



Measurement of RF Interference from an ODI1 Wireless Access & Intercom System

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

P.O. No. : 856015
Date Tested : October 26, 2007 through November 1, 2007
Test Personnel : Mark E. Longinotti
Specification : Part 15, Subpart C
: Industry Canada RSS-210
: Industry Canada RSS-GEN

Test Report By : *MARK E. LONGINOTTI*
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Registered Professional
Engineer of Illinois - 44894

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Revision History

Revision	Date	Description
—	11/01/2007	Initial release

Measurement of RF Emissions from an ODI1 Wireless Access & Intercom System

1 INTRODUCTION

1.1 Scope of Tests

This document represents the results of the series of radio interference measurements performed on a model ODI1 transmitter, Serial No. None Assigned (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 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 24°C and the relative humidity was 34%.

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 an ODI1 Wireless Access & Intercom System. 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 four (4) each "AA" 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 once the test item was powered up. Under normal operating conditions, the test item transmits for 840 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 are required.

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 transmitter used 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 3.5GHz was investigated using a peak detector function. The data was then processed by the computer to calculate equivalent field intensity.

The final emissions tests were then manually performed over the frequency range of 30MHz to 3500MHz. 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.

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. The 99% bandwidth was measured to be 212.42 kHz.

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 ODI1 Wireless Access & Intercom System, Serial No. None Assigned, did not 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

Page: 1

ELITE ELECTRONIC ENG. INC.

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Cal Inv	Due Date
Equipment Type: ANTENNAS								
NDP1	TUNED DIPOLE ANTENNA	EMCO	3121C-DB3	313	140-400MHZ	09/28/07 12		09/28/08
NDQ1	TUNED DIPOLE ANTENNA	EMCO	3121C-DB4	313	400-1000MHZ	03/28/07 12		03/28/08
NTA1	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL611	2054	0.03-2GHZ	06/05/07 12		06/05/08
NWH0	RIDGED WAVE GUIDE	TENSOR	4105	2081	1-12.4GHZ	10/13/07 12		10/13/08
Equipment Type: CONTROLLERS								
CDS2	COMPUTER	GATEWAY	MFATXPNT NMZ	0028483108	1.8GHZ		N/A	
Equipment Type: METERS								
MSI1	DIGITAL OSCILLOSCOPE (DCC-	LECROY CORP.	9310AM	4546	DC-400MHZ	07/23/07 12		07/23/08
Equipment Type: PRINTERS AND PLOTTERS								
HRE1	LASER JET 5P	HEWLETT PACKARD	C3150A	USHB061052	---		N/A	
Equipment Type: RECEIVERS								
RAKG	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.

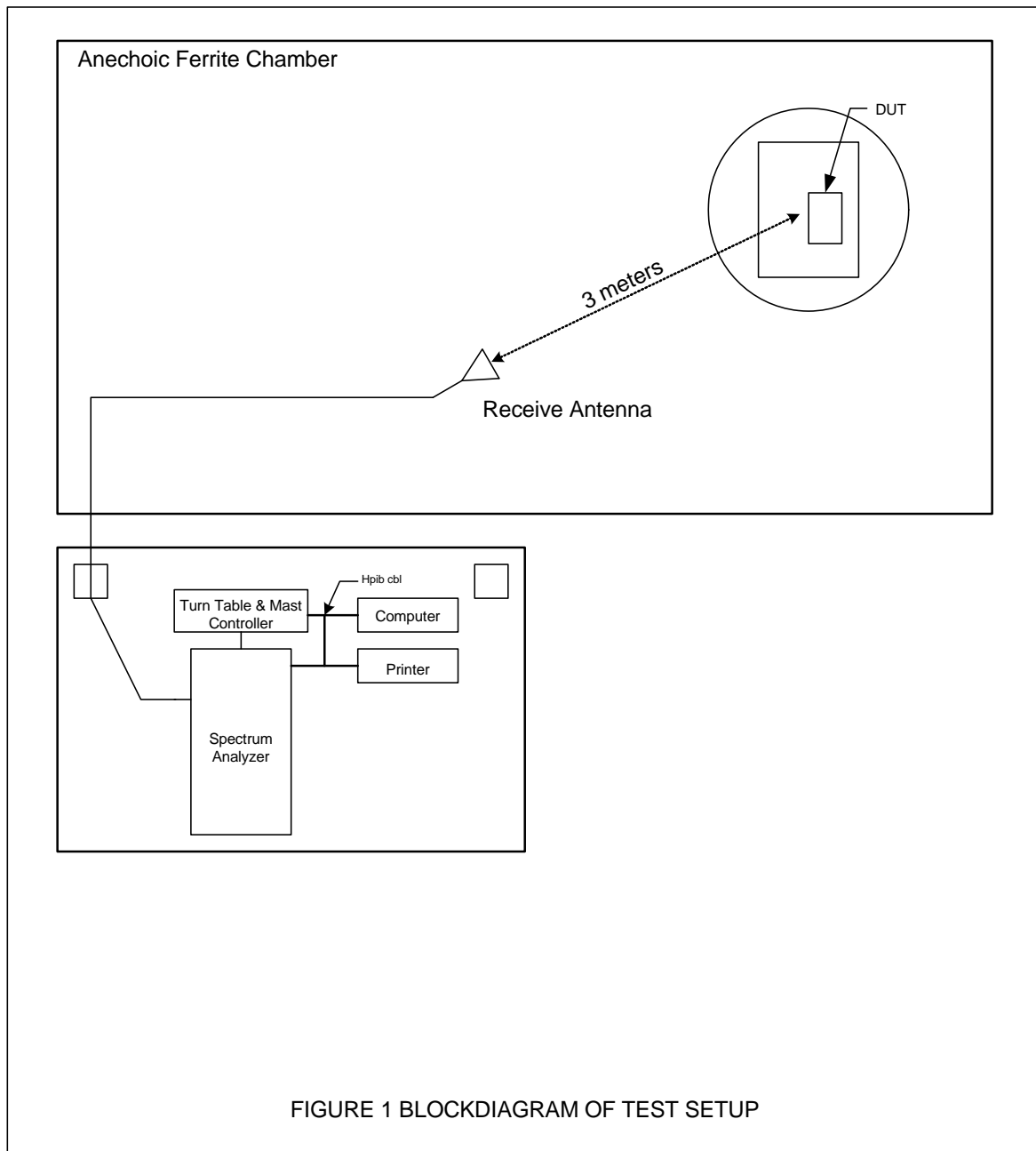


Figure 2

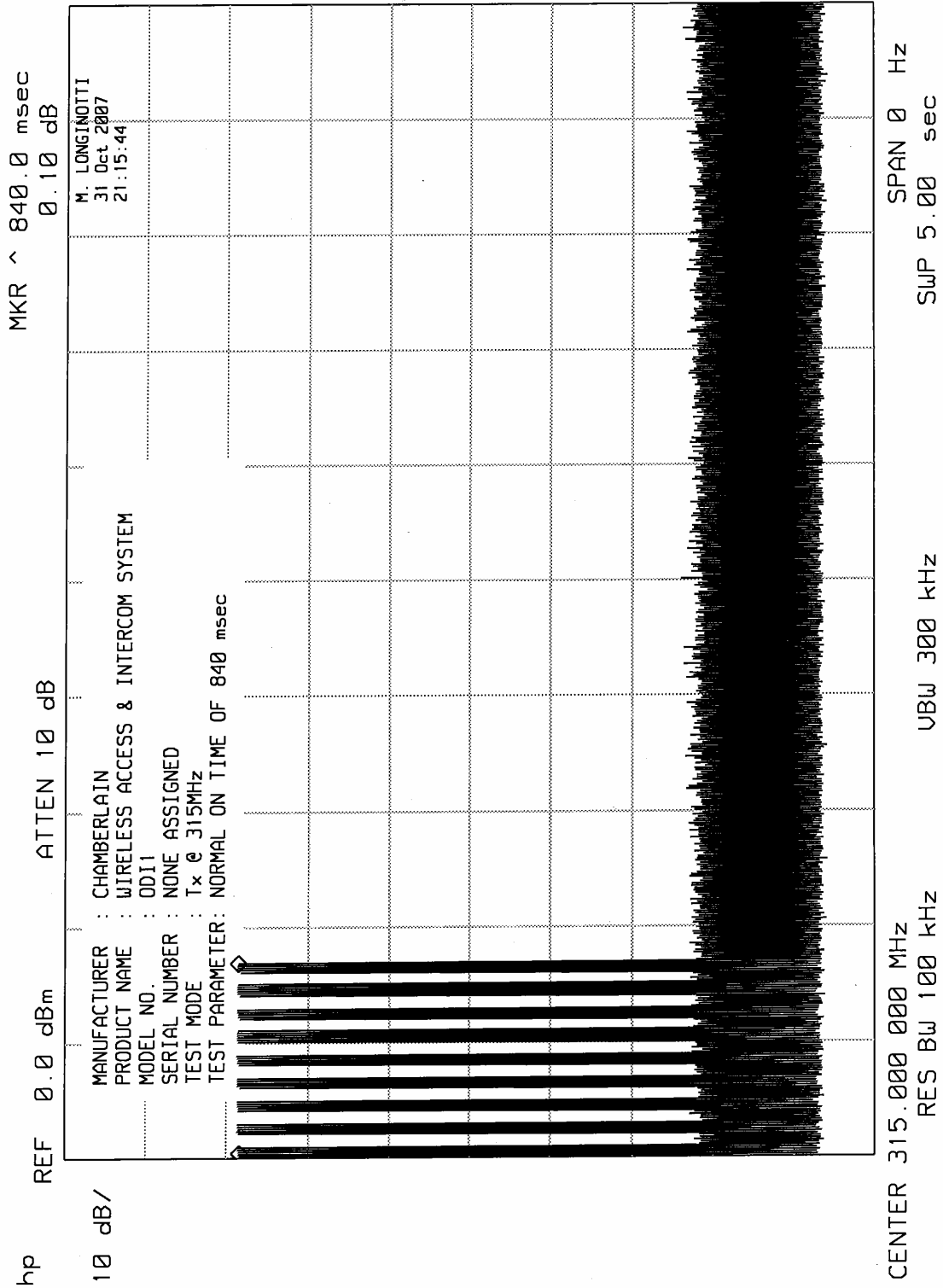


Test Set-up for Radiated Emissions – Horizontal Polarity



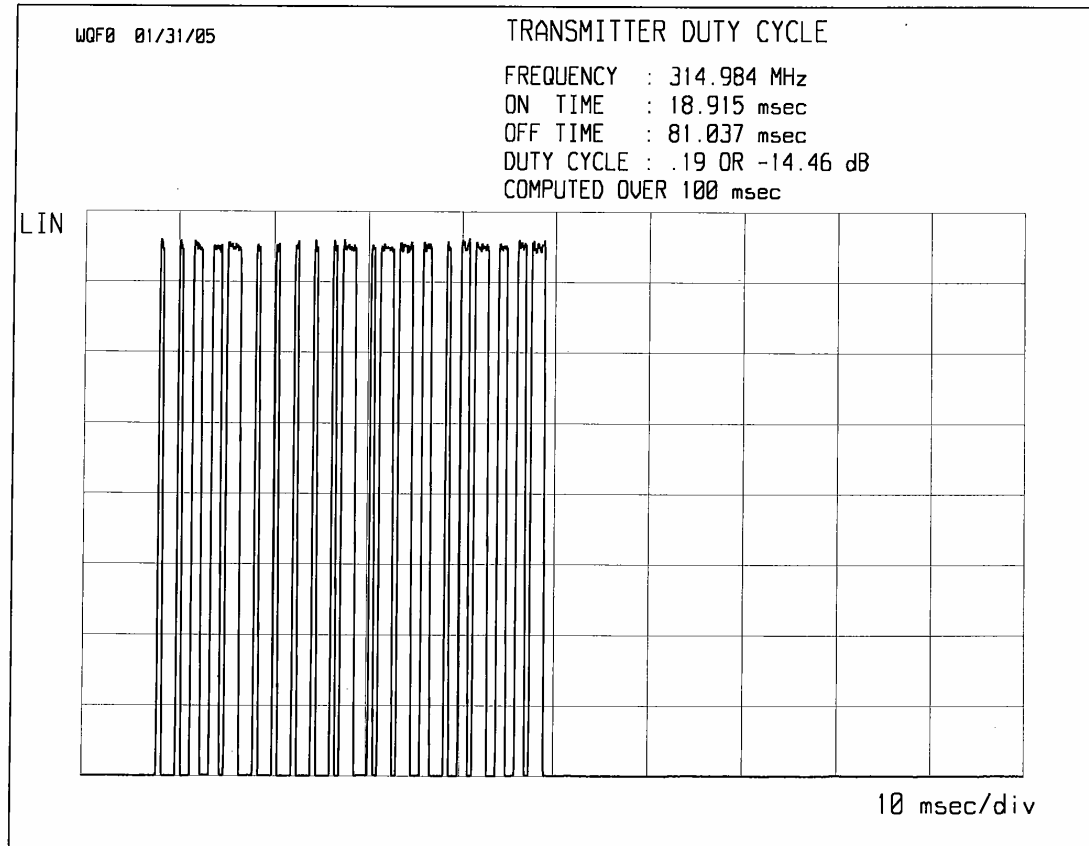
Test Set-up for Radiated Emissions – Vertical Polarity

ELITE ELECTRONIC ENGINEERING Inc.



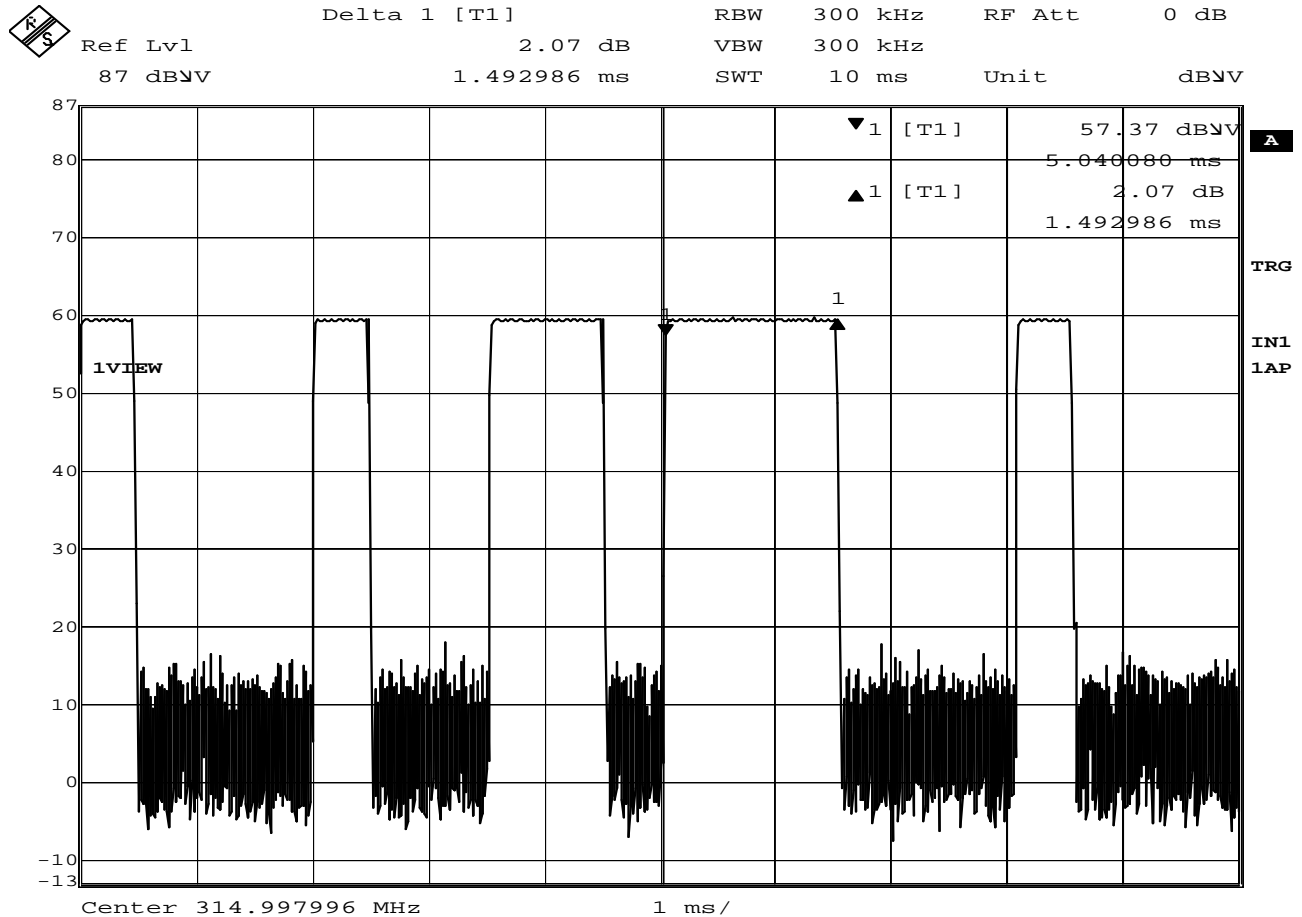


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, IL 60515



MANUFACTURER : CHAMBERLAIN
MODEL : ODI1
S/N : NONE ASSIGNED
NOTES : Tx @ 315MHz
DATE : 26 Oct 2007 13:14:43 M. LONGINOTTI

pg ____ of ____



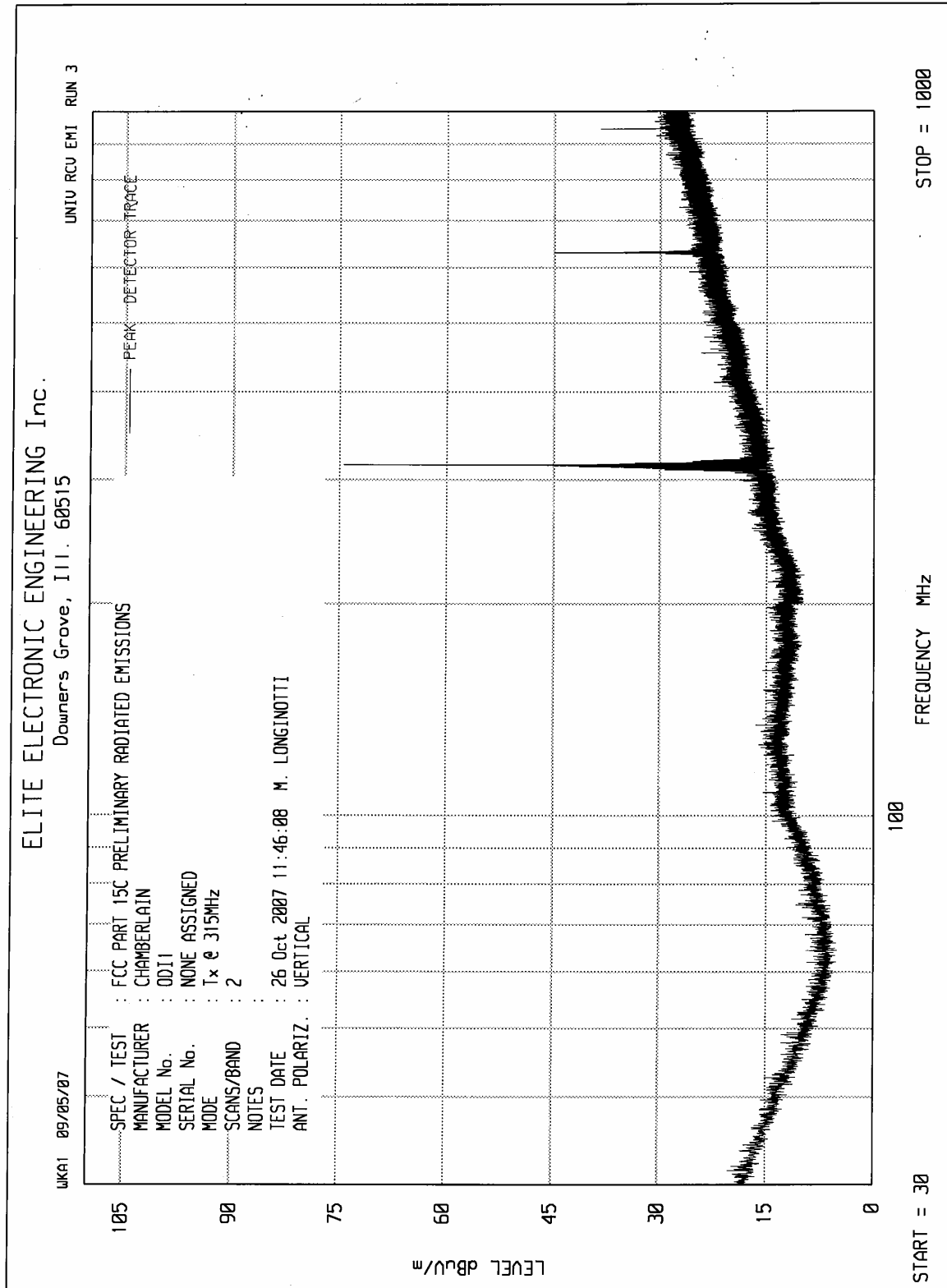
Date: 26.OCT.2007 12:56:56

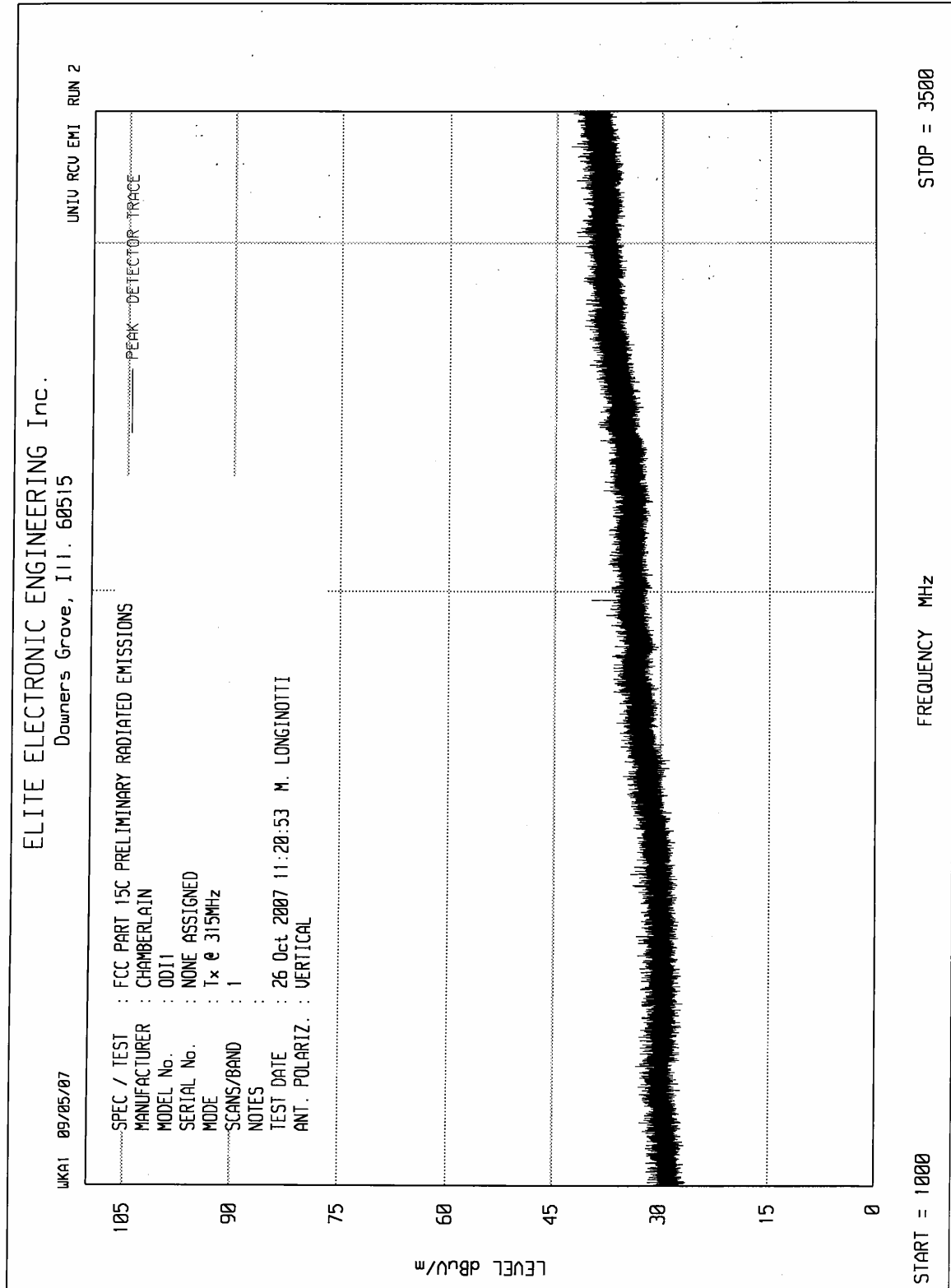
FCC 15.231 Duty Cycle Factor

MANUFACTURER : Chamberlain
PRODUCT NAME : Wireless Access & Intercom System
MODEL NUMBER : ODI1
SERIAL NUMBER : None Assigned
TEST MODE : Tx @ 315MHz
TEST PARAMETER : The display shows a widest pulse width of
: 1.493msec.

EQUIPMENT USED : RBA0, NTA1

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



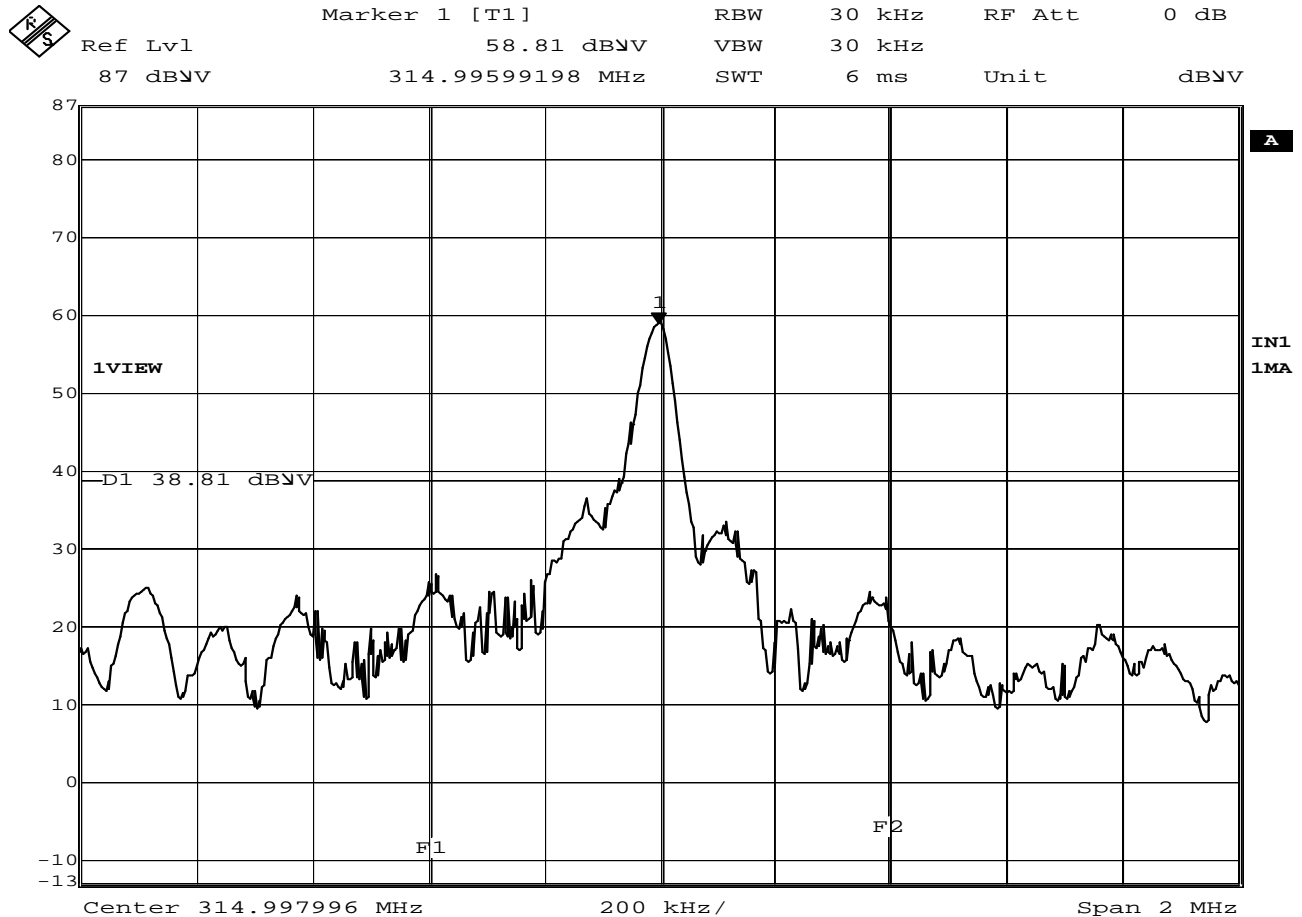




MANUFACTURER : Chamberlain
MODEL : ODI1
S/N : None Assigned
SPECIFICATION : FCC-15C Radiated Emissions
DATE : October 26, 2007
NOTES : Transmitting @ 315MHz
: TEST DISTANCE IS 3 METERS

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							
315.0	H	59.6		1.3	18.4	-10.0	69.3	2927.0	6041.7	-6.3
315.0	V	65.5		1.3	18.4	-10.0	75.2	5773.3	6041.7	-0.4
630.0	H	11.7		1.7	24.7	-10.0	28.1	25.6	604.2	-27.5
630.0	V	19.8		1.7	24.7	-10.0	36.2	64.9	604.2	-19.4
945.0	H	10.5		2.0	28.5	-10.0	31.0	35.3	604.2	-24.7
945.0	V	16.0		2.0	28.5	-10.0	36.5	66.5	604.2	-19.2
1260.0	H	13.4	Ambient	2.3	25.6	-10.0	31.4	37.0	604.2	-24.3
1260.0	V	12.7	Ambient	2.3	25.6	-10.0	30.7	34.2	604.2	-25.0
1575.0	H	12.1	Ambient	2.7	26.4	-10.0	31.1	36.0	500.0	-22.8
1575.0	V	12.8	Ambient	2.7	26.4	-10.0	31.8	39.1	500.0	-22.1
1890.0	H	11.5	Ambient	2.9	27.8	-10.0	32.3	41.0	604.2	-23.4
1890.0	V	11.6	Ambient	2.9	27.8	-10.0	32.4	41.5	604.2	-23.3
2205.0	H	10.6	Ambient	3.2	28.8	-10.0	32.7	43.1	500.0	-21.3
2205.0	V	12.1	Ambient	3.2	28.8	-10.0	34.2	51.2	500.0	-19.8
2520.0	H	11.9	Ambient	3.6	29.6	-10.0	35.1	56.8	604.2	-20.5
2520.0	V	12.2	Ambient	3.6	29.6	-10.0	35.4	58.8	604.2	-20.2
2835.0	H	12.2	Ambient	3.9	30.6	-10.0	36.6	67.8	500.0	-17.3
2835.0	V	13.4	Ambient	3.9	30.6	-10.0	37.8	77.9	500.0	-16.1
3150.0	H	11.6	Ambient	4.1	31.9	-10.0	37.6	75.5	604.2	-18.1
3150.0	V	11.6	Ambient	4.1	31.9	-10.0	37.6	75.5	604.2	-18.1

Checked By: MARK E. LONGINOTTI



Date: 26.OCT.2007 11:19:55

FCC 15.231

MANUFACTURER : Chamberlain
PRODUCT NAME : Wireless Access & Intercom System
MODEL NUMBER : ODI1
SERIAL NUMBER : None Assigned
TEST MODE : Tx @ 315MHz
TEST PARAMETER : Display Line (D1) represents the 20dB down point
: from the modulated carrier. Display Lines (F1 &
: F2) represent the 0.25% bandwidth.
EQUIPMENT USED : RBA0, NTA1