Description

UL TEST REPORT AND PROCEDURE

Standard:	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
Certification Type:	Component Recognition
CCN:	QQHC2 / QQHC8
Complementary CCNs:	
Product:	Switch Mode Power Supply

Model:	NV350 or NV3 or NV-350 followed by abcde
	(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. Units may be additionally marked with a product code: K3x or Q3x where x may be any number of characters).
	Where:
	a = Airflow option (which can be S, R, Q, P, V, C, T, U, K or L),
	b = Input option (which can be S, or I),
	c = Leakage option (which can be S, M, L, R or T) optionally followed by
	d = Global option (which can be EN#V, EN12V, EN13.5V, IN#V, IN12V, IN13.5V, ES#V, ES12V, ES13.5V, IS#V, IS12V or IS13.5V) # represents the standby output voltage and is in the range 5 to 5.5V.
	e = modules
	
	(Non-Standard model)
	K300yy#
	(where yy can be 45x, 52x. Where # can be any letter denoting non-safety related changes, e.g. extra labels on the unit and x is for revision changes not affecting safety)
	
	See report Model Differences for details.

Rating:	100-240Vac nominal 47-440Hz, 5.5A rms max.
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.

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:	Mark John De Sagun, Handler	Reviewed by:	Alessandra Missaglia, 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 series. Switch mode power supplies for building into end equipment.

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

Model Differences

Unit Configuration Code:
NV350 or NV3 or NV-350 followed by abcde (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). Units may be additionally marked with a product code: K3x or Q3x where x may be any number of characters).

Where a = 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)

Where b = S or I where:

Option Letter	Input Option
S	Screw input terminals
I	IEC input

Where c = 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 d = 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.

Where e = NV350 or NV3 or NV-350 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 Instruction Manual 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.
Note: Series connection of one NV350 unit to another NV350 unit is not permitted.

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.

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¥
DA CH2	11.9 to - 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).

Additional Information
The following tests were selected as representative of the test program applicable to model covered by this CBTR: Single Fault Condition tests(4.4, 4.4.1, 4.4.2.12), Mains Supply (5.1.3), Dielectric Voltage Withstand Test (6.8), Plugs and Connectors (6.10.3), Determination of Accessible Parts, Limit Values for Accessible Parts (6.2, 6.3), Temperature Test (10.1 - 10.4).

These tests have been witnessed for models selected as representative of the standard covered by this report and the applicable test program. (4791153162, DA file 331).

This report is a reissue of CBTR Ref. No. E331788-A17-CB-1, CB Test Certificate Ref. No. DK-33998-UL and E331788-A17-CB-1-Amendment-1, CB Test Certificate Ref. No. DK-33998-A1-UL. and CBTR Ref. No. E331788-A17-CB-1-Amendment-2, CB Test Certificate Ref. No.DK-33998-A2-UL. The original report was modified to include the following changes:
- The standard has been ugraded to the latest revision date.
- Standards were updated on critical omponent list
- Components licenses were attached 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 considered necessary to make these changes. 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.

Technical Considerations

- The product was investigated to the following additional standards: JIS C 1010-01(2019)
- The following additional investigations were conducted: -
- The product was not investigated to the following standards or clauses: -
- The following accessories were investigated for use with the product: -
- 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 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 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 considering rated input voltage and frequency.
  - 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 following magnetic devices (e.g. transformers or inductor) are provided with an OBJY32 insulation system with the indicated rating greater than Class A (105°C) : T1, T2, TX1 & TX2 (all Class F).
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.
Input tolerance +/-10% has been considered. If unit is used above this tolerance range, additional assessment must be considered in end-product.
The unit is for input connection to IEC 60320 (option I only) and terminal block and considered permanent connection when installed in end-application.