



PCTEST Engineering Laboratory, LLC

IoT (BLE) Gateway Product

FCC 15.249:2021

2400 - 2483.5 MHz Transceiver

FCC ID: 2AYQW-IOTGTWY

Report: PCTE0007, Issue Date: February 17, 2021



NVLAP LAB CODE: 200676-0



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CERTIFICATE OF TEST

qLast Date of Test: January 5, 2021
 PCTEST Engineering Laboratory, LLC
 EUT: IoT (BLE) Gateway Product
 FCC ID: 2AYQW-IOTGTWY

Radio Equipment Testing

Standards

Specification	Method
FCC 15.249:2021	ANSI C63.10:2013
FCC 2.1049	ANSI C63.10:2013

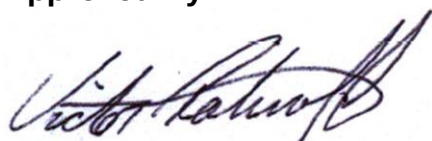
Results

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.
11.8.2	Occupied Bandwidth	Yes	N/A	Characterization of radio operation.

Deviations From Test Standards

None

Approved By:



Victor Ratinoff, 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

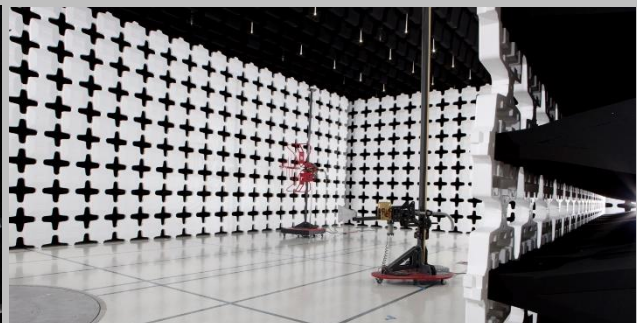
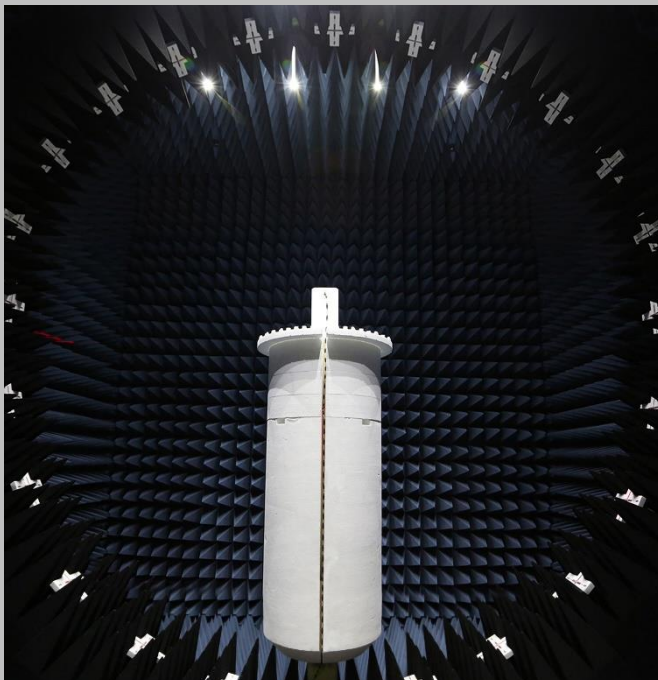
For details on the Scopes of our Accreditations, please visit:

<https://www.nwemc.com/emc-testing-accreditations>

FACILITIES



California Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	Minnesota Labs MN01-11 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/RRA, 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.

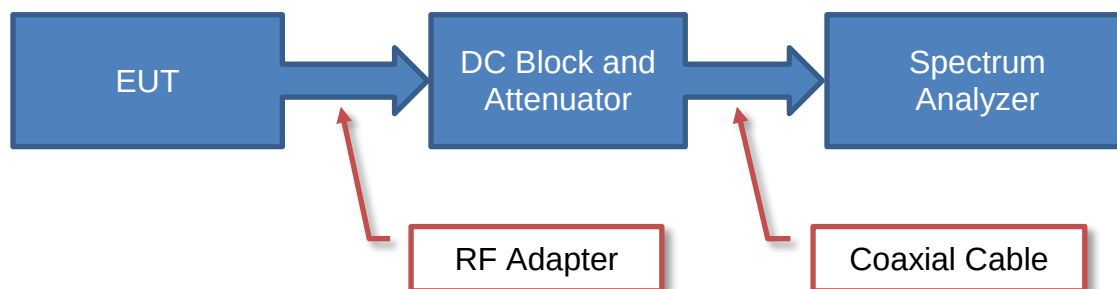
A measurement uncertainty estimation has been performed for each test per our internal quality document QM205.4.6. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) can be found in the table below. A lab specific value may also be found in the applicable test description section. 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.

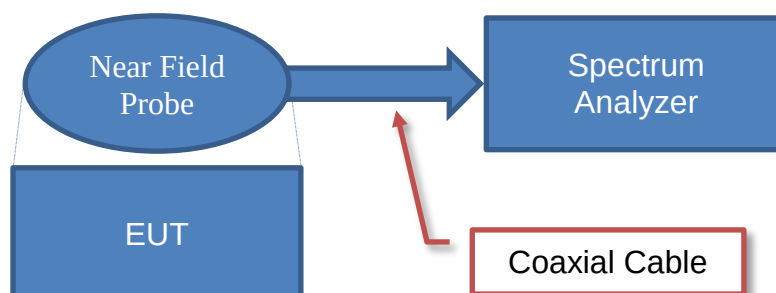
Test	+ MU	- MU
Frequency Accuracy	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	1.2 dB	-1.2 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field Strength (dB)	5.1 dB	-5.1 dB
AC Powerline Conducted Emissions (dB)	2.6 dB	-2.6 dB

Test Setup Block Diagrams

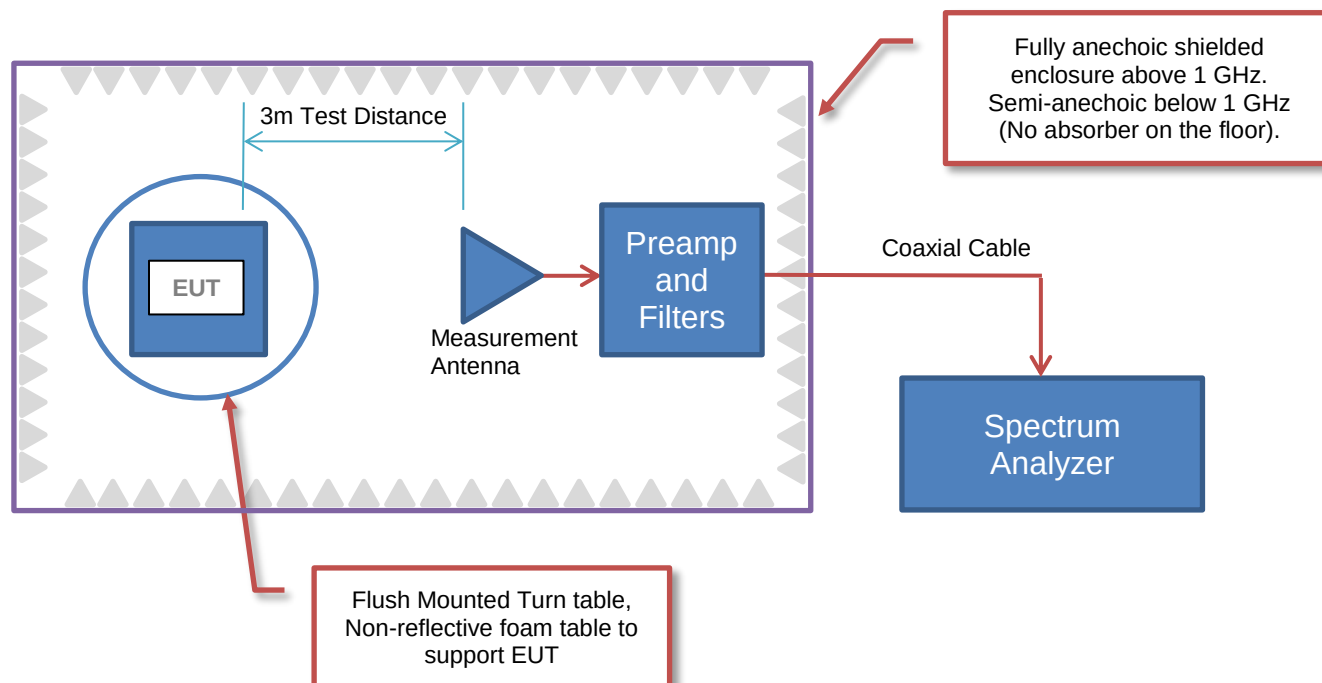
Antenna Port Conducted Measurements



Near Field Test Fixture Measurements



Spurious Radiated Emissions



PRODUCT DESCRIPTION



Client and Equipment Under Test (EUT) Information

Company Name:	Saucon Technologies
Address:	2455 Baglyos Circle
City, State, Zip:	Bethlehem, PA 18020
Test Requested By:	Juliana Wolf
EUT:	IoT (BLE) Gateway Product
First Date of Test:	January 5, 2021
Last Date of Test:	January 5, 2021
Receipt Date of Samples:	September 22, 2020
Equipment Design Stage:	Production
Equipment Condition:	No Damage
Purchase Authorization:	Verified

Information Provided by the Party Requesting the Test

Functional Description of the EUT:
IoT (BLE) Gateway Product
Testing Objective:
Seeking to demonstrate compliance under FCC 15.249:2021 for operation in the 2400 - 2483.5 MHz Band.
Additional Radio Information
FCC ID: 2AYQW-IOTGTWY

CONFIGURATIONS



Configuration PCTE0007- 1

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
IOT Gateway	SAUCON	4SEP-1	Unit #1

Peripherals in test setup boundary			
Description	Manufacturer	Model/Part Number	Serial Number
12V Battery	National Battery	NB 12-10	111008S

Cables					
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2
Twisted Pair	No	30cm	Yes	IOT Gateway	12V Battery
Diagnostic Cable	No	20cm	Yes	IOT Gateway	Unterminated

MODIFICATIONS



Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2021-01-05	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	2021-01-05	Field Strength of Fundamental	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
3	2021-01-12	Duty Cycle	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 2020.06.24.2

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

Transmitting Bluetooth Low Energy. Low Ch. 2402 MHz, Mid Ch. 2440 MHz, High Ch. 2480 MHz. Data rate: 1 Mbps, 2 Mbps, 250 kbps, 500 kbps. Output power: -4dBm

POWER SETTINGS INVESTIGATED

12VDC

CONFIGURATIONS INVESTIGATED

PCTE0007 - 1

FREQUENCY RANGE INVESTIGATED

Start Frequency	30 MHz	Stop Frequency	26000 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
Attenuator	Fairview Microwave	SA18H-20	TKQ	2020-07-01	12 mo
Filter - High Pass	Micro-Tronics	HPM50111	HGQ	2020-01-20	12 mo
Filter - Low Pass	Micro-Tronics	LPM50004	HGK	2020-01-20	12 mo
Amplifier - Pre-Amplifier	Miteq	JSDWK42-18004000-60-5P	PAN	2020-12-18	12 mo
Cable	D-Coax	None	OC4	2020-12-18	12 mo
Antenna - Double Ridge	A.H. Systems, Inc.	SAS-574	AXV	2020-06-03	24 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-12001800-30-10P	AVP	2020-03-02	12 mo
Antenna - Standard Gain	EMCO	3160-08	AHK	NCR	0 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-08001200-30-10P	AVL	2020-03-02	12 mo
Cable	ESM Cable Corp.	8-18GHz cables	OCY	2020-03-02	12 mo
Antenna - Standard Gain	ETS Lindgren	3160-07	AHX	NCR	0 mo
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	AVJ	2020-03-02	12 mo
Cable	ESM Cable Corp.	1-8GHz cables	OCX	2020-03-02	12 mo
Antenna - Double Ridge	ETS Lindgren	3115	AIR	2020-07-07	24 mo
Amplifier - Pre-Amplifier	Miteq	AM-1616-1000	PAD	2020-07-01	12 mo
Cable	ESM Cable Corp.	30-1GHz cables	OCW	2020-05-01	12 mo
Antenna - Biconilog	EMCO	3142	AXB	2020-04-15	24 mo
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFP	2020-07-09	12 mo

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 if required, 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 as well as the restricted band requirements.

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.

Where the radio test software does not provide for a duty cycle at continuous transmit conditions (> 98%) and the RMS (power average) measurements were made across the on and off times of the EUT transmissions, a duty cycle correction is added to the measurements using the formula of $10 \cdot \text{LOG}(dc)$.

FIELD STRENGTH OF HARMONICS AND SPURIOUS RADIATED EMISSIONS

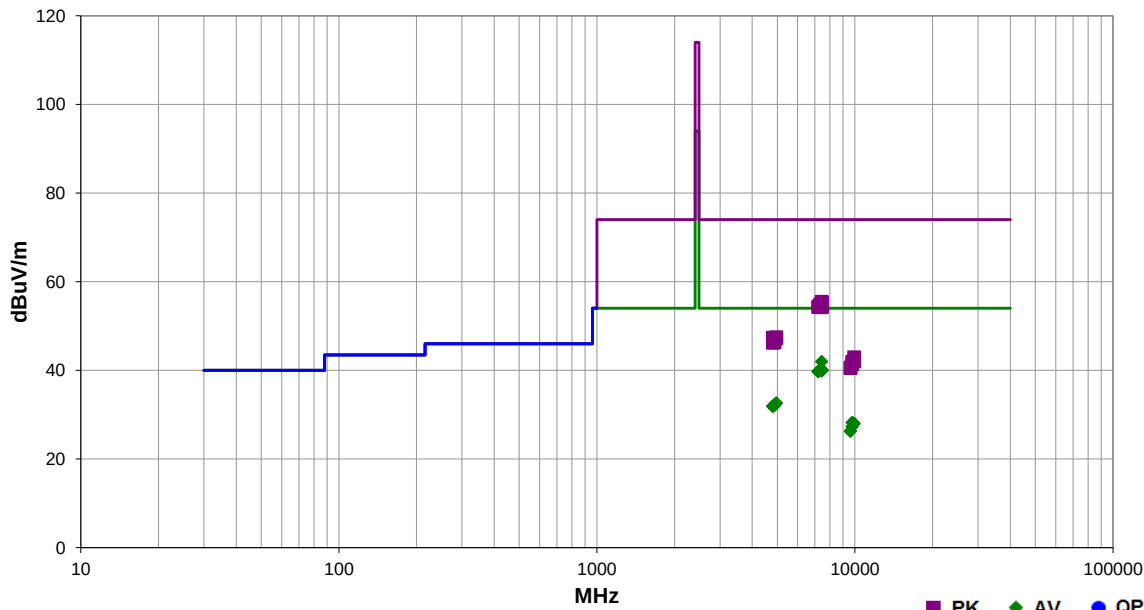


EmiRS 2020.12.09.0 PSA-ESCI 2020.06.24.2

Work Order:	PCTE0007	Date:	2021-01-05	
Project:	None	Temperature:	20.7 °C	
Job Site:	OC07	Humidity:	51.6% RH	
Serial Number:	Unit #1	Barometric Pres.:	1021 mbar	
Tested by: Mark Baytan				
EUT:	IoT (BLE) Gateway Product			
Configuration:	1			
Customer:	PCTEST Engineering Laboratory, LLC			
Attendees:	None			
EUT Power:	12VDC			
Operating Mode:	Transmitting Bluetooth Low Energy. Low Ch. 2402 MHz, Mid Ch. 2440 MHz, High Ch. 2480 MHz. Data rate: 1 Mbps, 2 Mbps, 250 kbps, 500 kbps. Output power: -4dBm			
Deviations:	None			
Comments:	Confirmed duty cycle operation at >98%. Tested at 1.5m table height above 1 GHz and 0.8m table height under 1 GHz			

Test Specifications	Test Method
FCC 15.249:2021	ANSI C63.10:2013

Run #	71	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
7440.667	29.8	12.2	2.5	82.0	3.0	0.0	Horz	AV	0.0	42.0	54.0	-12.0	High Ch, 1Mbps, EUT Vert
7440.725	28.0	12.2	2.5	82.0	3.0	0.0	Horz	AV	0.0	40.2	54.0	-13.8	High Ch, 500kbps, EUT Vert
7440.850	27.9	12.2	2.5	82.0	3.0	0.0	Horz	AV	0.0	40.1	54.0	-13.9	High Ch, 250kbps, EUT Vert
7440.708	27.8	12.2	1.5	201.0	3.0	0.0	Horz	AV	0.0	40.0	54.0	-14.0	High Ch, 1Mbps, EUT on Side
7437.500	27.8	12.2	3.8	330.0	3.0	0.0	Vert	AV	0.0	40.0	54.0	-14.0	High Ch, 1Mbps, EUT on Side
7440.633	27.8	12.2	1.5	349.0	3.0	0.0	Horz	AV	0.0	40.0	54.0	-14.0	High Ch, 1Mbps, EUT Horz
7437.500	27.8	12.2	1.8	81.0	3.0	0.0	Vert	AV	0.0	40.0	54.0	-14.0	High Ch, 1Mbps, EUT Horz
7441.275	27.8	12.2	2.5	82.0	3.0	0.0	Horz	AV	0.0	40.0	54.0	-14.0	High Ch, 2Mbps, EUT Vert
7441.283	27.8	12.2	3.8	330.0	3.0	0.0	Vert	AV	0.0	40.0	54.0	-14.0	High Ch, 2Mbps, EUT on Side
7440.625	27.8	12.2	3.8	330.0	3.0	0.0	Vert	AV	0.0	40.0	54.0	-14.0	High Ch, 250kbps, EUT on Side
7437.500	27.8	12.2	3.8	330.0	3.0	0.0	Vert	AV	0.0	40.0	54.0	-14.0	High Ch, 500kbps, EUT on Side
7319.000	28.3	11.7	1.5	316.0	3.0	0.0	Horz	AV	0.0	40.0	54.0	-14.0	Mid Ch, 1Mbps, EUT Vert
7319.000	28.3	11.7	1.5	25.0	3.0	0.0	Vert	AV	0.0	40.0	54.0	-14.0	Mid Ch, 1Mbps, EUT on Side
7437.500	27.7	12.2	1.5	112.0	3.0	0.0	Vert	AV	0.0	39.9	54.0	-14.1	High Ch, 1Mbps, EUT Vert
7206.677	28.7	11.1	2.2	92.0	3.0	0.0	Vert	AV	0.0	39.8	54.0	-14.2	Low Ch, 1Mbps, EUT on Side
7205.000	28.6	11.1	3.6	220.0	3.0	0.0	Horz	AV	0.0	39.7	54.0	-14.3	Low Ch, 1Mbps, EUT Vert
7441.308	43.3	12.2	1.5	201.0	3.0	0.0	Horz	PK	0.0	55.5	74.0	-18.5	High Ch, 1Mbps, EUT on Side
7440.333	43.2	12.2	2.5	82.0	3.0	0.0	Horz	PK	0.0	55.4	74.0	-18.6	High Ch, 1Mbps, EUT Vert
7441.350	43.1	12.2	2.5	82.0	3.0	0.0	Horz	PK	0.0	55.3	74.0	-18.7	High Ch, 250kbps, EUT Vert
7440.392	43.0	12.2	3.8	330.0	3.0	0.0	Vert	PK	0.0	55.2	74.0	-18.8	High Ch, 250kbps, EUT on Side
7438.292	42.8	12.2	2.5	82.0	3.0	0.0	Horz	PK	0.0	55.0	74.0	-19.0	High Ch, 2Mbps, EUT Vert
7438.875	42.8	12.2	2.5	82.0	3.0	0.0	Horz	PK	0.0	55.0	74.0	-19.0	High Ch, 500kbps, EUT Vert

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
7319.177	43.2	11.7	1.5	25.0	3.0	0.0	Vert	PK	0.0	54.9	74.0	-19.1	Mid Ch, 1Mbps, EUT on Side
7441.642	42.5	12.3	1.5	112.0	3.0	0.0	Vert	PK	0.0	54.8	74.0	-19.2	High Ch, 1Mbps, EUT Vert
7319.507	43.0	11.7	1.5	316.0	3.0	0.0	Horz	PK	0.0	54.7	74.0	-19.3	Mid Ch, 1Mbps, EUT Vert
7440.575	42.3	12.2	3.8	330.0	3.0	0.0	Vert	PK	0.0	54.5	74.0	-19.5	High Ch, 1Mbps, EUT on Side
7442.400	42.2	12.3	3.8	330.0	3.0	0.0	Vert	PK	0.0	54.5	74.0	-19.5	High Ch, 2Mbps, EUT on Side
7440.692	42.3	12.2	3.8	330.0	3.0	0.0	Vert	PK	0.0	54.5	74.0	-19.5	High Ch, 500kbps, EUT on Side
7439.183	42.2	12.2	1.5	349.0	3.0	0.0	Horz	PK	0.0	54.4	74.0	-19.6	High Ch, 1Mbps, EUT Horz
7206.840	43.3	11.1	2.2	92.0	3.0	0.0	Vert	PK	0.0	54.4	74.0	-19.6	Low Ch, 1Mbps, EUT on Side
7206.287	43.2	11.1	3.6	220.0	3.0	0.0	Horz	PK	0.0	54.3	74.0	-19.7	Low Ch, 1Mbps, EUT Vert
7438.992	42.0	12.2	1.8	81.0	3.0	0.0	Vert	PK	0.0	54.2	74.0	-19.8	High Ch, 1Mbps, EUT Horz
4959.000	28.2	4.4	1.5	88.0	3.0	0.0	Horz	AV	0.0	32.6	54.0	-21.4	High Ch, 1Mbps, EUT Vert
4959.000	28.2	4.4	1.5	350.0	3.0	0.0	Vert	AV	0.0	32.6	54.0	-21.4	High Ch, 1Mbps, EUT on Side
4879.000	28.0	4.1	1.5	298.0	3.0	0.0	Horz	AV	0.0	32.1	54.0	-21.9	Mid Ch, 1Mbps, EUT Vert
4879.000	28.0	4.1	2.8	257.0	3.0	0.0	Vert	AV	0.0	32.1	54.0	-21.9	Mid Ch, 1Mbps, EUT on Side
4803.000	27.9	4.0	1.7	154.0	3.0	0.0	Horz	AV	0.0	31.9	54.0	-22.1	Low Ch, 1Mbps, EUT Vert
4803.000	27.9	4.0	1.5	287.0	3.0	0.0	Vert	AV	0.0	31.9	54.0	-22.1	Low Ch, 1Mbps, EUT on Side
9760.950	34.7	-6.5	1.5	311.0	3.0	0.0	Horz	AV	0.0	28.2	54.0	-25.8	Mid Ch, 1Mbps, EUT Vert
9920.917	34.5	-6.4	2.5	54.0	3.0	0.0	Horz	AV	0.0	28.1	54.0	-25.9	High Ch, 1Mbps, EUT Vert
9919.142	34.3	-6.4	2.2	53.0	3.0	0.0	Vert	AV	0.0	27.9	54.0	-26.1	High Ch, 1Mbps, EUT on Side
4959.200	43.1	4.4	1.5	88.0	3.0	0.0	Horz	PK	0.0	47.5	74.0	-26.5	High Ch, 1Mbps, EUT Vert
4803.010	43.4	4.0	1.5	287.0	3.0	0.0	Vert	PK	0.0	47.4	74.0	-26.6	Low Ch, 1Mbps, EUT on Side
9761.000	33.8	-6.5	1.5	249.0	3.0	0.0	Vert	AV	0.0	27.3	54.0	-26.7	Mid Ch, 1Mbps, EUT on Side
4959.963	42.9	4.4	1.5	350.0	3.0	0.0	Vert	PK	0.0	47.3	74.0	-26.7	High Ch, 1Mbps, EUT on Side
4879.600	42.8	4.1	1.5	298.0	3.0	0.0	Horz	PK	0.0	46.9	74.0	-27.1	Mid Ch, 1Mbps, EUT Vert
9605.500	33.1	-6.8	1.0	11.0	3.0	0.0	Horz	AV	0.0	26.3	54.0	-27.7	Low Ch, 1Mbps, EUT Vert
9605.500	33.1	-6.8	3.2	173.0	3.0	0.0	Vert	AV	0.0	26.3	54.0	-27.7	Low Ch, 1Mbps, EUT on Side
4879.990	42.2	4.1	2.8	257.0	3.0	0.0	Vert	PK	0.0	46.3	74.0	-27.7	Mid Ch, 1Mbps, EUT on Side
4803.323	42.2	4.0	1.7	154.0	3.0	0.0	Horz	PK	0.0	46.2	74.0	-27.8	Low Ch, 1Mbps, EUT Vert
9919.575	49.4	-6.4	2.2	53.0	3.0	0.0	Vert	PK	0.0	43.0	74.0	-31.0	High Ch, 1Mbps, EUT on Side
9760.433	48.5	-6.5	1.5	311.0	3.0	0.0	Horz	PK	0.0	42.0	74.0	-32.0	Mid Ch, 1Mbps, EUT Vert
9919.342	48.4	-6.4	2.5	54.0	3.0	0.0	Horz	PK	0.0	42.0	74.0	-32.0	High Ch, 1Mbps, EUT Vert
9760.200	47.9	-6.5	1.5	249.0	3.0	0.0	Vert	PK	0.0	41.4	74.0	-32.6	Mid Ch, 1Mbps, EUT on Side
9607.325	47.6	-6.9	1.0	11.0	3.0	0.0	Horz	PK	0.0	40.7	74.0	-33.3	Low Ch, 1Mbps, EUT Vert
9609.258	47.4	-6.9	3.2	173.0	3.0	0.0	Vert	PK	0.0	40.5	74.0	-33.5	Low Ch, 1Mbps, EUT on Side

FIELD STRENGTH OF HARMONICS AND SPURIOUS RADIATED EMISSIONS

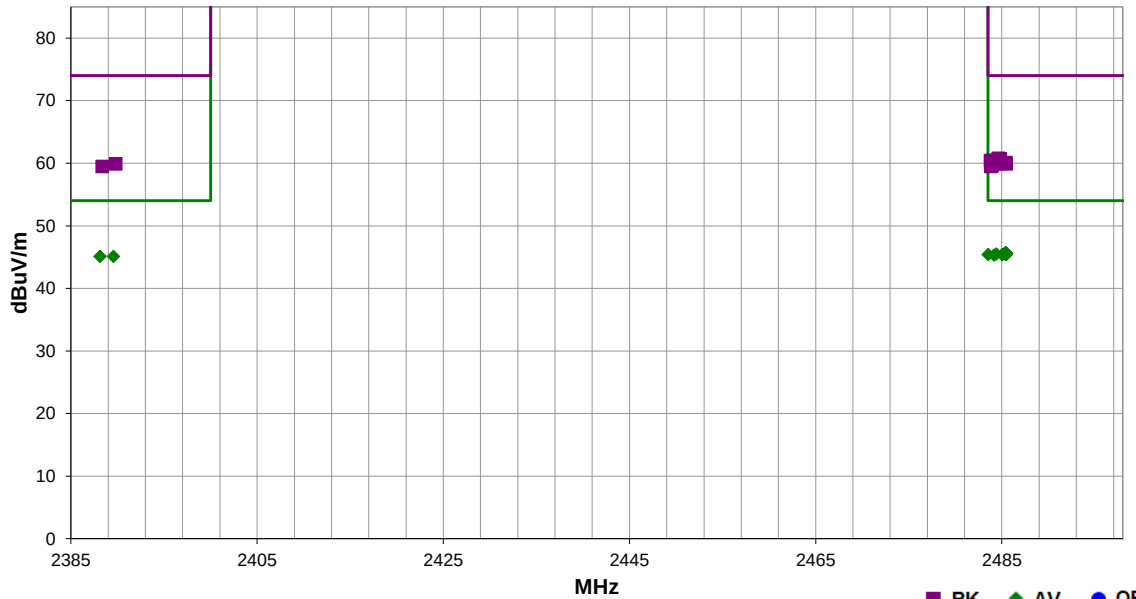


EmiRS 2020.12.09.0 PSA-ESCI 2020.06.24.2

Work Order:	PCTE0007	Date:	2021-01-05	
Project:	None	Temperature:	20.7 °C	
Job Site:	OC07	Humidity:	51.6% RH	
Serial Number:	Unit #1	Barometric Pres.:	1021 mbar	
Tested by: Mark Baytan				
EUT:	IoT (BLE) Gateway Product			
Configuration:	1			
Customer:	PCTEST Engineering Laboratory, LLC			
Attendees:	None			
EUT Power:	12VDC			
Operating Mode:	Transmitting Bluetooth Low Energy. Low Ch. 2402 MHz, High Ch. 2480 MHz. Data rate: 1 Mbps, 2 Mbps, 250 kbps, 500 kbps. Output power: -4dBm			
Deviations:	None			
Comments:	Confirmed duty cycle operation at >98%. Tested at 1.5m table height			

Test Specifications	Test Method
FCC 15.249:2021	ANSI C63.10:2013

Run #	70	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
2485.397	29.8	-4.1	1.18	103.0	3.0	20.0	Horz	AV	0.0	45.7	54.0	-8.3	High Ch, 1Mbps, EUT on Side
2485.433	29.7	-4.1	3.0	0.0	3.0	20.0	Vert	AV	0.0	45.6	54.0	-8.4	High Ch, 1Mbps, EUT on Side
2485.493	29.7	-4.1	1.5	186.0	3.0	20.0	Horz	AV	0.0	45.6	54.0	-8.4	High Ch, 1Mbps, EUT Vert
2485.500	29.7	-4.1	2.88	314.0	3.0	20.0	Horz	AV	0.0	45.6	54.0	-8.4	High Ch, 1Mbps, EUT Horz
2485.377	29.7	-4.1	1.39	170.0	3.0	20.0	Vert	AV	0.0	45.6	54.0	-8.4	High Ch, 1Mbps, EUT Horz
2484.420	29.7	-4.2	1.5	350.0	3.0	20.0	Vert	AV	0.0	45.5	54.0	-8.5	High Ch, 1Mbps, EUT Vert
2483.530	29.6	-4.2	1.18	103.0	3.0	20.0	Horz	AV	0.0	45.4	54.0	-8.6	High Ch, 2Mbps, EUT on Side
2485.063	29.5	-4.1	1.0	0.0	3.0	20.0	Vert	AV	0.0	45.4	54.0	-8.6	High Ch, 2Mbps, EUT on Side
2485.080	29.5	-4.1	1.0	0.0	3.0	20.0	Vert	AV	0.0	45.4	54.0	-8.6	High Ch, 250kbps, EUT on Side
2485.493	29.5	-4.1	1.18	103.0	3.0	20.0	Horz	AV	0.0	45.4	54.0	-8.6	High Ch, 250kbps, EUT on Side
2485.423	29.5	-4.1	1.0	0.0	3.0	20.0	Vert	AV	0.0	45.4	54.0	-8.6	High Ch, 500kbps, EUT on Side
2484.167	29.5	-4.2	1.18	103.0	3.0	20.0	Horz	AV	0.0	45.3	54.0	-8.7	High Ch, 500kbps, EUT on Side
2388.133	29.8	-4.7	1.5	181.0	3.0	20.0	Horz	AV	0.0	45.1	54.0	-8.9	Low Ch, 1Mbps, EUT on Side
2389.560	29.8	-4.7	1.5	2.0	3.0	20.0	Vert	AV	0.0	45.1	54.0	-8.9	Low Ch, 1Mbps, EUT on Side
2484.607	45.0	-4.2	3.0	0.0	3.0	20.0	Vert	PK	0.0	60.8	74.0	-13.2	High Ch, 1Mbps, EUT on Side
2484.830	44.9	-4.2	1.5	186.0	3.0	20.0	Horz	PK	0.0	60.7	74.0	-13.3	High Ch, 1Mbps, EUT Vert
2484.727	44.7	-4.2	1.5	350.0	3.0	20.0	Vert	PK	0.0	60.5	74.0	-13.5	High Ch, 1Mbps, EUT Vert
2483.980	44.7	-4.2	2.88	314.0	3.0	20.0	Horz	PK	0.0	60.5	74.0	-13.5	High Ch, 1Mbps, EUT Horz
2483.780	44.6	-4.2	1.18	103.0	3.0	20.0	Horz	PK	0.0	60.4	74.0	-13.6	High Ch, 1Mbps, EUT on Side
2484.203	44.4	-4.2	1.0	0.0	3.0	20.0	Vert	PK	0.0	60.2	74.0	-13.8	High Ch, 500kbps, EUT on Side
2485.427	44.2	-4.1	1.0	0.0	3.0	20.0	Vert	PK	0.0	60.1	74.0	-13.9	High Ch, 250kbps, EUT on Side
2484.983	44.2	-4.2	1.18	103.0	3.0	20.0	Horz	PK	0.0	60.0	74.0	-14.0	High Ch, 2Mbps, EUT on Side

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
2484.500	44.1	-4.2	1.39	170.0	3.0	20.0	Vert	PK	0.0	59.9	74.0	-14.1	High Ch, 1Mbps, EUT Horz
2485.450	44.0	-4.1	1.18	103.0	3.0	20.0	Horz	PK	0.0	59.9	74.0	-14.1	High Ch, 500kbps, EUT on Side
2389.800	44.6	-4.7	1.5	181.0	3.0	20.0	Horz	PK	0.0	59.9	74.0	-14.1	Low Ch, 1Mbps, EUT on Side
2483.963	43.8	-4.2	1.18	103.0	3.0	20.0	Horz	PK	0.0	59.6	74.0	-14.4	High Ch, 250kbps, EUT on Side
2483.823	43.7	-4.2	1.0	0.0	3.0	20.0	Vert	PK	0.0	59.5	74.0	-14.5	High Ch, 2Mbps, EUT on Side
2388.350	44.2	-4.7	1.5	2.0	3.0	20.0	Vert	PK	0.0	59.5	74.0	-14.5	Low Ch, 1Mbps, EUT on Side

FIELD STRENGTH OF FUNDAMENTAL



PSA-ESCI 2020.06.24.2

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

Transmitting Bluetooth Low Energy. Low Ch. 2402 MHz, Mid Ch. 2440 MHz, High Ch. 2480 MHz. Data rate: 1 Mbps, 2 Mbps, 125 kbps, 500 kbps. Output power: -4dBm

POWER SETTINGS INVESTIGATED

12VDC

CONFIGURATIONS INVESTIGATED

PCTE0007 - 1

FREQUENCY RANGE INVESTIGATED

Start Frequency	2400 MHz	Stop Frequency	2483.5 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
Cable	ESM Cable Corp.	1-8GHz cables	OCX	2020-03-02	12 mo
Antenna - Double Ridge	ETS Lindgren	3115	AIR	2020-07-07	24 mo
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	AVJ	2020-03-02	12 mo
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFP	2020-07-09	12 mo
Attenuator	S.M. Electronics	SA6-20	REO	2021-01-18	12 mo

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

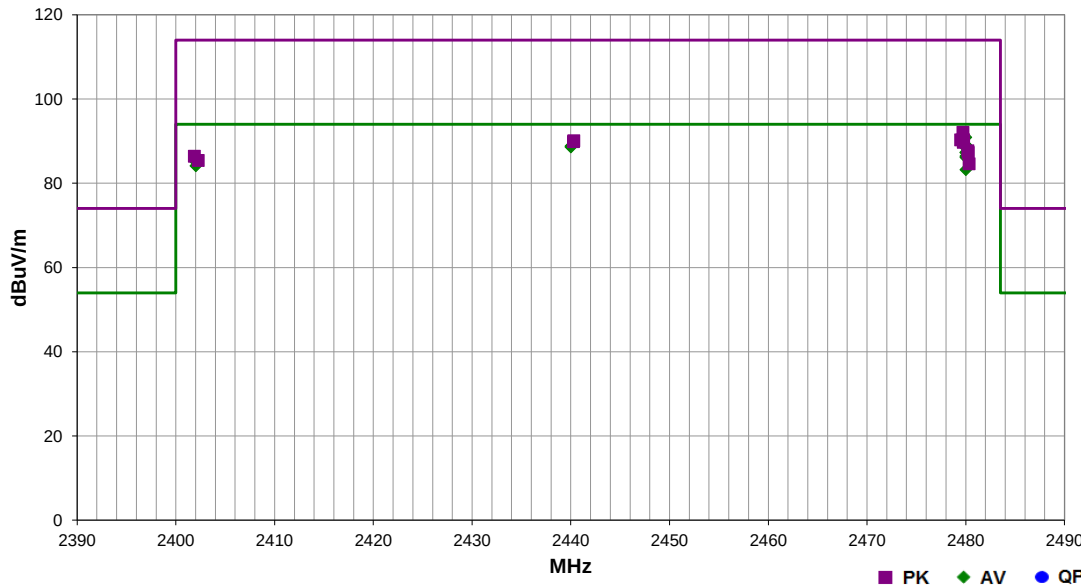


EmiR5 2020.12.09.0 PSA-ESCI 2020.06.24.2

Work Order:	PCTE0007	Date:	2021-01-05	
Project:	None	Temperature:	20.3 °C	
Job Site:	OC07	Humidity:	52% RH	
Serial Number:	Unit #1	Barometric Pres.:	1021 mbar	
EUT: IoT (BLE) Gateway Product				Tested by: Nolan De Ramos
Configuration: 1				
Customer: PCTEST Engineering Laboratory, LLC				
Attendees: None				
EUT Power: 12VDC				
Operating Mode: Transmitting Bluetooth Low Energy. Low Ch. 2402 MHz, Mid Ch. 2440 MHz, High Ch. 2480 MHz. Data rate: 1 Mbps, 2 Mbps, 125 kbps, 500 kbps. Output power: -4dBm				
Deviations: None				
Comments: Tested at 1.5m table height				

Test Specifications	Test Method
FCC 15.249:2021	ANSI C63.10:2013

Run #	57	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
2480.025	75.2	-4.3	1.01	290.0	3.0	20.0	Horz	AV	0.0	90.9	94.0	-3.1	EUT on Side, High Ch, 1 Mbps, -4dBm
2480.017	73.4	-4.3	1.01	291.0	3.0	20.0	Horz	AV	0.0	89.1	94.0	-4.9	EUT on Side, High Ch, 500 kbps, -4dBm
2480.017	73.2	-4.3	1.44	126.0	3.0	20.0	Horz	AV	0.0	88.9	94.0	-5.1	EUT Horz, High Ch, 1 Mbps, -4dBm
2480.008	73.1	-4.3	1.01	291.0	3.0	20.0	Horz	AV	0.0	88.8	94.0	-5.2	EUT on Side, High Ch, 125 kbps, -4dBm
2440.025	73.3	-4.5	3.59	262.0	3.0	20.0	Vert	AV	0.0	88.8	94.0	-5.2	EUT Vert, Mid Ch, 1 Mbps, -4dBm
2440.017	73.1	-4.5	1.13	287.0	3.0	20.0	Horz	AV	0.0	88.6	94.0	-5.4	EUT on Side, Mid Ch, 1 Mbps, -4dBm
2480.025	72.7	-4.3	1.44	304.0	3.0	20.0	Vert	AV	0.0	88.4	94.0	-5.6	EUT Vert, High Ch, 1 Mbps, -4dBm
2480.008	71.6	-4.3	1.01	290.0	3.0	20.0	Horz	AV	0.0	87.3	94.0	-6.7	EUT on Side, High Ch, 2 Mbps, -4dBm
2480.025	70.7	-4.3	1.82	150.0	3.0	20.0	Horz	AV	0.0	86.4	94.0	-7.6	EUT Vert, High Ch, 1 Mbps, -4dBm
2480.025	70.4	-4.3	3.51	162.0	3.0	20.0	Vert	AV	0.0	86.1	94.0	-7.9	EUT on Side, High Ch, 1 Mbps, -4dBm
2402.017	69.7	-4.6	1.0	292.0	3.0	20.0	Vert	AV	0.0	85.1	94.0	-8.9	EUT Vert, Low Ch, 1 Mbps, -4dBm
2402.025	68.7	-4.6	1.2	97.0	3.0	20.0	Horz	AV	0.0	84.1	94.0	-9.9	EUT on Side, Low Ch, 1 Mbps, -4dBm
2480.025	67.5	-4.3	3.56	240.0	3.0	20.0	Vert	AV	0.0	83.2	94.0	-10.8	EUT Horz, High Ch, 1 Mbps, -4dBm
2479.717	76.4	-4.3	1.01	290.0	3.0	20.0	Horz	PK	0.0	92.1	114.0	-21.9	EUT on Side, High Ch, 1 Mbps, -4dBm
2479.708	74.7	-4.3	1.01	291.0	3.0	20.0	Horz	PK	0.0	90.4	114.0	-23.6	EUT on Side, High Ch, 500 kbps, -4dBm
2479.492	74.6	-4.3	1.01	290.0	3.0	20.0	Horz	PK	0.0	90.3	114.0	-23.7	EUT on Side, High Ch, 1 Mbps, -4dBm
2479.758	74.6	-4.3	1.01	291.0	3.0	20.0	Horz	PK	0.0	90.3	114.0	-23.7	EUT on Side, High Ch, 125 kbps, -4dBm
2479.783	74.5	-4.3	1.44	126.0	3.0	20.0	Horz	PK	0.0	90.2	114.0	-23.8	EUT Horz, High Ch, 1 Mbps, -4dBm
2440.308	74.6	-4.5	3.59	262.0	3.0	20.0	Vert	PK	0.0	90.1	114.0	-23.9	EUT Vert, Mid Ch, 1 Mbps, -4dBm
2440.267	74.4	-4.5	1.13	287.0	3.0	20.0	Horz	PK	0.0	89.9	114.0	-24.1	EUT on Side, Mid Ch, 1 Mbps, -4dBm
2479.758	74.0	-4.3	1.44	304.0	3.0	20.0	Vert	PK	0.0	89.7	114.0	-24.3	EUT Vert, High Ch, 1 Mbps, -4dBm
2480.208	72.0	-4.3	1.82	150.0	3.0	20.0	Horz	PK	0.0	87.7	114.0	-26.3	EUT Vert, High Ch, 1 Mbps, -4dBm
2480.258	71.6	-4.3	3.51	162.0	3.0	20.0	Vert	PK	0.0	87.3	114.0	-26.7	EUT on Side, High Ch, 1 Mbps, -4dBm
2401.867	71.0	-4.6	1.0	292.0	3.0	20.0	Vert	PK	0.0	86.4	114.0	-27.6	EUT Vert, Low Ch, 1 Mbps, -4dBm
2402.267	70.0	-4.6	1.2	97.0	3.0	20.0	Horz	PK	0.0	85.4	114.0	-28.6	EUT on Side, Low Ch, 1 Mbps, -4dBm
2480.342	68.9	-4.3	3.56	240.0	3.0	20.0	Vert	PK	0.0	84.6	114.0	-29.4	EUT Horz, High Ch, 1 Mbps, -4dBm

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.

OCCUPIED BANDWIDTH

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.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Block - DC	Fairview Microwave	SD3379	AMV	2020-12-18	2021-12-18
Attenuator	Fairview Microwave	SA18H-20	TKR	2020-12-18	2021-12-18
Cable	Fairview Microwave	SCA1814-0101-120	OCZ	NCR	NCR
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFP	2020-07-09	2021-07-09

TEST DESCRIPTION

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth as defined in RSS-Gen.

The 99% occupied bandwidth was measured with the EUT configured for continuous modulated operation.

The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.

The resolution bandwidth (RBW) of the spectrum analyzer was set to the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) bandwidth was set to at least 3 times the resolution bandwidth. The analyzer sweep time was set to auto to prevent video filtering or averaging. A sample detector was used unless the device was not able to be operated in a continuous transmit mode, in which case a peak detector was used.

The spectrum analyzer occupied bandwidth measurement function was used to sum the power of the transmission in linear terms to obtain the 99% bandwidth.

OCCUPIED BANDWIDTH

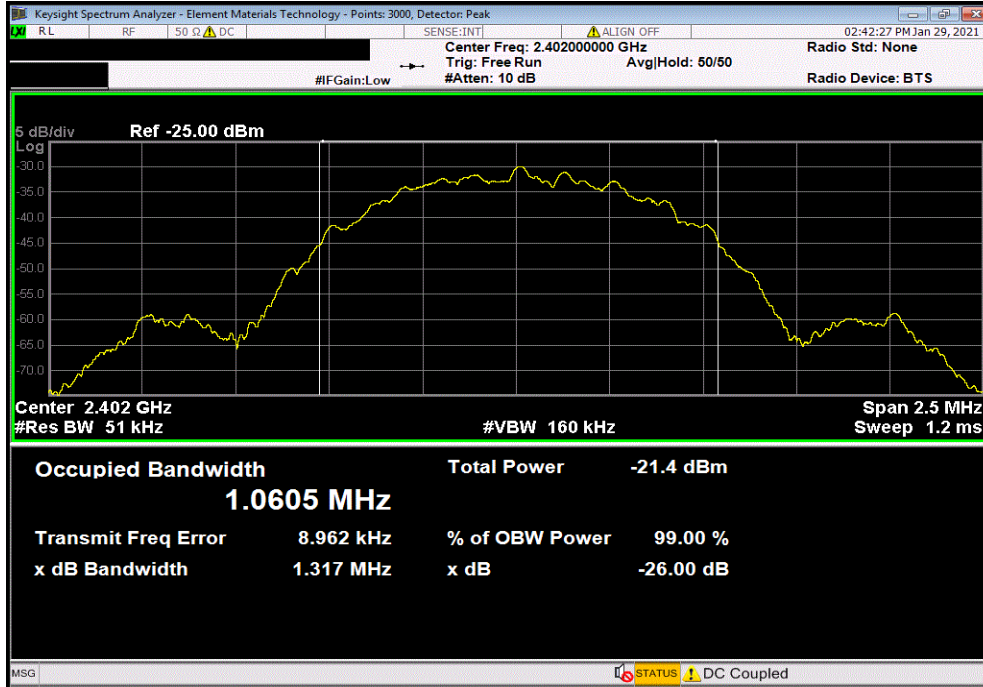


TxE1x 2019.08.30.0 XMI 2020.12.30.0

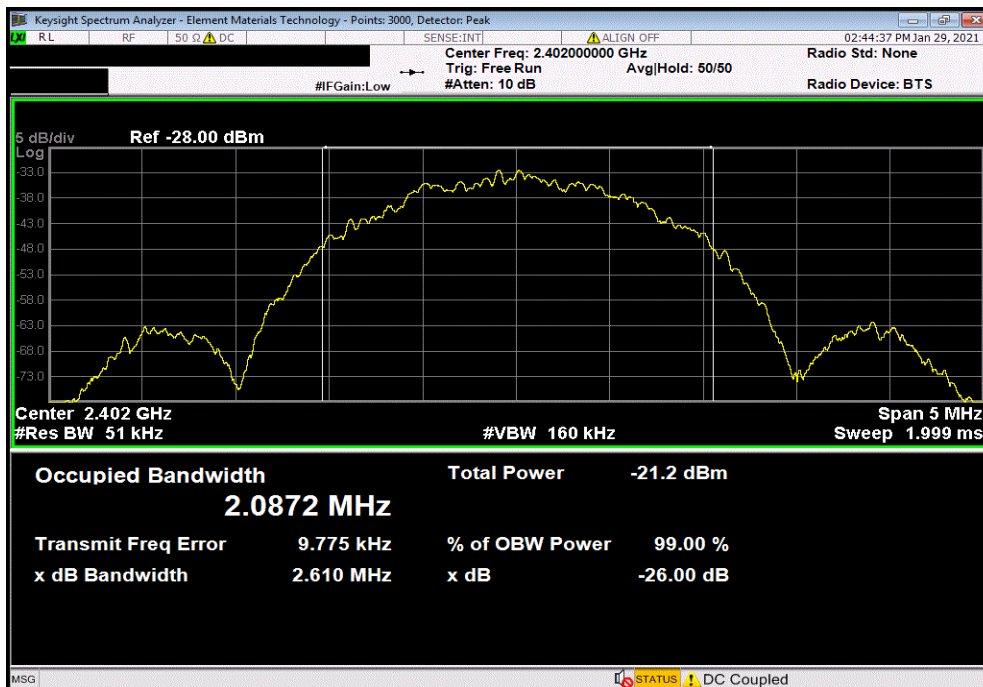
EUT: IoT (BLE) Gateway Product		Work Order: PCTE0007	
Serial Number: None		Date: 29-Jan-21	
Customer: PCTEST Engineering Laboratory, LLC		Temperature: 18.4 °C	
Attendees: None		Humidity: 50.3% RH	
Project: None		Barometric Pres.: 1018 mbar	
Tested by: Nolan De Ramos	Power: 12VDC	Job Site: OC13	
TEST SPECIFICATIONS		Test Method	
FCC 2.1049		ANSI C63.10:2013	
COMMENTS			
Transmitting Bluetooth Low Energy. Low Ch. 2402 MHz, Mid Ch. 2440 MHz, High Ch. 2480 MHz. Data rate: 1 Mbps, 2 Mbps, 125 kbps, 500 kbps. Output power: -4dBm			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1	<i>Signature</i> 	
		Value	Limit (≤) 0.5% of Center Frequency
BLE/GFSK Low Channel, 2402 MHz			
	1 Mbps	1.06 MHz	12.01 MHz
	2 Mbps	2.087 MHz	12.01 MHz
	125 kbps	1.081 MHz	12.01 MHz
	500 kbps	1.057 MHz	12.01 MHz
BLE/GFSK Mid Channel, 2440 MHz			
	1 Mbps	1.067 MHz	12.2 MHz
	2 Mbps	2.056 MHz	12.2 MHz
	125 kbps	1.081 MHz	12.2 MHz
	500 kbps	1.054 MHz	12.2 MHz
BLE/GFSK High Channel, 2480 MHz			
	1 Mbps	1.066 MHz	12.4 MHz
	2 Mbps	2.086 MHz	12.4 MHz
	125 kbps	1.084 MHz	12.4 MHz
	500 kbps	1.061 MHz	12.4 MHz

OCCUPIED BANDWIDTH

BLE/GFSK Low Channel, 2402 MHz, 1 Mbps					Limit	
					Value	(≤) 0.5% of Center Frequency
					1.06 MHz	12.01 MHz
						Pass



BLE/GFSK Low Channel, 2402 MHz, 2 Mbps					Limit	
					Value	(≤) 0.5% of Center Frequency
					2.087 MHz	12.01 MHz
						Pass

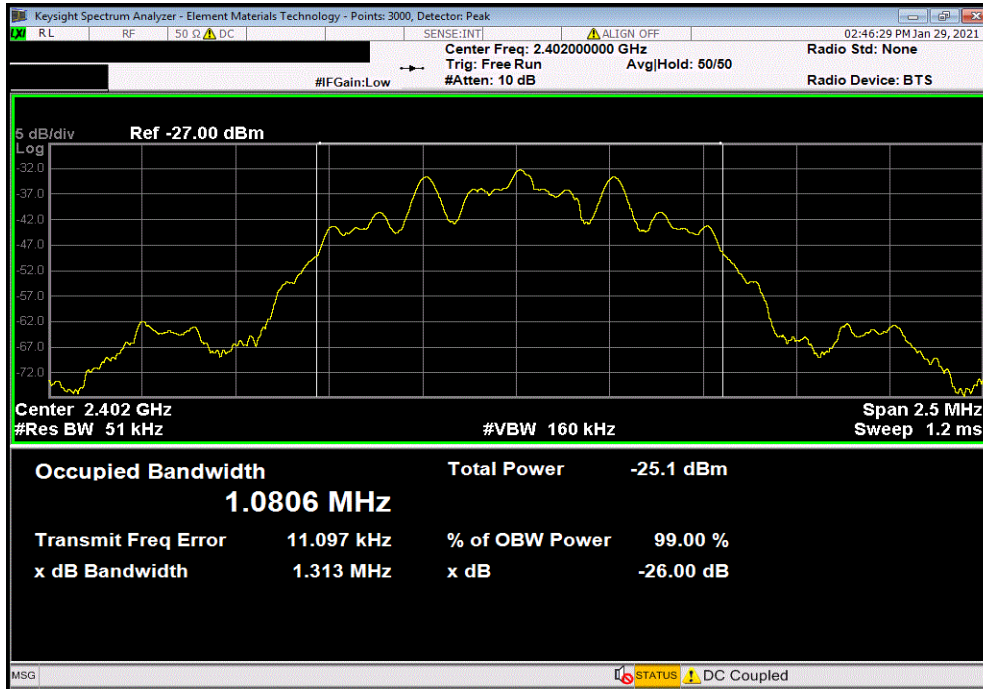


OCCUPIED BANDWIDTH

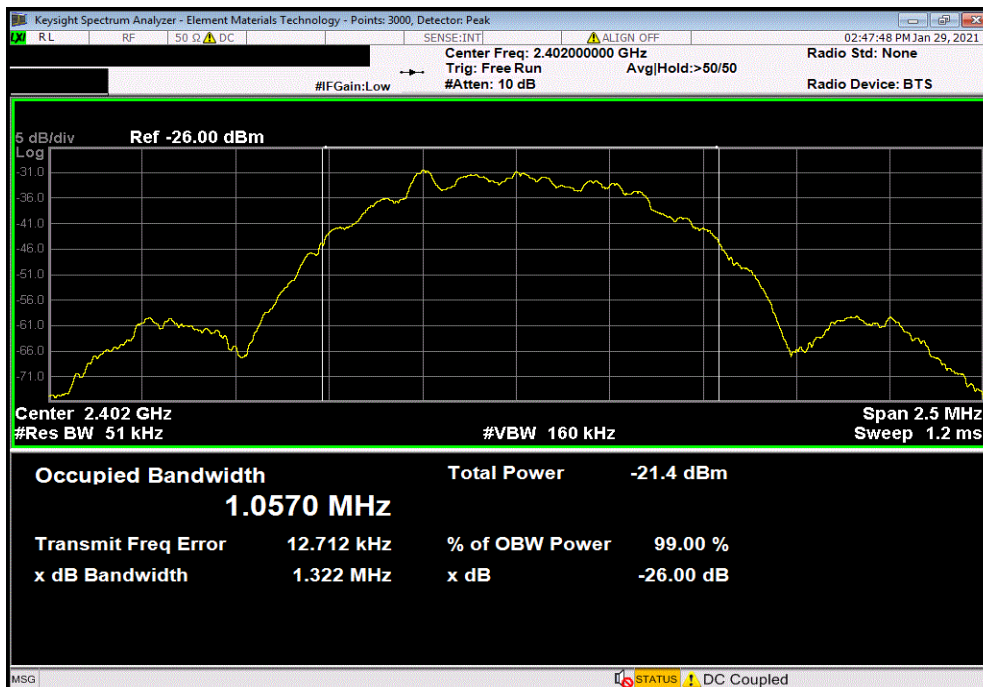


TbTx 2019.08.30.0 XMill 2020.12.30.0

BLE/GFSK Low Channel, 2402 MHz, 125 kbps					Limit	
Value					(≤) 0.5% of Center Frequency	Result
				1.081 MHz	12.01 MHz	Pass

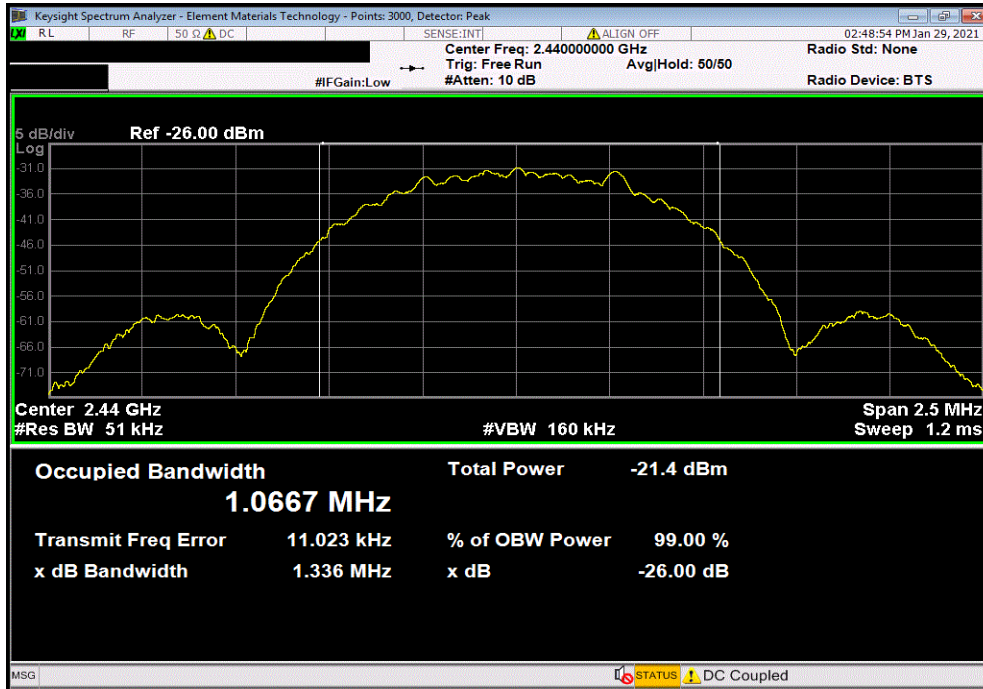


BLE/GFSK Low Channel, 2402 MHz, 500 kbps					Limit	
Value					(≤) 0.5% of Center Frequency	Result
				1.057 MHz	12.01 MHz	Pass

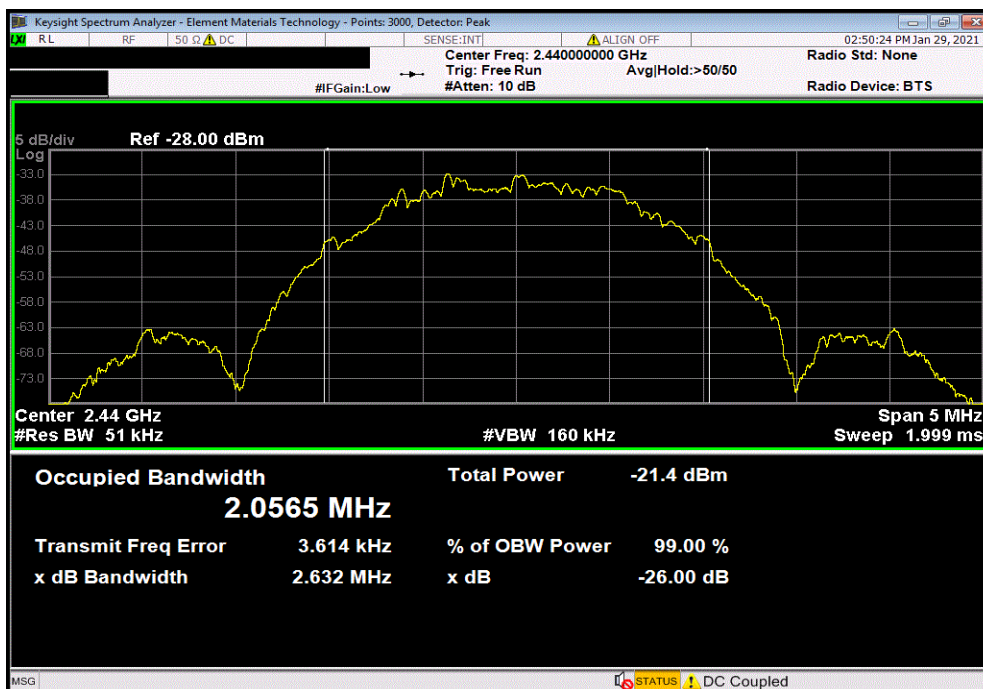


OCCUPIED BANDWIDTH

BLE/GFSK Mid Channel, 2440 MHz, 1 Mbps					Limit	
Value					(≤) 0.5% of Center Frequency	Result
				1.067 MHz	12.2 MHz	Pass

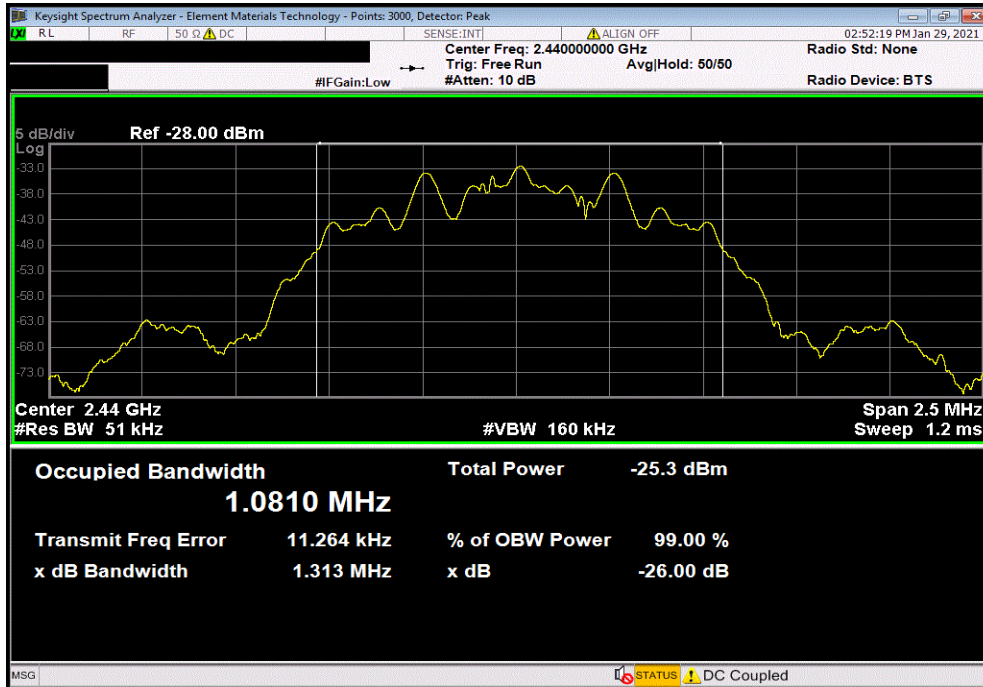


BLE/GFSK Mid Channel, 2440 MHz, 2 Mbps					Limit	
Value					(≤) 0.5% of Center Frequency	Result
				2.056 MHz	12.2 MHz	Pass

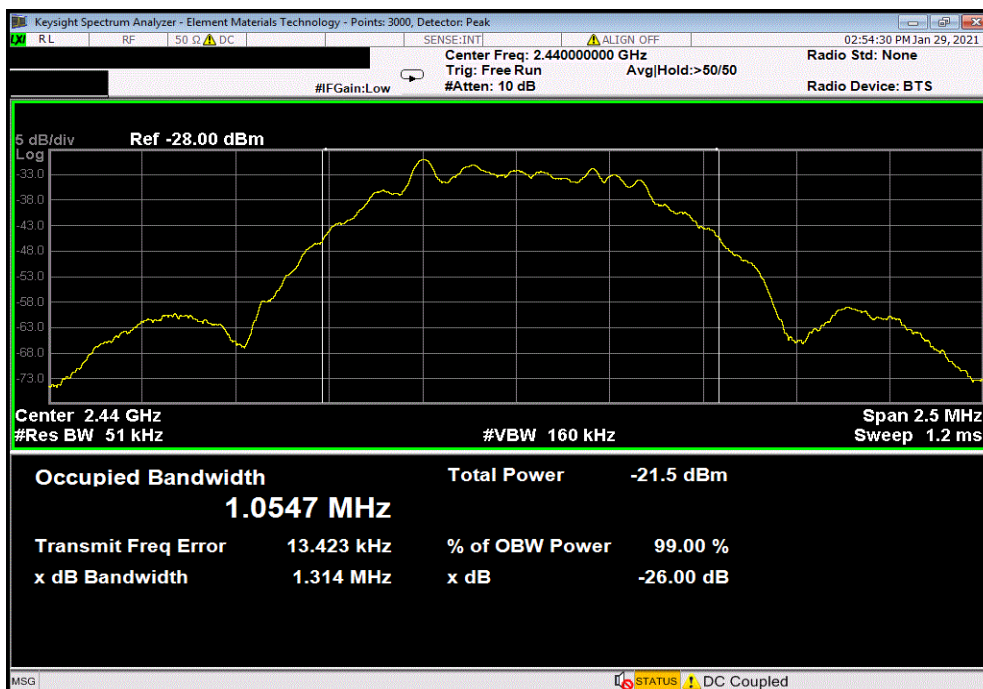


OCCUPIED BANDWIDTH

BLE/GFSK Mid Channel, 2440 MHz, 125 kbps					Limit	
Value					(≤) 0.5% of Center Frequency	Result
				1.081 MHz	12.2 MHz	Pass



BLE/GFSK Mid Channel, 2440 MHz, 500 kbps					Limit	
Value					(≤) 0.5% of Center Frequency	Result
				1.054 MHz	12.2 MHz	Pass

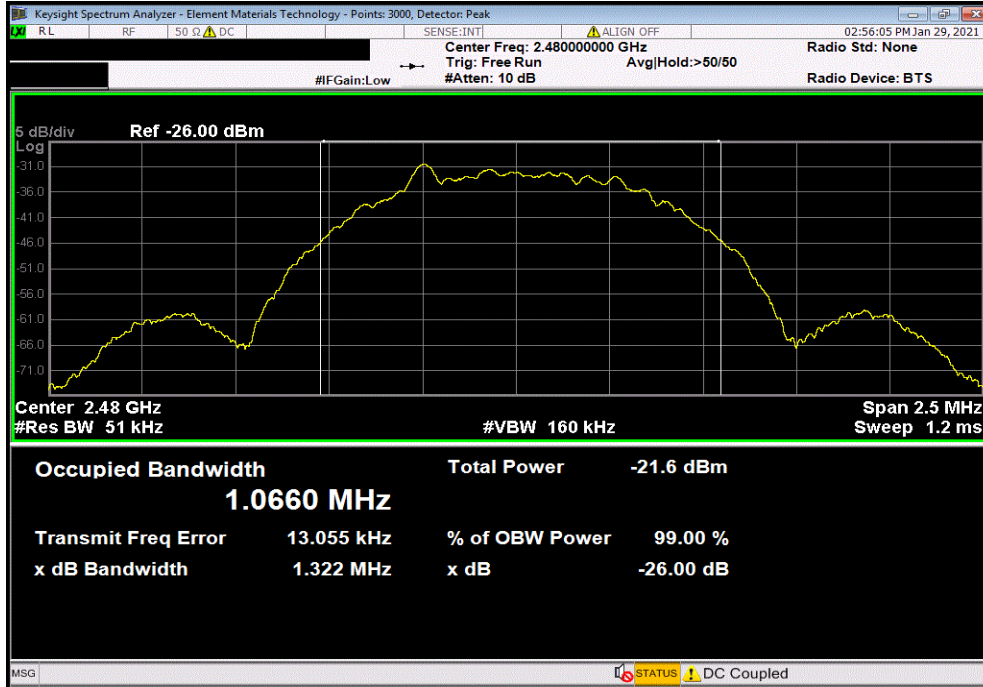


OCCUPIED BANDWIDTH

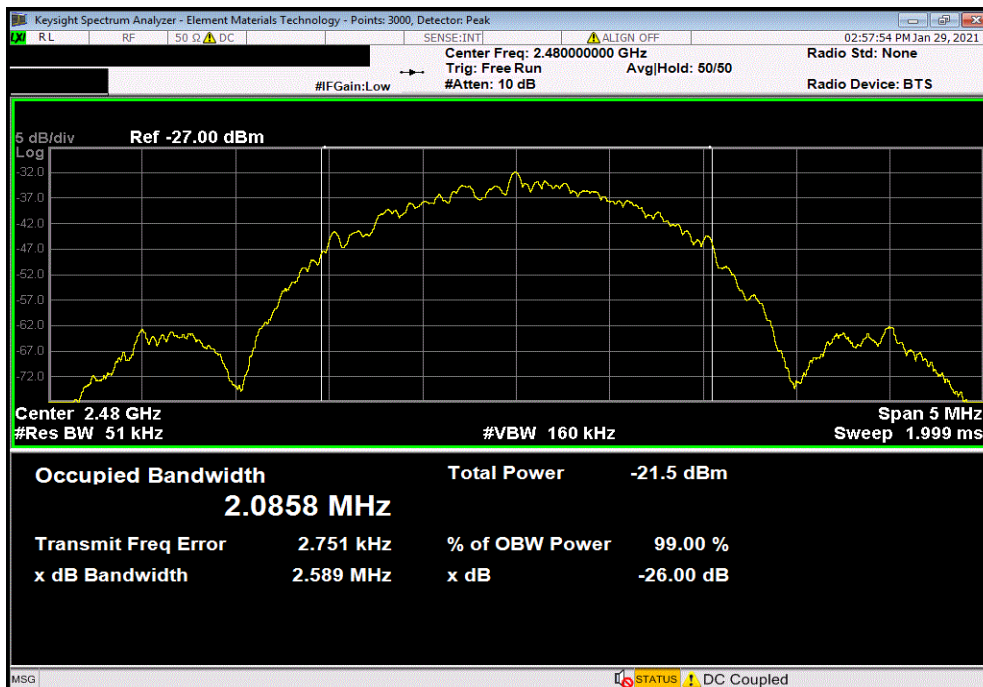


TbTx 2019.08.30.0 XMill 2020.12.30.0

BLE/GFSK High Channel, 2480 MHz, 1 Mbps					Limit	
Value				(≤) 0.5% of Center Frequency	Result	
1.066 MHz				12.4 MHz	Pass	



BLE/GFSK High Channel, 2480 MHz, 2 Mbps					Limit	
Value				(≤) 0.5% of Center Frequency	Result	
2.086 MHz				12.4 MHz	Pass	

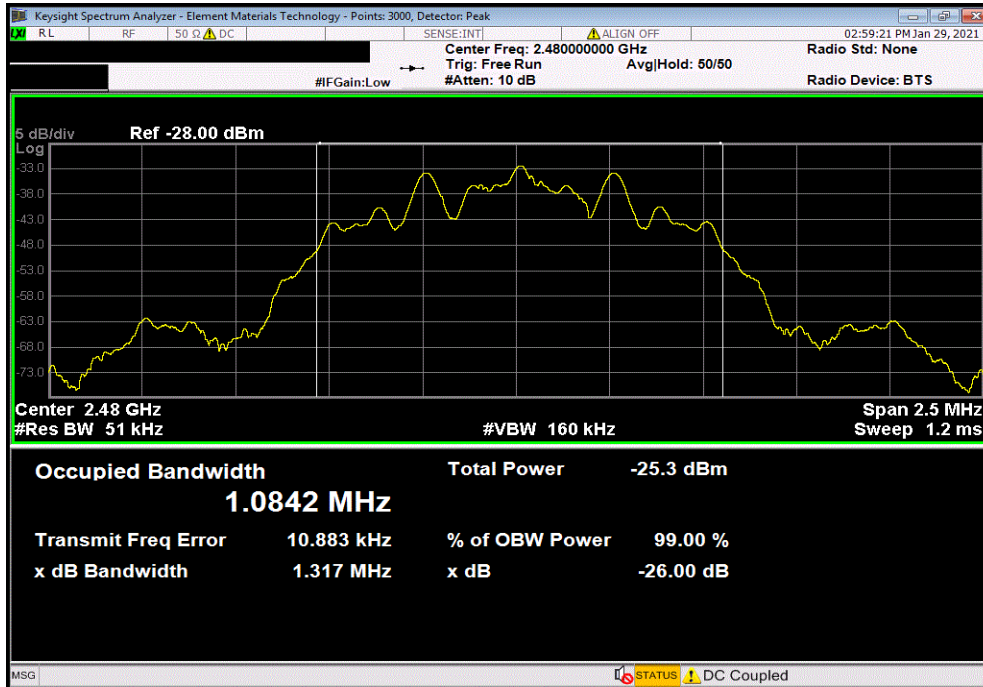


OCCUPIED BANDWIDTH



TbTx 2019.08.30.0 XMIT 2020.12.30.0

BLE/GFSK High Channel, 2480 MHz, 125 kbps					Limit	
Value					(≤) 0.5% of Center Frequency	Result
				1.084 MHz	12.4 MHz	Pass



BLE/GFSK High Channel, 2480 MHz, 500 kbps					Limit	
Value					(≤) 0.5% of Center Frequency	Result
				1.061 MHz	12.4 MHz	Pass

