Measurement of RF Interference from a Transmitter, Model 1A6210

For : Chamberlain Manufacturing
845 Larch Avenue
Elmhurst, IL 60126

P.O. No. : 851834
Date Received : June 22, 2005
Date Tested : June 22, 2005
Test Personnel : Richard E. King
Specification : FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C

Test Report By : Richard E. King

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EMC Engineer

Approved By : Craig W. Fanning

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NARTE Certified: ATL-0188-E & EMC-000296-NT

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Measurement of RF Emissions from a Transmitter Model 1A6210

1.0 INTRODUCTION:

1.1 Description of Test Item - This document represents the results of the series of radio interference measurements performed on a Transmitter, Model No.1A6210, no serial number was assigned, (hereinafter referred to as the test item). The test item was 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, Sections 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 2004

- 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 23.2°C and the relative humidity was 44%.

2.0 TEST ITEM SET-UP AND OPERATION:

The test item is a Transmitter, Part No.1A6210. A block diagram of the test item set-up is shown as Figure 1.

2.1 Power Input - The test item obtained 120VAC through a six foot length of extension cord.

2.2 Grounding - Since the test item was powered with 120VAC, it was grounded through the return lead during the tests.

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

2.4 Interconnect Cables - No interconnect cables were used or submitted with the test item:

2.5 Operational Mode - For all tests the test item and all peripheral equipment were 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 390MHz.

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.

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

4.0 REQUIREMENTS, PROCEDURES AND RESULTS:

4.1 Power line Conducted Emissions -

4.1.1 Requirements – All radio frequency voltages on the power lines for any frequency or frequencies of an intentional radiator shall not exceed the limits in the following table:

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 to 56*	56 to 46*
0.5 - 5	56	46
5 - 30	60	50

4.1.2 Procedures - The interference on each power lead was measured by connecting the measuring equipment to the appropriate meter terminal of the LISN. The meter terminal of the LISN not under test was terminated with 50 ohm. Measurements were first made over the entire frequency range from 150kHz through 30MHz with a peak detector and the results were automatically plotted. The data thus obtained was then searched by the computer for the highest levels. Quasi-peak measurements were automatically performed at the frequencies selected from the highest peak measurements, and the results printed.

4.1.3 Results - The plots of the peak preliminary conducted voltage levels on each power line are presented on pages 14 and 15. The conducted limit for intentional radiators is shown as a reference. The final quasi-peak results are presented on pages 16 and 17.

The emissions level closest to the limit (worst case) occurred at 308 kHz. The emissions level at this frequency was 25 dB within the limit. Photographs of the test configuration which yielded the highest or worst case, conducted emission levels are shown on Figure 2.

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 13. 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 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 390MHz, the limit at the fundamental is 9166.7uV/m @ 3m and the limit on 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 power lines and signal lines entering the enclosure pass through filters on the enclosure wall. The power line 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 data pages 18 and 19. 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 390MHz, are presented on data page 20. 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 2730MHz. The

emissions level at this frequency was 5.5dB within the limit. See data page 20 for details. Photographs of the radiated emission test setup are shown on Figure 3.

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 21. As can be seen from this data page, the transmitter met the occupied bandwidth requirements. The 99% emission bandwidth measurement was 240 kHz.

5.0 CONCLUSIONS:

It was determined that the Chamberlain Manufacturing Transmitter, Part No. 1A6210, no serial number assigned, 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:

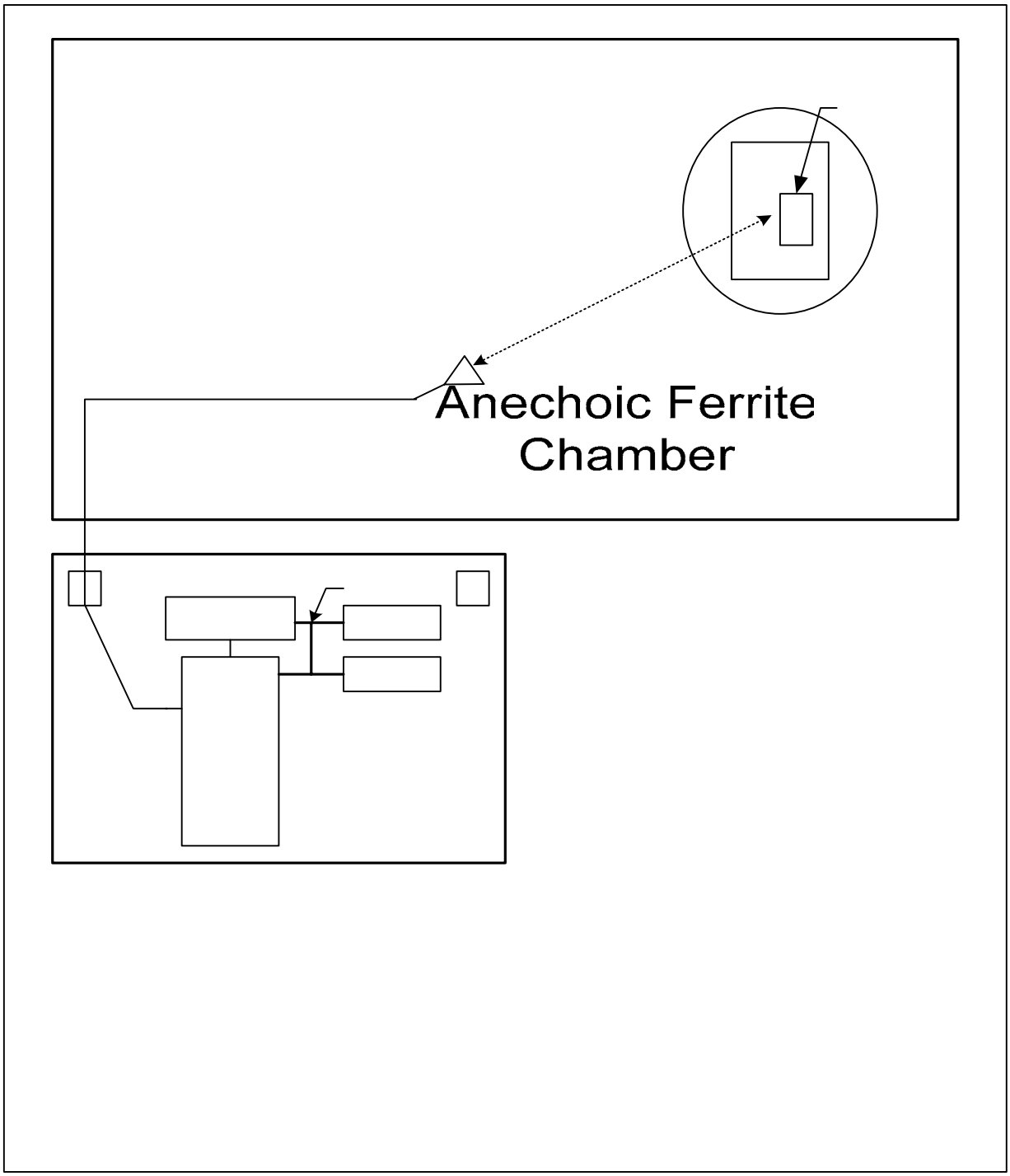
This report must not be used to claim product endorsement by NVLAP or any agency of the US Government.

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								
XZG3	ATTENUATOR/SWITCH DRIVER	HEWLETT PACKARD	11713A	2421A03059	---		N/A	
Equipment Type: AMPLIFIERS								
APK3	PREAMPLIFIER	AGILENT TECHNOL	8449B	3008A01593	1-26.5GHZ	06/03/05	12	06/03/06
Equipment Type: ANTENNAS								
NDP0	TUNED DIPOLE ANTENNA	EMCO	3121C-DB3	311	140-400MHZ	02/01/05	12	02/01/06
NTA0	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL611	2057	0.03-2GHZ	07/12/04	12	07/12/05
NWF0	RIDGED WAVE GUIDE	EMCO	3105	2035	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	C3150A	USHB061052	---		N/A	
Equipment Type: RECEIVERS								
RAC2	SPECTRUM ANALYZER	HEWLETT PACKARD	85660B	3638A08770	100HZ-22GHZ	02/09/05	12	02/09/06
RACD	RF PRESELECTOR	HEWLETT PACKARD	85685A	3010A01205	20HZ-2GHZ	02/09/05	12	02/09/06
RAF4	QUASIPEAK ADAPTER	HEWLETT PACKARD	85650A	2043A00320	0.01-1000MHZ	02/09/05	12	02/09/06

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.



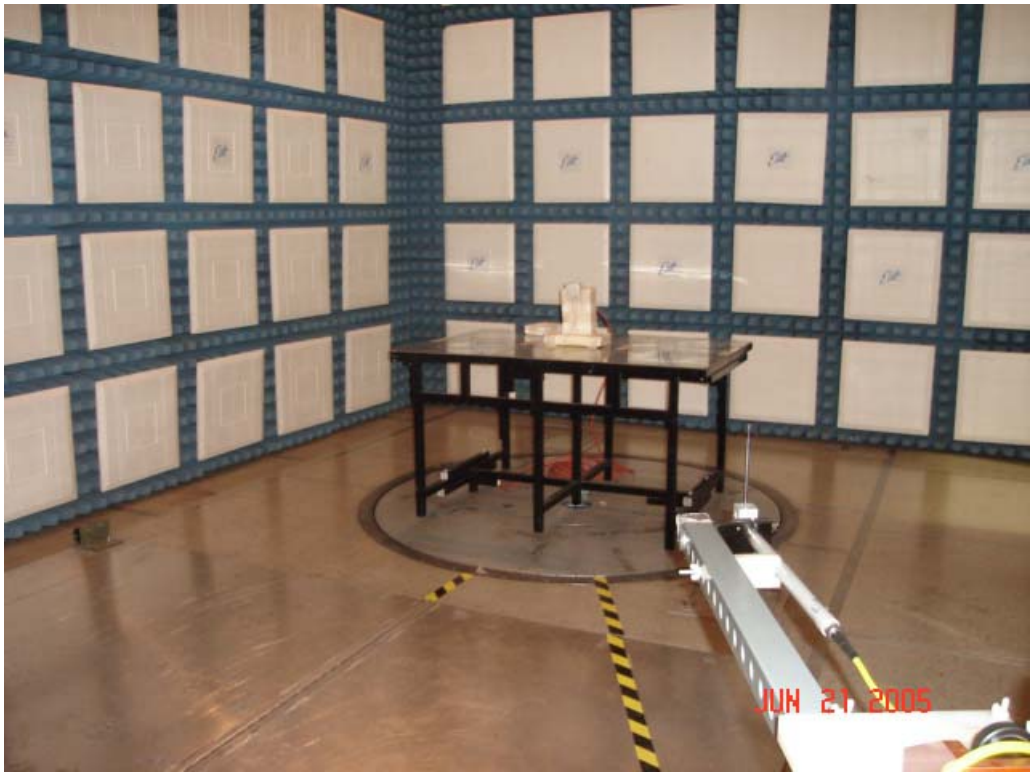
R

Hpib cbl

Figure 2

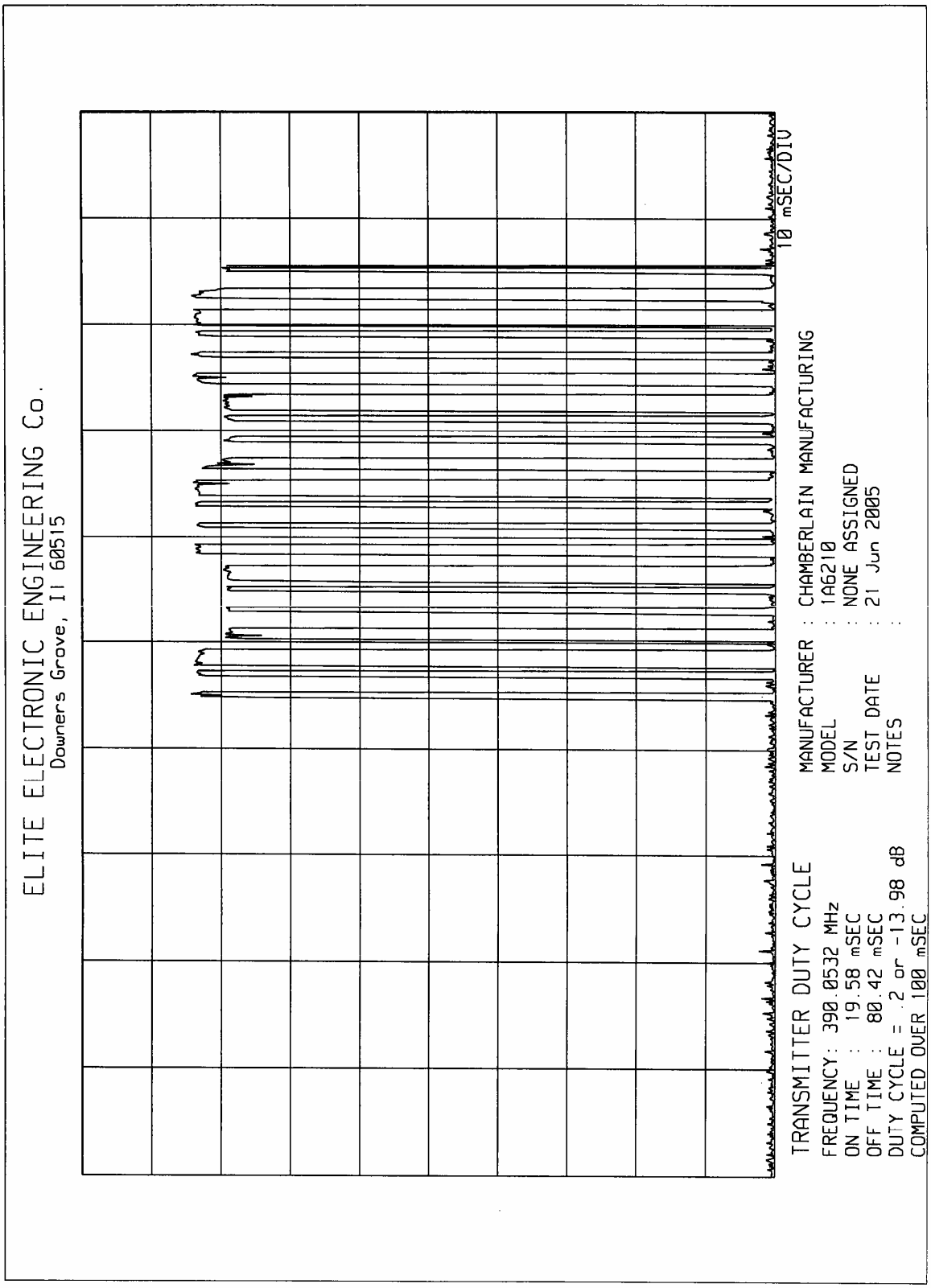
Test Set-up for Conducted Emissions

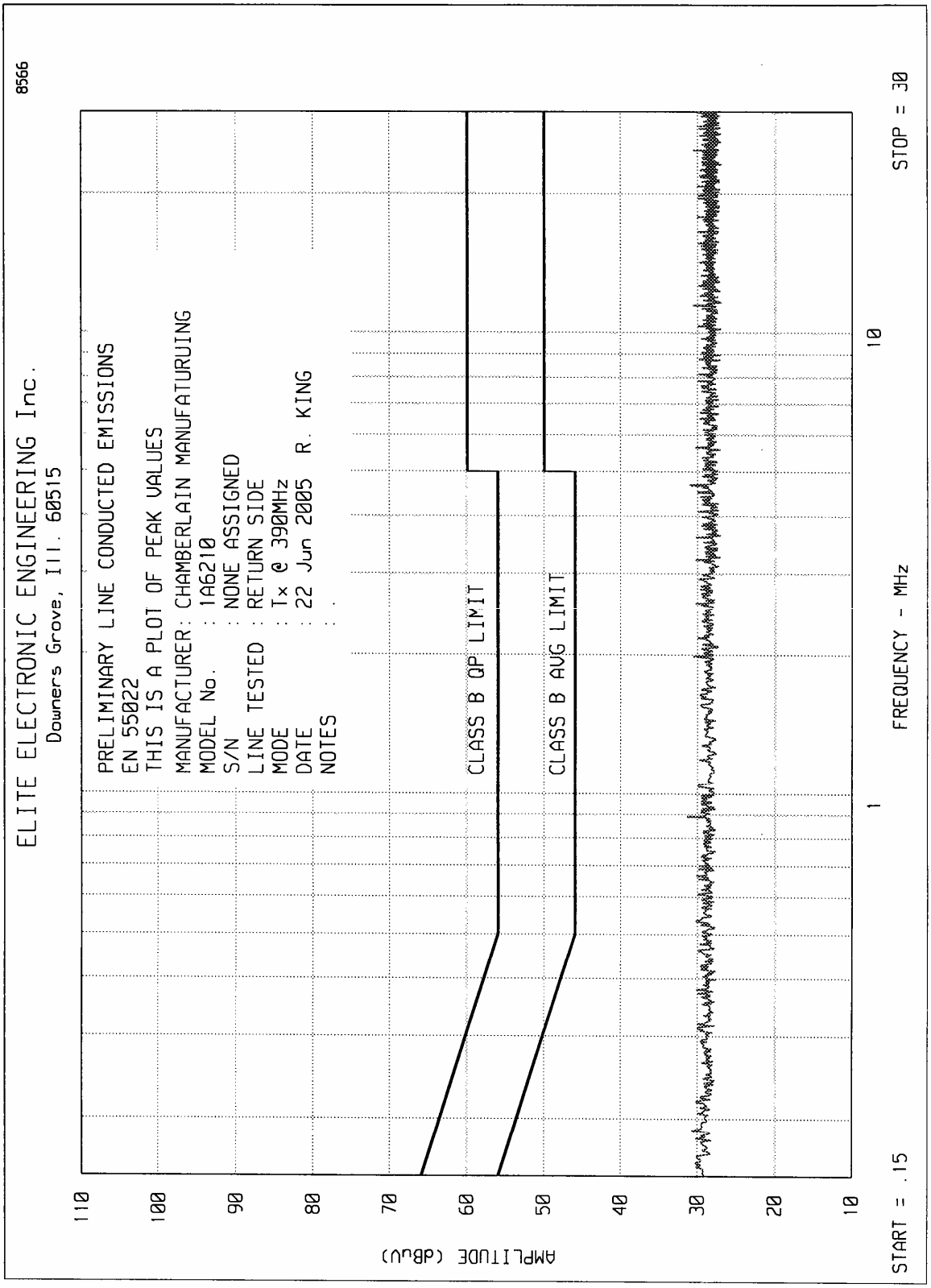
Figure 3

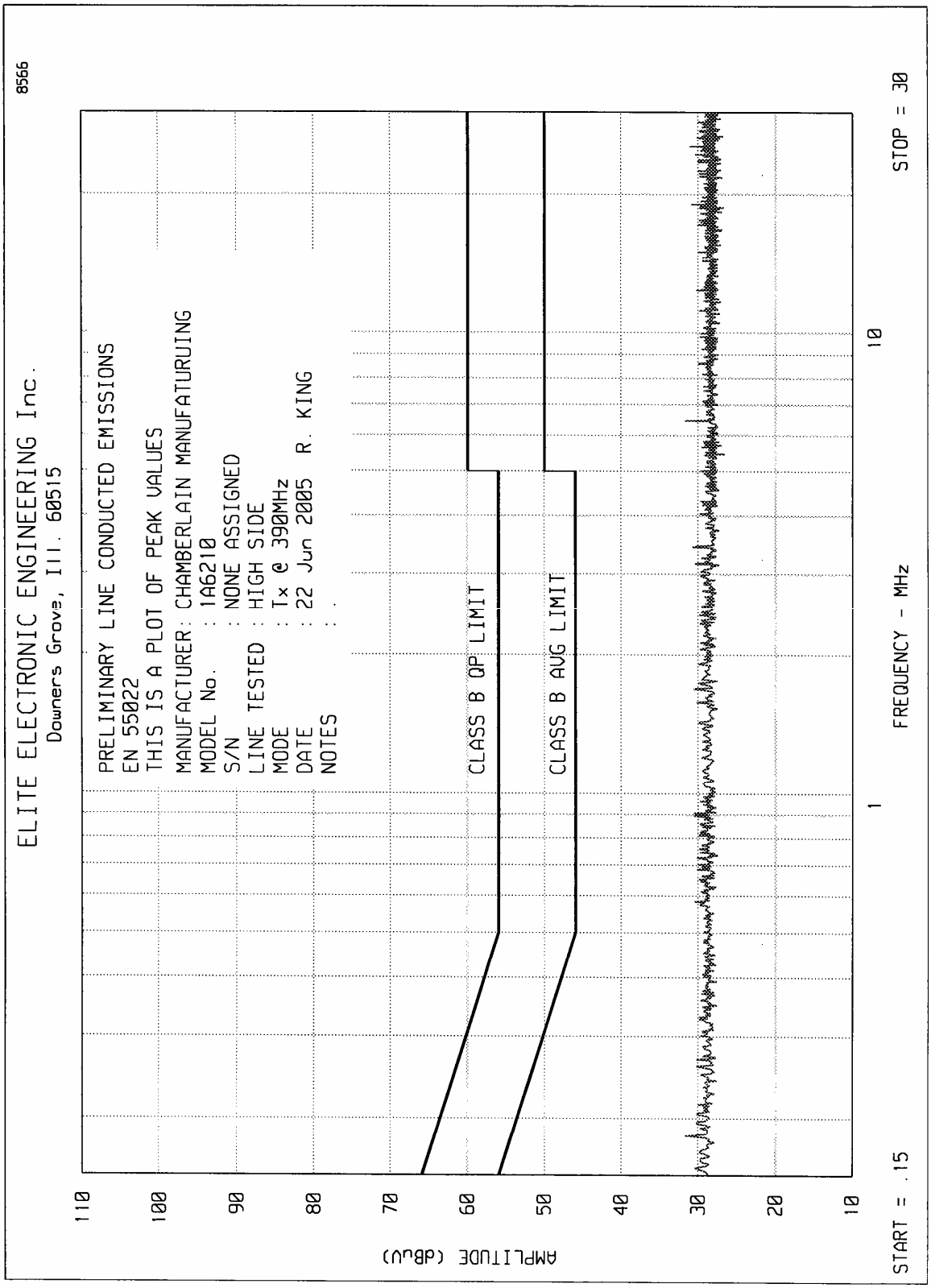


Test Set-up for Radiated Emissions Vertical Polarity

Test Set-up for Radiated Emissions Horizontal Polarity


ELITE ELECTRONIC ENGINEERING Co.
Downers Grove, Il 60515
10 mSEC/DIV
TRANSMITTER DUTY CYCLE
FREQUENCY: 390.0532 MHz
ON TIME : 19.58 mSEC
OFF TIME : 80.42 mSEC
DUTY CYCLE = .2 or -13.98 dB
COMPUTED OVER 100 mSEC
MANUFACTURER : CHAMBERLAIN MANUFACTURING
MODEL : 1A6210
S/N : NONE ASSIGNED
TEST DATE : 21 Jun 2005
NOTES :


8566
ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
PRELIMINARY LINE CONDUCTED EMISSIONS
EN 55022
THIS IS A PLOT OF PEAK VALUES
MANUFACTURER: CHAMBERLAIN MANUFATURUING
MODEL No. : 1A6210
S/N : NONE ASSIGNED
LINE TESTED : RETURN SIDE
MODE : Tx @ 390MHz
DATE : 22 Jun 2005 R. KING
NOTES : .
CLASS B QP LIMIT
CLASS B AVG LIMIT
AMPLITUDE (dBuV)
110
100
90
80
70
60
50
40
30
20
10
START = .15
1
10
STOP = 30
FREQUENCY - MHz


8566
ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
PRELIMINARY LINE CONDUCTED EMISSIONS
EN 55022
THIS IS A PLOT OF PEAK VALUES
MANUFACTURER: CHAMBERLAIN MANUFATURING
MODEL No. : 1A6210
S/N : NONE ASSIGNED
LINE TESTED : HIGH SIDE
MODE : Tx @ 390MHz
DATE : 22 Jun 2005 R. KING
NOTES : .
CLASS B QP LIMIT
CLASS B AVG LIMIT
AMPLITUDE (dBuV)
110
100
90
80
70
60
50
40
30
20
10
START = .15
1
10
STOP = 30
FREQUENCY - MHz

ETR No.
ELITE ELECTRONIC ENGINEERING CO.

MANUFACTURER : CHAMBERLAIN MANUFATURUING
MODEL : 1A6210
S/N : NONE ASSIGNED
SPECIFICATION : EN 55022, CLASS B
TEST : LINE CONDUCTED EMISSIONS
LINE TESTED : HIGH SIDE
MODE : Tx @ 390MHz
DATE : 22 Jun 2005
NOTES : .
RECEIVER : HP 8566 w/ HP85650A QP ADAPTOR
VALUES MEASURED WITH QP DETECTOR USING 9kHz BANDWIDTH

FREQUENCY MHz	METER RDG. dBuV	QP LIMIT dBuV	AVG RDG dBuV	AVG LIMIT dBuV	NOTES
.172	27.0	64.9		54.9	
.396	24.5	57.9		47.9	
.885	25.0	56.0		46.0	
1.676	24.7	56.0		46.0	
3.400	24.4	56.0		46.0	
4.972	23.6	56.0		46.0	
6.462	23.6	60.0		50.0	
9.778	23.6	60.0		50.0	
12.301	23.6	60.0		50.0	
15.253	23.6	60.0		50.0	
18.069	23.6	60.0		50.0	
21.956	23.6	60.0		50.0	
24.727	23.6	60.0		50.0	
27.369	23.6	60.0		50.0	

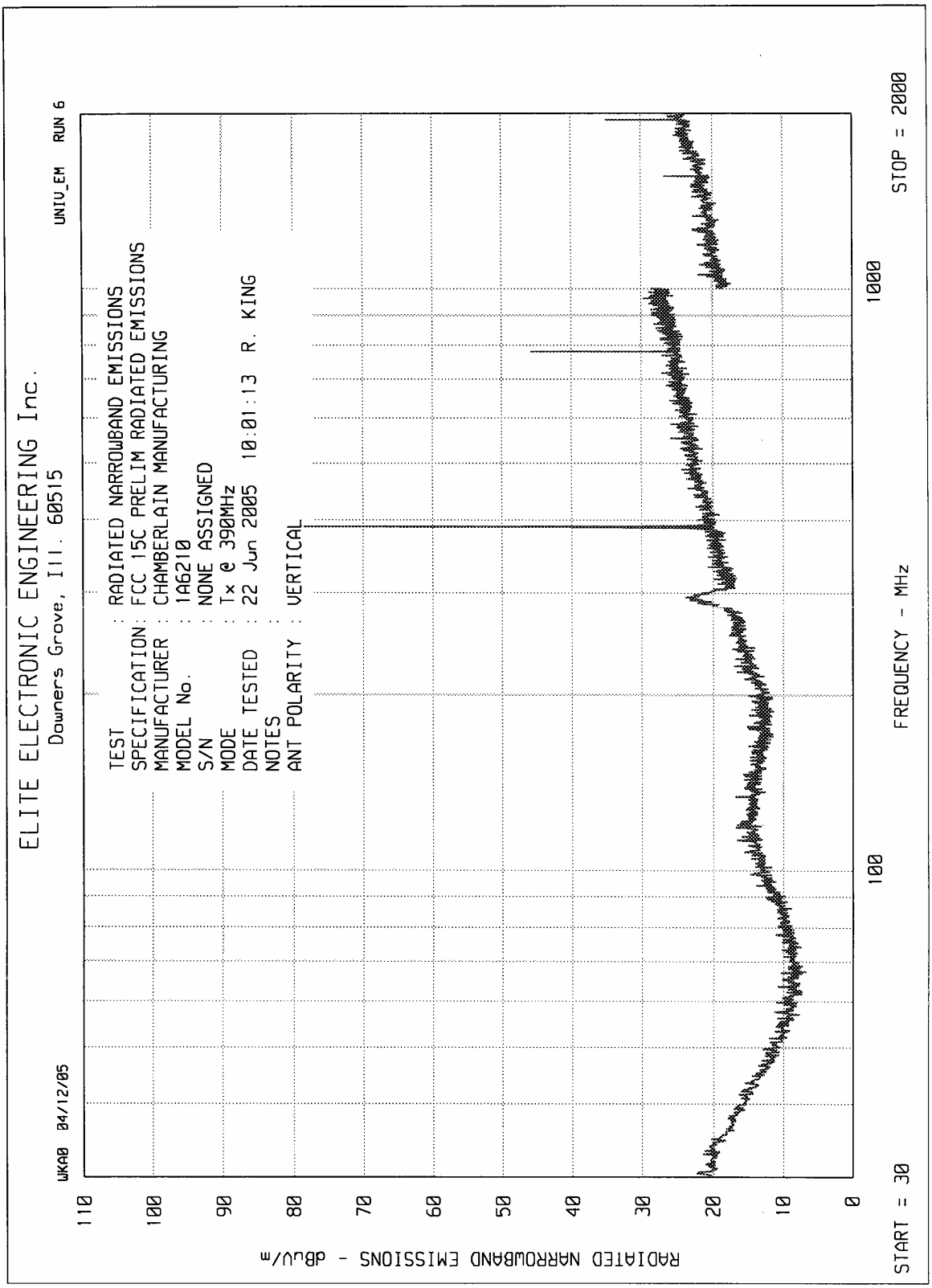
CHECKED BY: Richard S. King
R. KING

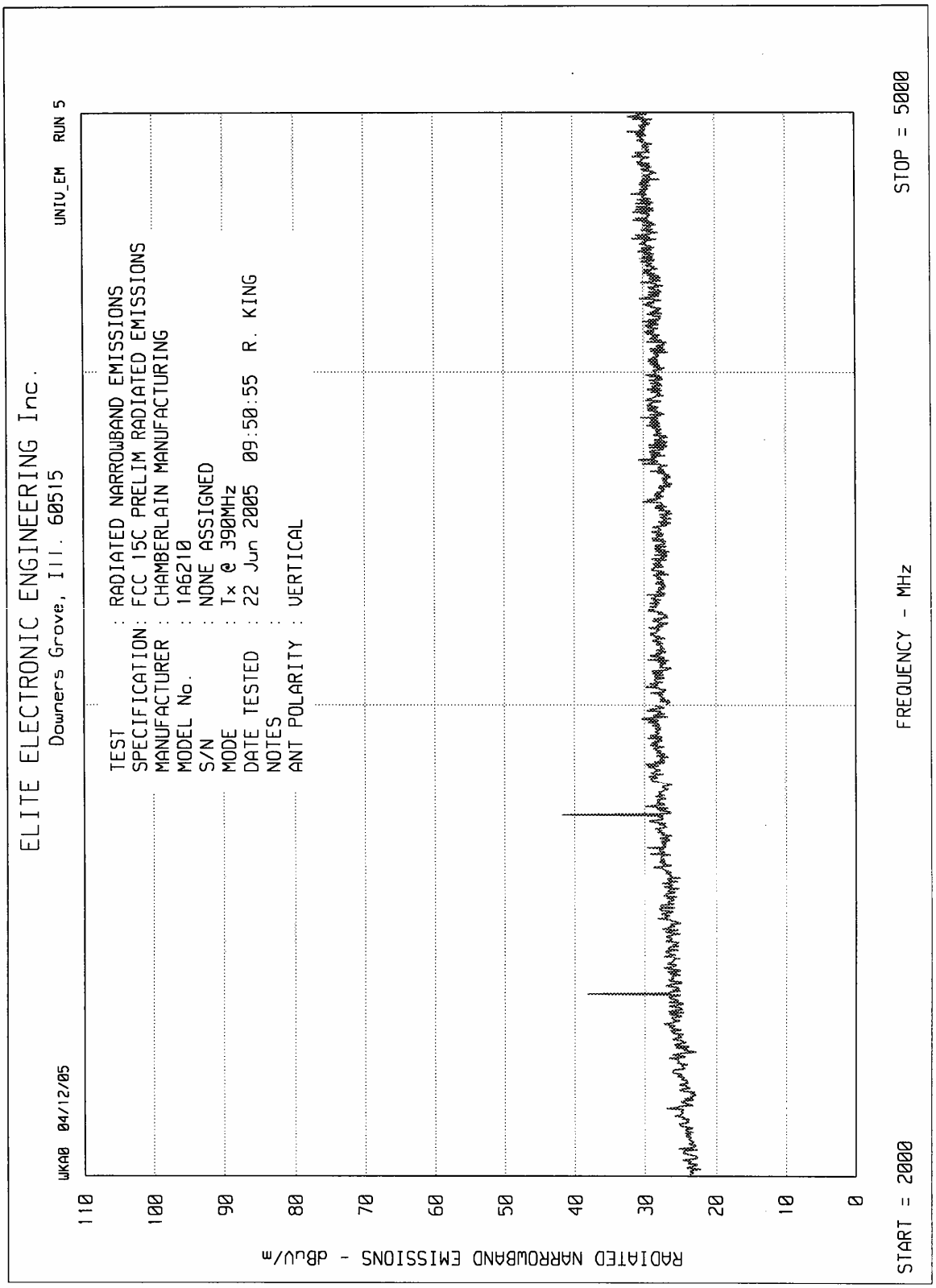
ETR No.
ELITE ELECTRONIC ENGINEERING CO.

MANUFACTURER : CHAMBERLAIN MANUFATURUING
MODEL : 1A6210
S/N : NONE ASSIGNED
SPECIFICATION : EN 55022, CLASS B
TEST : LINE CONDUCTED EMISSIONS
LINE TESTED : RETURN SIDE
MODE : Tx @ 390MHz
DATE : 22 Jun 2005
NOTES : .
RECEIVER : HP 8566 w/ HP85650A QP ADAPTOR
VALUES MEASURED WITH QP DETECTOR USING 9kHz BANDWIDTH

FREQUENCY MHz	METER RDG. dBuV	QP LIMIT dBuV	AVG RDG dBuV	AVG LIMIT dBuV	NOTES
.308	25.0	60.0		50.0	
.538	24.8	56.0		46.0	
.904	24.4	56.0		46.0	
1.978	24.5	56.0		46.0	
3.184	24.4	56.0		46.0	
5.588	23.6	60.0		50.0	
6.479	23.8	60.0		50.0	
8.858	23.8	60.0		50.0	
12.612	23.6	60.0		50.0	
15.695	23.8	60.0		50.0	
17.771	23.6	60.0		50.0	
20.688	23.6	60.0		50.0	
24.890	23.6	60.0		50.0	
27.892	23.4	60.0		50.0	

CHECKED BY: Richard E. King
R. KING


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV_EM RUN 6
WKA0 04/12/05
TEST : RADIATED NARROWBAND EMISSIONS
SPECIFICATION: FCC 15C PRELIM RADIATED EMISSIONS
MANUFACTURER : CHAMBERLAIN MANUFACTURING
MODEL No. : 1A6210
S/N : NONE ASSIGNED
MODE : Tx @ 390MHz
DATE TESTED : 22 Jun 2005 10:01:13 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
1000
STOP = 2000
FREQUENCY - MHz

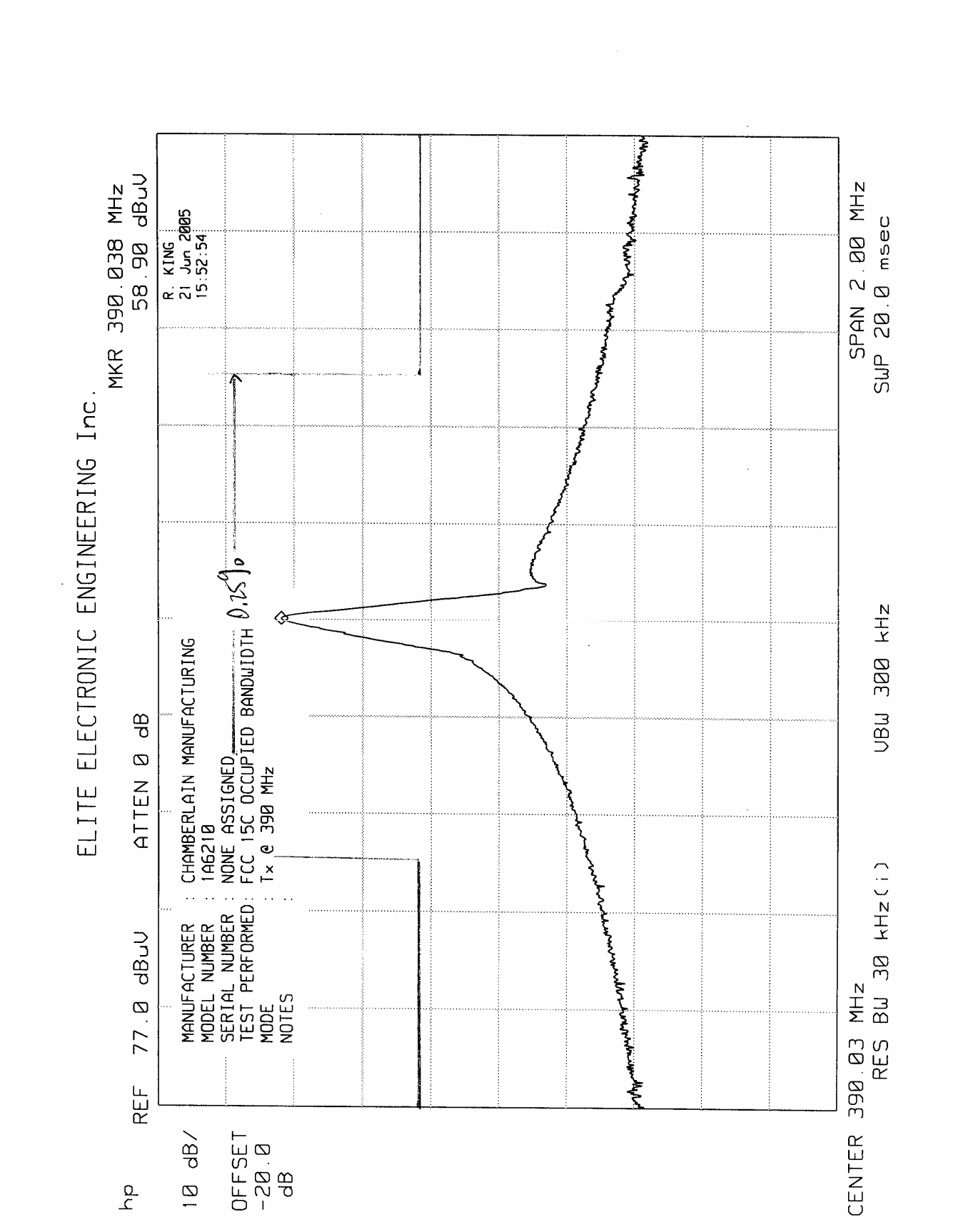

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV_EM RUN 5
WKA0 04/12/05
TEST : RADIATED NARROWBAND EMISSIONS
SPECIFICATION: FCC 15C PRELIM RADIATED EMISSIONS
MANUFACTURER : CHAMBERLAIN MANUFACTURING
MODEL No. : 1A6210
S/N : NONE ASSIGNED
MODE : Tx @ 390MHz
DATE TESTED : 22 Jun 2005 09:50:55 R. KING
NOTES :
ANT POLARITY : VERTICAL
RADIATED NARROWBAND EMISSIONS - dBuV/m
110
100
90
80
70
60
50
40
30
20
10
0
START = 2000
FREQUENCY - MHz
STOP = 5000

MANUFACTURER : **Chamberlain Manufacturing**
MODEL NO. : **1A6210**
SERIAL NO. : **None assigned**
SPECIFICATION : **FCC- 15C Transmitter Open Field Data**
DATE : **June 21, 2005**
NOTES : **Test Distance is 3 Meters**

Freq. (MHz)	Ant Pol	Meter Reading (dBuV)	Amb.	Cable Factor (dB)	Antenna Factor (dB)	Duty Cycle Factor (dB)	Total at 3 meters (dBuV/m)	Total at 3 meters (uV/m)	Limit at 3 meters (uV/m)	Margin
390.0	H	57.1		1.5	20.9	-13.5	66.0	1995.3	9166.7	-13.2
390.0	V	59.1		1.5	20.9	-13.5	68.0	2511.9	9166.7	-11.2
780.0	H	26.2		1.9	26.6	-13.5	41.2	114.8	916.7	-18.0
780.0	V	25.8		1.9	26.6	-13.5	40.8	109.6	916.7	-18.4
1170.0	H	23.9		2.2	26.2	-13.5	38.8	87.1	500.0	-15.2
1170.0	V	21.9		2.2	26.2	-13.5	36.8	69.2	500.0	-17.2
1560.0	H	17.5		2.6	27.0	-13.5	33.6	47.9	500.0	-20.4
1560.0	V	15.4	*	2.6	27.0	-13.5	31.5	37.6	500.0	-22.5
1950.0	H	18.1		3.0	28.6	-13.5	36.2	64.6	916.7	-23.0
1950.0	V	16.3	*	3.0	28.6	-13.5	34.4	52.5	916.7	-24.8
2340.0	H	11.8		3.4	30.1	-13.5	31.8	38.9	500.0	-22.2
2340.0	V	13.6		3.4	30.1	-13.5	33.6	47.9	500.0	-20.4
2730.0	H	13.3		3.8	31.4	0.0	48.5	266.1	500.0	-5.5
2730.0	V	12.5		3.8	31.4	0.0	47.7	242.7	500.0	-6.3
3120.0	H	7.3	*	4.1	32.3	0.0	43.7	153.1	916.7	-15.5
3120.0	V	6.8	*	4.1	32.3	0.0	43.2	144.5	916.7	-16.0
3510.0	H	5.9	*	4.3	32.3	0.0	42.5	133.4	916.7	-16.7
3510.0	V	6.5	*	4.3	32.3	0.0	43.1	142.9	916.7	-16.1
3900.0	H	6.5	*	4.5	32.9	0.0	43.9	156.7	500.0	-10.1
3900.0	V	5.9	*	4.5	32.9	0.0	43.3	146.2	500.0	-10.7

Checked BY : Richard E. King

Richard E. King


ELITE ELECTRONIC ENGINEERING Inc.
MKR 390.038 MHz
58.90 dBuV
hp
REF 77.0 dBuV
ATTEN 0 dB
10 dB/
OFFSET
-20.0
dB
R. KING
21 Jun 2005
15:52:54
MANUFACTURER : CHAMBERLAIN MANUFACTURING
MODEL NUMBER : 1A6210
SERIAL NUMBER : NONE ASSIGNED
TEST PERFORMED: FCC 15C OCCUPIED BANDWIDTH
MODE : Tx @ 390 MHz
NOTES :
0.25 Jp
CENTER 390.03 MHz
RES BW 30 kHz(i)
VBW 300 kHz
SPAN 2.00 MHz
SWP 20.0 msec