UL TEST REPORT AND PROCEDURE

Standard:	UL 62368-1, 3rd Ed, 2021-10-22 (Audio/video, information and communication technology equipment Part 1: Safety requirements) CAN/CSA C22.2 No. 62368-1:19, 3rd Ed, 2021-10-22 (Audio/video, information and communication technology equipment Part 1: Safety requirements)
Certification Type:	Component Recognition
CCN:	QQJQ2, QQJQ8 (Power Supplies for Use in Audio/Video, Information and Communication Technology Equipment)
Complementary CCN:	N/A
Product:	Power supply
Model:	EFE400 or EFE-400 series 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). May be prefixed by SP followed by / or – (SP represents a sales code). Followed by x-a-bcde-f-g-hij. See test report model differences for details of models and nomenclature. EFE400R or EFE-400R series 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). May be prefixed by SP followed by / or – (SP represents a sales code). Followed by x-a-bcde-km-f-g-hij. See test report model differences for details of models and nomenclature.
Rating:	100-240Vac, 45-440Hz, 6.1Arms Max, or, 133-318Vdc, 4.2Adc 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: Kamil Janeczek / 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

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).

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

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:

Output Channel	Vout Nom.	Adjustment Range (V)	Output Current (A)	Maximum 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.

Series connection

It is possible to connect two units in series (EFE400 models only). Doing so changes the working voltages and also changes the Energy Source Classification. Refer to Conditions of Acceptability.

Test Item Particulars	
Product group	built-in component
Classification of use by	Skilled person
Supply Connection	AC Mains DC Mains not mains connected: ES3
Supply tolerance	+10%/-10%
Supply connection – type	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)	70°C (de-rated output power by 2.5% per °C above 50°C)
IP protection class	IPX0
Power systems	TN
Altitude during operation (m)	5000 m
Altitude of test laboratory (m)	2000 m or less
Mass of equipment (kg)	1kg max.

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 Full load, increasing to 70°C maximum (output power derated 2.5% per degree 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 : +10%/-10%
- The equipment disconnect device is considered to be : provided by the host installation
- The following are available from the Applicant upon request : Installation (Safety) Instructions / Manual
- The product was investigated to the following additional standard : AS/NZS 62368.1:2018, CAN/CSA C22.2 No. 62368-1:19, 3rd Edition, EN IEC 62368-1:2020+A11:2020, UL 62368-1 3rd Edition, Issued December 13, 2019
- PSU is linearly de-rated from 90Vac to 85Vac 5W per volt to 375W

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 : Earthing Continuity, Electric Strength
- The end-product Electric Strength Test is to be based upon a maximum working voltage of : Primary-Secondary: 402 Vrms, 768 Vpk, Primary-Earthed Dead Metal: 388 Vrms, 666 Vpk
- The following output circuits are at ES1 energy levels : 12V, 24V and Fan outputs
- The following output circuits are at ES2 energy levels : 48V output
- The following output circuits are at ES3 energy levels : Series connected outputs
- The following output circuits are at PS3 energy levels : All circuits
- 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 components require special consideration during end-product Thermal (Heating) tests due to the indicated maximum temperature measurements during component-level testing : Models without a fan require component temperatures monitored as detailed in Additional Information.
- 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 : 5,000 m
- The equipment was evaluated for end-product where reverse polarity is prevented. Otherwise B.3.3 the test shall be considered in the end application
- 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) : TX2, TX3, L3 and L5 (Class F) (155°C)
- The maximum of 2 units of EFE400 models having output voltage 12 VDC or 24 VDC can be connected in series. This allowance is not applicable for EFE400R models having output voltage 48 VDC.
- Series connected outputs are classified as ES3. Accessibility shall be determined in end-product
- DC supply tolerance is equal to +10% / -10% due to restriction of connection to a conditioned power supply system
- Equipment is not intended to be used at tropical climatic conditions

Additional Information

Factory Production Note: Model EFE400 Series is produced at all three Factories noted on the CB Certificate. Model EFE400R Series is produced in the UK and China Factories noted on the CB Certificate but is not produced in the Factory located in Japan.

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 the requirements of IEC62368-1. 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 Instruction Manual/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.

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 Instruction Manual.
* 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.

Fans: The fan provided in this sub-assembly is provided with a fan guard to reduce the risk of operator contact with the rotor.

This report is a standard upgrade from IEC 62368-1 2nd edition to 3rd edition. Test data were accepted based on CBTR E135494-A6005-CB-1 and CBTC DK-81105-M2-UL dated 2024-03-18. Test records of 2nd edition are deemed representative for 3rd edition due to identical or onerous test methods were used and test results were found to meet edition 3 compliance criteria. The existing differences were covered by additional testing.

In this report, testing of ELECTRICAL STRENGTH TEST - TYPE TESTING OF SOLID INSULATION was conducted.

The test date and sample receipt date shown are those of the original testing and additional test under project no. 4790231446.

The marking label provided is representative of all models.

The following tests were selected as representative of the test program applicable to model covered by this CBTR: Input test: single phase (Cl. B.2.5), Operating temperature measurement conditions (Cl. B.2.6), Simulated Single Faults Conditions (B.4), Electric Strength (Cl. 5.4.9), Capacitor discharge after disconnection of a connector (Cl. 5,5.2.2), Touch current measurement - earth accessible conductive parts - single-phase equipment on TN or TT system, and Steady force test, 250 N (Cl. 4.4.3.2, T.5). These tests have been witnessed for models selected as representative of the standard covered by this report and the applicable test program. (4791153162, DA file 331).

The following scope limitations apply to this test report and additional evaluation and/or tests may be required when submitting this CB Report to a National Certification Body (NCB) to obtain a national mark:
- no EMC tests nor evaluation to EMC Directive 2004/108/EC and 2014/30/EU,
- no evaluation to RoHS Directives 2011/65/EU
- only English version of markings and instructions reviewed. Markings and instructions in French, German, Italian, Spanish and Portuguese or Chinese were not reviewed.

Additional Standards

The product fulfills the requirements of: AS/NZS 62368.1:2022, EN IEC 62368-1:2020+A11:2020, J62368-1(2023), CSA/UL 62368-1:2019, GB 4943.1-2022, J62368-1(2023)

Markings and Instructions

Clause Title	Marking or Instruction Details
Equipment identification marking – Manufacturer identification	Listee’s or Recognized Company’s 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

Inspect the transformer(s) listed in Production-Line Testing Requirements (Electric Strength Test Special Constructions). When the tests are conducted at other location, Inspect test record and specification sheet provided by the component manufacturer. Verify the specification sheet indicates 100% routine test specified in Production-Line Testing Requirements (Electric Strength Test Special Constructions) be conducted at the component manufacturer.

Test report Ref. No. E135494-A6005 exists for the same series of products EFE400 or EFE-400 series and EFE400R or EFE-400R series, but it is issued for IEC 62368-1, 2nd edition. Both reports shall be updated in case of any changes introduced to the products.