UL TEST REPORT AND PROCEDURE

Standard:	UL 60950-1, 2nd Edition, 2014-10-14 (Information Technology Equipment - Safety - Part 1: General Requirements) CAN/CSA C22.2 No. 60950-1-07, 2nd Edition, 2014-10 (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:	Switch Mode Power Supply
Model:	NV100 or NV-100 Range (see Model Differences for details)
Rating:	100-240Vac Nominal (90-264V max. tolerance) 45-440Hz, 1.7A 133-318Vdc Nominal (120-350Vdc max. tolerance), 1.2A (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.

Any information and documentation involving UL Mark services are provided on behalf of UL LLC (UL) or any authorized licensee of UL.

Prepared by: Mike Burns Reviewed by: David Snook

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

NV100 or NV-100 series are switch mode power supply modules for building into host equipment.

Model Differences

NV100 or NV-100 models as described below:

Units may be marked with a Product Code: U1x or Y1x where x may be any number of characters.

Unit Configuration (Description :) Code may be prefixed by NS # followed by / or - (where # may be any number of characters indicating non- safety related model differences).

Unit Configuration Code:

NVx-abcde-f-g

where:

x	=	A1 (NVA1 for NV100 or NV-100 series)
a	=	Number of Outputs : 4
b	=	Channel 1 Output Voltage†: 5, E or G
c	=	Channel 2 Output Voltage†: 3 or 5
d	=	Channel 3 Output Voltage†: T, F, G or K
e	=	Channel 4 Output Voltage†: T or F followed by P for positive output, or 0 for no output
f	=	U for U chassis, C for U chassis and cover or nothing for Open Frame
g	=	R for right angle connector

† Table1: Output Voltage Cross Reference

Designation	Nominal Output Voltage
3	3.3
5	5
T	12
F	15
E	18
G	24 or 24.5
K	36

ELECTRICAL AND THERMAL RATINGS:

Input parameters

NV100

	AC	DC
Nominal Input Voltage	100 - 240 Vac	133 - 318Vdc
Input Voltage Range	90 - 264Vac	120 - 350Vdc
Input Frequency Range	45 - 440Hz	DC
Maximum Input Current	1.7A rms	1.2Adc

All ratings apply for ambient temperatures up to 50°C. From 50 to 70°C the total output power and the module current ratings are both derated at 2.5% per deg C. Maximum ambient 50°C for still air.
There are five standard NV100 models with output parameters shown in the tables below:

Model: NVA1-453GF (can be followed by P, -U, -C or -R)

Output Channel	Voltage designation	Vout	Adjustment Range V	Output Current
CH1	5	5	4.75 - 5.25	10A
CH2	3	3.3	3.14 - 3.46	8A
CH3	G	24.5	Fixed*	1.5A
CH4	F	15	Fixed*	1A

Model: NVA1-453FF (can be followed by P, -U, -C or -R)

Output Channel	Voltage designation	Vout	Adjustment Range V	Output Current
CH1	5	5	4.75 - 5.25	10A
CH2	3	3.3	3.14 - 3.46	8A
CH3	F	15	Fixed*	3A
CH4	F	15	Fixed*	1A

Model: NVA1-453TT (can be followed by P, -U, -C or -R)

Output Channel	Voltage designation	Vout	Adjustment Range V	Output Current
CH1	5	5	4.75 - 5.25	10A
CH2	3	3.3	3.14 - 3.46	8A
CH3	T	12	Fixed*	3A
CH4	T	12	Fixed*	1A

Model: NVA1-4G5TT (can be followed by P, -U, -C or -R)

Output Channel	Voltage designation	Vout	Adjustment Range V	Output Current
CH1	G	24	23 - 25	4A
CH2	5	5	3.3 - 5.5	5A
CH3	T	12	Fixed*	3A
CH4	T	12	Fixed*	1A

Model: NVA1-4G5FF (can be followed by P, -U, -C or -R)

Output Channel	Voltage designation	Vout	Adjustment Range V	Output Current
CH1	G	24	23 - 25	4A
CH2	5	5	3.3 - 5.5	5A
CH3	F	15	Fixed*	3A
CH4	F	15	Fixed*	1A

*Channels 3 and 4 output voltage may vary +/-10% depending on channel 1 output voltage and current settings.

Variations and limitations of use:

All NV100 PSUs can output 100W. These power ratings are for channels 1 to 4.
Natural convection rating limited to 50W total output power with any channel at 50% max output current.
Natural convection cannot have -C option (cover fitted).
100W output can be achieved with 2m/s forced air from input to output. The rules below for "Cooling for Unit" must be adhered to for all methods of cooling, including natural convection.
Channel 1 & 2 combined power must not exceed 60W for 5V channel 1 models.

Non-standard NV100 model:

Model: Y10001A (NVA1-3E5K0, can be followed by -U, -C or -R)

Output Channel	Voltage designation	Vout	Adjustment Range V	Output Current
CH1	E	17.25	17.25 - 17.75	3A
CH2	5	5.15	5.15 - 5.90	4A
CH3	K	34.5	Fixed*	2A
CH4	0	-	-	-

*Channel 3 output voltage may vary +4.5%, -1.5% depending on channel 1 output voltage and current settings.

Variations and limitations of use for NV100 model Y10001A:

Unit can output 110W. These power ratings are for channels 1 to 3.
No natural convection rating for this unit.
Channel 1 & 2 combined power must not exceed 70W.
110W output can be achieved with 2m/s forced air from input to output. The rules below for "Cooling for Unit" must be adhered to for all methods of cooling.

Operating temperature from 0°C to 45°C.

ENVIRONMENTAL PARAMETERS

Operation

Temperature:	0 to 50°C
Humidity:	5 to 95% RH, non-condensing
Air Pressure:	54kPa to 106kPa
Altitude:	-200m to 5000m

Storage and Transportation

Temperature:	-40°C to +85°C
Humidity:	5 to 95% RH, non-condensing
Air Pressure:	54kPa to 106kPa
Altitude:	-200m to 5000m

Mounting Aspects

Orientations:	All except base PCB uppermost

Technical Considerations

- Equipment mobility : for building-in
- Connection to the mains : not directly connected to the mains (to be provided by host equipment)
- Operating condition : continuous
- Access location : for building-in
- Over voltage category (OVC) : OVC II
- Mains supply tolerance (%) or absolute mains supply values : +10%, -10%
- Tested for IT power systems : Yes (Norway only)
- IT testing, phase-phase voltage (V) : 230V
- Class of equipment : Class I (earthed)
- Considered current rating of protective device as part of the building installation (A) : 20A
- Pollution degree (PD) : PD 2
- IP protection class : IP X0
- Altitude of operation (m) : 5000m
- Altitude of test laboratory (m) : 64m
- Mass of equipment (kg) : < 18
- The product was investigated to the following additional standards: EN 60950-1:2006 + A11:2009 + A1:2010 + A12:2011 + A2:2013 (which includes all European national differences, including those specified in this test report).,
- Maximum altitude of operation is 5000m for all models.
- 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); 70°C (power and output current decreasing linearly by 2.5%/°C above 50°C)
- The product is intended for use on the following power systems: TN, DC mains supply
- 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
- The equipment disconnect device is considered to be: Provided by the end equipment
- The product was investigated to the following additional standards: EN 60950-1:2006 + A2:2013 (which includes all European national differences, including those specified in this test report), CSA C22.2 No. 60950-1-07 + A1:2011, UL 60950-1 2nd Ed. Revised 2011-12-19
- Multi-layer PWB's accepted under CBTR Ref. No: E349607-A23 dated 2014-07-31 and letter report, Enclosure 8-05 of this report

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:

- For the USA and Canada, double pole Neutral fusing is required, rated fuses T2AH, 250V must be fitted in the end-use application and marking in compliance with clause 1.7.6
- The following Production-Line tests are conducted for this product: Earthing Continuity Electric Strength
- The following secondary output circuits are SELV: All

- The end-product Electric Strength Test is to be based upon a maximum working voltage of: Primary-SELV: 393 Vrms, 666 Vpk Primary-Earthed Dead Metal: 395 Vrms, 411 Vpk
- The power supply terminals and/or connectors are: Suitable for factory wiring only
- The investigated Pollution Degree is: 2
- Proper bonding to the end-product main protective earthing termination is: Required
- The following end-product enclosures are required: Mechanical , Fire , Electrical
- The following output terminals were referenced to earth during performance testing: All outputs and their return lines individually referenced to earth to obtain maximum working voltage.
- The maximum investigated branch circuit rating is: 20A
- 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): Transformer T1 and T2 (Class F) - See table 1.5.1 for details of insulation systems used.
- An investigation of the protective bonding terminals has: Been conducted
- The following secondary output circuits are at non-hazardous energy levels: All

Additional Information

COOLING FOR UNIT

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 IEC60950-1:2005 Clause 4.5. 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 stabilised.

Circuit Ref.	Description	Max. Temp(°C)
L3, L7	Common mode choke winding	140
C1, C4	X capacitors	100
C6, C12	Capacitor	105
C11	Resonant capacitor	105
L2	Boost choke winding	130
C7	Electrolytic capacitor	70 (105)
T1, T2	Transformer winding	130
L1	Primary choke	130
XU3, XU4	Opto-couplers	100
L5	Channel 1 output choke	125
L4	3.3V (5V NVA1-3E5K0) channel 2 output choke	125
R3 & R4	PCB between R3 & R4	130
XU401	3.3V (5V NVA1-3E5K0) Ch2 IC XU401	115
XL402	5V Ch2 output choke	125

XV12	Ch3 FET	115
XD41	Ch4	115
Various	All other electrolytic capacitors	90 (105)

Higher temperature limits (in brackets) may be used but product life may be reduced.

This report is a reissue of CBTR Ref. No. E135494-A45, CB Test Certificate Ref. No.DK-29164-UL. Based on previously conducted testing and the review of product technical documentation including photos, schematics, wiring diagrams and similar, it has been determined that the product continues to comply with the standard. Only the following changes/additions for the NV100 were considered necessary for reissue of the report:

1. Update of the report to Amendment 2.
2. Assessed for 5000M
3. Addition/deletion and correction to CCL
4. Update of licenses
5. Change of factory name from Trio Engineering Co. Ltd to Panyu Trio Microtronic Co Ltd

Additional Standards

The product fulfills the requirements of: EN 60950-1:2006 + A1:2010 + A11:2009 + A12:2011 + A2:2013