



Australian Communications and Media Authority

EMC Test Report

Regarding Emissions Compliance of the

LulzBot TAZ 5 3D Printer

For Aleph Objects, Inc.

In Accordance with the Emissions Standards

AS/NZS CISPR 22:2009 + A1:2010

Class A

Revision History

Release	Date	Description
1.0	2 December 2015	Initial release

Description of Equipment Under Test (EUT)

Test Item : LulzBot TAZ 5 – 3D Printer
Manufacturer : Aleph Objects, Inc.
Receipt date : 20 November 2015

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 : AS/NZS CISPR 22:2009 + A1:2010
Tests completed : 20 November 2015

Result of Testing : **The EUT is in Compliance with AS/NZS CISPR 22:2009 + A1:2010, Class A for commercial use**

Senior EMC Engineer : Dennis King

Report written by : Dennis King – EMI Test Lab
Test Plan : Dennis King for Aleph Objects
Report date : 20 November 2015



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

Test Specification: AS/NZS CISPR 22:2009 + A1:2010 Prepared by EMI Test Lab - EMITestLab.com
Model Name of EUT: LulzBot TAZ 5
Manufacturer: Aleph Objects, Inc. Revision 1.0



Table of Contents

- 1. General Test Information.....page 4
 - 1.1. Applied Standards
 - 1.2. Detailed description of test configuration, input and output ports
 - 1.2.1. Description of test configuration
 - 1.2.2. Description of input and output ports and power supply information
 - 1.2.3. Operating modes
- 2. Emissions.....page 7
 - 2.1. AC Mains conducted emissions
 - 2.2. Enclosure radiated emissions
 - 2.2.1. 30-1,000 MHz
 - 2.2.2. 1-6 GHz
- 3. Modificationspage 31
- 4. User Guide statements and labelspage 31
- 5. Test equipment.....page 33
- 6. Measurement Uncertainty.....page 35
- 7. Test Planpage 37
- 8. Conclusionpage 38

1 General

1.1 Applied Standards

The LulzBot TAZ 5 3D Printer, made by Aleph Objects, Inc., was evaluated for emissions using AS/NZS CISPR 22:2009 + A1:2010 to show compliance regarding the Australian and New Zealand EMC requirements (Electro Magnetic Compatibility).

The Australian Communications and Media Authority (the ACMA) is responsible for regulating telecommunications, broadcasting, radiocommunications and the internet. The ACMA has responsibility under the *Radiocommunications Act 1992* for the regulation of electromagnetic compatibility (EMC).

The ACMA regulates EMC through the Radiocommunications Labelling (Electromagnetic Compatibility) Notice 2008 as amended (the EMC Labelling Notice) and the Radiocommunications (Electromagnetic Compatibility) Standard 2008 (the EMC Standard). The EMC Standard specifies the technical standards that apply to devices. The EMC Labelling Notice identifies the compliance, labelling and document-keeping requirements that apply to specific devices. It applies certain document-keeping requirements based on the risk of interference from a non-compliant device.

The Trans-Tasman Mutual Recognition Arrangement applies to EMC regulation in Australia and New Zealand. As a result, the EMC arrangements within the two countries comprise a common set of technical standards and regulatory processes for products supplied to the Australian and New Zealand markets. The aim of this is to allow free trade of devices between Australia and New Zealand without the need for additional regulatory approval in the importing country. The New Zealand Radiocommunications (Compliance) Notice is available on the [Radio Spectrum Management \(RSM\) website](#)

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

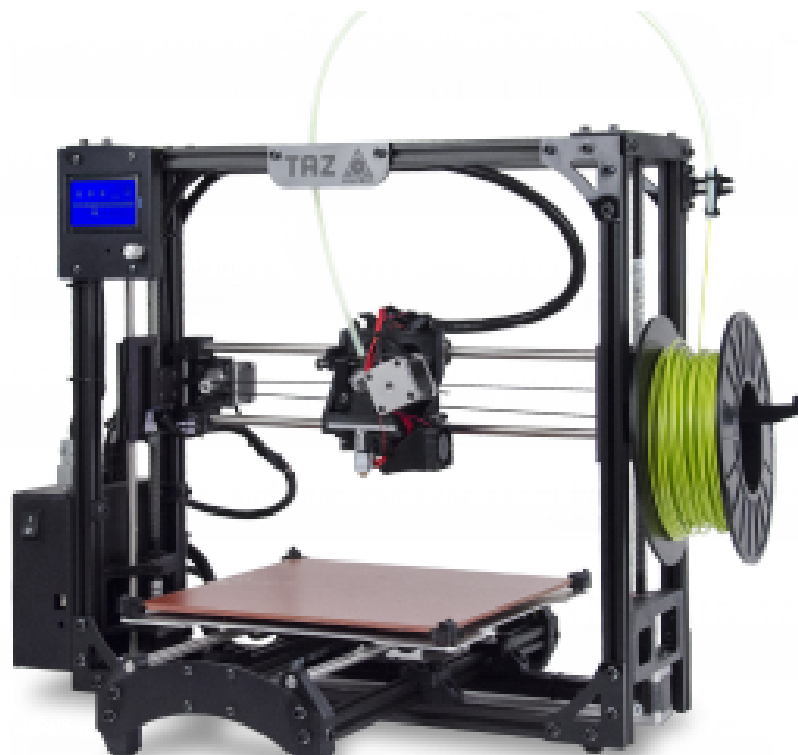
The 3D Printer was tested while printing a 3D image. The printer was connected to a laptop through the usb port on the printer and was also tested while printing from an SD card. The software was installed on the laptop by Aleph Objects and represents typical software currently used by the end user.

For all test configurations the equipment under test (EUT) is powered by nominal Australian AC power: 240VAC/50Hz. All I/O cables are less than 3 meters.

LulzBot TAZ 5 Software:

The default software for the LulzBot TAZ 5 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.

Firmware loaded on the TAZ 5 was Marlin 2015Q1



<https://www.lulzbot.com/products/lulzbot-taz-5-3d-printer>

1.2.1 Description of test configuration

EUT : LulzBot TAZ 5 3D Printer
Manufacturer : Aleph Objects, Inc.
System model name : TAZ 5
Serial Number : KT-PR0036NA-12245
Test Voltage : 240 VAC 50 Hz

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 TAZ5	Yes	Typical 6 ft. usb cable, no ferrites

Power supply location	Manufacturer	Model	Serial number	Shielded	Remarks
External AC supply	Mean Well in a housing designed by Aleph Objects	RSP-500-24	KT-PR0036NA-12245	Yes, metal enclosure	CE mark – Output; 24V 21A Tested with Steward ferrite P/N 28B0672-000.

1.2.2 Operation modes

During preliminary testing for emissions it was determined that the following configurations are worst case for emissions. 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 a 3D image. The printer was connected to a laptop through the usb port on the printer, the 3D printer was also tested while running from an on board SD card, no laptop attached. The software was installed on the laptop by Aleph Objects and represents typical software currently used by the end user.

2 Emissions

The EUT (equipment under test) has been tested to determine conformity with the relevant emissions parts of AS/NZS CISPR 22:2009 +A1:2010, Class A for commercial use.


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



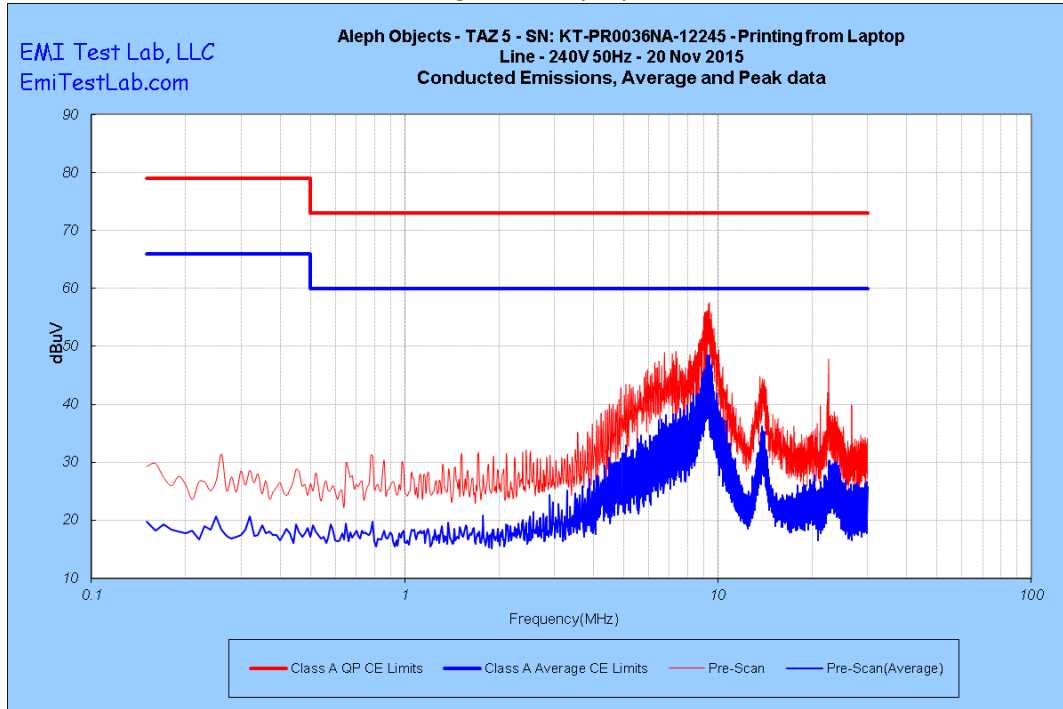
2.1 AC Mains Power Input Ports

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 : AS/NZS CISPR 22:2009 + A1:2010
- Frequency range 1 : 0.15 – 0.5 MHz
- Limit : 79.0 dBuV quasi peak, 66 dBuV average
- Frequency range 2 : 0.5 – 30 MHz
- Limit : 73 dBuV quasi peak, 60 dBuV average

Results of the measurements concerning the emissions of voltage levels at the AC mains input port of the EUT.	<u>PASS Class A</u>
Name of Test Engineer:	Dennis King
Signature:	
Date:	20 November 2015
Remarks. The configuration was tested at 240VAC 50Hz. <u>Conducted Emission Summary:</u> <u>The unit was printing during all conducted emissions tests.</u> PASS	

Printing from a laptop - Line



240 VAC 50 Hz Line

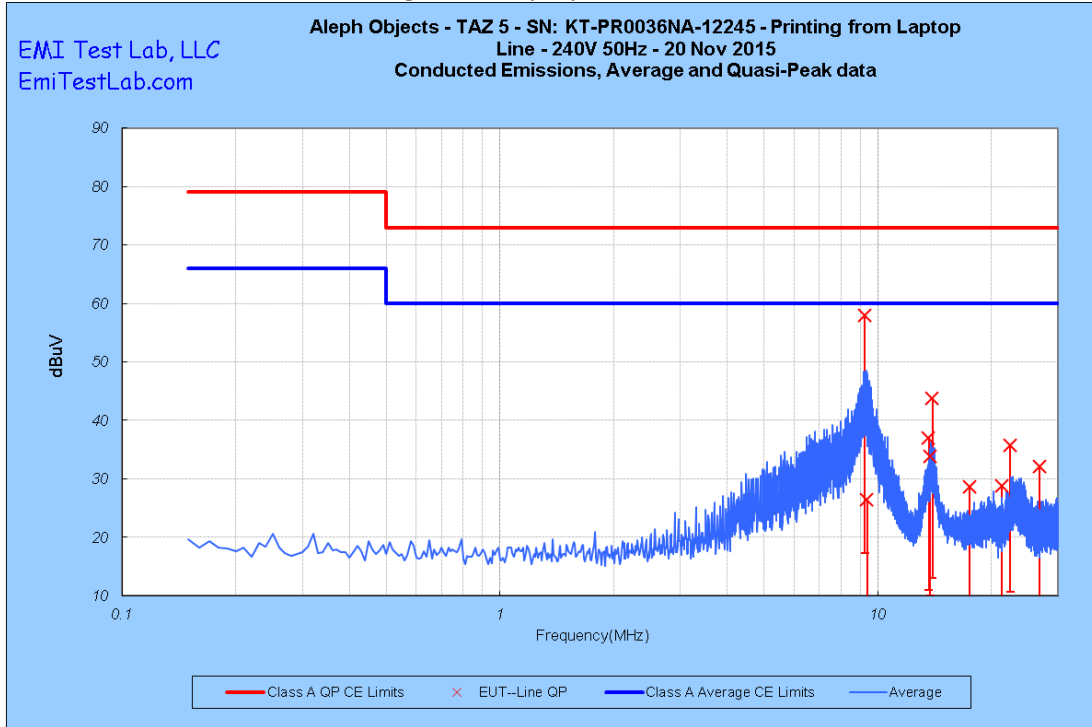
Peak passes the Quasi Peak (upper) and Average (lower) limits

Red is peak and blue is average

The above chart is corrected data;

**Spectrum Analyzer reading + Cable loss + Liss insertion loss + transient limiter
10 kHz Spectrum Analyzer resolution bandwidth**

Printing from a laptop – Line – QP data



240 VAC 50 Hz Line

Quasi Peak passes the Quasi Peak (upper) and Average (lower) limits

Red is peak and blue is average

The above chart is corrected data;

**Spectrum Analyzer reading + Cable loss + Liss insertion loss + transient limiter
10 kHz Spectrum Analyzer resolution bandwidth**



Printing from a laptop – Line – Tabular Data

Frequency (MHz)	QP Disturbance (dBuV)	QP Limit	Margin QP (dB)	Tranducer Connection	Correction Factor (dB)
9.250	57.91	73.00	15.09	AMN	1.18
9.380	26.45	73.00	46.55	AMN	1.18
13.640	36.95	73.00	36.05	AMN	1.25
13.770	33.76	73.00	39.24	AMN	1.26
13.960	43.71	73.00	29.29	AMN	1.26
17.510	28.61	73.00	44.39	AMN	1.31
21.310	28.67	73.00	44.33	AMN	1.37
22.430	35.61	73.00	37.39	AMN	1.39
26.820	32.04	73.00	40.96	AMN	1.45

240 VAC 50 Hz Line

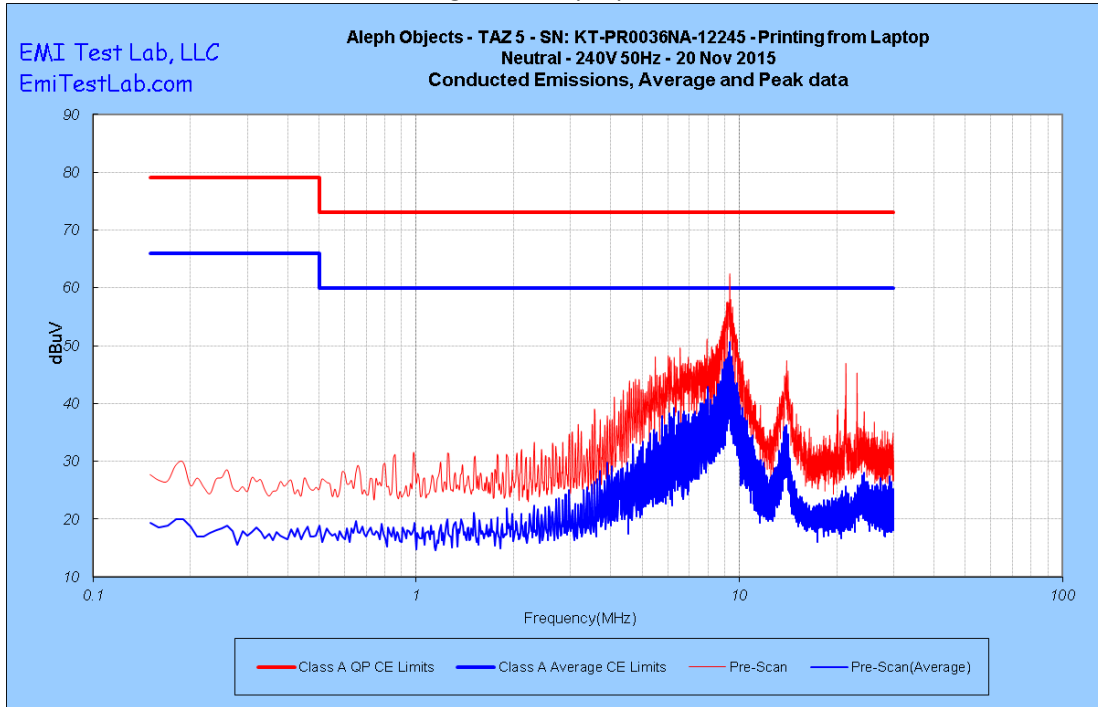
Quasi Peak passes the Quasi Peak (upper) and Average (lower) limits

Red is peak and blue is average

The above chart is corrected data;

**Spectrum Analyzer reading + Cable loss + Lisen insertion loss + transient limiter
 10 kHz Spectrum Analyzer resolution bandwidth**

Printing from a laptop - Neutral



240 VAC 50 Hz Line

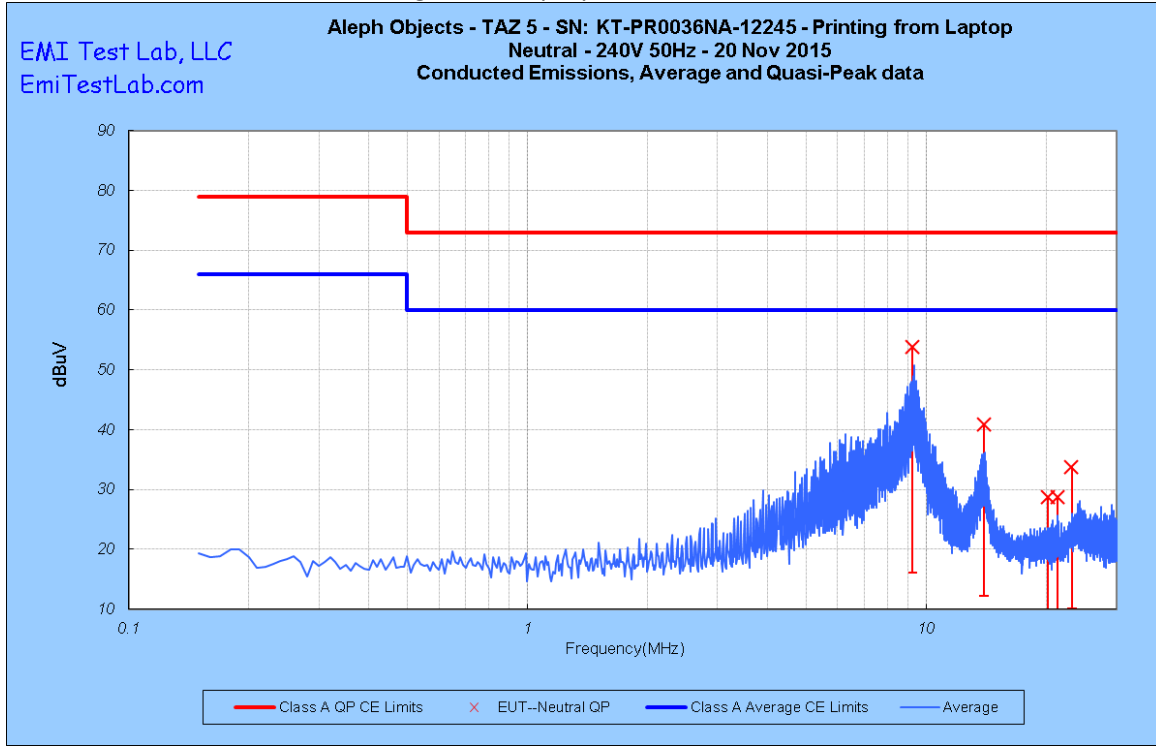
Peak passes the Quasi Peak (upper) and Average (lower) limits

Red is peak and blue is average

The above chart is corrected data;

**Spectrum Analyzer reading + Cable loss + Liss insertion loss + transient limiter
10 kHz Spectrum Analyzer resolution bandwidth**

Printing from a laptop – Neutral – QP data



240 VAC 50 Hz Line

Quasi Peak passes the Quasi Peak (upper) and Average (lower) limits

Red is peak and blue is average

The above chart is corrected data;

**Spectrum Analyzer reading + Cable loss + Lisc insertion loss + transient limiter
10 kHz Spectrum Analyzer resolution bandwidth**



Printing from a laptop – Neutral – Tabular Data

<i>Frequency (MHz)</i>	<i>QP Disturbance (dBUV)</i>	<i>QP Limit</i>	<i>Margin QP (dB)</i>	<i>Tranducer Connection</i>	<i>Correction Factor (dB)</i>
9.240	33.07	73.00	39.93	AMN	1.17
9.240	53.79	73.00	19.21	AMN	1.17
13.970	37.76	73.00	35.24	AMN	1.26
13.970	40.86	73.00	32.14	AMN	1.26
20.190	28.65	73.00	44.35	AMN	1.35
21.360	28.67	73.00	44.33	AMN	1.37
23.210	33.73	73.00	39.27	AMN	1.40

240 VAC 50 Hz Line

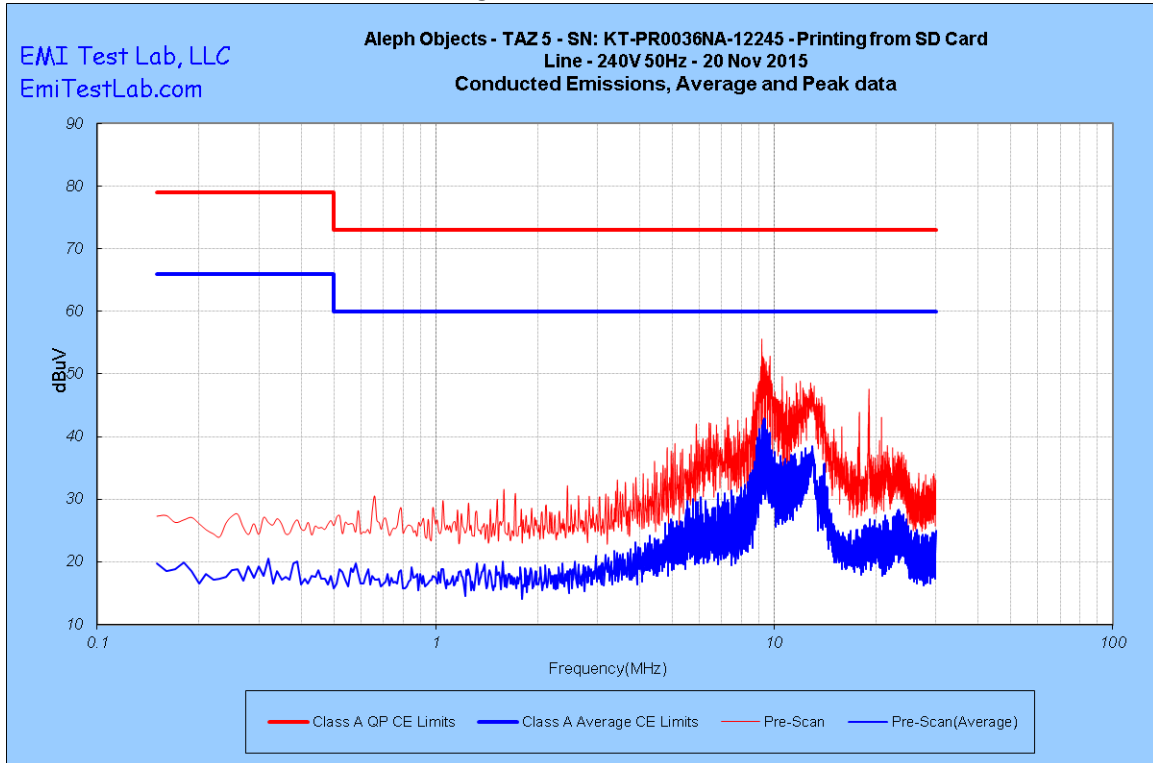
Quasi Peak passes the Quasi Peak (upper) and Average (lower) limits

Red is peak and blue is average

The above chart is corrected data;

**Spectrum Analyzer reading + Cable loss + Lisen insertion loss + transient limiter
 10 kHz Spectrum Analyzer resolution bandwidth**

Printing from an SD Card - Line



240 VAC 50 Hz Line

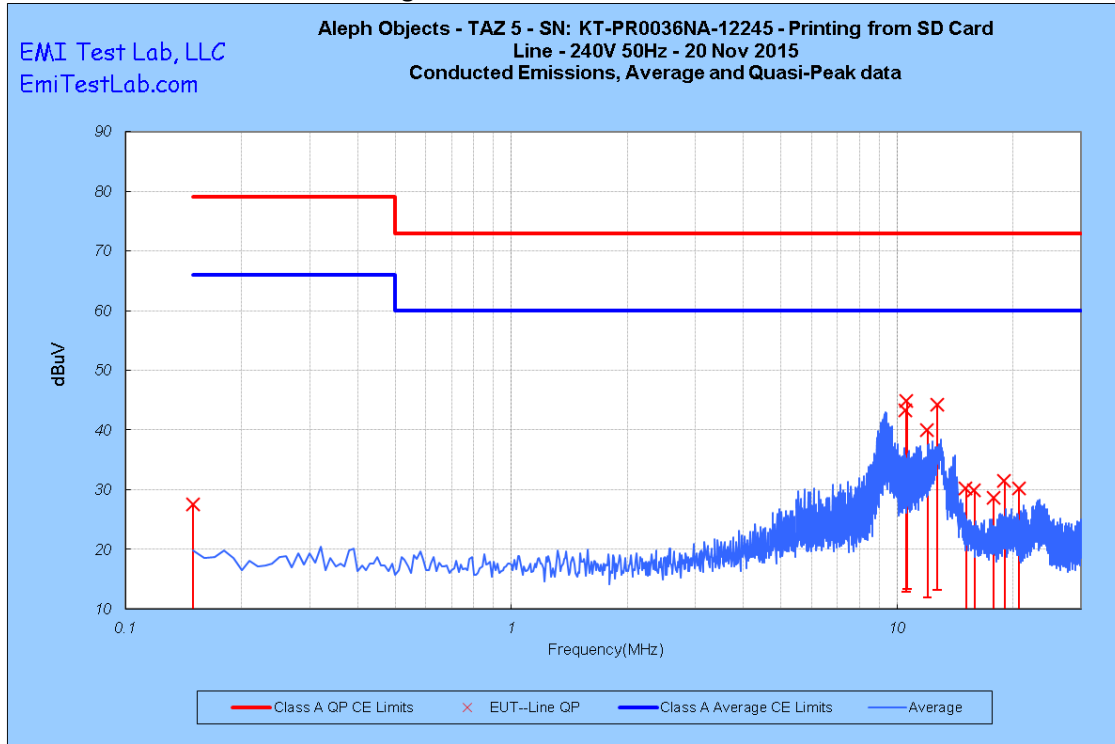
Peak passes the Quasi Peak (upper) and Average (lower) limits

Red is peak and blue is average

The above chart is corrected data;

**Spectrum Analyzer reading + Cable loss + Lisc insertion loss + transient limiter
10 kHz Spectrum Analyzer resolution bandwidth**

Printing from an SD card – Line – QP data



240 VAC 50 Hz Line

Quasi Peak passes the Quasi Peak (upper) and Average (lower) limits

Red is peak and blue is average

The above chart is corrected data;

**Spectrum Analyzer reading + Cable loss + Lisen insertion loss + transient limiter
10 kHz Spectrum Analyzer resolution bandwidth**

Printing from an SD Card – Line – Tabular Data

Frequency (MHz)	QP Disturbance (dBUV)	QP Limit	Margin QP (dB)	Tranducer Connection	Correction Factor (dB)
0.150	32.00	79.00	47.00	AMN	0.20
0.150	27.50	79.00	51.50	AMN	0.20
10.620	44.74	73.00	28.26	AMN	1.21
10.560	43.21	73.00	29.79	AMN	1.21
12.000	39.93	73.00	33.07	AMN	1.23
12.720	44.22	73.00	28.78	AMN	1.24
15.090	30.18	73.00	42.82	AMN	1.28
15.890	29.89	73.00	43.11	AMN	1.29
17.800	28.62	73.00	44.38	AMN	1.32
19.020	31.34	73.00	41.66	AMN	1.34
20.740	30.16	73.00	42.84	AMN	1.36

240 VAC 50 Hz Line

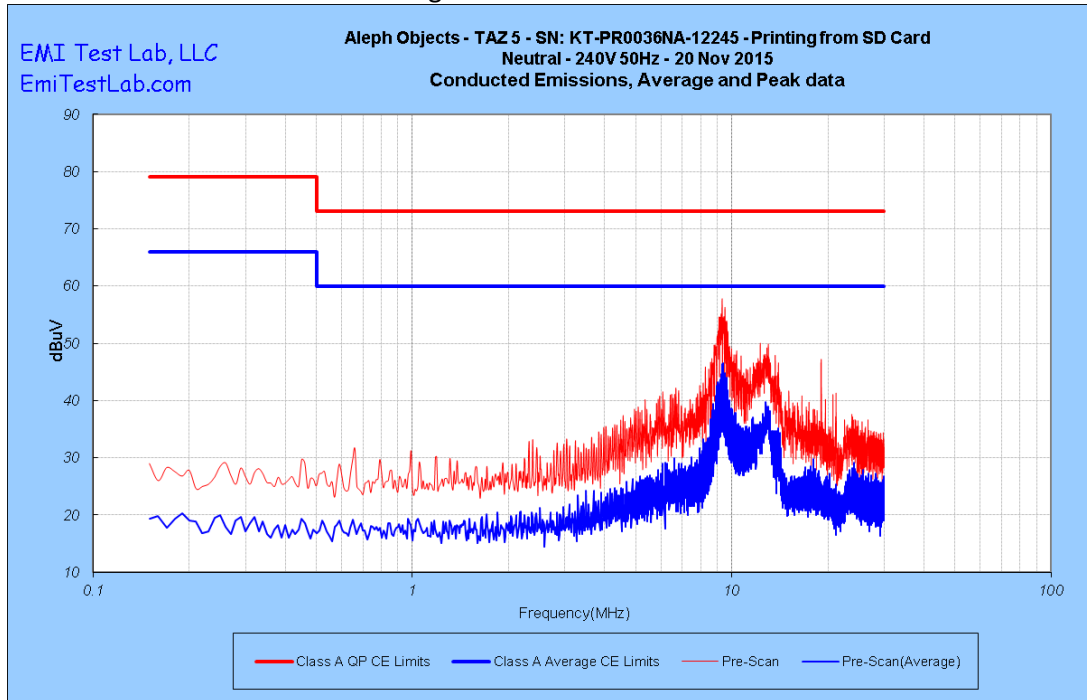
Quasi Peak passes the Quasi Peak (upper) and Average (lower) limits

Red is peak and blue is average

The above chart is corrected data;

**Spectrum Analyzer reading + Cable loss + Lisen insertion loss + transient limiter
10 kHz Spectrum Analyzer resolution bandwidth**

Printing from an SD Card - Neutral



240 VAC 50 Hz Line

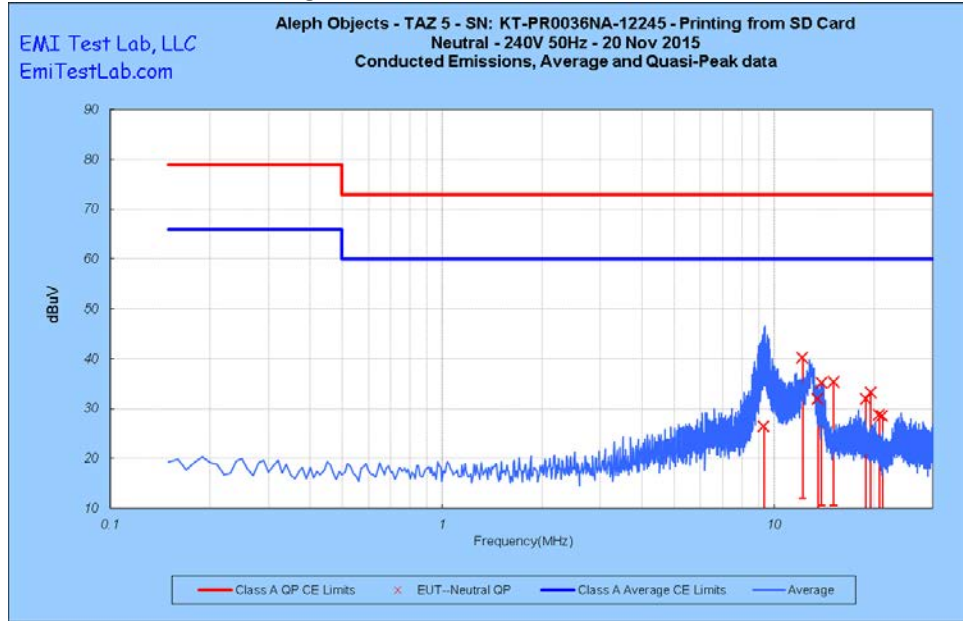
Peak passes the Quasi Peak (upper) and Average (lower) limits

Red is peak and blue is average

The above chart is corrected data;

**Spectrum Analyzer reading + Cable loss + Lisen insertion loss + transient limiter
10 kHz Spectrum Analyzer resolution bandwidth**

Printing from an SD Card – Neutral – QP data



240 VAC 50 Hz Line

Quasi Peak passes the Quasi Peak (upper) and Average (lower) limits

Red is peak and blue is average

The above chart is corrected data;

**Spectrum Analyzer reading + Cable loss + Liscn insertion loss + transient limiter
10 kHz Spectrum Analyzer resolution bandwidth**



Printing from an SD card – Neutral – Tabular Data

<i>Frequency (MHz)</i>	<i>QP Disturbance (dBUV)</i>	<i>QP Limit</i>	<i>Margin QP (dB)</i>	<i>Tranducer Connection</i>	<i>Correction Factor (dB)</i>
9.310	26.43	73.00	46.57	AMN	1.18
12.190	40.13	73.00	32.87	AMN	1.23
13.570	31.85	73.00	41.15	AMN	1.25
13.900	35.16	73.00	37.84	AMN	1.26
15.100	35.30	73.00	37.70	AMN	1.28
18.910	31.90	73.00	41.10	AMN	1.33
19.550	33.19	73.00	39.81	AMN	1.34
20.750	28.57	73.00	44.43	AMN	1.36
21.220	28.52	73.00	44.48	AMN	1.37

240 VAC 50 Hz Line

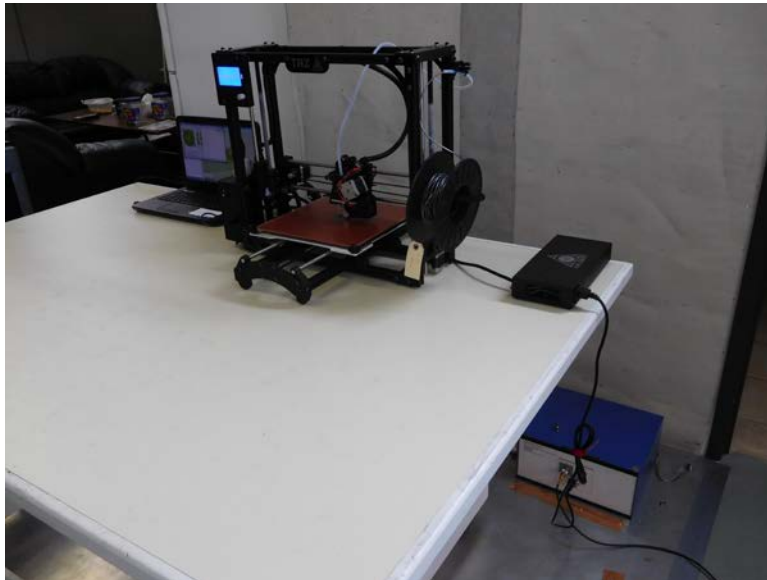
Quasi Peak passes the Quasi Peak (upper) and Average (lower) limits

Red is peak and blue is average

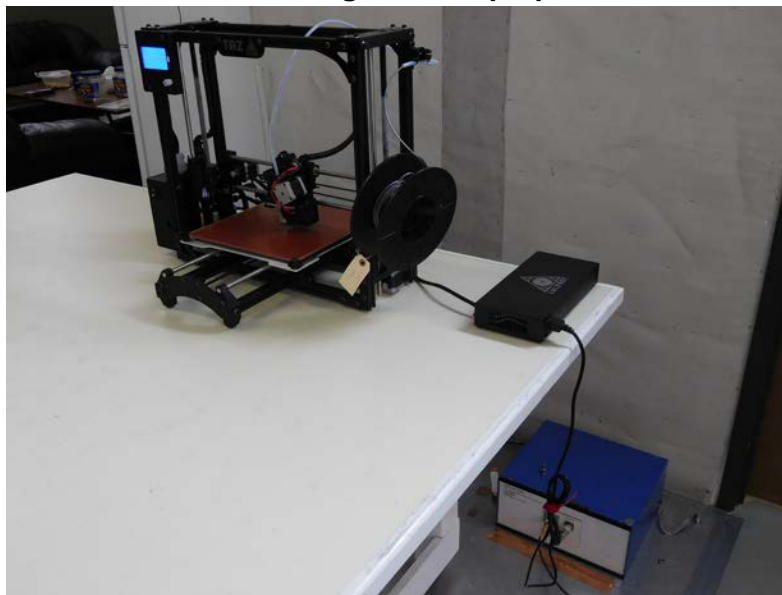
The above chart is corrected data;

**Spectrum Analyzer reading + Cable loss + Lisen insertion loss + transient limiter
 10 kHz Spectrum Analyzer resolution bandwidth**

Printing from an SD Card



Printing from a laptop



Conducted emissions test setup




2.2 Enclosure

2.2.1 30-1,000 MHz

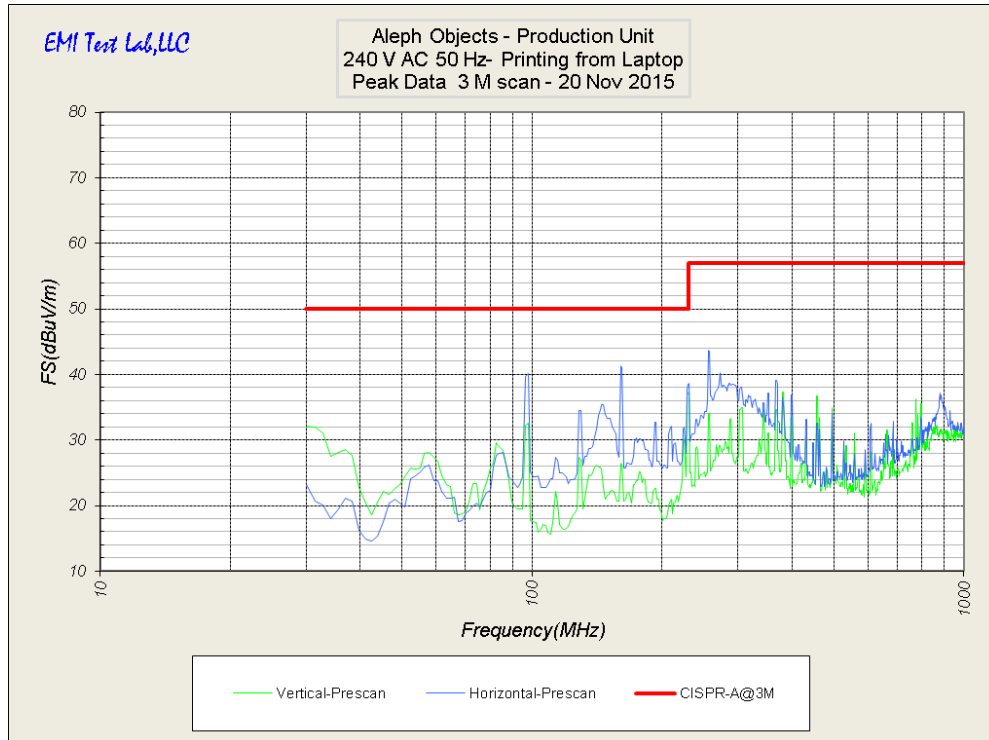
The radiated field strength levels (electric component) have been measured in conformity with and according to the criteria as stated below.

Basic standard	:	AS/NZS CISPR 22:2009 + A1:2010
Limit distance	:	3 meters
Frequency range 1	:	30 -230 MHz
Limits	:	50 dBuV/m
Frequency range 2	:	230 – 1,000 MHz
Limits	:	57 dBuV/m

Results of the measurements concerning radiated electromagnetic fields (electric component) emitted by the EUT, enclosure, as a tested system	<u>PASS Class A</u>
<p style="text-align: right;">Name of Test Engineer:</p> <p style="text-align: right;">Signature:</p> <p style="text-align: right;">Date:</p>	<p>Dennis King</p>  <p>20 November 2015</p>
<p>Remarks: The configuration was tested at 240 VAC 50 Hz</p> <p><u>Radiated Emissions Summary:</u></p> <p>The unit was tested printing from a laptop and printing from an SD card. 100 kHz SA res bw. Both configurations PASS with no modifications.</p>	

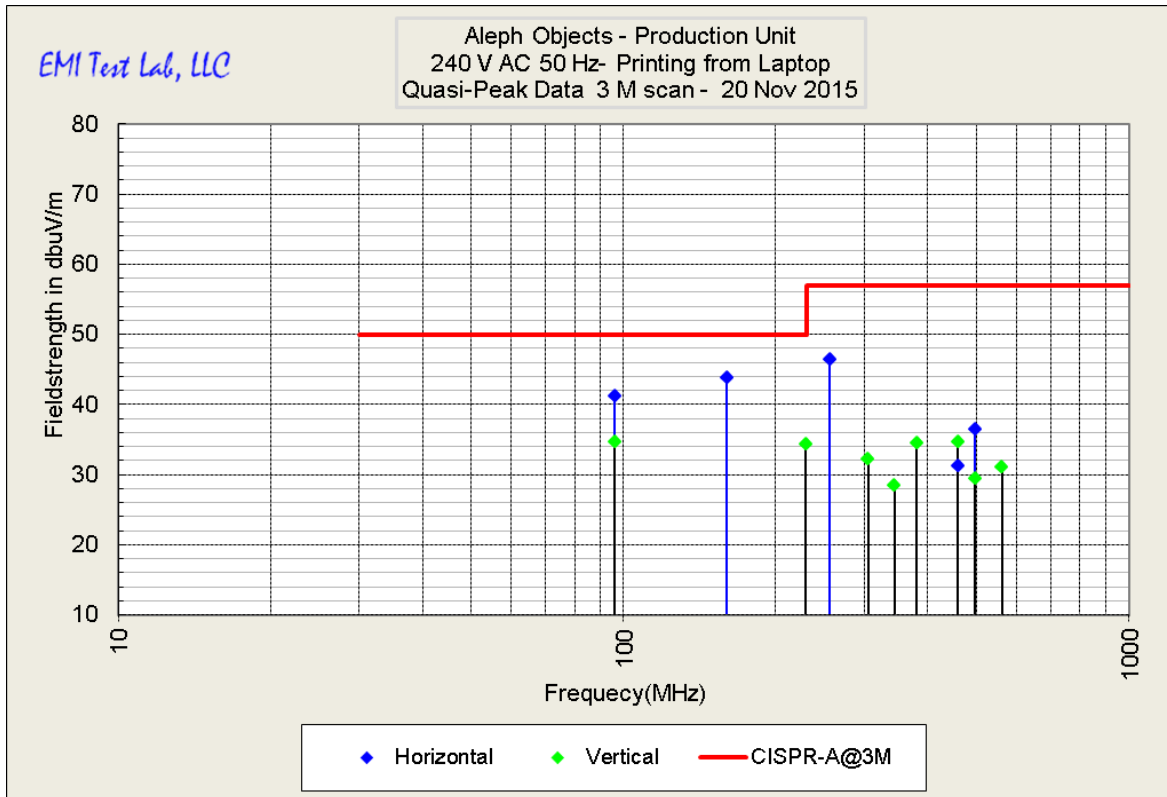
The chart below is peak data compared to a quasi-peak limit

Printing from a laptop



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

Printing from a laptop

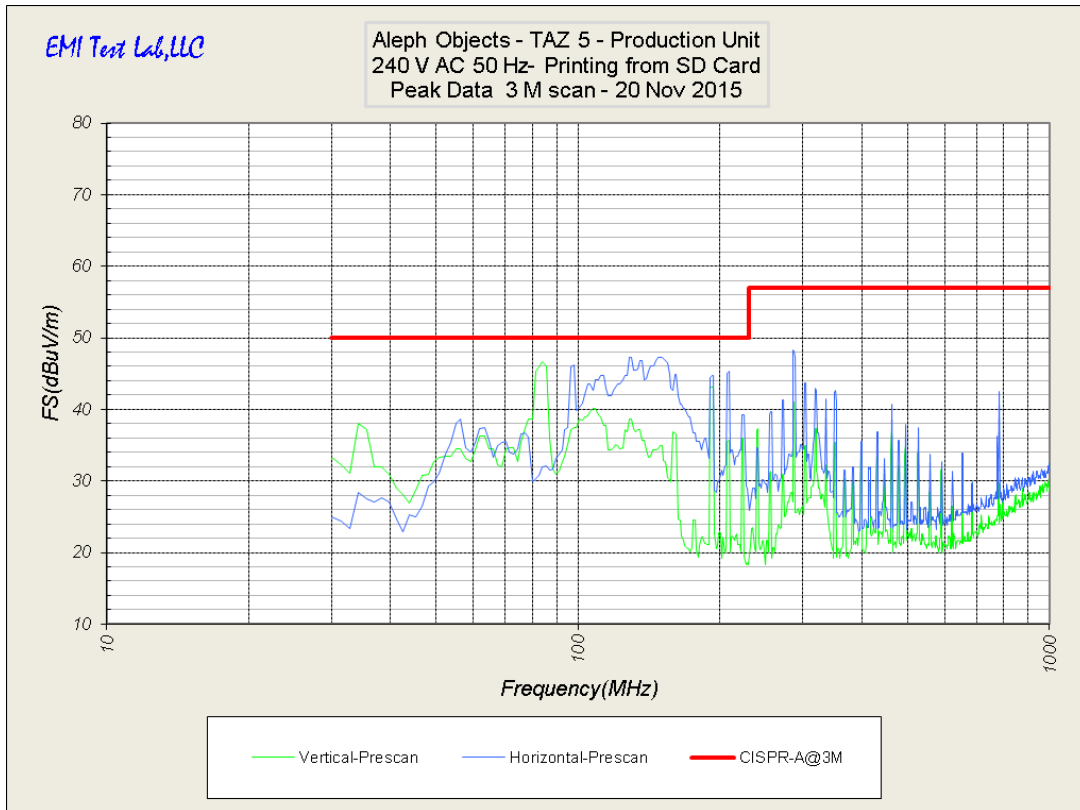


Printing from a laptop – quasi peak tabular data

<i>EMI Test Lab</i>						Sheet4
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	Limit delta
(MHz)	(dBuV/m)	(dBuV/m)	Degrees	Meters	H or V	dBuV
380.54	34.55	57	8.0	1	V	-22.5
559.98	31.05	57	40.0	1	V	-26.0
495.99	29.37	57	60.0	1	V	-27.6
229.21	34.30	50	92.0	1	V	-15.7
96.01	34.67	50	172.0	1	V	-15.3
304.42	32.20	57	312.0	1	V	-24.8
343.27	28.47	57	348.0	1	V	-28.5
458.40	34.65	57	348.0	1	V	-22.4
495.98	36.45	57	12.0	1	H	-20.6
255.99	46.42	57	140.0	1	H	-10.6
95.99	41.17	50	172.0	1	H	-8.8
159.98	43.82	50	208.0	1	H	-6.2
458.36	31.32	57	348.0	1	H	-25.7

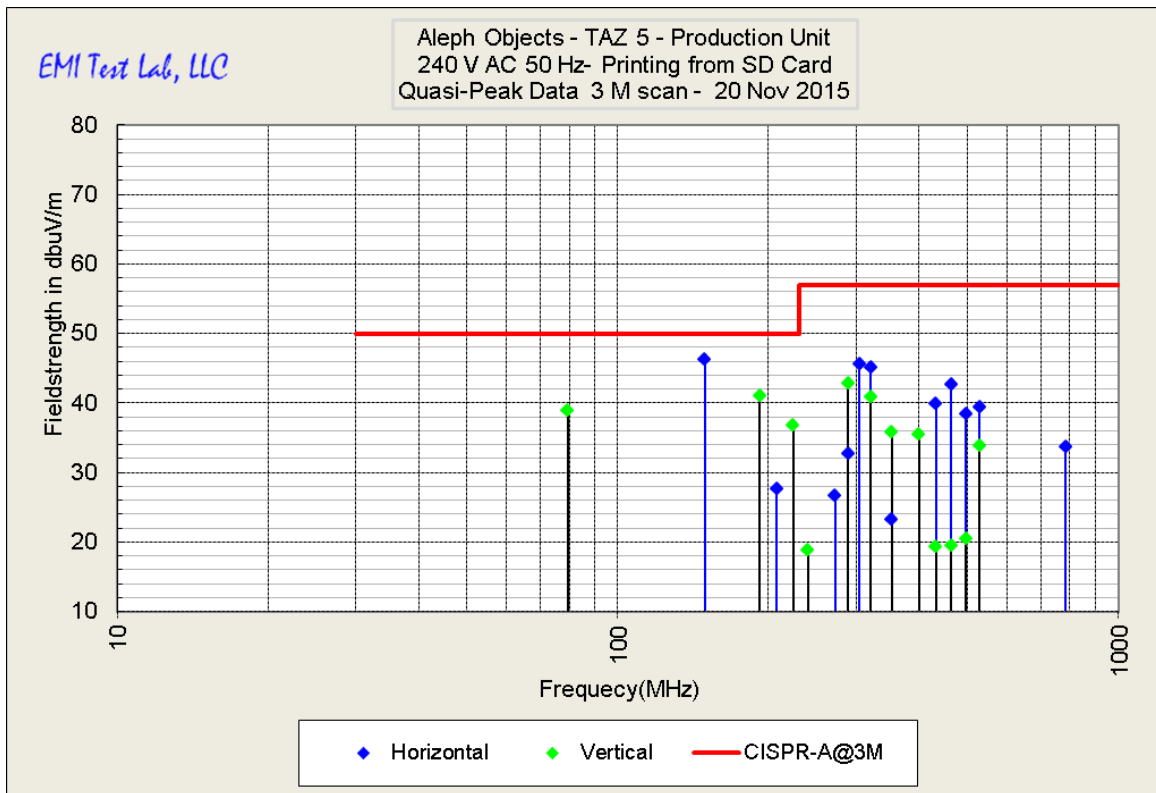
The chart below is peak data compared to a quasi-peak limit

Printing from an SD Card



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

Printing from an SD Card



Printing from an SD Card – quasi peak tabular data


<i>EMI Test Lab</i>						Sheet4
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	Limit delta
<i>(MHz)</i>	<i>(dBuV/m)</i>	<i>(dBuV/m)</i>	<i>Degrees</i>	<i>Meters</i>	<i>H or V</i>	<i>dBuV</i>
495.45	20.47	57	0.0	1	V	-36.5
463.98	19.45	57	4.0	1	V	-37.6
351.99	35.77	57	8.0	1	V	-21.2
224.00	36.82	50	16.0	1	V	-13.2
79.43	38.92	50	116.0	1	V	-11.1
527.97	33.80	57	128.0	1	V	-23.2
191.98	40.97	50	136.0	1	V	-9.0
431.98	19.40	57	168.0	1	V	-37.6
240.00	18.85	57	192.0	1	V	-38.2
399.98	35.47	57	196.0	1	V	-21.5
319.99	40.85	57	336.0	1	V	-16.2
287.99	42.92	57	336.0	1	V	-14.1
320.00	45.07	57	0.0	1	H	-11.9
463.98	42.65	57	20.0	1	H	-14.4
431.99	39.90	57	164.0	1	H	-17.1
527.98	39.42	57	176.0	1	H	-17.6
271.97	26.75	57	224.0	1	H	-30.3
149.35	46.30	50	232.0	1	H	-3.7
303.99	45.65	57	240.0	1	H	-11.4
352.19	23.20	57	328.0	1	H	-33.8
784.60	33.62	57	340.0	1	H	-23.4
495.81	38.40	57	344.0	1	H	-18.6
207.81	27.67	50	356.0	1	H	-22.3
288.37	32.70	57	356.0	1	H	-24.3



2.2.2 1-6 GHz

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

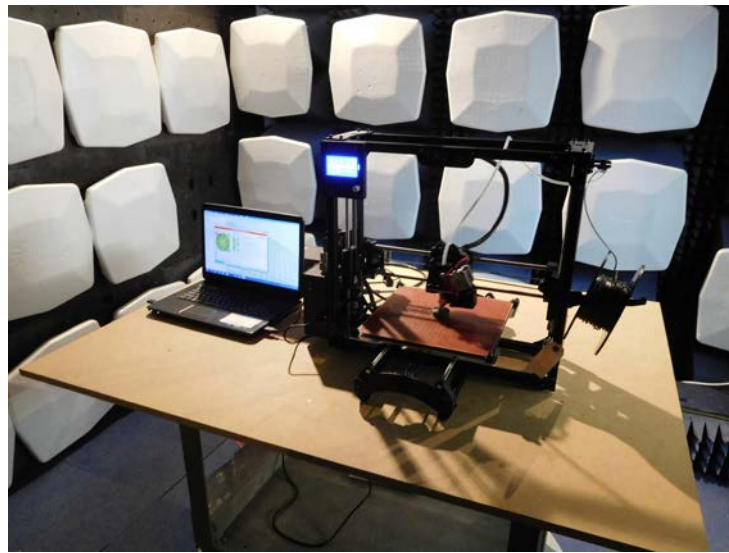
- Basic standard : FCC Part 15, Subpart B, ICES-003 Issue 5
- Test method : ANSI C63.4, CAN/CSA – CISPR 22-10
- Limit distance : 3 meters
- Frequency range 1 : 1-3 GHz
- Limits : Average 50 dBuV/m, Peak 70 dBuV/m
- Frequency range 2 : 3-6 GHz
- Limits : Average 54 dBuV/m, Peak 74 dBuV/m

Results of the measurements concerning radiated electromagnetic fields (electric component) emitted by the EUT, enclosure, as a tested system	<u>Not applicable- no clock frequency higher than 108 MHz</u>
<p style="text-align: right;">Name of Test Engineer:</p> <p style="text-align: right;">Signature:</p> <p style="text-align: right;">Date:</p>	<p>Dennis King</p>  <p>2 December 2015</p>
<p>Remarks:</p> <p><u>Not applicable , all clocks under 108 MHz.</u></p>	

Radiated Emissions Setup



Radiated emissions test setup – printing from SD Card



Radiated emissions test setup – printing from a laptop

3.0 Modifications

No modifications were made during the testing.

4.0 User Guide Statements – Labels

From CISPR 22 the following statement should be placed in the user guide:

4.2 Class A ITE

Class A ITE is a category of all other ITE which satisfies the class A ITE limits but not the class B ITE limits. Such equipment should not be restricted in its sale but the following warning shall be included in the instructions for use:

Warning

This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Information from the ACMA regarding the RCM Mark:

Note: The ACMA is amending the communications regulatory arrangements to introduce a consolidated mark (the Regulatory Compliance Mark—‘RCM’) for devices and equipment subject to the ACMA’s telecommunications, radiocommunications, EMC and EMR/EME compliance and labelling requirements. The new arrangements will commence on 1 March 2013 with a three-year transition period. This booklet, and information published on the ACMA website, will be updated at that time. Further information about the RCM and transitional arrangements is available on the [ACMA website](#).

What is the RCM?



The Regulatory Compliance Mark (RCM) is a trademark owned by Australian and New Zealand regulators. The design and use of the RCM is legally protected by registration in Australia and New Zealand. The RCM is used to indicate compliance with all sections of AS/NZS 4417 that are applicable to the device. These are:

AS/NZS 4417.1—general rules for use of the mark

Test Specification: AS/NZS CISPR 22:2009 + A1:2010

Prepared by EMI Test Lab - EMITestLab.com

Model Name of EUT: LulzBot TAZ 5

Manufacturer: Aleph Objects, Inc.

Revision 1.0

AS/NZS 4417.2—specific requirements for electrical safety regulatory applications

AS/NZS 4417.3—specific requirements for electromagnetic compatibility regulatory applications

AS/NZS 4417.4—specific requirements for radio apparatus regulatory applications.

A new version of AS/NZS 4417 is currently being prepared. In the case of radiocommunications, EMC and EME, the draft revised version of AS/NZS 4417 will only refer to the ACMA's regulatory arrangements and will not purport to describe the rules for the use of the mark for the purposes of complying with ACMA requirements.

Can I use the RCM?

The RCM may be used to indicate EMC compliance. If the RCM is used as a replacement for the C-Tick compliance mark, the device must comply with the other applicable regulations—such as electrical safety—that are covered by the RCM Standard AS/NZS 4417. The various parts of this standard specify the conditions for using the RCM for the different regulatory regimes. The RCM Standard is available from the [SAI Global website](#).

More information about the conditions of use of the RCM is in the RCM Standard AS/NZS 4417. Suppliers who intend to use the RCM must register with the RCM Registrar. Where the RCM is used to indicate compliance with EMC regulations, the supplier must advise the ACMA of their intention to use the RCM and the supplier identification information to be used.

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 2016
HP Quasi-Peak Adapter	Used for Radiated and Conducted Emissions	85650A	8574A00233	3 June 2016
Advantest Spectrum Analyzer	Used for Radiated and Conducted Emissions	R3361A	01730556	20 October 2016
Com-Power transient Limiter	Conducted Emissions	HZ560	001	3 June 2016
RF Bay Pre-Amp	Radiated emissions – 100kHz to 10 GHz	LPA-10-20	0643	12 Dec 2015
GTEM	Radiated Emissions and Radiated Immunity	5317	9703-1209	25 April 2016 – Field Uniformity Cal per IEC 61000-4-20
3 Meter FAR – Fully Anechoic Room	Radiated Immunity and Emissions	N/A	FAR #1	15 October 2016 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 2016
Chase BiLog Antenna	Radiated Emissions and Immunity	CBL6111	1121	20 March 2016
Marconi Instruments – Signal Generator 10kHz – 2.7 GHz	Radiated Immunity	2031	1196061031	20 October 2016
HP Signal Generator	Radiated Immunity	8657A	STD0578	3 May 2016

Electro Magnetic Interference Testing
EmiTestLab.com

HP Synthesized Sweep Generator .01-20 GHz	Radiated Immunity 1 GHz to 2.7 GHz	83752B	34462	3 May 2016
Amplifier Research .800 – 4.2 GHz Amp	Radiated Immunity – 1 GHz to 2.7 GHz	10S1G4	34516	4 May 2016
Antenna Research Associates – 100 Watt amplifier w/controller	Radiated Immunity – 80-1000 MHz in the FAR	ARAPS/PC757LC ARA757LC-CE	587V7 587V7	20 October 2016
Kalmus Power Amplifier	Radiated Immunity 150kHz – 1 GHz – in the GTEM	747LC-CE	7894-1	12 May 2016
Amplifier Research E- Field Probe	Radiated Immunity	FP 2000	12845	12 May 2016
Com-Power LISN	Conducted emissions	LI-115	241010	17 May 2016
Com-Power LISN	Conducted emissions	LI-115	241011	17 May 2016
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 2016
EMI Labs CDN	Conducted Immunity	EMICDN	001	9 Dec 2015
Schaffner ESD Gun	Electro Static Discharge	NSG435	54711	11 Dec 2015
KeyTek ECAT	Fast transients / Burst	E412	32612	5 June 2016
FCC Inc. RF Current Probe	Monitor Conducted Immunity signal	F-33-1	423	9 Dec 2015
EMI Labs Mag Loop	Magnetic Loop Antenna	Mag100	80162	12 Dec 2015
Thermo Keytek CE Master	Surge/ AC Dips and Interrupts	CE Master	0405277	15 Dec 2015

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.

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, CISPR 22 is $\pm 1.2\text{dB}$
The estimated combined standard uncertainty for Radiated Immunity, EN 61000-4-3 is $\pm 2.7\text{dB}$
The estimated combined standard uncertainty for EFT/Burst, EN 61000-4-4 is $\pm 5.8\%$
The estimated combined standard uncertainty for Surge, EN 61000-4-5 is $\pm 8\%$
The estimated combined standard uncertainty for Conducted Immunity, EN 61000-4-6 is $\pm 1.5\text{ dB}$
The estimated combined standard uncertainty for Magnetic Fields, EN 61000-4-8 is $\pm 0.6\%$
The estimated combined standard uncertainty for Voltage Dips and Interrupts, EN 61000-4-11 is $\pm 4.3\%$
The estimated combined standard uncertainty for Harmonic current and flicker is $\pm 11.6\%$
The estimated combined standard uncertainty for ESD testing, EN 61000-4-2 is $\pm 4\%$

7.0 Test Plan

Testing required

The LulzBot TAZ 5 3D Printer will be tested for Class A Radiated and Conducted Emissions per AS/NZS CISPR 22:2009 + A1:2010. The test voltage will be 240 VAC 50 Hz.

Test Setup

The LulzBot TAZ 5 will be operating in a typical use mode, printing an object during all the testing.

Two modes will be tested:

1. Printing from a laptop
2. Printing from an internal SD card.

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.

Typical software that the end user would use will be used during the testing.

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.

Status of the test unit

Production level.

8.0 Conclusion

The Aleph Objects – LulzBot TAZ 5 3D Printer complies with;

AS/NZS CISPR 22:2009 + A1:2010, Class A for commercial use

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

End of Report