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**Access, Terminals, Transmission and Multiplexing (ATTM);
External Common Power Supply for
Customer Premises Network and Access Equipment;
Part 4: CPS Type 2.b implementation details**

Reference
RTS/ATTM-02023

Keywords
connector, EMC, LAN, power supply, terminal

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Contents

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Access, Terminals, Transmission and Multiplexing (ATTM).

The present document is part 4 of a multi-part deliverable covering the External Common Power Supply for Customer Premises Network and Access Equipment, as identified below:

ES 202 874-1: "Functional requirements";

TS 102 874-2: "Integrated Broadband Cable and Television Networks";

TS 102 874-3: "CPS Type 1 implementation details";

TS 102 874-4: "CPS Type 2.b implementation details";

TS 102 874-5: "CPS Type 2.c implementation details";

TS 102 874-6: "CPS Type 2.d implementation details".

Introduction

The intended applications of these CPS categories are specified in ES 202 874-1 [i.1].

Table 1 summarizes the structure of the series.

Table 1: Multi-part deliverable structure

CPS category	Functional requirements	Implementation aspects
Type 1: 5 V, 2 A	ES 202 874-1 [i.1]	TS 102 874-3 [i.3]
Type 2.a: 12 V, 1 A		TS 102 874-2 [i.2]
Type 2.b: 12 V, 2 A		TS 102 874-4 (the present document)
Type 2.c: 12 V, 5 A		TS 102 874-5 [i.4]
Type 2.d: 12 V, 3,2 A		TS 102 874-6 [i.5]

The present document addresses the implementation details of the External Common Power Supply (CPS) for Customer Premises Network and Access Equipment - Type 2.b, rated to a maximum of 12 Vdc and a maximum current of 2 A for use with CPEs, set top boxes and other customer network devices with similar power needs.

Other methods for providing power to end devices are not in the scope of the present document (e.g. Power Over Ethernet, power on USB, etc.).

Tests are specified to verify the compliance of the external power supply against the requirements given by the present document.

The present document specifies design requirements and tests to ensure compliance of the CPS as well as reference to relevant European Directives including power efficiency on-load and no-load requirements given by European Commission Regulation No 278/2009 of 6 April 2009 [1].

1 Scope

The present document describes the specification for a high performance External Power Supply Unit for powering the Customer Premises Equipment to a maximum voltage rating of 12 V dc.

The specifications define the input, output characteristics and performance requirements for a switching mode AC to DC CPS rated to a maximum 12 V dc, and maximum 2 A.

The present document also specifies tests to verify the compliance of the external CPS.

Disclaimer: The present document does not guarantee compliance to legal directives or regulations. Details about these aspects can be found on the following links:

- http://ec.europa.eu/enterprise/sectors/electrical/index_en.htm;
- http://ec.europa.eu/enterprise/sectors/electrical/documents/lvd/standardisation/index_en.htm;
- http://ec.europa.eu/enterprise/sectors/electrical/documents/emc/standardisation/index_en.htm.

NOTE: Examples of documents to be considered are CE Marking 93/68/EEC [13], LVD Low Voltage Directive 2006/95/EC [12], EMC Directive 2004/108/EC [14]; for Ecodesign aspects: RoHS (Restriction of Hazardous Substances) European Directive 2011/65/EC [8] 8th June 2011 and WEEE Management Regulations (Waste Electrical and Electronic Equipment) European Directives 2002/96/EC 27th January 2003 and amendments [9].

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

2.1 Normative references

The following referenced documents are necessary for the application of the present document.

[1] Commission Regulation (EC) No 278/2009 of 6 April 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for no-load condition electric power consumption and average active efficiency of external power supplies.

[2] CENELEC EN 55022:2006 (+ Amendment 1: 2007): "Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement".

[3] CISPR 22: "Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement".

[4] CENELEC EN 61000-3-2: "Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current <= 16 A per phase)".

[5] CENELEC EN 61000-4-2: "Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test".

[6] CENELEC EN 61000-4-5: "Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test".

[7] CENELEC EN 61000-4-11: "Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests".

[8] Directive 2011/65/EC of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast).

[9] Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE) (ROHS Directive and amendments).

[10] CENELEC EN 60950-1: "Information technology equipment - Safety - Part 1: General requirements".

[11] CENELEC EN 50075: "Flat non-rewirable two-pole plugs, 2,5 A 250 V, with cord, for the connection of class II-equipment for household and similar purposes".

[12] Directive 2006/95/EC of the European Parliament and of the Council of 12 December 2006 on the harmonisation of the laws of Member States relating to electrical equipment designed for use within certain voltage limits (LVD directive).

[13] Council Directive 93/68/EEC (CE Marketing) of 22 July 1993 amending Directives 87/404/EEC (simple pressure vessels), 88/378/EEC (safety of toys), 89/106/EEC (construction products), 89/336/EEC (electromagnetic compatibility), 89/392/EEC (machinery), 89/686/EEC (personal protective equipment), 90/384/EEC (non-automatic weighing instruments), 90/385/EEC (active implantable medicinal devices), 90/396/EEC (appliances burning gaseous fuels), 91/263/EEC (telecommunications terminal equipment), 92/42/EEC (new hot-water boilers fired with liquid or gaseous fuels) and 73/23/EEC (electrical equipment designed for use within certain voltage limits).

[14] Directive 2004/108/EC of the European Parliament and of the Council of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EEC (EMC Directive).

[15] ETSI EN 300 019-1-1: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-1: Classification of environmental conditions; Storage".

[16] ETSI EN 300 019-1-2: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-2: Classification of Environmental Conditions; Transportation".

[17] ETSI EN 300 019-1-3: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-3: Classification of environmental conditions; Stationary use at weather protected locations".

[18] IEC 60754-1: "Test on gases evolved during combustion of materials from cables - Part 1: Determination of the amount of halogen acid gas".

[19] IEC 60754-2: "Test on gases evolved during combustion of electric cables - Part 2: Determination of degree of acidity of gases evolved during the combustion of materials taken from electric cables by measuring pH and conductivity".

[20] CENELEC EN 61204-3: "Low-voltage power supplies, d.c. output - Part 3: Electromagnetic compatibility (EMC)".

[21] ETSI EN 301 489-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements".

[22] ETSI EN 300 386: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Telecommunication network equipment; ElectroMagnetic Compatibility (EMC) requirements".

[23] CENELEC EN 55024: "Information technology equipment. Immunity characteristics - Limits and methods of measurements".

[24] CENELEC EN 61000-3-3: "Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current <= 16 A per phase and not subject to conditional connection".

[25] IEC 60950-1: "Information technology equipment - Safety - Part 1: General requirements".

[26] CISPR 24: "Information technology equipment - Immunity characteristics - Limit and methods of measurement".

[27] CENELEC EN 61000-4-3: "Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test".

[28] CENELEC EN 61000-4-4: "Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test".

[29] CENELEC EN 61000-4-6: "Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields".

2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ETSI ES 202 874-1 (V1.1.1): "Access, Terminals, Transmission and Multiplexing (ATTM); External Common Power Supply for Customer Premises Network and Access Equipment; Part 1: Functional requirements".

[i.2] ETSI TS 102 874-2: "Access, Terminals, Transmission and Multiplexing (ATTM); External Common Power Supply for Customer Premises Network and Access Equipment; Part 2: Integrated Broadband Cable and Television Networks".

[i.3] ETSI TS 102 874-3: "Access, Terminals, Transmission and Multiplexing (ATTM) External Common Power Supply for Customer Premises Network and Access Equipment; Part 3: CPS Type 1 implementation details".

[i.4] ETSI TS 102 874-5: "Access, Terminals, Transmission and Multiplexing (ATTM) External Common Power Supply for Customer Premises Network and Access Equipment; Part 5: CPS Type 2.c implementation details".

[i.5] ETSI TS 102 874-6: "Access, Terminals, Transmission and Multiplexing (ATTM); External Common Power Supply for Customer Premises Network and Access Equipment; Part 6: CPS Type 2.d implementation details".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

Customer Network (CN): in-house network composed by home gateway, end devices, network segments (physical wired or wireless connections between customer network elements), home network infrastructure devices such as network adapters (performing a L1/L2 conversion between different network segments) and nodes (network adapters with L3 routing capabilities)

NOTE: Also called Home Network (HN) or Customer Premises Network (CPN).

Customer Network Device (CND): physical device enabling service(s) usage

NOTE 1: Also called End Device (ED).

NOTE 2: EDs can be dedicated to the internet, conversational and audio-video services. But they could be also Consumer Electronics equipment and other devices which may have nothing to do with these premium services (e.g. services performing a content sharing within a HN, typically between a PC and a music system, through the HG).

Customer Network Gateway (CNG): gateway between the HN and the Access Network able to perform networking functions from physical connection to bridging and routing capabilities, but also possibly implementing functions related to the service support

NOTE: Also called Home Gateway (HG) or Small Business Gateway (SBG).

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ABS	Acrylonitrile Butadiene Styrene
AC	Alternating Current
CE	Commission Européenne
CND	Customer Network Device
CNG	Customer Network Gateway
CPE	Customer Premises Equipment
CPN	Customer Premises Network
CPS	Common Power Supply
DC	Direct Current
EC	European Commission
ED	End Device
EFT	Electrical Fast Transients
EMC	ElectroMagnetic Compatibility
ESD	Electrostatic Discharge
HG	Home Gateway
HN	Home Network
ITE	Information Technology Equipment
LVD	Low Voltage Directive
MTBF	Mean Time Between Failure
PC	PolyCarbonate
PE	Poly-Ethylene
PLT	Power lines Technologies
RH	Relative Humidity
RoHS	Restriction of Hazardous Substances
RTN	Return
SBG	Small Business Gateway
UL	Underwriters Laboratories
USB	Universal Serial Bus
WEEE	Waste Electrical and Electronic Equipment

4 Electrical Specifications

4.1 Input Requirements

The CPS shall be designed to meet the requirements and limits given in table 2.

Table 2: Input voltage and frequency

Normal Voltages (Vac)	Voltage Variation Range (Vac)	Normal Frequency (Hz)	Frequency Variation Range (Hz)
100 to 240	90 to 264	50 to 60	47 to 63

The AC input current shall not exceed 1 A, when operated at 100 Vac to 240 Vac with no-load to full load.

The inrush current must be limited to 100 A when operated at 240 Vac.

A fuse with a rating equal to the rating of the CPS i.e. up to maximum of 2,0 A shall be installed on the input line side near the input connector to protect the CPS.

4.2 Output Requirement

4.2.1 Output Voltage, Current And Ripple

Table 3: Output voltage, current and ripple

Input normal voltage (Vac)	Output Nominal Voltage (Vdc)	Output Regulation	Minimum Load (A)	Maximum Load (A)	Maximum ripple (mVp-p)	Output power (W)
100 to 240	12	±5 %	0	2,0	120	24
NOTE 1: Output voltages shall be measured at the output connector. NOTE 2: Measurements shall be made with an oscilloscope of at least 20 MHz bandwidth. Output shall be bypassed at the connector with a 0,1 µF ceramic disk capacitor and a 20 µF electrolytic capacitor to simulate system loading.						

Under any combinations of line and load variation and environmental conditions, the output shall remain within the tolerance defined in table 3.

4.2.2 Short Circuit Protection And Over Current Protection

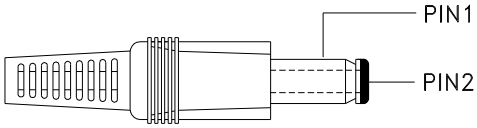
The CPS shall be protected from damage of a short circuit at the output or too high output current, irrespective of the duration of the existence of the fault and shall auto-recover when the fault is removed.

The CPS shall not activate the over current protection at start up, while the output is connected to a 2 200 µF electrolytic capacitor.

4.2.3 Output Over Voltage Protection

When 12 V output voltage reaches its over- voltage protection trigger point the CPS shall be shutdown and output voltage shall not exceed 16 V Max. This includes Control Loop failure.

4.2.4 Output Polarity



PIN #	Output level
1	RTN (-)
2	+12 V

Figure 1: Output polarity

4.3 Performance Requirement

4.3.1 Efficiency

The power supply shall comply with the European Commission Regulation No 278/2009 [1]. That means:

- No-load conditions shall not exceed 0,3 Watt.
- The CPS shall provide an efficiency of at least 82,2 %, measured as the average of the efficiencies at 25 %, 50 %, 75 % and 100 % of the rated load.

In addition, the CPS must provide an efficiency of at least 75 %, measured at the 10 % of the rated load.

4.3.2 Turn On Delay Time

The CPS shall switch on in less than 2 s at maximum load and both 110 Vac/60 Hz and 220 Vac/50 Hz inputs. The measurement shall be made from the start of the input voltage, up to the moment the rated output voltage has been reached.

4.3.3 Hold-up Time

The hold-up time shall be a minimum of 10 ms at maximum load and both 110 Vac/60 Hz and 220 Vac/50 Hz. The measurement shall be made following AC voltage interrupt from the moment at which the input current ceases, to the moment the output voltage drops below the rated voltage minus 5 %.

4.3.4 Brown-out and recovery

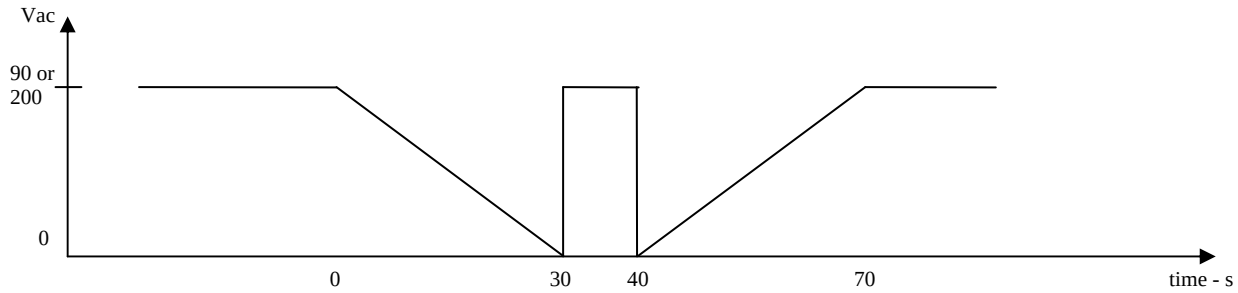


Figure 2: Input voltage brown-out and recovery

CPS must have clean ON/OFF and OFF/ON transition, maintaining the compliance to specification and without any permanent damage after the application of different voltages as described in figure 2.

Input voltage will be reduced from 90 V to 0 Vac in 30 s, then immediately increased to 90 Vac, maintained for 10 s, then brought back to 0 Vac, and finally increased to 90 Vac in 30 s. The same cycle will apply for a maximum input voltage of 200 V.

The test will be repeated 20 times.

4.3.5 Dynamic Load

The CPS must be capable of a higher output current than the rated output current during a time interval as given below:

- High Load: 250 %/30 ms of the rated load.
- Low Load: 100 %/1 s of the rated load.
- Slew Rate: 0,1 A/μs.

4.3.6 Max Open Circuit Voltage

When the circuit of over voltage protection is invalidated, the output voltage must be 16 V maximum.

4.3.7 Overshoot at turn on/Turn off

The overshoot at turn on and turn off shall not exceed 10 % of the nominal voltage value.

4.3.8 Output transient response/Transient load slew

With an input voltage, output load, ambient temperature and slew rate as given below, the undershoot or overshoot of output shall be not less than 5 % of the output voltage:

- Input voltage: 90 V ~ 264 Vac/47 ~ 63Hz.
- Output Load: 20 % to 80 %, 80 % to 20 %.
- Ambient temperature: 25 ºC ± 3 ºC, Slew rate 1,0 A/μs, T1 = T2 = 0,5 ms.

4.3.9 Rise time

Rise time shall be less than 50 ms when measured from 10 % to 90 % of the output voltage at normal input voltage.

5 Operational, Storage and Transportation Requirements

5.1 Temperature and Humidity

The CPS shall be able to operate in the following environmental conditions:

- Temperature: 5 °C to +40 °C.
- Relative humidity: 5 % to 95 %.

This corresponds to Class 3.1 "Temperature-controlled locations" of EN 300 019-1-3 [17].

The CPS shall be withstand the storage conditions defined in EN 300 019-1-1 [15].and related to temperature and humidity, corresponding to Class 1.2 "Weather protected, not temperature-controlled storage locations".

The CPS shall be withstand the transportation conditions defined in EN 300 019-1-2 [16] and related to temperature, humidity and vibration, corresponding to Class 2.3 "Public Transportation".

6 EMC, safety and Environmental requirements

6.1 Product EMC

As this CPS is intended to be used for Information Technology Equipment (ITE), they should be tested with the associated telecommunication equipment according to the following EMC standards for ITEs:

- CISPR 22, or EN 55022 [2], for the emission requirements.
- CISPR 24 [26], or EN 55024 [23] for the immunity requirements.

In table 4, the complete list of the EN standards to be considered and related cross references is reported.

Table 4: Input voltage and frequency

Standard	Other referred standard documents						
	Emissions	**Radiated immunity**	**Conducted immunity**	**ESD (see note 1)**	**Surge**	**EFT (see note 2)**	**Voltage dips, short interruption**
EN 301 489-1 [24]	EN 55022 [2]	EN 61000-4-3 [27]	EN 61000-4-6 [29]	EN 61000-4-2 [5]	EN 61000-4-5 [6]	EN 61000-4-4 [28]	EN 61000-4-11 [7]
EN 300 386 [22]	EN 55022 [2]	EN 61000-4-3 [27]	EN 61000-4-6 [29]	EN 61000-4-2 [5]	EN 61000-4-5 [6]	EN 61000-4-5 [6]	EN 61000-4-4 [28]
EN 61204-3 [20]	EN 55022 [2]	EN 61000-4-3 [27]	EN 61000-4- 6 [29]	EN 61000-4-2 [5]	EN 61000-4-5 [6]	EN 61000-4-5 [6]	EN 61000-4-4 [28]
EN 55024 [23]	N.A	EN 61000-4-3 [27]	EN 61000-4-6 [29]	EN 61000-4-2 [5]	EN 61000-4-5 [6]	EN 61000-4-5 [6]	EN 61000-4-4 [28]
NOTE 1: ESD stands for Electro Static Discharge. NOTE 2: EFT stands for Electrical Fast Transient.							

Additional requirements are provided below on specific requirements indicated by the EN 61000 series of standards.

6.1.1 Electrostatic Discharge (ESD)

The CPS shall meet EN 61000-4-2 [5]: ±15 kV Air Discharge, ±8 kV contact discharge.

6.1.2 Harmonic Current

The CPS shall meet the requirements of EN 61000-3-2 [4].

6.1.3 Voltage fluctuations and flicker

The CPS shall meet the requirements of EN 61000-3-3 [24].

6.2 Product Safety

The power supply must meet the requirements of IEC 60950-1 [25] or EN 60950-1 [10].

6.3 Environmental and Eco-Design Requirements

The following Ecodesign rules must be applied when manufacturing the CPS:

- The external case of the CPS shall be manufactured using recyclable plastic.
- The external case of the CPS should be manufactured using at least 50 % recycled plastic (preferred choice: ABS).

The cables of the CPS should be manufactured using halogen-free materials, tested following the method described in IEC 60754-1 [18] and IEC 60754-2 [19].

Preferred choices as materials for cables are Polyolefins and Polyurethane.

The electronic parts of the CPS should be manufactured using materials with low halogenated compound content.

Provided that all the safety related requirements are satisfied, of the CPS shall be designed to enable separation between plastic case and electronics at the end of the CPS life, regardless of the specific disposal processes defined for the product; use of screws must be minimised and snap-fit is preferred.

7 Reliability

7.1 Burn-in

All power supplies shall be burned-in for 2 hours under nominal input and 70 % ~ 80 % load at an ambient temperature of 40 ºC.

7.2 MTBF Calculation

The MTBF, Mean-Time-Between-Failures, shall be calculated and reported for each quality class offered.

The provisional model adopted is referring to the "bathtub curve" defining the behaviour of the failure rate as function of the time. While in the first part of the useful life the failure rate is higher, then it decreases to a value that remains constant for the rest of the useful life when wear out failures start.

The failure rate must correspond to a yearly percentage of failure less than 2,9 %, as per the basic principles contained in ES 202 874-1 [i.1]. As provisional models for reliability typically list reference values for components and systems referred to a operating temperature of 40 °C; the target value above reported refers to that environmental condition.

8 Mechanical Specification

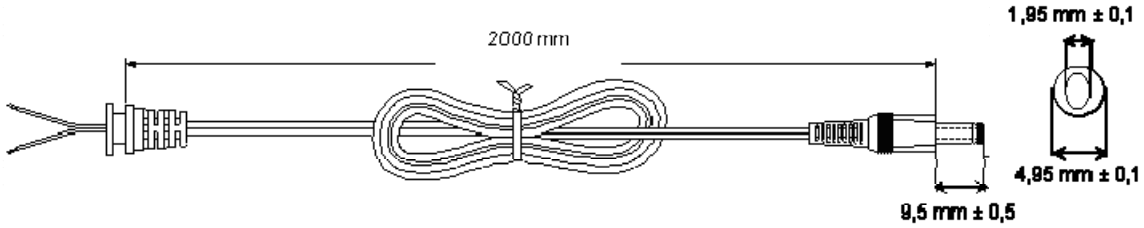
8.1 AC plug

The 230 VAC plug must form part of the main housing of the CPS or be part of a fixed cord of the main housing of the CPS.

The AC plug of the CPS shall comply with EN 50075 [11], but without the cord.

8.2 DC cord

The DC cord must comply with the data below with typical cord length of 2 m.



NOTE 1: Cable: UL 2468 style: 80 ºC, 300 V, 2 conductors.
NOTE 2: Plug: Ø 4,95 x 1,95 x 9,5 mm (tuning fork annexure entire insulation) black.

Figure 3: DC cord

8.3 Label specification

The CPS shall be affixed with a label, with appropriate wording in the language specific for the intended country for deployment, stating the CPS compliance with the appropriate European regulations.

Annex A (informative): Details on Tests Procedures

This annex is containing non normative recommendations on how tests should be performed to check the compliance with the requirements listed in the main body of the present document. This annex is not intended to replace the standardised test methods defined in the standards mentioned in the other clauses of the present document and contains references to them where applicable.

A.0 Overview of Tests

Table A.1 presents an over view of the tests. The description of each test and test detail is given in the subsequent clauses.

Table A.1: Overview of tests

N.	Test Item	Test at temperature ºC	
		25	40
1	Performance Test	yes	yes
2	Switcher Power Supply Loop Stability Test	yes	yes
3	Life Test		yes
4	Dynamic Load Switching Test		yes
5	Output Trans Response-Load Slew&step	yes	
6	AC input inrush current Test	yes	
7	Turn-on delay Test	yes	
8	Output Hold-up time Test		
9	Rise time & Overshoot Test	yes	
10	Output Transient Response /Deviation Test	yes	
11	Dynamic Load Test	yes	
12	Brown Out and Recovery Test	yes	
13	Temperature Storage Test		
14	Humidity Storage Test		
15	Power Cycle Test	yes	
16	Shipping, Single Drop, Vibration Test	yes	
17	Short Circuit Protection Test	yes	
18	Over Voltage Protection Test	yes	
19	Over Current Protection Test	yes	
20	Construction, Appearance and Weight	yes	
21	Safety tests	yes	
22	DC Mains Cord set and Plug Test	yes	
23	Energy Efficiency Test	yes	
24	Capacitive Load Test	yes	
25	Max Open Circuit Voltage Test	yes	
26	EMC tests	yes	

A.0.1 Test Equipment

All measurement equipment should be listed in the results report.

- Purpose of the measurement equipment.
- Manufacturer.
- Type.

- Serial number.
- Date of the latest calibration.
- Expiry date of the latest calibration.

A.1 Performance test

A.1.1 Test purpose

To verify the product basic functions. Delivery result report 1.

A.1.2 Test Condition

- Input voltage: 90 Vac/264 Vac.
- Input Frequency: 47 Hz ~ 63 Hz.
- Output Load: 0 %, 25 %, 50 % and 100 % of the rated load.
- Ambient temperature: see table A.1.
- Ambient humidity: 95 % RH.

A.1.3 Test Criteria

The electric performance should meet the clause 4.3.1 requirements.

A.1.4 Results report examples

Test A

- Input voltage: 90 Vac.
- Frequency: 47 Hz.
- Temperature: 0 ºC.
- Relative Humidity: 95 %.

Test B

- Input voltage: 90 Vac.
- Frequency: 47 Hz.
- Temperature: 25 ºC.
- Relative Humidity: 95 %.

Test C

- Input voltage: 90 Vac.
- Frequency: 47 Hz.
- Temperature: 40 ºC.
- Relative Humidity: 95 %.

Test D

- Input voltage: 264 Vac.
- Frequency: 63 Hz.
- Temperature: 0 ºC.
- Relative Humidity: 95 %.

Test E

- I Input voltage: 264 Vac.
- Frequency: 63 Hz.
- Temperature: 25 ºC.
- Relative Humidity: 95 %.

Test F

- I Input voltage: 264 Vac.
- Frequency: 63 Hz.
- Temperature: 40 ºC.
- Relative Humidity: 95 %.

For all these text the report should look like below.

Table A.2: Test report example

Item serial no.	0 % Load			25 % Load				50 % Load				100 % Load			
	IO (mA)	VL (V)	VR-P (mV)	IP (mA)	VL (V)	VR-P (mV)	Eff (%)	IP (mA)	VL (V)	VR-p (mV)	Eff (%)	IP (mA)	VL (V)	VR-p (mV)	Eff (%)
1#	5,0	12,24	13,2	78,3	12,18	17,8	78,1	148,9	12,12	21,6	79,4	292,6	12,00	29,6	76,9
2#	4,8	12,23	14,0	77,9	12,14	78,3	79,1	150,0	12,10	22,1	79,2	292,8	12,01	30,1	77,8
3#	5,2	12,23	12,2	78,2	12,16	17,6	78,6	148,8	12,11	21,8	79,6	292,6	12,02	29,8	78,1
4#	4,6	12,24	13,6	77,6	12,14	17,9	78,5	148,3	12,12	21,6	79,7	292,0	12,00	29,6	79,1
5#	4,9	12,22	12,8	78,0	12,14	17,8	78,8	149,2	12,11	21,8	79,4	292,3	11,99	30,6	76,8
6#	5,1	12,21	13,1	78,3	12,16	18,4	78,4	148,6	12,13	20,9	79,0	292,1	12,00	30,0	77,8
7#	4,6	12,24	14,0	77,8	12,16	18,3	78,3	148,3	12,10	21,4	79,3	292,4	12,01	29,8	76,9
8#	4,5	12,20	12,6	78,3	12,15	18,5	78,6	149,2	12,12	22,0	79,6	292,0	11,98	29,7	78,5
9#	4,8	12,23	13,4	78,4	12,15	18,0	79,1	149,0	12,10	21,6	79,5	292,5	12,03	30,1	77,9
10#	4,7	12,24	12,9	78,0	12,15	17,6	78,1	148,6	12,11	21,8	79,8	292,7	12,00	29,6	78,5
11#	5,0	12,22	13,1	77,9	12,18	17,7	77,9	149,3	12,10	22,4	79,8	292,3	12,02	29,8	76,9
12#	5,3	12,21	12,5	77,6	12,14	18,2	78,4	149,6	12,12	21,6	79,4	292,0	12,01	30,1	77,6
13#	4,9	12,20	14,0	78,3	12,16	17,4	78,6	149,6	12,11	22,3	79,7	292,0	12,01	29,7	78,4
14#	5,1	12,23	12,8	78,5	12,16	18,5	78,3	149,8	12,10	21,8	79,3	292,5	12,01	29,5	77,8
15#	4,6	12,21	13,1	78,4	12,17	18,0	78,6	150,2	12,13	22,4	79,8	291,6	11,96	30,1	76,9
16#	4,8	12,24	14,0	78,0	12,15	17,6	79,1	148,6	12,11	21,6	79,5	291,8	11,99	29,8	78,5
17#	5,1	12,22	12,6	77,9	12,14	17,7	78,1	149,3	12,10	22,3	79,2	292,4	12,00	29,1	77,9
18#	4,9	12,21	12,6	77,6	12,14	18,2	77,9	148,3	12,10	20,9	79,6	291,6	11,98	29,7	76,9
19#	5,1	12,24	13,4	78,0	12,16	17,9	78,4	149,2	12,12	21,4	79,5	291,8	12,01	30,3	78,5
20#	4,6	12,20	12,9	78,3	12,16	17,8	78,5	149,0	12,10	22,0	79,8	292,9	11,99	30,1	77,9
21#	4,5	12,23	13,1	77,8	12,17	18,4	78,8	148,6	12,11	21,6	79,8	292,0	12,01	29,8	78,5
22#	4,8	12,24	12,5	78,3	12,15	18,3	78,4	149,3	12,10	21,8	79,4	291,7	12,00	29,7	76,9
23#	4,7	12,22	14,0	78,4	12,15	18,5	78,3	149,6	12,12	22,4	79,7	291,6	12,02	30,3	77,6
24#	5,0	12,21	12,8	78,0	12,18	18,0	78,6	149,8	12,11	21,6	79,3	292,3	12,01	30,6	78,4

Item serial no.	0 % Load			25 % Load				50 % Load				100 % Load			
	IO (mA)	VL (V)	VR-P (mV)	IP (mA)	VL (V)	VR-P (mV)	Eff (%)	IP (mA)	VL (V)	VR-p (mV)	Eff (%)	IP (mA)	VL (V)	VR-p (mV)	Eff (%)
25#	5,3	12,20	13,1	77,9	12,17	17,6	79,1	150,2	12,10	21,6	79,8	291,6	12,01	29,8	77,8
26#	4,9	12,23	14,0	77,6	12,15	17,7	78,1	148,6	12,12	22,3	79,8	292,0	12,01	30,1	78,4
27#	5,1	12,22	13,6	78,3	12,15	17,6	77,9	149,3	12,10	21,8	79,4	291,7	11,96	29,7	77,8
28#	4,8	12,21	12,8	78,3	12,18	17,7	78,3	149,8	12,11	22,4	79,7	291,6	12,03	29,5	76,9
29#	4,7	12,24	13,1	78,4	12,14	18,5	78,6	150,2	12,10	21,6	79,3	292,3	12,00	30,1	78,5
30#	5,0	12,20	14,0	78,0	12,16	18,0	79,1	148,6	12,11	12,8	79,4	292,4	12,02	29,4	77,7

A.2 Switcher Loop Stability Test

A.2.1 Test Purpose

To verify that the control loop works under all AC input, DC load conditions and temperature. Measure and plot Open Loop Gain/Phase characteristics at each of the following test conditions.

A.2.2 Test Condition

- Input voltage: 90 Vac ~ 264 Vac.
- Input Frequency: 47 Hz ~ 63 Hz.
- Output Load: 25 %, 50 % and 100 % of the rated load.
- Ambient temperature: see table A.1.
- Ambient humidity: 95 % RH.

A.2.3 Test Criteria

When the ring return circuit is closed and the gain is 0 dB, the phase margin should be greater than 45°. When the phase is 0°, the gain margin should be lower than -6 dB. When the two conditions are met the test is considered to have been passed.

A.2.4 Results report example

Table A.3: Test report example

		0 ºC		25 ºC		40 ºC	
Input voltage/freq.	Output % Load (A)	Phase Margin (°)	Gain Margin (dB)	Phase Margin (°)	Gain Margin (dB)	Phase Margin (°)	Gain Margin (dB)
90 Vac/47 Hz	0,25	102,11	-15,252	102,12	-93,934	102,17	-43,627
	0,5	102,89	-18,552	102,91	-95,564	101,95	-92,869
	1,0	102,44	-12,820	102,17	-21,672	94,253	-92,149
120 Vac/60 Hz	0,25	102,06	-13,696	94,536	-97,039	102	-40,941
	0,5	103,49	-11,292	102,41	-34,034	102,06	-34,453
	1,0	102,96	-12,911	103	-88,753	102,73	-25,169
230 Vac/50 Hz	0,25	102,15	-13,669	102,05	-39,697	101,75	-49,524
	0,5	103,05	-8,798	103,35	-32,090	103,19	-36,213
	1,0	103,42	-16,245	102,84	-93,199	102,39	-91,762
264 Vac/63 Hz	0,25	102,17	-12,603	101,95	-36,273	101,81	-39,402
	0,5	103,04	-8,933	103,35	-71,241	103,28	-33,732
	1,0	103,55	-15,846	102,89	-37,331	102,57	-37,281

A.3 Life test

A.3.1 Test Purpose

To verify the reliability of products for the life test condition.

A.3.2 Test Condition

- Input voltage: 230 Vac.
- Input Frequency: 50 Hz.
- Output Load: a cycle of 5 s 50 % of the rated load and 5 s 100 % of the rated load.
- Ambient temperature: see table A.1.
- Ambient humidity: 90 % ~ 95 % RH.
- Time: 500 hours.

A.3.3 Test Criteria

After this test, the electric performance should meet the clause 7.2 requirement.

A.3.4 Results report example

Table A.4: Test report example

Serial number		Output Voltage (V)	Ripple (mV)	Efficiency (%)
Before test	1#	12,00	29,3	78,5
	2#	12,01	30,1	76,9
	3#	12,03	29,4	77,6
	4#	12,00	28,9	78,4
	5#	12,02	29,3	77,8
	6#	12,01	30,1	78,5
	7#	12,03	29,6	77,9
	8#	12,00	29,8	78,5
	9#	12,00	30,3	77,9
	10#	12,01	30,4	78,5
	11#	12,03	29,6	76,9
	12#	12,04	29,8	78,4
	13#	12,00	30,3	77,8
	14#	12,02	30,6	78,5
	15#	12,01	29,9	77,9

Serial number		Output Voltage (V)	Ripple (mV)	Efficiency (%)
After test	1#	12,03	29,8	77,8
	2#	12,00	30,3	78,5
	3#	12,00	30,4	77,9
	4#	12,01	29,6	78,5
	5#	12,03	29,8	77,9
	6#	12,04	30,3	78,5
	7#	12,00	30,6	76,9
	8#	12,02	29,9	78,4
	9#	12,01	29,7	77,8
	10#	12,00	30,1	78,5
	11#	12,01	29,6	77,9
	12#	12,00	29,3	76,9
	13#	12,03	30,1	77,6
	14#	12,01	29,6	78,4
	15#	12,02	29,8	77,8

A.4 Dynamic load switching test

A.4.1 Test Purpose

This test is to verify the reliability of the CPS for the dynamic load conditions.

A.4.2 Test Condition

- Input voltage: 230 Vac.
- Input Frequency: 50 Hz.
- Output Load: block current 5 s 50 % and 5 s 100 % of the rated load.
- Ambient temperature: see table A.1.
- Time: 500 hours.

A.4.3 Test Criteria

After the test, the electrical performance should meet the clause 4.3.5 requirement.

A.4.4 Results report example

The results report example is the same as in clause A.5.4.

A.5 Output trans response-load slew and step

A.5.1 Test Purpose

This test is to verify the reliability of the CPS for output trans response load conditions.

A.5.2 Test Condition

- Input voltage: 90 Vac ~ 264 Vac.
- Input Frequency: 47 Hz ~ 63 Hz.
- Output Load: current 20 % to 80 % and 80 % to 20 % of the rated load, with a slew rate of 1,0 A/µs and T1 = T2 = 0,5 ms.
- Ambient temperature: see table A.1.

A.5.3 Test Criteria

With the output current from 20 % to 80 %, and from 80 % to 20 %, the output voltage should change less than 5 %. At 12 Vdc, 5 % is 0,6 Vdc.

A.5.4 Results report example

Table A.5: Test report example

Item Serial number	Output voltage(V)			
	90 Vac/47 Hz	115 Vac/60 Hz	230 Vac/50 Hz	264 Vac/63 Hz
1#	0,2655	0,2988	0,2788	0,2911
2#	0,2859	0,3021	0,2924	0,2915
3#	0,2759	0,3125	0,2951	0,3015
4#	0,2958	0,3028	0,2891	0,3142
5#	0,2856	0,2958	0,2798	0,2898

A.6 AC input inrush current test

A.6.1 Test Purpose

This test is to verify the reliability of the CPS for AC input current test conditions.

A.6.2 Test Condition

- Input voltage: 90 Vac and 264 Vac.
- Input Frequency: 50 Hz.
- Output Load: 100 % of the rated load.
- The inrush current is measured at an ambient temperature of 25 ºC, with the test unit temperature stabilized in the power off condition until at ambient temperature.

A.6.3 Test Criteria

The AC inrush current should meet the clause 4.1 requirements.

A.6.4 Results report example

Table A.6: Test report example

Components Serial number	90 Vac/50 Hz (A)	264 Vac/50 Hz (A)
1#	10,3	10,8
2#	16,3	14,2
3#	13,8	15,0
4#	14,2	16,2
5#	15,0	14,9

A.7 Turn on delay test

A.7.1 Test Purpose

This test is to verify the turn on delay of the CPS.

A.7.2 Test Condition

- Input voltage: 110 Vac and 220 Vac.
- Input Frequency: 60 Hz and 50 Hz.
- Output Load: 100 % of the rated load.
- Ambient temperature: see table A.1.

A.7.3 Test Criteria

The turn-on delay should meet the clause 4.3.2 requirements.

A.7.4 Results report example

Table A.7: Test report example

Components serial number	Turn-on delay time (ms)
1#	1 241
2#	1 551
3#	1 435
4#	1 268
5#	1 554

A.8 Output hold-up time test

A.8.1 Test Purpose

This test is to verify the output hold-up time of the CPS.

A.8.2 Test Condition

- Input voltage: 110 Vac and 220 Vac.
- Input Frequency: 60 Hz and 50 Hz.
- Output Load: 100 % of the rated load.
- Ambient temperature: see table A.1.

A.8.3 Test Criteria

The output hold-up time should meet the clause 4.3.3 requirements .

A.8.4 Results report example

Table A.8: Test report example

Components Serial number	Hold-up time (ms)
1#	23,2
2#	21,5
3#	24,5
4#	20,7
5#	22,6

A.9 Rise time and overshoot test

A.9.1 Test Purpose

This test is to verify the output rise time and overshoot of the CPS.

A.9.2 Test Condition

- Input voltage: 90 Vac ~ 264 Vac.
- Input Frequency: 47 Hz ~ 63 Hz.
- Output Load: 0 % ~ 100 % of the rated load.
- Ambient temperature: see table A.1.

A.9.3 Test Criteria

The rise time should meet the clause 4.3.7 requirements.

The overshoot at turn on and turn off should meet the clause 4.3.9 requirements.

A.9.4 Results report example

Table A.9: Test report example

Input Voltage		90 Vac/47 Hz		115 Vac/60 Hz		230 Vac/50Hz		264 Vac/63Hz	
Serial number		Rise time (ms)	Overshoot (mV)	Rise time (ms)	Overshoot (mV)	Rise time (ms)	Overshoot (mV)	Rise time (ms)	Overshoot (mV)
1#	0 A	3,625	250	2,585	250	2,224	250	2,165	250
	1,0 A	5,205	250	3,554	250	3,185	250	3,564	250
2#	0 A	3,524	250	2,524	250	2,281	250	2,224	250
	1,0 A	5,152	250	3,621	250	3,239	250	3,314	250
3#	0 A	3,554	250	2,624	250	2,251	250	2,456	250
	1,0 A	5,213	250	3,651	250	3,218	250	3,329	250
4#	0 A	3,421	250	2,682	250	2,212	250	2,652	250
	1,0 A	5,128	250	3,652	250	3,258	250	3,332	250
5#	0 A	3,458	250	2,584	250	2,124	250	2,124	250
	1,0 A	5,211	250	3,624	250	3,264	250	3,241	250

A.10 Output transient response deviation test

A.10.1 Test Purpose

This test is to verify the output transient response deviation of the CPS.

A.10.2 Test Condition

- Input voltage: 90 Vac ~ 264 Vac.
- Input Frequency: 47 Hz ~ 63 Hz.
- Output Load: 0 % ~ 100 % of the rated load.
- Ambient temperature: see table A.1.

A.10.3 Test Criteria

The deviation percentage should meet the clause 4.3.8 requirements.

A.10.4 Results report example

Table A.10: Test report example

Input			90 Vac/47 Hz		115 Vac/60 Hz		230 Vac/50 Hz		264 Vac/63 Hz	
Serial number	Normal Voltage (V)	Load (A)	Output Voltage (V)	Deviation percent (%)	Output Voltage (V)	Deviation percent (%)	Output Voltage (V)	Deviation percent (%)	Output Voltage (V)	Deviation percent (%)
1#	12,0	0	12,22	1,92	12,22	1,92	12,22	1,92	12,22	1,92
		1,0	11,99		11,99		11,99		11,99	
2#		0	12,21	1,75	12,21	1,75	12,21	1,75	12,21	1,75
		1,0	12,00		12,00		12,00		12,00	
3#		0	12,24	1,92	12,24	1,92	12,24	1,92	12,24	1,92
		1,0	12,01		12,01		12,01		12,01	
4#		0	12,20	1,83	12,20	1,83	12,20	1,83	12,20	1,83
		1,0	11,98		11,98		11,98		11,98	
5#		0	12,23	1,67	12,23	1,67	12,23	1,67	12,23	1,67
		1,0	12,03		12,03		12,03		12,03	

A.11 Dynamic load test

A.11.1 Test Purpose

This test is to verify the dynamic load test of the CPS.

A.11.2 Test Condition

- Input voltage: 90 Vac.
- Input Frequency: 47 Hz.
- Output Load: 5 A/30 ms 2 A/1 s of the rated load.
- Slew rate: 0,1 A/μs.
- Ambient temperature: see table A.1.

A.11.3 Test Criteria

The output voltage should meet the clause 4.3.5 requirements.

A.11.4 Results report example

Table A.11: Test report example

Item Serial number	Output voltage (V)
1#	10,6
2#	10,8
3#	10,2
4#	10,6
5#	10,5

A.12 Brown out and recovery test

A.12.1 Test Purpose

This test is to verify the brown out and recovery of the CPS.

A.12.2 Test Condition

- Input voltage: reduce the AC input voltage to 0 Vac in 30 s then immediately increase the AC input voltage to 90 Vac, hold up 10 s, then fall to 0 Vac, and then increase AC input to 90 Vac in 30 s. Repeat this 20 times. Same cycle applied with voltage variation form 0 V to 200 V.
- Input Frequency: 50 Hz.
- Output Load: 100 % of the rated load.
- Ambient temperature: see table A.1.

A.12.3 Test Criteria

After the test, the electric performance should meet the clause 4.3.4 requirements. The CPS should have a clean ON OFF transition. No permanent damage.

A.12.4 Results report example

Table A.12: Test report example

Components Serial number	Power on		Power off	
	Input voltage	Start-up/Steady Output voltage	Input voltage	Steady/Fall Output Voltage
1#	47,8/56,6	11,48/11,85	55/47,5	11,85/11,26
2#	49,6/55,3	11,51/11,96	53/48,2	11,96/11,21
3#	49,2/55,6	11,42/12,03	54/47,3	12,03/11,35
4#	49,8/54,2	11,46/12,01	52/48,6	12,01/11,25
5#	49,7/55,1	11,40/11,99	53/48,0	11,99/11,23

A.13 Temperature storage test

A.13.1 Test Purpose

This test is to verify if the CPS can endure the storage temperature.

A.13.2 Test Condition

- Chamber temperature -40 ºC ~ +70 ºC.
- Cycle time: 3 hours.
- Cycles: 2.

A.13.3 Test Criteria

After the test, the electric performance should meet the clause 5.1 requirements. No permanent damage.

A.13.4 Results report example

Table A.13: Test report example

Item Serial number	Before test voltage (V)	After test voltage (V)	Hi-pot:P-S:3,75 kVA C 10 mA 1 min	Insulation: 500 Vdc 1 min 100 MΩ min	
			Input to output	To output plug	To housing
1#	12,01	12,02	OK	OK	OK
2#	12,03	12,01	OK	OK	OK
3#	12,04	12,00	OK	OK	OK
4#	12,00	12,01	OK	OK	OK
5#	12,02	12,00	OK	OK	OK
6#	12,01	12,03	OK	OK	OK
7#	12,00	12,01	OK	OK	OK
8#	12,01	12,02	OK	OK	OK
9#	12,00	12,02	OK	OK	OK
10#	12,03	12,01	OK	OK	OK
11#	12,01	12,03	OK	OK	OK
12#	12,02	12,00	OK	OK	OK
13#	12,02	12,02	OK	OK	OK
14#	12,01	12,01	OK	OK	OK
15#	12,03	12,04	OK	OK	OK
16#	12,00	12,00	OK	OK	OK
17#	12,02	12,00	OK	OK	OK
18#	12,01	12,00	OK	OK	OK
19#	12,03	12,02	OK	OK	OK
20#	12,00	12,01	OK	OK	OK
21#	12,00	12,02	OK	OK	OK
22#	12,01	12,02	OK	OK	OK
23#	12,03	12,01	OK	OK	OK
24#	12,04	12,03	OK	OK	OK
25#	12,00	12,00	OK	OK	OK
26#	12,00	12,02	OK	OK	OK
27#	12,00	12,01	OK	OK	OK
28#	12,02	12,00	OK	OK	OK
29#	12,01	12,00	OK	OK	OK
30#	12,03	12,02	OK	OK	OK

A.14 Humidity storage test

A.14.1 Test Purpose

This test is to verify if the CPS can endure the storage humidity.

A.14.2 Test Condition

- Chamber temperature: +50 ºC.
- Relative humidity: 95 %.
- Test time: 24 hours.

A.14.3 Test Criteria

After the test, the electric performance should meet the clause 5.1 requirements. No permanent damage.

A.14.4 Results report example

This example is the same as in clause A.13.4.

A.15 Power cycle test

A.15.1 Test Purpose

This test is to verify the power turn on/off and the stability of the CPS even after a break condition of the power line.

A.15.2 Test Condition

- Input voltage: 230 Vac.
- Input Frequency: 50 Hz.
- Input voltage: on 5 s, off 5 s repeat 10 000 times.
- Output Load: 100 % of the rated load.
- Ambient temperature: see table A.1.

A.15.3 Test Criteria

After the test, the electric performance should meet the clause 4.3 requirements. No permanent damage.

A.15.4 Results report example

This example is the same as in clause A.13.4.

A.16 Shipping, single drop, vibration test

A.16.1 Test Purpose

This test is to verify the endurance of the CPS for the vibration and non repetitive shock during transportation, operation, removal, and reliability of the CPS for a drop.

A.16.2 Test Condition

- Input: not connected.
- Output: not connected.
- Ambient temperature: see table A.1.
- Height: 61 cm.
- Faces: 4.

- Drop surface: 1 cm wood.
- Vibration frequency: 10 Hz ~ 55 Hz.
- Test axis: X, Y, Z axis.
- Time: 5 minutes per axis.
- This test should be performed in following order:
  1) Drop test.
  2) Vibration test.
     - Individual Drop.
     - Quantity = 1 box.
     - Drop test.

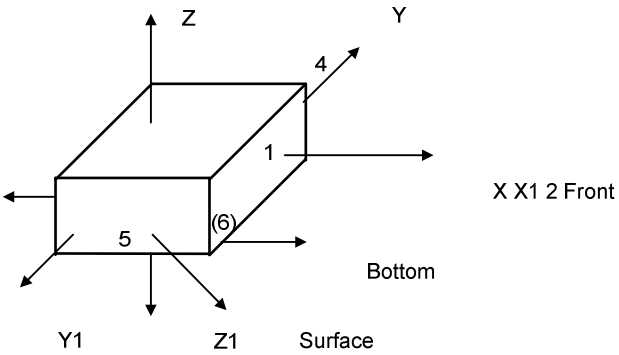


Figure A.1: Shipping, single drop, vibration test

A.16.3 Test Criteria

No appearance damage or component damage. After the test, the electric performance should meet the clause 5.1 requirements. No permanent damage.

A.16.4 Results report example

Table A.14: Test report example

Drop Test			
	Test Order	**Drop Height cm**	**Remarks**
1	Bottom Corner (most critical Corner)	90	
2	Top Corner (most critical Corner)	90	
3	Top Edge (most critical Edge)	90	
4	Vertical Edge (most critical Edge)	90	
5	Bottom Edge	90	Select different Edge for each 3 sample
6	Face 3	90	
7	Face 1	90	
8	Face 2	90	
9	Face 4	90	
10	Face 5	90	
11	Face 6	90	
Vibration Test			
	Test Order	**Test time (minutes)**	**Remarks**
12	Face 1 - Face 3	20	With Face 3 facing down
13	Face 2 - Face 4	20	
14	Face 5 - Face 6	20	

A.17 Short circuit protection test

A.17.1 Test Purpose

This test is to verify if the CPS can endure a short circuit at the output.

A.17.2 Test Condition

- Input: 230 Vac.
- Frequency: 50 Hz.
- Output: 100 % of the rated load - short circuit.
- Ambient temperature: see table A.1.

A.17.3 Test Criteria

The short circuit protection should meet the clause 4.2.2 requirements.

A.17.4 Results report example

Table A.15: Test report example

Item Serial number	**Protection time (s)**	**After test voltage (V)**
1#	2	12,03
2#	2	12,01
3#	2	12,00
4#	2	12,02
5#	2	12,01

A.18 Over voltage protection test

A.18.1 Test Purpose

This test is to verify if the CPS can endure over voltage.

A.18.2 Test Condition

- Input: 90 Vac ~ 264 Vac.
- Frequency: 47 Hz ~ 63 Hz.
- Ambient temperature: see table A.1.

A.18.3 Test Criteria

The over voltage circuit protection voltage should meet the clause 4.2.3 requirements.

A.18.4 Results report example

Table A.16: Test report example

Item Serial number	Output current (A)	Output voltage with over over-voltage is "on" (V)			
		90 Vac/47 Hz	115 Vac/60 Hz	230 Vac/50 Hz	264 Vac/63 Hz
1#	0	14,2	14,3	14,2	14,1
	1	14,4	14,5	14,5	14,5
2#	0	14,2	14,3	14,3	14,3
	1	14,4	14,4	14,4	14,4
3#	0	14,2	14,3	14,2	14,1
	1	14,4	14,5	14,5	14,5
4#	0	14,2	14,3	14,3	14,3
	1	14,4	14,4	14,4	14,4
5#	0	14,2	14,3	14,3	14,3
	1	14,4	14,4	14,4	14,4

A.19 Over current protection test

A.19.1 Test Purpose

This test is to verify if the CPS can endure over current.

A.19.2 Test Condition

- Input: 90 Vac ~ 264 Vac.
- Frequency: 47 Hz ~ 63 Hz.
- Ambient temperature: see table A.1.

A.19.3 Test Criteria

The over current circuit protection should meet the clause 4.2.2 requirements. After removing the short circuit after 15 minutes the CPS should auto recover without damage.

A.19.4 Results report example

Table A.17: Test report example

Item Serial number	Temperature (ºC)	Limit current (A)			
		90 Vac/47 Hz	115 Vac/60 Hz	230 Vac/50 Hz	264 Vac/63 Hz
1#	0	2,13	2,36	2,61	2,89
	50	2,14	2,38	2,65	2,92
2#	0	2,14	2,35	2,56	2,94
	50	2,12	2,34	2,58	2,91
3#	0	2,13	2,37	2,63	2,93
	50	2,14	2,38	2,65	2,92
4#	0	2,14	2,35	2,56	2,94
	50	2,14	2,35	2,56	2,94
5#	0	2,12	2,34	2,58	2,91
	50	2,13	2,37	2,63	2,93
Item Serial number	**Temperature (ºC)**	**Auto recover after 15 minutes short-circuit/output voltage (Vdc)**			
		90 Vac/47 Hz	**115 Vac/60 Hz**	**230 Vac/50 Hz**	**264 Vac/63 Hz**
1#	0	yes/12,13	yes/12,36	yes/12,61	yes/12,89
	50	yes/12,14	yes/12,38	yes/12,65	yes/12,92
2#	0	yes/12,14	yes/12,35	yes/12,56	yes/12,94
	50	yes/12,12	yes/12,34	yes/12,58	yes/12,91
3#	0	yes/12,13	yes/12,37	yes/12,63	yes/12,93
	50	yes/12,14	yes/12,38	yes/12,65	yes/12,92
4#	0	yes/12,14	yes/12,35	yes/12,56	yes/12,94
	50	yes/12,14	yes/12,35	yes/12,56	yes/12,94
5#	0	yes/12,12	yes/12,34	yes/12,58	yes/12,91
	50	yes/12,13	yes/12,37	yes/12,63	yes/12,93

A.20 Construction, Appearance and Weight

A.20.1 Test purpose

This test is to verify if the Construction, Appearance and Weight of the CPS is in compliance with the design and the safety requirements.

A.20.2 Test Condition

- Inspect the CPS with unaided naked eyes.
- Inspection distance 30 cm away from the naked eye.
- Ambient temperature: see table A.1.

A.20.3 Test Criteria

The construction, appearance and weight should meet the clause 6.2 and 6.3 requirements.

A.20.4 Results report example

Table A.18: Test report example

Item Serial number	Housing(mm)			DC cord	Appearance	Weight (g)
	Length	Width	Height	Length		
1#	71,90	33,55	69,06	1 839	OK	128,9
2#	71,92	33,52	69,03	1 839	OK	128,3
3#	71,91	33,53	69,03	1 842	OK	128,8
4#	71,91	33,54	69,05	1 840	OK	129,1
5#	71,90	33,53	69,07	1 842	OK	128,7

A.21 Safety tests

As detailed in the introduction to this annex, a number of tests related to safety are to be performed for the CPS and the test procedures are detailed in the standards referenced in the main body of the present document (see clause 5 for details).

A.22 DC cord set and plug test

A.22.1 Test Purpose

To verify the reliability of the cords and plugs.

A.22.2 Test Condition 1

- DC Cord bending cycles: 2 000 times.
- DC Cord velocity: 40 times/min.
- DC Cord Weight load: 200 g.
- Bending angle: 120°.
- Ambient temperature: see table A.1.

A.22.3 Test Condition 2

- Physical inspection DC plug.
- Physical inspection AC plug.

A.22.4 Test Criteria

The AC plug should meet the clause 8 requirements.

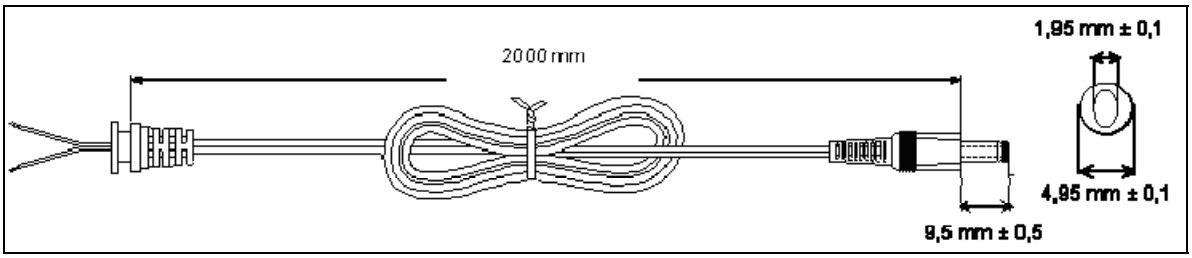


Figure A.2: DC cord

A.22.5 Results report example

Table A.19: Test report example

ITEM Serial number	Test cycles	Percentage of Copper cord broken	Determinant
1#	2 000	0 %	OK
2#	2 000	0 %	OK
3#	2 000	0 %	OK
4#	2 000	0 %	OK
5#	2 000	0 %	OK

A.23 Energy efficiency test

A.23.1 Test Purpose

To verify that the CPS meets the energy specifications.

A.23.2 Test Condition

- Input voltage: 115 Vac and 230 Vac.
- Input Frequency: 50 Hz.
- Output Load: 0 % ~ 100 % of the rated load.
- Ambient temperature: see table A.1.

A.23.3 Test Criteria

The average efficiency at 25 %, 50 %, 75 % and 100 % of the rated load, equal or better than 77,85 %.

No-load power use, less than 0,3 Watt.

A.23.4 Results report example

Per CPS tested, the next example applies.

Table A.20: Test report example

Serial number	**1#**					
Input 115 V/50 Hz	**Active Power Values**					**Average**
Output Current (mA)	0	250	500	750	1 000	---
Output Voltage (V)	12,15	12,09	12,04	11,99	11,94	---
Output Power (W)	0	2,4	6,0	9,0	12,0	---
AC Input Power (W)	0,13	3,8	7,4	11,0	14,9	---
Efficiency	---	63,16	81,08	81,82	80,54	76,65
Input 230 V/50 Hz	**Active Power Values**					**Average**
Output Current (mA)	0	250	500	750	1 000	---
Output Voltage (V)	12,15	12,09	12,04	11,99	11,94	---
Output Power (W)	0	2,4	6,0	9,0	12,0	---
AC Input Power (W)	0,26	3,9	7,6	11,3	14,9	---
Efficiency	---	61,54	78,95	79,65	80,54	75,17

A.24 Capacitive load test

A.24.1 Test Purpose

To verify that the CPS will not go into over current protection with the capacitive load.

A.24.2 Test Condition

- Input voltage: 90 Vac ~ 264 Vac.
- Input Frequency: 50 Hz ~ 60 Hz.
- Output Load: electrolytic capacitor of 2 200 μF.
- Ambient temperature: see table A.1.

A.24.3 Test Criteria

The CPS should not use the over current protection.

A.24.4 Results report example

Table A.21: Test report example

Serial number	**90 Vac/47 Hz**	**115 Vac/60 Hz**	**230 Vac/50 Hz**	**264 Vac/63 Hz**
1#	OK	OK	OK	OK
2#	OK	OK	OK	OK
3#	OK	OK	OK	OK
4#	OK	OK	OK	OK
5#	OK	OK	OK	OK

A.25 Maximum open circuit voltage test

A.25.1 Test Purpose

To verify that the CPS does not exceed the maximum open circuit voltage specification.

A.25.2 Test Condition

- Input voltage: 90 Vac ~ 264 Vac.
- Input Frequency: 50 Hz ~ 60 Hz.
- Output Load: 100 % of the rated power.
- Ambient temperature: see table A.1.

A.25.3 Test Criteria

The open circuit voltage should meet the clause 4.3.6 requirements.

A.25.4 Results report example

Table A.22: Test report example

Serial number	90 Vac/50 Hz (Vdc)	264 Vac/50 Hz (Vdc)
1#	14,84	14,79
2#	15,69	15,77
3#	14,65	14,75
4#	15,58	15,62
5#	14,82	14,78

A.26 EMC tests

As detailed in the introduction to this annex, a number of tests related to EMC are to be performed in CPS and the test procedures are detailed in the standards referenced in the main body of the present document (see clause 6 and table 2 for details).

Annex B (informative): PLT filters to limit interference and improve coexistence

Within the customer premises the CPS may be used where data transmission over power lines (PLT) is in use. To minimize the interference with PLT communications where the power wires themselves act as the data transmission medium and use the spectral region up to 50 MHz (up to 240 MHz is proposed), the switched mode power supplies that are connected to the power wires can significantly impair the characteristics of the communication channel in this band (the "PLT band"). As a result, the attainable bit rate of the PLT communications is reduced.

The main disturbance introduced by the CPS is caused by variations in the input impedance (the impedance looking into the AC supply terminals) of the CPS within the PLT band. The input impedance can vary with time at the frequency of the supply voltage. Because the input impedance changes when the supply voltage exceeds a threshold, the result is a time-varying impedance at 50 Hz or 60 Hz.

It should be noted that various PLT technologies have mechanisms to counteract cyclo-stationary noise (additive noise in synchronism with the supply voltage) and these mechanisms can partially counteract the impedance variation.

Power Supplies should be designed so as to minimise time varying impedance changes.

One potential technique for amelioration of the CPS in this regard is the introduction of filter circuits at the AC input. Figure B.1 is an example of such a filter circuit.

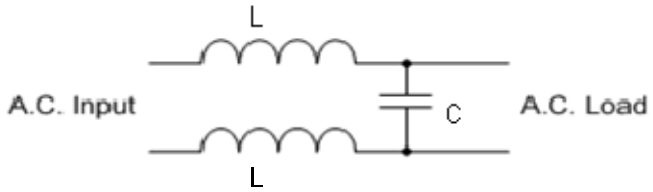


Figure B.1: Example of how to improve coexistence between CPS and PLT technology

In addition it is generally undesirable for CPE equipment to receive PLT transmissions where such transmissions impair the performance of the CPE.

Consequent recommendation:

As power supplies can introduce significant impedance variations on an AC line used for data transmission over Power lines, all CPS categories should be designed so as not to affect the bit rate of the data over PLT traffic by more than 5 % of the reference throughput.

In addition, to limit interference with Power line Communications equipment, the AC Power Port conducted emissions should not exceed 35 dBµV peak and 33 dBµV average in the frequency band from 1,6 MHz to 100 MHz. Other regulatory limits should be applied if they define values below these or cover a different frequency area.

B.1 Testing immunity of PLT equipment to CPS disturbances

As described in clause 9, power supplies can introduce significant impedance variations on an AC line used for data transmission over Power lines, so that all CPS categories should be designed so as not to affect the bit rate of the data over PLT traffic by more than 5 % of the reference throughput.

The test procedure here described is then referred to a product using a CPS compliant to the present document and is not part of the testing process of the CPS itself.

B.1.1 Test Purpose

To verify that the CPS does not affect the bit rate of the data over PLT traffic by more than 5 % of the reference throughput.

B.1.2 Test Condition

A PLT equipment, connected to a receiving end device, should be powered with its power supply provided in the package, and connected to another PLT equipment used as reference and able to transmit bidirectional traffic generated by a connected lab equipment at the maximum allowed bitrate, depending on the specific implementation of PLT technology (a typical value can be 200 Mbit/s). A traffic detector is then connected to the PLT equipment under test.

B.1.3 Test Criteria

The bitrate variation measured by the traffic detector should be limited within 5 % of the maximum bitrate detected.

B.1.4 Results report example

Table B.1: Test report example

Serial number	Max bitrate detected	Min. bitrate detected	% Variation
1#	OK	OK	OK
2#	OK	OK	OK
3#	OK	OK	OK
4#	OK	OK	OK
5#	OK	OK	OK

History

Document history		
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