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-A6003-CB-1
Date of issue.....:	2018-12-01
Total number of pages .....:	102
Applicant's name.....:	**TDK-LAMBDA UK LTD**
Address .....:	**KINGSLEY AVE** **ILFRACOMBE** **EX34 8ES UNITED KINGDOM** **UNITED KINGDOM**
Name of Test Laboratory preparing the Report .....:	UL International Polska Sp. z o.o. Aleja Krakowska 81, 05-090 Sekocin Nowy, Poland
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

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.
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The authenticity of this Test Report and its contents can be verified by contacting the NCB, responsible for this Test Report.

Test Item description :	AC-DC Switch Mode Power Supply
Trade Mark .....:	TDK·Lambda
Manufacturer .....:	TDK-LAMBDA UK LTD KINGSLEY AVE ILFRACOMBE EX34 8ES UNITED KINGDOM
Model/Type reference .....:	NV175 Series NV-175 Series NV1-1G000 (see Model Differences for details)
Ratings .....:	NV175 Series; NV-175 Series: 100-240Vac (Nominal), 90-264V (Full Tolerance), 45-440Hz, 3Arms NV175 Series; NV-175 Series: 133-318Vdc (Nominal), 120-350Vdc (Full Tolerance), 2.2Adc NV1-1G000 only: 88.9-240Vac (Nominal), 80-264V (Full Tolerance), 45-440Hz, 3Arms (See Model Differences for details)

Testing procedure and testing location:			
☐	CB Testing Laboratory:		
Testing location/ address ..... :			
☐	Associated CB Testing 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) .....:		
☒ Testing procedure: SMT/CTF Stage 3 or 4		
Testing location/ address..... :	TDK-Lambda, Kingsley Avenue, Ilfracombe, Devon, EX34 8ES, United Kingdom.	
Tested by (name + signature).....:		
Approved by (name + signature) .....:		
Supervised by (name + signature) .....:		

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

National Differences (23 pages)
Enclosures (103 pages)

Summary of testing:

Unless otherwise indicated, all tests were conducted at TDK-Lambda, Kingsley Avenue, Ilfracombe, Devon, EX34 8ES, United Kingdom..

Tests performed (name of test and test clause):	**Testing location:**
STEADY FORCE TEST, 250 N (4.4.4.2, ANNEX T.5) STEADY FORCE TEST, 30 N (4.4.4.2, ANNEX T.3) IMPACT TEST (4.4.4.4, ANNEX T.6) CLASSIFICATION OF ELECTRICAL ENERGY SOURCES (5.2, 5.7) DETERMINATION OF WORKING VOLTAGE (5.4.1.8) SEPARABLE THIN SHEET MATERIAL (5.4.4.6.2) 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) LOCKED-ROTOR OVERLOAD TEST FOR D.C. MOTORS (ANNEX G.5.4.6) 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)	TDK-Lambda, Kingsley Avenue, Ilfracombe, Devon, EX34 8ES, United Kingdom.

Summary of compliance with National Differences:

List of countries addressed: AU,NZ, EU Group Differences, US,CA

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

Copy of Marking Plate - Refer to Enclosure titled Marking Plate for copy.

TEST ITEM PARTICULARS:	
Classification of use by	Ordinary person, Skilled person
Supply Connection	AC Mains DC Mains
Supply % Tolerance	+10%/-10% (AC Mains), +20%/-15% (DC Mains)
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	65 °C
IP protection class	IPX0
Power Systems	TN
Altitude during operation (m)	3000 m standard or 5000 m for –H and –HR options m
Altitude of test laboratory (m)	2000 m or less
Mass of equipment (kg)	0.6
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..... :	2018-08-06 to 2018-10-29
Date (s) of performance of tests..... :	2018-08-08 to 2018-10-29
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 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:

Product Description

NV175 or NV-175 series switch mode power supplies for building into host equipment.

Model Differences

NV175 or NV-175 models as described below:

Units may be marked with a Product Code: K1x or Q1x 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 be followed by –SP to indicate “Special Price”.

Unit Configuration Code:

NVx-abcde-f-g-h-ijk

where:

x = 1 for 175

a = Number of Outputs : 1, 2, 3 or 4

b = Channel 1 Output Voltage†: 5, T, F, E or G

c = Channel 2 Output Voltage†: 1 , 2, 3, 5, 5L, 7, F or 0

d = Channel 3 Output Voltage†: 3L, 5L, 7, TL, FL, T, F, G followed by Y for negative output or 0

e = Channel 4 Output Voltage†: 3H, 5H, 7, T, F, TH, FH, 0H (fan only channel 4 output) followed by V for variable output followed by P for positive output or 0

f = Global Option : N for 5V version, N1 for 12V version, N2 for 13.5V version, N3 for 5V version with ATX compatibility, N4 for 12V version with ATX compatibility, N5 for 13.5V version with ATX, N6 for 12-13.5V version, N7 for 12-13.5V version with ATX or nothing for no Global Option present

g = U for U chassis, C for U chassis and cover, F for U chassis and cover with fan, I for U chassis and cover with fan and IEC inlet or nothing for Open Frame

h = Blank is the standard upright output connector, R is for the right angle output connector, H is for high altitude, HR is for high altitude with right angle output connector, M is for IEC60601-1, MR is for IEC60601-1 spacings with right angle connector

ijk = Three numbers from 0 to 9 which denotes various output voltages and currents within the specified ranges of each output for a particular unit or blank for standard output settings

† Table1: Output Voltage Cross Reference

Designation Output Voltage

0	Omit output
A	1.5
1	1.8
B	2
2	2.7
3	3.3
5	5
7	7
T	12
F	15
E	18
G	24

Output channels and Global Options ratings are in accordance with the following table subject to variations and limitations of use below:

Output Channel	Designation	Vout	Adj. Range	Output Current
CH1	5	5	5 – 5.5	25A
	T	12	12 – 15.5	15A
	F	15	12 – 15.5	15A
	E	18	16 – 20	10A
	G	24	24 – 28.5	7.5A
CH2	1	1.8	0.9 – 3.8	15A
	2	2.7	2.5 – 3.8	15A
	3	3.3	2.5 – 3.8	15A
CH2 (CH1 12V)	5	5	3.3 – 5.5	10A
CH2 (CH1 15V)	5	5	3.3 – 5.5	10A
CH2 (CH1 24V)	5L	5	Fixed	2A
	5	5	3.3 – 5.5	8A
	7	7	5.5 – 8	5.5A
	F	15	12 – 15.5	6A
CH3	7	+/-7	7 – 8	5A
	T	+/-12	12 – 15	5A
	F	+/-15	12 – 15	5A
	G	+/-24	18 – 24.5	2.5A
	3L	+/-3.3	Fixed	2A
	5L	+/-5	Fixed	2A
	TL	+/-12	Fixed	2A
	FL	+/-15	Fixed	2A
CH4	3H	+/-3.3	Fixed	2A
	5H	+/-5	Fixed	2A
	7	+/-7	7 – 8	1A
	T	+/-12	Fixed	1A
	F	+/-15	Fixed	1A
	TH	+/-12	Fixed	2A
	FH	+/-15	Fixed	2A
	THV	+/-12	12 – 15	2A
	FHV	+/-15	12 – 15	2A

CH4 (fan	OH	-	-	-
output) Global	N	5	Fixed	2A
Option	N1	12	Fixed	1A
	N2	13.5	Fixed	1A
	N3	5 (ATX)	Fixed	2A
	N4	12 (ATX)	Fixed	1A
	N5	13.5 (ATX)	Fixed	1A
	N6	12	12 – 13.5*	1A
	N7	12 (ATX)	12 – 13.5*	1A

Channels 1 and 2 combined output currents must not exceed 25A

*Can only be set at the factory.

Variations and limitations of use:

All NV175 or NV-175 PSUs can output 180W except 5V channel 1 models which can output 175W. These power ratings are for channels 1 to 4. The global option output can be run in addition to the channel 1 to 4 maximum power outputs.

Units with channel 1 T and G outputs (no other channels fitted) have a peak power output of 200W including the global option with the following duty cycles:

In any 5 minutes 30% at 200W followed by 70% at 171W (average 180W)

In any 5 minutes 20% at 200W followed by 80% at 175W (average 180W)

Options -H and -HR meet spacings for 5000m.

Options -M and -MR meet IEC60601-1 Edition 2 Reinforced spacing's with the following limitations (interpolated creepage spacings):

Channel 1 cannot be 5V model (T1 and T2 with foils)

Channel 2 cannot be fitted

Cannot be global option variants

Fan versions:

Channel 1 with G output, 25V maximum with 5V channel 2 maximum output current of 7A.

Channel 1 with G output, 25V maximum with 7V channel 2 maximum output current of 5.5A.

Channel 1 with G output, 5L channel 2 maximum output current 1.8A.

Channel 2 with T and F outputs, channel 2 maximum output current of 9A.

Channel 4 maximum output current of 1.5A

Model NV1-1G000 (with or without global option or -M/-MR option) may also be run with Channel 1 output voltage range 22.5V to 28V with maximum current of 7.5A and maximum power of 180W

Model NV1-1G000 (with or without -M option) may also be run at 80Vac to 264Vac input, output: 24V to 28V at 6.25A maximum current and 150W maximum power.

The products listed in the following table are typical examples:

Model	CH1	CH2	CH3	CH4	Global Option
NV1-453FF	5V/25A	3.3V/15A	15V/5A	15V/1A	-
NV1-4G5FFH-N3	24V/7.5A	5V/8A	15V/5A	15V/2A	5V/2A
NV1-350TT-N	5V/25A	-	12V/5A	12V/1A	5V/2A
NV1-453TT-N1	5V/25A	-	12V/5A	12V/1A	12V/1A
NV1-250T0-N2	5V/25A	-	12V/5A	-	13.5V/1A

Custom Models:

All ratings as per standard models unless otherwise stated.

Model: NS-LAM/NV1-453TTH-N2-H-C (K10035)
Rated to 4600m altitude
Input voltage range from 90Vac to 264Vac

Model: NS-LAMF/NV1-4G5TTH-F (K10066)
5L low current channel 2 fitted.
Channel 2 rated: 5V, 1.4A

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

Cooling for units with customer supplied air (open frame, U and C options)

The following method must be used for determining the safe operation of PSUs.

The components listed in the following table must not exceed the temperatures given. To determine the component temperatures the heating tests must be conducted in accordance with the requirements of the standard in question. 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)
L3, L7	Common mode choke winding	140
C1, C4	X capacitors	100
C6, C12	Capacitors	105
L2	Boost choke winding	130
C7	Electrolytic capacitor	70 (105)
T1, T2	Transformer winding	130
XU3	Control board optocoupler	100
TX701	Global option transformer	90
L5	Channel 1 output choke	125
XL401	Channel 2 output choke	125
XL601	5L channel 2 output choke	125
XU601	5L channel 2 IC	115
XL501 or XL601	Channel 3 and 4 output choke	125

IC1*	Channel 4 voltage regulator	110
XQ406	Channel 2 highside FET (SMA 2)	115
XV504	Channel 3 highside FET (SMA 3)	115
XU601	Channel 4 IC (SMA 4)	115
Various	All other electrolytic capacitors	90 (105)

* 1A channel 4 only

Higher temperatures limits (in brackets) may be used but product life may be reduced.

Technical Considerations

- The product was submitted and evaluated for use at the maximum ambient temperature (Tma) permitted by the manufacturer's specification of : 65°C (power and current de-rated 2.5% per °C from 50°C to 65°C),
- 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 : AC Mains +10%/-10%, DC Mains +20%/-15%
- The equipment disconnect device is considered to be : provided in the 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 following are available from the Applicant upon request : Installation (Safety) Instructions / Manual
- • Multilayer PWB's accepted under CBTR Ref. No.: E349607-A23 dated 2014-07-31 and letter Report, Enclosure 8-01 of this report

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-SELV: 444 Vrms, 660 Vpk., Primary-Earthed Dead Metal: 423 Vrms, 608 Vpk,
- The following output circuits are at ES1 energy levels : All outputs
- The following output circuits are at ES3 energy levels : Primary circuits
- The following output circuits are at PS3 energy levels : All circuits
- 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 : Mechanical, Electrical, Fire
- 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) : T1, T2, TX701 (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 the Additional Information,
- The equipment is suitable for direct connection to : AC mains supply (IEC inlet models only)

- The power supply was evaluated to be used at altitudes up to : 3000 m standard or 5000 m for –H and –HR options
- The power supply terminals and/or connectors are: Not investigated for field wiring
- Orientations: Customer air models: All except horizontal with PWB upppermost. Fan models: All except horizontal with chassis base uppermost and vertical with input uppermost

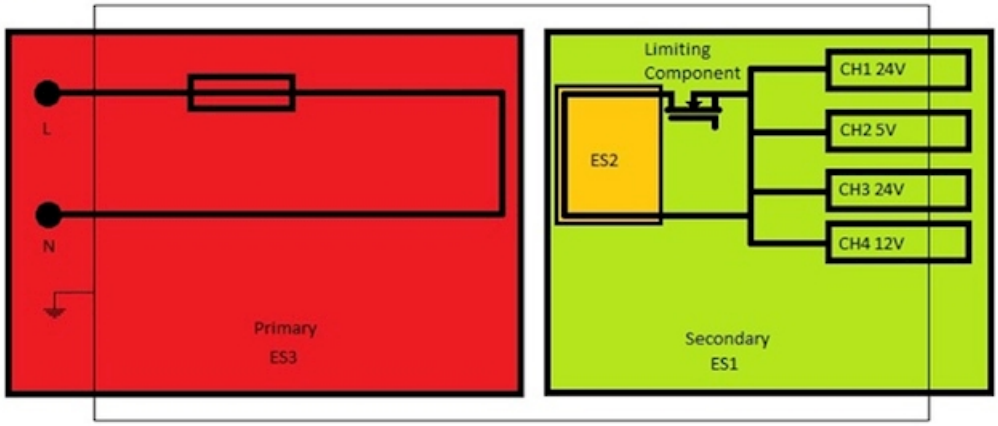
ENERGY SOURCE IDENTIFICATION AND CLASSIFICATION TABLE:	
(Note 1: Identify the following six (6) energy source forms based on the origin of the energy.) (Note 2: The identified classification e.g., ES2, TS1, should be with respect to its ability to cause pain or injury on the body or its ability to ignite 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 (Not accessible)	ES3
Input Connector (Stored capacitance)	ES1
Secondary Circuits before rectification	ES2
Secondary Circuits post rectification	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 circuits	PS3 (declared)
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/corners	MS1
Fan blades	MS1
Product 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)**
Metal enclosure/chassis	TS3 (accessible to skilled person only)
Open frame power supply	TS3 (accessible to skilled person only)
Accessible enclosure/chasses surface	TS1
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

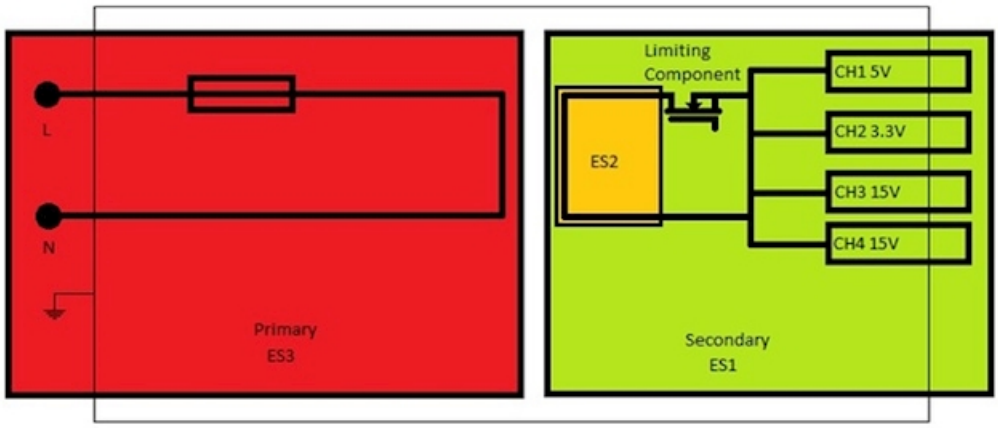
☒ ES ☒ PS ☒ MS ☒ TS ☐ RS

Electrical Energy Source Classification

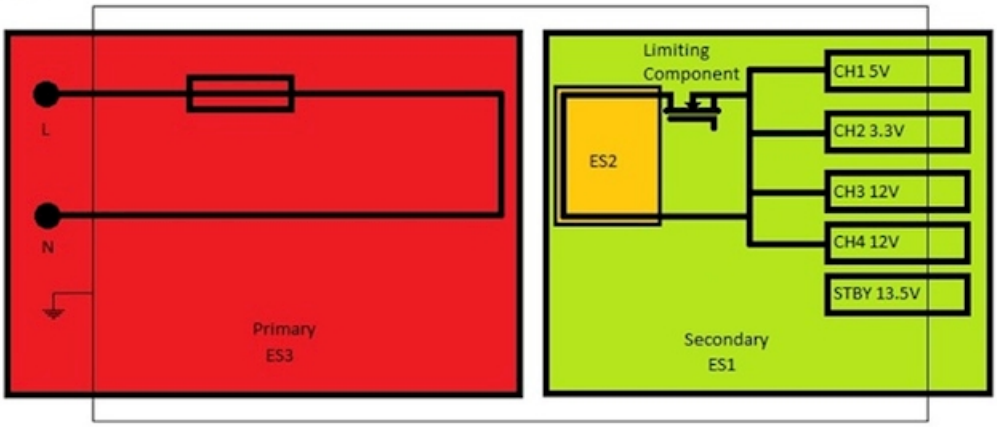
NV1-4G5GTHP



NV1-453FFH

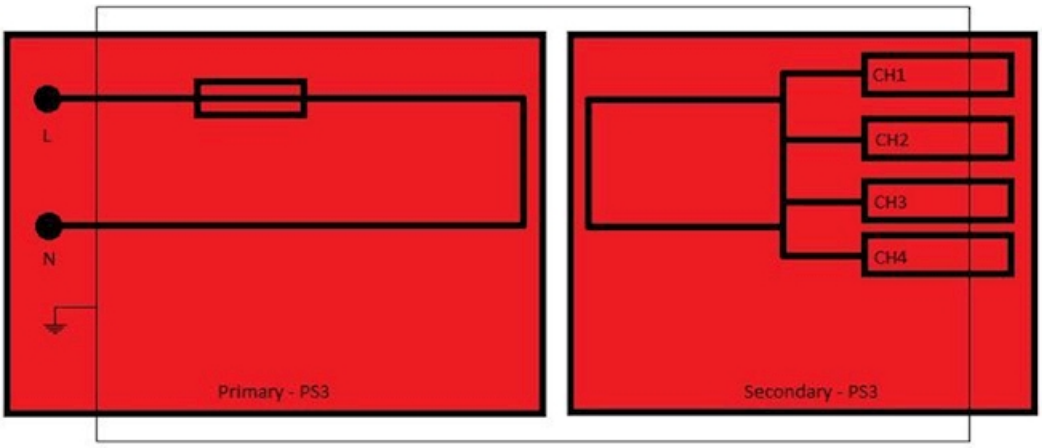


NV1-453TTH-N2



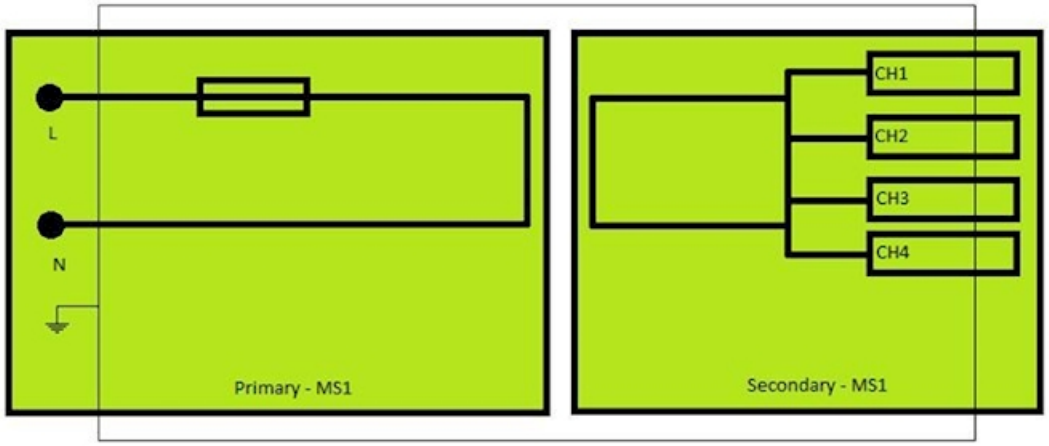
Power Source Classification

All Models



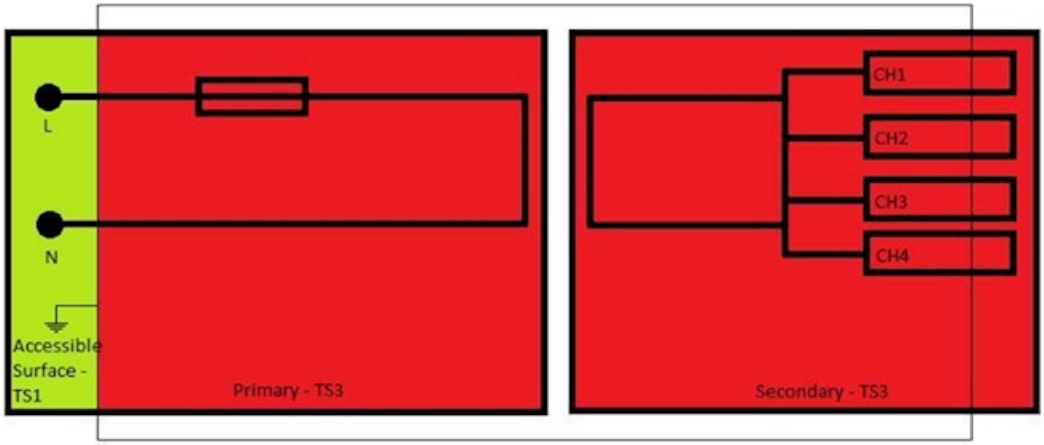
Mechanical Energy Source Classification

All Models

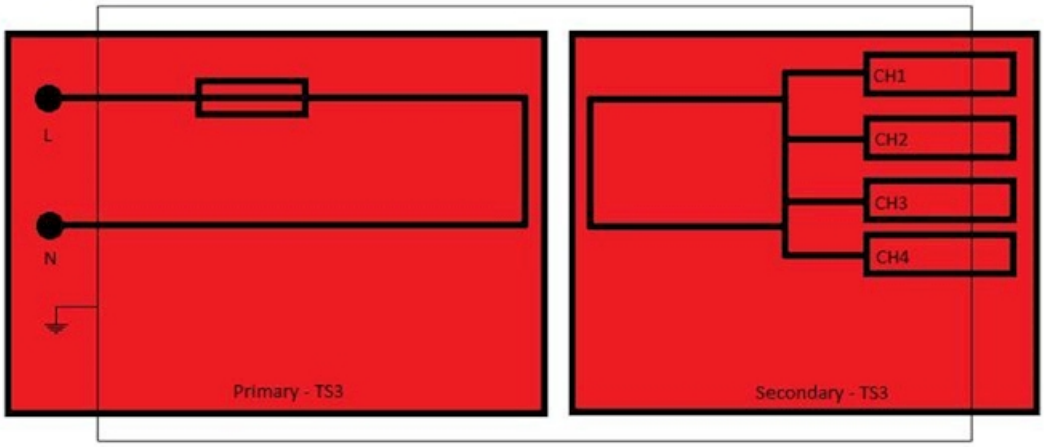


Thermal Energy Source Classification

Accessible Models



Non-Accessible Models



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)
Ordinary Person (outputs may be accessible)	ES3: Primary circuits	-	-	Component Safeguards (Transformers, Optical Isolators), clearance and creepage on PWB
Ordinary Person (chasiss)	ES3: Primary circuits	Clearance and creepage on PWB	Earthed chasiss	-
Ordinary Person (outputs may be accessible)	ES2: Secondary Circuits before rectification	Component safeguards (secondary circuits)	-	-
Skilled Person	ES3: Primary circuits	-	-	Skill safeguard
6.1	Electrically-caused fire			
Material part (e.g. mouse enclosure)	Energy Source (PS2: 100 Watt circuit)	Safeguards		
		Basic	Supplementary	Reinforced
PWB and all circuits	PS3 (declared)	No ignition, min. HB, temperatures does not attain 90% of spontaneous ignition temperature. See 6.3	Components made of material min. V-2 and mounted on V-1 rated PWB. Fire enclosure to be provided in end product.	-
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)

Ordinary Person	MS1: Sharp edges/corners	N/A	N/A	N/A
Ordinary Person	MS1: Fan blades	N/A	N/A	N/A
Ordinary Person	MS1: Product mass	N/A	N/A	N/A
9.1	Thermal Burn			
Body Part (e.g., Ordinary)	Energy Source (TS2)	Safeguards		
		Basic	Supplementary	Reinforced
Ordinary Person	TS1: accessible outputs/chassis surface	N/A	N/A	N/A
Skilled Person	TS3: Metal chassis/internal circuits	-	-	Skill safeguard
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				