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-A6027-CB-1
Date of issue .....:	2021-12-07
Total number of pages.....:	63
Name of Testing Laboratory preparing the Report.....:	UL RTP 12 Laboratory Drive, Research Triangle Park , NC, 27709, USA
Applicant's name.....:	**TDK-LAMBDA AMERICAS INC**
Address .....:	**3000 TECHNOLOGY DR, SUITE 100** **PLANO TX 75074** **UNITED STATES**
Test specification:	
Standard .....:	IEC 62368-1: 2018
Test procedure.....:	CB Scheme
Non-standard test method.....:	N/A
TRF template used .....:	IECEE OD-2020-F1:2020, Ed.1.3
Test Report Form No.....:	IEC62368_1E
Test Report Form(s) Originator...:	UL(US)
Master TRF.....:	Dated 2021-02-04

If this Test Report Form is used by non-IECEE members, the IECEE/IEC logo and the reference to the CB Scheme procedure shall be removed.

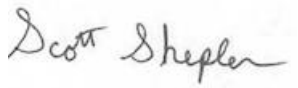
This report is not valid as a CB Test Report unless signed by an approved CB Testing Laboratory and appended to a CB Test Certificate issued by an NCB in accordance with IECEE 02.

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(s) .....:	TDK
Manufacturer.....:	TDK-LAMBDA AMERICAS INC 3000 TECHNOLOGY DR, SUITE 100 PLANO TX 75074 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)

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):	
☒ **CB Testing Laboratory:**	
Testing location/ address .....:	UL RTP, 12 Laboratory Drive, Research Triangle Park , NC, 27709, USA

Tested by (name, function, signature)..... :	Mengis Tesfay / Project Handler	
Approved by (name, function, signature) .. :	Scott Shepler / Reviewer	
☐ **Testing procedure: CTF Stage 1:**		
Testing location/ address ..... :		
Tested by (name, function, signature)..... :		
Approved by (name, function, 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, function, signature)..... :	Steve McKitrick / Tester	See original CBTR for signatures
Witnessed by (name, function, signature) . :	H. Kreuzer / Project Handler	See original CBTR for signatures
Approved by (name, function, signature) .. :	P. Mobs / Reviewer	See original CBTR for signatures
☐ **Testing procedure: CTF Stage 3:**		
☐ **Testing procedure: CTF Stage 4:**		
Testing location/ address ..... :		
Tested by (name, function, signature)..... :		
Witnessed by (name, function, signature) . :		
Approved by (name, function, signature) .. :		
Supervised by (name, function, signature) :		

List of Attachments (including a total number of pages in each attachment): National Differences (29 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**
5.4.1.5.2, 5.4.1.5.3 – TEST FOR POLLUTION DEGREE 1 ENVIRONMENT AND FOR AN INSULATING COMPOUND	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 the 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. This test was also considered representative to the test required per UL62368-1, 3rd Ed December 13, 2019; CAN/CSA-C22.2 No. 62368-1, 3rd Ed December 13, 2019; and IEC62368-1:2018, 3rd Ed.
5.4.7, 5.4.1.5.3 – TESTS FOR SEMICONDUCTOR COMPONENTS AND CEMENTED JOINTS	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 the 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. This test was also considered representative to the test required per UL62368-1, 3rd Ed December 13, 2019; CAN/CSA-C22.2 No. 62368-1, 3rd Ed December 13, 2019; and IEC62368-1:2018, 3rd Ed.
5.4.9 – ELECTRIC STRENGTH TEST	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 the 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. This test was also considered representative to the test required per UL62368-1, 3rd Ed December 13, 2019; CAN/CSA-C22.2 No. 62368-1, 3rd Ed December 13, 2019; and IEC62368-1:2018, 3rd Ed.
B.2.5 – INPUT TEST: SINGLE PHASE	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 the 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. This test was also considered representative to the test required per UL62368-1, 3rd Ed

	December 13, 2019; CAN/CSA-C22.2 No. 62368-1, 3rd Ed December 13, 2019; and IEC62368-1:2018, 3rd Ed.
B.1.5, B.2.6, 5.4.1.4, 6.3, 9.3 - NORMAL OPERATING CONDITIONS TEMPERATURE MEASUREMENT	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 the 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. This test was also considered representative to the test required per UL62368-1, 3rd Ed December 13, 2019; CAN/CSA-C22.2 No. 62368-1, 3rd Ed December 13, 2019; and IEC62368-1:2018, 3rd Ed.
B.3 - SIMULATED ABNORMAL OPERATING CONDITIONS	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 the 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. This test was also considered representative to the test required per UL62368-1, 3rd Ed December 13, 2019; CAN/CSA-C22.2 No. 62368-1, 3rd Ed December 13, 2019; and IEC62368-1:2018, 3rd Ed.
B.4 - SIMULATED SINGLE FAULT CONDITIONS	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 the 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. This test was also considered representative to the test required per UL62368-1, 3rd Ed December 13, 2019; CAN/CSA-C22.2 No. 62368-1, 3rd Ed December 13, 2019; and IEC62368-1:2018, 3rd Ed.

Summary of compliance with National Differences (List of countries addressed):

EU Group and National Differences, USA / Canada

☒ **The product fulfils the requirements of** EN IEC 62368-1:2020+A11:2020

Statement concerning the uncertainty of the measurement systems used for the tests

☐ **Internal procedure used for type testing through which traceability of the measuring uncertainty has been established:**

Procedure number, issue date and title:

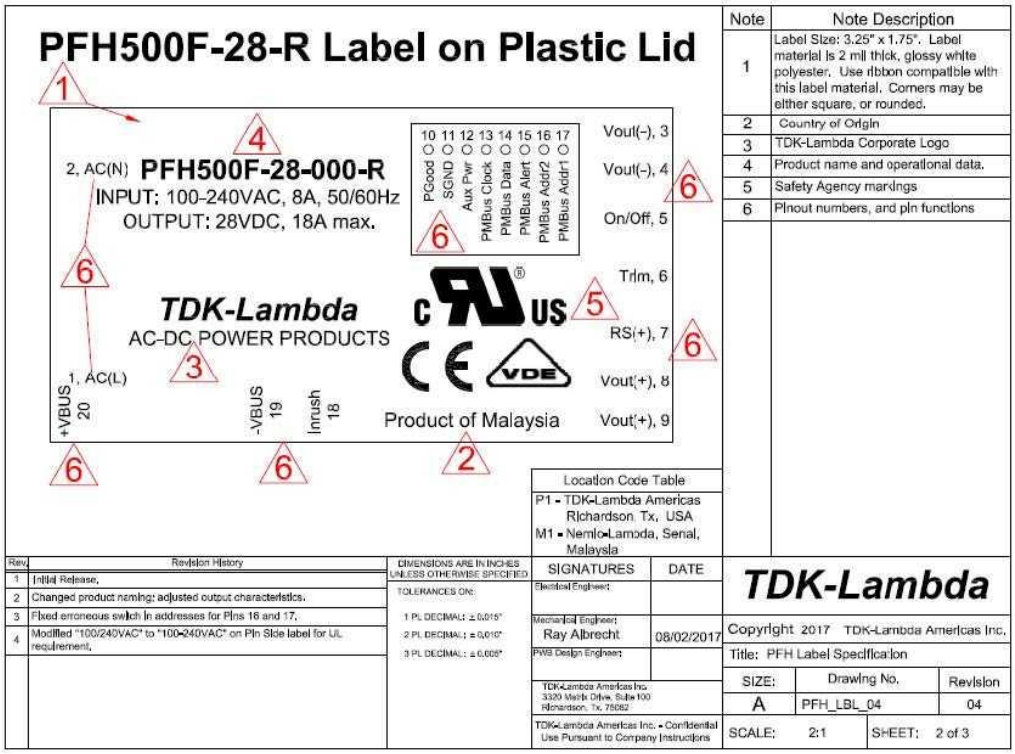
Calculations leading to the reported values are on file with the NCB and testing laboratory that conducted the testing.

☒ **Statement not required by the standard used for type testing**

(Note: When IEC or ISO standard requires a statement concerning the uncertainty of the measurement systems used for tests, this should be reported above. The informative text in parenthesis should be delete in both cases after selecting the applicable option)

Copy of marking plate:

The artwork below may be only a draft. The use of certification marks on a product must be authorized by the respective NCBs that own these marks.



Note: The above markings are the minimum requirements required by the safety lab. For the final production samples, the additional markings which do not give rise to misunderstanding may be added.

Test item particulars:	
Product group	--
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	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; Location: equipment
Equipment mobility	for building-in
Over voltage category (OVC)	OVC II
Class of equipment	Class II
Special installation location	N/A 0
Pollution degree (PD)	PD 2
Manufacturer's specified Tma (°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 3000 TECHNOLOGY DR, SUITE 100 PLANO TX 75074 UNITED STATES TDK-LAMBDA MALAYSIA SDN BHD PLO33 KAWASAN PERINDUSTRIAN SENAI SENAI JOHOR 81400 Malaysia

General product information and other remarks:

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 Information

This report is based on CB report references E220248-A6016-CB-1 and CB Test Certificate Ref. US-35792-UL, respectively which was previously evaluated to UL 62368-1, 2nd Edition, 2014-12-01, CSA C22.2 No. 62368-1-14, 2nd Edition, 2014-12, and IEC 62368-1:2014. Testing conducted in accordance with IEC UL 62368-1, 2nd Edition, 2014-12-01, CSA C22.2 No. 62368-1-14, 2nd Edition, 2014-12, and IEC 62368-1:2014, was deemed equivalent to the test required per UL62368-1, 3rd Ed December 13, 2019; CAN/CSA-C22.2 No. 62368-1, 3rd Ed December 13, 2019; and IEC62368-1:2018, 3rd Ed.

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 : +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 IEC 62368-1:2020+A11:2020

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.

OVERVIEW OF ENERGY SOURCES AND SAFEGUARDS				
Clause	**Possible Hazard**			
5	Electrically-caused injury			
Class and Energy Source (e.g. ES3: Primary circuit)	Body Part (e.g. Ordinary)	Safeguards		
		B	S	R
ES3: AC Input	Instructed	--	--	Double/Reinforced Insulation provided between input and secondary outputs. Suitable electrical enclosure to be provided by end use product.
ES1: DC Outputs	Instructed	n/a	--	--
6	Electrically-caused fire			
Class and Energy Source (e.g. PS2: 100 Watt circuit)	Material part (e.g. Printed board)	Safeguards		
		B	1st S	2nd S
PS3: All circuitry	Combustible Materials	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	Injury caused by hazardous substances			
Class and Energy Source (e.g. Ozone)	Body Part (e.g., Skilled)	Safeguards		
		B	S	R
n/a	--	--	--	--
8	Mechanically-caused injury			
Class and Energy Source (e.g. MS3: Plastic fan blades)	Body Part (e.g. Ordinary)	Safeguards		
		B	S	R

n/a	--	--	--	--
9	Thermal burn			
Class and Energy Source (e.g. TS1: Keyboard caps)	Body Part (e.g., Ordinary)	Safeguards		
		B	S	R
TS3: Not classified. Access to be determined in end use system.	--	--	--	--
10	Radiation			
Class and Energy Source (e.g. RS1: PMP sound output)	Body Part (e.g., Ordinary)	Safeguards		
		B	S	R
n/a	--	--	--	--
Supplementary Information:				
"B" – Basic Safeguard; "S" – Supplementary Safeguard; "R" – Reinforced Safeguard (1) See attached energy source diagram for additional details. (2) "N" – Normal Condition; "A" – Abnormal Condition; "S" Single Fault				

ENERGY SOURCE DIAGRAM
Optional. Manufacturers are to provide the energy sources diagram identify declared energy sources and identifying the demarcations are between power sources. Recommend diagram be provided included in power supply and multipart systems. Insert diagram below. Example diagram designs are; Block diagrams; image(s) with layered data; mechanical drawings

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