Measurement of RF Interference from a Model 11128 KEYFOB Transmitter

For	:	Innovative Design Solutions Troy, MI 48083
P.O. No.	:	10410-MC
Date Tested	:	April 16, 2010
Test Personnel	:	Richard King
Specification	:	FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C
	:	Industry Canada RSS-210
	:	Industry Canada RSS-GEN

Test Report By :
Richard King

Witnessed by :
Matt Collin
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Approved By :
Raymond J. Klouda
Registered Professional
Engineer of Illinois - 44894

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REVISION HISTORY

Revision	Date	Description
—	April 26, 2010	Initial release

Measurement of RF Emissions from a KEYFOB 11128 Transmitter

1 INTRODUCTION

1.1 Scope of Tests

This document represents the results of the series of radio interference measurements performed on a model KEYFOB , Part No. 11128, Serial No. 5 transmitter, (hereinafter referred to as the test item). The test item was designed to transmit at approximately 315 MHz using an internal. The test item was manufactured and submitted for testing by Innovative Design Solutions located in Troy, MI.

1.2 Purpose

The test series was performed to determine if the test item meets the conducted and radiated RF emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections 15.207 and 15.231 for Intentional Radiators and Industry Canada RSS-GEN Table 2 and RSS-210 Table 5. Testing was performed in accordance with ANSI C63.4-2003.

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 23.1°C and the relative humidity was 41%.

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 6, September 2005, “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 1, September 2005, “Spectrum Management and Telecommunications Radio Standards Specification, General Requirements and Information for the Certification of radio communication equipment”

3 TEST ITEM SETUP AND OPERATION

3.1 General Description

The test item is a KEYFOB , Part No. 11128. A block diagram of the test item setup is shown as Figure 1.

3.1.1 Power Input

The test item was powered with 3VDC from a 3VDC battery.

3.1.2 Peripheral Equipment

The following peripheral equipment was submitted with the test item:

3.1.3 Interconnect Cables

The following interconnect cables were submitted with the test item:

3.1.4 Grounding

Since the test item was powered with 3VDC through a 3VDC battery, it was ungrounded during the tests.

3.2 Operational Mode

For all tests the test item and all peripheral equipment were placed on an 80cm high non-conductive stand. The test item and all peripheral equipment were energized. The test item was active when ever a button was held down. The test item ceased operation when the button was released meeting the requirements of 15.231(a)(1).

3.3 Test Item Modifications

The test item was not modified to meet the 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.

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 Requirements

Since the test item was powered by internal batteries, no conducted emissions tests are required.

5.2 Duty Cycle Factor Measurements

5.2.1 Procedures

The duty cycle factor is used to convert peak detected readings to average readings. This factor is computed from the time domain trace of the pulse modulation signal. The duty cycle is calculated as the (on-time/on-time+off-time). The duty cycle factor is 20 * Log (duty cycle)

For Manchester modulations, the following procedure was used to verify the pulse train and calculate a duty cycle factor:

a) With the transmitter set up to transmit for maximum pulse density, the time domain trace is displayed on the spectrum analyzer.

b) The pulse on-time width is measured and a plot of this measurement is recorded.

c) The pulse off-time width is measured and a plot of this measurement is recorded.

d) The pulse width is measured and a plot of this measurement is recorded.

e) The entire message with both the pre-amble and the off-time before the next pre-amble is measured and a plot of this measurement is recorded.

f) The pulse width is measured and a plot of this measurement is recorded.

g) The message without both the pre-amble and the off-time before the next pre-amble is measured and a plot of this measurement is recorded.

5.2.2 Results

For Manchester Code:
The duty cycle of the word is 50%.
Total on-time for the word = Pre-amble + Message Length divided by 2.
Total off-time for the word = Message length divided by 2 + off-time before the next pre-amble
Since the word period is less than 100mS, the duty cycle factor is computed using on-time divided by the on-time plus the off-time.

Pre-Amble = 1.8 mS
Message Length = 19.9 mS
Off time before next pre-amble = 1.8 mS
Duty cycle equals 20*LOG(11.8ms/11.8+(11.8ms)) = -6.02 dB.

The plots for the duty cycle factor measurements for Manchester codes are shown on data pages 13 through 18. The pulse train and duty cycle was verified by the measured data shown on the plots.

5.3 Radiated Measurements

5.3.1 Requirements

The test item must comply with the requirements of FCC "Code of Federal Regulations Title 47", Part 15, Subpart C, Section 15.205 et seq.

Paragraph 15.231(b) has the following radiated emission limits:

Fundamental Frequency MHz	Field Intensity uV/m @ 3 meters	Field Strength Harmonics and Spurious @ 3 meters
260 to 470	3,750 to 12,500*	375 to 1,250*

* - Linear Interpolation

For 315 MHz, the limit at the fundamental is 6041.7 V/m @ 3m. The limit for the harmonics is 604.2uV/m @ 3m or the general limit shown in 15.209 whichever limit permits a higher field strength.

In addition, emissions appearing in the Restricted Bands of Operation listed in paragraph 15.205(a) shall not exceed the general requirements shown in paragraph 15.209.

5.3.2 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.

A preliminary radiated emissions test was performed to determine the emission characteristics of the test item. For the preliminary test, a broadband measuring antenna was positioned at a 3 meter distance from the test item. The entire frequency range from 30MHz to 4.0GHz was investigated using a peak detector function. The data was then processed by the computer to calculate equivalent field intensity.

The final open field emission tests were then manually performed over the frequency range of 30MHz to 4000MHz. Between 30MHz and 1000MHz, a bilog antenna was used as the pick-up device. A broadband double ridged waveguide antenna was used as the pick-up device for all frequencies above 1GHz. All significant broadband and narrowband signals were measured and recorded. The peak detected levels were converted to average levels using a duty cycle factor which was computed from the pulse train.

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

1) The test item was rotated so that all of its sides were exposed to the receiving antenna.
2) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.
3) The measuring antenna was raised and lowered from 1 to 4 meters for each antenna polarization to maximize the readings.
4) For hand-held or body-worn devices, the test item was rotated through three orthogonal axes to determine which orientation produces the highest emission relative to the limit.

5.3.3 Results

The preliminary plots, with the test item transmitting at 315MHz, are presented on data pages 19 through 22. The plots are presented for a reference only, and are not used to determine compliance.

The final open area radiated levels, with the test item transmitting at 315MHz, are presented on data page 23.

As can be seen from the data, all emissions measured from the test item 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.

5.4 Occupied Bandwidth Measurements

5.4.1 Requirement

In accordance with paragraph 15.231(c), all emissions within 20dB of the peak amplitude level of the center frequency are required to be within a band less than 0.25% of the center frequency wide.

5.4.2 Procedures

The test item was placed on an 80cm high non-conductive stand. The unit was set to transmit continuously. With an antenna positioned nearby, occupied bandwidth emissions were displayed on the spectrum analyzer. The resolution bandwidth was set to 50 kHz and span was set to 2 MHz. The frequency spectrum near the fundamental was plotted.

5.4.3 Results

The plots of the emissions near the fundamental frequencies are presented on data page 24. As can be seen from these data pages, the transmitter met the occupied bandwidth requirements. The maximum 99% bandwidth was measured to be 379.8kHz.

6 OTHER TEST CONDITIONS

6.1 Test Personnel and Witnesses

All tests were performed by qualified personnel from Elite Electronic Engineering Incorporated. The test series was witnessed by Innovative Design Solutions personal.

6.2 Disposition of the Test Item

The test item and all associated equipment were returned to Innovative Design Solutions upon completion of the tests.

7 CONCLUSIONS

It was determined that the Innovative Design Solutions KEYFOB , Part No. 11128, Serial No. 5, did fully meet the radiated emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.205 et seq. for Intentional Radiators, when tested per ANSI C63.4-2003.

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 test item at the test date as operated by Innovative Design Solutions personnel. 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.

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
HRE1	LASER JET 5P	HEWLETT PACKARD	C3150A	USHB061052	---	N/A	
NTA1	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL6112	2054	0.03-2GHZ	9/10/2009	9/10/2010
NWH0	RIDGED WAVE GUIDE	TENSOR	4105	2081	1-12.4GHZ	8/11/2009	8/11/2010
RAKG	RF SECTION	HEWLETT PACKARD	85462A	3549A00284	0.009-6500MHZ	2/16/2010	2/16/2011
RAKH	RF FILTER SECTION	HEWLETT PACKARD	85460A	3448A00324	---	2/16/2010	2/16/2011
RBB0	EMI TEST RECEIVER 20HZ TO 40 GHZ.	ROHDE & SCHWARZ	ESIB40	100250	20 HZ TO 40GHZ	3/16/2010	3/16/2011

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

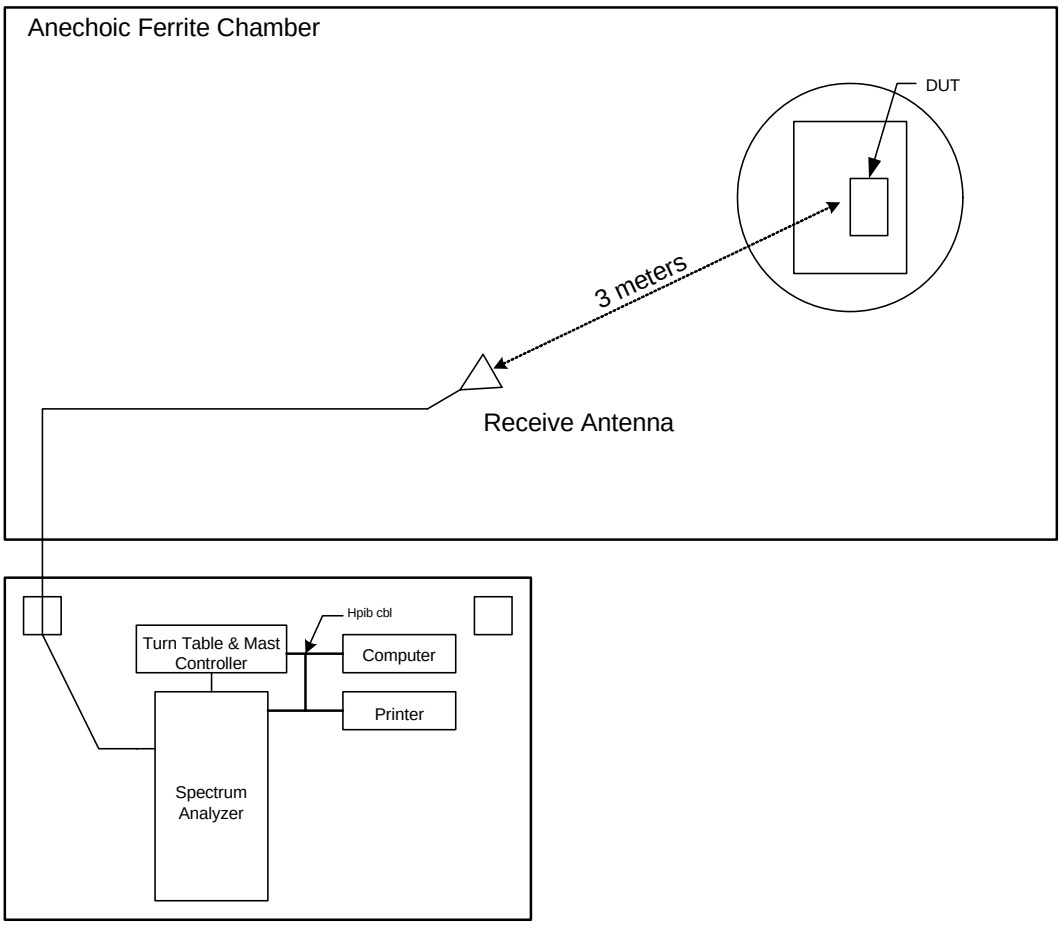
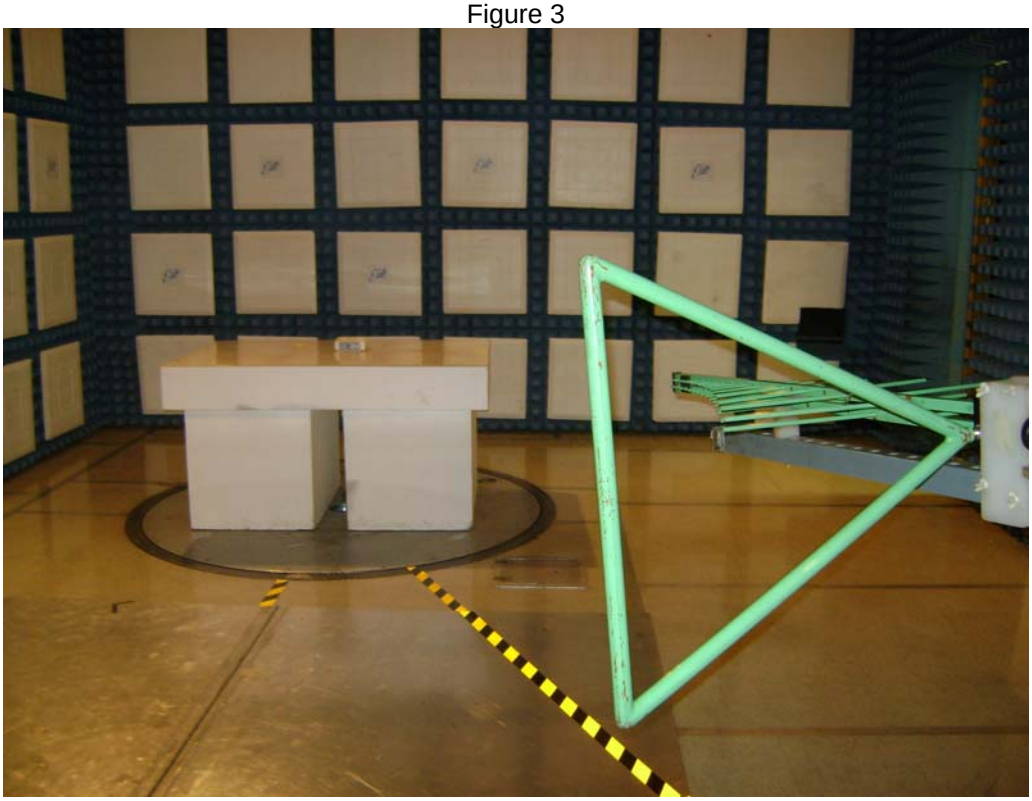
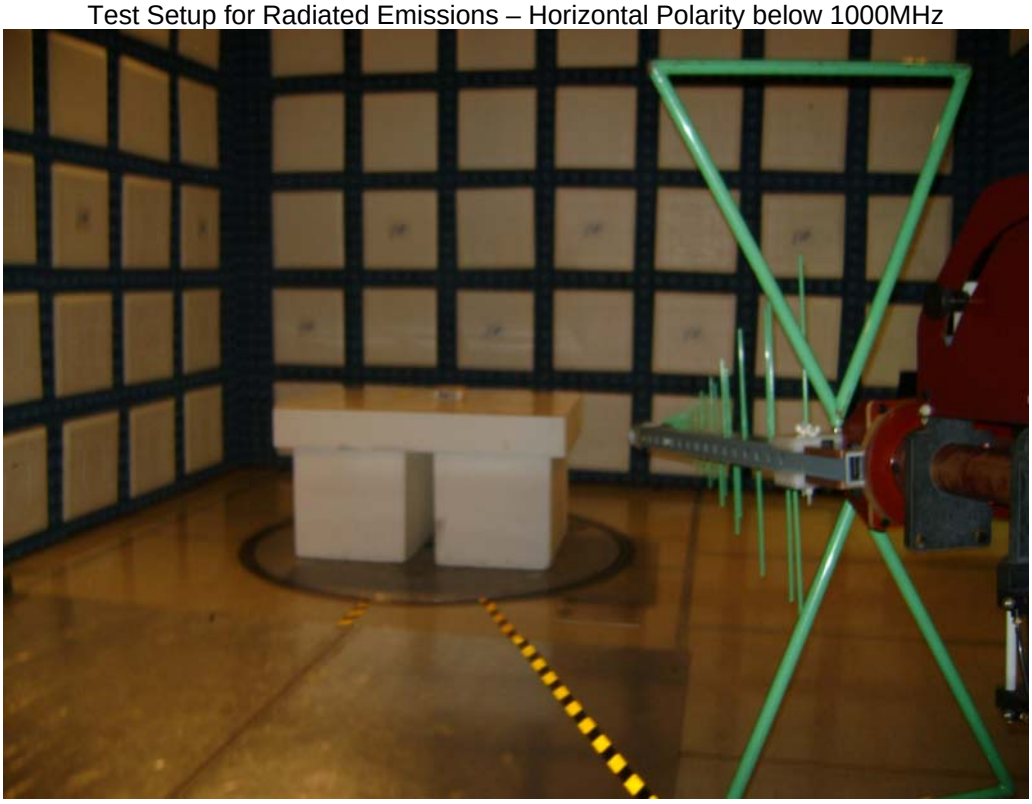


FIGURE 1 BLOCKDIAGRAM OF TEST SETUP

Figure 3



Test Setup for Radiated Emissions – Horizontal Polarity below 1000MHz

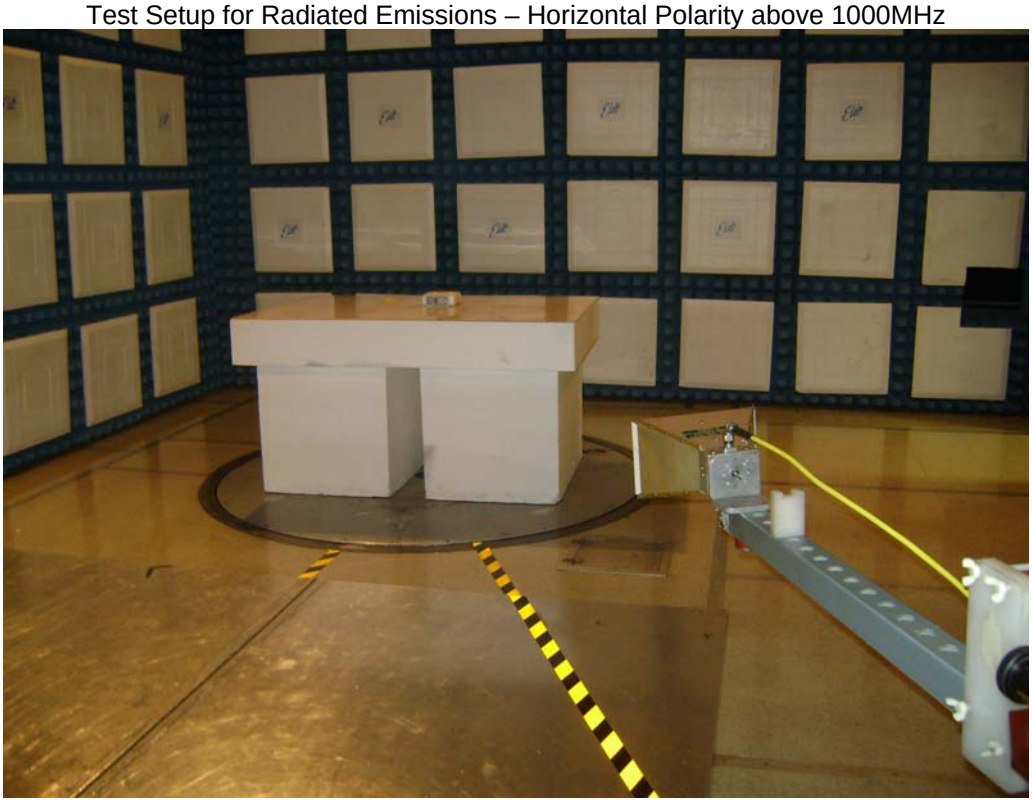


Test Setup for Radiated Emissions – Vertical Polarity below 1000MHz

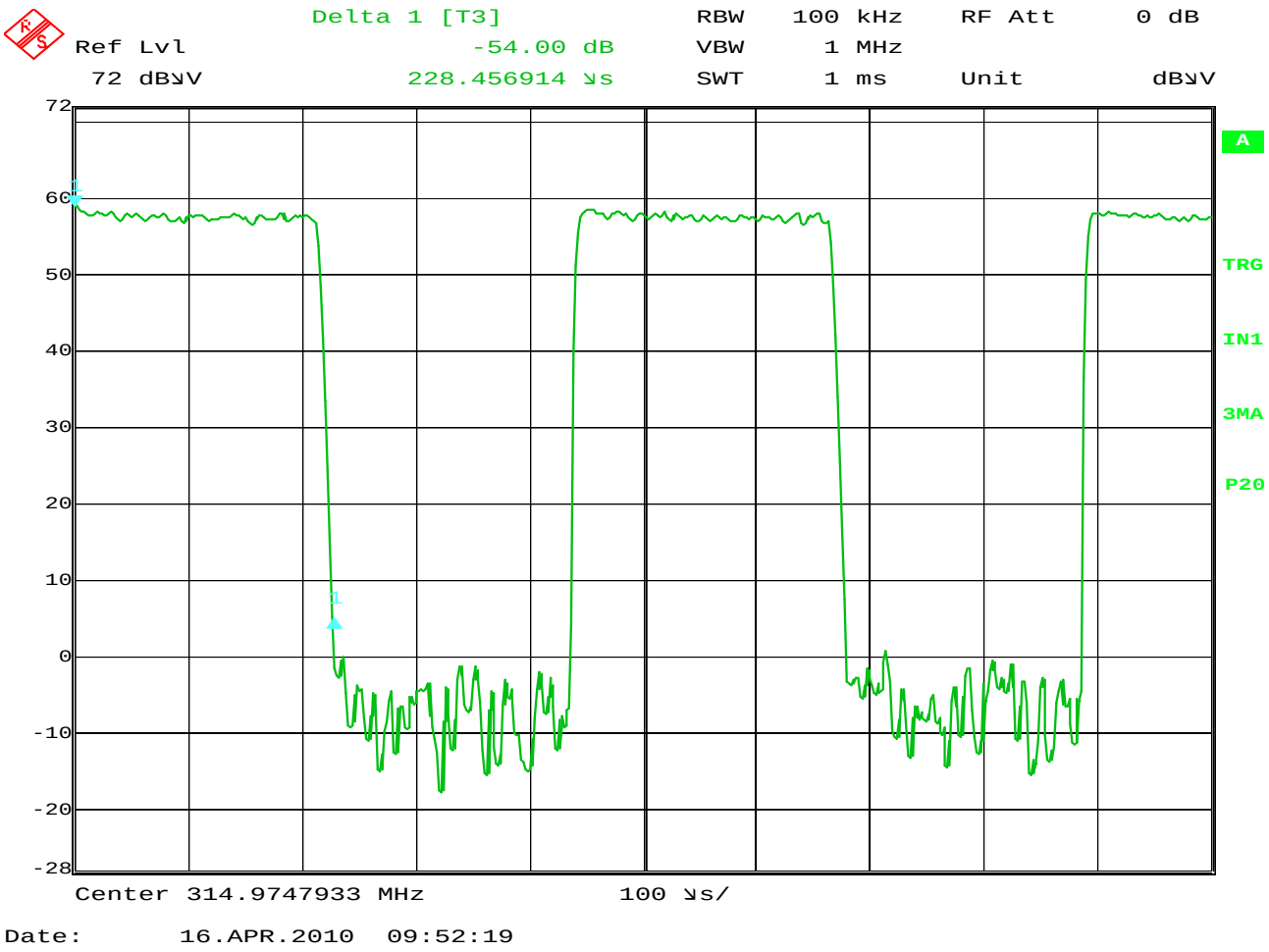
Figure 4

No photograph available.

Test Setup for Radiated Emissions – Horizontal Polarity above 1000MHz

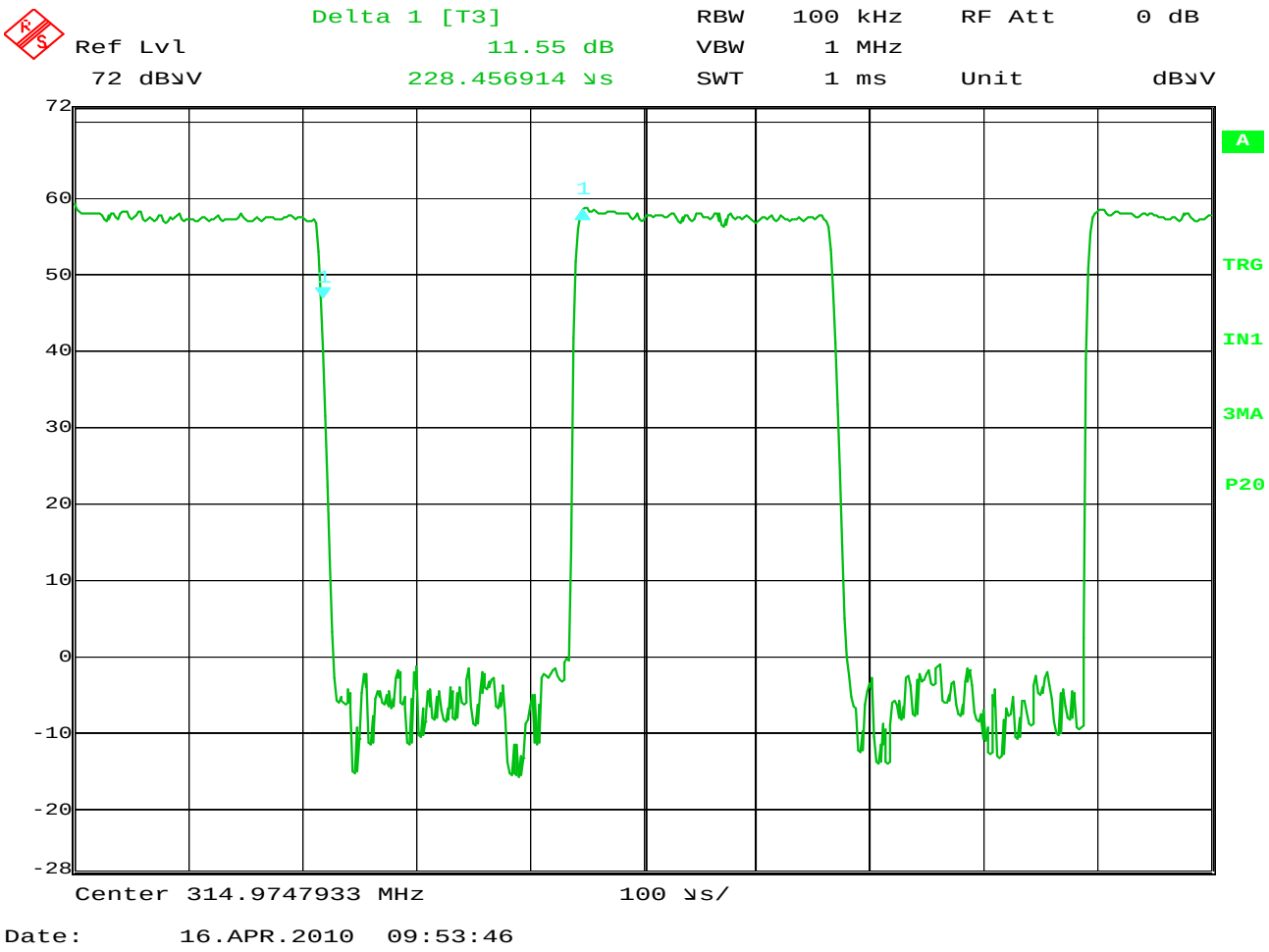


Test Setup for Radiated Emissions – Vertical Polarity above 1000MHz



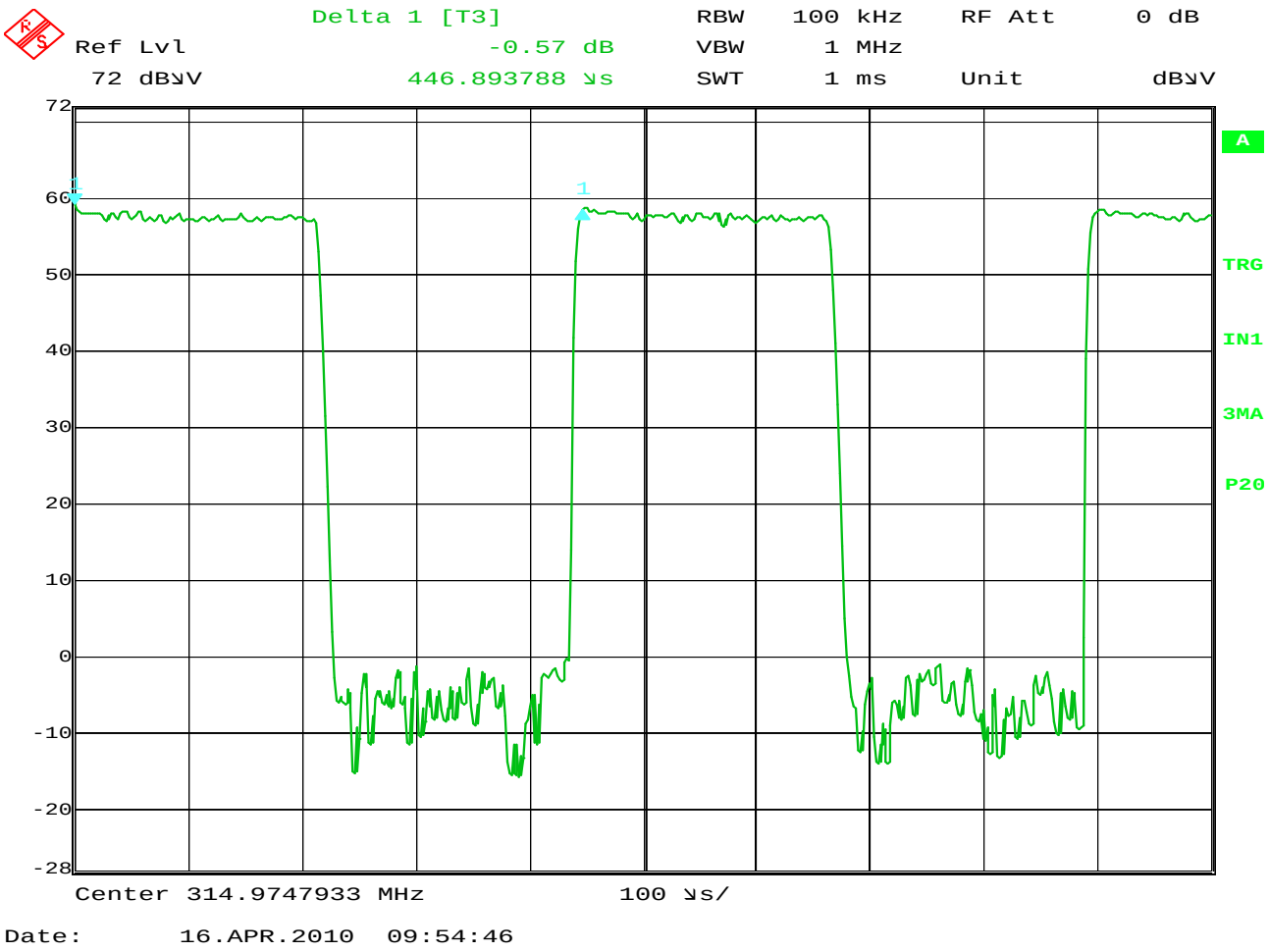
MANUFACTURER :Innovative Design Solutions
MODEL NUMBER :11128
SERIAL NUMBER :5
TEST MODE :Tx 315 MHz
TEST PARAMETERS :Duty Cycle Correction Factor
EQUIPMENT USED :RBB0, NTA1

NOTES



MANUFACTURER :Innovative Design Solutions
MODEL NUMBER :11128
SERIAL NUMBER :5
TEST MODE :Tx 315 MHz
TEST PARAMETERS :Duty Cycle Correction Factor
EQUIPMENT USED :RBB0, NTA1

NOTES



MANUFACTURER :Innovative Design Solutions
MODEL NUMBER :11128
SERIAL NUMBER :5
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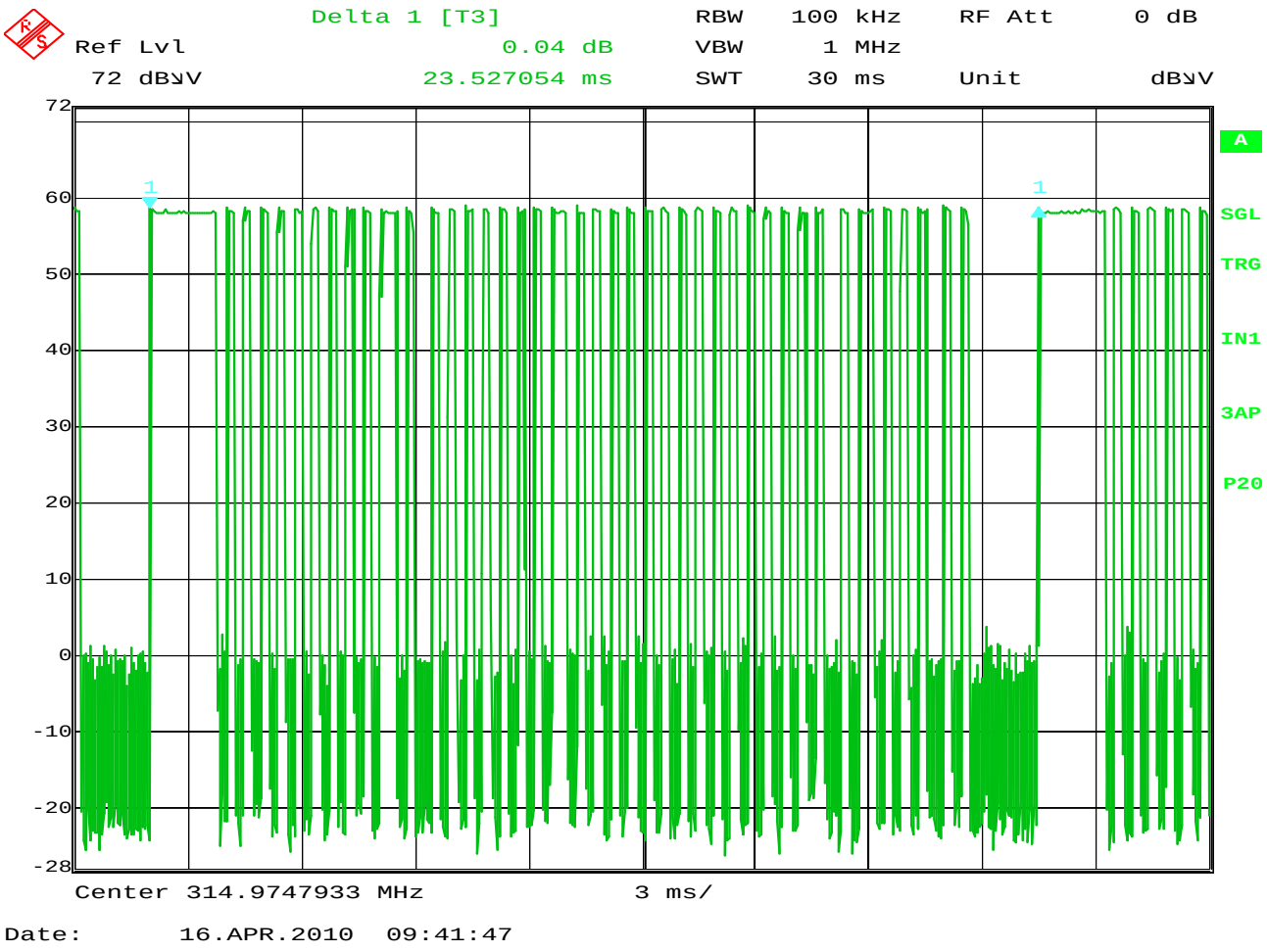
TEST PARAMETERS :Duty Cycle Correction Factor
EQUIPMENT USED :RBB0, NTA1

NOTES



MANUFACTURER :Innovative Design Solutions
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SERIAL NUMBER :5
TEST MODE :Tx 315 MHz
TEST PARAMETERS :Duty Cycle Correction Factor
EQUIPMENT USED :RBB0, NTA1

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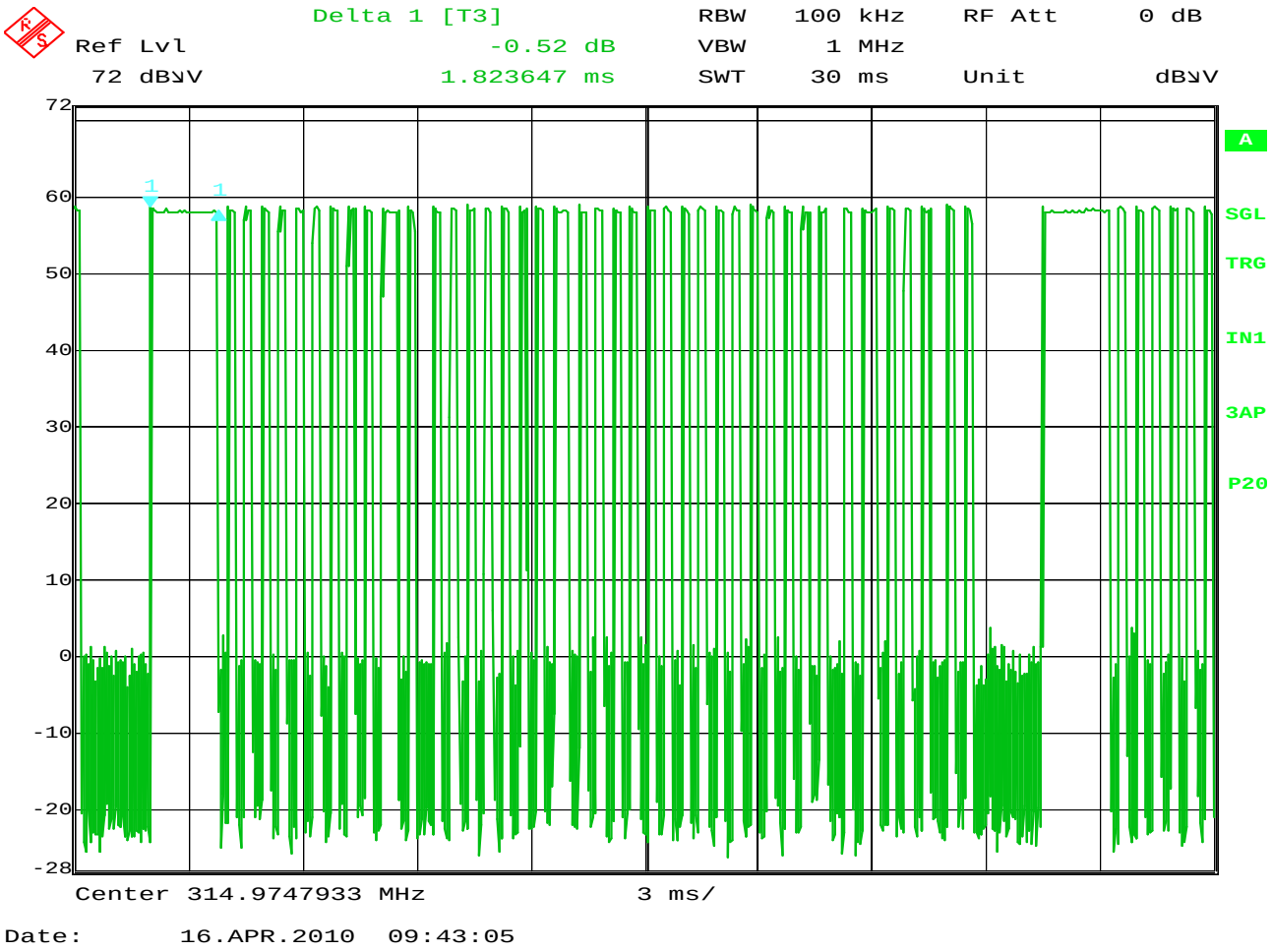
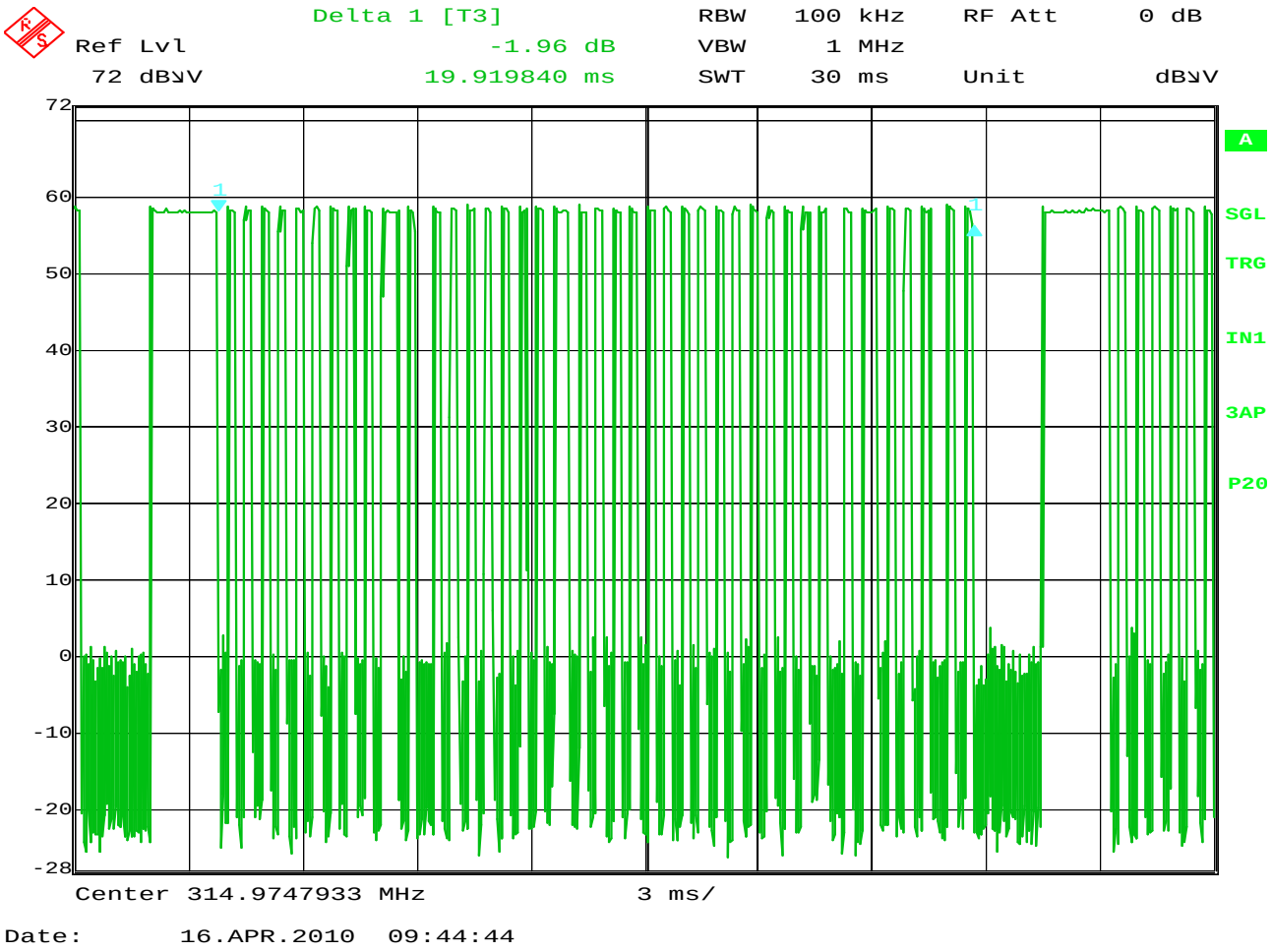


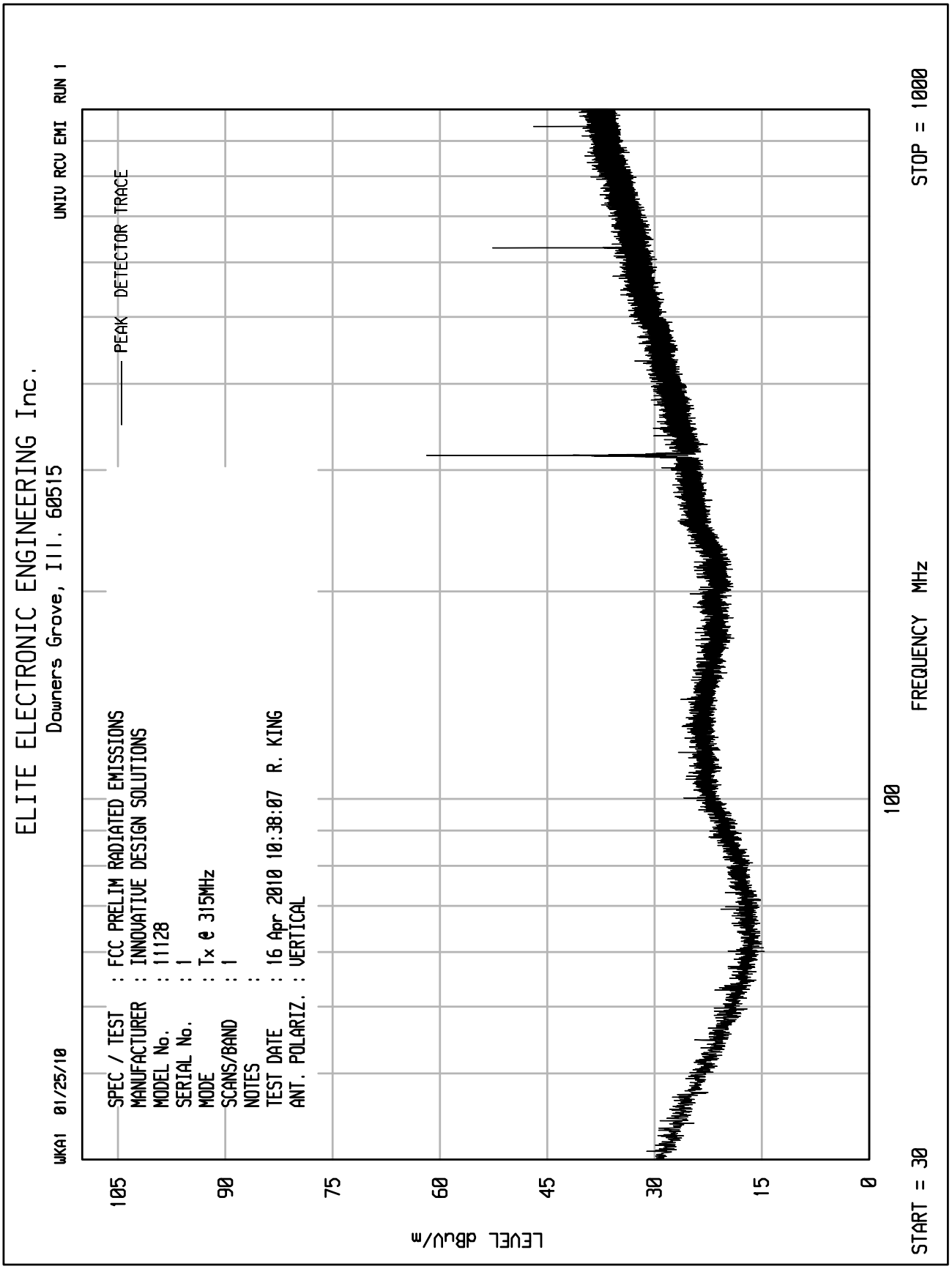
MANUFACTURER :Innovative Design Solutions
MODEL NUMBER :11128
SERIAL NUMBER :5
TEST MODE :Tx 315 MHz
TEST PARAMETERS :Duty Cycle Correction Factor
EQUIPMENT USED :RBB0, NTA1

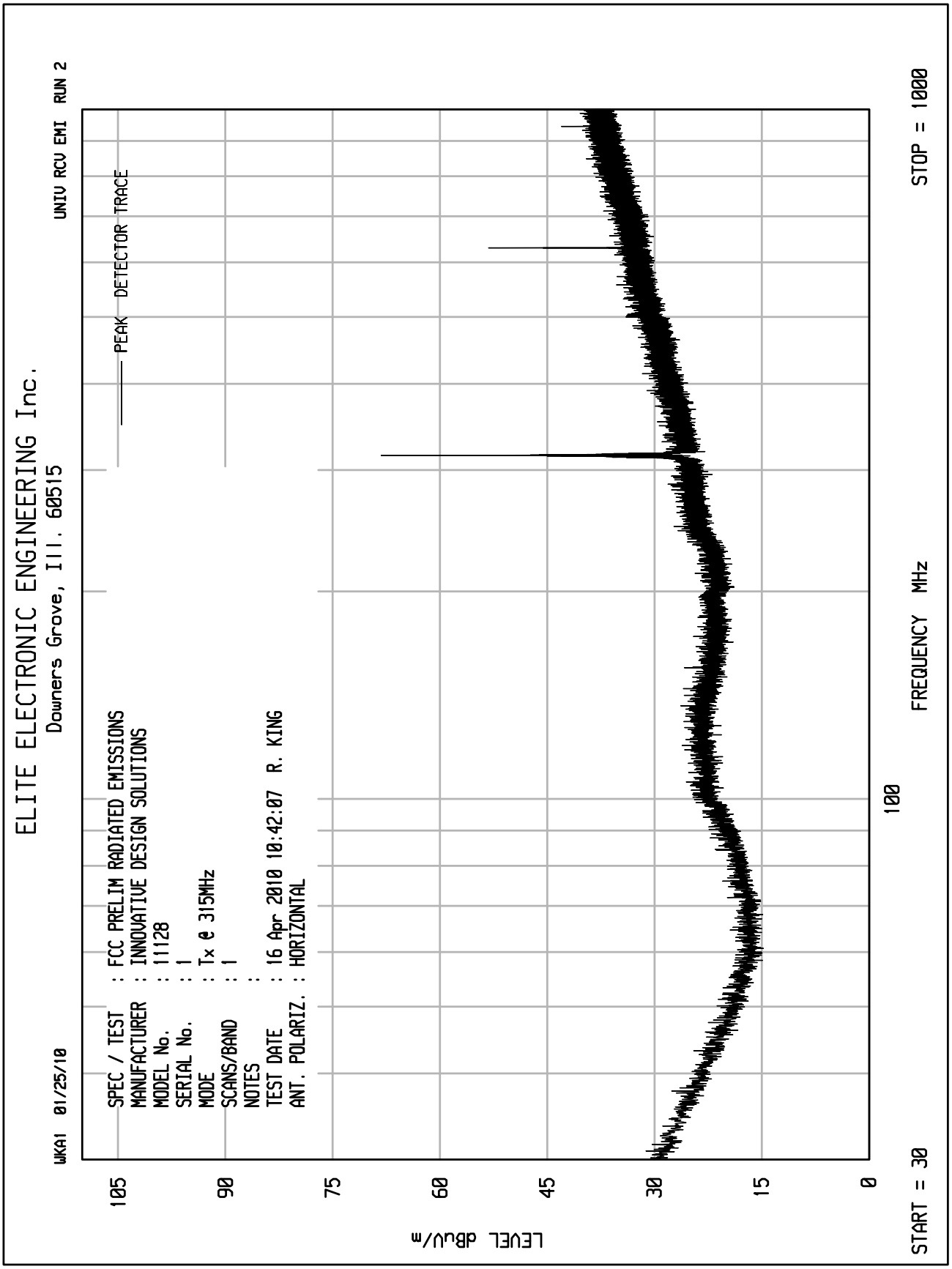
NOTES



MANUFACTURER :Innovative Design Solutions
MODEL NUMBER :11128
SERIAL NUMBER :5
TEST MODE :Tx 315 MHz
TEST PARAMETERS :Duty Cycle Correction Factor
EQUIPMENT USED :RBB0, NTA1

NOTES


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 1
WKA1 01/25/10
SPEC / TEST : FCC PRELIM RADIATED EMISSIONS
MANUFACTURER : INNOVATIVE DESIGN SOLUTIONS
MODEL No. : 11128
SERIAL No. : 1
MODE : Tx @ 315MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 16 Apr 2010 10:38:07 R. KING
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
105
90
75
60
45
30
15
0
START = 30
100
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 2
WKA1 01/25/10
SPEC / TEST : FCC PRELIM RADIATED EMISSIONS
MANUFACTURER : INNOVATIVE DESIGN SOLUTIONS
MODEL No. : 11128
SERIAL No. : 1
MODE : Tx @ 315MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 16 Apr 2010 10:42:07 R. KING
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
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75
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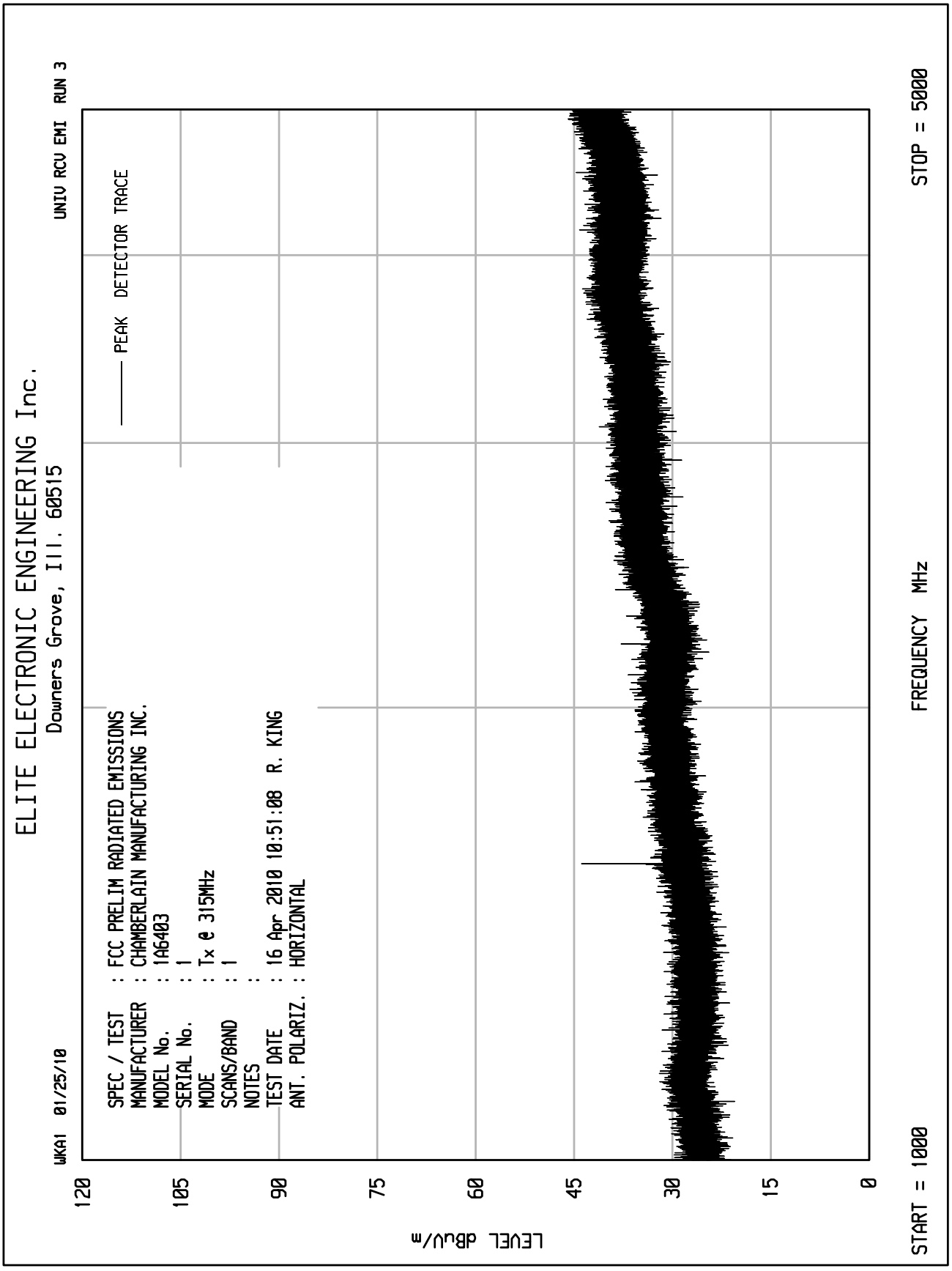
100
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 3
WKA1 01/25/10
SPEC / TEST : FCC PRELIM RADIATED EMISSIONS
MANUFACTURER : CHAMBERLAIN MANUFACTURING INC.
MODEL No. : 1A6403
SERIAL No. : 1
MODE : Tx @ 315MHz
SCANS/BAND : 1
NOTES :
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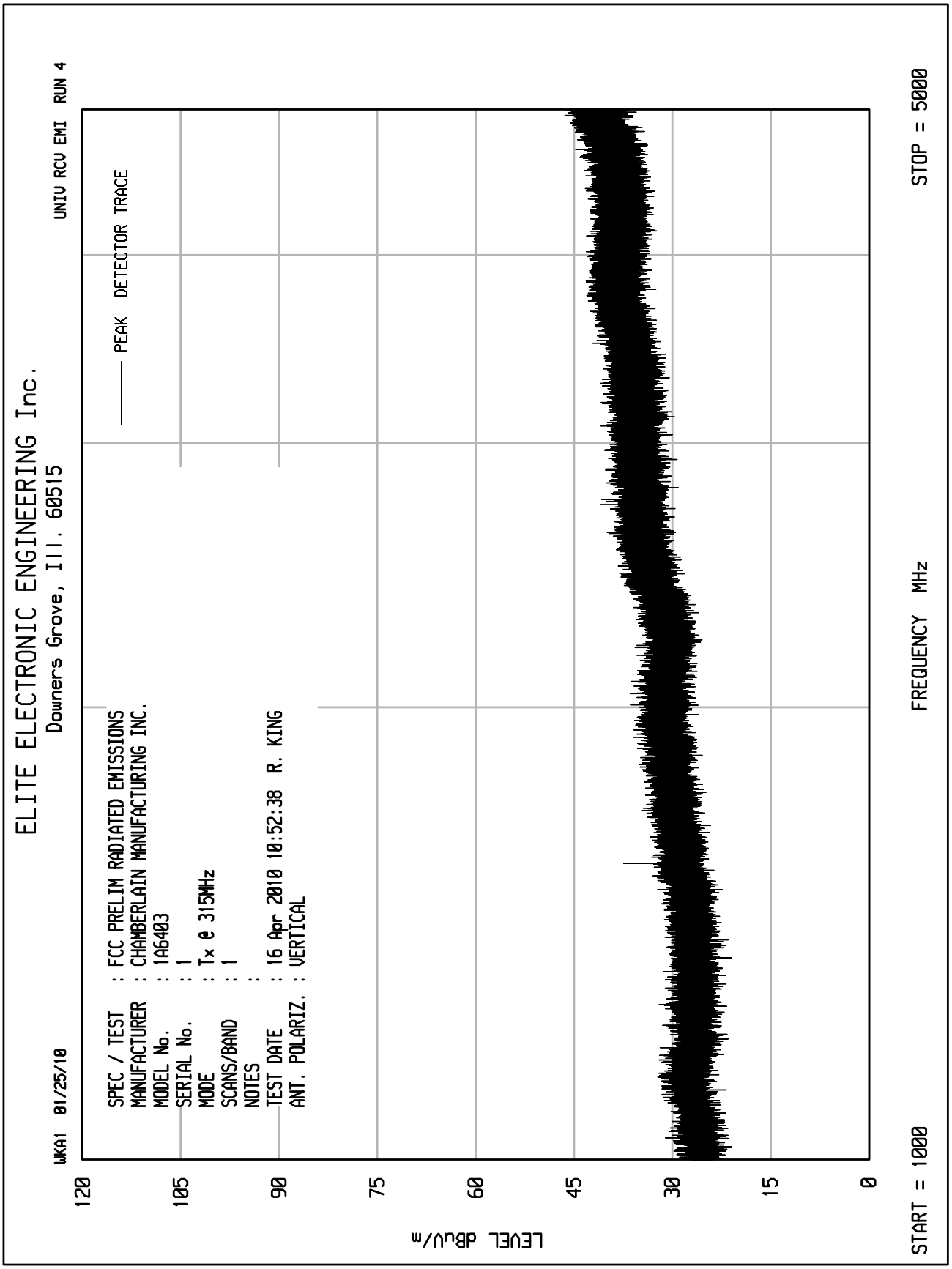
START = 1000
FREQUENCY MHz
STOP = 5000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 4
WKA1 01/25/10
SPEC / TEST : FCC PRELIM RADIATED EMISSIONS
MANUFACTURER : CHAMBERLAIN MANUFACTURING INC.
MODEL No. : 1A6403
SERIAL No. : 1
MODE : Tx @ 315MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 16 Apr 2010 10:52:38 R. KING
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 5000

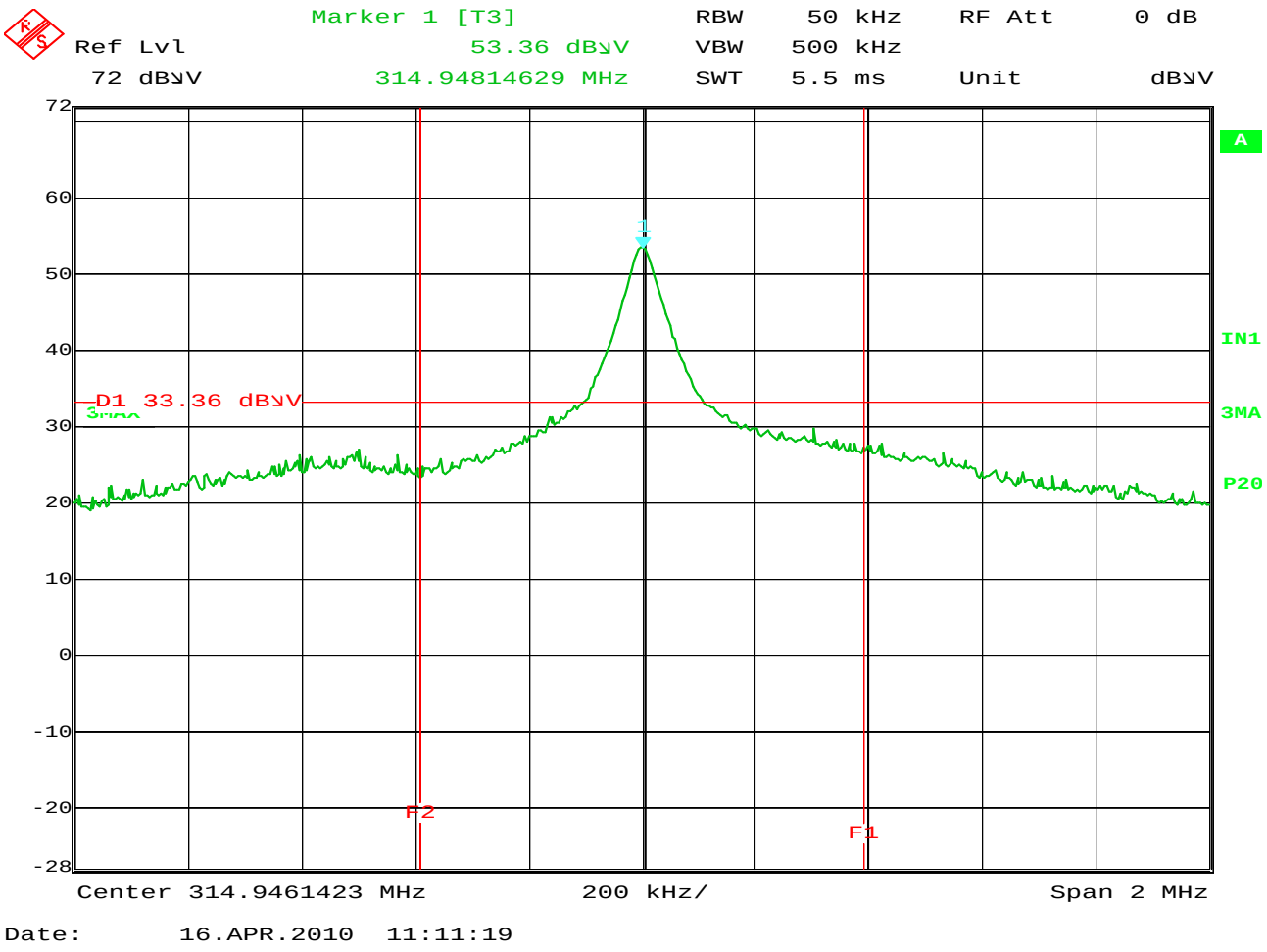
DATA PAGE

SPECIFICATION : FCC PART 15C TRANSMITTER OPEN FIELD DATA
MANUFACTURER : Innovative Design Solutions
TEST ITEM : KEYFOB
PART NO : 11128
S/N : 5
TEST DATE : April 16, 2010
NOTES : Tx @ 315 MHz

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	CBL Fac (dB)	Ant Fac (dB)	Duty Cycle Factor (dB)	Total dBuV/m at 3 M	Total uV/m at 3M	Limit uV/m at 3M	Margin (dB)
315.0	H	53.7	1.4	15.3	-6.0	64.4	1657.1	6041.7	-11.2
315.0	V	50.4	1.4	15.3	-6.0	61.0	1128.1	6041.7	-14.6
630.0	H	33.9	2.0	20.1	-6.0	50.0	316.1	604.2	-5.6
630.0	V	33.6	2.0	20.1	-6.0	49.7	306.4	604.2	-5.9
945.0	H	29.1	2.4	22.8	-6.0	48.3	259.3	604.2	-7.3
945.0	V	20.4	2.4	22.8	-6.0	39.6	95.7	604.2	-16.0
1260.0	H	25.0	2.9	25.6	-6.0	47.4	235.0	604.2	-8.2
1260.0	V	20.1	2.9	25.6	-6.0	42.5	133.4	604.2	-13.1
1575.0	H	19.6	3.2	26.4	-6.0	43.2	144.1	500.0	-10.8
1575.0	V	20.3	3.2	26.4	-6.0	43.9	157.4	500.0	-10.0
1890.0	H	15.3	3.5	27.7	-6.0	40.5	106.4	604.2	-15.1
1890.0	V	15.4	3.5	27.7	-6.0	40.7	108.0	604.2	-15.0
2205.0	H	14.2	3.7	28.7	-6.0	40.6	107.6	500.0	-13.3
2205.0	V	14.6	3.7	28.7	-6.0	41.0	112.5	500.0	-13.0
2520.0	H	15.0	3.9	29.5	-6.0	42.3	130.3	604.2	-13.3
2520.0	V	15.3	3.9	29.5	-6.0	42.6	134.6	604.2	-13.0
2835.0	H	13.8	4.0	30.6	-6.0	42.4	132.1	500.0	-11.6
2835.0	V	15.4	4.0	30.6	-6.0	44.0	158.4	500.0	-10.0
3150.0	H	14.2	4.2	31.7	-6.0	44.1	160.3	604.2	-11.5
3150.0	V	14.8	4.2	31.7	-6.0	44.7	171.9	604.2	-10.9

Checked BY Richard E. King :

Richard E. King



FCC 15.231(c) 20dB Bandwidth

MANUFACTURER : Innovative Design Solutions
MODEL NUMBER : 11128
SERIAL NUMBER : 5
TEST MODE : Tx 315 MHz
TEST PARAMETERS : Occupied Bandwidth
EQUIPMENT USED : RBB0, NTA1

NOTES