Test Report issued under the responsibility of:

TEST REPORT
IEC 60950-1
Information technology equipment - Safety - Part 1: General requirements

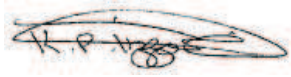
Report Reference No ..... :	E135494-A76-CB-3
Date of issue ..... :	2015-01-21
Total number of pages ..... :	108
CB Testing Laboratory ..... :	UL International Demko A/S
Address ..... :	Borupvang 5A, 2750 Ballerup, Denmark
Applicant's name ..... :	TDK-LAMBDA LTD
Address ..... :	KINGSLEY AVENUE ILFRACOMBE DEVON EX34 8ES UK
Test specification:	
Standard ..... :	IEC 60950-1:2005 (Second Edition); Am1:2009 + Am2:2013
Test procedure ..... :	CB Scheme
Non-standard test method ..... :	N/A
Test Report Form No. ..... :	IEC60950_1F
Test Report Form originator ..... :	SGS Fimko Ltd
Master TRF ..... :	Dated 2014-02

This report is not valid as a CB Test Report unless signed by an approved CB Testing Laboratory and appended to a CB Test Certificate issued by an NCB in accordance with IECEE 02.

General disclaimer

The test results presented in this report relate only to the object tested. This report shall not be reproduced, except in full, without the written approval of the Issuing CB Testing Laboratory. The authenticity of this Test Report and its contents can be verified by contacting the NCB, responsible for this Test Report.

Test item description	:	Switch mode power supply
Trade Mark	:	TDK-Lambda
Manufacturer	:	TDK-LAMBDA LTD KINGSLEY AVENUE ILFRACOMBE DEVON EX34 8ES UK
Model/Type reference	:	Vega DC or V0 or K0 range of PSU
Ratings	:	34 - 75 Vdc max. 17.5A max

Testing procedure and testing location:		
[ ]	**CB Testing Laboratory**	
	Testing location / address .....:	
[ ]	**Associated CB Test Laboratory**	
	Testing location / address .....:	
	Tested by (name + signature) .....:	
	Approved by (name + signature)....:	
[ ]	**Testing Procedure: TMP/CTF Stage 1**	
	Testing location / address .....:	
	Tested by (name + signature) .....:	
	Approved by (name + signature)....:	
[ ]	**Testing Procedure: WMT/CTF Stage 2**	
	Testing location / address .....:	
	Tested by (name + signature) .....:	
	Witnessed by (name + signature) ..:	
	Approved by (name + signature)....:	
[x]	**Testing Procedure: SMT/CTF Stage 3 or 4**	
	Testing location / address .....:	TDK-LAMBDA LTD KINGSLEY AVENUE ILFRACOMBE DEVON EX34 8ES UK
	Tested by (name + signature) .....:	T. Burgess S. Hirstwood 
	Approved by (name + signature)....:	K.P. Tizzard 
	Supervised by (name + signature) .:	David Snook 
[ ]	**Testing Procedure: RMT**	
	Testing location / address .....:	
	Tested by (name + signature) .....:	
	Approved by (name + signature)....:	
	Supervised by (name + signature) .:	

List of Attachments

National Differences (57 pages)

Enclosures (104 pages)

Summary of Testing:

All Applicable tests according to the referenced standard(s) have been carried out

Summary of Compliance with National Differences:

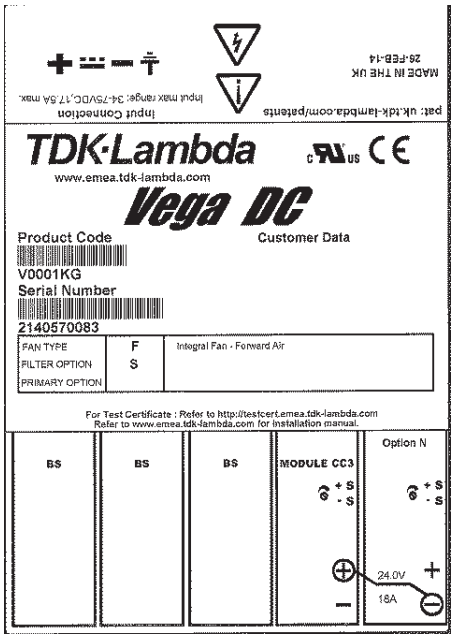
Countries outside the CB Scheme membership may also accept this report.

List of countries addressed: AR, AT, AU, BE, BG, BY, CA, CH, CN, CS, CZ, DE, DK, ES, EU, FI, FR, GB, GR, HU, IE, IL, IN, IT, JP, KR, MY, NL, NO, NZ, PL, PT, RO, SA, SE, SI, SK, UA, US, ZA

The product fulfills the requirements of: EN 60950-1:2006 + A1:2010 + A11:2009 + A12:2011 + A2:2013, UL 60950-1 2nd Ed. Revised 2011-12-19, CSA C22.2 No. 60950-1-07 + A1:2011

Copy of Marking Plate

The artwork below may be only a draft. The use of certification marks on a product must be authorized by the respective NCBs that own these marks.



Test item particulars :	
Equipment mobility .....:	for building-in
Connection to the mains .....:	for building-in
Operating condition .....:	continuous
Access location .....:	for building-in
Over voltage category (OVC) .....:	OVC II
Mains supply tolerance (%) or absolute mains supply values .....:	34 - 75 Vdc 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) .....:	20 A
Pollution degree (PD) .....:	PD 2
IP protection class .....:	IP X0
Altitude of operation (m) .....:	5000m
Altitude of test laboratory (m) .....:	50 m
Mass of equipment (kg) .....:	2.5 kg max
Possible test case verdicts:	
- test case does not apply to the test object .....:	N / A
- test object does meet the requirement .....:	P(Pass)
- test object does not meet the requirement .....:	F(Fail)
Testing:	
Date(s) of receipt of test item .....:	2012-07-18
Date(s) of Performance of tests .....:	2012-07-18
General remarks: "(see Enclosure #)" refers to additional information appended to the report. "(see appended table)" refers to a table appended to the report. Throughout this report a point is used as the decimal separator.	
Manufacturer's Declaration per Sub Clause 4.2.5 of IECEE 02:	Yes
The application for obtaining a CB Test Certificate includes more than one factory and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided ..... When differences exist, they shall be identified in the General Product Information section.	
Name and address of Factory(ies):	TDK-LAMBDA UK LTD KINGSLEY AVE ILFRACOMBE DEVON EX34 8ES UNITED KINGDOM

PANYU TRIO MICROTRONIC CO. LTD
SHIJI INDUSTRIAL ESTATE
DONGYONG
NANSHA
GUANGZHOU GUANGDONG CHINA

GENERAL PRODUCT INFORMATION:

Report Summary

All applicable tests according to the referenced standard(s) have been carried out.

Product Description

The Vega DC series are modular Switch Mode Power Supplies for building into a host equipment.

Model Differences

All models use the same converter but differ by the number of transformer winding turns and secondary modules/options. The attached marking plate is representative for all models.

Products Covered

Vega DC models as described below:

Unit Configuration Code:

a) V0, K0 or Vega DC
(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.

b) followed by: F, R or C

where F = Standard fan, forward airflow
R = Standard fan, reverse air
C = Customer air

c) optionally followed by: F, S

where F = Fast-on or quick connect input terminals
S = Screw input terminals

d) optionally followed by S

where S = Standard filter

e) optionally followed by: E, F, EV, FV or D

where E = DC input fail with PSU & fan enable and 5V aux supply
F = DC input fail with PSU & fan inhibit and 5V aux supply
EV = DC input fail with PSU & fan enable and 5V/300mA aux supply
FV = DC input fail with PSU & fan inhibit and 5V/300mA aux supply

D = Primary digital option. Provides PSU inhibit and enable, fan monitor, standby supply, hours of operation, serial numbers, mains fail, over temperature warning. When secondary digital options fitted also provides status bytes, unit and module IDs, grouping, digital voltage and current limit programming, secondary inhibit and enable, secondary turn on delay, global and secondary module good, module monitoring.

Module Configuration Code:

B@, C@, C1Y, D@, E@, F1, F2, H@/@ or H@_@, L@, W2 or W5

where the letter represents a module and @ is a number between 1 and 5, which represents the number of turns on the transformer secondary. By reference to the following table, this in turn defines the permitted voltage range of the module. Blanking plates may be fitted in place of modules.

@ may optionally be followed by the letter L or H, where L and H indicate the low or high output voltage variants of the module.

For W2 & W5 modules only: @ is followed by F or T, indicating fixed or tracking OVP.

Followed by F or S, where F indicates fast-on output terminals and S indicates screw output terminals.

or Z#

where # is a number between 1 and 99. This code represents any two of the above modules that have had their outputs paralleled together. The number # is a module reference number and does not represent the number of turns. May optionally followed by F or S, where F indicates fast-on output terminals and S indicates screw output terminals.

or BB@, CC@, DD@, EE@, HH@/@ or HH@_@, JJ@/@ or JJ@_@, LL@, C5B4 or B5B4

where @ is a number between 1 and 5, which represents the number of turns on the transformer secondary. For HH@/@ or HH@_@ the code represents one H module that has had its two outputs connected in series. For all other variants this code represents two modules, selected from those listed above, that have had their outputs connected in series. May optionally followed by F or S, where F indicates fast-on output terminals and S indicates screw output terminals.
Note: Seriesed outputs may make all outputs hazardous, see Electrical & Thermal Ratings section for details. JJ@/@ or JJ@_@ modules are HH@/@ or HH@_@ modules with reduced OVP and/or current ratings.

or X1, X2, X4 or X8

where the number relates to the maximum voltage capability of the X module in accordance with X1=10V, X2=20V, X4=40V, X8=80V. The X module is connected to the output terminals of D or E modules, which may be connected in series or parallel. The X module contains diodes in series with its output (for paralleling use) and additional circuitry for remote sense, paralleling with other X modules and module inhibit. A maximum of two X modules may be fitted in a PSU.

or B/S where B/S indicates that a blanking plate is fitted in place of a module.

Any of the above modules (except the X modules) may have the module letter preceded with # or # / # where # is represents the module output voltage.

Module Options:

N, P, R, T, L, K, D, V‡ or R‡

where N = Inhibit, module good and remote sense
P = Parallel with current share
R = Remote sense (twin output modules only)
T = Remote sense (one output of twin output modules only)
L = Module good using LED indication
K = Allows for Vega DC products to be paralleled with Omega products
D = Secondary digital option (may only be fitted to single output modules). Provides analogue voltage and resistive programming, current limit modes, inhibit output, enable output, turn on delay, module good, N+1 paralleling.
V‡ = Voltage programmable output voltage
R‡ = Resistance programmable output voltage

where ‡ represents a number between 1 and 99. Each number indicates an option variant which does not affect safety, of these the following are standard variants:
1 = Inhibit, fixed current limit
2 = Inhibit, programmable current limit
3 = Enable, fixed current limit
4 = Enable, programmable current limit

ELECTRICAL & THERMAL RATINGS:

Output modules:

Module	Output (V)	Rated (I)	Power	Slots	Sec. Turns	A/T
B1L	1 - 3.8V	20A	76W	1	1	20
B1H	3.9 - 5.5V	20A	110W	1	1	20
B2	5 - 9V	25A	225W	1	2	50
B3	9.1 - 16.2V	12A	195W	1	3	36
B4	16.3 - 21.5V	10A	215W	1	4	40
B5	21.6 - 31V	6A	186W	1	5	30
C1	1 - 4.1V	35A	144W	1	1	35
C1Y	1 - 4.1V	40A	164W	1	1	40
C3	9.1 - 16.2V	18A	292W	1	3	54
C4	16.3 - 21.5V	14A	301W	1	4	56
C5	21.6 - 31V	10A	310W	1	5	50
D1L	1 - 3.8	50A	190W	1.5	1	50
D1H	3.9 - 5.5	50A	275W	1.5	1	50
D2	3.8 - 9V	45A	405W	1.5	2	90
D3	8 - 16.5V	24A	396W	1.5	3	72
D4	14 - 21.5V	18A	387W	1.5	4	72
D5	21 - 28V	15A	420W	1.5	5	75
E1	1 - 3.8V	60A	228W	2	1	60
E2	3.8 - 8V	60A	480W	2	2	120
E3L	8 - 13.9V	40A	556W	2	3	120
E3H	14 - 15V	36A	540W	2	3	108
E4	14 - 19.9V	30A	597W	2	4	120
E5L	20 - 24V	27A	648W	2	5	135
E5H	24 - 28V	25A	650W	2	5	125
F1	1 - 3.8V	80A	640W	2	1	80
F2	3.8 - 8V	80A	640W	2	2	160
H1L/1L	1-3.8/1-3.8V	12A/8A	46W/31W	1	1/1	12/8

H1L/1H	1-3.8/3.9-5.5V	12A/8A	46W/44W	1	1/1	12/8
H1H/1L	3.9-5.5 /1-3.8V	12A/8A	66W/31W	1	1/1	12/8
H1H/1H	3.9-5.5 /3.9-5.5V	12A/8A	66W/44W	1	1/1	12/8
H1L/2	1-3.8/5-9V	12A/6A	46W/54W	1	1/2	12/12
H1H/2	3.9-5.5/5-9V	12A/6A	66W/54W	1	1/2	12/12
H1L/3	1-3.8/9.1-16.2V	12A/6A	46W/98W	1	1/3	12/18
H1H/3	3.9-5.5/9.1-16.2V	12A/6A	66W/98W	1	1/3	12/18
H1L/4	1-3.8/16.3-25V	12A/4.5A	46W/113W	1	1/4	12/18
H1H/4	3.9-5.5/16.3-25V	12A/4.5A	66W/113W	1	1/4	12/18
H2/1L	5.6-9/1-3.8V	10A/8A	90W/31W	1	2/1	20/8
H2/1H	5.6-9/3.9-5.5V	10A/8A	90W/44W	1	2/1	20/8
H2/2	5.6-9/5.6-9V	10A/6A	90W/54W	1	2/2	20/12
H2/3	5.6-9/9.1-16.2V	10A/6A	90W/98W	1	2/3	20/18
H2/4	5.6-9/16.3-25V	10A/4.5A	90W/113W	1	2/4	20/18
H3/1L	9.1-16.2/1-3.8V	10A/8A	162W/31W	1	3/1	30/8
H3/1H	9.1-16.2/3.9-5.5V	10A/8A	162W/44W	1	3/1	30/8
H3/2	9.1-16.2/5.6-9V	10A/6A	162W/54W	1	3/2	30/12
H3/3	9.1-16.2/9.1-16.2V	10A/6A	162W/98W	1	3/3	30/18
H3/4	9.1-16.2/16.3-25V	10A/4.5A	162W/113W	1	3/4	30/18
H5/1L	16.2-31/1-3.8V	5A/8A	155W/31W	1	5/1	25/8
H5/1H	16.2-31/3.9-5.5V	5A/8A	155W/44W	1	5/1	25/8
H5/2	16.2-31/5.6-9V	5A/6A	155W/54W	1	5/2	25/12
H5/3	16.2-31/9.1-16.2V	5A/6A	155W/98W	1	5/3	25/18
H5/4	16.2-31/16.3-25V	5A/4.5A	155W/113W	1	5/4	25/18
L1	4.2 - 5.5V	35A	193W	1	1	35
W2	0.25 - 7.5V	30A	225W	1	2	60
W5	0.25 - 32V	8.5A	272W	1	5	42.5
X1	10V (see Note 1)	90A	See Note 2	1	-	-
X2	20V (see Note 1)	64.5A	See Note 2	1	-	-
X4	40V (see Note 1)	32.4A	See Note 2	1	-	-
X8	80V (see Note 1)	16.2A	See Note 2	1	-	-

Note 1: Actual voltage and current output of an X module is dependent, and limited by, the ratings of the modules from which it is fed. The ratings given above are additional rating limitations imposed by the X module itself.

Note 2: The maximum power output of PSUs fitted with X modules is reduced from 450W by the following power: 0.55 x (total X1 current) + 0.7 x (total X2 & X4 current) + 0.9 x (total X8 current)

Additional module limitations:

E2 module fitted in slots 4/5 is limited to 55A.
C1Y module can only be fitted in slot 1.
F2 module may only be fitted in slots 1/2 and is limited to 75A for ambient temperatures of greater than 45°C.

For PSUs with three D modules fitted:
D1L & D1H in slots 2/3 is limited to 42A and in slots 4/5 is limited to 47A
D2 in slots 2/3 is limited to 40A

PSUs fitted with a W2 module are limited to a maximum ambient of 45°C.

All the above ratings and limitations apply to the individual modules from which a series or paralleled pair is made.

The PSU may additionally be marked with K0x or V0x where x can be any letters and/or numbers between 0 and 9 indicating non-safety related model differences.

SELV and Outputs Connected In Series:

Outputs are SELV except as described below:
Non-earthed outputs that have secondaries with 2 or more turns are non-SELV as a single fault in the secondary may make them exceed the SELV limit between output and earth.
Non-earthed outputs that are connected in series are non-SELV unless all the seriesed outputs use 1 turn secondaries and there are no more than 3 outputs connected in series.
Outputs connected in series are non-SELV if the total output voltage + 20% of the max. rated output voltage of the output with the highest rated voltage exceeds 60Vdc (the 20% addition allows for a single fault in any one individual channel).
The total voltage of a seriesed output must not exceed 160V.
If any output or seriesed output is non-SELV then all the outputs in the PSU must be considered non-SELV.
Note:
Non-SELV outputs must be guarded or a deflector fitted during installation to avoid a service engineer making inadvertent contact with the output terminals, or dropping a tool onto them.
All outputs have operational spacings to earth, and due consideration must be given to this in the end product design.

Input, Power and Thermal Ratings

Nominal input voltage: 48V dc
Input voltage range: 34 - 75 V dc max., 17.5A rms max.

Permitted orientations: Horizontal with chassis lowest, on either side or vertical with the airflow upwards.

Cooling Option	Max Amb	Input (V)	Max Power	Max AT (total)	Module Current Rating
F	50	34	344	140	100%
		36	360	140	100%
		44 - 75	450	180	100%
R	50	34	300	145	100%
		36	320	145	100%
		44 - 75	420	165	100%
C	50	See Customer Air Cooling section for ratings			

Power and AT (Ampere Turns) ratings may be interpolated.
Ampere Turns is the sum of (output amps x secondary turns)

Customer Air Cooling (option C):

The following method must be used for determining the safe operation of PSUs when C option (Customer Air) is fitted, i.e. fan not fitted to PSU.

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, ampere turns, 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 IEC60950-1: Clause 4.5. Consideration should also be given to the requirements of other safety 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 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 stabilised.

Circuit Ref.	Description	Max. Temperature (°C)
-	Power transformer primary, secondary and core	130
T1, TX101, TX201	Module current transformer windings	127
XQ1, XTR1	E, EV, F & FV Primary option transformers	90
L1, XT601	Choke winding	127
L4, T2	Choke winding	117
Various	All other choke & transformer windings	140
Various	All X capacitors and electrolytic capacitors	105

Additional Information

No tests were conducted under this investigation due to the reissue of CB Test Report Ref. Nos, E135494-A76 CB Certificate No. DK-27572-UL to upgrade to IEC 60950-1 2nd Edition + Amd 2. All required tests were conducted under the original investigation.
Based on the previously conducted testing and the review of product technical documentation including photos, schematics, wiring diagrams and similar, it has been determined that the product continues to comply with the standard.
The report was additionally modified to include the following changes/additions:-
1. Correction/addition to critical component list
2. Product assessed for 5000m
3. Enclosures updated to include revised handbook and critical component certificates
4. Assessed to IEC60950 amendment 2:2013

Technical Considerations

- The product was investigated to the following additional standards: EN 60950-1:2006 + A11:2009 + A1:2010 + A12:2011 + A2:2013 (which includes all European national differences, including those specified in this test report).,
- 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: DC mains supply --
- 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 power supply in this equipment was: Investigated to an earlier edition/amendment of IEC 60950. As part of the investigation of this product, the power supply and its test report were reviewed and found to comply with IEC 60950-1. Where this was not the case, extra tests were conducted. --
- The means of connection to the mains supply is: to be determined in the end-use product. --
- The clearances and creepage distances have additionally been assessed for suitability up to 5000m elevation. --
- The product was investigated to the following additional standards: EN60950-1:2006 + A11:2009 + A1:2010 + A12:2011 + A2:2013 (which includes all European national differences, including those

specified in this test report). --

Engineering Conditions of Acceptability

When installed in an end-product, consideration must be given to the following:

- The following Production-Line tests are conducted for this product: Electric Strength Earthing Continuity --
- The end-product Electric Strength Test is to be based upon a maximum working voltage of: Input circuit-Earthed Dead Metal: 251 Vrms, 292 Vpk Input circuit-SELV293 Vrms, 372 Vpk --
- 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 --
- An investigation of the protective bonding terminals has: Been conducted --
- The following output terminals were referenced to earth during performance testing: The negative input and all outputs and their return lines were individually referenced to earth to obtain a maximum working voltage. --
- 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): Transformer main TRX: (class F). See table 1.5.1 for details of insulation system used --
- The following end-product enclosures are required: Mechanical, Fire, Electrical --
- The following components require special consideration during end-product Thermal (Heating) tests due to the indicated maximum temperature measurements during component-level testing: Power transformer primary, secondary and core (130 °C). --
- The following secondary output circuits are SELV: See SELV and outputs connected in series comment under model differences. --
- The following secondary output circuits are at hazardous energy levels: O/P Modules B2, C3, C4, C5, D1H, D2, D3, D4, D5, E1, E2, E3L, E3H, E4, E5L, E5H, F1, F2, W5, W8, HH5/3, C5B4, Z2, Z3, Z4, Z6, Z7, Z18, , --
- The following secondary output circuits are at non-hazardous energy levels: See handbook output modules for details. --

Abbreviations used in the report:

- normal condition	N.C.	- single fault condition	S.F.C
- operational insulation	OP	- basic insulation	BI
- basic insulation between parts of opposite polarity:	BOP	- supplementary insulation	SI
- double insulation	DI	- reinforced insulation	RI

Indicate used abbreviations (if any)