



Test Report issued under the responsibility of:



**TEST REPORT
IEC 62368-1**

**Audio/video, information and communication technology equipment
Part 1: Safety requirements**

Report Number: E135494-A6038-CB-1
Date of issue.....: 2020-06-29
Total number of pages: 162

Applicant's name.....: **TDK-LAMBDA UK LTD**
Address: **KINGSLEY AVE
ILFRACOMBE
EX34 8ES UNITED KINGDOM**

Name of Test Laboratory: UL VS Limited
preparing the Report: Unit 1-3 Horizon, Wade Road, Kingsland Business Park, Basingstoke
RG24 8AH, United Kingdom

Test specification:
Standard: IEC 62368-1:2014 (Second Edition)
Test procedure: CB Scheme
Non-standard test method.....: N/A

Test Report Form No.....: IEC62368_1B
Test Report Form(s) Originator: UL(US)
Master TRF.....: 2014-03

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Test Item description	:	Switch Mode Power Supply
Trade Mark	:	TDK-Lambda TDK-Lambda
Manufacturer	:	TDK-LAMBDA UK LTD KINGSLEY AVE ILFRACOMBE EX34 8ES UNITED KINGDOM
Model/Type reference	:	CFE400M or CFE-400M series (See Model Differences for details of nomenclature)
Ratings	:	100 -240Vac nom, 6.1A rms max, 47 -440Hz (see Model Differences for details)
Testing procedure and testing location:		
<input type="checkbox"/>	CB Testing Laboratory:	
Testing location/ address		
Tested by (name + signature).....:		
Approved by (name + signature)		
Testing procedure: CTF Stage 1		
Testing location/ address..... :		
Tested by (name + signature).....:		
Approved by (name + signature)		
Testing procedure: CTF Stage 2		
Testing location/ address..... :		
Tested by (name + signature).....:		
Witnessed by (name + signature).....:		
Approved by (name + signature)		
<input checked="" type="checkbox"/>	Testing procedure: CTF Stage 3	
<input type="checkbox"/>	Testing procedure: CTF Stage 4	
Testing location/ address..... :		TDK-LAMBDA UK LTD KINGSLEY AVE ILFRACOMBE EX34 8ES UNITED KINGDOM

Tested by (name + signature).....:	Nick Marsh / Safety Engineer	
Witnessed by (name + signature).....:	Mark John De Sagun / Project Handler	
Approved by (name + signature)	Dennis Butcher / Reviewer	
Supervised by (name + signature)	Dennis Butcher / Reviewer	

List of Attachments (including a total number of pages in each attachment):

National Differences (30 pages)

Enclosures (53 pages)

Summary of testing:

Tests performed (name of test and test clause):

CLASSIFICATION OF ELECTRICAL ENERGY SOURCES (5.2, 5.7)

ELECTRIC STRENGTH TEST (5.4.9)

SAFEGUARDS AGAINST CAPACITOR DISCHARGE AFTER DISCONNECTION OF A CONNECTOR (5.5.2.2)

RESISTANCE OF THE PROTECTIVE BONDING SYSTEM (5.6.6.2)

PROSPECTIVE TOUCH VOLTAGE AND TOUCH CURRENT MEASUREMENT (5.7)

INPUT TEST: SINGLE PHASE (B.2.5)

NORMAL OPERATING CONDITIONS TEMPERATURE MEASUREMENT (B.2.6)

SIMULATED ABNORMAL OPERATING CONDITIONS (B.3)

SIMULATED SINGLE FAULT CONDITIONS (B.4)

TRANSFORMER OVERLOAD (ANNEX G.5.3.3)

ALTERNATIVE LOCKED-ROTOR OVERLOAD TEST FOR D.C. MOTORS (ANNEX G.5.4.6.3)

LIMITED SHORT CIRCUIT TEST (ANNEX R.1, 5.6.4.1, 5.6.4.4, 5.6.5.1)

STEADY FORCE TEST, 10 N (ANNEX T.2, 5.4.2.6, 5.4.3.2, G.15.3.6)

Testing Location:

**CTF Stage 3: TDK-LAMBDA UK LTD
KINGSLEY AVE
ILFRACOMBE
EX34 8ES UNITED KINGDOM**

Additional tests conducted as confirmation testing for 62368 approval.

See enclosure 7-03 for waiver of tests taken from 60950-1 report E135494-A81.

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Summary of compliance with National Differences:

List of countries addressed: Australia / New Zealand, EU Group and National Differences, Japan, USA / Canada

EU Group and National Differences applies to CENELEC member countries: Austria , Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom

The product fulfils the requirements of: EN 62368-1:2014 + A11:2017, CSA CAN/CSA-C22.2 No. 62368-1 2nd Edition, Issued December 1, 2014

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.



Marking label is representative of entire series

Note: The above markings are the minimum requirements required by the safety lab. For the final production samples, the additional markings which do not give rise to misunderstanding may be added.

TEST ITEM PARTICULARS:	
Classification of use by	Skilled person
Supply Connection	AC Mains
Supply % Tolerance	+10%/-10%
Supply Connection – Type	mating connector
Considered current rating of protective device as part of building or equipment installation	20 A; building;
Equipment mobility	for building-in
Over voltage category (OVC)	OVC II
Class of equipment	Class I
Access location	N/A
Pollution degree (PD)	PD 2
Manufacturer’s specified maximum operating ambient (°C)	50 (full load), 70°C (de-ratings apply)
IP protection class	IPX0
Power Systems	TN
Altitude during operation (m)	5000 m
Altitude of test laboratory (m)	2000 m or less
Mass of equipment (kg)	1
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 of receipt of test item..... :	2020-03-11 to 2020-05-15
Date (s) of performance of tests..... :	2020-03-11 to 2020-06-04
GENERAL REMARKS:	
<p>"(See Enclosure #)" refers to additional information appended to the report. "(See appended table)" refers to a table appended to the report.</p> <p>Throughout this report a <input type="checkbox"/> comma / <input checked="" type="checkbox"/> point is used as the decimal separator.</p>	
Manufacturer’s Declaration per sub-clause 4.2.5 of IEC60335-1:	
The application for obtaining a CB Test Certificate includes more than one factory location 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	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> Not applicable

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 EX34 8ES UNITED KINGDOM PANYU TRIO MICROTRONICS CO LTD SHIJI INDUSTRIAL ESTATE DONGYONG NANSHA GUANGZHOU GUANGDONG 511453 CHINA

GENERAL PRODUCT INFORMATION:

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

Product Description
 CFE400M or CFE-400M series switch mode power supplies for building into host equipment. (see Model Differences for nomenclature and details).

Model Differences
 CFE400M or CFE-400M series as described below:

 Units may be marked with a Product Code: U7x or Y7x where x may be any number of letters and/or numbers 0 to 9.

 Unit Configuration (Description) Code may be prefixed by NS # followed by / or - (where # may be any number of characters indicating non- safety related model differences). Code may alternatively be prefixed by SP followed by / or - (SP represents a sales code).

 Unit Configuration Code:

 CFE400Mx-a-bc-defg-hi-j-k-lmn-o

 Where:

 x = Blank for Y2 capacitors from output to earth
 P for Y1 capacitors from output to earth

 a = Channel 1 output Voltage (see Ch1 in the table below, adjustment range column).

 b = Standby voltage (see standby in the table below, adjustment range column).
 N for no supply

 c = N no for supply.
 C for 0.1A.

H for 1A.

d = NN for no fan, no fan supply

N1 for 12V nom / 0.25A fan supply. (V varies with Ch1 output voltage)

TF for chassis with fan fitted to cover.

e = U for chassis only.

C for chassis with perforated or top fan cover.

S for chassis with cover.

f = M for Molex KK type 41791 input connector or equivalent.

S for screw terminal input connector.

g = S for standard Leakage,

L for low Leakage,

R for reduced Leakage

T for tiny Leakage*

h = Y for Oring FET included.

N for no Oring FET.

i = N for no inhibit or enable.

T for inhibit.

E for enable.

j = Omit for standard channel 1 output voltage with no droop.

Dx where D is for units with programmed negative load regulation,

x is the voltage of the regulation in 100mVolts and is within the Output Adjustment range

(example, D5 = 0.5V of negative load regulation).

k = Omit for no secondary comms.

lmn = Blank for standard output settings or three numbers from 0 to 9 which denotes various output voltage/current settings within the specified ranges of each output for a particular unit. (may define non-safety related parameters/feature, e.g. reduced primary current limit, reduced OVP)

o = Blank for dual fuse input or -FL for single fuse input in the live line

* S >300µA Leakage, L <300µA Leakage, R <150µA Leakage and T <75µA Leakage

Input Parameters

Standard	62368-1
Nominal input voltage	100 - 240 Vac
Input voltage range	85 - 264 Vac
Input frequency range	47 - 440 Hz
Maximum input current	6.1A rms (6.4A rms 450W peak)

All ratings apply for ambient temperatures up to 50°C. (see variations and limitations below)

Output Parameters

There are three CFE400M standard models with various options and output parameters shown in the tables below.

Standard models:

Standard models at 50°C maximum ambient in forced air and top fan models:

Output Channel	Vout Nom.	Adjustment Range (V)	Maximum Output Current (A)	Maximum Power (W)
Channel 1	12	9 - 14.4	33.33 (35.7†)	400 (450†)
	15	14.4 - 15.5	24.67	370
	24	18 - 28.8	16.67 (18.75†)	400 (450†)
	48	36 - 54	8.34 (9.38†)	400 (450†)
Fan output (optional)	12	9 - 12	0.25	3
Standby output (optional)	5	5 - 5.5*	1	5.5
Standby output (optional)	5	5	0.1	0.5

Variations and limitations of use for Standard models at 50°C maximum ambient in forced air and fan models:

- * Can be adjusted at the factory only.
- Maximum continuous power output 400W.
- † Peak power of 450W for 10 seconds maximum, maximum rms power of 400W.
- See Cooling for customer air below for forced air and convection cooled models.
- Channel 1 output de-rated 10W/°C from 50°C - 70°C.

Standard model at 50°C maximum ambient convection cooled:

Output Channel	Vout Nom.	Adjustment Range (V)	Maximum Output Current (A)	Maximum Power (W)
Channel 1	12	9 - 14.4	20.83 (35.7†)	250 (450†)
	15	14.4 - 15.5	15.4	231
	24	18 - 28.8	10.41 (18.75†)	250 (450†)
	48	36 - 54	5.21 (9.38†)	250 (450†)
Fan output (optional)	12	9 - 12	0.25	3
Standby output (optional)	5	5 - 5.5*	1	5.5
Standby output (optional)	5	5	0.1	0.5

Variations and limitations of use for Standard models at 50°C maximum ambient convection cooled:

- * Can be adjusted at the factory only.
- Maximum continuous power output 250W.
- † Peak power of 450W for 10 seconds maximum, maximum rms power of 250W.

4. See Cooling for customer air below for convection cooled models.
5. Channel 1 output de-rated 10W/°C from 50°C - 60°C.

Standard model at 40°C maximum ambient convection cooled:

Output Channel	Vout Nom.	Adjustment Range	Maximum Output	Maximum Power
		(V)	Current (A)	(W)
Channel 1	12	9 - 14.4	25 (35.7†)	300 (450†)
	15	14.4 - 15.5	18.46	277
	24	18 - 28.8	12.5 (18.75†)	300 (450†)
	48	36 - 54	6.25 (9.38†)	300 (450†)
Fan output (optional)	12	9 - 12	0.25	3
Standby output (optional)	5	5 - 5.5*	1	5.5
Standby output (optional)	5	5	0.1	0.5

Variations and limitations of use for Standard models at 40°C maximum ambient convection cooled:

1. * Can be adjusted at the factory only.
2. Maximum continuous power output 300W.
3. † Peak power of 450W for 10 seconds maximum, maximum rms power of 300W.
4. See Cooling for customer air below for convection cooled models.
5. Channel 1 output de-rated 5W/°C from 40°C - 50°C.

Standard model at 40°C maximum ambient convection cooled:

Output Channel	Vout Nom.	Adjustment Range	Maximum Output	Maximum Power
		(V)	Current (A)	(W)
Channel 1	48	38 - 42	6.25 (15†)	300 (630†)
Standby output (optional)	5	5	0.1	0.5

Variations and limitations of use for Standard models at 40°C maximum ambient convection cooled:

1. Maximum continuous power output 300W.
2. † Peak power of 630W with Ch1: 10ms saw-tooth current waveform of 42V at 15A to 5A for 10s followed by 42V at 1A for 30s minimum. Standby at 5V, 0.1A continuous.
3. See Cooling for customer air below for convection cooled models.

Output Limitations

All outputs are ES1 except 48V which is ES2.

Series outputs are not allowed without further evaluation in end-use equipment.

All outputs have basic spacings to earth rated for mains - 250Vac, and due consideration must be given to this in the end product design.

Environmental parameters

Description	Operation	Storage
Use	Indoor	-
Temperature	0°C - +70°C *	-40°C - +70°C
Humidity	5 - 95% RH, non-condensing	5 - 95% RH, non-condensing
Altitude	-200m - 5000m	-200m - 5000m
Pressure	54kPa - 106kPa	54kPa - 106kPa
Orientation	Sides, vertical with input lowest, horizontal (customer air versions: all)	All
Material Group	IIIb	
Pollution Degree	2	
Overvoltage Category	II	
Class	I	

* See variations and limitations of use for each model above.

Additional application considerations – (Considerations used to test a component or sub-assembly) -

Marking label is representative of entire series

Customer Air Cooling:

The following method must be used for determining the safe operation of PSUs when NN, U or S options (Customer Air) are fitted, i.e. fan not fitted to PSU. The minimum permitted airflow for customer air cooling is 0.5m/s.

For PSUs and assemblies 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 shall still be complied with, eg. mains input voltage range, maximum output power, module voltage / current ratings and maximum ambient temperature. To determine the component temperatures the heating tests shall be conducted in accordance with the requirements of IEC60950-1. Consideration should also be given to the requirements of other safety standards.

Test requirements include: PSU/assembly 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/assembly. To determine the most adverse conditions consideration shall be given to the end use equipment maximum operating ambient, the PSU/assembly loading and input voltage, ventilation, end use equipment orientation, the position of doors & covers, etc. Temperatures shall 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 shall be run until all temperatures have stabilised.

Circuit Ref.	Description	Max. Temperature (°C) †
J1	Input connector	105
C7, C8	X capacitor	100
L1, L2	Common mode choke winding	110
L9	Series mode choke winding	120 (130)
TX1††, TX3	Standby trx winding	110 (130)
U2, U7	Opto-coupler	100
ASY4-B	PFC FET	120
ASY4-C	Boost diode	120

L3, L5	Boost choke winding	110 (140)
C9	Boost capacitor	83 (105)
ASY5	Bridge	125 (130)
RLY1	Relay	100
L6 winding	Primary resonant choke winding	125 (145)
TX5-A	Primary winding	110 (130)
TX5-B	Channel 1 winding	110 (130)
TX5-C	Sec aux winding	110 (130)
XQ18	HS Ch1 synchronous rectifier	120 (130)
XL1	Channel 1 output choke	110 (130)
ASY7-C (††)	Standby switch	120
ASYF4-F (††)	Oring FET	120
C1, C3, C5, C16, C17, C21 (††)	Electrolytic capacitors	82.5 (105)
C6, C18 (††)	Electrolytic capacitors	91 (105)
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† The higher temperatures limits in brackets may be used but product life may be reduced.

†† When fitted.

Technical Considerations

- The product was submitted and evaluated for use at the maximum ambient temperature (Tma) permitted by the manufacturer's specification of : 50°C (full load), 70°C (de-ratings apply) (see Product differences for limitations)
- The product is intended for use on the following power systems : TN
- Considered current rating of protective device as part of the building installation (A) : 20
- Mains supply tolerance (%) or absolute mains supply values : +10%/-10%
- The equipment disconnect device is considered to be : provided by the end equipment
- 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 product was investigated to the following additional standard : CSA CAN/CSA-C22.2 NO. 62368-1 2nd Ed, Issued December 1, 2014, EN 62368-1:2014 + A11:2017
- Multilayer PWB's accepted under CBTR Ref. No. E349607-A23 dated 2014-07-31 and letter report in Enclosure 8-01 of this report.
See enclosure 7-03 for rationale for waived test.

Engineering Conditions of Acceptability

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

- The following product-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-Secondary: 384 Vrms, 614 Vpk; Primary-Earthed Dead Metal: 340 Vrms, 614 Vpk
- The following output circuits are at ES1 energy levels : all except 48V, CH1 which is ES2.
- The following output circuits are at ES2 energy levels : 48V, CH1
- The following output circuits are at PS3 energy levels : All outputs (by the Manufacturers declaration)
- 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 end-product enclosures are required : Electrical, Fire, Mechanical
- 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) : TX1, TX3 and TX5 (Class F) - see table 1.5.1 for details of insulation systems used
- The following components require special consideration during end-product Thermal (Heating) tests due to the indicated maximum temperature measurements during component-level testing : Models without a fan require component temperatures monitored as detailed in Additional Information
- The power supply was evaluated to be used at altitudes up to : "5,000 m"
- The following output terminals were referenced to earth during performance testing: All secondary outputs and their return lines individually referenced to obtain maximum working voltage.
- Fans: The fan provided in this sub-assembly is provided with a fan guard to reduce the risk of operator contact with the fan. The fan provided in this sub-assembly is not intended for operator access.
- When operated at a frequency greater than 63Hz, evaluation of the end equipment against the requirements of clause 5.7 must be considered.