

Description

UL TEST REPORT AND PROCEDURE

Standard:	UL 61010-1, 3rd Edition, May 11, 2012, Revised July 19, 2019 CAN/CSA-C22.2 No. 61010-1(2012-05), 3rd Edition, with revisions through 2018-11
Certification Type:	Component Recognition
CCN:	QQHC2 / QQHC8
Complementary CCNs:	
Product:	Switch mode power supply
Model:	EFE400 or EFE-400, EFE400R or EFE-400R series. (may be followed by characters as described in Model Differences, see Model Differences for details)
Rating:	100-240 Vac nom, 45-440 Hz 6.1 Arms max (see Model Differences for details)
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 as applicable.

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: Krzysztof Wasilewski, 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.

Refer to the Report Modifications page for any modifications made to this report.

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 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*	16.7	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 may be prefixed by SP followed by / or – (SP represents a sales code).

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.

Output Limitations

All single unit outputs are SELV. Outputs connected in series are considered to be non-SELV and must not be made accessible in the end equipment.

Additional Information

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 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 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.

No tests conducted under this investigation due to reissue of CB Test Report Ref. No.E331788-D1002-1/A0/C0-CB. All required tests were carried out under the original investigation

This report is a reissue of CBTR Ref. No. E331788-D1002-1/A0/C0-CB and CB Test Certificate Ref. No. DK-

77750-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.

The report was modified to include the following changes:

1. Standard edition has been upgraded to the latest revision date.
 2. Updates to the LoCC - standards has been updated, Licenses attached to the report and alternate Y capacitor Murata RA series with the same ratings was added
 3. Updates to the Enclosures - Licenses.
 4. Addition of alternate factory address Trio-Tronics (Thailand) Ltd
 5. Non-safety related nomenclature option added under Model Differences section.
- No testing was deemed necessary.

The following tests were selected as representative of the test program applicable to model covered by this CBTR: Insulation requirements (Working voltage measurements) (6.7, Annex K), Plugs and connectors (6.10.3), Mains supply (5.1.3), Impedance of protective bonding plug connected equipment (6.5.2.4), Temperature test (10.1-10.4). These tests have been witnessed for models selected as representative of the standard covered by this report and the applicable test program. (Ref: 4790834540, DA file 331).

Technical Considerations

- The product was investigated to the following additional standards: -
 - The following additional investigations were conducted: -
 - The product was not investigated to the following standards or clauses: -
 - The following accessories were investigated for use with the product: -
 - Equipment class: Class I building-in
Equipment type: For
- The product was submitted and tested for use at the maximum recommended ambient temperature (Tmra) of 50°C (70°C de-rated above 50°C, see Model Differences)
Evaluated for a maximum altitude of 3000m

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:

- 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 Edition, May 11, 2012, Revised July 19, 2019, CAN/CSA-C22.2 No. 61010-1(2012-05), 3rd Edition, with revisions through 2018-11, IEC 61010-1:2010/AMD1:2016/COR1:2019, EN 61010-1:2010/A1:2019 (Edition 3.1)
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
A maximum of 2 units are permitted to be connected in series (outputs' connection)
The output of units connected in series shall not be made accessible
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 Vrms;
666 Vpeak primary to earth, 286 Vrms; 768 Vpeak 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
Multilayer PWB's accepted under CBTR Ref. No.: E349607-A23 dated 2014-07-31 and letter Report,
Enclosures - Licenses (001) of this report
For units connected in series (series connection of secondary outputs) the following tests shall be
considered in end-product: Earth Leakage Current, Voltage or Charge Limitation, Temperature Test.