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.....:	**T223-0580/18 A1**
Date of issue.....:	2019-02-05
Total number of pages.....:	175 pages
Applicant's name.....:	TDK-Lambda UK Limited
Address.....:	Kingsley Avenue, Ilfracombe, Devon EX34 8ES, 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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General disclaimer:

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Test Item description	:	Switch mode power supply for building-in
Trade Mark	:	TDK-Lambda
Manufacturer	:	TDK-Lambda UK Limited Kingsley Avenue, Ilfracombe, Devon EX34 8ES, United Kingdom
Model/Type reference	:	ZMS100-X/E/T/J or CUS100MA-X/E/T/J Where: -X = Output Voltage as detailed in the Output Parameters tables below. /E = Curve B radiated for emc /T = Earth fast-on terminal not fitted /J = JST input and/or output connectors fitted Type references may be prefixed by SP and/or NS # followed by / or - (where # may be any number of characters indicating non-safety related model differences)
Ratings	:	Input: 100 – 240 Vac; 47 – 63 Hz; 2,2 A max. Output:

Forced air cooling

Model	Output voltage (V⎓)	Output current (A)	Output power (W)
ZMS100-12	12	8,4	100,8
ZMS100-15	15	6,7	100,5
ZMS100-24	24	4,2	100,8
ZMS100-28	28	3,6	100,8
ZMS100-36	36	2,8	100,8
ZMS100-48	48	2,1	100,8

Convection cooling

ZMS100-12	12	6,7	80,4
ZMS100-15	15	5,4	81
ZMS100-24	24	3,4	81,6
ZMS100-28	28	2,9	81,2
ZMS100-36	36	2,25	81
ZMS100-48	48	1,67	80,2

Testing procedure and testing location:			
☒	CB Testing Laboratory:	SIQ Ljubljana SIQ Ljubljana is accredited by Slovenian Accreditation with accreditation number.: LP-009 in the field of testing	
Testing location/ address		Tržaška c. 2, SI-1000 Ljubljana Slovenia	
☐	Associated CB Testing Laboratory:		
Testing location/ address			
Tested by (name + signature)		Luka Košir	
Approved by (name + signature).....		Boštjan Glavič	
☐	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).....			
☐	Testing procedure: SMT/CTF Stage 3 or 4		
Testing location/ address			
Tested by (name + signature)			
Approved by (name + signature).....			
Supervised by (name + signature)			

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

1. National differences according to IEC 62368-1:2014 (Second Edition) – Enclosure No. 1 (43 pages)
2. Pictures of the unit – Enclosure No. 2 (9 pages)
3. Technical documentation – schematics, layouts, transformer data – Enclosure No. 3 (22 pages)
4. Additional test data – Enclosure No. 5 (12 pages)

Summary of testing:

Tests performed (name of test and test clause):

5.2 Electrical energy source measurement*

5.4.1.4 Measurement of maximum operating temperatures for materials, components and systems

5.4.1.8 Determination of working voltage

5.4.2 / 5.4.3 Clearance and creepage distances*

5.4.4.2 Minimum distance through insulation

5.4.4.6.2 Separable thin sheet material

5.4.8 Humidity conditioning

5.4.9 Electric strength test*

5.4.10 Safeguards against transient voltages from external circuits

5.4.11 Separation between external circuits and earth

5.5.2.2 Capacitor discharge test (Rev. No. 1)*

5.6.6 Resistance of the protective bonding system*

5.7 Prospective touch voltage, touch current and protective conductor current*

6.2.2.2 Power measurement for worst-case fault*

6.2.2.3 Power measurement for worst-case power source fault*

9.2.5 Temperature test

B.2.5 Input test

B.4.1 – B.4.9 Simulated single fault conditions:
- Short circuit of clearances for functional insulation
- Short circuit of creepage distances for functional insulation
- Short circuit semiconductors
- Short circuit or disconnection of passive devices
- Continuous operation of components

F.3.10 Permanence of markings

G.5.3.3 Transformer overload test

Annex R* Limited short-circuit test

T.2 Steady force test, 10 N

Testing location:

Initial testing performed at:
SIQ Ljubljana,
Tržaška c. 2, SI-1000 Ljubljana, Slovenia

Additional tests according to IEC 62368-1:2014 (Second Edition) performed at:
SIQ Ljubljana,
Mašera-Spasićeva ulica 10, SI-1000 Ljubljana, Slovenia.

See also history sheet.

Only limited tests were conducted under this investigation based on testing previously conducted under CBTR T223-0448/14 to IEC 60950-1:2005 (Second Edition), Am1:2009 + Am2:2013. All additional tests performed under this investigation marked with *. For all other tests results from T223-0448/14 report were considered acceptable based on comparison between methods and based on review of test data.	

Summary of compliance with National Differences:

List of countries addressed

Australia, Austria, Canada, China, Denmark*, Finland*, Ireland, Germany*, Israel, Italy*, Japan, Korea, Norway*, Slovenia, Spain, Sweden*, Switzerland, Turkey, United Kingdom*, USA as listed in online CB-Bulletin.

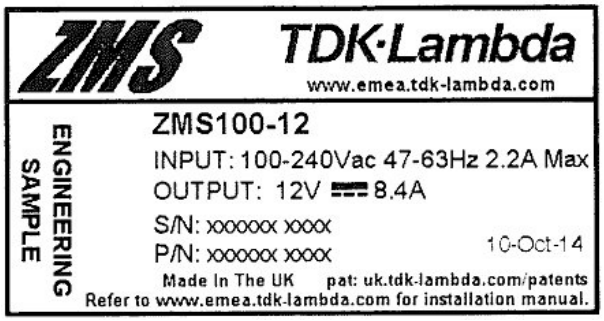
* European Group Differences and National Differences

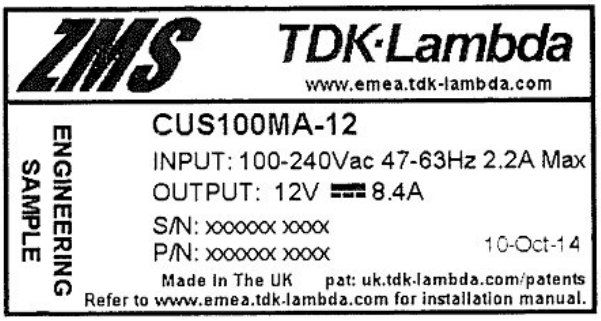
See enclosure No. 1 for details.

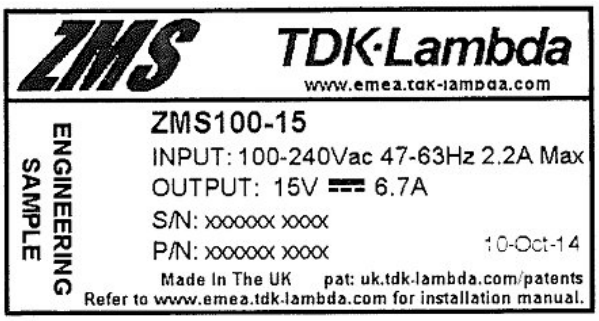
☒ **The product fulfils the requirements of EN 62368-1:2014 + A11:2017**

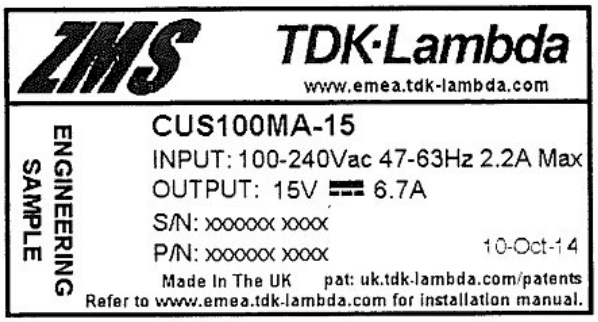
Copy of marking plate:

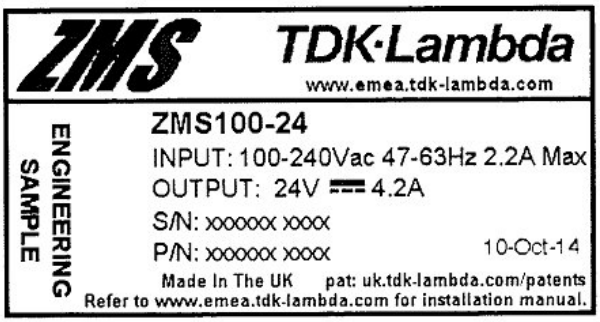
The artwork below may be only a draft. The use of certification marks on a product must be authorized by the respective NCBs that own these marks.

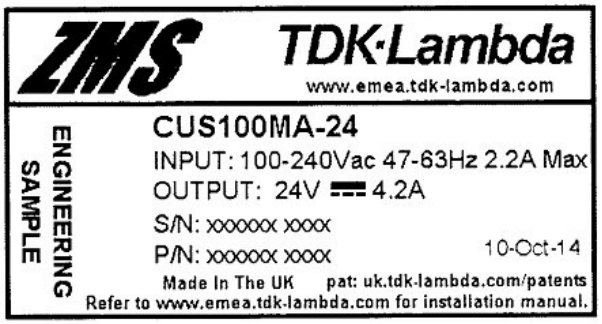


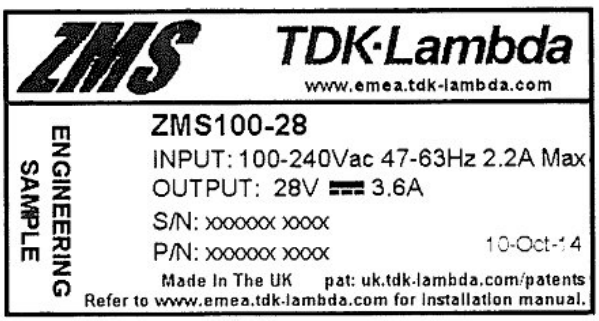


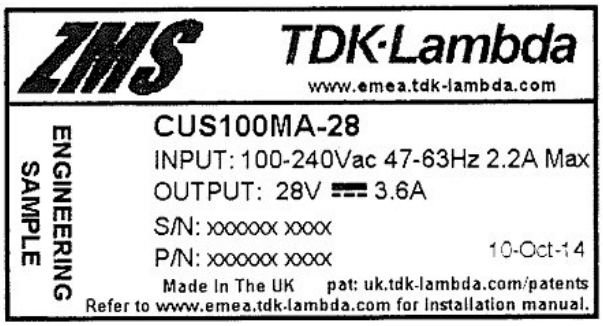


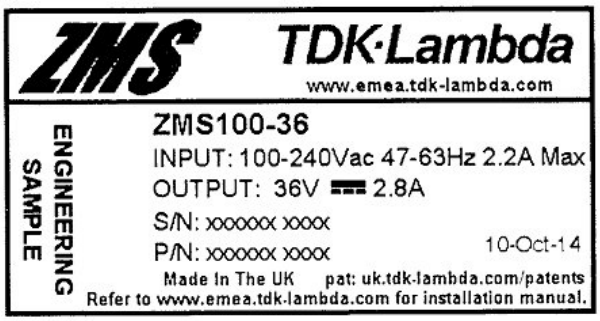


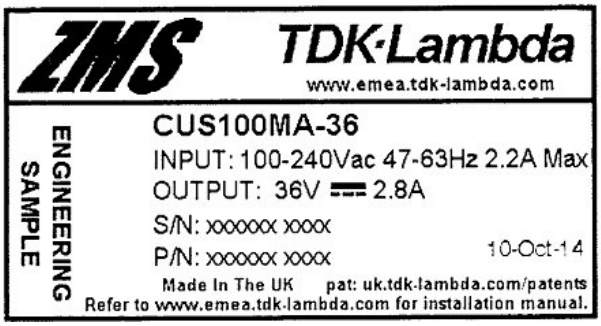


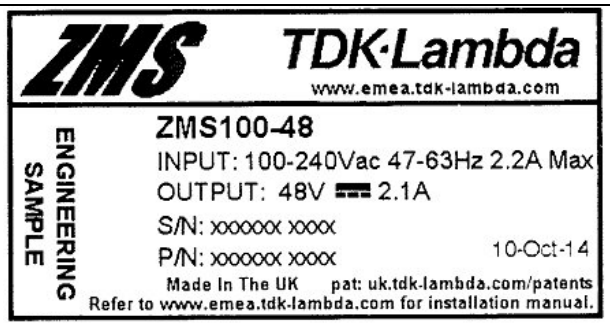


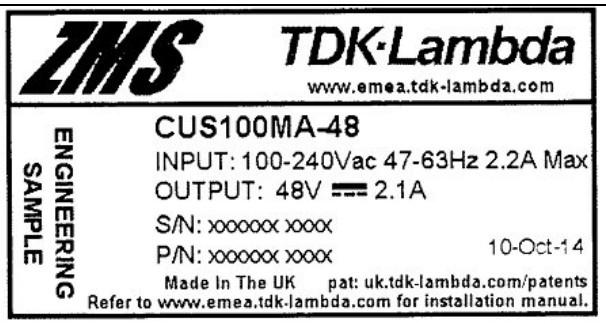









ZMS
TDK·Lambda
www.emea.tdk-lambda.com
ENGINEERING SAMPLE
ZMS100-48
INPUT: 100-240Vac 47-63Hz 2.2A Max
OUTPUT: 48V ⎓ 2.1A
S/N: xxxxxx xxxx
P/N: xxxxxx xxxx
10-Oct-14
Made In The UK pat: uk.tdk-lambda.com/patents
Refer to www.emea.tdk-lambda.com for installation manual.


ZMS
TDK·Lambda
www.emea.tdk-lambda.com
ENGINEERING SAMPLE
CUS100MA-48
INPUT: 100-240Vac 47-63Hz 2.2A Max
OUTPUT: 48V ⎓ 2.1A
S/N: xxxxxx xxxx
P/N: xxxxxx xxxx
10-Oct-14
Made In The UK pat: uk.tdk-lambda.com/patents
Refer to www.emea.tdk-lambda.com for installation manual.

TEST ITEM PARTICULARS:	
Classification of use by.....:	☐ Ordinary person ☐ Instructed person ☒ Skilled person ☐ Children likely to be present
Supply Connection.....:	☒ AC Mains ☐ DC Mains ☐ External Circuit - not Mains connected - ☐ ES1 ☐ ES2 ☐ ES3
Supply % Tolerance .....:	☐ +10%/-10% ☐ +20%/-15% ☒ +15%/ -10% ☐ None
Supply Connection – Type .....:	☐ pluggable equipment type A - ☐ non-detachable supply cord ☐ appliance coupler ☐ direct plug-in ☐ mating connector ☐ pluggable equipment type B - ☐ non-detachable supply cord ☐ appliance coupler ☐ permanent connection ☒ mating connector ☐ other:_____
Considered current rating of protective device as part of building or equipment installation ..... :	16A and 20 A; Installation location: ☒ building; ☐ equipment
Equipment mobility ..... :	☐ movable ☐ hand-held ☐ transportable ☐ stationary ☒ for building-in ☐ direct plug-in ☐ rack-mounting ☐ wall-mounted
Over voltage category (OVC) ..... :	☐ OVC I ☒ OVC II ☐ OVC III ☐ OVC IV ☐ other: _____
Class of equipment ..... :	☒ Class I ☒ Class II ☐ Class III SMPS complies with either class I or Class II construction (unit for building-in). End product consideration.
Access location ..... :	☐ restricted access location ☒ N/A
Pollution degree (PD) ..... :	☐ PD 1 ☒ PD 2 ☐ PD 3
Manufacturer's specified maxium operating ambient :	70°C with derating above 50°C (2,5%/°C)
IP protection class ..... :	☒ IPX0 ☐ IP___
Power Systems ..... :	☒ TN ☐ TT ☐ IT - ____ V_{L-L}
Altitude during operation (m) ..... :	☐ 2000 m or less ☒ 5000 m
Altitude of test laboratory (m) ..... :	☐ 2000 m or less ☒ 300 m
Mass of equipment (kg) ..... :	☒ 0,15 kg
POSSIBLE TEST CASE VERDICTS:	
- test case does not apply to the test object ..... :	N/A

IEC62368_1B

- test object does meet the requirement.....:	P (Pass)
- test object does not meet the requirement.....:	F (Fail)
TESTING:	
Date of receipt of test item.....:	2018-08-07
Date (s) of performance of tests.....:	From 2018-09-04 to 2018-10-12

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 ☒ comma / ☐ point is used as the decimal separator.

Manufacturer's Declaration per sub-clause 4.2.5 of IECEE 02:

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.....:	☒ **Yes** ☐ **Not applicable**

When differences exist; they shall be identified in the General product information section.

Name and address of factory (ies) .....:	TDK-Lambda UK Limited Kingsley Avenue, Ilfracombe, Devon EX34 8ES, United Kingdom Panyu Trio Microtronic Co., Ltd Shiji Industrial Estate, Dongyong, Nansha, Guangzhou Guangdong, China

GENERAL PRODUCT INFORMATION:

Product Description

The power supply is an open frame switch mode power supply for building-in.

The power supply can be used as Class I or Class II construction.

- For Class I construction, the SMPS need to be reliably earthed and professionally installed and fixed with metal screws.
- For Class II construction no earthing connection is required. The SMPS need to be fixed so, that it is insulated from any unearthed accessible conductive part by reinforced insulation for a working voltage of 240 Vrms (e.g. fixed to metal enclosure by means of plastic spacers and plastic screws).

The power supply provides internally two fuses, one in line and one in neutral.

The power supply may be either forced air or convection cooled. Due to the fact, that air flow for cooling depends on end product use, only convection cooling was considered during temperature measurement.

Therefore, the following temperatures within end equipment use shall not be exceeded:

Circuit Ref.	Description	Max. Temperature (°C)
L1	Common Mode Choke	155
C6, C7, C8	Electrolytic Capacitors	105
C5	Electrolytic Capacitors	105
C1	X Capacitor	100
C2, C3, C4, C10, C11	Y Capacitors	125
TX1	Transformer Winding	140
XU2, XU4	Opto-Coupler	100
J1	Input Connector	85
J2	Output Connector	85

Model Differences

All models provide different transformer construction. The secondary output windings have different number of turns to get different secondary output voltages.

12V and 15V models have an additional secondary winding (W4). This winding is not used for the other models. Winding W4 utilises triple insulated wire, which provides reinforced insulation between the output contacts. Therefore, no short or overload was applied directly on the output contacts.

2 different PCB layouts are used: the 12V & 15V models share the same PCB layout, and the 24V, 28V, 36V and 48V models share the same PCB layouts.

The unit differences are also in electrical scheme due to different output voltages:

- 12V & 15V models have different values of resistors XR20, XR21, XR35 and XR42
- 24V, 28V, 36V and 48V models have different values of resistors XR20, XR21, XR5, XR41

The following components are glued to prevent movement:

- For 12V & 15V models: RT1, C5, C11, C7, C8, C9, C12, FE wire on PCB near C8, primary windings of transformer TX1 on PCB
- 24V, 28V, 36V and 48V models: RT1, C5, C6, C7, C8, C11, C2, FE wire on PCB near C2/C11, primary windings of transformer TX1 on PCB

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

Limited tests were conducted under this investigation based on testing previously conducted under CBTR Ref. No. T223-0448/14. IEC 60950-1:2005 (Second Edition),
Am1:2009 + Am2:2013. All required tests were carried out under the previous investigation except where specifically noted.

1. The products were tested to be suitable for connection to ≤ 20 A branch circuit in series. The unit is approved for TN mains star connections and IT mains with 230 Vac phase to phase voltage and IEC60664 Over voltage category II and IT mains 400 Vac phase to phase. The unit provides internally one fuse in line and one in neutral.

2. All secondary output circuits are separated from mains by reinforced insulation and rated ES1.

3. In case the power supply is used as class I construction, the power supply shall be properly bonded to the main protective bonding termination in the end product. The earth leakage current is within the specified limits.

4. The transformers TX1 provide reinforced insulation and utilize a UL Insulation System (see list of critical components for details)

5. The equipment has been evaluated for use in a Pollution Degree 2 and overvoltage category II environment and a maximum altitude of 5000m.

6. A suitable Electrical and Fire enclosure shall be provided in the end equipment.

7. The SMPS was evaluated for convection cooling for a maximum ambient of 50°C with the following output load condition. Additionally, from 85 Vac to 90 Vac input voltage, the output power is de-rated linearly from 80 W to 70 W.

Model	Output voltage (V⎓)	Output current (A)	Output power (W)
ZMS100-12	12	6,7	80,4
ZMS100-15	15	5,4	81,0
ZMS100-24	24	3,4	81,6
ZMS100-28	28	2,9	81,2
ZMS100-36	36	2,25	81,0
ZMS100-48	48	1,67	80,2

8. The SMPS was also evaluated for convection cooling for a maximum ambient up to 70°C with the output power (see table above) de-rated at 2,5% per °C from 50°C to 70°C ambient.

9. The power supply may be either forced air or convection cooled. Due to the fact, that air flow for cooling depends on end product use, only convection cooling was considered during temperature measurement.

10. Disconnect device is end product consideration.

11. Safety Instructions: Built in product, safety instructions are end product considerations

12. Approval within the end product:

Leakage current measurement should be verified with the unit built into the end product. At 440Hz leakage current is above ES1 limits and therefore must be assessed in the end use application. EMC testing has to be performed together with the end product. Temperatures within end equipment use shall not be exceeded.

History Sheet:

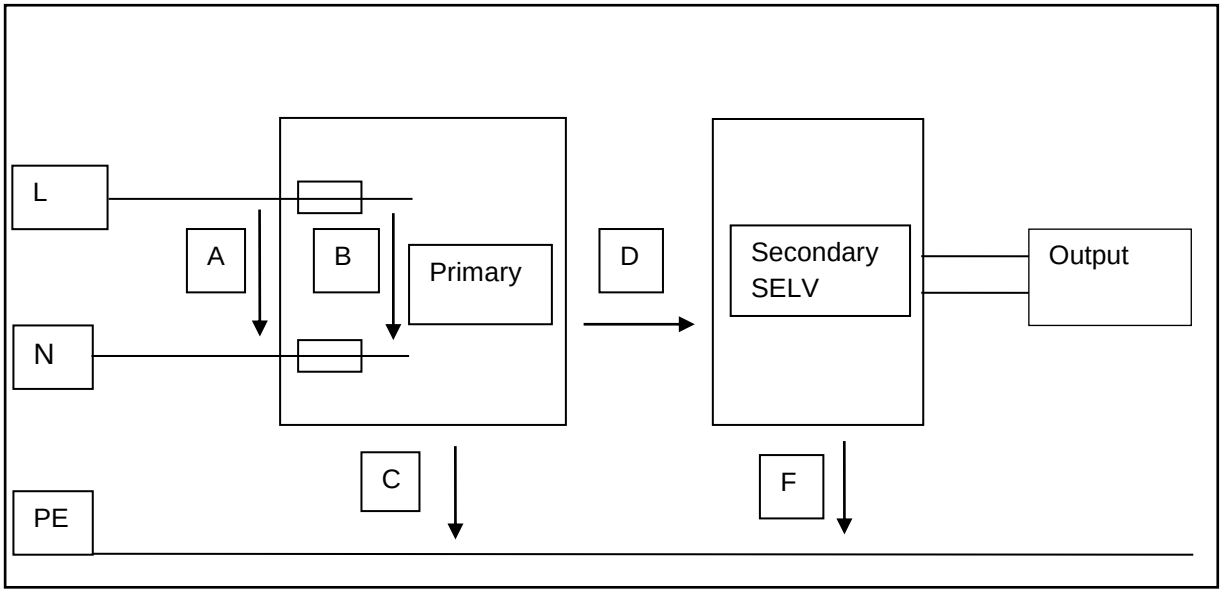
Date	Report No.	Change/Modification	Rev. No.
2014-12-05	T223-0448/14	Initial report issued according to IEC 60950-1: 2005 + A1 + A2 and IEC 60601-1:2005 (3rd Ed.) + CORR. 1 (2006) + CORR. 2 (2007) + A1:2012	-
2018-11-07	T223-0580/18	This test report is based on above mentioned CB Test Report T223-0488/14 acc. to IEC 60950-1:2005 (Second Edition) + Am 1:2009 + Am 2:2013. Additional tests were performed to comply also according to IEC 62368-1:2014 (Second Edition) & EN 62368-1:2014 + A11:2017: 5.2 Electrical energy source measurement 5.4.9 Electric strength test 5.5.2.2 Capacitor discharge test 5.6.6 Resistance of the protective bonding system 5.7 Prospective touch voltage, touch current and protective conductor current 6.2.2.2, 6.2.2.3 Power Measurements Annex R Limited short-circuit test (protective bonding)	-
2019-02-05	T223-0580/18 A1	Added rational for acceptance of test previously conducted according IEC 60950-1:2005 + A1 + A2 standard.	1.0

ENERGY SOURCE IDENTIFICATION AND CLASSIFICATION TABLE:	
(Note 1: Identify the following six (6) energy source forms based on the origin of the energy.) (Note 2: The identified classification e.g., ES2, TS1, should be with respect to its ability to cause pain or injury on the body or its ability to ignite a combustible material. Any energy source can be declared Class 3 as a worse case classification e.g. PS3, ES3.	
Electrically-caused injury (Clause 5): (Note: Identify type of source, list sub-assembly or circuit designation and corresponding energy source classification) Example: +5 V dc input ES1	
Source of electrical energy	**Corresponding classification (ES)**
Primary circuits supplied by a.c. mains	ES3 (steady-state voltage and current)
Supply terminals	ES3 (stored capacitance)
Secondary circuit before rectifier of TX1	ES3
Secondary output connector	ES1
Electrically-caused fire (Clause 6): (Note: List sub-assembly or circuit designation and corresponding energy source classification) Example: Battery pack (maximum 85 watts): PS2	
Source of power or PIS	**Corresponding classification (PS)**
All primary circuits and secondary circuits	PS3
Injury caused by hazardous substances (Clause 7) (Note: Specify hazardous chemicals, whether produces ozone or other chemical construction not addressed as part of the component evaluation.) Example: Liquid in filled component Glycol	
Source of hazardous substances	**Corresponding chemical**
N/A	N/A
Mechanically-caused injury (Clause 8) (Note: List moving part(s), fan, special installations, etc. & corresponding MS classification based on Table 35.) Example: Wall mount unit MS2	
Source of kinetic/mechanical energy	**Corresponding classification (MS)**
Sharp edges and corners	N/A (no external enclosure)
Equipment mass	MS1
Thermal burn injury (Clause 9) (Note: Identify the surface or support, and corresponding energy source classification based on type of part, location, operating temperature and contact time in Table 38.) Example: Hand-held scanner – thermoplastic enclosure TS1	
Source of thermal energy	**Corresponding classification (TS)**
Accessible surfaces	N/A (no external enclosure)

ENERGY SOURCE IDENTIFICATION AND CLASSIFICATION TABLE:	
Radiation (Clause 10) (Note: List the types of radiation present in the product and the corresponding energy source classification.) Example: DVD – Class 1 Laser Product RS1	
Type of radiation	**Corresponding classification (RS)**
N/A	N/A

ENERGY SOURCE DIAGRAM
Indicate which energy sources are included in the energy source diagram. Insert diagram below

☒ **ES** ☒ **PS** ☒ **MS** ☒ **TS** ☐ **RS**



AC input: ES3 (steady state and capacitance), PS3
Primary circuit: ES3, PS3
Secondary circuit of TX1: ES3, PS3
Output of the unit: ES1, PS3
Unit all parts: TS3 (Unit for building-in. Enclosure is end product consideration)
Mass, edges/corners: MS1; wall mounting (≤2m): MS1

OVERVIEW OF EMPLOYED SAFEGUARDS				
Clause	**Possible Hazard**			
5.1	Electrically-caused injury			
Body Part (e.g. Ordinary)	Energy Source (ES3: Primary Filter circuit)	Safeguards		
		Basic	Supplementary	Reinforced (Enclosure)
Skilled	ES3: Primary circuit	N/A	N/A	Equipment Enclosure
Skilled (Ordinary person in the final unit)	ES3: supply terminal (Stored Energy)	N/A	N/A	Bleeder resistors (5.5.2.2)
Skilled	ES3: Secondary circuit of T1 before rectification	N/A	N/A	Equipment Enclosure
Ordinary	ES1: output of the unit	N/A	N/A	N/A
6.1	Electrically-caused fire			
Material part (e.g. mouse enclosure)	Energy Source (PS2: 100 Watt circuit)	Safeguards		
		Basic	Supplementary	Reinforced
All combustible materials	PS3 Less than 4000W	No ignition and no excessive temperature under normal and abnormal operation.	No fire after single fault condition. Unit for building-in. Fire enclosure is end product consideration.	N/A
Output connector	PS3	No ignition and no excessive temperature under normal and abnormal operation.	No fire after single fault condition. Unit for building-in. Fire enclosure is end product consideration.	N/A
7.1	Injury caused by hazardous substances			
Body Part (e.g., skilled)	Energy Source (hazardous material)	Safeguards		
		Basic	Supplementary	Reinforced
N/A	N/A	N/A	N/A	N/A
8.1	Mechanically-caused injury			
Body Part (e.g. Ordinary)	Energy Source (MS3:High Pressure Lamp)	Safeguards		
		Basic	Supplementary	Reinforced (Enclosure)
Skilled	MS1: sharp edges and corners	N/A	N/A	N/A

Skilled	MS1: equipment mass	N/A	N/A	N/A
9.1	Thermal Burn			
Body Part (e.g., Ordinary)	Energy Source (TS2)	Safeguards		
		Basic	Supplementary	Reinforced
Skilled	TS3	N/A	N/A	N/A
10.1	Radiation			
Body Part (e.g., Ordinary)	Energy Source (Output from audio port)	Safeguards		
		Basic	Supplementary	Reinforced
N/A	N/A	N/A	N/A	N/A
Supplementary Information: (1) See attached energy source diagram for additional details. (2) “N” – Normal Condition; “A” – Abnormal Condition; “S” Single Fault				