Measurement of RF Emissions from a 447-0328 PulsON 412 Ultra Wide Band (UWB) Transmitter

For	Caterpillar Underground Mining Pty Ltd Building D 53-55 Main Road Wivenhoe Tasmania, AUSTRALIA 7320
P.O. Number	4600266839
Date Tested	July 23-25, 2014 and August 28, 2014
Test Personnel	Richard King
Test Specification	FCC "Code of Federal Regulations" Title 47 Part15, Subpart F

Test Report By: Richard E. King

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EMC Engineer

Approved By: Raymond J Klouda

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REVISION HISTORY

Revision	Date	Description
—	04 September 2014	Initial release

Measurement of RF Emissions from a PulsON 412, Model No. 447-0328 Ultra Wide Band (UWB) Transmitter

1. INTRODUCTION

1.1. Scope of Tests

This report presents the results of the RF emissions measurements performed on a PulsON 412, Model No. 447-0328, Serial No. 19994, (hereinafter referred to as the Equipment Under Test (EUT)). The EUT was designed to transmit at approximately 4GHz using a BroadSpec PulsOn 200 Dipole . The EUT was manufactured and submitted for testing by Caterpillar Underground Mining Pty Ltd located in Tasmania, AUSTRALIA.

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 F, Section 15.517 for Ultra Wideband Radiators. Testing was performed in accordance with ANSI C63.4-2009.

1.3. Deviations, Additions and Exclusions

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

1.4. EMC Laboratory Identification

This series of tests was performed by Elite Electronic Engineering Incorporated of Downers Grove, Illinois. The laboratory is accredited by The American Association for Laboratory Accreditation (A2LA). A2LA Certificate Number: 1786.01.

1.5. Laboratory Conditions

The temperature at the time of the test was 23.3^{o}C and the relative humidity was 46%.

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 F, dated 1 October 2013
- 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"

3. EUT SETUP AND OPERATION

3.1. General Description

The EUT is a Caterpillar Underground Mining Pty Ltd, PulsON 412, Model No. 447-0328. A block diagram of the EUT setup is shown as Figure 1.

3.1.1. Power Input

The EUT obtained 27VDC power via a 2 wire, 6 foot long, unshielded power cord. The high and low leads 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 C63.4-2009.

3.1.2.Peripheral Equipment

The following peripheral equipment was submitted with the EUT:

Item	Description
Laptop	HP EliteBook 8730w was setup and connected to the EUT through 40 feet of CAT 5 ethernet cable. The laptop was setup in the monitor chamber and used to operate set its proper poad characteristics

3.1.3.Signal Input/Output Leads

The following interconnect cables were submitted with the EUT:

Item	Description
CAT 5 Ethernet cable	40 feet of CAT 5 Ethernet from EUT to the laptop Computer.

3.1.4.Grounding

The EUT was powered with 27VDC through a DC power supply and was ungrounded during testing.

3.2. Software

The EUT requires Software Version RangeNet 1.2 to control the device and provide correct load characteristics during testing.

3.3. Operational Mode

For all tests the EUT was placed on an 80cm high non-conductive stand. The EUT was energized. The EUT was set to transmit through a series of software commands.

3.4. EUT Modifications

The EUT was modified by placing a Fair-Rite brand ferrite bead model 0431176451 on the input power lead. This modification was required to meet the radiated emission requirements in the frequency range below 960MHz.

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. Ultra Bandwidth Requirements

5.1.1. Requirements

UWB bandwidth. For the purpose of this subpart, the UWB bandwidth is the frequency band bounded by the points that are 10 dB below the highest radiated emission, as based on the complete transmission system including the antenna. The upper boundary is designated f_H and the lower boundary is designated f_L. The frequency at which the highest radiated emission occurs is designated f_M.

The UWB bandwidth of a UWB system operating under the provisions of section 15.517(b) must be contained between 3,100 MHz and 10,600 MHz and a UWB bandwidth equal to or greater than 500MHz regardless of the frational bandwidth.

5.1.2. Procedures

All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. The walls and ceiling of the shielded chamber are lined with ferrite tiles. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4-2009 for site attenuation.

The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall. The powerline filters prevent extraneous signals from entering the enclosure on these leads.

The field emission tests were then manually performed over the frequency range of the fundamental emission. A broadband double ridged waveguide antenna was used as the pick-up device for all frequencies above 1GHz.

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

1) The EUT was rotated so that all of its sides were exposed to the receiving antenna.
2) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.
3) The measuring antenna was raised and lowered from 1 to 4 meters for each antenna polarization to maximize the readings.

5.1.3.Results

A plot of the peak fundamental emission is shown on page 17. Plots of the frequencies f_L and f_H where the emissions levels are 10dB below the peak emission level are shown on pages 18 and 19.

As the data shows the UWB bandwidth meets the requirements. The UWB bandwidth is equal to 1.747 GHz. The UWB bandwidth is contained between 3,100 MHz and 10,600 MHz and is greater then the 500 MHz requirement.

Photographs of the test configuration which yielded the highest or worst case, conducted emission levels are shown on Figure 3.

5.2. Radiated Emissions Above 960MHz

5.2.1.Requirements

Emissions from a transmitter operating under section 15.517(c) shall not exceed the following equivalent isotropically radiated power (EIRP) density levels:

The radiated emissions above 960 MHz from a device operating under the provitions of this section shall not exceed the following RMS average limits based on the measurements using a 1 MHz resolution bandwidth:

Frequency (MHz)	EIRP (dBm at 3 M)	EIRP (dBuV/m at 3 M)	EIRP (dBuV/m at 1 M)	EIRP (dBuV/m at ½ M)
960-1610	-75.3	19.9	29.4	35.4
1610-1990	-53.3	41.9	51.4	57.4
1990-3100	-51.3	43.9	53.4	59.4
3100-10600	-41.3	53.9	63.4	69.4
Above 10600	-51.3	43.9	53.4	59.4

Emissions from digital circuitry used to enable the operation of the UWB transmitter shall comply with the limits in §15.209, rather than the limits specified in this subpart, provided it can be clearly demonstrated that those emissions from the UWB device are due solely to emissions from digital circuitry contained within the transmitter and that the emissions are not intended to be radiated from the transmitter's antenna. Emissions from associated digital devices, as defined in §15.3(k), e.g., emissions from digital circuitry used to control additional functions or capabilities other than the UWB transmission, are subject to the limits contained in Subpart B of this part.

Some bands may have been scanned at a distance closer than 1 meter. If any emissions were detected in these bands, final measurements were made at a distance of 1 meter or greater. The actual test distance for final measurements is indicated in the measurement data.

5.2.2.Procedures

All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. The walls and ceiling of the shielded chamber are lined with ferrite tiles. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4-2009 for site attenuation.

The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall. The powerline filters prevent extraneous signals from entering the enclosure on these leads.

The field emission tests were then manually performed over the frequency range of the fundamental emission Between 960 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. The resolution bandwidth was set to 1MHz.

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

1) The EUT was rotated so that all of its sides were exposed to the receiving antenna.
2) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.
3) The measuring antenna was raised and lowered from 1 to 4 meters for each antenna polarization to maximize the readings.

5.2.3. Results

The plots and tabular data are presented on pages 20 through 55. All emissions attributed to the transmitter are within the Section 15.517 (c) limits. Some emissions can be seen in excess of the limits however these emissions were present when the transmitter function was turned off and can be attributed to the digital circuitry. These emissions attributed to the digital circuitry were within the general limit of 15.209.

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

5.3. Radiated Emissions in the GPS Receive Band

5.3.1. Requirements

Emissions from a transmitter operating under section 15.517(d) shall not exceed the following RMS average limits when measured using a resolution bandwidth of no less than 1kHz:

Frequency (MHz)	EIRP (dBm at 3 M)	EIRP (dBuV/m at 3 M)	EIRP (dBuV/m at 1 M)
1164-1240	-85.3	9.9	19.4
1559-1610	-85.3	9.9	19.4

5.3.2. Procedures

All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. The walls and ceiling of the shielded chamber are lined with ferrite tiles. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4-2009 for site attenuation.

The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall. The powerline filters prevent extraneous signals from entering the enclosure on these leads.

The field emission tests were then manually performed over the frequency range of the GPS receive bands. A broadband double ridged waveguide antenna was used as the pick-up device for all frequencies above 1GHz. The resolution bandwidth was set to no less then 1kHz.

To ensure that maximum or worst case, emission levels were 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.

5.3.3.Results

The plots and tabular data are presented on pages 56 through 63. All emissions attributed to the transmitter are within the specification limits.

As can be seen from the data, some emissions can be seen in excess of the limits however these emissions were present when the transmitter function was turned off and can be attributed to the digital circuitry. Since these emissions were not related to the transmitter function, these emissions can be ignored.

5.4. Peak Power within a 50 MHz Bandwidth

5.4.1.Requirements

Peak Emissions from a transmitter operating under section 15.517(e) contained within a 50 MHz bandwidth centered in the 3100-10600 MHz band shall not exceed the following limits:

Frequency (MHz)	EIRP in 50MHz BW (dBm)	EIRP in 50 MHz BW (dBuV/m at 3 M)	EIRP in 50 MHz BW (dBuV/m at 1 M)
3100-10600	0	95.2	104.7

Peak EIRP Emissions Limit from a transmitter operating under section 15.517(e) contained within a 50 MHz bandwidth centered in the 3100-10600 MHz band is calculated as 20*log (RBW/50) where the RBW is listed in MHz and shown in the following table:

Limits converted to 1MHz RBW

Frequency (MHz)	EIRP in 1MHz BW (dBm)	EIRP in 1 MHz BW (dBuV/m at 3 M)	EIRP in 1 MHz BW (dBuV/m at 1 M)
3100-10600	-34	61.2	80.3

The RBW shall not be lower than 1 MHz or greater then 50 MHz. The VBW shall not less then the RBW.

5.4.2.Procedures

All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. The walls and ceiling of the shielded chamber are lined with ferrite tiles. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4-2009 for site attenuation.

The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall. The powerline filters prevent extraneous signals from entering the enclosure on these leads.

The final open field emission tests were then manually performed with a broadband double ridged waveguide antenna as the pick-up device. All significant broadband and narrowband signals were measured and recorded.

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

4) The EUT was rotated so that all of its sides were exposed to the receiving antenna.
5) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.
6) The measuring antenna was raised and lowered from 1 to 4 meters for each antenna polarization to maximize the readings.

5.4.3.Results

The Peak Power within a 50 MHz Bandwidth is presented on data page 65. 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 radiated emission levels are shown on Figure 3.

5.5. Radiated Emissions Below 960MHz

5.5.1.Requirement

All emanations from a UWB transmitter shall be below the levels shown on the following table in the 30 MHz to 960 MHz range:

RADIATION LIMITS PER FCC 15.209

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

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

5.5.2. Procedures:

All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. The walls and ceiling of the shielded chamber are lined with ferrite tiles. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4-2009 for site attenuation.

The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall. The powerline filters prevent extraneous signals from entering the enclosure on these leads.

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

The broadband measuring antenna was positioned at a 3 meter distance from the EUT. The frequency range from 30MHz to 960MHz was investigated using a peak detector function with the bilog antenna at several heights, horizontal and vertical polarization, and with several different orientations of the EUT with respect to the antenna. The maximum levels for each antenna polarization were plotted. The resultant field strength (FS) is a summation in decibels (dB) of the receiver meter reading (MTR), the antenna correction factor (AF), and the cable loss factor (CF). If an external pre-amplifier is used, the total is reduced by its gain (-PA). If a distance correction (DC) is required, it is added to the total.

Formula 1: FS (dBuV/m) = MTR (dBuV) + AF (dB/m) + CF (dB) + (- PA (dB)) + DC (dB)

To convert the Field Strength dBuV/m term to uV/m, the dBuV/m is first divided by 20. The Base 10 AntiLog is taken of this quotient. The result is the Field Strength value in uV/m terms.

Formula 2: FS (uV/m) = AntiLog [(FS (dBuV/m))/20]

Final radiated emissions were performed on all significant broadband and narrowband emissions found in the

preliminary sweeps using the following methods:

1) Measurements from 30MHz to 1GHz were made using a quasi-peak detector and a broadband bilog antenna.

2) To ensure that maximum or worst case, emission levels were 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.

5.5.3.Results

The preliminary plots and tabular data for the EUT are presented on pages 66 through 68. The EUT was modified by placing a Fair-Rite brand ferrite bead model number 0431176451 on the input power lead in order the reduced the radiated emission level below the specification level. As can be seen from the data, with this ferrite bead in place all emissions measured were within the specification limits.

Photographs of the test configuration which yielded the highest or worst case, radiated emission levels are shown on Figure 2.

6. OTHER TEST CONDITIONS

6.1. Test Personnel and Witnesses

All tests were performed by qualified personnel from Elite Electronic Engineering Incorporated.

6.2. Disposition of the EUT

The EUT and all associated equipment were returned to Caterpillar Underground Mining Pty Ltd upon completion of the tests.

7. CONCLUSIONS

It was determined that the Caterpillar Underground Mining Pty Ltd PulsON 412, Model No. 447-0328, Serial No. 19994, with the Fair-Rite brand ferrite bead model 0431176451 in place did fully meet the radiated emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Subpart F for Ultra Wide Band Intentional Radiators, when tested per ANSI C63.4-2009.

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. 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	3/11/2014	3/11/2015
APW3	PREAMPLIFIER	PLANAR ELECTRONICS	PE2-35-120-5R0-10-12	PL2924	1GHZ-20GHZ	10/8/2013	10/8/2014
APW4	PREAMPLIFIER	PLANAR	PE2-36-2D540G-5R0-10	PL3043/0651	26.5GHZ-40GHZ		
NHG0	STANDARD GAIN HORN ANTENNA	NARDA	638	---	18-26.5GHZ	NOTE 1	
NHH0	STANDARD GAIN HORN ANTENNA	NARDA	V637	---	26.5-40GHZ	NOTE 1	
NTA2	BILOG ANTENNA	TESEQ	6112D	28040	25-1000MHz	8/30/2013	8/30/2014
NWQ2	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS LINDGREN	3117	66659	1GHZ-18GHZ	3/20/2014	3/20/2015
RAKG	RF SECTION	HEWLETT PACKARD	85462A	3549A00284	0.009-6500MHZ	3/20/2014	3/20/2015
RAKH	RF FILTER SECTION	HEWLETT PACKARD	85460A	3448A00324	---	3/20/2014	3/20/2015
RBB0	EMI TEST RECEIVER 20HZ TO 40 GHZ.	ROHDE & SCHWARZ	ESIB40	100250	20 HZ TO 40GHZ	3/11/2014	3/11/2015
RBD1	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESU40	100009	20Hz-40GHz	12/9/2013	12/9/2014
WKA1	SOFTWARE, UNIVERSAL RCV EMI	ELITE	UNIV_RCV_EMI	1	---	I/O	
WQB0	RE_8546A						

I/O: Initial Only
N/A: Not Applicable
Note 1: For the purpose of this test, the equipment was calibrated over the specified frequency range, pulse rate, or modulation prior to the test or monitored by a calibrated instrument.

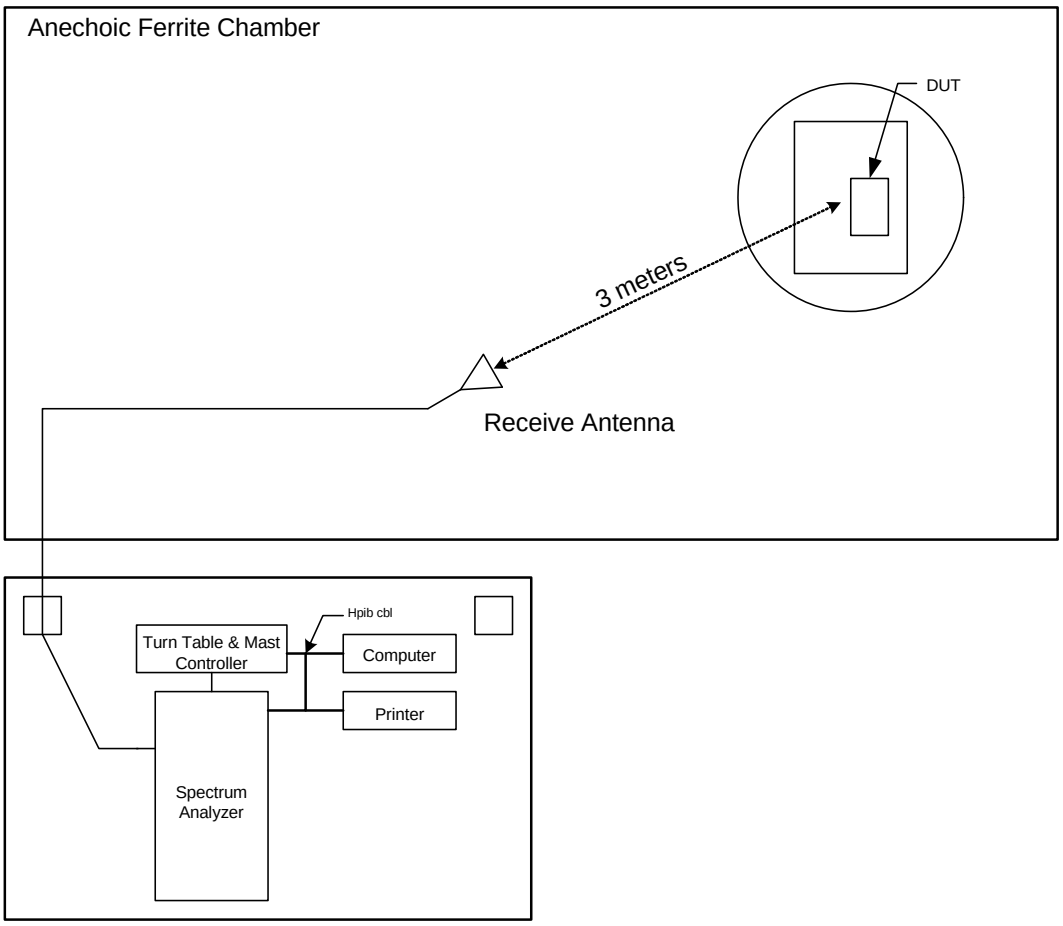
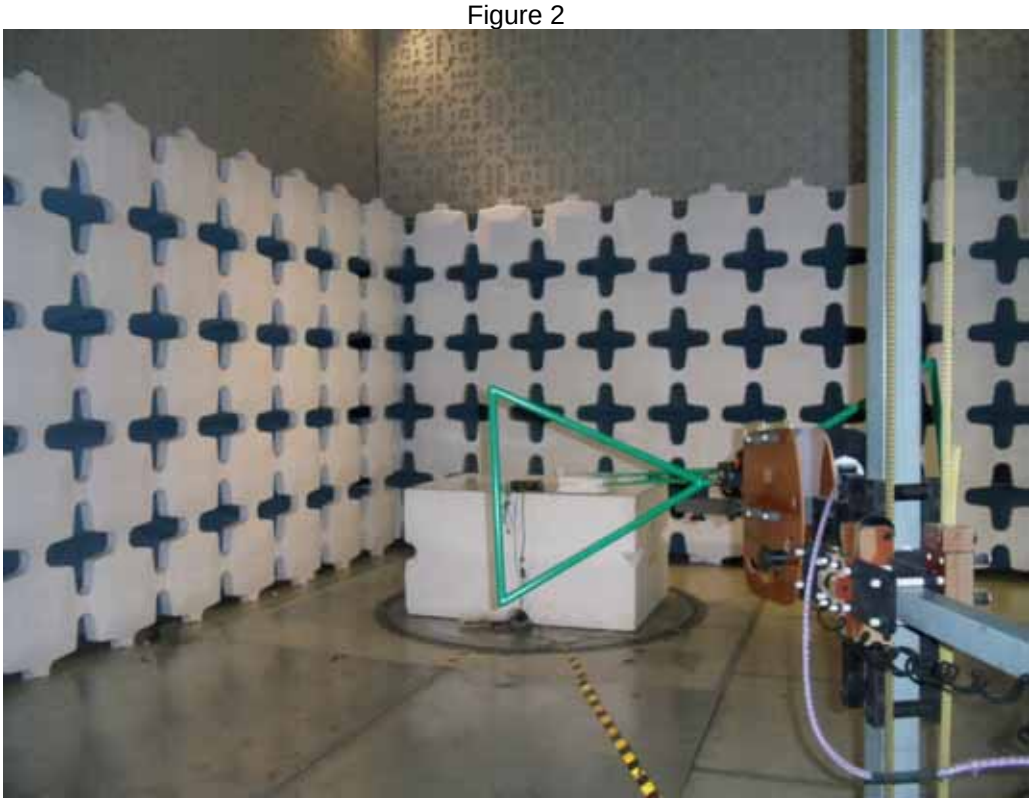


FIGURE 1 BLOCKDIAGRAM OF TEST SETUP

Figure 2



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

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

Figure 3

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

Test Setup for Radiated Emissions, Above 1GHz – Vertical Polarization at 1Meter

Date: 24.JUL.2014 11:30:12

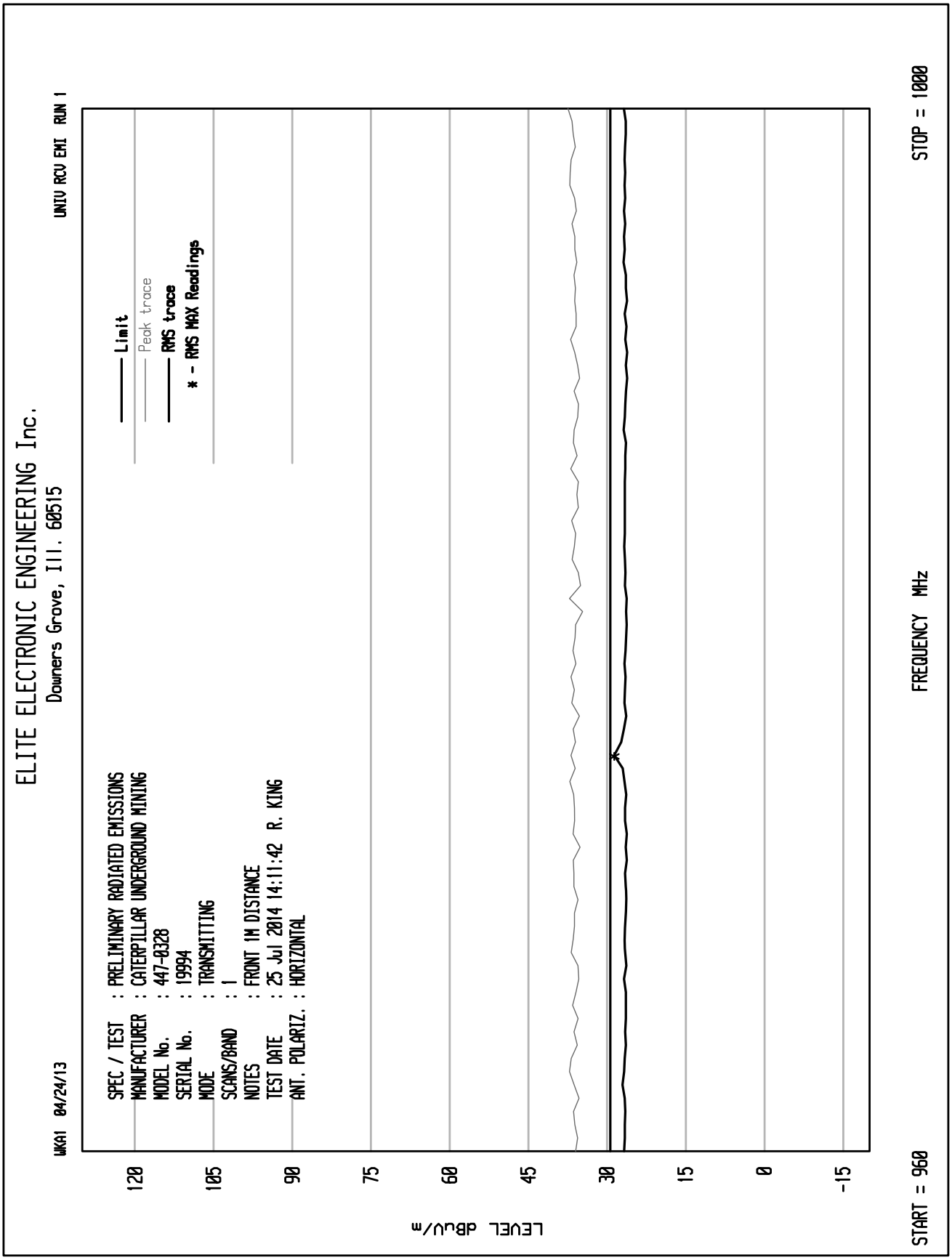
MANUFACTURER	:	Carerpillar Underground Mining
MODEL NUMBER	:	447-0328
SERIAL NUMBER	:	19994
TEST MODE	:	Transmit
TEST PARAMETER	:	Evaluation of -10dB bandwidth
EQUIPMENT USED	:	NWQ2, APW3, RBD1
NOTES	:	f_m = 4.042 GHz
	:	

Date: 24.JUL.2014 11:31:32

MANUFACTURER	:	Carerpillar Underground Mining
MODEL NUMBER	:	447-0328
SERIAL NUMBER	:	19994
TEST MODE	:	Transmit
TEST PARAMETER	:	Evaluation of -10dB bandwidth
EQUIPMENT USED	:	NWQ2, APW3, RBD1
NOTES	:	f_L = 3.177 GHz
	:	

Date: 24.JUL.2014 11:33:33

MANUFACTURER	:	Carerpillar Underground Mining
MODEL NUMBER	:	447-0328
SERIAL NUMBER	:	19994
TEST MODE	:	Transmit
TEST PARAMETER	:	Evaluation of -10dB bandwidth
EQUIPMENT USED	:	NWQ2, APW3, RBD1
NOTES	:	f_H = 4.924 GHz
	:	


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 1
WKA1 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMITTING
SCANS/BAND : 1
NOTES : FRONT 1M DISTANCE
TEST DATE : 25 Jul 2014 14:11:42 R. KING
ANT. POLARIZ. : HORIZONTAL
Limit
Peak trace
RMS trace
* - RMS MAX Readings
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
-15
START = 960
FREQUENCY MHz
STOP = 1000

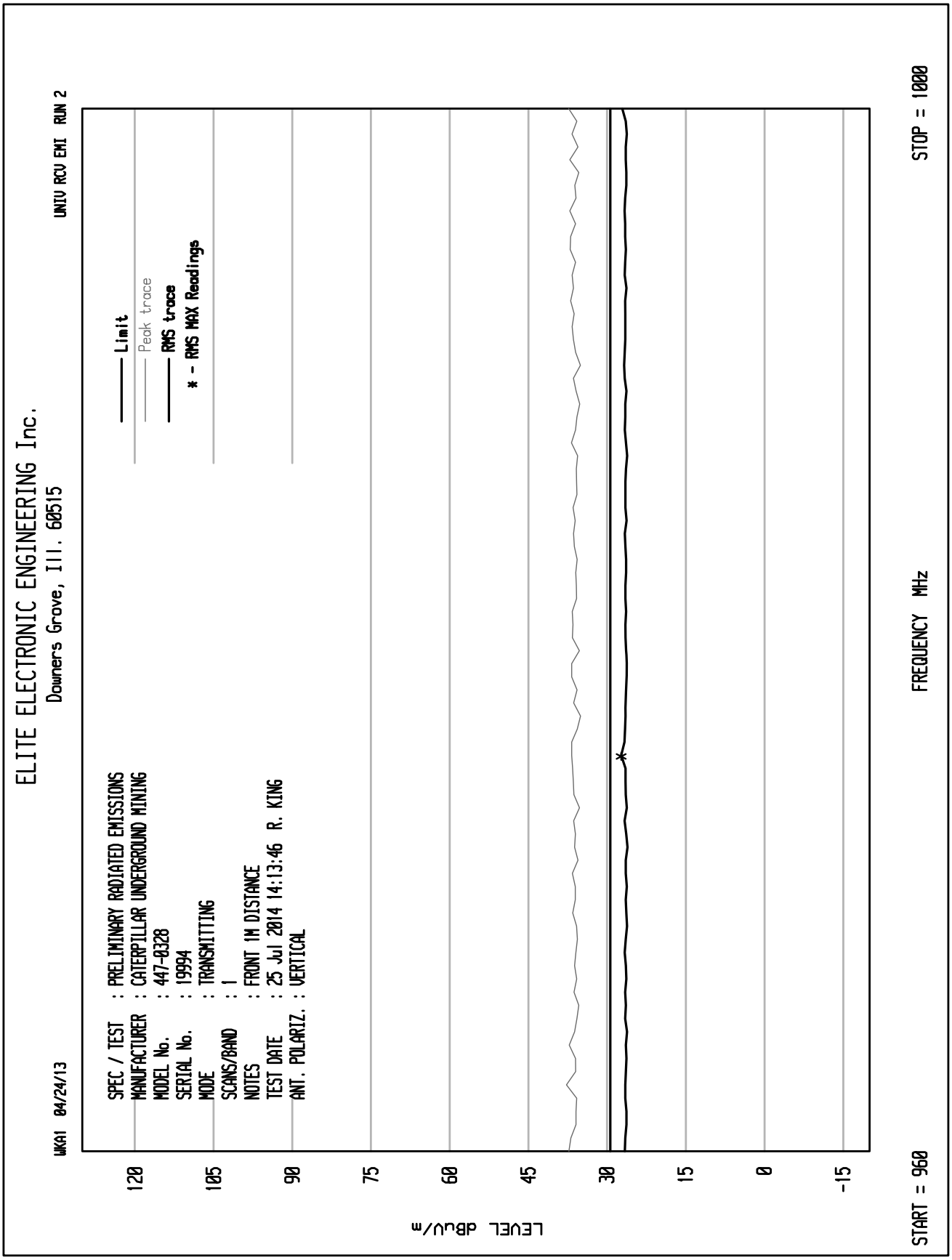
SIGNIFICANT EMISSIONS WKA1 04/24/13

SPEC/TEST : RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL : 447-0328
S/N : 19994
MODE : TRANSMITTING
NOTES : FRONT 1M DISTANCE
ANT. POLARIZ. : HORIZONTAL
TEST RANGE : 960 - 1000 MHz
TEST DATE : 25 Jul 2014 14:11:42 R. KING
PRINT CRITERIA : ALL PEAKS ABOVE -2 dB MARGIN FROM LIMIT
RUN NUMBER : 1

Freq MHz	RES BW MHz	STEP FREQ MHz	PEAK Rdg dBuV/m	RMS Rdg dBuV/m	Limit dBuV/m at 1M	Limit Margin dB	OVER LIMIT
975.000000	1.000000	.500000	36.9	28.6	29.4	-.8	
1000.000000	1.000000	.500000	37.5		29.4	8.1	

Checked BY Richard E. King :

Richard E. King


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 2
WKA1 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMITTING
SCANS/BAND : 1
NOTES : FRONT 1M DISTANCE
TEST DATE : 25 Jul 2014 14:13:46 R. KING
ANT. POLARIZ. : VERTICAL
Limit
Peak trace
RMS trace
* - RMS MAX Readings
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
-15
START = 960
FREQUENCY MHz
STOP = 1000

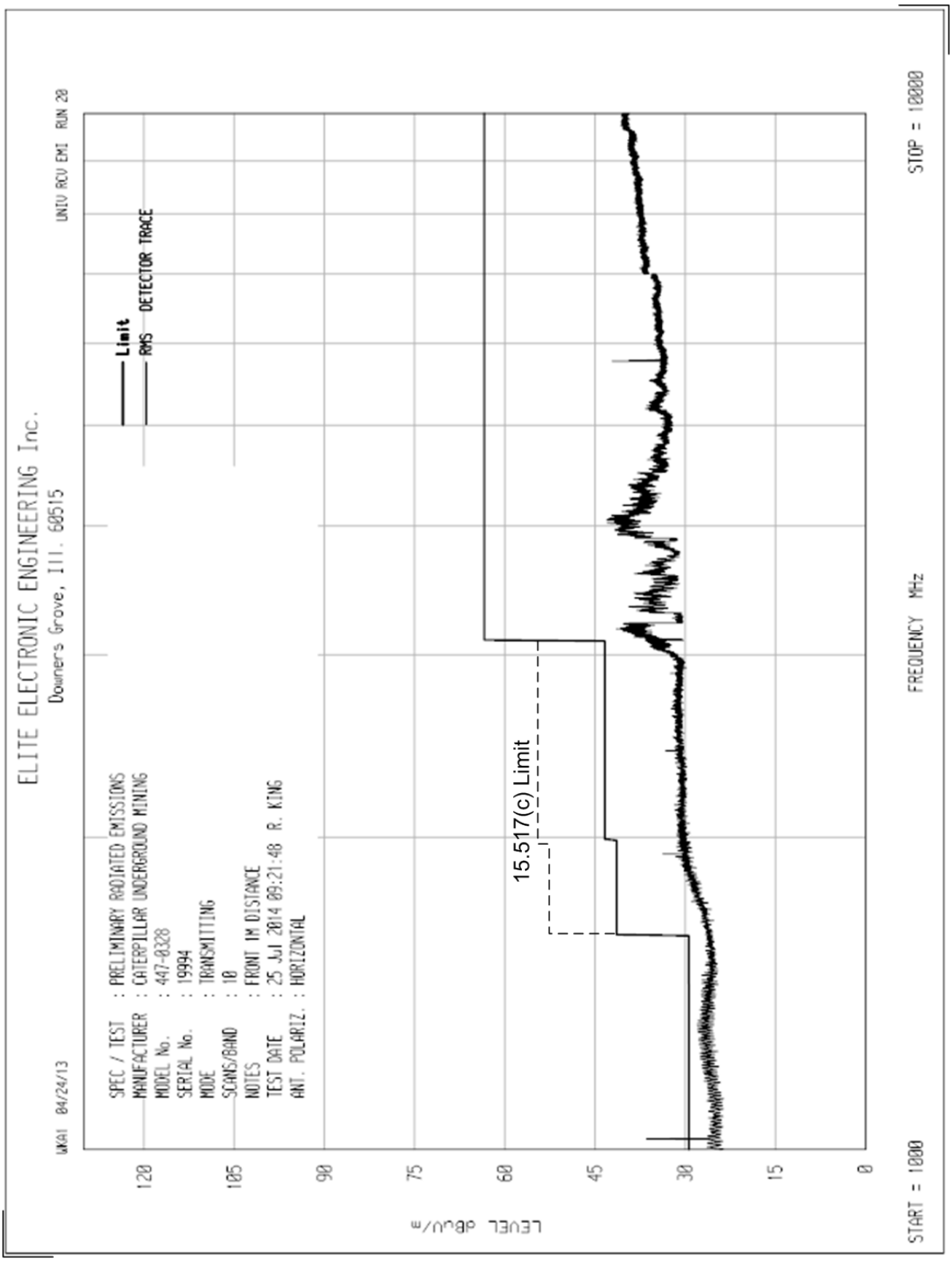
SIGNIFICANT EMISSIONS WKA1 04/24/13

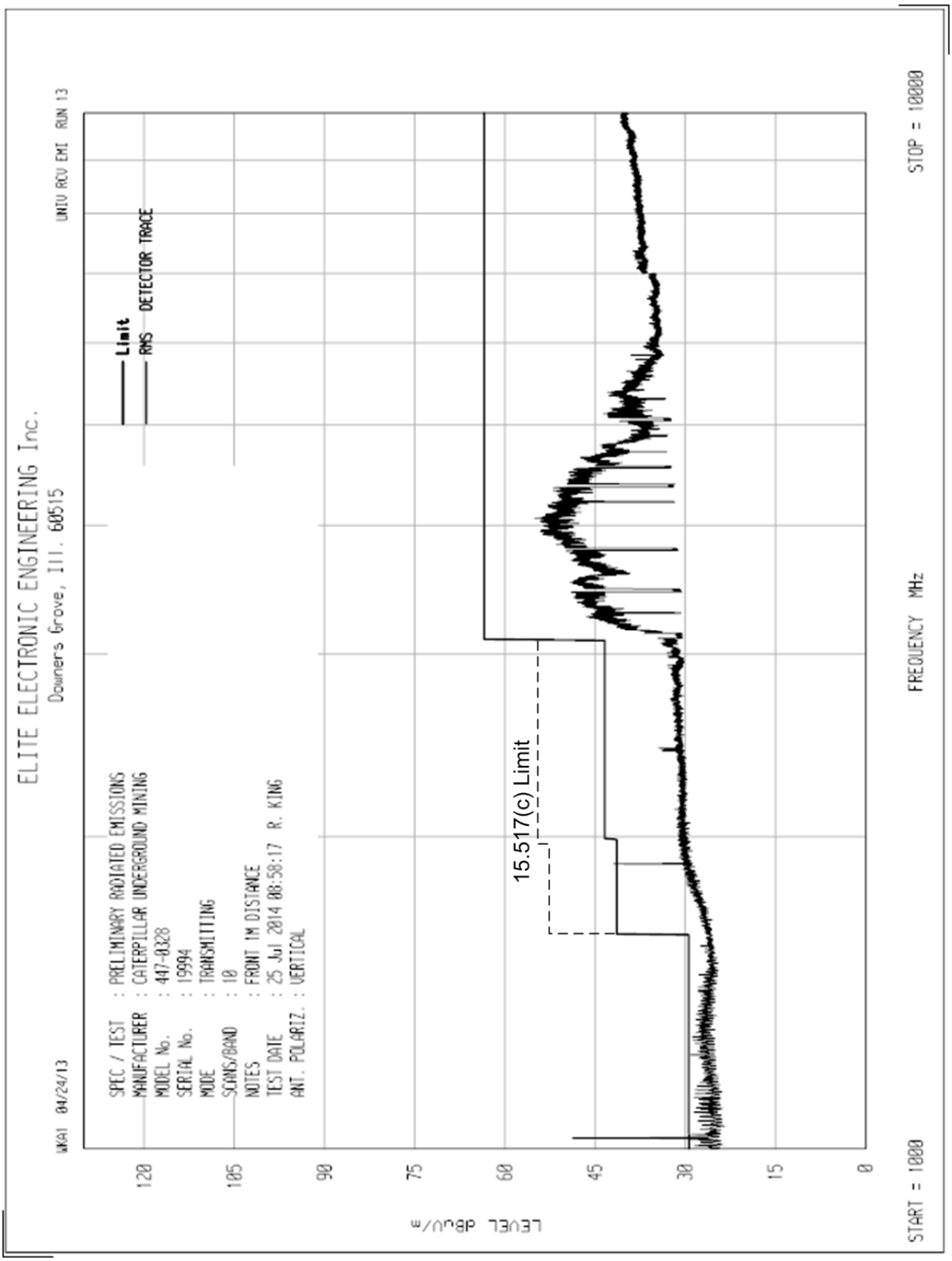
SPEC/TEST : RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL : 447-0328
S/N : 19994
MODE : TRANSMITTING
NOTES : FRONT 1M DISTANCE
ANT. POLARIZ. : VERTICAL
TEST RANGE : 960 - 1000 MHz
TEST DATE : 25 Jul 2014 14:13:46 R. KING
PRINT CRITERIA : ALL PEAKS ABOVE -2 dB MARGIN FROM LIMIT
RUN NUMBER : 2

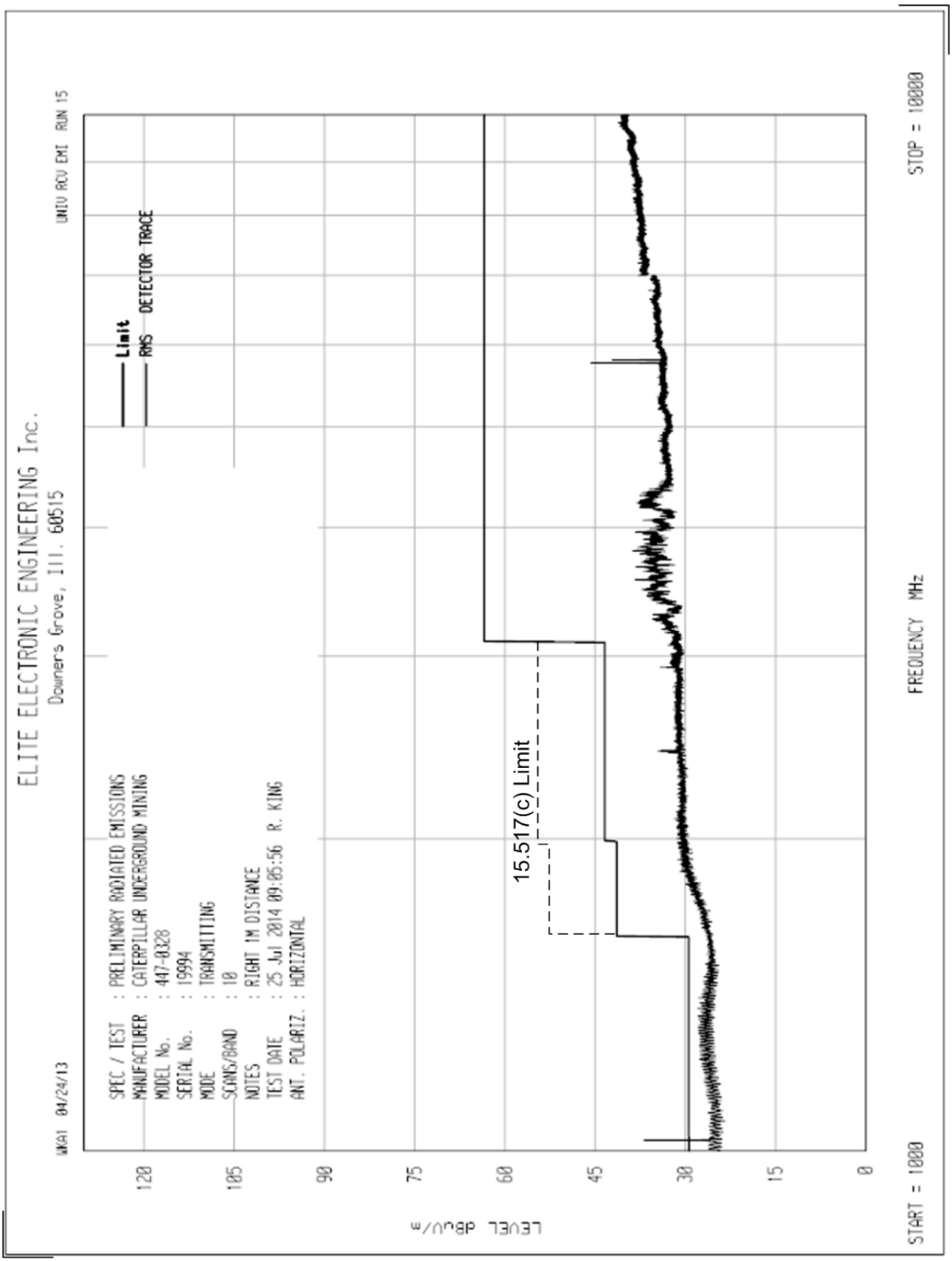
Freq MHz	RES BW MHz	STEP FREQ MHz	PEAK Rdg dBuV/m	RMS Rdg dBuV/m	Limit dBuV/m at 1M	Limit Margin dB	OVER LIMIT
962.500000	1.000000	.500000	37.7		29.4	8.3	
975.000000	1.000000	.500000	36.8	27.3	29.4	-2.1	

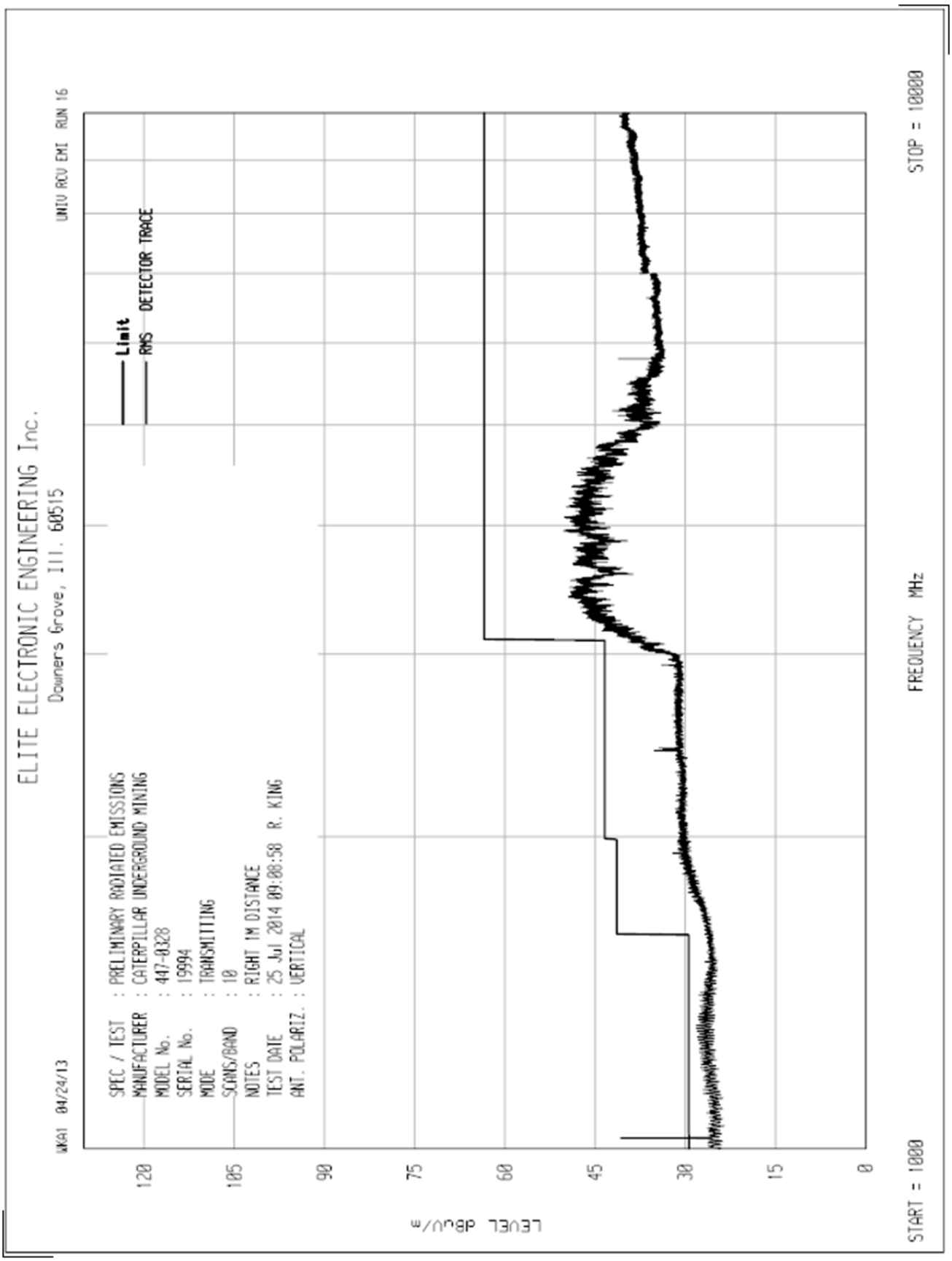
Checked BY Richard E. King :

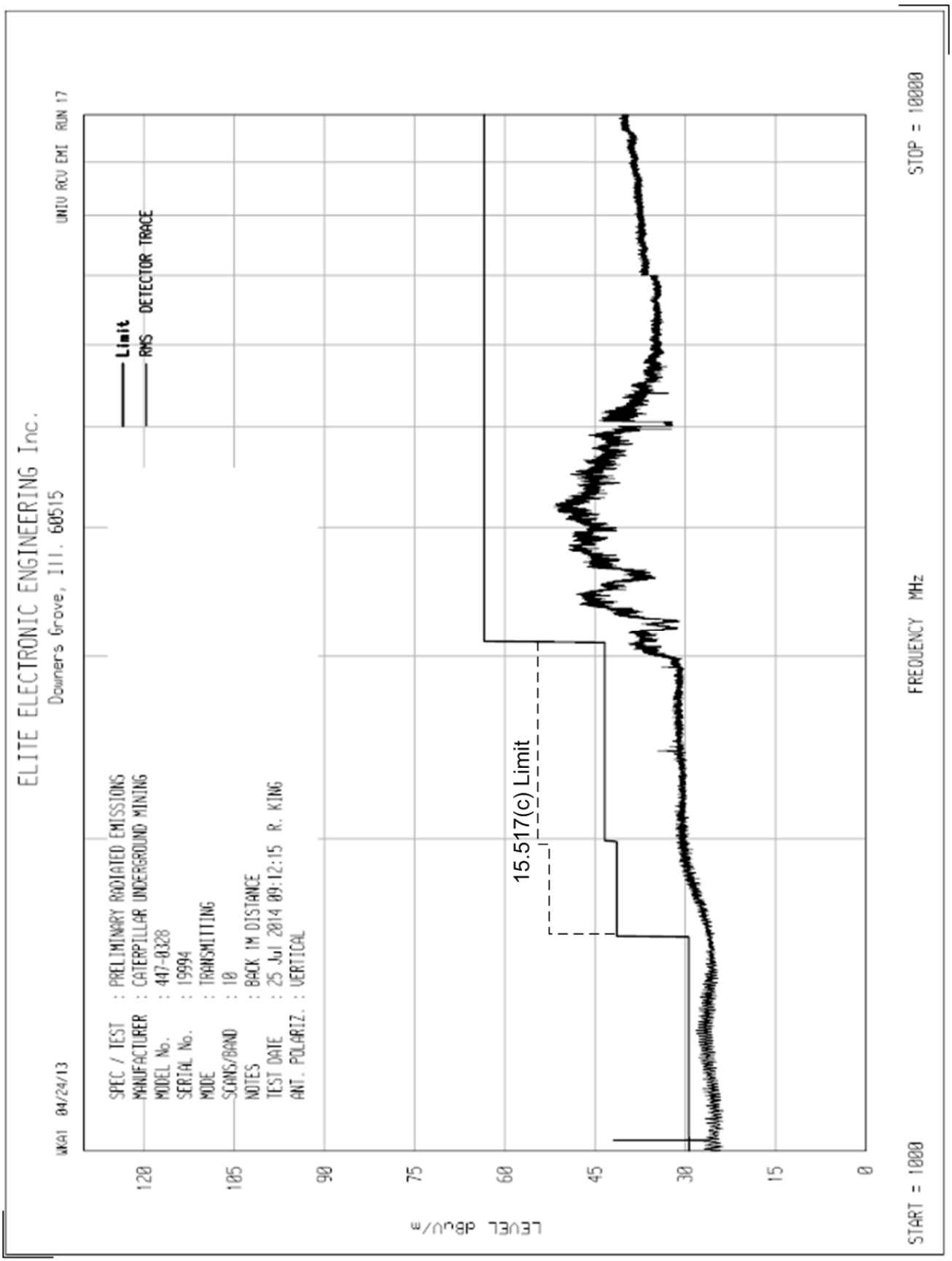
Richard E. King

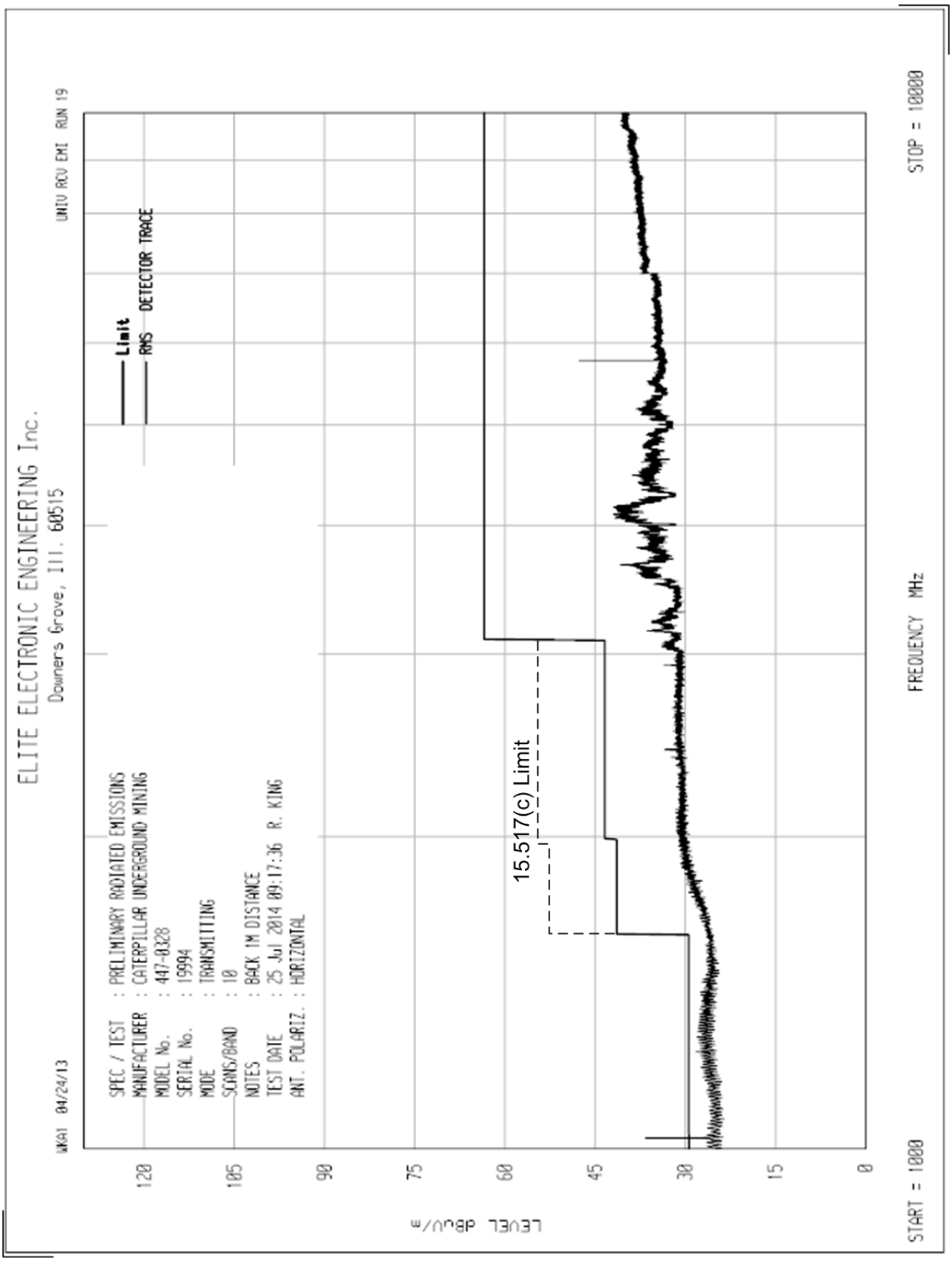

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 20
WKAI 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMITTING
SCANS/BAND : 10
NOTES : FRONT IM DISTANCE
TEST DATE : 25 Jul 2014 09:21:48 R. KING
ANT. POLARIZ. : HORIZONTAL
Limit
RMS DETECTOR TRACE
15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

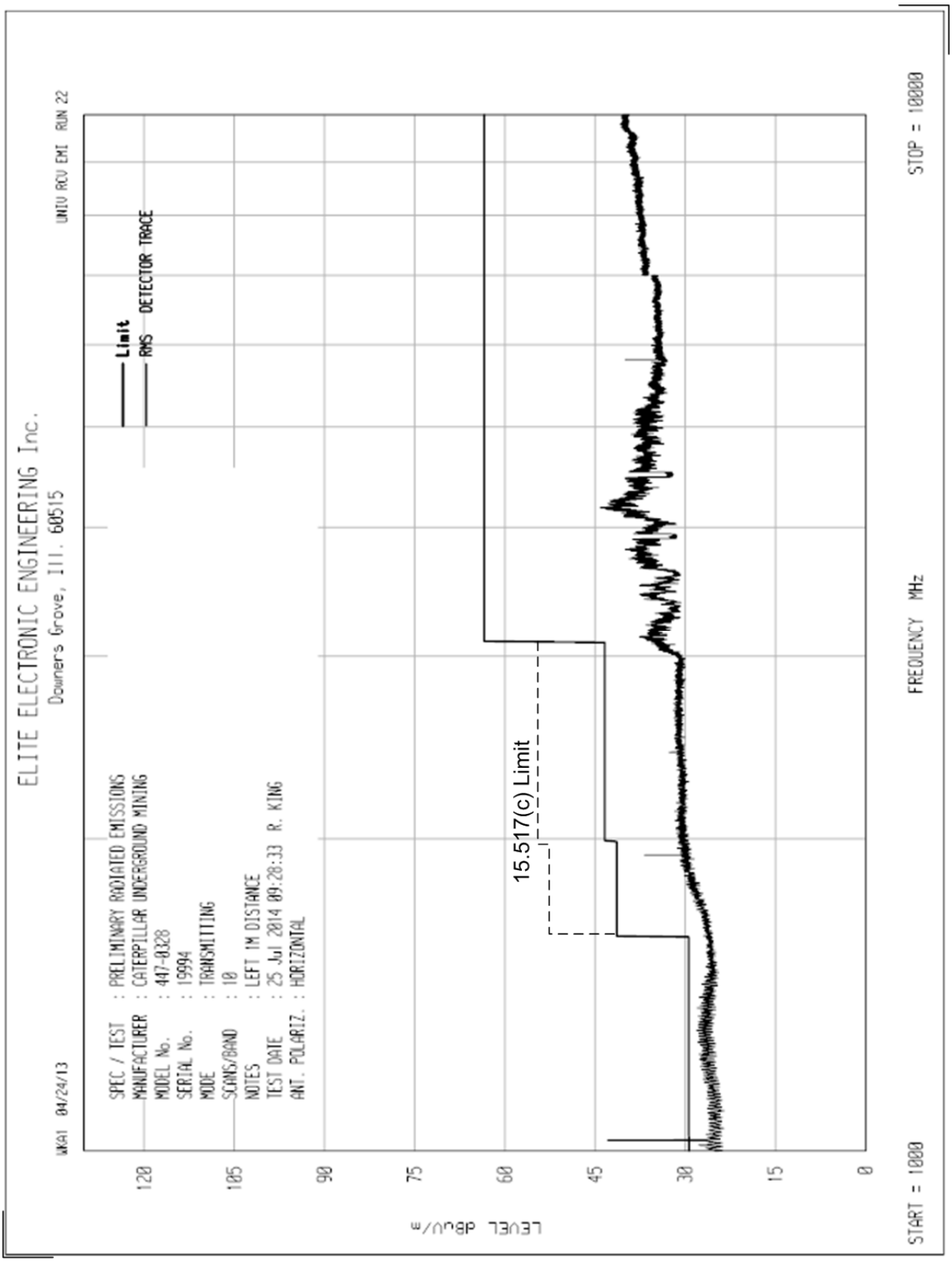

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 13
WKA1 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMITTING
SCANS/BAND : 10
NOTES : FRONT 1M DISTANCE
TEST DATE : 25 Jul 2014 08:58:17 R. KING
ANT. POLARIZ. : VERTICAL
Limit
RMS DETECTOR TRACE
15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

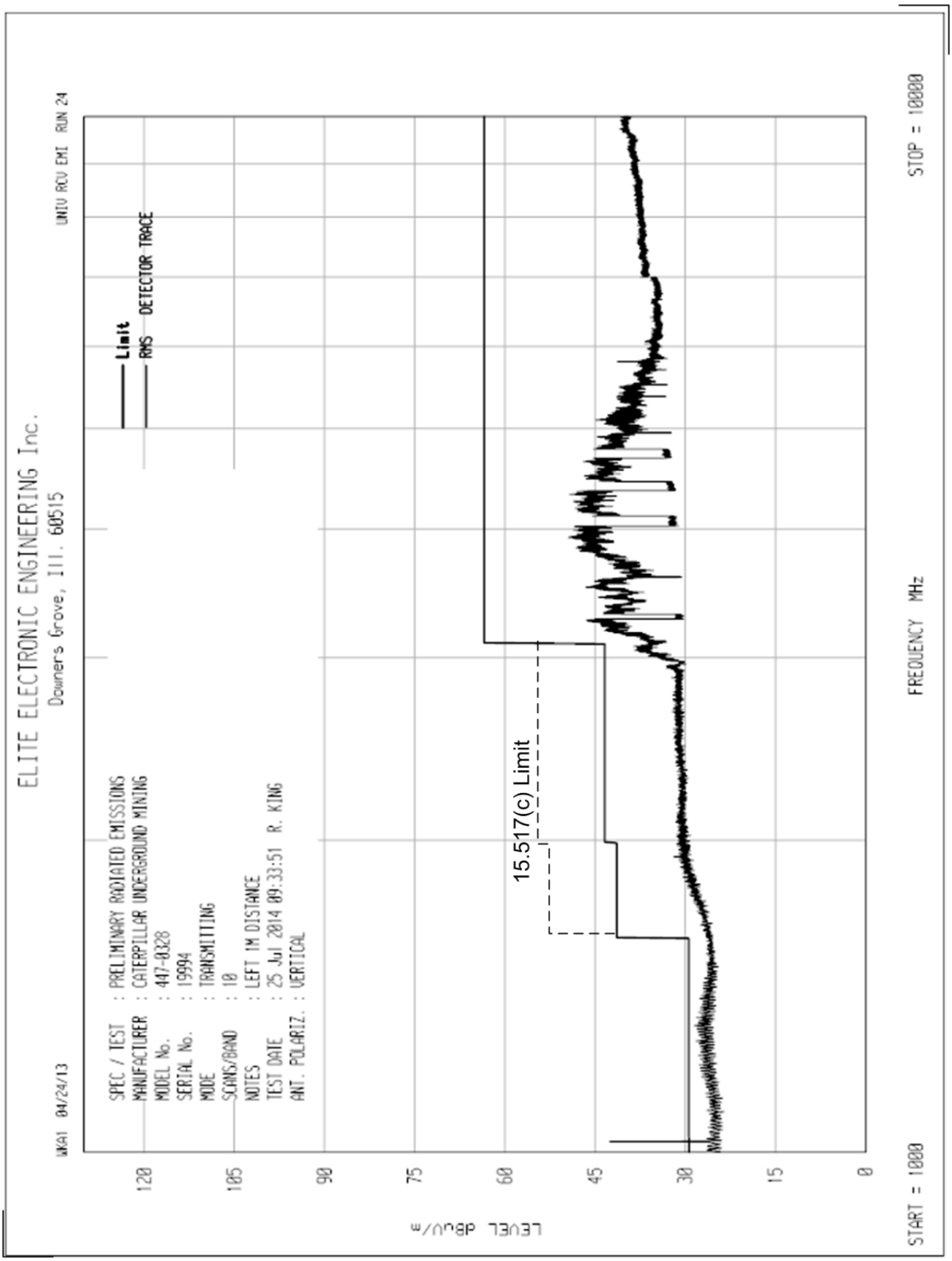

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 15
WKAI 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMITTING
SCANS/BAND : 10
NOTES : RIGHT 1M DISTANCE
TEST DATE : 25 Jul 2014 09:05:56 R. KING
ANT. POLARIZ. : HORIZONTAL
Limit
RMS DETECTOR TRACE
15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

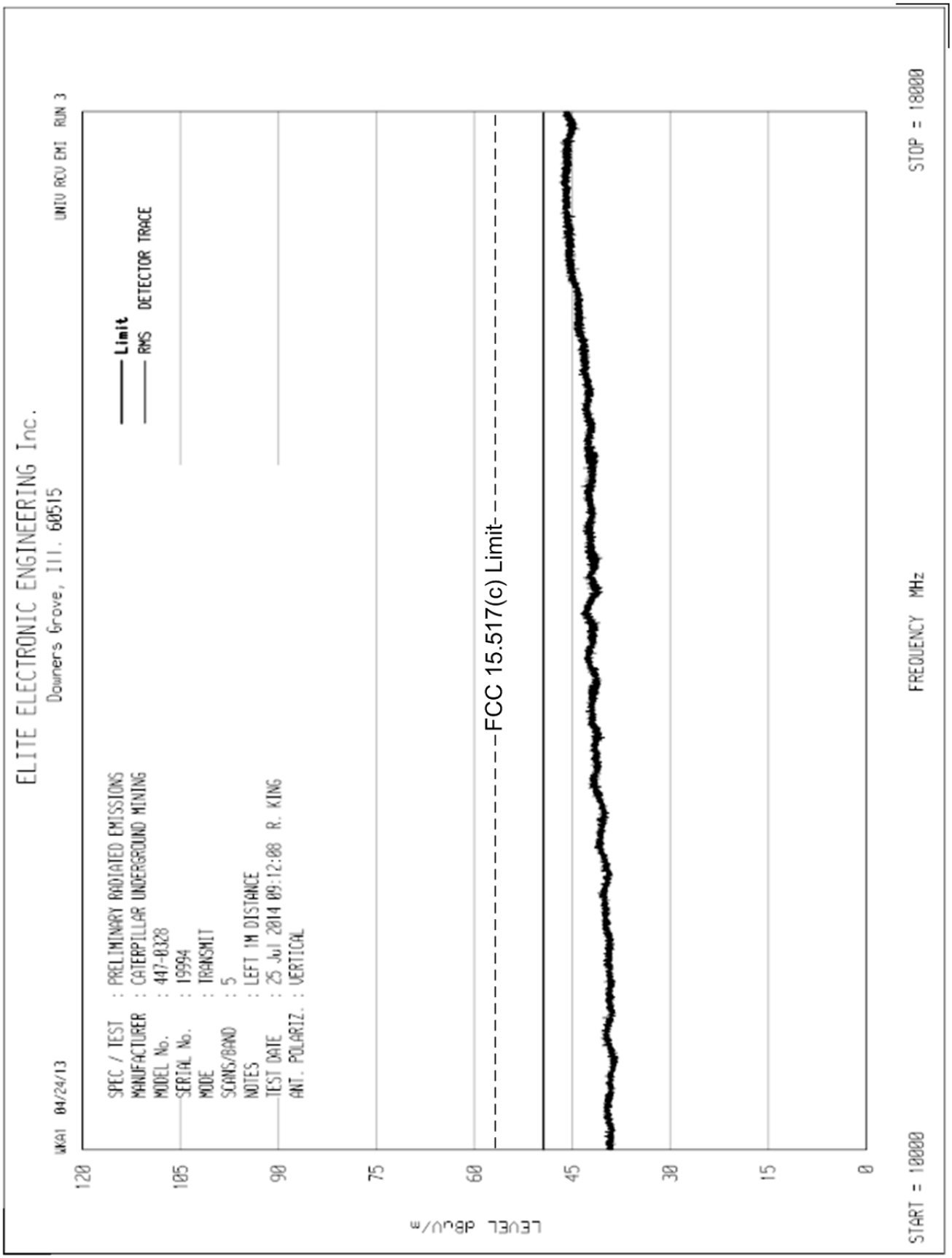

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 16
WKA1 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMITTING
SCANS/BAND : 10
NOTES : RIGHT 1M DISTANCE
TEST DATE : 25 Jul 2014 09:08:58 R. KING
ANT. POLARIZ. : VERTICAL
Limit
RMS DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

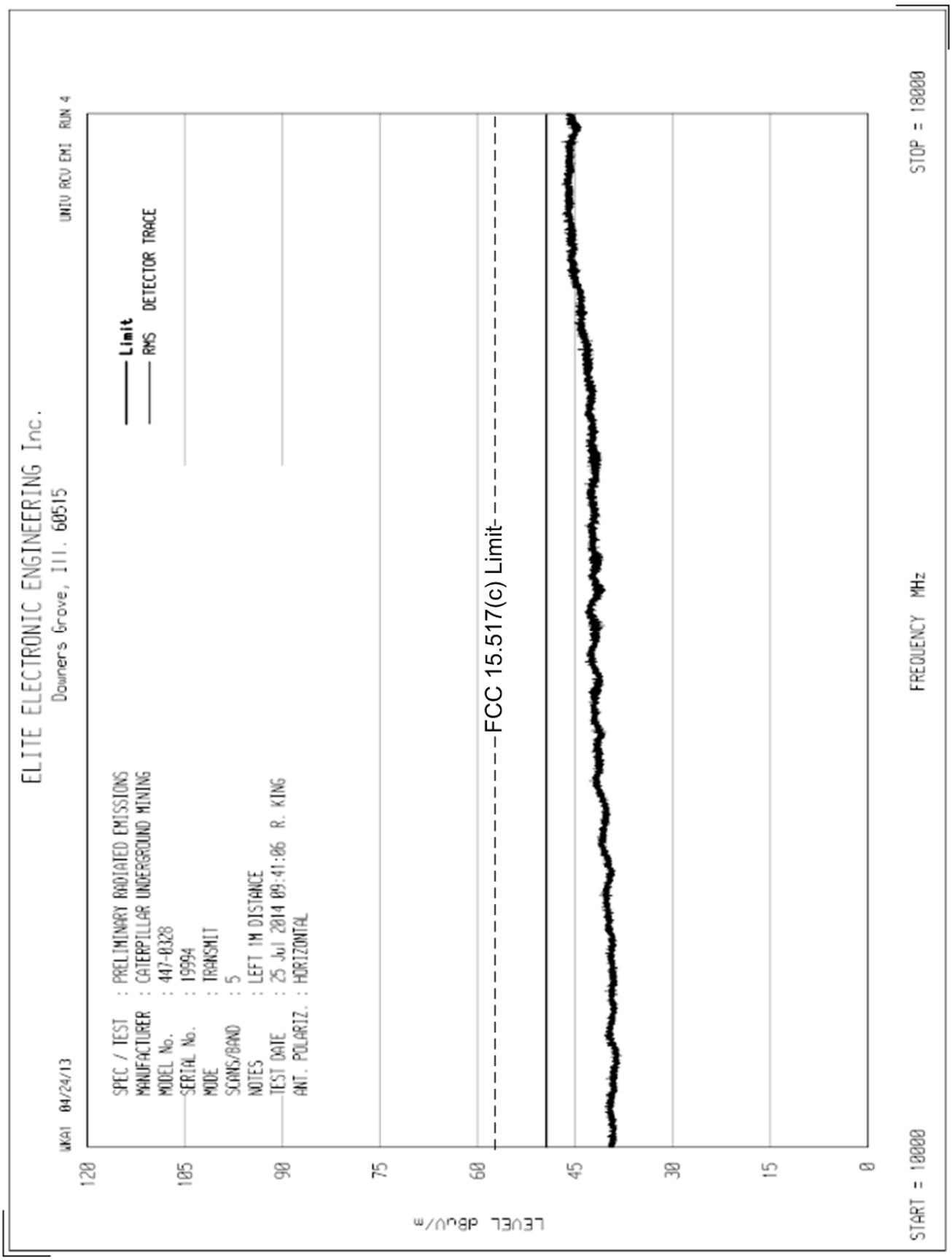

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 17
WKA1 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMITTING
SCANS/BAND : 10
NOTES : BACK 1M DISTANCE
TEST DATE : 25 Jul 2014 09:12:15 R. KING
ANT. POLARIZ. : VERTICAL
Limit
RMS DETECTOR TRACE
15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

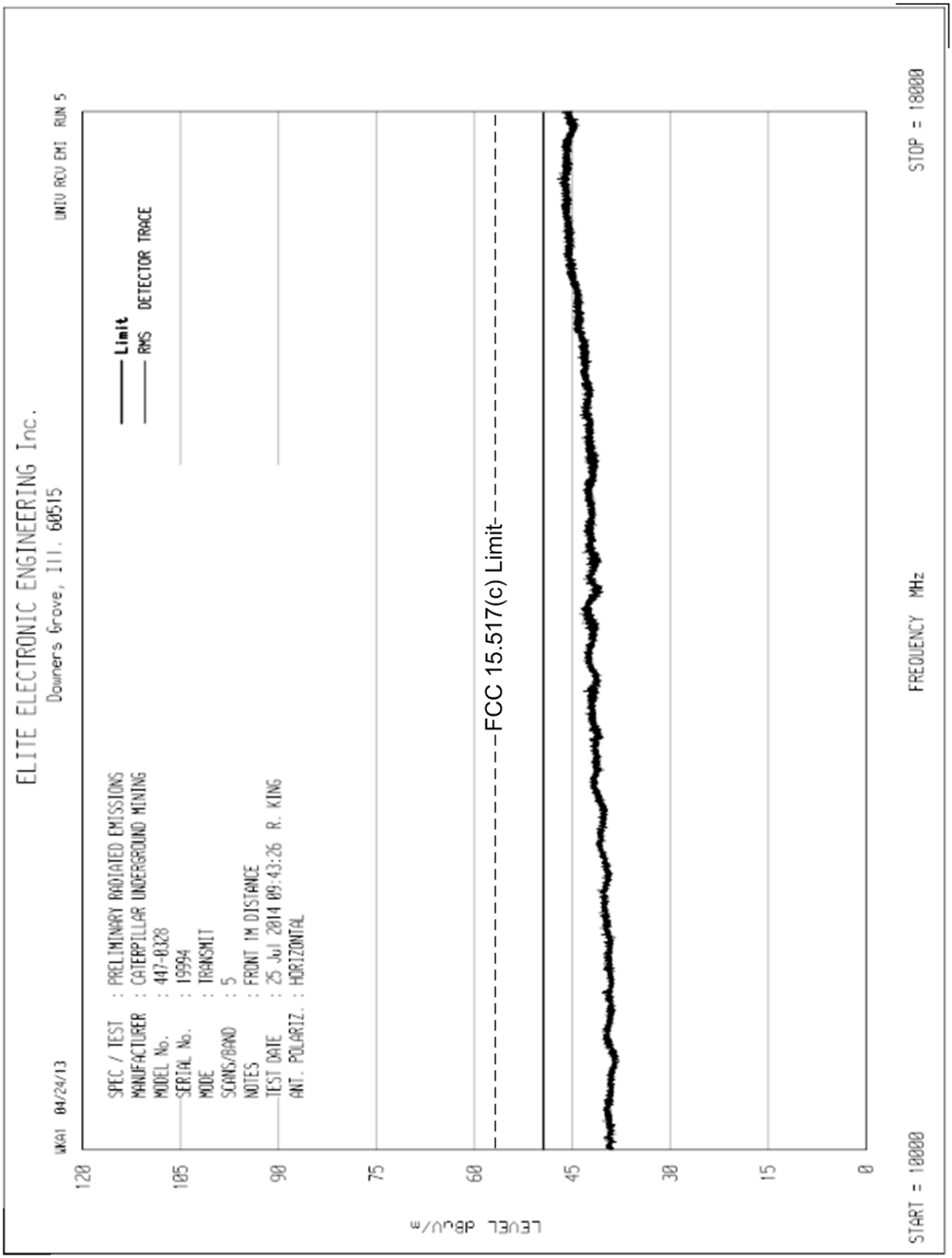

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 19
WKA1 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMITTING
SCANS/BAND : 10
NOTES : BACK 1M DISTANCE
TEST DATE : 25 Jul 2014 09:17:36 R. KING
ANT. POLARIZ. : HORIZONTAL
Limit
RMS DETECTOR TRACE
15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

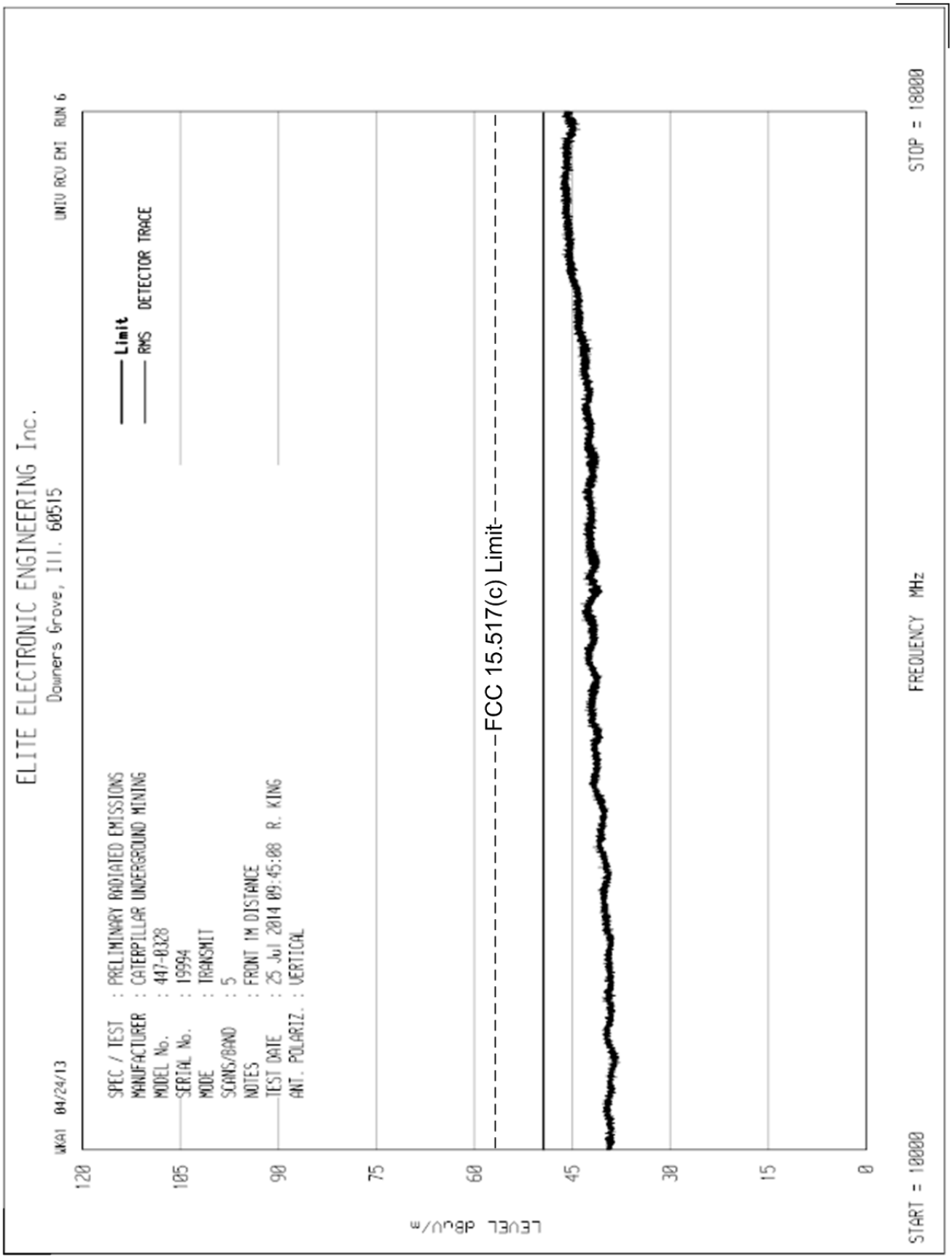

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 22
WKAI 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMITTING
SCANS/BAND : 10
NOTES : LEFT 1M DISTANCE
TEST DATE : 25 Jul 2014 09:28:33 R. KING
ANT. POLARIZ. : HORIZONTAL
Limit
RMS DETECTOR TRACE
15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

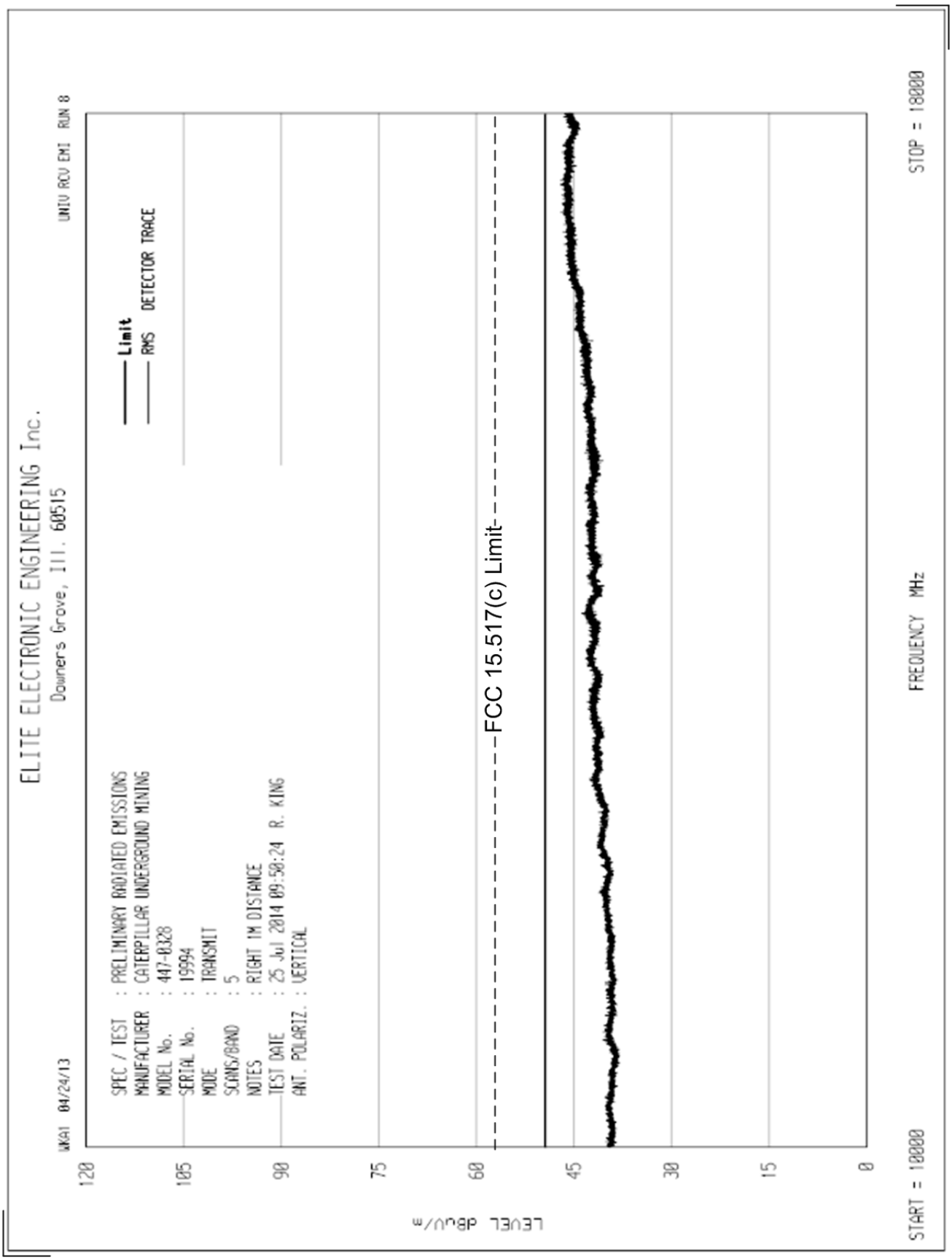

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKAI 04/24/13
UNIV RCV EMI RUN 24
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMITTING
SCANS/BAND : 10
NOTES : LEFT 1M DISTANCE
TEST DATE : 25 Jul 2014 09:33:51 R. KING
ANT. POLARIZ. : VERTICAL
Limit
RMS DETECTOR TRACE
15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

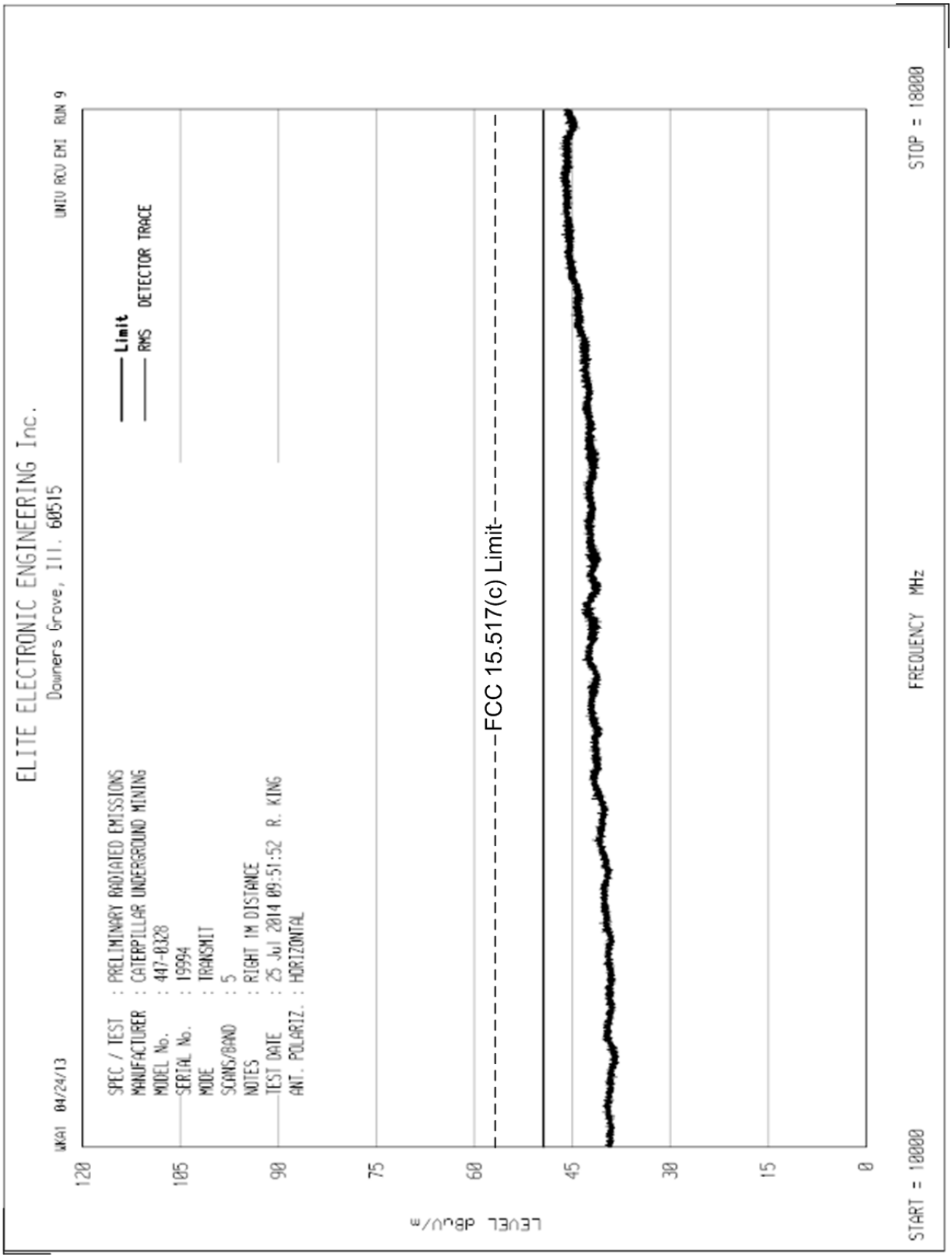

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 3
WKAI 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMIT
SCANS/BAND : 5
NOTES : LEFT 1M DISTANCE
TEST DATE : 25 Jul 2014 09:12:08 R. KING
ANT. POLARIZ. : VERTICAL
Limit
RMS DETECTOR TRACE
FCC 15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 10000
FREQUENCY MHz
STOP = 18000

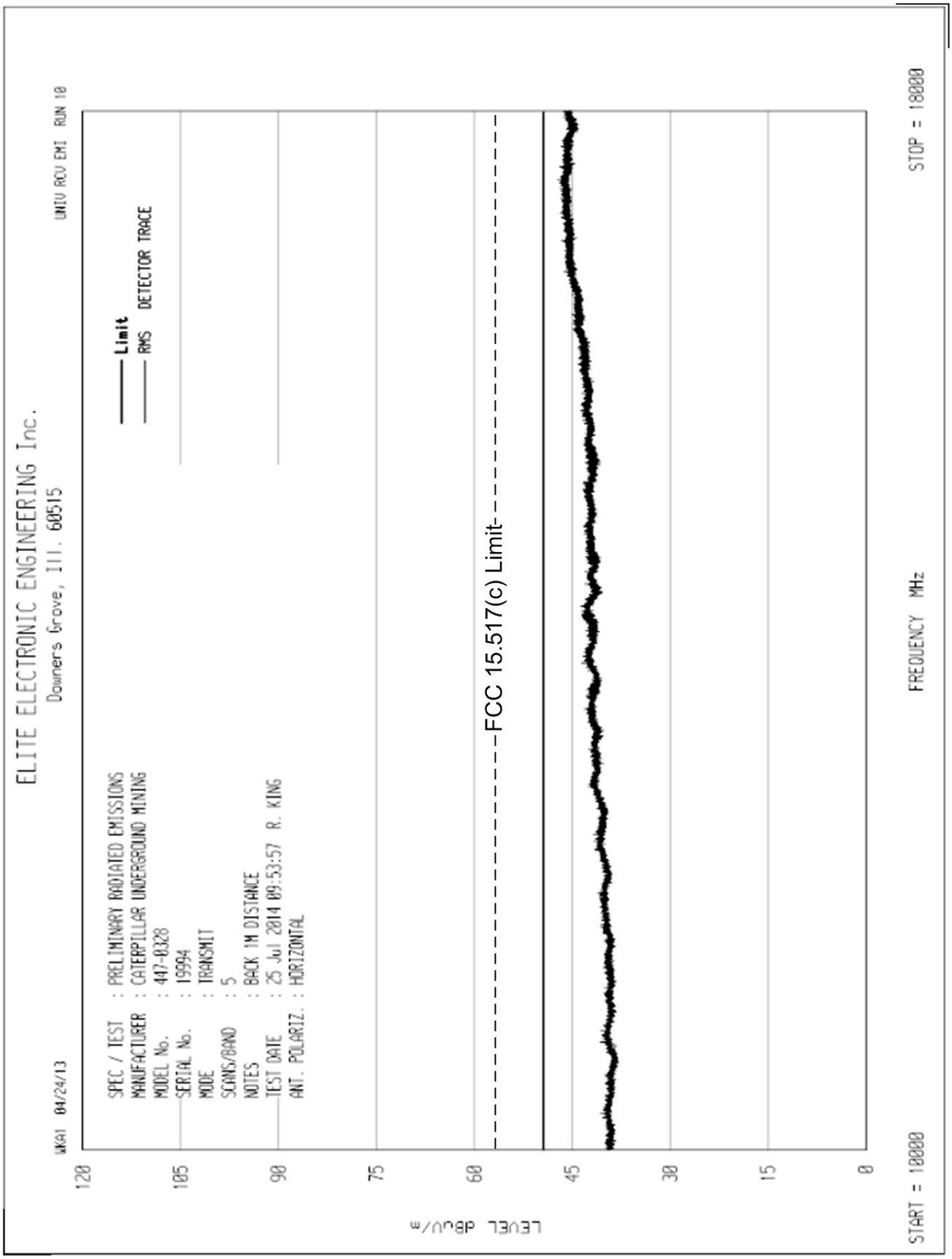

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 4
WKA1 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMIT
SCANS/BAND : 5
NOTES : LEFT 1M DISTANCE
TEST DATE : 25 Jul 2014 09:41:06 R. KING
ANT. POLARIZ. : HORIZONTAL
Limit
RMS DETECTOR TRACE
FCC 15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 10000
FREQUENCY MHz
STOP = 18000

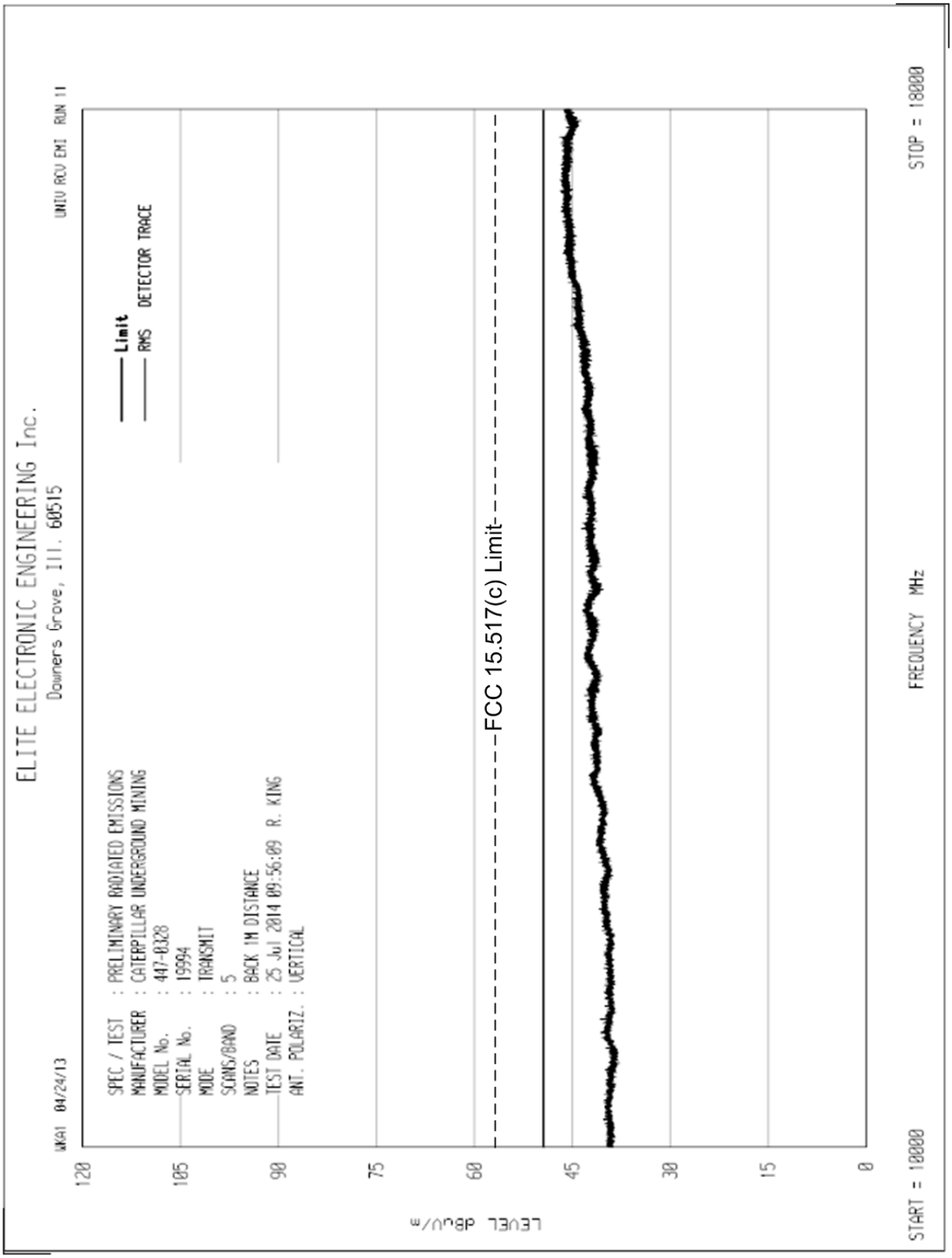

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 5
WKAI 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMIT
SCANS/BAND : 5
NOTES : FRONT 1M DISTANCE
TEST DATE : 25 Jul 2014 09:43:26 R. KING
ANT. POLARIZ. : HORIZONTAL
Limit
RMS DETECTOR TRACE
FCC 15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 10000
FREQUENCY MHz
STOP = 18000

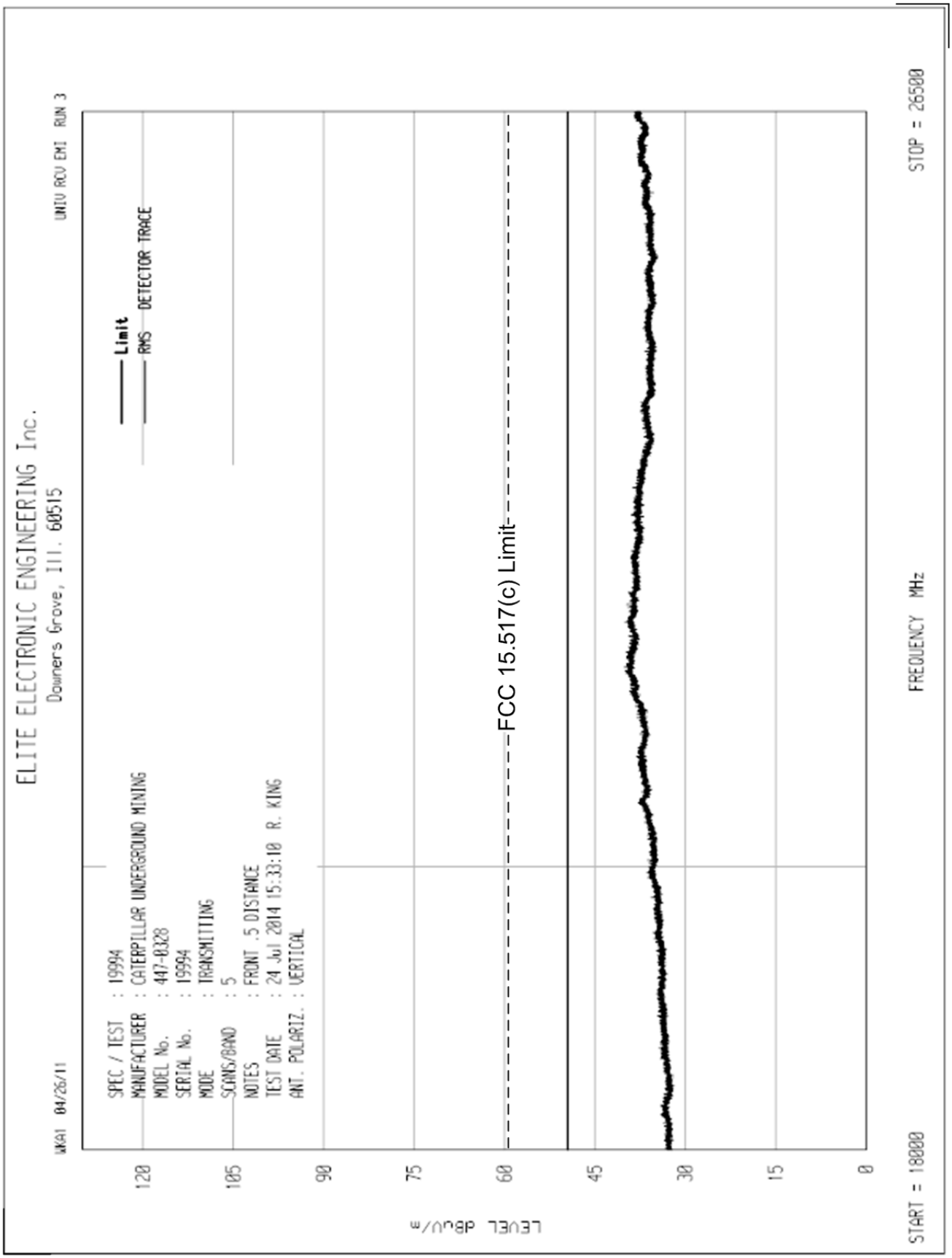

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 6
WKAI 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMIT
SCANS/BAND : 5
NOTES : FRONT IM DISTANCE
TEST DATE : 25 Jul 2014 09:45:08 R. KING
ANT. POLARIZ. : VERTICAL
Limit
RMS DETECTOR TRACE
FCC 15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 10000
FREQUENCY MHz
STOP = 18000

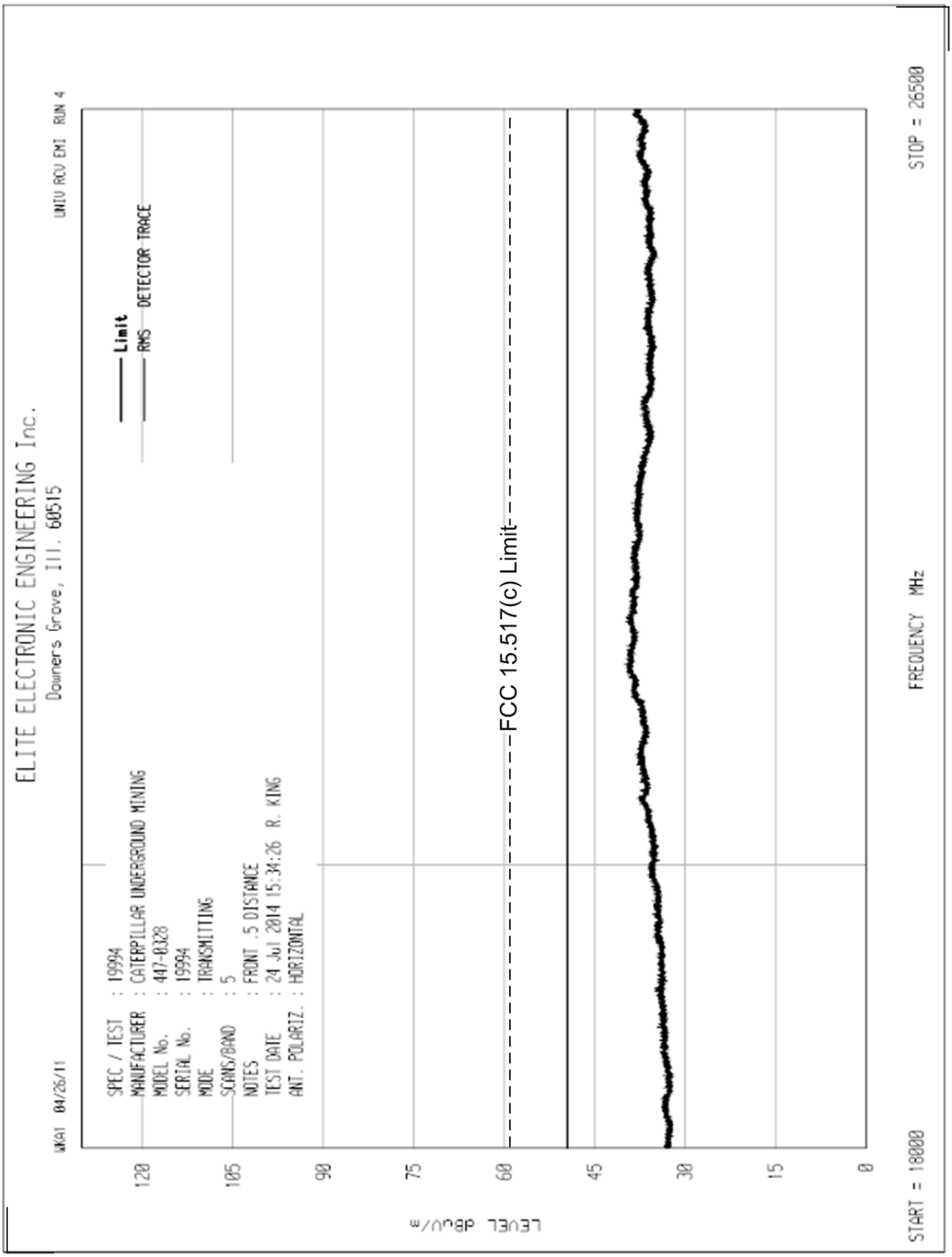

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 8
WKA1 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMIT
SCANS/BAND : 5
NOTES : RIGHT 1M DISTANCE
TEST DATE : 25 Jul 2014 09:58:24 R. KING
ANT. POLARIZ. : VERTICAL
Limit
RMS DETECTOR TRACE
FCC 15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 10000
FREQUENCY MHz
STOP = 18000

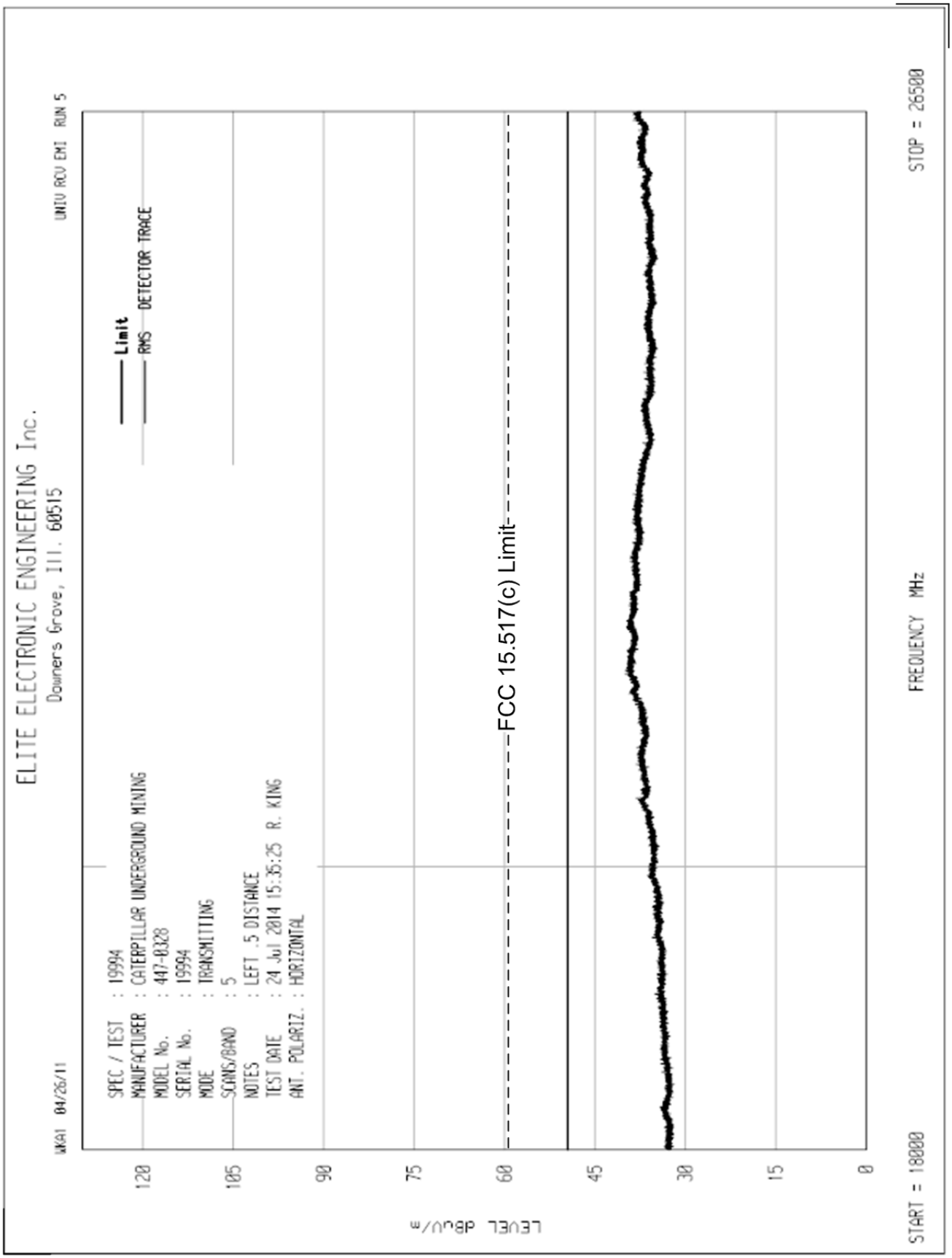

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV ROV EMI RUN 9
WKA1 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMIT
SCANS/BAND : 5
NOTES : RIGHT 1M DISTANCE
TEST DATE : 25 Jul 2014 09:51:52 R. KING
ANT. POLARIZ. : HORIZONTAL
Limit
RMS DETECTOR TRACE
FCC 15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 10000
FREQUENCY MHz
STOP = 18000

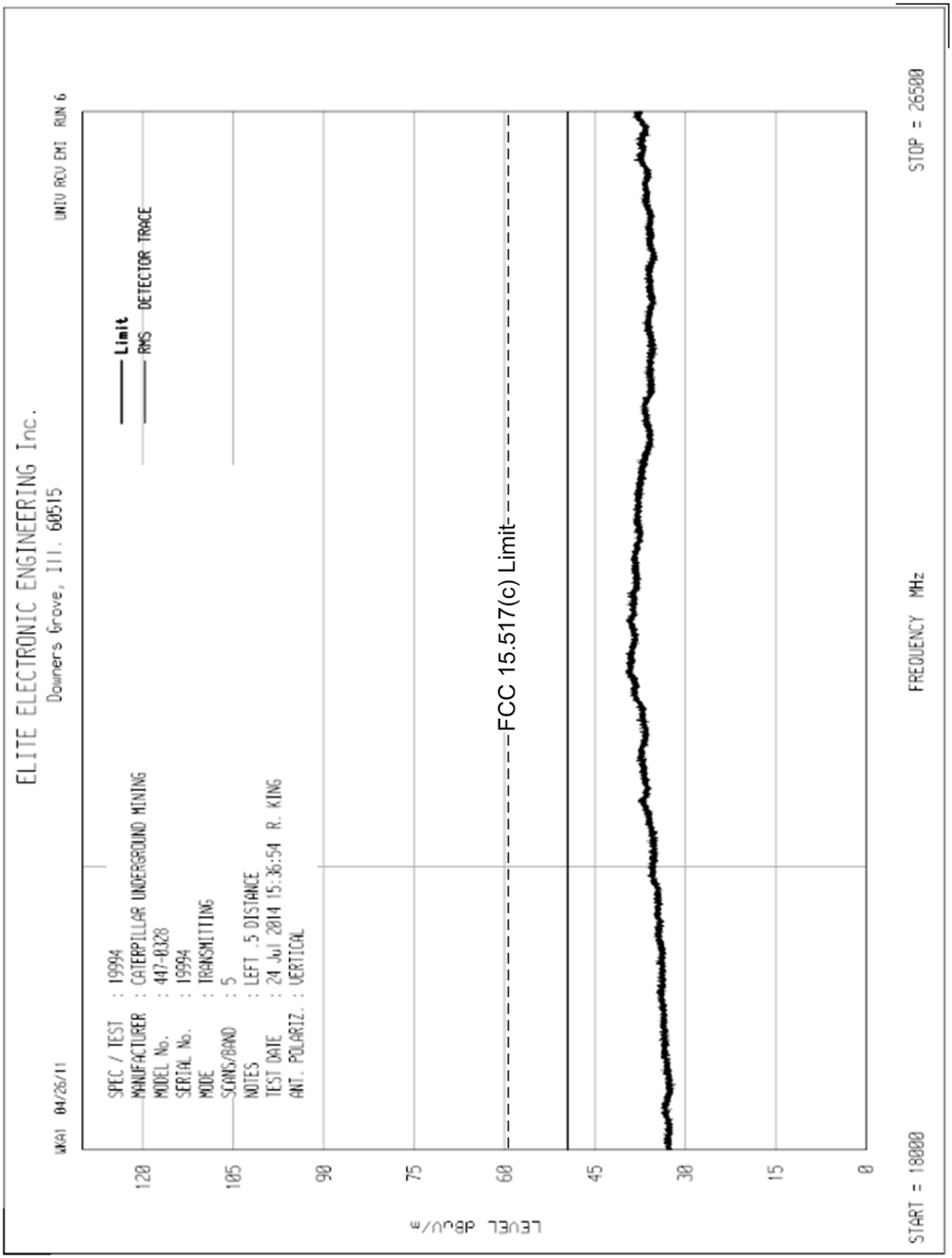

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKAI 04/24/13
UNIV RCV EMI RUN 10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMIT
SCANS/BAND : 5
NOTES : BACK 1M DISTANCE
TEST DATE : 25 Jul 2014 09:53:57 R. KING
ANT. POLARIZ. : HORIZONTAL
Limit
RMS DETECTOR TRACE
FCC 15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 10000
FREQUENCY MHz
STOP = 18000

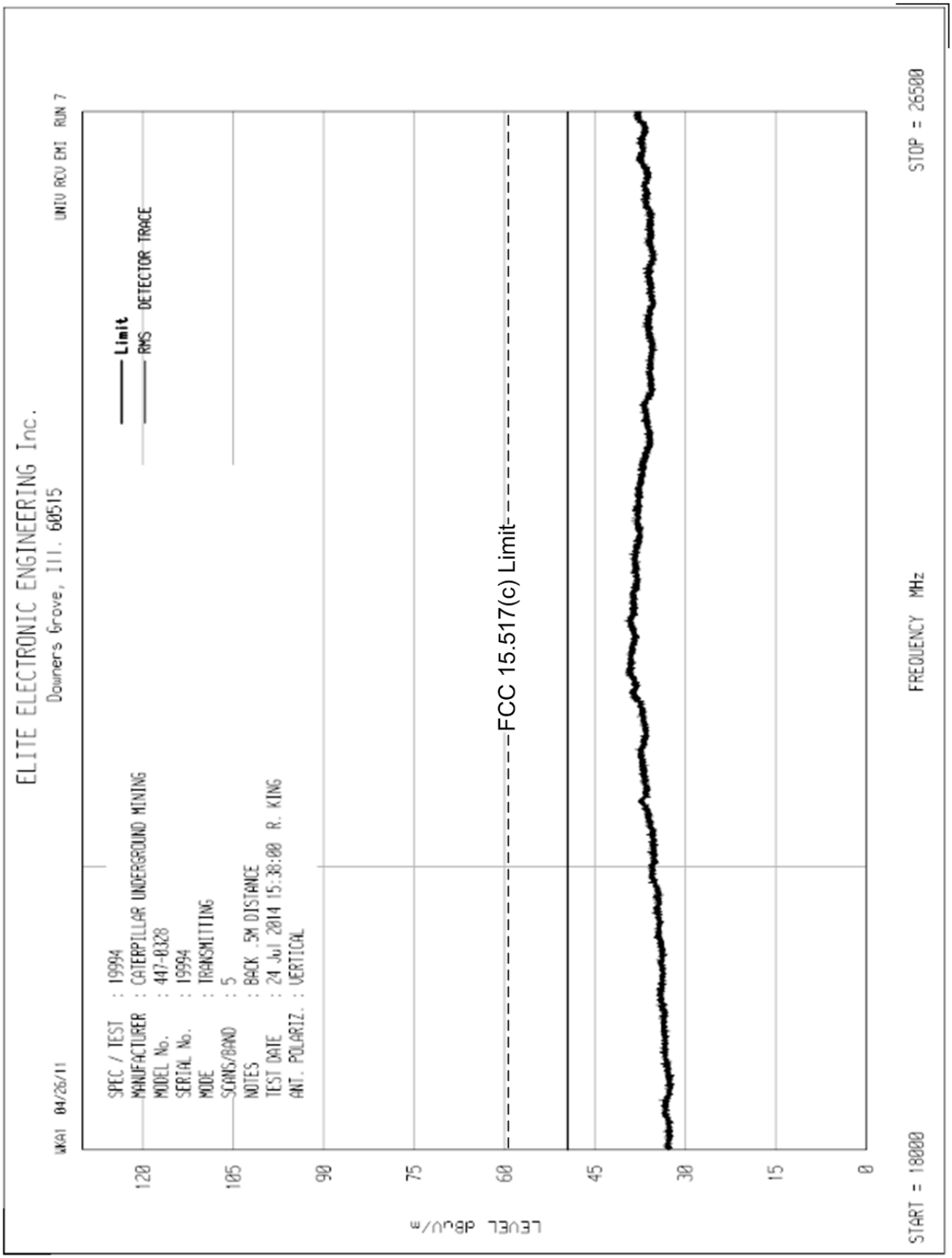

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV ROV EMI RUN 11
WKA1 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMIT
SCANS/BAND : 5
NOTES : BACK 1M DISTANCE
TEST DATE : 25 Jul 2014 09:56:09 R. KING
ANT. POLARIZ. : VERTICAL
Limit
RMS DETECTOR TRACE
FCC 15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 10000
FREQUENCY MHz
STOP = 18000

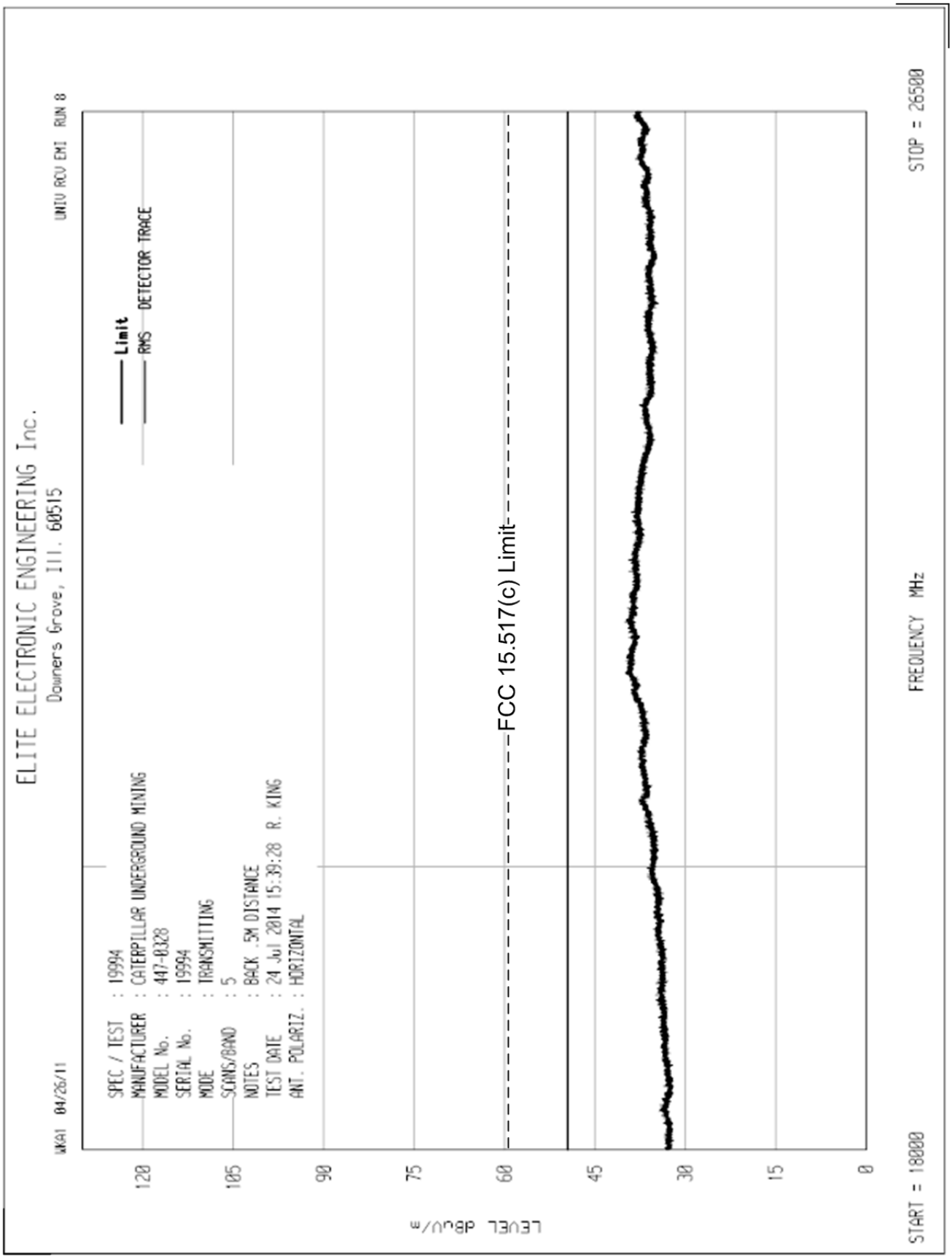

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 3
WKA1 04/26/11
SPEC / TEST : 19994
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMITTING
SCANS/BAND : 5
NOTES : FRONT .5 DISTANCE
TEST DATE : 24 Jul 2014 15:33:10 R. KING
ANT. POLARIZ. : VERTICAL
Limit
RMS DETECTOR TRACE
FCC 15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 18000
FREQUENCY MHz
STOP = 26500

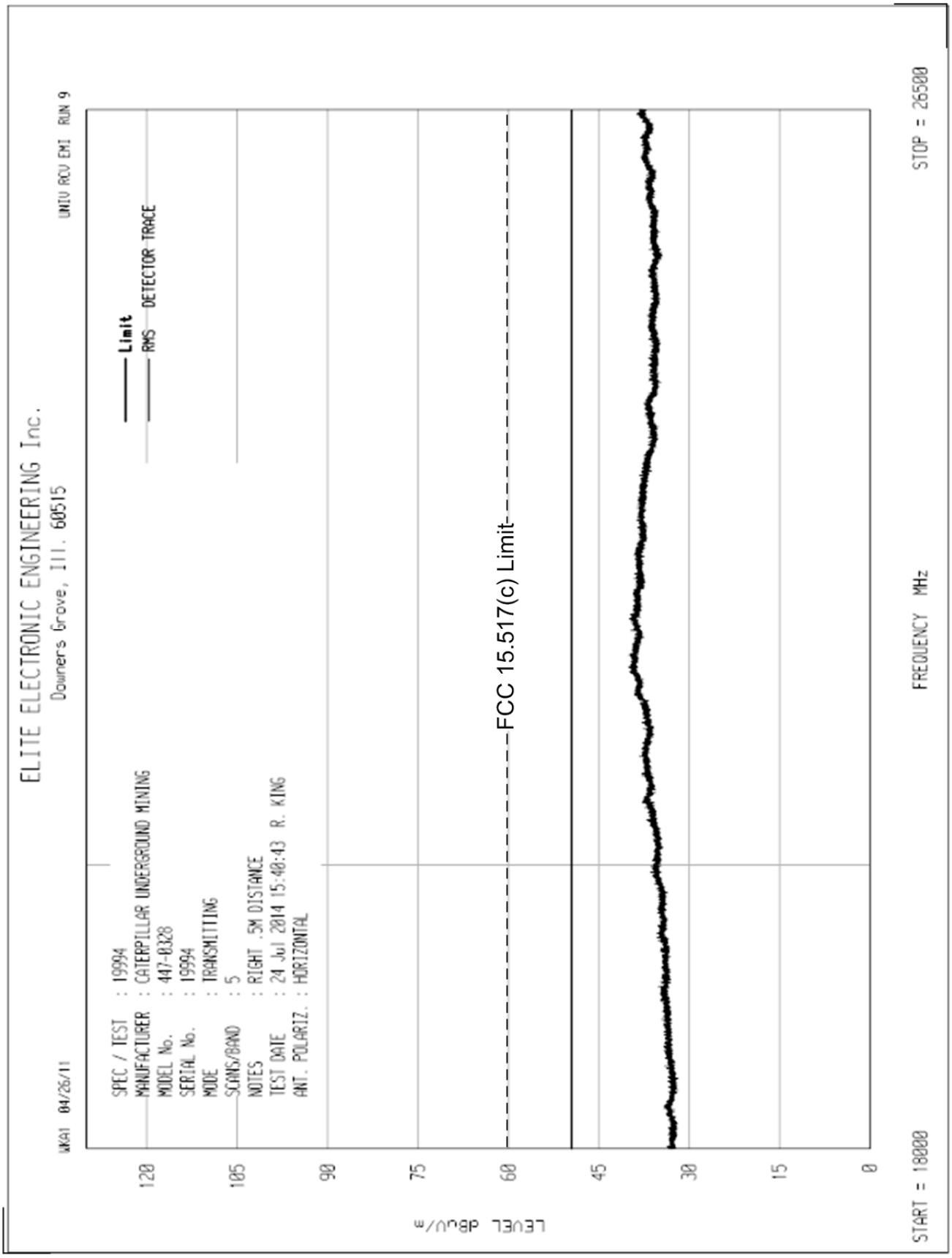

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 4
WKA1 04/26/11
SPEC / TEST : 19994
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMITTING
SCANS/BAND : 5
NOTES : FRONT .5 DISTANCE
TEST DATE : 24 Jul 2014 15:34:26 R. KING
ANT. POLARIZ. : HORIZONTAL
Limit
RMS DETECTOR TRACE
FCC 15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 18000
FREQUENCY MHz
STOP = 26500

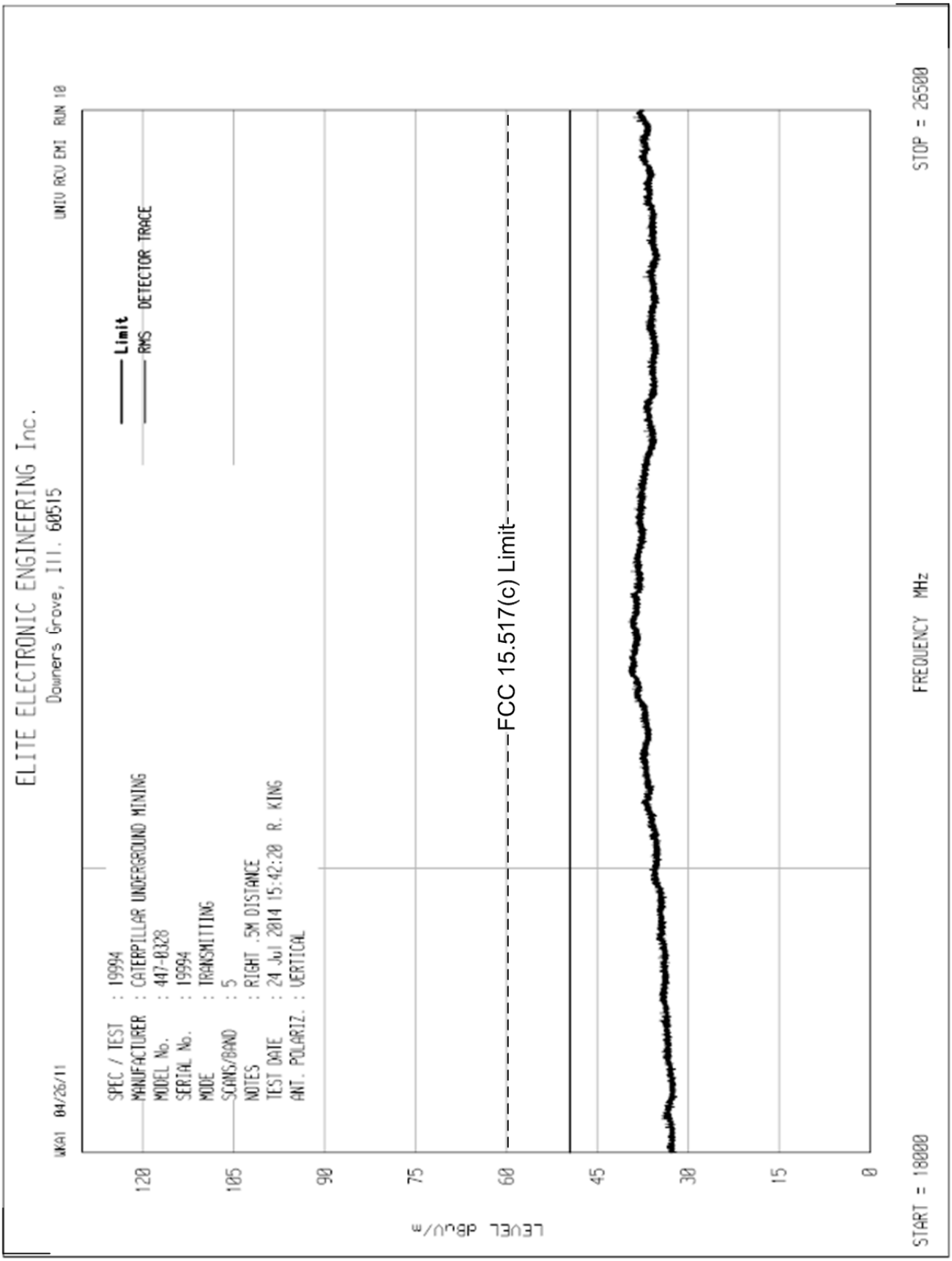

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 5
WKA1 04/26/11
SPEC / TEST : 19994
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMITTING
SCANS/BAND : 5
NOTES : LEFT .5 DISTANCE
TEST DATE : 24 Jul 2014 15:35:25 R. KING
ANT. POLARIZ. : HORIZONTAL
Limit
RMS DETECTOR TRACE
FCC 15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 18000
FREQUENCY MHz
STOP = 26500

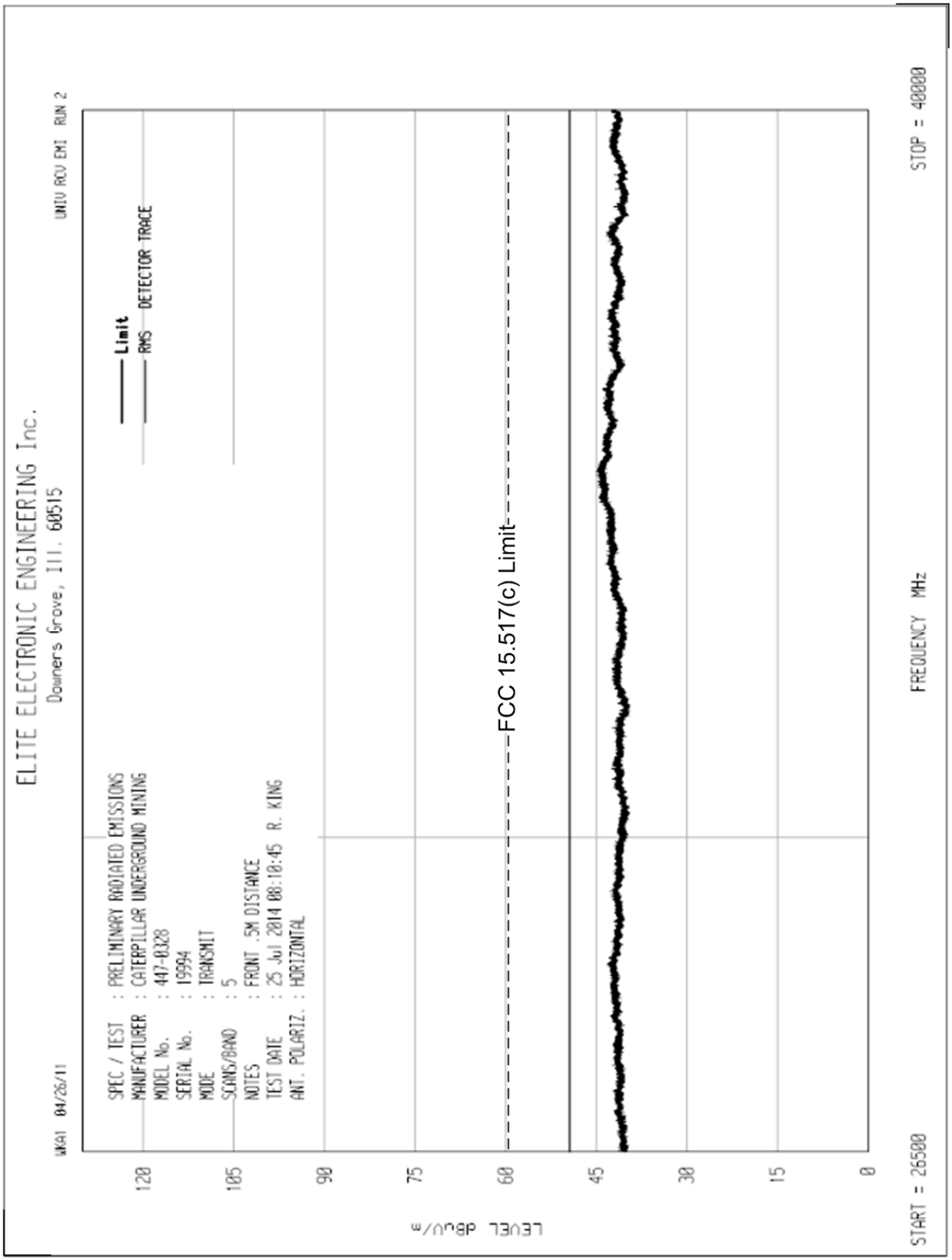

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 6
WKA1 04/26/11
SPEC / TEST : 19994
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMITTING
SCANS/BAND : 5
NOTES : LEFT .5 DISTANCE
TEST DATE : 24 Jul 2014 15:36:54 R. KING
ANT. POLARIZ. : VERTICAL
Limit
RMS DETECTOR TRACE
FCC 15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 18000
FREQUENCY MHz
STOP = 26500

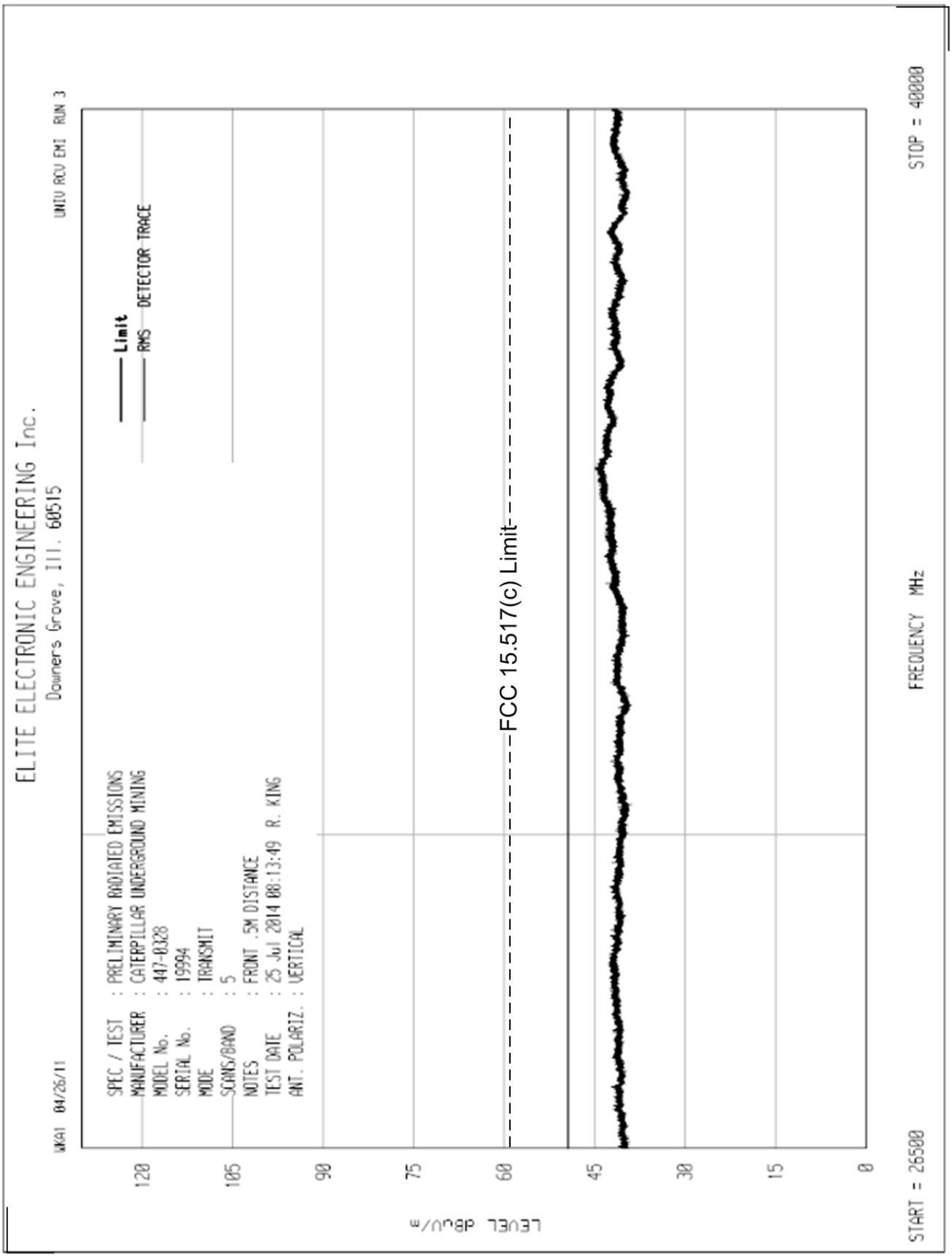

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 7
WKA1 04/26/11
SPEC / TEST : 19994
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMITTING
SCANS/BAND : 5
NOTES : BACK .5M DISTANCE
TEST DATE : 24 Jul 2014 15:38:00 R. KING
ANT. POLARIZ. : VERTICAL
Limit
RMS DETECTOR TRACE
FCC 15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 18000
FREQUENCY MHz
STOP = 26500

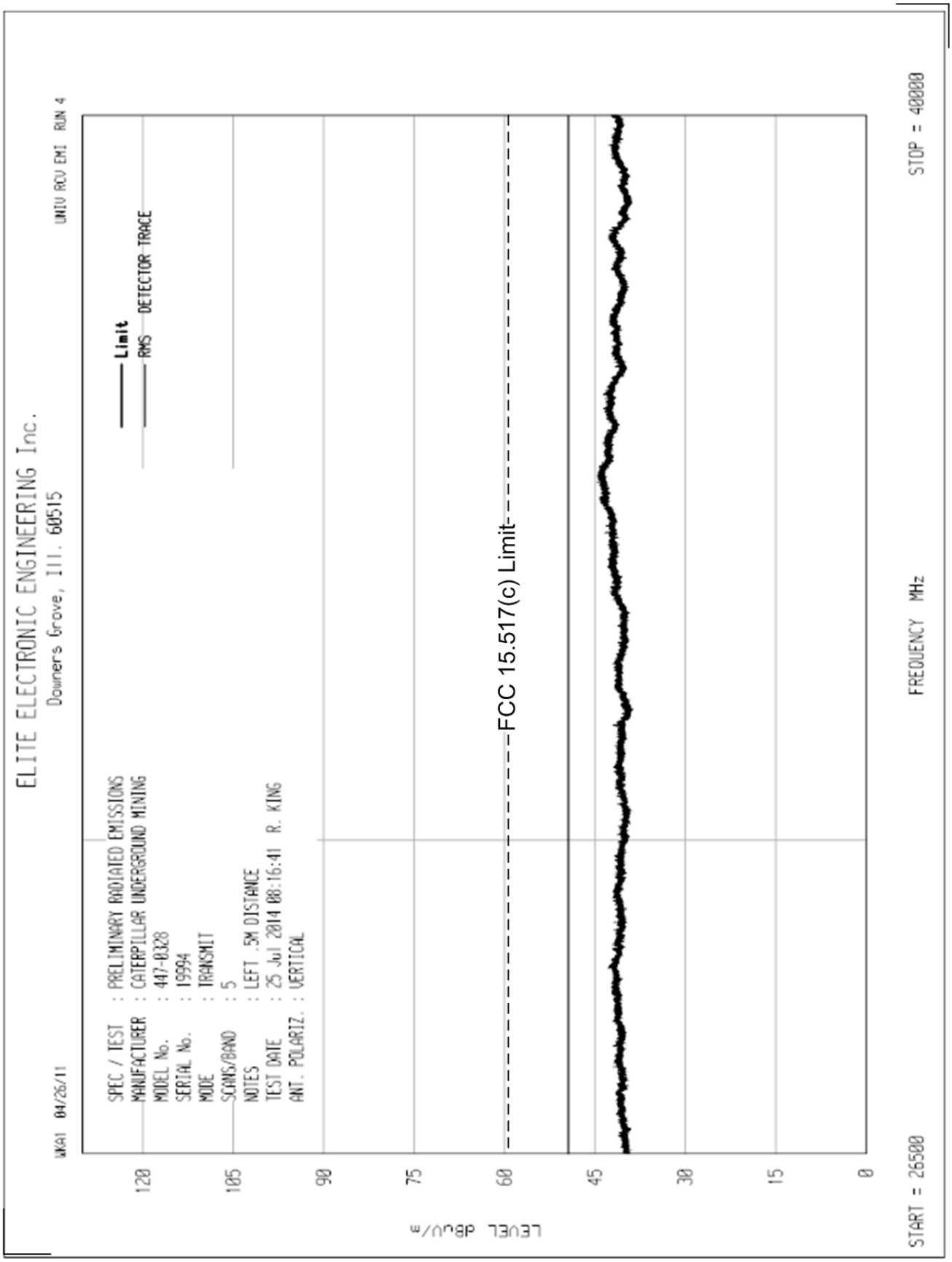

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 8
WKA1 04/26/11
SPEC / TEST : 19994
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMITTING
SCANS/BAND : 5
NOTES : BACK .5M DISTANCE
TEST DATE : 24 Jul 2014 15:39:28 R. KING
ANT. POLARIZ. : HORIZONTAL
Limit
RMS DETECTOR TRACE
FCC 15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 18000
FREQUENCY MHz
STOP = 26500

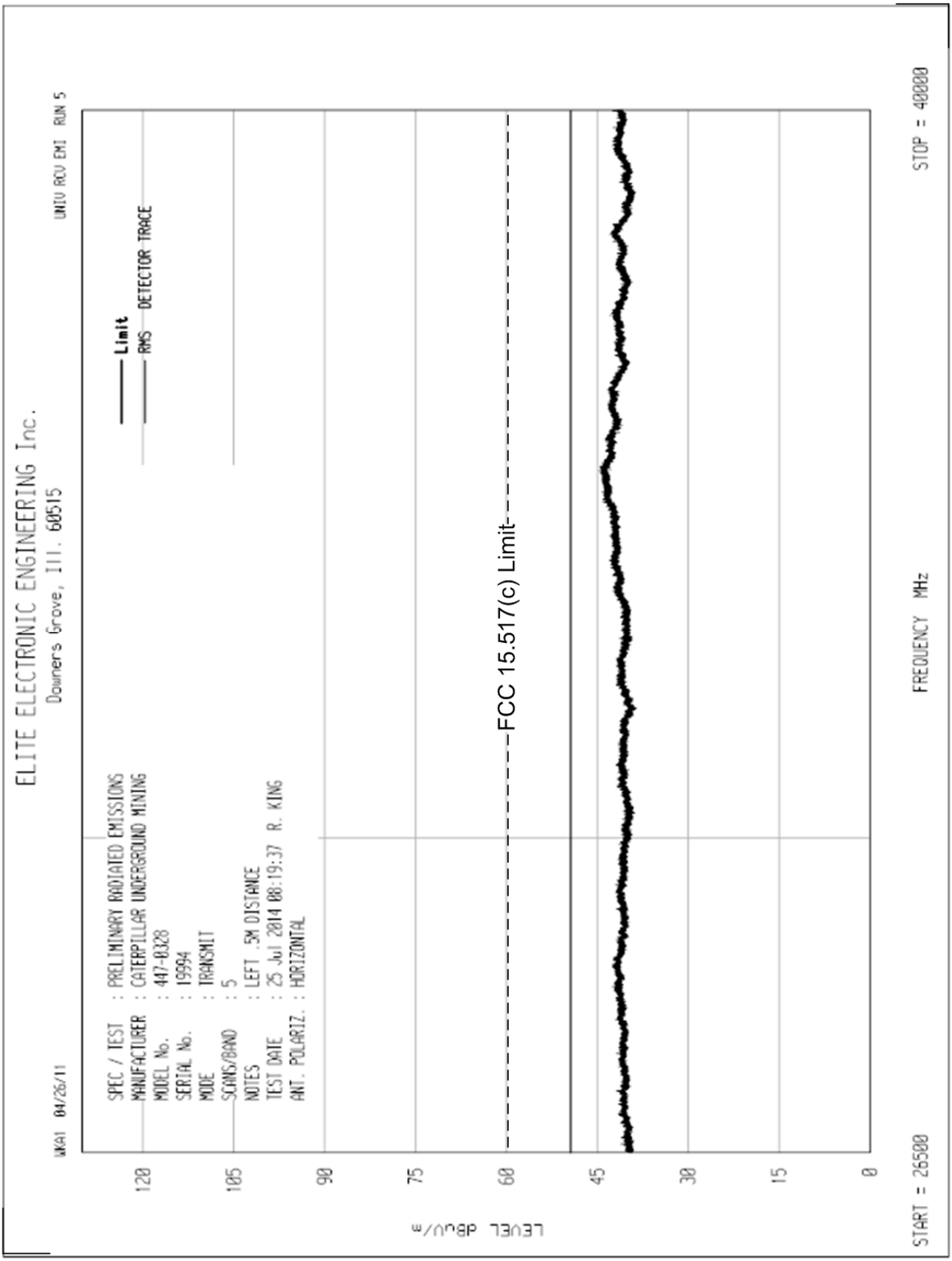

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 9
WKA1 04/26/11
SPEC / TEST : 19994
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMITTING
SCANS/BAND : 5
NOTES : RIGHT .5M DISTANCE
TEST DATE : 24 Jul 2014 15:40:43 R. KING
ANT. POLARIZ. : HORIZONTAL
Limit
RMS DETECTOR TRACE
FCC 15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 18000
FREQUENCY MHz
STOP = 26500

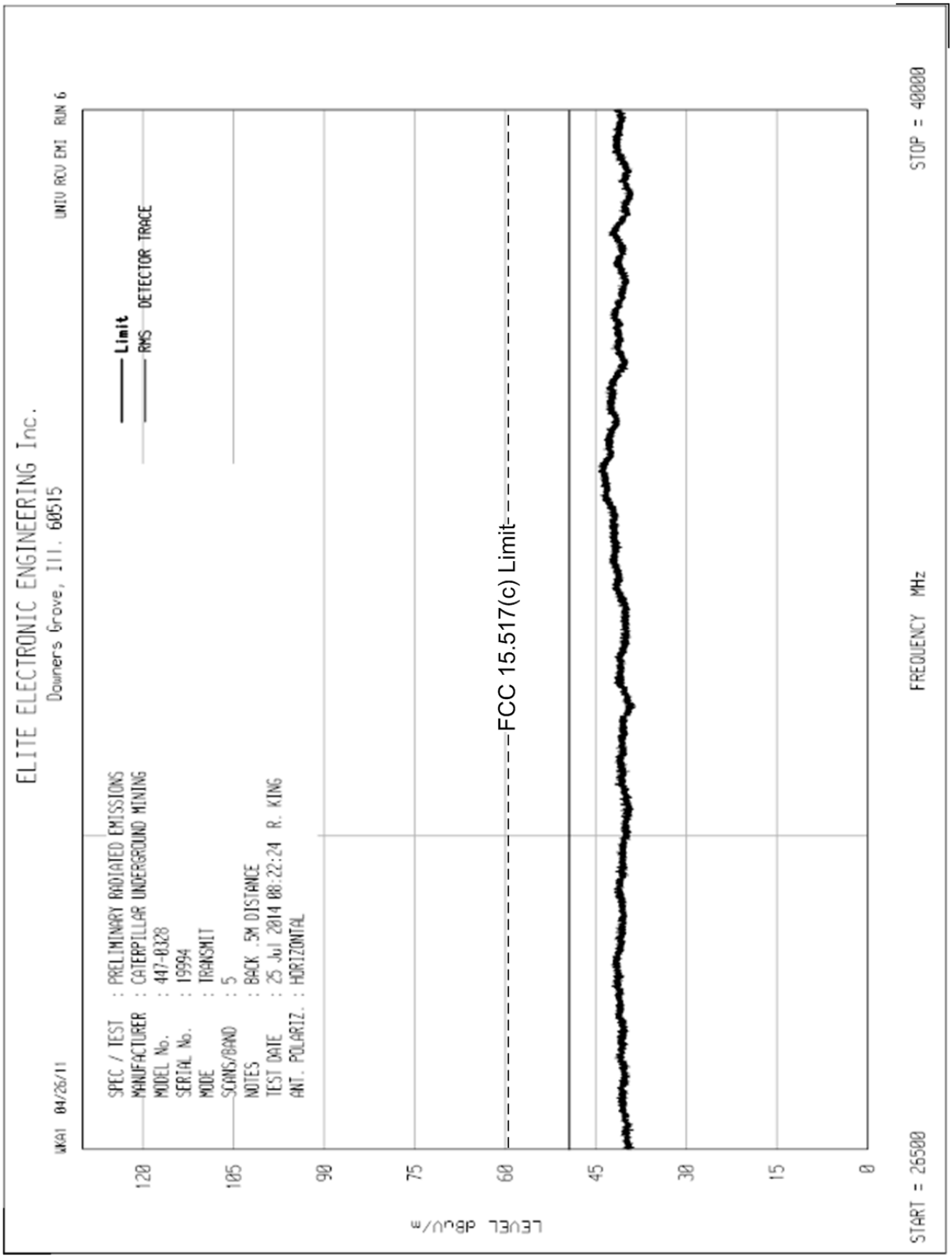

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV ROV EMI RUN 10
WKA1 04/26/11
SPEC / TEST : 19994
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMITTING
SCANS/BAND : 5
NOTES : RIGHT .5M DISTANCE
TEST DATE : 24 Jul 2014 15:42:20 R. KING
ANT. POLARIZ. : VERTICAL
Limit
RMS DETECTOR TRACE
FCC 15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 18000
FREQUENCY MHz
STOP = 26500

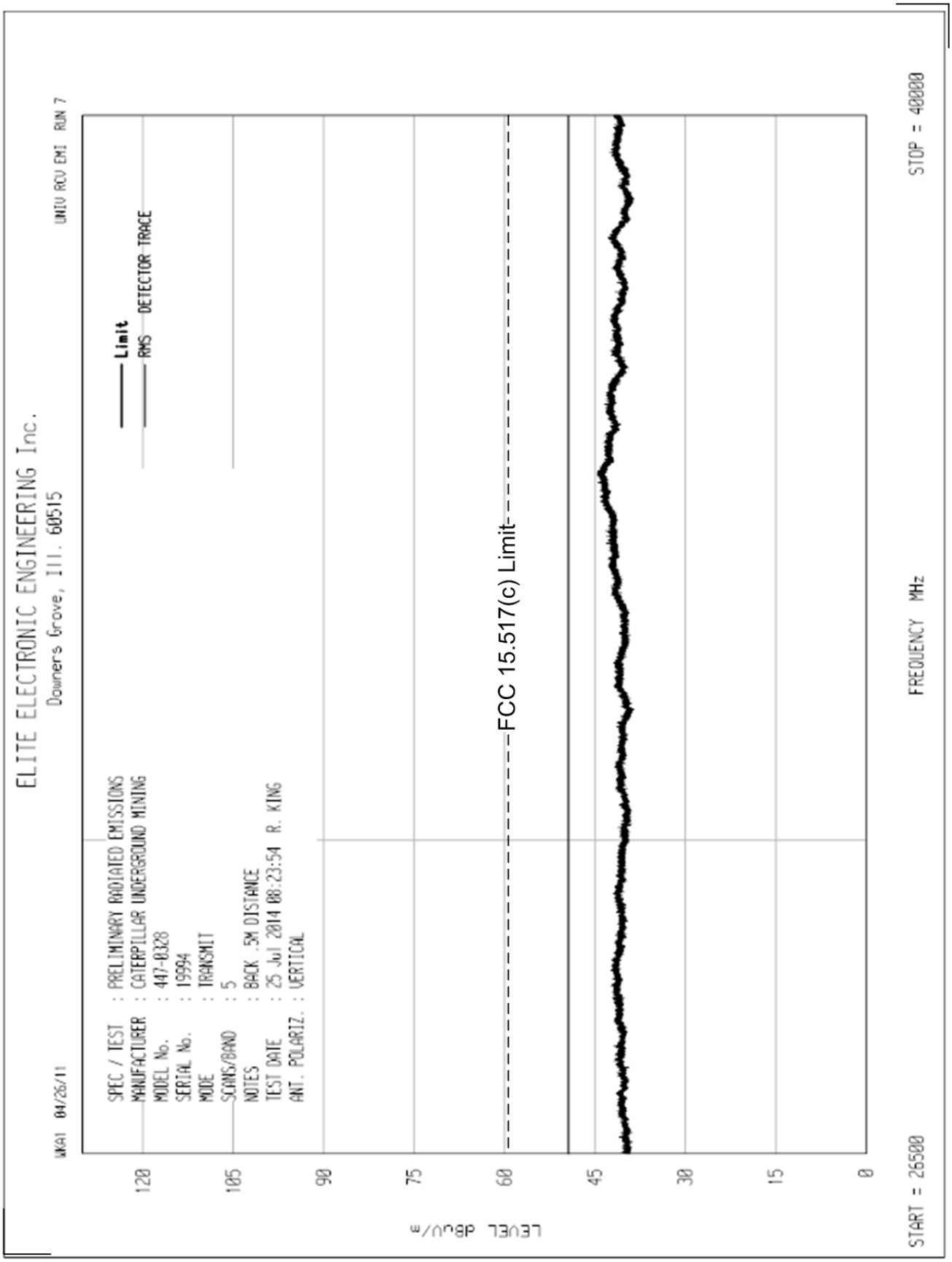

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV ROV EMI RUN 2
WKA1 04/26/11
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMIT
SCANS/BAND : 5
NOTES : FRONT .5M DISTANCE
TEST DATE : 25 Jul 2014 08:10:45 R. KING
ANT. POLARIZ. : HORIZONTAL
Limit
RMS DETECTOR TRACE
FCC 15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 26500
FREQUENCY MHz
STOP = 40000

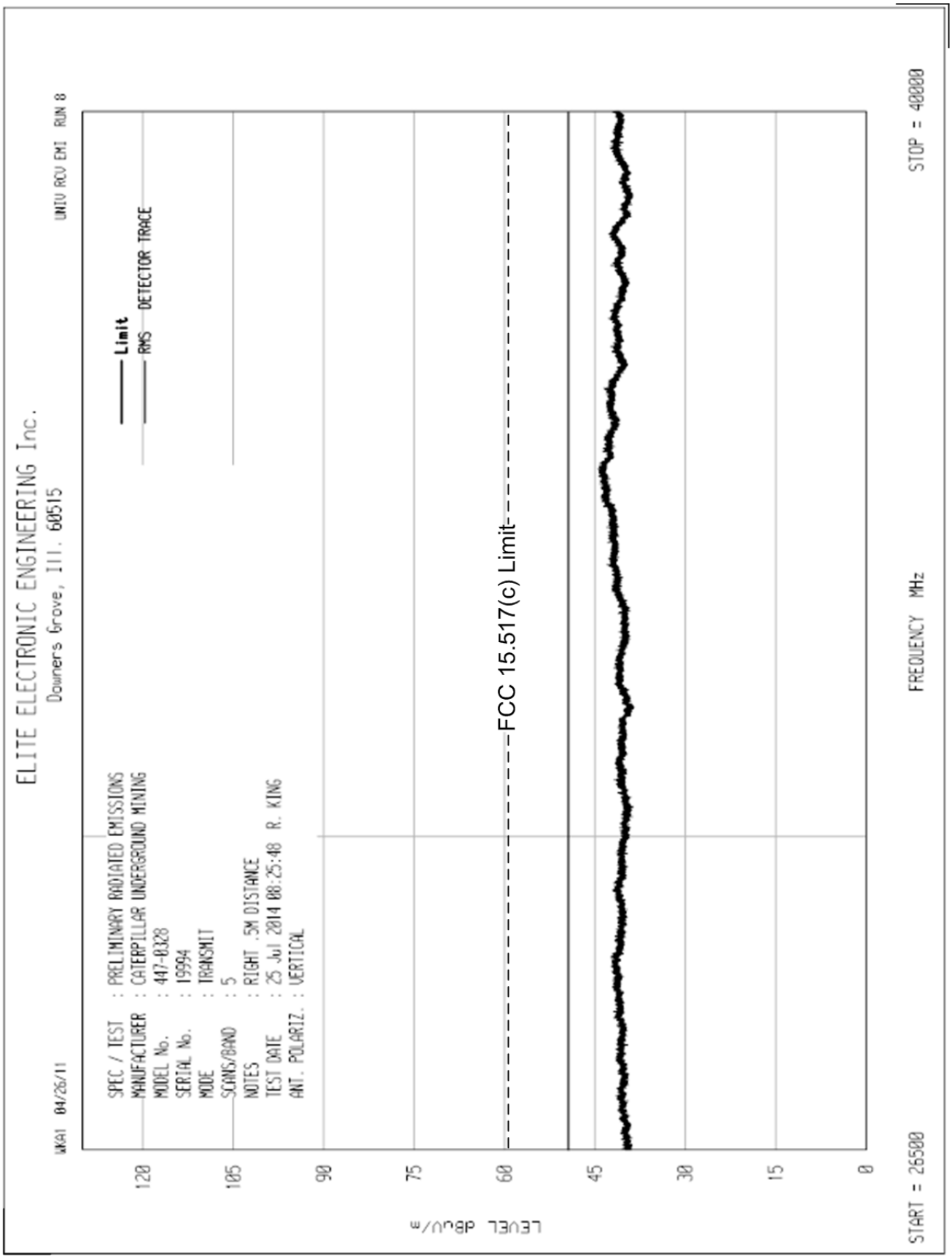

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV ROV EMI RUN 3
WKA1 04/26/11
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMIT
SCANS/BAND : 5
NOTES : FRONT .5M DISTANCE
TEST DATE : 25 Jul 2014 08:13:49 R. KING
ANT. POLARIZ. : VERTICAL
Limit
RMS DETECTOR TRACE
FCC 15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 26500
FREQUENCY MHz
STOP = 40000

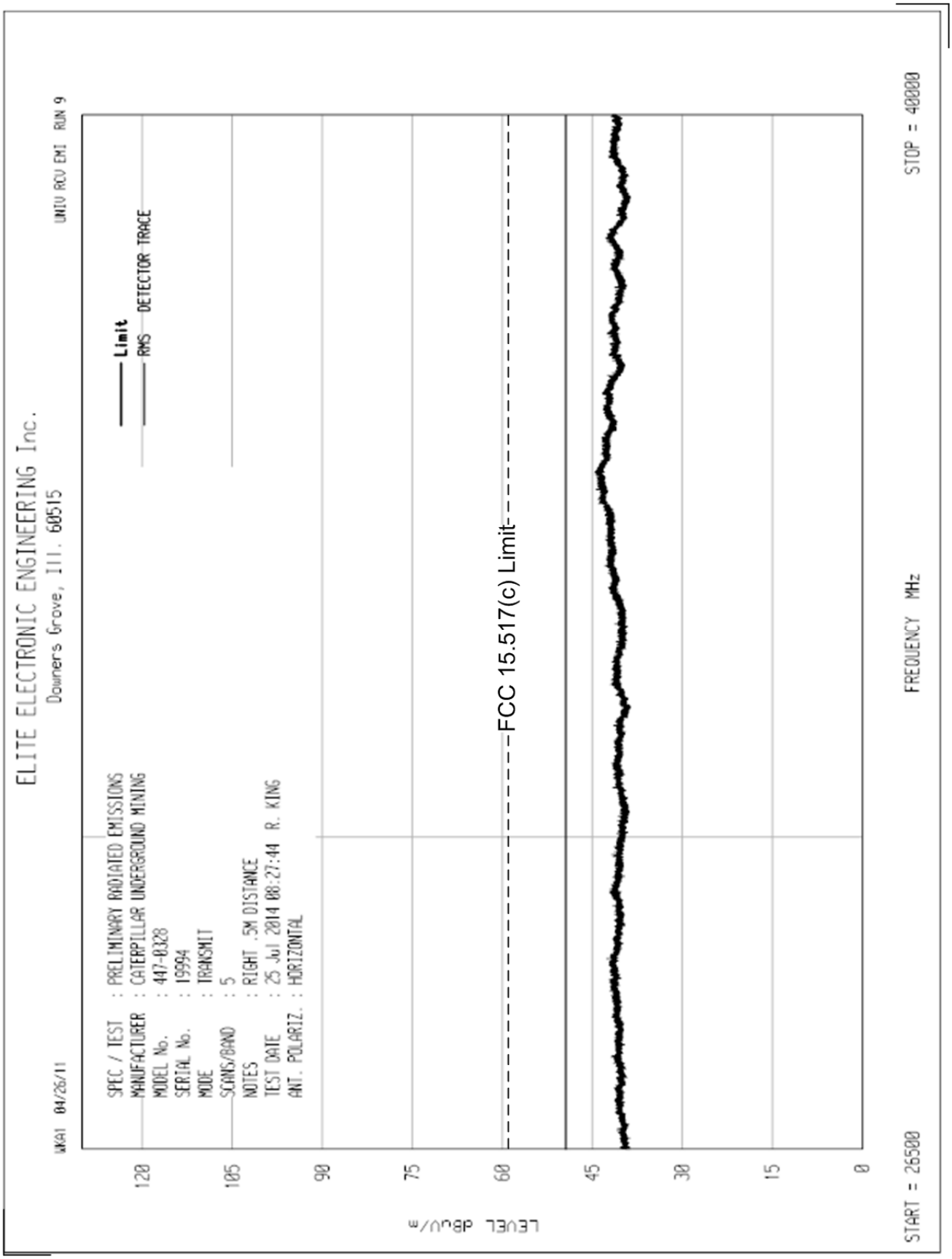

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV ROU EMI RUN 4
KKA1 04/26/11
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMIT
SCANS/BAND : 5
NOTES : LEFT .5M DISTANCE
TEST DATE : 25 Jul 2014 08:16:41 R. KING
ANT. POLARIZ. : VERTICAL
Limit
RMS DETECTOR TRACE
FCC 15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 26500
FREQUENCY MHz
STOP = 40000

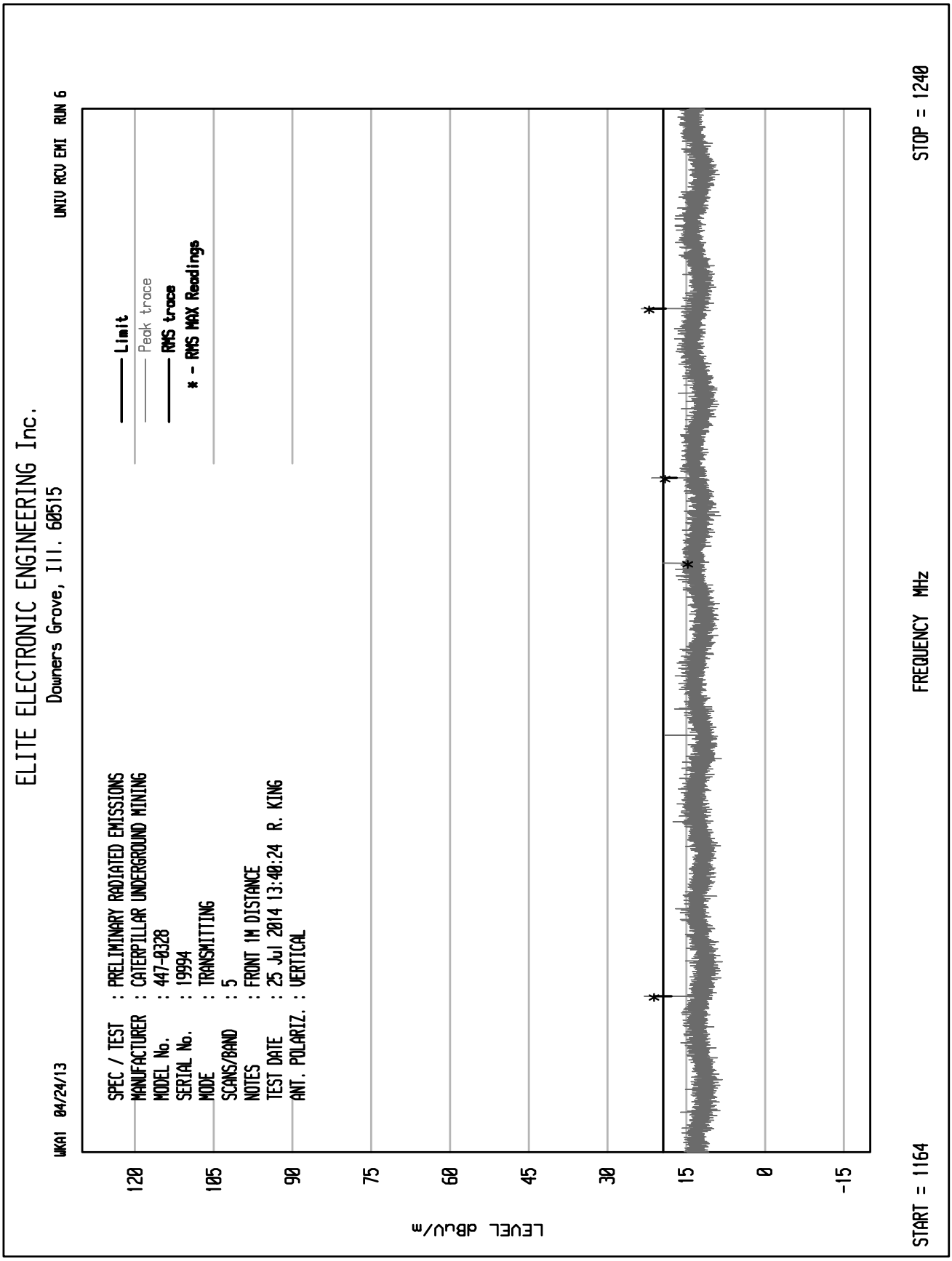

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV ROV EMI RUN 5
WKA1 04/26/11
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMIT
SCANS/BAND : 5
NOTES : LEFT .5M DISTANCE
TEST DATE : 25 Jul 2014 08:19:37 R. KING
ANT. POLARIZ. : HORIZONTAL
Limit
RMS DETECTOR TRACE
FCC 15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 26500
FREQUENCY MHz
STOP = 40000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV ROV EMI RUN 6
WKA1 04/26/11
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMIT
SCANS/BAND : 5
NOTES : BACK .5M DISTANCE
TEST DATE : 25 Jul 2014 08:22:24 R. KING
ANT. POLARIZ. : HORIZONTAL
Limit
RMS DETECTOR TRACE
FCC 15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 26500
FREQUENCY MHz
STOP = 40000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV ROU EMI RUN 7
KKA1 04/26/11
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMIT
SCANS/BAND : 5
NOTES : BACK .5M DISTANCE
TEST DATE : 25 Jul 2014 08:23:54 R. KING
ANT. POLARIZ. : VERTICAL
Limit
RMS DETECTOR TRACE
FCC 15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 26500
FREQUENCY MHz
STOP = 40000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 8
WKAI 04/26/11
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMIT
SCANS/BAND : 5
NOTES : RIGHT .5M DISTANCE
TEST DATE : 25 Jul 2014 08:25:48 R. KING
ANT. POLARIZ. : VERTICAL
Limit
RMS DETECTOR TRACE
FCC 15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 26500
FREQUENCY MHz
STOP = 40000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 9
KKAI 04/26/11
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMIT
SCANS/BAND : 5
NOTES : RIGHT .5M DISTANCE
TEST DATE : 25 Jul 2014 08:27:44 R. KING
ANT. POLARIZ. : HORIZONTAL
Limit
RMS DETECTOR TRACE
FCC 15.517(c) Limit
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 26500
FREQUENCY MHz
STOP = 40000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 6
WKA1 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMITTING
SCANS/BAND : 5
NOTES : FRONT 1M DISTANCE
TEST DATE : 25 Jul 2014 13:40:24 R. KING
ANT. POLARIZ. : VERTICAL
Limit
Peak trace
RMS trace
* - RMS MAX Readings
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
-15
START = 1164
FREQUENCY MHz
STOP = 1240

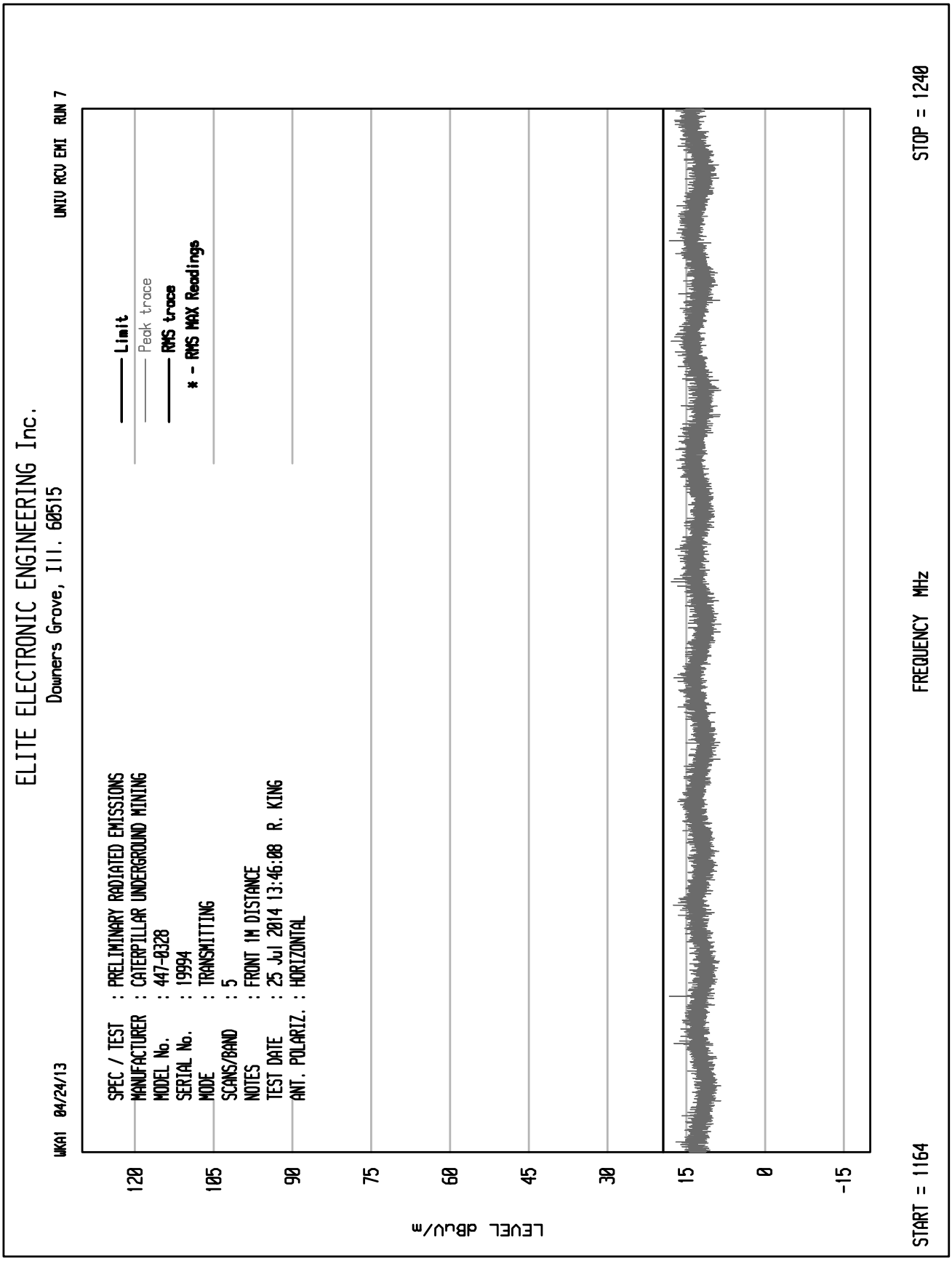
SIGNIFICANT EMISSIONS WKA1 04/24/13

SPEC/TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL : 447-0328
S/N : 19994
MODE : TRANSMITTING
NOTES : FRONT 1M DISTANCE
ANT. POLARIZ. : VERTICAL
TEST RANGE : 1164 - 1240 MHz
TEST DATE : 25 Jul 2014 13:40:24 R. KING
PRINT CRITERIA : ALL PEAKS ABOVE -2 dB MARGIN FROM LIMIT
RUN NUMBER : 6

Freq	RES BW	STEP FREQ	PEAK Rdg	RMS Rdg	Limit	Limit Margin	OVER LIMIT
MHz	MHz	MHz	dBuV/m	dBuV/m	dBuV/m	dB	
1175.052000	.009000	.004500	23.0	21.2	19.4	1.8	YES
1187.553000	.009000	.004500	17.6		19.4	-1.8	
1193.806001	.009000	.004500	19.1		19.4	-.3	
1206.307001	.009000	.004500	19.5	14.7	19.4	-4.7	
1212.553001	.009000	.004500	21.6	19.0	19.4	-.4	
1225.054001	.009000	.004500	23.6	22.1	19.4	2.7	YES

Checked BY Richard E. King :

Richard E. King


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 7
WKA1 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMITTING
SCANS/BAND : 5
NOTES : FRONT 1M DISTANCE
TEST DATE : 25 Jul 2014 13:46:08 R. KING
ANT. POLARIZ. : HORIZONTAL
Limit
Peak trace
RMS trace
* - RMS MAX Readings
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
-15
START = 1164
FREQUENCY MHz
STOP = 1240

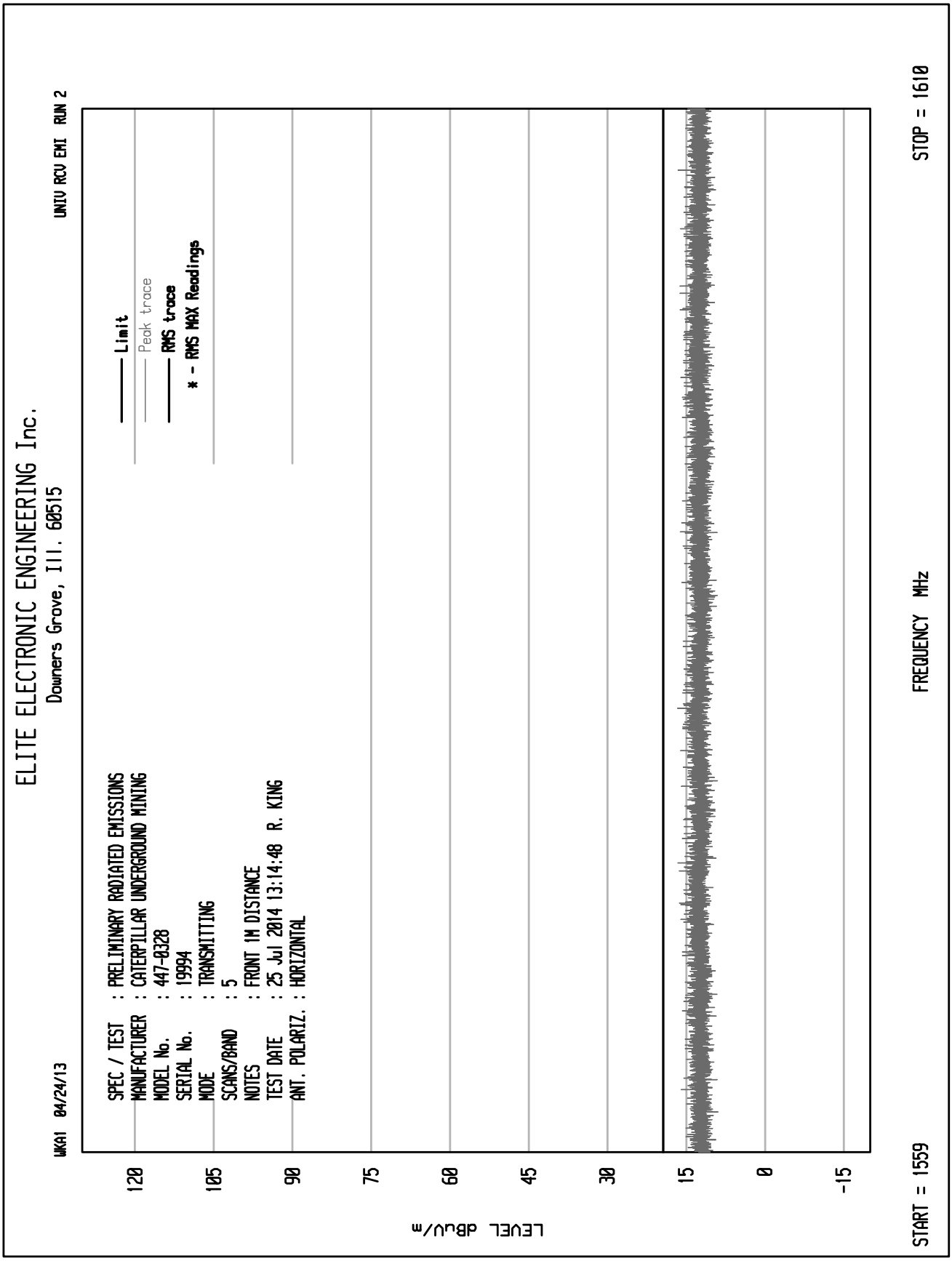
SIGNIFICANT EMISSIONS WKA1 04/24/13

SPEC/TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL : 447-0328
S/N : 19994
MODE : TRANSMITTING
NOTES : FRONT 1M DISTANCE
ANT. POLARIZ. : HORIZONTAL
TEST RANGE : 1164 - 1240 MHz
TEST DATE : 25 Jul 2014 13:46:08 R. KING
PRINT CRITERIA : ALL PEAKS ABOVE -2 dB MARGIN FROM LIMIT
RUN NUMBER : 7

Freq MHz	RES BW MHz	STEP FREQ MHz	PEAK Rdg dBuV/m	RMS Rdg dBuV/m	Limit dBuV/m	Limit Margin dB	OVER LIMIT
1175.052000	.009000	.004500	18.3		19.4	-1.1	
1181.559000	.009000	.004500	17.5		19.4	-1.9	
1204.961501	.009000	.004500	17.9		19.4	-1.5	
1222.637501	.009000	.004500	17.9		19.4	-1.5	
1230.103001	.009000	.004500	18.3		19.4	-1.1	

Checked BY Richard E. King :

Richard E. King


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 2
WKA1 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMITTING
SCANS/BAND : 5
NOTES : FRONT 1M DISTANCE
TEST DATE : 25 Jul 2014 13:14:48 R. KING
ANT. POLARIZ. : HORIZONTAL
Limit
Peak trace
RMS trace
* - RMS MAX Readings
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
-15
START = 1559
FREQUENCY MHz
STOP = 1610

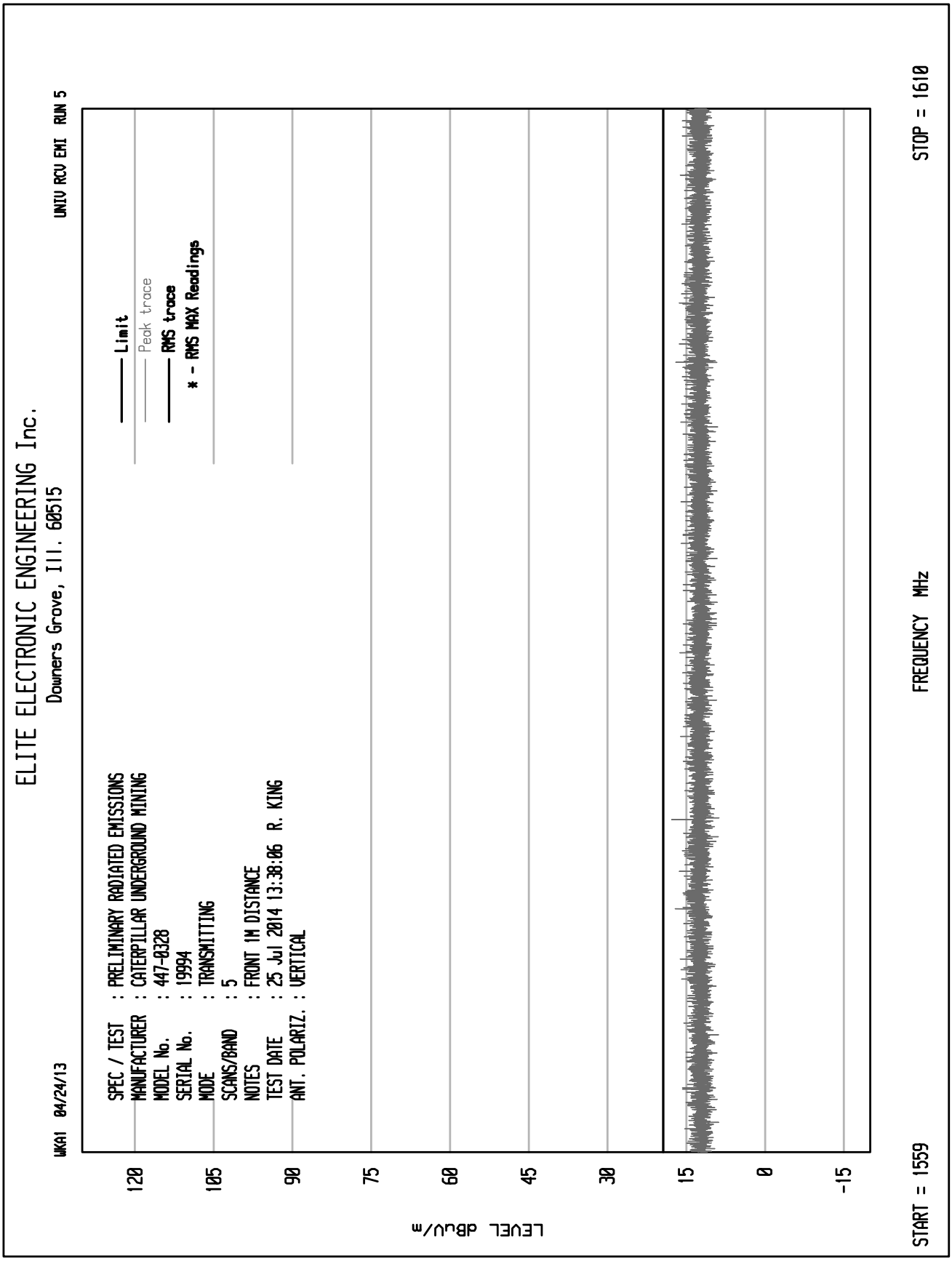
SIGNIFICANT EMISSIONS WKA1 04/24/13

SPEC/TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL : 447-0328
S/N : 19994
MODE : TRANSMITTING
NOTES : FRONT 1M DISTANCE
ANT. POLARIZ. : HORIZONTAL
TEST RANGE : 1559 - 1610 MHz
TEST DATE : 25 Jul 2014 13:14:48 R. KING
PRINT CRITERIA : ALL PEAKS ABOVE -3 dB MARGIN FROM LIMIT
RUN NUMBER : 2

Freq	RES BW	STEP FREQ	PEAK Rdg	RMS Rdg	Limit	Limit Margin	OVER LIMIT
MHz	MHz	MHz	dBuV/m	dBuV/m	dBuV/m	dB	
1572.977000	.009000	.004500	16.6		19.4	-2.8	
1580.496500	.009000	.004500	16.7		19.4	-2.7	
1606.947500	.009000	.004500	16.6		19.4	-2.8	

Checked BY Richard E. King :

Richard E. King


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 5
WKA1 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
SERIAL No. : 19994
MODE : TRANSMITTING
SCANS/BAND : 5
NOTES : FRONT 1M DISTANCE
TEST DATE : 25 Jul 2014 13:38:06 R. KING
ANT. POLARIZ. : VERTICAL
Limit
Peak trace
RMS trace
* - RMS MAX Readings
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
-15
START = 1559
FREQUENCY MHz
STOP = 1610

SIGNIFICANT EMISSIONS WKA1 04/24/13

SPEC/TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL : 447-0328
S/N : 19994
MODE : TRANSMITTING
NOTES : FRONT 1M DISTANCE
ANT. POLARIZ. : VERTICAL
TEST RANGE : 1559 - 1610 MHz
TEST DATE : 25 Jul 2014 13:38:06 R. KING
PRINT CRITERIA : ALL PEAKS ABOVE -2 dB MARGIN FROM LIMIT
RUN NUMBER : 5

Freq	RES BW	STEP FREQ	PEAK Rdg	RMS Rdg	Limit	Limit Margin	OVER LIMIT
MHz	MHz	MHz	dBuV/m	dBuV/m	dBuV/m	dB	
1575.074000	.009000	.004500	17.8		19.4	-1.6	

Checked BY Richard E. King :

Richard E. King

SIGNIFICANT EMISSIONS WKA1 04/24/13

SPEC/TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL : 447-0328
S/N : 19994
MODE : TRANSMITTING
NOTES : FRONT 1M DISTANCE
ANT. POLARIZ. : VERTICAL
TEST RANGE : 1559 - 1610 MHz
TEST DATE : 25 Jul 2014 13:38:06 R. KING
PRINT CRITERIA : ALL PEAKS ABOVE -2 dB MARGIN FROM LIMIT
RUN NUMBER : 5

Freq	RES BW	STEP FREQ	PEAK Rdg	RMS Rdg	Limit	Limit Margin	OVER LIMIT
MHz	MHz	MHz	dBuV/m	dBuV/m	dBuV/m	dB	
1575.074000	.009000	.004500	17.8		19.4	-1.6	

Checked BY Richard E. King :

Richard E. King

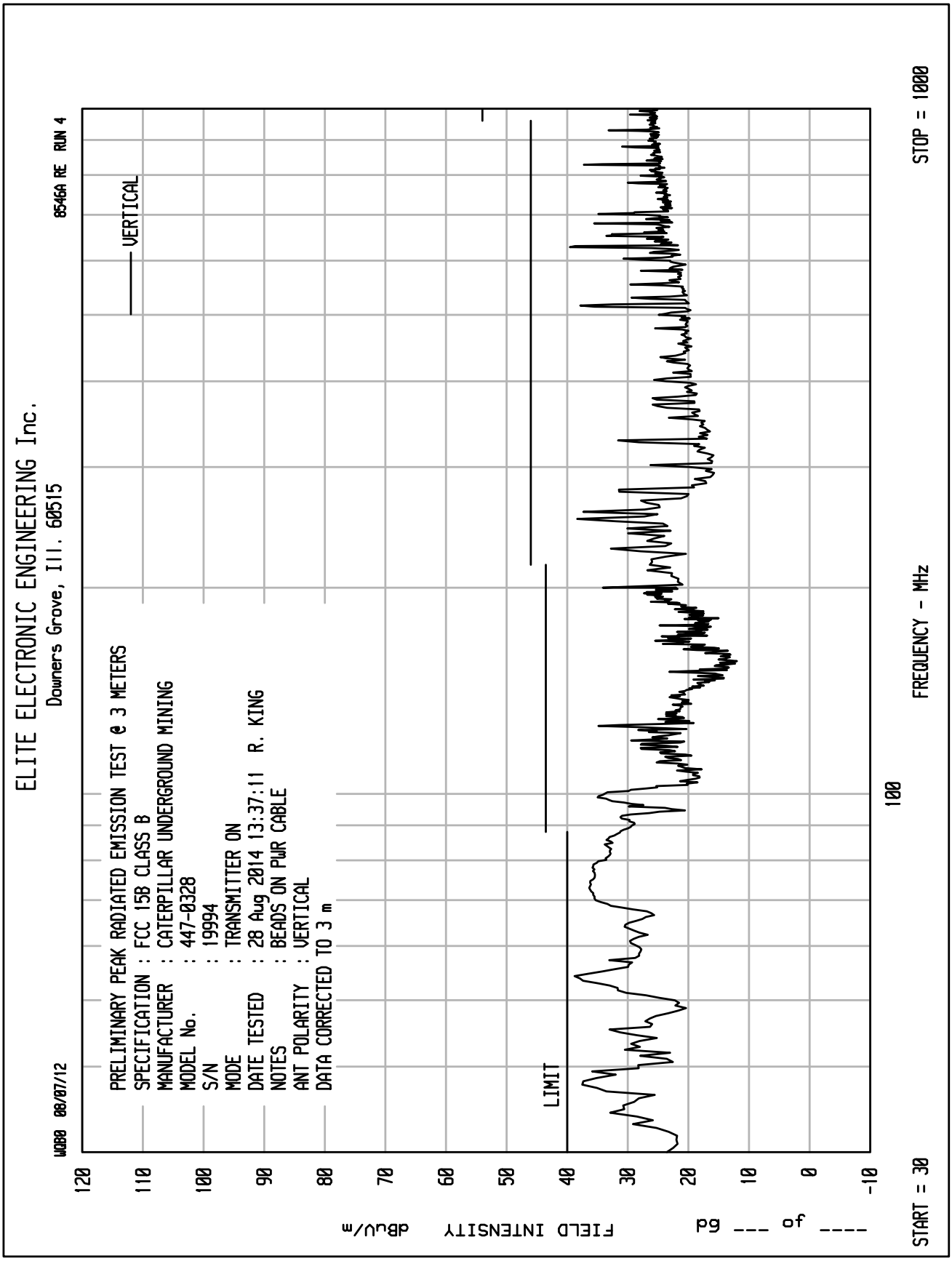
PEAK POWER IN A 50 MHz BANDWIDTH

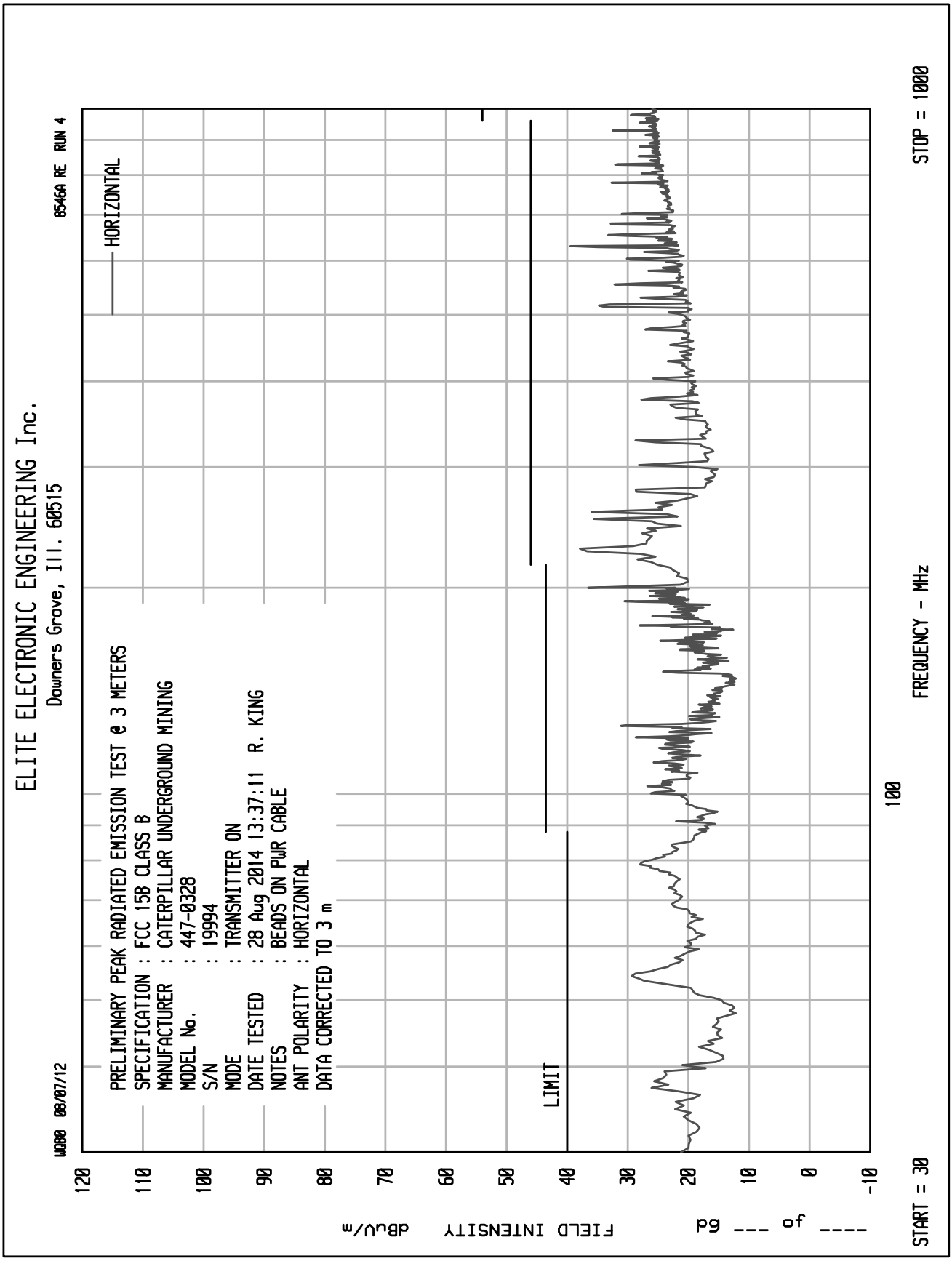
SPEC/TEST : RADIATED EMISSIONS
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL : 447-0328
S/N : 19994
MODE : TRANSMITTING
NOTES : EMISSION MAXIMIZED - 1M TEST DISTANCE
NOTES : RBW = 1MHz VBW = 3MHz
TEST DATE : 25 Jul 2014 R. KING

Freq. (MHz)	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Total (dBuV/m) at 1M	Limit (dBuV/m) at 1M	Margin (dB)
4042.000	H	38.7		4.5	33.3	-39.9	36.5	80.3	-43.8
4042.000	V	65.6		4.5	33.3	-39.9	63.4	80.3	-16.9

Checked BY Richard E. King :

Richard E. King


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
8546A RE RUN 4
W080 08/07/12
PRELIMINARY PEAK RADIATED EMISSION TEST @ 3 METERS
SPECIFICATION : FCC 15B CLASS B
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
S/N : 19994
MODE : TRANSMITTER ON
DATE TESTED : 28 Aug 2014 13:37:11 R. KING
NOTES : BEADS ON PWR CABLE
ANT POLARITY : VERTICAL
DATA CORRECTED TO 3 m
VERTICAL
LIMIT
FIELD INTENSITY dBuV/m
FREQUENCY - MHz
START = 30
100
STOP = 1000
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
pg ___ of ____


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
8546A RE RUN 4
W080 08/07/12
PRELIMINARY PEAK RADIATED EMISSION TEST @ 3 METERS
SPECIFICATION : FCC 15B CLASS B
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL No. : 447-0328
S/N : 19994
MODE : TRANSMITTER ON
DATE TESTED : 28 Aug 2014 13:37:11 R. KING
NOTES : BEADS ON PWR CABLE
ANT POLARITY : HORIZONTAL
DATA CORRECTED TO 3 m
HORIZONTAL
LIMIT
FIELD INTENSITY dBuV/m
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
START = 30
100
STOP = 1000
FREQUENCY - MHz
pg ___ of ____

ETR No. 8546A
DATA SHEET TEST NO. 4

RADIATED QP EMISSION MEASUREMENTS in a 3 m SEMI-ANECHOIC ROOM
SPECIFICATION : FCC 15B CLASS B
MANUFACTURER : CATERPILLAR UNDERGROUND MINING
MODEL NO. : 447-0328
SERIAL NO. : 19994
TEST MODE : TRANSMITTER ON
NOTES : BEADS ON PWR CABLE
TEST DATE : 28 Aug 2014 13:37:11
TEST DISTANCE : 3 m (DATA EXTRAPOLATED TO 3 m)

FREQUENCY	QP READING	ANT FAC	CBL FAC	EXT ATTN	DIST FAC	TOTAL	QP LIMIT	AZ	ANT HT	POLAR
MHz	dBuV	dB	dB	dB	dB	dBuV/m	dBuV/m	deg	cm	
35.51	11.5	16.1	.5	0.0	0.0	28.1	40.0	90	120	V
54.04	30.3	8.4	.5	0.0	0.0	39.2	40.0	90	120	V
78.67	29.8	7.8	.5	0.0	0.0	38.1	40.0	45	120	V
98.10	22.4	11.3	.5	0.0	0.0	34.3	43.5	135	120	V
124.98	22.0	13.0	.7	0.0	0.0	35.6	43.5	90	120	V
166.33	13.9	10.4	.9	0.0	0.0	25.2	43.5	135	120	V
174.98	17.4	10.1	.9	0.0	0.0	28.4	43.5	270	200	H
199.98	25.2	10.8	1.0	0.0	0.0	37.0	43.5	270	200	H
324.99	15.2	14.6	1.1	0.0	0.0	30.9	46.0	90	200	V
374.99	10.5	15.7	1.4	0.0	0.0	27.7	46.0	225	340	H
511.97	17.8	17.9	1.5	0.0	0.0	37.2	46.0	135	340	V
625.00	18.6	19.5	1.6	0.0	0.0	39.7	46.0	180	120	V
700.01	6.6	19.6	1.8	0.0	0.0	27.9	46.0	0	120	V
825.01	13.7	21.1	2.0	0.0	0.0	36.8	46.0	180	120	V
925.02	8.3	21.7	2.0	0.0	0.0	32.0	46.0	180	340	V

Checked BY Richard E. King :

Richard E. King