# UL TEST REPORT AND PROCEDURE

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| **Standard:** | UL 60950-1, 2nd Edition, 2007-03-27 (Information Technology Equipment - Safety - Part 1: General Requirements)<br>CAN/CSA C22.2 No. 60950-1-07, 2nd Edition, 2007-03 (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) |
| **Product:** | Power Supply |
| **Model:** | HWS1500-3, HWS1500-5, HWS1500-6, HWS1500-7, HWS1500-12, HWS1500-15, HWS1500-24, HWS1500-36, HWS1500-48, HWS1500-48/SB1800, and HWS1500-60 may be followed by "/CO", "/DOV", "/HD", "/LNF", "/RL", "/SB", "/RY", "/RYCO", "/RYLLF", "/RYHD" or "/LNF3K".<br><br>Suffix "/DOV" for Model HWS1500-24 only. Suffix "/LNF" for Models HWS1500-24, HWS1500-36, and HWS1500-48 only. Suffixes "/RY", "/RYCO", "/RYLLF" or "/RYHD" for Model HWS1500-24 only. Suffix "/LNF3K" for Model HWS1500-24 only. |
| **Rating:** | 100-240 Vac, 50/60 Hz, 20 A (except for Model HWS1500-3)<br>100-240 Vac, 50/60 Hz, 15 A (for Model HWS1500-3)<br>See Additional Information in General Product Information for Output Ratings. |
| **Applicant Name and Address:** | TDK-LAMBDA CORP<br>NAGAOKA TECHNICAL CENTER<br>R&D DIV<br>2704-1 SETTAYA-MACHI<br>NAGAOKA-SHI<br>NIIGATA 940-1195 JAPAN |

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.

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**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 products are Component AC/DC Switching Power Supply with Fan intended for use in Information Technology Equipment (ITE).

**Model Differences**

Models HWS1500-12, HWS1500-15, HWS1500-24, HWS1500-36, HWS1500-48, and HWS1500-60 are identical, except for output rating, Transformer (T201), Inductor (L401) and some components on secondary circuit.

Model HWS1500-3 is identical in construction to Model HWS1500-12, except for Transformer (T201), FETs, PWB [Board No. PDA-033#] and some primary and secondary components described in Table 1.5.1.

Models HWS1500-3, HWS1500-5, and HWS1500-6 are identical in construction, except for temperature rating of Thermostat (TH201).

Models HWS1500-3 and HWS1500-7 are identical in construction, except for Transformer (T201), temperature rating of Thermostat (TH201) and some secondary components described in Table 1.5.1.

Model HWS1500-48/SB1800 is identical in construction to Model HWS1500-48/SB except for output power at 180-240Vac input, the use of class H Transformer (T201) only and the difference of constant of some secondary components.

Differences - Type Designation Suffixes:
"/blank": No thin coating for PWB.
"/CO": Thin coating for solder side of PWB.
"/DOV": OVP range is changed to maximum 30.5 Vdc. Changed rating of Resistor (R919) for Model HWS1500-24 only.
"/HD": Thin coating for both side of PWB.
"/LNF": Provided with Low Noise Fan. For Models HWS1500-24, HWS1500-36, and HWS1500-48 only. Models with this suffix have Tma different from other models. See CE1.2 in Technical Considerations.
"/LNF3K": Provided with Low Noise Fan and corresponded to an altitude of 3000 m. For Model HWS1500-24 only. Model with this suffix have Tma different from other models. See CE1.2 in Technical Considerations.
"/RL": Logic of Remote ON/OFF control is reversing. Change PWB name to PDA-034.
"/SB": This suffix model is identical in construction to models without the /SB suffix except the output terminal +) and -) is shortened by 11.0 mm.
"/RY": Uses relay instead of optocoupler in signal circuit of Model HWS1500.

"/RYCO": Based on /CO except with relay.
"/RYLLF": Based on /RY except fan. Fan is longer life fan.
"/RYHD": Based on /HD except with relay

Only 24 Vdc output models may be followed by suffixes "/RY", "/RYCO", "/RYLLF" or "/RYHD" and PWB p/n is changed from PDA-010_ to SCB365_ because of design change for above models.

**Technical Considerations**

- Equipment mobility : for building-in
- Connection to the mains : permanent connection
- Operating condition : continuous
- Access location : operator accessible
- Over voltage category (OVC) : OVC II
- Mains supply tolerance (%) or absolute mains supply values : +10%, -10%
- Tested for IT power systems : No
- IT testing, phase-phase voltage (V) : N/A
- Class of equipment : Class I (earthed)
- Considered current rating (A) : 20
- Pollution degree (PD) : PD 2
- IP protection class : IP X0
- Altitude of operation (m) : Up to 2000 (Up to 3000 for Model HWS1500-24/LNF3K only)
- Altitude of test laboratory (m) : Approximately 10 to 20
- Mass of equipment (kg) : Approximately 3.5
- The means of connection to the mains supply is: Permanently connected
- The product is intended for use on the following power systems: TN
- The power supply was submitted and evaluated for use at the maximum ambient temperature (Tma) permitted by the manufacturer's specification of: Models HWS1500-3 and HWS1500-5: 40°C [100% Output Load] and 70°C [50% Output Load]. Models HWS1500-6, HWS1500-7, HWS1500-12, HWS1500-15, HWS1500-24, HWS1500-36, HWS1500-48, and HWS1500-60: 50°C [100% Output Load] and 70°C [50% Output Load]. Models HWS1500-24/LNF, HWS1500-36/LNF, HWS1500-48/LNF, and HWS1500-24/LNF3K: 30°C [100% Output Load], 50°C [60% Output Load], and 70°C [20% Output Load]. Model HWS1500-24/RYLLF: 35°C [100% Output Load], 50°C [70% Output Load], and 70°C [20% Output Load]. See Enclosure Id. 6-01 for Model HWS1500-24/RYLLF derating curve details. Models HWS1500-48/SB1800: 40°C [100% Output Load], and 70°C [50% Output Load]. See Enclosure Id. 6-02 for Models HWS1500-48/SB1800.

**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 chassis of power supply must be properly connected to Protective Earthing Conductor or Protective Earthing Terminal in the end product via Protective Bonding Conductor.
- Inductors (L3, L401) and Transformer (T202) equipped with Insulator made of UL Recognized Component Plastic with suitable RTI; therefore, did not apply Class A Insulation.
- All tests measuring temperatures of components were conducted with power supply in horizontal

position. (Nameplate/Rating Label Side Up)

- The following components require special consideration in the end product Heating Test due to the indicated maximum temperature measurements in component level Heating Test: Transformer (T201) Coil Component Side (Maximum 134°C), Transformer (T201) Coil Solder Side (Maximum 131°C), Transformer (T202) Coil (Maximum 93°C), Transformer (T203) Coil (Maximum 81°C), Transformer (T204) Coil (Maximum 83°C), Transformer (T205) Coil (Maximum 82°C), Transformer (T700) Coil (Maximum 83°C), Inductor (L1) Coil (Maximum 76°C), Inductor (L2) Coil (Maximum 78°C), Inductor (L3) Coil (Maximum 105°C), Inductor (L5) Coil (Maximum 82°C), and Inductor (L401) Coil (Maximum 116°C)
- FG Terminals of Terminal Block (TB1) has not been evaluated as Protective Bonding Terminal. FG Terminals were isolated from primary circuit by basic insulation only.
- Terminal Block (TB1) was not evaluated for direct connection of power supply cord.
- Cover and Chassis have not been evaluated as external/internal enclosure.
- The following secondary output circuit is Hazardous Voltage: Output of Model HWS1500-60 (Output voltage did not comply with SELV and ELV requirements. Output separated by double/reinforced insulation.)
- Variable Resistor (VR900) used for output voltage setting of rated output. There is a possibility that increase maximum output voltage/current/power as Variable Resistor (VR900) is adjusted. However, manufacturer is not considering re-adjustment of Variable Resistor (VR900) following shipment of power supply. Therefore, must not adjust Variable Resistor (VR900) in the end product with the exception of Models HWS1500-3, HWS1500-5, HWS1500-6, HWS1500-7, and HWS1500-60.
- Model HWS1500-60 was tested with output voltage range of 48.0 - 66.0 Vdc. (Maximum 25.6 A at 100 - 180 Vac Input / Maximum 28.0 A at 180 - 240 Vac Input / Maximum 1536 W at 100 - 180 Vac Input / Maximum 1680 W at 180 - 240 Vac Input); Model HWS1500-3 was tested with output voltage range of 2.64 - 3.96 Vdc. (Maximum 300 A, Maximum 990 W); Model HWS1500-5 was tested with output voltage range of 4.0 - 6.0 Vdc. (Maximum 300 A, Maximum 1500 W); Model HWS1500-6 was tested with output voltage range of 4.8 - 7.2 Vdc. (Maximum 250 A, Maximum 1500 W); Model HWS1500-7 was tested with output voltage range of 6.0 - 9.0 Vdc. (Maximum 200 A, Maximum 1500 W); Adjustment was made via Variable Resistor (VR900). Tests were conducted under rated output voltage and ampere load, and rated VA. Additional testing shall be considered if the end product is outside this range.
- The following magnetic devices (e.g. Transformers or Inductor) are provided with an insulation system with the indicated rating greater than Class A (105°C): T2 (Class B) and L1 (155°C), T201 (Class F) for Models HWS1500-12, HWS1500-15, HWS1500-24, HWS1500-36, and HWS1500-48, T201 (Class H) for Models HWS1500-3, HWS1500-5, HWS1500-6, HWS1500-7, HWS1500-12, HWS1500-15, HWS1500-24, HWS1500-24/DOV, HWS1500-36, HWS1500-48, HWS1500-48/SB1800, and HWS1500-60 (Class H), T700 (Class B)
- The end product Electric Strength Test is to be based upon a maximum working voltage of: Primary - Secondary: 346 Vrms, 656 Vpk and Primary - Earthed Dead Metal: 346 Vrms, 624 Vpk for all models except for Models HWS1500-60, HWS1500-3, HWS1500-5, HWS1500-6, and HWS1500-7. Primary - Secondary: 373 Vrms, 736 Vpk and Primary - Earthed Dead Metal: 373 Vrms, 540 Vpk for Model HWS1500-60. Primary - Secondary: 380 Vrms, 540 Vpk and Primary - Earthed Dead Metal: 380 Vrms, 540 Vpk for Models HWS1500-3, HWS1500-5, HWS1500-6, and HWS1500-7. Primary - Secondary and Primary - Earthed Dead Metal: 237 Vrms, 664 Vpk for Model HWS1500-48/SB1800.
- The following secondary output circuits are SELV: Outputs of Models HWS1500-3, HWS1500-5, HWS1500-6, HWS1500-7, HWS1500-12, HWS1500-15, HWS1500-24, HWS1500-24/DOV, HWS1500-36, and HWS1500-48.
- The following secondary output circuits are at hazardous energy levels: Outputs of Models HWS1500-3, HWS1500-5, HWS1500-6, HWS1500-7, HWS1500-12, HWS1500-15, HWS1500-24, HWS1500-24/DOV, HWS1500-36, HWS1500-48, HWS1500-48/SB1800 and HWS1500-60.

- The power supply terminals and/or connectors are: Suitable for factory wiring only.
- The maximum investigated branch circuit rating is: 30 A
- The investigated Pollution Degree is: 2
- Proper bonding to the end product main protective earthing termination is: Required
- The following input terminals/connectors must be connected to the end product supply neutral: Terminal 2 of Terminal Block (TB1)
- The following end product enclosures are required: Fire and Electrical
- Capacitance Discharge Test should be evaluated in the end product.
- Model HWS1500-24/LNF3K was evaluated with considering altitude of 3000 m.

**Additional Information**

Output Rating:
HWS1500-3: 3.3 Vdc, 300 A
HWS1500-5: 5 Vdc, 300 A
HWS1500-6: 6 Vdc, 250 A
HWS1500-7: 7.5 Vdc, 200 A
HWS1500-12: 12 Vdc, 125 A
HWS1500-15: 15 Vdc, 100 A
HWS1500-24: 24 Vdc, 65 A at 100-180 Vac input;
HWS1500-24: 24 Vdc, 70 A at 180-240 Vac input
HWS1500-36: 36 Vdc, 42 A at 100-180 Vac input;
HWS1500-36: 36 Vdc, 46.5 A at 180-240 Vac input
HWS1500-48: 48 Vdc, 32 A
HWS1500-60: 60 Vdc, 25.6 A at 100-180 Vac input;
HWS1500-60: 60 Vdc, 28.0 A at 180-240 Vac input

Following Peak Output: Peak Current 42 A (Maximum 2520 W) Maximum 10 Seconds, Duty 35% (for 180-240 Vac input)
Note: Above models have each Derating Curve. See CE2.0 in Technical Considerations.

HWS1500-48/SB1800: 48 Vdc, 32 A at 100-180 Vac input;
HWS1500-48/SB1800: 48 Vdc, 37.5 A at 180-240 Vac input

Following Peak Output: Peak Current 52.5 A (Maximum 2520 W) Maximum 10 Seconds, Duty 35% (for 180-240 Vac input)
Note: Above models have each Derating Curve. See CE2.1 in Technical Considerations.

**Markings and instructions**

| Clause Title | Marking or Instruction Details |
|---|---|
| Power rating - Model | Model Number |
| Fuses - Rating | Rated current and voltage and type located on or adjacent to fuse or fuseholder. |
| 1.7.1 - Power rating - Company identification | Recognized company's name or tradename: "E122103", "TDK Lambda" or Trademark |

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| 1.7.1 - Power rating - Ratings | Optional. Ratings (voltage, frequency/dc, current) |

**Special Instructions to UL Representative**

Special Requirements based on the sub-clause 2.10.5.3: 1. General: The manufacturer shall subject 100 percent of production of all products to a routine Production-Line Electric Strength Test as described in below. 2. Test Equipment: See AC2.3.2 of GENERIC INSPECTION INSTRUCTIONS. 3. Method: See AC2.3.3 of GENERIC INSPECTION INSTRUCTIONS except AC2.3.3.1 and AC2.3.3.3. Use following item numbers 6 and 7 instead of AC2.3.3.1 and AC2.3.3.3. 4. Basis for Acceptability: See AC2.3.4 of GENERIC INSPECTION INSTRUCTIONS. 5. In Cases of Non-conformance: See AC2.3.4 of GENERIC INSPECTION INSTRUCTIONS. 6. Each product shall withstand without electrical breakdown, as a routine production-line test, the application of an ac potential at a frequency within the range of 40-70 Hz or a dc potential between [a] primary Terminals (Line and Neutral) on Terminal Block (TB1), and [b] secondary Output Terminals (+V and -V). For purposes of these instructions, primary wiring encompasses input wiring for connection to power systems associated with both ac mains and dc mains that exceeds 60 Vdc. 7. Test Potential/Time: 3000 Vrms/second or 4242 Vdc/1second. The manufacturer's test conditions may be higher than those when necessary to comply with other international product safety certifications. BE1.0 - Sample pick up should be conducted annually. Inspect the transformer(s) listed in BD1.1 per AA1.1-C.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 BD1.1 be conducted at the component manufacturer.