

Credence ID LLC

TEST REPORT

SCOPE OF WORK

FCC TESTING—CE1-CID-16-4G-011

REPORT NUMBER

210916025SZN-001

ISSUE DATE

25 March 2022

[REVISED DATE]

[-----]

PAGES

25

DOCUMENT CONTROL NUMBER

FCC ID 249_C

© 2017 INTERTEK



Credence ID LLCApplication
For
Certification**FCC ID: 2AMBZ-CE1-16-4G-11****Rugged Handheld Device****Model: CE1-CID-16-4G-011****Brand Name: Credence ID**

2.4GHz Transceiver

Report No.: 210916025SZN-001

We hereby certify that the sample of the above item is considered to comply with the requirements of FCC Part 15, Subpart C for Intentional Radiator, mention 47 CFR [10-1-20]

Prepared and Checked by:

Approved by:

Jeff Liang
Project Engineer

Peter Kang
Senior Technical Supervisor
Date: 25 March 2022

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

Intertek Testing Services Shenzhen Ltd. Longhua Branch

101, 201, Building B, No. 308 Wuhe Avenue, Zhangkengjing Community, GuanHu Subdistrict, LongHua District, ShenZhen, P.R. China
Tel: (86 755) 8601 6288 Fax: (86 755) 8601 6751

MEASUREMENT/TECHNICAL REPORT

This report concerns (check one:) Original Grant X Class II Change _____

Equipment Type: DXX - Part 15 Low Power Communication Device Transmitter

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? Yes _____ No X

If yes, defer until: _____
date

Company Name agrees to notify the Commission by: _____
date

of the intended date of announcement of the product so that the grant can be issued on that date.

Transition Rules Request per 15.37? Yes _____ No X

If no, assumed Part 15, Subpart C for intentional radiator – the new 47 CFR [10-1-20 Edition] provision.

Report prepared by:

Jeff Liang
Intertek Testing Services Shenzhen Ltd. Longhua Branch
101, 201, Building B, No. 308 Wuhe Avenue, Zhangkengjing
Community, GuanHu Subdistrict, LongHua District, ShenZhen,
P.R. China
Tel / Fax: 86-755-8614 0743/86-755-8601 6661

Table of Contents

1.	Summary of Test Result	4
2.	General Description	5
2.1	Product Description	5
2.2	Related Submittal(s) Grants.....	5
2.3	Test Methodology.....	5
2.4	Test Facility	5
3.	System Test Configuration	6
3.1	Justification	6
3.2	EUT Exercising Software	6
3.3	Special Accessories	6
3.4	Equipment Modification.....	6
3.5	Measurement Uncertainty	7
3.6	Support Equipment List and Description.....	7
4.	Emission Results	8
4.1	Radiated Test Results.....	8
4.1.1	Field Strength Calculation.....	8
4.1.2	Radiated Emission Configuration Photograph	9
4.1.3	Radiated Emissions	9
4.1.4	Transmitter Spurious Emissions (Radiated).....	12
4.2	Conducted Emission Configuration Photograph	15
4.2.1	Conducted Emission	15
5.	Equipment Photographs	18
6.	Product Labelling	18
7.	Technical Specifications	18
8.	Instruction Manual	18
9.	Miscellaneous Information	19
9.1	Bandedge Plot.....	19
9.2	20dB bandwidth.....	22
9.3	Discussion of Pulse Desensitization	23
9.4	Calculation of Average Factor.....	23
9.5	Emissions Test Procedures	24
10.	Test Equipment List	25

1. Summary of Test Result

Applicant: Credence ID LLC

Applicant Address: 2335 Broadway Suite 100 Oakland California United States

Manufacturer: Credence ID LLC

Manufacturer Address: 2335 Broadway Suite 100 Oakland California United States

MODEL: CE1-CID-16-4G-011

FCC ID: 2AMBZ-CE1-16-4G-11

Test Specification	Reference	Results
Transmitter Radiated Emission	15.249 &15.209 &15.205	Pass
Conducted Emission	15.207	Pass
Bandedge	15.249 &15.209 &15.205	Pass
20dB Bandwidth	15.215(c)	Pass

Notes: The EUT uses an Integral Antenna which in accordance to Section 15.203 is considered sufficient to comply with the provisions of this section.

2. General Description

2.1 Product Description

The equipment under test (EUT) is a Rugged Handheld Device with Bluetooth 5.0 (Dual mode) function operating in 2402-2480MHz. The EUT is powered by DC 5V/2.5A or DC 9V/1.5A by adapter. For more detail information pls. refer to the user manual.

Antenna Type: Integral antenna

Modulation Type: GFSK, $\pi/4$ -DQPSK and 8-DPSK

Antenna Gain: 0.4dBi Max

Bluetooth Version: 5.0 (Dual mode)

For electronic filing, the brief circuit description is saved with filename: descri.pdf.

2.2 Related Submittal(s) Grants

This is an application for certification of a transceiver for the Rugged Handheld Device which has Bluetooth (EDR) function.

For the Bluetooth (BLE) function was tested and demonstrated in report 210916025SZN-002.

For the 2.4G WIFI function was tested and demonstrated in report 210916025SZN-003.

For the 5G WIFI function was tested and demonstrated in report 210916025SZN-004.

For the WCDMA/LTE function was tested and demonstrated in report 210916025SZN-005.

For the NFC function was tested and demonstrated in report 210916025SZN-006.

For the other function was tested and demonstrated in FCC SDoC report 210916025SZN-008.

2.3 Test Methodology

Both AC mains line-conducted and radiated emission measurements were performed according to the procedures in ANSI C63.10 (2013). Radiated emission measurement was performed in Semi-anechoic chamber and conducted emission measurement was performed in shield room. For radiated emission measurement, preliminary scans were performed in the semi-anechoic chamber only to determine the worst-case modes. All radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "Justification Section" of this Application. All other measurements were made in accordance with the procedures in part 2 of CFR 47.

2.4 Test Facility

The Semi-Anechoic chamber and shield room used to collect the radiated data and conducted data are **Intertek Testing Services Shenzhen Ltd. Longhua Branch** and located at 101, 201, Building B, No. 308 Wuhe Avenue, Zhangkengjing Community, GuanHu Subdistrict, LongHua District, ShenZhen, P.R. China. This test facility and site measurement data have been fully placed on file with the FCC (Registration Number: CN1188).

3. System Test Configuration

3.1 Justification

The system was configured for testing in a typical fashion (as a customer would normally use it), and in the confines as outlined in ANSI C63.10 (2013).

The EUT was powered by a fully DC 3.8V rechargeable Li-ion battery and charged by DC 5V/2.5A or DC 9V/1.5A through adapter during the test, only the worst data was reported in this report.

All packets DH1, DH3 & DH5 mode in modulation type GFSK, $\pi/4$ -DQPSK and 8-DPSK were tested and only the worst data was reported in this report.

For maximizing emissions below 30 MHz, the EUT was rotated through 360°, the centre of the loop antenna was placed 1 meter above the ground, and the antenna polarization was changed. For maximizing emissions, the EUT was rotated through 360°, the antenna height was varied from 1 meter to 4 meters above the ground plane, and the antenna polarization was changed. This step by step procedure for maximizing emissions led to the data reported in Section 4.

The EUT and transmitting antenna was centered on the turntable.

The equipment under test (EUT) was configured for testing in a typical fashion (as a customer would normally use it). The EUT was placed on a turn table, which enabled the engineer to maximize emissions through its placement in the three orthogonal axes.

3.2 EUT Exercising Software

The EUT exercise program (provided by client) used during testing was designed to exercise the various system components in a manner similar to a typical use.

Testing Software: Nonsignaling operation platform

3.3 Special Accessories

USB cable (Shielded, Length 100cm)

3.4 Equipment Modification

Any modifications installed previous to testing by Credence ID LLC will be incorporated in each production model sold / leased in the United States.

No modifications were installed by Intertek Testing Services Shenzhen Ltd. Longhua Branch.

3.5 Measurement Uncertainty

When determining the test conclusion, the Measurement Uncertainty of test has been considered.

3.6 Support Equipment List and Description

Description	Manufacturer	Remark
Power Adapter	(Provided by Applicant)	MODEL: HJ-FC001K7-UK INPUT: 100-240V~50/60Hz 0.6A OUTPUT: 5.0V=3.0A OR 9.0V=2.0A OR 12.0V=1.5A 18W
USB Cable	(Provided by Applicant)	shielded, 100cm

4. Emission Results

Data is included worst-case configuration (the configuration which resulted in the highest emission levels).

4.1 Radiated Test Results

A sample calculation, configuration photographs and data tables of the emissions are included.

4.1.1 Field Strength Calculation

The field strength is calculated by adding the reading on the Spectrum Analyzer to the factors associated with preamplifiers (if any), antennas, cables, pulse desensitization and average factors (when specified limit is in average and measurements are made with peak detectors). A sample calculation is included below.

$$FS = RA + AF + CF - AG + PD + AV$$

Where

- FS = Field Strength in dB μ V/m
- RA = Receiver Amplitude (including preamplifier) in dB μ V
- CF = Cable Attenuation Factor in dB
- AF = Antenna Factor in dB
- AG = Amplifier Gain in dB
- PD = Pulse Desensitization in dB
- AV = Average Factor in -dB

In the radiated emission table which follows, the reading shown on the data table may reflect the preamplifier gain. An example of the calculations, where the reading does not reflect the preamplifier gain, follows:

$$FS = RA + AF + CF - AG + PD + AV$$

Assume a receiver reading of 62.0 dB μ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted. The pulse desensitization factor of the spectrum analyzer was 0 dB, and the resultant average factor was -10 dB. The net field strength for comparison to the appropriate emission limit is 32 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

RA = 62.0 dB μ V
AF = 7.4 dB
CF = 1.6 dB
AG = 29.0 dB
PD = 0 dB
AV = -10 dB
 $FS = 62 + 7.4 + 1.6 - 29 + 0 = 42 \text{ dB}\mu\text{V/m}$

Level in μ V/m = Common Antilogarithm $[(42 \text{ dB}\mu\text{V/m})/20] = 125.9 \mu\text{V/m}$

4.1.2 Radiated Emission Configuration Photograph

For electronic filing, the worst case radiated emission configuration photograph is saved with filename: radiated photos. pdf.

4.1.3 Radiated Emissions

The data on the following page lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

Worst Case Radiated Emission
at
84.902000 MHz

Judgement: Passed by 10.5 dB

TEST PERSONNEL:

Sign on file

Jeff Liang, Project Engineer
Typed/Printed Name

9 November 2021
Date

Applicant: Credence ID LLC

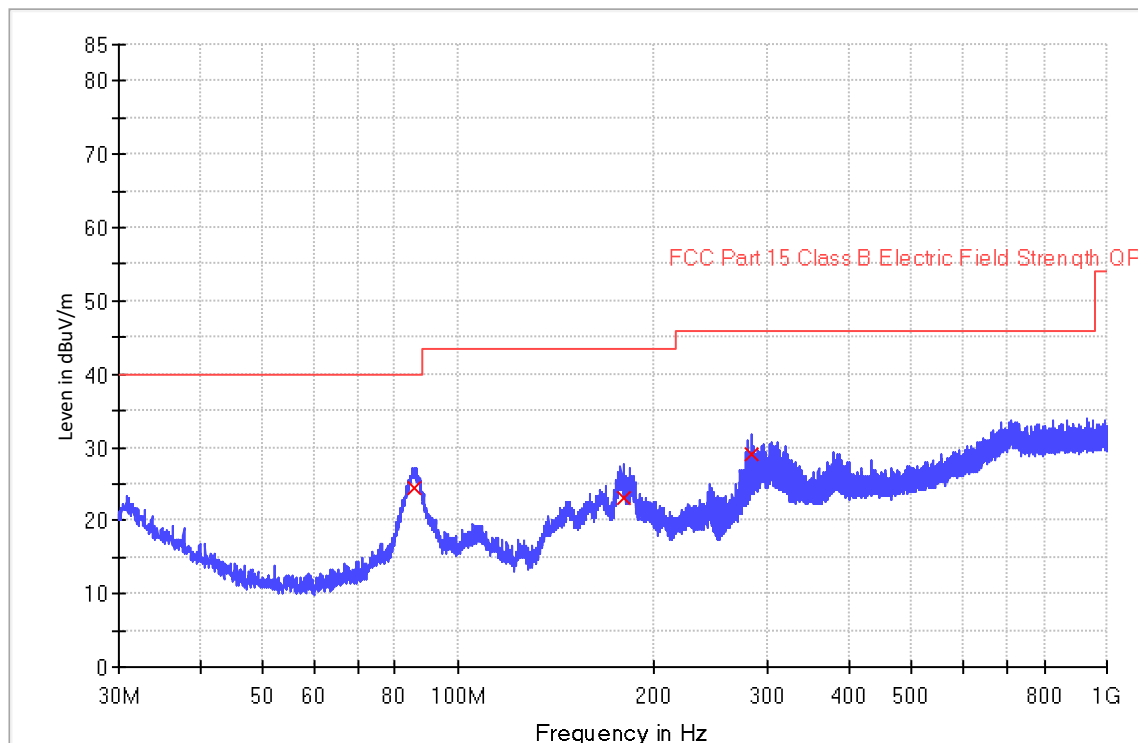
Model: CE1-CID-16-4G-011

Date of Test: 9 November 2021

Worst Case Operating Mode: BT Link

ANT Polarity: Horizontal

FCC Part 15



Frequency (MHz)	QuasiPeak (dBuV/m)	Meas. Time (ms)	Bandwidth (kHz)	Polarization	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBuV/m)
85.581000	24.4	1000.0	120.000	H	13.6	15.6	40.0
179.638667	23.1	1000.0	120.000	H	17.5	20.4	43.5
283.202333	29.0	1000.0	120.000	H	20.2	17.0	46.0

Remark:

1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. QuasiPeak (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Limit Line(dBμV/m) – Level (dBμV/m)

Applicant: Credence ID LLC

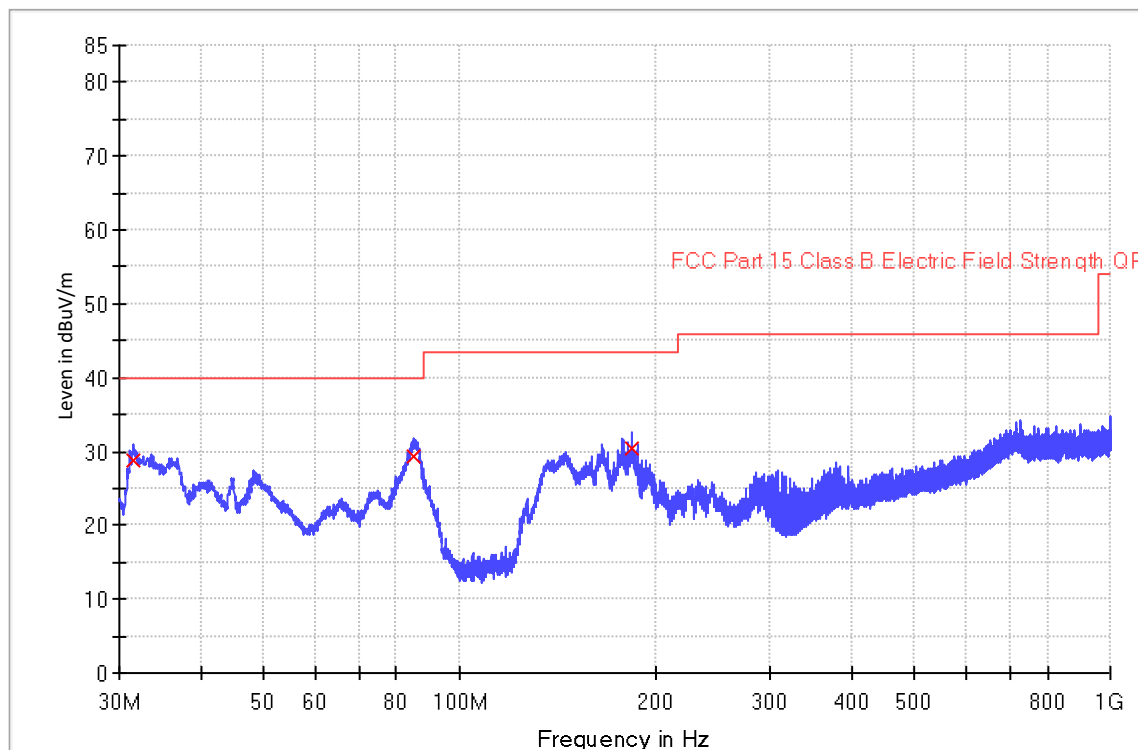
Model: CE1-CID-16-4G-011

Date of Test: 9 November 2021

Worst Case Operating Mode: BT Link

ANT Polarity: Vertical

FCC Part 15



Frequency (MHz)	QuasiPeak (dBuV/m)	Meas. Time (ms)	Bandwidth (kHz)	Polarization	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBuV/m)
31.487333	28.7	1000.0	120.000	V	21.8	11.3	40.0
84.902000	29.5	1000.0	120.000	V	13.6	10.5	40.0
184.262333	30.4	1000.0	120.000	V	17.6	13.1	43.5

Remark:

1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. QuasiPeak (dBuV/m) = Corr. (dB/m) + Read Level (dBuV)
3. Margin (dB) = Limit Line (dBuV/m) – Level (dBuV/m)

4.1.4 Transmitter Spurious Emissions (Radiated)

Worst Case Radiated Emission
at
2441.000 MHz

For electronic filing, the worst case radiated emission configuration photograph is saved with filename: radiated photos. pdf.

The data on the following page lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

Judgement: Passed by 2.7 dB

TEST PERSONNEL:

Sign on file

Jeff Liang, Project Engineer

Typed/Printed Name

5 November 2021

Date

Applicant: Credence ID LLC

Model: CE1-CID-16-4G-011

Date of Test: 5 November 2021

Worst Case Operating Mode: Transmitting

Radiated Emissions (above 1GHz)

(2402MHz)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	2402.000	117.1	36.7	28.1	108.5	114.0	-5.5
Horizontal	4804.000	40.3	36.7	35.5	39.1	74.0	-34.9
Horizontal	7206.000	42.7	36.1	36.5	43.1	74.0	-30.9
Horizontal	9608.000	46.1	36.3	38.0	47.8	74.0	-26.2

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Average Factor (-dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	2402.000	117.1	36.7	28.1	22.5	86.0	94.0	-8.0
Horizontal	4804.000	40.3	36.7	35.5	22.5	16.6	54.0	-37.4
Horizontal	7206.000	42.7	36.1	36.5	22.5	20.6	54.0	-33.4
Horizontal	9608.000	46.1	36.3	38.0	22.5	25.3	54.0	-28.7

(2441MHz)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	2441.000	119.9	36.7	28.1	111.3	114.0	-2.7
Horizontal	4882.000	37.0	36.7	35.5	35.8	74.0	-38.2
Horizontal	7323.000	42.0	36.1	37.2	43.1	74.0	-30.9
Horizontal	9764.000	44.8	36.2	37.0	45.6	74.0	-28.4

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Average Factor (-dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	2441.000	119.9	36.7	28.1	22.5	88.8	94.0	-5.2
Horizontal	4882.000	37.0	36.7	35.5	22.5	13.3	54.0	-40.7
Horizontal	7323.000	42.0	36.1	37.2	22.5	20.6	54.0	-33.4
Horizontal	9764.000	44.8	36.2	37.0	22.5	23.1	54.0	-30.9

(2480MHz)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	2480.000	115.4	36.7	28.1	106.8	114.0	-7.2
Horizontal	4960.000	37.0	36.7	35.5	35.8	74.0	-38.2
Horizontal	7440.000	42.0	36.1	37.2	43.1	74.0	-30.9
Horizontal	9920.000	43.0	36.3	38.9	45.6	74.0	-28.4

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Average Factor (-dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	2480.000	115.4	36.7	28.1	22.5	84.3	94.0	-9.7
Horizontal	4960.000	37.0	36.7	35.5	22.5	13.3	54.0	-40.7
Horizontal	7440.000	42.0	36.1	37.2	22.5	20.6	54.0	-33.4
Horizontal	9920.000	43.0	36.3	38.9	22.5	23.1	54.0	-30.9

Notes:

1. Peak detector is used for the emission measurement.
2. All measurements were made at 3 meter. Harmonic emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
3. Negative value in the margin column shows emission below limit.
4. Horn antenna is used for the emission over 1000MHz.

Test Engineer: Jeff Liang

4.2 Conducted Emission Configuration Photograph

For electronic filing, the worst case conducted emission configuration photographs are saved with filename: conducted photos.pdf.

4.2.1 Conducted Emission

Worst Case Conducted Configuration

at

1.522000MHz

Judgement: Passed by 5.4dB margin

TEST PERSONNEL:

Sign on file

Jeff Liang, Project Engineer

Typed/Printed Name

19 October 2021

Date

Applicant: Credence ID LLC

Model: CE1-CID-16-4G-011

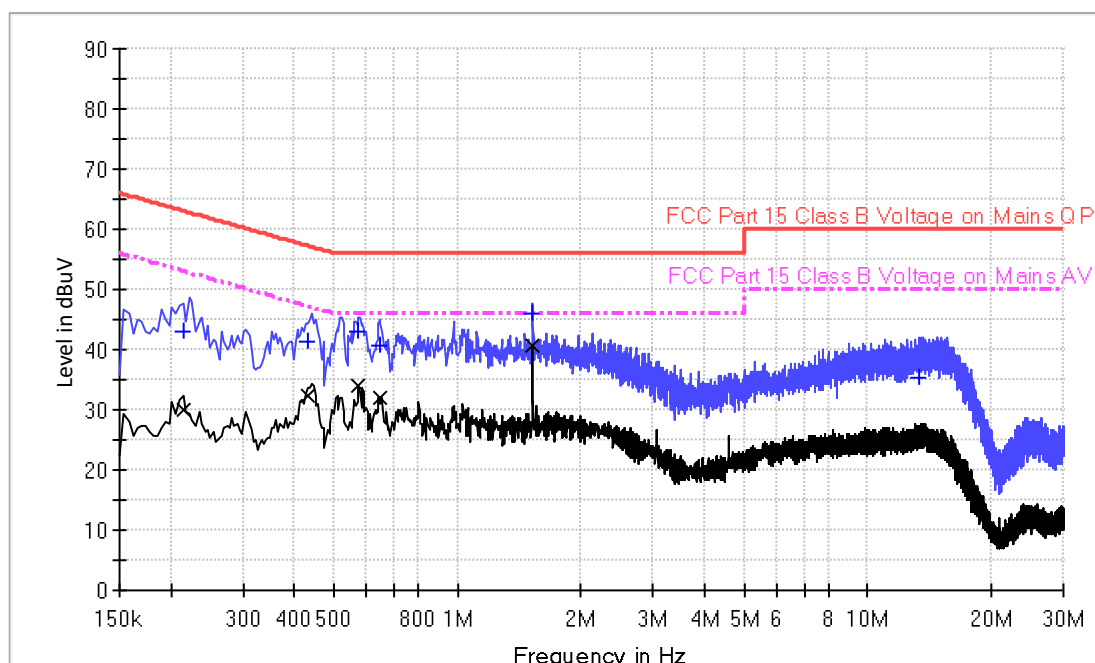
Date of Test: 19 October 2021

Worst Case Operating Mode: BT Link

Phase: Live

Graphic / Data Table

Conducted Emissions Pursuant to FCC 15.207: Emissions Requirement



Limit and Margin QP

Frequency (MHz)	QuasiPeak (dBuV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBuV)
0.214000	43.1	9.000	L1	9.6	19.9	63.0
0.434000	41.3	9.000	L1	9.6	15.9	57.2
0.574000	43.2	9.000	L1	9.6	12.8	56.0
0.646000	40.5	9.000	L1	9.6	15.5	56.0
1.522000	46.0	9.000	L1	9.6	10.0	56.0
13.394000	35.5	9.000	L1	10.0	24.5	60.0

Limit and Margin AV

Frequency (MHz)	Average (dBuV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBuV)
0.214000	29.9	9.000	L1	9.6	23.1	53.0
0.434000	32.3	9.000	L1	9.6	14.9	47.2
0.574000	34.1	9.000	L1	9.6	11.9	46.0
0.646000	32.1	9.000	L1	9.6	13.9	46.0
1.522000	40.6	9.000	L1	9.6	5.4	46.0
13.394000	25.6	9.000	L1	10.0	24.4	50.0

Applicant: Credence ID LLC

Model: CE1-CID-16-4G-011

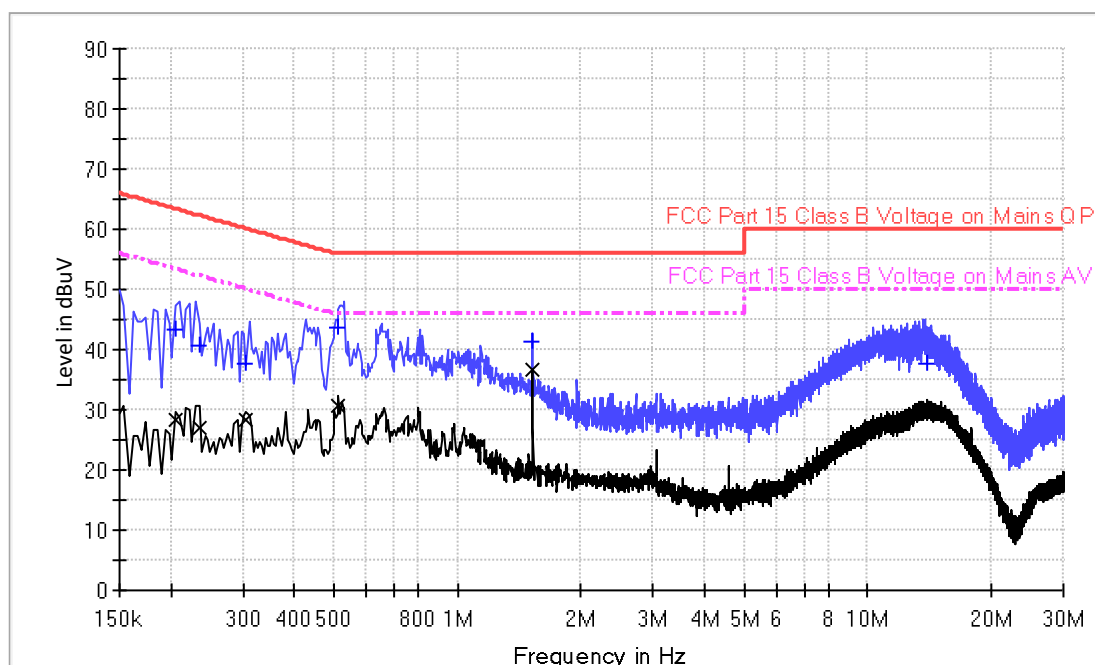
Date of Test: 19 October 2021

Worst Case Operating Mode: BT Link

Phase: Neutral

Graphic / Data Table

Conducted Emissions Pursuant to FCC 15.207: Emissions Requirement



Limit and Margin QP

Frequency (MHz)	QuasiPeak (dBuV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBuV)
0.206000	43.5	9.000	N	9.5	19.9	63.4
0.234000	40.8	9.000	N	9.5	21.5	62.3
0.306000	37.7	9.000	N	9.5	22.4	60.1
0.514000	43.5	9.000	N	9.5	12.5	56.0
1.522000	41.2	9.000	N	9.5	14.8	56.0
13.994000	37.8	9.000	N	10.0	22.2	60.0

Limit and Margin AV

Frequency (MHz)	Average (dBuV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBuV)
0.206000	28.3	9.000	N	9.5	25.1	53.4
0.234000	27.0	9.000	N	9.5	25.3	52.3
0.306000	28.3	9.000	N	9.5	21.8	50.1
0.514000	30.7	9.000	N	9.5	15.3	46.0
1.522000	36.7	9.000	N	9.5	9.3	46.0
13.994000	29.8	9.000	N	10.0	20.2	50.0

5. Equipment Photographs

For electronic filing, the photographs of the tested EUT are saved with filename: external photos.pdf & internal photos.pdf.

6. Product Labelling

For electronic filing, the FCC ID label artwork and the label location are saved with filename: label.pdf.

7. Technical Specifications

For electronic filing, the block diagram and schematics of the tested EUT are saved with filename: block.pdf and circuit.pdf respectively.

8. Instruction Manual

For electronic filing, a preliminary copy of the Instruction Manual is saved with filename: manual.pdf.

This manual will be provided to the end-user with each unit sold/leased in the United States.

9. Miscellaneous Information

This miscellaneous information includes details of the measured bandedge, 20dB Bandwidth, the test procedure and calculation of factor such as pulse desensitization.

9.1 Bandedge Plot

The test plots are attached as below. For electronic filing, the plot shows the fundamental emission when modulated is saved with filename: bw.pdf. From the plot, the field strength of any emissions appearing between the band edges and up to 10 kHz above and below the band edges are attenuated at least 50dB below the level of the unmodulated carrier. It fulfil the requirement of 15.249(d).

From the below plots, the field strength of any emissions outside of the specified frequency band are attenuated to the general radiated emission limits in section 15.209. It fulfils the requirement of 15.249(d).

Peak Measurement

Bandedge compliance is determined by applying marker-delta method, i.e (Bandedge Plot).

(i) Lowest frequency channel (2402MHz):

Peak Resultant field strength = Fundamental emissions (peak value) – delta from the bandedge plot

$$\begin{aligned} &= 108.50 \text{ dB}\mu\text{v/m} - 50.59 \text{ dB} \\ &= 57.91 \text{ dB}\mu\text{v/m} \end{aligned}$$

Average Resultant field strength = Fundamental emissions (average value) – delta from the bandedge plot

$$\begin{aligned} &= 86.00 \text{ dB}\mu\text{v/m} - 50.59 \text{ dB} \\ &= 35.41 \text{ dB}\mu\text{v/m} \end{aligned}$$

(ii) Highest frequency channel (2480MHz)

Peak Resultant field strength = Fundamental emissions (peak value) – delta from the bandedge plot

$$\begin{aligned} &= 106.80 \text{ dB}\mu\text{v/m} - 49.45 \text{ dB} \\ &= 57.35 \text{ dB}\mu\text{v/m} \end{aligned}$$

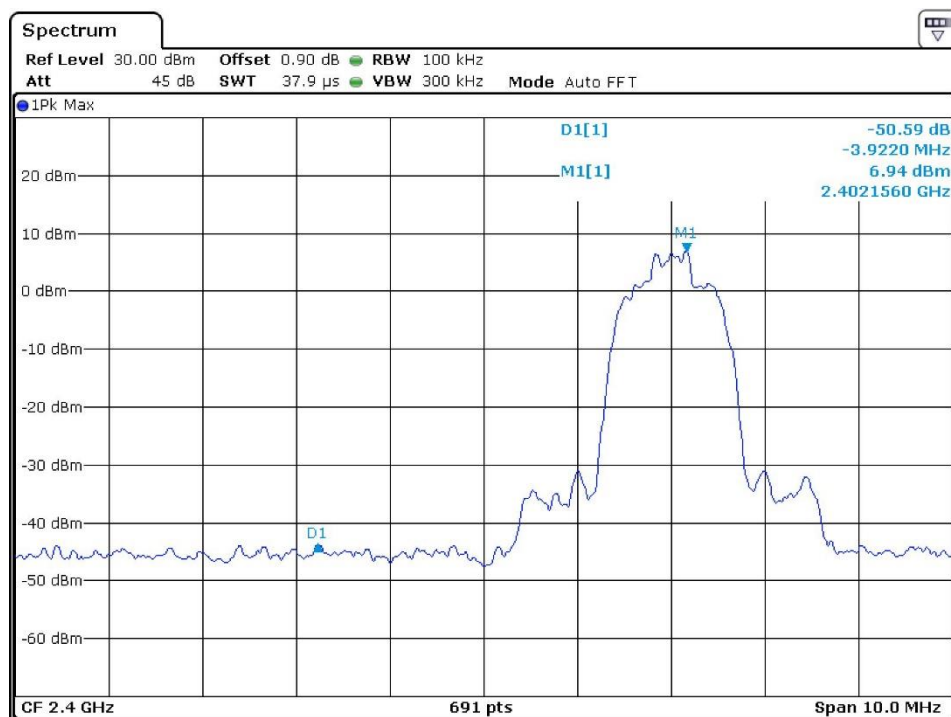
Average Resultant field strength = Fundamental emissions (average value) – delta from the bandedge plot

$$\begin{aligned} &= 84.30 \text{ dB}\mu\text{v/m} - 49.45 \text{ dB} \\ &= 34.85 \text{ dB}\mu\text{v/m} \end{aligned}$$

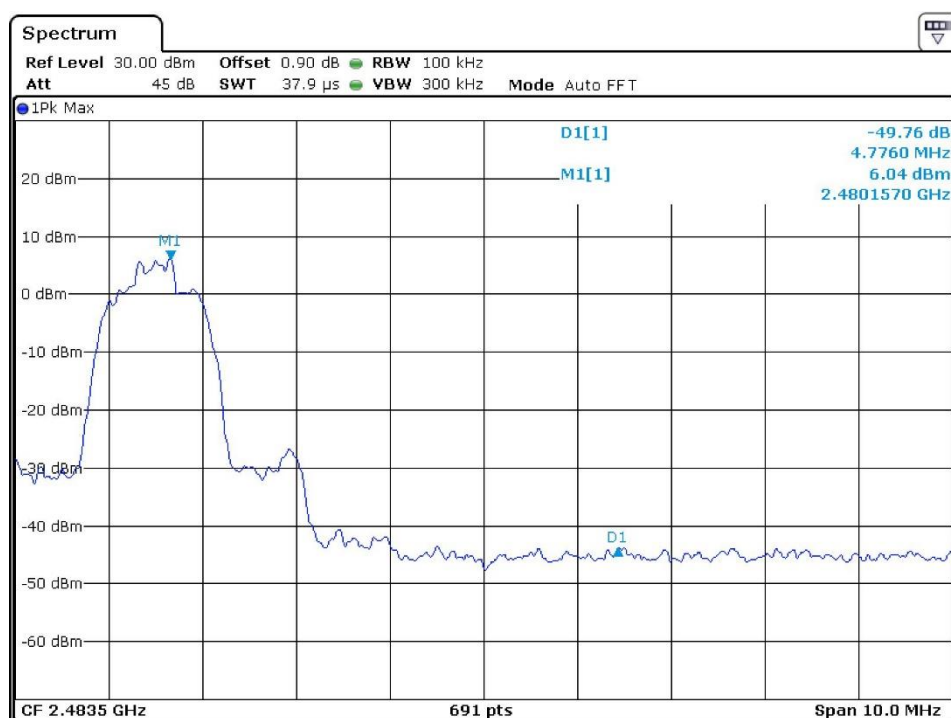
The resultant field strength meets the general radiated emission limit in section 15.209, which does not exceed 74dB μ v/m (Peak Limit) and 54dB μ v/m (Average Limit).

Hopping function off

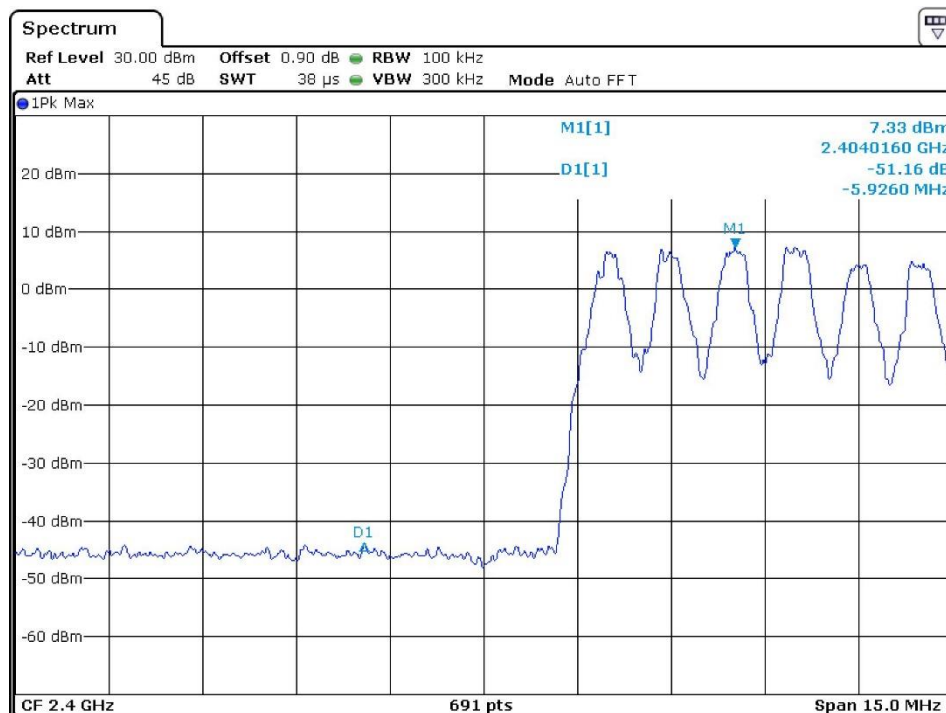
Lowest frequency Channel



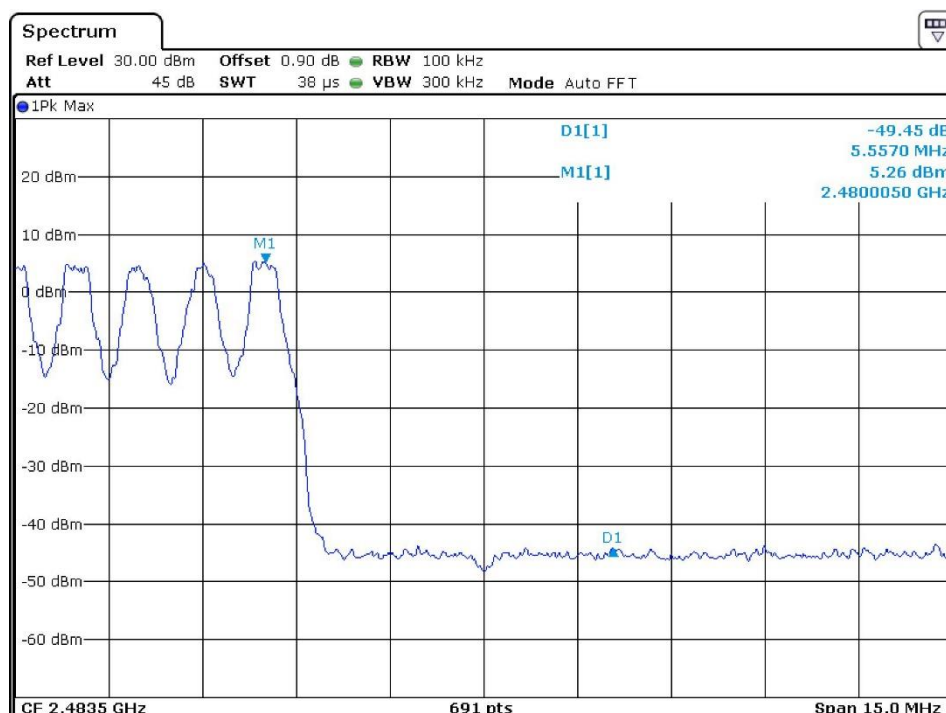
Highest frequency Channel



Hopping function on Lowest frequency Channel

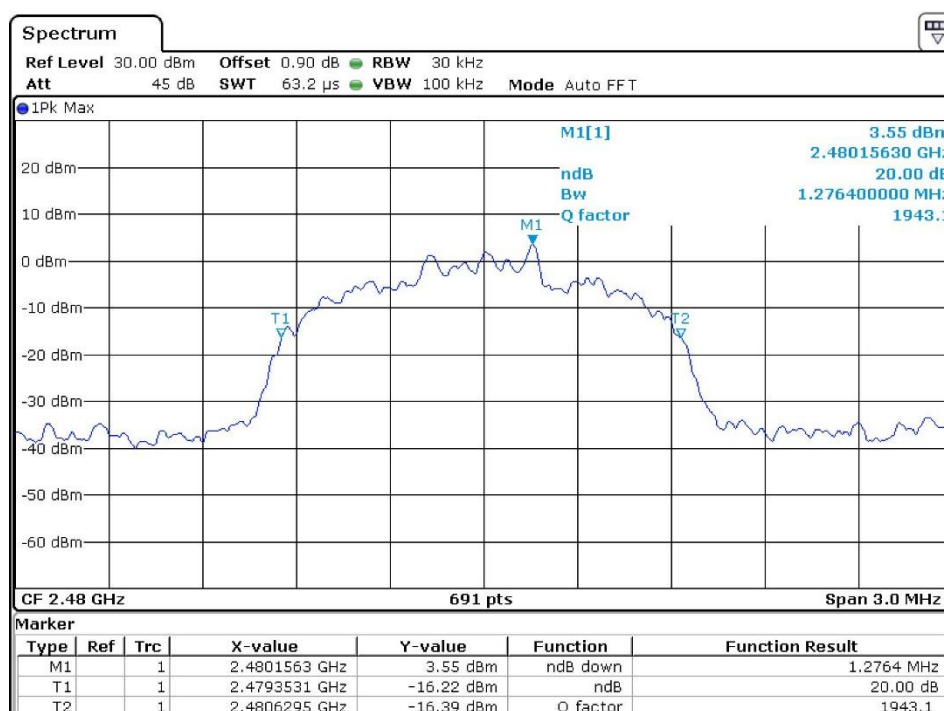
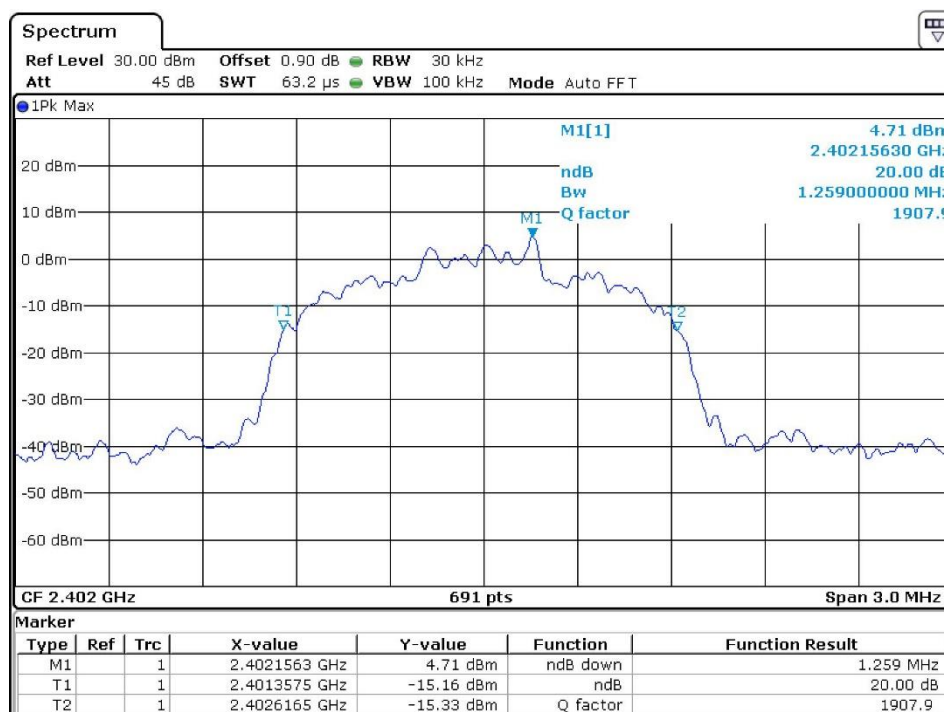


Highest frequency Channel



9.2 20dB bandwidth

Pursuant to FCC part 15 Section 15.215(c), the 20dB bandwidth of the emission was contained within the frequency band designated (mentioned as above) which the EUT operated. The effects, if any, from frequency sweeping, frequency hopping, other modulation techniques and frequency stability over excepted variations in temperature and supply voltage were considered. The test plots are reported as below.



9.3 Discussion of Pulse Desensitization

Pulse desensitivity is not applicable for this device. The effective period (Teff) is approximately 625µs for Bluetooth. With a resolution bandwidth (3dB) of 1MHz, so the pulse desensitivity factor is 0dB.

9.4 Calculation of Average Factor

Based on the Bluetooth Specification Version 5.0 (EDR mode) and worst case AFH mode, transmitter ON time is independent of packet type (DH1, DH3 and DH5) and packet length, the AFH mode Duty cycle connection factor as below:

Channel hop rate = 800 hops/second (AFH Mode)

Adjusted channel hop rate for DH5 mode = 133.33 hops/second

Time per channel hop = $1 / 133.33 \text{ hops/second} = 7.5 \text{ ms}$

Time to cycle through all channels = $7.5 \times 20 \text{ channels} = 150 \text{ ms}$

Number of times transmitter hits on one channel = $100 \text{ ms} / 150 \text{ ms} = 1 \text{ time(s)}$

Worst case dwell time = 7.5 ms

Duty cycle connection factor = $20\log_{10} (7.5\text{ms} / 100\text{ms}) = -22.5 \text{ dB}$

9.5 Emissions Test Procedures

The following is a description of the test procedure used by Intertek Testing Services in the measurements of transmitters operating under Part 15, Subpart C rules.

The test set-up and procedures described below are designed to meet the requirements of ANSI C63.10 - 2013.

The transmitting equipment under test (EUT) is placed on a styrene turntable which is four feet in diameter and approximately 0.8 meter up to 1GHz and 1.5 meter above 1GHz in height above the ground plane. During the radiated emissions test, the turntable is rotated and any cables leaving the EUT are manipulated to find the configuration resulting in maximum emissions. The EUT is adjust through all three orthogonal axes to obtain maximum emission levels. The antenna height and polarization are varied during the testing to search for maximum signal levels.

Detector function for radiated emissions is in peak mode. Average readings, when required, are taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings. A detailed description for the calculation of the average factor can be found in section 9.4.

The frequency range scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or 40 GHz, whichever is lower.

Detector function for conducted emissions is in QP & AV mode and IFBW setting is 9 kHz from the frequency band 150 kHz to 30MHz.

The EUT is warmed up for 15 minutes prior to the test.

AC power to the unit is varied from 85% to 115% nominal and variation in the fundamental emission field strength is recorded. If battery powered, a new, fully charged battery is used.

Conducted measurements are made as described in ANSI C63.10 - 2013.

The IF bandwidth used for measurement of radiated signal strength was 10 kHz for emission below 30 MHz and 120 kHz for emission from 30 MHz to 1000 MHz. Where pulsed transmissions of short enough pulse duration warrant, a greater bandwidth is selected according to the recommendations of Hewlett Packard Application Note 150-2. Above 1000 MHz, a resolution bandwidth of 1 MHz is used (RBW 3MHz used for fundamental emission).

Transmitter measurements are normally conducted at a measurement distance of three meters. However, to assure low enough noise floor in the restricted bands and above 1 GHz, signals are acquired at a distance of one meter or less. All measurements are extrapolated to three meters using inverse scaling, but those measurements taken at a closer distance are so marked.

10. Test Equipment List

Equipment No.	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due Date
SZ056-06	Signal Analyzer	R&S	FSV 40	101101	2020-12-22	2021-12-22
SZ062-10	RF Cable	Bedeia	RG 58	--	2021-06-01	2021-12-01
SZ056-08	Signal Analyzer	R&S	FSV 40	101430	2020-12-22	2021-12-22
SZ185-03	EMI Receiver	R&S	ESR7	101975	2020-12-22	2021-12-22
SZ061-06	Active Loop Antenna	Electro-Metrics	EM-6876	217	2021-05-18	2023-05-18
SZ061-12	BiConiLog Antenna	ETS	3142E	00166158	2021-08-04	2024-08-04
SZ061-09	Double-Ridged Waveguide Horn Antenna	ETS	3115	00092347	2020-10-17	2022-10-17
SZ181-08	Microwave System Amplifier	Agilent	83017A	MY57280108	2021-08-04	2022-08-04
SZ188-05	Anechoic Chamber	ETS	FACT 3-2.0	CT001880-Q1391	2021-05-25	2024-05-25
SZ062-23	RF Cable	RADIAL	SF104PE	MY4262/4PE	2021-09-26	2022-09-26
SZ062-35	RF Cable	Rebes	A50-3.5M3.5M-8M	19100879	2021-09-26	2022-09-26
SZ067-04	Notch Filter	Micro-Tronics	BRM50702-02	015	2021-05-11	2022-05-11
SZ185-02	EMI Test Receiver	R&S	ESCI	100692	2021-07-12	2022-07-12
SZ187-02	Two-Line V-Network	R&S	ENV216	100072	2021-05-12	2022-05-12
SZ188-03	Shielding Room	ETS	RFD-100	4100	2020-01-07	2023-01-07

***** End of Report*****