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RF Test Report

Test Report Number	EEI-22061661-LG-FCC-IRXPTO-RFID
FCC ID	2ANAC-IRXPTO
Applicant	Essex Electronics, Inc.
Applicant Address	1130 Mark Ave. Carpinteria, CA 93013
Product Name	iRox RFID Wall Reader
Model (s)	IRXPTO-B
Date of Receipt	12/07/2022
Date of Test	12/07/2022 – 03/02/2023
Report Issue Date	03/02/2023
Test Standards	47CFR Part 15.225
Test Result	**PASS**

Issued by:

Vista Compliance Laboratories
1261 Puerta Del Sol, San Clemente, CA 92673 USA
www.vista-compliance.com

Devin Tai (Test Engineer)

David Zhang (Technical Manager)

REVISION HISTORY

Report Number	Version	Description	Issued Date
EEI-22061661-LG-FCC-IRXPTO-RFID	01	Initial report	03/02/2023

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1 Test Summary

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Antenna Requirement	47 CFR Part 15.203	ANSI C63.10 (2013)	Pass
Emission Mask Limit in the band of 13.110 – 14.010 MHz	47 CFR Part 15.225	ANSI C63.10 (2013)	Pass
Radiated Spurious Emission below 30MHz	47 CFR Part 15.209 47 CFR Part 15.225	ANSI C63.10 (2013)	Pass
Radiated Spurious Emissions below 1GHz	47 CFR Part 15.209 47 CFR Part 15.225	ANSI C63.10 (2013)	Pass
AC Power Line Conducted Emissions	47 CFR Part 15.207	ANSI C63.10 (2013)	Pass
Frequency Stability	47 CFR Part 15.225	ANSI C63.10 (2013)	Pass

2 General Information

2.1 Applicant

Applicant	Essex Electronics, Inc.
Applicant address	1130 Mark Ave. Carpinteria, CA 93013
Manufacturer	Essex Electronics, Inc.
Manufacturer Address	1130 Mark Ave. Carpinteria, CA 93013

2.2 Product information

Product Name	iRox RFID Wall Reader
Model Number	IRXPTO-B
Family Models	N/A
Serial Number	N/A
Frequency Band	RFID: 125KHz, 13.56MHz Bluetooth BLE: 2402-2480MHz
Type of modulation	RFID: ASK Bluetooth BLE: GFSK
Equipment Class	DCD, DXX, DTS
Antenna Information	125KHz: Internal coil antenna 13.56MHz: Internal PCB trace coil antenna BLE: Chip antenna, 0.5 dBi peak gain
Clock Frequencies	RFID: ASK Bluetooth BLE: GFSK
Port/Connectors	Wire connection port
Input Power	5V DC +/10% or 12 VDC +/-10%, 250mA, Max (3W)
Power Adapter Manufacturer/Model	N/A
Power Adapter SN	N/A
Hardware version	N/A
Software version	N/A
Simultaneous Transmission	RFID and BLE can transmit simultaneously. The simultaneous transmission has been evaluated in the testing. The RFID remains active during the operation with BLE.
Additional Info	Input voltage is 12VDC during testing

2.3 Test standard and method

Test standard	47CFR Part 15.209 47CFR Part 15.225
Test method	ANSI C63.10-2013

3 Test Site Information

Lab performing tests	Vista Laboratories, Inc.
Lab Address	1261 Puerta Del Sol, San Clemente, CA 92673 USA
Phone Number	+1 (949) 393-1123
Website	www.vista-compliance.com

Test Condition	Temperature	Humidity	Atmospheric Pressure
RF Testing	23.5°C	58.2%	996 mbar
Radiated Emission Testing	23.5°C	58.2%	996 mbar

4 Modification of EUT / Deviations from Standards

N/A

5 Test Configuration and Operation

5.1 EUT Test Configuration

The EUT is set to transmit continuously to support the RF TX/RX measurement in different aspects.

The following software was used for testing and to monitor EUT performance

Software	Description
EMISoft Vasona	EMC/RF Spurious emission test software used during testing

5.2 Supporting Equipment

Description	Manufacturer	Model #	Serial #	Remark
AC/DC Adapter	Dell	DA130PE1-00	JU012	N/A
Test Laptop	Dell	Latitude E6510	3RZC1M1	N/A
12VDC battery	DURACELL	DURDC12-5F	840821062487	N/A
DC power supply	WERKER	WK12V1000	NA	N/A

6 Uncertainty of Measurement

Test item	Measurement Uncertainty (dB)
RF Output Power (Conducted)	±1.2 dB
Unwanted Emission (conducted)	±2.6 dB
Radiated Emission (9KHz-30MHz)	±3.5 dB
Radiated Emission (30MHz-1GHz)	±4.6 dB

7 Test Results

7.1 Antenna Requirement

7.1.1 Requirement

Per § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

7.1.2 Result

Analysis:

For RFID, that antenna type is on PCB board coil or PCB trace coil antenna. There isn't standard antenna connector used.

For BLE, the antenna type is chip antenna. EUT has a u.FL connector with short RF cable to connect to the chip antenna. The u.FL connector is not a standard antenna connector and is considered a unique coupling.

Conclusion:

- EUT complies with antenna requirement in § 15.203.

7.2 Emission Mask Limit in the band of 13.110 – 14.010 MHz

7.2.1 Requirement

Per §15.225 Operation within the band 13.110–14.010 MHz:

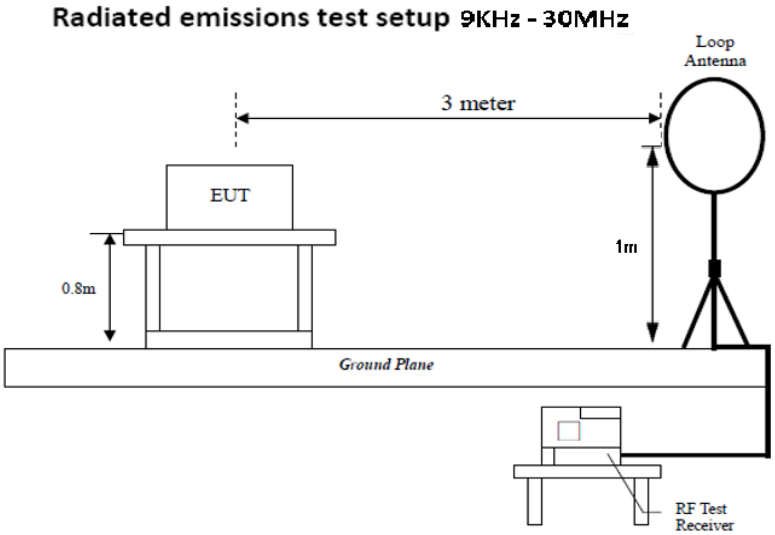
(a) The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.

(b) Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

(c) Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

(d) The field strength of any emissions appearing outside of the 13.110–14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

7.2.2 Test Setup



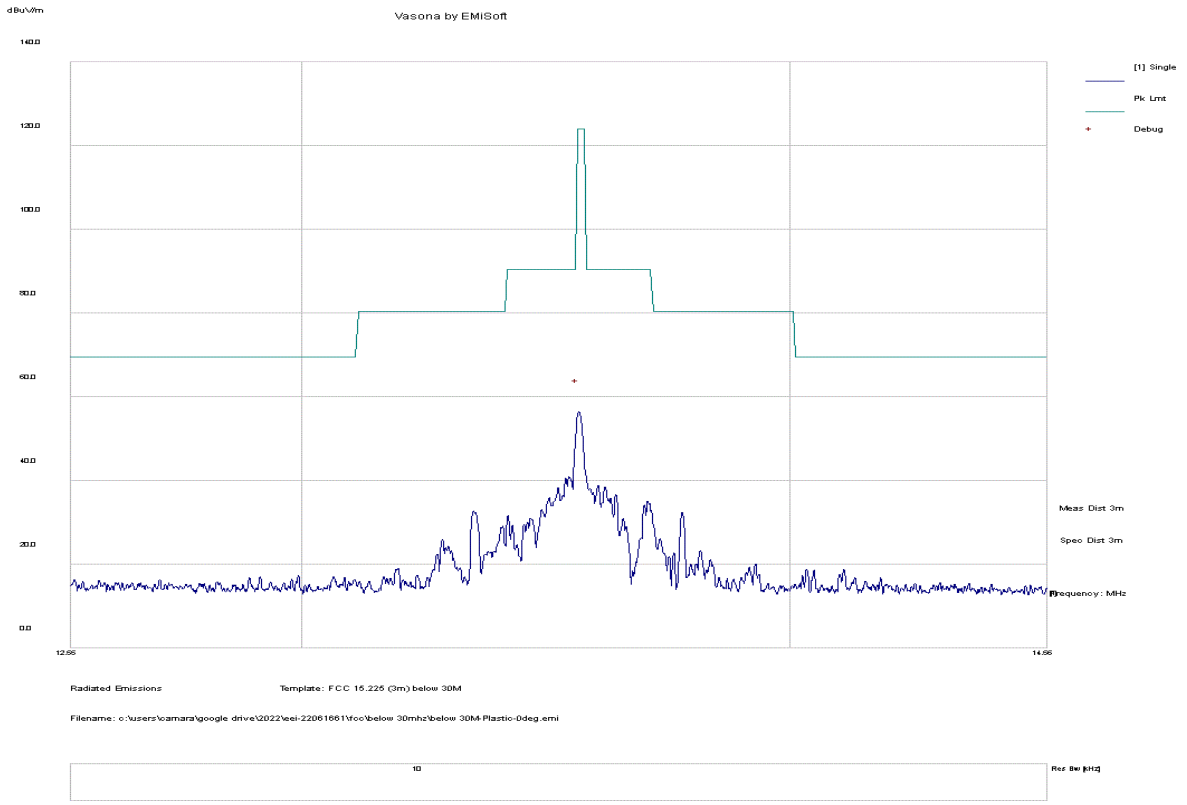
7.2.3 Test Procedure

According to section 6.4 of ANSI C63.10-2013 The process will be repeated in 3 EUT orientations.

1. The EUT was placed on a non-conducting table and switched on and allowed to warm up to its normal operating condition. Measuring loop antenna is placed at 1m height and at 3m distance away from EUT.
2. The test was carried out at the selected frequency points obtained from the EUT characterization. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna orientation at both 0 deg and 90 deg.
3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 300 Hz for frequency below 150KHz.
4. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 10 kHz for frequency between 150KHz – 30MHz.
5. Steps 2 and 4 were repeated for the next frequency point, until all selected frequency points were measured.

7.2.4 Test Result

Test Standard:	15.225	Mode:	RFID TX
Frequency Range:	Below 30MHz	Test Date:	02/24/2023
Antenna Type/Polarity:	Loop / 0 deg	Test Personnel:	Devin Tai
Remark:	N/A	Test Result:	Pass

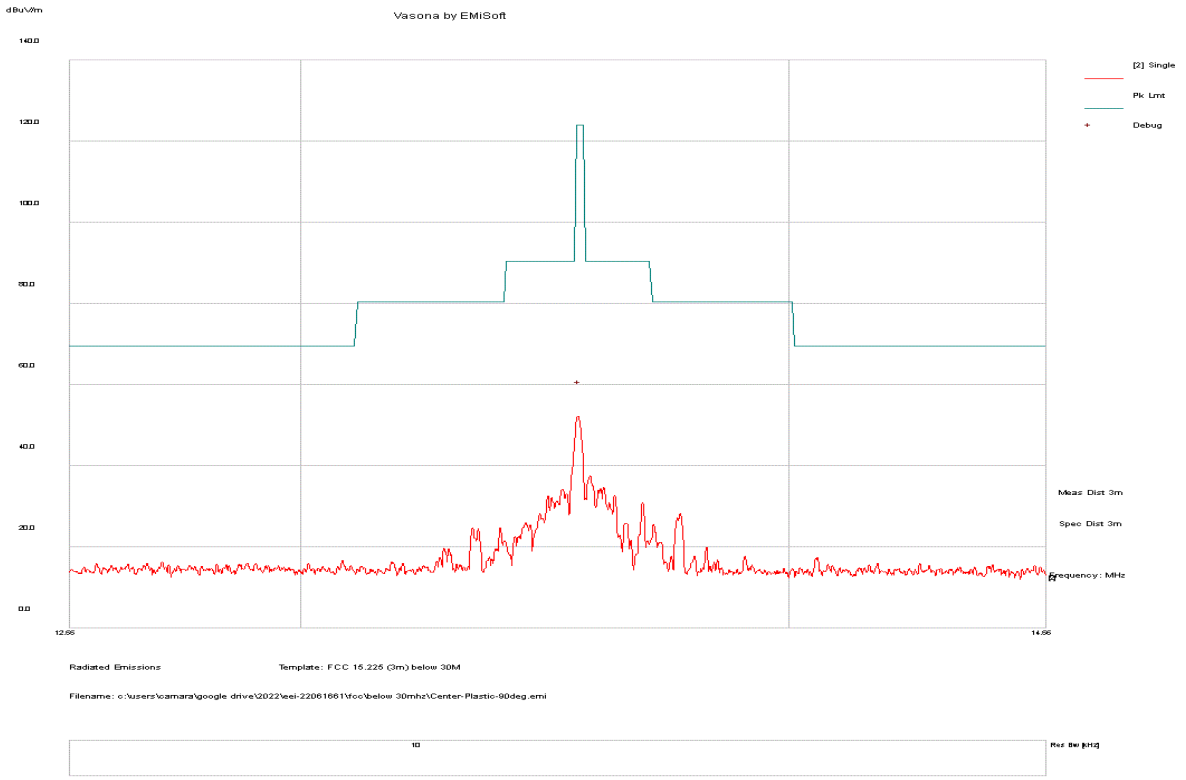


Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
13.556	38.9	1.3	15.1	55.3	QP	0	100	125	124	-68.7	Pass

Remarks:

1. Level (dBuV) = Raw (dBuV) + Cable loss(dB) + AF (dB).
2. AF(dB/m) = Antenna Factor (dB) – Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)

Test Standard:	15.225	Mode:	RFID TX
Frequency Range:	Below 30MHz	Test Date:	02/24/2023
Antenna Type/Polarity:	Loop / 90 deg	Test Personnel:	Devin Tai
Remark:	N/A	Test Result:	Pass



Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
13.561	35.6	1.3	15.1	52.1	QP	90	100	98	124	-71.9	Pass

Remarks:

1. Level (dBuV) = Raw (dBuV) + Cable loss(dB) + AF (dB).
2. AF(dB/m) = Antenna Factor (dB) – Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)

7.3 Radiated Spurious Emission below 30MHz

7.3.1 Requirement

Per §15.225 Operation within the band 13.110–14.010 MHz:

(a) The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.

(b) Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

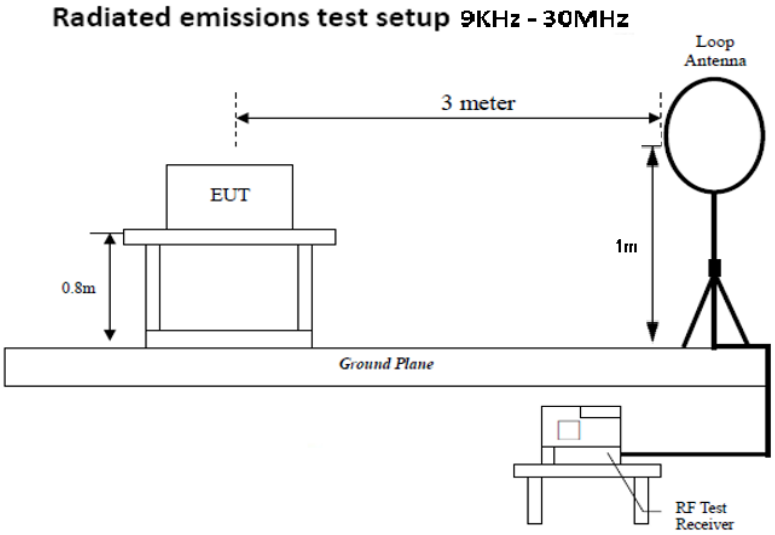
(c) Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

(d) The field strength of any emissions appearing outside of the 13.110–14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

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)).

Frequency Range (MHZ)	Field Strength (μV/m)
0.009~0.490	2400/F(KHz)
0.490~1.705	24000/F(KHz)
1.705~30.0	30
30 – 88	100
88 – 216	150
216 960	200
Above 960	500

7.3.2 Test Setup



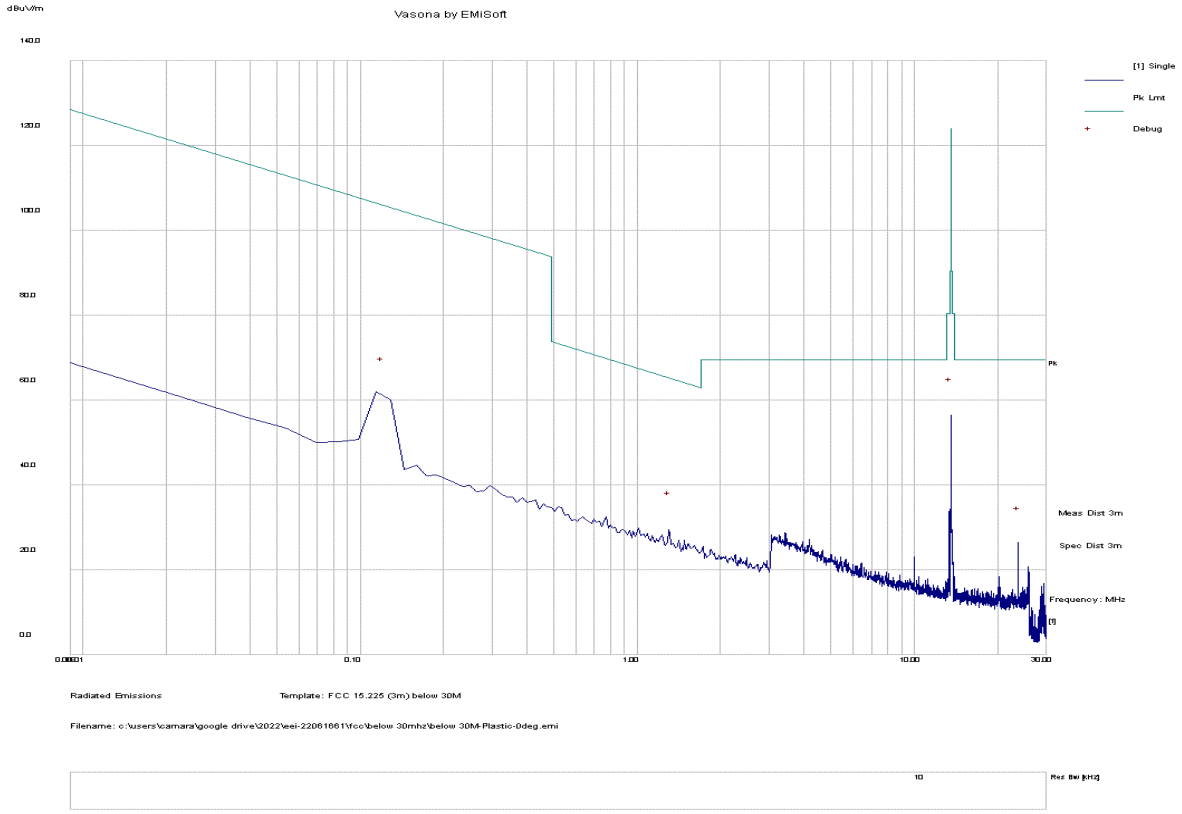
7.3.3 Test Procedure

According to section 6.4 of ANSI C63.10-2013 The process will be repeated in 3 EUT orientations.

1. The EUT was placed on a non-conducting table and switched on and allowed to warm up to its normal operating condition. Measuring loop antenna is placed at 1m height and at 3m distance away from EUT.
2. The test was carried out at the selected frequency points obtained from the EUT characterization. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna orientation at both 0 deg and 90 deg.
3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 300 Hz for frequency below 150KHz.
4. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 10 kHz for frequency between 150KHz – 30MHz.
5. Steps 2 and 4 were repeated for the next frequency point, until all selected frequency points were measured.

7.3.4 Test Result

Test Standard:	15.209, 15.225	Mode:	125KHz & 13.56MHz RFID TX
Frequency Range:	Below 30MHz	Test Date:	02/24/2023
Antenna Type/Polarity:	Loop / 0 deg	Test Personnel:	Devin Tai
Remark:	N/A	Test Result:	Pass

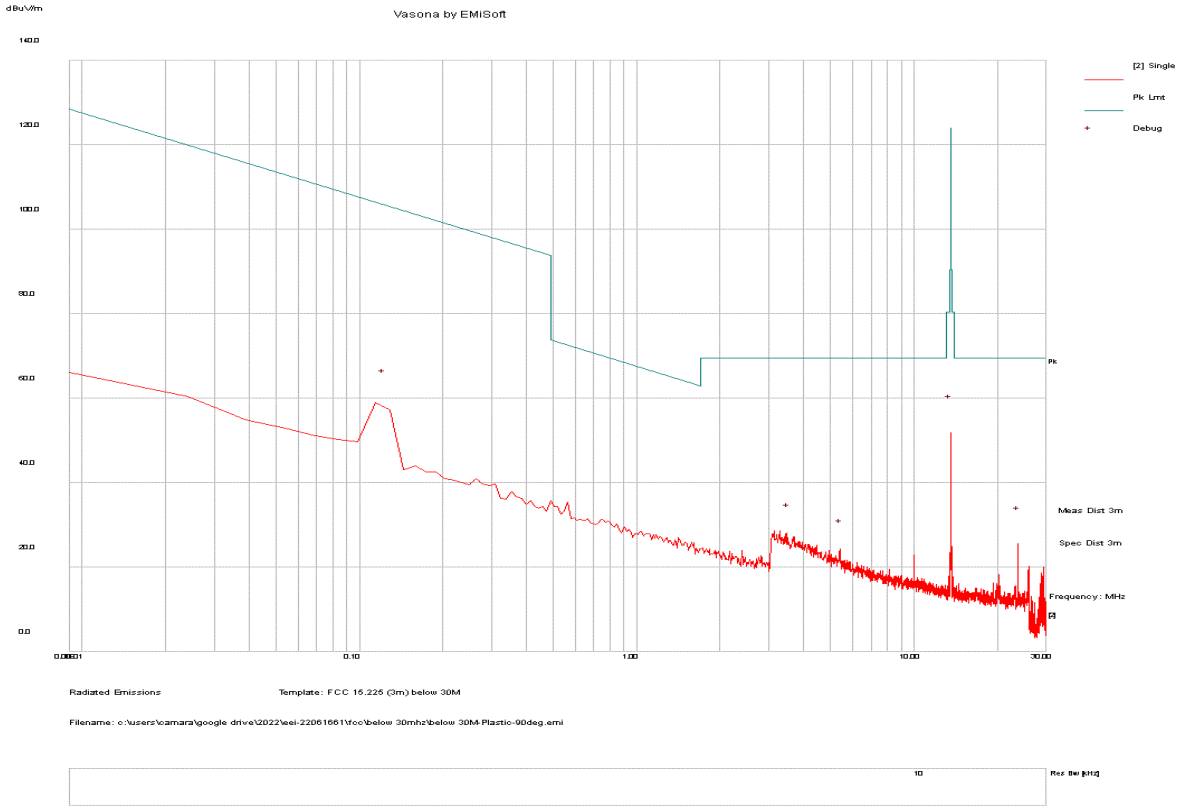


Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
0.12466	46.2	0.6	14.4	61.1	Peak	0	100	343	105.7	-44.6	Pass
1.299	13.7	0.8	15	29.5	Peak	0	100	347	65.3	-35.8	Pass
13.555	39.8	1.3	15.1	56.3	Peak	0	100	319	124.0	-67.7	Pass
23.738	9.4	2	14.7	26	Peak	0	100	192	69.5	-43.5	Pass

Remarks:

1. Level (dBuV) = Raw (dBuV) + Cable loss(dB) + AF (dB).
2. AF(dB/m) = Antenna Factor (dB) – Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)

Test Standard:	15.209, 15.225	Mode:	125KHz & 13.56MHz RFID TX
Frequency Range:	Below 30MHz	Test Date:	02/24/2023
Antenna Type/Polarity:	Loop / 90 deg	Test Personnel:	Devin Tai
Remark:	N/A	Test Result:	Pass



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
0.124737	43.1	0.6	14.4	58	Peak	90	100	109	105.7	-47.7	Pass
3.51	10.3	0.9	15	26.2	Peak	90	100	190	69.5	-43.3	Pass
13.564	35.4	1.3	15.1	51.9	Peak	90	100	265	124	-72.1	Pass
23.739	8.8	2	14.7	25.4	Peak	90	100	352	69.5	-44.1	Pass
5.417	6.3	0.9	15.2	22.4	Peak	90	100	260	69.5	-47.1	Pass

Remarks:

1. Level (dBuV) = Raw (dBuV) + Cable loss(dB) + AF (dB).
2. AF(dB/m) = Antenna Factor (dB) – Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)

7.4 Radiated Spurious Emissions below 1GHz

7.4.1 Requirement

Per §15.225 Operation within the band 13.110–14.010 MHz:

(a) The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.

(b) Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

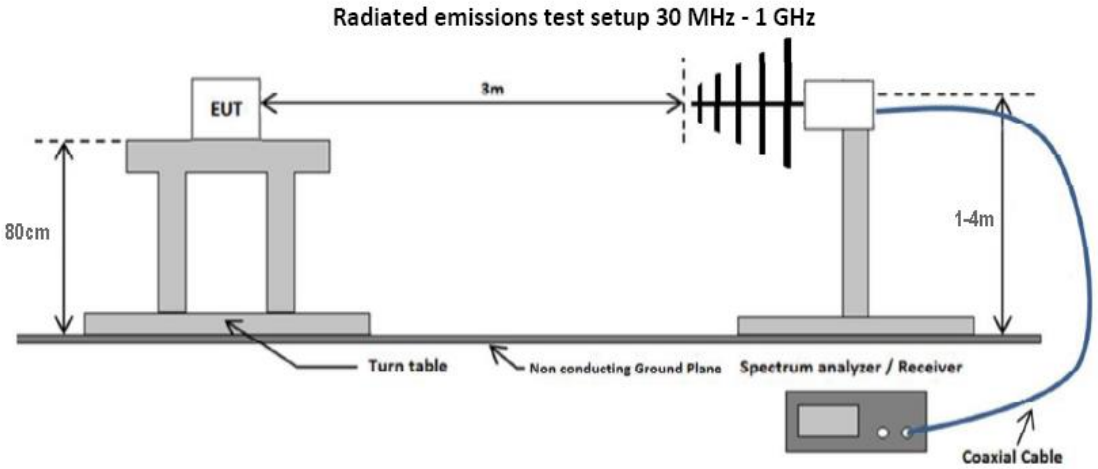
(c) Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

(d) The field strength of any emissions appearing outside of the 13.110–14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

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)).

Frequency Range (MHZ)	Field Strength (μV/m)
0.009~0.490	2400/F(KHz)
0.490~1.705	24000/F(KHz)
1.705~30.0	30
30 – 88	100
88 – 216	150
216 960	200
Above 960	500

7.4.2 Test Setup



7.4.3 Test Procedure

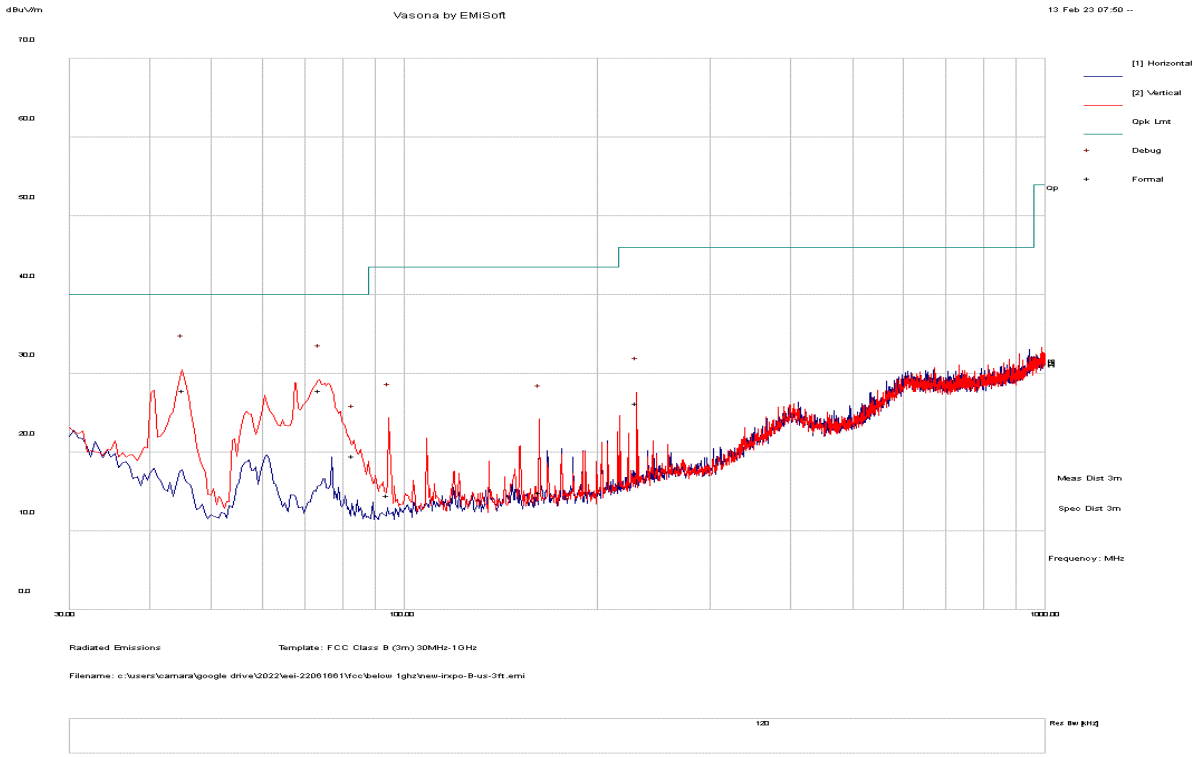
According to section 6.5 of ANSI C63.10-2013 as well as the procedures for maximizing and measuring radiated emissions that are described in ANSI C63.10 was followed. Boresight antenna mast was used during the scanning to point to EUT to maximize the emission. The process will be repeated in 3 EUT orientations.

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. The test was carried out at the selected frequency points obtained from the EUT characterization. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
   a. Vertical or horizontal polarization (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
   b. The EUT was then rotated to the direction that gave the maximum emission.
   c. Finally, the antenna height was adjusted to the height that gave the maximum emission.
3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 300 Hz for frequency below 150KHz.
4. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 10 kHz for frequency between 150KHz – 30MHz.
5. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-Peak detection at frequency between 30MHz - 1GHz.
6. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz with Peak detection for Peak and average measurement at frequency above 1GHz.
7. Steps 2 and 3 were repeated for the next frequency point, until all selected frequency points were measured.

7.4.4 Test Result

RADIATED EMISSIONS BELOW 1 GHZ

Test Standard:	15.209, 15.225	Mode:	125KHz & 13.56MHz RFID TX
Frequency Range:	30 MHz - 1 GHz	Test Date:	02/13/2023
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Zach Peng
Remark:	N/A	Test Result:	Pass



Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
45.145	44.7	2.7	-19.5	27.9	Quasi Max	V	111	62	40	-12.1	Pass
73.839	44.8	3.2	-20.2	27.9	Quasi Max	V	101	254	40	-12.1	Pass
230.487	36.7	5.1	-15.5	26.2	Quasi Max	V	217	218	46	-19.8	Pass
83.343	36.5	3.4	-20.2	19.6	Quasi Max	V	100	270	40	-20.4	Pass
94.313	30.7	3.5	-19.7	14.5	Quasi Max	V	112	163	43.5	-29	Pass
162.642	28.2	4.4	-17.6	15	Quasi Max	V	320	182	43.5	-28.5	Pass

Remarks:

1. Level (dBuV) = Raw (dBuV) + Cable loss(dB) + AF (dB).
2. AF(dB/m) = Antenna Factor (dB) – Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)

7.5 Conducted Emissions

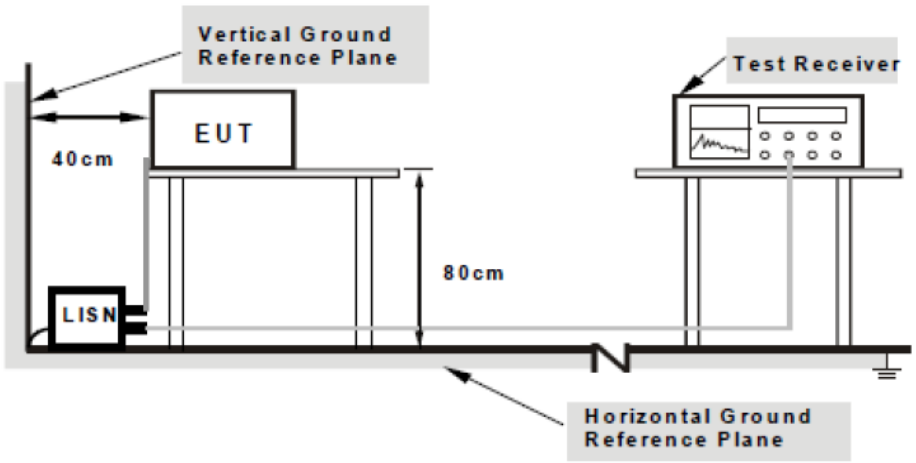
7.5.1 Requirement

Per § 15.207 (a) and RSS-Gen, an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Limits for Conducted Emissions at the Mains Ports

Section	Frequency ranges (MHz)	Limit (dBuV)	
		QP	Average
Class B devices	0.15 – 0.5	66 – 56	56 – 46
	0.5 – 5	56	46
	5 - 30	60	50
NOTE 1 The lower limit shall apply at the transition frequencies.			

7.5.2 Test setup



Note: 1.Support units were connected to second LISN.
2.Both of LISNs (AMN) are 80cm from EUT and at least 80cm from other units and other metal planes support units.

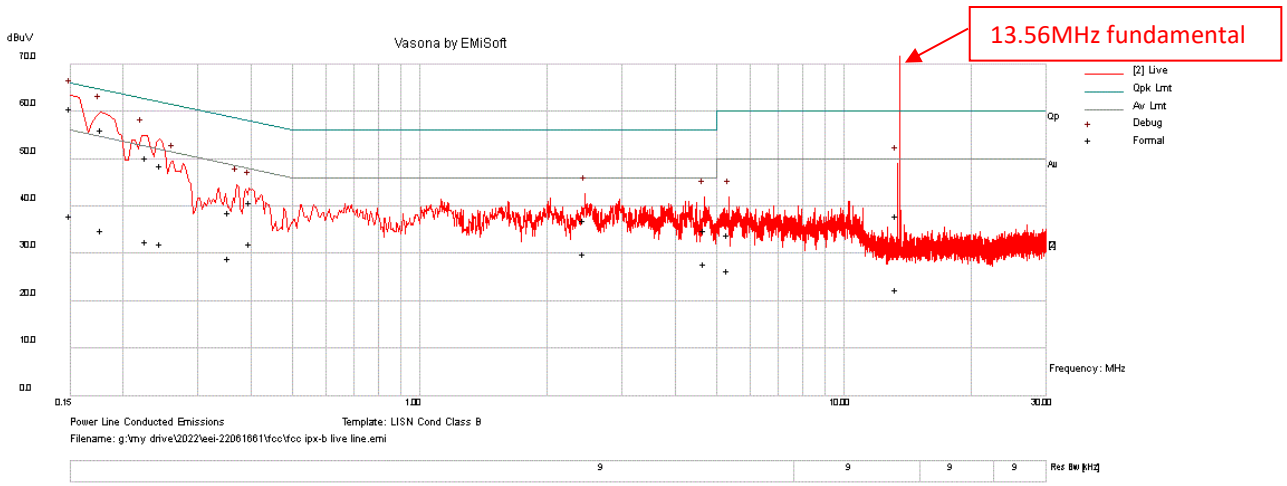
7.5.3 Test Procedure

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table.
2. The power supply for the EUT was fed through a 50Ω/50µH EUT LISN, connected to filtered mains.
3. The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss coaxial cable.
4. All other supporting equipment was powered separately from another main supply.
5. The EUT was switched on and allowed to warm up to its normal operating condition.
6. A scan was made on the NEUTRAL line (for AC mains) or Earth line (for DC power) over the required frequency range using an EMI test receiver.
7. High peaks, relative to the limit line, were then selected.
8. The EMI test receiver was then tuned to the selected frequencies and the necessary measurements made with a receiver bandwidth setting of 10 kHz. Both Quasi-peak and Average measurements were made
9. All possible modes of operation were investigated. Only the worst case emissions were measured and reported. All other emissions were relatively insignificant.

7.5.4 Test Result

CONDUCTED EMISSIONS

Test Standard:	LISN B Cond Class B	Mode:	Normal operation
Frequency Range:	0.15 - 30MHz	Test Date:	03/02/2023
Line:	Live	Test Personnel:	Zach Peng
Remark:	Tested with supporting power adapter	Test Result:	Pass

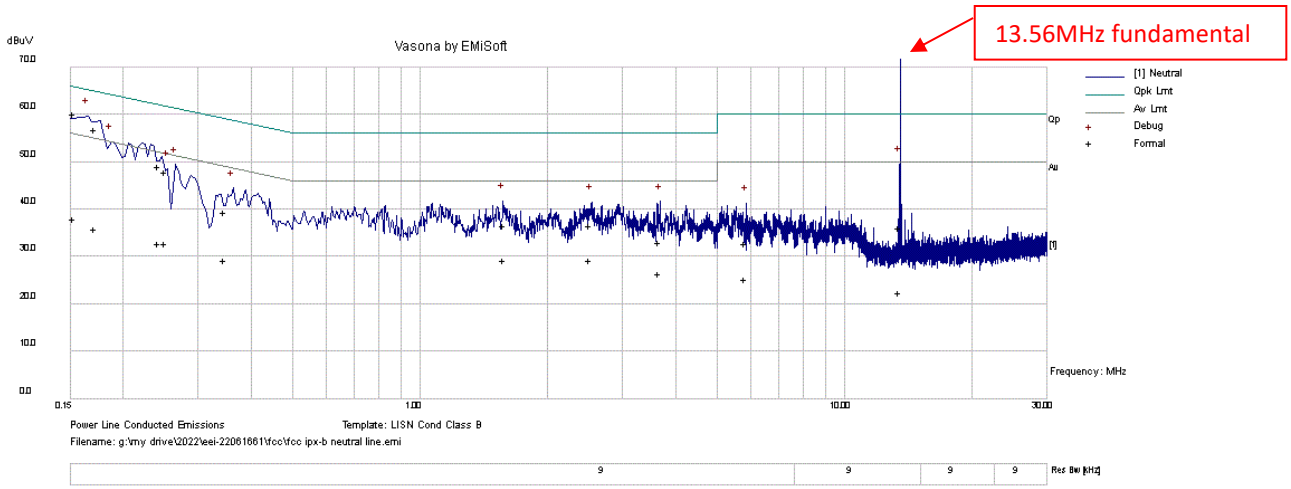


No.	Frequency MHz	Raw dBuV	Cable Loss dB	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB	Pass/Fail
1	0.15	50.2	10.1	0.2	60.5	Quasi Peak	Live	66	-5.4	Pass
2	0.179	45.8	10.1	0.2	56.1	Quasi Peak	Live	64.6	-8.4	Pass
3	0.227	40.1	10.1	0.2	50.3	Quasi Peak	Live	62.6	-12.2	Pass
4	0.246	38.4	10.1	0.2	48.6	Quasi Peak	Live	61.9	-13.3	Pass
5	2.445	26.7	10.2	0.1	37.1	Quasi Peak	Live	56	-18.9	Pass
6	0.355	28.5	10.1	0.1	38.7	Quasi Peak	Live	58.9	-20.1	Pass
7	4.688	24.5	10.4	0.1	35	Quasi Peak	Live	56	-21	Pass
8	0.398	30.6	10.1	0.1	40.8	Quasi Peak	Live	57.9	-17.1	Pass
9	5.346	23.4	10.4	0.2	34	Quasi Peak	Live	60	-26	Pass
10	0.15	27.7	10.1	0.2	38	Average	Live	56	-18	Pass
11	0.179	24.7	10.1	0.2	35	Average	Live	54.6	-19.6	Pass
12	0.227	22.3	10.1	0.2	32.5	Average	Live	52.6	-20	Pass
13	0.246	21.9	10.1	0.2	32.1	Average	Live	51.9	-19.8	Pass
14	2.445	19.5	10.2	0.1	29.9	Average	Live	46	-16.1	Pass
15	0.355	18.9	10.1	0.1	29.1	Average	Live	48.9	-19.7	Pass
16	4.688	17.3	10.4	0.1	27.8	Average	Live	46	-18.2	Pass
17	0.398	21.9	10.1	0.1	32.1	Average	Live	47.9	-15.8	Pass
18	5.346	15.9	10.4	0.2	26.5	Average	Live	50	-23.5	Pass

Remarks:

1. Level (dBuV) = Raw (dBuV) + Cable loss(dB) + Factor (dB).
2. Margin = Level (dBuV) - Limit value(dBuV)
3. The emission at 13.56MHz is from the RFID's intentional fundamental emission.

Test Standard:	LISN B Cond Class B	Mode:	Normal operation
Frequency Range:	0.15 - 30MHz	Test Date:	03/02/2023
Line:	Neutral	Test Personnel:	Zach Peng
Remark:	Tested with supporting power adapter	Test Result:	Pass



No.	Frequency MHz	Raw dBuV	Cable Loss dB	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB	Pass/Fail
1	0.153	49.9	10.1	0.2	60.3	Quasi Peak	Neutral	65.8	-5.6	Pass
2	0.172	46.6	10.1	0.2	56.9	Quasi Peak	Neutral	64.9	-7.9	Pass
3	0.252	37.7	10.1	0.2	48	Quasi Peak	Neutral	61.7	-13.7	Pass
4	0.243	38.9	10.1	0.2	49.1	Quasi Peak	Neutral	62	-12.9	Pass
5	0.346	29.3	10.1	0.1	39.5	Quasi Peak	Neutral	59.1	-19.6	Pass
6	1.579	26.2	10.2	0.1	36.5	Quasi Peak	Neutral	56	-19.5	Pass
7	3.664	22.7	10.3	0.1	33.2	Quasi Peak	Neutral	56	-22.8	Pass
8	2.519	26.2	10.3	0.1	36.6	Quasi Peak	Neutral	56	-19.4	Pass
9	5.853	22.2	10.4	0.2	32.8	Quasi Peak	Neutral	60	-27.2	Pass
10	0.153	27.8	10.1	0.2	38.1	Average	Neutral	55.8	-17.7	Pass
11	0.172	25.5	10.1	0.2	35.8	Average	Neutral	54.9	-19.1	Pass
12	0.252	22.5	10.1	0.2	32.8	Average	Neutral	51.7	-18.9	Pass
13	0.243	22.5	10.1	0.2	32.7	Average	Neutral	52	-19.3	Pass
14	0.346	19.2	10.1	0.1	29.4	Average	Neutral	49.1	-19.7	Pass
15	1.579	19.1	10.2	0.1	29.4	Average	Neutral	46	-16.6	Pass
16	3.664	16.1	10.3	0.1	26.6	Average	Neutral	46	-19.4	Pass
17	2.519	19	10.3	0.1	29.4	Average	Neutral	46	-16.6	Pass
18	5.853	14.7	10.4	0.2	25.3	Average	Neutral	50	-24.7	Pass

Remarks:

1. Level (dBuV) = Raw (dBuV) + Cable loss(dB) + Factor (dB).
2. Margin = Level (dBuV) - Limit value(dBuV)
3. The emission at 13.56MHz is from the RFID's intentional fundamental emission.

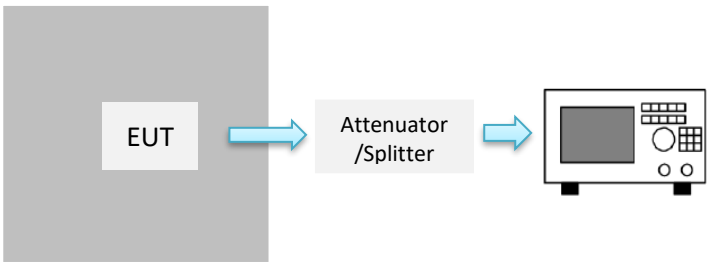
7.6 Frequency Stability

7.6.1 Requirement

Per §15.225 Operation within the band 13.110–14.010 MHz:

(e) The frequency tolerance of the carrier signal shall be maintained within ±0.01% of the operating frequency over a temperature variation of −20 degrees to + 50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

7.6.2 Test Setup



7.6.3 Test Procedure

According to section 6.8 of ANSI C63.10-2013

The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW ≥ 3 × RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.

1. Set RBW = 1% to 5% of the actual occupied BW.
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Span = large enough to capture all products of the modulation process
7. Allow the trace to stabilize.
8. Use automatic bandwidth measurement capability on instrument to obtain BW result.

7.6.4 Test Result

Frequency Stability versus Temperature: The Frequency tolerance of the carrier signal shall be maintained within ± 0.01% of the operating frequency over a temperature variation of -20ºC to +50ºC at normal supply voltage.

Reference Frequency: 13.56MHz at 20°C at 12 Vdc

Frequency Stability						
Temperature	Test Mode	Frequency (MHz)	Measured Freq.	Freq. Drift (%)	Freq. Deviation (Limit: 0.01%)	Result
50	RFID	13.56	13.5591	-0.0066	<0.01	Pass
40	RFID	13.56	13.5597	-0.0022	<0.01	Pass
30	RFID	13.56	13.5593	-0.0052	<0.01	Pass
20	RFID	13.56	Reference			
10	RFID	13.56	13.5592	-0.0059	<0.01	Pass
0	RFID	13.56	13.5595	-0.0037	<0.01	Pass
-10	RFID	13.56	13.5591	-0.0066	<0.01	Pass
-20	RFID	13.56	13.5598	-0.0015	<0.01	Pass

Frequency Stability versus Input Voltage: The Frequency tolerance of the carrier signal shall be maintained within ± 0.01%, the frequency of the transmitter was measured at 85% and at 115% of the rated power supply voltage at a 20ºC environmental temperature.

Carrier Frequency: 13.56MHz at 20°C at 12Vdc

Measured Voltage ±15% of nominal (VDC)	Measured Freq. (MHz)	Freq. Drift (%)	Freq. Deviation (Limit: 0.01%)	Pass/Fail
13.8	13.5596	-0.0029	<0.01	Pass
10.2	13.5595	-0.0037	<0.01	Pass

8 EUT and Test Setup Photos

See FCC exhibits

9 Test Instrument List

Equipment	Manufacturer	Model	Instrument Number	Cal. Date	Cal. Due
Semi-Anechoic Chamber	ETS-Lindgren	10M	VL001	10/18/2022	10/18/2023
Shielding Control Room	ETS-Lindgren	Series 81	VL006	N/A	N/A
Spectrum Analyzer	Keysight	N9020A	MY50110074	06/09/2022	06/09/2023
EMC Test Receiver	R&S	ESL6	100230	06/07/2022	06/07/2023
LISN (9KHz – 30MHz)	EMCO	3816/2	9705-1066	07/12/2022	07/12/2023
Bi-Log Antenna	ETS-Lindgren	3142E	217921	07/19/2022	07/19/2023
Horn Antenna (1-18GHz)	Electro-Metrics	EM-6961	6292	07/21/2022	07/21/2023
Horn Antenna (18-40GHz)	Com-Power	AH-840	101109	07/21/2022	07/21/2023
Preamplifier	RF Bay, Inc.	LPA-10-20	11180621	07/16/2022	07/16/2023
True RMS Multi-meter	UNI-T	UT181A	C173014829	06/07/2022	06/07/2023
Temp / Humidity / Pressure Meter	PCE Instruments	PCE-THB 40	R062028	06/07/2022	06/07/2023
RF Attenuator	Pasternack	PE7005-3	VL061	07/16/2022	07/16/2023
Preamplifier 100KHz - 40GHz	Aeroflex	33711-392-77150-11	064	07/16/2022	07/16/2023
EM Center Control	ETS-Lindgren	7006-001	160136	N/A	N/A
Turn Table	ETS-Lindgren	2181-3.03	VL002	N/A	N/A
Boresight Antenna Tower	ETS-Lindgren	2171B	VL003	N/A	N/A
Loop Antenna (9k-30MHz)	Com-Power	AL-130	121012	06/10/2022	06/10/2023
RE test cable(below 6GHz)	Vista	RE-6GHz-01	RE-6GHz-01	07/16/2022	07/16/2023
RE test cable (1-18GHz)	PhaseTrack	II-240	RE-18GHz-01	07/16/2022	07/16/2023
RE test cable (>18GHz)	Sucoflex	104	344903/4	07/16/2022	07/16/2023
Pulse limiter	Com-Power	LIT-930A	531727	07/16/2022	07/16/2023
CE test cable #1	FIRST RF	FRF-C-1002-001	CE-6GHz-01	07/16/2022	07/16/2023
CE test cable#2	FIRST RF	FRF-C-1002-001	CE-6GHz-02	07/16/2022	07/16/2023

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