Measurement of RF Interference from a Model H-D 76537-08 Transmitter

For : MEC Innovation
5855 North Glen Park Road
Milwaukee, Wisconsin 53209

P.O. No. : P55-003387
Date Tested : 29 May 2007
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 :

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Revision History

Revision	Date	Description
—	30 May 2007	Initial release
A	27 June 2007	Update model from 6524-08 to 76537-08

Measurement of RF Emissions from a Model H-D 76537-08 Transmitter

1 INTRODUCTION

1.1 Scope of Tests

This document represents the results of the series of radio interference measurements performed on a model H-D 76537-08, Serial No. 1 transmitter, (hereinafter referred to as the test item). The test item was designed to transmit at approximately 433.92MHz using an internal antenna. The test item was manufactured and submitted for testing by MEC Innovation located in Milwaukee, Wisconsin.

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, Section 15.231 for Intentional Radiators. 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°C and the relative humidity was 33%.

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 B for Receivers, dated 1 October 2006

- 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 Transmitter, Model No. H-D 76537-08. A block diagram of the test item setup is shown as Figure 1.

3.1.1 Power Input

The test item obtained power from a 3VDC lithium battery installed inside the device.

3.1.2 Peripheral Equipment

No peripheral equipment was needed or submitted with the test item:

3.1.3 Interconnect Cables

The test item is a self contained device and does not have any interconnect cables.

3.1.4 Grounding

Since the test item was powered with 3VDC from a lithium 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 was energized.

The test item was set to continuously transmit at approximately 433.92MHz by depressing the transmit key with a non-conductive fixture.

3.3 Test Item Modifications

No modifications were required for compliance to the 15.231 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. All equipment was calibrated per the instruction manuals supplied by the manufacturer.

Radiated emissions were performed with a spectrum analyzer. This receiver allows measurements with the bandwidths specified by the FCC and with the quasi-peak detector function. The receiver bandwidth was 120kHz for the 30MHz to 1000MHz radiated emissions data and 1MHz for 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 budgets were based on guidelines in "ISO Guide to the Expression of Uncertainty in Measurements" and NAMAS NIS81 "The Treatment of Uncertainty in EMC Measurements".

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 were performed.

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.

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).

5.2.2 Results

The plot of the duty cycle is shown on data page 13. The duty cycle factor was computed to be -6.4dB.

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 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.

5.3.2 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 5.0GHz 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 5000MHz. Between 30MHz and 1000MHz, a log periodic 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 433.92MHz, are presented on data pages 14 through 17. 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 433.92MHz, are presented on data page 18. As can be seen from the data, all emissions measured from the test item were within the specification limits. The emissions level closet to the limit (worst case) occurred at 1301.76MHz. The emissions level at this frequency was 7.9dB within the limit. See data page 18 for details. 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 30 kHz and span was set to 2 MHz. The frequency spectrum near the fundamental was plotted.

5.4.3 Results

The plot of the emissions near the fundamental frequency is presented on data page 19. As can be seen from this data page, the transmitter met the occupied bandwidth requirements.

The 99% bandwidth was measured to be 180kHz.

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 Test Item

The test item and all associated equipment were returned to MEC Innovation upon completion of the tests.

7 CONCLUSIONS

It was determined that the MEC Innovation Transmitter, Model No. H-D 76537-08, Serial No. 1, did fully meet the conducted and 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. 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

ELITE ELECTRONIC ENG. INC. Page: 1

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Cal Inv	Due Date
	Equipment Type: ACCESSORIES, MISCELLANEOUS							
XZG5	ATTENUATOR/SWITCH DRIVER	HEWLETT PACKARD	11713A	2508A05689	PROGRAMMABLE		NOTE 1	
	Equipment Type: AMPLIFIERS							
APK5	PREAMPLIFIER	HEWLETT PACKARD	8449B	29331A00183	2GHZ-22GHZ	04/27/06	13	05/27/07
	Equipment Type: ANTENNAS							
NTA0	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL611	2057	0.03-2GHZ	08/21/06	12	08/21/07
NWF0	RIDGED WAVE GUIDE	EMCO	3105	2035	1-12.4GHZ	10/09/06	12	10/09/07
	Equipment Type: CONTROLLERS							
CDS2	COMPUTER	GATEWAY	MFATXPNT NMZ	0028483108	1.8GHZ		N/A	
CMA0	MULTI-DEVICE CONTROLLER	EMCO	2090	9701-1213	---		N/A	
	Equipment Type: PRINTERS AND PLOTTERS							
HRE1	LASER JET 5P	HEWLETT PACKARD	C3150A	USHB061052	---		N/A	
	Equipment Type: RECEIVERS							
RAC2	SPECTRUM ANALYZER	HEWLETT PACKARD	85660B	2504A01234	100HZ-22GHZ	08/24/06	12	08/24/07
RACH	RF PRESELECTOR	HEWLETT PACKARD	85685A	8574A00284	20HZ-2GHZ	10/11/06	12	10/11/07
RAF6	QUASIPEAK ADAPTOR W/ RECEI	HEWLETT PACKARD	85650A	2412A00403	0.01-1000MHZ	08/17/06	12	08/17/07
RAKG	RF SECTION	HEWLETT PACKARD	85462A	3549A00284	0.009-6500MHZ	11/27/06	12	11/27/07
RAKH	RF FILTER SECTION	HEWLETT PACKARD	85460A	3448A00324	---	11/27/06	12	11/27/07

Cal. Interval: Listed in Months 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.

Radiated Emissions Test Setup Anechoic Ferrite Chamber

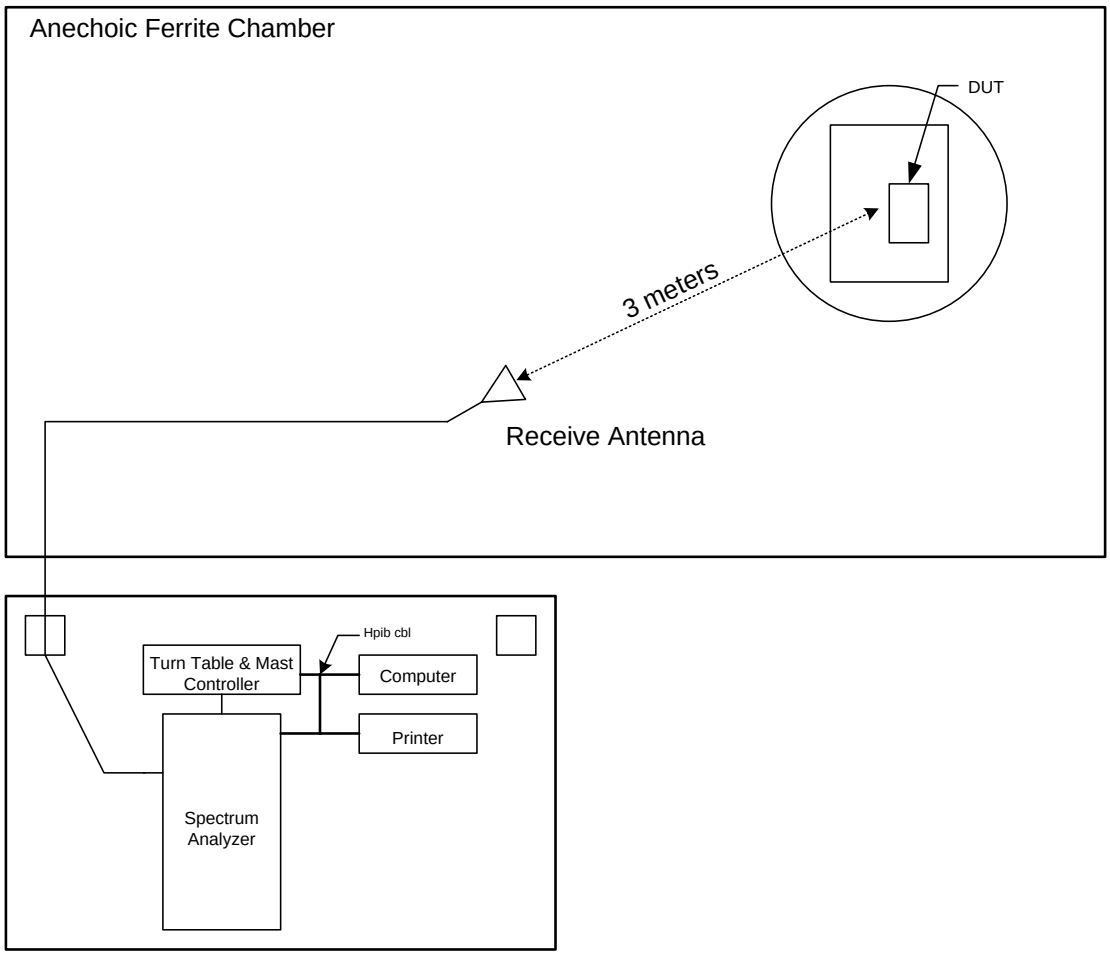
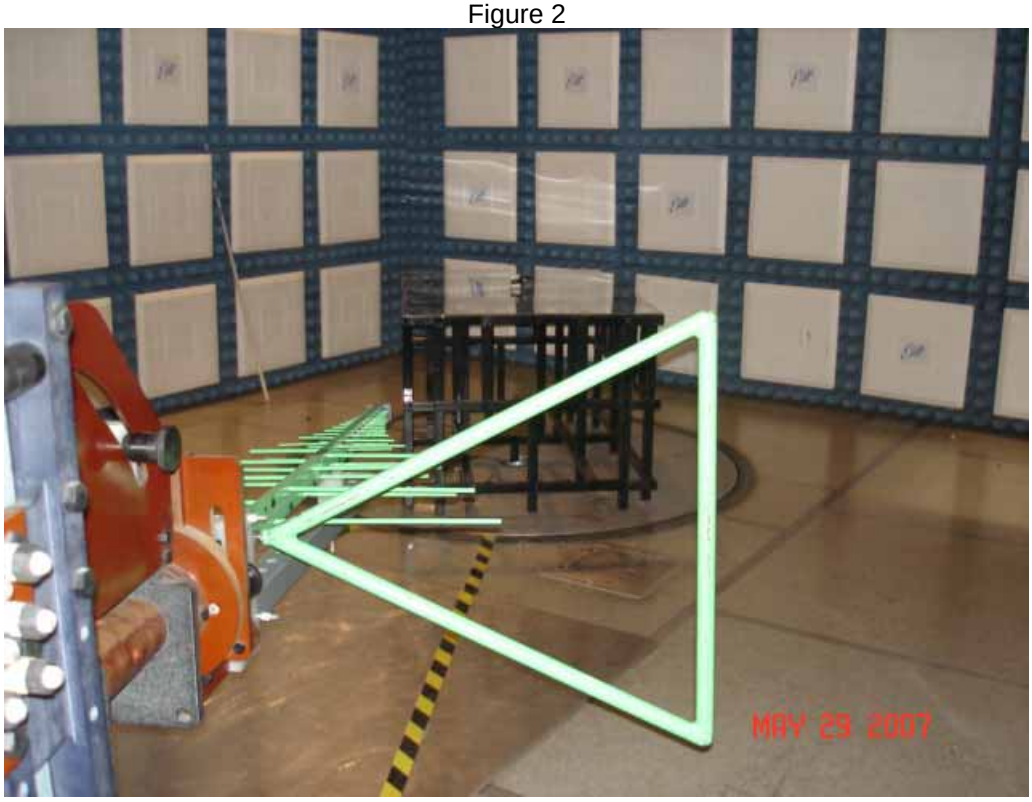
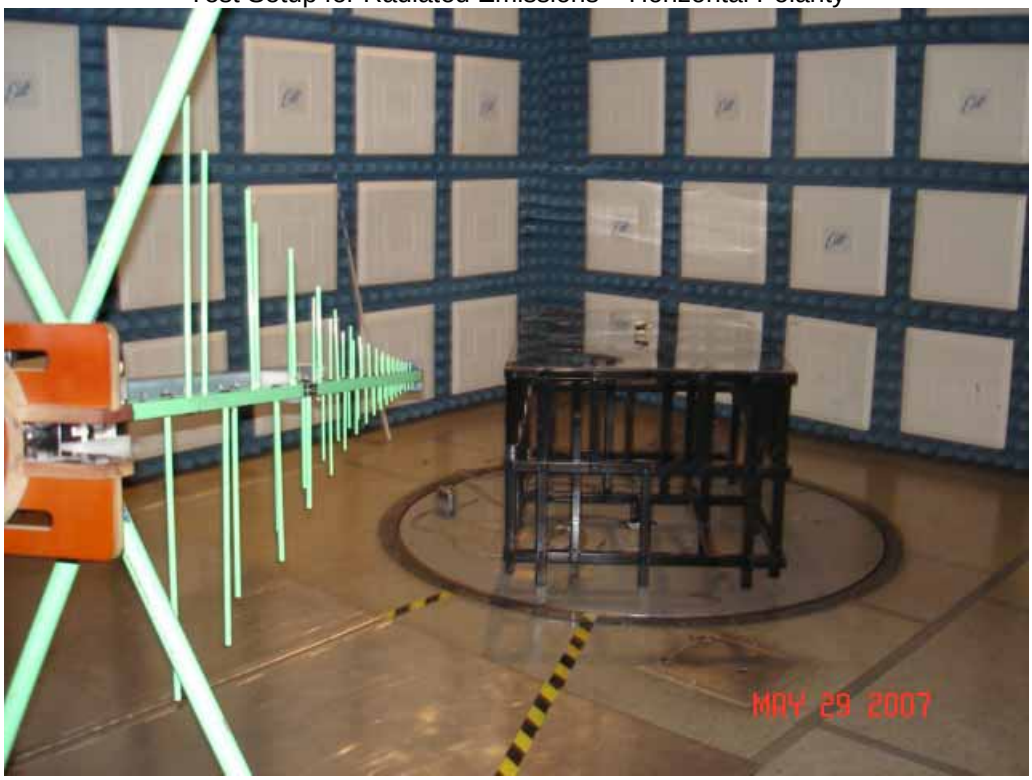


FIGURE 1 BLOCKDIAGRAM OF TEST SETUP

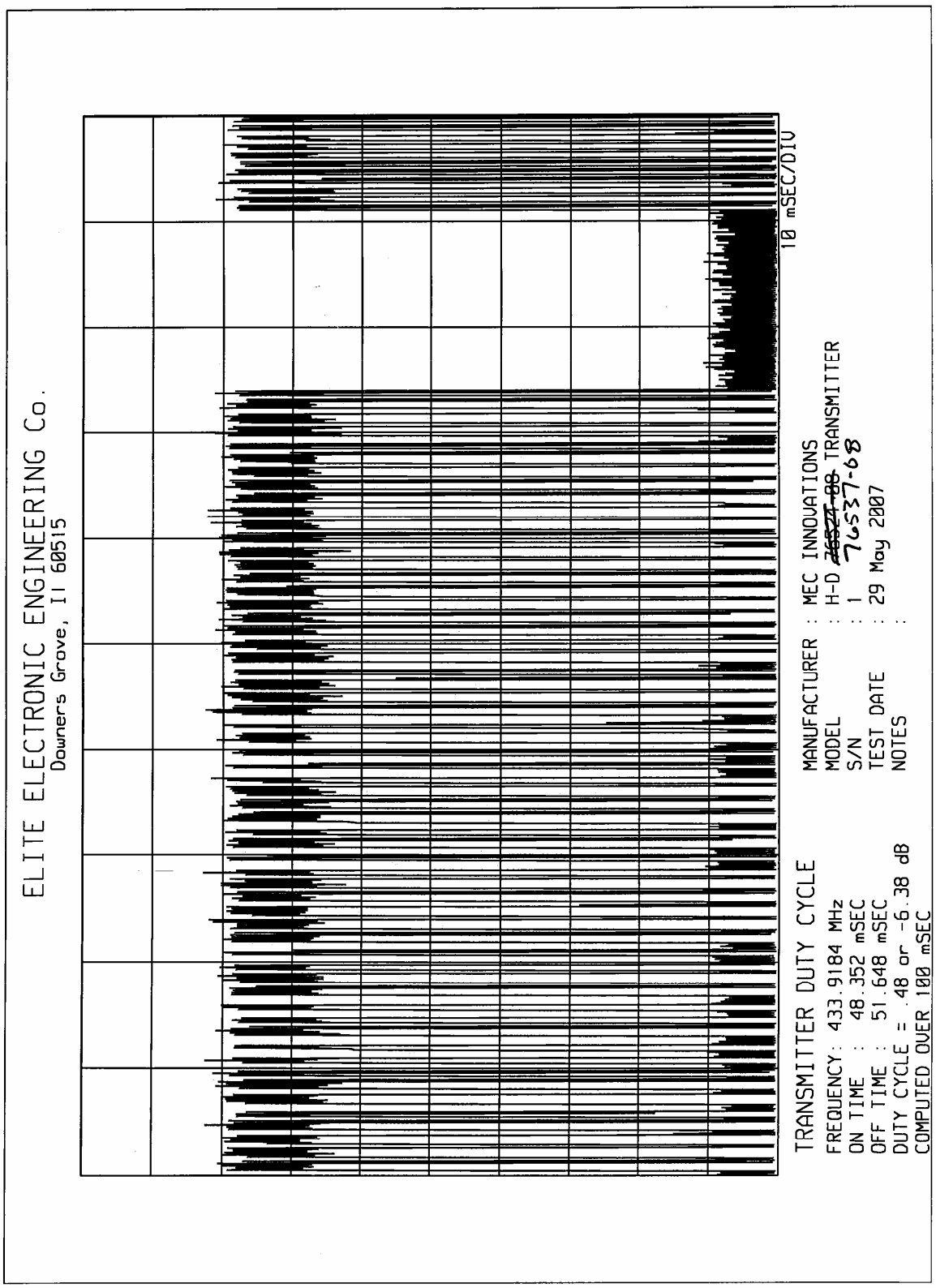
Figure 2

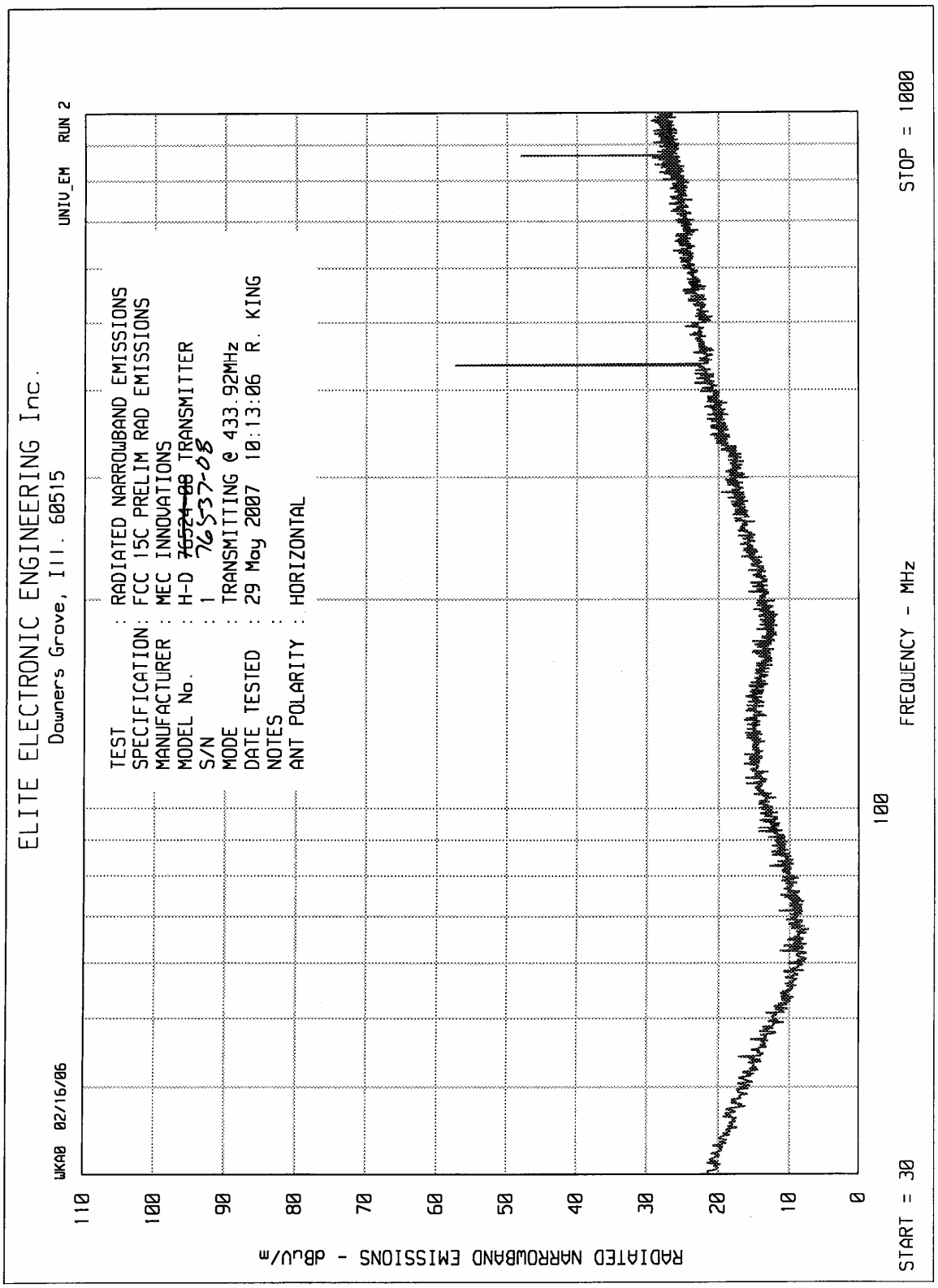


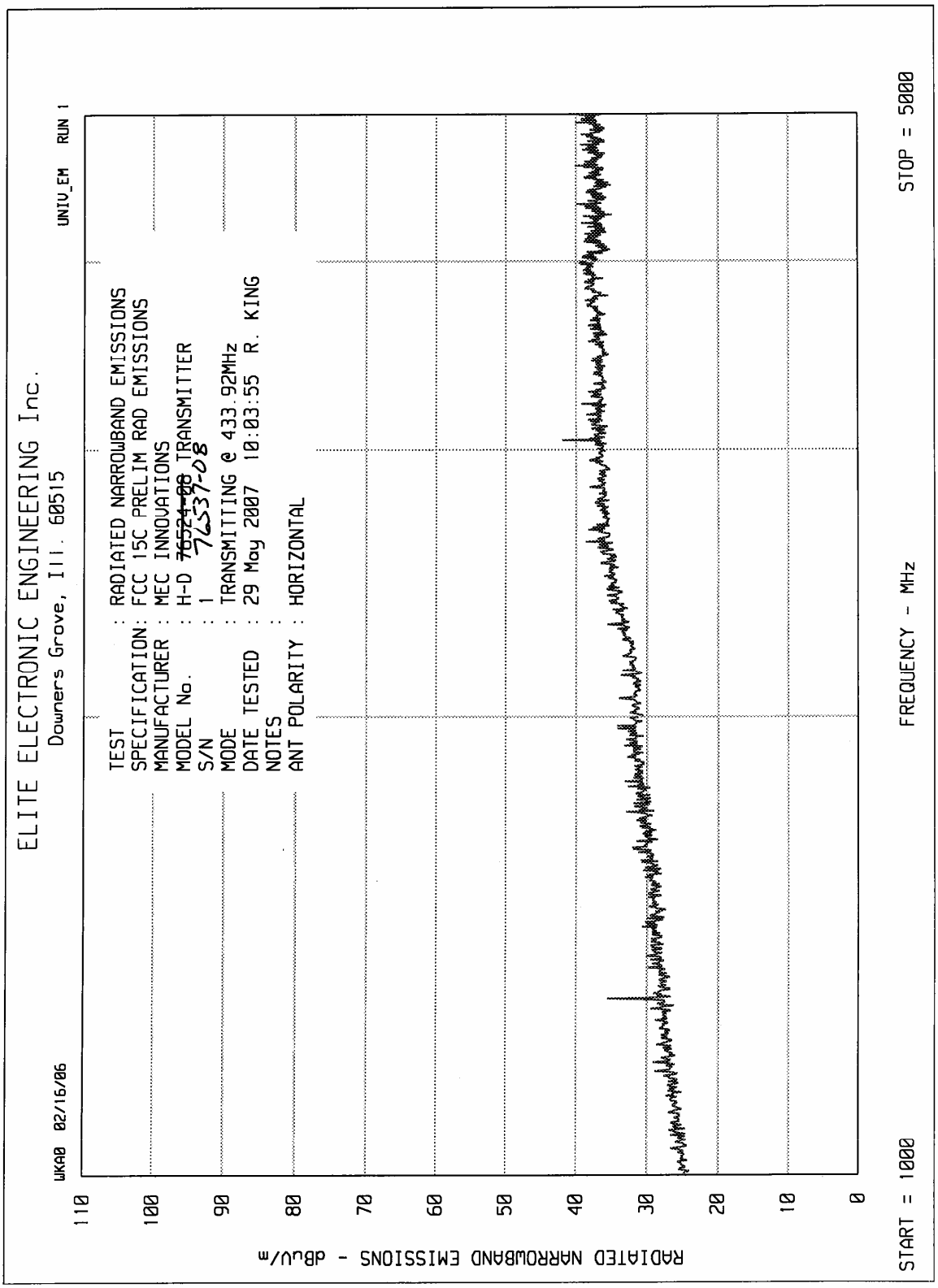
Test Setup for Radiated Emissions – Horizontal Polarity

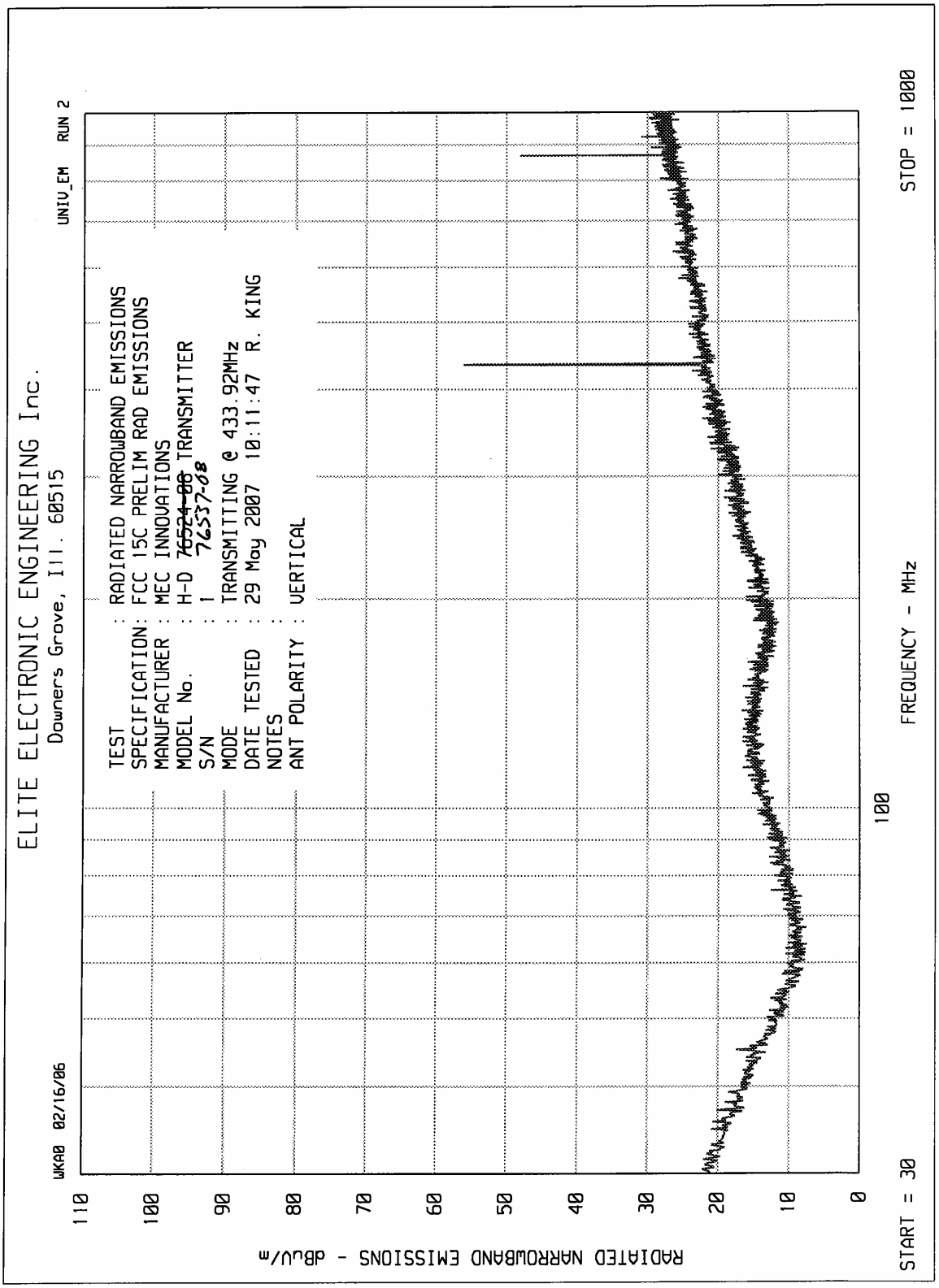


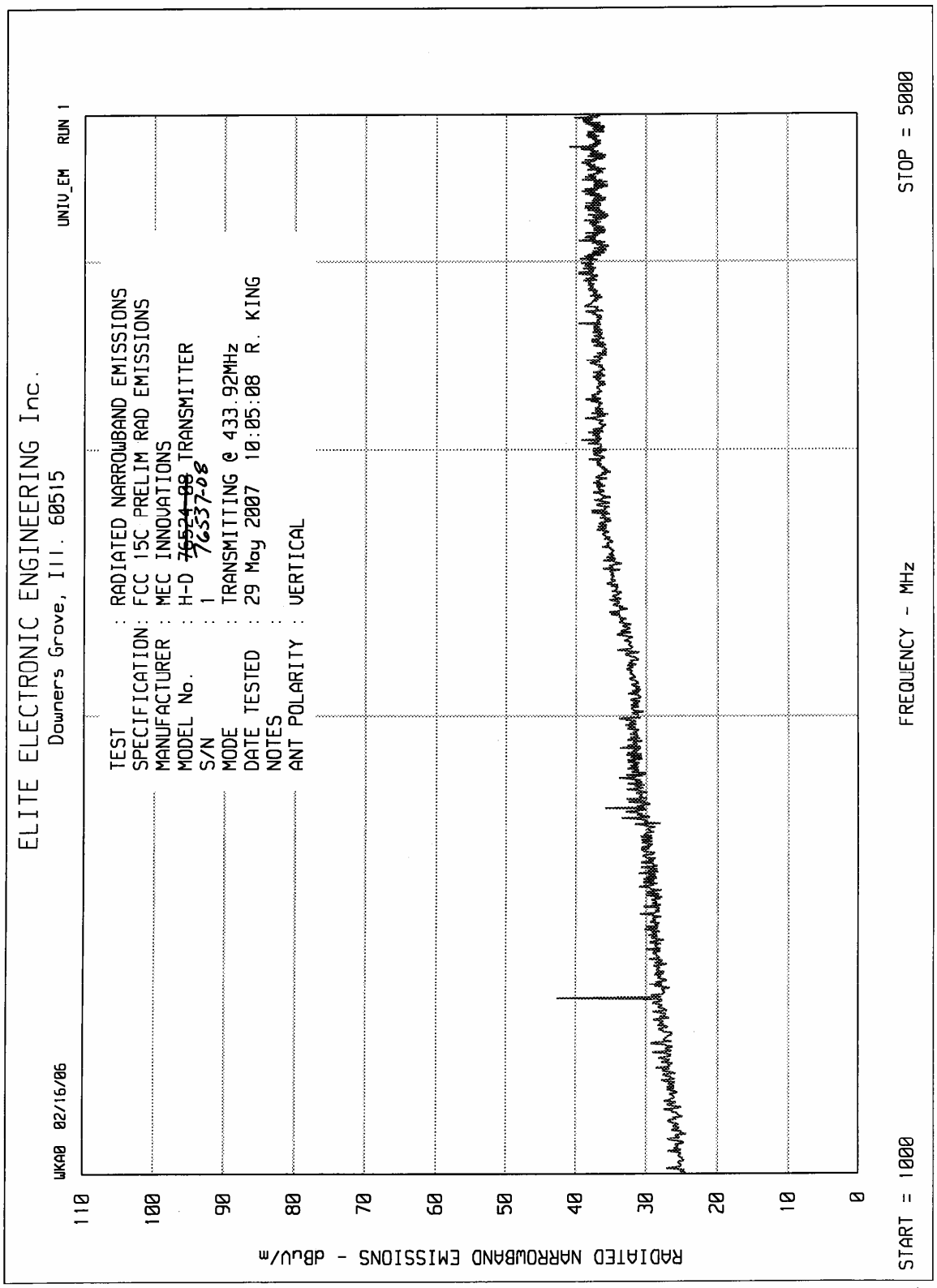
Test Setup for Radiated Emissions – Vertical Polarity


ELITE ELECTRONIC ENGINEERING Co.
Downers Grove, Il 60515
10 mSEC/DIV
TRANSMITTER DUTY CYCLE
FREQUENCY: 433.9184 MHz
ON TIME : 48.352 mSEC
OFF TIME : 51.648 mSEC
DUTY CYCLE = .48 or -6.38 dB
COMPUTED OVER 100 mSEC
MANUFACTURER : MEC INNOVATIONS
MODEL : H-D 26S24-08 TRANSMITTER
S/N : 1 76537-68
TEST DATE : 29 May 2007
NOTES :


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV_EM RUN 2
WKA0 02/16/06
TEST : RADIATED NARROWBAND EMISSIONS
SPECIFICATION: FCC 15C PRELIM RAD EMISSIONS
MANUFACTURER : MEC INNOVATIONS
MODEL No. : H-D 76524-08 76537-08 TRANSMITTER
S/N : 1
MODE : TRANSMITTING @ 433.92MHz
DATE TESTED : 29 May 2007 10:13:06 R. KING
NOTES :
ANT POLARITY : HORIZONTAL
RADIATED NARROWBAND EMISSIONS - dBuV/m
110
100
90
80
70
60
50
40
30
20
10
0
START = 30
100
FREQUENCY - MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV_EM RUN 1
WKA0 02/16/06
TEST : RADIATED NARROWBAND EMISSIONS
SPECIFICATION: FCC 15C PRELIM RAD EMISSIONS
MANUFACTURER : MEC INNOVATIONS
MODEL No. : H-D 76524-00 TRANSMITTER
7537-08
S/N : 1
MODE : TRANSMITTING @ 433.92MHz
DATE TESTED : 29 May 2007 10:03:55 R. KING
NOTES :
ANT POLARITY : HORIZONTAL
RADIATED NARROWBAND EMISSIONS - dBuV/m
110
100
90
80
70
60
50
40
30
20
10
0
START = 1000
FREQUENCY - MHz
STOP = 5000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV_EM RUN 2
WKA0 02/16/06
TEST : RADIATED NARROWBAND EMISSIONS
SPECIFICATION: FCC 15C PRELIM RAD EMISSIONS
MANUFACTURER : MEC INNOVATIONS
MODEL No. : H-D ~~76524-08~~ 76537-08 TRANSMITTER
S/N : 1
MODE : TRANSMITTING @ 433.92MHz
DATE TESTED : 29 May 2007 10:11:47 R. KING
NOTES : :
ANT POLARITY : VERTICAL
RADIATED NARROWBAND EMISSIONS - dBuV/m
110
100
90
80
70
60
50
40
30
20
10
0
START = 30
100
STOP = 1000
FREQUENCY - MHz

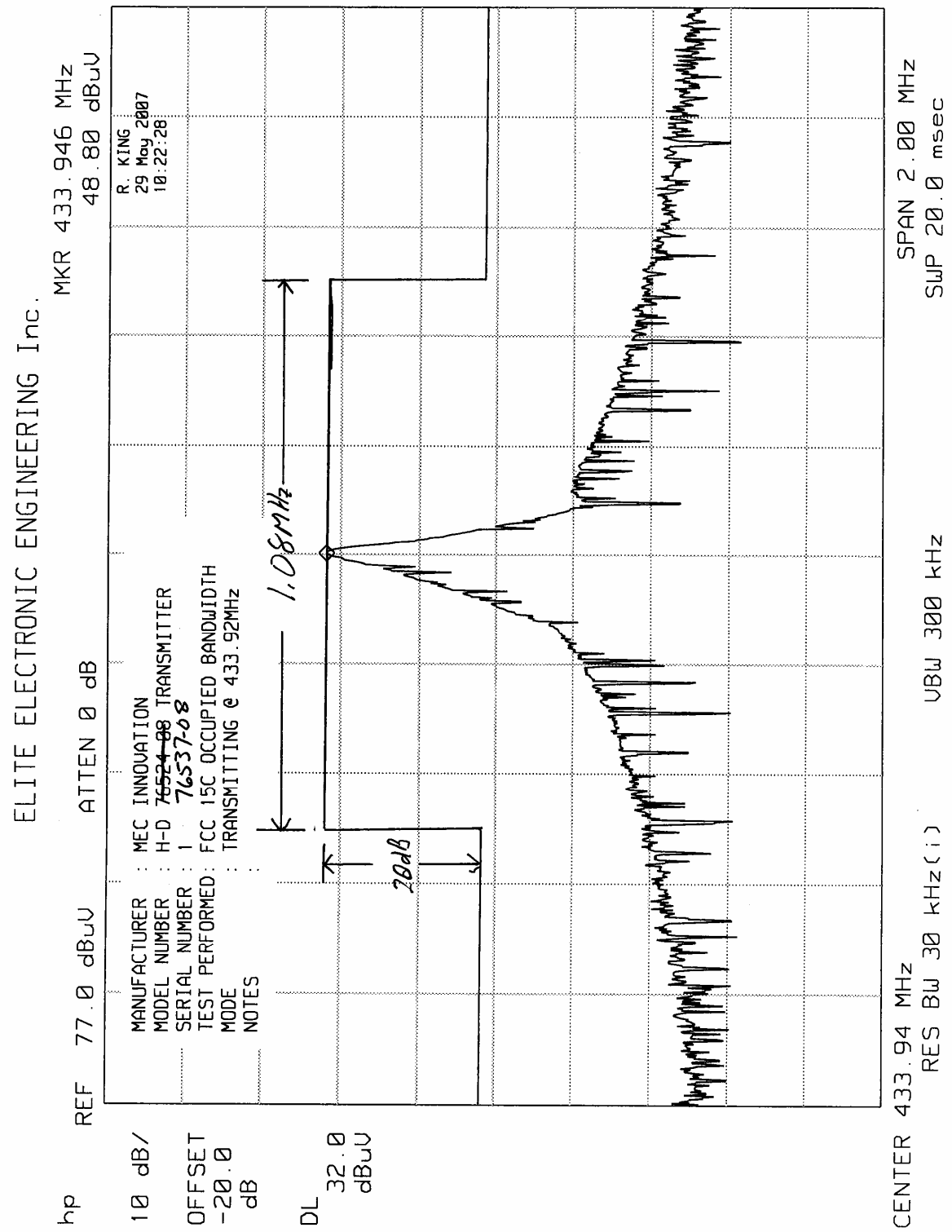

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV_EM RUN 1
WKA0 02/16/06
TEST : RADIATED NARROWBAND EMISSIONS
SPECIFICATION: FCC 15C PRELIM RAD EMISSIONS
MANUFACTURER : MEC INNOVATIONS
MODEL No. : H-D 76524-08 TRANSMITTER
S/N : 1 76537-08
MODE : TRANSMITTING @ 433.92MHz
DATE TESTED : 29 May 2007 10:05:08 R. KING
NOTES :
ANT POLARITY : VERTICAL
RADIATED NARROWBAND EMISSIONS - dBuV/m
110
100
90
80
70
60
50
40
30
20
10
0
START = 1000
FREQUENCY - MHz
STOP = 5000

MANUFACTURER : MEC Innovation
MODEL : H-D 76537-08
S/N : 1
SPECIFICATION : FCC-15C, Radiated Emissions
DATE : 29 May 2007
NOTES :
: TEST DISTANCE IS 3 METERS

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Duty Cycle (dB)	Total dBuV/m at 3 M	Total uV/m at 3M	Limit uV/m at 3M	Margin (dB)
433.92	H	49.3		1.5	17.6	0.0	-6.4	62.0	1262.3	10996.7	-18.8
433.92	V	36.7		1.5	17.6	0.0	-6.4	49.4	295.9	10996.7	-31.4
867.84	H	32.4		1.9	22.1	0.0	-6.4	50.0	317.8	1099.7	-10.8
867.84	V	23.7		1.9	22.1	0.0	-6.4	41.3	116.7	1099.7	-19.5
1301.76	H	51.0		2.4	26.4	-27.3	-6.4	46.1	201.5	500.0	-7.9
1301.76	V	49.1		2.4	26.4	-27.3	-6.4	44.2	161.9	500.0	-9.8
1735.68	H	46.4		2.8	27.7	-28.7	-6.4	41.8	123.6	1099.7	-19.0
1735.68	V	43.7		2.8	27.7	-28.7	-6.4	39.2	90.8	1099.7	-21.7
2169.60	H	43.1		0.4	29.4	-29.2	-6.4	37.4	73.8	1099.7	-23.5
2169.60	V	42.0		0.4	29.4	-29.2	-6.4	36.3	65.0	1099.7	-24.6
2603.52	H	42.5		0.4	31.0	-29.6	-6.4	38.0	79.1	1099.7	-22.9
2603.52	V	41.9	*	0.4	31.0	-29.6	-6.4	37.4	73.8	1099.7	-23.5
3037.44	H	43.4		0.5	32.3	-29.8	-6.4	40.0	100.0	1099.7	-20.8
3037.44	V	41.1		0.5	32.3	-29.8	-6.4	37.7	76.7	1099.7	-23.1
3471.36	H	39.5	*	3.3	32.3	-30.1	-6.4	38.7	85.6	1099.7	-22.2
3471.36	V	39.5	*	3.3	32.3	-30.1	-6.4	38.7	85.6	1099.7	-22.2
3905.28	H	39.4	*	1.2	32.9	-30.0	-6.4	37.1	72.0	500.0	-16.8
3905.28	V	39.9	*	1.2	32.9	-30.0	-6.4	37.6	76.2	500.0	-16.3
4339.20	H	41.8	*	1.2	32.9	-29.3	-6.4	40.2	102.1	500.0	-13.8
4339.20	V	40.3	*	1.2	32.9	-29.3	-6.4	38.7	85.9	500.0	-15.3

Richard E. King

CHECKED BY: _____
REK


ELITE ELECTRONIC ENGINEERING Inc.
hp
REF 77.0 dBuV
ATTEN 0 dB
MKR 433.946 MHz
48.80 dBuV
10 dB/
OFFSET
-20.0
dB
DL
32.0
dBuV
MANUFACTURER : MEC INNOVATION
MODEL NUMBER : H-D ~~76524-08~~ TRANSMITTER
SERIAL NUMBER : 1 7637-08
TEST PERFORMED: FCC 15C OCCUPIED BANDWIDTH
MODE : TRANSMITTING @ 433.92MHz
NOTES :
R. KING
29 May 2007
10:22:28
1.08MHz
20dB
CENTER 433.94 MHz
RES BW 30 kHz(i)
VBW 300 kHz
SPAN 2.00 MHz
SWP 20.0 msec