Measurement of RF Emissions from a VER188X_R4 Mini Asset Tag

For	Versus Technology, Inc. 2600 Miller Creek Road Traverse City, MI 49684
P.O. Number	VTI-2016-357
Date Tested	October 21, 2016 through October 28, 2016
Test Personnel	Mark Longinotti
Test Specification	FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections 15.207 and 15.231 for Intentional Radiators with Periodic Operation above 70MHz ISED RSS-GEN ISED RSS-210

Test Report By: MARK E. LONGINOTTI

Mark E. Longinotti
EMC Engineer

Requested By: Robert Wiser
Versus Technology, Inc.

Approved By: Raymond J Klouda

Raymond J. Klouda
Registered Professional
Engineer of Illinois - 44894

Elite Electronic Engineering Inc.
1516 CENTRE CIRCLE
DOWNERS GROVE, IL 60515
TEL: 630 - 495 - 9770
FAX: 630 - 495 - 9785
www.elitetest.com

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REVISION HISTORY

Revision	Date	Description
—	1 Dec 2016	Initial release

Measurement of RF Emissions from a Mini Asset Tag, Model No. VER188X_R4

1. INTRODUCTION

1.1. Scope of Tests

This report presents the results of the RF emissions measurements performed on a Mini Asset Tag, Model No. VER188X_R4, Serial No. None Assigned, (hereinafter referred to as the Equipment Under Test (EUT)). 5 (five) samples were submitted for testing:

Sample Number	Description	Used For
T-CW	TDK-CW Mode	Radiated Emissions
T-NC-CW	TDK-No Crystal CW Mode	Radiated Emissions
T-FS	TDK-Fast Signal Mode	Duty Cycle and Occupied Bandwidth Tests
T-NC-FS	TDK-No Crystal- Fast Signal Mode	Duty Cycle and Occupied Bandwidth Tests
T-PROD	TDK-Production Software	Periodic Operation Tests

The EUT was designed to transmit at approximately 433.92MHz using an integral 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 with Periodic Operation above 70MHz. Testing was performed in accordance with ANSI C63.4-2014 and ANSI C63.10-2013.

The test series was also performed to determine if the EUT meets the conducted and radiated RF emission requirements of the Innovation, Science and Economic Development Canada (ISED) RSS-Gen Section 8.8 and RSS-210, Annex A for momentarily operated transmitters. Testing was performed in accordance with ANSI C63.4-2014 and ANSI C63-10-2013.

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 34%.

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 2015

- ANSI C63.4-2014, "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"

- ANSI C63.10-2013, “American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices”

- ISED Radio Standards Specification, RSS-Gen, “General Requirements for Compliance of Radio Apparatus”, Issue 4, November 2014

- ISED Radio Standards Specification, RSS-210, “License-Exempt Radio Apparatus:
- Category I Equipment”, Issue 9, August 2016

3. EUT Setup and Operation

3.1. General Description

The EUT is a Versus Technology, Inc., Mini Asset Tag, Model No. VER188X_R4. A block diagram of the EUT setup is shown as Figure 1.

3.1.1. Power Input

The EUT was powered with 3VDC from a single CR 2477 battery.

3.1.2. Grounding

The EUT was ungrounded during the tests.

3.2. Software

For all tests the EUT had Firmware VER188x_R1.000.hex loaded onto the device to provide correct load characteristics and to control the device during testing.

3.3. Operational Mode

For all tests the EUT was placed on a non-conductive stand. The EUT was energized. The EUT was programmed so that once a battery was inserted it would continuously transmit at 433.92MHz.

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 C63.4-2014 for site attenuation.

4.2. Test Instrumentation

The test instrumentation and auxiliary equipment used during the tests are listed in Table 9-1.

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 with a calibration interval not greater than two

years. 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. Powerline Conducted Emissions

5.1.1. Requirements

Since the EUT is powered by internal batteries and has no connection to AC power, no conducted emissions tests are required.

5.2. Periodic Operation Measurements

5.2.1. Requirements

Devices operated under the provisions of paragraph 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.

5.2.3. Results

The plots of the periodic timing are shown on data pages 17 and 18. The data shows that the EUT transmission falls within the periodic operation requirements of paragraph 15.231(e).

5.3. Duty Cycle Factor Measurements

5.3.1. 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 factor was calculated from information supplied by the manufacturer. Since this EUT utilizes a rolling code modulation, the duty 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) Finally the length of the word period is measured and a third plot is recorded. If the word period exceeds 100 msec, the word period is limited to 100 msec.

e) 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).

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

5.3.2.Results

Representative plots of the duty cycle for the T-FS are shown on data pages 19 through 21. Representative plots of the duty cycle for the T-NC-FS are shown on data pages 22 through 24.

Since the EUT 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-four 206usec 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 EUT transmitting at 433.92MHz, the worst case (highest emissions) 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 for automatically activated transmitters.

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 433.92MHz, the limit at the fundamental is 4398.7uV/m @ 3m and the limit on the harmonics is 439.9uV/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 C63.4-2014 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 strengths of all emissions below 1 GHz were measured using a bi-log antenna. The bi-log antenna was positioned at a 3 meter distance from the EUT. The EUT was placed on an 80cm high non-conductive stand. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.

The field strengths of all emissions above 1 GHz were measured using a double-ridged waveguide antenna. The waveguide antenna was positioned at a 3 meter distance from the EUT. The EUT was placed on a 1.5 meter high non-conductive stand. A peak detector with a resolution bandwidth of 1 MHz was used on the spectrum analyzer.

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 4.0GHz was investigated using a peak detector function. The data was then processed by the computer to calculate equivalent field intensity.

The final radiated emission tests were then manually performed over the frequency range of 30MHz to 4000MHz. Between 30MHz and 1000MHz, a bi-log 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.

5.4.3.Results

T-CW:

The preliminary plots, with the EUT transmitting at 433.92MHz, are presented on data pages 25 through 28. The plots are presented for a reference only, and are not used to determine compliance.

The final radiated levels, with the EUT transmitting at 433.92MHz, are presented on data page 29. As can be seen from the data, all emissions measured from the EUT were within the specification limits. The emissions level closet to the limit (worst case) occurred at 433.92MHz. The emissions level at this frequency was 14.5dB within the limit. See data page 29 for details. Photographs of the test configuration which yielded the highest or worst case, radiated emission levels are shown on Figures 3 and 4.

T-NC-CW:

The preliminary plots, with the EUT transmitting at 433.92MHz, are presented on data pages 30 through 33. The plots are presented for a reference only, and are not used to determine compliance.

The final radiated levels, with the EUT transmitting at 433.92MHz, are presented on data page 34. As can be seen from the data, all emissions measured from the EUT were within the specification limits. The emissions level closet to the limit (worst case) occurred at 433.92MHz. The emissions level at this frequency was 14.3dB within the limit. See data page 34 for details. Photographs of the test configuration which yielded the highest or worst case, radiated emission levels are shown on Figures 3 and 4.

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 4 MHz. The frequency spectrum near the fundamental was plotted. The 99% bandwidth was measured to be 376kHz.

5.5.3.Results

T-FS:
The plot of the emissions near the fundamental frequency is presented on data page 35. As can be seen from this data page, the EUT met the occupied bandwidth requirements. The 99% bandwidth was measured to be 621kHz.

T-NC-FS:
The plot of the emissions near the fundamental frequency is presented on data page 36. As can be seen from this data page, the EUT met the occupied bandwidth requirements. The 99% bandwidth was measured to be 613kHz.

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. Mini Asset Tag, Model No. VER188X_R4, 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, Section 15.231 for Intentional Radiators, when tested per ANSI C63.4-2014 and C63.10-2013.

It was also determined that the Versus Technology, Inc. Mini Asset Tag, Model No. VER188X_R4, Serial No. None Assigned, did fully meet the conducted and radiated emission requirements of the ISED specification, RSS-Gen and RSS-210, for transmitters, when tested per ANSI C63.4-2014 and ANSI C63.10-2013.

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 A2LA, 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
CDY0	WORKSTATION	ELITE	WORKSTATION		WINDOWS 7	N/A	
NTA2	BILOG ANTENNA	TESEQ	6112D	28040	25-1000MHz	10/27/2015	11/27/2016
NWQ2	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS LINDGREN	3117	66659	1GHZ-18GHZ	3/2/2016	3/2/2018
PHA0	MAGNETIC FIELD PROBE	ELECTRO-METRICS	EM-6882	134	22-230MHZ	NOTE 1	
RBB0	EMI TEST RECEIVER 20HZ TO 40 GHZ.	ROHDE & SCHWARZ	ESIB40	100250	20 HZ TO 40GHZ	2/16/2016	2/16/2017

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.

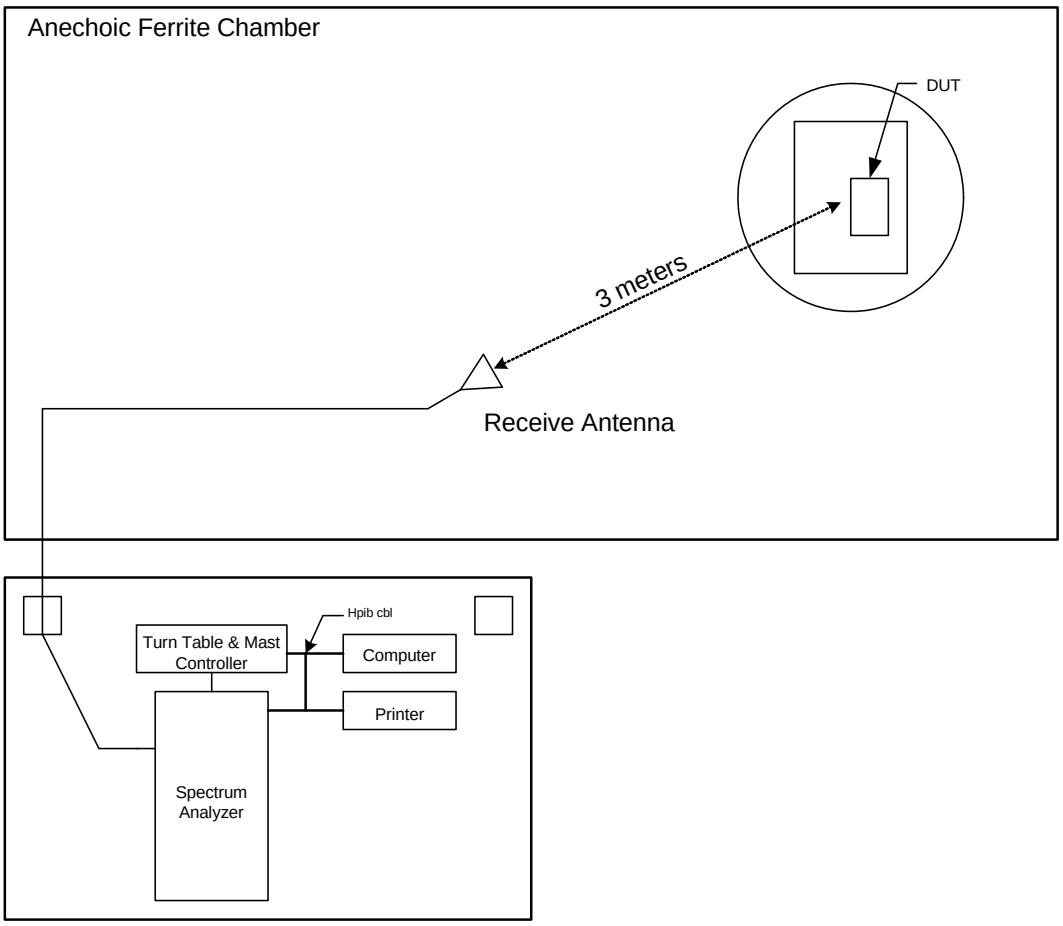
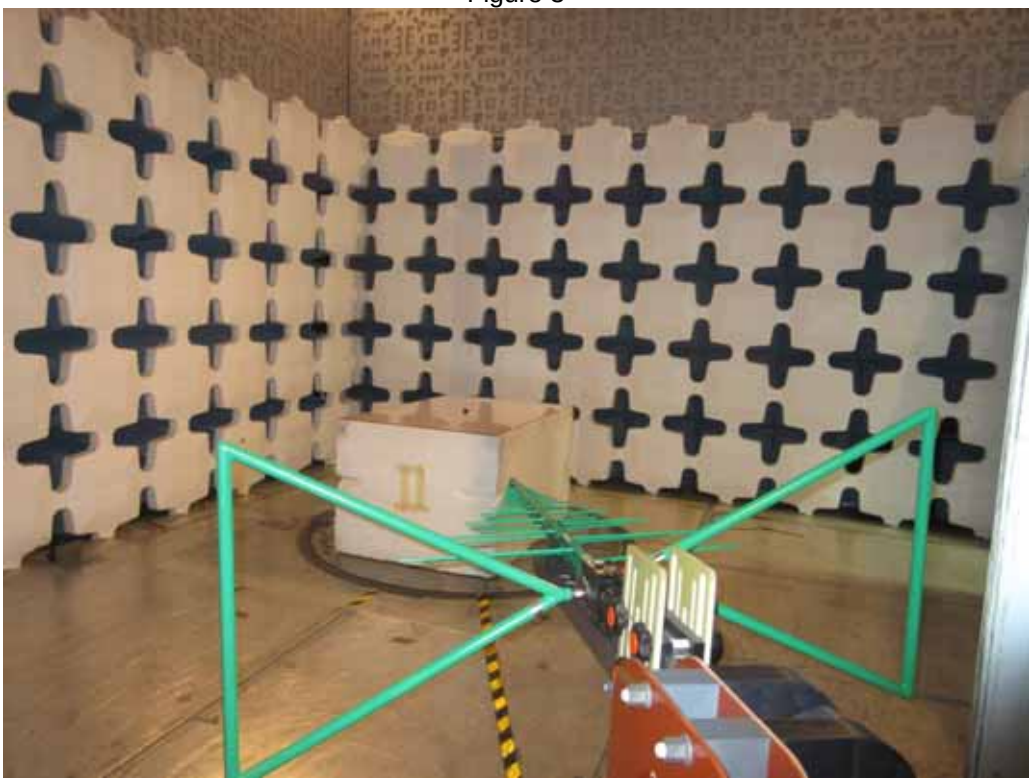


FIGURE 1 BLOCKDIAGRAM OF TEST SETUP

Figure 2: Photograph of the EUT

Figure 3



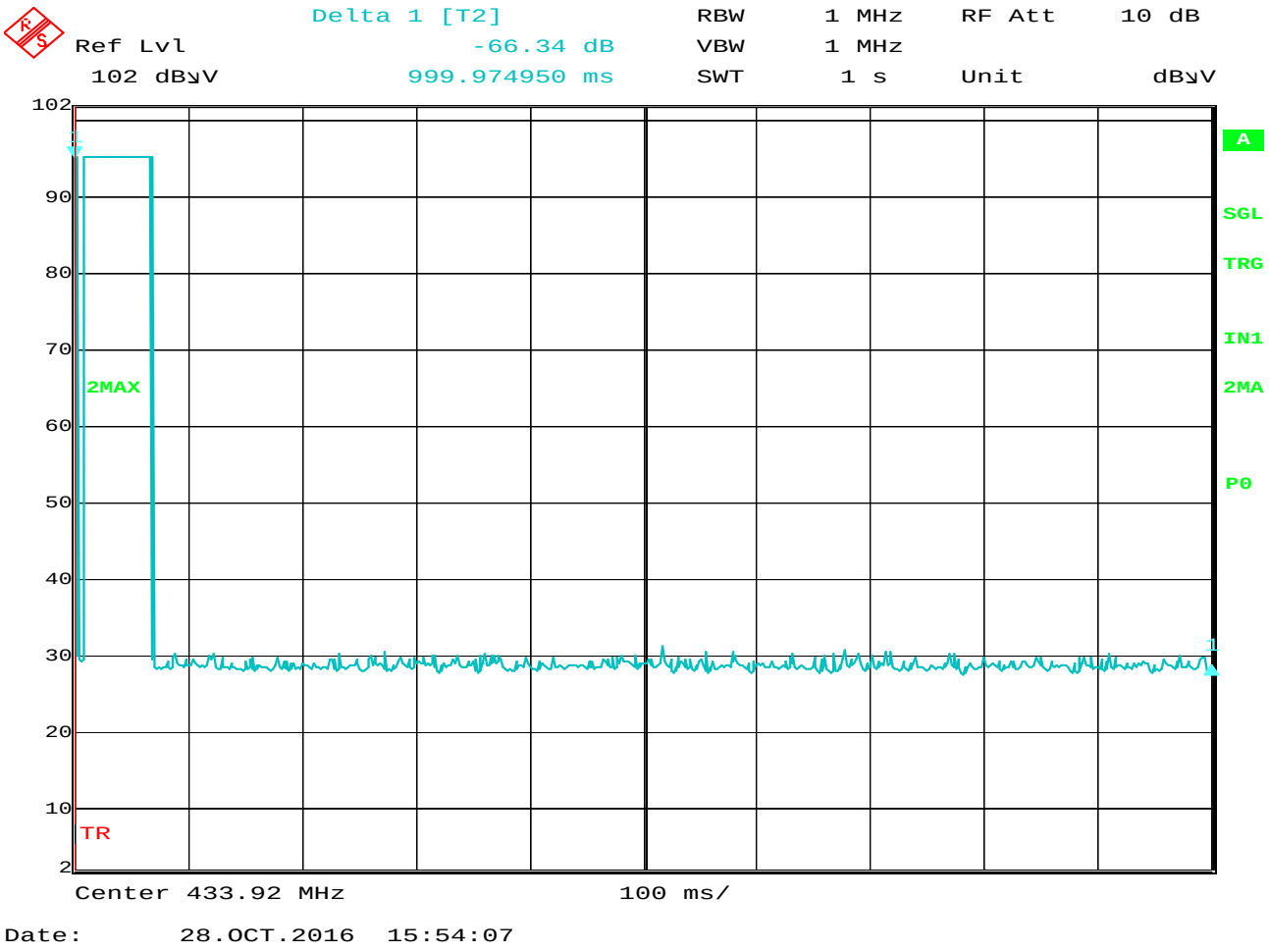
Test Setup for Radiated Emissions, 30MHz to 1GHz – Horizontal Polarization

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

Figure 4

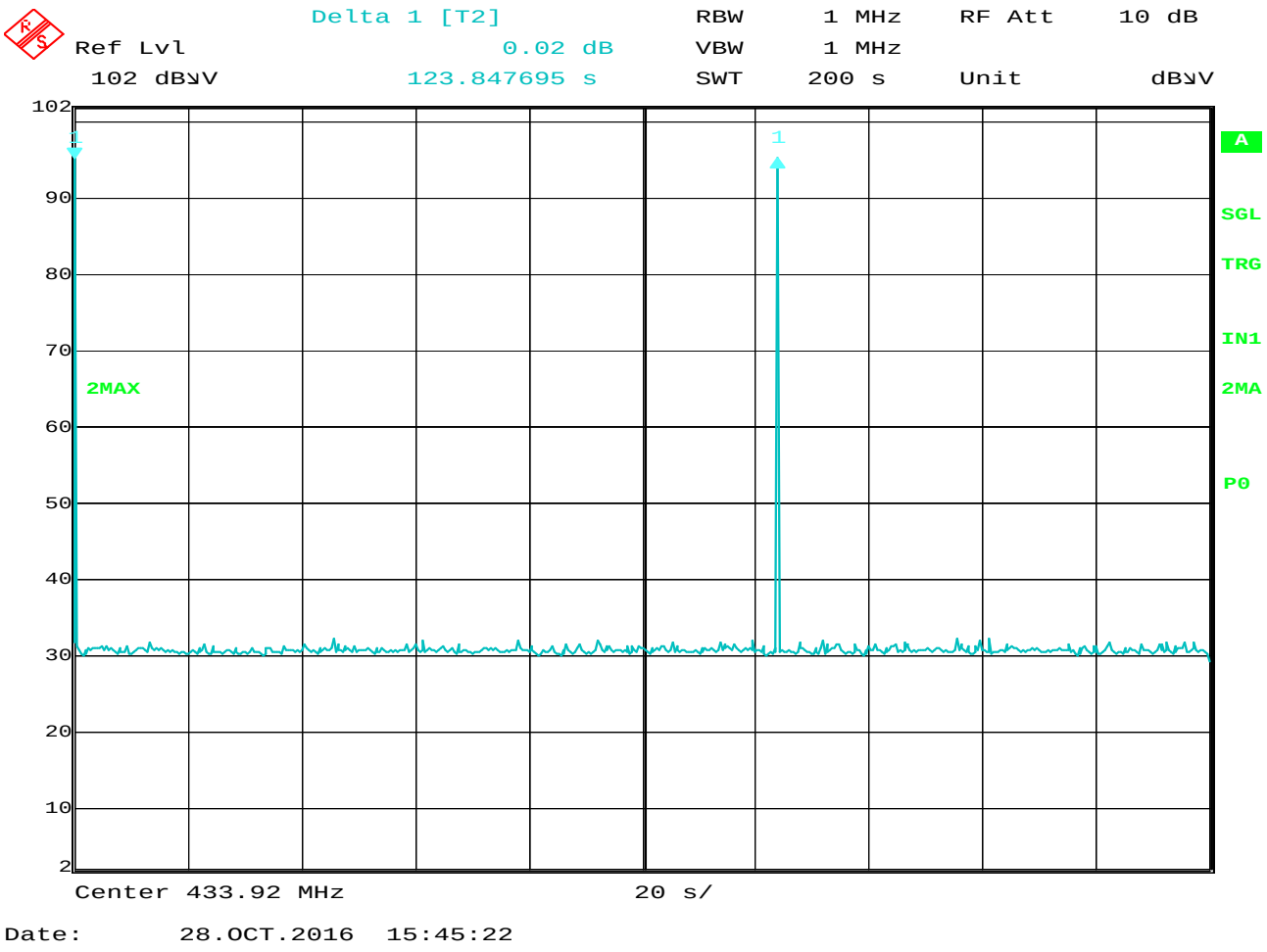
Test Setup for Radiated Emissions above1GHz – Horizontal Polarization

Test Setup for Radiated Emissions, above 1GHz – Vertical Polarization



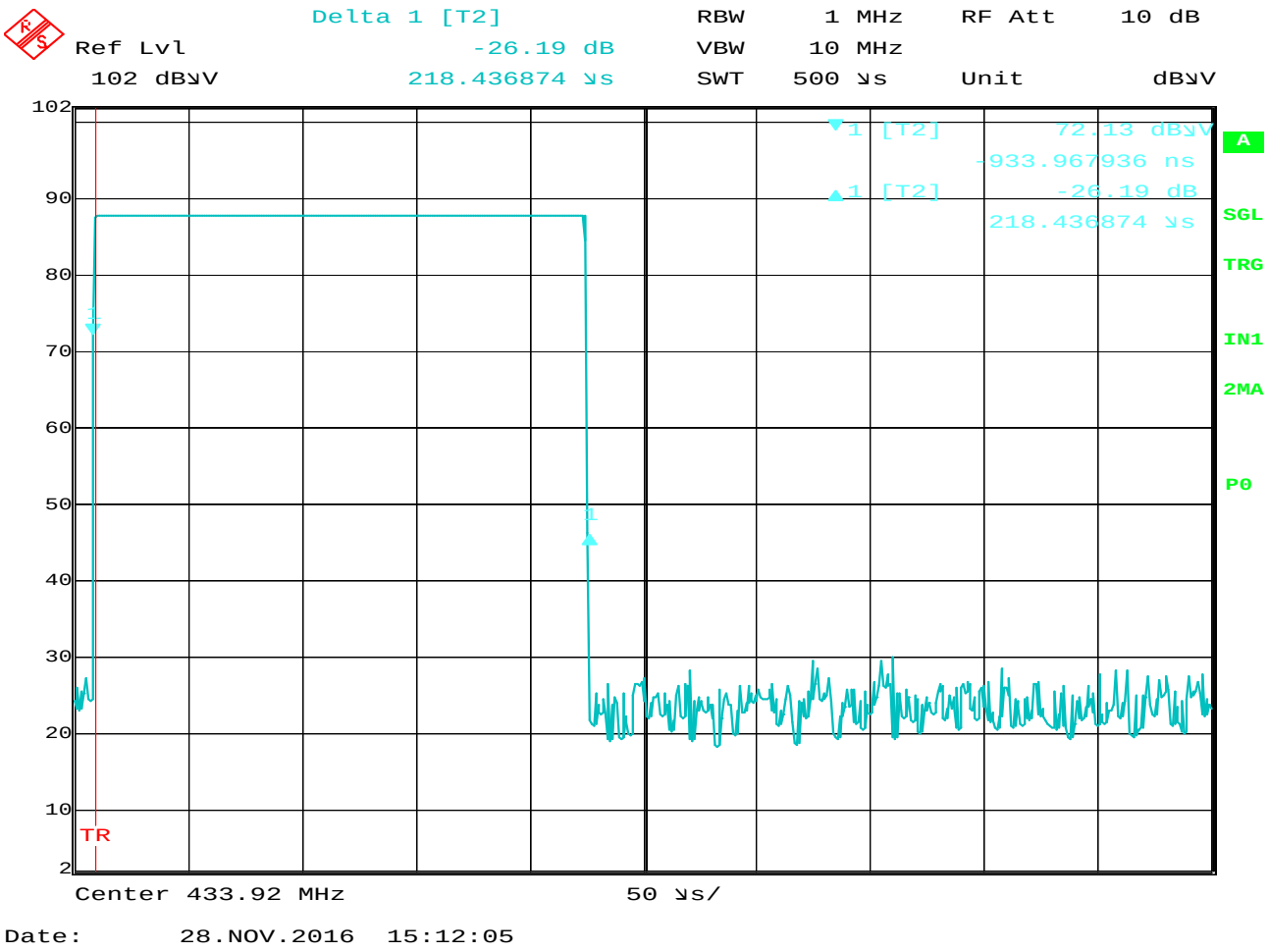
FCC 15.35(e) Periodic Operation

MANUFACTURER	:	Versus
MODEL NUMBER	:	T-PROD
SERIAL NUMBER	:	None Assigned
TEST MODE	:	Transmit at 433.92MHz
TEST PARAMETERS	:	Transmission Duration
EQUIPMENT USED	:	RBB0, PHA0
NOTES	:	Transmission Duration = 70.1usec



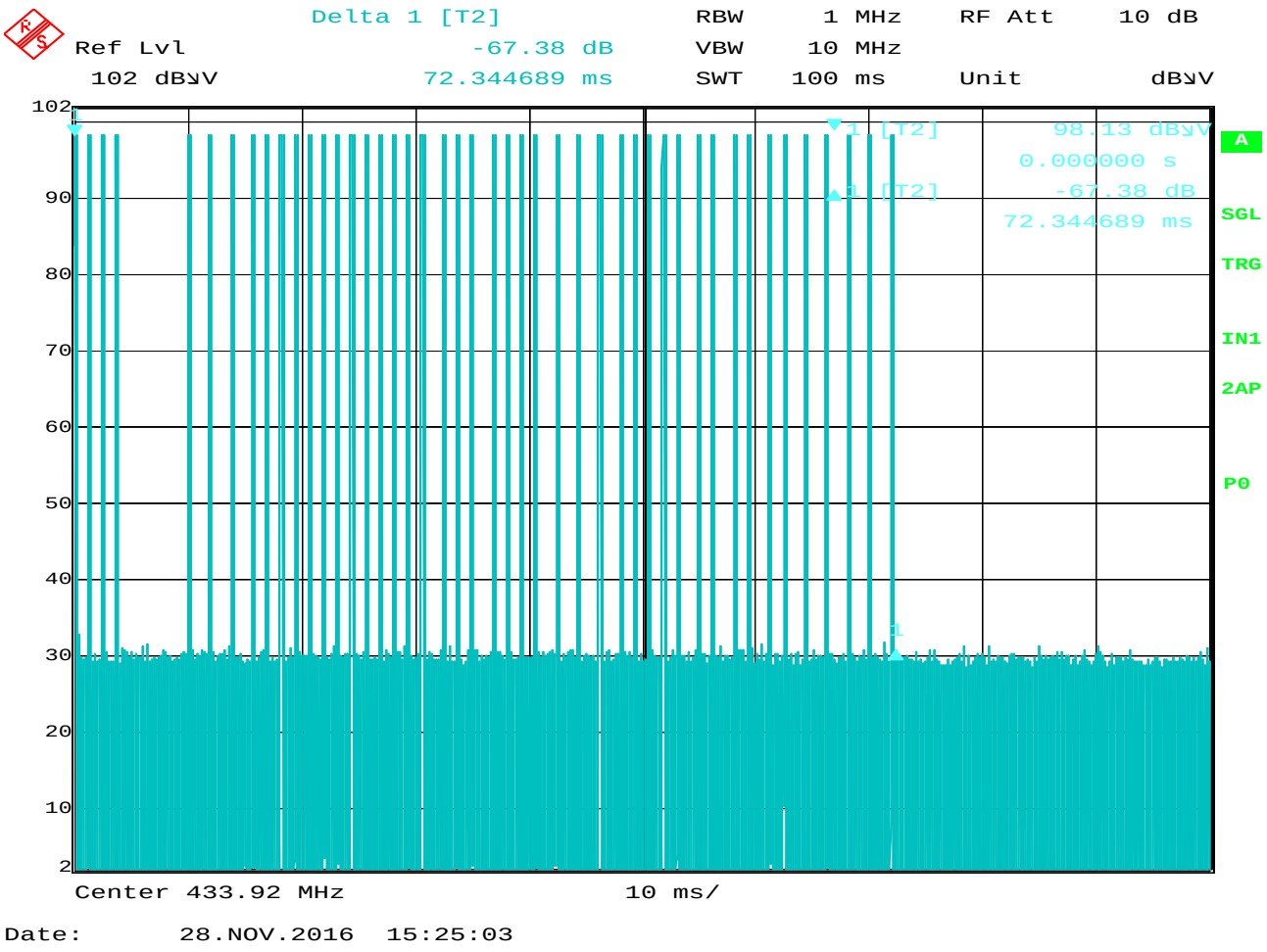
FCC 15.35(e) Periodic Operation

MANUFACTURER	:	Versus
MODEL NUMBER	:	T-PROD
SERIAL NUMBER	:	None Assigned
TEST MODE	:	Transmit at 433.92MHz
TEST PARAMETERS	:	Silent Period Between Transmissions
EQUIPMENT USED	:	RBB0, PHA0
NOTES	:	Silent Period Between Transmissions is 123.8 seconds



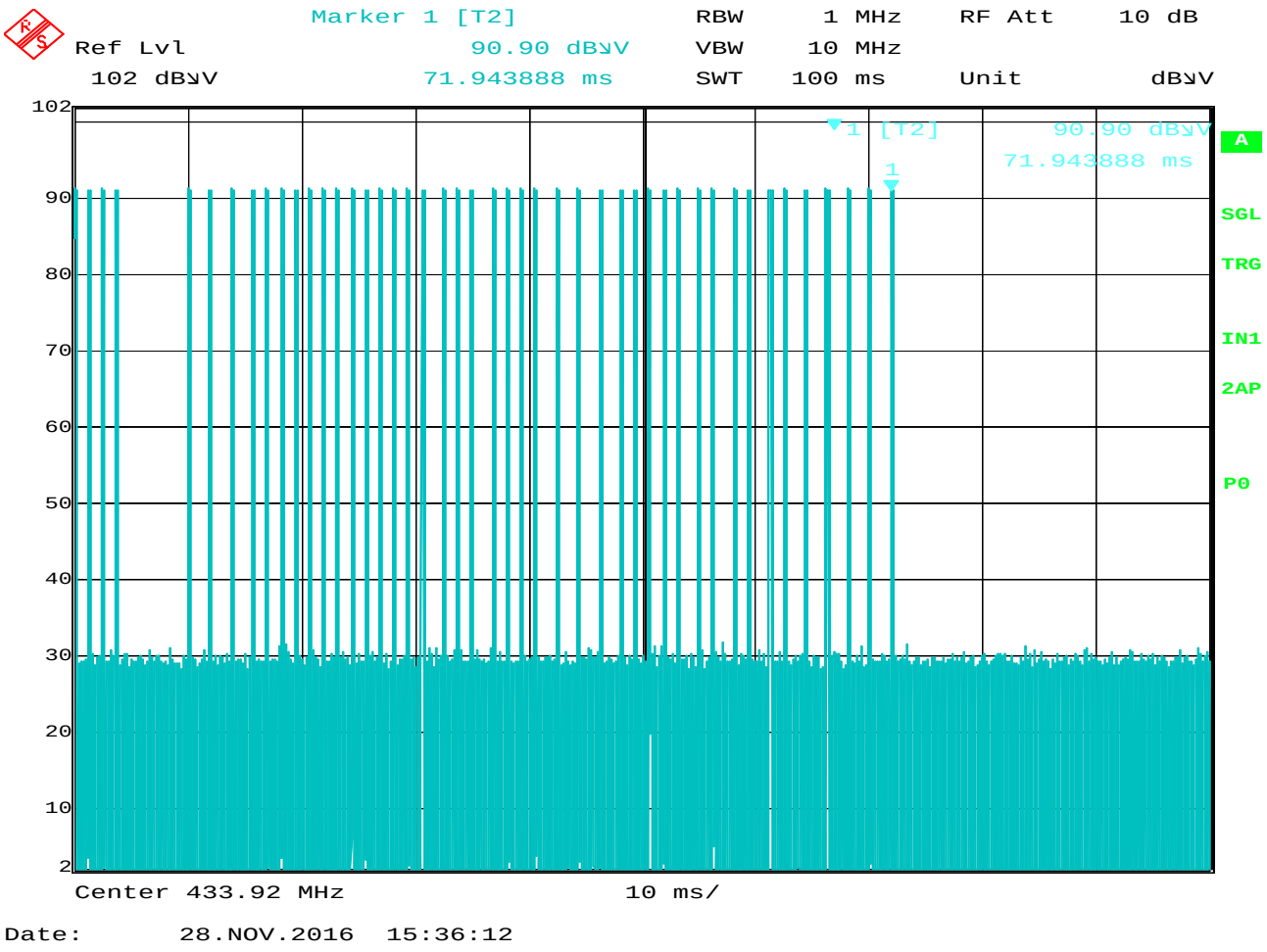
FCC 15C 15.35 / Duty Cycle (Representative Sample)

MANUFACTURER	: Versus
MODEL NUMBER	: T-FS
SERIAL NUMBER	: None Assigned
TEST MODE	: Transmit at 433.92MHz
TEST PARAMETERS	: Pulse Width
EQUIPMENT USED	: RBB0, PHA0
NOTES	: Pulse Width = 218.43usec



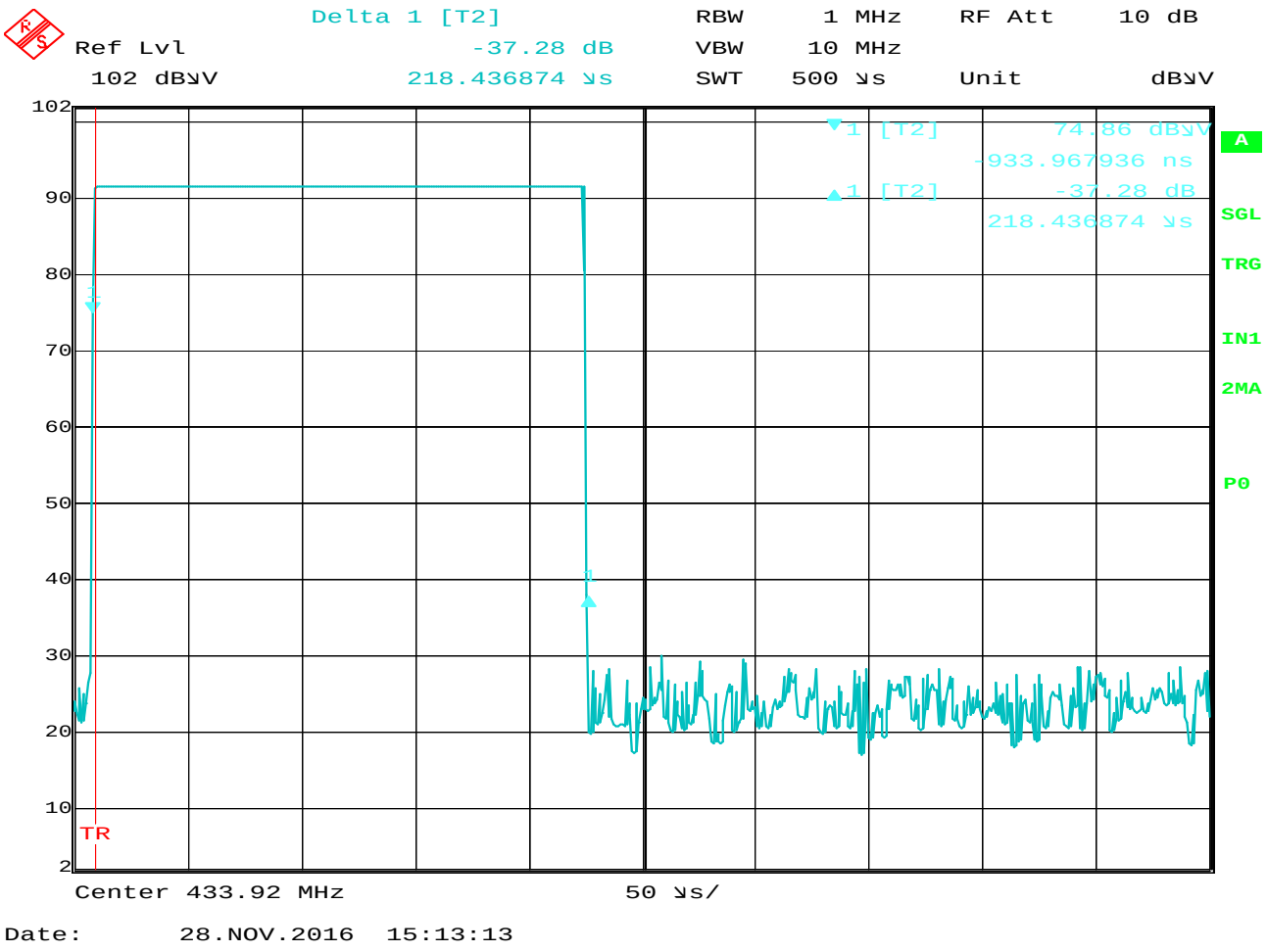
FCC 15C 15.35 / Duty Cycle (Representative Sample)

MANUFACTURER	:	Versus
MODEL NUMBER	:	T-FS
SERIAL NUMBER	:	None Assigned
TEST MODE	:	Transmit at 433.92MHz
TEST PARAMETERS	:	Pulse Train
EQUIPMENT USED	:	RBB0, PHA0
NOTES	:	Pulse Train Duration = 72.34msec



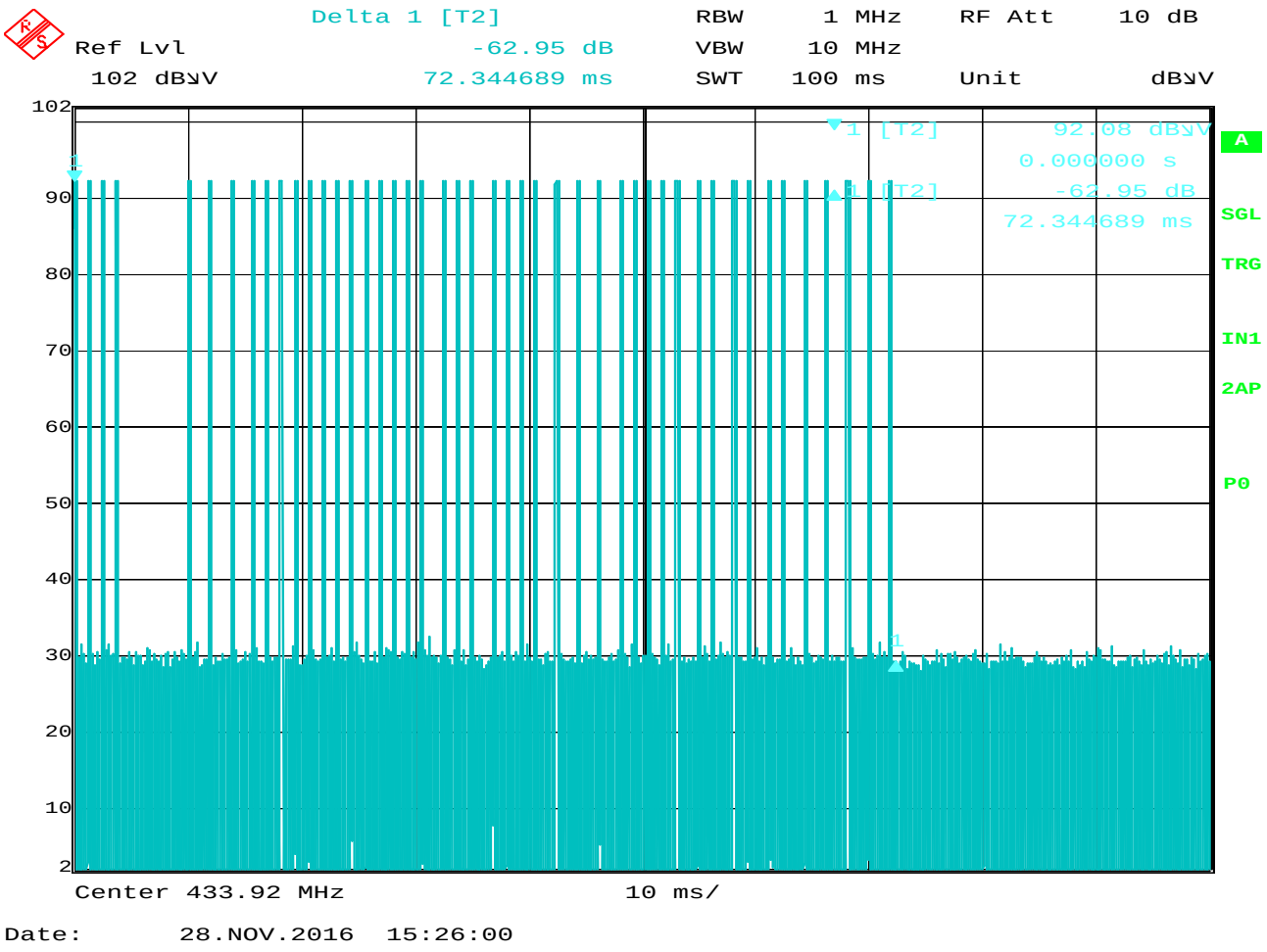
FCC 15C 15.35 / Duty Cycle (Representative Sample)

MANUFACTURER	: Versus
MODEL NUMBER	: T-FS
SERIAL NUMBER	: None Assigned
TEST MODE	: Transmit at 433.92MHz
TEST PARAMETERS	: 46 pulses per pulse train
EQUIPMENT USED	: RBB0, PHA0
NOTES	: Duty Cycle Correction Factor = 20log((pulse width)x(# pulses)/(Pulse Train Duration))
	: Duty Cycle Correction Factor = 20log(218.43usec)x(46 pulses)/(72.34msec)
	: Duty Cycle Correction Factor = 20log(0.139)
	: Duty Cycle Correction Factor = -17.1dB



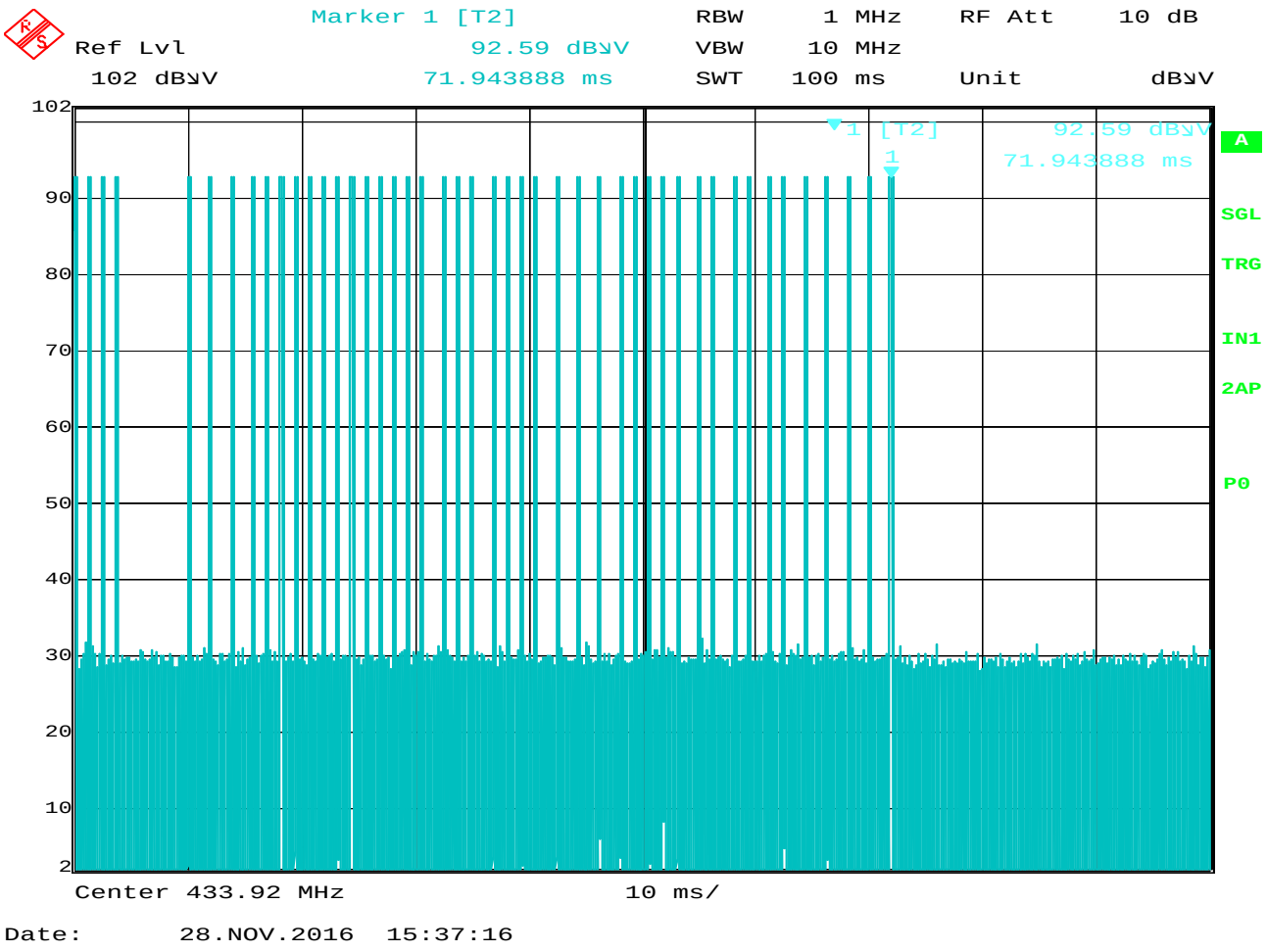
FCC 15C 15.35 / Duty Cycle (Representative Sample)

MANUFACTURER	: Versus
MODEL NUMBER	: T-NC-FS
SERIAL NUMBER	: None Assigned
TEST MODE	: Transmit at 433.92MHz
TEST PARAMETERS	: Pulse Width
EQUIPMENT USED	: RBB0, PHA0
NOTES	: Pulse Width = 218.43usec



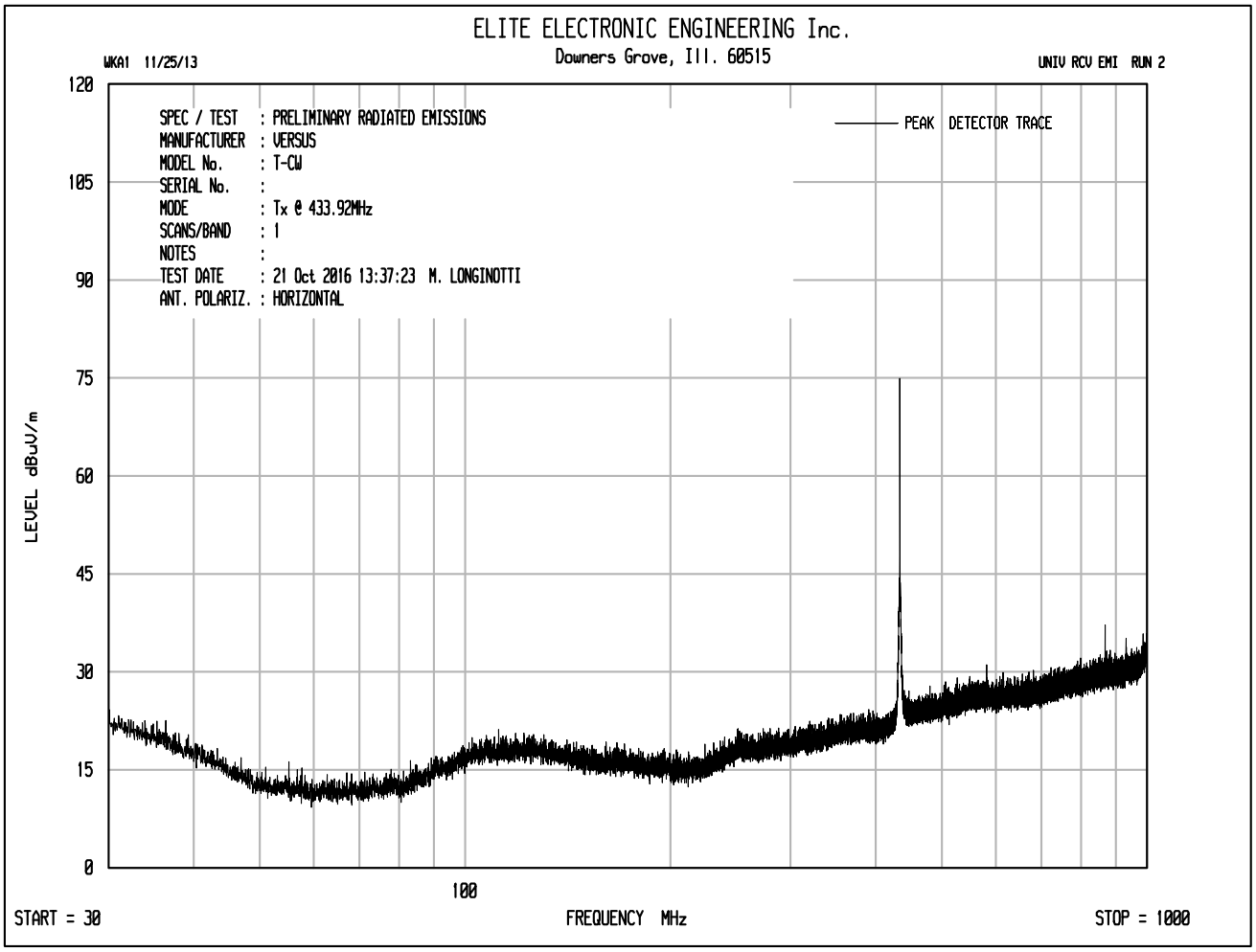
FCC 15C 15.35 / Duty Cycle (Representative Sample)

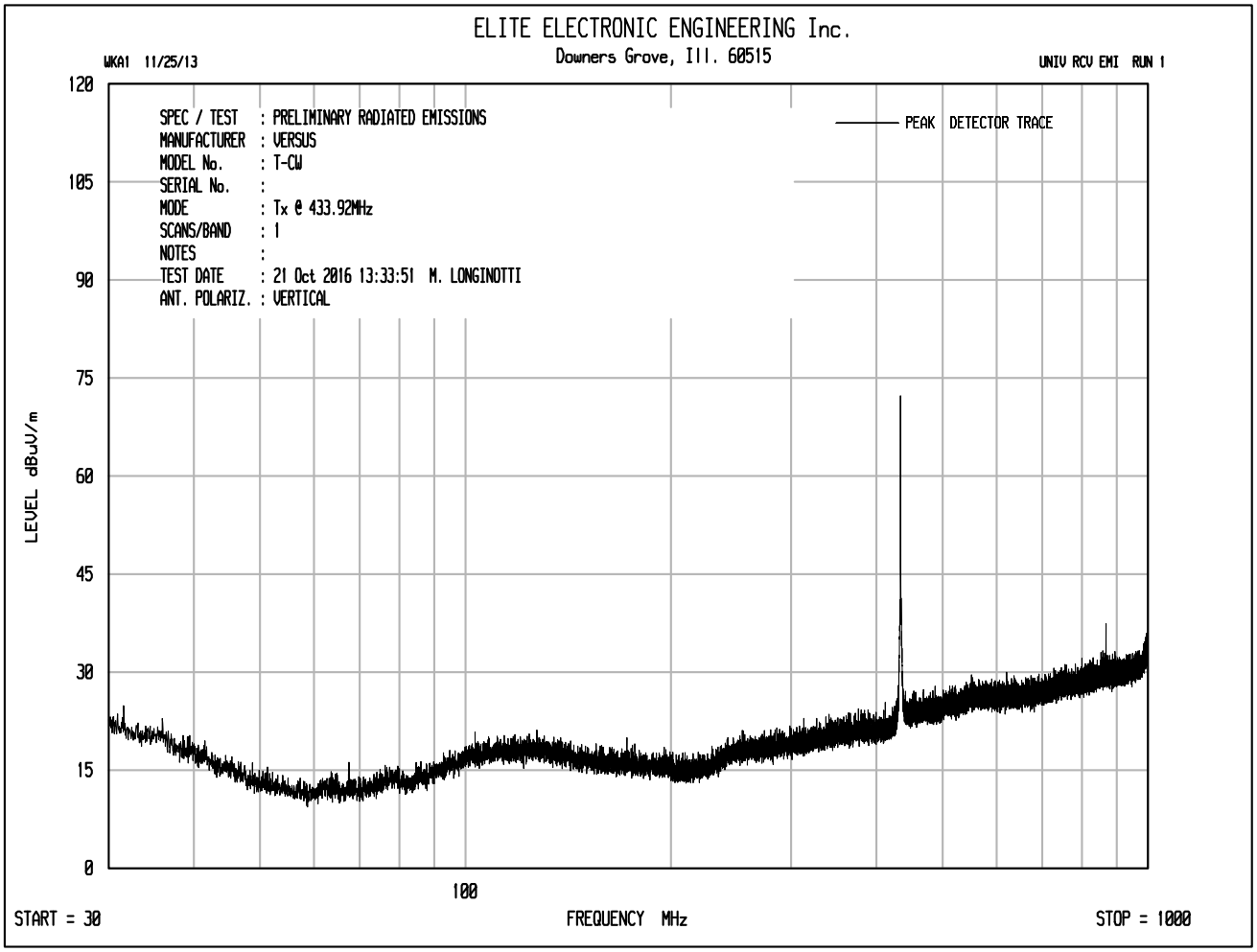
MANUFACTURER	:	Versus
MODEL NUMBER	:	T-NC-FS
SERIAL NUMBER	:	None Assigned
TEST MODE	:	Transmit at 433.92MHz
TEST PARAMETERS	:	Pulse Train
EQUIPMENT USED	:	RBB0, PHA0
NOTES	:	Pulse Train Duration = 72.34msec



FCC 15C 15.35 / Duty Cycle (Representative Sample)

MANUFACTURER	: Versus
MODEL NUMBER	: T-NC-FS
SERIAL NUMBER	: None Assigned
TEST MODE	: Transmit at 433.92MHz
TEST PARAMETERS	: 46 pulses per pulse train
EQUIPMENT USED	: RBB0, PHA0
NOTES	: Duty Cycle Correction Factor = 20log((pulse width)x(# pulses)/(Pulse Train Duration))
	: Duty Cycle Correction Factor = 20log(218.43usec)x(46 pulses)/(72.34msec)
	: Duty Cycle Correction Factor = 20log(0.139)
	: Duty Cycle Correction Factor = -17.1dB


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 2
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : VERSUS
MODEL No. : T-CW
SERIAL No. :
MODE : Tx @ 433.92MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 21 Oct 2016 13:37:23 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBµV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 1
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : VERSUS
MODEL No. : T-CW
SERIAL No. :
MODE : Tx @ 433.92MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 21 Oct 2016 13:33:51 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
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105
90
75
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45
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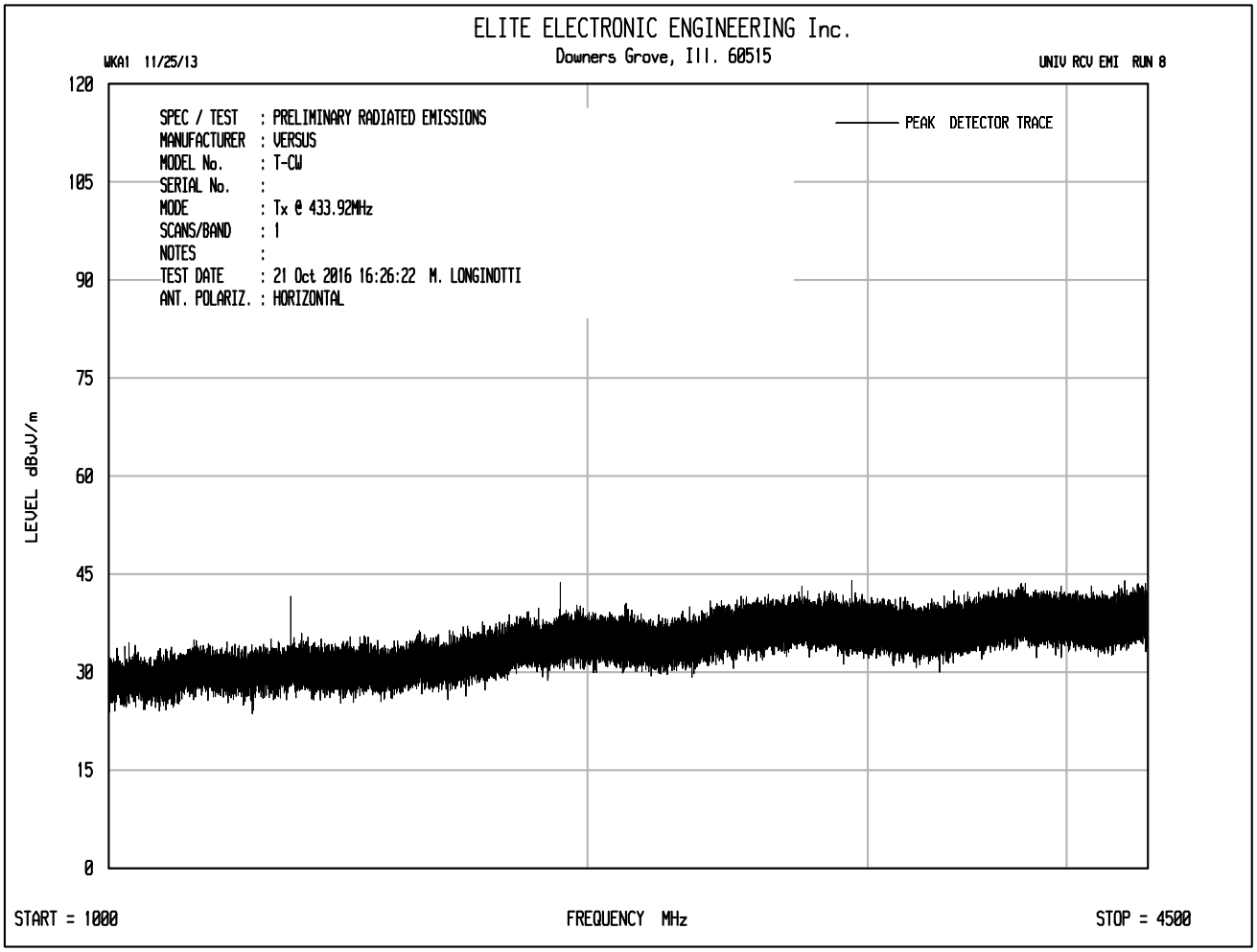
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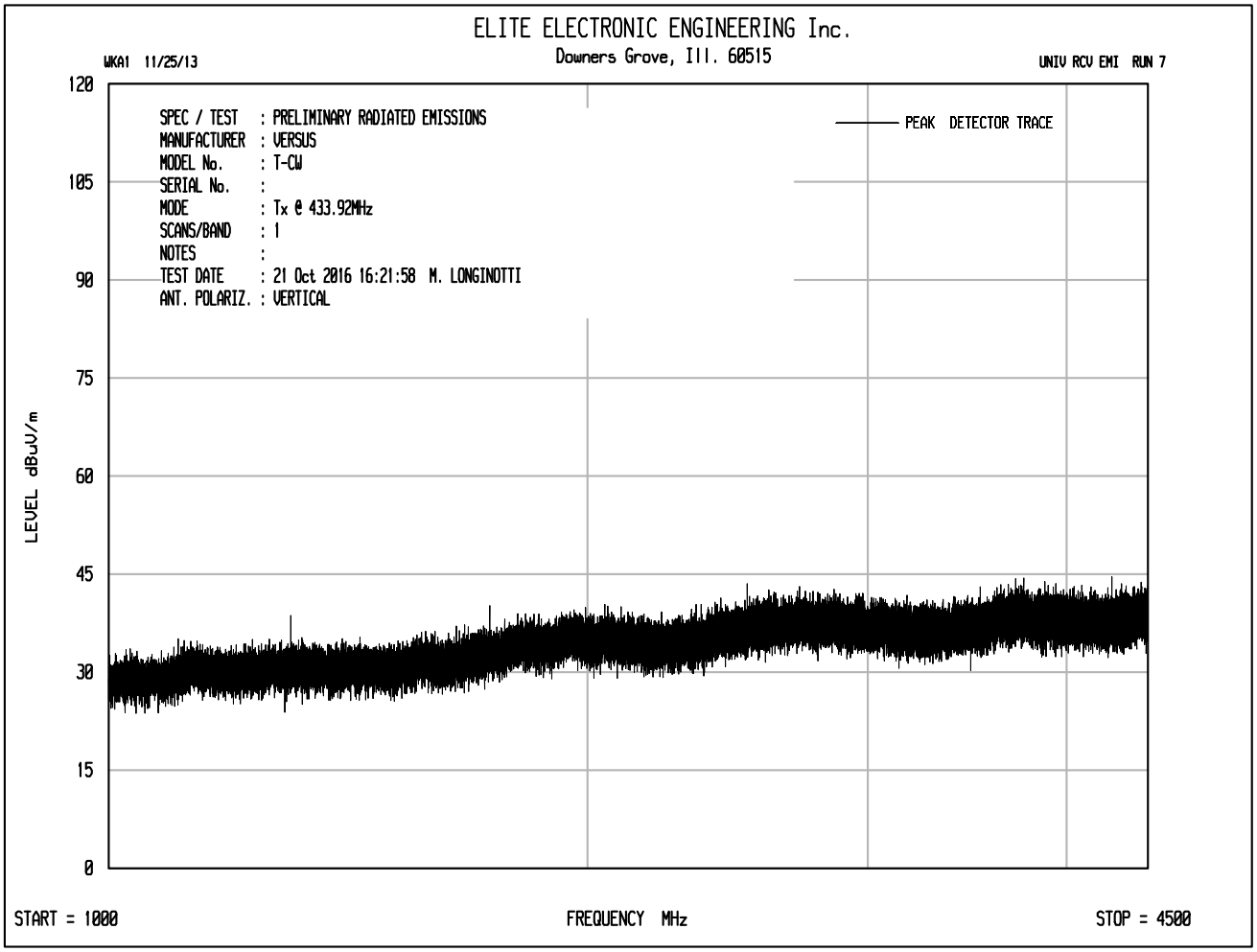
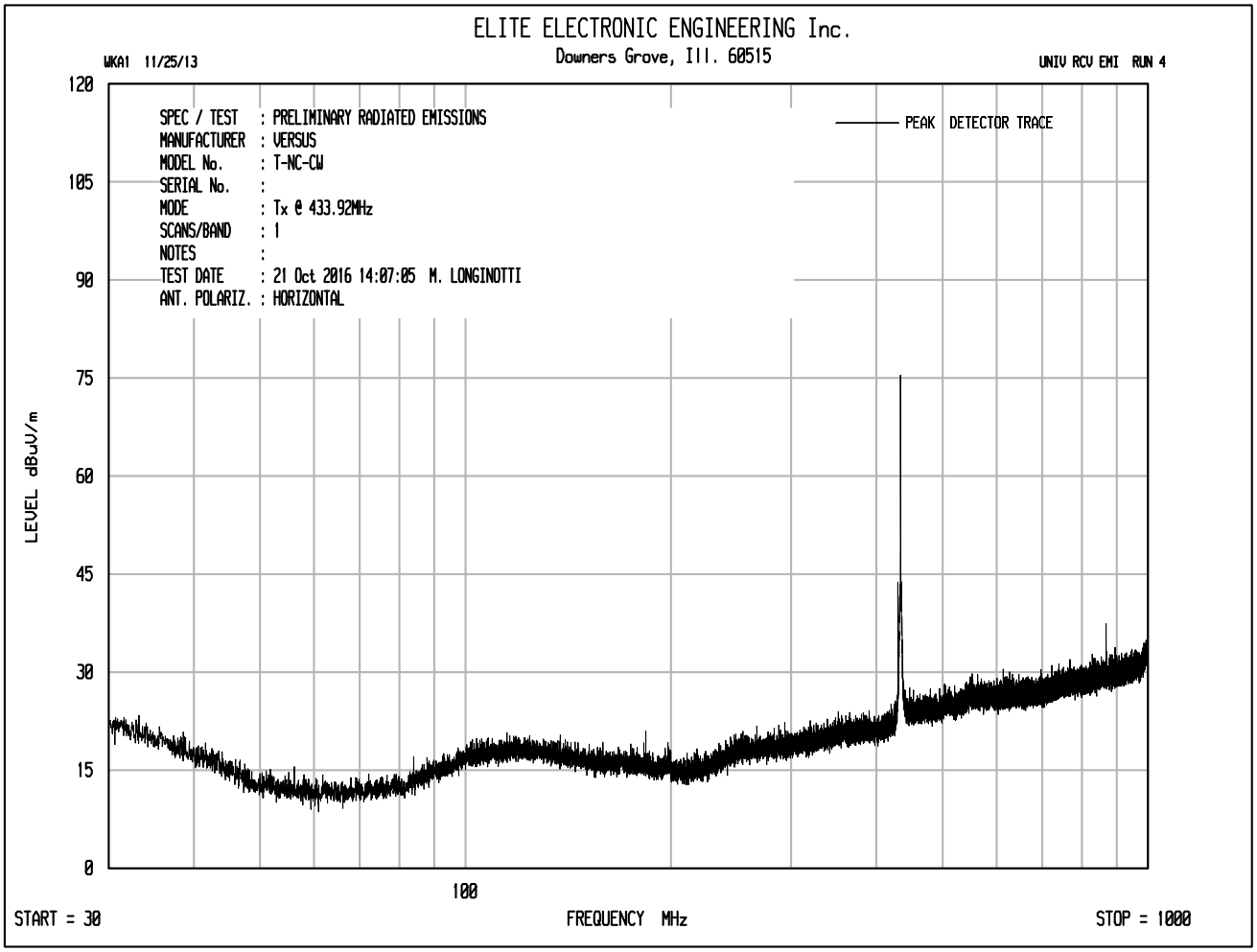
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 8
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : VERSUS
MODEL No. : T-CW
SERIAL No. :
MODE : Tx @ 433.92MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 21 Oct 2016 16:26:22 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 4500

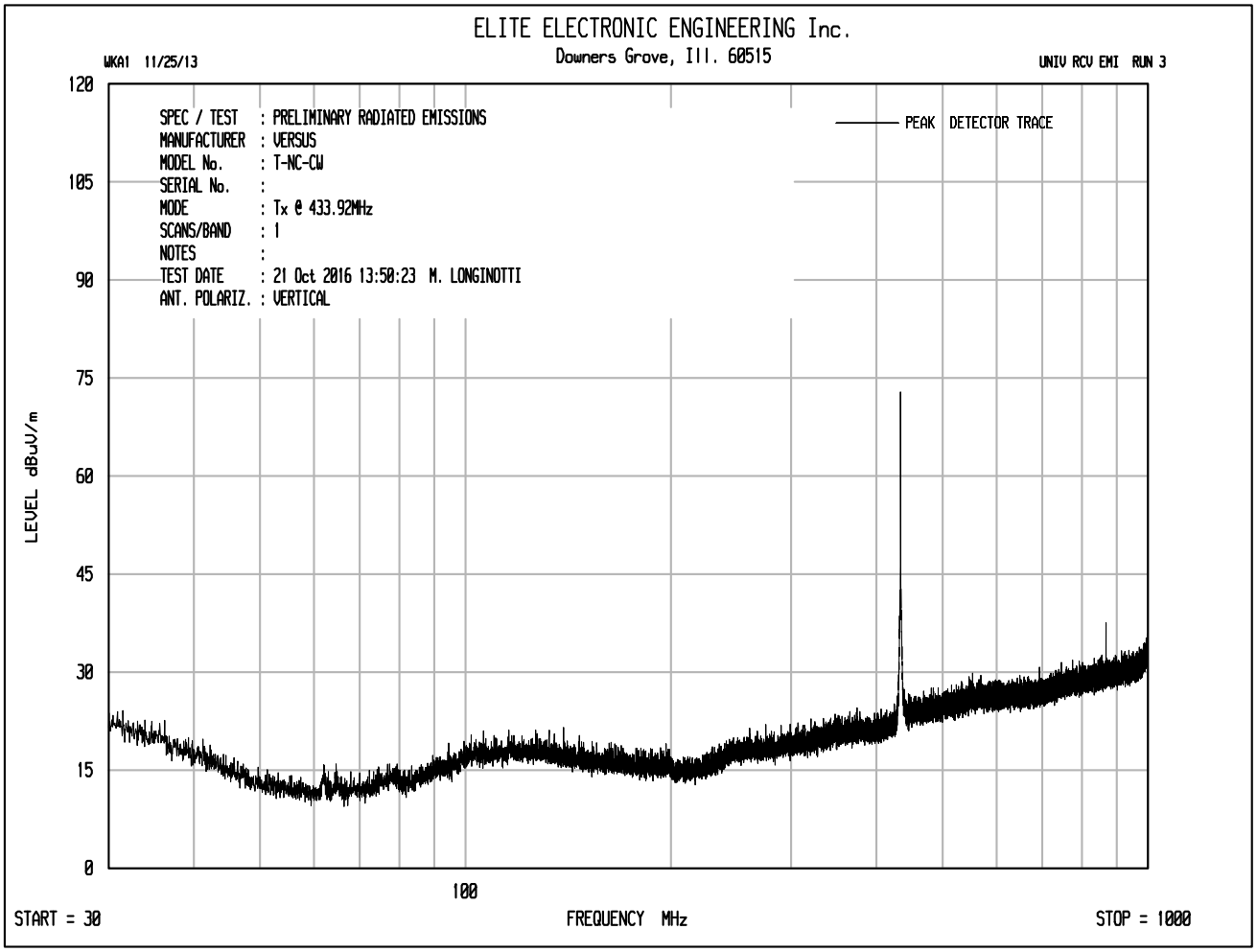

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 7
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : VERSUS
MODEL No. : T-CW
SERIAL No. :
MODE : Tx @ 433.92MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 21 Oct 2016 16:21:58 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 4500

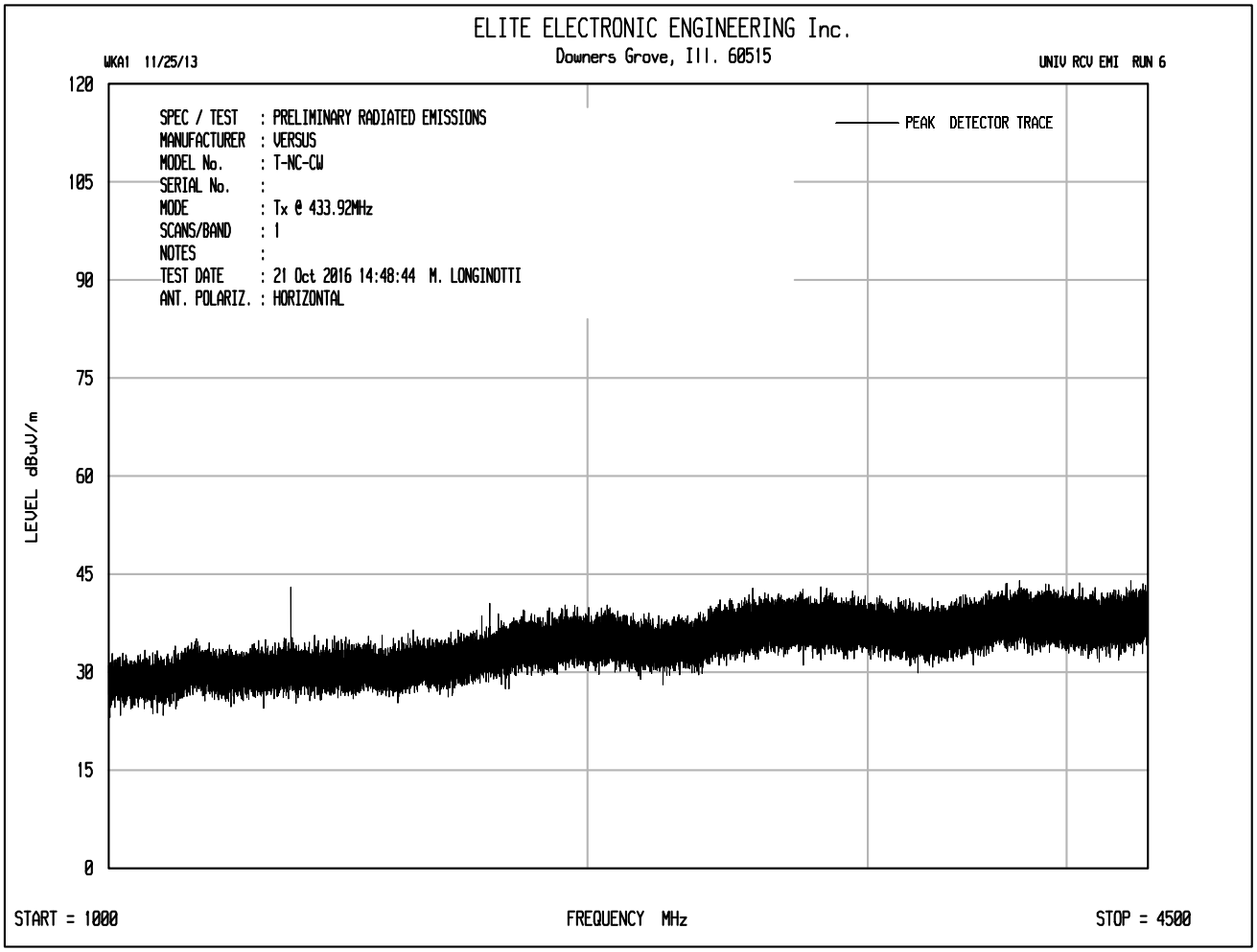
Manufacturer : Versus Technology, Inc.
Test Item : Mini Asset Tag
Model No. : VER188X_R4
Sample No. : T-CW
Serial No. : None Assigned
Mode : Transmit @ 433.92MHz
Test Specification : FCC-15.231(e)
Date : October 21, 2016
Test Distance : 3 meters
Notes : Peak Detector with 1MHz Resolution Bandwidth

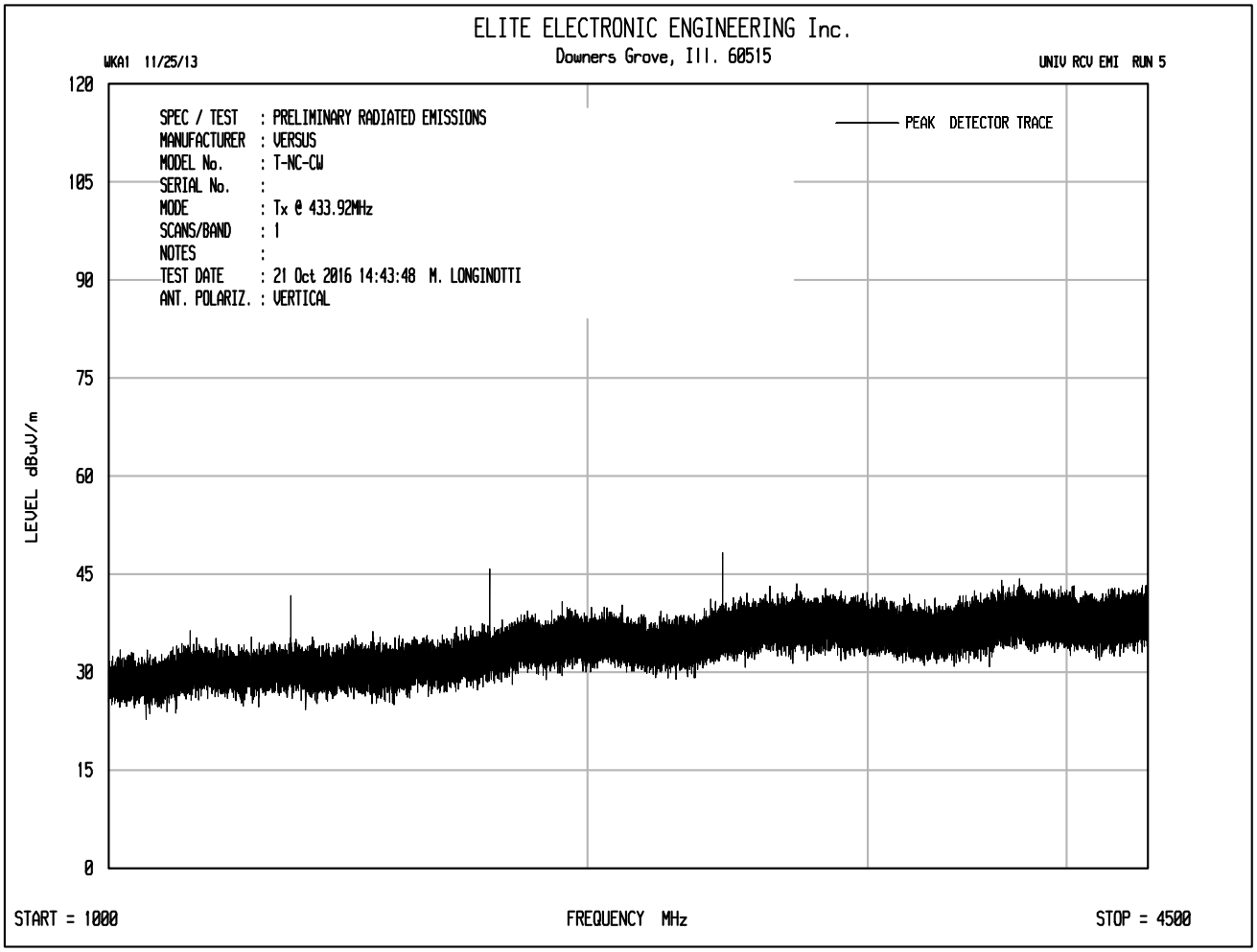
Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Duty Cycle (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
433.920	H	51.6		1.4	21.5	0.0	-16.2	58.3	825.9	4398.7	-14.5
433.920	V	49.4		1.4	21.5	0.0	-16.2	56.1	641.1	4398.7	-16.7
867.840	H	11.2		2.0	26.6	0.0	-16.2	23.6	15.1	439.9	-29.3
867.840	V	9.3		2.0	26.6	0.0	-16.2	21.7	12.1	439.9	-31.2
1301.760	H	17.7	Ambient	2.5	28.6	0.0	-16.2	32.6	42.7	500.0	-21.4
1301.760	V	15.9	Ambient	2.5	28.6	0.0	-16.2	30.8	34.7	500.0	-23.2
1735.680	H	18.8	Ambient	2.9	29.9	0.0	-16.2	35.4	58.6	500.0	-18.6
1735.680	V	19.3	Ambient	2.9	29.9	0.0	-16.2	35.9	62.1	500.0	-18.1
2169.600	H	16.3	Ambient	3.2	31.7	0.0	-16.2	35.1	56.6	500.0	-18.9
2169.600	V	16.4	Ambient	3.2	31.7	0.0	-16.2	35.2	57.2	500.0	-18.8
2603.520	H	17.6	Ambient	3.6	32.4	0.0	-16.2	37.4	73.9	500.0	-16.6
2603.520	V	16.8	Ambient	3.6	32.4	0.0	-16.2	36.6	67.4	500.0	-17.4
3037.440	H	16.1	Ambient	3.9	32.8	0.0	-16.2	36.6	67.6	500.0	-17.4
3037.440	V	17.4	Ambient	3.9	32.8	0.0	-16.2	37.9	78.6	500.0	-16.1
3471.360	H	16.4	Ambient	4.2	33.1	0.0	-16.2	37.5	75.2	500.0	-16.5
3471.360	V	16.7	Ambient	4.2	33.1	0.0	-16.2	37.8	77.9	500.0	-16.2
3905.280	H	16.7	Ambient	4.4	33.4	0.0	-16.2	38.3	82.1	500.0	-15.7
3905.280	V	17.3	Ambient	4.4	33.4	0.0	-16.2	38.9	88.0	500.0	-15.1
4339.200	H	16.0	Ambient	4.6	33.8	0.0	-16.2	38.2	81.5	500.0	-15.8
4339.200	V	16.1	Ambient	4.6	33.8	0.0	-16.2	38.3	82.4	500.0	-15.7

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp + Duty Cycle


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 4
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : VERSUS
MODEL No. : T-NC-CW
SERIAL No. :
MODE : Tx @ 433.92MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 21 Oct 2016 14:07:05 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000

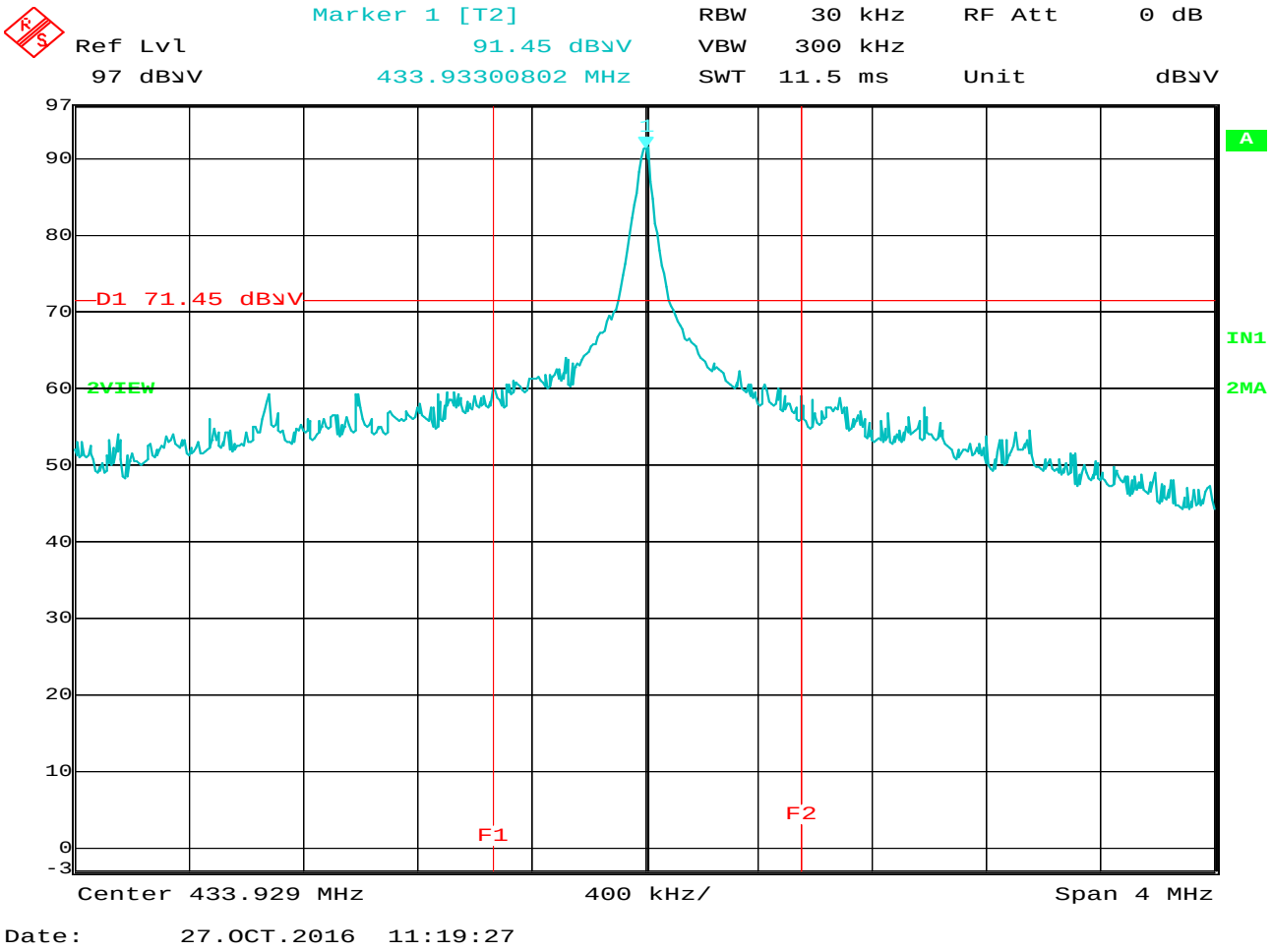

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 3
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : VERSUS
MODEL No. : T-NC-CW
SERIAL No. :
MODE : Tx @ 433.92MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 21 Oct 2016 13:50:23 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 6
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : VERSUS
MODEL No. : T-NC-CW
SERIAL No. :
MODE : Tx @ 433.92MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 21 Oct 2016 14:48:44 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 = 4500


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 5
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : VERSUS
MODEL No. : T-NC-CW
SERIAL No. :
MODE : Tx @ 433.92MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 21 Oct 2016 14:43:48 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 4500

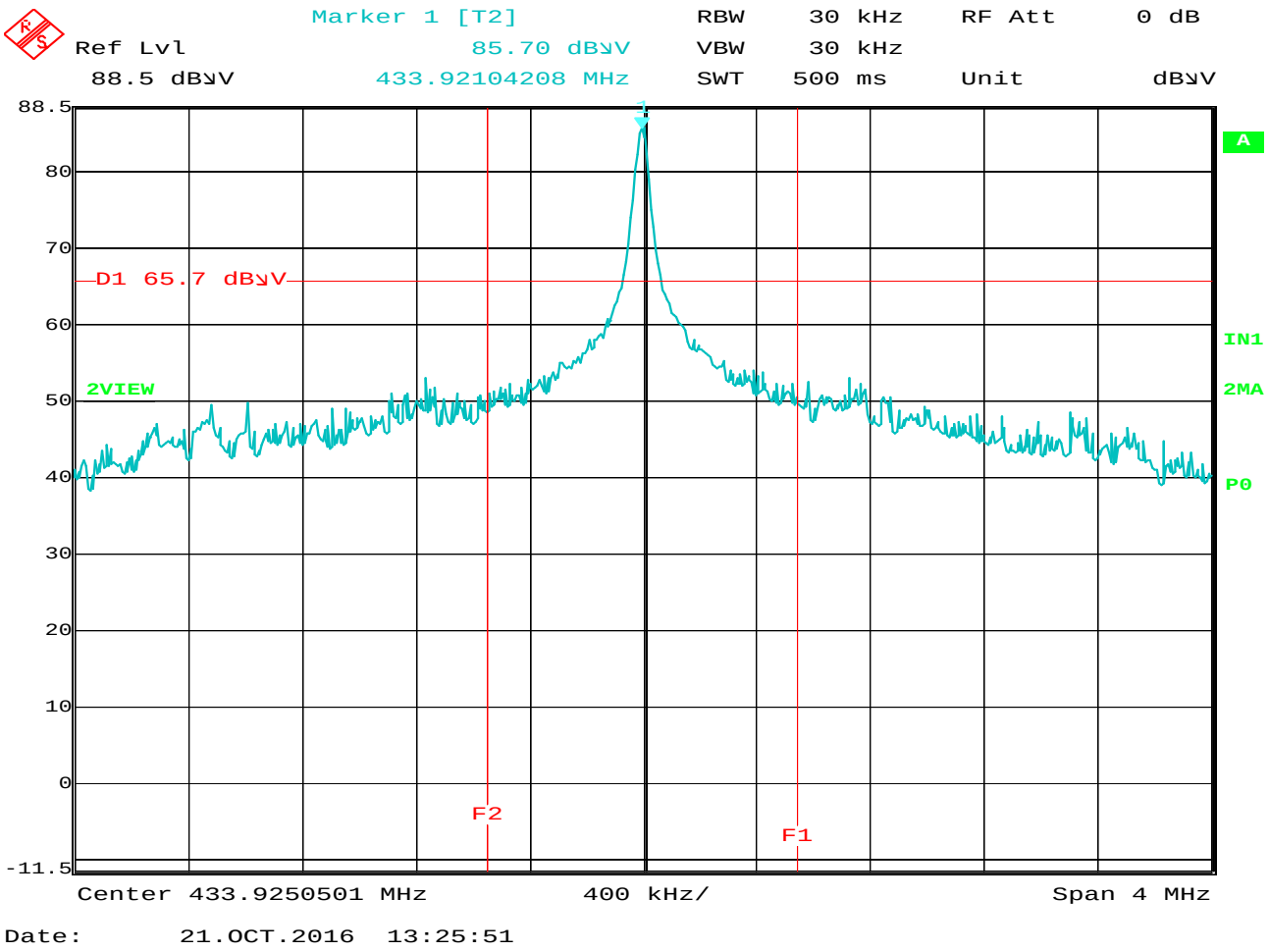
Manufacturer : Versus Technology, Inc.
Test Item : Mini Asset Tag
Model No. : VER188X_R4
Sample No. : T-NC-CW
Serial No. : None Assigned
Mode : Transmit @ 433.92MHz
Test Specification : FCC-15.231(e)
Date : October 21, 2016
Test Distance : 3 meters
Notes : Peak Detector with 1MHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Duty Cycle (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
433.920	H	51.8		1.4	21.5	0.0	-16.2	58.5	845.2	4398.7	-14.3
433.920	V	49.8		1.4	21.5	0.0	-16.2	56.5	671.4	4398.7	-16.3
867.840	H	10.8		2.0	26.6	0.0	-16.2	23.2	14.4	439.9	-29.7
867.840	V	9.1		2.0	26.6	0.0	-16.2	21.5	11.8	439.9	-31.4
1301.760	H	17.6	Ambient	2.5	28.6	0.0	-16.2	32.5	42.2	500.0	-21.5
1301.760	V	16.1	Ambient	2.5	28.6	0.0	-16.2	31.0	35.5	500.0	-23.0
1735.680	H	19.7	Ambient	2.9	29.9	0.0	-16.2	36.3	65.0	500.0	-17.7
1735.680	V	19.0	Ambient	2.9	29.9	0.0	-16.2	35.6	59.9	500.0	-18.4
2169.600	H	15.9	Ambient	3.2	31.7	0.0	-16.2	34.7	54.0	500.0	-19.3
2169.600	V	16.2	Ambient	3.2	31.7	0.0	-16.2	35.0	55.9	500.0	-19.0
2603.520	H	16.2	Ambient	3.6	32.4	0.0	-16.2	36.0	62.9	500.0	-18.0
2603.520	V	16.6	Ambient	3.6	32.4	0.0	-16.2	36.4	65.9	500.0	-17.6
3037.440	H	16.6	Ambient	3.9	32.8	0.0	-16.2	37.1	71.6	500.0	-16.9
3037.440	V	16.2	Ambient	3.9	32.8	0.0	-16.2	36.7	68.4	500.0	-17.3
3471.360	H	16.7	Ambient	4.2	33.1	0.0	-16.2	37.8	77.9	500.0	-16.2
3471.360	V	16.3	Ambient	4.2	33.1	0.0	-16.2	37.4	74.4	500.0	-16.6
3905.280	H	16.7	Ambient	4.4	33.4	0.0	-16.2	38.3	82.1	500.0	-15.7
3905.280	V	17.1	Ambient	4.4	33.4	0.0	-16.2	38.7	86.0	500.0	-15.3
4339.200	H	16.6	Ambient	4.6	33.8	0.0	-16.2	38.8	87.3	500.0	-15.2
4339.200	V	16.2	Ambient	4.6	33.8	0.0	-16.2	38.4	83.4	500.0	-15.6



FCC 15.231 20dB Bandwidth

MANUFACTURER	:	Versus
MODEL NUMBER	:	T-FS
SERIAL NUMBER	:	None Assigned
TEST MODE	:	Transmit at 433.92MHz
TEST PARAMETERS	:	20dB bandwidth
EQUIPMENT USED	:	RBB0, PHA0
NOTES	:	Display lines F1 and F2 represent the 0.25% bandwidth
	:	Display line D1 represents the 20dB down point from the transmit frequency



FCC 15.231 20dB Bandwidth

MANUFACTURER	: Versus
MODEL NUMBER	: T-NC-FS
SERIAL NUMBER	: None Assigned
TEST MODE	: Transmit at 433.92MHz
TEST PARAMETERS	: 20dB bandwidth
EQUIPMENT USED	: RBB0, PHA0
NOTES	: Display Lines F1 and F2 represent the 0.25% bandwidth
	: Display Line D1 represents the 20dB down point from the transmit frequency