

UL TEST REPORT AND PROCEDURE

Standard:	UL 62368-1, 2nd Ed, 2014-12-01 (Audio/video, information and communication technology equipment Part 1: Safety requirements) CAN/CSA C22.2 No. 62368-1-14, 2nd Ed, Issued: 2014-12-01 (Audio/video, information and communication technology equipment Part 1: Safety requirements)
Certification Type:	Component Recognition
CCN:	QQJQ2, QQJQ8 (Power Supplies for Use in Audio/Video, Information and Communication Technology Equipment)
Complementary CCN:	N/A
Product:	Power Supply
Model:	NV350 or NV3 or NV-350 (these models are identical) (may be prefixed by NS - # / or - where # may be up to any four letters and may be followed by - \$; where \$ maybe any number between 000 to 999, indicating non-safety related model differences.)
Rating:	100-240 Vac nominal, (85-264 Vac including tolerances) 47-440 Hz, 5.5 A rms max.
Applicant Name and Address:	TDK-LAMBDA UK LTD KINGSLEY AVE ILFRACOMBE 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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Prepared By: Guoqing Zhang / Project Engineer

Reviewed By: Hubert Koszewski / Reviewer

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

NV350 is a range of switching power supplies intended for building-in as component which employ isolating transformers. Reinforced insulation is provided between primary and secondary circuits. Basic insulation is provided between primary circuit and PE (Protective Earth).

Model Differences

Unit Configuration Code:

NV350 or NV3 or NV-350 (these models are identical)

(may be prefixed by NS - # / or - where # may be up to any four letters and may be followed by - \$; where \$ maybe any number between 000 to 999, indicating non-safety related model differences)

Unit Configuration Code (Description :) may be prefixed by SP followed by / or – (SP represents a sales code)

followed by: S, R, Q, P, V, C, T, U, K or L where:

Option Letter	Airflow Option
S	Forward airflow, standard fan
R	Reverse airflow, standard fan
Q	Forward airflow, quiet fan
P	Reverse airflow, quiet fan
V	Forward airflow, temperature controlled fan
C	Customer air, fan not fitted
T	Forward airflow, top fan
U	Customer air, fan not fitted, cover not fitted
K	Custom fan/chassis assembly
L	Fixed speed fan (see non-standards below)

followed by: S or I where:

Option Letter Input Option

Revision Date: 2021-04-18

S Screw input terminals
I IEC input

followed by: S, M, L, R, or T, where:

Option Letter	Leakage Option
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.

optionally followed by: EN#V, EN12V, EN13.5V, IN#V, IN12V, IN13.5V, ES#V, ES12V, ES13.5V, IS#V, IS12V or IS13.5V. Where:

Description	Option Description
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 of 12-13.5V.

The Global Options Inhibit and Enable functions permit the customer to turn off or on the main PSUs outputs and the fan. The standby supply is for use by the customer and provides an ES1 output that continues to operate when all the main PSUs 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 ES1.

NV350 Modules:

Up to 3 of the following modules types may be fitted:

@B
or @BH
or @C
or @CM

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

or @/#DB (/ can be replaced with a _)

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 (/ can be replaced with a _)

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

where 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 @BHDB (/ can be replaced with a _)

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.

Note.

For all outputs connected in series:

Series modules are non-standard units.

Refer to the Handbook for Energy Source Classification of series modules.

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: NV350 LSS 24/24DB 15.5/5.5DB (K30045A)

Maximum outputs: 24V, 1A; 24V, 0.7A; 15.5V, 6.4A; 5.5V, 6.4A. (total power 175W max.)

Maximum ambient: 50°C

Orientations: Horizontal with chassis lowest, on either side.
Comments: PSU has fan drive voltage fixed at 5.5V.

Model: NV350 LSS 24/24DB (K30045B)
Maximum outputs: 24V, 7A; 24V, 0.7A. (total power 184.8W max.)
Maximum ambient: 50°C
Orientations: Horizontal with chassis lowest, on either side.
Comments: PSU has fan drive voltage fixed at 5.5V.

Model: NV350 TSS 24B 15BH 5/15DB (K30052X, where X can be any character)
Maximum outputs: 350W max.
Comments: PSU has top fan fitted.
Compliant with EN/IEC/UL/CSA 60950-1 and 62368-1 only

Model: NV350 KISES5V 12/12DB 5B (X00004#, where # can be any number of characters)
Maximum outputs: 350W max.
Comments: PSU has top fan, at an angle fitted. Output cables of 12 to 24 AWG, max 50 cm long are supplied with this model.
Compliant with EN/IEC/UL/CSA 60950-1 and 62368-1 only

Model: NV350 NV3LISIS5V 3.3B 12BH (K30068X, where X can be any character)
Maximum outputs: 201.4W max.
Comments: PSU has fixed, reduced speed fan set to 5.5V.
Compliant with EN/IEC/UL/CSA 60950-1 and 62368-1 only

ELECTRICAL & THERMAL RATINGS:

Input Parameters

Nominal input voltage (V)	100 - 240
Input voltage range (V)	85 - 264
Input frequency range (Hz)	47 - 440*
Maximum input current (A)	5.5
Inrush Current (A)	<15

*For frequencies above 60Hz, refer to Engineering Conditions of Acceptability.

For input voltages between 85 and 89.9V the output power is derated to 94% of the values given in the Cooling Options Table.

Output Modules:

Module	Output Voltage	Slots	Maximum Average Current According to Slot Position (A)				
			Slot 1	Slot 2	Slot 3	Slot 4	Slot 5

B	3.14-3.6V	2	40	-	40	40	40
	4.75-5.5V	2	40*	-	40*	40*	40*
	7-9V	2	2.5**	-	22.5**	22.5**	22.5**
	12-15.5V	2	16***	-	16***	16***	16***
	24-28V	2	8****	-	8****	8****	8****
BH	12-15.5V	2	20#	-	20#	20#	20#
	24-28V	2	10##	-	10##	10##	10##
C	12-13.2V	3	33.34†	-	33.34†	33.34†	-
	15-16.5V	3	26.67†	-	26.67†	26.67†	-
	24-26.4V	3	16.67†	-	16.67†	16.67†	-
	27-32V	3	14.82††	-	14.82††	14.82††	-
CM	12-13.2V	3	-	33.34†††	33.34†††	33.34†††	-
	15-16.5V	3	-	26.67†††	26.67†††	26.67†††	-
	24-26.4V	3	-	16.67†††	16.67†††	16.67†††	-
	27-32V	3	-	14.82†††	14.82†††	14.82†††	-
DA CH1	11.88-12.25V	1	-	-	-	-	3¥
	11.9 to -						
DA CH2	11.6V	1	-	-	-	-	1¥¥
DB	3.14-3.6V	2	25	-	25	25	25
CH1	4.75-5.5V	2	25	-	25	25	25
	5.5-6.5V††††	2	25	-	25	25	25
	12-15.5V	2	13¥¥¥	-	13¥¥¥	13¥¥¥	13¥¥¥
	24-28V	2	7¥¥¥	-	7¥¥¥	7¥¥¥	7¥¥¥
DB	3.3-6V‡	2	10	-	10	10	10
CH2	7-15.5V	2	5	-	5	5	5
	24-32V	2	2	-	2	2	2

* - Linearly derate from 40 to 36A over the voltage range 5.2 to 5.5 V.

** - Linearly derate from 22.5 to 20A over the voltage range 8 to 9V.

*** - Linearly derate from 16 to 13A over the voltage range 13.5 to 15.5 V.

**** - Linearly derate from 8 to 7A over the voltage range 26 to 28 V.

- Linearly derate from 20 to 16.5A over the voltage range 13.2 to 15.5 V.

- Linearly derate from 10 to 8.5A over the voltage range 25.7 to 28 V.

† - C & CM modules may output up to 600W for up to 10 seconds providing that the converter ratings are not exceeded and the average power from the module does not exceed the following: 400W for 115 - 264Vac input or 350W for 90Vac input (average power may be linearly interpolated between 90 and 115Vac input).

†† - Derate to 400W above 27V. C & CM modules may output up to 600W for up to 10 seconds providing that the converter ratings are not exceeded and the average power from the module does not exceed the following: 400W for 115 - 264Vac input or 350W for 90Vac input (average power may be linearly interpolated between 90 and 115Vac input).

††† - CM Module cannot be fitted to slot 1 due to medical spacing requirements.

†††† - See Table below

DB modules with 6V nominal, Output Channel1

Cooling options C, S, T & V O/P 1 : 5.5 - 6V O/P 1 + O/P 2 : 195W total.
 O/P 1 : 6 - 6.5V O/P 1 + O/P 2 : Linearly derate from 195 to 170W total.
 Cooling option Q O/P 1 : 5.5 - 6V O/P 1 + O/P 2 : 180W total.
 O/P 1 : 6 - 6.5V O/P 1 + O/P 2 : Linearly derate from 180 to 140W total.
 Cooling options P & R O/P 1 : 5.5 - 6.5V O/P 1 + O/P 2 : 120W total.

DB modules with 6V nominal channel 1 are not allowed when channel 2 exceeds 5.5V.

¥ - 3A forward air, 2A reverse air.

¥¥ - 1A forward air, 0.6A reverse air.

¥¥¥ - Linearly derate from 13 to 10A over the voltage range 12.5 to 15.5 V.

¥¥¥¥ - Linearly derate from 7 to 6A over the voltage range 25 to 28 V.

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

Cooling Options:

Cooling option	Input volts	continuous O/P power	peak power O/P (W)	Ambient(°C)	Derating(°C) †
(S, V, T) Forward air standard fan	90-264(Vac) ‡	350W	400 peak if 350 average #	65	2.5% per°C above 50
(S, V) Forward air standard fan	115-264(Vac)	450W	510 peak if 450 average #	65	2.5% per°C above 50
(S, V, T) Forward air standard fan	180-264(Vac)	664W	740 peak if 600 average #	65	2.5% per°C above 50
(R) Reverse air standard fan	90-264(Vac) ‡	250W	N/A	65	2.5% per°C above 50
(Q) Forward air quiet fan	90-264(Vac) ‡	350W	N/A	65	2.5% per°C above 50
(P) Reverse air quiet fan	90-264(Vac) ‡	250W	N/A	60	3.8% per°C above 50

C, U Cooling Option : Customer air, fan not fitted. Refer to Customer Air Cooling section in for details.

† Both the total output power and the module output currents are derated by the given value.

‡ For input voltages between 85 and 89.9V the output power is derated to 94% of the values given for 90V input.

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.

Continuous, peak and average power ratings may be linearly interpolated for input voltages between 90 and 180V.

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, but they are subject to the current deratings for operation above 50°C.

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.

For reverse airflow cooling all B, BH and DB modules are limited to a maximum output power of 150W (total for both channels on dual output modules).

NV350 PFC

ELECTRICAL & THERMAL RATINGS:

Input Parameters

Nominal input voltage (V)	100 - 240
Input voltage range (V)	85 - 264
Input frequency range (Hz)	47 – 440*
Maximum input current (A)	5.5
Inrush Current (A)	<15

*For frequencies above 60Hz, refer to Engineering Conditions of Acceptability.

For input voltages between 85 and 89.9V the output power is derated to 94% of the values given in the Cooling Options Table.

Output Parameters

Max Output Power is 350W up to 50°C. Above 50°C, derate by 2.5%/°C.

Output Voltage - 375V +/- 20V

Fan Output - 12V nom at 0.25A max

Test Item Particulars	
Classification of use by	Skilled person
Supply Connection	AC Mains
Supply % Tolerance	+10%, -10%
Supply Connection – Type	pluggable equipment type A - appliance coupler mating connector
Considered current rating of protective device as part of building or equipment installation	20 A; building;
Equipment mobility	for building-in
Over voltage category (OVC)	OVC II

Class of equipment	Class I
Access location	N/A
Pollution degree (PD)	PD 2
Manufacturer's specified maximum operating ambient (°C)	50°C (Full Load); 65°C (Output power decreased linearly by 2.5%/°C above 50°C)
IP protection class	IPX0
Power Systems	TN
Altitude during operation (m)	5000 m
Altitude of test laboratory (m)	64 m
Mass of equipment (kg)	1 kg max

Technical Considerations

- 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) to 65°C maximum (see cooling options for models and conditions to which the extended ambient applies) with de-ratings.
- The product is intended for use on the following power systems : TN
- Mains supply tolerance (%) or absolute mains supply values : +10%/-10%
- The equipment disconnect device is considered to be : appliance coupler (if fitted), or provided by the end equipment.
- 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 product was investigated to the following additional standard : EN 62368-1:2014 + A11:2017 (which includes all European national differences, including those specified in this test report). , CSA CAN/CSA-C22.2 NO. 62368-1 2nd Ed, Issued December 1, 2014
- Capacitors are rated for 230V due to the IT power system used in Norway. Further evaluation may be required in the end use product.
- The NV350 range is suitable for use at an altitude of 5000 metres.
- Multilayer PWB's accepted under CBTR Ref. No. E349607-A23. See enclosure 7-03 for rationale for waived tests.

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:

- The following product-line tests are conducted for this product : Earthing Continuity, Electric Strength
- The end-product Electric Strength Test is to be based upon a maximum working voltage of : Primary-Secondary: 363 Vrms, 650 Vpk;, Primary – Earthed Dead Metal: 343 Vrms, 622 Vpk
- The following output circuits are at ES1 energy levels : All except for 24VDB CH2 which is ES2
- The following output circuits are at PS3 energy levels : All circuits
- The maximum investigated branch circuit rating is : 20 A
- The investigated Pollution Degree is : 2
- Proper bonding to the end-product main protective earthing termination is : Required
- An investigation of the protective bonding terminals has : been conducted
- The following input terminals/connectors must be connected to the end-product supply neutral : N
- The following end-product enclosures are required : Mechanical, Fire, Electrical with the exception of the IEC inlet face of units fitted with an IEC60320 inlet.
- The following magnetic devices (e.g. transformers or inductor) are provided with an OBJY2 insulation system with the indicated rating greater than Class A (105°C) : T1, T2, TX1 & TX2 (all Class F). See table 1.5.1 for details of insulation systems used.
- The following components require special consideration during end-product Thermal (Heating) tests due to the indicated maximum temperature measurements during component-level testing : Refer to additional application considerations.
- The equipment is suitable for direct connection to : AC mains supply
- The power supply terminals and/or connectors are: Screw terminals (where used) are suitable for factory wiring only.
- The following output terminals were referenced to earth during performance testing: All outputs and their return lines individually referenced to obtain maximum working voltage.
- Fans: The end fan provided in this sub-assembly is provided with a fan guard to reduce the risk of accidental contact with the stator. The top fan provided in this sub-assembly is not intended for access by ordinary person.
- When operated at a frequency greater than 60Hz, evaluation of the end equipment against the requirements of clause 5.7 must be considered.

Additional Information

Project # 4789845826 line 1:

The original report was revised to include the following technical/administrative changes/additions:

Update CCL with the addition of 2 alternate Relays: TE Connectivity Relay 2-1416010-6 (RE034012) & Hongfa HF171F12-H3

The alternate components have same or better ratings, considered technically equivalent, no tests were deemed necessary, the sample requirements were waived, the product continues to comply with the standard.

This test report should be read in conjunction with the original Report, No.: E135494-A6017-CB-1, issued date 2020-01-31 with CB Certificate DK-92750-UL, issued on 2020-01-31.

Customer Air Cooling (options C or U):

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

For PSUs 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 must 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 must be conducted in accordance with the requirements of the appropriate 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/assembly 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.

Circuit Ref.	Description	Max. Temperature (°C)
L2, L3, L4	Filter/PFC assy: Choke winding	155
C3, C4	Filter/PFC assy: X capacitors	100
L1	Filter/PFC assy: Boost choke winding	130
C1	Filter/PFC assy: Electrolytic capacitor	60 (105)
T1	Filter/PFC assy: Flyback transformer winding	130
RLY1	Filter/PFC assy: Relay	100
TX1, TX2	Modules: Power transformer windings	130
L1, XL1	B, BH & DB module chokes	130
L1	C & CM module chokes	140
Global option T2	Global Options: Transformer winding	90 (130)
Various	All other choke & transformer windings	110
Various	All <=10mm diameter electrolytic capacitors	80 (105)
Various	All 12.5mm diameter electrolytic capacitors	85 (105)
TX1	DA Module: Flyback transformer windings	100 (130)
XTH101	Primary IMS measured adjacent to XTH101	100 (105)

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

 The manufacturer submitted representative production sample(s) of NV350. The following sample ID 2764822 was used for construction review.

NV3SSS24/24DB24BH28BH, NV350-SSS12BH13.2B12.5/6DB and etc, were used for test purposes and are considered representative of the entire series.


Report based on testing conducted in E135494-A57 for details see list of tests.

Additional Standards

The product fulfills the requirements of: EN 62368-1:2014 + A11:2017, CSA CAN/CSA-C22.2 No. 62368-1 2nd Edition, Issued December 1, 2014

Markings and Instructions

Clause Title	Marking or Instruction Details
Equipment identification marking – Manufacturer identification	Listee's or Recognized companys name, Trade Name, Trademark or File Number

Equipment identification marking – model identification	Model Number
Equipment rating marking – ratings	"Input Ratings (voltage, frequency/dc, current/power)", "Output Ratings (voltage, frequency/dc, current/power)"
See Installation Instructions	The symbol 
Special Instructions to UL Representative N/A	