H.B. Compliance Solutions

Intentional Radiator Test Report

For the

Tri plus grupa d.o.o.

RGBW Bulb

Tested under

The FCC Rules contained in Title 47 of the CFR, Part 15.249 for

Z-Wave Operation

Prepared for:

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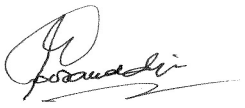

Hoosamuddin Bandukwala

Cert # ATL-0062-E

Engineering Statement: The measurements shown in this report were made in accordance with the procedure indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurement made, the equipment tested is capable of operation in accordance with the requirements of Part 15 of the FCC Rules under normal use and maintenance.

Report Status Sheet

Revision #	Report Date	Reason for Revision
Ø	July 18, 2014	Initial Issue
1	July 21, 2014	Added data for Industry Canada (RSS-GEN)

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EXECUTIVE SUMMARY

1. Testing Summary

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15.249. All tests were conducted using measurement procedure from 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 9kHz to 40GHz as appropriate.

Test Name	Test Method/Standard	Result	Comments
Unintentional Radiated Emissions	15.109	Pass	
A/C Power Line Conducted Emissions	15.207(a)	Pass	
Occupied Bandwidth	15.215	Pass	
Radiated Fundamental Emissions	15.249(a)	Pass	
Radiated Spurious Emissions	15.249(a)(d)(e), 15.209(a), 15.205, 15.35(C)	Pass	

EQUIPMENT CONFIGURATION

1. Overview

H.B Compliance Solutions was contracted by Tri Plus grupa d.o.o. to perform testing on the RGBW Bulb under the quotation number Q14061001.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Tri plus grupa d.o.o, RGBW Bulb.

The tests were based on FCC Part 15 Rules. The tests described in this document were formal tests as described with the objective of the testing was to evaluate compliance of the Equipment Under Test (EUT) to the requirements of the aforementioned specifications. Tri plus grupa d.o.o. should retain a copy of this document and it should be kept on file for at least five years after the manufacturing of the EUT has been permanently discontinued. The results obtained relate only to the item(s) tested.

Product Name:	RGBW Bulb
Model(s) Tested:	N/A
FCC ID:	2AAU7-RGBWZWSU
Supply Voltage Input:	Primary Power : 120 VAC
Frequency Range:	908.4MHz & 916MHz
No. of Channels:	Two
Type(s) of Modulation:	FSK
Range of Operation Power:	0.0000316 Watts (Radiated)
Emission Designator:	N/A
Channel Spacing(s)	None
Test Item:	Pre-Production
Type of Equipment :	Fixed
Antenna Requirement (§15.203) :	Type of Antenna: Helix Antenna Gain of Antenna: 2.0dBi
Environmental Test Conditions:	Temperature: 15-35°C Humidity: 30-60% Barometric Pressure: 860-1060 mbar
Modification to the EUT:	None
Evaluated By:	Staff at Emerson Network & H.B Compliance Solutions
Test Date(s):	07/02/14 till 07/21/14

2. Test Facility

All testing was performed at Emerson Network Power. This facility is located at 2900 S. Diablo Way, Suite 190, Tempe, AZ 85282. All equipment used in making physical determination is accurate and bears recent traceability to the National Institute of Standards and Technology.

Test facility at Emerson Network power is an A2LA accredited test site. The A2LA certificate number is 2716.01. The scope of accreditation covers the FCC Method - 47 CFR Part 15, ICES-003, CISPR 22, AS/NZS 3548 and VCCI

Radiated Emissions measurements were performed in a semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at Emerson Network Power.

3. Description of Test Sample

The Tri plus grupa d.o.o., RGBW Bulb is a smart LED bulb which communicates with the Zipabox home controller to adjust lighting by using any smartphone.

4. Equipment Configuration

Ref. ID	Name / Description	Model Number	Serial Number
# 1	RGBW Bulb	-	None

Table 1. Equipment Configuration

5. Support Equipment

All support equipment supplied is listed in the following Support Equipment List.

Ref ID	Name / Description	Manufacturer	Model #	Serial #
# 2	AC Bulb Socket	-	-	None

Table 2. Support Equipment

6. Ports and Cabling Information

Ref ID	Port name on the EUT	Cable Description	Qty.	Length (m)	Shielded? (Y/N)	Termination Box ID & Port ID
-	-	-	-	-	-	-

Table 3. Ports and Cabling Information

7. Method of Monitoring EUT Operation

A test receiver will be used to monitor the data transmission from the EUT.

8. Mode of Operation

The EUT will be configured to transmit at maximum power level. Test mode was provided to select between CW to modulated mode by using a laptop computer which was connected through a serial port. These settings were created for testing purpose only. The power level of the software was set to “3F” for 908.4MHz and “1E” for 916MHz.

9. Modifications

9.1 Modifications to EUT

No modifications were made to the EUT

9.2 Modifications to Test Standard

No Modifications were made to the test standard.

10. Disposition of EUT

The test sample including all support equipment submitted to H.B Compliance Solutions for testing will be returned to Tri plus grupa d.o.o. upon completion of testing & certification

Criteria for Un-Intentional Radiators

1. Radiated Emissions

Test Requirement(s):	§15.109	**Test Engineer(s):**	Frank Farrone
Test Results:	Pass	**Test Date(s):**	07/09/2014

Test Procedures:

The final radiated emissions test was performed using the parameters described above as worst case. That final test was conducted at a facility that meets the ANSI C63.4 NSA requirements. The frequency range noted in the data sheets was scanned/tested at that facility. Emissions were maximized as specified, by varying table azimuth, antenna height, and manipulating cables.

Using the mode of operation and configuration noted within this report, a final radiated emissions test was performed. The frequency range investigated (scanned), is also noted in this report. Radiated emissions measurements were made at the EUT azimuth and antenna height such that the maximum radiated emissions level will be detected. This requires the use of a turntable and an antenna positioner. The preferred method of a continuous azimuth search is utilized for frequency scans of the EUT field strength with both polarities of the measuring antenna. A calibrated, linearly polarized antenna was positioned at the specified distance from the periphery of the EUT.

> *Note: The specified distance is the horizontal separation between the closest periphery of the EUT and the center of the axis of the elements of the receiving antenna. However, if the receiving antenna is a log-periodic array, the specified distance shall be the distance between the closest periphery of the EUT and the front-to-back center of the array of elements.*

Tests were made with the antenna positioned in both the horizontal and vertical polarization planes. The measurement was varied in height above the conducting ground plane to obtain the maximum signal strength. Though specified in the report, the measurement distance shall be 3 meters. At any measurement distance, the antenna height was varied from 1 meter to 4 meters. These height scans apply for both horizontal and vertical polarization, except that for vertical polarization the minimum height of the center of the antenna shall be increased so that the lowest point of the bottom of the antenna clears the ground surface by at least 25 cm.

Frequency Range (MHz)	Peak Data (kHz)	Quasi-Peak Data (kHz)	Average Data (kHz)
30 MHz to 1 GHz	120 kHz	120 kHz	N/A
1 GHz to 11 GHz	1MHz	N/A	1MHz
Measurements were made using the bandwidths and detectors specified. The video filter was at least as wide as the IF bandwidth of the measuring receiver.			

Table 4. Radiated Emissions – Measurement Bandwidth

Emissions Tests Calculations

In the case of indoor measurements, radiated emissions measurements are made by the manipulation of correction factors using Rohde and Schwarz ES-K1 software. This is done automatically by the software during the final measurement process.

In both cases, the level of the Field Strength of the interfering signal is calculated by adding the Antenna Factor, Cable Factor and by subtracting the Amplifier Gain from the measured reading. The basic equation is as follows:

FS = RA + AF + (CF –AG)

Where: FS = Field Strength

RA = Receiver (indicated) Amplitude

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Amplifier Gain

This laboratory uses an approach of combining the CF and AG using an end-to-end measurement of the entire cabling system, including the test cable, any in-line amplifiers, attenuators, or transient protection networks, all measured in-situ.

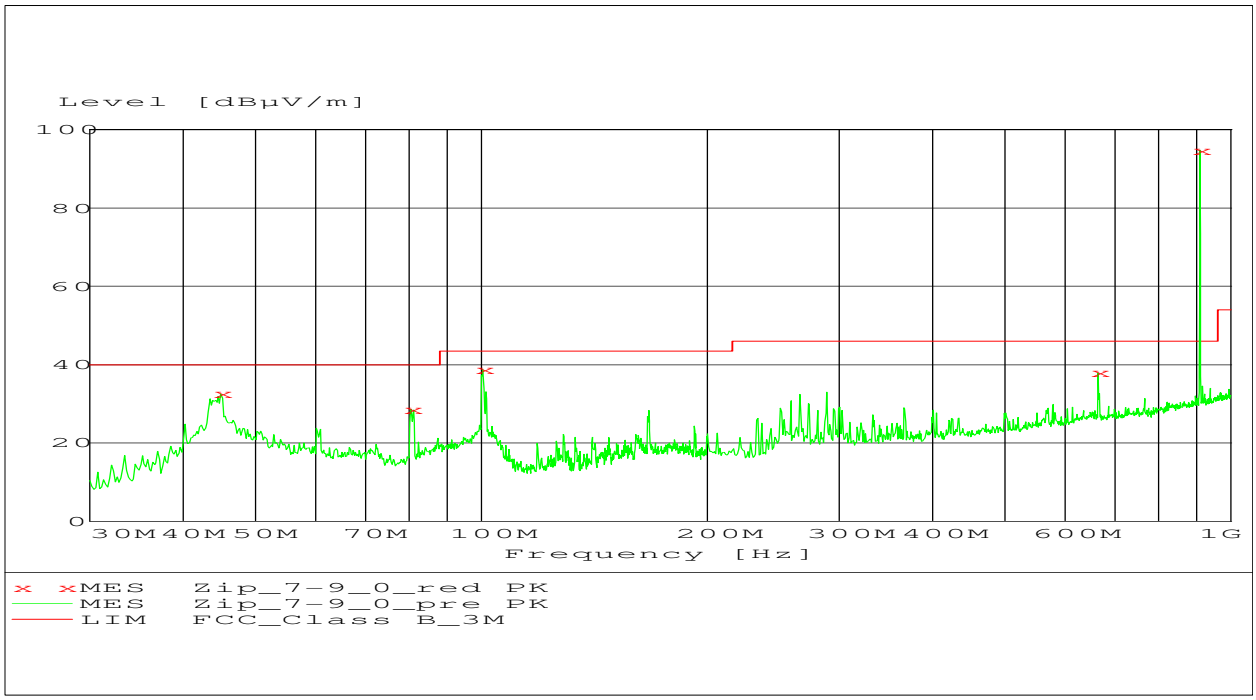
For a sample calculation, assume a receiver reading of 52.5 dBuV is obtained. With an antenna factor of 7.4 and a combined cable factor (CF + AG) of -27.9:

FS = 52.5 + 7.4 + (-27.9) = 32 dBuV/m

FS = 32 dBuV/m

If desired, this can be converted into its corresponding level in uV/m:

FS = 10^((32 dBuV/m)/20) = 39.8 uV/m

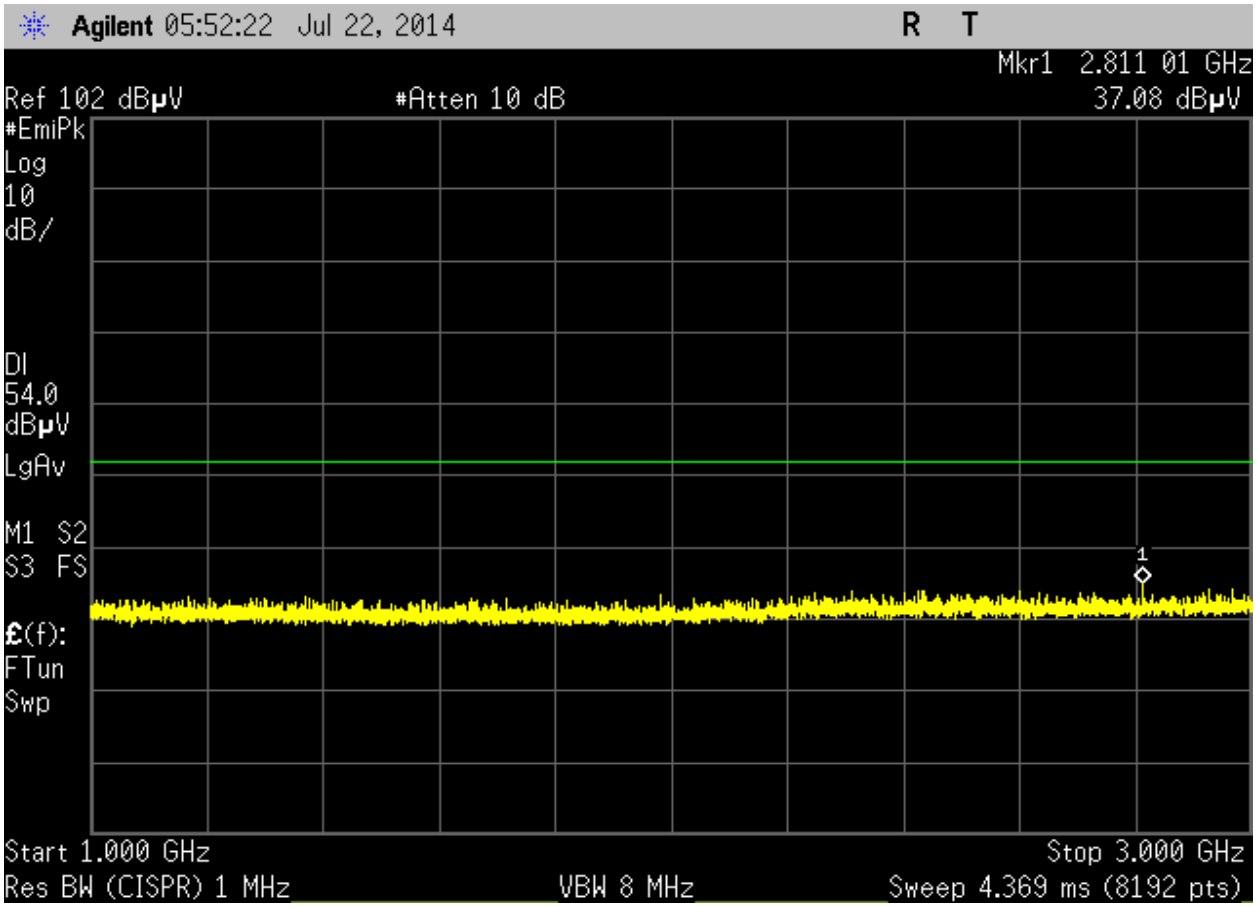


Plot 1 – Radiated Emissions – 30MHz to 1GHz

Frequency (MHz)	Measured Level	Height(cm)	Azimuth (deg)	Polarization
43.20	33.0	100	270	Vertical
80.03	28.1	100	180	Vertical
99.98	38.0	200	219	Vertical
666.44	30.3	100	315	Horizontal

Table 5. Final Measurement Results for Radiated Emissions

Note: The peak measurement at 908MHz is transmitter fundamental frequency



Plot 1 – Radiated Emissions – 1GHz to 3GHz (For Industry Canada RSS-GEN)

2. Conducted Emissions

Test Requirement(s):	§15.207	Test Engineer(s):	Hoosam B.
Test Results:	Pass	Test Date(s):	07/16/2014

Test Procedures: The EUT was placed on a non-metallic table, 80cm above the ground plane inside a shielded enclosure. The EUT was powered through a 50Ω/50µH LISN. The conducted emissions tests were performed using the mode of operation and configuration noted within this report. The frequency range investigated (scanned), is also noted in this report. Conducted power line measurements are made, unless otherwise specified, over the frequency range from 150 kHz to 30 MHz to determine the line-to-ground radio-noise voltage that is conducted from the EUT power-input terminals that are directly (or indirectly via separate transformer or power supplies) connected to a public power network. Equipment is tested with power cords that are the same as those cords normally used or that have electrical or shielding characteristics that are the same as those cords normally used. Typically those measurements are made using a LISN (Line Impedance Stabilization Network). All 50 Ohm measuring ports of the LISN are terminated by 50 Ohms, either by the 50 Ohm EMI receiver or a 50 Ohm resistive load.

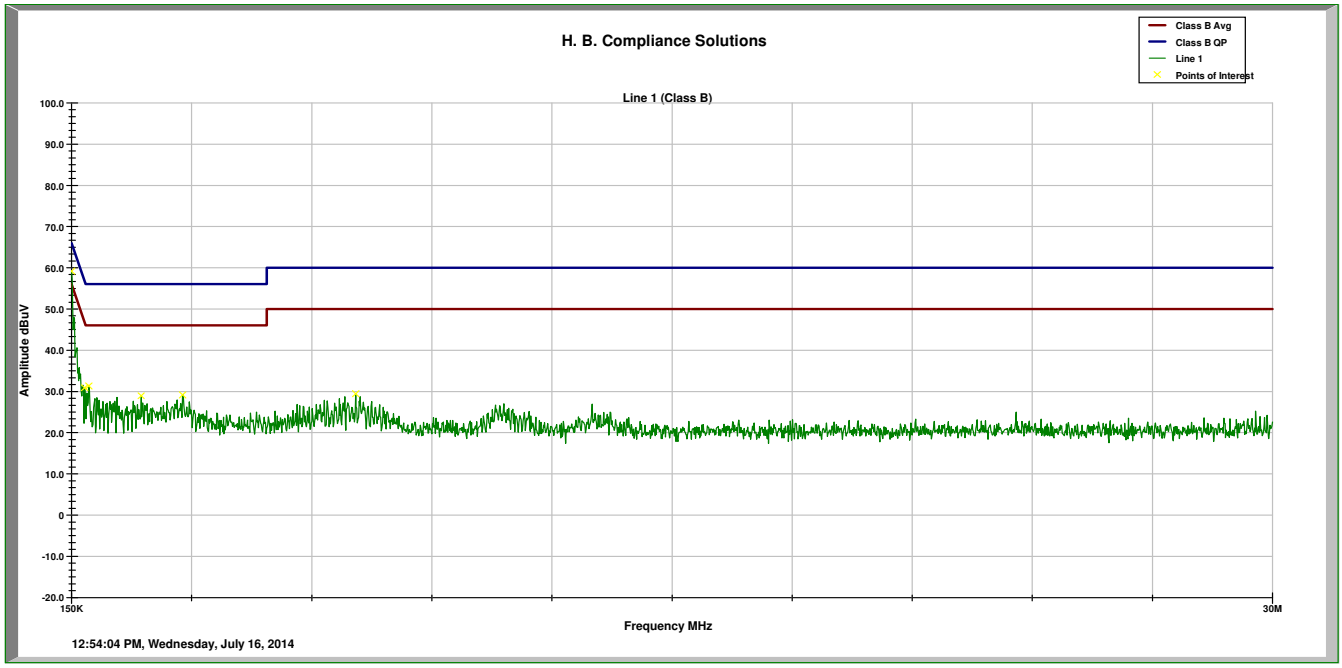
Refer to the Emissions Tests Calculations section in the Radiated Emissions section for sample calculations. For the purposes of the conducted emissions test, the Antenna Factor (AF) is replaced by the LISN correction factor.

Frequency Range (MHz)	Peak Data (kHz)	Quasi-Peak Data (kHz)	Average Data (kHz)
0.150 - 30	9.0	9.0	9.0
Measurements were made using the bandwidths and detectors specified. No video filter was used.			

Table 6.Conducted Emissions – Measurement Bandwidth

Frequency Range (MHz)	15.107(b), Class A Limits (dBuV)		15.107(a), Class B Limits (dBuV)	
	Quasi-Peak	Average	Quasi Peak	Average
0.15 – 0.5	79	66	66 - 56	56 - 46
0.5 – 5.0	73	60	56	46
5.0 – 30	73	60	60	50
Note 1 – The lower limit shall apply at the transition frequencies.				

Table 7. Conducted Emissions Limits – FCC Limits from Section 15.107(a)(b)



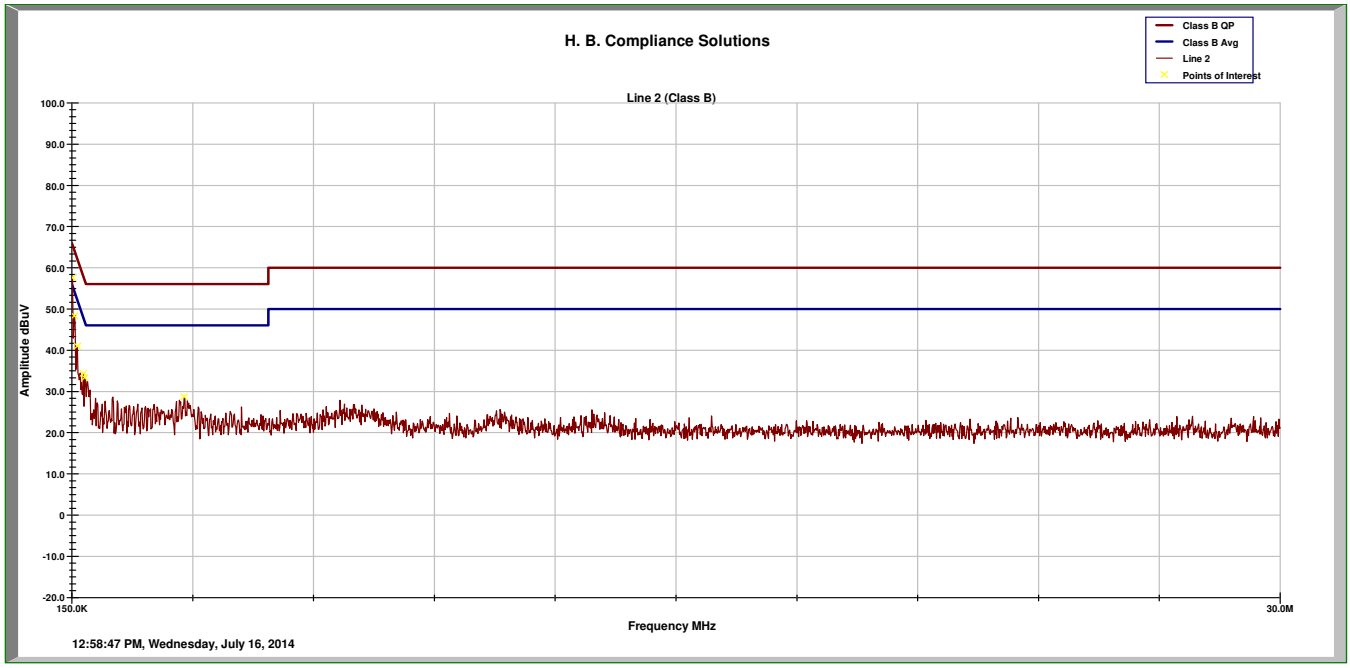
Plot 1 – Conducted Emission Plot – Line Side (Class B)

Frequency (MHz)	Measured Level (dBuV)	Limit (dBuV)	Margin (dB)
0.161	51.68	65.673	-13.993
0.480	31.44	56.546	-25.106
0.585	27.12	56	-28.88
1.886	22.73	56	-33.27
2.910	23.84	56	-32.16
7.205	23.08	60	-36.92

Table 3. Measurement Results for QP

Frequency (MHz)	Measured Level (dBuV)	Limit (dBuV)	Margin (dB)
0.161	34.088	55.673	-21.586
0.480	16.53	46.546	-30.016
0.585	15.335	46	-30.665
1.886	14.51	46	-31.49
2.910	17.572	46	-28.428
7.205	15.128	50	-34.873

Table 4. Measurement Results for Average



Plot 2 – Conducted Emissions – Neutral Side (Class B)

Frequency (MHz)	Measured Level (dBuV)	Limit (dBuV)	Margin (dB)
0.165	56.02	65.571	-9.551
0.222	47.64	63.916	-16.276
0.279	40.45	62.293	-21.843
0.435	29.91	57.843	-27.933
0.477	31.12	56.635	-25.515
2.913	23.94	56	-32.06

Table 5. Measurement Results for Quasi Peak

Frequency (MHz)	Measured Level (dBuV)	Limit (dBuV)	Margin (dB)
0.165	39.34	55.571	-16.231
0.222	30.788	53.916	-23.128
0.279	23.43	52.293	-28.863
0.435	18.142	47.843	-29.701
0.477	15.99	46.635	-30.645
2.913	17.017	46	-28.983

Table 6. Measurement Results for Average

2. Occupied Bandwidth

Test Requirement(s):	15.215(c)	**Test Engineer(s):**	Hoosam B.
Test Results:	Pass	**Test Date(s):**	07/02/2014

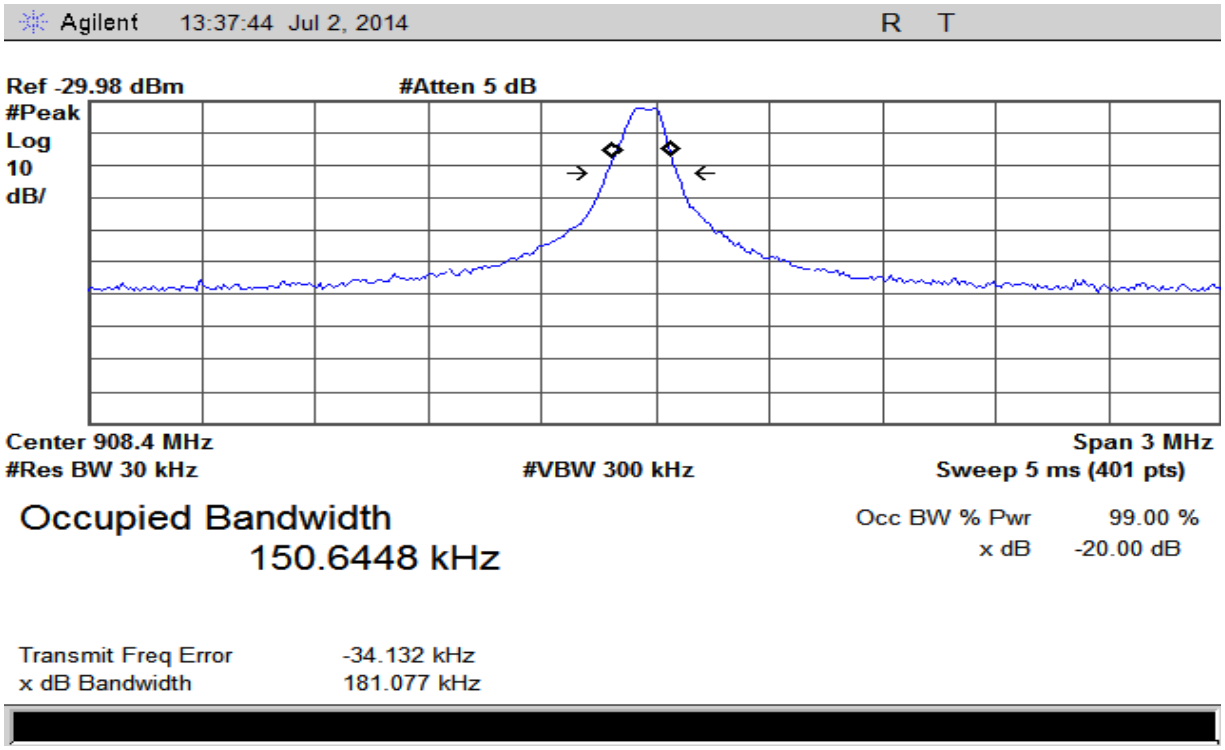
Test Procedure: As required by 47 CFR 15.215(c): The bandwidth of the emission shall be determined at the points 20dB down from the modulated carrier.

Customer provided a test mode internal to the EUT to control the RF modulation. The EUT antenna was attached and the waveform was received by the test antenna which was connected to the spectrum analyzer. The measured highest peak power was set relative to zero dB reference. The RBW of the Spectrum Analyzer was set to 30kHz and VBW>RBW.

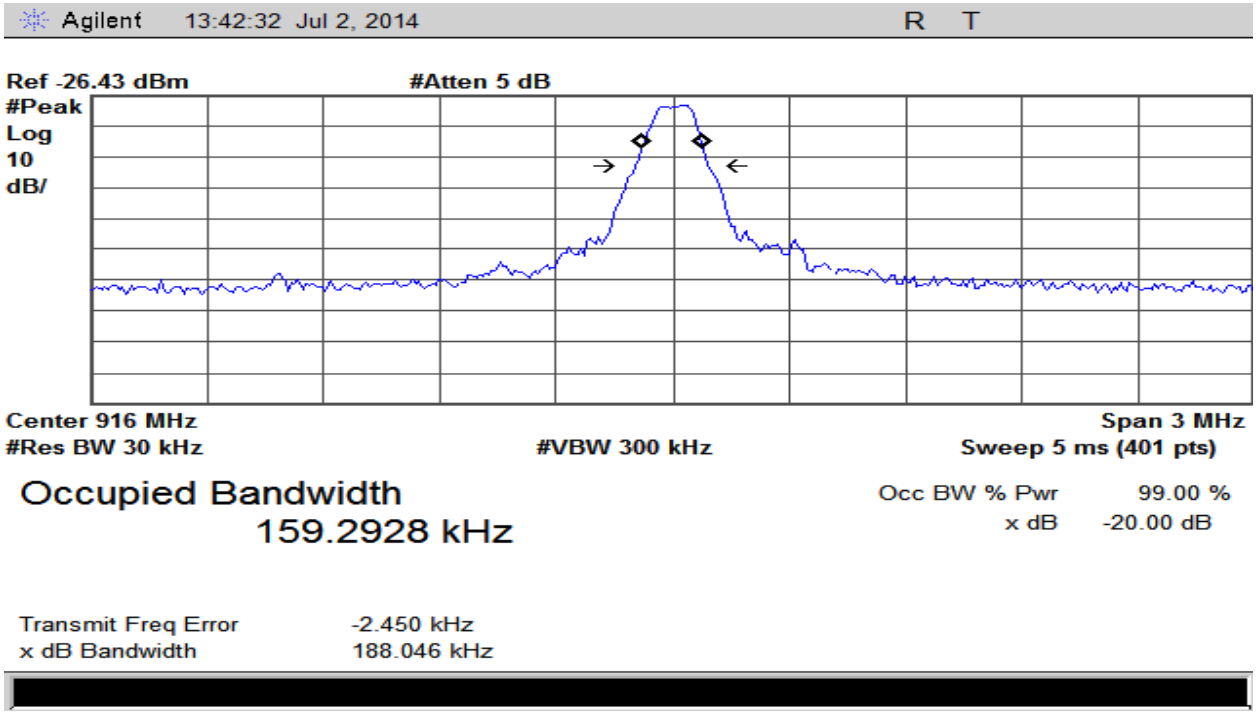
Frequency (MHz)	20dB Bandwidth (kHz)	99% Bandwidth (kHz)
908.4	181.07	150.64
916.0	188.04	159.29

Table 8. Occupied Bandwidth Summary, Test Results

The following pages show measurements of Occupied Bandwidth plot:



Plot 2 – 20dB BW FSK Modulation & 99% Occupied BW (For IC Only)



Plot 3 – 20dB BW FSK Modulation & 99% Occupied BW (For IC Only)

5. Radiated Fundamental Emissions

Test Requirement(s):	§15.249(a)	**Test Engineer(s):**	Frank Farrone
Test Results:	Pass	**Test Date(s):**	07/09/2014

Test Procedures: As required by 47 CFR 15.249, Radiated emission measurements were made in accordance with the procedures of the ANSI C63.4 - 2003.

The EUT was placed on a wooden table inside a 3 meter semi-anechoic chamber. The EUT was set on continuous transmit.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT

Frequency Range	Detector Setting	Resolution Bandwidth	Video Bandwidth	Span
30MHz – 1000 MHz	Quasi Peak	120kHz	As Specified in §15.35(c)	Zero
1000 MHz – 5GHz	Peak	1MHz	1MHz	As necessary
1000 MHz – 5GHz	Average	1MHz	As Specified in §15.35(c)	As necessary

Table 12 - Analyzer Settings

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical

Frequency (MHz)	Peak Measurement @ 3m (dBuV/m)	Antenna Polarity (H/V)	Quasi Peak Amplitude (dBuV/m)	FCC Quasi Peak Limit (dBuV/m)	Quasi Peak Margin (dB)	Comment
908.4	92.0	H	-	94	-2.0	Fundamental
916.0	92.4	H	-	94	-1.6	Fundamental

Table 13 – Fundamental Field Strength

Remark:

To get a maximum emission level from the EUT, the EUT was moved throughout the X-axis, Y-axis and Z-Axis. Worst case is X-axis.

6. Radiated Spurious Emissions

Test Requirement(s):	§15.249(a)(b)(e), 15.209(a), 15.205, 15.35	**Test Engineer(s):**	Hoosam B.
Test Results:	Pass	**Test Date(s):**	07/16/2014

Test Procedures: As required by 47 CFR 15.231, Radiated emission measurements were made in accordance with the procedures of the ANSI C63.4 - 2003.

The EUT was placed on a wooden table inside a 3 meter semi-anechoic chamber. The EUT was set on continuous transmit.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The frequency range up to the 10th harmonic was investigated.

Frequency Range	Detector Setting	Resolution Bandwidth	Video Bandwidth	Span
30MHz – 1000 MHz	Quasi Peak	120kHz	As Specified in §15.35(c)	Zero
1000 MHz – 5GHz	Peak	1MHz	1MHz	As necessary
1000 MHz – 5GHz	Average	1MHz	As Specified in §15.35(c)	As necessary

Table 12 - Analyzer Settings

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical

Frequency (MHz)	Peak Measurement @ 3m (dBuV/m)	Antenna Polarity (H/V)	Average Amplitude (dBuV/m)	FCC Average Limit (dBuV/m)	FCC Peak Limit (dBuV/m)	Average Margin (dB)	Peak Margin (dB)	Comment
1816.8	33.03	H	N/A	54	74	-17.8	-40.9	Low Channel
2725.2	56.43	V	52.43	54	74	-1.57	-17.5	Low Channel
3633.6	43.11	H	N/A	54	74	-10.89	-30.8	Low Channel
4542	48.03	V	37.4	54	74	-16.6	-25.9	Low Channel
1832	33.86	H	28.69	54	74	-25.31	-40.1	High Channel
2748*	56.33	V	52.67	54	74	-1.33	-17.6	High Channel
3664	31.71	V	N/A	54	74	-22.29	-42.2	High Channel
4580	48.43	V	N/A	54	74	-5.57	-25.2	High Channel

Table 13 - Radiated Spurious Emission Data – 30MHz – 25GHz

Note: Frequency marked with "*" falls under the restricted band for Industry Canada and or FCC.

Remark:

To get a maximum emission level from the EUT, the EUT was moved throughout the X-axis, Y-axis and Z-Axis. Worst case is X-axis.

Test Equipment

Equipment	Manufacturer	Model	Serial #	Last Cal Date	Cal Due Date
Spectrum Analyzer	Agilent	E4402B	US41192757	Dec/10/13	Dec/10/14
Temperature Meter	Control Company	4184	122670346	Nov/15/12	Nov/15/14
Spectrum Analyzer	Hewlett Packard	8563E	3821A09316	Sep/11/13	Sep/11/14
High Pass Filter	Mini-Circuits	VHF-3100+	1023	NCR	None
Spectrum Analyzer	Hewlett Packard	8595E	3543A01606	Nov/16/13	Nov/16/14
EMI Receiver	R&S	ESCS-30	828985/007	Sep/03/13	Sep/03/14
High Pass Filter	Mini-Circuits	VHF-1320+	1034	NCR	None
Signal Generator	R&S	SMY02	1062.5502.12	NCR	None
Attenuator 10dB	Huber+Suhner	6810.17.A	747300	NCR	None
Horn Antenna	Com-Power	AHA-118	071150	Sep/13/13	Sep/13/14
Bilog Antenna	Chase	CBL6140	1040	Nov/09/13	Nov/09/14
LISN	Laplace	LISN1600	152946	Nov/19/13	Nov/19/14
Power Supply	Hewlett Packard	E3610A	KR83021468	NCR	None

Table 14 – Test Equipment List

***Statement of Traceability:** Test equipment is maintained and calibrated on a regular basis. All calibrations have been performed by a 17025 accredited test facility, traceable to National Institute of Standards and Technology (NIST)

END OF TEST REPORT