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 .....:	E135494-A6024-CB-2
Date of issue .....:	2023-01-12
Total number of pages.....:	293
Name of Testing Laboratory preparing the Report.....:	UL VS Limited Unit 1-3 Horizon, Wade Road, Kingsland Business Park, Basingstoke RG24 8AH, United Kingdom
Applicant's name.....:	**TDK-LAMBDA UK LTD**
Address .....:	**KINGSLEY AVE** **ILFRACOMBE** **EX34 8ES UNITED KINGDOM**
Test specification:	
Standard .....:	IEC 62368-1: 2018
Test procedure.....:	CB Scheme
Non-standard test method.....:	N/A
TRF template used .....:	IECEE OD-2020-F1:2021, Ed.1.4
Test Report Form No.....:	IEC62368_1E
Test Report Form(s) Originator...:	UL(US)
Master TRF .....:	Dated 2022-04-14

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 .....:	Modular Power Converter
Trade Mark(s) .....:	TDK LAMBDA
Manufacturer.....:	TDK-LAMBDA UK LTD KINGSLEY AVE ILFRACOMBE EX34 8ES UNITED KINGDOM
Model/Type reference .....:	Alpha 400, Alpha 400W, MA400, CA400, Alpha-400, Alpha-400W, MA-400, CA-400 Alpha 600, CA600, Alpha 600W, Alpha-600, CA-600 Alpha 800, Alpha 800W, CA800 Alpha 1000, Alpha 1000W, CA1000 Alpha 1500, Alpha 1500W, CA1500
Ratings .....:	Alpha 400, Alpha 400W, MA400, CA400, Alpha-400, Alpha-400W, MA-400, CA-400: 100 – 240Vac nominal, 7A max, 47-63Hz Alpha 600, CA600, Alpha 600W, Alpha-600, CA-600: 100 - 240Vac or 177-326Vdc nominal. 47-63Hz, 10Aac or 6Adc Alpha 800, Alpha 800W, CA800, Alpha 1000, Alpha 1000W, CA1000: 94.5 - 240Vac nominal, 133-328Vdc nominal,16Aac, 11Adc, 47-63Hz Alpha 1500, Alpha 1500W, CA1500: 94.4-240Vac nominal, 16A Max, 47-63 Hz

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):			
☒	**CB Testing Laboratory:**		
Testing location/ address .....:		UL VS Limited, Unit 1-3 Horizon, Wade Road, Kingsland Business Park, Basingstoke RG24 8AH, United Kingdom	
Tested by (name, function, signature).....:		Hubert Koszewski / Project Handler	
Approved by (name, function, signature) ..:		Jan J. Jensen / 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 ..... :		
Tested by (name, function, signature)..... :		
Witnessed by (name, function, signature) . :		
Approved by (name, function, signature) .. :		
☒ **Testing procedure: CTF Stage 3:**		
☐ **Testing procedure: CTF Stage 4:**		
Testing location/ address ..... :	TDK-LAMBDA UK LTD KINGSLEY AVE ILFRACOMBE EX34 8ES UNITED KINGDOM	
Tested by (name, function, signature)..... :	Mark Gibsey / Tester	see prior report CBTR for signature
Witnessed by (name, function, signature) . :	Mark John De Sagun / Witness	Refer to GPI for detals
Approved by (name, function, signature) .. :	David Snook / Reviewer	see prior report CBTR for signature
Supervised by (name, function, signature) :	Mark John De Sagun / Project Handler	see prior report CBTR for signature

List of Attachments (including a total number of pages in each attachment):

National Differences (28 pages)
Enclosures (295 pages)

Summary of testing:

Tests performed (name of test and test clause):	**Testing Location:** **CTF Stage 3: TDK-LAMBDA UK LTD** **KINGSLEY AVE** **ILFRACOMBE** **EX34 8ES UNITED KINGDOM**
5.2.2.1-5.2.2.6 – CLASSIFICATION OF ELECTRICAL ENERGY SOURCES	Conducted in original investigation. Test performed according to IEC/UL 62368-1 2nd ed. Compliance criteria equivalent to 3rd ed no additional evaluation required.
5.4.1.8 – DETERMINATION OF WORKING VOLTAGE	Conducted in original investigation. Test performed according to IEC/UL 62368-1 2nd ed. Compliance criteria equivalent to 3rd ed no additional evaluation required.
5.4.4.6.2 – SEPARABLE THIN SHEET MATERIAL	Conducted in original investigation. Test performed according to IEC/UL 62368-1 2nd ed. Compliance criteria equivalent to 3rd ed no additional evaluation required.
5.4.9.1 – ELECTRIC STRENGTH TEST – TYPE TESTING OF SOLID INSULATION	Conducted in original investigation. Test performed according to IEC/UL 62368-1 2nd ed. Compliance criteria equivalent to 3rd ed no additional evaluation required.
5.5.2.2 – CAPACITOR DISCHARGE AFTER DISCONNECTION OF A CONNECTOR	Conducted in original investigation. Test performed according to IEC/UL 62368-1 2nd ed. Compliance criteria equivalent to 3rd ed no additional evaluation required.
5.6.6.2 – RESISTANCE OF THE PROTECTIVE BONDING SYSTEM	Conducted in original investigation. Test performed according to IEC/UL 62368-1 2nd ed. Compliance criteria equivalent to 3rd ed no additional evaluation required.
5.7.5 – TOUCH CURRENT MEASUREMENT – EARTHED ACCESSIBLE CONDUCTIVE PARTS – SINGLE-PHASE EQUIPMENT ON TN OR TT SYSTEM	Conducted in original investigation. Test performed according to IEC/UL 62368-1 2nd ed. Compliance criteria equivalent to 3rd ed no additional evaluation required.
B.2.5 – INPUT TEST: SINGLE PHASE	Conducted in original investigation. Test performed according to IEC/UL 62368-1 2nd ed. Compliance criteria equivalent to 3rd ed no additional evaluation required.
B.2.6, 5.4.1.4, 6.3, 9.3, B.1.5 – NORMAL OPERATING CONDITIONS TEMPERATURE MEASUREMENT	Conducted in original investigation. Test performed according to IEC/UL 62368-1 2nd ed. Compliance criteria equivalent to 3rd ed no additional evaluation required.
B.3 – SIMULATED ABNORMAL OPERATING CONDITIONS	Conducted in original investigation. Test performed according to IEC/UL 62368-1 2nd ed. Compliance criteria equivalent to 3rd ed no additional evaluation required.
B.4 – SIMULATED SINGLE FAULT CONDITIONS	Conducted in original investigation. Test performed according to IEC/UL 62368-1 2nd ed. Compliance criteria equivalent to 3rd ed no additional evaluation required.
G.5.3.3 – TRANSFORMER OVERLOAD	Conducted in original investigation. Test performed according to IEC/UL 62368-1 2nd ed. Compliance criteria equivalent to 3rd ed no additional evaluation required.

R.1-R.4 - LIMITED SHORT CIRCUIT TEST	Conducted in original investigation. Test performed according to IEC/UL 62368-1 2nd ed. Compliance criteria equivalent to 3rd ed no additional evaluation required.
T.2, 5.4.2.6, 5.4.3.2, G.15.2.6 – STEADY FORCE TEST, 10 N	Conducted in original investigation. Test performed according to IEC/UL 62368-1 2nd ed. Compliance criteria equivalent to 3rd ed no additional evaluation required.

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, CSA/UL 62368-1:2019

Use of uncertainty of measurement for decisions on conformity (decision rule) :

☒ No decision rule is specified by the IEC standard, when comparing the measurement result with the applicable limit according to the specification in that standard. The decisions on conformity are made without applying the measurement uncertainty (“simple acceptance” decision rule, previously known as “accuracy method”).

☐ Other:… (to be specified, for example when required by the standard or client, or if national accreditation requirements apply)

Information on uncertainty of measurement:

The uncertainties of measurement are calculated by the laboratory based on application of criteria given by OD-5014 for test equipment and application of test methods, decision sheets and operational procedures of IECEE. IEC Guide 115 provides guidance on the application of measurement uncertainty principles and applying the decision rule when reporting test results within IECEE scheme, noting that the reporting of the measurement uncertainty for measurements is not necessary unless required by the test standard or customer.

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

Copy of Marking Plate - Refer to Enclosure titled Marking Plate for copy.

Test item particulars:	
Product group	built-in component
Classification of use by	Skilled person
Supply Connection	AC Mains DC Mains
Supply tolerance	+10%/-10%
Supply connection – type	to be determined in End Product (mating connector)
Considered current rating of protective device	20 A; Location: building
Equipment mobility	for building-in
Over voltage category (OVC)	OVC II
Class of equipment	Class I
Special installation location	N/A
Pollution degree (PD)	PD 2
Manufacturer's specified Tma (°C)	50; 45 (for Alpha 1000 series only)
IP protection class	IPX0
Power systems	TN TT
Altitude during operation (m)	3000 m
Altitude of test laboratory (m)	64 m
Mass of equipment (kg)	max. 3.5
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 .....:	2019-06-13 to 2020-09-24, 2020-08-24, 2020-08-27, 2020-09-03
Date (s) of performance of tests .....:	2020-06-03 to 2020-10-01, 2022-07-28 TO 2022-07-29
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 UK LTD KINGSLEY AVE ILFRACOMBE EX34 8ES UNITED KINGDOM Panyu Trio Microtronics Co Ltd SHIJI INDUSTRIAL ESTATE DONGYONG NANSHA GUANGZHOU GUANGDONG 511453 CHINA

General product information and other remarks:

Product Description

The Alpha is a factory configurable modular switch mode power supply intended for building in to host equipment. The range covers the following: Alpha 400, Alpha 600, Alpha 800 (or Alpha 1000) and Alpha 1500 (there are non-standard variations to all ranges).

Model Differences

Alpha 400 is identical to the Alpha 400W, MA400, CA400, Alpha-400, Alpha-400W, MA-400 and CA-400. The Alpha 400 has a single forward converter with 5 output slots for a maximum of 5 modules. Cooling is provided by a single fan. Alpha 400 Series has a 400 W maximum output.

Alpha 600 is identical to the CA600, Alpha 600W, Alpha-600 and CA-600. The Alpha 600 has a single forward converter with 5 output slots for a maximum of 5 modules. Cooling is provided by a single fan. Alpha 600 Series has a 600 W maximum output.

Alpha 800 is identical to the Alpha 800W and CA800. Alpha 1000 is identical to the Alpha 1000W and CA1000. The Alpha 800/Alpha 1000 are electrically and mechanically identical with different ratings. These psu's have two forward converters with 7 output slots with up to 7 output modules. Cooling is provided by two fans. Alpha 800 Series has a 800 W maximum output and the Alpha 1000 Series has a 1000 W maximum output

Alpha 1500 and Alpha 1500W are identical to CA1500. These psu's have two forward converters with 8 output slots with up to 8 output modules. Cooling is provided by two fans.

Refer to enclosure 7-03 for ratings, loading conditions, module ratings table, secondary options, and other information.

Additional Information

Reissue 1:

This report is a reissue of CBTR Reference Number E135494-A6024-CB-1 issued on 2022-11-15 with CB Test Certificate Ref. DK-105070-M1-UL with the following changes:

- test report updated to the latest edition of the standard IEC 62368-1:2018

Based on the previously conducted testing and the review of product technical documentation including photos, schematics, wiring diagrams and similar, has been determined that the product continues to comply with the standard.

Project No. 4790099713: The following tests were selected as representative of the test program applicable to model covered by this CBTR: Normal Operating Conditions Temperature Measurement (Cl. B.2.6), Simulated Abnormal Operating Conditions (B.3), and Electric Strength (Cl. 5.4.9). These tests have been witnessed for models selected as representative of the standard covered by this report and the applicable test program.

(UL Project 4790521043_11-2022) The following tests were selected as representative of the test program applicable to model covered by this CBTR: Operating temperature measurement conditions (Cl. B.2.6), Simulated Abnormal Operating Conditions (B.3), and Electric Strength (Cl. 5.4.9).

These tests have been witnessed for models selected as representative of the standard covered by this report and the applicable test program.

The marking label provided is representative of all models.

The main transformers for this product (T205 Alpha 400, T203 Alpha 600, T202 & T302 Alpha 800/1000 and 1500) do not have an overall part number as some parts are listed in the bill of materials for the forward converters (primary windings, cores etc.) and others are listed in the bill of materials for individual modules (secondary's).

Technical Considerations

- The product was submitted and evaluated for use at the maximum ambient temperature (Tma) permitted by the manufacturer's specification of : 50°C, 45 (for Alpha 1000 series only - see CofA)
- The product is intended for use on the following power systems : TN, TT, DC mains supply
- Considered current rating of protective device as part of the building installation (A) : 20
- Mains supply tolerance (%) or absolute mains supply : +10%/-10%
- The equipment disconnect device is considered to be : Appliance inlet for models equipped with one, or evaluated in End Product for models with spade or screw connectors.
- The following were investigated as part of the protective earthing/bonding : Printed wiring board trace (refer to Enclosure - Schematics + PWB for layouts)
- The Risk Group of a lamp or lamp system (including LEDs) is : Exempt
- The following are available from the Applicant upon request : Installation (Safety) Instructions / Manual, also in languages other than English, including French language for Canadian national difference.
- Components have been evaluated for compliance to IEC or national standards. It shall be noted that provision of clause 4.1.1 was considered for components and subassemblies complying with IEC 60950-1 or IEC 60065 used as part of equipment covered by this standard without further evaluation other than to give consideration to the appropriate use of the component or subassembly in the end-product. Additional certificates may be required at the discretion of the accepting NCB or local authorities.

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 : Earthing Continuity, Electric Strength
- The following output circuits are at ES1 energy levels : All outputs (also refer to module description on Enclosure 7-03, section "Energy source levels and outputs connected in series")
- The following output circuits are at ES2 energy levels : Modules with greater than 3 turn secondary's with unearthed output/s (also refer to module description on Enclosure 7-03, section "Energy source levels and outputs connected in series")
- The following output circuits are at PS3 energy levels : All outputs (by declaration)
- The maximum investigated branch circuit rating is : 20 A
- The investigated Pollution Degree is : 2
- Proper bonding to the end-product main protective earthing termination is : Required
- An investigation of the protective bonding terminals has : been conducted
- The following input terminals/connectors must be connected to the end-product supply neutral : "N"
- The following end-product enclosures are required : Electrical, Fire, Mechanical
- The following magnetic devices (e.g. transformers or inductor) are provided with an OBJY2 insulation system with the indicated rating greater than Class A (105°C) : Alpha 400: T205 (Class F); , Alpha 600: T203 (Class F); , Alpha 800/1000: T202 (Class F), T302 (Class F), T4/T1 (Class F or Class A optional – refer to CCL); , Alpha 1500: T202 (Class F), T302 (Class F);
- The following components require special consideration during end-product Thermal (Heating) tests due to the indicated maximum temperature measurements during component-level testing : X Capacitors (100°C), Electrolytic Capacitors (105°C), Chokes (130°C), TRX (130°C), Optocouplers (100°C), PCB (130°C)
- The equipment is suitable for direct connection to : AC mains supply,; DC mains supply for models with DC input rating.
- The power supply was evaluated to be used at altitudes up to : 3000m
- The end-product Electric Strength Test for the Alpha 400 is to be based upon a maximum working voltage of : Primary – Earthed Dead Metal: 291 Vrms / 400 Vpk, Primary-Secondary: 336 Vrms /864 Vpk
- The end-product Electric Strength Test for the Alpha 600 is to be based upon a maximum working voltage of : Primary – Earthed Dead Metal: 380 Vrms / 412 Vpk, Primary-Secondary: 406 Vrms / 728 Vpk
- The end-product Electric Strength Test for the Alpha 800/1000 is to be based upon a maximum working voltage of : Primary – Earthed Dead Metal: 360 Vrms / 384 Vpk, Primary-Secondary: 377 Vrms / 824Vpk
- The end-product Electric Strength Test for the Alpha 1500 is to be based upon a maximum working voltage of : Primary – Earthed Dead Metal: 284 Vrms / 384 Vpk, Primary-Secondary: 330 Vrms / 652 Vpk
- For Alpha 1000 series, where the specified Tma is 45°C, an elevated Tma (for example 50°C) can be considered and evaluated in the end use application allowing for specific load conditions.