







Test Report issued under  
the responsibility of:



<b>TEST REPORT</b> <b>IEC 61010-1</b> <b>Safety requirements for electrical equipment for measurement, control, and laboratory use</b> <b>Part 1: General requirements</b>	
<b>Report Reference No</b> .....	E331788-A19-CB-2
<b>Date of issue</b> .....	2015-08-07
<b>Total number of pages</b> .....	121
<b>CB Testing Laboratory</b> .....	UL International Germany GmbH
<b>Address</b> .....	Admiral-Rosendahl-Strasse 23, 63263 Neu-Isenburg (Zeppelinheim), Germany
<b>Applicant's name</b> .....	TDK-LAMBDA UK LTD
<b>Address</b> .....	KINGSLEY AVE ILFRACOMBE DEVON EX34 8ES UNITED KINGDOM
<b>Test specification:</b>	
<b>Standard</b> .....	IEC 61010-1:2010, 3rd Edition
<b>Test procedure</b> .....	CB Scheme
<b>Non-standard test method</b> .....	N/A
<b>Test Report Form No.</b> .....	IEC61010_1H
<b>Test Report Form originator</b> .....	VDE Testing and Certification Institute
<b>Master TRF</b> .....	2011-11
<b>Copyright © 2011 Worldwide System for Conformity Testing and Certification of Electrotechnical Equipment and Components (IECEE), Geneva, Switzerland. All rights reserved.</b>	
<p>This publication may be reproduced in whole or in part for non-commercial purposes as long as the IECEE is acknowledged as copyright owner and source of the material. IECEE takes no responsibility for and will not assume liability for damages resulting from the reader's interpretation of the reproduced material due to its placement and context.</p>	
<p>If this test Report is used by non-IECEE members, the IECEE/IEC logo and the reference to the CB Scheme procedure shall be removed.</p>	
<p><b>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.</b></p>	
<b>General disclaimer</b>	
<p>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</p>	

Report and its contents can be verified by contacting the NCB, responsible for this Test Report.

<b>Test item description</b> .....	Switch mode power supply
Trade Mark .....	TDK-Lambda
	
Manufacturer .....	TDK-LAMBDA UK LTD KINGSLEY AVE ILFRACOMBE DEVON EX34 8ES UNITED KINGDOM
Model/Type reference .....	EFE400 or EFE-400, EFE400R or EFE-400R series. (may be followed by characters as described in Model Differences, see Model Differences for details)
Ratings .....	100-240 Vac nom, 45-440 Hz 6.1 Arms max (see Model Differences for details)

<b>Testing procedure and testing location:</b>	
<input type="checkbox"/> <b>CB Testing Laboratory</b>	Testing location / address .....
<input type="checkbox"/> <b>Associated CB Test Laboratory</b>	Testing location / address .....
	Tested by (name + signature) .....
	Approved by (name + signature).....
<input type="checkbox"/> <b>Testing Procedure: TMP/CTF Stage 1</b>	Testing location / address .....
	Tested by (name + signature) .....
	Approved by (name + signature).....
<input type="checkbox"/> <b>Testing Procedure: WMT/CTF Stage 2</b>	Testing location / address .....
	Tested by (name + signature) .....
	Witnessed by (name + signature) ..
	Approved by (name + signature).....
<input checked="" type="checkbox"/> <b>Testing Procedure: SMT/CTF Stage 3 or 4</b>	Testing location / address .....: TDK-LAMBDA UK LTD, Kingsley Avenue, Ilfracombe, Devon, EX34 8ES, UK
	Tested by (name + signature) .....: T. Burgess S. Hirstwood 
	Approved by (name + signature).....: K.P. Tizzard 
	Supervised by (name + signature) .: Bartlomiej Zmijewski 
<input type="checkbox"/> <b>Testing Procedure: RMT</b>	Testing location / address .....
	Tested by (name + signature) .....
	Approved by (name + signature).....
	Supervised by (name + signature) .:

<b>List of Attachments</b>
National Differences (15 pages)
Enclosures (136 pages)
<b>Summary Of Testing</b>
Unless otherwise indicated, all tests were conducted at TDK-LAMBDA UK LTD, Kingsley Avenue, Ilfracombe, Devon, EX34 8ES, UK.

Tests performed (name of test and test clause)	Testing location / Comments
Cooling Abnormal Test (4.4.2.10) Temperature Test (10.1-10.4)	
<b>Summary of Compliance with National Differences:</b> Countries outside the CB Scheme membership may also accept this report. List of countries addressed: AT, BE, CA, CH, CZ, DE, DK, FI, FR, GB, IL, IT, JP, NO, SE, SI, SK, US The product fulfills the requirements of: UL 61010-1 3rd Ed., CAN/CSA 22.2 No. 61010-1-12 3rd Ed., EN61010-1:2010	
<b>Copy of Marking Plate</b> - Refer to Enclosure titled Marking Plate for copy.	

<b>Test item particulars :</b>	
Type of item tested .....	Laboratory
Description of equipment function .....	switch mode power supply
Connections to mains supply .....	via host equipment
Overvoltage category .....	II
Pollution degree .....	2
Means of Protection .....	Class I (PE connected)
Environmental conditions .....	Normal
For use in wet locations .....	No
Equipment mobility .....	N/A, for building into host equipment
Operating conditions .....	continuous
Overall size of the equipment: (W X D X H) (mm) :	85 x 198 x 41 with end fan and cover
Mass of the equipment (kg) .....	less than 1kg
Marked degree of protection to IEC 60529 .....	none
<b>Possible test case verdicts:</b>	
- 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)
<b>Testing:</b>	
Date(s) of receipt of test item .....	2013-06-25, 2014-11-21 to 2014-11-29
Date(s) of Performance of tests .....	2013-07-05 to 2013-07-08, 2014-11-24 to 2014-12-16
<b>General remarks:</b>	
"(see Enclosure #)" refers to additional information appended to the report.	
"(see Form A.xx)" refers to a table appended to the report.	
Bottom lines for measurement tables Form A.xx are optional if used as record.	
Throughout this report a point is used as the decimal separator.	
<b>Manufacturer's Declaration per Sub Clause 4.2.5 of IEC 60384-14:</b>	
The application for obtaining a CB Test Certificate includes more than one factory 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 .....	
When differences exist, they shall be identified in the General Product Information section.	
<b>Name and address of Factory(ies):</b>	TDK-LAMBDA UK LTD KINGSLEY AVE ILFRACOMBE DEVON EX34 8ES UNITED KINGDOM  PANYU TRIO MICROTRONIC CO. LTD

SHIJI INDUSTRIAL ESTATE  
 DONGYONG  
 NANSHA  
 GUANGZHOU GUANGDONG CHINA

**GENERAL PRODUCT INFORMATION:**

**Report Summary**

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

**Product Description**

The EFE400 or EFE-400 and EFE400R or EFE-400R Series are switch mode power supplies for building into host equipment.

**Model Differences**

EFE400 or EFE-400 models as described below:

Units may be marked with a Product Code: U4x or Y4x where x may be any number of characters.

Unit Configuration Code (Description :) may be prefixed by NS # (where # may be any number of characters indicating non-safety related model differences).

Unit Configuration Code:

EFE400x-a-bcde-f-g-hij

Where:

- x = Nothing or J for Japanese models (may have non-safety differences)
- a = Channel 1 Output Voltage: any voltage within the Adjustment Range for the Vout (nom) from the Output Table below, e.g. 12.8 for 12.8V output (12Vout nom), 24.6 for 24.6V output (24Vout nom).
- b = CN for Open Frame with fan output, CU for U chassis with fan output, CC for U chassis and cover with fan output, EC for U chassis and cover with fan (temperature controlled).
- c = M for Molex input connector or equivalent, J for JST connector or equivalent.
- d = D for dual fused input, FL for single fuse input in the Live Line.
- e = S for Standard Leakage, L for Low Leakage, R for Reduced Leakage, T for Tiny Leakage.\*
- f = Nothing for horizontal output connector, V for vertical output connector.
- g = Nothing for standard channel 1 output voltage, xD or xPD where D is for units with programmed negative load regulation, PD is for units with programmed positive load regulation, x is the voltage of the regulation in 100mVolts and is within the Output Adjustment range (example, 7D = 0.7V of negative load regulation, 24PD = 2.4V of positive load regulation).
- hij = Three numbers from 0 to 9 which denotes various output voltage/current settings within the specified ranges of each output for a particular unit or blank for standard output settings. (may define non-safety related parameters/feature, e.g. reduced primary current limit, reduced OVP).

**Output Parameters**

Standard models:

Adjustment	Output	Maximum
------------	--------	---------

Output Channel	Vout Nom.	Range (V)	Current (A)	Power (W)
Channel 1	12	11.4 - 13.2*	33.33	400 (530**)
	24	22.8 - 26.4*	16.67	400 (530**)
Fan output (optional)	12	Fixed	0.25	3

Variations and limitations of use:

1. Maximum ambient 70°C (de-rating output power 2.5% per °C above 50°C).
2. \* Can be adjusted at the factory only.
3. Maximum continuous power output 400W (excluding fan output).
4. \*\* Peak power for 10 seconds maximum, maximum rms power of 400Wrms.

EFE400R or EFE-400R models as described below:

Units may be marked with a Product Code: U4x or Y4x where x may be any number of characters.

Unit Configuration Code (Description :) may be prefixed by NS # (where # may be any number of characters indicating non-safety related model differences).

Unit Configuration Code:

EFE400Rx-a-bcde-km-f-g-hij

Where:

x = Nothing or J for Japanese models (may have non-safety differences)

a = Channel 1 Output Voltage: any voltage within the Adjustment Range for the Vout (nom) from the Output Table below.

b = CN for Open Frame with fan output, CU for U chassis with fan output, CC for U chassis and cover with fan output, EC for U chassis and cover with fan (temperature controlled), NN for open frame with no fan output.

c = M for Molex input connector or equivalent, J for JST connector or equivalent.

d = D for dual fused input, FL for single fuse input in the Live Line.

e = S for Standard Leakage, L for Low Leakage, R for Reduced Leakage, T for Tiny Leakage.\*

f = Nothing for horizontal output connector, V for vertical output connector.

g = Nothing for standard channel 1 output voltage, xD or xPD where D is for units with programmed negative load regulation, PD is for units with programmed positive load regulation, x is the voltage of the regulation in 100mVolts and is within the Output Adjustment range (example, 7D = 0.7V of negative load regulation, 24PD = 2.4V of positive load regulation).

hij = Three numbers from 0 to 9 which denotes various output voltage/current settings within the specified ranges of each output for a particular unit or blank for standard output settings. (may define non-safety related parameters/feature, e.g. reduced primary current limit, reduced OVP).

k = Y for or-ing device or N for none fitted.

m = E for enable or T for inhibit.

Output Channel	Vout Nom.	Adjustment Range (V)	Max Output Current (A)	Maximum Power (W)
Channel 1	48	47-50*	8.5	400 (470**)
Fan output (optional)	12	Fixed	0.25	3

Variations and limitations of use:

1. Maximum ambient 70°C (de-rating output power 2.5% per °C above 50°C).
2. \* Can be adjusted at the factory only.

3. Maximum continuous power output 400W (excluding fan output).
4. \*\* Peak power for 10 seconds maximum, maximum rms power of 400Wrms.

#### Additional Information

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

Cooling for units with customer supplied air (all except EC models):

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 IEC61010-1. 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 stabilised.

#### COMPONENTS TO BE MONITORED

Circuit Ref.	Description	Max. Temperature (°C)
J1	Input connector	75* (105)
L1, L2	Common mode choke	core 115, wire 140
C7, C8	X capacitors	100
C9	Reservoir capacitor (electrolytic)	70 (105)
L3 (EFE400)	Boost choke	core 115, winding 140
L3 (EFE400R)	Boost choke/TRX	core 115, winding 120
TX2	Transformer winding	120
TX2	Transformer core	120
TX2	Transformer braid (to pin 13)	120
U2	Optocoupler	75
C11	Channel 1 output capacitor	90 (105)
L7	Channel 1 Output choke	115
L4	Primary choke (24V model only)	120 (130)
XU8	Fan regulator	95
XQ225	Boost FET (IMS board)	115
Q1(EFE400)	Channel 1 output FET	115
Q2(EFE400R)	Channel 1 output FET	115
XU3	Main driver IC	100
Various	All other electrolytic capacitors	90 (105)

See components to be monitored diagram in the handbook.

\* For temperatures above 75°C a suitably temperature rated mating connector must be used.

Higher temperatures limits for electrolytic capacitors (in brackets) may be used but product life may be reduced.



This report is a re-issue of CBTR Ref. No. E331788-A19-CB-1, CB Test Certificate Ref. No. DK-34008-UL dated 2013-07-26. Based on previously conducted testing and the review of product construction, only the cooling test 4.4.2.10 and temperature test 10.1-10.4 were deemed necessary to cover the following changes:

1. Addition/deletion of multilayer PWBs to critical component list
2. Correction/addition to critical component list
3. Enclosures updated to include revised handbook, drawings, certificates and marking plate
4. Alternative fan added (Y.S. Tech)
5. Change of factory name + address and CBTL

#### Technical Considerations

- Equipment classification: Professional, Commercial
- Equipment class: Class I
- Equipment type: For building-in
- The product was submitted and tested for use at the maximum recommended ambient temperature (T<sub>mra</sub>) of: 50°C (70°C de-rated above 50°C, see Model Differences)
- Evaluated for a maximum altitude of 3000m --

#### Engineering Conditions of Acceptability

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

- This component has been judged on the basis of the creepage and clearances required in the indicated Standards, which would cover the component itself if submitted for Listing: UL 61010-1 3rd Ed., CAN/CSA 22.2 No. 61010-1-12 3rd Ed., IEC/EN61010-1:2010, 3rd Ed.
- The end-product shall consider that: The enclosure does not serve as a fire/electrical/mechanical enclosure
- The need for the following shall be considered in the end-product: Bonding to protective earthing terminal (Class I construction), MAINS disconnected device
- The output connectors are: Not investigated for field wiring
- Creepage and clearance distances were based on a maximum working voltage of: 349 V<sub>rms</sub>; 666 V<sub>peak</sub> Basic, 286 V<sub>rms</sub>; 768 V<sub>peak</sub> Reinforced
- Insulation between primary circuits and accessible dead metal complies with the requirements for : Basic insulation
- Insulation between primary and secondary circuits complies with the requirements for: Reinforced insulation
- The following tests shall be performed in the end-product evaluation: Dielectric Strength (in accordance with the handbook), Temperature (for customer air models, see Additional Information)
- The unit is considered acceptable for use at on a max branch circuit of: 20 A
- The unit is considered acceptable for use in a max ambient of: 70°C (de-rated above 50°C, see Model Differences for details)
- End-product temperature tests for power supplies shall consider that the following transformers employ the indicated insulation system: Transformer TX2, Class F (155 °C)
- End-product dielectric strength tests shall be based on the maximum working voltage of: 349 V<sub>rms</sub>; 666 V<sub>peak</sub> primary to earth, 286 V<sub>rms</sub>; 768 V<sub>peak</sub> primary to secondary
- At input frequencies above 63Hz Clause 6.4.4a requires investigation in the end application --
- Customer air models must be thermally tested as described in the Additional Information --

- Input connector J2 pin 1 has been investigated as the protective bonding terminal for the product --
- The risk associated with clause 5.4.5 requires assessment in the end equipment --
- Input connector is: Not investigated for field wiring --