
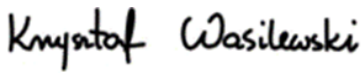


Test Report issued under the responsibility of:



| <b>TEST REPORT</b><br><b>IEC 61010-1</b><br><b>Safety requirements for electrical equipment for measurement,</b><br><b>control, and laboratory use</b><br><b>Part 1: General requirements</b>  |   |
|--|---|
| Report Reference No. ....:   | E331788-D1003-2/A0/C0-UL  |
| Date of issue .....  | 2021-11-16  |
| Total number of pages .....  | 140   |
| Testing Laboratory .....   | UL International Germany GmbH   |
| Address .....  | Admiral-Rosendahl-Strasse 23, Zeppelinheim 63263 Neu-Isenburg , Germany |
| Applicant's name .....   | TDK-LAMBDA UK LTD   |
| Address .....  | KINGSLEY AVE<br>ILFRACOMBE<br>DEVON EX34 8ES UNITED KINGDOM             |
| Test specification:  |   |
| Standard .....   | IEC 61010-1:2010, IEC 61010-1:2010/AMD1:2016                            |
| Test procedure .....   | UL Certification  |
| Non-standard test method.....:   | N/A   |
| Test Report Form No.....:  | IEC61010_1P   |
| <b>General disclaimer:</b><br>The test results presented in this report relate only to the object tested.<br>This report shall not be reproduced, except in full, without the written approval of the Issuing UL testing laboratory. The authenticity of this Test Report and its contents can be verified by contacting UL. |   |

|  |   |   |
|--|---|---|
| Test item description:   | Switch mode power supply  |   |
| Trade Mark:  | TDK-LAMBDA  |   |
| Manufacturer:  | Same as Applicant   |   |
| Model/Type reference:  | NV175 Series; NV-175 Series; NV1-1G000 (See Model Differences for details)  |   |
| Ratings:   | NV175 Series; NV-175 Series:<br>100-240Vac (Nominal), 90-264V (Full Tolerance), 45-440Hz, 3Arms<br><br>NV1-1G000 only:<br>88.9-240Vac (Nominal), 80-264V (Full Tolerance), 45-440Hz, 3Arms<br><br>(See Model Differences for details) |   |
| Testing procedure and testing location:                        |   |   |
| <input checked="" type="checkbox"/> UL/DAP Testing Laboratory: |   |   |
| Testing location/ address:                                     | UL International Germany GmbH<br>Admiral-Rosendahl-Strasse 23, Zeppelinheim 63263 Neu-Isenburg , Germany  |   |
| Tested by (name, function, signature):                         | Marcin Zurek, Project handler   |   |
| Approved by (name, function, signature):                       | Krzysztof Wasilewski, Review  |  |
| <input type="checkbox"/> Testing procedure: WMT:               |   |   |
| Testing location/ address:                                     |   |   |
| Tested by (name, function, signature):                         |   |   |
| Approved by (name, function, signature):                       |   |   |

List of Attachments (including a total number of pages in each attachment):

Refer to Appendix A of this report. All attachments are included within this report.

Summary of testing

Tests performed (name of test and test clause):

Testing location:

*Refer to the Test List in Appendix D of this report if testing was performed as part of this evaluation.*

Copy of marking plate

The artwork below may be only a draft. The use of certification marks on a product must be authorized by the respective owners of these marks.

*Refer to the enclosure(s) titled Marking Label in the Enclosures section in Appendix A of this report for a copy.*

|   |   |
|---|---|
| Test item particulars :   |   |
| Type of item:   | Laboratory  |
| Description of equipment function:  | Switch mode power supply  |
| Connection 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:   | Extended (Specify): Temperature: 0 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); Humidity: 5 to 95% RH, non-condensing; Air Pressure: 70kPa to 106kPa; Altitude: -200m to 3000m (-H and -HR models, 5000m). |
| For use in wet locations:   | No  |
| Equipment mobility:   | Built-in  |
| Operating conditions:   | continuous  |
| Overall size of equipment ( W x D x H)  | 174 x 103 x 41 mm   |
| Mass of equipment (kg):   | 0.6 kg max  |
| Marked degree of protection to IEC 60529:   | none  |
| Testing   |   |
| Date of receipt of test item(s) .....   | 2018-09-13 to 2018-10-29  |
| Dates tests performed .....   | 2018-09-17 to 2019-01-10  |
| Possible test case verdicts:  |   |
| - test case does not apply to the test object .....   | N/A   |
| - test object does meet the requirement.....  | Pass (P)  |
| - test object was not evaluated for the requirement .....   | N/E   |
| - test object does not meet the requirement.....  | Fail (F)  |
| Abbreviations used in the report:   |   |
| - normal condition: N.C.  | - single fault condition: S.F.C.  |
| General remarks:  |   |
| The test results presented in this report relate only to the object tested.<br>This report shall not be reproduced, except in full, without the written approval of the Issuing NCB. The authenticity of this Test Report and its contents can be verified by contacting the NCB, responsible for this Test Report. |   |
| Throughout this report a point is used as the decimal separator.  |   |
| <b>GENERAL PRODUCT INFORMATION:</b>   |   |
| <b>Report Summary</b>   |   |
| All applicable tests according to the referenced standard(s) have been carried out.<br>Refer to the Report Modifications for any modifications made to this report.   |   |
| <b>Product Description</b>  |   |

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   |
|                  | 7   | 7         | 5.5 - 8   | 5.5A |      |
|                  | F   | 15        | 12-15.5   | 6A   |      |
| CH3              | 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 module current ratings are both derated at 2.5% per deg C) |
| 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

#### Additional Information

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

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

No tests conducted under this investigation due to reissue of CB Test Report Ref. No.EE331788-D1003-1/A0/C0-ULCB. All required tests were carried out under the original investigation

This report is a reissue of CBTR Ref. No.E331788-D1003-1/A0/C0-ULCB and CB Test Certificate Ref. No. DK-80454-UL. Based on the previously conducted testing and the review of product technical documentation including photos, schematics, wiring diagrams and similar, has been determined that the product continues to comply with the standard.

The original report was modified to include the following changes:

- The standard has been upgraded to the latest revision date.
- Standards were updated on critical component list
- Components licenses were attached to the report

- Factory TRIO-TRONICS (THAILAND) LTD.was added to the report  
 - Capacitor Murata SA series and RA series with the same electrical ratings has been added as alternate to critical component list.  
 No testing was deemed necessary.

### Technical Considerations

- The product was investigated to the following standards:

#### Main Standard(s):

UL 61010-1, 3rd Edition, May 11, 2012, Revised July 19, 2019, CAN/CSA-C22.2 No. 61010-1(2012-05), 3rd Edition, with revisions through 2018-11

#### From Country Differences:

- USA: UL 61010-1, 3rd Edition, May 11, 2012, Revised July 19, 2019
- Canada: CAN/CSA-C22.2 No. 61010-1(2012-05), 3rd Edition, with revisions through 2018-11
- EU Group: EN 61010-1:2010/A1:2019 (Edition 3.1)

#### Additional Standards:

N/A

- The following additional investigations were conducted: N/A
- The product was not investigated to the following standards or clauses: N/A
- The following accessories were investigated for use with the product: N/A
- Equipment class: Class I

Equipment type: For building in

The product was submitted and tested for use at the maximum recommended ambient temperature (T<sub>mra</sub>) 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

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 Edition, May 11, 2012, Revised July 19, 2019, CAN/CSA-C22.2 No. 61010-1(2012-05), 3rd Edition, with revisions through 2018-11, IEC 61010-1:2010/AMD1:2016/COR1:2019, EN 61010-1:2010/A1:2019 (Edition 3.1)  
 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 V<sub>rms</sub>; 616 V<sub>peak</sub>  
 Primary to Secondary

337 V<sub>rms</sub>; 608 V<sub>peak</sub> 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 Multi-layer PWB Letter Reports of this report.