

**Description****UL TEST REPORT AND PROCEDURE**

<b>Standard:</b>	AAMI ES60601-1:2005,ES60601-1:2005/AMD1 1:2012 , ES60601-1:2005/AMD2:2021, CAN/CSA-C22.2 No. 60601-1:08, CAN/CSA-C22.2 No. 60601-1:14 (including amendment 1) and Amendment 2:2022 (MOD) to CAN/CSA-C22.2 No. 60601-1:14, IEC 60601-1:2005, AMD1:2012, AMD2:2020
<b>Certification Type:</b>	Component Recognition
<b>CCN:</b>	QQHM2, QQHM8
<b>Complementary CCNs:</b>	
<b>Product:</b>	Switch Mode Power Supply
<b>Model:</b>	NV700x or NV-700x Series followed by abcd  May be prefixed by SP followed by / or – (SP represents a sales code)  (may be prefixed by NS – # / or – where # may be any characters indicating non-safety related model differences. Units may be additionally marked with a product code: K7x or NV7x where x may be up to any six letters and/or numbers 0 to 9.  x = H or blank for hold up option a = S, C or U for airflow option b = S or I for input option c = S,M,L,R or T for leakage option d = optionally followed by EN#V, EN*V, IN#V, IN*V, ES#V, ES*V, IS#V, IS*V where # represents standby output voltage of 5-5.5V and # represents standby output voltage of 12-13.5V followed by up to 4 modules
<b>Rating:</b>	100-240Vac nominal (90-264V max. tolerance), 47-63Hz, 11A rms Max (see Model Differences for details of model ratings) Risk Management process not evaluated
<b>Applicant Name and Address:</b>	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 as applicable.

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

Prepared by: Steve Chiu (Project

Reviewed by: Grzegorz Kowalski, Reviewer

Handler)

### 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 NV700 products are switched mode power supplies for building into host equipment. They are not intended to be accessible to an operator. However, if any surface of the product is accessible further tests may be necessary in the end application. Risk Management has not been applied to these products. This product range is available as a forced air cooled version (in-built fan) with screw terminal input 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.

Refer to the Report Modifications page for any modifications made to this report.

### Model Differences

NV700 models as described below:

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

May be prefixed by SP followed by / or - (SP represents a sales code)

Unit Configuration (Description :) Code:

NV-700x or NV7x (these models are identical) followed by abcd

Where x = H for high hold up or blank for standard hold up

a) 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

b) followed by: S or I

where S = Screw input terminals I = IEC input

c) followed by: S, M, L, R, or T where S = Standard Leakage ( 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.

d) 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:

@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.

@/#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 signalling 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 - 63 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 2.5% per °C above 45°C	Forward airflow standard fan	90 - 99.9	700W continuous (850W peak if 700W average #)	65
S 2.5% per °C above 50°C	Forward airflow standard fan	100 - 149.9	700W continuous (850W peak if 700W average #)	65
S 2.5% per °C above 45°C	Forward airflow standard fan	150 - 264	1150W continuous (1450W peak if 1150W average #)	65
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 5	3.135 - 3.6 4.75 - 5.5	40A 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			
above 16V	16	15 - 17.6	15 - 16V: 28.12A. Derated to 450W
above 24V	24	24 - 26.4	24V: 18.75A. Derated to 450W
above 27V	30	27 - 32	27V: 16.67A. Derated to 450W

† 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.

### 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 IEC60601-1. 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 Instruction manual/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 stabilised.

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	110
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 NCB's/CBTL's.

These power supplies have been previously evaluated by UL to Edition 3 IEC 60601-1: 2005, EN60601-1:2006, ANSI/AAMI ES60601-1: 2005, CAN/CSA C22.2 No. 60601-1: 2008 based on the previous Edition 2 IEC 60601-1:1988 + A1:1991 + A2:1995, EN 60601-1: 1990 + A1:1993 + A2:1995, UL 60601-1, 1st Edition, 2006-04-26 (includes National Differences for USA), CAN/CSA-C22.2 No. 601.1-M90 (R2005) (includes National Differences for Canada), report reference E349607-D1-CB-1 (CB Test Certificate Ref. No. DK-5230 dated 29-NOV-2011 was prepared by UL International Demko A/S).

CB Test certificates for components are included in Licenses Enclosure. In accordance with the current rules of CB Scheme, CB Test certificate is effective for 3 years. Recognizing NCB may challenge the CBTC when certificates are more than 3 years old.

When submitting this Test Report to other Certification Body, the manufacturer is responsible for providing any additional information that the Body may need in order to issue its Mark, including testing for compliance

with the applicable collateral standards.

### Technical Considerations

- The product was investigated to the following additional standards: EN 60601-1:2006 /A2:2021; ANSI/AAMI ES60601-1: 2005/A2: 2021; CAN/CSA C22.2 No. 60601-1:14 AMD2: 2022
- The following additional investigations were conducted: N/A
- The product was not investigated to the following standards or clauses: Electromagnetic Compatibility (IEC 60601-1-2)  
Clause 14, Programmable Electronic Systems  
Biocompatibility (ISO 10993-1)
- The following accessories were investigated for use with the product: N/A
- Scope of Power Supply evaluation defers the following clauses to be determined as part of the end product investigation:  
Clause 7.5 (Safety Signs),  
Clause 7.9 (Accompanying Documents),  
Clause 9 (ME Hazard), except 9.1 and 9.3 are evaluated,  
Clause 10 (Radiation),  
Clause 14 (PEMS),  
Clause 16 (ME Systems)  
Risk Management was excluded from this investigation
  - The degree of protection against harmful ingress of water is: Ordinary
  - The product is suitable for use in the presence of a flammable anaesthetics mixture with air or oxygen or with nitrous oxide: No
  - The product is classified only to the following hazards: shock, fire, casualty
  - Product evaluated for an operating temperature of 50°C (full load), to 65°C maximum
  - The product has been assessed for an altitude of 5000 m.
  - Multilayer PWBs accepted under CBTR Ref. No. E349607-A23 dated 2014-07-31 and letter report in enclosure 8-07 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:

- When installed in an end-product, consideration must be given to the following:
  - For use only in or with complete equipment where the acceptability of the combination is determined by Underwriters Laboratories Inc.
  - Consideration should be given to measuring the temperature on power electronic components and transformer windings when the power supply is installed in the end-use equipment. The end-use product shall ensure that the power supply is used within its ratings.
  - The output circuits have not been evaluated for direct patient connection (Type B, BF or CF)
  - Considerations to the applied part requirement, to be conducted as part of the end-product evaluation.

- The input/output connectors are not acceptable for field connections; they are only intended for factory wiring inside the end-use product
- The component shall be installed in compliance with the enclosure, mounting, marking, spacing and separation requirements of the end use application. Temperature, leakage current, protective earthing, dielectric voltage withstand and interruption of power supply tests should be considered as part of the end product evaluation.
- Proper bonding to the end-product main protective earthing is required.
- The product was submitted and tested for use at the manufacturer's recommended ambient temperature (T<sub>mra</sub>) of 50°C at full load and 65°C maximum (see model configuration and output details for models and conditions to which the extended ambient applies).
- The products were tested on a 16 A (20 A for North America and Canada) branch circuit.
- The end-product evaluation shall ensure that the requirements related to accompanying documents, clause 7.9 are met
- End product risk management process to include consideration of requirements specific to the power supply
- End product risk management process to consider the need for simultaneous fault condition testing.
- End product risk management process to consider the need for different orientations of installation during testing.
- End product to determine the acceptability of risk in conjunction to insulation to resistance to heat, moisture and dielectric strength
- Insulation (separation) between primary - secondary output circuits: 2 MOOPs
- Insulation (separation) between primary to earth: 1 MOPP
- Insulation (separation) between secondary circuits and earth: 1 MOPP (at working voltage) for CM module and 1 MOOP for all other modules.
- Insulation (separation) between input and output for CM modules: 2 MOPPs at 4000 m only
- The following outputs are considered SELV: All outputs are SELV except under the following circumstance:- Outputs connected in series are non-SELV if the total output voltage + 30% of the max. rated output voltage of the output with the highest rated voltage exceeds 60Vdc (the 30% addition allows for a single fault in any one individual channel).
- Consideration should be given to repeating the earth leakage tests in the end use equipment.
- Except for permanently installed equipment, the overall equipment in which these products are installed must be fitted with double pole fusing as detailed in the special instructions section of the NV700 Instruction manual
- It should be noted that the power supplies have been assessed as a component part of end equipment. It is the installer's responsibility to ensure that the final installation is in accordance with the NV700 Instruction manual and that it is in compliance with the 60601-1 standards.
- The following outputs are considered an energy hazard and must not be accessible to an end user:-  
12BH, 24BH, 12C, 16C, 24C, 30C, 12CM, 16CM, 24CM and 30CM.
- These power supplies have been assessed as a component part of a host equipment.
- This product must be earthed (class I).