Test Report issued under the responsibility of:

TEST REPORT
IEC 62368-1
Audio/video, information and communication technology equipment
Part 1: Safety requirements

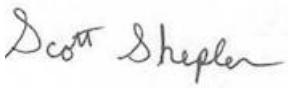
Report Number .....:	E220248-A6016-CB-1
Date of issue.....:	2020-05-18
Total number of pages .....:	64
Applicant's name.....:	**TDK-LAMBDA AMERICAS INC**
Address .....:	**SUITE 100** **3320 MATRIX DR** **RICHARDSON TX 75082** **UNITED STATES**
Name of Test Laboratory preparing the Report .....:	UL RTP 12 Laboratory Drive, Research Triangle Park , NC, 27709, USA
Test specification:	
Standard .....:	IEC 62368-1:2014 (Second Edition)
Test procedure .....:	CB Scheme
Non-standard test method.....:	N/A
Test Report Form No.....:	IEC62368_1B
Test Report Form(s) Originator .....:	UL(US)
Master TRF.....:	2014-03

This report is not valid as a CB Test Report unless signed by an approved CB Testing Laboratory and appended to a CB Test Certificate issued by an NCB in accordance with IECEE 02.

General disclaimer:

The test results presented in this report relate only to the object tested.
This report shall not be reproduced, except in full, without the written approval of the Issuing CB Testing Laboratory.
The authenticity of this Test Report and its contents can be verified by contacting the NCB, responsible for this Test Report.

Test Item description :	Power Supply
Trade Mark .....:	TDK
Manufacturer .....:	TDK-LAMBDA AMERICAS INC SUITE 100 3320 MATRIX DR RICHARDSON TX 75082 UNITED STATES
Model/Type reference .....:	Models: 1) PFH500X-48-xxx-R, 2) PFH500X-28-xxx-R, 3) PFH500X-12-xxx-R Where "X" is to indicate that this can be a “F” for full feature or a “S” for simple feature. Where xxx can be any alphanumeric character or blank representing non-safety critical options such as pin length, mounting style, control function, etc.
Ratings .....:	Rating: 1) PFH500X-48-xxx-R, Input: AC 100-240 V, 7A, 50/60 Hz Output: DC 48 V, 10.5 A 2) PFH500X-28-xxx-R, Input: AC 100-240 V, 8A, 50/60 Hz Output: DC 28 V, 18 A 3) PFH500X-12-xxx-R Input: AC 100-240 V, 7.5A, 50/60 Hz Output: DC 12 V, 42 A Max 504 Watts (for model matrix refer to appendix)
Testing procedure and testing location:	
☒ CB Testing Laboratory:	
Testing location/ address ..... :	UL RTP, 12 Laboratory Drive, Research Triangle Park , NC, 27709, USA

Tested by (name + signature).....:	Mengis Tesfay / Project Handler	
Approved by (name + signature) .....:	Scott Shepler / Reviewer	
☐ Testing procedure: CTF Stage 1		
Testing location/ address..... :		
Tested by (name + signature).....:		
Approved by (name + signature) .....:		
☒ Testing procedure: CTF Stage 2		
Testing location/ address..... :	TDK-LAMBDA AMERICAS INC SUITE 100 3320 MATRIX DR RICHARDSON TX 75082 UNITED STATES	
Tested by (name + signature).....:	See previously issued VDE CBTR for names, functions, and signatures / --	See previously issued VDE CBTR for names, functions, and signatures
Witnessed by (name + signature).....:	See previously issued VDE CBTR for names, functions, and signatures / --	See previously issued VDE CBTR for names, functions, and signatures
Approved by (name + signature) .....:	See previously issued VDE CBTR for names, functions, and signatures / --	See previously issued VDE CBTR for names, functions, and signatures
☐ Testing procedure: CTF Stage 3		
☐ Testing procedure: CTF Stage 4		
Testing location/ address..... :		
Tested by (name + signature).....:		
Witnessed by (name + signature).....:		
Approved by (name + signature) .....:		
Supervised by (name + signature) .....:		

List of Attachments (including a total number of pages in each attachment): National Differences (30 pages) Enclosures (48 pages)	
Summary of testing:	
Tests performed (name of test and test clause):	**Testing Location:** **CTF Stage 2: TDK-LAMBDA AMERICAS INC** **SUITE 100** **3320 MATRIX DR** **RICHARDSON TX 75082** **UNITED STATES**
TEST FOR POLLUTION DEGREE 1 ENVIRONMENT AND FOR AN INSULATING COMPOUND (5.4.1.5.2, 5.4.1.5.3)	2.10.10, 2.10.9 - Test For Pollution Degree 1 Environment And For Insulating Compound. Testing conducted under IEC 60950-1:2005 (Second Edition); Am1:2009 + Am2:2013 evaluation was considered equivalent. Tests were covered under VDE CB report 236820-C13-1 and CB Test Certificate Ref. DE1-59169 respectively which were previously evaluated to UL/CSA/IEC 60950-1, 2nd edition, + Amendment 1 & 2 by VDE Testing and Certification Institute.
DETERMINATION OF WORKING VOLTAGE (5.4.1.8)	2.10.2 - Determination of Working Voltage. Testing conducted under IEC 60950-1:2005 (Second Edition); Am1:2009 + Am2:2013 evaluation was considered equivalent. Tests were covered under VDE CB report 236820-C13-1 and CB Test Certificate Ref. DE1-59169 respectively which were previously evaluated to UL/CSA/IEC 60950-1, 2nd edition, + Amendment 1 & 2 by VDE Testing and Certification Institute.
TESTS FOR SEMICONDUCTOR COMPONENTS AND CEMENTED JOINTS (5.4.7, 5.4.1.5.3)	2.10.11, 2.10.9 - Test for Semiconductor components and cemented joints - Testing conducted under IEC 60950-1:2005 (Second Edition); Am1:2009 + Am2:2013 evaluation was considered equivalent. Tests were covered under VDE CB report 236820-C13-1 and CB Test Certificate Ref. DE1-59169 respectively which were previously evaluated to UL/CSA/IEC 60950-1, 2nd edition, + Amendment 1 & 2 by VDE Testing and Certification Institute.
HUMIDITY CONDITIONING (5.4.8)	2.9.1, 2.9.2, 5.2.2 - Humidity Test. Testing conducted under IEC 60950-1:2005 (Second Edition); Am1:2009 + Am2:2013 evaluation was considered equivalent. Tests were covered under VDE CB report 236820-C13-1 and CB Test Certificate Ref. DE1-59169 respectively which were previously evaluated to UL/CSA/IEC 60950-1, 2nd edition, + Amendment 1 & 2 by VDE Testing and Certification Institute.
ELECTRIC STRENGTH TEST (5.4.9)	5.2.2 – Electric Strength Test - Testing conducted under IEC 60950-1:2005 (Second Edition); Am1:2009 + Am2:2013 evaluation was considered equivalent. Tests were covered under VDE CB report 236820-C13-1 and CB Test Certificate Ref. DE1-59169 respectively which were previously evaluated to UL/CSA/IEC 60950-1, 2nd

	edition, + Amendment 1 & 2 by VDE Testing and Certification Institute.
INPUT TEST: SINGLE PHASE (B.2.5)	INPUT TEST (1.6.2). Testing conducted under IEC 60950-1:2005 (Second Edition); Am1:2009 + Am2:2013 evaluation was considered equivalent. Tests were covered under VDE CB report 236820-C13-1 and CB Test Certificate Ref. DE1-59169 respectively which were previously evaluated to UL/CSA/IEC 60950-1, 2nd edition, + Amendment 1 & 2 by VDE Testing and Certification Institute.
NORMAL OPERATING CONDITIONS TEMPERATURE MEASUREMENT (B.2.6)	HEATING TEST. 4.5. Testing conducted under IEC 60950-1:2005 (Second Edition); Am1:2009 + Am2:2013 evaluation was considered equivalent. Tests were covered under VDE CB report 236820-C13-1 and CB Test Certificate Ref. DE1-59169 respectively which were previously evaluated to UL/CSA/IEC 60950-1, 2nd edition, + Amendment 1 & 2 by VDE Testing and Certification Institute.
SIMULATED ABNORMAL OPERATING CONDITIONS (B.3)	Abnormal Operation (5.3.1 - 5.3.9). Testing conducted under IEC 60950-1:2005 (Second Edition); Am1:2009 + Am2:2013 evaluation was considered equivalent. Tests were covered under VDE CB report 236820-C13-1 and CB Test Certificate Ref. DE1-59169 respectively which were previously evaluated to UL/CSA/IEC 60950-1, 2nd edition, + Amendment 1 & 2 by VDE Testing and Certification Institute.
SIMULATED SINGLE FAULT CONDITIONS (B.4)	FAULT CONDITION TEST (5.3); Power Supply Output Short-Circuit/Overload (5.3.7) Component Failure (5.3.1, 5.3.4, 5.3.7). Testing conducted under IEC 60950-1:2005 (Second Edition); Am1:2009 + Am2:2013 evaluation was considered equivalent. Tests were covered under VDE CB report 236820-C13-1 and CB Test Certificate Ref. DE1-59169 respectively which were previously evaluated to UL/CSA/IEC 60950-1, 2nd edition, + Amendment 1 & 2 by VDE Testing and Certification Institute.

Summary of compliance with National Differences:

List of countries addressed: Australia / New Zealand, EU Group and National Differences, Japan, USA / Canada

EU Group and National Differences applies to CENELEC member countries: Austria , Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom

☒ **The product fulfils the requirements of:** EN 62368-1:2014 + A11:2017

TEST ITEM PARTICULARS:	
Classification of use by	Instructed person
Supply Connection	AC Mains
Supply % Tolerance	+10%/-10%
Supply Connection – Type	For building in
Considered current rating of protective device as part of building or equipment installation	10 A (The power modules are not internally fused. An external input line fast-acting fuse with a maximum value of 10 A is required.) A; equipment
Equipment mobility	for building-in
Over voltage category (OVC)	OVC II
Class of equipment	Class II
Access location	N/A
Pollution degree (PD)	PD 2
Manufacturer's specified maximum operating ambient (°C)	25 °C
IP protection class	IPX0
Power Systems	TN
Altitude during operation (m)	2000 m or less
Altitude of test laboratory (m)	2000 m or less
Mass of equipment (kg)	Less than 1 kg
POSSIBLE TEST CASE VERDICTS:	
- test case does not apply to the test object..... :	N/A
- test object does meet the requirement ..... :	P (Pass)
- test object does not meet the requirement ..... :	F (Fail)
TESTING:	
Date of receipt of test item..... :	2017-02-20, 2020-04-28, 2020-05-06
Date (s) of performance of tests..... :	2017-03-15 to 2017-07-27, 2020-05-06
GENERAL REMARKS:	
"(See Enclosure #)" refers to additional information appended to the report. **"(See appended table)" refers to a table appended to the report.** **Throughout this report a ☐ comma / ☒ point is used as the decimal separator.**	
Manufacturer's Declaration per sub-clause 4.2.5 of IECEE 02:	

The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided ..... :	☒ **Yes** ☐ **Not applicable**
When differences exist; they shall be identified in the General product information section.	
Name and address of factory (ies) ..... :	TDK-LAMBDA AMERICAS INC SUITE 100 3320 MATRIX DR RICHARDSON TX 75082 UNITED STATES TDK-LAMBDA MALAYSIA SDN BHD PLO33 KAWASAN PERINDUSTRIAN SENAI 81400 SENAI JOHOR MALAYSIA

GENERAL PRODUCT INFORMATION:

Report Summary

All applicable tests according to the referenced standard(s) have been carried out.

Product Description

Open frame power supply for building-in, electrical components are mounted on PWB.

The PFH product family consists of high density AC-DC power converter modules intended to be used as a component in an end-user's power system. The input voltage range is from 85Vac – 265Vac (RMS) input. The output voltage range will be between 12V and 48V depending upon the model number.

The PFH product is available in one mechanical configuration using the same transformer core set, the same input PFC (Power Factor Correction) inductor core set, and the same output filter inductor core set with the same geometry except for the air gap and number of turns used in the output inductor. PFH product is a fully vacuum potted power module using Momentive TSE3331 Silicon Rubber Compound with dielectric strength of 26kV/mm.

There are two house-keeping transformers used in PFH platform, AT00175 bias transformer with triple insulation wires, and AT00174 current sensing transformer with molded one (1) primary turn.

There are also two digital controllers responsible for PFC and DC-DC controls. A 4-channel digital isolator with wide body SOIC-16 package is used to deliver the drive pulses and PMBus communication commands to cross the primary to secondary isolation boundary with reinforced isolation. The digital isolator is UL 1577 recognized up to 5kVrms, CSA component notice 5A approval, (IEC 60950-1 reinforced insulation), VDE Certification conformity, and CQC certification approval, GB4943.1.

Model Differences

All models within this report are identical, except for model designation, output rating, and secondary winding of main Transformer.

Additional application considerations – (Considerations used to test a component or sub-assembly) -

This report is based on VDE CB report 236820-C13-1 and CB Test Certificate Ref. DE1-59169 respectively which was previously evaluated to UL/CSA/IEC 60950-1, 2nd edition, + Amendment 1, and Amendment 2. Testing conducted in accordance with IEC 60950-1:2005 (Second Edition), Am1:2009 + Am2:2013; UL 60950-1, 2nd Edition, 2014-10-14; and CAN/CSA C22.2 No. 60950-1-07, 2nd Edition, 2014-10, and was deemed equivalent to test required by IEC62368-1, 2nd Edition, CAN/CSA-C22.2 NO. 62368-1 2nd Ed, Issued December 1, 2014, and UL 62368-1 2nd Ed, Issued December 1, 2014. Testing correlation explanation is provided in Enclosure.

All original sample and test dates are noted in the testing portion of this report. 2020-05-06 is for construction review only.

The nameplate included in the report is representative of all models covered under this report.

Technical Considerations

- The product was submitted and evaluated for use at the maximum ambient temperature (Tma) permitted by the manufacturer's specification of : 25°C
- The product is intended for use on the following power systems : TN
- Considered current rating of protective device as part of the building installation (A) : 10 A (The power modules are not internally fused. An external input line fast-acting fuse with a maximum value of 10 A is required.)
- Mains supply tolerance (%) or absolute mains supply values : +10%/-10%. No direct connection to Mains.
- The equipment disconnect device is considered to be : N/A - to be determined in end use application
- The following are available from the Applicant upon request : Installation (Safety) Instructions / Manual
- The product was investigated to the following additional standard : EN 62368-1:2014 + A11:2017

Engineering Conditions of Acceptability

When installed in an end-product, consideration must be given to the following:

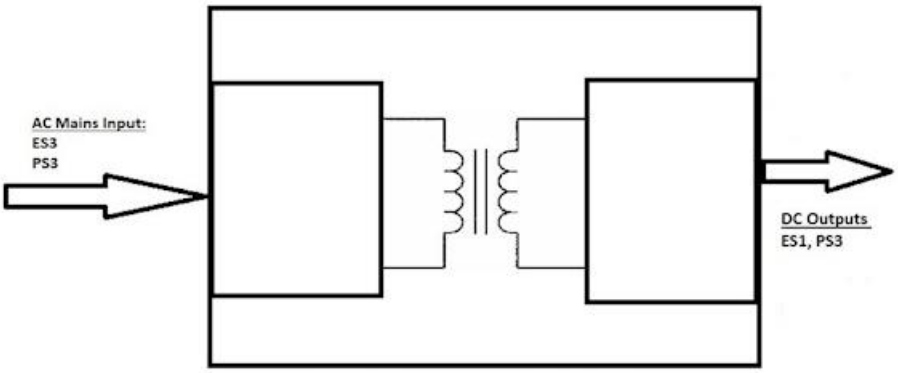
- The following product-line tests are conducted for this product : Electric Strength
- The end-product Electric Strength Test is to be based upon a maximum working voltage of : Primary-Secondary: 265 Vrms, 375 Vpk ,
- The following output circuits are at ES1 energy levels : Secondary Outputs
- The following output circuits are at PS3 energy levels : All
- The maximum investigated branch circuit rating is : 10 A (The power modules are not internally fused. An external input line fast-acting fuse with a maximum value of 10 A is required.)
- The investigated Pollution Degree is : 1
- The following end-product enclosures are required : Fire, Electrical
- The following components require special consideration during end-product Thermal (Heating) tests due to the indicated maximum temperature measurements during component-level testing : T1 Winding and core, and T2
- The maximum continuous power supply output (Watts) relied on forced air cooling from : All Heating Test were performed with 11.5cm x 11.5cm x 3.5cm tall pin fin heat sink attached to PFH module. Fan (Minebea Matsushita Motor Corp – model #3110KL-04WB30, 12VDC) was used to cool heat sink. For Heating test, the following fan voltage and resulting airflow (approximate due to turbulence) were used: (1)90Vin, 10.5Vfan, ~200LFM (2)100Vin, 13.5Vfan, ~325LFM (3)240Vin, 3.8Vfan, ~55LFM (4)265Vin, 3.5Vfan, ~30LFM.
- The power supply was evaluated to be used at altitudes up to : "2,000 m"

- 1.11 The power supply terminals and/or connectors are: Not investigated for field wiring
- Cap discharge test was not conducted. End product consideration.
- EUT is for building in. Prospective touch voltage and touch current test to be conducted in the end product.
- EUT is for building in. Input terminals not suitable for direct connection to Mains.
- Separation of primary and secondary circuits shall be maintained.

ENERGY SOURCE IDENTIFICATION AND CLASSIFICATION TABLE:	
(Note 1: Identify the following six (6) energy source forms based on the origin of the energy.) (Note 2: The identified classification e.g., ES2, TS1, should be with respect to its ability to cause pain or injury on the body or its ability to ignite a combustible material. Any energy source can be declared Class 3 as a worse case classification e.g. PS3, ES3.	
Electrically-caused injury (Clause 5): (Note: Identify type of source, list sub-assembly or circuit designation and corresponding energy source classification) Example: +5 V dc input ES1	
Source of electrical energy	**Corresponding classification (ES)**
AC Input (All Models)	ES3
DC Outputs (All Models)	ES1
Electrically-caused fire (Clause 6): (Note: List sub-assembly or circuit designation and corresponding energy source classification) Example: Battery pack (maximum 85 watts): PS2	
Source of power or PIS	**Corresponding classification (PS)**
AC Input (All Models)	PS3
DC Output (All Models)	PS3
Injury caused by hazardous substances (Clause 7) (Note: Specify hazardous chemicals, whether produces ozone or other chemical construction not addressed as part of the component evaluation.) Example: Liquid in filled component Glycol	
Source of hazardous substances	**Corresponding chemical**
n/a	--
Mechanically-caused injury (Clause 8) (Note: List moving part(s), fan, special installations, etc. & corresponding MS classification based on Table 35.) Example: Wall mount unit MS2	
Source of kinetic/mechanical energy	**Corresponding classification (MS)**
Mass	MS1
Thermal burn injury (Clause 9) (Note: Identify the surface or support, and corresponding energy source classification based on type of part, location, operating temperature and contact time in Table 38.) Example: Hand-held scanner – thermoplastic enclosure TS1	
Source of thermal energy	**Corresponding classification (TS)**
TS3	Access to be determined in end use product.
Radiation (Clause 10) (Note: List the types of radiation present in the product and the corresponding energy source classification.) Example: DVD – Class 1 Laser Product RS1	
Type of radiation	**Corresponding classification (RS)**
n/a	--

ENERGY SOURCE DIAGRAM
Indicate which energy sources are included in the energy source diagram. Insert diagram below

☒ **ES** ☒ **PS** ☐ **MS** ☐ **TS** ☐ **RS**



OVERVIEW OF EMPLOYED SAFEGUARDS				
Clause	**Possible Hazard**			
5.1	Electrically-caused injury			
Body Part (e.g. Ordinary)	Energy Source (ES3: Primary Filter circuit)	Safeguards		
		Basic	Supplementary	Reinforced (Enclosure)
Instructed	ES3: AC Input	--	--	Double/Reinforced Insulation provided between input and secondary outputs. Suitable electrical enclosure to be provided by end use product.
Instructed	ES1: DC Outputs	n/a	--	--
6.1	Electrically-caused fire			
Material part (e.g. mouse enclosure)	Energy Source (PS2: 100 Watt circuit)	Safeguards		
		Basic	Supplementary	Reinforced
Combustible Materials	PS3: All circuitry	No ignition. Temperatures under normal and abnormal conditions	--	Control of Fire Spread - components/materials complied with sub-clause 6.4.6; Suitable Fire Enclosure to be determined as part of end product evaluation.
7.1	Injury caused by hazardous substances			
Body Part (e.g., skilled)	Energy Source (hazardous material)	Safeguards		
		Basic	Supplementary	Reinforced
--	n/a	--	--	--
8.1	Mechanically-caused injury			
		Safeguards		

Body Part (e.g. Ordinary)	Energy Source (MS3:High Pressure Lamp)	Basic	Supplementary	Reinforced (Enclosure)
--	n/a	--	--	--
9.1	Thermal Burn			
Body Part (e.g., Ordinary)	Energy Source (TS2)	Safeguards		
		Basic	Supplementary	Reinforced
--	TS3: Not classified. Access to be determined in end use system.	--	--	--
10.1	Radiation			
Body Part (e.g., Ordinary)	Energy Source (Output from audio port)	Safeguards		
		Basic	Supplementary	Reinforced
--	n/a	--	--	--
Supplementary Information:				
(1) See attached energy source diagram for additional details. (2) “N” – Normal Condition; “A” – Abnormal Condition; “S” Single Fault				