

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:	Series Alpha 400, Alpha 400W, MA400, CA400, Alpha-400, Alpha-400W, MA-400, CA-400
Rating:	Nominal Input Voltage Range: 100 - 240VAC, 7A max, 47-63Hz Output: See Model Differences
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.

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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 subject units are switch mode power supply sub-assemblies incorporating semiconductor components. They are provided with isolating transformers and associated circuitry mounted on printed wiring boards, in addition to input connectors for connection to mating connectors or wiring within the end equipment.

Model Differences

The Alpha 400, CA 400 and MA 400 Series Power Supplies are electrically and mechanically identical.

The system build is further specified by additional suffixes, described as follows:

may be followed by A, LL, RL, ML, TL or no letter; where

A=Class A input filter

LL=Low Leakage Input Filter

RL=Reduced Leakage Input filter

TL= Tiny Leakage Input filter

ML = Medium Leakage input filter

No letter = Class B input filter

may be followed by LSF, QF or RA; where

LSF=Low Speed Fan

QF=Quiet Fan

RA=Reverse Air Fan

followed by up to five of the following:

@ 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: _X, _MF, MFE, MFU, MFV or _MFV, MFPF, _PA, _IN, _PP, MJ, RJ, PJ, IJ, _RP, RPA, RPB, RPC, RPD, _MG or _D

@/@ or @_@ followed by: E, EB, EQ, EL, EH, H, P or PL:

where @ and @/@ or @_@ = 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 or _MFV = Mains fail option with VME bus

_PA, _PP, _IN, _RP = Secondary module options

B/S = blanking slot which occupies one 23 mm slot.

Only up to five 23 mm slots may be filled up per unit, noting that all modules occupy one 23 mm slot except for AA, A, F, G, J, K, R, S and T modules which occupy two 23 mm slots. All primary MF options can only be fitted in slot 1.

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

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

Secondary Options:

Option	Description
_MG	Provides a module good signal which indicates output voltage is within limits
_PA, RJ	Forces paralleled modules to share load current. Additionally it also provides the module good signal
_PP, PJ	Provides either of the following functions: a) Reduces module current limit and caters for paralleled modules with bus bar 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 bus bar linking
_IN, IJ	Provides an external signal which may be used to inhibit the output of the module
_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	Provides a delay to 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.

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

- a) A, AA & AL modules can be used in slots 1-5 up to 60A/channel
- b) BB & B modules can be used in slots 1-4 up to 25A/channel and in slot 5 up to 20A/channel
- c) C, CC, CL, CM & CH modules can be used in slots 1-5 up to 16A/channel if o/p is limited to 12V. At 15 to 16V C modules can be used up to 12A/channel. Module derates linearly between 12 and 15V
- d) D & DD modules can be used in slots 1-5 up to 8A/channel
- e) E, EL & EH modules can be used in slots 1-3 up to 8A/channel and in slots 4 and 5 up to 6A/channel
- f) EB modules can be used in slots 1-5 up to 9A/channel
- g) EQ modules can be used in slots 1-3 up to 9A/channel and in slots 4 and 5 up to 6.75A/channel
- h) F & FF modules can be used in slots 1-5 up to 33A/channel
- i) G & GG modules can be used in slots 1-5 up to 20A/channel
- j) H modules can be used in slots 1-3 up to 5A/channel and in slots 4 and 5 up to 4A/channel. For output voltages 30.01 to 32V maximum rated current is 1A
- k) J & JJ modules can be used in slots 1-5 at 30-41V at 10A max. For output of 48V at 8A max. For voltages between 41 and 48V the current is linearly interpolated
- l) K & KK modules can be used in slots 1-5 up to 15A
- m) M & MM modules can be used in slots 1-5 up to 8A/channel
- n) L & LL modules can be used in slots 1-4 up to 25A/channel and in slot 5 up to 20A per channel
- o) N & NN modules can be used in slots 1-5 up to 5A/channel for output voltages up to 29V. For output voltages 29.01 to 32V maximum rated current is 1A
- p) P & PL modules 18-29V outputs can be used in slots 1-3 up to 5A and in slots 4-5 at up to 4A. 5-16V outputs can be used in slots 1-3 up to 8A and in slots 3-4 at up to 6A
- q) Q & QQ modules can be used in slots 1-5 up to 25A/channel
- r) R & RR modules can be used in slots 1-5 up to 60A/channel
- s) S & SS modules can be used in slots 1/2 up to 75A, slots 2/3 up to 71A, slots 3/4 up to 69A & slots 4/5 up to 66A
- t) T & TT modules can be used in slots 1-5 up to 60A
- u) U & UU modules can be used in slots 1-3 up to 16A, slot 4 up to 15A and slot 5 up to 13A
- v) W & WW modules can be used in slots 1-5 up to 15A/channel
- w) Z & ZZ modules can be used in slots 1-4 up to 25A/channel and in slot 5 up to 20A per channel.

The following limitations also apply:

(a) For power supplies having one or more A, AA, AL, R, RR, T and/or TT modules and mounted vertically with the airflow downwards, the output is limited to 350W.

(b) For power supplies having one or more F or FF modules, the output is limited to 375W, only when operated in a vertical position with the fan on top of the power supply

(c) For power supplies fitted with an LSF option fan, the output is limited to 300W and 60AT. Operation in a vertical orientation with the fan at the top is not permitted

(d) For power supplies fitted with the fan reversed (RA option), the output is limited to 300W and 60AT. Operation in a vertical orientation is not permitted

(e) For power supplies having input or output connector housings fitted the total output is limited as follows:

PSU Orientation	Total Power Output
Vertical with no fan	$P = 14.7 + 3.67 \cdot V_{in}$
All other orientations	$P = 80 + 3.2 \cdot V_{in}$

subject to a maximum total power output of 400W and a minimum mains input voltage of 90Vac. Where $P =$

maximum total output power and V_{in} = mains input voltage

An example of product would be: CA400 @B @B @C @/@E or @_@E, @M where @ and @/@ or @_@ would be written on the product label as numbers representing the voltage of the module eg. 5B

Additional Module limitations:

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, D, F, G, J, M, K, N, U Modules.

Ampere turns for J module is calculated as $AT = (\text{output current} + 15A) \times 4$

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.

Technical Considerations

- Equipment mobility : for building-in
- Connection to the mains : no direct connection to the mains
- Operating condition : continuous
- Access location : for building-in
- Over voltage category (OVC) : OVC II
- Mains supply tolerance (%) or absolute mains supply values : 90 - 264VAC max
- Tested for IT power systems : No
- 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) : -
- Pollution degree (PD) : PD 2
- IP protection class : IP X0
- Altitude of operation (m) : 3000
- Altitude of test laboratory (m) : 64
- 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 (T_{ma}) permitted by the manufacturer's specification of: 50°C
- The product is intended for use on the following power systems: TT TN
- The equipment disconnect device is considered 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 determined in end-product
- The product was investigated to the following additional standards: BS EN 60950-1:2006 + 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-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.
- 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 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.
- 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 400 - see model differences
- The power supply terminals and/or connectors are: Suitable for factory wiring only
- 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.
- 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): see critical components table for details.
- The following end-product enclosures are required: Electrical , Fire
- 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: 291 Vrms, 400 Vpk Primary-SELV: 336 Vrms, 864 Vpk
- The maximum investigated branch circuit rating is: 20 A
- 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 secondary output circuits are SELV: See information in Additional Information.
- 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, MM, N, NN, P, PL, Q, QQ, W, WW, Z and ZZ
- Fans: The fan provided in this sub-assembly is provided with a fan guard to reduce the risk of operator contact with the fan.