Measurement of RF Interference from a Chamberlain Model 001A6140 Garage Door Opener

For : Chamberlain Manufacturing
Elmhurst, IL

P.O. No. : 851338
Date Received : October 21, 2004
Date Tested : October 22, 2004
Test Personnel : Richard E. King
Specification : FCC "Code of Federal Regulations" Title 47
Part 15, Subpart C

Test Report By : Richard E. King

Richard E. King

Witnessed by : Chamberlain Manufacturing

Approved By : Raymond J. Klouda
Registered Professional Engineer of
Illinois - 44894

Elite Electronic Engineering Inc.
1516 Centre Circle
Downers Grove, IL 60515
Tel : (630) 495-9770
Fax: (630) 495-9785
www.elitetest.com

TABLE OF CONTENTS

Measurement of RF Emissions from a Model 001A6140 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 Chamberlain model 001A6140, no serial number was assigned to the transmitter, (hereinafter referred to as 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 15.231 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 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 21.3ºC and the relative humidity was 51%.

2.0 TEST ITEM SETUP AND OPERATION:

The test item is a Chamberlain Model 001A6140 garage door opener. A block diagram of the test item setup is shown as Figure 1.

2.1 Power Input - The test received +3VDC from a +3VDC battery.

2.2 Grounding - Since the test item was powered with +3VDC through a +3VDC battery, it was ungrounded during the tests.

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

2.4 Interconnect Cables - No interconnect cables were 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 test item was energized by pressing the transmit button.

2.6 Test Item Modifications - No modifications were required for compliance to the CFR 15.231 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 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 - The plot of the duty cycle is shown on data page 11. The duty cycle factor was computed to be -13.5 dB. Representative plot of the duty cycle at the transmit frequency is shown on data page 11.

A representative plot of the duty cycle is shown on data page 11. Since the transmitters use a rolling code, the duty cycle used was calculated based on the worst case. The worst case information was supplied by Chamberlain Manufacturing. With the test item transmitting at 315MHz, the worst case duty cycle 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	Field Intensity	Field Strength Harmonics and

MHz	uV/m @ 3 meters	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 6036.2uV/m @ 3m and the limit on the harmonics is 603.6uV/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 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 4000MHz. 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 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 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 315MHz, are presented on data 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 1259.5MHz. The emissions level at this frequency was 5.3dB within the limit. See data page 14 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 15. As can be seen from this data page, the transmitter met the occupied bandwidth requirements.

5.0 CONCLUSIONS:

It was determined that the Chamberlain Manufacturing 001A6140, No serial number was assinged, 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: ANTENNAS								
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								
CMA0	MULTI-DEVICE CONTROLLER	EMCO	2090	9701-1213	---		N/A	
Equipment Type: METERS								
MSI2	DIGITAL OSCILLOSCOPE	LECROY CORP.	9310AM	4544	DC-400MHZ	05/05/04	12	05/05/05
Equipment Type: RECEIVERS								
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.

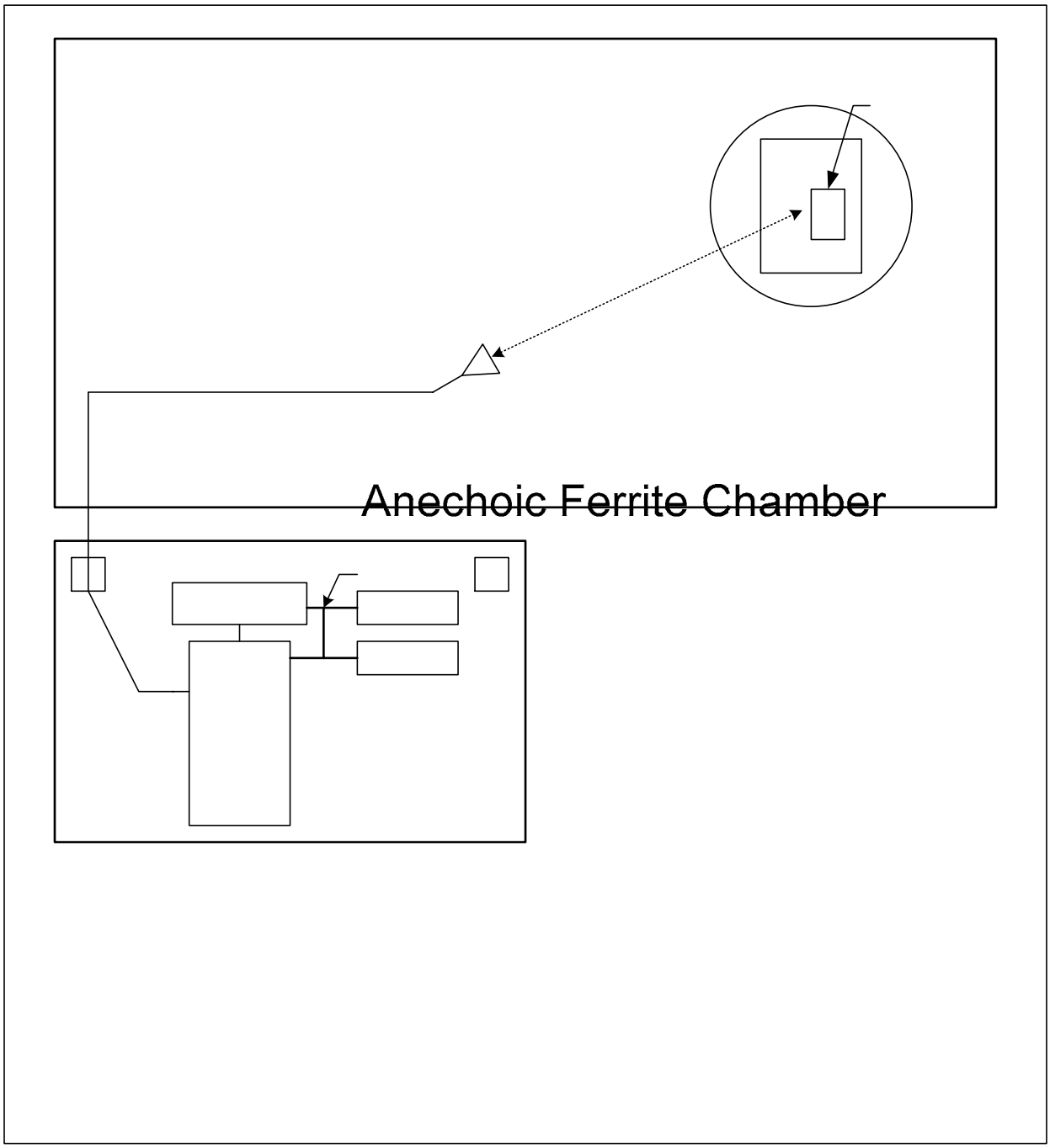
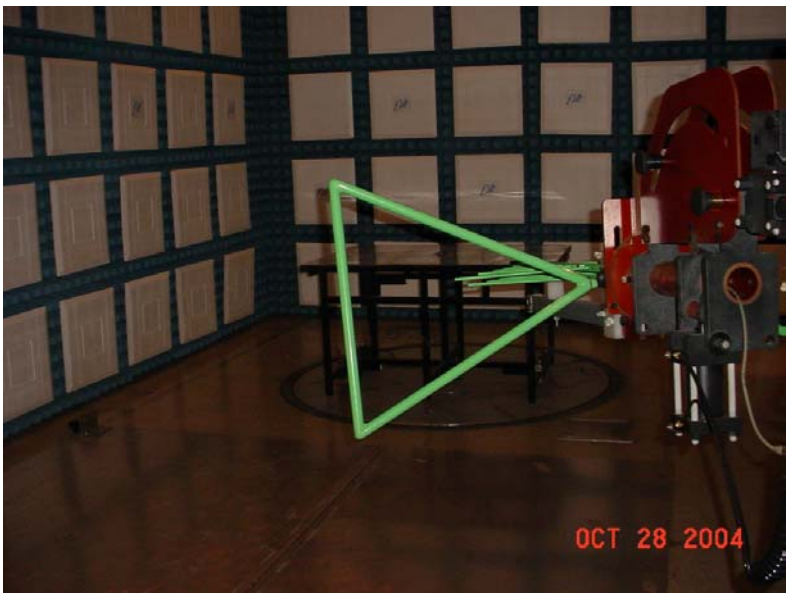

Anechoic Ferrite Chamber

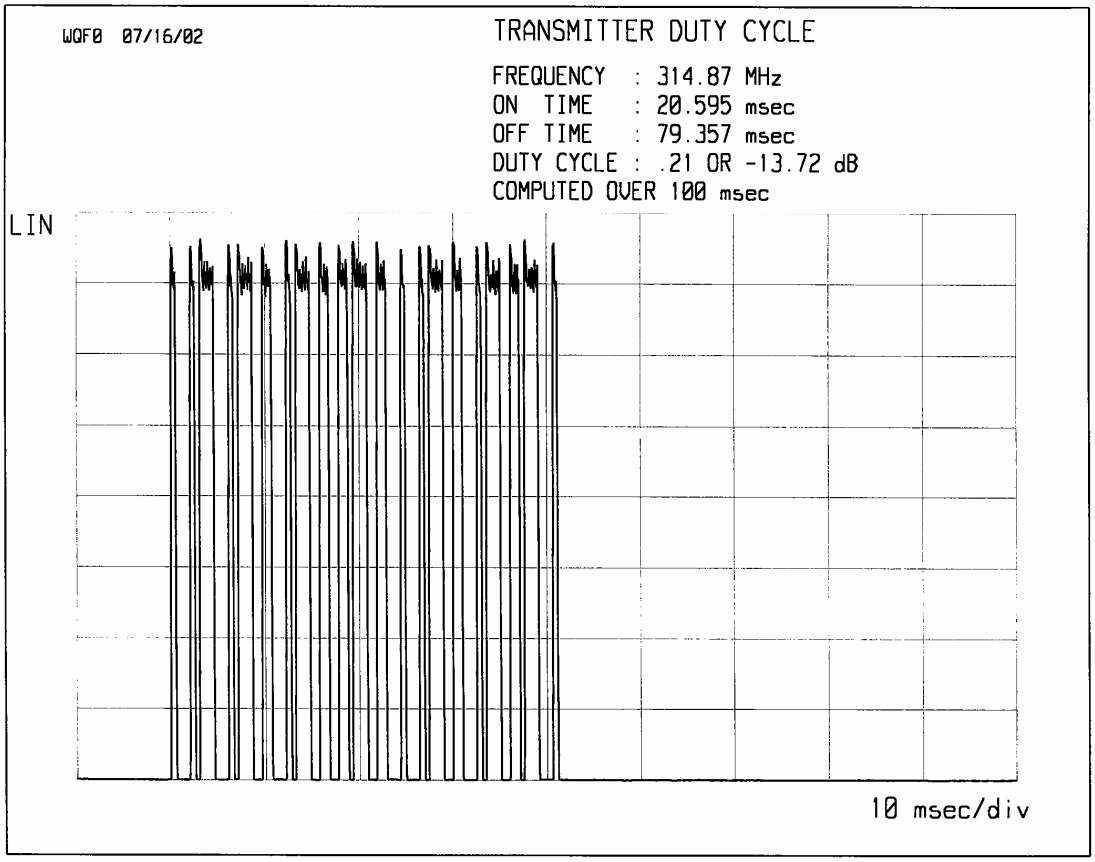
Figure 2



Test Setup for Radiated Emissions Horizontal Polarity

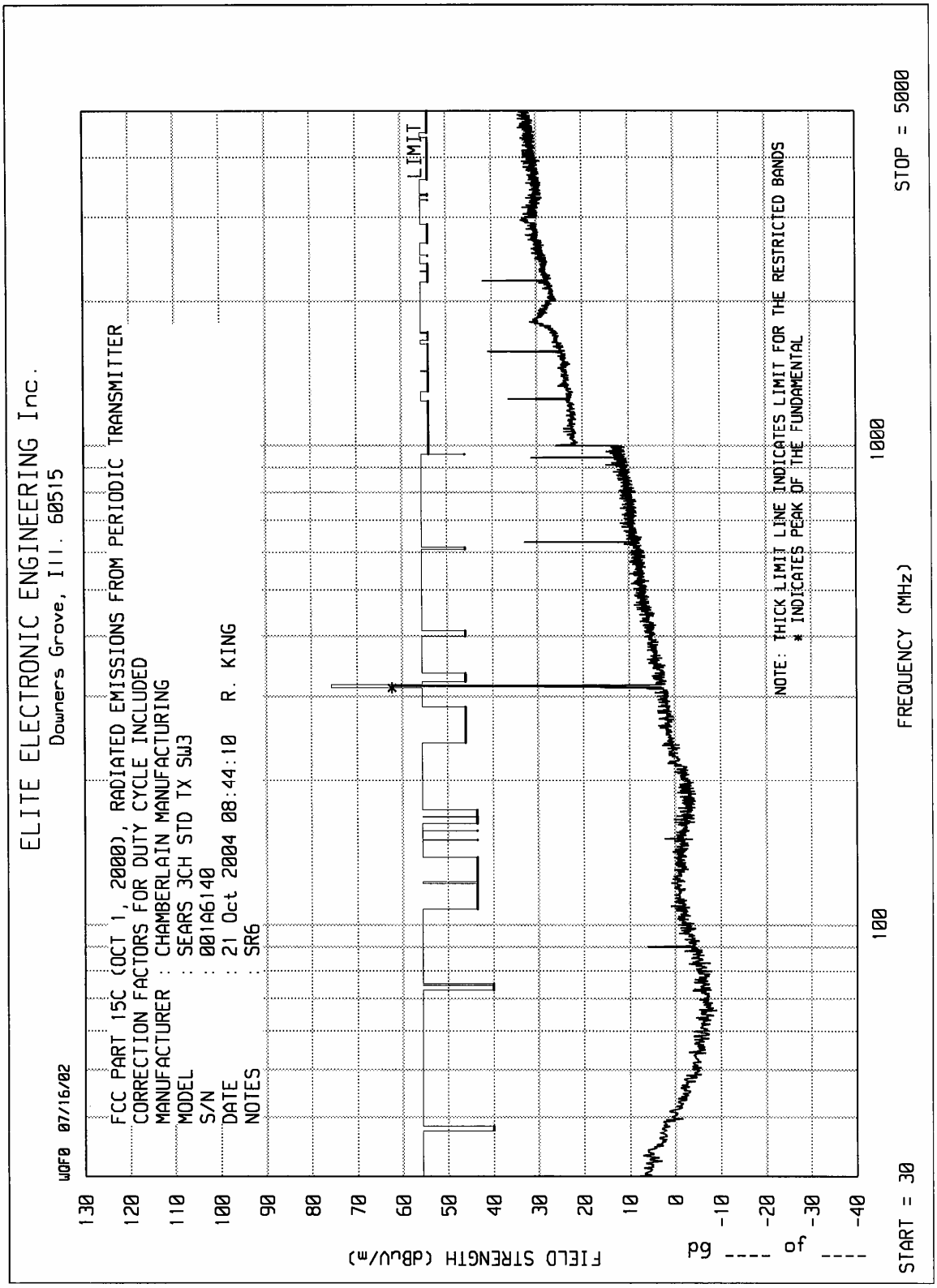
Test Setup for Radiated Emissions Vertical Polarity

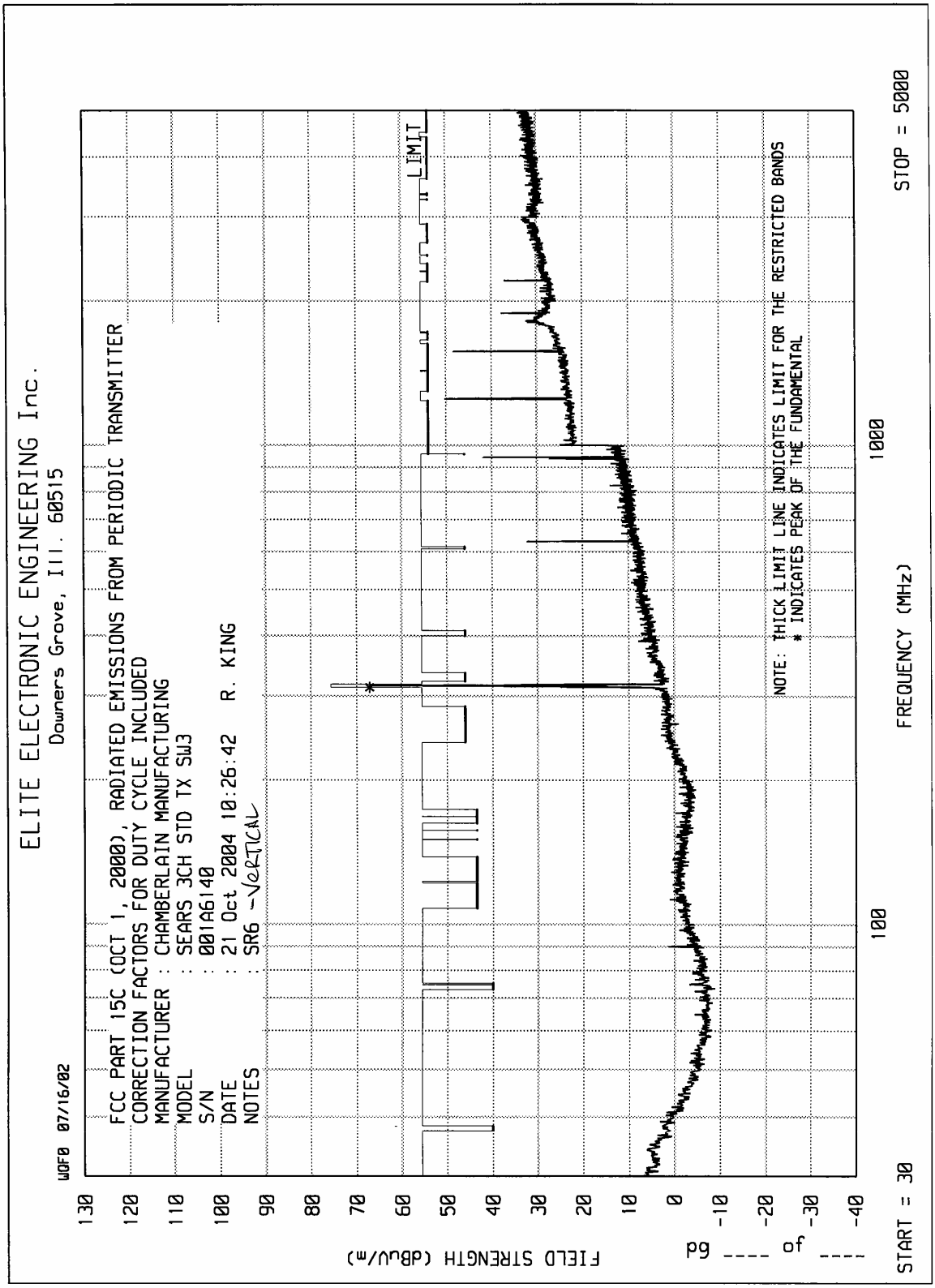
ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Il 60515



MANUFACTURER : CHAMBERLAIN MANUFACTURING
MODEL : SEARS 3CH STD TX SW3
S/N : 001A6140
NOTES : SR6
DATE : 21 Oct 2004 08:44:10 R. KING

pg ____ of ____


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WOF0 07/15/02
FCC PART 15C (OCT 1, 2000), RADIATED EMISSIONS FROM PERIODIC TRANSMITTER
CORRECTION FACTORS FOR DUTY CYCLE INCLUDED
MANUFACTURER : CHAMBERLAIN MANUFACTURING
MODEL : SEARS 3CH STD TX SW3
S/N : 001A6140
DATE : 21 Oct 2004 08:44:10 R. KING
NOTES : SR6
LIMIT
NOTE: THICK LIMIT LINE INDICATES LIMIT FOR THE RESTRICTED BANDS
* INDICATES PEAK OF THE FUNDAMENTAL
FIELD STRENGTH (dBuV/m)
FREQUENCY (MHz)
START = 30
100
1000
STOP = 5000
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
---- of ---- pg

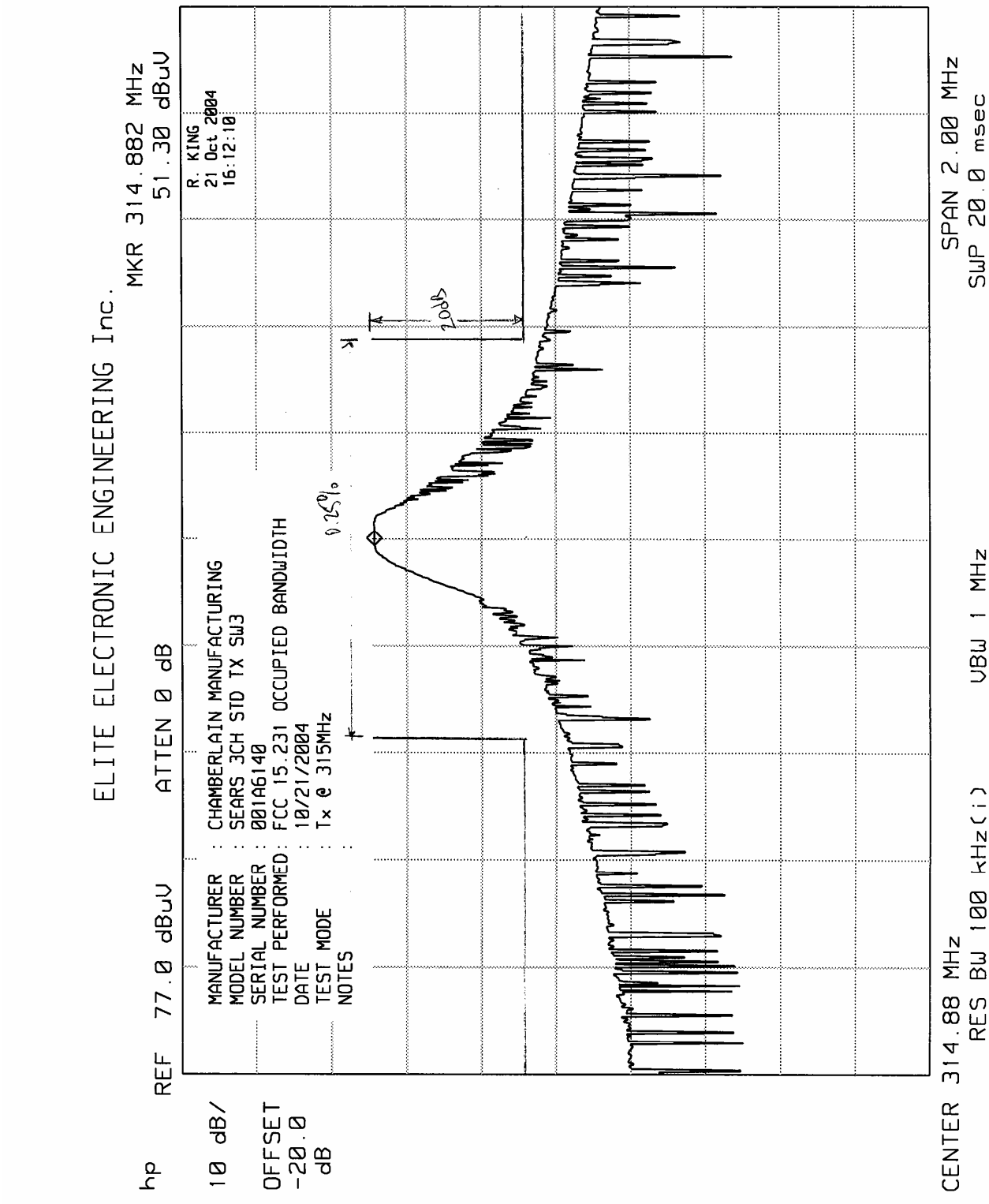

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WOF0 07/16/02
FCC PART 15C (OCT 1, 2000), RADIATED EMISSIONS FROM PERIODIC TRANSMITTER
CORRECTION FACTORS FOR DUTY CYCLE INCLUDED
MANUFACTURER : CHAMBERLAIN MANUFACTURING
MODEL : SEARS 3CH STD TX SW3
S/N : 001A6140
DATE : 21 Oct 2004 10:26:42 R. KING
NOTES : SR6 -Vertical
LIMIT
NOTE: THICK LIMIT LINE INDICATES LIMIT FOR THE RESTRICTED BANDS
* INDICATES PEAK OF THE FUNDAMENTAL
FIELD STRENGTH (dBuV/m)
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
dB ---- of ----
START = 30
100
1000
STOP = 5000
FREQUENCY (MHz)

HARMONIC AND EXCESSIVE EMISSIONS FROM TRANSMITTER

SPECIFICATION : FCC PART 15C (OCT 1, 2000)
MANUFACTURER : CHAMBERLAIN MANUFACTURING
MODEL : SEARS 3CH STD TX SW3
S/N : 001A6140
DATE : 21 Oct 2004 10:26:42 R. KING
NOTES : SR6 - VERTICAL
DUTY CYCLE : -13.5 dB
TOTAL FAC. = ANTENNA + CABLE + DUTY CYCLE FAC. + EXT. ATTENUATION (dB)

HARM. INDEX	FREQ MHz	METER READING dBuV	TOTAL FACTOR dB	TOTAL dBuV/m @3m	TOTAL uV/m @3m	LIMIT uV/m @3m	EMI.-LIM MARGIN dB	RESTR. BAND
FUND.	314.9	64.7	2.4	67.1	2264.4	6036.2	-8.5	NO
2	629.7	23.9	8.3	32.2	40.6	603.6	-23.5	NO
3	944.6	30.3	11.5	41.8	123.5	603.6	-13.8	NO
4	1259.5	35.1	15.2	50.3	326.2	603.6	-5.3	NO
5	1574.3	32.1	16.2	48.3	260.0	500.0	-5.7	YES
6	1889.2	20.0	17.8	37.8	77.6	603.6	-17.8	NO
7	2204.1	17.8	19.3	37.1	71.6	500.0	-16.9	YES
8	2519.0	9.0	20.8	29.8	30.9	603.6	-25.8	NO
9	2833.8	8.7	22.2	30.9	35.0	500.0	-23.1	YES
10	3148.7	9.2	22.9	32.1	40.1	603.6	-23.6	NO

pg ____ of ____


ELITE ELECTRONIC ENGINEERING Inc.
MKR 314.882 MHz
51.30 dBuV
R. KING
21 Oct 2004
16:12:10
hp
REF 77.0 dBuV
ATTEN 0 dB
10 dB/
OFFSET
-20.0
dB
MANUFACTURER : CHAMBERLAIN MANUFACTURING
MODEL NUMBER : SEARS 3CH STD TX SW3
SERIAL NUMBER : 001A6140
TEST PERFORMED: FCC 15.231 OCCUPIED BANDWIDTH
DATE : 10/21/2004
TEST MODE : Tx @ 315MHz
NOTES :
0.25%
20dB
CENTER 314.88 MHz
RES BW 100 kHz(i)
VBW 1 MHz
SPAN 2.00 MHz
SWP 20.0 msec