



Measurement of RF Interference from a Model 3340 Zigbee Transceiver

For	California Eastern Labs 1253 N Old Rand Road Wauconda, IL 60084
P.O. Number	197437
Date Tested	December 15, 2014 through January 5, 2015
Test Personnel	Richard King
Specification	FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections 15.207 and 15.247 for Digital Modulation Intentional Radiators Operating within the bands 2400-2483.5MHz FCC "Code of Federal Regulations" Title 47, Part 15, Subpart 15B, Section 15.107 and 15.109 for Receivers Industry Canada RSS-210 Industry Canada RSS-GEN

Test Report By: *Richard E. King*
Richard King
EMC Engineer

Requested By: Dave Wilde
California Eastern Labs

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

Elite Electronic Engineering Inc.

1516 CENTRE CIRCLE
DOWNS GROVE, IL 60515

TEL: 630 - 495 - 9770

FAX: 630 - 495 - 9785

www.elitetest.com

TABLE OF CONTENTS

PARAGRAPH	DESCRIPTION OF CONTENTS	PAGE NO.
1.	INTRODUCTION.....	5
1.1	Scope of Tests.....	5
1.2	Purpose.....	5
1.3	Deviations, Additions and Exclusions.....	5
1.4	EMC Laboratory Identification.....	5
1.5	Laboratory Conditions.....	5
2.	APPLICABLE DOCUMENTS.....	5
3.	EUT SET-UP AND OPERATION.....	6
3.1	General Description.....	6
3.1.1	Power Input.....	6
3.1.2	Peripheral Equipment.....	6
3.1.3	Interconnect Cables.....	6
3.1.4	Grounding.....	6
3.2	Software.....	6
3.3	Operational Mode.....	6
3.4	EUT Modifications.....	6
4.	TEST FACILITY AND TEST INSTRUMENTATION.....	6
4.1	Shielded Enclosure.....	6
4.2	Test Instrumentation.....	6
4.3	Calibration Traceability.....	7
4.4	Measurement Uncertainty.....	7
5.	TEST PROCEDURES.....	7
5.1	Receiver.....	7
5.1.1	Requirements.....	7
5.2	Transmitter.....	7
5.2.1	Powerline Conducted Emissions.....	7
5.2.1.1	Requirements.....	7
	Since the EUT was powered by internal batteries, no conducted emissions tests were required.	7
5.2.2	6dB Bandwidth.....	7
5.2.2.1	Requirements.....	7
5.2.2.2	Procedures.....	8
5.2.2.3	Results.....	8
5.2.3	Peak Output Power.....	8
5.2.3.1	Requirements.....	8
5.2.3.2	Procedures.....	8
5.2.3.3	Results.....	8
5.2.4	Antenna Conducted Spurious Emissions.....	8
5.2.4.1	Requirements.....	8
5.2.4.2	Procedures.....	9
5.2.4.3	Results.....	9
5.2.5	Radiated Spurious Emissions Measurements.....	9
5.2.5.1	Requirements.....	9
5.2.5.2	Procedures.....	9
5.2.5.3	Results.....	10
5.2.6	Band Edge Compliance.....	10
5.2.6.1	Requirements.....	10

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



5.2.6.2 Procedures 10
 5.2.6.2.1 Low Band Edge 10
 5.2.6.2.2 High Band Edge 11
5.2.6.3 Results 11
5.2.7 Power Spectral Density 11
 5.2.7.1 Requirement 11
 5.2.7.2 Procedures 11
 5.2.7.3 Results 11
6. CONCLUSIONS 12
7. CERTIFICATION 12
8. ENDORSEMENT DISCLAIMER 12
9. EQUIPMENT LIST 13
Table 9-1 Equipment List 13

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

REVISION HISTORY

Revision	Date	Description
—	02/02/2015	Initial release

Measurement of RF Emissions from a Zigbee Transceiver, Part No. 3340 Transceiver

1. INTRODUCTION

1.1 Scope of Tests

This document represents the results of the series of radio interference measurements performed on a California Eastern Labs Zigbee Transceiver, Part No. 3340, Serial No. SN2, (hereinafter referred to as the EUT). The EUT is a digital modulation spread spectrum transceiver. The transceiver was designed to transmit and receive in the 2400-2483.5 MHz band using an integral antenna. The EUT was manufactured and submitted for testing by California Eastern Labs located in Wauconda, IL.

1.2 Purpose

The test series was performed to determine if the EUT meets the conducted and radiated RF emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart B, Sections 15.107 and 15.109, for receivers and Subpart C, Sections 15.207 and 15.247 for Intentional Radiators Operating within the 2400-2483.5 MHz band.

The test series was also performed to determine if the EUT meets the conducted and radiated RF emission requirements of the Industry Canada Radio Standards Specification, RSS-Gen, Section 7.2.4 and Section 6.1 for receivers and the Industry Canada Radio Standards Specification RSS-Gen Section 7.2.4 and RSS-210 Annex 8, for Transmitters.

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 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 22.4C and the relative humidity was 18%.

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, Subparts B and C, dated 1 October 2014
- 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"
- FCC Public Notice, DA 00-705, "Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems", Released March 30, 2000
- "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247", June 5 2014
- Industry Canada RSS-210, Issue 8, December 2010, "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 4, November 2014, “Spectrum Management and Telecommunications Radio Standards Specification, General Requirements for Compliance of Radio Apparatus”

3. EUT SET-UP AND OPERATION

3.1 General Description

The EUT is a Zigbee Transceiver, Part No. 3340. A block diagram of the EUT setup is shown as Figure 1.

3.1.1 Power Input

The EUT was powered by with 3VDC from a DC power supply simulating power from internal batteries.

3.1.2 Peripheral Equipment

The EUT does not have peripheral equipment.

3.1.3 Interconnect Cables

The EUT does not have signal leads.

3.1.4 Grounding

Since the EUT was powered with 3VDC from internal batteries, it was ungrounded during the tests.

3.2 Software

For all tests the EUT had Firmware Version CEL HW/SW version 2.1.7. loaded onto the device to provide correct load characteristics. The EUT requires Software Version CEL Test Tool version 1.1.18.0 to control the device during testing.

3.3 Operational Mode

For all tests the EUT was placed on an 80cm high non-conductive stand. The EUT was energized.

A wireless communication link was established between the EUT and a second setup EUT located near the EUT. The EUT was controlled through the wireless communication link.

The EUT was programmed to transmit at the following frequencies:

- Transmit at 2405MHz
- Transmit at 2440MHz
- Transmit at 2480MHz

3.4 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.

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	1.06	-1.06
Expanded Uncertainty (95% confidence)	2.12	-2.12

Radiated Emissions Measurements		
Combined Standard Uncertainty	2.09	-2.09
Expanded Uncertainty (95% confidence)	4.19	-4.19

5. TEST PROCEDURES

5.1 Receiver

5.1.1 Requirements

Per the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart B, Section 15.101(b), receivers operating above 960MHz are exempt from complying with the technical provisions of part 15.

Per RSS-Gen Issue 4 Para. 5.3 states that: "Only radiocommunication receivers operating in stand-alone mode within the band 30-960 MHz, as well as scanner receivers, are subject to Industry Canada requirements, as described above. All other receivers are exempted from any Industry Canada certification, testing, labelling and reporting requirements." Since the receiver operates above 960MHz, the receiver is exempt from complying with the technical provisions of the RSS standards.

5.2 Transmitter

5.2.1 Powerline Conducted Emissions

5.2.1.1 Requirements

Since the EUT was powered by internal batteries with no connections for AC power, no conducted emissions tests are required.

5.2.2 6dB Bandwidth

5.2.2.1 Requirements

Per 15.247(a)(2), the minimum 6dB bandwidth shall be at least 500kHz for all systems using digital modulation techniques.

5.2.2.2 Procedures

The output of the EUT was connected to the spectrum analyzer through 21dB of attenuation.

The EUT was allowed to transmit continuously. The transmit channel was set separately to low, middle, and high channels. The resolution bandwidth (RBW) was set to 100kHz and the span was set to greater than the RBW.

The 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined. The analyzer's display was plotted using a 'screen dump' utility.

5.2.2.3 Results

The plots on pages 19 through 21 show that the minimum 6 dB bandwidth was 1.8MHz which is greater than minimum allowable 6dB bandwidth requirement of 500kHz for systems using digital modulation techniques. The 99% bandwidth was measured to be 2.26MHz.

5.2.3 Peak Output Power

5.2.3.1 Requirements

Per section 15.247(b)(3), for systems using digital modulation the maximum peak output conducted power shall not be greater than 1.0W (30dBm). Per section 15.247(b)(4), this limit is based on the use of antennas with directional gains that do not exceed 6dBi. Since the limit allows for a 6dBi antenna gain, the maximum EIRP can be increased by 6dB to 4 Watt (36dBm).

5.2.3.2 Procedures

The output of the EUT was connected to the spectrum analyzer through 21dB of attenuation. The EUT was set to transmit separately at the low, middle, and high channels. The resolution bandwidth (RBW) was set to greater than the 6dB bandwidth. The 'Max-Hold' function was engaged. The maximum meter reading was recorded. The peak power output was calculated for the low, middle and high channels.

The EUT was placed on the non-conductive stand and set to transmit. A dipole antenna (double ridged waveguide antenna for all measurements above 1GHz) was placed at a test distance of 3 meters from the EUT. The resolution bandwidth (RBW) of the spectrum analyzer was set to greater than the 6dB bandwidth. The EUT was maximized for worst case emissions (or maximum output power) at the measuring antenna. The maximum meter reading was recorded. The peak power output was measured for the low, middle and high channels.

The equivalent power was determined from the field intensity levels measured at 3 meters using the substitution method. To determine the emission power, a second dipole antenna (double ridged waveguide antenna for all measurements above 1GHz) was then set in place of the EUT and connected to a calibrated signal generator. The output of the signal generator was adjusted to match the received level at the spectrum analyzer. The signal level was recorded. The reading was then corrected to compensate for cable loss (and antenna gain for all measurements above 1GHz), as required. The peak power output was calculated for low, middle, and high hopping frequencies.

5.2.3.3 Results

The results are presented on pages 22 and 23. The maximum peak conducted output power from the transmitter was 0.005W (7.3dBm) which is below the 1 Watt limit. The maximum EIRP measured from the transmitter was 9.5 dBm or 0.009 W which is below the 4 Watt de facto limit.

5.2.4 Antenna Conducted Spurious Emissions

5.2.4.1 Requirements

Per section 15.247(c), the spurious emissions in any 100 kHz BW outside the frequency band must be at least 20dB below the highest 100 kHz BW level measured within the band.

5.2.4.2 Procedures

The output of the EUT was connected to the spectrum analyzer through 21dB of attenuation. The resolution bandwidth (RBW) was set to 100kHz. The peak detector and 'Max-Hold' function were engaged. The emissions in the frequency range from 30MHz to 25GHz were observed and plotted separately with the EUT transmitting at low, middle and high channels.

5.2.4.3 Results

The results of the antenna conducted emissions levels were plotted. These plots are presented on pages 24 through 29. These plots show that the spurious emissions were at least 20 dB below the level of the fundamental.

5.2.5 Radiated Spurious Emissions Measurements

5.2.5.1 Requirements

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must comply with the radiated emission limits specified in §15.209(a).

Paragraph 15.209(a) has the following radiated emission limits:

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	3
30.0-88.0	100	3
88.0-216.0	150	3
216.0-960.0	200	3
Above 960	500	3

5.2.5.2 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.

Preliminary radiated emissions tests were 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 25GHz used for 2400-2483.5MHz range was investigated using a peak detector function.

The final open field emission tests were then manually performed over the frequency range of 30MHz to 25GHz used for 2400-2483.5Mhz range.

- 1) For all emissions in the restricted bands, the following procedure was used:
 - a) The field strengths of all emissions below 1 GHz were measured using a bi-log antenna. The bi-log antenna was positioned at a 3 meter distance from the EUT. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.
 - b) The field strengths of all emissions above 1 GHz were measured using a double-ridged waveguide antenna. The waveguide antenna was positioned at a 3 meter distance from the EUT. A peak detector with a resolution bandwidth of 1 MHz was used on the spectrum analyzer.
 - c) To ensure that maximum or worst case emission levels were measured, the following steps were taken when taking all measurements:

- i) The EUT was rotated so that all of its sides were exposed to the receiving antenna.
 - ii) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.
 - iii) The measuring antenna was raised and lowered for each antenna polarization to maximize the readings.
 - iv) In instances where it was necessary to use a shortened cable between the measuring antenna and the spectrum analyzer. The measuring antenna was not raised or lowered to ensure maximized readings, instead the EUT was rotated through all axis to ensure the maximum readings were recorded for the EUT.
- d) For all radiated emissions measurements below 1 GHz, if the peak reading is below the limits listed in 15.209(a), no further measurements are required. If however, the peak readings exceed the limits listed in 15.209(a), then the emissions are remeasured using a quasi-peak detector.
 - e) For all radiated emissions measurements above 1 GHz, the peak readings must comply with the 15.35(b) limits. 15.35(b) states that when average radiated emissions measurements are specified, there also is a limit on the peak level of the radiated emissions. The limit on the peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. Therefore, all peak readings above 1 GHz must be no greater than 20 dB above the limits specified in 15.209(a).
 - f) Next, for all radiated emissions measurements above 1GHz, the resolution bandwidth was set to 1MHz. The analyzer was set to linear mode with a 10Hz video bandwidth in order to simulate an average detector. An average reading was taken. These readings must be no greater than the limits specified in 15.209(a).

5.2.5.3 Results

Preliminary radiated emissions plots with the EUT transmitting at Low Frequency, Middle Frequency, and High Frequency are shown on pages 30 through 53. Final radiated emissions data are presented on data pages 54 through 59. As can be seen from the data, all emissions measured from the EUT were within the specification limits.

Photographs of the test configuration which yielded the highest, or worst case, radiated emission levels are shown on Figures 3 through 6.

5.2.6 Band Edge Compliance

5.2.6.1 Requirements

Per section 15.247(d), the emissions at the band-edges must be at least 20dB below the highest level measured within the band but attenuation below the general limits listed in 15.209(a) is not required.

5.2.6.2 Procedures

5.2.6.2.1 Low Band Edge

- 1) The output of the EUT was connected to the spectrum analyzer through 21dB of attenuation.
- 2) The EUT was set to transmit continuously at the channel closest to the low band-edge.
- 3) To determine the band edge compliance, the following spectrum analyzer settings were used:
 - a. Center frequency = low band-edge frequency.
 - b. Span = Wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products which fall outside of the authorized band of operation.
 - c. Resolution bandwidth (RBW) \geq 1% of the span.
 - d. The 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined.
 - e. The marker was set on the peak of the in-band emissions. A display line was placed

20dB down from the peak of the in-band emissions. All emissions which fall outside of the authorized band of operation must be below the 20dB down display line. (All emissions to the left of the center frequency (band-edge) must be below the display line.)

- f. The analyzer's display was plotted using a 'screen dump' utility.

5.2.6.2.2 High Band Edge

- 1) The EUT was set to transmit continuously at the channel closest to the high band-edge.
- 2) A double ridged waveguide was placed 3 meters away from the EUT. The antenna was connected to the input of a spectrum analyzer.
- 3) The center frequency of the analyzer was set to the high band edge (2483.5MHz)
- 4) The resolution bandwidth was set to 1MHz.
- 5) To ensure that the maximum or worst case emission level was measured, the following steps were taken:
 - a. The EUT 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.
- 6) The highest measured peak reading was recorded.
- 7) The highest measured average reading was recorded.

5.2.6.3 Results

Pages 60 and 61 show the band-edge compliance results. As can be seen from these plots, the conducted emissions at the low end band edge are within the 20 dB down limits. The radiated emissions at the high end band edge are within the general limits.

5.2.7 Power Spectral Density

5.2.7.1 Requirement

Per section 15.247(d), the peak power spectral density from the intentional radiator shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

5.2.7.2 Procedures

- 1) The output of the EUT was connected to the spectrum analyzer through a 21dB pad and the EUT was set to transmit at the low channel.
- 2) To determine the power spectral density, the following spectrum analyzer settings were used for channel 2:
 - a. Center frequency = transmit frequency
 - b. Span = 1.5 times the DTS bandwidth
 - c. Resolution bandwidth (RBW) = $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
 - d. Video bandwidth (VBW) = $\text{VBW} \geq 3 \times \text{RBW}$
 - e. Sweep time = auto couple
 - f. The peak detector and 'Max-Hold' function was engaged.
 - g. The display line represents the 8 dBm limit
 - h. The analyzer's display was plotted using a 'screen dump' utility.
- 3) Steps 1 and 2 were repeated with the EUT set to transmit at the mid channel.
- 4) Steps 1 and 2 were repeated with the EUT set to transmit at the high channel.

5.2.7.3 Results

Pages 62 through 64 shows the power spectral density results. As can be seen from this plot, the peak power density is less than 8dBm in a 100kHz band during any time interval of continuous transmission.

6. CONCLUSIONS

It was determined that the California Eastern Labs Zigbee Transceiver, Part No. 3340, Serial No. SN2, did fully meet the conducted and radiated emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart B, Sections 15.107 and 15.109 for receivers and Subpart C, Sections 15.207 and 15.247 for Intentional Radiators Operating within the 2400-2483.5 MHz band, when tested per ANSI C63.4-2009.

It was also determined that the California Eastern Labs Zigbee Transceiver, Part No. 3340, Serial No. SN2, did fully meet the conducted and radiated RF emission requirements of the Industry Canada Radio Standards Specification, RSS-Gen, Section 5.3 for receivers and the Industry Canada Radio Standards Specification RSS-210 Annex 8 for transmitters, when tested per ANSI C63.4-2014.

7. 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. 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.

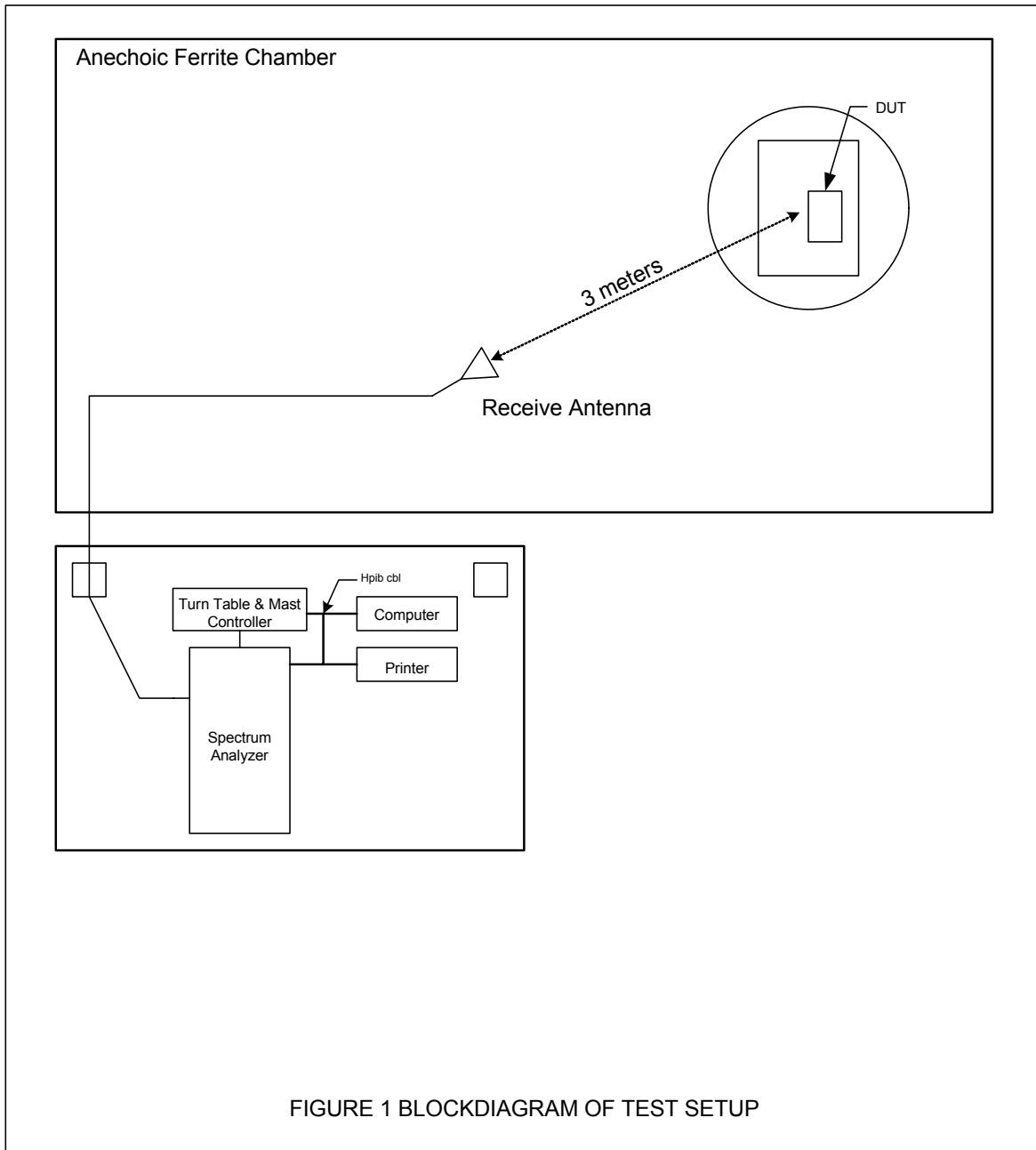
8. ENDORSEMENT DISCLAIMER

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
ETD0	ENV Chambers For Auto Dept Use Only	Thermotron	S-8	15461	-70 to 150 degrees C	NOTE 1	
ETDC	Temperature Controller	Thermotron	2800	753726	Programmable	NOTE 1	
GBR7	SIGNAL GENERATOR	HEWLETT PACKARD	8648D	3847M00602	9KHZ-4000MHZ	2/25/2014	2/25/2015
GRE0	SIGNAL GENERATOR	AGILENT TECHNOLOGIES	E4438C	MY42083127	250KHZ-6GHZ	2/21/2014	2/21/2015
NTA2	BILOG ANTENNA	TESEQ	6112D	28040	25-1000MHz	10/10/2014	10/10/2015
NTA3	BILOG ANTENNA	TESEQ	6112D	32853	25-1000MHz	2/19/2014	2/19/2015
NWF0	RIDGED WAVE GUIDE	EMCO	3105	2035	1-12.4GHZ	7/8/2014	7/8/2015
NWP1	DOUBLE RIDGED WAVEGUIDE ANTENNA	EATON	3115	2100	1GHZ-12.4GHZ	7/22/2014	7/22/2015
NWQ0	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS LINDGREN	3117	66657	1GHZ-18GHZ	3/11/2014	3/11/2015
NWQ1	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS-LINDGREN	3117	66655	1GHZ-18GHZ	3/11/2014	3/11/2015
NWQ2	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS LINDGREN	3117	66659	1GHZ-18GHZ	3/20/2014	3/20/2015
RBA0	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB26	100145	20HZ-26.5GHZ	3/7/2014	3/7/2015
RBB0	EMI TEST RECEIVER 20HZ TO 40 GHZ.	ROHDE & SCHWARZ	ESIB40	100250	20 HZ TO 40GHZ	3/11/2014	3/11/2015
SMAB	POWER SUPPLY	MASTECH	HY3020EX	1008	30 Volt, 20 Amp	NOTE 1	
T2D2	20DB, 25W ATTENUATOR	WEINSCHL	46-20-43	AV5815	DC-18GHZ	7/21/2014	7/21/2015
XL4	5W, 50 OHM TERMINATION	JFW INDUSTRIES	50T-052	---	DC-2GHZ	1/14/2015	1/14/2016
XLZ6	50 OHM TERMINATION	PASTERNAK	PE6009	004	DC-18GHZ	7/22/2014	7/22/2015



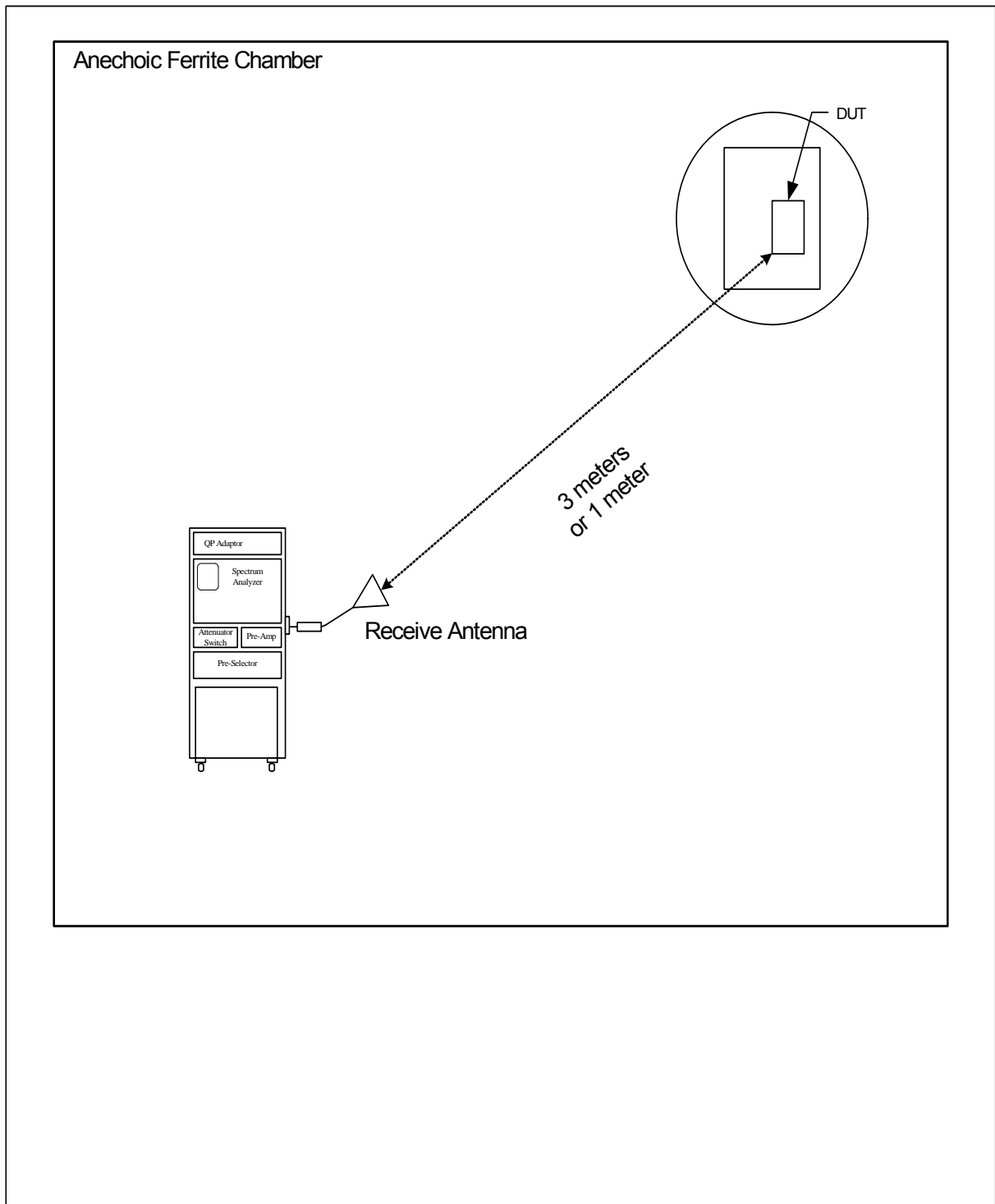


Figure 2: BLOCK DIAGRAM OF TEST SETUP FOR RADIATED EMISSIONS ABOVE 18GHZ

Figure 3



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



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

Figure 4

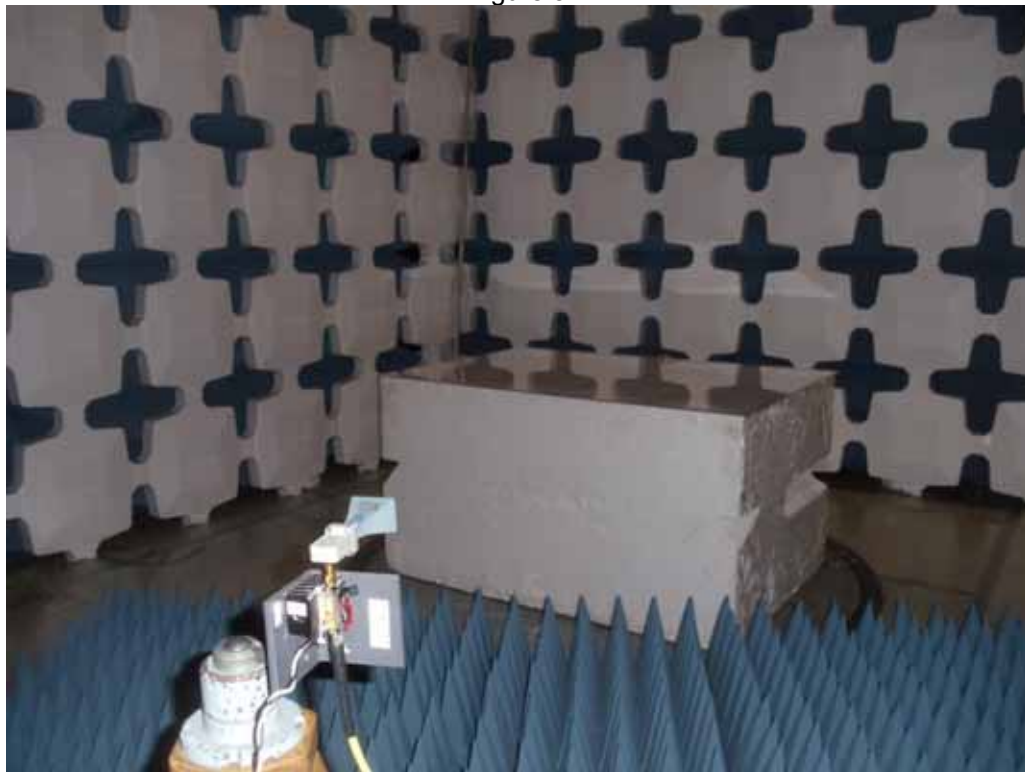


Test Setup for Radiated Emissions – 2GHz to 18GHz, Horizontal Polarization



Test Setup for Radiated Emissions – 2GHz to 18GHz, Vertical Polarization

Figure 5



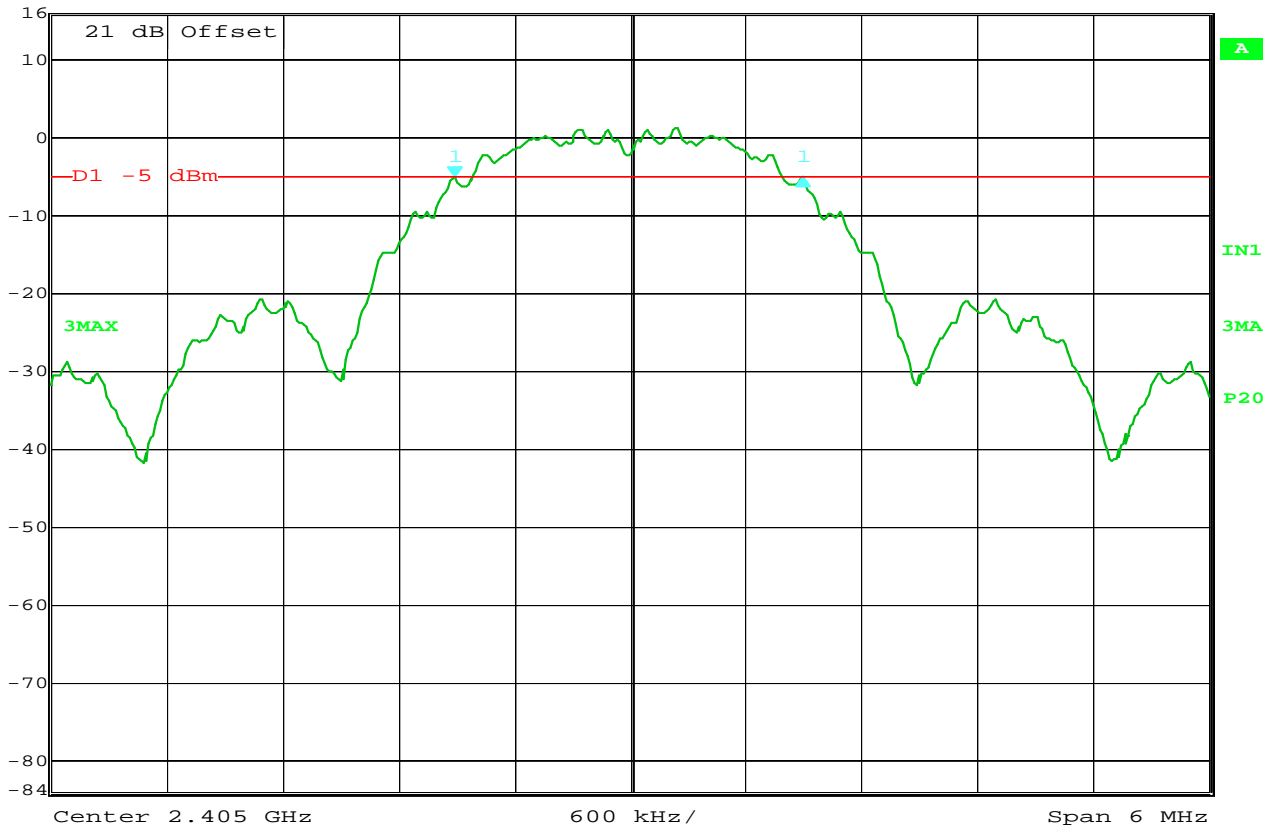
Test Setup for Radiated Emissions – 18GHz to 25GHz, Horizontal Polarization



Test Setup for Radiated Emissions – 18GHz to 25GHz, Vertical Polarization



Delta 1 [T3] RBW 100 kHz RF Att 30 dB
 Ref Lvl -0.03 dB VBW 1 MHz
 16 dBm 1.80360721 MHz SWT 20 ms Unit dBm



Date: 2.JAN.2015 14:39:41

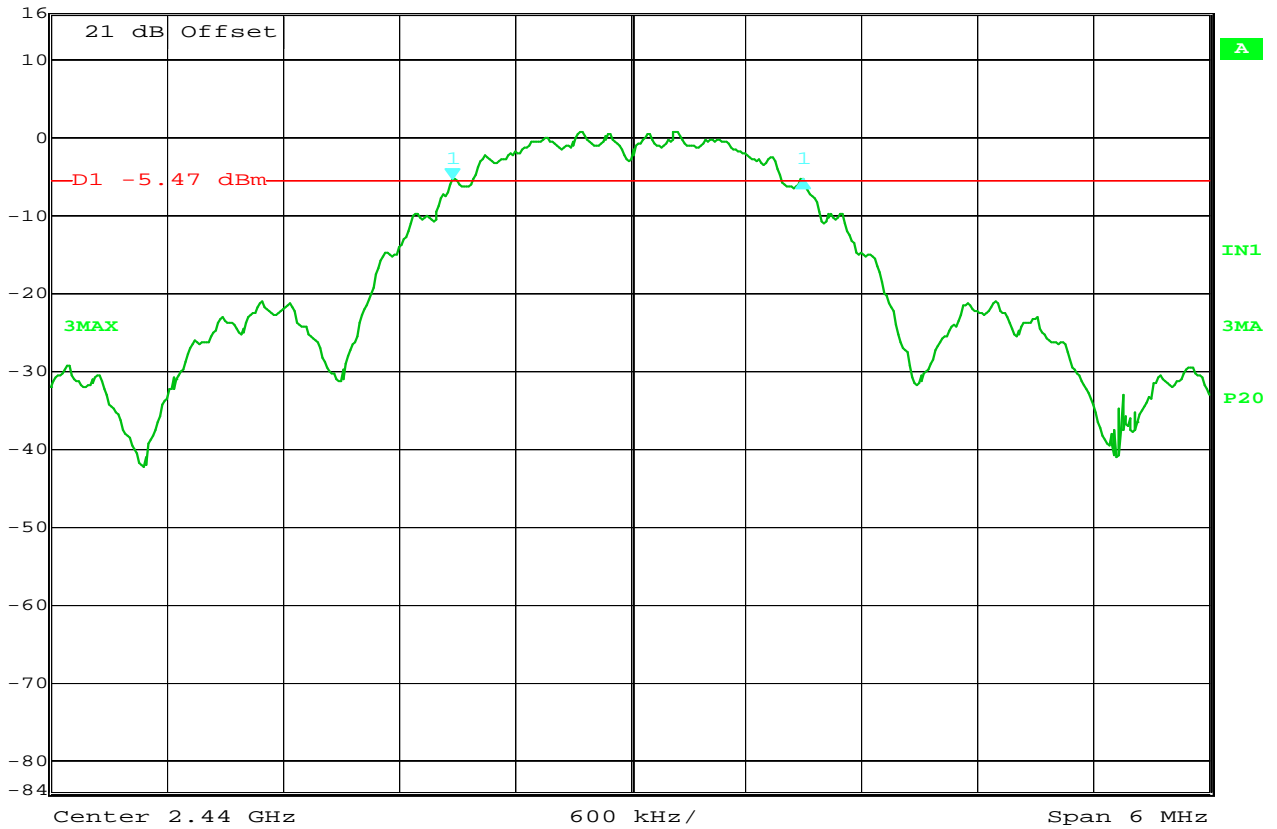
FCC 15.247 6 dB Bandwidth

MANUFACTURER : California Eastern Labs
 MODEL NUMBER : 3340
 TEST MODE : Tx @ 2405MHz modulated
 : PEAK detector
 NOTES : 6 dB Bandwidth = 1.8MHz
 :

NOTES



Delta 1 [T3] RBW 100 kHz RF Att 30 dB
 Ref Lvl 0.10 dB VBW 1 MHz
 16 dBm 1.81563126 MHz SWT 20 ms Unit dBm



Date: 2.JAN.2015 14:44:11

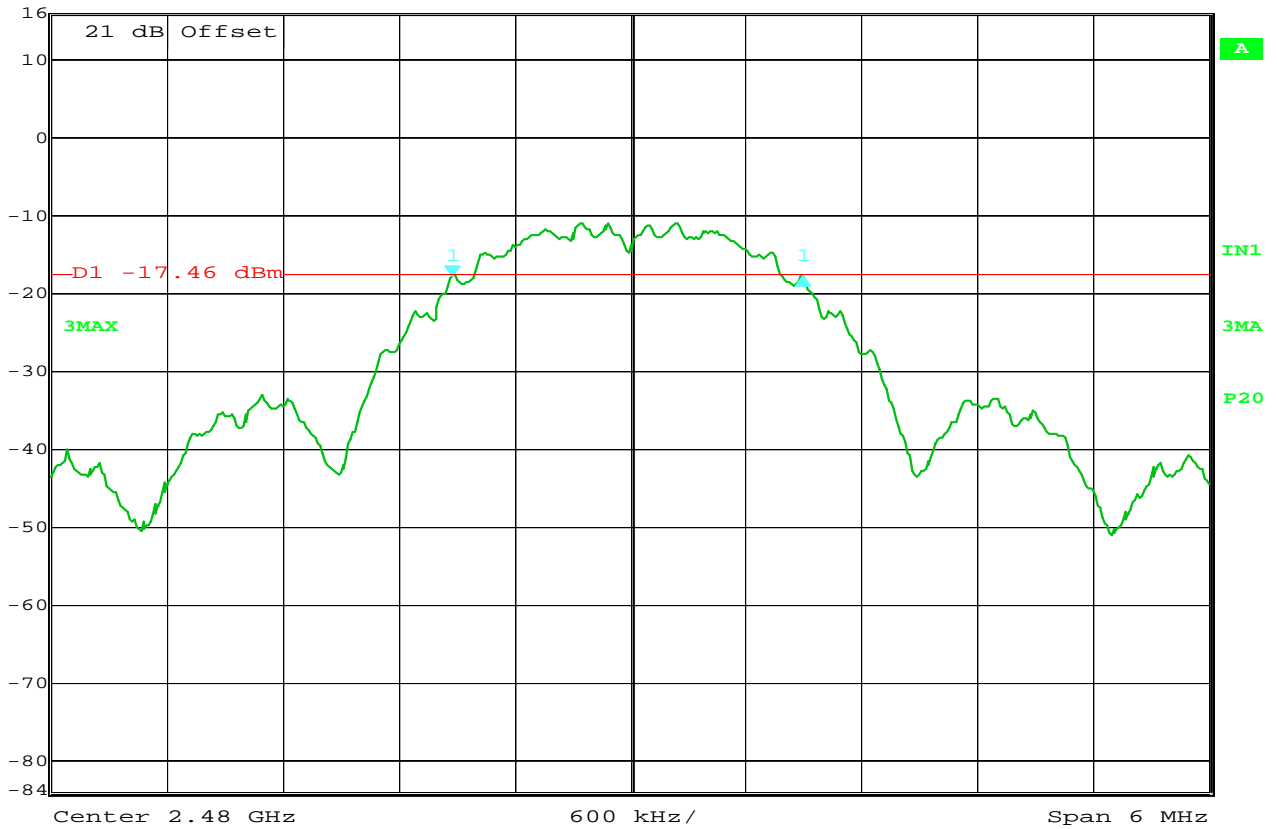
FCC 15.247 6 dB Bandwidth

MANUFACTURER : California Eastern Labs
 MODEL NUMBER : 3340
 TEST MODE : Tx @ 2440MHz modulated
 : PEAK detector
 NOTES : 6 dB Bandwidth = 1.81MHz
 :

NOTES



Delta 1 [T3] RBW 100 kHz RF Att 30 dB
 Ref Lvl 0.01 dB VBW 1 MHz
 16 dBm 1.81563126 MHz SWT 20 ms Unit dBm



FCC 15.247 6 dB Bandwidth

MANUFACTURER : California Eastern Labs
 MODEL NUMBER : 3340
 TEST MODE : Tx @ 2480MHz modulated
 : PEAK detector
 NOTES : 6 dB Bandwidth = 1.81MHz
 :

NOTES



DATA SHEET

Manufacturer : California Eastern Labs
Test Item : Zigbee Transceiver
Model No. : 3340
Test Specification : FCC Part 15, Subpart C, Section 15.247, Peak Output Power
Date : Jan. 2, 2015
Notes :

Freq (MHz)	Total (dBm)	Total (Watts)	Limit (dBm)	Limit (Watts)
2405.0	7.3	0.005	30	1
2440.0	6.8	0.004	30	1
2480.0	-6.6	0.0002	30	1

Checked BY RICHARD E. KING :

Richard E. King



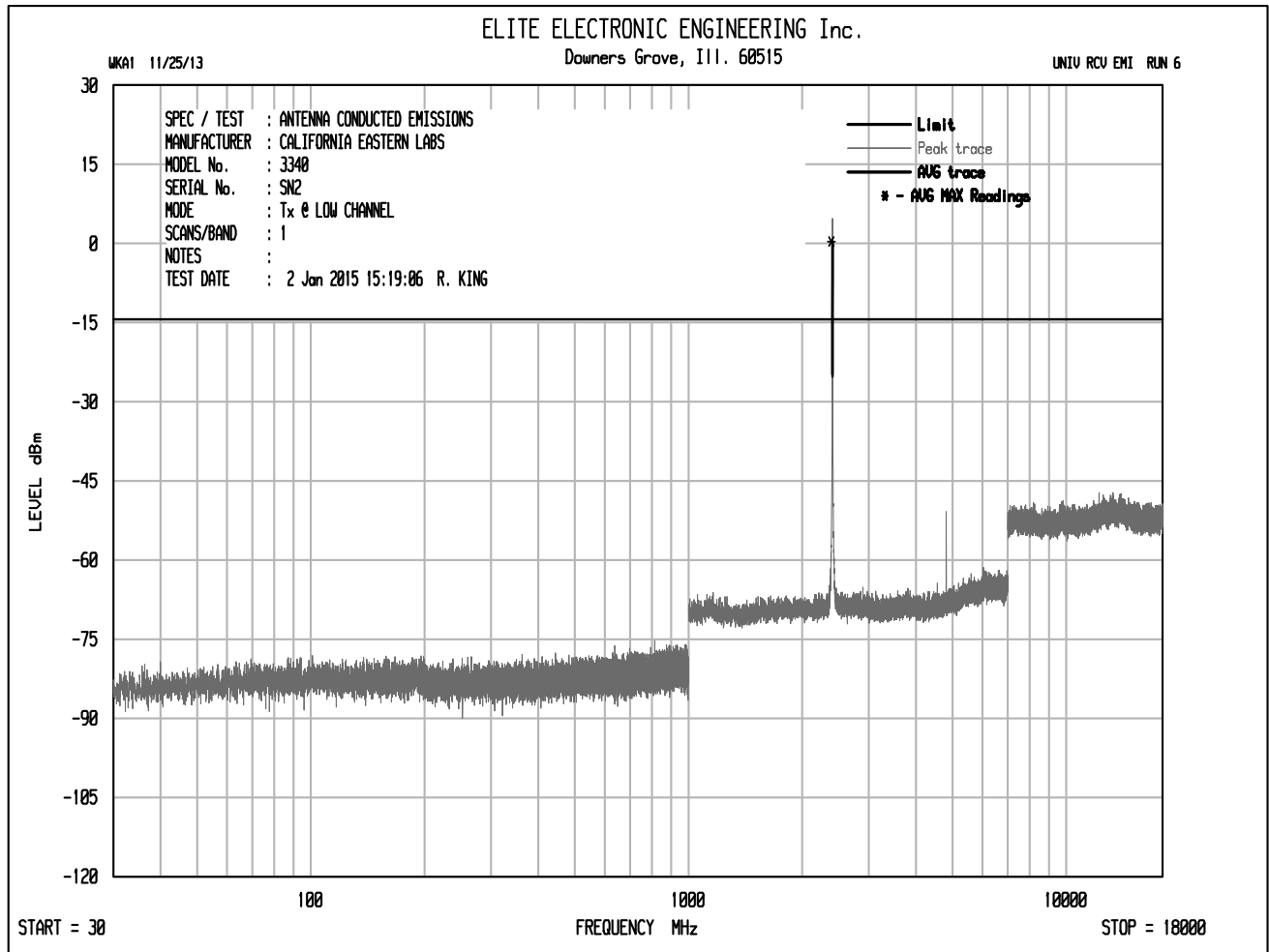
DATA SHEET

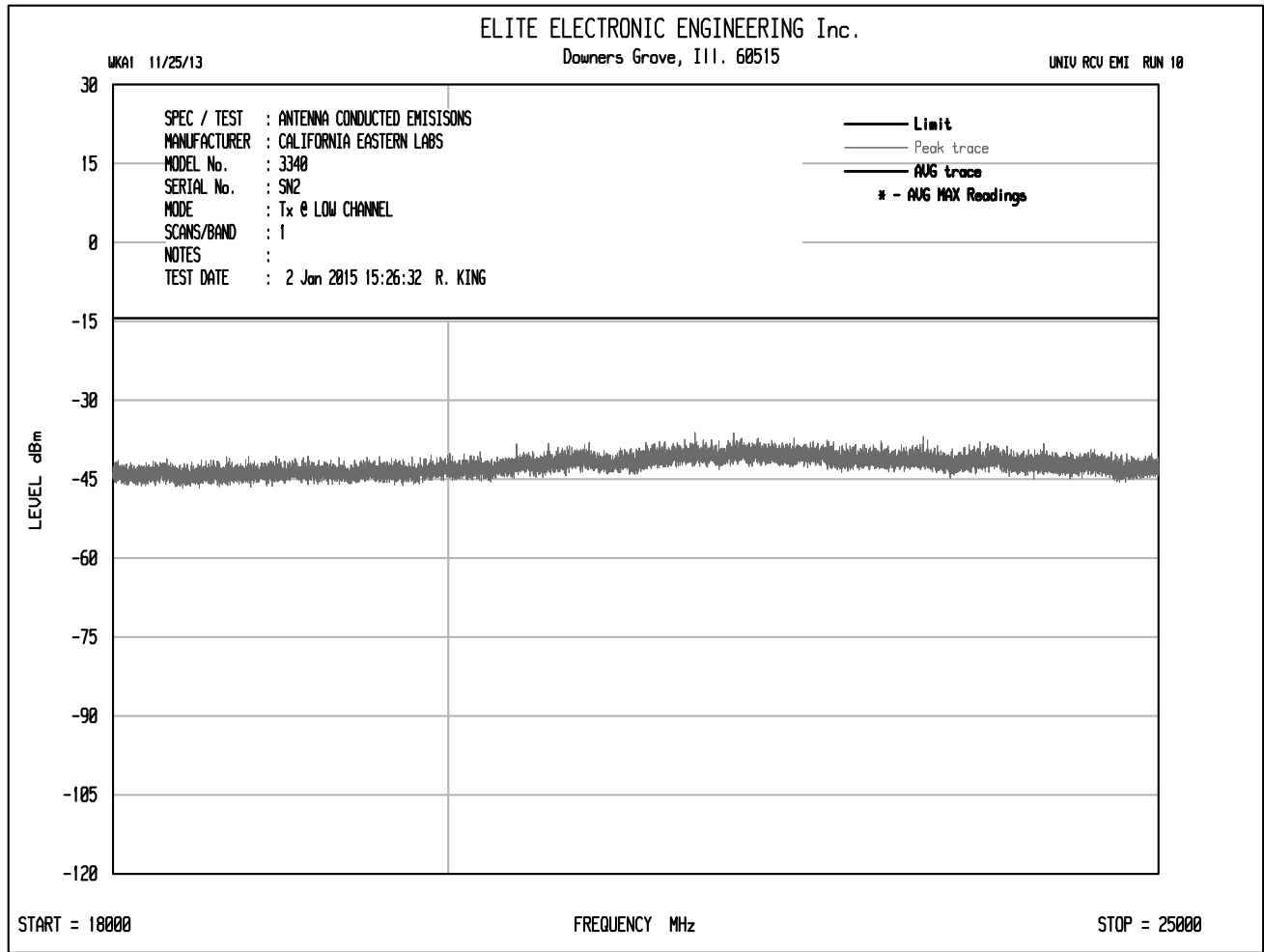
Manufacturer : California Eastern Labs
Test Item : Zigbee Transceiver
Model No. : 3340
Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Peak Output Power
Date : December 18, 2014
Notes : EIRP = Matched Signal - Cable Loss + Antenna Gain

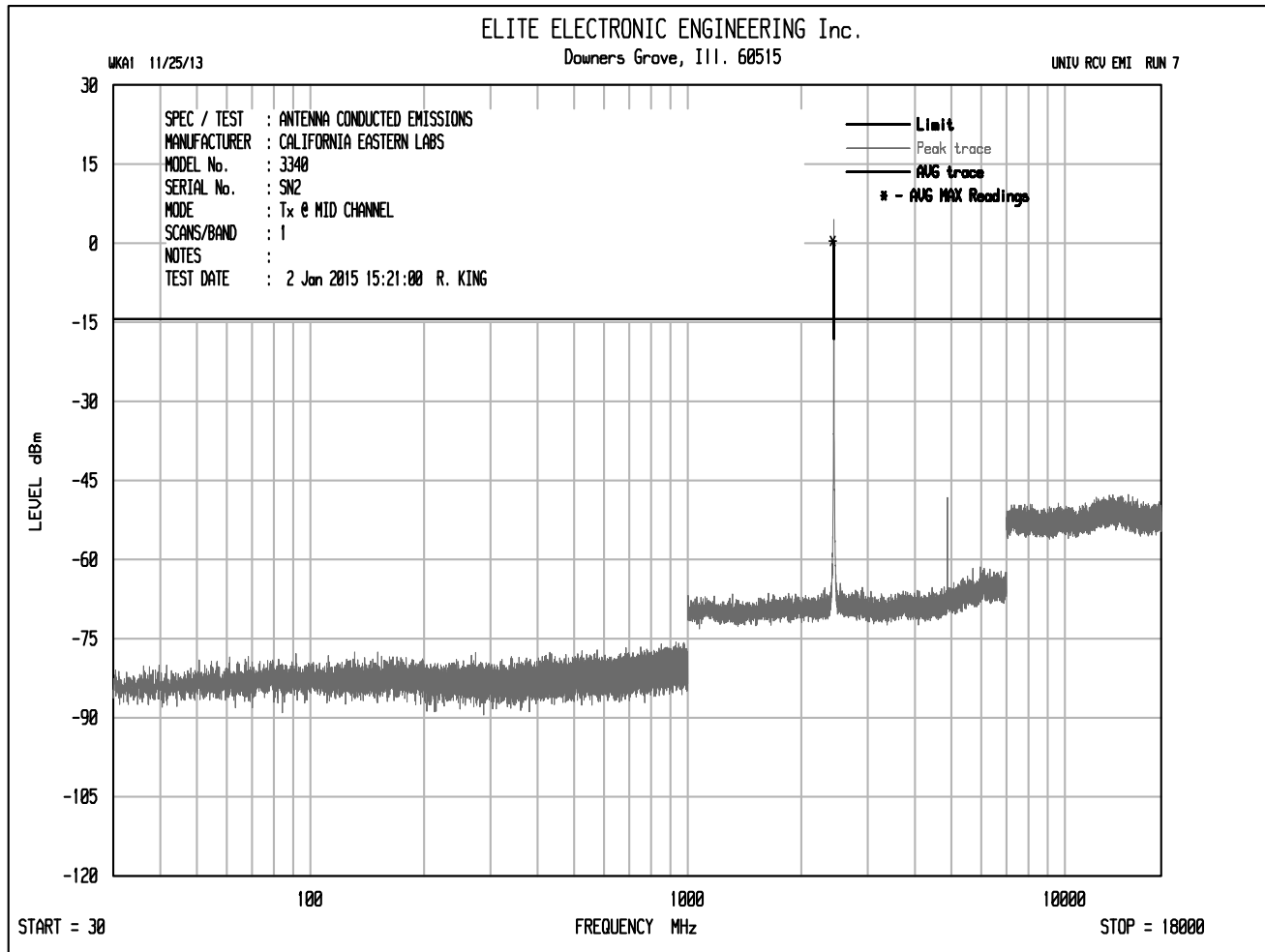
Freq (MHz)	Ant Pol	Meter Reading (dBuV)	Matched SIG. GEN. (dB)	Ant Gain (dB)	CBL (dB)	Total (dBm)	Limit
2405	H	71.2	6.9	5.3	2.8	9.4	36
2405	V	64.2	4.7	5.3	2.8	7.2	36
2440	H	72.5	6.9	5.4	2.8	9.5	36
2440	V	67.0	5.2	5.4	2.8	7.8	36
2480	H	57.8	-6.1	5.5	2.8	-3.4	36
2480	V	53.2	-9.8	5.5	2.8	-7.1	36

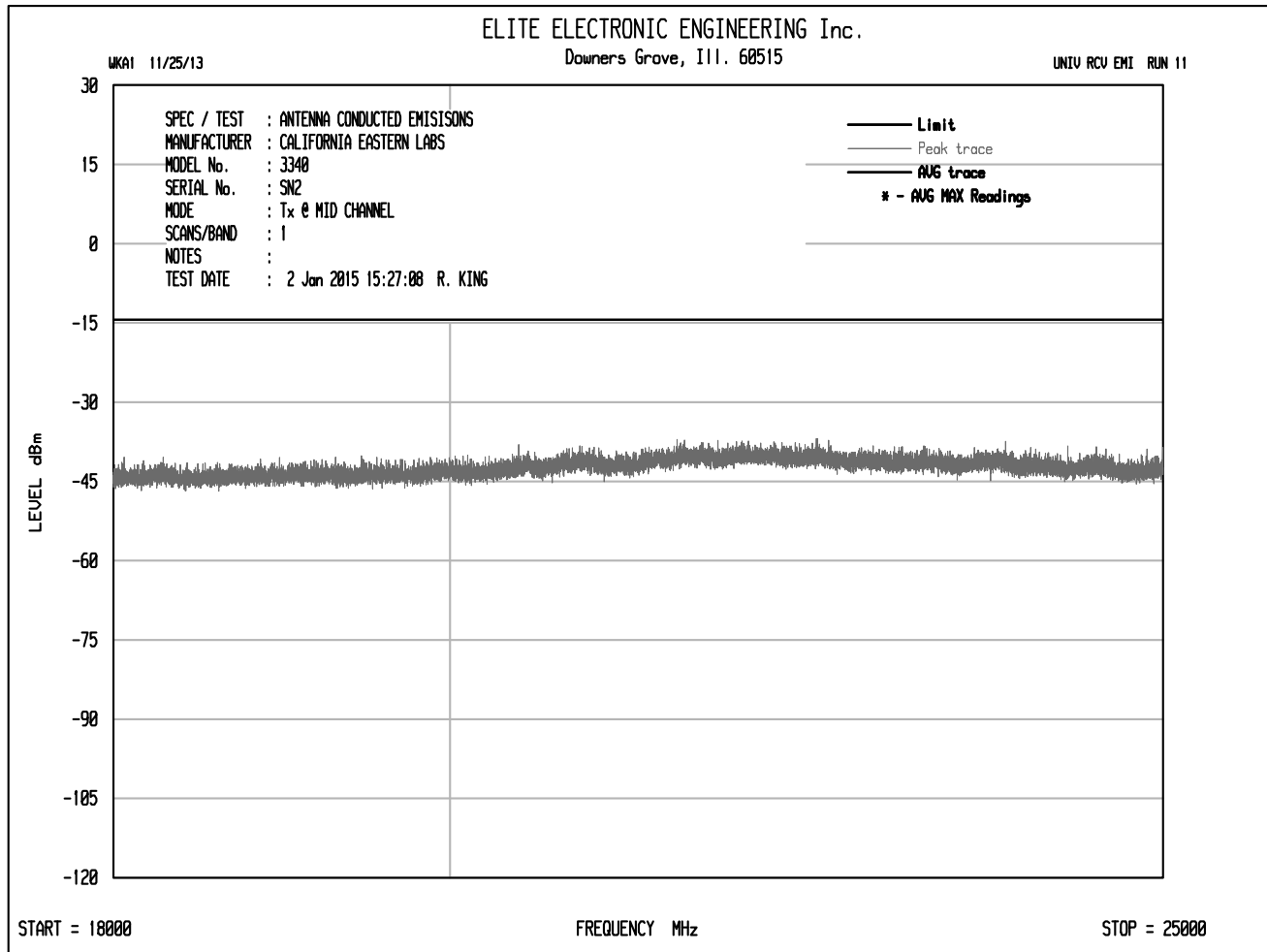
Checked BY RICHARD E. KING :

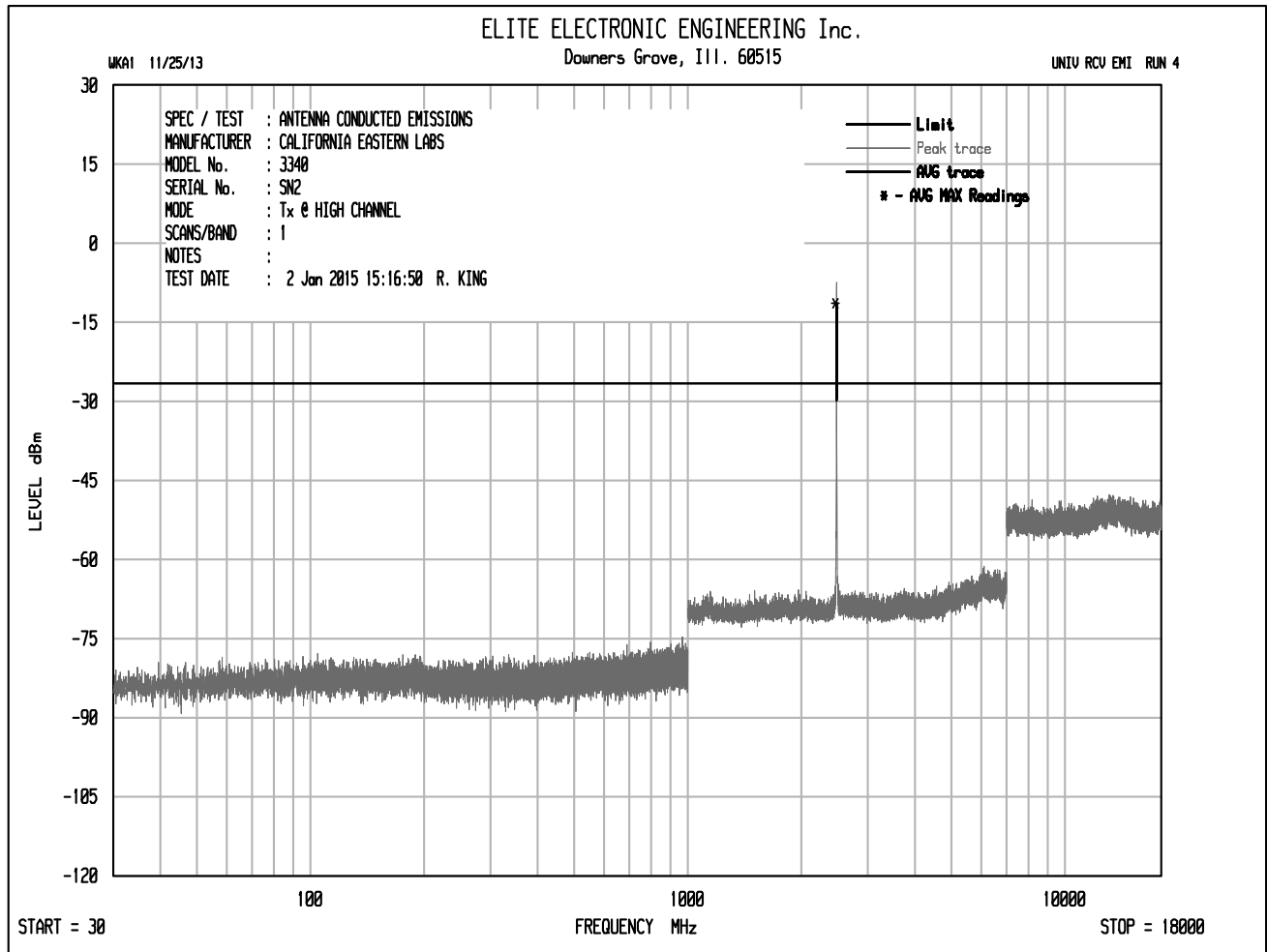
Richard E. King

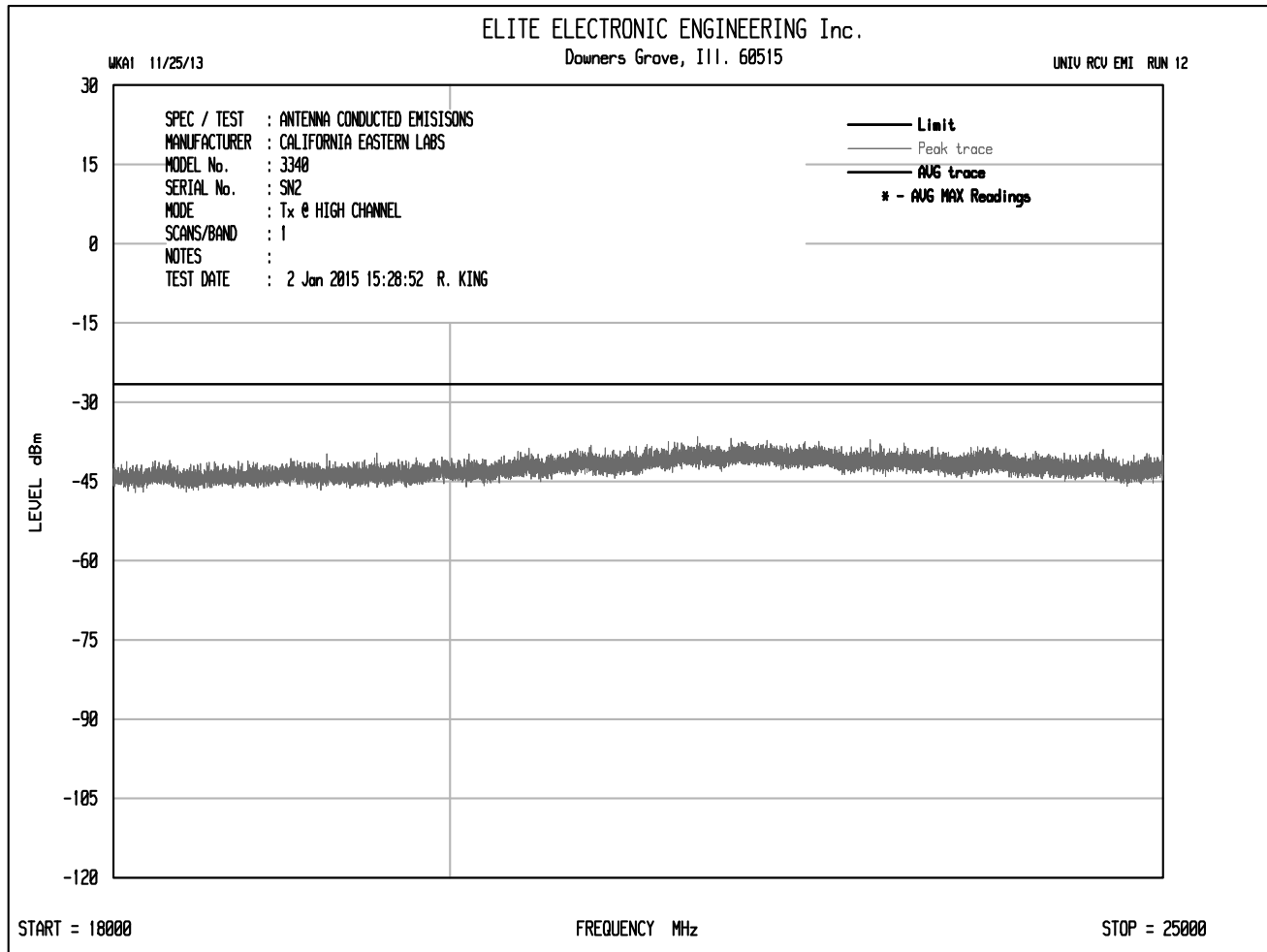


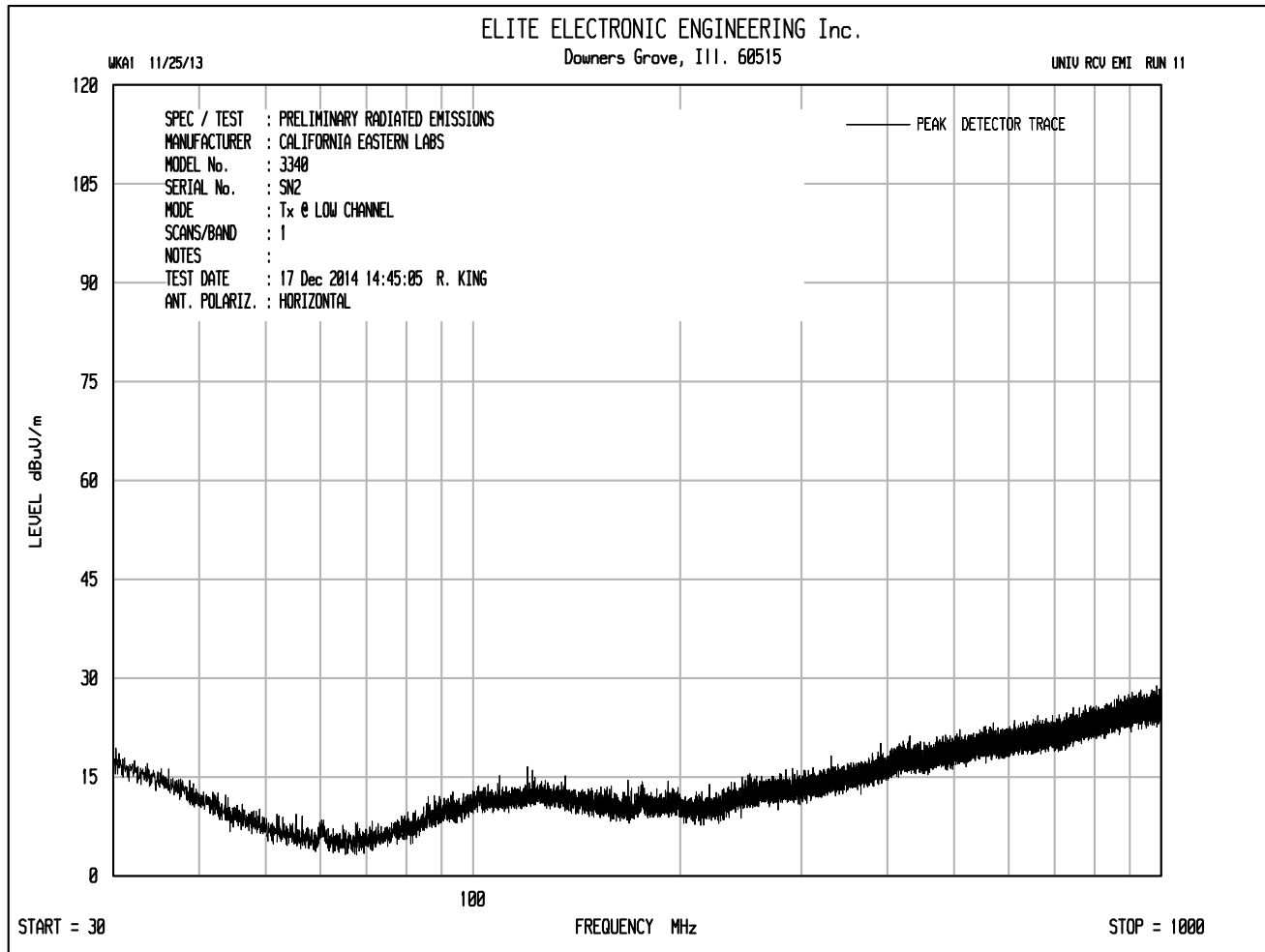


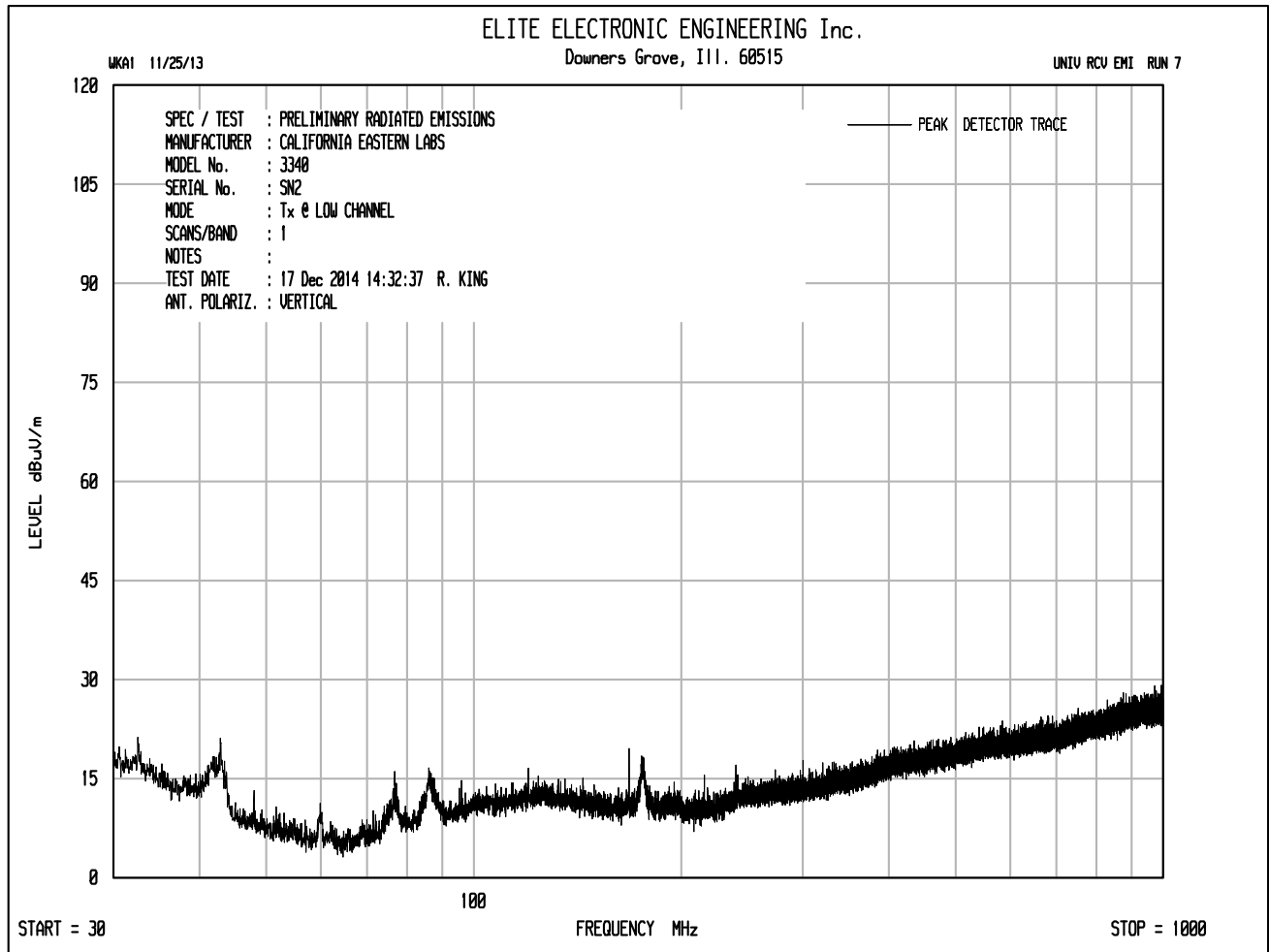


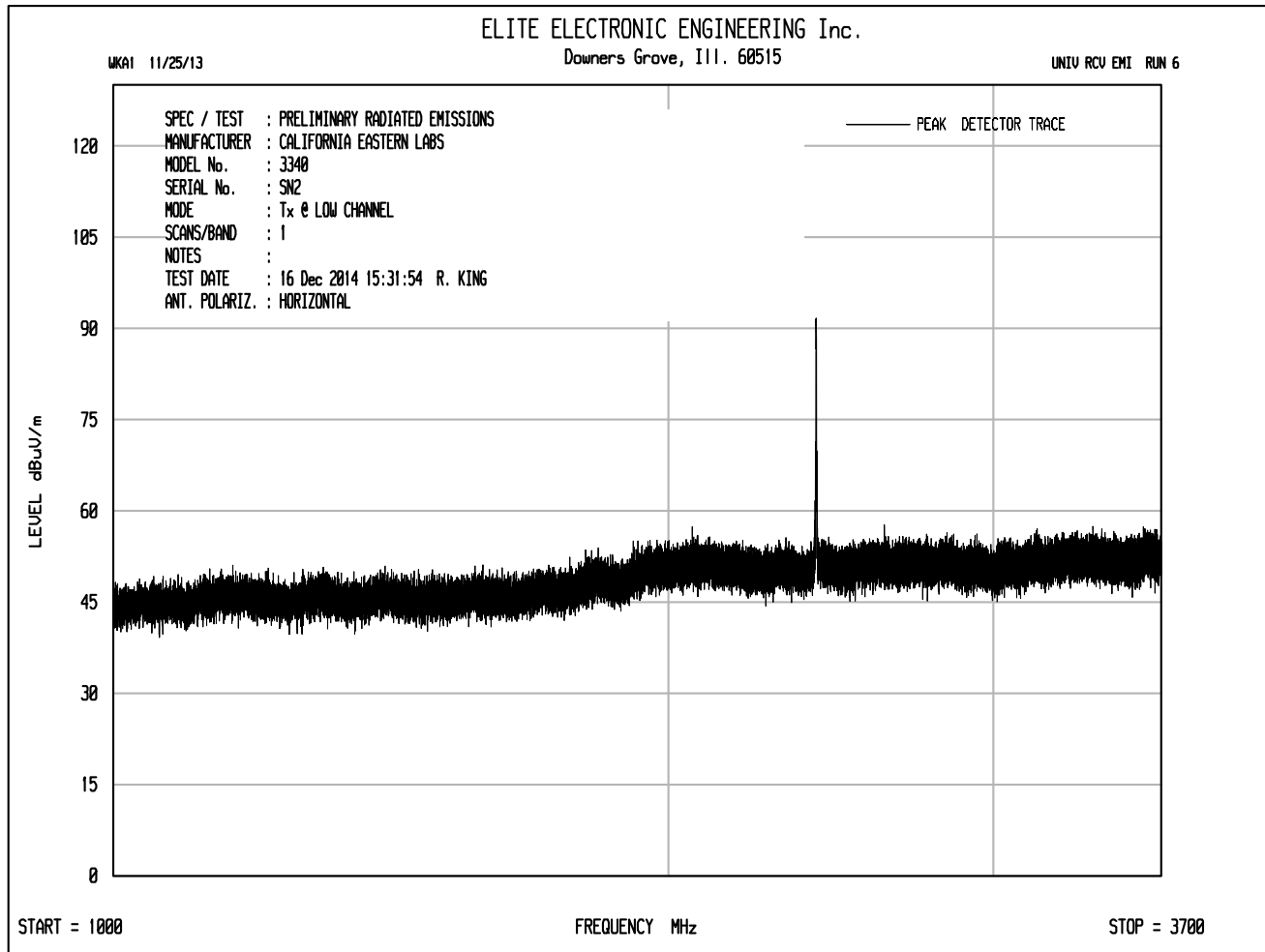


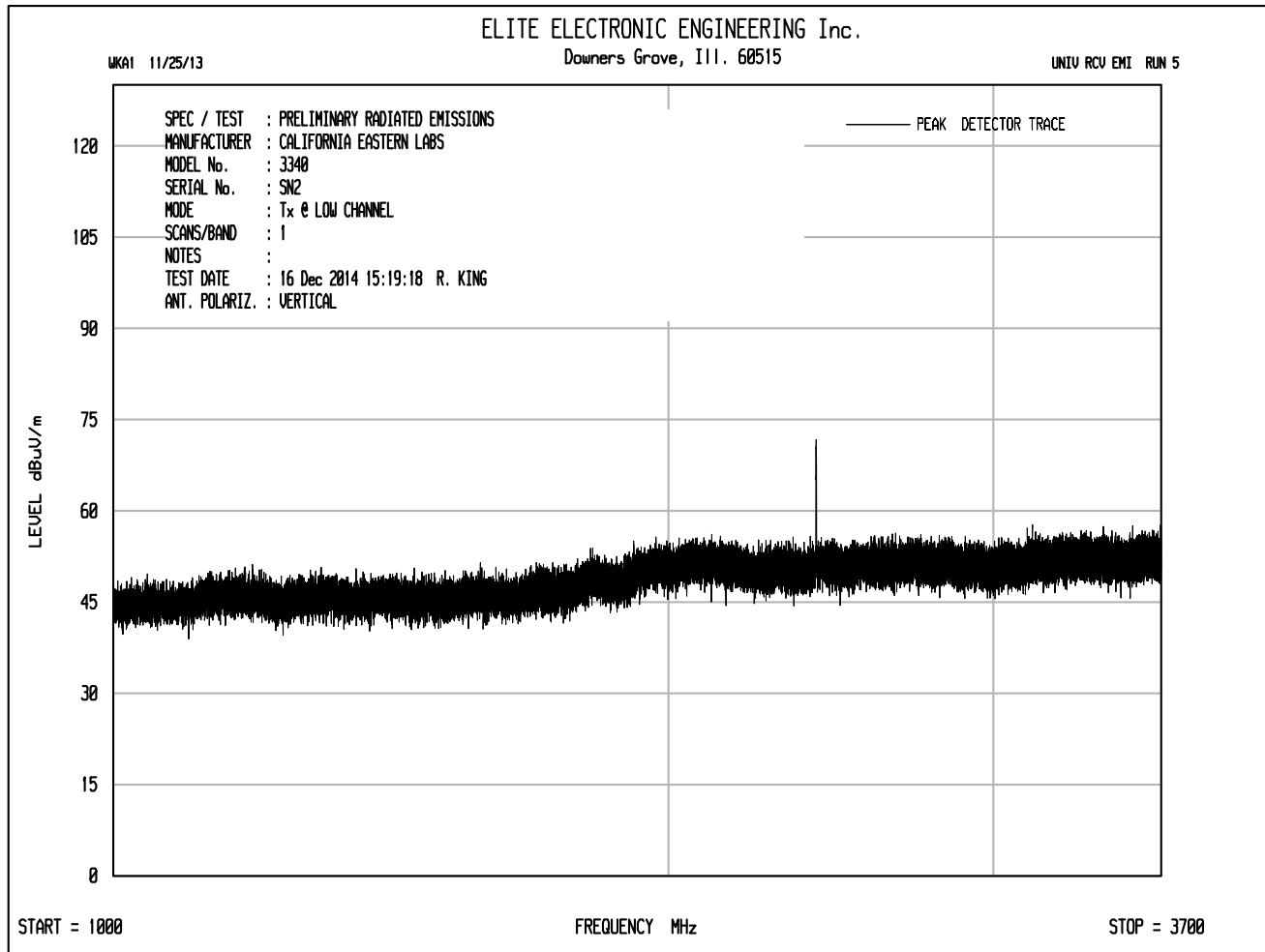


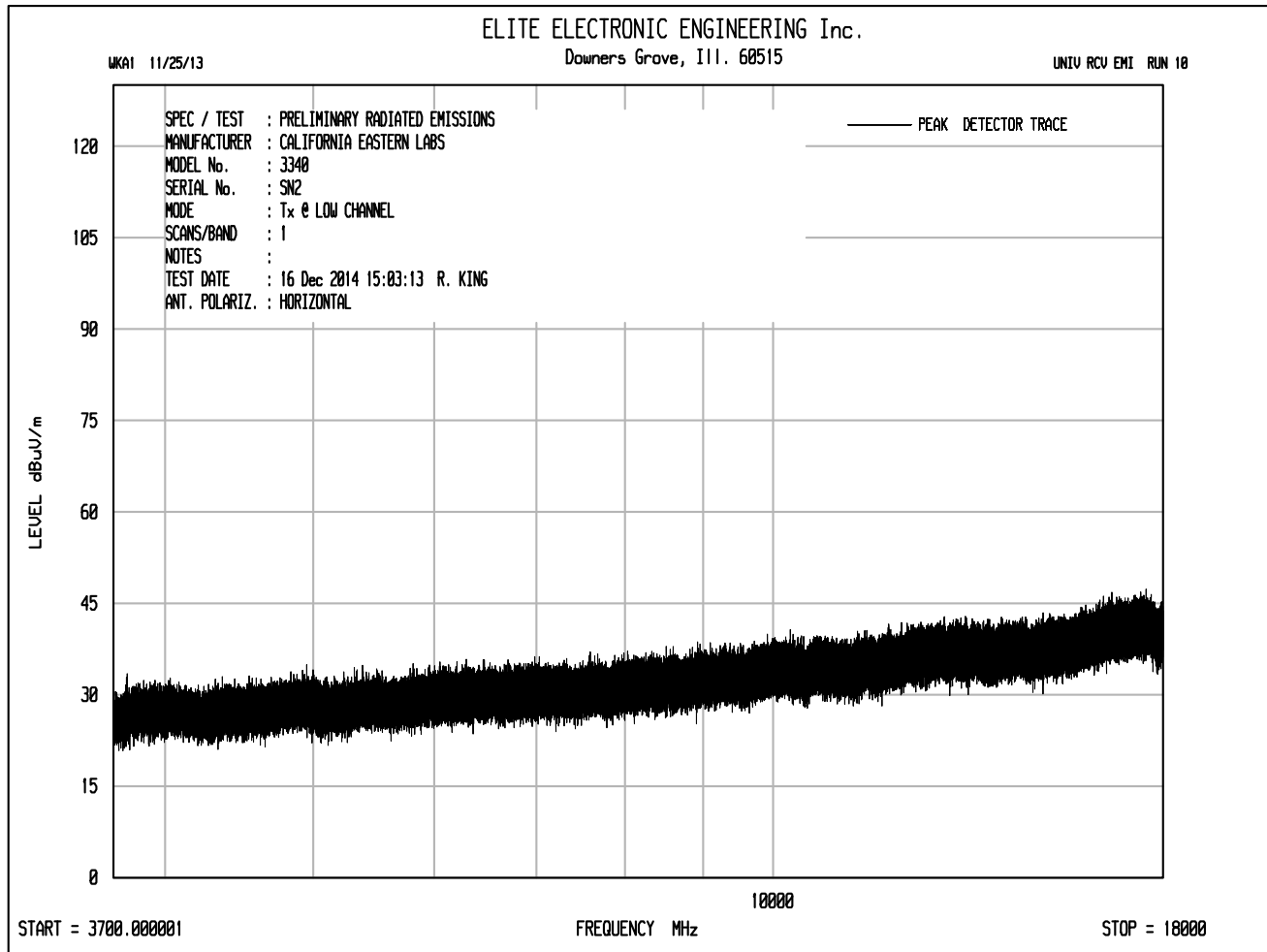


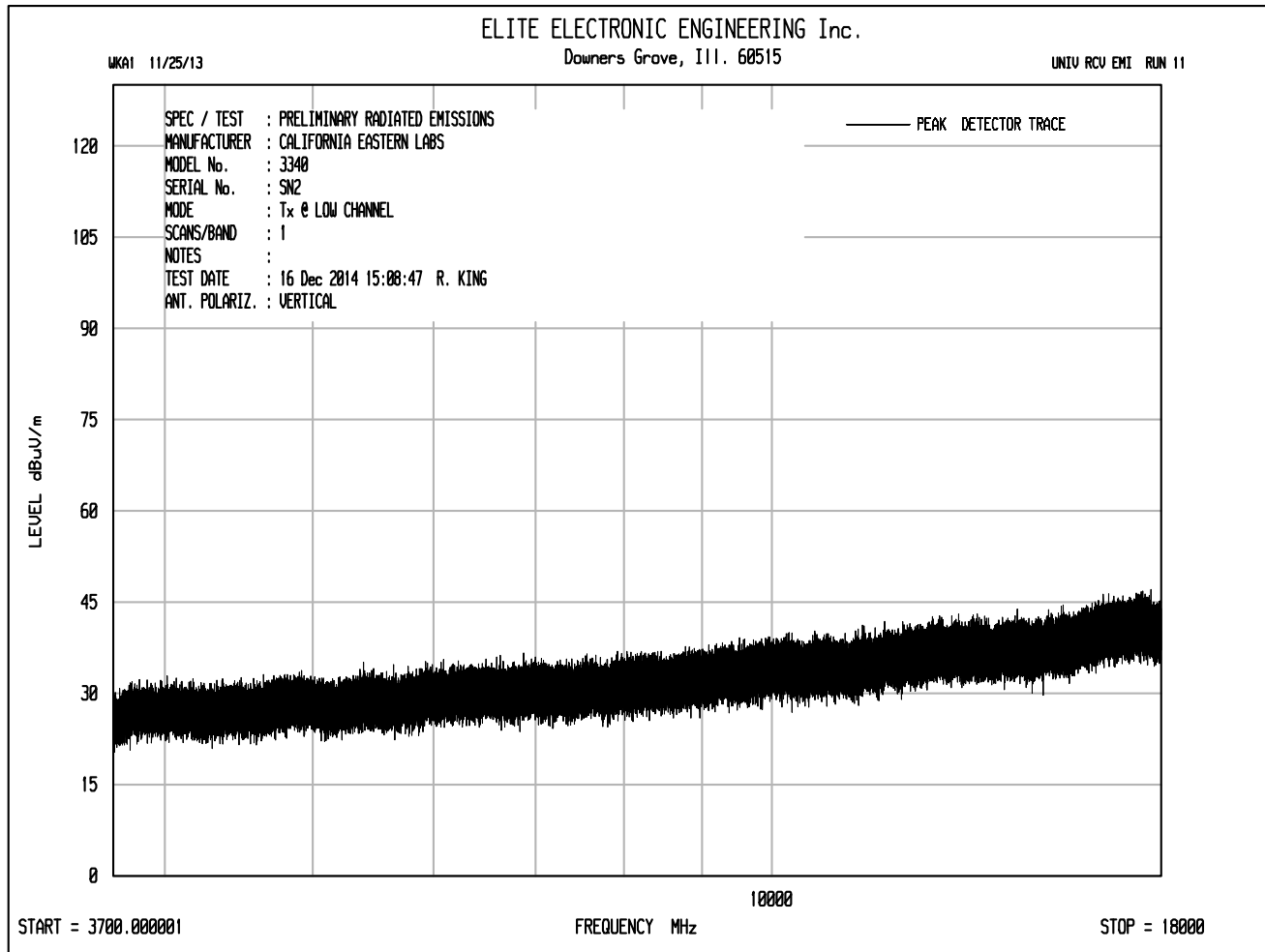


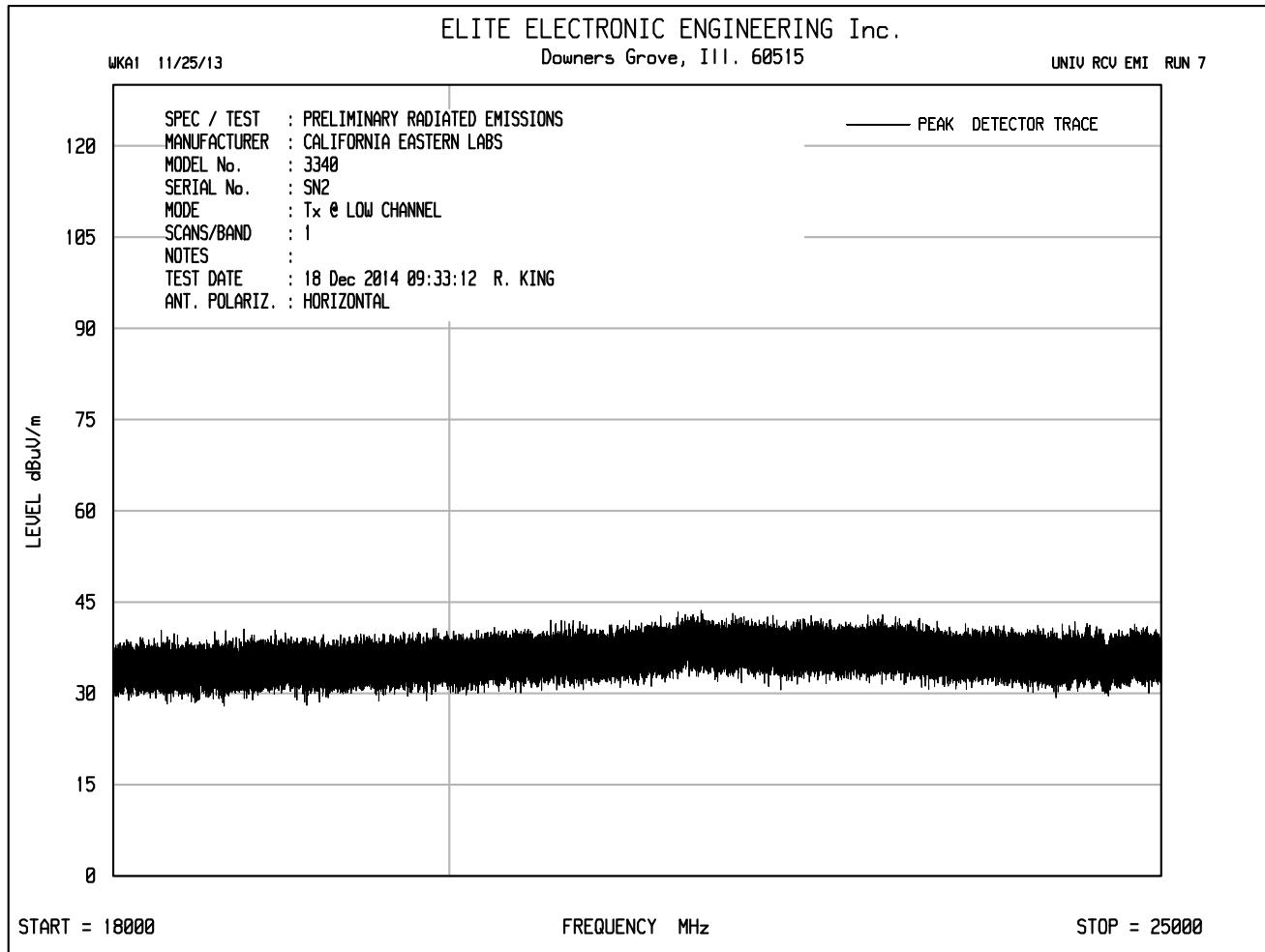


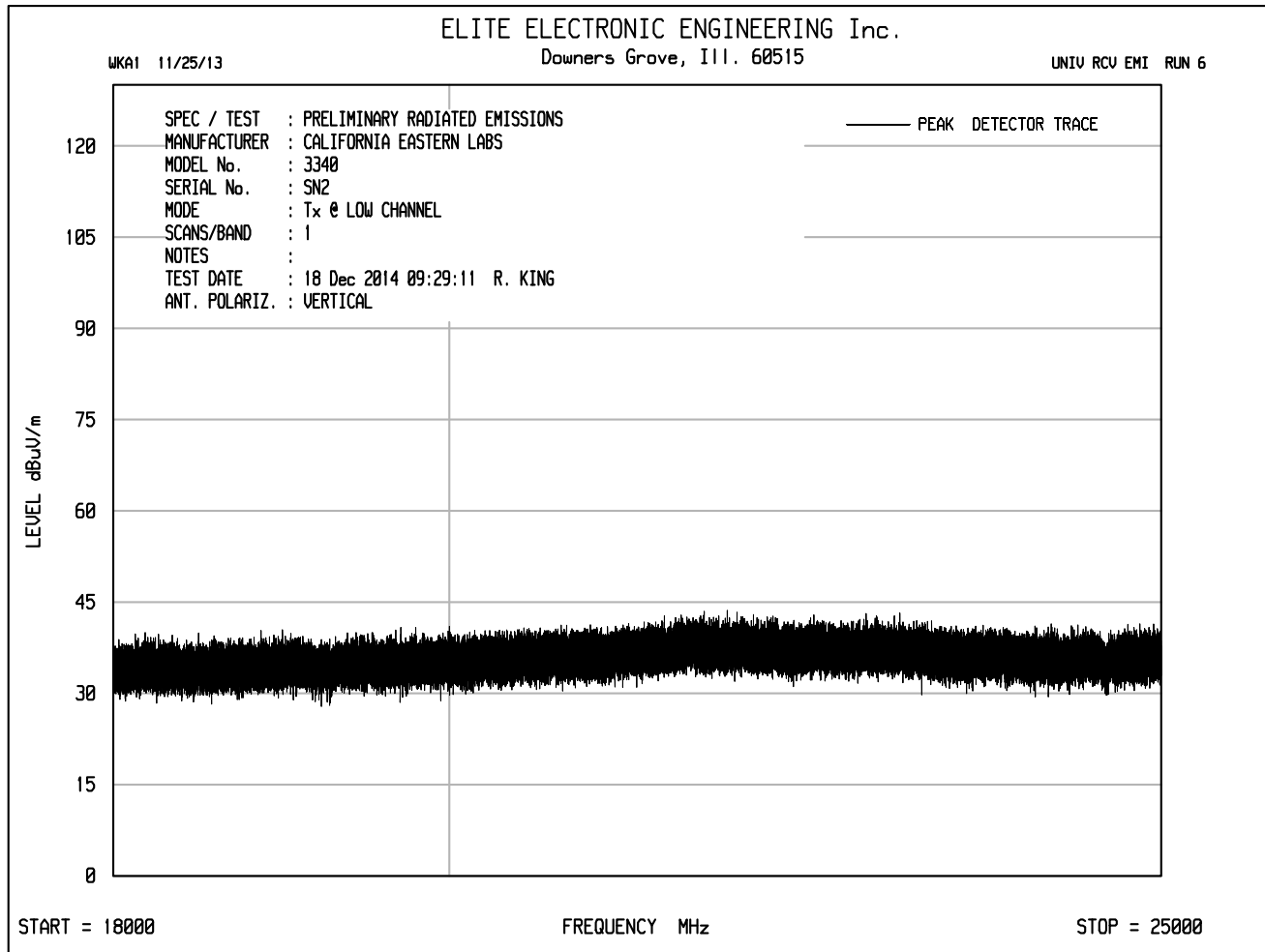


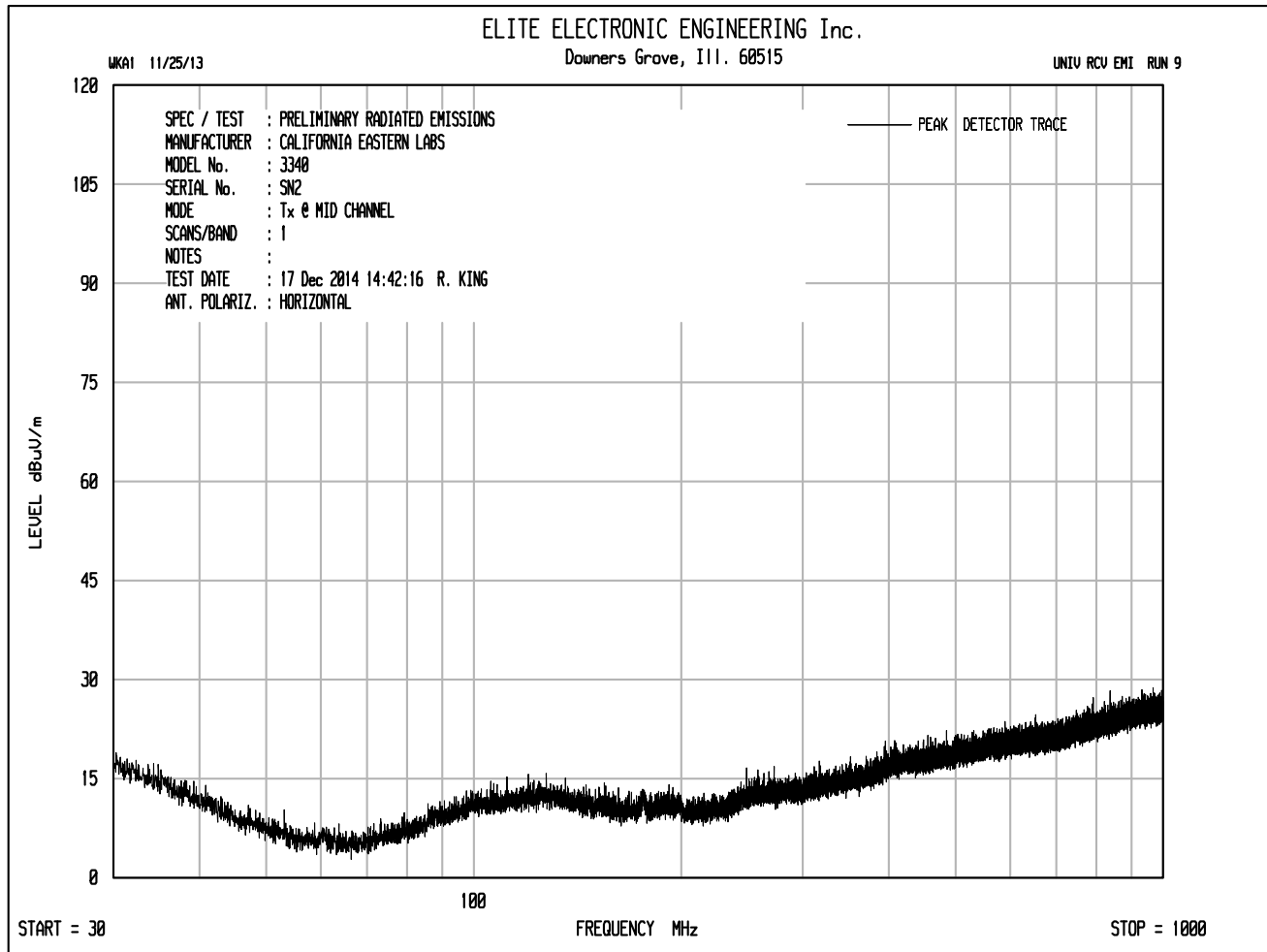


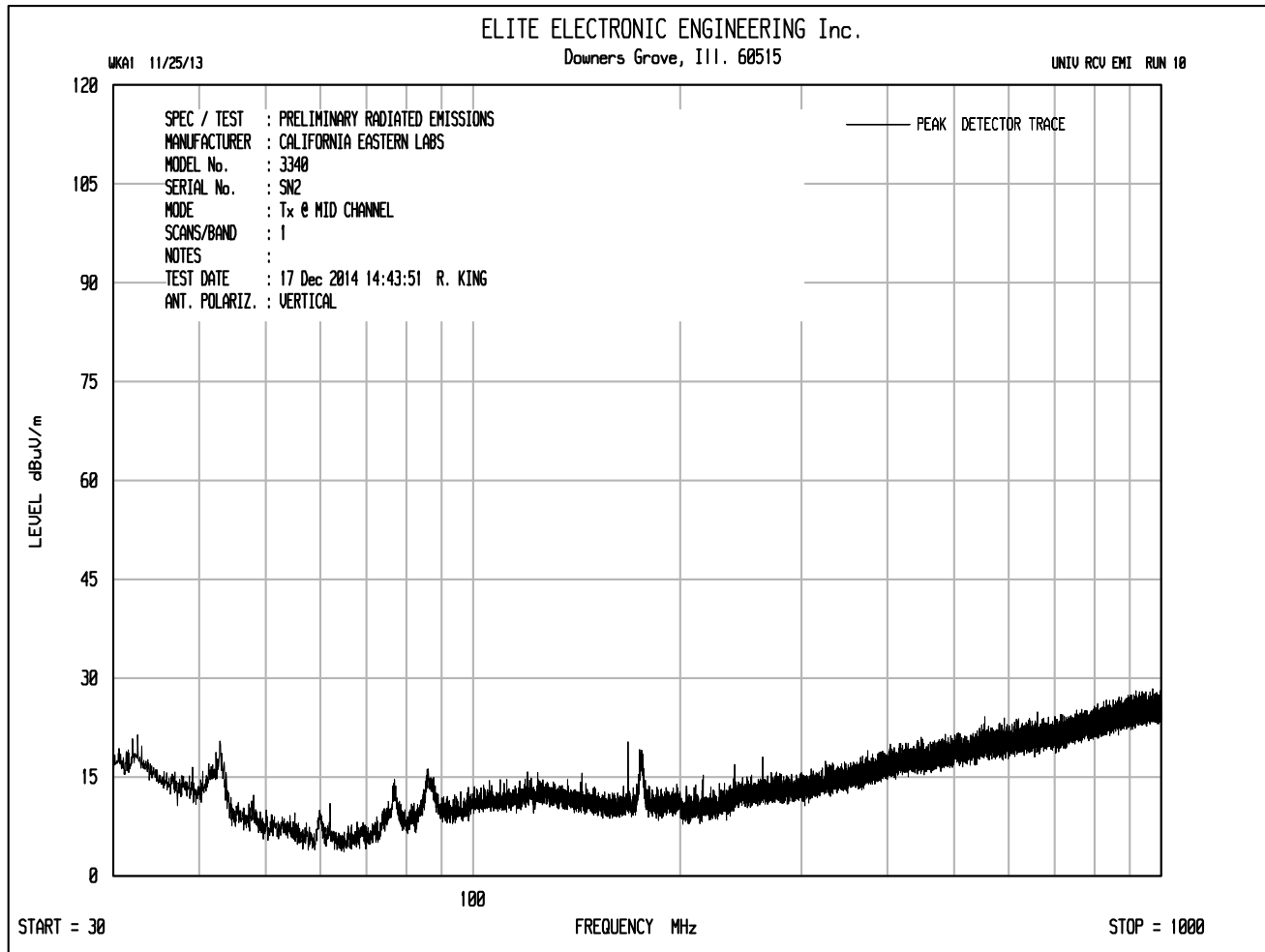


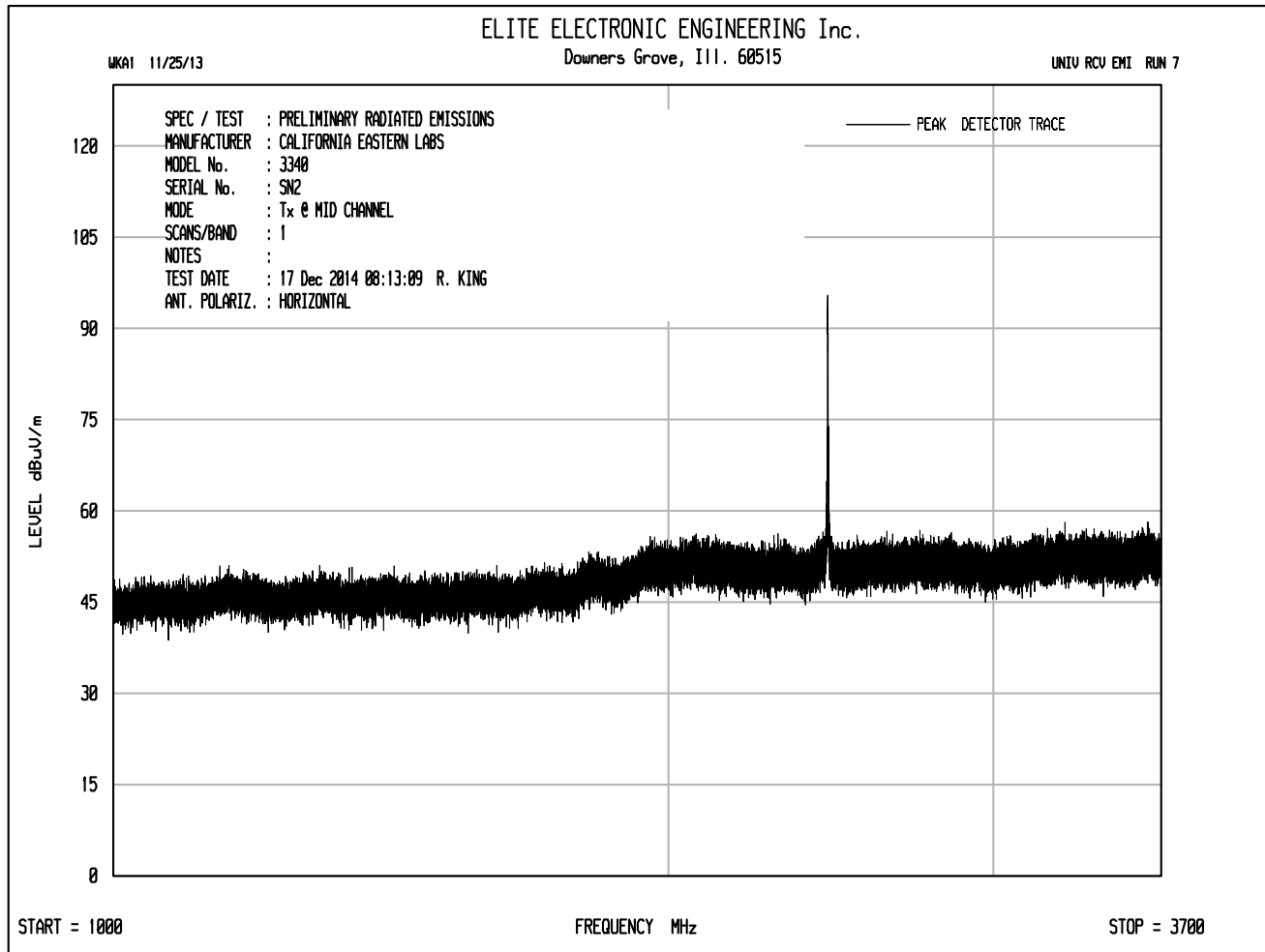


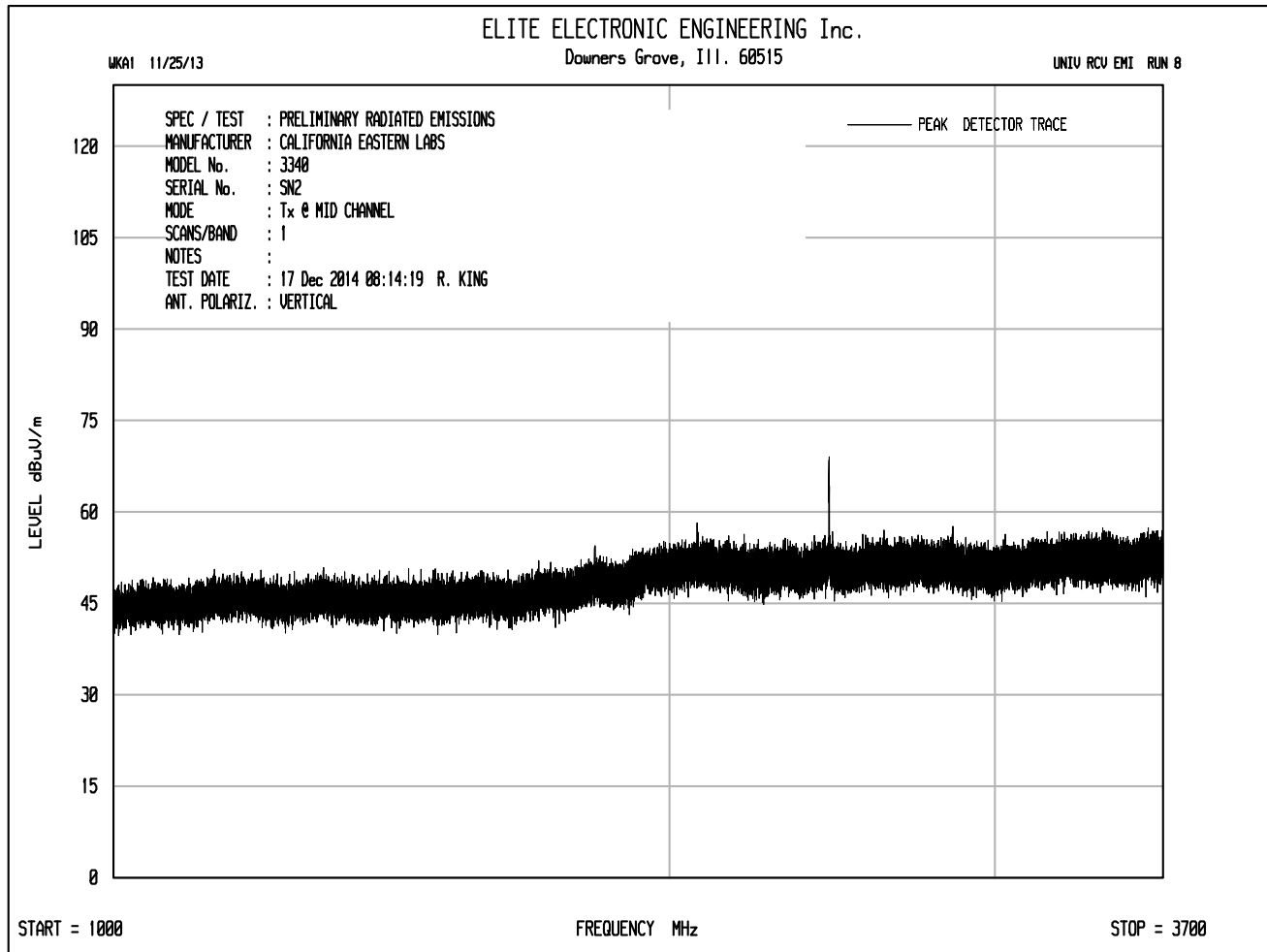


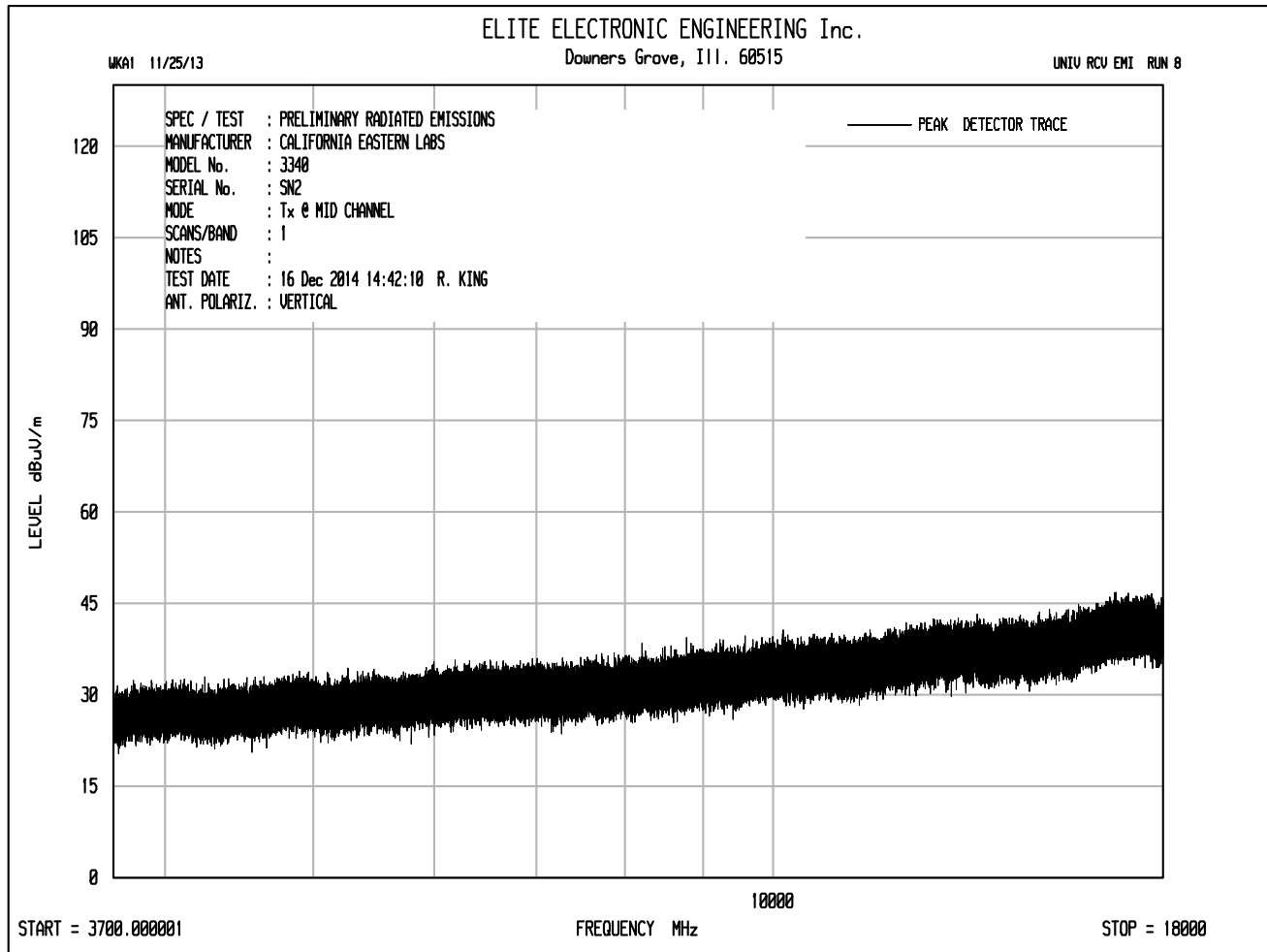


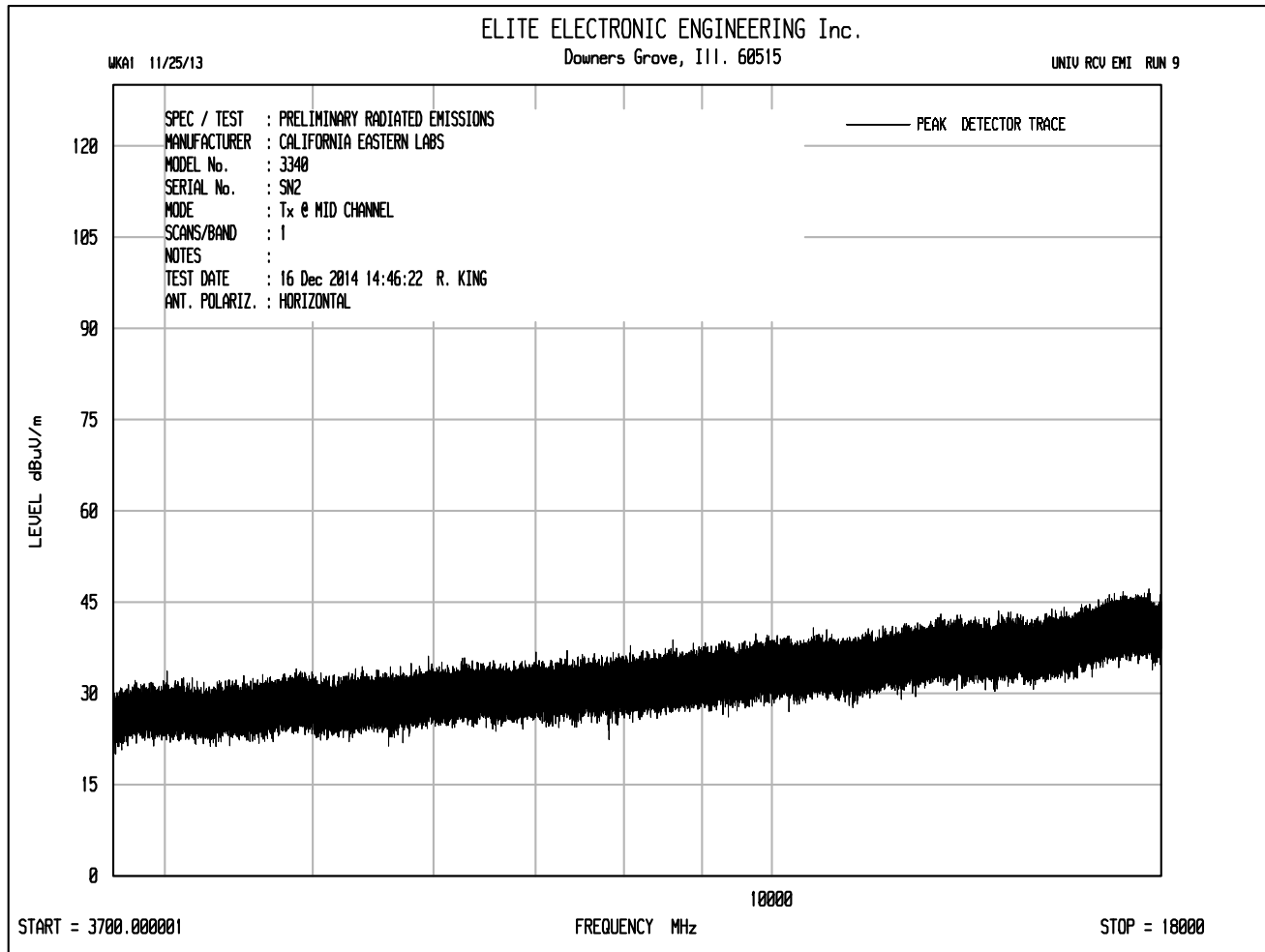


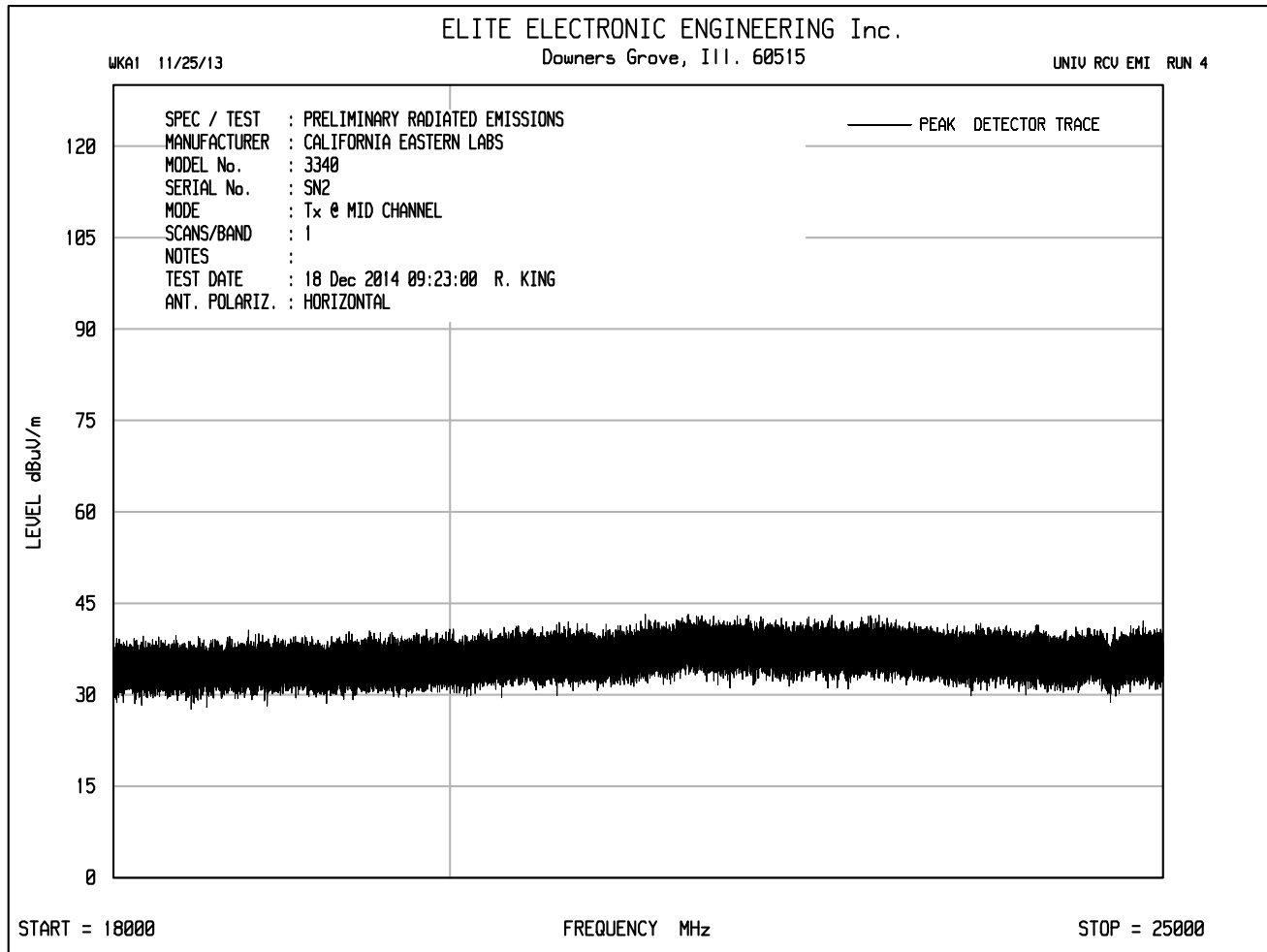


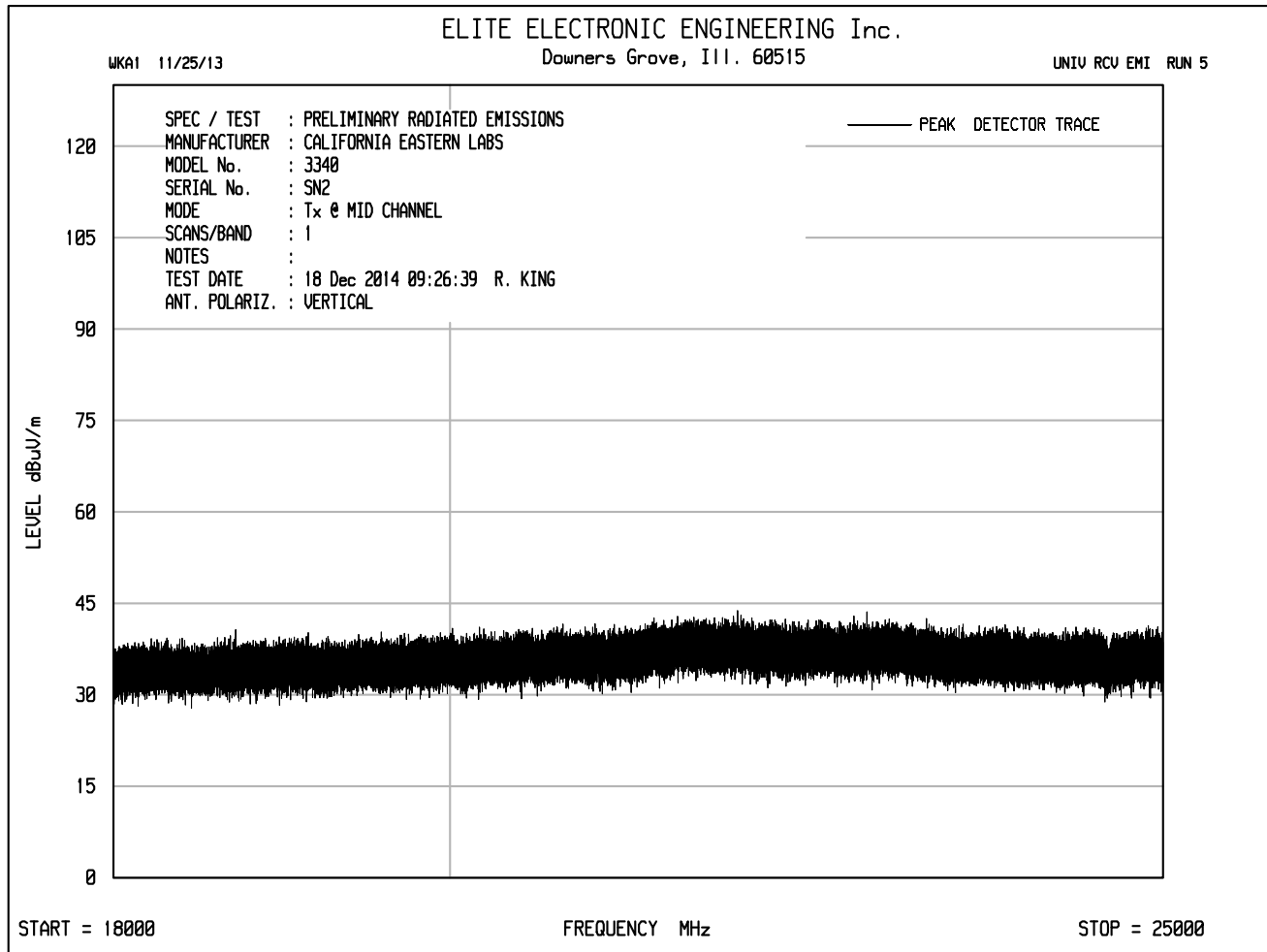


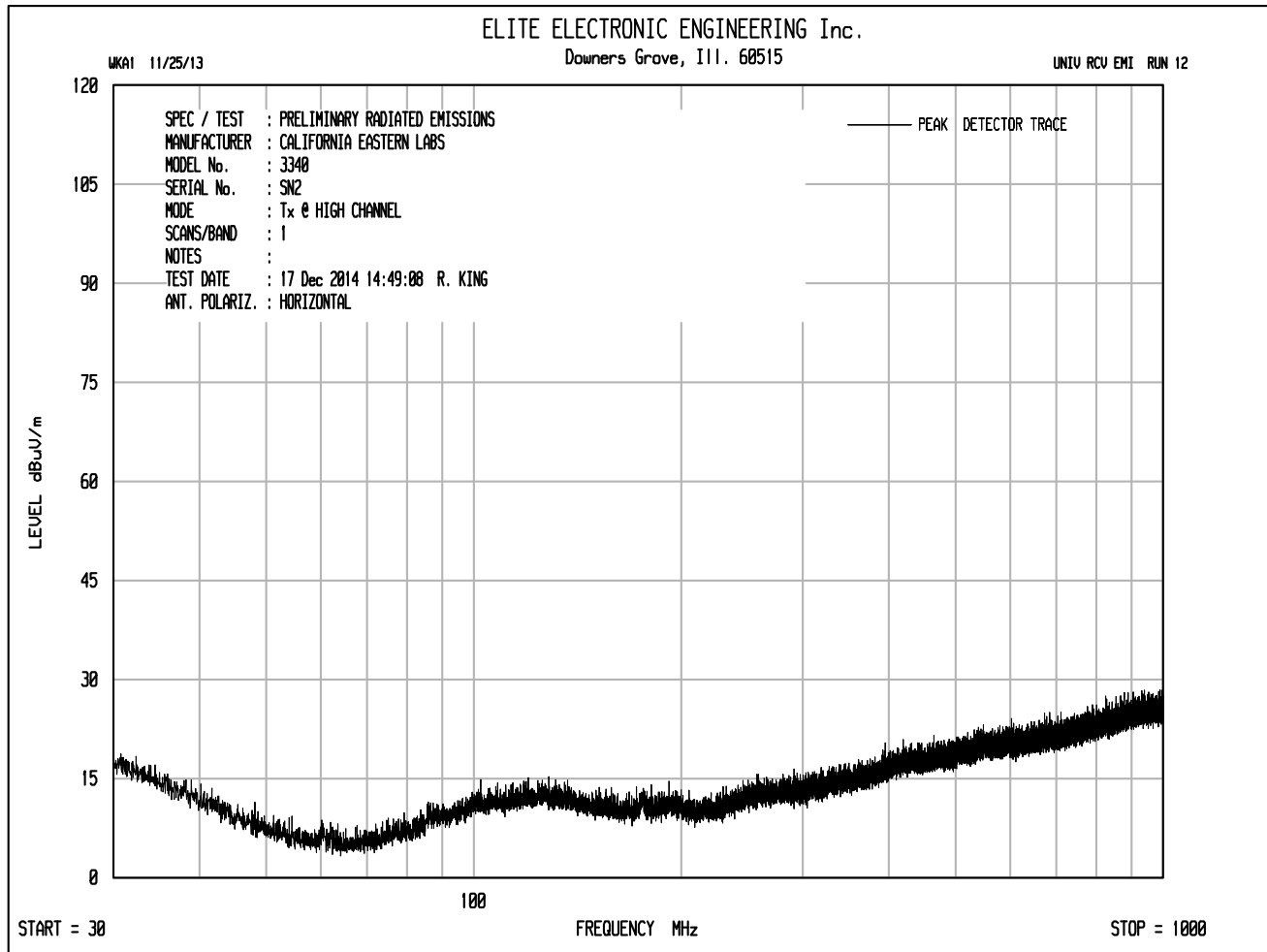


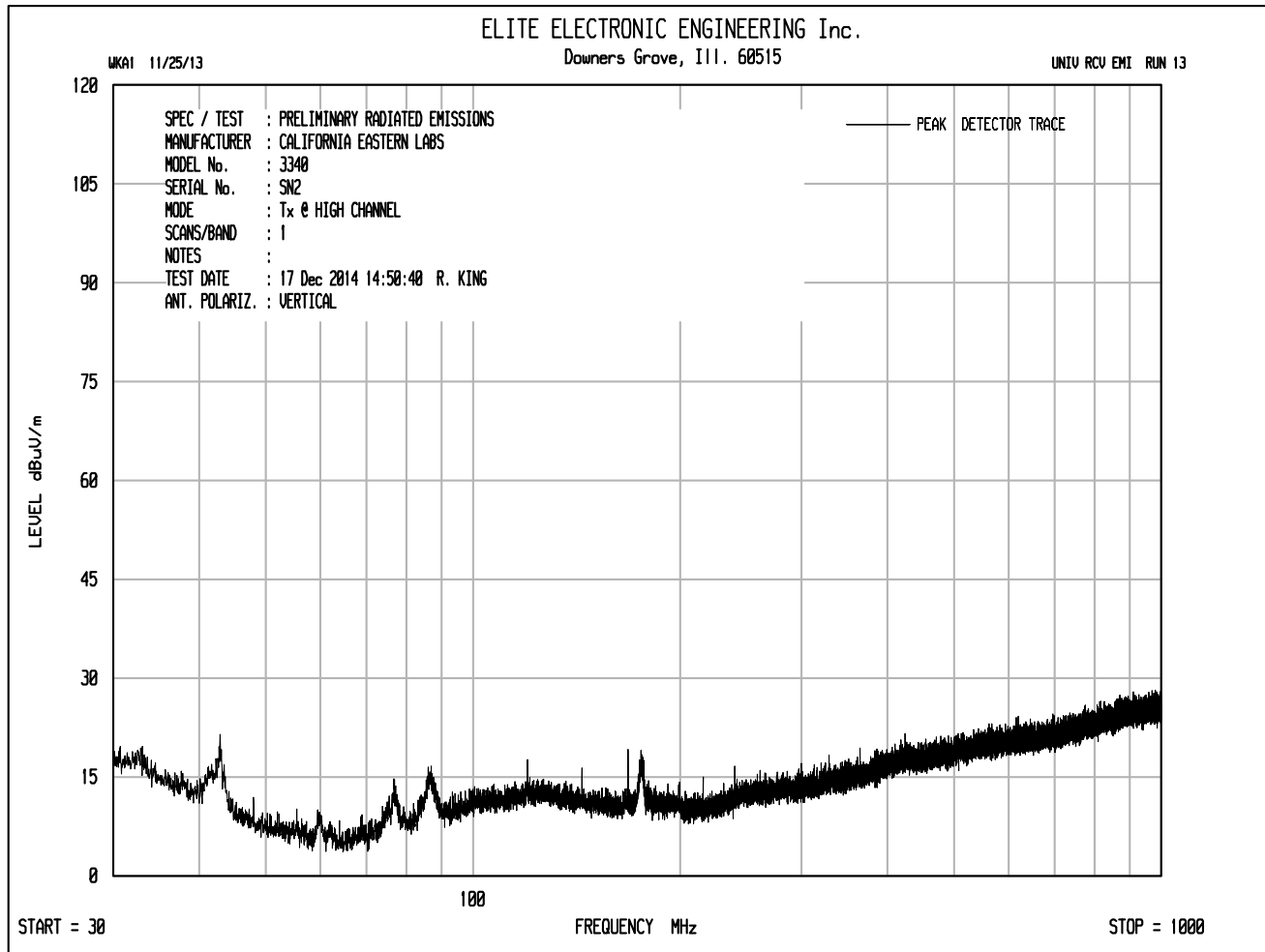


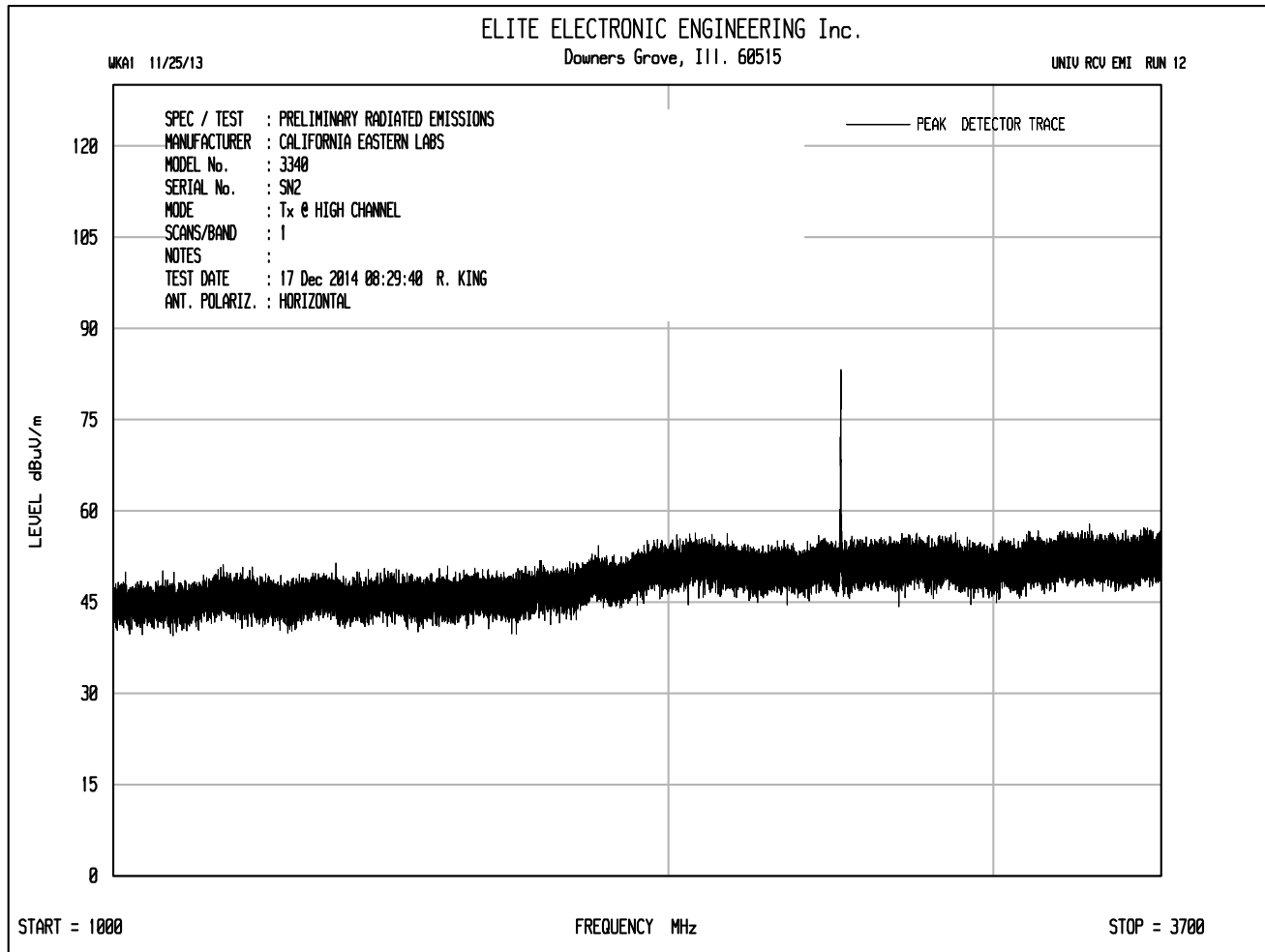


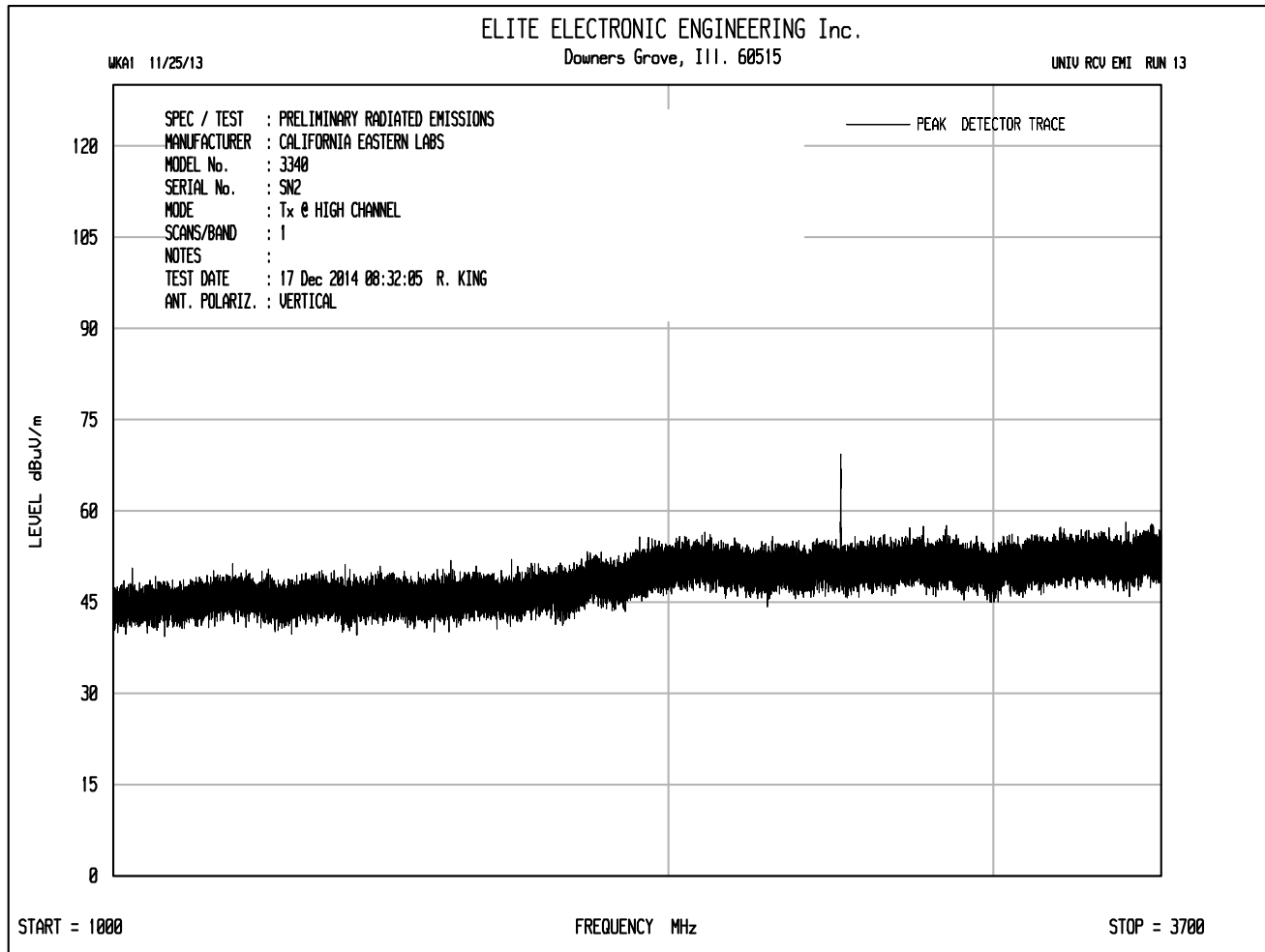


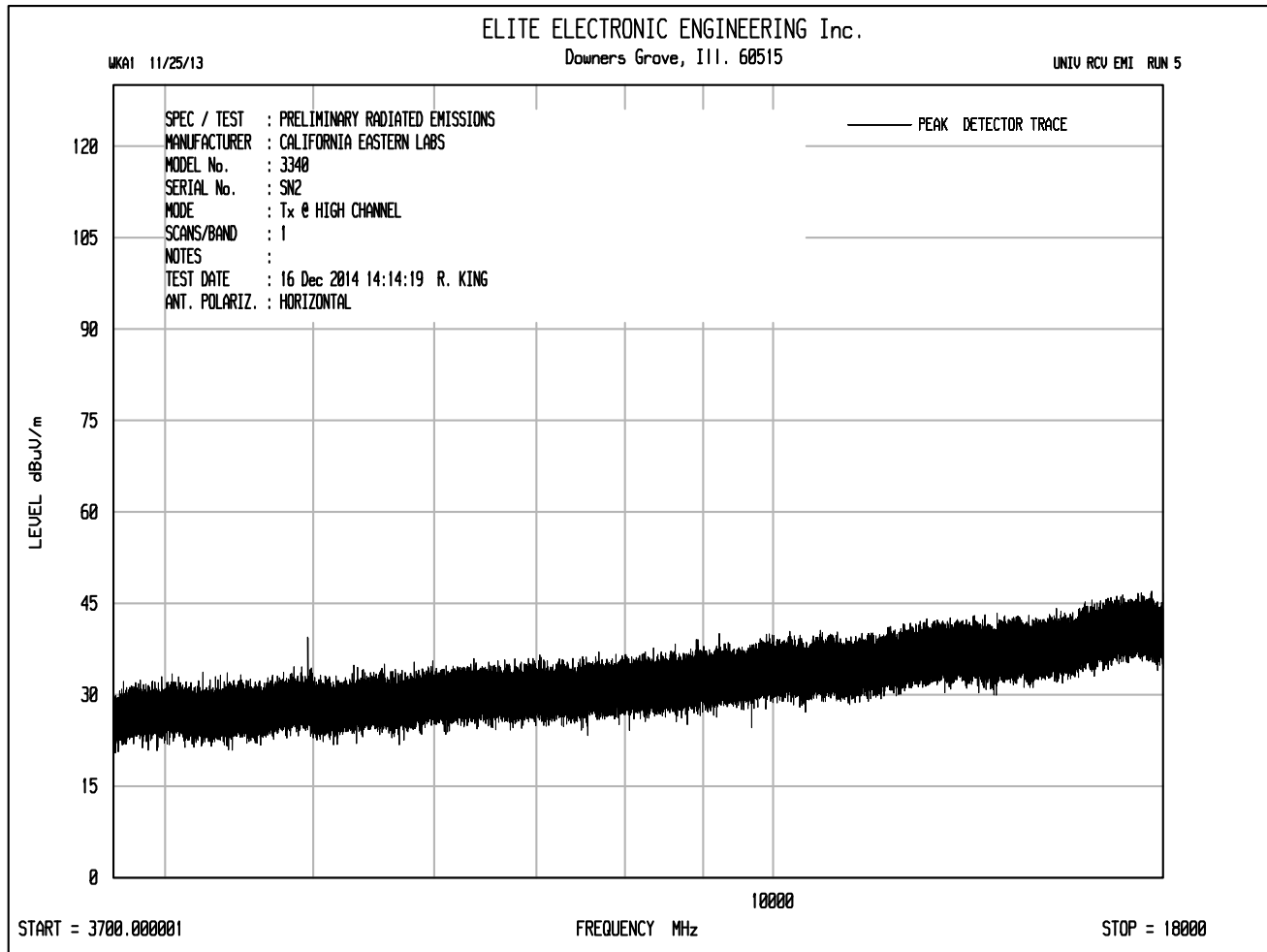


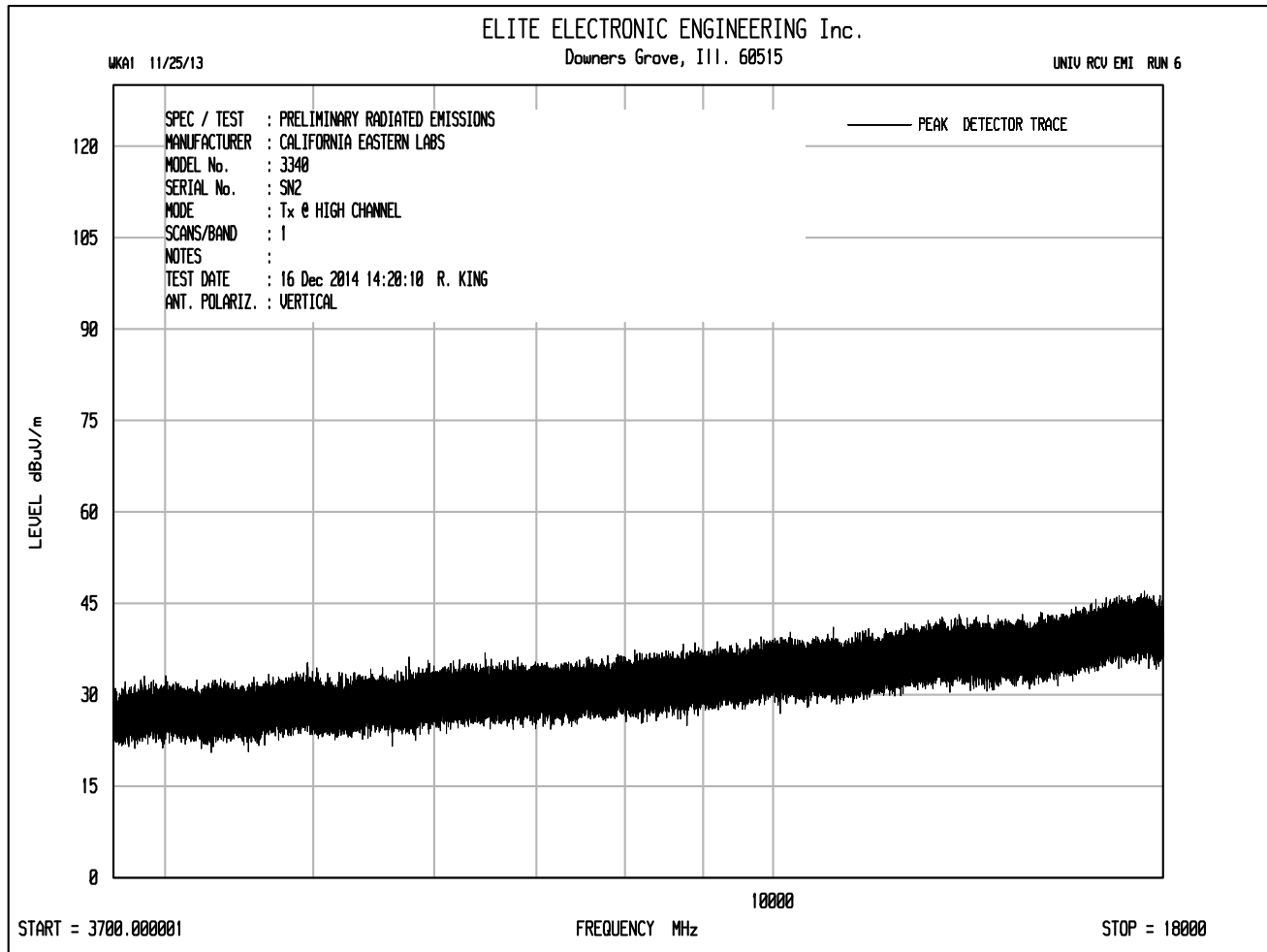


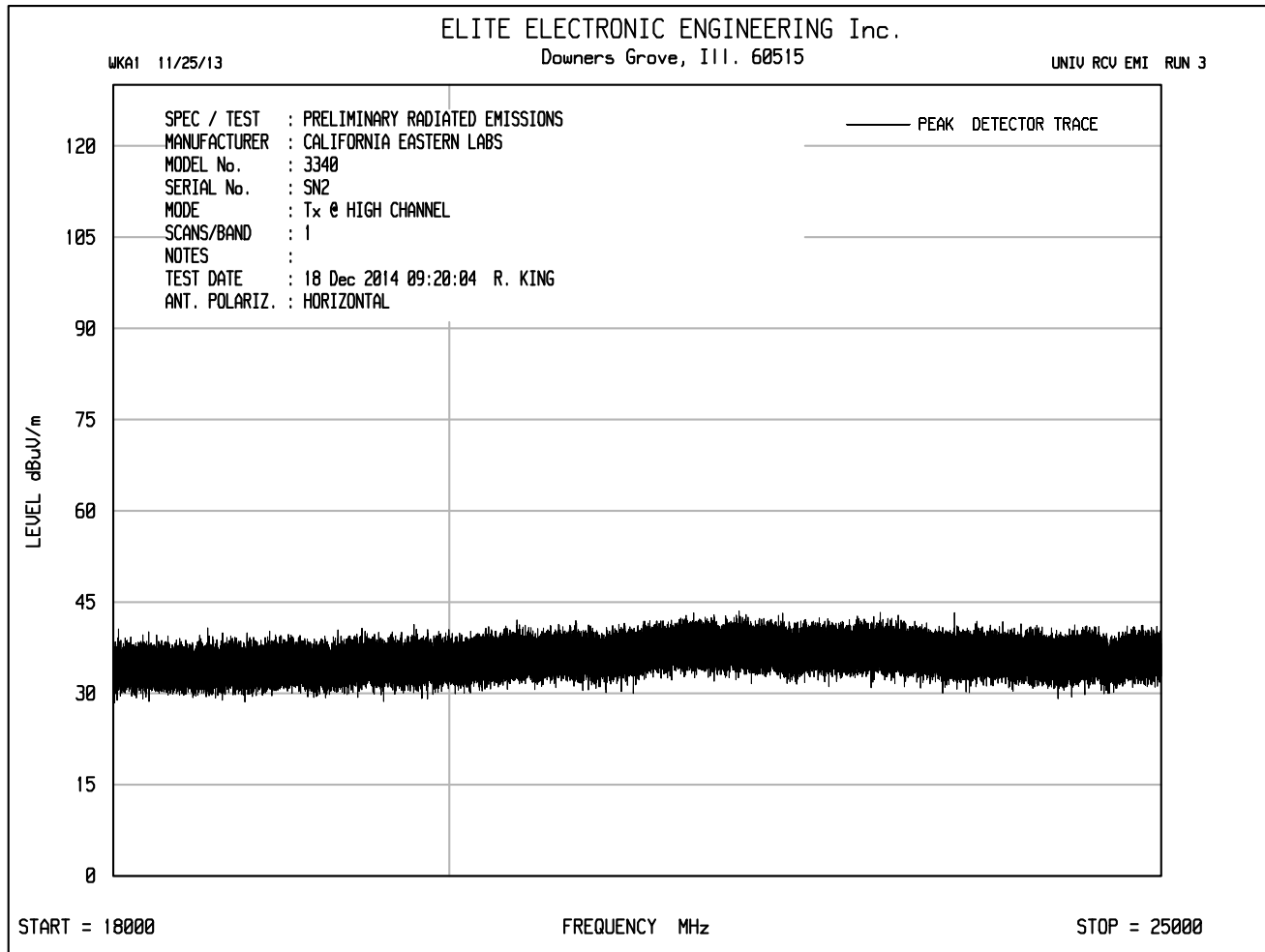


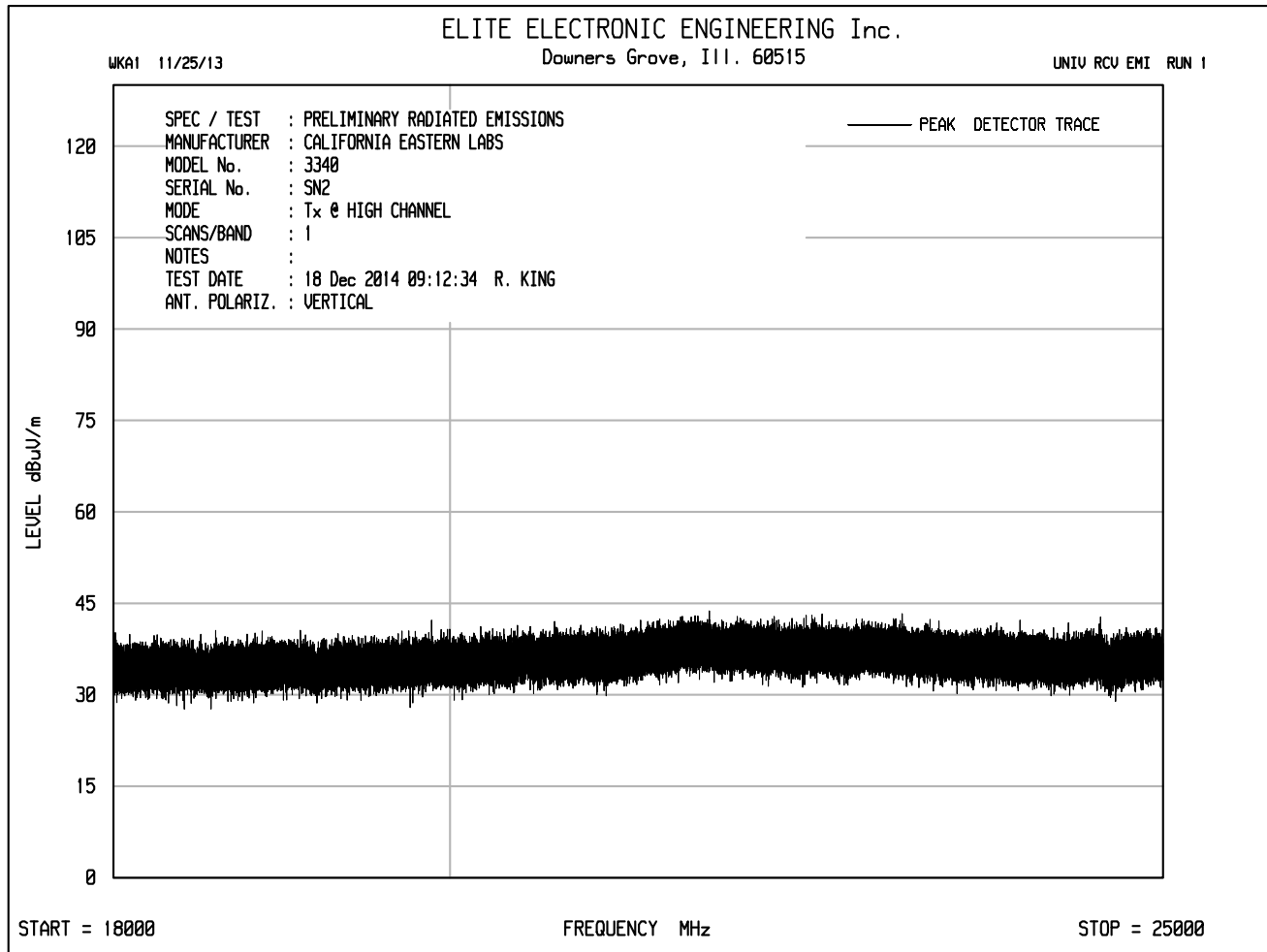














Manufacturer : California Eastern Labs
Test Item : Zigbee Transceiver
Model No. : 3340
Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Emissions
Date : Dec. 18 and 19, 2014
Mode : Transmit @ 2405MHz
Test Distance : 3 meters
Notes : Peak Measurement

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

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Total dBuV/m at 3 M	Total uV/m at 3M	Limit uV/m at 3M	Margin (dB)
4810.00	H	57.3	4.8	34.4	-40.1	56.3	656.1	5000.0	-17.6
4810.00	V	56.5	4.8	34.4	-40.1	55.5	597.7	5000.0	-18.4
12025.00	H	45.4	8.0	39.0	-39.7	52.7	429.2	5000.0	-21.3
12025.00	V	46.2	8.0	39.0	-39.7	53.5	474.9	5000.0	-20.4
19240.00	H	33.9	2.2	40.4	-28.0	48.5	266.4	5000.0	-25.5
19240.00	V	32.7	2.2	40.4	-28.0	47.3	232.0	5000.0	-26.7

Checked BY RICHARD E. KING :

Richard E. King



Manufacturer : California Eastern Labs
Test Item : Zigbee Transceiver
Model No. : 3340
Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Emissions
Date : Dec. 18 and 19, 2014
Mode : Transmit @ 2405MHz
Test Distance : 3 meters
Notes : Average Measurement

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

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Total dBuV/m at 3 M	Total uV/m at 3M	Limit uV/m at 3M	Margin (dB)
4810.00	H	50.0	4.8	34.4	-40.1	49.1	284.4	500.0	-4.9
4810.00	V	49.5	4.8	34.4	-40.1	48.6	268.5	500.0	-5.4
12025.00	H	32.3	8.0	39.0	-39.7	39.6	95.9	500.0	-14.3
12025.00	V	32.4	8.0	39.0	-39.7	39.7	96.2	500.0	-14.3
19240.00	H	21.0	2.2	40.4	-28.0	35.6	60.4	500.0	-18.4
19240.00	V	20.8	2.2	40.4	-28.0	35.4	58.9	500.0	-18.6

Checked BY Richard E. King :

Richard E. King



Manufacturer : California Eastern Labs

Test Item : Zigbee Transceiver
Model No. : 3340
Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Emissions
Date : Dec. 18 and 19, 2014
Mode : Transmit @ 2440MHz
Test Distance : 3 meters
Notes : Peak Measurement

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

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Total dBuV/m at 3 M	Total uV/m at 3M	Limit uV/m at 3M	Margin (dB)
4880.00	H	56.1	4.9	34.4	-40.2	55.2	576.8	5000.0	-18.8
4880.00	V	55.7	4.9	34.4	-40.2	54.8	550.8	5000.0	-19.2
7320.00	H	51.0	6.2	35.4	-39.8	52.7	433.7	5000.0	-21.2
7320.00	V	49.2	6.2	35.4	-39.8	50.9	352.5	5000.0	-23.0
12200.00	H	44.3	8.0	39.0	-39.5	51.8	387.8	5000.0	-22.2
12200.00	V	45.5	8.0	39.0	-39.5	53.0	444.7	5000.0	-21.0
19520.00	H	33.9	2.2	40.4	-27.8	48.7	271.3	5000.0	-25.3
19520.00	V	32.7	2.2	40.4	-27.8	47.5	236.3	5000.0	-26.5

Checked BY RICHARD E. KING :

Richard E. King



Manufacturer : California Eastern Labs
Test Item : Zigbee Transceiver
Model No. : 3340
Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Emissions
Date : Dec. 18 and 19, 2014
Mode : Transmit @ 2440MHz
Test Distance : 3 meters
Notes : Average Measurement

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

Freq (MHz)	Ant Pol	Meter Reading (dBUV)	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Total dBuV/m at 3 M	Total uV/m at 3M	Limit uV/m at 3M	Margin (dB)
4880.00	H	48.3	4.9	34.4	-40.2	47.4	235.0	500.0	-6.6
4880.00	V	47.5	4.9	34.4	-40.2	46.7	215.5	500.0	-7.3
7320.00	H	40.96	6.2	35.4	-39.8	42.7	137.1	500.0	-11.2
7320.00	V	39.3	6.2	35.4	-39.8	41.0	112.8	500.0	-12.9
12200.00	H	32.4	8.0	39.0	-39.5	39.9	98.9	500.0	-14.1
12200.00	V	32.4	8.0	39.0	-39.5	39.9	99.0	500.0	-14.1
19520.00	H	21.0	2.2	40.4	-27.8	35.8	61.5	500.0	-18.2
19520.00	V	20.8	2.2	40.4	-27.8	35.6	60.0	500.0	-18.4

Checked BY Richard E. King :

Richard E. King



Manufacturer : California Eastern Labs

Test Item : Zigbee Transceiver
 Model No. : 3340
 Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Emissions
 Date : Dec. 18 and 19, 2014
 Mode : Transmit @ 2480MHz
 Test Distance : 3 meters
 Notes : Peak Measurement

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

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Total dBuV/m at 3 M	Total uV/m at 3M	Limit uV/m at 3M	Margin (dB)
4960.00	H	49.4	4.9	34.5	-40.2	48.6	269.7	5000.0	-25.4
4960.00	V	47.9	4.9	34.5	-40.2	47.1	225.8	5000.0	-26.9
7440.00	H	44.5	6.2	35.5	-39.8	46.4	208.6	5000.0	-27.6
7440.00	V	43.4	6.2	35.5	-39.8	45.3	184.0	5000.0	-28.7
12400.00	H	44.6	8.0	38.9	-39.3	52.2	408.0	5000.0	-21.8
12400.00	V	44.6	8.0	38.9	-39.3	52.2	408.0	5000.0	-21.8
19840.00	H	33.9	2.2	40.4	-27.7	48.8	276.9	5000.0	-25.1
19840.00	V	32.7	2.2	40.4	-27.7	47.6	241.2	5000.0	-26.3
22320.00	H	34.5	2.2	40.6	-28.5	48.8	275.2	5000.0	-25.2
22320.00	V	34.7	2.2	40.6	-28.5	49.0	281.7	5000.0	-25.0

Checked BY Richard E. King :

Richard E. King



Manufacturer : California Eastern Labs
Test Item : Zigbee Transceiver
Model No. : 3340
Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Emissions
Date : Dec. 18 and 19, 2014
Mode : Transmit @ 2480MHz
Test Distance : 3 meters
Notes : Average Measurement

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

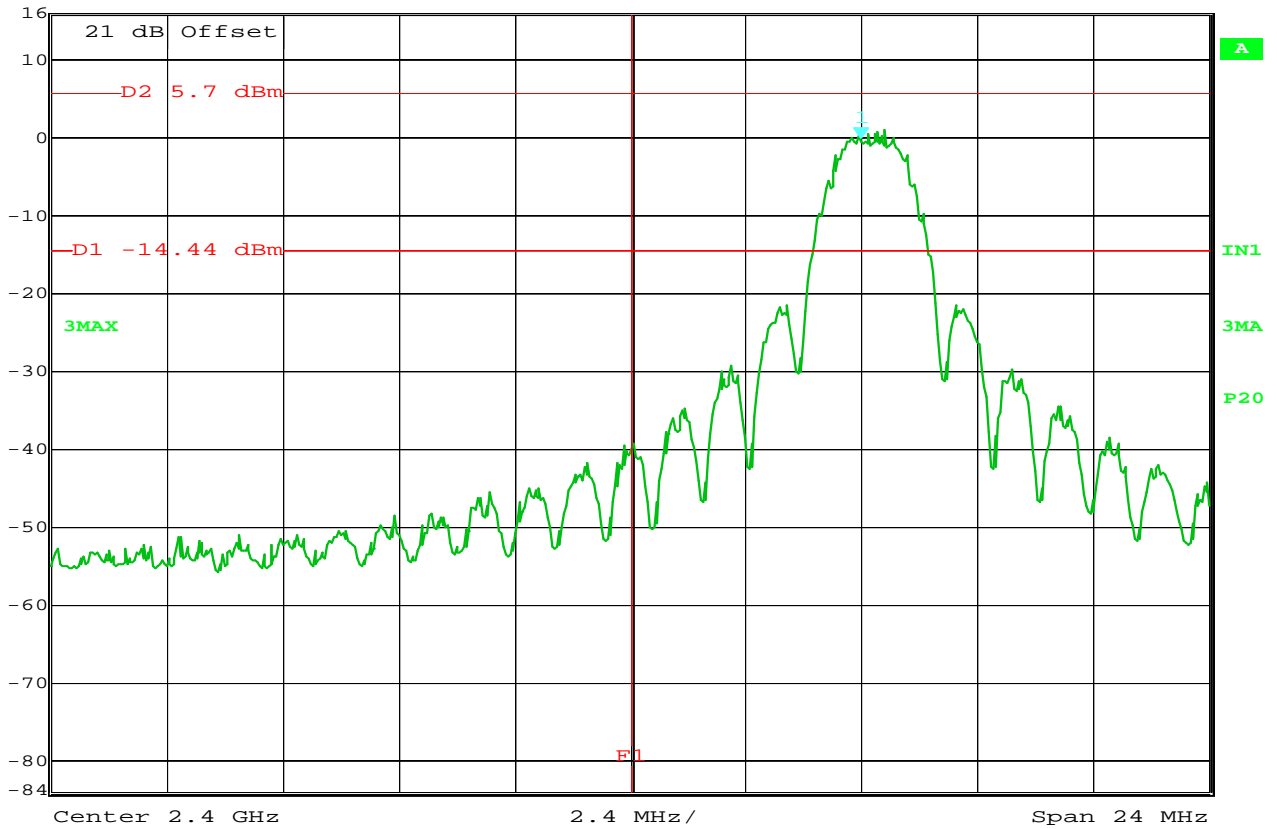
Freq (MHz)	Ant Pol	Meter Reading (dBuV)	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Total dBuV/m at 3M	Total uV/m at 3M	Limit uV/m at 3M	Margin (dB)
4960.0	H	29.5	5.8	34.5	-37.3	32.5	42.1	500.0	-21.5
4960.0	V	29.5	5.8	34.5	-37.3	32.5	42.1	500.0	-21.5
7440.0	H	30.7	7.7	38.1	-37.5	39.0	89.1	500.0	-15.0
7440.0	V	30.7	7.7	38.1	-37.5	39.0	89.1	500.0	-15.0
12400.0	H	33.9	9.9	41.3	-36.9	48.3	259.6	500.0	-5.7
12400.0	V	33.8	9.9	41.3	-36.9	48.2	256.7	500.0	-5.8
19840.0	H	34.1	2.2	40.4	-36.8	40.0	99.5	500.0	-14.0
19840.0	V	34.1	2.2	40.4	-36.8	40.0	99.5	500.0	-14.0
22320.0	H	35.2	2.2	40.6	-27.1	50.9	352.2	500.0	-3.0
22320.0	V	35.2	2.2	40.6	-27.1	50.9	352.2	500.0	-3.0

Checked BY Richard E. King :

Richard E. King



Marker 1 [T3] RBW 100 kHz RF Att 30 dB
 -0.03 dBm VBW 1 MHz
 2.40478557 GHz SWT 20 ms Unit dBm
 Ref Lvl 16 dBm



Date: 2.JAN.2015 14:56:46

FCC 15.247 Bandedge Compliance

MANUFACTURER : California Eastern Labs
 MODEL NUMBER : 3340
 TEST MODE : Tx @ 2405MHz modulated
 : PEAK detector
 NOTES : D2 Represents the max output power measurement
 : D1 Represents the -20 dBc point from the Max Output Power
 : F1 Represent the Bandedge at 2400MHz

NOTES



Manufacturer : California Eastern Labs
Test Item : Zigbee Transceiver
Model No. : 3340
Serial No. : SN2
Test Specification : FCC Part 15, Subpart C, Section 15.247, Band-edge compliance
Date : Dec. 18, 2014
Mode : Transmit @ 2480MHz
Test Distance : 3 meters
Notes : none

Frequency MHz	Antenna Polarity	Meter Reading dBuV	Cable Loss dB	Antenna Factor dB	Total dBuV/m	Total uV/m	Limit uV/m
2483.50	H	17.9	3.5	32.4	53.8	487.6	500.0
2483.50	V	16.8	3.5	32.4	52.7	429.6	500.0

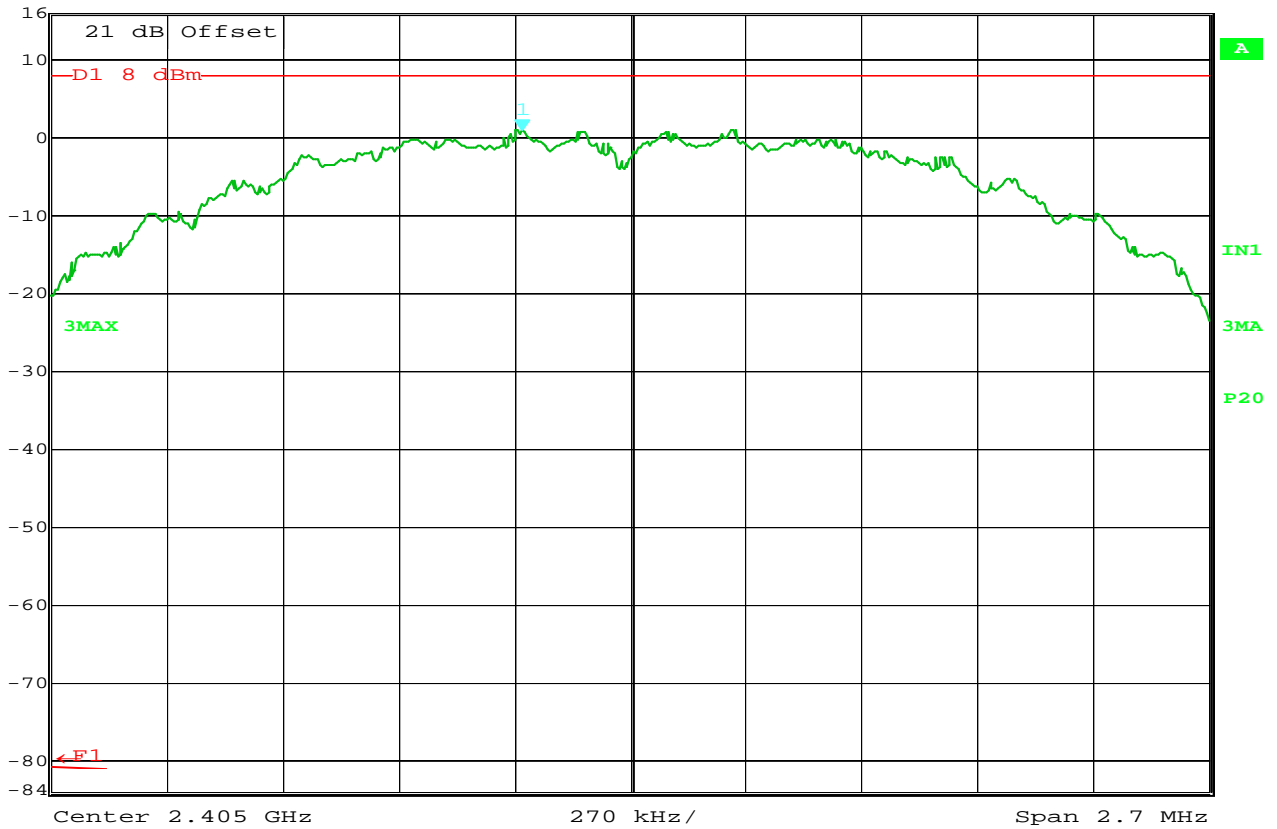
Total = Meter Reading + Cable Loss + Antenna Factor

Checked BY Richard E. King :

Richard E. King



Marker 1 [T3] RBW 100 kHz RF Att 30 dB
 Ref Lvl 0.77 dBm VBW 1 MHz
 16 dBm 2.40474840 GHz SWT 5 ms Unit dBm



Date: 2.JAN.2015 15:11:32

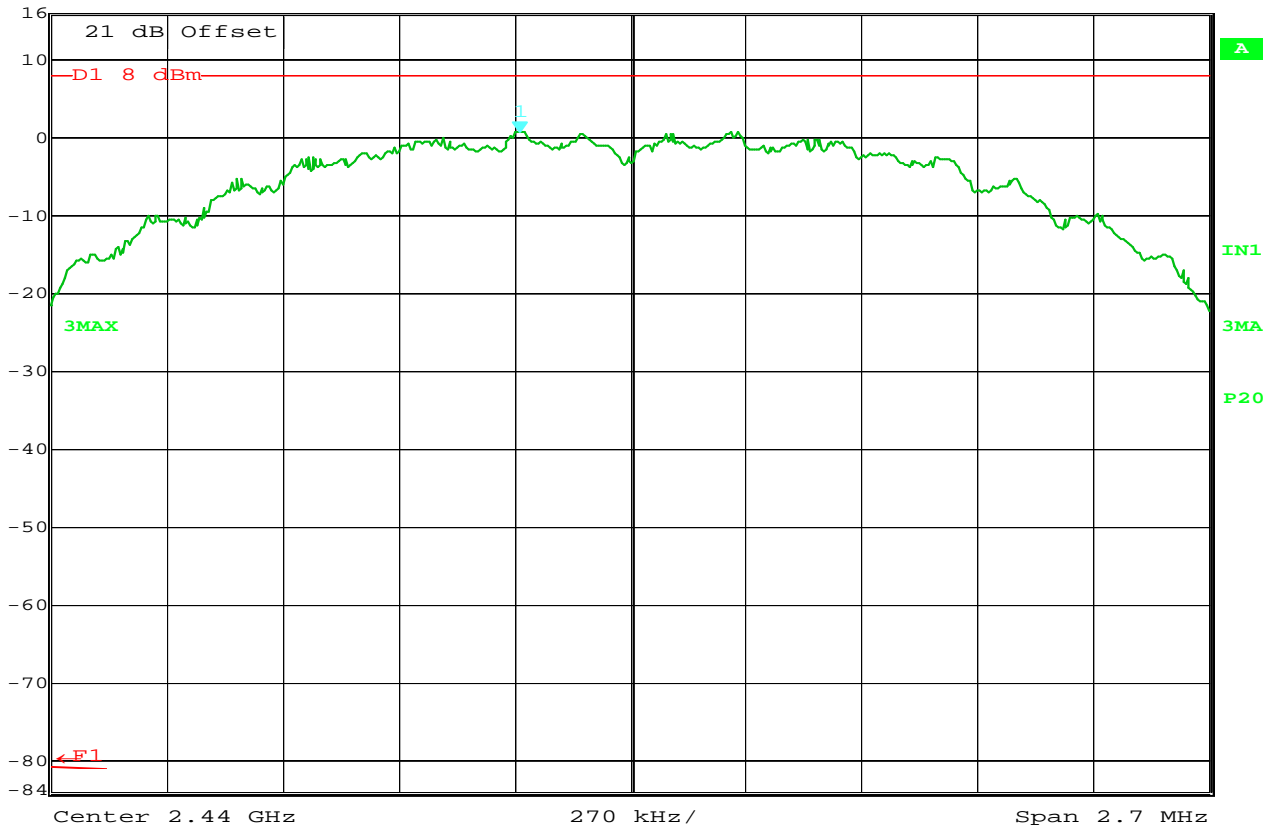
FCC 15.247 Power Spectral Density

MANUFACTURER : California Eastern Labs
 MODEL NUMBER : 3340
 TEST MODE : Tx @ 2405MHz modulated
 : PEAK detector
 NOTES : D1 Represents the 8dBm Limit
 :

NOTES



Marker 1 [T3] RBW 100 kHz RF Att 30 dB
 Ref Lvl 0.68 dBm VBW 1 MHz
 16 dBm 2.43974299 GHz SWT 5 ms Unit dBm



Date: 2.JAN.2015 15:14:11

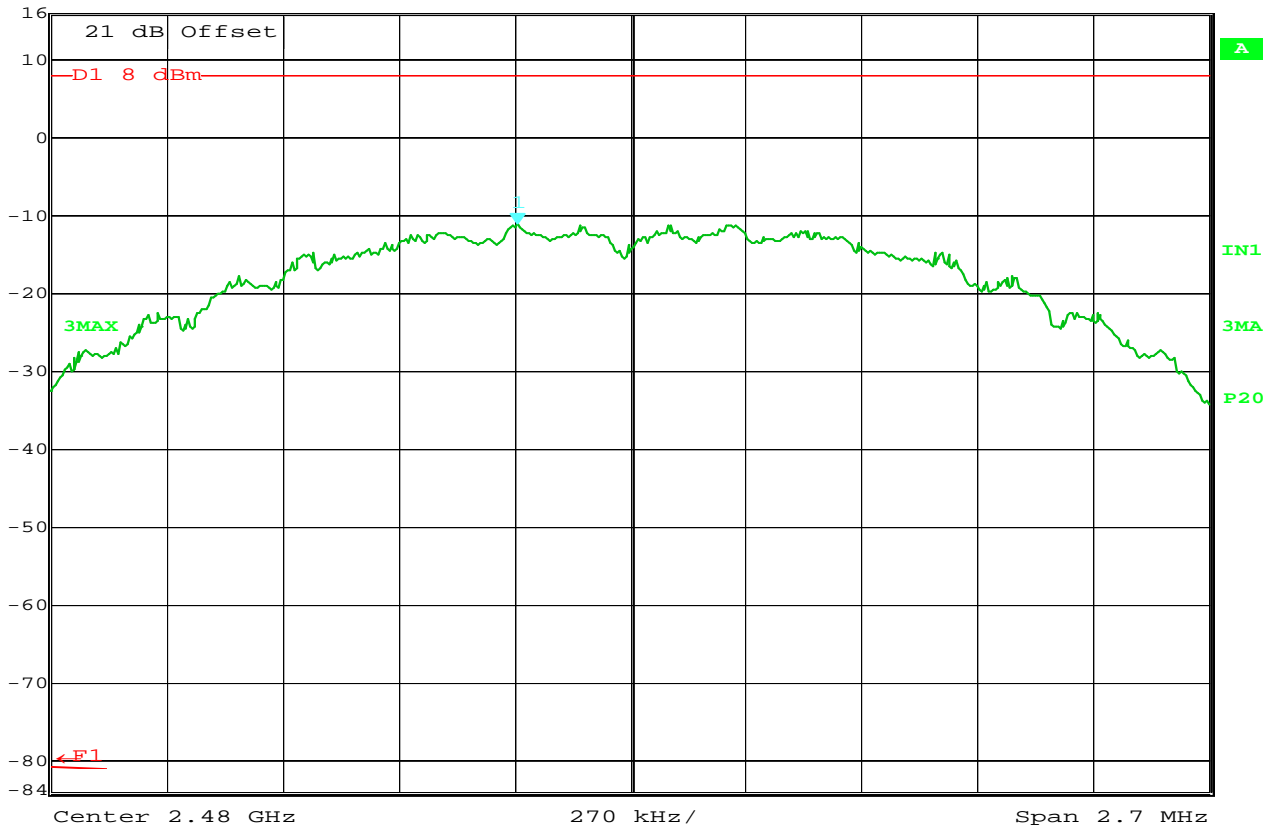
FCC 15.247 Power Spectral Density

MANUFACTURER : California Eastern Labs
 MODEL NUMBER : 3340
 TEST MODE : Tx @ 2440MHz modulated
 : PEAK detector
 NOTES : D1 Represents the 8dBm Limit
 :

NOTES



Marker 1 [T3] RBW 100 kHz RF Att 30 dB
 Ref Lvl -11.20 dBm VBW 1 MHz
 16 dBm 2.47973758 GHz SWT 5 ms Unit dBm



Date: 2.JAN.2015 15:15:27

FCC 15.247 Power Spectral Density

MANUFACTURER : California Eastern Labs
 MODEL NUMBER : 3340
 TEST MODE : Tx @ 2480MHz modulated
 : PEAK detector
 NOTES : D1 Represents the 8dBm Limit
 :

NOTES