

UL TEST REPORT AND PROCEDURE

Standard:	UL 61010-1, 3rd Edition, 2012-05-11 (ELECTRICAL EQUIPMENT FOR MEASUREMENT, CONTROL, AND LABORATORY USE - Part 1: General Requirements) CAN/CSA-C22.2 No. 61010-1, 3rd Edition, 2012-05, (ELECTRICAL EQUIPMENT FOR MEASUREMENT, CONTROL, AND LABORATORY USE - Part 1: General Requirements)
Certification Type:	Component Recognition
CCN:	QQHC2, QQHC8 (Power Supplies for Measurement, Control and Laboratory Use)
Product:	Switch mode power supply
Model:	NV175 Series NV-175 Series NV1-1G000
Rating:	(See Model Differences for details) NV175 Series; NV-175 Series: 100-240Vac (Nominal), 90-264V (Full Tolerance), 45-440Hz, 3Arms NV1-1G000 only: 88.9-240Vac (Nominal), 80-264V (Full Tolerance), 45-440Hz, 3Arms (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.

Issue Date: 2013-07-30
2015-08-04

Page 2 of 19

Report Reference #

E331788-A18-UL

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: Ermanno Rebecchi

Reviewed by: Bartlomiej Zmijewski

Copyright © 2015

Created by UL Document Assembler 2015-08-19 02:34:11 -05:00

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

NV175 or NV-175 series . Switch mode power supplies for building into end equipment.

Model Differences

NV175 or NV-175 models as described below:

Units may be marked with a Product Code: K1x or Q1x where x may be any number of letters and/or numbers 0 to 9.

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-h-ijk

where:

x = 1 for 175

a = Number of Outputs : 1, 2, 3 or 4

b = Channel 1 Output Voltage: 5, T, F, E or G

c = Channel 2 Output Voltage: 1, 2, 3, 5, 5L, 7, F or 0

d = Channel 3 Output Voltage: 3L, 5L, 7, TL, FL, T, F, G followed by Y for negative output or 0

e = Channel 4 Output Voltage: 3H, 5H, 7, T, F, TH, FH, 0H (fan only channel 4 output) followed by V for variable output followed by P for positive output or 0

f = Global Option : N for 5V version, N1 for 12V version, N2 for 13.5V version, N3 for 5V version with ATX compatibility, N4 for 12V version with ATX compatibility, N5 for 13.5V version with ATX, N6 for 12-13.5V version, N7 for 12-13.5V version with ATX or nothing for no Global Option present

g = U for U chassis, C for U chassis and cover, F for U chassis and cover with fan, I for U chassis and cover with fan and IEC inlet or nothing for Open Frame

h = Blank is the standard upright output connector, R is for the right angle output connector, H is for high altitude, HR is for high altitude with right angle output connector, M is for IEC60601-1, MR is for IEC60601-1 spacings with right angle connector

ijk = Three numbers from 0 to 9 which denotes various output voltages and currents within the specified ranges of each output for a particular unit or blank for standard output settings

† Table1: Output Voltage Cross Reference

Designation	Output Voltage
0	Omit output
A	1.5
1	1.8
B	2
2	2.7
3	3.3
5	5
7	7
T	12
F	15
E	18
G	24

Output channels and Global Options ratings are in accordance with the following table subject to variations and limitations of use below:

Output Channel	Designation	Vout	Adj. Range	Output Current
CH1	5	5	5 - 5.5	25A
	T	12	12 - 15.5	15A
	F	15	12 - 15.5	15A
	E	18	16 - 20	10A
	G	24	24 - 28.5	7.5A
CH2	1	1.8	0.9 - 3.8	15A
	2	2.7	2.5 - 3.8	15A
	3	3.3	2.5 - 3.8	15A
CH2 (CH1 12V)	5	5	3.3 - 5.5	10A
CH2 (CH1 15V)	5	5	3.3 - 5.5	10A
CH2 (CH1 24V)	5L	5	Fixed	2A
	5	5	3.3 - 5.5	8A
CH3	7	7	5.5 - 8	5.5A
	F	15	12-15.5	6A
	7	+/-7	7 - 8	5A
	T	+/-12	12 - 15	5A
	F	+/-15	12 - 15	5A
	G	+/-24	18 - 24.5	2.5A
	3L	+/-3.3	Fixed	2A
	5L	+/-5	Fixed	2A
	TL	+/-12	Fixed	2A
	FL	+/-15	Fixed	2A
CH4	3H	+/-3.3	Fixed	2A
	5H	+/-5	Fixed	2A
	7	+/-7	7 - 8	1A
	T	+/-12	Fixed	1A
	F	+/-15	Fixed	1A
	TH	+/-12	Fixed	2A
	FH	+/-15	Fixed	2A
	THV	+/-12	12 - 15	2A
	FHV	+/-15	12 - 15	2A
	CH4 (fan output)	OH	-	-
Global Option	N	5	Fixed	2A
	N1	12	Fixed	1A
	N2	13.5	Fixed	1A

N3	5(ATX)	Fixed	2A
N4	12(ATX)	Fixed	1A
N5	13.5(ATX)	Fixed	1A
N6	12	12-13.5*	1A
N7	12(ATX)	12-13.5*	1A

Channels 1 and 2 combined output currents must not exceed 25A

*Can only be set at the factory.

Variations and limitations of use:

All NV175 or NV-175 PSUs can output 180W except 5V channel 1 models which can output 175W. These power ratings are for channels 1 to 4. The global option output can be run in addition to the channel 1 to 4 maximum power outputs.

Units with channel 1 T and G outputs (no other channels fitted) have a peak power output of 200W including the global option with the following duty cycles:

In any 5 minutes 30% at 200W followed by 70% at 171W (average 180W)
In any 5 minutes 20% at 200W followed by 80% at 175W (average 180W)

Options -H and -HR meet spacings for 5000m.

Options -M and -MR meet IEC60601-1 Edition 2 Reinforced spacing's with the following limitations (interpolated creepage spacings):

Channel 1 cannot be 5V model (T1 and T2 with foils)
Channel 2 cannot be fitted
Cannot be global option variants

Fan versions:

Channel 1 with G output, 25V maximum with 5V channel 2 maximum output current of 7A.
Channel 1 with G output, 25V maximum with 7V channel 2 maximum output current of 5.5A.
Channel 1 with G output, 5L channel 2 maximum output current 1.8A.
Channel 2 with T and F outputs, channel 2 maximum output current of 9A.
Channel 4 maximum output current of 1.5A

Model NV1-1G000 (with or without global option or -M/-MR option) may also be run with Channel 1 output voltage range 22.5V to 28V with maximum current of 7.5A and maximum power of 180W

Model NV1-1G000 (with or without -M option) may also be run at 80Vac to 264Vac input, output: 24V to 28V at 6.25A maximum current and 150W maximum power.

The products listed in the following table are typical examples:

Model	CH1	CH2	CH3	CH4	Global Option
NV1-453FF	5V/25A	3.3V/15A	15V/5A	15V/1A	-
NV1-4G5FFH-N3	24V/7.5A	5V/8A	15V/5A	15V/2A	5V/2A
NV1-350TT-N	5V/25A	-	12V/5A	12V/1A	5V/2A
NV1-453TT-N1	5V/25A	3.3V/15A	12V/5A	12V/1A	12V/1A
NV1-250T0-N2	5V/25A	-	12V/5A	-	13.5V/1A

Custom Models:

All ratings as per standard models unless otherwise stated.

Model: NS-LAM/NV1-453TTH-N2-H-C (K10035)
Rated to 4600m altitude
Input voltage range from 90Vac to 264Vac

Model: NS-LAMF/NV1-4G5TTH-F (K10066)
5L low current channel 2 fitted.
Channel 2 rated: 5V, 1.4A
ELECTRICAL AND THERMAL RATINGS

Nominal Input Voltage	100 - 240 Vac
Input Voltage Range	90 - 264Vac
Input Frequency Range	45 - 440Hz
Maximum Input Current	3A rms

All ratings apply for ambient temperatures up to 50°C. From 50 to 65°C the total output power and the module current ratings are both derated at 2.5% per deg C.

ENVIRONMENTAL PARAMETERS

Operation

Temperature:	0 to 50°C (From 50 to 65°C the total output power and the
Humidity:	5 to 95% RH, non-condensing
Air Pressure:	70kPa to 106kPa
Altitude:	-200m to 3000m (-H and -HR models, 5000m)

Storage and Transportation

Temperature:	-40°C to +70°C
Humidity:	5 to 95% RH, non-condensing
Air Pressure:	54kPa to 106kPa
Altitude:	-200m to 5000m

Mounting Aspects

Orientations:	All except PCB uppermost
---------------	--------------------------

Technical Considerations

- Type of item tested : Laboratory
- Description of equipment function : Switch mode power supply
- Connections to mains supply : To be determined in the end use equipment or IEC inlet
- Overvoltage category : II
- Pollution degree : 2
- Means of Protection : Class I (PE connected)
- Environmental conditions : Normal
- For use in wet locations : No
- Equipment mobility : Built-in

- Operating conditions : continuous
- Overall size of the equipment: (W X D X H) (mm) : 174 x 103 x 41 mm
- Mass of the equipment (kg) : 0.6 kg max
- Marked degree of protection to IEC 60529 : none
- Equipment classification: Professional, Commercial
- Equipment class: Class I
- Equipment type: For building in
- The product was submitted and tested for use at the maximum recommended ambient temperature (Tmra) of: 50°C (full load): 65°C maximum (output de-rated 2.5% /°C above 50°C)
- Evaluated for a maximum altitude of 3000m (5000m for the -H and -HR models)

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 Ed., CAN/CSA 22.2 No. 61010-1-12 3rd Ed., IEC 61010-1 3rd Ed., EN 61010-1 3rd Ed.
- The end-product shall consider that: The enclosure does not serve as a fire/electrical/mechanical enclosure (except the IEC inlet version end cover)
- The need for the following shall be considered in the end-product: Bonding to protective earthing terminal (Class I construction), MAINS disconnect device (except the IEC inlet)
- The output connectors are: Not investigated for field wiring,
- Creepage and clearance distances were based on a maximum working voltage of: 337 Vrms; 616 Vpeak Primary to Secondary , 337 Vrms; 608 Vpeak Primary to Earth
- 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, Temperature (customer air models)
- 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: 50°C (full load): 65°C maximum (output de-rated 2.5% /°C above 50°C)
- End-product temperature tests for power supplies shall consider that the following transformers employ the indicated insulation system: Transformer T1, T2, TX701 Class F (155 °C)
- End-product dielectric strength tests shall be based on the maximum working voltage of: 337 Vrms; 616 Vpeak Primary to Secondary , 337 Vrms; 608 Vpeak Primary to Earth
- 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 is: Not investigated for field wiring
- Input connector J2 pin 1 was investigated as the protective bonding terminal for the product
- The risk associated with clause 5.4.5 requires assessment in the end equipment
- Multilayer PWB's accepted under CBTR Ref. No.: E349607-A23 dated 2014-07-31 and letter Report,

Enclosure 8-05 of this report

Additional Information

The original report was modified to include the following changes/additions:

1. Addition/deletion of multilayer PWBs to critical component list.
2. Critical component certificate updates.
3. Change to additional Manufacturers address.
4. Correction/Addition to CCL components. (transformer 33489 left out of previous report by error)
5. Addition of 18V channel 1 with fan output (transformer 230089). (thermal test carried out)
6. Removal of the DC-DC front end RA-NVDC-01/R14408 from the CCL.

Based on the previously conducted testing, limited testing for this report and the review of product technical documentation including photos, schematics, wiring diagrams and similar, it has been determined that the product complies with the standard.

Cooling for NV175 or NV-175 series units with customer supplied air (open frame, U and C options):

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 the standard concerned. 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. See handbooks for component locations.

Circuit Ref.	Description	Max. Temperature (°C)
L3, L7	Common mode choke winding	140
C1, C4	X capacitors	100
C6, C12	Capacitor	105
L2	Boost choke winding	130
C7	Electrolytic capacitor	70 (105)
T1, T2	Transformer winding	130
XU3	Control board optocoupler	100
TX701	Global option transformer	90
L5	Channel 1 Output choke	125
XL401	Channel 2 Output choke	125
XL601	5L channel 2 output choke	125
XU601	5L channel 2 IC	115
XL501 or XL601	Channel 3 and 4 output choke	125
IC1*	Channel 4 Voltage regulator	110
XQ406	Ch2 highside FET (SMA 2)	115
XV504	Ch3 highside FET (SMA 3)	115
XU601	Ch4 IC (SMA 4)	115
Various	All other electrolytic capacitors	90 (105)

* 1A channel 4 only

Issue Date: 2013-07-30
2015-08-04

Page 9 of 19

Report Reference #

E331788-A18-UL

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

Additional Standards

The product fulfills the requirements of: UL 61010-1 3rd Ed., CAN/CSA 22.2 No. 61010-1-12 3rd Ed., EN61010-1:2010