EMI Test Lab LLC
Electro Magnetic Interference Testing
EmiTestLab.com

Electro Magnetic Compatibility Test Report

Regarding the CE Mark and the

Australia / New Zealand Compliance of the

Aleph Objects

TAZ Workhorse 3D Printer

In Accordance with the Information Technology Standards

AS/NZS CISPR 24, AS/NZS CISPR 32 and EN 55024, EN 55032,

EN 61000-3-2, EN 61000-3-3 for Emissions, Class B for home use

Report Revision History

Revision	Date	Reason
1.0	27 June 2019	Initial Release

Description of Equipment Under Test (EUT)

Test Item	:	TAZ Workhorse 3D Printer
Manufacturer	:	Aleph Objects, Inc.

Manufacturer's information

Manufacturers Representative	:	Mark Pelletier - Engineer
Company	:	Aleph Objects, Inc.
Address	:	626 West 66th Street Loveland, Colorado 80538 U.S.A.
Website	:	https://www.lulzbot.com/store/printers/lulzbot-taz-Workhorse

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	:	EN 55024, EN 55032, CISPR 24, CISPR 32, AS/NZS CISPR 24 and 32, All Class B emissions
Tests completed	:	28 May 2019
Result of Testing	:	**The EUT is in Compliance with EN 61000-3-2, EN 61000-3-3 EN 55024:2010+A1:2015, EN 55032:2015, CISPR 24:2015, CISPR 32:2015, Class B AS/NZS CISPR 24:2013, AS/NZS CISPR 32:2015**
Senior EMC Engineer	:	Dennis King
Report written by	:	Dennis King – EMI Test Lab
Test Plan	:	Dennis King and Mark Pelletier for Aleph Objects
Report date	:	27 June 2019

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 Aleph TAZ Workhorse 3D Printer was evaluated for emissions using the international standards CISPR 32:2015, the EU European standards EN 55032:2015 and Australia's standard AS/NZS CISPR 32:2015.

Immunity standards applied are the international standards CISPR 24:2015, the EU European standard EN 55024:2010+A1:2015 and Australia's standard AS/NZS CISPR 24:2013.

CISPR are the international standards, countries across the world adopt the CISPR standards with sometimes minor changes and sometimes with no changes at all. The EU adopts the CISPR standards and adds the prefix "EN". Australia and New Zealand adopt the CISPR standards and adopt the prefix AS/NZS, and so on around the world. North America has harmonized with the CISPR emissions standards but has no requirement for immunity.

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

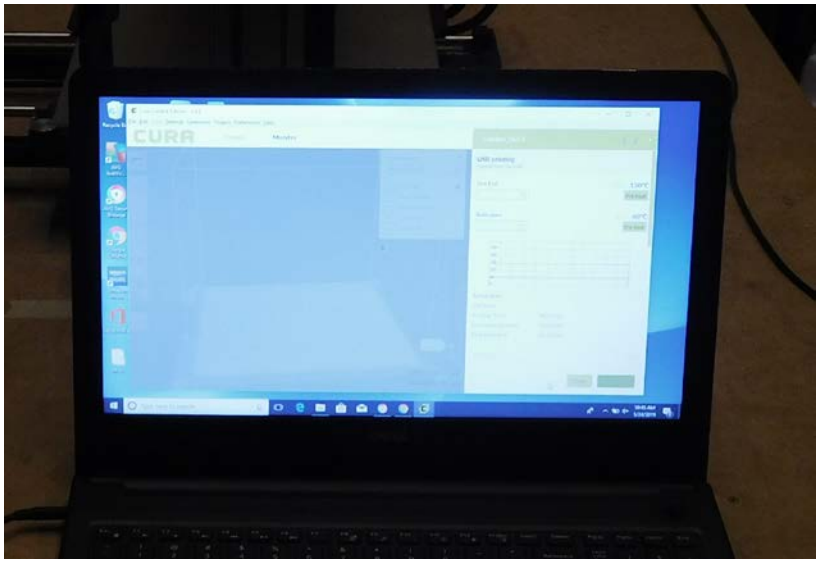
The 3D Printer was tested while running test code that simulates a worst case for operation of the printer. The heater bed was on during all the testing.

Test code used is called TEST_2.gcode

For all test configurations the equipment under test (EUT) is powered by European AC power: 230VAC/50Hz. This voltage also covers Australia and New Zealand. All I/O cables are less than 3 meters.

LulzBot Software:

The default software for the TAZ WORKHORSE 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.



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

1.2.1 Description of test configuration

EUT	:	TAZ Workhorse 3D Printer
Manufacturer	:	Aleph Objects, Inc.
System model name	:	TAZ Workhorse
Serial Number	:	WH001
Test Voltage	:	230 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	unterminated	TAZ Workhorse	Yes	6 ft. Tripp Lite model: U023-006 – ferrites on both ends

Power supply location	Manufacturer	Model	Serial number	Shielded	Remarks
Internal AC supply	Meanwell	RSP-500-24	Not available	Shielded enclosure	UL and TUV Rheinland Certified – Output; 24V 21A

1.2.3 Operation modes

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 3D Printer was tested while running test code that continuously moves the print heads and heats the heater bed.

The 3D Printer was checked while printing from the SD Card and also while operated from a laptop connecting to the printer through a USB cable that is supplied with the unit.

The TAZ Workhorse – 3D Printer

https://www.lulzbot.com/store/printers/lulzbot-taz-workhorse

2 Emissions

The EUT (equipment under test) has been tested to determine conformity with the relevant emissions parts of EN 55032:2015, CISPR 32, and AS/NZS 32:2015.

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

Harmonic currents at the AC mains connection terminals of the EUT were measured in conformance with and according to EN 61000-3-2:2014.

Voltage fluctuations and flicker at the AC mains connection terminals of the EUT were measured in conformance with and according to EN 61000-3-3:2013.

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	:	CISPR 32:2015
Test setup	:	EN 55032, AS/NZS CISOR 32
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**
Name of Test Engineer: Signature: Date:	Dennis King  27 May 2019

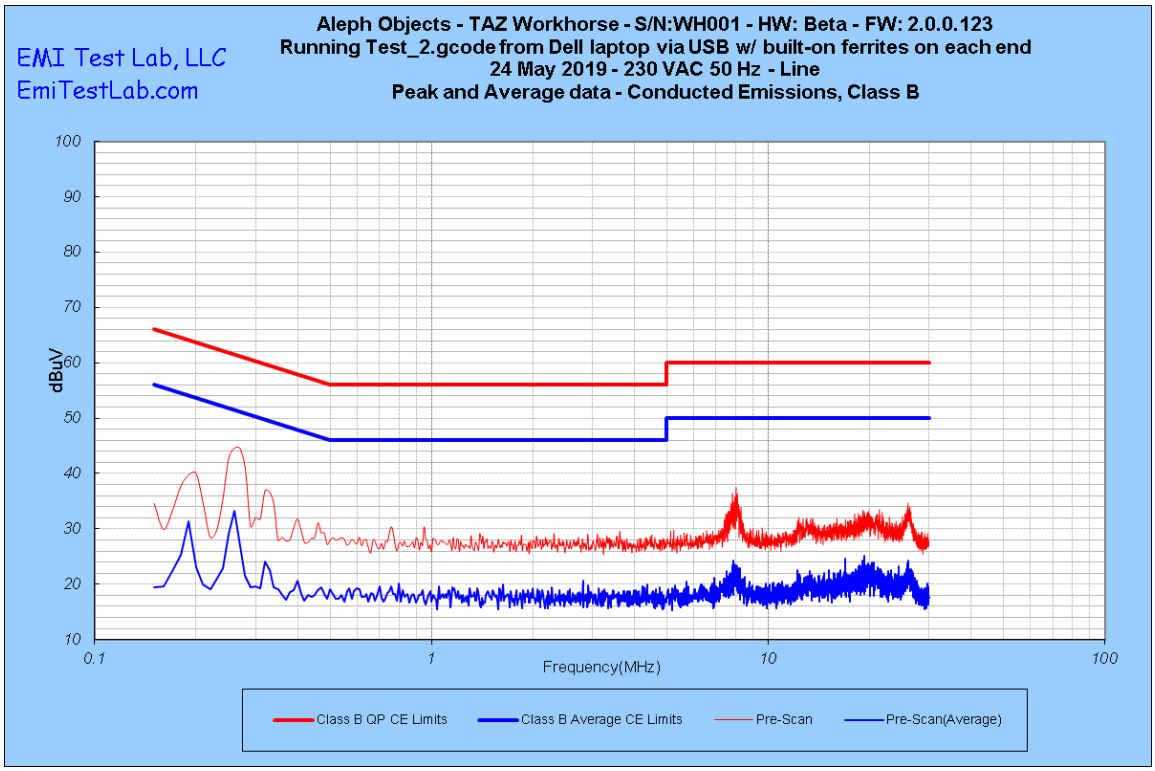
Remarks: The configuration was tested at 230 VAC 50Hz.

Conducted Emission Summary:

Passing.

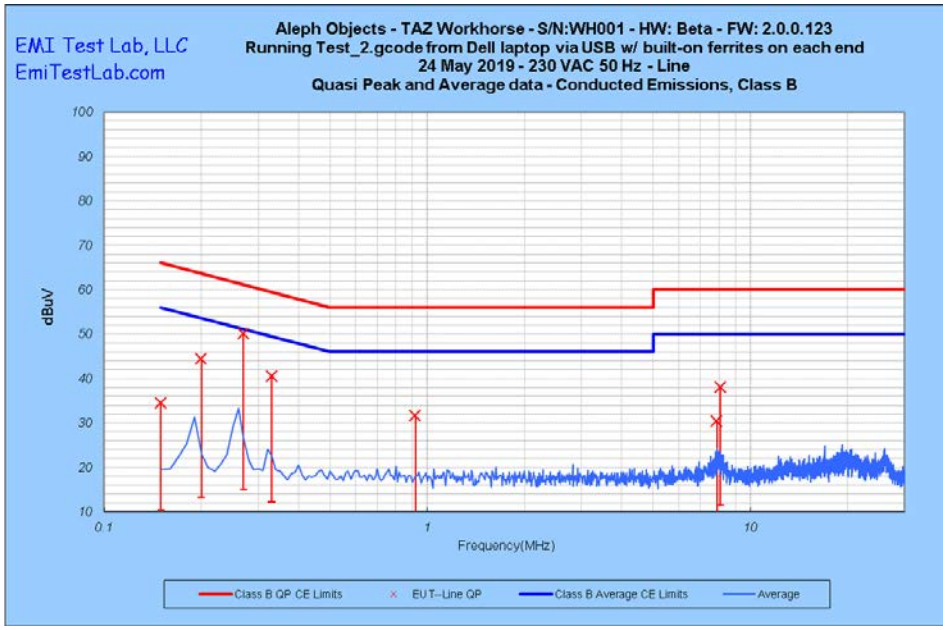
230 VAC 50 Hz – Line – Peak passing Quasi peak limit – Average data passing the average limit

Running from a laptop through usb



230 VAC 50 Hz – Line – Peak passing Quasi peak limit – Average data passing the average limit

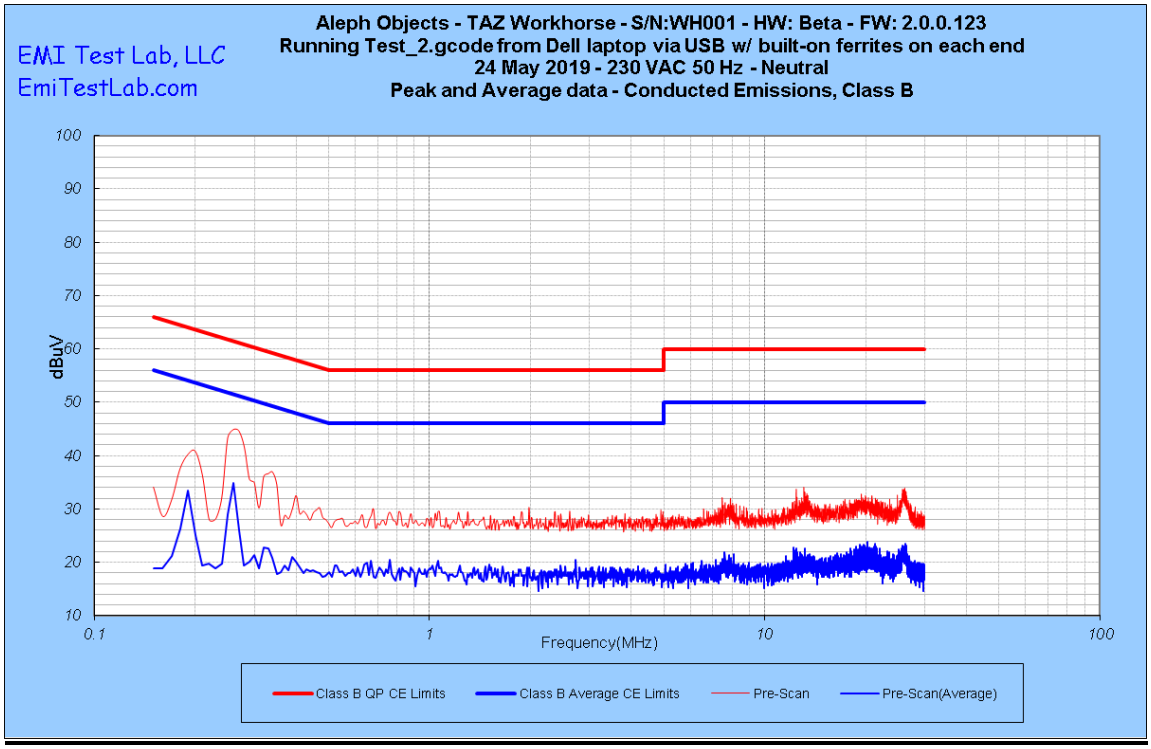
Running from a laptop through usb



Frequency (MHz)	*QP Disturbance (dBuV)*	*QP Limit*	*EUT--Line QP*	*Tranducer Connection*	*Correction Factor (dB)*
0.150	36.00	66.00	30.00	AMN	0.20
7.880	30.43	60.00	29.57	AMN	1.13
0.200	44.31	64.57	20.26	AMN	0.21
0.338	40.55	60.63	20.08	AMN	0.25
0.270	50.03	62.56	12.53	AMN	0.23
0.920	31.60	56.00	24.40	AMN	0.80
8.100	38.08	60.00	21.92	AMN	1.14

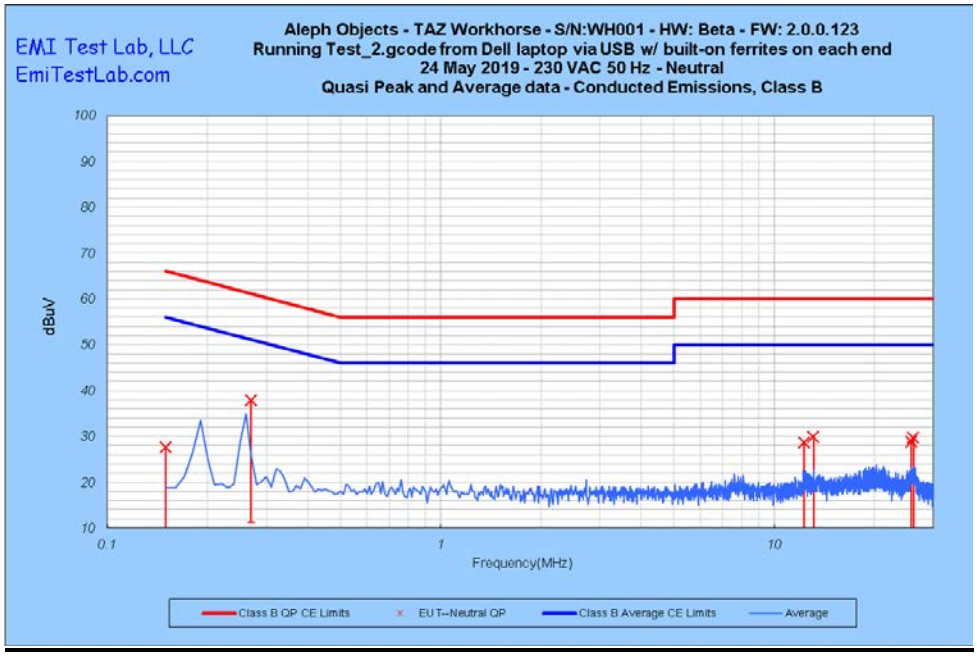
230 VAC 50 Hz – Neutral – Peak passing Quasi peak limit – Average data passing the average limit

Running from a laptop through usb



230 VAC 50 Hz – Neutral – Peak passing Quasi peak limit – Average data passing the average limit

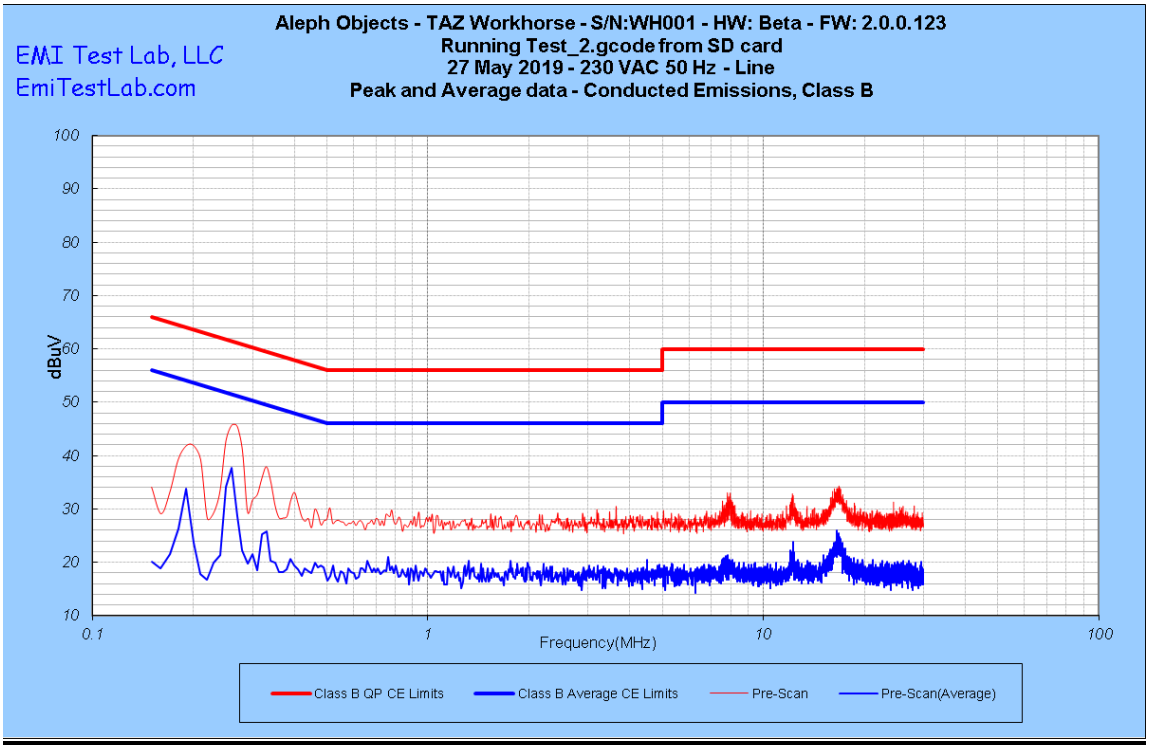
Running from a laptop through usb



Frequency (MHz)	QP Disturbance (dBuV)	QP Limit	EUT--Line QP	Tranducer Connection	Correction Factor (dB)
0.150	36.40	66.00	29.60	AMN	0.20
0.270	43.34	62.57	19.23	AMN	0.23
12.320	28.53	60.00	31.47	AMN	1.23
13.130	29.92	60.00	30.08	AMN	1.25
25.770	28.74	60.00	31.26	AMN	1.44
26.150	29.71	60.00	30.29	AMN	1.44

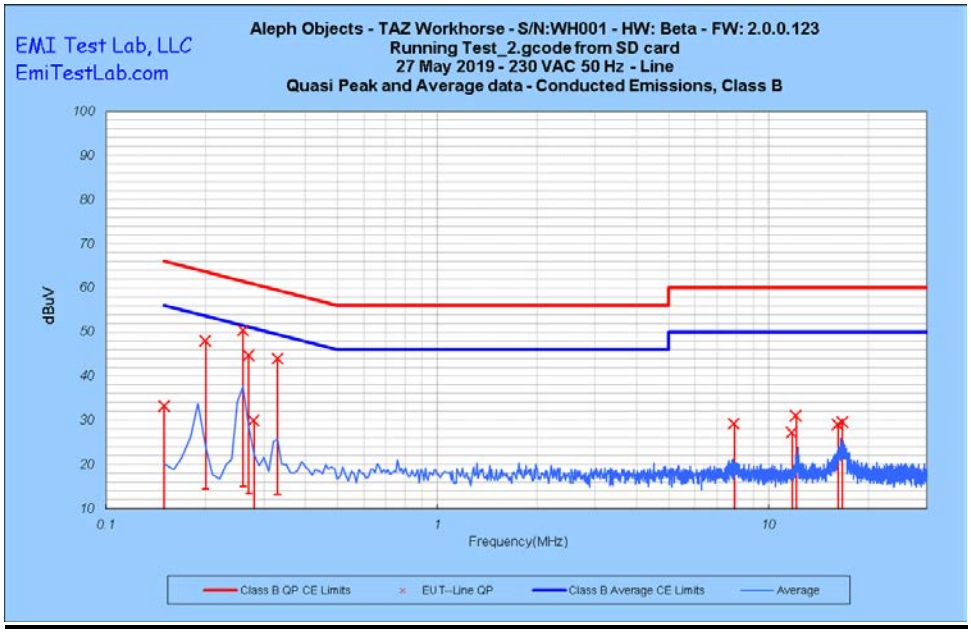
230 VAC 50 Hz – Line – Peak passing Quasi peak limit – Average data passing the average limit

Running from the SD card



230 VAC 50 Hz – Line – Peak passing Quasi peak limit – Average data passing the average limit

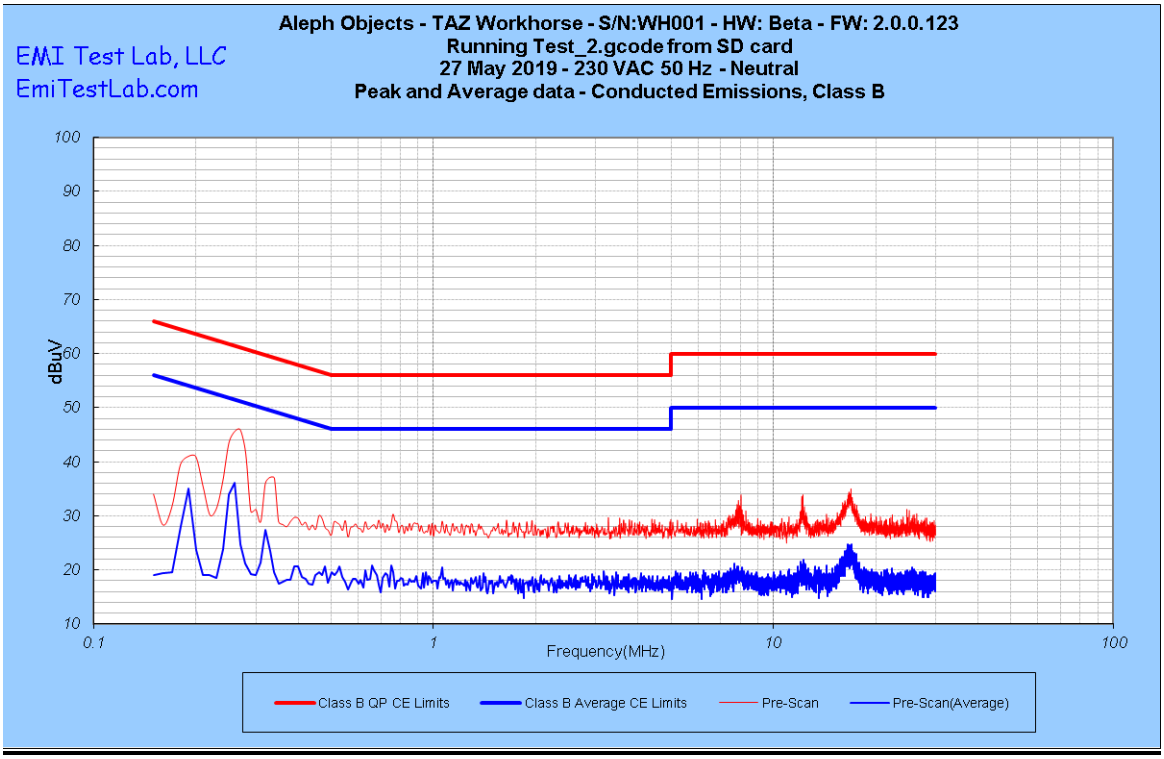
Running from the SD card



Frequency (MHz)	QP Disturbance (dBuV)	QP Limit	EUT--Line QP	Tranducer Connection	Correction Factor (dB)
0.150	36.00	66.00	30.00	AMN	0.20
0.270	44.56	62.57	18.01	AMN	0.23
0.280	29.84	62.28	32.45	AMN	0.24
7.880	29.22	60.00	30.78	AMN	1.13
11.780	27.15	60.00	32.85	AMN	1.23
12.120	30.94	60.00	29.06	AMN	1.23
16.190	28.95	60.00	31.05	AMN	1.29
16.710	29.60	60.00	30.40	AMN	1.30
0.203	48.02	64.49	16.48	AMN	0.22
0.269	50.23	62.61	12.38	AMN	0.23
0.339	43.95	60.61	16.66	AMN	0.25

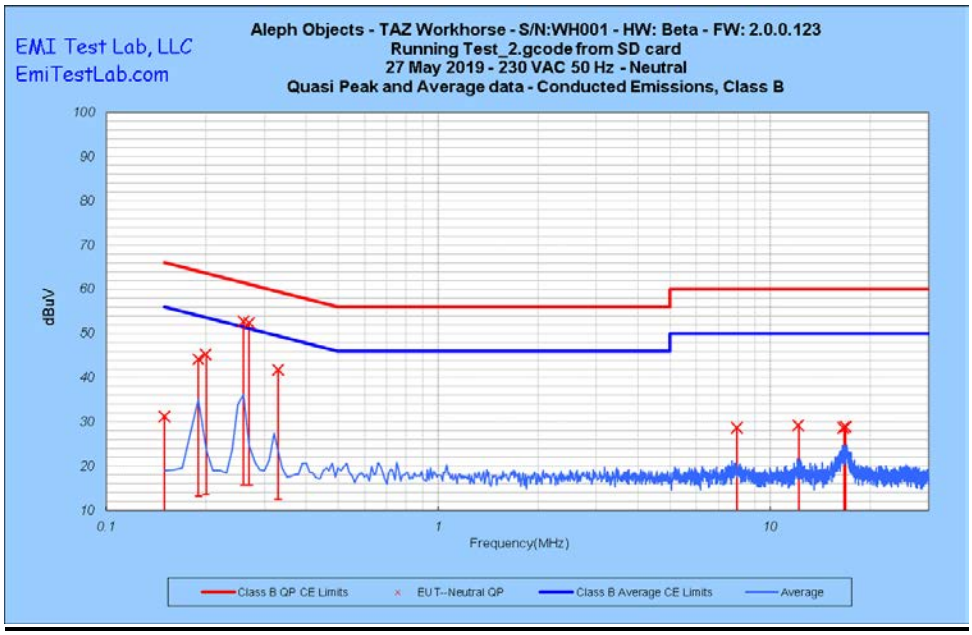
230 VAC 50 Hz – Neutral – Peak passing Quasi peak limit – Average data passing the average limit

Running from the SD card

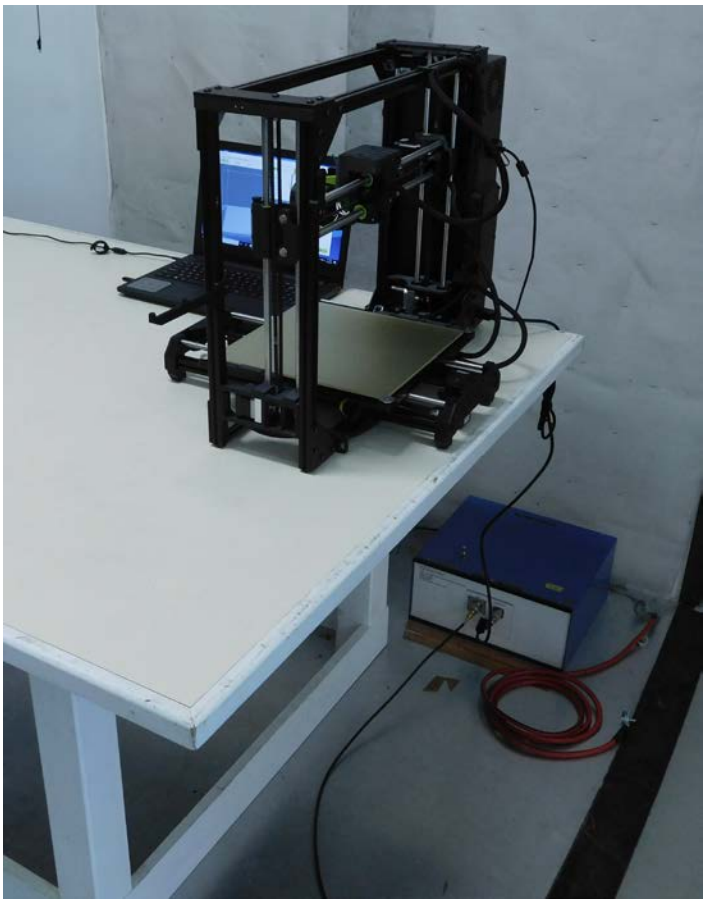


230 VAC 50 Hz – Neutral – Peak passing Quasi peak limit – Average data passing the average limit

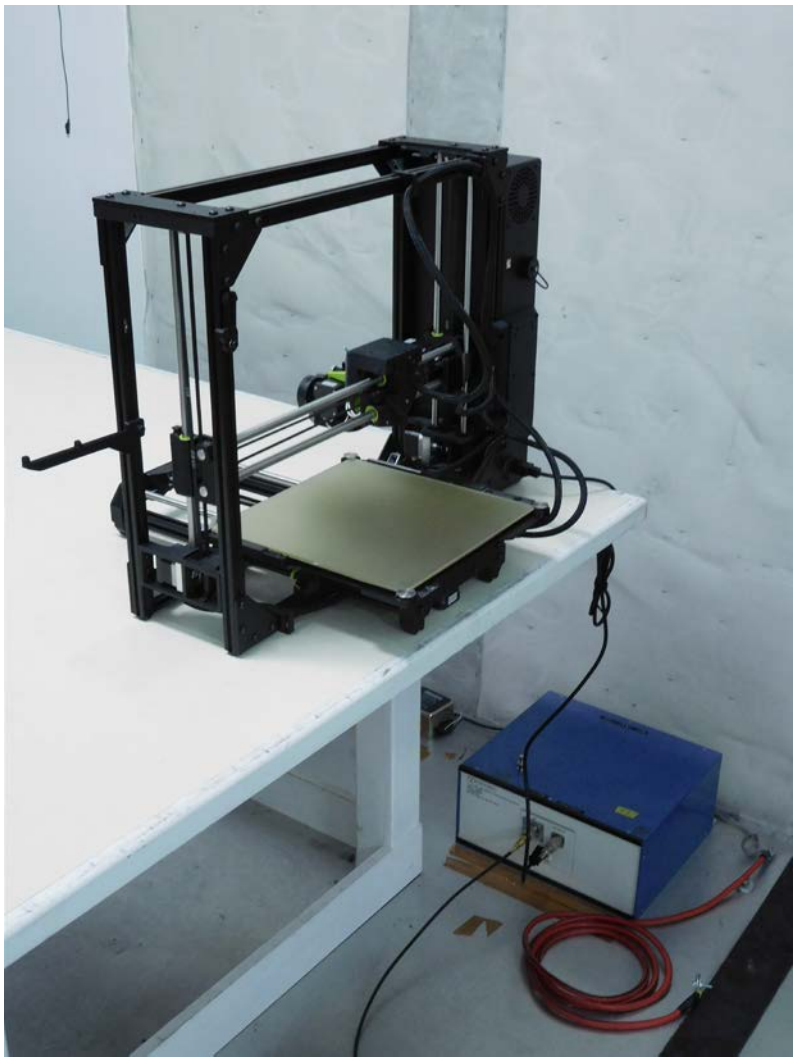
Running from the SD card



Frequency (MHz)	QP Disturbance (dBuV)	QP Limit	EUT--Line QP	Tranducer Connection	Correction Factor (dB)
0.150	34.70	66.00	31.30	AMN	0.20
7.950	28.61	60.00	31.39	AMN	1.13
0.150	31.10	66.00	34.90	AMN	0.20
12.180	29.16	60.00	30.84	AMN	1.23
16.680	28.60	60.00	31.40	AMN	1.30
16.880	28.71	60.00	31.29	AMN	1.30
0.204	45.22	64.45	19.23	AMN	0.22
0.200	44.01	64.57	20.56	AMN	0.21
0.270	52.73	62.58	9.85	AMN	0.23
0.337	41.65	60.64	18.99	AMN	0.25



Test setup for Conducted Emissions – with laptop



Test setup for Conducted Emissions – with SD Card

2.2 Enclosure

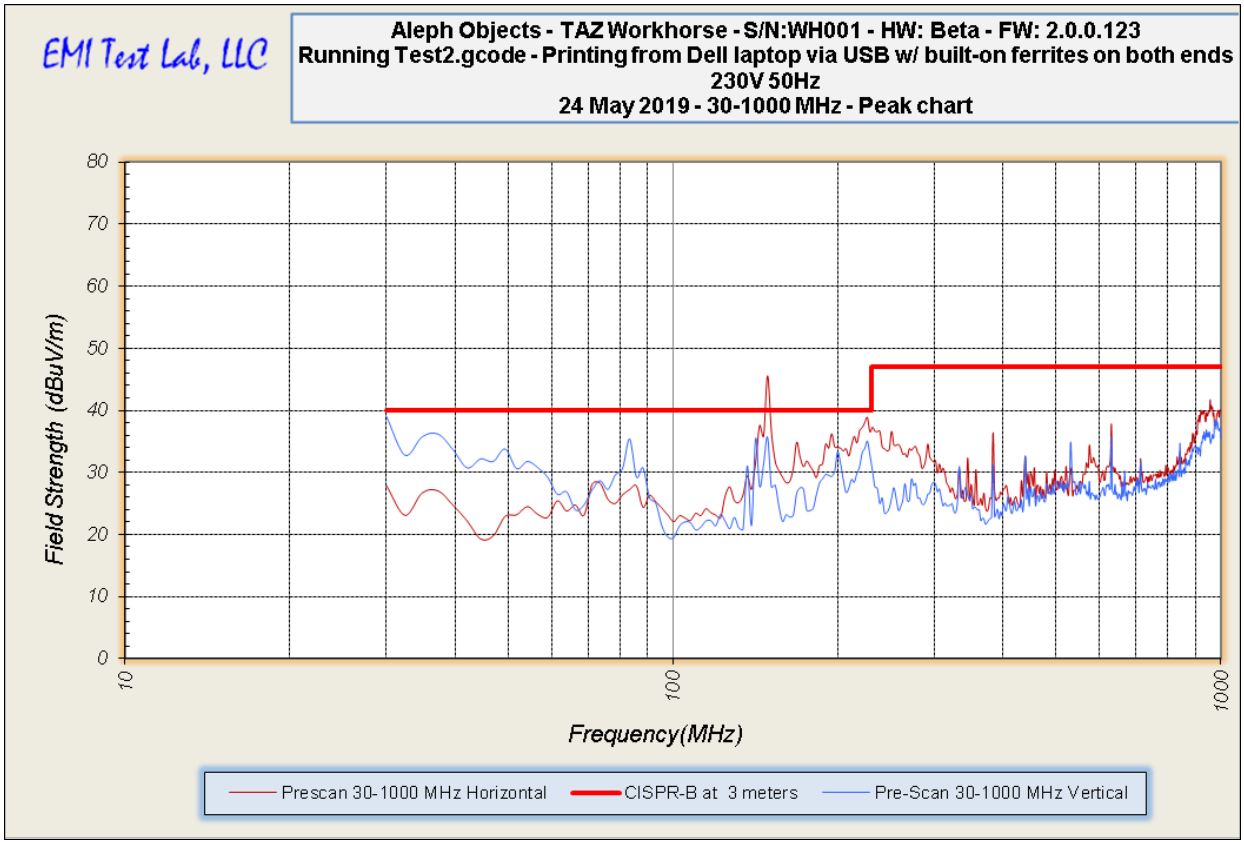
2.2.1 30-1,000 MHz

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

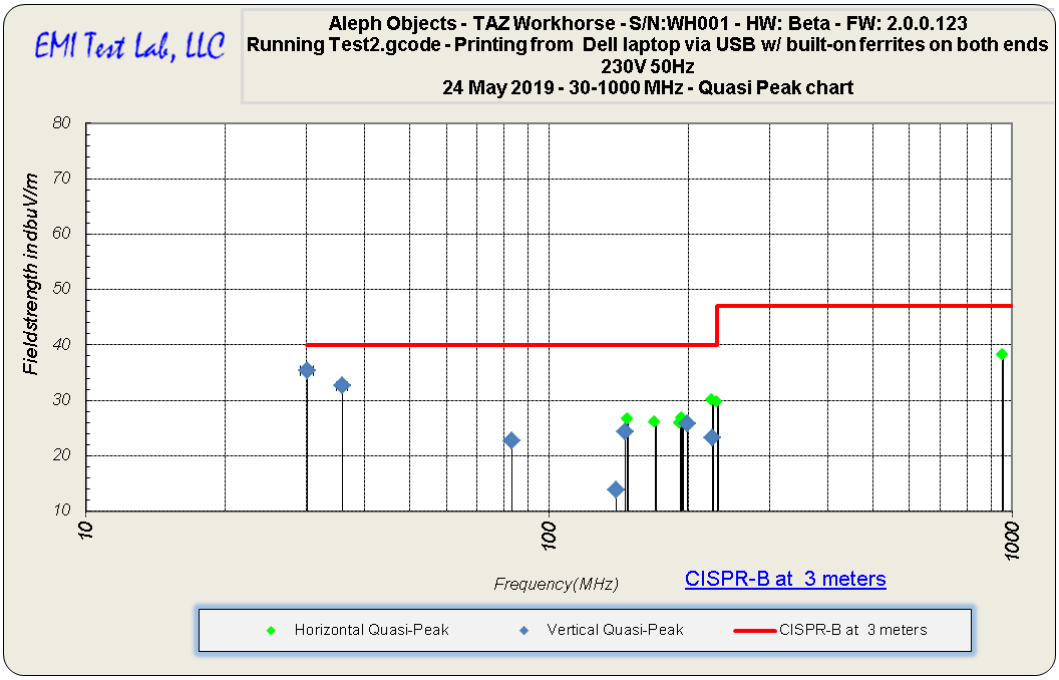
Basic standard	:	CISPR 32:2015
Test setup	:	EN 55032, AS/NZS CISPR 32
Limit distance	:	3 meters
Frequency range 1	:	30 -230 MHz
Limits	:	40 dBuV/m
Frequency range 2	:	230 – 1,000 MHz
Limits	:	47 dBuV/m

Results of the measurements concerning radiated electromagnetic fields (electric component) emitted by the EUT, enclosure, as a tested system	**PASS Class B**
Name of Test Engineer: Signature: Date:	Dennis King  24 May 2019
Remarks: **Radiated Emissions Summary:** Passing Class B for Home and Commercial use.	

Peak data compared to a quasi peak limit – see the next chart for the passing quasi peak data – with usb connection



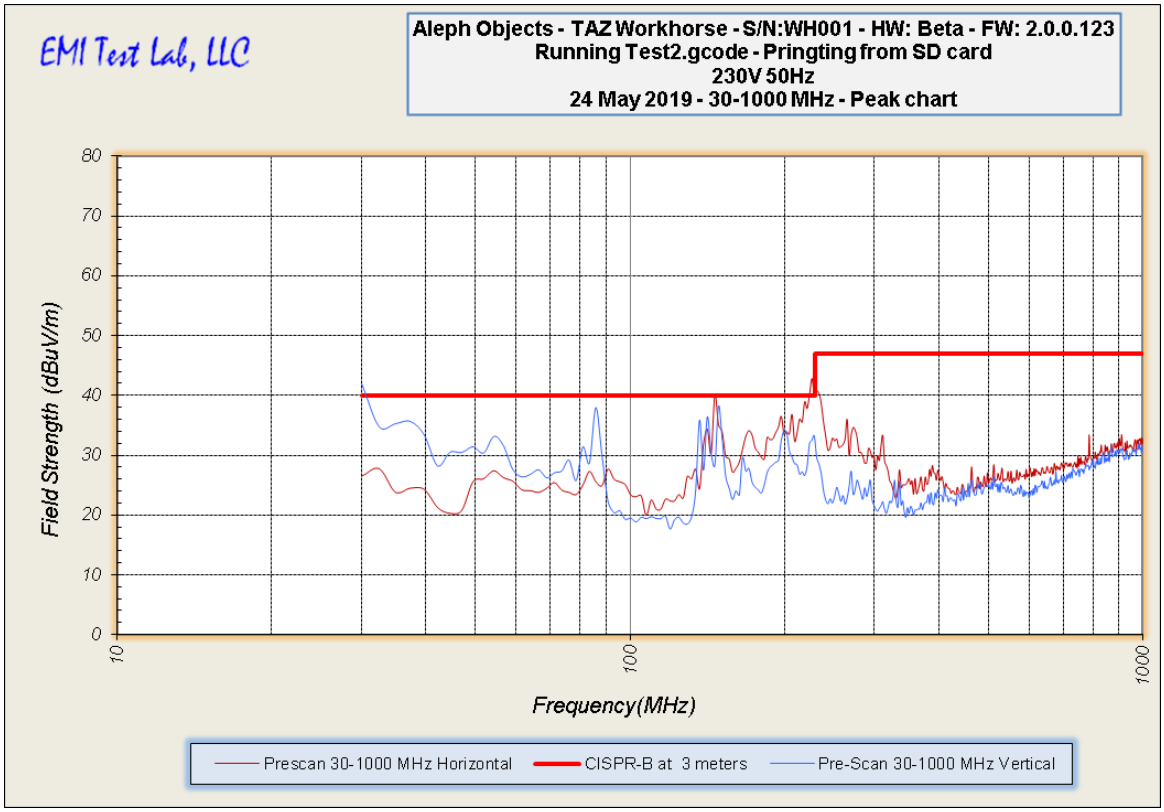
Passing Quasi peak data compared to the quasi peak limit – with usb connection



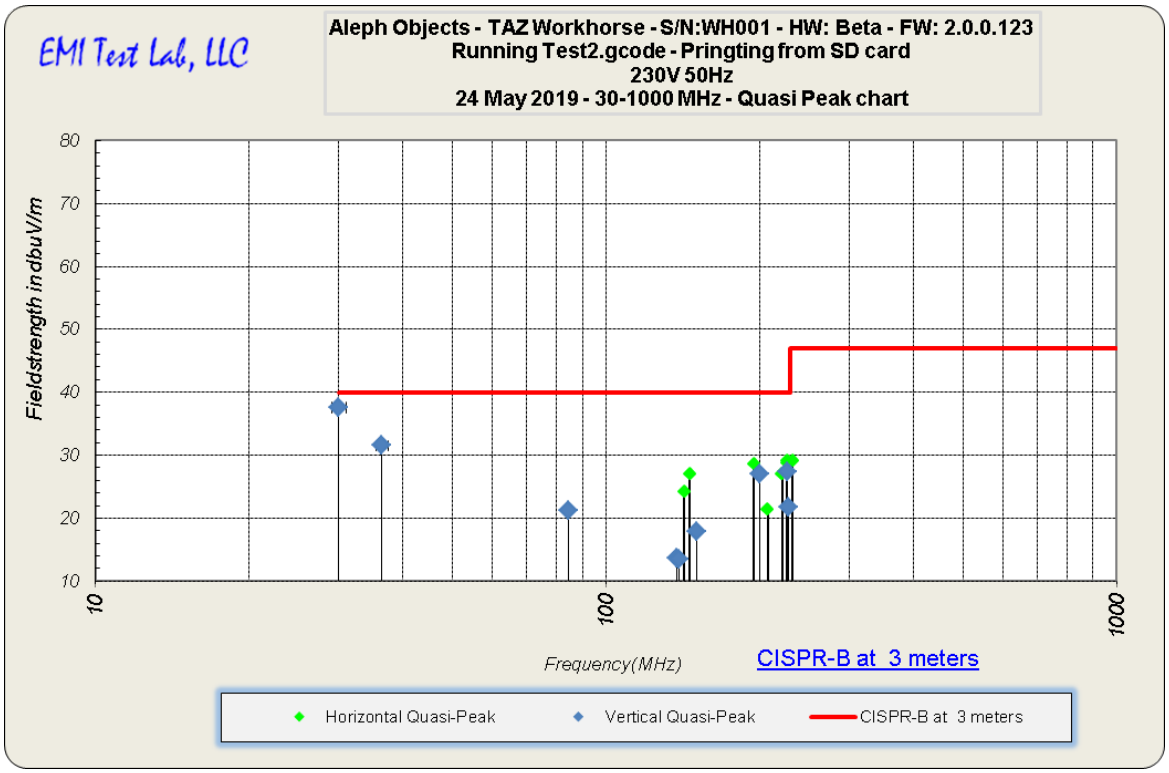
Quasi peak data – with usb connection

EMI Test Lab						Sheet4
Frequency	**Field Strength EUT**	**Limit**	**Azimuth**	**Height**	**Antenna Polarization**	**Delta from the Limit**
(MHz)	*(dBuV/m)*	*(dBuV/m)*	*Degrees*	*meters*	*H or V*	*dB micro volts*
199.45	25.83	40	20.0	1.4	V	-14.17
139.55	13.84	40	32.0	1.4	V	-26.16
225.26	23.32	40	168.0	1.4	V	-16.68
83.36	22.76	40	192.0	1.4	V	-17.24
30.04	35.37	40	236.0	1.4	V	-4.63
35.74	32.61	40	272.0	1.4	V	-7.39
146.39	24.28	40	356.0	1.4	V	-15.72
231.56	29.51	47	4.0	1.4	H	-17.49
192.20	25.75	40	76.0	1.4	H	-14.25
225.99	30.53	40	168.0	1.4	H	-9.47
955.71	38.17	47	228.0	1.4	H	-8.83
170.03	25.88	40	316.0	1.4	H	-14.12
194.40	26.65	40	356.0	1.4	H	-13.35
225.55	29.98	40	356.0	1.4	H	-10.02
148.05	26.56	40	356.0	1	H	-13.44

Peak data compared to a quasi peak limit – see the next chart for the passing quasi peak data – with SD Card



Passing Quasi peak data compared to the quasi peak limit – with SD Card



Quasi peak data – with SD Card

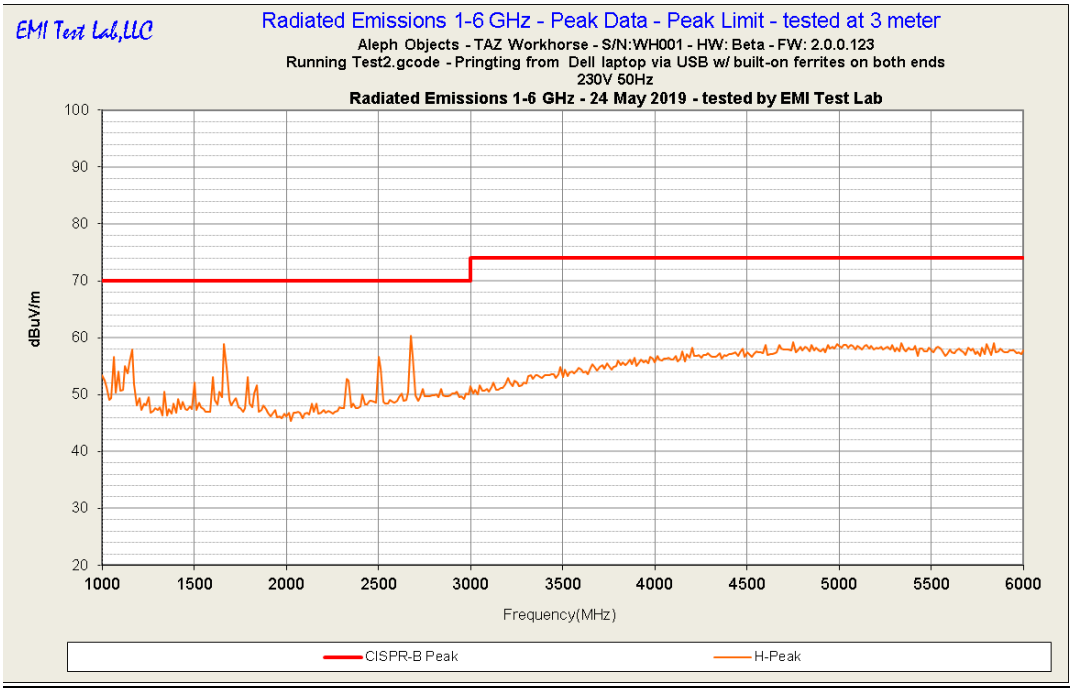
EMI Test Lab						Sheet4
Frequency	**Field Strength EUT**	**Limit**	**Azimuth**	**Height**	**Antenna Polarization**	**Delta from the Limit**
(MHz)	*(dBuV/m)*	*(dBuV/m)*	*Degrees*	*meters*	*H or V*	*dB micro volts*
227.65	21.69	40	32.0	1.4	V	-18.31
137.95	13.6	40	32.0	1.4	V	-26.4
227.30	27.36	40	48.0	1.4	V	-12.64
150.40	17.79	40	148.0	1.4	V	-22.21
84.36	21.13	40	152.0	1.4	V	-18.87
30.00	37.60	40	232.0	1.4	V	-2.4
36.45	31.52	40	264.0	1.4	V	-8.48
139.15	13.50	40	340.0	1.4	V	-26.5
200.46	26.94	40	352.0	1.4	V	-13.06
146.13	26.99	40	0.0	1.4	H	-13.01
207.49	21.42	40	24.0	1.4	H	-18.58
195.14	28.52	40	24.0	1.4	H	-11.48
226.44	28.74	40	32.0	1.4	H	-11.26
232.29	29.15	47	48.0	1.4	H	-17.85
226.59	29.21	40	48.0	1	H	-10.79
221.64	27.00	40	192.0	1	H	-13
142.35	24.22	40	340.0	1	H	-15.78

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	:	CISPR 32:2015
Test setup	:	EN 55032, AS/NZS CISPR 32
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

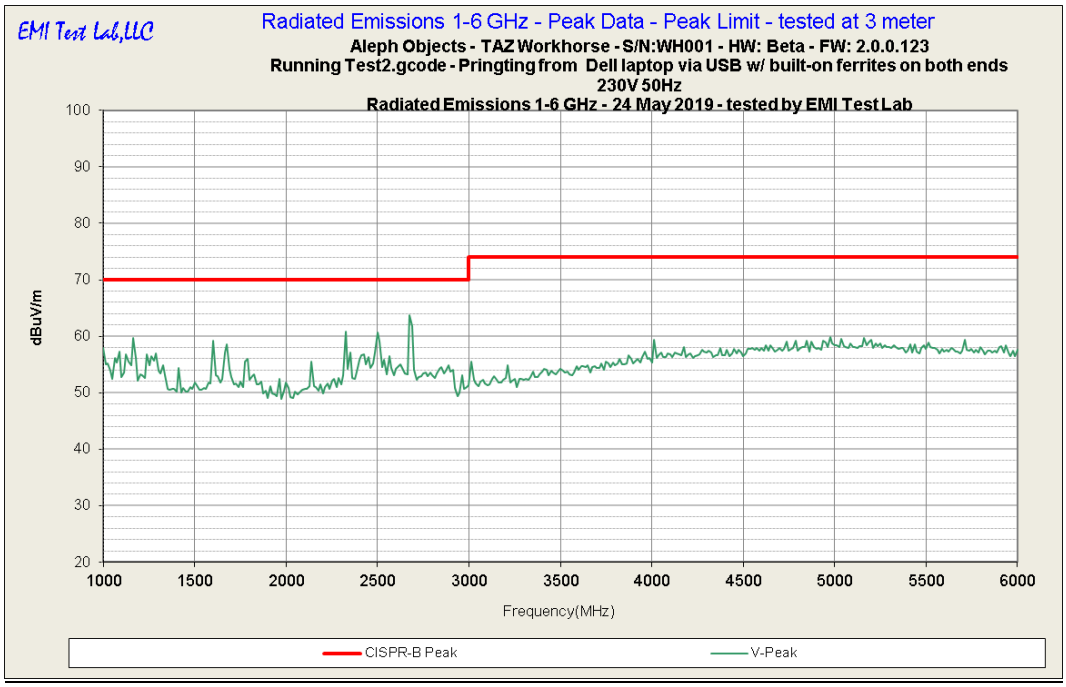
Results of the measurements concerning radiated electromagnetic fields (electric component) emitted by the EUT, enclosure, as a tested system	**Pass**
Name of Test Engineer:	Dennis King
Signature:	
Date:	24 May 2019
Remarks: Passing from 1-6 GHz	



3 meter test limits

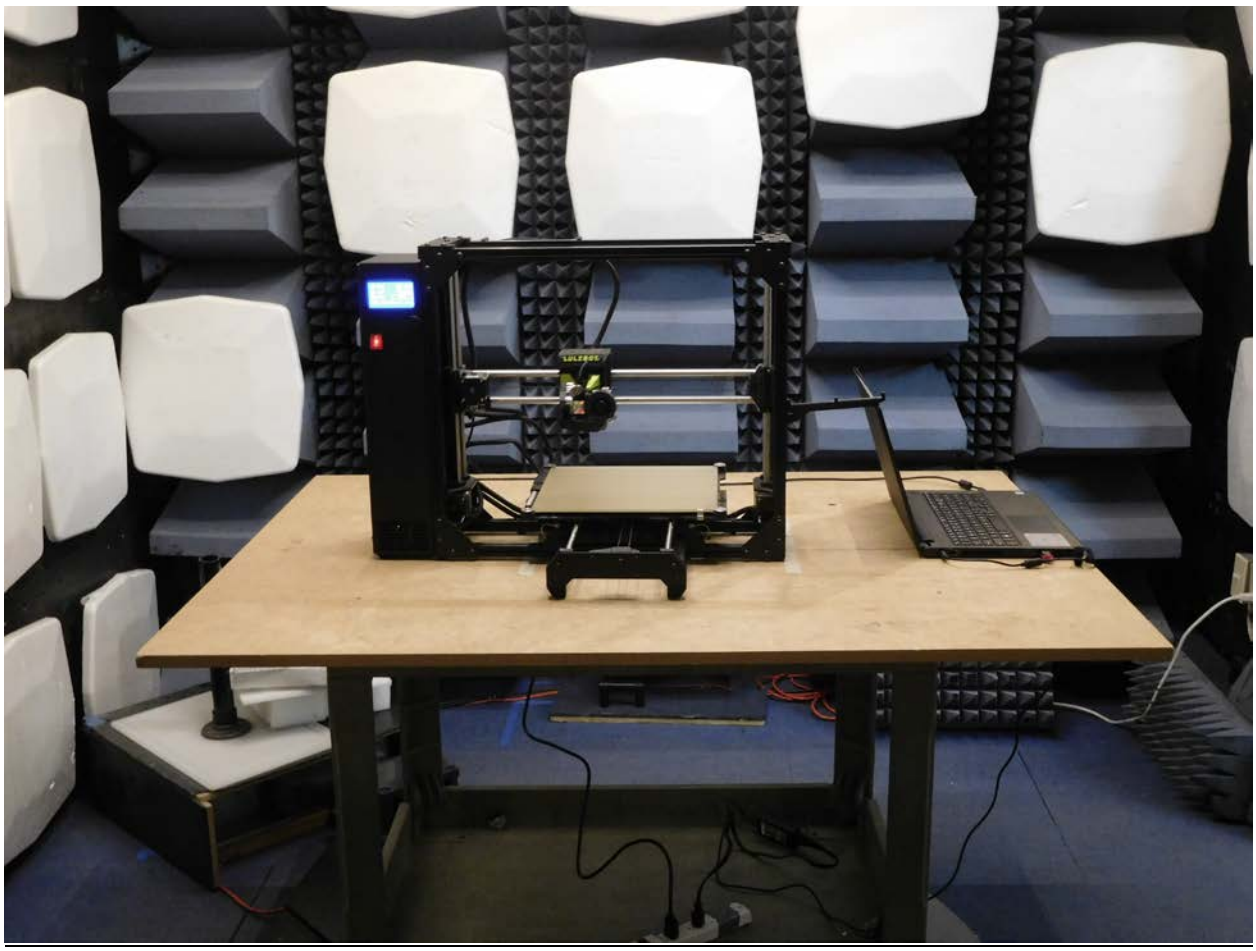
Frequency Range	Class A Limits		Class B Limits	
	FCC[Note 1]	CISPR	FCC	CISPR
1 – 3GHz	Avg 60dBuV/m Pk 80dBuV/m	Avg 56dBuV/m Pk 76dBuV/m	Avg 54dBuV/m Pk 74dBuV/m	Avg 50dBuV/m Pk 70dBuV/m
3 – 6GHz	Avg 60dBuV/m Pk 80dBuV/m	Avg 60dBuV/m Pk 80dBuV/m	Avg 54dBuV/m Pk 74dBuV/m	Avg 54dBuV/m Pk 74dBuV/m
6 – 40 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

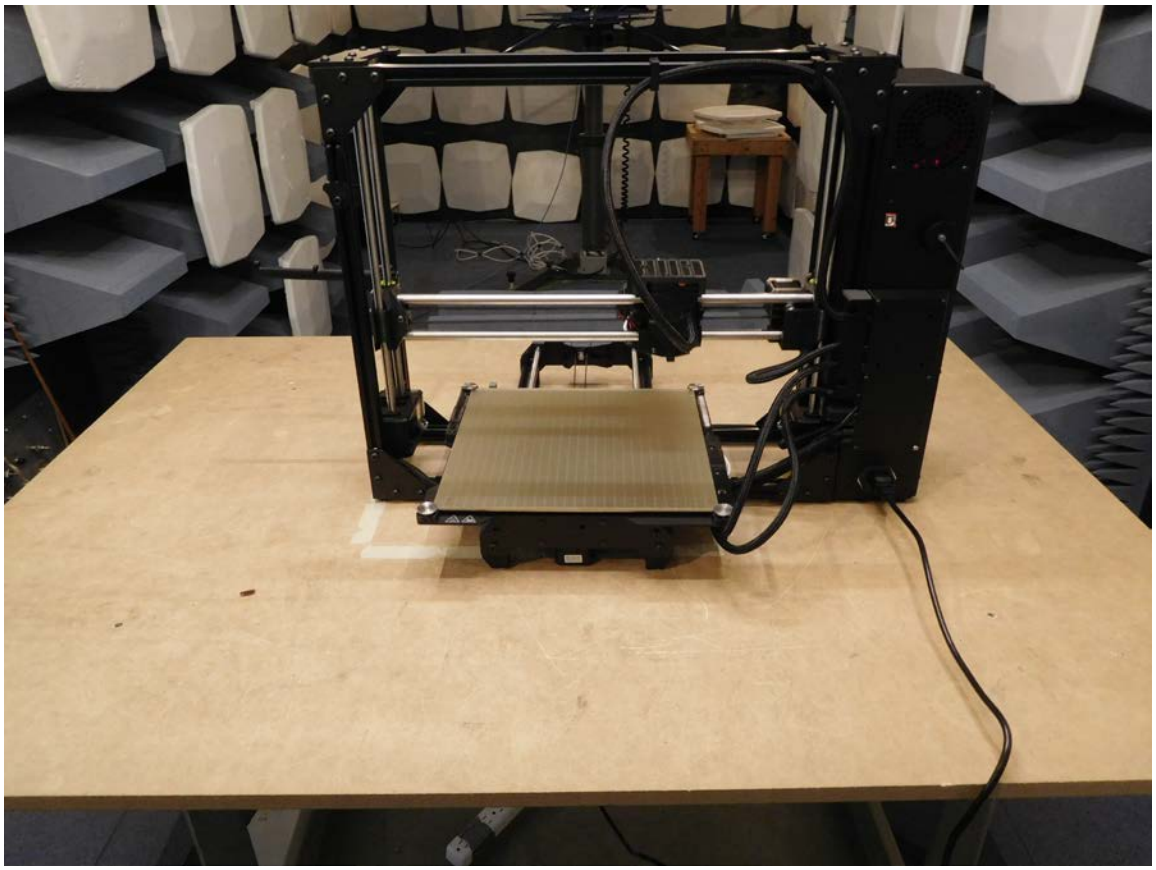


Frequency Range	Class A Limits		Class B Limits	
	FCC[Note 1]	CISPR	FCC	CISPR
1 – 3GHz	Avg 60dBuV/m Pk 80dBuV/m	Avg 56dBuV/m Pk 76dBuV/m	Avg 54dBuV/m Pk 74dBuV/m	Avg 50dBuV/m Pk 70dBuV/m
3 – 6GHz	Avg 60dBuV/m Pk 80dBuV/m	Avg 60dBuV/m Pk 80dBuV/m	Avg 54dBuV/m Pk 74dBuV/m	Avg 54dBuV/m Pk 74dBuV/m
6 – 40 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



Test setup for Radiated Emissions - usb



Test setup for Radiated Emissions – SD Card

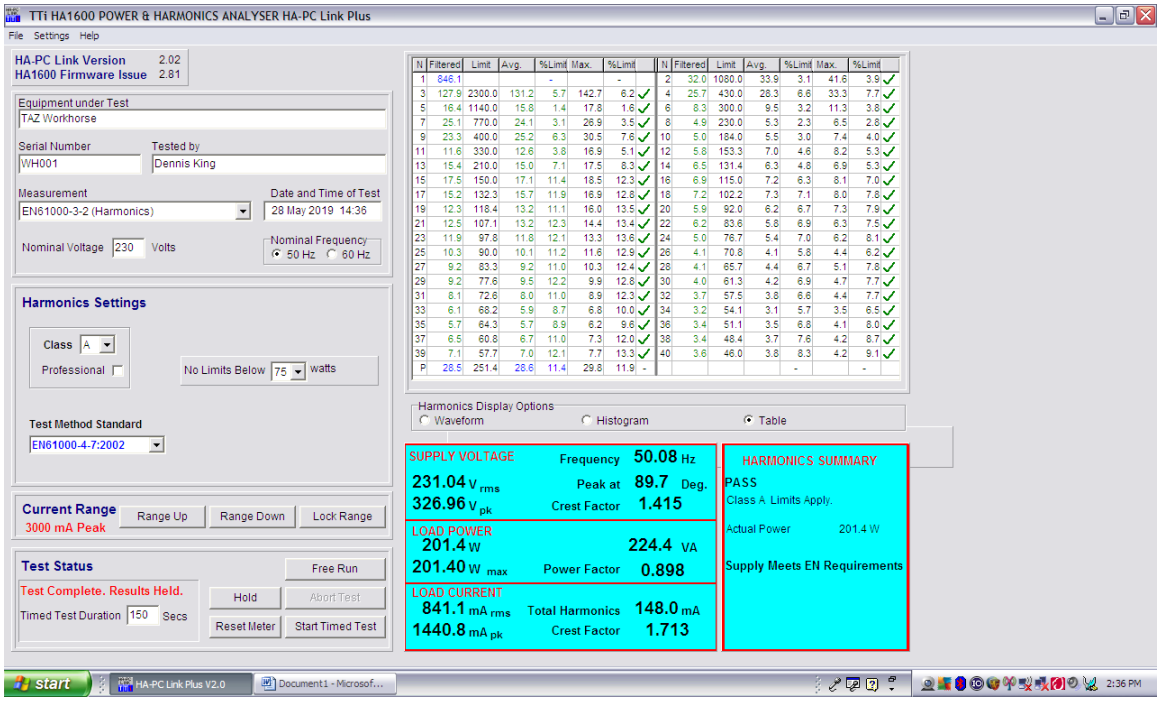
Test setup for Radiated Emissions – SD card – 1- 6 GHz Horn antenna

2.3 Harmonic current emissions

The emissions of harmonic currents at the AC mains connection terminals of the EUT were measured in conformance with and according to the criteria as stated below.

Basic standard : EN 61000-3-2:2014
Test setup : EN 61000-3-2:2014
Frequency range : 100 Hz – 2000 Hz

Results of the measurements concerning the emission of harmonic currents at the AC mains connection terminals of the EUT	**PASS**
Name of Test Engineer: Signature: Date:	Dennis King  28 May 2019
Remarks: The power supply was tested at 230VAC 50Hz.	



HA-PC Link Plus. Software v2.02. Firmware v2.81
Report Number : 165
Tested On : 28 May 2019 15:40 for 150 Seconds.
Equipment Under Test : TAZ Workhorse
Serial Number :
Tested by : Dennis King
Supply Voltage : 230.8 to 231.1 Vrms 327.0 Vpk Frequency : 50.07 to 50.18 Hz
Supply Meets EN Requirements
Load Power : 0.36 to 386.80 W 199.7 VA Power Factor 0.881
Load Current : 0.9 to 1555.1 mArms 1.4 to 2512.0 mApk Crest Factor: 1.703
Measurement Standard : EN61000-4-7:2002
Limits Applied : EN61000-3-2 Class A Limits Apply.

Harmonic Number	Limit Current mA	Average (filtered) mA	% Limit	max. Value (Filtered) mA	% Limit	Assessment
Fundamental :		846.1				
2 :	1080.0	33.9	3.1	41.6	3.9	Pass
3 :	2300.0	131.2	5.7	142.7	6.2	Pass
4 :	430.0	28.3	6.6	33.3	7.7	Pass

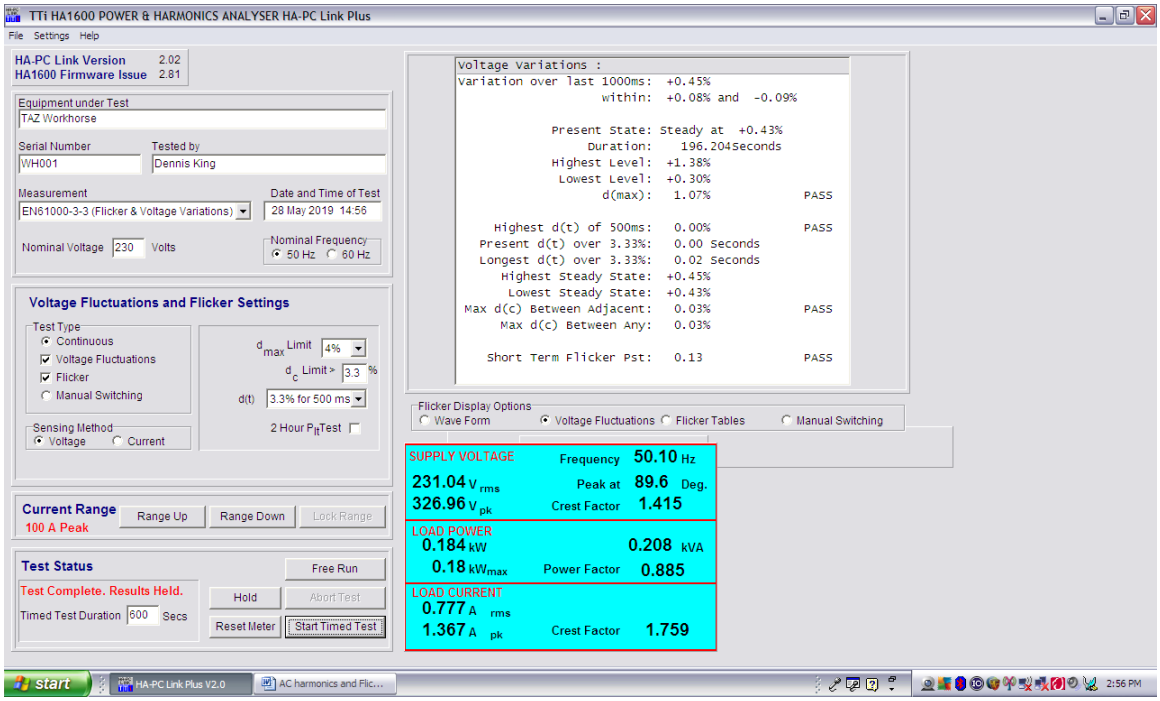
5 :	1140.0	15.8	1.4	17.8	1.6	Pass
6 :	300.0	9.5	3.2	11.3	3.8	Pass
7 :	770.0	24.1	3.1	26.9	3.5	Pass
8 :	230.0	5.3	2.3	6.5	2.8	Pass
9 :	400.0	25.2	6.3	30.5	7.6	Pass
10 :	184.0	5.5	3.0	7.4	4.0	Pass
11 :	330.0	12.6	3.8	16.9	5.1	Pass
12 :	153.3	7.0	4.6	8.2	5.3	Pass
13 :	210.0	15.0	7.1	17.5	8.3	Pass
14 :	131.4	6.3	4.8	6.9	5.3	Pass
15 :	150.0	17.1	11.4	18.5	12.3	Pass
16 :	115.0	7.2	6.3	8.1	7.0	Pass
17 :	132.3	15.7	11.9	16.9	12.8	Pass
18 :	102.2	7.3	7.1	8.0	7.8	Pass
19 :	118.4	13.2	11.1	16.0	13.5	Pass
20 :	92.0	6.2	6.7	7.3	7.9	Pass
21 :	107.1	13.2	12.3	14.4	13.4	Pass
22 :	83.6	5.8	6.9	6.3	7.5	Pass
23 :	97.8	11.8	12.1	13.3	13.6	Pass
24 :	76.7	5.4	7.0	6.2	8.1	Pass
25 :	90.0	10.1	11.2	11.6	12.9	Pass
26 :	70.8	4.1	5.8	4.4	6.2	Pass
27 :	83.3	9.2	11.0	10.3	12.4	Pass
28 :	65.7	4.4	6.7	5.1	7.8	Pass
29 :	77.6	9.5	12.2	9.9	12.8	Pass
30 :	61.3	4.2	6.9	4.7	7.7	Pass
31 :	72.6	8.0	11.0	8.9	12.3	Pass
32 :	57.5	3.8	6.6	4.4	7.7	Pass
33 :	68.2	5.9	8.7	6.8	10.0	Pass
34 :	54.1	3.1	5.7	3.5	6.5	Pass
35 :	64.3	5.7	8.9	6.2	9.6	Pass
36 :	51.1	3.5	6.8	4.1	8.0	Pass
37 :	60.8	6.7	11.0	7.3	12.0	Pass
38 :	48.4	3.7	7.6	4.2	8.7	Pass
39 :	57.7	7.0	12.1	7.7	13.3	Pass
40 :	46.0	3.8	8.3	4.2	9.1	Pass
21 - 39 :	251.4	28.6	11.4	29.8	11.9	-

2.4 Voltage fluctuations and flicker

Voltage fluctuations and flicker at the AC mains connection terminals of the EUT were measured in conformance with and according to the criteria as stated below.

Basic standard : EN 61000-3-3:2013
Test setup : EN 61000-3-3:2013

Results of the measurements concerning voltage fluctuations and flicker at the AC mains connection terminals of the EUT	**PASS**
Name of Test Engineer:	Dennis King
Signature:	
Date:	28 May 2019
Remarks: The unit was tested at 230VAC 50Hz.	



HA-PC Link Plus. Software v2.02. Firmware v2.81
Report Number : 166
Tested On : 28 May 2019 14:30 for 600 Seconds.
Equipment Under Test : TAZ Workhorse
Serial Number : WH001
Tested by : Dennis King

Supply Voltage : 231.1 Vrms 327.0 Vpk Frequency : 50.07 to 50.18 Hz
Load Current : 0.8 Arms 1.4 Apk Crest Factor: 1.707

Test Method: EN61000-3-3:2008

Voltage Variations :
Highest Level: +1.38%
Lowest Level: +0.30%
d(max): 1.07% PASS

Highest d(t) of 500ms: 0.00% PASS
Present d(t) over 3.33%: 0.00 Seconds
Longest d(t) over 3.33%: 0.02 Seconds
Highest Steady State: +0.45%

Lowest Steady State: +0.43%
Max d(c) Between Adjacent: 0.03% PASS
Max d(c) Between Any: 0.03%

Short Term Flicker Pst: 0.13 PASS

Flicker Results :

Pst Classifier Duration	Flicker	Plt Calculation Interval	Pst
0.1%	0.18		
0.7%	0.04		
1.0%	0.04		
1.5%	0.03		
2.2%	0.03		
3%	0.03		
4%	0.03		
6%	0.02		
8%	0.02		
10%	0.02		
13%	0.02		
17%	0.02		
30%	0.02		
50%	0.02		
80%	0.01		

MEAN WELL

500W Single Output with PFC Function **RSP-500 series**

- Features :
- Universal AC input / Full range
- Built-in active PFC function, PF>0.95
- Protections: Short circuit / Overload / Over voltage / Over temperature
- Forced air cooling by built-in DC Fan (Note5)
- 1U low profile 40.5mm
- High efficiency up to 90.5%
- Built-in remote ON-OFF control
- Built-in remote sense function
- LED indicator for power on
- 3 years warranty

SPECIFICATION

MODEL		RSP-500-3.3	RSP-500-4	RSP-500-5	RSP-500-12	RSP-500-15	RSP-500-24	RSP-500-27	RSP-500-48
OUTPUT	DC VOLTAGE	3.3V	4V	5V	12V	15V	24V	27V	48V
	RATED CURRENT	90A	90A	90A	41.7A	33.4A	21A	18.6A	10.5A
	CURRENT RANGE	0 ~ 90A	0 ~ 90A	0 ~ 90A	0 ~ 41.7A	0 ~ 33.4A	0 ~ 21A	0 ~ 18.6A	0 ~ 10.5A
	RATED POWER	297W	360W	450W	500.4W	501W	504W	502.2W	504W
	RIPPLE & NOISE (max.) Note.2	120mVp-p	120mVp-p	150mVp-p	150mVp-p	150mVp-p	150mVp-p	150mVp-p	150mVp-p
	VOLTAGE ADJ. RANGE	2.8 ~ 3.6V	3.6 ~ 4.3V	4.5 ~ 5.5V	10 ~ 13.2V	13.5 ~ 18V	20 ~ 26.4V	26 ~ 30V	41 ~ 56V
	VOLTAGE TOLERANCE Note.3	±2.0%	±2.0%	±2.0%	±1.0%	±1.0%	±1.0%	±1.0%	±1.0%
	LINE REGULATION	±0.5%	±0.5%	±0.5%	±0.3%	±0.3%	±0.2%	±0.2%	±0.2%
	LOAD REGULATION	±1.0%	±1.0%	±1.0%	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%
	SETUP, RISE TIME	1500ms, 80ms/230VAC 3000ms, 80ms/115VAC at full load							
	HOLD UP TIME (Typ.)	18ms/230VAC 14ms/115VAC at full load							
INPUT	VOLTAGE RANGE Note.4	85 ~ 264VAC 120 ~ 370VDC							
	FREQUENCY RANGE	47 ~ 63Hz							
	POWER FACTOR (Typ.)	PF>0.95/230VAC PF>0.98/115VAC at full load							
	EFFICIENCY (Typ.)	81%	83%	84%	88%	88%	89%	89.5%	90.5%
	AC CURRENT (Typ.)	4.2A/115VAC	2.1A/230VAC	5.3A/115VAC	2.65A/230VAC				
	INRUSH CURRENT (Typ.)	20A/115VAC 40A/230VAC							
	LEAKAGE CURRENT	<2mA / 240VAC							
PROTECTION	OVERLOAD	105 ~ 130% rated output power							
		Protection type : Constant current limiting, recovers automatically after fault condition is removed							
	OVER VOLTAGE	3.8 ~ 4.5V	4.5 ~ 5.3V	5.75 ~ 6.75V	13.8 ~ 16.2V	18.8 ~ 21.8V	27.6 ~ 32.4V	32.9 ~ 38.3V	58.4 ~ 68V
		Protection type : Shut down o/p voltage, re-power on to recover							
	OVER TEMPERATURE	Shut down o/p voltage, recovers automatically after temperature goes down							
FUNCTION	REMOTE CONTROL	POWER ON:open or 0~0.8VDC between RC+(Pin 4)&RC-(Pin3) on CN100 POWER OFF: 4~10VDC between RC+(Pin 4)&RC-(Pin3) on CN100							
	REMOTE SENSE	Compensate voltage drop on the load wiring up to 0.3V							
	FAN CONTROL (Typ.)	RTH2≧50°C±10°C Fan on ; RTH2≦40°C±10°C Fan off (Fan always on for 3.3~5V,Fan ON/OFF control for 12~48V)							
ENVIRONMENT	WORKING TEMP.	-30 ~ +70°C (Refer to "Derating Curve")							
	WORKING HUMIDITY	20 ~ 90% RH non-condensing							
	STORAGE TEMP., HUMIDITY	-40 ~ +85°C, 10 ~ 95% RH							
	TEMP. COEFFICIENT	±0.03%/°C (0 ~ 50°C)							
	VIBRATION	10 ~ 500Hz, 2G 10min./1cycle, 60min. each along X, Y, Z axes							
SAFETY & EMC (Note 4)	SAFETY STANDARDS	UL60950-1, TUV EN60950-1, EAC TP TC 004 , CCC GB4943.1 , BSMI CNS14336-1approved							
	WITHSTAND VOLTAGE	I/P-O/P:3KVAC I/P-FG:2KVAC O/P-FG:0.5KVAC							
	ISOLATION RESISTANCE	I/P-O/P, I/P-FG, O/P-FG:100M Ohms / 500VDC / 25°C / 70% RH							
	EMC EMISSION	Compliance to EN55032 (CISPR32) Class B, EN61000-3-2,-3, EAC TP TC 020,GB/T 9254, CNS13438 Class B							
	EMC IMMUNITY	Compliance to EN61000-4-2,3,4,5,6,8,11, EN55024, EN61000-6-2, EN61204-3 heavy industry level, criteria A, EAC TP TC 020							
OTHERS	MTBF	187.7K hrs min. MIL-HDBK-217F (25°C)							
	DIMENSION	230*127*40.5mm (L*W*H)							

3 Immunity

The EUT has been tested in conformity with the standards EN 55024:2010+A1:2015, CISPR 24:2015 and AS/NZS CISPR 24:2013 (immunity) concerning susceptibility and transient, conducted and radiated disturbances including electrostatic discharges.

3.1 Performance criteria

The general principles (performance criteria) for the evaluation of the immunity test results are given below. The details are in EN 55024:2010+A1:2015, CISPR 24:2015 and AS/NZS CISPR 24:2013.

Performance Criterion A: The apparatus shall continue to operate as intended during the test. No degradation of performance or loss of function is allowed below a performance level (or permissible loss of performance) specified by the manufacturer, when the apparatus is used as intended.

Performance Criterion B: The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level (or permissible loss of function) specified by the manufacturer, when the apparatus is used as intended. During the test, degradation of performance is allowed, however, no change of actual operating state or stored data is allowed.

Performance Criterion C: Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls, or by any operation specified in the instructions for use.

3.2 Enclosure Port

3.2.1 Radio-frequency electromagnetic field. Amplitude modulated.

The susceptibility of the EUT to radio-frequency electromagnetic fields has been tested in conformity with and according to the criteria as stated below.

Basic standard	:	CISPR 24:2015
Test setup	:	EN 61000-4-3
Frequency range	:	80 MHz to 1000 MHz
Field strength level	:	3 V/m (selected w/o modulation, applied w/mod.)
Modulation	:	1 kHz AM modulation, 80% depth
Performance criteria	:	Criteria A

Results of the measurements concerning the susceptibility of the EUT to radio-frequency electromagnetic fields	**PASS Criteria A**
Name of Test Engineer:	Dennis King
Signature:	
Date:	27 May 2019

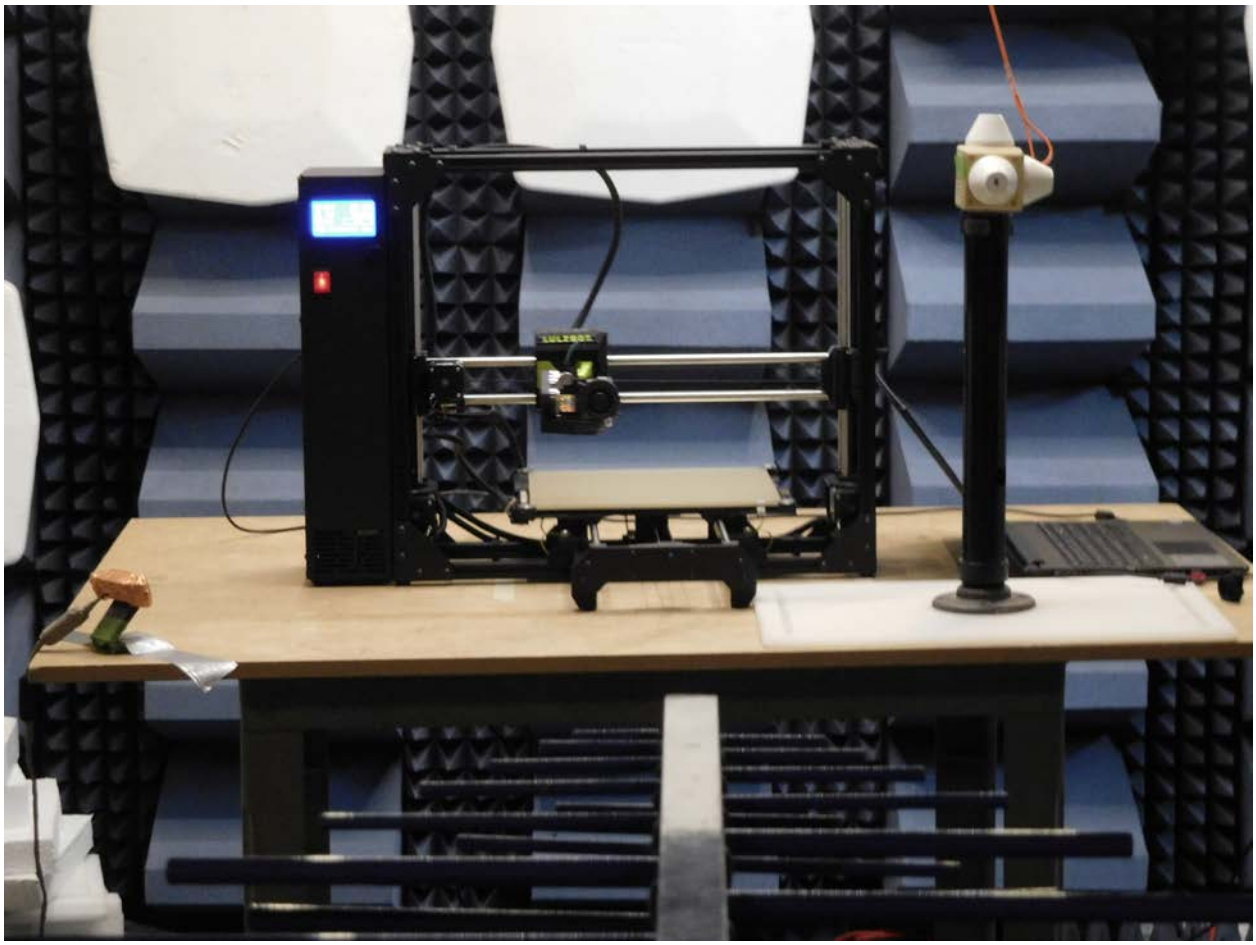
Remarks:

No loss of performance was observed during and after the test, all sides and both antenna polarizations meet Performance Criteria A.

Radiated Immunity Summary:

Configuration **:The printer was running test software during the entire test using the usb cable connected to a laptop: PASS 3 V/M**

No loss of function or data was detected during the testing.



Radiated immunity test setup – 80-1,000 MHz

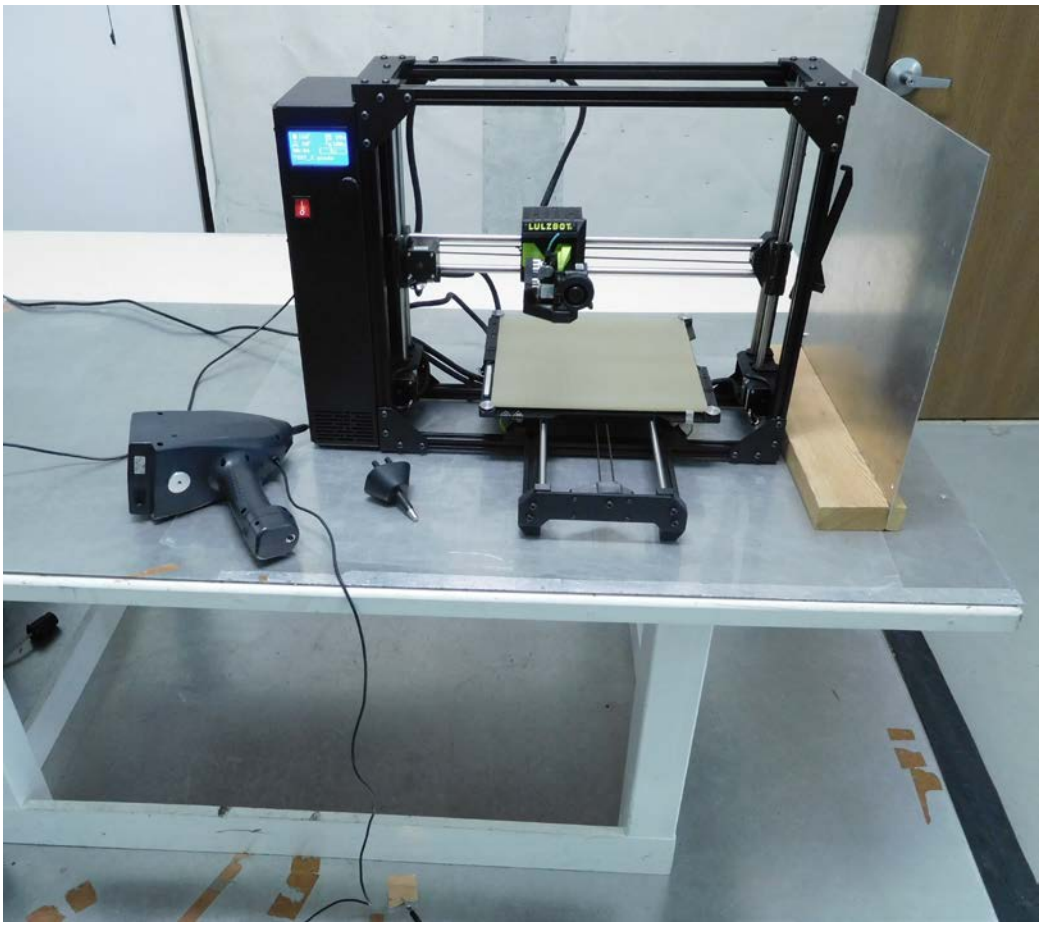
All 4 sides, Vertical and Horizontal were checked at 3 V/M
No errors were detected - passing Criteria A.

3.2.2 Electrostatic discharge

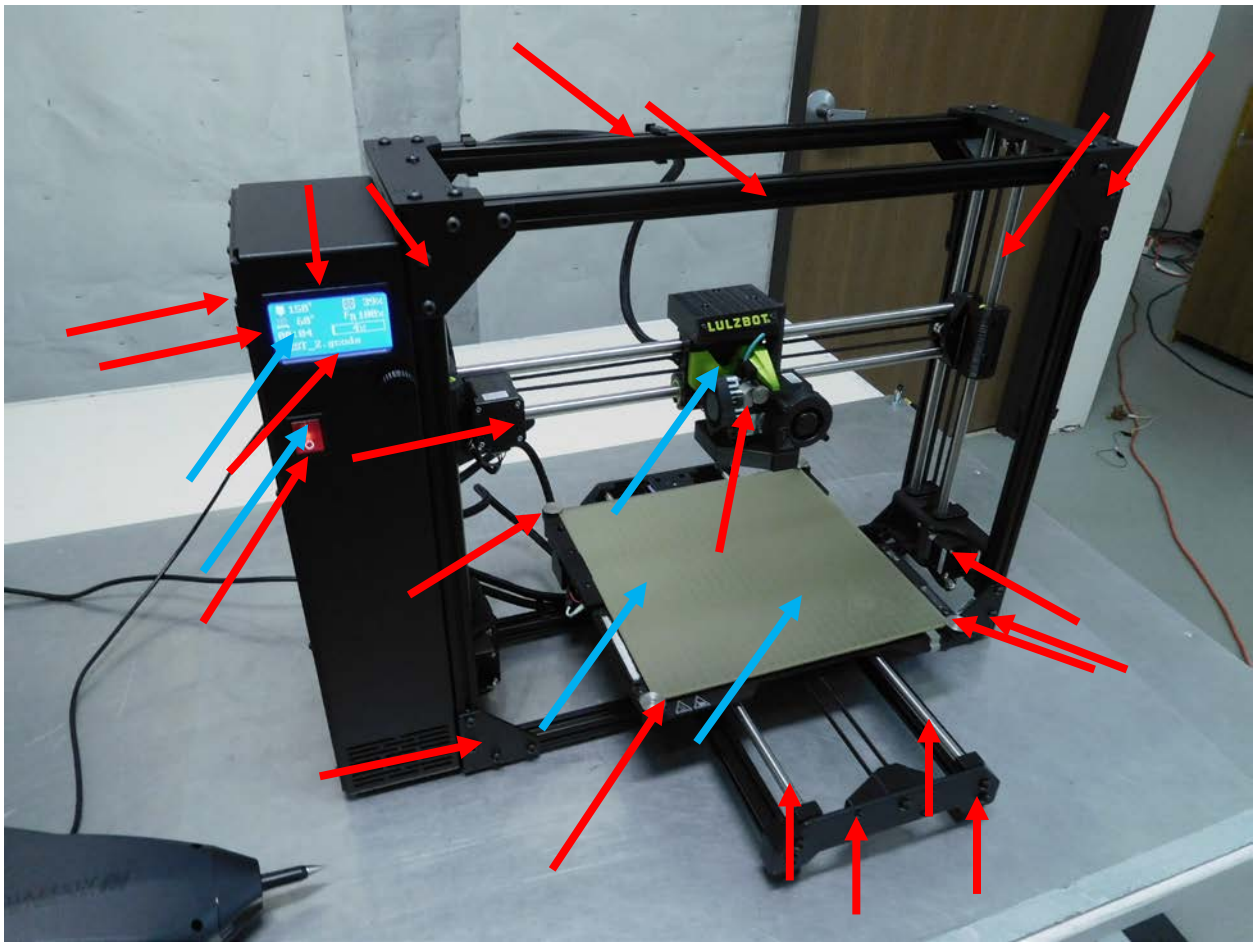
The susceptibility of the EUT to electrostatic discharge was tested.

Basic standard	:	CISPR 24:2015
Test setup	:	EN 61000-4-2
Test levels	:	+- 2,4kV and +- 8 kV air discharge +- 2kV and +- 4 kV contact discharge +- 2kV and +- 4 kV, indirect, horizontal and vertical coupling plane.
Performance criteria	:	B

Results of the test concerning the susceptibility of the EUT to electrostatic discharges (enclosure port)	**Pass Criteria A**
Name of Test Engineer: Signature: Date:	Dennis King  27 May 2019
Remarks: The printer continued to function as intended during the testing with no loss of data or function. **PASS Criteria A.**	



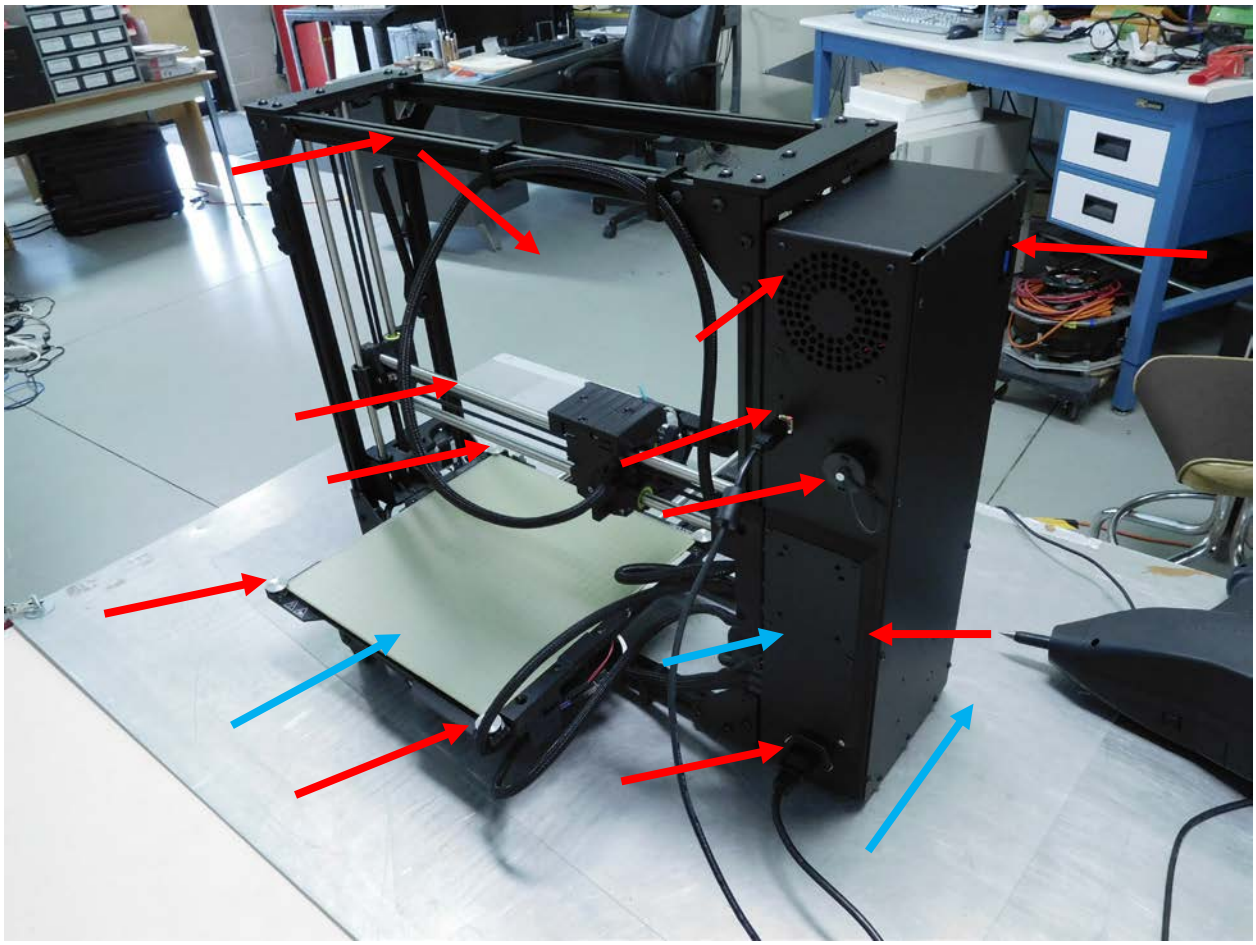
ESD test setup per EN 61000-4-2
Horizontal and Vertical coupling planes were also checked



ESD Test Setup per EN 61000-4-2:2009

Blue arrows are places that were checked for Air Discharge
Red arrows are places that were checked for Contact Discharge

All metal parts that the user might touch were tested for contact discharge. All plastic areas that the user might touch were tested for air discharge.



ESD Test Setup per EN 61000-4-2:2009

Blue arrows are places that were checked for Air Discharge
Red arrows are places that were checked for Contact Discharge

All metal parts that the user might touch were tested for contact discharge. All plastic areas that the user might touch were tested for air discharge.

Signal ports including telecommunication ports

3.2.3 Radio-frequency (common mode). Amplitude modulated

The susceptibility of the EUT to radio-frequency (common mode, amplitude modulated) signals to be tested in conformity with and according to the criteria as stated below

Basic Standard	:	CISPR 24:2015
Test setup	:	EN 61000-4-6
Frequency range	:	0.15 – 80 MHz
Test level	:	3 Vrms
Modulation	:	1 kHz AM to a depth of 80%
Source impedance	:	150 Ohms
Performance criteria	:	Criteria A

Note: Conducted only on ports interfacing with cables whose total length, according to the manufacturer's functional specification, may exceed 3 meters.

Results of the test concerning the susceptibility of the EUT to radio-frequency signals (common mode, AM modulated applied to signal and telecom ports)	**Not Applicable**
Name of Test Engineer: Signature: Date:	Dennis King  27 May 2019
Remarks: No I/O cables 3 meters or longer. There are no interconnecting cables on the unit that exceed 3 meters. See the test plan.	

3.2.4 Fast Transients

The susceptibility of the EUT to fast transients has been tested in conformity with and according to the criteria as stated below.

Basic standard	:	CISPR 24:2015
Test setup	:	EN 61000-4-4
Test level	:	+- 0.5 KV
Tr/Th	:	5/50 nSec
Repetition frequency	:	5 kHz
Performance criteria	:	Criteria B

Note: Conducted only on ports interfacing with cables whose total length, according to the manufacturer's functional specification, may exceed 3 meters.

Results of the test concerning the susceptibility of the EUT to fast transients	**Not Applicable**
Name of Test Engineer: Signature: Date:	Dennis King  27 May 2019
Remarks: There are no interconnecting cables on the unit that exceed 3 meters.	

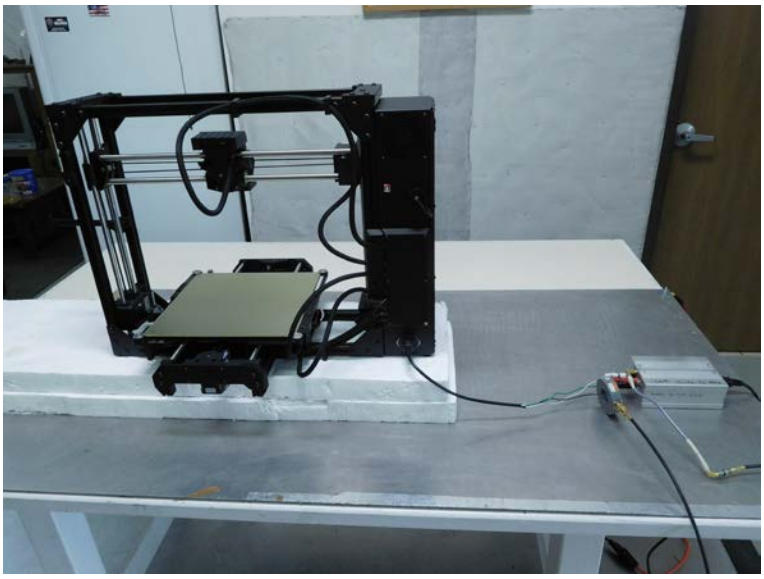
3.3 AC input and AC output power ports

3.3.1 Radio-frequency (common mode, amplitude modulated)

The susceptibility of the EUT to radio-frequency signals (common mode, amplitude modulated, has been tested in conformity with and according to the criteria as stated below.

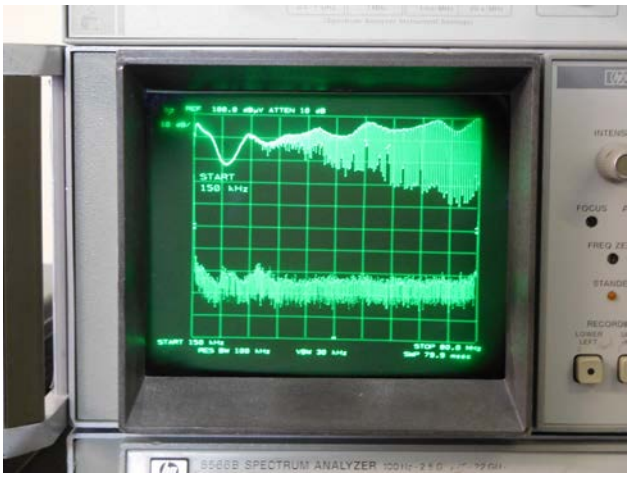
Basic standard	:	CISPR 24:2015
Test setup	:	EN 61000-4-6
Frequency range	:	0.15 – 80 MHz
Test level	:	3 Vrms
Source impedance	:	150 Ohms
Performance criteria	:	Criteria A

Results of the test concerning the susceptibility of the EUT to radio-frequency signals (common mode, amplitude modulated) – AC input and AC output power ports	**Pass Criteria A – 3 Vrms**
Name of Test Engineer: Signature: Date:	Dennis King  27 May 2019
Remarks: Tested at 230 VAC 50 Hz – the EUT continued to operate as intended with no loss of data or function. **The TAZ WORKHORSE passed Criteria A, 3 Vrms** **PASS**	



AC power line conducted immunity setup per EN 61000-4-6
The injected signal is monitored with the current clamp on the spectrum analyzer

The spectrum analyzer display is recorded below



3.3.2 Surges

The susceptibility of the EUT to surges has been tested in conformity with and according to the criteria as stated below

Basic Standard	:	CISPR 24:2015
Test setup	:	EN 61000-4-5
Test level 1	:	+- 0.5 kV, +- 1.0 kV, Differential mode
Test level 2	:	+- 0.5 kV, +- 1.0 kV, +- 2 kV Common Mode
Tr/Th	:	1.2/50(8/20) micro Seconds
Number of pulses		
Per phase angle/voltage	:	5
Performance criteria	:	Criteria B
Note	:	***Applicable only to input AC ports***

Results of the test concerning the susceptibility of the EUT to surges (AC input and AC output power ports	**Pass Criteria A**
Name of Test Engineer:	Dennis King
Signature:	
Date:	27 May 2019
Remarks: Tested at the highest voltage levels since this is a confirmation of the original passing data from the power supply manufacturer. **PASS**	

Surge Test Data

● Step #1 Setup

Filename: Internal\500V L-N			
****** Setup ******			
Peak Voltage:	+500 V	**Repetition Rate:**	1 min
Async:		**Number of Surge:**	10
Trigger:	Auto	**Test Mode:**	Standard
Output:	Line		
L1-N	ON	**L1-PE**	OFF
N-PE	OFF		
Test Stop and Line Off	**External Source:**	ON	
Monitor Line Current:	ON	**Max Line Current**	16 A
Monitor Peak Voltage min:	OFF	**Peak Voltage min:**	---
Monitor Peak Voltage max:	OFF	**Peak Voltage max:**	---
Monitor Peak Current min:	OFF	**Peak Current min:**	---
Monitor Peak Current max:	OFF	**Peak Current max:**	---
****** Test End ******			
Line:	OFF	**Sound:**	ON
****** Transition Function ******			
**** Alternate Polarity:**	ON		
No. of Surge Positive:	5	**No. of Surge Negative**	5
**** Peak Voltage Transition:**	OFF		
**** Phase Transition:**	OFF		

● Step #2 Setup

Filename: Internal\1 kV L-N			
****** Setup ******			
Peak Voltage:	+1.00 kV	**Repetition Rate:**	1 min
Line sync:	Transition	**Number of Surge:**	10
Trigger:	Auto	**Test Mode:**	Standard
Output:	Line		
L1-N	ON	**L1-PE**	OFF
N-PE	OFF		
****** EUT Fail ******			
EUT Fail Action:	Test Stop and Line Off	**External Source:**	ON
Monitor Line Current:	ON	**Max Line Current**	16 A
Monitor Peak Voltage min:	OFF	**Peak Voltage min:**	---

Monitor Peak Voltage max:	OFF	**Peak Voltage max:**	---
Monitor Peak Current min:	OFF	**Peak Current min:**	---
Monitor Peak Current max:	OFF	**Peak Current max:**	---
****** Test End ******			
Line:	OFF	**Sound:**	ON
****** Transition Function ******			
**** Alternate Polarity:**	ON		
No. of Surge Positive:	5	**No. of Surge Negative**	5
**** Peak Voltage Transition:**	OFF		
**** Phase Transition:**	ON		
Start Phase:	0 deg	**Delta Phase:**	90 deg
Stop Phase:	270 deg		

Logs

O Sequence Log

Step No.	Start Date	Start Time	End Date	End Time	Result
#1	27.05.2019	10:26:01			
#1			27.05.2019	10:36:02	**PASSED**
#2	27.05.2019	10:40:57			
#2			27.05.2019	11:21:00	**PASSED**

● Step #1 AXOS Surge Log

Date	Time	Coupling Path	Repetition Rate	Peak Voltage	Sync	U peak	I peak	
27.05.2019	10:26:02	L1-N	1 min	+500 V	---	-2.39 kV	-0.05 kA	*Test Start*
27.05.2019	10:27:02	L1-N	1 min	+500 V	---	+0.40 kV	0.12 kA	
27.05.2019	10:28:02	L1-N	1 min	+500 V	---	+0.37 kV	0.11 kA	
27.05.2019	10:29:02	L1-N	1 min	+500 V	---	+0.40 kV	0.11 kA	
27.05.2019	10:30:02	L1-N	1 min	+500 V	---	+0.47 kV	0.11 kA	
27.05.2019	10:31:02	L1-N	1 min	+500 V	---	+0.38 kV	0.11 kA	
27.05.2019	10:32:02	L1-N	1 min	-500 V	---	-0.36 kV	-0.11 kA	
27.05.2019	10:33:02	L1-N	1 min	-500 V	---	-0.47 kV	-0.11 kA	
27.05.2019	10:34:02	L1-N	1 min	-500 V	---	-0.46 kV	-0.12 kA	
27.05.2019	10:35:02	L1-N	1 min	-500 V	---	-0.49 kV	-0.12 kA	
27.05.2019	10:36:02	L1-N	1 min	-500 V	---	-0.34 kV	-0.11 kA	
27.05.2019	10:36:02	L1-N	1 min	-500 V	---	-0.34 kV	-0.11 kA	*Test End*

● Step #2 AXOS Surge Log

Date	Time	Coupling Path	Repetition Rate	Peak Voltage	Sync	U peak	I peak	
27.05.2019	10:40:57	L1-N	1 min	+1.00 kV	0 deg	+0.84 kV	0.23 kA	*Test Start*
27.05.2019	10:41:57	L1-N	1 min	+1.00 kV	0 deg	+0.83 kV	0.23 kA	
27.05.2019	10:42:57	L1-N	1 min	+1.00 kV	0 deg	+0.83 kV	0.23 kA	
27.05.2019	10:43:57	L1-N	1 min	+1.00 kV	0 deg	+0.84 kV	0.23 kA	
27.05.2019	10:44:57	L1-N	1 min	+1.00 kV	0 deg	+0.84 kV	0.23 kA	
27.05.2019	10:45:57	L1-N	1 min	+1.00 kV	0 deg	+0.84 kV	0.23 kA	
27.05.2019	10:45:58	L1-N	1 min	+1.00 kV	90 deg	+0.84 kV	0.23 kA	
27.05.2019	10:46:58	L1-N	1 min	+1.00 kV	90 deg	+0.56 kV	0.26 kA	
27.05.2019	10:47:58	L1-N	1 min	+1.00 kV	90 deg	+0.60 kV	0.26 kA	
27.05.2019	10:48:58	L1-N	1 min	+1.00 kV	90 deg	+0.60 kV	0.26 kA	
27.05.2019	10:49:58	L1-N	1 min	+1.00 kV	90 deg	+0.61 kV	0.26 kA	
27.05.2019	10:50:58	L1-N	1 min	+1.00 kV	90 deg	+0.61 kV	0.26 kA	
27.05.2019	10:50:58	L1-N	1 min	+1.00 kV	180 deg	+0.61 kV	0.26 kA	
27.05.2019	10:51:58	L1-N	1 min	+1.00 kV	180 deg	+0.85 kV	0.24 kA	
27.05.2019	10:52:58	L1-N	1 min	+1.00 kV	180 deg	+0.76 kV	0.24 kA	
27.05.2019	10:53:58	L1-N	1 min	+1.00 kV	180 deg	+0.76 kV	0.24 kA	
27.05.2019	10:54:58	L1-N	1 min	+1.00 kV	180 deg	+0.76 kV	0.24 kA	
27.05.2019	10:55:58	L1-N	1 min	+1.00 kV	180 deg	+0.76 kV	0.24 kA	
27.05.2019	10:55:58	L1-N	1 min	+1.00 kV	270 deg	+0.76 kV	0.24 kA	
27.05.2019	10:56:58	L1-N	1 min	+1.00 kV	270 deg	+0.93 kV	0.23 kA	
27.05.2019	10:57:58	L1-N	1 min	+1.00 kV	270 deg	+0.92 kV	0.23 kA	
27.05.2019	10:58:58	L1-N	1 min	+1.00 kV	270 deg	+0.92 kV	0.23 kA	
27.05.2019	10:59:58	L1-N	1 min	+1.00 kV	270 deg	+0.92 kV	0.23 kA	
27.05.2019	11:00:58	L1-N	1 min	+1.00 kV	270 deg	+0.92 kV	0.23 kA	
27.05.2019	11:00:58	L1-N	1 min	-1.00 kV	0 deg	+0.92 kV	0.23 kA	
27.05.2019	11:01:58	L1-N	1 min	-1.00 kV	0 deg	-0.78 kV	-0.24 kA	
27.05.2019	11:02:58	L1-N	1 min	-1.00 kV	0 deg	-0.76 kV	-0.24 kA	
27.05.2019	11:03:58	L1-N	1 min	-1.00 kV	0 deg	-0.76 kV	-0.24 kA	
27.05.2019	11:04:58	L1-N	1 min	-1.00 kV	0 deg	-0.76 kV	-0.24 kA	
27.05.2019	11:05:58	L1-N	1 min	-1.00 kV	0 deg	-0.78 kV	-0.24 kA	
27.05.2019	11:05:59	L1-N	1 min	-1.00 kV	90 deg	-0.78 kV	-0.24 kA	
27.05.2019	11:06:59	L1-N	1 min	-1.00 kV	90 deg	-0.92 kV	-0.23 kA	
27.05.2019	11:07:59	L1-N	1 min	-1.00 kV	90 deg	-0.94 kV	-0.24 kA	
27.05.2019	11:08:59	L1-N	1 min	-1.00 kV	90 deg	-0.94 kV	-0.24 kA	
27.05.2019	11:09:59	L1-N	1 min	-1.00 kV	90 deg	-0.94 kV	-0.24 kA	
27.05.2019	11:10:59	L1-N	1 min	-1.00 kV	90 deg	-0.94 kV	-0.24 kA	
27.05.2019	11:10:59	L1-N	1 min	-1.00 kV	180 deg	-0.94 kV	-0.24 kA	

27.05.2019	11:11:59	L1-N	1 min	-1.00 kV	180 deg	-0.85 kV	-0.23 kA	
27.05.2019	11:12:59	L1-N	1 min	-1.00 kV	180 deg	-0.77 kV	-0.23 kA	
27.05.2019	11:13:59	L1-N	1 min	-1.00 kV	180 deg	-0.84 kV	-0.23 kA	
27.05.2019	11:14:59	L1-N	1 min	-1.00 kV	180 deg	-0.88 kV	-0.23 kA	
27.05.2019	11:15:59	L1-N	1 min	-1.00 kV	180 deg	-0.85 kV	-0.23 kA	
27.05.2019	11:15:59	L1-N	1 min	-1.00 kV	270 deg	-0.85 kV	-0.23 kA	
27.05.2019	11:16:59	L1-N	1 min	-1.00 kV	270 deg	-0.58 kV	-0.27 kA	
27.05.2019	11:17:59	L1-N	1 min	-1.00 kV	270 deg	-0.62 kV	-0.27 kA	
27.05.2019	11:18:59	L1-N	1 min	-1.00 kV	270 deg	-0.62 kV	-0.27 kA	
27.05.2019	11:19:59	L1-N	1 min	-1.00 kV	270 deg	-0.61 kV	-0.27 kA	
27.05.2019	11:20:59	L1-N	1 min	-1.00 kV	270 deg	-0.60 kV	-0.27 kA	
27.05.2019	11:21:00	L1-N	1 min	-1.00 kV	270 deg	-0.60 kV	-0.27 kA	*Test End*

Results

Sequence Result

⊙	➔ Sequence Result (summary) :	**PASSED**
ⓘ	➔ Immunity supervised :	**YES**
ⓘ	➔ EUT Immunity Criteria :	**Normal performance of device**

Step Results

Step No.	Step Type	Generator	Filename	Comments	Result
#1	TEST	AXOS	Internal\500V L-N		**PASSED**
#2	TEST	AXOS	Internal\1 kV L-N		**PASSED**

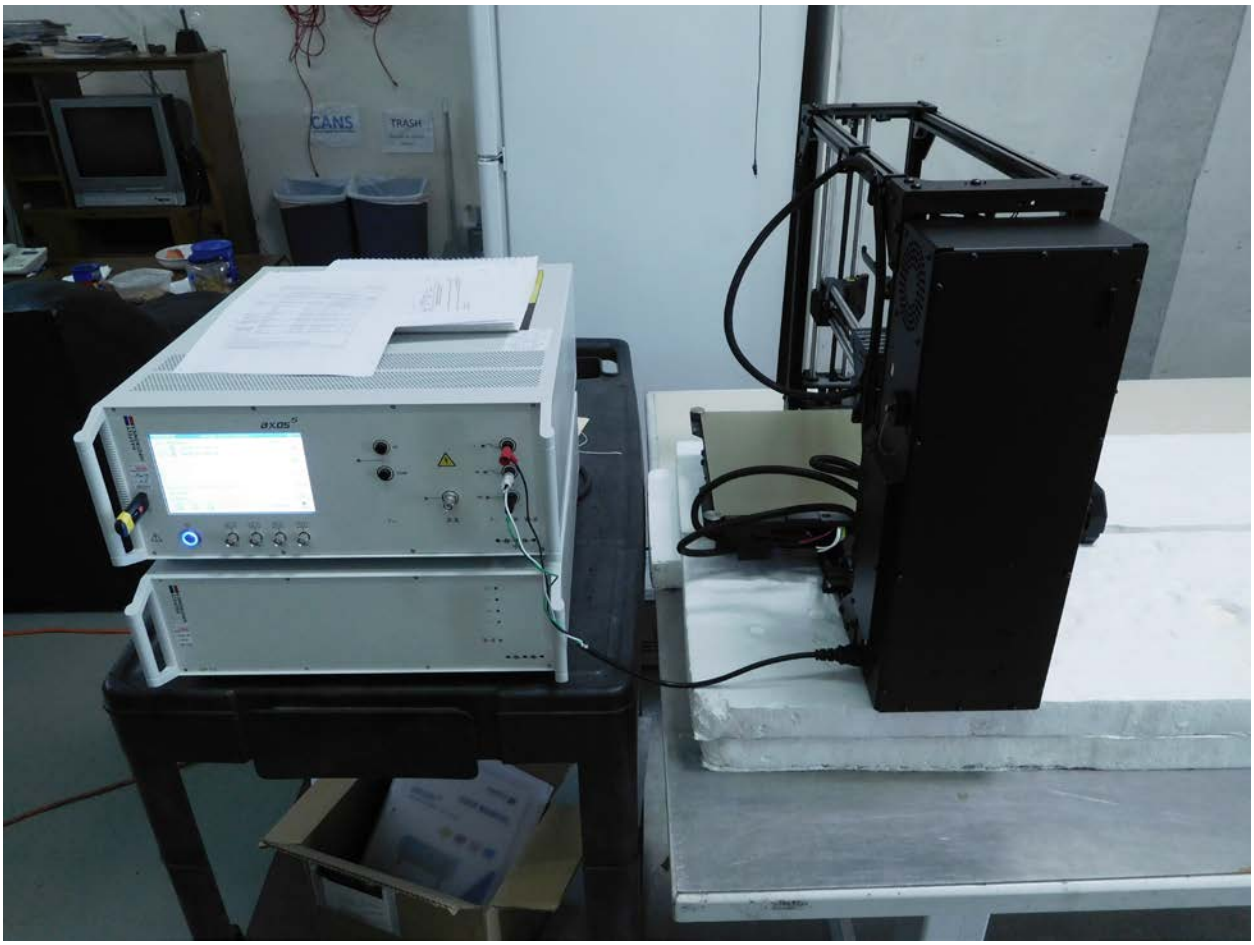
Date	Time	Coupling Path	Repetition Rate	Peak Voltage	Sync	U peak	I peak
#1	27.05.2019	17:51:26					
#1			27.05.2019	19:11:29	**PASSED**		

1 ● Step #1 AXOS Surge Log

2 Date	3 Time	4 Coupling Path	Repetition Rate	Peak Voltage	Sync	U peak	I peak	5
27.05.2019	17:51:26	L1-PE	1 min	+2.00 kV	0 deg	+0.00 kV	0.00 kA	*Test Start*
27.05.2019	17:52:27	L1-PE	1 min	+2.00 kV	0 deg	+2.49 kV	0.04 kA	
27.05.2019	17:53:27	L1-PE	1 min	+2.00 kV	0 deg	+2.50 kV	0.04 kA	
27.05.2019	17:54:27	L1-PE	1 min	+2.00 kV	0 deg	+2.47 kV	0.05 kA	
27.05.2019	17:55:27	L1-PE	1 min	+2.00 kV	0 deg	+2.46 kV	0.05 kA	
27.05.2019	17:56:27	L1-PE	1 min	+2.00 kV	0 deg	+2.46 kV	0.05 kA	
27.05.2019	17:56:27	L1-PE	1 min	+2.00 kV	90 deg	+2.46 kV	0.05 kA	
27.05.2019	17:57:27	L1-PE	1 min	+2.00 kV	90 deg	+2.33 kV	0.05 kA	
27.05.2019	17:58:27	L1-PE	1 min	+2.00 kV	90 deg	+2.29 kV	0.05 kA	
27.05.2019	17:59:27	L1-PE	1 min	+2.00 kV	90 deg	+2.35 kV	0.05 kA	
27.05.2019	18:00:27	L1-PE	1 min	+2.00 kV	90 deg	+2.36 kV	0.05 kA	
27.05.2019	18:01:27	L1-PE	1 min	+2.00 kV	90 deg	+2.32 kV	0.05 kA	
27.05.2019	18:01:27	L1-PE	1 min	+2.00 kV	180 deg	+2.32 kV	0.05 kA	
27.05.2019	18:02:27	L1-PE	1 min	+2.00 kV	180 deg	+2.47 kV	0.05 kA	
27.05.2019	18:03:27	L1-PE	1 min	+2.00 kV	180 deg	+2.49 kV	0.05 kA	
27.05.2019	18:04:27	L1-PE	1 min	+2.00 kV	180 deg	+2.51 kV	0.05 kA	
27.05.2019	18:05:27	L1-PE	1 min	+2.00 kV	180 deg	+2.50 kV	0.05 kA	
27.05.2019	18:06:27	L1-PE	1 min	+2.00 kV	180 deg	+2.51 kV	0.04 kA	
27.05.2019	18:06:27	L1-PE	1 min	+2.00 kV	270 deg	+2.51 kV	0.04 kA	
27.05.2019	18:07:27	L1-PE	1 min	+2.00 kV	270 deg	+2.47 kV	0.05 kA	
27.05.2019	18:08:27	L1-PE	1 min	+2.00 kV	270 deg	+2.48 kV	0.05 kA	
27.05.2019	18:09:27	L1-PE	1 min	+2.00 kV	270 deg	+2.48 kV	0.05 kA	
27.05.2019	18:10:27	L1-PE	1 min	+2.00 kV	270 deg	+2.49 kV	0.05 kA	
27.05.2019	18:11:27	L1-PE	1 min	+2.00 kV	270 deg	+2.51 kV	0.04 kA	
27.05.2019	18:11:27	L1-PE	1 min	-2.00 kV	0 deg	+2.51 kV	0.04 kA	
27.05.2019	18:12:27	L1-PE	1 min	-2.00 kV	0 deg	-2.49 kV	-0.05 kA	
27.05.2019	18:13:27	L1-PE	1 min	-2.00 kV	0 deg	-2.56 kV	-0.04 kA	
27.05.2019	18:14:27	L1-PE	1 min	-2.00 kV	0 deg	-2.57 kV	-0.04 kA	

27.05.2019	18:15:27	L1-PE	1 min	-2.00 kV	0 deg	-2.58 kV	-0.04 kA
27.05.2019	18:16:27	L1-PE	1 min	-2.00 kV	0 deg	-2.57 kV	-0.04 kA
27.05.2019	18:16:27	L1-PE	1 min	-2.00 kV	90 deg	-2.57 kV	-0.04 kA
27.05.2019	18:17:27	L1-PE	1 min	-2.00 kV	90 deg	-2.60 kV	-0.05 kA
27.05.2019	18:18:27	L1-PE	1 min	-2.00 kV	90 deg	-2.59 kV	-0.05 kA
27.05.2019	18:19:27	L1-PE	1 min	-2.00 kV	90 deg	-2.59 kV	-0.05 kA
27.05.2019	18:20:27	L1-PE	1 min	-2.00 kV	90 deg	-2.57 kV	-0.05 kA
27.05.2019	18:21:27	L1-PE	1 min	-2.00 kV	90 deg	-2.58 kV	-0.05 kA
27.05.2019	18:21:28	L1-PE	1 min	-2.00 kV	180 deg	-2.58 kV	-0.05 kA
27.05.2019	18:22:28	L1-PE	1 min	-2.00 kV	180 deg	-2.56 kV	-0.04 kA
27.05.2019	18:23:28	L1-PE	1 min	-2.00 kV	180 deg	-2.57 kV	-0.04 kA
27.05.2019	18:24:28	L1-PE	1 min	-2.00 kV	180 deg	-2.56 kV	-0.04 kA
27.05.2019	18:25:28	L1-PE	1 min	-2.00 kV	180 deg	-2.57 kV	-0.04 kA
27.05.2019	18:26:28	L1-PE	1 min	-2.00 kV	180 deg	-2.56 kV	-0.04 kA
27.05.2019	18:26:28	L1-PE	1 min	-2.00 kV	270 deg	-2.56 kV	-0.04 kA
27.05.2019	18:27:28	L1-PE	1 min	-2.00 kV	270 deg	-2.46 kV	-0.06 kA
27.05.2019	18:28:28	L1-PE	1 min	-2.00 kV	270 deg	-2.41 kV	-0.06 kA
27.05.2019	18:29:28	L1-PE	1 min	-2.00 kV	270 deg	-2.41 kV	-0.06 kA
27.05.2019	18:30:28	L1-PE	1 min	-2.00 kV	270 deg	-2.39 kV	-0.05 kA
27.05.2019	18:31:28	L1-PE	1 min	-2.00 kV	270 deg	-2.39 kV	-0.06 kA
27.05.2019	18:31:28	N-PE	1 min	+2.00 kV	0 deg	-2.39 kV	-0.06 kA
27.05.2019	18:32:28	N-PE	1 min	+2.00 kV	0 deg	+2.42 kV	0.05 kA
27.05.2019	18:33:28	N-PE	1 min	+2.00 kV	0 deg	+2.44 kV	0.05 kA
27.05.2019	18:34:28	N-PE	1 min	+2.00 kV	0 deg	+2.46 kV	0.05 kA
27.05.2019	18:35:28	N-PE	1 min	+2.00 kV	0 deg	+2.47 kV	0.05 kA
27.05.2019	18:36:28	N-PE	1 min	+2.00 kV	0 deg	+2.48 kV	0.05 kA
27.05.2019	18:36:28	N-PE	1 min	+2.00 kV	90 deg	+2.48 kV	0.05 kA
27.05.2019	18:37:28	N-PE	1 min	+2.00 kV	90 deg	+2.35 kV	0.05 kA
27.05.2019	18:38:28	N-PE	1 min	+2.00 kV	90 deg	+2.25 kV	0.05 kA
27.05.2019	18:39:28	N-PE	1 min	+2.00 kV	90 deg	+2.34 kV	0.05 kA
27.05.2019	18:40:28	N-PE	1 min	+2.00 kV	90 deg	+2.31 kV	0.05 kA
27.05.2019	18:41:28	N-PE	1 min	+2.00 kV	90 deg	+2.31 kV	0.05 kA
27.05.2019	18:41:29	N-PE	1 min	+2.00 kV	180 deg	+2.31 kV	0.05 kA
27.05.2019	18:42:29	N-PE	1 min	+2.00 kV	180 deg	+2.47 kV	0.05 kA
27.05.2019	18:43:29	N-PE	1 min	+2.00 kV	180 deg	+2.44 kV	0.05 kA
27.05.2019	18:44:29	N-PE	1 min	+2.00 kV	180 deg	+2.43 kV	0.05 kA
27.05.2019	18:45:29	N-PE	1 min	+2.00 kV	180 deg	+2.47 kV	0.05 kA
27.05.2019	18:46:29	N-PE	1 min	+2.00 kV	180 deg	+2.44 kV	0.05 kA
27.05.2019	18:46:29	N-PE	1 min	+2.00 kV	270 deg	+2.44 kV	0.05 kA
27.05.2019	18:47:29	N-PE	1 min	+2.00 kV	270 deg	+2.50 kV	0.05 kA
27.05.2019	18:48:29	N-PE	1 min	+2.00 kV	270 deg	+2.51 kV	0.05 kA
27.05.2019	18:49:29	N-PE	1 min	+2.00 kV	270 deg	+2.51 kV	0.05 kA
27.05.2019	18:50:29	N-PE	1 min	+2.00 kV	270 deg	+2.52 kV	0.05 kA
27.05.2019	18:51:29	N-PE	1 min	+2.00 kV	270 deg	+2.52 kV	0.04 kA
27.05.2019	18:51:29	N-PE	1 min	-2.00 kV	0 deg	+2.52 kV	0.04 kA
27.05.2019	18:52:29	N-PE	1 min	-2.00 kV	0 deg	-2.54 kV	-0.05 kA
27.05.2019	18:53:29	N-PE	1 min	-2.00 kV	0 deg	-2.54 kV	-0.05 kA

27.05.2019	18:54:29	N-PE	1 min	-2.00 kV	0 deg	-2.53 kV	-0.05 kA	
27.05.2019	18:55:29	N-PE	1 min	-2.00 kV	0 deg	-2.51 kV	-0.05 kA	
27.05.2019	18:56:29	N-PE	1 min	-2.00 kV	0 deg	-2.53 kV	-0.05 kA	
27.05.2019	18:56:29	N-PE	1 min	-2.00 kV	90 deg	-2.53 kV	-0.05 kA	
27.05.2019	18:57:29	N-PE	1 min	-2.00 kV	90 deg	-2.58 kV	-0.04 kA	
27.05.2019	18:58:29	N-PE	1 min	-2.00 kV	90 deg	-2.59 kV	-0.04 kA	
27.05.2019	18:59:29	N-PE	1 min	-2.00 kV	90 deg	-2.58 kV	-0.04 kA	
27.05.2019	19:00:29	N-PE	1 min	-2.00 kV	90 deg	-2.59 kV	-0.04 kA	
27.05.2019	19:01:29	N-PE	1 min	-2.00 kV	90 deg	-2.60 kV	-0.04 kA	
27.05.2019	19:01:29	N-PE	1 min	-2.00 kV	180 deg	-2.60 kV	-0.04 kA	
27.05.2019	19:02:29	N-PE	1 min	-2.00 kV	180 deg	-2.57 kV	-0.04 kA	
27.05.2019	19:03:29	N-PE	1 min	-2.00 kV	180 deg	-2.58 kV	-0.04 kA	
27.05.2019	19:04:29	N-PE	1 min	-2.00 kV	180 deg	-2.56 kV	-0.04 kA	
27.05.2019	19:05:29	N-PE	1 min	-2.00 kV	180 deg	-2.54 kV	-0.04 kA	
27.05.2019	19:06:29	N-PE	1 min	-2.00 kV	180 deg	-2.53 kV	-0.05 kA	
27.05.2019	19:06:29	N-PE	1 min	-2.00 kV	270 deg	-2.53 kV	-0.05 kA	
27.05.2019	19:07:29	N-PE	1 min	-2.00 kV	270 deg	-2.43 kV	-0.05 kA	
27.05.2019	19:08:29	N-PE	1 min	-2.00 kV	270 deg	-2.40 kV	-0.05 kA	
27.05.2019	19:09:29	N-PE	1 min	-2.00 kV	270 deg	-2.41 kV	-0.05 kA	
27.05.2019	19:10:29	N-PE	1 min	-2.00 kV	270 deg	-2.40 kV	-0.05 kA	
27.05.2019	19:11:29	N-PE	1 min	-2.00 kV	270 deg	-2.39 kV	-0.05 kA	
27.05.2019	19:11:29	N-PE	1 min	-2.00 kV	270 deg	-2.39 kV	-0.05 kA	*Test End*



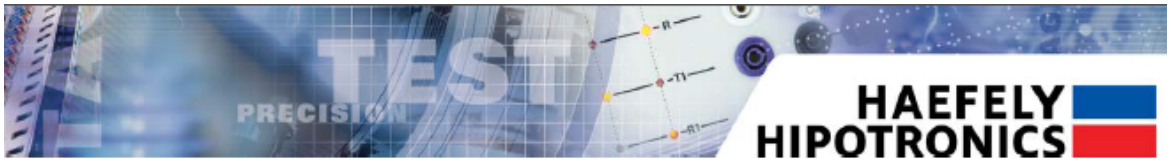
Test setup according to EN 61000-4-5, Surge

3.2.4 Fast Transients

The susceptibility of the EUT to fast transients (common mode) has been tested in conformity with and according to the criteria as stated below.

Basic standard	:	CISPR 24:2015
Test setup	:	EN 61000-4-4
Test level	:	+- 1 KV
Tr/Th	:	5/50 nSec
Repetition frequency	:	5 kHz
Performance criteria	:	Criteria B
Note	:	***Conducted on the AC input.***

Results of the test concerning the susceptibility of the EUT to fast transients (common mode, AC input and AC output ports)	**Pass Criteria A**
Name of Test Engineer: Signature: Date:	Dennis King  27 May 2019
Remarks: Tested at 230 VAC 50 Hz . The unit continued to function as intended.	



Test Report

Description of used Test System :	AXOS 5
Sequence File Name :	Internal\ITE- EFT Lvl 2 - Power ports.asq

Setups

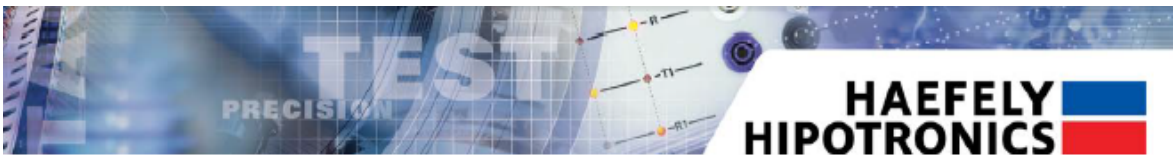
○ Sequence Setup (Sequence of ● Steps)

Step No.	Step Type	Test Type	Generator Name	Filename
#1	TEST	EFT	AXOS	Internal\+1kv - 5khz-Line.asb
#2	TEST	EFT	AXOS	Internal\-1kv - 5khz-Line.asb

● Step #1 Setup

Filename: Internal\+1kv - 5khz-Line.asb

**** Setup ****			
Peak Voltage:	+1.00 kV	Burst Duration:	750 µs
Repetition Frequency:	5.0 kHz	Burst Period:	300 ms
Async:		Test Time:	1 min
Burst Mode:	Normal	Trigger:	Auto
Test Mode:	Standard		
Output:	Line		
L1-GND	ON	N-GND	ON
PE-GND	ON	L1N-GND	ON
L1PE-GND	ON	NPE-GND	ON
L1NPE-GND	ON		
**** EUT Fail ****			
EUT Fail Action:	Test Stop and Line Off	External Source:	ON
Monitor Line Current:	OFF	Max Line Current	---
**** Test End ****			
Line:	OFF	Sound:	ON
**** Transition Function ****			
** Alternate Polarity:	OFF		
** Peak Voltage Transition:	OFF		
** Repetition Freq. Transition:	OFF		
** Phase Transition:	OFF		



- **Step #2 Setup**

Filename: Internal\-1kv - 5khz-Line.asb

****** Setup ******			
Peak Voltage:	-1.00 kV	**Burst Duration:**	750 µs
Repetition Frequency:	5.0 kHz	**Burst Period:**	300 ms
Async:		**Test Time:**	1 min
Burst Mode:	Normal	**Trigger:**	Auto
Test Mode:	Standard		
Output:	Line		
L1-GND	ON	**N-GND**	ON
PE-GND	ON	**L1N-GND**	ON
L1PE-GND	ON	**NPE-GND**	ON
L1NPE-GND	ON		
****** EUT Fail ******			
EUT Fail Action:	Test Stop and Line Off	**External Source:**	ON
Monitor Line Current:	OFF	**Max Line Current**	---
****** Test End ******			
Line:	OFF	**Sound:**	ON
****** Transition Function ******			
**** Alternate Polarity:**	OFF		
**** Peak Voltage Transition:**	OFF		
**** Repetition Freq. Transition:**	OFF		
**** Phase Transition:**	OFF		

Logs

Sequence Log

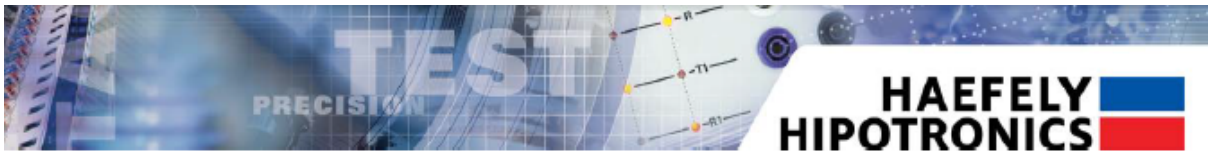
Step No.	Start Date	Start Time	End Date	End Time	Result
#1	27.05.2019	11:09:35			
#1			27.05.2019	11:17:02	PASSED
#2	27.05.2019	11:17:05			
#2			27.05.2019	11:24:32	PASSED

Step #1 AXOS EFT / Burst Log

Date	Time	Coupling Path	Peak Voltage	Repetition Frequency	Burst Period	Burst-duration	Sync	
27.05.2019	11:09:35	L1-GND	+1.00 kV	5.0 kHz	300 ms	750 µs	---	*Test Start*
27.05.2019	11:10:40	N-GND	+1.00 kV	5.0 kHz	300 ms	750 µs	---	
27.05.2019	11:11:44	PE-GND	+1.00 kV	5.0 kHz	300 ms	750 µs	---	
27.05.2019	11:12:48	L1N-GND	+1.00 kV	5.0 kHz	300 ms	750 µs	---	
27.05.2019	11:13:52	L1PE-GND	+1.00 kV	5.0 kHz	300 ms	750 µs	---	
27.05.2019	11:14:56	NPE-GND	+1.00 kV	5.0 kHz	300 ms	750 µs	---	
27.05.2019	11:16:01	L1NPE-GND	+1.00 kV	5.0 kHz	300 ms	750 µs	---	
27.05.2019	11:17:02	L1NPE-GND	+1.00 kV	5.0 kHz	300 ms	750 µs	---	*Test End*

Step #2 AXOS EFT / Burst Log

Date	Time	Coupling Path	Peak Voltage	Repetition Frequency	Burst Period	Burst-duration	Sync	
27.05.2019	11:17:05	L1-GND	-1.00 kV	5.0 kHz	300 ms	750 µs	---	*Test Start*
27.05.2019	11:18:10	N-GND	-1.00 kV	5.0 kHz	300 ms	750 µs	---	
27.05.2019	11:19:14	PE-GND	-1.00 kV	5.0 kHz	300 ms	750 µs	---	
27.05.2019	11:20:18	L1N-GND	-1.00 kV	5.0 kHz	300 ms	750 µs	---	
27.05.2019	11:21:22	L1PE-GND	-1.00 kV	5.0 kHz	300 ms	750 µs	---	
27.05.2019	11:22:26	NPE-GND	-1.00 kV	5.0 kHz	300 ms	750 µs	---	
27.05.2019	11:23:31	L1NPE-GND	-1.00 kV	5.0 kHz	300 ms	750 µs	---	
27.05.2019	11:24:32	L1NPE-GND	-1.00 kV	5.0 kHz	300 ms	750 µs	---	*Test End*



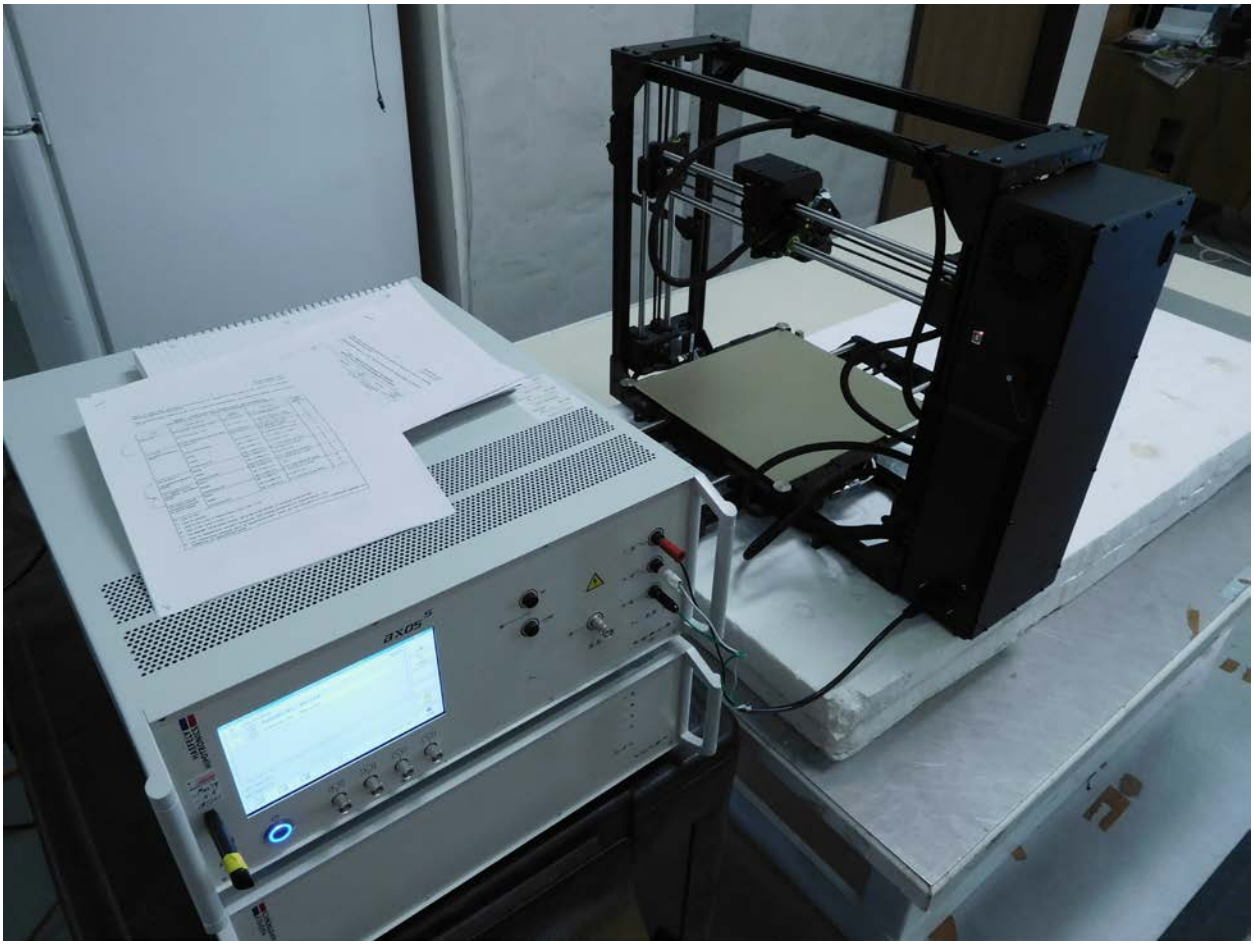
Results

Sequence Result

→ Sequence Result (summary) :	**PASSED**
→ Immunity supervised :	**YES**
→ EUT Immunity Criteria :	**Normal performance of device**

Step Results

Step No.	Step Type	Generator	Filename	Comments	Result
#1	TEST	AXOS	Internal\+1kv - 5khz-Line.asb		**PASSED**
#2	TEST	AXOS	Internal\-1kv - 5khz-Line.asb		**PASSED**



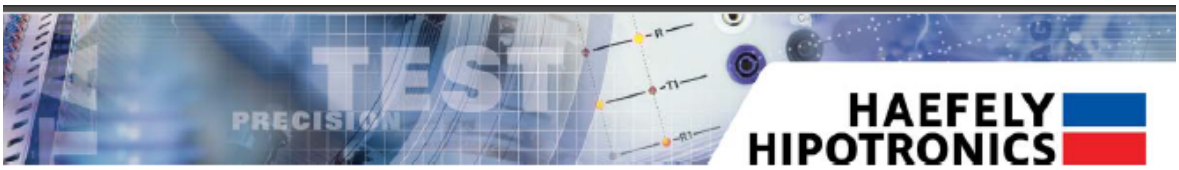
Test Setup per EN 61000-4-4

3.3.4 Voltage Dips and Interruptions

The susceptibility of the EUT to voltage dips and interruptions has been tested in conformity with and according to the criteria as stated below.

Basic Standard	:	CISPR 24:2015
Test setup	:	EN 61000-4-11
Test level (a)	:	Line at <5% of nominal for 0 .5 cycles
Test level (b)	:	Line at 70% of nominal for 25 cycles
Test level (c)	:	Line at <5% of nominal for 250 cycles

Results of the test concerning the susceptibility of the EUT to voltage dips and interruptions – AC input and AC output ports	**Pass**
Name of Test Engineer: Signature: Date:	Dennis King  27 May 2019
Remarks: Tested at 230 VAC 50 Hz while printing. The unit continued to function as intended.	



Test Report

Description of used Test System : AXOS 5 + DIP 116

Sequence File Name : Internal\AC Dips - Basic enviro - ITE- Lab.asq

Setups

○ Sequence Setup (Sequence of ● Steps)

Step No.	Step Type	Test Type	Generator Name	Filename
#1	TEST	VOLTAGE DIPS	AXOS	Internal\0% Open .5 P[half cyc].asd
#2	TEST	VOLTAGE DIPS	AXOS	Internal\0% Open 1 P[1 cyc].asd
#3	TEST	VOLTAGE DIPS	AXOS	Internal\70% 25 of 30 cyc.asd
#4	TEST	VOLTAGE DIPS	AXOS	Internal\0% 250 of 300 cyc.asd

● Step #1 Setup

Filename: Internal\0% Open .5 P[half cyc].asd

****** Setup ******			
Dip Voltage:	0%	**Duration:**	0.5 P
		Interval:	1 min
Line sync:	0 deg	**Test Time:**	3 min
Trigger:	Auto	**Test Mode:**	Standard
****** EUT Fail ******			
EUT Fail Action:	Test Stop and Line Off	**External Source:**	ON
Monitor Line Current:	ON	**Max Line Current**	16 A
****** Test End ******			
Line:	OFF	**Sound:**	ON
****** Transition Function ******			
**** Duration Transition:**	OFF		
**** Interval Transition:**	OFF		
**** Phase Transition:**	OFF		

● **Step #2 Setup**

Filename: Internal\0% Open 1 P[1 cyc].asd

****** Setup ******			
Dip Voltage:	0%	**Duration:**	1 P
		Interval:	1 min
Line sync:	0 deg	**Test Time:**	3 min
Trigger:	Auto	**Test Mode:**	Standard
****** EUT Fail ******			
EUT Fail Action:	Test Stop and Line Off	**External Source:**	ON
Monitor Line Current:	ON	**Max Line Current**	16 A
****** Test End ******			
Line:	OFF	**Sound:**	ON
****** Transition Function ******			
**** Duration Transition:**	OFF		
**** Interval Transition:**	OFF		
**** Phase Transition:**	OFF		

● **Step #3 Setup**

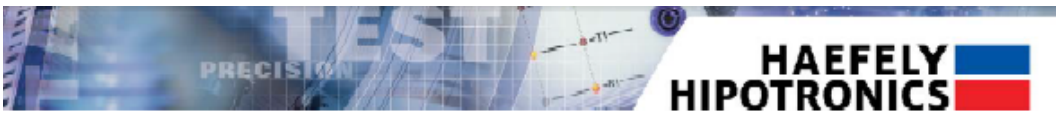
Filename: Internal\70% 25 of 30 cyc.asd

****** Setup ******			
Dip Voltage:	70%	**Duration:**	30 P
		Interval:	1 min
Line sync:	0 deg	**Test Time:**	3 min
Trigger:	Auto	**Test Mode:**	Standard
****** EUT Fail ******			
EUT Fail Action:	Test Stop and Line Off	**External Source:**	ON
Monitor Line Current:	ON	**Max Line Current**	16 A
****** Test End ******			
Line:	OFF	**Sound:**	ON
****** Transition Function ******			
**** Duration Transition:**	OFF		
**** Interval Transition:**	OFF		
**** Phase Transition:**	OFF		

● **Step #4 Setup**

Filename: Internal\0% 250 of 300 cyc.asd

****** Setup ******			
Dip Voltage:	0%	**Duration:**	300 P
		Interval:	1 min
Line sync:	0 deg	**Test Time:**	3 min
Trigger:	Auto	**Test Mode:**	Standard
****** EUT Fail ******			
EUT Fail Action:	Test Stop and Line Off	**External Source:**	ON
Monitor Line Current:	ON	**Max Line Current**	16 A
****** Test End ******			
Line:	OFF	**Sound:**	ON
****** Transition Function ******			
**** Duration Transition:**	OFF		
**** Interval Transition:**	OFF		
**** Phase Transition:**	OFF		



Logs

Sequence Log

Step No.	Start Date	Start Time	End Date	End Time	Result
#1	27.05.2019	11:31:53			
#1			27.05.2019	11:34:55	PASSED
#2	27.05.2019	11:34:56			
#2			27.05.2019	11:37:57	PASSED
#3	27.05.2019	11:37:59			
#3			27.05.2019	11:41:00	PASSED
#4	27.05.2019	11:41:02			
#4			27.05.2019	11:44:03	PASSED

Step #1 AXOS Voltage Dips Log

Date	Time	Duration	Interval	Sync	
27.05.2019	11:31:53	0.5 P	1 min	0 deg	*Test Start*
27.05.2019	11:34:55	0.5 P	1 min	0 deg	*Test End*

Step #2 AXOS Voltage Dips Log

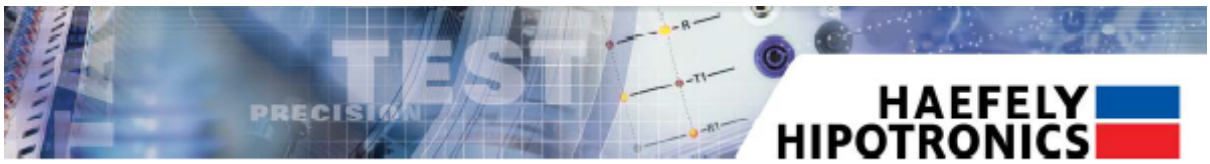
Date	Time	Duration	Interval	Sync	
27.05.2019	11:34:56	1 P	1 min	0 deg	*Test Start*
27.05.2019	11:37:57	1 P	1 min	0 deg	*Test End*

Step #3 AXOS Voltage Dips Log

Date	Time	Duration	Interval	Sync	
27.05.2019	11:37:59	30 P	1 min	0 deg	*Test Start*
27.05.2019	11:41:00	30 P	1 min	0 deg	*Test End*

Step #4 AXOS Voltage Dips Log

Date	Time	Duration	Interval	Sync	
27.05.2019	11:41:02	300 P	1 min	0 deg	*Test Start*
27.05.2019	11:44:03	300 P	1 min	0 deg	*Test End*



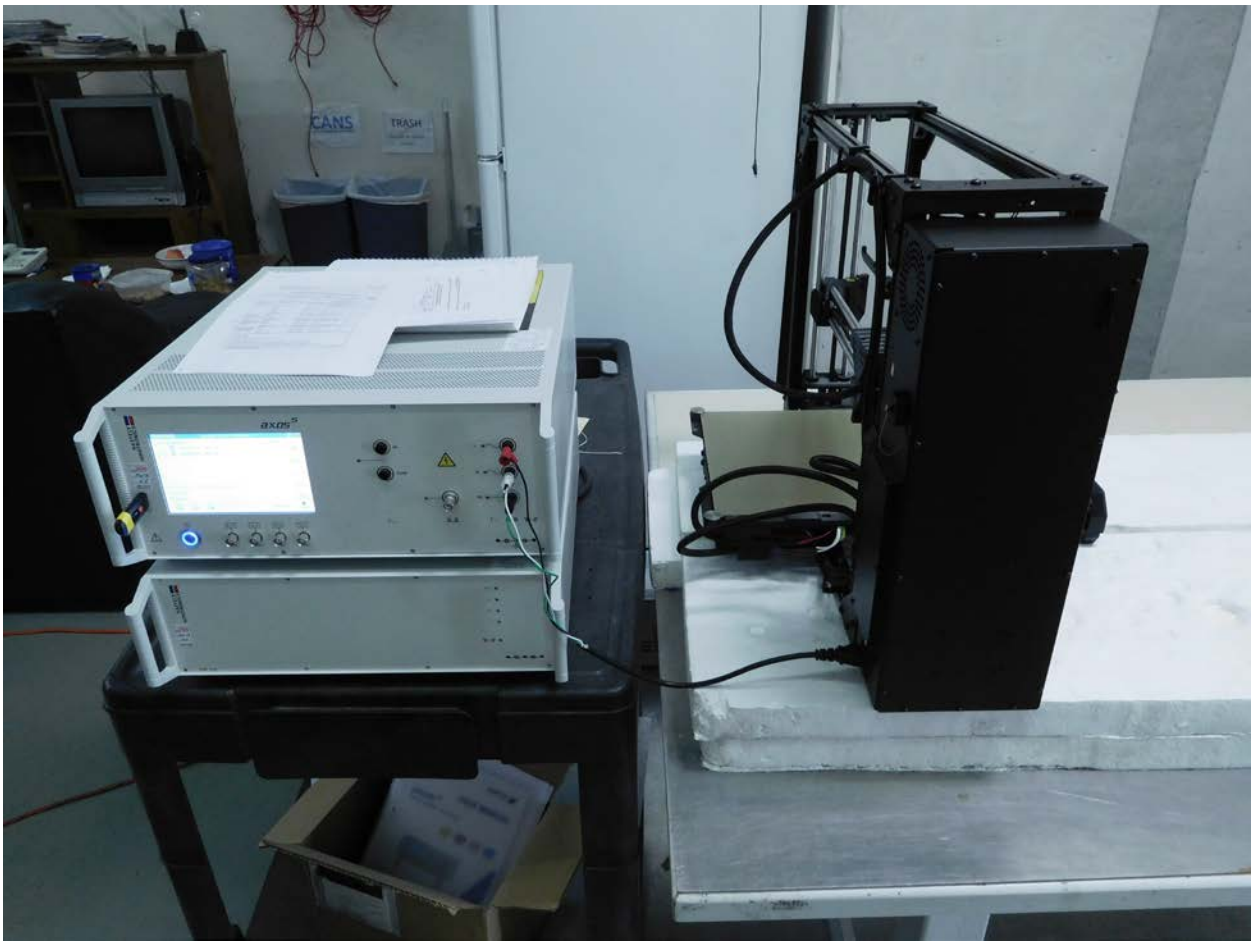
Results

Sequence Result

- ➔ Sequence Result (summary) : **PASSED**
- ➔ Immunity supervised : **YES**
- ➔ EUT Immunity Criteria : **Normal performance of device**

Step Results

Step No.	Step Type	Generator	Filename	Comments	Result
#1	TEST	AXOS	Internal\0% Open .5 P[half cyc].asd		PASSED
#2	TEST	AXOS	Internal\0% Open 1 P[1 cyc].asd		PASSED
#3	TEST	AXOS	Internal\70% 25 of 30 cyc.asd		PASSED
#4	TEST	AXOS	Internal\0% 250 of 300 cyc.asd		PASSED



Test setup according to EN 61000-4-11

3.3.5 Power Frequency Magnetic Fields

The susceptibility of the EUT to power frequency magnetic fields has been tested in conformity with and according to the criteria as stated below.

Basic Standard	:	CISPR 24:2015
Test setup	:	EN 61000-4-8
Test level	:	3 Amps per meter, X,Y and Z axis

Results of the test concerning the susceptibility of the EUT to	**Not applicable**
Name of Test Engineer:	Dennis King
Signature:	
Date:	27 May 2019

Remarks:

Due to previous experience and magnetic field testing with this line of 3D printers there are no magnetically sensitive components in the system. Per the standard this test is not required.

4.0 Modifications

No modifications required at the time of the compliance testing.

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 72-74 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	Serial number	Next cal due
EMC Compact Tester - Haefely	EFT, Surge, AC Dips and Interrupts	AXOS 5	185501	28 March 2020
HP Spectrum Analyzer	Used for Radiated and Conducted Emissions	8566B	2607A02760	3 June 2020
HP Quasi-Peak Adapter	Used for Radiated and Conducted Emissions	85650A	8574A00233	3 June 2020
HP/Agilent Spectrum Analyzer	Used for Radiated and Conducted Emissions	E7401A	US41110467	22 Jan 2021
HP/Agilent Spectrum Analyzer	Used for Radiated Emissions 1-22 GHz	8593E	3710A02875	9 Jan 2021
HP/Agilent Spectrum Analyzer	Used for Radiated and Conducted Emissions	E7401A	US40240440	9 Jan 2021
Com-Power transient Limiter	Conducted Emissions	HZ560	001	3 June 2020
RF Bay Pre-Amp	Radiated emissions – 100kHz to 10 GHz	LPA-10-20	0643	12 Dec 2019
GTEM	Radiated Emissions and Radiated Immunity	5317	9703-1209	25 April 2020 – Field Uniformity Cal per IEC 61000-4-20
3 Meter FAR – Fully Anechoic Room	Radiated Immunity and Emissions	N/A	FAR #1	15 October 2019 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 2020
Chase BiLog Antenna	Radiated Emissions and Immunity	CBL6111	1121	20 March 2020
Marconi Instruments – Signal Generator 10kHz	Radiated Immunity	2031	1196061031	20 October 2019

– 2.7 GHz				
HP Signal Generator	Radiated Immunity	8657A	STD0578	3 May 2020
Amplifier Research .800 – 4.2 GHz Amp	Radiated Immunity – 1 GHz to 2.7 GHz	10S1G4	34516	4 May 2020
Antenna Research Associates – 100 Watt amplifier w/controller	Radiated Immunity – 80-1000 MHz in the FAR	ARAPS/PC757LC ARA757LC-CE	587V7 587V7	20 October 2019
Kalmus Power Amplifier	Radiated Immunity 150kHz – 1 GHz – in the GTEM	747LC-CE	7894-1	12 May 2020
Amplifier Research E- Field probe	Radiated Immunity	FP 2000	12845	12 May 2020
Com-Power LISN	Conducted emissions	LI-115	241010	17 May 2020
Com-Power LISN	Conducted emissions	LI-115	241011	17 May 2020
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 2020
EMI Labs CDN	Conducted Immunity	EMICDN	001	9 Dec 2019
Hafely ESD Gun	Electro Static Discharge	ONYX16	181726	24 June 2020
KeyTek ECAT	Fast transients / Burst	E412	32612	5 June 2020
FCC Inc. RF Current probe	Monitor Conducted Immunity signal	F-33-1	423	9 Dec 2019
EMI Labs Mag Loop	Magnetic Loop Antenna	Mag100	80162	12 Dec 2019
Thermo Keytek CE Master	Surge/ AC Dips and Interrupts	CE Master	0405277	15 Dec 2019
Audio Frequency Helmholtz Coil – Tektronix Audio Signal Generator and Audio Amplifier Test System	50 Hz to 10 kHz Magnetic field, homogenous – Immunity test	Audio Magnetic Field Test System	EMI-HH001	20 August 2020

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 ESD testing, EN 61000-4-2 is ± 4%
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 Conducted Emissions is ± 1.2dB
The estimated combined standard uncertainty for Harmonic current and flicker is ± 11.6%

7.0 Test Plan

Testing required

The LulzBot TAZ WORKHORSE 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 EMC standards. Previous power supply testing may be used as applicable.

Test Setup

The TAZ WORKHORSE will be operating using test software during all the testing.

The test software will be installed on an SD card, the program will be loaded from this drive.

The Printer will also be tested while connected and operated from a laptop through the usb cable supplied with the unit.

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

Beta build.

8.0 Conclusion

The Aleph Objects – TAZ Workhorse 3D Printer complies with the emissions standards:

1. **AS/NZS CISPR 32:2015**
2. **EN 55032:2015**
3. **EN 61000-3-2:2014**
4. **EN 61000-3-3:2013**

and the immunity standards:

1. **AS/NZS CISPR 24:2013**
2. **EN 55024:2015**

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

End of Report