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:	Switching power supplies and accessory rack
Model:	1. Single power supply modules: HFE3500-24/FSD, HFE3500-24/TSD, HFE3500-24/FSE, HFE3500-24/TSE, HFE3500-48/FSD, HFE3500-48/TSD, HFE3500-48/FSE, HFE3500-48/TSE 2. Rack module: HFE3500-S1U/TB
Rating:	1. Single Power Supply Modules ratings: Input: 100-240 V a.c.; 25 A max; 47 – 440 Hz; (for 2016 W output) 200-240 V a.c.; 22 A max; 47 – 440 Hz; (for 3504 W output) Output: 24 V d.c., 84 A (2016 W); 12 V d.c., 1 A (24 V version power supply module @ input 100-240 V a.c.) 24 V d.c., 146 A (3504 W); 5 V d.c., 2 A (24 V version power supply module @ input 200-240 V a.c.) 48 V d.c., 42 A (2016 W); 12 V d.c., 1 A (48 V version power supply module @ input 100-240 V a.c.) 48 V d.c., 73 A (3504 W); 5 V d.c., 2 A (48 V version power supply module @ input 200-240 V a.c.) 2. Rack module ratings: Input: refer to power supply modules (4 power supply modules included in the rack; each power supply module with individual connection to mains). Output: For output voltage refer to power supply modules (up to 4 power supply modules included in the rack), max output current of the rack: 584 A (max 320 A per metal busbar), max output power of the rack: 14016 W.

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: Grzegorz Osik / Project Handler Reviewed By: Robert Dmitruk / 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 single power supply modules series HFE3500 is a family of front-end (component) power supplies for built-in use with 3504 W output power. All units provide a handle on front side for plugging/unplugging the unit to/from the rack. Rear side contains a connector with AC pins, output DC pins and signal pins. Only the front side is accessible to ordinary person once unit installed in the accessory racks.

The power supply modules are intended for accessory racks. The power supply modules may be used in the complete set of the accessory rack HFE3500-S1U/TB.

The complete EUT is rack module equipped with up to 4 power supply modules included for building-in intended for use within information technology or audio/video equipment. There exist two different main output options (24 V d.c. or 48 V d.c.). Max. total power of each power supply module is 3504 W and max. power of rack module is 14016 W.

Model Differences

Minor changes between 48 V and 24 V version power supply modules such as transformer turns, output capacitors, synchronous rectifiers.

Power supply modules nomenclature

Unit Configuration Code:

HFEx-y/abcde

Where:

x - 3500

y - 24 or 48

Channel 1 output voltage

- Input Voltage: 100-240Vac, Output Voltage Channel 1: 24V, Voltage Range: 21.6-28.8V, Max Iout: 84A, Max Pout: 2016W

- Input Voltage: 100-240Vac, Output Voltage Channel 1: 48V, Voltage Range: 43.2-57.6V, Max Iout: 42A, Max Pout: 2016W

- Input Voltage: 200-240Vac, Output Voltage Channel 1: 24V, Voltage Range: 21.6-28.8V, Max Iout: 146A, Max Pout: 3504WW

- Input Voltage: 200-240Vac, Output Voltage Channel 1: 48V, Voltage Range: 43.2-57.6V, Max Iout: 73A, Max Pout: 3504WW

a - Standby Output Voltage

F = 5V @ 2A

T = 12V @ 1A
b - Digital Interface
S = PMBus (fitted as standard)
c - Air flow
Blank = standard air flow
d - Fuse options
D = Dual AC Fuse
E = Single AC fuse in the live line
e - Coating options
blank = no coating options
CO = Coating
COx = Alternate Coating
Example: HFE3500-48/FSD
For a HFE3500, 48V with 5V standby, PMBus and dual fuse

Rack module nomenclature
Unit Configuration Code:
HFEx-y/abc
Where:
x - 3500
y - S1U
a – TB
b - LAN Digital Interface
Blank = Not fitted (note PMBus is provided as standard on rack)
LAN = LAN interface (integrated into rack backplane, connector on rack rear panel)
c - Coating options
Blank = No Coating
CO = Coating
COx = Alternate Coating

Test Item Particulars

Product group ..... :	built-in component
Classification of use by ..... :	Ordinary person Skilled person
Supply Connection ..... :	AC Mains
Supply tolerance ..... :	+ 10 % / - 15 %
Supply connection – type ..... :	permanent connection mating connector
Considered current rating of protective device ... :	32 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) ..... :	40 or 50

IP protection class..... :	IPX0
Power systems ..... :	TN TT
Altitude during operation (m)..... :	5000 m
Altitude of test laboratory (m) ..... :	2000 m or less
Mass of equipment (kg) ..... :	Approx. 1.950 kg (Power Supply Modules) Approx.12.750 kg (Rack equipped with all 4 Power Supply Modules)

Technical Considerations

- The products were tested to be suitable for connection to max. 32 A branch circuit (each internal Power Supply Module).
- All secondary output circuits are separated from mains by reinforced insulation and rated ES1.
- The transformers T301 (aux), TX1 and TX2 (inside of the power supply modules) provide reinforced insulation. These transformers are built up to fulfil the requirement of insulation class F and provide in addition an UR (OBJY2) insulation system).
- The products were evaluated for a maximum ambient of 40°C for 48 V output power supply modules and 40°C or 50°C for 24 V output power supply modules. De-rating as specified below be considered for ambient above 40°C (for 24 V output power supply modules). De-rating as specified under Supplement 07-01 shall be considered for input voltage.
  De-rating for 24 V output power supply modules for ambient above 40°C:
  Input voltage: 180 Vac → output load 3300 W (@ambient 50°C)
  Input voltage: 264 Vac → output load 3300 W (@ambient 50°C)
- The unit is approved for connection to the following connections to TN / TT power distribution systems.

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:

- Disconnect device is end system consideration.
- Safety Instructions: Built in product, safety instructions are end product considerations.
- Power supply cords not part of investigation.
- The power supplies and complete rack is rated Class I. The power supply modules and rack module shall be properly bonded to the main protective bonding termination in the end product.
- The equipment has been evaluated for use in a Pollution Degree 2 and Overvoltage Category II environment and a maximum altitude of 5000 m.
- A suitable Electrical and Fire enclosure shall be provided in the end equipment. Front side of power supply modules (parts near fans when power supply modules inserted in the rack) are comply with the requirements of the fire and electrical enclosure.
- Measured touch current exceeds ES2 limits: “Caution” on the label → High touch current. Output of the unit should be connected with PE in end application. Reliable earth should be provided in end application.

Additional Information

N/A

Additional Standards

The product fulfills the requirements of: N/A

Markings and Instructions

Clause Title	Marking or Instruction Details
Protective conductor current – Symbol	 (IEC 60417-6042) and  (IEC 60417-6173) and  (IEC 60417-5019)
Hot surface - symbol	The symbol  (IEC 60417-5041)
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)
Class I equipment -Terminal for main protective earthing	Provided adjacent to the main protective earthing terminal  (IEC 60417-5019)

Safety Instructions - Rack Mount	"Rack Mount Instructions - The following or similar rack-mount instructions are included with the installation instructions: A) Elevated Operating Ambient - If installed in a closed or multi-unit rack assembly, the operating ambient temperature of the rack environment may be greater than room ambient. Therefore, consideration should be given to installing the equipment in an environment compatible with the maximum ambient temperature (Tma) specified by the manufacturer. B) Reduced Air Flow - Installation of the equipment in a rack should be such that the amount of air flow required for safe operation of the equipment is not compromised. C) Mechanical Loading - Mounting of the equipment in the rack should be such that a hazardous condition is not achieved due to uneven mechanical loading. D) Circuit Overloading - Consideration should be given to the connection of the equipment to the supply circuit and the effect that overloading of the circuits might have on overcurrent protection and supply wiring. Appropriate consideration of equipment nameplate ratings should be used when addressing this concern. E) Reliable Earthing - Reliable earthing of rack-mounted equipment should be maintained. Particular attention should be given to supply connections other than direct connections to the branch circuit (e.g. use of power strips)."

Special Instructions to UL Representative

Inspect the transformer(s) listed in Production-Line Testing Requirements (Electric Strength Test Special Constructions) per BD1.0.
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%.