

UL TEST REPORT AND PROCEDURE

Standard:	UL 60950-1, 2nd Edition, 2019-05-09 (Information Technology Equipment - Safety - Part 1: General Requirements) CAN/CSA C22.2 No. 60950-1-07, 2nd Edition, 2014-10 (Information Technology Equipment - Safety - Part 1: General Requirements)
Certification Type:	Component Recognition
CCN:	QQGQ2, QQGQ8 (Power Supplies for Information Technology Equipment Including Electrical Business Equipment)
Complementary CCN:	N/A
Product:	Power Supply
Model:	EFE300 series (EFE300x-a-bcde- f-g-hij, see model differences for details of models and nomenclature).
Rating:	133-318Vdc nom 100-240Vac nom, 45-440Hz 4.7A rms max, 3.8Adc max.
Applicant Name and Address:	TDK-LAMBDA UK LTD KINGSLEY AVE ILFRACOMBE DEVON EX34 8ES UNITED KINGDOM

This is to certify that representative samples of the products covered by this Test Report have been investigated in accordance with the above referenced Standards. The products have been found to comply with the requirements covering the category and the products are judged to be eligible for Follow-Up Service under the indicated Test Procedure. The manufacturer is authorized to use the UL Mark on such products which comply with this Test Report and any other applicable requirements of UL LLC ('UL') in accordance with the Follow-Up Service Agreement. Only those products which properly bear the UL Mark are considered as being covered by UL's Follow-Up Service under the indicated Test Procedure.

The applicant is authorized to reproduce the referenced Test Report provided it is reproduced in its entirety.

UL authorizes the applicant to reproduce the latest pages of the referenced Test Report consisting of the first page of the Specific Technical Criteria through to the end of the Conditions of Acceptability.

Any information and documentation involving UL Mark services are provided on behalf of UL LLC (UL) or any authorized licensee of UL.

Prepared By: Borys Bakun/Supervised by Dennis Butcher / Project Handler Reviewed By: Grzegorz Goraj / Reviewer

Supporting Documentation

The following documents located at the beginning of this Procedure supplement the requirements of this Test Report:

A. Authorization - The Authorization page may include additional Factory Identification Code markings.

B. Generic Inspection Instructions -

- i. Part AC details important information which may be applicable to products covered by this Procedure. Products described in this Test Report must comply with any applicable items listed unless otherwise stated in the body of this Test Report.
- ii. Part AE details any requirements which may be applicable to all products covered by this Procedure. Products described in this Test Report must comply with any applicable items listed unless otherwise stated in the body of each Test Report.
- iii. Part AF details the requirements for the UL Certification Mark which is not controlled by the technical standard used to investigate these products. Products are permitted to bear only the Certification Mark(s) corresponding to the countries for which it is certified, as indicated in each Test Report.

Product Description

EFE300 range. Switch mode power supplies for building into end equipment.

Model Differences

Nominal Input Voltage Range 100 - 240V AC or 133 - 318VDC

Maximum Input Voltage Range 90* - 264V AC or 120 - 350VDC

Input Frequency 45-440 Hz maximum or DC

Maximum Input Current 4.7A rms or 3.8A DC

* Channel 1 output is linearly derated from 90Vac to 85Vac, 4W per volt to 280W.

All ratings apply for ambient temperatures up to 50°C. From 50 to 70°C the output power is derated at 2.5% per deg C.

Unit Configuration Code:

EFE300 or EFE-300x-a-bcde- f-g-hij

(may be prefixed by NS - # / where # may be any number of characters indicating non safety related model differences). Products may additionally be marked with U2x or Y2x where x can be any number of characters indicating non-safety related model differences.

May be prefixed by SP followed by / or - (SP represents a sales code)

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.

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

d=D for dual fused input or L for single fuse 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)

* At 440Hz, leakage current is > 3.5mA and therefore must be assessed in the end use application.

* L < 300uA leakage, R < 150uA leakage and T < 75uA leakage.

Output parameters:

O/P Channel	Vout nom (V).	Range (V)	Max O/P (A)	Max O/P (W)
CH1	12	11.4 - 13.2*	25	300 (400**)
	24	22.8 - 26.4*	12.5	300 (400**)
Fan output	12	Fixed	0.25	3

* Can be adjusted from nominal at the factory only.

** Peak power of 400W for 10 seconds maximum, maximum rms power of 300W

Maximum continuous power output 300W (excluding fan output)

Output Limitations

All outputs are SELV

All outputs have functional spacing's to earth, and due consideration must be given to this in the end product.

Customer Air Cooling (CN, CU and CC options):

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 concerned.

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.

Circuit Ref.	Description	Max. Temperature (°C)
--------------	-------------	-----------------------

J1	Input connector	75
L1, L2	Common mode choke winding	115 (130)
C7, C8	X capacitors	100
C9	Reservoir capacitor (electrolytic)	60 (105)
L3	Boost choke winding	115 (140)
TX2	Transformer winding	120 (130)
TX2	Transformer core	120 (130)
TX2	Transformer braid	120 (130)
U2	Optocoupler	75 (100)
C10, C11	Channel 1 output capacitors	80 (105)
L6	Primary choke (24V model only)	120 (130)
L4	Channel 1 Output choke	115 (130)
XU2/XU8	Fan regulator	115 (130)
XQ201	Boost FET (IMS board)	115 (130)
Q1	Channel 1 output FET (adjacent to R4)	115 (130)
XU3	Primary driver IC	100 (130)
Various	All other electrolytic capacitors	80 (105)

Test Item Particulars

Equipment mobility	for building-in
Connection to the mains	To be determined in the end use application
Operating condition	continuous
Access location	for building in
Over voltage category (OVC)	OVC II
Mains supply tolerance (%) or absolute mains supply values	90-264Vac or 120-350Vdc
Tested for IT power systems	Yes (Norway only)
IT testing, phase-phase voltage (V)	230V
Class of equipment	Class I (earthed)
Considered current rating of protective device as part of the building installation (A)	20A
Pollution degree (PD)	PD 2
IP protection class	IP X0
Altitude of operation (m)	3000m
Altitude of test laboratory (m)	64m
Mass of equipment (kg)	0.8kg

Technical Considerations

- Equipment was evaluated for a maximum supply tolerance of 90-264Vac and 120-350Vdc
- 1.2 The product was submitted and evaluated for use at the maximum ambient temperature (T_{ma}) permitted by the manufacturer's specification of: 50°C (full load); 70°C (power and output current decreasing linearly by 2.5%/°C above 50°C)
- 1.4 The product is intended for use on the following power systems: IT (Norway only)
 - TN,
 - DC mains supply

- 1.11 The following were investigated as part of the protective earthing/bonding: Printed wiring board trace (refer to Enclosure - Schematics + PWB for layouts)
- 1.13 The following are available from the Applicant upon request: Installation (Safety) Instructions / Manual
- 1.5 The equipment disconnect device is considered to be: Provided by the end equipment
- 1.7 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).
- Multi-layer PWB's accepted under CBTR Ref. No. E349607-A23 dated 2014-07-31 and letter report, Enclosure 8-06 of this report.

Engineering Conditions of Acceptability

For use only in or with complete equipment where the acceptability of the combination is determined by UL LLC. When installed in an end-product, consideration must be given to the following:

- The end unit must be considered against clause 5.1.7 leakage current for input frequencies above 63Hz.
- 1.2 The following Production-Line tests are conducted for this product: Earthing Continuity
Electric Strength
- 1.5 The following secondary output circuits are SELV: All
- 1.3 The end-product Electric Strength Test is to be based upon a maximum working voltage of:
Primary-SELV: 392 Vrms, 762 Vpk
Primary-Earthed Dead Metal: 392 Vrms, 668 Vpk
- 1.11 The power supply terminals and/or connectors are: Suitable for factory wiring only
- 1.13 The investigated Pollution Degree is: 2
- 1.15 Proper bonding to the end-product main protective earthing termination is: Required
- 1.19 The following end-product enclosures are required: Mechanical
Fire
Electrical
- 1.10 The following output terminals were referenced to earth during performance testing: All outputs and their return lines individually referenced to obtain maximum working voltage.
- 1.12 The maximum investigated branch circuit rating is: 16A (For IEC); 20A (For North America)
- 1.16 An investigation of the protective bonding terminals has: been conducted
- 1.18 The following magnetic devices (e.g. transformers or inductor) are provided with an OBJY3 insulation system with the indicated rating greater than Class A (105°C): Transformer TX2 (Class F) - See table 1.5.1 for details of insulation systems used.
- 1.6 The following secondary output circuits are at hazardous energy levels: Channel 1 output
- 1.20 The following components require special consideration during end-product Thermal (Heating) tests due to the indicated maximum temperature measurements during component-level testing: Input connector J1 (75°C)
Common mode choke winding L1, L2 (130°C)
X capacitors C7, C8 (100°C)
Reservoir capacitor C9 (105°C)
Boost choke winding L3 (140°C)
Transformer winding TX2 (130°C)
Transformer core TX2 (130°C)
Transformer braid (to pin 13) TX2 (130°C)
Optocoupler U2 (100°C)
Channel 1 output capacitors C10, C11 (105°C)
Primary choke (24V model only) L6 (130°C)
Channel 1 Output choke L4 (130°C)
Fan regulator XU2 or XU8 (130°C)
Boost FET (IMS board) XQ201 (130°C)
Channel 1 output FET (adjacent to R4) Q1 (130°C)
Primary driver IC XU3 (130°C)
All other electrolytic capacitors (105°C)
- 1.35 Fans: The fan provided in this sub-assembly is provided with a fan guard to reduce the risk of contact with the rotor.
The fan provided in this sub-assembly is not intended for operator access.

Additional Information

This report is an amendment of CBTR Ref. No. E135494-A33-CB-4, CB Test Certificate Ref. No. DK-44432-M1-UL dated 2015-03-27. Based on the 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 with only limited testing being required.

The following modifications were made:

1. Modification of the base PWB to accommodate an additional 2x discharge resistors with the relevant testing to show continued compliance.
2. Addition of alternate fan,
3. Updates to the CCL,
4. Updates to the enclosures.

Additional Standards

The product fulfills the requirements of: EN 60950-1:2006 + A11:2009 + A1:2010 + A12:2011 + A2: 2013, CSA C22.2 NO. 60950-1-07 + AMD 1 AMD 2 - Edition 2 - Revision Date 2014/10/14

Markings and Instructions

Clause Title	Marking or Instruction Details
1.7.1 Power rating - Ratings	Ratings (voltage, frequency/dc, current)
1.7.1 Power rating - Company identification	Listee's or Recognized company's name, Trade Name, Trademark or File Number
1.7.1 Power rating - Model	Model Number
1.7.6 Fuses - Non-operator access/soldered-in fuses	Unambiguous reference to service documentation for instructions for replacement of fuses replaceable only by service personnel
2.7.6 Warning to service personnel	"CAUTION: Double pole/neutral fusing"

Special Instructions to UL Representative

N/A