



Measurement of RF Interference from an Model No. ZICM2410P2 Zigbee Transmitter

For : California Eastern Labs
: 1253 N. Old Rand Road
: Wauconda, IL

P.O. No. : 173960
Date Tested : June 24 – 25, 2010
Test Personnel : Richard E King
Specification : FCC "Code of Federal Regulations" Title 47, Part 15,
Subpart B and Subpart C, Section 15.247 for Digital
Transmission Systems Operating within The band 2400-
2483.5MHz
Industry Canada RSS-210
Industry Canada RSS-GEN

Richard E. King

Test Report By :
Richard E King
EMC Test Engineer

Witnessed By : Dave Wilde
California Eastern Labs

Craig W. Fanning

Approved By :
Craig W. Fanning
EMC Lab Manager
iNARTE® Certified: EMC-000296-NT
and ATL-0188-E

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REVISION HISTORY

Revision	Date	Description
—	1 July 2010	Initial release

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Measurement of RF Emissions from a Zigbee Transmitter, Model No. ZICM2410P2

1 INTRODUCTION

1.1 Scope of Tests

This document represents the results of the series of radio interference measurements performed on a Zigbee Transmitter, Model No. ZICM2410P2 (hereinafter referred to as the test item). Serial No 853-ES3-X3 or 856-ES3-X3. The test item was designed to transmit and receive in the 2405MHz to 2480MHz band using an internal antenna. The test item transmitted using digital transmission system techniques. The test item 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 test item continues to meet the conducted and radiated RF emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections 15.207 and 15.247 for Intentional Radiators operating within the 2400-2483.5MHz band. Testing was performed in accordance with ANSI C63.4-2003. Testing was limited to the transmitter operation of the test item due to a change in the test items voltage regulator to the power amplifier component.

1.3 Deviations, Additions and Exclusions

There were no deviations, additions to, or exclusions from the test specification during this test series

1.4 EMC Laboratory Identification

This series of tests was performed by Elite Electronic Engineering Incorporated of Downers Grove, Illinois. The laboratory is accredited by the National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP). NVLAP Lab Code: 100278-0.

1.5 Laboratory Conditions

The temperature at the time of the test was 23°C and the relative humidity was 35%.

2 APPLICABLE DOCUMENTS

The following documents of the exact issue designated form part of this document to the extent specified herein:

- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 15, Subpart C, dated 1 October 2009.
- ANSI C63.4-2003, "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz".
- Industry Canada RSS-210, Issue 7, September 2007, "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 2, September 2007, "Spectrum Management and Telecommunications Radio Standards Specification, General Requirements and Information for the Certification of radio communication equipment".
- Public Notice 558074, "New Guidance on Measurements for Digital Transmission Systems in 15.247".
- Public Notice DA 00-705, "Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems".

3 TEST ITEM SET-UP AND OPERATION

3.1 General Description

The test item is a Zigbee Transmitter, Model No. ZICM2410P2, Serial number 853-ES3-X3 or 856-ES3-X3. A block diagram of the test item set-up is shown as Figure 1. A photograph of the test item is shown as Figure 2.

3.1.1 Power Input

The test item was powered with 3.2VDC through a 2 meter long, 2 wire unshielded power lead. The high and low leads of the input power were connected through a line impedance stabilization network (LISN) which was located on the ground plane. The network complies with the requirements of Paragraph 4.1.2 of ANSI C63.4-2001.

3.1.2 Peripheral Equipment

The test item was submitted with a twelve inch test harness connected to a test board, the test board was connected to an Acer Aspire laptop. The test board and laptop were used for programming the transceiver only and was disconnected for testing.

3.1.3 Interconnect Cables

The test item does not require or utilize interconnect cables to operate.

3.1.4 Grounding

The test item was grounded only through the return lead of the input power.

3.2 Operational Mode

The output power, 6dB bandwidth and spectral density tests were performed on a unit modified with an antenna port. All remaining tests were performed with the antenna port removed. For all tests, the test item was placed on an 80cm high non-conductive stand. The test item was energized.

For radiated emissions tests, the test item was programmed to operate in one of the following modes:

- transmit @ 2405MHz
- transmit @ 2440MHz
- transmit @ 2480MHz

3.3 Test Item Modifications

No modifications were required for compliance to the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections 15.207 and 15.247 requirements.

4 TEST FACILITY AND TEST INSTRUMENTATION

4.1 Shielded Enclosure

All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. With the exception of the floor, the reflective surfaces of the shielded chamber are lined with ferrite tiles on the walls and ceiling. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4-2003 for site attenuation.

4.2 Test Instrumentation

The test instrumentation and auxiliary equipment used during the tests are listed in Table 9-1 Equipment List. All equipment was calibrated per the instruction manuals supplied by the manufacturer.

Conducted emission tests were performed with a spectrum analyzer in conjunction with a quasi-peak adapter. Radiated emissions were performed with a spectrum analyzer. This receiver allows measurements with the bandwidths detector functions specified by the FCC.

4.3 Calibration Traceability

Test equipment is maintained and calibrated on a regular basis. All calibrations are traceable to the National Institute of Standards and Technology (NIST).

4.4 Measurement Uncertainty

All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system.

The measurement uncertainty for these tests is presented below:

Conducted Emission Measurements		
Combined Standard Uncertainty	1.07	-1.07
Expanded Uncertainty (95% confidence)	2.1	-2.1
Radiated Emission Measurements		
Combined Standard Uncertainty	2.26	-2.18
Expanded Uncertainty (95% confidence)	4.5	-4.4

5 TEST PROCEDURES

5.1 Powerline Conducted Emissions

5.1.1 Transmitter

5.1.1.1 Requirements

All radio frequency voltages on the power lines of an intentional radiator shall be below the values shown below when using a quasi-peak or average detector:

CONDUCTED LIMITS FOR AN INTENTIONAL RADIATOR

Frequency MHz	RFI Voltage dBuV(QP)	RFI Voltage dBuV(Average)
0.15-0.5	66 decreasing with logarithm of frequency to 56	56 decreasing with logarithm of frequency to 46
0.5 – 5.0	56	46
5.0 – 30.0	60	50

Note 1: The lower limit shall apply at the transition frequencies.

Note 2: If the levels measured using the QP detector meet both the QP and the Average limits, the test item is considered to have met both requirements and measurements do not need to be performed using the Average detector.

5.1.1.2 Procedures

The interference on each power lead was measured by connecting the measuring equipment to the appropriate meter terminal of the LISN. The meter terminal of the LISN not under test was terminated with 50 ohms. Measurements were first made over the entire frequency range from 150kHz through 30MHz with a peak detector and the results were automatically plotted. The data thus obtained was then searched by the computer for the highest levels. Quasi-peak measurements were automatically performed at the frequencies selected from the highest peak measurements, and the results printed.

5.1.1.3 Results

The plots of the peak preliminary conducted voltage levels on each power line, with the test item transmitting at 2440MHz are presented on pages 18 and 19. The conducted emissions limits are shown as a reference. The final quasi-peak and average results are presented on pages 20 and 21. As can be seen from the data, all emissions measured from the test item were within the specification limits. Photographs of the test set-up are shown in Figure 3.

5.2 Radiated Measurements

5.2.1 Transmitter

5.2.1.1 Requirements

Per section 15.247(d), in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated emissions measurement. Attenuation below the general limits specified in §15.209(a) is not required. In addition, 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

5.2.1.2 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 test item. For the preliminary test, a broadband measuring antenna was positioned at a 3 meter distance from the test item. The entire frequency range from 30MHz to 25GHz 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.

- 1) For all harmonics not in the restricted bands, the following procedure was used:
 - a) The field strength of the fundamental was measured using a double-ridged waveguide antenna. The double-ridged waveguide antenna was positioned at a 3 meter distance from the test item. A peak detector with a resolution bandwidth of 100kHz was used on the spectrum analyzer.
 - b) The field strength of all of the harmonics not in the restricted band were then measured using a double-ridged waveguide antenna. The waveguide antenna was positioned at a 3 meter distance from the test item. A peak detector with a resolution bandwidth of 100kHz was used on the spectrum analyzer.
 - c) To ensure that maximum or worst case emission levels were measured, the following steps were taken when measuring the fundamental emissions and the spurious emissions:
 - i) The test item 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.
 - d) All harmonics not in the restricted bands must be at least 20dB below level measured at the fundamental. However, attenuation below the general limits specified in §15.209(a) is not required.
- 2) For all emissions in the restricted bands, the following procedure was used:
 - a) The field strength of all emissions below 1GHz was measured using a bi-log antenna. The bi-log antenna was positioned at a 3 meter distance from the test item. A peak detector with a resolution bandwidth of 100kHz was used on the spectrum analyzer.
 - b) The field strength of all emissions above 1GHz was measured using a double-ridged waveguide antenna. The waveguide antenna was positioned at a 3 meter distance from the test item. A peak detector with a resolution bandwidth of 1MHz 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 test item 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.
 - d) For all radiated emissions measurements below 1GHz, 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 re-measured using a quasi-peak detector.
 - e) For all radiated emissions measurements above 1GHz, measurements were taken using a 1MHz resolution bandwidth and a 10Hz video bandwidth. For pulsed emissions, these readings were corrected to average levels using a duty cycle factor which was computed from the pulse train. All average levels must comply with the limits specified in 15.209(a).

5.2.1.3 Results

Preliminary radiated emissions plots with the test item transmitting are shown on pages 22 through 45. The final radiated emissions data is presented on data pages 46 through 51. As can be seen from the data, all emissions measured from the test item were within the specification limits. Photographs of the test are shown on Figure 4.

5.3 6dB Bandwidth and 99% Bandwidth

5.3.1 Requirements

Per 15.247(a) (2), for systems using digital modulation in the 2400-2483.5MHz band, the minimum 6dB bandwidth shall be at least 500kHz.

5.3.2 Procedures

- a) The test item was connected to the receiver through 50 dB of attenuation. With the modulation enabled, and the data rate set to 250kHz the test item was allowed to transmit continuously at 2405MHz.
- b) The center frequency of the spectrum analyzer was set to the transmit frequency of the test item. The resolution bandwidth on the analyzer was set to 100kHz.
- c) The 'Max-Hold' function of the spectrum analyzer was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined.
- d) The marker-to-peak function of the analyzer was used to set the marker to the peak of the emission. The marker-delta function was used to measure 6dB down point from the peak of the emission. The marker-delta function was reset and the marker was moved to the other side of the emission until it is even with the reference marker level. The marker-delta reading at this point is the 6dB bandwidth.
- e) The analyzer's display was plotted using a 'screen dump' utility.
- f) The resolution bandwidth was then reduced to 30kHz.
- g) The 'Max-Hold' function of the spectrum analyzer was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined. The 99% bandwidth function of the spectrum analyzer was then used to measure the 99% bandwidth. The measurement was recorded.
- h) Steps (a) through (h) were repeated with the test item transmitting at the 500kHz data rate.
- i) Steps (a) through (h) were repeated with the test item transmitting at the 1MBps data rate.
- j) Steps (a) through (i) were repeated with the test item transmitting at 2440MHz.
- k) Steps (a) through (i) were repeated with the test item transmitting at 2480MHz.

5.3.3 Results

The plots of the 6dB bandwidth, with the test item transmitting in both high power and low power are shown on pages 52 through 60. As can be seen from the plots, the minimum 6dB bandwidth measured was 1.52MHz which is greater than the minimum required 6dB bandwidth of 500kHz. The 99% bandwidth was measured to be 3.10MHz.

5.4 Peak Output Power

5.4.1 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).

5.4.2 Procedures

- a) With the transmitter set to CW, the test item was allowed to transmit continuously at 2405MHz.
- b) The test item was connected to the receiver through 50 dB of attenuation. The output power was measured and recorded.
- c) With the modulation enabled, the test item was allowed to transmit continuously at 2405MHz.

- d) A double-ridged waveguide antenna was positioned at a 3 meter distance from the test item. The output of the double-ridged waveguide antenna was connected to a spectrum analyzer.
- e) The center frequency of the spectrum analyzer was set to the transmit frequency of the test item. The resolution bandwidth on the analyzer was set to 3MHz (greater than the 6dB bandwidth of the test item).
- f) The test item was maximized for worst case emissions (or maximum output power) at the measuring antenna. The maximum meter reading was recorded.
- g) The equivalent isotropic power was determined from the field intensity levels measured at 3 meters using substitution method. To determine the emission power, a second double ridged waveguide antenna was then set in place of the test item 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, as required.
- h) Steps (a) through (e) were repeated with the test item transmitting at 2440MHz.
- i) Steps (a) through (e) were repeated with the test item transmitting at 2480MHz.

5.4.3 Results

The results are presented on pages 61 and 62. The maximum conducted output power measured from the transmitter was 20.29dBm or 0.107W which is below the 1 Watt or 30dBm limit. The maximum EIRP measured from the transmitter was 20.9dBm or 0.123W which is below the 4 Watt or 36 dBm defacto limit.

5.5 Power Spectral Density

5.5.1 Requirements

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

5.5.2 Procedures

- a) The test item was connected to the receiver through 50 dB of attenuation.
- b) With the modulation enabled, and the data rate set to 250kHz, the test item was allowed to transmit continuously at 2405MHz.
- c) The center frequency of the spectrum analyzer was set to the transmit frequency of the test item. The resolution bandwidth on the analyzer was set to 3MHz (greater than the 6dB bandwidth of the test item).
- d) The display line on the spectrum analyzer was set. (This level represents the 8.0dBm power spectral density level.) The resolution bandwidth (RBW) was set to 3kHz, the sweep time was set to a time equal to or greater than the span divided by 3kHz (4 MHz/3kHz = 1333 seconds). The peak detector and 'Max-Hold' function was engaged.
- e) The analyzer's display was plotted using a 'screen dump' utility.
- l) Steps (a) through (e) were repeated with the test item transmitting at the 500kHz data rate.
- m) Steps (a) through (e) were repeated with the test item transmitting at the 1MBps data rate.

5.5.3 Results

Data pages 63 through 65 show the power spectral density results. As can be seen from this plot, the power spectral density is less than 8dBm in a 3kHz band during any time interval of continuous transmission.

5.6 Band-edge Compliance

5.6.1 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. In addition, the radiated emissions which fall in the restricted band beginning at 2483.5 MHz must meet the general limits of 15.209(a).

5.6.2 Procedures

- a) The test item was set up inside the test chamber on a non-conductive stand.
- b) A broadband measuring antenna was placed at a test distance of 3 meters from the test item.
- c) The test item was set to transmit continuously at the channel closest to the low band-edge.
- d) The test item was maximized for worst case emissions at the measuring antenna. The maximum meter reading was recorded.
- e) To determine the band-edge compliance, the following spectrum analyzer settings were used:
 - i. 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.
 - ii. Resolution bandwidth (RBW) = 100kHz.
 - iii. The 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined.
 - iv. 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.)
 - v. The analyzer's display was plotted using a 'screen dump' utility.
- f) The test item was set to transmit continuously at the channel closest to the high band-edge.
- g) Per Public Notice DA00-705, the Marker-Delta method of measuring band edge compliance can only be used for measuring emissions that are up to two "standard" bandwidths away from the band-edge. (Since C63.4 specifies a 1MHz resolution bandwidth for measurements above 1GHz, two "standard" bandwidths away from the band-edge would be 2MHz away from the band-edge.) Radiated emissions that are removed by more than two "standard" bandwidths must be measured in the conventional manner.
- h) The highest transmit frequency used by the test item is 2480MHz. Since this is more than two "standard" bandwidths away from the band-edge, conventional radiated emissions measurements were taken at the band-edge.
- i) The test item was set up in the test chamber. With the modulation enabled, the test item was allowed to transmit continuously at 2480MHz.
- j) A double-ridged waveguide antenna was positioned at a 3 meter distance from the test item. The output of the double-ridged waveguide antenna was connected to a spectrum analyzer.
- k) The center frequency of the spectrum analyzer was set to the band-edge (2483.5MHz). The resolution bandwidth on the analyzer was set to 1MHz.
- l) The test item was maximized for worst case emissions at the measuring antenna. The video bandwidth was reduced to 10Hz and an average reading was taken.

5.6.3 Results

Page 66 shows the radiated band-edge compliance results at 2400MHz. As can be seen from the plot, the emissions at the band-edge are within the 20 dB down limits.

Page 67 shows the radiated band-edge compliance results at 2483.5MHz. As can be seen from the data, the emissions at the band-edge are within the general limits.

6 CONCLUSIONS

It was determined that the California Eastern Labs Zigbee Transmitter, Model No. ZICM2410P2, did fully meet the conducted and radiated emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C Sections 15.207 and 15.247 for Intentional Radiators Operating within the 2400MHz to 2483.5MHz band, when tested per ANSI C63.4-2003.

It was also determined that the California Eastern Labs Zigbee Transmitter, Model No. ZICM2410P2 did not fully meet the conducted emissions requirements of the Industry Canada Radio Standards Specification, RSS-Gen. Section 7.2.2 and the radiated emissions requirements of the Industry Canada Radio Standards Specification RSS-210, Annex 8 for transmitters, when tested per ANSI C63.4-2003.

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 test item at the test date. Any electrical or mechanical modification made to the test item subsequent to the specified test date will serve to invalidate the data and void this certification.

8 ENDORSEMENT DISCLAIMER

This report must not be used to claim product endorsement by NVLAP or any agency of the US Government.

9 EQUIPMENT LIST

Table 9-1 Equipment List

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
APW0	PREAMPLIFIER	PLANAR ELECTRONICS	PE2-30-20G20R6G	PL2926/0646	20GHZ-26.5GHZ	7/28/2009	7/28/2010
APW3	PREAMPLIFIER	PLANAR ELECTRONICS	PE2-35-120-5R0-10-12	PL2924	1GHZ-20GHZ	7/28/2009	7/28/2010
GRE0	SIGNAL GENERATOR	AGILENT TECHNOLOGIES	E4438C	MY42083127	250KHZ-6GHZ	2/16/2010	2/16/2011
NHG0	STANDARD GAIN HORN ANTENNA	NARDA	638	---	18-26.5GHZ	NOTE 1	
NTA1	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL6112	2054	0.03-2GHZ	9/10/2009	9/10/2010
NWF0	RIDGED WAVE GUIDE	EMCO	3105	2035	1-12.4GHZ	12/5/2009	12/5/2010
NWH0	RIDGED WAVE GUIDE	TENSOR	4105	2081	1-12.4GHZ	8/11/2009	8/11/2010
NWI0	RIDGED WAVE GUIDE	AEL	H1498	153	2-18GHZ	12/5/2009	12/5/2010
NWI1	RIDGED WAVE GUIDE	AEL	H1498	154	2-18GHZ	12/5/2009	12/5/2010
PLL9	50UH LISN 462D	ELITE ELECTRONIC ENG	462D/70A	010	0.01-400MHZ	3/2/2010	3/2/2011
PLLA	50UH LISN 462D	ELITE ELECTRONIC ENG	462D/70A	011	0.01-400MHZ	3/3/2010	3/3/2011
RBA0	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB26	100145	20HZ-26.5GHZ	3/12/2010	3/12/2011
RBB0	EMI TEST RECEIVER 20HZ TO 40 GHZ.	ROHDE & SCHWARZ	ESIB40	100250	20 HZ TO 40GHZ	3/16/2010	3/16/2011
T1E8	10DB 25W ATTENUATOR	WEINSCHEL	46-10-34	BH7996	DC-18GHZ	12/8/2009	12/8/2010
T1EE	10DB 25W ATTENUATOR	WEINSCHEL	46-10-34	BN2321	DC-18GHZ	11/17/2009	11/17/2010
T2D1	20DB, 25W ATTENUATOR	WEINSCHEL	46-20-43	AV5814	DC-18GHZ	3/30/2010	3/30/2011
T2DN	20DB, 25W ATTENUATOR	WEINSCHEL	46-20-34	BS2147	DC-18GHZ	8/24/2009	8/24/2010
XDN4	50DB, 1500W BIDIRECTIONAL COUPLER	AMPLIFIER RESEARCH	DC6580A	0328862	80-1000MHz	3/9/2010	3/9/2011
XDW3	50DB 1500W BIDIRECTIONAL COUPLER	AMPLIFIER RESEARCH	DC7128A	306045	800MHZ-2.8GHZ	7/6/2009	7/6/2010
XLJ1	5W, 50 OHM TERMINATION	JFW INDUSTRIES	50T-052	2	DC-2GHZ	8/24/2009	8/24/2010
XLQC	5W, 50 OHM TERMINATION	JFW INDUSTRIES	50T-052	47	DC-2GHZ	8/31/2009	8/31/2010
XLZ3	50 OHM TERMINATION	PASTERNACK	PE6009	004	DC-18GHZ	8/24/2009	8/24/2010

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.

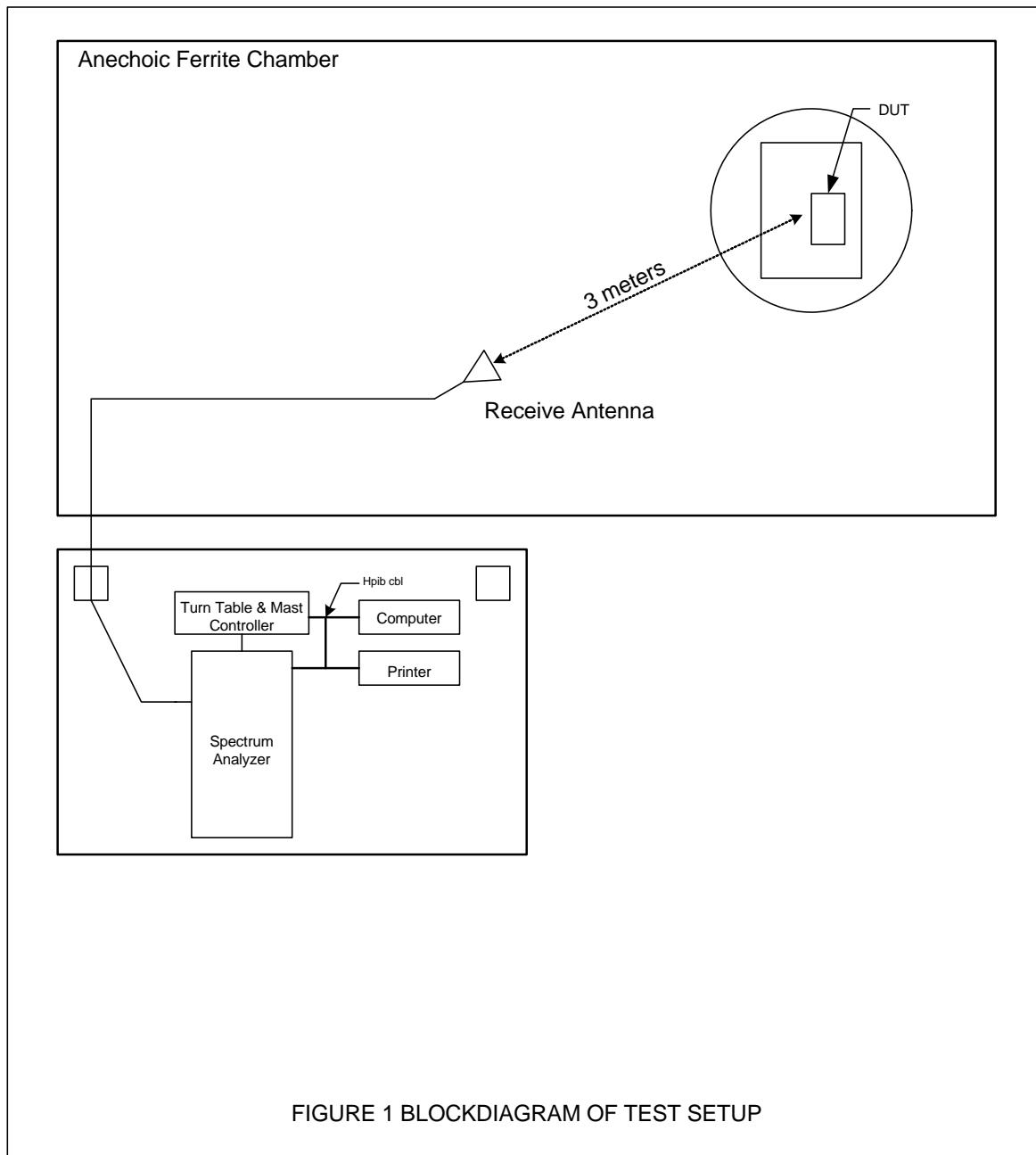


Figure 3

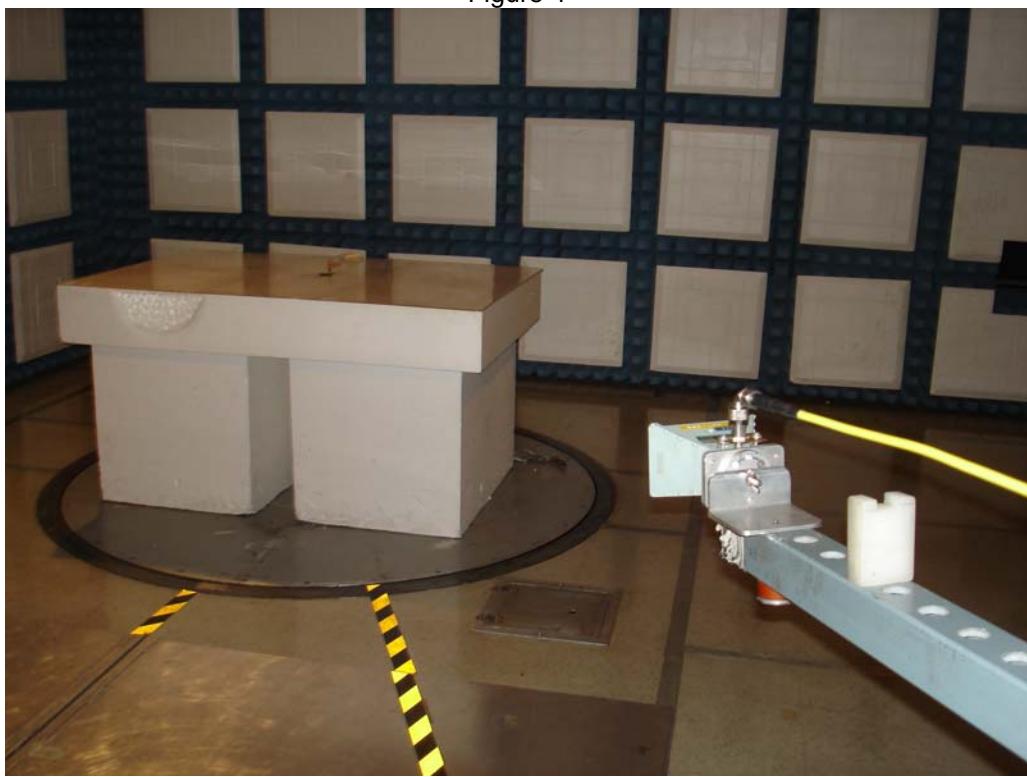


Test Set-up for Conducted Emissions

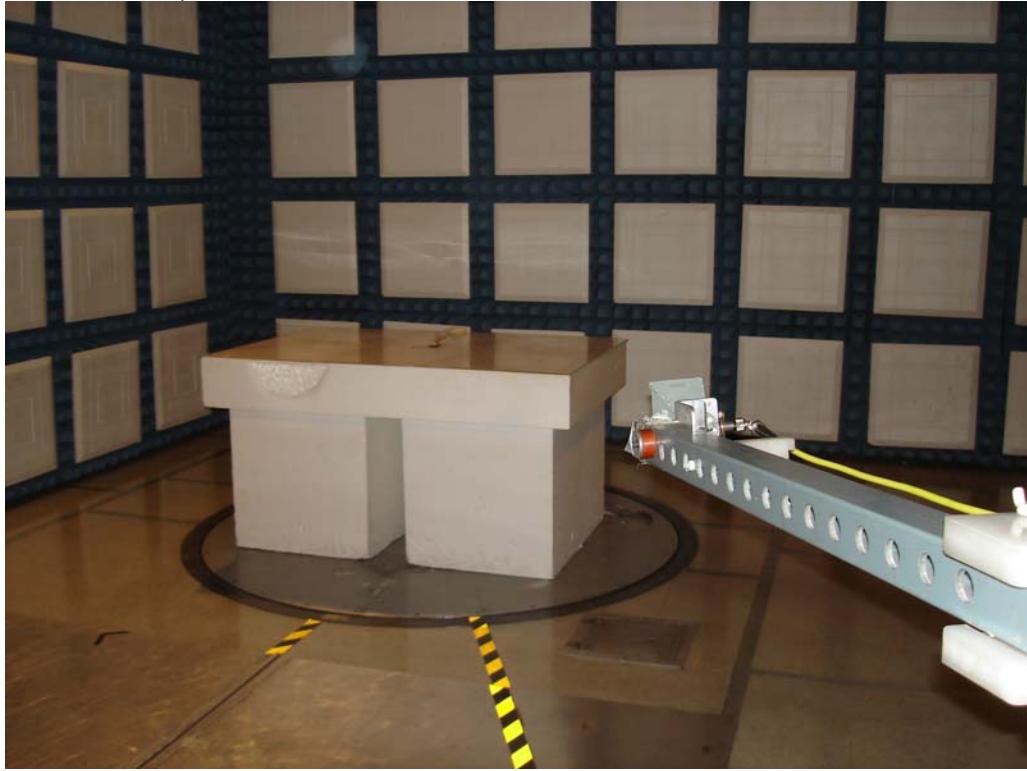


Test Set-up for Conducted Emissions

Figure 4



Test Set-up for Radiated Emissions – 2GHz to 18GHz, Horizontal Polarization



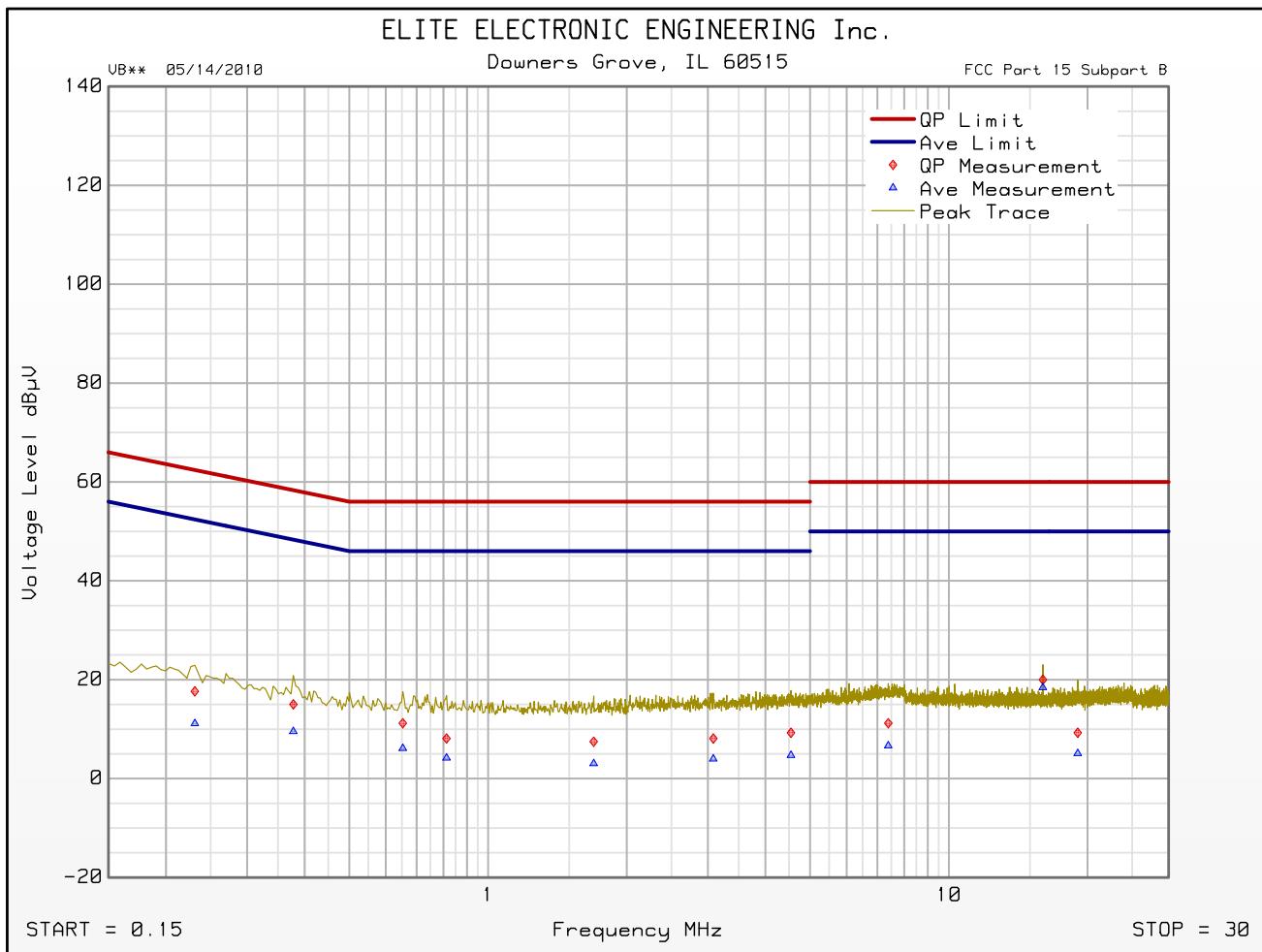
Test Set-up for Radiated Emissions – 2GHz to 18GHz, Vertical Polarization

FCC Part 15 Subpart B Conducted Emissions Test

Cumulative Data

VB** 05/14/2010

Manufacturer : CALIFORNIA EASTERN LABS
Model : ZICM2410P2
Serial Number : 856-ES3-X3
DUT Mode : Tx @ 2440MHz
Line Tested : +3VDC
Scan Step Time [ms] : 30
Meas. Threshold [dB] : -10
Test Engineer : R. King
Limit : Class B
Test Date : Jun 25, 2010 02:27:13 PM



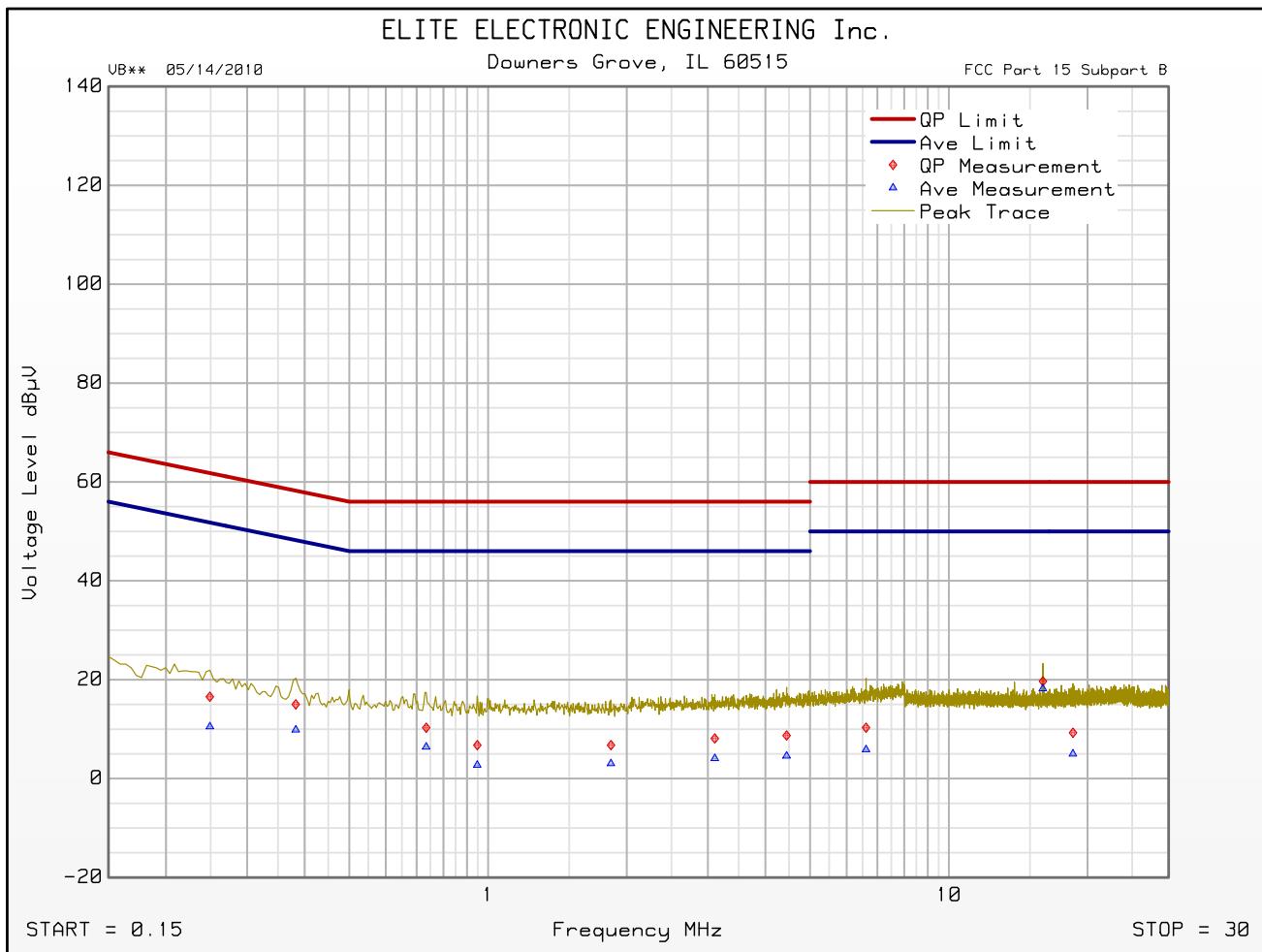
Emissions Meet QP Limit
Emissions Meet Ave Limit

FCC Part 15 Subpart B Conducted Emissions Test

Cumulative Data

VB** 05/14/2010

Manufacturer : CALIFORNIA EASTERN LABS
Model : ZICM2410P2
Serial Number : 856-ES3-X3
DUT Mode : Tx @ 2440MHz
Line Tested : -3VDC
Scan Step Time [ms] : 30
Meas. Threshold [dB] : -10
Test Engineer : R. King
Limit : Class B
Test Date : Jun 25, 2010 02:34:28 PM



Emissions Meet QP Limit
Emissions Meet Ave Limit

FCC Part 15 Subpart B Conducted Emissions Test

Significant Emissions Data

VB** 05/14/2010

Manufacturer : CALIFORNIA EASTERN LABS
Model : ZICM2410P2
Serial Number : 856-ES3-X3
DUT Mode : Tx @ 2440MHz
Line Tested : +3VDC
Scan Step Time [ms] : 30
Meas. Threshold [dB] : -10
Test Engineer : R. King
Limit : Class B
Test Date : Jun 25, 2010 02:27:13 PM
Data Filter : Up to 80 maximum levels detected with 6 dB level excursion threshold over 10 dB margin below limit

Freq MHz	Quasi-peak Level dB μ V	Quasi-peak Limit dB μ V	Excessive Quasi-peak Emissions	Average Level dB μ V	Average Limit dB μ V	Excessive Average Emissions
0.231	17.6	62.4		11.2	52.4	
0.378	15.0	58.3		9.5	48.3	
0.653	11.2	56.0		6.1	46.0	
0.813	8.1	56.0		4.2	46.0	
1.696	7.5	56.0		3.1	46.0	
3.083	8.1	56.0		4.0	46.0	
4.544	9.3	56.0		4.7	46.0	
7.390	11.2	60.0		6.7	50.0	
16.002	20.0	60.0		18.4	50.0	
19.040	9.3	60.0		5.1	50.0	

Checked BY

RICHARD E. KING :

Richard E. King

FCC Part 15 Subpart B Conducted Emissions Test

Significant Emissions Data

VB** 05/14/2010

Manufacturer : CALIFORNIA EASTERN LABS
Model : ZICM2410P2
Serial Number : 856-ES3-X3
DUT Mode : Tx @ 2440MHz
Line Tested : -3VDC
Scan Step Time [ms] : 30
Meas. Threshold [dB] : -10
Test Engineer : R. King
Limit : Class B
Test Date : Jun 25, 2010 02:34:28 PM
Data Filter : Up to 80 maximum levels detected with 6 dB level excursion threshold over 10 dB margin below limit

Freq MHz	Quasi-peak Level dB μ V	Quasi-peak Limit dB μ V	Excessive Quasi-peak Emissions	Average Level dB μ V	Average Limit dB μ V	Excessive Average Emissions
0.249	16.5	61.8		10.5	51.8	
0.383	15.0	58.2		9.9	48.2	
0.734	10.3	56.0		6.4	46.0	
0.948	6.8	56.0		2.7	46.0	
1.849	6.8	56.0		3.0	46.0	
3.105	8.1	56.0		4.1	46.0	
4.445	8.7	56.0		4.6	46.0	
6.611	10.3	60.0		5.9	50.0	
16.002	19.7	60.0		18.2	50.0	
18.595	9.3	60.0		5.0	50.0	

Checked BY *RICHARD E. KING* :

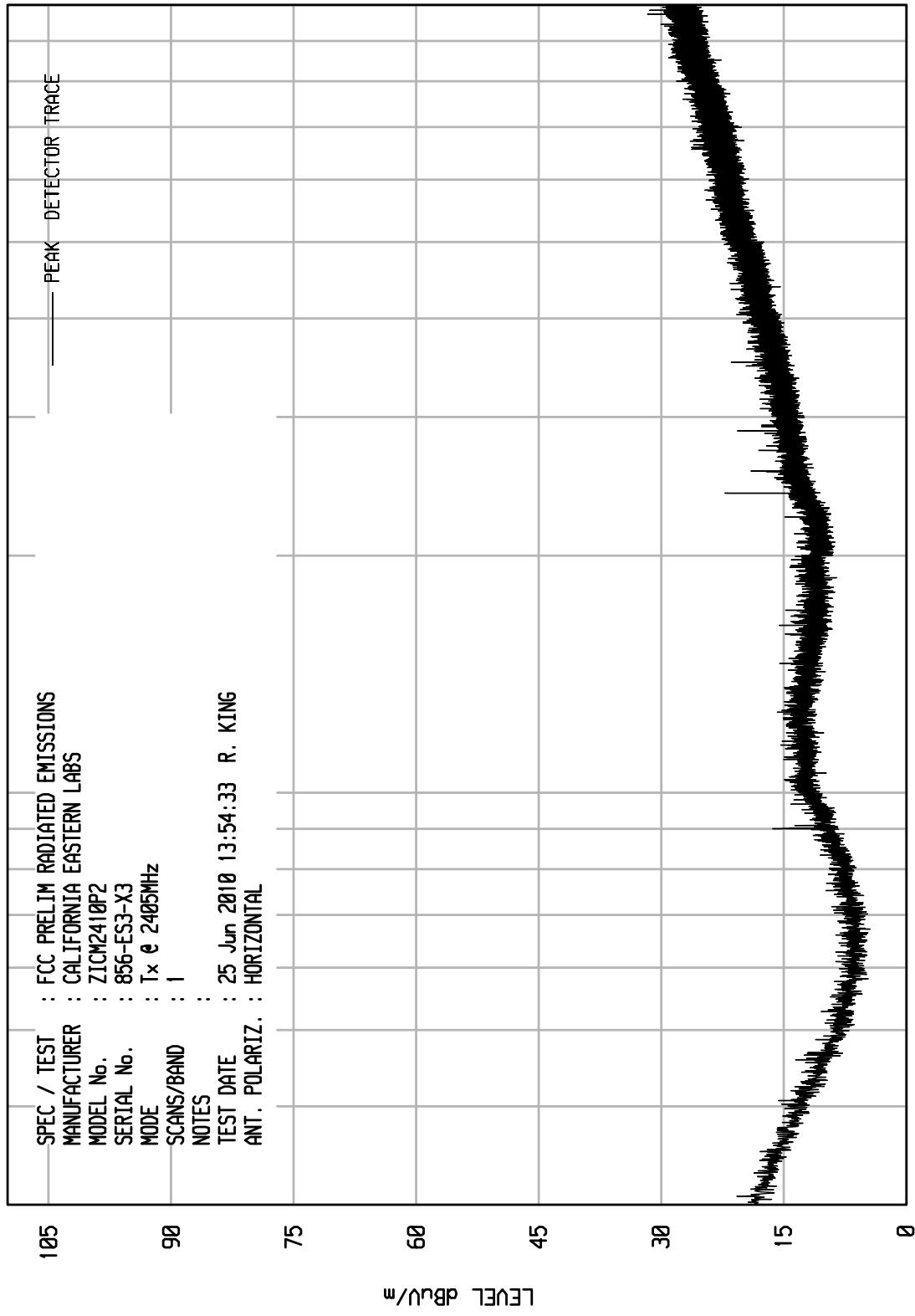
Richard E. King

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515

UNI U RCU EMI RUN 13

WKAI 01/25/10

SPEC / TEST	FCC PRELIM RADIATED EMISSIONS
MANUFACTURER	CALIFORNIA EASTERN LABS
MODEL No.	ZICM2410P2
SERIAL No.	856-ES3-X3
MODE	Tx & 2405MHz
SCANS/BAND	1
NOTES	
TEST DATE	25 Jun 2010 13:54:33
ANT. POLARIZ.	HORIZONTAL

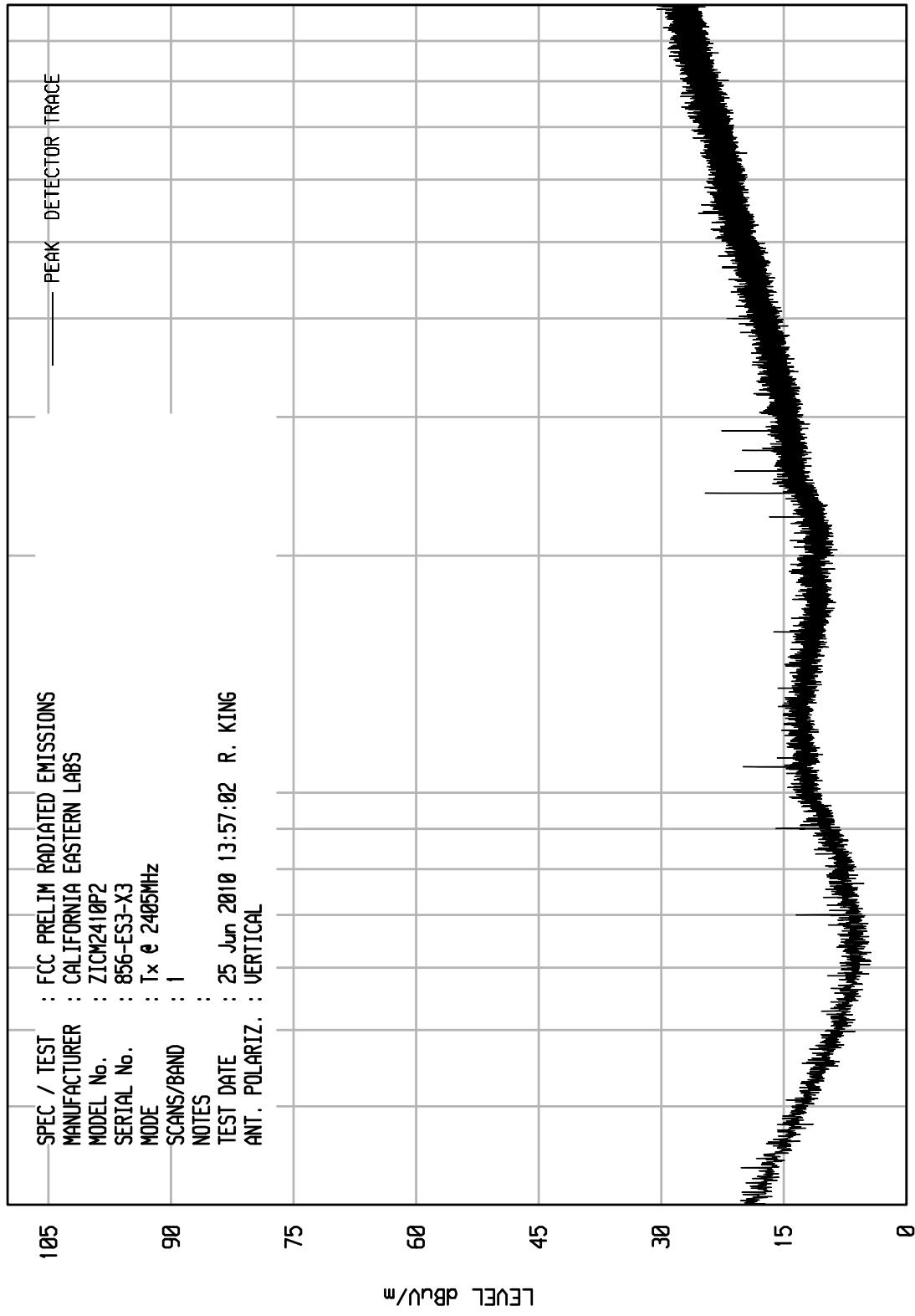


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UNI U RCU EMI RUN 14

WKA1 01/25/10

SPEC / TEST	FCC PRELIM RADIATED EMISSIONS
MANUFACTURER	CALIFORNIA EASTERN LABS
MODEL No.	ZICM2410P2
SERIAL No.	856-ES3-X3
MODE	Tx & 2405MHz
SCANS/BAND	1
NOTES	
TEST DATE	25 Jun 2010 13:57:02
ANT. POLARIZ.	VERTICAL



ELITE ELECTRONIC ENGINEERING Inc.
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UNI U RCU EMI RUN 12

WKA1 01/25/10

105	SPEC / TEST	PRELIM RADIATED EMISSIONS
	MANUFACTURER	CALIFORNIA EASTERN LABS
	MODEL No.	ZICM2410P2
	SERIAL No.	856-ES3-X3
	MODE	Tx & 2405MHz
	SCANS/BAND	1
	NOTES	
90	TEST DATE	25 Jun 2010 13:45:23 R. KING
	ANT. POLARIZ.	HORIZONTAL

120

LEVEL dBUL/m

105

75

60

45

30

15

0

PEAK DETECTOR TRACE

PEAK DETECTOR TRACE

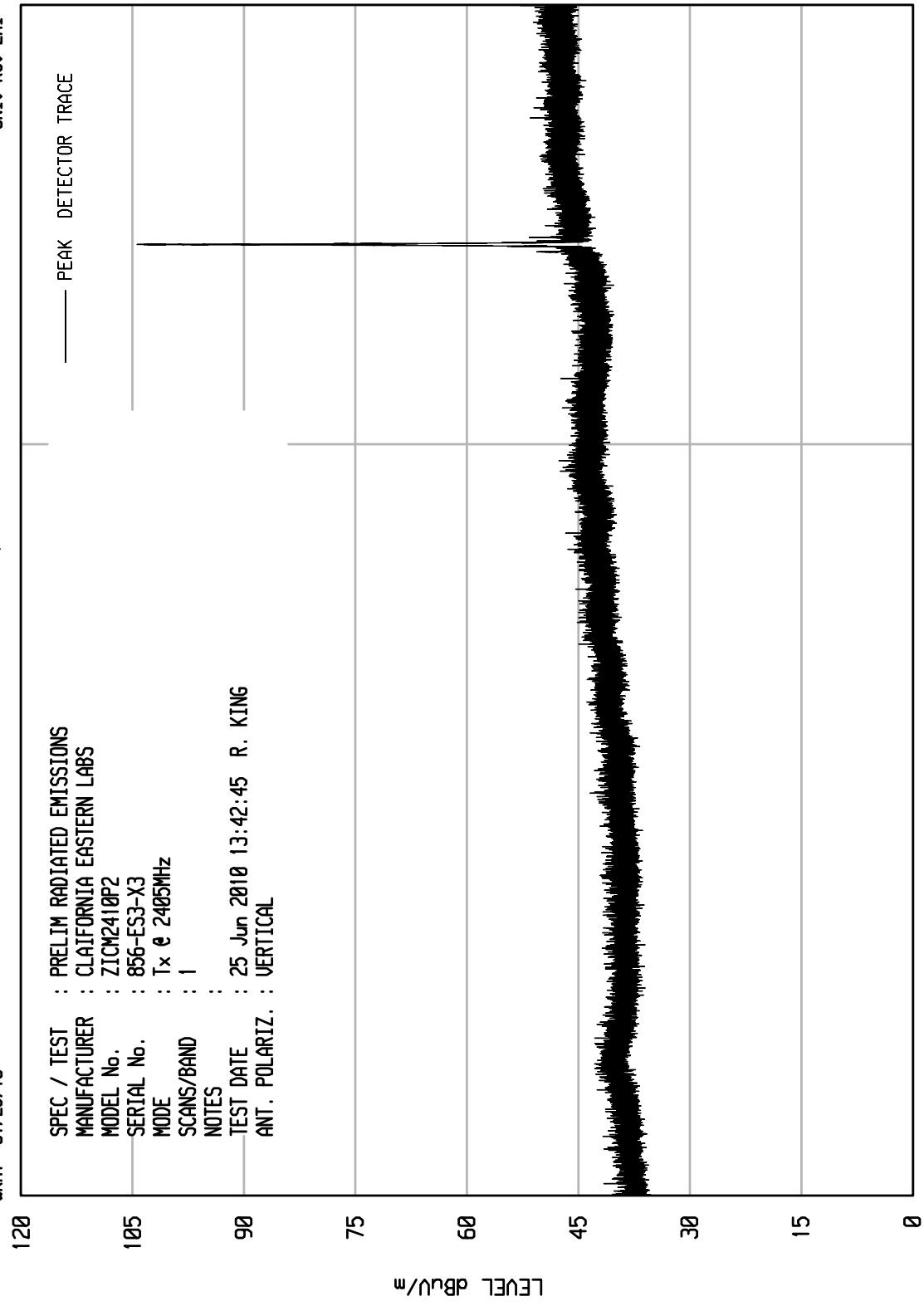
START = 1000

FREQUENCY MHz

STOP = 30000

ELITE ELECTRONIC ENGINEERING Inc.
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UNIV RCV EMI RUN 11



START = 1000

FREQUENCY MHz

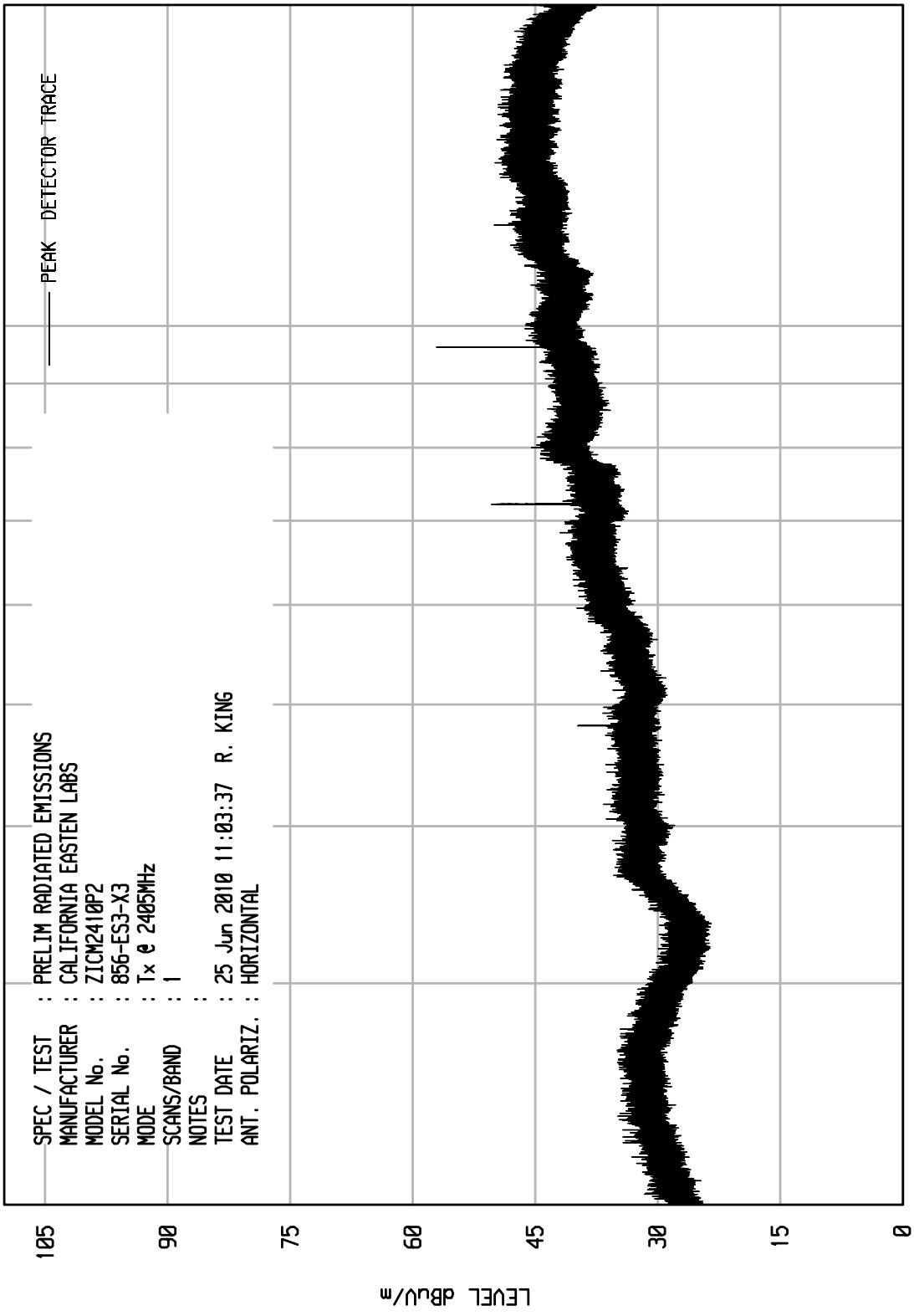
STOP = 3000

ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515

UKAI 01/25/10

UNIV RCU EMI RUN 4

SPEC / TEST	PRELIM RADIATED EMISSIONS	
MANUFACTURER	CALIFORNIA EASTEN LABS	
MODEL No.	ZICH2410P2	
SERIAL No.	856-ES3-X3	
MODE	Tx & 2405MHz	
SCANS/BAND	1	
NOTES		
TEST DATE	25 Jun 2010 11:03:37	
ANT. POLARIZ.	R. KING HORIZONTAL	



START = 2000

FREQUENCY MHz

1000

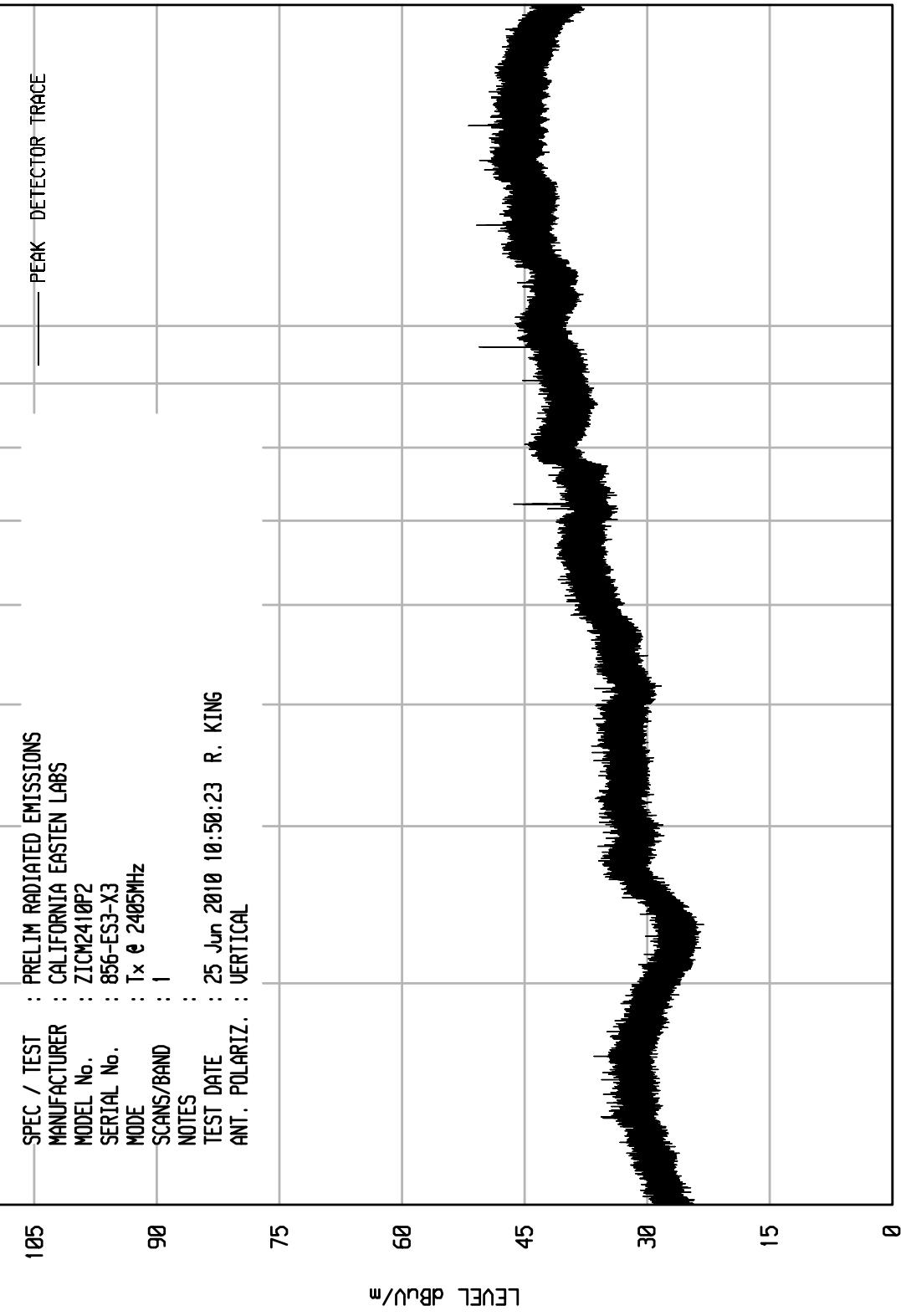
STOP = 18000

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515

UNIV RCU EMI RUN 3

WKA1 01/25/10

105	SPEC / TEST	PRELIM RADIATED EMISSIONS
	MANUFACTURER	CALIFORNIA EASTEN LABS
	MODEL No.	ZICM2410P2
	SERIAL No.	856-ES3-X3
	MODE	Tx & 2405MHz
90	SCANS/BAND	1
	NOTES	
	TEST DATE	25 Jun 2010 10:50:23 R. KING
	ANT. POLARIZ.	VERTICAL

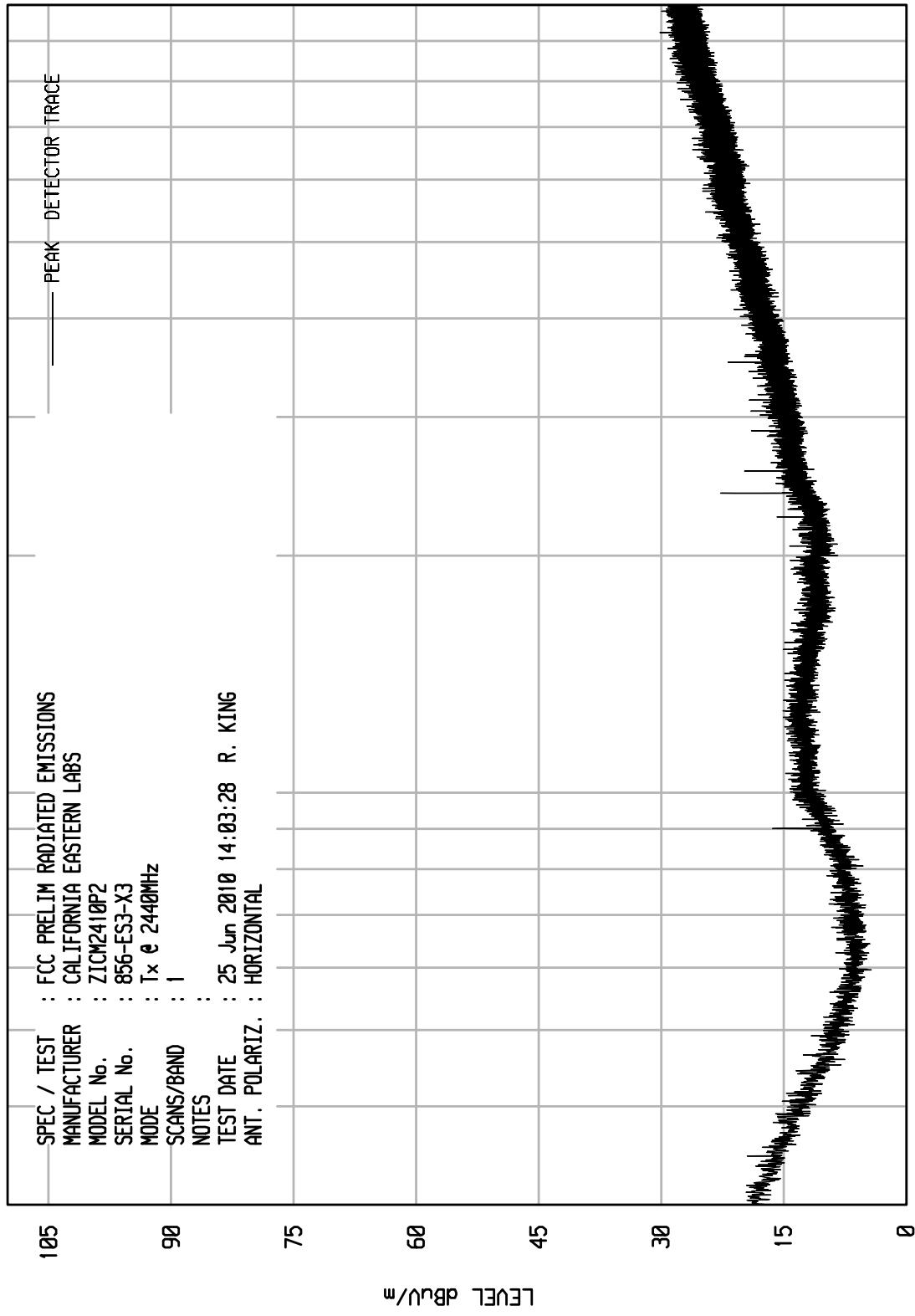


ELITE ELECTRONIC ENGINEERING Inc.
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UNI U RCU EMI RUN 16

WKAI 01/25/10

SPEC / TEST	FCC PRELIM RADIATED EMISSIONS
MANUFACTURER	CALIFORNIA EASTERN LABS
MODEL No.	ZICM2410P2
SERIAL No.	856-ES3-X3
MODE	Tx & 240MHz
SCANS/BAND	1
NOTES	
TEST DATE	25 Jun 2010 14:03:28
ANT. POLARIZ.	HORIZONTAL

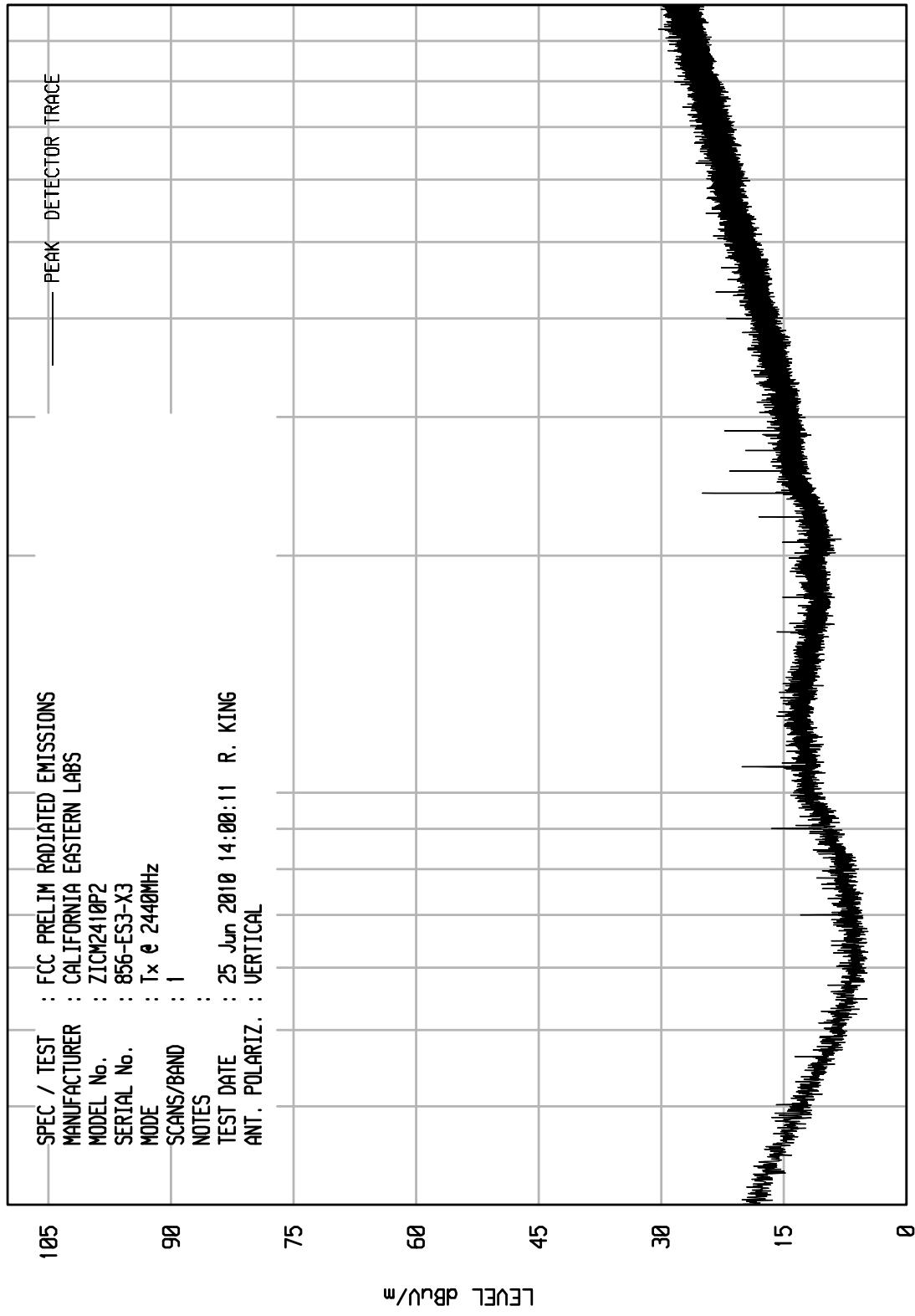


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515

UNIV RCU EMI RUN 15

WKA1 01/25/10

SPEC / TEST	:	FCC PRELIM RADIATED EMISSIONS
MANUFACTURER	:	CALIFORNIA EASTERN LABS
MODEL No.	:	ZICM2410P2
SERIAL No.	:	856-ES3-X3
MODE	:	Tx & 240MHz
SCANS/BAND	:	1
NOTES	:	
TEST DATE	:	25 Jun 2010 14:00:11
ANT. POLARIZ.	:	VERTICAL



START = 30

100

FREQUENCY MHz

STOP = 10000

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Downers Grove, Ill. 60515

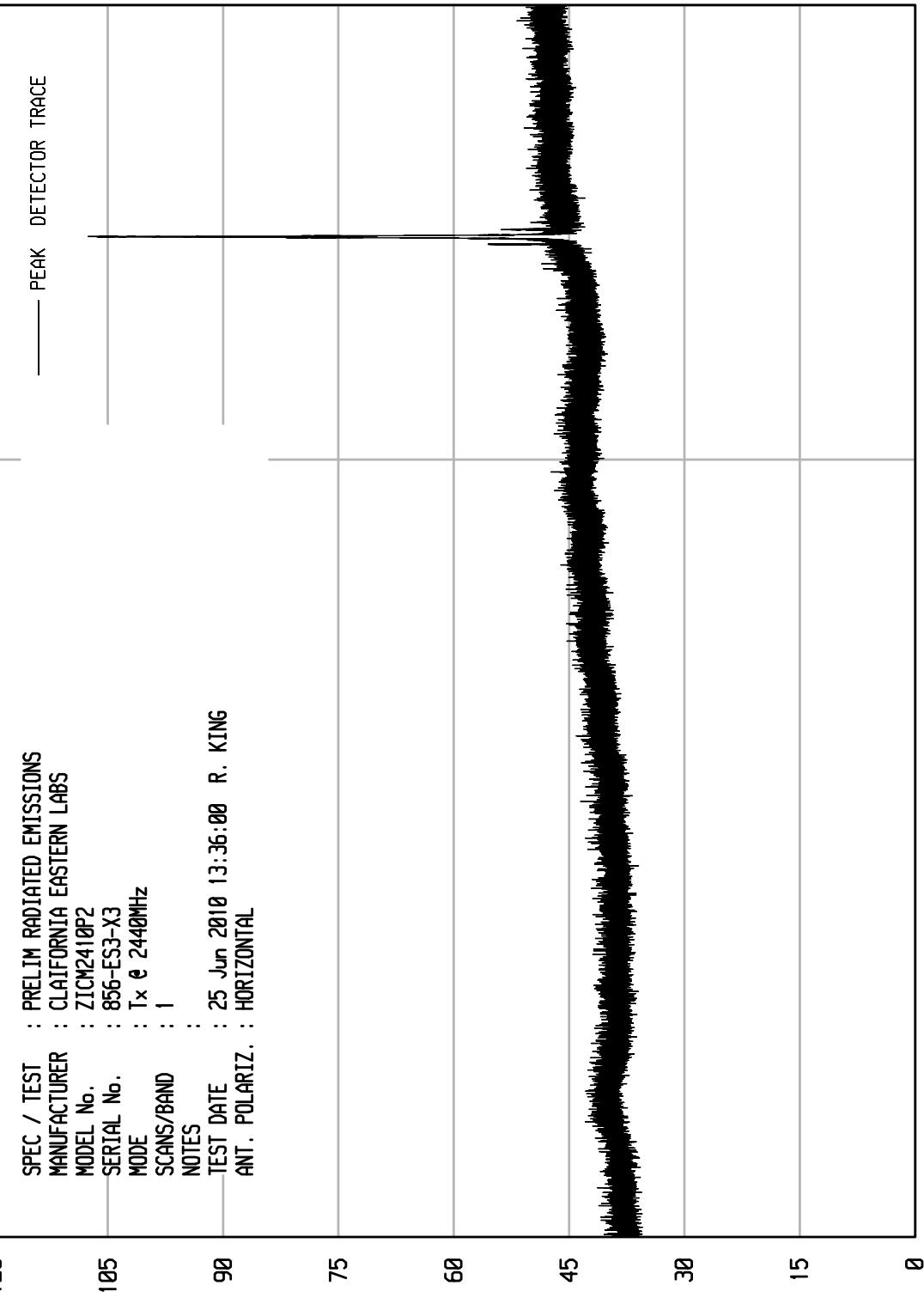
UNI U RCU EMI RUN 9

WKAI 01/25/10

105	SPEC / TEST	PRELIM RADIATED EMISSIONS
	MANUFACTURER	CALIFORNIA EASTERN LABS
	MODEL No.	ZICM2410P2
	SERIAL No.	856-ES3-X3
	MODE	Tx & 240MHz
	SCANS/BAND	1
	NOTES	
90	TEST DATE	25 Jun 2010 13:36:00 R. KING
	ANT. POLARIZ.	HORIZONTAL

120

LEVEL dBUL/m

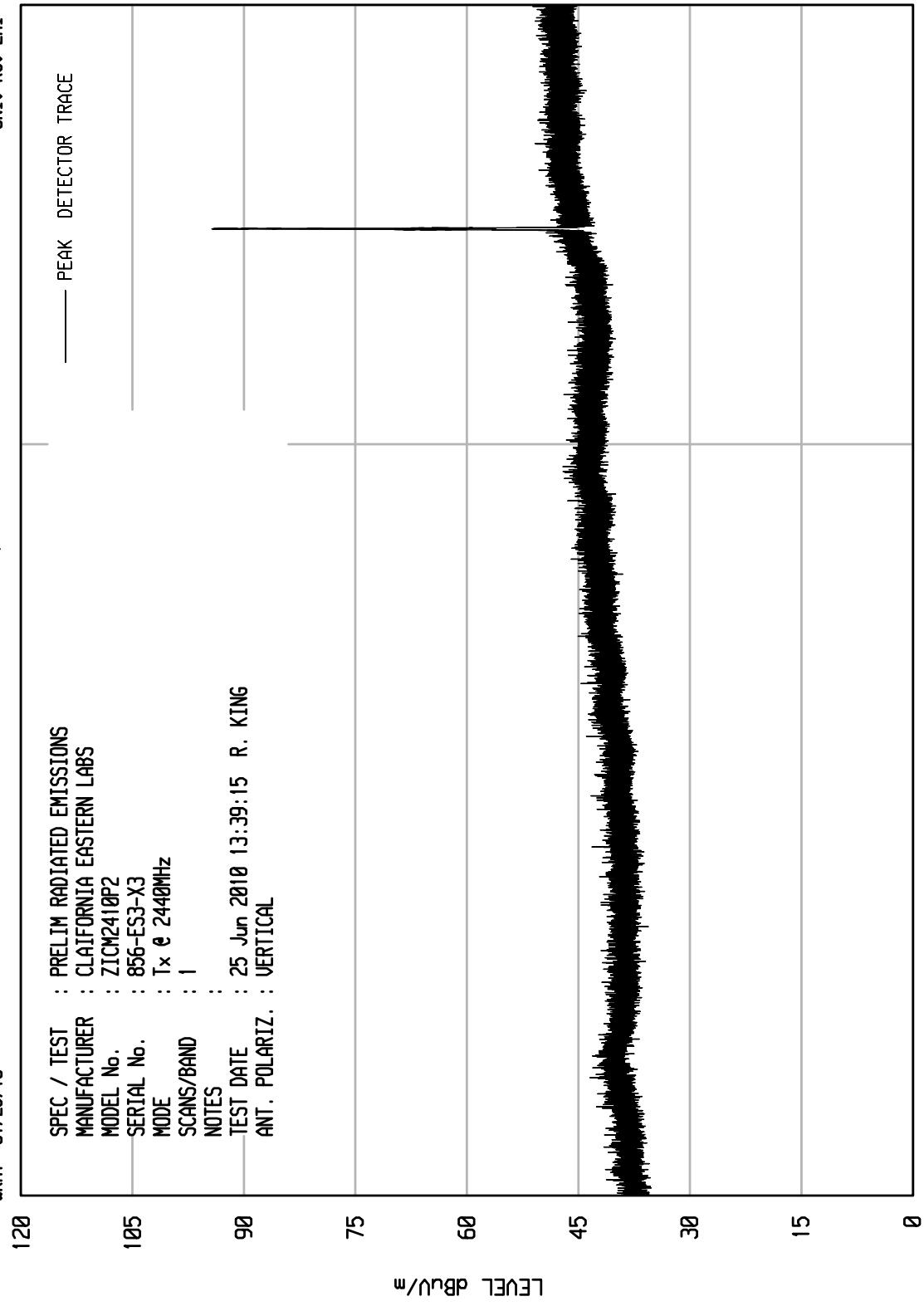


START = 1000

STOP = 3000

ELITE ELECTRONIC ENGINEERING Inc.
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UNIV RCV EMI RUN 10



START = 1000

FREQUENCY MHz

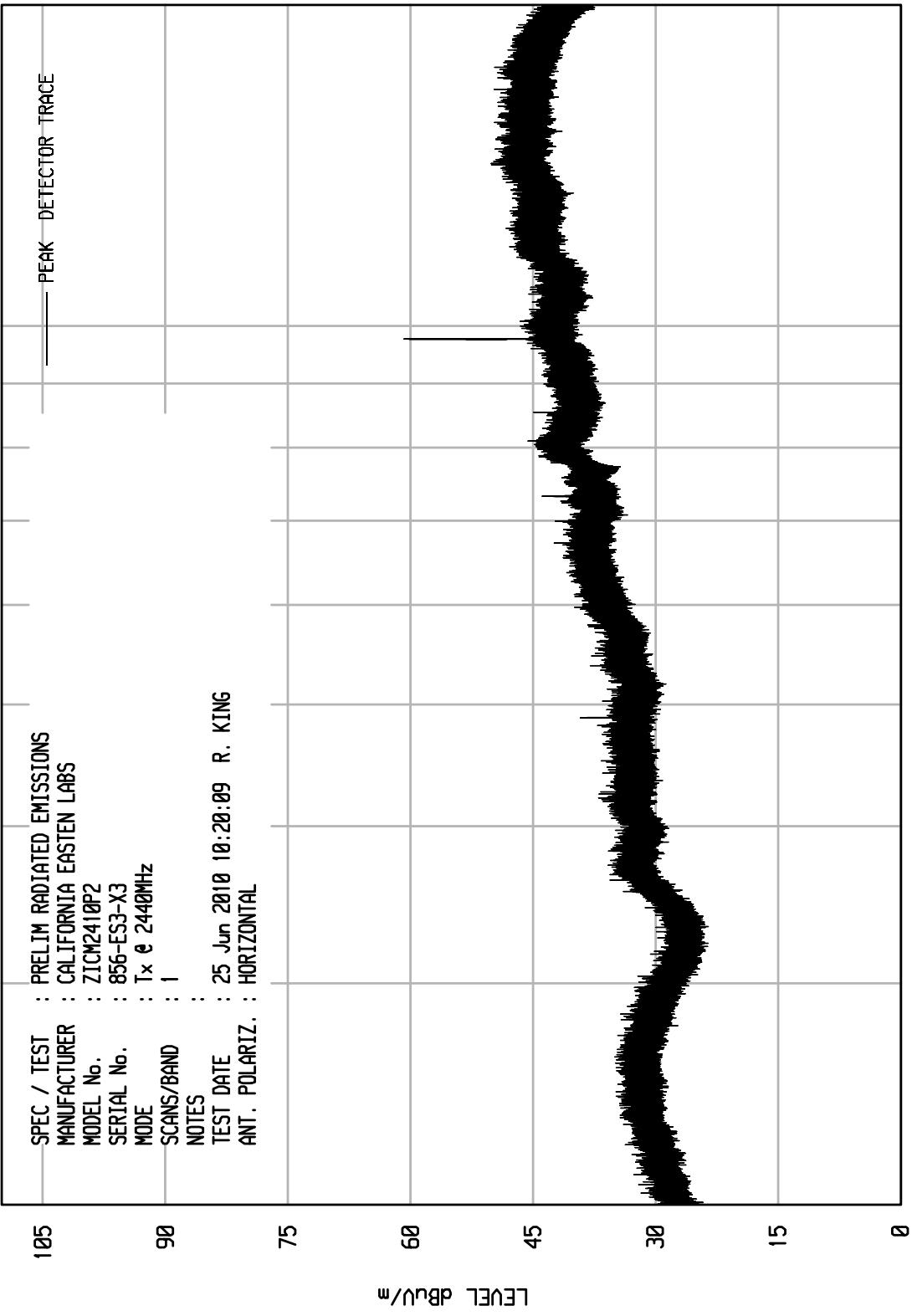
STOP = 3000

ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515

ウクライナ 01/25/10

UNIV RCU EMI RUN 1

SPEC / TEST	:	PRELIM RADIATED EMISSIONS
MANUFACTURER	:	CALIFORNIA EASTEN LABS
MODEL No.	:	ZICH2410P2
SERIAL No.	:	856-ES3-X3
MODE	:	Tx @ 2440MHz
SCANS/BAND	:	1
NOTES	:	
TEST DATE	:	25 Jun 2010
ANT. POLARIZ.	:	HORIZONTAL



START = 2000

FREQUENCY MHz

1000

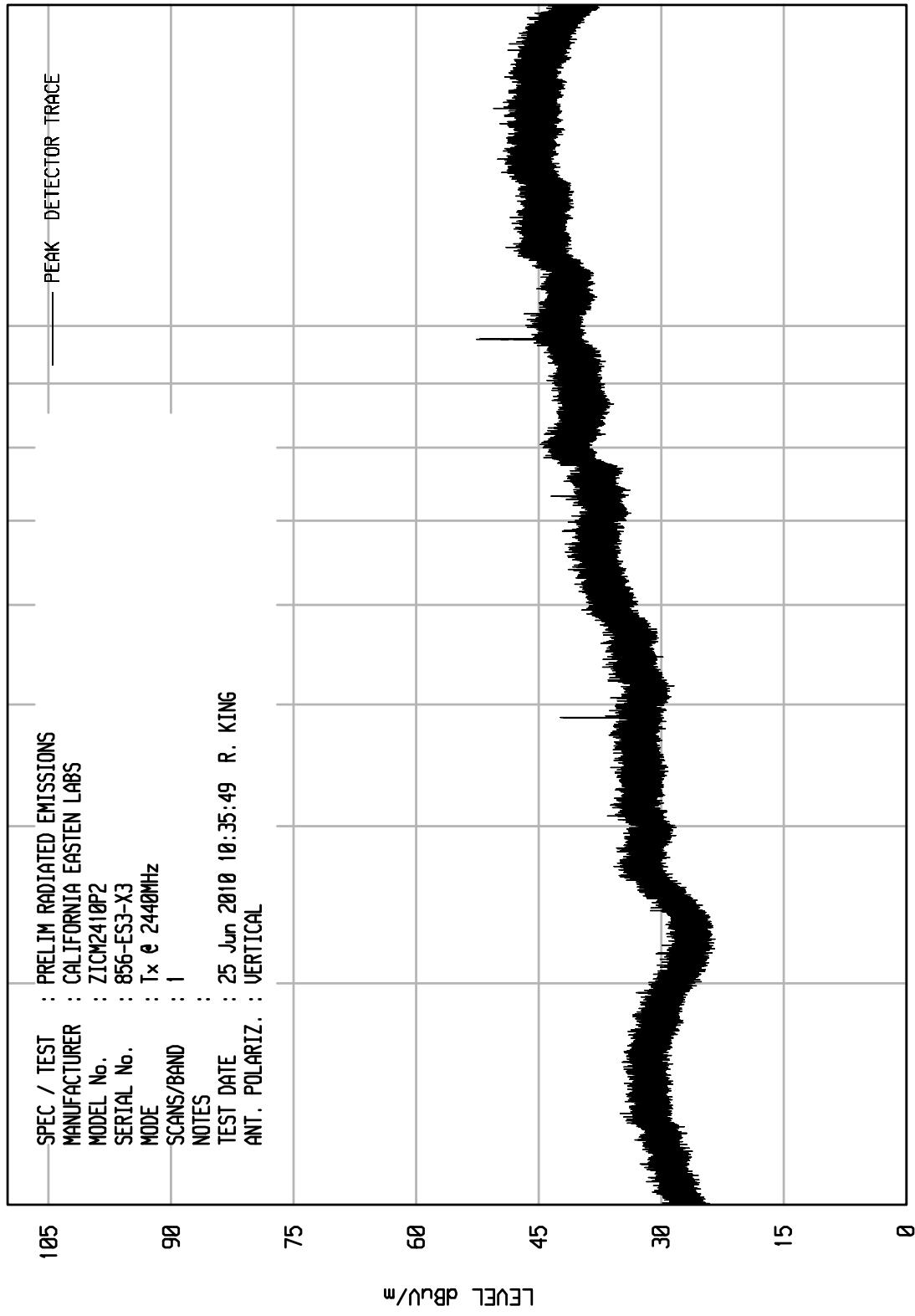
STOP = 18000

ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515

ウクライナ 01/25/10

UNIV RCU EMI RUN 2

SPEC / TEST	PRELIM RADIATED EMISSIONS	
MANUFACTURER	CALIFORNIA EASTEN LABS	
MODEL No.	ZICH2410P2	
SERIAL No.	856-ES3-X3	
MODE	Tx @ 2440MHz	
SCANS/BAND	1	
NOTES		
TEST DATE	25 Jun 2010 10:35:49	
ANT. POLARIZ.	VERTICAL	



START = 2000

FREQUENCY MHz

1000

STOP = 18000