Measurement of RF Interference from a Model 1A6346 Transmitter

For : Chamberlain Manufacturing
Elmhurst, IL

P.O. No. : 852444
Date Received : April 19, 2006
Dates Tested : April 19 through May 2, 2006
Test Personnel : Daniel E. Crowder, NARTE® Certified EMC Test Engineer, ATL-0152-E
Specification : FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C

Test Report By : Daniel E. Crowder

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REVISION HISTORY

Revision	Date	Description
—	5/18/2006	Initial release

Measurement of RF Emissions from a Model 1A6346 Transmitter

1.0 INTRODUCTION:

1.1 Description of Test Item - This document represents the results of the series of radio interference measurements performed on a model 1A6346 Transmitter, (hereinafter referred to as the test item). No serial number was assigned to the test item. The test item was designed to transmit at approximately 315MHz using an internal antenna. The test item was manufactured and submitted for testing by Chamberlain Manufacturing located in Elmhurst, IL.

1.2 Purpose - The test series was performed to determine if the test item meets the conducted and radiated RF emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections 15.207 and 15.231 for Intentional Radiators. 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 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 2005
- 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"

1.5 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.

1.6 Laboratory Conditions The temperature at the time of the test was 23°C and the relative humidity was 32%.

2.0 TEST ITEM SET-UP AND OPERATION:

The test item is a Model 1A6346 transmitter. A block diagram of the test item set-up is shown as Figure 1.

2.1 Power Input - The test item obtained power from an internal battery.

2.2 Grounding - The test item was ungrounded during the test.

2.3 Peripheral Equipment - The test item no ports for peripheral equipment.

2.4 Interconnect Cables - The test item no ports for interconnect cables.

2.5 Operational Mode - For all tests the test item was placed on an 80cm high non-conductive stand. The test item was energized and set to transmit continuously at approximately 315MHz.

2.6 Test Item Modifications - Modifications were made to the test item and were documented by Chamberlain Manufacturing personnel.

3.0 TEST EQUIPMENT:

3.1 Test Equipment List - A list of the test equipment used can be found on Table I. All equipment was calibrated per the instruction manuals supplied by the manufacturer.

3.2 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).

3.3 Measurement Uncertainty - All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system.

The measurement uncertainty for these tests is presented below:

Conducted Emission Measurements		
Combined Standard Uncertainty	1.07	-1.07
Expanded Uncertainty (95% confidence)	2.1	-2.1

Radiated Emission Measurements		
Combined Standard Uncertainty	2.26	-2.18
Expanded Uncertainty (95% confidence)	4.5	-4.4

4.0 REQUIREMENTS, PROCEDURES AND RESULTS:

4.1 Powerline Conducted Emissions

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

4.2 Duty Cycle Factor Measurements:

4.2.1 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).

4.2.2 Results: A representative plot of the duty cycle is shown on data page 12. Since the transmitter uses a rolling code, the duty cycle correction factor used was calculated based on the average case. The following average case information was supplied by Chamberlain Manufacturing:

An average ON time is used because of the ever changing rolling code.

For 100 msec period:

1msec average sync pulse (50% of the time the sync pulse is 0.5msec and 50% of the time the sync pulse is 1.5msec)

20 digits for a total time of 40 msec, but only half of them are ON (oscillator running) for an average of 20 msec.

59msec average blanktime

The total is 100msec.

20 log 21/100 = -13.5

With the test item transmitting at 315MHz, the average case duty cycle correction factor would be -13.5dB.

4.3 Radiated Measurements

4.3.1 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 315MHz, the limit at the fundamental is 6041.7uV/m @ 3m and the limit on the harmonics is 604.2uV/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.

4.3.2 Procedures - Open field measurements were performed in a 32ft. x 20ft. x 14ft. high shielded enclosure. The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall. The powerline filters prevent extraneous signals from entering the enclosure on these leads.

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

The final open field emission tests were then manually performed over the frequency range of 30MHz to 4.0GHz. Between 30MHz and 1000MHz, a tuned dipole 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.

4.3.3 Results - The preliminary plots, with the test item transmitting at 315MHz, are presented on data pages 14 and 15. The plots are presented for a reference only, and are not used to determine compliance.

The final open area radiated levels, with the test item transmitting at 315MHz, are presented on data page 16. 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 315.0MHz. The emissions level at this frequency was 4.9dB within the limit. See data page 16 for details. Photographs of the test configuration which yielded the highest or worst case radiated emission levels are shown on Figure 2.

4.4 Occupied Bandwidth Measurements

4.4.1 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.

4.4.2 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

4.4.3 Results - The plot of the emissions near the fundamental frequency are presented on data page 17. As can be seen from this data page, the transmitter met the occupied bandwidth requirements. In addition, the 99% emission bandwidth measured 214kHz when using the analyzer's special function key.

5.0 CONCLUSIONS:

With modifications made to the test item by Chamberlain Manufacturing personnel, it was

determined that the Chamberlain Manufacturing Model 1A6346, 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.

6.0 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.

7.0 ENDORSEMENT DISCLAIMER:

This report must not be used to claim product endorsement by NVLAP or any agency of the US Government.

TABLE I: TEST 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								
XZG3	ATTENUATOR/SWITCH DRIVER	HEWLETT PACKARD	11713A	2421A03059	---		N/A	
Equipment Type: AMPLIFIERS								
APK3	PREAMPLIFIER	AGILENT TECHNOL	8449B	3158A01593	1-26.5GHZ	06/03/05	12	06/03/06
Equipment Type: ANTENNAS								
NDP1	TUNED DIPOLE ANTENNA	EMCO	3121C-DB3	313	140-400MHZ	03/10/06	12	03/10/07
NDQ1	TUNED DIPOLE ANTENNA	EMCO	3121C-DB4	313	400-1000MHZ	03/10/06	12	03/10/07
NTA0	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL611	2057	0.03-2GHZ	08/15/05	12	08/15/06
NWF0	RIDGED WAVE GUIDE	EMCO	3105	2035	1-12.4GHZ	10/01/05	12	10/01/06
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	3638A08770	100HZ-22GHZ	02/10/06	12	02/10/07
RACD	RF PRESELECTOR	HEWLETT PACKARD	85685A	3010A01205	20HZ-2GHZ	12/23/05	12	12/23/06
RAF4	QUASIPEAK ADAPTER	HEWLETT PACKARD	85650A	2043A00320	0.01-1000MHZ	02/10/06	12	02/10/07
RAKG	RF SECTION	HEWLETT PACKARD	85462A	3549A00284	0.009-6500MHZ	11/22/05	12	11/22/06
RAKH	RF FILTER SECTION	HEWLETT PACKARD	85460A	3448A00324	---	11/22/05	12	11/22/06

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.

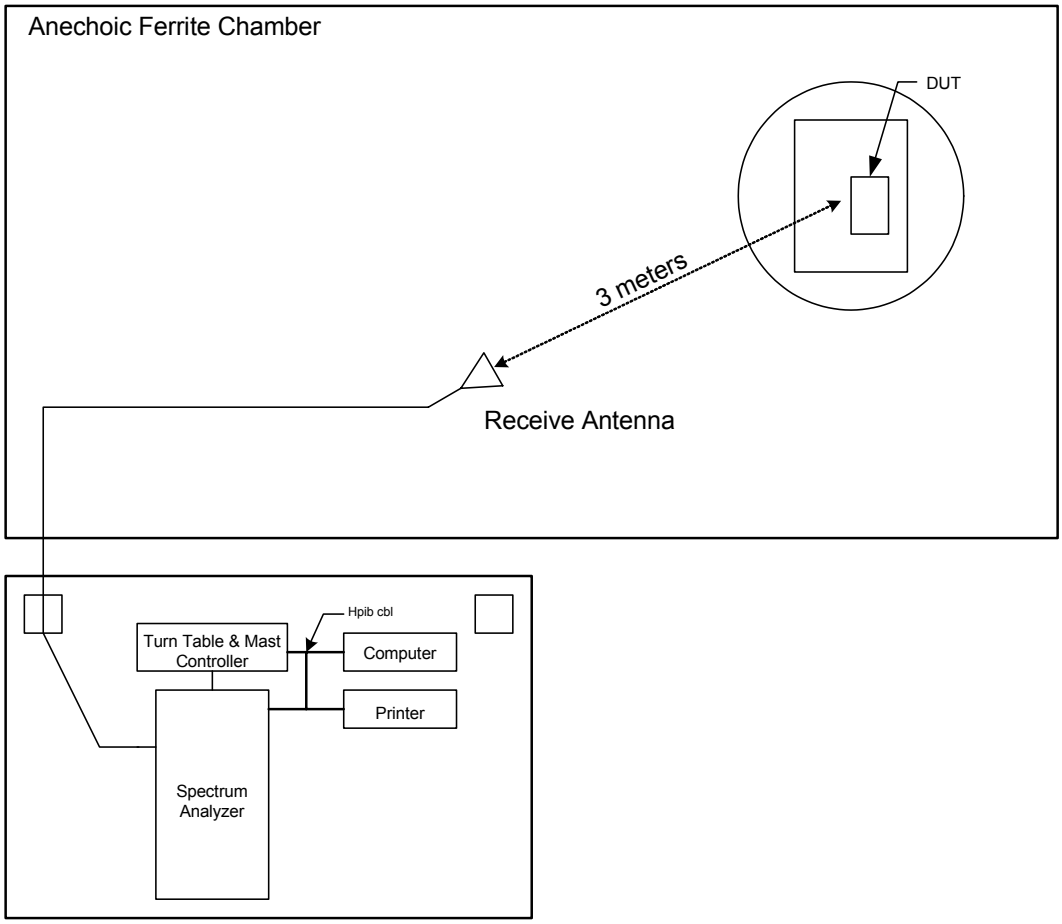
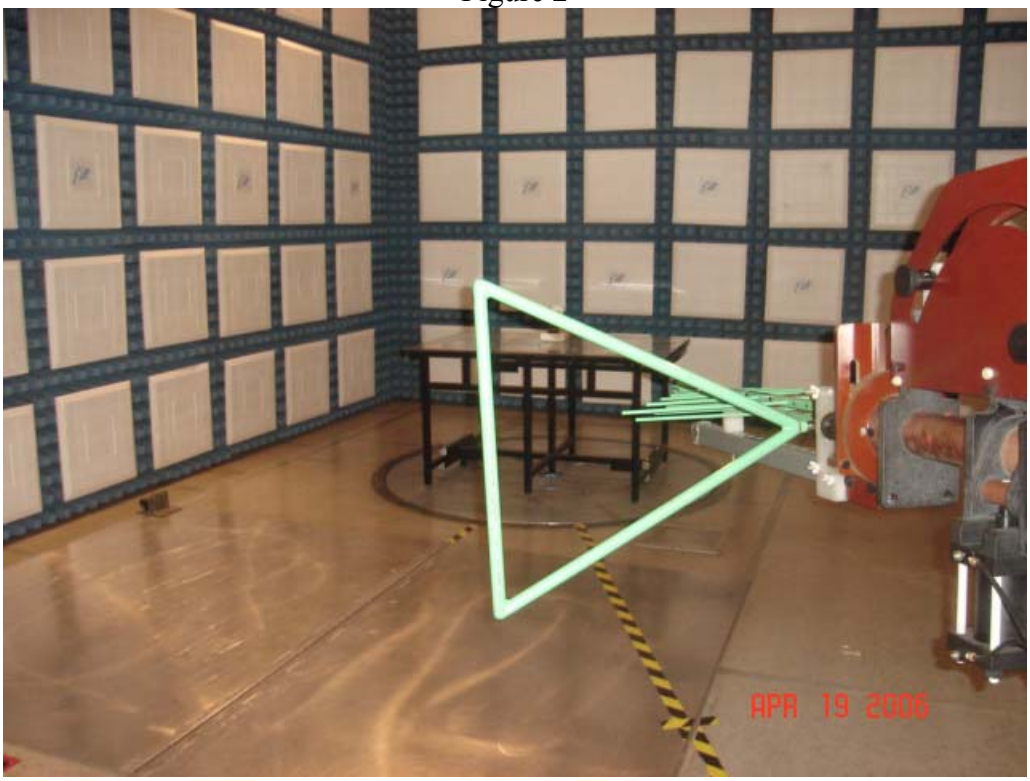


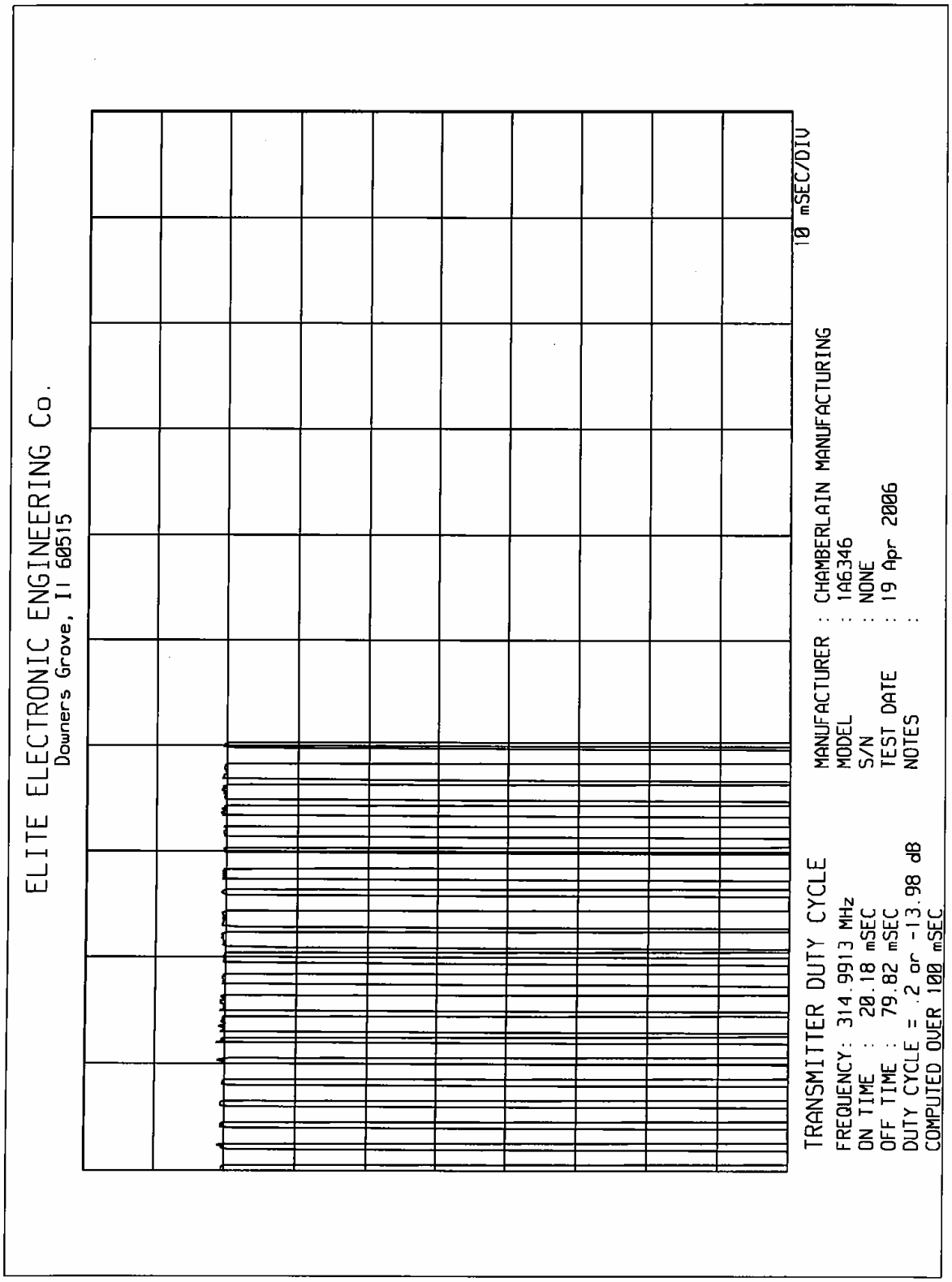
FIGURE 1 BLOCKDIAGRAM OF TEST SETUP

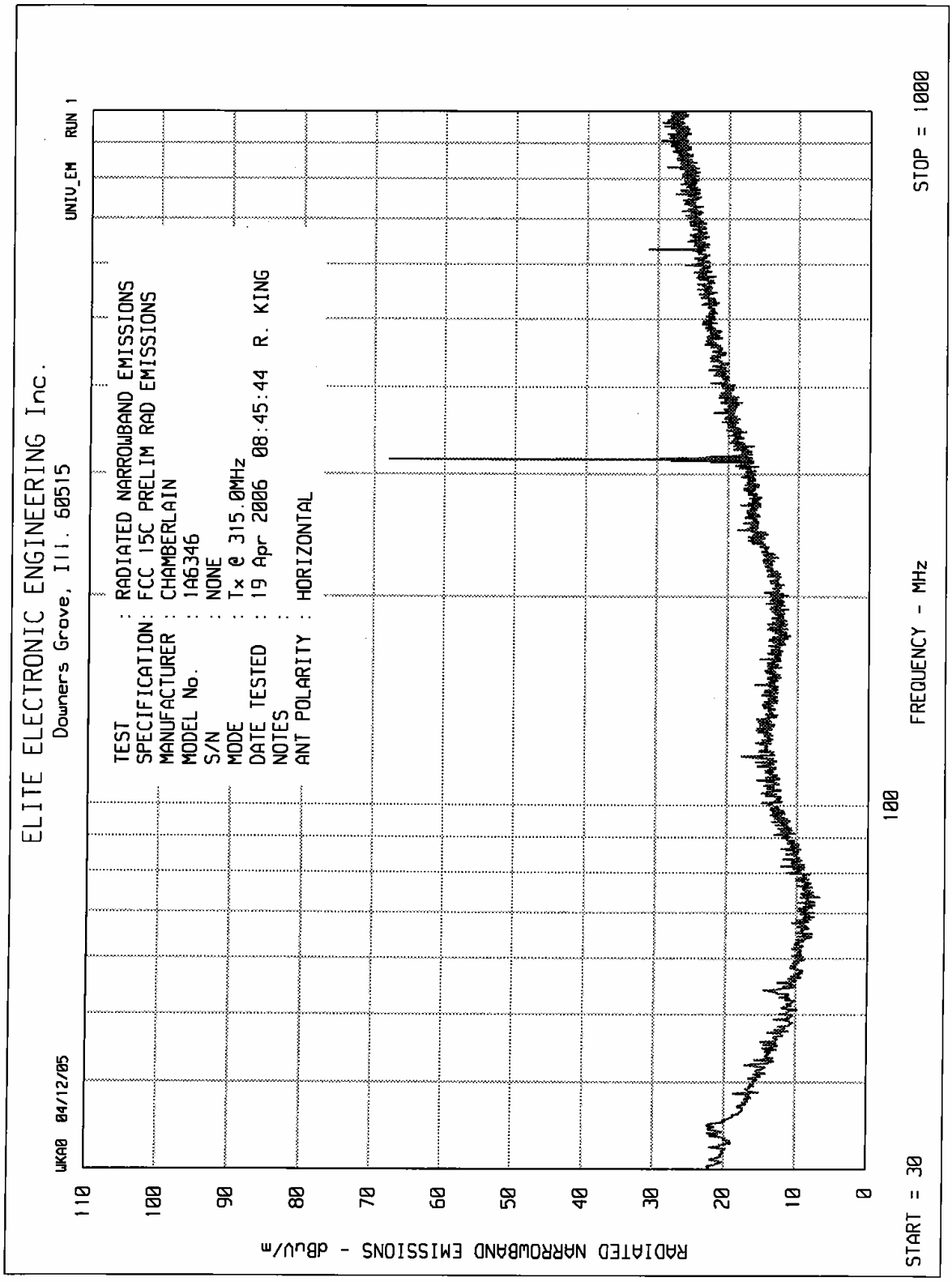
Figure 2

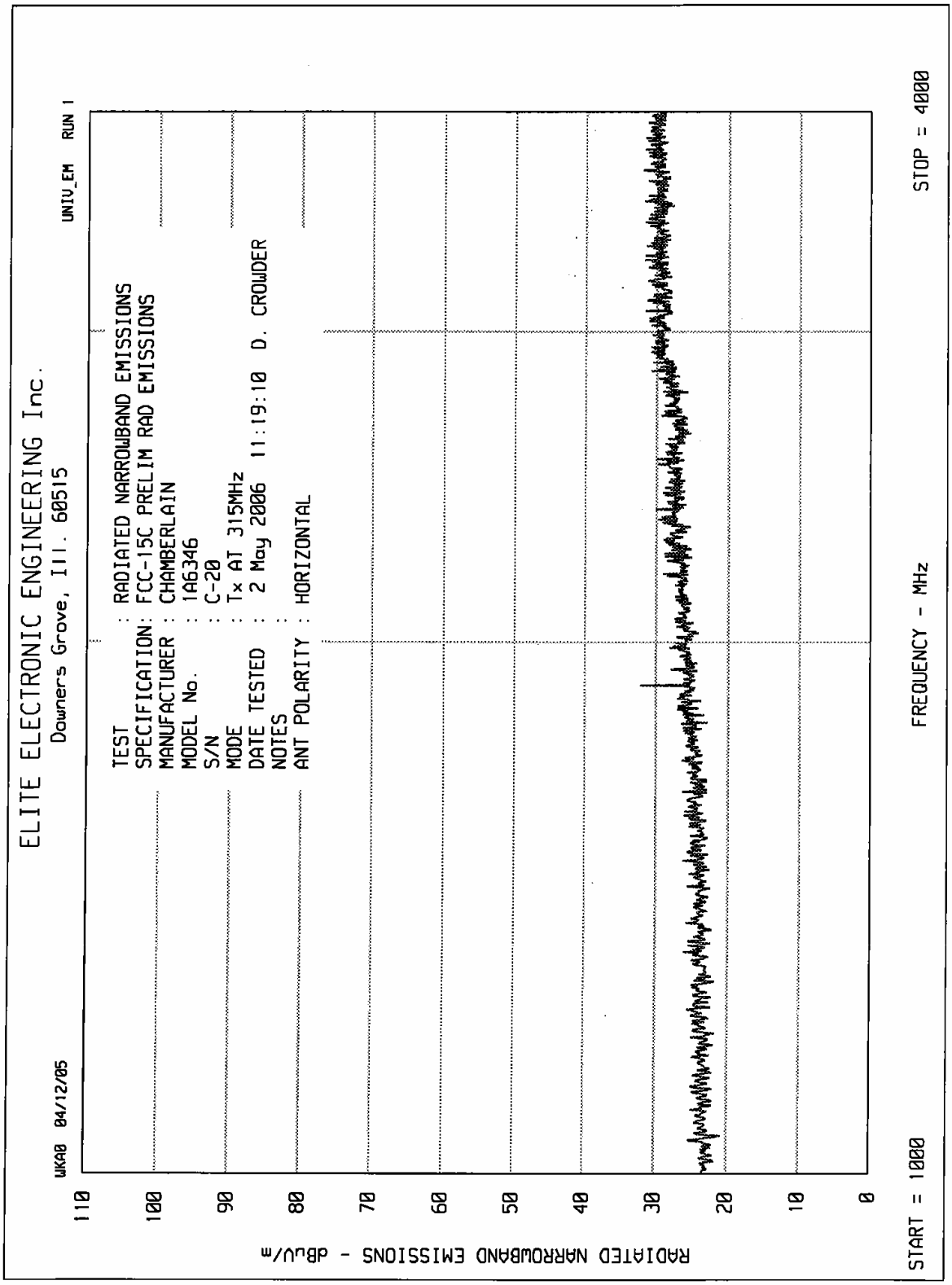


Test Set-up for Radiated Emissions – Horizontal Polarization

Test Set-up for Radiated Emissions – Vertical Polarization


ELITE ELECTRONIC ENGINEERING Co.
Downers Grove, Il 60515
10 mSEC/DIV
TRANSMITTER DUTY CYCLE
FREQUENCY: 314.9913 MHz
ON TIME : 20.18 mSEC
OFF TIME : 79.82 mSEC
DUTY CYCLE = .2 or -13.98 dB
COMPUTED OVER 100 mSEC
MANUFACTURER : CHAMBERLAIN MANUFACTURING
MODEL : 1A6346
S/N : NONE
TEST DATE : 19 Apr 2006
NOTES :

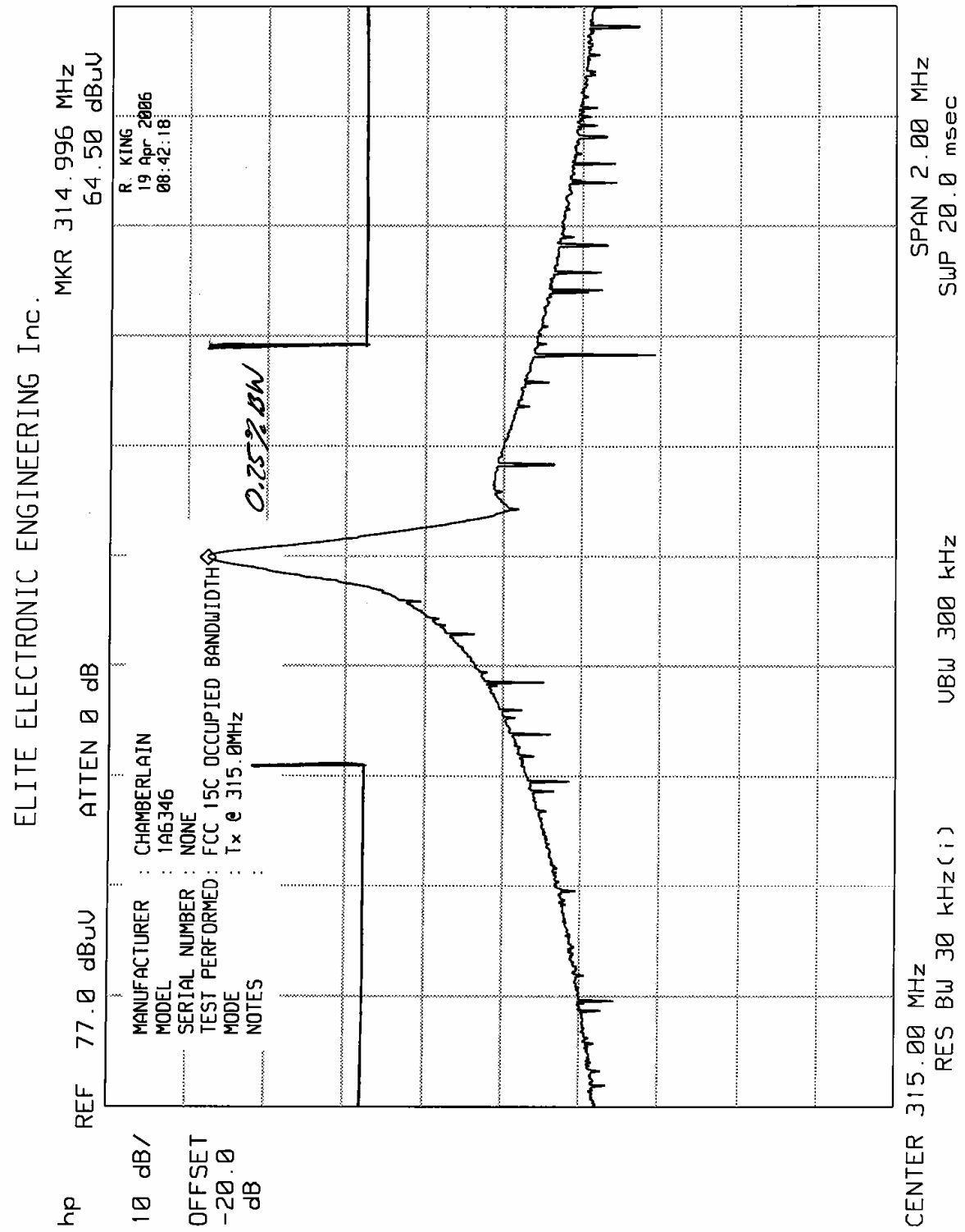

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV_EM RUN 1
WKA0 04/12/05
TEST : RADIATED NARROWBAND EMISSIONS
SPECIFICATION: FCC 15C PRELIM RAD EMISSIONS
MANUFACTURER : CHAMBERLAIN
MODEL No. : 1A6346
S/N : NONE
MODE : Tx @ 315.0MHz
DATE TESTED : 19 Apr 2006 08:45:44 R. KING
NOTES :
ANT 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 04/12/05
TEST : RADIATED NARROWBAND EMISSIONS
SPECIFICATION: FCC-15C PRELIM RAD EMISSIONS
MANUFACTURER : CHAMBERLAIN
MODEL No. : 1A6346
S/N : C-20
MODE : Tx AT 315MHz
DATE TESTED : 2 May 2006 11:19:10 D. CROWDER
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 = 4000

MANUFACTURER : Chamberlain
TEST ITEM : Transmitter
MODEL NO. : 1A6346
SERIAL NO. : None Assigned
SPECIFICATION : FCC-15.231
TEST EQUIPMENT : See Table I
MODE : Transmit at 315MHz
DATE : May 2, 2006
NOTES : Test Distance is 3 meters

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	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)	Antenna Height (cm)
315.0	H	62.2	1.3	14.1	0.0	-13.5	64.1	1608.4	6041.7	-11.5	278.0
315.0	V	68.8	1.3	14.1	0.0	-13.5	70.7	3438.6	6041.7	-4.9	246
630.0	H	18.3	1.7	19.7	0.0	-13.5	26.2	20.5	500.0	-27.7	225
630.0	V	26.6	1.7	19.7	0.0	-13.5	34.5	53.4	500.0	-19.4	315
945.0	H	8.0	2.0	22.8	0.0	-13.5	19.3	9.2	500.0	-34.7	125
945.0	V	15.6	2.0	22.8	0.0	-13.5	26.9	22.1	500.0	-27.1	181
1260.0	H	61.2	2.3	25.0	-35.0	-13.5	40.1	100.6	500.0	-13.9	110
1260.0	V	53.2	2.3	25.0	-35.0	-13.5	32.1	40.1	500.0	-21.9	100
1575.0	H	52.8	2.7	26.0	-34.6	-13.5	33.3	46.3	500.0	-20.7	131
1575.0	V	56.3	2.7	26.0	-34.6	-13.5	36.8	69.3	500.0	-17.2	140
1890.0	H	61.3	2.9	27.6	-34.5	-13.5	43.8	155.2	500.0	-10.2	171
1890.0	V	55.2	2.9	27.6	-34.5	-13.5	37.7	76.9	500.0	-16.3	162
2205.0	H	55.3	3.2	28.5	-34.4	-13.5	39.2	90.9	500.0	-14.8	181
2205.0	V	48.6	3.2	28.5	-34.4	-13.5	32.5	42.0	500.0	-21.5	128
2520.0	H	43.7	3.6	29.2	-34.4	-13.5	28.6	26.9	500.0	-25.4	254
2520.0	V	45.5	3.6	29.2	-34.4	-13.5	30.4	33.1	500.0	-23.6	120
2835.0	H	44.2	3.9	30.2	-34.5	-13.5	30.2	32.4	500.0	-23.8	120
2835.0	V	43.6	3.9	30.2	-34.5	-13.5	29.6	30.2	500.0	-24.4	120
3150.0	H	41.5	4.1	31.0	-34.6	-13.5	28.5	26.6	500.0	-25.5	137
3150.0	V	42.3	4.1	31.0	-34.6	-13.5	29.3	29.2	500.0	-24.7	120

CHECKED BY:


ELITE ELECTRONIC ENGINEERING Inc.
MKR 314.996 MHz
64.50 dBuV
R. KING
19 Apr 2006
08:42:18
hp
REF 77.0 dBuV
ATTEN 0 dB
10 dB/
OFFSET
-20.0
dB
MANUFACTURER : CHAMBERLAIN
MODEL : 1A6346
SERIAL NUMBER : NONE
TEST PERFORMED: FCC 15C OCCUPIED BANDWIDTH
MODE : Tx @ 315.0MHz
NOTES :
0.25% ON
CENTER 315.00 MHz
RES BW 30 kHz(i)
VBW 300 kHz
SPAN 2.00 MHz
SWP 20.0 msec