

FCC/ISED DXX Part 15.225 Test Report

Prepared for: Labstrong International Inc.

Address: 7709 Commerce Park
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United States

Product: EA00351 NFC Controller

Test Report No: R20190211-23-03A

Approved By:



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	Report Number:	R20190211-23-03	Rev	A
	Prepared for:	Labstrong International Inc.		

Revision Page

Rev. No.	Date	Description
Original	25 August 2022	Original – Prepared by KVepuri Approved by NJohnson
A	3 September 2022	Added additional clarification to Sections 3.1.1 and 2.3. -NJ

	Report Number:	R20190211-23-03	Rev	A
	Prepared for:	Labstrong International Inc.		

TABLE OF CONTENTS

1	Summary of Test Results	4
1.1	Emissions Test Results	4
2	EUT Description.....	5
2.1	Equipment under Test (EUT)	5
2.2	Laboratory Description	5
2.3	EUT Setup	5
3	Test Results	6
3.1	Radiated Emissions, Band Width, Output Power and Band edge	6
3.2	Frequency Error	13
3.3	Conducted Emissions.....	15
	Annex A: Measurement Uncertainty.....	18
	Annex B: Sample Field Strength Calculation	19
	REPORT END	21

	Report Number:	R20190211-23-03	Rev	A
	Prepared for:	Labstrong International Inc.		

1 Summary of Test Results

The EUT was tested for compliance to the following standards and/or regulations;

1.1 Emissions Test Results

The EUT was tested for compliance to:

US CFR Title 47 FCC Part 15.225

RSS-210 Issue 10

RSS-Gen Issue 5

Below is a summary of the test results. Complete results of testing can be found in Section 3.

Table 1 – Emissions Test Results

Emissions Tests	Test Method and Limits	Result
Radiated Emissions	FCC Part 15.225 (a), (b), (c), (d) RSS-210 Issue 10, B.6	Complies
Frequency Error	FCC Part 15.225 (e) RSS-210 Issue 10, B.6 (b)	Complies
Conducted Emissions	FCC Part 15.207 RSS-Gen Issue 5, Sec 8.8	Complies

	Report Number:	R20190211-23-03	Rev	A
	Prepared for:	Labstrong International Inc.		

2 EUT Description

The Equipment Under Test (EUT) was an NFC transceiver from Labstrong.

2.1 Equipment under Test (EUT)

Table 2 – Equipment under Test (EUT)

Model	EA00351 NFC Controller
EUT Received	20 January 2022
EUT Tested	20 January 2022
Serial No.	010106 (assigned by Lab)
Operating Band	13.56 MHz
Device Type	Low-power
Antenna	Trace Antenna

2.2 Laboratory Description

All testing was performed at the following Facility:

The Nebraska Center for Excellence in Electronics (NCEE Labs)
 4740 Discovery Drive
 Lincoln, NE 68521

A2LA Certificate Number: 1953.01
 FCC Accredited Test Site Designation No: US1060
 Industry Canada Test Site Registration No: 4294A-1
 NCC CAB Identification No: US0177

Environmental conditions varied slightly throughout the tests:

Relative humidity of $35 \pm 4\%$
 Temperature of $22 \pm 3^{\circ}\text{C}$

2.3 EUT Setup

The EUT was powered by 12 VDC for all tests. The 12 VDC was supplied from a typical host device that was placed on the floor during testing with a long extension cable leading to the module. The EUT was tested with production firmware and a tag was used to initiate transmit

	Report Number:	R20190211-23-03	Rev	A
	Prepared for:	Labstrong International Inc.		

3 Test Results

3.1 Radiated Emissions, Band Width, Output Power and Band edge

Test:	FCC Part 15.225 (a), (b), (c), (d) using ANSI C63.10, Sections 6.4, 6.5, and 6.9
Test Result:	Complies

3.1.1 Test Description

All radiated emissions and fundamental emission measurements were made from 30MHz to 1GHz at a distance of 3m (Radiated Emissions and Band edges) and 1m (Band width and Output Power) inside a semi-anechoic chamber. The EUT was rotated 360°, the antenna height varied from 1-4 meters and both the vertical and horizontal antenna polarizations examined. The results were compared against the limits. Measurements were made by first using a spectrum analyzer to acquire the signal spectrum; individual frequencies were then measured using a CISPR 16.1 compliant receiver with the following bandwidth setting:

30MHz – 1GHz:120kHz IF bandwidth, 60kHz steps

10MHz – 30MHz, 9kHz RBW, 5 kHz steps

3.1.2 Test Results

No radiated emissions measurements were found in excess of the limits. Test result data can be seen below.

3.1.3 Test Environment

Testing was performed at the NCEE Labs Lincoln facility in the 10m semi-anechoic chamber. Laboratory environmental conditions varied slightly throughout the test:

Relative humidity of $30 \pm 5\%$

Temperature of $23 \pm 2^\circ \text{C}$

3.1.4 Test Setup

See Section 2.3 for further details. Power supply used was AC/DC M/N:TR30RAM120.

3.1.5 Test Equipment Used

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE	CALIBRATION DUE DATE
Keysight MXE Signal Analyzer (26.5GHz)	N9038A	MY56400083	July 19, 2022	July 19, 2024
SunAR RF Motion	JB1	A091418	July 27, 2021	July 27, 2022***
Com-Power	AI-130R	10160084	2022 Apr 12	2023 Apr 12
TDK Emissions Lab Software	V11.25	700307	NA	NA

*Two Year Calibration Cycle

	Report Number:	R20190211-23-03	Rev	A
	Prepared for:	Labstrong International Inc.		

3.1.6 Test Pictures and/or Figures

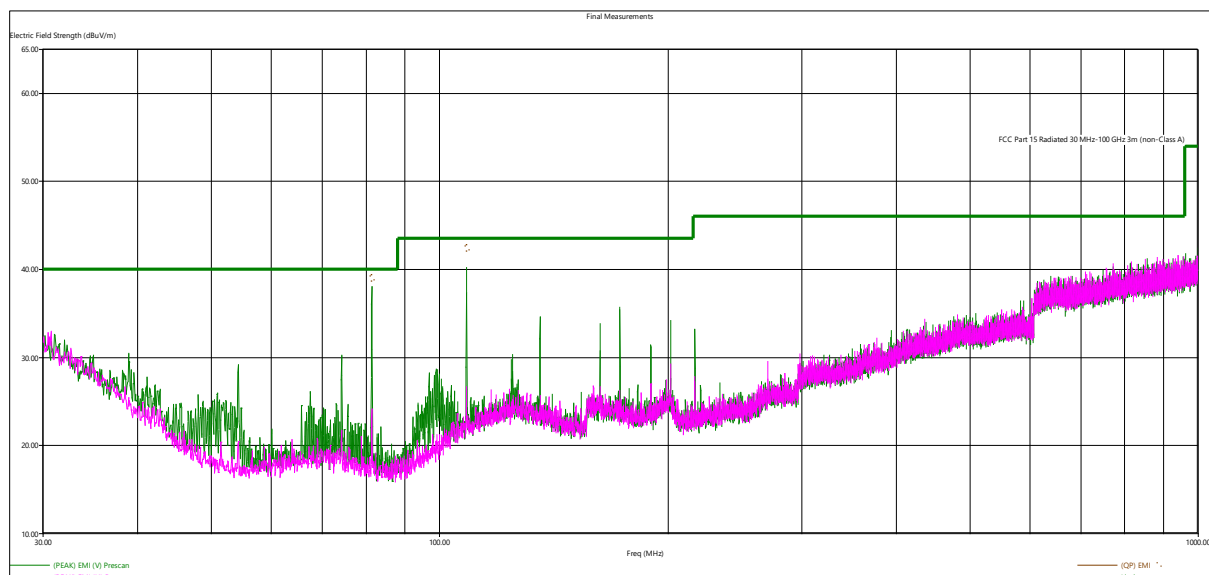


Figure 1 – Radiated Emissions Plot, 30 MHz- 1 GHz

Table 3 – Radiated Emissions QP Data

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBμV/m	dBμV/m	dB	cm.	deg	
81.389040	38.96	40.00	1.04	104.00	310.00	V
108.492240	42.37	43.52	1.15	112.00	71.00	V

	Report Number:	R20190211-23-03	Rev	A
	Prepared for:	Labstrong International Inc.		

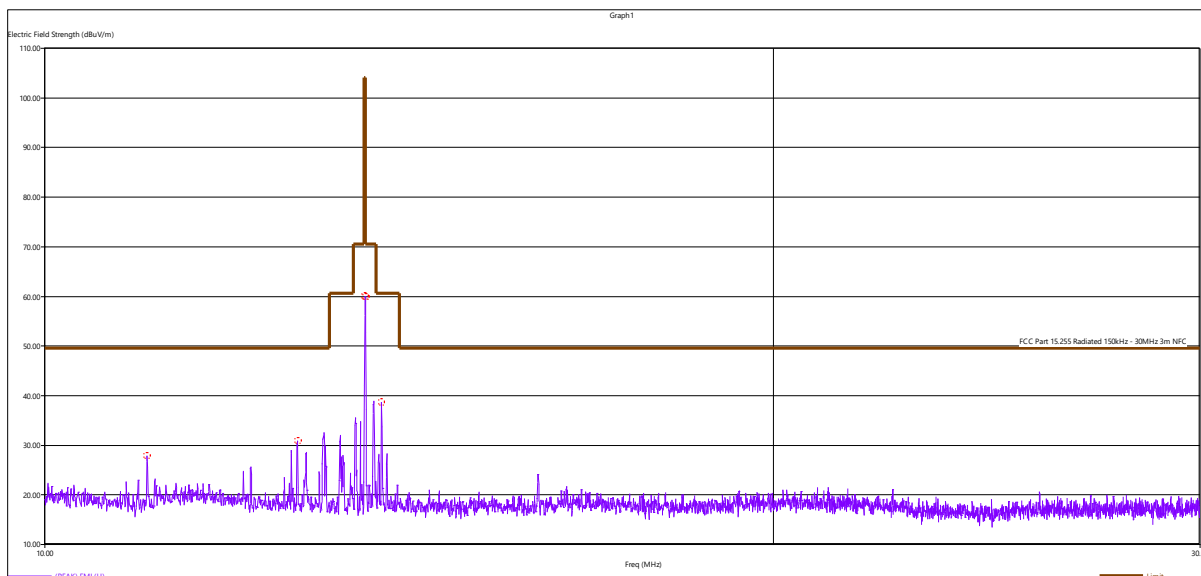


Figure 2 – Radiated Emissions Peak Plot, Vertical Polarization, 10 MHz- 30 MHz

Limit Extrapolation: 103.99 within the band 13.553-13.567 and 49.54 outside the band (Extrapolated from 30 m to 3 m)

Loop antenna was used in all three axis, worst axis is reported.

Frequency	Level	Limit	Margin
MHz	dB μ V/m	dB μ V/m	dB
11.022000	27.82	49.54	21.72
12.714000	30.88	49.54	18.66
13.560000	59.98	104.00	44.02
13.564500	59.85	104.00	44.15
13.776000	38.55	60.51	21.96

	Report Number:	R20190211-23-03	Rev	A
	Prepared for:	Labstrong International Inc.		

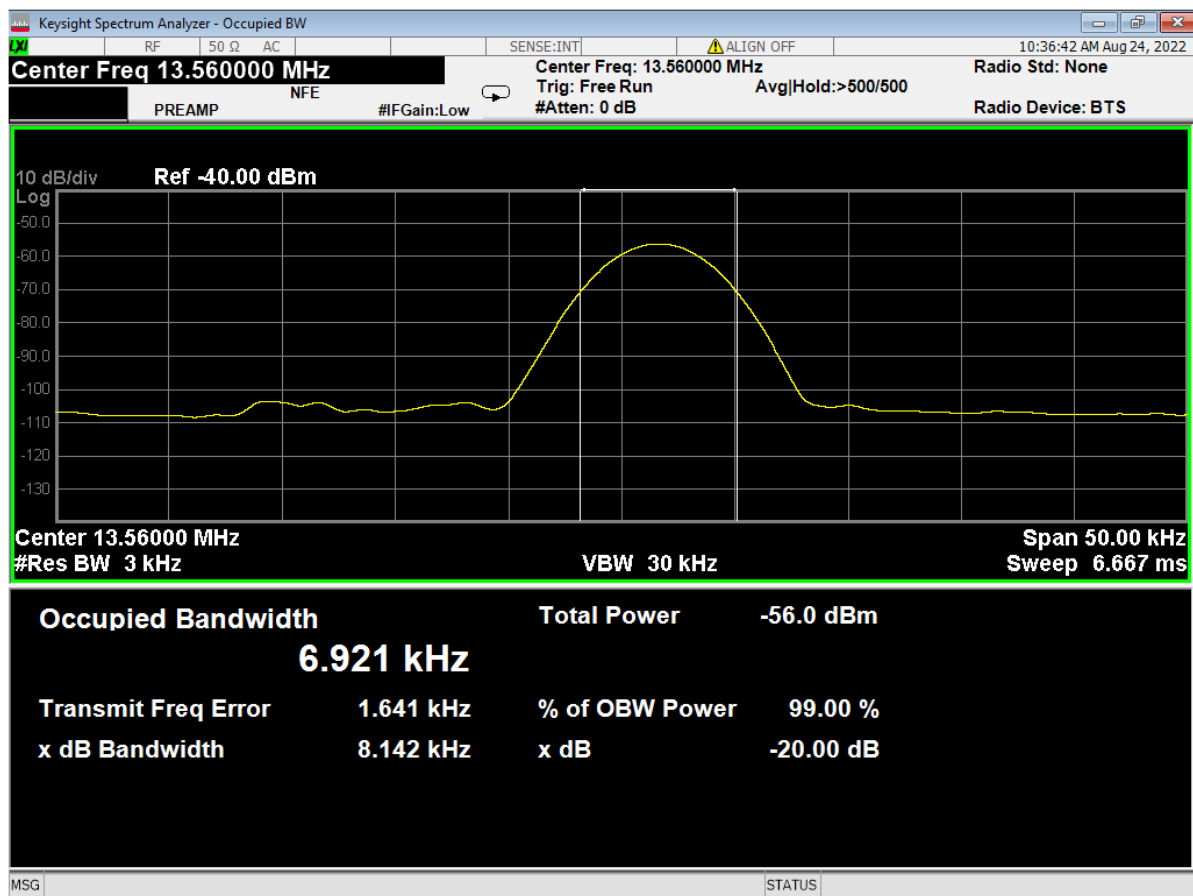


Figure 3 - 99% Occupied Bandwidth

	Report Number:	R20190211-23-03	Rev	A
	Prepared for:	Labstrong International Inc.		

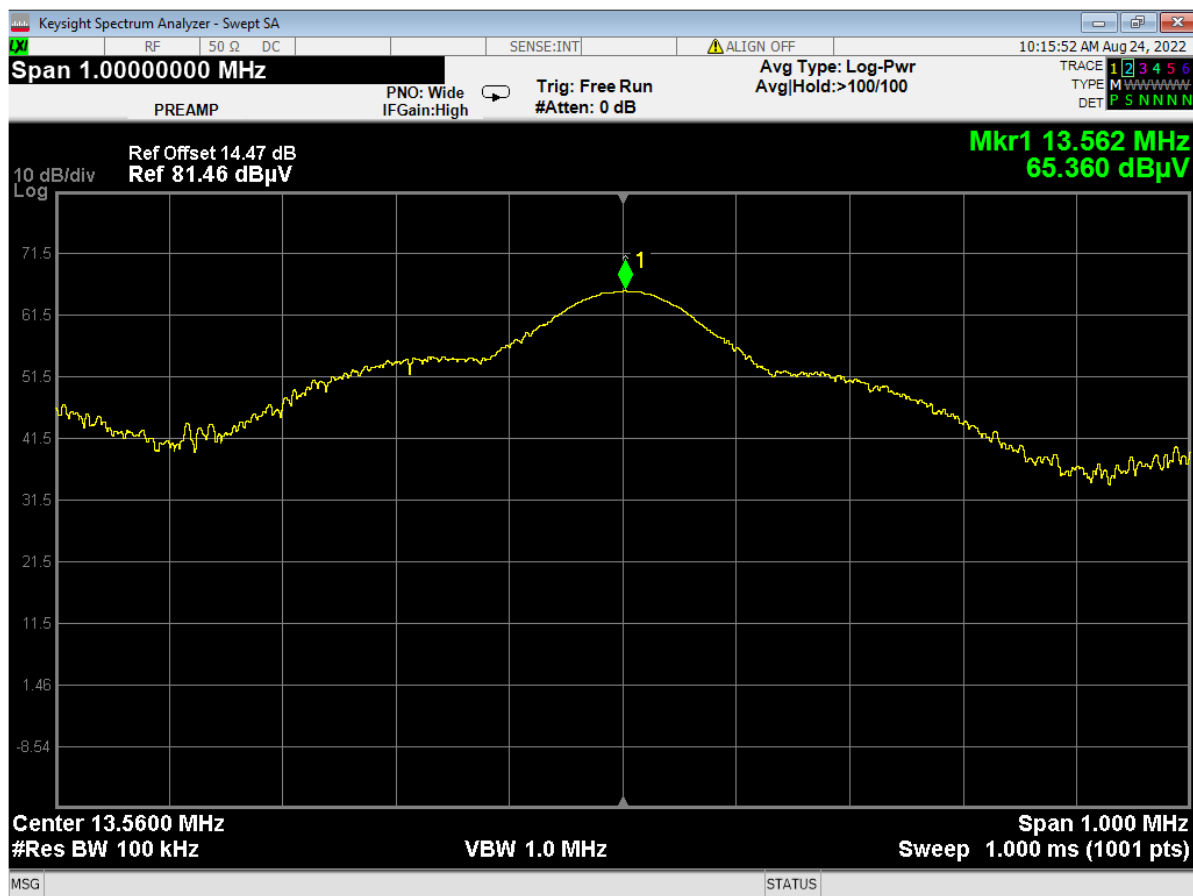


Figure 4 – Output Power, NFC

Figure 5 – Field Strength

Corrected level dBμV/m@ 3m	Corrected level dBμV/m@ 30m	Limit @30m	Margin	Result
65.360	45.360	83.99	38.63	PASS

	Report Number:	R20190211-23-03	Rev	A
	Prepared for:	Labstrong International Inc.		

Band Edge Measurements:

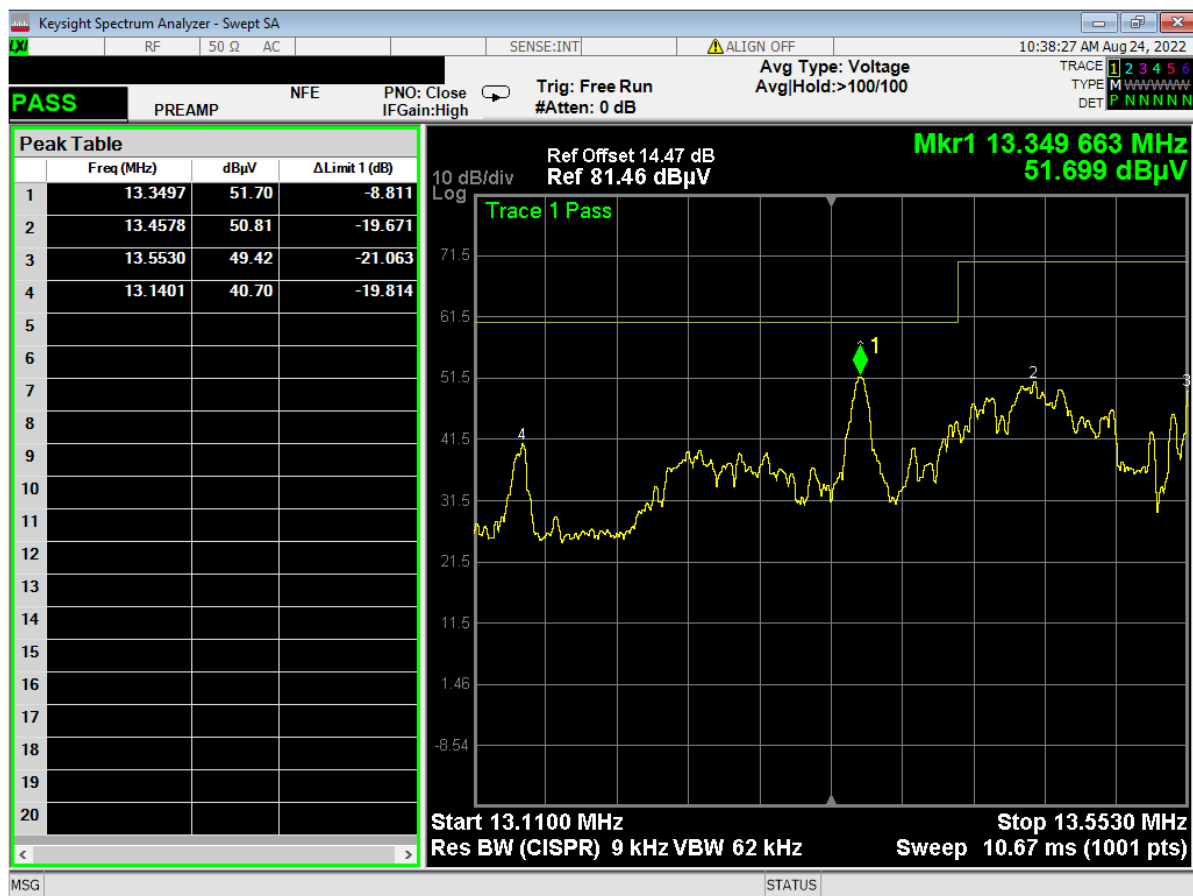


Figure 6 – Lower Band-edge

	Report Number:	R20190211-23-03	Rev	A
	Prepared for:	Labstrong International Inc.		



Figure 7 – Higher Band-edge

	Report Number:	R20190211-23-03	Rev	A
	Prepared for:	Labstrong International Inc.		

3.2 Frequency Error

Test:	FCC Part 15.225 (e)
Test Result:	Complies

3.2.1 Test Description

Radiated power was measured on a spectrum analyzer with resolution bandwidth and video bandwidth set to 3 kHz and 10 kHz respectively. The center frequency was found by measuring the frequency of the signal 10dB below the peak on the high and low end of the signal. The frequency halfway in between these frequencies was recorded as the center frequency. The temperature was varied from -20°C to -50°C. Limit: 100 PPM

3.2.2 Test Results

No results were found to be in excess of the limits. A plot of the results can be seen below.

3.2.3 Test Environment

Testing was performed at the NCEE Labs Lincoln facility on the 10-meter chamber ground plane. Laboratory environmental conditions varied slightly throughout the test:

Relative humidity of $30 \pm 5\%$

Temperature of $23 \pm 2^\circ \text{C}$

3.2.4 Test Setup

See Section 2.3 for further details.

3.2.5 Test Equipment Used

Serial No.	Manufacturer	Model	Description	Last Cal.
31373	Thermotron	SE1000-5-5	Temp chamber	NA
MY56070862	Keysight	N9010A*	EXA Signal Analyzer	July 20, 2021
10160084	Com-power	AI-130R	Active Loop Antenna	2022 Apr 12
18020052	Omega	iTHX-SD*	3m Temp. Humidity Meter	2021 Apr 28

*Two Year Calibration Cycle

	Report Number:	R20190211-23-03	Rev	A
	Prepared for:	Labstrong International Inc.		

3.2.6 Test results

Table 4 - Frequency Range Measurements

Center Frequency - 13.561 MHz	
Temperature (C)	Error (Hz)
-20	640
-10	667
0	653
10	634
20	626
30	566
40	536
50	542

Limit: 100 PPM=1.3561 kHz

Table 5 - Voltage Range Measurements

Temperature (C)	Voltage (VDC)	Error (Hz)
20	13.8	627
20	12	634
20	10.2	633

Voltage ranges provided by the manufacturer, Limit: 100 PPM=1.3561 kHz

	Report Number:	R20190211-23-03	Rev	A
	Prepared for:	Labstrong International Inc.		

3.3 Conducted Emissions

Test Method:	ANSI C63.10-2013, Section(s) 6.2
Test Result:	Complies

3.3.1 Test Description

Conducted emissions measurements were made from 150kHz to 30MHz via a 50μH Line Impedance Stabilization Network (LISN). The results were compared against the limits. Measurements were made on both the line and neutral conductors by first using a spectrum analyzer to acquire the signal spectrum; individual frequencies were then measured using a CISPR 16.1 compliant receiver with the following bandwidth setting:

150kHz – 30MHz: 9kHz IF bandwidth, 5kHz steps

3.3.2 Test Results

No results were found to be in excess of the limits. A plot of the results can be seen below.

3.3.3 Test Environment

Testing was performed at the NCEE Labs Lincoln facility. Laboratory environmental conditions varied slightly throughout the test:

Relative humidity of $30 \pm 5\%$

Temperature of $23 \pm 2^{\circ}\text{C}$

3.3.4 Test Setup

See Section 2.3 for further details. Power supply used was AC/DC M/N:PSD121A5-230.

3.3.5 Test Equipment Used

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE	CALIBRATION DUE DATE
Com-Power LISN 50μH / 250μH - 50Ω	LI-220C	20070017	July 18, 2022	July 18, 2024
Keysight MXE Signal Analyzer (44GHz)	N9038A	MY59050109	July 19, 2022	July 19, 2024

*Two Year Calibration Cycle

	Report Number:	R20190211-23-03	Rev	A
	Prepared for:	Labstrong International Inc.		

3.3.6 Test Pictures and/or Figures

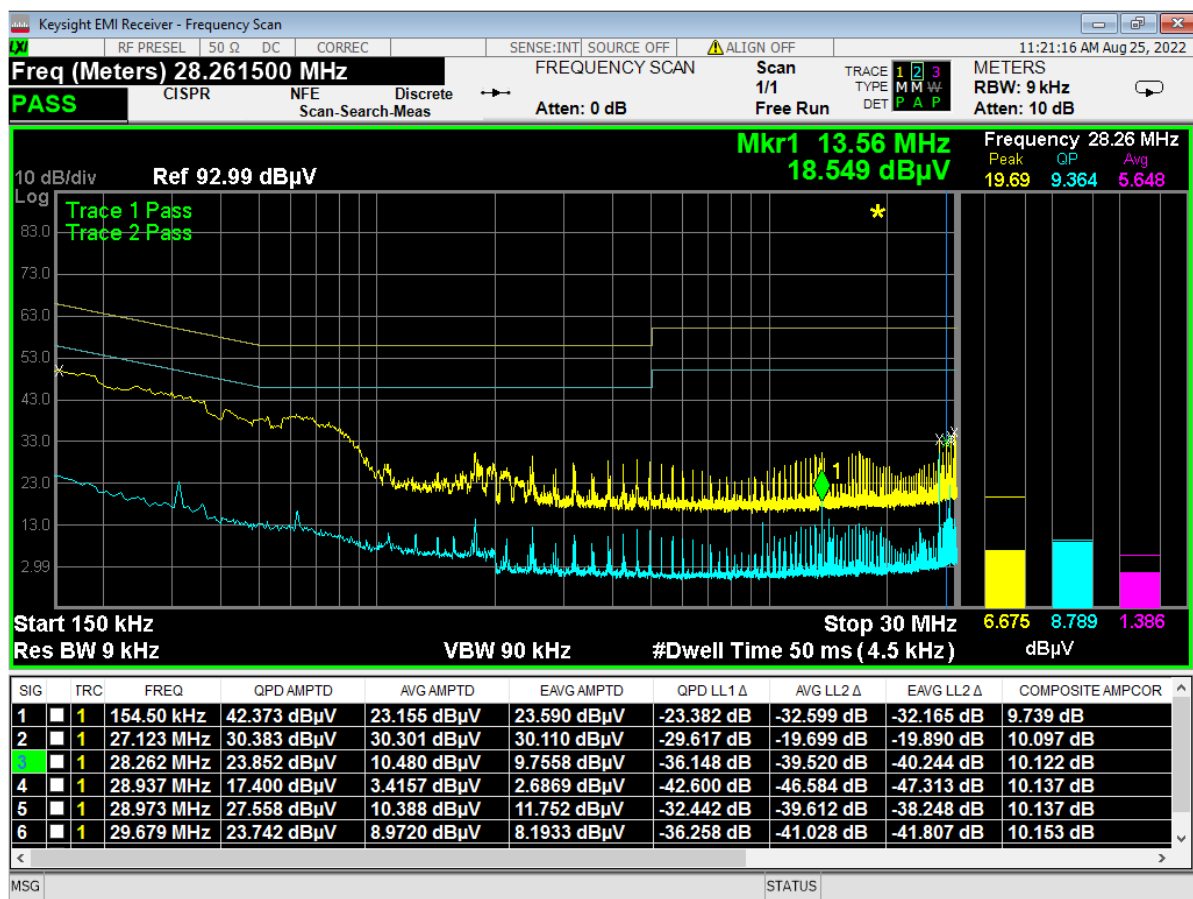


Figure 8 - Conducted Emissions, Line, NFC

	Report Number:	R20190211-23-03	Rev	A
	Prepared for:	Labstrong International Inc.		

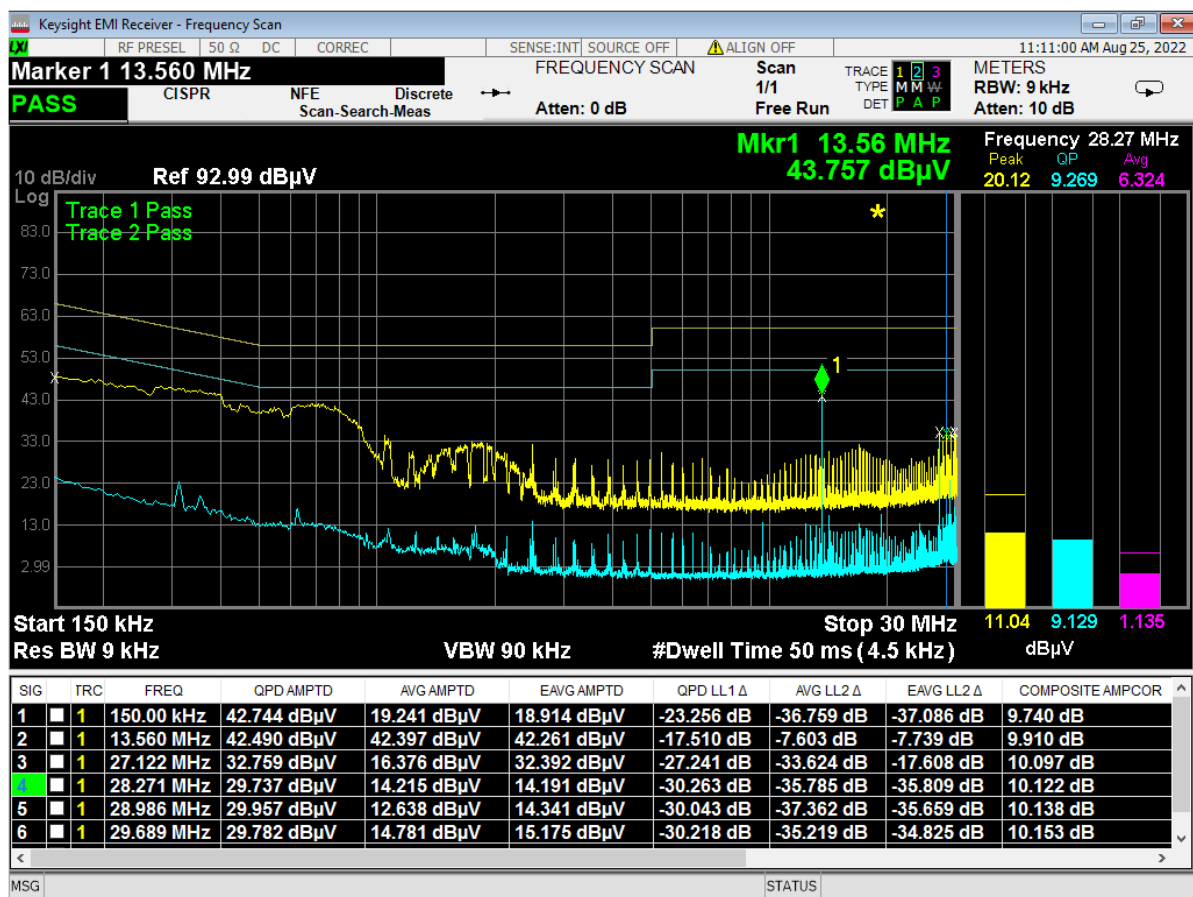


Figure 9 - Conducted Emissions, Neutral, NFC

	Report Number:	R20190211-23-03	Rev	A
	Prepared for:	Labstrong International Inc.		

Annex A: Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been for tests performed in this test report:

Test	Frequency Range	Uncertainty Value (dB)
Radiated Emissions, 3m	30MHz - 1GHz	±4.31
Radiated Emissions, 3m	1GHz - 18GHz	±5.08
Emissions limits, conducted	30MHz – 18GHz	±3.03 dB

Values were calculated per CISPR 16-4-2:2011

Expanded uncertainty values are calculated to a confidence level of 95%.

	Report Number:	R20190211-23-03	Rev	A
	Prepared for:	Labstrong International Inc.		

Annex B: Sample Field Strength Calculation

Radiated Emissions

The field strength is calculated in decibels (dB) by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = R + AF - (-CF + AG)$$

where FS = Field Strength

R = Receiver Amplitude Receiver reading in dBμV

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Preamplifier Amplifier Gain

Assume a receiver reading of 55.00 dBμV is obtained. The Antenna Factor of 12.00 and a Cable Factor of 1.10 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.10 dBμV/m.

$$FS = 55.00 + 12.00 - (-1.10 + 20.00) = 48.1 \text{ dB}\mu\text{V/m}$$

The 48.1 dBμV/m value can be mathematically converted to its corresponding level in μV/m.

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(48.1 \text{ dB}\mu\text{V/m})/20] = 254.1 \mu\text{V/m}$$

Conducted Emissions

Receiver readings are compared directly to the conducted emissions limits in decibels (dB) by adding the cable loss and LISN insertion loss to the receiver reading. The basic equations with a sample calculation is as follows;

$$FS = R + IL - (-CF)$$

where V = Conducted Emissions Voltage Measurement

R = Receiver reading in dBμV

	Report Number:	R20190211-23-03	Rev	A
	Prepared for:	Labstrong International Inc.		

IL = LISN Insertion Loss

CF = Cable Attenuation Factor

Assume a receiver reading of 52.00 dB μ V is obtained. The LISN insertion loss of 0.80 dB and a Cable Factor of 1.10 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.1 dB μ V/m.

$$V = 52.00 + 0.80 - (-1.10) = 53.90 \text{ dB}\mu\text{V/m}$$

The 53.90 dB μ V/m value can be mathematically converted to its corresponding level in μ V/m.

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(48.1 \text{ dB}\mu\text{V/m})/20] = 495.45 \mu\text{V/m}$$

Margin is calculated by taking the limit and subtracting the Field Level.

	Report Number:	R20190211-23-03	Rev	A
	Prepared for:	Labstrong International Inc.		

REPORT END