Test Report issued under the responsibility of:

TEST REPORT

IEC 60950-1
Information technology equipment – Safety – Part 1: General requirements

Report Number. .....:	E135494-A113-CB-2
Date of issue .....:	2021-04-23
Total number of pages.....	73
Name of Testing Laboratory preparing the Report .....:	UL International Polska sp. z o.o. Równoległa 4, PL-02-235 Warszawa, Poland
Applicant's name .....:	TDK-LAMBDA UK LTD
Address .....:	KINGSLEY AVE ILFRACOMBE EX34 8ES UNITED KINGDOM
Test specification:	
Standard.....:	IEC 60950-1:2005, AMD1:2009, AMD2:2013
Test procedure .....:	CB Scheme
Non-standard test method .....:	N/A
Test Report Form No. .....:	IEC60950_1G
Test Report Form(s) Originator ....:	SGS Fimko Ltd
Master TRF.....:	Dated 2019-07-02

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.
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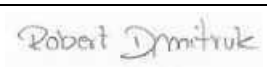
Test item description ..... :	AC-DC Power Supply
Trade Mark ..... :	TDK-Lambda
Manufacturer ..... :	TDK-LAMBDA UK LTD KINGSLEY AVE ILFRACOMBE EX34 8ES UNITED KINGDOM
Model/Type reference ..... :	CUS100ME CUS150M (see model differences for details of nomenclature)
Ratings ..... :	Input AC rated models: 100-240Vac; 47-63Hz or 47-440Hz; 2.2Arms max. Input DC rated models (CUS150M only): 133 - 318Vdc; 1.8A max. Output: 12, 15, 18, 24, 28, 36 or 48Vdc nominal, max. 100 or 150W (see model differences for full details)

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):			
☒	**CB Testing Laboratory:**		
Testing location/ address.....:		UL International Polska sp. z o.o., Równoległa 4, PL-02-235 Warszawa, Poland	
Tested by (name, function, signature).....:		Pawel Ciuba / Project Handler	
Approved by (name, function, signature)...:		Robert Dmitruk / 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 + signature) .....:		
Witnessed by (name, function, signature) .:		
Approved by (name, function, signature)...:		
☐ **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 (61 pages)
Enclosures (150 pages)

Summary of testing:

Tests performed (name of test and test clause): None	**Testing Location: None**

Summary of compliance with National Differences:

List of countries addressed: Argentina, Australia / New Zealand, China, EU Group and National Differences, Israel, Japan, Korea, Singapore, 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 60950-1:2006 + A1:2010 + A11:2009 + A12:2011 + A2:2013

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

Test item particulars..... :	
Equipment mobility	for building-in
Connection to the mains	not directly connected to the mains
Operating condition	continuous
Access location	for building-in
Over voltage category (OVC)	OVC II
Mains supply tolerance (%) or absolute mains supply values	+10%, -10%
Tested for IT power systems	Yes
IT testing, phase-phase voltage (V)	230Vac (Norway)
Class of equipment	to be determined in the end-product (may be used in Class I or Class II application)
Considered current rating of protective device as part of the building installation (A)	20 A
Pollution degree (PD)	PD 2
IP protection class	IP X0
Altitude of operation (m)	up to 5000 meters
Altitude of test laboratory (m)	less than 2000 meters
Mass of equipment (kg)	0.2

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.....:	2017-01-12, 2017-01-19, 2017-01-27, 2017-07-11, 2018-01-03, 2018-01-12, 2018-01-15, 2018-02-12
Date (s) of performance of tests .....:	2017-02-17 to 2017-02-28, 2017-03-03 to 2017-03-06, 2017-04-04, 2017-07-18, 2018-02-19 to 2018-03-07

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 TDK-LAMBDA MALAYSIA SDN BHD LOT 2 & 3, BATU 9 3/4 KAWASAN PERINDUSTRIAN BANDAR BARU JAYA GADING 26070 KUANTAN PAHANG MALAYSIA PANYU TRIO MICROTRONICS CO LTD SHIJI INDUSTRIAL ESTATE DONGYONG NANSHA GUANGZHOU GUANGDONG 511453 CHINA

General product information:

Product Description

The product is a power supply for building in to end equipment. It is available as open frame, U chassis, U chassis and lid, Base plate and with a top fan version (CUS150M model only).

The power supply can be used as either a Class I or a Class II construction.

- For Class I construction, the power supply will need to be reliably earthed, professionally installed and fixed with suitable, metal screws.
- For Class II construction no earthing connection is required. The power supply needs to be fixed so that it is insulated from any unearthed accessible conductive part by reinforced insulation.

The power supply provides two fuses for input protection. One in the Live line and one in the Neutral line. Option E uses one fuse only. This is fitted in the live line only.

The power supply can be forced air (top fan or customer air), convection or conduction cooled. Due to the fact that air flow for cooling depends on end product use, only convection cooling and top fan configurations were considered during temperature measurement.

The component temperatures listed in the additional information shall not be exceeded.

Model Differences

The CUS has two ranges of 100W and 150W each with seven nominal output voltages of 12, 15, 18, 24, 28, 36 and 48 Vdc. Each output has a range shown in the table below which is factory configurable only.

CUS models as described below:

Units may be marked with a Product Code: CUSZ-xxVx/yyyy where Z is 100ME or 150M and x may be any number of numbers or left blank to indicate the output voltage. V represents a decimal place when required or can left be left blank. y can be any number of numbers or letters (excluding M, E, U, A, F, B, H) when indicating non-safety related model differences. y can be M, E, U, A, F, B, H when indicating the standard options as listed below.
Unit Product Code may be prefixed by K, SP # and/or NS # followed by / or - (where # may be any number of characters indicating non-safety related model differences).

Unit Product Code:

CUSZ-xxVx/yyyy

Where
Z = 150M for 150W model (May be followed by 'D' for DC input)
100ME for 100W model
xxVx = Channel 1 output voltage from within the output voltage adjustment range from the Output Parameters Table below.
yyyy = Unit options from list of standard unit options below, or non-safety related model differences

/M = Molex connectors
/E = Single fuse in the live line
/U = U chassis
/A = Cover and U chassis
/F = Top fan, cover and U chassis (CUS150M model only)
/B = Baseplate
/H = alternate link wire and discharge resistors (60335-1 compliant, 60950-1approved only)

Non standards

KCUS150MKCUSZ-xx-yyyy/H

Where:

Where
Z = 150M for 150W model (May be followed by 'D' for DC input)
100ME for 100W model
xxVx = Channel 1 output voltage from within the output voltage adjustment range from the Output Parameters Table below.
yyyy = Unit options from list of standard unit options below, or non-safety related model differences

/M = Molex connectors
/E = Single fuse in the live line
/U = U chassis
/A = Cover and U chassis
/F = Top fan, cover and U chassis (CUS150M model only)
/B = Baseplate

Followed by
/H = alternate link wire and discharge resistors (60335-1 compliant, 60950-1 approved onlyCUS150M model and 60950-1 only)

Input Parameters

Standard	60601-1	60950-1/61010-1	60950-1/61010-1/60601-1*
Nominal input voltage	100 - 240Vac	100 - 240Vac	133 - 318Vdc
Input voltage range	85 - 264Vac	85 - 264Vac	120 - 350Vdc
Input frequency range	47 - 63Hz	47 - 440Hz	DC
Maximum input current	2.2A rms	2.2A rms	1.8A

* 60601-1 2nd ed, 300Vdc input max.

All ratings apply for ambient temperatures up to 50°C. (see Variations and Limitations below)
Output power is reduced linearly by 10% for input voltages from 90 to 85Vac

Output Parameters

There are seven CUS150M and CUS100ME standard models as shown in the tables below. All of these models may be fan(CUS150M model only), forced air, conduction or convection cooled. The output parameters are shown in the tables below.
Outputs are not user adjustable but can be factory set.

CUS150M

Model	Vout Range (V)	*Fan Vnom (V)	Max Iout (A)	Max Pout (W)	*Fan Output ratings Inom (A)	Pnom (W)
12	12-13.2	11.6	12.5	150	0.5	5.8
15	15-16.5	9.8	10	150	0.5	4.9
18	18-19.8	11.6	8.33	150	0.5	5.8
24	24-26.4	11.6	6.25	150	0.5	5.8
28	28-30.8	10.8	5.4	150	0.5	5.4
36	36-39.6	11.6	4.2	150	0.5	5.8
48	48-50	11.6	3.125	150	0.5	5.8

* Fan output tracks Vout Range

Variation and Limitations:

Customer Forced Air Cooling max ambient 85°C (note 1)
Convection and conduction/cold plate Cooling (U chassis with lid-Option A) max ambient 75°C (note 1)
Convection and conduction/cold plate Cooling (U chassis and open frame) max ambient 80°C (note 1)
Fan supplied ratings/Option F max ambient 70°C, from 50°C to 70°C the output power is de-rated by 0.5°C per watt
Note 1. Maximum output power and current ratings are dependent on the ambient used in the end equipment.

CUS100M

Model	Vout Range (V)	Max Iout (A)	Max Pout (W)
12	12-13.2	8.33	100
15	15-16.5	6.66	100
18	18-19.8	5.55	100
24	24-26.4	4.16	100
28	28-30.8	3.57	100
36	36-39.6	2.77	100
48	48-50	2.08	100

Variation and Limitations:

Customer Forced Air Cooling max ambient 85°C (note 1)
Convection and conduction/cold plate Cooling (U chassis with lid-Option A) max ambient 75°C (note 1)
Convection and conduction/cold plate Cooling (U chassis and open frame) max ambient 80°C (note 1)

Note 1. Maximum output power and current ratings are dependent on the ambient used in the end equipment.

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

Cooling for units with forced air cooling.

The product can also operate at input voltage lowered to 85Vac with linear output de-rating to -10%.

The following method must be used for determining the safe operation of PSUs.

The components listed in the following table must not exceed the temperatures given. To determine the component temperatures the heating tests must be conducted in accordance with the requirements of the standard in question. Consideration should also be given to the requirements of other safety standards.

Test requirements include: PSU to be fitted in its end-use equipment and operated under the most adverse conditions permitted in the end-use equipment handbook/specification and which will result in the highest temperatures in the PSU. To determine the most adverse conditions consideration should be given to the end use equipment maximum operating ambient, the PSU loading and input voltage, ventilation, end use equipment orientation, the position of doors & covers, etc. Temperatures should be monitored using type K fine wire thermocouples (secured with cyanoacrylate adhesive or similar) placed on the hottest part of the component (out of any direct airflow) and the equipment should be run until all temperatures have stabilized.

Cooling for unit temperature table:

CUS150M Cooling for Unit Temperature Table:

Circuit Ref.	Description	Max. Temperature (°C)
L1	Common Mode Choke	110 (130)
L2	PFC choke	125 (130)
L3	Differential mode choke	125 (130)
C1	Film capacitor	105
C2, C110	Electrolytic Capacitors	86 (105)
C6, C102, C104, C105	Electrolytic Capacitors	92 (105)
C3	X Capacitor	100
C5, C100, C101, C103	Y Capacitors	105
TX100	Transformer Winding	110
XU101, XU102	Opto-Coupler	100 (110)
XD8	Diode	130
J1	Input Connector	105
J100	Output Connector	105

CUS100ME Cooling for Unit Temperature Table:

Circuit Ref.	Description	Max. Temperature (°C)
L1	Common Mode Choke	110 (130)
L2	PFC choke	125 (130)
L3	Differential mode choke	125 (130)
C1	Film capacitor	105
C2	Electrolytic Capacitors	90 (105)

C104, C105	Electrolytic Capacitors	92	(105)
C6, C102	Electrolytic Capacitors	93	(105)
C3	X Capacitor	100	
C5, C100, C101, C103,	Y Capacitors	105	
TX100	Transformer Winding	110	
XU101, XU102	Opto-Coupler	100	(110)
XD8	Diode	130	
J1	Input Connector	105	
J100	Output Connector	105	

Higher temperature limits (in brackets) may be used but product life may be reduced.

Amendment 1

The original test report was modified due to the following changes:

- touch current test repeated per the client's request, new measurements replaced the previous test results.

No construction changes in the product.

Based on the new test results and the results from the previous investigation the product continues to comply with the requirements of the Standard.

Correction 1

The original test report E135494-A113 was modified due to minor typographical corrections.

No testing deemed to be necessary.

Amendment 2

The original test report was modified due to the following changes:

- Added CUS100ME models
- Added CUS150M with the following output voltages: 15, 18, 28 and 36Vdc
- Added DC input rating option for CUS150M models
- Critical component list updated to include the new models

Based on the new test results and the results from the previous investigation limited testing was necessary.

Reissue 1:

This report is a reissue of report Ref. No. E135494-A113-CB-1 dated 2017-05-04, Correction 1 dated 2017-05-08, Amendment 1 dated 2017-09-20, Amendment 2 dated 2018-03-16, Amendment 3 dated 2019-11-17, CB certificate DK-63210-UL, DK-63211-UL, DK-63210-A1-UL, DK-63211-A1-UL, DK-63210-A2-UL, DK-63211-A2-UL, DK-63210-A3-UL. DK-63211-A3-UL.

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.

In addition during this report reissue the following changes have been applied:

- added alternate input connector J1 - 09652038 (5273 Series) manufactured by Molex,
- added manufacturer to the TX100 insulation system CB2 and CB3.
- CBTL changed to UL International Poland Sp. z o.o.

No tests conducted under this investigation due to reissue of CB Test Report Ref. No. E135494-A113-CB-1 with all amendments. All required tests were carried out under the original investigation.

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
- The means of connection to the mains supply is : to be determined in the end-product
- The product is intended for use on the following power systems : DC mains supply (CUS150M DC-rated only), IT (Norway), TT, TN
- The equipment disconnect device is considered to be : determined in the end-product
- The product was investigated to the following additional standards : EN 60950-1:2006 + A11:2009 + A1:2010 + A12:2011 + A2:2013 (which includes all European national differences, including those specified in this test report).
- The following accessible locations (with circuit/schematic designation) are within a limited current circuit : Load side of the C101-C103 capacitors
- The following are available from the Applicant upon request : Installation (Safety) Instructions / Manual
- Above 50°C the total output power and current ratings are both de-rated to ensure power curves are met. Refer to Handbook in Enclosures 6-01 and 6-02 for the power curves.
- For Class I construction, the power supply will need to be reliably earthed, professionally installed and fixed with suitable, metal screws. For Class II construction no earthing connection is required. The power supply needs to be fixed so that it is insulated from any unearthed accessible conductive part by reinforced insulation.
- The component temperatures listed in the Additional Information shall not be exceeded.
- The minimum CLEARANCE is multiplied by the factor 1.48 corresponding altitude of 5000m given in IEC 60664-1.

Engineering Conditions of Acceptability

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

- The following Production-Line tests are conducted for this product : Earthing Continuity, Electric Strength
- The end-product Electric Strength Test is to be based upon a maximum working voltage of : Primary-SELV: 268 Vrms, 480 Vpk, Primary-Earthed Dead Metal: 350 Vrms, 410 Vpk
- The following secondary output circuits are SELV : PSU output
- The following secondary output circuits are at non-hazardous energy levels : PSU output
- The following secondary output circuits are Limited Current Circuits : Load side of the C101-C103 capacitors
- The following output terminals were referenced to earth during performance testing : Output negative
- The power supply terminals and/or connectors are : Not investigated for field wiring
- The maximum investigated branch circuit rating is : 20 A
- The investigated Pollution Degree is : 2
- 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) : TX100 (class B)
- The following end-product enclosures are required : Mechanical, Electrical, Fire
- Fans : The fan provided in this sub-assembly is not intended for operator access.
- The power supply can be forced air (top fan or customer air) or convection cooled. Due to the fact that air flow for cooling depends on end product use, only convection cooling and top fan configurations were considered during temperature measurement

Abbreviations used in the report:

- normal conditions	**N.C.**	- single fault conditions	**S.F.C**
- functional insulation	**OP**	- basic insulation	**BI**
- double insulation	**DI**	- supplementary insulation	**SI**
- between parts of opposite polarity	**BOP**	- reinforced insulation	**RI**

Indicate used abbreviations (if any)