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2018-04-26

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Report Reference #

E331788-A15-UL

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: | NV700 or NV7 or NV-700 (see model differences for details of NV700 range model configurations) |
| Rating: | 100-240Vac nominal, (90-264Vac including tolerances). 47-440Hz, 11A rms Max. (see model differences for details of model ratings) |
| 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.

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Reviewed by: Bartłomej Zmijewski (Reviewer)

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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

NV700 or NV-700 series. Switch mode power supplies for building into end equipment. (See model differences for details of model configurations)

This product range is available as a forced air cooled version (in-built fan) with screw terminal connections or an IEC 60320 inlet. It is also available as a customer air cooled version where the end cap is not fitted and the customer must provide an air flow and measure appropriate temperatures of components within the product.

Model Differences

NV700 models as described below:

Units may be marked with a Product Code: K7x or NV7x where x may be up to any six letters and/or numbers 0 to 9.

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

Unit Configuration (Description :) Code:

a) NV-700x or NV7x (these models are identical)

where x = H for high hold-up or blank for standard hold-up

b) followed by: S, C or U

| | | | |
|-------|---|---|--|
| where | S | = | Forward airflow, standard fan |
| | C | = | Customer air, fan not fitted |
| | U | = | Customer air, fan not fitted, cover not fitted |

c) followed by: S or I

| | | | |
|-------|---|---|-----------------------|
| where | S | = | Screw input terminals |
| | I | = | IEC input |

d) followed by: S, M, L, R, or T

| | | | |
|-------|---|---|-----------------------------------|
| where | S | = | Standard Leakage (Class B Filter) |
| | M | = | Medium Leakage |
| | L | = | Low Leakage |
| | R | = | Reduced Leakage |
| | T | = | Tiny Leakage |

Unit configuration may be given using the above code and/or by the option description. The input terminal type (screw or IEC) may alternatively be determined by examination of the unit.

e) optionally followed by: EN#V, EN*V, IN#V, IN*V, ES#V, ES*V, IS#V, IS*V.

| | | | |
|-------|------|---|---|
| where | EN#V | = | AC good, global module good, PSU enable, 5-5.5V, 2A standby output |
| | EN*V | = | AC good, global module good, PSU enable, 12-13.5V, 1A standby output |
| | IN#V | = | AC good, global module good, PSU inhibit, 5-5.5V, 2A standby output |
| | IN*V | = | AC good, global module good, PSU inhibit, 12-13.5V, 1A standby output |
| | ES#V | = | AC good, PSU enable, 5-5.5V, 2A standby output |
| | ES*V | = | AC good, PSU enable, 12-13.5V, 1A standby output |
| | IS#V | = | AC good, PSU inhibit, 5-5.5V, 2A standby output |
| | IS*V | = | AC good, PSU inhibit, 12-13.5V, 1A standby output |

where # represents the standby output voltage and is in the range 5 to 5.5V

where * represents the standby output voltage and is in the range 12-13.5V

The Global Options Inhibit and Enable functions permit the customer to turn off or on the main psu outputs and the fan. The standby supply is for use by the customer and provides an SELV output that continues to operate when all the main psu outputs have been turned off using the Inhibit or Enable functions. All the functions of the Global Option pass through a single 8 way PWB socket and are all rated SELV.

Modules:

Up to 4 of the following modules types may be fitted:

or @B
or @C
or @CM
or @BH

where @ is the output voltage of the module and is within the range given in the single output module table.

or @/#DB or @_#DB

where @ is the output voltage of channel 1 and # is the output voltage of channel 2 of the module. Voltages are within the range given in the DB module tables.

or @/#DA or @_#DA

where @ is the output voltage of channel 1 and # is the output voltage of channel 2 of the module. Voltages are within the range given in the DA module tables. Only 1 DA module may be fitted.

or B/S or B_S

where B/S or B_S indicates that a blanking plate is fitted in place of a module.

The following nomenclature may optionally be used for outputs connected in series:

(Note that outputs may be connected in series even when this nomenclature is not used)

@BB or @ BHB or @BBH or @BHBH or @CC or @CCM

where @ is the total voltage of any two B, BH, C or CM modules connected in series.

or @/#BDB or @_#BDB or @BHDB

where @ is the total series voltage of any B or BH module and DB module channel 1. # is the output voltage of the DB module channel 2. Voltages for # are within the range given in the DB module tables.

or @HDB

where @ is the total series voltage of any DB module channel 1 and channel 2.

For all outputs connected in series:

Permissible min. value for @ is given by summing the min. voltage ratings of the outputs connected in series.

Permissible max. value for @ is given by summing the max. voltage ratings of the outputs connected in series.

Custom Models:

Model: NV-700 RSS IN5V 12BH 12BH

Maximum outputs: 12.5V, 20A; 12.5V, 20A (total power 500W max.)

Maximum ambient: 65°C with 2.5%/°C derating of total power and module current above 50°C

Orientations: Horizontal with chassis lowest, on either side or vertical with the airflow upwards.

Comments: PSU has reverse air.

Model: NV-700 CSS ES5V 12C (NV722DCC and NV7Y019T)

Maximum output: 12V, 37.5A (peak power rating as given in electrical and thermal ratings section on following page)

Maximum ambient: 65°C with 2.5%/°C derating of total power and module current above 50°C

Orientations: Horizontal with chassis lowest, on either side or vertical with the airflow upwards.

Maximum operating altitude: 5000m

Output Interface Assembly:

One of the following output interface assemblies may optionally be fitted:

Wxxx

where xxx is a number between 001 and 999. These assemblies attach to the module output(s) and contain circuitry providing one or more of the following: current sharing, reduced current limit, fusing, sequencing, diode or-ing, module good, filtering, connectors or terminal blocks for outputs or signaling purposes, indicator lamps or LEDs.

Documentation to be made available to the customer detailing ratings of all assembly outputs.

ELECTRICAL AND THERMAL RATINGS

Nominal Input Voltage 100 - 240 Vac

Input Voltage Range 90 - 264 Vac #

Input Frequency Range 47 - 440 Hz

Maximum Input Current 11 A rms

Subject to limitations, see table below.

| Code | Cooling Option | Input Voltage) Range (Vac) | Total output power (W) | Maximum ambient (°C) | Derating |
|------|---------------------------------|---|--|-------------------------|---------------------------|
| S | Forward airflow standard fan | 90 - 99.9 | 700W continuous (850W peak if 700W average #) | 65 | 2.5% per °C above 45°C |
| S | Forward airflow standard fan | 100 - 149.9 | 700W continuous (850W peak if 700W average #) | 65 | 2.5% per °C above 50°C |
| S | Forward airflow standard fan | 150 - 264 | 1150W continuous (1450W peak if 1150W average #) | 65 | 2.5% per °C above 45°C |
| C, U | Customer air fan not fitted | Refer to Customer Air Cooling section for details | | | |

Global Option standby outputs (12-13.5V at 1A or 5-5.5V at 2A) should not be included when calculating total PSU output power.

The total output power, module output currents and Global Option output currents are derated by the given value.

The PSU may output the given peak power for up to 10 seconds providing that the average power from the PSU does not exceed the stated value.

Global Options with output voltages between 5.01 and 5.5V have their max. output current linearly derated from 2A at 50°C ambient to 1.4A at 65°C ambient.

Permitted orientations: Horizontal with chassis lowest, on either side or vertical with the airflow upwards.

Single Output Modules:

| Module | Nominal Voltage (V) | Voltage Range (V) # | Max. Current |
|--------|------------------------|------------------------|---|
| B | 3.3 | 3.135 - 3.6 | 40A |
| | 5 | 4.75 - 5.5 | 4.75 - 5.0V: 40A 5.0 - 5.5V: Linearly derate from 40 to 36A |
| | 8 | 7 - 9 | 7 - 8V: 22.5A 8 - 9V: Linearly derate from 22.5 to 20A |
| | 12 | 12 - 15.5 | 12 - 12.5V: 19.5A 12.5 - 15.5V: Linearly derate from 19.5 to 15A |
| | 24 | 24 - 28 | 24V: 10A 24 - 28V: Linearly derate from 10 to 8A |
| BH | 12 | 12 - 15.5 | 12 - 12.5V: 20A 12.5 - 15.5V: Linearly derate from 20 to 15.5A |
| | 24 | 24 - 28 | 24V: 10A 24 - 28V: Linearly derate from 10 to 8.5A |
| C & CM | 12 | 12 - 13.2 | 12V: 37.5A. Derated to 450W above 12V |
| | 16 | 15 - 17.6 | 15 - 16V: 28.12A. Derated to 450W above 16V |
| | 24 | 24 - 26.4 | 24V: 18.75A. Derated to 450W above 24V |
| | 30 | 27 - 32 | 27V: 16.67A. Derated to 450W above 27V |

C & CM modules may output up to 600W for up to 10 seconds providing that the average power from the module does not exceed 450W.

Dual Output Modules:

Dual Output Modules, Output 1

| Module | Nominal Voltage (V) | Voltage Range (V) # | Max. Current |
|--------|---------------------|---------------------|---|
| DA | 12 | 12.25 | 3A |
| DB | 3.3 | 3.135 - 3.6 | 25A |
| | 5 | 4.75 - 5.5 | 25A |
| | 6 | 5.5 - 6.5 | 25A |
| | 12 | 12 - 15.5 | 12 - 12.5V: 13A 12.5 - 15.5V: Linearly derate from 13 to 10A |
| | 24 | 24 - 28 | 24 - 25V: 7A 25 - 28V: Linearly derate from 7 to 6A |

Dual Output Modules, Output 2

| Module | Nominal Voltage (V) | Voltage Range (V) # | Max. Current(A) | Max. Power(W) |
|--------|---------------------|---------------------|-----------------|---------------|
| DA | 12 | (-)11.6 - (-)11.9 | 1 | 11.9 |
| DB | 5 | 3.3 - 6 | 10 | 60 |
| | 12 | 7 - 15.5 | 5 | 60 |
| | 24 | 24 - 32 | 2 | 50 |

Voltage measured at the module power terminals. This voltage must not be exceeded when remote sense is used.

DB modules with 6V nominal channel 1 derated as follows:

Ch.1 : 5.5 - 6V Ch.1 + Ch.2 : 195W total.

Ch.1 : 6.01 - 6.5V Ch.1 + Ch.2 : 170W total.

The DB module may be used with output 1 up to 24V at 8.3A and output 2 up to 16V at 3.13A provided the ambient temperature does not exceed 42°C.

SELV and Outputs Connected In Series:

All individual outputs are SELV. Outputs connected in series are non-SELV if the total output voltage + 30% of the highest of those outputs exceeds 60Vdc (the 30% addition allows for a single fault in any one individual channel).

If the total voltage of outputs connected in series exceeds the 60Vdc SELV limit then all outputs must be considered non-SELV.

The total voltage of outputs connected in series must not exceed 160V.

Non-SELV outputs are hazardous and must be guarded or a deflector fitted during installation to avoid a service engineer making inadvertent contact with the output terminals, or dropping a tool onto them.

All outputs have operational spacings to earth, and due consideration must be given to this in the end product design.

Technical Considerations

- Type of item tested : Laboratory
- Description of equipment function : Switch Mode Power Supply for building in.
- Connections to mains supply : None unless via the IEC60320 inlet.
- Overvoltage category : II
- Pollution degree : 2
- Means of Protection : Class I (PE connected)
- Environmental conditions : 50°C ambient
- For use in wet locations : No
- Equipment mobility : Built-in
- Operating conditions : continuous
- Overall size of the equipment: (W X D X H) (mm) : 280 x 125 x 41mm Max.
- Mass of the equipment (kg) : 2kg Max.
- Marked degree of protection to IEC 60529 : N/A
- Equipment classification: Commercial, Professional
- 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. From 50°C to 65°C the total output power and the module current ratings are both derated at 2.5% per °C.

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 61010-1:2010 3rd Ed., EN 61010-1:2010.
- The end-product shall consider that: The enclosure does not serve as a fire/electrical/mechanical enclosure excluding the external face of the IEC60320 inlet.
- The need for the following shall be considered in the end-product: Bonding to protective earthing terminal (Class I construction)
- The output connectors are: Suitable for factory wiring only
- Creepage and clearance distances were based on a maximum working voltage of: Primary to earth dead metal: 622Vpeak, 343Vrms., Primary to secondary: 650Vpeak, 363Vrms.
- 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: Double and Reinforced insulation
- The following tests shall be performed in the end-product evaluation: Temperature for customer air models, Permissible Limits for Accessible Parts, Dielectric Strength
- The unit is considered acceptable for use at on a max branch circuit of: 20A
- The unit is considered acceptable for use in a max ambient of: 50°C. From 50°C to 65°C the total output power and the module current ratings are both derated at 2.5% per °C.

- End-product temperature tests for power supplies shall consider that the following transformers employ the indicated insulation system: Transformer TX1 Class F (155°C), Transformer TX2 Class F (155°C), Transformer T1 Class F (155°C), Transformer T2 Class F (155°C),
- End-product dielectric strength tests shall be based on the maximum working voltage of: Primary to earth dead metal: 622Vpeak, 343Vrms., Primary to secondary: 650Vpeak, 363Vrms.
- The leakage current tests have been provided for information only. This test must be considered in the end product application and must be repeated for frequencies above 63Hz.
- This product has been assessed for a maximum altitude of 3000m
- The risk associated with clause 5.4.5 shall be assessed in the end product.

Additional Information

Customer Air Cooling:

The following method must be used for determining the safe operation of PSUs when C or U options (Customer Air) are fitted, i.e. fan not fitted to PSU. The minimum permitted airflow for customer air cooling is 0.5m/s.

For PSUs and assemblies cooled by customer supplied airflow the components listed in the following table must not exceed the temperatures given. Additionally ratings specified for units with an internal fan shall still be complied with, e.g. mains input voltage range, maximum output power, module voltage/current ratings and maximum ambient temperature. To determine the component temperatures the heating tests shall be conducted in accordance with the requirements of IEC61010-1. Consideration should also be given to the requirements of other safety standards.

Test requirements include: PSU/assembly 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/assembly. To determine the most adverse conditions consideration shall be given to the end use equipment maximum operating ambient, the PSU/assembly loading and input voltage, ventilation, end use equipment orientation, the position of doors & covers, etc. Temperatures shall 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 shall be run until all temperatures have stabilized.

| Circuit Ref. (°C) | Description | Max Temperature |
|----------------------|--|--------------------|
| L2, L3 | Filter/PFC assy: Choke winding | 155 |
| C1, C3, C4 | Filter/PFC assy: X capacitors | 100 |
| L1 | Filter/PFC assy: Boost choke winding | 130 |
| C12, C13 | Filter/PFC assy: Electrolytic capacitor | 105 |
| T1 | Filter/PFC assy: Flyback transformer winding | 130 |
| RL1 | Filter/PFC assy: Relay | 100 |
| TX1, TX2 | Modules: Power transformer windings | 130 |
| L1, XL1 | B, BH & DB module chokes | 125 |
| L1 | C & CM module chokes | 140 |
| T2 | Global Options: Transformer winding | 130 |
| Various | All other choke & transformer windings | 120 |
| Various | All <=10mm diameter electrolytic capacitors | 105 |
| Various | All 12.5mm diameter electrolytic capacitors | 105 |

The schematics are kept in file at the CBTL and can be provided by the manufacturer upon request by

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NCB's/CBTL's.

This report to include IEC61010-1 is a re-issue of CBTR Ref. No. E331788-A15-CB-1 dated 2013-07-25 including amendments and corrections with CB Test Certificate Ref. No. DK-33974-UL dated 2013-07-25. 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 tests below were deemed necessary.

The original report was modified on 2015-05-05 to include the following changes/additions:-

1. Addition/deletion of multilayer PWBs to critical component list
2. Alternative input connector (J1) same ratings, no testing considered.
3. Critical component certificates updated
4. Correction/addition to critical components list
5. Enclosures updated to include revised handbook and drawings
6. Alternative fuse (F2 (Daito)) tested
7. Alternative fan (YS Tech) tested
8. Assessed to IEC61010-1
9. Cemented joint test updated

Project 4787707401 information:

This is Amendment 1 to the CB Test Report E331788-A15-CB-2 dated 2015-08-03 with Correction 1 dated 2015-09-22 and with CB Test Certificate DK-48638-UL.

This Amendment is published due to changes provided in Report Summary.

No additional testing has been done.

This amendment shall be read in conjunction with Original Test Report and Test Certificate and with previous Correction 1.

Additional Standards

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