

## UL TEST REPORT AND PROCEDURE

<b>Standard:</b>	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)
<b>Certification Type:</b>	Component Recognition
<b>CCN:</b>	QQGQ2, QQGQ8 (Power Supplies for Information Technology Equipment Including Electrical Business Equipment)
<b>Product:</b>	Switch Mode Power Supply
<b>Model:</b>	Series Alpha 1500, Alpha 1500W, CA1500
<b>Rating:</b>	Input: 94.4-240 Vac, 16 A Max, 47-63 Hz
<b>Applicant Name and Address:</b>	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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**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 product is a modular switching power supply unit. A range of output modules can be mounted in 8 available slots. The Primary sub-assembly, including the primary windings of the main barrier transformer, is common to all products in this series. The Secondary regulators are built into separate modules and have flexible secondary windings attached to them See also Model Differences.

**Model Differences**

**PRODUCTS COVERED**

Unit Configuration Code:

Alpha 1500 and Alpha 1500W are identical to CA1500.

(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 1500, Alpha 1500W or CA1500 may be followed by: TL, RL, LL or ML

Where TL = Tiny leakage input filter  
RL = Reduced leakage input filter  
LL = Low leakage input filter  
ML = Medium leakage input filter  
(Standard leakage filter - no letters)

may be followed by up to eight of any of the following:

@ followed by AA, A, AL, BB, B, C, CL, CM, CH, D, FF, F, GG, G, J, K, L, M, N, Q, R, S, T, U, UU, W, or Z.

optionally followed by \_MF, MFE, \_X, \_XL, MFL, MFU, MFV or \_MFV, MFPP, \_PA, \_IN, \_PP, \_RP, RPA, RPB, RPC, RPD, \_D, \_MG or \_CD

or @/@ (where / may be replaced with \_) followed by: E, EB, EQ, EL, EH, H, P or PL:

or B/S

Where @ and @/@ = applicable voltage range and the following one or two letters are the module type.

\_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  
 MFPF = Mains fail, module parallel and PSU/fan inhibit  
 MFL, \_XL = Mains fail latch  
 \_PA, \_PP, \_IN, \_RP, RPA, RPB, RPC, \_D, RPD, \_CD and \_MG = Secondary module options.  
 B/S = Blanking slot which occupies one 23mm slot.

Only up to eight 23mm slots may be filled up per unit, noting that all modules occupy one 23mm slot except for AA, A, AL, F, FF, G, GG, J, K, R, S and T modules which occupy two 23mm slots.

Valid voltage ranges for @ and @/@ for each module are as follows:

Module	Voltage Range	Module	Voltage Range
AA	@ = 4.5 - 7V	G, GG	@ = 17.5 - 29V
A	@ = 4.5 - 6V	H@/@	= 18 - 32V / 18 - 32V
AL	@ = 4.75 - 5.3V	J	@ = 30 - 48V
BB	@ = 4.5 - 7V	K	@ = 18 - 31V
B	@ = 4.5 - 6V	L	@ = 1.8 - 3.2V
C	@ = 5 - 16V	M	@ = 5 - 16V
CL	@ = 4.6 - 5.6V	N	@ = 18 - 32V
CM	@ = 5 - 7V	P@/@	= 18 - 29V / 5 - 16V
CH	@ = 11.4 - 13.5V	PL	@ = 22 - 26 / 5 - 7V
D	@ = 18 - 29V	Q	@ = 2.7 - 3.9V
E	@/@ = 5 - 16V / 5 - 16V	R	@ = 2.7 - 3.9V
EB	@/@ = 4.5 - 5.5V / 4.5 - 5.5V	S	@ = 1 - 5.7V
EQ	@/@ = 4.5 - 5.5V / 2.7 - 3.9V	T@	= 1.8 - 3.2V
EL	@ = 5 - 7V / 11 - 13V	U, UU@	= 10 - 21V
EH	@ = 11 - 13V / 11 - 13V	W	@ = 4.5 - 5.5V
F, FF	@ = 9 - 16V	Z	@ = 4.5 - 5.7V

**RATINGS & LIMITATIONS:**

Max power & per converter	858W
Max. Ampere Turns per converter	138
Max. Ampere Turns (total)	260
Max number of secondary windings per converter	10
Max Input Current	16A
Input frequency range	47 - 63Hz
Maximum operating altitude	3000m

Module	Note	Output V	Current	Slots	Turns	Max Current Limit	Hazardous energy setting
A	1	4.5-5.5V	60A	2	1	79.2A	>3V
AA	1	4.5-6.2V	60A	2	1	79.2A	>3V
AL	1	4.95-5.05V	60A	2	1	79.2A	>3V
B	2	4.5-5.5V	25A	1	1	33A	-
BB	2	4.5-6.5V	25A	1	1	33A	-
C	6	5-16V	16A	1	2	21.2A	>11.3V
CM	6	5.2-6.6V	16A	1	2	21.2A	-
CL	6	4.75-5.3V	16A	1	2	21.2A	-
CH	6,8	11.9-12.7V	16A	1	2	21.2A	>11.3V

D	6	18-29V	8A	1	4	10.6A	>.22.6V
E		5-16V	8A	1	2	10.6A	-
		5-16V	8A		2	10.6A	-
EB		4.5-5.5V	9A	1	1	11.9A	-
		4.5-5.5V	9A		1	11.9A	-
EH		11.9-12.7V	8A	1	2	10.6A	-
		11.9-12.7V	8A		2	10.6A	-
EL		5.2-6.6V	8A	1	2	10.6A	-
		11.9-12.7V	8A		2	10.6A	-
EQ		4.5-5.5V	9A	1	1	11.9A	-
		2.7-3.9V	9A		1	11.9A	-
F	6	9-16V	33A	2	2	43.6A	>5.5V
FF	6	10-13V	33.5A	2	2	34.5A	>6.9V
GG	6	17.5-29V	24.5A	2	4	25A	>9.6V
G	6	17.5-29V	25A	2	4	33A	>7.2V
H	5	18-32V	5A	1	4	6.6A	-
		18-32V	5A		4	6.6A	-
J	4,6,7	30-48V	10A	2	4(16)	13A	>18.4V
K	6	18-29V	15A	2	4	19.8A	>12V
L	2,6	1.8-3.2V	25A	1	1	33A	-
M	6	5-16V	8A	1	2	10.6A	-
N	5,6	18-32V	5A	1	4	6.6A	-
P		18-29V	5A	1	4	6.6A	-
		5-16V	8A		2	10.6A	-
PL		23.6-24.5V	5A	1	4	6.6A	-
		4.75-5.3V	8A		2	10.6A	-
Q	2,6	2.7-3.9V	25A	1	1	33A	-
R	1,6	2.7-3.9V	60A	2	1	79.2A	>3V
S	3,6	2.5-5.7V	85A	2	1	110.5A	>2.2V
T	1,6	1.8-3.2V	60A	2	1	79.2A	>3V
U	6	10-21V	16A	1	3	21.2A	>11.3V
UU	6	10-21V	15.5A	1	3	16A	>15V
W		4.5-5.5V	15A	1	1	19.8A	-
Z	2	4.5-5.5V	25A	1	1	33A	-

All modules can be used at their full rated current in all slot positions unless otherwise stated below:

Note:

- 1.. For A, AA, AL, R and T modules in slots 7 & 8, max output current is 51A .
- 2 For B, BB, Q, L and Z modules in slot 8, max output current is 20A .
3. For S modules in slots 1 & 2, max output current is 73A, in slots 2 and 3 max output current is 68A, in slots 3 & 4 max output current is 66A, in slots 4 & 5 max output current is 85A, in slots 5 & 6 max output current is 80A, in slots 6 & 7 max output current is 66A and in slots 7 & 8 max output current is 65A.
4. For J modules the output current derates linearly by 0.25A per volt above 40V.
5. For H and N modules with output > 29V, max output current is 1A.
6. 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, FF,G, GG,J, M, K, N, U, UU, V Modules.
7. Ampere turns for J module is calculated as  $AT=(output\ current + 15A) \times 4$ .
8. For C and CH modules, the maximum output current is 12A for output voltages >12V.
9. 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 output voltage adjustment and remove the mains supply for 30 seconds

Secondary Options:

Option	Description
_MG	Provides a module good signal with indicates output voltage is within limits.
_PA	Forces paralleled modules to share load current. Additionally it also provides the module good signal.
_PP	Provides either of the following functions: a) Reduces module current limit and caters for paralleled modules with busbar linking. For use with modules providing a max output of up to 16V only; or b) Identical to _PA except that the module is paralleled at the output of the module with busbar linking.
_IN	Provides an external signal which may be used to inhibit the output of the module.
Option	Description
_RP	Provides remote programming of the module output voltage.
RPA	Provides voltage programming of the module output voltage only.
RPB	Provides voltage programming of the module output voltage and has an output VA limiting circuit.
RPC	Provides an output VA limiting circuit
RPD	Provides voltage programming of the module output voltage and has an output VA limiting circuit.
_D	Delay option. Provides for a delay in the turn on time of the output.

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.  
They are not for use with a module voltage range of 18-29V or twin output modules.

Custom Models:

Model: CA1500 7C\_MF, 24K\_D, 16U\_D, 18/18H\_D, 9/9E\_D, 28/20H\_D, 28/28H\_D (NS-LAM-145)  
Input voltage range: 150-264Vac  
Outputs: 7V 16A, 24V 15A, 16V 16A, 18V 5A, 18V 5A, 9V 8A, 9V 8A, 28V 5A, 20V 5A, 28V 5A, 28V 5A,  
(1500W, 260AT total)  
Ambient: 50degC max  
Orientations: All except psu vertical with airflow downwards and psu upside down.

Model: CA1500 8.5C, 36J\_D, 12C\_D, 24D\_D, 18.5D\_D, 18.5N\_D, 30/18H\_D (NS-LAM-136)  
Input voltage range: 150-264Vac  
Outputs: 9.5V 10A, 37V 8.5A, 13V 16A, 25V 9A, 19.5V 6.5A, 19.5V 3.7A, 31V 4A, 19V 2A (1203W, 235AT  
total)  
Ambient: 50degC max  
Orientations: All except psu vertical with airflow downwards and psu upside down.

Model: CA1500 12FF\_MF, 12FF, 12FF, 12FF (NS - AMD - 004)  
Input voltage range: 207-264Vac  
Outputs: 13V 34.5A max, 13V 34.5A max, 13V 34.5A max, 13V 26.5A max  
Max Output Power: 1690W, 260AT  
Ambient: 50degC max  
Orientations: Horizontal Only

Model: CA1500 5BRP, 5SRP, 12FRP, 12FRP  
Input voltage range: 150-264Vac  
Outputs: 5.5V 25A max, 5.7V 85A max, 13V 33A max, 13V 33A max  
Max Output Power: 1480W, 242AT  
Ambient: 50degC max

Orientations: All except psu vertical with airflow downwards and psu upside down.

Model: CA1500 5A\_MF, 3.3R, 2.5T, 24D, 12/12E (NS-LAM-212)

Input voltage range: 90-264Vac

Outputs: 5V 35A max, 3.3V 48A max, 2.5V 56A max, 24V 11A max, 12/12V 8/0.2A max

Max Output Power: 836W

Ambient: 50degC max

Orientations: All except psu vertical with airflow downwards and psu upside down.

Model: CA1500 5.1A\_MF, 3.4R, 2.5T, 24.5D, 12.2/12.2E

Input voltage range: 90-264Vac

Outputs: 5.1V 35A max, 3.4V 48A max, 2.5V 56A max, 24.5V 11A max, 12.2/12.2V 8/0.2A max

Max Output Power: 852W

Ambient: 50degC max

Orientations: All except psu vertical with airflow downwards and psu upside down.

Model: CA1500 24G\_MF 24G\_IN 24D\_IN 24D\_IN 24D\_IN 24D\_IN

Input voltage range: 90 - 264Vac

Outputs: 24V, 10A max, 24V, 20A max, 24V, 10A max, 24V, 10A max, 24V, 8A max, 24V, 8A max

Max Output Power: As per the Units Limitations table on page 1 of this handbook

Ambient: 50degC max.

Orientations: All except psu vertical with airflow downwards and psu upside down.

Model: CA1500 24G\_MF 24G\_IN 24D\_IN 24D\_IN 28D\_IN 28D\_IN

Input voltage range: 90 - 264Vac

Outputs: 24V, 10A max, 24V, 20A max, 24V, 10A max, 24V, 10A max, 28V, 8A max, 28V, 8A max

Max Output Power: As per the Units Limitations table on page 1 of this handbook

Ambient: 50degC max.

Orientations: All except psu vertical with airflow downwards and psu upside down.

#### Technical Considerations

- Equipment mobility : for building-in
- Connection to the mains : to be determined in the end application
- Operating condition : continuous
- Access location : for building-in
- Over voltage category (OVC) : OVC II
- Mains supply tolerance (%) or absolute mains supply values : +10%, -10%
- Tested for IT power systems : Norway only
- IT testing, phase-phase voltage (V) : N/A
- Class of equipment : Class I (earthed)
- Considered current rating of protective device as part of the building installation (A) : 20A
- Pollution degree (PD) : 2
- IP protection class : IPX0
- Altitude of operation (m) : 3000 m
- Altitude of test laboratory (m) : 64 meters
- Mass of equipment (kg) : 3.5kg
- • Clearances and Creepage Distances have additionally been assessed for suitability up to 3000 m elevation.

- The means of connection to the mains supply is: to be determined in end-product
- The product was investigated to the following additional standards: CSA C22.2 No. 60950-1-07+A1:2011, UL 60950-1 2nd Ed. Revised 2011-12-19, 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).
- The following were investigated as part of the protective earthing/bonding: Printed wiring board trace (refer to Enclosure - Schematics + PWB for layouts)
- The product is intended for use on the following power systems: TT TN
- The product was submitted and evaluated for use at the maximum ambient temperature (T<sub>ma</sub>) permitted by the manufacturer's specification of: 50°C
- The equipment disconnect device is considered to be: provided in the end product

#### **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 Clearances and Creepage Distances have additionally been assessed for suitability up to 3000 m elevation.
- Additional requirements may apply if product is used in end application in Restricted Access Location.
- Additional requirements may apply if fuse is replaceable in end product
- 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.
- For limitations of using Alpha 1500 - see Model differences.
- The fan provided in this sub-assembly is not suitable for operator access
- The fan provided in this sub-assembly is provided with fan guard to reduce the risk of operator contact with the fan
- 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-Earthed Dead Metal: 284 Vrms, 384 Vpk, Primary-SELV: 330 Vrms, 652 Vpk,
- The following secondary output circuits are SELV: See Additional Information
- The following secondary output circuits are at hazardous energy levels: See Additional Information
- The power supply terminals and/or connectors are: not investigated for field wiring.
- 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. The power supply chassis shall be properly bonded to earth in the end-use product, as the units were investigated for Class 1 construction. The grounding pin at the input terminal is connected to a printed wiring board. The grounding path on the printed wiring board has not been investigated as a protective earthing conductor. An additional evaluation shall be made, if the power supply is intended for use in other than Class I equipment.
- 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 OBJ3 insulation

system with the indicated rating greater than Class A (105°C): T202 (Class F) and T302 (Class F)

- The following end-product enclosures are required: Mechanical, Fire, Electrical
- The fans included as part of this component are suitable for use in a user access area: No

#### Additional Information

This report, to include IEC60950-1 Amd 2:2013, is a reissue of CBTR Ref. No.: E135494-A49-CB-2 dated 2012-08-10 including any amendments and corrections with CB Test Certificate Ref. No. DK-27559-UL dated 2012-08-10. 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. Only the changes listed below were deemed necessary.

1. Assessed to 60950-1 Am2:2013
2. Addition/deletion and correction to the CCL
3. Update of component licenses
4. Remove miscellaneous enclosures: 7-02, 7-05 & 7-07

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-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.

The original testing was carried out on the basis of 8 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 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 units are internal forced-air cooled. They require a minimum of 50mm clearance in the vicinity of the ventilation holes. Whilst relatively orientation insensitive, operation of 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 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.

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

#### Additional Standards

The product fulfills the requirements of: CSA C22.2 No. 60950-1-07+A1:2011, EN 60950-1:2006 + A11:2009 + A12:2011 + A1:2010 + A2:2013