



FCC PART 15, SUBPART C ISED C RSS-247, ISSUE 2, FEBRUARY 2017

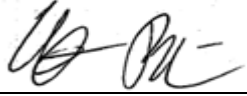

TEST REPORT

For

Culvert-IoT Corporation

1999 S Bascom Ave., Ste. 230, Campbell, CA 95008, USA

FCC ID: 2AQ98-DOS
IC: 26298-DOS

Report Type: Class II Permissive Change	Product Type: Asset Tracker
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Report Number: R2206083-247	
Report Date: 2022-08-29	
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* This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "*" (Rev.2)

TABLE OF CONTENTS

1	General Description.....	4
1.1	Product Description for Equipment Under Test (EUT)	4
1.2	Objective.....	4
1.3	Related Submittal(s)/Grant(s)	4
1.4	Test Methodology	4
1.5	Measurement Uncertainty	5
1.6	Test Facility Registrations	5
1.7	Test Facility Accreditations	5
2	System Test Configuration.....	8
2.1	Justification	8
2.2	EUT Exercise Software.....	8
2.3	Duty Cycle Correction Factor	8
2.4	Equipment Modifications.....	9
2.5	Local Support Equipment	9
2.6	Support Equipment	9
2.7	Power Supply/Adapter	9
2.8	Interface Ports and Cabling.....	10
3	Summary of Test Results	11
4	FCC §15.209, §15.247(d) & ISEDC RSS-247 §5.5, RSS-Gen §8.9, §8.10 - Spurious Radiated Emissions	12
4.1	Applicable Standards	12
4.2	Test Setup	13
4.3	Test Procedure	14
4.4	Corrected Amplitude and Margin Calculation	14
4.5	Test Setup Block Diagram	15
4.6	Test Equipment List and Details.....	15
4.7	Test Environmental Conditions	15
4.8	Summary of Test Results	16
4.9	Spurious Emissions Test Results	17
5	FCC §15.247(a) (2) & ISEDC RSS-247 §5.2 -Emission Bandwidth	19
5.1	Applicable Standards	19
5.2	Measurement Procedure.....	19
5.3	Test Setup Block Diagram	19
5.4	Test Equipment List and Details.....	20
5.5	Test Environmental Conditions	20
5.6	Test Results.....	21
6	Annex A- EUT Setup Photographs	24
7	Annex B- EUT External Photographs	25
8	Annex C- EUT Internal Photographs	26
9	Annex D (Normative) - A2LA Electrical Testing Certificate.....	27

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R2206083-247	CIIPC	2022-08-29

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *Culvert-IoT Corporation*, and their product model: *DOS, FCC ID: 2AQ98-DOS, IC: 26298-DOS* or the “EUT” as referred to in this report. The EUT is an Asset Tracker with BLE, LTE, Wi-Fi (Receiving only) and GPS (Receiving only) capabilities. LTE radio was incorporated by installing pre-certified radio module, FCC ID: XPY2AGQN4NNN, IC: 8595A-2AGQN4NNN. BLE and LTE do not transmit simultaneously.

1.2 Objective

This report was prepared on behalf of *Culvert-IoT Corporation*, in accordance with Part 2, Subpart J, and Part 15, Subpart and C of the Federal Communication Commission’s rules and ISEDC RSS-247 Issue 2, February 2017.

The objective was to determine continued compliance with FCC Part 15.247 and ISEDC RSS-247 rules for 6 dB Bandwidth and Radiated Spurious Emissions.

This report was for a Permissive Change II submission for the purpose of part substitution.

1.3 Related Submittal(s)/Grant(s)

None.

1.4 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices and FCC KDB 558074 D01 DTS Meas Guidance v04: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247.

1.5 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Parameter	Measurement uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±0.57 dB
Power Spectral Density, conducted	±1.48dB
Unwanted Emissions, conducted	±1.57dB
All emissions, radiated	±4.0 dB
AC power line Conducted Emission	±2.0 dB
Temperature	±2 ° C
Humidity	±5 %
DC and low frequency voltages	±1.0 %
Time	±2 %
Duty Cycle	±3 %

1.6 Test Facility Registrations

BACLs test facilities that are used to perform Radiated and Conducted Emissions tests are currently recognized by the Federal Communications Commission as Accredited with NIST Designation Number US1129.

BACL's test facilities that are used to perform Radiated and Conducted Emissions tests are currently registered with Industry Canada under Registration Numbers: 3062A-1, 3062A-2, and 3062A-3.

BACL is a Chinese Taipei Bureau of Standards Metrology and Inspection (BSMI) validated Conformity Assessment Body (CAB), under Appendix B, Phase I Procedures of the APEC Mutual Recognition Arrangement (MRA). BACL's BSMI Lab Code Number is: SL2-IN-E-1002R.

BACL's test facilities that are used to perform AC Line Conducted Emissions, Telecommunications Line Conducted Emissions, Radiated Emissions from 30 MHz to 1 GHz, and Radiated Emissions from 1 GHz to 6 GHz are currently recognized as Accredited in accordance with the Voluntary Control Council for Interference [VCCI] Article 15 procedures under Registration Number A-0027.

1.7 Test Facility Accreditations

Bay Area Compliance Laboratories Corp. (BACL) is:

A- An independent, 3rd-Party, Commercial Test Laboratory accredited to ISO/IEC 17025:2017 by A2LA (Test Laboratory Accreditation Certificate Number 3297.01), in the fields of: Electromagnetic Compatibility and Telecommunications. Unless noted by an Asterisk (*) in the Compliance Matrix (See Section 3 of this Test Report), BACL's ISO/IEC 17025:2017 Scope of Accreditation includes all of the Test Method Standards and/or the Product Family Standards detailed in this Test Report.

BACL's ISO/IEC 17025:2017 Scope of Accreditation includes a comprehensive suite of EMC Emissions, EMC Immunity, Radio, RF Exposure, Safety and wireline Telecommunications test methods applicable to a wide range of product categories. These product categories include Central Office Telecommunications Equipment [including NEBS - Network Equipment Building Systems], Unlicensed and Licensed Wireless and RF devices, Information Technology Equipment (ITE); Telecommunications Terminal Equipment (TTE); Medical Electrical Equipment; Industrial, Scientific and Medical Test Equipment; Professional Audio and Video Equipment; Industrial and Scientific Instruments and Laboratory Apparatus; Cable Distribution Systems, and Energy Efficient Lighting.

B- A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3297.02) to certify

- For the USA (Federal Communications Commission):
 - 1- All Unlicensed radio frequency devices within FCC Scopes A1, A2, A3, and A4;
 - 2- All Licensed radio frequency devices within FCC Scopes B1, B2, B3, and B4;
 - 3- All Telephone Terminal Equipment within FCC Scope C.
- For the Canada (Industry Canada):
 - 1 All Scope 1-Licence-Exempt Radio Frequency Devices;
 - 2 All Scope 2-Licensed Personal Mobile Radio Services;
 - 3 All Scope 3-Licensed General Mobile & Fixed Radio Services;
 - 4 All Scope 4-Licensed Maritime & Aviation Radio Services;
 - 5 All Scope 5-Licensed Fixed Microwave Radio Services
 - 6 All Broadcasting Technical Standards (BETS) in the Category I Equipment Standards List.
- For Singapore (Info-Communications Development Authority (IDA)):
 - 1 All Line Terminal Equipment: All Technical Specifications for Line Terminal Equipment – Table 1 of IDA MRA Recognition Scheme: 2011, Annex 2
 - 2. All Radio-Communication Equipment: All Technical Specifications for Radio-Communication Equipment – Table 2 of IDA MRA Recognition Scheme: 2011, Annex 2
- For the Hong Kong Special Administrative Region:
 - 1 All Radio Equipment, per KHCA 10XX-series Specifications;
 - 2 All GMDSS Marine Radio Equipment, per HKCA 12XX-series Specifications;
 - 3 All Fixed Network Equipment, per HKCA 20XX-series Specifications.
- For Japan:
 - 1 MIC Telecommunication Business Law (Terminal Equipment):
 - All Scope A1 - Terminal Equipment for the Purpose of Calls;
 - All Scope A2 - Other Terminal Equipment
 - 2 Radio Law (Radio Equipment):
 - All Scope B1 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 1 of the Radio Law
 - All Scope B2 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 2 of the Radio Law
 - All Scope B3 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 3 of the Radio Law

C- A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3297.03) to certify Products to USA's Environmental Protection Agency (EPA) ENERGY STAR Product Specifications for:

- 1 Electronics and Office Equipment:
 - for Telephony (ver. 3.0)
 - for Audio/Video (ver. 3.0)
 - for Battery Charging Systems (ver. 1.1)
 - for Set-top Boxes & Cable Boxes (ver. 4.1)
 - for Televisions (ver. 6.1)

- for Computers (ver. 6.0)
- for Displays (ver. 6.0)
- for Imaging Equipment (ver. 2.0)
- for Computer Servers (ver. 2.0)
- 2 Commercial Food Service Equipment
 - for Commercial Dishwashers (ver. 2.0)
 - for Commercial Ice Machines (ver. 2.0)
 - for Commercial Ovens (ver. 2.1)
 - for Commercial Refrigerators and Freezers
- 3 Lighting Products
 - For Decorative Light Strings (ver. 1.5)
 - For Luminaires (including sub-components) and Lamps (ver. 1.2)
 - For Compact Fluorescent Lamps (CFLs) (ver. 4.3)
 - For Integral LED Lamps (ver. 1.4)
- 4 Heating, Ventilation, and AC Products
 - for Residential Ceiling Fans (ver. 3.0)
 - for Residential Ventilating Fans (ver. 3.2)
- 5 Other
 - For Water Coolers (ver. 3.0)

D- A NIST Designated Phase-I and Phase-II Conformity Assessment Body (CAB) for the following economies and regulatory authorities under the terms of the stated MRAs/Treaties:

- Australia: ACMA (Australian Communication and Media Authority) – APEC Tel MRA -Phase I;
- Canada: (Innovation, Science and Economic development Canada - ISEDC) Foreign Certification Body – FCB – APEC Tel MRA -Phase I & Phase II;
- Chinese Taipei (Republic of China – Taiwan):
 - o BSMI (Bureau of Standards, Metrology and Inspection) APEC Tel MRA -Phase I;
 - o NCC (National Communications Commission) APEC Tel MRA -Phase I;
- European Union:
 - o EMC Directive 2014/30/EU US-EU EMC & Telecom MRA CAB (NB)
 - o Radio Equipment (RE) Directive 2014/53/EU US-EU EMC & Telecom MRA CAB (NB)
 - o Low Voltage Directive (LVD) 2014/35/EU
- Hong Kong Special Administrative Region: (Office of the Telecommunications Authority – OFTA) APEC Tel MRA -Phase I & Phase II
- Israel – US-Israel MRA Phase I
- Republic of Korea (Ministry of Communications - Radio Research Laboratory) APEC Tel MRA -Phase I
- Singapore: (Infocomm Media Development Authority - IMDA) APEC Tel MRA -Phase I & Phase II;
- Japan: VCCI - Voluntary Control Council for Interference US-Japan Telecom Treaty VCCI Side Letter-
- USA:
 - o ENERGY STAR Recognized Test Laboratory – US EPA
 - o Telecommunications Certification Body (TCB) – US FCC;
 - o Nationally Recognized Test Laboratory (NRTL) – US OSHA
- Vietnam: APEC Tel MRA -Phase I;

2 System Test Configuration

2.1 Justification

The EUT was configured for testing according to ANSI C63.10-2013 and FCC KDB 558074 D01 DTS Meas Guidance v04.

The EUT was tested in a testing mode to represent worst-case results during the final qualification test.

The worst-case configurations were verified to be consistent with the previous results by checking the radiated Field Strength.

2.2 EUT Exercise Software

The test firmware used was Tera Term, provided by *Culvert-IoT Corporation*, the software is compliant with the standard requirements being tested against.

Modulation	Frequency (MHz)	Power Setting
BLE	2402	-4
	2428	-4
	2480	-12

The data rate tested for the BLE radio was 1 Mbps.

2.3 Duty Cycle Correction Factor

According to KDB 558074 D01 DTS Meas Guidance v04 section 6.0:

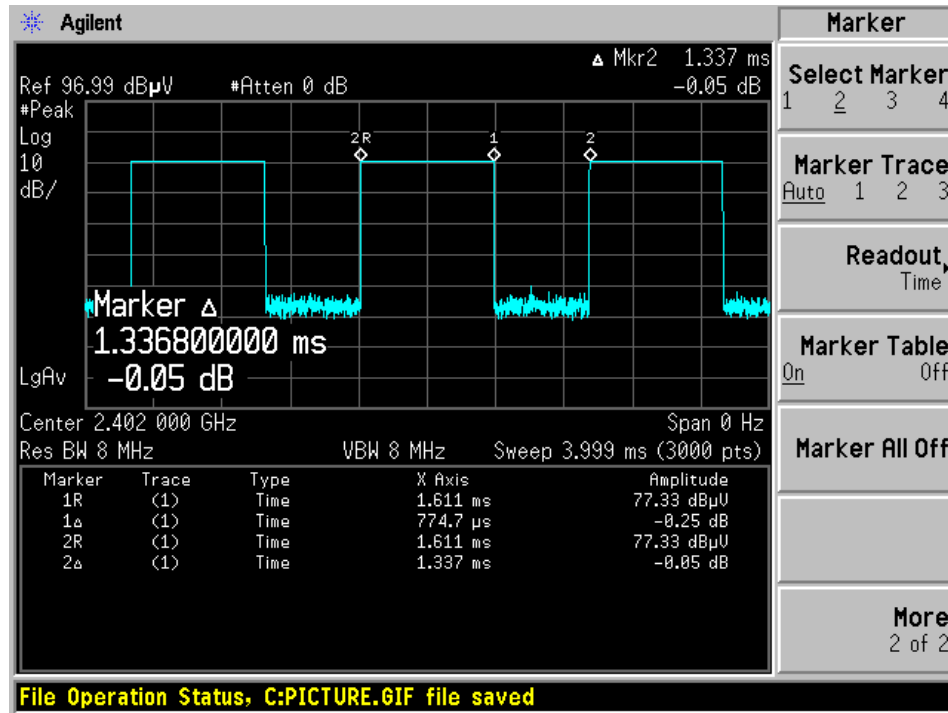
Preferably, all measurements of maximum conducted (average) output power will be performed with the EUT transmitting continuously (i.e., with a duty cycle of greater than or equal to 98%). When continuous operation cannot be realized, then the use of sweep triggering/signal gating techniques can be utilized to ensure that measurements are made only during transmissions at the maximum power control level. Such sweep triggering/signal gating techniques will require knowledge of the minimum transmission duration (T) over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation. Sweep triggering/signal gating techniques can then be used if the measurement/sweep time of the analyzer can be set such that it does not exceed T at any time that data is being acquired (i.e., no transmitter off-time is to be considered).

Radio Mode	Total On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
BLE	0.775	1.337	57.97	2.368

Duty Cycle = On Time (ms)/ Period (ms)

Duty Cycle Correction Factor (dB) = $10 \cdot \log(1/\text{Duty Cycle})$

Please refer to the following plots.



2.4 Equipment Modifications

None

2.5 Local Support Equipment

Manufacturer	Description	Model	Serial Number
Dell	Laptop	Latitude E6410	3CKRAQ1

2.6 Support Equipment

Manufacturer	Description	Model
Culvert	Debug Board	Culvert Dongle

2.7 Power Supply/Adapter

None

2.8 Interface Ports and Cabling

Description	Length (m)	To	From
USB to Micro USB	< 1 m	Laptop	Debug Board
USB C to USB C	< 1 m	Debug Board	EUT

3 Summary of Test Results

Results reported relate only to the product tested.

FCC and ISEDC Rules	Description of Test	Results
FCC §2.1053, §15.205, §15.209, §15.247 (d) ISEDC RSS-247 §5.5 ISEDC RSS-Gen §8.9 and §8.10	Radiated Spurious Emissions	Compliant
FCC §15.247(a)(2) ISEDC RSS-247 §5.2(a)	6 dB and 99% Emission Bandwidth	Compliant

4 FCC §15.209, §15.247(d) & ISEDC RSS-247 §5.5, RSS-Gen §8.9, §8.10 - Spurious Radiated Emissions

4.1 Applicable Standards

As per FCC §15.35(b): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz.

As Per FCC §15.205(a) and RSS-Gen except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	960 – 1240	4.5 – 5.15
0.495 – 0.505	16.69475 – 16.69525	1300 – 1427	5.35 – 5.46
2.1735 – 2.1905	25.5 – 25.67	1435 – 1626.5	7.25 – 7.75
4.125 – 4.128	37.5 – 38.25	1645.5 – 1646.5	8.025 – 8.5
4.17725 – 4.17775	73 – 74.6	1660 – 1710	9.0 – 9.2
4.20725 – 4.20775	74.8 – 75.2	1718.8 – 1722.2	9.3 – 9.5
6.215 – 6.218	108 – 121.94	2200 – 2300	10.6 – 12.7
6.26775 – 6.26825	123 – 138	2310 – 2390	13.25 – 13.4
6.31175 – 6.31225	149.9 – 150.05	2483.5 – 2500	14.47 – 14.5
8.291 – 8.294	156.52475 – 156.52525	2690 – 2900	15.35 – 16.2
8.362 – 8.366	156.7 – 156.9	3260 – 3267	17.7 – 21.4
8.37625 – 8.38675	162.0125 – 167.17	3332 – 3339	22.01 – 23.12
8.41425 – 8.41475	167.72 – 173.2	3345.8 – 3358	23.6 – 24.0
12.29 – 12.293	240 – 285	3600 – 4400	31.2 – 31.8
12.51975 – 12.52025	322 – 335.4		36.43 – 36.5
12.57675 – 12.57725	399.9 – 410		Above 38.6
13.36 – 13.41	608 – 614		

As per FCC §15.209(a): Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table

Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz.

However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

As per FCC §15.247 (d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

As per ISEDC RSS-Gen §8.9, except where otherwise indicated in the applicable RSS, radiated emissions shall comply with the field strength limits shown in the table below. Additionally, the level of any transmitter unwanted emission shall not exceed the level of the transmitter's fundamental emission.

General Field Strength Limits at Frequencies above 30 MHz

Frequency (MHz)	Field Strength ($\mu\text{v}/\text{m}$ at 3 meters)
30-88	100
88-216	150
216-960	200
Above 960	500

As per ISEDC RSS-247 §5.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

4.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.10-2013. The specification used was the FCC 15 Subpart C and ISEDC RSS-247 limits.

The spacing between the peripherals was 10 centimeters.

External I/O cables were draped along the edge of the test table and bundle when necessary.

4.3 Test Procedure

The EUT host, and all support equipment power cords were connected to the AC floor outlet.

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

For radiated testing the EUT was set 3 meter away from the testing antenna, which was varied from 1-4 meter, and the EUT was placed on a turntable, which was 0.8 meter and 1.5 meter above the ground plane for below and above 1000 MHz measurements, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna's polarity should be changed between horizontal and vertical.

The spectrum analyzer or receiver was set as:

Below 1000 MHz:

$$\text{RBW} = 100 \text{ kHz} / \text{VBW} = 300 \text{ kHz} / \text{Sweep} = \text{Auto}$$

Above 1000 MHz:

- (1) Peak: $\text{RBW} = 1\text{MHz} / \text{VBW} = 3\text{MHz} / \text{Sweep} = 100 \text{ ms}$
- (2) Average: Peak – DC Correction

4.4 Corrected Amplitude and Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) to indicated Amplitude (Ai) reading. The basic equation is as follows:

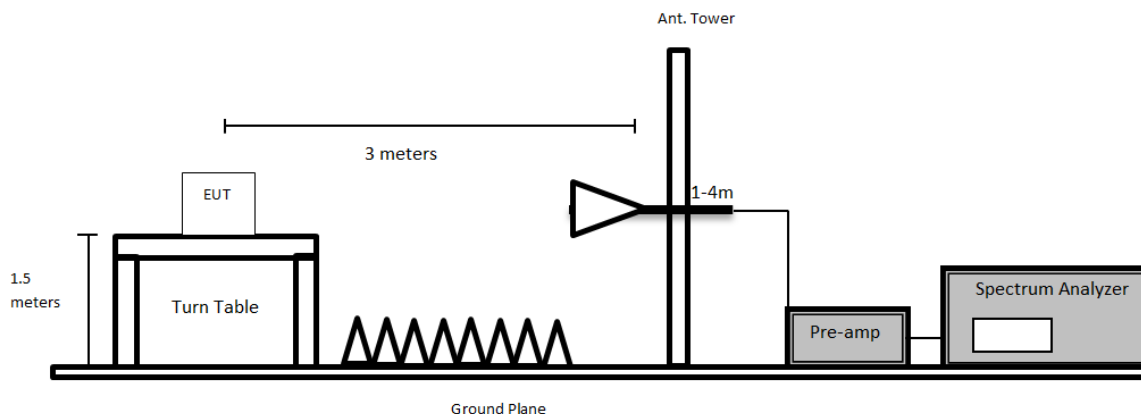
$$\text{CA} = \text{Ai} + \text{AF} + \text{CL} + \text{Atten} - \text{Ga}$$

For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

The “**Margin**” column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corrected Amplitude} - \text{Limit}$$

4.5 Test Setup Block Diagram



4.6 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
624	Agilent	Spectrum Analyzer	E4446A	MY48250238	2021-06-23	1 year
-	Sunol Science Corp	System Controller	SC99V	011003-1	N/R	N/R
1192	ETS Lindgren	Horn Antenna	3117	00218973	2021-09-14	2 years
1077	Insulated Wire Corp.	157 Series 2.92 SM (x2) Armored 33 ft. Cable	KPS-1571A-3960-KPS	DC 1917	2022-03-30	1 year
-	-	SMA cable	-	-	Each time ¹	N/A
-	-	Notch Filter	-	-	Each time ¹	N/A
32	HP	Pre Amplifier	8449B	3008A01978	2022-05-09	1 year

Note¹: cables and notch filter included in the test set-up will be checked each time before testing.

Statement of Traceability: BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".

4.7 Test Environmental Conditions

Temperature:	20-22 °C
Relative Humidity:	42-50 %
ATM Pressure:	102.7 kPa

The testing was performed by Christian McCaig from 2020-05-19 to 2020-05-20 in 5m chamber 3.

4.8 Summary of Test Results

According to the data hereinafter, the EUT complied with FCC Title 47, Part 15C and ISEDC RSS-247 standard's radiated emissions limits, and had the worst margin of:

Mode: Transmitting		
Margin (dB)	Frequency (MHz)	Mode, channel
-0.358	4856	Middle channel

Please refer to the following table and plots for specific test result details

4.9 Spurious Emissions Test Results

1) 1–26.5 GHz Measured at 3 meters

Frequency (MHz)	S.A. Reading (dB μ V)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dB μ V/m)	FCC/ISED		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dB μ V/m)	Margin (dB)	
Low Channel 2402 MHz											
2402	77.5	10	285	V	32.6	5.594	-	115.69	-	-	Peak
2402	81.16	325	297	H	32.6	5.594	-	119.35	-	-	Peak
2390	68.370	274	153	H	32.228	6.011	38.154	68.455	74	-5.545	Peak
2390	61.990	299	134	V	32.228	6.011	38.154	62.075	74	-11.925	Peak
2390	48.601	274	153	H	32.228	6.011	38.154	48.686	54	-5.314	Ave
2390	42.955	299	142	V	32.228	6.011	38.154	43.040	54	-10.960	Ave
4804	51.510	237	131	H	34.709	8.542	37.125	57.636	74	-16.364	Peak
4804	51.230	276	101	V	34.709	8.542	37.125	57.356	74	-16.644	Peak
4804	46.558	237	131	H	34.709	8.542	37.125	52.684	54	-1.316	Ave
4804	45.918	276	101	V	34.709	8.542	37.125	52.044	54	-1.956	Ave
7206	49.200	305	150	H	35.618	10.39	36.461	58.748	85.69 ¹	-26.942	Peak
7206	49.120	76	212	V	35.618	10.39	36.461	58.668	89.35 ¹	-30.682	Peak
Middle Channel 2428 MHz											
4856	51.840	234	150	H	34.709	8.562	37.027	58.084	74	-15.916	Peak
4856	51.920	272	101	V	34.709	8.562	37.027	58.164	74	-15.836	Peak
4856	44.851	234	150	H	34.709	8.562	37.027	51.095	54	-2.905	Ave
4856	47.398	272	101	V	34.709	8.562	37.027	53.642	54	-0.358	Ave
7284	48.970	84	124	H	35.618	10.56	36.454	58.699	74	-15.301	Peak
7284	47.390	62	212	V	35.618	10.56	36.454	57.119	74	-16.881	Peak
7284	42.646	84	124	H	35.618	10.56	36.454	52.375	54	-1.625	Ave
7284	41.831	62	212	V	35.618	10.56	36.454	51.560	54	-2.440	Ave

Frequency (MHz)	S.A. Reading (dB μ V)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dB μ V/m)	FCC/ISED		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dB μ V/m)	Margin (dB)	
High Channel 2480 MHz											
2483.5	60.350	271	160	H	32.665	6.099	38.075	61.039	74	-12.961	Peak
2483.5	63.120	85	292	V	32.665	6.099	38.075	63.809	74	-10.191	Peak
2483.5	50.502	271	160	H	32.665	6.099	38.075	51.191	54	-2.809	Ave
2483.5	51.413	85	292	V	32.665	6.099	38.075	52.102	54	-1.898	Ave
4960	51.530	360	267	H	34.709	8.720	37.027	57.932	74	-16.068	Peak
4960	50.640	272	100	V	34.709	8.720	37.027	57.042	74	-16.958	Peak
4960	43.568	360	267	H	34.709	8.720	37.027	49.970	54	-4.030	Ave
4960	43.858	272	100	V	34.709	8.720	37.027	50.260	54	-3.740	Ave
7440	48.220	81	260	H	35.618	10.750	36.496	58.092	74	-15.908	Peak
7440	47.380	279	132	V	35.618	10.750	36.496	57.252	74	-16.748	Peak
7440	40.731	81	260	H	35.618	10.750	36.496	50.603	54	-3.397	Ave
7440	40.789	279	132	V	35.618	10.750	36.496	50.661	54	-3.339	Ave

Note¹: Outside of Restricted Bands. Limit is 30dB down from peak Fundamental Field Strength.

5 FCC §15.247(a) (2) & ISEDC RSS-247 §5.2 -Emission Bandwidth

5.1 Applicable Standards

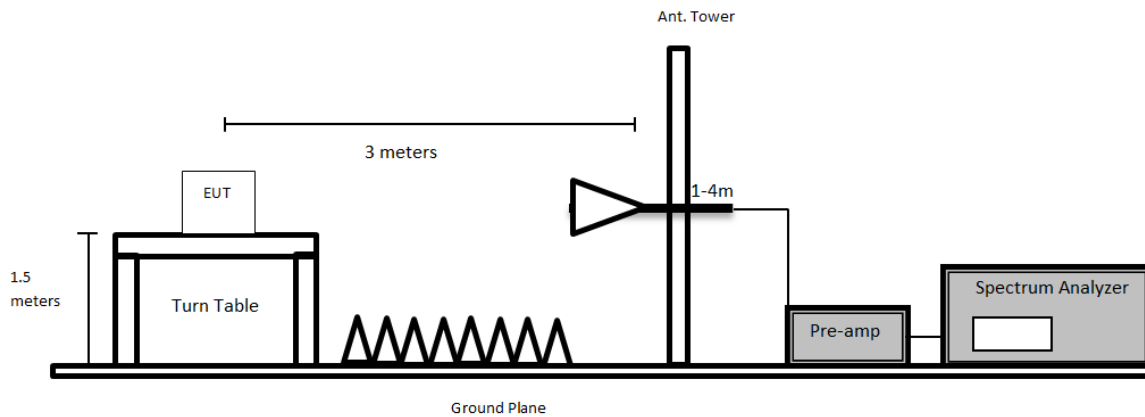
According to ECFR §15.247(a) (2) and ISEDC RSS-247 §5.2(a), systems using digital modulation techniques may operate in the 902~928 MHz, 2400~2483.5 MHz, and 5725~5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz

5.2 Measurement Procedure

The 6 dB bandwidth, i.e., DTS bandwidth, measurements were based on FCC KDB 558074 D01 DTS Meas Guidance v05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 8.2: DTS bandwidth.

The 99% occupied bandwidth was measured in accordance with IC RSS-Gen Issue 5, Section 6.7.

5.3 Test Setup Block Diagram



5.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
624	Agilent	Spectrum Analyzer	E4446A	US44300386	2021-06-23	1 year
32	HP	Pre Amplifier	8449B	3008A01978	2022-05-09	1 year
323	Sunol Sciences	System Controller	SC99V	011003-1	N/R	N/A
1077	Insulated Wire Corp.	157 Series 2.92 SM (x2) Armored 33 ft. Cable	KPS-1571A-3960-KPS	DC 1917	2022-03-30	1 year
1192	ETS Lindgren	Horn Antenna	3117	00218973	2021-09-14	2 years

Note¹: cables included in the test set-up will be checked each time before testing.

Statement of Traceability: BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".

5.5 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Christian McCaig on 2020-05-20 in 5m chamber 3.

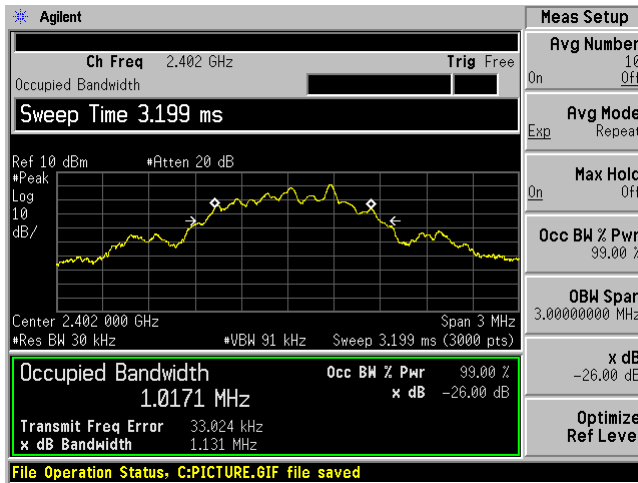
5.6 Test Results

99% and 6 dB Bandwidth

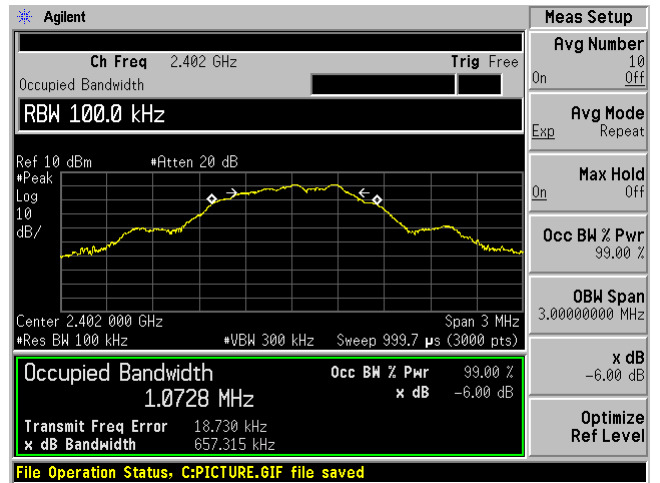
Channel	Frequency (MHz)	99% OBW (MHz)	6 dB OBW (kHz)	6 dB BW limit (kHz)
Low	2402	1.0171	657.315	>500
Middle	2428	1.0132	690.391	>500
High	2480	1.0213	693.776	>500

Please refer to the following plots.

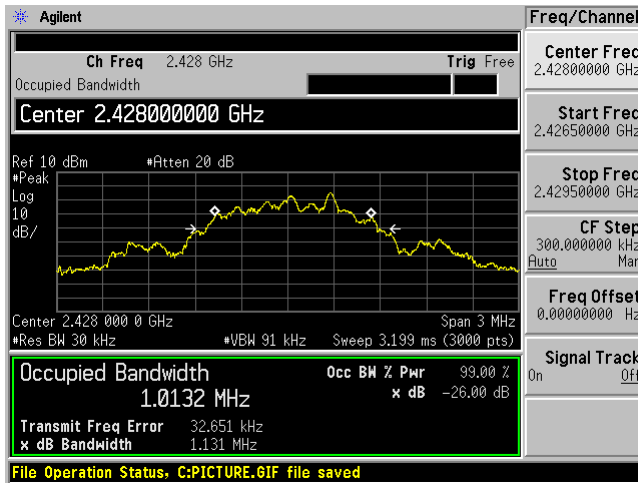
BLE mode 2402 MHz 99% OBW



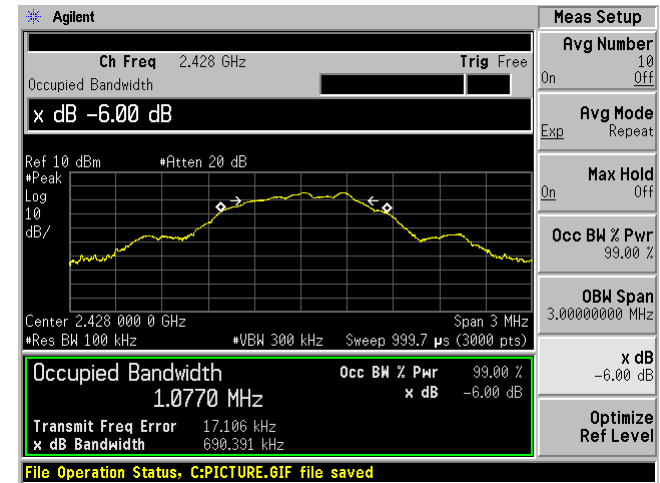
BLE mode 2402 MHz 6 dB OBW



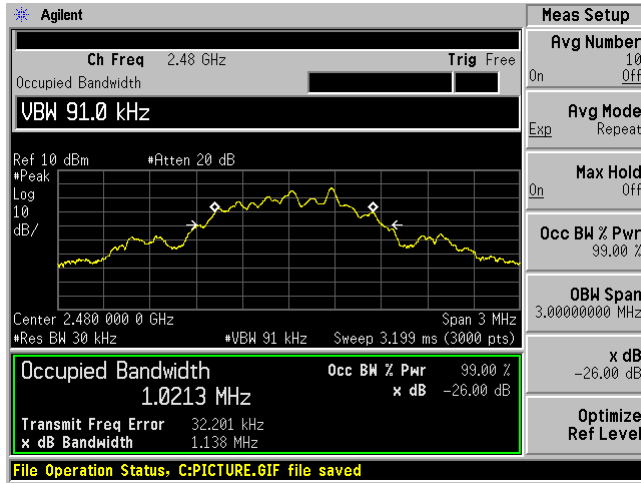
BLE mode 2428 MHz 99% OBW



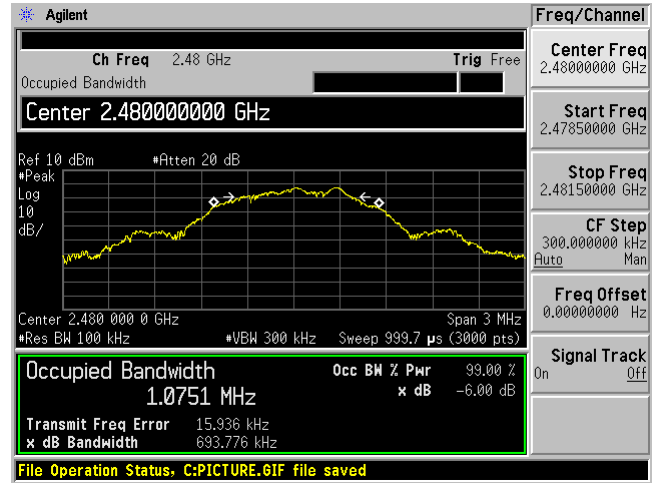
BLE mode 2428 MHz 6 dB OBW



BLE mode 2480 MHz 99% OBW



BLE mode 2480 MHz 6 dB OBW



6 Annex A- EUT Setup Photographs

Please refer to the attachment

7 Annex B- EUT External Photographs

Please refer to the attachment

8 Annex C- EUT Internal Photographs

Please refer to the attachment

9 Annex D (Normative) - A2LA Electrical Testing Certificate



Accredited Laboratory

A2LA has accredited

BAY AREA COMPLIANCE LABORATORIES CORP.

Sunnyvale, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets A2LA R222 - *Specific Requirements EPA ENERGY STAR Accreditation Program*. 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 April 2017).

Presented this 10th day of March 2021.



Trace McInturf, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 3297.02
Valid to September 30, 2022

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

Please follow the web link below for a full ISO 17025 scope

<https://www.a2la.org/scopepdf/3297-02.pdf>

--- END OF REPORT ---