FCC Part 15 Subpart B Class B

Verification Test Report

Industry Canada ICES-003 Test Report

Regarding Emissions Compliance of the

Aleph Objects

LulzBot Mini "Gladiola" 3D Printer

In Accordance with the Emissions Standards

FCC's Title 47 CFR Part 15 Subpart B Class B

ICES-003 Information Technology Equipment Class B

Revision History

Release	Date	Description
1.0	6 November 2016	Initial release

Description of Equipment Under Test (EUT)

Test Item	:	LulzBot Mini "Gladiola" 3D Printer
Manufacturer	:	Aleph Objects, Inc.
Receipt date	:	21 October 2016

Manufacturer's information

Manufacturers Representative	:	Eric Kuzmenko
Company	:	Aleph Objects, Inc.
Address	:	626 West 66th Street Loveland, Colorado 80538 U.S.A.
Website	:	https://www.alephobjects.com/index.html

Tests Performed at

Address	:	EMI Test Lab LLC 1822 Skyway Drive Unit J Longmont, Colorado 80504 U.S.A
Website	:	http://www.emitestlab.com/

Test Specifications	:	FCC Part 15 Subpart B Class B, ICES-003 Class B
Tests completed	:	26 October 2016

Result of Testing : The EUT is in Compliance with FCC Part 15 Class B for home use. The EUT also meets ICES-003 Class B (Canada)

Senior EMC Engineer	:	Dennis King
Report written by	:	Dennis King – EMI Test Lab
Test Plan	:	Dennis King and Eric Kuzmenko for Aleph Objects
Report date	:	6 November 2016

These test results relate only to the specific unit that was tested. A periodic production audit to verify continued compliance is recommended.

Table of Contents

1 General

1.1 Applied Standards

The LulzBot Mini "Gladiola" was evaluated for emissions using the FCC's Title 47 CFR Part 15 Subpart B Class B for home use and Industry Canada's ICES-003 Issue 6 Class B.

The following documents were also used as guidance for testing;

- (a) Canadian Standards Association Standard CAN/CSA-CISPR 22-10(R2014), *Information technology equipment — Radio disturbance characteristics — Limits and methods of measurement*

  - This is an adoption with Canadian deviations of the identically titled IEC (International Electrotechnical Commission) Standard CISPR (International Special Committee on Radio Interference) 22, Sixth edition, 2008-09.

- (b) ANSI C63.4-2014, *American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz*, 2014

1.2 Detailed description of the test configuration, input and output ports

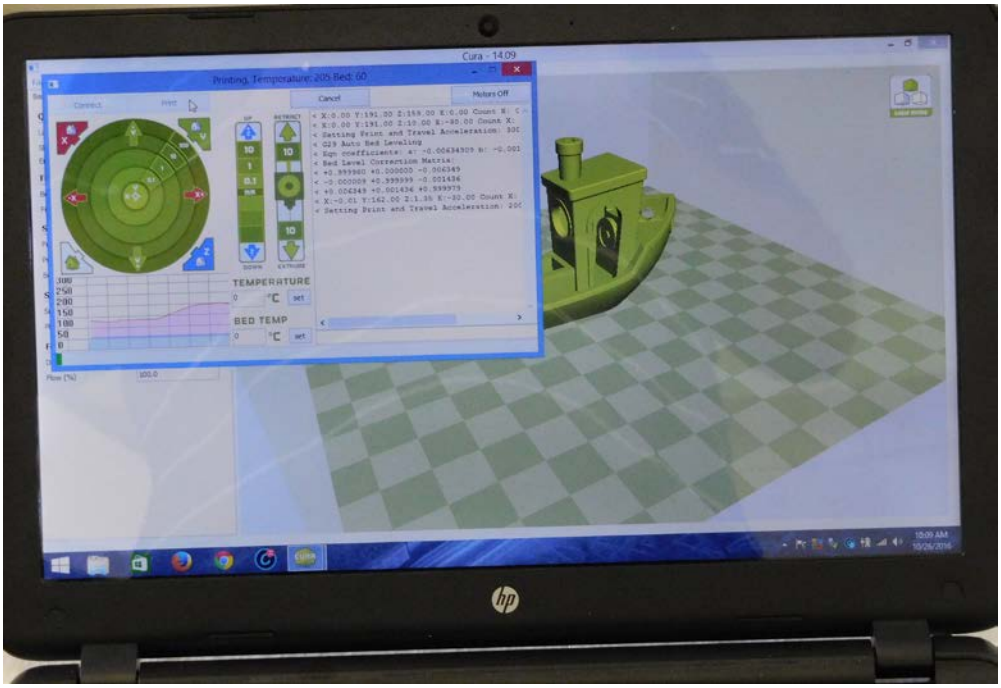
Test Configuration Definition:

The 3D Printer was tested while printing. The printer was connected to a laptop through the usb port on the printer. The software was installed on the laptop by Aleph Objects and represents typical software currently used by the end user.

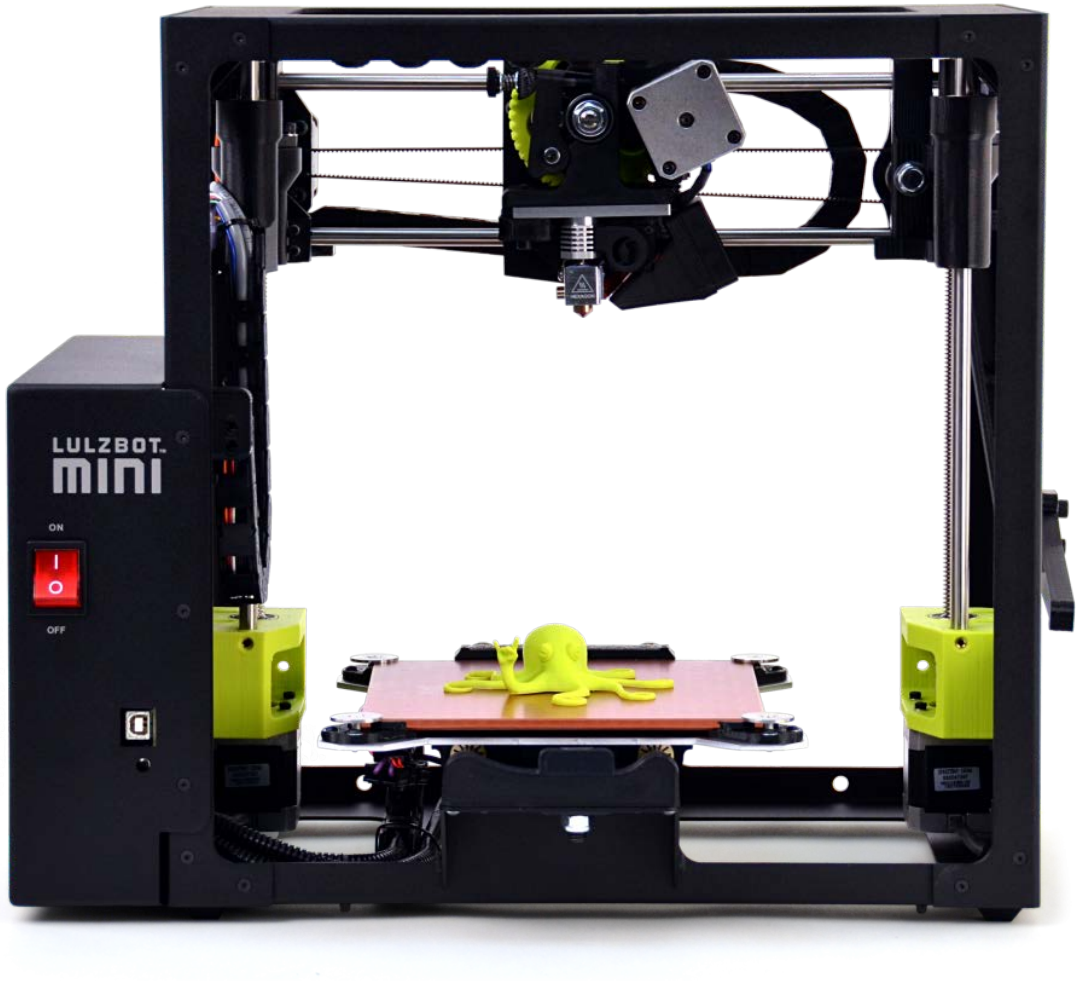
All testing was done at 120 VAC 60 Hz, the nominal North American voltage and frequency.

LulzBot Mini Software:

The default software for the LulzBot Mini 3D printer is called Cura LulzBot Edition. Cura is a Free Software program that both prepares your files for printing (by converting your model into GCODE), and also allows you to control the operation of your LulzBot 3D printer. The revision used during the testing was 14.09.



Typical screen shot of software used during emissions and immunity testing.



The LulzBot Mini – 3D Printer

https://www.lulzbot.com/blog/lulzbot-mini-3d-printer

1.2.1 Description of test configuration

EUT	:	LulzBot Mini “Gladiola” 3D Printer
Manufacturer	:	Aleph Objects, Inc.
System model name	:	Mini
Serial Number	:	001 and 002 two units were tested for radiated emissions
Test Voltage	:	230/240 VAC 50 Hz
Firmware revision	:	Marlin v1.1.0.9
Hardware revision	:	1.04

1.2.2. Description of tested input and output ports and power supply information

Number of cable type	Type of Cable	From	To	Shielded?	Remarks - length
1	USB	Test Laptop	LulzBot Mini	Yes	6 ft. Tripp Lite model: U023-006 – ferrites on both ends

Power supply location	Manufacturer	Model	Serial number	Shielded	Remarks
Internal AC supply	Delta Electronics, Inc.	PMC-24V150W1AA	Not available	Shielded enclosure	TUV Rheinland Certified – Output; 24V 6.25A

1.2.3 Operation modes

The Equipment Under Test (EUT) was set up and operated as described in section 1.2.

During preliminary testing for emissions it was determined that the following configurations are worst case for emissions and immunity. All further testing was done in these modes.

The system is operating in a typical mode as used by the end user.

The 3D Printer was tested while printing. The printer was connected to a laptop through the usb port on the printer. The software was installed on the laptop by Aleph Objects and represents typical software currently used by the end user.

All testing was done at 120 VAC 60 Hz, the nominal North American voltage and frequency.

2 Emissions

The EUT (equipment under test) has been tested to determine conformity with the relevant emissions parts of the FCC's Title 47 CFR Part 15 Subpart B Class B for home or commercial use - section 15.107 for conducted and section 15.109 for radiated - and ICES-003 Issue 6 Class B for Canada.

AC Power line conducted and radiated field strength measurements concerning the emission of radiated and conducted electromagnetic disturbances were made.

2.1 AC Mains Power Input Ports

The disturbance voltage emissions levels at the AC mains power port of the EUT were measured in conformity with and according to the criteria as stated below.

Basic standard	:	FCC Part 15, Subpart B, ICES-003 Issue 6
Test method	:	ANSI C63.4-2014, CAN/CSA – CISPR 22-10
Frequency range 1	:	0.15 – 0.5 MHz
Limit	:	66 dBuV quasi peak, 56 dBuV average Decreasing with the log of frequency to range 2
Frequency range 2	:	0.5 – 5 MHz
Limit	:	56 dBuV quasi peak, 46 dBuV average
Frequency range 3	:	5 – 30 MHz
Limit	:	60 dBuV quasi peak, 50 dBuV average

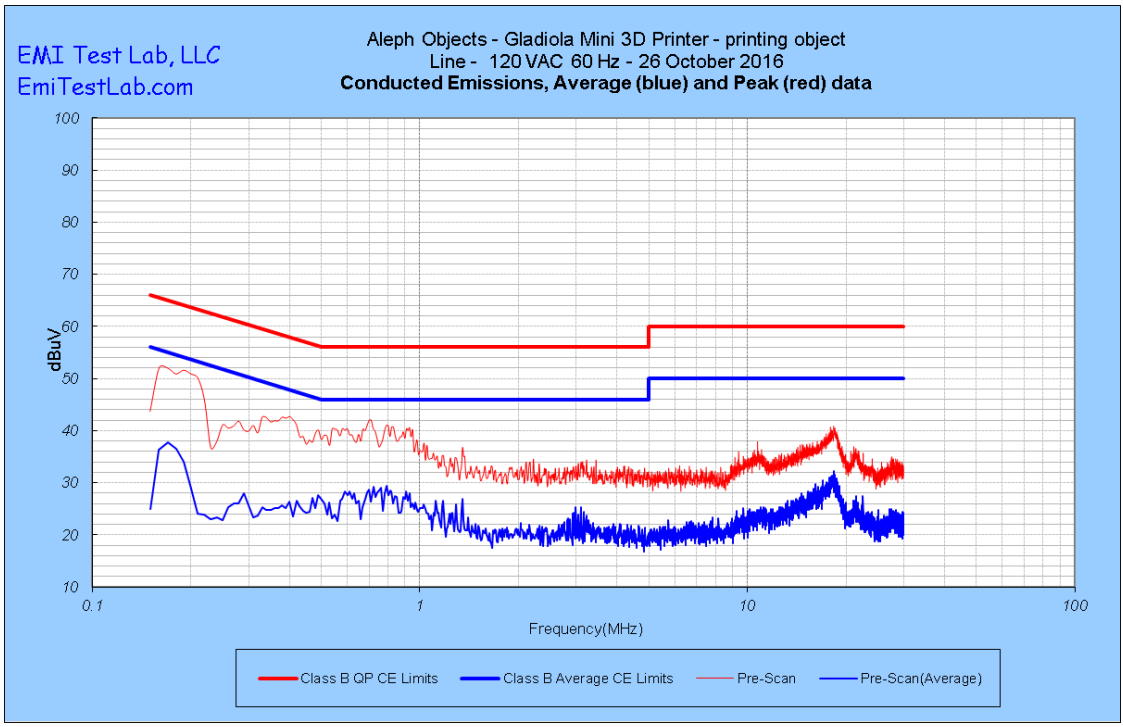
Results of the measurements concerning the emissions of voltage levels at the AC mains input port of the EUT.	**PASS Class B for home or commercial use**
Name of Test Engineer: Signature: Date:	Dennis King  26 October 2016

Remarks.
The EUT is plugged into the LISN powered at 120 VAC 60 Hz.

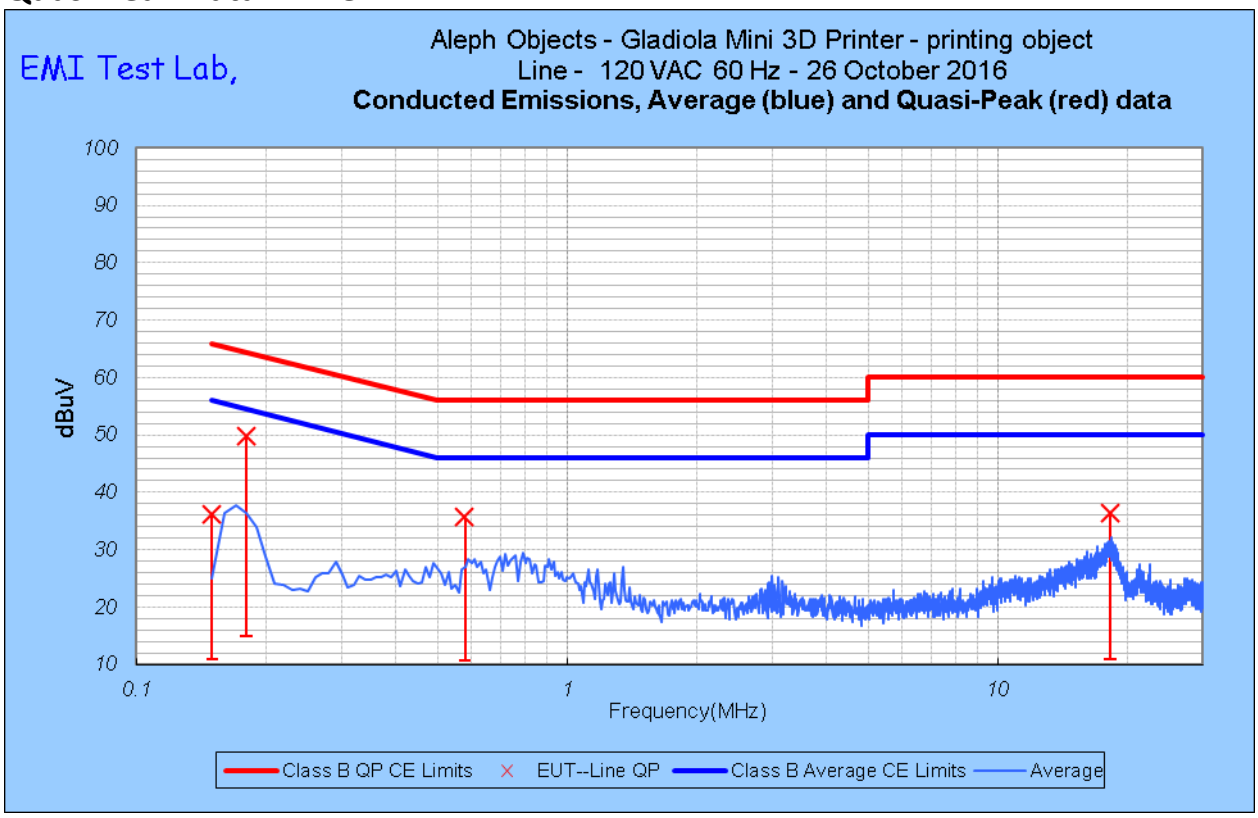
Conducted Emission Summary:

The EUT passes both the quasi peak and the average limits. **PASS**

Peak Data – Line - see the following page for passing quasi peak data unit s/n 001

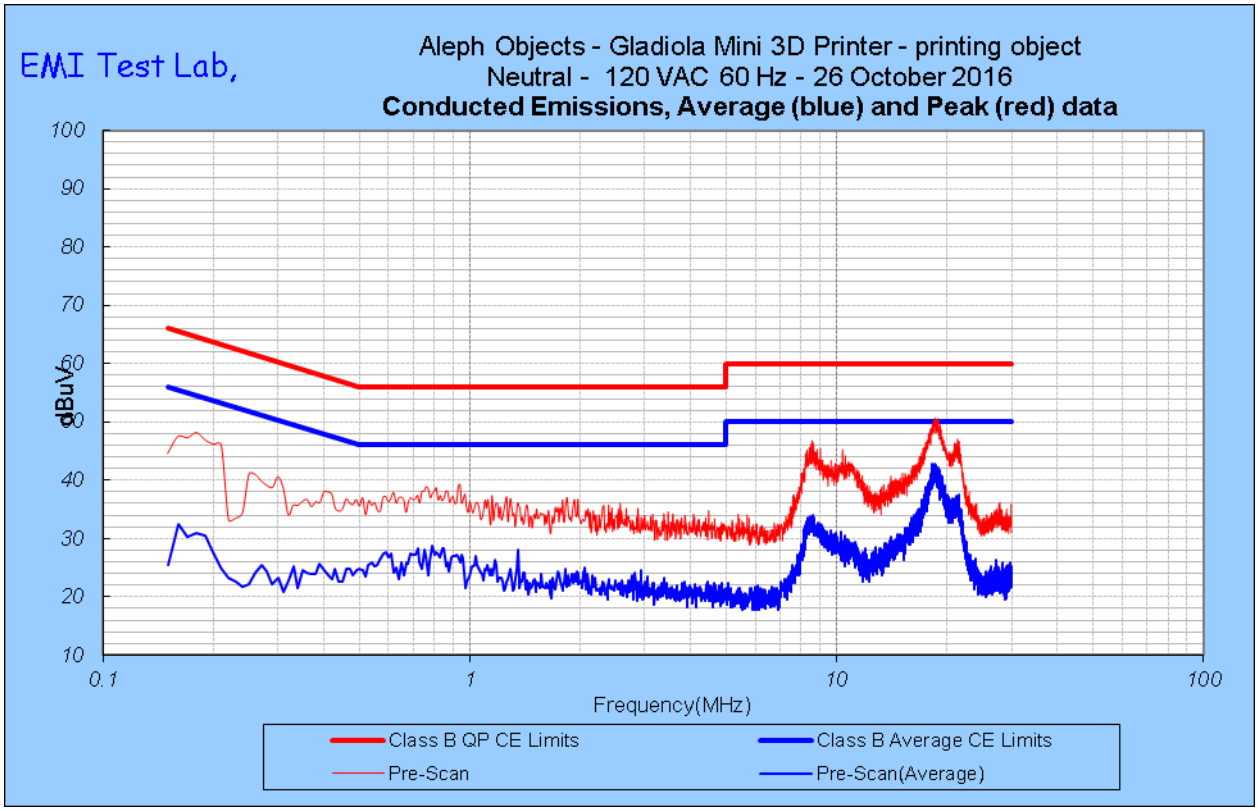


Quasi Peak Data – Line

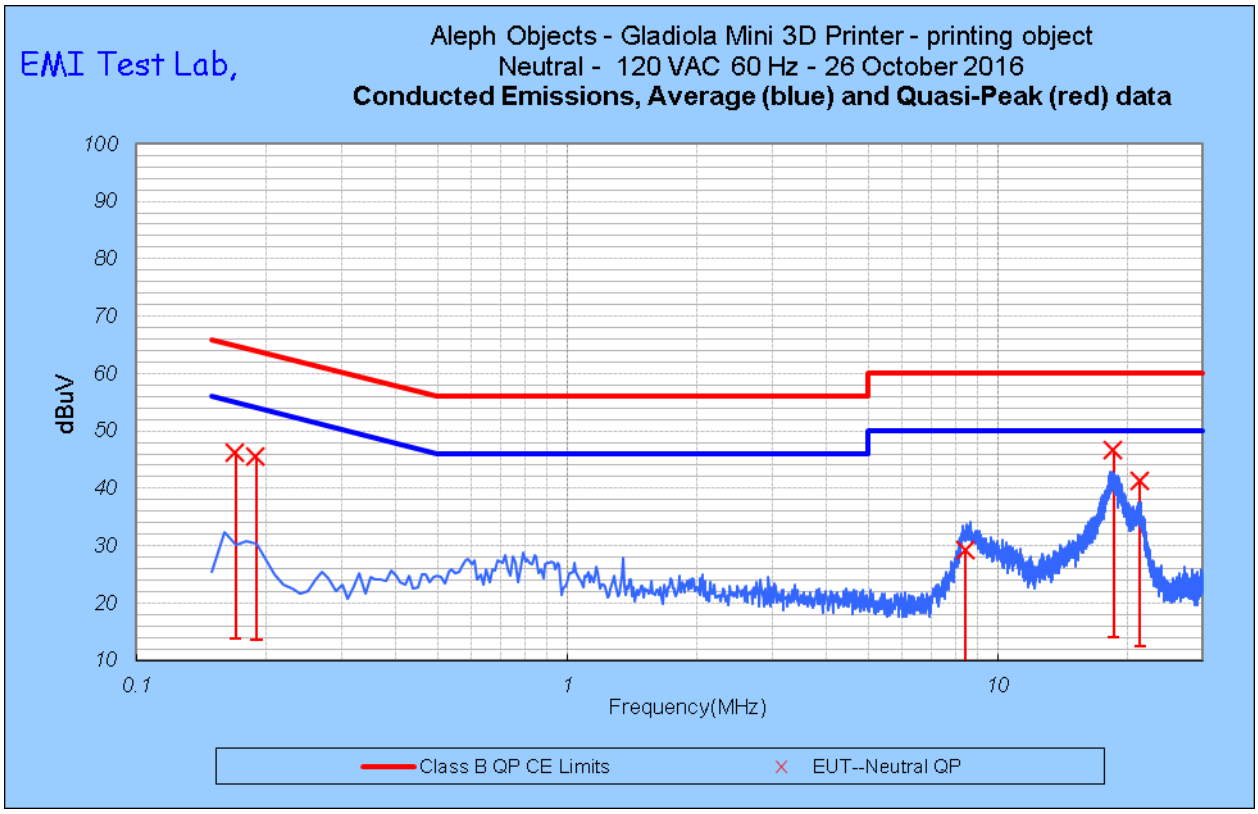


Frequency (MHz)	QP Disturbance (dBuV)	QP Limit	Margin QP (dB)	Tranducer Connection	Correction Factor (dB)
0.150	36.03	66.00	29.97	AMN	0.20
0.590	35.53	56.00	20.47	AMN	0.41
18.260	36.33	60.00	23.67	AMN	1.32
0.189	49.71	64.88	15.17	AMN	0.21

Peak Data – Neutral - see the following page for passing quasi peak data unit s/n 001



Quasi Peak Data – Neutral



Frequency (MHz)	QP Disturbance (dBuV)	QP Limit	Margin QP (dB)	Tranducer Connection	Correction Factor (dB)
8.450	29.13	60.00	30.87	AMN	1.15
18.580	46.53	60.00	13.47	AMN	1.33
21.430	41.30	60.00	18.70	AMN	1.37
0.180	46.14	65.15	19.01	AMN	0.21
0.193	45.42	64.77	19.35	AMN	0.21

Conducted emissions test setup

2.2 Enclosure

2.2.1 30-1,000 MHz

The radiated field strength levels (electric component) have been measured in conformity with and according to the criteria as stated below.

Basic standard	:	FCC Part 15, Subpart B, ICES-003 Issue 6
Test method	:	ANSI C63.4-2014, CAN/CSA – CISPR 22-10
Limit distance	:	3 meters
Frequency range 1	:	30 -230 MHz
Limits	:	40 dBuV/m
Frequency range 2	:	230 – 1,000 MHz
Limits	:	47 dBuV/m

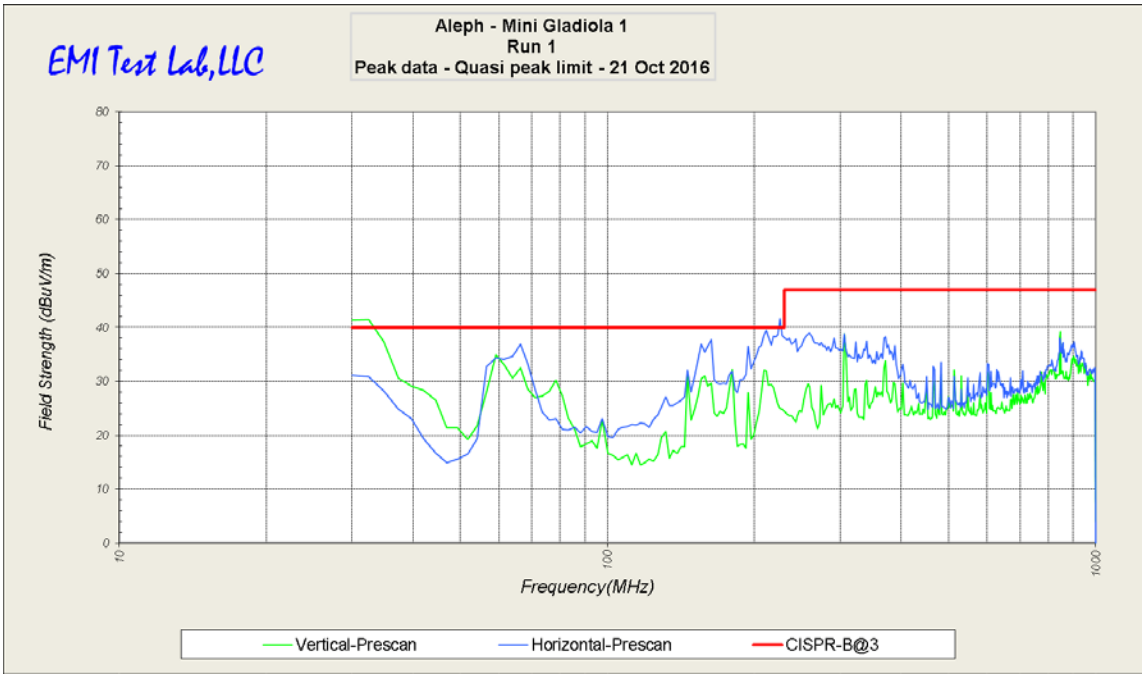
Results of the measurements concerning radiated electromagnetic fields (electric component) emitted by the EUT, enclosure, as a tested system	**PASS Class B for home or commercial use**
Name of Test Engineer:	Dennis King
Signature:	
Date:	21 October 2016

Radiated Emissions Summary: **PASS Class B**

Remarks: The EUT was in a typical use mode during all the testing.

Two units pass Class B.

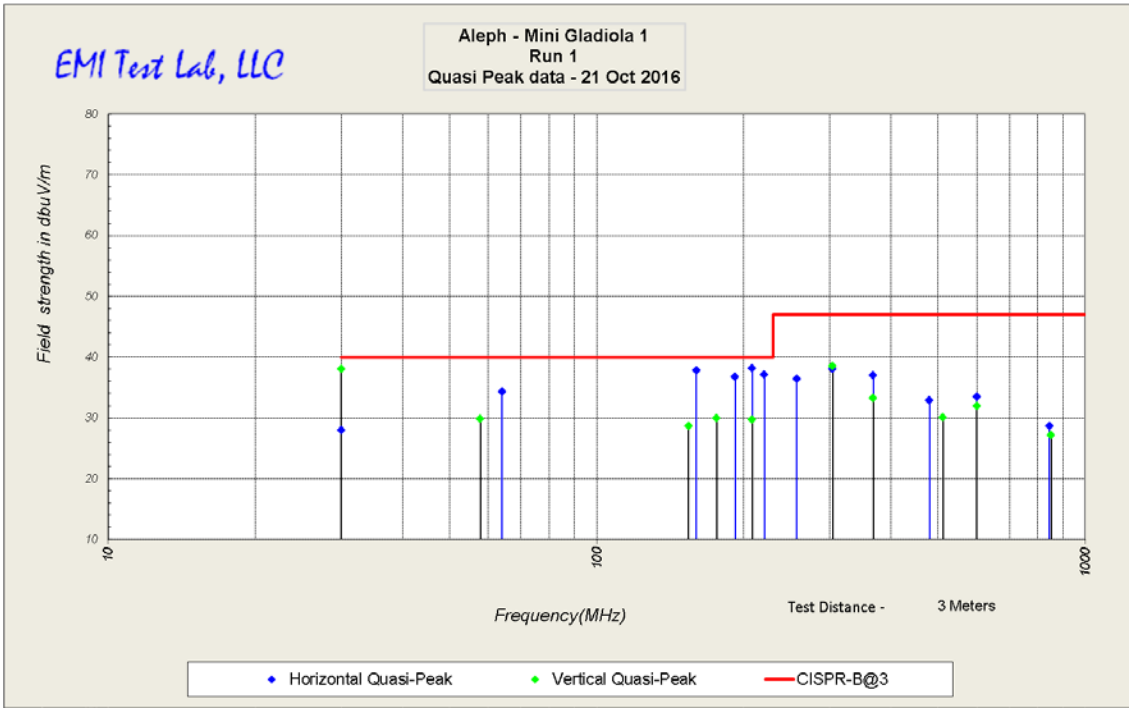
The chart below is peak data compared to a quasi-peak limit



The above chart is corrected peak data;

Spectrum Analyzer reading + Cable loss + Antenna Factor – pre-amp gain

The chart below is quasi peak data compared to a quasi-peak limit



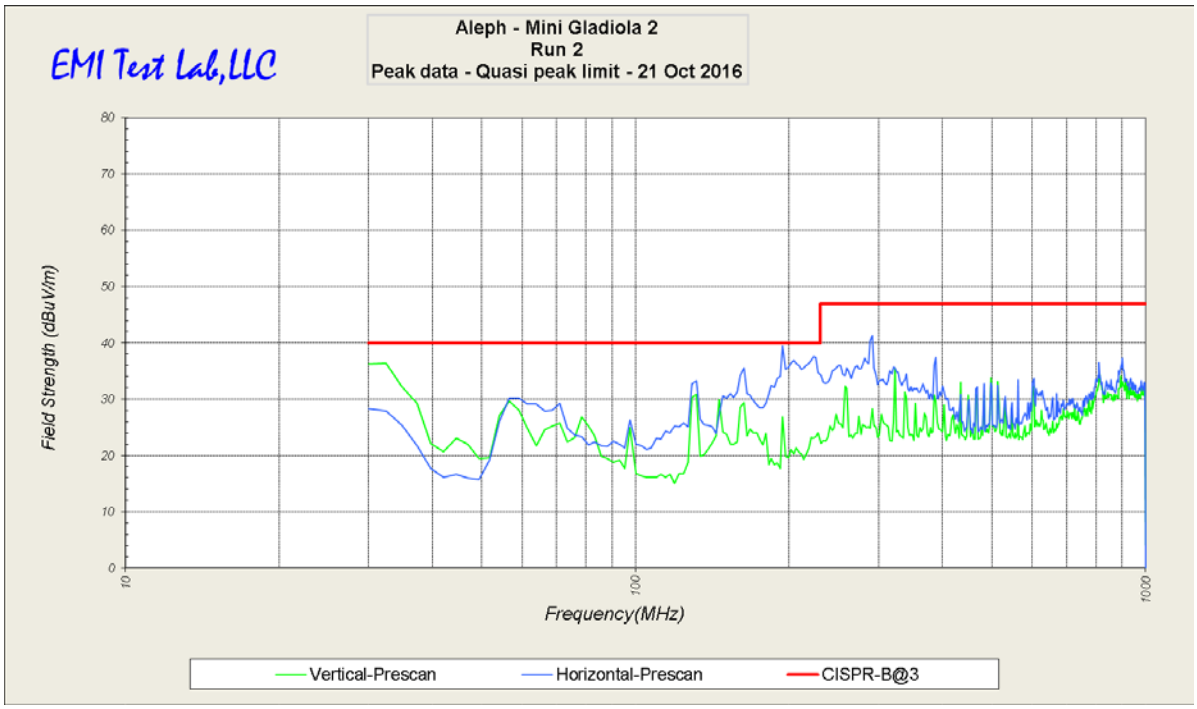
The above chart is corrected quasi peak data;
Spectrum Analyzer reading + Cable loss + Antenna Factor – pre-amp gain

Quasi peak data unit #1

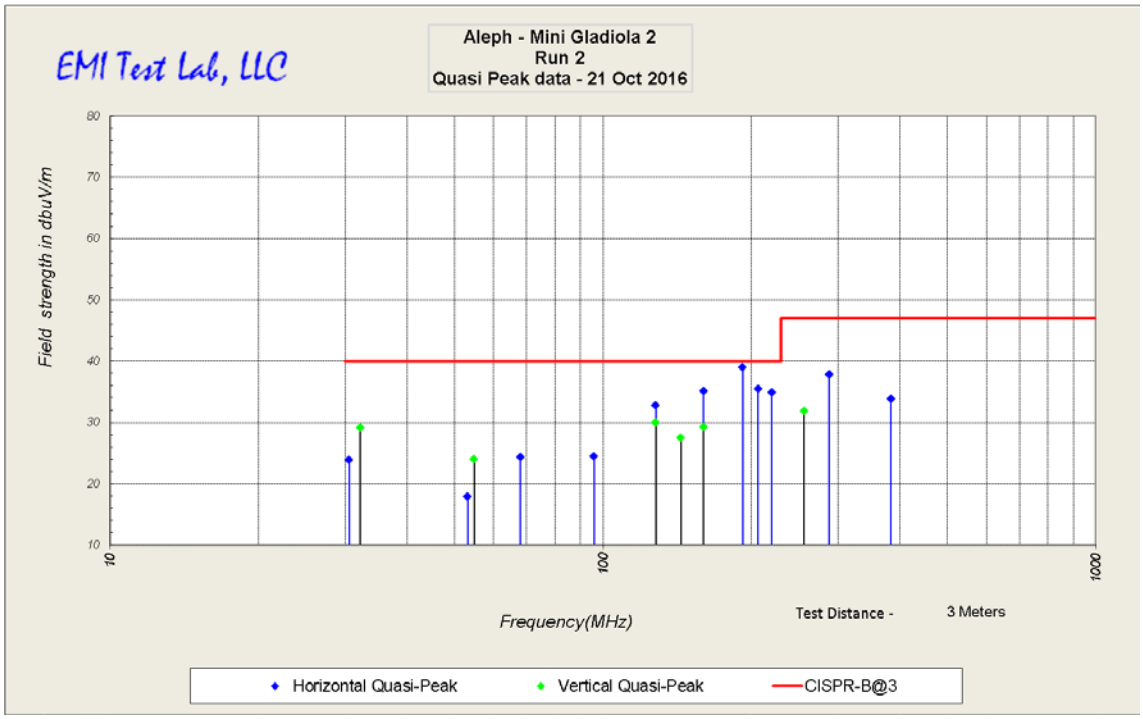
EMI Test Lab
1822 Skyway Drive, Unit J, Longmont Co Dennis King dennis@emitestlab.com , Cell 303-746-0611

Frequency	F.S. EUT	Limit	Azimuth	Height	Antenna Polarization	
(MHz)	*(dBuV/m)*	*(dBuV/m)*	*Degrees*	*Meters*	*H or V*	*Margin*
304.01	38.52	47	12.0	1.40	V	-8.48
368.01	33.28	47	20.0	1.40	V	-13.72
511.99	30.06	47	28.0	1.40	V	-16.94
600.01	31.97	47	72.0	1.40	V	-15.03
176.01	29.93	40	84.0	1.40	V	-10.07
154.09	28.71	40	148.0	1.40	V	-11.29
207.97	29.73	40	288.0	1.40	V	-10.27
57.81	29.86	40	320.0	1.40	V	-10.14
851.62	27.13	47	336.0	1.40	V	-19.87
480.00	32.90	47	8.0	1.40	H	-14.10
256.93	36.37	47	20.0	1.40	H	-10.63
220.30	37.07	40	20.0	1.40	H	-2.93
600.02	33.43	47	56.0	1.40	H	-13.57
368.02	37.03	47	120.0	1.40	H	-9.97
304.01	38.04	47	124.0	1.40	H	-8.96
192.00	36.80	40	140.0	1.40	H	-3.20
208.01	38.25	40	168.0	1.40	H	-1.75
208.02	38.18	40	168.0	1.40	H	-1.82
160.01	36.19	40	192.0	1.40	H	-3.81
64.01	34.31	40	276.0	1.40	H	-5.69
845.25	28.69	47	288.0	1.40	H	-18.31
160.01	37.81	40	332.0	1.40	H	-2.19
30.00	38.00	40	37.0	1.40	V	-2.00

Peak data compared to a quasi peak limit – see the next chart for the passing quasi peak data – unit # 2



Passing Quasi peak data compared to the quasi peak limit – unit # 2



Quasi peak data unit #2

EMI Test Lab
1822 Skyway Drive, Unit J, Longmont Co Dennis King dennis@emitestlab.com , Cell 303-746-0611

Frequency	F.S. EUT	Limit	Azimuth	Height	Antenna Polarization	
(MHz)	*(dBuV/m)*	*(dBuV/m)*	*Degrees*	*Meters*	*H or V*	*Margin*
255.99	31.86	47	0.0	1.40	V	-15.14
144.02	27.53	40	76.0	1.40	V	-12.47
160.02	29.22	40	92.0	1.40	V	-10.78
128.00	29.93	40	164.0	1.40	V	-10.07
32.18	29.10	40	228.0	1.40	V	-10.90
54.80	23.97	40	320.0	1.40	V	-16.03
219.97	34.84	40	24.0	1.40	H	-5.16
287.99	37.78	47	132.0	1.40	H	-9.22
192.01	39.03	40	152.0	1.40	H	-0.97
30.53	23.81	40	156.0	1.40	H	-16.19
383.98	33.84	47	164.0	1.40	H	-13.16
160.02	35.07	40	188.0	1.40	H	-4.93
68.05	24.34	40	224.0	1.40	H	-15.66
95.98	24.41	40	232.0	1.40	H	-15.59
128.00	32.82	40	236.0	1.40	H	-7.18
206.32	35.48	40	240.0	1.40	H	-4.52
53.13	17.89	40	336.0	1.40	H	-22.11

2.2.2 1 – 40 GHz

The radiated field strength levels (electric component) have been measured in conformity with and according to the criteria as stated below.

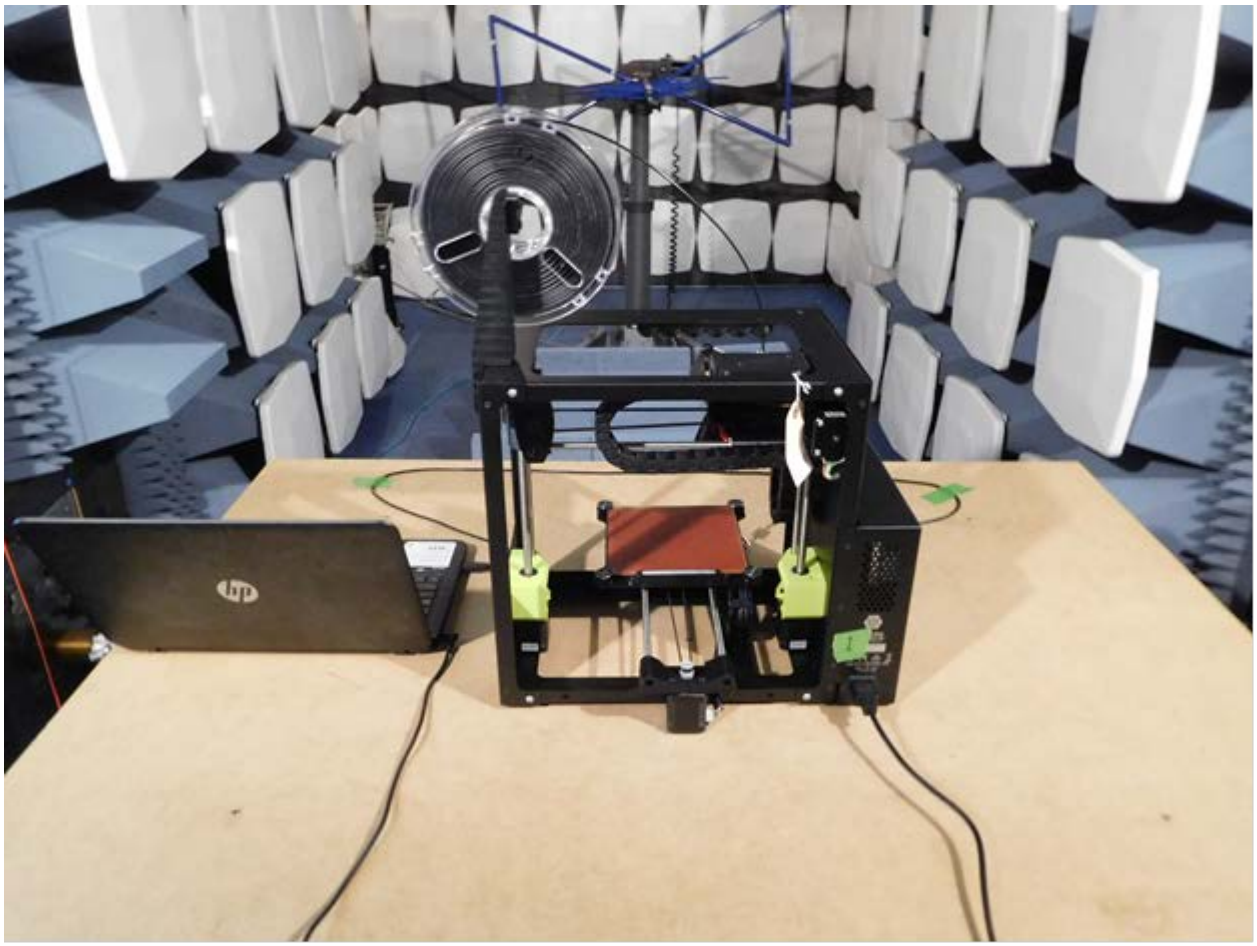
Basic standard	:	FCC Part 15, Subpart B, ICES-003 Issue 6
Test method	:	ANSI C63.4-2014, CAN/CSA – CISPR 22-10
Limit distance	:	3 meters
Frequency range	:	1-40 GHz
Limits	:	Average 54 dBuV/m, Peak 74 dBuV/m

Results of the measurements concerning radiated electromagnetic fields (electric component) emitted by the EUT, enclosure, as a tested system	**Not Required** **Highest frequency clock is less than 108 MHz**
Name of Test Engineer: Signature: Date:	Dennis King  6 November 2016
Remarks: The highest frequency clock is < 108 MHz.	**Not required**

Frequency Range	Class A Limits		Class B Limits	
	FCC Note 1	CISPR	FCC	CISPR
1 – 3GHz	Avg 60dBuV/m Pk 80dBuV/m	Avg 56dBuV/m Pk 76dBuV/m	Avg 54dBuV/m Pk 74dBuV/m	Avg 50dBuV/m Pk 70dBuV/m
3 – 6GHz	Avg 60dBuV/m Pk 80dBuV/m	Avg 60dBuV/m Pk 80dBuV/m	Avg 54dBuV/m Pk 74dBuV/m	Avg 54dBuV/m Pk 74dBuV/m
6 – 40 GHz	Avg 60dBuV/m Pk 80dBuV/m	No requirement	Avg 54dBuV/m Pk 74dBuV/m	No requirement Note 3

Note 1: The limit above has been extrapolated from 10m (as detailed in FCC rules) to 3m. The 10m limits are 49.5dBuV/m for average and 69.5dBuV/m for peak.
Note 2: **Pk** indicates the peak limit and **Avg** indicates the average limit. There are some differences in the specifications for the detectors used to make peak and average measurements between FCC/ANSI and CISPR standards.
Note 3: Work is in progress to extend the frequency range to 18 GHz

Radiated Emissions Setup



Radiated emissions test setup

3.0 Modifications

No modifications were made during the testing.

4.0 User Guide Statements and labels

From the FCC's CFR Part 15 Subpart B

1.1 §15.105 Information to the user.

User Guide Statement

(a) For a Class A digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment under FCC rules.

(b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

—Reorient or relocate the receiving antenna.

—Increase the separation between the equipment and receiver.

—Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

—Consult the dealer or an experienced radio/TV technician for help.

Modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment under FCC rules.

§15.19 Labelling requirements.

(a) In addition to the requirements in part 2 of this chapter, a device subject to certification, or verification shall be labelled as follows:
(1) Receivers associated with the operation of a licensed radio service, e.g., FM broadcast under part 73 of this chapter, land mobile operation under part 90, etc., shall bear the following statement in a conspicuous location on the device:

This device complies with part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

(2) A stand-alone cable input selector switch, shall bear the following statement in a conspicuous location on the device:

This device is verified to comply with part 15 of the FCC Rules for use with cable television service.

(3) All other devices shall bear the following statement in a conspicuous location on the device:

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

(4) Where a device is constructed in two or more sections connected by wires and marketed together, the statement specified under paragraph (a) of this section is required to be affixed only to the main control unit.

(5) When the device is so small or for such use that it is not practicable to place the statement specified under paragraph (a) of this section on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

Canadian Label requirement

From ICES-003 Issue 6 Published: January 2016 Updated: June 2016

9. Labelling Requirements

The manufacturer, importer or supplier shall meet the labelling requirements set out in this section and in Notice 2014-DRS1003 for electronic labelling for every unit: (i) prior to marketing in Canada, for ITE manufactured in Canada and (ii) prior to importation into Canada, for imported ITE. Each unit of an ITE model shall bear a label (see below) that represents the manufacturer's or the importer's SDoC with Innovation, Science and Economic Development Canada's ICES-003. This label shall be permanently affixed to the ITE or displayed electronically and its text must be clearly legible. If the dimensions of the device are too small or if it is not practical to place the label on the ITE and electronic labelling has not been implemented, the label shall be, upon agreement with Innovation, Information Technology Equipment (Including Digital Apparatus) — Limits and Methods of Measurement ICES-003 9 Science and Economic Development Canada, placed in a prominent location in the user manual supplied with the ITE. The user manual may be in an electronic format and must be readily available.

Innovation, Science and Economic Development Canada ICES-003 Compliance Label:

CAN ICES-3 (*)/NMB-3(*)

* Insert either "A" or "B" but not both to identify the applicable Class of ITE.

5.0 Test equipment and Environmental Conditions

All tests were conducted within parameters specified for each test, for example >30% humidity for ESD.
The lab temperature during all testing was between 70-72 degrees F.
All equipment used for testing has been calibrated or verified for cal using NIST traceable standards.
Each piece of test equipment has a cal verification procedure that is conducted before and after each test.

Table of Test Equipment

Equipment	Description and Test	Model number	Serial number	Next cal due
HP Spectrum Analyzer	Used for Radiated and Conducted Emissions	8566B	2607A02760	3 June 2017
HP Quasi-Peak Adapter	Used for Radiated and Conducted Emissions	85650A	8574A00233	3 June 2017
Advantest Spectrum Analyzer	Used for Radiated and Conducted Emissions	R3361A	01730556	20 October 2017
Com-Power transient Limiter	Conducted Emissions	HZ560	001	3 June 2017
TTi	AC Harmonics and Flicker	HA1600A	353276	17 July 2017
RF Bay Pre-Amp	Radiated emissions – 100kHz to 10 GHz	LPA-10-20	0643	2 Dec 2016
GTEM	Radiated Emissions and Radiated Immunity	5317	9703-1209	26 April 2017 – Field Uniformity Cal per IEC 61000-4-20
3 Meter FAR – Fully Anechoic Room	Radiated Immunity and Emissions	N/A	FAR #1	15 October 2017 Field Uniformity per IEC/EN 61000-4-3 and Correlation data to GTEM
ComPower Horn Antenna	1-18 GHz – Radiated Immunity and Emissions	AH 118	071040	20 March 2017
Chase BiLog Antenna	Radiated Emissions and Immunity	CBL6111	1121	20 March 2017
Marconi Instruments – Signal Generator 10kHz – 2.7 GHz	Radiated Immunity	2031	1196061031	20 October 2017
HP Signal Generator	Radiated Immunity	8657A	STD0578	3 May 2017
HP Synthesized Sweep	Radiated Immunity	83752B	34462	3 May 2017

Generator .01-20 GHz	1 GHz to 2.7 GHz			
Amplifier Research .800 – 4.2 GHz Amp	Radiated Immunity – 1 GHz to 2.7 GHz	10S1G4	34516	4 May 2017
Antenna Research Associates – 100 Watt amplifier w/controller	Radiated Immunity – 80-1000 MHz in the FAR	ARAPS/PC757LC ARA757LC-CE	587V7 587V7	20 October 2017
Kalmus Power Amplifier	Radiated Immunity 150kHz – 1 GHz – in the GTEM	747LC-CE	7894-1	10 May 2017
Amplifier Research E- Field Probe	Radiated Immunity	FP 2000	12845	10 May 2017
Com-Power LISN	Conducted emissions	LI-115	241010	17 May 2017
Com-Power LISN	Conducted emissions	LI-115	241011	11 September 2017
California Instruments 1000 VA Power Source	Emissions and Immunity - used as a 100/120/230/240-VAC 50/60 Hz AC source	1001WP	L04788	4 June 2017
EMI Labs CDN	Conducted Immunity	EMICDN	001	9 Dec 2016
Schaffner ESD Gun	Electro Static Discharge	NSG435	54711	11 Dec 2016
KeyTek ECAT	Fast transients / Burst	E412	32612	5 June 2017
FCC Inc. RF Current Probe	Monitor Conducted Immunity signal	F-33-1	423	9 Dec 2016
EMI Labs Mag Loop	Magnetic Loop Antenna	Mag100	80162	12 Dec 2016
Thermo Keytek CE Master	Surge/ AC Dips and Interrupts	CE Master	0405277	15 Dec 2016

6.0 Measurement Uncertainty - Radiated Emissions example;

Table of Uncertainty Calculation					
√	**Contribution**	**Designation**	**Probability Distribution**	**k**	**Uncertainty (dB)**
	Equipment Under Test Uncertainties	U_{EUT}			Note 1
√	Measuring Receiver Amplitude Accuracy	$U_{RXaccuracy}$	rectangular	$\sqrt{3}$	± 0.9
√	GTEM Uniformity	$U_{Uniformity}$	rectangular	$\sqrt{3}$	± 4.0
√	Secondary Field Components	$U_{Secondary}$			Excluded by Test Method
√	Mismatch Uncertainty-GTEM to Pre-Amplifier	$U_{Mismatch}$	U-shaped	$\sqrt{2}$	+0.63 and -0.65
√	Mismatch Uncertainty-Pre-Amplifier to Spectrum Analyzer	$U_{Mismatch}$	U-shaped	$\sqrt{2}$	+0.92 and -1.03
√	System Sensitivity Error	$U_{Sensitivity}$	rectangular	$\sqrt{3}$	0.28
√	GTEM Electric-Field Frequency Response	$U_{E-Field}$	rectangular	$\sqrt{3}$	± 1.6
	Ambient Signal Uncertainty	U_{Abient}			Not Significant
√	GTEM to OATS Correlation	U_{Corr}	rectangular	$\sqrt{3}$	±1.2
√	Septum Height Variation	U_{Septum}	normal	2	+0.72 and -0.82
	Coaxial Cable Temperature Variations	$U_{CableTemperature}$			Not Significant
√	Coaxial Cable Calibration	$U_{CableCalibration}$	rectangular	$\sqrt{3}$	±0.05
√	Pre-amplifier Calibration Uncertainty	$U_{Pre-Amp}$	rectangular	$\sqrt{3}$	±0.05
	Combined Uncertainty(dB) Positive Terms				2.77
	Combined Uncertainty(dB) Negative Terms				-2.75
	Expanded Uncertainty Positive Terms		Normal	2	5.54
	Expanded Uncertainty Negative Terms		Normal	2	-5.50

Typical Measurement Uncertainty for the following Tests:

The estimated combined standard uncertainty for Conducted Emissions is ± 1.2dB
The estimated combined standard uncertainty for Radiated Immunity, EN 61000-4-3 is ± 2.7dB
The estimated combined standard uncertainty for EFT/Burst, EN 61000-4-4 is ± 5.8%
The estimated combined standard uncertainty for Surge, EN 61000-4-5 is ± 8%
The estimated combined standard uncertainty for Conducted Immunity, EN 61000-4-6 is ± 1.5 dB
The estimated combined standard uncertainty for Magnetic Fields, EN 61000-4-8 is ± 0.6%
The estimated combined standard uncertainty for Voltage Dips and Interrupts, EN 61000-4-11 is ± 4.3%
The estimated combined standard uncertainty for Harmonic current and flicker is ± 11.6%
The estimated combined standard uncertainty for ESD testing, EN 61000-4-2 is ± 4%

7.0 Test Plan

Testing required

The LulzBot Mini Gladiola 3D Printer will be tested for Radiated and Conducted emissions, Harmonics and Flicker and all applicable Immunity tests as required for the EMC portion of the CE Mark and the Australia / New Zealand, FCC and Canadian EMC standards.

Two units will be tested for radiated emissions.

Test Setup

The LulzBot Mini Gladiola will be operating in a typical use mode, printing an object during all the testing.

The user software is installed on a laptop and is controlling the 3D printer. There are no other I/O cables on the 3D Printer.

The ferrites that were used to pass radiated emissions will be in place during all the testing. Also, the USB cable with ferrites on both ends, used to pass radiated emissions, will be used during the entire test. Typical software that the end user would use will be used during the testing.

Failure Criteria

If the unit stops working or the printing process is altered by the injected noise, this would be considered a failure.

I/O cables

The unit has only one I/O cable, the USB cable that is used to control the printer from software installed on the host computer. There are no I/O cables on the unit 3 meters or longer.

Status of the test unit

Production level.

8.0 Conclusion

The Aleph Objects – LulzBot Mini Gladiola 3D Printer complies with the emissions standards:

FCC Part 15 Class B for home or commercial use and Industry Canada's ICES-003 Class B, also for home or commercial use.

in the configurations and operating modes as stated in this test report.

End of Report