

Nemko USA, Inc.

2210 Faraday Ave, Suite 150

Carlsbad, CA 92008

Phone (760) 444-3500 Fax (760) 444-3005



# EMC TEST REPORT

*For The*  
*3-Phase Power Supply*

*Model: TPS300024*

Prepared for:  
TDK-Lambda Americas, Inc.  
401 Mile of Cars Way, Suite 325  
San Diego, CA 91950, United States

Testing performed per the following:

FCC Part 15B	EMC Directive 2004/108/EC
The FCC logo is the letters "FCC" in a bold, blue, sans-serif font.	The CE mark logo consists of the letters "C" and "E" in a bold, black, sans-serif font, positioned side-by-side.

PREPARED on 9/11/2015

Revision 1: 3/30/2016

REPORT NUMBER: 2015 092293051 EMC EU R1

PROJECT NUMBER: Q10285384

NEX NUMBER: 306151



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## 2 Document History and Certification

### 2.1 Document History

REVISION	DATE	COMMENTS
-	9/10/2015	Prepared By: William Dey
-	9/17/2015	Initial Release: James Morris
Rev. 1	3/30/2016	Amendment 1: Updated Company address. Amendment 2: Added additional surge testing at 4kV +/- common mode. Rodel Resolme

NOTE: Nemko USA, Inc. hereby makes the following statements so as to conform to the Subclause 5.10 Requirements of ISO/IEC 17025 "General Criteria for the Competence of Testing and Calibration Laboratories":

- The unit described in this report was received at Nemko USA, Inc.'s facilities on 8/31/2015.
- Testing was performed on the unit described in this report on 8/31/2015 to 9/10/2015. Updated testing on 3/30/2016.
- The Test Results reported herein apply only to the Unit actually tested, and to substantially identical Units.
- This report does not imply the endorsement of the Federal Communications Commission (FCC), NVLAP or any other government agency.

This Report is the property of Nemko USA, Inc., and shall not be reproduced, except in full, without prior written approval of Nemko USA, Inc. However, all ownership rights are hereby returned unconditionally to TDK-Lambda Americas, Inc. and approval is hereby granted to TDK-Lambda Americas, Inc. and its employees and agents to reproduce all or part of this report for any legitimate business purpose without further reference to Nemko USA, Inc.

### 2.2 Test Site Accreditation

Nemko USA, Inc. is accredited through National Voluntary Laboratory Accreditation Program.



NVLAP LAB CODE 200116-0

*This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.*

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**2.3 Certification**

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The compatibility testing and this report have been prepared by Nemko USA, Inc., an independent electromagnetic compatibility consulting and test laboratory.

Testing and data collection were accomplished in accordance with the test methods listed in this report.

I certify the data evaluation and equipment configuration herein to be a true and accurate representation of the sample's test characteristics, as of the test date(s), and for the design of the test sample utilized to compile this report.

A handwritten signature in black ink that reads "James E Morris".

James Morris  
EMC Division Manager, Nemko USA, Inc.

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### 3 Administrative Data and Test Summary

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#### 3.1 Administrative Test Data

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CLIENT: TDK-Lambda Americas, Inc.  
401 Mile of Cars Way, Suite 325  
San Diego, CA 91950, United States  
(619) 628-2890

CONTACT: Kenneth Rose  
kenneth.rose@us.tdk-lambda.com

DATE(S) OF TEST: 8/31/2015 to 9/10/2015 & 3/30/2016

EQUIPMENT UNDER TEST (EUT): 3-Phase Power Supply

MODEL: TPS300024

SERIAL NUMBER: 153322024004

SOFTWARE REVISION: N/A

HIGHEST FREQUENCY GENERATED OR USED: 132 kHz

CONDITION UPON RECEIPT: Acceptable

TEST SPECIFICATION: Radio Frequency Emissions per:  
➤ EN 55022: 2010+AC: 2011  
➤ FCC Part 15B.

EMISSIONS CLASS: Class A

Electromagnetic Immunity tests per:  
➤ EN 55024: 2010

Powerline Measurements per:  
➤ EN 61000-3-3: 2013

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### 3.2 Referenced Standards for Radiated Emissions

Test Type	In Accordance with Document	Document Title
Conducted and Radiated Emissions	FCC 15B, Sec. 107, FCC 15B, Sec. 109	Title 47 -- Telecommunications, Federal Communications Commission Part 15 – Radio Frequency Devices
Conducted and Radiated Emissions	EN 55022: 2010+AC: 2011	Information technology equipment—Radio disturbance characteristics —Limits and methods of measurement

### 3.3 Referenced Standards for Powerline Harmonics and Fluctuations

Test Type	Test Standard	Document Title
Power Line Harmonics	EN 61000-3-2: 2006+A1:2009+A2:2009	Electromagnetic Compatibility, Limits for Harmonic Current Emissions, Equipment Input Current < 16A
Power Line Flicker	EN 61000-3-3: 2013	Electromagnetic Compatibility, Limitation of Voltage Fluctuations and Flicker In Low-Voltage Supply Systems for Equipment with Rated Current < 16A

### 3.4 Referenced Standards for Immunity Tests

Test Type	In Accordance with Document EN 55024	Document Title
Electrostatic Discharge	EN 61000-4-2: 2009	Electromagnetic Compatibility—Testing and measurement techniques - Electrostatic discharge immunity test
Radio Frequency	EN 61000-4-3: 2006 +A1:2008 +A2:2010	Electromagnetic Compatibility—Testing and measurement techniques - Radiated radio frequency electromagnetic field immunity test
Electrical Fast Transient Burst	EN 61000-4-4: 2004	Electromagnetic Compatibility—Testing and measurement techniques - Electrical fast transient / burst immunity
Power Line Surge Immunity	EN 61000-4-5: 2006	Electromagnetic Compatibility—Testing and measurement techniques - Surge immunity test
RF Common Mode	EN 61000-4-6: 2009	Electromagnetic Compatibility—Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields
Power Frequency Magnetic Field	EN 61000-4-8: 2010	Electromagnetic Compatibility—Testing and measurement techniques - for Power Frequency Magnetic Field, Immunity Test
Voltage Dips and Short Interruptions	EN 61000-4-11: 2004	Electromagnetic Compatibility—Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests



### 3.5 Test Summary

#### 3.5.1 Emissions Test Summary

The Compliance Status is a judgment based on the calculated highest emissions to appropriate standard limits. Measurement uncertainty values, provided on calibration certificates, were not be used in the judgment of the final status of compliance.

Test Methods	Frequency Range	Compliance Status
FCC 15B, Sec. 107, Class "A" Conducted Emissions	0.15 MHz – 30 MHz	<b>PASS</b>
FCC 15B, Sec. 109, Class "A" Radiated Emissions	30 MHz – 1.0GHz	<b>PASS</b>
EN 55022: 2010+AC: 2011, Class "A" Conducted Emissions	0.15 MHz – 30 MHz	<b>PASS</b>
EN 55022: 2010+AC: 2011, Class "A" Telecom Conducted Emissions	0.15 MHz – 30 MHz	<b>No telecom ports</b>
EN 55022: 2010+AC: 2011, Class "A" Radiated Emissions	30 MHz – 6000 MHz	<b>PASS</b>

#### 3.5.2 Power Line Measurements Test Summary

Test Methods	Measurement Range	Compliance Status
EN 61000-3-2: 2006+A1:2009+A2:2009 Power Line Harmonics	up to the 40 <sup>th</sup> Harmonic	<b>Not Evaluated</b>
EN 61000-3-3: 2013 Power Line Flicker	Voltage Change $d_{max}$ shall not exceed 4%; Value of $d(t)$ shall not exceed 3.3% for more than 500 ms	<b>PASS</b>

### 3.6 Device Performance Criteria for Immunity Tests

**Criterion A** - The equipment shall continue to operate as intended without operator intervention. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer when the equipment is used as intended. The performance level may be replaced by a permissible loss of performance. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and by what the user may reasonably expect from the equipment if used as intended.

**Criterion B** - During the test, degradation of performance is allowed. However, no change of operating state or stored data is allowed to persist after the test. After the test, the equipment shall continue to operate as intended without operator intervention. The performance level may be replaced by a permissible loss of performance. If the manufacturer does not specify the minimal performance level (or the permissible performance loss), then either of these may be derived from the product description and documentation, or by what the user may reasonably expect from the equipment if used as intended.

**Criterion C** - Loss of function is allowed, provided the function is self-recoverable, or can be restored by the operation of the controls by the user in accordance with the manufacturer's instructions. Functions, and/or information stored in non-volatile memory, or protected by a battery backup, shall not be lost.

For each test method, the test standard specifies the appropriate criterion to be met.

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3.6.1 Immunity Test Summary

Test Methods	Minimum Criterion Level Required as per EN 55024	Criterion Level Tested	Compliance Status
IEC 61000-4-2: 2008 ESD Immunity	<b>Criterion B</b> ±8 kV air discharge, ±4 kV contact discharge	<b>Criterion B</b> ±8 kV Air Discharge, ±4 kV Contact Discharge	<b>PASS</b>
IEC 61000-4-3: 2006 A1:2007 +A2: 2010 Radio Frequency Immunity	<b>Criterion A</b> 3 V/m from 80-1000 MHz (80% AM at 1kHz)	<b>Criterion A</b> 3 V/m from 80-1000 MHz (80% AM at 1kHz)	<b>PASS</b>
IEC 61000-4-4: 2011 Electrical Fast Transient Immunity	<b>Criterion B</b> Power line pulses of ± 1 kV; I/O line pulses of ± 0.5 kV	<b>Criterion B</b> Power line pulses of ± 1 kV; I/O line pulses of ± 0.5 kV	<b>PASS</b>
IEC 61000-4-5: 2005 Surge Immunity	<b>Criterion B</b> ±2kV common mode, ±1kV differential mode	<b>Criterion B</b> ±4kV common mode, ±2kV differential mode	<b>PASS</b>
IEC 61000-4-6:2013 RF Common Mode Immunity	<b>Criterion A</b> 150 kHz - 80 MHz at 3 Vrms 1 kHz 80% amplitude modulated	<b>Criterion A</b> 150 kHz - 80 MHz at 3 Vrms 1 kHz 80% amplitude modulated	<b>PASS</b>
IEC 61000-4-8: 2009 Power Frequency Magnetic Field	<b>Criterion A</b> Inductive loop at 50 Hz, to 1.0 amps (rms) per meter	<b>Criterion A</b> Inductive loop at 50 Hz, to 1.0 amps (rms) per meter	<b>PASS</b>
IEC 61000-4-11: 2004 Voltage Dips and Short Interruptions	<b>Criterion B and C</b> Voltage Dips of 30% and >95%; Interruptions of >95%.	<b>Criterion B and C</b> Voltage Dips of 30% and >95%; Interruptions of >95%.	<b>PASS</b>

Refer to the test results section for further details.

## 4 SYSTEM CONFIGURATION

### 4.1 System Components and Power Cables

Device	Manufacturer	Length
	Model	Shield?/# of Cond/Guage
	SN	Connector type
EUT - 3 phase power supply	TDK-Lambda Americas, Inc.	2 meters
	TPS300024	unshielded / 4 wire / 10 AWG
	153322024004	IEC Connector
Support - Mixed Signal Oscilloscope	Tektronix	1.8 meters
	MSO2024	unshielded / 3 wire / 18 AWG
	C010904	IEC Connector
Support - Multimeter	Fluke	1.8 meters
	45 Dual Display Multimeter	unshielded / 3 wire / 18 AWG
	5455010	IEC Connector
Support - Resistive Load (0.2 ohms)	N/A	N/A
	N/A	N/A
	N/A	N/A
Support - Voltage Probe	Tektronix	1.6 meters
	P2221	unshielded / 2 wire / 22 AWG
	N/A	BNC Connector

### 4.2 Device Interconnection and I/O Cables

FROM DEVICE	TO DEVICE	CABLE DESCRIPTION
EUT - 3 phase power supply	Support - Resistive Load	2 wire, DC output cables, 2 AWG, 1.3 meters
EUT - 3 phase power supply	Support - Multimeter	2 wire, banana jack, 16 AWG
EUT - 3 phase power supply	Support - Mixed Signal Oscilloscope	2 wire, voltage probe, BNC Cable

### 4.3 Description and Method of Exercising the EUT

The TPS300024 (EUT) is a 3 phase power supply. The function of the EUT is to provide a DC output voltage. The EUT was exercised in normal operation with an output voltage of 24 Volts DC at 3000 Watts. A change in state as indicated by a monitored DC output as displayed on the support oscilloscope or support Multimeter during immunity testing may indicate a failure. The EUT has no reported firmware/software program.

The EUT's performance during test was evaluated against the performance criterion specified by applicable test standards. Performance results are detailed in the test results section of this report.

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### 4.4 Design Modifications for Compliance

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Device: 3-Phase Power Supply

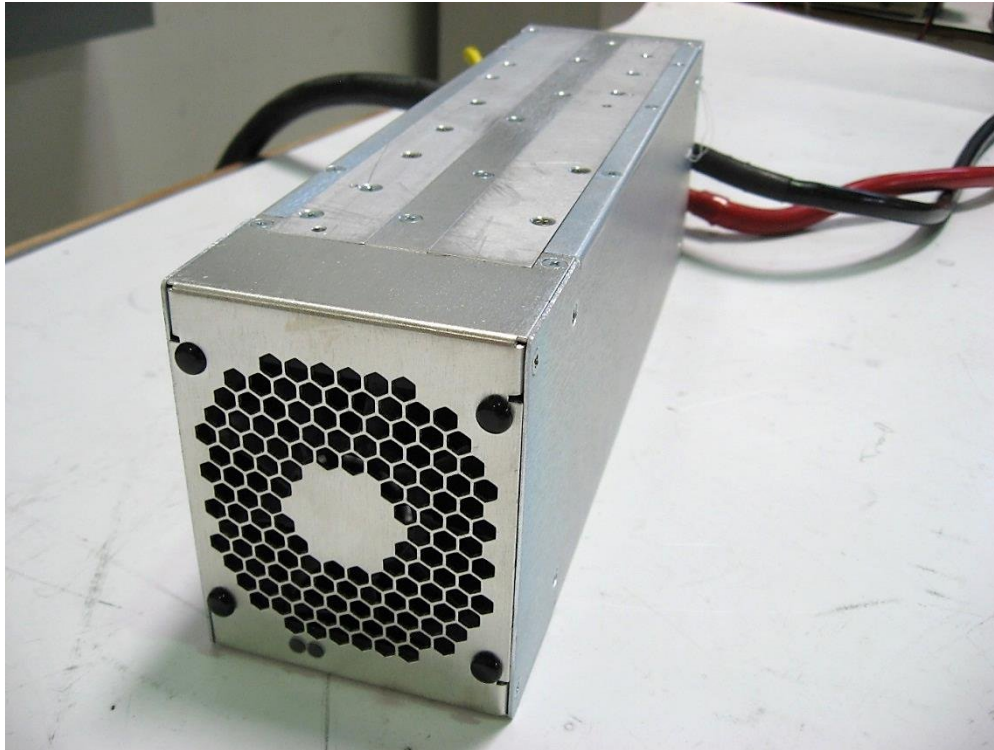
Model: TPS300024

The following design modifications were made to the EUT during testing.

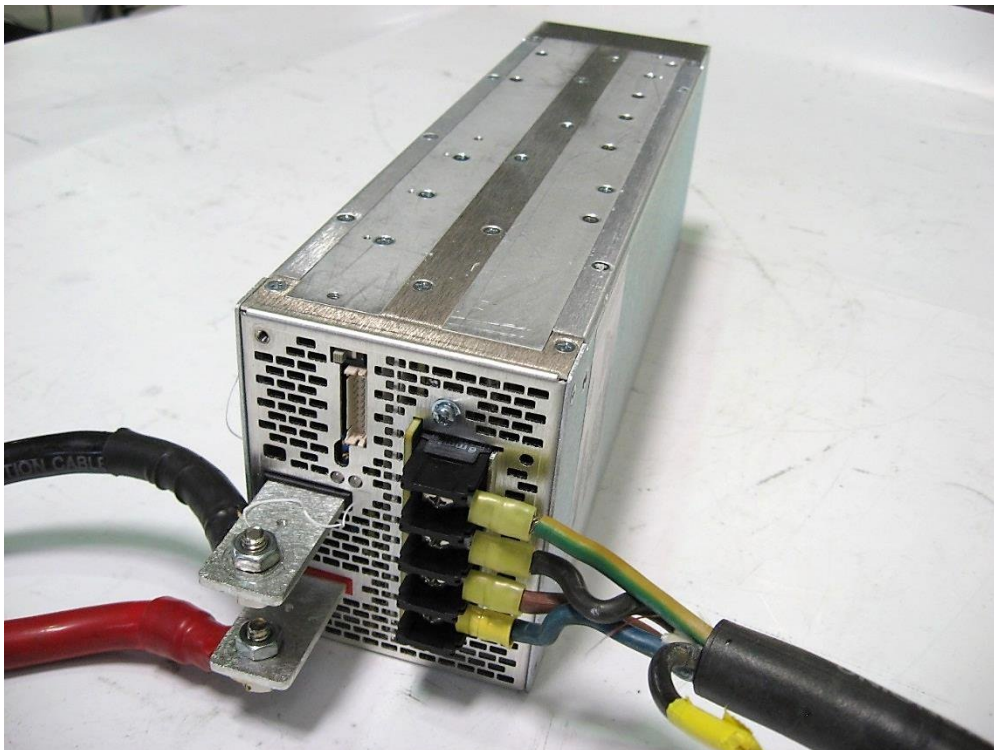
None. No design modifications were made to the EUT during testing.

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#### 4.4.1 Front of EUT



#### 4.4.2 Rear of EUT



## Nemko USA, Inc.

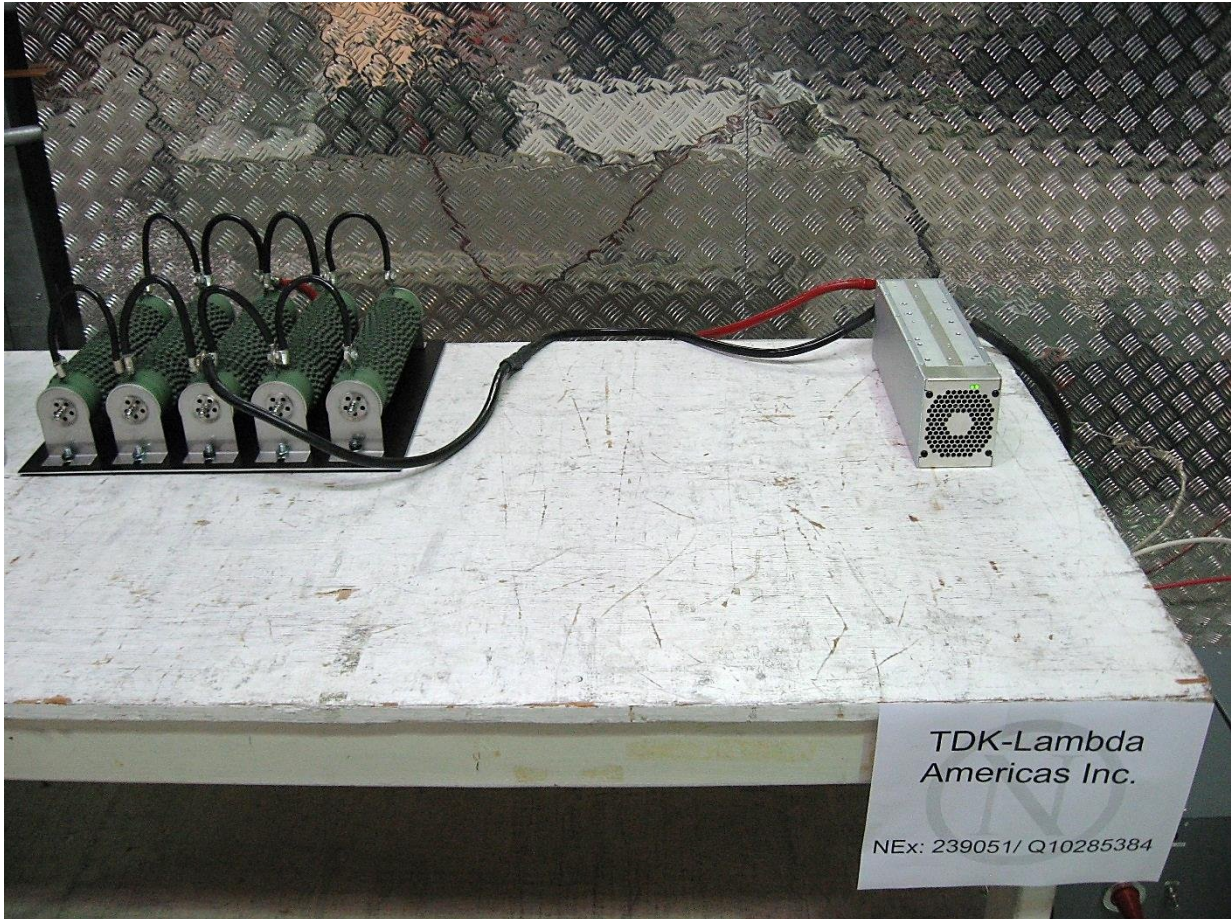
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### 4.4.3 Configuration of the EUT



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## 5 Description of Test Site

### 5.1 Description of Test Site

The test site is located at 2210 Faraday Ave., Suite 150, Carlsbad, CA 92008. Radiated emissions measurements are performed in the 10 meter Semi-Anechoic chamber, which conforms to the volumetric normalized site attenuation (VNSA) for three and ten-meter measurements. The chamber also conforms to the SVSWR compliance requirements for 1-18 GHz measurements. The VNSA and SVSWR meet the technical requirements, as set, in the CISPR 16 and ANSI C63.4 documents. Facility test areas for conducted emissions and immunity testing also meet the construction and characteristics, as required by CISPR 16 and ANSI C63.4 documents.

Emissions measurements are performed using TILE software. Version 4.0.A.7 for radiated and version 3.4.K.24 for conducted.

### 5.2 Test Site Registrations

Organization	Registration and Recognition numbers
Federal Communications Commission	392943 / US5058
Industry Canada	2040B-3
VCCI	A-0217
Korean Ministry (APEC Tel MRA)	US0088

*This report does not imply the endorsement of the recognizing organizations or any other government agency.*



# Nemko USA, Inc.

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## 5.3 Equipment List

Nemko ID	Device	Manufacturer	Model	Serial Number	Cal Date	Cal Due Date
<b>Conducted Emissions</b>						
815	Multimeter	Fluke	111	78130066	11/14/2014	11/14/2015
E1044	Temp Humidity Meter	Davis Instruments	7400	PE80513A01	1/29/2015	1/29/2016
E1017	9kHz to 7GHz Spectrum Analyzer	Rohde & Schwarz	FSP7	839337/0022	11/3/2014	11/3/2015
Rental Equip	LISN	FCC	FISC-LISN-50-100-1-02	100555	2/2/2015	2/2/2016
Rental Equip	LISN	FCC	FISC-LISN-50-100-1-02	130309	2/2/2015	2/2/2016
Rental Equip	LISN	FCC	FISC-LISN-50-100-1-02	9666	7/29/2015	7/29/2016
<b>Radiated Emissions</b>						
815	Multimeter	Fluke	111	78130066	11/14/2014	11/14/2015
E1044	Temp Humidity Meter	Davis Instruments	7400	PE80513A01	1/29/2015	1/29/2016
901	Preamplifier	Sonoma	310 N	130607	1/7/2015	1/7/2016
E1064	Spectrum Analyzer	Agilent	E4440A	US42221762	12/22/2014	12/22/2015
D1480	Antenna, Bilog	Schaffner-Chase	CBL6111C	2572	5/18/2015	5/18/2016
<b>Power Line</b>						
815	Multimeter	Fluke	111	78130066	11/14/2014	11/14/2015
E1044	Temp Humidity Meter	Davis Instruments	7400	PE80513A01	1/29/2015	1/29/2016
D1851	Power Source Analyzer IX Series	California Instruments/Ametek	9003ix	59380(master)	7/2/2015	7/2/2016
<b>-2, Electrostatic Discharge</b>						
815	Multimeter	Fluke	111	78130066	11/14/2014	11/14/2015
E1044	Temp Humidity Meter	Davis Instruments	7400	PE80513A01	1/29/2015	1/29/2016
Rental 13746	ESD simulator	Teseq	NSG 438	1263	3/19/2015	3/19/2016
<b>-3, Radio Frequency</b>						
815	Multimeter	Fluke	111	78130066	11/14/2014	11/14/2015
E1044	Temp Humidity Meter	Davis Instruments	7400	PE80513A01	1/29/2015	1/29/2016
740	RF Amplifier	Amplifier Research	500W1000M5 (80 to 1000MHz)	23680	NCR	NCR
D1818	Antenna, Biconical, high power	TDK RF Solutions	HBA-2030	130496	NCR	NCR
350	Antenna	Electrometrics	RGA-30	114	NCR	NCR
751	Signal Generator	HP	8642B	3034A03286	11/20/2014	11/20/2016
932	Signal Generator	Hewlett-Packard	8673C	2822A00556	2/17/2015	2/17/2016
<b>-4, Electrical Fast/Burst</b>						
815	Multimeter	Fluke	111	78130066	11/14/2014	11/14/2015
E1044	Temp Humidity Meter	Davis Instruments	7400	PE80513A01	1/29/2015	1/29/2016
Rental Equip	6.6KV Conducted Immunity Generator	Teseq	NSG 3060	1291	8/7/2014	11/21/2015
Rental Equip	Coupling Network 3-ph	Teseq	CDN 3063	32	11/24/2014	11/24/2015
<b>-5, Power Line Surge</b>						
815	Multimeter	Fluke	111	78130066	11/14/2014	11/14/2015
E1044	Temp Humidity Meter	Davis Instruments	7400	PE80513A01	1/29/2015	1/29/2016
Rental Equip	6.6KV Conducted Immunity Generator	Teseq	NSG 3060	1291	8/7/2014	11/21/2015
Rental Equip	Coupling Network 3-ph	Teseq	CDN 3063	32	11/24/2014	11/24/2015
<b>-6, RF Conducted Disturbance</b>						
815	Multimeter	Fluke	111	78130066	11/14/2014	11/14/2015
E1044	Temp Humidity Meter	Davis Instruments	7400	PE80513A01	1/29/2015	1/29/2016
629	CDN	FCC	FCC-801-M5-25	97-01	4/27/2015	4/27/2016
846	CDN	FCC	FCC-801-M3-25A	5015	10/13/2014	10/13/2015
436	Current Injection Probe	Solar Electronics Co.	9144 1N (10kHz to 100MHz)	935717	NCR	NCR
913	RF Amplifier	EIN	3100L	103	NCR	NCR
751	Signal Generator	HP	8642B	3034A03286	11/20/2014	11/20/2016
<b>-8, Power Frequency; Magnetic</b>						
815	Multimeter	Fluke	111	78130066	11/14/2014	11/14/2015
E1044	Temp Humidity Meter	Davis Instruments	7400	PE80513A01	1/29/2015	1/29/2016
851	Exposure Level Tester	Narda	ELT-400	F-0011	2/16/2015	2/16/2016
852	Magnetic Field Probe	Narda	B-field sensor	F-0012	2/16/2015	2/16/2016
E1036	Large Magnetic Coil	Nemko	N/A	N/A	NCR	NCR
962	AC Power Source	Teseq	NSG 1007-5-208	58962	7/2/2015	7/2/2016
<b>-11, Voltage Dips</b>						
815	Multimeter	Fluke	111	78130066	11/14/2014	11/14/2015
E1044	Temp Humidity Meter	Davis Instruments	7400	PE80513A01	1/29/2015	1/29/2016
D1851	Power Source Analyzer IX Series	California Instruments/Ametek	9003ix	59380(master)	7/2/2015	7/2/2016

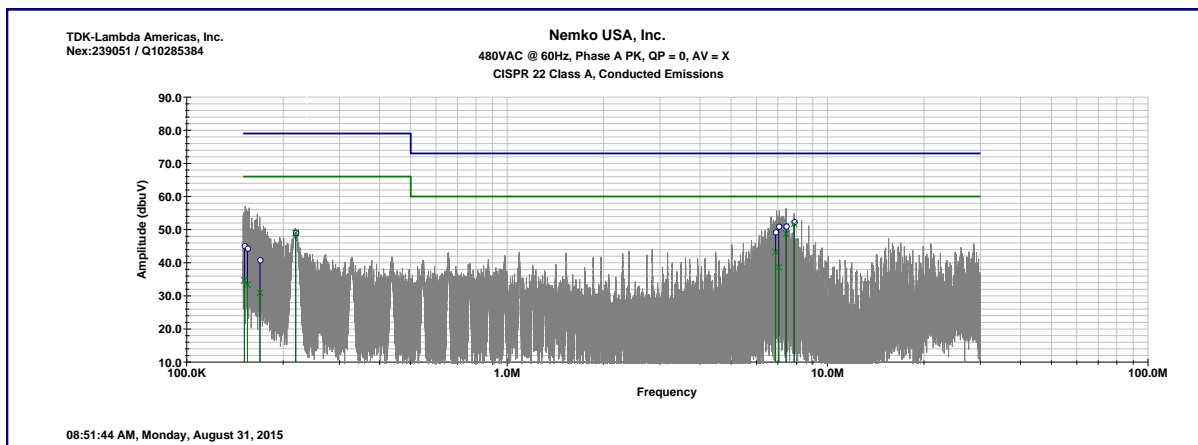
## 6 Test Results

### 6.1 Conducted Emissions

This test measures the levels emanating from the EUT into the AC Mains, evaluating the potential for the EUT to cause radio frequency interference to other electronic devices. The description of the tests, the test methods, and the test set-ups are given in the standards referenced in the test summary section of this report. The EUT was configured based upon the requirements of the applicable test standard.

#### 6.1.1 Conducted Emissions, Phase A

Client	TDK-Lambda Americas, Inc.		
NEx #	293051	Temperature	23 °C
EUT Name	3-Phase Power Supply	Humidity	60 %
EUT Model	TPS300024	Pressure	100.3 kPa
Governing Doc	EN 55022	Test Location	Ground Plane 3
Basic Standard	IEC/CISPR 22	Test Engineer	William Dey
Test Voltage	477V/60Hz 3 Phase	Date	8/31/2015



Frequency (kHz)	Measured (dBµV)		Limit (dBµV)		Margin (dB)		Result
	Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average	
151.361	45.1	34.7	79	66	-33.9	-31.3	Pass
154.803	44.4	33.4	79	66	-34.6	-32.6	Pass
169.26	40.9	30.9	79	66	-38.1	-35.1	Pass
218.87	49.1	49	79	66	-29.9	-17	Pass
6880.19	49.3	43.3	73	60	-23.7	-16.7	Pass
7037.2	51	38.6	73	60	-22	-21.4	Pass
7420.44	51	48.8	73	60	-22	-11.2	Pass
7859.43	52.4	51.7	73	60	-20.6	-8.3	Pass

Compliance			
Compliant?	Yes	Additional Comments	N/A

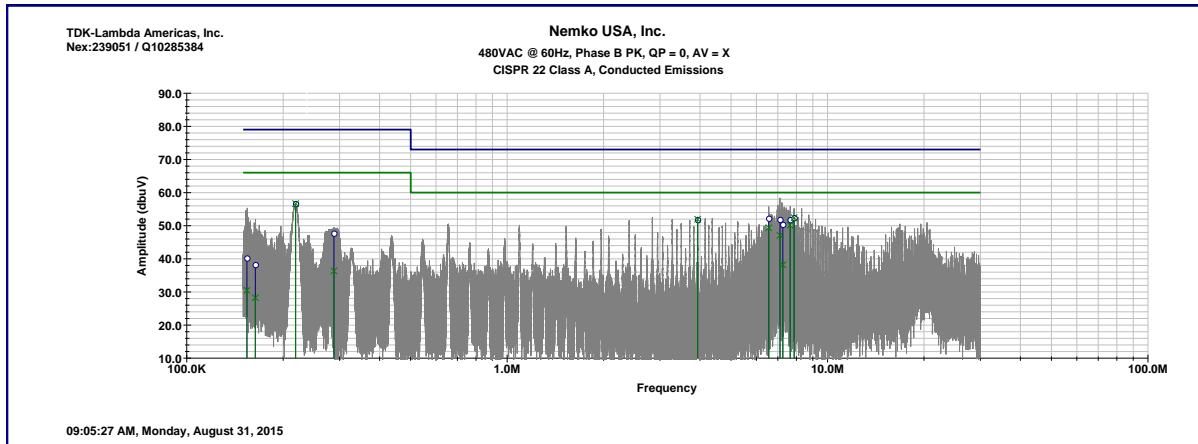
# Nemko USA, Inc.

2210 Faraday Ave, Suite 150  
 Carlsbad, CA 92008  
 Phone (760) 444-3500 Fax (760) 444-3005



## 6.1.2 Conducted Emissions, Phase B

Client	TDK-Lambda Americas, Inc.		
NEx #	293051	Temperature	23 °C
EUT Name	3-Phase Power Supply	Humidity	60 %
EUT Model	TPS300024	Pressure	100.3 kPa
Governing Doc	EN 55022	Test Location	Ground Plane 3
Basic Standard	IEC/CISPR 22	Test Engineer	William Dey
Test Voltage	477V/60Hz 3 Phase	Date	8/31/2015



Frequency (kHz)	Measured (dBµV)		Limit (dBµV)		Margin (dB)		Result
	Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average	
154.161	40.2	30.5	79	66	-38.8	-35.5	Pass
163.783	38.2	28.2	79	66	-40.8	-37.8	Pass
218.668	56.6	56.7	79	66	-22.4	-9.3	Pass
288.085	47.7	36.3	79	66	-31.3	-29.7	Pass
3930.45	51.8	51.9	73	60	-21.2	-8.1	Pass
6551.49	52.2	49.4	73	60	-20.8	-10.6	Pass
7100.03	51.8	47.1	73	60	-21.2	-12.9	Pass
7245.72	50.4	38.2	73	60	-22.6	-21.8	Pass
7643.6	51.8	50.1	73	60	-21.2	-9.9	Pass
7862.29	52.4	52.4	73	60	-20.6	-7.6	Pass

Compliance			
Compliant?	Yes	Additional Comments	N/A

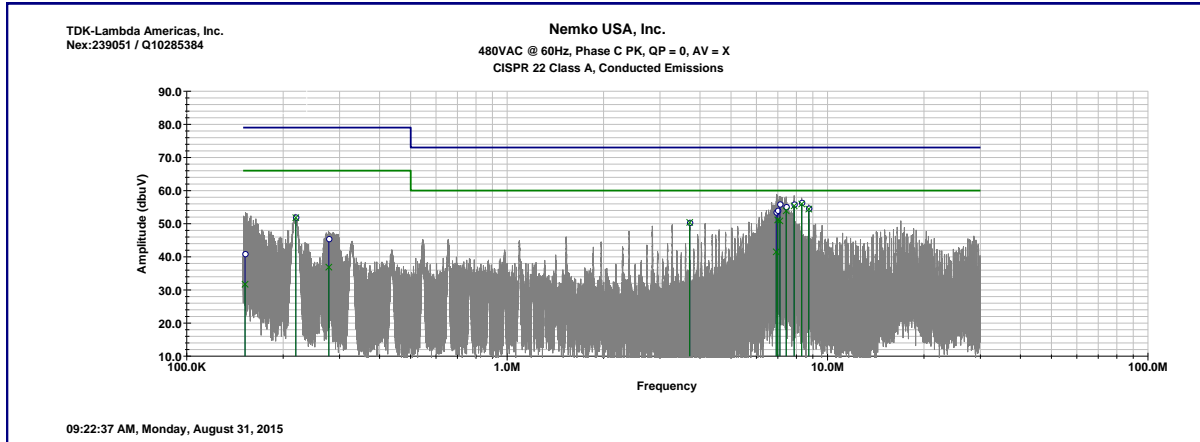
# Nemko USA, Inc.

2210 Faraday Ave, Suite 150  
 Carlsbad, CA 92008  
 Phone (760) 444-3500 Fax (760) 444-3005



## 6.1.3 Conducted Emissions, Phase C

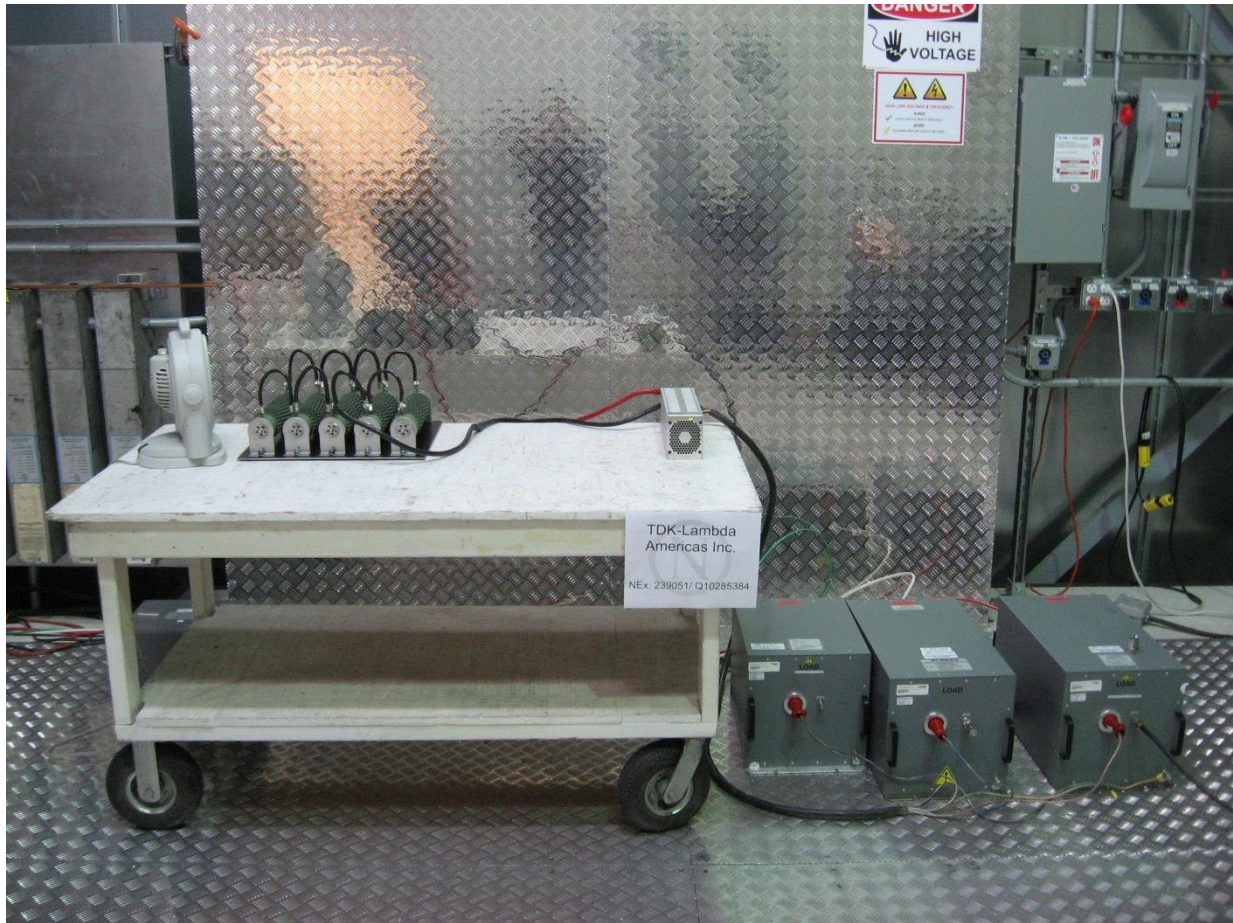
Client	TDK-Lambda Americas, Inc.		
NEx #	293051	Temperature	23 °C
EUT Name	3-Phase Power Supply	Humidity	60 %
EUT Model	TPS300024	Pressure	100.3 kPa
Governing Doc	EN 55022	Test Location	Ground Plane 3
Basic Standard	IEC/CISPR 22	Test Engineer	William Dey
Test Voltage	477V/60Hz 3 Phase	Date	8/31/2015



Frequency (kHz)	Measured (dBµV)		Limit (dBµV)		Margin (dB)		Result
	Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average	
152.098	40.9	31.7	79	66	-38.1	-34.3	Pass
219.038	51.9	51.8	79	66	-27.1	-14.2	Pass
277.711	45.4	36.9	79	66	-33.6	-29.1	Pass
3712	50.4	50.4	73	60	-22.6	-9.6	Pass
6909.86	53.5	41.5	73	60	-19.5	-18.5	Pass
6988.83	54	51.1	73	60	-19	-8.9	Pass
7095.54	55.9	50.8	73	60	-17.1	-9.2	Pass
7425.93	55.1	53.9	73	60	-17.9	-6.1	Pass
7861.4	55.9	55.4	73	60	-17.1	-4.6	Pass
8297.89	56.4	56	73	60	-16.6	-4	Pass
8734.13	54.7	54.4	73	60	-18.3	-5.6	Pass

Compliance			
Compliant?	Yes	Additional Comments	N/A

6.1.4 Reference Photos



Conducted Emissions Test Configuration Photograph

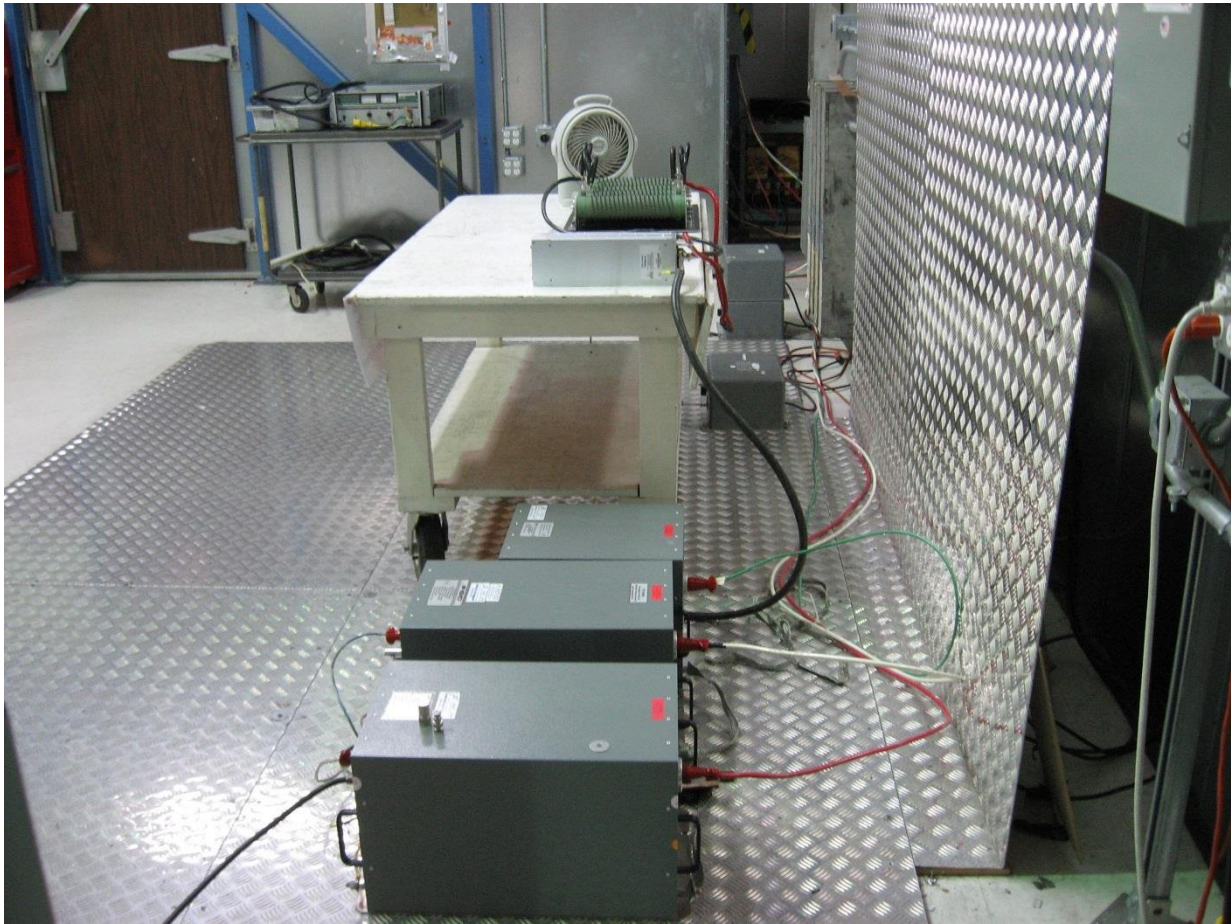
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Carlsbad, CA 92008

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Conducted Emissions Test Configuration Photograph

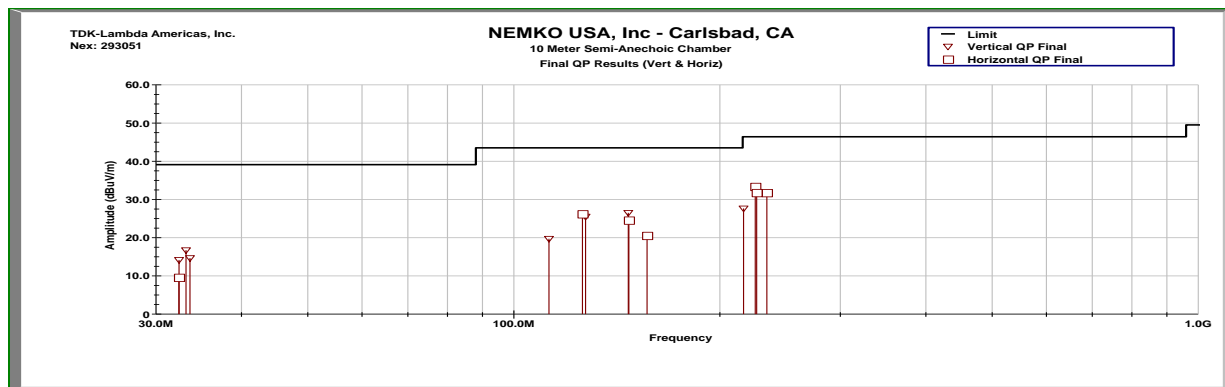
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## 6.2 Radiated Emissions

This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices. Measurement methods were used in accordance with the test standard(s) referenced in the test summary section of this report.

### 6.2.1 Radiated Emissions, <1GHz

Client	TDK-Lambda Americas, Inc.			
NEx #	293051	Temperature	23	°C
EUT Name	3-Phase Power Supply	Humidity	60	%
EUT Model	TPS300024	Pressure	100.3	kPa
Governing Doc	FCC, Part 15 B	Test Location	10 Meter Chamber	
Basic Standard	ANSI C63.4	Test Engineer	William Dey	
Test Voltage	477V/60Hz 3 Phase	Date	8/31/2015	



#### VERTICAL

Frequency (MHz)	Quasi-Peak Measured	Quasi-Peak Adjustments	Turn Table (degrees)	Antenna Height (cm)	Corrected Reading	Limit (dB $\mu$ V/m)	Margin (dB)	Result
32.415	28.07	-13.91	1	245	14.16	39.1	-24.94	Pass
33.193	31.09	-14.37	1	245	16.72	39.1	-22.38	Pass
33.634	29.29	-14.63	1	245	14.66	39.1	-24.44	Pass
112.556	39.85	-20.14	1	245	19.72	43.5	-23.78	Pass
127.308	44.53	-19.01	45	154	25.52	43.5	-17.98	Pass
146.962	45.91	-19.42	145	197	26.5	43.5	-17	Pass
216.567	48.82	-21.19	1	146	27.64	46.4	-18.76	Pass

#### HORIZONTAL

Frequency (MHz)	Quasi-Peak Measured	Quasi-Peak Adjustments	Turn Table (degrees)	Antenna Height (cm)	Corrected Reading	Limit (dB $\mu$ V/m)	Margin (dB)	Result
32.4111	23.49	-13.91	179	246	9.58	39.1	-29.52	Pass
125.985	45.26	-19.06	21	346	26.21	43.5	-17.29	Pass
147.26	43.98	-19.41	89	345	24.57	43.5	-18.93	Pass
156.564	40.36	-19.81	179	246	20.56	43.5	-22.94	Pass
225.263	53.88	-20.5	45	346	33.38	46.4	-13.02	Pass
226.391	52.13	-20.36	45	346	31.77	46.4	-14.63	Pass
234.246	51.31	-19.55	45	346	31.76	46.4	-14.64	Pass

#### Compliance

Compliant?	Yes	Additional Comments	N/A
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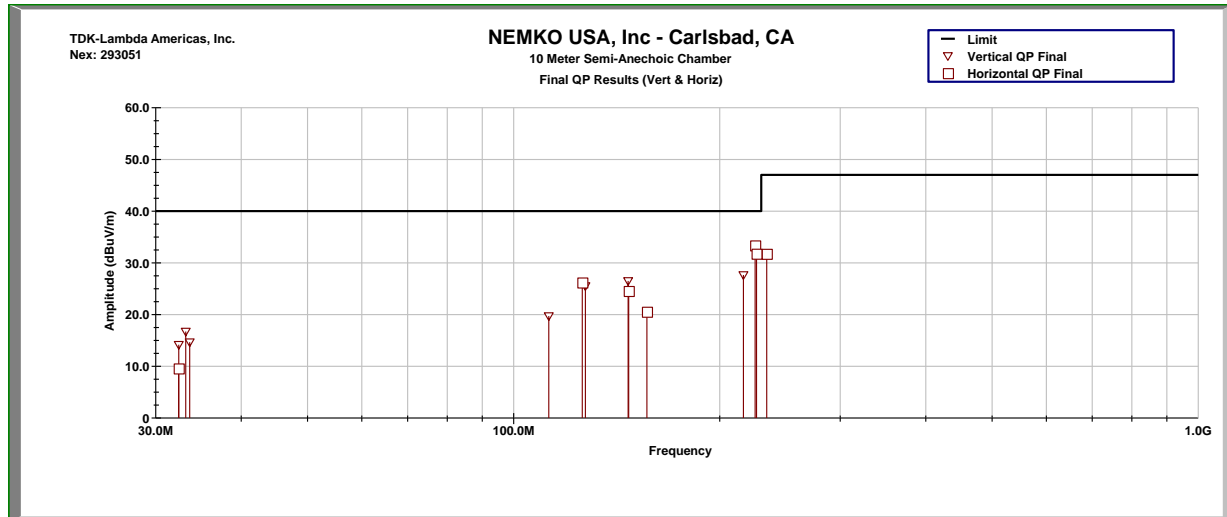
# Nemko USA, Inc.

2210 Faraday Ave, Suite 150  
 Carlsbad, CA 92008  
 Phone (760) 444-3500 Fax (760) 444-3005



## 6.2.2 Radiated Emissions, <1GHz

Client	TDK-Lambda Americas, Inc.		
NEx #	293051	Temperature	23 °C
EUT Name	3-Phase Power Supply	Humidity	60 %
EUT Model	TPS300024	Pressure	100.3 kPa
Governing Doc	EN 55022	Test Location	10 Meter Chamber
Basic Standard	IEC/CISPR 22	Test Engineer	William Dey
Test Voltage	477V/60Hz 3 Phase	Date	8/31/2015



### VERTICAL

Frequency (MHz)	Quasi-Peak Measured	Quasi-Peak Adjustments	Turn Table (degrees)	Antenna Height (cm)	Corrected Reading	Limit (dBµV/m)	Margin (dB)	Result
32.415	28.07	-13.91	1	245	14.16	40	-25.84	Pass
33.193	31.09	-14.37	1	245	16.72	40	-23.28	Pass
33.634	29.29	-14.63	1	245	14.66	40	-25.34	Pass
112.556	39.85	-20.14	1	245	19.72	40	-20.28	Pass
127.308	44.53	-19.01	45	154	25.52	40	-14.48	Pass
146.962	45.91	-19.42	145	197	26.5	40	-13.5	Pass
216.567	48.82	-21.19	1	146	27.64	40	-12.36	Pass

### HORIZONTAL

Frequency (MHz)	Quasi-Peak Measured	Quasi-Peak Adjustments	Turn Table (degrees)	Antenna Height (cm)	Corrected Reading	Limit (dBµV/m)	Margin (dB)	Result
32.4111	23.49	-13.91	179	246	9.58	40	-30.42	Pass
125.985	45.26	-19.06	21	346	26.21	40	-13.79	Pass
147.26	43.98	-19.41	89	345	24.57	40	-15.43	Pass
156.564	40.36	-19.81	179	246	20.56	40	-19.44	Pass
225.263	53.88	-20.5	45	346	33.38	40	-6.62	Pass
226.391	52.13	-20.36	45	346	31.77	40	-8.23	Pass
234.246	51.31	-19.55	45	346	31.76	47	-15.24	Pass

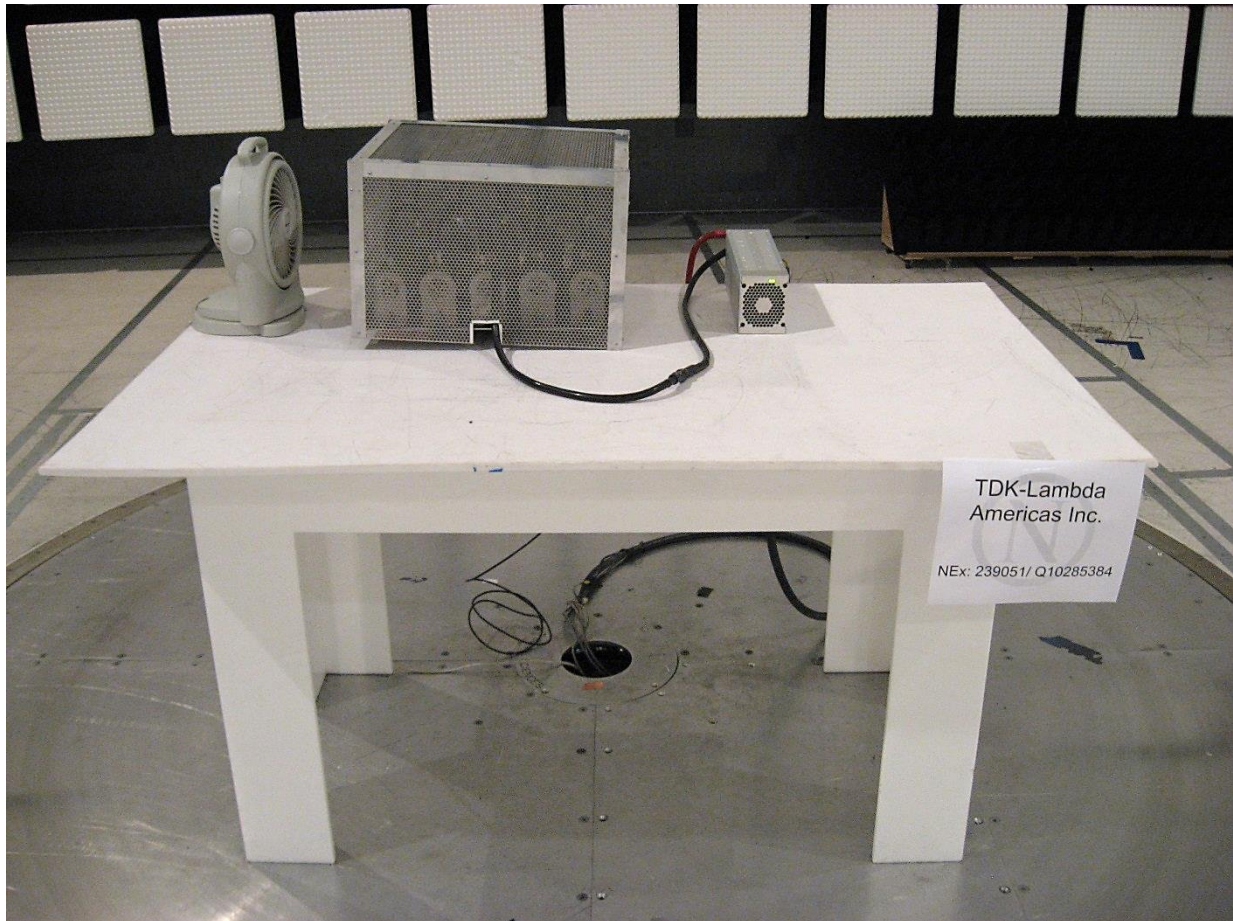
### Compliance

Compliant?	Yes	Additional Comments	N/A
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### 6.2.3 Reference Photos



Radiated Emissions Test Configuration Photograph

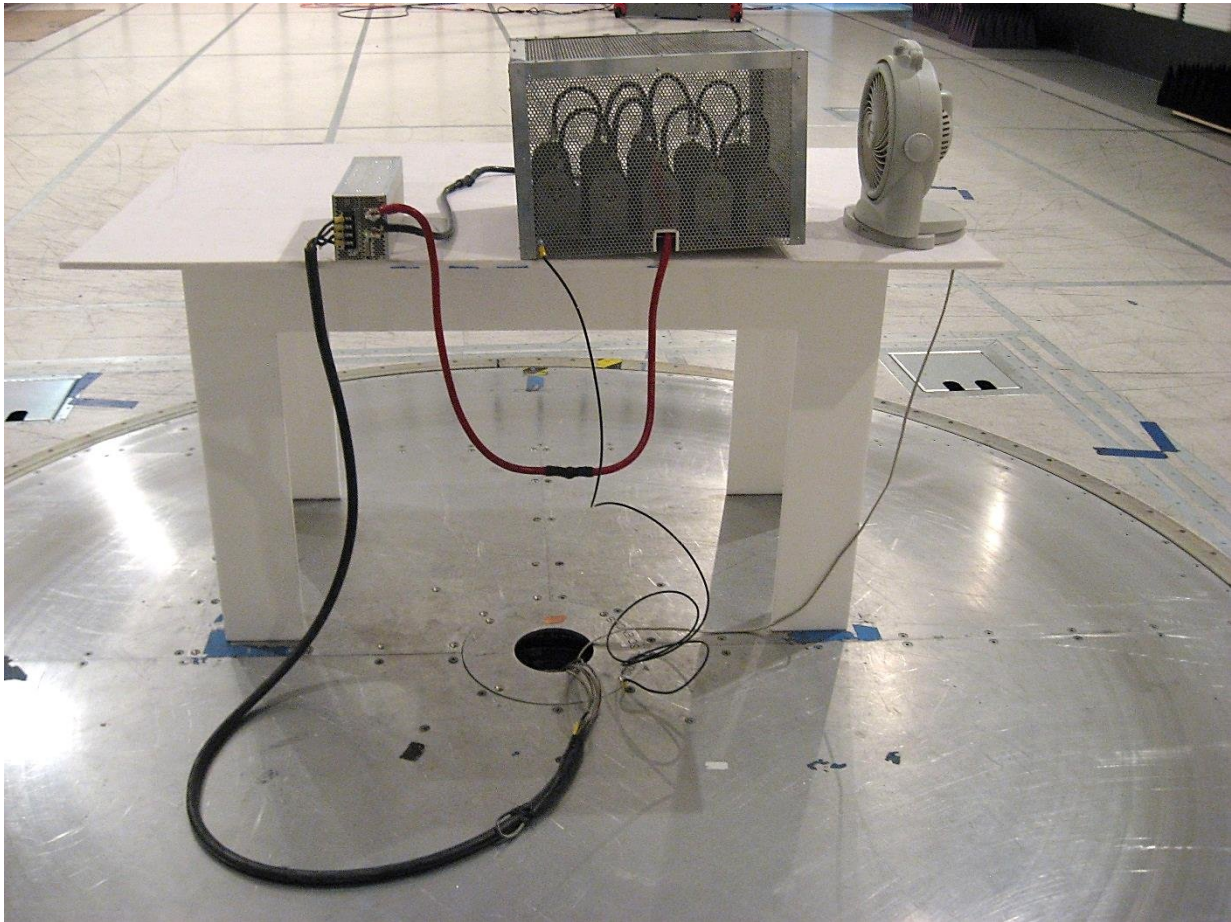
DATE	DOCUMENT NAME	DOCUMENT #	PAGE
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**Nemko USA, Inc.**

2210 Faraday Ave, Suite 150

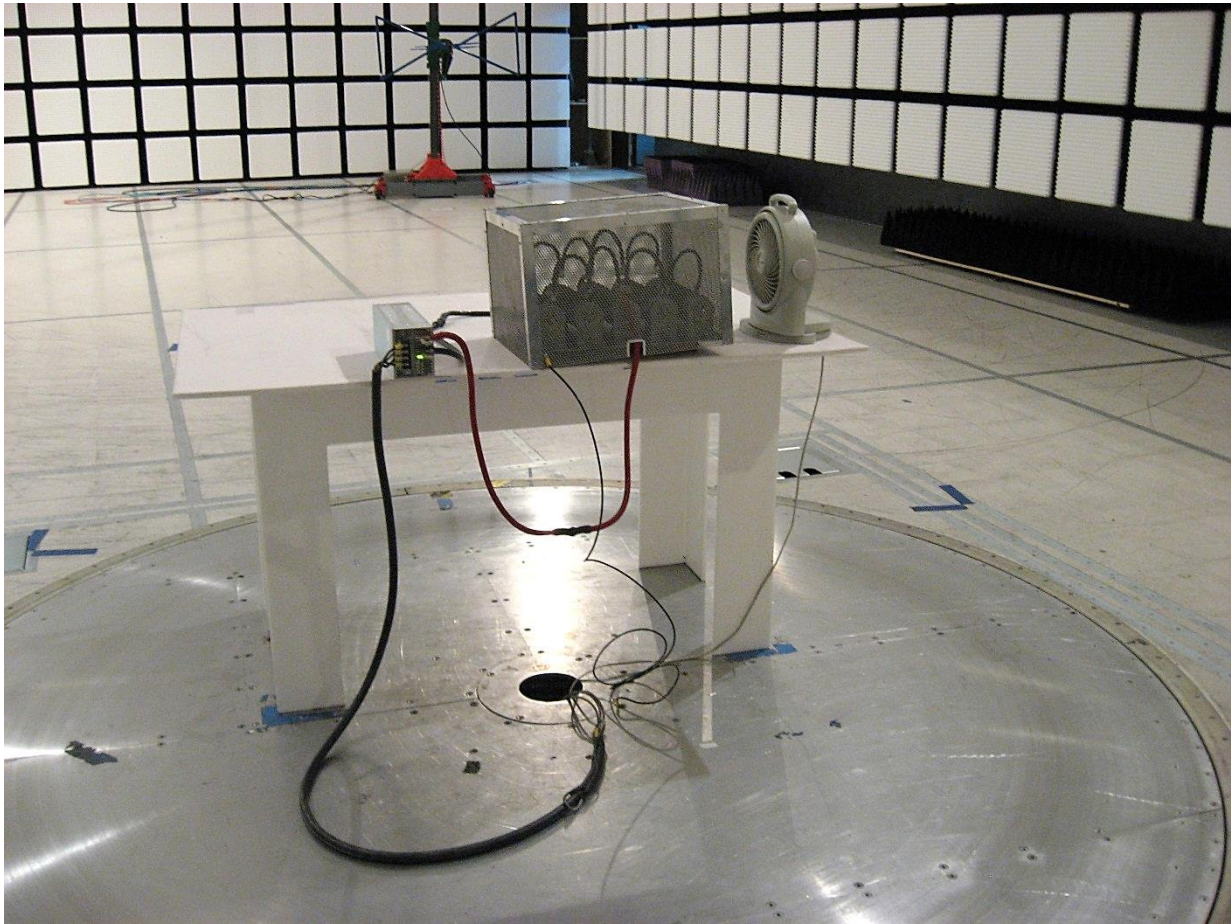
Carlsbad, CA 92008

Phone (760) 444-3500 Fax (760) 444-3005



Radiated Emissions Test Configuration Photograph

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Radiated Emissions Test Configuration Photograph

6.2.4 Power Line Flicker

Flicker Test Summary per EN/IEC61000-3-3 (Phase A-Run time)

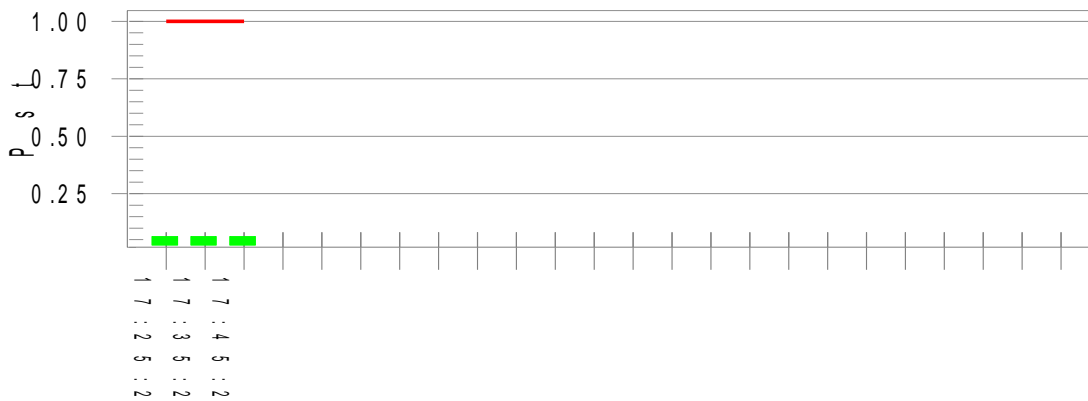
EUT: TPS300024  
 Test category: All parameters (European limits)  
 Test date: 9/2/2015 Start time: 5:15:04 PM  
 Test duration (min): 30 Data file name: F-000511.cts\_data  
 Comment: NEx: 293051  
 Customer: TDK-Lambda Americas, Inc.

Tested by: W. Dey  
 Test Margin: 100  
 End time: 5:45:27 PM

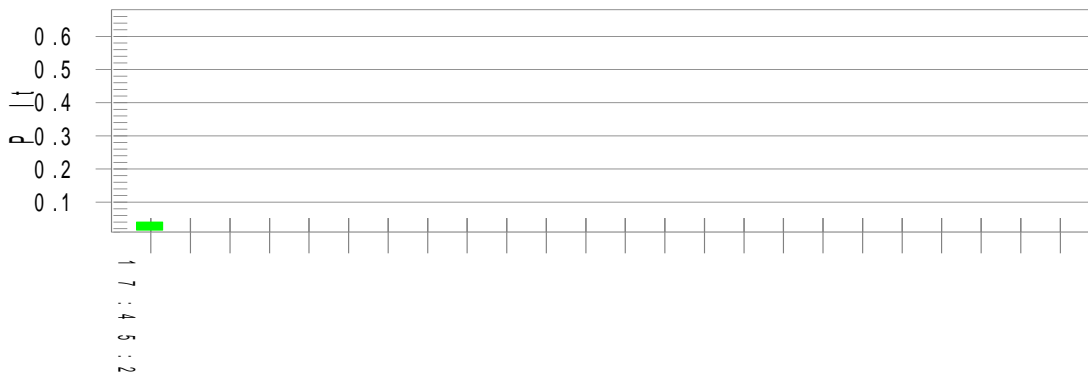
Test Result: Pass Status: Test Completed

Pstj and limit line

European Limits



Plt and limit line



Parameter values recorded during the test:

Vrms at the end of test (Volt):	276.06		
Highest dt (%):	0.00	Test limit (%):	3.30 Pass
Time(mS) > dt:	0.0	Test limit (mS):	500.0 Pass
Highest dc (%):	0.00	Test limit (%):	3.30 Pass
Highest dmax (%):	0.00	Test limit (%):	4.00 Pass
Highest Pst (10 min. period):	0.064	Test limit:	1.000 Pass
Highest Plt (2 hr. period):	0.040	Test limit:	0.650 Pass

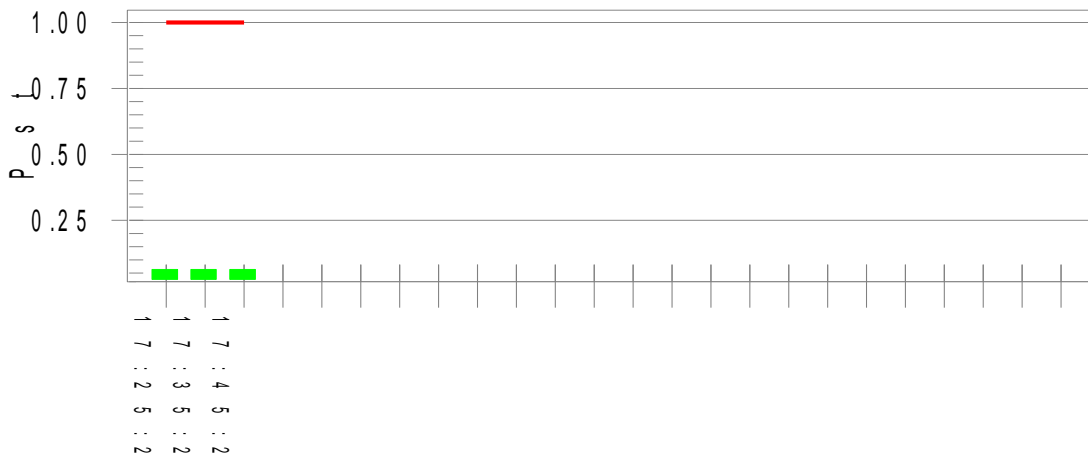
### Flicker Test Summary per EN/IEC61000-3-3 (Phase B-Run time)

EUT: TPS300024	Tested by: W. Dey
Test category: All parameters (European limits)	Test Margin: 100
Test date: 9/2/2015	Start time: 5:15:04 PM
Test duration (min): 30	End time: 5:45:27 PM
Comment: NEx: 293051	Data file name: F-000511.cts_data
Customer: TDK-Lambda Americas, Inc.	

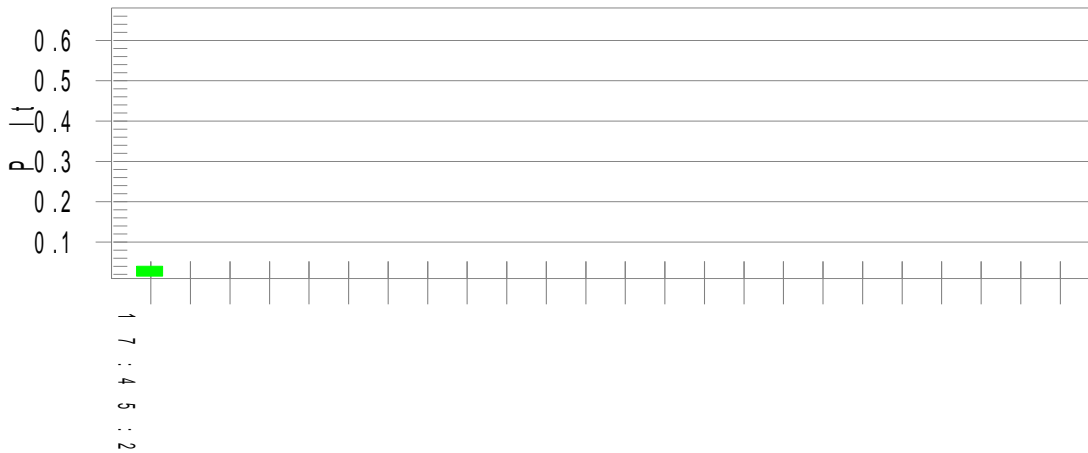
Test Result: Pass  
Pstj and limit line

Status: Test Completed

European Limits



Plt and limit line



Parameter values recorded during the test:

Vrms at the end of test (Volt):	276.16		
Highest dt (%):	0.00	Test limit (%):	3.30 Pass
Time(mS) > dt:	0.0	Test limit (mS):	500.0 Pass
Highest dc (%):	0.00	Test limit (%):	3.30 Pass
Highest dmax (%):	0.00	Test limit (%):	4.00 Pass
Highest Pst (10 min. period):	0.064	Test limit:	1.000 Pass
Highest Plt (2 hr. period):	0.040	Test limit:	0.650 Pass

### Flicker Test Summary per EN/IEC61000-3-3 (Phase C-Run time)

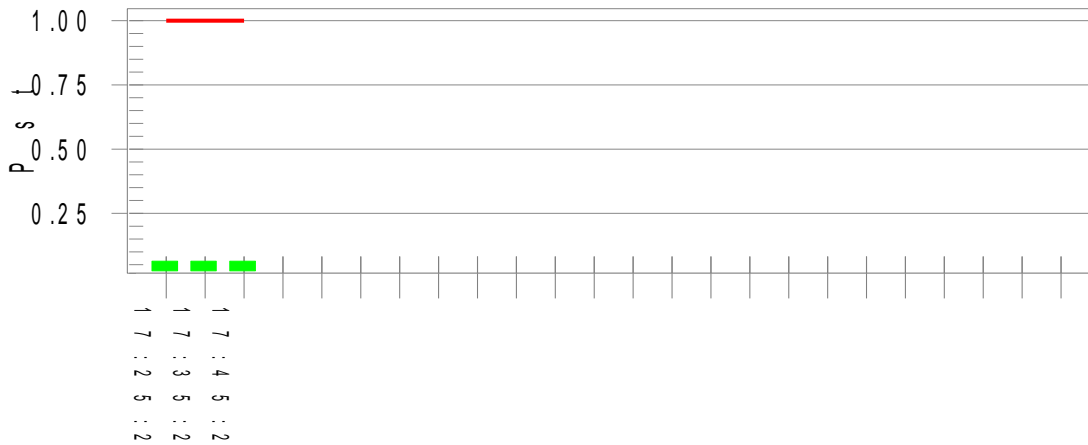
EUT: TPS300024  
 Test category: All parameters (European limits)  
 Test date: 9/2/2015 Start time: 5:15:04 PM  
 Test duration (min): 30 Data file name: F-000511.cts\_data  
 Comment: NEx: 293051  
 Customer: TDK-Lambda Americas, Inc.

Tested by: W. Dey  
 Test Margin: 100  
 End time: 5:45:27 PM

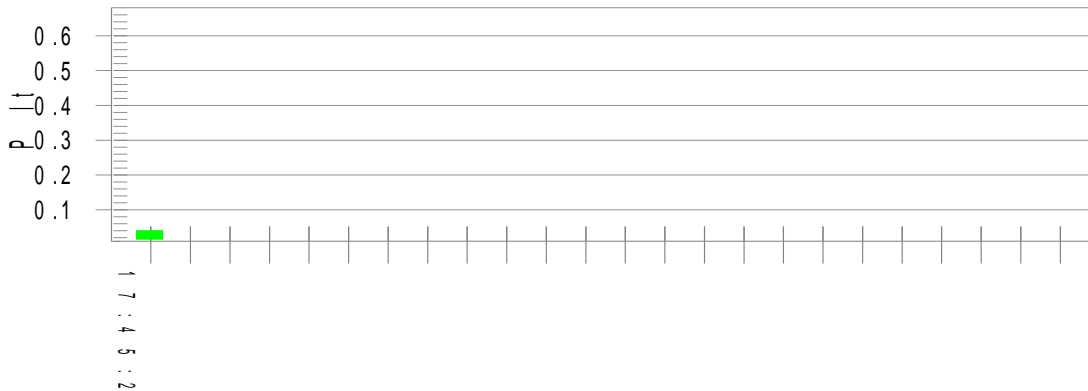
Test Result: Pass  
Pstj and limit line

Status: Test Completed

European Limits



Plt and limit line

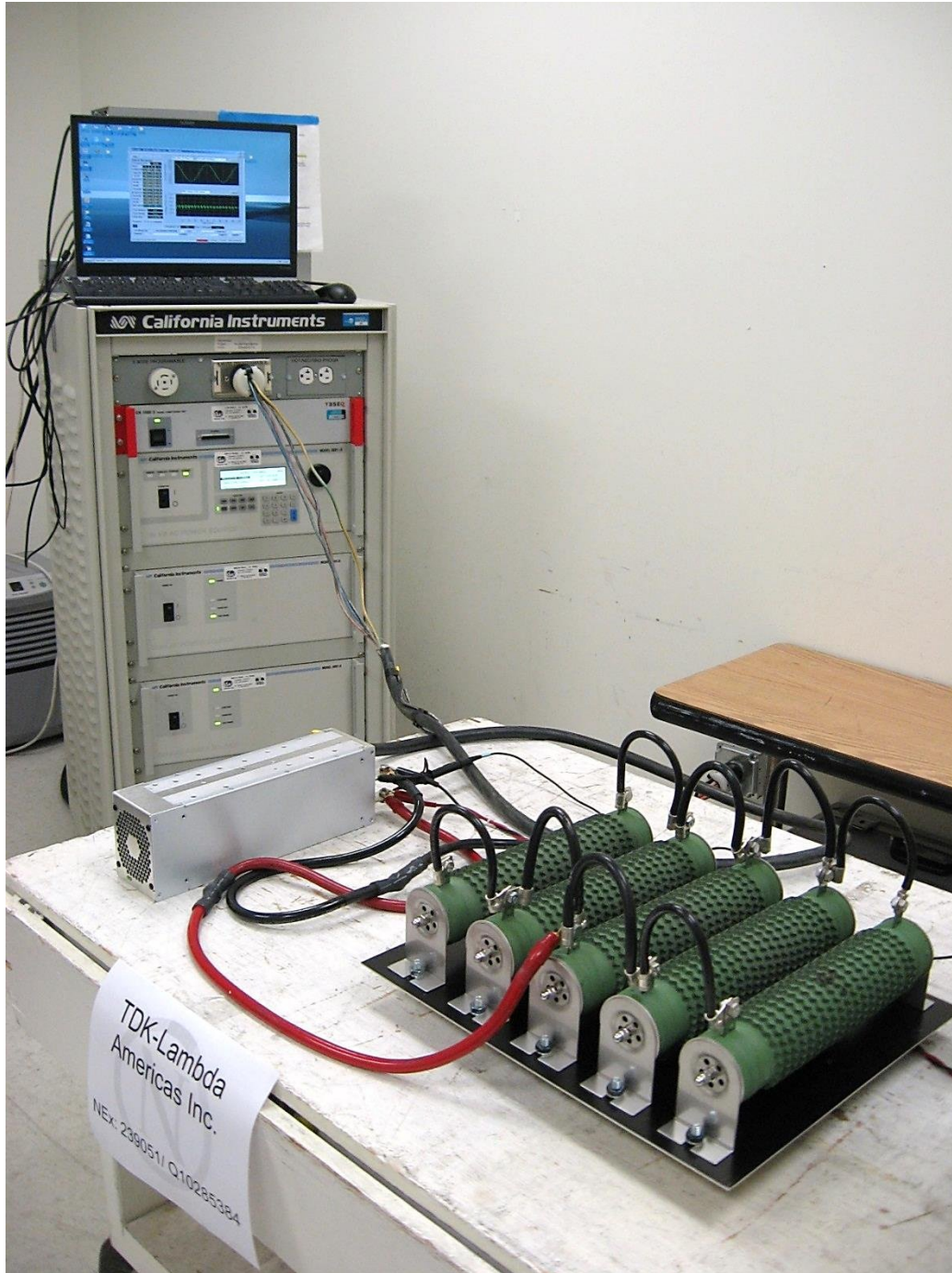


Parameter values recorded during the test:

Vrms at the end of test (Volt):	276.39		
Highest dt (%):	0.00	Test limit (%):	3.30 Pass
Time(mS) > dt:	0.0	Test limit (mS):	500.0 Pass
Highest dc (%):	0.00	Test limit (%):	3.30 Pass
Highest dmax (%):	0.00	Test limit (%):	4.00 Pass
Highest Pst (10 min. period):	0.064	Test limit:	1.000 Pass
Highest Plt (2 hr. period):	0.040	Test limit:	0.650 Pass

Compliance			
Compliant?	Yes	Additional Comments	N/A

### 6.2.5 Reference Photos



Power Line Test Configuration Photograph

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### 6.3 -2, Electrostatic Discharge

This test simulates electrostatic events and evaluates the ability of the EUT to tolerate such events. Testing was performed in accordance with IEC/EN 61000-4-2. All accessible enclosure surfaces and ports are evaluated unless specified as a static sensitive surface. The product specific standard sets the level and the number of test strikes to apply.

#### 6.3.1 Electrostatic Discharge Test Results

Client	TDK-Lambda Americas, Inc.		
NEx #	293051	Temperature	23 °C
EUT Name	3-Phase Power Supply	Humidity	55 %
EUT Model	TPS300024	Pressure	100.5 kPa
Governing Doc	EN 55024	Test Location	Ground Plane 2
Basic Standard	IEC/EN 61000-4-2	Test Engineer	William Dey
Test Voltage	477V/60Hz 3 Phase	Date	9/1/2015

Test Conditions	
Discharge Rep. Rate	1 per second
Number of Discharges	25 per location
Performance Criteria:	B
EUT Mode:	Normal Operation / EUT output 24 Volts DC at 3000 Watts

Contact Discharge					
Voltage: (+/- kV)	2 <input checked="" type="checkbox"/>	4 <input checked="" type="checkbox"/>	6 <input type="checkbox"/>	8 <input type="checkbox"/>	Other <input type="checkbox"/>

Location	Comments
Vertical Coupling Plane	No susceptibility noted.
Horizontal Coupling Plane	No susceptibility noted.
Contact Locations	No susceptibility noted.

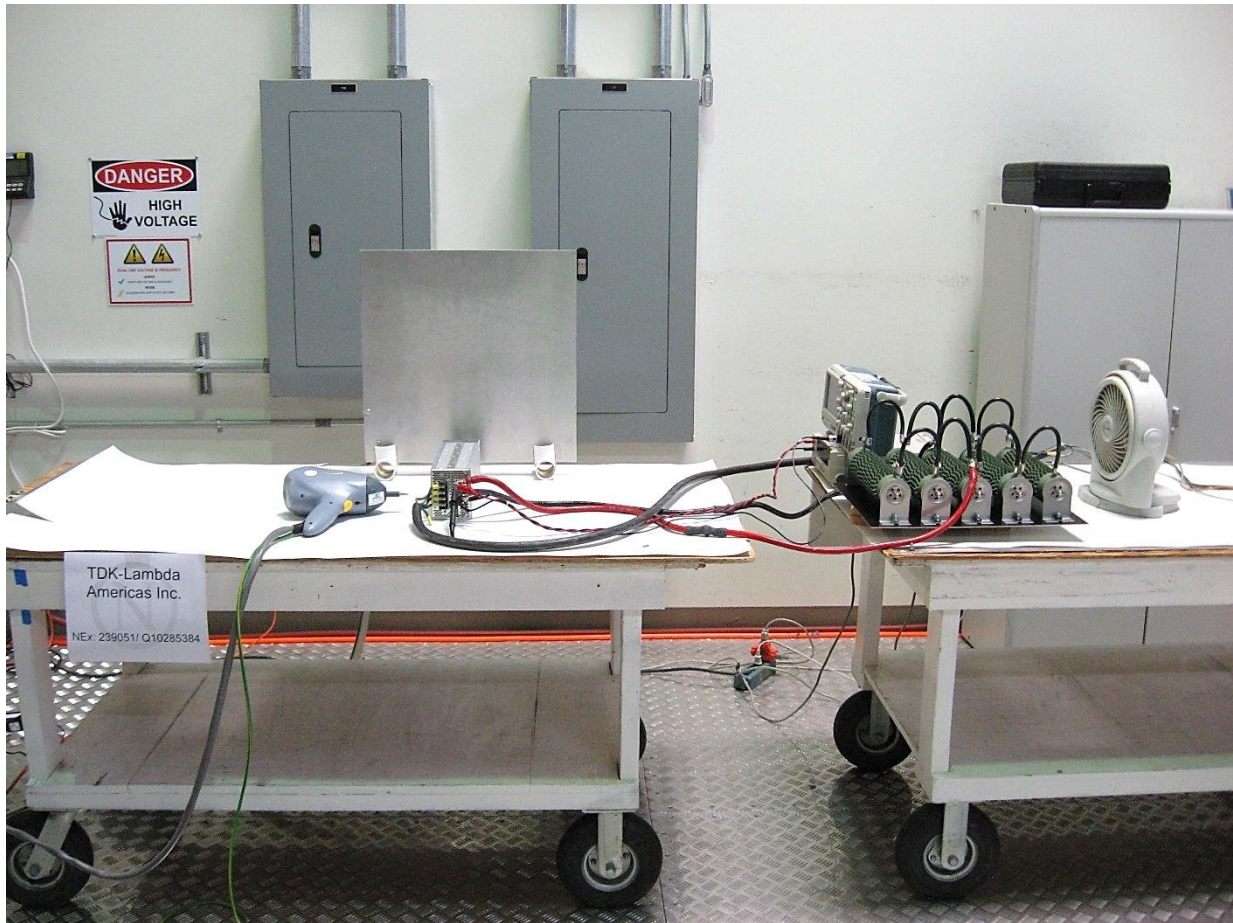
Air Discharge					
Voltage: (+/- kV)	2 <input checked="" type="checkbox"/>	4 <input checked="" type="checkbox"/>	8 <input checked="" type="checkbox"/>	15 <input type="checkbox"/>	Other <input type="checkbox"/>

Location	Comments
Air Locations	No susceptibility noted.
"Spark" event(s)	None

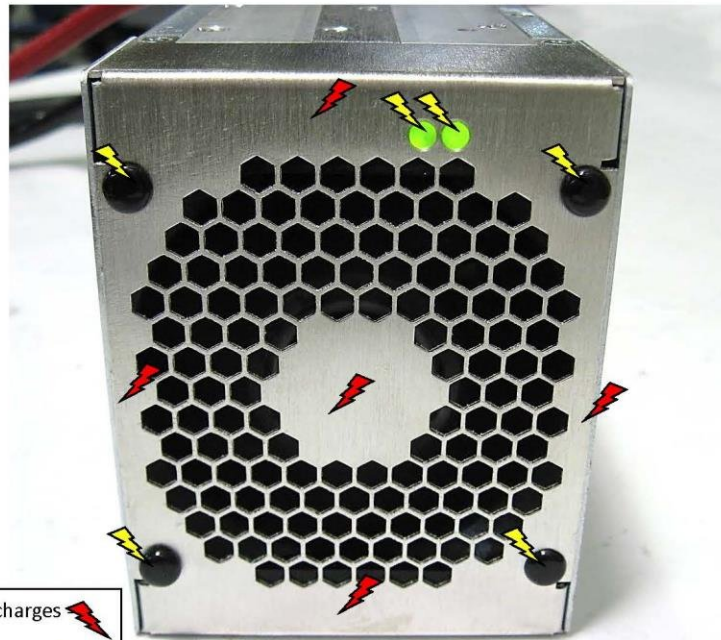
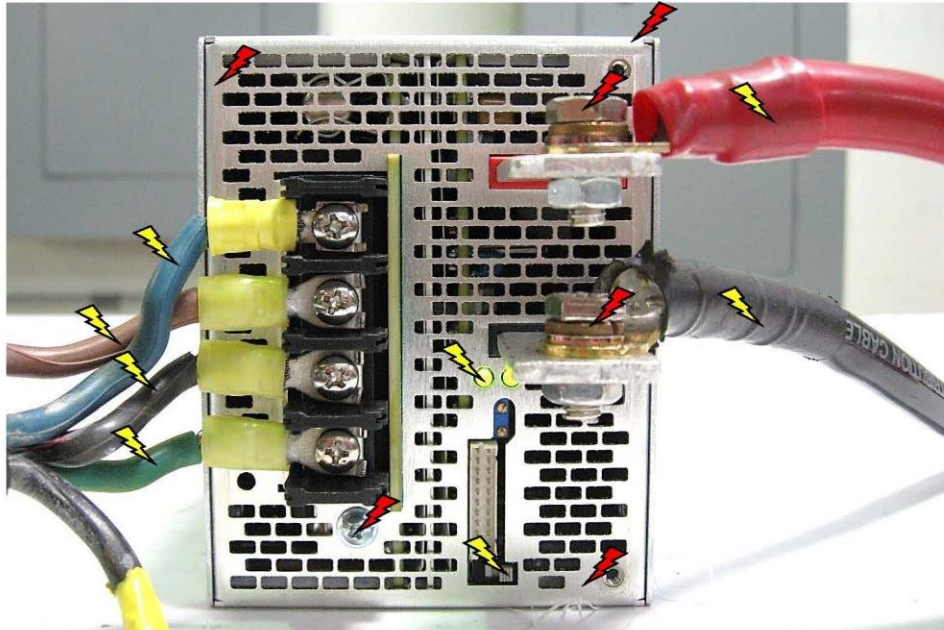
Compliance			
Compliant?	Yes	Additional Comments	N/A





### 6.3.2 Reference Photos

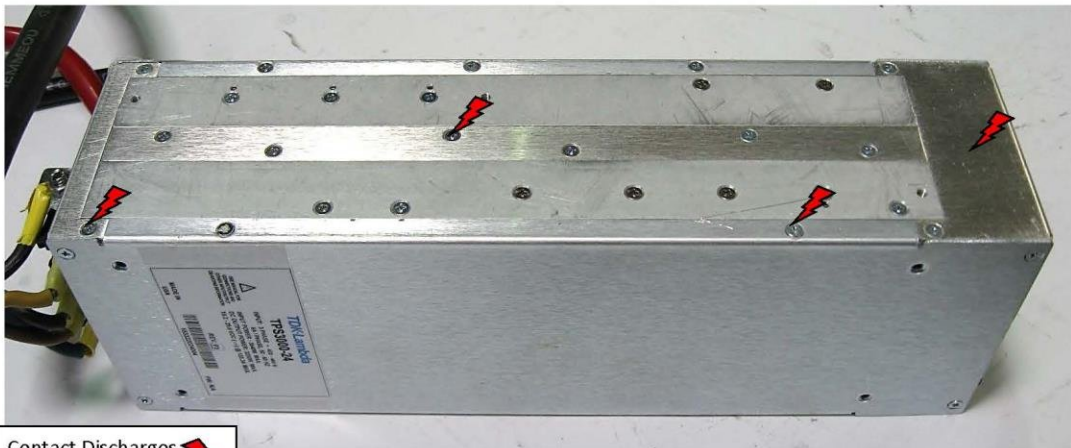
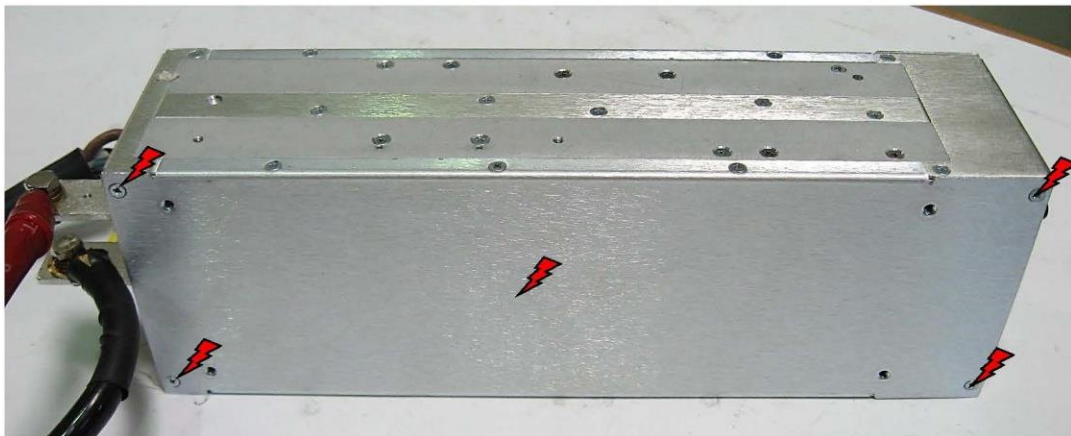
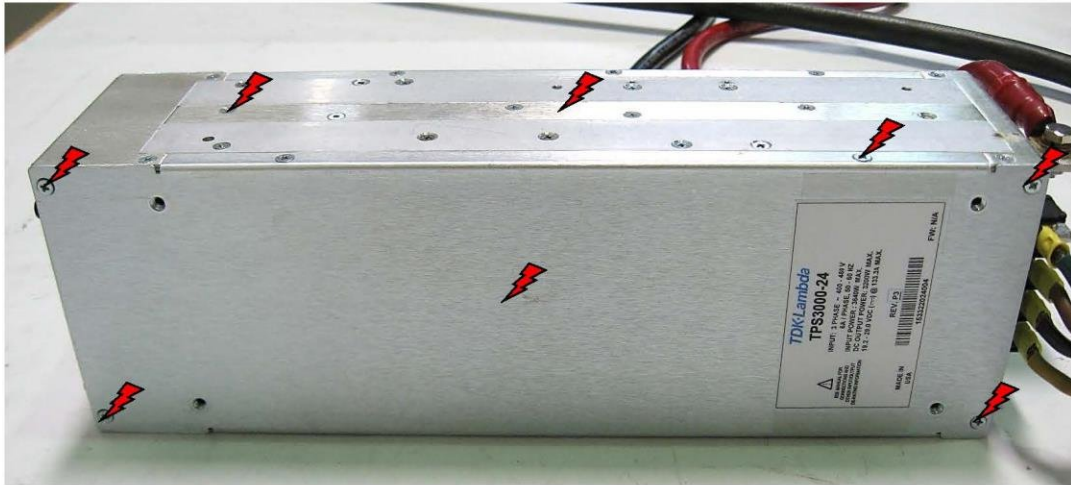




ESD Test Configuration Photograph



Contact Discharges   
Air Discharges = 

ESD Test Point Locations



Contact Discharges   
Air Discharges = 

ESD Test Point Locations

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## 6.4 -3, Radio Frequency

The radiated RF immunity test exposes the equipment under test to a calibrated uniform field of radiated electromagnetic energy. The EUT is continuously monitored while exposed to the required frequency range and field strength. The test chamber, radiating antennas, and calibrated fields meet the requirements of referenced standards. The product specific standard sets the level, duration, and the frequency range to apply.

### 6.4.1 Radiated Immunity Test Results

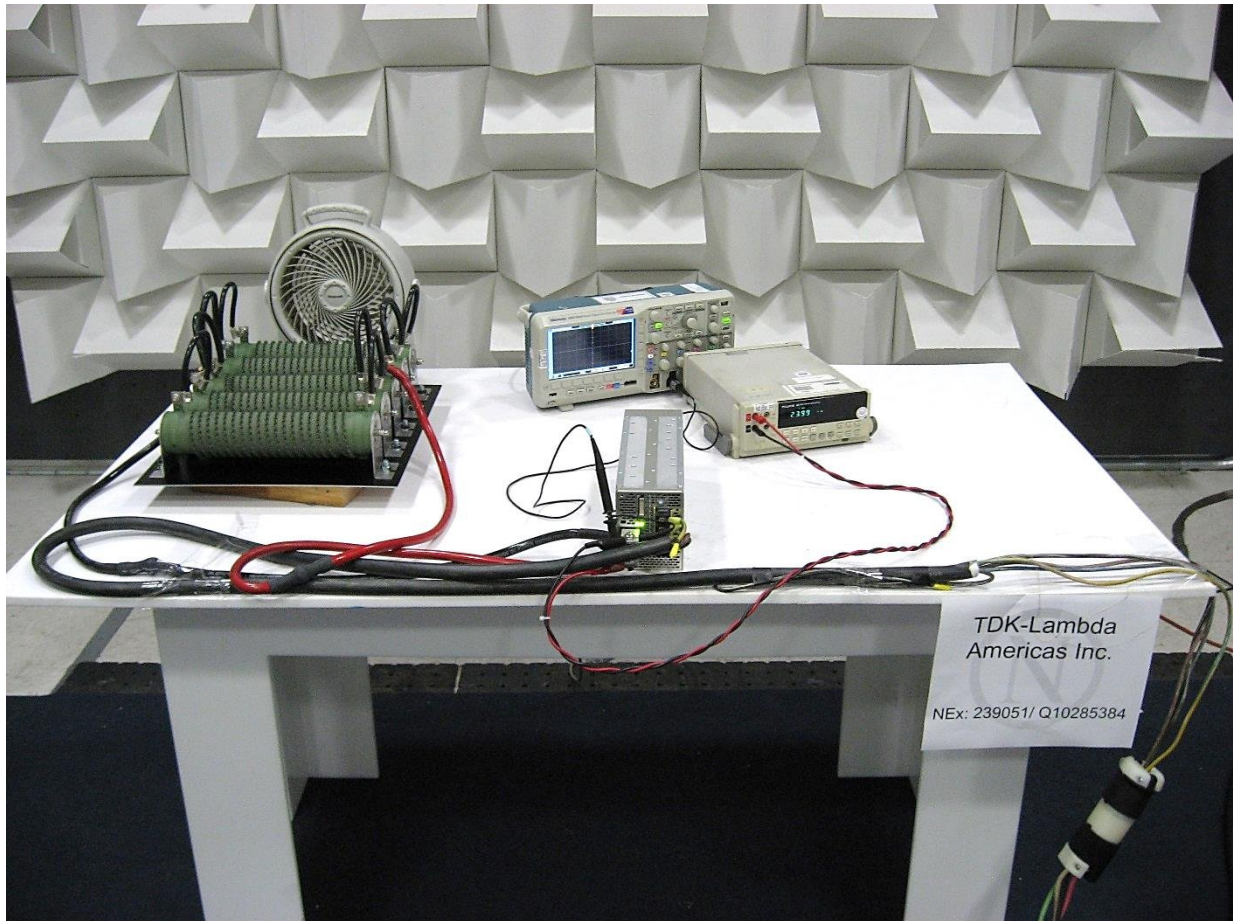
Client	TDK-Lambda Americas, Inc.		
NEx #	293051	Temperature	23 °C
EUT Name	3-Phase Power Supply	Humidity	55 %
EUT Model	TPS300024	Pressure	100.5 kPa
Governing Doc	EN 55024	Test Location	Ground Plane 2
Basic Standard	IEC/EN 61000-4-3	Test Engineer	William Dey
Test Voltage	477V/60Hz 3 Phase	Date	9/1/2015

Test Conditions	
Test Level	3 V/m
Frequency Swept	80 MHz to 1 GHz
Selected Frequencies	N/A
Modulation	1kHz modulated at 80% AM
Frequency Step	1%
Dwell Time	1 second
Performance Criteria	A
EUT Mode	Normal Operation / EUT output 24 Volts DC at 3000 Watts

Test Scans Accomplished				
Frequency (MHz)	Antenna Polarization	Compliant	Orientation	Comments
80 to 1000	Horizontal	Yes	Front	No Susceptibility Noted.
80 to 1000	Horizontal	Yes	Rear	No Susceptibility Noted.
80 to 1000	Horizontal	Yes	Side Left	No Susceptibility Noted.
80 to 1000	Horizontal	Yes	Side Right	No Susceptibility Noted.
80 to 1000	Vertical	Yes	Front	No Susceptibility Noted.
80 to 1000	Vertical	Yes	Rear	No Susceptibility Noted.
80 to 1000	Vertical	Yes	Side Left	No Susceptibility Noted.
80 to 1000	Vertical	Yes	Side Right	No Susceptibility Noted.

Compliance			
Compliant?	Yes	Additional Comments	N/A

### 6.4.2 Reference Photos



Radiated RFI Test Configuration Photograph

DATE	DOCUMENT NAME	DOCUMENT #	PAGE
9/11/2015	TDK-Lambda Americas, Inc. - TPS300024 - EMC Test Report	2015 092293051 EMC EU R1	37 of 53

## 6.5 -4, Electrical Fast/Burst

This test injects a transient/burst interference onto the Mains input power supply and signal I/O lines. The EUT and peripherals were placed on a non-conductive support platform, 10cm above the test ground plane. The EUT was monitored for disturbances during required exposure time of positive and negative bursts. The product specific standard sets the level and exposure time to apply.

### 6.5.1 Electrical Fast Transients Test Results

Client	TDK-Lambda Americas, Inc.			
NEx #	293051	Temperature	23	°C
EUT Name	3-Phase Power Supply	Humidity	58	%
EUT Model	TPS300024	Pressure	100.6	kPa
Governing Doc	EN 55024	Test Location	Ground Plane 2	
Basic Standard	IEC/EN 61000-4-4	Test Engineer	William Dey	
Test Voltage	477V/60Hz 3 Phase	Date	9/2/2015	

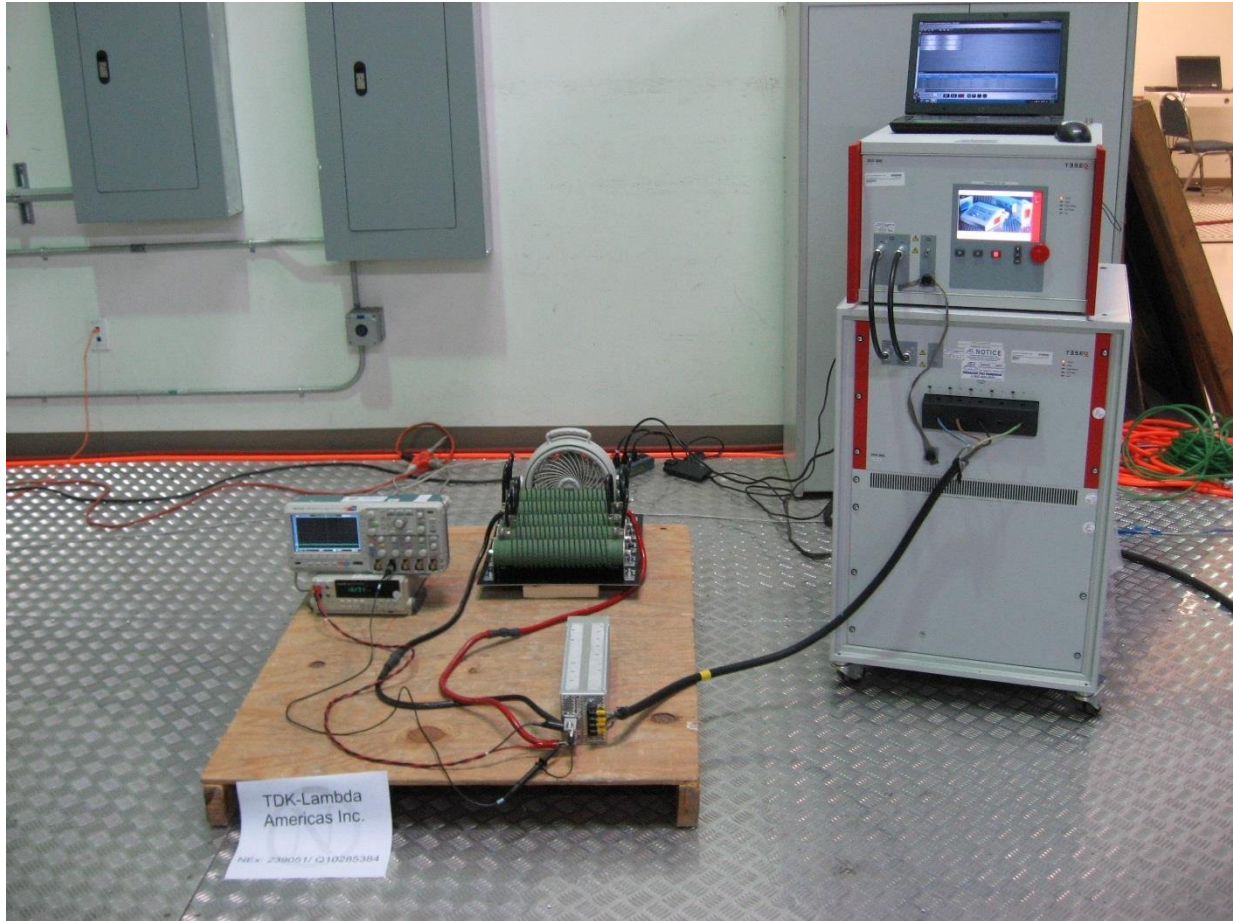
Test Conditions	
Power Port	AC Mains
Highest Power Port Test Level	1.0kV
Highest Signal Port Test Level	N/A
Test Duration	60 Seconds
Burst	5kHz
Performance Criteria	B
EUT Mode	Normal Operation / EUT output 24 Volts DC at 3000 Watts

Direct Injection Output Path						
Test Level	L1	L2	L3	PE	n/a	Comments
+/-1.0kV	X					No Susceptibility Noted
+/-1.0kV		X				No Susceptibility Noted
+/-1.0kV			X			No Susceptibility Noted
+/-1.0kV				X		No Susceptibility Noted
+/-1.0kV	X	X				No Susceptibility Noted
+/-1.0kV	X		X			No Susceptibility Noted
+/-1.0kV		X	X			No Susceptibility Noted
+/-1.0kV	X	X	X	X		No Susceptibility Noted

Test Level	Cable Description	Comments
N/A	N/A	No Cables

Compliance			
Compliant?	Yes	Additional Comments	N/A

### 6.5.2 Reference Photos



EFT Test Configuration Photograph



## 6.6 -5, Power Line Surge

This test simulates a lightning event by inducing transients onto the AC/DC power supply lines in common and differential mode. Testing was performed in accordance with IEC/EN 61000-4-5. The product specific standard determines the minimum requirement for the exposure to surge transient levels, as detailed below.

### 6.6.1 Power Line Surge Test Results

Client	TDK-Lambda Americas, Inc.			
NEx #	293051	Temperature	23	°C
EUT Name	3-Phase Power Supply	Humidity	58	%
EUT Model	TPS300024	Pressure	100.6	kPa
Governing Doc	EN 55024	Test Location	Ground Plane 2	
Basic Standard	IEC/EN 61000-4-5	Test Engineer	William Dey/Rodel Resolme	
Test Voltage	477V/60Hz 3 Phase	Date	9/2/2015 & 3/30/2016	

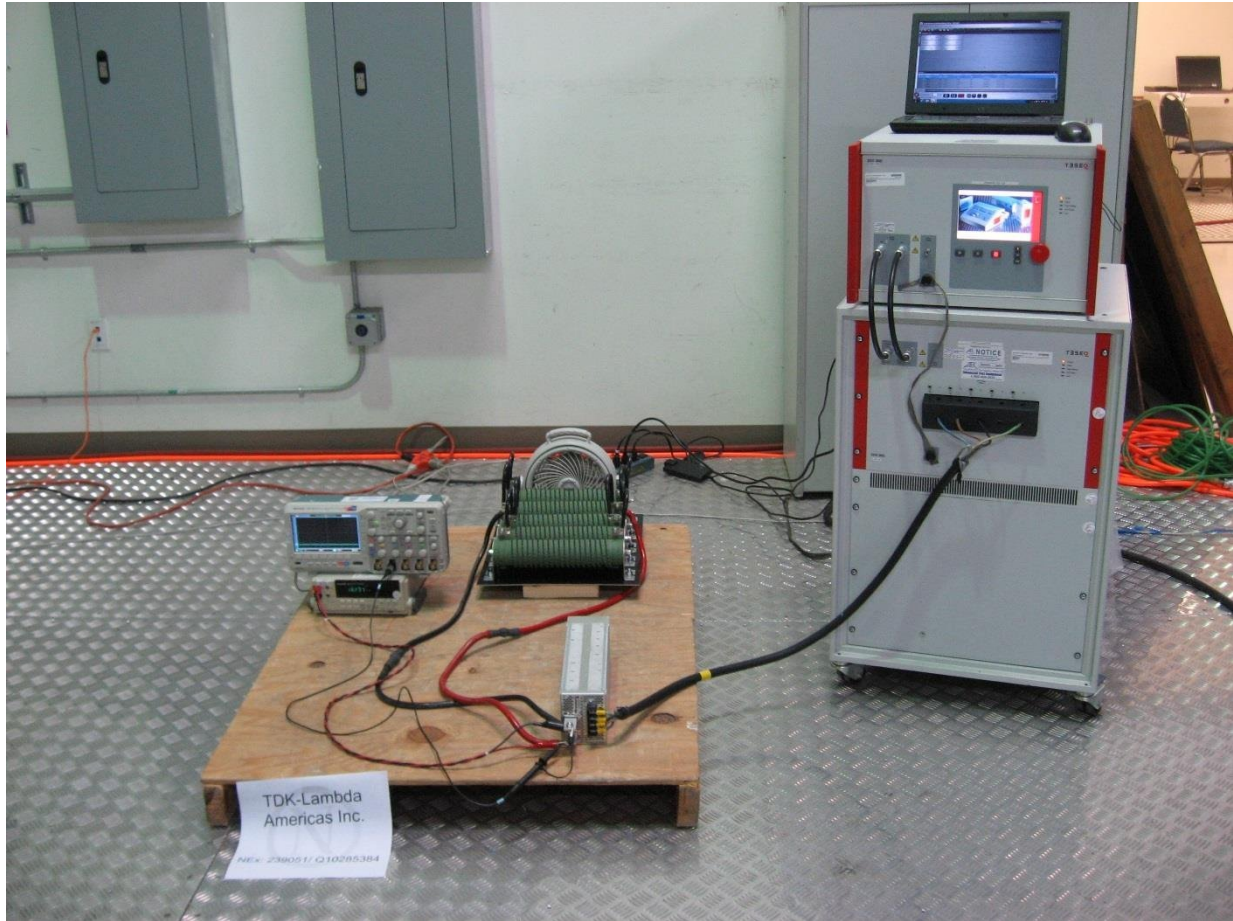
Test Conditions	
Power Port	AC Mains 3 Phase
Highest Power Port Test Level Line – Line	2.0kV
Highest Power Port Test Level Line – Ground	4.0kV
Highest Signal Port Test Level	N/A
Rest Duration between Strikes	60 Seconds
Number of Strikes per Voltage	Thirty (30)
Repetitions	5 each polarity
Polarity	Negative and Positive
Strike Angles on power frequency phase	0°, 90°, 180°, 270°
Waveform Generator Type	Combination
Performance Criteria	B
EUT Mode	Normal Operation / EUT output 24 Volts DC at 3000 Watts

Direct Injection Output Path											Comments
Line	Level 1		Level 2		Level 3		Level 4		Special		
	CM	DM	CM	DM	CM	DM	CM	DM	CM	DM	
	0.5 kV	0.5 kV	1 kV	1 kV	2 kV	2 kV	4 kV	4 kV	_ kV	_ kV	
L1-Gnd	±		±		±		±				No Susceptibility Noted.
L2-Gnd	±		±		±		±				No Susceptibility Noted.
L3-Gnd	±		±		±		±				No Susceptibility Noted.
L1-L2		±		±		±					No Susceptibility Noted.
L1-L3		±		±		±					No Susceptibility Noted.
L2-L1		±		±		±					No Susceptibility Noted.
L2-L3		±		±		±					No Susceptibility Noted.
L3-L1		±		±		±					No Susceptibility Noted.
L3-L2		±		±		±					No Susceptibility Noted.

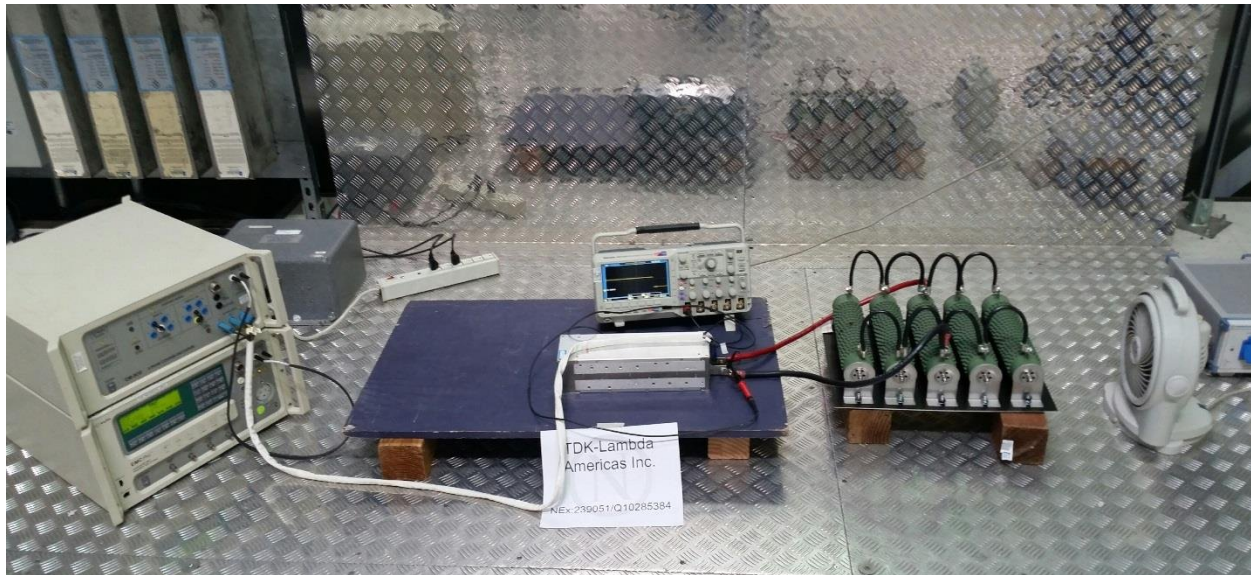
Compliance			
Compliant?	Yes	Additional Comments	Added 4kv +/- CM test 3/30/2016



### 6.6.2 Reference Photos



Surge Test Configuration Photograph



Surge Test Configuration 4kV updated Photograph

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## 6.7 -6, RF Conducted Disturbance

This test injects a disturbance directly onto AC/DC power and signal I/O cables. Testing was performed in accordance with IEC/EN 61000-4-6. The product specific standard sets the level, duration, and the frequency range to apply.

### 6.7.1 Conducted Immunity Test Results

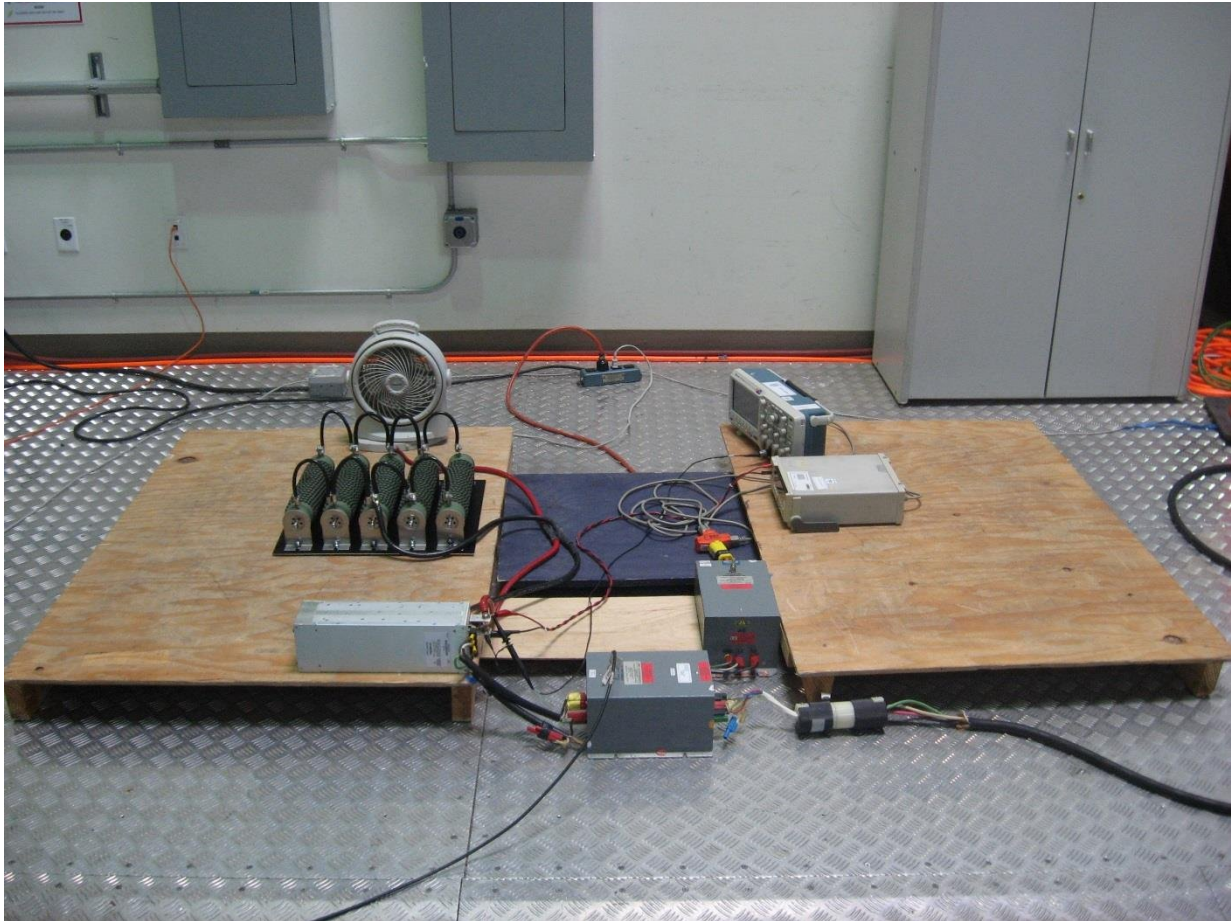
Client	TDK-Lambda Americas, Inc.			
NEx #	293051	Temperature	23	°C
EUT Name	3-Phase Power Supply	Humidity	55	%
EUT Model	TPS300024	Pressure	100.5	kPa
Governing Doc	EN 55024	Test Location	Ground Plane 2	
Basic Standard	IEC/EN 61000-4-6	Test Engineer	William Dey	
Test Voltage	477V/60Hz 3 Phase	Date	9/1/2015	

Test Conditions	
Test Level	3V
Modulation	1kHz modulated at 80% AM
Frequency Range	150kHz - 80MHz
Selected Frequencies	None
Step	1%
Dwell Time	3 Seconds
Performance Criteria	A
EUT Mode	Normal Operation / EUT output 24 Volts DC at 3000 Watts

No.	Injection Point	Injection Method	Comments
1	AC mains / 3 Phase	CDN	No Susceptibility Noted.
2	DC output Cables	Clamp	No Susceptibility Noted.
3			
4			
5			

Compliance			
Compliant?	Yes	Additional Comments	N/A

### 6.7.2 Reference Photos



Conducted RF Test Configuration Photograph



Conducted RF Test Configuration Photograph

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## 6.8 -8, Power Frequency; Magnetic

This test subjects devices to the fields produced by current carrying conductors of standard building power. Testing was performed in accordance with IEC/EN 61000-4-8. The EUT was exposed to 50 Hz and 60 Hz power frequency magnetic fields, to the level required by the product specific standard.

### 6.8.1 Power Frequency Magnetic Field Test Results

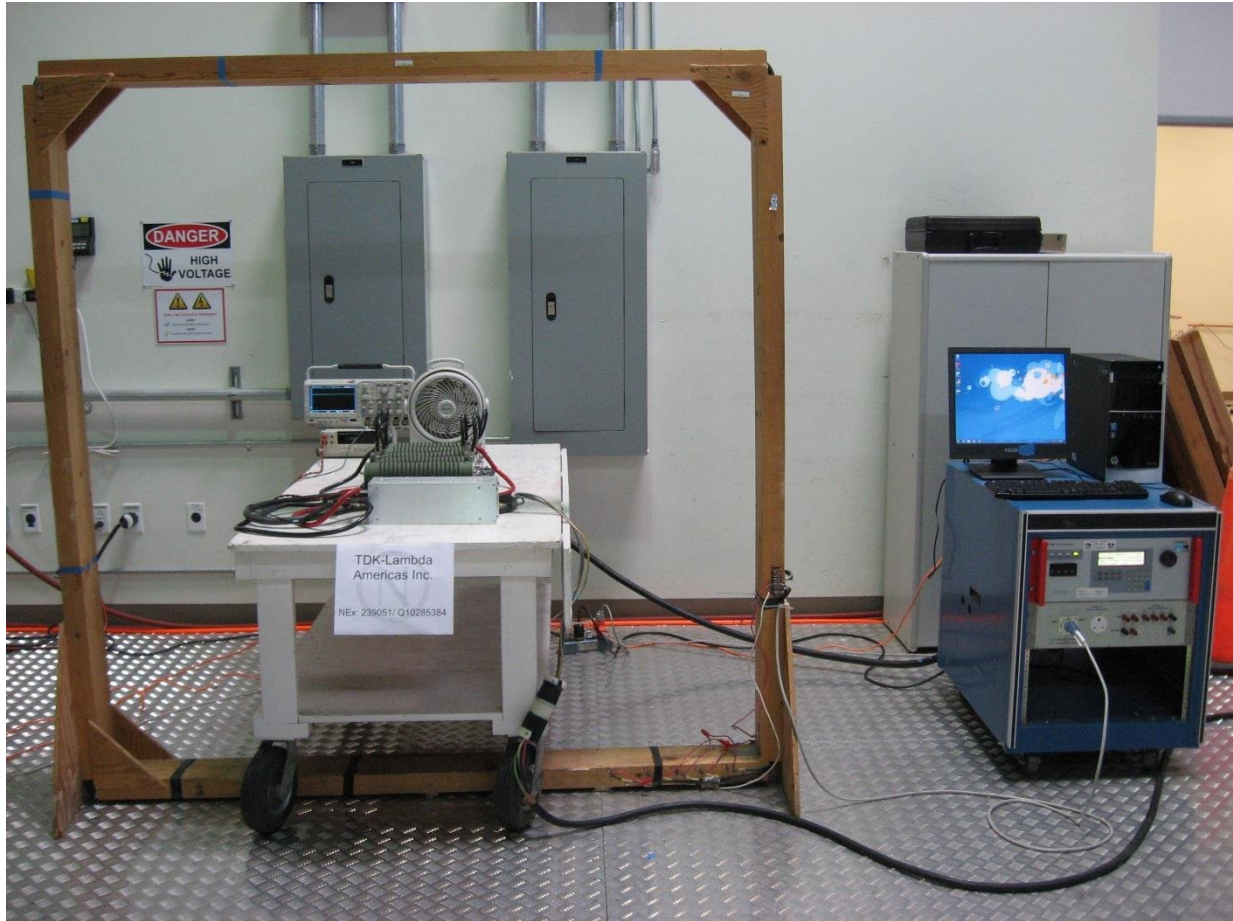
Client	TDK-Lambda Americas, Inc.		
NEx #	293051	Temperature	23 °C
EUT Name	3-Phase Power Supply	Humidity	55 %
EUT Model	TPS300024	Pressure	100.5 kPa
Governing Doc	EN 55024	Test Location	Ground Plane 2
Basic Standard	IEC/EN 61000-4-8	Test Engineer	William Dey
Test Voltage	477V/60Hz 3 Phase	Date	9/1/2015

Test Conditions	
Test Level	30A/m and 300A/m
Frequency	50Hz ad 60Hz
Duration Per Axis	5 minutes
Performance Criteria	A
EUT Mode	Normal Operation / EUT output 24 Volts DC at 3000 Watts

Text Axis	Compliant	Comments
X	Yes	No Susceptibility Noted. 50Hz Test
Y	Yes	No Susceptibility Noted. 50Hz Test
Z	Yes	No Susceptibility Noted. 50Hz Test
X	Yes	No Susceptibility Noted. 60Hz Test
Y	Yes	No Susceptibility Noted. 60Hz Test
Z	Yes	No Susceptibility Noted. 60Hz Test

Compliance			
Compliant?	Yes	Additional Comments	N/A

### 6.8.2 Reference Photos



Magnetic Field Test Configuration Photograph

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## 6.9 -11, Voltage Dips

This test subjects the EUT to power network faults and “brownouts”. Testing was performed in accordance with IEC/EN 61000-4-11. The EUT is powered up to a nominal voltage, and then software-controlled voltage dips and interruptions are introduced. The product specific standard sets the level and duration of the voltage dips.

### 6.9.1 Voltage Dips and Interruptions

Client	TDK-Lambda Americas, Inc.		
NEx #	293051	Temperature	23 °C
EUT Name	3-Phase Power Supply	Humidity	58 %
EUT Model	TPS300024	Pressure	100.6 kPa
Governing Doc	EN 55024	Test Location	Ground Plane 2
Basic Standard	IEC/EN 61000-4-11	Test Engineer	William Dey
Test Voltage	477V/60Hz 3 Phase	Date	9/2/2015

Voltage Dips		
Performance Criteria	B and C	
Changes Occur At	Zero Crossing	
% Reduction (Dip)	Duration in cycles/periods	Compliance / Comments
>95	0.5/10ms	No Susceptibility Noted.
30	25/500ms	No Susceptibility Noted.

Overall Compliance Voltage Dips			
Compliant?	Yes	Additional Comments	N/A

Voltage Interruptions		
Performance Criteria	C	
Changes Occur At	Zero Crossing	
% Reduction (Dip)	Duration in cycles/periods	Compliance / Comments
>95	250/5000ms	EUT turns off and returns to normal operation after the test.
		EUT meets criteria B

Overall Compliance Voltage Interruptions			
Compliant?	Yes	Additional Comments	N/A

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**6.9.2 Voltage Dips and Interruptions**

Client	TDK-Lambda Americas, Inc.		
NEx #	293051	Temperature	23 °C
EUT Name	3-Phase Power Supply	Humidity	59 %
EUT Model	TPS300024	Pressure	100.5 kPa
Governing Doc	SEMI F47-0706	Test Location	ESD Ground Plane
Basic Standard	IEC/EN 61000-4-11	Test Engineer	William Dey
Test Voltage	477V/60Hz 3 Phase	Date	9/10/2015

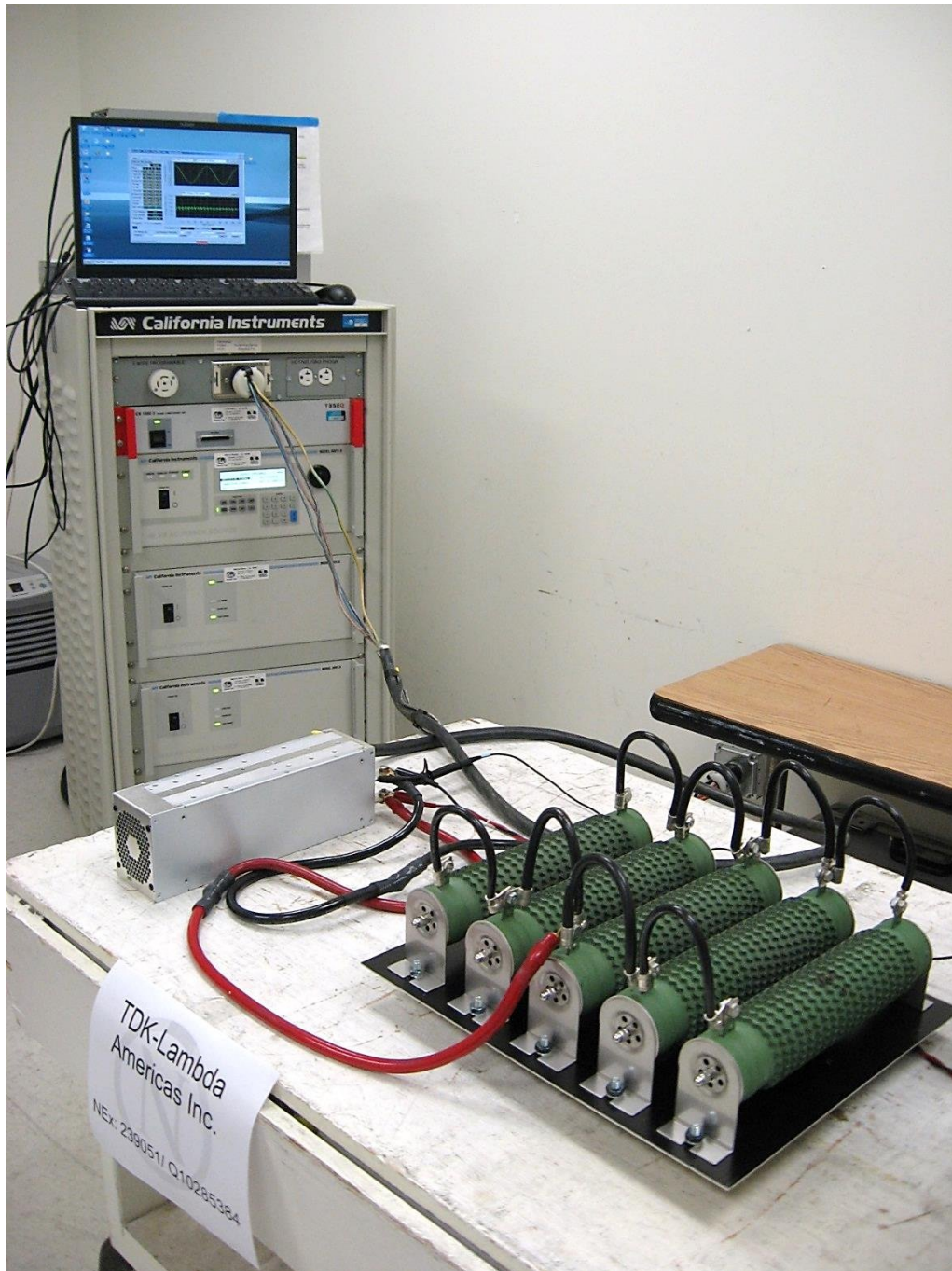
Voltage Dips	
Performance Criteria	B and C
Changes Occur At	zero crossing

% Reduction (Dip)	Duration in cycles/periods	Compliance / Comments
50	10/200ms	No Susceptibility Noted.
30	25/500ms	No Susceptibility Noted.
20	50/1000ms	No Susceptibility Noted.
100	1/20ms	No Susceptibility Noted.
20	500/10000ms	No Susceptibility Noted.

Overall Compliance Voltage Dips			
Compliant?	Yes	Additional Comments	N/A



6.9.3 Reference Photos



VDSI Test Configuration Photograph

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**APPENDIX A**

**A. Radiated Emissions Measurement Uncertainties**

**1. Introduction**

ISO/IEC 17025:2005 and ANSI/NC SL Z540.3: 2006 require that all measurements contained in a test report be “traceable”. “Traceability” is defined in the International Vocabulary of Basic and General Terms in Metrology (ISO: 1993) as: “the property of the result of a measurement... whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons, all having stated uncertainties”.

The purposes of this Appendix are to “state the Measurement Uncertainties” of the conducted emissions and radiated emissions measurements contained in Section 5 of this Test Report, and to provide a practical explanation of the meaning of these measurement uncertainties.

**2. Statement of the Worst-Case Measurement Uncertainties for the Conducted and Radiated Emissions Measurements Contained in This Test Report**

**Table 1: Worst-Case Expanded Uncertainty "U" of Measurement for a k=2 Coverage Factor**

<b>Conducted and Radiated Emissions Measurement Detection Systems</b>	<b>Applicable Frequency Range</b>	<b>"U" for a k=2 Coverage Factor</b>
Spectrum Analyzer and LISN	100 kHz – 30 MHz	+/-2.8 dB
Spectrum Analyzer and Telecom ISN	100 kHz – 30 MHz	+/-1.38dB
Spectrum Analyzer, Pre-amp, and Antenna	30 MHz-200 MHz	+/-3.9 dB
Spectrum Analyzer, Pre-amp, and Antenna	200 MHz-1000 MHz	+/- 3.5 dB
Spectrum Analyzer, Pre-amp, and Antenna	1 GHz - 18 GHz	+/-2.6 dB

**NOTES:**

1. Applies to 3 and 10 meter measurement distances
2. Applies to all valid combinations of Transducers (i.e. LISNs, Line Voltage Probes, and Antennas, as appropriate)
3. Excludes the Repeatability of the EUT



### 3. Practical Explanation of the Meaning of Radiated Emissions Measurement Uncertainties

In general, a “Statement of Measurement Uncertainty” means that with a certain (specified) confidence level, the “true” value of a measurement will be between a (stated) upper bound and a (stated) lower bound.

In the specific case of EMC Measurements in this test report, the measurement uncertainties of the conducted emissions measurements and the radiated emissions measurements have been calculated in accordance with the method detailed in the following documents:

- ANSI Z540.2 (2002) Guide to the Expression of Uncertainty in Measurement
- NIS 81:1994, The Treatment of Uncertainty in EMC Measurements (NAMAS, 1994)
- NIST Technical Note 1297(1994), Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results (NIST, 1994)

The calculation method used in these documents requires that the stated uncertainty of the measurements be expressed as an “expanded uncertainty”, U, with a k=2 coverage factor.

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## APPENDIX B

### B. Nemko USA, Inc. Test Equipment & Facilities Calibration Program

Nemko USA, Inc. operates a comprehensive Periodic Calibration Program in order to ensure the validity of all test data. Nemko USA's Periodic Calibration Program is fully compliant to the requirements of NVLAP Policy Guide PG-1-1988, ANSI/NCCL Z540.3: 2006, ISO 10012:2003, ISO/IEC 17025:2005, and ISO-9000: 2000. Nemko USA, Inc.'s calibrations program therefore meets or exceeds the US national commercial and military requirements [N.B. ANSI/NCCL Z540-1-1994 replaced MIL-STD-45662A].

Specifically, all of Nemko USA's primary reference standard devices (e.g. vector voltmeters, multimeters, attenuators and terminations, RF power meters and their detector heads, oscilloscope mainframes and plug-ins, spectrum analyzers, RF preselectors, quasi-peak adapters, interference analyzers, impulse generators, signal generators and pulse/function generators, field-strength meters and their detector heads, etc.) and certain secondary standard devices (e.g. RF Preamplifiers used in CISPR 11/22 and FCC Part 15/18 tests) are periodically recalibrated by:

- A Nemko USA-approved independent (third party) metrology laboratory that uses NIST-traceable standards and that is ISO Guide 25-accredited as a calibration laboratories by NIST; or,
- A Nemko USA-approved independent (third party) metrology laboratory that uses NIST-traceable standards and that is ISO Guide 25-accredited as a calibration laboratory by another accreditation body (such as A2LA) that is mutually recognized by NIST; or,
- A manufacturer of Measurement and Test Equipment (M&TE), if the manufacturer uses NIST-traceable standards and is ISO Guide 25-accredited as calibration laboratory either by NIST or by another accreditation body (such as A2LA) that is mutually recognized by NIST; or
- A manufacturer of M&TE (or by a Nemko USA-approved independent third party metrology laboratory) that is not ISO Guide 25-accredited.(In these cases, Nemko USA conducts an annual audit of the manufacturer or metrology laboratory for the purposes of proving traceability to NIST, ensuring that adequate and repeatable calibration procedures are being applied, and verifying conformity with the other requirements of ISO Guide 25).

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In all cases, the entity performing the Calibration is required to furnish Nemko USA with a calibration test report and/or certificate of calibration, and a “calibration sticker” on each item of M&TE that is successfully calibrated.

Calibration intervals are normally one year, except when the manufacture advises a shorter interval or if US Government directives or client requirements demand a shorter interval. Items of instrumentation/related equipment which fail during routine use, or which suffer visible mechanical damage (during use or while in transit), are sidelined pending repair and recalibration. (Repairs are carried out either in-house [if minor] or by a Nemko USA-approved independent [third party] metrology laboratory, or by the manufacturer of the item of M&TE).

Each antenna used for CISPR 11, CISPR 14, CISPR 22, and FCC Part 15 and Part 18 radiated emissions testing (and for testing to the equivalent European Norms) is calibrated annually by either a NIST (or A2LA) ISO Standard 17025-Accredited third-party Antenna Calibration Laboratory or by the antenna’s OEM if the OEM is NIST or A2LA ISO Standard 17025-accredited as an antenna calibration laboratory. The antenna calibrations are performed using the methods specified in CISPR 16-1-4 or ANSI C63.5-2006, including the “Three-Antenna Method”. Certain other kinds of antennas (e.g. magnetic-shielded loop antennas) are calibrated annually by either a NIST (or A2LA) ISO Standard 17025-accredited third-party antenna calibration laboratory, or by the antenna’s OEM if the OEM is NIST or A2LA ISO Standard 17025-accredited as an antenna calibration laboratory using the procedures specified in the latest version of SAE ARP-958.

In accordance with FCC and other regulations, Nemko USA recalibrates its suite of antennas used for radiated emissions tests on an annual basis. These calibrations are performed as a precursor to the FCC-required annual revalidation of the Normalized Site Attenuation properties of Nemko USA’s 10-meter Semi-Anechoic chamber. Nemko USA, Inc. uses the procedures given in CISPR 16-1-4 and, ANSI C63.4-2009 when performing the normalized site attenuation measurements.

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