UL TEST REPORT AND PROCEDURE

Standard:	UL 60950-1, 2nd Edition, 2014-10-14 (Information Technology Equipment - Safety - Part 1: General Requirements) CAN/CSA C22.2 No. 60950-1-07, 2nd Edition, 2014-10 (Information Technology Equipment - Safety - Part 1: General Requirements)
Certification Type:	Component Recognition
CCN:	QQGQ2, QQGQ8 (Power Supplies for Information Technology Equipment Including Electrical Business Equipment)
Product:	Switch Mode Power Supply
Model:	Alpha 600 series, CA600 series, Alpha 600W series, Alpha-600 series, CA-600 series
Rating:	Nominal Input Voltage Range: 100-240 Vac or 177-326 Vdc. 47-63Hz. 10A AC or 6A DC. Output: See Model Differences
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.

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.

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

Prepared by: Mike Burns Reviewed by: David Snook

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

Switch Mode power supply for installation within end equipment. A range of output modules can be mounted in 5 available slots. The primary sub-assembly, including the primary windings of the main barrier transformer, is common to all products in this family. The secondary regulators are built into separate modules and have flexible secondary windings attached to them.

Model Differences

Alpha 600 is identical to CA 600, Alpha-600, CA-600 and Alpha 600W.
(may be prefixed by NS - # / or - where # may be up to any four letters and may be followed by - $; where $ may be any number between 000 to 999, indicating non-safety related model differences.)

Alpha 600 may be followed by: A, TL, RL, LL or ML
Where:
A = Class A input filter (Class B fitted as standard)
TL = Tiny leakage input filter
RL = Reduced leakage input filter
LL = Low leakage input filter
ML = Medium leakage input filter
may be followed by: LSF, RA or QF
Where:
LSF = Low speed fan
RA = Reverse air fan
QF = Quiet fan option

@ followed by AA, A, AL, BB, B, CC, C, CL, CM, CH, DD, D, FF, F, GG, G, JJ, J, KK, K, LL, L, MM, M, NN, N, QQ, Q, RR, R, SS, S, TT, T, UU, U, WW, W, ZZ or Z.
or B/S

optionally followed by _MF, MFE, MFU, MFV or _MFV, _PA, _IN, _PP, _RP, RPA, RPB, RPC, RPD, _D or _MG

@/@ (Where / may be replaced with _)followed by: E, EB, EQ, EL, EH, H, P or PL:
Where @ and @/@ = applicable voltage range and the following one or two letters are the module type.

Secondary Options:
_MF, MFE = Mains fail option (may also be called X).

MFU = Mains fail option with uncommitted output connections.
MFV = Mains fail option with VME bus
_PA, _PP, _IN, _RP, RPA, RPB, RPC, RPD, _D and _MG = Secondary module options. (Note: The RPA option can only be used on modules with output voltages rated up to 32V. The RP, RPB, RPC and RPD options can only be used on modules with output voltages rated up to 16V. Not for use with a module voltage range of 18-29V or twin output modules.)

B/S = Blanking slot which occupies one 23mm slot.
Only up to five 23mm slots may be filled up per unit, noting that all modules occupy one 23mm slot except for AA, A, F, FF, G, J, K, R, S and T modules which occupy two 23mm slots.

Valid voltage ranges for @ and @/@ for each module are as follows:
AA @ = 4.5-7V, G, GG @ = 17.5 - 29V
A @ = 4.5-6V, H @/@ = 18 - 32V / 18 - 32V
AL @ = 4.75-5.3V, J, JJ @ = 30 - 48V
BB @ = 4.5-7V, K, KK @ = 18 - 31V
B @ = 4.5-6V, L, LL @ = 1.8 - 3.2V
C, CC @ = 5-16V, M, MM @ = 5 - 16V
CL @ = 4.6-5.6V , N, NN @ = 18 - 32V
CM @ = 5-7V, P @/@ = 18 - 29V / 5 - 16V
CH @ = 11.4-13.5V, PL @ = 22 - 26 / 5 - 7V
D, DD @ = 18-29V, Q, QQ @ = 2. 7 - 3.9V
E @/@ = 5-16V / 5-16V, R, RR @ = 2. 7 - 3.9V
EB @/@ = 4.5-5.5V / 4.5-5.5V, S, SS @ = 1 - 5.7V
EQ @/@ = 4.5-5.5V / 2.7-3.9V, T, TT @ = 1.8 - 3.2V
EL @ = 5 -7V / 11-13V, U, UU @ = 10 - 21V
EH @ = 11-13V / 11-13V, W, WW @ = 4.5 - 5.5V
F, FF @ = 9-16V, Z, ZZ @ = 4.5 - 5.7V

Additional module limitations:
Notes:
1) For C, CH, modules the max output current is 12A for voltages > 12V.
2) For E, EH, EL modules the max output current is limited to 7A in slot 3 and 6A in Slot 4.
3) For H modules the max output current is limited to 4A in slot 4. For voltages >29V, the output current is limited to 1A
4) For P, PL modules the max output current is limited to 5A for channel 1 and for channel 2, 8A in slot 1, 7A in slots 2, 3 and 5, and 6A in slot 4.
5) For J modules output current derates by 0.25A per volt above 40V.
6) N modules with output voltage greater than 29V have max output current of 1 Amp.
7) For S modules the max output current is limited to 75A in slots 2 & 3, 77A in slots 3 & 4, & 80A in slots 4 & 5.
8) When using remote sense, the max output voltage will be reduced by 0.5V for L, S, T, Q and R modules, and by 1.0V for C, CH, CL, CM, D, F, G, J, M, K, N, U modules.
9) Ampere turns for J module is calculated as AT = (output current + 15A) x 4.
10) For L modules the max. output current is limited to 20A in slot 5.
11) Adjusting output voltage beyond the stated range may cause overvoltage protection (OVP) to operate, whereby all outputs will turn off. To reset OVP, turn back the output voltage adjustment and remove the mains supply for 30 seconds and then switch back on.

Unit limitations:
i) For PSUs fitted with RA option (reverse air flow), the output is limited to 475W and 100AT at a max ambient of 40°C, or 400W, 85AT for a max ambient of 50°C (horizontal only). Operation in any vertical position is not permitted.
ii) For PSUs fitted with the LSF option, the output is limited to 400W and 88.9AT. The QF option is limited to

600W and 120AT.
iii) For power supplies having input or output connector housings fitted there is no effect on ratings in any orientation.

Adjustment and Derating.

The Alpha 600 series is designed to provide a maximum output power of 600W at nominal output voltages. The following procedure must be used to ensure the PSU is operated within its ratings:

a) Calculate user power for each module (volts x amps).
b) Add all the individual module powers together. The total power must not exceed the power rating of the converter, 600W.
c) Calculate secondary transformer turns x amps or each module see outputs table for transformer secondary turns.
d) Add all the module turns x amps together and this must not exceed 120AT.
e) If necessary reduce the loading until the conditions are met. i.e. power and ampere-turns maxima.

SELV and Outputs Connected In Series:
- Outputs can be connected in series thus producing non-SELV levels, or in parallel thus producing new energy hazards, and this must be taken into account in the end-use application. When non-seriesed outputs are earthed in the end use equipment they are SELV. If the outputs are not earthed they must be considered hazardous, as a single fault in the secondary may make them exceed the SELV limits between output and earth. If any output is non-SELV then all outputs become non-SELV.
- All outputs have operational spacing to earth, and due consideration must be given to this in the end product design.

Custom Model:

Model: CA600 18G (NS-WAK-001)
Input voltage range: 90-264Vac
Outputs 18V 25A (450W, 100AT total)
Ambient 50°C max
Orientations All except psu vertical with airflow downwards and psu upside down
Model NS-WAK-001 is identical to Model Alpha 600 18G.
Both Models are identical to the standard product, except they may be fitted with a Papst 612NGM fan.

Input Connections:

Input tabs- 6.3mm x 0.8mm, tin plated brass, rated 15A.

Output Connections:

Output Connector Ratings:
1) 6.35mm fastons are rated at 15A.
2) 9.5mm Faston terminals are rated at 32A (tab thickness = 1.0mm, suitable Faston terminals are AMP 151667-2 or AMP 280223-2)
3) M5 screw terminals are rated at 100A subject to the wire and wire connector used to connect them. Maximum recommended torque setting for M5 screws is 2.5 - 3.0Nm.

Technical Considerations

- Equipment mobility : for building-in
- Connection to the mains : no direct connection to the mains
- Operating condition : continuous

- Access location : not accessible
- Over voltage category (OVC) : OVC II
- Mains supply tolerance (%) or absolute mains supply values : 90 - 264VAC max; 160 - 358VDC max
- Tested for IT power systems : Yes, Norway only
- IT testing, phase-phase voltage (V) : 230V
- Class of equipment : Class I (earthed)
- Considered current rating of protective device as part of the building installation (A) : 20A
- Pollution degree (PD) : PD 2
- IP protection class : IP X0
- Altitude of operation (m) : 3000
- Altitude of test laboratory (m) : 64m
- Mass of equipment (kg) : 2.5kg
- Clearances and Creepage Distances have additionally been assessed for suitability up to 3000 m elevation.
- The product was submitted and evaluated for use at the maximum ambient temperature (Tma) permitted by the manufacturer's specification of: 50°C
- The product is intended for use on the following power systems: TN
- The equipment disconnect device is considered to be: to be provided in end product
- The following were investigated as part of the protective earthing/bonding: Printed wiring board trace (refer to Enclosure - Schematics + PWB for layouts)
- The means of connection to the mains supply is: to be provided in end product
- The product was investigated to the following additional standards: CSA C22.2 No. 60950-1-07, 2nd Edition, 2014-10, UL 60950-1 2nd Ed, 2014-10-14, EN 60950-1:2006 + A11:2009 + A12:2011 + A1:2010 + A2:2013 (which includes all European national differences, including those specified in this test 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:

- These products were considered to be a component part of a larger piece of Class 1 equipment. Full compliance with the standards will therefore depend on the installation in the final application. Some modules could present an energy hazard. Additionally, outputs can be connected in series thus producing non-SELV levels, or in parallel thus producing new energy hazards, and this must be taken into account in the end-use application. When non-series outputs are earthed in the end use equipment they are SELV. If the outputs are not earthed they must be considered hazardous, as a single fault in the secondary may make them exceed the SELV limits between output and earth. If any output is non-SELV then all outputs become non-SELV.
- These units are internally forced-air cooled. They require a minimum of 50mm clearance in the vicinity of the ventilation holes. Whilst relatively orientation insensitive, operation of the these units when mounted vertically with the air flow in a downward direction is affected by convection acting against the cooling airflow, and results in slightly hotter temperatures (2 to 5 degrees) than if operated in the horizontal position. As a consequence of this, heating tests were carried out in the vertical orientation with airflow downwards to give the worst case temperatures, unless otherwise stated. No additional air flow during tests was applied, only the internal fans were used.
- Additional requirement may apply if product used in end application in Restricted Access Location

- Consideration should be given to measuring the temperatures on power electronic components and transformer windings, when the power supply is installed in the end-use equipment.
- The following Production-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-SELV: 406 Vrms, 728 Vpk , Primary-Earthed Dead Metal: 380 Vrms, 412 Vpk
- The power supply terminals and/or connectors are: Suitable for factory wiring only
- 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: Not been conducted
- The following input terminals/connectors must be connected to the end-product supply neutral: input terminal marked "N"
- The following magnetic devices (e.g. transformers or inductor) are provided with an OBJY3 insulation system with the indicated rating greater than Class A (105°C): T203 (Class F)
- The following end-product enclosures are required: Mechanical , Fire , Electrical
- The following output terminals were referenced to earth during performance testing: For output SELV testing, the positive and negative outputs in turn were connected to earth. ,
- The following secondary output circuits are at hazardous energy levels: All
- Fans: The fan provided in this sub-assembly is provided with a fan guard to reduce the risk of operator contact with the fan blades. Further evaluation shall be considered in the end product.
- The following secondary output circuits are at hazardous energy levels: modules A, AA, AL, C, CC, CH, D, DD, F, FF, G, GG, J, JJ, K, KK, R, RR, S, SS, T, TT, U and UU
- The following secondary output circuits are at non-hazardous energy levels: modules B, BB, CL, CM, E, EB, EH, EL, EQ, H, L, LL, M, MN, N, NN, P, PL, Q, QQ, W, WW, Z and ZZ

Additional Information

This report, to include IEC60950-1 Amd 2:2013, is a reissue of CBTR Ref. No.: E135494-A48-CB-2 dated 2012-11-19 including CB Test Certificate Ref. No. DK-29306-UL dated 2012-11-19. Based on previously conducted testing and the review/update of product technical documentation including photos, schematics, wiring diagrams and similar, it has been determined that the product continues to comply with the standard. No testing was deemed necessary to include the following changes, assessment to 60950-1 Am 2:2013, addition/deletion and correction to the CCL and update of component licenses

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The original testing was carried out on the basis of 5 slots being filled, each slot being one 23mm module space wide. This is the maximum number of module slots allowed under this approval, and provides the worst case situation. Heating tests were carried out with the maximum number of slots filled, but with numerous loading conditions to cover any condition of loading in any slot position. Also, the models tested under Clause 4.5 represent the least efficient, highest current module configurations. Abnormals were carried out on the expected worst case situation for that abnormal, and on as many configurations as considered necessary to represent the entire range of products covered by this approval. For the other tests, the conditions and configurations used were the expected worst case.

These products use optional coatings which are normally applied with a brush and are used within the primary area of the power supply on limited surface therefore deemed as non-safety critical. The coatings are not used for any safety purpose although they improve dielectric strength.