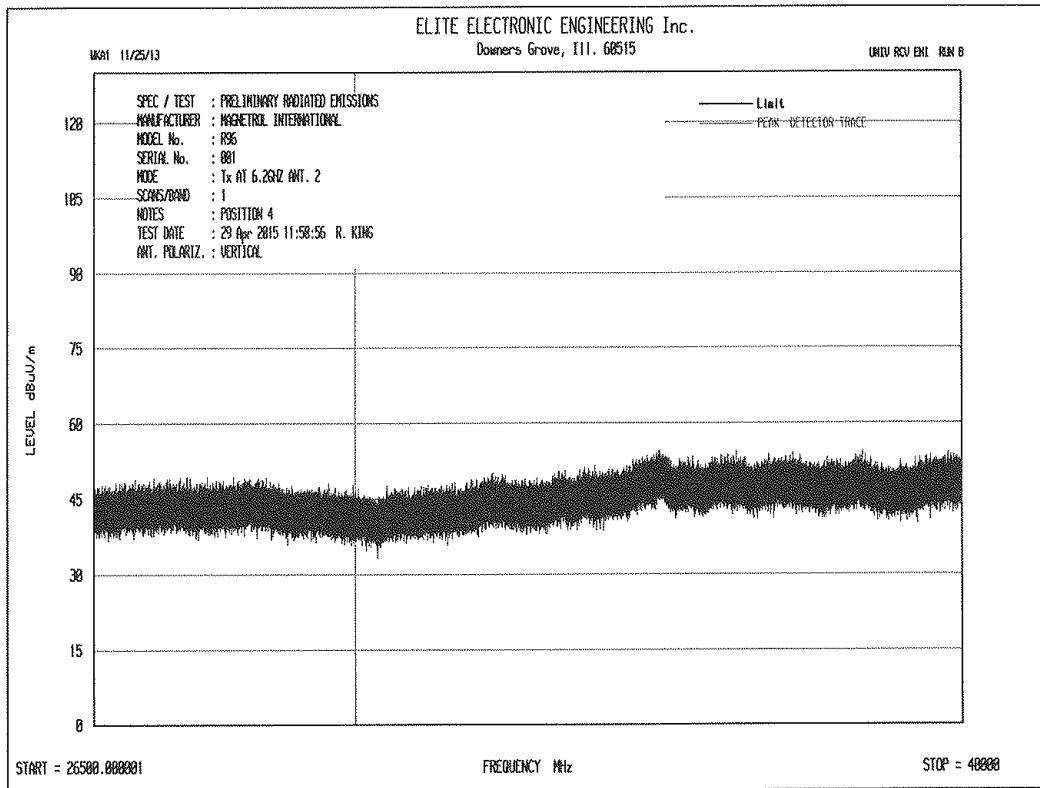


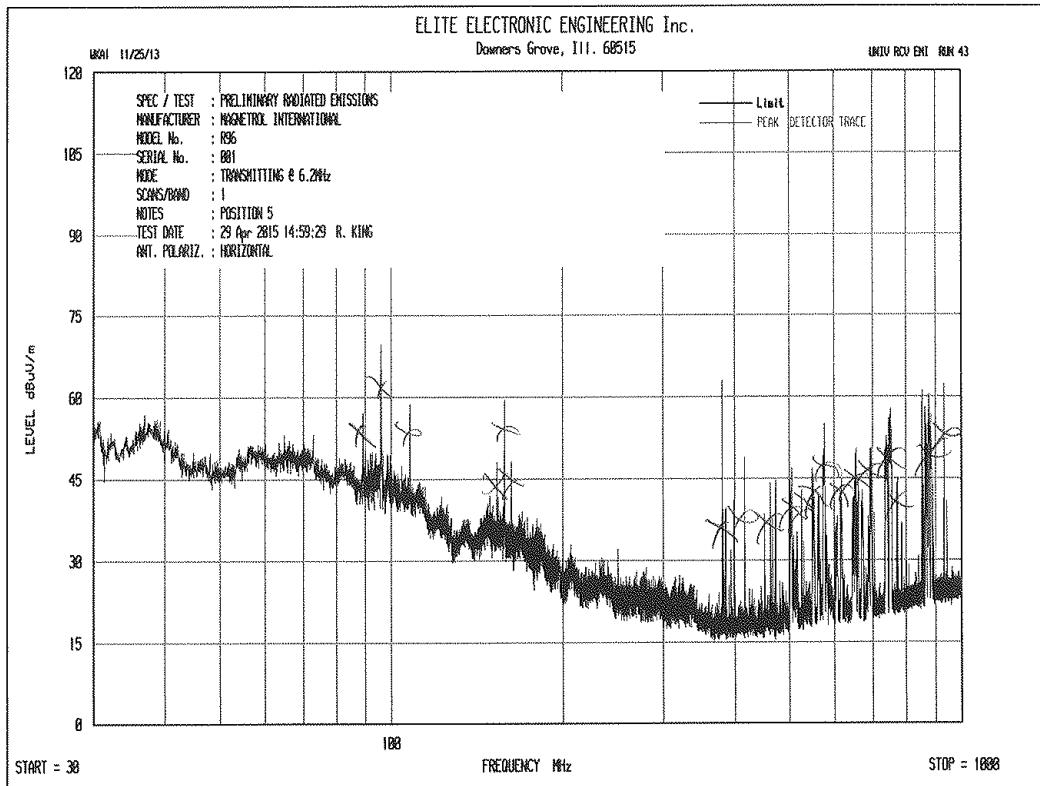
all emissions measured were attributed to the ambient environment.



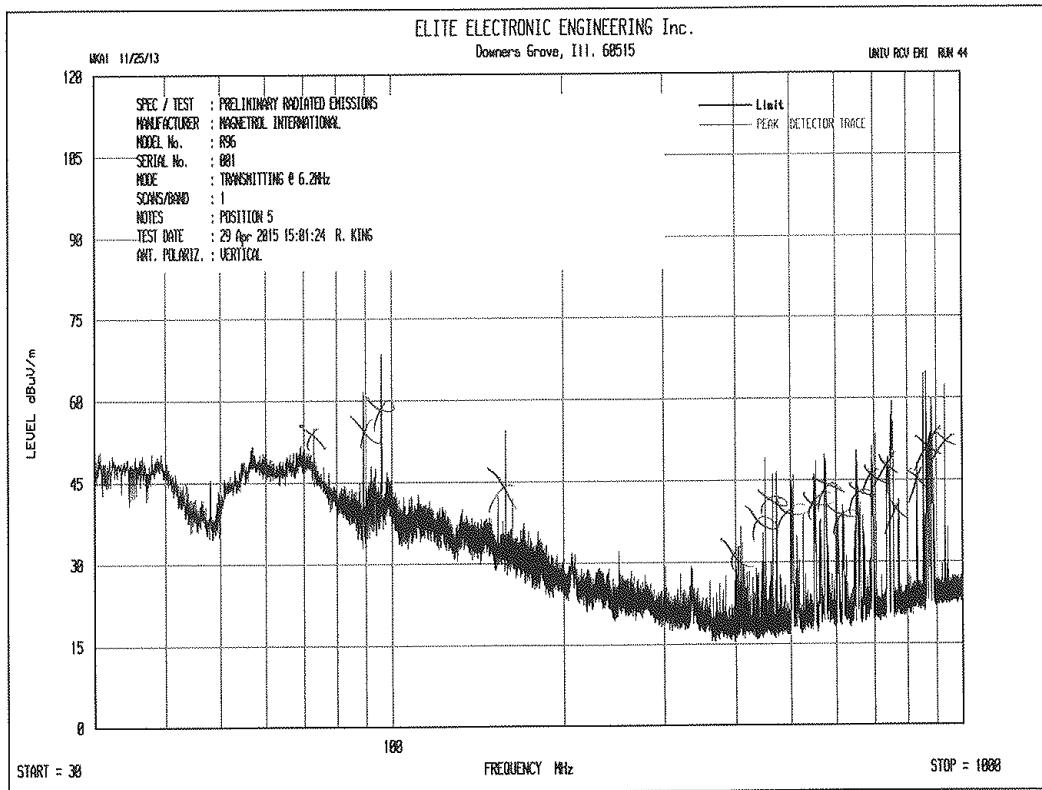




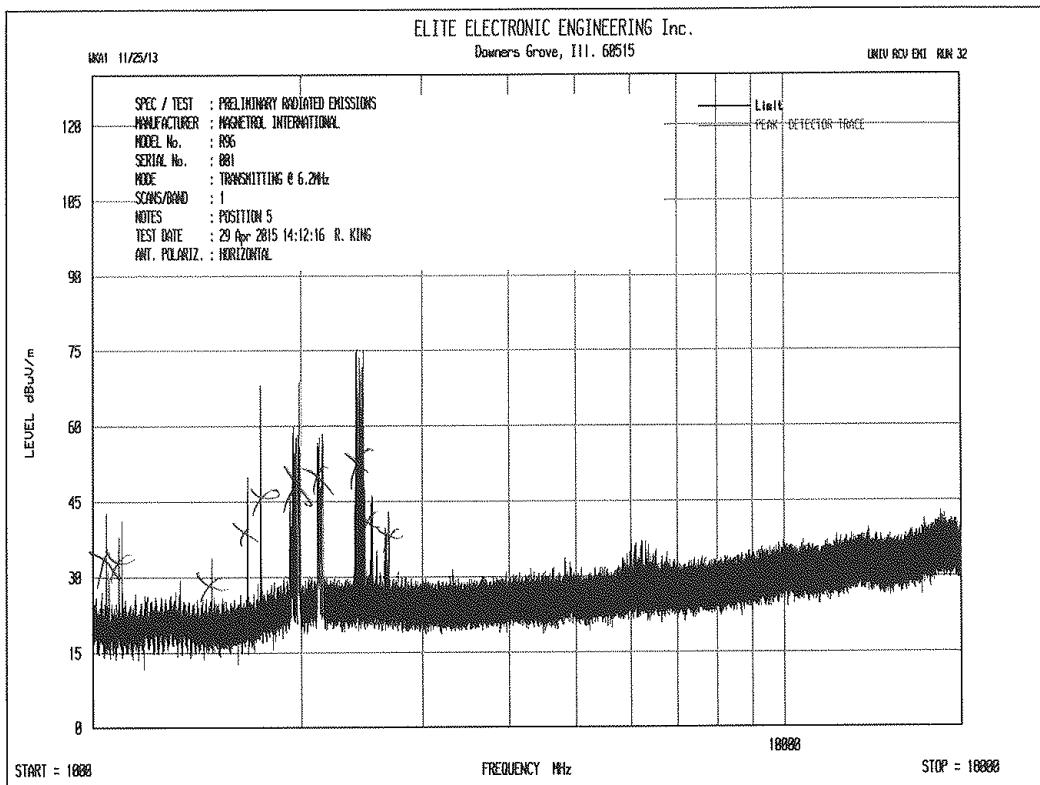




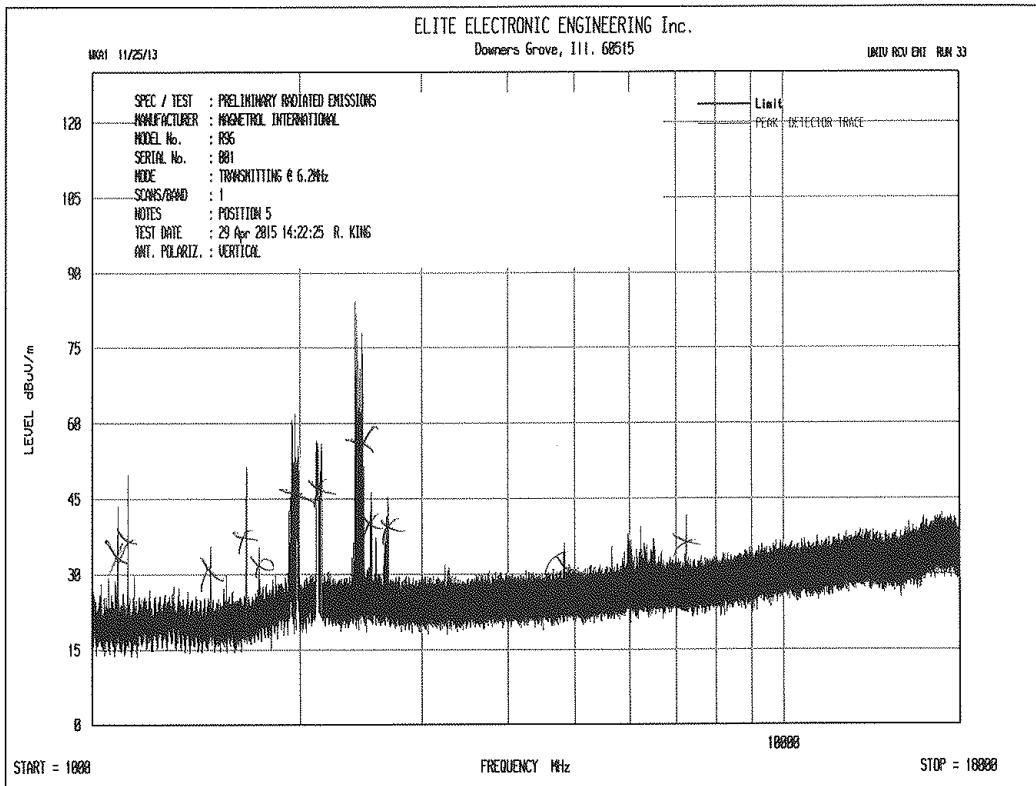
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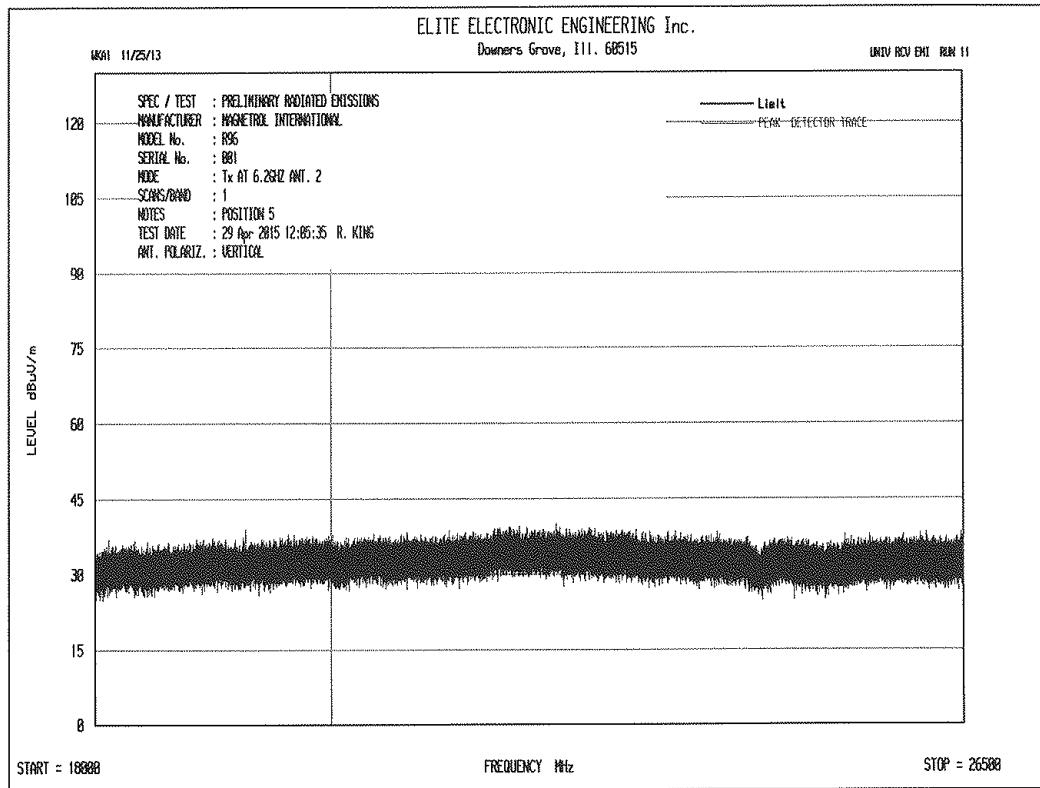
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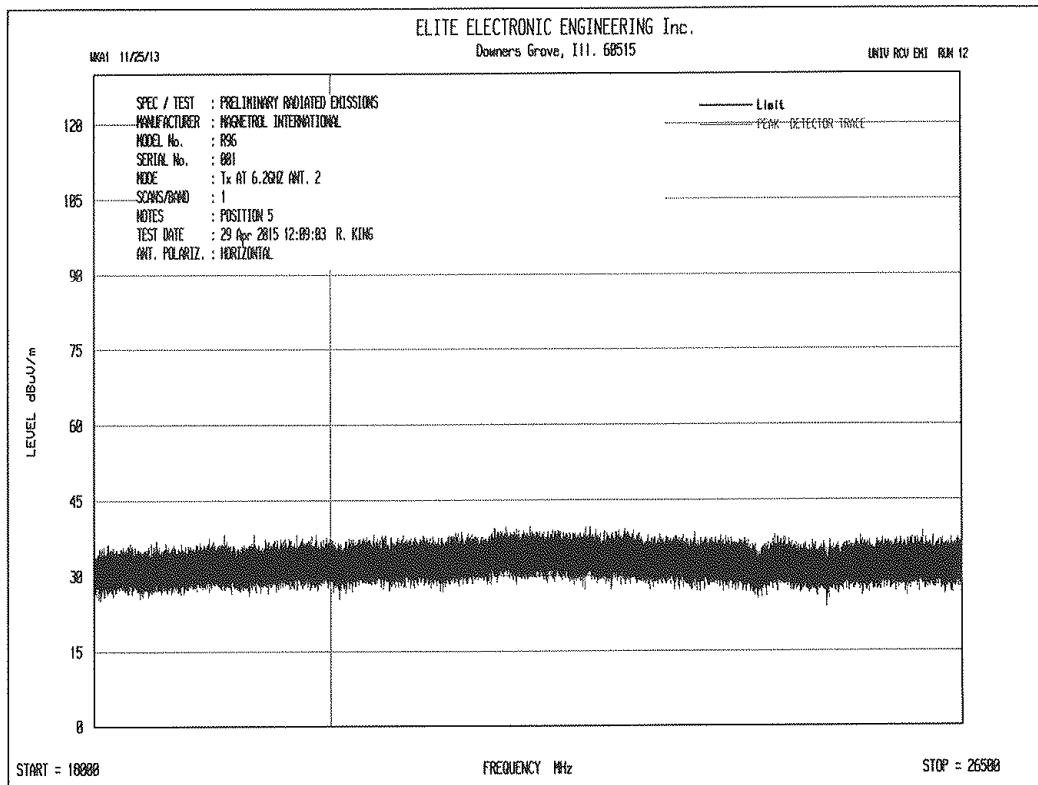


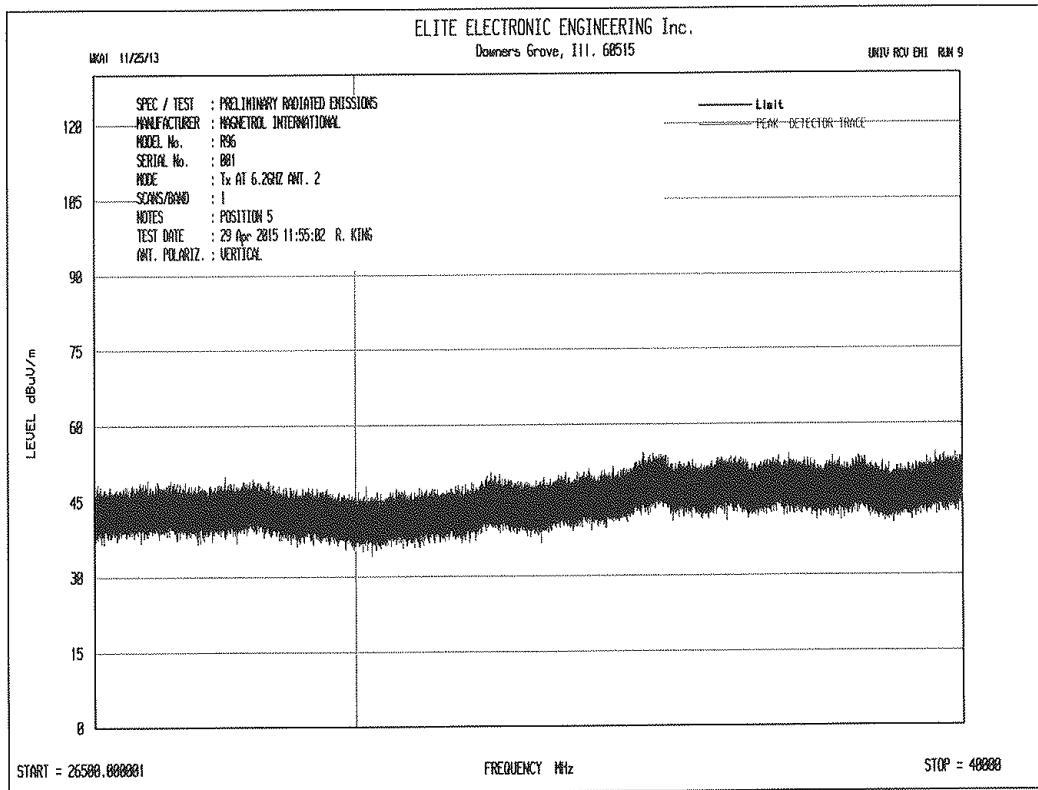
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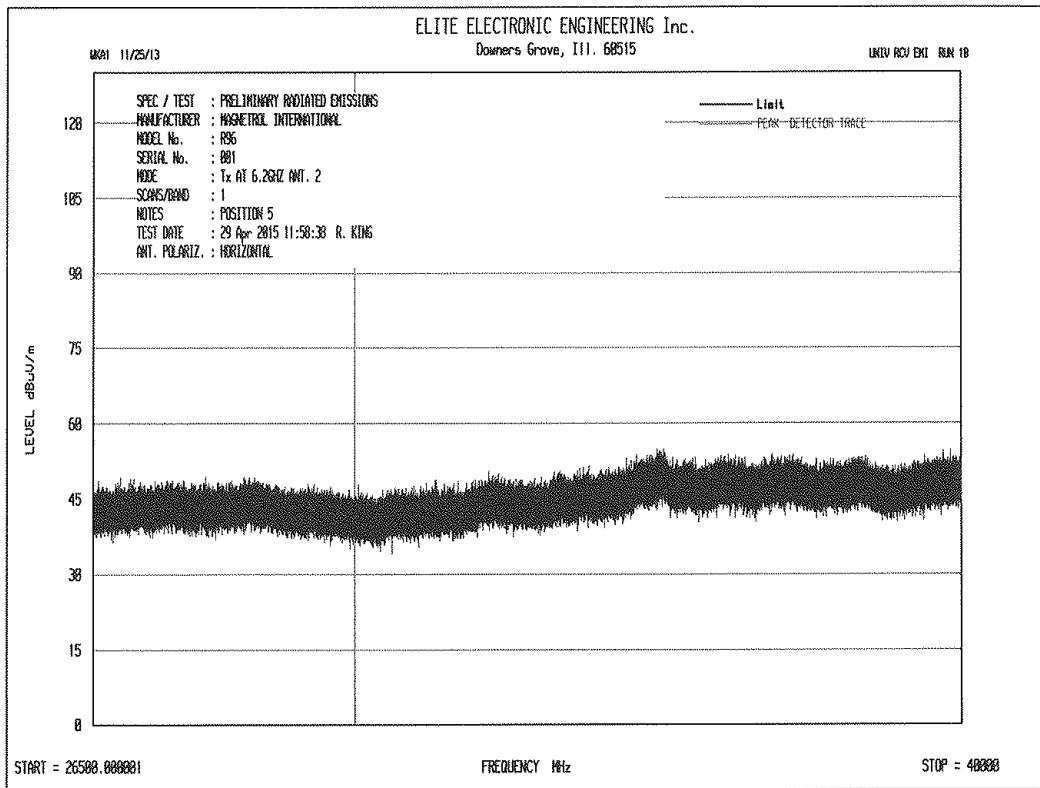


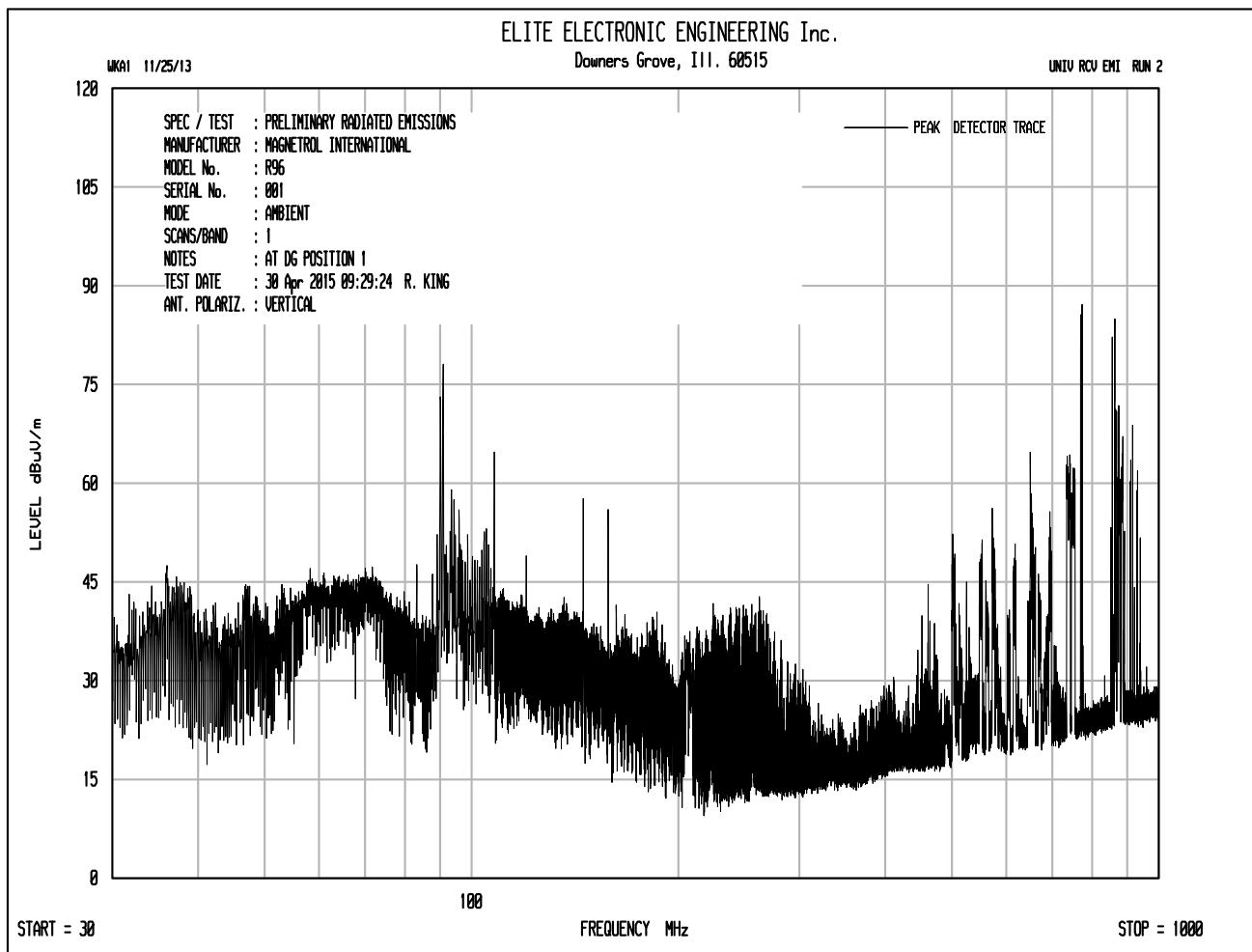
All emissions measured were attributed to the ambient environment.

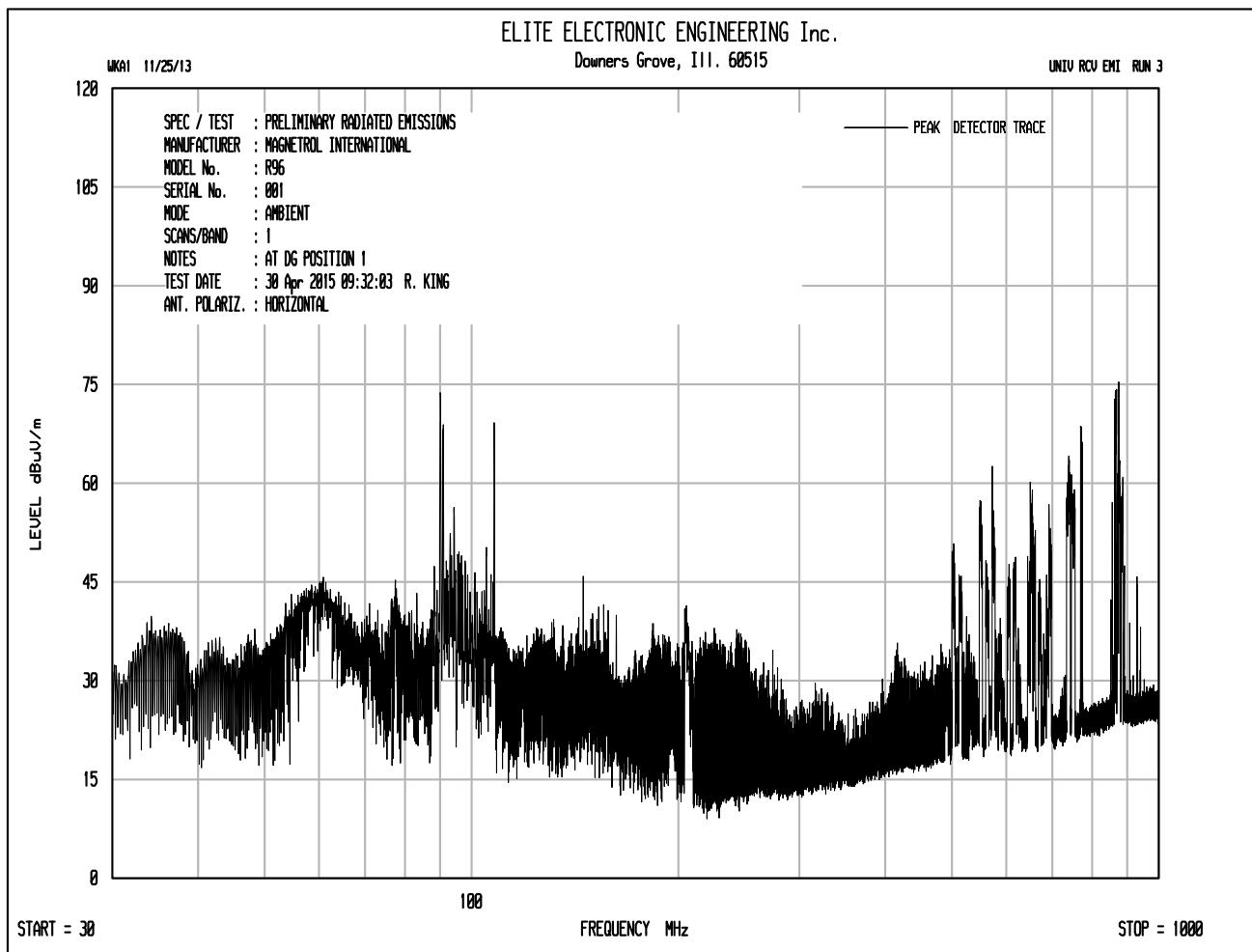


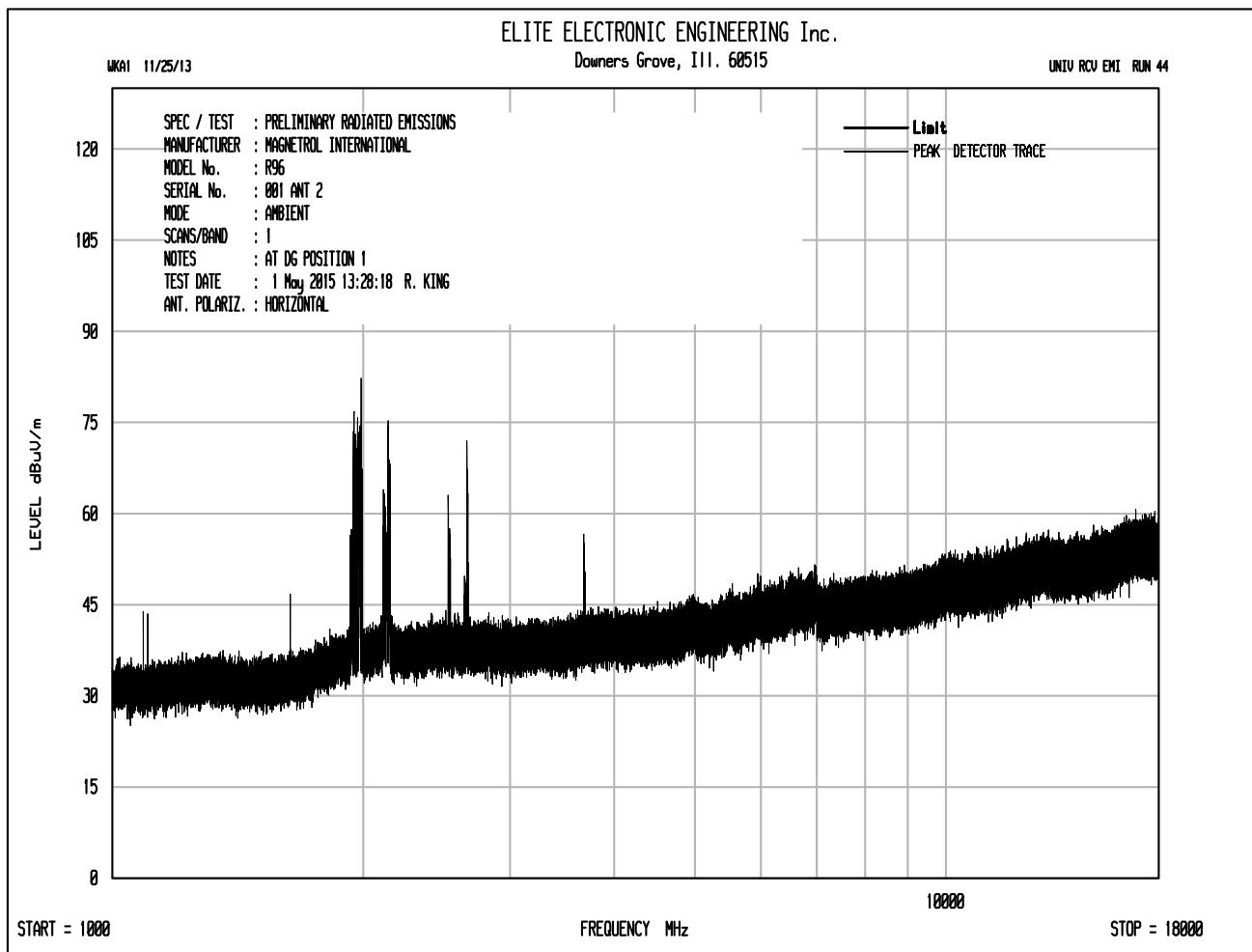


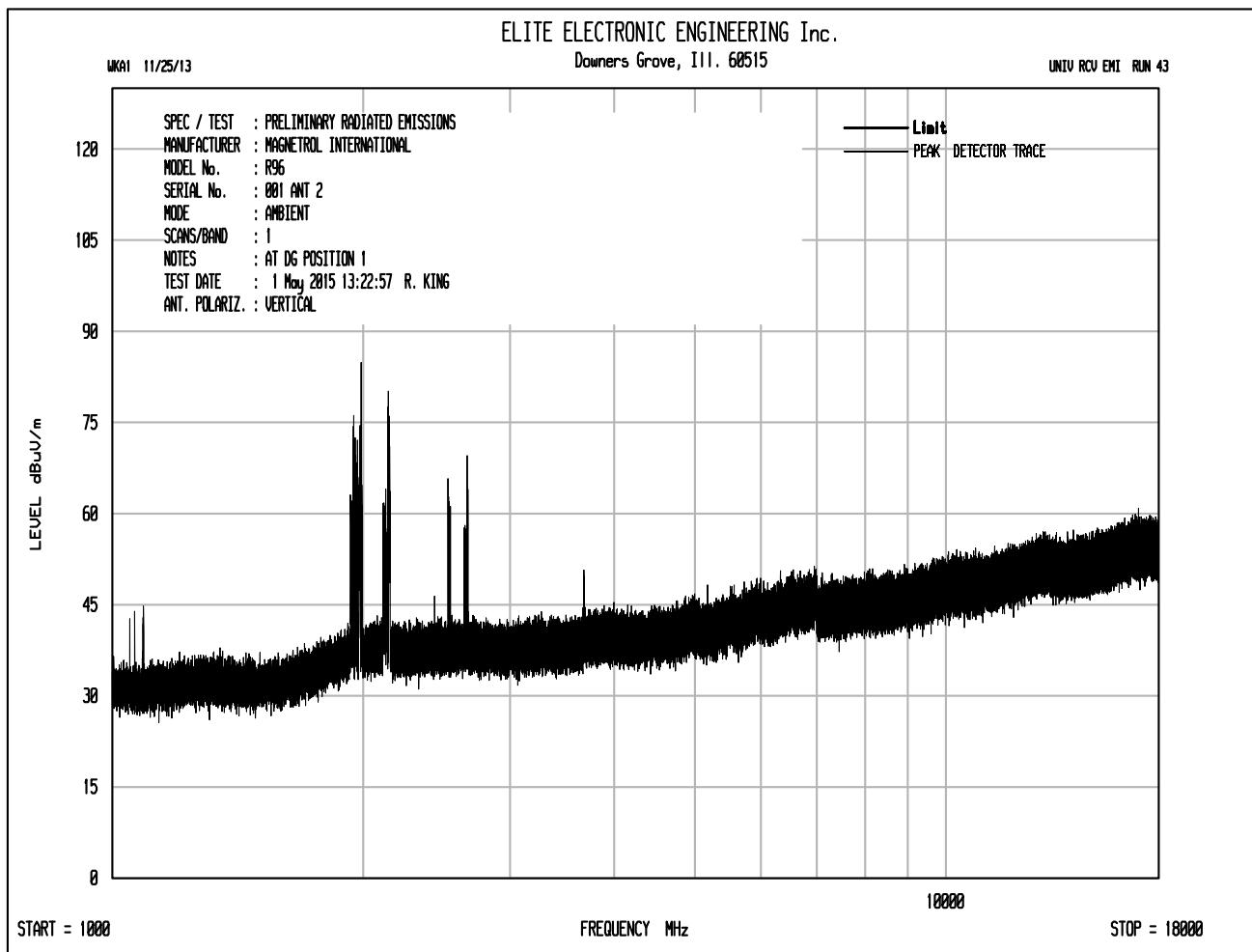










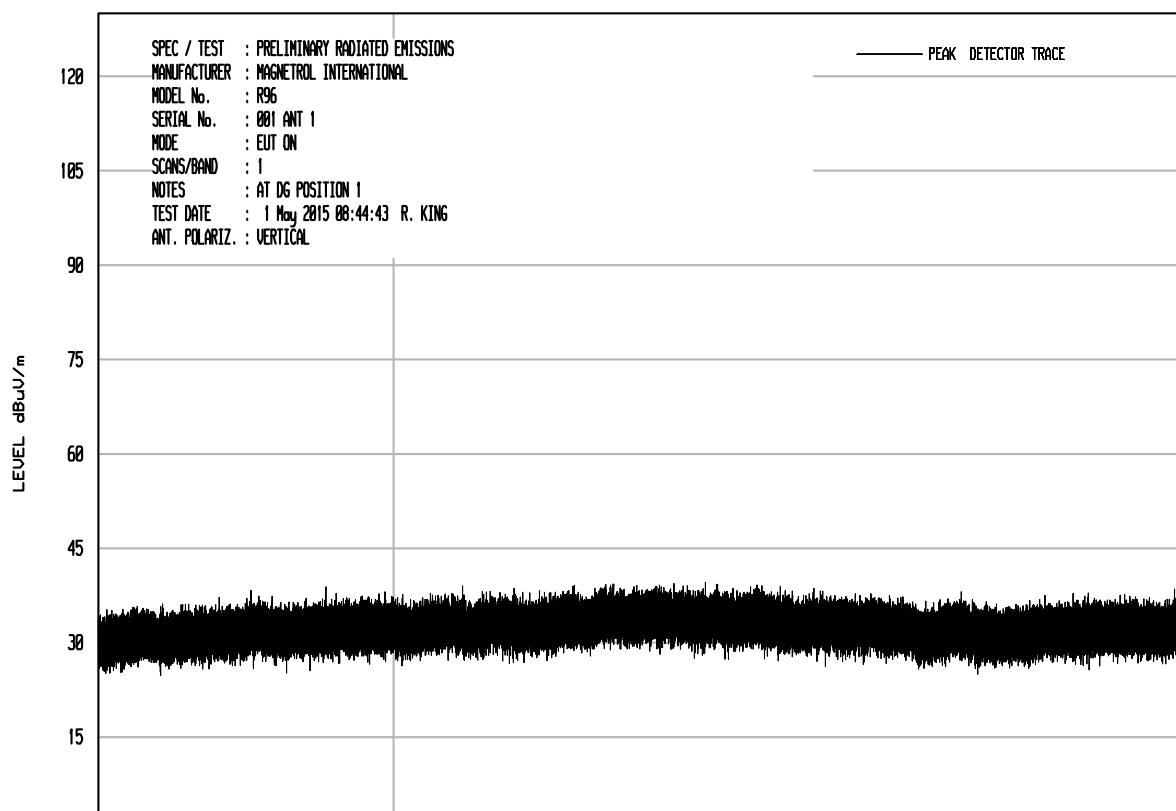


WKA1 11/25/13

## ELITE ELECTRONIC ENGINEERING Inc.

Downers Grove, Ill. 60515

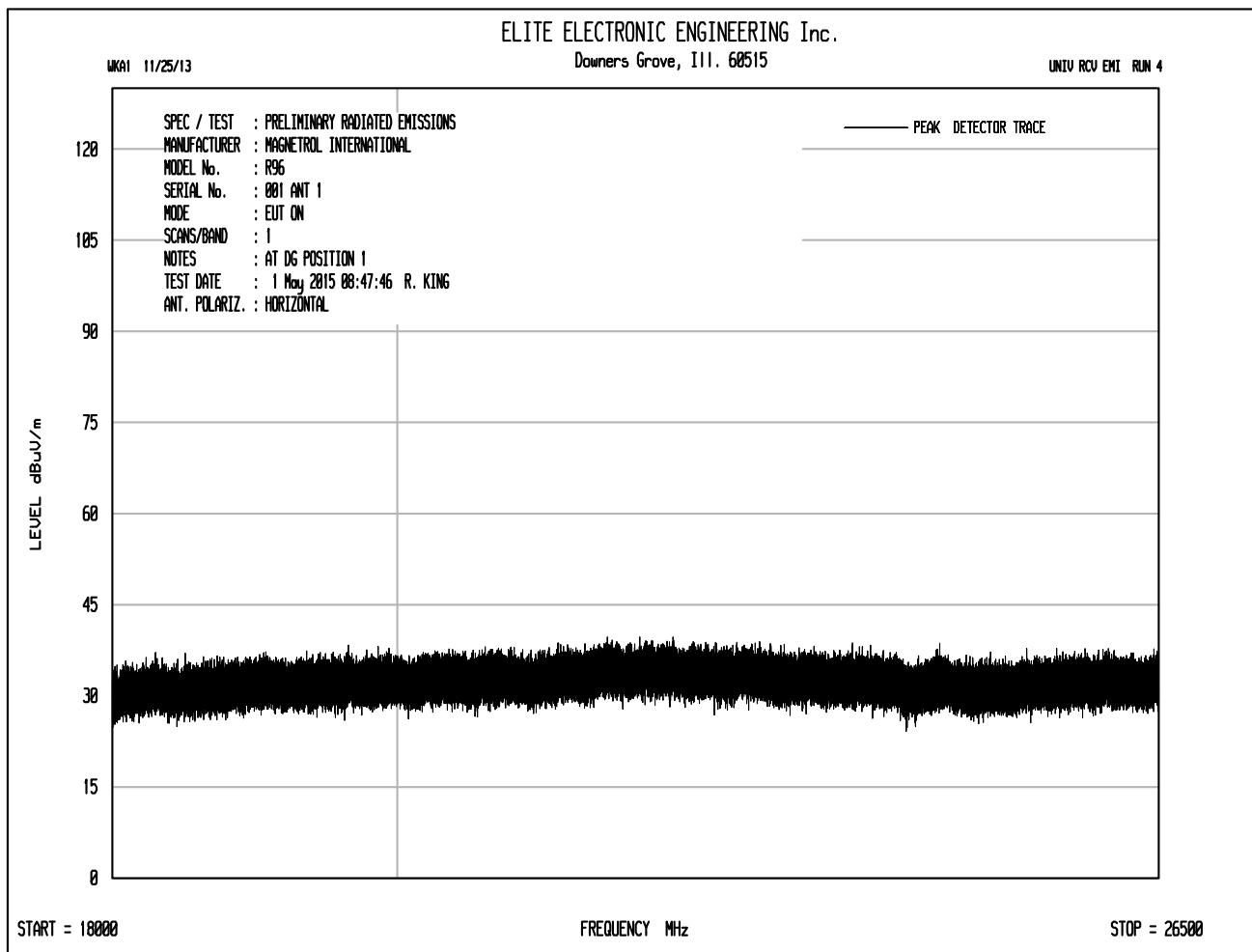
UNIV RCV EMI RUN 3

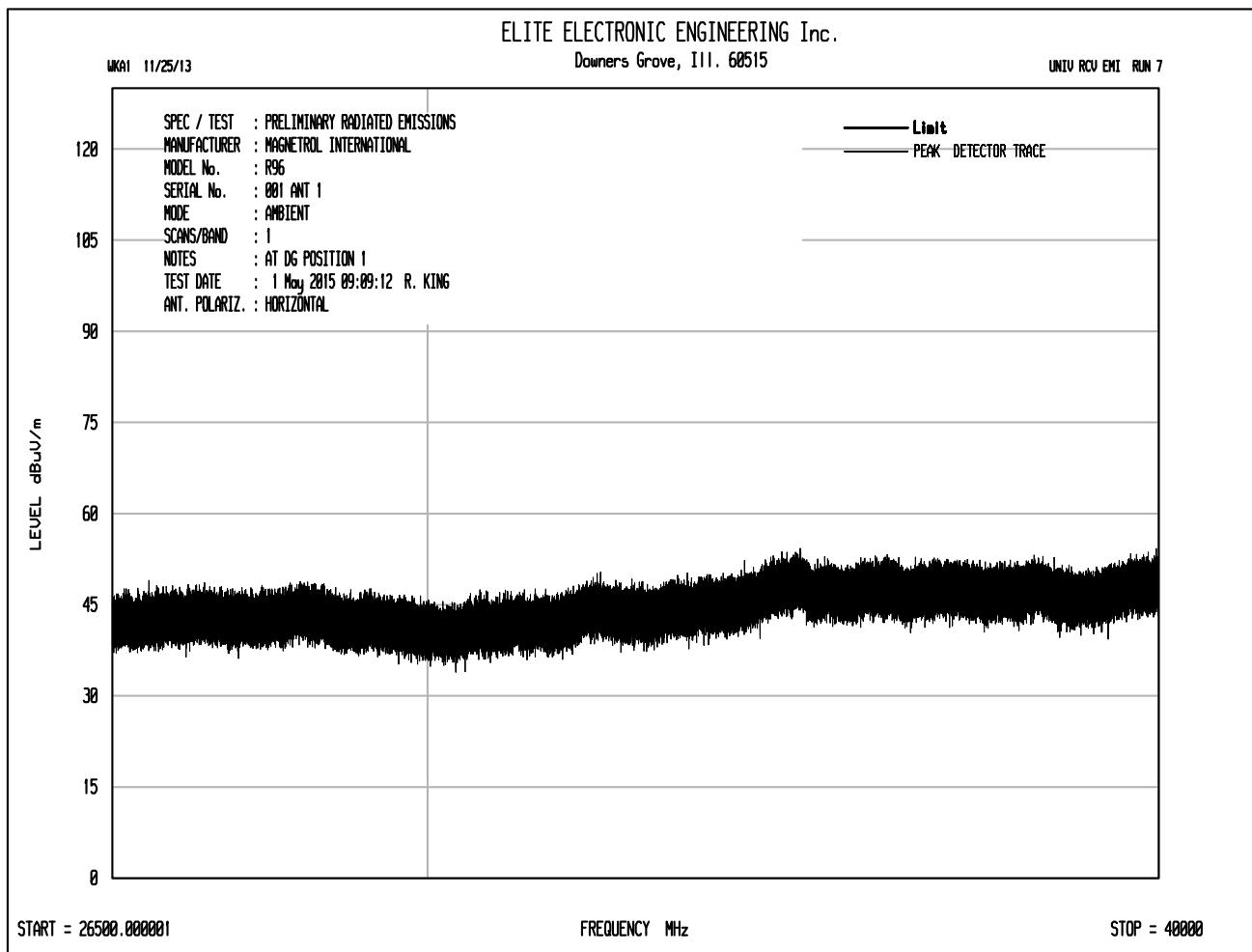


START = 18000

FREQUENCY MHz

STOP = 26500







ELITE ELECTRONIC ENGINEERING Inc.

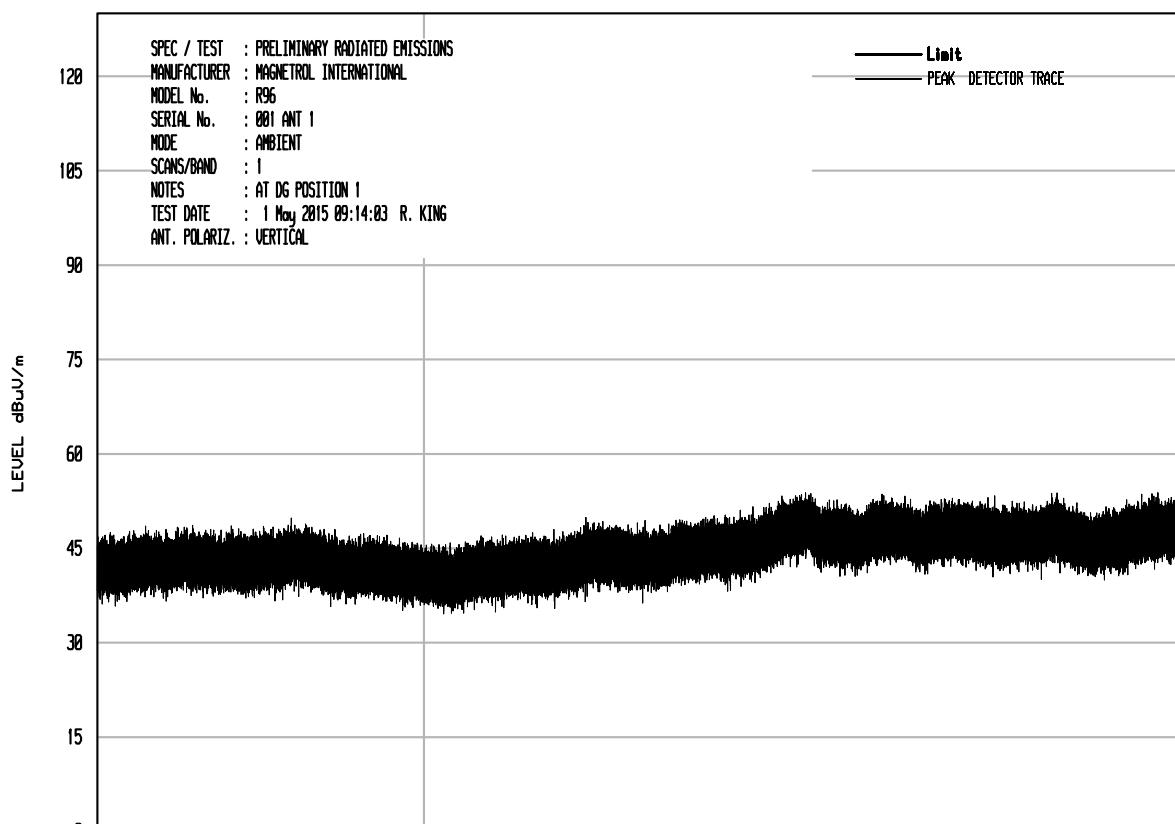
Downers Grove, Ill. 60515

UNIV RCU EMI RUN 8

WKA1 11/25/13

SPEC / TEST : PRELIMINARY RADIATED EMISSIONS  
MANUFACTURER : MAGNETROL INTERNATIONAL  
MODEL No. : R96  
SERIAL No. : 081 ANT 1  
MODE : AMBIENT  
SCANS/BAND : 1  
NOTES : AT DG POSITION 1  
TEST DATE : 1 May 2015 09:14:03 R. KING  
ANT. POLARIZ. : VERTICAL

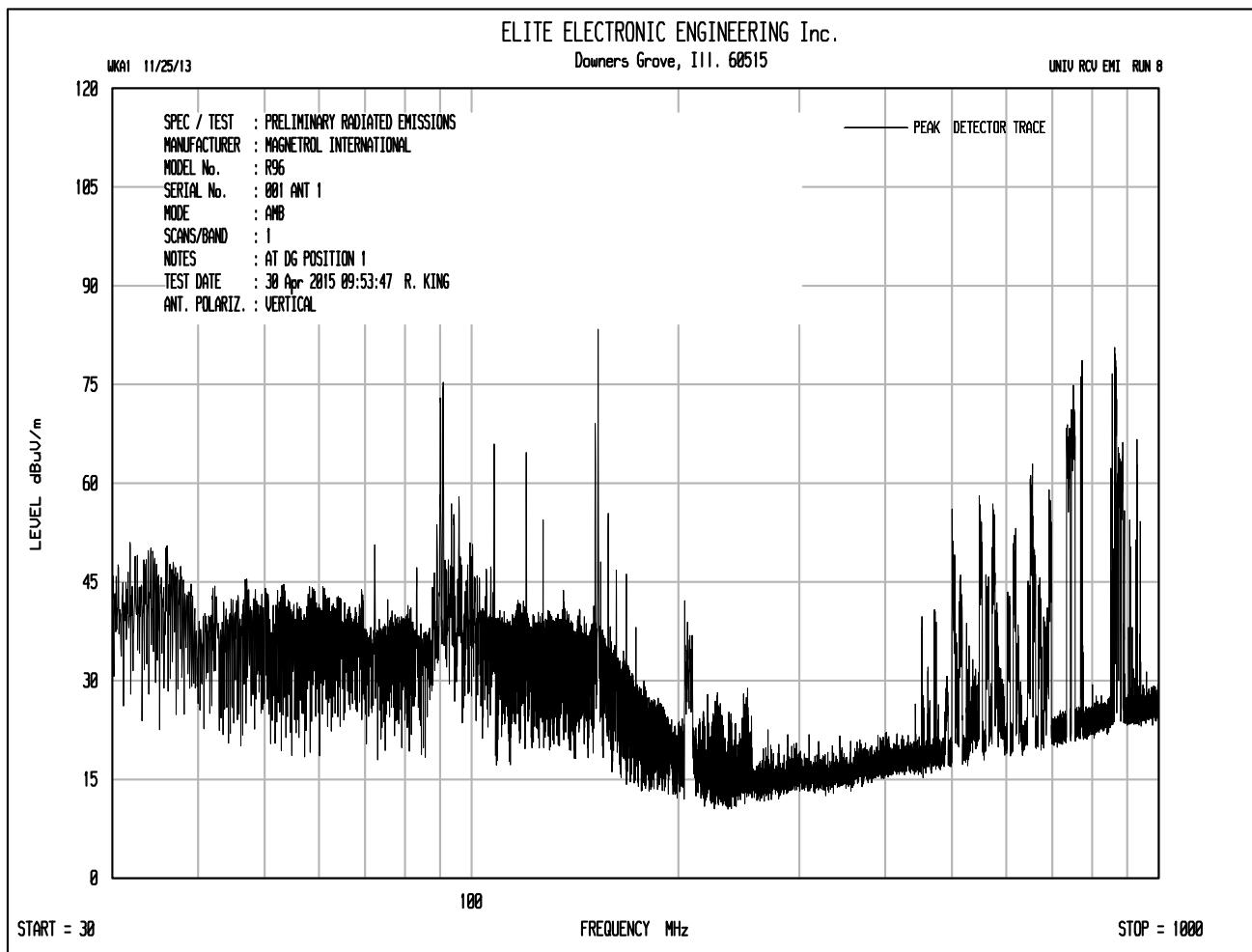
— Limit  
— PEAK DETECTOR TRACE

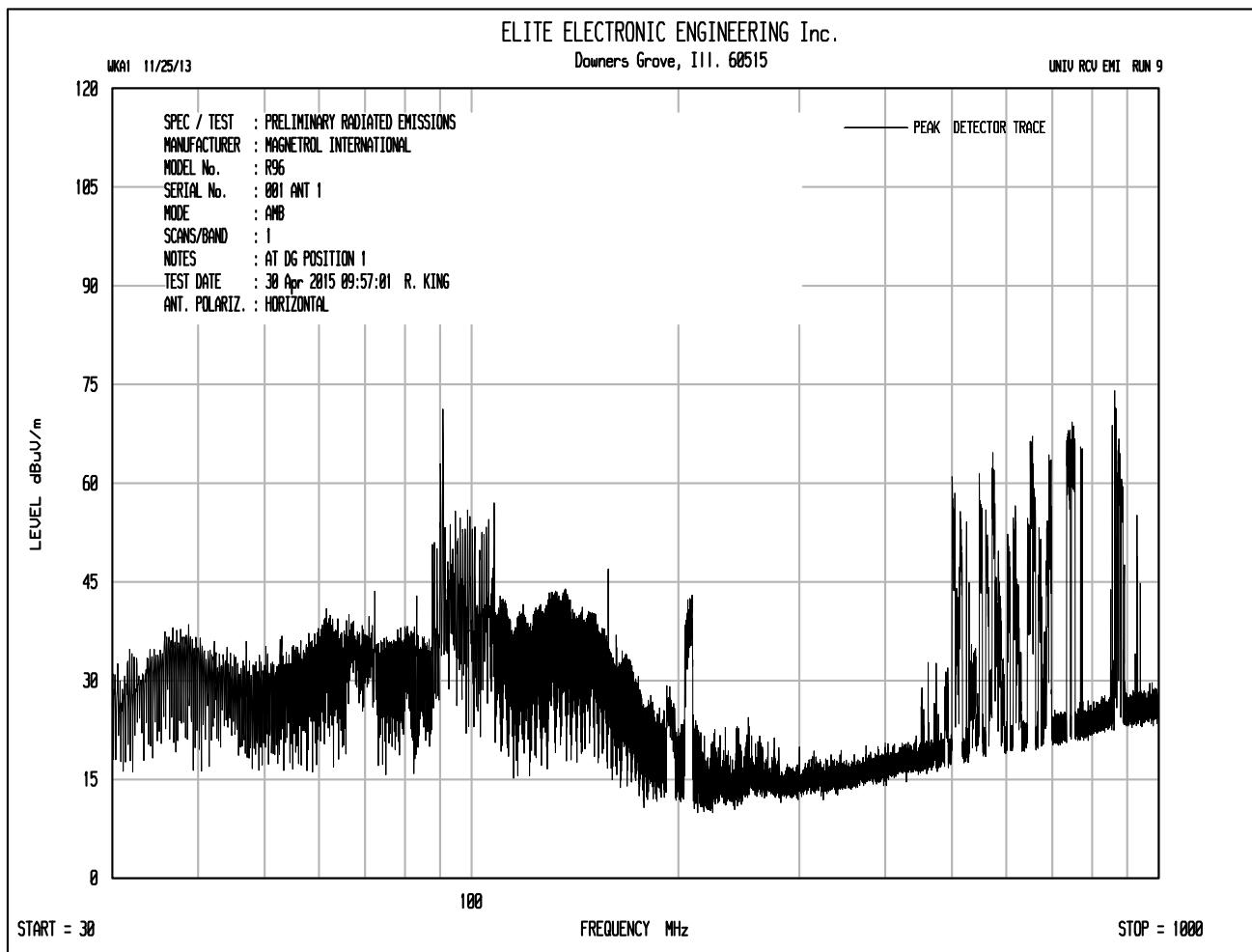


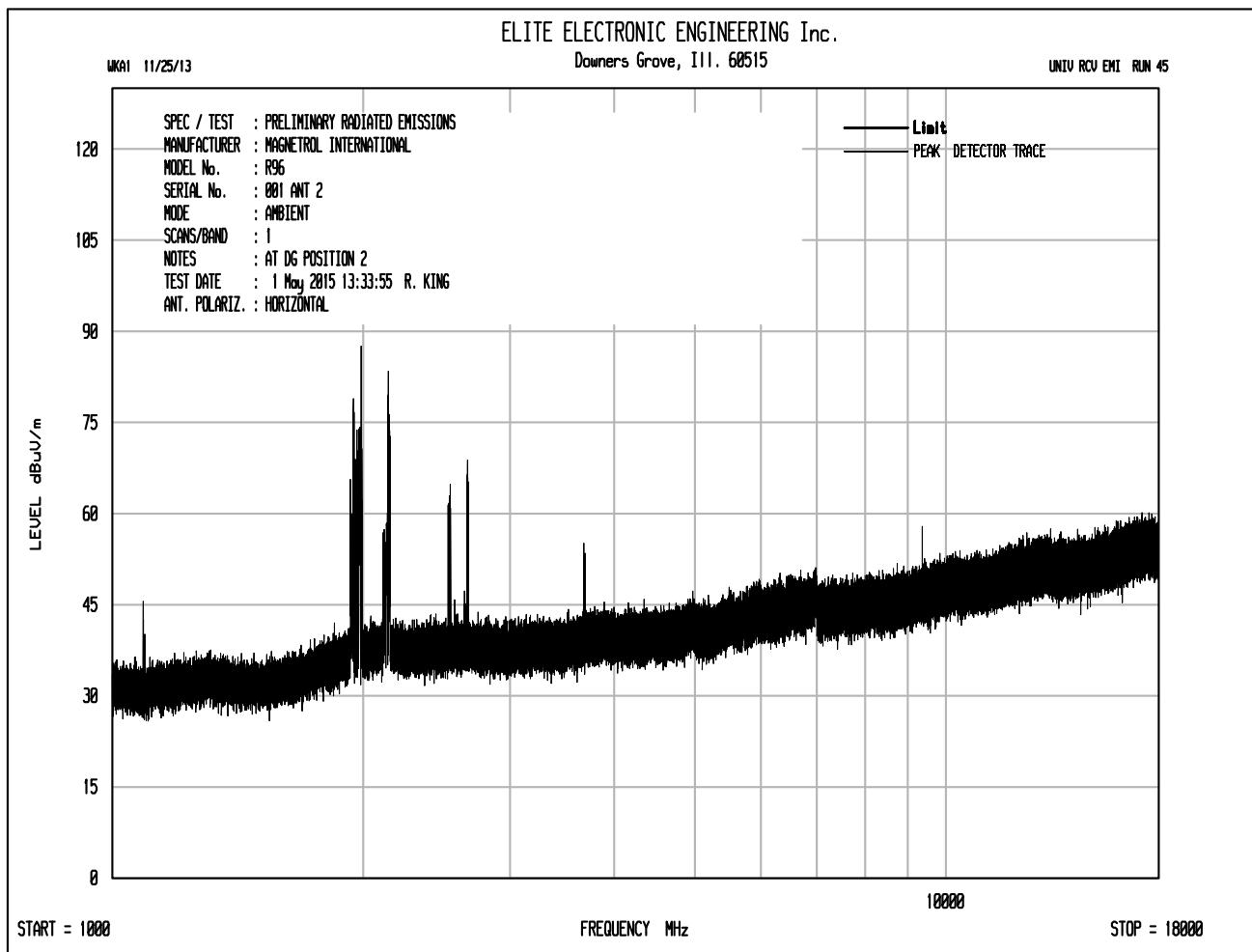
START = 26500.000001

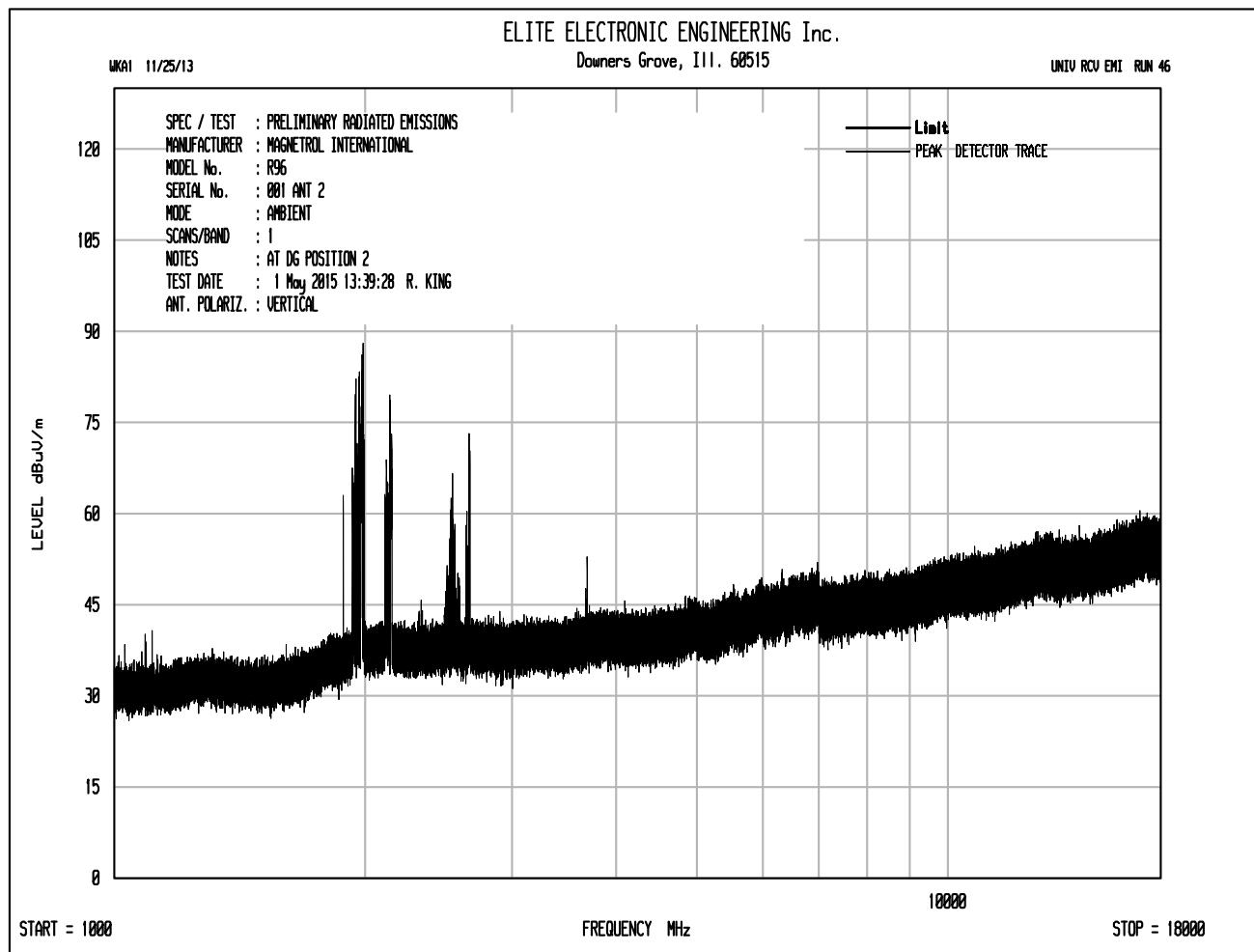
**FREQUENCY MHz**

STOP = 40000







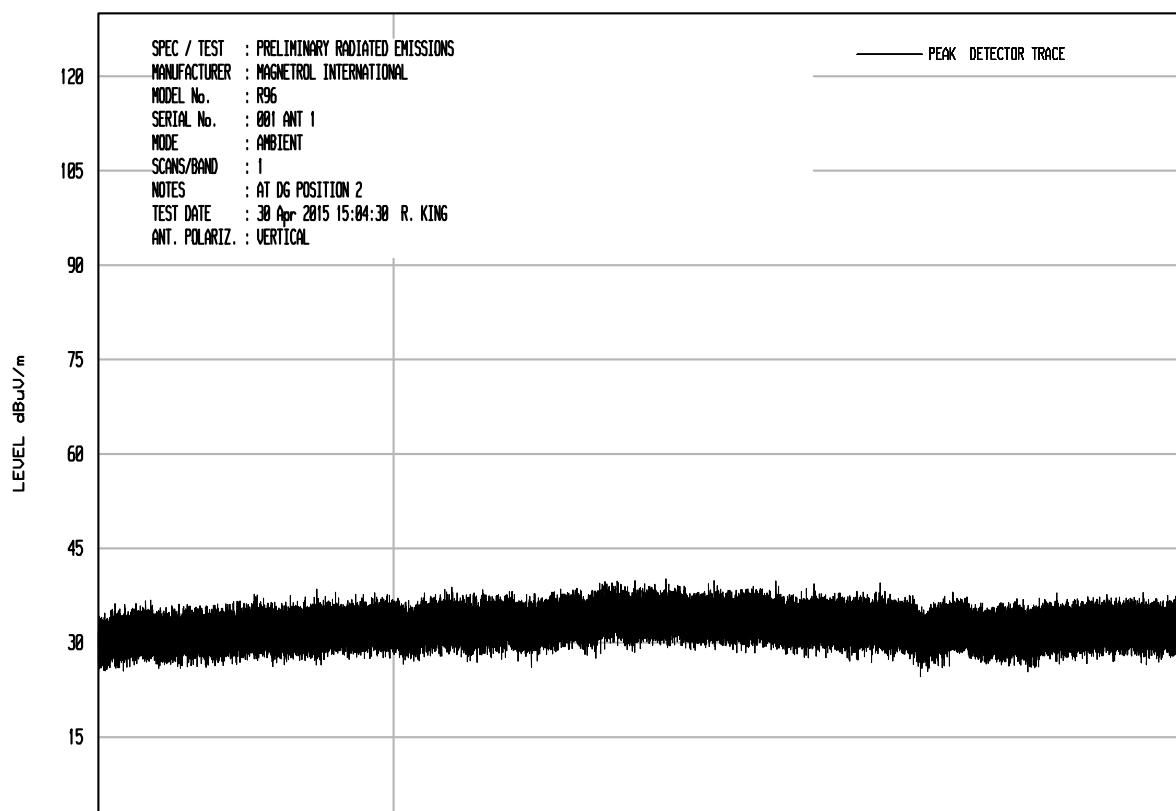


WKA1 11/25/13

## ELITE ELECTRONIC ENGINEERING Inc.

Downers Grove, Ill. 60515

UNIV RCV EMI RUN 48



START = 18000

FREQUENCY MHz

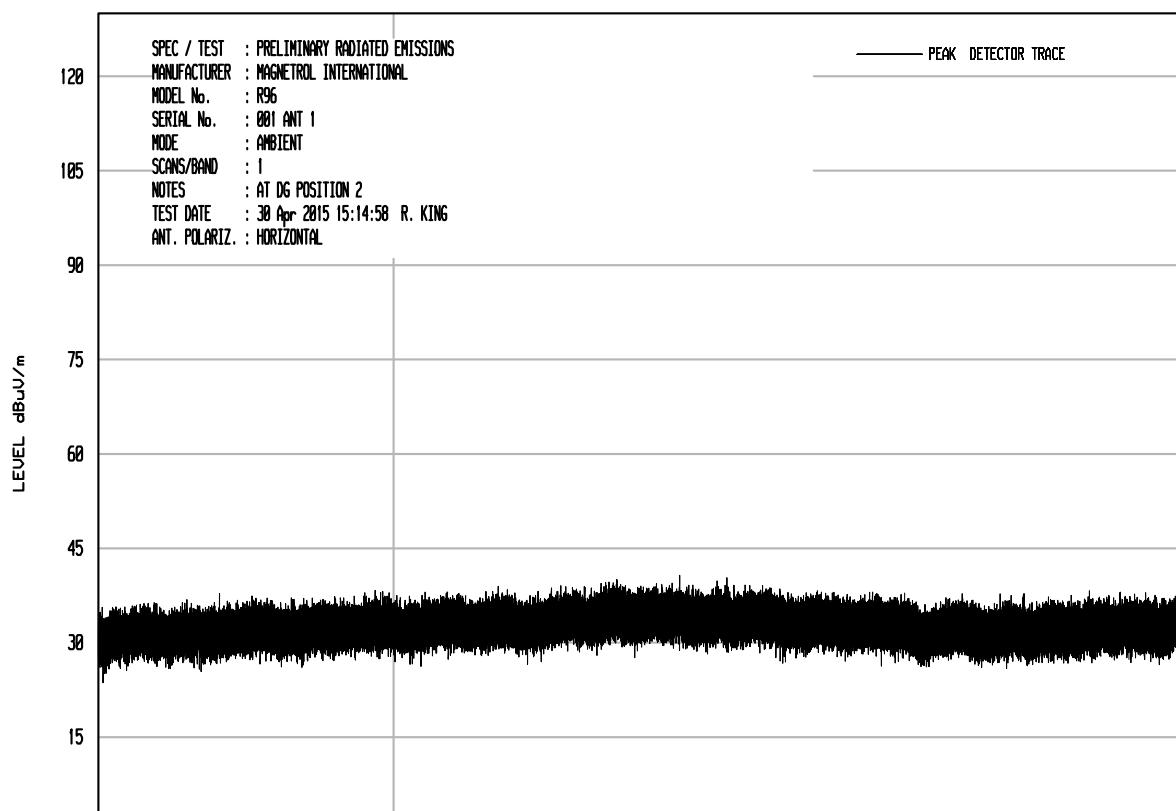
STOP = 26500

WKA1 11/25/13

## ELITE ELECTRONIC ENGINEERING Inc.

Downers Grove, Ill. 60515

UNIV RCV EMI RUN 51



START = 18000

FREQUENCY MHz

STOP = 26500

