



element

Prevent Biometrics

Head Impact Monitor Mouth Guard

FCC 15.249:2019

2400 – 2483.5 MHz Transceiver

Report # PVBM0002.1



NVLAP LAB CODE: 200881-0



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CERTIFICATE OF TEST

Last Date of Test: August 7, 2019
Prevent Biometrics
Model: Head Impact Monitor Mouth Guard

Radio Equipment Testing

Standards

Specification	Method
FCC 15.249:2019	ANSI C63.10:2013

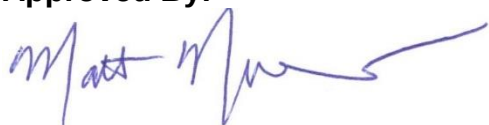
Results

Method Clause	Test Description	Applied	Results	Comments
6.2	Powerline Conducted Emissions	No	N/A	Not required for a battery powered EUT.
6.5, 6.6	Field Strength of Harmonics and Spurious Radiated Emissions	Yes	Pass	
6.6	Field Strength of Fundamental	Yes	Pass	
7.5	Duty Cycle	Yes	N/A	Characterization of radio operation.

Deviations From Test Standards

None

Approved By:



Matt Nuernberg, Operations Manager

Product compliance is the responsibility of the client; therefore, the tests and equipment modes of operation represented in this report were agreed upon by the client, prior to testing. The results of this test pertain only to the sample(s) tested. The specific description is noted in each of the individual sections of the test report supporting this certificate of test. This report reflects only those tests from the referenced standards shown in the certificate of test. It does not include inspection or verification of labels, identification, marking or user information. As indicated in the Statement of Work sent with the quotation, Element's standard process is to always use the latest published version of the test methods even when earlier versions are cited in the test specification. Issuance of a purchase order was de facto acceptance of this approach. Otherwise, the client would have advised Element in writing of the specific version of the test methods they wanted applied to the subject testing.

REVISION HISTORY



Revision Number	Description	Date (yyyy-mm-dd)	Page Number
00	None		

ACCREDITATIONS AND AUTHORIZATIONS



United States

FCC - Designated by the FCC as a Telecommunications Certification Body (TCB). Certification chambers, Open Area Test Sites, and conducted measurement facilities are listed with the FCC.

A2LA - Accredited by A2LA to ISO / IEC 17065 as a product certifier. This allows Element to certify transmitters to FCC and IC specifications.

NVLAP - Each laboratory is accredited by NVLAP to ISO 17025

Canada

ISED - Recognized by Innovation, Science and Economic Development Canada as a Certification Body (CB) and as a CAB for the acceptance of test data.

European Union

European Commission – Within Element, we have a EU Notified Body validated for the EMCD and RED Directives.

Australia/New Zealand

ACMA - Recognized by ACMA as a CAB for the acceptance of test data.

Korea

MSIT / RRA - Recognized by KCC's RRA as a CAB for the acceptance of test data.

Japan

VCCI - Associate Member of the VCCI. Conducted and radiated measurement facilities are registered.

Taiwan

BSMI – Recognized by BSMI as a CAB for the acceptance of test data.

NCC - Recognized by NCC as a CAB for the acceptance of test data.

Singapore

IDA – Recognized by IDA as a CAB for the acceptance of test data.

Israel

MOC – Recognized by MOC as a CAB for the acceptance of test data.

Hong Kong

OFCA – Recognized by OFCA as a CAB for the acceptance of test data.

Vietnam

MIC – Recognized by MIC as a CAB for the acceptance of test data.

SCOPE

For details on the Scopes of our Accreditations, please visit:

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FACILITIES



California Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	Minnesota Labs MN01-10 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	Oregon Labs EV01-12 6775 NE Evergreen Pkwy #400 Hillsboro, OR 97124 (503) 844-4066	Texas Labs TX01-09 3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	Washington Labs NC01-05 19201 120 th Ave NE Bothell, WA 98011 (425)984-6600
NVLAP				
NVLAP Lab Code: 200676-0	NVLAP Lab Code: 200881-0	NVLAP Lab Code: 200630-0	NVLAP Lab Code:201049-0	NVLAP Lab Code: 200629-0
Innovation, Science and Economic Development Canada				
2834B-1, 2834B-3	2834E-1, 2834E-3	2834D-1	2834G-1	2834F-1
BSMI				
SL2-IN-E-1154R	SL2-IN-E-1152R	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R
VCCI				
A-0029	A-0109	A-0108	A-0201	A-0110
Recognized Phase I CAB for ISED, ACMA, BSMI, IDA, KCC/RRR, MIC, MOC, NCC, OFCA				
US0158	US0175	US0017	US0191	US0157



MEASUREMENT UNCERTAINTY



Measurement Uncertainty

When a measurement is made, the result will be different from the true or theoretically correct value. The difference is the result of tolerances in the measurement system that cannot be completely eliminated. To the extent that technology allows us, it has been our aim to minimize this error. Measurement uncertainty is a statistical expression of measurement error qualified by a probability distribution.

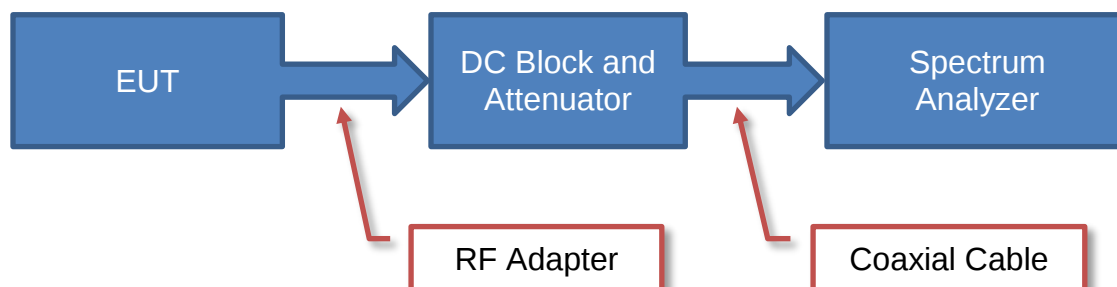
A measurement uncertainty estimation has been performed for each test per our internal quality document QM205.4.6. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) can be found included as part of the applicable test description page. Our measurement data meets or exceeds the measurement uncertainty requirements of the applicable specification; therefore, the test data can be compared directly to the specification limit to determine compliance. The calculations for estimating measurement uncertainty are based upon ETSI TR 100 028 (or CISPR 16-4-2 as applicable), and are available upon request.

The following table represents the Measurement Uncertainty (MU) budgets for each of the tests that may be contained in this report.

Test	+ MU	- MU
Frequency Accuracy (Hz)	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	1.2 dB	-1.2 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field Strength (dB)	5.2 dB	-5.2 dB
AC Powerline Conducted Emissions (dB)	2.4 dB	-2.4 dB

Test Setup Block Diagrams

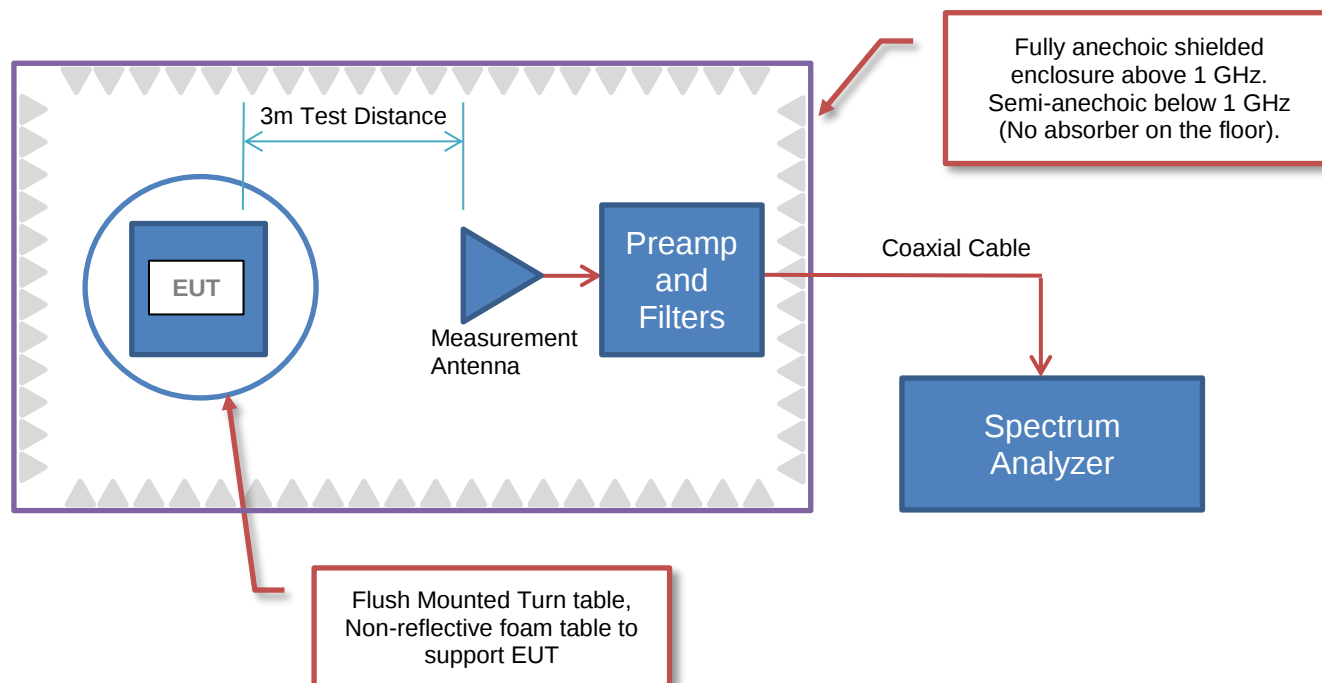
Antenna Port Conducted Measurements



Near Field Test Fixture Measurements



Spurious Radiated Emissions



PRODUCT DESCRIPTION



Client and Equipment Under Test (EUT) Information

Company Name:	Prevent Biometrics
Address:	4530 W 77th St Suite 300 Suite 300
City, State, Zip:	Edina, MN 55435
Test Requested By:	Anh Nguyen
Model:	Head Impact Monitor Mouth Guard
First Date of Test:	August 7, 2019
Last Date of Test:	August 7, 2019
Receipt Date of Samples:	August 7, 2019
Equipment Design Stage:	Production
Equipment Condition:	No Damage
Purchase Authorization:	Verified

Information Provided by the Party Requesting the Test

Functional Description of the EUT:
Mouth Guard with a Bluetooth radio. This is paired with an inductive recharger (with no communication).
Testing Objective:
Seeking to demonstrate compliance under FCC 15.249:2019 for operation in the 2400 - 2483.5 MHz Band.

CONFIGURATIONS



Configuration PVBM0002- 2

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
Head Impact Monitor Mouth Guard	Prevent Biometrics	IMM 1.3	35121
Head Impact Monitor Mouth Guard	Prevent Biometrics	IMM 1.3	35682
Head Impact Monitor Mouth Guard	Prevent Biometrics	IMM 1.3	35417
Head Impact Monitor Mouth Guard	Prevent Biometrics	IMM 1.3	35660
Head Impact Monitor Mouth Guard	Prevent Biometrics	IMM 1.3	35748
Head Impact Monitor Mouth Guard	Prevent Biometrics	IMM 1.3	35782

Remote Equipment Outside of Test Setup Boundary			
Description	Manufacturer	Model/Part Number	Serial Number
Laptop	Dell	E6430	G013SY1
NRF 51 Dongle	York	NRF 51	680656044
AC Adapter (Laptop)	Dell	PA10 Series	N/A

Cables					
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2
AC Cable (Laptop)	No	1.5 m	Yes	AC Adapter (Laptop)	AC Mains
DC Cable (Laptop)	No	1.5 m	No	Laptop	AC Adapter (Laptop)

MODIFICATIONS



Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2019-08-07	Field Strength of Harmonics and Spurious Radiated Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
2	2019-08-07	Field Strength of Fundamental	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

FIELD STRENGTH OF HARMONICS AND SPURIOUS RADIATED EMISSIONS



PSA-ESCI 2019.05.10

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

MODES OF OPERATION

Tx at Low Ch 0 2402 MHz, Mid Ch 18 2440 Mhz, and High Ch 39 2480 Mhz, 1 and 2 Mbps Data Rates

POWER SETTINGS INVESTIGATED

Battery

CONFIGURATIONS INVESTIGATED

PVBM0002 - 2

FREQUENCY RANGE INVESTIGATED

Start Frequency	30 MHz	Stop Frequency	18000 MHz
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SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFN	1-May-2019	12 mo
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNU	11-Apr-2019	12 mo
Antenna - Standard Gain	ETS Lindgren	3160-09	AHG	NCR	0 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-12001800-30-10P	AVW	8-Feb-2019	12 mo
Antenna - Standard Gain	ETS Lindgren	3160-08	AIQ	NCR	0 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-08001200-30-10P	AVV	8-Feb-2019	12 mo
Cable	ESM Cable Corp.	Standard Gain Horn Cables	MNJ	8-Mar-2019	12 mo
Antenna - Standard Gain	ETS Lindgren	3160-07	AXP	NCR	0 mo
Filter - High Pass	Micro-Tronics	HPM50111	LFN	24-Sep-2018	12 mo
Attenuator	Fairview Microwave	SA18E-20	TWZ	24-Sep-2018	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	AVT	8-Feb-2019	12 mo
Cable	ESM Cable Corp.	Double Ridge Guide Horn Cables	MNI	24-Sep-2018	12 mo
Antenna - Double Ridge	ETS-Lindgren	3115	AJQ	NCR	0 mo
Amplifier - Pre-Amplifier	Miteq	AM-1616-1000	AVO	2-Nov-2018	12 mo
Cable	ESM Cable Corp.	Bilog Cables	MNH	2-Nov-2018	12 mo
Antenna - Biconilog	Teseq	CBL 6141B	AYD	25-Jan-2018	24 mo

MEASUREMENT BANDWIDTHS

Frequency Range (MHz)	Peak Data (kHz)	Quasi-Peak Data (kHz)	Average Data (kHz)
0.01 - 0.15	1.0	0.2	0.2
0.15 - 30.0	10.0	9.0	9.0
30.0 - 1000	100.0	120.0	120.0
Above 1000	1000.0	N/A	1000.0

TEST DESCRIPTION

The highest gain antenna of each type to be used with the EUT was tested. The EUT was configured for the required transmit frequencies and the modes as showed in the data sheets.

For each configuration, the spectrum was scanned throughout the specified range as part of the exploratory investigation of the emissions. These "pre-scans" are not included in the report. Final measurements on individual emissions were then made and included in this test report.

The individual emissions from the EUT were maximized by rotating the EUT on a turntable, adjusting the position of the EUT and EUT antenna in three orthogonal axis, and adjusting the measurement antenna height and polarization (per ANSI C63.10). A preamp and high pass filter (and notch filter) were used for this test in order to provide sufficient measurement sensitivity.

Measurements were made with the required detectors and annotated on the data for each individual point using the following annotation:

QP = Quasi-Peak Detector

PK = Peak Detector

AV = RMS Detector

Measurements were made to satisfy the specific requirements of the test specification for out of band emissions.

If there are no detectable emissions above the noise floor, the data included may show noise floor measurements for reference only.

Measurements at the edges of the allowable band may be presented in an alternative method as provided for in the ANSI C63.10 Marker-Delta method. This method involves performing an in-band fundamental measurement followed by a screen capture of the fundamental and out-of-band emission using reduced measurement instrumentation bandwidths. The amplitude delta measured on this screen capture is applied to the fundamental emission value to show the out-of-band emission level as applied to the limit.

FIELD STRENGTH OF HARMONICS AND SPURIOUS RADIATED EMISSIONS

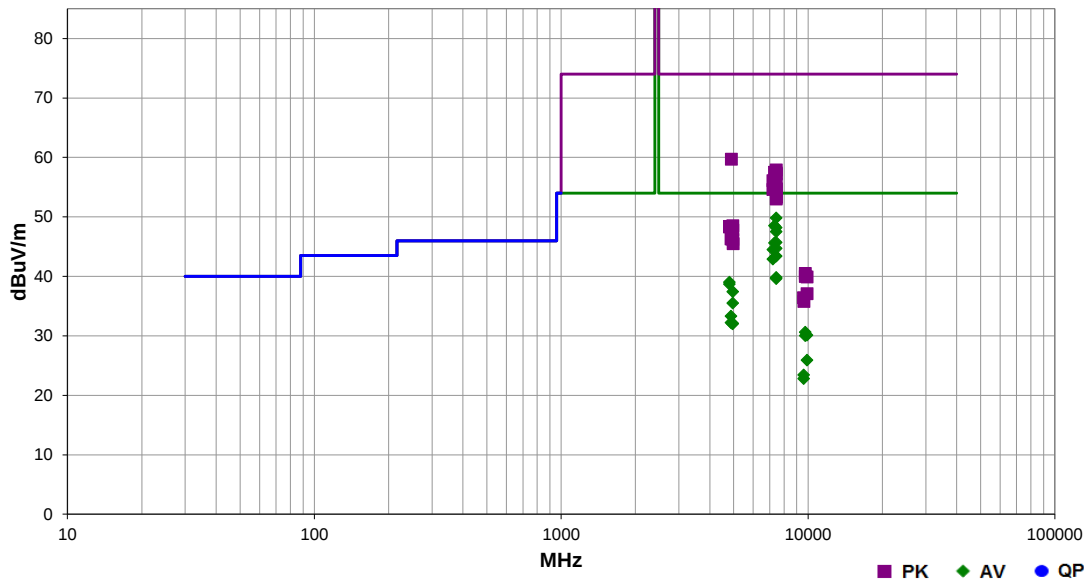


EmiR5 2019.08.01 PSA-ESCI 2019.05.10

Work Order:	PVBM0002	Date:	7-Aug-2019	
Project:	None	Temperature:	21.3 °C	
Job Site:	MN05	Humidity:	58.8% RH	
Serial Number:	Various	Barometric Pres.:	1011 mbar	
EUT:	Head Impact Monitor Mouth Guard			
Configuration:	2			
Customer:	Prevent Biometrics			
Attendees:	Scott Deyo, Kyle Maloney			
EUT Power:	Battery			
Operating Mode:	Tx at Low Ch 0 2402 MHz, Mid Ch 18 2440 Mhz, and High Ch 39 2480 Mhz, 1 and 2 Mbps Data Rates			
Deviations:	None			
Comments:	Bandedge measurements. SN 35121 Mid, High Ch, 1 Mbps; SN 35121 High Ch, 2 Mbps; SN 35748 Low, Mid, High Ch, 1 Mbps; SN 35782 High Ch, 2 Mbps; SN 35782 Low Ch, 1 Mbps; SN 35682 Low Ch, 1 Mbps			

Test Specifications	Test Method
FCC 15.249:2019	ANSI C63.10:2013

Run #	24	Test Distance (m)	3	Antenna Height(s)	1 to 4(m)	Results	Pass
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Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
7440.625	37.9	11.9	1.6	101.0	3.0	0.0	Vert	AV	0.0	49.8	54.0	-4.2	EUT Horz, High Ch, 1 Mbps, SN 35121
7320.583	36.9	11.6	2.1	173.0	3.0	0.0	Vert	AV	0.0	48.5	54.0	-5.5	EUT Horz, Mid Ch, 1 Mbps, SN 35748
7440.667	36.3	11.9	2.0	1.0	3.0	0.0	Horz	AV	0.0	48.2	54.0	-5.8	EUT On Side, High Ch, 1 Mbps, SN 35121
7441.250	35.6	11.9	1.8	357.0	3.0	0.0	Vert	AV	0.0	47.5	54.0	-6.5	EUT Horz, High Ch, 2 Mbps, SN 35782
7440.625	33.8	11.9	1.5	210.0	3.0	0.0	Horz	AV	0.0	45.7	54.0	-8.3	EUT Vert, High Ch, 1 Mbps, SN 35121
7320.583	34.0	11.6	2.7	27.9	3.0	0.0	Horz	AV	0.0	45.6	54.0	-8.4	EUT On Side, Mid Ch, 1 Mbps, SN 35748
7440.625	32.8	11.9	1.0	318.9	3.0	0.0	Horz	AV	0.0	44.7	54.0	-9.3	EUT Horz, High Ch, 1 Mbps, SN 35121
7206.667	33.1	11.4	1.1	141.0	3.0	0.0	Vert	AV	0.0	44.5	54.0	-9.5	EUT Horz, Low Ch, 1 Mbps, SN 35782
7440.625	31.5	11.9	1.8	59.9	3.0	0.0	Vert	AV	0.0	43.4	54.0	-10.6	EUT Vert, High Ch, 1 Mbps, SN 35121
7206.625	31.5	11.4	3.6	174.0	3.0	0.0	Horz	AV	0.0	42.9	54.0	-11.1	EUT On Side, Low Ch, 1 Mbps, SN 35782
7441.375	27.9	11.9	1.5	297.0	3.0	0.0	Horz	AV	0.0	39.8	54.0	-14.2	EUT On Side, High Ch, 2 Mbps, SN 35121
4891.250	55.3	4.4	1.5	288.0	3.0	0.0	Horz	PK	0.0	59.7	74.0	-14.3	EUT On Side, Mid Ch, 1 Mbps, SN 35748
7440.625	27.7	11.9	2.0	235.9	3.0	0.0	Vert	AV	0.0	39.6	54.0	-14.4	EUT On Side, High Ch, 1 Mbps, SN 35121
4804.167	34.7	4.3	2.4	198.0	3.0	0.0	Horz	AV	0.0	39.0	54.0	-15.0	EUT On Side, Low Ch, 1 Mbps, SN 35782
4804.125	34.4	4.3	2.3	166.0	3.0	0.0	Vert	AV	0.0	38.7	54.0	-15.3	EUT Horz, Low Ch, 1 Mbps, SN 35782
7440.625	46.0	11.9	1.6	101.0	3.0	0.0	Vert	PK	0.0	57.9	74.0	-16.1	EUT Horz, High Ch, 1 Mbps, SN 35121
7319.708	45.9	11.6	2.1	173.0	3.0	0.0	Vert	PK	0.0	57.5	74.0	-16.5	EUT Horz, Mid Ch, 1 Mbps, SN 35748
4960.958	32.9	4.5	2.9	276.9	3.0	0.0	Vert	AV	0.0	37.4	54.0	-16.6	EUT Horz, High Ch, 2 Mbps, SN 35782
7441.125	45.5	11.9	1.8	357.0	3.0	0.0	Vert	PK	0.0	57.4	74.0	-16.6	EUT Horz, High Ch, 2 Mbps, SN 35782
7440.708	45.3	11.9	2.0	1.0	3.0	0.0	Horz	PK	0.0	57.2	74.0	-16.8	EUT On Side, High Ch, 1 Mbps, SN 35121
7206.042	44.7	11.4	1.1	141.0	3.0	0.0	Vert	PK	0.0	56.1	74.0	-17.9	EUT Horz, Low Ch, 1 Mbps, SN 35782
4960.958	31.0	4.5	2.4	225.0	3.0	0.0	Horz	AV	0.0	35.5	54.0	-18.5	EUT On Side, High Ch, 2 Mbps, SN 35121
7440.500	43.5	11.9	1.5	210.0	3.0	0.0	Horz	PK	0.0	55.4	74.0	-18.6	EUT Vert, High Ch, 1 Mbps, SN 35121
7320.667	43.8	11.6	2.7	27.9	3.0	0.0	Horz	PK	0.0	55.4	74.0	-18.6	EUT On Side, Mid Ch, 1 Mbps, SN 35748
7439.000	42.8	11.9	1.0	318.9	3.0	0.0	Horz	PK	0.0	54.7	74.0	-19.3	EUT Horz, High Ch, 1 Mbps, SN 35121
7439.458	42.8	11.9	1.8	59.9	3.0	0.0	Vert	PK	0.0	54.7	74.0	-19.3	EUT Vert, High Ch, 1 Mbps, SN 35121
7206.500	43.2	11.4	3.6	174.0	3.0	0.0	Horz	PK	0.0	54.6	74.0	-19.4	EUT On Side, Low Ch, 1 Mbps, SN 35782

Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
4880.250	28.9	4.4	1.2	209.0	3.0	0.0	Vert	AV	0.0	33.3	54.0	-20.7	EUT Horz, Mid Ch, 1 Mbps, SN 35748
7451.000	41.4	11.9	1.5	297.0	3.0	0.0	Horz	PK	0.0	53.3	74.0	-20.7	EUT On Side, High Ch, 2 Mbps, SN 35121
7443.792	41.1	11.9	2.0	235.9	3.0	0.0	Vert	PK	0.0	53.0	74.0	-21.0	EUT On Side, High Ch, 1 Mbps, SN 35121
4879.708	27.8	4.4	1.5	288.0	3.0	0.0	Horz	AV	0.0	32.2	54.0	-21.8	EUT On Side, Mid Ch, 1 Mbps, SN 35748
4956.667	27.6	4.5	1.5	73.9	3.0	0.0	Vert	AV	0.0	32.1	54.0	-21.9	EUT Horz, High Ch, 1 Mbps, SN 35682
4953.542	27.5	4.5	1.5	34.0	3.0	0.0	Horz	AV	0.0	32.0	54.0	-22.0	EUT On Side, High Ch, 1 Mbps, SN 35682
9759.083	35.4	-4.8	1.7	163.9	3.0	0.0	Vert	AV	0.0	30.6	54.0	-23.4	EUT Horz, Mid Ch, 1 Mbps, SN 35121
9919.042	34.8	-4.7	2.2	135.0	3.0	0.0	Vert	AV	0.0	30.1	54.0	-23.9	EUT Horz, High Ch, 1 Mbps, SN 35748
9760.875	34.8	-4.8	2.2	354.9	3.0	0.0	Horz	AV	0.0	30.0	54.0	-24.0	EUT On Side, Mid Ch, 1 Mbps, SN 35121
4960.750	44.0	4.5	2.4	225.0	3.0	0.0	Horz	PK	0.0	48.5	74.0	-25.5	EUT On Side, High Ch, 2 Mbps, SN 35121
4804.042	44.1	4.3	2.4	198.0	3.0	0.0	Horz	PK	0.0	48.4	74.0	-25.6	EUT On Side, Low Ch, 1 Mbps, SN 35782
4803.750	44.0	4.3	2.3	166.0	3.0	0.0	Vert	PK	0.0	48.3	74.0	-25.7	EUT Horz, Low Ch, 1 Mbps, SN 35782
4961.042	43.2	4.6	2.9	276.9	3.0	0.0	Vert	PK	0.0	47.8	74.0	-26.2	EUT Horz, High Ch, 2 Mbps, SN 35782
4877.500	41.9	4.4	1.2	209.0	3.0	0.0	Vert	PK	0.0	46.3	74.0	-27.7	EUT Horz, Mid Ch, 1 Mbps, SN 35748
4955.583	41.7	4.5	1.5	34.0	3.0	0.0	Horz	PK	0.0	46.2	74.0	-27.8	EUT On Side, High Ch, 1 Mbps, SN 35682
9919.000	30.6	-4.7	1.5	29.0	3.0	0.0	Horz	AV	0.0	25.9	54.0	-28.1	EUT On Side, High Ch, 1 Mbps, SN 35748
4971.542	40.9	4.6	1.5	73.9	3.0	0.0	Vert	PK	0.0	45.5	74.0	-28.5	EUT Horz, High Ch, 1 Mbps, SN 35682
9607.083	28.8	-5.4	1.1	52.0	3.0	0.0	Vert	AV	0.0	23.4	54.0	-30.6	EUT Horz, Low Ch, 1 Mbps, SN 35748
9606.958	28.2	-5.4	1.5	278.0	3.0	0.0	Horz	AV	0.0	22.8	54.0	-31.2	EUT On Side, Low Ch, 1 Mbps, SN 35748
9760.875	45.3	-4.8	1.7	163.9	3.0	0.0	Vert	PK	0.0	40.5	74.0	-33.5	EUT Horz, Mid Ch, 1 Mbps, SN 35121
9758.875	44.8	-4.8	2.2	354.9	3.0	0.0	Horz	PK	0.0	40.0	74.0	-34.0	EUT On Side, Mid Ch, 1 Mbps, SN 35121
9920.792	44.6	-4.7	2.2	135.0	3.0	0.0	Vert	PK	0.0	39.9	74.0	-34.1	EUT Horz, High Ch, 1 Mbps, SN 35748
9918.875	41.8	-4.7	1.5	29.0	3.0	0.0	Horz	PK	0.0	37.1	74.0	-36.9	EUT On Side, High Ch, 1 Mbps, SN 35748
9597.000	41.7	-5.3	1.1	52.0	3.0	0.0	Vert	PK	0.0	36.4	74.0	-37.6	EUT Horz, Low Ch, 1 Mbps, SN 35748
9619.333	41.2	-5.4	1.5	278.0	3.0	0.0	Horz	PK	0.0	35.8	74.0	-38.2	EUT On Side, Low Ch, 1 Mbps, SN 35748

FIELD STRENGTH OF FUNDAMENTAL



PSA-ESCI 2019.05.10

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

MODES OF OPERATION

Tx at Low Ch 2402 MHz, Mid Ch 2440 MHz, and High Ch 2480 MHz, 1 Mbps and 2 Mbps

POWER SETTINGS INVESTIGATED

Battery

CONFIGURATIONS INVESTIGATED

PVBM0002 - 2

FREQUENCY RANGE INVESTIGATED

Start Frequency	1 GHz	Stop Frequency	3 GHz
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SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFN	1-May-2019	12 mo
Attenuator	Fairview Microwave	SA18E-20	TWZ	24-Sep-2018	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	AVT	8-Feb-2019	12 mo
Cable	ESM Cable Corp.	Double Ridge Guide Horn Cables	MNI	24-Sep-2018	12 mo
Antenna - Double Ridge	ETS-Lindgren	3115	AJQ	NCR	0 mo

MEASUREMENT BANDWIDTHS

Frequency Range (MHz)	Peak Data (kHz)	Quasi-Peak Data (kHz)	Average Data (kHz)
0.01 - 0.15	1.0	0.2	0.2
0.15 - 30.0	10.0	9.0	9.0
30.0 - 1000	100.0	120.0	120.0
Above 1000	1000.0	N/A	1000.0

TEST DESCRIPTION

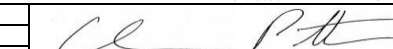
The antennas to be used with the EUT were tested. The EUT was transmitting and while set at the lowest channel, a middle channel, and the highest channel available. While scanning, emissions from the EUT were maximized by rotating the EUT, adjusting the measurement antenna height and polarization, and manipulating the EUT and EUT antenna in 3 orthogonal planes.

FIELD STRENGTH OF FUNDAMENTAL



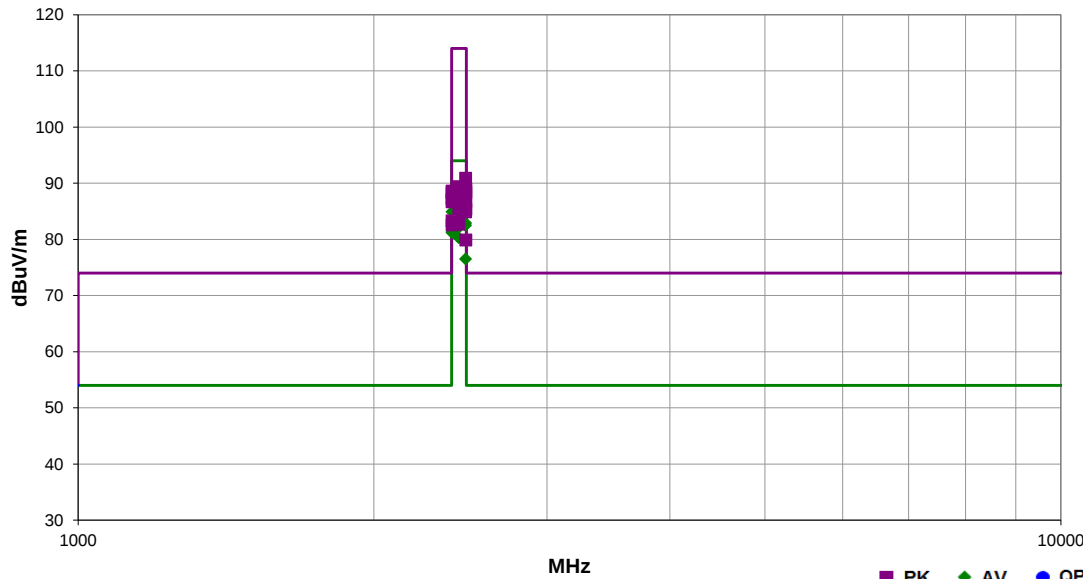
EmiRS 2019.08.01

PSA-ESCI 2019.05.10

Work Order:	PVBM0002	Date:	7-Aug-2019		
Project:	None	Temperature:	21.8 °C		
Job Site:	MN05	Humidity:	67.9% RH		
Serial Number:	35121	Barometric Pres.:	1011 mbar		
EUT:	Head Impact Monitor Mouth Guard			Tested by:	Chris Patterson
Configuration:	2				
Customer:	Prevent Biometrics				
Attendees:	Scott Deyo, Kyle Maloney				
EUT Power:	Battery				
Operating Mode:	Tx at Low Ch 2402 MHz, Mid Ch 2440 MHz, and High Ch 2480 MHz, 1 Mbps and 2 Mbps				
Deviations:	None				
Comments:	Band Edge measurements. SN 35748 High CH, 1 Mbps; SN 35246 Mid Ch, 1 Mbps; Sn 35682 Low Ch, 1 Mbps; SN 35660 High Ch, 2 Mbps				

Test Specifications	FCC 15.249:2019	Test Method	ANSI C63.10:2013
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Run #	6	Test Distance (m)	3	Antenna Height(s)	1 to 4(m)	Results	Pass
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Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
2479.983	53.1	36.1	3.9	289.0	3.0	0.0	Horz	AV	0.0	89.2	94.0	-4.8	EUT On Side, High Ch, 1 Mbps, SN 35748
2479.983	51.5	36.1	1.0	142.9	3.0	0.0	Vert	AV	0.0	87.6	94.0	-6.4	EUT Vert, High Ch, 1 Mbps, SN 35748
2439.992	51.5	36.1	3.2	271.0	3.0	0.0	Horz	AV	0.0	87.6	94.0	-6.4	EUT On Side, Mid Ch, 1 Mbps, SN 35246
2480.000	51.3	36.1	1.5	293.9	3.0	0.0	Horz	AV	0.0	87.4	94.0	-6.6	EUT Horz, High Ch, 1 Mbps, SN 35748
2402.008	51.4	36.0	1.5	342.0	3.0	0.0	Vert	AV	0.0	87.4	94.0	-6.6	EUT Vert, Low Ch, 1 Mbps, SN 35682
2401.992	50.6	36.0	2.5	87.0	3.0	0.0	Horz	AV	0.0	86.6	94.0	-7.4	EUT On Side, Low Ch, 1 Mbps, SN 35682
2402.000	50.5	36.0	1.5	34.0	3.0	0.0	Horz	AV	0.0	86.5	94.0	-7.5	EUT Horz, Low Ch, 1 Mbps, SN 35682
2439.992	49.8	36.1	1.5	29.0	3.0	0.0	Horz	AV	0.0	85.9	94.0	-8.1	EUT Horz, Mid Ch, 1 Mbps, SN 35246
2440.000	49.8	36.1	1.5	163.0	3.0	0.0	Vert	AV	0.0	85.9	94.0	-8.1	EUT Vert, Mid Ch, 1 Mbps, SN 35246
2479.983	48.9	36.1	1.1	254.9	3.0	0.0	Vert	AV	0.0	85.0	94.0	-9.0	EUT On Side, High Ch, 1 Mbps, SN 35748
2480.000	48.9	36.1	2.8	264.9	3.0	0.0	Horz	AV	0.0	85.0	94.0	-9.0	EUT On Side, High Ch, 1 Mbps, SN 35748
2401.992	48.9	36.0	1.0	142.0	3.0	0.0	Horz	AV	0.0	84.9	94.0	-9.1	EUT Vert, Low Ch, 1 Mbps, SN 35682
2439.992	48.6	36.1	1.0	253.0	3.0	0.0	Vert	AV	0.0	84.7	94.0	-9.3	EUT On Side, Mid Ch, 1 Mbps, SN 35246
2479.983	46.8	36.1	1.0	322.0	3.0	0.0	Horz	AV	0.0	82.9	94.0	-11.1	EUT Vert, High Ch, 1 Mbps, SN 35748
2480.000	46.4	36.1	1.5	63.9	3.0	0.0	Vert	AV	0.0	82.5	94.0	-11.5	EUT Vert, High Ch, 2 Mbps, SN 35660
2439.992	46.0	36.1	3.0	63.0	3.0	0.0	Vert	AV	0.0	82.1	94.0	-11.9	EUT Horz, Mid Ch, 1 Mbps, SN 35246
2401.975	45.3	36.0	1.5	332.0	3.0	0.0	Vert	AV	0.0	81.3	94.0	-12.7	EUT On Side, Low Ch, 1 Mbps, SN 35682
2402.000	45.2	36.0	3.0	164.9	3.0	0.0	Vert	AV	0.0	81.2	94.0	-12.8	EUT Horz, Low Ch, 1 Mbps, SN 35682
2439.992	44.2	36.1	1.5	335.0	3.0	0.0	Horz	AV	0.0	80.3	94.0	-13.7	EUT Vert, Mid Ch, 1 Mbps, SN 35246
2480.000	40.4	36.1	1.5	297.9	3.0	0.0	Vert	AV	0.0	76.5	94.0	-17.5	EUT Horz, High Ch, 1 Mbps, SN 35748
2479.750	54.8	36.1	3.9	289.0	3.0	0.0	Horz	PK	0.0	90.9	114.0	-23.1	EUT On Side, High Ch, 1 Mbps, SN 35748
2439.750	53.3	36.1	3.2	271.0	3.0	0.0	Horz	PK	0.0	89.4	114.0	-24.6	EUT On Side, Mid Ch, 1 Mbps, SN 35246
2480.175	52.9	36.1	1.0	142.9	3.0	0.0	Vert	PK	0.0	89.0	114.0	-25.0	EUT Vert, High Ch, 1 Mbps, SN 35748
2402.158	52.6	36.0	1.5	342.0	3.0	0.0	Vert	PK	0.0	88.6	114.0	-25.4	EUT Vert, Low Ch, 1 Mbps, SN 35682
2480.292	52.4	36.1	1.5	293.9	3.0	0.0	Horz	PK	0.0	88.5	114.0	-25.5	EUT Horz, High Ch, 1 Mbps, SN 35748
2402.250	52.3	36.0	2.5	87.0	3.0	0.0	Horz	PK	0.0	88.3	114.0	-25.7	EUT On Side, Low Ch, 1 Mbps, SN 35682
2479.583	52.0	36.1	2.8	264.9	3.0	0.0	Horz	PK	0.0	88.1	114.0	-25.9	EUT On Side, High Ch, 1 Mbps, SN 35660

Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
2439.717	51.3	36.1	1.5	29.0	3.0	0.0	Horz	PK	0.0	87.4	114.0	-26.6	EUT Horz, Mid Ch, 1 Mbps, SN 35246
2439.800	51.2	36.1	1.5	163.0	3.0	0.0	Vert	PK	0.0	87.3	114.0	-26.7	EUT Vert, Mid Ch, 1 Mbps, SN 35246
2402.292	51.2	36.0	1.5	34.0	3.0	0.0	Horz	PK	0.0	87.2	114.0	-26.8	EUT Horz, Low Ch, 1 Mbps, SN 35682
2480.158	50.7	36.1	1.1	254.9	3.0	0.0	Vert	PK	0.0	86.8	114.0	-27.2	EUT On Side, High Ch, 1 Mbps, SN 35748
2402.267	50.7	36.0	1.0	142.0	3.0	0.0	Horz	PK	0.0	86.7	114.0	-27.3	EUT Vert, Low Ch, 1 Mbps, SN 35682
2440.183	50.3	36.1	1.0	253.0	3.0	0.0	Vert	PK	0.0	86.4	114.0	-27.6	EUT On Side, Mid Ch, 1 Mbps, SN 35246
2480.542	49.3	36.1	1.5	63.9	3.0	0.0	Vert	PK	0.0	85.4	114.0	-28.6	EUT Vert, High Ch, 2 Mbps, SN 35660
2479.775	48.8	36.1	1.0	322.0	3.0	0.0	Horz	PK	0.0	84.9	114.0	-29.1	EUT Vert, High Ch, 1 Mbps, SN 35748
2439.725	48.1	36.1	3.0	63.0	3.0	0.0	Vert	PK	0.0	84.2	114.0	-29.8	EUT Horz, Mid Ch, 1 Mbps, SN 35246
2402.175	47.3	36.0	1.5	332.0	3.0	0.0	Vert	PK	0.0	83.3	114.0	-30.7	EUT On Side, Low Ch, 1 Mbps, SN 35682
2439.942	46.6	36.1	1.5	335.0	3.0	0.0	Horz	PK	0.0	82.7	114.0	-31.3	EUT Vert, Mid Ch, 1 Mbps, SN 35246
2402.042	46.6	36.0	3.0	164.9	3.0	0.0	Vert	PK	0.0	82.6	114.0	-31.4	EUT Horz, Low Ch, 1 Mbps, SN 35682
2480.225	43.8	36.1	1.5	297.9	3.0	0.0	Vert	PK	0.0	79.9	114.0	-34.1	EUT Horz, High Ch, 1 Mbps, SN 35748

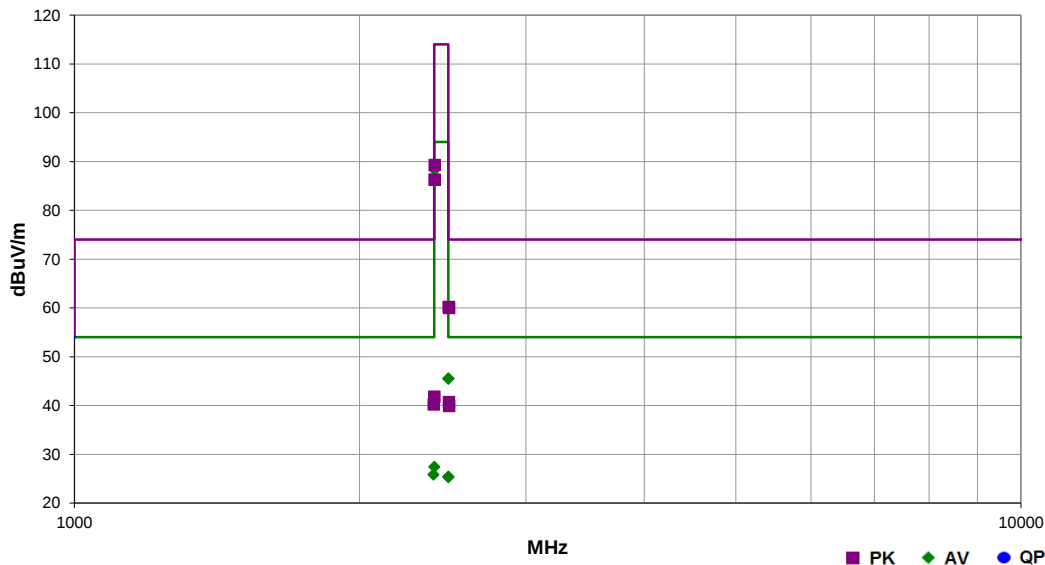
FIELD STRENGTH OF FUNDAMENTAL



Work Order:	PVBM0002	Date:	7-Aug-2019	
Project:	None	Temperature:	21.8 °C	
Job Site:	MN05	Humidity:	67.9% RH	
Serial Number:	Various	Barometric Pres.:	1011 mbar	
EUT:		Head Impact Monitor Mouth Guard		
Configuration:	2			
Customer:	Prevent Biometrics			
Attendees:	Scott Deyo, Kyle Maloney			
EUT Power:	Battery			
Operating Mode:	Tx at Low Ch 2402 MHz, and High Ch 2480 MHz, 1 Mbps and 2 Mbps			
Deviations:	None			
Comments:	Band Edge measurements. 35660, Low Ch 2 Mbps; SN 35782, High Ch, 2 Mbps; SN 35121 Low, High Ch, 1 Mbps			SN

Test Specifications	Test Method
FCC 15.249:2019	ANSI C63.10:2013

Run #	8	Test Distance (m)	3	Antenna Height(s)	1 to 4(m)	Results	Pass
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Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
2400.000	30.8	-3.4	1.5	346.0	3.0	0.0	Horz	AV	0.0	27.4	54.0	-26.6	EUT On Side, Low Ch, 2 Mbps, SN 35660
2395.080	29.2	-3.4	1.5	110.9	3.0	0.0	Vert	AV	0.0	25.8	54.0	-28.2	EUT Vert, Low Ch, 2 Mbps, SN 35660
2483.542	29.3	-3.9	2.35	95.9	3.0	0.0	Horz	AV	0.0	25.4	54.0	-28.6	EUT On Side, High Ch, 2 Mbps, SN 35782
2484.283	29.2	-3.9	1.5	318.0	3.0	0.0	Vert	AV	0.0	25.3	54.0	-28.7	EUT Vert, High Ch, 2 Mbps, SN 35782
2399.990	45.2	-3.4	1.5	346.0	3.0	0.0	Horz	PK	0.0	41.8	74.0	-32.2	EUT On Side, Low Ch, 2 Mbps, SN 35660
2487.125	44.5	-3.8	1.5	318.0	3.0	0.0	Vert	PK	0.0	40.7	74.0	-33.3	EUT Vert, High Ch, 2 Mbps, SN 35782
2396.060	43.6	-3.4	1.5	110.9	3.0	0.0	Vert	PK	0.0	40.2	74.0	-33.8	EUT Vert, Low Ch, 2 Mbps, SN 35660
2488.008	43.7	-3.8	2.35	95.9	3.0	0.0	Horz	PK	0.0	39.9	74.0	-34.1	EUT On Side, High Ch, 2 Mbps, SN 35782
2402.000	71.8	-3.5	2.84	84.0	3.0	20.0	Horz	AV	0.0	88.3	94.0	-5.7	EUT On Side, Low Ch, 1 Mbps, SN 35121
2402.000	69.5	-3.5	1.5	344.9	3.0	20.0	Vert	AV	0.0	86.0	94.0	-8.0	EUT Vert, Low Ch, 1 Mbps, SN 35121
2484.000	29.4	-3.9	3.68	199.0	3.0	20.0	Horz	AV	0.0	45.5	54.0	-8.5	EUT On Side, High Ch, 1 Mbps, SN 35121
2483.850	29.4	-3.9	1.5	220.0	3.0	20.0	Vert	AV	0.0	45.5	54.0	-8.5	EUT Vert, High Ch, 1 Mbps, SN 35121
2485.467	44.0	-3.8	1.5	220.0	3.0	20.0	Vert	PK	0.0	60.2	74.0	-13.8	EUT Vert, High Ch, 1 Mbps, SN 35121
2487.758	43.8	-3.8	3.68	199.0	3.0	20.0	Horz	PK	0.0	60.0	74.0	-14.0	EUT On Side, High Ch, 1 Mbps, SN 35121
2402.250	72.8	-3.5	2.84	84.0	3.0	20.0	Horz	PK	0.0	89.3	114.0	-24.7	EUT On Side, Low Ch, 1 Mbps, SN 35121
2401.750	69.8	-3.5	1.5	344.9	3.0	20.0	Vert	PK	0.0	86.3	114.0	-27.7	EUT Vert, Low Ch, 1 Mbps, SN 35121

DUTY CYCLE



TEST DESCRIPTION

The Duty Cycle (x) were measured for each of the EUT operating modes. The measurements were made using a zero span on the spectrum analyzer to see the pulses in the time domain. The transmit power was set to its default maximum.

The duty cycle was calculated by dividing the transmission pulse duration (T) by the total period of a single on and total off time.

The EUT operates at 100% Duty Cycle.