Testing Tomorrow's Technology

# Application for Certification

**Per**
**Title 47 USC Part 2, Subpart J, Equipment Authorization Procedures, Paragraph 2.907, Certification and Part 15, Subpart C, Intentional Radiators, Paragraph 15.231, Periodic Operation in the band 40.66 MHz to 40.70 MHz and above 70 MHz**
**And**
**Innovation, Science, and Economic Development Canada Certification Per**
**ICRSS-Gen General Requirements for Radio Apparatus**
**And**
**RSS-210 Licence-Exempt Radio Apparatus: Category I Equipment**

**For the**

**Wink Labs, Inc.**

**Model: Wink Hub 2**

**UST Project: 16-0222**
**Issue Date: September 8, 2016**

Number of Pages in this report: 18

**3505 Francis Circle Alpharetta, GA 30004**
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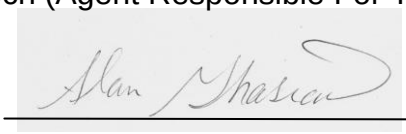
**www.ustech-lab.com**

I certify that I am authorized to sign for the test facility and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US Tech (Agent Responsible For Test):

By: 

Name: Alan Ghasiani

Title: President – Consulting Engineer

Date: September 8, 2016

NVLAP LAB CODE 200162-0



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## MEASUREMENT/TECHNICAL REPORT

**COMPANY NAME:** Wink Labs, Inc.
**MODEL:** WINK HUB 2
**FCC ID:** 2ACAJ-WHUB2
**IC:** 11938A-WHUB2
**DATE:** September 13, 2016

This report concerns (check one): Original grant X
Class II change_____

Equipment type: 431 MHz transmitter module

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes_____ No X

If yes, defer until:_____
date

N.A. agrees to notify the Commission by N.A.
date
of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

US Tech
3505 Francis Circle
Alpharetta, GA 30004

Phone Number: (770) 740-0717
Fax Number: (770) 740-1508

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# 1. General Information

This report is prepared as a means of presenting test data to be used by a Telecom Certification Body in determination of whether this product is permitted for unlicensed dissemination to the general public according to the Innovation, Science, and Economic Development Canada and FCC Rules and Regulations for RF Devices Intentional Radiators.

## 1.1 Product Description

The Equipment under Test (EUT) is the Wink Labs, Inc. home automation hub, model Wink Hub 2. The Wink Hub 2 has five transmitters, including: three 2.4 GHZ transmitters (Wifi (2.4/5GHz), Bluetooth, and Zigbee), one 431 MHz transmitter (Lutron), and one 915 MHz transmitter (Zwave). The circuit board uses four on-board transmitter antennas. The Bluetooth and Wifi radios share one antenna and the other transmitters each have their own antennas.

This report will cover in detail the test results for the Lutron transmitter, which is a 431 MHz transmitter. The test results for the other transmitters will be covered in separate reports.

Because the periodic rate does not exceed the requirement of paragraph (a), paragraph (e) is not invoked.

## 1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on August 26, 2016 in good operating condition.

## 1.3 Related Submittal(s)/Grant(s)

The EUT is subject to the following FCC Equipment Authorizations:

a) Certification of the transmitter.

b) Verification as a class B digital device.

## 2. Tests and Measurements

### 2.1 Configuration of Tested System

The Test sample was tested per *ANSI C63.10:2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices* to show compliance to CFR 47, Part 15.231.

All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was set to 3 times the resolution bandwidth or off throughout the evaluation process. There were no interconnecting cables to manipulate in an attempt to maximize emissions; however, the physical position of the EUT was varied through the three mutually exclusive orthogonal planes in an attempt to maximize the emissions. The worse case position is the position used for final measurements and is gathered in this test report. A block diagram of the tested system is shown in Figure 1.

### 2.2 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA. This site has been fully described and registered with the FCC, under site registration number 186022. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number 9900A-1 and is also a NVLAP accredited test lab; lab code 200162-0.

### 2.3 Test Equipment

**Table 1. EUT and Peripherals**

| PERIPHERAL MANUFACTURER | MODEL NUMBER | SERIAL NUMBER | FCC/IC ID: | CABLES P/D |
|---|---|---|---|---|
| Gateway Wink Labs, Inc. (EUT) | WINK HUB 2 | Engineering Sample | Pending: FCC ID: 2ACAJ-WHUB2 IC:11938A-WHUB2 | 1.5 m U P<br>1.0 m U D |
| AC/DC Power Supply Adapter Wink Labs, Inc | S012BEU120 0100 | None | None | 1.5 m U P |
| Router | Various | Various | Various | 1.5 m U P |
| Antenna See antenna details | -- | -- | -- | -- |

S= Shielded, U=Unshielded, P= Power line, D= Data line

## Table 2. Test Instruments

| TEST INSTRUMENT | MODEL NUMBER | MANUFACTURER | SERIAL NUMBER | DATE OF LAST CALIBRATION |
|---|---|---|---|---|
| SPECTRUM ANALYZER | E4407B | AGILENT | US41442935 | 2/11/2016 |
| RF PREAMP 100 kHz to 1.3 GHz | 8447D | HEWLETT-PACKARD | 1937A02980 | 12/2/2015 |
| LOOP ANTENNA | SAS-200/562 | A. H. Systems | 142 | 9/28/2015 2 yr cycle |
| BICONICAL ANTENNA | 3110B | EMCO | 9307-1431 | 8/25/2015 2 yr cycle |
| BICONICAL ANTENNA | 3110B | EMCO | 9306-1708 | 11/24/2014 2 yr cycle |
| LOG PERIODIC ANTENNA | 3146 | EMCO | 9110-3236 | 11/19/2014 2 yr cycle |
| LOG PERIODIC ANTENNA | 3146 | EMCO | 9305-3600 | 7/1/2014 2 yr cycle extended 90 days |
| HORN ANTENNA | 3115 | EMCO | 9107-3723 | 7/8/2014 2 yr cycle extended 90 days |
| PREAMP 1.0 GHz to 26.0 GHz | 8449B | HEWLETT-PACKARD | 3008A00480 | 12/1/2015 |
| CALCULATION PROGRAM | N/A | N/A | Ver. 6.0 | N/A |

Note: The calibration interval of the above test instruments are 12 months unless stated otherwise and all calibrations are traceable to NIST/USA.

## 2.4 EUT Antenna Description (FCC Sec. 15.203)

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

The Wink Labs, Inc., Model Wink Hub 2 incorporates the antennas detailed in Table 3 for the Lutron transmitter.

**Table 3. Antenna Description**

| REPORT REFERENCE | MANUFACTURER | TYPE OF ANTENNA | MODEL | GAIN $dB_i$ | TYPE OF CONNECTOR |
|---|---|---|---|---|---|
| None | Pulse | Helical | W3127 | -2.9 | Helical coil solder |

## 2.5 Modifications to Equipment

No modifications were needed to bring the EUT into compliance with the FCC Part or IC RSS requirements.

## 2.6 Test Procedure

The EUT was configured as shown in the following block diagram(s) and photograph(s). The sample was tested per ANSI C63.10:2013. Conducted and radiated emissions data were taken with the test receiver or spectrum analyzer's resolution bandwidth adjusted to 9 kHz and 120 kHz depending on the frequency range of testing, 150 kHz-30 MHz or 30 MHz to 1000 MHz, respectively. All measurements are peak unless stated otherwise. The video filter on the spectrum analyzer was OFF throughout the evaluation process. Interconnecting cables were manipulated as necessary to maximize emissions. The EUT was rotated 360 degrees with the turntable to maximize emissions. The physical position of the EUT was varied through the three mutually exclusive orthogonal planes in an attempt to maximize the emissions. The final setup description is found in the test section of this report.

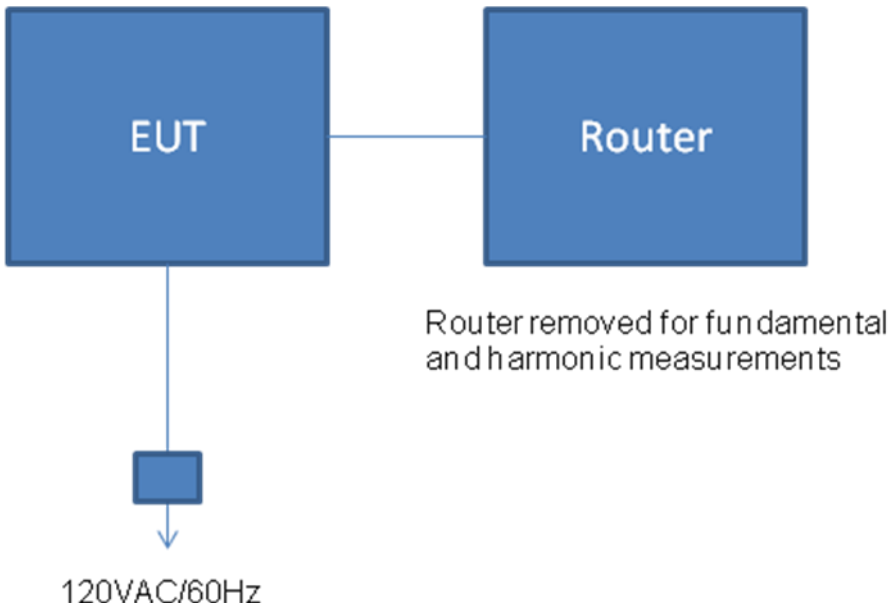


**Figure 1. Block Diagram of Test Configuration**

## 2.7 Compliance to CFR 15.231(a) Transmitter Activation/Deactivation

According to CFR 15.231(a) The provisions of this section are restricted to periodic operation within the band 40.66-40.70 MHz and above 70 MHz. Except as shown in paragraph (e) of this section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Continuous transmissions, voice, video and the radio control of toys are not permitted. Data is permitted to be sent with a control signal. The following conditions shall be met to comply with the provisions for this periodic operation:

*(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.*

The transmitter is not a manually operated transmitter.

*(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.*

The transmitter is classified as an automatically activated transmitter and the transmitter does comply with transmissions ceasing after 5 seconds. See Figure 2 below.

*(3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.*

This does not apply; the transmitter does not have periodic transmissions at pre-determined intervals, and does not have polling or supervision transmissions to determine system integrity. Transmissions from the Clear Connect transmitter in this product are always initiated by a user initiated event, such as a button press on a product in the system or a user interaction in a smart-phone app to adjust the position of the light dimmer or window shade.

*(4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.*

This does not apply; the transmitter is not employed for radio control purposes during emergencies.

*(5) Transmission of set-up information for security systems may exceed the transmission duration limits in paragraphs (a)(1) and (a)(2) of this section, provided such transmissions are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically. Such set-up information may include data.*

This does not apply; the transmitter is not used for security systems.

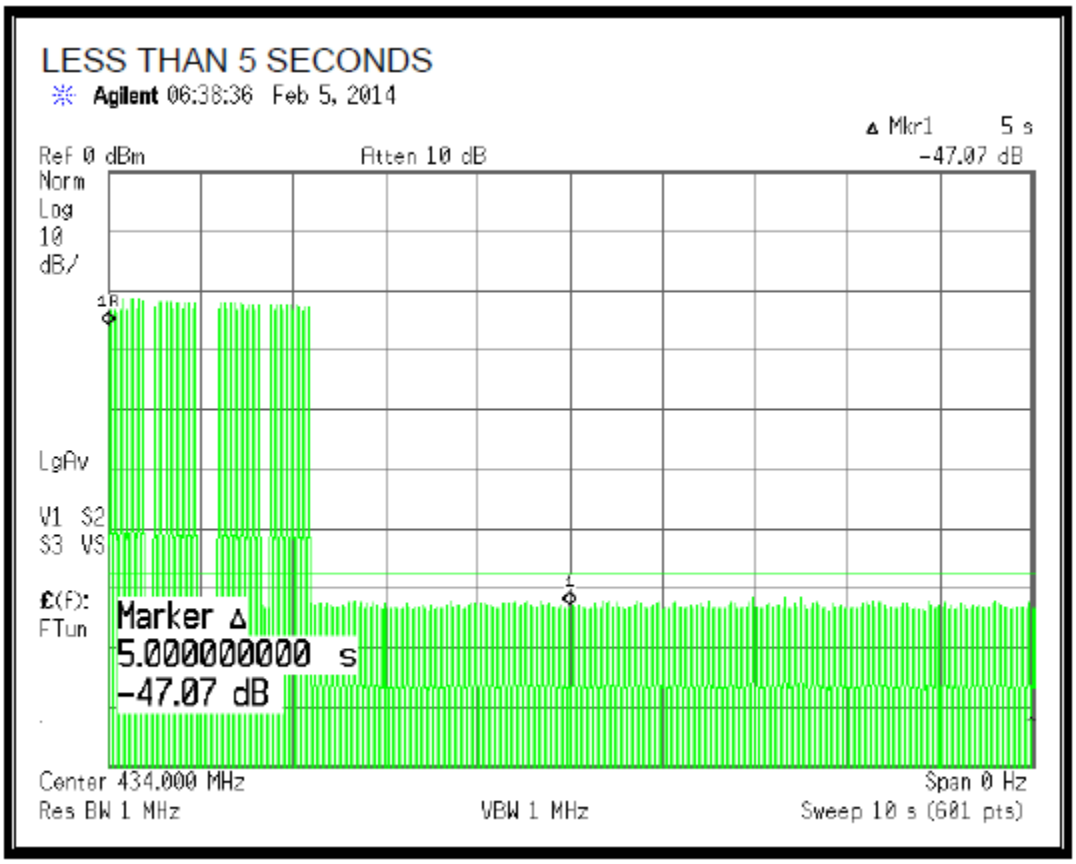


**Figure 2. Deactivation per 15.231(a)(1)**

Note 1: The EUT deactivates within 5 seconds.

Note 2: The screen shot above was taken from the report prepared by UL for the Lutron Radio, FCC ID: JPZ0105 and IC: 2158A-JPZ0105. The Lutron Clear Connect firmware is loaded onto the Lutron ST coprocessor as part of the production code. This implements their proprietary “Clear Connect” protocol. The 5 second deactivation is built into that production code. The Lutron radio and associated FW protocol is identical.

## 2.8 Field Strength of Fundamental (47 CFR 15.231(b))

The results of the measurements for peak fundamental emissions are given in Table 4. The EUT emissions measurement was started by setting up the Antenna in the vertical orientation at a distance of 3 meters from the EUT and at a height of 1.0 meters above the ground. The EUT's major axis was set normal to the direction of the measuring antenna.

The Spectrum Analyzer (SA) displays were set to: Channel A free-running, Channel B to Max-Hold. Choose a frequency or frequency range and scan it at a coupled rate. When a signal is detected, raise and lower the antenna to maximize the signal.

When the signal has been maximized, the antenna height is fixed the turn-table is rotated through 360 degrees to further maximize the signal.

When all signals have been maximized for antenna height and direction, the EUT case is carefully maneuvered in each of the three mutually exclusive orthogonal planes while observing the same Max-hold/free-running SA display indication. When the EUT position is found that further maximizes the signal, record the antenna height, rotation orientation, EUT orthogonal position and signal strength on the data sheet for that particular frequency.

Next, the measurement antenna is re-oriented to a Horizontal polarization at 1 meter height and the process described above is repeated. All signals within 6 dB of the limit are recorded.

Finally, the collected data is input into the calculation spread sheet. The spread sheet is designed to calculate for the true value that is collected. The spread sheet takes into account the SA reading, the antenna correction factor, cable losses and duty cycle factors. See the data tables herein.

## 2.9 Limits for Operation in the Band above 70 MHz (CFR15.231 (b))

This limit versus frequency table is as follows (test distance = 3.0 meters):

| **Fundamental Frequency (MHz)** | **Limit Fundamental (Average ) uV/m** | **Limit Harmonics and other spurious (Average) uV/m** |
|---|---|---|
| 260 to 470 | 3750 to 12500[*, 1] | 375 to 1250[*,2] |
| * Linear Interpolation | | |

Note: formula 1: $limit_1 = E = 41.667F – 7083.5$
2: $limit_2 = E = 4.1667F – 708.35$
E= Electric field strength
F= fundamental frequency in MHz

The frequency spectrum above the fundamental to its 10th harmonic was examined and measured for signals falling into the restricted bands of 15.205. If average emissions measurements are employed, the provisions in 15.35 for averaging pulsed emissions and for limiting peak emissions were applied. Spurious and harmonics signals meet the requirements of the above table or the requirements of 15.209, whichever requirement permits higher field strength.

## 2.10 Radiated Spurious Emissions

The radiated spurious emissions were measured over the frequency range of 30 MHz to the 10th harmonic of the fundamental frequency of the intentional transmitter. The test results are shown below.

## Table 4. Intentional Radiated Emissions, Peak Measurements

| Tested By: RM | | Test: Part 15B, Para 15.231 | | Client: Wink Labs, Inc. | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Project: 16-0222 | | Model: Wink Hub 2 | | | | |
| **Frequency (MHz)** | **Test Data (dBuV)** | **Additional Factor (dB)** | **AF+CL-PA (dB/m)** | **Corrected Results (dBuV/m)** | **Limits (dBuV/m)** | **Distance / Polarization** | **Margin (dB)** | **Detection Method** |
| 431.00 | 78.66 | 0.0 | 18.25 | 96.91 | 100.7 | 3m./VERT | 3.8 | **PK** |
| 861.92 | 33.28 | 0.0 | 6.52 | 39.80 | 80.7 | 3m./VERT | 40.9 | **PK** |
| 1293.00 | 30.85 | 0.0 | 8.23 | 39.08 | 80.7 | 3.0m./VERT | 41.6 | **PK** |
| 1724.00 | 27.73 | 0.0 | 8.84 | 36.57 | 80.7 | 3.0m./VERT | 44.1 | **PK** |
| 2155.00 | 29.72 | 0.0 | 11.93 | 41.65 | 80.7 | 3.0m./VERT | 39.0 | **PK** |
| 2586.00 | 29.07 | 0.0 | 14.12 | 43.19 | 80.7 | 3.0m./VERT | 37.5 | **PK** |
| 3017.00 | 27.19 | 0.0 | 16.68 | 43.87 | 80.7 | 3.0m./VERT | 36.8 | **PK** |
| **No other emissions found less than 20 dB from the applicable limit.** | | | | | | | | |

1. (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 20 dB relaxation for peak measurements of CFR 15.35.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
3. (~) Measurements taken at 1 meter were extrapolated to 3 meter using a factor of (-9.5 dB).

Sample Calculation at 431.00:

| | | |
|---|---|---|
| Magnitude of Measured Frequency | 78.66 | dBuV |
| +Antenna Factor + Cable Loss+ Amplifier Gain | 18.25 | dB/m |
| +Additional Factor | 0 | dB |
| Corrected Result | 96.91 | dBuV/m |

Test Date: August 30, 2016
Tested By
Signature:  Name: Robert K. Mills

Note: The transmitter was programmed to transmit at >98% duty cycle; therefore wherever applicable, the duty cycle factor calculated above was applied to correct for the actual duty cycle of the transmitter.

## Table 5. Intentional Radiated Emissions, AVG Measurements

| Tested By: RM | | Test: Part 15B, Para 15.231 | | Client: Wink Labs, Inc. | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Project: 16-0222 | | Model: WINK HUB 2 | | | | |
| **Frequency (MHz)** | **Test Data (dBuV)** | **Additional Factor (dB)** | **AF+CL-PA (dB/m)** | **Corrected Results (dBuV/m)** | **Limits (dBuV/m)** | **Distance / Polarization** | **Margin (dB)** | **Detection Method** |
| 431.00 | 78.58 | -19.17 | 18.25 | 77.66 | 80.7 | 3m./VERT | 3.0 | **QP** |
| 861.92 | 25.13 | -19.17 | 6.52 | 12.48 | 60.7 | 3m./VERT | 48.2 | **QP** |
| 1293.00 | 21.26 | -19.17 | 8.23 | 10.32 | 60.7 | 3.0m./VERT | 50.4 | **AVG** |
| 1724.00 | 15.46 | -19.17 | 8.84 | 5.13 | 60.7 | 3.0m./VERT | 55.6 | **AVG** |
| 2155.00 | 17.60 | -19.17 | 11.93 | 10.36 | 60.7 | 3.0m./VERT | 50.3 | **AVG** |
| 2586.00 | 17.88 | -19.17 | 14.12 | 12.83 | 60.7 | 3.0m./VERT | 47.9 | **AVG** |
| 3017.00 | 17.85 | -19.17 | 16.68 | 15.36 | 60.7 | 3.0m./VERT | 45.3 | **AVG** |
| **No other emissions found less than 20 dB from the applicable limit.** | | | | | | | | |

1. (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 20 dB relaxation for peak measurements of CFR 15.35.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
3. All measurements are corrected with a -19.17 dB duty cycle. See section 2.8

Sample Calculation at 431.00MHz:

| | | |
|---|---|---|
| Magnitude of Measured Frequency | 78.58 | dBuV |
| +Antenna Factor + Cable Loss+ Amplifier Gain | 18.25 | dB/m |
| +Duty Cycle | -19.17 | dB |
| Corrected Result | 77.66 | dBuV/m |

Test Date: August 30, 2016
Tested By
Signature: _____ Name: Robert K. Mills

Note: The transmitter was programmed to transmit at >98% duty cycle, therefore wherever applicable the duty cycle factor calculated above was applied to correct for the actual duty cycle of the transmitter.

## 2.11 Transmitter Duty Cycle (47 CFR 15.35 (c))

The duty cycle de-rating factor used in the calculation of average radiated limits (per CFR 15.209 and 15.35(c)) is described below. This factor was calculated by first determining the worst case scenario for system operation. With the worst case operating scenario the transmission duty cycle is calculated as:

**Total Time On from Figure 3. = 11.0mS**

**(11.0mS Total Time On)/(100mS FCC Standard) = 0.11 Numeric Duty Cycle**
**Duty Cycle = 20 Log (.11) = -19.17 dB**

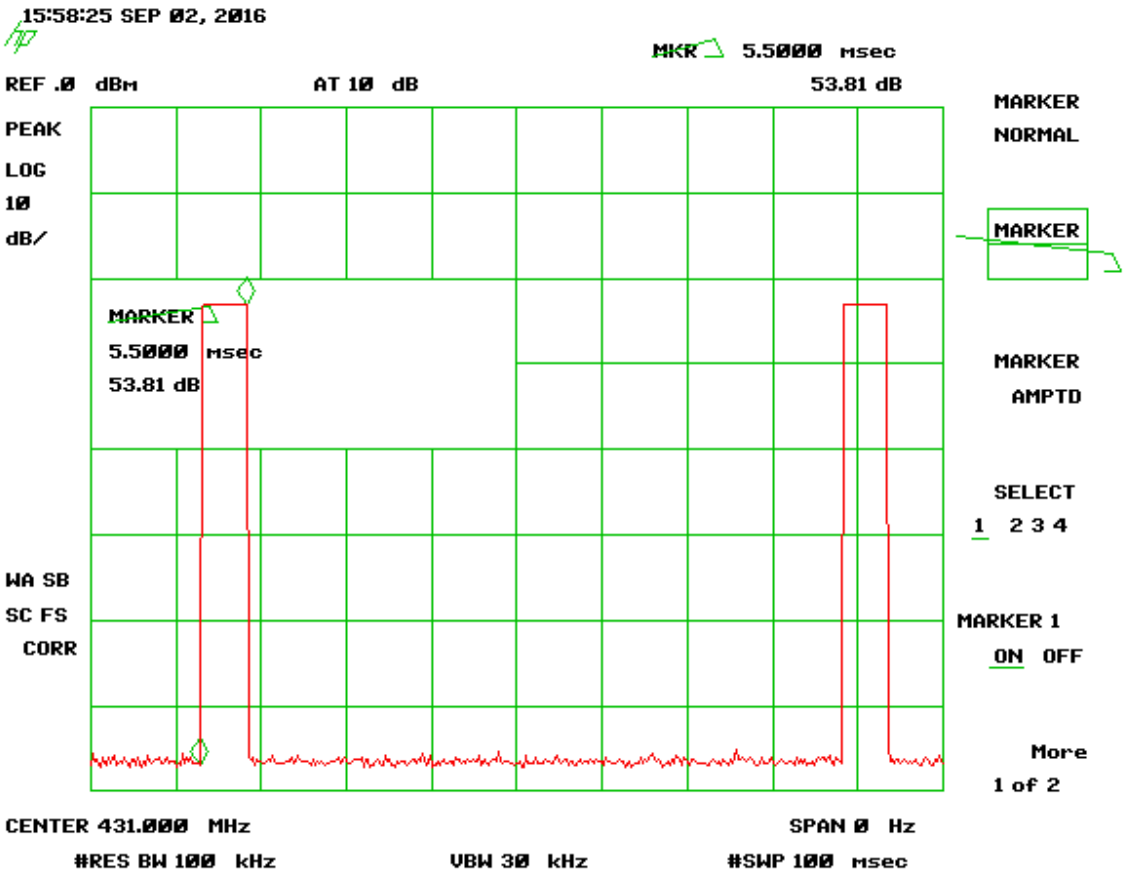


**Figure 3. Duty Cycle**

## 2.12 Bandwidth of Fundamental (CFR15.231 (c))

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. Bandwidth is determined by those frequencies that are at least 20 dB down on either side of the center frequency of the pulse.

0.0025 x 431,000,000.00 = 1.0775 MHz

The measured bandwidth is 407.50 kHz, well within the limit. See the figure below.

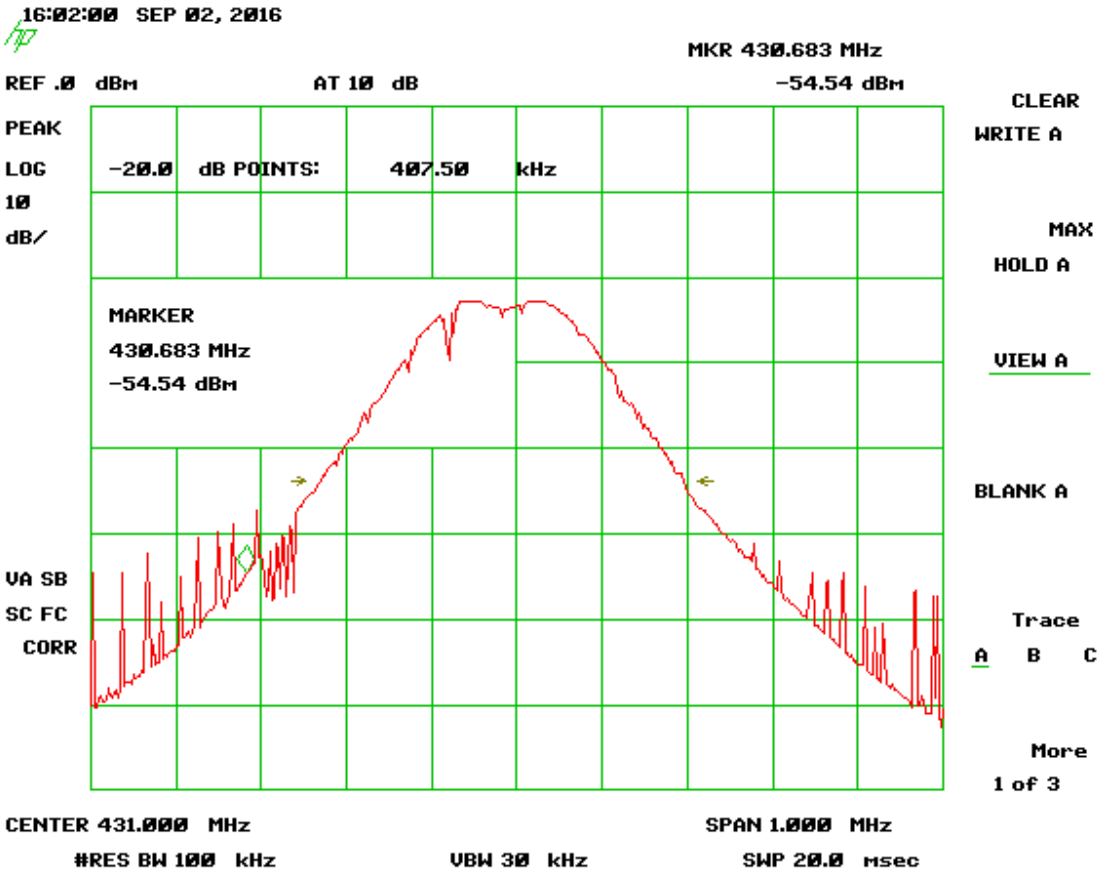


**Figure 4. Occupied Bandwidth (20 dB BW)**