International Compliance Laboratories

FCC Part 15 Subpart C
Transmitter Certification Test Report

ICL Report # 1963A
FCC ID: 2AC46ST-3H

Test Specification: FCC Rule Part 15 Subpart C, Section 15.249
Transmitters Operating in Frequency Band: 902-928 MHz

Manufacturer: Mesh Systems, LLC
Model Name: ABInteract Social Tap
Model Number: 3h
Serial Number: 8.0.0.75

Test Dates: 7/28 - 7/31, 8/1, 8/4, 8/6 - 8/10/2014

Report Issue Date: 9/3/2014

Test Result: MEETs Requirements

Prepared By:

Daniel L Berg

Daniel L. Berg
ICL Compliance Engineer

Reviewed By:

Ronald W. Zimmerman

Ronald W. Zimmerman
ICL President and NCE

Table of Contents

1.0 Purpose

The purpose of this report is to demonstrate compliance with FCC: Telecommunication – Code of Federal Regulations, CFR 47, Part 15. This report will assist with obtaining an FCC Certification Authorization for a Low-Power License-Exempt Transmitter. Accepted methods and procedures from ANSI C63.4 were used to perform the necessary emissions measurements to show conformance.

2.0 Summary of Testing

Electromagnetic Radiated Emissions		
FCC 15.203	Antenna Requirement	MEETs Requirements
FCC (No limit specified for 15.249)	20dB Bandwidth	No Requirement. Measurment Reported.
FCC 15.249 (a) & (c)	Maximum Field Strength	MEETs Requirements
FCC 15.249 (a) & (c) FCC 15.209	Transmitter Harmonic and Spurious Emissions	MEETs Requirements
FCC 15.209 (b) FCC 15.249 (d)	Band-Edge Compliance	MEETs Requirements
FCC 1.1307, 1.1310, 2.1091, and 2.1093	RF Exposure Limits	MEETs Requirements

Table 2.0-1, Summary of Testing

3.0 Product Description

3.1 General

As described in the *Theory of Operation* document, the ABInteract SocialTap Model 3h (hereafter referred to as “SocialTap”) is a battery powered wireless LED display and sensor device designed to be mounted onto a conventional draft beer tap handle. It is used for a variety of interactive merchandising applications, including display of messages on a dot-matrix LED array and flashing of a high-brightness LED in response to external triggers. The SocialTap further includes an accelerometer for sensing motion and orientation of the beer tap handle. The SocialTap communicates with an infrastructure device (mvG EZRA 4000 Gateway) using a low power RF transceiver operating in the 902 to 928 MHz ISM band.

3.2 Manufacturer Information

Mesh Systems, LLC
N1070 Quality Drive
Greenville, WI 54942

Contact: Edward Beistle
Title: Senior Software Engineer
Phone: (920) 799-4700
FAX: (317) 661-4801
Email: Edward.Beistle@mesh-systems.com
Website: http://mesh-systems.com/

3.3 Equipment Under Test Details

Details on the EUT and its general operation can be found in the Mesh Systems, LLC document *Theory of Operation.*

Each item in the EUT (Equipment Under Test) set-up was tagged and identified. See Figure 1. Front view of the AB Social Tap (Equipment Under Test).Figure 1**Error! Reference source not found.** and Figure 2 for photos of the system components. Additional details for each item are listed below:

EUT:

Antenna: The antenna is a surface mount helical monopole from Pulse Electronics, part number W3112A, and is mounted on the main circuit board. The circuit board is generally not accessible by the end user.

Power: The device is battery operated and requires (3) AA alkaline batteries (4.5Vdc nominal). The batteries are accessible and replaceable by the end user. There is no way to connect external power or increase the power of the transmitter.

Frequency: The device uses one channel in the 902-928MHz band. It is 905.998993 MHz.

Modulation: The device used one type of modulation. It is 2-GFSK

Deviation: The deviation is 5.1 kHz.

Data Rate: One data rate of 2400 bps (2.4kbps).

Receiver Bandwidth: 58 kHz.

Internal Operating Frequencies: The device contains 2 crystals: 32.768kHz for the MCU, and 40.000MHz for the transceiver IC. 40MHz is used to synthesize the 905.008993MHz RF signal. It has a tight tolerance of 20 ppm.

Serial Number 8.0.0.75 was used as a configurable transmit unit (for maximum duty cycle – modulated).

Infrastructure Device (hub):

The infrastructure device, mvG EZRA 4000 Gateway, contained custom software to configure the EUT to continuously transmit without modulation (by pushing the ■ button), continuously transmit with modulation at maximum duty cycle (by pushing the ► button), and normal operation (no button push – default).

Figure 1. Front view of the AB Social Tap (Equipment Under Test).

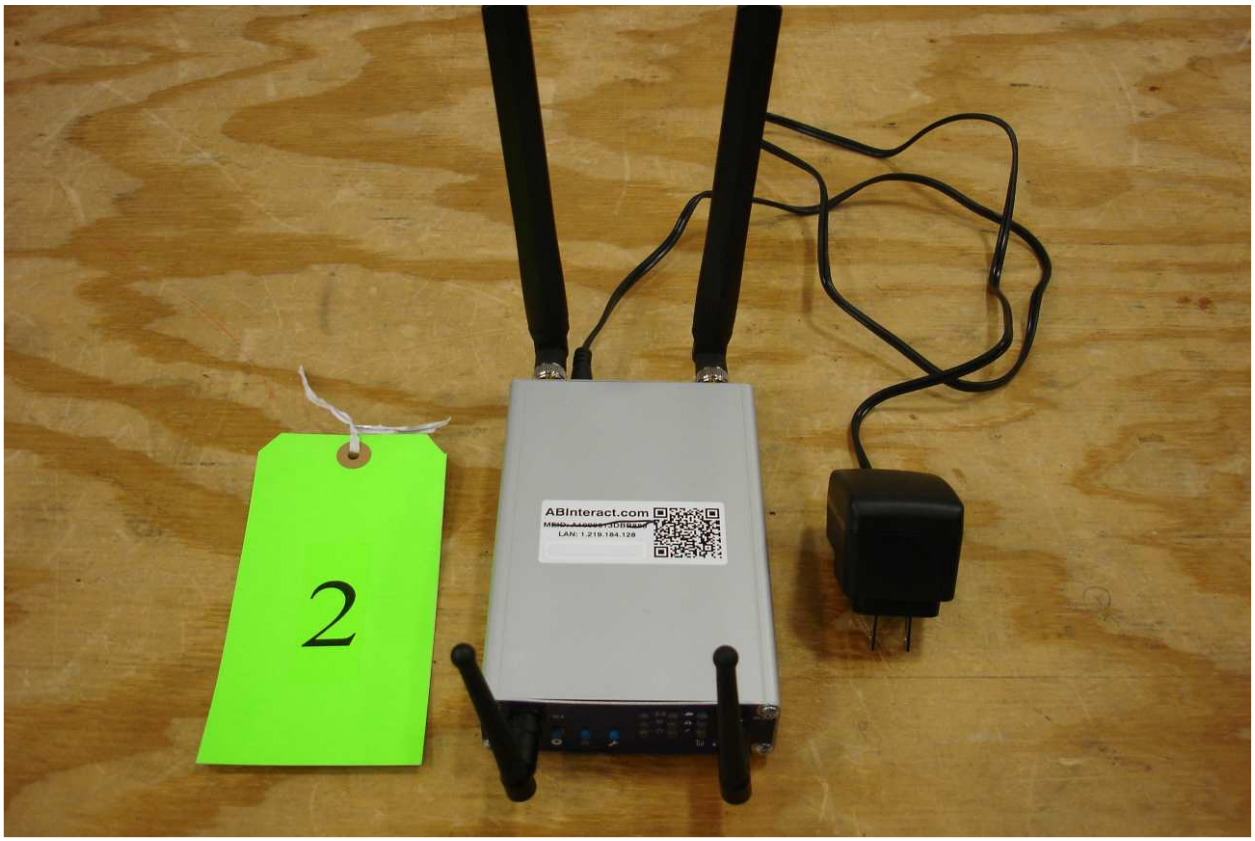


Figure 2. Auxiliary Communications Hub (see photo below for more details located on back of product)

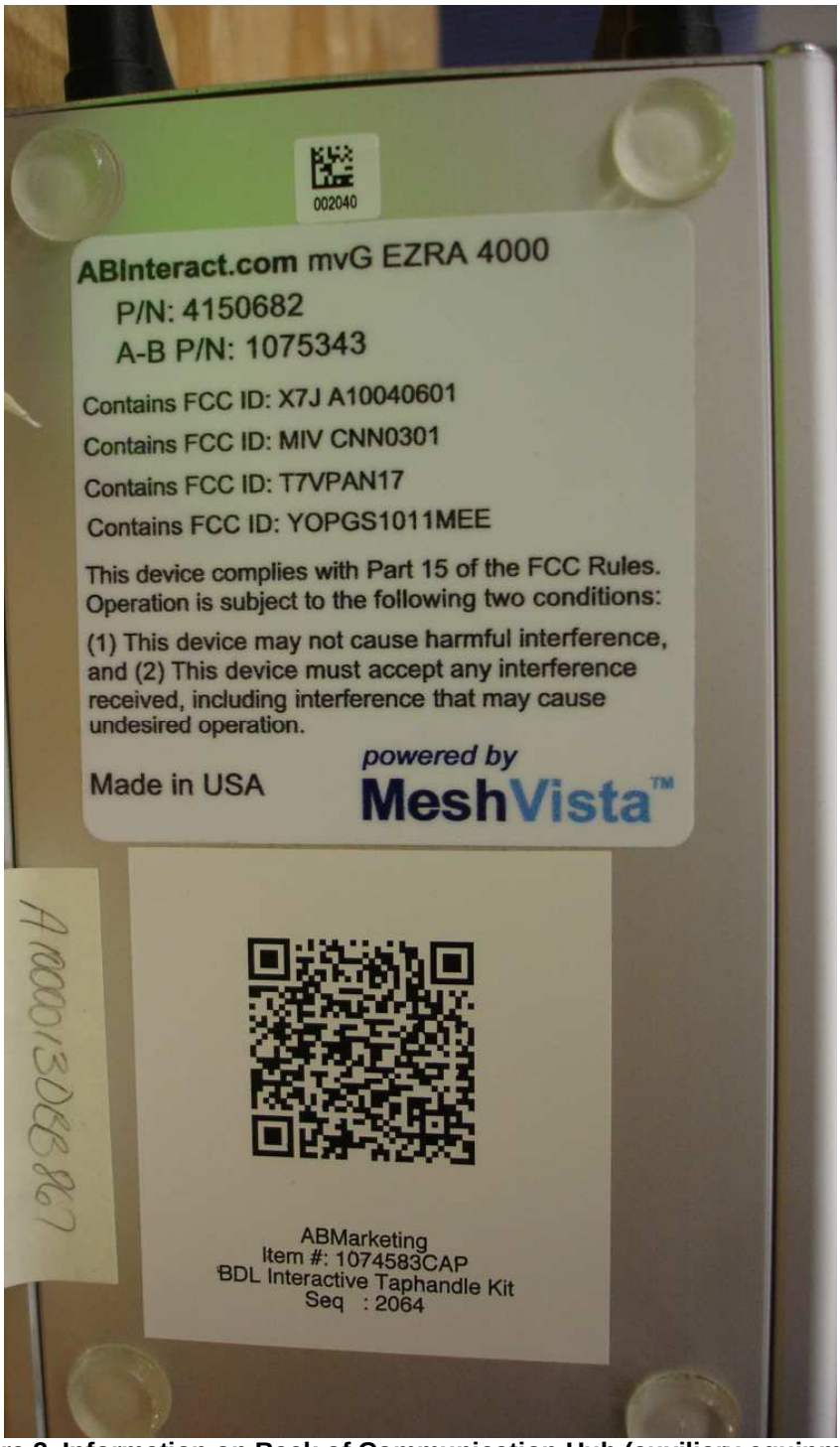


Figure 3. Information on Back of Communication Hub (auxiliary equipment).

4.0 Test Facilities

4.1 Location

The radiated emissions test site is located at the following address:

International Compliance Laboratories, LLC
1057 Tullar Court
Neenah, WI 54904
Phone: (920) 720-5555
Fax: (920) 720-5556

4.2 Laboratory Accreditations/Recognitions/Certifications

The Semi-Anechoic Chamber Test Site has been fully described, submitted to, and accepted by the FCC and Industry Canada. In addition, ICL is compliant to ISO 17025 as certified by the American Association for Laboratory Accreditation (A2LA) under their National Voluntary Laboratory Accreditation Program. The following certification numbers have been issued in recognition of these accreditations and certifications:

Accredited Test Firm with Designation Number: US1117
Test Firm Registration Number: 918349
A2LA Certificate Number: 2599.01

American Association for Laboratory Accreditation

Accredited Laboratory

A2LA has accredited

INTERNATIONAL COMPLIANCE LABORATORIES, LLC

Neenah, WI

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009*).

Presented this 10th day of June 2014.

President & CEO
For the Accreditation Council
Certificate Number 2599.01
Valid to April 30, 2016

For the types of tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

American Association for Laboratory Accreditation

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

INTERNATIONAL COMPLIANCE LABORATORIES, LLC
1057 Tullar Court
Neenah WI 54956
Ronald W. Zimmerman Phone: 920 720 5555

ELECTRICAL (EMC)

Valid to: April 30, 2016 Certificate Number: 2599.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following electromagnetic compatibility and product safety tests:

Test Technology:	**Test Method(s):**
Emissions	
RF (Radiated and Conducted)	CFR 47 FCC, Part 15 (using ANSI C63.4:2009) (*up to 18 GHz*); CFR 47 FCC, Part 18 (using MP-5); CISPR 11 (*up to 1 GHz*); EN 55011 (*up to 1 GHz*); CISPR 14-1 (*excluding clause 6*); EN 55014-1 (*excluding clause 6*); CISPR 15 (*clause 8 only*); EN 55015 (*clause 8 only*); CISPR 22 (*up to 1 GHz, Class B devices only*); EN 55022 (*up to 1 GHz, Class B devices only*); ICES-001; ICES-003
Harmonic Current Emissions	IEC 61000-3-2; EN 61000-3-2
Voltage Fluctuations and Flicker	IEC 61000-3-3; EN 61000-3-3
Immunity	
Electrostatic Discharge (ESD)	IEC 61000-4-2
Radiated Immunity	IEC 61000-4-3 (*up to 2.7 GHz*)
Electrical Fast Transients (EFT)/Burst	IEC 61000-4-4
Electrical Surge	IEC 61000-4-5
Conducted Immunity	IEC 61000-4-6

5301 Buckeystown Pike, Suite 350 | Frederick, Maryland 21704-8373 | Phone: 301 644 3248 | Fax: 301 662 2974 | www.A2LA.org

Test Technology:	Test Method(s):
Immunity (Cont'd)	
Power Frequency and Magnetic Field	IEC 61000-4-8 (*excluding short duration mode*)
Voltage Dip, Interruptions, and Variations	IEC 61000-4-11
Generic and Product Specific EMC Standards	
Generic Immunity Residential	IEC 61000-6-1; EN 61000-6-1
Generic Immunity Industrial	IEC 61000-6-2; EN 61000-6-2
Generic Emissions Residential	IEC 61000-6-3 (*up to 16A*); EN 61000-6-3 (*up to 16A*)
Generic Emissions Industrial	IEC 61000-6-4; EN 61000-6-4
Laboratory Equipment	IEC 61326-1; EN 61326-1
Medical Equipment	IEC 60601-1-2:2001; IEC 60601-1-2
Information Technology Equipment	CISPR 24; EN 55024
Household Appliances and Similar	CISPR 14-2; EN 55014-2
Industry Canada Radio Tests	RSS-GEN; RSS-210 *(up to 18 GHz)*
ETSI Radio Tests	
Immunity	EN 301 489-1 *(up to 16A)*; EN 301 489-17
Automotive Component EMC	
Emissions	CISPR 25; SAE J1113-41
Bulk Current Injection (BCI)	SAE J1113-4; ISO 11452-4
Electrostatic Discharge (ESD)	SAE J1113-13; ISO 10605
Radiated RF Immunity	SAE J1113-21; ISO 11452-2
Electrical Transients	SAE J1113-11; ISO 7637-2

Test Technology:	**Test Method(s):**
Harley Davidson Component EMC	
Engineering Guideline	EG-812-22614
Radiated Emissions	EG-812-22614-401
Conducted Emissions	EG-812-22614-402
Bulk Current Injection (BCI)	EG-812-22614-405
Electrostatic Discharge (ESD)	EG-812-22614-407
United Nations UNECE	
Emissions	E/ECE/324 Addendum 9: Regulation 10, Annexes 7 and 8
Immunity	E/ECE/324 Addendum 9: Regulation 10, Annex 9

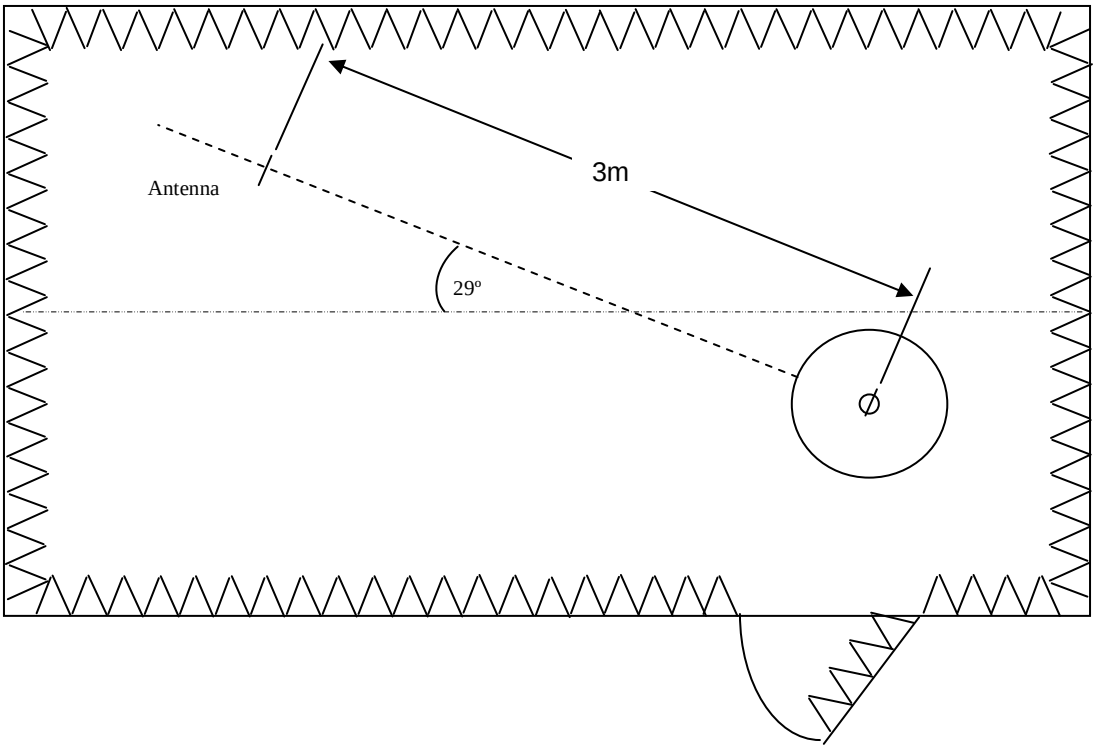
On the following products or types of products:
Light Industrial, Commercial, Residential, Heavy Industrial, Scientific, Medical, Portable Test and Measurement Equipment, Information Technology Equipment, Telecom, Automotive, and other Electrical and Electronic Equipment

5.0 Radiated Emissions Test Site Description

5.1 Semi-Anechoic Chamber Test Site

The semi-anechoic chamber is a Series 81 EMC test chamber manufactured by ETS – Rayproof. This chamber was moved in 2006 to International Compliance Laboratories in Neenah, WI. The interior walls and ceiling are completely covered with 4" x 4" ferrite tiles and 16" absorber cones. The chamber is also equipped with a 1.2 meter flush mounted turntable. The test chamber's dimensions are 30ft. x 20ft. x 20ft. The test volume is 2.0-meter in diameter and 2 meters high and is centered on the turntable.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 4 below:



Power to the room was filtered to prevent ambient noise from coupling to the EUT and measurement equipment. The four filters were model number 07294/GFUL57915-1x100 (100 Amp 277/480Vac 50/60Hz) manufactured by Genisco Electronics Corporation.

The room is of sufficient size to test table top and floor standing equipment in accordance with section 6.3.1 & 6.3.2 of ANSI C63.4.

5.2 Radiated Emissions Measurement Equipment Used

Three measurement set-ups were used for each of the following frequency ranges:

1. Low frequency (9kHz – 30MHz) – Loop Antenna, HP 8564A Receiver and Filter Section
2. Mid frequency (30MHz – 1000MHz) – Biconilog Antenna, HP 8564A Receiver and Filter Section
3. High frequency (1GHz - 10GHz) – Horn Antenna, two preamplifers (HP8449B and HP 83006A) R&S ESIB 26 Receiver, with RF absorber placed on the anechoic chamber floor.

See section 7.0 for additional details on each piece of equipment.

6.0 Reference documents

The following standards and references were used:

ANSI C63.4: 2009, American National Standard for Methods of Measurement of Radio-Noise Emissions

US Code of Federal Regulations (CFR): Title 47 - Telecommunication, Chapter I – Federal Communications Commission, Subchapter A – General, Part 1, *Practice and Procedure* (Oct. 1, 2013)

US Code of Federal Regulations (CFR): Title 47 - Telecommunication, Chapter I – Federal Communications Commission, Subchapter A – General, Part 2, *Frequency Allocations and Radio Treaty Matters; General Rules and Regulations* (Oct. 1, 2013)

US Code of Federal Regulations (CFR): Title 47 - Telecommunication, Chapter I – Federal Communications Commission, Subchapter A – General, Part 15, *Radio Frequency Devices* (Oct. 1, 2013)

KDB 447498 D01 *General RF Exposure Guidance* v05r02 02-07-2014

ABInteract Social Tap Model 3h Block Diagram and Theory of Operation, Revision 0, dated August 27, 2014 as provided by Mesh Systems, LLC

7.0 List of Test Equipment

Equipment List					
Manufacturer	**Equipment Type**	**Model**	**Serial**	**Last Calibrated**	**Cal Interval**
Hewlett Packard	EMI Test Receiver	8546A	3746A00414	4/25/2014	1 year
Hewlett Packard	Filter Section	85460A	3704A00360	4/25/2014	1 year
EMCO	Biconilog Antenna	3141	9706-1052	1/4/2012	3 years
EMCO	Horn Antenna	3115	6217	3/31/2014	3 years
Hewlett Packard	Pre-Amplifier, 1.0 – 26.5 GHz	8449B	3008A00151	12/11/2013	2 years
Hewlett Packard	Pre-Amplifier, 10MHz – 26.5 GHz	83006A	3104A00552	12/11/2013	2 years
ETS-Rayproof	Absorber-Lined Shielded Enclosure	Series 81	n/a	NSA: 4/1/2014	2 years
Rohde & Schwarz	EMI Test Receiver	ESI 26 1088.7490.26	100040	7/9/2014	1 year
COM Power	Loop Antenna	AL-130	121016	4/1/2014	3 years

Table 1. List of Calibrated Test Equipment

8.0 Equipment Under Test (EUT) Set-up

The EUT was placed in one of three orthogonal positions: 1) upright, 2) laying on the table (horizontally) with its face to the antenna, or 3) laying on the table (horizontally) with its face up to the ceiling.

Unless otherwise specified the EUT was placed in a maximum duty cycle and modulated. This was accomplished with special code which allowed test personnel to push the “play” button on the communications hub which configured the EUT’s transmitter mode. If no button was pushed the EUT remained in its normal mode of operation.

Since a typical transmission would normally only occur once per minute it was necessary to place the EUT in a constant mode of transmission to obtain radiated emission data in a timely manner.

9.0 Summary of Tests

9.1 Antenna Requirement – FCC Section 15.203

The EUT employs an integral antenna which satisfies the requirements of CFR 47 Part 15.203. The antenna type is internal and specifically the following:

The antenna is a surface mount helical monopole from Pulse Electronics, part number W3112A, and is mounted on the main circuit board. The circuit board is generally not accessible by the end user. The antenna has a peak gain of 0.9dBi.

9.2 Occupied Bandwidth (20dB)

9.2.1 Test Procedure

The 20dB bandwidth was measured in the following way. With the EUT in continuous transmit, modulation, and maximum duty cycle, each of the EUT’s orthogonal orientations was maximized at the fundamental frequency (turn table and antenna height) and a measurement was taken. The resolution bandwidth (RBW) of the spectrum analyzer was set to 100 kHz and video bandwidth (VBW) to 300 kHz. The span was set at 500 kHz, large enough to capture the entire emissions and greater than the RBW. The peak function of the HP Receiver was used in conjunction with delta markers to effectively mark the two 20dB down positions on the waveform and calculate the occupied bandwidth. Results are below. Figure 6 shows a photo of one of the set-ups used to evaluate occupied bandwidth.

9.2.2 Test Results

The maximum occupied bandwidth was found with the EUT upright and antenna in the horizontal polarization. Results are shown below in Table 2 and Figure 5.

Frequency (MHz)	Occupied Bandwidth (kHz)	Turn Table (degrees)	Antenna Height (cm)	Limit	Result
905.998	380.0	254.5	108.3	None Specified	Pass

Table 2. Summary of 20dB Bandwidth Test

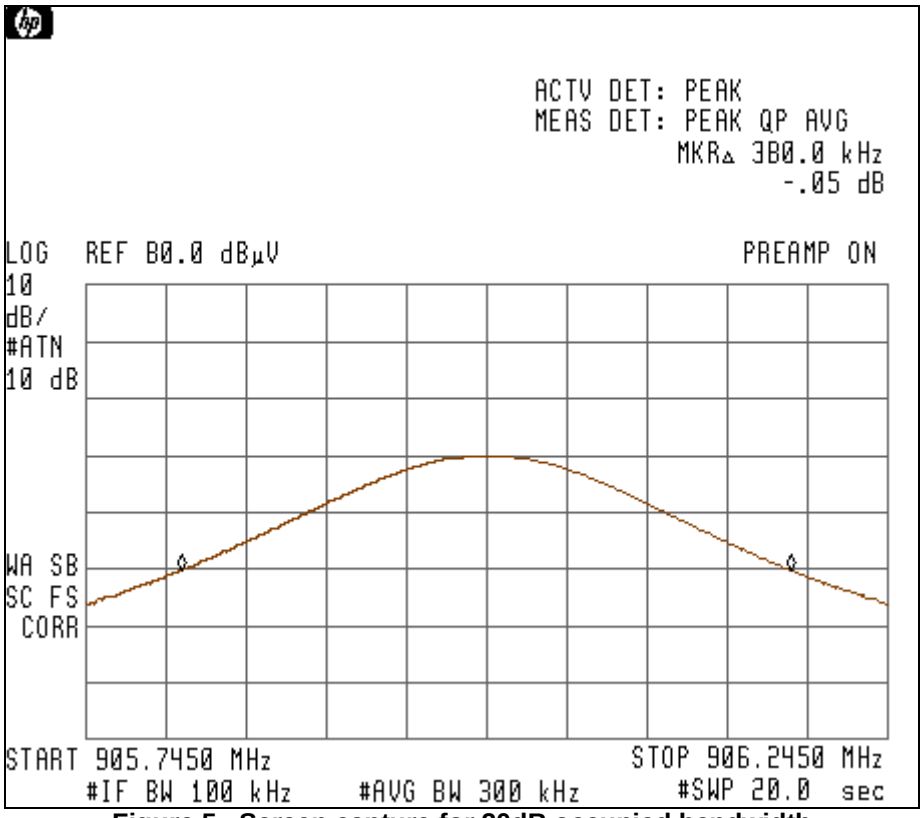


Figure 5. Screen capture for 20dB occupied bandwidth

Note: Maximum found with EUT upright and antenna in horizontal polarity.

9.3 Maximum Field Strength Requirement – FCC Section 15.249 (a) & (c)

9.3.1 Test Procedure

The maximum field strength was measured following procedures and practices found in ANSI C63.4:2009. The maximum fundamental emission was explored in each of the three orthogonal orientations of the EUT. The resolution bandwidth (RBW) of the spectrum analyzer was set to 120 kHz and video bandwidth (VBW) set to 300 kHz. While the EUT was placed in continuous transmit, modulation, and maximum duty cycle, the spectrum analyzer peak detector was used to find the position (turn table and antenna height) where maximum emissions occurred. A quasi-peak measurement was then taken and data corrected. A sample calculation is below.

Corrected Reading = Analyzer Reading + Cable Loss + Antenna Factor
Margin (dB) = Applicable Limit - Corrected Reading

9.3.2 Test Results

FCC 15.249 (a) & (c) dictate that the fundamental operating in the 902-928 MHz band shall not exceed 50 mV/m as measured from a 3 meter distance. Converted to dBuV/m, this limit is 93.98.

Table 1 below summarizes the data collected from the procedure above and shows margin to this limit.

Antenna Polarity	EUT Orientation	QP Meas. (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Turn Table (degrees)	Antenna Height (cm)	Result
Horizontal	Front to Antenna	83.35	93.98	10.63	37.3	101.9	Pass
	Front Up	82.62	93.98	11.36	187.8	100.8	Pass
	Upright	77.51	93.98	16.47	254.5	108.3	Pass
Vertical	Front to Antenna	77.69	93.98	16.29	327.4	274.4	Pass
	Front Up	80.91	93.98	13.07	301.2	116.1	Pass
	Upright	83.86	93.98	10.12	6.9	135.2	Pass

Table 3. Summary of maximum field strength at fundamental – 905.998MHz

Figure 6. Photo of radiated emissions set-up used during fundamental evaluation.

9.4 Harmonic and Spurious Emissions – FCC Section 15.249 (a) & (c) and 15.209

9.4.1 Test Procedure

The maximum field strength was measured following procedures and practices found in ANSI C63.4:2009. The maximum harmonic and spurious emissions were explored in each of the three orthogonal orientations of the EUT. The resolution bandwidth (RBW) and video bandwidth of the spectrum analyzer were set as indicated below. While the EUT was placed in continuous transmit, modulation, and maximum duty cycle, the spectrum analyzer peak detector was used to find the position (turn table and antenna height) where maximum emissions occurred. The appropriate detector was then used to take a raw measurement and the data corrected. Sample calculations are given below for each frequency range.

9kHz-30MHz Frequency Range (RBW = 9kHz, VBW = 30kHz):
Corrected Reading = Analyzer Reading + Cable Loss + Antenna Factor (which includes the internal gain from the amplifier) – 3m Distance Correction Factor (applicable for 300m and 30m limits – see limits table)
Margin (dB) = Applicable Limit - Corrected Reading

30MHz-1000MHz Frequency Range (RBW = 120kHz, VBW = 300kHz):
Corrected Reading = Analyzer Reading + Cable Loss + Antenna Factor
Margin (dB) = Applicable Limit - Corrected Reading

1GHz-10GHz Frequency Range (RBW = 1MHz, VBW = 3MHz):
Corrected Reading = Analyzer Reading + Cable Loss + Antenna Factor – Preamp1 – Preamp2
Margin (dB) = Applicable Limit - Corrected Reading

The EUT was investigated for radiated spurious emissions from 9kHz to 10GHz, encompassing 10 times the highest fundamental frequency and containing any low frequency clock frequencies (i.e. 32.768kHz for the MCU). Antenna polarities investigated were as follows: 1) three orthogonal planes for the loop antenna – 9kHz to 30MHz , and 2) horizontal and vertical polarities for the biconilog and horn antennas - 30MHz to 10GHz.

9.4.2 Test Results

FCC 15.249 (a) & (c) dictate that a harmonic of the fundamental operating in the 902-928 MHz band shall not exceed 500 uV/m as measured from a 3 meter distance. Converted to dBuV/m, this limit is 53.98 dBuV/m. In regard to spurious emissions outside of the band, FCC 15.249 (d) also states that radiated emissions shall be either: a) 50dB below the level of the fundamental or b) comply with emissions limits of 15.209. The lesser attenuation of the two shall apply. The following tables detail these limits. All measurements are corrected to a 3 meter distance.

Frequency	Limit (uV/m) @ Distance	Limit (dBuV/m)	Distance Correction
9kHz – 490kHz	2400/F(kHz) @ 300m	48.5 – 13.8 @ 300m	300m to 3m = 80dB
490kHz – 1.705MHz	24000/F(kHz) @ 30m	33.8 – 22.97@ 30m	300m to 3m = 40dB
1.705MHz – 30MHz	30 @ 30m	29.54 @ 30m	300m to 3m = 40dB
30MHz – 88MHz	100 @ 3m	40.0 @ 3m	n/a
88MHz – 216MHz	150 @ 3m	43.5 @ 3m	n/a
216MHz – 960MHz	200 @ 3m	46.0 @ 3m	n/a
960MHz – 40GHz	500 @ 3m	54.0 @ 3m	n/a

Table 4. Limits from FCC 15.209 (a)

Frequency	Limit (uV/m) @ 3m	Limit (dBuV/m) @ 3m
Harmonics of Fundamental in 902MHz - 928MHz band 15.249 (a)	500	53.98
Emissions outside of 902MHz – 928MHz band 15.249 (d)	n/a	83.86 (measured fundamental) minus 50dB = 33.86. Note: Use this only if it is the lesser attenuation compared to 15.209.

Table 5. Limits from FCC 15.249 (a) and 15.249 (d).

The below summarizes the highest harmonic emissions seen from the data collected using the procedure above.

Harmonic (GHz)	Antenna Polarity	EUT Orientation	PK Meas. (dBuV/m)	PK Limit (dBuV/m)	PK Margin (dB)	AVG Meas. (dBuV/m)	AVG Limit (dBuV/m)	AVG Margin (dB)	Turn Table (deg)	Antenna Height (cm)
1.812	H	Front to Antenna	57.25	73.98	16.73	53.09	53.98	0.89	200.1	330.4
1.812	V	Upright	58.02	73.98	15.96	53.43	53.98	0.55	47.9	121.4
2.718	H	Front to Antenna	49.41	73.98	24.57	66.50	41.46	12.52	204.6	294.2
2.718	V	Upright	50.67	73.98	23.31	68.45	41.85	12.13	39.0	122.3
3.624	H	Upright	51.04	73.98	22.94	67.08	43.35	10.63	89.1	108.1
3.624	V	Upright	43.85	73.98	30.13	66.22	42.49	11.49	59.3	112.5

Maximum spurious emissions including restricted bands using a **peak detector** can be seen in the following graphs. Graphs depict maximum emissions found across all turntable angles, antenna heights, antenna polarities and product orientations.

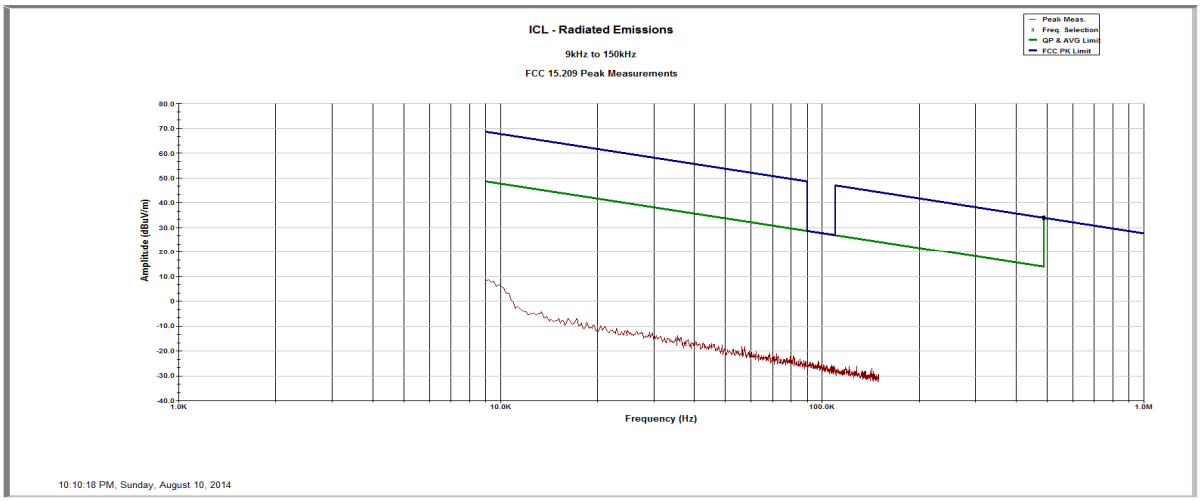


Figure 7. Maximum Radiated Emissions for 9kHz - 150kHz

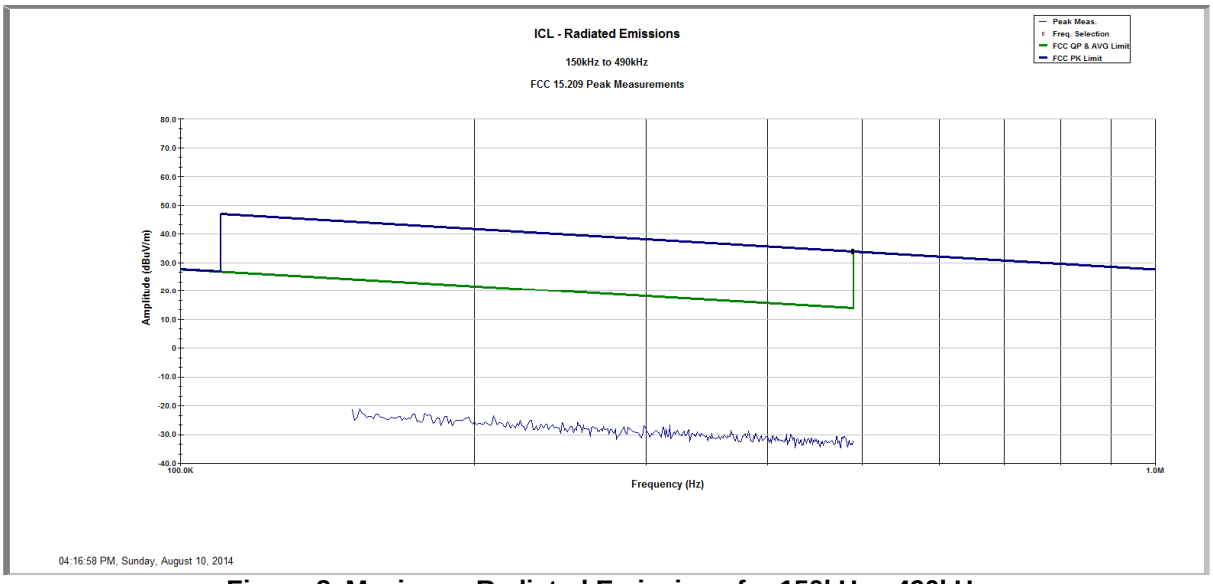


Figure 8. Maximum Radiated Emissions for 150kHz - 490kHz

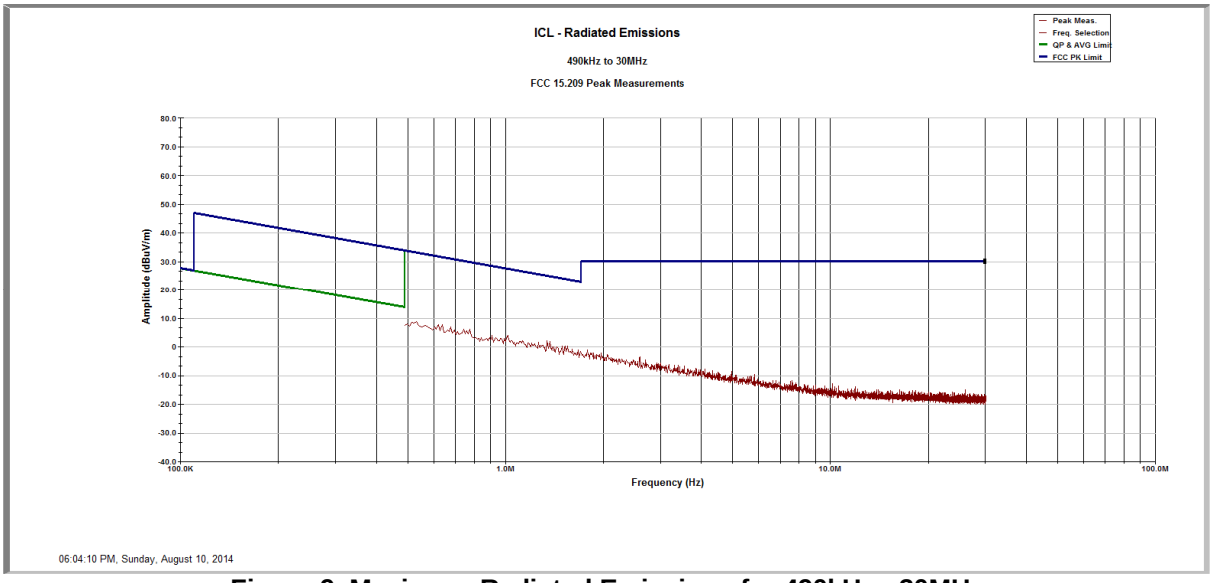


Figure 9. Maximum Radiated Emissions for 490kHz - 30MHz

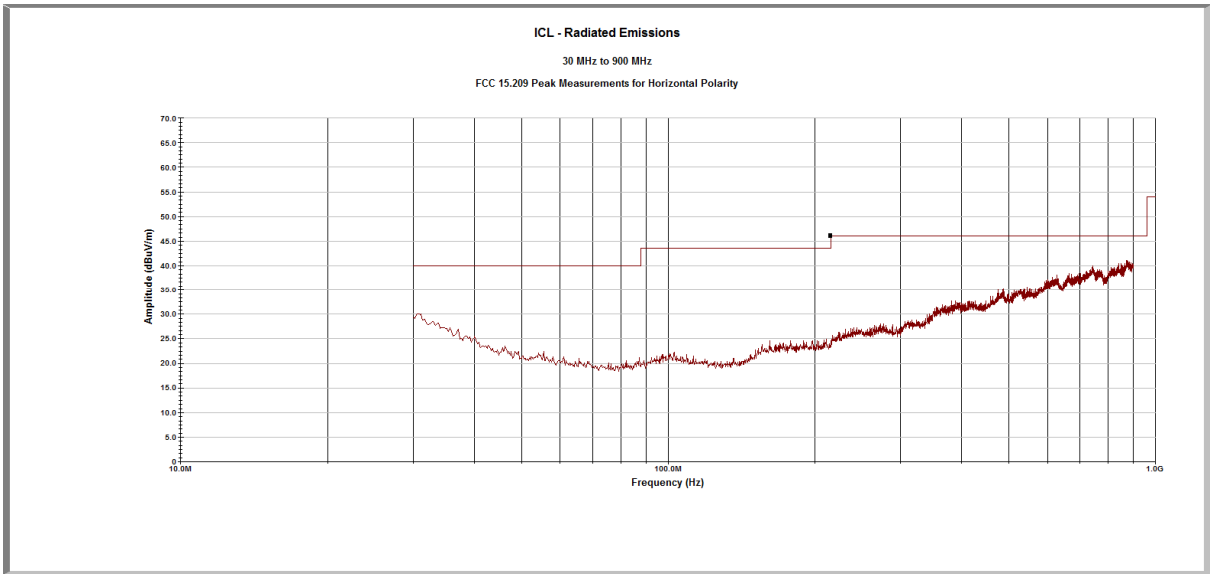


Figure 10. Maximum Radiated Emissions for 30MHz - 900MHz, Horizontal Antenna Polarity

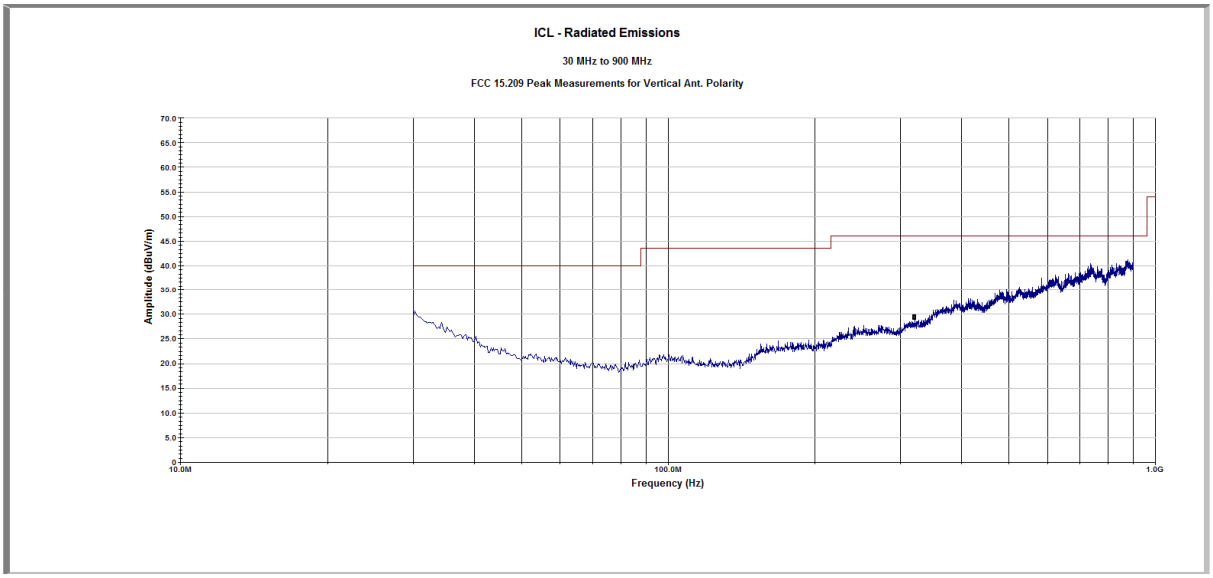


Figure 11. Maximum Radiated Emissions for 30MHz - 900MHz, Vertical Antenna Polarity

Note: Radiated Emissions from 900 MHz to 930 MHz supplied in Band-Edge Compliance section of this report.

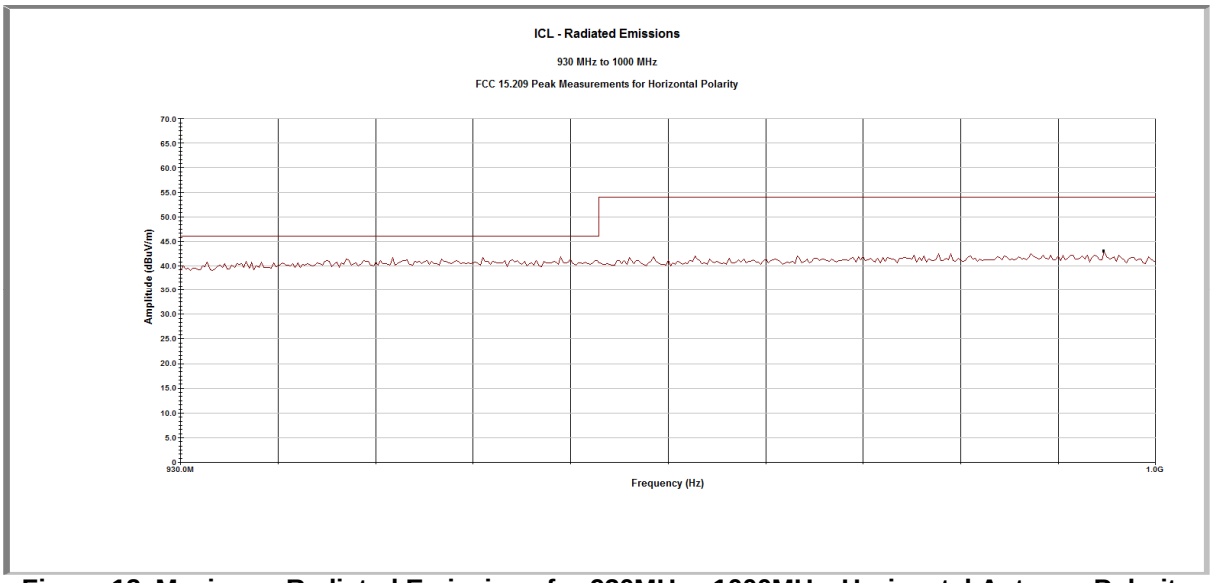


Figure 12. Maximum Radiated Emissions for 930MHz - 1000MHz, Horizontal Antenna Polarity

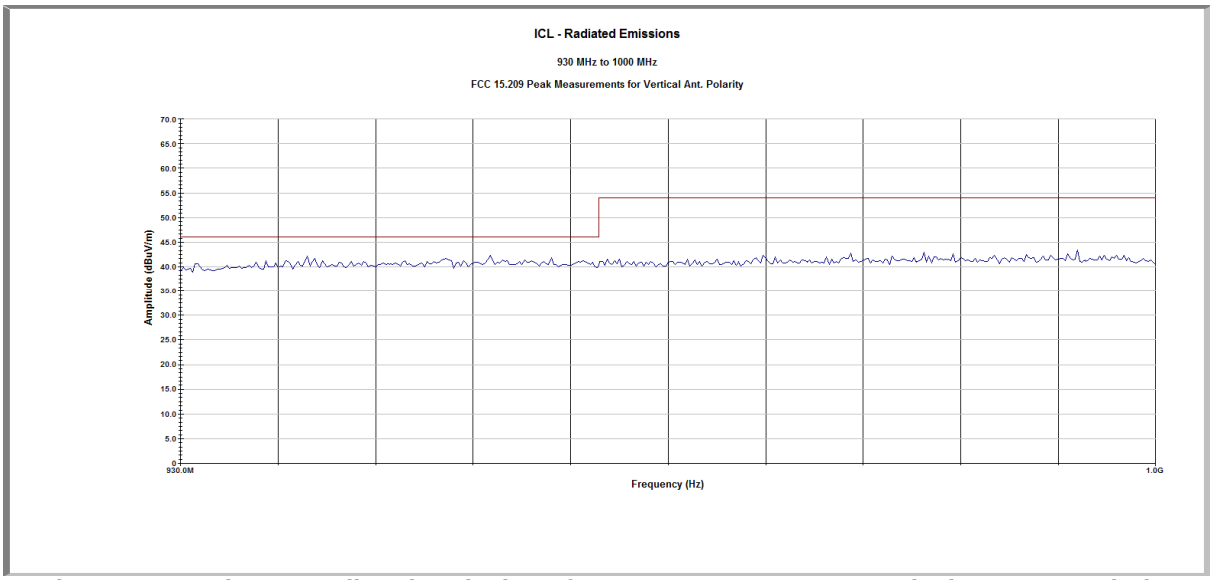


Figure 13. Maximum Radiated Emissions for 930MHz - 1000MHz, Vertical Antenna Polarity

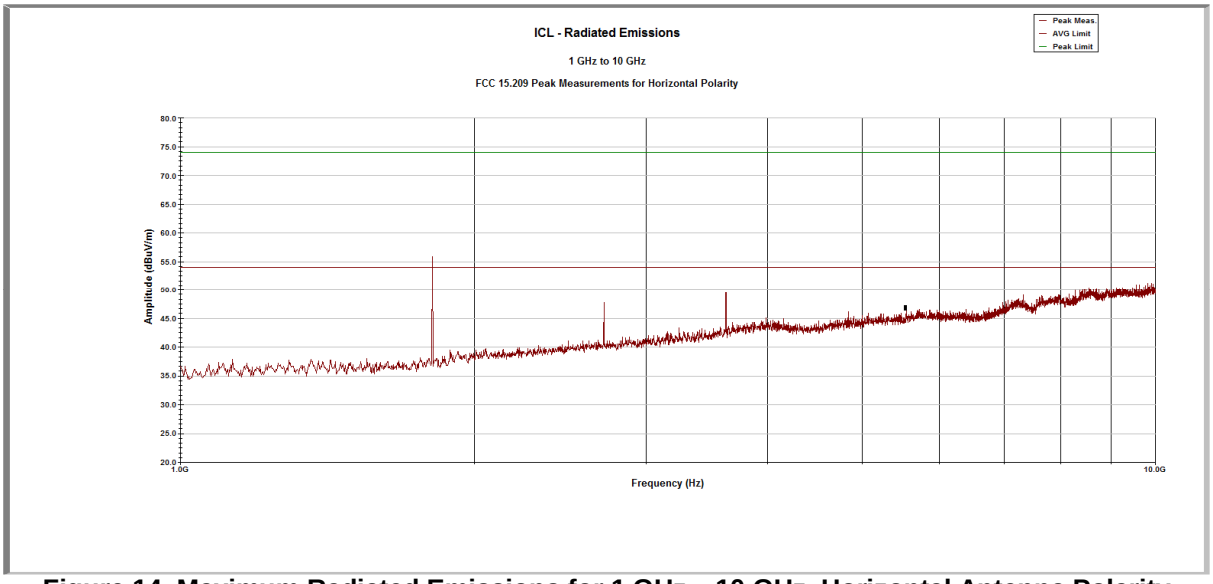


Figure 14. Maximum Radiated Emissions for 1 GHz – 10 GHz, Horizontal Antenna Polarity

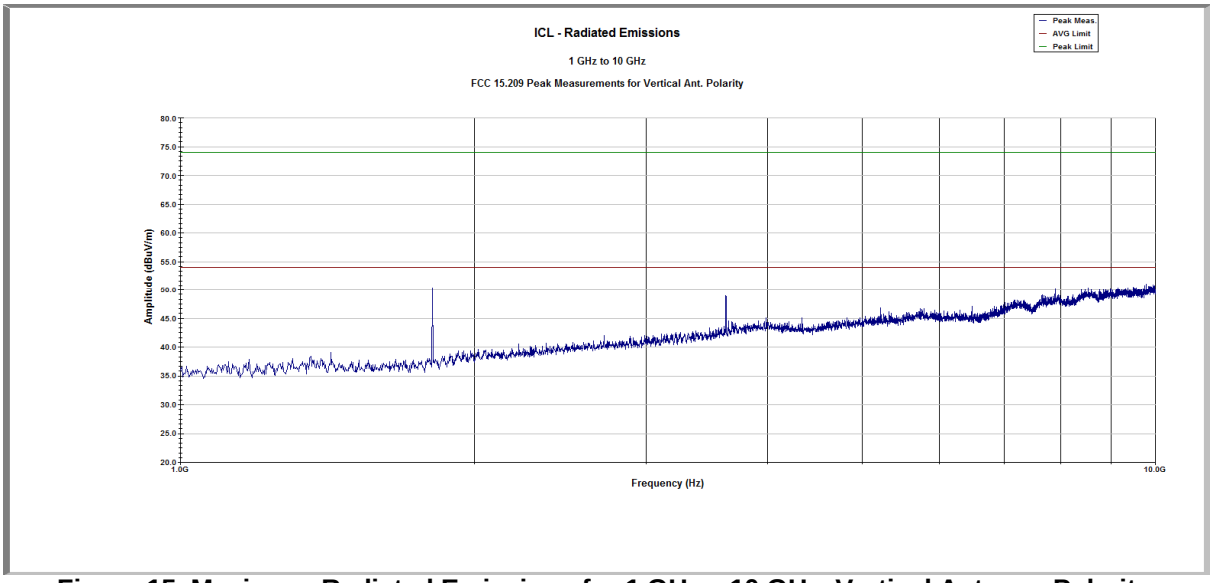


Figure 15. Maximum Radiated Emissions for 1 GHz – 10 GHz, Vertical Antenna Polarity

9.5 Band-Edge Compliance - Radiated RF Emissions – FCC Section 15.209 (b) and 15.249 (d)

9.5.1 Test Methodology

To determine band-edge compliance, focus was given to the lower and upper frequencies of the operational band (902 MHz and 928 MHz). Three EUT orientations were explored and their positions optimized with the turn table and antenna tower to create the maximum radiated emissions. A slight larger range of 900 MHz to 930 MHz was explored. RBW was set to 120kHz and 300kHz as is proper for this frequency range. The appropriate limit as detailed below was plotted and the peak measurements evaluated against the limit.

9.5.2 Test Results

The limits for Band Edge Compliance are those as detail in Table 6 below. As shown in the maximum radiated emissions graphs (Figure 16 and Figure 17) below and measurement table (Table 7) the peak measurements were below the limit. This met the requirements detailed in FCC Section 15.209 (b) and 15.249 (d). The measurement need to meet the lesser attenuation of the limits detailed in the Table 6 below.

Frequency	QP Limit (uV/m) @ 3m	QP Limit (dBuV/m) @ 3m
216MHz – 960MHz band 15.209 (b)	200	46.0
Emissions outside of 902MHz – 928MHz band 15.249 (d)	n/a	83.86 (measured fundamental) minus 50dB = 33.86. Note: Use this only if it is the lesser attenuation compared to 15.209.

Table 6. Limits for Band Edge Compliance per 15.209 (b) and 15.249 (d).

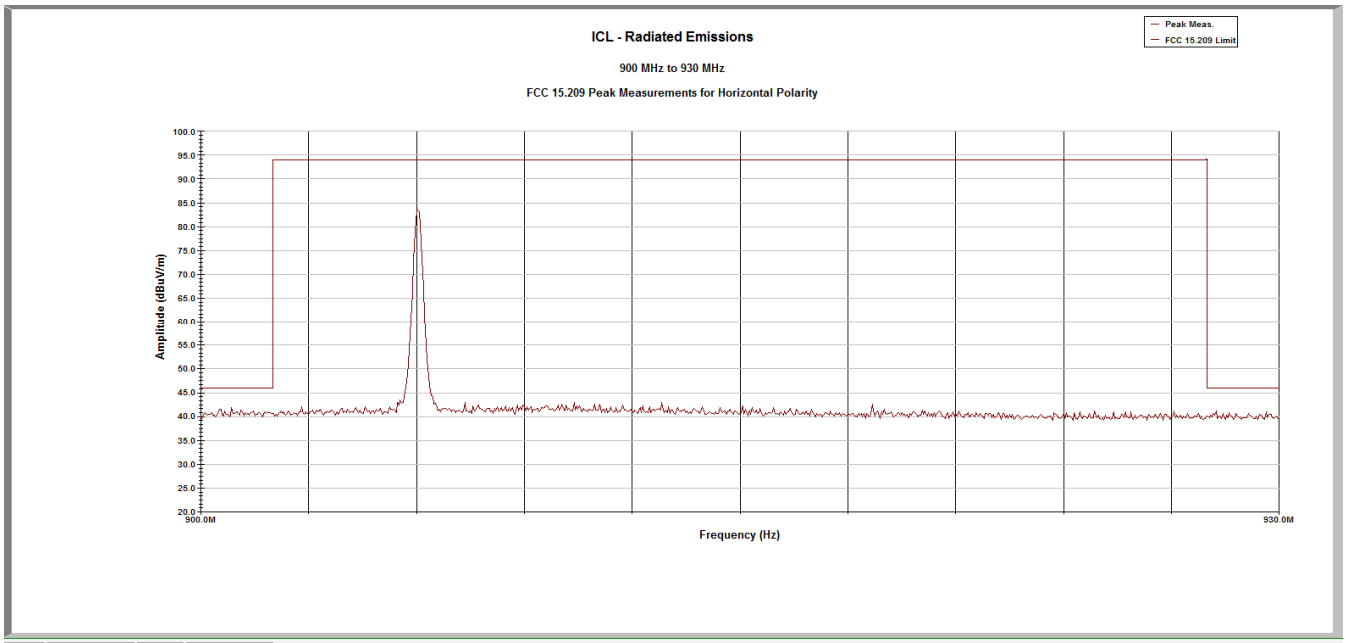


Figure 16. Maximum Radiated Emissions for 900 MHz – 930 MHz, Horizontal Antenna Polarity

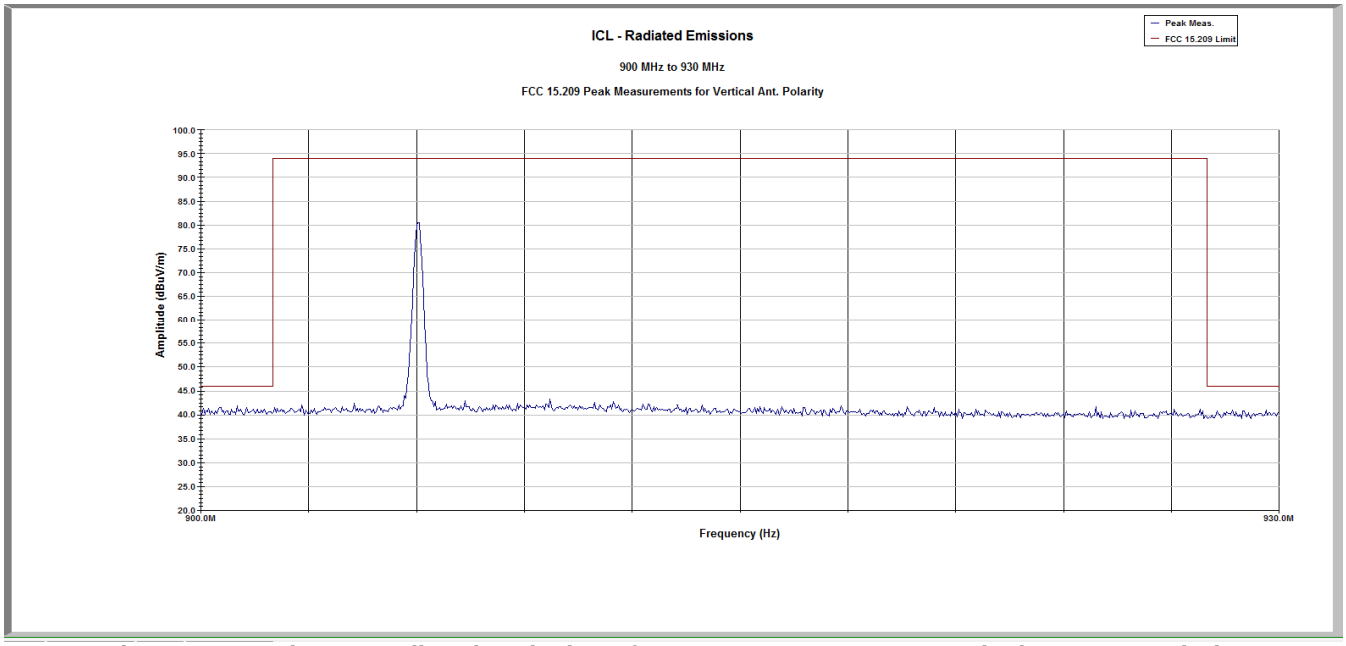


Figure 17. Maximum Radiated Emissions for 900 MHz – 930 MHz, Vertical Antenna Polarity

Frequency (MHz)	Antenna Polarity (H or V)	Peak Measurement (dBuV/m)	QP Limit (dBuV/m)	Difference (dB)
902	H	40.6	46.0	5.4
902	V	40.4	46.0	5.6
928	H	40.0	46.0	6.0
928	V	39.4	46.0	6.6

Table 7. Band Edge Measurements.

9.6 RF Exposure Limits

According to FCC's definition as given in Part 2.1093 (b), the EUT is classified as a portable device. Additionally, since this type of portable equipment (following Part 15.249) does not fit into any of the Parts mentioned in FCC Part 2.1093 (c), it is categorically excluded from routine environmental evaluation for RF exposure. However, it still must be evaluated against the *published RF exposure KDB procedures* according to the test exclusion provisions and measurement requirements (*KDB 447498* section 2).

Using the *KDB 447498* general guidance document, the following direction is given. Since the device is used by a person using their hands (to pour a beer), "extremity" requirements apply. Section 4.2.3 of the *KDB* (Extremity exposure conditions) directs that section 4.3 be applied to determine the 10-g extremity *SAR Test Exclusion Thresholds* to determine SAR test requirements. Several parameters are defined and two calculations performed.

Calculation 1:

Maximum Power of Channel. Since only radiated emissions were performed at 3 meters a conversion to power is necessary. See below.

$$P_t = \frac{E^2 r^2}{30 \times G_t} = \frac{(0.016)^2 (3)^2}{30 \times (0.9)} = 0.000085\ \text{W} = 0.085\text{mW}$$

Where the variables are defined as

- P_t = net input RF power (W)
- E = E-field produced (V/m) Note: Conversion from dBuV/m to V/m necessary.
- r = distance (m)
- G_t = antenna gain (dBi)

Calculation 2:
From section 4.3.1 (Standalone SAR test exclusion considerations) a calculation can be perform to see if an exclusion applies for extremity SAR.

$$\left[\frac{(max.power\ of\ channel, including\ tune\text{-}up\ tolerance, mW)}{min.\ test\ seperation\ distance, mm}\right] \cdot \left[\sqrt[2]{f_{(GHz)}}\right] \leq 7.5$$

Where the variables are defined as

- $f_{(\text{GHz})}$ is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- The test exclusions are applicable only when the minimum *test separation distance* is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum *test separation distance* is < 5 mm, a distance of 5 mm according to 5) in section 4.1 of the KDB is applied to determine SAR test exclusion. Actual test separation distance is < 5mm.

$\left[\frac{(0\ mW)}{5\ mm}\right] \cdot \left[\sqrt[2]{0.906}\right] = 0$ which is less than the required 7.5 to apply the exclusion.

In summary, the EUT is excluded from RF Exposure Limits due to its very low transmit power following FCC regulations and knowledge database guidance documents**.**

10.0 CONCLUSION

It was found that the Mesh Systems, LLC ABInteract Social Tap, Model# 3h **MEETs** the emission requirements of the CFR47, Part 15, Subpart C, Section 15.249 for operating within the 902-928 MHz Band.