

## UL TEST REPORT AND PROCEDURE

<b>Standard:</b>	UL 62368-1, 2nd Ed, 2014-12-01 (Audio/video, information and communication technology equipment Part 1: Safety requirements) CAN/CSA C22.2 No. 62368-1-14, 2nd Ed-(Audio/video, information and communication technology equipment Part 1: Safety requirements)
<b>Certification Type:</b>	Component Recognition
<b>CCN:</b>	QQJQ2, QQJQ8 (Power Supplies for Use in Audio/Video, Information and Communication Technology Equipment)
<b>Complementary CCN:</b>	N/A
<b>Product:</b>	AC-DC Power Supply
<b>Model:</b>	EFE300 Series or EFE-300 Series (See model differences for details of models and nomenclature)
<b>Rating:</b>	100-240Vac nom, 4.7Arms max, 45-440Hz (optional) 133-318Vdc nom, 3.8Adc max (optional)  (See model differences for details of ratings)
<b>Applicant Name and Address:</b>	TDK-LAMBDA UK LTD KINGSLEY AVE ILFRACOMBE 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: Danny Adams / Project Handler      Reviewed By: Dennis Butcher / 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 or EFE-300 Series. Switch mode power supplies for building into end equipment

### Model Differences

Model Differences –

Nominal Input Voltage Range 100 – 240Vac or 133 – 318Vdc (conditioned)

Maximum Input Voltage Range 90\* – 264Vac 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/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 °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, 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 100mV 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 the standard output settings (may define non-safety related parameters/features 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 = < 300µA leakage, R = < 150µA Leakage and T = <75µA 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 ES1.

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

#### Test Item Particulars

Classification of use by	Skilled person
Supply Connection	AC Mains DC Mains ES3
Supply % Tolerance	+10%/-10%
Supply Connection – Type	mating connector
Considered current rating of protective device as part of building or equipment installation	20 A; building;
Equipment mobility	for building-in
Over voltage category (OVC)	OVC II

Class of equipment	Class I
Access location	N/A
Pollution degree (PD)	PD 2
Manufacturer's specified maximum operating ambient (°C)	50°C (Full Load); 70°C (Output power decreased linearly by 2.5%/°C above 50°C)
IP protection class	IPX0
Power Systems	TN
Altitude during operation (m)	3000 m
Altitude of test laboratory (m)	2000 m or less
Mass of equipment (kg)	< 1kg

#### Technical Considerations

- The product was submitted and evaluated for use at the maximum ambient temperature (T<sub>ma</sub>) 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)
- 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) : 20
- Mains supply tolerance (%) or absolute mains supply values : +10%/-10%
- The equipment disconnect device is considered to be : To provided in the end equipment
- The following were investigated as part of the protective earthing/bonding : Printed wiring board trace (refer to Enclosure - Schematics + PWB for layouts)
- The following are available from the Applicant upon request : Installation (Safety) Instructions / Manual
- The product was investigated to the following additional standards : EN 62368-1:2014 + A11:2017
- Capacitors are rated for 230V due to the IT power system used in Norway. Further evaluation may be required in the end use product.
- • Multi-layer PWB's accepted under CBTR Ref. No. E349607-A23 dated 2014-07-31. Letter report included under Enclosure 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 following product-line tests are conducted for this product : Electric Strength, Earthing Continuity
- The end-product Electric Strength Test is to be based upon a maximum working voltage of : Primary-Secondary: 392 Vrms, 762 Vpk, Primary – Earthed Dead Metal: 392 Vrms 668 Vpk
- The following output circuits are at ES1 energy levels : All
- The following output circuits are at PS3 energy levels : All Outputs
- 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 end-product enclosures are required : Mechanical, Fire, Electrical
- 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) : Transformer TX2 (Class F) – See table 4.1.2 for details of insulation system used.
- The following components require special consideration during end-product Thermal (Heating) tests due to the indicated maximum temperature measurements during component-level testing : Customer air models require component temperatures to be monitored as detailed in the Additional Application Considerations section under additional information of this report.
- The equipment is suitable for direct connection to : AC and/or DC mains supply
- The power supply was evaluated to be used at altitudes up to : 3000m
- 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**

Additional application considerations – (Considerations used to test a component or sub-assembly) – Customer Air Cooling (CN, CU and CC options):

The following components require special consideration during end-product thermal (heating) tests due to the indicated maximum temperature measurements during component-level testing. The components listed in the following table must not exceed the temperature given. To determine the component temperatures the heating tests must be conducted in accordance with the requirement of the standard concerned. There is no requirement to perform abnormal or single fault testing as this has been considered in the testing of this report.

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 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 Reference 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 Opto-coupler 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)

**Additional Standards**

The product fulfills the requirements of: EN 62368-1:2014 + A11:2017

**Markings and Instructions**

Clause Title	Marking or Instruction Details
Equipment identification marking – Manufacturer identification	Listees or Recognized companys name, Trade Name, Trademark or File Number
Equipment identification marking – model identification	Model Number
Equipment rating marking – ratings	"Input Ratings (voltage, frequency/dc, current/power)", "Output Ratings (voltage, frequency/dc, current/power)"

**Special Instructions to UL Representative**

N/A

<b>BD1.0</b>	<b>TABLE: Production-Line Testing Requirements</b>					
<b>BD1.1</b>	<b>Electric Strength Test Special Constructions – Refer to Generic Inspection Instructions, Part AC for further information.</b>					
Model	Component	Removable parts	Test probe location	Test V rms	Test V dc	Test Time, s
All Models	TX2	-	Primary to secondary	-	4000	1
<b>BD1.2</b>	<b>Earthing Continuity Test Exemptions – This test is not required for the following models:</b>					
	N/A					
<b>BD1.3</b>	<b>Electric Strength Test Exemptions – This test is not required for the following models:</b>					
	N/A					
<b>BD1.4</b>	<b>Electric Strength Test Component Exemptions – The following solid-state components may be disconnected from the remainder of the circuitry during the performance of this test.</b>					
	N/A					

<b>BE1.0</b>	<b>Sample and Test Specifics for Follow-Up Tests at UL</b>				
Model	Component	Material	Test	Sample (s)	Test Specifics