Measurement of RF Interference from a Model 001A6183-1 Keypad Transmitter

For : Chamberlain Manufacturing
: Elmhurst, IL 60126

P.O. No. : 851545
Date Received : February 8, 2005
Date Tested : February 10, 2005
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 :

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Approved By :

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Measurement of RF Emissions from a Model 001A6183-1 Keypad Transmitter

1.0 INTRODUCTION:

1.1 Description of Test Item - This document presents the results of the series of radio interference measurements performed on a model 001A6183-1 Keypad Transmitter, (hereinafter referred to as the test item). No serial number was assigned to the test item. The test item is a transmitter designed to transmit at approximately 390MHz 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 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 2003
- 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 Subcontractor 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 21ºC and the relative humidity was 17%.

2.0 TEST ITEM SETUP AND OPERATION:

The test item is a model 001A6183-1 Keypad transmitter. A block diagram of the test item setup is shown as Figure 1.

2.1 Power Input - The test item was powered with 3VDC from two each 1.5VDC batteries.

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

2.3 Peripheral Equipment - There was no peripheral equipment submitted with the test item.

2.4 Interconnect Cables - There were no interconnect cables submitted with the test item.

2.5 Operational Mode - For all tests, the test item was placed on an 80cm high non-conductive stand. The transmit button of the test item was held down during testing thereby setting the unit to transmit continuously. The transmitting mechanism automatically deactivated when the transmit button was released. The battery voltage was periodically checked to ensure proper operation. The test was performed with the test item transmitting at 390.0MHz.

2.6 Test Item Modifications - No modifications were required for compliance to the FCC Part 15C requirements.

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.

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 were performed.

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 11. 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 40msec, but only half of them are ON (oscillator running) for an average of 20msec

59msec average blanktime

The total is 100msec

20 log 21/100 = -13.5

With the test item transmitting at 390MHz, 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 390.0MHz, the limit at the fundamental is 9166.7uV/m @ 3m and the limit for the harmonics is 916.7uV/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.

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 390MHz, are presented on pages 12 and 13. 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 390.0MHz, are presented on page 14. 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 390.0MHz. The emissions level at this frequency was 5.1dB within the limit. 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 frequencies is presented on page 15. As can be seen from the data page, the transmitter met the occupied bandwidth requirements.

5.0 CONCLUSIONS:

It was determined that the Chamberlain Manufacturing 001A6183-1 Keypad Transmitter, did fully meet the 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								
XZG1	ATTENUATOR/SWITCH DRIVER	HEWLETT PACKARD	11713A	3439A02724	---		N/A	
Equipment Type: AMPLIFIERS								
APK1	PRE-AMPLIFIER	HEWLETT PACKARD	8449B	3008A01243	1-26.5GHZ	02/04/04	12	02/04/05
Equipment Type: ANTENNAS								
NDP1	TUNED DIPOLE ANTENNA	EMCO	3121C-DB3	313	140-400MHZ	02/19/04	12	02/19/05
NDQ1	TUNED DIPOLE ANTENNA	EMCO	3121C-DB4	313	400-1000MHZ	02/19/04	12	02/19/05
NTA0	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL611	2057	0.03-2GHZ	07/12/04	12	07/12/05
NWH0	RIDGED WAVE GUIDE	TENSOR	4105	2081	1-12.4GHZ	09/05/04	12	09/05/05
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	C3900A	USHB061052	---		N/A	
Equipment Type: RECEIVERS								
RACC	RF PRESELECTOR	HEWLETT PACKARD	85685A	2648A00507	20HZ-2GHZ	02/04/04	12	02/04/05
RAE5	SPECTRUM ANALYZER	HEWLETT PACKARD	85660B	2532A02136	100HZ-22GHZ	02/04/04	12	02/04/05
RAKG	RF SECTION	HEWLETT PACKARD	85462A	3549A00284	0.009-6500MHZ	03/22/04	12	03/22/05
RAKH	RF FILTER SECTION	HEWLETT PACKARD	85460A	3448A00324	---	03/22/04	12	03/22/05

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.

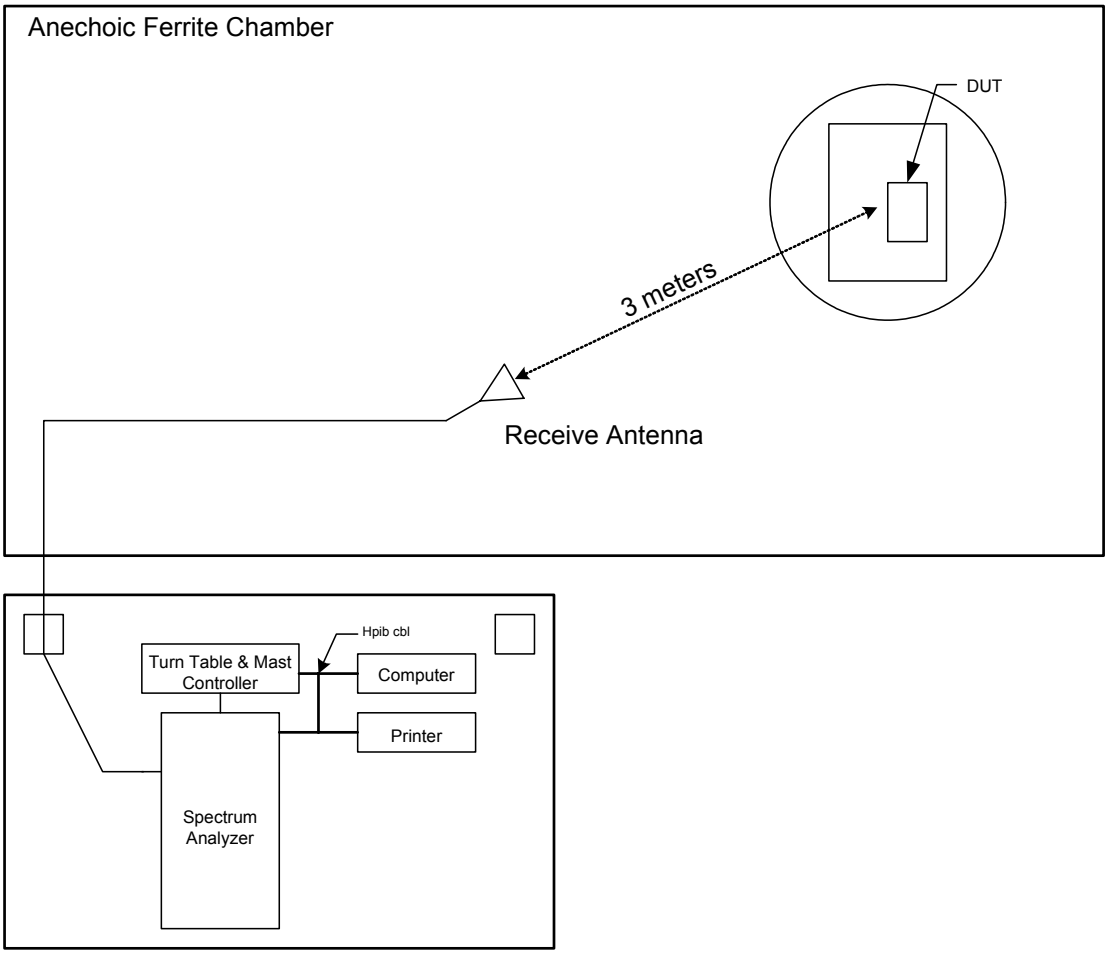
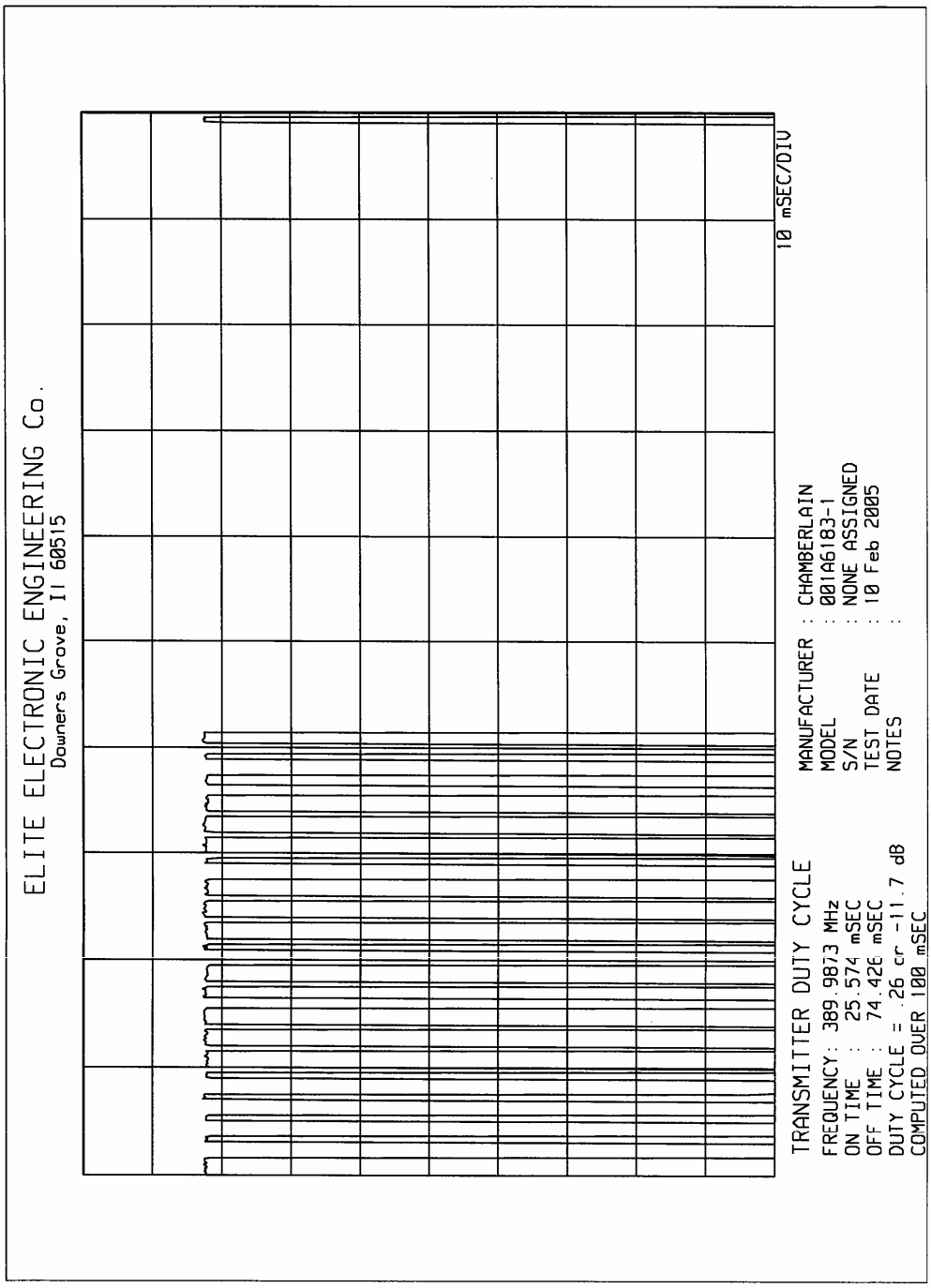


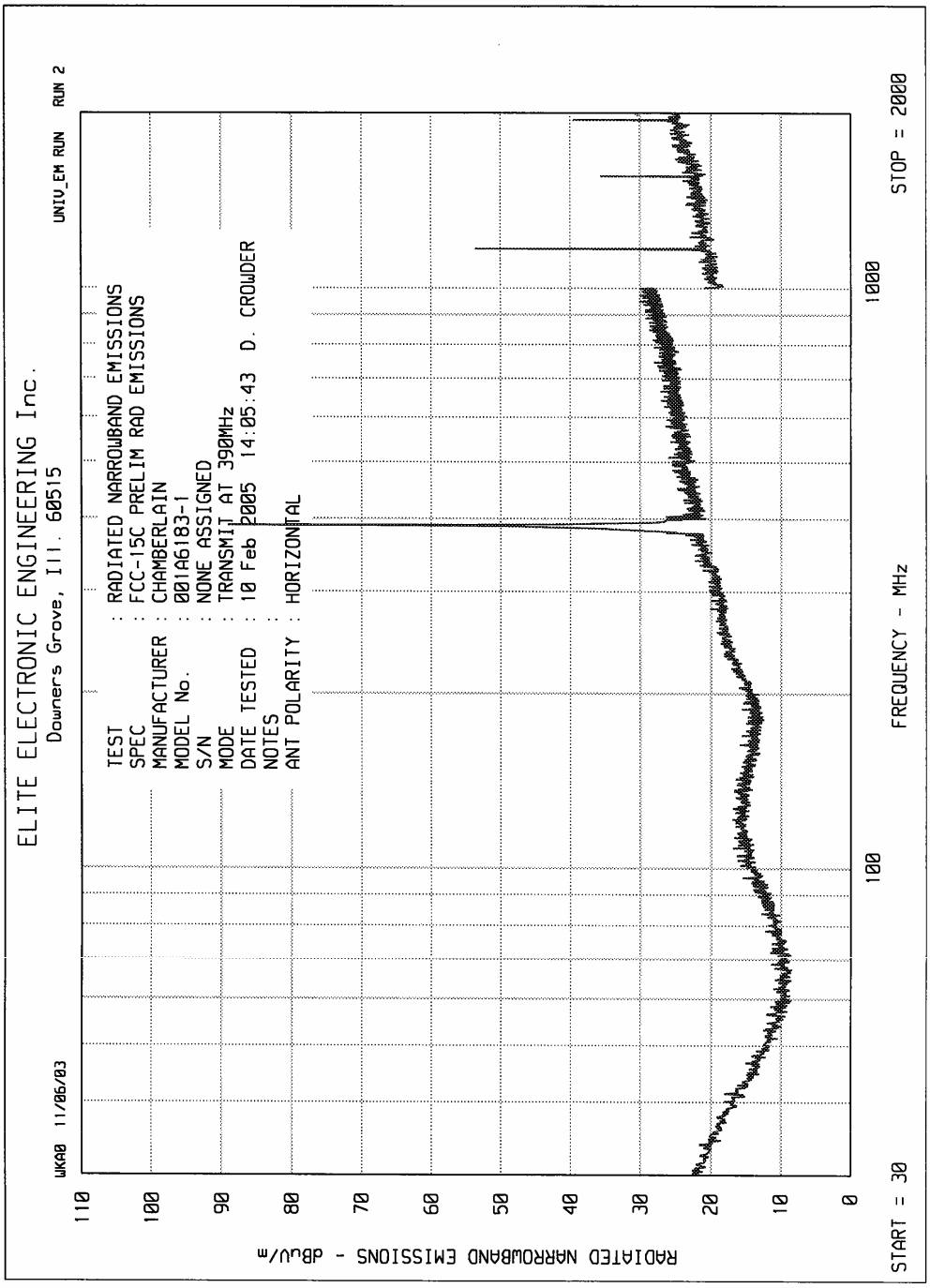
FIGURE 1 BLOCKDIAGRAM OF TEST SETUP

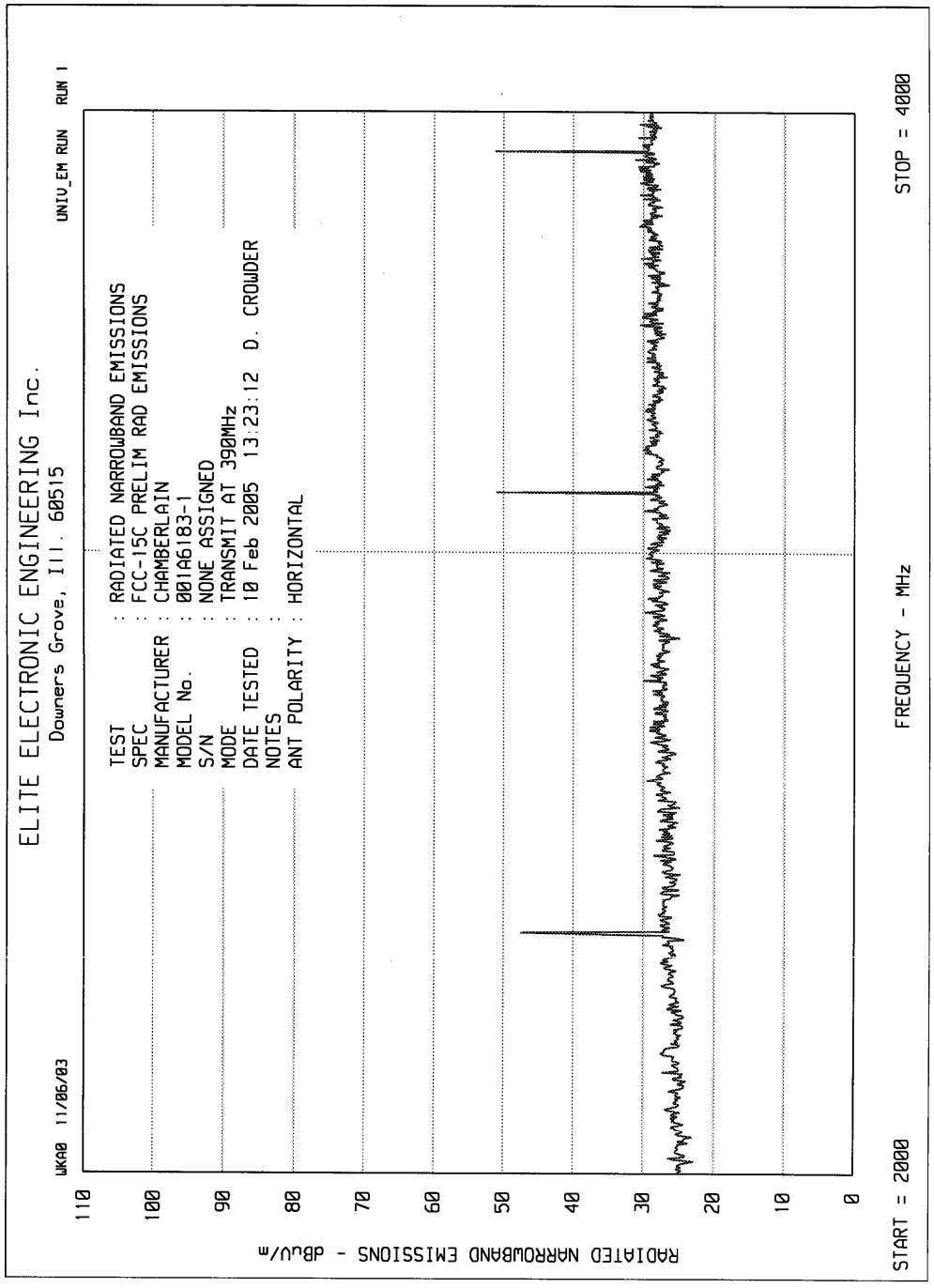
Figure 2

Test Setup for Highest Radiated Emissions Measurement
Horizontal Polarity

Test Setup for Highest Radiated Emissions Measurement
Vertical Polarity


ELITE ELECTRONIC ENGINEERING Co.
Downers Grove, Il 60515
10 mSEC/DIV
TRANSMITTER DUTY CYCLE
FREQUENCY: 389.9873 MHz
ON TIME : 25.574 mSEC
OFF TIME : 74.426 mSEC
DUTY CYCLE = .26 or -11.7 dB
COMPUTED OVER 100 mSEC
MANUFACTURER : CHAMBERLAIN
MODEL : 001A6183-1
S/N : NONE ASSIGNED
TEST DATE : 10 Feb 2005
NOTES :


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV_EM RUN RUN 2
WKA0 11/06/03
TEST : RADIATED NARROWBAND EMISSIONS
SPEC : FCC-15C PRELIM RAD EMISSIONS
MANUFACTURER : CHAMBERLAIN
MODEL No. : 001A6183-1
S/N : NONE ASSIGNED
MODE : TRANSMIT AT 390MHz
DATE TESTED : 10 Feb 2005 14:05:43 D. CROWDER
NOTES : :
ANT POLARITY : HORIZONTAL
RADIATED NARROWBAND EMISSIONS - dBuV/m
110
100
90
80
70
60
50
40
30
20
10
0
START = 30
100
1000
STOP = 2000
FREQUENCY - MHz


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV_EM RUN RUN 1
WKA0 11/06/03
TEST : RADIATED NARROWBAND EMISSIONS
SPEC : FCC-15C PRELIM RAD EMISSIONS
MANUFACTURER : CHAMBERLAIN
MODEL No. : 001A6183-1
S/N : NONE ASSIGNED
MODE : TRANSMIT AT 390MHz
DATE TESTED : 10 Feb 2005 13:23:12 D. CROWDER
NOTES :
ANT POLARITY : HORIZONTAL
RADIATED NARROWBAND EMISSIONS - dBuV/m
110
100
90
80
70
60
50
40
30
20
10
0
START = 2000
FREQUENCY - MHz
STOP = 4000

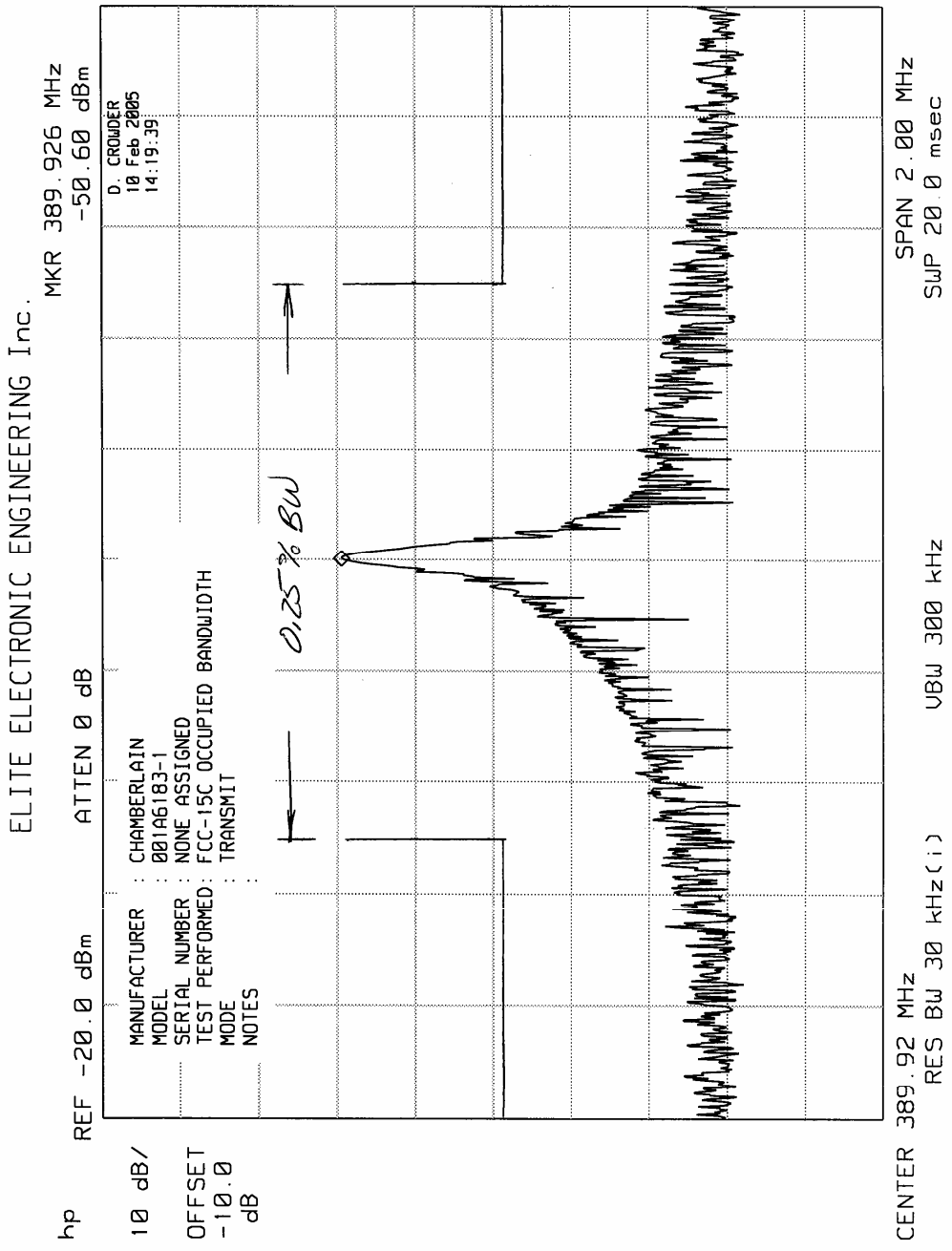
ETR No.
DATA PAGE

SPECIFICATION : FCC PART 15C TRANSMITTER OPEN FIELD DATA
MANUFACTURER : CHAMBERLAIN
MODEL : 001A6183-1
S/N : NONE ASSIGNED
TEST DATE : 10 Feb 2005
NOTES :
TEST ANTENNA : ROBERTS DIPOLE & DRWG ANTENNAS

FREQUENCY MHz	ANT POL	MTR RDG dBuV	CBL FAC dB	ANT FAC dB	DUTY CYCLE dB	TOTAL dBuV/m @3m	TOTAL uV/m @3m	LIMIT uV/m @3m	NOTES
390.00	H	65.7	1.5	20.4	-13.5	74.1	5059.3	9166.7	
390.00	V	64.6	1.5	20.4	-13.5	73.0	4457.5	9166.7	
780.00	H	22.3	1.9	26.4	-13.5	37.1	71.3	916.7	
780.00	V	17.5	1.9	26.4	-13.5	32.3	41.0	916.7	
1170.00	H	30.1	2.2	26.2	-13.5	45.0	178.6	500.0	*
1170.00	V	29.1	2.2	26.2	-13.5	44.0	159.2	500.0	*
1560.00	H	27.1	2.6	27.0	-13.5	43.2	145.0	500.0	*
1560.00	V	28.1	2.6	27.0	-13.5	44.2	162.7	500.0	*
1950.00	H	24.3	3.0	28.6	-13.5	42.4	131.5	916.7	
1950.00	V	16.8	3.0	28.6	-13.5	34.9	55.5	916.7	
2340.00	H	18.9	3.4	30.1	-13.5	38.9	87.6	500.0	*
2340.00	V	17.3	3.4	30.1	-13.5	37.3	72.9	500.0	*
2730.00	H	20.1	3.8	31.4	-13.5	41.8	122.9	500.0	*
2730.00	V	22.1	3.8	31.4	-13.5	43.8	154.7	500.0	*
3120.00	H	13.6	4.1	32.3	-13.5	36.5	66.7	916.7	
3120.00	V	16.4	4.1	32.3	-13.5	39.3	92.0	916.7	
3510.00	H	9.1	4.3	32.3	-13.5	32.2	40.8	916.7	
3510.00	V	10.7	4.3	32.3	-13.5	33.8	49.1	916.7	
3900.00	H	24.5	4.5	32.9	-13.5	48.4	262.4	500.0	*
3900.00	V	23.8	4.5	32.9	-13.5	47.7	242.1	500.0	*

* DENOTES A FREQUENCY CONFLICT WITH RESTRICTED BANDS

checked by: _____
D. CROWDER


ELITE ELECTRONIC ENGINEERING Inc.
hp
REF -20.0 dBm
ATTEN 0 dB
MKR 389.926 MHz
-50.60 dBm
10 dB/
OFFSET
-10.0
dB
MANUFACTURER : CHAMBERLAIN
MODEL : 001A6183-1
SERIAL NUMBER : NONE ASSIGNED
TEST PERFORMED: FCC-15C OCCUPIED BANDWIDTH
MODE : TRANSMIT
NOTES :
D. CROWDER
10 Feb 2005
14:19:39
0.25% BW
CENTER 389.92 MHz
RES BW 30 kHz(i)
VBW 300 kHz
SPAN 2.00 MHz
SWP 20.0 msec