



Testing Tomorrow's Technology

Application for

**US Code Title 47, Part 2, Subpart J, Section 2.947
Certification Per
Part 15, Subpart C, for Intentional Radiators, Section 15.249, Intentional Radiator
Operating within the Band 902 MHz to 928 MHz
And
Innovation, Science, and Economic Development Canada
Certification Per
IC RSS-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: 16-0220
Test Date(s): August 29-31, 2016
Issue Date: September 2, 2016**

Total Pages in this Report: 20

**3505 Francis Circle Alpharetta, GA 30004
PH: 770-740-0717 Fax: 770-740-1508
www.ustech-lab.com**



Testing Tomorrow's Technology

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: Consulting Engineer - President

Date: September 2, 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 2, 2016

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

Equipment type: **Intentional Radiator Operating within the band 902-928 MHz**

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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SUMMARY OF TEST REQUIREMENTS

<u>FCC Requirement</u>	<u>Title</u>	<u>Disposition</u>
15.205	Restricted Bands	Pass
15.207	Intentional Radiator Power Line Conducted Emissions	Pass
15.209	Intentional Radiator Radiated Emissions	Pass
15.249(a)	Fundamental Field Strength	Pass

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1 General Information

1.1 Purpose of this Report

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 IC RSS and FCC Rules and Regulations for RF Devices Intentional Radiators.

1.2 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 908.42 MHz band 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 908.42 MHz transmitter. The test results for the other transmitters will be covered in separate reports.

The transmitter operates only on a single channel, 908.42 MHz. The radio utilizes GFSK modulation with a data rate set to 100kb/s data rate. Proprietary firmware developed by the manufacture was used to set the radio into an FCC test mode.

1.3 Related Submittal(s)/Grant(s)

1.3.1 The EUT is subject to the following FCC authorizations:

- a) Certification under section 15.249 as a transmitter
- b) Verification under 15.101 as a digital device and receiver

1.3.2 Certification of the Transmitter

The EUT is not being certified under CFR 15.247 because its minimum 6 dB bandwidth is less than 500 kHz and its field strength levels meet the requirements of Part 15.249, therefore Part 15.249 will be applied. The EUT will operate at 908.42 MHz within the 902-928 MHz band.

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1.3.3 Verification of the Digital Apparatus

The digital apparatus has been tested to meet the verification requirements of FCC Part 15.107 and Part 15.109. The test results for these measurements are not included in this test report as this test report is meant to show only the compliance test data for the 908.42 MHz intentional radiator.

2 Tests and Measurements

2.1 Configuration of Tested System

The sample was setup and tested per *ANSI C63.10: 2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices*. Conducted and radiated emissions data were taken with the EMC test receiver (or spectrum analyzer's) resolution bandwidth adjusted to 9 kHz and 120 kHz, respectively. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was off throughout the evaluation process. A Block diagram of the tested system is shown in Figure 1. A listing of the EUT and its test peripherals is found in Table 1 below. Test configuration photographs for spurious and fundamental emissions measurements are in the attached appendices.

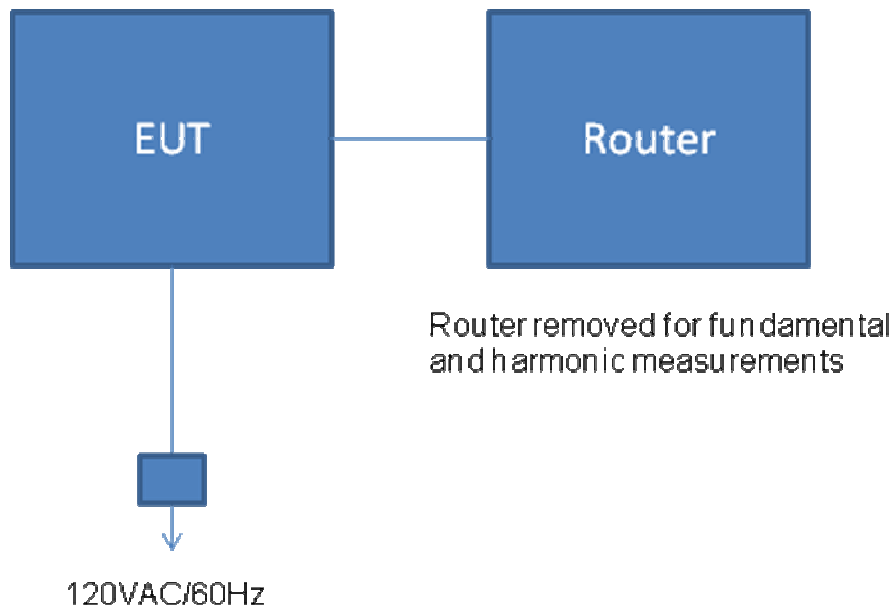


Figure 1. Block Diagram of Test Configuration

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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 1.0 m U D
AC/DC Power Supply adapter Wink Labs, Inc	S012BEU1 200100	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 = Powerline, D= Data

2.2 EUT Characterization

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

2.3 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.

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2.4 Test Equipment

Table 2. Test Instruments Used for Evaluation

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
HORN ANTENNA	3116	EMCO	9505-2255	1/27/2015 2 yr cycle
CALCULATION PROGRAM	N/A	N/A	Ver. 6.0	N/A

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

2.5 Modifications to EUT

No modifications were made by US Tech to bring the EUT into compliance with FCC Part 15.249 or IC RSS-210 requirements.

2.6 Measurement Standards (CFR 15.31)

Intentional and unintentional radiators are to use the methods of ANSI C63.10:2013. Measurements were made on an Open Area Test Site (OATS) wherever possible. For battery powered equipment, new (or fully charged) batteries are used. Section 15.31(m) indicates that if the EUT System operates at 900 MHz ISM band, measurements must be made near the bottom of the band (around 902 MHz for example) and near the top of the band (908 MHz). However this EUT only operates at 908.42 MHz therefore only one channel, 908.42 MHz, was evaluated.

2.7 Frequency Range of Radiated Measurements (CFR 15.33)

The frequency range is detailed below for intentional and unintentional radiators.

2.7.1 Frequency Range for Intentional Radiators

The spectrum was investigated from the lowest RF signal generated without going below 9 kHz to the 10th harmonic of the highest fundamental transmitter frequency.

2.7.2 Frequency Range for Unintentional Radiators

The spectrum was investigated from the lowest RF signal generated without going below the lowest frequency for which an emissions limit is specified (30 MHz) to the 5th harmonic of the highest fundamental frequency of the digital device (5 GHz maximum).

2.7.3 Measurement Detector Function and Bandwidth (CFR 15.35)

On any frequency below 1000 MHz, the limits shown are based upon measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths. On frequencies above 1000 MHz, the radiation limits are based upon the use of measuring instrumentation employing an average detector function.

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When average detector measurements are specified for use, including emission measurements below 1000 MHz, there is also a corresponding limit for Peak detector measurements having a limit of 20 dB above the corresponding average limit unless a different peak emission limit is specified. Measurements above 1000 MHz utilize a minimum resolution bandwidth of 1 MHz.

When radiated emissions limits are expressed in terms of the average value of the emission and pulsed operation is employed, the measurement field strength is determined by averaging over one complete pulse train (Duty Cycle) including blanking intervals for pulse trains up to 0.1 second in duration. The exact method of calculating the average field strength is included in paragraph 2.11 of this report.

Manufacturer stated duty cycle correction:

This radio module is identical to the radio module bearing the following FCC ID: KJ8-0003177 and the manufacturer of this product has not changed the radio parameters.

The worst case duty cycle was determined to be 60% or 60ms within a 100ms period. The duty cycle correction factor is determined using the following formula: $20 \log (0.60) = -4.44 \text{ dB}$.

The duty cycle correction factor therefore is -4.44 dB.

Note: The transmitter was programmed to transmit at >98% during all testing. Therefore where applicable (when using AVG detection) the duty cycle factor calculated above was applied.

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2.8 Antenna Requirement (CFR 15.203)

The intentional radiator is designed to assure that no antenna other than that furnished by the manufacturer is used with the device. The use of a permanently attached antenna is considered sufficient to comply with this requirement. Below is a table of the permanently attached antenna used with this system and its characteristics. If, in the future, additional antennas are contemplated for use, they must be formally evaluated and approved for suitability to these requirements.

Table 3. Wink Hub 2 Antennas

Manufacturer	Model Number	Antenna Type	Frequency Range	Peak Gain dBi	Impedance Ohms
Johanson Technology	0915AT43A 0026	Chip	902-928 MHz	0.0	50

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2.9 Intentional Radiator, Radiated and Power Line Conducted Emissions (CFR 15.207, CFR 15.209)

The end product along with the intentional radiator has been tested to meet the verification requirements of Part 15.207 and Part 15.209. The test results for these measurements are not included in this test report as this test report is meant to show only the compliance test data for the 908.42 MHz intentional radiator.

2.10 Intentional Radiator, Radiated Emissions (CFR 15.249 (a), (e))

The EUT was placed into a continuous transmit mode of operation (> 98% duty cycle). A preliminary scan was performed on the EUT to find signal frequencies that were caused by the transmitter part of the product and to obtain the worse case result the EUT was tested in all X, Y and Z axis. Radiated measurements below 1 GHz were tested with a RBW = 120 kHz. Radiated measurements above 1 GHz were measured using a RBW = 1 MHz VBW = 3 MHz.

2.11 Restricted Bands of Operation (CFR 15.205)

Only radiated harmonics and other spurious signals can be permitted to fall into the restricted bands of 15.205. All signals found in paragraph 2.7 above shall be examined for this requirement. Limits are based upon the limits of paragraph 15.209. Above 1 GHz, the limits are for Average value. See Tables 4 and 5 below for peak and Average measurements. According to CFR 15.35, the peak limits can exceed the average limits by 20 dB. For emissions below 1 GHz the limits are QP limits.

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Table 4. Intentional Radiated Emissions (Peak)

Tested By: RKM		Test: Part 15B, Para 15.249			Client: Wink Labs, Inc.			
		Project: 16-0220			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 Mode
908.42	73.13	0.00	27.19	100.32	114.0	3m./HORZ	13.7	PK
1819.20	39.69	0.00	31.20	70.89	74.0	3.0m./VERT	3.1	PK
2724.82	41.33	0.00	26.05	67.38	74.0	3.0m./VERT	6.6	PK

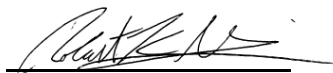
- (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 20 dB relaxation for peak measurements of CFR 15.35.
- No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic

Sample Calculation at 908.4MHz:

Magnitude of Measured Frequency	73.13	dBuV
Additional Factor	0.00	dB
+Antenna Factor + Cable Loss+ Amplifier Gain	27.19	dB/m
Corrected Result	100.32	dBuV/m

Test Date: August 29, 2016

Tested By

Signature: 

Name: Robert K. Mills

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Table 5. Intentional Radiated Emissions (Average)

Tested By: RKM		Test: Part 15B, Para 15.249			Client: Wink Labs, Inc.			
		Project: 16-0220			Model: Wink Hub 2			
Frequency (MHz)	Test Data (dBuV)	Additional Factor (dB)	AF+CL-PA-DC (dB/m)	Corrected Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detection Mode
908.42	65.61	0.00	27.19	92.80	94.0	3m./HORZ	1.2	QP
1819.20	18.01	0.00	31.20	49.21	54.0	3.0m./VERT	4.8	AVG
2724.82	25.17	0.00	26.05	51.22	54.0	3.0m./VERT	2.8	AVG
No other emissions detected.								

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. The EUT was programmed with the following TX power setting: 19/64.

Sample Calculation at 908.4MHz:

Magnitude of Measured Frequency	65.61	dBuV
Additional Factor (duty cycle)	0.00	dB
+Antenna Factor + Cable Loss+ Amplifier Gain	27.19	dB/m
Corrected Result	92.80	dBuV/m

Test Date: August 29, 2016

Tested By

Signature: 

Name: Robert K. Mills

2.12 20 dB (99%) occupied Bandwidth Measurement (RSS-GEN Issue 4 (6.6))

The EUT antenna port was connected to a spectrum analyzer having a 50 Ω input impedance. Measurements were performed following the procedures described in RSS-Gen Issue 4 (2014) clause 6.6.

Measured Bandwidth: 400.0 KHz

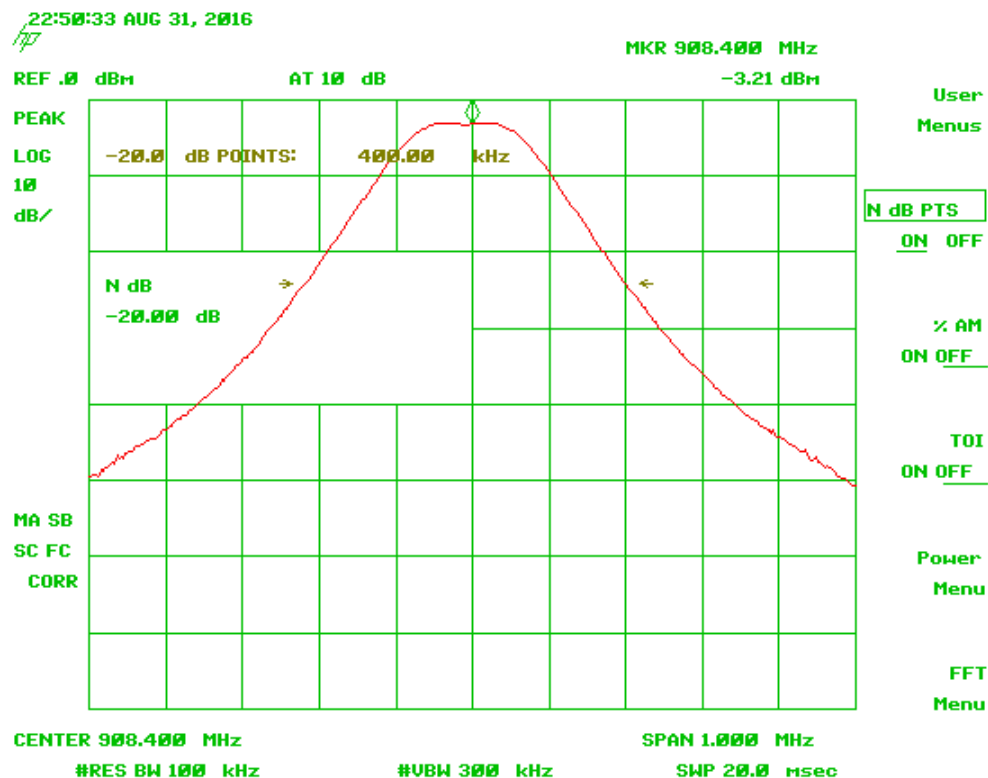


Figure 2. 20 dB Bandwidth Measurement

2.13 Band Edge Measurements (CFR15.249(d))

The EUT has only one fundamental frequency. Therefore the Band Edge measurements were made at one frequency. A measurement was made of the fundamental and the emission was measured using a quasi peak setting. A Resolution Bandwidth of $> 1\%$ of the emission bandwidth was used. This procedure was repeated for the high side. The limits were derived in the following sections.

2.13.1 High Band Edge

Below 908.42 MHz the emissions must be 20 dB or greater from the fundamental frequency. Above 908.42 MHz the limit per section 15.249(d) is 50 db below the fundamental or the value expressed by CFR 15.209 (46 dBuV/m) whichever is the lesser attenuation.

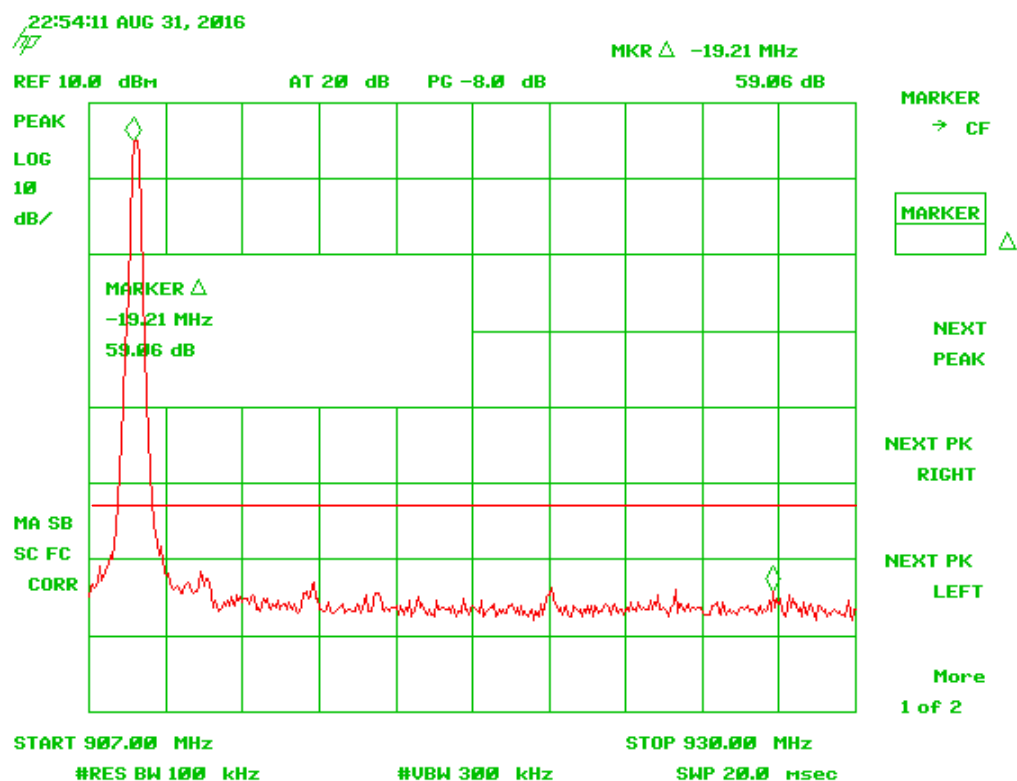


Figure 3. Conducted Band Edge Compliance – High Channel

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All emissions are greater than 50 dB from the fundamental.

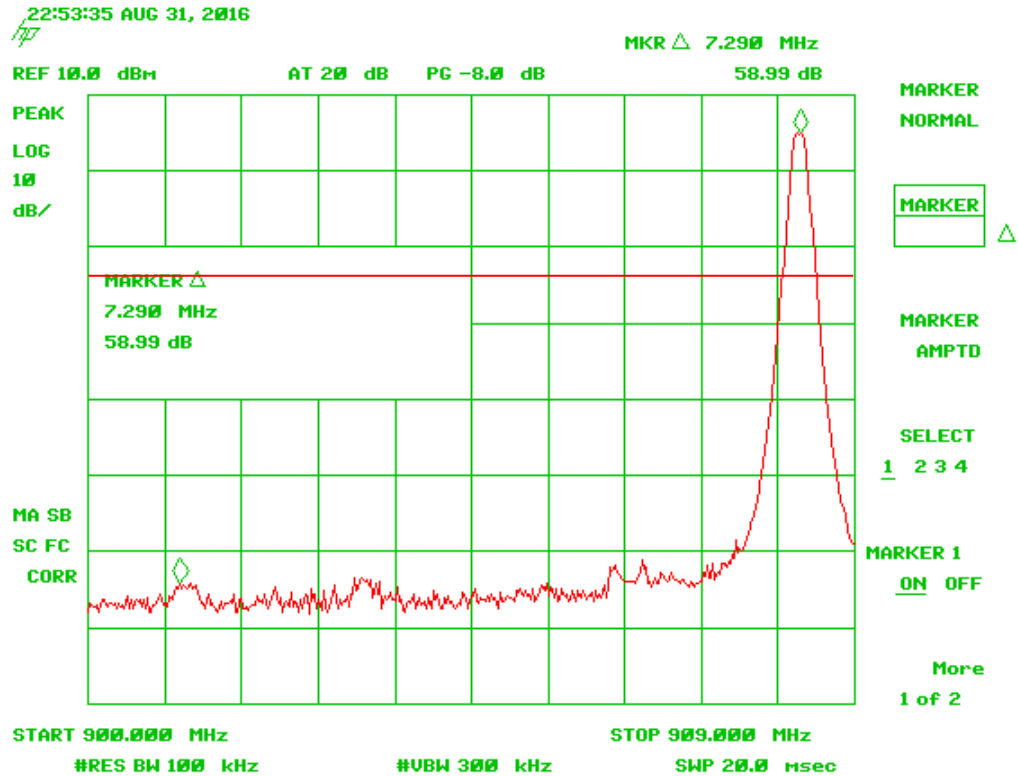


Figure 4. Conducted Band Edge Compliance – Low Channel

Note: All emissions are greater than 20 dB from the fundamental.