

Credence ID LLC

TEST REPORT

SCOPE OF WORK

FCC TESTING— Model: CT3-CID-16-4G-011

REPORT NUMBER

230315012SZN-006

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Credence ID LLC

Application for Certification

FCC ID: 2AMBZ-CT3-16-4G-011

Rugged Handheld Device

Model: CT3-CID-16-4G-011

13.56MHz Transceiver

Report No.: 230315012SZN-006

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 [10-1-21]

Prepared and Checked by:

Approved by:

Jeff Liang
Project Engineer

Ryan Chen
Project Engineer
Date: 13 July 2023

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1.0 Summary of Test Result

Applicant: Credence ID LLC

Applicant Address: 2335 Broadway, Suite 100, Oakland, California, 94612, United States

Manufacturer: Credence ID LLC

Manufacturer Address: 2335 Broadway, Suite 100, Oakland, California, 94612, United States

MODEL: CT3-CID-16-4G-011

FCC ID: 2AMBZ-CT3-16-4G-011

Test Specification	Reference	Results
Transmitter Radiated Emission	15.225(a)(b)(c)	Pass
Band edge	&15.209 &15.205	
Frequency Stability	15.225(e)	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.

2.0 General Description

2.1 Product Description

The equipment under test (EUT) is a Rugged Handheld Device operating at 13.56 MHz. The EUT can be 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

Antenna Gain: 0dBi

Modulation Type: ASK

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 the Rugged Handheld Device which has NFC function.

For the Bluetooth (EDR) function was tested and demonstrated in report 230315012SZN-001.

For the Bluetooth (BLE) function was tested and demonstrated in report 230315012SZN-002.

For the 2.4G WIFI function was tested and demonstrated in report 230315012SZN-003.

For the 5G WIFI function was tested and demonstrated in report 230315012SZN-004.

For the WCDMA/LTE function was tested and demonstrated in report 230315012SZN-005.

For the other function was tested and demonstrated in FCC SDoC report 230315012SZN-008.

2.3 Test Methodology

Radiated emission measurements were performed according to the procedures in ANSI C63.10 (2013). Radiated emission measurement was performed in Semi-anechoic chamber. 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 used to collect the radiated data is **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, People's Republic of China. This test facility and site measurement data have been fully placed on file with the FCC (Registration Number: CN1188).

3.0 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.

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

There was no special software to exercise the device.

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

4.0 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/m
- 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/m 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.

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

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

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
94.92 MHz

Judgement: Passed by 15.1 dB

TEST PERSONNEL:

Sign on file

Jeff Liang, Project Engineer
Typed/Printed Name

16 December 2021
Date

Applicant: Credence ID LLC

Date of Test: 16 December 2021

Worst Case Operating Mode:

Model: CT3-CID-16-4G-011

Transmitting

Table 1
Fundamental & Spurious Emission Below 30MHz

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB/m)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Vertical	13.560	53.5	0	10.8	64.3	124.0	-59.7
Vertical	27.120	48.0	20	9.5	37.5	69.5	-32.0

Table 2
Spurious emission (30MHz ~ 1GHz)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB/m)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	85.581000	30.8	20	13.6	24.4	40.0	-15.6
Horizontal	179.638667	25.6	20	17.5	23.1	43.5	-20.4
Horizontal	283.202333	28.8	20	20.2	29.0	46.0	-17.0
Vertical	31.487333	26.9	20	21.8	28.7	40.0	-11.3
Vertical	84.902000	35.9	20	13.6	29.5	40.0	-10.5
Vertical	184.262333	32.8	20	17.6	30.4	43.5	-13.1

NOTES:

1. Peak Detector Data unless otherwise stated.
2. All measurements were made at 3 meter. Harmonic emissions not detected at the 3-meter distances 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 sign in the column shows value below limit.
4. Loop antenna is used for the emissions below 30 MHz
5. Limits at 3 meter for radiated emissions below 30 MHz is converted from the Limits at 30 meter according to the Formula:
Limits at 3 meter (dBμV/m) = Limits at 30 meter (dBμV/m) + 40 log (30/3)

4.2 Frequency Stability

If required, the operating or transmitting frequency of an intentional radiator should be measured in accordance with the following procedure to ensure that the device operates outside certain precluded frequency bands and within the frequency range. No modulation needs to be supplied to the intentional radiator during these tests, unless modulation is required to produce an output, e.g., single-sideband suppressed carrier transmitters.

The frequency stability of the transmitter is measured by:

- Temperature: The temperature is varied from -10°C to + 60°C using an environmental chamber.
- for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20°C.

The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% of the operating frequency.

Measurement Result:

Voltage (%)	Power	Temperature (°C)	Frequency (MHz)	Limit	Result
100	3.8Vdc	-10	13.560376	±0.01% (±1356Hz)	Pass
		0	13.560430		Pass
		10	13.560397		Pass
		20	13.560403		Pass
		30	13.560413		Pass
		40	13.560394		Pass
		50	13.560421		Pass
		60	13.560396		Pass

Temperature (°C)	Power	Voltage (%)	Frequency (MHz)	Limit	Result
20	3.8Vdc	85	13.560362	±0.01% (±1356Hz)	Pass
		90	13.560374		Pass
		95	13.560384		Pass
		100	13.560402		Pass
		105	13.560392		Pass
		110	13.560371		Pass
		115	13.560401		Pass

Note: The device is deemed to comply with requirement of FCC Part 15.225(e).

5.0 Equipment Photographs

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

6.0 Product Labelling

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

7.0 Technical Specifications

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

8.0 Instruction Manual

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

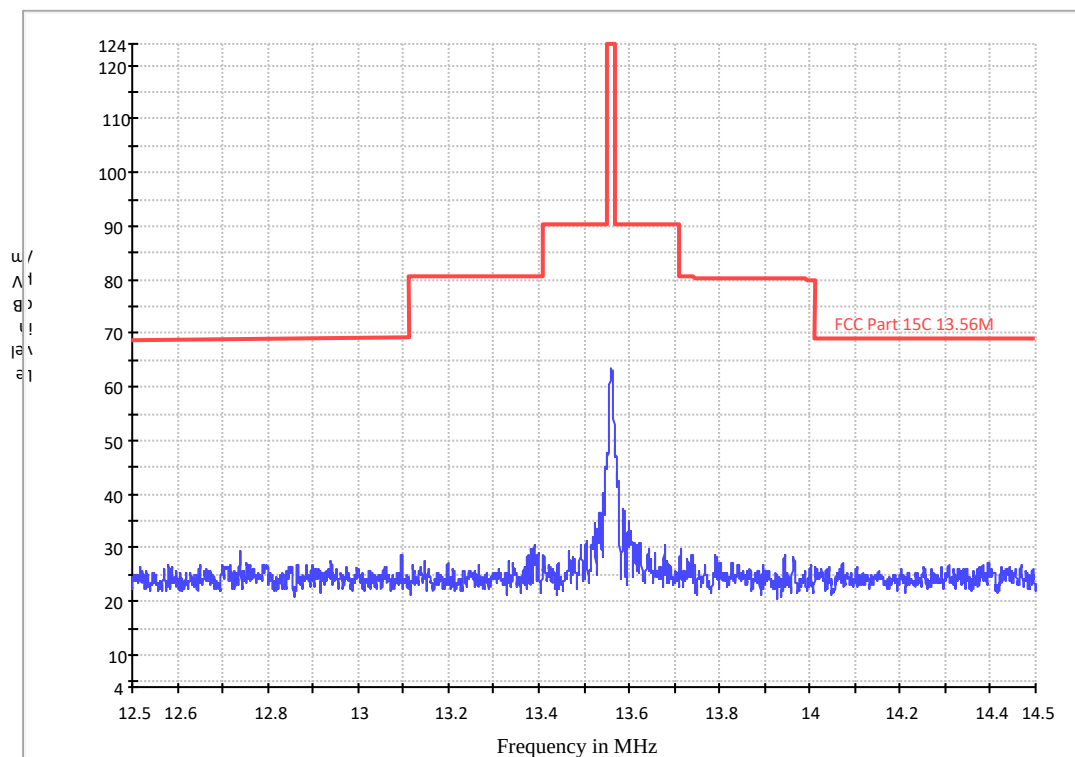
This manual will be provided to the end-user with each unit sold/leased in the United States.

9.0 Miscellaneous Information

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

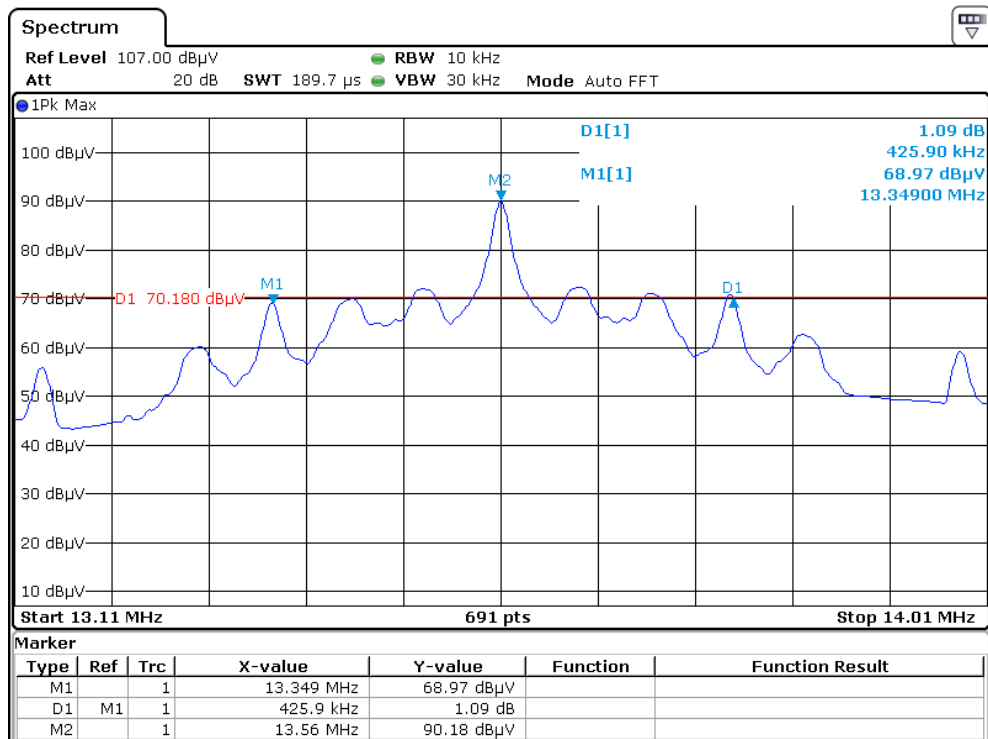
9.1 Band edge Plot

The test plots are attached as below. From the plot, the field strength of any emissions is below the limit of 90.5dBuV/m in the range of outside of (13.410–13.553 MHz and 13.567–13.710 MHz) and the limit of 80.5dBuV/m in the frequency range of (13.110-13.410MHz and 13.710-14.010MHz). Therefore, they meet the requirement of Section 15.225(b), (c).



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 (13.110-14.010MHz) 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 since the transmitter transmits the RF signal continuously.

9.4 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 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 adjusted 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. The frequency range scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz up to the 1GHz.

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.

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. A discussion of whether pulse desensitivity is applicable to this unit is included in this report (See Section 9.3).

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.

10.0 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
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