Measurement of RF Emissions from a CW-HP/PLS-HP Transmitter

For	Versus Technology, Inc. 2600 Miller Creek Road Traverse City, MI 49684
P.O. Number	VTI-2014-027
Date Tested	January 23, 2014
Test Personnel	Mark Longinotti
Test Specification	FCC "Code of Federal Regulations" Title 47 Part15, Subpart C Industry Canada RSS-GEN Industry Canada RSS-210

Test Report By: MARK E. LONGINOTTI

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Requested By: Robert Wiser
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TABLE OF CONTENTS

REVISION HISTORY

Revision	Date	Description
—	05 Feb 2014	Initial release

Measurement of RF Emissions from a Transmitter, Model No. CW-HP/PLS-HP

1. INTRODUCTION

1.1. Scope of Tests

This report presents the results of the RF emissions measurements performed on a Transmitter. Three (3) samples were submitted for testing: Model No. CW-HP, Serial No. None Assigned, Model No. PLS-HP, Serial No. None Assigned, and a third sample with no model number or serial number (hereinafter referred to as the Equipment Under Test (EUT)). The EUT was designed to transmit at approximately 433.9MHz using an internal, non-removable antenna. The EUT was manufactured and submitted for testing by Versus Technology, Inc. located in Traverse City, MI.

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 C, Sections 15.207 and 15.231 for Intentional Radiators. Testing was performed in accordance with ANSI C63.4-2009.

The test series was performed to determine if the EUT meets the conducted RF emission requirements of the Industry Canada Radio Standards Specification, RSS-Gen, Section 7.2.4 and the radiated RF emission requirements of the Industry Canada Radio Standards Specification, RSS-210, Annex 1 for transmitters. Testing was performed in accordance with ANSI C63.4-2009.

1.3. Deviations, Additions and Exclusions

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

1.4. EMC Laboratory Identification

This series of tests was performed by Elite Electronic Engineering Incorporated of Downers Grove, Illinois. The laboratory is accredited by The 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^{o}C and the relative humidity was 17%.

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 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"
- Industry Canada Radio Standards Specification, RSS-Gen, “General Requirements and Information for the Certification of Radiocommunication Equipment”, Issue 3, December 2010
- Industry Canada Radio Standards Specification, RSS-210, “Low-power License-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment”, Issue 8, December 2010

3. EUT Setup and Operation

3.1. General Description

The EUT is a Versus Technology, Inc., Transmitter, Model No. CW-HP/PLS-HP. A block diagram of the EUT setup is shown as Figure 1.

3.1.1. Power Input

The EUT obtained 3VDC from an internal CR2477 lithium battery.

3.1.2. Peripheral Equipment

No peripheral equipment was submitted with the EUT.

3.1.3. Signal Input/Output Leads

No interconnect cables were submitted with the EUT.

3.1.4. Grounding

The EUT was not grounded during the tests.

3.2. Software

For the radiated emissions tests, firmware “CW test code” was loaded onto model number CW-HP. For the periodic operations tests, firmware “Beta Rev 1 Development code” was loaded onto the sample with no model number or serial number. For all other tests, firmware “Fast pulse test code” was loaded onto model number PLS-HP.

3.3. Operational Mode

For all tests the EUT was placed on an 80cm high non-conductive stand. The EUT was energized. Model No. CW-HP was programmed so that once the battery was installed in the EUT, it would constantly transmit an unmodulated (CW) signal. Model No. PLS-HP was programmed so that once the battery was installed in the EUT, it would transmit a modulated signal once every 3.1 seconds. The third sample with no model number or serial number was programmed so that once the battery was installed in the EUT, it would transmit in the normal operation mode.

3.4. EUT Modifications

No modifications were required for compliance.

4. Test Facility and Test Instrumentation

4.1. Shielded Enclosure

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

4.2. Test Instrumentation

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

Conducted and radiated emission measurements were performed with a spectrum analyzer. This receiver allows measurements with the bandwidths and detector functions specified by the FCC. The receiver bandwidth was 120kHz for the 30MHz to 1000MHz radiated emissions data and 1MHz for the 1000MHz to 5000MHz radiated emissions data.

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	1.07	-1.07
Expanded Uncertainty (95% confidence)	2.1	-2.1

Radiated Emissions 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 EUT was powered by internal batteries, no conducted emissions tests are required.

5.2. Periodic Operation Measurements

5.2.1.Requirements

Devices operated under the provisions of 15.231(e) shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

5.2.2.Procedures

The spectrum analyzer was setup to display the time domain trace. The EUT was set to transmit normally. The spectrum analyzer was used to record the amount of time that the EUT remained active following activation, to record the duration of each transmission, and to record the silent time between transmissions.

5.2.3.Results

The plot of the periodic timing is shown on data page 15. The data shows that each of the transmissions from the EUT is not greater than one second and that the silent period between transmissions is at least 30 times the duration of the transmissions but not less than 10 seconds.

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5.3. Duty Cycle Factor Measurements

5.3.1. Requirements

The duty cycle factor is used to convert peak detected readings to average readings. Per 15.35(c), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.

5.3.2. Procedures

The duty cycle factor was calculated from information supplied by the manufacturer. Since this EUT utilizes a rolling code modulation, the duty cycle correction factor is calculated based on the worst case. The following procedure was used to measure a representative sample:

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 width is measured and a plot of this measurement is recorded.

c) Next the number of pulses in the word period is measured and a plot is recorded.

d) The pulse width and number of pulses for the word period are used to compute the on-time. The duty cycle is then computed as the (on-time/ word period).

e) The duty cycle factor is computed from the duty cycle.

5.3.3. Results

Representative plots of the duty cycle are shown on pages 16 and 17. Since the transmitter uses a rolling code, the duty cycle correction factor used was calculated based on the maximum case. The following maximum case information was supplied by Versus Technology, Inc.:

An encoded transmission consists of defined train of Forty-six 206 usec pulses.
The encoding of the logical 1's and 0's is determined by the space (off time) between the pulses.
The off time of approximately 1.04mSec determines the logical "0" (zero).
The off time of approximately 1.61mSec determines the logical "1" (one).
The pulse train consists of:

1. Four Preamble pulses separated by approximately 1.04mSec off time
2. An 'off' time of approximately 6.2mSec.
3. Forty-Two pulses separated by 'off' time of either 1.04mSec or 1.61mS.

If all forty-two encoding pulses are separated by 1.04mS, then the maximum value of the emission is calculated as follows:

Pulse on time:

1. Total on time 46 x 0.206mS	9.48 mS

Pulse word period:

1. Preamble on time 4 x .206mS	0.824 mS
2. Preamble off time 3 x 1.04mS	3.12 mS
3. Preamble space time 6.20mS	6.20 mS
4. Encoded pulses 42 x 0.206mS	8.652 mS
5. Encoded off time 41 x 1.04mS	42.64 mS

TOTAL pulse word period: 61.44 mS

Duty cycle factor (maximum time on) is:

1. Duty cycle: (9.48mS / 61.44mS) = 0.154
2. Duty cycle factor: 20 * log (0.16) = -16.2dB

With the test item transmitting at 433.9MHz, the maximum case duty cycle correction factor was calculated to be -16.2dB.

5.4. Radiated Measurements

5.4.1.Requirements

The EUT must comply with the requirements of FCC "Code of Federal Regulations Title 47", Part 15, Subpart C, Section 15.231(e).

Paragraph 15.231(e) 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	1500 to 5000*	150 to 500*

* - Linear Interpolation

For 433.9MHz, the limit at the fundamental is 4398.4uV/m @ 3m and the limit on the harmonics is 439.8uV/m @ 3m.

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.

5.4.2.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.

A preliminary radiated emissions test was performed to determine the emission characteristics of the EUT. For the preliminary test, a broadband measuring antenna was positioned at a 3 meter distance from the EUT. The entire frequency range from 30MHz to 5.0GHz was investigated using a peak detector function. The data was then processed by the computer to calculate equivalent field intensity.

The final emission tests were then manually performed over the frequency range of 30MHz to 5000MHz. 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 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.
4) For hand-held or body-worn devices, the EUT was rotated through three orthogonal axes to determine which orientation produces the highest emission relative to the limit.

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 duty cycle 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]

5.4.3.Results

The preliminary plots, with the EUT transmitting at 433.9MHz, are presented on data pages 18 through 21. The plots are presented for a reference only, and are not used to determine compliance.

The final radiated levels, with the EUT transmitting at 433.9MHz, are presented on data page 23. As can be seen from the data, all emissions measured from the EUT were within the specification limits. The effective radiated power was calculated to be -36dBm. The emissions level closet to the limit (worst case) occurred at1735.6MHz. The emissions level at this frequency was -5.7dB within the limit. See data page 23 for details. Photographs of the test configuration which yielded the highest, or worst case, radiated emission levels are shown on Figure 2 and Figure 3.

5.5. Occupied Bandwidth Measurements

5.5.1.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.

5.5.2.Procedures

The EUT 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 30 kHz and span was set to 2 MHz. The frequency spectrum near the fundamental was plotted. The 99% bandwidth was measured to be 136.3kHz

5.5.3.Results

The plot of the emissions near the fundamental frequency is presented on data page 24. As can be seen from this data page, the transmitter met the occupied bandwidth requirements.

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 Versus Technology, Inc. upon completion of the tests.

7. CONCLUSIONS

It was determined that the Versus Technology, Inc. Transmitter, Model No. CW-HP/PLS-HP, Serial No. None Assigned, 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 15.231 for Intentional Radiators, when tested per ANSI C63.4-2009.

It was also determined that the Versus Technology, Inc. Transmitter, Model No. CW-HP/PLS-HP, Serial No. None Assigned, did fully meet the conducted and radiated emission requirements of the of the Industry Canada Radio Standards Specification, RSS-Gen, Section 7.2.4 and the radiated RF emission requirements of the Industry Canada Radio Standards Specification, RSS-210, Annex 1 for transmitters, 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 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
CDY0	WORKSTATION	ELITE	WORKSTATION			N/A	
CMA1	Controllers	EMCO	2090	9701-1213	---	N/A	
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	3/18/2013	3/18/2014
RBB0	EMI TEST RECEIVER 20HZ TO 40 GHZ.	ROHDE & SCHWARZ	ESIB40	100250	20 HZ TO 40GHZ	3/7/2013	3/7/2014
WKA1	SOFTWARE, UNIVERSAL RCV EMI	ELITE	UNIV_RCV_EMI	1	---	I/O	

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.

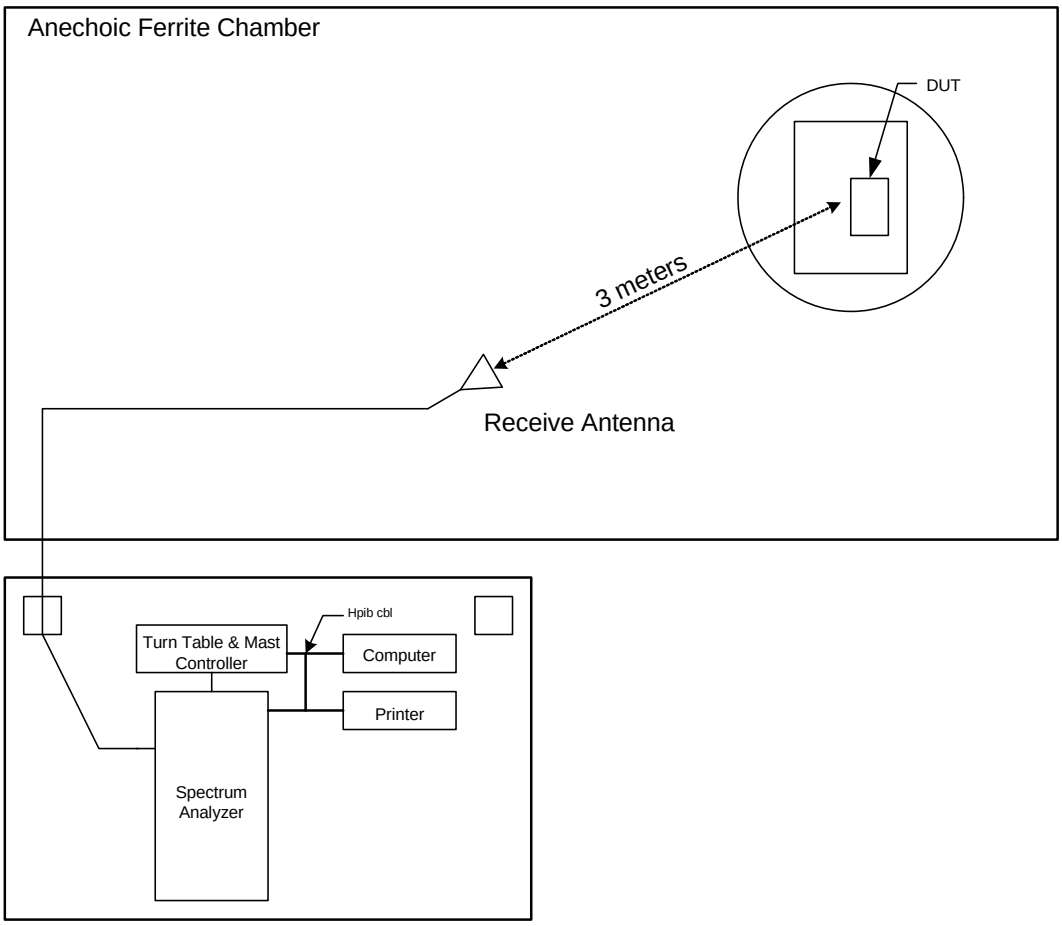
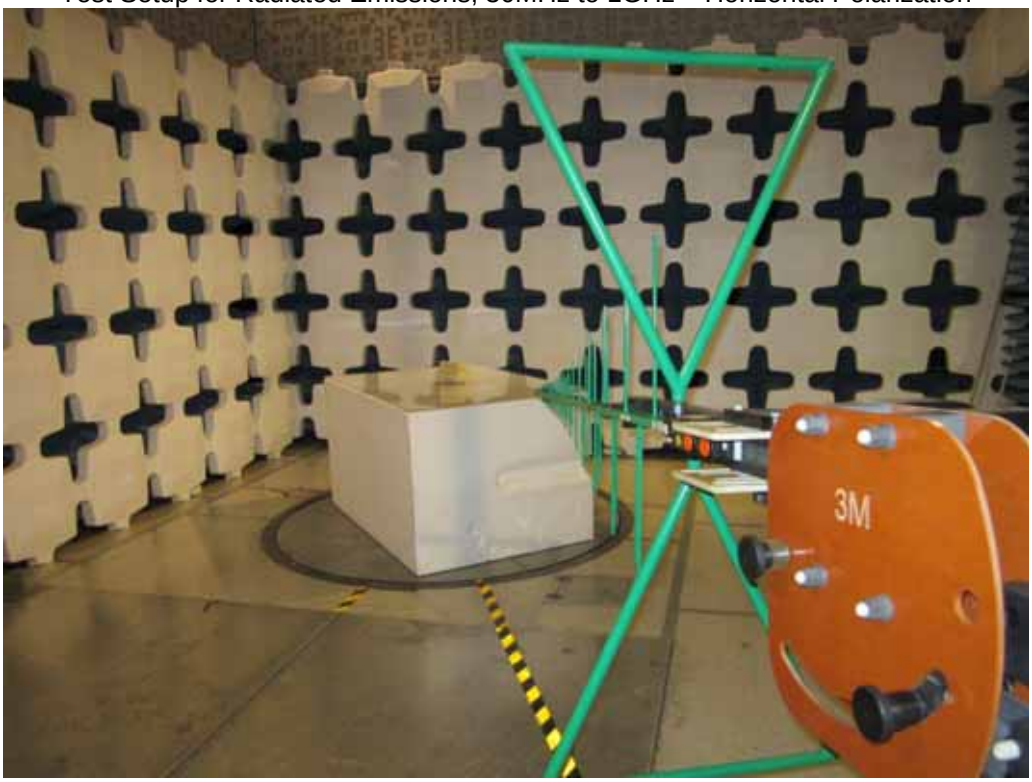


FIGURE 1 BLOCKDIAGRAM OF TEST SETUP

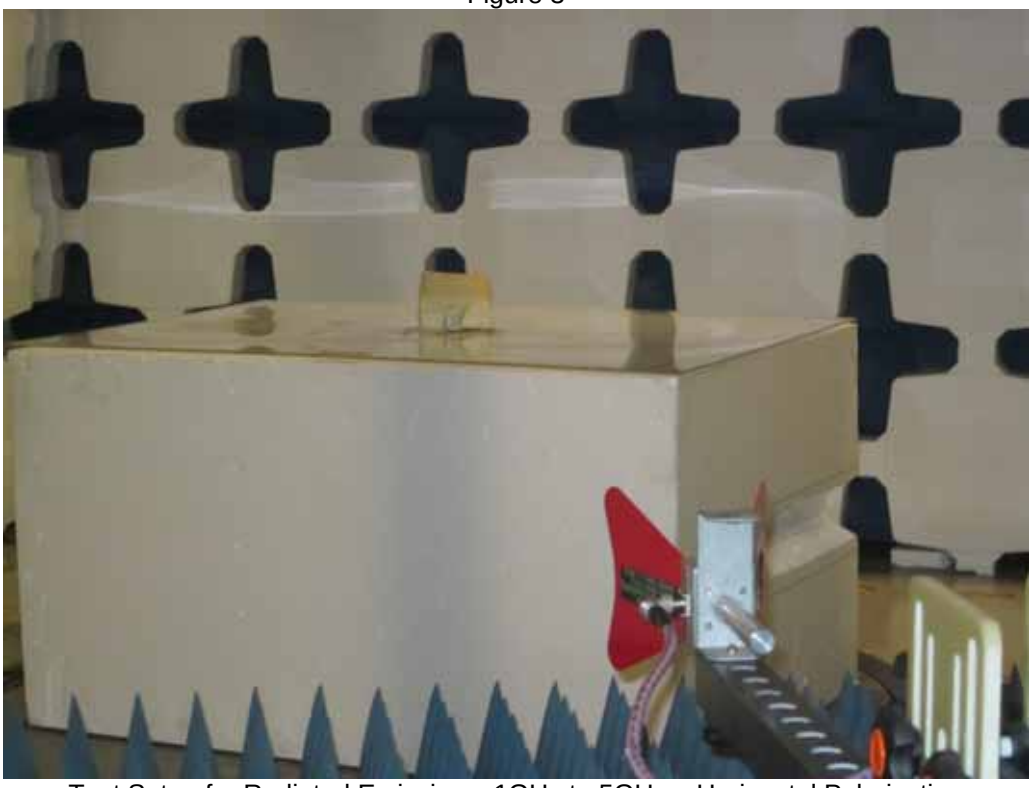
Figure 3

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



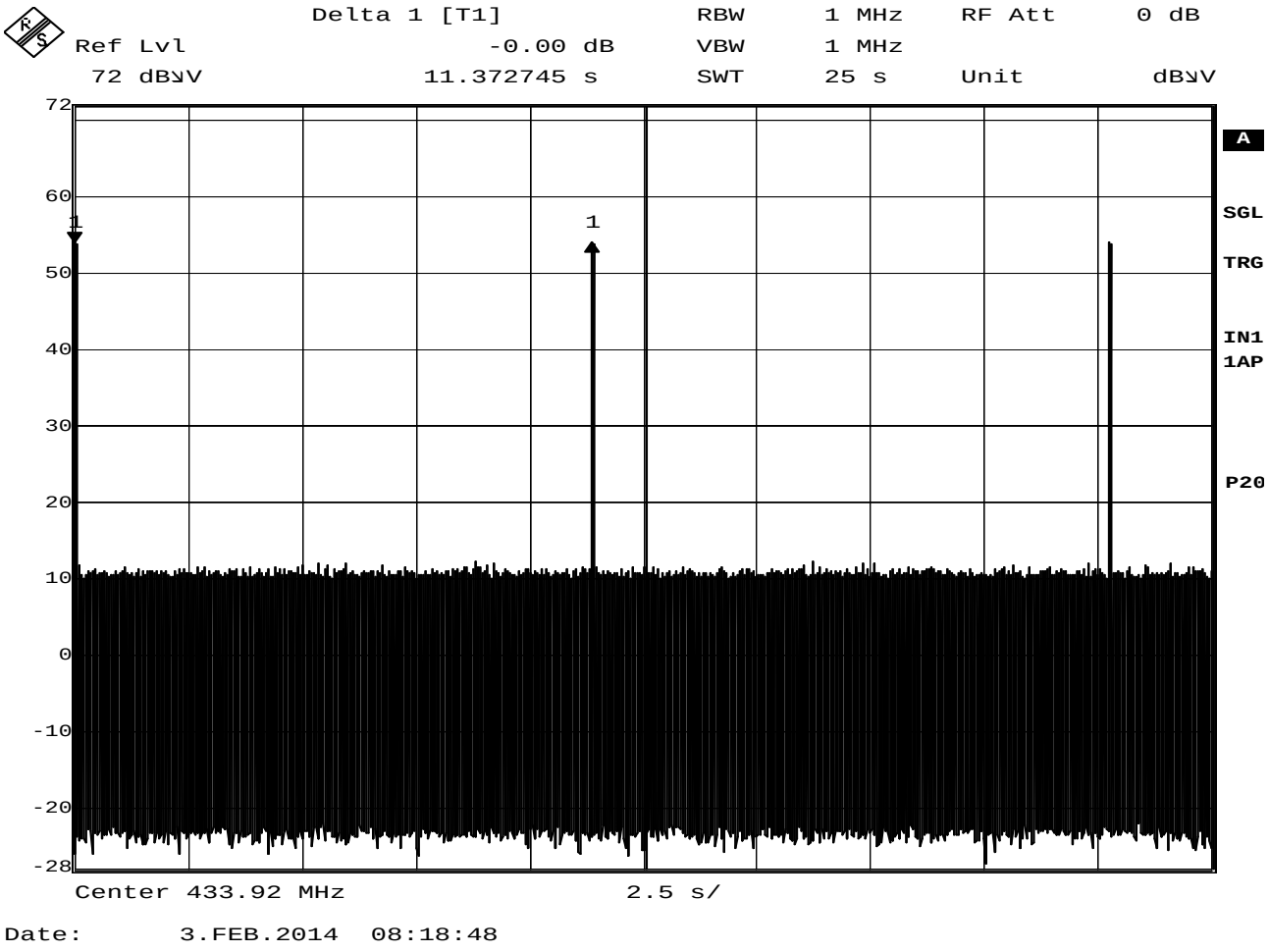
Test Setup for Radiated Emissions, 30MHz to 1GHz – Vertical Polarization

Figure 3



Test Setup for Radiated Emissions, 1GHz to 5GHz – Horizontal Polarization

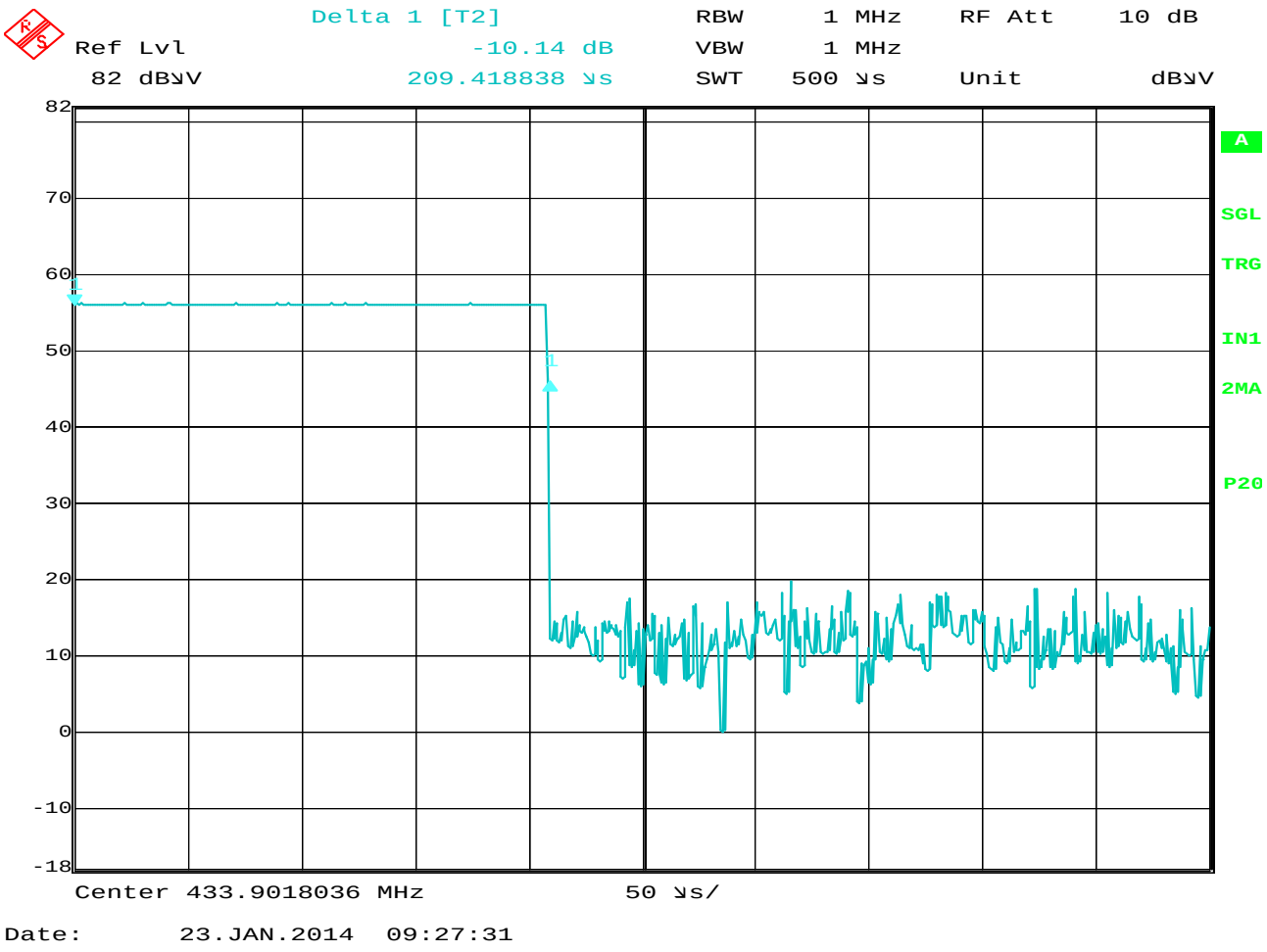
Test Setup for Radiated Emissions, 1GHz to 5GHz – Vertical Polarization



Periodic Operation

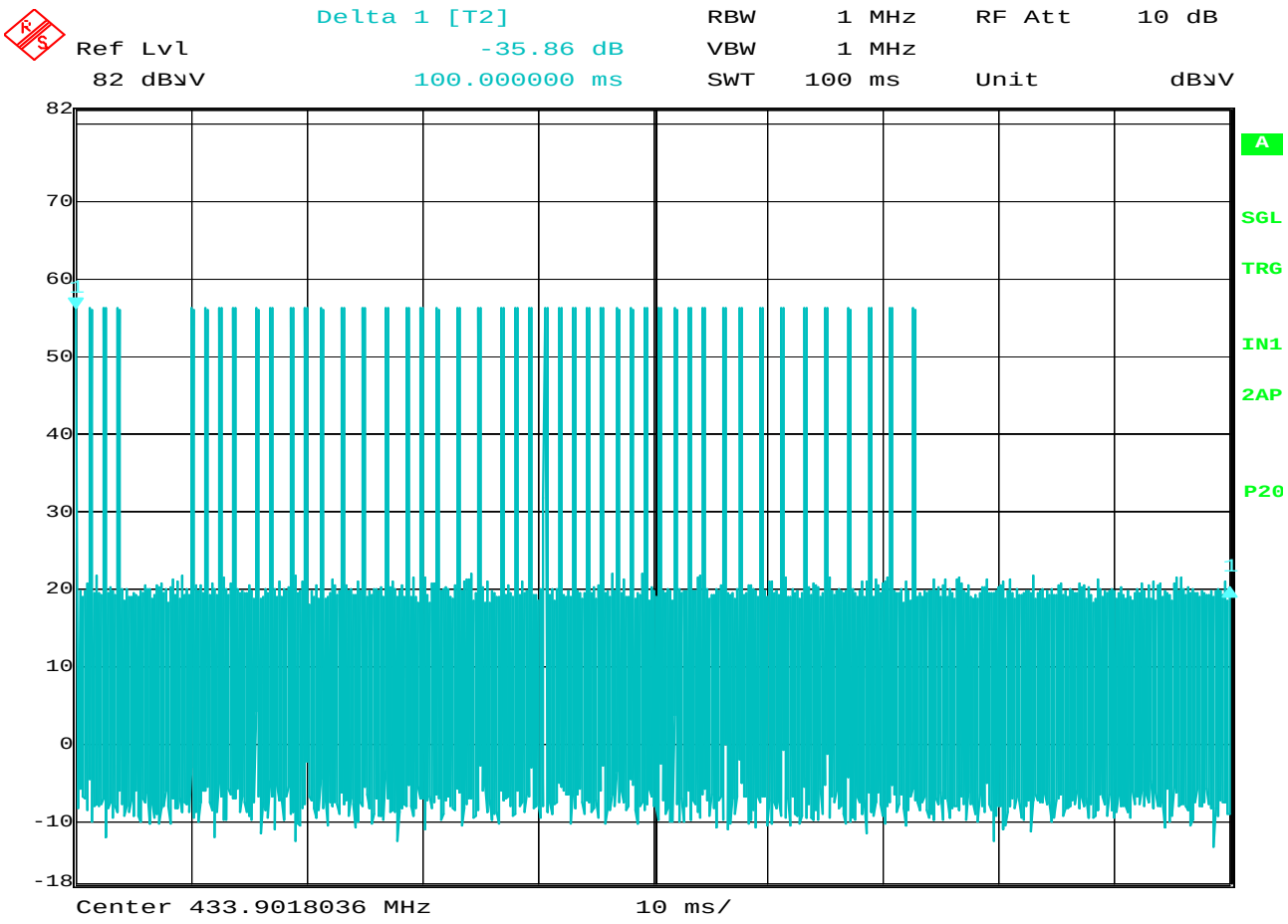
MANUFACTURER	:	Versus
MODEL NUMBER	:	PLS
SERIAL NUMBER	:	
TEST MODE	:	Tx @ 433.9MHz (normal operation)
TEST DATE	:	February 3, 2014
TEST PARAMETERS	:	A periodic operation transmitters shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.
EQUIPMENT USED	:	RBB0, NTA2

NOTES



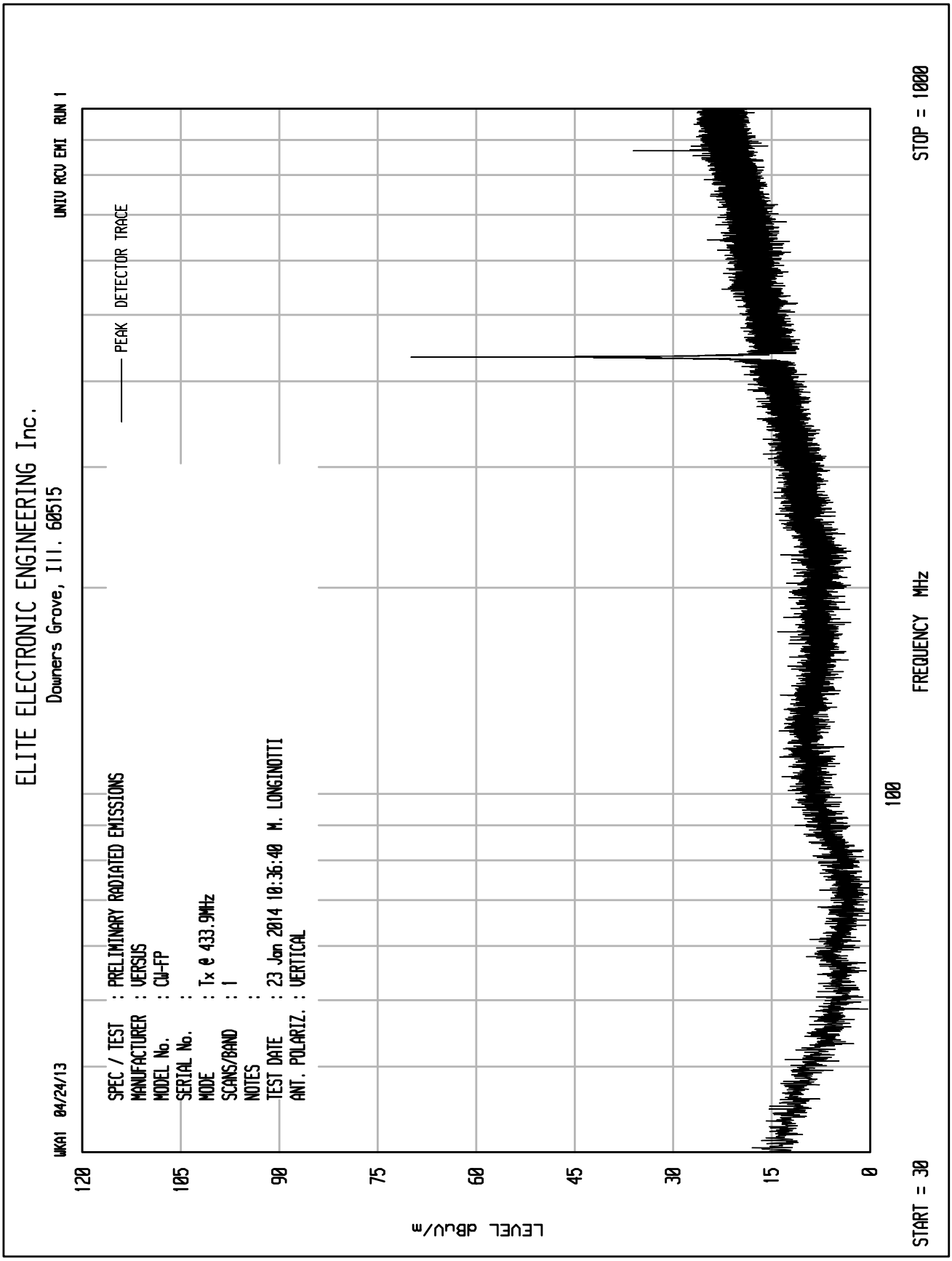
Duty Cycle Factor

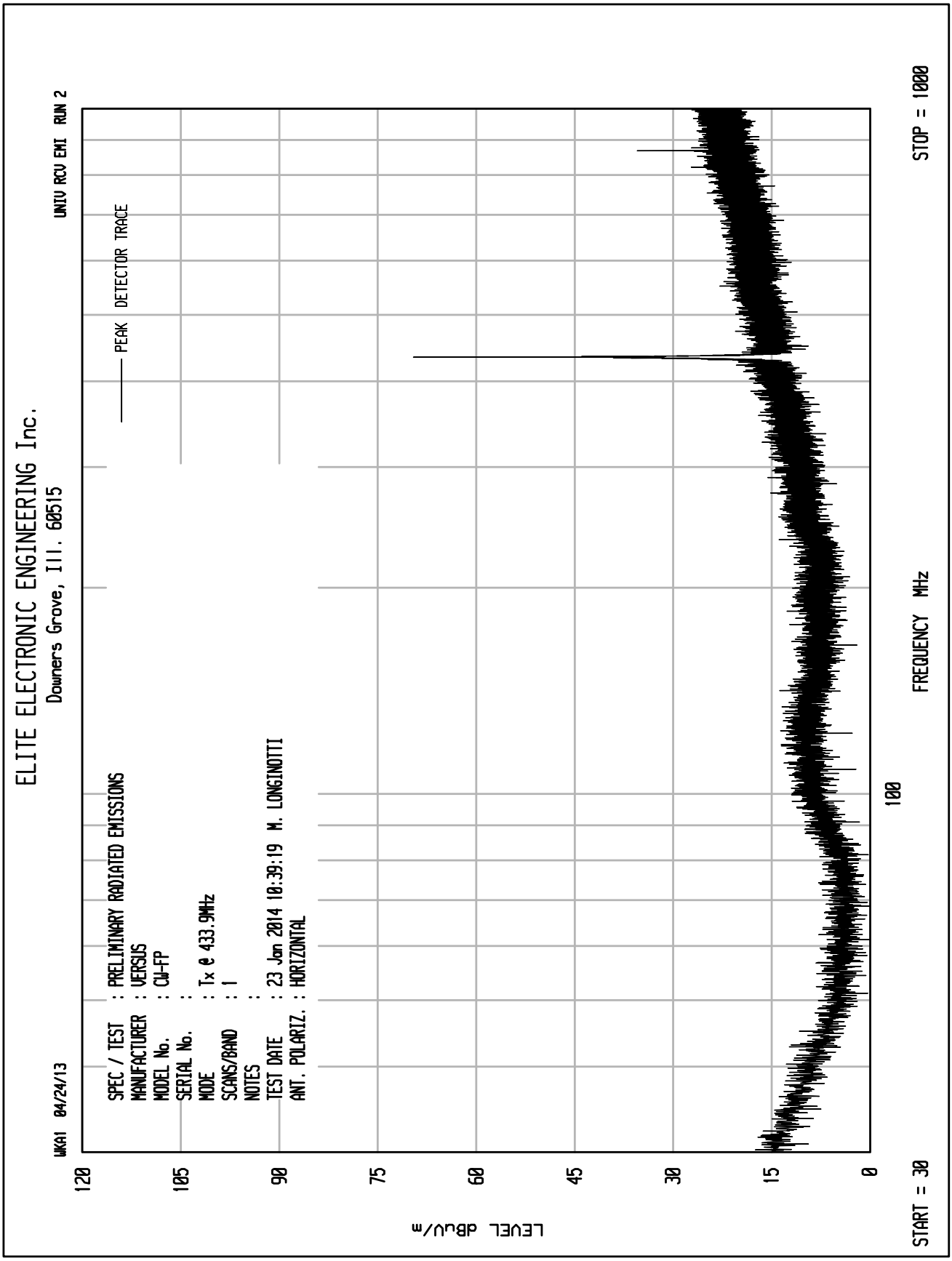
MANUFACTURER	:	Versus
MODEL NUMBER	:	PLS-HP
SERIAL NUMBER	:	
TEST MODE	:	Tx @ 433.9MHz
NOTES	:	
TEST DATE	:	January 23, 2014
TEST PARAMETERS	:	Duty Cycle Factor
NOTES	:	Pulse Width = 209.4usec
EQUIPMENT USED	:	RBB0, NTA2

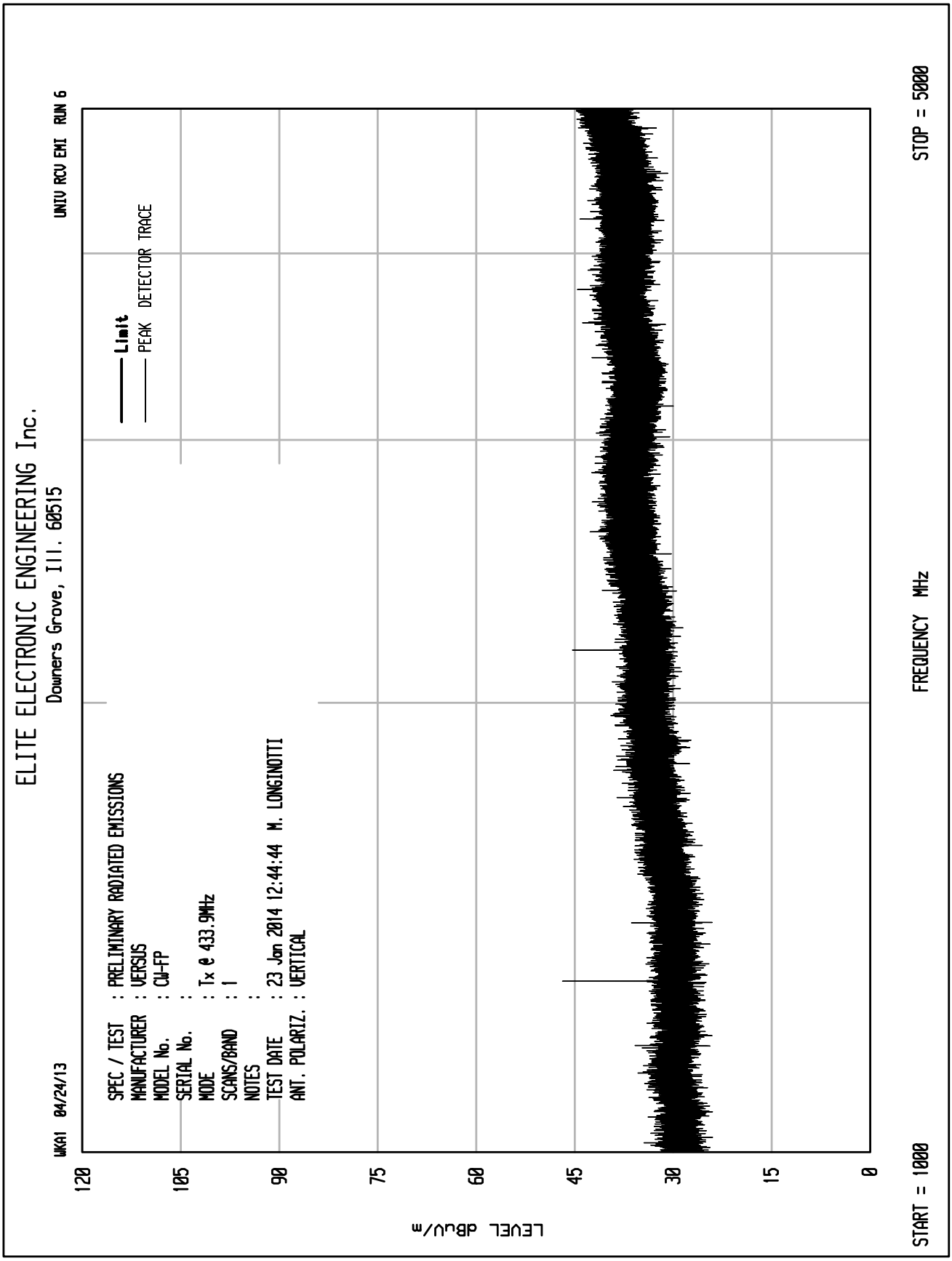


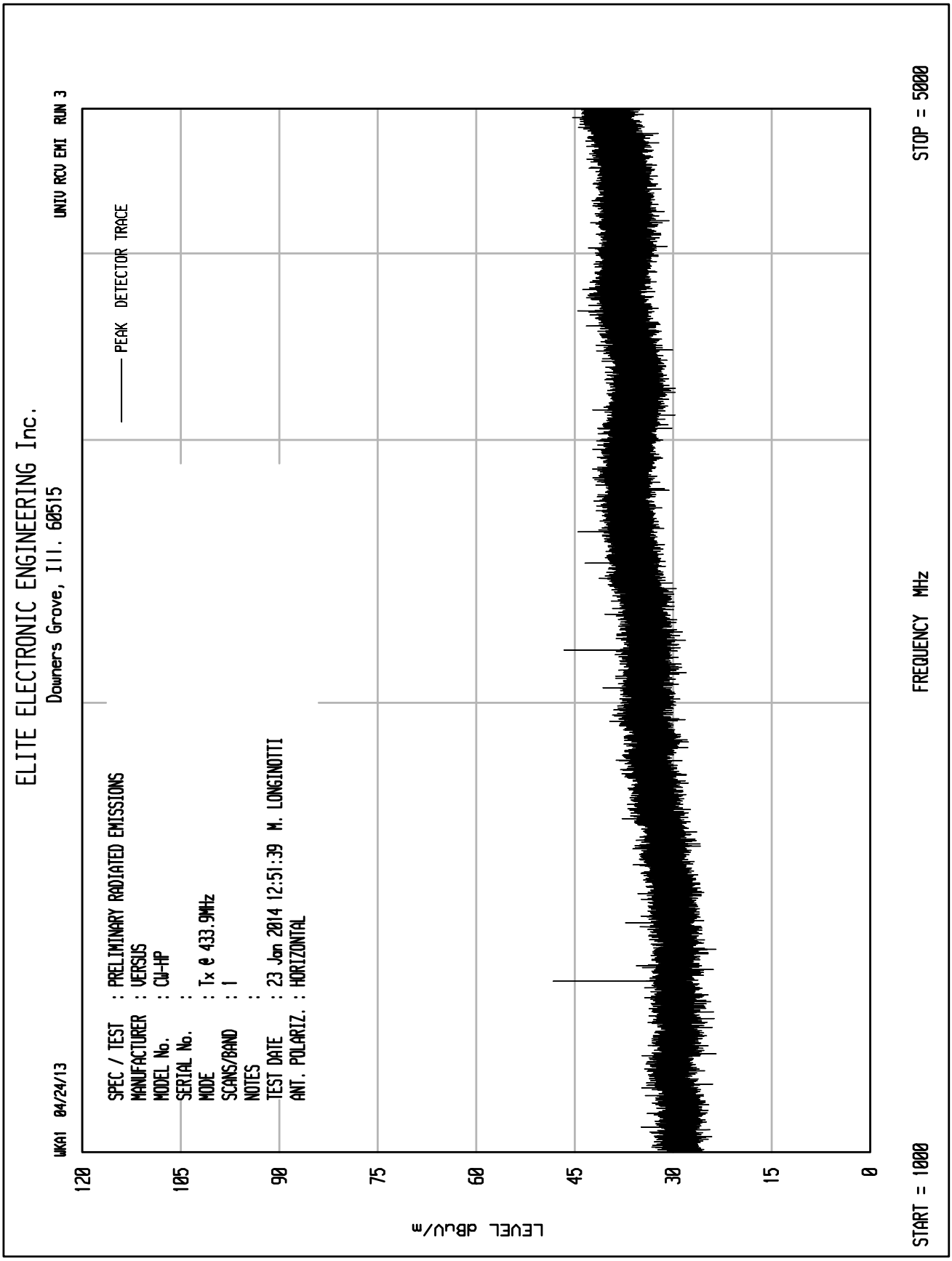
Duty Cycle Factor

MANUFACTURER	:	Versus
MODEL NUMBER	:	PLS-HP
SERIAL NUMBER	:	
TEST MODE	:	Tx @ 433.9MHz
NOTES	:	
TEST DATE	:	January 23, 2014
TEST PARAMETERS	:	Duty Cycle Factor
NOTES	:	46 pulses in a 100msec period
	:	Duty cycle = 20 x log (on time/100msec) = 20 x log (((pulse width) x (# pulses))/100msec) = 20 x log (((209.4usec/pulse) x (46pulses))/100msec) = 20 x log (9.6msec/100msec) = 20 x log (0.096) = -20.3dB
EQUIPMENT USED	:	RBB0, NTA2


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 1
WKA1 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : VERSUS
MODEL No. : CW-FP
SERIAL No. :
MODE : Tx @ 433.9MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 23 Jan 2014 10:36:40 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
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 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : VERSUS
MODEL No. : CW-FP
SERIAL No. :
MODE : Tx @ 433.9MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 23 Jan 2014 10:39:19 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
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 6
WKA1 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : VERSUS
MODEL No. : CW-FP
SERIAL No. :
MODE : Tx @ 433.9MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 23 Jan 2014 12:44:44 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 5000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 3
WKA1 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : VERSUS
MODEL No. : CW-HP
SERIAL No. : :
MODE : Tx @ 433.9MHz
SCANS/BAND : 1
NOTES : :
TEST DATE : 23 Jan 2014 12:51:39 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 5000

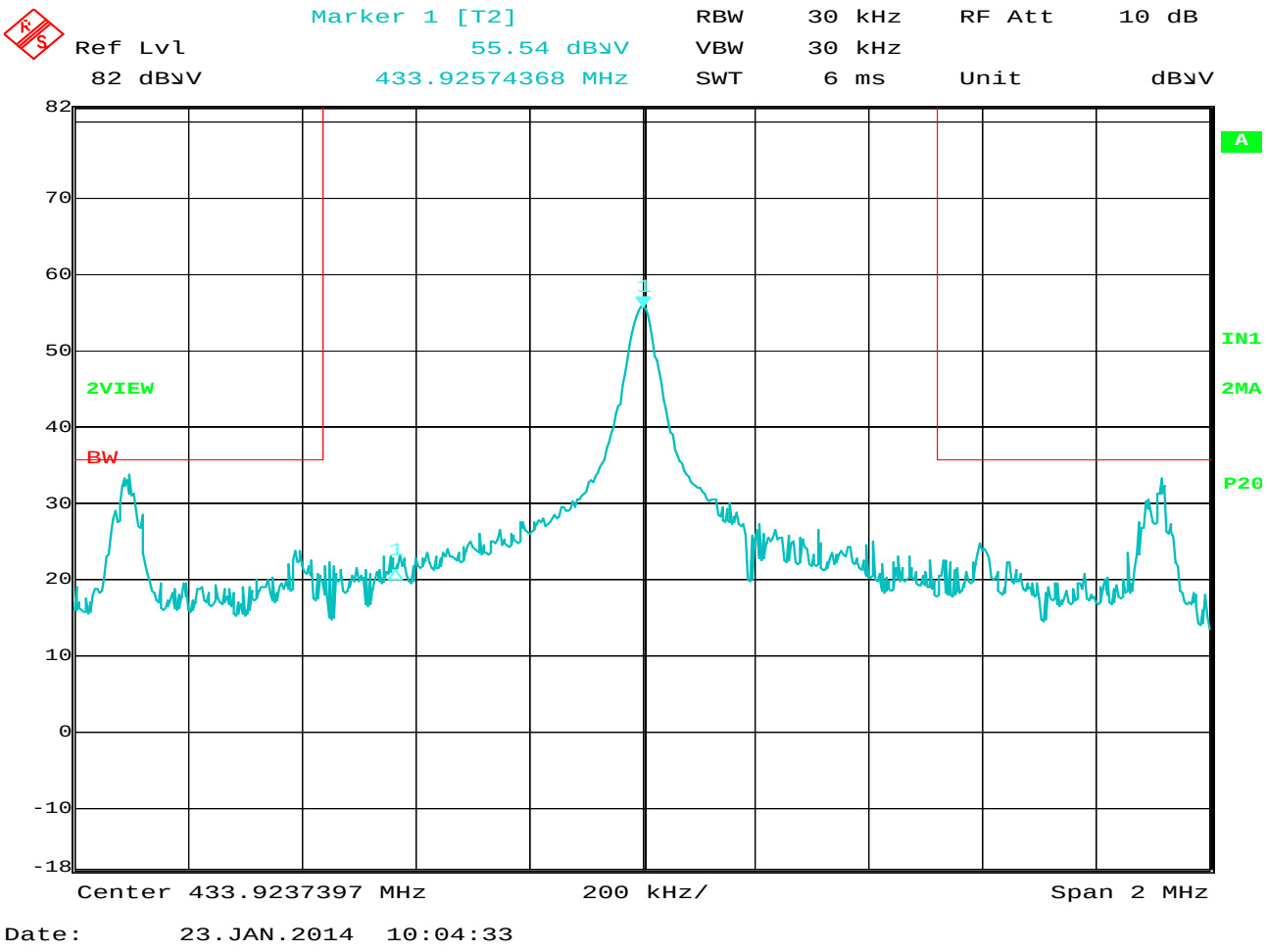
Manufacturer : Versus Technology, Inc.
Test Item : Transmitter
Model No. : CW-HP
Serial No. : None Assigned
Mode : Transmit at 433.92MHz
Test Specification : FCC 15.231e
Date : January 23, 2014
Test Distance : 3 meters
Note :

Freq. (MHz)	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Duty Cycle (dB)	Total (dBuV/m)	Total (uV/m)	Limit (uV/m)	Margin (dB)
433.902	H	59.3		1.4	16.7	0.0	-16.2	61.2	1148.1	4398.4	-11.7
433.902	V	53.4		1.4	16.7	0.0	-16.2	55.3	582.1	4398.4	-17.6
867.804	H	15.8		2.0	20.8	0.0	-16.2	22.4	13.2	439.8	-30.5
867.804	V	14.9		2.0	20.8	0.0	-16.2	21.5	11.9	439.8	-31.4
1301.706	H	22.5		2.5	28.8	0.0	-16.2	37.6	75.7	500.0	-16.4
1301.706	V	23.2		2.5	28.8	0.0	-16.2	38.3	82.0	500.0	-15.7
1735.608	H	31.6		2.9	30.0	0.0	-16.2	48.3	259.1	500.0	-5.7
1735.608	V	30.0		2.9	30.0	0.0	-16.2	46.7	215.5	500.0	-7.3
2169.510	H	18.1		3.2	31.9	0.0	-16.2	37.0	70.7	500.0	-17.0
2169.510	V	18.2		3.2	31.9	0.0	-16.2	37.1	71.5	500.0	-16.9
2603.412	H	17.5		3.6	32.5	0.0	-16.2	37.4	74.3	500.0	-16.6
2603.412	V	17.9		3.6	32.5	0.0	-16.2	37.8	77.8	500.0	-16.2
3037.314	H	20.6		3.9	32.8	0.0	-16.2	41.1	114.0	500.0	-12.8
3037.314	V	19.3		3.9	32.8	0.0	-16.2	39.8	98.2	500.0	-14.1
3471.216	H	17.5		4.2	32.9	0.0	-16.2	38.4	83.1	500.0	-15.6
3471.216	V	16.3		4.2	32.9	0.0	-16.2	37.2	72.3	500.0	-16.8
3905.118	H	17.3		4.4	33.3	0.0	-16.2	38.8	87.0	500.0	-15.2
3905.118	V	16.6		4.4	33.3	0.0	-16.2	38.1	80.2	500.0	-15.9
4339.020	H	16.3		4.6	33.6	0.0	-16.2	38.4	82.8	500.0	-15.6
4339.020	V	16.7		4.6	33.6	0.0	-16.2	38.8	86.7	500.0	-15.2

Freq. (MHz)	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Duty Cycle (dB)	Total (dBuV/m)	Total (uV/m)	Limit (uV/m)	Margin (dB)
433.902	H	59.3		1.4	16.7	0.0	-16.2	61.2	1148.1	4398.4	-11.7
433.902	V	53.4		1.4	16.7	0.0	-16.2	55.3	582.1	4398.4	-17.6
867.804	H	15.8		2.0	20.8	0.0	-16.2	22.4	13.2	439.8	-30.5
867.804	V	14.9		2.0	20.8	0.0	-16.2	21.5	11.9	439.8	-31.4
1301.706	H	22.5		2.5	28.8	0.0	-16.2	37.6	75.7	500.0	-16.4
1301.706	V	23.2		2.5	28.8	0.0	-16.2	38.3	82.0	500.0	-15.7
1735.608	H	31.6		2.9	30.0	0.0	-16.2	48.3	259.1	500.0	-5.7
1735.608	V	30.0		2.9	30.0	0.0	-16.2	46.7	215.5	500.0	-7.3
2169.510	H	18.1		3.2	31.9	0.0	-16.2	37.0	70.7	500.0	-17.0
2169.510	V	18.2		3.2	31.9	0.0	-16.2	37.1	71.5	500.0	-16.9
2603.412	H	17.5		3.6	32.5	0.0	-16.2	37.4	74.3	500.0	-16.6
2603.412	V	17.9		3.6	32.5	0.0	-16.2	37.8	77.8	500.0	-16.2
3037.314	H	20.6		3.9	32.8	0.0	-16.2	41.1	114.0	500.0	-12.8
3037.314	V	19.3		3.9	32.8	0.0	-16.2	39.8	98.2	500.0	-14.1
3471.216	H	17.5		4.2	32.9	0.0	-16.2	38.4	83.1	500.0	-15.6
3471.216	V	16.3		4.2	32.9	0.0	-16.2	37.2	72.3	500.0	-16.8
3905.118	H	17.3		4.4	33.3	0.0	-16.2	38.8	87.0	500.0	-15.2
3905.118	V	16.6		4.4	33.3	0.0	-16.2	38.1	80.2	500.0	-15.9
4339.020	H	16.3		4.6	33.6	0.0	-16.2	38.4	82.8	500.0	-15.6
4339.020	V	16.7		4.6	33.6	0.0	-16.2	38.8	86.7	500.0	-15.2

Checked By: MARK E. LONGINOTTI

Mark E. Longinotti



20dB bandwidth

MANUFACTURER	:	Versus
MODEL NUMBER	:	PLS-HP
SERIAL NUMBER	:	
TEST MODE	:	Tx @ 433.9MHz
NOTES	:	
TEST DATE	:	January 23, 2014
TEST PARAMETERS	:	The bandwidth of the emission shall be no wider than 0.25% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.
NOTES	:	The display line represents the 20 dB bandwidth limits.
EQUIPMENT USED	:	RBB0, NTA2