UL TEST REPORT AND PROCEDURE

Standard:	UL 60950-1, 2nd Edition, 2007-03-27 (Information Technology Equipment - Safety - Part 1: General Requirements) CSA C22.2 No. 60950-1-07, 2nd Edition, 2007-03 (Information Technology Equipment - Safety - Part 1: General Requirements)
Certification Type:	Power Supplies for Information Technology Equipment Including Electrical Business Equipment
CCN:	QQGQ2, QQGQ8
Product:	Single/triple Switching Power supplies and Racks
Model:	Single Power Supply Modules: FPS1000-48, -32, -24, -12, may be followed by "/P" or "/S" or "/PS". FPS1000-48 may also be followed by "/POE" in addition to the above suffixes. RFE1000-48, -32, -24 or -12, may be followed by "/S" or " -Y". RFE1000-48 may also be followed by "/POE" in addition to the above suffixes. PSG1000-48. Empty Racks: FPS-S1U may be followed by "/P", FPS-T1U may be followed by "/P", FPS-TB. Triple Power Supply Modules: FPS3000-48, -32, -24 or -12, may be followed by "/P" or "/S" or "/PS".
Rating:	Series FPS1000-48, -32, -24, -12, RFE1000-48, -32, -24, -12; Input= 100 - 240 Vac, 13-6.3 A, 50/60 Hz; Outputs: Series FPS1000-48, -32, -24, -12, without appliance inlet (may be followed by /S), FPS1000-48/POE and FPS1000-48/S/POE; Series RFE1000-48, -32, -24 or -12, may be followed by "/S" or " -Y". RFE1000-48 may also be followed by "/POE" in addition to the above suffixes. [-48 @ T=50℃]: V1= 48 Vdc, 21 A; V2= 12V dc, 0.25A ; [-48 @ T=70℃]: V1= 48 Vdc, 11.55 A; V2= 12V dc, 0. 25A; [-32 @ T=50℃]: V1= 32 Vdc, 31 A; V2= 12V dc, 0.25A ; [-32 @ T=70℃]: V1= 32 Vdc, 17 A; V2= 12V dc, 0.25A ; [-24 @ T=50℃]: V1= 24 Vdc, 40 A; V2= 12V dc, 0.25A ; [-24 @ T=70℃]: V1= 24 Vdc, 22 A; V2= 12V dc, 0.25A ; [-12 @ T=50℃]: V1= 12 Vdc, 72 A; V2= 12V dc, 0.25A ; [-12 @ T=70℃]: V1= 12 Vdc, 39.6 A; V2= 12V dc, 0.2 5A; Series FPS1000-48, -32, -24, -12 with appliance inlet (followed by /P or

Copyright © 2010

	/PS), FPS1000-48/P/POE and FPS1000-48/PS/POE [-48 @ T=50℃]: V1= 48 Vdc, 21 A; V2= 12V dc, 0.25A ; [-48 @ T=60℃]: V1= 48 Vdc, 16.8 A; V2= 12V dc, 0.2 5A; [-32 @ T=50℃]: V1= 32 Vdc, 31 A; V2= 12V dc, 0.25A ; [-32 @ T=60℃]: V1= 32 Vdc, 24.8 A; V2= 12V dc, 0.2 5A; [-24 @ T=50℃]: V1= 24 Vdc, 40 A; V2= 12V dc, 0.25A ; [-24 @ T=60℃]: V1= 24 Vdc, 32 A; V2= 12V dc, 0.25A ; [-12 @ T=50℃]: V1= 12 Vdc, 72 A; V2= 12V dc, 0.25A ; [-12 @ T=60℃]: V1= 12 Vdc, 57.6 A; V2= 12V dc, 0.2 5A; FPS-S1U rack and series FPS3000 based on FPS-S1U rack: Input (per each installed unit, up to 3 units): 100-240Vac, 13-6.3A, 50/60 Hz; Outputs: [-48 @ T=50℃]: V1= 48 Vdc, 63 A; V2= 12V dc, 0.75A ; [-48 @ T=60℃]: V1= 48 Vdc, 50.4 A; V2= 12V dc, 0.7 5A; [-32 @ T=50℃]: V1= 32 Vdc, 93 A; V2= 12V dc, 0.75A ; [-32 @ T=60℃]: V1= 32 Vdc, 74.4 A; V2= 12V dc, 0.7 5A; [-24 @ T=50℃]: V1= 24 Vdc, 120 A; V2= 12V dc, 0.75 A; [-24 @ T=60℃]: V1= 24 Vdc, 96 A; V2= 12V dc, 0.75A . [-12 @ T=50℃]: V1= 12 Vdc, 216 A; V2= 12V dc, 0.75 A; [-12 @ T=60℃]: V1= 12 Vdc, 172.8 A; V2= 12V dc, 0. 75A. FPS-T1U rack and series FPS3000 based on FPS-T1U rack: Input (per each installed unit, up to 3 units): 100-240 Vac, 13-6.3 A, 50/60 Hz; Outputs (per each installed unit): same as above for FPS1000-xx units with appliance inlet (followed by /P or /PS), FPS1000-48/P/POE and FPS1000-48/PS/POE, PSG1000-48 (modified FPS1000-48) Input= 100-240 Vac, 13-6.3 A, 50/60 Hz; Outputs: [-48 @ T=50℃]: V1= 48 Vdc, 21 A; V2= 12V dc, 0.25A ; [-48 @ T=70℃]: V1= 48 Vdc, 11.55 A; V2= 12V dc, 0. 25A; FPS-TB rack Input: 100-240 Vac, 13-6.3 A, 50/60 Hz; Outputs (per installed unit): same as for FPS1000-xx, /S, /P, /PS units, FPS1000-48/POE, /P/POE, /PS/POE See Label attached in enclosure "Miscellaneous"
Applicant Name and Address:	TDK-LAMBDA CORP NAGAOKA TECHNICAL CENTER R&D DIV 2701 TOGAWA, SETTAYA NAGAOKA-SHI NIIGATA 940-1195 JAPAN

Copyright © 2010

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 Underwriters Laboratories Inc. ('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 Underwriters Laboratories Inc. (UL) or any authorized licensee of UL.

Prepared by: AnnaMarie Vessey
Underwriters Laboratories Inc.

Reviewed by: David Keen
Underwriters Laboratories Inc.

Copyright © 2010

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 are Class I equipment, designed to be installed in a 19" rack 1U high. All the outputs are unearthed. It has a metal enclosure without openings on top, bottom, left and right sides. In the front side there are 2 openings with grids protecting two cooling fans. The rear side is completely opened and the input/output power and signal connector are located there.

The triple power supply modules are designed to embed up to three single power supplies enclosing them in a 19" rack 1U high named FPS-S1U or FPS-T1U. The rack contains additional circuitry to control the DC outputs of the 3 single power supplies. It has a metal enclosure on all the sides. On the rear side may be located 3 appliance inlets adjacent each others (one for each single power supply) according to the option.

Accessory Rack FPS-TB is intended for installation of a single FPS1000-xx.

Model Differences

Single power supply modules: FPS1000-48, -32, -24, -12, may be followed by:
"/P" for Appliance Inlet located on the front side;
"/S" for a Secondary Communication Option (located in SELV);
"PS" for both options at the same time.

Single power supply modules: RFE1000-48, -32, -24, -12; may be followed by:
"/S" for a Secondary Communication Option (located in SELV);
"-Y" for units with "or-ing" diodes in the SELV output to allow for parallel connection.
RFE1000-48 may also be followed by "/POE" in addition to the above suffixes.

RFE1000-xx is the same as FPS-1000-xx except for RFE1000-xx has an input terminal block for mains connection and DC output bus-bars screws. The input terminals are identified by L, N, PE and the output terminals are identified by +, -.

Single power supply modules: FPS1000-48/POE is identical to model FPS1000-48 and RFE1000-48/POE is identical to model RFE1000-48, except for model designation and minor changes in the SELV output circuit EMI filtering capacitors.

Model FPS1000-32 is identical to model FPS1000-48, except for model number, output ratings, number of turns in the secondary of transformers, T101 and T102, and resistors.

Model PSG1000-48 is identical to model FPS1000-48, except for model number and I/O connector located in

the rear of the power supply. Model PSG1000-48 employs separate input and output wires with connectors, while FPS1000-48 employs one I/O connector.

Empty rack: FPS-S1U. (Single Output) May be followed by:
"/P" for Appliance Inlets located in the front side, one on each front of single power supply. The hole on the back is covered.

Empty rack: FPS-TB (Single Output) is an empty single rack intended for installation of one FPS1000-xx power supply. Provided with an input terminal block.

Empty rack: FPS-T1U. (Triple Output) May be followed by:
"/P" for Appliance Inlets located in the front side, one on each front of single power supply. The hole on the back is covered.

Triple power supply in rack: FPS3000-48 or FPS1000-24. May be followed by:
"/P" for Appliance Inlet located on the front side; the hole on the back is covered.
"/S" for a Secondary Communication Option (located in SELV);
"PS" for both options at the same time.

Power Supply FPS3000-XX: Accessory rack model FPS-S1U or FPS-T1U with three installed FPS1000-XX power units. Basic model: with three AC inlets located on the rear side; Model name can be followed by: "/S": with secondary communication option (in SELV circuit); "/P": without AC inlets on the rear side (for installation of power supply modules with an appliance inlet on the front panel); "/PS": for both options above.

Technical Considerations

- Equipment mobility : for building-in
- Connection to the mains : N/A
- Operating condition : continuous
- Access location : restricted access location
- 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) : 20A
- Pollution degree (PD) : PD 2
- IP protection class : IP X0

- Altitude of operation (m) : up to 2000m
- Altitude of test laboratory (m) : < 150m
- Mass of equipment (kg) : 2kg for each FPS1000-xx, RFE1000-xx series power supplies and PSG1000-48; 0.5 kg for FRS-TB empty rack; 4 kg for FPS-T1U and FPS-S1U empty accessory racks; 10 kg for the FPS3000 series power supplies.
- The product was submitted and evaluated for use at the maximum ambient temperature (Tma) permitted by the manufacturer's specification of: 50℃ at 100% or less of rated output for all units; 60℃ at 80% or less of rated output for FPS1000-xx and units with appliance inlet (followed by /P or /PS), FPS1000-48/P/POE, FPS1000-48/PS/POE, empty racks FPS-S1U, FPS-T1U and triple FPS3000-xx, 70℃ at 55% or less of rated output for FPS1000-xx units without appliance inlet (not followed or followed by, /S), FPS1000-48/POE, FPS1000-48/S/POE, PSG1000-48, and RFE1000-xx , -xx/S, xx-Y -48/POE, -48-Y/POE -48/S/POE, -48-Y/S/POE, - for FPS-TB rack:, - 50℃ for 100% or less of rated output - for all installed FPS1000-xx units;, - 60℃ for 80% or less of rated output - for installed units with an appliance inlet (FPS1000-xx/P, FPS1000-, xx/PS, FPS1000-48/P/POE, FPS1000-48/PS/POE)., - 70℃ for 55% or less of rate d output -for installed units without an appliance inlet (FPS1000-xx, PS1000-, xx/S, FPS1000-48/POE, FPS1000-48/S/POE and PSG1000-48). The same de-ratings apply for the equivalent RFE1000-xx series.
- The means of connection to the mains supply is: Pluggable A, for the following: /P units, /PS units, the empty racks FPS-S1U, FPS-T1U and FPS3000-xx units.
- The product is intended for use on the following power systems: TT, TN
- 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
- Reinforced insulation is provided between Primary and SELV circuits.
- Equipment is intended for installation in RAL (Restricted Access Location) only.
- Thermal cut-off (TS101) is not necessary for safety and it was by-passed during testing.
- To consider operation at max. 3000 meter, all values in clearance tables were multiplied by a factor of 1.14.
- The equipment disconnect device is considered to be: Appliance inlets for the triple power supply mounted in rack; Appliance inlet for single power supply equipped with"/P" option; mixed power/signal connector for single power supply not equipped with "/P" option. The FPS1000-xx , -xx/S, -48/POE, -48/S/POE, RFE1000-xx , -xx/S, -xx-Y, -48/POE, -48-Y/POE, -48/S/POE, -48-Y/S/POE, FPS-TB with installed FPS1000-xx or /S and PSG1000-48 have no a disconnected device provided with unit. An appropriate disconnected device shall be provided by endproduct.

Engineering Conditions of Acceptability

For use only in or with complete equipment where the acceptability of the combination is determined by Underwriters Laboratories Inc. When installed in an end-product, consideration must be given to the following:

- The following Production-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: [-24]: Primary-SELV: 424 Vrms, 883 Vpk; [-24]: Primary-Earthed Dead Metal: 429 Vrms, 825 Vpk. [-48, and -32]: Primary-SELV: 359 Vrms, 695 Vpk;, [-48, and -32]: Primary-Earthed Dead Metal: 416 Vrms, 780 Vpk.
- The following secondary output circuits are SELV: All
- The following secondary output circuits are at hazardous energy levels: Output V1 (48 Vdc, 32Vdc, 24 Vdc and 12Vdc)
- The following secondary output circuits are at non-hazardous energy levels: Output V2 (12 Vdc)
- The following output terminals were referenced to earth during performance testing: -V, SIGNAL_RTN
- The power supply terminals and/or connectors are: Not investigated for field wiring
- The maximum investigated branch circuit rating is: 20 A for each input.
- 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 input terminals/connectors must be connected to the end-product supply neutral: ACN
- 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℃): T101, T102, T103 (Class F - 155℃)
- The following end-product enclosures are required: Fire, Electrical (only for series FPS1000-48, -32, -24 or -12, PSG1000-48), FPS1000-48/POE, RFE1000-xx, FPS-TB. Power supplies FPS3000-xx and empty racks FPS-S1U, FPS-T1U comply with the fire and electrical enclosure requirements.
- The following components require special consideration during end-product Thermal (Heating) tests due to the indicated maximum temperature measurements during component-level testing: C146 (82.1℃) on 32 Vdc and 48Vdc models, L102 (96.3℃) on 32 Vdc and 48Vdc models, L101 (94.9℃) on 32 Vdc and 48Vdc models, L104 (102.1℃) on 32 Vd c and 48Vdc models, C102 (84.5.0℃) on 32 Vdc and 48Vdc models, L103 (92.0℃) on 32 Vdc and 4 8Vdc models, C101 (82.3℃) on 24Vdc models, L104 (97.9℃) on 24Vdc models, C102 (83.9℃) on 24Vdc models, L102 (92.9℃) on 24Vdc models, L101 (93.7℃) on 24Vdc models

- The equipment is suitable for direct connection to: AC mains supply
- Earthing of the 48Vdc, 32Vdc, 24Vdc or 12Vdc SELV outputs are not allowed in the single power supply unit, but permitted when installed in the end-product.
- The maximum ambient operating temperature:, 50℃ at 100% or less of rated output for all units;, 60℃ at 80% or less of rated output for FPS1000- xx units with appliance inlet (followed by /P or /PS),, FPS1000-48/P/POE, FPS1000-48/PS/POE, empty racks FPS-S1U, FPS-T1U and triple FPS3000-xx, 70℃ at 55% or less of rated output for FPS1000 -xx units without appliance inlet (not followed or followed by, /S), FPS1000-48/POE ,FPS1000-48/S/POE and PSG1000-48., - for FPS-TB rack:, - 50℃ for 100% or less of rated output – for all ins talled FPS1000-xx units;, - 60℃ for 80% or less of rated output – for installed units with an appliance inlet (FPS1000-xx/P,, FPS1000-, xx/PS, FPS1000-48/P/POE, FPS1000-48/PS/POE)., - 70℃ for 55% or le ss of rated output –for installed units without an appliance inlet (FPS1000-xx, PS1000-, xx/S, FPS1000-48/POE, FPS1000-48/S/POE and PSG1000-48).

Additional Information

The 48 Vdc, 32 Vdc, 24 Vdc or 12 Vdc output is suitable for field installation (screw terminals).
To consider operation at max. 3000 meter, all values in clearance tables were multiplied by a factor of 1.14.

Markings and instructions

Clause Title	Marking or Instruction Details
Power rating - Ratings	Ratings (voltage, frequency/dc, current)
Power rating - Company identification	Listee's or Recognized company's name, Trade Name, Trademark or File Number
Power rating - Model	Model Number
Fuses - Rating	Rated current and voltage and type located on or adjacent to fuse or fuseholder.
Fuses - Non-operator access/soldered-in fuses	Unambiguous reference to service documentation for instructions for replacement of fuses replaceable only by service personnel
Multiple power sources	"Disconnect ___ power supply cords before servicing"

Special Instructions to UL Representative

N/A