



Measurement of RF Interference from a Model Oracle Pro Transmitter

For : The Chamberlain Group, Inc.
845 Larch Ave.
Elmhurst, IL 60126

P.O. No. : 855609
Date Tested : September 20 through 24, 2007
Test Personnel : Daniel E. Crowder
Specification : Part 15, Subpart C
: Industry Canada RSS-210
: Industry Canada RSS-GEN

Test Report By : 
Daniel E. Crowder

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

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Revision History

Revision	Date	Description
—	10/3/2007	Initial release

Measurement of RF Emissions from a Model Oracle Pro Transmitter

1 INTRODUCTION

1.1 Scope of Tests

This document represents the results of the series of radio interference measurements performed on a model Oracle Pro 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 The Chamberlain Group, Inc. 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 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 31%.

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 C, 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 SET-UP AND OPERATION

3.1 General Description

The test item is a Model Oracle Pro Transmitter. A block diagram of the test item set-up is shown as Figure 1.

3.1.1 Power Input

The test item obtained 6VDC power from internal batteries.

3.1.2 Peripheral Equipment

The test item has no ports for peripheral equipment.

3.1.3 Interconnect Cables

The test item has no ports for interconnect cables.

3.1.4 Grounding

Since the test item was powered with 6VDC through batteries, it was ungrounded during the tests

3.2 Operational Mode

For all tests, the test item was energized and placed on an 80cm high non-conductive stand. For test purposes, The test item was programmed to continuously transmit when a particular code was entered on the keypad. Under normal operating conditions, the test item transmits for 785 msec. A plot of this is shown on page 12.

3.3 Test Item Modifications

No modifications were required for compliance to the FCC Part 15C 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.

Conducted emission tests were performed with a spectrum analyzer in conjunction with a quasi-peak adapter.

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.

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.



5 TEST PROCEDURES

5.1 Powerline Conducted Emissions

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

A representative plot of the duty cycle is shown on page 13. Since the transmitters use a rolling code the duty cycles used were calculated based on the worst case. Page 14 shows a close up of the pulses verifying the widest pulse length of 1.5msec. The worst case information was supplied by The Chamberlain Group, Inc.. With the test item transmitting at 315MHz, the worst case duty cycle would be -10.03dB.

A worst case ON time is used because of the ever changing rolling code.

For 100 msec period:

21, 1.5msec pulses in a 100msec

$$20 \log 31.5/100 = -10.03\text{dB}$$

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

Example 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.

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 4000MHz. Between 30MHz and 1000MHz, a broadband 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.

5.3.3 Results

The preliminary plots, with the test item transmitting at 315MHz, are presented on data pages 15 and 16. 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 17. As can be seen from the data, all emissions measured from the test item were within the specification limits. See data page 17 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 18. As can be seen from this data page, the transmitter met the occupied bandwidth requirements.

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 The Chamberlain Group, Inc. upon completion of the tests.

7 CONCLUSIONS

It was determined that The Chamberlain Group, Inc. Model Oracle Pro Transmitter, Serial No. None Assigned, 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 as presented by The Chamberlain Group, Inc. personnel. 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	04/27/07 12	04/27/08
Equipment Type: ANTENNAS							
NDP1	TUNED DIPOLE ANTENNA	EMCO	3121C DB3	313	140 400MHZ	03/10/07 12	03/10/08
NDQ1	TUNED DIPOLE ANTENNA	EMCO	3121C DB4	313	400 1000MHZ	03/10/07 12	03/10/08
NTA0	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL611	2057	0.03 2GHZ	08/21/07 12	08/21/08
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	02/10/07 12	02/10/08
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	08/17/07 12	08/17/08
RAK6	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.

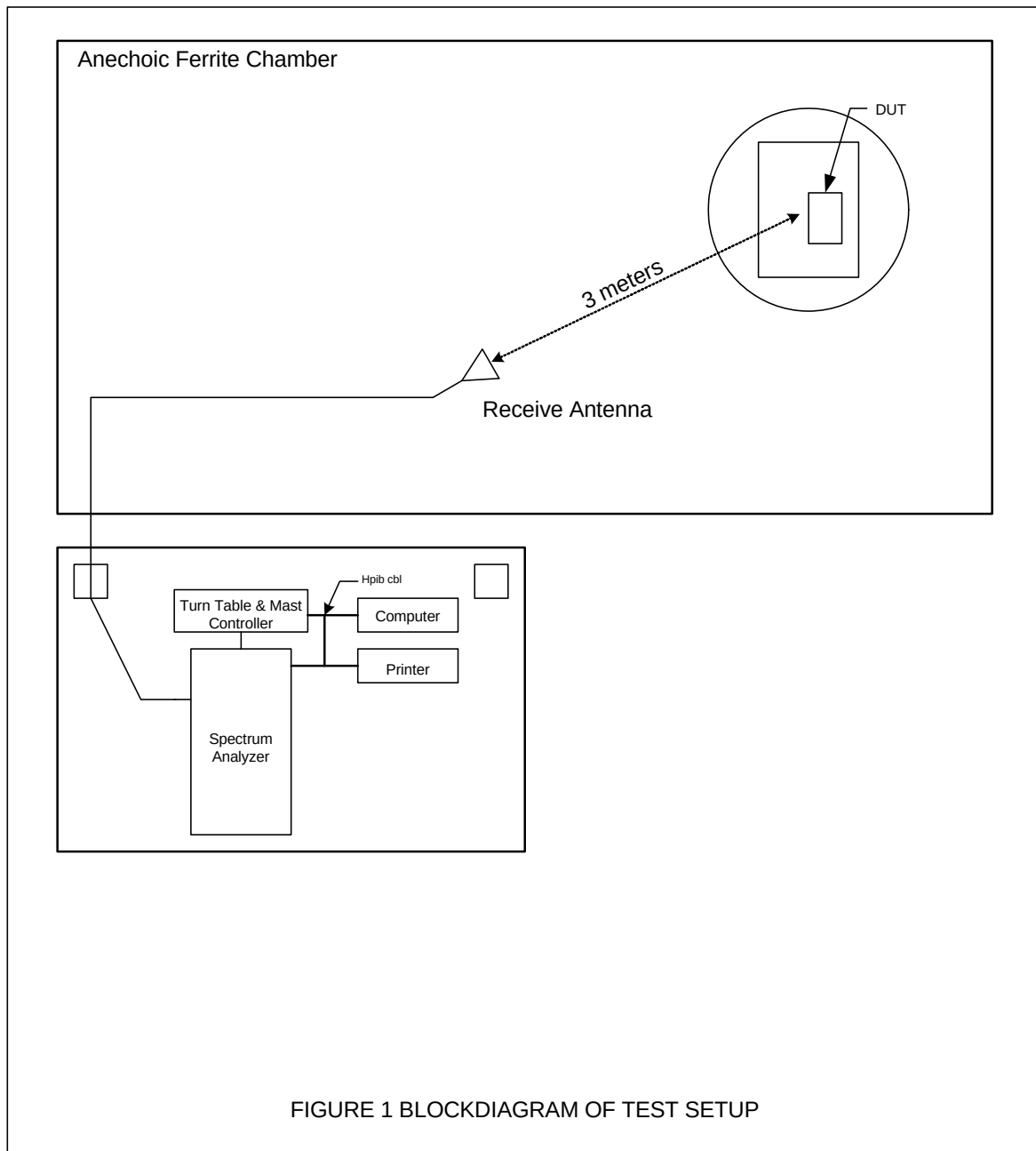
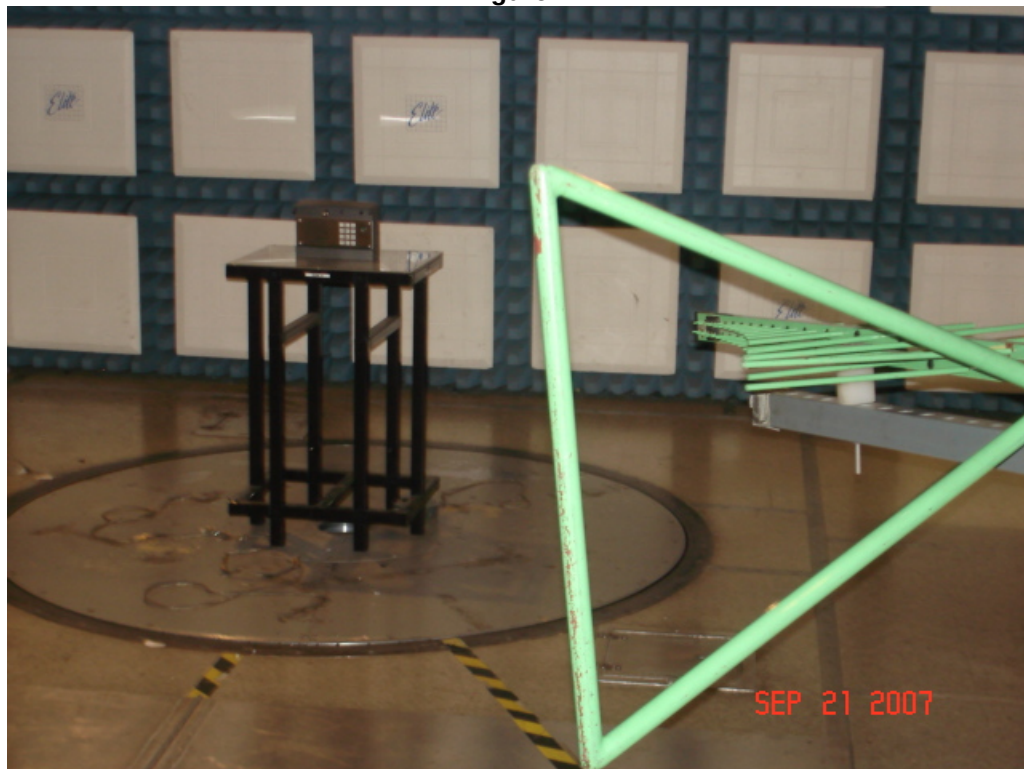
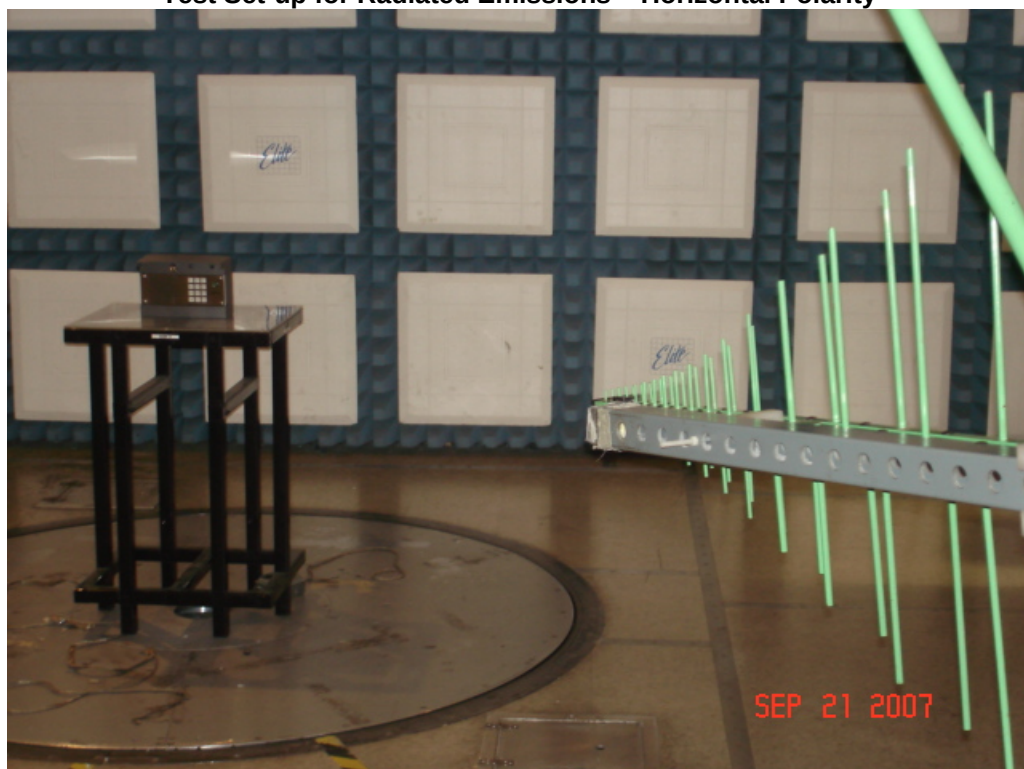


Figure 2

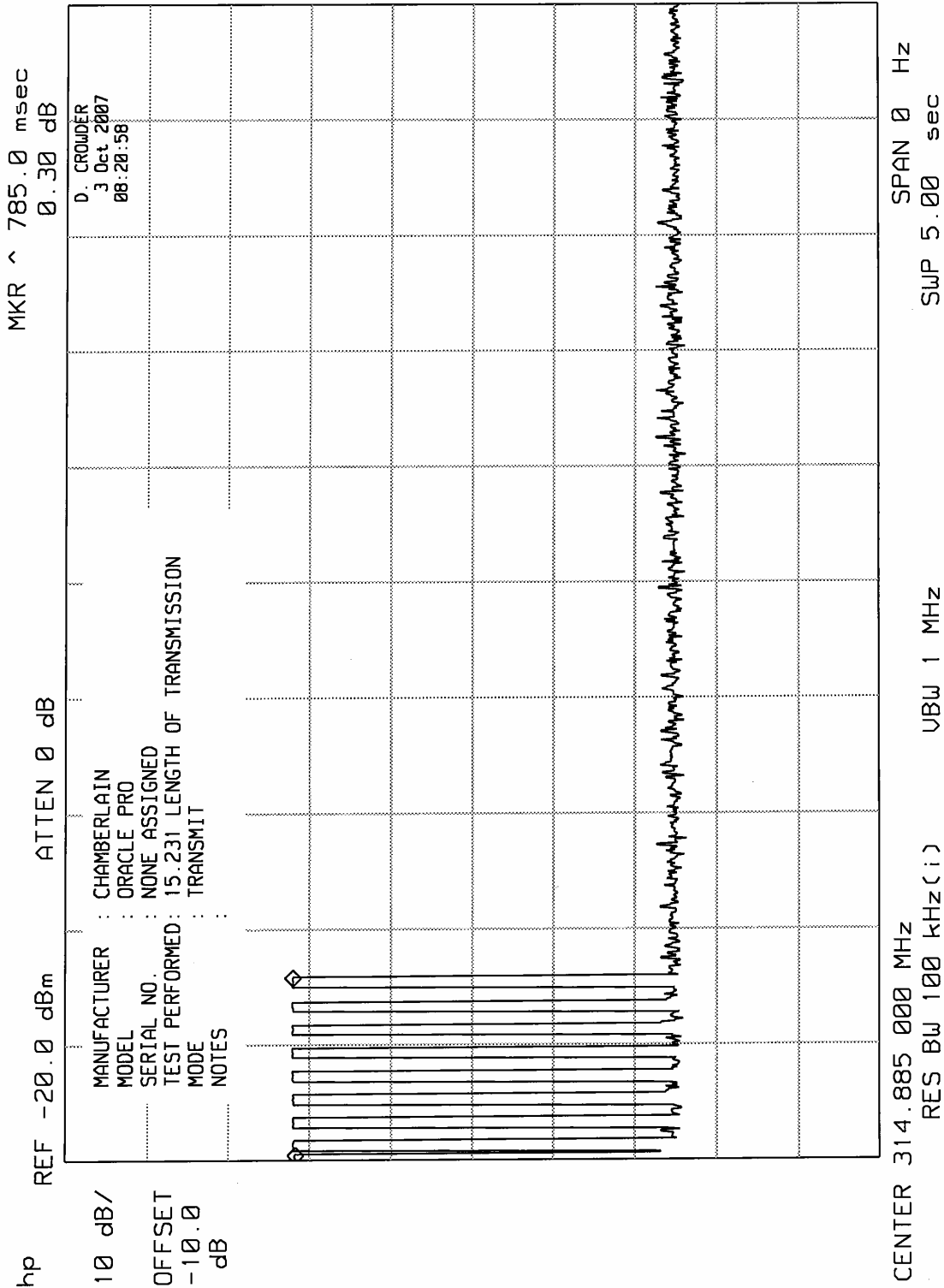


Test Set-up for Radiated Emissions – Horizontal Polarity

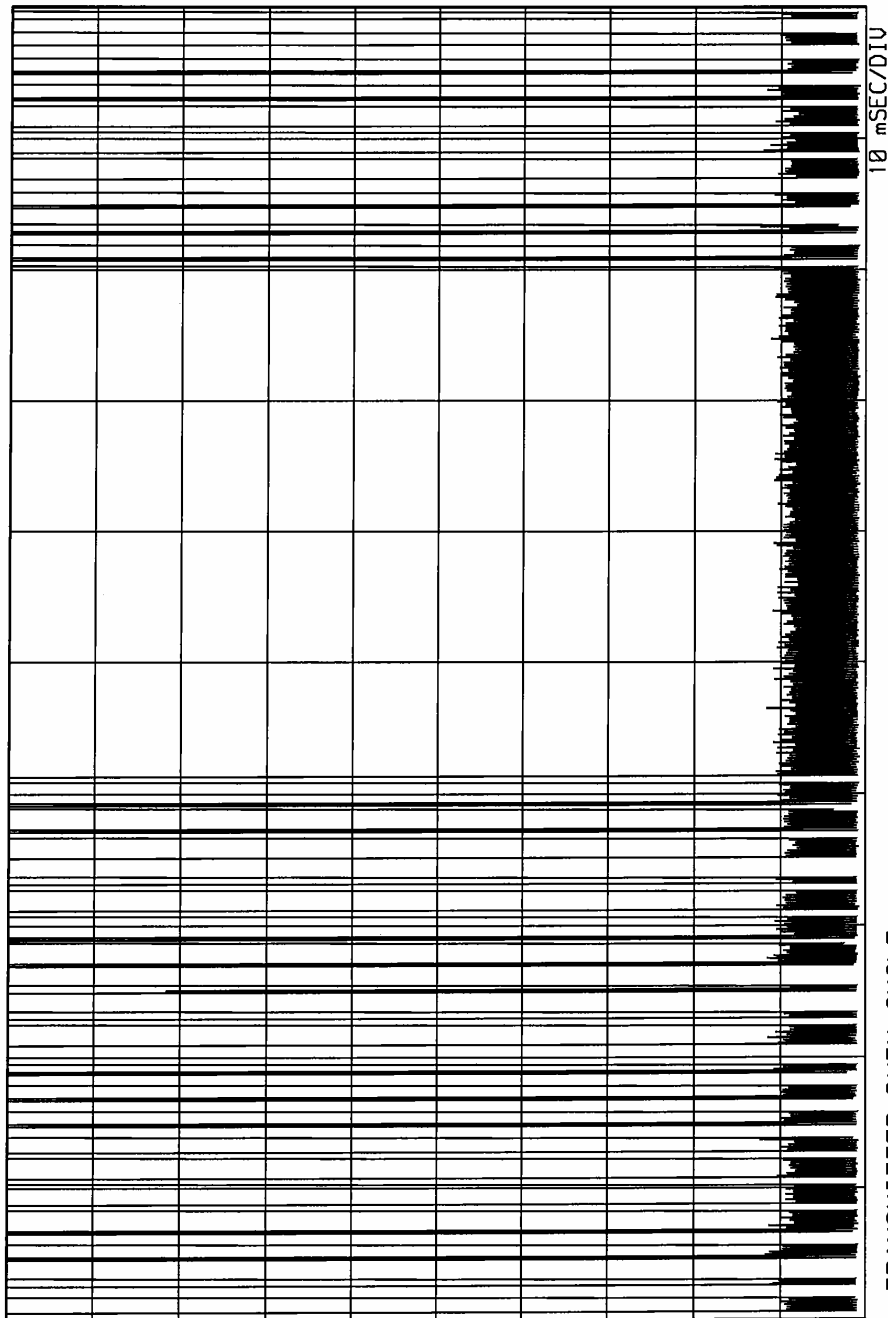


Test Set-up for Radiated Emissions – Vertical Polarity

ELITE ELECTRONIC ENGINEERING Inc.



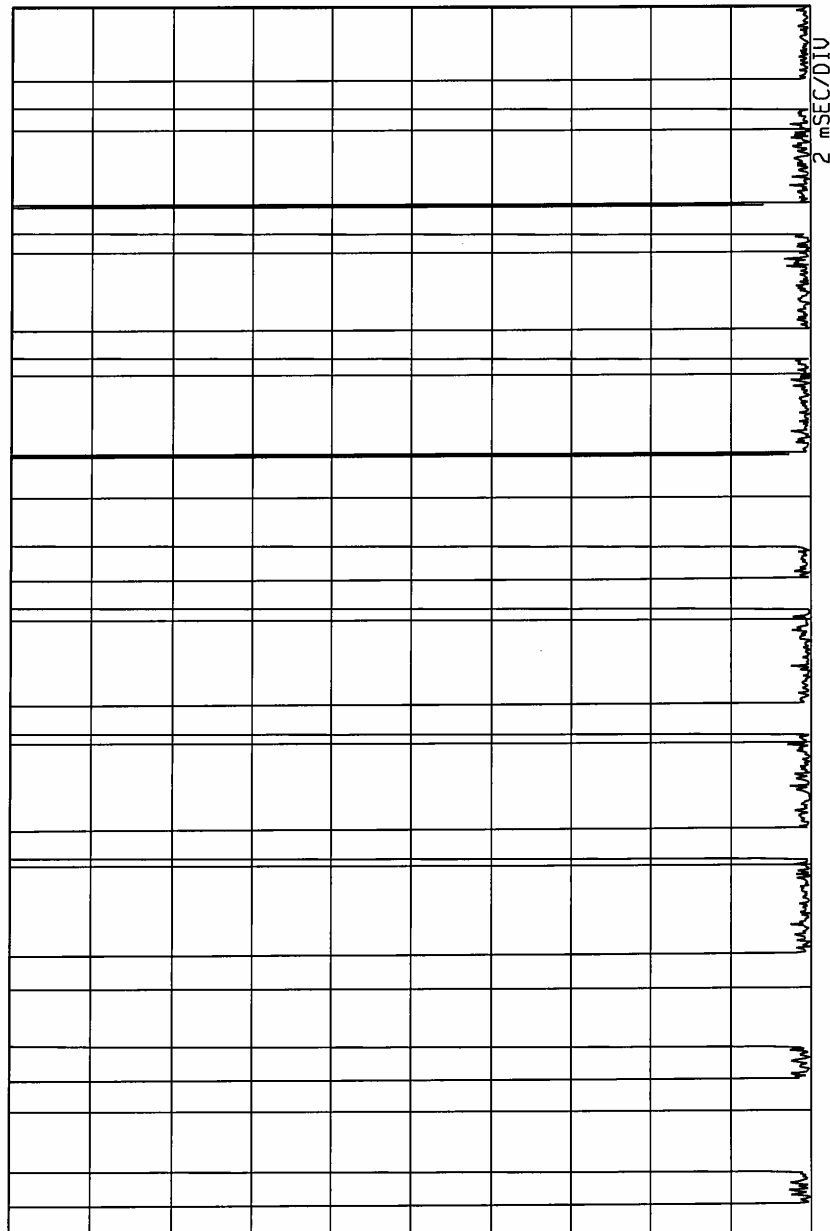
ELITE ELECTRONIC ENGINEERING Co.
Downers Grove, IL 60515



TRANSMITTER DUTY CYCLE
 FREQUENCY: 314.8627 MHz
 ON TIME : 27.473 mSEC
 OFF TIME : 72.527 mSEC
 DUTY CYCLE = .27 or -11.37 dB
 COMPUTED OVER 100 mSEC

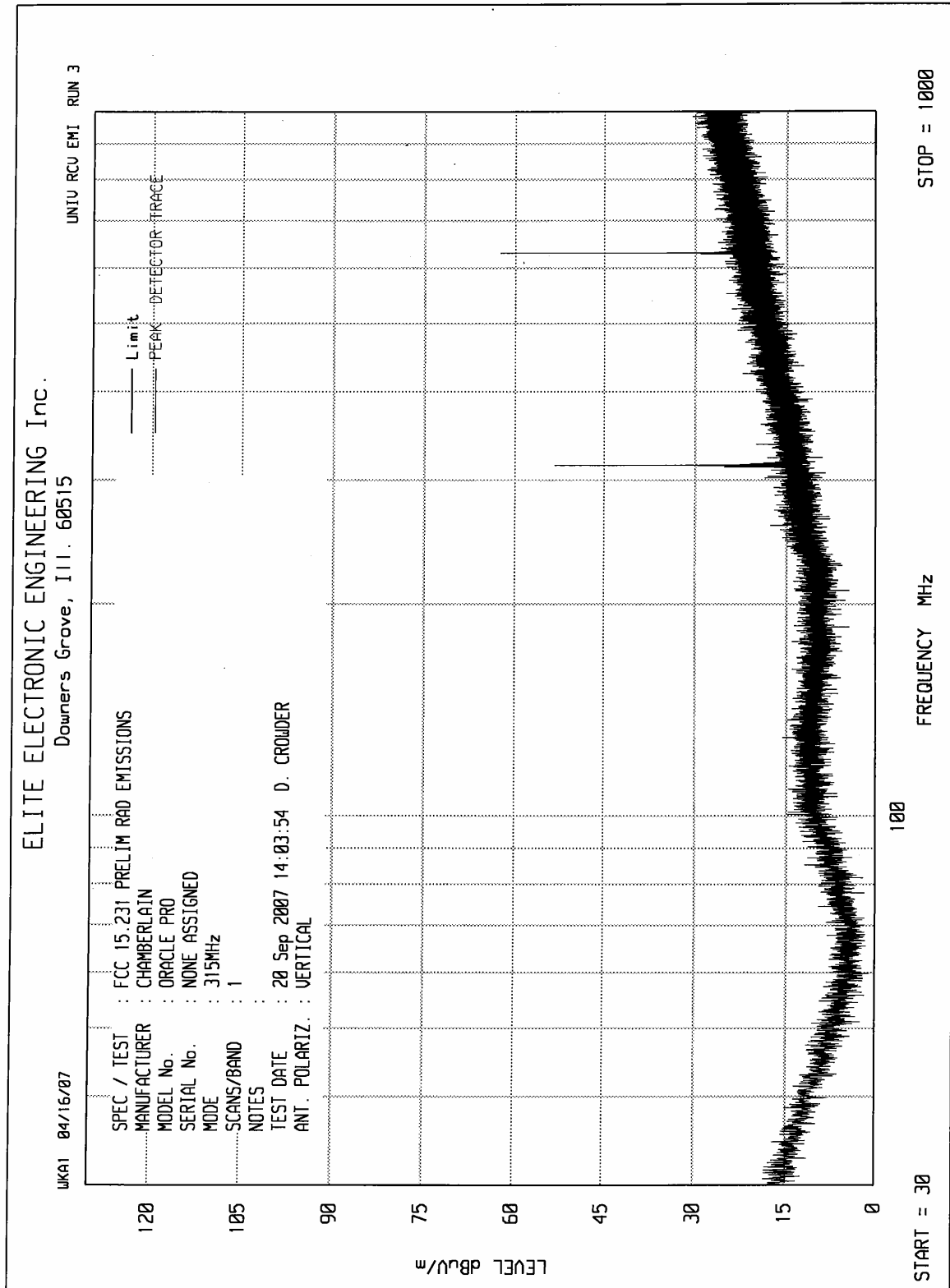
MANUFACTURER : CHAMBERLAIN
 MODEL : ORACLE PRO
 S/N : NONE ASSIGNED
 TEST DATE : 24 Sep 2007
 NOTES :

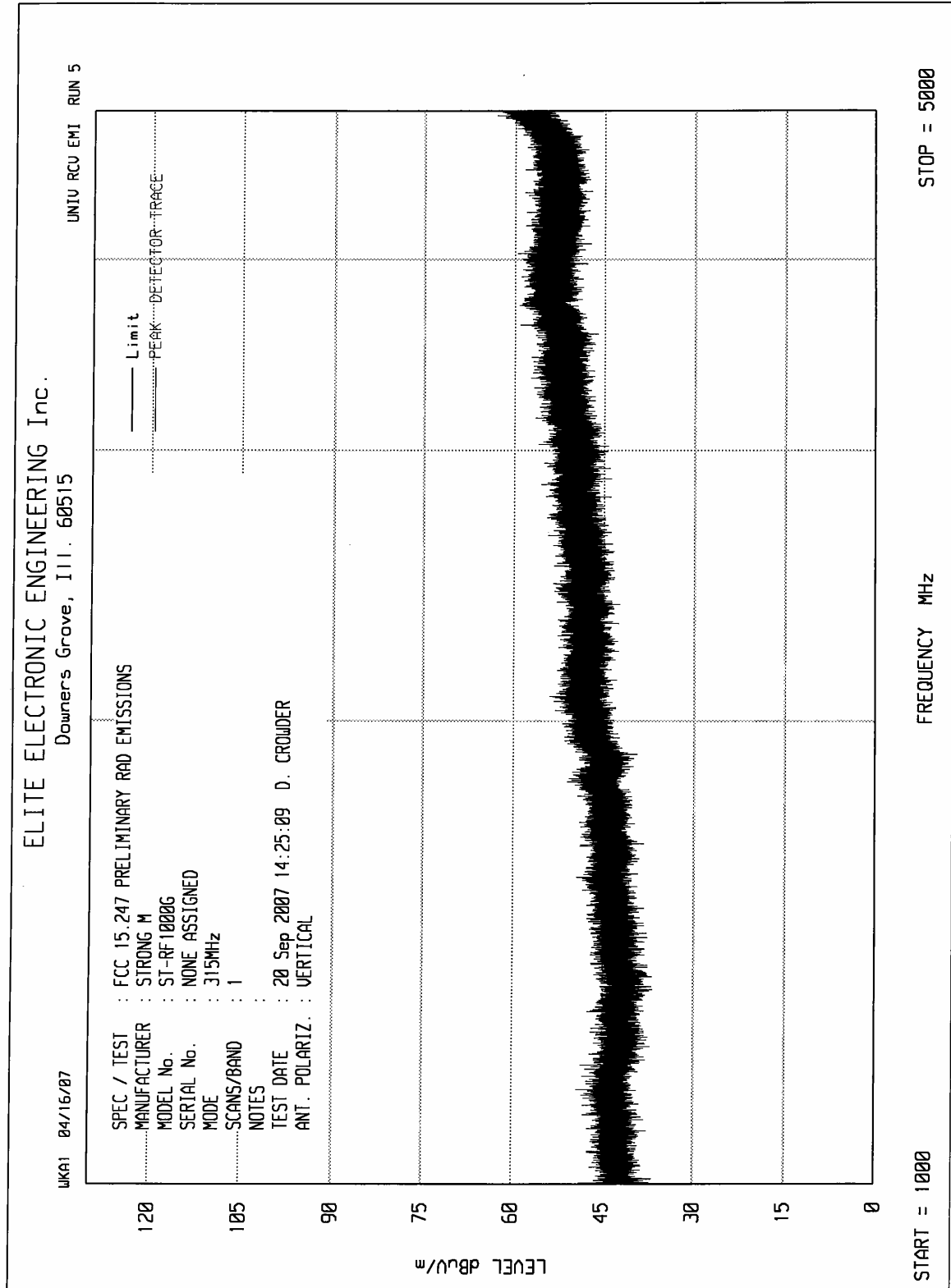
ELITE ELECTRONIC ENGINEERING Co.
Downers Grove, IL 60515



TRANSMITTER DUTY CYCLE		MANUFACTURER : CHAMBERLAIN	
FREQUENCY : 314.8783 MHz	MODEL : ORACLE PRO		
ON TIME : 7.732 mSEC	S/N : NONE ASSIGNED		
OFF TIME : 12.268 mSEC	TEST DATE : 24 Sep 2007		
DUTY CYCLE = .39 or -8.18 dB	NOTES :		
COMPUTED OVER 100 mSEC			

This plot is presented to demonstrate the maximum pulse width. It was not used to calculate the Duty Cycle.







MANUFACTURER : Chamberlain
MODEL : Oracle Pro
S/N : None Assigned
SPECIFICATION : FCC-15C Radiated Emissions
DATE : September 24, 2007
NOTES : Transmitting @ 315MHz
: TEST DISTANCE IS 3 METERS

Freq (MHz)	Ant Pol	Meter		CBL Fac (dB)	Ant Fac (dB)	Duty Cycle (dB)	Total dBuV/m at 3 M	Total uV/m at 3M	Limit uV/m at 3M	Margin (dB)
		Reading (dBuV)	Ambient							
315.00	H	67.1		1.3	14.4	-10.0	72.8	4373.3	6041.7	-2.8
315.00	V	57.7		1.3	14.4	-10.0	63.4	1481.9	6041.7	-12.2
630.00	H	27.6		1.7	20.0	-10.0	39.3	92.7	604.2	-16.3
630.00	V	40.8		1.7	20.0	-10.0	52.5	423.6	604.2	-3.1
945.00	H	28.2		2.0	22.5	-10.0	42.7	135.8	604.2	-13.0
945.00	V	25.1		2.0	22.5	-10.0	39.6	95.1	604.2	-16.1
1260.00	H	24.4		2.3	25.6	-10.0	42.3	130.5	604.2	-13.3
1260.00	V	24.5		2.3	25.6	-10.0	42.4	132.0	604.2	-13.2
1575.00	H	17.4		2.6	26.3	-10.0	36.3	65.2	500.0	-17.7
1575.00	V	20.0		2.6	26.3	-10.0	38.9	87.9	500.0	-15.1
1890.00	H	19.8		2.9	27.7	-10.0	40.4	104.8	604.2	-15.2
1890.00	V	18.5		2.9	27.7	-10.0	39.1	90.2	604.2	-16.5
2205.00	H	13.1	Ambient	3.2	28.8	-10.0	35.1	56.6	500.0	-18.9
2205.00	V	12.6	Ambient	3.2	28.8	-10.0	34.6	53.4	500.0	-19.4
2520.00	H	12.3	Ambient	3.5	29.5	-10.0	35.3	58.4	604.2	-20.3
2520.00	V	12.0	Ambient	3.5	29.5	-10.0	35.0	56.4	604.2	-20.6
2835.00	H	12.0	Ambient	3.8	30.4	-10.0	36.3	65.0	500.0	-17.7
2835.00	V	11.6	Ambient	3.8	30.4	-10.0	35.9	62.1	500.0	-18.1
3150.00	H	11.9	Ambient	4.1	31.6	-10.0	37.6	75.5	604.2	-18.1
3150.00	V	12.0	Ambient	4.1	31.6	-10.0	37.7	76.3	604.2	-18.0

Checked By:

ELITE ELECTRONIC ENGINEERING Inc.

