



Measurement of RF Emissions from a NOTIFI Wireless Video System Transmitter Model WLTX-3010

For	HeathCo LLC 2445 Nashville Rd Bowling Green, Kentucky 42102
P.O. Number	N/A
Date Tested	November 18-23, 2015 and January 18, 2016
Test Personnel	Richard King
Test Specification	FCC "Code of Federal Regulations" Title 47 Part15, Subpart C Industry Canada RSS-GEN Industry Canada RSS-210

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REVISION HISTORY

Revision	Date	Description
—	19 Jan 2016	Initial release
A	Jan 21, 2016 By R. King	<ul style="list-style-type: none">- Added "Rev. A" to the cover page and the header on each page of the report.- Adjusted the duty cycle calculation on page 8.

Measurement of RF Emissions from a NOTIFI Wireless Video System, Model No. WLTX-3010 Transmitter

1. INTRODUCTION

1.1. Scope of Tests

This report presents the results of the RF emissions measurements performed on a NOTIFI Wireless Video System, Model No. WLTX-3010, Serial No. #2, (hereinafter referred to as the Equipment Under Test (EUT)). The EUT was designed to transmit at approximately 315MHz using an internal. The EUT was manufactured and submitted for testing by HeathCo LLC located in Bowling Green, Kentucky.

1.2. Purpose

The test series was performed to determine if the EUT 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 C63.4-2014.

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 21°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
- ANSI C63.4-2014, "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"
- ANSI C63.10-2013, " American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices"
- Industry Canada Radio Standards Specification, RSS-Gen, "General Requirements and Information for the Certification of Radiocommunication Equipment", Issue 4, November 2014
- Industry Canada Radio Standards Specification, RSS-210, "Low-power License-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment", Issue 8, December 2010 Update May 2015

3. EUT SETUP AND OPERATION

3.1. General Description

The EUT is a HeathCo LLC, NOTIFI Wireless Video System, Model No. WLTX-3010. A block diagram of the EUT setup is shown as Figure 1.



3.1.1. Power Input

The EUT obtained 12VDC from a Naccon Ultra Alkaline A23 12V battery.

3.1.2. Peripheral Equipment

No peripheral equipment was submitted with the EUT.

3.1.3. Signal Input/Output Leads

No interconnect cables were submitted with the EUT.

3.1.4. Grounding

Since the EUT was powered with 12VDC through a 12VDC battery, it was ungrounded during the tests.

3.2. Software

For all tests the EUT had Firmware Version 0.0.1 loaded onto the device to provide correct load characteristics.

3.3. Operational Mode

For all tests the EUT and all peripheral equipment were placed on a non-conductive stand per ANSI C63.10. ANSI C63.10 states for frequencies below 1GHz the non-conductive stand shall be 80cm and frequencies above 1GHz the non-conductive stand shall be 150cm.

The cables were manually maximized during the preliminary emissions sweeps. The cable arrangement which resulted in the worst case emissions was utilized.

The EUTs' transmit button was held down there by setting the device to transmit continuously.

3.4. EUT Modifications

No modifications were required for compliance to the FCC 15.231 you tested to 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 C63.4-2014 for site attenuation.

4.2. Test Instrumentation

The test instrumentation and auxiliary equipment used during the tests are listed in Table 9-1.

Conducted and radiated emission measurements were performed with a spectrum analyzer. This receiver allows measurements with the bandwidths and detector functions specified by the FCC. The receiver bandwidth was 120kHz for the 30MHz to 1000MHz radiated emissions data and 1MHz for the 1000MHz to 5000MHz radiated emissions data.

4.3. Calibration Traceability

Test equipment is maintained and calibrated on a regular basis with a calibration interval no greater than 2 years. 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 Emissions Measurements		
Combined Standard Uncertainty	1.06	-1.06
Expanded Uncertainty (95% confidence)	2.12	-2.12

Radiated Emissions Measurements		
Combined Standard Uncertainty	2.09	-2.09
Expanded Uncertainty (95% confidence)	4.19	-4.19

5. TEST PROCEDURES

5.1. Powerline Conducted Emissions

5.1.1. Requirements

Since the EUT was powered by internal batteries and has no connections for AC power, no conducted emissions tests are 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 EUT was set to transmit normally. The spectrum analyzer was used to record the amount of time that the EUT remained active following activation.

5.2.3. Results

The plot of the periodic timing is shown on data page 16. The data shows that the EUT 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 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).



The EUT uses on off keying as the pulse train. The pulse train is made up of 13 bits. One enable bit, 8 address bits and 4 data bits. The duty cycle was calculated as $20 \cdot \log \left(\frac{\text{on-time}}{\text{on-time} + \text{off-time or the word}} \right)$.

Enable bit = 320.2uS

8 Address Bits = largest bit is 651.3uS

4 data bits = largest bit is 651.3uS

Assuming worst case address and data bits being 651.3uS

On Time = 360.2uS + (651.3uS*12)

On-Time + Off-time = 28.7mS

Duty cycle = $20 \cdot \log \left(\frac{360.2\text{uS} + (651.3\text{uS} \cdot 12)}{28.7\text{mS}} \right) = -11.2 \text{ dB}$

5.3.2.Results

The plots of the duty cycle are shown on data pages 17 through 19. The duty cycle factor was computed to be -3.5 dB.

5.4. Radiated Measurements

5.4.1.Requirements

The EUT 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 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

All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. The walls and ceiling of the shielded chamber are lined with ferrite tiles. 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 C63.4-2014 for site attenuation.

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 EUT. For the preliminary test, a broadband measuring antenna was positioned at a 3 meter distance from the EUT. 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. * Replace with the proper frequency range.

The final open field emission tests were then manually performed over the frequency range of 30MHz to 4000MHz. 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 EUT 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 EUT 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 EUT is rotated through all axes to ensure the maximum readings are recorded.

5.4.3.Results

The preliminary plots, with the EUT transmitting at 315MHz, are presented on data pages 20 and 23. The plots are presented for a reference only, and are not used to determine compliance.

The final open area radiated levels, with the EUT transmitting at 315MHz, are presented on data page 24. As can be seen from the data, all emissions measured from the EUT were within the specification limits.

Photographs of the test configuration which yielded the highest or worst case, radiated emission levels are shown on Figures 2 and 3.

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 EUT 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. The 99% bandwidth was measured to be 442.3kHz.

5.5.3.Results

The plot of the emissions near the fundamental frequency is presented on data page 25. 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 EUT

The EUT and all associated equipment were returned to HeathCo LLC upon completion of the tests.

7. CONCLUSIONS

It was determined that the HeathCo LLC NOTIFI Wireless Video System, Model No. WLTX-3010, Serial No. #2, 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 C63.4-2014.

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 EUT at the test date. Any electrical or mechanical modification made to the EUT 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 certification, approval, or endorsement by A2LA, NIST or any agency of the Federal Government.



9. EQUIPMENT LIST

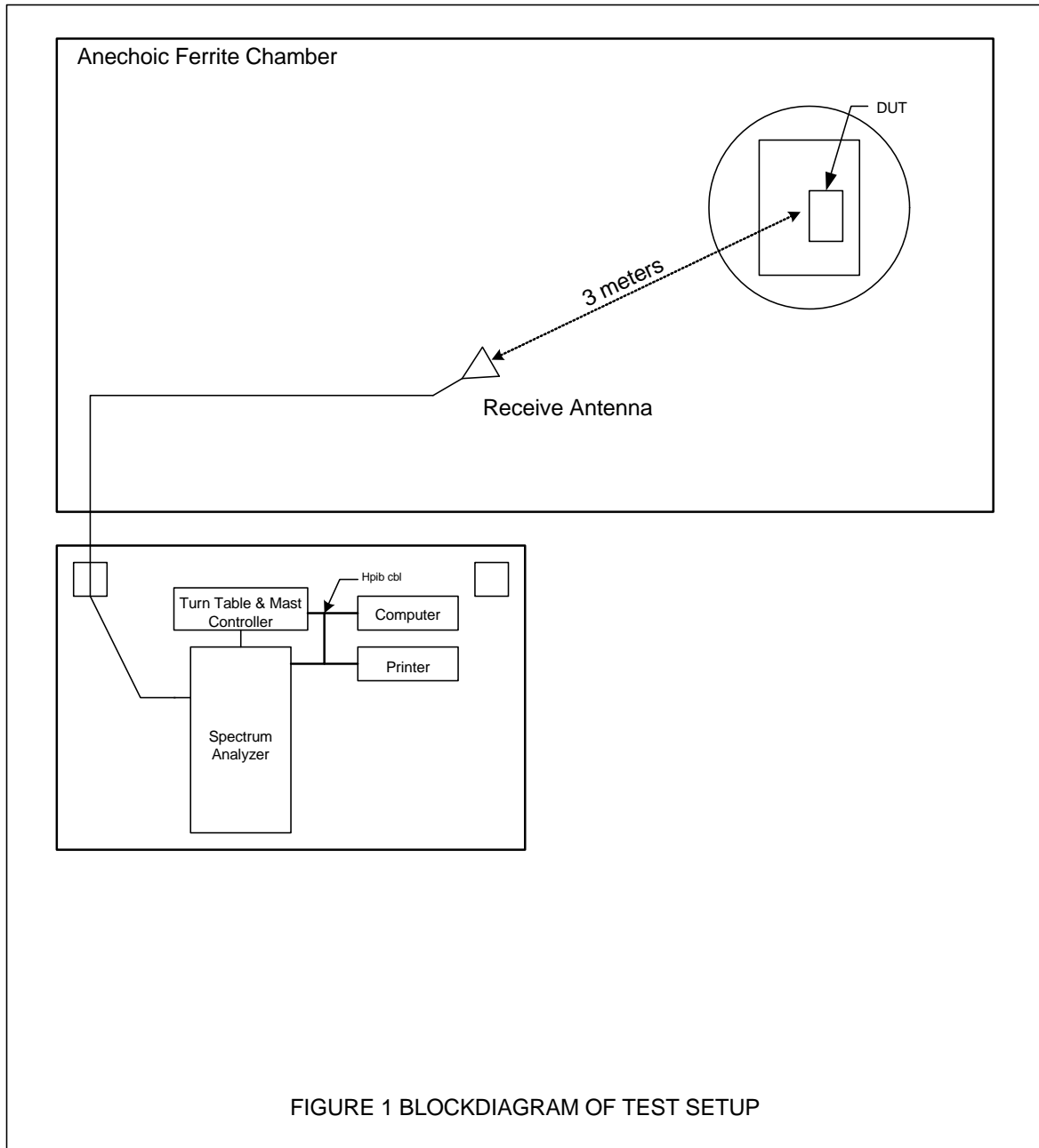
Table 9-1 Equipment List

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
NTA3	BILOG ANTENNA	TESEQ	6112D	32853	25-1000MHz	3/27/2015	3/27/2016
NWQ2	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS LINDGREN	3117	66659	1GHZ-18GHZ	2/9/2014	2/9/2016
PHA0	MAGNETIC FIELD PROBE	ELECTRO-METRICS	EM-6882	134	22-230MHZ	NOTE 1	
RBA0	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB26	100145	20HZ-26.5GHZ	3/3/2015	3/3/2016
WOJ0	SOFTWARE, BSI61000-4-3 RS	ELITE	BSI_610004_3_RS	1	80-2000MHZ	I/O	
WQC0	HF_8546A						

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.



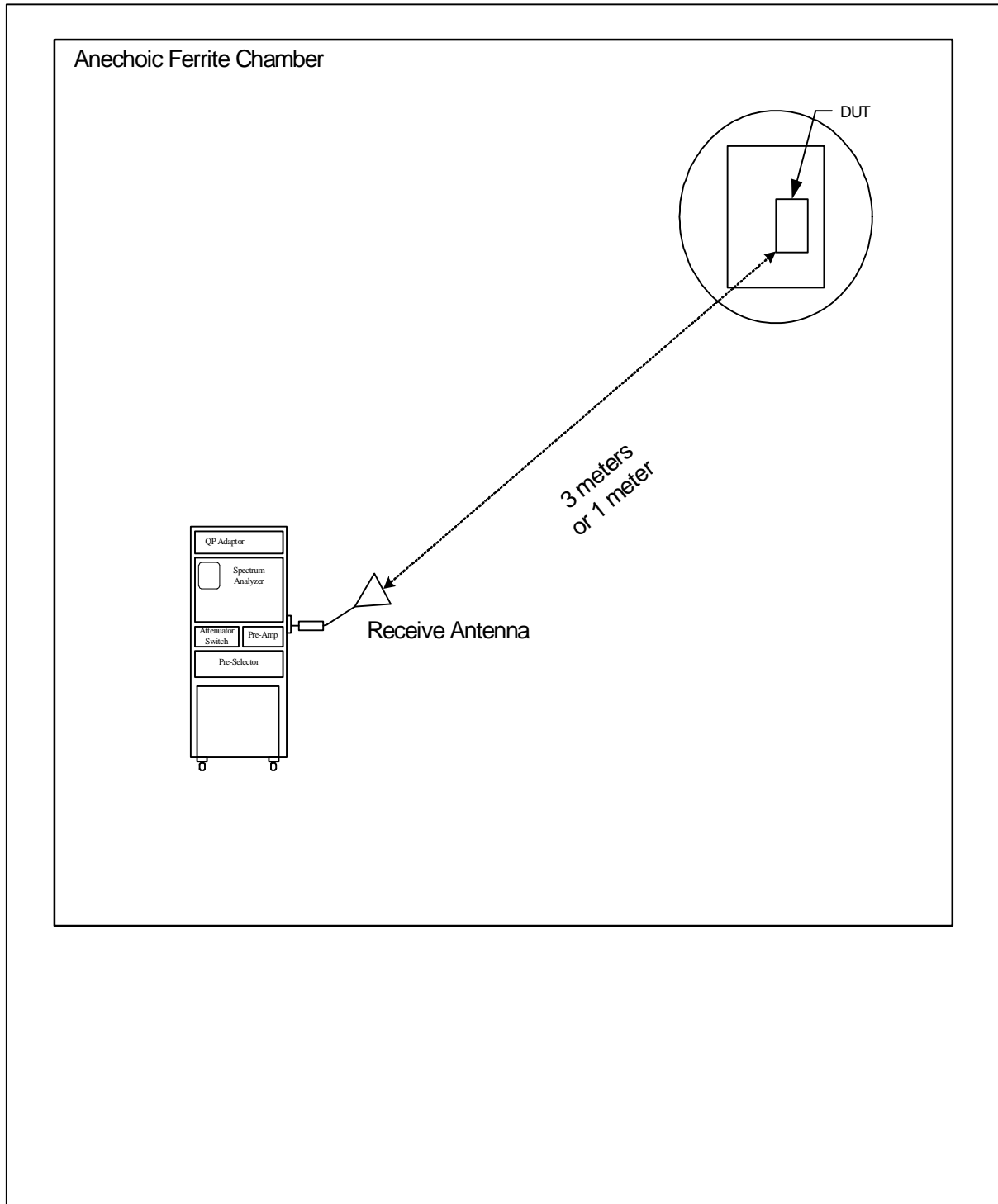
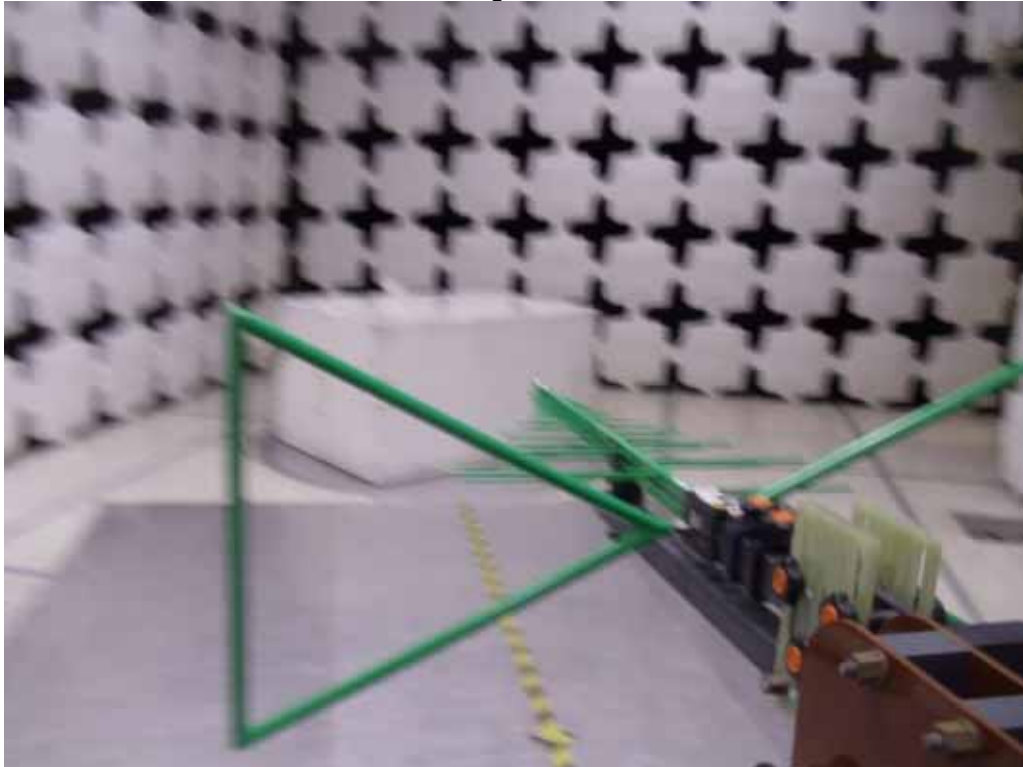
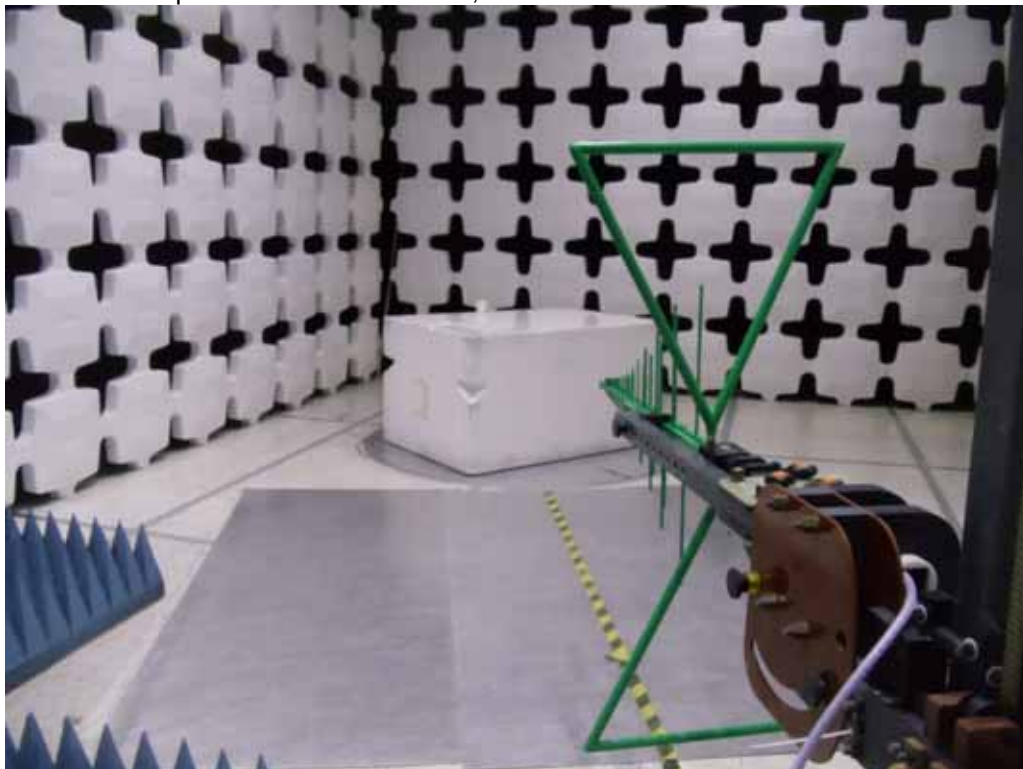


Figure 3



Test Setup for Radiated Emissions, 30MHz to 1GHz – Horizontal Polarization

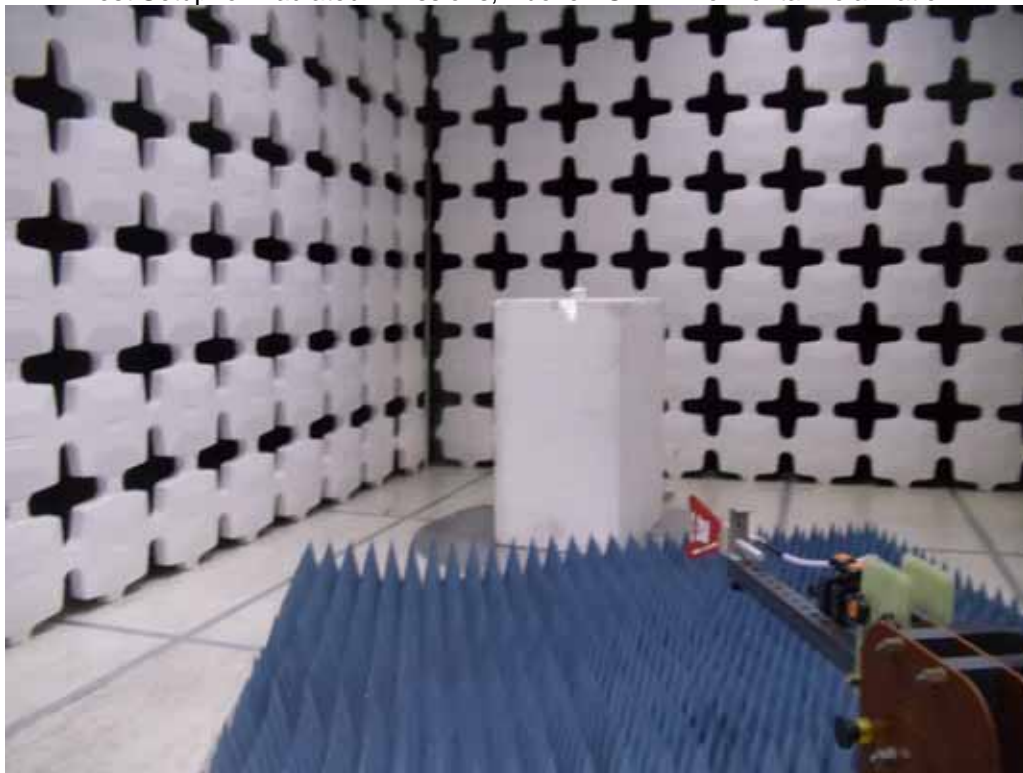


Test Setup for Radiated Emissions, 30MHz to 1GHz – Vertical Polarization

Figure 4



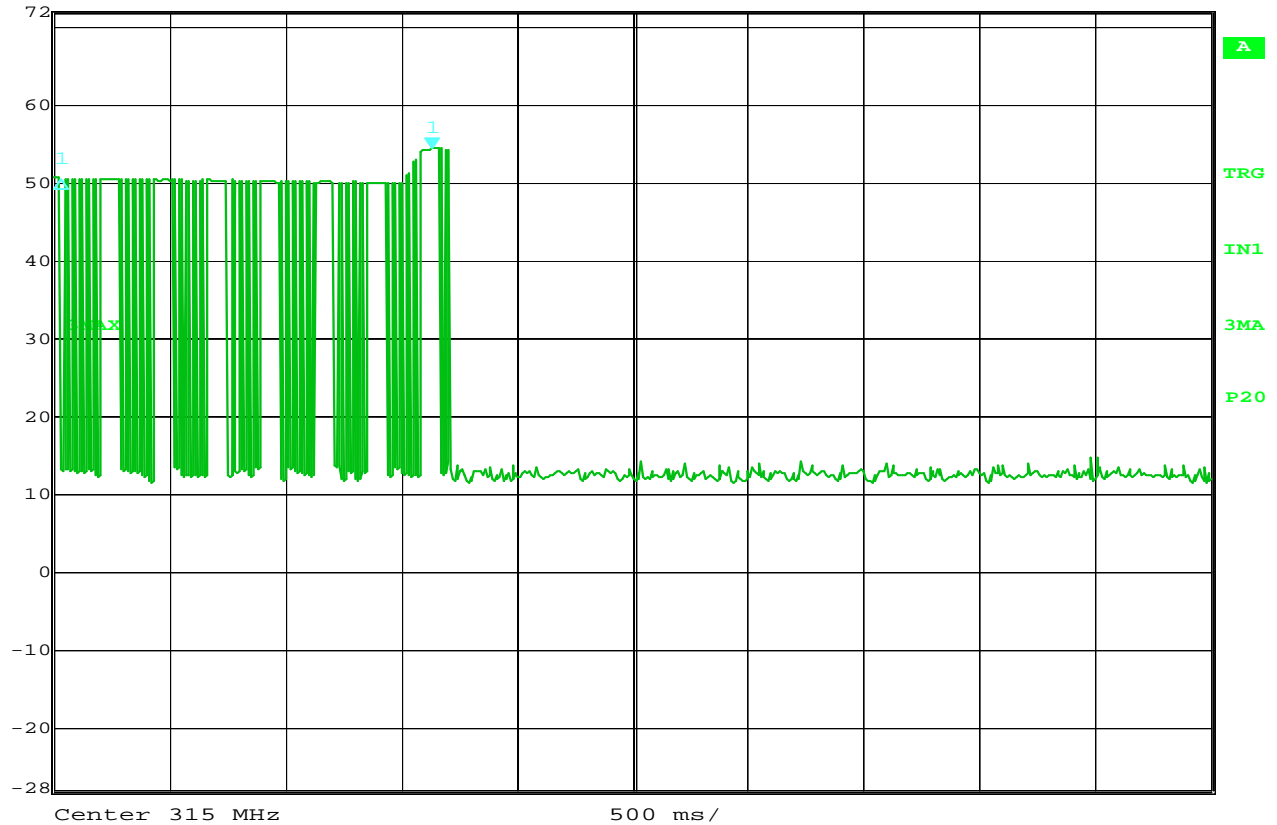
Test Setup for Radiated Emissions, Above 1GHz – Horizontal Polarization



Test Setup for Radiated Emissions, Above 1GHz – Vertical Polarization



Marker 1 [T3] RBW 1 MHz RF Att 0 dB
Ref Lvl 54.26 dBμV VBW 10 MHz
72 dBμV 1.633267 s SWT 5 s Unit dBμV



Date: 23.NOV.2015 14:09:07

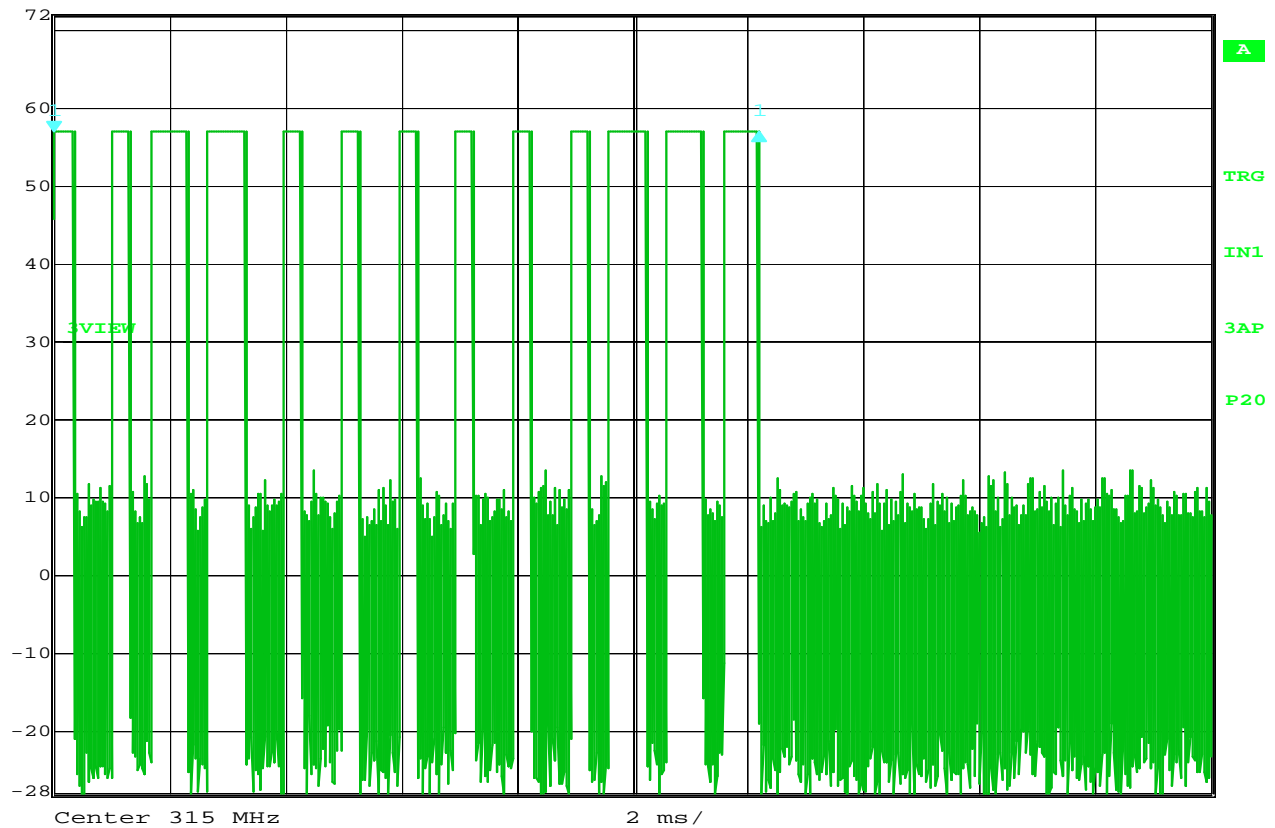
Periodic Transmission 15.231

MANUFACTURER : HeathCO LLC.
MODEL NUMBER : WLTX-3010
SERIAL NUMBER : #2
TEST MODE : Tx @ 315MHz
EQUIPMENT USED : RBA0, PHA0

NOTES



Delta 1 [T3] RBW 1 MHz RF Att 0 dB
Ref Lvl -0.12 dB VBW 10 MHz
72 dBV 12.184369 ms SWT 20 ms Unit dBV



Date: 23.NOV.2015 13:38:49

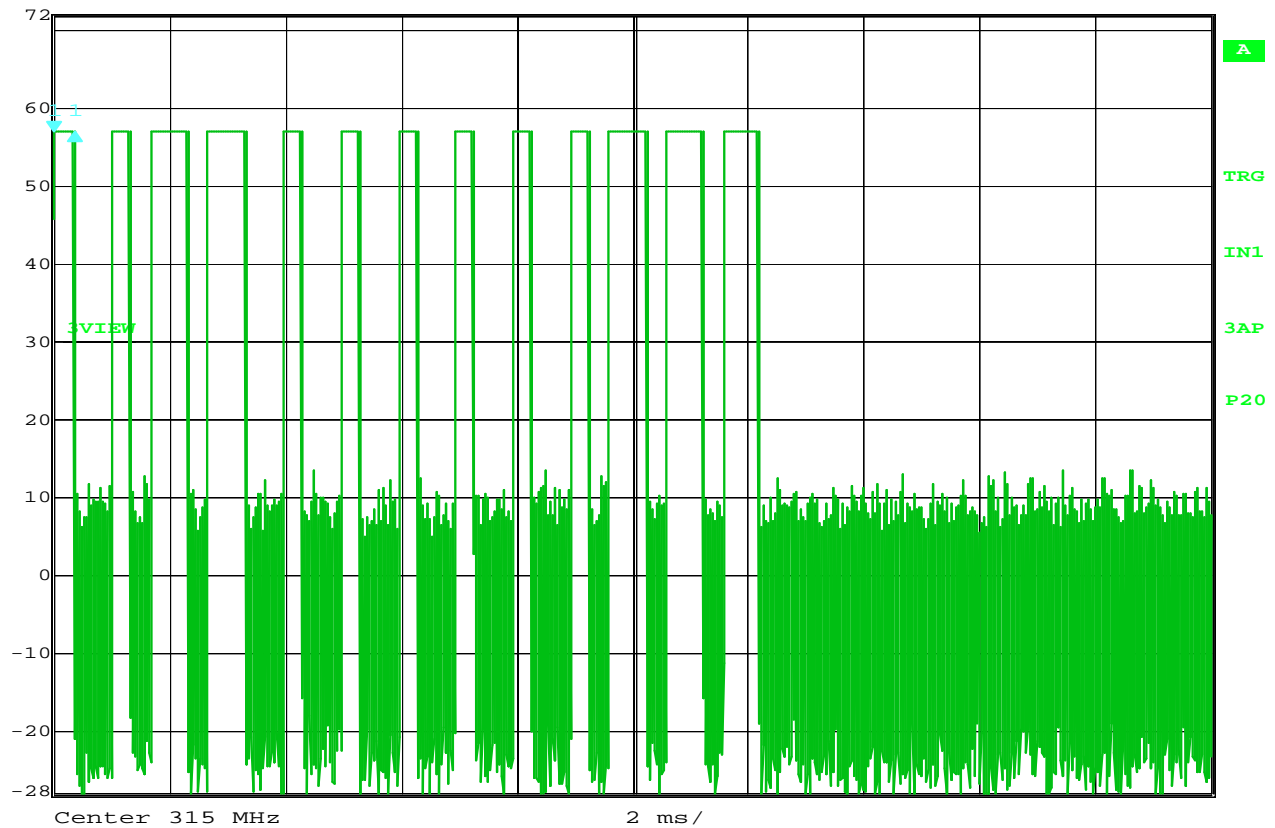
FCC 15.231 Duty Cycle

MANUFACTURER : HeathCO LLC.
MODEL NUMBER : Notifi
TEST MODE : Tx @ 315MHz
EQUIPMENT USED : RBA0, PHA0
NOTES : Word = 12.18ms

NOTES



Delta 1 [T3] RBW 1 MHz RF Att 0 dB
Ref Lvl -0.12 dB VBW 10 MHz
72 dBμV 360.721443 μs SWT 20 ms Unit dBμV



Date: 23.NOV.2015 13:44:55

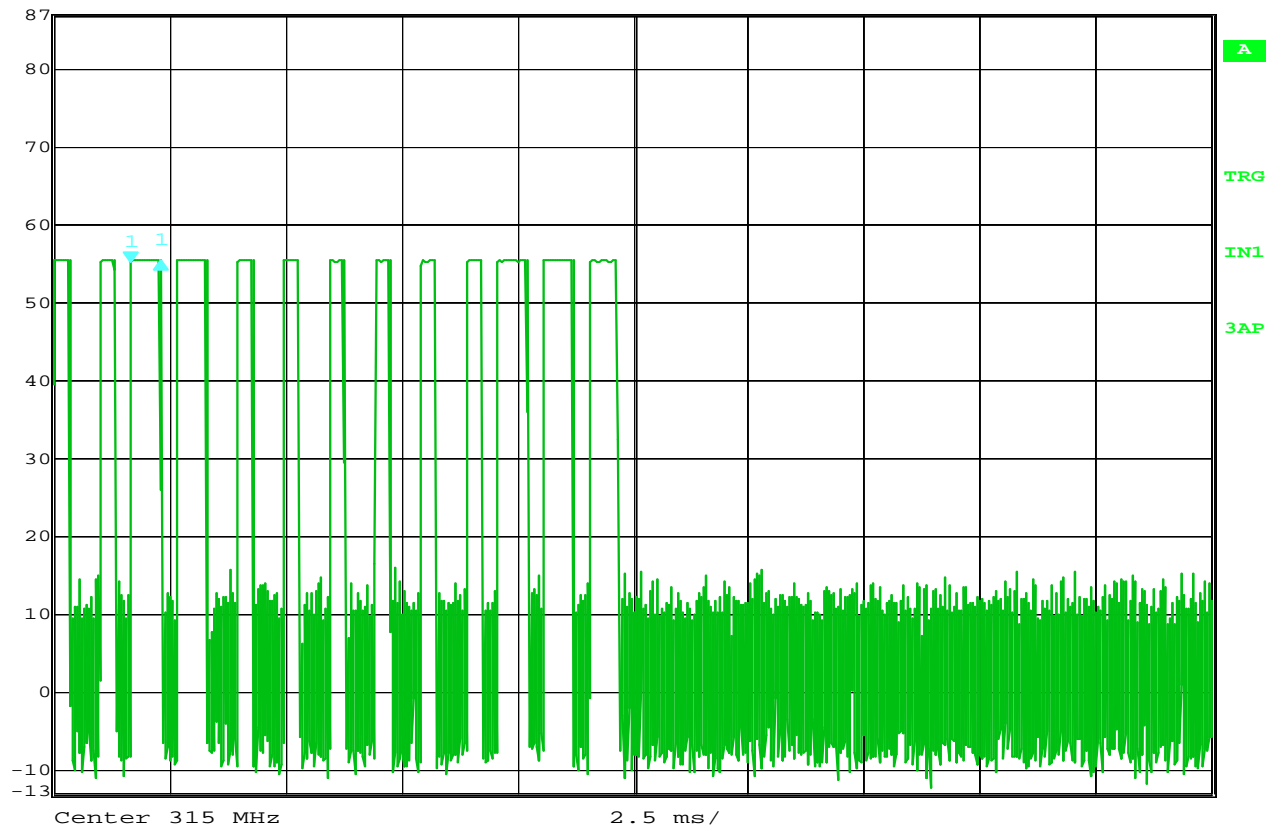
FCC 15.231 Duty Cycle

MANUFACTURER : HeathCO LLC.
MODEL NUMBER : Notifi
TEST MODE : Tx @ 315MHz
EQUIPMENT USED : RBA0, PHA0
NOTES : Enable Bit = 360.7uS

NOTES



Delta 1 [T3] RBW 100 kHz RF Att 0 dB
Ref Lvl 0.08 dB VBW 1 MHz
87 dBμV 651.302605 μs SWT 25 ms Unit dBμV

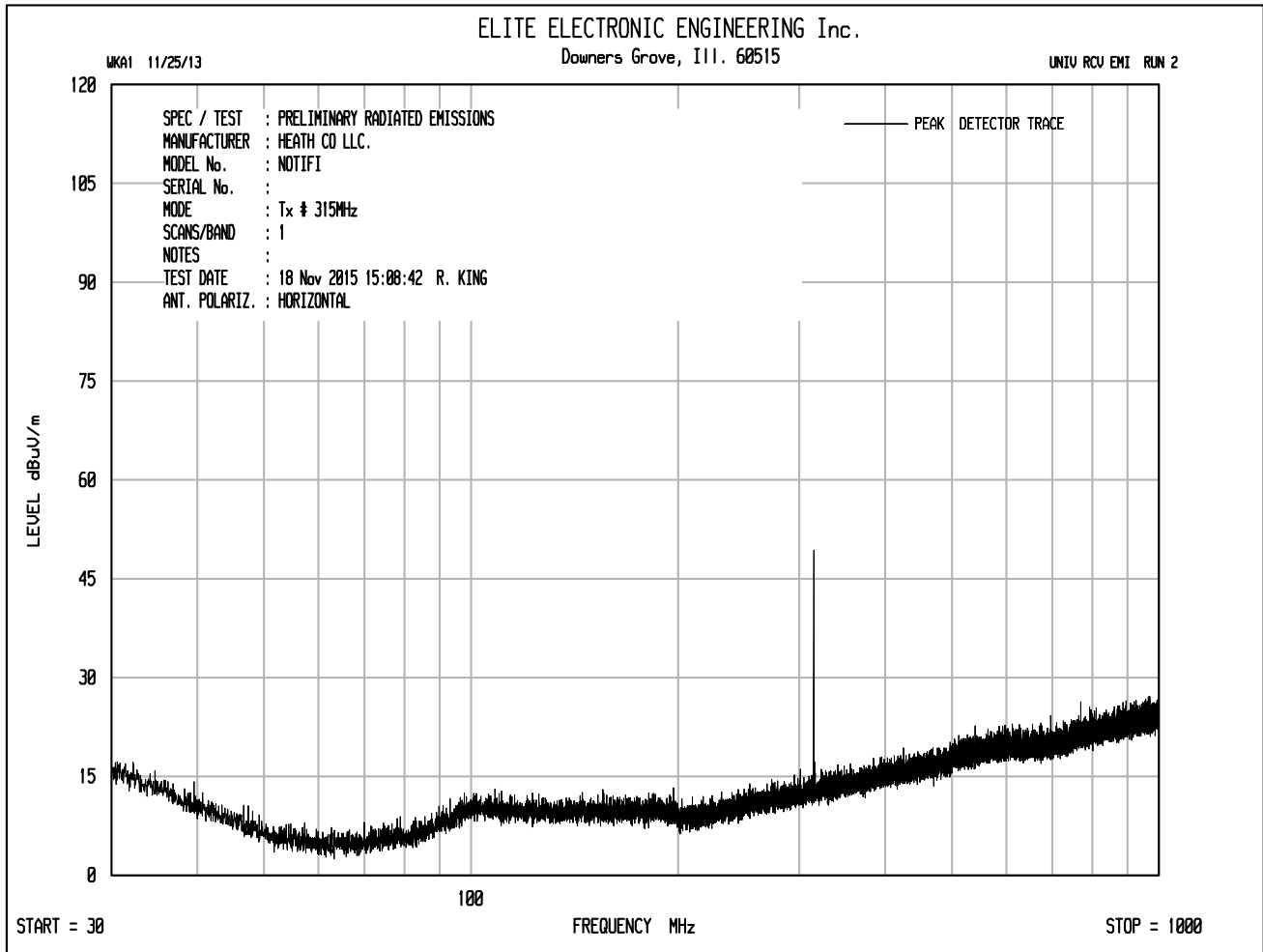


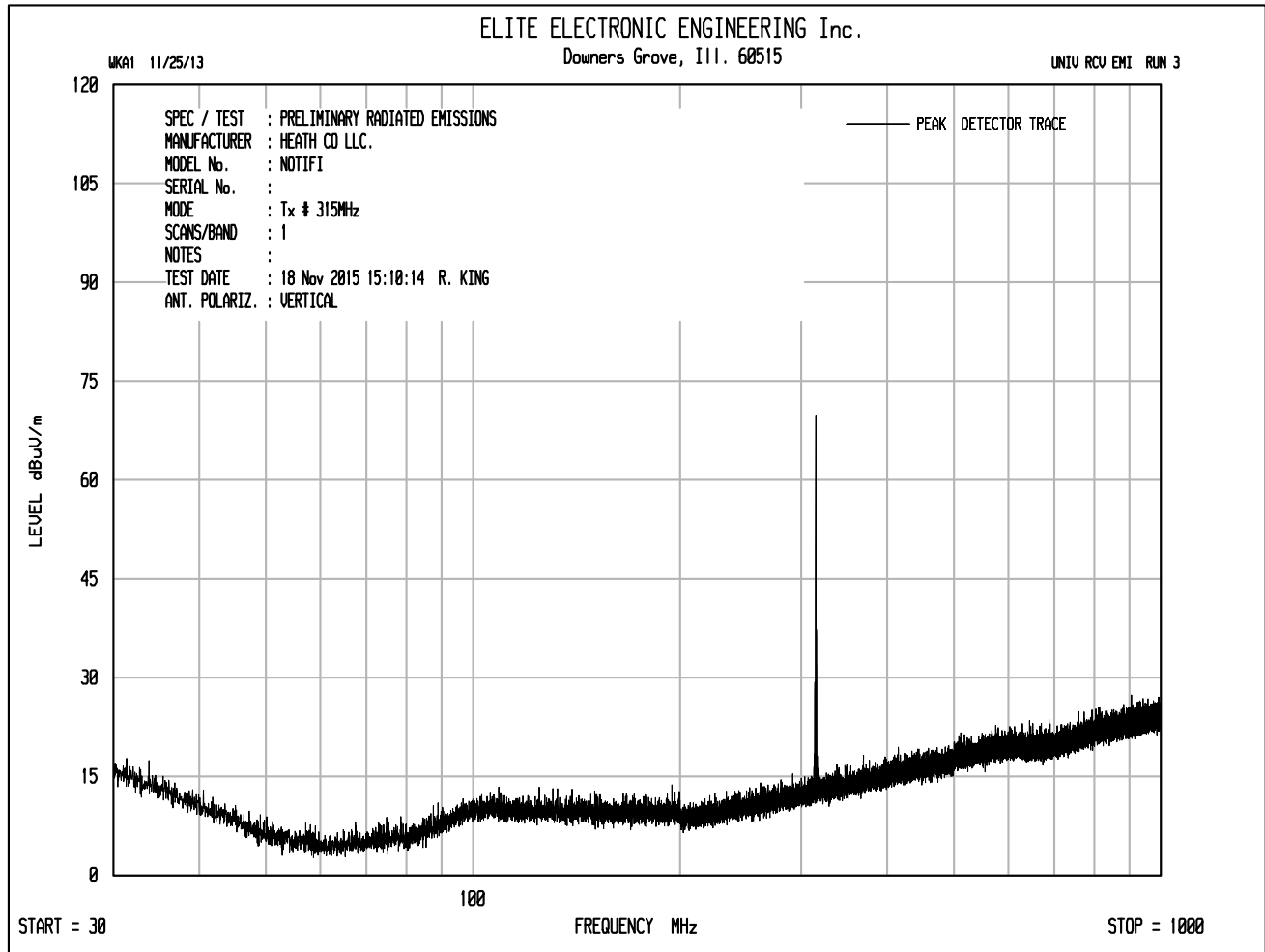
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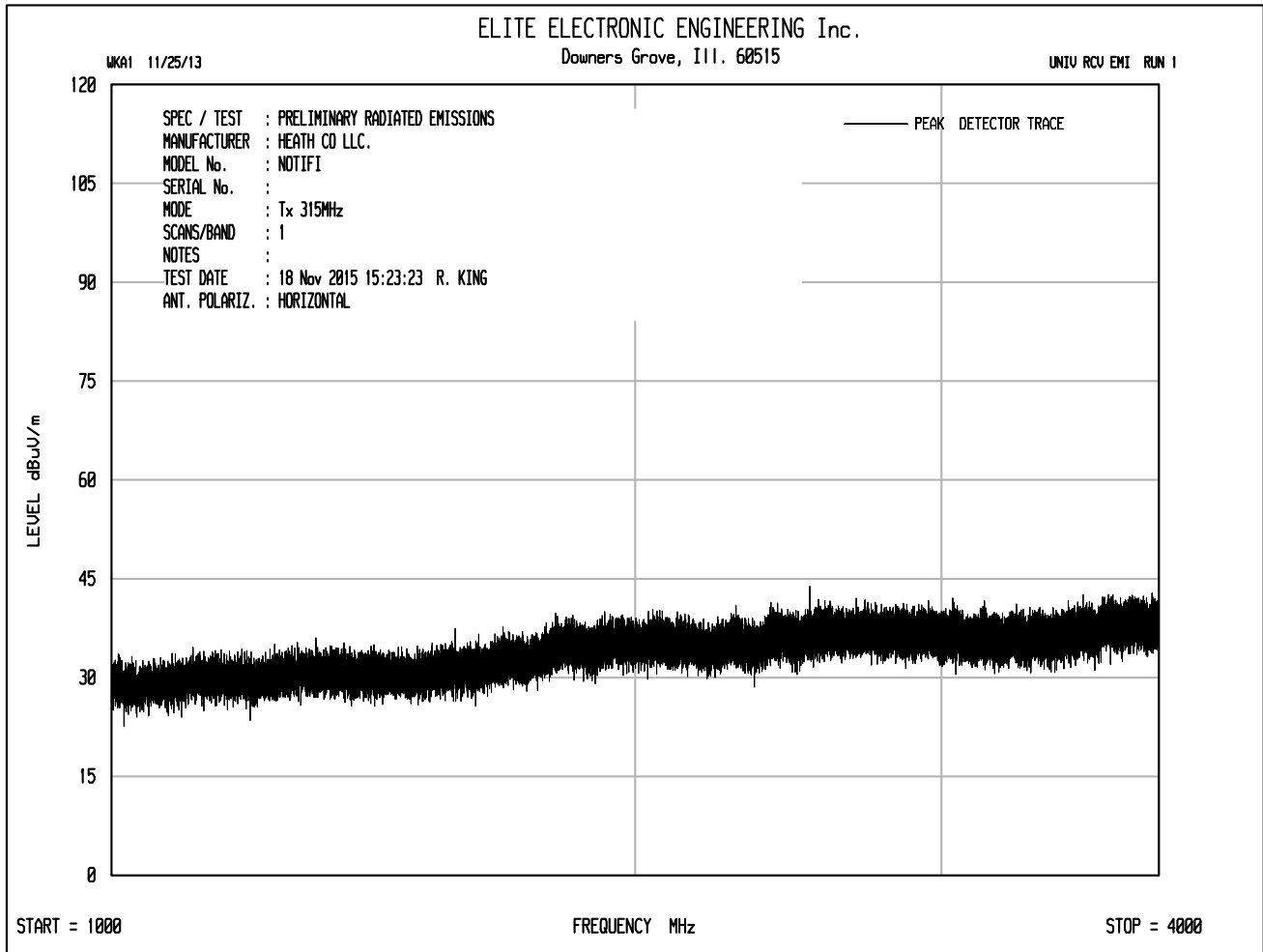
FCC 15.231 Duty Cycle

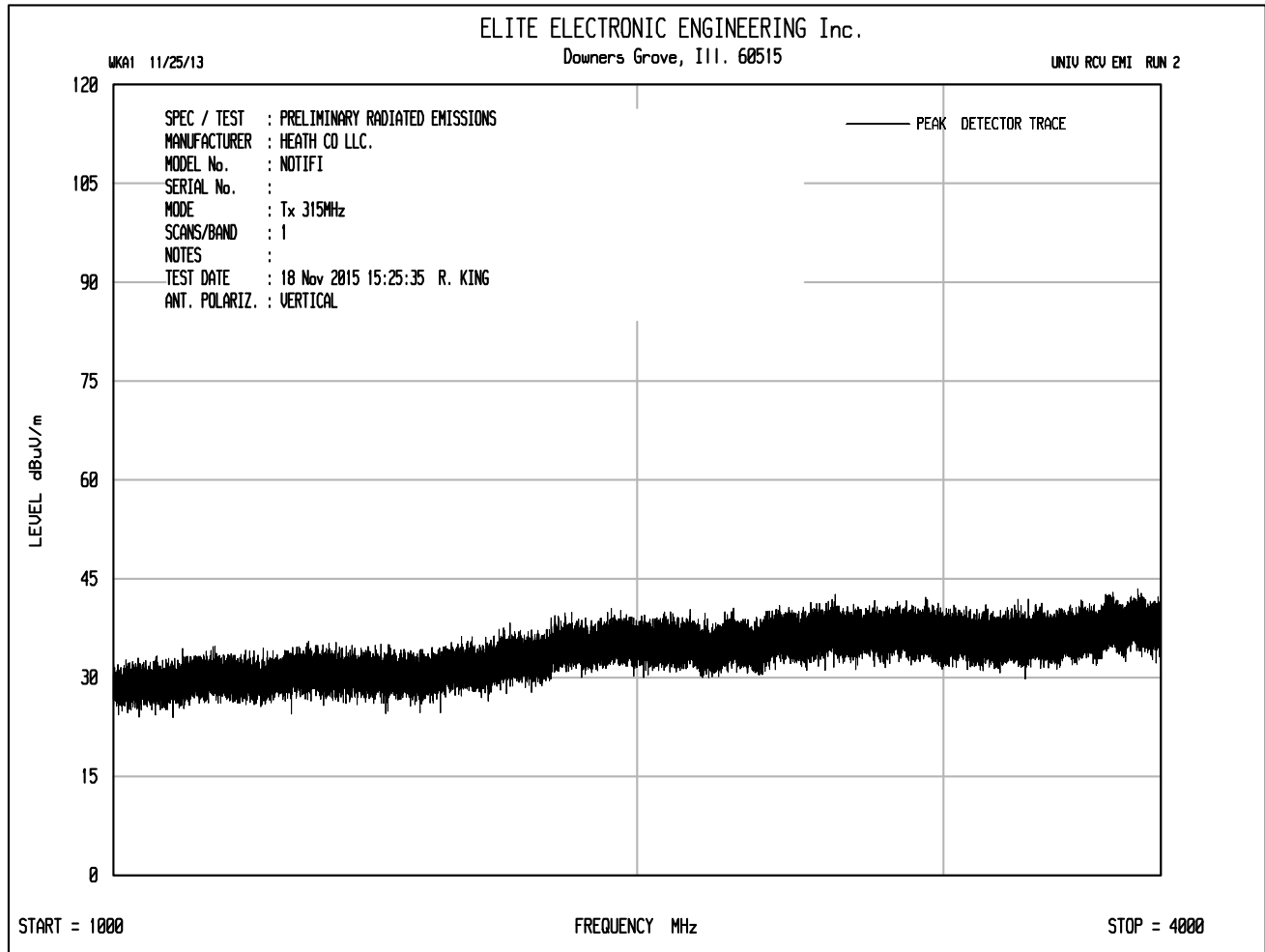
MANUFACTURER : HeathCO LLC.
MODEL NUMBER : Notifi
TEST MODE : Tx @ 315MHz
EQUIPMENT USED : RBA0, PHA0
NOTES : Largest Bit = 651.3uS

NOTES











Manufacturer : HeathCo LLC
Model No. : WLTx-3010
Specification : FCC-15.231 Spurious Radiated Emissions in Restricted Bands
Date : November 18, 2015
Mode : Tx 315MHz
Notes : Test Distance is 3 meters
Notes : Maximized Peak Readings

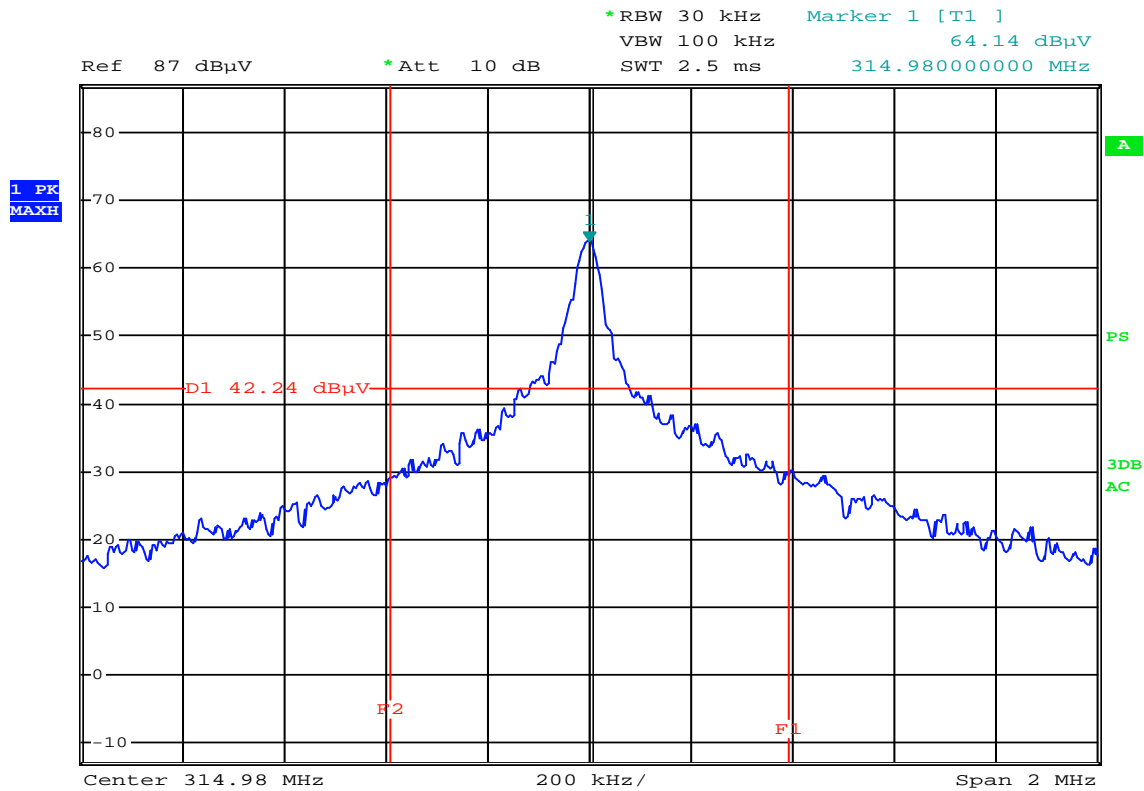
Freq. (MHz)	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Duty Cycle (dB)	Total (dBuV/m)	Total (uV/m)	Limit (uV/m)	Margin (dB)
315.000	H	61.0		0.9	13.8	0.0	-11.2	64.5	1676.0	6041.7	-11.1
315.000	V	52.7		0.9	13.8	0.0	-11.2	56.1	641.6	6041.7	-19.5
630.000	H	14.4	*	1.3	19.1	0.0	-11.2	23.5	15.0	604.2	-32.1
630.000	V	5.0	*	1.3	19.1	0.0	-11.2	14.2	5.1	604.2	-41.5
945.000	H	9.3	*	1.6	21.2	0.0	-11.2	20.9	11.1	604.2	-34.7
945.000	V	5.6	*	1.6	21.2	0.0	-11.2	17.2	7.2	604.2	-38.5
1260.000	H	15.0	*	1.9	28.9	0.0	-11.2	34.5	52.9	604.2	-21.2
1260.000	V	14.0	*	1.9	28.9	0.0	-11.2	33.5	47.5	604.2	-22.1
1575.000	H	15.0	*	2.1	28.2	0.0	-11.2	34.1	50.5	500.0	-19.9
1575.000	V	15.1	*	2.1	28.2	0.0	-11.2	34.2	51.3	500.0	-19.8
1890.000	H	14.0	*	2.3	31.4	0.0	-11.2	36.5	66.6	604.2	-19.1
1890.000	V	13.9	*	2.3	31.4	0.0	-11.2	36.3	65.6	604.2	-19.3
2205.000	H	17.5		2.5	31.6	0.0	-11.2	40.4	104.9	500.0	-13.6
2205.000	V	13.6		2.5	31.6	0.0	-11.2	36.5	66.9	500.0	-17.5
2520.000	H	14.8	*	2.7	32.5	0.0	-11.2	38.8	87.4	604.2	-16.8
2520.000	V	15.8	*	2.7	32.5	0.0	-11.2	39.8	97.6	604.2	-15.8
2835.000	H	15.6	*	2.9	32.6	0.0	-11.2	39.9	98.6	500.0	-14.1
2835.000	V	14.6	*	2.9	32.6	0.0	-11.2	38.8	87.3	500.0	-15.2
3150.000	H	13.9	*	3.0	33.5	0.0	-11.2	39.2	91.3	604.2	-16.4
3150.000	V	13.6	*	3.0	33.5	0.0	-11.2	38.9	88.6	604.2	-16.7

Total (dBuV/m) = Meter Reading (dBuV) + Cable Factor (dB) + Antenna Factor (dB) + Pre Amp Gain (dB) + duty cycle

Total uV/m = $10^{((\text{Peak Total (dBuV/m)})/20)}$

Checked BY RICHARD E. King :

Richard E. King



Date: 19.NOV.2015 13:43:50

FCC 15.231 Occupied Bandwidth

MANUFACTURER : HeathCO LLC.
MODEL NUMBER : Notifi
SERIAL NUMBER : #2
TEST MODE : Tx @ 315MHz
TEST PARAMETERS : 0.25% of the center frequency
: $315\text{MHz} \times 0.0025 = 787.5\text{kHz}$ (0.25% of center freq)
: $787.5\text{kHz} / 2 = 393.75\text{kHz}$ (determines the bandedges)
EQUIPMENT USED : RBA0, PHA0
NOTES : Display Line L1 equals the 20dBc Limit.
: Display Line F1 equals the upper bandedge
: at $((315\text{MHz} + 393.75\text{kHz}) = 315.39345\text{ MHz}$
: Display Line F2 equals the lower bandedge
: at $((315\text{MHz} - 393.75\text{kHz}) = 314.606250\text{ MHz}$

NOTES