




Measurement of RF Interference from a Model 6444 Remote Control Doorbell Transmitter

For : HeathCo LLC
2445 Nashville Road
Bowling Green, KY 42102

P.O. No. :
Date Tested : June 1 and 2, 2010
Test Personnel : Daniel Crowder
Specification : FCC "Code of Federal Regulations" Title 47
Part 15, Subpart C
: Industry Canada RSS-210
: Industry Canada RSS-GEN

Test Report By : 
Daniel Crowder
EMC Engineer

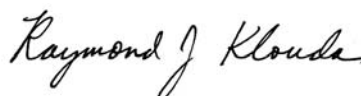
Approved By : 
Raymond J. Klouda
Registered Professional
Engineer of Illinois - 44894



TABLE OF CONTENTS

PARAGRAPH	DESCRIPTION OF CONTENTS	PAGE NO.
1	INTRODUCTION.....	5
1.1	Scope of Tests.....	5
1.2	Purpose	5
1.3	Deviations, Additions and Exclusions.....	5
1.4	EMC Laboratory Identification	5
1.5	Laboratory Conditions	5
2	APPLICABLE DOCUMENTS.....	5
3	TEST ITEM SETUP AND OPERATION.....	6
3.1	General Description.....	6
3.1.1	Power Input	6
3.1.2	Peripheral Equipment.....	6
3.1.3	Interconnect Cables	6
3.1.4	Grounding.....	6
3.2	Operational Mode	6
3.3	Test Item Modifications.....	6
4	TEST FACILITY AND TEST INSTRUMENTATION.....	6
4.1	Shielded Enclosure.....	6
4.2	Test Instrumentation.....	6
4.3	Calibration Traceability	6
4.4	Measurement Uncertainty	6
5	TEST PROCEDURES.....	7
5.1	Powerline Conducted Emissions.....	7
5.1.1	Requirements	7
5.2	Periodic Operation Measurements.....	7
5.2.1	Requirements	7
5.2.2	Procedures	7
5.2.3	Results	7
5.3	Duty Cycle Factor Measurements	7
5.3.1	Procedures	7
5.3.2	Results	7
5.4	Radiated Measurements	8
5.4.1	Requirements	8
5.4.2	Procedures	8
5.4.3	Results	9
5.5	Occupied Bandwidth Measurements.....	9
5.5.1	Requirement.....	9
5.5.2	Procedures	9
5.5.3	Results	9
6	OTHER TEST CONDITIONS.....	9

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TABLE OF CONTENTS

<u>PARAGRAPH</u>	<u>DESCRIPTION OF CONTENTS</u>	<u>PAGE NO.</u>
6.1	Test Personnel and Witnesses.....	9
6.2	Disposition of the Test Item.....	9
7	CONCLUSIONS.....	9
8	CERTIFICATION.....	9
9	EQUIPMENT LIST.....	10

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REVISION HISTORY

Revision	Date	Description
—	June 3,2010	Initial release

Measurement of RF Emissions from a Model 6444 Remote Control Doorbell Transmitter

1 INTRODUCTION

1.1 Scope of Tests

This document represents the results of the series of radio interference measurements performed on a model 6444 Remote Control Doorbell 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 HeathCo LLC located in Bowling Green, KY.

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 and Industry Canada Radio Standards Specification RSS-Gen and RSS-210. 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 American Association for Laboratory Accreditation (A2LA). A2LA Certificate Number: 1786.01.

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 2009
- 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 7, June 2007, "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 2, June 2007, "Spectrum Management and Telecommunications Radio Standards Specification, General Requirements and Information for the Certification of radio communication equipment"



3 TEST ITEM SETUP AND OPERATION

3.1 General Description

The test item is a Remote Control Doorbell, Part No. 6444. A block diagram of the test item setup is shown as Figure 1.

3.1.1 Power Input

The test item obtained 6VDC via 2 CR2032 Lithium batteries.

3.1.2 Peripheral Equipment

The test item had no ports for connection to peripheral equipment.

3.1.3 Interconnect Cables

The test item had no ports for connection to 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 placed on an 80cm high non-conductive stand. The test item was energized and set to transmit continuously.

3.3 Test Item Modifications

No modifications were required for compliance to the 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.

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.

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

5 TEST PROCEDURES

5.1 Powerline Conducted Emissions

5.1.1 Requirements

Since the test item was powered by internal batteries, conducted emission tests are not required.

5.2 Periodic Operation Measurements

5.2.1 Requirements

A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released. Also, a transmitter activated automatically shall cease transmission within 5 seconds after activation.

5.2.2 Procedures

The spectrum analyzer was setup to display the time domain trace. The test item was set to transmit normally. The spectrum analyzer was used to record the amount of time that the test item remained active following activation.

5.2.3 Results

The plot of the timing is shown on page 13. The data shows that when the transmit button is released, the test item ceases operation within the allotted time.

5.3 Duty Cycle Factor Measurements

5.3.1 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 the sweep time set to observe the entire word period. 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).

5.3.2 Results

Plots of the duty cycle are shown on pages 14 through 16. The duty cycle factor was computed to be -10.1 dB.



5.4 Radiated Measurements

5.4.1 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.

5.4.2 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 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 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.
- 5) In instances where it was necessary to use a shortened cable between the measuring antenna and the spectrum analyzer and the antenna cannot be raised to 4 meters. The measuring antenna is raised or lowered as much as the cable will allow and the test item is rotated through all axis to ensure the maximum readings are recorded. See attached Figure.



5.4.3 Results

The preliminary plots, with the test item transmitting at 315MHz, are presented on pages 17 and 18. 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 page 19. As can be seen from the data, all emissions measured from the test item were within the specification limits. The effective radiated power was calculated to be -23.2dBm. Photographs of the test configuration which yielded the highest, or worst case, radiated emission levels are shown on Figure 2.

5.5 Occupied Bandwidth Measurements

5.5.1 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.

5.5.2 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 50 kHz and span was set to 2 MHz. The frequency spectrum near the fundamental was plotted.

5.5.3 Results

The plot of the emissions near the fundamental frequency is presented on page 20. As can be seen from this data page, the transmitter met the occupied bandwidth requirements. The 99% bandwidth was measured to be 280kHz.

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 HeathCo LLC upon completion of the tests.

7 CONCLUSIONS

It was determined that the HeathCo LLC Remote Control Doorbell, Part No. 6444, 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 and Industry Canada Radio Standards Specification RSS-Gen and RSS-210, 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. 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

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
CMA0	MULTI-DEVICE CONTROLLER	EMCO	2090	9701-1213	---	N/A	
NTA1	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL6112	2054	0.03-2GHZ	9/10/2009	9/10/2010
NWH0	RIDGED WAVE GUIDE	TENSOR	4105	2081	1-12.4GHZ	8/11/2009	8/11/2010
PHA0	MAGNETIC FIELD PROBE	ELECTRO-METRICS	EM-6882	134	22-230MHZ	NOTE 1	
RBB0	EMI TEST RECEIVER 20HZ TO 40 GHZ.	ROHDE & SCHWARZ	ESIB40	100250	20 HZ TO 40GHZ	3/16/2010	3/16/2011

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.

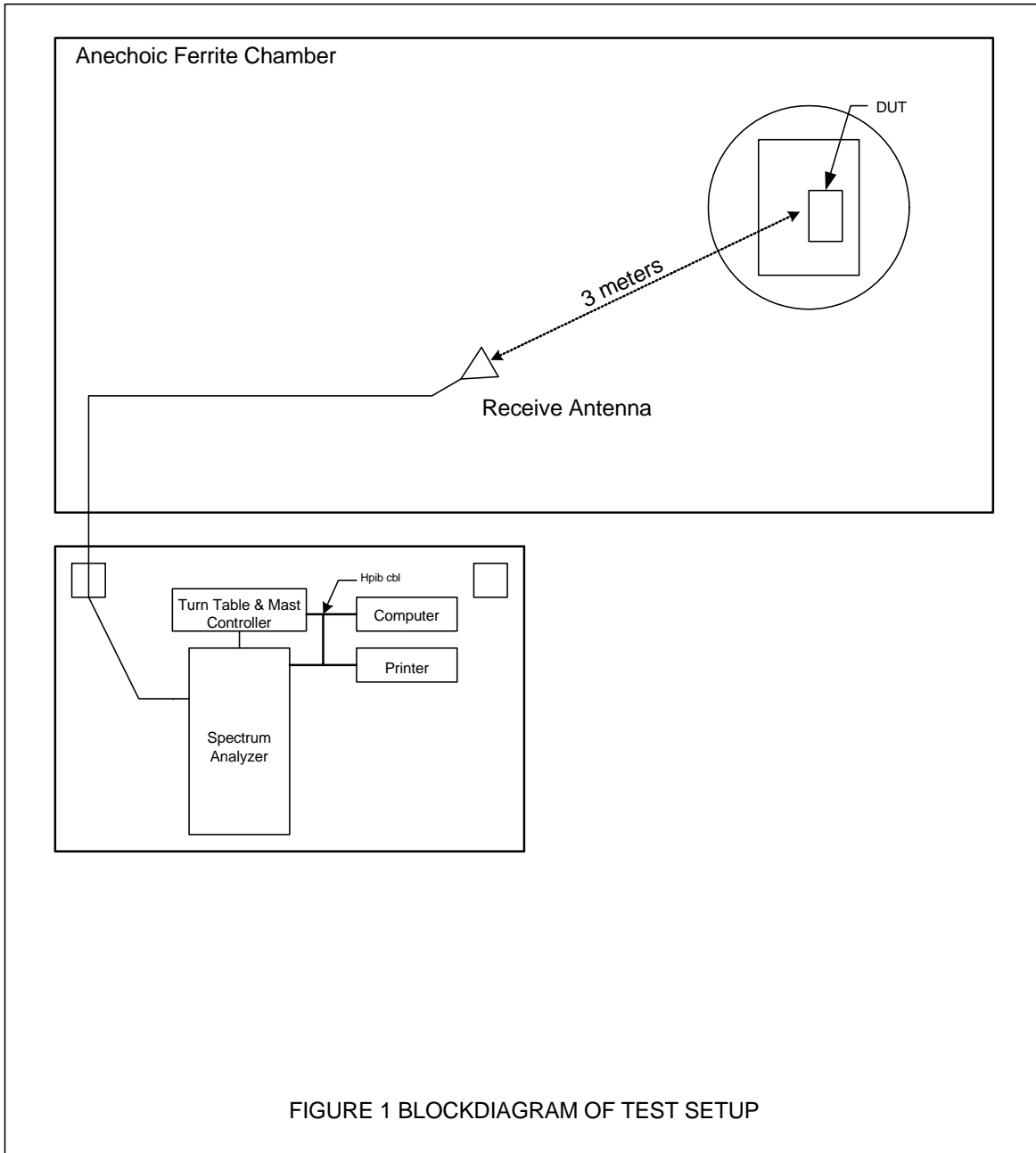


Figure 2



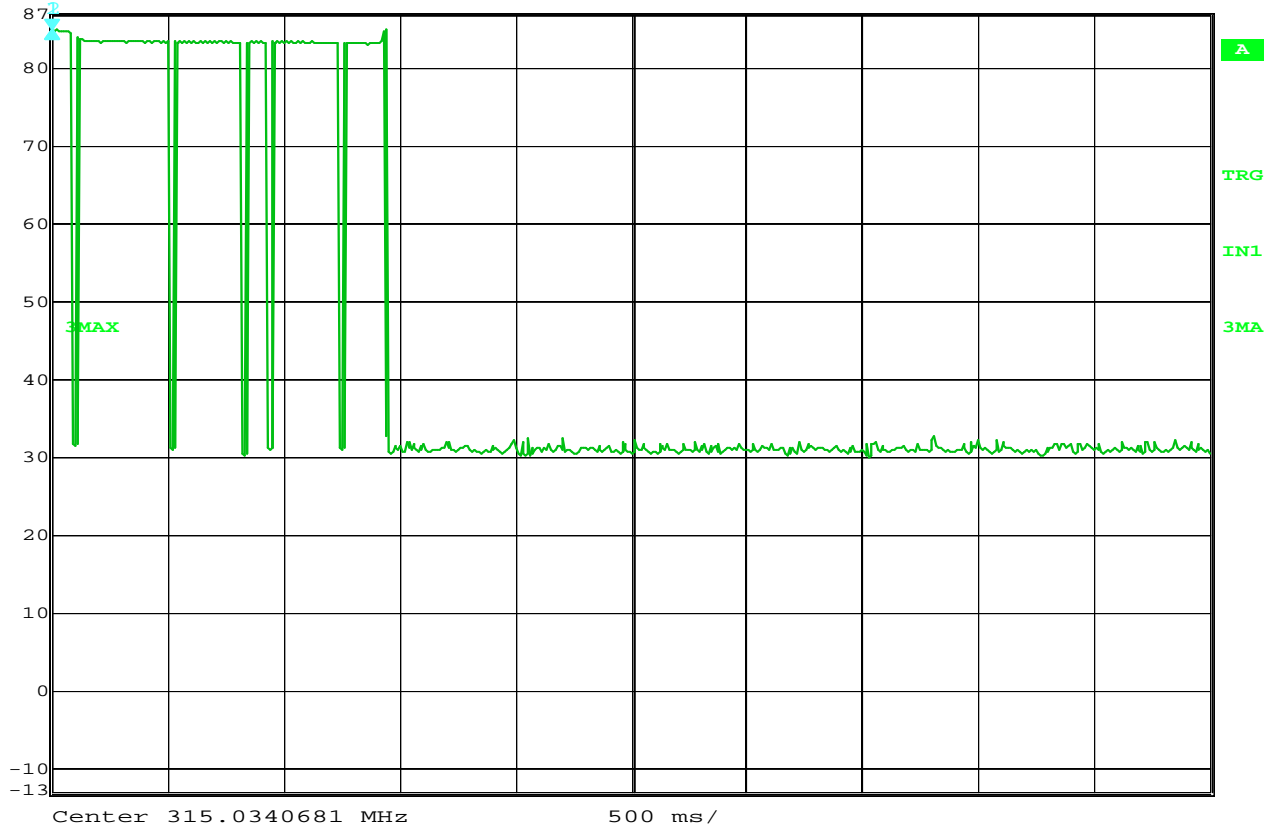
Test Setup for Radiated Emissions – Horizontal Polarity



Test Setup for Radiated Emissions – Vertical Polarity



Delta 2 [T3] RBW 1 MHz RF Att 10 dB
 Ref Lvl 0.00 dB VBW 1 MHz
 87 dBμV 0.000000 s SWT 5 s Unit dBμV



Date: 1.JUN.2010 15:48:43

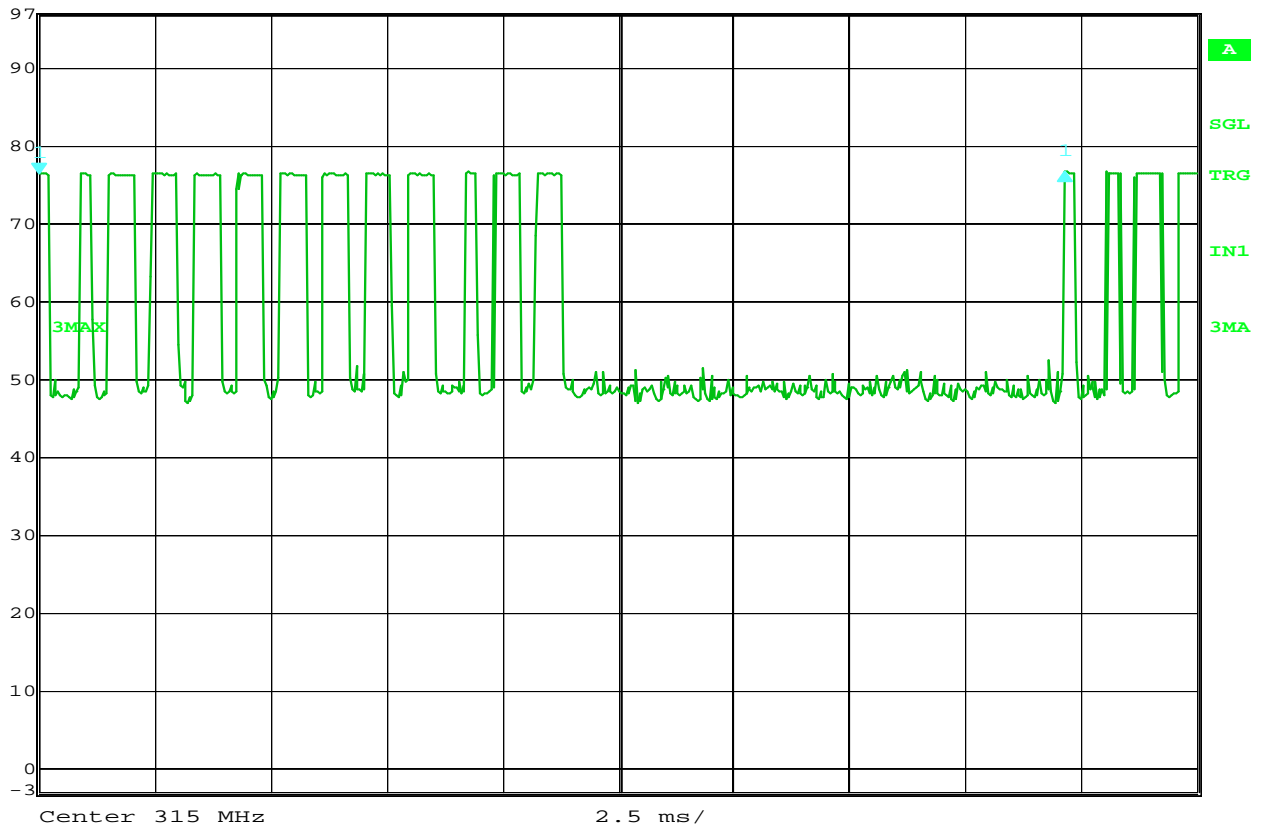
FCC-15C Deactivation within 5 Seconds

MANUFACTURER : HeathCo.
 MODEL NUMBER : 6444 Remote Control Doorbell
 SERIAL NUMBER : None Assigned
 TEST MODE : Transmit
 TEST PARAMETERS : The test item ceased transmission as soon as the transmit button was released
 (Transmission must cease within 5 seconds).
 EQUIPMENT USED : RBB0, PHA0

NOTES



	Delta 1 [T3]	RBW	10 MHz	RF Att	20 dB
Ref Lvl	0.28 dB	VBW	10 MHz		
97 dB μ V	22.144289 ms	SWT	25 ms	Unit	dB μ V



Date: 1.JUN.2010 15:28:39

FCC-15C Duty Cycle Measurements

MANUFACTURER : HeathCo.
 MODEL NUMBER : 6444 Remote Control Doorbell
 SERIAL NUMBER : None Assigned
 TEST MODE : Transmit
 TEST PARAMETERS : Word Period = 22.14mSec. The word consisted of 13 bits, 3 short and 10 long. The word on time was calculated as 3 * 290.6uSec (871.8uSec) + 10 * 601.2uSec (6012uSec) or 6.88mSec. The duty cycle was calculated as 6.88mSec/22.14mSec or 0.31. The duty cycle factor was calculated as 20Log0.31 or -10.1dB
 EQUIPMENT USED : RBB0, PHA0

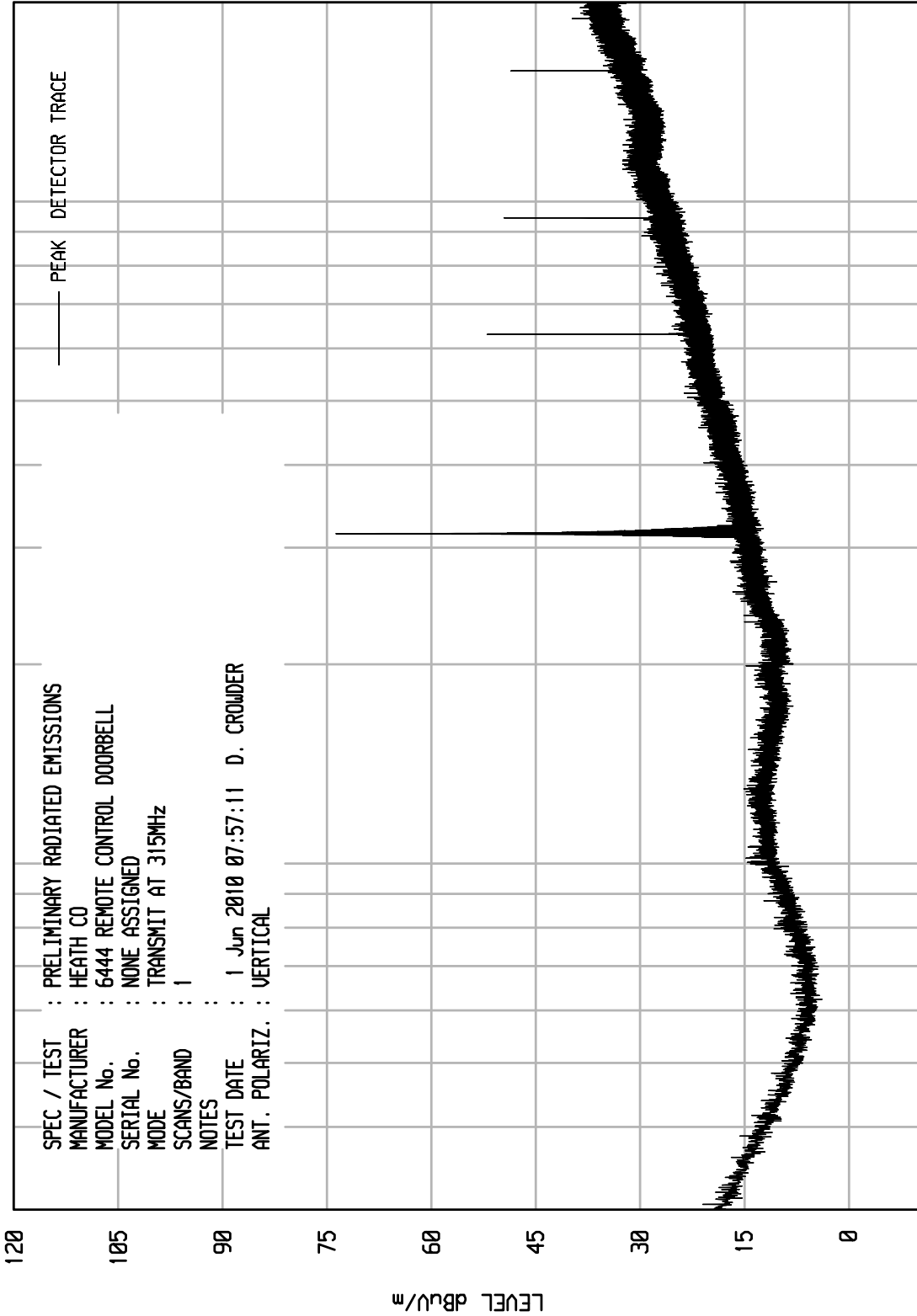
NOTES

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515

UNITV RCU EMI RUN 2

WKAI 01/25/10

SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
 MANUFACTURER : HEATH CO
 MODEL No. : 6444 REMOTE CONTROL DOORBELL
 SERIAL No. : NONE ASSIGNED
 MODE : TRANSMIT AT 315MHz
 SCANS/BAND : 1
 NOTES :
 TEST DATE : 1 Jun 2010 07:57:11 D. CROWDER
 ANT. POLARIZ. : VERTICAL



STOP = 2000

1000

FREQUENCY MHz

100

START = 30

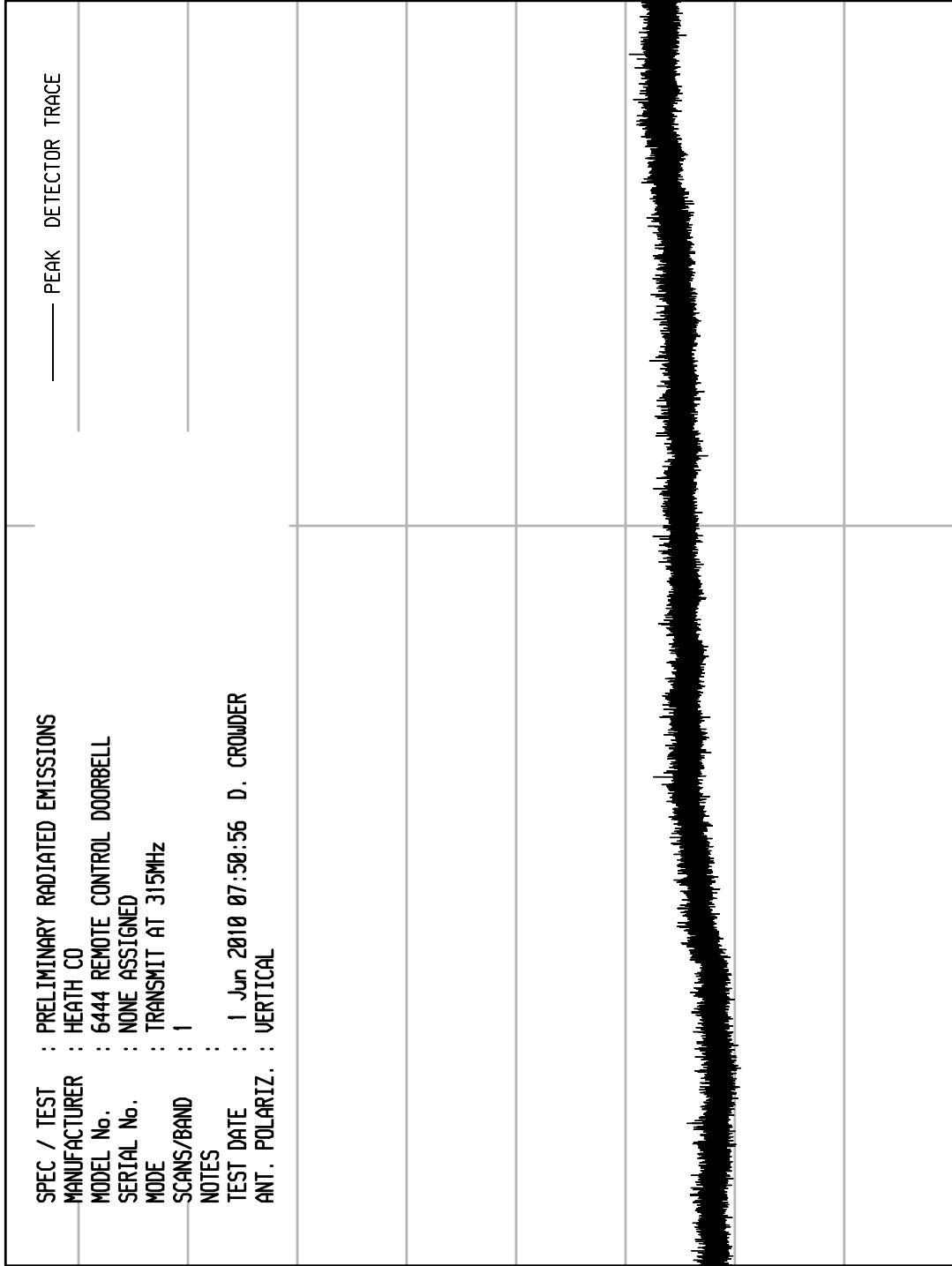
ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515

UNITV RCU EMI RUN 1

WKA1 01/25/10

SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
 MANUFACTURER : HEATH CO
 MODEL No. : 6444 REMOTE CONTROL DOORBELL
 SERIAL No. : NONE ASSIGNED
 MODE : TRANSMIT AT 315MHz
 SCANS/BAND : 1
 NOTES :
 TEST DATE : 1 Jun 2010 07:50:56 D. CROWDER
 ANT. POLARIZ. : VERTICAL

— PEAK DETECTOR TRACE



START = 2000

FREQUENCY MHz

STOP = 4000



ETR No.
DATA PAGE

SPECIFICATION : FCC PART 15C TRANSMITTER OPEN FIELD DATA
MANUFACTURER : HEATH CO
MODEL : 6444 REMOTE CONTROL DOORBELL
S/N : NONE ASSIGNED
TEST DATE : 2 Jun 2010
NOTES :
TEST ANTENNA : CHASE BI-LOG & DRWG ANTENNAS

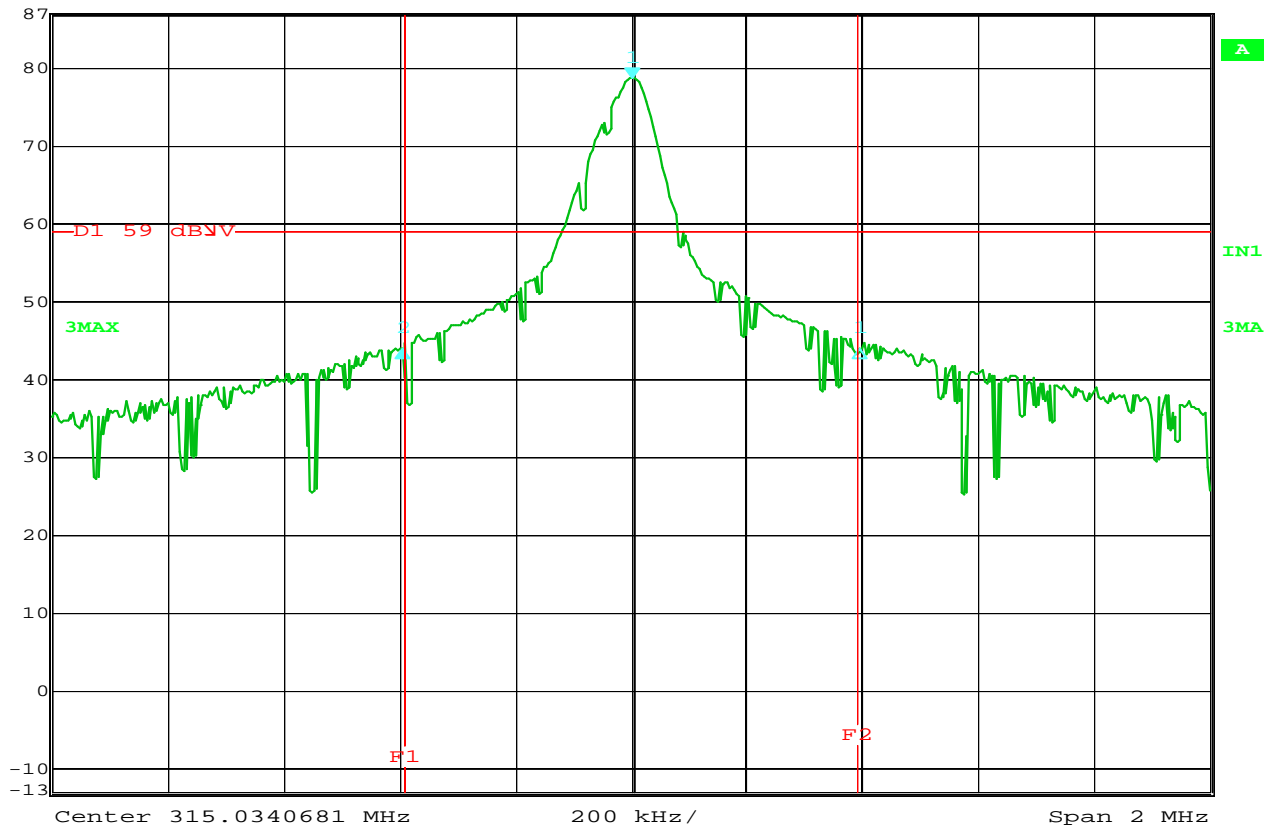
FREQUENCY MHz	ANT POL	MTR RDG dBuV	CBL FAC dB	ANT FAC dB	DUTY CYCLE dB	TOTAL dBuV/m @3m	TOTAL uV/m @3m	LIMIT uV/m @3m	NOTES
315.00	H	58.6	1.5	14.3	-10.1	64.3	1634.0	6041.7	
315.00	V	68.3	1.5	14.3	-10.1	74.0	4991.6	6041.7	
630.00	H	20.2	2.1	19.8	-10.1	32.0	39.7	604.2	
630.00	V	31.9	2.1	19.8	-10.1	43.7	152.5	604.2	
945.00	H	17.5	2.5	22.7	-10.1	32.5	42.3	604.2	
945.00	V	26.9	2.5	22.7	-10.1	41.9	124.7	604.2	
1260.00	H	18.0	2.8	24.8	-10.1	35.5	59.6	604.2	
1260.00	V	18.2	2.8	24.8	-10.1	35.7	61.0	604.2	
1575.00	H	23.4	3.2	25.3	-10.1	41.8	122.5	500.0	*
1575.00	V	32.4	3.2	25.3	-10.1	50.8	345.3	500.0	*
1890.00	H	15.0	3.4	27.4	-10.1	35.7	60.8	604.2	
1890.00	V	14.5	3.4	27.4	-10.1	35.2	57.4	604.2	
2205.00	H	14.5	3.8	27.6	-10.1	35.7	61.3	500.0	*
2205.00	V	14.1	3.8	27.6	-10.1	35.3	58.5	500.0	*
2520.00	H	14.8	4.1	29.2	-10.1	38.0	79.7	604.2	
2520.00	V	15.4	4.1	29.2	-10.1	38.6	85.4	604.2	
2835.00	H	15.1	4.5	29.7	-10.1	39.1	90.5	500.0	*
2835.00	V	14.8	4.5	29.7	-10.1	38.8	87.5	500.0	*
3150.00	H	14.3	4.7	31.4	-10.1	40.3	103.2	604.2	
3150.00	V	15.2	4.7	31.4	-10.1	41.2	114.5	604.2	

* DENOTES A FREQUENCY CONFLICT WITH RESTRICTED BANDS

checked by: _____
D. CROWDER



Delta 2 [T3] RBW 50 kHz RF Att 10 dB
 Ref Lvl -34.73 dB VBW 50 kHz
 87 dBmV -394.78957916 kHz SWT 5 ms Unit dBmV



Date: 1.JUN.2010 15:44:00

FCC-15C Occupied Bandwidth Measurement

MANUFACTURER : HeathCo.
 MODEL NUMBER : 6444 Remote Control Doorbell
 SERIAL NUMBER : None Assigned
 TEST MODE : Transmit
 TEST PARAMETERS : 0.25% Bandwidth = 788kHz
 EQUIPMENT USED : RBB0, PHA0

NOTES