Electromagnetic Compatibility Test Report

Tests Performed on a btwTAG Safety, LLC

915 MHz Transciever Transciever, Model 20A061

Radiometrics Document RP-9296

Product Detail:
FCC ID: 2AWIV-20A061 Equipment type: 915 MHz Low power Transceiver
Test Standards:
US CFR Title 47, Chapter I, FCC Part 15 Subpart C FCC Part 15 CFR Title 47: 2020 This report concerns: Original Grant for Certification FCC Part 15.249

Tests Performed For:	*Test Facility:*
btwTAG Safety, LLC 1730 Park Street, Suite 123 Naperville, IL 60563	**Radiometrics Midwest Corporation** 12 Devonwood Avenue Romeoville, IL 60446-1349 (815) 293-0772

Test Date(s):
June 2-4, 2020

Document RP-9296 Revisions:		
Rev.	Issue Date	Revised By
0	June 9, 2020	

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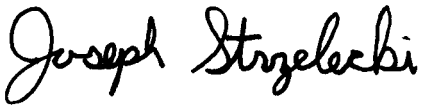
1.0 ADMINISTRATIVE DATA

Equipment Under Test:	
A btwTAG Safety, LLC, 915 MHz Transciever Model: 20A061 Serial Number: RMC1 This will be referred to as the EUT in this Report	
Date EUT Received at Radiometrics:	*Test Date(s):*
June 2, 2020	June 2-4, 2020
Test Report Written and Authorized By:	*Test Witnessed By:*
Joseph Strzelecki Senior EMC Engineer	The tests were not witnessed by personnel from btwTAG Safety, LLC.
Radiometrics' Personnel Responsible for Test:	*EUT Checked By:*
 06/09/2020 Date Joseph Strzelecki Senior EMC Engineer NARTE EMC-000877-NE Chris D'Alessio EMC Technician Richard L. Tichgelaar EMC Technician	Joseph Strzelecki Richard Tichgelaar Chris D'Alessio Radiometrics

2.0 TEST SUMMARY AND RESULTS

The EUT (Equipment Under Test) is a 915 MHz Transciever, Model 20A061, manufactured by btwTAG Safety, LLC. The detailed test results are presented in a separate section. The following is a summary of the test results.

Emissions Tests Results

Environmental Phenomena	Frequency Range	Basic Standard	Test Result
RF Radiated Emissions	30-9300 MHz	FCC Part 15	Pass
Conducted Emissions, AC Mains	0.15 - 30 MHz	FCC Part 15	Pass
Occupied Bandwidth Test	Fundamental Freq.	FCC Part 15	Pass

IEC 17025 Decision Rule:
The declaration of pass or fail is based on the specifications listed above. The declaration of pass or fail did not consider measurement uncertainty.

2.1 RF Exposure Compliance Requirements

The EUT meets the FCC requirement for RF exposure and is exempt from SAR and RF exposure evaluations There are no power level adjustments available to the end user. The antenna is permanently attached. The detailed calculations for RF Exposure are presented in a separate document.

3.0 EQUIPMENT UNDER TEST (EUT) DETAILS

3.1 EUT Description

The EUT is a 915 MHz Transciever, Model 20A061, manufactured by btwTAG Safety, LLC. The EUT was in good working condition during the tests, with no known defects.

3.1.1 FCC Section 15.203 & RSS-GEN Antenna Requirements

The antenna is permanently attached to the printed circuit board. The antenna is internal to the EUT and it is not readily available to be modified by the end user. Therefore, it meets the 15.203 Requirements.

4.0 TESTED SYSTEM DETAILS

4.1 Tested System Configuration

The system was configured for testing in a typical fashion. The EUT was placed on an 80-cm or 150 cm high, nonconductive test stand. The testing was performed in conditions as close as possible to installed conditions. Wiring was consistent with manufacturer's recommendations. The Charger is a standard off the shelf device.

The EUT was tested as a stand-alone device. Power was supplied at 120 VAC, 60 Hz single-phase to its charger. The identification for all equipment, plus descriptions of all cables used in the tested system, are:

Tested System Configuration List

Item	Description	Type*	Manufacturer	Model Number	Serial Number
1	915 MHz Transciever	E	btwTAG Safety, LLC	20A061	RMC1
2	USB power Supply (PS-01)	P	Apple	A1385	D292034F1QYDHLHAE

* Type: E = EUT, P = Peripheral, S = Support Equipment; H = Host Computer

List of System Cables

QTY	Length (m)	Cable Description	Shielded?
1	1.0	AC Cord to USB charger	No
2	1.0	USB Charge Cable	Yes

4.2 EUT Operating Modes

The transmit mode for all tests was continuous. It was tested in two modes: 1) While charging with a standard USB power supply. 2) Operating from its internal battery.

4.3 Special Accessories

No special accessories were used during the tests in order to achieve compliance.

4.4 Equipment Modifications

No modifications were made to the EUT at Radiometrics' test facility in order to comply with the standards listed in this report.

5.0 TEST SPECIFICATIONS

Document	Date	Title
FCC CFR Title 47	2020	Code of Federal Regulations Title 47, Chapter 1, Federal Communications Commission, Part 15 - Radio Frequency Devices

6.0 TEST PROCEDURE DOCUMENTS

The tests were performed using the procedures from the following specifications:

Document	Date	Title
ANSI C63.4-2014	2014	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	2013	American National Standard for Testing Unlicensed Wireless Devices
558074 D01 DTS Meas Guidance	2019	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247; v05r02

7.0 RADIOMETRICS' TEST FACILITIES

The results of these tests were obtained at Radiometrics Midwest Corp. in Romeoville, Illinois, USA. Radiometrics is accredited by A2LA (American Association for Laboratory Accreditation) to conform to ISO/IEC 17025: 2017 "General Requirements for the Competence of Calibration and Testing Laboratories". Radiometrics' Lab Code is 121191 and Certification Number is 1495.01. Radiometrics' scope of accreditation includes all of the test methods listed herein. A copy of the accreditation can be accessed on our web site (www.radiomet.com). Radiometrics accreditation status can be verified at A2LA's web site (www.a2la2.org).

The following is a list of shielded enclosures located in Romeoville, Illinois used during the tests:

Chamber E: Is a custom-made anechoic chamber that measures 52' L X 30' W X 18' H. The walls and ceiling are fully lined with RF absorber. Pro-shield of Collinsville, Oklahoma manufactured the chamber. The floor has a 9' x 9' section of microwave absorber for testing above 1 GHz.

Test Station F: Is an area that measures 10' D X 12' W X 10' H. The floor and back wall are metal shielded. This area is used for conducted emissions measurements.

A separate ten-foot long, brass plated, steel ground rod attached via a 6-inch copper braid grounds each of the above chambers. Each enclosure is also equipped with low-pass power line filters.

The FCC has accepted these sites as test site number US1065. The FCC test site Registration Number is 732175. Details of the site characteristics are on file with the Industry Canada as site number IC 3124A-1.

A complete list of the test equipment is provided herein. The calibration due dates are indicated on the equipment list. The equipment is calibrated in accordance to ANSI/NCSL Z540-1 with traceability to the National Institute of Standards and Technology (NIST).

8.0 DEVIATIONS AND EXCLUSIONS FROM THE TEST SPECIFICATIONS

There were no deviations or exclusions from the test specifications.

9.0 CERTIFICATION

Radiometrics Midwest Corporation certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specification and the data contained herein was taken with calibrated test equipment. The results relate only to the EUT listed herein.

10.0 TEST EQUIPMENT TABLE

RMC ID	Manufacturer	Description	Model No.	Serial No.	Frequency Range	Cal Period	Cal Date
AMP-05	RMC/Celeritek	Pre-amplifier	MW110G	1001	1.0-12GHz	12 Mo.	01/14/20
ANT-66	ETS-Lindgren	Horn Antenna	3115	62580	1.0-18GHz	24 Mo.	03/05/19
ANT-68	EMCO	Log-Periodic Ant.	93146	9604-4456	200-1000MHz	24 Mo.	01/02/20
ANT-80	AH Systems	Bicon Antenna	SAS-540	294	20-330MHz	24 Mo.	12/14/18
CAB-106A	Teledyne	Coaxial Cable	N/A	106A	DC-2 GHz	24 Mo.	01/29/20
CAB-1090	Teledyne	Coaxial Cable	N/A	1090	DC-18 GHz	24 Mo.	02/12/19
CAB-160B	Teledyne	Coaxial Cable	N/A	160B	DC-18 GHz	24 Mo.	02/05/20
CAB-090A	Teledyne	Coaxial Cable	N/A	090A	DC-26 GHz	24 Mo.	02/07/20
CAB-295A	Teledyne	Coaxial Cable	N/A	295A	DC-26 GHz	24 Mo.	02/07/20
HPF-01	Solar	High Pass Filter	7930-100	HPF-1	0.15-30MHz	24 Mo.	03/02/20
LSN-01	Electrometrics	50 uH LISN	FCC/VDE 50/2	1001	0.01-30MHz	24 Mo.	08/12/19
REC-11	HP / Agilent	Spectrum Analyzer	E7405A	US39110103	9Hz-26.5GHz	24 Mo	04/16/20
REC-20	HP / Agilent	Spectrum Analyzer	85460A/84562A	33330A00135 3410A00178	30Hz-6GHz	24 Mo.	08/14/19
REC-21	Agilent	Spectrum Analyzer	E7405A	MY45118341	9Hz-26.5 GHz	24 Mo.	01/14/20
THM-02	Fluke	Temp/Humid Meter	971	93490471	N/A	24 Mo.	11/08/19

Note: All calibrated equipment is subject to periodic checks.

Software Company	Test Software Name	Version	Applicable Tests
Radiometrics	EN550XX0	07.16.19	RF Conducted Emissions (FCC Part 15 & EN 55032)
Radiometrics	REREC11D	07.16.19	RF Radiated Emissions (FCC Part 15 & EN 55032)
Agilent	PSA/ESA-E/L/EMC	2.4.0.42	Bandwidth and screen shots

11.0 TEST SECTIONS

11.1 AC Conducted Emissions

The tests and limits are in accordance with FCC section 15.207 and RSS Gen section 8.8.

A computer-controlled analyzer was used to perform the conducted emissions measurements. The frequency range was divided into 500 subranges equally spaced on a logarithmic scale. The computer recorded the peak of each subrange. This data was then plotted on a semi-log graph generated by the computer. Adjusting the positions of the cables and orientation of the test system then maximizes the highest emissions.

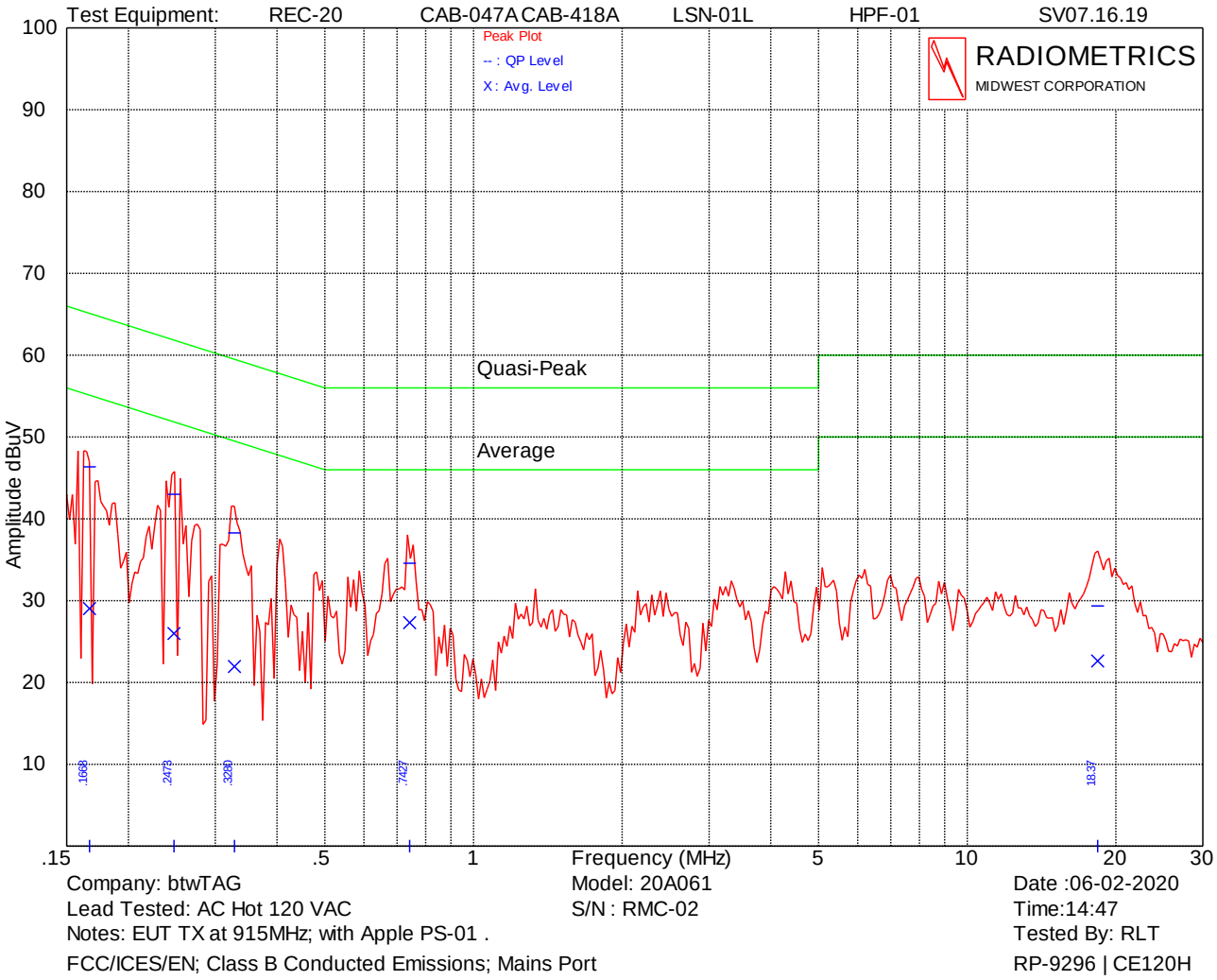
Mains Conducted emission measurements were performed using a 50 Ohm/50 uH Line Impedance Stabilization Network (LISN) as the pick-up device. Measurements were repeated on both leads within the power cord. If the EUT power cord exceeded 80 cm in length, the excess length of the power cord was made into a 30 to 40 cm bundle near the center of the cord. The LISN was placed on the floor at the base of the test platform and electrically bonded to the ground plane.

FCC Limits of Conducted Emissions at the AC Mains Ports

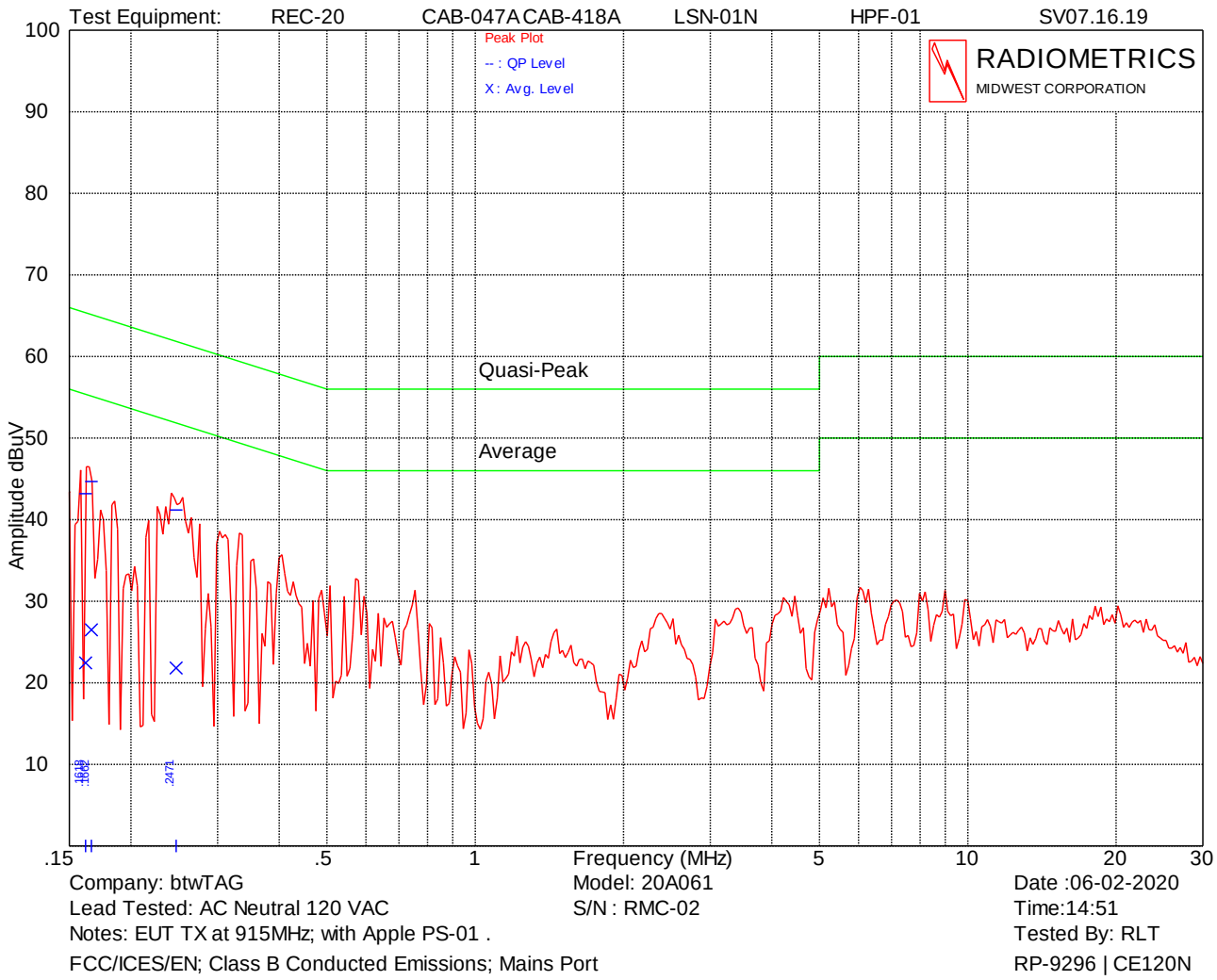
Frequency Range (MHz)	Class B Limits (dBuV)	
	Quasi-Peak	Average
0.150 - 0.50*	66 - 56	56 - 46
0.5 – 5.0	56	46
5.0 - 30	60	50
* The limit decreases linearly with the logarithm of the frequency in this range.		

The initial step in collecting conducted data is a peak detector scan and the plotting of the measurement range. Significant peaks are then marked as shown on the following table, and these signals are then measured with the quasi-peak detector. The following represents the worst case emissions from Charger (with the EUT connected) power cord, after testing all modes of operation.

Test Date : June 2, 2020
The Amplitude is the final corrected value with cable and LISN Loss.



Frequency (MHz)	QP Amplitude (dBuV)	QP Limit (dBuV)	Average Amplitude (dBuV)	Average Limit (dBuV)	Margin (dB)
0.167	46.4	65.1	29.0	55.1	18.8
0.247	43.0	61.8	26.0	51.8	18.8
0.328	38.3	59.5	22.0	49.5	21.2
0.743	34.6	56.0	27.3	46.0	18.7
18.372	29.4	60.0	22.6	50.0	27.4

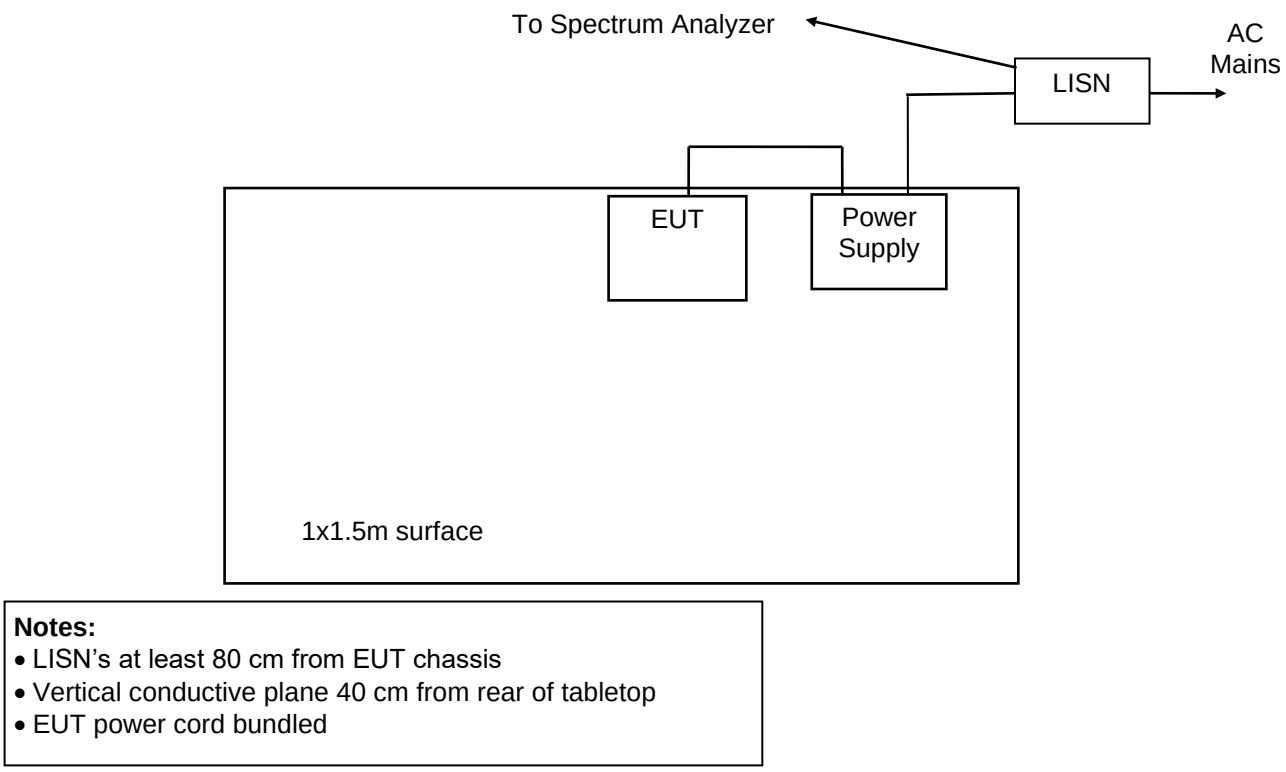


Frequency (MHz)	QP Amplitude (dBuV)	QP Limit (dBuV)	Average Amplitude (dBuV)	Average Limit (dBuV)	Margin (dB)
0.162	43.2	65.4	22.5	55.4	22.2
0.166	44.7	65.1	26.5	55.1	20.5
0.247	41.2	61.9	21.8	51.9	20.7

The above are the worst case results with three frequencies test for each EUT
* QP readings are quasi-peak with a 9 kHz bandwidth and no video filter.

Judgment: Passed by at least 8 dB

Figure 1. Conducted Emissions Test Setup



Notes:
- LISN's at least 80 cm from EUT chassis
- Vertical conductive plane 40 cm from rear of tabletop
- EUT power cord bundled

11.2 Radiated RF Emissions

Radiated emission measurements were performed with linearly polarized broadband antennas. The results obtained with these antennas can be correlated with results obtained with a tuned dipole antenna. The radiated emission measurements were performed with a spectrum analyzer. The bandwidth used from 150 kHz to 30 MHz is 9 or 10 kHz and the bandwidth from 30 MHz to 1000 MHz is 100 or 120 kHz. Above 1 GHz, a 1 MHz bandwidth is used. A 10 dB linearity check is performed prior to start of testing in order to determine if an overload condition exists. Figure 4 herein lists the details of the test equipment used during radiated emissions tests.

The EUT was rotated through three orthogonal axis as per 5.10.1 of ANSI C63.10 during the radiated tests.

Final radiated emissions measurements were performed inside of an anechoic chamber at a test distance of 3 meters. The anechoic chamber is designated as Chamber E. This Chamber meets the Site Attenuation requirements of ANSI C63.4 and CISPR 16-1. Chamber E is located at 12 Devonwood Ave. Romeoville, Illinois EMI test lab.

The entire frequency range from 30 to 9300 MHz was slowly scanned. Measurements were performed using two antenna polarizations, (vertical and horizontal). The worst case emissions were recorded. All measurements may be performed using either the peak, average or quasi-peak detector functions. If the peak detector data exceeds or is marginally close to the limits, the measurements are repeated using a quasi-peak detector or average function as required by the specification for final determination of compliance. The QP and average detectors have a linear response.

The detected emission levels were maximized by rotating the EUT, adjusting the positions of all cables, and by scanning the measurement antenna from 1 to 4 meters above the ground.

Radiated Emissions Field Strength Limits

Frequency Range (MHz)	Test Distance (meters)	Class B Limits	
		uV/m	dB(uV/m)
30 - 88	3	100	40.0
88 - 216	3	150	43.5
216 - 960	3	200	46.0
Above 960	3	500	54.0

The emission limits shown in the above table are based on measurements using a CISPR quasi-peak detector except for the frequency band above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

11.2.1 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and by subtracting the Amplifier Gain from the measured reading. The basic equation is as follows:

FS = RA + AF + CF - AG + PKA

Where: FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Attenuation Factor
AG = Amplifier Gain
PKA = Peak to Average Factor (This is only used for average measurements above 1 GHz). See below for an explanantion.

11.3 Duty Cycle

The averave value of the pulsed emissions were measured as per section 7.5, formula (10) of of ANSI C63.10-2013.

a) The EUT was set to the “worst-case” pulse ON time.
b) The RF output was coupled to the input of a spectrum analyzer by a “near-field” coupling method. The signal received shall be of sufficient level to trigger adequately the spectrum analyzer sweep display.
c) The center frequency of the spectrum analyzer was set to the center of the RF signal.
d) The spectrum analyzer was set for ZERO SPAN.
e) The sweep time was of the analyzer was set to 100 ms and other times to show the duty cycle.
f) Since the pulse train has a period that exceeds 100 ms, or as an alternative to step f), then:
1) The trigger on the spectrum analyzer was set to capture the greatest amount of pulse “ON time” over 100 ms.
2) The 100 ms period that contains the maximum “on time” was found.
3) The duty cycle was determined by dividing the total maximum “ON time” by 100 ms (tON/100 ms).

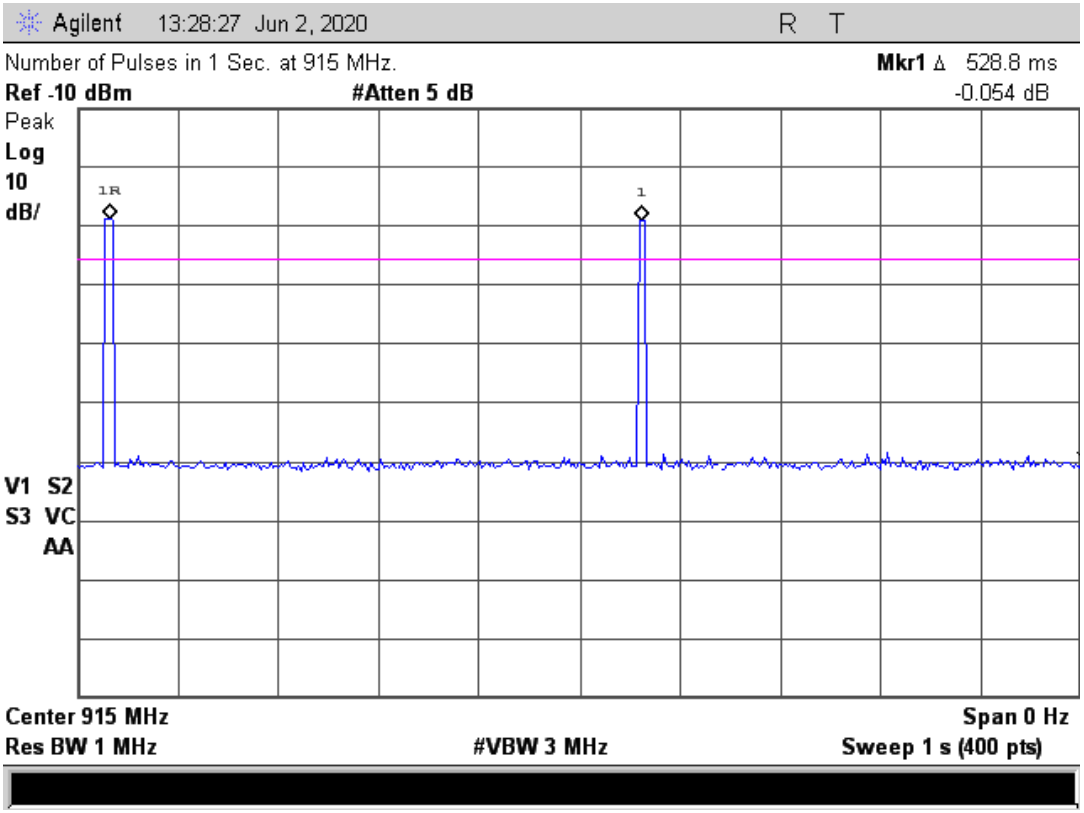
The Peak to average factor is calculated by the highest duty cycle in percent over any 100mS transmission. The factor in dB is 20 * Log(Duty cycle/100). The transmitter operates for a maximum duration of 6.366 ms in any 100 ms interval for a 6.366% maximum duty cycle. 20 Log*(6.366mSec/100mSec) = -23.92 dB Peak to average Correction factor.

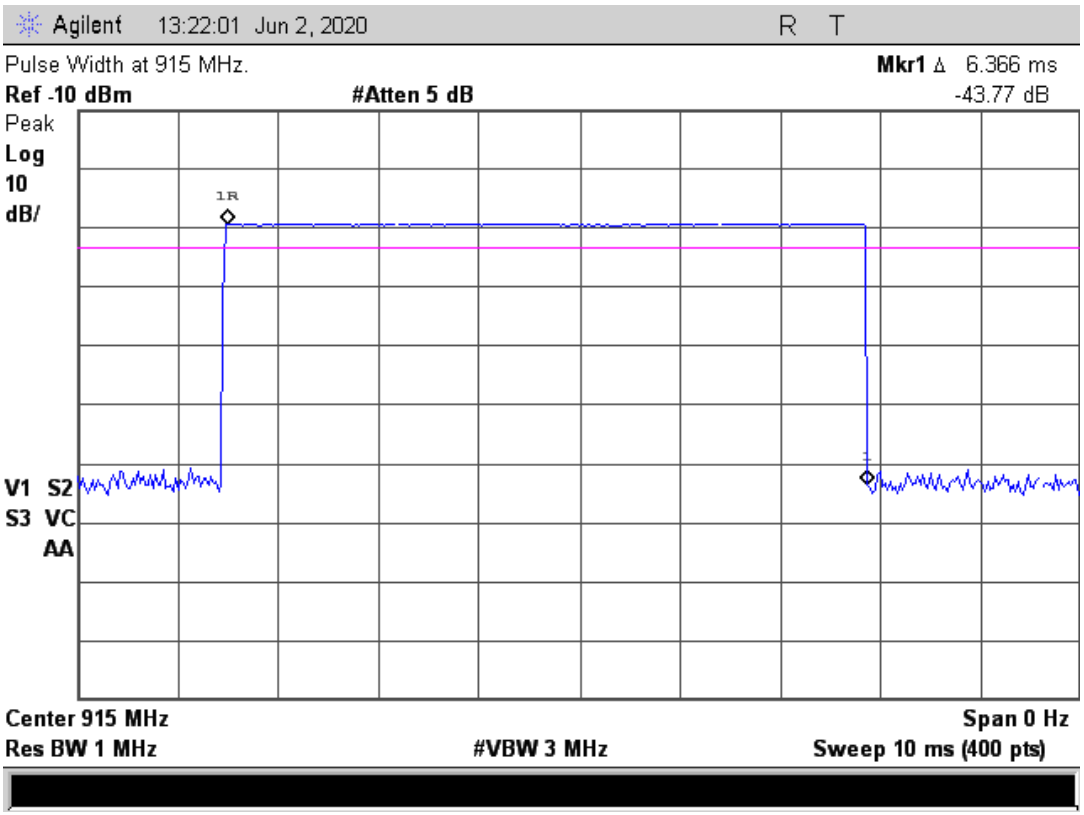
Since the difference between the peak and the average limits are 20 dB, there is no need to use a correction factor of more than 20 dB. Therefore, a 20 dB factor was used.

Tested by: Richard Tichgelaar

Test Date: June 2, 2020

Figure 2. Duty Cycle Plots





11.3.1 Radiated Emissions Test Results

Test Date	6/02/2020
Test Distance	3 Meters
Specification	FCC Part 15 Subpart C & RSS-210 Section B.10
Abbreviations	Pol = Antenna Polarization; V = Vertical; H = Horizontal; P = peak; Q = QP
Notes	Worst case emissions

This table includes all emissions except Fundamental, Band Edge and Harmonics emissions.

Freq. MHz	Meter Reading dBuV	Dect.	Ant. Pol.	Ant Factor dB/m	Cbl/amp Factors	Dist Fact dB	EUT dBuV/m	Limit dBuV/m	Margin Under Limit dB	Note
58.7	12.7	P	H	9.2	0.8	0.0	22.7	40.0	17.3	
72.5	7.6	P	H	9.3	0.9	0.0	17.8	40.0	22.2	
134.4	8.3	P	H	12.3	1.3	0.0	21.9	43.5	21.6	
143.8	8.7	P	H	12.6	1.3	0.0	22.6	43.5	20.9	
220.6	8.7	P	H	15.0	1.6	0.0	25.3	46.0	20.7	
221.2	9.3	P	H	15.0	1.6	0.0	25.9	46.0	20.1	
276.6	13.2	P	H	12.8	1.8	0.0	27.8	46.0	18.2	
302.4	8.0	P	H	14.5	1.9	0.0	24.4	46.0	21.6	
378.0	9.6	P	H	14.7	2.1	0.0	26.4	46.0	19.6	
379.9	11.2	P	H	14.7	2.1	0.0	28.0	46.0	18.0	
466.2	10.5	P	H	17.0	2.3	0.0	29.8	46.0	16.2	
471.3	9.9	P	H	17.0	2.4	0.0	29.3	46.0	16.7	
587.5	9.5	P	H	18.6	2.6	0.0	30.7	46.0	15.3	
601.3	7.0	P	H	18.7	2.7	0.0	28.4	46.0	17.6	
746.3	7.6	P	H	20.9	3.0	0.0	31.5	46.0	14.5	
748.8	8.8	P	H	20.9	3.0	0.0	32.7	46.0	13.3	
908.8	9.0	P	H	22.9	3.3	0.0	35.2	46.0	10.8	
957.5	8.4	P	H	23.4	3.4	0.0	35.2	46.0	10.8	
1217.5	39.5	P	H	25.0	-32.3	0.0	32.2	74.0	41.8	1
1687.5	42.4	P	H	26.0	-32.0	0.0	36.4	74.0	37.6	1
1765.0	42.2	P	H	26.7	-31.9	0.0	37.0	74.0	37.0	1
1847.5	41.8	P	H	27.0	-31.6	0.0	37.2	74.0	36.8	1
2170.0	39.8	P	H	27.7	-31.4	0.0	36.1	74.0	37.9	1
2267.5	40.9	P	H	27.7	-31.2	0.0	37.4	74.0	36.6	1
2415.0	43.0	P	H	28.4	-30.8	0.0	40.6	74.0	33.4	1
2577.5	40.0	P	H	28.7	-31.5	0.0	37.2	74.0	36.8	1
2720.0	40.1	P	H	28.8	-31.2	0.0	37.7	74.0	36.3	1
3037.5	38.0	P	H	30.4	-30.4	0.0	38.0	74.0	36.0	1
3120.0	38.2	P	H	30.7	-30.1	0.0	38.8	74.0	35.2	1
3210.0	37.9	P	H	30.9	-29.7	0.0	39.1	74.0	34.9	1
3512.5	38.1	P	H	31.2	-29.0	0.0	40.3	74.0	33.7	1
3870.0	36.4	P	H	32.9	-28.3	0.0	41.0	74.0	33.0	1
4180.0	37.9	P	H	32.3	-28.0	0.0	42.2	74.0	31.8	1
4490.0	35.5	P	H	32.5	-27.1	0.0	40.9	74.0	33.1	1
4907.5	35.0	P	H	33.2	-26.3	0.0	41.9	74.0	32.1	1
46.6	13.0	P	V	9.9	0.7	0.0	23.6	40.0	16.4	
53.2	13.3	P	V	9.4	0.8	0.0	23.5	40.0	16.5	
60.9	8.6	P	V	9.2	0.9	0.0	18.7	40.0	21.3	
112.3	10.0	P	V	11.1	1.1	0.0	22.2	43.5	21.3	
141.6	9.2	P	V	12.6	1.3	0.0	23.1	43.5	20.4	
175.3	10.6	P	V	13.2	1.4	0.0	25.2	43.5	18.3	
233.9	10.3	P	V	15.1	1.6	0.0	27.0	46.0	19.0	
238.3	9.3	P	V	15.2	1.7	0.0	26.2	46.0	19.8	

Freq. MHz	Meter Reading dBuV	Dect.	Ant. Pol.	Ant Factor dB/m	Cbl/amp Factors	Dist Fact dB	EUT dBuV/m	Limit dBuV/m	Margin Under Limit dB	Note
271.5	10.3	P	V	12.5	1.8	0.0	24.6	46.0	21.4	
293.6	8.8	P	V	13.7	1.8	0.0	24.3	46.0	21.7	
375.5	10.2	P	V	14.6	2.1	0.0	26.9	46.0	19.1	
379.9	10.6	P	V	14.7	2.1	0.0	27.4	46.0	18.6	
475.0	9.8	P	V	17.1	2.4	0.0	29.3	46.0	16.7	
476.9	10.9	P	V	17.1	2.4	0.0	30.4	46.0	15.6	
582.5	7.6	P	V	18.5	2.6	0.0	28.7	46.0	17.3	
596.3	7.4	P	V	18.7	2.7	0.0	28.8	46.0	17.2	
748.8	7.8	P	V	20.9	3.0	0.0	31.7	46.0	14.3	
755.0	7.7	P	V	21.0	3.0	0.0	31.7	46.0	14.3	
950.0	7.8	P	V	23.2	3.4	0.0	34.4	46.0	11.6	
966.3	9.3	P	V	23.4	3.5	0.0	36.2	54.0	17.8	
1300.0	39.6	P	V	25.0	-32.3	0.0	32.3	74.0	41.7	1
1512.5	41.2	P	V	25.2	-32.1	0.0	34.3	74.0	39.7	1
1687.5	40.8	P	V	26.0	-32.0	0.0	34.8	74.0	39.2	1
2090.0	40.2	P	V	27.6	-31.5	0.0	36.3	74.0	37.7	1
2172.5	40.4	P	V	27.7	-31.4	0.0	36.7	74.0	37.3	1
2315.0	40.7	P	V	27.9	-31.0	0.0	37.6	74.0	36.4	1
2412.5	47.8	P	V	28.4	-30.9	0.0	45.3	74.0	28.7	1
2897.5	40.9	P	V	29.4	-31.0	0.0	39.3	74.0	34.7	1
3052.5	39.0	P	V	30.5	-30.4	0.0	39.1	74.0	34.9	1
3127.5	37.3	P	V	30.7	-30.1	0.0	37.9	74.0	36.1	1
3135.0	38.7	P	V	30.8	-30.1	0.0	39.4	74.0	34.6	1
3545.0	36.3	P	V	31.3	-29.1	0.0	38.5	74.0	35.5	1
3855.0	37.9	P	V	32.9	-28.4	0.0	42.4	74.0	31.6	1
3865.0	36.3	P	V	32.9	-28.4	0.0	40.8	74.0	33.2	1
4260.0	37.3	P	V	32.2	-27.9	0.0	41.6	74.0	32.4	1
4900.0	36.9	P	V	33.2	-26.3	0.0	43.8	74.0	30.2	1

Note: All Peak readings above 1 GHz were under the Average limits, so average readings are not required.

Fundammental and Harmonic Emissions FCC 15.249; Three axis

	Tx	Spectrum Analyzer Readings dBuV									EUT	Peak	Ave	Peak	Ave	Margin
hrm	Freq	Peak			Ave	Peak			Ave	Corr.	Emission	Tot. FS		Limit		Under
		Vertical Polarization				Horizontal Polarization				Fact	Freq					Limit
#	MHz	X	Y	Z	Max	X	Y	Z	Max	dB/m	MHz	dBuV/m		dBuV/m		dB
1	915	53.6	56.5	55.8	36.5	54.3	55.1	55.9	35.9	26.2	915.0	82.7	62.7	94	94	11.3
2	915	43.3	46.0	43.2	26.0	43.8	42.9	43.2	23.8	-5.0	1830.0	41.0	21.0	74	54	33.0
3	915	44.5	47.5	45.0	27.5	45.3	45.5	45.2	25.5	-2.5	2745.0	45.0	25.0	74	54	29.0
4	915	40.9	40.6	41.1	21.1	40.6	40.5	40.2	20.6	3.2	3660.0	44.3	24.3	74	54	29.7
5	915	40.3	40.3	40.6	20.6	39.5	40.1	39.9	20.1	5.8	4575.0	46.4	26.4	74	54	27.6
6	915	37.6	37.3	37.6	17.6	37.3	37.1	37.1	17.3	8.9	5490.0	46.5	26.5	74	54	27.6
7	915	37.6	37.0	37.1	17.6	36.7	36.7	37.4	17.4	9.9	6405.0	47.5	27.5	74	54	26.6
8	915	37.3	37.6	37.9	17.9	36.7	36.7	37.1	17.1	12.2	7320.0	50.1	30.1	74	54	24.0
9	915	37.9	36.8	36.7	17.9	37.6	37.4	37.3	17.6	13.6	8235.0	51.5	31.5	74	54	22.6
10	915	36.8	37.6	37.6	17.6	37.1	37.7	37.4	17.7	15.2	9150.0	52.9	32.9	74	54	21.1
Column numbers (see below for explanations)																
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

Column #1. hrm = Harmonic; BE = Band Edge emissions
Column #2. Frequency of Transmitter.
Column #3. Uncorrected readings from the spectrum analyzer with First Axis Rotation.

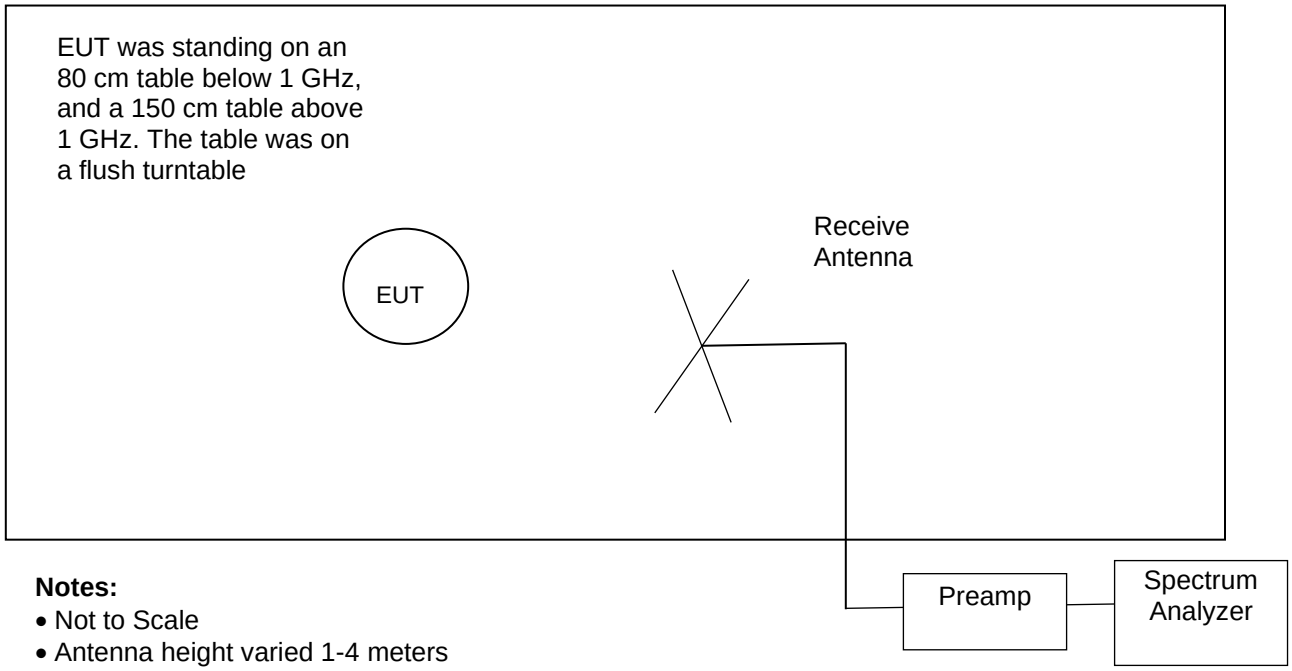
Column #4. Uncorrected readings from the spectrum analyzer with Second Axis Rotation.
Column #5. Uncorrected readings from the spectrum analyzer with Third Axis Rotation.
Column #6. Average Reading based on peak reading reduced by the Duty cycle correction
Column #7. Uncorrected readings from the spectrum analyzer with First Axis Rotation.
Column #8. Uncorrected readings from the spectrum analyzer with Second Axis Rotation.
Column #9. Uncorrected readings from the spectrum analyzer with Third Axis Rotation.
Column #10. Average Reading based on peak reading reduced by the Duty cycle correction
Column #11. Corr. Factors = Cable Loss – Preamp Gain + Antenna Factor
Column #12. Frequency of Tested Emission
Column #13. Highest peak field strength at listed frequency.
Column #14. Highest Average field strength at listed frequency.
Column #15. Peak Limit.
Column #16. Average Limit.
Column #17. The margin (last column) is the worst case margin under the peak or average limits for that row.

Overall Judgment: Passed by at least 10 dB

No other Emissions were detected from 30 to 9,300 MHz within 10 dB of the limits.
All emissions outside of the band from 902 to 928 were below the limits of 15.209.

Figure 3. Drawing of Radiated Emissions Setup

Chamber E, anechoic



Notes:
- Not to Scale
- Antenna height varied 1-4 meters
- Distance from antenna to tested system is 3 meters
- AC cords not shown. They are connected to AC outlet with low-pass filter on turntable

Frequency Range	Receive Antenna	Pre-Amplifier	Spectrum Analyzer
30 to 200 MHz	ANT-80	Internal	REC-21
200 to 1000 MHz	ANT-68	Internal	REC-21
1 to 10 GHz	ANT-66	AMP-05	REC-21

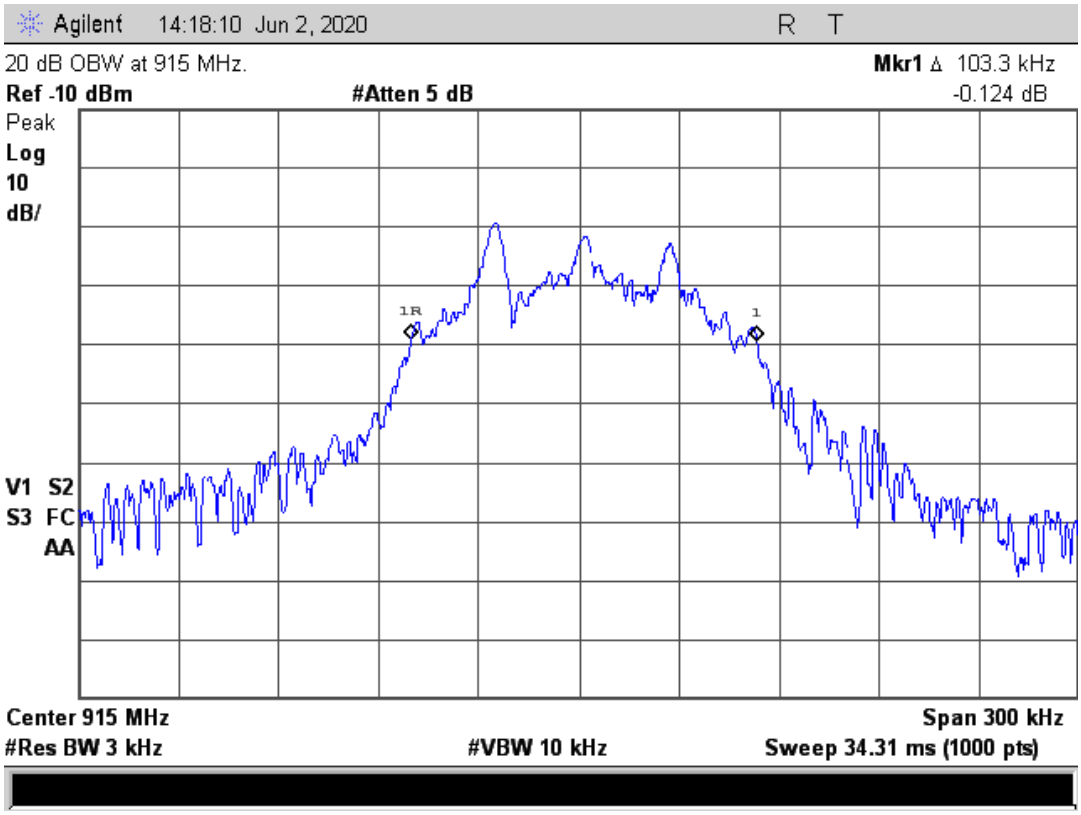
11.4 Occupied Bandwidth Data

The occupied bandwidth of the RF output was measured using a spectrum analyzer. The bandwidth was measured using the peak detector function. The spectrum analyzer was set to the MAX HOLD mode to record the worst case of the modulation. The marker-to-peak function was set to the peak of the emission. Then the marker-delta function was used to measure 20 dB down one side of the emission. The marker-delta function was reset and then moved to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the bandwidth of the emission. The plots of the occupied bandwidth for the EUT are supplied on the following pages.

The 20 dB OBW is within the allowed 902-928 MHz authourized band.

Channel	20 dB OBW kHz
915	103.3

Figure 4. Occupied Bandwidth Plot



11.5 Unintentional Emissions (Receive Mode)

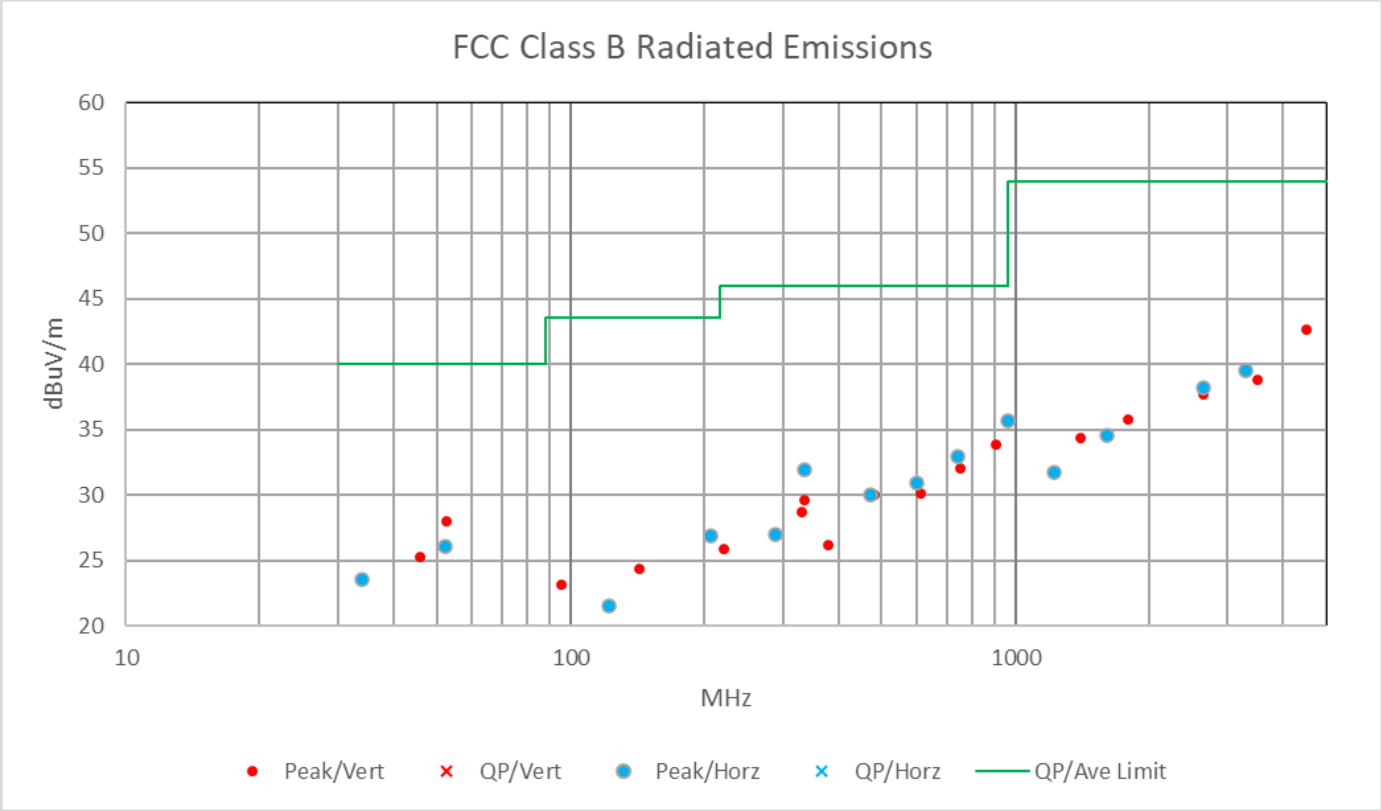
This section is only needed for 900 MHz receivers

Manufacturer	btwTAG Safety, LLC	Specification	FCC Part 15.209 & RSS-GEN
Model	20A061	Test Date	06-03-2020
Serial Number	RMC1	Test Distance	3 Meters
Abbreviations	Pol = Antenna Polarization; V = Vertical; H = Horizontal; P = peak; Q = QP		
Notes	Corr. Factors = Cable Loss – Preamp Gain		
Configuration	Charging in Receive mode		

Freq. MHz	Meter Reading dBuV	Dect.	Ant. Pol.	Ant Factor dB/m	Cbl/amp Factors dB	Dist Fact dB	EUT dBuV/m	Limit dBuV/m	Margin Under Limit dB	Note
33.9	10.3	P	H	12.6	0.6	0.0	23.5	40.0	16.5	
52.1	15.9	P	H	9.4	0.8	0.0	26.1	40.0	13.9	
121.7	8.5	P	H	11.8	1.2	0.0	21.5	43.5	22.0	
206.8	10.8	P	H	14.6	1.5	0.0	26.9	43.5	16.6	
287.9	11.8	P	H	13.4	1.8	0.0	27.0	46.0	19.0	
335.8	15.7	P	H	14.2	2.0	0.0	31.9	46.0	14.1	
473.8	10.5	P	H	17.1	2.4	0.0	30.0	46.0	16.0	
601.3	9.5	P	H	18.7	2.7	0.0	30.9	46.0	15.1	
743.8	9.0	P	H	20.9	3.0	0.0	32.9	46.0	13.1	
960.0	8.9	P	H	23.4	3.4	0.0	35.7	46.0	10.3	
1218.0	39.0	P	H	25.0	-32.3	0.0	31.7	74.0	42.3	1
1602.5	41.5	P	H	25.2	-32.1	0.0	34.6	74.0	39.4	1
2650.0	40.6	P	H	28.8	-31.2	0.0	38.2	74.0	35.8	1
3292.5	38.2	P	H	31.0	-29.7	0.0	39.5	74.0	34.5	1
46.0	14.6	P	V	10.0	0.7	0.0	25.3	40.0	14.7	
52.7	17.8	P	V	9.4	0.8	0.0	28.0	40.0	12.0	
95.7	12.0	P	V	10.0	1.1	0.0	23.1	43.5	20.4	
142.7	10.4	P	V	12.6	1.3	0.0	24.3	43.5	19.2	
221.2	9.3	P	V	15.0	1.6	0.0	25.9	46.0	20.1	
330.8	12.6	P	V	14.1	2.0	0.0	28.7	46.0	17.3	
335.8	13.4	P	V	14.2	2.0	0.0	29.6	46.0	16.4	
380.5	9.3	P	V	14.8	2.1	0.0	26.2	46.0	19.8	
480.7	10.4	P	V	17.2	2.4	0.0	30.0	46.0	16.0	
613.8	8.6	P	V	18.8	2.7	0.0	30.1	46.0	15.9	
752.5	8.1	P	V	20.9	3.0	0.0	32.0	46.0	14.0	
907.5	7.7	P	V	22.8	3.3	0.0	33.8	46.0	12.2	
1400.0	41.4	P	V	25.1	-32.1	0.0	34.4	74.0	39.6	1
1797.5	41.3	P	V	26.4	-31.9	0.0	35.8	74.0	38.2	1
2652.5	40.1	P	V	28.8	-31.2	0.0	37.7	74.0	36.3	1
3507.5	36.6	P	V	31.2	-29.0	0.0	38.8	74.0	35.2	1
4515.0	37.1	P	V	32.5	-27.0	0.0	42.6	74.0	31.4	1

Note: All Peak readings above 1 GHz were under the Average limits, so average readings are not required.

Overall Judgment: Passed by at least 10 dB



Radiated emissions in a graphical format. The above chart is the same data as the previous table. The peak limit is not shown, since the peak readings meet the lower average limit.

11.5.1 Measurement Instrumentation Uncertainty

Measurement	Uncertainty
Conducted Emissions, LISN method, 150 kHz to 30 MHz	2.2 dB
Radiated Emissions, E-field, 3 meters, 30 to 200 MHz	4.7 dB
Radiated Emissions, E-field, 3 meters, 200 to 1000 MHz	6.2 dB
Radiated Emissions, E-field, 3 meters, 1 to 6 GHz	5.0 dB
Bandwidth using marker delta method at a span of 10 MHz	4 kHz
Bandwidth using marker delta method at a span of 50 kHz	470 Hz
99% Occupied Bandwidth using REC-43	1% of frequency span
Temperature THM-02	0.6 Deg C

The uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k=2 in accordance with CISPR 16-4-2.

12.0 REVISION HISTORY

Document RP-9296 Revisions:			
Rev.	Affected Sections	Description	Rationale