



Measurement of RF Emissions from a 20140 Transmitter

For	Riverside Manufacturing, Inc. 14510 Lima Road Ft. Wayne, IN 46818
P.O. Number	84181
Date Tested	February 22, 2011
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
Mark Longinotti
EMC Engineer

Requested By:

John Reid
Riverside Manufacturing, Inc.

Approved By:

Raymond J. Klouda
Raymond J. Klouda
Registered Professional
Engineer of Illinois - 44894

TABLE OF CONTENTS

PARAGRAPH	DESCRIPTION OF CONTENTS	PAGE NO.
1.	Introduction.....	4
1.1.	Scope of Tests.....	4
1.2.	Purpose	4
1.3.	Deviations, Additions and Exclusions.....	4
1.4.	EMC Laboratory Identification	4
1.5.	Laboratory Conditions.....	4
2.	Applicable Documents.....	4
3.	EUT Setup and Operation	5
3.1.	General Description.....	5
3.1.1.	Power Input.....	5
3.1.2.	Peripheral Equipment	5
3.1.3.	Signal Input/Output Leads	5
3.1.4.	Grounding	5
3.2.	Operational Mode	5
3.3.	EUT Modifications.....	5
4.	Test Facility and Test Instrumentation	5
4.1.	Shielded Enclosure.....	5
4.2.	Test Instrumentation.....	5
4.3.	Calibration Traceability	5
4.4.	Measurement Uncertainty	5
5.	Test Procedures	6
5.1.	Powerline Conducted Emissions.....	6
5.1.1.	Requirements.....	6
5.2.	Periodic Operation Measurements	6
5.2.1.	Requirements.....	6
5.2.2.	Procedures.....	6
5.2.3.	Results	6
5.3.	Duty Cycle Factor Measurements	6
5.3.1.	Procedures.....	6
5.3.2.	Results	7
5.4.	Radiated Measurements	7
5.4.1.	Requirements.....	7
5.4.2.	Procedures.....	7
5.4.3.	Results	8
5.5.	Occupied Bandwidth Measurements.....	8
5.5.1.	Requirement.....	8
5.5.2.	Procedures.....	8
5.5.3.	Results	8
6.	Other Test Conditions	8
6.1.	Test Personnel and Witnesses.....	8
6.2.	Disposition of the EUT	8
7.	Conclusions	8
8.	Certification.....	9
9.	Equipment List.....	10

THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE
WRITTEN APPROVAL OF ELITE ELECTRONIC ENGINEERING INCORPORATED.



REVISION HISTORY

Revision	Date	Description
—	February 28, 2011	Initial release

Measurement of RF Emissions from a Model No. 20140 Transmitter

1. INTRODUCTION

1.1. Scope of Tests

This report presents the results of the RF emissions measurements performed on a Transmitter, Model No. 20140, Serial No. None Assigned, (hereinafter referred to as the Equipment Under Test (EUT)). The EUT was designed to transmit at approximately 433.9MHz using an internal antenna. The EUT was manufactured and submitted for testing by Riverside Manufacturing, Inc. located in Ft. Wayne, IN.

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. The test series was also performed to determine if the EUT meets the conducted and radiated RF emission requirements of the Industry Canada Radio Standards Specification, RSS-Gen, Section 7.2.4 and Annex 1 of RSS-210. 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 American Association for Laboratory Accreditation (A2LA). A2LA Certificate Number: 1786.01.

1.5. Laboratory Conditions

The temperature at the time of the test was 22°C and the relative humidity was 21%.

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 2010
- 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 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 Riverside Manufacturing, Inc., Transmitter, Model No. 20140. A block diagram of the EUT setup is shown as Figure 1.

3.1.1. Power Input

The EUT obtained 3VDC from an internal CR2032 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 ungrounded during the test.

3.2. Operational Mode

For all tests the EUT was placed on an 80cm high non-conductive stand. The EUT was energized. For radiated emissions testing purposes only, an EUT was modified so that once the transmit button was pushed, it would continuously transmitted at 433.9MHz.

3.3. 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 C63.4-2003 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 2000MHz 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 and will not be connected to the AC Mains, no conducted emissions tests are required.

5.2. Periodic Operation Measurements

5.2.1. Requirements

A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released. Also, a transmitter activated automatically shall cease transmission within 5 seconds after activation.

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 plot of the periodic timing is shown on data page 15. The data shows that the EUT ceases operation within the allotted time.

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.

With the transmitter set up to transmit for maximum pulse density, the time domain trace is displayed on the spectrum analyzer. This trace is obtained by tuning center frequency to the transmitter frequency and then setting a zero span width with 10msec/div. The amplitude settings are adjusted so that the on/off transitions clear the 4th division from the bottom of the display. The markers are set at the beginning and end of a word period. If the word period exceeds 100 msec the word period is set to 100 msec. The on-time and off-time are then measured. The on-time is total time signal level exceeds the 4th division. Off-time is time under for the word period. The duty cycle is then computed as the (On-time/ word period) where the word period = (On-time + Off-time).

5.3.2. Results

The plot of the duty cycle is shown on data page 16. The duty cycle factor was computed to be -14.2dB.

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(b) and Industry Canada RSS-210, Annex 1.

Paragraph 15.231(b) of FCC CFR Title 47 Part15C and Annex 1 of Industry Canada RSS-210 have 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 433.92MHz, the limit at the fundamental is 10996.7uV/m @ 3m and the limit on the harmonics is 1099.7uV/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 C63.4-2003 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 4.5GHz 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 4500MHz. 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 distance correction (DC) is required, it is added to the total.

Formula 1: $FS (\text{dBuV/m}) = MTR (\text{dBuV}) + AF (\text{dB/m}) + CF (\text{dB}) + (-PA (\text{dB})) + DC (\text{dB})$

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: $FS (\text{uV/m}) = \text{AntiLog} [(FS (\text{dBuV/m})) / 20]$

5.4.3. Results

The preliminary plots, with the EUT transmitting at 433.9MHz, are presented on data pages 17 through 20. The plots are presented for a reference only, and are not used to determine compliance.

The final open area radiated levels, with the EUT transmitting at 433.9MHz, are presented on data page 21. As can be seen from the data, all emissions measured from the EUT were within the specification limits. The emissions level closest to the limit (worst case) occurred at 1301.76MHz. The emissions level at this frequency was 11.9dB within the limit. See data page 21 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 100kHz and span was set to 2 MHz. The frequency spectrum near the fundamental was plotted.

5.5.3. Results

The plot of the emissions near the fundamental frequency is presented on data page 22. As can be seen from this data page, the transmitter met the occupied bandwidth requirements.

The 99% bandwidth was measured to be 296.6kHz.

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 Riverside Manufacturing, Inc. personnel.

6.2. Disposition of the EUT

The EUT and all associated equipment were returned to Riverside Manufacturing, Inc. upon completion of the tests.

7. CONCLUSIONS

It was determined that the Riverside Manufacturing, Inc. Transmitter, Model No. 20140, 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. It was also determined that the Riverside Manufacturing, Inc. Transmitter, Model No. 20140, Serial No. None Assigned, did fully meet the conducted and radiated emission requirements of the Industry Canada Radio Standards Specification, RSS-Gen, Section 7.2.4 and Annex 1 of RSS-210. Testing was performed in accordance with 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 EUT at the test date as operated by Riverside Manufacturing, Inc. personnel. 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
CDW3	COMPUTER			004		N/A	
CMA1	Controllers	EMCO	2090	9701-1213	---	N/A	
NTA2	BILOG ANTENNA	TESEQ	6112D	28040	25-1000MHz	6/7/2010	6/7/2011
NWH0	RIDGED WAVE GUIDE	TENSOR	4105	2081	1-12.4GHz	8/31/2010	8/31/2011
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	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.

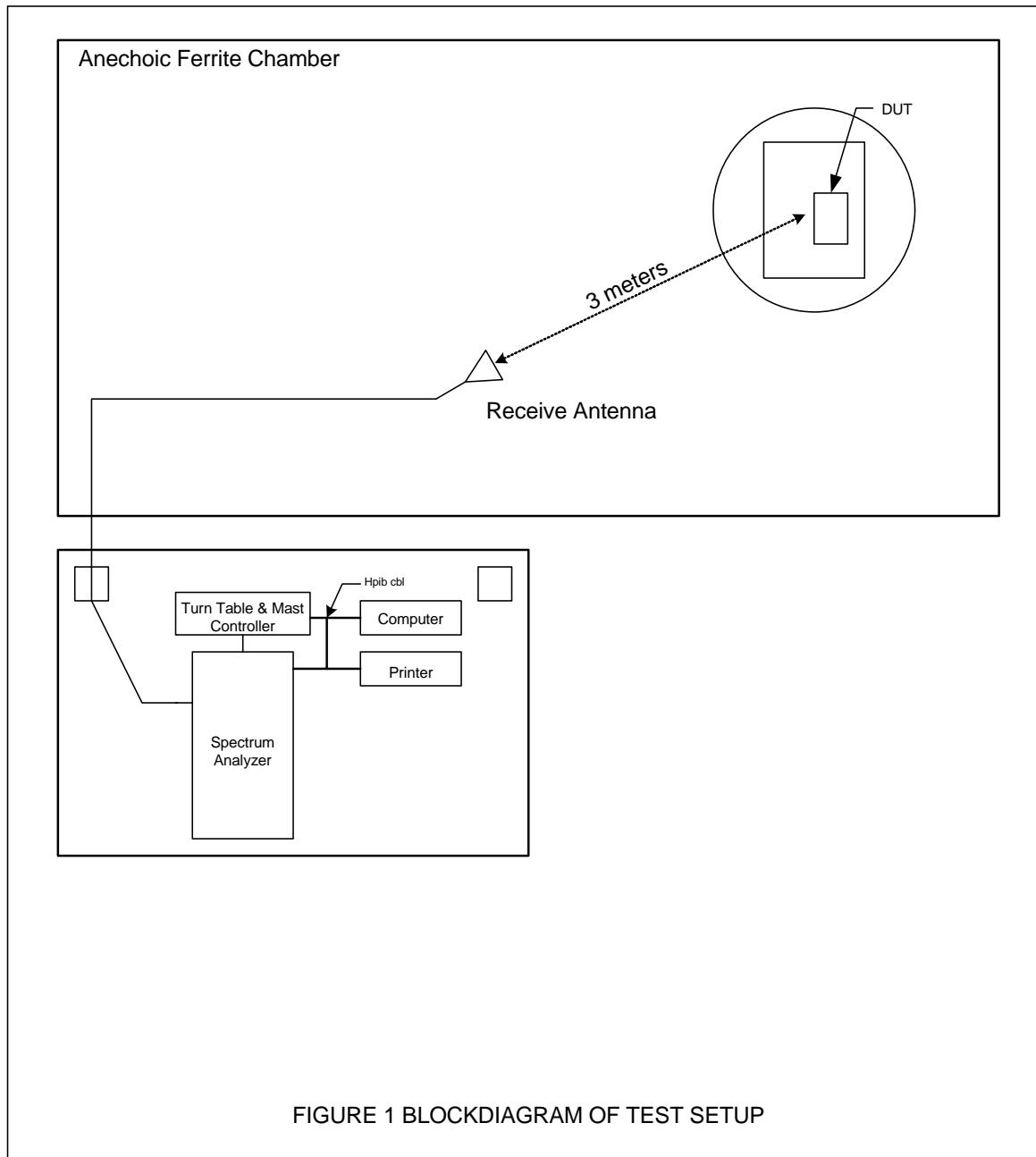
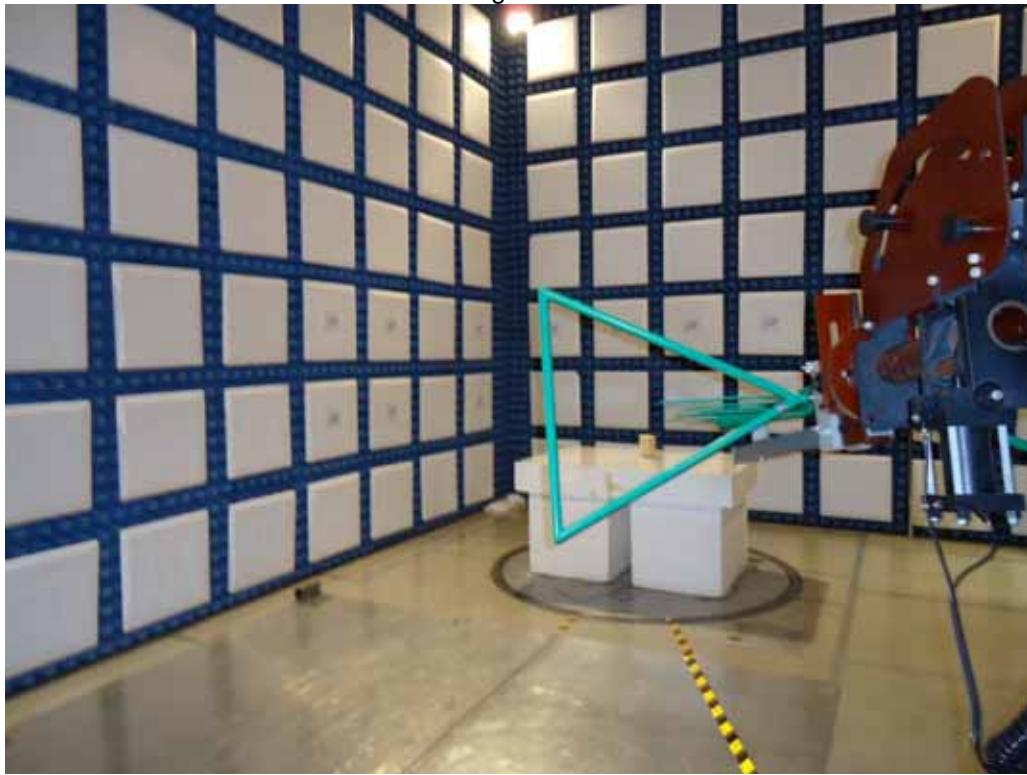


Figure 2

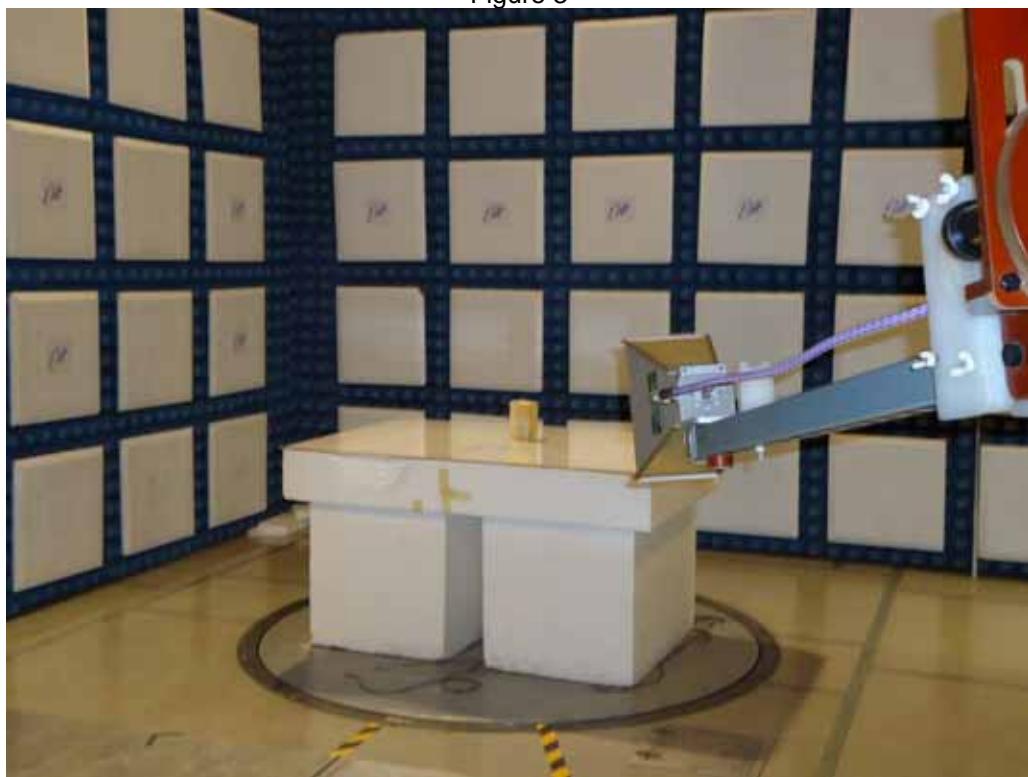


Test Setup for Radiated Emissions, 30MHz to 1GHz – Horizontal Polarization



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

Figure 3



Test Setup for Radiated Emissions, 1GHz to 2GHz – Horizontal Polarization

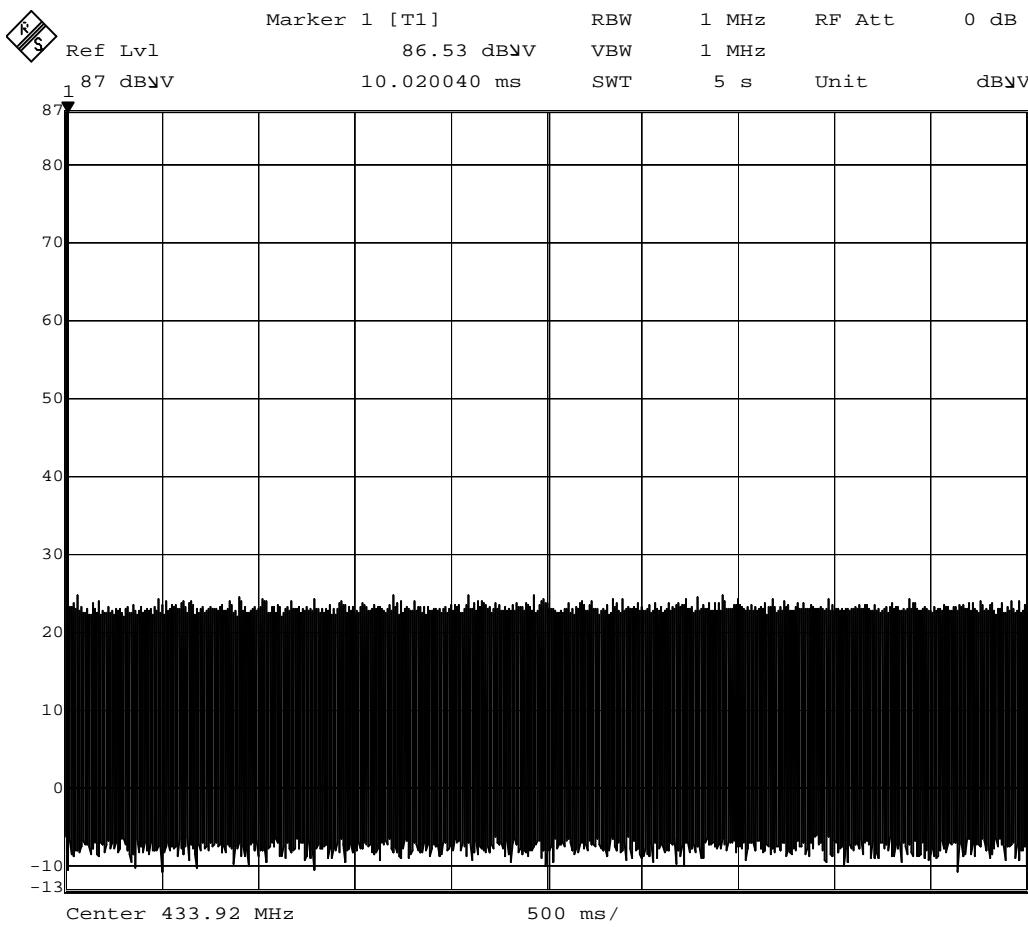


Test Setup for Radiated Emissions, 1GHz to 2GHz – Vertical Polarization

Figure 4



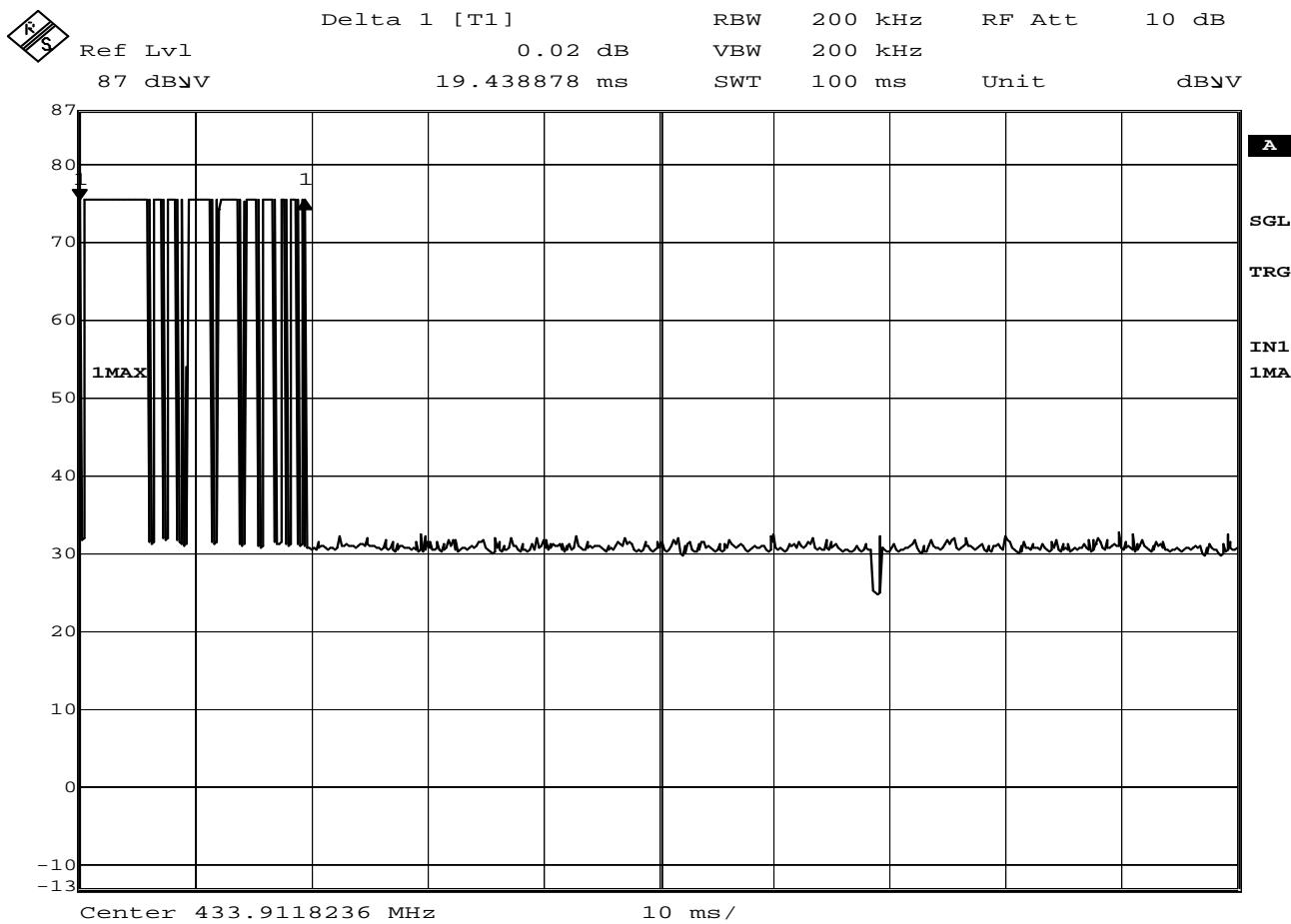
Test Item Setup



Date: 22.FEB.2011 10:20:25

15.231(a)(1) Manually operated transmitter

MANUFACTURER	: Riverside Manufacturing, Inc.
MODEL NUMBER	: 20140
SERIAL NUMBER	: None Assigned
TEST MODE	: Transmit at 433.9MHz
NOTES	: A manually operated transmitter shall employ a switch that : will automatically deactivate the transmitter within not more : than 5 seconds of being released.
EQUIPMENT USED	: RBB0, PHA0



Date: 22.FEB.2011 09:14:49

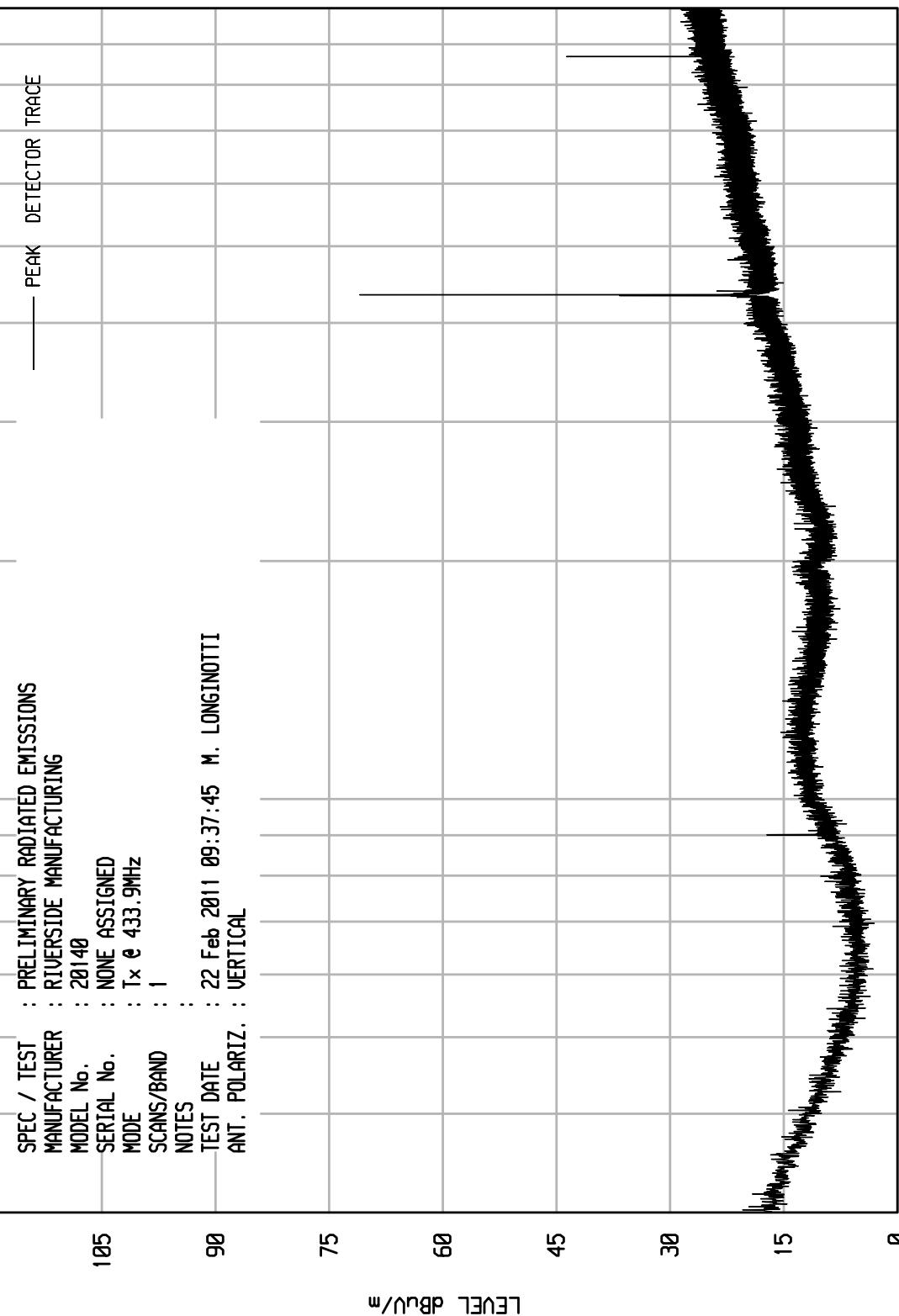
5.231 Duty Cycle Correction Factor

MANUFACTURER	: Riverside Manufacturing, Inc.
MODEL NUMBER	: 20140
SERIAL NUMBER	: None Assigned
TEST MODE	: Transmit at 433.9MHz
NOTES	: Duty Cycle = 20xlog(on time/100msec) = 20xlog(19.44msec/100msec) = -14.2dB
EQUIPMENT USED	: RBB0, PHA0

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515

WKA1 10/20/10 UNIV RCU EMI RUN 2

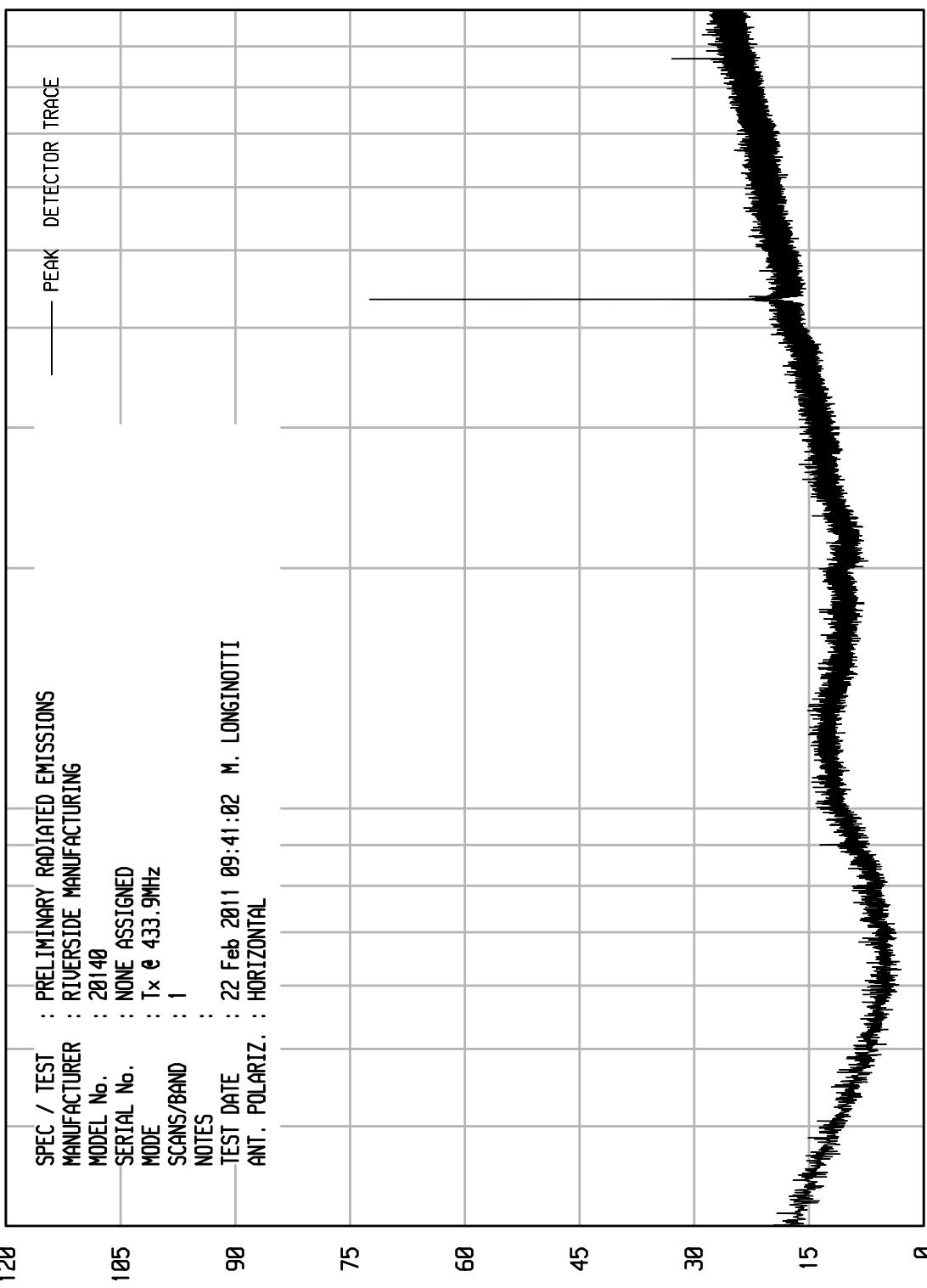
SPEC / TEST	:	PRELIMINARY RADIATED EMISSIONS
MANUFACTURER	:	RIVERSIDE MANUFACTURING
MODEL No.	:	28140
SERIAL No.	:	NONE ASSIGNED
MODE	:	Tx & 433.9MHz
SCANS/BAND	:	1
NOTES	:	
TEST DATE	:	22 Feb 2011 09:37:45
ANT. POLARIZ.	:	VERTICAL



ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515

UNIV RCU EMI RUN 3

WKAI	10/20/10	SPEC / TEST	: PRELIMINARY RADIATED EMISSIONS
		MANUFACTURER	: RIVERSIDE MANUFACTURING
105		MODEL No.	: 28140
		SERIAL No.	: NONE ASSIGNED
		MODE	: Tx & 433.9MHz
		SCANS/BAND	: 1
		NOTES	
90		TEST DATE	: 22 Feb 2011 09:41:02
		ANT. POLARIZ.	: HORIZONTAL

LEVEL dBu/ μ 

START = 30

100

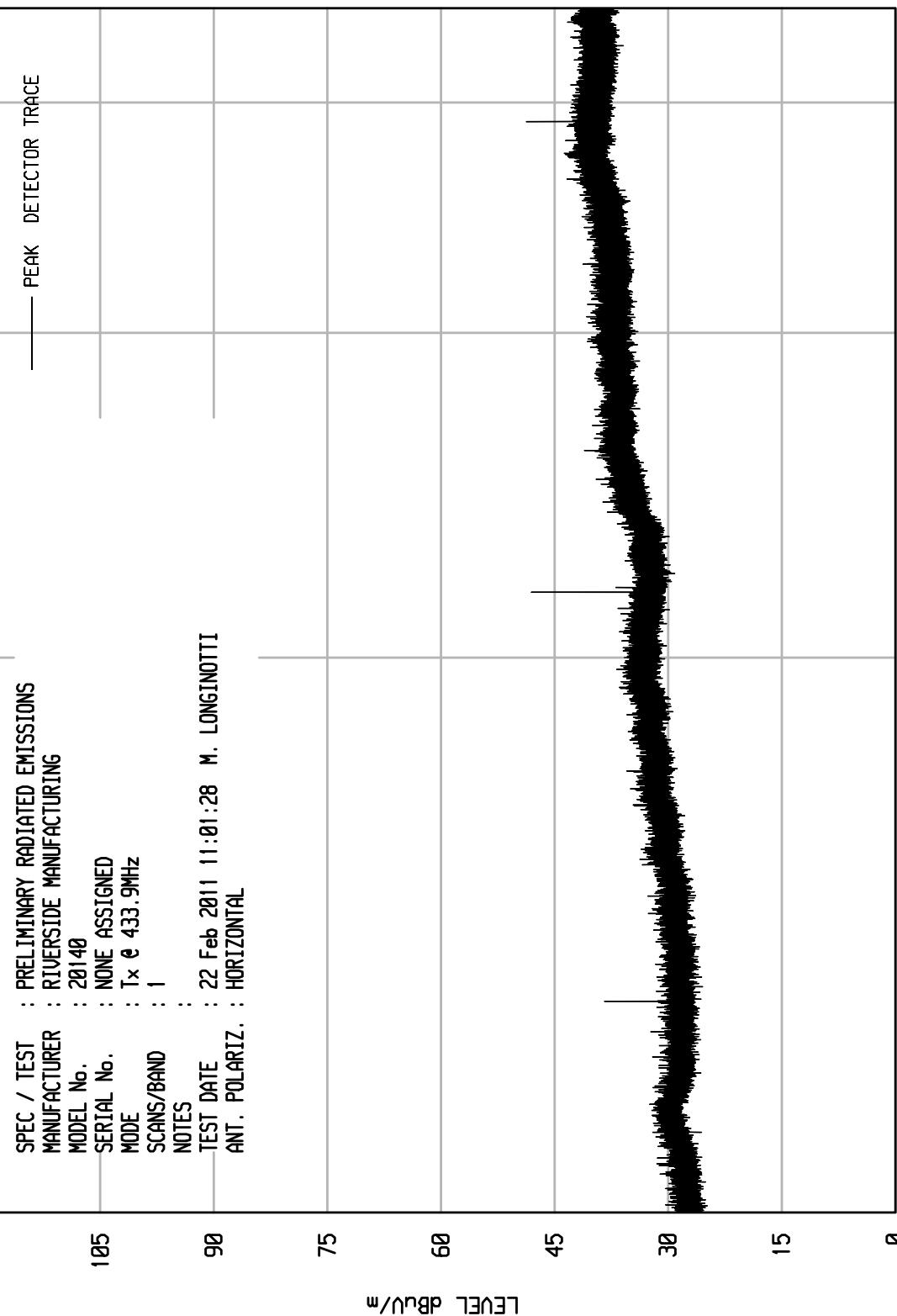
FREQUENCY MHz

STOP = 1000

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515

WKA1 10/20/10 UNIV RCU EMI RUN 5

SPEC / TEST	:	PRELIMINARY RADIATED EMISSIONS
MANUFACTURER	:	RIVERSIDE MANUFACTURING
MODEL No.	:	28140
SERIAL No.	:	NONE ASSIGNED
MODE	:	Tx & 433.9MHz
SCANS/BAND	:	1
NOTES	:	
TEST DATE	:	22 Feb 2011 11:01:28
ANT. POLARIZ.	:	M. LONGINOTTI



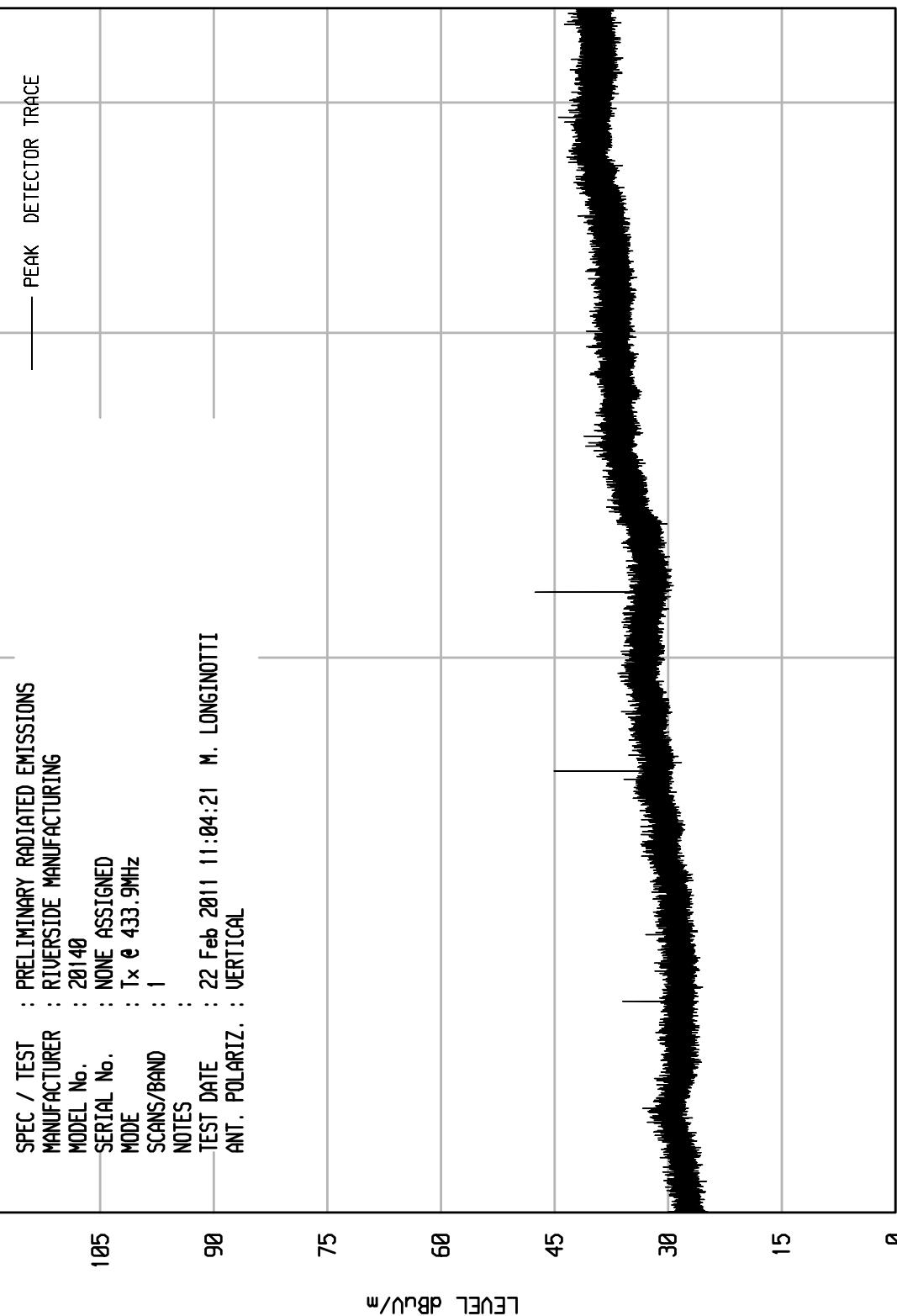
START = 1000

STOP = 4500

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515

WKA1 10/20/10 UNIV RCU EMI RUN 6

SPEC / TEST	:	PRELIMINARY RADIATED EMISSIONS
MANUFACTURER	:	RIVERSIDE MANUFACTURING
MODEL No.	:	28140
SERIAL No.	:	NONE ASSIGNED
MODE	:	Tx & 433.9MHz
SCANS/BAND	:	1
NOTES	:	
TEST DATE	:	22 Feb 2011 11:04:21
ANT. POLARIZ.	:	VERTICAL



START = 1000

STOP = 4500



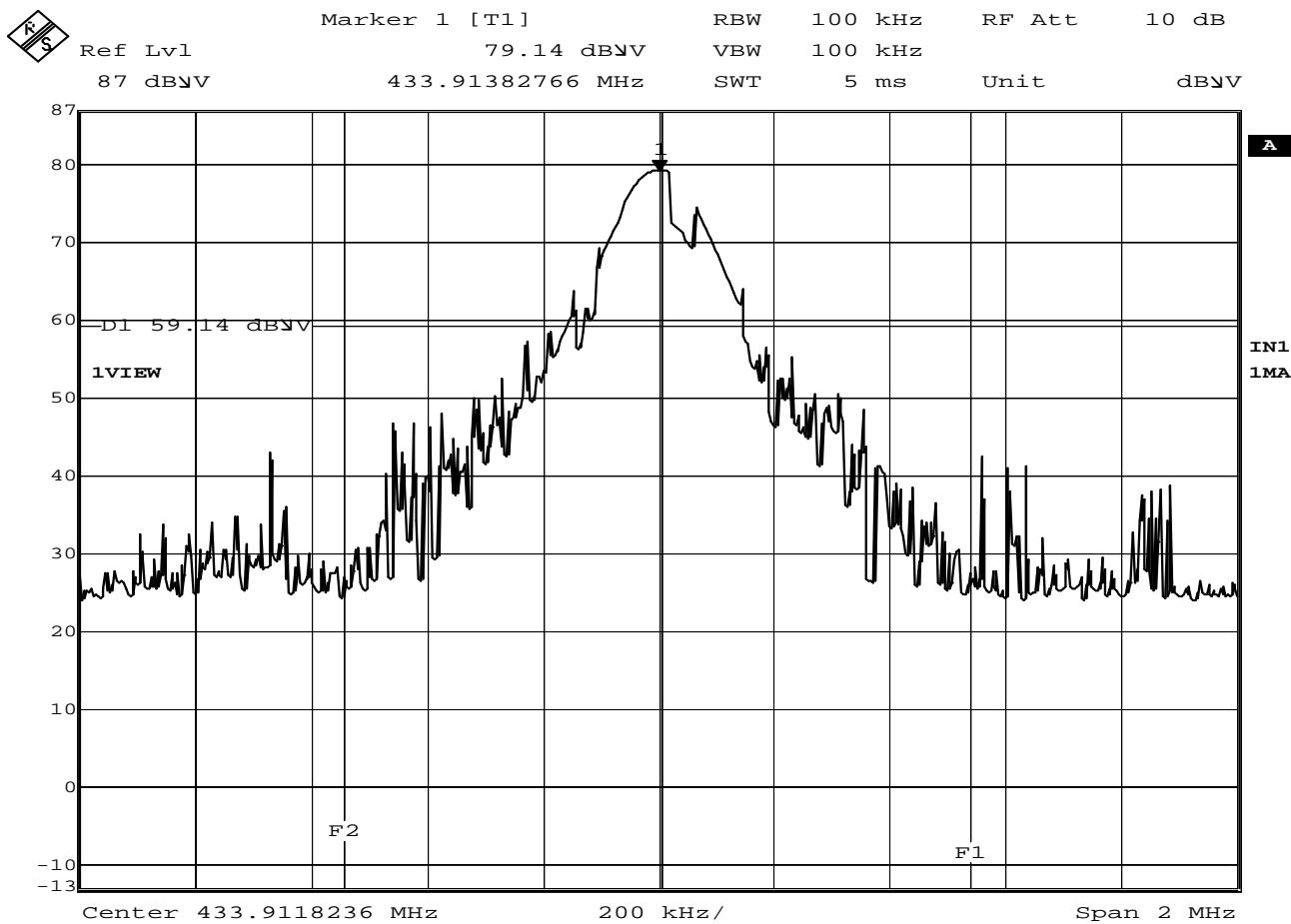
MANUFACTURER : Riverside Manufacturing, Inc.
MODEL : 20140 Transmitter
SERIAL NO. : None Assigned
SPECIFICATION : FCC-15B Spurious Radiated Emissions
DATE : February 22, 2011
NOTES : Tx @ 433.9MHz
: Test Distance is 3 meters

Frequency MHz	Antenna Polarity	Meter Reading dBuV	Ambient	Cable Factor dB	Antenna Factor dB	Duty Cycle dB	Total dBuV/m	Total uV/m	Limit uV/m
433.920	H	64.1		1.5	17.0	-14.2	68.4	2636.3	10996.7
433.920	V	57.3		1.5	17.0	-14.2	61.6	1205.0	10996.7
867.840	H	17.9		2.0	21.4	-14.2	27.1	22.7	1099.7
867.840	V	24.3		2.0	21.4	-14.2	33.5	47.5	1099.7
1301.760	H	24.0		2.4	24.9	-14.2	37.1	71.4	500.0
1301.760	V	29.0		2.4	24.9	-14.2	42.1	127.0	500.0
1735.680	H	16.1		2.8	26.4	-14.2	31.1	36.0	1099.7
1735.680	V	20.6		2.8	26.4	-14.2	35.6	60.4	1099.7
2169.600	H	21.1		3.2	27.6	-14.2	37.7	76.9	1099.7
2169.600	V	23.1		3.2	27.6	-14.2	39.7	96.8	1099.7
2603.520	H	17.4		3.6	29.7	-14.2	36.4	66.4	1099.7
2603.520	V	18.1		3.6	29.7	-14.2	37.1	72.0	1099.7
3037.440	H	17.8	Ambient	3.9	30.8	-14.2	38.3	82.4	1099.7
3037.440	V	17.5	Ambient	3.9	30.8	-14.2	38.0	79.6	1099.7
3471.360	H	17.7	Ambient	4.2	31.9	-14.2	39.6	95.3	1099.7
3471.360	V	17.2	Ambient	4.2	31.9	-14.2	39.1	90.0	1099.7
3905.280	H	19.0	Ambient	4.5	33.1	-14.2	42.4	131.6	500.0
3905.280	V	19.2	Ambient	4.5	33.1	-14.2	42.6	134.7	500.0
4339.200	H	16.5	Ambient	4.7	32.9	-14.2	39.9	98.5	500.0
4339.200	V	17.0	Ambient	4.7	32.9	-14.2	40.4	104.3	500.0

V - Vertical

H - Horizontal

Checked By: MARK E. LONGINOTTI



Date: 22.FEB.2011 09:23:21

FCC 15.231 20dB Bandwidth

MANUFACTURER : Riverside Manufacturing, Inc.
 MODEL NUMBER : 20140
 SERIAL NUMBER : None Assigned
 TEST MODE : Transmit at 433.9MHz
 NOTES : Display Line (D1) represents the 20dB down point. Display lines (F1) and (F2) represent the 0.25% span from the center frequency.
 EQUIPMENT USED : RBB0, PHA0